



Subscriber Charging

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Feature Summary and Revision History

Summary Data

Table 1: Summary Data

| | |
|--|-----------------------------------|
| Applicable Products or Functional Area | SMF |
| Applicable Platforms | SMI |
| Feature Default Setting | Disabled – Configuration Required |
| Related Changes in this Release | Not Applicable |
| Related Documentation | Not Applicable |

Revision History

Table 2: Revision History

| Revision Details | Release |
|---|--------------|
| Added support for extension in Charging Characteristics ID range values. | 2021.02.3.t3 |
| Added support for Query Interface IE. | 2021.02.0 |
| Introduced support for reconciliation of billing records when CHF is unreachable. | 2021.02.0 |

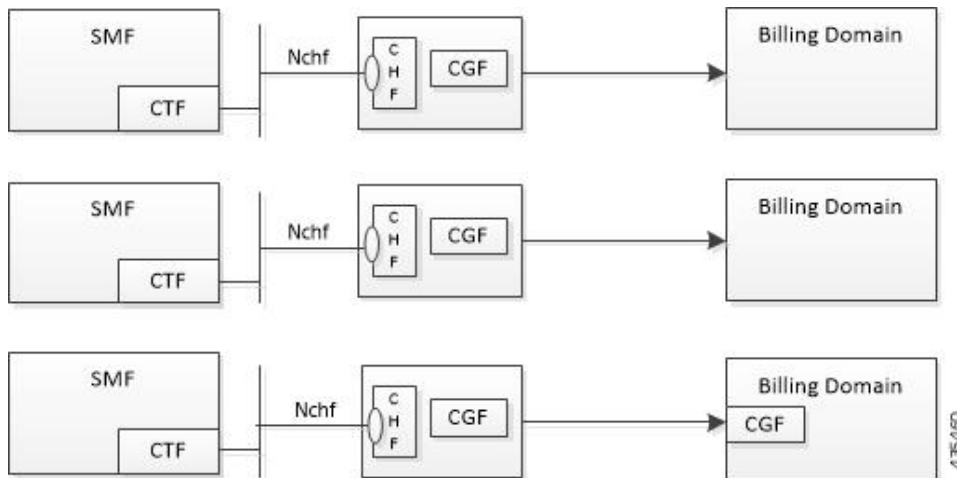
| Revision Details | Release |
|---|---------------|
| Added session-level limitations on the N4 interface. | 2021.01.1 |
| Introduced support for the following: <ul style="list-style-type: none"> • Zero Usage Report Suppression • Dynamic ACS Configuration Change | 2021.01.0 |
| First introduced. | Pre-2020.02.0 |

Feature Description

The SMF acts as a Charging Transfer Function (CTF). The CTF generates charging events toward the Charging Function (CHF), which is responsible for generating Charging Data Records (CDRs).

This SMF interacts with various interfaces, such as N40, N4, N7, and N10, facilitating charging in entirety. Cisco SMF uses the Nchf/N40 interface to generate charging events.

Figure 1: SMF as a Charging Transfer Function



The SMF Charging feature supports the following functionality:

- Converged Online and Offline charging
- PDU session charging using the service-based interface.
- Network slice instance charging
- Charging information collection per PDU session for UEs served under 3GPP and non-3GPP access (untrusted non-3GPP access, trusted non-3GPP access and wireline).
- Unique identity number assignment per PDU session for billing purposes.
- Separate count of data volumes on both the uplink and downlink directions. The data volumes reflect the data as delivered to and forwarded from the user.
- Charging mechanism that provides the date and time information when the PDU session starts.

- Handling of Charging Characteristics specific to a subscription or a subscribed DNN.
- Identification of data volumes, elapsed time, or events for individual service data flows (flow-based charging). One PCC rule identifies one service data flow.
- Usage reporting of a service or a detected application per rating group or per combination of the rating group and service ID. This reporting level can be activated per PCC rule.
- Quota management per Rating Group (RG) per PDU session.
- Charging for IP-based PDU session types.

Converged Charging

The 5G system supports converged charging for offline and online charging scenarios.

The SMF performs converged charging for each of the following:

- Charging data that is related to PDU session.
- Charging data that are related to service-data flows within a PDU session.

The scope of convergent charging in this implementation includes quota management and usage reporting. For convergent charging, the SMF interacts with the CHF for charging data related to PDU sessions. The Charging Data Request and the Charging Data Response messages are exchanged between the SMF and the CHF based on session-based charging (SCUR scenarios). The Charging Data Request is issued by the SMF only when conditions that are related to chargeable events are met.

Chargeable Events

PCC rules can be activated, deactivated, and modified at any time during the PDU session lifetime.

The following attributes can be modified by the PCF in a dynamic PCC rule active in the SMF:

- Charging Key
- Service Identifier
- Measurement Method

Activities on PCC rules and QoS flows are not chargeable events. However, change of charging rule in PCC rules lead to chargeable events such as:

- Start of service data flow
- Termination of service data flow, for the last service data flow for the original PCC rule

The charging key (that is, rating group) is used to request online charging quota.

Charging Identifier

The charging identifier correlates charging information between the SMF and CHF during the duration of a PDU session. The SMF generates and assigns a charging identifier when a PDU session is established. The charging identifier is unique for that PDU session and is used in all messages that are exchanged in that PDU session.

Charging Information

The SMF collects the following charging information for converged online and offline charging:

- Usage of access and core network resources: Describes the amount of data that is delivered to and forwarded from the UE.
- Usage duration: Time interval from PDU Session Establishment to PDU Session Release.
- User: UE information used by the user for a PDU session.
- Data network: Data network address as determined by the DNN.
- Start time: PDU session start time.
- User location: HPLMN and VPLMN reporting area.

For service-data flows (flow-based charging), the SMF collects the following information:

- PDU session description.
- Data that are transmitted in uplink and downlink directions based on the rating-group information, or a combination of rating-group and service ID during volume-based charging.
- Duration of service data flow based on the rating group, or a combination of rating-group and service ID during event-based charging.
- The number of events and corresponding time stamps categorized by rating group or combination of the rating group and service id when event based charging applies.

The SMF collects charging information for service data flows per UPF, within a PDU session, based on the rating-group or based on a combination of rating-group and service ID.

How it Works

Charging Session

The SMF supports converged session-based charging (SCUR) as specified in *3GPP TS 32.290, section 5.3.2.3*.

The SMF establishes charging session with the CHF with the Charging Data Request and Response (Initial) exchange. During the life of the PDU session, usage is reported with Charging Data Request/Response (Update) exchange. After the session is released, Charging Data Request/Response (Termination) messages are exchanged.

Offline Charging and Online Charging

Charging is enabled for a session based on the input that is received from the PCF.

For offline charging, the SMF sends Charging Data Request Initial toward the Charging Function (CHF) based on the presence of charging descriptors and refChgData field set in the smPolicyDecision message from the PCF in SmPolicyControlCreate response.

On determining if charging is required during initial session establishment or post-session establishment, charging is enabled for the PDU session. Once charging is enabled, SMF sends the Charging Data Request (Initial) Message toward the CHF.

The SMF determines Volume/Time threshold value either locally or from Charging Data Response. These values are used to update Volume/Time threshold IE in URR and to set the reporting trigger accordingly. The measurement method that is used in URR is derived from charging data.

For online charging, the SMF receives the Volume/Time Threshold and Quota values from the CHF. These values are received in the Charging Data Response (Initial) or using a Charging Data Request (Update) during a PDU Session Establishment. The SMF relays these Volume/Time Threshold and quota values to the UPF in the corresponding URR.



Note The threshold values from CHF always override the locally configured values.

