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Universal Mobile Telecommunications System (UMTS);
LTE;
Telecommunication management;
Charging management;
Charging Data Record (CDR) file format and transfer
(3GPP TS 32.297 version 16.2.0 Release 16)**



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Foreword

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1 Scope

The present document is part of a series of Technical Specifications (TSs) that specify charging functionality and charging management in 3GPP networks. The 3GPP core network charging architecture and principles are specified in TS 32.240 [1], which provides an umbrella for other charging management TSs that specify:

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

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

The present document specifies file based mechanism used to transfer the CDRs from the network to the operator's billing domain (e.g. the post-processing system or a mediation device).

The present document is related to other 3GPP charging TSs as follows:

- The common 3GPP charging architecture is specified in TS 32.240 [1];
- The parameters, abstract syntax and encoding rules for the CDRs are specified in TS 32.298 [51];
- A transaction based mechanism for the transfer of CDRs within the network is specified in TS 32.295 [54].
- The 3GPP Diameter application that is used for offline and online charging is specified in TS 32.299 [50].
- The services, operations and procedures of charging, using Service Based Interface are specified in TS 32.290 [57].
- The charging service of 5G system is specified in TS 32.291 [58].

All terms, definitions and abbreviations used in the present document, that are common across 3GPP TSs, are defined in the 3GPP Vocabulary, TR 21.905 [100]. Those that are common across charging management in 3GPP domains services, or subsystems are provided in the umbrella document TS 32.240 [1] and are copied into clause 3 of the present document for ease of reading. Finally, those items that are specific to the present document are defined exclusively in the present document.

Furthermore, requirements that govern the charging work are specified in TS 22.115 [101].

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 32.240: "Telecommunication management; Charging management; Charging architecture and principles".
- [2] - [9] Void.
- [10] 3GPP TS 32.250: "Telecommunication management; Charging management; Circuit Switched (CS) domain charging".
- [11] 3GPP TS 32.251: "Telecommunication management; Charging management; Packet Switched (PS) domain charging".
- [12] Void.
- [13] 3GPP TS 32.253: "Telecommunication management; Charging management; Control Plane (CP) data transfer domain charging".
- [14] 3GPP TS 32.254: "Telecommunication management; Charging management; Exposure function Northbound Application Program Interfaces (APIs) charging".
- [15] 3GPP TS 32.255: "Telecommunication management; Charging management; 5G Data connectivity domain charging; stage 2".
- [16] 3GPP TS 32.256: "Charging management; 5G connection and mobility domain charging; Stage 2".
- [17] - [19] Void
- [20] 3GPP TS 32.260: "Telecommunication management; Charging management; IP Multimedia Subsystem (IMS) charging".
- [21] - [29] Void.
- [30] 3GPP TS 32.270: "Telecommunication management; Charging management; Multimedia Messaging Service (MMS) charging".
- [31] 3GPP TS 32.271: "Telecommunication management; Charging management; Location Services (LCS) charging".
- [32] 3GPP TS 32.272: "Telecommunication management; Charging management; Push-to-talk over Cellular (PoC) charging".
- [33] 3GPP TS 32.273: "Telecommunication management; Charging management; Multimedia Broadcast and Multicast Service (MBMS) charging".
- [34] 3GPP TS 32.274: "Telecommunication management; Charging management; Short Message Service (SMS) charging".
- [35] 3GPP TS 32.275: "Telecommunication management; Charging management; Multimedia Telephony (MMTel) charging".
- [36] Void.

- [37] 3GPP TS 32.277: "Telecommunication management; Charging management; Proximity-based Services (ProSe) Charging".
- [38] 3GPP TS 32.278: "Telecommunication management; Charging management; Monitoring Event charging".
- [39] - [49] Void.
- [50] 3GPP TS 32.299: "Telecommunication management; Charging management; Diameter charging application".
- [51] 3GPP TS 32.298: "Telecommunication management; Charging management; Charging Data Record (CDR) encoding rules description".
- [52] Void.
- [53] 3GPP TS 32.296: "Telecommunication management; Charging management; Online Charging System (OCS) applications and interfaces".
- [54] 3GPP TS 32.295: "Telecommunication management; Charging management; Charging Data Record (CDR) transfer".
- [55] - [56] Void.
- [57] 3GPP TS 32.290: "Telecommunication management; Charging management; 5G system; Services, operations and procedures of charging using Service Based Interface (SBI)".
- [58] 3GPP TS 32.291: "Telecommunication management; Charging management; 5G system; Charging service, stage 3".
- [59] - [99] Void.
- [100] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [101] 3GPP TS 22.115: "Service aspects; Charging and billing".
- [102] - [199] Void.
- [200] 3GPP TS 23.078: "Customised Applications for Mobile network Enhanced Logic (CAMEL); Stage 2".
- [201] 3GPP TS 32.341: "Telecommunication management; File Transfer (FT) Integration Reference Point (IRP); Requirements".
- [202] 3GPP TS 32.342: "Telecommunication management; File Transfer (FT) Integration Reference Point (IRP); Information Service (IS)".
- [203] 3GPP TS 32.343: "Telecommunication management; File Transfer (FT) Integration Reference Point (IRP); Common Object Request Broker Architecture (CORBA) Solution Set (SS)".
- [204] 3GPP TS 32.344: "Telecommunication management; File Transfer (FT) Integration Reference Point (IRP); Common Management Information Protocol (CMIP) Solution Set (SS)".
- [205] - [299] Void
- [300] 3GPP TS 28.201: "Charging management; Network slice performance and analytics charging in the 5G System (5GS); Stage 2".
- [301] 3GPP TS 28.202: "Charging management; Network slice management charging in the 5G System (5GS); Stage 2
- [302] - [399] Void
- [400] IETF RFC 959 (1985): "File Transfer Protocol".
- [401] ATIS-PP-0300075.1.200X "Usage Data Management for Packet-Based Services - Service Neutral Protocol Specification for Billing Applications"

- [402] IPDR "IPDR/File Transfer Protocol".
- [403] IPDR "IPDR/SP Protocol Specification".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [100], TS 32.240 [1] and the following apply:

Billing Domain: part of the operator network, which is outside the telecommunication network that receives and processes charging information from the core network charging functions. It includes functions that can provide billing mediation and billing or other (e.g. statistical) end applications. It is only applicable to offline charging (see "Online Charging System" for equivalent functionality in online charging).

