

Configuring Roaming Restrictions

OPERATION DIRECTIONS

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1 Introduction

This document describes how to configure the Roaming Restriction feature for GSM, WCDMA, and LTE access types.

The Roaming Restrictions feature is used to restrict the access to a Location Area (LA) or a Geographical Area (GA) for specified subscribers. A GA contains one or more TAs. When subscribers are denied access to an LA or TA, an operator-configured cause code may be sent to the subscribers.

For more information, see [LTE Mobility Management](#), [GSM Mobility Management](#), and [WCDMA Mobility Management](#).

Note: The network mobility configuration must be performed before other interface configuration.

1.1 Scope

This document covers the following issues:

- Prerequisites for the configuration
- Configuration processes for network mobility configuration
- Configuration processes for checking the consistency of the configuration, and activating and checkpointing it
- Available operations

The configuration is transacted through CLI commands. The O&M environment, including CLI, is further described in [Operation and Maintenance Description](#).

1.2 Target Groups

This document is intended for personnel configuring the SGSN-MME.

2 Prerequisites

This section outlines the prerequisites for the configuration.



2.1 Planning

Consider the following issues when planning the configuration:

- The necessary parameters for GA listed in the [Parameter Description](#) and those associated with roaming restrictions listed in [Roaming Restriction \(CLI\) and Parameter Description](#).
- If any default values of the parameters listed in the interface descriptions must be modified.
- The configured roaming restrictions are ignored for UE with IMS Emergency Services.
- Roaming Restrictions Software (SW) feature license certificate
- A list of IMSI number series for which the Roaming Restrictions Based on IMSI Number Series functionality is to be configured

For more information on IMSI number series, refer to [Creating an IMSI Number Series](#).

- A list of TAs or LAs where Roaming Restrictions are to be configured

2.2 User

To follow the CLI instructions in this document, the user must be logged on as an O&M user with configuration rights. For more information, see [Operator Access Handling](#).

The person configuring should have a solid knowledge of and training in the following areas:

- GPRS communication in the GSM and WCDMA systems
- EPS network in the LTE system
- How to work in UNIX™
- Operation of the SGSN-MME

2.3 Activation

Changes to configuration are implemented in runtime and do not require a restart.



3 Configuring Roaming Restrictions Based on IMSI Number Series

This section describes how to configure the Roaming Restrictions Based on IMSI number series functionality.

To display the configuration classes and parameters related to the Roaming Restrictions Based on IMSI number series functionality, use the `get_config_area -can RoamingRestrictions` CLI command.

Instructions

Activate and configure the Roaming Restrictions Based on IMSI Number Series functionality in an SGSN-MME by performing the following (mandatory) instructions:

1. Enable the Roaming Restrictions Based on IMSI Number Series functionality, by setting the feature state to ACTIVATED for the `national_roaming_restriction` parameter, using the `modify_feature_state` CLI command.
2. Create a GA that contains the TAs to be configured with Roaming Restrictions.
3. Configure the cause code for rejecting attach, Routing Area Update (RAU), and Tracking Area Update (TAU) requests in the LA or GA to be configured with Roaming Restrictions, by using the `create_rr_cause_code` CLI command. This command creates a configuration object, `RrCauseCode`, that is used for storing reject cause codes #11-#15.
4. Connect an `RrCauseCode` to a GA to be configured with Roaming Restrictions, by using the `create_rr_cause_code_ga` command (LTE only).

Connect an `RrCauseCode` to an LA to be configured with Roaming Restrictions, by using the `create_rr_cause_code_la` command.
5. Enable the Roaming Restrictions Based on IMSI Number Series functionality for one or more configured IMSI number series by connecting these IMSI number series sequentially to the configured `RrCauseCode`. Use the `create_rr_cause_code_imsins` command.
6. Check and activate the configuration, see Section 6 on page 7.



Note: If attach, TAU, RAU, or X2-based handover procedures are rejected, a cause code is sent to the MS or UE. The MS receives cause code #11, #13, #14, or #15. The UE receives a cause code between #11 and #15. The cause code is operator-configured and sent in the reject message.

In all handover reject messages, the default cause code #6 is sent to the eNodeB.

For more information on cause codes, see [GSM Mobility Management](#), [WCDMA Mobility Management](#), [LTE Mobility Management](#), [Event-Based Monitoring](#), and [EBM Cause Codes](#).