The following table maps the IEs that are shared with the UPF during Create or Update URR during online or offline charging scenarios:

Table 3: IE Mapping for Online and Offline Charging Scenarios

| IE | Online | Offline | Derived From |
|--------------------|--------|---------|--|
| Volume Limit | Yes | Yes | CHF Response or Local Configuration |
| Time Limit | Yes | Yes | CHF Response or Local Configuration |
| Volume Quota | Yes | No | CHF Response |
| Time Quota | Yes | No | CHF Response |
| Quota Holding Time | Yes | — | CHF Response |
| Monitoring Time | Yes | Yes | <ul style="list-style-type: none"> • Local configuration for offline charging • CHF response for online charging |
| Reporting Trigger | Yes | Yes | The respective triggers that are set as shown in the following table. |

The following table lists the reporting triggers and their derived source:

Table 4: Reporting Triggers and the Derived Source

| Reporting Trigger | Derived From |
|--|--|
| Volume Threshold Trigger | If Volume threshold is set |
| Time Threshold Trigger | If Time threshold is set |
| Volume Quota Trigger | If Quota Exhausted trigger is set from CHF |
| Time Quota Trigger | If Quota Exhausted trigger is set from CHF |
| Linked Usage Reporting (LIUSA) Trigger | If URR contains Linked URR |

Quota Management

The SMF requests quota from the CHF upon meeting any of the following conditions:

- The Rating Group (RG) is installed for the first time and the charging method is Online for the dynamic rule.

- The start of traffic trigger is initiated from the UPF for the RG in the case of static or predefined rules.
- A specific trigger type, as defined in the 3GPP specification 32.255, is received in the usage report for the online charging service from the UPF.

The SMF uses the **quota request always** CLI command to request the quota always. This CLI command is available in the Charging Profile configuration mode. Upon configuring this CLI command, the SMF always requests for quota when reporting the usage to the CHF for the online services. The quota requesting ends when the charging service stops.

Irrespective of the **quota request [always | standard]** CLI configuration, the quota request is disabled for the trigger type "qht" configured through the **quota suppress triggers** CLI command.

Service Units for Quota Management

The SMF sends Charging Data Request (CDR) to the Charging Function (CHF) for the service to be granted authorization to start, and to reserve the number of units. While triggering the CDR, the SMF requests volume (uplink, downlink, total) and time quota from CHF to support VoLTE and other use cases. The values of the requested units for static rules are obtained from the Diameter configuration under Active Charging Service. For the dynamic audio or video rules, the values for the requested service units are configured through the **requested-service-unit** CLI command in the Charging Profile Configuration mode.

Support for Validity Time

The SMF uses time quota value and its corresponding trigger on N4 interface to arm the UPF about the time when the SMF needs the reporting of validity time.

The CHF arms the SMF to report the usage for the rating group when the timer associated with the validity_time expires.

Based on the presence of Validity Quota and Time Quota, the SMF behaves as specified in the following ways:

- When the CHF sends only the Time Quota and not the Validity Quota, the SMF relays the CDR-U to the CHF and reports as Quota_EXHAUSTED upon receiving the usage report from the UPF.
- When the CHF sends only the Validity Quota and not the Time Quota, the SMF relays the CDR-U to the CHF and reports as VALIDITY_TIME upon receiving the usage report from the UPF.
- When the CHF sends both the Validity Quota and the Time Quota, the SMF determines the lower value of time_quota and validity_time, and then relays the CDR-U to the CHF accordingly. The SMF sends the "VALIDITY_TIME" trigger when the validity_time is lesser than the time_quota value. Similarly, when the validity_time is greater than the time_quota value, the SMF sends the "Quota_EXHAUSTED" trigger.

CHF Selection

The CHF selection can be performed through one of the following options:

1. PCF provides one or more CHF addresses as part of the PCC rule.
2. UDM-provided charging characteristics.
3. NRF-based discovery.
4. SMF locally provisioned charging characteristics.



Important The SMF uses one of the last two options to fetch the CHF IP address and port details. The SMF initially performs NRF-based discovery to select the CHF server. If the SMF fails to identify the server, then it uses the locally provisioned charging characteristics.

Charging Activities at SMF

URR Generation Toward N4

The SMF receives charging-data and usage-monitoring-data from the PCF. Based on this information, the SMF derives URR toward N4. In case the SMF is configured with volume/time limit at the session level, the SMF creates session-level URR.

Handling of Initial Event in Charging Component

The session context of SMF is configured with trigger/threshold as per the default described in *3GPP TS 32.255*. It overrides the same based on configuration present in the charging profile. The same values can be further overridden by CHF Charging Data Response Initial. Currently, trigger/threshold cannot be overridden when in PDU Establishment state.

The charging profile is referenced from the charging-characteristic profile. The CC profile is taken from UDM subscription for PDU session. If the CC profile is not mentioned in the UDM response, it is taken from the DNN profile.

After trigger/threshold/quota are determined, the SMF N4 Setup Request with set of Create URRs are derived from charging-data with one session-level URR.

If the session-level reporting is determined, the session-level URR is associated to each SDF URR.

The following triggers are supported:

- Volume/Time trigger at session/RG level
- AMBR change
- QoS change
- Quota threshold and quota exhausted
- Quota handling time
- Tariff time change

Obtaining Threshold Values at SMF

Threshold values, during online charging, are always obtained from the CHF. Whereas the threshold values, during offline charging, are obtained either from the CHF or from the charging profile configuration.

If charging profile is not determined during PDU establishment, the SMF refers to the charging profile from the DNN profile. Once the Charging Profile is determined, the SMF uses the determined Charging Profile to obtain the threshold values for Session/SDF URR.

The configuration has threshold values at a session level or rating-group level. The rating-group level threshold values are generic and not about a rating-group. These threshold values are overwritten by CHF response.



Note The CHF response has various triggers. If some trigger is available at the session level or rating-group level, and if the volume or time threshold value is unavailable, then these values are assumed to be disabled at the corresponding level.

Trigger Determination at SMF

The SMF has triggers enabled by default, as specified in 3GPP TS 32.255, section 5.2.1.4.

These triggers can be overwritten at a session level by trigger configurations present in the charging profile. Further, these triggers can also be overwritten by CHF responses.

Trigger configuration in charging profile is only applicable at a session level. It is not applicable for rating-groups.

Reporting Category

The charging trigger can be of two reporting categories—Immediate and Deferred. The usage report of the immediate category must be reported to the CHF immediately. For reporting events that must be deferred, the SMF stores the usage report locally, and publishes either when the next trigger of the immediate category is invoked, or when the storage limit is exhausted.

When reporting stored usage reports to the CHF, the usage report is triggered because of the trigger type in UsedUnitCategory and the message is triggered because of the trigger type in ChargingDataRequest.

Sometimes, a scenario can have two triggers hit at the same time. AMBR_Change and QoS Change can happen at the same time. In which case, all the triggers as applicable at the RG level or session level will have multiple trigger values.

A trigger can be enabled at the RG level, and for some RG it can be immediate reporting and for others it can be deferred reporting. When a trigger event is hit, various usage reports will have a corresponding category filled respectively in usedUnitContainer.

Deferred CDR will be relayed in the following scenarios:

- An immediate category event happens.
- Maximum number of charging conditions are crossed.
- Configured number of maximum deferred reporting is crossed.

Maximum Charging Characteristics (CC) is reset whenever there are push CDRs. This could be because of maximum CC limits being crossed or because of immediate category reporting.



Note Currently, SMF does not support two charging descriptors with the same rating group.

Handling Reporting Level

The reporting category is classified into the following:

- Rating Group (RG) level: The RG is mandatory at this level.
- Service ID level: The RG and service ID is mandatory at this level.

- Sponsor ID level: The RG and Sponsor ID is mandatory at this level.

PCF communicates the reporting level to the SMF through the Charging Data Request. If the reporting level is RG, then RG is the primary key. If the reporting level is Service level or Sponsor Level, then RG and Service ID or RG and Sponsor ID respectively become the primary key. The SMF drops the charging descriptors from the PCF if the preceding requirement is not satisfied.

Re-Authorization

The CHF triggers Reauthorization of charging descriptors using Charging Notify request. Reauthorization is implemented at the session-level or at a RG-level for both online and offline charging.

The SMF processes the reauthorization details (which contain an array of RG, ServiceId, QuotaMgmtIndicator) received in CHF Notify and retrieves the charging descriptors associated with the current PDU session. SMF ignores any unmatched reauthorization item.

For the charging descriptors identified for reauthorization, the SMF queries for usage reports from UPF and sends it to the CHF.

As part of the CHF response, the SMF detects any change in quota or threshold information and performs N4 Session Modification to update URRs.

