# SaMOG Gateway Offline Charging

The SaMOG Gateway supports generation of CDR files for offline charging. In Offline Charging, charging information is collected concurrently with resource usage and passed through a chain of logical charging functions. At the end of the process, CDR files are generated by the network and transferred to the network operator's Billing Domain.

Figure 1: 3GPP Offline Charging Architecture
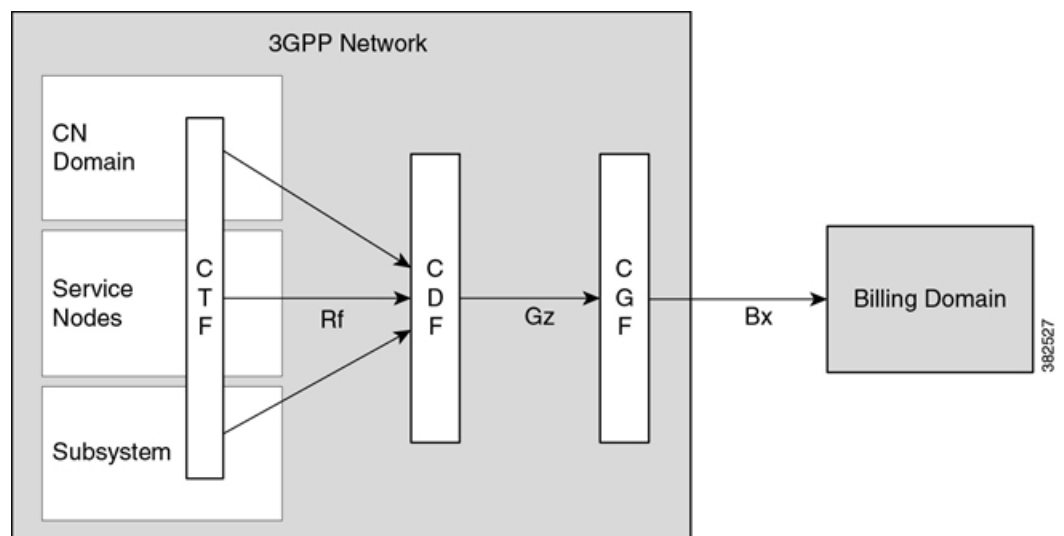
The Charging Trigger Function (CTF) generates charging events and forwards them to the Charging Data Function (CDF). The CDF then generates CDRs and transfers it to the Charging Gateway Function (CGF). Finally, the CGF create CDR files and forwards them to the Billing Domain.

The SaMOG Gateway integrates with the CTF and CDF functions, generates CDRs based on the triggered events, and sends the same to the CGF over the Gz/Wz interface (using the GTPP protocol).

SaMOG CDR Formats

As 3GPP specifications does not define a CDR format for SaMOG, the S-GW CDR and SGSN CDR record formats are used to define the CDR formats. The record format can be selected using a CLI command under the GTPP Group Configuration Mode. By default, for an SaMOG general license, the S-GW record type is used, and for an SaMOG 3G license, the SGSN (SGSNPDPRecord) record type is used.

This section provides a reference for the S-GW and SGSN CDR fields supported by SaMOG.

The category column in all tables use keys described in the following table.

Table 1: Dictionary Table Key

Abbreviation	Meaning	Description
M	Mandatory	A field that must be present in the CDR.
C	Conditional	A field that must be present in the CDR if certain conditions are met.
OM	Operator Provisionable: Mandatory	A field that an operator has provisioned and must be included in the CDR for all conditions.
OC	Operator Provisionable: Conditional	A field that an operator has provisioned that must included in the CDR if certain conditions are met.

SaMOG S-GW CDR Format

The following table lists the S-GW CDR fields present in the available GTPP dictionary used by the SaMOG Gateway.

Table 2: SaMOG S-GW CDR Format

Field	Category	Description
Record Type	M	S-GW IP CAN bearer record. Set to S-GW record type.
Served IMSI	M	IMSI of the served party. Received in User name Radius AVP from WLC.
S-GW Address used	M	The control plane IP address of the S-GW used. CGW service IP address.