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

Charging Data Record (CDR): formatted collection of information about one or more chargeable event(s) (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 the chargeable event(s) a separate CDR is 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.

charging function: entity inside the core network domain, subsystem or service that is involved in charging for that domain, subsystem or service.

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

domain: part of the 3GPP telecommunication network that provides network resources using a certain bearer technology.

GPRS: packet switched bearer and radio services for GSM and UMTS systems.

middle tier TS: term used for the 3GPP charging TSs that specify the domain / subsystem / service specific, online and offline, charging functionality. These are all the TSs in the numbering range from TS 32.250 [10] to TS 32.27x [3x]; e.g. TS 32.250 [10] for the CS domain, or TS 32.270 [30] for the MMS service. Currently, there is only one "tier 1" charging TS in 3GPP, which is TS 32.240 [1] that specifies the charging architecture and principles. Finally, there are a number of top tier charging TSs in the 32.29x [5x] numbering range that specify common charging aspects such as parameter definitions, encoding rules, the common billing domain interface or common charging applications.

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

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

online charging: charging mechanism where charging information **can** affect, in real-time, the service rendered and therefore a direct interaction of the charging mechanism with session/service control is required.

packet switched domain: domain in which data is transferred between core network elements.

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

3.2 Symbols

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

| | |
|-----|--|
| Bam | Reference point for the CDR file transfer from the 5G connection and mobility CGF to the BD. |
| Bc | Reference point for the CDR file transfer from the Circuit Switched CGF to the BD. |
| Bcp | Reference point for the CDR file transfer from the CP data transfer CGF to the BD. |
| Bd | Reference point for the CDR file transfer from the 5G Data Connectivity CGF to the BD. |
| Bea | Reference point for the CDR file transfer from the Exposure function API CGF to the BD. |

| | |
|-----|---|
| Bi | Reference point for the CDR file transfer from the IMS CGF to the BD. |
| Bl | Reference point for the CDR file transfer from the GMLC CGF to the BD. |
| Bm | Reference point for the CDR file transfer from the MMS CGF to the BD. |
| Bmb | Reference point for the CDR file transfer from the MBMS CGF to the BD. |
| Bmn | Reference point for the CDR file transfer from the Monitoring Event CGF to the BD. |
| Bns | Reference point for the CDR file transfer from the Network slice CGF to the BD. |
| Bo | Reference point for the CDR file transfer from the OCF CGF to the BD. |
| Bp | Reference point for the CDR file transfer from the Packet Switched CGF to the BD. |
| Bpr | Reference point for CDR file transfer between ProSe CGF and the BD. |
| Bs | Reference point for the CDR file transfer for CAMEL services to the BD, i.e. from the SCF CGF to the BD. |
| Bsm | Reference point for the CDR file transfer from SMS CGF to the BD |
| Bt | Reference point for the CDR file transfer from the PoC CGF to the BD. |
| Bw | Reference point for the CDR file transfer from the WLAN CGF to the BD (discontinued in Release 12). |
| Bx | Reference point for CDR file transfer between any (generic) 3G domain, subsystem or service CGF and the BD. |
| Ga | Reference point for CDR transfer between a CDF and the CGF. |
| Rf | Offline Charging Reference Point between the CTF within a 3G network entity and the CDF. |

3.3 Abbreviations

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

| | |
|---------|---|
| bcd | binary coded decimal |
| BD | Billing Domain |
| CAMEL | Customised Applications for Mobile network Enhanced Logic |
| CDF | Charging Data Function |
| CDR | Charging Data Record |
| CGF | Charging Gateway Function |
| CP | Control Plane |
| CS | Circuit Switched |
| CTF | Charging Trigger Function |
| EPS | Evolved Packet System |
| E-UTRAN | Evolved Universal Terrestrial Radio Access Network |
| FTP | File Transfer Protocol |
| GMLC | Gateway MLC |
| GPRS | General Packet Radio Service |
| IMS | IP Multimedia Subsystem |
| IP | Internet Protocol |
| IPDR | Internet Protocol Detail Record |
| I-WLAN | Interworking WLAN |
| LAN | Local Area Network |
| MBMS | Multimedia Broadcast/Multicast Service |
| MLC | Mobile Location Center |
| MMS | Multimedia Messaging Service |
| OAM&P | Operation, Administration, Maintenance and Provisioning |
| OCF | Online Charging Function |
| OCS | Online Charging System |
| PoC | Push-to-talk over Cellular |
| ProSe | Proximity-based Services |
| PS | Packet Switched |
| SCF | Service Control Function |
| SMS | Short Message Service |
| UTC | Universal Time Coordinated |
| WLAN | Wireless LAN |

4 Architecture considerations

"Bx" is a common designator for the reference points from the network to the Billing Domain (BD) that are intended for the transport of CDR files. The letter "x" indicates the different 3GPP network domain, subsystem or service, where

- am represents 5G connection and mobility in TS 32.256 [16],
- c represents Circuit Switched (CS) in TS 32.250 [10],
- cp represents Control Plane data transfer (CP) in TS 32.253 [13],
- d represents 5G Data Connectivity in TS 32.255 [15],
- ea represents Exposure function API in TS 32.254 [14],
- i represents IP Multimedia Subsystem (IMS) in TS 32.260 [20],
- l represents Location Service (LCS) in TS 32.271 [31],
- m represents Multimedia Messaging Service (MMS) in TS 32.270 [30],
- mb represents Multimedia Broadcast/Multicast Service (MBMS) in TS 32.273 [33],
- ns represents Network Slice in TS 28.201 [300] and TS 28.202 [301],
- o represents the Online Charging System (OCS) in TS 32.296 [53],
- p represents Packet Switched (PS) in TS 32.251 [11],
- pr represents Proximity-based Services (ProSe) in TS 32.277 [37],
- s represents the CAMEL SCF in TS 23.078 [200],
- sm represents Short MessageService (SMS) in TS 32.274 [34],
- t represents the PoC service (PoC) in TS 32.272 [32],
- w represents interworking Wireless LAN (discontinued in Release 12), and
- mn represents Monitoring Event in TS 32.278 [38]. .

In the 3GPP charging architecture, the Bx reference point connects the CGF in each network domain, service or subsystem to the Billing Domain.

Further details of the Billing Domain, i.e. beyond terminating Bx, are outside the scope of 3GPP standardization. Refer to TS 32.240 [1] for the complete description of the 3GPP charging architecture.

Note that the OCS can also generate CDRs and transfer them to the BD across the Bo reference point as described in TS 32.296 [53].

Furthermore the GSM SCF, defined in CAMEL, can also generate CDRs and transfer them to the BD across the Bs reference point as described in TS 23.078 [200].

