Technical Specification Group Services and System Aspects
Meeting #12, Stockholm, Sweden, 18-21 June 2001

TSGS#12(01)0236

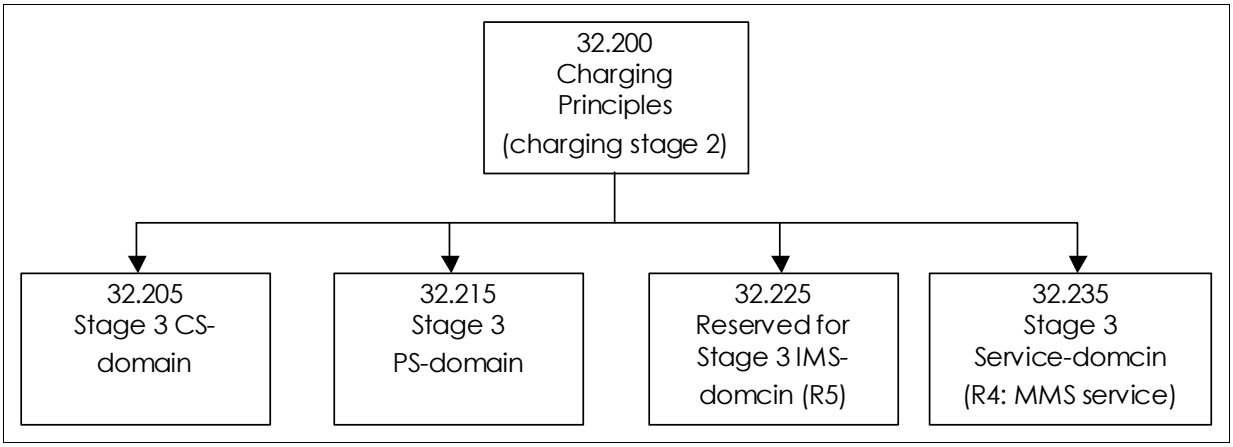
Source:	**SA5**
Title:	**Four (4) New Draft specifications on Charging Release 4- (Drafts V1.x.y of 32.200, 32.205, 32.215 and 32.235)**
Document for:	**Information**
Agenda Item:	**7.5.3**

Document Summary: Attached are four Technical Specifications recommended for presentation at SA#12 for Information.

TS 32.205 was previously presented for information at SA#11.
It has since undergone deletion of substantial obsolete information, a major structural alteration, error corrections, and other technical changes. Because corroboration of no further changes is still required, it is again submitted for information.

Charging Management (OAM-CH Rel4) - Status at SA#12:
80% for Information TSG#12, 100% for Approval TSG#13 (Rel4, 80% complete)

The relationship among these charging specifications is illustrated below.



Attachments:

32.200 V1.0.1 (32200_101.doc)

32.205 V1.1.1 (32205_111.doc)

32.215 V1.0.1 (32215_101.doc)

32.235 V1.0.1 (32235_101.doc)

3GPP TS 32.200 V1.0.1 (2001-06)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
Telecommunication Management;
Charging Management;
Charging Principles
(Release 4)

Reference
xxx

Keywords
Charging, Call Event, Billing, Accounting

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Contents

Foreword

This Technical Specification has been produced by the 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 this TS, 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 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 specification;

Introduction

This Technical Specification (TS) is part of a set of TSs which describe the requirements and information necessary for the standardised charging of 3G system.

1 Scope

This Technical Specification describes the architecture, requirements, and principles of charging and billing for the provision of service and services by a 3G system.

This standard is not intended to duplicate existing standards or standards being developed by other groups on these topics, and will reference these where appropriate. This standard will elaborate on the charging requirements described in the Charging Principles in UMTS 22.01 Service Principles. It will allow the generation of accurate charging information to be used in the commercial and contractual relationships between the parties concerned.

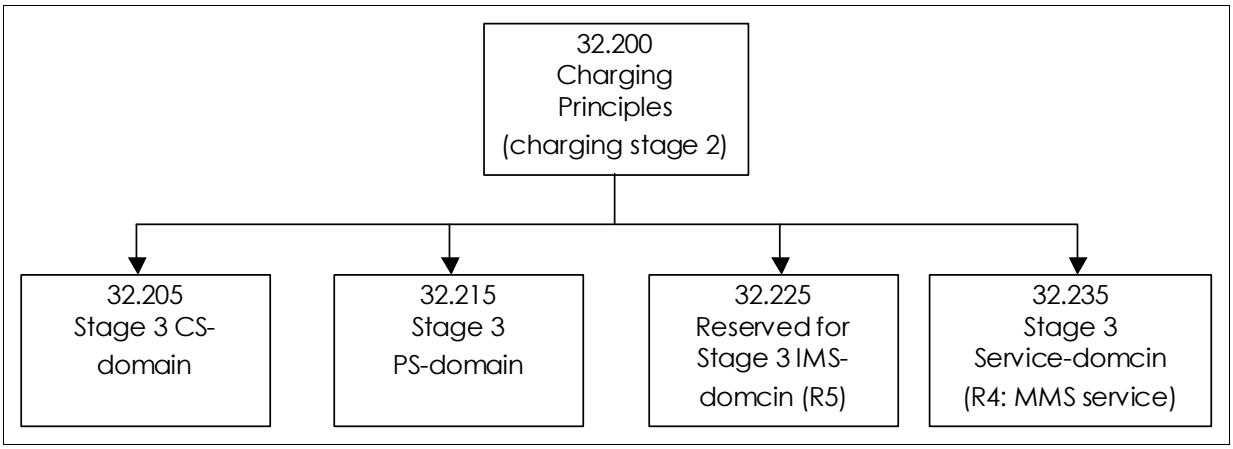
The charging data records generated by the network elements of the 3G network, are required for a number of telecom management activities including, but not limited to, the following:

- the billing of home subscribers, either directly or via service providers, for network utilisation charges;
- the settlement of accounts for traffic carried or services performed by fixed network and other operators;
- the settlement of accounts with other PLMNs for roaming traffic via the transferred account procedure;
- statistical analysis of service usage;
- as historical evidence in dealing with customer service and billing complaints;

In addition to the information collected from these network elements, network management functions are required for the administration of charging data.

This document is part of a series of documents specifying charging functionality in UMTS networks. The UMTS charging architecture and principles are specified in the present document which provides an umbrella for other charging documents that specify the structure and content of the CDRs and the interface protocol that is used to transfer them to the collecting node. The CDRs used in the Circuit Switched (CS) domain are specified in document TS 32.205 [5]. The CDRs content and transport within the PS domain are described in TS 32.215 [6] document, while CDRs used for application services are defined in document TS 32.235 [17].

The relationship among these charging specifications is illustrated below.



For the purpose of the present document, the charging data is considered to be collected, in real-time, by network element function (NEF) blocks located within the recording entities.

The data collected by the NEFs is sent to, or collected by, the appropriate Operations System Function (OSF) blocks for storage and further processing.

The location of the OSF is implementation specific and may, for example, be provided either by a Billing System, a Charging Gateway Function (CGF), or integrated within the network elements themselves.

The objectives of this standardisation are:

- to provide the descriptions of events and triggers for the generation of Charging Data Records;
- to provide the descriptions for Charging Data Records;
- to produce a description of the collection techniques for accounting administration and CDR generation;

and

- to define a method for the transmission of CDRs over an open interface.

This TS describes the principles of offline charging. Other documents describe the principles for MMS charging and for prepaid charging (based on online method).

2 References

The following documents contains 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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

2.1 Normative references

[1] 3GPP TS 22.101 “Service aspects; Service Principles”;

[2] 3GPP TS 22.115 “Service aspects; Charging and Billing”;

[3] 3GPP TS 32.101 “3G Telecom Management principles and high level requirements”

[4] 3GPP TS 32.102 “3G Telecom Management architecture”

[5] 3GPP TS 32.205: "Circuit Switched (CS) domain charging data description"

[6] 3GPP TS 32.215: "Packet Switched (PS) domain charging data description".

[7] 3GPP TS 22.024: "Description of Charge Advice Information (CAI)".

[8] 3GPP TS 22.086: "Advice of charge (AoC) supplementary services - Stage 1".

[9] 3GPP TS 24.008: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[10] GSM 12.00: "Digital cellular telecommunication system (Phase 2); Objectives and structure of Network Management (NM)".

[11] GSM 12.01: "Digital cellular telecommunication system (Phase 2); Common aspects of GSM Network Management (NM)".

[12] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[13] 3GPP TS 23.078: "Customised Application for Mobile network Enhanced Logic (CAMEL) - Phase 2; Stage 2".

[14] 3GPP TS 29.078: "Customised Application for Mobile network Enhanced Logic (CAMEL); CAMEL Application Part (CAP) specification - Phase 2".

[15] IETF RFC 959: “File Transfer Protocol (FTP)”; October 1985, J. Postel, J. Reynolds, ISI.
(Status: Standard)

[16] IETF RFC 783: “Trivial File Transfer Protocol (TFTP)”; rev. 2, June 1981, K.R. Sollins MIT.
(Status: Unknown)[17] 3GPP TS 32.235: “Charging Data Descriptions for MMS”

[18] ITU-T D.93

[19] 3GPP TS 23 140: “Multimedia Messaging Service (MMS), Functional Description, Stage 2”.

[20] 3GPP TR 21.905: "3G Vocabulary".

[21] 3GPP TS 23.002: “Network Architecture (Release 4)”.

[22] 3GPP TS 23.009: “Handover Procedures”.

[23] 3GPP TS 24.086: "Advice of charge (AoC) supplementary services - Stage 3".

3 Definitions and Abbreviations

3.1 Definitions

This section includes definitions specific to the charging functionality or necessary to understand the present specification. Other definitions are specified in TR 21.905 [20].**(GSM only): a qualifier** indicating that this clause or paragraph applies only to a GSM system. For multi-system cases this is determined by the current serving radio access network.

(UMTS only): a qualifier indicating that this clause or paragraph applies only to a UMTS system. For multi-system cases this is determined by the current serving radio access network.

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

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

2G- / 3G- : The prefixes 2G- and 3G- refers to functionality that supports only GSM or UMTS, respectively, e.g., 2G-SGSN refers only to the GSM functionality of an SGSN. When the prefix is omitted, reference is made independently from the GSM or UMTS functionality.

in GSM,...: a qualifier indicating that this paragraph applies only to GSM System. For multi system cases this is determined by the current serving radio access network.

in UMTS,...: a qualifier indicating that this paragraph applies only to UMTS System. For multi system cases this is determined by the current serving radio access network.

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

accounting meter record: A record containing one or more counters employed to register the usage of resources en masse. Includes simple event counters and/ or cumulative call second counters.

accounting: The process of apportioning charges between the Home Environment, Serving Network and User.

advice of charge: The real-time display of the network utilisation charges incurred by the Mobile Station. The charges are displayed in the form of charging units. If a unit price is stored by the MS then the display may also include the equivalent charge in the home currency.

aoc service: A combination of one or more services, both basic and supplementary, together with a number of other charging relevant parameters to define a customised service for the purpose of advice of charge.

billing: A function whereby CDRs generated by the charging function are transformed into bills requiring payment.

CAMEL: A network feature that provides the mechanisms to support operator specific services even when roaming outside HPLMN.

CAMEL subscription information: Identifies a subscriber as having CAMEL services.

CDR (Charging Data Record): A 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.

chargeable event: An activity utilising telecommunications network infrastructure and related services for user to user communication (e.g. a single call, a data communication session or a short message), or for user to network communication (e.g. service profile administration), or for inter-network communication (e.g. transferring calls, signalling, or short messages), or for mobility (e.g. roaming or inter-system handover), which the network operator wants to charge for.

charged party: A user involved in a chargeable event who has to pay parts or the whole charges of the chargeable

event, or a third party paying the charges caused by one or all users involved in the chargeable event, or a network operator.

charging: A function whereby information related to a chargeable event is formatted and transferred in order to make it possible to determine usage for which the charged party may be billed.

circuit switched domain: A domain within UMTS in which information is transferred in circuit mode.

GPRS: Packet Services for GSM and UMTS systems.

inter-system change: a change of radio access between different radio access technologies such as GSM and UMTS.

observed IMEI ticket: A record used to describe an EIR relevant event e.g. a blacklisted IMEI

off-line charging: tbd

on-line charging: tbd

packet switched domain: A domain within UMTS in which data is transferred in packet mode.

settlement: Payment of amounts resulting from the accounting process.

short time: Time, typically in number of minutes, to perform the off-line mechanism used for accounting.

successful transaction: A circuit connection that reaches the communication or data transfer phase e.g. the "answered" state for speech connections. A packet connection that achieves completed data transfer. All other connection attempts are regarded as unsuccessful.

tariff period: A part of one (calendar) day during which a particular tariff is applied. Defined by the time at which the period commences (the switch-over time) and the tariff to be applied after switch-over.

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

3.2 Abbreviations

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

3G	3rd Generation
3GPP	3G Partnership Project
AoC	Advice of Charge
APN	Access Point Name
BMD	Billing Mediation Device
BS	Billing System
CAI	Charge Advice Information
CAMEL	Customised Applications for Mobile network Enhanced Logic
CDR	Charging Data Record
CG	Charging Gateway
CGF	Charging Gateway Function
CI	Cell Identity
CS	Circuit Switched
CUG	Closed User Group
DP	Detection Point
DRP	Data Record Packet
EDP	Event Detection Point
EIR	Equipment Identity Register
EM	Element Management
ETSI	European Telecommunications Standards Institute
FCI	Furnish Charging Information
FTAM	File Transfer, Access and Management
FTP	File Transfer Protocol
G-CDR	GGSN generated– CDR
GGSN	Gateway GPRS Service Node

GMSC	Gateway MSC
GPRS	General Packet Radio Service
gsmSCF	GSM Service Control Function
gsmSSF	GSM Service Switching Function
GSN	GPRS Support Node (either SGSN or GGSN)
GTP	GPRS Tunnelling Protocol
HLR	Home Location Register
HPLMN	Home PLMN
HSCSD	High Speed Circuit Switched Data
ICS	Implementation Conformance Statements
IE	Information Element
IHOSS:OSP	Internet Hosted Octet Stream Service: Octet Stream Protocol
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISP	Internal Standardized Profiles
Itf	Interface
ITU-T	International Telecommunication Union - Telecommunications Standardisation Sector
LAC	Location Area Code
LCS	Location Services
M-CDR	Mobility Management generated-Charging Data Record
ME	Mobile Equipment
MMS	Multimedia Messaging Service
MMSE	Multimedia Messaging Service Environment
MGW	Media Gateway
MOC	Mobile Originated Call (attempt)
MS	Mobile Station
MSC	Mobile Services Switching Centre
MSISDN	Mobile Station ISDN number
MSRN	Mobile Station Roaming Number
MTC	Mobile Terminated Call (attempt)
NE	Network Element
NM	Network Management
NMC	Network Management Centre
NSS	Network and Switching Subsystem
OA&M	Operation, Administration and Maintenance
OACSU	Off air call set-up
O-CSI	Originating CAMEL Subscription Information
OMC	Operations and Maintenance Centre
PBX	Private Branch eXchange
PDN	Packet Data Network
PDP	Packet Data Protocol, e.g. IP
PDU	Packet Data Unit
PLMN	Public Land Mobile Network
PPP	Point-to-Point Protocol
PPS	Post-processing system
PS	Packet-Switched
PSPDN	Packet-Switched Public Data Network
PT	Protocol Type (Field in GTP' header)
QoS	Quality of Service
RAB	Radio Access Bearer
RAC	Routing Area Code
RNC	Radio Network Controller
SAC	Service Area Code
S-CDR	SGSN (PDP context) generated – CDR
SCF	Service Control Function
SCI	Subscriber Controlled (MMI) Input
SCS	System Conformance Statement

SGSN	Serving GPRS Service Node
SMF	System Management Function
SMS	Short Message Service
SS7	Signalling System No. 7
S-SMO-CDR	SGSN delivered Short message Mobile Originated – CDR
S-SMT-CDR	SGSN delivered Short message Mobile Terminated – CDR
TAP	Transferred Account Procedure
T-CSI	Terminating CAMEL Subscription Information
TDP	Trigger Detection Point
TID	Tunnel Identifier
TLV	Type, Length, Value (GTP header format)
TMN	Telecommunications Management Network
TS	Technical Specification
TV	Type, Value
UMTS	Universal Mobile Telecommunications System
URA	UTRAN Registration Area
USIM	User Service Identity Module
USSD	Unstructured Supplementary Service Data
UTRAN	UMTS Terrestrial Radio Access Network
VAS	Value Added Service
VLR	Visitor Location Register
VMSC	Visited MSC
VPLMN	Visited PLMN

3.3 Symbols

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

A	Interface between an MSC and a BSC.
Ga	Charging data collection interface between a CDR transmitting unit (e.g. GGSN or SGSN) and a CDR receiving functionality (CGF).
Gb	Interface between an SGSN and a BSC.
Gc	Interface between an GGSN and an HLR.
Gd	Interface between an SMS-GMSC and an SGSN, and between a SMS-IWMSC and an SGSN.
Gf	Interface between an SGSN and an EIR.
Gi	Reference point between the Packet-Switched domain and an external packet data network.
Gn	Interface between two GSNs within the same PLMN.
Gp	Interface between two GSNs in different PLMNs. The Gp interface allows support of Packet-Switched domain services across areas served by the co-operating Packet-Switched domain PLMNs.
Gr	Interface between an SGSN and an HLR.
Gs	Interface between an SGSN and an MSC/VLR.
Iu	Interface between the RNS and the core network. It is also considered as a reference point.
kbit/s	Kilobits per second.
Mbit/s	Megabits per second. 1 Mbit/s = 1 million bits per second.
Mc	Interface between the MGW and (G)MSC server

R	Reference point between a non-ISDN compatible TE and MT. Typically this reference point supports a standard serial interface.
Reporting Area	The service area for which an MS's location shall be reported.
Service Area	The location accuracy level needed for service management purposes in the 3G-SGSN, e.g. a routing area or a cell. The 3G-SGSN can request the SRNC to report: i) the MS's current service area; ii) when the MS moves into a given service area; or iii) when the MS moves out of a given service area.
Um	Interface between the Mobile Station (MS) and the GSM fixed network part. The Um interface is the GSM network interface for providing Packet-Switched services over the radio to the MS. The MT part of the MS is used to access the Packet-Switched services in GSM through this interface.
Uu	Interface between the Mobile Station (MS) and the UMTS fixed network part. The Uu interface is the UMTS network interface for providing Packet-Switched services over the radio to the MS. The MT part of the MS is used to access the Packet-Switched services in UMTS through this interface.

4. Architecture

4.1 3G logical and charging logical architecture

Figures 1 shows the 3G logical architecture for Release 4 as described in TS 23.002. [21]

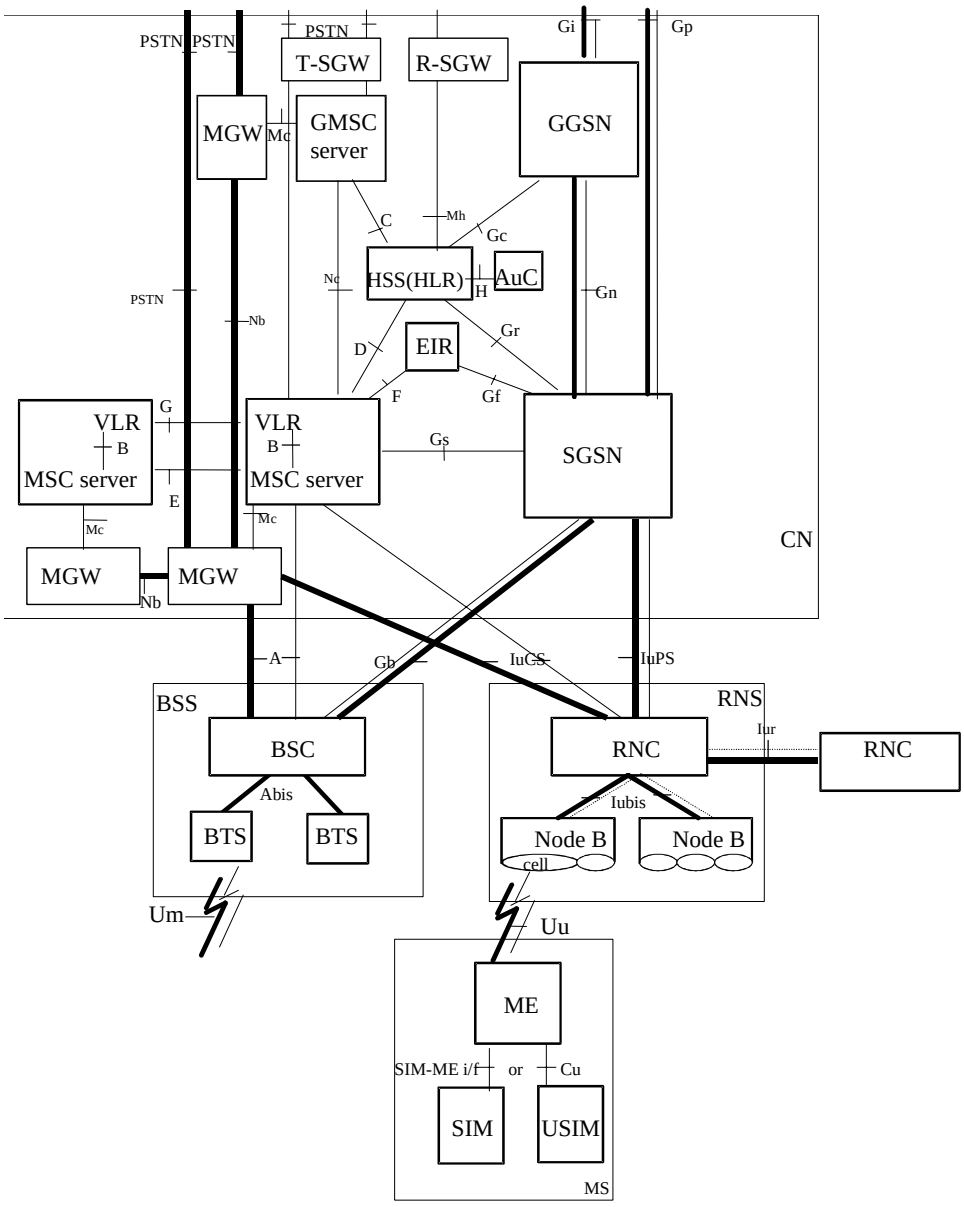


Figure 1: Overview of the 3G Logical Architecture

The 3rd Generation Mobile system is logically implemented on the GSM/GPRS structure through the addition of a new air interface supported by two network nodes, the RNC and the Node B. No inference should be drawn about the physical configuration on an interface from Figure 1.

The CAMEL entities are not shown in Figure 1. For the relationship ship of the CAMEL entities to the core network entities illustrated above, refer to TS 23.002 [21].

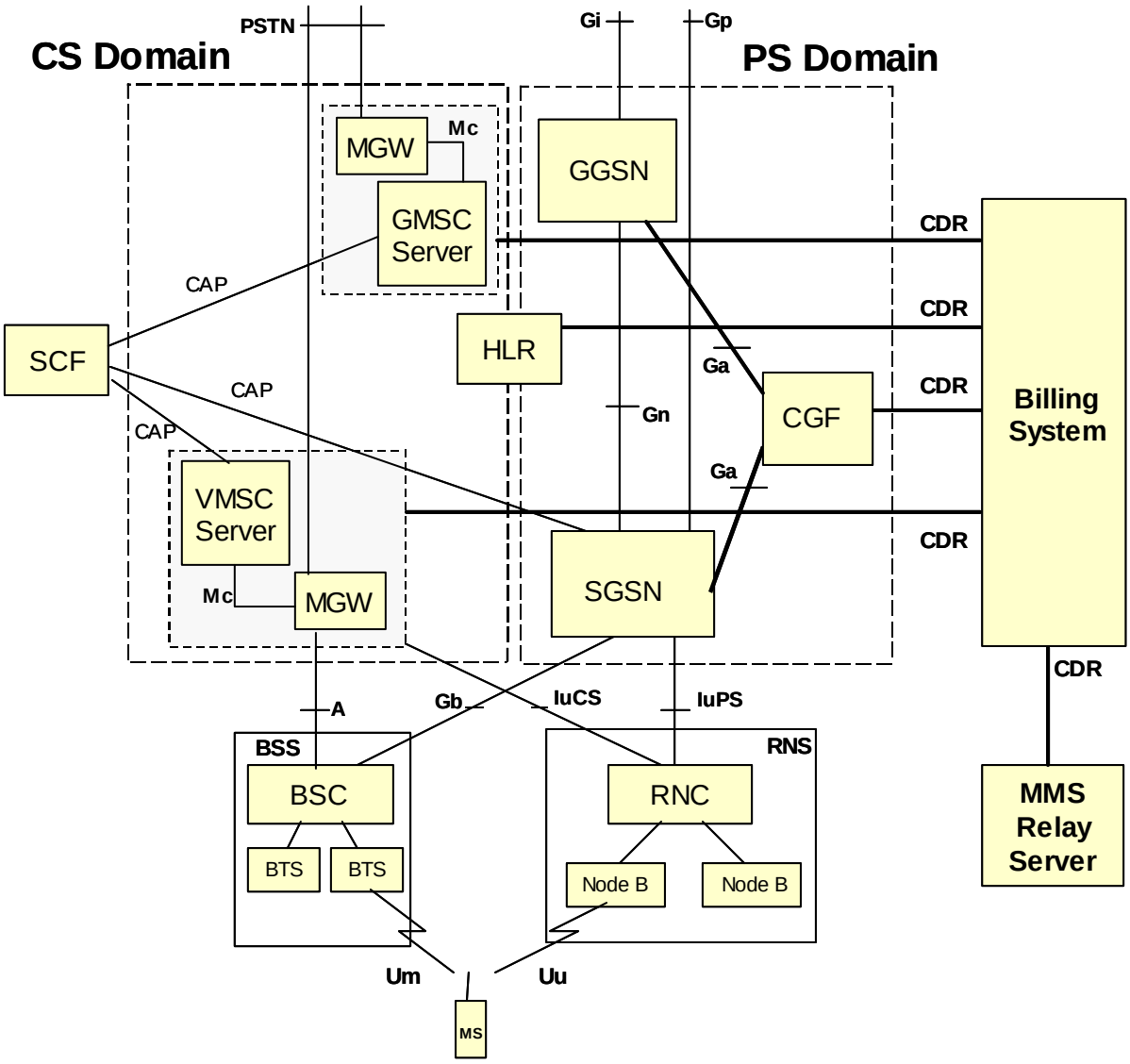


Figure 2: 3G charging logical architecture

Figure 2 illustrates the 3rd Generation Charging architecture is subdivided by the two transmission planes, the Circuit Switched (CS) domain and the Packet Switched (PS) domain. The charging data records generated by the serving nodes (SGSN, GGSN) for the appropriate domain are forwarded via the Charging Gateway Functionality (CGF) entities to the Billing System for processing. Note that the SCF may also transfer CDRs directly to the Billing System. (While not shown explicitly in this figure, the VLR may also generate charging data records.)

[Additional description of the implications of the separation of signalling and traffic in the Release 4 architecture will be added.]

4.2 Charging Gateway Functionality

The Charging Gateway Functionality (CGF), within the Packet-Switched domain, provides a mechanism to transfer charging information from the SGSN and GGSN nodes to the network operator's chosen Billing Systems. The Charging Gateway concept enables an operator to have just one logical interface between the CGF and the Billing System. The CGF may be supported in one of the following ways:

- as a centralised separate Network Element – NE (Charging Gateway);
- as a distributed functionality resident in the SGSNs and GGSNs.

Support of the centralised or distributed CGF in a network is implementation dependent, and subject to vendor/manufacturer agreement. Regardless of the way in which the CGF is supported in the network, the functionality of the CGF is similar. Figure 3 gives an overview of the two basic configurations: In scenario 1, the GSNs support an external interface to the charging gateways they are connected to. In scenario 2, the GSNs support the charging gateway functionality internally.

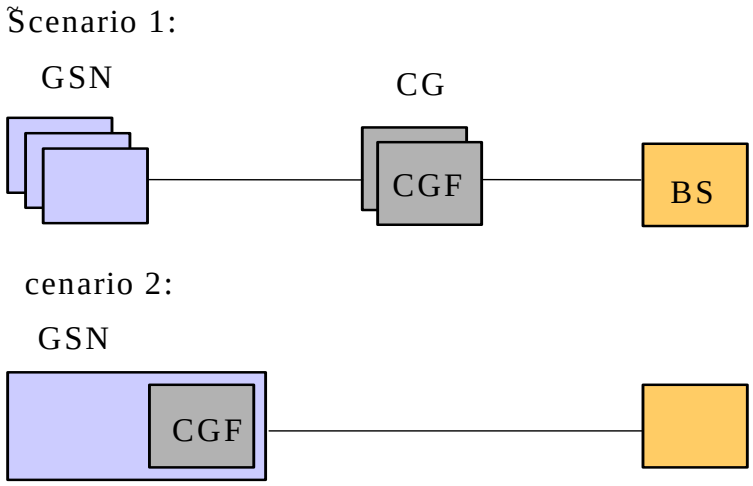


Figure 3: Basic architectural scenarios for the CGF location

If the GSNs with internal charging gateway functionality also support the external interface, additional configurations as shown in Figure 4 are possible. In scenario 3, the GSN with integrated charging gateway function also acts as CGF for other GSNs. In scenario 4, the GSN with integrated charging gateway function also supports the transmission of CDRs to external CGFs.

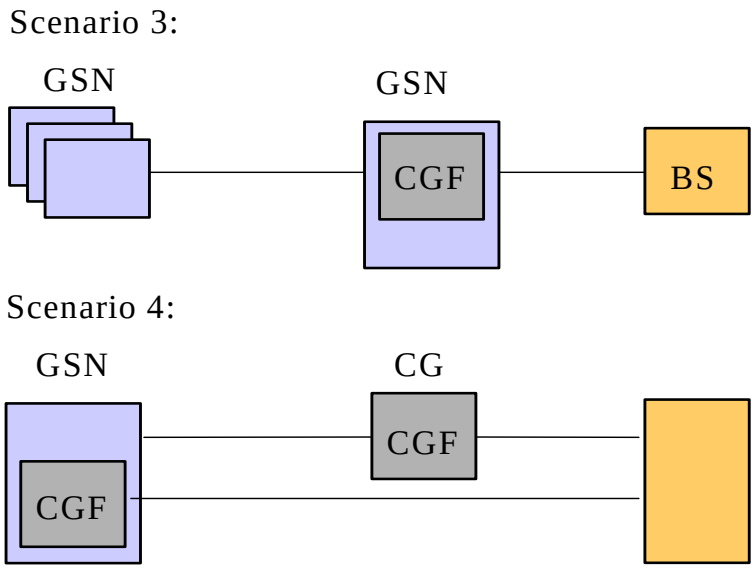


Figure 4: Optional scenarios for the CGF configuration

The four scenarios in Figure 3 and 4 are not exhaustive.

The CGF provides the mechanism to transfer charging information from the SGSN and GGSN nodes to the network operator's chosen Billing Systems(s). The main functions of the CGF are:

- the collection of Packet-Switched CDRs from the Packet-Switched nodes generating CDRs;
- intermediate CDR storage buffering;
- the transfer of the CDR data to the billing systems.

The CGF acts as storage buffer for real-time CDR collection. It provides the CDR data to the billing system. The present document identifies the external interfaces of the CGF, but does not specify the internal functionality of the CGF. However, in order to assist in the understanding of the CGF, it may perform specific activities, such as consolidation of CDRs, pre-processing of CDR fields, filtering of un-required CDR fields, and adding of Operator defined fields for specific billing systems. These specific activities may be performed to optimise the charging information that is to be forwarded to the Billing System, which should reduce the load in the Billing System.

In addition to the centralised CGF it is possible to have the CGF distributed to the SGSNs and/or GGSNs.

The CGF can reside in a separate Network Element (Charging Gateway) or be integrated in the GSNs. It can receive CDR fields from the GSNs in real-time mode. It should have enough storage to enable it to transmit the collected charging data to the Billing System in file mode.

The CGF may have to support several transmission protocols towards the Billing System, depending on the Billing System(s) used. One of the main purposes of the CG (or even just a CGF) is to reduce the number of different interfaces between the Billing System and the GGSNs and SGSNs sending charging data. If a new Billing System is introduced it shall be interfaced to the CGF, i.e. the protocol stacks and configurations of the GSNs do not need not to be updated. The usage and load of mass memory media can be more evenly distributed. The portion of the CGF embedded into a single physical device is called the Charging Gateway entity. The CGF may be distributed to several physical Charging Gateways or GSNs, to facilitate redundancy. If that Charging Gateway entity that is the Primary Charging Gateway entity, does not respond to communication originating from the GSNs, the GSNs will try to send the CDR data to a Secondary Charging Gateway entity. Here each GSN will have several IP addresses (of different priority) for the Charging Gateway entities, thus avoiding downtime of the CGF.

5 Circuit-Switched Domain

5.1 Charging Principles

5.1.1 Requirements according to TS 22.115

The following requirements are a high-level interpretation which summarize the more detailed requirements of TS 22.115 [2].

1. to provide a charging data record for all charges incurred and requiring settlement between the different commercial roles;

2. to allow itemised billing for all services (including CAMEL) charged to each subscription, including voice and data calls, and services offered by home environments, taking into account:

    - information provided by the user (including authentication parameters, etc.)
    - information provided by the serving network (including Serving Network Id, timestamps, etc.)
    - information provided by the service (including charged party, long calling, multimedia, etc.)

3. to allow fraud control by the Home Environment and the Serving network;

4.

5.1.2 Charging Information

The MSC server charging function is responsible for the collection of all charging relevant information for each MS, PBX and ISUP connection and for the storage of this information in the form of charging data records.

Circuit switched calls can be charged in one MSC server (the anchor MSC server) where all relevant data is available. That is guaranteed by routing all signalling information though the anchor MSC server even if the traffic channel of a call is routed through another MSC server due to handover.

If subscribed-to IN services apply to MS / PBXs the MSC servers contain CAMEL subscription data providing the information required for invokation of the CAMEL dialogues for controlling the MS terminating / PBX incoming and MS originating / PBX outgoing calls. Billing record parameters resulting from the CAMEL treatment applying to MS / PBX calls shall be derived from the MS / PBX's CAMEL subscription data.

In addition to user subscribed services , specific dialled CAMEL services might be invoked which also influence existing records or even trigger the generation of separate records steered by service logic.

The following general requirements have to be considered during the implementation of the charging function:

- the billing of home subscribers, either directly or via service providers, for network utilisation charges;
- the settlement of accounts for traffic carried or services performed by fixed network and other operators;
- the settlement of accounts with other PLMNs for roaming traffic via the transferred account procedure;
- statistical analysis of service usage;
- as historical evidence in dealing with customer service and billing complaints.

In addition to the information collected from these network elements, network management functions are required for the administration of on-line charging data stored in the MSC servers. This data is employed to drive the charge display in the Mobile Station (MS) as required by the advice of charge (AoC) service and defined by TS 22.086 [8] and TS 22.024 [7].

5.1.2.1 Subscriber billing

The charging data collected from the HPLMN, interrogating PLMN, and/or VPLMN network elements is employed to determine the network utilisation charges for the basic and supplementary services utilised by the home subscribers of the PLMN. The charges calculated are then combined with the network access (subscription) charges and billed to those customers directly serviced by the PLMN.

For those subscribers handled by Service Providers, the billing information is employed for both wholesale (Network Operator to Service Provider) and retail (Service Provider to Subscriber) billing. Consequently, having been processed by the PLMN Billing System, the charging data collected from the network elements may also be sent to the Service Provider for further processing.

5.1.2.2 Settlements of Charges

5.1.2.2.1 Inter-PLMN accounting

Inter-PLMN accounts for roaming traffic are determined in accordance with ITU-T principles (see ITU-T D.93 [18])and are settled by means of the Transferred Account Procedure (TAP).

5.1.2.2.2 'Visitors' from other PLMNs

The charging data records collected from the network also include details of the services employed by visiting (roaming) subscribers. The charges for mobile originated calls (MOCs) and for supplementary services used are calculated as for home subscribers, converted to an agreed accounting currency and included in the charging data records for the TAP. Even if mobile terminated calls (MTCs) are zero-priced in the visited network (VPLMN), in the absence of 'optimised routing' the MTC TAP records are still required by the home network (HPLMN) in order to determine the re-routing charges from the HPLMN to the VPLMN.

The TAP records generated are exchanged with each HPLMN on a regular basis. These TAP records form the basis of the invoice submitted by the VPLMN for the traffic carried.

5.1.2.2.3 'Home' subscribers roaming in other PLMNs

The HPLMN receives TAP records from each VPLMN for services employed by home subscribers whilst roaming. These records are employed to verify the invoices from the VPLMN and to bill the home subscribers for the services used. The charges contained in the TAP records are converted from the accounting currency to the local currency and a handling surcharge (mark-up) is added if required. The TAP records are subsequently passed to the subscriber billing process described in subclause 5.1.2.1.

5.1.2.2.4 Fixed network operators and other service providers

The settlement of accounts with the operators of fixed networks for traffic carried, is generally performed on a bulk basis according to the principles outlined in the ITU-T D-series of recommendations.

The traffic accounted for in this manner may include:

- outgoing (Mobile to Land) traffic;
- incoming (Land to Mobile) traffic;
- transit traffic, carried by intermediate networks;
- signalling (MAP/SCCP, CAP/SCCP) traffic e.g. location updates.

Accounting information may also be required for the use of services provided by other operators such as short message service centres and other value added service (VAS) providers.

The charges for the various traffic shares may be determined on the basis of the charging data records generated by the network elements or on the basis of bulk counters (accounting meter records) in the gateway MSC servers (GMSC servers). For the purpose of the present document, the management information required is assumed to be derived from charging data records. The management of accounting meters is outside the scope of the present document.

5.1.2.3 Service Information

The charging data collected from the network elements may be used to provide statistical information concerning the use of services, by both home and visiting subscribers, within the network. In addition, the introduction of new services and/ or modifications to the tariffs of existing services may also require the distribution of the appropriate tariff information to the network elements for Advice of Charge purposes.

5.1.3 General Aspects of Charging Data

Charging data record generation and contents should be flexible and unnecessary redundancy in data should be avoided.

Charging data are collected for successful and for some unsuccessful subscriber transactions. The subscriber transaction is seen as being successful in the MSC server (where the charging data record is generated) either if a call is answered , if the Short Message Service Center has confirmed the successful receipt of a mobile originated short message, or a supplementary service.

Unsuccessfull call attempts are recorded in the case of partial record generation due to IN FollowOnCalls. If in such a call constellation the answer state is reached at least once, subsequent unsuccessful set-up of a connection configuration is also recorded in order to provide a complete sequence of FIRST, INTERMEDIATE and LAST records.

At termination of the subscriber transaction these data are formatted into charging data records. These records are forwarded onto MSC server's disk file which constitute the source for further transportation of that data to a Billing System. For the purpose of the present document, the charging data records are considered to be collected, in real-time, by Network Element Function (NEF) blocks located within the MSC servers, MGWs, and location registers.

The data collected by the NEFs is sent to, or collected by, the appropriate Operations System Function (OSF) blocks for storage and further processing.

Similarly, the tariff data required by the NEFs to provide on-line charging information is distributed by the appropriate OSF.

5.2 Collection of Charging Data Records

5.2.1 Charging Data Record Generation

In order to provide the data required for the management activities outlined in the previous chapters (billing, accounting, statistics etc.), the NEF of the MSC server and/or Location Registers shall be able to produce an charging data record for each of the following:

- Mobile originated call attempt;
- Mobile originated emergency call attempt;
- Mobile originated, call forwarding attempt;
- Mobile terminated call attempt;
- Roaming call attempt in a gateway MSC server;
- Incoming call attempt in a gateway MSC server;
- Outgoing call attempt from a gateway MSC server;
- Transit call attempt;
- Terminating CAMEL interrogation call attempt;
- Supplementary service actions;
- HLR interrogation;
- Location updating (HLR & VLR);
- Short message service (point-to-point), mobile originated;
- Short message service (point-to-point), mobile terminated;
- Short message service (point-to-point), mobile originated interworking MSC server;
- Short message service (point-to-point), mobile terminated gateway MSC server;
- Common equipment usage.

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 TS 32.205 [5].

5.2.1.1 AoC serviceIn addition to the information collected from these Network Elements, network management functions are required for the administration of on-line charging data stored in the MSC server. Two levels of AoC service are available: information level and charging level. The information level is used only to provide AoC information to the user. For the charging level, if no approval of the AoC information by the MS is received in the MSC server, the call is released immediately. This data is employed to drive the charge display in the Mobile Station (MS) as required by the advice of charge (AoC) service and defined by 3GPP TS 22.086 [8] and 3GPP TS 22.024 [7].
An AoC service definition shall consist of a combination of the following:

- one or more basic services; and/or
- one or more supplementary services; and/or
- one or more network specific services; and/or
- one or more power capability classes (MS classmark); and/or
- the type of radio traffic channel used/ requested;
- the transparency mode of the basic service employed (transparent/non-transparent);
- the type of call or connection (e.g. MOC/ MTC).

This list may also be extended to include additional network specific parameters.

5.2.1.2 CAMEL services

CAMEL service can be activated for originating, forwarded and terminated calls and originating SMS. Several fields describing CAMEL subscription and free format data are recorded to appropriate CDR. For originating and forwarded calls two different CAMEL services can be active and part of stored information is different depending on the CAMEL call model and which triggers occur. CAMEL fields describing usage level of service, CAMEL modified parameters and CAMEL initiated call forwarding include information for one call leg including impacts on all CAMEL services.

5.2.1.3 Use of supplementary services

The recording of supplementary service usage permits the OS to specify the supplementary service actions (invocation, registration etc.) to be recorded.

In addition to specifying the actions to be recorded, the OS may also determine how these events are to be recorded. Non-call related events, such as the administration of supplementary services by the subscriber via the MMI of the MS, shall result in the production of supplementary service action records. Call related events (e.g. invocation of supplementary services) shall be recorded "in-line" in the appropriate charging data record and/ or in a separate SS-action record depending on the configuration specified by the OS.

Where the use of a supplementary service results in the production of further connections (e.g. call forwarding, multi-party service etc.) additional charging data records shall be produced to describe the relevant connections. The use of such services is described in more detail both in this subclause and in the example scenarios.

5.2.1.4 Use of call forwarding

When one of the call forwarding services is used, the NEF of the MSC server that forwards the call, shall produce the MOC record for the forwarded part of the call.

For further information concerning the recording of call forwarding services see the example scenarios in section 5.2.2.6 and 5.2.2.7.

5.2.1.5 Use of call hold and multi-party services

The use of the call hold service shall be recorded either in-line in the appropriate charging data record or in a separate supplementary service "invocation" record as described above. For the avoidance of doubt, the duration for which the call is held, i.e. is inactive, is not recorded.

The use of the multi-party service requires a minimum of 3 subscribers and the use of a conference circuit. For the purpose of the following description the subscriber invoking the service is referred to as the conference originator ("A")

and the conference call is regarded as consisting of a number of individual "legs" between the organiser and the other parties ("B", "C", etc.) in the call.

Normal MOC and MTC charging data records shall be generated for each party and each leg of the call. In addition, if common equipment records are enabled, a common equipment record shall be produced for the conference originator in order to record the use of a conference bridge and to record the total duration of the conference connection.

Example: Subscriber "C" calls subscriber "A". Subscriber "A" places the call from "C" on hold and makes a second call to subscriber "B". Subscriber "A" then invokes the multi-party service in order to set-up a conference call with "B" and "C".

Assuming that the appropriate types of record are enabled, the following charging data records shall be produced:

- An MOC record for subscriber "C" and the "C"->"A" leg of the call;
- An MTC record for subscriber "A" and the "C"->"A" leg of the call;
- An MOC record for subscriber "A" and the "A"->"B" leg of the call;
- An SS-Action record for the invocation of the call hold service by subscriber "A";
- An MTC record for subscriber "B" and the "A"->"B" leg of the call;
- An SS-Action record for the invocation of the multi-party service by subscriber "A";
- A common equipment record for the use of the conference bridge by subscriber "A";

Each of the MOC/MTC records for the conference originator ("A") shall include the supplementary service code for the multi-party service.

Any subsequent action affecting only one leg of the connection shall be recorded either in a separate supplementary service action record or in-line in the appropriate charging data record. Any action affecting the conference as a whole e.g. the originator holding the conference shall be recorded either in a separate supplementary service action record or in the common equipment usage record.

For further information concerning the recording of multi-party services see the example scenario in section 5.2.2.9.

5.2.1.6 Partial records

In order to increase the security of the recording process and to simplify post-processing, it may be desirable to generate a sequence of charging data records to describe a single connection or transaction.

In case of connections of extended duration, the loss of a single charging data record may result in an unacceptable loss of revenue. If the connection is, for example, recorded in a number of consecutive partial records generated at say hourly intervals, then the maximum loss of revenue is the equivalent of a one hour continuous connection.

Most modern billing systems employ some form of cumulative credit-limit checking based on the stream of input charging data records. If however, a charging data record is only produced at the end of the connection then a subscriber may avoid such credit checking by employing a connection for days, weeks or even months without a single charging data record being produced.

All of the records defined in the present document are of variable length and some at least are potentially unlimited in size (SET OF, SEQUENCE OF etc.). However, the storage capacity of the internal records within the NEF is normally subject to strict size limitations. Under such conditions a partial record may be required in order to circumvent internal resource limitations. For example, if an internal MOC record can only support the use of four supplementary service invocations then the use of a fifth may result in the generation of a partial record.

Alternatively, for those manufacturers whose systems are based on fixed length records, partial records may be employed instead of the various lists contained within the present document definitions. In such cases a partial record will be produced each time one of the key fields alters during the connection.

Finally, in case of radio link failure and subsequent call re-establishment partial records shall be generated to record the duration of the call prior to the radio link failure and the subsequent duration of the call once the call has been re-established.

To summarise, the following events may result in the generation of a partial record:

- expiry of the partial record timer;
- change of basic service during a connection;
- change of location (LAC or Cell Id. or the Service Access Code, for UMTS) during a connection;
- change of MS classmark during a connection;
- change of AoC Parameters during a call;
- change of Radio Channel Type (full/half rate) during a call;
- radio link failure and subsequent call re-establishment;
- change of HSCSD Parameters (for GSM only) during a call;
- change of CAMEL destination (CAMEL controlled/initiated) during a call.

All partial records for the same connection shall contain the same call reference and shall be ordered via a running sequence number. The time stamps involved shall apply to the individual partial records rather than the connection as a whole i.e. the "end" time stamp (duration) of one record shall, in general, coincide with the "start" time stamp (answer time) of the next. Each time a new partial record is created the cause for termination of the previous field shall contain the value "partial record ". The cause for termination of the final partial record shall contain the true cause for termination of the connection.

It should be noted that the records produced in case of call re-establishment are not contiguous and that the value of the cause for term field in the record that is closed on radio link failure contains the value "partial record call re-establishment".

The partial records generated may repeat each of the non-varying fields contained in the original record. Alternatively, a form of reduced partial record may be generated which includes only those fields required to identify the original record together with the field(s) that actually change.

5.2.1.7 Use of packet data services

If packet data services are employed in conjunction with a Packet-Switched Public Data Network (PSPDN) then an MOC/MTC charging data record may be produced in the originating/terminating MSC server and a gateway record in the gateway/interworking MSC server. If the packet volume is not available within the PLMN then this information may also be provided in the form of a charging data record from the PSPDN. In such cases the OS is responsible for the correlation of the various records describing the connection. The definition of such PSPDN charging data records is outside the scope of the present document.

5.2.1.8 Inter-MSC server handover

In the case of an inter-MSC server handover the controlling MSC server, as defined by TS 23.009 [22], remains in control of the connection and shall therefore, produce the charging data record. For the avoidance of doubt, it is not necessary to produce charging data records in the subsequent MSC server(s).

5.2.1.9 Call re-establishment

In case of radio link failure as described in TS 24.008 [9], the MS may attempt to re-establish the call using the procedures described in TS 24.008 [9].

For the time period between the detection of the radio link failure by the mobile station and the successful re-establishment of the call, the advice of charge function in the MS is suspended as described in TS 24.086 [23]. In order to minimise the difference in charges between the on-line calculations performed by the MS and the off-line processing on the basis of the charging data records, it is necessary to exclude the time taken for the re-establishment phase from the chargeable duration stored in the charging data records.

If the re-establishment attempt fails then an ordinary charging data record (MOC/MTC) shall be produced with the cause for termination value "stable call abnormal termination". The chargeable duration stored in this record covers the time period from "Answer" to the detection of the radio link failure by the MSC server.

If, the attempt to re-establish the call succeeds then the current charging data record shall be closed with the cause for termination value "partial record call re-establishment" and a new partial record shall be opened for the re-established call. The chargeable duration stored in the original record is once again the time period from "answer" to detection of the radio link failure by the MSC server. Both the "seizure" and "answer" times of the subsequent partial record correspond to the time at which the new traffic channel is allocated for the re-established call.

Further radio link failures during the re-established call may result in the generation of additional partial records as described above. All of the partial records belonging to the same connection are identified by the same call reference and a running sequence number.

NOTE: As the MS and MSC server may detect the radio link failure at different points in time, it is not possible to guarantee that the duration used for the AOC display corresponds to that recorded in the charging data records. The purpose of the above procedure is merely to minimise any discrepancies that may occur.

5.2.1.10 Restricted directory numbers

In addition to the information pertaining to the served mobile subscriber (IMSI, MSISDN, etc.), the charging data records defined in the present document also contain the directory numbers of other parties involved in the recorded connections or transactions. In order to comply with data protection legislation, it is necessary to distinguish between those numbers that may be passed on to third parties and those that needs to be handled confidentially. As a result, each of the number fields (e.g. calling/connected number) contains the presentation and screening information defined in both TS 24.008 [9] and ISUP signalling. If this information is supported by the network, then even restricted numbers may be included in the appropriate records and suppressed off-line by the administration or billing system. If this information is not supported then the entire directory number shall be suppressed by the MSC server/VLR.

5.2.1.11 IMEI Observation

In order to provide the data required by the mobile equipment management activities outlined in the previous chapters, the NEF of the MSC server shall be capable of producing IMEI tickets for each of the following events:

- usage of a blacklisted IMEI;
- usage of a greylisted IMEI;
- usage of an IMEI not found on the white list.

An observed IMEI ticket is generated whenever greylisted, blacklisted or non-whitelisted mobile equipment is detected during an IMEI check. The purpose of the ticket is to link the mobile equipment under observation with its current user (IMSI). The ticket also includes information describing when and where the equipment was used to enable the tracking of such equipment. Finally, if the ticket was triggered by a call attempt, a call reference is provided in order to locate the corresponding charging data record.

The IMEI tickets are generated by the NEF of the MSC server performing the IMEI check.

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:

- that the MSC server and VLR are co-located;
- that the records are sent to a post-processing system;
- that the generation of all of the record types described in this section has been enabled;
- that the HLR interrogation records are produced in the HLR and not the interrogating MSC server;
- that supplementary service actions are recorded in separate charging data records.

The following conventions have been used for the figures contained within this subclause:

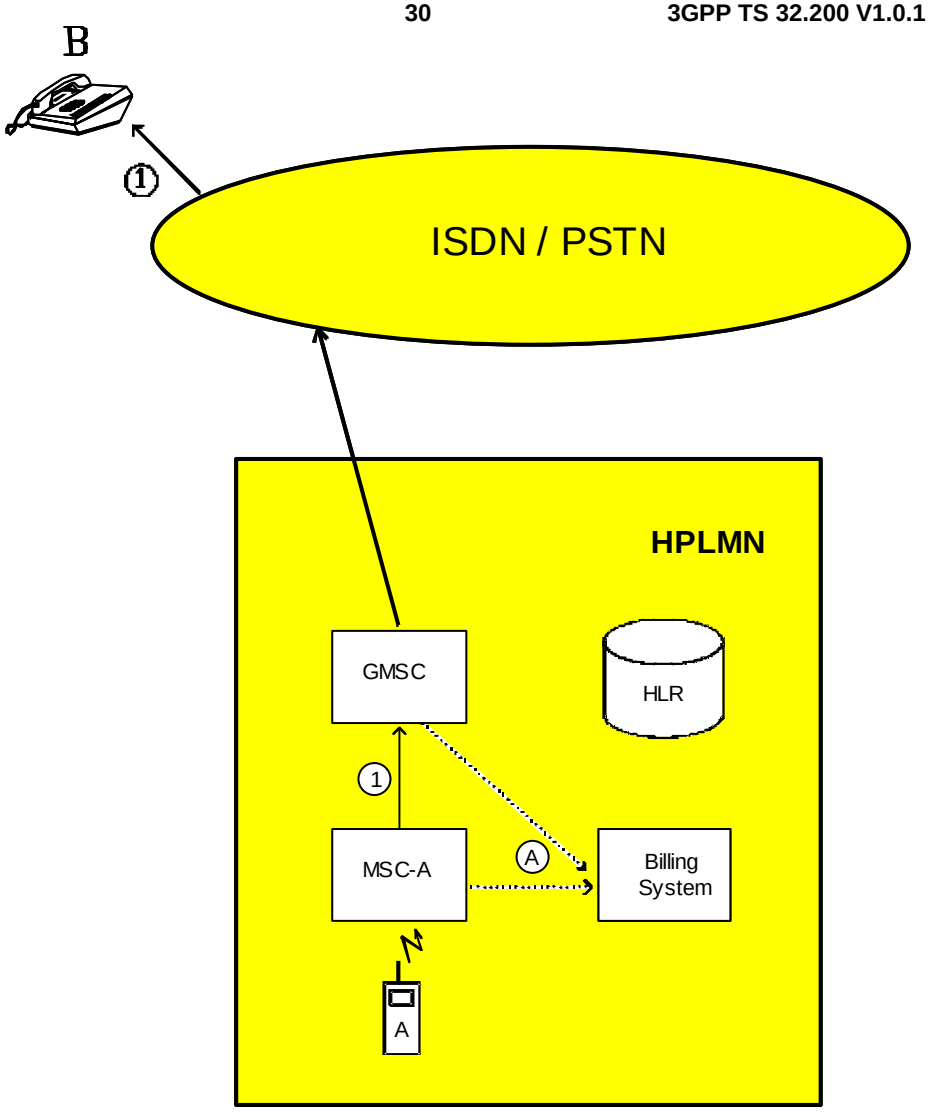
1) Network connections and signalling transactions are illustrated by means of solid lines and referenced by number e.g. (1).