It is often desirable for an operator to keep the subscriber in their own PLMN, even if the subscriber has restricted access to a specific area. In most cases, this results in changing the Radio Access Type (RAT). This can be achieved by configuring the proper cause code in the reject message to the MS or UE. The available cause codes #11 - #15 are listed in [SoC for 3GPP TS 24.301](#).

Note: An IMSI number series can be restricted from using a certain access type in the entire SGSN-MME node by using the feature [Access Restriction](#).

4 Configuring Roaming Restrictions Based on IMEI TAC

This section describes how to configure the Roaming Restrictions Based on International Mobile station Equipment Identity Type Approval Code (IMEI TAC) functionality.

To display the configuration classes and parameters related to the Roaming Restrictions Based on IMEI TAC functionality, use the `get_config_area -can RoamingRestrictions` CLI command.

Instructions

Activate and configure the Roaming Restrictions Based on IMEI TAC functionality in the MME according to the following instructions:

1. Enable the Roaming Restrictions Based on IMEI TAC functionality, by setting the feature state to `ACTIVATED` for the `roaming_restriction_based_on_imei_tac` parameter, using the `modify_feature_state` CLI command.
2. Create a UE device type by using the `create_ue_device_type` CLI command.
3. Connect an IMEI-TAC with the UE device type by using the `create_ue_device_type_imei_tac` or connect an IMEI-TAC SV with the UE



device type by using the `create_ue_device_type_imei_tac_sv` CLI command. The IMEI-TAC or IMEI-TAC SV specifies a UE device type to be configured with Roaming Restrictions.

4. Create a UE device group by using the `create_ue_device_group` CLI command.
5. Add a UE device type to the UE device group by using the `create_ue_dg_device_type` CLI command. The UE device group includes a list of IMEI-TAC, or IMEI-TAC SV, or both, which defines all UE device types to be configured with Roaming Restrictions.
6. Create a GA by using the `create_ga` CLI command.
7. Configure TA ranges for the GA by using the `create_ga_ta_range` CLI command.
8. Configure cause codes for rejecting attach or TAU requests by using the `create_rr_cause_code` CLI command.
9. Connect a Roaming Restriction Cause Code to the GA by using the `create_rr_cause_code_ga` CLI command.
10. Create a connection between the UE device group and a Roaming Restriction Cause Code by using the `create_rr_cause_code_imei_tac_list` CLI command.
11. Check and activate the configuration, see Section 6 on page 7.



Note: If several UE device groups are mapped to the same GA, these UE device groups specified by the IMEI-TAC or IMEI-TAC SV lists are not allowed to configure as different list roles.

Only one whitelist is allowed to be configured for each GA.

The IMEI-TAC or IMEI-TAC SV list can be configured as a blacklist to be restricted in the GA, or a white list to be allowed in the GA.

- If the UE device group is configured as a blacklist, the UEs of that device group are restricted from access to a specified area, and a roaming restriction cause code configured for that area is sent to the UEs in the reject messages.

The exempted IMEI list can be configured to allow the access for the UEs, even if the IMEI-TAC of the UEs is configured in the blacklist.

If a UE device type is specified by the IMEI-TAC in one device group, and also specified by the IMEI-TAC SV in another device group, the following happens:

- The reject cause code is sent based on the configuration of the IMEI-TAC SV.
- The exempted IMEI or IMEISV list is based on the restriction of IMEI-TAC SV.
- If the UE device group is configured as a whitelist, the UEs of that device group are allowed to access a specified area.

The UEs not in the IMEI-TAC or IMEI-TAC SV whitelist are rejected in the area, and receive the configured roaming restriction cause codes in the reject messages.

5 Verifying the Roaming Restriction Feature

Verify whether the Roaming Restriction feature works by using the optional feature Event-Based Monitoring (EBM).

For more information about the EBM feature, see [Event-Based Monitoring](#).

Instructions

1. Enable EBM logging or streaming by using the `modify_event_job` CLI command with the following event types related to the Roaming Restriction feature:



- l_attach
- l_handover
- l_tau

For more information about activating the Event-Based Monitoring feature, see [Configuring Event-Based Monitoring](#).

2. Verify the Roaming Restriction feature in the EBM output by filtering the sub cause codes.
 - For the Roaming Restriction Based on IMSI Number Series functionality, the sub cause code is 415 NATIONAL_ROAMING_RESTRICTION.
 - For the Roaming Restriction Based on IMEI TAC functionality, the sub cause code is 848 SCC_ROAMING_RESTRICTION_BASED_ON_IMEI_TAC.