5 CDR file transfer principles and scenarios

5.0 General

This clause contains specifications for the principles and scenarios covering the CDR file transfer interface from the network to the Billing Domain. These specifications apply to all domains, subsystems and services that are listed in clause 4, including the OCS Bo and the GSM SCF's Bs interface. Alternatively, in the CS domain (i.e. for Bc), the file transfer mechanism specified in TS 32.250 [10] may be used. Consequently, for Bc it is up to implementation choice to provide either the legacy interface, the interface specified in the present document, or both.

The scenarios in this clause are divided into the following categories:

- Local CDR and CDR file handling;
- File format principles;
- File transport and protocol;
- File transfer modes and session management.

Other interface principles such as security and performance are dependent on vendor implementation and operator's network design and are not covered by the present document.

5.1 Local CDR and CDR file handling

5.1.1 CDR processing

The CGF collects CDRs from the CDF. If the CDF and the CGF are separate entities, then the standard Ga interface as specified in TS 32.295 [54] is used to transfer the CDRs from the CDF to the CGF.

If CDF and CGF are integrated, then a proprietary, internal mechanism is used. The possibilities of separate or integrated CDF and CGF are specified per domain, subsystem and service in the respective "middle tier" charging TSs, i.e. those in the [10] through [49] reference number range, and in TS 32.296 [53] for the OCS.

In any case, CDRs are transferred, in near real-time, from the CDF to the CGF as soon as they have been closed by the CDF. Refer to TS 32.295 [54] for further details. Once received by the CGF, the CDRs may undergo semantical and/or syntactical sanity checks, however, these checks are not specified further within the present document.

If the CGF determines that a CDR is not well formatted, or otherwise incorrect, then the defective CDR parameter(s) shall be filled with an appropriate "replacement" indicator within the limits of the syntax allowed for the parameter. If the error renders the complete CDR unusable (i.e. the above replacement of erroneous parameters is not possible), then no further action of the CGF can be performed regarding this CDR. An example of a case where the erroneous parameter cannot be replaced is when the "CDR type" attribute of a CDR received by the CGF is corrupted. Details of this function are implementation specific.

CDRs that have been processed by the CGF without error, or where errors have been corrected by the CGF as described above, are considered "acceptable" by the CGF. CDRs that have non-recoverable errors are not considered "acceptable" by the CGF. The "acceptable" CDRs are immediately placed into a CDR file by the CGF.

The CDRs that are not "acceptable" should be properly reflected in an error log and appropriate alarms should be generated, after which they may be destroyed. Furthermore, to the extent possible, the number of lost CDRs and the fact that CDRs were lost, shall be indicated in the CDR file.

It is acknowledged that the processing of a CDR between being received until it is placed on the CDR file, takes a small amount of time. Hence, where the present document mandates the "immediate" treatment of CDRs received by the CGF, it is to be interpreted such that it is not allowed to postpone the processing of any received CDRs for any reason. In technical terms, "immediate" shall be interpreted as:

- The system shall be capable of complying with near real-time requirements as specified in clause 3.1.
- The system should be capable of complying, as closely as possible, with real-time requirements as specified in clause 3.1.

Once a CDR has been stored on the appropriate file, the CGF may destroy any other reference to that CDR.

5.1.2 CDR routing

In the default mode of operation, the CGF manages a single ("default") file for the storage of all "acceptable" CDRs. However, the CGF may also route CDRs to different files that are kept open concurrently, i.e. additional files may be configured by OAM&P commands together with associated CDR routing filters. While the CGF stores only those CDRs matching the associated routing filter on each of the additional files, the default file is used to store all CDRs that do not match any of the routing filters configured for the additional files.

The CDR routing function shall apply CDR parameters and CDR origin to decide into which file to place the CDR. The file name shall, within the limits of the file naming conventions, contain an indication of the CDR routing filter applied.

As a minimum, each CGF implementation shall support the CDR type and the sending CDF as selection criteria for CDR routing. It shall then be possible to include in a file only the following CDRs:

- CDRs of a single type;
- CDRs of a set of specified types (e.g. only IMS CDR types);
- CDRs originated by a single CDF;
- CDRs originated by a set of CDFs;
- Any combination of the above.

Further details of the CDR routing function, such as:

- the maximum number of simultaneously open CDR files;
- the order in which the routing filters are evaluated;
- the way CDR filters can be configured by OAM&P;

are implementation specific. In order to avoid arbitrary routing of CDRs, operators should assure that the routing filters assigned per file, do not overlap with each other.

The term "matching CDR" is used in the present document to denote a CDR that matches the routing filter of a given CDR file.

5.1.3 Local CDR file management

For the default case, plus each of the additional CDR routing filters that may be set up on the CGF (see clause 5.1.2), the CGF provides a non-interrupted chain of CDR files. As described above, each CDR is immediately stored in the appropriate file after being received and determined "acceptable" by the CGF.

Several conditions may govern the closure of a CDR file by the CGF:

- A configurable file size limit;
- A configurable file closure time;
- A configurable file lifetime ("interval");
- A configurable number of CDRs within the file;
- CDR release, version or encoding change;
- Manual OAM&P actions;
- System defined reasons (e.g. file system full).

When a CDR file is closed, the next matching CDR shall be placed in the next file in the chain. The exact time when this next CDR file is physically generated, i.e.:

- immediately after the previous file has been closed (i.e. the earliest possible time),
- when the next matching CDR arrives (i.e. the latest possible time),
- anytime in between,

is implementation specific. However, each CDR file shall contain all "acceptable" matching CDRs received and processed by the CGF between the closure of the previous file and the configured file closure trigger of the current file, as specified above. In any case, a file shall be generated and closed upon the occurrence of the file closure trigger, i.e. an empty file (containing no CDRs) if no matching CDRs arrived since the closure of the last file in the chain. Upon file closure, the CDR file is immediately available for transfer to the BD.

CDR files may be removed from the CGF in one of the following ways:

- By the BD issuing corresponding commands provided by the file transfer protocol;
- By the CGF application once the file has been transferred;
- Due to CGF file system storage limitation or configurable file age limits;
- OAM&P action.

In order to avoid loss of CDRs, operators should manage the system in a way that the "system defined" file closure triggers mentioned above do not occur.

5.2 File format principles

The CDR file format is depicted in figure 5.2.1.