Field	Category	Description
PDN Connection Charging ID	OM	Charging ID of the EPS default bearer in GTP case. Set to befault bearer charging ID. SaMOG only supports default bearer setup. Therefore, the PDN connection charging ID and charging ID will be the same.
TWAN User Location Information	OC	UE location in a Trusted WLAN Access Network (TWAN) (SSID, and if available, BSSID of the access point), as defined in TS 29.274 [210] on an S2a GTP interface. For more information, refer **gtpp attribute twanuli** and **samog-cdr twanuli ap-group-name** commands under *Configuring the SaMOG CDRs* section of this chapter.
Charging ID	M	IP CAN bearer identifier used to identify this IP CAN bearer in different records created by PCNs. Provided by P-GW during Create session response.
Serving Node Address	OC	List of serving node control plane IP addresses (e.g. S-GW, SaMOG) used during record generation. MRME service IP address.
Serving Node IPv6 Address	OC	List of serving node control plane IPv6 addresses, in case of IPv4v6 dual stack used during record generation.
Serving Node Type	OC	List of serving node types in control plane.
PGW PLMN Identifier	OC	PLMN identifier (MCC MNC) of the P-GW used. Received in the APN OI part in PBU. For SaMOG 3G license, it will be set to GGSN PLMN ID.

Field	Category	Description
Access Point Name Network Identifier	OM	Logical name of the connected access point to the external Packet Data Network (network identifier part of APN). Received in Service Selection AVP in DER from AAA. If this field is not received in the DER, the session goes down.
PDP/PDN Type	OM	This field indicates PDN type (i.e IPv4, IPv6 or IPv4v6). Set to IPv4, IPv6, or IPv4v6. Received from AAA in DEA.
Served PDP/PDN Address	OC	IP address allocated for the PDP context/PDN connection, i.e. IPv4 or IPv6, if available. Allocated IP address.
Served PDP/PDN Address Extension	OC	IPv4 address of the served IMSI, if available, when PDN type is IPv4v6.
Dynamic Address Flag	OC	Indicates whether served PDP/PDN address is dynamic. This field will always set, as static address is not supported.
Dynamic Address Flag Extension	OC	Indicates whether the served IPv4 PDP/PDN address allocated during IP CAN bearer activation, initial attach (E-UTRAN or over S2x) and UE requested PDN connectivity with PDP/PDN type IPv4v6 is dynamic. This field will not be available if IPv4 address is static.
List of Traffic Data Volumes	OM	List of changes in charging conditions for IP CAN bearer, categorized based on traffic volumes/per traffic period or changed QoS. Generated by the SaMOG Gateway.

Field	Category	Description
Record Opening Time	M	Time stamp when IP CAN bearer is activated in S-GW, or record opening time on subsequent partial records. Generated by the SaMOG Gateway.
Duration	M	Duration of this record in the S-GW.
Cause for Record Closing	M	The reason for the release of record from S-GW. **Values:** • normalRelease • abnormalRelease • volumeLimit • timeLimit • maxChangeCond • managementIntervention
Diagnostics	OM	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. A running sequence number with range of 1 through 4294967295 used to link partial records generated by the SaMOG for a specific bearer context (characterized with the same Charging ID and SaMOG address pair). This field will not be present if the first record is also the final record.
Node ID	OM	Name of the recording entity. This field contains an identifier string for the node that generates the CDR. On the SaMOG Gateway, the NodeID field is a printable string of the ndddSTRING format.

Field	Category	Description
Local Record Sequence Number	OM	Consecutive record number created by the node. The number is allocated sequentially including all CDR types. For each Node ID, the number with range 1 through 4294967295 is allocated sequentially for each CDR.
APN Selection Mode	OM	An index indicating how the APN was selected. Set to 0:MS or network provided APN, subscriber verified.
Served MSISDN	OM	The primary MSISDN of the subscriber. Received in the Subscription-ID AVP in DEA.
Charging Characteristics	M	The Charging Characteristics applied to the IP CAN bearer. Will be received from AAA in DEA 3GPP-Charging-Characteristics.
Charging Characteristics Selection Mode	OM	Holds information about how Charging Characteristics were selected. **Values:** • ServingNodeSupplied • homeDefault • roamingDefault • visitingDefault
P-GW Address Used	OC	P-GW IP address for the Control Plane The P-GW address received from the AVP MIP6-Agent-Info in DEA. If this value is not received, MRME performs DNS.
Serving Node PLMN Identifier	OC	Serving node PLMN Identifier (MCC and MNC) used during this record, if available. Received in NAI in Radius Access request.