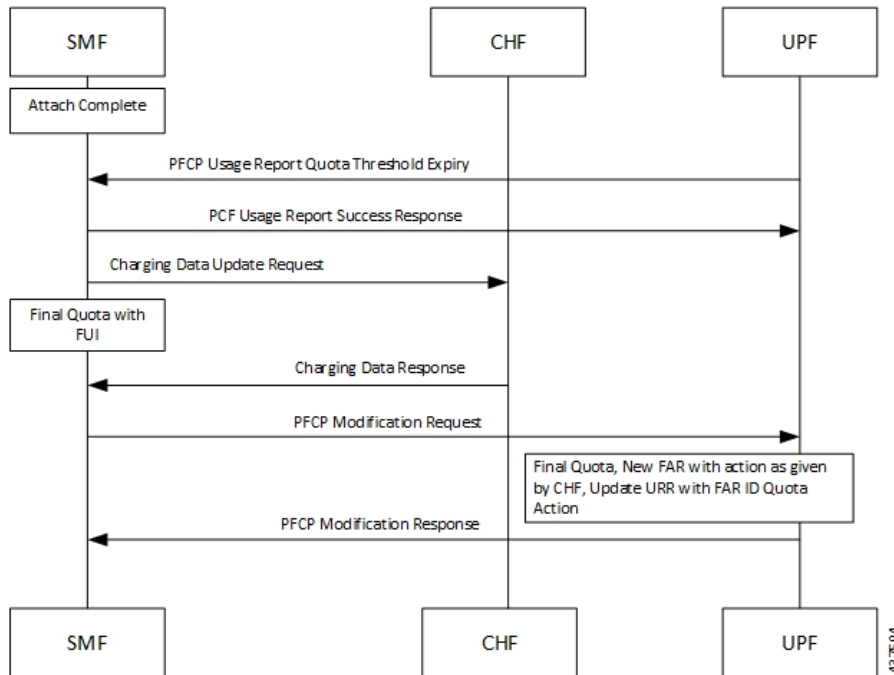
Final Unit Indication Support

The SMF supports Final Unit Indication (FUI) in the Charging Data Initial or Update Response from CHF as per 3GPP TS 32.291, section 6.1.6.2.1.12.

On receiving FUA, the SMF installs new FAR and associates its FAR-ID in the URR, in the FAR ID Quota Action IE. If a FAR with same parameters exists, the SMF uses its FAR-ID in the Create or Update URR. The UPF initiates appropriate actions set in FAR after quota exhaustion.

Currently, the SMF only supports Terminate and Redirect FU actions.

Figure 2: FUI in the Charging Data Initial or Update Response from CHF



- At any instance, CHF provides granted unit (Quota) to the SMF along with FUI.
- When SMF receives the granted unit with FUI, the SMF creates FAR toward N4 and associates it to the corresponding URR which carries the Quota information.
- After UPF receives the FAR associated with the URR, the corresponding FAR action is implemented when the quota exhausts.

Reconciliation of Billing Records



Important The Reconciliation of Billing Records is a customer-specific feature that requires IE level compliance across both the SMF and the CHF.

The communication of SMF and CHF involves both the converged CHF and offline CHF. When all the converged CHF servers are unreachable, the SMF falls back to the offline CHF for uninterrupted usage reporting. Then, the SMF sends the usage to the offline CHF.

The reporting to offline CHF does not include any differentiator in Used Unit Container (UUC) for the offline service and the converted offline service.

SMF supports a new enumerated value “CONVERTED_OFFLINE” in the Quota Management Indicator (QMI) added to the UUC. The SMF uses this enumerated value to mark the converted offline usage records sent to the offline CHF.

With this feature, the offline CHF server can differentiate between normal offline usage and converted usage records.

Static and Predefined Rules for Charging

Configuration of static or predefined rules is similar to the procedures on SMF and UPF. The layout of configuration is as follows:

1. **Rulebase:** A one-to-many rulebase is configurable. For a single PDU session, you can activate a single rulebase any time. PCF can activate the rulebase at SMF by sending the rulebase name in the PCC rule.
2. **Ruledef:** Each rulebase can have one-to-many ruledef configurations. A ruledef can either be of static or predefined type. Each ruledef is assigned to a charging action.
3. **Charging Action:** Contains QoS and charging information.

The SMF derives charging data for each charging action in the rulebase. Charging action associated to static rules in the rulebase is immediately derived and updated in the PDU context. Charging action that is associated to predefined rules is derived and updated when PCF activates the specific predefined rule at SMF.

The charging action derived URR has the following behavior:

- Online charging is identified by the "**cca charging credit**" configuration under charging action.
- Offline charging is identified by the "**billing action egcdr**" configuration under charging action.
- Armed triggers for volume-limit and time-limit are under the gtp group configuration, under APN. The UPF automatically detects these values and sends the respective usage reports.
- The SMF, unlike the dynamic case, does not send the Create URR immediately for charging data that is derived from the configured rules.
- Using the online charging method, the UPF sends usage report with the "Start" trigger. The SMF uses CHF to derive the quota for the RG and relays the same information to the UPF in the Update URR message.
- You can configure the UPF threshold at a rulebase level. It creates a rulebase-level URR that is linked to all ruledef-level URR within the rulebase.

Modification Scenarios in Charging

PCF Update

The PCF performs the following actions during a modification scenario:

- Addition of PCC rules
- Modification of reference data
- Deletion of PCC rules
- Content update in charging data - using Measurement method

CHF Response

The CHF response, during an exchange, sends updated volume and time thresholds and quota. The SMF relays the updated URR toward N4.

A change in threshold, trigger, or quota triggers an Update URR, which leads to the N4 relay.

SMF sends the Update URR based on the following triggers:

- Volume or time threshold
- Volume or time quota
- Tariff time change
- Quota holding time, and so on

CDR Update for Immediate CC Events

The QUERY_INTERFACE IE supports sending the CDR message to the CHF for immediate CC events. If the CC trigger occurs at SMF and the trigger is armed at session level, the SMF queries the online and offline URRs at UPF, and the RADIUS URR if accounting is enabled. The QUERY_INTERFACE IE enables SMF to discover the URR that is available at UPF. This IE is configured along with the QUARR flag while sending the N4 Modification Request.

If the QUARR flag is not configured, the UPF does not report all URRs even if the QUERY_INTERFACE IE is configured. If QUARR flag is configured with the QUERY_INTERFACE IE, the Query URR will not be relayed to the UPF. This functionality is enabled or disabled using the **query-all-urr** CLI command in the Charging Profile configuration. By default, the configuration is enabled.

The QUERY_INTERFACE IE is a composite IE with bits for various interfaces.

The following flags are mapped to the specific URRs:

- GZ_Offline—Maps to interface 1 and UPF reports all offline SDF URRs.
- GY_Online—Maps to interface 7 and UPF reports all online SDF URRs.
- Radius_URR—Maps to interface 9 and UPF reports RADIUS URR.
- Bearer_URR—Maps to interface 2 and UPF reports all QBC URRs.
- Sess_URR—Maps to interface 12 and UPF reports Session level URR.

URR Linking

If you have configured session-level volume or time value locally or have received them from the CHF, the SMF creates session-level URR and links it to all URR corresponding to offline charging descriptors.

If PCF receives multiple charging descriptors that are of the same rating group, the SMF creates extra URR and links it to all URR derived from charging descriptors of the same rating group.

URR Format

Following is the URR ID format:

- URR ID is 32-bit.
- MSB (32nd) bit for static or predefined URRs is configured to 1, and for dynamic URRs is configured to 0.
- First four LSB bits are configured for interface type.
 - 1 for offline
 - 7 for online
- Bit 4-31 is for URR ID number.