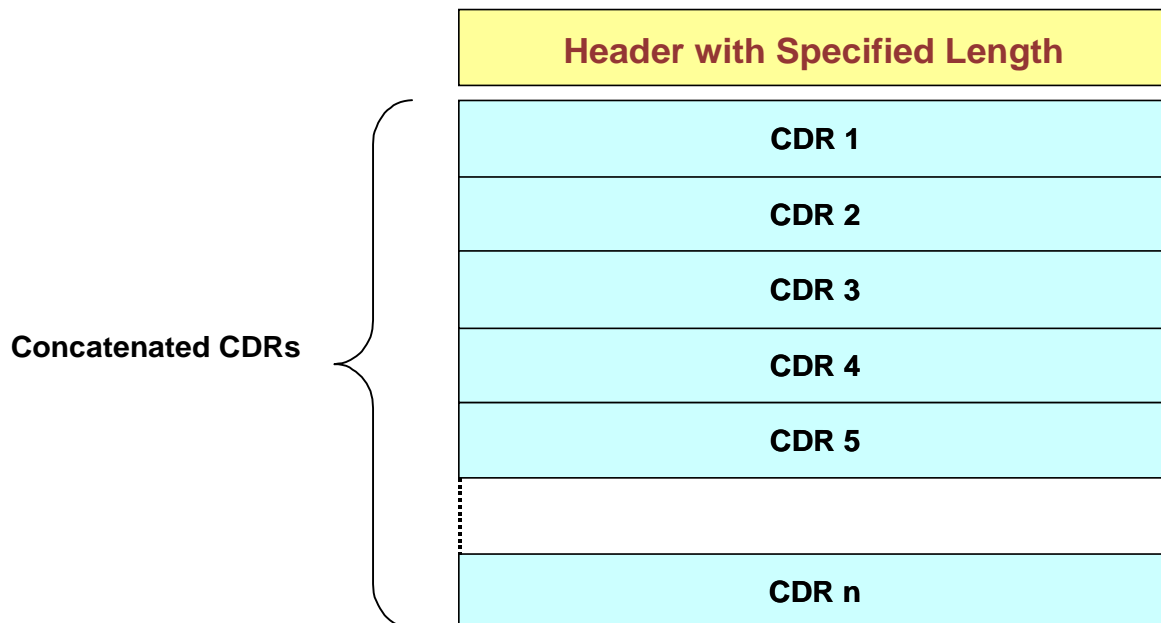


Figure 5.2.1: CDR file format

The CDR files contain a variable length header section followed by a variable sized CDR data section. The CDR data section contains zero or more concatenated CDRs. Each CDR in a file includes a header indicating the CDR length, data record format, release, version and encoding scheme.

The BD should use a decoder with a version number which is equal or greater of this version to be able to decode all the CDRs in the file.

Clause 6 specifies the file format applying the above principles at bit level detail.

5.3 File transport and protocol

5.3.0 General

Two mechanisms are defined for the transport of CDR files from the CGF to the BD:

- A basic transport mechanism is defined in clause 5.3.1 and shall be supported by all CGF implementations;
- The use of the File Transfer IRP as described in clause 5.3.2 may additionally be supported by the CGF as an implementation option.

The use of IPDR as described in clause 5.3.3 may optionally be supported on the Bx reference point.

5.3.1 Basic file transport mechanism

The following stipulations govern the choice and usage of file transport protocol for this transport mechanism.

- a) The default protocol for CDR file transport is FTP (RFC 959 [400]).
- b) The use of other protocols is optional, however FTP shall always be supported.
- c) The CDR files may be transferred in either push or pull mode on the Bx interface. Further specifications of these transfer modes are provided in clause 5.4.1 and clause 5.4.2, respectively.
- d) All standard FTP commands specified in RFC 959 [400] shall be supported by the CGF.

All further requirements specified within the present document with reference to the operation of the file transfer protocol in this mechanism (see clause 6), are solely related to FTP as the transfer protocol, as no assumptions can be made as to the ways of working of optional other protocols. However, additional protocols shall be implemented such that, to the extent possible, the same logic is applied as described in the present document for FTP.

5.3.2 Use of File Transfer IRP

The File Transfer IRP is specified in TS 32.341 [201], TS 32.342 [202], TS 32.343 [203] and TS 32.344 [204]. The support of the solution sets (CORBA, CMIP or both) is left to implementation choice. Otherwise, the CGF implementation of the IRP shall comply with the above TSs; i.e. there are no further additions or limitations with regard to the use of the IRP in charging.

5.3.3 Use of IPDR

As depicted in ATIS-PP-0300075.1.200X [401] IPDR file transfer or streaming protocol can be used for the Bx reference point.

The IPDR file transfer is specified in IPDR/File Transfer Protocol [402].
The IPDR streaming protocol is specified in IPDR/SP [403].

5.4 File transfer modes and session management

5.4.1 Basic file transfer mechanism

5.4.1.0 Introduction

Files can be transferred to the BD in one, or both, of the following modes.
Detailed FTP file transfer and session management procedures are specified in clause 6.

5.4.1.1 Push mode

In this transfer mode the CDR files are written from the CGF to the BD filestore at a time and/or frequency controlled by the CGF. I.e. the CGF *pushes* the files to the BD. This implies that the CGF operates in client mode and the BD in server mode. If the CGF generates concurrent CDR files based on the CDR routing function specified in clause 5.1.2, then it shall be able to send the different files to different BD systems; i.e. the BD address is part of the CDR file routing filter.

As a minimum, the following events shall be capable of triggering a file push in the CGF:

- A (configured number of) new CDR file(s) has become available for transmission;
- The CDR file / files has / have exceeded a configurable (total) size limit;
- A configurable, regular time interval has elapsed;
- The CGF filestore utilization has exceeded a configurable level.

If the file transfer fails, the CGF should properly reflect this in an error log and generate appropriate alarms.
Possible measures to handle file transfer failures are discussed in clause 6.

Security measures, e.g. the mutual identification / verification of the peer systems, are outside the scope of the present document.

5.4.1.2 Pull mode

In this transfer mode the BD reads the CDR files that are available in the appropriate CGF directories.
The time and/or frequency of the file transfer is controlled by the BD. I.e. the BD *pulls* the files from the CGF.
This implies that the CGF operates in server mode and the BD in client mode.

In this mode, the BD may request the files from the CGF at any point in time at the discretion of the BD, i.e. the CGF cannot make any assumptions of the time or frequency of the file pull to occur. If the file transfer fails, any further action is up to the BD, however, the CGF should properly reflect this in an error log and generate appropriate alarms.
Possible measures to handle file transfer failures are covered in clause 6.