2) Operation & Maintenance actions, such as the transfer of charging data records, are represented by means of dotted lines and referenced by letter e.g. (A).

3) The Billing Systemhas been included in some, but not all, of the examples. The only reason for this decision is to simplify the resulting figures. For the avoidance of doubt, the presence of a Billing Systemis assumed even if not explicitly included.

The following examples are included:

1) Mobile to Land (outgoing) call;
2) Land to Mobile (incoming) call;
3) Mobile to Mobile call within the same network;
4) Incoming call to a roaming subscriber;
5) Incoming call to a PLMN Service Centre;
6) Call Forwarding Unconditional;
7) Call Forwarding conditional (on Busy);
8) Delivery of a Mobile Terminated Short Message;
9) Call Hold and Multi-party services;
10) Outgoing call handled by CAMEL;
11) Incoming call handled by CAMEL without redirection;
12) Incoming call to a roaming subscriber handled by CAMEL;
13) Incoming call handled by CAMEL with redirection decided and forwarding leg handled by CAMEL;
14) Incoming call handled by CAMEL without redirection and forwarded early using GSM SS but controlled by CAMEL;
15) Incoming call handled by CAMEL without redirection and forwarded late using GSM SS but controlled by CAMEL;
16) Early forwarded call controlled by CAMEL;
17) Late forwarded call controlled by CAMEL;
18) Incoming call handled by CAMEL with redirection initated by CAMEL feature.



5.2.2.1 Mobile to land (outgoing) call

Figure 5illustrates a simple outgoing call from a PLMN subscriber "A" to a fixed network subscriber "B" (1).

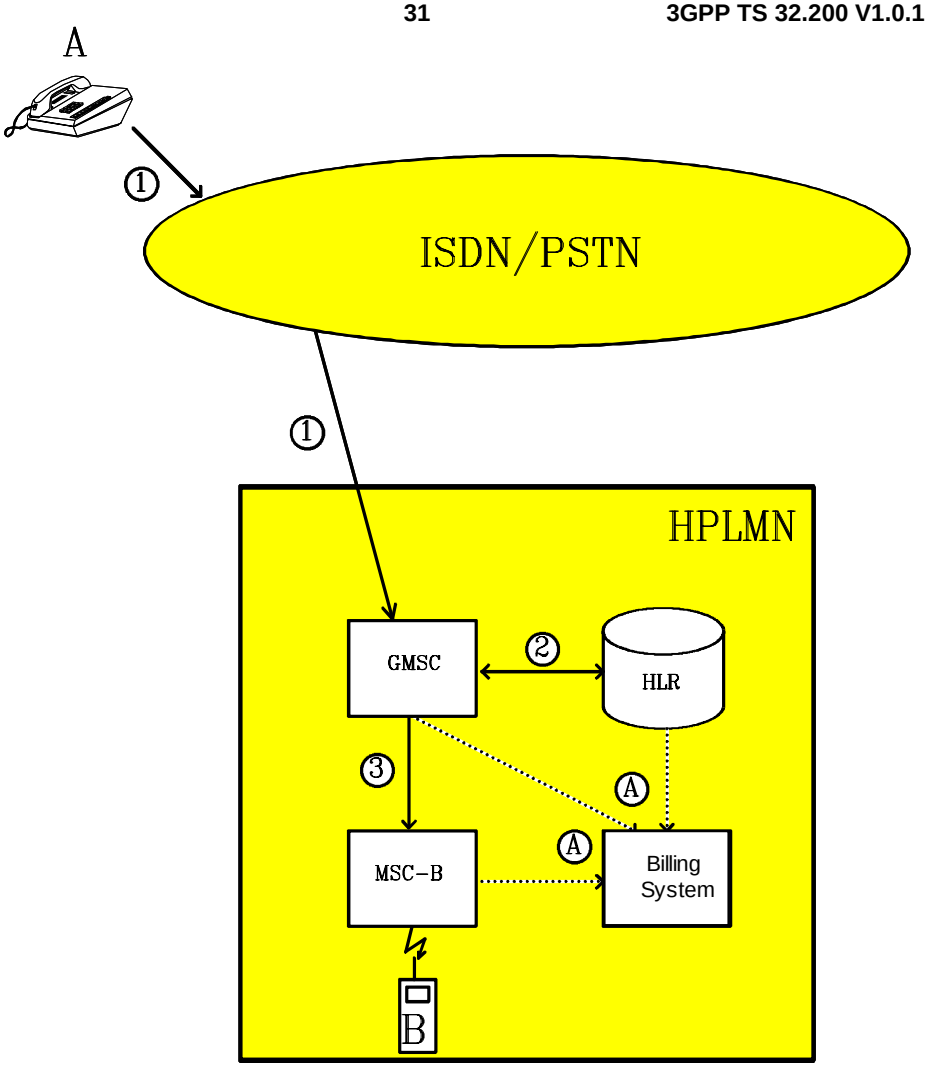
The originating MSC server (MSC-A) shall generate an MOC record for subscriber "A".

The GMSC server shall create an outgoing gateway record for accounting with the fixed network including details of the point at which the call left the PLMN i.e. the GMSC server id. and outgoing trunk group. This record also includes time stamps to determine both the holding time of the outgoing trunk and the duration of the conversation.

For the avoidance of doubt, even if the MSC server and GMSC server are co-located both records shall be produced.

The records generated are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

Figure 5: Mobile to land (outgoing) call



5.2.2.2 Land to mobile (incoming) call

Figure 6illustrates a simple incoming call from a fixed network subscriber "A" to a PLMN subscriber "B".

The incoming call is first routed to a GMSC server (1). The GMSC server shall create an incoming gateway record for fixed network accounting purposes to record the point at which the call entered the network together with the time stamps required to calculate the holding time of the incoming trunk and the conversation duration. This gateway record shall contain the IMSI of the called subscriber.

The GMSC server interrogates the HLR of the called subscriber in order to determine his current location (2). The HLR shall create an HLR interrogation charging data record.

The GMSC server routes the call to the MSC server at which the subscriber is currently registered (3). This terminating MSC server (MSC-B) shall create an MTC record for subscriber "B".

For the avoidance of doubt, even if the MSC server and GMSC server are co-located both the MTC and gateway records shall be produced.

The records generated are subsequently transferred to the post-processing system either on release of the connection or when collected by the post-processing system (A).

Figure 6: Land to mobile (incoming) call

5.2.2.3 Mobile to mobile call within the same network

Figure 7illustrates a simple mobile to mobile call from subscriber "A" to subscriber "B" both within the same PLMN.

The originating MSC server (MSC-A) shall produce an MOC record for the call to subscriber "B".

Having received a setup request from subscriber "A" (1), MSC-A interrogates the HLR of the called subscriber in order to determine his current location (2). The HLR shall create an HLR interrogation charging data record.

MSC-A routes the call to the MSC server at which subscriber is currently registered (3). This terminating MSC server (MSC-B) shall create an MTC record for subscriber "B". If MSC-A and MSC-B are co-located then two records, one MOC and one MTC, shall be produced for this call.

The records generated are subsequently transferred to the post-processing system either immediately following the release of the connection or when collected by the post-processing system.

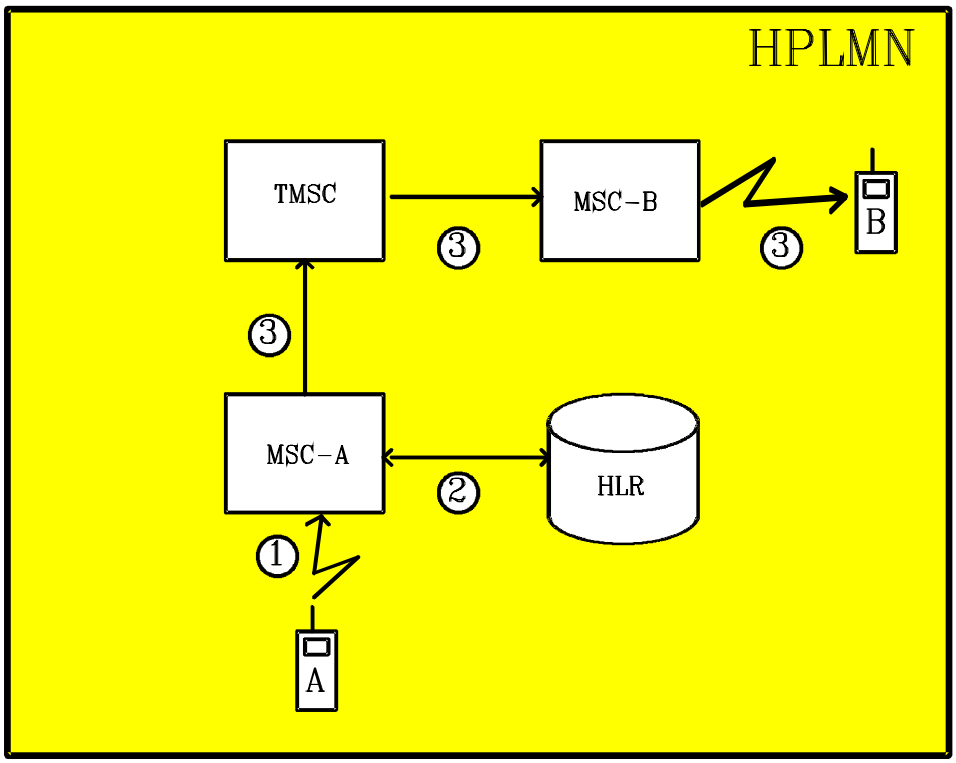
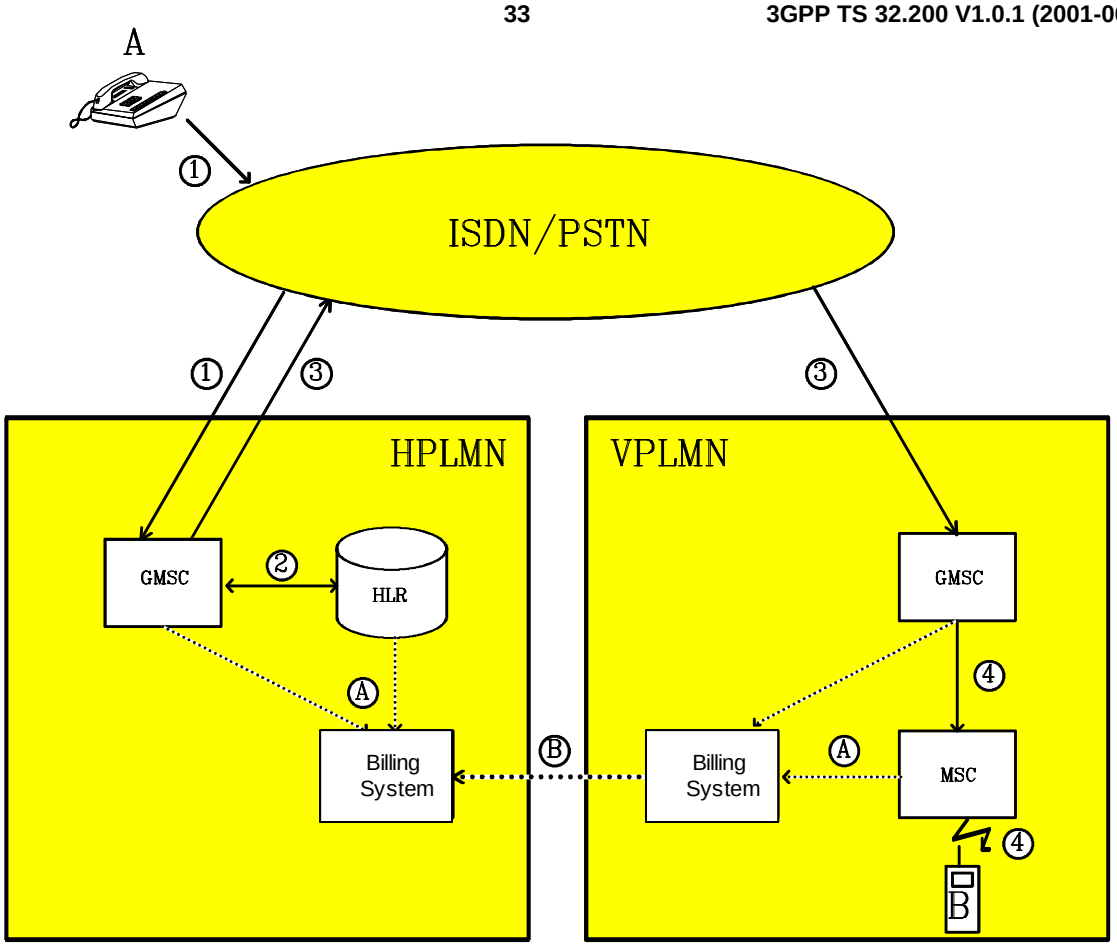


Figure 7: Mobile to mobile call



5.2.2.4 Incoming call to a roaming subscriber

Figure 8illustrates an incoming call from a fixed network subscriber "A" to a PLMN subscriber "B" who is currently roaming in another PLMN.

The call is first routed to a GMSC server (1) and the GMSC server shall create an incoming gateway record for accounting purposes as described in subclause 5.2.2.2. The GMSC server interrogates the HLR of the called subscriber in order to determine his current location (2). The HLR shall create an Interrogation event record.

The GMSC server routes the call to the VPLMN in which subscriber "B" is currently located (3). The GMSC server shall create an outgoing gateway record for accounting purposes. The GMSC server shall also create a roaming record. This record includes the IMSI of the "B" subscriber and may be used as a cross-check for the TAP information received from the VPLMN.

The call is then routed by the VPLMN to the MSC server at which the subscriber is currently located (4). The GMSC server of the VPLMN shall produce an incoming gateway record and the terminating MSC server shall create an MTC record for the call to "B".

The records generated are subsequently transferred to the post-processing system of the appropriate PLMN (A). The MTC record generated by the terminating MSC server shall be employed to create the appropriate MTC TAP record. The TAP records shall be included in a TAP file and transmitted to the HPLMN (B).

Figure 8: Incoming call to a roaming subscriber

5.2.2.5 Incoming call to a PLMN service centre

Figure 9illustrates an incoming call from a fixed network subscriber "A" to a Service Centre directly connected to an MSC server within a PLMN network. Examples for services provided by such a Service Centre include Voice Mail services, Operator services etc.

The call is routed to a GMSC server within the PLMN (1). The GMSC server analyzes the dialled digits and routes the call directly to the MSC server to which the Service Centre is connected (2).

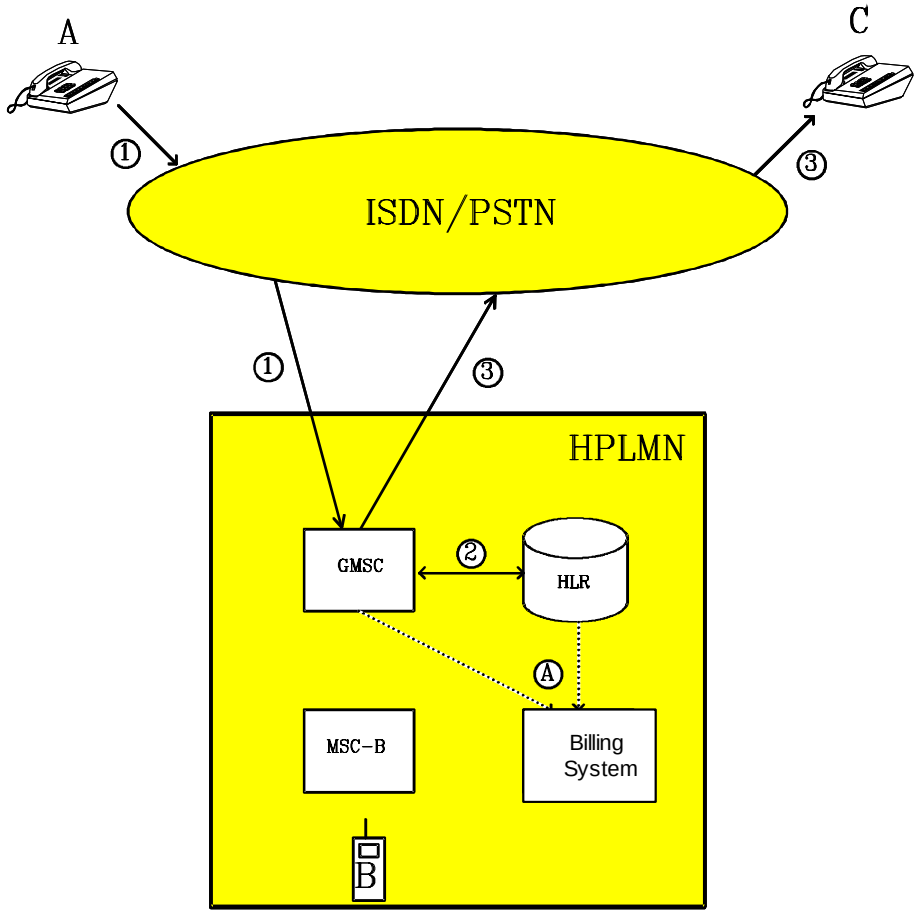
As HLR interrogation is not required, there will be no HLR Interrogation record. The GMSC server shall however, create an incoming gateway record based on the point at which the call entered the network and the destination (Service Centre) of the call.

The MSC server then connects the calling subscriber to the service centre. As no mobile subscriber is involved, the MSC server will not create an MTC record, however, the MSC server shall create a transit record describing the destination of the call.

The records generated are subsequently transferred to the post-processing system of the PLMN (A).

It should be noted that without the transit record, the MSC server would not generate a record for this connection.

Figure 9: Incoming call to a PLMN service centre



5.2.2.6 Call forwarding unconditional

Figure 10 illustrates an incoming call from a fixed network subscriber "A" to a mobile subscriber "B" who has registered and activated Call Forwarding Unconditional (CFU) for the appropriate service. The call is subsequently forwarded to a second fixed network subscriber "C".

For simplicity the registration and activation of CFU have not been included in the diagram. These actions shall of course be recorded in the appropriate supplementary service records.

The incoming call is routed to a GMSC server (1). This part of the connection is identical to the scenario outlined in subclause 5.2.2.2.

The GMSC server interrogates the HLR of the called subscriber in order to determine his current location (2). The HLR shall create an HLR interrogation charging data record. The HLR informs the GMSC server that "B" has activated CFU to subscriber "C".

The GMSC server forwards the call to the fixed network subscriber "C" (3). The GMSC server shall create an MTC record for the "B" subscriber for the call from "A" and an MOC (call forwarding) record for the "B" subscriber for the call to "C". Both records shall contain the supplementary service employed (CFU). The GMSC server shall also produce an outgoing gateway record as described in subclause 5.2.2.1.

The records generated are subsequently transferred to the post-processing system of the HPLMN (A).

Figure 10: Call forwarding unconditional

5.2.2.7 Call forwarding conditional (on busy)

Figure 11 illustrates a mobile originated call from subscriber "A" to a second mobile subscriber "B" who has registered and activated Call Forwarding on Busy (CFB) for the appropriate service. The call is subsequently forwarded to a third mobile subscriber "C". In this example, all three subscribers are currently located within the same (the home) network.

For simplicity the registration and activation of CFB have not been included in the diagram.

Having received a setup request from subscriber "A" (1), the originating MSC server (MSC-A) interrogates the HLR of subscriber "B" in order to determine his current location (1a). The call is then routed to MSC-B (2).

MSC-A shall create an MOC record for subscriber "A" containing details of the call to "B". The HLR shall produce an HLR interrogation record.

On determining that subscriber "B" is busy and that CFB is active, the forwarding MSC server/VLR (MSC-B) interrogates the HLR of subscriber "C" to determine his current location (2a) and forwards the call accordingly (3).

MSC-B shall produce an MTC record for the "B" subscriber for the call from "A" and an MOC record for the "B" subscriber for the call to "C". Both records shall include the supplementary service employed (CFB). The HLR shall produce an Interrogation record.

The terminating MSC server (MSC-C) shall create a normal MTC record for subscriber "C".

The records generated are subsequently transferred to the post-processing system of the PLMN.

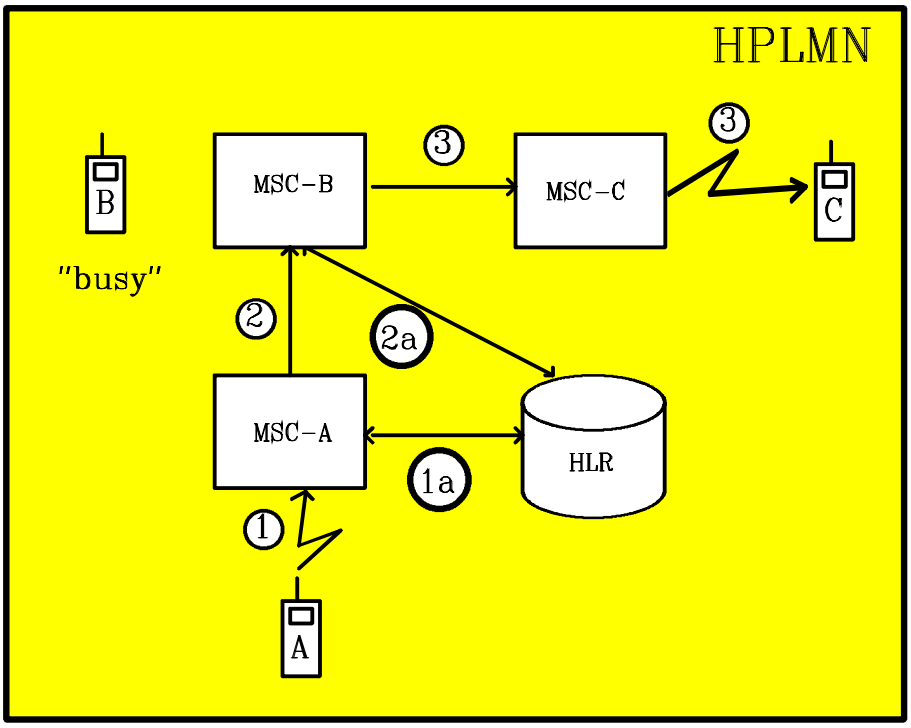
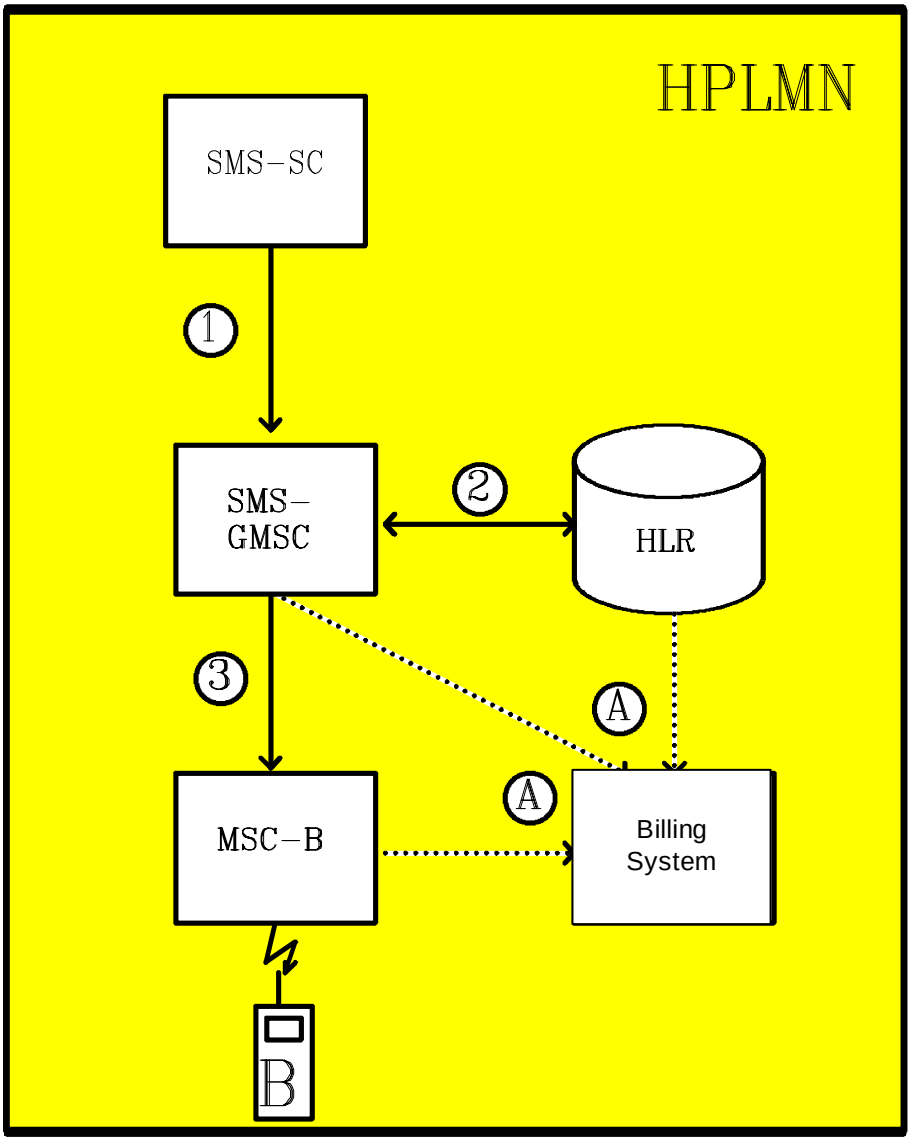


Figure 11: Call forwarding conditional (busy)



5.2.2.8 Delivery of a mobile terminated short message

Figure 12 illustrates the delivery of a short message to a mobile subscriber.

The short message service center delivers the message to a GMSC server or gateway function (1). The GMSC server shall create an SMS gateway MT record.

The GMSC server then interrogates the HLR of the subscriber to determine his current location (2). The HLR shall create an HLR interrogation record.

The message is subsequently transmitted to the MSC server serving the mobile subscriber and finally to the mobile station of that subscriber (3). The MSC server shall create an SMS MT record.

The records generated are subsequently transferred to the post-processing system of the HPLMN (A).

Figure 12: Delivery of a short message to a mobile subscriber

5.2.2.9 Call hold and multi-party service

Figure 13illustrates the use of the call hold and multi-party services.

A mobile subscriber ("A") sets up an outgoing call (1) to an ISDN subscriber ("B"). This call is recorded as outlined in subclause 5.2.2.1.

Subscriber "A" then invokes the call hold service. MSC-A shall produce a supplementary service action record for the invocation.

Subscriber "A" then sets up a side-call (2) to a second mobile subscriber ("C") within the same network. This call is recorded as outlined in subclause 5.2.2.3.

Subscriber "A" subsequently invokes the multi-party service in order to set up a three-party conference with "B" and "C". MSC-A shall produce a common equipment record for the use of a conference circuit by subscriber "A". This record shall record the duration of the whole conference irrespective of the number of parties subsequently added to, or removed from the conference connection.

Note that the MOC records produced by MSC-A for both the A -> B and A -> C legs of the conference shall contain the supplementary service code for multi-party.

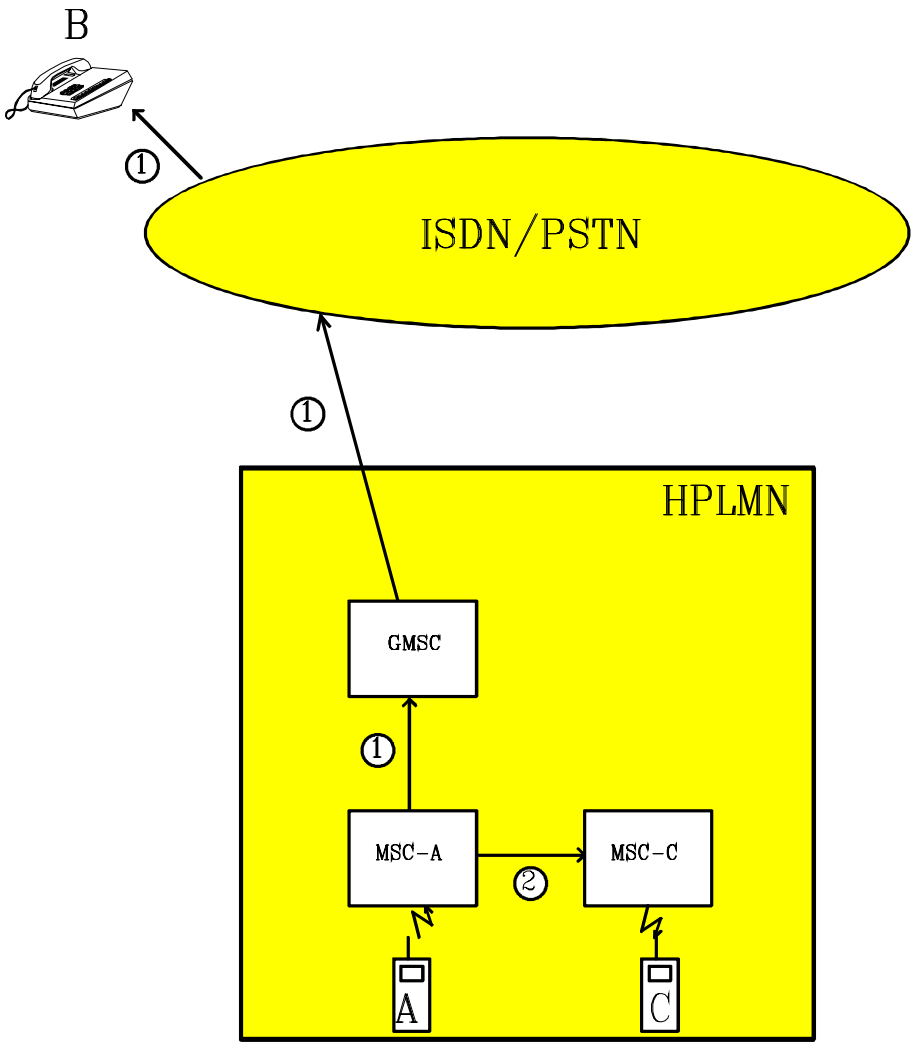


Figure 13: Call hold and multi-party service

5.2.2.10 Outgoing call handled by CAMEL

Figure 14 illustrates an outgoing CAMEL call from a mobile CAMEL subscriber "A" to a fixed network subscriber "B" (1).

The "A" subscriber has an active O-CSI (stored in the VLR). Therefore MSC server-A requests instructions from the gsmSSF which passes the CAMEL service key to the gsmSCF to indicate which service logic it should apply (2).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to MSC-A.

MSC server-A generates an MOC record for the "A" subscriber. This record may be linked to an optional SCF-record. The record includes O-CSI data.

The GMSC server routes the call to the "B" subscriber (3). The GMSC server shall create an outgoing gateway record as described in subclause 5.2.2.1.

The generated records are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

The following records are generated in HPLMN in this call scenario:

Table 1: Records Generated for an Outgoing Call Handled by CAMEL

GMSC server	MSC server	HLR
Outgoing gateway record	MOC record	-

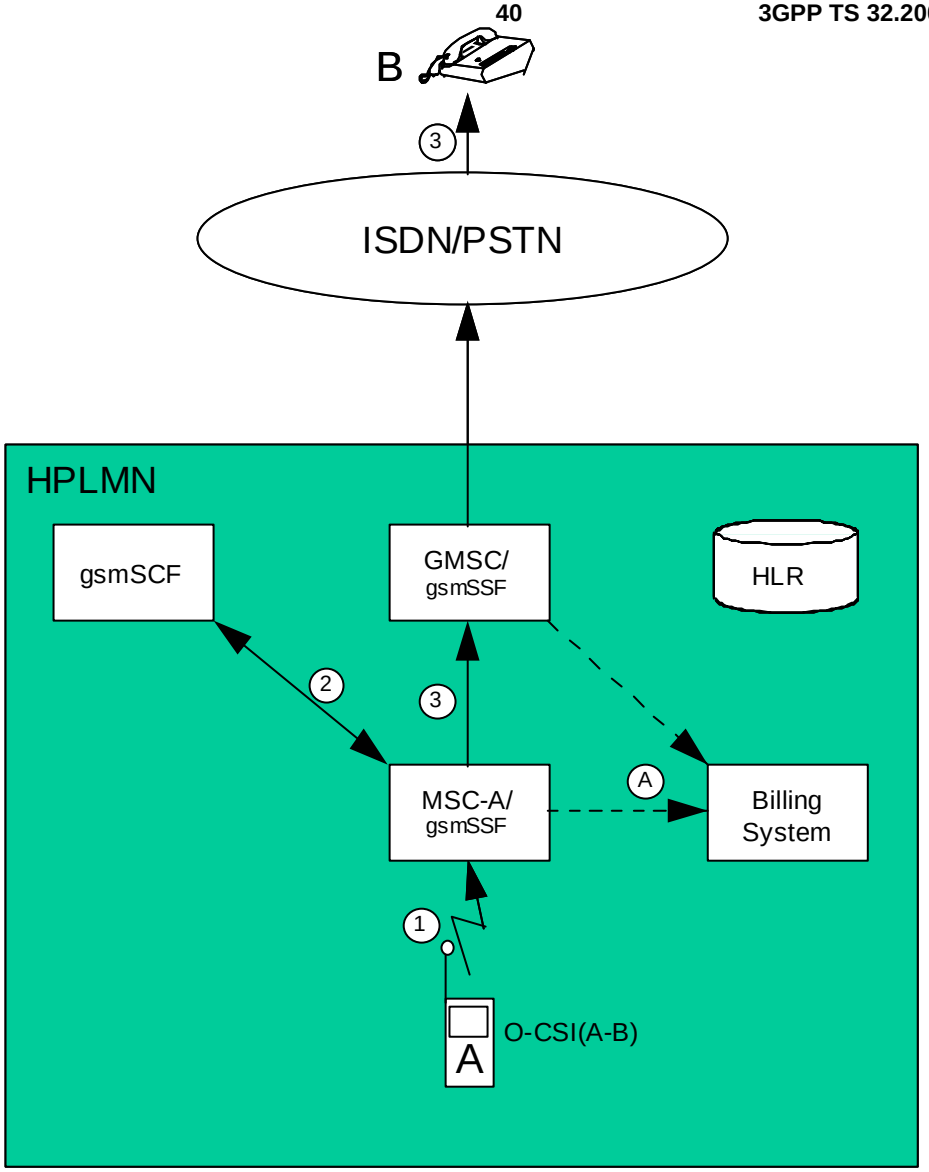


Figure 14: Outgoing call handled by CAMEL

5.2.2.11 Incoming call handled by CAMEL without redirection

Figure 15 illustrates an incoming call from a fixed network subscriber "A" to a mobile CAMEL subscriber "B".

The incoming call is first routed to the GMSC server (1). The GMSC server shall create an incoming gateway record for fixed network accounting purposes.

The GMSC server interrogates the HLR of the called subscriber in order to fetch the T-CSI (2). The HLR shall create an HLR interrogation record.

The "B" subscriber has an active T-CSI. Therefore the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to a gsmSCF to indicate which service logic it should apply (3).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to the GMSC server. The GMSC server shall generate a terminating CAMEL interrogation record which contains T-CSI data.

The GMSC server interrogates the HLR in order to determine his current location (4). The HLR shall create an HLR interrogation record.

The call is routed to MSC-B (5). An MTC record shall be generated.

For avoidance of doubt, even if the MSC server and GMSC server are co-located both the MTC and gateway records shall be produced.

The generated records are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

The following records are generated in HPLMN in this call scenario:

Table 2: Records Generated for an Incoming Call Handled by CAMEL without Re-direction

GMSC server	MSC server	HLR
Incoming gateway record	MTC record	HLR interrogation record
Terminating CAMEL int. record		

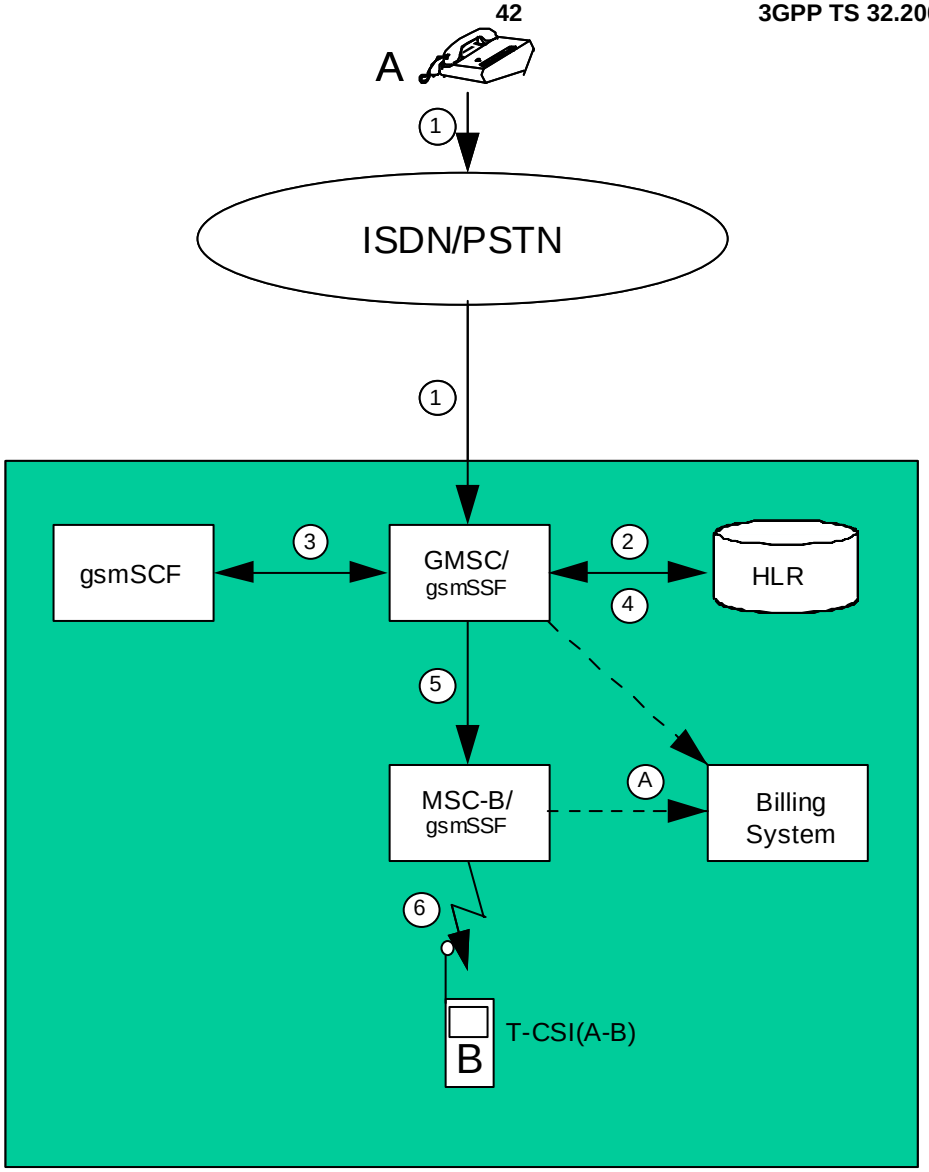


Figure 15: Incoming call handled by CAMEL without redirection

5.2.2.12 Incoming call to a roaming subscriber handled by CAMEL

Figure 16 illustrates an incoming call from a fixed network subscriber "A" to a mobile CAMEL subscriber "B" who is currently roaming in another PLMN.

The call is first routed to a GMSC server (1) and the GMSC server shall create an incoming gateway record for fixed network accounting purposes.

The GMSC server interrogates the HLR of the called subscriber in order to fetch the T-CSI (2). The HLR shall create an HLR interrogation record.

The "B" subscriber has an active T-CSI. Therefore the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to a gsmSCF to indicate which service logic it should apply (3).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to the GMSC server . The GMSC server shall generate a terminating CAMEL interrogation record which contains T-CSI data.

The GMSC server interrogates the HLR in order to determine his current location (4). The HLR shall create an HLR interrogation record.

The GMSC server routes the call to the VPLMN in which subscriber "B" is currently located (5). The GMSC server shall create an outgoing gateway record for accounting purposes. The GMSC server shall also create a roaming record. This record includes the IMSI of the "B" subscriber and may be used as a cross-check for the TAP information received from the VPLMN.

The call is then routed by the VPLMN to the MSC server at which the subscriber is currently located (6). The GMSC server of the VPLMN shall produce an incoming gateway record and the terminating MSC server shall create an MTC record for the call to "B".

The records generated are subsequently transferred to the post-processing system of the appropriate PLMN (A). The MTC record generated by the terminating MSC server shall be employed to create the appropriate MTC TAP record. The TAP records shall be included in a TAP file and transmitted to the HPLMN (B).

The following records are generated in HPLMN in this call scenario:

Table 3: Records Generated in the HPLMN for an Incoming Call to a Roaming Subscriber Handled by CAMEL

GMSC server	MSC server	HLR
Incoming gateway record	-	HLR interrogation record
Terminating CAMEL int. record		
Roaming record		
Outgoing gateway record		

The following records are generated in VPLMN in this call scenario:

Table 4: Records Generated in the VPLMN for an Incoming Call to a Roaming Subscriber Handled by CAMEL

GMSC server	MSC server	HLR
Incoming gateway record	MTC record	-

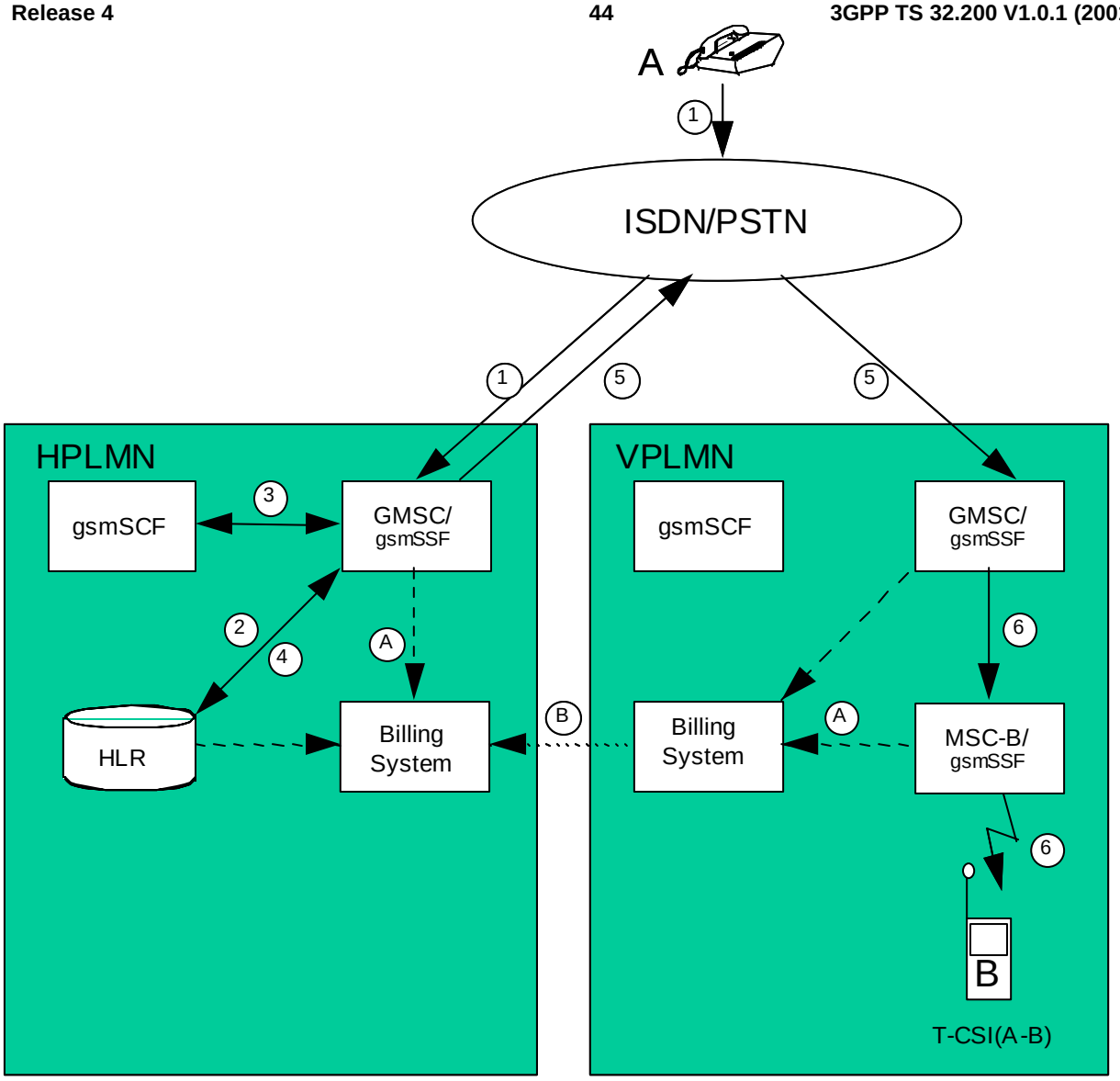


Figure 16: Incoming call to a roaming subscriber handled by CAMEL

5.2.2.13 Incoming call handled by CAMEL with redirection decided and forwarding leg handled by CAMEL

Figure 17 illustrates an incoming call from a fixed network subscriber "A" to a mobile CAMEL subscriber "B". The call is subsequently forwarded to a second fixed network subscriber "C" by CAMEL initiated Call Forwarding.

The incoming call is routed to the GMSC server (1). The GMSC server shall create an incoming gateway record for fixed network accounting purposes.

The GMSC server interrogates the HLR of the called subscriber in order to fetch the T-CSI and O-CSI (2).

The "B" subscriber has an active T-CSI. Therefore the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to a gsmSCF to indicate which service logic it should apply (3).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

The gsmSCF modifies the Called Party number and sets the CAP parameter ‘Apply O-CSI’. When gsmSCF processing is complete the call control is returned to the GMSC server. The GMSC server shall generate a terminating CAMEL interrogation record which contains T-CSI data.

The "B" subscriber has an active O-CSI. Therefore the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to a gsmSCF to indicate which service logic it should apply (4).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to the GMSC server.

The GMSC server redirects the call to the fixed network subscriber "C" (5). The GMSC server shall generate an MTC record for the "B" subscriber for the call from "A" and an MOC (call forwarding) record for the "B" subscriber for the call to "C". The MOC record includes O-CSI data and the parameter ‘CAMEL initiated CF indicator’. The GMSC server shall also produce an outgoing gateway record as described in subclause 5.2.2.1.

The generated records are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

The following records are generated in HPLMN in this call scenario:

Table 5: Records Generated in the Incoming Call with Redirection Decided and Forwarded Leg Handled by CAMEL

GMSC server	MSC server	HLR
Incoming gateway record	-	HLR interrogation record
Terminating CAMEL int. record		
MTC record		
MOC (CF) record		
Outgoing gateway record		

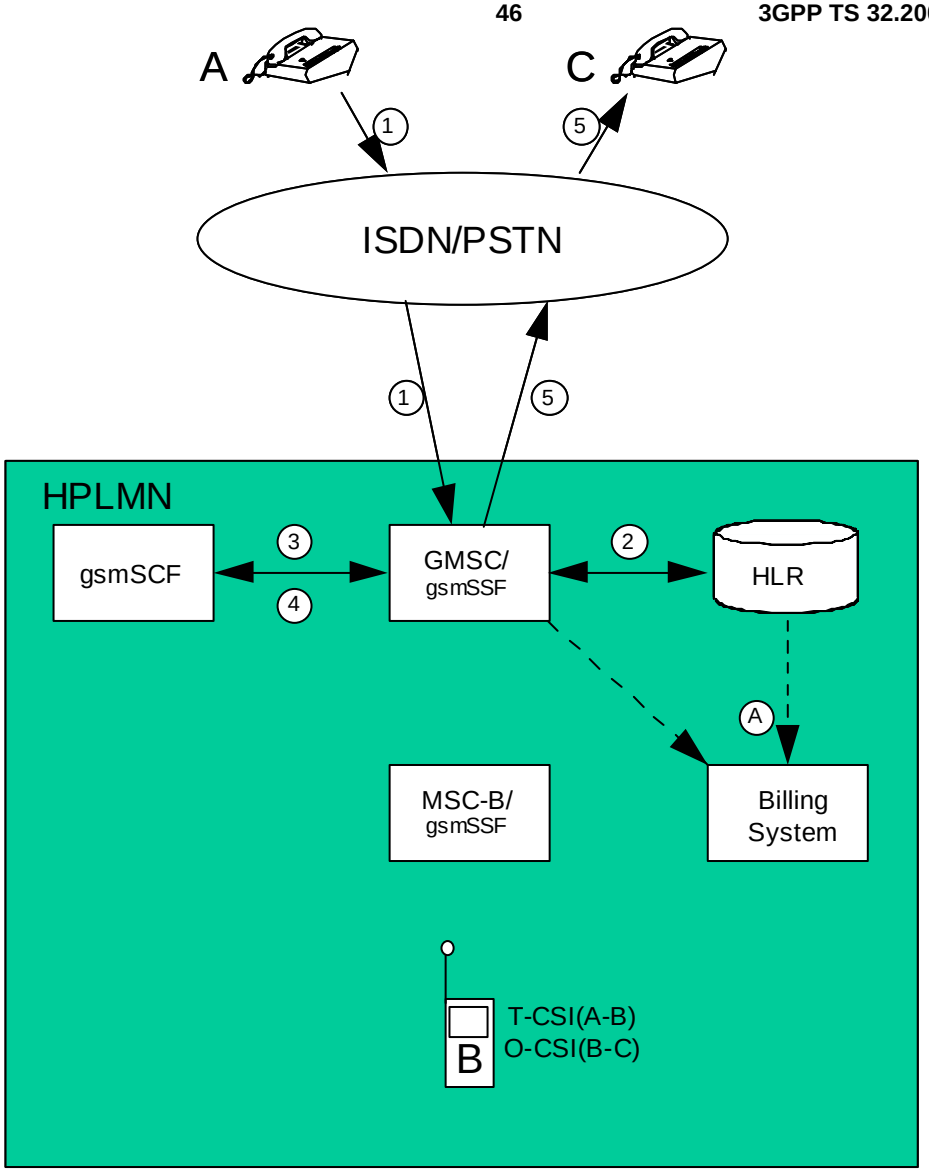


Figure 17: Incoming call handled by CAMEL with redirection decided and forwarding leg handled by CAMEL

5.2.2.14 Incoming call handled by CAMEL without redirection and forwarded early using GSM SS but controlled by CAMEL

Figure 18 illustrates an incoming call from a fixed network subscriber "A" to a mobile CAMEL subscriber "B". The call is subsequently forwarded to a second fixed network subscriber "C" by GSM SS Call Forwarding Unconditional (CFU) but controlled by CAMEL.

For simplicity the activation and registration of CFU have not been included in the diagram. These actions shall of course be registrated in the appropriate supplementary service records.

The incoming call is routed to the GMSC server (1). The GMSC server shall create an incoming gateway record for fixed network accounting purposes.

The GMSC server interrogates the HLR of the called subscriber in order to fetch the T-CSI and O-CSI (2). The HLR shall create an HLR interrogation record. The HLR informs the GMSC server that "B" has activated CFU.

The "B" subscriber has an active T-CSI. Therefore the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to a gsmSCF to indicate which service logic it should apply (3).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to the GMSC server. The GMSC server shall generate a terminating CAMEL interrogation record which contains T-CSI data.

The "B" subscriber has an active O-CSI. Because the "B" subscriber has activated CFU he acts as the originating party for the forwarded leg. Therefore the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to a gsmSCF to indicate which service logic it should apply (5).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to the GMSC server.

The GMSC server redirects the call to the fixed network subscriber "C" (6). The GMSC server shall generate an MTC record for the "B" subscriber for the call from "A" and an MOC (call forwarding) record for the "B" subscriber for the call to "C". The MOC record includes O-CSI data. The GMSC server shall also produce an outgoing gateway record as described in subclause 5.2.2.1.

If the B-subscriber do not have an active O-CSI the call is forwarded to the "C" subscriber after the first gsmSCF invocation.