The `parse_ebm_log.pl` script can be used to parse the EBM log file.

Note: Ericsson does not recommend running the `parse_ebm_log.pl` script directly on the SGSN-MME, which has impact on the node stability.

6 Activating and Checkpointing the Configuration, and Checking Its Consistency

This section describes the procedures for checking the consistency of the configuration, and for activating and checkpointing it.

6.1 Checking the Consistency of the Configuration

A consistency check must always be performed before activating the pending configuration. It is performed to guarantee that an inconsistent configuration is not activated. A consistency check is performed on the configuration that will be active after an activation, that is, the active configuration combined with the changes in the pending configuration.

A consistency check displays warnings, such as variables out of the recommended range.

Instructions

Run a consistency check on the active configurations with pending configurations by using the `check_config` CLI command.



List the pending configuration by using the `list_config_pending` CLI command.

Cancel the pending configuration by using the `undo_config_pending` CLI command.

The consistency check does not guarantee full coverage in all situations. For a further description of the consistency rules and expected coverage, see the `check_config` CLI command. In a troubleshooting situation, it can be beneficial to run a consistency check with an empty pending configuration.

6.2 Activating the Configuration

The pending configuration must be activated for the configuration to take effect.

Activate the pending configuration, by using the `activate_config_pending` CLI command.

6.3 Checkpointing the SC

To store the Software Configuration (SC) in the SGSN-MME persistently, perform a checkpoint.

Checkpoint the SC, by using the `checkpoint` CLI command.

7 Examples of Configuring Roaming Restrictions Based on IMSI Number Series

The following example describes a scenario in a town center area with LTE coverage, in which a specific IMSI number series can be restricted.

The operator wants to reserve the EPS service in the town for home subscribers or privileged subscribers. This can be achieved by configuring the Roaming Restrictions Based on IMSI Number Series functionality for the IMSI number series representing the subscribers to be denied access to the EPS services. It is, however, desired that those users stay in the operator's PLMN network.

Cause code #15 can be configured together with the combination of the town center area and the IMSI number series that are to be restricted from using the EPS services. This cause code triggers the UE to search for another TA offering LTE services or another LA offering WCDMA or GSM services.



7.1 Example of Configuring Roaming Restrictions Based on IMSI Number Series for LTE

This section presents two examples of configuring the Roaming Restrictions Based on IMSI Number Series functionality for LTE.

Note: Both examples are purely hypothetical and are used only to illustrate the possibilities of configuring the Roaming Restrictions Based on IMSI Number Series functionality.

7.1.1 Roaming Restrictions Based on IMSI Number Series (LTE)

Figure 1 shows an overview of how the Roaming Restrictions Based on IMSI Number Series functionality can be used to send different cause codes based on IMSI number series.

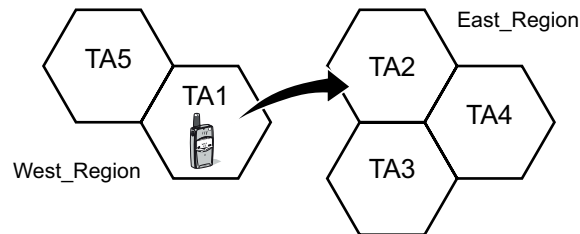


Figure 1 Configuring Roaming Restrictions Based on IMSI Number Series in a GA

In Figure 1, each hexagon represents a TA. TAs are grouped into GAs West_Region and East_Region where the Roaming Restrictions Based on IMSI Number Series functionality can be configured in the SGSN-MME(s) serving them.

When the UE tries to access a new TA by performing an attach, TAU, or handover procedure, the SGSN-MME checks if there are any roaming restrictions. If the new TA belongs to a GA with roaming restrictions for the IMSI number series to which the UE belongs, access to the new TA is denied.

Note: The UE may be refused access to the RAT or the new TA based on other restrictions checked by the SGSN-MME before roaming restrictions is checked. For more information, see [LTE Mobility Management](#).

In Figure 1, the UE moves from TA1 in West_Region to TA2 in East_Region. The SGSN-MME checks if Roaming Restrictions are configured for UE belonging to IMSI number series 123456, 456789, and 789999 for TA2 in East_Region.