Security measures, e.g. the mutual identification / verification of the peer systems, are outside the scope of the present document.

5.4.2 Use of File Transfer IRP

File transfer modes and session management using the optional File Transfer IRP are governed by TS 32.341 [201], TS 32.342 [202], TS 32.343 [203] and TS 32.344 [204].

5.4.3 Use of IPDR

File transfer mode and session management using the optional IPDR protocols are governed by IPDR File Transfer [402] or streaming protocol [403].

6 CDR file format specification

6.0 General

This clause provides detail specifications for the CDR file format. These specifications apply to all domains, subsystems and services listed in clause 4. Alternatively, in the CS domain (i.e. for Bc), the file transfer mechanism specified in TS 32.250 [10] may be used. Consequently, for Bc it is up to implementation choice to provide either the legacy interface, the interface specified in the present document, or both.

The file format specification in this clause is divided into the following categories:

- File format conventions;
- File naming and directory conventions;
- Detailed file transfer and session management procedures;
- Error handling.

Only the basic file transfer mechanism is covered in the present document. Refer to TS 32.341 [201], TS 32.342 [202], TS 32.343 [203] and TS 32.344 [204] for the corresponding details when using the optional File Transfer IRP and [402], [403] when using the optional IPDR protocols.

6.1 File format conventions

The file format shall apply the following conventions.

- a) The CDR files contain a variable length file header immediately followed by a variable number (zero or more) of concatenated CDRs which are structured according to the CDR format specified in the middle tier charging TSs.
- b) The syntax and encoding rules for the CDRs are specified in TS 32.298 [51].
- c) Each CDR is immediately preceded by a fixed length plain text header.
- d) The file header fields and CDR header fields are in Network byte order (Big Endian).
- e) The file header contains fields specified in clause 6.1.1.
- f) The CDR header contains fields specified in clause 6.1.2.
- g) File header fields that are not known at the time the file is opened are populated after all the CDRs are included and the file is ready to be closed.

The CDR file is named based on the naming convention specified in clause 6.2.

6.1.1 CDR file header format

6.1.1.0 General

The exact format of the CDR file header is given in table 6.1.1.1.

Table 6.1.1.0.1: Format of CDR file header

| Octets | Bits | | | | | | | |
|------------|--|---|---|---|-------------------------|---|---|---|
| | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 1..4 | File length | | | | | | | |
| 5..8 | Header length | | | | | | | |
| 9 | High Release Identifier | | | | High Version Identifier | | | |
| 10 | Low Release Identifier | | | | Low Version Identifier | | | |
| 11..14 | File opening timestamp | | | | | | | |
| 15..18 | Timestamp when last CDR was appended to file | | | | | | | |
| 19..22 | Number of CDRs in file | | | | | | | |
| 23..26 | File sequence number | | | | | | | |
| 27 | File Closure Trigger Reason | | | | | | | |
| 28..47 | IP Address of Node that generated file | | | | | | | |
| 48 | Lost CDR indicator | | | | | | | |
| 49..50 | Length of CDR routing filter | | | | | | | |
| 51..xy | CDR routing filter | | | | | | | |
| xy+1..xy+2 | Length of Private Extension | | | | | | | |
| xy+3..n | Private Extension | | | | | | | |
| n+1 | High Release Identifier extension | | | | | | | |
| n+2 | Low Release Identifier extension | | | | | | | |

The following subclauses specify the contents and encoding of the CDR file header fields. Unless otherwise specified in the subclauses below, all parameters are mandatory and shall always be included in a CDR file header.

6.1.1.1 File length

The "file length" parameter contains a binary value that identifies the total length of the CDR file in octets, including the file header and the total CDR payload length.

The value with all bits set to "1" is reserved for future extensions (e.g. for CDR files longer than that value) and shall therefore not be used.

6.1.1.2 Header length

The "header length" parameter contains a binary value that identifies the total length of the CDR file header in octets.

The value with all bits set to "1" is reserved for future extensions (e.g. for CDR file headers longer than that value) and shall therefore not be used.

6.1.1.3 High release / version identifier

This field is a copy of octet 3 of the CDR header. It is copied from the CDR where the equation:

$$\text{Release Identifier} * 100 + \text{Version Identifier}$$

For Rel-10 and higher this equation shall be used:

$$(\text{Release Identifier} + \text{Release Identifier Extension} + 1) * 100 + \text{Version Identifier}$$

yields the highest result of all CDRs in the file. The representation of Release Identifier and Version Identifier in this field is the same as in octet 3 of the CDR header.

For Rel-10 and higher, i.e with High Release Identifier field set to value "7", the release identifier is included in "High Release Identifier extension" field.

6.1.1.4 Low release / version identifier

This field is a copy of octet 3 of the CDR header. It is copied from the CDR where the equation:

$$\text{Release Identifier} * 100 + \text{Version Identifier}$$

For Rel-10 and higher this equation shall be used:

$$(\text{Release Identifier} + \text{Release Identifier Extension} + 1) * 100 + \text{Version Identifier}$$

yields the lowest result of all CDRs in the file. The representation of Release Identifier and Version Identifier in this field is the same as in octet 3 of the CDR header.

For Rel-10 and higher, i.e with Low Release Identifier field set to value "7", the release identifier is included in "Low Release Identifier extension" field.

6.1.1.5 File opening timestamp

These parameters indicate the time when the file was opened, according to the following binary format:

- The first four binary bits indicate the month (1 .. 12), according to the CGF's local time zone;
- The next five binary bits contain the date (1 :: 31), according to the CGF's local time zone;
- The next five binary bits contain the hour (0 .. 23), according to the CGF's local time zone;
- The next six binary bits contain the minute (0 .. 59), according to the CGF's local time zone;
- The next bit indicates the sign of the local time differential from UTC (bit set to "1" expresses "+" or bit set to "0" expresses "-" time deviation), in case the time differential to UTC is 0 then the sign may be arbitrarily set to "+" or "-";
- The next five binary bits contain the hour (0 .. 23) deviation of the local time towards UTC, according to the CGF's local time zone;
- The next six binary bits contain the minute (0 .. 59) deviation of the local time towards UTC, according to the CGF's local time zone;

Note that the CDR file name contains detailed date and time information related to file closure (see clause 6.2)

6.1.1.6 Last CDR append timestamp

This parameter is formatted the same as in clause 6.1.1.5, and indicates the time when the last CDR was appended to the file in UTC format. In case of an empty file (i.e. no CDRs included), the value of the parameter is "0".