The generated records are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

The following records are generated in HPLMN in this call scenario:

Table 6: Records Generated in the Incoming call handled by CAMEL without redirection and forwarded early using GSM SS but controlled by CAMEL

GMSC server	MSC server	HLR
Incoming gateway record	-	HLR interrogation record
Terminating CAMEL int. record		
MTC record		
MOC (CF) record		
Outgoing gateway record		

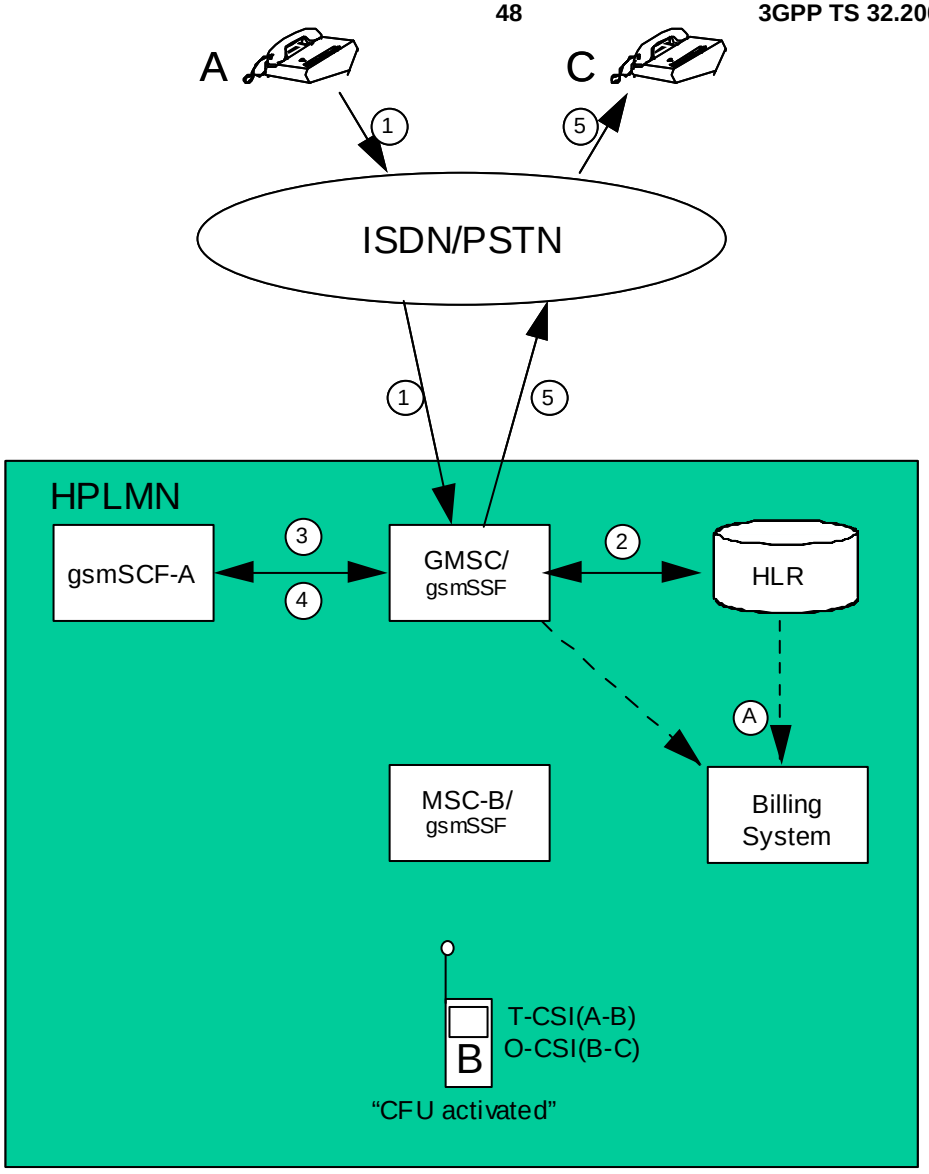


Figure 18: Incoming call handled by CAMEL without redirection and forwarded early using GSM SS but controlled by CAMEL

5.2.2.15 Incoming call handled by CAMEL without redirection and forwarded late using GSM SS but controlled by CAMEL

Figure 19 illustrates an incoming call from a fixed network subscriber "A" to a mobile CAMEL subscriber "B" who has registered and activated Call Forwarding on No Reply (CFNRY) for the appropriate service. The call is subsequently forwarded to a second fixed network subscriber "C".

For simplicity the registration and activation of CFNRY have not been included in this diagram. These actions shall be recorded in the appropriate supplementary service records.

The incoming call is routed to the GMSC server (1). The GMSC server shall create an incoming gateway record for fixed network accounting purposes.

The GMSC server interrogates the HLR of the called subscriber in order to fetch the T-CSI and O-CSI (2). The HLR shall create an HLR interrogation record.

The "B" subscriber has an active T-CSI. Therefore the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to the gsmSCF to indicate which service logic it should apply (3).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to the GMSC server. The GMSC server shall generate a terminating CAMEL interrogation record which contains T-CSI data.

The GMSC server interrogates the HLR in order to determine his current location (4). The HLR shall create an HLR interrogation record.

The call is routed to MSC-B (5). The "B" subscriber do not answer the call. MSC-B shall produce an MTC record for the "B" subscriber for the call from "A".

The "B" subscriber has an active O-CSI. Because the "B" subscriber has activated CFNRY he acts as the originating party for the forwarded leg. Therefore MSC-B requests instructions from the gsmSSF which passes the CAMEL service key to the gsmSCF to indicate which service logic it should apply (6).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to MSC-B.

MSC-B forwards the call via the GMSC server to the "C" subscriber (7). MSC-B shall produce an MOC (call forwarding) for the "B" subscriber for the call to "C". The record includes O-CSI data. The GMSC server shall also produce an outgoing gateway record as described in subclause 5.2.2.1.

If the B-subscriber do not have an active O-CSI the call is forwarded to the "C" subscriber after detecting the call forwarding condition.

The generated records are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

The following records are generated in HPLMN in this call scenario:

Table 7: Records Generated in the Incoming call handled by CAMEL without redirection and forwarded late using GSM SS but controlled by CAMEL

GMSC server	MSC server	HLR
Incoming gateway record	MTC record	-
Terminating CAMEL int. record	MOC (CF) record	
Outgoing gateway record		

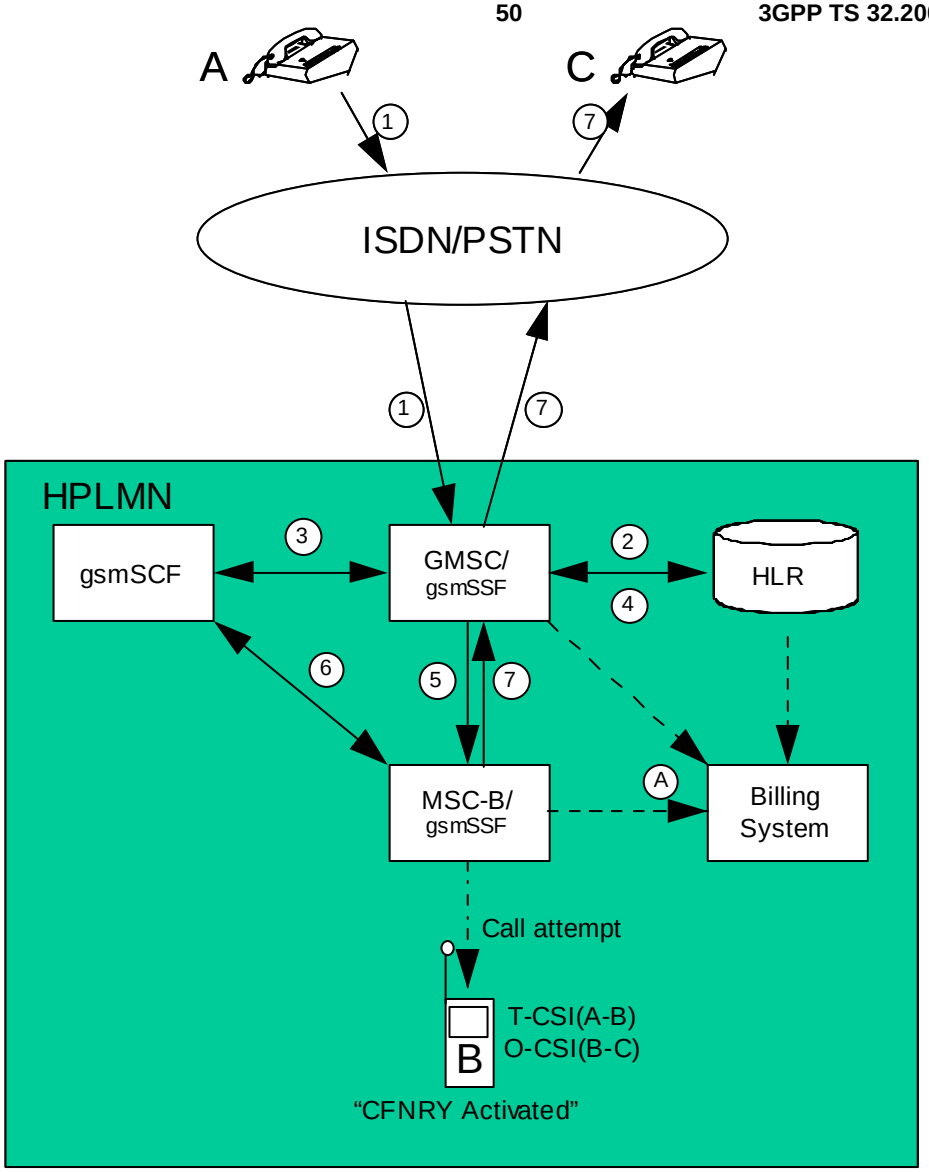


Figure 19: Incoming call handled by CAMEL without redirection and forwarded late using GSM SS but controlled by CAMEL

5.2.2.16 Early forwarded call controlled by CAMEL

Figure 20 illustrates an incoming call from a fixed network subscriber "A" to a mobile CAMEL subscriber "B". The call is subsequently forwarded to a second fixed network subscriber "C" by GSM SS Call Forwarding Unconditional (CFU) but controlled by CAMEL.

For simplicity the activation and registration of CFU have not been included in the diagram. These actions shall of course be registrated in the appropriate supplementary service records.

The incoming call is routed to the GMSC server (1). The GMSC server shall create an incoming gateway record for fixed network accounting purposes.

The GMSC server interrogates the HLR of the called subscriber in order to fetch the O-CSI (2). The HLR shall create an HLR interrogation record. The HLR informs the GMSC server that "B" has activated CFU.

The "B" subscriber has an active O-CSI. Because the "B" subscriber has activated CFU he acts as the originating party for the forwarded leg. Therefore the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to a gsmSCF to indicate which service logic it should apply (3).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to the GMSC server.

The GMSC server redirects the call to the fixed network subscriber "C" (5). The GMSC server shall generate an MTC record for the "B" subscriber for the call from "A" and an MOC (call forwarding) record for the "B" subscriber for the call to "C". The MOC record includes O-CSI data. The GMSC server shall also produce an outgoing gateway record as described in subclause 5.2.2.1.

The generated records are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

The following records are generated in HPLMN in this call scenario:

Table 8: Records Generated in the Early forwarded call controlled by CAMEL

GMSC server	MSC server	HLR
Incoming gateway record	-	HLR interrogation record
MTC record		
MOC (CF) record		
Outgoing gateway record		

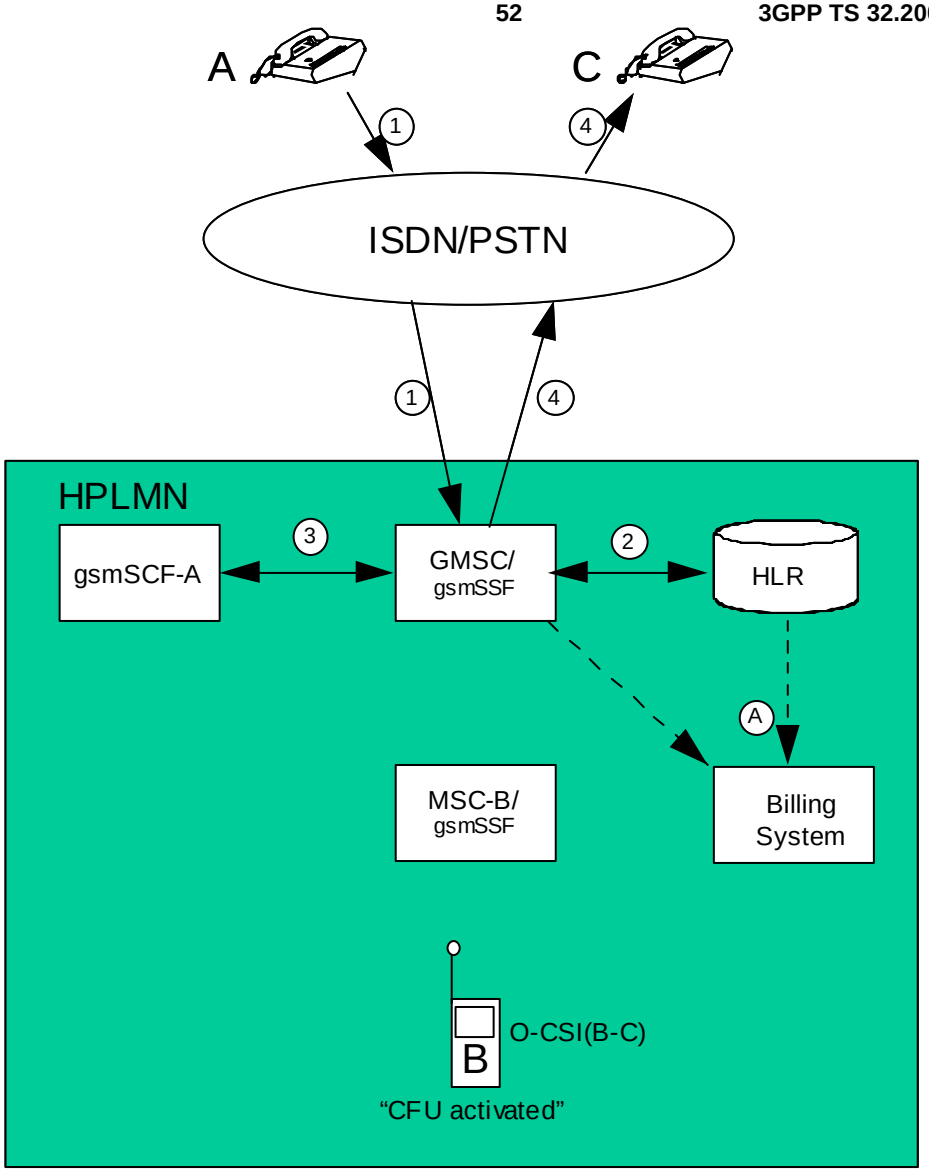


Figure 20: Early forwarded call controlled by CAMEL

5.2.2.17 Late forwarded call controlled by CAMEL

Figure 21 illustrates an incoming call from a fixed network subscriber "A" to a mobile CAMEL subscriber "B" who has registered and activated Call Forwarding on No Reply (CFNRY) for the appropriate service. The call is subsequently forwarded to a second fixed network subscriber "C".

For simplicity the registration and activation of CFNRY have not been included in this diagram. These actions shall be recorded in the appropriate supplementary service records.

The incoming call is routed to the GMSC server (1). The GMSC server shall create an incoming gateway record for fixed network accounting purposes.

The GMSC server interrogates the HLR of the called subscriber in order to determine the current location (2). The HLR shall create an HLR interrogation record.

The call is routed to MSC-B (3). The "B" subscriber do not answer the call. MSC-B shall produce an MTC record for the "B" subscriber for the call from "A".

The "B" subscriber has an active O-CSI. Because the "B" subscriber has activated CFNRY he acts as the originating party for the forwarded leg. Therefore MSC-B requests instructions from the gsmSSF which passes the CAMEL service key to gsmSCF-B to indicate which service logic it should apply (4).

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

When gsmSCF processing is complete the call control is returned to MSC-B.

MSC-B forwards the call via the GMSC server to the "C" subscriber (5). MSC-B shall produce an MOC (call forwarding) for the "B" subscriber for the call to "C". The record includes O-CSI data. The GMSC server shall also produce an outgoing gateway record as described in subclause 5.2.2.1.

The generated records are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

The following records are generated in HPLMN in this call scenario:

Table 9: Records Generated in the Late forwarded call controlled by CAMEL

GMSC server	MSC server	HLR
Incoming gateway record	MTC record	HLR interrogation record
Outgoing gateway record	MOC (CF) record	

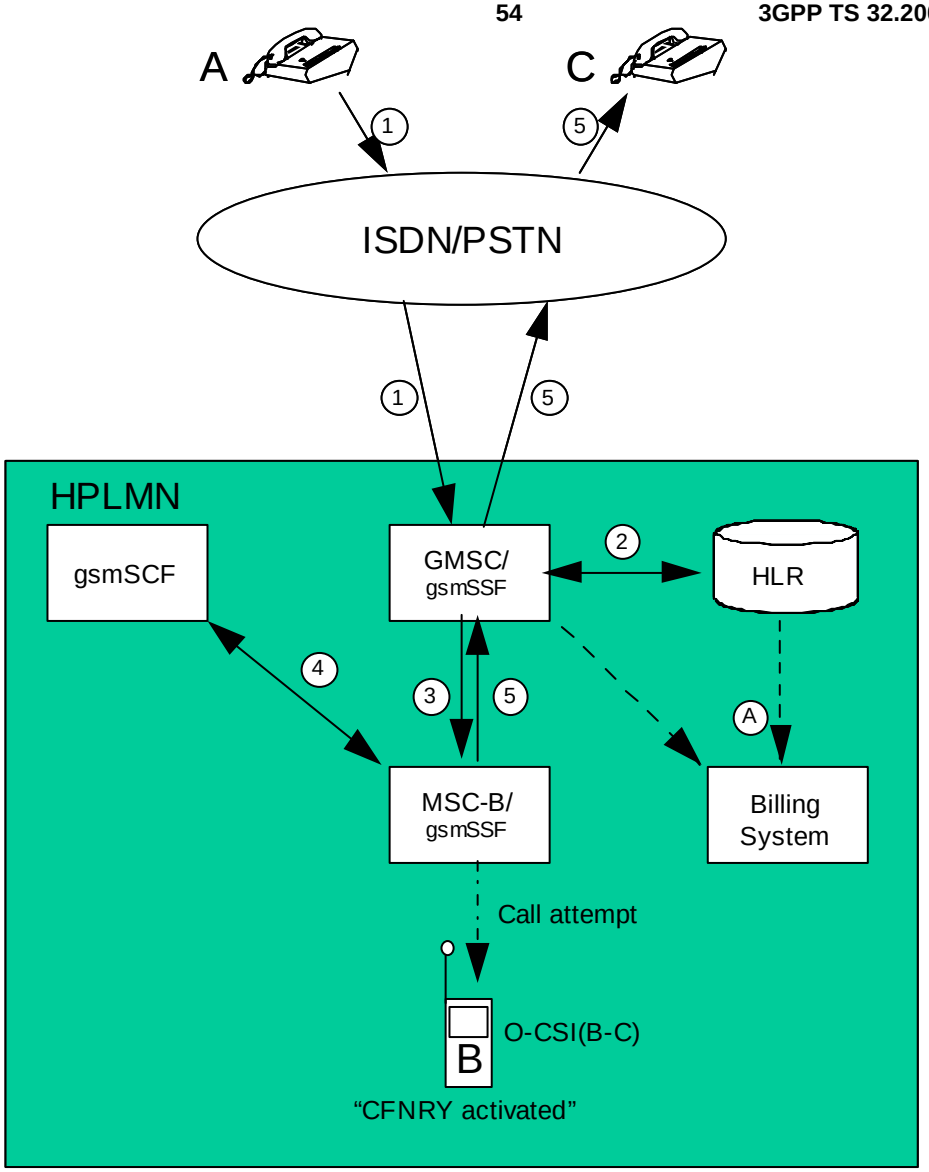


Figure 21: Late forwarded call controlled by CAMEL

5.2.2.18 Incoming call handled by CAMEL with redirection initiated by CAMEL feature

Figure 22 illustrates an incoming call from a fixed network subscriber "A" to a mobile CAMEL subscriber "B". The call is subsequently redirected to a second fixed network subscriber "C" by CAMEL initiated redirection.

The incoming call is routed to the GMSC server (1). The GMSC server shall create an incoming gateway record for fixed network accounting purposes.

The GMSC server interrogates the HLR of the called subscriber in order to fetch the T-CSI (2) and the O-CSI (2). The HLR shall create an HLR interrogation record.

Since subscriber "B" has an active T-CSI and the trigger criterias are met the GMSC server requests instructions from the gsmSSF which passes the CAMEL service key to a gsmSCF to indicate which service logic it should apply (3). A terminating CAMEL interrogation record is generated in the GMSC server for invoking the terminating CAMEL call handling.

The gsmSCF may interrogate the HLR for subscriber information. As a network option, the operator may refuse to provide the requested information.

The gsmSCF returns a modified destination routing address to the GMSC server (without the option "apply O-CSI"). Therefore for the redirection leg (B-C) the CAMEL feature is not invoked.

The GMSC server redirects the call to the fixed network subscriber "C" (4). For fixed network accounting purposes the GMSC server shall generate an outgoing gateway record as described in subclause 5.2.2.1.

The generated records are subsequently transferred to the post-processing system (A) either as event reports following the release of the connection or when collected by the post-processing system.

The following records are generated in HPLMN in this call scenario:

Table 10: Records Generated in the Incoming call handled by CAMEL with redirection initiated by CAMEL feature

GMSC server	MSC server	HLR
Incoming gateway record		HLR interrogation record
Terminating CAMEL interrogation record		
Outgoing gateway record		

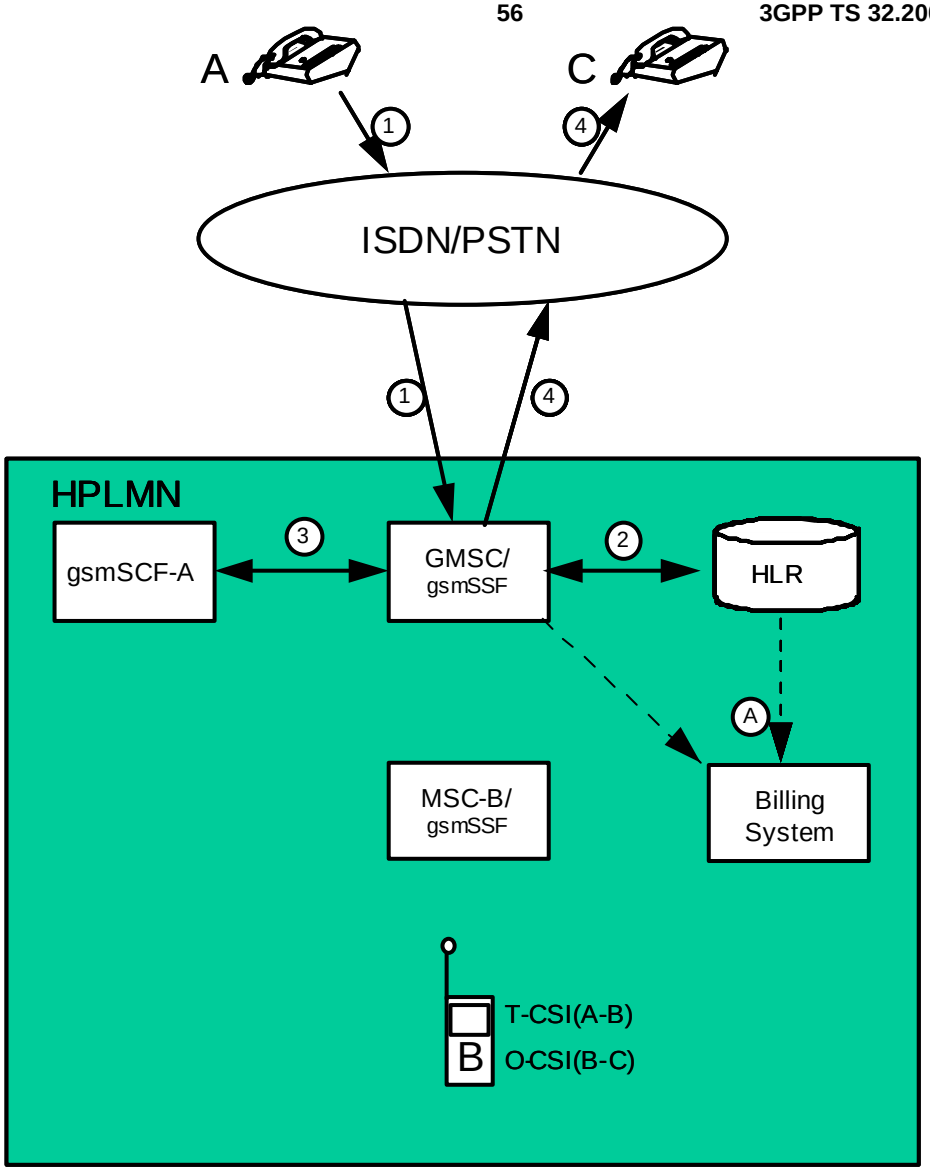


Figure 22: Incoming call handled by CAMEL with redirection initiated and by CAMEL feature

5.2.2.19 CAMEL Scenario for Visiting Terminator Trigger Calls

[To be supplied.]

5.2.2.20 CAMEL Scenario for Dialed CSI Trigger Calls

[To be supplied.]

6. Packet-Switched Domain

6.1 Charging Principles

6.1.1 Requirements

Based on the requirements in 3GPP TS 22.115 [2] here are the specific details relating to the packet domain.

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 specific charging characteristics provided through either HLR subscription data or default values. This is to improve charging record generation efficiency determined by the operator, based on the configuration of CDR trigger parameters at the GSNs.

6) SGSN shall support charging of CAMEL services.

6.1.2 Charging Information

Charging information in the Packet-Switched 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 Packet-Switched 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 categorised 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 Packet-Switched domain resources: the charging information shall describe the usage of other Packet-Switched domain-related resources and the MSs Packet-Switched 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 GGSN is SGSN address.

6.1.3 General Aspects of Charging Data

Call data record generation and contents should be flexible and unnecessary redundancy in data should be avoided.

1. Each PDP context generates its own record types (the S-CDR for the SGSN and the G-CDR for the GGSN related to PDP contexts).

2. The SGSN can optionally provide a record for mobility management of the attached MS in the M-CDR.

3. The SGSN shall provide two SMS related records, in case of Packet-Switched domain delivered MO short message S-SMO-CDR and MT short message S-SMT-CDR.

4. MS Location information shall be included in the SGSN PDP context records.

5. Records shall only include relevant information, i.e. traffic activity since last record.

   The criteria for record generation is based on real-time needs, information safety (backup) and some specific events, such as expiry of the partial record timer(s), transferred data volume limit(s), inter SGSN routing area update, inter/intra system handover.

6. Change of tariff period (if used) should not cause new CDRs to be sent to avoid peaks in data transfer. Instead such events should close the existing volume counters and open new ones when appropriate traffic is detected. This can be done by having a new record in the same message. It is up to the operator how often the CDRs are transferred from a GSN.

7. Both SGSN and GGSN nodes shall collect information from same chargeable sessions (PDP contexts). A unique reference (Charging ID in combination with GGSN address) is needed to enable correlation between information from several records produced from same PDP context.

8. The RNC shall collect the amount of not transferred downlink data, i.e., data that the RNC has either discarded or forwarded to a 2G-SGSN, for an MS's RABs when instructed by the 3G-SGSN.

6.1.4 Volume counting in RNC

The 3G-SGSN counts all downlink data sent to the RNC over Iu interface. Any discarded data between MS and RNC causes inaccurate charging, as the 3G-SGSN cannot account for this and subsequently causing overcharging. Additionally any buffered data in the RNC at RAB release or forwarded to another SGSN during handover is possible counted again i.e. twice, which causes overcharging.

To avoid inaccurate charging at the 3G-SGSN, the 3G-SGSN will always instruct the RNC at RAB set-up to count the unsent downlink data towards the MS.

The reporting of unsent data by the RNC to the 3G-SGSN will only occur at RAB release. This occurs at either the termination of the PDP context or handover.

The 3G-SGSN shall not use the optional 'Data Volume Request' message to RNC in any situation, as this shall cause a significant performance impact to both the RNC and 3G-SGSN.

When 3G-SGSN receives a report of unsent data volume from the RNC at RAB release. The 3G-SGSN shall report this value to the 'RNC Unsent Downlink Volume' field in the S-CDR.

6.1.5 Generation of Charging ID

The concept of serving connections is different in the Circuit-Switched domain to that for the Packet-Switched domain. Therefore different mechanisms are needed to supply the Billing Systems with charging information.

In the Packet-Switched domain the complete PDP context handling can be switched over from an old SGSN to a new SGSN due to routing area updates with the consequence that charging records will be generated in more than one SGSN. Furthermore different data has to be collected in the SGSNs and GGSNs. So for one PDP context, charging records are needed from both the SGSN and GGSN.

The Billing System (BS) shall be provided with all relevant information from the network to charge for that one activated PDP context.

During the active PDP context all records, which belong to this context could normally be identified by the TID. However:

- an MS can activate and deactivate PDP contexts in a very short time interval, and these PDP contexts can have the same TID (only parallel established PDP contexts have different TIDs);
- different SGSNs can be involved in the same PDP context as described above;
- the timing clocks of the GSN elements may not be fully synchronised.

Therefore it is nearly impossible for a billing post-processing system to gather the records of one PDP context only by using the IMSI, NSAPI (TID) and time.

This is solved by assigning a unique Charging ID number (C-ID) to all records generated for that one PDP context.

The unique C-ID is generated in the GGSN when the PDP context is activated. A C-ID is generated for each activated context, so that each has a unique C-ID. The C-ID shall be transferred from the GGSN to the new SGSN in the routing area update response message. All CDRs for each activated PDP context generated by each SGSNs and GGSNs shall therefore contain the same unique combination of the C-ID and GGSN address, to permit subsequent Charging Gateway / Billing System (BS) correlation of the generated CDRs.

This combination of GGSN address together with the C-ID should be a unique identification over a long period of time in all Packet-Switched domain networks.

6.1.6 Charging for SMS

SMS transmission (MO or MT) can be provided in the Packet-Switched domain via the SGSN. The SGSN shall provide an S-SMO-CDR when short message is mobile originated and an S-SMT-CDR when it is mobile terminated. In addition, also SMS-IWMSC (MO-SMS) and SMS-GMSC (MT-SMS) may provide SMS related CDRs as described in 3GPP TS 32.205 [5].

No active PDP context is required when sending or receiving short messages. If the subscriber has an active PDP context, volume counters of S-CDR are not updated due to short message delivery.

The contents of S-SMO and S-SMT CDRs are presented in TS 32.205 [5].

6.1.7 Charging support for CAMEL

CAMEL Packet-Switched domain interworking can be activated for the Packet-Switched session, SGSN PDP context and mobile originated SMS based on subscription information stored in HLR. Control point for all CAMEL interactions in Packet-Switched domain reside at gprsSSF typically co-located with SGSN. GGSN is not aware of CAMEL service at all. For more information about CAMEL interworking (see 3GPP TS 23.078 [13]).

An M-CDR, S-CDR and S-SMO-CDR include basic information about CAMEL service information, such as service key and SCF address, and service usage, such as CAMEL modification information and amount of signalling. CAMEL service may also send transparent free format data in one or several messages to be stored in the CDR. Each received free format data indicates whether it is overwritten or appended to previously received free format data.

CAMEL service may deny the GPRS attach, PDP context activation or sending of short message. CAMEL service may also change the APN determined by SGSN before activating PDP context or it may change the destination information of short message.

CAMEL feature to download advice of charge parameters does not need to be supported because sending of these parameters down to MS and usage in the MS is not standardised for Packet-Switched domain terminals. The message itself shall however be supported and in case of a relative tariff switch is received, then at that tariff switch time volume counts shall be reported to CAMEL service.

6.2 Charging Data Collection

In order to provide the data required for the management activities outlined in the previous chapters (billing, accounting, statistics etc.), the SGSN and GGSN shall be able to produce an Charging Data Records (CDR) 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 TS 32. 215 [6].

6.2.1 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.

Charging Characteristics may be specified for a PDP context. It is determined as described in subclause 6.2.1.2.2 and 6.2.1.3. If set, it will determine the S-CDRs and G-CDRs generation and trigger values. If no Charging Characteristics are set for a PDP context, a default set of trigger values shall be applied.

In the GSNs it shall be possible to activate and deactivate CDR generation for each Charging Characteristics. If CDR generation is activated, it shall be possible to define separate trigger conditions values per Charging Characteristics 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.

6.2.1.1 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 of a PDP context, CDR generation is activated an S-CDR shall be opened at PDP context activation, and 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 subsequent subclauses identify the conditions for adding information to, and closing of the S-CDR for generation towards the CGF.

6.2.1.1.1 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 11 identifies which conditions are supported to trigger S-CDR charging information addition.

Table 11: 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.

6.2.1.1.2 Triggers for S-CDR Closure

The S-CDR shall be closed on encountering some trigger conditions. Table 12 identifies which conditions are supported to permit closure of the S-CDR.

Table 12: 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:- - termination of PDP context, - SGSN change (inter-SGSN routing area update including system handover), - any abnormal release.
Partial Record Reason	O&M reasons permit the closure of the CDR for internal reasons. The trigger condition covers:- - data volume limit, - time (duration) limit, - maximum number of charging condition changes, - management intervention.

The Partial Record generation trigger thresholds are those associated to the Charging Characteristics of the related PDP context. The Charging Characteristics of the PDP context are determined as follows:

- If a "PDP context Charging Characteristics" is present in the subscriber's data for this PDP context, than it shall be used;

- If there is no "PDP context Charging Characteristics" but a "Subscribed Charging Characteristics" is present in the subscriber's data, the "Subscribed Charging Characteristics" shall be used;

- If neither a "PDP context Charging Characteristics" nor a "Subscribed Charging Characteristics" is present, a default charging profile shall be applied.

The Partial Record generation trigger thresholds are GSN configuration parameters defined by the operator through O&M means.

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.

6.2.1.2 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 subclauses identify the conditions for adding information to, and closing of the M-CDR for generation towards the CGF.

6.2.1.2.1 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 13 identifies which conditions are supported to trigger M-CDR charging information addition.

Table 13: 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.

6.2.1.2.2 Triggers for M-CDR Closure

The M-CDR shall be closed on encountering some trigger conditions. Table 14 identifies which conditions are supported to permit closures of the M-CDR.

Table 14: 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:- - SGSN change (inter-SGSN routing area update including system handover), - GPRS detach, - any abnormal release.
Partial Record Reason	O&M reasons permit the closure of the CDR for internal reasons. The trigger condition covers:- - time (duration) limit, - maximum number of mobility changes, and - Management intervention, - Intra system handover (change of radio interface from GSM to 3G or visa versa).

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.

6.2.1.3 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 of a PDP context, CDR generation is activated a G-CDR shall be opened at PDP context activation, and 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.

A G-CDR shall be opened for each activated PDP context, 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 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 subclause 6.2.2.1 on "Triggers for S-CDR Charging Information Collection") with exception that an SGSN change of the same system type (GSM or 3G) 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 to the Charging Characteristics of the related PDP context determined as follows:

- If a "PDP context Charging Characteristics" is present in the PDP context data, it shall be used;
- Otherwise a default charging profile shall be applied.

The Partial Record generation trigger thresholds are GSN configuration parameters defined by the operator through O&M means.

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.

6.2.2 Charging scenarios

This subclause 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 charging data records are sent to a CGF;
- the generation of all of the charging data record types has been enabled.

The following conventions have been used for the Figures23, 24, 25 and 26, contained within this subclause:

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 charging data records, are represented by means of dotted lines and referenced by letter e.g. (A).

Note, visiting scenarios are excluded.

6.2.2.1 Mobile to PDN Context

Figure 23 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.

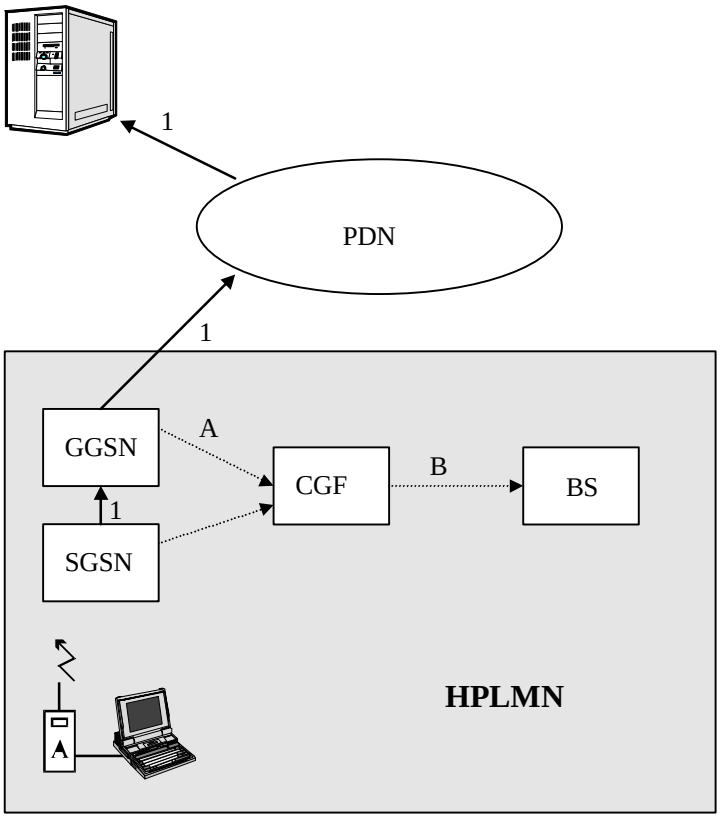


Figure 23: Mobile to PDN Context

6.2.2.2 Mobile to Mobile Context

Figure 24 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.

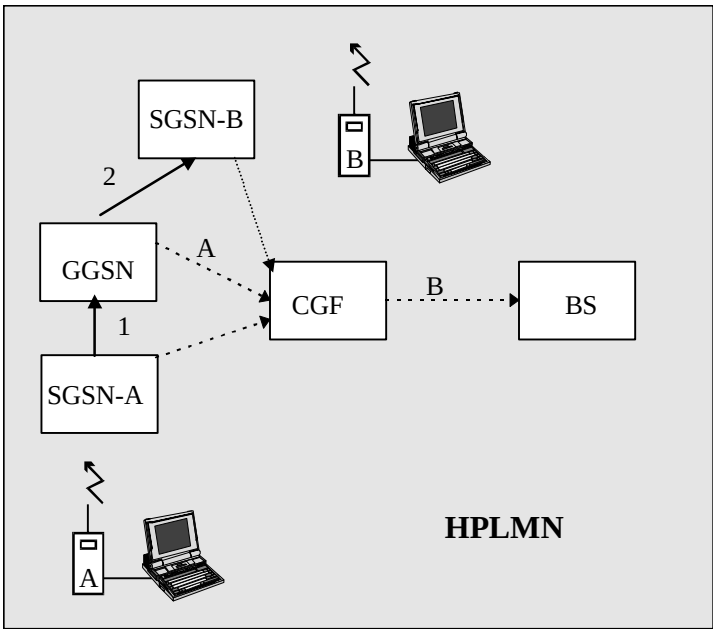


Figure 24: Packet-Switched Mobile to Mobile Context

6.2.2.3 PDN to Mobile Context

Figure 25 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.

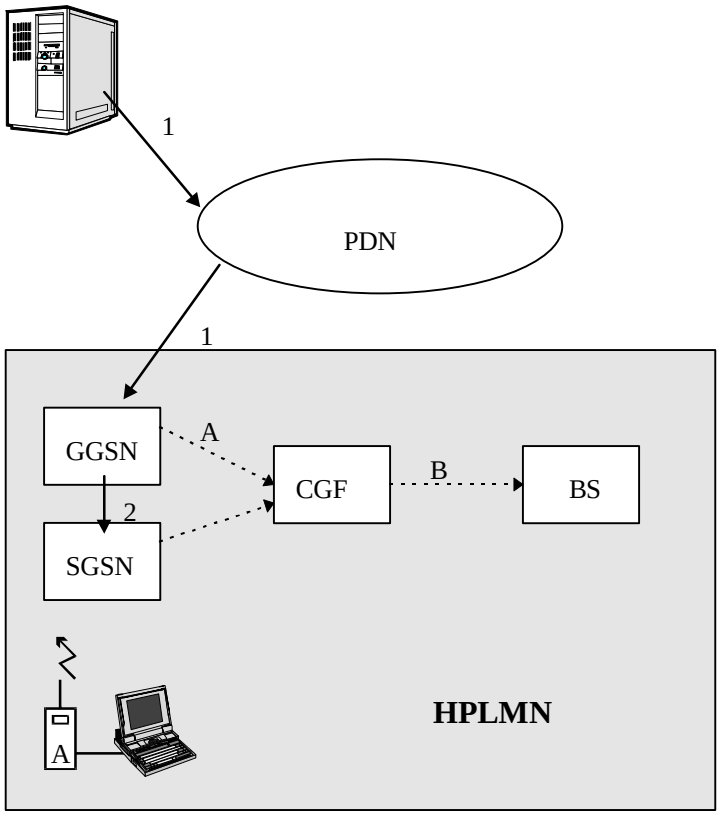


Figure 25: PDN to Mobile Context

6.2.2.4 Mobile to PDN Context while roaming, GGSN in HPLMN

Figure 26 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.

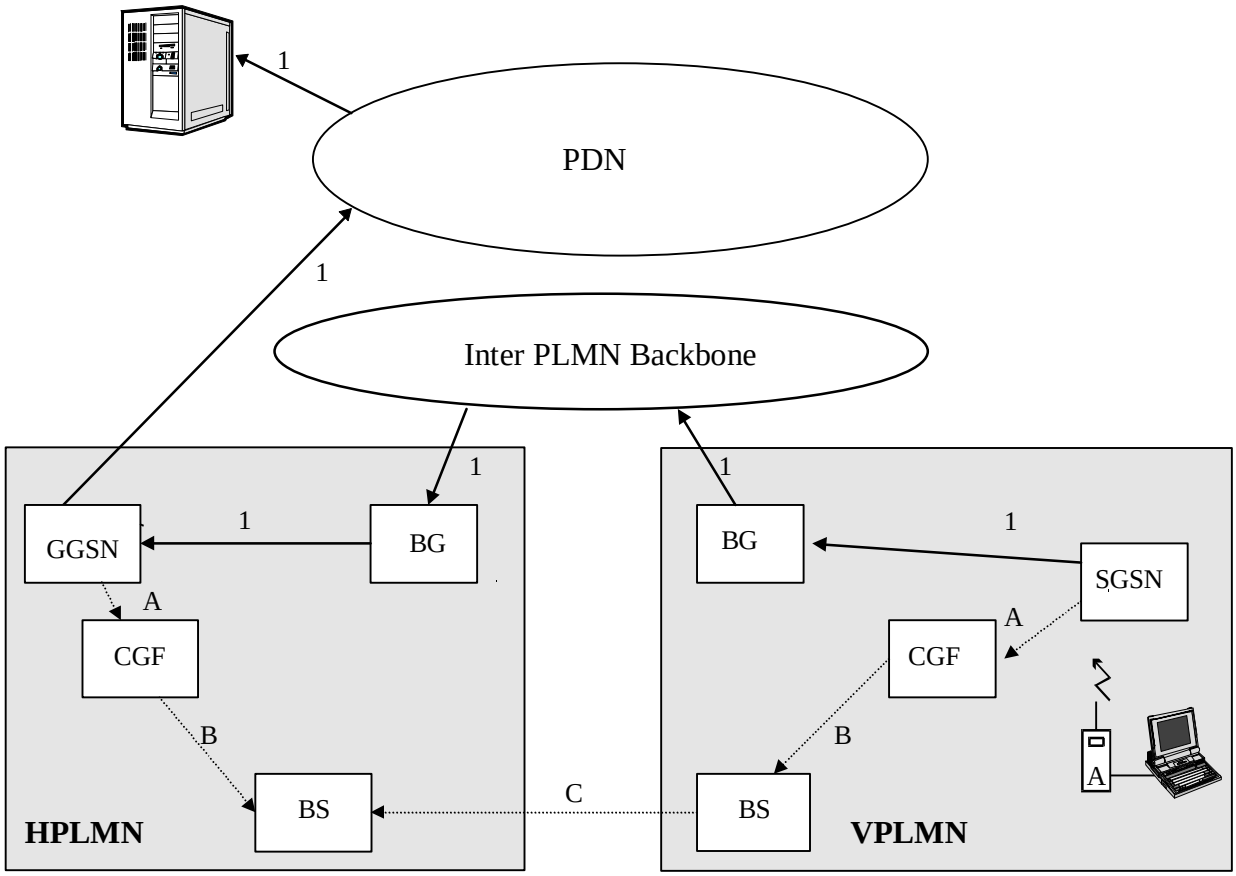


Figure 26: Mobile to PDN Context whilst roaming via BG

7. Charging Data Description for Application Services

As well as the 3G Network specific services i.e. MMS, LCS applications/services will be provided to the 3G subscribers by service nodes outside the scope of the 3G core network. These servers (service nodes) responsible for the provision of an application services to a subscriber, can generate a service related CDR to record the details of the service transaction provided. The specific CDRs are defined in the specification 32.235 “Charging data description for application services” [17].

7.1 MMS Service

In the first version the MMS-CDR defined which are based on the interface description in TS 23.140 “Multimedia Messaging Service, Functional description, Stage 2 [19]. These MMS-CDRs are delivered by the MMS Relay/Server when receiving or delivering multimedia messages to the MMS User Agent or to another Multimedia Messaging Service Environment (MMSE).

8.1 Bulk Data Transfer

The call and eventcharging data records shall be transferred from the NEF to the OSF by the use of FTAM, FTP, and TFTP services. For further details of the use of FTAM see GSM 12.01 [19].

Annex A (informative): Change history

This annex lists all change requests approved for this document since the specification was first approved by 3GPP TSG-SA.

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
May 2001			-		Result of the SA5#20 plenary.	-	1.0.0
Jun 2001	S_12	SP-010236	-		Submitted to TSG SA #12 for Information	1.0.0	1.0.1

3GPP TS 32.205 V1.1.1 (2001-06)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
Telecommunication Management;
Charging and Billing;
3G charging data description for the Circuit Switched (CS) domain
(Release 4)

Keywords
UMTS, circuit mode, charging

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Contents

Foreword

This Technical Specification (TS) 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.

1 Scope

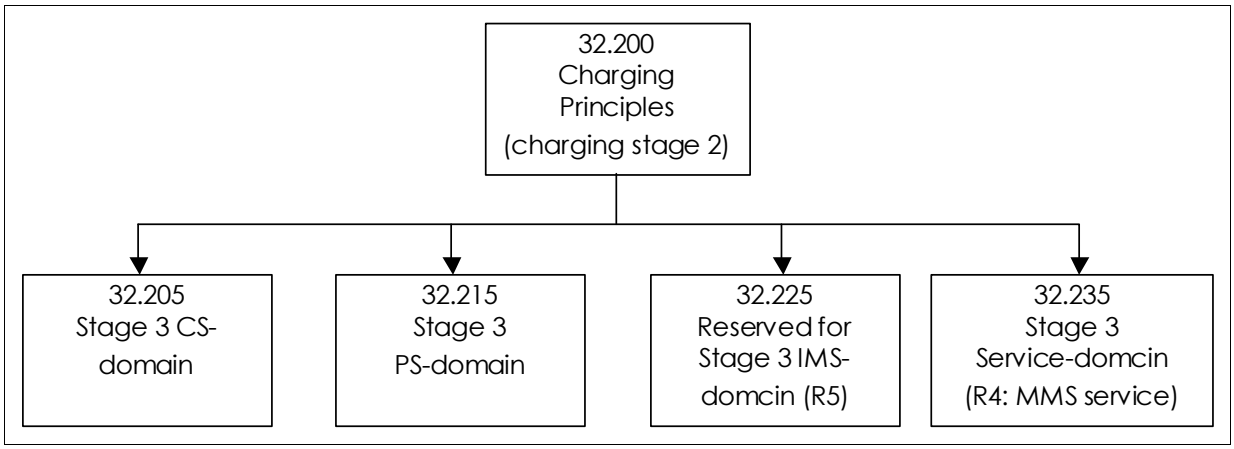
The GSM and UMTS PLMNs support a wide range of circuit based services. In order to enable operators the ability to provide a commercially viable service there is a need to provide charging functions.

This document is part of a series of documents specifying charging functionality in UMTS networks. The UMTS charging architecture and principles are specified in TS 32.200 [22] which provides an umbrella for other charging documents that specify the structure and content of the CDRs and the interface protocol that is used to transfer them to the collecting node.

The present document specifies the structure and the contents of the CDRs that are collected by the relevant network elements for circuit switched services in 2G (GSM) and 3G (UMTS) networks. It also defines the syntax for the transfer of these CDRs from the collecting nodes to billing post-processing systems using standard file transfer protocols.

The CDRs content and transport within the PS domain are described in TS 32.215 [23] document, while CDRs used for application services are defined in document TS 32.235 [24].

The relationship among these charging specifications is illustrated below.



The interface definitions of GSM 12.05 are maintained for 2G, in order to assure backward compatibility to earlier GSM releases.

The charging architecture and principles that the present document is based on are specified in TS 32.200 [22].

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 TS 21.905: "3G vocabulary".

[2] 3GPP TS 23.003: "Numbering, addressing and identification".

[3] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS); Point-to-Point (PP)".

[4] 3GPP TS 24.008: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[5] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[6] ITU-T Recommendation X.121: "International Numbering Plan for Public Data Networks".

[7] ISO8824-1 (94) / X.680 (94): "Information technology - Abstract Syntax Notation One (ASN.1) - Specification of Basic Notation".

[8] ITU-T X.208: “Specification of Abstract Syntax Notation One (ASN.1)”

[9] ITU-T X.209: “Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1)”

[10] 3GPP TS 22.024: "Description of Charge Advice Information (CAI)".

[11] 3GPP TS 22.086: "Advice of charge (AoC) supplementary services - Stage 1".

[12] ITU-T E.164: “Numbering plan for the ISDN era”.

[13] 3GPP TS 29.078: “CAMEL: Stage 3”.

[14] ISUP Q.767: “Specifications of Signalling System No.7; Application of the ISDN user part of CCITT signalling System No.7 for international ISDN interconnections”.

[15] 3GPP TS 23.040: “Technical Realization of Short Message Service”.

[16] 3GPP TS 23.003: “Numbering, Addressing, and Identification”.

[17] 3GPP TS 23.002: “Network Architecture”.

[18] 3GPP TS 22.115: “Service Aspects Charging and Billing”.

[19] 3GPP TS 22.004: “General on Supplementary Services”.

[20] 3GPP TS 22.003: “Circuit Teleservices Supported by a Public Land Mobile Network (PLMN)”.

[21] 3GPP TS 22.002: “Circuit Bearer Services Supported by a PLMN”.

[22] 3GPP TS 32.200: “Charging Principles”

[23] 3GPP TS 32.215: "Packet Switched (PS) domain charging data description".

[24] 3GPP TS 32.235: “Charging Data Descriptions for MMS”.

[25] GSM 12.01: "Digital cellular telecommunication system (Phase 2); Common aspects of GSM Network Management (NM)".

3 Definitions, abbreviations and symbols

3.1 Definitions

(GSM only): indicates that this section or paragraph applies only to a GSM system. For multi-system cases this is determined by the current serving radio access network.**(UMTS only):** indicates that this section or paragraph applies only to a UMTS system. For multi-system cases this is determined by the current serving radio access network.**advice of charge:** The real-time display of the network utilisation charges incurred by the Mobile Station. The charges are displayed in the form of charging units. If a unit price is stored by the MS then the display may also include the equivalent charge in the home currency.

aoc service: A combination of one or more services, both basic and supplementary, together with a number of other charging relevant parameters to define a customised service for the purpose of advice of charge.

call data: One or more call records.

call detail record (CDR): A formatted collection of information about a chargeable event (e.g. time of call set-up, duration of the call, amount of data transferred, etc) for use in billing and accounting. For each party to be charged for parts of or all charges of a chargeable event a separate CDR shall be generated, i.e more than one CDR may be generated for a single chargeable event, e.g. because of its long duration, or because more than one charged party is to be charged.

CAMEL: A network feature that provides the mechanisms to support operator specific services even when roaming outside HPLMN.

CAMEL subscription information: Identifies a subscriber as having CAMEL services.

charging destination: Also referred to as a destination for charging, this is a nominal reference defining the point of termination of a connection for charging purposes.

charging origin: A nominal reference defining the point of origin of a connection for charging purposes.

observed IMEI ticket: A record used to describe an EIR relevant event e.g. a blacklisted IMEI

successful call: A connection that reaches the communication or data transfer phase e.g. the "answered" state for speech connections. All other connection attempts are regarded as unsuccessful.

3.2 Abbreviations

For the purposes of the present document the following abbreviations apply. Additional applicable abbreviations can be found in TS 21.905 [1].

AoC	Advice of Charge
CAI	Charge Advice Information
CAMEL	Customised Applications for Mobile network Enhanced Logic
CDR	Call Detail Record
DP	Detection Point
EDP	Event Detection Point
EIR	Equipment Identity Register
ETSI	European Telecommunications Standard Institute
FTAM	File Transfer, Access and Management
GMSC	Gateway MSC
gsmSCF	GSM Service Control Function
gsmSSF	GSM Service Switching Function
HLR	Home Location Register
HPLMN	Home PLMN
HSCSD	High Speed Circuit Switched Data
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
ISDN	Integrated Services Digital Network
MOC	Mobile Originated Call (attempt)
MS	Mobile Station
MSC	Mobile Switching Centre
MSRN	Mobile Station Roaming Number
MTC	Mobile Terminated Call (attempt)
NE	Network Element
PLMN	Public Land Mobile Network
SCI	Subscriber Controlled Input
SCF	Service Control Function
SMS	Short Message Service
SS7	Signalling System No. 7
T-CSI	Terminating CAMEL Subscription Information
TDP	Trigger Detection Point
TMN	Telecommunications Management Network

USIM	User Service Identity Module
USSD	Unstructured Supplementary Service Data
UTRAN	UMTS Terrestrial Radio Access Network
VAS	Value Added Service
VLR	Visitor Location Register
VMSC	Visited MSC
VPLMN	Visited PLMN

3.3 Symbols

Refer to TS 32.200 [22] for applicable symbols.