For example: Dynamic first URR if ID is 1:

0x00 00 01 01 Offline

0x00 00 01 07 Online

Static or Predefined first URR if ID is 1:

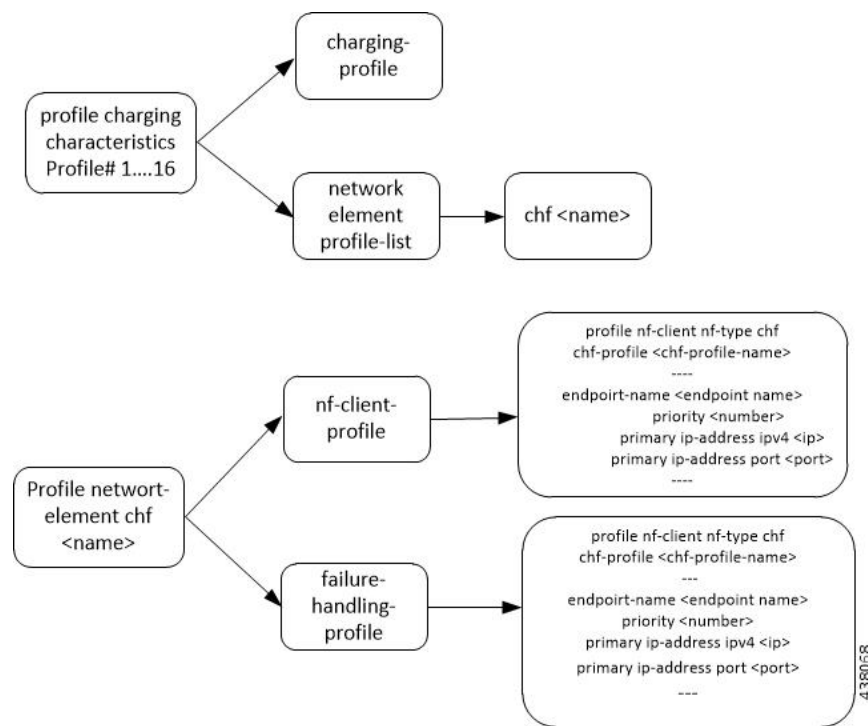
0x80 00 01 01 Offline

0x80 00 01 07 Online

Local Configuration

The following figure illustrates how local configuration works.

Figure 3: Local Configuration



- The SMF supports up to 16 charging characteristic profiles.
- Each CC profile comprises of charging group and charging profile.
- The charging server group and charging profile are linked to the DNN profile. Currently, the charging profile supports configuration for trigger and thresholds.

Zero Usage Report Suppression

The SMF relays the offline resource usage report from the UPF to the CHF if any of the following conditions is met:

- Reporting type is immediate.

- Reporting type is deferred and the maximum number of deferred reportings is crossed.

The usage report includes the charging records with zero value as well. These zero value records (UUC and CDR-U) occupy unnecessary disk space on the CHF. To avoid this issue, the SMF leverages new configuration to control the offline charging records with zero byte data count.

When you configure the **offline zero-usage** CLI command in the Charging Profile configuration mode, the SMF relays the usage to the CHF without any overload of UUC or CDR-U.

The users can select the UUC or CDRs they want to suppress based on the CLI configuration.



Important The CDR release is never suppressed even if the **offline zero-usage drop cdr** command is configured in the Charging Profile configuration mode.

For details on the configuration, see the [Charging Profile Configuration, on page 18](#) section.

Call Flows

This section shows the following call flows:

PDU Session Establishment

The following figure illustrates the call flow of PDU session establishment.

Figure 4: PDU Session Establishment Call Flow

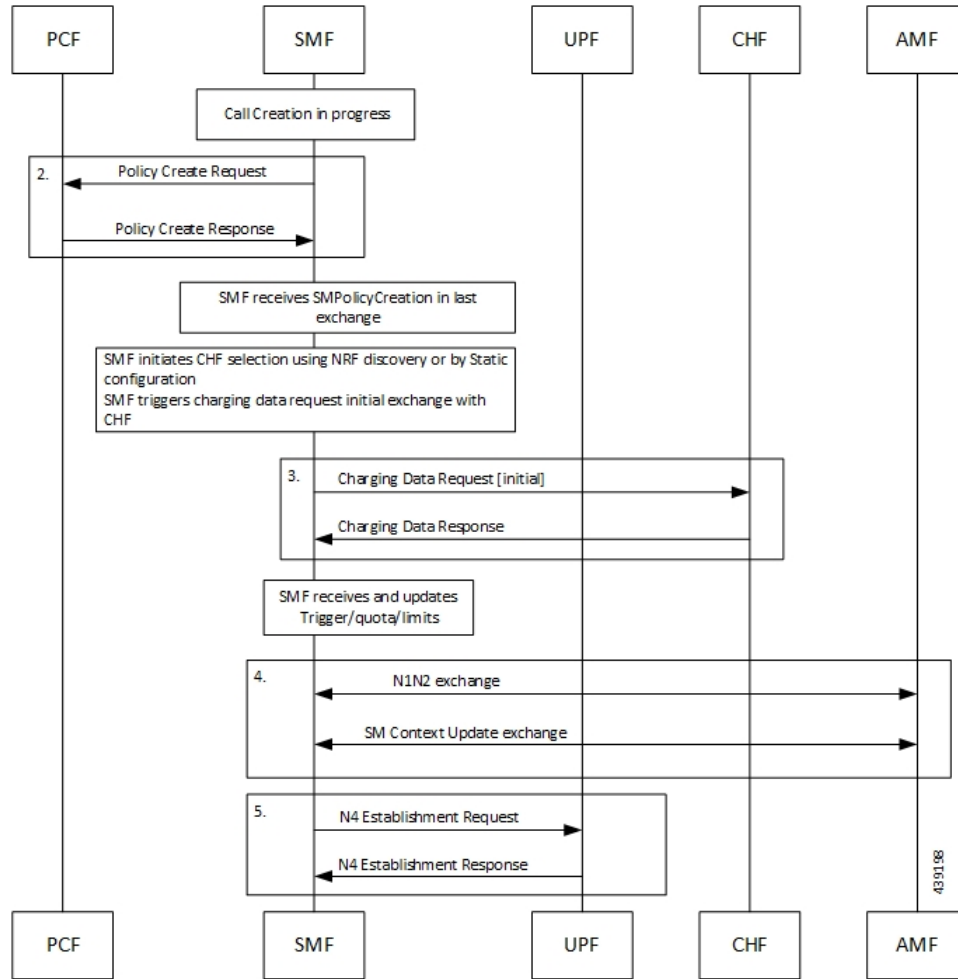


Table 5: PDU Session Establishment Call Flow Description

| Step | Description |
|------|---|
| 1. | Call creation starts at SMF. |
| 2. | SMF performs a Policy Create exchange with PCF. In this exchange, the SMF can receive Charging Data that is associated to a PCC Rule. This Charging data indicates that charging is enabled for the session in progress. PCF may enable Static or Predefined rules. These rules can be also enabled with charging, based on the configuration. |

| Step | Description |
|------|---|
| 3. | <p>After the charging is detected at SMF, SMF initiates a Charging Data Request Initial exchange with CHF. In this exchange SMF may receive the following information from CHF:</p> <ul style="list-style-type: none"> • CC triggers at session or RG level • Session level Time or Volume limits • Time or Volume limits at RG level • Quota at RG level |
| 4. | SMF sends the N1N2 Exchange and SM Context Update Exchange to AMF. |
| 5. | SMF initiates N4 session establishment request exchange with UPF. In the same request, SMF relays the information related to charging in the Create URRs. |

Limitations

The SMF Charging feature has the following limitations on the N4 interface:

- If the session-level URR (CDR-I) is created once, it remains active throughout the session. This URR is not deleted in the subsequent session (CDR-U).
- If the session-level URR is not created, then it is not created in the subsequent CDR-U even if the session limits are available.

Standards Compliance

The SMF Charging feature complies with the following standards:

- *3GPP TS 32.255, version 15.3.0*
- *3GPP TS 32.290*

3GPP June 2019 Compliance for Charging Interface

The SMF is compliant with the 3GPP June 2019 specification TS 32.290 version 15.3.0.

For the June release, the messages goes over the version "v2" as indicated in the following URI format:

```
nchf-convergedcharging/v2/chargingdata
```

The CLI command for compliance configuration is: **service nchf-convergedcharging**. If this CLI command or version is not configured, the default version from 3GPP December 2018 is applied.

With the 3GPP June 2019 compliance, the following information elements (IE) are added:

- Authorized QoS
- Subscribed QoS
- IEs in QoSData
- Serving Network Function ID

Configuring SMF Charging

The SMF Charging involves the following configurations:

- [DNN Profile Configuration, on page 17](#)
- [Charging Characteristics Profile Configuration, on page 17](#)
- [Charging Profile Configuration](#)

DNN Profile Configuration

Use the following configuration to configure a DNN profile for SMF Charging.

```
config
  profile dnn profile_name
    charging-profile profile_name
    network-element-profiles chf profile_name
  end
```

NOTES:

- **charging-profile:** Specifies the Charging Profile configuration.
- **network-element-profiles:** Specifies the network element profile. Network element profile can be one of the following:
 - chf:** Specifies the CHF network element profile.
- *profile_name:* Specifies the name of selected network element profile. After you select the network profile, enter a string.