Field	Category	Description
RAT Type	OC	Radio Access Technology (RAT) type currently used by the Mobile Station, when available. Set to WLAN.
Start Time	OC	Time when User IP-CAN session starts, available in the CDR for the first bearer in an IP-CAN session. Set by the SaMOG Gateway.
Stop Time	OC	Time when User IP-CAN session is terminated, available in the CDR for the last bearer in an IP-CAN session. Set by the SaMOG Gateway.

SaMOG SGSN CDR Format

The following table lists the SGSN (SGSNPDPRecord) CDR fields present in the available GTPP dictionary used by the SaMOG Gateway.

Table 3: SaMOG SGSN CDR Format

Field	Category	Description
Record Type	M	SGSN IP CAN bearer record. Set to SGSN record type.
Served IMSI	C	IMSI of the served party, if available. Received in User name Radius AVP from WLC.
SGSN Address used	OM	The IP address of the current SGSN. CGW service IP address.
Charging ID	M	IP CAN bearer identifier used to identify this IP CAN bearer in different records created by PCNs. Provided by GGSN in Create PDP context response.

Field	Category	Description
GGSN Address Used	M	The control plane IP addresses of the P-GW currently used. Set to GGSN address where PDP is context is created.
Access Point Name Network Identifier	OM	Logical name of the connected access point to the external Packet Data Network (network identifier part of APN). Received in Service Selection AVP in DER from AAA. If this field is not received in the DER, the session goes down.
PDP Type	OM	This field indicates PDN type (i.e IPv4, IPv6, IPv4v6, PPP, IHOSS:OSP). Set to IPv4.
Served PDP Address	OC	PDP address of the served IMSI, i.e. IPv4 address when PDP Type is IPv4, or IPv6 prefix when PDP Type is IPv6 or IPv4v6 Allocated UE IP address by GGSN.
List of Traffic Data Volumes	OM	List of changes in charging conditions for current IP CAN bearer, categorized based on traffic volumes/per traffic period, or initial and subsequently changed QoS. Set by the SaMOG Gateway.
Record Opening Time	M	Time stamp when IP CAN bearer is activated in the current SGSN, or record opening time on subsequent partial records. Set by the SaMOG Gateway.
Duration	M	Duration of current record in the SGSN. Set by the SaMOG Gateway.

Field	Category	Description
Cause for Record Closing	M	The reason for the release of record from current SGSN. **Values:** • normalRelease • abnormalRelease • volumeLimit • timeLimit • maxChangeCond • managementIntervention
Diagnostics	OM	A more detailed reason for the release of the connection.
Record Sequence Number	C	Partial record sequence number in the current SGSN, only present in case of partial records. A running sequence number with range of 1 through 4294967295 used to link partial records generated by the SaMOG for a specific bearer context (characterized with the same Charging ID and SaMOG address pair). This field will not be present if the first record is also the final record.
Node ID	OM	Name of the recording entity. This field contains an identifier string for the node that generates the CDR. On the SaMOG Gateway, the NodeID field is a printable string of the ndddSTRING format.
Record Extensions	OC	Set of network operator/manufacturer specific extensions to the record. Conditioned upon the existence of an extension.

Field	Category	Description
Local Record Sequence Number	OM	Consecutive record number created by the current node. The number is allocated sequentially including all CDR types. For each Node ID, the number with range from1 through 4294967295 is allocated sequentially for each CDR.
APN Selection Mode	OM	An index indicating how the APN was selected. Set to 0:MS or network provided APN, subscriber verified.
Access Point Name Operator Identifier	OM	The Operator Identifier part of the APN.
Served MSISDN	OM	The primary MSISDN of the subscriber. Received in the Subscription-ID AVP in DEA.
Charging Characteristics	M	The Charging Characteristics applied to the IP CAN bearer. Will be received from AAA in DEA 3GPP-Charging-Characteristics.
RAT Type	OC	Radio Access Technology (RAT) type currently used by the Mobile Station as defined TS 29.061 [205], when available. Set to WLAN.
Charging Characteristics Selection Mode	OM	Holds information about how Charging Characteristics were selected. **Values:** • AAASupplied • homeDefault • roamingDefault • visitingDefault

Field	Category	Description
Dynamic Address Flag	OC	Indicates whether the served PDP address that is allocated during IP CAN bearer activation, is dynamic. This field will not be available if the address is static. Always set.