6.1.1.7 Number of CDRs in file

This parameter contains a binary value that specifies the total number of CDRs that are included in the file.

The value with all bits set to "1" is reserved for future extensions (e.g. for CDR files containing more CDRs than represented by that value) and shall therefore not be used.

6.1.1.8 File sequence number

This parameter is a value in binary that contains a running number of the CDR file generated by the same CGF. The first file of a CGF is indicated by the value "0". When the maximum number of file is reached (all bits set to "1"), the sequence shall be restarted with "0".

6.1.1.9 File closure trigger reason

The file closure reason provides a means to determine the reason that the file was closed by the CGF. It is encoded as a single octet as follows:

Normal closure reasons (Binary values 0 to 127):

- 0 = Normal closure (Undefined normal closure reason).
- 1 = File size limit reached (OAM&P configured).
- 2 = File open-time limit reached (OAM&P configured).
- 3 = Maximum number of CDRs in file reached (OAM&P configured).
- 4 = File closed by manual intervention.
- 5 = CDR release, version or encoding change.
- 6 to 127 are reserved for future use.

Abnormal closure reasons (Binary values 128 to 255):

- 128 = Abnormal file closure (Undefined error closure reason).
- 129 = File system error.
- 130 = File system storage exhausted.
- 131 = File integrity error.
- 132 to 255 are reserved for future use.

6.1.1.10 Node IP address

This parameter indicates the IP address of the CGF generating the file. For both IPv4 and IPv6 CGF addresses, the parameter is encoded in IPv6 representation. The first four bytes of the parameter, which are preceding this IPv6 address, are insignificant, e.g. filled with 'FF'.

6.1.1.11 Lost CDR indicator

This parameter indicates if and how many CDRs were lost during their processing in the CGF (see clause 5.1.1). The term "lost" implies that the CDR(s) could not be placed into the destination file due to irrecoverable errors.

Due to the possibility that the irrecoverable CDR errors may have impacted CDR parameters that are relevant for CDR routing, it is possible that the CGF cannot determine for a particular file whether CDRs have been lost. Appropriate indication shall be given according to the following encoding of the "lost CDR indicator".

- MSB bit "0", all other bits "0": no CDRs have been lost;
- MSB bit "0", all other bits set to a value corresponding to decimal 1 to decimal 126: CGF has identified that a number of CDRs corresponding to the value of the lower 7 bits were lost, while it is unknown whether more CDRs were lost;
- MSB bit "0", all other bits set to "1": CGF has identified that 127 or more CDRs were lost, while it is unknown whether more CDRs were lost;
- MSB bit "1", all other bits "0": CDRs have been lost but CGF cannot determine the number of lost CDRs;
- MSB bit "1", all other bits set to a value corresponding to decimal 1 to decimal 126: CGF has calculated the number of lost CDRs as indicated in the value of the lower 7 bits;
- MSB bit "1", all other bits set to "1": CGF has calculated the number of lost CDRs to be 127 or more.

6.1.1.12 Length of CDR routing filter

This parameter contains a binary value that specifies the length of the subsequent CDR routing filter in octets. The value excludes the two octets of the "length" parameter itself.

The value of "65535" (all bits set to "1") is reserved for future extensions (e.g. for CDR routing filters longer than 65534 octets) and shall therefore not be used.

6.1.1.13 CDR routing filter

This parameter indicates the filter that determined the routing of CDRs into this file. Its encoding is vendor specific.

6.1.1.14 Length of private extension

This parameter contains a binary value that specifies the length of the subsequent "private extension" field in octets. It is present only if a private extension field is included in the CDR file header. Its value excludes the two octets of the "length" parameter itself.

The value of "65535" (all bits set to "1") is reserved for future extensions (e.g. for private extensions longer than 65534 octets) and shall therefore not be used.

6.1.1.15 Private extension

This optional field contains a vendor specific private extension to the CDR file header, if any. Its encoding, if present, is vendor specific.

6.1.1.16 "High Release Identifier" extension

This eight bit field contains a binary value that identifies the 3GPP Release of TS 32.298 [51]. For "High Release Identifier" beyond Rel-9, the representation of "High Release Identifier" in this field is the same as in octet 5 of CDR header.

This field shall be present only when "High Release Identifier" field is set with value "7" (all bits set to "1").

6.1.1.17 "Low Release Identifier" extension

This eight bit field contains a binary value that identifies the 3GPP Release of the TS 32.298 [51]. For "Low Release Identifier" beyond Rel-9, the representation of "Low Release Identifier" in this field is the same as in octet 5 of CDR header.

This field shall be present only when "Low Release Identifier" field is set with value "7" (all bits set to "1").

6.1.2 CDR header format

6.1.2.0 General

The exact format of the CDR header is given in table 6.1.2.0.1.

Table 6.1.2.0.1: Format of CDR header

| Octets | Bits | | | | | | | |
|--------|------------------------------|---|---|---|--------------------|---|---|---|
| | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 1..2 | CDR length | | | | | | | |
| 3 | Release Identifier | | | | Version Identifier | | | |
| 4 | Data Record Format | | | | TS number | | | |
| 5 | Release Identifier extension | | | | | | | |

The following subclauses specify the contents and encoding of the CDR header fields.

The CDR header is 4 octets or 5 octets length: presence the "Release Identifier extension" octet depends on Release Identifier value.

6.1.2.1 CDR length

This two octet field contains a binary value that specifies the length of the subsequent CDR, excluding the header octets. The value of "65535" (all bits set to "1") in the CDR length field implies that it is reserved for future extensions and shall therefore not be used.

6.1.2.2 Release Identifier

This three bit field contains a binary value that identifies the 3GPP Release of the Technical Specification (TS) indicated in "TS number" (see clause 6.1.2.5). Its value is set / used according to the following rules:

Table 6.1.2.2.1: Release Identifier

| Release Identifier (3 bits) | 3GPP Release | Indicates 3GPP "TS number" for the release | Comment |
|-----------------------------|--------------|--|--|
| "0" | Rel-99 | 32.005 or 32.015 | this parameter shall be ignored |
| "1" | Rel-4 | 32.205, 32.215 or 32.235 | |
| "2" | Rel-5 | 32.205, 32.215, 32.225 or 32.235 | |
| "3" | Rel-6 | 32.250, 32.251, 32.252, 32.260, 32.270, 32.271, 32.272 or 32.273 | |
| "4" | Rel-7 | 32.250, 32.251, 32.252, 32.260, 32.270, 32.271, 32.272 or 32.273 | |
| "5" | Rel-8 | 32.250, 32.251, 32.252, 32.260, 32.270, 32.271, 32.272, 32.273 or 32.275 | |
| "6" | Rel-9 | 32.250, 32.251, 32.252, 32.260, 32.270, 32.271, 32.272, 32.273, 32.274 or 32.275 | |
| "7" | Beyond Rel-9 | The 3GPP Release for "TS number" is included in "Release Identifier extension" field | this parameter is used as an indicator |

When "TS number" is "32.296" the Release Identifier contains proprietary values.