Charging Characteristics Profile Configuration

Use the following configuration to configure charging characteristics profile for SMF Charging.

```
config
  profile charging-characteristics cc_value
    charging-profile profile_name network-element-profile-list chf chf_name
  end
```

NOTES:

- *cc_value:* Specifies the charging characteristics value, which must be a 1 to 4 digit hexadecimal string in the range of 0x1 to 0xffff. For example, 11AB.

Charging Characteristics ID Configuration

Use the following configuration to configure the charging characteristics ID, which is used to select the charging profile, if you have enabled the offline charging.

```
config
  profile dnn intershat charging-characteristics-id cc_id_value
  end
```

NOTES:

- **profile dnn intershat charging-characteristics-id** *cc_id_value*: Specify the charging characteristics ID value, which must be a 1 to 4 digit hexadecimal string in the range of 0x1 to 0xffff. For example, 11AB.

Charging Profile Configuration

Use the following configuration to configure the charging profile parameters for SMF charging.

```

config
  profile charging profile_name
    limit [ rating-group ] { duration duration_value | volume volume_value }
    max-charging-condition max_cc_value
    max-deferred-urr max_urr_value
    method { none | offline | online }
    offline zero-usage [ drop { cdr | uuc } | measurement { duration |
volume } | trigger { external | final | internal } ]
    query-all-urr { false | true }
    quota request [ always | standard ]
    quota suppress triggers [ qht ]
    reporting-level { offline | online { [rating-group]
| rating-group | service-id }
    requested-service-unit time seconds volume downlink downlink_value
uplink uplink_value total total_value
    tight-interworking-mode { false | true }
    triggers session session_level_triggers
  end

```

NOTES:

- **limit**: Specifies the threshold limit.
- **duration**: Specifies the duration threshold for charging. The threshold value ranges from 0 through 2147483647.
- **volume**: Specifies the volume threshold for charging. The threshold value ranges from 0 through 9223372036854775807.
- **rating-group**: Specifies the volume and duration threshold for a Rating Group.
- **max-charging-condition** *max_cc_value*: Specifies the maximum number of changes to the charging condition. *max_cc_value* must be an integer ranging from 0 through 500. The default value is 20.
- **max-deferred-urr** *max_urr_value*: Specifies the maximum number of deferred USU containers. *max_urr_value* must be an integer ranging from 0 through 200. The default value is 50.
- **method**: Specifies the charging method. The default charging method is offline.
- **offline zero-usage { drop | measurement | trigger }**: The SMF suppresses the offline URR with zero volume and duration. By default, the zero usage drop configuration is disabled on SMF.
 - **drop { cdr | uuc }**: The SMF suppresses the CDR or UUC with zero usage. If there are multiple reports, then the SMF drops only the reports with zero usage. Note that there is no impact on the online reporting.

If the **drop** command is not configured, the SMF stops sending UUC for the offline usage report.

- **measurement { duration | volume }**: The SMF specifies the measurement method of the network usage for suppression. The measurement method is based on volume and duration.

If the **measurement** command is not configured, the SMF suppresses the records with both zero volume and zero duration, or the records with zero volume or zero duration depending on the configuration.

- **trigger { external | final | internal }**: Specifies the list of triggers to be suppressed.
 - **external**: The SMF suppresses the usage reports that are generated due to external triggers, such as QoS Change, RAT change, User Location change, and PLMN Change.
 - **final**: The SMF suppresses the usage reports that are generated at the end of a context.
 - **internal**: The SMF suppresses the usage reports that are generated due to internal triggers such as, volume limit, time limit, and tariff change.

- **query-all-urr { false | true }**: Specify to query all URRs. By default, this configuration is enabled (set to true).

If this CLI command is disabled (configured to false) or the CC trigger is not armed at session level, the SMF will send QUERY_URR and report CC events along with usage report.

- **quota request [always | standard]**: Controls the requesting of quota from the CHF for online charging services based on the configuration. If the **quota request always** is configured, the SMF always requests for quota. If the **no quota request** or **quota request standard** CLI command is configured, then the SMF requests the quota for specific trigger types as defined in standard, which is the default behaviour.
- **quota suppress triggers [qht]**: Suppresses the quota from the CHF upon configuring the usage report trigger type "qht".
- **reporting-level**: Specifies the reporting level configuration to be used for offline and online charging. The default value is [rating-group] level.
- **requested-service-unit**: Configures the value for the requested service units.
 - **time seconds**: Configures the time quota value in seconds from 1 through 4000000000.
 - **downlink downlink_value**: Configures the downlink volume in bytes from 1 through 4000000000.
 - **uplink uplink_value**: Configures the uplink volume in bytes from 1 through 4000000000.
 - **total total_value**: Configures the total volume in bytes from 1 through 4000000000.
- **tight-interworking-mode**: Configuration to enable tight interworking mode for online or offline charging methods.
- **triggers**: Specifies the list of triggers to be configured.
- **session session_level_triggers**: Specifies the list for Session Level Triggers. The list of Session Level Triggers is as follows:
 - **repor3gpp-ps-change**
 - **ambr-change**
 - **max-number-of-changes-in-charging-conditions**

- **plmn-change**
- **qos-change**
- **rat-change**
- **serv-node-change**
- **tarrif-time-change**
- **ue-pra-change**
- **ue-time-change**
- **upf-add**
- **upf-rem**
- **user-loc-change**

The following is a sample configuration for SMF Charging:

```
config
profile dnn intershat1
  charging-profile chgprf1
exit
profile charging chgprf2
  limit volume 15000
  limit duration 90
  limit rating-group volume 12000
  limit rating-group duration 80
  triggers session [ ambr-change qos-change max-number-of-changes-in-charging-conditions ]
  max-charging-condition 1
  max-deferred-urr 3
  reporting-level online service-id
  reporting-level offline service-id
exit
```

Mapping of Charging Scenario on Various Interfaces

Feature Description

The charging functionality and behavior of the SMF is influenced by the parameters and messages received from the CHF, PCF, and UPF on the N40, N7 and N4 interfaces. Based on the charging data that SMF receives, it provides reporting level support for online and offline charging.

How it Works

The SMF provides the different reporting levels for online and offline charging with the following rules:

- Configured rules are derived from the static or predefined charging actions.
- Session-level Usage Reporting Rule (URR) is derived from CHF trigger or local configuration.
- The SMF does not associate session-level URR for online and offline method charging description.
- The SMF does not associate session-level URR to the configured charging-action URRs.

- Rulebase URR is applicable only for the offline configured URR.
- For the configured online or online-offline charging method, if Ignore Service ID configuration exists, the URR list must contain "rg x urr-id y". Else, the SMF drops the charging actions as malformed.



Important The SMF supports multiple charging methods within the same rating group.

Charging Mapping

The N7 interface uses Charging Data from PCC rules or local configuration, N4 interface uses URR or Packet Detection Rule (PDR), and N40 interface uses Used Unit Container (UUC).

The SMF charging mapping on N7, N4, and N40 interfaces with various charging methods is described as follows.

Offline Method When Charging Data is Derived from One PCC Rule

Reporting level: Rating Group level or Service ID level

N4 interface:

- First URR is derived from the first Charging Data. Charging data limits from rating group trigger or local configuration.
- Second URR is derived from Session Limit, which is CHF or local configuration.
- Second URR is linked to the first URR.
- First PDR is derived from the first PCC rule.
- First and second URRs are linked to the first PDR.

N40 interface:

- First UUC is derived from the usage report of the first URR.
- First UUC may or may not have a service identifier.



-
- Note**
- Session-level URR is not associated to the configured URRs.
 - If configured, rulebase URR replaces session-level URR.
 - If configured and rulebase URR exists, it is linked to the first URR.
-

Online Method When Charging Data is Derived from One PCC Rule

Reporting level: Service ID level or Rating Group level

N4 interface:

- First URR is derived from the first Charging Data, which is threshold or quota from rating group granted-unit.

- Second URR is derived from Session Limit, which is CHF or local configuration.
- Second URR is linked to the first URR.
- First PDR is derived from the first PCC rule.
- First and second URRs are linked to the first PDR.

