LORC Subscriber Overcharging Protection for S4-SGSN

The SGSN's Subscriber Overcharging Protection feature has been enhanced and now extends to the S4-SGSN to prevent both 2G and 3G subscribers from being overcharged when a loss of radio coverage (LORC) occurs over the S4 interface.

As part of this functionality, the operator configures all cause codes on the SGSN. If the SGSN receives a cause code, via Iu/Gb interfaces, that matches one of the cause codes configured on the SGSN, then the SGSN includes the ARRL (Abnormal Release of Radio Link) bit in the Release Access Bearer Request.

Feature Description

Subscriber Overcharging Protection prevents subscribers from being overcharged when a loss of radio coverage (LORC) occurs.

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Important In order for the Subscriber Overcharge Protection feature to be most effective, the SGSN supports initiation of Release Access Bearer Request on Iu-Release for all subscribers (even for non-ISR and non-DT cases). Refer to the section on *Release Access Bearer Requests* below for details.

LORC Subscriber Overcharge Protection on the S4-SGSN

LORC is standardized in 3GPP release 12.0 specifications. According to 3GPP TS 23.401, the SGSN includes the ARRL (Abnormal Release of Radio Link) Indication in Release Access Bearer Request messages if the Iu-Release procedure is due to an abnormal release of the radio link.

It should be noted that 3GPP has not defined LORC for UMTS / GPRS access in an EPS network. Currently, it is defined only for E-UTRAN access. However, the SGSN can use the defined 3GPP mechanism to achieve PDN pause of charging in UMTS / GPRS access as well.

With this feature the S4-SGSN should include the ARRL (Abnormal Release of Radio Link) bit in indication flags IE of Release Access Bearer Request when Iu-Release occurs due to the cause 'Radio Connection With UE Lost (46)' in 3G.

Also the S4-SGSN should include the ARRL (Abnormal Release of Radio Link) bit in indication flags IE of Release Access Bearer Request when Radio Status Bad ia received in 2G.

The operator configures all cause codes on the SGSN so if the SGSN receives a cause code via Iu/Gb interfaces that matches one of the cause codes configured on the SGSN, then the SGSN includes the ARRL bit in the Release Access Bearer Request.

Release Access Bearer Requests

3G (UMTS):

Upon RNC failure or Iu-Release, the SGSN preserves non-GBR (i.e., non-guaranteed bit rate) PDPs (interactive / background) by default. From release 15.0 onwards, for DT and ISR cases the SGSN supports sending Release Access Bearer Request on Iu-Release. In accordance with TS 23.060 v11.7.0, the SGSN can optionally send a Release Access Bearers Request to the S-GW to remove the downlink user plane on S4 for non-DT and non-ISR subscribers.

As part of this feature, the operator can configure the S4-SGSN to send Release Access Bearer Request on Iu-Release for non-DT and non-ISR subscribers. For DT and ISR subscribers, Release Access Bearer Initiation functions as it has done prior to this feature's implementation.

2G (GPRS):

Upon Ready-to-Standby, the SGSN preserves non-GBR (that is, non-guaranteed bit rate) PDPs (interactive / background) by default. From release 15.0 onwards, for ISR cases the S4-SGSN supports sending Release Access Bearer Request on Ready-to-Standby state transition. In accordance with 3GPP TS 23.060 v11.7.0, the SGSN optionally sends a Release Access Bearers Request to the S-GW to remove the downlink user plane on S4 for non-ISR subscriberes.

As part of this feature, the operator can configure the S4-SGSN to send Release Access Bearer Request on Ready-to-Standby or Radio Status Bad for non-ISR subscribers. For ISR subscribers, Release Access Bearer Initiation is independent and functions as it has done prior to this feature's implementation.

Relationships

- The S-GW should support receiving ARRL bit on S4 interface.
- For this feature to function effectively, the S-GW and P-GW also be configured to support the "PGW Pause of Charging" procedure.

How It Works

The S4-SGSN handles LORC-based subscriber overcharging protection functionality in accordance with 3GPP specifications as described below.