4 Record types and contents

The following tables describe the contents of each of the call and event records generated in the CS domain, i.e. by the MSCs (see the example scenarios in TS 32.200 [22]). For each CDR type the field definition includes the field name, description and category.

Equipment vendors shall be able to provide all of the fields listed in the CDR content table in order to claim compliance with this document. However, since CDR processing and transport consume network resources, operators may opt to eliminate some of the fields that are not essential for their operation. This operator provisionable reduction is specified by the field category.

A field category can have one of two primary values:

M This field is **M**andatory and shall always be present in the CDR.

C This field shall be present in the CDR only when certain **C**onditions are met.. These Conditions are specified as part of the field definition.

All other fields are designated as Operator provisionable[1]. Using TMN management functions or specific tools provided by an equipment vendor, operators may choose if they wish to include or omit the field from the CDR. Once omitted, this field is not generated in a CDR. To avoid any potential ambiguity, a CDR generating element MUST be able to provide all these fields. Only an operator can choose whether or not these fields should be generated in their system. Those fields that the operator wishes to be present are further divided into a mandatory and conditional categories:

O_M This is a field that, if provisioned by the operator to be present, shall always be included in the CDRs. In other words, an O_M parameter that is provisioned to be present is a mandatory parameter.

O_C This is afield 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_C parameter that is configured to be present is a conditional parameter.

4.1 Mobile originated call attempt

If the generation of these records is enabled then an MOC record shall be created for each outgoing call attempt made by a mobile station. These MOC records shall be produced in the originating MSC.

Table 1: MOC record

Field	2G	3G	Description
Record Type	M	M	Mobile originated.

[1] The term “Operator provisionable” has replaced the “Optional” category specified in earlier release.

Served IMSI	M	M	IMSI of the calling party.
Served IMEI	C	C	IMEI of the calling ME, if available.
Served MSISDN	O_M	O_M	The primary MSISDN of the calling party.
Called Number	M	M	The address of the called party i.e. the number dialled by the calling subscriber.
Translated Number	O_C	O_C	The called number after digit translation within the MSC (if applicable)
Connected Number	O_C	O_C	The number of the connected party if different to the Called Number
Roaming Number	O_C	O_C	The Mobile Station Roaming Number employed to route this connection, if applicable.
Recording Entity	M	M	The E.164 number of the visited MSC producing the record.
Incoming TKGP	O_M	O_c	The MSC trunk group on which the call originated , usually from the BSS. If available in 3G, this parameter shall be supplied.
Outgoing TKGP	O_M	O_c	The trunk group on which the call left the MSC. If available in 3G, this parameter shall be supplied.
Location	M	M	The identity of the cell or the SAC at the time of CDR creation, including the location area code.
Change of Location	O_C	O_C	A list of changes in Location Area Code / Service Area Code / Cell Id. each time-stamped.
Basic service	M	M	Bearer or teleservice employed.
Transparency Indicator	C	C	Only provided for those teleservices which may be employed in both transparent and non-transparent mode.
ChangeOfService	O_C	O_C	A list of changes of basic service during a connection each time-stamped.
Supp. Services	C	C	Supplementary services invoked as a result of this connection.
AOC Parameters	O_C	O_C	The charge advice parameters sent to the MS on call set-up
Change of AOC Parameters	O_C	O_C	New AOC parameters sent to the MS e.g. as a result of a tariff switch over, including the time at which the new set was applied.
MS Classmark	M	M	The mobile station classmark employed on call setup.
Change of Classmark	O_C	O_C	A list of changes to the classmark during the connection each time-stamped
Event time stamps:	C	C	Seizure of incoming traffic channel (for unsuccessful call attempts)
Call duration	C O_M M	C O_M M	Answer (for successful calls) Release of traffic channel The chargeable duration of the connection for successful calls, the holding time for call attempts.
Radio Chan. Requested	O_M	-	The type of radio traffic channel (full / half etc.) requested by the MS.
Radio Chan. Used	M	-	The type of radio channel actually used (full or half rate).
Change of Rad. Chan.	O_C	-	A list of changes each time stamped
Cause for termination	M	M	The reason for the release of the connection.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Data volume	C	-	The number of data segments transmitted if available at the MSC
Sequence no.	C	C	Partial record sequence number, only present in case of partial records.
Call reference	M	M	A local identifier distinguishing between transactions on the same MS
Additional Chg. Info	O_C	O_C	Charge/no charge indicator and additional charging parameters
Record extensions	O_C	O_C	A set of network / manufacturer specific extensions to the record.
gsmSCF address	C	C	Identifies the CAMEL server serving the subscriber.
Service key	C	C	The CAMEL service logic to be applied.
Network call reference	C	C	An identifier to correlate transactions on the same call taking place in different network nodes, shall be present if CAMEL is applied.
MSC Address	C	C	This field contains the E.164 number assigned to the MSC that generated the network call reference.
Default call handling	O_C	O_C	Indicates whether or not a CAMEL call encountered default call handling. This field shall be present only if default call handling has been applied.
Number of HSCSD Channels Requested	C	-	The maximum number of HSCSD channels requested as received from the MS at call set-up
Number of HSCSD Channels Allocated	C	-	The number of HSCSD channels allocated to the MS at call set-up
Change of HSCSD Parameters	C	-	A list of network or user initiated changes of number of HSCSD channels during a connection each timestamped. Shall only be present in case of an HSCSD call, if the basic HSCSD parameters are modified due the user or network initiated modification procedure.
Fixed Network User Rate	O_C	O_C	May be present for 2G HSCSD connections and for UMTS connections.
Air Interface User Rate Requested	C	-	The total Air Interface User Rate Requested by the MS at call setup. Shall only be present for non-transparent HSCSD connections.
Channel Coding Accepted	C	-	A list of the traffic channels codings accepted by the MS. Shall only be present for HSCSD connections.
Channel Coding Used	C	-	The traffic channels codings negotiated between the MS and the network

			at call setup. Shall only be present for HSCSD connections.
Speech Version Used	O_M	-	Speech version used for that call
Speech Version Supported	O_M	-	Speech version supported by the MS with highest priority indicated by MS
Number of DP encountered	O_C	O_C	Number that counts how often armed detection points (TDP and EDP) were encountered.
Level of CAMEL service	O_C	O_C	Indicator for the complexity of the CAMEL feature used.
Free format Data	C	C	This field contains data sent by the gsmSCF in the FCI message(s). The data can be sent either in one FCI message or several FCI messages with append indicator.
CAMEL call leg information	C	C	Set of CAMEL information IEs. Each of these IEs contains information related to one outgoing CAMEL call leg.
Free format data append indicator	C	C	Indicator if free format data from this CDR is to be appended to free format data in previous partial CDR.
Default call handling 2	O_C	O_C	Indicates whether or not a CAMEL call encountered default call handling for 2nd service such as dialled service. This field shall be present only if default call handling has been applied.
GsmSCF address 2	C	C	Identifies the CAMEL server serving the subscriber for 2nd service such as dialled service.
Service key 2	C	C	The CAMEL service logic to be applied for 2nd service such as dialled service.
Free format Data 2	C	C	This field contains data sent by the gsmSCF in the FCI message(s) for 2nd service such as dialled service. The data can be sent either in one FCI message or several FCI messages with append indicator.
Free format data append indicator 2	C	C	Indicator if free format data for 2nd service from this CDR is to be appended to free format data in previous partial CDR.
System Type	-	M	Indicates the use of the UTRAN or GERAN radio access

4.2 Mobile originated emergency call attempt

If the generation of MOC records is enabled then an MOC emergency record shall be created for each outgoing emergency call attempt made by a mobile station. These records shall be produced in the originating MSC.

Table 2: MOC emergency record

Field	2G	3G	Description
Record Type	M	M	Mobile originated.
Served IMSI	C	C	IMSI of the calling party in case of an emergency call with a SIM card.
Served IMEI	C	C	IMEI of the calling mobile equipment if available.
Served MSISDN	O_C	O_C	The primary MSISDN of the calling party, if supplied by the UE.
Translated Number	O_C	O_C	The called number after digit translation within the MSC (if applicable)
Recording Entity	M	M	The E.164 number of the visited MSC producing the record.
Incoming TKGP	O_M	O_C	The MSC trunk group on which the call originated, usually from the BSS. If available in 3G, this parameter shall be supplied.
Outgoing TKGP	O_M	O_C	The trunk group on which the call left the MSC. If available in 3G, this parameter shall be supplied.
Location	M	M	The identity of the cell or the SAC in which the call originated including the location area code.
Change of Location	O_C	O_C	A list of changes in Location Area Code / Service Area Code / Cell Id. each time-stamped.
Basic service	M	M	Teleservice 'emergency call'.
AOC Parameters	O_C	O_C	The charge advice parameters sent to the MS on call set-up
Change of AOC Parameters	O_C	O_C	New AOC parameters sent to the MS e.g. as a result of a tariff switch over, including the time at which the new set was applied.
MS Classmark	M	M	The mobile station classmark employed on call set-up.
Change of classmark	O_C	O_C	A list of changes to the classmark during the connection each time-stamped
Event time stamps:	C C O_M	C C O_M	Seizure of incoming traffic channel (for unsuccessful call attempts) Answer (for successful calls) Release of traffic channel
Call duration	M	M	The chargeable duration of the connection for successful calls, the holding time for call attempts.
Radio Chan. Requested	O_M	-	The type of radio traffic channel (full / half etc.) requested by the MS.
Radio Chan. Used	M	-	The type of radio channel used (full or half rate).
Change of Rad. Chan.	O_C	-	A list of changes each time stamped

Cause for termination	M	M	The reason for the release of the connection.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Sequence no.	C	C	Partial record sequence number, only present in case of partial records.
Call reference	M	M	A local identifier distinguishing between transactions on the same MS
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
System Type	-	M	Indicates the use of the UTRAN or GERAN radio access

4.3 Mobile originated call forwarding attempt

If the generation of MOC records is enabled in the forwarding MSC then the forwarding MSC shall produce an MOC record for the forwarded-leg of the call.

Table 3: MOC, call forwarding record

Field	2G	3G	Description
Record Type	M	M	Mobile originated.
Served IMSI	M	M	IMSI of the calling party.
Served MSISDN	O_M	O_M	The MSISDN of the forwarding party.
Calling Number	O_M	O_M	The address of the calling party.
Called Number	M	M	The address of the "forwarded-to" party.
Translated Number	O_C	O_C	The called number after digit translation within the MSC (if applicable)
Connected Number	O_C	O_C	The number of the connected party if different to the Called Number
Roaming Number	O_C	O_C	The Mobile Station Roaming Number employed to route this connection, if applicable.
Recording Entity	M	M	The E.164 number of the forwarding MSC
Incoming TKGP	O_M	O_M	The MSC trunk group on which the call originated at the forwarding MSC.
Outgoing TKGP	O_M	O_M	The trunk group on which the call left the forwarding MSC
Basic service	C	C	Bearer or teleservice employed, not always available e.g. in case of call forwarding unconditional.
Transparency Indicator	C	C	Only provided for those teleservices which may be employed in both transparent and non-transparent mode.
ChangeOfService	O_C	O_C	A list of changes of basic service during a connection each time-stamped.
Supplementary Services	C	C	Supplementary services invoked as a result of this connection, if this information is available to the forwarding node.
Event time stamps: 	C C O_M	C C O_M	Seizure of incoming traffic channel (for unsuccessful call attempts) Answer (for successful calls) Release of traffic channel
Call duration	M	M	The chargeable duration of the connection for successful calls, the holding time of call attempts.
Cause for termination	M	M	The reason for the release of the connection.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Data volume	C	-	The number of data segments transmitted if available at the MSC
Sequence no.	C	C	Partial record sequence number, only present in case of partial records.
Call reference	M	M	A local identifier distinguishing between transactions on the same MS
Additional Chg. Info	O_C	O	Charge/no charge indicator and additional charging parameters
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
gsmSCF address	C	C	Identifies the CAMEL server serving the subscriber.
Service key	C	C	The CAMEL service logic to be applied.
Network call reference	C	C	An identifier to correlate transactions on the same call taking place in different network nodes, shall be present if CAMEL is applied.
MSC Address	C	C	This field contains the E.164 number assigned to the MSC that generated the network call reference.
CAMEL initiated CF indicator	C	C	Indicates that the CAMEL server initiated call forwarding.
Default call handling	O_C	O_C	Indicates whether or not a CAMEL call encountered default call handling. This field shall be present only if default call handling has been applied.
Number of DP encountered	O_C	O_C	Number that counts how often armed detection points (TDP and EDP) were encountered.
Level of CAMEL service	O_C	O_C	Indicator of the complexity of the CAMEL feature used.
Free format Data	C	C	This field contains data sent by the gsmSCF in the FCI messages. The data can be sent either in one FCI message or several FCI messages with append indicator.

CAMEL call leg information	C	C	Set of CAMEL information IEs. Each of these IEs contains information related to one outgoing CAMEL call leg.
Free format data append indicator	C	C	Indicator if free format data from this CDR is to be appended to free format data in previous partial CDR.
Default call handling 2	O_C	O_C	Indicates whether or not a CAMEL call encountered default call handling for 2nd service such as dialled service. This field shall be present only if default call handling has been applied.
GsmSCF address 2	C	C	Identifies the CAMEL server serving the subscriber for 2nd service such as dialled service.
Service key 2	C	C	The CAMEL service logic to be applied for 2nd service such as dialled service.
Free format Data 2	C	C	This field contains data sent by the gsmSCF in the FCI message(s) for 2nd service such as dialled service. The data can be sent either in one FCI message or several FCI messages with append indicator.
Free format data append indicator 2	C	C	Indicator if free format data for 2nd service from this CDR is to be appended to free format data in previous partial CDR.

4.4 Mobile terminated call attempt

If the generation of these records is enabled, then an MTC record shall be created for each incoming call attempt made for a mobile station. The MTC records shall be produced in the terminating MSC.

Table 4: MTC record

Field	2G	3G	Description
Record Type	M	M	Mobile Terminated.
Served IMSI	M	M	IMSI of the called party.
Served IMEI	C	C	IMEI of the called ME, if available.
Served MSISDN	O_M	O_M	The MSISDN of the called party.
Calling Number	C	C	The number of the calling party if available.
Connected Number	O_C	O_C	Only relevant in case of call forwarding where the "forwarded-to" number is recorded.
Recording Entity	M	M	The E.164 number of the visited (terminating) MSC
Incoming TKGP	O_M	O_M	The MSC trunk group on which the call originated.
Outgoing TKGP	O_M	O_C	The trunk group on which the call left the MSC, usually to the BSS. If available in 3G, this parameter shall be supplied.
Location	C	C	The identity of the cell or the SAC occupied by the called party when the call was set up, including the location area code.
Change of Location	O_C	O_C	A list of changes in Location Area Code / Service Area Code / Cell Id. each time-stamped.
Basic Service	M	M	Bearer or teleservice employed
Transparency Indicator	C	C	Only provided for those teleservices which may be employed in both transparent and non-transparent mode.
Change of Service	O_C	O_C	A list of changes of basic service during a connection each time-stamped.
Supplementary services	C	C	Supplementary services invoked as a result of this connection.
AOC Parameters	O_C	O_C	The charge advice parameters sent to the MS on call set-up
Change of AOC Parameters.	O_C	O_C	New AOC parameters sent to the MS e.g. as a result of a tariff switch-over, including the time at which the new set was applied.
MS Classmark	M	M	The mobile station class mark.
Change of Classmark	O_C	O_C	A list of changes to the classmark during the connection each time-stamped
Event time stamps:	C C O_M	C C O_M	Seizure of traffic channel for unsuccessful call attempts Answer time for successful calls Release of traffic channel
Call duration	M	M	The chargeable duration of the connection if successful, the holding time of the call if unsuccessful.
Radio Chan. Requested	O_M	-	The type of radio traffic channel (full / half etc.) requested by the MS.
Radio Chan. Used	M	-	The type of radio channel used (full or half rate).
Change of Rad. Chan	O_C	-	A list of changes each time stamped
Cause for termination	M	M	The reason for the release of the call.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Data volume	C	-	The number of data segments transmitted, if available at the MSC
Sequence no.	C	C	Partial record sequence number, only present in case of partial records.

Call reference	M	M	A local identifier distinguishing between transactions at the same MS
Additional Chg. Info	O_C	O_C	Charge/no charge indicator and additional charging parameters
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
Network call reference	C	C	An identifier to correlate transactions on the same call taking place in different network nodes, shall be present if CAMEL is applied.
MSC Address	C	C	This field contains the E.164 number assigned to the MSC that generated the network call reference.
Number of HSCSD Channels Requested	O_C	-	The maximum number of HSCSD channels requested as received from the MS at call set-up
Number of HSCSD Channels Allocated	O_C	-	The number of HSCSD channels allocated to the MS at call set-up
Change of HSCSD Parameters	O_C	-	A list of network or user initiated changes of number of HSCSD channels during a connection each timestamped. Shall only be present in case of an HSCSD call, if the basic HSCSD parameters are modified due the user or network initiated modification procedure.
Fixed Network User Rate	O_C	-	May be present for HSCSD connections.
Air Interface User Rate Requested	C	C	The total Air Interface User Rate Requested by the MS at call setup. Shall only be present for non-transparent HSCSD connections.
Channel Coding Accepted	C	-	A list of the traffic channels codings accepted by the MS. Shall only be present for HSCSD connections.
Channel Coding Used	C	-	The traffic channels codings negotiated between the MS and the network at call setup. Shall only be present for HSCSD connections.
Speech Version Used	O_M	-	Speech version used for that call
Speech Version Supported	O_M	-	Speech version supported by the MS with highest priority indicated by MS
gsmSCF address	C	C	Identifies the CAMEL server serving the subscriber.
Service Key	C	C	The CAMEL service logic to be applied.
Default call handling	O_C	O_C	Indicates whether or not a CAMEL call encountered defeault call handling. This field shall be present only if default call handling has been applied.
Number of DP encountered	O_C	O_C	Number that counts how often armed detection points (TDP and EDP) were encountered.
Level of CAMEL service	O_C	O_C	Indicator for the complexity of the CAMEL feature used.
Free format Data	C	C	This field contains data sent by the gsmSCF in the FCI messages. The data can be sent either in one FCI message or several FCI messages with append indicator.
CAMEL call leg information	C	C	Set of CAMEL information IEs. Each of these IEs contains information related to one outgoing CAMEL call leg.
Free format data append indicator	C	C	Indicator if free format data from this CDR is to be appended to free format data in previous partial CDR.
System Type	-	C	Indicates the use of the UTRAN or GERAN radio access

Note: This record is incomplete with respect to recording information related to the VT-CSI CAMEL trigger. On request to the operators we should check if this functionality is required for an interrogating record for the visiting MSC server. Similar for the TIR CDR.

4.5 Roaming call attempt

If the generation of these records is enabled then, a roaming record shall be created for each call redirected to a mobile subscriber roaming outside the HPLMN. These roaming records shall be produced in the GMSC of the roaming subscriber's HPLMN.

Table 5: Roaming record

Field	2G	3G	Description
Record Type	M	M	Roaming record.
Served IMSI	M	M	IMSI of the called (roaming) party.
Served MSISDN	O_M	O_M	The MSISDN of the called (roaming) party.
Calling Number	C	C	The address of the calling party, if available.
Roaming Number	M	M	The Mobile Station Roaming Number employed to route this connection.
Recording Entity	M	M	The E.164 number of the GMSC
Incoming TKGP	O_M	O_M	The GMSC trunk group on which the call originated.
Outgoing TKGP	O_M	O_M	The trunk group on which the call left the GMSC
Basic service	M	M	Bearer or teleservice employed.

Transparency Indicator	C	C	Only provided for those teleservices which may be employed in both transparent and non-transparent mode.
ChangeOfService	O_C	O_C	A list of changes of basic service during a connection each time-stamped.
Supplementary Services	C	C	Supplementary services invoked as a result of this connection.
Event time stamps	C C O_M	C C O_M	Seizure of incoming traffic channel (for unsuccessful call attempts) Answer (for successful calls) Release of traffic channel
Call duration	M	M	The chargeable duration of the connection for successful calls, the holding time of call attempts.
Cause for termination	M	M	The reason for the release of the connection.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Data volume	C	C	The number of data segments transmitted if available at the GMSC
Sequence no.	C	C	Partial record sequence number, only present in case of partial records.
Call reference	M	M	A local identifier distinguishing between transactions on the same MS
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
Network call reference	C	C	An identifier to correlate transactions on the same call taking place in different network nodes, shall be present if CAMEL is applied.
MSC Address	C	C	This field contains the E.164 number assigned to the MSC that generated the network call reference.

4.6 Incoming gateway call attempt

If generation of these records is enabled, an incoming gateway record shall be created for each incoming call attempt received by a gateway MSC from another network. These records, produced in the gateway MSC, may be used to settle accounts with other networks. The generation of gateway records shall not be influenced by the production of MTC records i.e. even if the GMSC and terminating MSC are co-located a gateway record shall still be produced.

Table 6: Incoming gateway record

Field	2G	3G	Description
Record Type	M	M	Incoming gateway record
Calling Number	C	C	The number of the calling party if available at this node.
Called Number	M	M	The address of the called party as seen by the GMSC. This is the number employed by the GMSC for routing.
Recording Entity	M	M	The E.164 number of the GMSC
Incoming TKGP	M	M	The incoming GMSC trunk group on which the call originated.
Outgoing TKGP	O_M	O_C	The trunk group on which the call left the GMSC. If available in 3G, this parameter shall be supplied.
Event time stamps:	M C O_M	M C O_M	Seizure of incoming trunk Answer (successful calls only) Release of incoming trunk
Call duration	M	M	The accountable duration (answer -> release of incoming trunk) of the connection if successful, the call holding time of the incoming trunk for call attempts.
Data Volume	C	-	If applicable and known at the GMSC
Cause for termination	M	M	The reason for the release of the connection.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Sequence no.	C	C	Partial record sequence number, if applicable.
Call Reference	M	M	A local identifier distinguishing between transactions.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

4.7 Outgoing gateway call attempt

If generation of these records is enabled, an outgoing gateway record shall be created for each outgoing call attempt from a gateway MSC to another network. These records, produced in the gateway MSC, may be used to settle accounts with other networks. The generation of gateway records shall not be influenced by the production of MOC records i.e. even if the GMSC and originating MSC are co-located a gateway record shall still be produced.

Table 7: Outgoing gateway record

Field	2G	3G	Description
Record Type	M	M	Outgoing gateway record
Calling Number	C	C	The number of the calling party if available at this node.
Called Number	M	M	The address of the called party as seen by the GMSC. This is the number employed by the GMSC for routing.
Recording Entity	M	M	The E.164 number of the GMSC
Incoming TKGP	O_M	O_C	The incoming GMSC trunk group on which the call originated. If available in 3G, this parameter shall be supplied.
Outgoing TKGP	M	M	The trunk group on which the call left the GMSC.
Event time stamps:	M C O_M	M C O_M	Seizure of outgoing trunk Answer (successful calls only) Release of outgoing trunk
Call duration	M	M	The accountable duration (answer -> release of outgoing trunk) of the connection if successful, the call holding time of the outgoing trunk for call attempts.
Data Volume	C	-	If applicable and known at the GMSC
Cause for termination	M	M	The reason for the release of the connection.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Sequence no.	C	C	Partial record sequence number, if applicable.
Call Reference	M	M	A local identifier distinguishing between transactions.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

4.8 Transit call attempt

If generation of these records is enabled then a transit record may be generated for each incoming call attempt received by a Transit MSC i.e. neither originating nor terminating. For the avoidance of doubt, a transit record shall only be produced if no MOC or MTC record is produced for this call attempt by this MSC. The transit records, produced in the TMSC, may be used to record traffic from particular origins or to particular destinations.

Table 8: Transit record

Field	2G	3G	Description
Record Type	M	M	Transit.
Calling Number	C	C	The number of the calling party if available at this node.
Called Number	M	M	The address of the called party as seen by the TMSC.
ISDN Basic Service	O_M	O_M	The ISDN basic service employed
Recording Entity	M	M	The E.164 number of the transit MSC
Incoming TKGP	M	M	The TMSC trunk group on which the call originated.
Outgoing TKGP	M	M	The trunk group on which the call left the TMSC.
Event time stamps:	C C O_M	C C O_M	Seizure of incoming trunk for unsuccessful call attempts Answer (successful calls only) Release of traffic channel
Call duration	M	M	The chargeable duration of the connection if successful, the call holding time for call attempts.
Data Volume	C	-	If applicable and known at the transit MSC
Cause for term.	M	M	The reason for the release of the connection.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Sequence no.	C	C	Partial record sequence number, if applicable.
Call Reference	M	M	A local identifier distinguishing between transactions.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

4.9 Supplementary service actions

A supplementary service record may be produced in the NEF of the appropriate MSC or HLR for each supplementary service action (activation, deactivation, invocation etc.) performed or initiated by the subscriber.

There are two basic types of SS-actions:

- Call related i.e. as a result of a connection e.g. Invocation of CLIP / CLIR / AOC etc.

- Non-call related i.e. as a result of subscriber controlled input (SCI) e.g. Registration of call forwarding

Each supplementary service action shall be performed on one or more basic service groups. If the action applies to all tele- and all bearer services (i.e. to all basic services) then the basic services field shall be omitted.

SCI actions may be recorded in individual SS-action records. Call related actions may be recorded in either the appropriate call record (MOC/MTC) or in separate SS-action records.

Additional non-standard supplementary service actions may be made available within some networks in the form of Unstructured Supplementary Service Data (USSD). These actions may also be recorded in SS-action records. However, as these actions are non-standard they may not include an appropriate action type, supplementary service code or basic service code.

Table 9: SS-action record

Field	2G	3G	Description
Record Type	M	M	Supplementary service action.
Served IMSI	M	M	The IMSI of the MS performing the action.
Served IMEI	O_C	O_C	The IMEI of the ME performing the action.
Served MSISDN	O_M	O_M	The primary MSISDN of the party performing the action.
MS Classmark	M	M	The mobile station classmark.
Recording Entity	M	M	The E.164 number of the visited MSC / HLR.
Location	O_M	O_M	The identity of the cell or the SAC, including the location area code, from which the request originated.
Supplementary Service	C	C	The supplementary service or group of supplementary services for which the request was made. May not be available in case of USSD.
Basic Services	C	C	The basic service group(s) to which the supplementary service applies. This field is not provided if the action applies to all basic services.
SS Action	C	C	Activation, deactivation, interrogation etc. May not be available in case of USSD.
SS Action time stamp	M	M	The time at which the action was requested.
SS Parameters	C	C	Service dependent parameters or unstructured supplementary service data, if defined for the SS action recorded in this CDR.
SS Action Result	C	C	Result of the requested transaction if unsuccessful.
Call Reference	M	M	A local identifier distinguishing between transactions at the same MS.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
System Type	-	M	Indicates the use of the UTRAN or GERAN radio access.

4.10 HLR interrogation

If enabled, a HLR interrogation record shall be created for each interrogation performed for a mobile subscriber. These records may be produced in either the HLR itself or the interrogating MSC.

Table 10: HLR interrogation record

Field	2G	3G	Description
Record Type	M	M	HLR interrogation.
Served IMSI	C	C	The IMSI of the party being interrogated, if successful
Served MSISDN	M	M	The MSISDN of the subscriber being interrogated.
Recording Entity	M	M	The E.164 Number of the HLR / MSC.
Routing Number	C	C	Routing number (MSRN, forwarding no.) provided by the HLR if the interrogation was successful.
Basic Service	O_C	O_C	Only for teleservice 21 (SMS-MT).
Interrogation time stamp	M	M	Time at which the interrogation was invoked.
Number of Forwarding	C	C	The number of times the call has been forwarded if provided by ISUP.
Interrogation Result	C	C	The result of the interrogation request if unsuccessful.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

4.11 Location update (VLR)

If enabled, a VLR location update record shall be produced in the VLR for each location registration or location update received by the VLR for a mobile subscriber.

Table 11: Location update (VLR) record

Field	2G	3G	Description
Record Type	M	M	Location update.
Served IMSI	M	M	IMSI of the served MS.
Served MSISDN	O_M	O_M	The primary MSISDN of the party performing the location update
Recording Entity	M	M	The E.164 number of the entity (VLR or MSC/VLR) generating the record.
Old location			Not present for registration:
	C	C	VMSC E.164 Number
	C	C	Location Area Code
New location	M	M	VMSC E.164 Number
	M	M	Location Area Code
	O_M	O_M	Cell Identification or Service Area Code
MS Classmark	M	M	The mobile station classmark.
Update time stamp	M	M	Time at which the update was invoked.
Update Result	C	C	The result of the location update if unsuccessful.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
System Type			Ffs for this CDR type

4.12 Location update (HLR)

If enabled, an HLR location update record shall be produced in the HLR for each location registration or location update received by the HLR for a mobile subscriber including location updates received from subscribers roaming in foreign PLMNs.

Table 12: Location Update (HLR) record

Field	2G	3G	Description
Record Type	M	M	Location update.
Served IMSI	M	M	IMSI of the served MS.
Recording Entity	M	M	The E.164 Number of the HLR.
Old location	O_C	O_C	VMSC E.164 Number
	O_C	O_C	VLR E.164 Number
New location	M	M	VMSC E.164 Number
	M	M	VLR E.164 Number
Update time stamp	M	M	Time at which the update was invoked.
Update Result	C	C	The result of the location update if unsuccessful.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

4.13 Short message service, mobile originated

If enabled, an SMS-MO record shall be produced, within the originating MSC, for each short message sent by a mobile subscriber.

Table 13: SMS-MO record

Field	2G	3G	Description
Record Type	M	M	SMS-Mobile originated.
Served IMSI	M	M	The IMSI of the subscriber sending the short message.
Served IMEI	O_C	O_C	The IMEI of the ME sending the message, if available.
Served MSISDN	O_M	O_M	The primary MSISDN of the subscriber sending the message.
MS Classmark	M	M	The mobile station classmark.
Service Centre	M	M	The address (E.164) of the SMS-service centre.
Recording Entity	M	M	The E.164 number of the visited MSC

Location	O_M	O_M	The Location Area Code and Cell Identity / Service Area Code from which the message originated.
Event Time stamp	M	M	The time at which the message was received by the MSC from the subscriber.
Message Reference	M	M	A reference, provided by the MS uniquely identifying this message.
SMS Result	C	C	The result of the attempted delivery if unsuccessful.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
Destination number	O_M	O_M	The destination number dialled by the MS sending the short message.
CAMELSMSInformation	C	C	Set of CAMEL information IEs. Each of these IEs contains information related to CAMEL call leg related for the SMS.
System Type	-	M	Indicates the use of the UTRAN or GERAN radio access.

4.14 Short message service, mobile terminated

If enabled, an SMS-MT record shall be produced, within the terminating MSC, for each short message received by a mobile subscriber.

Table 14: SMS-MT record

Field			Description
Record Type	M	M	SMS-Mobile Terminated.
Service Centre	M	M	The E.164 address of the SMS centre.
Served IMSI	M	M	The IMSI of the receiving party.
Served IMEI	O_C	O_C	The IMEI of the receiving party, if available.
Served MSISDN	O_M	O_M	The MSISDN of the receiving party.
MS Classmark	M	C	The mobile station classmark.
Recording Entity	M	M	The E.164 number of the visited MSC.
Location	O_M	O_M	The Location Area Code and Cell Identity /Service Area Code to which the message was delivered.
Event time stamp	M	M	Delivery time stamp, time at which message was sent to the MS by the MSC.
SMS Result	C	C	The result of the attempted delivery if unsuccessful.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
System Type	-	M	Indicates the use of the UTRAN or GERAN radio access.

4.15 SMS-MO interworking record

If enabled, an SMS-MO interworking record shall be produced, within the interworking MSC, for each short message generated by a mobile subscriber. These records may be used to settle accounts between PLMNs and SMS service centres. Where the Interworking MSC is also the originating MSC, an SMS-MO CDR will also be generated.

Table 15: SMS-MO interworking record

Field	2G	3G	Description
Record Type	M	M	SMS-MO interworking record.
Service Centre	M	M	The E.164 address of the SMS service centre.
Served IMSI	M	M	The IMSI of the sending party.
Recording Entity	M	M	The E.164 number of the visited MSC.
Time stamp	M	M	The time at which the message was received by the interworking function.
SMS Result	C	C	The result of the attempted delivery if unsuccessful.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

4.16 SMS-MT gateway record

If enabled, an SMS-MT gateway record shall be produced, within the gateway MSC, for each short message sent to a mobile subscriber. Where the Gateway MSC is also the terminating MSC, an SMS-MT CDR will also be generated.

Table 16: SMS-MT gateway record

Field	2G	3G	Description
Record Type	M	M	SMS-MT gateway record.
Service Centre	M	M	The E.164 address of the SMS service centre.
Served IMSI	M	M	The IMSI of the receiving party.
Served MSISDN	O_M	O_M	The MSISDN of the receiving party.
Recording Entity	M	M	The E.164 number of the visited MSC.
Time stamp	M	M	The time at which the message was received by the gateway.
SMS Result	C	C	The result of the attempted delivery if unsuccessful.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

4.17 Common equipment usage record

If enabled, a common equipment usage record shall be created in the VMSC to record the usage (duration) of common equipment, e.g. conference circuits, employed by a mobile subscriber.

Table 17: Common equipment usage record

Field	2G	3G	Description
Record Type	M	M	Common equipment usage record.
Equipment type	M	M	e.g. Conference circuit.
Equipment Id.	C	C	The local id. of the equipment employed.
Served IMSI	M	M	The IMSI of the party responsible for the seizure of the equipment..
Served MSISDN	O_M	O_M	The primary MSISDN of the served party..
Recording Entity	M	M	The E.164 number of the MSC in which the equipment is located.
Basic service	C	C	Bearer or teleservice employed, if appropriate.
ChangeOfService	O_C	O_C	A list of changes of basic service during a connection each time-stamped.
Supp. Services	C	C	Supplementary services invoked in connection with this equipment.
Event Time Stamp	M O_M	M O_M	Seizure time: the time at which the equipment was seized. Release time: the time at which the equipment was released.
Call Duration	M	M	The total duration of the usage of the equipment.
Call Reference	M	M	A local identifier distinguishing between transactions.
Sequence no.	C	C	Partial record sequence number if applicable.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
System Type	-	M	Indicates the use of the UTRAN or GERAN radio access.

4.18 Reduced partial records

In order to minimise the amount of data transferred, the contents of partial record may be reduced to those fields required to uniquely identify the connection and those fields that actually change. Table 18 contains an example of such a record for a mobile originated call attempt. Reduced partial records may be generated for any of the relevant call records.

Table 18: Reduced partial (MOC) record

Field	2G	3G	Description
Record Type	M	M	Mobile originated.
Served IMSI	C	C	IMSI of the calling party, if available
Called Number	C	C	If available.
Recording Entity	M	M	The E.164 number of the visited MSC producing the record.
Change of Location	C	C	A list of changes in Location Area Code / Cell Id. each time-stamped.
ChangeOfService	C	C	A list of changes of basic service during a connection each time-stamped.

Change of AOC Parameters	O_C	O_C	New AOC parameters sent to the MS e.g. as a result of a tariff switch over, including the time at which the new set was applied.
Change of Classmark	C	C	A list of changes to the classmark during the connection each time-stamped
Event time stamps	M	M	Answer time, start of this partial record.
Call duration	M	M	The chargeable duration of this partial record.
Change of Radio Channel	C	C	A list of changes each time stamped
Cause for termination	M	M	The reason for the release of the connection.
Diagnostics	O_C	O_C	Only relevant for the last record in the sequence.
Data volume	C	-	The number of data segments transmitted during this partial output
Sequence no.	M	M	Partial record sequence number, only present in case of partial records.
Call reference	M	M	A local identifier distinguishing between transactions on the same MS
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

4.19 Terminating CAMEL interrogation call attempt

If the generation of these records is enabled, a terminating CAMEL interrogation call attempt record shall be generated for each call toward a subscriber with a T-CSI and if the terminating trigger criteria are met. The record is generated in the GMSC/gsmSSF carrying out the terminating CAMEL call handling.

Table 19: Terminating CAMEL interrogation record

Field	2G	3G	Description
Record Type	M	M	Terminating CAMEL interrogation.
Served IMSI	M	M	IMSI of the called party
Served MSISDN	O_M	O_M	The MSISDN of the called party.
Recording Entity	M	M	The E.164 number of the GMSC.
Interrogation time stamp	M	M	Time at which the interrogation was invoked.
CAMEL Destination Number	M	M	The number available for routing after the CAMEL server enquiry.
gsmSCF Address	M	M	The CAMEL server serving the subscriber.
Service key	M	M	The CAMEL service logic to be applied.
Network call reference	M	M	An identifier to correlate transactions on the same call taking place in different network nodes.
MSC Address	M	M	This field contains the E.164 number assigned to the MSC that generated the network call reference.
Default call handling	O_C	O_C	Indicates whether or not a CAMEL call encountered default call handling. This field shall be present only if default call handling has been applied.
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.
Called Number	M	M	The address of the called party as received by the GMSC/gsmSSF.
Calling Number	C	C	The address of the calling party, if available.
Incoming TKGP	O_M	O_C	The GMSC trunk group on which the call originated. If available in 3G, this parameter shall be supplied.
Outgoing TKGP	O_M	O_C	The trunk group on which the call left the GMSC. If available in 3G, this parameter shall be supplied.
Event time stamps:	C C O_M	C C O_M	Seizure of incoming traffic channel (for unsuccessful call attempts) Answer (for successful calls) Release of traffic channel
Call duration	M	M	The chargeable duration of the connection for successful calls, the holding time of call attempts.
Data volume	C	-	The number of data segments transmitted if available at the GMSC
Cause for termination	M	M	The reason for the release of the connection.
Diagnostics	O_M	O_M	A more detailed reason for the release of the connection.
Call reference	M	M	A local identifier distinguishing between transactions on the same MS
Sequence no.	C	C	Partial record sequence number, only present in case of partial records.
Number of DP encountered	O_C	O_C	Number that counts how often armed detection points (TDP and EDP) were encountered.
Level of CAMEL service	O_C	O_C	Indicator of the complexity of the CAMEL feature used.
Free format Data	C	C	This field contains data sent by the gsmSCF in the FCI message(s). The data can be sent either in one FCI message or several FCI messages with append indicator.
CAMEL call leg information	C	C	Set of CAMEL information IEs. Each of these IEs contains information related to one outgoing CAMEL call leg.

Free format data append indicator	C	C	Indicator if free format data from this CDR is to be appended to free format data in previous partial CDR.

4.20 IMEI observation ticket

An observed IMEI ticket is generated whenever greylisted, blacklisted or non-whitelisted mobile equipment is detected during an IMEI check. The purpose of the ticket is to link the mobile equipment under observation with its current user (IMSI). The ticket also includes information describing when and where the equipment was used to enable the tracking of such equipment. Finally, if the ticket was triggered by a call attempt, a call reference is provided in order to locate the corresponding call record.

The IMEI tickets are generated by the NEF of the MSC performing the IMEI check.

Table 20: IMEI ticket

Field	2G	3G	Description
Served IMEI	M	M	IMEI of the observed mobile equipment
IMEI Status	M	M	The result of the IMEI check e.g. blacklisted, greylisted, unknown.
Served IMSI	M	M	The IMSI of the subscriber currently using the mobile equipment.
Served MSISDN	C	C	The MSISDN of the subscriber currently using the observed mobile equipment, only available if the event that triggered the IMEI check was an MOC, MTC, SMS-MO or SMS-MT
Recording Entity	M	M	The E.164 number of the recording MSC.
Event Time Stamp	M	M	The time at which the IMEI check was performed.
Location	M	M	The location area code and cell identity of the cell from which the mobile equipment was used.
IMEI Check Event	O_M	O_M	The event that caused IMEI checking to take place
Call Reference	O_C	O_C	Only available if the IMEI check was related to an MOC or MTC
Record extensions	O_C	O_C	A set of network/ manufacturer specific extensions to the record.

5 Description of Record Fields

This subclause contains a brief description of each field of the CDRs described in the previous subclause.

5.1 Additional Charging Information

This field consists of two parts, a charge indicator and additional charging parameters. The charge indicator is derived from the information contained within the ISUP "backward call indicator" and may be used to store a charge indicator (charge/no charge) received from another network node. The additional charging parameters are non-standard and intended to permit the inclusion of further charging information received from Intelligent Network and/or Value Added Service nodes.

5.2 AoC parameters / change of AoC parameters

The AoC parameter field contains the set of charge advice (AoC) parameters sent to the MS on call set-up. If further sets of parameters are sent during the call, as a result of a tariff switch-over for example, then this may be recorded in the Change of AoC Parameter field including the time at which the change occurred.

It should be noted that the Change of AoC Parms. field is optional and not required if partial records are generated on tariff switch-over.

The AoC parameters are defined in TS 22.024 [10].

5.3 Basic Service / change of service / ISDN Basic Service

The basic service field contains the code of the basic service employed on call set-up. Any alteration to the basic service during the connection may be recorded in the change of service field including the time at which the change took place.

The change of service field is optional and may be omitted if partial records are created whenever the basic service is changed.

The coding of basic services is defined in detail in TS 29.002 [05].

In the case of the transit record the GSM basic service employed is generally not available. However, if the device on which the call originates/terminates is connected via ISDN digital subscriber signalling then the appropriate ISDN basic service code may be recorded in the record. One possible example includes the direct connection of an ISDN PABX to an MSC/VLR.

5.4 Call duration

This field contains the relevant call duration in seconds. For incomplete calls (call attempts) the relevant duration is the call holding time from the seizure to the release of the traffic channel. For complete (answered) calls this is the chargeable duration from answer to release of the traffic channel. For partial records this is the duration of the individual partial record and not the cumulative duration of the call.

It should be noted that the time stamps may be expressed in terms of tenths of seconds or even milliseconds and, as a result, the calculation of the call duration may result in the rounding or truncation of the measured duration to a whole number of seconds.

Whether or not rounding or truncation is to be used is considered to be outside the scope of the present document subject to the following restrictions:

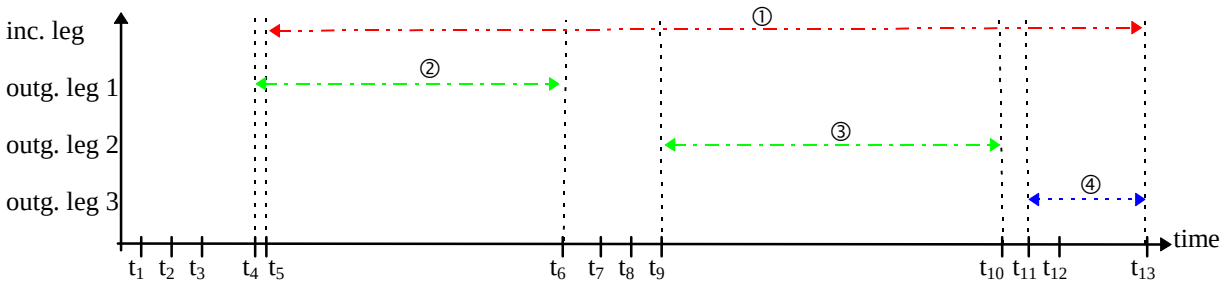
1) A call duration of zero seconds shall not be accepted.
2) The same method of truncation/rounding shall be applied to both single and partial records.

If CAMEL is invoked for the call and a control relationship is existing, the call might continue after a RELEASE or a DISCONNECT from the called party side received by the gsmSSF. The call duration of the incoming leg is stored in the main body of the call record. For each outgoing leg the call duration is stored in the respective 'CAMELInformation' module. If a call leg does not reach answer status and attempt charging is enabled a 'CAMELInformation' module containing the holding time is generated.

An example of how to use the call duration and the timestamps is given in Figure B.0. It shows a CAMEL controlled mobile originated follow-on scenario. The uppermost arrow ① marks the over all duration of the call that is to be measured and stored in the main body of the respective MOC record. The duration before t_5 (incoming leg) or t_4 (outgoing leg) needs not to be stored since the call is answered later on. The call duration in the first outgoing leg module contains the time interval from t_4 to t_6 (period ②). The call duration measurement of the second outleg is started with t_9 and ended with t_{10} (interval ③).

Since the last outgoing leg is not answered, the respective module contains the holding time starting with t_{11} and ending with t_{13} (period ④).

(The timestamps t_1, t_2, t_3, t_7, t_8 and t_{12} are mentioned for completion reasons only.)



call duration of incoming leg =

call duration of outgoing leg =

holding time of outgoing leg =

Point in time	Signalling message sent/received trigger detection point encountered	Duration logging
t_1	SETUP; TDP(control)	
t_2	IAM	seizure of outg. leg 1
t_3	ACM	
t_4	ANSWER	start of call duration (outg. leg 1)
t_5	CONNECT	start of call duration (inc. leg)
t_6	RELEASE; EDP(control)	stop of call duration (outg. leg 1)
t_7	IAM	seizure of outg. leg 2
t_8	ACM	
t_9	ANSWER	start of call duration (outg. leg 2)
t_{10}	RELEASE; EDP(control)	stop of call duration (outg. leg 2)
t_{11}	IAM	seizure of outg. leg 3 start of holding time (outg. leg 3)
t_{12}	ACM	
t_{13}	RELEASE; EDP(control)	stop of holding time (outg. leg 3)

Figure B.0: Call duration measurement in follow-on scenarios

5.5 Call reference

This field uniquely identifies a call or transaction on one side of the interface (i.e. 'A' or 'B' side) and is derived from the transaction identifier of TS 24.008 [04]. It is also used to identify all partial records and transactions belonging to the same connection.

For the avoidance of doubt, there is **no** global call reference defined within GSM and the call reference field **cannot** be used to combine, for example, the MOC and MTC records of a mobile-to-mobile connection.

5.5.1.1 Network call reference

Whenever CAMEL is applied, this field is used for correlation of call records outputted from the originating MSC (when applicable), the GMSC and the terminating MSC, and a network optional call record from the gsmSCF.

5.6 Calling / called / connected / translated number

In general a CCITT E.164 [12] number but may also include other numbering plans e.g. X.121. Each of these fields includes the type of number and number plan as specified in detail in TS 24.008 [04]. Where appropriate, these fields may also contain the presentation and screening information also specified in TS 24.008 [04].

The called number is the number received from the mobile station on mobile originated call set-up as defined in TS 24.008 [04]. Similarly, the calling number is the number received from the network on mobile terminated call set-up. In case of CAMEL initiated CF, the called (forwarded-to) number is returned by CAMEL.

The translated number is the result of any digit translation performed by the MSC on the called number received from the mobile station on mobile originated call set-up. This parameter is not included in the CDR if no digit translation has taken place.

The connected number is the number of the actual party reached as defined in TS 24.008 [04]. Although this is normally identical to the called number it may differ. This parameter is not included if identical to the called number.

The following examples are intended to explain the use of these fields:

Example 1: Called Number = Connected Number
Normal call from a mobile subscriber to a mobile subscriber or to a PSTN subscriber.

Example 2: Called Number != Connected Number
In case of routing to a PABX with Automatic Call Distribution or to an ISDN Basic Access with several devices attached. The connected number is that of the party actually reached. N.B. The recording of the actual number connected may be limited by the capability of intermediate signalling connections.

Example 3: MTC record for Call Forwarding ("A" -> "B" -> "C")
In case of call forwarding, the connected number recorded in the MTC record of the "B" subscriber is that of the forwarded-to party or "C" subscriber. The calling party field contains the number of the "A" subscriber.

Example 4: Translated Number
This field is only present if digit translation is applied by the MSC to the called number received from the mobile station. Examples include abbreviated dialling codes and service numbers.

5.7 Calling Party Number

This field contains Calling Party Number modified by CAMEL service.

5.8 CAMEL call leg information

This field contains a set of CAMEL information IEs according to the number of outgoing CAMEL call legs.

5.9 CAMEL information

This field contains a list of parameters with information related to one CAMEL outgoing call leg.

As a network option, parameters that are identical to the corresponding values in the top level structure of the record are not recorded again. That means whenever a value is not mentioned in this set the value provided in the basic record is valid instead. This might lead to an empty or even absent structure, if no parameter was modified.

5.10 CAMEL initiated CF indicator

The purpose of this field is to distinguish CAMEL call forwarding service scenarios from standard GSM call forwarding scenarios.

From the BCSM's point of view this field is set to 'CF' whenever the O_CSI was applied after terminating CAMEL call processing had been taken place changing the call destination. For the avoidance of doubt: this flag does not depend on other modified call parameter(s) (e.g.: redirection information, etc.) received in the CAP_CONNECT message of the T_CSI service.

This flag also indicates that another record might be generated, one containing the charging information related to the terminating CAMEL service and one containing the charging information related to the originating CAMEL service.

5.11 CAMEL modified Service Centre

This field contains SMS-C address modified by CAMEL service. If this field is present the field Service Centre contain SMS-C address before CAMEL modification.

5.12 CAMEL SMS Information

This field contains following CAMEL information for mobile originated SMS:

- Default SMS handling

  This field indicates whether or not a CAMEL encounters default SMS handling. This field shall be present only if default SMS handling has been applied.

- Free format data

  See subclause 5. 22.

- Calling Party Number

  This field contains Calling Party Number modified by CAMEL service.

- CAMEL modified Service Centre

  This field contains SMS-C address modified by CAMEL service.

- CAMELDestination Subscriber Number

  This field contains short message Destination Number modified by CAMEL service.

5.13 Cause for termination

This field contains a generalised reason for the release of the connection including the following:

- normal release;
- CAMEL initiated call release;
- partial record generation;
- partial record call re-establishment;
- unsuccessful call attempt;
- abnormal termination during the stable phase.

A more detailed reason may be found in the diagnostics field.

5.14 Data volume

This field includes the number of 64 octet segments transmitted during the use of data services if known (see B.1.3 Packet Data Services).

5.15 Default call/SMS handling

This field indicates whether or not a CAMEL encountered default call/SMS handling. This field shall be present only if default call/SMS handling has been applied. Parameter is defined in HLR as part of CAMEL subscription information.

5.16 Destination Subscriber Number

This field contains Destination/Called Subscriber Number modified by CAMEL service. If not modified then this field may contain original Destination Number also when CAMEL is not active.

5.17 Diagnostics

This field includes a more detailed technical reason for the release of the connection and may contain one of the following:

- a MAP error from TS 29.002 [05];
- a Cause from TS 24.008 [04];
- a Cause from TS 29.078 [13];
- a Cause from ISUP Q.767 [14].

The diagnostics may also be extended to include manufacturer and network specific information.

5.18 Entity number

This field contains the ITU-T E.164 [12] number assigned to the entity (MSC, VLR, HLR etc.) that produced the record. For further details concerning the structure of MSC and location register numbers see 3GPP TS 23.003 [2].

5.19 Equipment id

This field contains a local identifier used to distinguish between equipment of the same equipment type e.g. the number of the conference circuit employed if more than one is available.

5.20 Equipment type

This field contains the type of common equipment employed e.g. conference circuit for multi-party service.

5.21 Event time stamps

These fields contain the event time stamps relevant for each of the individual record types.

The call records may contain three significant call handling time stamps:

- The time at which the resource in question was seized (Seizure time)
- The time at which the call was answered or at which charging commences. (Answer time)
- The time at which the resource was released (Release time)

For both Mobile Originated and Mobile Terminated calls, the Seizure time is the time at which the traffic channel is allocated i.e. the time at which the ASSIGN COMMAND message is sent to the MS.

For Mobile Originated calls the Answer time is the time at which the CONNECT message is sent to the calling party. For Mobile Terminated calls the time at which the CONNECT message is received from the called party. However, if the subscriber has subscribed to the advice of charge charging level service, then the answer time shall be derived from the time at which the FACILITY message is received from the MS containing the acknowledgement of receipt of the AOC parameters. Similarly, if the AOC parameters are changed during the call then the change time recorded for a subscriber with AOC charging level is the receipt of the FACILITY message from the MS. For a subscriber with AOC information level the change time recorded is the time at which the FACILITY is sent to the MS. Finally, in case of call re-establishment the answer time is the time at which the new traffic channel is allocated by the MSC i.e. when the ASSIGN COMMAND is sent to the MS.

The Release time is the time at which the connection is released by either party i.e. a DISCONNECT or RELEASE is sent by the network or a DISCONNECT is received from the MS. In the case of a radio link failure, the release time is the time at which the failure was detected by the MSC.

For unsuccessful call attempts the Seizure time is mandatory. The Release time is optional and the call duration recorded is the call holding time i.e. the difference between the two.

For successful calls the Answer time is mandatory and both the Seizure and Release times are optional. The call duration recorded is the chargeable duration i.e. the difference between the Answer and Release time stamps.

The event records include the following time stamps:

- HLR-int time:The receipt of a MAP_SEND_ROUTING_INFO request by the HLR.
- Loc.Upd. time: The receipt of a MAP_UPDATE_LOCATION_AREA request by the VLR or the receipt of a MAP_UPDATE_LOCATION request by the HLR.
- SS-Action: The receipt of a supplementary service request by the VLR.
  e.g. MAP_REGISTER_SS, MAP_INVOKE_SS
- SMS-MO: The receipt of an RP_DATA message from the MS containing an SMS_SUBMIT PDU.
- SMS-MT: The transmission of an RP_DATA message to the MS containing anSMS_DELIVER PDU.

It should be noted that the events listed above are only examples in order to demonstrate the principles and that the list is by no means exhaustive.

All time-stamps include a minimum of date, hour, minute and second.

5.22 Free format data

This field contains charging information sent by the gsmSCF in the FCI messages as defined in TS 29.078 [13]. The data can be sent either in one FCI message or several FCI messages with append indicator. This data is transferred transparently in the CAMEL sections of the relevant call records. ‘Free format data‘ sent to the legID=1 is always stored in the top level of the respective record. ‘Free format data‘ sent to the legID >1 is stored in the appropriate CAMEL call leg information field.