N40 interface:

- First UUC is derived from the usage report of the first URR.
- First UUC may or may not have a service identifier.



Note • Session-level URR is not associated to the configured URRs.

Offline Method When Charging Data is Derived from Two PCC Rules

Reporting level: Service ID level

N4 interface:

- First URR is derived from the first Charging Data. Charging data has no limit and the rating trigger must be LIUSA.
- Second URR is derived from the second Charging Data. Charging data has no limit and the rating trigger must be LIUSA.
- Third URR is derived from rating group level, which limits from Rating-Group trigger or local configuration.
- Fourth URR is derived from Session Limit, which is CHF or local configuration.
- The third and fourth URRs are linked to the first and second URRs.
- First PDR is derived from first PCC rule.
- Second PDR is derived from second PCC rule.
- First, third, and fourth URRs are linked to the first PDR.
- Second, third, and fourth URRs are linked to the second PDR.

N40 interface:

- First UUC is derived from the usage report of the first URR.
- Second UUC is derived from the usage report of the second URR.
- Both the first and the second UUCs have a service identifier.



Note • Session-level URR is not associated to the configured URRs.

• If configured, rulebase URR is linked to the first and second URRs.

Online Method When Charging Data is Derived from Two PCC Rules

Reporting level: Service ID level

N4 interface:

- First URR is derived from the first Charging Data. Charging data has no limit and the rating trigger must be Linked Usage Reporting (LIUSA).
- Second URR is derived from the second Charging Data. Charging data has no limit and the rating trigger must be LIUSA.
- Third URR is derived from rating group level, which is threshold or quota from the rating group granted unit.
- Fourth URR is derived from Session Limit, which is CHF or local configuration.
- Third and fourth URRs are linked to the second and fourth URRs.
- First PDR is derived from the first PCC rule.
- Second PDR is derived from the second PCC rule.
- First, third, and fourth URRs are linked to the first PDR.
- Second, third, and fourth URRs are linked to the second PDR.

N40 interface:

- First UUC is derived from usage report of the first URR.
- Second UUC is derived from the usage report of the second URR.
- Both the first and the second UUCs have a service identifier.



Note

- Session-level URR is not associated to the configured URRs.
 - If Ignore Service ID is configured, this method is not valid.
-

Offline-Online Method When Charging Data is Derived from One PCC Rule

Reporting level: Service ID level or Rating Group level

N4 interface:

- Offline URR is derived from the first Charging Data, which limits rating group trigger or local configuration.
- Online URR is derived from the first Charging Data, which limits from the granted unit.
- First PDR is derived from the first PCC rule.
- Offline and online URRs are linked to the first PDR.

N40 interface:

- First UUC is derived from the usage report of the offline URR.

- Second UUC is derived from the usage report of the online URR.

Offline-Online Method When Charging Data is Derived from Two PCC Rules

Reporting level: Service ID level

N4 interface:

- First offline URR is derived from the first Charging Data. Charging data has no limit and the rating trigger must be LIUSA. Charging data has the linked URR ID as URR_Off3.
 - Second offline URR is derived from the second Charging Data. Charging data has no limit and the rating trigger must be LIUSA. Charging data has the linked URR ID as URR_Off3.
 - Third offline URR is the rating group level, which limits the rating group trigger or local configuration.
- First online URR is derived from the first Charging Data. Charging data has no limit and the rating trigger must be LIUSA. Charging data has the linked URR ID as URR_Online3.
- Second online URR is derived from the second Charging Data. Charging data has no limit and the rating trigger must be LIUSA. Charging data has the linked URR ID as URR_Online3.
- Third online URR is the rating group level, which limits from the granted unit.
- First PDR is derived from the first PCC rule.
- Second PDR is derived from the second PCC rule.
- First offline URR, first online URR, third offline URR, and third online URR are linked to the first PDR.
- Second offline URR, third online URR, third offline URR, and third online URR are linked to the second PDR.

N40 interface:

- First UUC is derived from the usage report of the first offline URR and has a service identifier.
- Second UUC is derived from the usage report of the second offline URR and has a service identifier.
- Third UUC is derived from the usage report of the first online URR and has a service identifier.
- Fourth UUC is derived from the usage report of the second online URR and has a service identifier.

Offline-Online Method When Charging Data is Derived from One PCC Rule with No Service Identifier

The offline and online reporting levels are at Service ID and Rating Group levels respectively.

Prerequisite: No Reporting Level from PCF

- CLI:
 - Tight interworking mode
 - Ignore Service Identifier
 - Offline Reporting: Service Identifier
 - Online Reporting: Rating Group



-
- Note**
- The SMF ignores the volume or time limit trigger from CHF at the rating group level.
 - Session-level URR is not associated to URRs that are derived from the first Charging Data.
-

N4 interface:

- Offline URR is derived from the first Charging Data. Charging data has no limit and the rating trigger must be LIUSA. Charging data has the linked URR ID as URR_Online.
- Online URR is derived from the first Charging Data, which limits from the granted unit.
- First PDR is derived from the first PCC rule.
- Online URR and offline URR are linked to the first PDR.

N40 interface:

- First UUC is derived from the usage report of the offline URR and has a service identifier.
- Second UUC is derived from the usage report of the online URR and does not have a service identifier.



-
- Note**
- Session-level URR is not associated to the configured URRs.
 - If URR is configured, URR rulebase is derived from egcdr and is linked to both the offline and the online URRs.
-

Offline-Online Method When Charging Data is Derived from Two PCC Rules with No Service Identifier

The offline and online reporting levels are at Service ID and Rating Group levels respectively.

Prerequisite: No Reporting Level from PCF

- CLI:
 - Tight interworking mode
 - Ignore Service Identifier
 - Offline Reporting: Service Identifier
 - Online Reporting: Rating Group



-
- Note**
- The SMF ignores the volume or time limit trigger from CHF at the rating group level.
 - Session-level URR is not associated to URRs that are derived from the first Charging Data.
-

N4 interface:

- First offline URR is derived from the first Charging Data. Charging data has no limit and the rating trigger must be LIUSA. Charging data has the linked URR ID as URR_Online.
- Second online URR is derived from the second Charging Data. Charging data has no limit and the rating trigger must be LIUSA. Charging data has the linked URR ID as URR_Online.
- URR_Online is derived from the second Charging Data, which limits from the granted unit.
- First PDR is derived from the first PCC rule.
- Second PDR is derived from the second PCC rule.
- First offline URR and URR_Online are linked to the first PDR.
- Second offline URR and URR_Online are linked to the second PDR.

N40 interface:

- First UUC is derived from the usage report of the first offline URR and has a service identifier.
- Second UUC is derived from the usage report of the second offline URR and has a service identifier.
- Third UUC is derived from the usage report of the URR_Online and does not have a service identifier.



Note

- Session-level URR is not associated to the configured URRs.
 - If URR is configured, URR rulebase is derived from egcdr and is linked to both the first and second offline URRs along with URR_Online.
-

Limitations

This feature has the following limitations:

- Tight interworking mode is not supported for the service which is at the rating group level.
- One service at the rating group level and another service at service ID level are not supported.

Standards Compliance

The Different Reporting Level Support for Online and Offline Charging feature complies with the following standards:

- 3GPP TS 32.255
- 3GPP TS 32.290

Failure Handling Scenarios

This section describes the different failure handling scenarios associated with the errors that occur during SMF charging.

Application Error and Result Code Handling

SMF supports the application error codes from CHF at command level as defined in 3GPP TS 32.291 specification, version 15.3.0, section 6.1.7.3. The SMF also supports RG-level result codes as defined in 3GPP 32.291 specification, version 15.3.0 section 6.1.6.3.14.

The following labels are defined in the "chf_appl_err_stats" counter to indicate the CHF response failures at the application level.