Triggers for Generation of Charging Records

The following section describes the triggers for the generation of partial and final SaMOG CDRs.

SaMOG CDRs are updated (not closed) for any of the following conditions:

- QoS Change: When a QoS change is detected, the "List of Traffic Data Volumes" is added to the CDR.
- Tarrif Time Change: When the tarrif time changes, the "List of Traffic Data Volumes" is added to the CDR.
- CDR Closure: The "List of Traffic Data Volumes" is added to the CDR when this event occurs.

The "List of Traffic Volumes" attribute in the SaMOG CDR consists of a set of containers that are added when specific trigger conditions are met. The volume count per IP CAN bearer is also identified and separated for uplink and downlink traffic when the trigger condition occurs.

The SAMOG CDRs are closed as the final record for a subscriber session for the following events:

- End of IP-CAN bearer: The CDR is closed when the IP-CAN bearer is deactivated. The trigger condition includes:

  - UE detach
  - AAA detach
  - PGW/GGSN detach
  - any abnormal release
  - Admin clear

The following events trigger closure and sending of a partial SaMOG CDR:

- Volume Limit: The CDR is partially closed when the configured volume threshold is exceeded.
- Time Limit: The CDR is partially closed when the configured interval is reached.
- Maximum number of charging condition changes: The CDR is partially closed when the LOTV container exceeds its limit.
- Management intervention

Configuring the SaMOG CDRs

The SaMOG Gateway uses the custom24 GTPP dictionary to generate SGW and SGSN CDRs.

The following table lists the configuration commands related to creating and formatting the CDRs. These commands appear at different portions of the system configuration file.

- **gttp group** *<name>* - These are commands specified within the billing context.

Table 4: CDR Configuration Parameters

Command	Default	Comment
Trigger-related Configuration **gttp group**<*name*> in Billing Context		
gtpp trigger volume-limit	Enabled	When this trigger is disabled, no partial record closure occurs when the volume limit is reached.
gtpp trigger time-limit	Enabled	When this trigger is disabled, no partial record closure occurs when the configured time limit is reached.
gtpp trigger tariff-time-change	Enabled	When this trigger is disabled, container closure does not occur for a tariff-time change.
gtpp trigger qos-change	Enabled	Disabling this trigger ignores a qos-change and does not open a new CDR for it.
CDR Attribute-related Configuration		
gtpp attribute diagnostics	No	Includes the Diagnostic field in the CDR that is created when PDP contexts are released.
gtpp attribute duration-ms	No	Specifying this option results in mandatory "Duration" field in the CDR to be recorded in milliseconds rather than seconds.
gtpp attribute local-record-sequence-number	No	Specifying this option includes optional fields "Local Record Sequence Number" and "Node-ID" in the CDR. Since the "Local Record Sequence Number" has to be unique within one node (identified by "Node-ID"), "Node-ID" field will consist of sessMgr Recovery count + AAA Manager identifier + the name of the GSN service. Since each AAA Manager generate S-CDRs independently, the "Local Record Sequence Number" and "Node ID" fields will uniquely identify a CDR.

Command	Default	Comment
gtpp attribute msisdn	Enabled	Specifying this option includes field "MSISDN" in the CDR.
gtpp attribute node-id-suffix *<string>*	No String between 1 and 16 characters	Specifies the string suffix to use in the NodeID field of S- CDRs. With the default setting of "no", the SaMOG Gateway uses the GTPP context name for the Node ID field.
gtpp attribute record-type {sgwrecord | sgsnpdprecord }	No	If not explicitly configured, the record type selection is based on the SaMOG license used.
gtpp attribute twanuli	Disabled	Specifying this option includes the "TWAN User Location Information" in the S-GW CDRs. **Important** SaMOG services and standalone S-GW services must not share a GTTP group that has the **gtpp attribute twanuli** command configured. Instead, configure the command under different GTPP groups for each service.
Policy Accounting in Source Context		
cc profile *<index>* **buckets** *<number>*	index = 0-15 number = 4	Specifies the number of traffic volume container changes due to QoS changes or tariff time that can occur before an accounting record is closed.
cc profile *<index>* **interval** *<seconds>*	No	Specifies the normal time duration that must elapse before an accounting record is closed.