6.1.2.3 Version Identifier

This five bit field contains a binary value that identifies the version of the TS 32.298 [51]. Its value corresponds to the middle digit of the version number of that TS, as indicated on the TS cover sheet.

When "TS number" is "32.296" the Version Identifier contains proprietary values.

6.1.2.4 Data record format

This three bit field contains a binary value that identifies the CDR encoding according to:

- "1" signifies the use of Basic Encoding Rules (BER);
- "2" signifies the use of unaligned basic Packed Encoding Rules (PER);
- "3" signifies the use of aligned basic Packed Encoding Rules (PER);
- "4" signifies the use of XML Encoding Rules (XER).

6.1.2.5 TS number

This five bit field contains a binary value that identifies the number of the TS associated to the domain CDRs encoding according to table 6.1.2.5.1:

Table 6.1.2.5.1: "TS number" identifier

| "TS number" identifier (5 bits) | TS number |
|--|-----------|
| 0 | 32.005 |
| 1 | 32.015 |
| 2 | 32.205 |
| 3 | 32.215 |
| 4 | 32.225 |
| 5 | 32.235 |
| 6 | 32.250 |
| 7 | 32.251 |
| 9 | 32.260 |
| 10 | 32.270 |
| 11 | 32.271 |
| 12 | 32.272 |
| 13 | 32.273 |
| 14 | 32.275 |
| 15 | 32.274 |
| 16 | 32.277 |
| 17 | 32.296 |
| 18 | 32.278 |
| 19 | 32.253 |
| 20 | 32.255 |
| 21 | 32.254 |
| 22 | 32.256 |
| 23 | 28.201 |
| 24 | 28.202 |
| NOTE 1: 25-31 are for future use. | |
| NOTE 2: 8 is discontinued in Release 12. | |

6.1.2.6 "Release Identifier extension"

This eight bit field contains a binary value that identifies the 3GPP Release of the TS 32.298 [51].
For Releases beyond Rel-9, its value is set / used according to the following rules:

Table 6.1.2.6.1: "Release Identifier extension"

| Release Identifier (8 bits) | 3GPP Release | Comment |
|--|--------------|---------|
| "0" | Rel-10 | |
| "1" | Rel-11 | |
| "2" | Rel-12 | |
| "3" | Rel-13 | |
| "4" | Rel-14 | |
| "5" | Rel-15 | |
| "6" | Rel-16 | |
| NOTE: Additional "Release Identifier extension" value incremented by "1" indicates subsequent releases | | |

This field shall be present only when "Release Identifier" field is set with value "7" (all bits set to "1").

6.2 CDR file naming convention

The file naming convention ensures that CDR file names are unique among a large number of CGF nodes over an extended period of time (at least several months). In order to accomplish this requirement, the file name includes the following information:

<NodeID>_<RC>.<date>_<time>[.<PI>][.<FE>]

- 1) NodeID. This is the name of the CGF that generated the file. When the CGF is integrated in another node (see TS 32.240 [1]), then this parameter contains the NodeID of the node that the CGF is integrated in.
- 2) The RC parameter is a running count, starting with the value of "1". Note that the delimiter preceding this field is made up of an underscore character (_), followed by a minus character (-), followed by another underscore character (-).
- 3) The "date" field indicates in ASCII, the date when the CDR file was closed. It is of the form YYYYMMDD, where:
 - YYYY is the year in four-digit notation;
 - MM is the month in two digit notation (01 - 12);
 - DD is the day in two-digit notation (01 - 31).

Note that this field is preceded by a point (.) character as delimiter.

- 4) The "time" field indicates in ASCII, the time when the CDR file was closed. It is of the form HHMMshmm, where:
 - HH is the two-digit hour of the day (local time), based on 24-hour clock (00 - 23);
 - MM is the two digit minute of the hour (local time);
 - s is in ASCII, the sign of the local time differential from UTC (+ or -), in case the time differential to UTC is 0 then the sign may be arbitrarily set to "+" or "-";
 - hh is the two-digit number of hours of the local time differential from UTC (00-23);
 - mm is the two digit number of minutes of the local time differential from UTC (00-59).

Note that the delimiter preceding this field is made up of an underscore character (_), followed by a minus character (-), followed by another underscore character (-).

- 5) Optional private information: The content of this field is implementation specific. This field, if present, is preceded by a point (.) character delimiter.
- 6) Optional file extension: The content of this field is implementation specific. This field, if present, is preceded by a point (.) character delimiter.

Some examples describing file-naming convention (note that the quotation marks do not form part of the file name):

- 1) file name: "CGFNodeId_-_1234.20050401_-_2315+0200",
meaning: file #1234 produced by CGF <CGFNodeId> on April 1, 2005 at 23:15 local time, with a time differential of +2 hours against UTC.
- 2) file name: "CGFNodeId_-_44.20051224_-_1700-1130.thankgoditschristmas.abc",
meaning: file #44 produced by CGF <CGFNodeId> on December 24, 2005 at 17:00 local time, with a time differential of -11:30 hours against UTC, private information "thankgoditschristmas" and extension "abc".
- 3) file name: "CGFNodeId_-_44.20051224_-_1700-1130..abc",
meaning: same file as 2) above but this time without private extension. Note that there are two point characters (.) preceding the file extension due to the missing (=empty) private extension.

There shall be a configurable base directory on the CGF which contains one or more subdirectories that contain all CDR files that are ready for transfer to the BD. Further details of the directory structure on the CGF for the storage of CDR files are implementation specific.

6.3 Detailed FTP transfer and session management procedures

The detailed FTP transfer and session management procedures are out of scope of the current 3GPP release. However, the following items should be considered in actual implementations.

- FTP client behaviour;
- FTP server role;
- File transfer triggers;
- Each of the above in relation to push and pull modes.

6.4 Error handling

The detailed error handling on the CGF is out of scope of the current 3GPP Release. However, the following items should be considered in actual implementations.