- http2_err_code—Includes the following values:
 - 403
 - 400
 - 404
- appl_err_code—Includes the following values:
 - END_USER_REQUEST_REJECTED
 - END_USER_SERVICE_DENIED
 - QUOTA_LIMIT_REACHED
 - CHARGING_NOT_APPLICABLE
- appl_err_action—Includes the following values:
 - drop_traffic
 - disable_charging
 - terminate
- appl_err_exchg_type—Includes the following values:
 - initial
 - update

Application Error Codes

The following table provides details of the application error codes with the corresponding SMF action.

| Application Error /Session Level | HTTP2 Code | SMF Action | CHF Expected Actions | Limitations |
|----------------------------------|------------|--|------------------------|-------------|
| CHARGING_FAILED | 400 | Terminate | None | None |
| RE_AUTHORIZATION_FAILED | 400 | None | Take corrective action | - |
| CHARGING_NOT_APPLICABLE | 403 | Continue subscriber session without Charging (no offline charging as well) | None | None |

| Application Error /Session Level | HTTP2 Code | SMF Action | CHF Expected Actions | Limitations |
|----------------------------------|------------|--|--|-------------|
| USER_UNKNOWN | 404 | Terminate | None | None |
| END_USER REQUEST_DENIED | 403 | Terminate | None | None |
| QUOTA_LIMIT_REACHED | 403 | Drop traffic for the online services. Offline services are not impacted. | CHF sends notify (RAR) after this condition is recovered for the session | |

**Note**

- The error code 403 is not configured in the failure handling template.
- CHARGING_NOT_APPLICABLE (Disable charging) for static and predefined rules, occurs when a proprietary IE “Charging Disabled” in subscriber params is sent in the N4 modification or establishment request. This request is sent to prevent UPF from generating Start of Traffic for the URRs pending for activation.

RG-level Result Codes

The following table provides details of the result code with the corresponding SMF action.

| RG-level Result code | HTTP Status Code | SMF Behaviour | CHF Expected Behaviour | Limitations |
|---------------------------------|------------------|--|--|---|
| RATING_FAILED | 200 | Drop traffic corresponding to the rating group | None | None |
| QUOTA_MANAGEMENT_NOT_APPLICABLE | 200 | Convert to offline | None | None |
| USER_UNKNOWN | 200 | Ignored (supported only at session level) | Not expected from CHF | None |
| END_USER SERVICE_DENIED | 200 | Drop traffic corresponding to the rating group | CHF sends notify (RAR) after this condition is recovered for the rating group. | Traffic will be dropped for offline service as well for online or offline services. |

| RG-level Result code | HTTP Status Code | SMF Behaviour | CHF Expected Behaviour | Limitations |
|---------------------------|------------------|--|--|-------------|
| QUOTA_LIMIT_REACHED | 200 | Drop traffic corresponding to the rating group | CHF sends notify (RAR) after this condition is recovered for the session | None |
| END_USER_SERVICE_REJECTED | 200 | Drop traffic corresponding to the rating group | CHF sends notify (RAR) after this condition is recovered for the session | None |

Charging Server Reconciliation

The SMF falls back to the first available offline CHF server when the NF selected by NF discovery is unreachable. The CHF Reconciliation feature involves deleting the existing subscribers that are associated to a set of offline NFs, and the subscribers that are in offline fallback mode.



Note The CHF reconciliation is applicable only when CHF endpoint is selected by NRF through NF discovery service.

The CHF server reconciliation works when one of the following two conditions is met:

1. If the NRF detects that an offline CHF server is active.
2. If the RAR is received from the CHF server on an offline converted session.

For the second condition, the session gets deleted directly. With the NF discovery, this feature involves the following steps:

1. SMF subscribes for the notification of NF instance IDs from NRF through NF_LIB component of Rest-EP.
2. If the NF discovery query determines that all the NFs are down, the NF_LIB component treats these set of NFs as offline. If any one of the NFs is available again, the NRF triggers notification for the same to the SMF.
3. The SMF performs NF discovery after revalidation timer. If the NRF detects any new NF, the SMF receives the corresponding notification from the NRF.
4. When the SMF identifies that an NF is online with all the required NF discovery query parameters, then the SMF initiates the CHF server reconciliation.

The following labels are introduced as part of this feature:

- `disc_pdurel_chf_reconciliation`: This label is defined under `SMF_DISCONNECT_STATS` to show the reason of disconnection.
- `chf_reconl_pdu_sess_rel`: This label is defined under `smf_service_stats` metric to show the number of times the PDU session release procedure is initiated.

Dynamic Update of Charging Configurations

Feature Description

The Dynamic Configuration Change Support feature allows SMF to dynamically handle the configuration changes of the charging parameters while minimizing the configuration errors. The existing and new SMF Charging parameters allow implementation of the dynamic configuration updates. This feature supports the following charging configurations:

- Active Charging Service (ACS) Profile
 - Rulebase
 - Ruledef
 - Charging-Action
 - Credit-Control-group
- Charging Profile
- Charging Characteristics
- GTPP Group
- Upf-Apn Configuration Group

How it Works

This section describes how dynamic change in configuration works for the supported Failure Handling Profile and Charging Profile configuration.

ACS Profile

The SMF supports dynamic change in the ACS configuration during the run time. The ACS Profile configuration defines various parameters for the ACS profile.

The following table lists the SMF and UPF behavioral changes during the dynamic update of ACS configuration in different scenarios.

Table 6: ACS Profile Configurations and its Impact during Dynamic Update

| Configuration | Config Applied on both SMF and UPF | Config Applied only on SMF | Config Applied only on UPF |
|---------------|------------------------------------|----------------------------|----------------------------|
|---------------|------------------------------------|----------------------------|----------------------------|

| | | | |
|-------------------|---|--|--|
| Rulebase addition | <p>Existing Session: Continue to use the current rulebase value</p> <p>New Session: No impact for the new session</p> | <p>Existing Session: Change in the rulebase gets rejected at UPF</p> <p>New Session: Session creation fails at UPF for this rulebase</p> | <p>Existing Session: Change in the rulebase gets rejected at SMF</p> <p>New Session: Session creation fails at SMF for this rulebase</p> |
| Rulebase removal | <p>Existing Session: Not allowed without node drain</p> <p>New Session: No impact for the new session</p> | <p>Existing Session: Not allowed without node drain</p> <p>After the configuration change, the rulebase configuration remains stale on SMF if the rulebase removal on UPF is missed</p> <p>New Session: No impact for the new session</p> | <p>Existing Session: Not allowed without node drain</p> <p>After the configuration change, the rulebase configuration remains stale on UPF if the rulebase removal on SMF is missed</p> <p>New Session: No impact for the new session</p> |
| Ruledef addition | <p>Existing Session: Activates the new rule successfully</p> <p>New Session: No impact for the new session</p> | <p>Existing Session - Static Rule: The UPF neither activates the rule nor sends the report for this rule.</p> <p>Existing Session - Predefined Rule: Fails to activate the new rule until the UPF receives it.</p> <p>New Session: Same as the existing session</p> | <p>Existing Session - Static Rule: The UPF activates this rule and reports the usage. The SMF has the charging data for this RG+ServID. It creates dummy ChrgParam and associates URR to it.</p> <p>Existing Session - Predefined Rule: Fails to activate the new rule until the SMF receives it</p> <p>New Session: Same as the existing session</p> |
| Ruledef deletion | <p>Existing Session: The current flows remain as is. If the flow is not created, it will never be created for this session. The SMF or UPF does not remove the associated charging.</p> <p>New Session: No impact for the new session</p> | <p>Existing Session - Predefined rule : The SMF rejects this rule creation.</p> <p>Static and Activated Predefined Rules: Existing flows remain as is. The SMF or UPF does not remove the associated charging. The received usage is reported successfully.</p> <p>If the SMF has not received the first usage report and when the first report arrives, the SMF creates chrgParam/Urr context from RG+ServID.</p> <p>New Session: Same as the existing session</p> | <p>Existing Session - Predefined rule: The SMF continues to allow this rule creation but fails at the UPF.</p> <p>Static and Activated Predefined Rules: The UPF continues with the created URR for these flows. The SMF reports the usage without any issue.</p> <p>New Session: Same as the existing session</p> |