If the FCI is received more then once during one continuing incoming/outgoing CAMEL call leg, the append indicator defines whether the FCI information is appended to previous FCI and stored in the relevant record or the information of the last FCI received is stored in the relevant record (the previous FCI information shall be overwritten).

In the event of partial output the currently valid ‘Free format data’ is stored in the partial record.

5.23 Free format data append indicator

This field contains an indicator whether free format data is to be appended to free format data stored in previous partial CDR. This field is needed in CDR postprocessing to sort out valid free format data for that call leg from sequence of partial records. Creation of partial records is independent on received FCIs and thus valid free format data may be divided to different partial records.

If field is missing then free format data in this CDR replaces all received free format data in previous CDRs. Append indicator is not needed in the first partial record. In following partial records indicator shall get value true if all FCIs received during that partial record have append indicator. If one or more of the received FCIs for that call leg during the partial record do not have append indicator then this field shall be missing.

5.24 GsmSCF address

This field identifies the CAMEL server serving the subscriber. Address is defined in HLR as part of CAMEL subscription information.

5.25 HSCSD parameters / Change of HSCSD parameters

The basic HSCSD parameters are negotiated between the MS and the network at call setup time. They comprise of the following parameters:

- the FNUR (Fixed Network User Rate) (optionally)
- the total AIUR (Air Interface User Rate) requested by the MS (for non-transparent HSCSD connections only)
- a list of the channel codings accepted by the MS
- the maximum number of traffic channels accepted by the MS (this is noted in the channels requested field)
- the channel coding and the number of traffic channels actually used for the call.

In case the network or user initiated modification procedure takes place during the call, the AIUR requested, the channel coding used and the number of traffic channel requested/used might be recorded in the Change of HSCSD parameters field including the time at which the change occurred and which entity requested the change.

It should be noted that the Change of HSCSD Parameters field is optional and not required if partial records are generated when a Change of HSCSD Parameters takes place.

5.26 Incoming/ outgoing trunk group

The incoming trunk group describes the trunk on which the call originates as seen from the MSC. For mobile originated calls this will generally be a BSS trunk. Similarly, the outgoing trunk group describes the trunk on which the call leaves the MSC.

For 3G, this parameter may not be available. When available, this parameter shall be supplied in the CDRs.

5.27 Interrogation result

This field contains the result of the HLR interrogation attempt as defined in the MAP (TS 29.002 [05]).

NOTE: This field is only provided if the attempted interrogation was unsuccessful.

.

5.28 IMEI Check Event

This field identifies the type of event that caused the IMEI check to take place:

- Mobile originating call attempt;
- Mobile terminating call attempt;
- Mobile originating SMS;
- Mobile terminating SMS;
- Supplementary service actions performed by the subscriber;
- Location update

5.29 IMEI Status

This field contains the result of the IMEI checking procedure:

- Greylisted;
- Blacklisted;
- Non-whitelisted.

5.30 Level of CAMEL service

This field describes briefly the complexity of CAMEL invocation.

- 'Basic' means that CAMEL feature is invoked during the setup phase (e.g.: to modify the destination) of the call only.
- 'Online charging' means that CAMEL supported AoC parameter were sent to the mobile station (SCI is received from the gsmSCF).
- The flag 'call duration supervision' is set whenever the call duration supervision is applied in the gsmSSF of the VPLMN (apply charging message is received from the gsmSCF).

5.31 Location / change of location

The location field contains a combination of the location area code (LAC) and cell identity (CI) of the cell in which the served party is currently located. Any change of location may be recorded in the change of location field including the time at which the change took place.

The change of location field is optional and not required if partial records are generated when the location changes.

The LAC and CI are both 2 octet quantities and coded according to TS 24.008 [04].

5.32 Message reference

This field contains a unique message reference number allocated by the mobile station when transmitting a short message to the service centre. This field corresponds to the TP-Message-Reference element of the SMS_SUBMIT PDU defined in TS 23.040 [15].

5.33 Mobile station classmark / change of classmark

This MS classmark field contains the mobile station classmark employed by the served MS on call set-up as defined in TS 24.008 [04] (see mobile station classmark 2). Any alteration in the classmark during the connection may be recorded in the change of classmark field and will include the time at which the change took place.

It should be noted that the change of classmark field is optional and not required if partial records are created when the classmark is altered.

5.34 Number of DP encountered

This field indicates how often CAMEL armed detection points (TDP and EDP) were encountered and is a measure of signalling between serving network and CAMEL service and complements 'Level of CAMEL service' field. Detection points from all applied CAMEL services for a single call leg and processed in the same gsmSSF shall be counted together.

5.35 Number of forwarding

This field, if provided via ISUP signalling, contains the number of times a call has been forwarded prior to the interrogation of the HLR and is defined in TS 29.002 [05].

5.36 Old /new location

These fields contain the location of a mobile subscriber before and after a location update. In case of VLR location update the location information consists of a VMSC number and location area code. In case of HLR location update the field contains the VMSC number and the VLR number.

5.37 Radio channel requested / rad. channel used / change of rad. channel / speech version supported / speech version used

The radio channel requested field contains the type of channel requested by the user. The following values are permitted:

- full rate;
- half rate;
- dual mode half rate preferred;
- dual mode full rate preferred.

The radio channel used field indicates the type of traffic channel actually employed for the connection i.e. either full rate (Bm) or half rate (Lm) as described in GSM 05.01. Any change in the type of channel used may be recorded in the change of radio channel used field including the time at which the change occurred and the speech version used after the change of radio channel.

The speech version supported field contains the speech version supported by the MS with the highest priority. The speech version used field contains the speech codec version assigned for that call. The coding is according GSM 08.08 speech version identifier with the extension bit 8 set to 0.

It should be noted that the change of radio channel field is optional and not required if partial records are generated.

5.38 Record extensions

The field enables network operators and/ or manufacturers to add their own extensions to the standard record definitions.

5.39 Record type

The field identifies the type of the record e.g. mobile originated, mobile terminated etc.

5.40 Routing number / roaming number

The routing number field of the HLR interrogation record contains either a mobile station roaming number or, in case of call forwarding, a forwarded-to number.

The roaming number field of the MOC record contains the mobile subscriber roaming number as defined in TS 23.003 [16] and coded according to TS 29.002 [05].

5.41 Sequence number

This field contains a running sequence number employed to link the partial records generated for a particular connection (see 7.2.4 Partial records).

5.42 Served IMEI

This fields contains the international mobile equipment identity (IMEI) of the equipment served. The term "served" equipment is used to describe the ME involved in the transaction recorded e.g. the called ME in case of an MTC record.

The structure of the IMEI is defined in TS 23.003 [16].

5.43 Served IMSI

This fields contains the international mobile subscriber identity (IMSI) of the served party. The term "served" party is used to describe the mobile subscriber involved in the transaction recorded e.g. the calling subscriber in case of an MOC record.

The structure of the IMSI is defined in TS 23.003 [16].

5.44 Served MSISDN

This fields contains the mobile station ISDN number (MSISDN) of the served party. The term "served" party is used to describe the mobile subscriber involved in the transaction recorded e.g. the called subscriber in case of an MTC record. In case of multi-numbering the MSISDN stored in a MOC record will be the primary MSISDN of the calling party.

The structure of the MSISDN is defined in TS 23.003 [16].

5.45 Service centre address

This field contains a CCITT E.164 [12] number identifying a particular service centre e.g. short message service centre (see TS 23.040 [15]).

5.46 Service key

This field identifies the CAMEL service logic applied. Service key is defined in HLR as part of CAMEL subscription information.

5.47 Short message service result

This field contains the result of an attempt to deliver a short message either to a service centre or to a mobile subscriber (see TS 29.002 [05]). Note that this field is only provided if the attempted delivery was unsuccessful.

5.48 Sub-system type

Indicates 3G-UMTS Sub-System support.

5.49 Supplementary service(s)

The supplementary service field in the Supplementary Service record type contains the code of the supplementary service on which the action was performed.

The supplementary services field in the MOC / MTC records contains the codes of the supplementary services invoked as a result of, or during, a connection.

The coding of supplementary service is described in detail in TS 29.002 [05].

5.50 Supplementary service action

This field contains the type of supplementary service action requested by the subscriber or performed by the network. Possible values include:

- registration;
- erasure;
- activation;
- deactivation;
- interrogation;
- invocation.

For further details see TS 22.004 [19].

5.51 Supplementary service action result

This field contains the result of an attempted supplementary service action (see TS 29.002 [05]). Note that this field is only provided if the SS-action was at least partially unsuccessful.

5.52 Supplementary service parameters

This field contains the parameters associated with a supplementary service action requested by the subscriber. For further details of the parameters involved see the GSM 02.8n series of documents.

5.53 Supplementary service(s)

The supplementary service field in the Supplementary Service record type contains the code of the supplementary service on which the action was performed.

The supplementary services field in the MOC / MTC records contains the codes of the supplementary services invoked as a result of, or during, a connection.

The coding of supplementary service is described in detail in 3GPP TS 29.002 [5].

5.54 Transparency indicator

This field indicates whether the basic service was employed in transparent or non-transparent mode. It should also be noted that this field is only relevant for those services which may be operated in both transparent and non-transparent modes.

5.55 Update result

This field contains the result of the location update request as defined in the MAP (TS 29.002 [05]). Note that this field is only provided if the attempted update was unsuccessful.

6 Charging Data Record Structure

6.1 ASN.1 definitions for CDR information

Within the current 3GPP TS 32-series of specifications the ASN.1 definitions are based on X.208 [08] which has been superseded by X.680. This newer version not only includes new features but also removes some that were present in X.208. It was agreed that where possible, the GPRS work would be based on those ASN.1 features that were common to both. However, where necessary, the new features in X.680 [07] be used in some places. X.208 [08] feature that are no longer in X.680 [07] will not be used.

```
TS32205-DataTypes {itu-t (0) identified-organization (4) etsi(0) mobileDomain (0) umts-Operation-
Maintenance (3) ts-32-205 (205) informationModel (0) asn1Module (2) version1 (1)}


DEFINITIONS IMPLICIT TAGS   ::=

BEGIN

-- EXPORTS everything

IMPORTS

NumberOfForwarding, CallReferenceNumber
FROM MAP-CH-DataTypes { ccitt identified-organization (4) etsi(0) mobileDomain (0) gsm-Network (1)
modules (3) map-CH-DataTypes (13) version6 (6) }
```

```
AddressString, ISDN-AddressString, BasicServiceCode, IMSI, IMEI
FROM MAP-CommonDataTypes { ccitt identified-organization (4) etsi(0) mobileDomain (0) gsm-Network
(1) modules (3) map-CommonDataTypes (18) version6 (6) }

DestinationRoutingAddress
FROM CAP-DataTypes { ccitt identified-organization (4) etsi(0) mobileDomain (0)
gsm-Network(1) modules(3) cap-datatypes (52) version1 (0) }

ServiceKey, DefaultCallHandling, DefaultSMS-Handling
FROM MAP-MS-DataTypes { ccitt identified-organization (4) etsi(0) mobileDomain (0)
gsm-Network(1) modules(3) map-MS-DataTypes (11) version6 (6) }


BearerServiceCode
FROM MAP-BS-Code { ccitt identified-organization (4) etsi(0) mobileDomain(0) gsm-Network (1) modules
(3) map-BS-Code (20) version6 (6) }

TeleserviceCode
FROM MAP-TS-Code { ccitt identified-organization (4) etsi(0) mobileDomain(0) gsm-Network (1) modules
(3) map-TS-Code (19) version2 (2) }

SS-Code
FROM MAP-SS-Code { ccitt identified-organization (4) etsi(0) mobileDomain(0) gsm-Network (1) modules
(3) map-SS-Code (15) version6 (6) }

BasicService
FROM Basic-Service-Elements { ccitt identified-organization (4) etsi (0)
196 basic-service-elements (8) }
--
-- See "Digital Subscriber Signalling System No. one (DSS1) protocol"
-- ETS 300 196
--

ObjectInstance
FROM CMIP-1 {joint-iso-ccitt ms(9) cmip(1) version1 (1) protocol (3)}

ManagementExtension
FROM Attribute-ASN1Module {joint-iso-ccitt ms(9) smi(3) part2 (2) asn1Module(2) 1}

SystemType
FROM TS32215-DataTypes {itu-t (0) identified-organization (4) etsi (0) mobileDomain (0) umts-
Operation-Maintenance (3) ts-32-215 (215) informationModel (0) asn1Module (2) version1 (1)}

SGSNPDPRecord, GGSNPDPRecord, SGSNMMRecord, SGSNSMORecord, SGSNSMTRecord
FROM TS32215-DataTypes {itu-t (0) identified-organization (4) etsi (0) mobileDomain (0) umts-
Operation-Maintenance (3) ts-32-215 (215) informationModel (0) asn1Module (2) version1 (1)}

MMSORecord, MMSTRecord
FROM TS32235-DataTypes {itu-t (0) identified-organization (4) etsi(0) mobileDomain (0) umts-
Operation-Maintenance (3) ts-32-235 (235) informationModel (0) asn1Module (2) version1 (1)}

AE-title
FROM ACSE-1 {joint-iso-ccitt association-control(2) abstract-syntax(1) apdus(0) version(1) };
--
-- Note that the syntax of AE-title to be used is from
-- CCITT Rec. X.227 / ISO 8650 corrigendum and not "ANY"
-------------------------------------------------------------------------------
--
--  CALL AND EVENT RECORDS
--
-------------------------------------------------------------------------------

CallEventRecord ::= CHOICE
--
-- Record values 0..16 are 3G curcuit switch specific
--              20..24 are 3G packet switch specific
--              30..31 are application specific
--
{
    moCallRecord            [0] MOCallRecord,
    mtCallRecord            [1] MTCallRecord,
    roamingRecord           [2] RoamingRecord,
    incGatewayRecord        [3] IncGatewayRecord,
    outGatewayRecord        [4] OutGatewayRecord,
    transitRecord           [5] TransitCallRecord,
    moSMSRecord         [6] MOSMSRecord,
    mtSMSRecord         [7] MTSMSRecord,
    moSMSIWRecord           [8] MOSMSIWRecord,
    mtSMSGWRecord           [9] MTSMSGWRecord,
    ssActionRecord          [10] SSActionRecord,
    hlrIntRecord            [11] HLRIntRecord,
    locUpdateHLRRecord      [12] LocUpdateHLRRecord,
```

```
    locUpdateVLRRecord      [13] LocUpdateVLRRecord,
    commonEquipRecord       [14] CommonEquipRecord,
    recTypeExtensions       [15] ManagementExtensions,
    termCAMELIntRecord      [16] TermCAMELIntRecord,

    sgsnPDPRecord           [20] SGSNPDPRecord,
    ggsnPDPRecord           [21] GGSNPDPRecord,
    sgsnMMRecord            [22] SGSNMMRecord,
    sgsnSMORecord           [23] SGSNSMORecord,
    sgsnSMTRecord           [24] SGSNSMTRecord,

    mmsORecord              [30] MMSORecord,
    mmsTRecord              [31] MMSTRecord
}

MOCallRecord    ::= SET
{
    recordType                  [0] CallEventRecordType,
    servedIMSI                  [1] IMSI OPTIONAL,
    servedIMEI                  [2] IMEI OPTIONAL,
    servedMSISDN                [3] MSISDN OPTIONAL,
    callingNumber               [4] CallingNumber OPTIONAL,
    calledNumber                [5] CalledNumber OPTIONAL,
    translatedNumber            [6] TranslatedNumber OPTIONAL,
    connectedNumber         [7] ConnectedNumber OPTIONAL,
    roamingNumber               [8] RoamingNumber OPTIONAL,
    recordingEntity         [9] RecordingEntity,
    mscIncomingTKGP         [10] TrunkGroup OPTIONAL,
    mscOutgoingTKGP         [11] TrunkGroup OPTIONAL,
    location                    [12] LocationAreaAndCell OPTIONAL,
    changeOfLocation            [13] SEQUENCE OF LocationChange OPTIONAL,
    basicService                [14] BasicServiceCode OPTIONAL,
    transparencyIndicator       [15] TransparencyInd OPTIONAL,
    changeOfService         [16] SEQUENCE OF ChangeOfService OPTIONAL,
    supplServicesUsed           [17] SEQUENCE OF  SuppServiceUsed OPTIONAL,
    aocParameters               [18] AOCParameters OPTIONAL,
    changeOfAOCParms            [19] SEQUENCE OF AOCParmChange OPTIONAL,
    msClassmark             [20] Classmark OPTIONAL,
    changeOfClassmark           [21] ChangeOfClassmark OPTIONAL,
    seizureTime             [22] TimeStamp OPTIONAL,
    answerTime                  [23] TimeStamp OPTIONAL,
    releaseTime             [24] TimeStamp OPTIONAL,
    callDuration                [25] CallDuration,
    dataVolume                  [26] DataVolume OPTIONAL,
    radioChanRequested          [27] RadioChanRequested OPTIONAL,
    radioChanUsed               [28] TrafficChannel OPTIONAL,
    changeOfRadioChan           [29] ChangeOfRadioChannel OPTIONAL,
    causeForTerm                [30] CauseForTerm,
    diagnostics             [31] Diagnostics OPTIONAL,
    callReference               [32] CallReference,
    sequenceNumber              [33] INTEGER OPTIONAL,
    additionalChgInfo           [34] AdditionalChgInfo OPTIONAL,
    recordExtensions            [35] ManagementExtensions OPTIONAL,
    gsm-SCFAddress              [36] Gsm-SCFAddress OPTIONAL,
    serviceKey                  [37] ServiceKey OPTIONAL,
    networkCallReference        [38] NetworkCallReference OPTIONAL,
    mSCAddress                  [39] MSCAddress OPTIONAL,
    cAMELInitCFIndicator        [40] CAMELInitCFIndicator OPTIONAL,
    defaultCallHandling     [41] DefaultCallHandling OPTIONAL,
    hSCSDChanRequested          [42] NumOfHSCSDChanRequested OPTIONAL,
    hSCSDChanAllocated          [43] NumOfHSCSDChanAllocated OPTIONAL,
    changeOfHSCSDParms          [44] SEQUENCE OF HSCSDParmsChange OPTIONAL,
    fnur                        [45] Fnur OPTIONAL,
    aiurRequested               [46] AiurRequested OPTIONAL,
    chanCodingsAcceptable       [47] SEQUENCE OF ChannelCoding OPTIONAL,
    chanCodingUsed              [48] ChannelCoding OPTIONAL,
    speechVersionSupported  [49] SpeechVersionIdentifier OPTIONAL,
    speechVersionUsed           [50] SpeechVersionIdentifier OPTIONAL,
    numberOfDPEncountered       [51] INTEGER OPTIONAL,
    levelOfCAMELService     [52] LevelOfCAMELService OPTIONAL,
    freeFormatData              [53] FreeFormatData OPTIONAL,
    cAMELCallLegInformation [54] SEQUENCE OF CAMELInformation OPTIONAL,
    freeFormatDataAppend        [55] BOOLEAN OPTIONAL,
    defaultCallHandling-2       [56] DefaultCallHandling OPTIONAL,
    gsm-SCFAddress-2            [57] Gsm-SCFAddress OPTIONAL,
    serviceKey-2                [58] ServiceKey OPTIONAL,
    freeFormatData-2            [59] FreeFormatData OPTIONAL,
    freeFormatDataAppend-2  [60] BOOLEAN OPTIONAL,
    systemType                  [61] SystemType

}
```

```
MTCallRecord            ::= SET
{
    recordType              [0] CallEventRecordType,
    servedIMSI              [1] IMSI,
    servedIMEI              [2] IMEI OPTIONAL,
    servedMSISDN            [3] CalledNumber OPTIONAL,
    callingNumber           [4] CallingNumber OPTIONAL,
    connectedNumber     [5] ConnectedNumber OPTIONAL,
    recordingEntity     [6] RecordingEntity,
    mscIncomingTKGP     [7] TrunkGroup OPTIONAL,
    mscOutgoingTKGP     [8] TrunkGroup OPTIONAL,
    location                [9] LocationAreaAndCell OPTIONAL,
    changeOfLocation        [10] SEQUENCE OF LocationChange OPTIONAL,
    basicService            [11] BasicServiceCode OPTIONAL,
    transparencyIndicator   [12] TransparencyInd OPTIONAL,
    changeOfService     [13] SEQUENCE OF ChangeOfService OPTIONAL,
    supplServicesUsed       [14] SEQUENCE OF SuppServiceUsed OPTIONAL,
    aocParameters           [15] AOCParameters OPTIONAL,
    changeOfAOCParms        [16] SEQUENCE OF AOCParmChange OPTIONAL,
    msClassmark         [17] Classmark OPTIONAL,
    changeOfClassmark       [18] ChangeOfClassmark OPTIONAL,
    seizureTime         [19] TimeStamp OPTIONAL,
    answerTime              [20] TimeStamp OPTIONAL,
    releaseTime         [21] TimeStamp OPTIONAL,
    callDuration            [22] CallDuration,
    dataVolume              [23] DataVolume OPTIONAL,
    radioChanRequested      [24] RadioChanRequested OPTIONAL,
    radioChanUsed           [25] TrafficChannel OPTIONAL,
    changeOfRadioChan       [26] ChangeOfRadioChannel OPTIONAL,
    causeForTerm            [27] CauseForTerm,
    diagnostics         [28] Diagnostics OPTIONAL,
    callReference           [29] CallReference,
    sequenceNumber          [30] INTEGER OPTIONAL,
    additionalChgInfo       [31] AdditionalChgInfo OPTIONAL,
    recordExtensions        [32] ManagementExtensions OPTIONAL,
    networkCallReference    [33] NetworkCallReference OPTIONAL,
    mSCAddress              [34] MSCAddress OPTIONAL,
    hSCSDChanRequested      [35] NumOfHSCSDChanRequested OPTIONAL,
    hSCSDChanAllocated      [36] NumOfHSCSDChanAllocated OPTIONAL,
    changeOfHSCSDParms      [37] SEQUENCE OF HSCSDParmsChange OPTIONAL,
    fnur                    [38] Fnur OPTIONAL,
    aiurRequested           [39] AiurRequested OPTIONAL,
    chanCodingsAcceptable   [40] SEQUENCE OF ChannelCoding OPTIONAL,
    chanCodingUsed          [41] ChannelCoding OPTIONAL,
    speechVersionSupported[42] SpeechVersionIdentifier OPTIONAL,
    speechVersionUsed       [43] SpeechVersionIdentifier OPTIONAL,
    gsm-SCFAddress          [44] Gsm-SCFAddress OPTIONAL,
    serviceKey              [45] ServiceKey OPTIONAL,
    networkCallReference    [46] NetworkCallReference OPTIONAL,
    mSCAddress          [47] MSCAddress OPTIONAL,
    defaultCallHandling [48] DefaultCallHandling OPTIONAL,
    numberOfDPEncountered   [49] INTEGER OPTIONAL,
    levelOfCAMELService [50] LevelOfCAMELService OPTIONAL,
    freeFormatData          [51] FreeFormatData OPTIONAL,
    freeFormatDataAppend    [52] BOOLEAN OPTIONAL,
    systemType              [53] SystemType
}

RoamingRecord           ::= SET
{
    recordType              [0] CallEventRecordType,
    servedIMSI              [1] IMSI,
    servedMSISDN            [2] MSISDN OPTIONAL,
    callingNumber           [3] CallingNumber OPTIONAL,
    roamingNumber           [4] RoamingNumber OPTIONAL,
    recordingEntity     [5] RecordingEntity,
    mscIncomingTKGP     [6] TrunkGroup OPTIONAL,
    mscOutgoingTKGP     [7] TrunkGroup OPTIONAL,
    basicService            [8] BasicServiceCode OPTIONAL,
    transparencyIndicator   [9] TransparencyInd OPTIONAL,
    changeOfService     [10] SEQUENCE OF ChangeOfService OPTIONAL,
    supplServicesUsed       [11] SEQUENCE OF  SuppServiceUsed OPTIONAL,
    seizureTime         [12] TimeStamp OPTIONAL,
    answerTime              [13] TimeStamp OPTIONAL,
    releaseTime         [14] TimeStamp OPTIONAL,
    callDuration            [15] CallDuration,
    dataVolume              [16] DataVolume OPTIONAL,
    causeForTerm            [17] CauseForTerm,
    diagnostics         [18] Diagnostics OPTIONAL,
    callReference           [19] CallReference,
    sequenceNumber          [20] INTEGER OPTIONAL,
    recordExtensions        [21] ManagementExtensions OPTIONAL,
    networkCallReference    [22] NetworkCallReference OPTIONAL,
```

```
    mSCAddress              [23] MSCAddress OPTIONAL
}
TermCAMELIntRecord  ::= SET
{
    recordtype                  [0] CallEventRecordType,
    servedIMSI                  [1] IMSI,
    servedMSISDN                [2] MSISDN OPTIONAL,
    recordingEntity         [3] RecordingEntity,
    interrogationTime           [4] TimeStamp,
    destinationRoutingAddress   [5] DestinationRoutingAddress,
    gsm-SCFAddress              [6] Gsm-SCFAddress,
    serviceKey                  [7] ServiceKey,
    networkCallReference        [8] NetworkCallReference OPTIONAL,
    mSCAddress                  [9] MSCAddress OPTIONAL,
    defaultCallHandling     [10] DefaultCallHandling OPTIONAL,
    recordExtensions            [11] ManagementExtensions OPTIONAL,
    calledNumber                [12] CalledNumber,
    callingNumber               [13] CallingNumber OPTIONAL,
    mscIncomingTKGP         [14] TrunkGroup OPTIONAL,
    mscOutgoingTKGP         [15] TrunkGroup OPTIONAL,
    seizureTime             [16] TimeStamp OPTIONAL,
    answerTime                  [17] TimeStamp OPTIONAL,
    releaseTime             [18] TimeStamp OPTIONAL,
    callDuration                [19] CallDuration,
    dataVolume                  [20] DataVolume OPTIONAL,
    causeForTerm                [21] CauseForTerm,
    diagnostics             [22] Diagnostics OPTIONAL,
    callReference               [23] CallReference,
    sequenceNumber              [24] INTEGER OPTIONAL,
    numberOfDPEncountered       [25] INTEGER OPTIONAL,
    levelOfCAMELService     [26] LevelOfCAMELService OPTIONAL,
    freeFormatData              [27] FreeFormatData OPTIONAL,
    cAMELCallLegInformation [28] SEQUENCE OF CAMELInformation OPTIONAL,
    freeFormatDataAppend        [29] BOOLEAN OPTIONAL,

}

IncGatewayRecord        ::= SET
{
    recordType          [0] CallEventRecordType,
    callingNumber       [1] CallingNumber OPTIONAL,
    calledNumber        [2] CalledNumber,
    recordingEntity [3] RecordingEntity,
    mscIncomingTKGP [4] TrunkGroup OPTIONAL,
    mscOutgoingTKGP [5] TrunkGroup OPTIONAL,
    seizureTime     [6] TimeStamp OPTIONAL,
    answerTime          [7] TimeStamp OPTIONAL,
    releaseTime     [8] TimeStamp OPTIONAL,
    callDuration        [9] CallDuration,
    dataVolume          [10] DataVolume OPTIONAL,
    causeForTerm        [11] CauseForTerm,
    diagnostics     [12] Diagnostics OPTIONAL,
    callReference       [13] CallReference,
    sequenceNumber      [14] INTEGER OPTIONAL,
    recordExtensions    [15] ManagementExtensions OPTIONAL,
}

OutGatewayRecord        ::= SET
{
    recordType          [0] CallEventRecordType,
    callingNumber       [1] CallingNumber OPTIONAL,
    calledNumber        [2] CalledNumber,
    recordingEntity [3] RecordingEntity,
    mscIncomingTKGP [4] TrunkGroup OPTIONAL,
    mscOutgoingTKGP [5] TrunkGroup OPTIONAL,
    seizureTime     [6] TimeStamp OPTIONAL,
    answerTime          [7] TimeStamp OPTIONAL,
    releaseTime     [8] TimeStamp OPTIONAL,
    callDuration        [9] CallDuration,
    dataVolume          [10] DataVolume OPTIONAL,
    causeForTerm        [11] CauseForTerm,
    diagnostics     [12] Diagnostics OPTIONAL,
    callReference       [13] CallReference,
    sequenceNumber      [14] INTEGER OPTIONAL,
    recordExtensions    [15] ManagementExtensions OPTIONAL,

}

TransitCallRecord       ::= SET
{
    recordType              [0] CallEventRecordType,
    recordingEntity     [1] RecordingEntity,
    mscIncomingTKGP     [2] TrunkGroup OPTIONAL,
```

```
    mscOutgoingTKGP     [3] TrunkGroup OPTIONAL,
    callingNumber           [4] CallingNumber OPTIONAL,
    calledNumber            [5] CalledNumber,
    isdnBasicService        [6] BasicService OPTIONAL,
    seizureTimestamp        [7] TimeStamp OPTIONAL,
    answerTimestamp     [8] TimeStamp OPTIONAL,
    releaseTimestamp        [9] TimeStamp OPTIONAL,
    callDuration            [10] CallDuration,
    dataVolume              [11] DataVolume OPTIONAL,
    causeForTerm            [12] CauseForTerm,
    diagnostics         [13] Diagnostics OPTIONAL,
    callReference           [14] CallReference,
    sequenceNumber          [15] INTEGER OPTIONAL,
    recordExtensions        [16] ManagementExtensions OPTIONAL,

}

MOSMSRecord             ::= SET
{
    recordType          [0] CallEventRecordType,
    servedIMSI          [1] IMSI,
    servedIMEI          [2] IMEI OPTIONAL,
    servedMSISDN        [3] MSISDN OPTIONAL,
    msClassmark     [4] Classmark,
    serviceCentre       [5] AddressString,
    recordingEntity [6] RecordingEntity,
    location            [7] LocationAreaAndCell OPTIONAL,
    messageReference    [8] MessageReference,
    originationTime [9] TimeStamp,
    smsResult           [10] SMSResult OPTIONAL,
    recordExtensions    [11] ManagementExtensions OPTIONAL,
    destinationNumber   [12] CalledNumber OPTIONAL,
    cAMELSMSInformation [13] CAMELSMSInformation OPTIONAL,
    systemType          [14] SystemType


}

MTSMSRecord             ::= SET
{
    recordType          [0] CallEventRecordType,
    serviceCentre       [1] AddressString,
    servedIMSI          [2] IMSI,
    servedIMEI          [3] IMEI OPTIONAL,
    servedMSISDN        [4] MSISDN OPTIONAL,
    msClassmark     [5] Classmark,
    recordingEntity [6] RecordingEntity,
    location            [7] LocationAreaAndCell OPTIONAL,
    deliveryTime        [8] TimeStamp,
    smsResult           [9] SMSResult OPTIONAL,
    recordExtensions    [10] ManagementExtensions OPTIONAL,
    systemType          [11] SystemType

}

MOSMSIWRecord           ::= SET
{
    recordType          [0] CallEventRecordType,
    serviceCentre       [1] AddressString,
    servedIMSI          [2] IMSI,
    recordingEntity [3] RecordingEntity,
    eventTime           [4] TimeStamp,
    smsResult           [5] SMSResult OPTIONAL,
    recordExtensions    [6] ManagementExtensions OPTIONAL
}

MTSMSGWRecord           ::= SET
{
    recordType          [0] CallEventRecordType,
    serviceCentre       [1] AddressString,
    servedIMSI          [2] IMSI,
    servedMSISDN        [3] MSISDN OPTIONAL,
    recordingEntity [4] RecordingEntity,
    eventTime           [5] TimeStamp,
    smsResult           [6] SMSResult OPTIONAL,
    recordExtensions    [7] ManagementExtensions OPTIONAL
}

SSActionRecord          ::= SET
{
    recordType          [0] CallEventRecordType,
    servedIMSI          [1] IMSI,
    servedIMEI          [2] IMEI OPTIONAL,
```

```
    servedMSISDN        [3] MSISDN OPTIONAL,
    msClassmark     [4] Classmark,
    recordingEntity [5] RecordingEntity,
    location            [6] LocationAreaAndCell OPTIONAL,
    basicServices       [7] BasicServices OPTIONAL,
    supplService        [8] SS-Code OPTIONAL,
    ssAction            [9] SSActionType OPTIONAL,
    ssActionTime        [10] TimeStamp,
    ssParameters        [11] SSParameters OPTIONAL,
    ssActionResult      [12] SSActionResult OPTIONAL,
    callReference       [13] CallReference,
    recordExtensions    [14] ManagementExtensions OPTIONAL,
    systemType          [15] SystemType

}

HLRIntRecord            ::= SET
{
    recordType              [0] CallEventRecordType,
    servedIMSI              [1] IMSI,
    servedMSISDN            [2] MSISDN,
    recordingEntity     [3] RecordingEntity,
    basicService            [4] BasicServiceCode OPTIONAL,
    routingNumber           [5] RoutingNumber,
    interrogationTime       [6] TimeStamp,
    numberOfForwarding      [7] NumberOfForwarding OPTIONAL,
    interrogationResult [8] HLRIntResult OPTIONAL,
    recordExtensions        [9] ManagementExtensions OPTIONAL,
    systemType              [10] SystemType

}

LocUpdateHLRRecord      ::= SET
{
    recordType              [0] CallEventRecordType,
    servedIMSI              [1] IMSI,
    recordingEntity     [2] RecordingEntity,
    oldLocation         [3] Visited-Location-info OPTIONAL,
    newLocation         [4] Visited-Location-info,
    updateTime              [5] TimeStamp,
    updateResult            [6] LocUpdResult OPTIONAL,
    recordExtensions        [7] ManagementExtensions OPTIONAL,
    systemType              [8] SystemType

}

LocUpdateVLRRecord      ::= SET
{
    recordType              [0] CallEventRecordType,
    servedIMSI              [1] IMSI,
    servedMSISDN            [2] MSISDN OPTIONAL,
    recordingEntity     [3] RecordingEntity,
    oldLocation         [4] Location-info OPTIONAL,
    newLocation         [5] Location-info,
    msClassmark         [6] Classmark,
    updateTime              [7] TimeStamp,
    updateResult            [8] LocUpdResult OPTIONAL,
    recordExtensions        [9] ManagementExtensions OPTIONAL,
    systemType              [10] SystemType

}


CommonEquipRecord       ::= SET
{
    recordType              [0] CallEventRecordType,
    equipmentType           [1] EquipmentType,
    equipmentId         [2] EquipmentId,
    servedIMSI              [3] IMSI,
    servedMSISDN            [4] MSISDN OPTIONAL,
    recordingEntity     [5] RecordingEntity,
    basicService            [6] BasicServiceCode OPTIONAL,
    changeOfService     [7] SEQUENCE OF ChangeOfService OPTIONAL,
    supplServicesUsed       [8] SEQUENCE OF SuppServiceUsed OPTIONAL,
    seizureTime         [9] TimeStamp,
    releaseTime         [10] TimeStamp OPTIONAL,
    callDuration            [11] CallDuration,
    callReference           [12] CallReference,
    sequenceNumber          [13] INTEGER OPTIONAL,
    recordExtensions        [14] ManagementExtensions OPTIONAL
}
```

```
--
--  OBSERVED IMEI TICKETS
--
-------------------------------------------------------------------------------

ObservedIMEITicket      ::= SET
{
    servedIMEI          [0] IMEI,
    imeiStatus          [1] IMEIStatus,
    servedIMSI          [2] IMSI,
    servedMSISDN        [3] MSISDN OPTIONAL,
    recordingEntity [4] RecordingEntity,
    eventTime           [5] TimeStamp,
    location            [6] LocationAreaAndCell ,
    imeiCheckEvent      [7] IMEICheckEvent OPTIONAL,
    callReference       [8] CallReference OPTIONAL,
    recordExtensions    [9] ManagementExtensions OPTIONAL,
    systemType          [10] SystemType

}


-------------------------------------------------------------------------------
--
--  FTAM / FTP / TFTP FILE CONTENTS
--
-------------------------------------------------------------------------------

CallEventDataFile       ::= SEQUENCE
{
    headerRecord        [0] HeaderRecord,
    callEventRecords    [1] SEQUENCE OF CallEventRecord,
    trailerRecord       [2] TrailerRecord,
    extensions          [3] ManagementExtensions
}

ObservedIMEITicketFile  ::= SEQUENCE
{
    productionDateTime      [0] TimeStamp,
    observedIMEITickets [1] SEQUENCE OF ObservedIMEITicket,
    noOfRecords         [2] INTEGER,
    extensions              [3] ManagementExtensions
}

HeaderRecord            ::= SEQUENCE
{
    productionDateTime      [0] TimeStamp,
    recordingEntity     [1] RecordingEntity,
    extensions              [2] ManagementExtensions
}

TrailerRecord           ::= SEQUENCE
{
    productionDateTime      [0] TimeStamp,
    recordingEntity     [1] RecordingEntity,
    firstCallDateTime       [2] TimeStamp,
    lastCallDateTime        [3] TimeStamp,
    noOfRecords         [4] INTEGER,
    extensions              [5] ManagementExtensions
}

-------------------------------------------------------------------------------
--
--  COMMON DATA TYPES
--
-------------------------------------------------------------------------------

AdditionalChgInfo       ::= SEQUENCE
{
    chargeIndicator [0] ChargeIndicator OPTIONAL,
    chargeParameters    [1] OCTET STRING OPTIONAL
}

AiurRequested           ::= ENUMERATED
{
    --
    -- See Bearer Capability TS 24.008
    -- (note that value "4" is intentionally missing
    --  because it is not used in TS 24.008)
    --

    aiur09600BitsPerSecond      (1),
    aiur14400BitsPerSecond      (2),
```

```
    aiur19200BitsPerSecond      (3),
    aiur28800BitsPerSecond      (5),
    aiur38400BitsPerSecond      (6),
    aiur43200BitsPerSecond      (7),
    aiur57600BitsPerSecond      (8),
    aiur38400BitsPerSecond1     (9),
    aiur38400BitsPerSecond2     (10),
    aiur38400BitsPerSecond3     (11),
    aiur38400BitsPerSecond4     (12)
}

AOCParameters           ::= SEQUENCE
{
    --
    -- See TS 22.024.
    --
    e1                  [1] EParameter OPTIONAL,
    e2                  [2] EParameter OPTIONAL,
    e3                  [3] EParameter OPTIONAL,
    e4                  [4] EParameter OPTIONAL,
    e5                  [5] EParameter OPTIONAL,
    e6                  [6] EParameter OPTIONAL,
    e7                  [7] EParameter OPTIONAL
}

AOCParmChange           ::= SEQUENCE
{
    changeTime          [0] TimeStamp,
    newParameters       [1] AOCParameters
}

BasicServices           ::= SET OF BasicServiceCode

BCDDirectoryNumber      ::= OCTET STRING
    -- This type contains the binary coded decimal representation of
    -- a directory number e.g. calling/called/connected/translated number.
    -- The encoding of the octet string is in accordance with the
    -- the elements "Calling party BCD number", "Called party BCD number"
    -- and "Connected number" defined in TS 24.008.
    -- This encoding includes type of number and number plan information
    -- together with a BCD encoded digit string.
    -- It may also contain both a presentation and screening indicator
    -- (octet 3a).
    -- For the avoidance of doubt, this field does not include
    -- octets 1 and 2, the element name and length, as this would be
    -- redundant.

CallDuration            ::= INTEGER
    --
    -- The call duration in seconds.
    -- For successful calls this is the chargeable duration.
    -- For call attempts this is the call holding time.
    --

CallEventRecordType     ::= INTEGER
{
    moCallRecord        (0),
    mtCallRecord        (1),
    roamingRecord       (2),
    incGatewayRecord    (3),
    outGatewayRecord    (4),
    transitCallRecord   (5),
    moSMSRecord     (6),
    mtSMSRecord     (7),
    moSMSIWRecord       (8),
    mtSMSGWRecord       (9),
    ssActionRecord      (10),
    hlrIntRecord        (11),
    locUpdateHLRRecord  (12),
    locUpdateVLRRecord  (13),
    commonEquipRecord   (14),
    moTraceRecord       (15),
    mtTraceRecord       (16),
    termCAMELIntRecord  (17),
--
--  Record values 18..22 are GPRS specific.
--  The contents are defined in TS 32.015
--
    sgsnPDPRecord       (18),
    ggsnPDPRecord       (19),
    sgsnMMRecord        (20),
    sgsnSMORecord       (21),
    sgsnSMTRecord       (22),
```

```
    mmsORecord          (23),
    mmsTRecord          (24)

}

CalledNumber            ::= BCDDirectoryNumber

CallingNumber           ::= BCDDirectoryNumber

CallingPartyCategory    ::= Category

CallReference           ::= INTEGER

CallType                ::= INTEGER
{
    mobileOriginated    (0),
    mobileTerminated    (1)
}

CallTypes               ::= SET OF CallType

CAMELDestinationNumber  ::= DestinationRoutingAddress

CAMELInformation        ::= SET
{
    cAMELDestinationNumber  [1] CAMELDestinationNumber OPTIONAL,
    connectedNumber         [2] ConnectedNumber OPTIONAL,
    roamingNumber               [3] RoamingNumber OPTIONAL,
    mscOutgoingTKGP         [4] TrunkGroup OPTIONAL,
    seizureTime             [5] TimeStamp OPTIONAL,
    answerTime                  [6] TimeStamp OPTIONAL,
    releaseTime             [7] TimeStamp OPTIONAL,
    callDuration                [8] CallDuration OPTIONAL,
    dataVolume                  [9] DataVolume OPTIONAL,
    cAMELInitCFIndicator        [10] CAMELInitCFIndicator OPTIONAL,
    causeForTerm                [11] CauseForTerm OPTIONAL,
    cAMELModification           [12] ChangedParameters OPTIONAL,
    freeFormatData              [13] FreeFormatData OPTIONAL,
    diagnostics             [14] Diagnostics OPTIONAL,
    freeFormatDataAppend        [15] BOOLEAN OPTIONAL,
    freeFormatData-2            [16] FreeFormatData OPTIONAL,
    freeFormatDataAppend-2  [17] BOOLEAN OPTIONAL
}


CAMELSMSInformation     ::= SET
{
    gsm-SCFAddress                      [1] Gsm-SCFAddress OPTIONAL,
    serviceKey                          [2] ServiceKey OPTIONAL,
    defaultSMSHandling                  [3] DefaultSMS-Handling OPTIONAL,
    freeFormatData                      [4] FreeFormatData OPTIONAL,
    CallingPartyNumber              [5] CallingNumber OPTIONAL,
    DestinationSubscriberNumber     [6] CalledNumber OPTIONAL,
    cAMELSMSCAddress                    [7] AddressString OPTIONAL
}

CAMELInitCFIndicator    ::= ENUMERATED
{
    noCAMELCallForwarding       (0),
    cAMELCallForwarding     (1)
}

CAMELModificationParameters ::= SET
    --
    -- The list contains only parameters changed due to CAMEL call
    -- handling.
    --
{
    callingPartyNumber          [0] CallingNumber OPTIONAL,
    callingPartyCategory        [1] CallingPartyCategory OPTIONAL,
    originalCalledPartyNumber   [2] OriginalCalledNumber OPTIONAL,
    genericNumbers              [3] GenericNumbers OPTIONAL,
    redirectingPartyNumber      [4] RedirectingNumber OPTIONAL,
    redirectionCounter          [5] NumberOfForwarding OPTIONAL
}


Category        ::= OCTET STRING (SIZE(1))
    --
    -- The internal structure is defined in CCITT Rec Q.763.
    --

CauseForTerm            ::= INTEGER
```

```
    --
    -- Cause codes from 16 up to 31 are defined in GSM12.15 as 'CauseForRecClosing'
    -- (cause for record closing).
    -- There is no direct correlation between these two types.
    --
{
    normalRelease                       (0),
    partialRecord                       (1),
    partialRecordCallReestablishment    (2),
    unsuccessfulCallAttempt         (3),
    stableCallAbnormalTermination   (4),
    cAMELInitCallRelease                (5)
}

CellId  ::= OCTET STRING (SIZE(2))
    --
    -- Coded according to TS 24.008
    --

ChangedParameters       ::= SET
{
    changeFlags     [0] ChangeFlags,
    changeList      [1] CAMELModificationParameters OPTIONAL
}

ChangeFlags             ::= BIT STRING
{
callingPartyNumberModified          (0),
callingPartyCategoryModified            (1),
originalCalledPartyNumberModified   (2),
genericNumbersModified              (3),
redirectingPartyNumberModified      (4),
redirectionCounterModified          (5)
}

ChangeOfClassmark       ::= SEQUENCE
{
    classmark           [0] Classmark,
    changeTime          [1] TimeStamp
}

ChangeOfRadioChannel    ::= SEQUENCE
{
    radioChannel        [0] TrafficChannel,
    changeTime          [1] TimeStamp,
    speechVersionUsed   [2] SpeechVersionIdentifier OPTIONAL
}

ChangeOfService         ::= SEQUENCE
{
    basicService        [0] BasicServiceCode,
    transparencyInd [1] TransparencyInd OPTIONAL,
    changeTime          [2] TimeStamp
}

ChannelCoding           ::= ENUMERATED
{
   tchF4800             (1),
   tchF9600             (2),
   tchF14400               (3)
}

ChargeIndicator         ::= INTEGER
{
    noCharge            (0),
    charge              (1)
}

Classmark               ::= OCTET STRING
    --
    -- See Mobile station classmark  2,  TS 24.008
    --

ConnectedNumber         ::= BCDDirectoryNumber

DataVolume              ::= INTEGER
    --
    -- The volume of data transferred in segments of 64 octets.
    --

Day                     ::= INTEGER (1..31)

DayClass                ::= ObjectInstance
```

```
DayClasses              ::= SET OF DayClass

DayDefinition           ::= SEQUENCE
{
    day                 [0] DayOfTheWeek,
    dayClass            [1] ObjectInstance
}

DayDefinitions          ::= SET OF DayDefinition

DateDefinition          ::= SEQUENCE
{
    month               [0] Month,
    day                 [1] Day,
    dayClass            [2] ObjectInstance
}

DateDefinitions         ::= SET OF DateDefinition

DayOfTheWeek            ::= ENUMERATED
{
    allDays             (0),
    sunday              (1),
    monday              (2),
    tuesday             (3),
    wednesday           (4),
    thursday            (5),
    friday              (6),
    saturday            (7)
}

Diagnostics                     ::= CHOICE
{
    gsm0408Cause                [0] INTEGER,
    -- See TS 24.008
    gsm0902MapErrorValue        [1] INTEGER,
    -- Note: The value to be stored here corresponds to
    -- the local values defined in the MAP-Errors and
    -- MAP-DialogueInformation modules, for full details
    -- see TS 29.002.
    ccittQ767Cause              [2] INTEGER,
    -- See CCITT Q.767
    networkSpecificCause        [3] ManagementExtension,
    -- To be defined by network operator
    manufacturerSpecificCause   [4] ManagementExtension
    -- To be defined by manufacturer
}

Destinations            ::= SET OF AE-title

EmergencyCallIndEnable  ::= BOOLEAN

EmergencyCallIndication ::= SEQUENCE
{
    cellId              [0] CellId,
    callerId            [1] IMSIorIMEI
}

EParameter  ::= INTEGER (0..1023)
    --
    -- Coded according to  TS 22.024  and TS 24.080
    --

EquipmentId             ::= INTEGER

EquipmentType           ::= INTEGER
{
    conferenceBridge    (0)
}

FileType                ::= INTEGER
{
    callRecords     (1),
    traceRecords        (9),
    observedIMEITicket  (14)
}

Fnur                    ::= ENUMERATED
{
   --
   -- See Bearer Capability TS 24.008
   --
```

```
   fnur9600-BitsPerSecond    (1),
   fnur14400BitsPerSecond    (2),
   fnur19200BitsPerSecond    (3),
   fnur28800BitsPerSecond    (4),
   fnur38400BitsPerSecond    (5),
   fnur48000BitsPerSecond    (6),
   fnur56000BitsPerSecond    (7),
   fnur64000BitsPerSecond    (8)
}

ForwardToNumber         ::= AddressString

FreeFormatData          ::= OCTET STRING (SIZE(1..160))
    --
    -- Free formated data as sent in the FCI message
    -- See TS 29.078
    --

GenericNumber           ::= BCDDirectoryNumber

GenericNumbers          ::= SET OF GenericNumber

Gsm-SCFAddress          ::= ISDN-AddressString
    --
    -- See TS 29.002
    --

HLRIntResult            ::= Diagnostics

HSCSDParmsChange        ::= SEQUENCE
{
    changeTime              [0] TimeStamp,
    hSCSDChanAllocated      [1] NumOfHSCSDChanAllocated,
    initiatingParty     [2] InitiatingParty OPTIONAL,
    aiurRequested           [3] AiurRequested OPTIONAL,
    chanCodingUsed          [4] ChannelCoding,
    hSCSDChanRequested      [5] NumOfHSCSDChanRequested OPTIONAL
}

IMEICheckEvent          ::= INTEGER
{
    mobileOriginatedCall    (0),
    mobileTerminatedCall    (1),
    smsMobileOriginating    (2),
    smsMobileTerminating    (3),
    ssAction                (4),
    locationUpdate          (5)
}

IMEIStatus              ::= ENUMERATED
{
    greyListedMobileEquipment           (0),
    blackListedMobileEquipment      (1),
    nonWhiteListedMobileEquipment   (2)
}

IMSIorIMEI              ::= CHOICE
{
    imsi                [0] IMSI,
    imei                [1] IMEI
}

InitiatingParty         ::= ENUMERATED
{
    network             (0),
    subscriber          (1)
}

LevelOfCAMELService     ::= BIT STRING
{
    basic                       (0),
    callDurationSupervision (1),
    onlineCharging              (2)
}

LocationAreaAndCell     ::= SEQUENCE
{
    locationAreaCode    [0] LocationAreaCode,
    cellId              [1] CellId
}

LocationAreaCode        ::= OCTET STRING (SIZE(2))
    --
```

```
    -- See TS 24.008
    --

LocationChange          ::= SEQUENCE
{
    location            [0] LocationAreaAndCell,
    changeTime          [1] TimeStamp
}

Location-info           ::= SEQUENCE
{
    mscNumber               [1] MscNo OPTIONAL,
    location-area           [2] LocationAreaCode,
    cell-identification [3] CellId OPTIONAL
}

LocUpdResult            ::= Diagnostics

ManagementExtensions    ::= SET OF ManagementExtension

MCCMNC  ::= GraphicString (SIZE(5))
    --
    -- This type contains the mobile country code (MCC) and the mobile      -- network code (MNC) of
a PLMN.
    --

MessageReference        ::= OCTET STRING

Month                   ::= INTEGER (1..12)

MSCAddress              ::= AddressString

MscNo                   ::= ISDN-AddressString
    --
    -- See TS 23.003
    --

MSISDN  ::= ISDN-AddressString
    --
    -- See TS 23.003
    --

MSPowerClasses          ::= SET OF RFPowerCapability

NetworkCallReference    ::= CallReferenceNumber --
    -- See TS 29.002
    --

NetworkSpecificCode     ::= INTEGER
    --
    -- To be defined by network operator
    --

NetworkSpecificServices ::= SET OF NetworkSpecificCode

NumOfHSCSDChanRequested     ::= INTEGER

NumOfHSCSDChanAllocated     ::= INTEGER

ObservedIMEITicketEnable    ::= BOOLEAN

OriginalCalledNumber        ::= BCDDirectoryNumber

OriginDestCombinations      ::= SET OF OriginDestCombination

OriginDestCombination       ::= SEQUENCE
{
    origin                  [0] INTEGER OPTIONAL,
    destination         [1] INTEGER OPTIONAL
    --
    -- Note that these values correspond to the contents
    -- of the attributes originId and destinationId
    -- respectively. At least one of the two must be present.
    --
}

PartialRecordTimer      ::= INTEGER

PartialRecordType       ::= ENUMERATED
{
    timeLimit                   (0),
    serviceChange               (1),
    locationChange              (2),
```

```
    classmarkChange         (3),
    aocParmChange               (4),
    radioChannelChange          (5),
    hSCSDParmChange         (6),
    changeOfCAMELDestination    (7)
}

PartialRecordTypes      ::= SET OF PartialRecordType

RadioChannelsRequested  ::= SET OF RadioChanRequested

RadioChanRequested      ::= ENUMERATED
{
    --
    -- See Bearer Capability TS 24.008
    --
    halfRateChannel         (0),
    fullRateChannel         (1),
    dualHalfRatePreferred       (2),
    dualFullRatePreferred       (3)
}

RecordClassDestination  ::= CHOICE
{
    osApplication       [0] AE-title,
    fileType            [1] FileType
}

RecordClassDestinations ::= SET OF RecordClassDestination

RecordingEntity         ::= AddressString

RecordingMethod         ::= ENUMERATED
{
    inCallRecord        (0),
    inSSRecord          (1)
}

RedirectingNumber       ::= BCDDirectoryNumber

RFPowerCapability       ::= INTEGER
    --This field contains the RF power capability of the
    --  Mobile station
    -- classmark 1 and 2 of TS 24.008 expressed as an integer.
    --

RoamingNumber           ::= ISDN-AddressString
    --
    -- See TS 23.003
    --

RoutingNumber           ::= CHOICE
{
    roaming             [1] RoamingNumber,
    forwarded           [2] ForwardToNumber
}

Service                     ::= CHOICE
{
    teleservice             [1] TeleserviceCode,
    bearerService               [2] BearerServiceCode,
    supplementaryService        [3] SS-Code,
    networkSpecificService  [4] NetworkSpecificCode
}

ServiceDistanceDependencies ::= SET OF ServiceDistanceDependency

ServiceDistanceDependency   ::= SEQUENCE
{
    aocService              [0] INTEGER,
    chargingZone            [1] INTEGER OPTIONAL
    --
    -- Note that these values correspond to the contents
    -- of the attributes aocServiceId and zoneId
    -- respectively.
    --
}

SimpleIntegerName           ::= INTEGER

SimpleStringName            ::= GraphicString

SMSResult                   ::= Diagnostics
```

```
SpeechVersionIdentifier ::= OCTET STRING (SIZE(1))

--  see GSM 08.08

--  000 0001    GSM speech full rate version 1
--  001 0001    GSM speech full rate version 2   used for enhanced full rate
--  010 0001    GSM speech full rate version 3   for future use
--  000 0101    GSM speech half rate version 1
--  001 0101    GSM speech half rate version 2  for future use
--  010 0101    GSM speech half rate version 3  for future use

SSActionResult              ::= Diagnostics

SSActionType                ::= ENUMERATED
{
    registration            (0),
    erasure                 (1),
    activation              (2),
    deactivation            (3),
    interrogation           (4),
    invocation              (5),
    passwordRegistration    (6)
}

SSParameters                ::= CHOICE
{
    forwardedToNumber       [0] ForwardToNumber,
    unstructuredData        [1] OCTET STRING
}

SystemType              ::= ENUMERATED
{
    unknown             (0),
    iuUTRAN             (1)
}

SupplServices               ::= SET OF SS-Code

SuppServiceUsed             ::= SEQUENCE
{
    ssCode                  [0] SS-Code,
    ssTime                  [1] TimeStamp OPTIONAL
}

SwitchoverTime              ::= SEQUENCE
{
    hour                    INTEGER (0..23),
    minute                  INTEGER (0..59),
    second                  INTEGER (0..59)
}

TariffId                    ::= INTEGER

TariffPeriod                ::= SEQUENCE
{
    switchoverTime          [0] SwitchoverTime,
    tariffId                [1] INTEGER
    -- Note that the value of tariffId corresponds
    -- to the attribute tariffId.
}

TariffPeriods               ::= SET OF TariffPeriod

TariffSystemStatus          ::= ENUMERATED
{
    available               (0),    -- available for modification
    checked                 (1),    -- "frozen" and checked
    standby                 (2),    -- "frozen" awaiting activation
    active                  (3) -- "frozen" and active
}

TimeStamp                   ::= OCTET STRING (SIZE(9))
    --
    -- The contents of this field are a compact form of the UTCTime format
    -- containing local time plus an offset to universal time. Binary coded
    -- decimal encoding is employed for the digits to reduce the storage and
    -- transmission overhead
    -- e.g. YYMMDDhhmmssShhmm
    -- where
    -- YY   =   Year 00 to 99       BCD encoded
    -- MM   =   Month 01 to 12      BCD encoded
    -- DD   =   Day 01 to 31        BCD encoded
```

```
    -- hh   =   hour 00 to 23       BCD encoded
    -- mm   =   minute 00 to 59     BCD encoded
    -- ss   =   second 00 to 59     BCD encoded
    -- S    =   Sign 0 = "+", "-"   ASCII encoded
    -- hh   =   hour 00 to 23       BCD encoded
    -- mm   =   minute 00 to 59     BCD encoded
    --

TrafficChannel          ::= ENUMERATED
{
    fullRate            (0),
    halfRate            (1)
}

TranslatedNumber        ::=     BCDDirectoryNumber

TransparencyInd         ::= ENUMERATED
{
    transparent     (0),
    nonTransparent      (1)
}

TrunkGroup              ::=  CHOICE
{
    tkgpNumber          [0] INTEGER,
    tkgpName            [1] GraphicString
}

TSChangeover            ::= SEQUENCE
{
    newActiveTS     [0] INTEGER,
    newStandbyTS        [1] INTEGER,
    changeoverTime      [2] GeneralizedTime OPTIONAL,
    authkey             [3] OCTET STRING OPTIONAL,
    checksum            [4] OCTET STRING OPTIONAL,
    versionNumber       [5] OCTET STRING OPTIONAL
    -- Note that if the changeover time is not
    -- specified then the change is immediate.
}

TSCheckError            ::= SEQUENCE
{
    errorId             [0] TSCheckErrorId,
    fail                [1] ANY DEFINED BY errorId OPTIONAL
}

TSCheckErrorId          ::= CHOICE
{
    globalForm          [0] OBJECT IDENTIFIER,
    localForm           [1] INTEGER
}

TSCheckResult           ::= CHOICE
{
    success             [0] NULL,
    fail                [1] SET OF TSCheckError
}

TSCopyTariffSystem      ::= SEQUENCE
{
    oldTS               [0] INTEGER,
    newTS               [1] INTEGER
}

TSNextChange            ::= CHOICE
{
    noChangeover        [0] NULL,
    tsChangeover        [1] TSChangeover
}

TypeOfSubscribers       ::= ENUMERATED
{
    home                (0),    -- HPLMN subscribers
    visiting            (1),    -- roaming subscribers
    all (2)
}

TypeOfTransaction       ::= ENUMERATED
{
    successful          (0),
    unsuccessful        (1),
    all                 (2)
}
```

```
Visited-Location-info           ::= SEQUENCE
{
    mscNumber           [1] MscNo,
    vlrNumber           [2] VlrNo,
}

VlrNo                   ::= ISDN-AddressString
    --
    -- See TS 23.003
    --


END
```

7. Charging Data Record Transfer

7.1 Bulk Data Transfer

The charging data records shall be transferred from the NEF to the OSF by the use of FTAM protocol on X.25 or TCP/IP, FTP over TCP/IP, or TFTP over TCP/IP services. For further details of the use of FTAM see GSM 12.01 [25].