3G Iu-Release Procedure and Overcharge Protection over S4

The following call flow is derived from section 12.7.3.2 of TS 23.060 v11.7.0 and it illustrates how the S4-SGSN handles the Iu-Release procedure due to LORC with the overcharging protection functionality enabled.

*Figure 1: Iu-Release and Overcharging Protection on the S4*
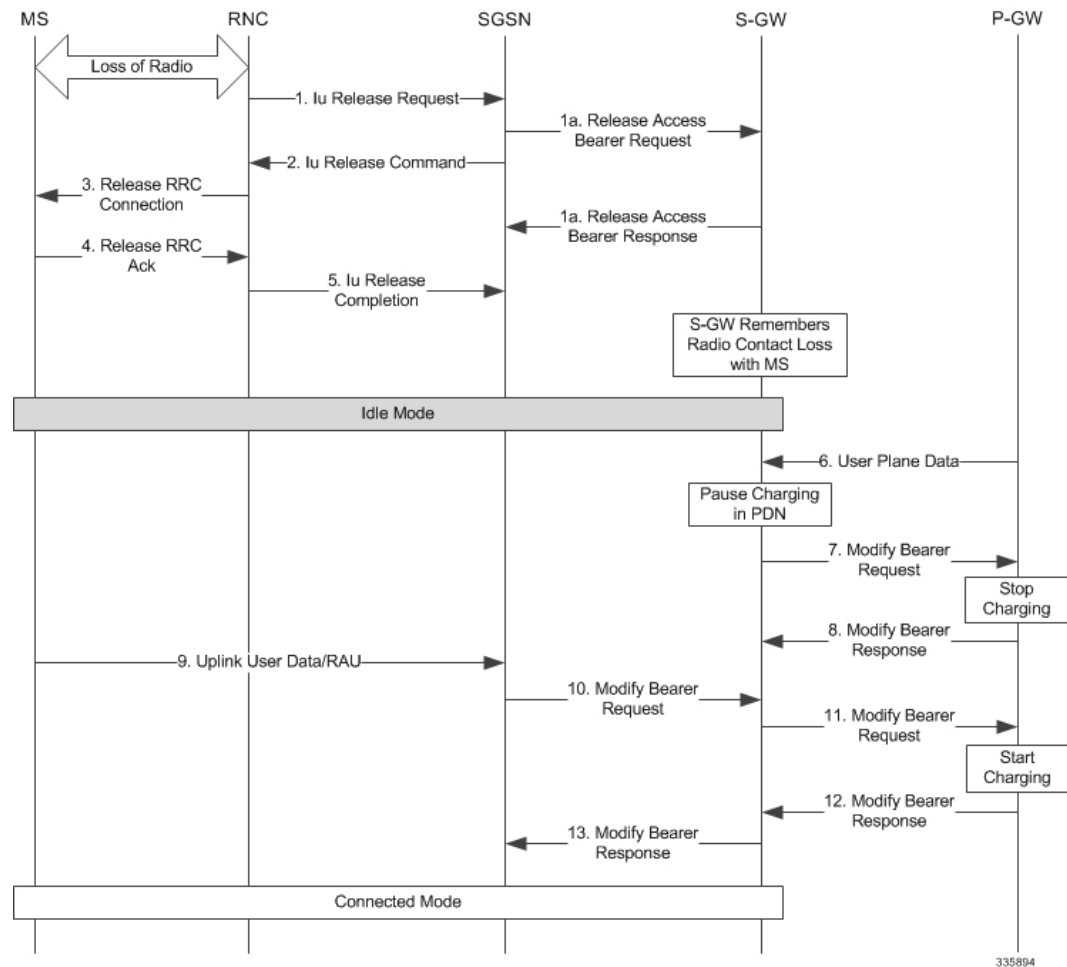
If the cause in the Iu-Release Request matches with the cause code configured under the LTE Policy and if overcharge protection is enabled under the SGSN-service, then the S4-SGSN includes ARRL (i.e., Abnormal Release of Radio Link) bit in the Release Access Bearer Request. For configuration details, refer to the section on *Configuring Subscriber Overcharging Protection*

2G Ready-to-Standby State Transition and Overcharge Protection over S4

The following flow is derived from section 8.1.3a of TS 23.060 v11.7.0 and it illustrates how the S4-SGSN handles the state transiton with regard to the overcharging protection functionality.