To configure the Roaming Restrictions Based on IMSI Number Series functionality for East_Region by performing the following instructions:

1. Create the GA to be configured with the Roaming Restrictions Based on IMSI Number Series functionality, in this case East_Region.

```
create_ga -gan East_Region
```



2. Populate East_Region with one or more TAs to be configured with the Roaming Restrictions Based on IMSI Number Series functionality, in this case TA2, TA3, and TA4.

```
create_ga_ta_range -gan East_Region -tan East_Region_TA2_TA4  
-mcc 123 -mnc 456 -first 2 -last 4
```

3. Create the RrCauseCodes.

```
create_rr_cause_code -rc East_Region_cc11 -cc 11  
create_rr_cause_code -rc East_Region_cc12 -cc 12  
create_rr_cause_code -rc East_Region_cc14 -cc 14
```

4. Map the RrCauseCodes to the GAs.

```
create_rr_cause_code_ga -rc East_Region_cc11 -gan East_Region  
create_rr_cause_code_ga -rc East_Region_cc12 -gan East_Region  
create_rr_cause_code_ga -rc East_Region_cc14 -gan East_Region
```

5. Map the IMSI number series to the RrCauseCodes.

```
create_rr_cause_code_imsins -rc East_Region_cc11 -imsi 123456  
create_rr_cause_code_imsins -rc East_Region_cc12 -imsi 456789  
create_rr_cause_code_imsins -rc East_Region_cc14 -imsi 789999
```

6. Check and activate the configuration, see Section 6 on page 7.

After following the configuration example, the SGSN-MME restricts TA2 (also TA3 and TA4) in East_Region for UE belonging to IMSI number series 123456, 456789, and 789999.

- If a UE that belongs to IMSI number series 123456 tries to perform a TAU or attach to TA2 within East_Region, the SGSN-MME sends a reject message with cause code #11 to the UE.
- If a UE that belongs to IMSI number series 456789 tries to perform a TAU or attach to TA2 within East_Region, the SGSN-MME sends a reject message with cause code #12 to the UE.
- If a UE that belongs to IMSI number series 789999 tries to perform a TAU or attach to TA2 within East_Region, the SGSN-MME sends a reject message with cause code #14 to the UE.

For more information on cause codes sent to the UE, see LTE Mobility Management.



7.1.2

Roaming Restrictions Based on IMSI Number Series with Once Cause Code for Each TA

Figure 2 shows an overview of how the Roaming Restrictions Based on IMSI Number Series functionality can be used to send different cause codes based on different TAs.

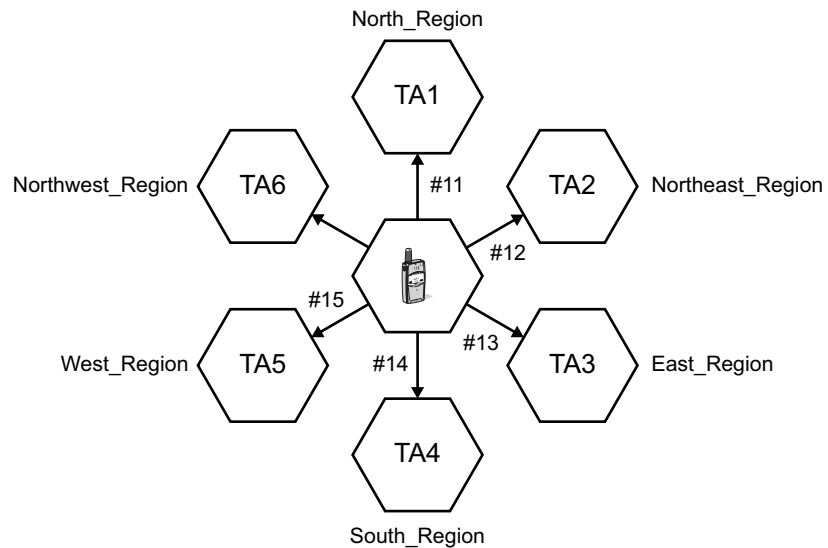


Figure 2 Configuring Roaming Restrictions Based on IMSI Number Series with One Cause Code for Each TA

The scenario in Figure 2 shows six different possibilities are presented. A UE that belongs to IMSI number series 123456, moves to one of the six different TAs. Except for TA6, all TAs have the Roaming Restrictions Based on IMSI Number Series functionality configured for UE belonging to IMSI numbers series 123456.