| | | | |
|--|---|--|--|
| Charging Action addition with new RG/Svc Id (With addition of new rules associated to that CA) | <p>Existing Session - Static Rule: The SMF creates charging entry for this RG when the first URR is received.</p> <p>Existing Session - Predefined Rule: The SMF activates the rule based on the PCF trigger.</p> <p>New Session: No impact for the new session</p> | <p>Existing Session - Static Rule: The UPF does not activate this flow. The SMF never receives the usage.</p> <p>Existing Session - Predefined Rule: The UPF fails to install predefined rule due to the unavailability of ruledef info.</p> <p>New Session: Same as the existing session</p> | <p>Existing Session - Static Rule: The UPF activates this flow. The SMF creates the charging entry for this RG when the first URR is received.</p> <p>In this case, the SMF does not find Charging-action with this RG+ServID. It creates dummy ChrgParam with the received RG+ServID.</p> <p>Existing Session - Predefined Rule: Same as mentioned for the static rule.</p> <p>New Session: Same as the existing session</p> |
| Charging action (and associated rules) removal | <p>Existing Session - Static Rules: The SMF and UPF continue with the current flow and report any URRs for this RG.</p> <p>Predefined Rules:</p> <p>The SMF and UPF continue with the current flow and report any URRs for this RG. Once the rule is deactivated, it will not be activated again.</p> <p>New Session: No impact for the new session</p> | <p>Existing Session - Static Rules: The SMF and UPF continue with the current flow and report any URRs for this RG.</p> <p>Predefined Rules:</p> <p>The SMF and UPF continue with the current flow and report any URRs for this RG. Once the rule is deactivated, it will not be activated again.</p> <p>New Session: Same as the existing session</p> | <p>Existing Session - Static Rules: The SMF and UPF continue with the current flow and report any URRs for this RG.</p> <p>Predefined Rules:</p> <p>The SMF and UPF continue with the current flow and report any URRs for this RG. Once the rule is deactivated, it will not be activated again.</p> <p>New Session: Same as the existing session</p> |
| RG/Svc Id, Online/Offline Config changed within CA | <p>Static Rules and Already Active Predefined Rules: The UPF creates new URRs and reports them. The SMF reconciles from URR ID table and creates charging data for these URRs as and when reported.</p> <p>Post config change activation of predefined rules: No issues. Both SMF and UPF are in sync.</p> <p>New Session: No impact for the new session</p> | <p>Static Rules and Already Active Predefined Rules: The UPF continues reporting with old URR ID and the SMF continues to report it without any issue.</p> <p>Post config change activation of predefined rules: Same as Static Rules</p> <p>New Session: The UPF rejects the establishment request if the predefined rules are activated during session establishment.</p> | <p>Static Rules and Already Active Predefined Rules: The UPF creates new URRs and reports them. The SMF reconciles from URR ID table and creates dummy chrgParam and associates URR to it.</p> <p>Post config change activation of predefined rules: Same as Static Rules</p> <p>New Session: The UPF rejects the establishment request if the predefined rules are activated during session establishment.</p> |

| | | | |
|--|-------------------------|-------------------------|---|
| URR Id table entry addition (New RG addition) | No action needed on SMF | No action needed on SMF | The UPF creates URR. |
| URR Id table entry removal | No impact | No impact | The UPF creates URR. The removal has no impact on the created URR. |
| URR Id table entry modification | No impact | No impact | The UPF creates URR. Removal has no impact on the created URR. If the same URR-id is allocated to different RG+ServID, the removal impacts the URR. The UPF fails to create new URR for the new RG+ServId. |

NOTES:

- If the online report includes service id and the ignore-service-id is not configured in credit control profile, the SMF drops the report.
- If the new online URR contains the same RG as an existing URR, then the SMF drops the usage report.
- If the new offline URR contains the same RG+service ID as an existing URR, the SMF drops the usage report.
- In the same usage report, if the next online URRs include the same RG and the next offline URRs include with the same RG + service ID, the SMF drops the usage report.

Charging Profile

The Charging Profile supports dynamically updating the configuration based on the values that you pass during the runtime. The refresh operation of the values takes place considering the following scenarios:

- **Configuration reflects in the next encounter to access:** If the values are updated while an operation is in-progress, the SMF ignores the new values and continues to use the old values. For example, Limits in Charg-Profile and CC triggers.
- **Configuration reflects only on a new session:** If the configuration is specific to a session and the session has already considered the values, then the SMF does not consider the new values. For example, PduContext (DB entry). This case indicates that any update to the configuration does not impact the sessions that are already created. For instance, Charging Method in Profile or Charg-Profile in Charging Characteristics.
- **Configuration reflects instantly:** Configurations immediately consider the dynamic values whenever they are updated. If SMF has already used a configuration and it is later updated, then it uses the latest values.

If a session is created using a Charging Profile, which later gets deleted from the Ops Center, the session might attempt to access the configuration structure of the deleted profile. In such cases, the Smf-Service pod maintains a default profile mapped to the sessions whose profiles are missing.

The Charging Profile is responsible for handling the SMF charging parameters.

The following table lists the configuration parameters with the dynamic configuration change and its impact on the existing sessions.

Table 7: Charging Profile Parameters

| Configuration Parameters | Dynamic Change | Impact on Existing Sessions |
|-----------------------------|----------------|---|
| limit rating-group duration | Allowed | New values are used during the new URR creation or the subsequent URR update for the existing sessions Note The dynamic configuration does not initiate a URR update. |
| max-charging-condition | Allowed | No impact |
| max-deferred-urr | Allowed | No impact |
| metering-method | Allowed | New values are used during the new URR creation for the existing sessions |
| method | Allowed | No impact |
| reporting-level | Allowed | No impact |
| requested-service-unit time | Allowed | No impact |
| tight-interworking-mode | Allowed | No impact |
| triggers session | Allowed | No impact |
| Request Quota | Allowed | No impact |

Charging-Characteristics Profile

The Charging-Characteristics Profile configuration defines the various parameters for managing the charging characteristics for SMF Charging.

The following table illustrates if the configuration parameters allow dynamic configuration change.

Table 8: Charging-Characteristics Profile Parameters

| Configuration Parameters | Dynamic Change | Impact on Existing Sessions |
|--------------------------|----------------|---|
| charging-profile | Not Allowed | The configuration is used only once while setting up the session. |

Charging-Action Profile

The Charging-Action Profile configuration defines the QoS and charging related parameters associated with the rule definitions.

The following table illustrates if configuration parameters allow dynamic configuration change.

Table 9: Charging-Action Profile Parameters

| Configuration Parameters | Dynamic Change | Impact on Existing Sessions |
|-----------------------------|----------------|-----------------------------|
| Rating group and Service ID | Allowed | No impact |

Credit-Control-Group Profile

The Credit-Control-Group configuration defines the parameters to be used for subscribers who use the mapped rulebase.

The following table illustrates if configuration parameters allow dynamic configuration change.

Table 10: Credit-Control-Group Profile Parameters

| Configuration Parameters | Dynamic Change | Impact on Existing Sessions |
|--------------------------|----------------|-----------------------------|
| Ignore Service ID | Allowed | No impact |

Rulebase Profile

The Rulebase configuration parameters define the protocol rules to match a flow and the associated actions to be taken for the matching flow.

The following table illustrates if configuration parameters allow dynamic configuration change.

Table 11: Rulebase Profile Parameters

| Configuration Parameters | Dynamic Change | Impact on Existing Sessions |
|--|----------------|--|
| Ruledef association to Charging-action | Allowed | No impact |
| Credit-Control-Group | Allowed | The configuration is used only once while setting up the session |

GTPP Group Profile

The GTPP Group Profile configuration specifies the parameters for creating the GTPP group.

The following table illustrates if configuration parameters allow dynamic configuration change.

Table 12: GTPP Group Profile Parameters

| Configuration Parameters | Dynamic Change | Impact on Existing Sessions |
|------------------------------------|----------------|--|
| Limits for offline configured urrs | Allowed | New values are used during the new URR creation for the existing sessions. |

UPF-APN Configuration Profile

The UPF-APN Configuration Profile configuration defines the various parameters for the UPF-APN profile.

The following table illustrates if the configuration parameters allow dynamic configuration change.

Table 13: UPF-APN Configuration Profile Parameters

| Configuration Parameters | Dynamic Change | Impact on Existing Sessions |
|---------------------------------|-----------------------|---|
| Association of GTPP Group | Allowed | The configuration is used only once while setting up the session. |

Network Profile for Peer CHF

The network profile for peer CHF configuration defines the various network configurations.

The following table illustrates if configuration parameters allow dynamic configuration change.

Table 14: Network Profile for Peer CHF Parameters

| Configuration Parameters | Dynamic Change | Impact on Existing Sessions |
|---------------------------------|-----------------------|------------------------------------|
| Set of CHFs configured | Allowed | No impact |