When idle mode packet buffering is performed on the S-GW, the SGSN needs to inform the S-GW each time that the MS changes from Ready state to Standby state. The following figure illustrates the procedure between the SGSN and the S-GW.

Figure 2: 2G Ready-to-Standby State Transition Using S4
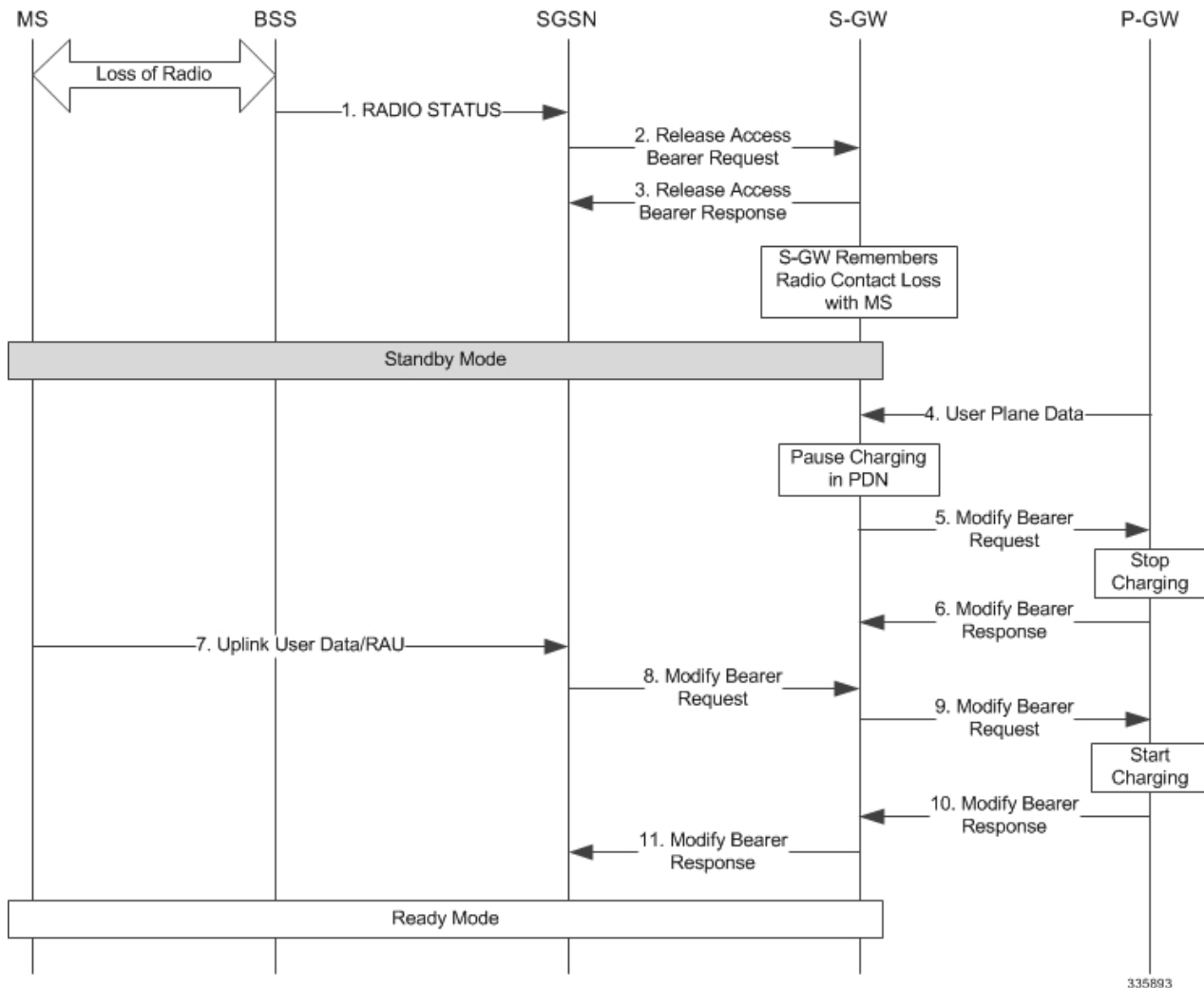
If the BSSGP radio-cause code that is configured by the operator matches with the radio cause code received in the RADIO STATUS message and if the overcharge protection functionality is enabled under GPRS-service, then the SGSN includes the ARRL bit in Release Access Bearer Request. For configuration details, refer to the section on *Configuring Subscriber Overcharging Protection*.