Command	Default	Comment
cc profile *<index>* **volume { downlink** *<vol_down_octets>* **uplink** *<vol-up_octets>* **| total** *<total_octets>* **}**	No	Specifies the downlink, uplink, and total volumes that must be met before closing an accounting record. • vol_down_octets is measured in octets and can be configured to any integer value from 100,000 to 4,000,000,000. • vol_up_octets is measured in octets and can be configured to any integer value from 100,000 to 4,000,000,000. • total_octets is the total traffic volume (up and downlink) measured in octets and can be configured to any integer value from 100,000 to 4,000,000,000.
cc profile *<index>* **tariff time1** *mins hours* **time2** *mins hours* **time3** *mins hours* **time4** *mins hours*	No	Specifies time-of-day time values to close the current traffic volume container (but not necessarily the accounting record). Four different tariff times may be specified. If less than four times are required, the same time can be specified multiple times.
Show Commands		
show gtpp counters	None	Displays GTPP counters for configured charging gateway functions (CGFs) within the given context.
show gtpp statistics	None	Displays GTPP statistics for configured CGFs within the context.
show gtpp storage-server counters	None	Displays counters pertaining to the configured GTPP storage server.
show gtpp storage-server statistics	None	Displays statistics pertaining to the configured GTPP storage server.
show gtpp group	None	Displays information pertaining to the configured GTPP storage server group.

Command	Default	Comment
Global Configuration Commands		
gtpp single-source	None	Configures the system to reserve a CPU for performing a proxy function for GTPP accounting. This command is mandatory for dispatching S-CDR. If not specified during bootup, the S-GW CDRs will be generated and buffered in the AAAMgr but not sent out. This is as similar to charging not being done. The maximum number of CDRs which will be buffered in AAAMgr is 128 MB (by size) or 26400 CDRs (by count), whichever comes first.
Call Control Profile Configuration		
accounting mode gtpp	gtpp Enabled	Enable this command to generate the bearer based SaMOG CDRs.
accounting context *<context>* [**gtpp group** *<group>*]	GTPP group Default	If GTPP group is not configured, the default value is used. If the accounting context is not configured, SaMOG service context is used.
cc { behavior-bit no-records *bit_value* | **local-value behavior** *bit_value* **profile index_bit** | *prefer { hlr-hss-value | local-value } }* **no cc behavior-bit no-records** remove cc { behavior-bit no-records | local-value | prefer }	None Enabled	Specifies how the Charging Characteristics should be selected in SaMOG. This command defines the charging characteristics to be applied for CDR generation when the handling rules are applied via. the Operator Policy feature.
associate accounting-policy *<name>*	Not associated	The accounting policy configured various SGW-CDR triggers for the CC profiles. If no policy is configured then triggers based on CC will not be generated and the Accounting policy in SaMOG service context is used.

Command	Default	Comment
samog-cdr twanuli ap-group-name **no samog-cdr twanuli ap-group-name**	SSID	Enable this command to send the AP Group Name in the SSID field of tWANUserLocationInformation in the S-GW CDR. To enable the SaMOG Gateway to send the TWAN ULI attribute in the GTPP requests, use the **gtpp attribute twanuli** command under the GTPP Group Configuration Mode. By default, when the **gtpp attribute twanuli** command is enabled and **samog-cdr twanuli ap-group-name** command is not configured, the SaMOG Gateway sends the SSID information in the TWANUserLocationInformation attribute.
APN Profile Configuration		
accounting mode gtpp	gtpp	Enable this command to generate the bearer based SaMOG CDRs. If not configured, the configuration under the CC profile is used.
accounting context *<context>* [**gtpp group** *<group>*]	GTPP group Default	If this command is not configured, the configuration under the CC profile is used.
associate accounting-policy *<name>*	Not associated	If this command is not configured, the configuration under the CC profile is used.