Annex A (informative):
Change history

This annex lists all change requests approved for this document since the specification was first approved by 3GPP TSG-SA.

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
Mar 2001	S_11	SP-010025	-		Replaces Release 99 of 3GPP 32.005, which will be discontinued from Release 4 onwards.	-	1.0.0
May 2001			-		Result of the SA5#20 plenary.	1.0.1	1.1.0
Jun 2001	S_12	SP-010236	-		Re-submitted to SA#12 for Information	1.1.0	1.1.1

3G TS 32.215 V1.0.1 (2001-06)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; 3G Telecom Management; Charging Management; Charging Data Description For The Packet Switched (PS) Domain (Release 4)

Keywords
UMTS, packet switching mode, charging

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1. Contents

Foreword

This Technical Specification (TS) 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.

1. Scope

The GSM and UMTS PLMN support a wide range of packet based services by means of the General Packet Radio Service (GPRS), as defined in 3GPP TS 22.060 [1] and 3GPP TS 23.060 [2]. In order to enable operators the ability to provide a commercially viable service, there is a need to provide charging functions. For GPRS these functions include the generation of Charging Data Records (CDRs) by the Serving GPRS Support Node (SGSN) and the Gateway GPRS Support Node (GGSN) as well as the transport of these CDRs to a Billing System (BS) through a Charging Gateway Function (CGF).

This document is part of a series of documents specifying charging functionality in UMTS networks. The UMTS charging architecture and principles are specified in document TS 32.200 [3] which provides an umbrella for other charging documents that specify the structure and content of the CDRs and the interface protocol that is used to transfer them to the collecting node.. The CDRs content and transport within the PS domain are described in the present document. The CDRs used in the Circuit Switched (CS) domain are specified in document TS 32.205 [4] while CDRs used for application services are defined in document TS 32.235 [5]. This document structure is depicted in Figure 1.

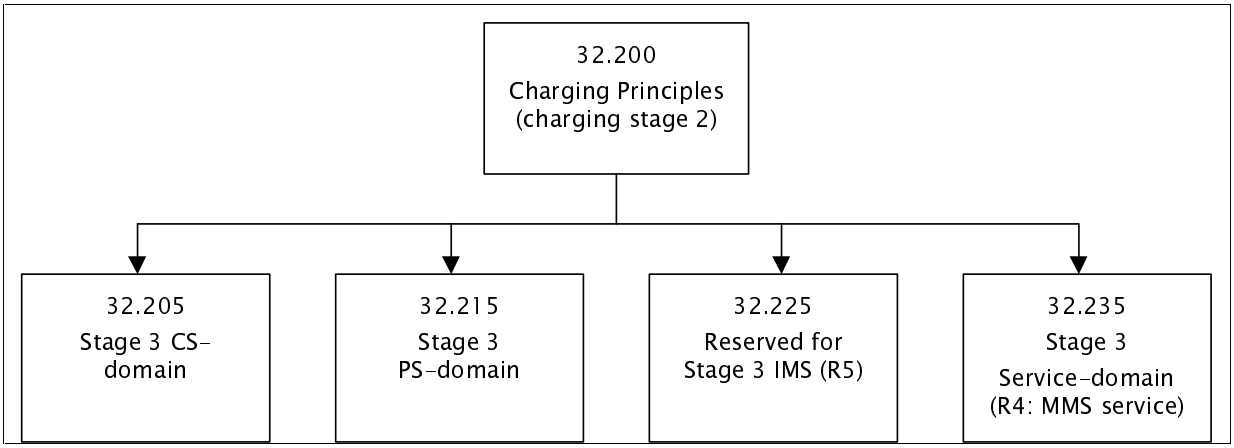

Figure 1: Charging Documents Structure

All references, abbreviations, definitions, descriptions, principles and requirements that are common to charging in UMTS domains or subsystems are provided in the umbrella document [3]. To avoid unnecessary duplications, they are not repeated in the present document unless it is essential.

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.

[1] 3GPP TS 22.060: "General Packet Radio Service (GPRS); Service description; Stage 1".

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

[3] 3GPP TS 32.200: "3G charging architecture and principles for services".

[4] 3GPP TS 32.205: "Charging data description for the Circuit Switched (CS) domain ".

[5] 3GPP TS 32.235: "charging data description for application services"

[6] 3GPP TS 21.905: "3G vocabulary".

[7] 3GPP TS 23.003: "Numbering, addressing and identification".

[8] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[9] 3GPP TS 29.078: "Digital cellular telecommunications system (Phase 2+); CAMEL Application Part (CAP) specification - Phase 3".

[10] 3GPP TS 24.008: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[11] 3GPP TS 25.413: "UTRAN Iu Interface RANAP Signalling".

[12] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[13] ISUP Q.767: "Specifications of Signalling System No.7; Application of the ISDN user part of CCITT signalling System No.7 for international ISDN interconnections"

[14] 3GPP TS 23.040: "Technical realisation of the Short Message Service (SMS); Point-to-Point (PP)".

[15] ITU-T X.721 Information Technology - Open Systems Interconnection - Structure Of Management Information

[16] ISO8824 (90) / X.208 (88): "Information technology - open System Interconnection - Specification of Abstract Syntax Notation One (ASN.1)".

[17] ISO8824-1 (94) / X.680 (94): "Information technology - Abstract Syntax Notation One (ASN.1) - Specification of Basic Notation".

[18] IETF RFC 768 (1980): "User Datagram Protocol" (STD 6).

[19] IETF RFC 793 (1981): "Transmission Control Protocol" (STD 7).

[20] IETF RFC 791 (1981): "Internet Protocol" (STD 5).

[21] IETF RFC 792 (1981): "Internet Control Message Protocol" (STD 5).

3. Definitions, abbreviations and symbols

3.1 Definitions

For the purposes of the present document the following definitions apply. Additional applicable definitions for charging principles in UMTS are provided in TS 32.200 [3]. Other general definitions can be found in 3GPP TS 22.060 [1] .

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

Packet Switched domain: A domain within UMTS 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.

CDR (Charging Data Record): A record generated by a network element for the purpose of billing a subscriber for the provided service. (In the PS domain 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).

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

Mandatory – A field that shall be present in the CDR**.**

Conditional – A 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.

Partial CDR: A CDR that provides information on part of a subscriber session. A long session may be covered by several partial CDRs. In this document, two formats are considered for Partial CDRs. One that contains all of the necessary fields; the second has a reduced format.

Full Qualified Partial CDR (CPC): A partial CDR that contains a complete set of the fields specified in this 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 (See section 4.1). The first Partial CDR shall be a Full Qualified Partial CDR.

Reduced Partial CDR (RPC): Partial CDRs that only provide mandatory fields and information regarding changes in the session parameters relative to the previous CDR. For example, location information is not repeated in these CDRs if the subscriber did not change its location. See Section 4.1 for further details.

3.2 Abbreviations

For the purposes of the present document the following abbreviations apply. Additional applicable abbreviations can be found in 3GPP TS 21.905 [6].

APN	Access Point Name
BMD	Billing Mediation Device
BS	Billing System
CAMEL	Customised Applications for Mobile network Enhanced Logic
CDR	Charging Data Record
CG	Charging Gateway
CGF	Charging Gateway Function
CI	Cell Identity
CS	Circuit Switched
DRP	Data Record Packet
EM	Element Management
FCI	Furnish Charging Information
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
IE	Information Element
IHOSS: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 4IPv6 Internet Protocol version 6
LAC	Location Area Code
M-CDR	Mobility Management generated-Charging Data RecordME Mobile Equipment
MS	Mobile Station
MSISDN	Mobile Station ISDN number

NE	Network Element
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
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:

Ga	Charging data collection interface between a CDR transmitting unit (e.g. GGSN or SGSN) and a CDR receiving unit (CGF).
GTP'	The GPRS protocol used for CDR transport. It is based on GTP with specific enhancements to improve transport reliability necessary for CDRs. (Note that it is not used for tunneling).

4. Record types and contents

4.1 CDR Fields

Five types of CDRs can be generated in the PS domain by the GSNs. As described in document 32.200 [3], the types that can be generated by the SGSN are: S-CDR, M-CDR, S-SMO-CDR and S-SMT-CDR. The GGSN generates a G-CDR. The content of each CDR type is defined in one of the five tables that are part of this section. For each CDR type

the field definition includes the field name, description and category.

Equipment vendors shall be able to provide all of the fields listed in the CDR content table in order to claim compliance with this document. However, since CDR processing and transport consume network resources, operators may opt to eliminate some of the fields that are not essential for their operation. This operator provisionable reduction is specified by the field category.

A field category can have one of two primary values:

M This field is **M**andatory and shall always be present in the CDR.

C This field shall be present in the CDR only when certain Conditions are met.. These Conditions are specified as part of the field definition. .

All other fields are designated as Operator provisionable[1]. Using TMN management functions or specific tools provided by an equipment vendor, operators may choose if they wish to include or omit the field from the CDR. Once omitted, this field is not generated in a CDR. To avoid any potential ambiguity, a CDR generating element MUST be able to provide all these fields. Only an operator can choose whether or not these fields should be generated in their system.

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

O_M This is a field that, if provisioned by the operator to be present, shall always be included in the CDRs. In other words, an O_M parameter that is provisioned to be present is a mandatory parameter.

O_C This is afield 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_C parameter that is configured to be present is a conditional parameter.

A logical diagram showing the possible field categories is shown in Figure 2.

The content of the CDRs shall be specified on all the open network interfaces that are used for CDR transport. They include the GSN - CGF interface and the outward interface from the core network to the billing system. The rules governing the CDR specifications on these interfaces are summarised in the following subclause.

[1] The term “Operator provisionable” has replaced the “Optional” category specified in earlier release.

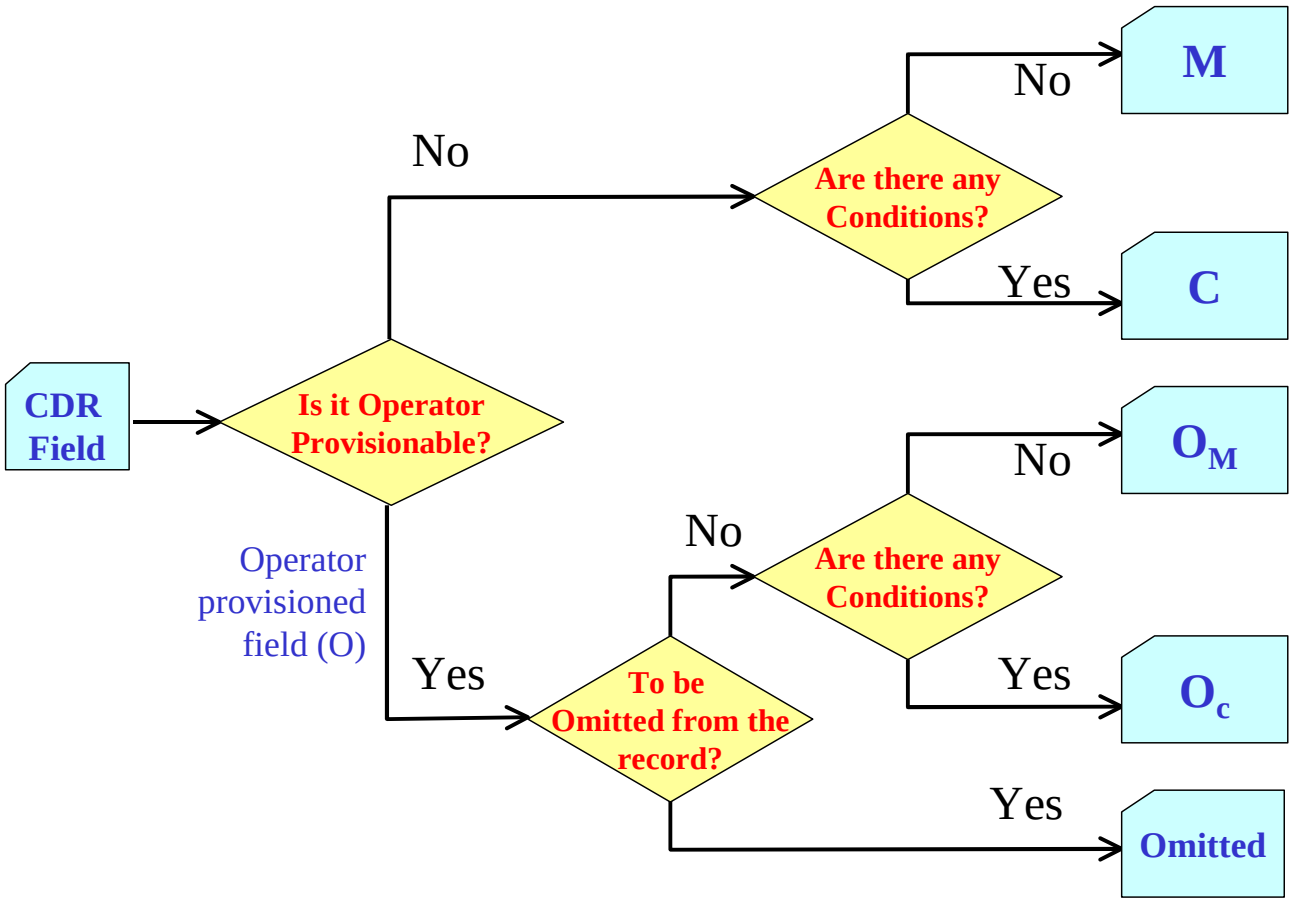

Figure 2: Logical Diagram illustrating the different CDR Field Categories

4.1.1 CDR Fields on the GSN/CGF (Ga) interface

The tables in the subsequent parts of section 4 specify the Mandatory (M), Conditional (C) and Operator optional (O_M or O_C) designations at the GSN / CGF interface(i.e., the G_a interface).. A CDR containing all Mandatory, Conditional and those optional fields provisioned by the operator (O_M and O_C) is considered to be a *Complete CDR.* The size of the CDRs could be optionally reduced by allowing a reduced format for *Partial CDRs* (see definitions in Section 3.1). During a long user session several *Partial CDRs* may be generated for the same session. In this case, some information can be eliminated rather than repeated in all the partial CDRs for that session. Only changes from one CDR to the next, in addition to mandatory information, can be reported. All the missing information can be reconstructed from fields in previous partial CDRs for the session. For example, if the subscriber did not change location, the Reduced Partial CDR would not include any location information.

Therefore, two formats are considered for Partial CDRs:

- a *Full 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 Full 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** fields MUST always be included.

The GSNs and the CGF from all vendors that comply with this standard 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.

4.1.2 CDR Fields on the Core Network-Billing System Interface

The CGF must be able to provide complete CDRs at the CGF / Billing System (BS) interface in the format and encoding described in the present document. Additional CDR formats and contents, generated by the CGF, may be available at this interface to meet the BS requirements.

If the GSNs are generating Reduced Partial CDRs on the Ga interface, the CGF must be able to convert the CDRs into Full QualifiedPartial CDRs. However, if the BS can support Reduced Partial CDRs, no conversion to the full qualified partial CDRs is required.

The possible charging configurations that can be supported on both the Ga and the outbound interfaces are illustrated in Figure 3. 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 Complete Partial CDRs. Configuration c) depicts the case were Reduced Partial CDRs can be received in the billing domain and no conversion is needed.

Equipment vendors shall declare if the GSNs, the CGF and the BS domain support Reduced Partial CDRs based on the above rules. If the CGF can not support Reduced Partial CDRs, , then all the GSNs shall be provisioned to generate only full qualified Partial CDRs (i.e., only configuration a) is possible). On the other hand, if the CGF can convert Partial CDRs formatthen the GSNs may generate Reduced Partial CDRs based on the rules specified above. In this case configurations b) can also be supported. Reduced Partial CDRs may also be generated by the GSNs if the billing domain can support the reduced format regardless of the CGF features (configuration c).

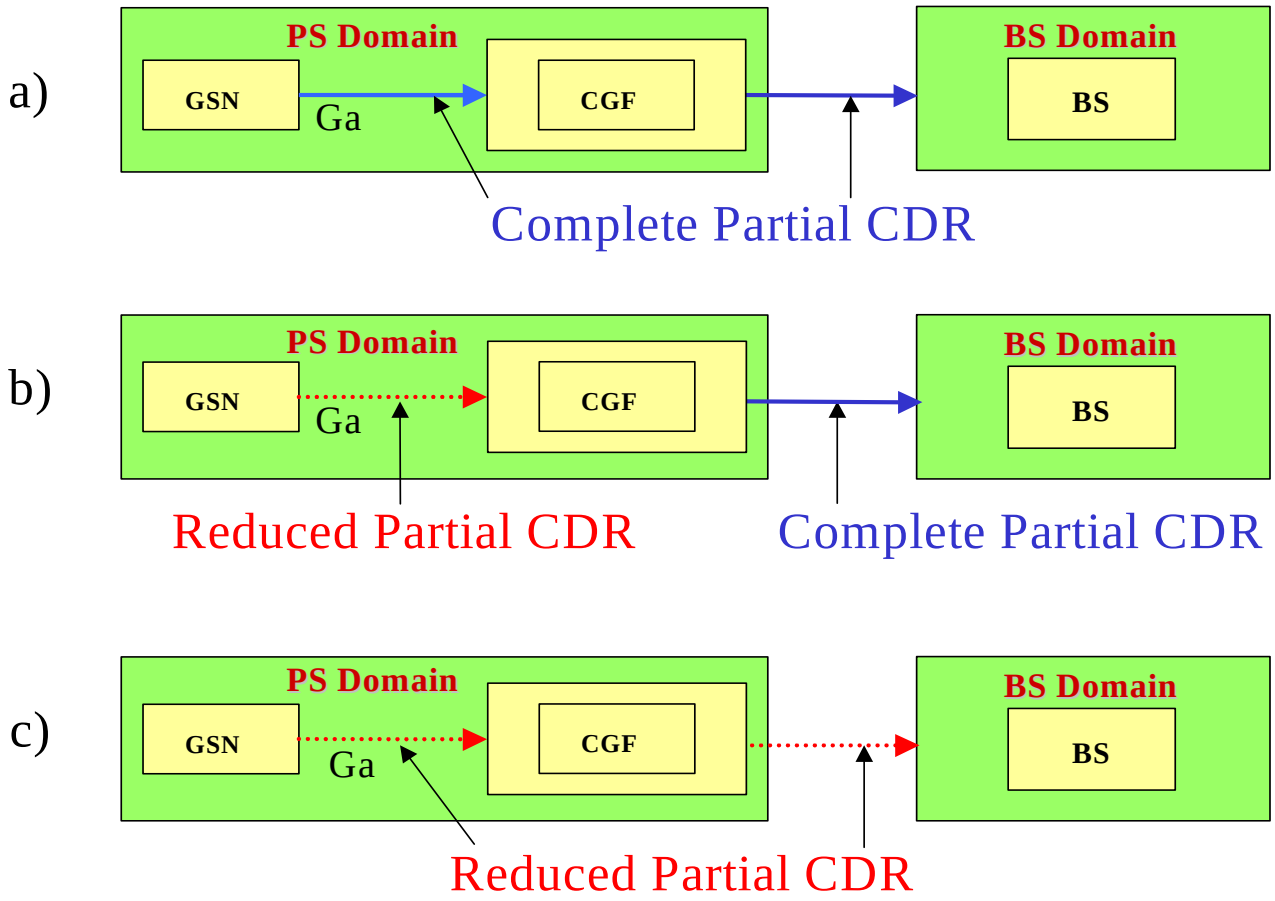

Figure 3: Possible Configurations of CDR Formats that can be supported on the PS domain open interfaces. Configuration a) shall be available in all systems. Other Configurations may be used in addition.

4.2 Charging data in SGSN (S-CDR)

If the collection of CDR data is enabled then the SGSN data specified in Table 1 shall be available for each PDP context. The table provides a brief description of each field. A more elaborate definition of the fields, sorted by the field name in alphabetical order, is provided in Section 5.

Table 1: SGSN PDP context data (S-CDR)

Field	Category	Description
Record Type	M	SGSN PDP context record.
Network Initiated PDP Context	O_C	A flag that is present if this is a network initiated PDP context.
System Type	O_C	Indicates the type of air interface used, e.g. UTRAN.
Served IMSI	M	IMSI of the served party
Served IMEI	O_C	The IMEI of the ME, if available.
Served MSISDN	M	The primary MSISDN of the subscriber.
SGSN Address	O_M	The IP address of the current SGSN.
MS Network Capability	O_M	The mobile station Network Capability.
Routing Area Code (RAC)	O_M	RAC at the time of "Record Opening Time"
Location Area Code (LAC)	O_M	LAC at the time of "Record Opening Time"
Cell Identifier	O_M	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_M	The logical name of the connected access point to the external packet data network (network identifier part of APN).
APN Selection Mode	O_M	An index indicating how the APN was selected.
PDP Type	O_M	PDP type, i.e. IP, PPP, IHOSS:OSP
Served PDP Address	O_C	PDP address of the served IMSI, i.e. IPv4 or IPv6
Dynamic Address Flag	O_C	Indicates whether served PDP address is dynamic, which is allocated during PDP context activation.
List of Traffic Data Volumes	O_M	A list of changes in charging conditions for this PDP context, each change is time stamped. Charging conditions are used to categorise 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_M	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_M	Name of the recording entity
Record Extensions	O_C	A set of network/ manufacturer specific extensions to the record.
Local Record Sequence Number	O_M	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Access Point Name Operator Identifier	O_M	The Operator Identifier part of the APN.
RNC Unsent Downlink Volume	O_C	The downlink data volume which the RNC has not sent to MS.
CAMEL Information	O_C	Set of CAMEL information related to PDP context. For more information see Description of Record Fields.
Charging Characteristics	M	The Charging Characteristics applied to the PDP context.
Charging Characteristics Selection Mode	O_M	Subscribed Ch.Ch., APN specific Ch.Ch., Default Ch.Ch., ...

4.3 Charging data in GGSN (G-CDR)

If the collection of CDR data is enabled then the GGSN data specified in Table 2 shall be available for each PDP context. The table provides a brief description of each field. A more elaborate definition of the fields, sorted by the field name in alphabetical order, is provided in Section 5.

Table 2: GGSN PDP context data (G-CDR)

Field	Category	Description
Record Type	M	GGSN PDP context record.
Network initiated PDP context	O_C	A flag that is present if this is a network initiated PDP context.
Served IMSI	M	IMSI of the served party
Served MSISDN	M	The primary MSISDN of the subscriber.
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_M	The logical name of the connected access point to the external packet data network (network identifier part of APN).
APN Selection Mode	O_M	An index indicating how the APN was selected.
PDP Type	O_M	PDP type, i.e. IP, PPP, or IHOSS:OSP
Served PDP Address	O_C	PDP address, i.e. IPv4 or IPv6
Dynamic Address Flag	O_C	Indicates whether served PDP address is dynamic, which is allocated during PDP context activation.
List of Traffic Data Volumes	O_M	A list of changes in charging conditions for this PDP context, each change is time stamped. Charging conditions are used to categorise 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_M	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_M	Name of the recording entity.
Record Extensions	O_C	A set of network/ manufacturer specific extensions to the record.
Local Record Sequence Number	O_M	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Charging Characteristics	M	The Charging Characteristics applied to the PDP context.
Charging Characteristics Selection Mode	O_M	Subscribed Ch.Ch., APN specific Ch.Ch., Default Ch.Ch., ...

4.4 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 3 each time the mobile is attached to the SGSN. The table provides a brief description of each field. A more elaborate definition of the fields, sorted by the field name in alphabetical order, is provided in Section 5.

Table 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_C	The IMEI of the ME, if available.
Served MSISDN	M	The primary MSISDN of the subscriber.
SGSN Address	O_M	The IP address of the current SGSN.
MS Network Capability	O_M	The mobile station network capability.
Routing Area Code	O_M	Routing Area at the time of the Record Opening Time.
Local Area Code	O_M	Location Area Code at the time of Record Opening Time.
Cell Identifier	O_M	The Cell Identity for GSM or Service Area Code (SAC) for UMTS at the time of the Record Opening Time.
Change of Location	O_C	A list of changes in Routing Area Code, each with a time stamp.
Record Opening Time	M	Timestamp when MS is attached to this SGSN or record opening time on following partial record.
Duration	M	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_M	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_M	Name of the recording entity.
Record Extensions	O_C	A set of network/ manufacturer specific extensions to the record.
Local Record Sequence Number	O_M	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.
Charging Characteristics Selection Mode	O_M	Subscription Ch.Ch., Default Ch.Ch., ...
System Type	O_C	Indicates the type of air interface used, e.g. UTRAN.
CAMEL Information	O_C	Set of CAMEL information related to Attach/Detach session. For more information see Description of Record Fields.

4.5 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 4. The table provides a brief description of each field. A more elaborate definition of the fields, sorted by the field name in alphabetical order, is provided in Section 5.

Table 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_C	The IMEI of the ME, if available.
Served MSISDN	M	The primary MSISDN of the subscriber.
MS Network Capability	O_M	The mobile station network capability.
Service Centre	O_M	The address (E.164) of the SMS-service centre.
Recording Entity	O_M	The E.164 number of the SGSN.
Location Area Code	O_M	The Location Area Code from which the message originated.
Routing Area Code	O_M	The Routing Area Code from which the message originated.
Cell Identifier	O_M	The Cell Identity for GSM or Service Area Code (SAC) for UMTS from which the message originated.
Event Time Stamp	M	The time at which the message was received by the SGSN from the subscriber.
Message Reference	M	A reference provided by the MS uniquely identifying this message.
SMS Result	C	The result of the attempted delivery if unsuccessful.
Record Extensions	O_C	A set of network/ manufacturer specific extensions to the record.
Node ID	O_M	Name of the recording entity.
Local Record Sequence Number	O_M	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Charging Characteristics	O_MC	The Charging Characteristics flag set used by the SGSN.
Charging Characteristics Selection Mode	O_M	Subscription Ch.Ch., Default Ch.Ch., ...
System Type	O_C	Indicates the type of air interface used, e.g. UTRAN.
Destination Number	O_M	The destination short message subscriber number.
CAMEL Information	O_C	Set of CAMEL information related to SMS session. For more information see Description of Record Fields.

4.6 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 5. The table provides a brief description of each field. A more elaborate definition of the fields, sorted by the field name in alphabetical order, is provided in Section 5.

Table 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_C	The IMEI of the ME, if available.
Served MSISDN	M	The primary MSISDN of the subscriber.
MS Network Capability	O_M	The mobile station network capability
Service Centre	O_M	The address (E.164) of the SMS-service centre.
Recording Entity	O_M	The E.164 number of the SGSN.
Location Area Code	O_M	The Location Area Code to which the message was delivered.
Routing Area Code	O_M	The Routing Area Code to which the message was delivered.
Cell Identifier	O_M	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_C	A set of network/ manufacturer specific extensions to the record.
Node ID	O_M	Name of the recording entity.
Local Record Sequence Number	O_M	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Charging Characteristics	$O_M C$	The Charging Characteristics flag set used by the SGSN.
Charging Characteristics Selection Mode	O_M	Subscription Ch.Ch., Default Ch.Ch., ...
System Type	O_C	Indicates the type of air interface used, e.g. UTRAN.

5. Description of Record Fields

This subclause contains a brief description of each field of the CDRs described in the previous subclause. The fields are listed in alphabetical order according to the field name as specified in one of the five tables above.

5.1 Access Point Name (APN) Network/Operator Identifier

These fields contain the actual connected Access Point Name Network/Operator Identifier determined either by MS, SGSN or modified by CAMEL service. An APN can also be a wildcard, in which case the SGSN selects the access point address.

The APN Network Identifier containing more than one label corresponds to an Internet domain name. The APN Operator Identifier is composed of three labels. The first and second labels together shall uniquely identify the GPRS PLMN (e.g. “operator name>.<operator group>.gprs”).

See 3GPP TS 23.003 [7] and 3GPP TS 23.060 [2] for more information about APN format and access point decision rules.

5.2 APN Selection Mode

This field indicates how the SGSN selected the APN to be used. The values and their meaning are as specified in 3GPP TS 29.060 [8] subclause 7.9 'Information elements'.

5.3 CAMEL Information

This field includes following CAMEL information elements for PDP context (S-CDR), Attach/Detach session (M-CDR) and Mobile originated SMS (S-SMO-CDR) if corresponding CAMEL service is activated.

- CAMEL Access Point Name NI (S-CDR)

  This field contains the network identifier part of APN before modification by the SCF.

- CAMEL Access Point Name OI (S-CDR)

  This field contains the operator identifier part of APN before modification by the SCF.

- CAMEL Calling Party Number (S-SMO-CDR)

  This field contains the Calling Party Number modified by the CAMEL service.

- CAMEL Destination Subscriber Number (S-SMO-CDR)

  This field contains the short message Destination Number modified by the CAMEL service.

- CAMEL SMSC Address (S-SMO-CDR)

  This field contains the SMSC address modified by the CAMEL service.

- SCF address (S-CDR, M-CDR, S-SMO-CDR)

  This field identifies the CAMEL server serving the subscriber. Address is defined in HLR as part of CAMEL subscription information

- Service key (S-CDR, M-CDR, S-SMO-CDR)

  This field identifies the CAMEL service logic applied. Service key is defined in HLR as part of CAMEL subscription information.

- Default Transaction/SMS Handling (S-CDR, M-CDR, S-SMO-CDR)

  This field indicates whether or not a CAMEL encountered default GPRS- or SMS-handling. This field shall be present only if default call handling has been applied. Parameter is defined in HLR as part of CAMEL subscription information.

- Free Format Data (S-CDR, M-CDR, S-SMO-CDR)

  This field contains charging information sent by the gsmSCF in the Furnish Charging Information GPRS messages as defined in 3GPP TS 29.078 [9]. The data can be sent either in one FCI message or several FCI messages with append indicator. This data is transferred transparently in the CAMEL sections of the relevant call records.

  If the FCI is received more then once during one CAMEL call, the append indicator defines whether the FCI information is appended to previous FCI and stored in the relevant record or the information of the last FCI received is stored in the relevant record (the previous FCI information shall be overwritten).

  In the event of partial output the currently valid 'Free format data' is stored in the partial record.

- FFD Append Indicator (S-CDR, M-CDR)

  This field contains an indicator whether CAMEL free format data is to be appended to free format data stored in previous partial CDR. This field is needed in CDR post processing to sort out valid free format data for that call leg from sequence of partial records. Creation of partial records is independent of received FCIs and thus valid free format data may be divided to different partial records.

  If field is missing then free format data in this CDR replaces all received free format data in previous CDRs. Append indicator is not needed in the first partial record. In following partial records indicator shall get value true if all FCIs received during that partial record have append indicator. If one or more of the received FCIs for that call leg during the partial record do not have append indicator then this field shall be missing.

- Level of CAMEL services (S-CDR, M-CDR)

  This field describes briefly the complexity of CAMEL invocation. Categories are the same as in circuit switched services and measure of resource usage in VPLMN requested by HPLMN.

  - 'Basic' means that CAMEL feature is invoked during the PDP context activation phase only (e.g. to modify APN_NI / APN_OI).

  - 'Call duration supervision' means that PDP context duration or volume supervision is applied in the gprsSSF of the VPLMN (Apply Charging message is received from the gsmSCF)

- Number of DP encountered (S-CDR, M-CDR)

  This field indicates how often armed CAMEL detection points (TDP and EDP) were encountered and is a measure of signalling between VPLMN and CAMEL service and complements 'Level of CAMEL service' field.

5.4 Cause for Record Closing

This field contains a reason for the release of the CDR including the following:

- normal release: PDP context release or GPRS detach;
- partial record generation: data volume limit, time (duration) limit, SGSN change or maximum number of changes in charging conditions;
- abnormal termination (PDP or MM context);

  management intervention (request due to O&M reasons).

A more detailed reason may be found in the diagnostics field.

5.5 Cell Identifier

For GSM, the Cell Identifier is defined as the Cell Id, reference 24.008[10], and for UMTS it is defined as the Service Area Code in TS 25.413 [11].

5.6 Charging Characteristics

The Charging Characteristics field as defined in Figure 4 allows the operator to apply different kind of charging methods for the CDRs.

The functional requirements for the Charging Characteristics are further defined in normative Annex A.

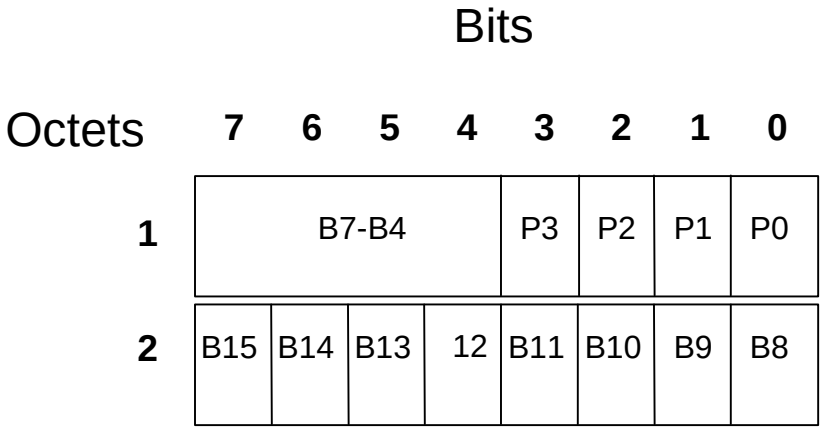

Figure 4: Charging Characteristics flags

5.7 Charging Characteristics Selection Mode

This field indicates the charging characteristic type that the GSNs applied to the CDR. In the SGSN the allowed values are:

- Home default
- Visiting default
- Roaming default
- APN specific
- Subscription specific

In the GGSN the allowed values are:

- Home default
- Visiting default
- Roaming default
- SGSN supplied.

Further details are provided in Annex A.

5.8 Charging ID

This field is a charging identifier, which can be used together with GGSN address to identify all records produced in SGSN(s) and GGSN involved in a single PDP context. Charging ID is generated by GGSN at PDP context activation and transferred to context requesting SGSN. At inter-SGSN routing area update charging ID is transferred to the new SGSN as part of each active PDP context.

Different GGSNs allocate the charging ID independently of each other and may allocate the same numbers. The CGF and/or BS may check the uniqueness of each charging ID together with the GGSN address and optionally (if still ambiguous) with the record opening time stamp.

5.9 Destination Number

This field contains short message Destination Number requested by the user. See 32.205 [4].

5.10 Diagnostics

This field includes a more detailed technical reason for the release of the connection and may contain one of the following:

- a MAP error from 3GPP TS 29.002 [12];
- a Cause from 3GPP TS 29.078 [9]; or
- a Cause from 3GPP TS 24.008 [10]
- a Cause from ISUP Q.767 [13].

The diagnostics may also be extended to include manufacturer and network specific information.

5.11 Duration

This field contains the relevant duration in seconds for PDP contexts (S-CDR, G-CDR, and attachment (M-CDR). It is the duration from Record Opening Time to record closure. For partial records this is the duration of the individual partial record and not the cumulative duration.

It should be noted that the internal time measurements may be expressed in terms of tenths of seconds or even milliseconds and, as a result, the calculation of the duration may result in the rounding or truncation of the measured duration to a whole number of seconds.

Whether or not rounding or truncation is to be used is considered to be outside the scope of the present document subject to the following restrictions:

1) A duration of zero seconds shall be accepted providing that the transferred data volume is greater than zero.

2) The same method of truncation/rounding shall be applied to both single and partial records.

5.12 Dynamic Address Flag

This field indicates that PDP address has been dynamically allocated for that particular PDP context. This field is missing if address is static i.e. part of PDP context subscription. Dynamic address allocation might be relevant for charging e.g. the duration of PDP context as one resource offered and possible owned by network operator.

5.13 Event Time Stamps

These fields contain the event time stamps relevant for each of the individual record types.

All time-stamps include a minimum of date, hour, minute and second.

5.14 GGSN Address Used

These fields are the current serving GGSN IP Address for Control Plane.

5.15 List of Traffic Data Volumes

This list includes one or more containers, which each include the following fields:

Data Volume Uplink, Data Volume Downlink, Change Condition and Time Stamp.

Data Volume includes the number of octets transmitted during the use of packet data services.

Change condition defines the reason for closing the container (see 5.7.1 and 5.7.3), such as tariff time change, QoS change or closing the CDR. Change time is a time stamp, which defines the moment when the new volume counts are started or CDR is closed. All the active PDP contexts do not need to have exactly the same time stamp e.g. due to same tariff time change (variance of the time stamps is implementation and traffic load dependent, and is out of the scope of standardisation).

First container includes following optional fields: QoS Requested (not in G-CDR) and QoS Negotiated. In following containers QoS Negotiated is present if previous change condition is QoS change.

Table 6 illustrates an example of a list, which has three containers (sets of volume counts) caused by one QoS change and one tariff time change.

Table 6: Example list of traffic data volumes

QoS Requested = QoS1 QoS Negotiated = QoS1	QoS Negotiated = QoS2	
Data Volume Uplink = 1 Data Volume Downlink = 2	Data Volume Uplink = 5 Data Volume Downlink = 6	Data Volume Uplink = 3 Data Volume Downlink = 4
Change Condition = QoS change Time Stamp = TIME1	Change Condition = Tariff change Time Stamp = TIME2	Change Condition = Record closed Time Stamp = TIME3

First container includes initial QoS values and corresponding volume counts. Second container includes new QoS values and corresponding volume counts before tariff time change. Last container includes volume counts after the tariff time change. The total volume counts can be itemised as shown in Table 7 (tariff1 is used before and tariff2 after the tariff time change):

Table 7: Itemised list of total volume count corresponding to Table 6

		Container
QoS1+Tariff1	uplink = 1, downlink = 2	1
QoS2+Tariff1	uplink = 5, downlink = 6	2
QoS2+Tariff2	uplink = 3, downlink = 4	3
QoS1	uplink = 1, downlink = 2	1
QoS2	uplink = 8, downlink = 10	2+3
Tariff1	uplink = 6, downlink = 8	1+2
Tariff2	uplink = 3, downlink = 4	1

The amount of data counted in the GGSN shall be the payload of the GTP-U protocol at the Gn interface. Therefore the data counted already includes the IP PDP bearer protocols i.e. IP or PPP.

The data volume counted in the SGSN is dependent on the system. For GSM SGSN the data volume is the payload of the SNDCP PDUs at the Gb interface. For UMTS-SGSN it is the GTP-U PDUs at the Iu-PS interface. Therefore, in both systems, the data counted already includes the overheads of any PDP bearer protocols.

In GSM, in order to avoid that downstream packets transmitted from the old SGSN to the new SGSN at inter SGSN RA update induce the increase of the PDP CDR downstream volume counters in both SGSN the following rules must be followed:

- For PDP contexts using LLC in unacknowledged mode: an SGSN shall update the PDP CDR when the packet has been sent by the SGSN towards the MS;

- For PDP contexts using LLC in acknowledged mode, a GSM-SGSN shall only update the PDP CDR at the reception of the acknowledgement by the MS of the correct reception of a downstream packet. In other worlds, for inter SGSN RA update, the new SGSN shall update the PDP CDR record when a downstream packet sent by the old SGSN is received by the MS and acknowledged by the MS towards the new SGSN through the RA update complete message.

In UMTS, the not transferred downlink data can be accounted for in the S-CDR with 'RNC Unsent Downlink Volume' field which is the data that the RNC has either discarded or forwarded during handover. Data volumes retransmitted (by RLC or LLC) due to poor radio link conditions shall not be counted.

5.16 Local Record Sequence Number

This field includes a unique record number created by this node. The number is allocated sequentially including all CDR types. The number is unique within one node, which is identified either by field Node ID or by record-dependent node address (SGSN address, GGSN address, Recording Entity).

The field can be used e.g. to identify missing records in post processing system.

5.17 Message reference

This field contains a unique message reference number allocated by the Mobile Station (MS) when transmitting a short message to the service centre. This field corresponds to the TP-Message-Reference element of the SMS_SUBMIT PDU defined in 3GPP TS 23.040 [14].

5.18 MS Network Capability

This MS Network Capability field contains the MS network capability value of the MS network capability information element of the served MS on PDP context activation or on GPRS attachment as defined in 3GPP TS 24.008 [10].

5.19 Network Initiated PDP Context

This field indicates that PDP context is network initiated. The field is missing in case of mobile activated PDP context.

5.20 Node ID

This field contains an optional operator configurable identifier string for the node, which generated the CDR. The Node ID may or may not be the DNS host name of the node.

5.21 PDP Type

This field defines the PDP type, e.g. IP, PPP, or IHOSS:OSP (see 3GPP TS 29.060 [8] for exact format).

5.22 QoS Requested/QoS Negotiated

Quality of Service Requested contains the QoS wanted by MS at PDP context activation. QoS Negotiated indicates the applied QoS accepted by the network.

If a pre-Release '99 only capable terminal is served, the QoS profile consists of five (5) attributes as follows: reliability, delay, precedence, peak throughput and mean throughput. The encoding of this QoS profile shall be in accordance with GSM 12.15.

In Release 99 and R4, the QoS profile consists of the above 2G parameters plus the following UMTS attributes: Traffic class ('conversational', 'streaming', 'interactive', 'background'), Maximum bit-rate (kbps), Delivery order (y/n), Maximum SDU size (octets), SDU error ratio, Residual bit error ratio, Delivery of erroneous SDUs (y/n/-), Transfer

delay (ms), Traffic handling priority, Allocation/Retention Priority. This QoS profile shall be encoded according to the “Quality of Service (QoS) Profile” parameter specified in 3GPP TS 29.060 [8].

5.23 Record Extensions

This field enables network operators and/or manufacturers to add their own Recommendation extensions to the standard record definitions. This field contains a set of "management extensions" as defined in ITU-T X.721 [15]. This is conditioned upon the existence of an extension.

5.24 Record Opening Time

This field contains the time stamp when the MS is attached to a SGSN (M-CDR) or PDP context is activated in SGSN/GGSN (S-CDR, G-CDR) or record opening time on subsequent partial records (see 3GPP TS 32.205 [4] for exact format).

Record opening reason does not have a separate field. For G-CDR and M-CDR it can be derived from the field "Sequence number"; i.e. missing field or value one means activation of PDP context and GPRS attachment. For S-CDR also field "SGSN change" need to be taken into account.

5.25 Record Sequence Number

This field contains a running sequence number employed to link the partial records generated in the SGSN/GGSN for a particular MM context or PDP context (characterised with the same Charging ID and GGSN address pair). For M-CDR or S-CDR the sequence number is always started from one after inter-SGSN routing area update, see field "SGSN change". The Record Sequence Number is missing if the record is the only one produced in the SGSN/GGSN for an MM context or a PDP context CDR (e.g. inter-SGSN routing area update can result to two M-CDR or two S-CDRs without sequence number and field "SGSN change" present in the second record).

5.26 Record Type

The field identifies the type of the record e.g. S-CDR, G-CDR, M-CDR, S-SMO-CDR and S-SMT-CDR.

5.27 Recording Entity Number

This field contains the ITU-T E.164 number assigned to the entity that produced the record. For further details see 3GPP TS 23.003 [7].

5.28 RNC Unsent Downlink Volume

This field contains the unsent downlink volume that the RNC has either discarded or forwarded to 2G-SGSN and already included in S-CDR. This field is present when RNC has provided unsent downlink volume count at RAB release and can be used by a downstream system to apply proper charging for this PDP context.

5.29 Routing Area Code/Cell Identifier/Change of location

The location information contains a combination of the Routing Area Code (RAC) and an optional Cell Identifier of the routing area and cell in which the served party is currently located. In GSM the Cell Identifier is defined by the Cell Identity (CI) and in UMTS by the Service Area Code (SAC). Any change of location (i.e. Routing Area change) may be recorded in the change of location field including the time at which the change took place.

The change of location field is optional and not required if partial records are generated when the location changes.

The RAC and (optionally) CI are coded according to 3G TS 24.008 [10] and the SAC according 3GPP TS 25.413 [11].

5.30 Served IMEI

This field contains the International Mobile Equipment Identity (IMEI) of the equipment served, if available. The term "served" equipment is used to describe the ME involved in the transaction recorded e.g. the called ME in the case of a network initiated PDP context.

The structure of the IMEI is defined in 3GPP TS 23.003 [7].

5.31 Served IMSI

This field contains the International Mobile Subscriber Identity (IMSI) of the served party. The term "served" party is used to describe the mobile subscriber involved in the transaction recorded e.g. the calling subscriber in case of a mobile initiated PDP context.

The structure of the IMSI is defined in 3GPP TS 23.003 [7].

5.32 Served MSISDN

This field contains the Mobile Station (MS) ISDN number (MSISDN) of the served party. The term "served" party is used to describe the mobile subscriber involved in the transaction recorded e.g. the called subscriber in case of an MTC record. In case of multi-numbering the MSISDN stored in an MOC record will be the primary MSISDN of the calling party.

The structure of the MSISDN is defined in 3GPP TS 23.003 [7].

5.33 Served PDP Address

This field contains the PDP address of the served IMSI. This is a network layer address i.e. of type IP version 4, IP version 6. The address for each PDP type is allocated either temporarily or permanently (see "Dynamic Address Flag" field in subclause 6.1.6.6). This parameter shall be present except when both the PDP type is PPP and dynamic PDP address assignment is used.

5.34 Service Centre Address

This field contains a ITU-T E.164 number identifying a particular service centre e.g. Short Message Service (SMS) centre (see 3GPP TS 23.040 [14]).

5.35 SGSN Address

These fields contain one or several IP addresses of SGSN. The IP address of the SGSN can be either control plane address or user plane address.

The S-CDR fields contain single address of current SGSN and GGSN used.

The G-CDR fields contains the address of the current GGSN and a list of SGSNs addresses, which have been connected during the record (SGSN change due to inter SGSN Routing Area update).

The M-CDR only contains the address of the current SGSN. The M-CDR does not identify any information related to active PDP context(s) and thus does not know connected (used) GGSN(s).

5.36 SGSN Change

This field is present only in the S-CDR to indicate that this is the first record after an inter-SGSN routing area update.

5.37 Short Message Service (SMS) Result

This field contains the result of an attempt to deliver a short message either to a service centre or to a mobile subscriber (see 3GPP TS 29.002[12]). Note that this field is only provided if the attempted delivery was unsuccessful.

5.38 System Type

This field is present conditionally, indicating the use of a UMTS air-interface for the provision of service recorded by this CDR.

In the case of service provided by a GSM air interface, the field is not present.