Standards Compliance

Overcharging protection complies with the following standards:

- TS 23.060 version 11
- TS 23.401 version 11
- TS 29.274 version 11
- TS 25.413 version 11
- TS 48.018 version 11

Configuring Subscriber Overcharging Protection

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Important In order for the Subscriber Overcharging Protection feature to be most effective, the operator should first enable sending the Release Access Bearer Request and next configure the cause codes for the SGSN for matching with received codes which enables the SGSN to include the Abnormal Release of Radio Link (ARRL) bit in the Release Access Bearer Request.

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Important For details about all the commands listed in the Configuration sections below, refer to the *Command Line Interface Reference, StarOS Release 17*.

Enabling Release Access Bearer Request

The operator can control the sending of Release Access Bearer Request on Iu-Release for non-DT and non-ISR subscribers in 3G and on Ready-to-Standby or Radio-Status-Bad for non-ISR subscribers in 2G.

Use commands similar to those illustrated below to enable sending of the Release Access Bearer Request:

```
configure
    call-control-profile  profile_name
        release-access-bearer [ on-iu-release | on-ready-to-standby ]
        remove release-access-bearer [ on-iu-release | on-ready-to-standby
 ]
        end
```

Notes:

- **on-iu-release**: This optional keyword instructs the SGSN to send Release Access Bearer upon Iu-Release in a 3G network so that Release Access Bearer will be initiated for non-ISR and non-DT subscribers upon Iu-Release. For ISR and DT subscribers, Release Access Bearer will be initiated unconditionally.
- **on-ready-to-standby**: This optional keyword instructs the SGSN to send Release Access Bearer on Ready-to-Standby transition in a 2G network so that Release Access Bearer will be initiated for non-ISR subscribers on Ready-to-Standby transition. For ISR subscribers, Release Access Bearer will be initiated unconditionally.
- If no optional keywords are included with the **release-access-bearer** command, then the S4-SGSN applies Release Access Bearer for both 2G and 3G networks.

Configuring the Causes to Include ARRL in Release Access Bearer Request

In support of the subscriber overcharging protection functionality, the operator must configure all cause codes on the SGSN. If the SGSN receives a cause code via Iu/Gb interfaces that matches one of the cause codes configured on the SGSN, then the SGSN includes the ARRL (Abnormal Release of Radio Link) bit in the Release Access Bearer Request.

Configuring the Causes for 2G

Use the following configuration commands to define the cause codes received over the Gb interface for GPRS 2G service (BSSGP) when the SGSN initiates Release Access Bearer Request with ARRL bit set.

```
configure
  lte-policy
        cause-code-group group_name protocol bssgp
            radio-cause cause_code
            end
```

Notes:

- Under LTE Policy, the maximum number of cause code groups supported is 4. **Note** that this means that the total number of cause code groups available across all the services (SGSN+GPRS+MME) is 4.
- *group_name*: Enter an alphanumeric string up to 16 characters long.
- **bssgp**:

    - Accesses BSSGP Cause Code Group configuration mode for the commands to define the cause codes for the 2G service
    - Presents a prompt similar to the following: [local]sgsn-test(bssgp-cause-code)
    - **radio-cause**: A maximum of 16 BSSGP protocol radio cause codes can be defined per group. This command, in the new BSSGP Cause Code Group configuration mode, enables the operator to define multiple cause codes for the 2G service so that

        - if the BSSGP radio cause code configured by the operator matches with the radio cause received in the Radio Status message, and
        - if the Subscriber Overcharging Protection feature is enabled for 2G service in the GPRS-Service configuration (see command information above),
        - then the S4-SGSN includes ARRL (Abnormal Release of Radio Link) bit in Release Access Bearer Request message Initiated on Ready-to-Standby state transition.