- Replacement of invalid CDR parameters;
- Handling of irrecoverable CDRs;
- System dependent failures (file system full, etc.);
- File transfer failure in relation to:
 - Pull mode;
 - Push mode.

Annex A (informative): Bibliography

This Annex is a placeholder for documents which are not explicitly cited in this specification.

Annex B (informative): Change history

| Change history | | | | | | | | |
|----------------|-------|-----------|------|-----|---|-----|--------|--------|
| Date | TSG # | TSG Doc. | CR | Rev | Subject/Comment | Cat | Old | New |
| Jun 2003 | SP-20 | SP-030273 | -- | -- | Submitted to TSG SA#20 for Information | -- | 1.0.0 | -- |
| Mar 2004 | SP-23 | SP-040142 | -- | -- | Submitted to TSG SA#23 for Approval | -- | 2.0.0 | 6.0.0 |
| Jun 2005 | SP-28 | SP-050272 | 0001 | 1 | Corrections, alignments and additions to complete remaining technical gaps | C | 6.0.0 | 6.1.0 |
| Sep 2006 | SP-33 | SP-060526 | 0003 | -- | Correct field descriptions to the appropriate formats that represent binary | F | 6.1.0 | 6.2.0 |
| Sep 2006 | SP-33 | SP-060544 | 0004 | -- | Add optional solution set for the Bx reference point to fulfil the ITU-T requirement on CDR file transfer with IPDR in context of NGN Accounting (FBI-TISP2-CH) | B | 6.2.0 | 7.0.0 |
| Mar 2008 | SP-39 | SP-080190 | 0005 | 2 | Correction of errors and inconsistencies – Align with 32.240 | F | 7.0.0 | 7.1.0 |
| Sep 2008 | SP-41 | SP-080466 | 0006 | - | Clarification on EPC Charging | B | 7.1.0 | 8.0.0 |
| Sep 2008 | SP-41 | SP-080462 | 0007 | - | Alignment on Bx interface | D | 7.1.0 | 8.0.0 |
| Dec 2008 | SP-42 | SP-080706 | 0008 | - | TS 32.297 evolution for Rel-8 | B | 8.0.0 | 8.1.0 |
| Jun 2009 | SP-44 | SP-090293 | 0009 | - | Correction on length of Node IP Address | F | 8.1.0 | 8.2.0 |
| Dec 2009 | - | - | - | - | Update to Rel-9 version (MCC) | - | 8.2.0 | 9.0.0 |
| Mar 2011 | SP-51 | SP-110109 | 0010 | 1 | Release considerations beyond Release 9 for CDR headers | C | 9.0.0 | 10.0.0 |
| Sep 2011 | SP-53 | SP-110530 | 0011 | 1 | Correction of the release/version identifier in CDR file header format | F | 10.0.0 | 10.1.0 |
| Dec 2011 | SP-54 | SP-110710 | 0012 | - | Correction of the high/low release identifier in CDR file header format | F | 10.1.0 | 10.2.0 |
| Dec 2011 | SP-54 | SP-110710 | 0013 | - | Correction on CDR header format | F | 10.1.0 | 10.2.0 |
| Sep-2012 | - | - | - | - | Update to Rel-11 version (MCC) | - | 10.2.0 | 11.0.0 |
| Mar 2014 | SP-63 | SP-140045 | 0014 | - | Introduction of CDRs File transfer for SMS offline Charging | B | 11.0.0 | 12.0.0 |
| Jul 2014 | - | - | - | - | Rapporteur/MCC: General editorial changes and clean-up. | - | 12.0.0 | 12.0.1 |
| Sep 2014 | SP-65 | SP-140564 | 0015 | 1 | Corrections for alignment between charging specifications | F | 12.0.1 | 12.1.0 |
| | | SP-140563 | 0016 | 1 | Removal of I-WLAN solution | F | | |
| Dec 2014 | SP-66 | SP-140805 | 0017 | - | Corrections on definition for parameter category | F | | |
| | | SP-140804 | 0018 | 1 | Additional corrections for removal of I-WLAN solution | F | | |
| | | SP-140808 | 0019 | - | Introduction of TS 32.277 for CDRs File Transfer | B | 12.1.0 | 12.2.0 |
| | | SP-140805 | 0020 | - | Introduction of Rel-12 for CDRs File Transfer | F | | |
| Jun-2015 | SP-68 | SP-150326 | 0021 | 1 | Introduction of Rel-13 for CDRs File Transfer | B | 12.2.0 | 13.0.0 |
| | | | 0022 | 1 | Introduction of CDRs File Transfer over Bo | F | | |
| Mar 2016 | SP-71 | SP-160035 | 0023 | 1 | MONTE charging impact of CDR files format and transfer | B | 13.0.0 | 13.1.0 |

| Change history | | | | | | | |
|----------------|---------|-----------|------|-----|-----|--|-------------|
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2016-06 | SA#72 | SP-160411 | 0025 | 3 | B | Introduce File Transfer for CP data transfer CDRs | 13.2.0 |
| 2017-03 | SA#75 | SP-170138 | 0026 | 1 | D | Remove reference to RFC 3588 | 14.0.0 |
| 2018-03 | SA#79 | SP-180064 | 0027 | 1 | B | Introduce the Bea for NAPS Charging | 15.0.0 |
| 2018-03 | SA#79 | SP-180066 | 0029 | 1 | D | Add Bmn for Monitoring event CDRs file transfer in symbols | 15.0.0 |
| 2018-09 | SA#81 | SP-180833 | 0030 | 1 | B | Introduce the Bd for 5G Charging | 15.1.0 |
| 2018-12 | SA#82 | SP-181057 | 0031 | - | F | Add new 5G TS in CDR header description | 15.2.0 |
| 2019-03 | SA#83 | SP-190133 | 0033 | - | A | Correction of Release Identifier | 15.3.0 |
| 2019-09 | SA#85 | SP-190840 | 0035 | 1 | F | Correction of reference architecture in 5G | 15.4.0 |
| 2019-09 | SA#85 | SP-190763 | 0034 | 1 | B | Introduce AMF and Rel-16 | 16.0.0 |
| 2020-07 | SA#88-e | SP-200511 | 0037 | 1 | B | Add the Bnspace interface | 16.1.0 |
| 2020-09 | SA#89e | SP-200745 | 0038 | - | B | Introduction of TS 28.202 | 16.2.0 |

History

| Document history | | |
|-------------------------|---------------|-------------|
| V16.1.0 | August 2020 | Publication |
| V16.2.0 | November 2020 | Publication |
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