6. Charging Data Record Structure

6.1 ASN.1 definitions for CDR information

The ASN.1 definitions are based on ISO8824 (90) / X.208 (88) [16], which has been superseded by ISO8824-1 (94) / X.680 (94)[17]. This newer version not only includes new features but also removes some that were present in ISO8824 (90) / X.208 (88) [16]. Where possible, the GPRS work would be based on those ASN.1 features to both. However, where necessary, the new features in ISO8824-1 (94) / X.680 (94) [17] be used in some places. ISO8824 (90) / X.208 (88) [16] features that are no longer in ISO8824-1 (94) / X.680 (94) [17] will not be used.

```
Changes (enhancements) in TS32205-DataTypes:

CallEventRecordType     ::= INTEGER
{
    moCallRecord            (0),
    mtCallRecord            (1),
    roamingRecord           (2),
    incGatewayRecord        (3),
    outGatewayRecord        (4),
    transitCallRecord       (5),
    moSMSRecord             (6),
    mtSMSRecord             (7),
    moSMSIWRecord           (8),
    mtSMSGWRecord           (9),
    ssActionRecord          (10),
    hlrIntRecord            (11),
    locUpdateHLRRecord      (12),
    locUpdateVLRRecord      (13),
    commonEquipRecord       (14),
    moTraceRecord           (15),
    mtTraceRecord           (16),
    termCAMELIntRecord      (17),
    sgsnPDPRecord           (18),
    ggsnPDPRecord           (19),
    sgsnMMRecord            (20),
    sgsnSMORecord           (21),
    sgsnSMTRecord           (22)

}
TS32215-DataTypes {itu-t (0) identified-organization (4) etsi (0) mobileDomain (0) umts-Operation-
Maintenance (3) ts-32-215 (215) informationModel (0) asn1Module (2) version1 (1)}


DEFINITIONS IMPLICIT TAGS   ::=

BEGIN

-- EXPORTS everything

IMPORTS

CellId, Diagnostics, CallDuration, ManagementExtensions, TimeStamp, MSISDN, LocationAreaCode,
MessageReference, RecordingEntity, SMSResult, LevelOfCAMELService, CalledNumber, CallingNumber
```

```
FROM TS32205-DataTypes {itu-t (0) identified-organization (4) etsi(0) mobileDomain (0) umts-
Operation-Maintenance (3) ts-32-205 (205) informationModel (0) asn1Module (2) version1 (1)}gsm-
AddressString, ISDN-AddressString, IMSI, IMEI
FROM MAP-CommonDataTypes { ccitt identified-organization (4) etsi(0) mobileDomain (0) gsm-Network
(1) modules (3) map-CommonDataTypes (18) version6 (6) }

DefaultGPRS-Handling, DefaultSMS-Handling, ServiceKey
FROM MAP-MS-DataTypes    { ccitt identified-organization (4) etsi (0) mobileDomain (0)
gsm-Network (1) modules (3) map-MS-DataTypes (11) version6 (6)  }

ManagementExtension
FROM Attribute-ASN1Module {joint-iso-ccitt ms(9) smi(3) part2 (2) asn1Module(2) 1}
;

--
-------------------------------------------------------------------------------
--
--  CALL AND EVENT RECORDS
--
-------------------------------------------------------------------------------

CallEventRecord ::= CHOICE
{
-- Record values 0..16 are 3G curcuit switch specific
--
    moCallRecord            [0] MOCallRecord,
    mtCallRecord            [1] MTCallRecord,
    roamingRecord           [2] RoamingRecord,
    incGatewayRecord        [3] IncGatewayRecord,
    outGatewayRecord        [4] OutGatewayRecord,
    transitRecord           [5] TransitCallRecord,
    moSMSRecord             [6] MOSMSRecord,
    mtSMSRecord             [7] MTSMSRecord,
    moSMSIWRecord           [8] MOSMSIWRecord,
    mtSMSGWRecord           [9] MTSMSGWRecord,
    ssActionRecord          [10] SSActionRecord,
    hlrIntRecord            [11] HLRIntRecord,
    locUpdateHLRRecord      [12] LocUpdateHLRRecord,
    locUpdateVLRRecord      [13] LocUpdateVLRRecord,
    commonEquipRecord       [14] CommonEquipRecord,
    recTypeExtensions       [15] ManagementExtensions,
    termCAMELIntRecord      [16] TermCAMELIntRecord,
--
    sgsnPDPRecord           [20] SGSNPDPRecord,
    ggsnPDPRecord           [21] GGSNPDPRecord,
    sgsnMMRecord            [22] SGSNMMRecord,
    sgsnSMORecord           [23] SGSNSMORecord,
    sgsnSMTRecord           [24] SGSNSMTRecord
}

GGSNPDPRecord   ::= SET
{
    recordType                  [0] CallEventRecordType,
    networkInitiation           [1] NetworkInitiatedPDPContext OPTIONAL,
    servedIMSI                  [3] IMSI,
    ggsnAddress                 [4] GSNAddress,
    chargingID                  [5] ChargingID,
    sgsnAddress                 [6] SEQUENCE OF GSNAddress,
    accessPointNameNI           [7] AccessPointNameNI OPTIONAL,
    pdpType                     [8] PDPType OPTIONAL,
    servedPDPAddress            [9] PDPAddress OPTIONAL,
    dynamicAddressFlag          [11] DynamicAddressFlag OPTIONAL,
    listOfTrafficVolumes        [12] SEQUENCE OF ChangeOfCharCondition OPTIONAL,
    recordOpeningTime           [13] TimeStamp,
    duration                    [14] CallDuration,
    causeForRecClosing          [15] CauseForRecClosing,
    diagnostics                 [16] Diagnostics OPTIONAL,
    recordSequenceNumber        [17] INTEGER OPTIONAL,
    nodeID                      [18] NodeID OPTIONAL,
    recordExtensions            [19] ManagementExtensions OPTIONAL,
    localSequenceNumber         [20] LocalSequenceNumber OPTIONAL,
    apnSelectionMode            [21] APNSelectionMode OPTIONAL,
    servedMSISDN                [22] MSISDN,
    chargingCharacteristics     [23] ChargingCharacteristics,
    chChSelectionMode           [24] ChChSelectionMode OPTIONAL
    }

SGSNMMRecord    ::= SET
{
    recordType                  [0] CallEventRecordType,
    servedIMSI                  [1] IMSI,
    servedIMEI                  [2] IMEI OPTIONAL,
    sgsnAddress                 [3] GSNAddress OPTIONAL,
```

```
    msNetworkCapability         [4] MSNetworkCapability OPTIONAL,
    routingArea                 [5] RoutingAreaCode OPTIONAL,
    locationAreaCode            [6] LocationAreaCode OPTIONAL,
    cellIdentifier              [7] CellId OPTIONAL,
    changeLocation              [8] SEQUENCE OF ChangeLocation OPTIONAL,
    recordOpeningTime           [9] TimeStamp,
    duration                    [10] CallDuration,
    sgsnChange                  [11] SGSNChange OPTIONAL,
    causeForRecClosing          [12] CauseForRecClosing,
    diagnostics                 [13] Diagnostics OPTIONAL,
    recordSequenceNumber        [14] INTEGER OPTIONAL,
    nodeID                      [15] NodeID OPTIONAL,
    recordExtensions            [16] ManagementExtensions OPTIONAL,
    localSequenceNumber         [17] LocalSequenceNumber OPTIONAL,
    servedMSISDN                [18] MSISDN,
    chargingCharacteristics     [19] ChargingCharacteristics,
    cAMELInformationMM          [20] CAMELInformationMM OPTIONAL,
    systemType                  [21] SystemType OPTIONAL,
    chChSelectionMode           [22] ChChSelectionMode OPTIONAL
}

SGSNPDPRecord   ::= SET
{
    recordType                  [0] CallEventRecordType,
    networkInitiation           [1] NetworkInitiatedPDPContext OPTIONAL,
    servedIMSI                  [3] IMSI,
    servedIMEI                  [4] IMEI OPTIONAL,
    sgsnAddress                 [5] GSNAddress OPTIONAL,
    msNetworkCapability         [6] MSNetworkCapability OPTIONAL,
    routingArea                 [7] RoutingAreaCode OPTIONAL,
    locationAreaCode            [8] LocationAreaCode OPTIONAL,
    cellIdentifier              [9] CellId OPTIONAL,
    chargingID                  [10] ChargingID,
    ggsnAddressUsed             [11] GSNAddress,
    accessPointNameNI           [12] AccessPointNameNI OPTIONAL,
    pdpType                     [13] PDPType OPTIONAL,
    servedPDPAddress            [14] PDPAddress OPTIONAL,
    listOfTrafficVolumes        [15] SEQUENCE OF ChangeOfCharCondition OPTIONAL,
    recordOpeningTime           [16] TimeStamp OPTIONAL,
    duration                    [17] CallDuration OPTIONAL,
    sgsnChange                  [18] SGSNChange OPTIONAL,
    causeForRecClosing          [19] CauseForRecClosing,
    diagnostics                 [20] Diagnostics OPTIONAL,
    recordSequenceNumber        [21] INTEGER OPTIONAL,
    nodeID                      [22] NodeID OPTIONAL,
    recordExtensions            [23] ManagementExtensions OPTIONAL,
    localSequenceNumber         [24] LocalSequenceNumber OPTIONAL,
    apnSelectionMode            [25] APNSelectionMode OPTIONAL,
    accessPointNameOI           [26] AccessPointNameOI OPTIONAL,
    servedMSISDN                [27] MSISDN,
    chargingCharacteristics     [28] ChargingCharacteristics,
    systemType                  [29] SystemType OPTIONAL,
    cAMELInformationPDP         [30] CAMELInformationPDP OPTIONAL,
    rNCUnsentDownlinkVolume     [31] DataVolumeGPRS OPTIONAL,
    chChSelectionMode           [32] ChChSelectionMode OPTIONAL,
    dynamicAddressFlag          [33] DynamicAddressFlag OPTIONAL

}

SGSNSMORecord   ::= SET
{
    recordType                  [0] CallEventRecordType,
    servedIMSI                  [1] IMSI,
    servedIMEI                  [2] IMEI OPTIONAL,
    servedMSISDN                [3] MSISDN,
    msNetworkCapability         [4] MSNetworkCapability OPTIONAL,
    serviceCentre               [5] AddressString OPTIONAL,
    recordingEntity             [6] RecordingEntity OPTIONAL,
    locationArea                [7] LocationAreaCode OPTIONAL,
    routingArea                 [8] RoutingAreaCode OPTIONAL,
    cellIdentifier              [9] CellId OPTIONAL,
    messageReference            [10] MessageReference,
    originationTime             [11] TimeStamp,
    smsResult                   [12] SMSResult OPTIONAL,
    recordExtensions            [13] ManagementExtensions OPTIONAL,
    nodeID                      [14] NodeID OPTIONAL,
    localSequenceNumber         [15] LocalSequenceNumber OPTIONAL,
    chargingCharacteristics     [16] ChargingCharacteristics,
    systemType                  [17] SystemType OPTIONAL,
    destinationNumber           [18] CalledNumber OPTIONAL,
    cAMELInformationSMS         [19] CAMELInformationSMS OPTIONAL,
    chChSelectionMode           [20] ChChSelectionMode OPTIONAL
}
```

```
SGSNSMTRecord   ::= SET
{
    recordType              [0] CallEventRecordType,
    servedIMSI              [1] IMSI,
    servedIMEI              [2] IMEI OPTIONAL,
    servedMSISDN            [3] MSISDN,
    msNetworkCapability     [4] MSNetworkCapability OPTIONAL,
    serviceCentre           [5] AddressString OPTIONAL,
    recordingEntity         [6] RecordingEntity OPTIONAL,
    locationArea            [7] LocationAreaCode OPTIONAL,
    routingArea             [8] RoutingAreaCode OPTIONAL,
    cellIdentifier          [9] CellId OPTIONAL,
    originationTime         [10] TimeStamp, smsResult               [11] SMSResult OPTIONAL,
    recordExtensions        [12] ManagementExtensions OPTIONAL,
    nodeID                  [13] NodeID OPTIONAL,
    localSequenceNumber     [14] LocalSequenceNumber OPTIONAL,
    chargingCharacteristics [15] ChargingCharacteristics,
    systemType              [16] SystemType OPTIONAL,
    chChSelectionMode       [17] ChChSelectionMode OPTIONAL

}

-------------------------------------------------------------------------------
--
--  OBJECT IDENTIFIERS
--
-------------------------------------------------------------------------------

ts32215InformationModel OBJECT IDENTIFIER ::=
    {itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
    umts-Operation-Maintenance (3) ts-32-215 (215) informationModel (0) }


ts32215ASN1Module   OBJECT IDENTIFIER ::=
    { ts32215InformationModel asn1Module(2) }

-------------------------------------------------------------------------------
--
--  COMMON DATA TYPES
--
-------------------------------------------------------------------------------

AccessPointNameNI   ::= IA5String (SIZE(1..63))
    --
    -- Network Identifier part of APN in "dot" representation
    -- see TS 23.003
    --

AccessPointNameOI   ::= IA5String (SIZE(1..37))
    --
    -- Operator Identifier part of APN in dot representation
    -- see TS 23.003
    --

APNSelectionMode::= ENUMERATED
{
    --
    -- See Information Elements TS 29.060
    --
    mSorNetworkProvidedSubscriptionVerified            (0),
    mSProvidedSubscriptionNotVerified                  (1),
    networkProvidedSubscriptionNotVerified             (2)
}

CAMELAccessPointNameNI  ::= AccessPointNameNI

CAMELAccessPointNameOI  ::= AccessPointNameOI

CAMELInformationMM      ::= SET
{
    sCFAddress                      [1] SCFAddress OPTIONAL,
    serviceKey                      [2] ServiceKey OPTIONAL,
    defaultTransactionHandling      [3] DefaultGPRS-Handling OPTIONAL,
    numberOfDPEncountered           [4] NumberOfDPEncountered OPTIONAL,
    levelOfCAMELService             [5] LevelOfCAMELService OPTIONAL,
    freeFormatData                  [6] FreeFormatData OPTIONAL,
    fFDAppendIndicator              [7] FFDAppendIndicator OPTIONAL
}

CAMELInformationPDP ::= SET
{
    sCFAddress                      [1] SCFAddress OPTIONAL,
```

```
    serviceKey                      [2] ServiceKey OPTIONAL,
    defaultTransactionHandling      [3] DefaultGPRS-Handling OPTIONAL,
    cAMELAccessPointNameNI          [4] CAMELAccessPointNameNI OPTIONAL,
    cAMELAccessPointNameOI          [5] CAMELAccessPointNameOI OPTIONAL,
    numberOfDPEncountered           [6] NumberOfDPEncountered OPTIONAL,
    levelOfCAMELService             [7] LevelOfCAMELService OPTIONAL,
    freeFormatData                  [8] FreeFormatData OPTIONAL,
    fFDAppendIndicator              [9] FFDAppendIndicator OPTIONAL
}

CAMELInformationSMS     ::= SET
{
    sCFAddress                              [1] SCFAddress OPTIONAL,
    serviceKey                              [2] ServiceKey OPTIONAL,
    defaultSMSHandling                      [3] DefaultSMS-Handling OPTIONAL,
    cAMELCallingPartyNumber                 [4] CallingNumber OPTIONAL,
    cAMELDestinationSubscriberNumber        [5] CalledNumber OPTIONAL,
    cAMELSMSCAddress                        [6] AddressString OPTIONAL,
    freeFormatData                          [7] FreeFormatData OPTIONAL
}

CauseForRecClosing  ::= INTEGER
{
    --
    -- in GGSN the value sGSNChange should be used for partial record
    -- generation due to SGSN Address List Overflow
    --
    -- cause codes 0 to 15 are defined in TS 32.205 as 'CauseForTerm' (cause for termination)
    --
    normalRelease               (0),
    abnormalRelease             (4),
    cAMELInitCallRelease        (5),
    volumeLimit                 (16),
    timeLimit                   (17),
    sGSNChange                  (18),
    maxChangeCond               (19),
    managementIntervention      (20)
}

ChangeCondition ::= ENUMERATED
{
    qoSChange               (0),
    tariffTime              (1),
    recordClosure           (2)
}

ChangeOfCharCondition   ::= SEQUENCE
    --
    -- used in PDP context record only
    --
{
    qosRequested                [1] QoSInformation OPTIONAL,
    qosNegotiated               [2] QoSInformation OPTIONAL,
    dataVolumeGPRSUplink        [3] DataVolumeGPRS,
    dataVolumeGPRSDownlink      [4] DataVolumeGPRS,
    changeCondition             [5] ChangeCondition,
    changeTime                  [6] TimeStamp
}

ChangeLocation  ::= SEQUENCE
    --
    -- used in SGSNMMRecord only
    --
{
    locationAreaCode        [0] LocationAreaCode,
    routingAreaCode         [1] RoutingAreaCode,
    cellId                  [2] CellId OPTIONAL,
    changeTime              [3] TimeStamp
}

ChargingCharacteristics ::= OCTET STRING (SIZE(2))
    --
    --  Bit 0-3: Profile Index
    --  Bit 4-15: For Behavior
    --

ChargingID  ::= INTEGER (0..4294967295)
    --
    -- generated in GGSN, part of PDP context, see TS 23.060
    -- 0..4294967295 is equivalent to 0..2**32-1

ChChSelectionMode       ::= ENUMERATED
{
```

```
    sGSNSupplied                (0),    -- For GGSN only
    subscriptionSpecific        (1),    -- For SGSN only
    aPNSpecific                 (2),    -- For SGSN only
    homeDefault                 (3),    -- For SGSN and GGSN
    roamingDefault              (4),    -- For SGSN and GGSN
    visitingDefault             (5)     -- For SGSN and GGSN
}


DataVolumeGPRS  ::= INTEGER
    --
    -- The volume of data transferred in octets.
    --

DynamicAddressFlag  ::= BOOLEAN

ETSIAddress ::= AddressString
    --
    --first octet for nature of address, and numbering plan indicator (3 for X.121)
    --other octets TBCD
    -- See TS 29.002
    --

FFDAppendIndicator  ::= BOOLEAN

FreeFormatData  ::= OCTET STRING (SIZE(1..160))
    --
    -- Free formated data as sent in the FurnishChargingInformationGPRS
    -- see TS 29.078
    --

GSNAddress  ::= IPAddress

GSMQoSInformation   ::=SEQUENCE
{
    reliability             [0] QoSReliability,
    delay                   [1] QoSDelay,
    precedence              [2] QoSPrecedence,
    peakThroughput          [3] QoSPeakThroughput,
    meanThroughput          [4] QoSMeanThroughput
}

IPAddress   ::= CHOICE
{
    iPBinaryAddress  IPBinaryAddress,
    iPTextRepresentedAddress     IPTextRepresentedAddress
}

IPBinaryAddress ::= CHOICE
{
    iPBinV4Address          [0] OCTET STRING (SIZE(4)),
    iPBinV6Address          [1] OCTET STRING (SIZE(16))
}

IPTextRepresentedAddress    ::= CHOICE
{   --
    -- IP address in the familiar "dot" notation
    --
    iPTextV4Address         [2] IA5String (SIZE(7..15)),
    iPTextV6Address         [3] IA5String (SIZE(15..45))
}

LocalSequenceNumber ::= INTEGER (0..4294967295)
    --
    -- Sequence number of the record in this node
    -- 0.. 4294967295 is equivalent to 0..2**32-1, unsigned integer in four octets

MSNetworkCapability ::= OCTET STRING (SIZE(1))

NetworkInitiatedPDPContext  ::= BOOLEAN
    --
    -- Set to true if PDP context was initiated from network side
    --

NodeID  ::= IA5String (SIZE(1..20))

PDPAddress  ::= CHOICE
{
    iPAddress               [0] IPAddress,
    eTSIAddress             [1] ETSIAddress
}

PDPType     ::= OCTET STRING (SIZE(2))
```

```
    --
    --OCTET 1: PDP Type Organization
    --OCTET 2: PDP Type Number
    -- See TS 29.060
    --
QoSDelay        ::= ENUMERATED
{
    --
    -- See Quality of service TS 24.008
    --
    delayClass1             (1),
    delayClass2             (2),
    delayClass3             (3),
    delayClass4             (4)
}

QoSInformation  ::= CHOICE
{
    gsmQosInformation       [0] GSMQoSInformation,
    umtsQosInformation      [1] OCTET STRING (SIZE (12))}
--
-- The “GSMQoSInformation corresponds to the encoding specified in GSM TS 12.15, and
-- shall be used for pre-Release 99 terminals only.  The umtsQosInformation octet string
-- is a 1:1 copy of the contents (i.e. starting with octet 4) of the “Quality of
-- service Profile” information element specified in 3GPP TS 29.060 [22].

QoSMeanThroughput   ::= ENUMERATED
{
    --
    -- See Quality of service TS 24.008
    --
    bestEffort              (0),
    mean100octetPh          (1),
    mean200octetPh          (2),
    mean500octetPh          (3),
    mean1000octetPh         (4),
    mean2000octetPh         (5),
    mean5000octetPh         (6),
    mean10000octetPh        (7),
    mean20000octetPh        (8),
    mean50000octetPh        (9),
    mean100000octetPh       (10),
    mean200000octetPh       (11),
    mean500000octetPh       (12),
    mean1000000octetPh      (13),
    mean2000000octetPh      (14),
    mean5000000octetPh      (15),
    mean10000000octetPh     (16),
    mean20000000octetPh     (17),
    mean50000000octetPh     (18)
}
QoSPeakThroughput   ::= ENUMERATED
{
    --
    -- See Quality of service TS 24.008
    --
    unspecified             (0),
    upTo1000octetPs         (1),
    upTo2000octetPs         (2),
    upTo4000octetPs         (3),
    upTo8000octetPs         (4),
    upTo16000octetPs        (5),
    upTo32000octetPs        (6),
    upTo64000octetPs        (7),
    upTo128000octetPs       (8),
    upTo256000octetPs       (9)
}
QoSPrecedence   ::= ENUMERATED
{
    --
    -- See Quality of service TS 24.008
    --
    unspecified             (0),
    highPriority            (1),
    normalPriority          (2),
    lowPriority             (3)
}
QoSReliability  ::= ENUMERATED
{
```

```
    --
    -- See Quality of service TS 24.008
    --
    unspecifiedReliability      (0),
    acknowledgedGTP             (1),
    unackGTPAcknowLLC           (2),
    unackGTPLLCAcknowRLC        (3),
    unackGTPLLCRLC              (4),
    unacknowUnprotectedData     (5)
}

RoutingAreaCode ::= OCTET STRING (SIZE(1))
    --
    -- See TS 24.008    --
    --

SCFAddress  ::= AddressString
    --
    -- See TS 29.002    --
    --


NumberOfDPEncountered  ::= INTEGER
--
--

SGSNChange  ::= BOOLEAN
    --
    -- present if first record after inter SGSN routing area update
    -- in new SGSN
    --

SystemType  ::= ENUMERATED
{

    unknown             (0),
    iuUTRAN             (1)

}END
```

7. Charging Protocols

The GTP' charging protocol is optional. GSNs generate CDRs that are collected by the CGF. GTP' has been designed for CDR transport.

The CGF-BS interface is also described in this subclause.

7.1 CDR Transport by GTP'

The GTP' has been designed to deliver CDRs to the CGF(s) from the network elements that generate charging records. This protocol is required when the CGF resides outside the CDR generating nodes and utilizes some aspects of GTP (defined in 3GPP TS 29.060 [8]) which is used for packet data tunnelling in the backbone network.

GTP' operates on the Ga interface and does not imply the use of any specific backbone network.

GTP' contains the following functions:

- CDR transfer mechanism between the GSNs and the CGF.
- Redirection of CDR transfer to another CGF.
- Ability to detect communication failures between communicating peers using echo messaging.- Ability of a CDR handling node to advertise to its peer about its CDR transfer capability (e.g., after a period of service downtime).
- An option to prevent duplicate CDRs that might arise during redundancy operations. If so configured, the CDR duplication prevention function may also be carried out by marking potentially duplicated CDR packets and delegating the final duplicate deletion task to CGF or Billing System - BS (instead of handling the possible duplicates solely by GTP' messaging).

7.1.1 SGSN - CGF communication

As illustrated in Figure 5, the SGSN - CGF communications are carried out using GTP' over UDP/TCP and IP.

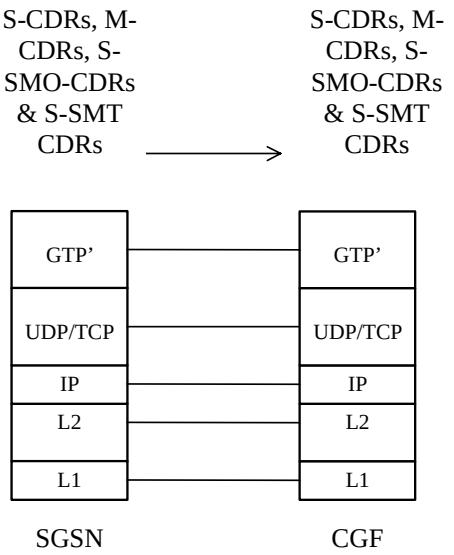

Figure 5: Protocol layers between the SGSN and the CGF

7.1.2 GGSN - CGF communication

The GGSN – CGF communications are conducted using GTP' over UDP/TCP and IP, as depicted in Figure 6:

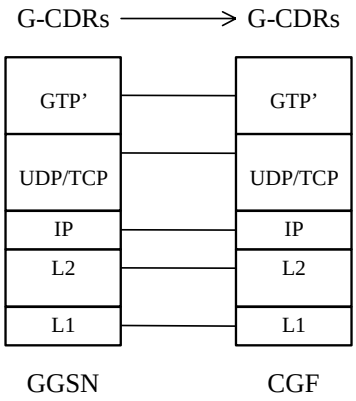

Figure 6: Protocol layers between the GGSN and the CGF

7.1.3 CGF - CGF communication

If necessary, CGF to CGF communications are carried out using GTP' over UDP/TCP and IP. This is illustrated in Figure 7.

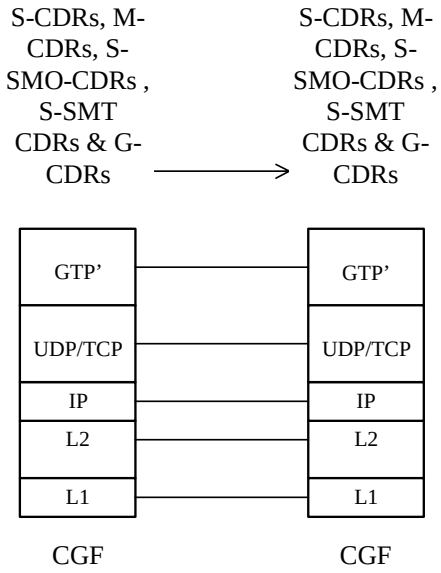

Figure 7: Protocol layers between CGFs

7.1.4 Port usage

Charging may be facilitated by transporting the CDRs from the GSNs to the CGF over the Ga interface. The Path Protocol may be UDP (compliant with STD 0006[18]) or TCP (compliant with STD 0007[19]) over IP.

7.1.4.1 UDP as the Path Protocol

Ports for signalling the request messages:

- The UDP Destination Port may be the server port number 3386 which has been reserved for GTP'. Alternatively another port can be used, which has been configured by O&M.

- The UDP Source Port is a locally allocated port number at the sending GSN.

Ports for signalling the response messages:

- The UDP Destination Port value shall be the value of the Source Port of the corresponding request message.
- The UDP Source Port shall be the value from the Destination Port of the corresponding request message.

7.1.4.2 TCP as Path Protocol

The TCP Destination Port may be the server port number 3386, which has been reserved for G-PDUs. Alternatively, another port may be used as configured by O&M. Extra implementation-specific destination ports are possible but all CGFs shall support the server port number.

The TCP Source Port is a random port, locally assigned at the sending GSN.

7.1.4.3 Network layer and lower layers

Beneath the Path Protocol there is the network IP layer, which shall be the Internet Protocol (IP) compliant with STD 0005(see [20] and [21]). Beneath the network IP layer are the L2 and L1 layers, which are not specified, in the present document.

7.1.5 Charging related requirements for PS Domain nodes

Each node (e.g., SGSN, GGSN etc.and CGF) that supports or may support GTP' shall be capable of handling or responding with a "Service/Version not supported" message if that node is configured to be addressed by another peer node.

When a new PDP context is activated or after an inter SGSN handover the GGSN will inform the related SGSN which CGF it should send its CDRs to. All other non-PDP context related CDRs are sent to the current default CGF for that CDR generating node. Each CDR generating node will have an O&M configurable CGF address list to which it can send its CDRs. The list will be organized in CGF address priority order. If the Primary CGF is not available (e.g., out of service) then the CDR generating node shall send the CDRs to the Secondary CGF and so on.

Each GPRS CDR generating node will only send the records to the CGF(s) of the same GPRS PLMN, not to CGF(s) located in other PLMNs.

Each CGF in the GPRS PLMN shall know of all other CGFs network addresses. This is achieved by O&M configuration facilities that will enable each CGF to have a configurable list of peer CGF addresses.

7.2 The GTP' charging protocol

This subclause describes the features of GTP'. The message types described in subclause 7.3.2 ("Reused GTP message types") are also described in the related subchapters of 3GPP TS 29.060 [8].

7.2.1 Usage of GTP Header in charging

In GTP' messaging, only the signalling plane of GTP is partly reused. The GTP' header is shown in Figure 8.

Bit 5 of octet 1 of the GTP header is the Protocol Type flag and is '0' if the message is GTP'.

The Version bits indicate the GTP' protocol version when the Protocol Type flag is '0'.

Bit 1 of octet 1 is not used in GTP' (except in v0), and it is '0' in the GTP' header.

The Length indicates the length of payload (number of octets after the GTP' header).

The Sequence Number of the packet is part of the GTP' header.

Octets	Bits 8	7	6	5	4	3	2	1
1	Version			PT	Spare ' 1 1 1 '			' 0 '
2	Message Type							
3 - 4	Length							
5 - 6	Sequence Number							

Figure 8: GTP' header

7.2.2 Information Elements (IEs)

The messages may contain several Information Elements (IEs). The TLV (Type, Length, Value) or TV (Type, Value) encoding formats shall be used for the GTP' IEs. The GTP' messages shall have the IEs sorted with the Type fields in ascending order. The Length field shall contain the IE length excluding the Type and Length fields.

Within the Type field the most significant bit will be set to 0 when the TV format is used and set to 1 when the TLV format is used. This is illustrated in Figures 9a and b, respectively.

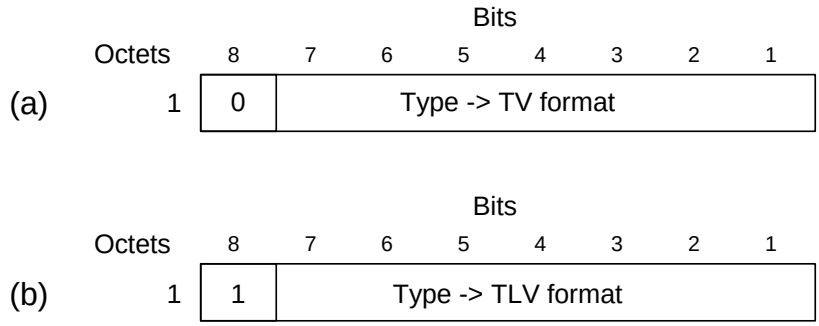

Figure9: Type field for (a) TV and (b) TLV format

7.3 GTP' Message Types

7.3.1 List of all GTP' message types

GTP' defines a set of messages between two associated nodes. The GTP' messages defined are shown in Table 8. The messages introduced by GTP' are in **boldface** letters**.** The other messages are inherited from the GTP protocol.

Of the GTP' introduced signalling message types, Node Alive Request, Node Alive Response, Redirection Request and Redirection Response belong to the "Path Management messages". The Data Record Transfer Request and Data Record Transfer Response form the message type group "Record Transmission messages".

The reserved fields in the signalling messages shall be filled with ones, and are intended for future use.

GTP' reuses the GTP Cause values. The message type numbers required for the newly introduced GTP' messages have been derived from the unallocated message type number space specified in the GTP message table defined in 3GPP TS 29.060 [8].

The number ranges allocated for GTP' are as follows:

For Information Elements: 117-127 (TV type fields) and 239-254 (for TLV type fields).

TLV Information Element types introduced in the present document:
- 254 Address of Recommended Node
- 253 Requests Responded
- 252 Data Record Packet
- 251 Charging Gateway Address (this IE is also used in 3GPP TS 29.060 [8])
- 250 Sequence Numbers of Cancelled Packets
- 249 Sequence Numbers of Released Packets

TV Information Element types introduced in the present document:
- 127 Charging ID
- 126 Packet Transfer Command

For Cause Codes: Cause values used in requests: 49 to 63, Cause values used in responses indicating acceptance: 177 to 191, Cause values used in responses indicating rejection: 241 to 255.

Charging related Cause values introduced for the present document:

In requests:
- 63 This node is about to go down
- 62 Another node is about to go down
- 61 The receive buffers are becoming full
- 60 The transmit buffers are becoming full
- 59 System failure

In responses indicating acceptance:
- 177 CDR decoding error

In responses indicating rejection:
- 255 Request not fulfilled
- 254 Sequence numbers of released/cancelled packets IE incorrect
- 253 Request already fulfilled
- 252 Request related to possibly duplicated packets already fulfilled

The charging related message types are listed in Table 8.. Brief descriptions of the GTP messages reused in GTP' are provided in subclause 7.3.2 ("Reused GTP message types") below. Further details are provided in 3GPP TS 29.060 [8], the GTP specification.

Table 8: GTP' messages

Message Type value (Decimal)	GTP' message
1	Echo Request
2	Echo Response
3	Version Not Supported
4	**Node Alive Request**
5	**Node Alive Response**
6	**Redirection Request**
7	**Redirection Response**
240	**Data Record Transfer Request**
241	**Data Record Transfer Response**
others	reserved for future use

7.3.2 Reused GTP message types

The existing **Echo Request** and **Echo Response** messages defined in 3GPP TS 29.060 [8] are also used in PS domain charging. They may be used by the CDR generating nodes SGSN or GGSN, or by the CGF for checking if another GSN or CGF is alive. If the present document and 3GPP TS 29.060 [8] differ in their description then the 3GPP TS 29.060 [8] is to be taken as the latest specification status of the related Information Elements. If the path protocol is TCP, Echo Request and Echo Response messages are not required.

The **Version Not Supported** message in the GTP' resembles the corresponding GTP message. It indicates the latest GTP' version that the GTP' entity can support. If a receiving node receives a GTP' message of an unsupported version, that node shall return a GTP' Version Not Supported message indicating in the Version field of the GTP' header the latest GTP' version that that node supports. The received payload data of the GTP' packet shall then be discarded.

The Version bits in the GTP' header have currently the following possible values:

GTP' version 0 (binary '000') is the GSM 12.15 v7.0.0 (October 1998) level, with the following Message Type values: 3 = Version Not Supported, 4 = Node Alive Request, 5 = Node Alive Response, 6 = Redirection Request, 7 = Redirection Response. In clause 7.3.4.6 the Requests Responded information element has Length field in place of the Number of Requests Responded field, to make that TLV IE to be handled like normal TLV IEs. If the GTP' v0 is used in parallel to GTP' v2 or a newer version, then a 6 octet header length (with no trailing dummy octets) is used also with v0 (like in GTP' v2). The mark of the usage of GTP' v0 with 6 octet header (instead of the original 20 octet long header) is then the version bits being 0 and the bit 1 of octet 1being '1' (instead of '0').

GTP' version 1 (binary '001') is the same as version 0, but with the duplicate CDR prevention mechanism, introduced in GSM 12.15 version 7.2.1 (1999-07) of the GPRS charging specification.

GTP' version 2 (binary '010') is the same as version 1, but the header is just 6 octets long (no unused trailing octets). IPv6 address type is also supported (for Address of Recommended Node information element of the Redirection Request).

7.3.3 GTP message type modifications implied by GTP'

The PS domain charging related features in GTP are in the Create PDP Context Response: the Charging ID Information Element (IE) and the Charging Gateway Address IE, in the Update PDP Context Response the Charging ID Information Element (IE) and the Charging Gateway Address IE, in the Create AA PDP Context Response: the Charging ID IE and the Charging Gateway Address IE. Refer to 3GPP TS 29.060 [8] for details.

The general principle is that the CDRs are always sent to a CGF residing in the same network as the CDR generating node. In the case of roaming it is conceivable that some CDRs relating to the same PDP context will be sent to different networks' CGFs. The cost balancing of the roaming traffic is to be agreed between the UMTS Operators.

7.3.4 GTP' message types

7.3.4.1 Node Alive Request

The Node Alive Request message may be used to inform that a node in the network has started its service (e.g. after a service break due to software or hardware maintenance or data service interruption after an error condition). A node may send a different Node Address than its own in the Information Element, e.g. informing the "next node in the chain" that the "previous node in the chain" (which is located on the other side of the sender of this message) is now ready for service. This message type is optional if the Path Protocol is TCP.

The Node Alive Request message allows a quicker reconnect capability than the Echo Request message based polling can provide, and its usage will have a reduced load effect on the network, particularly when the number of network nodes using GTP' is high. It may also be used to inform when a new network node has become available for service. If the Echo Request message is also used then the usage of the Node Alive Request message allows the interval of Echo Requests to be longer than would be otherwise required, thus reducing network loading with many Echo Requests. The Information elements in a Node Alive Request message are shown in Table 9.

Table 9: Information Elements in a Node Alive Request

Information Element	Presence requirement
Node Address	Mandatory
Private Extension	Optional

The Node Address format is the same as for the Charging Gateway Address format described in 3GPP TS 29.060 [8]).

The optional Private Extension IE contains vendor- or operator-specific information.

7.3.4.2 Node Alive Response

The Node Alive Response message, shown in Table 10, shall be sent as a response to a received Node Alive Request.

Table 10: Information Elements in a Node Alive Response

Information Element	Presence requirement
Private Extension	Optional

The optional Private Extension IE contains vendor- or operator-specific information.

7.3.4.3 Redirection Request

There are two kinds of usage for the Redirection Request message. One is to advise that received CDR traffic is to be redirected to another CGF due to that CGF node is about to stop service (due to an outage for maintenance or an error condition). The second purpose is to inform a CDR generating node (e.g. SGSN) that is currently sending data to this node (e.g. CGF), that the next node in the chain (e.g. a mediator device or Billing Computer) has lost connection to this node (e.g. CGF).

The Information Elements in a Redirection Request Message are listed in Table 11. An Address of Recommended Node may be given if for example a CGF maintenance outage is handled by first introducing another CGF ready to take incoming CDRs. In this way the network performance can be maintained. The Address of Recommended Node shall only describe an intra-PLMN node containing a CGF, and not to a node in any other PLMN.

Table 11: Information Elements in a Redirection Request

Information Element	Presence requirement
Cause	Mandatory
Address of Recommended Node	Optional
Private Extension	Optional

Possible Cause values are:
- "This node is about to go down";
- "Another node is about to go down";
- "System failure";
- "Receive buffers becoming full";
- "Send buffers becoming full".

The Address of Recommended Node information element, shown in Figure 10, defines the IPv4 or IPv6 format address that the node is identified by in the UMTS network.

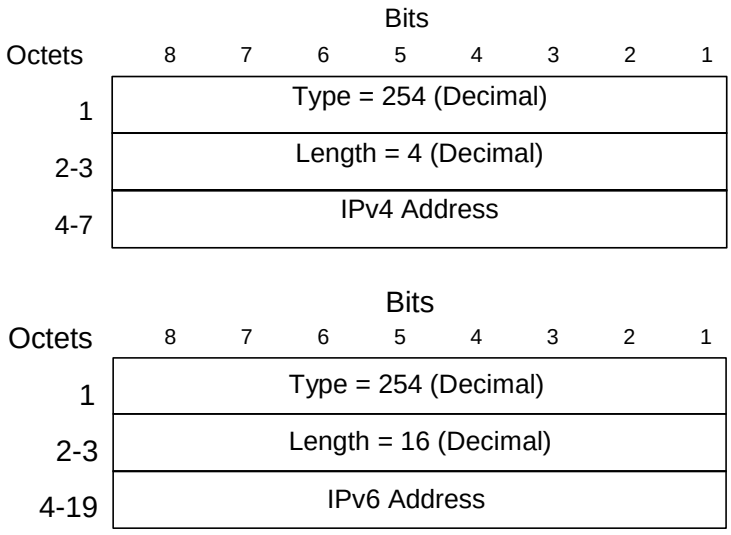

Figure 10: Address of Recommended Node information elements

The optional Private Extension contains vendor- or operator- specific information.

7.3.4.4 Redirection Response

A Redirection Response message shall be sent as a response of a received Redirection Request. The information elements of this message are listed in Table 12.

Table 12: Information Elements in a Redirection Response

Information Element	Presence requirement
Cause	Mandatory
Private Extension	Optional

Possible Cause values are:
- "Request Accepted";
- "No resources available";
- "Service not supported";
- "System failure";
- "Mandatory IE incorrect";
- "Mandatory IE missing";
- "Optional IE incorrect";
- "Invalid message format";
- "Version not supported".

The optional Private Extension contains vendor- or operator-specific information.

7.3.4.5 Data Record Transfer Request

This message is used in PS domain charging to transmit the CDR information. The CDR information is placed in the Data Record information element.

7.3.4.5.1 General logic

This subclause is intended to be read together with subclause 7.3.4.7 "Examples of GTP' messaging cases". The normal communication would be GSN sending Data Record Packets to a CGF, which answers with "Request Accepted" responses. Under normal condition the CDR transmission uses a Request-Response messaging sequence in the GSN to CGF GTP' protocol communication.

Sometimes a non-PDP context related CDR (e.g. M-CDRs) is transmitted, and thus the GGSN does not pass the CGF address information to the SGSN. The SGSN will in this case direct the CDRs to the current default CGF for the SGSN. This is the configured Primary CGF address, or if that CGF is out of service, then the secondary CGF address etc.

Note: The redundancy mechanism should be corrected, eliminated or made optional.

Summary of the CGF redundancy mechanism that prevents duplicated CDR packets to enter the BS is described below. Other mechanisms may be deployed.The general logic of the duplicate CDR packet prevention in CGF redundancy cases is shown in Figure 11, where the messages are numbered sequentially Alternative messages are indicated by an index character ('a' or 'b') that follows the arrow sequence number.The main mechanism of the messaging in CGF redundancy cases (when a GSN-CGF link is down or a CGF is not working) is based on (1) first trying to send a CDR packet to CGF1. Then if no successful response is received (2) because the request does not reach CGF1 even when retried (or the responses from CGF1 to GSN are lost after CGF1 either stored it securely or sent it towards post-processing (2b)), the unacknowledged CDR packets are redirected to CGF2. The GSN may first test the GSN-CGF2 link by an Echo Request message that the CGF2 would respond by Echo Response. The CDR packets not successfully received by the primary CGF (=CGF1) are sent to another CGF2 (3), marked as potential duplicates, and CGF2 responds the request(s) (4). Those CDRs will wait there for further commands from GSN. When the GSN detects (5) and (6) that CGF1 is again able to communicate with it by receiving Node Alive Request (or getting a Echo Response from CGF2 to a Echo Request sent by the GSN) it answers by Node Alive Respond. Then the GSN tests with an empty packet (7), retrying continuously if no response, using e.g. increasing timeouts (using the old unacknowledged packet's Sequence Number, if the CGF1 would consider the packet to be a new one (8a) or an already received one (8b)). According to the response of the CGF1, the GSN gives the CGF2 a command to either release (9a) or cancel (9b) the corresponding CDR packet from CGF2. CGF2 then confirms the decision (10), and is able to send the CDRs towards the BS (11a).

Error handling: As a default, retransmissions after configurable timeouts are used. If after CGF1 communication failure the CDR packet sending from GSN to CGF2 does not succeed, the GSN tries to use CGF3 as the intermediate CDR packet storage entity, etc. If the acknowledgement (10) is not got by the GSN for its message (9a) or (9b), the GSN will retransmit the message (9a) or (9b) continuously and persistently, using e.g. increasing time intervals. An alarm should be sent to the O&M system if a communication link goes down. It shall be possible to release/cancel CDR packets from

CGFs and unacknowledged sequence numbers from GSNs by O&M operations if permanent GSN-CGF link failures would occur. The buffers containing Sequence Numbers of potentially duplicated packets and the buffers containing the numbers of unacknowledged CDR packets shall be kept up to date (with CDR packet transfers) using atomary transaction mechanisms. If the GSN-CGF1 communication link is down, any new CDRs generated by the GSN are sent to a properly working CGF2, instead of the CGF1.

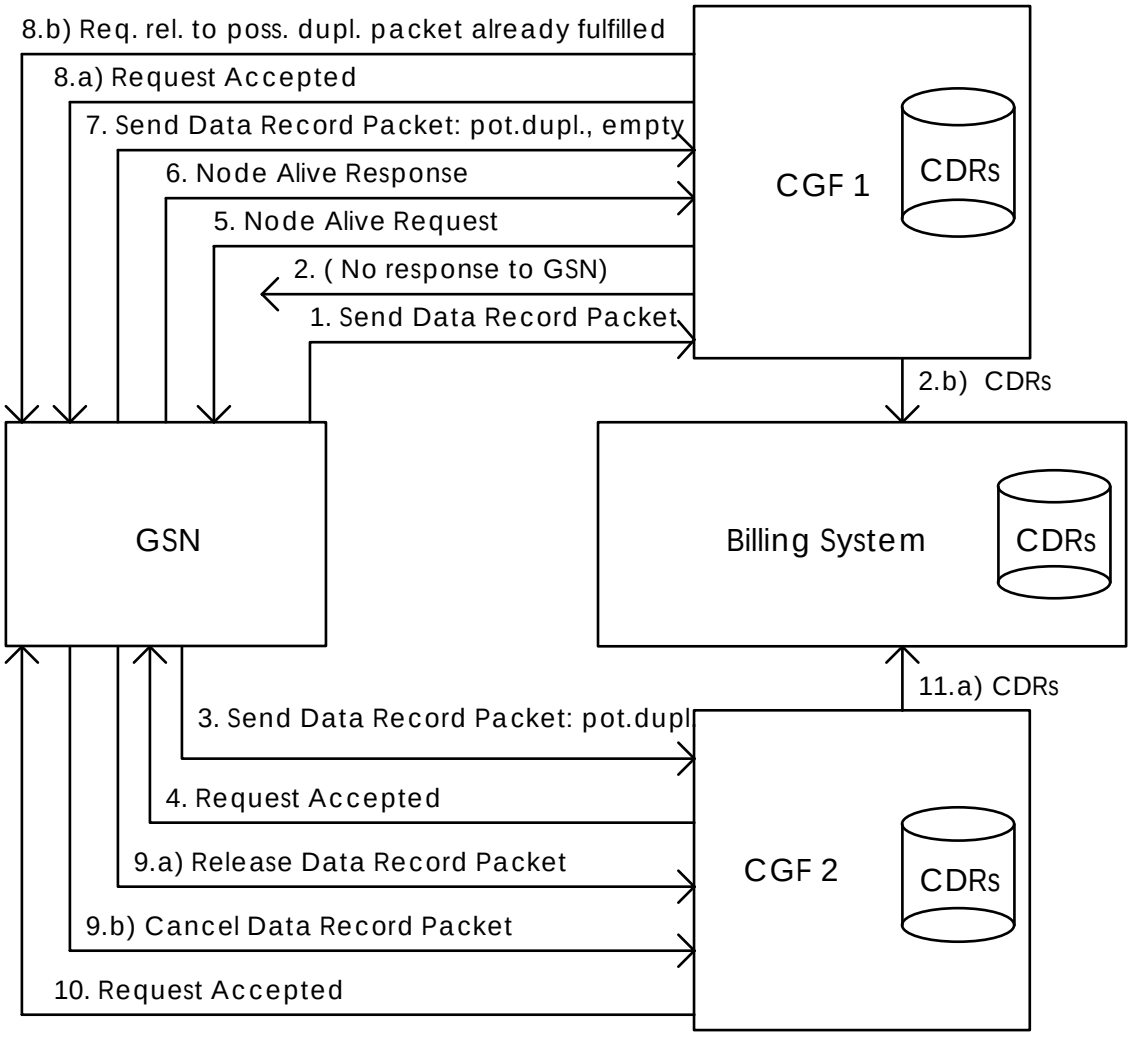

Figure 11: General CGF redundancy messaging scheme

A more detailed description of the CGF redundancy mechanism:

Due to a network failure or node failure, a CGF might not send a response within the configured timeout period to a request it got from a GSN. As a first attempt, retries of requests are to be used as defined in 3GPP TS 29.060 [8], if the response is not received in the configured time.

If a CDR generating node loses its connection to the CGF unexpectedly, it may send the CDRs to the next CGF in the priority list. If the CGF changes, the GSN can continue sending CDRs to different CGF nodes, depending on which CGF has been configured as the receiver of CDRs for a particular PDP context.

Sequence number buffers: The GSN might lose its connection to its primary CGF due to a link failure or CGF going down. In this kind of redundancy condition the GSN attempts to redirect the CDR traffic to a secondary CGF (after possible retries have failed). The GSN maintains an internal buffer for Sequence Numbers of requests not yet successfully responded by the primary CGF, for the case that it may become capable of communicating to the primary CGF at a later date. The GSN will send the not responded Data Record Packets (DRPs) to the secondary CGF, and the GSN maintains also a buffer for the Sequence Numbers related to those DRPs that have been temporarily stored to this

secondary CGF. (If the communication towards the secondary CGF would not work, the transfer of possibly duplicated DRPs and Sequence Number bookkeeping would be done for a tertiary CGF etc.) Also the CGFs maintain Sequence Number buffers for each of their GSN links. The Sequence Numbers may in future be needed in relation to the possibly duplicated CDRs that the CGFs have got from the GSN(s). The Sequence Numbers are stored to wait for a final decision to release them towards the BS (if the primary CGF had not received successfully the packets originally sent by a GSN) or to cancel them (if the primary CGF had received and processed successfully the originally by GSN sent packets).

The GSN is able to cancel (or release for transfer towards the BS) CDR packets sent to a secondary CGF if the primary CGF becomes available for service. To make the right decision the GSN first sends an empty test packet with the 'Send possibly duplicated Data Record Packet' Packet Transfer Command to the primary CGF, using a previously not responded Sequence Number.

In case that the empty test packet to the primary CGF which was temporarily down (or to which the link was down) is responded with the Cause value "Request Accepted", the GSN will release the corresponding CDRs waiting for final decision in the secondary CGF, towards the Billing System (BS) with the Packet Transfer Command 'Release Data Record Packet'.

If the primary CGF responses this test message with the Cause value "Request related to possibly duplicated packets already fulfilled", the GSN will cancel the corresponding CDRs waiting for final decision in the secondary CGF, using the Packet Transfer Command 'Cancel Data Record Packet'.

To enable that a GSN failure (destroying its Sequence Number buffers per each CGF link for non-responded requests or possibly duplicated packets) would not cause CDR packets to stay forever in the temporary decision waiting buffers of CGFs, there should also be O&M means of emptying those CGF buffers.

There shall be a also configurable parameter in the CGF for making the final decision as to whether or not it is able to send the CDRs to the Billing System (BS) for the case where the backup buffering mechanism in the GSN could not be used until the end of the messaging sequence related to a certain CDR packet has completed. This way the operator can:

A) Select that the GSNs and CGFs take care of duplicate prevention and the BS is not required to do duplicate checking due to possible duplicates caused by GPRS node redundancy.

B) Select that BS performs the duplicate prevention. To do this in the most effective way, the CGF may include an additional flag linked to possibly duplicated CDRs sent to Billing System, that they have not been released by a GSN for BS use (or use special kind of file name if a file protocol is used between CGF and BS). This means that the BS has somewhat more processing work to do, but the BS would anyway get a duplicate free end result. CGF is in this case always authorised to forward CDRs towards the BS, also when they contain possibly duplicated data. For this case the CGFs may also have a configurable flag that Data Record Packet Cancel/Release operations are not needed.

7.3.4.5.2 Information Elements in Data Record Transfer Request

The Information Elements in Data Record Transfer Request message as specified in Table 13.

Table 13: Information Elements in a Data Record Transfer Request

Information Element	Presence requirement
Packet Transfer Command	Mandatory
Data Record Packet	Conditional
Sequence Numbers of Released Packets	Conditional
Sequence Numbers of Cancelled Packets	Conditional
Private Extension	Optional

7.3.4.5.3 Packet Transfer Command IE

The value of the Packet Transfer Command in its Information Element tells the nature of the message:

1 = 'Send Data Record Packet';

2 = 'Send possibly duplicated Data Record Packet';

3 = 'Cancel Data Record Packet';

4 = 'Release Data Record Packet'.

The following describes the usage of each Packet Transfer Command. The first command is for normal CDR transfer while the other values are only used as part of the redundancy mechanism.

1) Send Data Record Packet. This is used for the normal CDR sending, and it is the usual Packet Transfer Command, Shown in Figure 12. Other commands are being used only in error recovery cases. Of the conditional IEs, the "Data Record Packet" is present in the message.

2) Send possibly duplicated Data Record Packet. When the CDR packet is directed to a secondary CGF (by a CDR generating node) because the currently used CGF not working or the CDR transfer is not working properly, then this Packet Transfer Command is used instead of the normal 'Send Data Record Packet'. Of the conditional IEs, the Data Record Packet" is present in the message, when sending the message to a CGF acting as temporary storage, when the original primary CGF could not be contacted. This Packet Transfer Command is used also when sending "empty" test packets with older (but not yet acknowledged) sequence numbers after a peer node or link recovery, to check if the CGF had received some Data Record Packets (whose acknowledgement did not come to the Data Record Packet sending node) before the link to the recipient node became inoperable.

3) Cancel Data Record Packet. Of the conditional IEs, the "Sequence Numbers of Cancelled Packets" is present in the message.

4) Release Data Record Packet. Of the conditional IEs, the "Sequence Numbers of Released Packets" is present in the message.

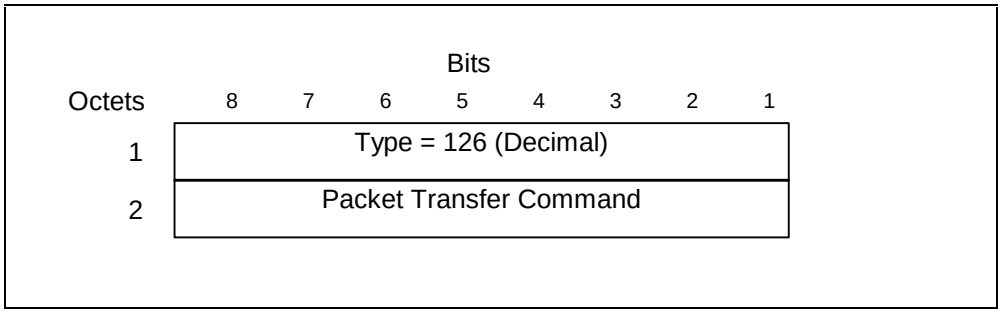

Figure 12: Packet Transfer Command information element

After the CGF has received the Packet Transfer Command 'Release Data Record Packet' with the Sequence Number(s) for earlier sent 'Send possibly duplicated Data Record Packet' command(s), it can consider itself authorised to send the Data Record Packets previously marked as possibly duplicated towards the Billing System (BS) as normal (not duplicated) CDRs.

7.3.4.5.4 Data Record Packet IE

The Data Record Packet element, which is present conditionally if the Packet Transfer Command is 'Send Data Record Packet', may contain one or more data records. This is illustrated in Figure 13. If an "empty packet" is to be sent, then the Data Record Packet IE contains only the Type (with value 252 in decimal) and the Length (with value 0) fields. The format of the records is ASN.1 or another format, identified by the Data Record Format. The Data Record Format Version numbering starts from 1.