    - Under each cause code group the maximum number of cause codes (ranap+bssgp+s1ap) that can be supported is 16.
    - *cause_code* : Enter an integer from 0 to 255 to identify a BSSGP protocol radio cause code, as defined in the *Radio Cause* section of the 3GPP TS 48.028 specification.

Note The SGSN does not support Enhanced Radio Status functionality therefore, the SGSN treats cause code values 0x03 and 0x04 as "Radio contact lost with MS". Therefore, the valid configurable cause codes values are 0, 1, and 2.

Configuring the Causes for 3G

Use the following configuration commands to define the cause codes received over the the Iu interface for UMTS 3G service (RANAP) when the SGSN initiates Release Access Bearer Request with ARRL bit set.

```
configure
  lte-policy
        cause-code-group group_name protocol ranap
            cause cause_code
            end
```

Notes:

- Under LTE Policy, the maximum number of cause code groups supported is 4. **Note** that this means that the total number of cause code groups available across all the services (SGSN+GPRS+MME) is 4.
- *group_name*: Enter an alphanumeric string up to 16 characters long.
- **ranap**:

  - Accesses the RANAP Cause Code Group configuration mode for the commands to define the cause codes for the 3G service
  - Presents a prompt similar to the following: [local]sgsn-test(ranap-cause-code)
  - **cause**: A maximum of 16 RANAP protocol cause codes can be defined per group. This command, in the new RANAP Cause Code Group configuration mode, enables the operator to define multiple cause codes for the 3G service so that

    - if the RANAP cause code configured by the operator matches with the radio cause received in the Iu-Release Request message, and
    - if the Subscriber Overcharging Protection feature is enabled for 3G service in the SGSN-Service configuration,
    - then the S4-SGSN includes ARRL (Abnormal Release of Radio Link) bit in Release Access Bearer Request message Initiated on Ready-to-Standby state transition.

  - Under each cause code group the maximum number of cause codes (ranap+bssgp+s1ap) that can be supported is 16.
  - *cause_code* : Enter an integer from 1 to 512 to identify a cause code. Valid options are listed in 3GPP TS 25.413 v11.5.0 (or later version), subsection on *Cause* in subsection for *Radio Network Layer Related IEs*.

Enabling Subscriber Overcharging Protection on S4

Configuring for 3G

Use commands similar to those illustrated below to

- enable or disable Subscriber Overcharging Protection feature for the S4-SGSN in the 3G network.
- associate a cause code group with the SGSN Service configuration.

```
configure
    context   context_name
        sgsn-service service_name
            s4-overcharge-protection ranap-cause-code-group group_name
            no s4-overcharge-protection
            end
```

Notes:

- *group_name*: Enter an alphanumeric string up to 16 characters long to identify the cause code group.

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Important   This CLI does not have any control over Release Access Bearer Initiation. If Release Access Bearer is going out of the S4-SGSN, the ARRL bit will be included if this CLI is enabled and if LORC (loss of radio coverage) is detected.

Configuring for 2G

Use commands similar to those illustrated below to

- enable Subscriber Overcharging Protection feature for the S4-SGSN in the 2G network.
- associate a cause code group with the GPRS Service configuration.

```
configure
    context context_name
        gprs-service service_name
            s4-overcharge-protection bssgp-cause-code-group group_name
            end
```

Notes:

- *group_name*: Enter an alphanumeric string up to 16 characters long to identify the cause code group.

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Important   This CLI does not have any control over release access bearer initiation. If Release Access Bearer is going out of the S4-SGSN, the ARRL bit will be included if this CLI is enabled and if LORC (loss of radio coverage) is detected.