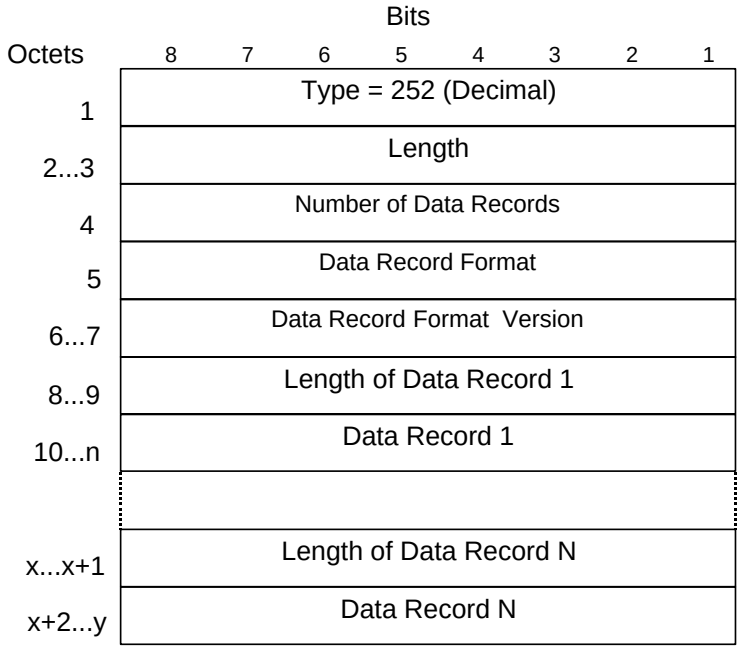

Figure 13: Data Record Packet information element

7.3.4.5.5 Sequence Numbers of Released Packets IE

The Sequence Numbers of Released Packets is present if the Packet Transfer Command is 'Cancel Data Record Packet'. The format of the Information Element is described in Figure 14 below:

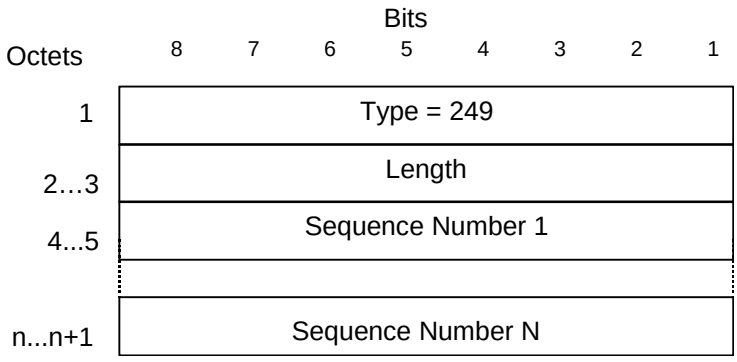

Figure 14: Sequence Numbers of Released Packets information element

7.3.4.5.6 Sequence Numbers of Cancelled Packets IE

The Sequence Numbers of Cancelled Packets information element is shown in Figure 15 and contains the IE Type, Length and the Sequence Number(s) (each 2 octets) of the cancelled Data Record Transfer Request(s). It is present if the Packet Transfer Command is 'Cancel Data Record Packet'.

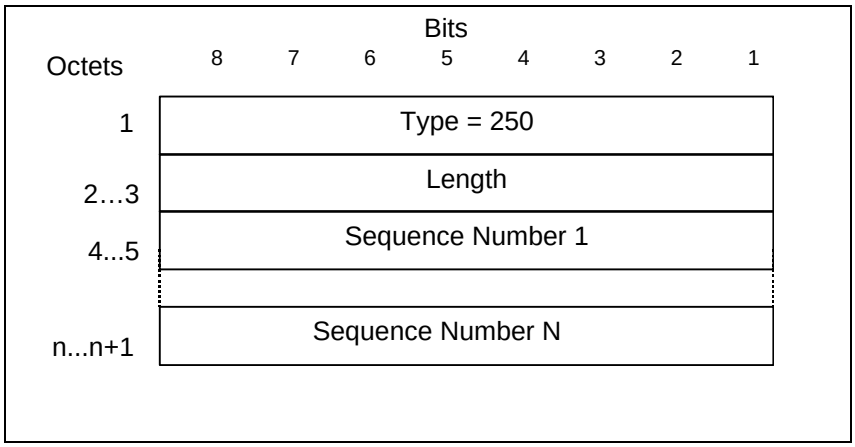

Figure 15: Sequence Numbers of Cancelled Packets information element

7.3.4.5.7 Private Extension IE

The optional Private Extension contains vendor or operator specific information.

7.3.4.6 Data Record Transfer Response

The message shall be sent as a response of a received Data Record Transfer Request. Also, several Data Record Transfer Requests can be responded by a single Data Record Transfer Response.

Table 14: Information Elements in a Data Record Transfer Response

Information Element	Presence requirement
Cause	Mandatory
Requests Responded	Mandatory
Private Extension	Optional

The Cause value is the same (whatever the value) for all those messages responded by that particular Response.

Possible Cause values are:
- "Request Accepted";
- "No resources available";
- "Service not supported";
- "System failure";
- "Mandatory IE incorrect";
- "Mandatory IE missing";
- "Optional IE incorrect";
- "Invalid message format";
- "Version not supported";
- "Request not fulfilled";
- “CDR decoding error“;
- "Request already fulfilled";
- "Request related to possibly duplicated packet already fulfilled".

The cause value “CDR decoding error” is optional, primarily intended to inform the CDR generating node that the receiving node can not decode the CDR. Thus, special features in the receiving node that are based on information within the CDR would not be operable. This message could alert the operator of a remote generating node of incompatible CDR encoding. It is Optional and no action or response is required.

The Requests Responded information element contains the IE Type, Length and the Sequence Numbers (each 2 octets) of the Data Record Transfer Requests. It is shown in Figure 16.

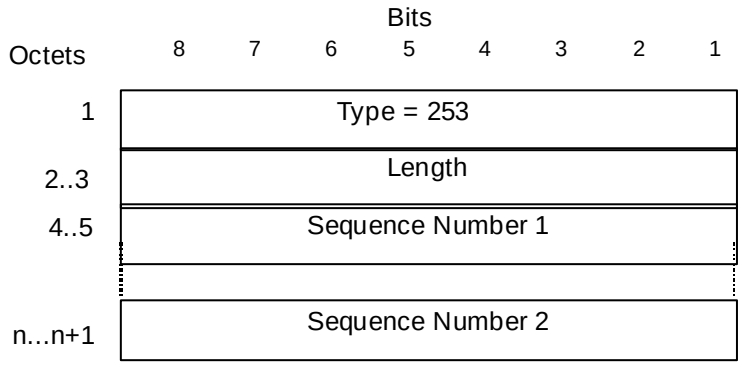

Figure 16: Requests Responded information element

The optional Private Extension contains vendor or operator specific information.

Depending on the Cause value severity and general occurrence frequency, the node that sent the corresponding Data Record Transfer Request, may start to direct its CDRs to another CGF.

7.3.4.7 Examples of GTP' messaging cases

The following example cases represent the three different key Data Record Transfer Request/Response messaging related CDR packet handling schemes. Cases 2 and 3 represents situations involving the redundancy mechanism.

Case 1): The normal CDR packet transfer:

> GSN sends successfully a CDR packet to the CGF, and since the GSN gets a response (Request Accepted) for the Data Record Transfer Request, there is no need to revert to the CGF redundancy mechanism and redirect the CDR packet traffic flow to an other CGF.

Case 2) : The GSN-CGF1 connection breaks before a successful CDR reception:

> In this example case the CDR packet sent by the GSN is lost before it is received by the CGF1. (The loss might be caused by a link failure or e.g. a major CGF1 failure.)

Case 3): The GSN-CGF1 connection breaks after a successful CDR reception:

> In this example case the CDR packet sent by the GSN is received correctly by the CGF1 and moved to its non-volatile memory (or even to the next NE in the communication chain). Anyhow, the GSN-CGF1 communication stops in this example case working before the GSN gets the positive response (Data Record Transfer Response: Request Accepted) that would acknowledge that the CDR packet was successfully received by CGF1.

The next three subclauses describe in more detail each of the key Data Record Transfer Request/Response messaging schemes.

7.3.4.7.1 Case 1: The normal CDR packet transfer

Figure 17 represents the default mode of CDR transfer from the CDR generating entities (GSNs) to the CDR packet collecting entities (CGFs).

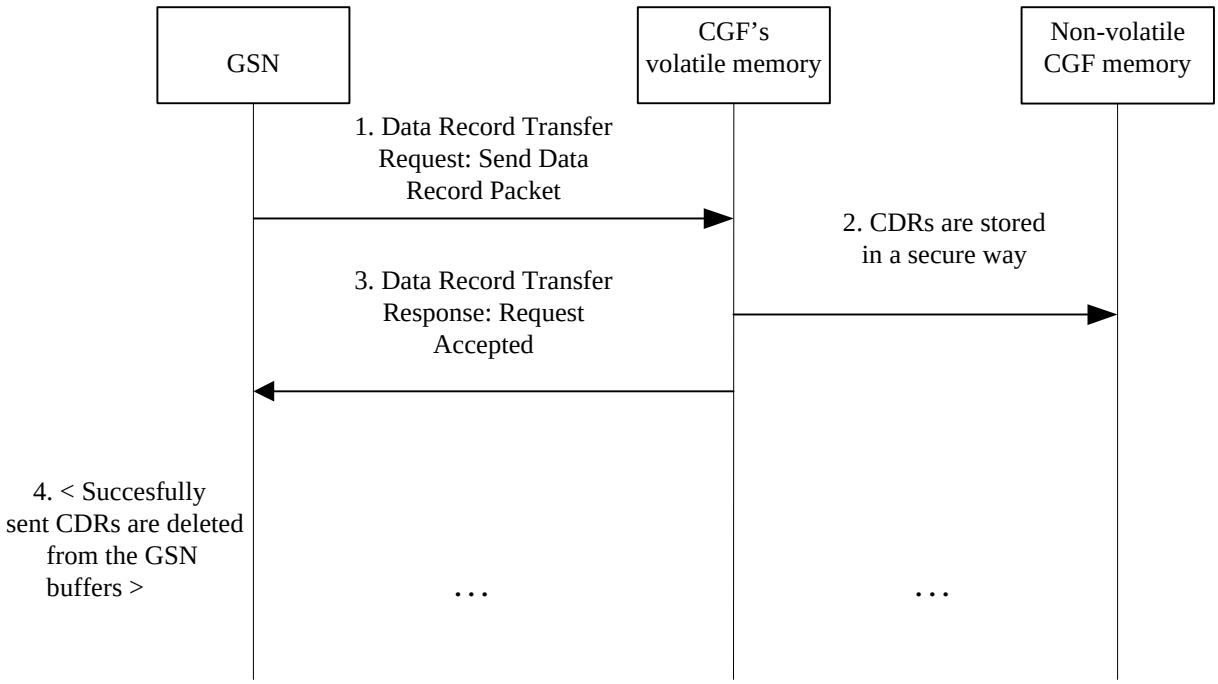

Figure 17: A normal CDR transfer process between a GSN and CGF

1) The CDR generating entity (here the GSN symbolises either SGSN or GGSN) sends CDR(s) in a packet to CGF (that is the current primary Charging Gateway Functionality for the specific CDR generating node, "CGF1"). The sending is performed by using the Data Record Transfer Request message, with the Packet Transfer Command IE having the value 'Send Data Record Packet'.

2) The CGF opens the received message and stores the packet contents in a safe way (to e.g. a redundant RAM memory unit or a mirrored non-volatile memory or even to another node).

3) The CDR receiving entity (CGF) sends confirmation of the successful packet reception to the CDR generating node (GSN). The confirmation is performed by using the Data Record Transfer Response message, with the Cause value being 'Request Accepted'.

4) After the positive response 'Request Accepted' is received by the GSN, it may delete the successfully sent CDRs from its send buffer.

The general principle of GTP' to retransmit the request if the response has not been received within a configurable time-out limit, is also followed here in point 1). The maximum amount of retries is a configurable value.

7.3.4.7.2 Case 2: The GSN-CGF1 connection breaks before a successful CDR reception

Figure 18 describes the exceptional case when the CDR transfer from a CDR generating entity (GSN) to the primary CDR packet collecting entity (CGF1) fails in a way that the CGF1 is not able to store the CDR packet sent by the GSN. (The reason for the failure in packet transfer may be e.g. a link failure between the GSN and CGF1, or a capacity exhausting error in the storage device of CGF1, or a general CGF1 system failure or CGF1 maintenance break.)

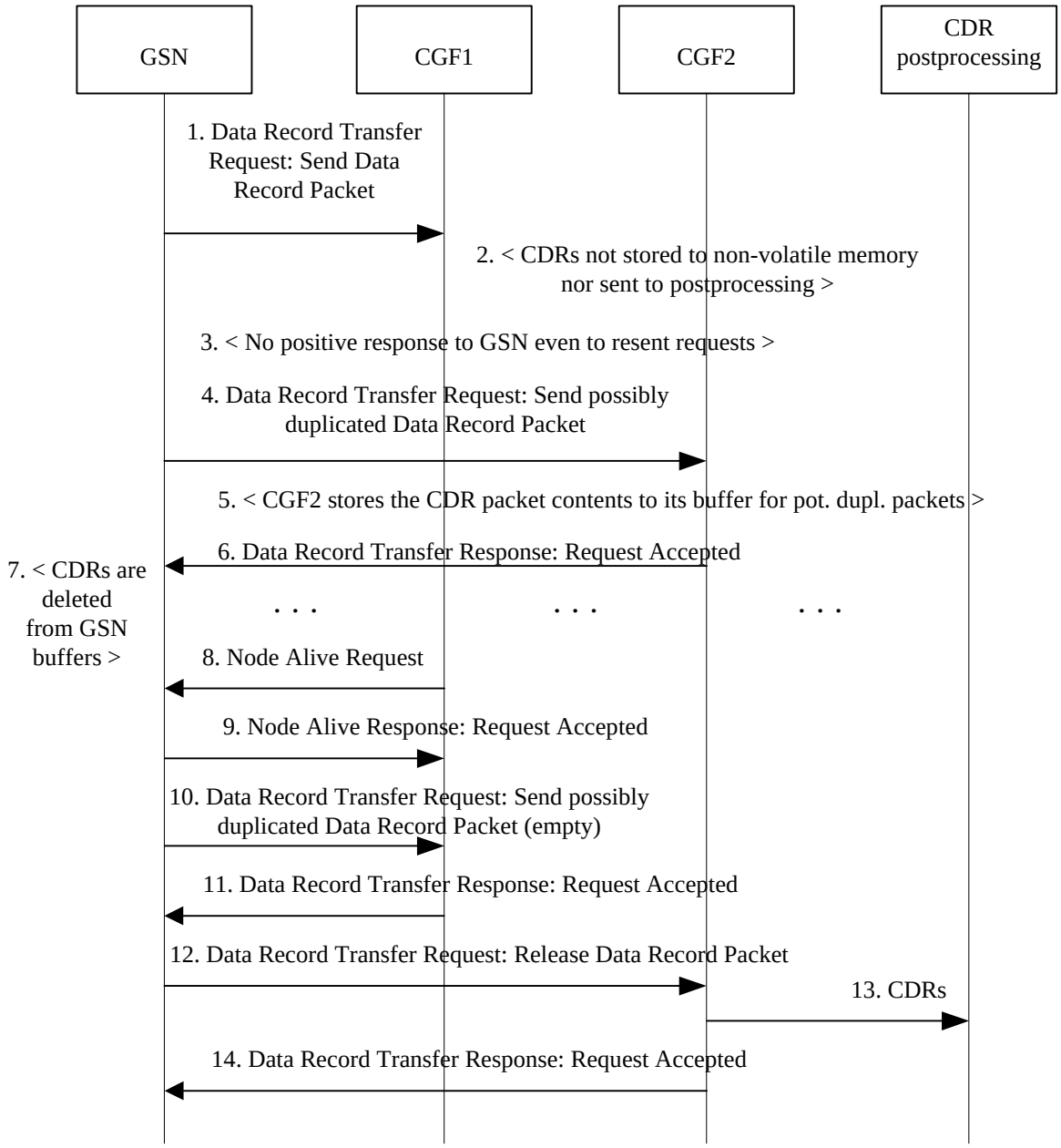

Figure 18: Duplicate prevention case: CDR sending via CGF1 had not succeeded

1) The CDR generating entity (GSN) sends CDR(s) in a packet to CGF (that is the current primary Charging Gateway Functionality for the specific CDR generating node, "CGF1"). The sending is performed by using the Data Record Transfer Request message, with the Packet Transfer Command IE having the value ‘Send Data Record Packet’.

2) Due to a failure in the GSN-CGF1 communication link of CGF1, the CGF1 is not able to store the packet sent by the GSN in a safe way (to e.g. a redundant RAM memory unit or a mirrored non-volatile memory or to another node).

3) Therefore the GSN is not able to get a response (or it could alternatively get a negative response like "No resources available" as the Cause value in the Data Record Transfer Response message).

4) (The GSN may now first test the GSN-CGF2 link by an Echo Request message that the CGF2 would respond by the Echo Response.) Then the GSN sends the same CDR packet that could not be sent to CGF1 to the next CGF in its CGF preference list (here CGF2) using the Data Record Transfer Request message, with the Packet Transfer Command IE having the value ‘Send possible duplicated Data Record Packet’.

5) As the connection to the CGF2 is working, the CGF2 is able to process the CDR packet. Since the packet was marked by the sending GSN to be potentially duplicated, it is stored into the CGF2, but not yet sent forward towards the Billing System.

6) The CGF2 sends confirmation of the successful packet reception to the GSN. The confirmation is performed by using the Data Record Transfer Response message, with the Cause value being ‘Request Accepted’

7) The GSN can now delete the now successfully sent (potentially duplicated) CDRs from its CDR buffer (but it keeps the sequence number(s) of the sent potentially duplicated packet(s) in a buffer dedicated for that.

8) When CGF1 is recovering after a system reboot, it sends a Node Alive Request message to the configured peer GSN(s), and so the GSN notices that it can again successfully communicate with the CGF1. (The GSN may also detect this by using the Echo Request messages, which would be answered by CGF1 by the Echo Response message.)

9) GSN acknowledges the CGF1 by Node Alive Response message.

10) For the earlier unacknowledged Data Record Transfer Request message(s), the GSN sends CGF1 empty test packet(s) (with no CDR payload in the Data Record Packet IE but just the other parts of the message frame).

11) CGF1 responds with Data Record Transfer Response message, with the Cause value being ‘Request Accepted’, because in this example case CGF1 had lost the communication capability towards GSN before storing the previously received (and by CGF1 unacknowledged) CDR packet.

12) Now GSN knows that the CGF1 had not originally been able to process and forward the original version of the CDR packet from the GSN, and it indicates CGF2 that CGF2 can send the CDR packet(s) related to the previously unacknowledged GTP’ Sequence Number(s) to post-processing. Those packets’ Sequence Numbers are indicated in the Sequence Numbers of the Released Packets IE.

13) CGF2 shall now be able to send the released packets towards post-processing.

14) CGF2 responds with Data Record Transfer Response message, with the Cause value being ‘Request Accepted’.

After all the potentially duplicated packets are cleared form CGF(s), the GSN can continue in normal way the transfer of CDRs.

7.3.4.7.3 Case 3: The GSN-CGF1 connection breaks after a successful CDR reception

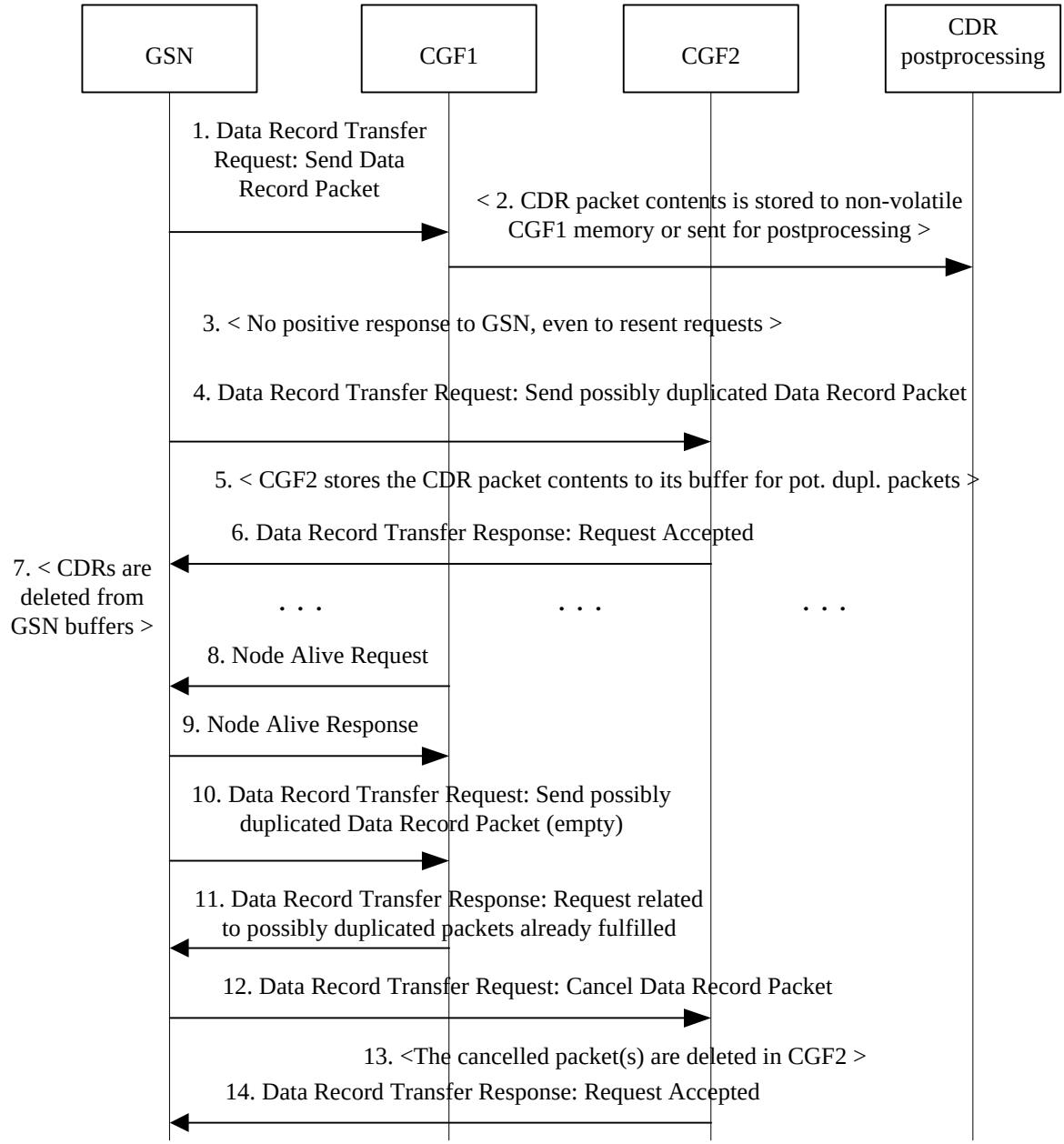

Figure 19: Duplicate prevention case: CDR sending via CGF1 had succeeded

1) The CDR generating entity (GSN) sends CDR(s) in a packet to CGF (that is the current primary Charging Gateway Functionality for the specific CDR generating node, "CGF1"). The sending is performed by using the Data Record Transfer Request message, with the Packet Transfer Command IE having the value ‘Send Data Record Packet’.

2) The CGF1 is able to store the packet sent by the GSN in a safe way (to e.g. a redundant RAM memory unit or a mirrored non-volatile memory or to another node).

3) Since the GSN-CGF1 communication connection is now broken, the GSN is not able to get the response "Request Accepted" as the Cause value in the Data Record Transfer Response message.

4) Then the GSN sends the same CDR packet that could not be sent to CGF1 to the next CGF in its CGF preference list (here CGF2) a Data Record Transfer Request message, with the Packet Transfer Command IE having the value 'Send possible duplicated Data Record Packet'. (That sending may be preceded by the testing of the GSN-CGF2 link by an Echo Request message, that the CGF2 would respond by the Echo Response.)

5) As the connection to CGF2 is working, CGF2 is able to process the CDR packet. Since the packet was marked by the sending GSN to be potentially duplicated, it is stored in CGF2, but not yet sent forward towards the post processing or Billing System.

6) The CGF2 sends confirmation of the successful packet reception to the GSN. The confirmation is performed by using the Data Record Transfer Response message, with the Cause value being 'Request Accepted'

7) The GSN can now delete the now successfully sent (potentially duplicated) CDRs from its CDR buffer (but it keeps the sequence number(s) of the sent potentially duplicated packet(s) in a buffer dedicated for that.

8) When CGF1 is recovering after a system reboot, it sends a Node Alive Request message to the configured peer GSN(s), and so the GSN notices that it can again successfully communicate with the CGF1. (The GSN may also detect this by using the Echo Request messages, which would be answered by CGF1 by the Echo Response message.)

9) GSN acknowledges the CGF1 by Node Alive Response message.

10) For the earlier unacknowledged Data Record Transfer Request message(s), the GSN sends CGF1 empty test packet(s) (with no CDR payload in the Data Record Packet IE but just the other parts of the message frame).

11) CGF1 responds with Data Record Transfer Response message, with the Cause value being 'Request related to possibly duplicated packets already fulfilled', because in this example case CGF1 had lost the communication capability towards GSN after storing the previously received (and by CGF1 unacknowledged) CDR packet.

12) Now GSN knows that the CGF1 had originally been able to process and forward the original version of the CDR packet from the GSN, and it indicates CGF2 that CGF2 can cancel the CDR packet(s) related to the previously unacknowledged GTP' GSN-CGF1 Sequence Number(s). Those packets' Sequence Numbers are indicated in the Sequence Numbers of the Cancelled Packets IE.

13) CGF2 shall now delete the cancelled packet(s) from its buffer for potentially duplicated packets.

14) CGF2 responds with Data Record Transfer Response message, with the Cause value being 'Request Accepted'.

After all the potentially duplicated packets are cleared form CGF(s), the GSN can continue in normal way the transfer of CDRs.

7.4 Data Record Formats used in GTP'

The format of the CDRs sent between the UMTS Network Elements that generate the PS domain CDRs and the CGF are defined by the Data Record Format of Data Record Packet information element. In addition to 1 standard format (ASN.1), there are private formats.

7.4.1 ASN.1 format

See clause 6 and the ASN.1 language descriptions for the definitions. Basic Encoding Rules (BER) provides the transfer syntax for abstract syntax defined in ASN.1. The Data Record Format code for ASN.1 is 1.

7.4.2 Other formats

The physical CDR format can also be a private one. The Data Record Format identifiers 11...50 (decimal) are reserved for private (implementation specific) use.

7.5 CGF - BS Protocol Interface

7.5.1 The transfer protocols at CGF - BS interface

The present document gives several recommendations for the main protocol layers for the Charging Gateway Functionality - Billing System (BS) interface protocol stack. These recommendations are not strictly specified features, since there are a lot of variations among the existing Billing Systems. The recommendations are FTAM protocol on X.25 or TCP/IP, and FTP over TCP/IP.

7.5.2 The format of the CDRs at CGF - BS interface

The contents of the CDRs sent between the CGF and the Billing System (BS) are defined by the ASN.1 language clause 6, Charging Data Record Structure. Other CDR contents or formats are possible if the CGF provides processing functionality for the CDRs.

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 preconfigured 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) 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 Table below is an informative example intended for clarification.

Table 14: Charging Characteristics table

	S-CDR					G-CDR	
Profile Index bits 1,2,3,4	Active	Timelimit	Volumelimit	Changecond	Tarifftimes	Active	…
0	yes	30 min	100 K	2	0-7, 7-12, …		
1	No	-	-	-	-		
2	Yes	10 min	50 K	1	0-24		
..	..	..	..	..	..		

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 preconfigured 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. The first four bits shall be used to select 1 out of 16 possible 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.

plus 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.

The remaining 12 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 preconfigured SMSC addresses.
- Disable G-CDRs for roamers that use the HPLMN GGSN.
- Tbd

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.

Annex B (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
May 2001			-		Transferred from 3GPP 32.015 v3.5.0.	-	1.0.0
Jun 2001	S_12	SP-010236	-		Submitted to TSG SA #12 for Information	1.0.0	1.0.1

3GPP TS 32.235 V1.0.1 (2001-06)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group;
Charging Management;
Charging Data Description for Application services;
(Release 4)

Keywords
MMS, Application charging

3GPP

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Contents

Foreword

This Technical Specification 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.

1 Scope

This document is part of a series of documents specifying charging functionality in UMTS network with application services. The UMTS core network charging principles are specified in document TS 32.200 [2] which provides an umbrella for other charging documents that specify the structure and content of the CDRs and the interface protocol that is used to transfer them to the collecting node. The document structure is defined in figure 1. The CDR content and transport for application services are described in the present document especially for MMS. As the basis and reference for this work is taken the functional description of the MMS specified for stage 1 in TS 22.140[3] and stage 2 in TS 23.140[4].

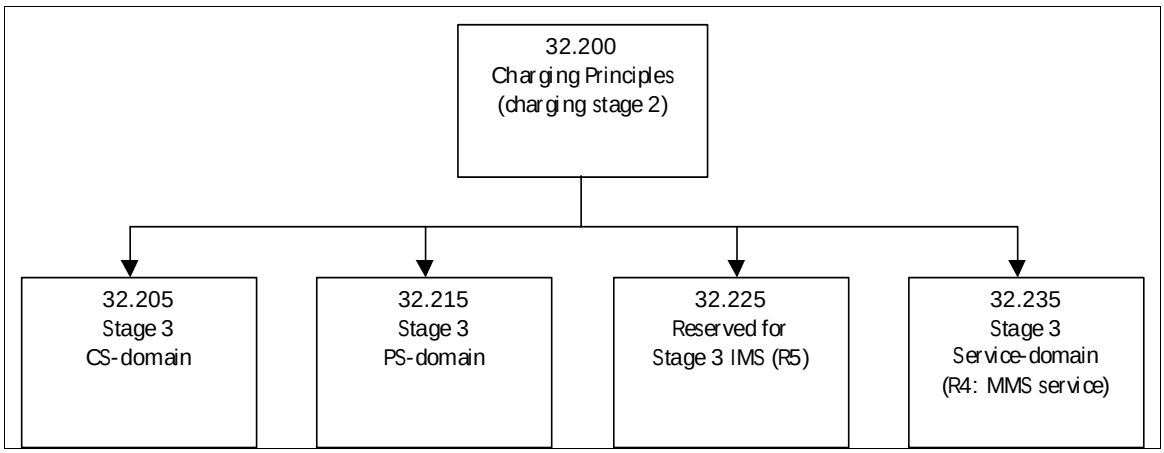

Figure 1 Charging Document Structure

All references, abbreviations, definitions, descriptions, principles and requirements that are common are defined in the 3GPP Vocabulary [1] and specialised to charging in UMTS domains or subsystems are provided in the umbrella document [2].

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.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 32.200: “Charging Principles”.

[3] 3GPP TS 22.140: "Multimedia Messaging Service, Stage 1".

[4] 3GPP TS 23 140: “Multimedia Messaging Service (MMS), Functional Description, Stage 2”.

[5] STD 11 (RFC 822) Internet Message Standard Format, IETF.

[6] RFC 2046 Multipurpose Internet Mail extension (MIME) Part Two: Media Types, IETF.

[7] 3GPP TR 23.039: “Interface protocols for the connection of Short Message Service Centres (SSMCs) to Short Message Entities (SMEs)”

[8] "The Unicode Standard", Version 2.0, Unicode Consortium, Addision-Wesley Dev. Press, 1996.

[9] US-ASCII: "Coded Character Set 7 Bit; American Standard Code for Information Interchange"; ANSI X3.4, 1986.

[10] ISO-8859-1 (1987): "Information Processing - 8-bit Single-Byte Coded Graphic Character Sets; Part 1: Latin Alphabet No. 1".

[11] RFC 2279, "UTF-8, A Transformation format of ISO 10646", IETF.

[12] 3GPP TS 26.090: "AMR Speech Codec Speech Transcoding Functions".

[13] Internet draft “ RTP payload format for AMR”; IETF
URL: http://search.ietf.org/internet-drafts/draft-ietf-avt-rtp-amr-03.txt

[14] MP3, MPEG1-Audio ISO/IEC 11172-3, MPEG2-Audio ISO/IEC 11172-3.

[15] MIDI SDS, International Midi Association, 5316 West 57th Street, Los Angeles, CA 90056, (415) 321-MIDI.

[16] WAV: Waveform Audio File Format, MIME Sub-type Registration www.ietf.org

[17] ITU-T Recommendation T.81 | ISO/IEC 10918-1:1992, “Information Technology - Digital Compression and Coding of Continuous-Tone Still Images - Requirements and Guidelines”.

[18] Graphics Interchange Format (Version 89a), Compuserve, Inc., Columbus, Ohio, 1990.

[19] 3GPP TS 26.234: "Packet-switched Streaming Service (PSS); Protocols and Codecs".

[20] ISO/IEC 14496-1 (1999): Information Technology - Generic Coding of Audio-Visual Objects - Part 1: Systems. ISO/IEC 14496-2 (1999): Information Technology - Generic Coding of Audio-Visual Objects - Part 2: Visual.

[20] ITU-T Recommendation H.263 (1998): "Video coding for low bit rate communication".

[21] 3GPP TR 26.911: "Codec(s) for Circuit Switched Multimedia Telephony Service; Terminal Implementor’s Guide".

[22] Quick-Time. URL: http://www.apple.com.

[23] STD 10 (RFC 821) "Simple Mail Transfer Protocol", IETF.

[24] Tag Image File Format (TIFF) Version 6: Adobe Systems, http://www.adobe.com.

[25] 3GPP TS 32.205: "Charging Data Description for the Circuit Switched (CS) domain".

[26] 3GPP TS 32.215: "Charging Data Description for the Packet Switched (PS) domain".

[27] GSM 12.01: "Digital cellular telecommunication system (Phase 2); Common aspects of GSM Network Management (NM)".

[28] IETF RFC 959: "File Transfer Protocol (FTP)"; October 1985, J. Postel, J. Reynolds, ISI.

[29] IETF RFC 783: "Trivial File Transfer Protocol (TFTP)"; rev. 2, June 1981, K.R. Sollins MIT.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply in addition to those defined in 3GPP TR 21.905 [1] and 3GPP TS 22.140 [3]:

MMSE: A collection of MMS-specific elements under the control of a single administration.

MMS Relay/Server: An MMS-specific network entity/application that is under the control of an MMS service provider. An MMS Relay/Server transfers messages, provides operations of the MMS that are specific to or required by the mobile environment and provides (temporary and/or persistent) storage services to the MMS.

MMS User Agent: An application residing on a UE, an MS or an external device that performs MMS-specific operations on a user's behalf. An MMS User Agent is not considered part of an MMSE.

Originator MMS User Agent: An MMS User Agent associated with the sender of an MM.

Recipient MMS User Agent: An MMS User Agent associated with the recipient of an MM.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply in addition to those defined in [1] and [2] :

MIME	Multipurpose Internet Mail Extensions
MM	Multimedia Message
MMS	Multimedia Messaging Service

4 Record Description

Two types of CDRs can be generated in the service domain for MMS by the MMS Relay/Servers. As described in document 32.200 [2], the types that can be generated by the MMS Relay/Server are: MMSO-CDR and MMSR-CDR. The content of each CDR type is defined in one of the two tables that are part of this section. For each CDR type the field definition includes the field name, description and category.

The following tables describe the contents of each of the charging data records generated by the MMS Relay/Server (see the example scenarios in TS 23.140[4]). For each CDR type the field definition includes the field name, description and category..

The category field has the following meaning:

M This field is mandatory and always present in the CDR.

C This field is only present in the CDR under certain conditions. These conditions are individually described for every applicable parameter.

O_M This field is a mandatory parameter that can be configured by the EM to be always present or always absent in the CDRs. In other words, a O_M parameter that is configured to be present will behave like a mandatory parameter. For the avoidance of doubt, optional does not mean that the parameter is not supported by the network element. Equipment manufacturers shall be capable of providing all of these fields in order to claim conformance with this document.

O_C This field is a conditional parameter that can be configured by the EM to be conditionally present or always absent in the CDRs. In other words, an O_C parameter that is configured to be present will

behave like a conditional parameter. For the avoidance of doubt, optional does not mean that the parameter is not supported by the network element. Equipment manufacturers shall be capable of providing all of these fields in order to claim conformance with this document.

The Mandatory (M), Conditional (C) and Optional (O_M and O_C) designations are described at the MMS interface(i.e. MM4). The MMS Relay/Server shall also be able to provide the CDRs at the BS interface in the format and encoding described in the present document. Additional CDR formats and contents, generated by the MMS Relay/Server, may be available at the BS interface to meet the Billing System (BS) requirements.

4.1 Service record for originating MMS (MMSO-CDR)

If enabled, an MMSO-CDR mobile originated MMS record shall be produced for each originating MM sent by a mobile user agent via the MMS Relay/Server.

Table 1: Mobile originated MMS record (MMSO-CDR)

Field	Category	Description
Record Type	M	Mobile Originated MMS.
MMS Relay Address	M	The IP address of the MMS Relay/Server of the originated MM.
Message ID	M	The MM identification provided by the originator MMS Relay/Server.
Originator address	M	The address of the originator MMS user agent of the original MM, i.e. the recipient of the read-reply report.
Recipient(s) address	M	The address(es) of the recipient(s) MMS user agent of the original MM, i.e. the originator of the read-reply report. Multiple addresses are possible. Note: a multiple group may be addressed.
Content type	M	The content type of the MM content.
Message type	M	The category of the MM.
Message class	M	The class selection such as personal, advertisement, information service.
Message size	M	The approximate size of the MM.
ChargeInformation	C	The charge indication and charging type.
Submission Time	M	The time at which the MM was submitted from the originator MMS user agent.
Delivery Time	M	The time at which the MM was delivered to the recipient MMS user agent.
Time of Expiry	C	The desired duration of time prior to expiry for the MM or reply-MM if specified by the originator MMS user agent.
DurationOfTransmission	O_M	The time used for transmission of the MM.
DurationOfStorage	O_M	The storage time of the MM in the MMS Relay/Server.
DeliveryType	O_M	The status code of the delivered MM.
DeliveryResult	C	The status of the delivered MM if requested.
StatusCode	O_M	This field includes a more detailed technical status of delivering the message

4.2 Service record for recipient MMS (MMSR-CDR)

If enabled, an MMSR-CDR mobile recipient MMS record shall be produced for each terminating MM sent by a mobile user agent via the MMS Relay/Server.

Table 2: Mobile recipient MMS record (MMSR-CDR)

Field	Category	Description
Record Type	M	Mobile Recipient MMS.
MMS Relay Address	M	The IP address of the current MMS Relay/Server of the recipient MM.
Message ID	M	The MM identification delivered by the originator MMS Relay/Server.
Originator address	M	The address of the originator MMS user agent of the original MM, i.e. the recipient of the read-reply report.
Recipient address	M	The address of the recipient MMS user agent of the original MM, i.e. the originator of the read-reply report. Multiple addresses are possible. Note: a multiple group may be addressed.
Content type	M	The content type of the MM content.
Message type	M	The category of the MM.
Message class	M	The class selection such as personal, advertisement, information service.
Message size	M	The approximate size of the MM.
ChargeInformation	C	The charge indication and charging type.
Submission Time	M	The time at which the MM was submitted from the originator MMS user agent.
Delivery Time	M	The time at which the MM was received by the recipient MMS user agent.
Time of Expiry	C	The desired duration of time prior to expiry for the MM or reply-MM if specified by the originator MMS user agent.
DurationOfTransmission	O_M	The time used for transmission of the MM.
DurationOfStorage	O_M	The storage time of the MM in the MMS Relay/Server.
DeliveryRequest	C	The indication for the delivery request

5 Parameter Description

5.1 Charge Information

This field consists of two parts, the charge indicator and the charge type. The charge indicator (charge/no charge) should be defined by the MMS Relay/Server.
An originator of the MMS may be take over the charge for the sending of a reply-MM to their submitted MM from the recipient(s). Therefore the originator MM should mark the MM as no charge (reply-charged). The originator's MMSE could either accept the user's settings for charge type 'reply' or not.

5.2 Content Type

Multiple media elements shall be combined into a composite single MM using MIME multipart format as defined in RFC 2046 [6]. Content-type maps directly since both are defined as being MIME content types.
The content type of the message from the external server should be mapped to an appropriate MIME type/subtype and attached to the MM. (e.g. SMS via 3GPP TR 23.039[7] -> MM with text/plain).
The media type of a single MM element shall be identified by its appropriate MIME type whereas the media format shall be indicated by its appropriate MIME subtype.
In order to guarantee a minimum support and compatibility between multimedia messaging capable terminals, the following media formats shall be at least supported.
To ensure interoperability with formats widely used e.g. in the internet community the support of the following formats or codecs is suggested:

The CB rapporteur group hereby request that the above four documents be approved by SA5 for forwarding to SA#12 for information.

1. Text types

Minimum supported set of:

- plain text. Any character encoding (charset) that contains a subset of the logical characters in Unicode [8] shall be used (e.g. US-ASCII [9], ISO-8859-1[10], UTF-8[11], Shift_JIS, etc.).

Unrecognised subtypes of "text" shall be treated as subtype "plain" as long as the MIME implementation knows how to handle the charset.

2. Image type

Minimum supported set of:

- Baseline JPEG [17].

Suggested format/codec for media type Image:

- GIF 89a [18].
- TIFF[24]
- ...

3. Audio types

Minimum supported set of:

- AMR [12]; organised in the Bitstream Syntax as proposed by the IETF [13]

Suggested formats/codecs for media type Audio:

- MP3 [14]
- MIDI [15]
- WAV [16].
- ...

4. Video types

Suggested formats/codecs :

- MPEG 4 (Visual Simple Profile, Level 1) [20] according to the restrictions specified in 3GPP TS 26.911 [21]
- ITU-T H.263 [22]
- Quicktime [23]
- ...

To ensure interoperability for the transport of speech, audio and/or video media associated with an MM, the MP4 file format shall be supported. The usage of the MP4 file format shall follow the technical specifications and the implementation guidelines specified in 3GPP TS 26.234 [19]. (NOTE:This TS specifies a mechanism for the registration of AMR and H.263 codestreams to be included in MP4 files.)

5. Application type

Any other unrecognised subtype and unrecognised charset which aren’t handled as “text/plain” shall be treated as "application/octet - stream".

5.3 Delivery Request/Delivery Result

This is the indication in the MMSR-CDR of the recipient MMS User Agent that a delivery report is requested if such a delivery report has been requested by the originator MMS User Agent. This field in the MMSO_CDR contains the result of the MM delivery to the recipient.

5.4 Delivery Time

The delivery time field contain the time stamps relevant for the handling of the MM by the recipient MMS Relay/Server (read, deleted without being read, etc.). The time-stamp include a minimum of date, hour, minute and second.

5.5 Delivery Type

This field contains an appropriate status value to the delivered MM.

5.6 Duration of Transmission/Storage

These fields contains the relevant time in seconds. The Duration of Transmission is the time from the begin to the end of the MM transfer e.g. for streaming purposes. The Duration of storage is the time there the message is temporary and/or persistent stored in the MMS Relay/Server.

5.7 Message ID

The MMS Relay/Server shall provide a message identification for a message, which it routed forward or has accepted for delivery. The MM Message-ID is not directly mapped to a corresponding STD 11 [5] “Message-ID:” header. Each STD 11 message must have a unique message id, which is carried in the “Message-ID:” header.

5.8 Message Class

A class of message such as personal, advertisement, information service etc. For more information see TS 23.140[4].

5.9 Message Size

The message size includes the number of octets during the MM transmission.

5.10 Message Type

A type that consists of one of the following four choises: notification, message MM, delivery report, read-reply.

5.11 MMS Relay Address

This field contains the IP address of the MMS Relay/Server which is generated the message ID.

5.12 MMS Result

The MMS Result shall carry the status of the MM delivery, e.g. retrieved, rejected, expired or indeterminate.

5.13 Originator Address/Recipient Address

These fields contains the originator /recipient MMS user agent address. The MMS support the use of E-Mail addresses (RFC 822) [5] or MSISDN (E.164) or both.

5.14 Record Type

The field identifies the type of the record , e.g. MMSO-CDR and MMSR-CDR.

5.15 Status Code

This field includes a more detailed technical status for delivery of the message and may contain one of the following causes:

- cause for termination refer TS 32.205[25]
- cause for record closing refer TS 32.215[26].

The status code is also extended by MMS specific information.

5.16 Submission Time

The submission time field contain the time stamps relevant for the submission of the MM. The time-stamp include a minimum of date, hour, minute and second.

5.17 Time of Expiry

This filed contains the desired duration of expiry for the MM if specified by the originator MMS User Agent. In case of reply-charging the time of expiry is the latest time of submission of a reply-MM.

6 Charging Data Record Structure

6.1 ASN.1 definitions for CDR information

The ASN.1 definitions are based on the charging specific data types within the current 3GPP 32-series, the TS 32.205 for CS domain[25] and TS 32.215 for PS domain[26].

```
TS32235-DataTypes {itu-t (0) identified-organization (4) etsi(0) mobileDomain (0) umts-
Operation-Maintenance (3) ts-32-235 (235) informationModel (0) asn1Module (2) version1 (1)}

DEFINITIONS IMPLICIT TAGS   ::=

BEGIN

-- EXPORTS everything

IMPORTS

ChargeIndicator, CallDuration, TimeStamp, MSISDN
FROM TS32205-DataTypes {itu-t (0) identified-organization (4) etsi(0) mobileDomain (0) umts-
Operation-Maintenance (3) ts-32-205 (205) informationModel (0) asn1Module (2) version1 (1)}
--
-- see TS 32.205[25]
--

ChargingID, IPAddress
FROM TS32215-DataTypes {itu-t (0) identified-organization (4) etsi (0) mobileDomain (0) umts-
Operation-Maintenance (3) ts-32-215 (215) informationModel (0) asn1Module (2) version1 (1)}
--
-- see TS 32.215[26]
--


ManagementExtension
FROM Attribute-ASN1Module {joint-iso-ccitt ms(9) smi(3) part2 (2) asn1Module(2) 1};

-------------------------------------------------------------------------------
--
--  CALL AND EVENT RECORDS
--
-------------------------------------------------------------------------------

CallEventRecord ::= CHOICE
--
-- Record values 0..16 are 3G curcuit switch specific
--               20..24 are 3G packet switch specific
--               30..31 are application specific
--
{
    moCallRecord            [0] MOCallRecord,
    mtCallRecord            [1] MTCallRecord,
    roamingRecord           [2] RoamingRecord,
    incGatewayRecord        [3] IncGatewayRecord,
    outGatewayRecord        [4] OutGatewayRecord,
    transitRecord           [5] TransitCallRecord,
```

```
    moSMSRecord             [6] MOSMSRecord,
    mtSMSRecord             [7] MTSMSRecord,
    moSMSIWRecord           [8] MOSMSIWRecord,
    mtSMSGWRecord           [9] MTSMSGWRecord,
    ssActionRecord          [10] SSActionRecord,
    hlrIntRecord            [11] HLRIntRecord,
    locUpdateHLRRecord      [12] LocUpdateHLRRecord,
    locUpdateVLRRecord      [13] LocUpdateVLRRecord,
    commonEquipRecord       [14] CommonEquipRecord,
    recTypeExtensions       [15] ManagementExtensions,
    termCAMELIntRecord      [16] TermCAMELIntRecord,

    sgsnPDPRecord           [20] SGSNPDPRecord,
    ggsnPDPRecord           [21] GGSNPDPRecord,
    sgsnMMRecord            [22] SGSNMMRecord,
    sgsnSMORecord           [23] SGSNSMORecord,
    sgsnSMTRecord           [24] SGSNSMTRecord,

    mmsORecord              [30] MMSORecord,
    mmsRRecord              [31] MMSRRecord
}

MMSORecord  ::= SET
{
    recordType              [0] CallEventRecordType,
    mmsRelayAddress         [1] IPAddress,
    messageID               [2] ChargingID,
    orinatorAddress         [3] MMSAgentAddress,
    recipientAddress        [4] MMSAgentAddresses,
    contentType             [5] ContentType,
    messageSize             [6] DataVolume,
    messageType             [7] MessageType,
    messageClass            [8] MessageClass,
    chargeInformation       [9] ChargeInformation OPTIONAL,
    submissionTime          [10] TimeStamp,
    deliveryTime            [11] TimeStamp,
    timeOfExpiry            [12] INTEGER OPTIONAL,
    durationOfTransmission  [13] INTEGER OPTIONAL,
    durationOfStorage       [14] INTEGER OPTIONAL,
    deliveryType            [15] DeliveryType OPTIONAL,
    deliveryResult          [16] BOOLEAN OPTIONAL,
    statusCode              [17] StatusCode
}

MMSRRecord  ::= SET
{
    recordType              [0] CallEventRecordType,
    mmsRelayAddress         [1] IPAddress,
    messageID               [2] ChargingID,
    originatorAddress       [3] MMSAgentAddress,
    recipientAddress        [4] MMSAgentAddresses,
    contentType             [5] ContentType,
    messageSize             [6] DataVolume,
    messageType             [7] MessageType,
    messageClass            [8] MessageClass,
    chargeInformation       [9] ChargeInformation OPTIONAL,
    submissionTime          [10] TimeStamp,
    deliveryTime            [11] TimeStamp,
    timeOfExpiry            [12] INTEGER OPTIONAL,
    durationOfTransmission  [13] INTEGER OPTIONAL,
    durationOfStorage       [14] INTEGER OPTIONAL,
    deliveryRequest         [15] BOOLEAN OPTIONAL
}

-------------------------------------------------------------------------------
--
--  COMMON DATA TYPES
--
-------------------------------------------------------------------------------


ApplicationType         ::= ENUMERATED
{
    octetstream         (0)
    --
    -- Any other unrecognised subtype and unrecognised charset
    -- shall be treated as "application/octet - stream".
    --
```

```
}

AudioType           ::= ENUMERATED
{
    amr             (0),    -- AMR; organised in the Bitstream Syntax
    mp3             (1),    -- MP3
    midi            (2),    -- MIDI
    wav             (3)     -- WAV
}

ChargeInformation   ::= SEQUENCE
{
    chargeindication        [0] ChargeIndicator,
    chargetype              [1] ChargeType
}

ChargeType          ::= ENUMERATED
{
    normal                  (0),
    pre-paid                (1),
    reply                   (2),
    third-party-financed    (3)
}

ContentType         ::= SEQUENCE
{
    text-plain          [0] TextType,
    image               [1] ImageType,
    audio               [2] AudioType,
    video               [3] VideoType,
    application         [4] ApplicationType
}

DataVolume          ::= INTEGER
    --
    -- The volume of data transfered in octets.
    --
DeliveryType        ::= ENUMERATED
{
    retrieved       (0),
    forwarded       (1),
    expired         (2),
    rejected        (3),
    deferred        (4),
    unrecognised    (5)
}

ImageType           ::= ENUMERATED
{
    jpeg            (0),    -- Baseline JPEG
    gif             (1)     -- GIF 89a
}

MessageType     ::= ENUMERATED
{
    notification        (0),
    message-MM          (1),
    delivery-report     (2),
    read-reply          (3)
}

MessageClass        ::= ENUMERATED
{
    personal            (0),
    advertisement       (1),
    information-service (2)
}


MMSAgentAddress     ::= SEQUENCE
{
    iPAddress       [0] IPAddress,
    mSISDN          [1] MSISDN OPTIONAL
}

MMSAgentAddresses   ::= SET OF MMSAgentAddress

StatusCode  ::= INTEGER
```

```
{
    --
    -- cause codes 0 to 15 are defined in TS 32.205[25] as 'CauseForTerm'
    -- (cause for termination) and cause code 16 to 20 are defined
    -- in TS 32.215 [26] as 'CauseForRecClosing'
    --
    normalRelease               (0),    -- ok
    abnormalRelease             (4),    -- error unspecified
    servicedenied               (30),
    messageformatcorrupt        (31),
    sendingaddressunresolved    (32),
    messagenotfound             (33),
    networkproblem              (34),
    contentnotaccepted          (35),
    unsupportedmessage          (36)
}

TextType            ::= ENUMERATED
{
    plaintext       (0)
    --
    -- Any character encoding (charset) that contains a subset of the logical characters
    -- in Unicode shall be used (e.g. US-ASCII, ISO-8859-1, UTF-8, Shift_JIS, etc.).
    --
}

VideoType           ::= ENUMERATED
{
    mp4             (0),    -- MP4 file format used
    mpeg4           (1),    -- MPEG 4 (Visual Simple Profile, Level 1)
    h263            (2),    -- ITU-T H.263
    quicktime       (3)     -- Quicktime
}

END
```

7 Charging Data Record Transfer

The generated MMS-CDR in the MMS Relay/Server shall be transferred to the Billing System by the use of FTAM protocol on X.25 or TCP/IP, or FTP or TFTP over TCP/IP. For further details of the use of FTAM see GSM 12.01 [27] and of the use of FTP see [28] and TFTP see [29].

Annex A (informative): Change history

This annex lists all change requests approved for this document since the specification was first approved by 3GPP TSG-SA.

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
May 2001			-		Result of the SA5#20 plenary.	-	1.0.0
Jun 2001	S_12	SP-010236	-		Submitted to TSG SA #12 for Information	1.0.0	1.0.1