For each TA, except TA6, the SGSN-MME sends a reject message with a different cause code to the UE. Configure this scenario by performing the following instructions:

1. Create the GAs to be configured with the Roaming Restrictions Based on IMSI Number Series functionality, in this case North_Region, Northeast_Region, East_Region, South_Region, and West_Region.

```
create_ga -gan North_Region
```

```
create_ga -gan Northeast_Region
```

```
create_ga -gan East_Region
```

```
create_ga -gan South_Region
```

```
create_ga -gan West_Region
```



2. Populate all GAs with their respective TAs to be configured with the Roaming Restrictions Based on IMSI Number Series functionality.

```
create_ga_ta_range -gan North_Region -tan North_Region_TA1 -mcc 123 -mnc 456 -first 1 -last 1
```

```
create_ga_ta_range -gan Northeast_Region -tan Northeast_Region_TA2 -mcc 123 -mnc 456 -first 2 -last 2
```

```
create_ga_ta_range -gan East_Region -tan East_Region_TA3 -mcc 123 -mnc 456 -first 3 -last 3
```

```
create_ga_ta_range -gan South_Region -tan South_Region_TA4 -mcc 123 -mnc 456 -first 4 -last 4
```

```
create_ga_ta_range -gan West_Region -tan West_Region_TA5 -mcc 123 -mnc 456 -first 5 -last 5
```

3. Create the RrCauseCodes.

```
create_rr_cause_code -rc North_Region_cc11 -cc 11
```

```
create_rr_cause_code -rc Northeast_Region_cc12 -cc 12
```

```
create_rr_cause_code -rc East_Region_cc13 -cc 13
```

```
create_rr_cause_code -rc South_Region_cc14 -cc 14
```

```
create_rr_cause_code -rc West_Region_cc15 -cc 15
```

4. Map the RrCauseCodes to the GAs.

```
create_rr_cause_code_ga -rc North_Region_cc11 -gan North_Region
```

```
create_rr_cause_code_ga -rc Northeast_Region_cc12 -gan Northeast_Region
```

```
create_rr_cause_code_ga -rc East_Region_cc13 -gan East_Region
```

```
create_rr_cause_code_ga -rc South_Region_cc14 -gan South_Region
```

```
create_rr_cause_code_ga -rc West_Region_cc15 -gan West_Region
```

5. Map the IMSI number series to the RrCauseCodes.

```
create_rr_cause_code_imsins -rc North_Region_cc11 -imsi 123456
```

```
create_rr_cause_code_imsins -rc Northeast_Region_cc12 -imsi 123456
```

```
create_rr_cause_code_imsins -rc East_Region_cc13 -imsi 123456
```

```
create_rr_cause_code_imsins -rc South_Region_cc14 -imsi 123456
```



```
create_rr_cause_code_imsins -rc West_Region_cc15 -imsi 123456
```

6. Check and activate the configuration, see Section 6 on page 7.

The UE that belongs to IMSI number series 123456 is now restricted in TA1, TA2, TA3, TA4, and TA5.

- If the UE tries to perform a TAU or attach to TA1 within North_Region, the SGSN-MME sends a reject message with cause code #11 to the UE.
- If the UE tries to perform a TAU or attach to TA2 within Northeast_Region, the SGSN-MME sends a reject message with cause code #12 to the UE.
- If the UE tries to perform a TAU or attach to TA3 within East_Region, the SGSN-MME sends a reject message with cause code #13 to the UE.
- If the UE tries to perform a TAU or attach to TA4 within South_Region, the SGSN-MME sends a reject message with cause code #14 to the UE.
- If the UE tries to perform a TAU or attach to TA5 within West_Region, the SGSN-MME sends a reject message with cause code #15 to the UE.

In this example, the UE that belongs to IMSI number series 123456, is allowed to perform a TAU or attach to TA6 since no Roaming Restrictions Based on IMSI Number Series functionality is placed upon this TA.

7.2 Example of Configuring Roaming Restrictions Based on IMSI Number Series for GSM and WCDMA

Two GSM and WCDMA configuration examples for the Roaming Restrictions Based on IMSI Number Series functionality are presented.

Note: All examples are purely hypothetical and used to illustrate the possibilities for configuring the Roaming Restrictions Based on IMSI Number Series functionality only.

For example, upon receiving cause code #11, the MS stores the current PLMN in the list of forbidden PLMNs. This means that even though other LAs may have different cause codes configured, the MS will never be able to go there for as long as the PLMN remains in the forbidden PLMN list.

7.2.1 Roaming Restrictions Based on IMSI Number Series (GSM and WCDMA)

Figure 3 shows an overview of how the Roaming Restrictions Based on IMSI Number Series functionality can be used to send different cause codes based on IMSI number series.

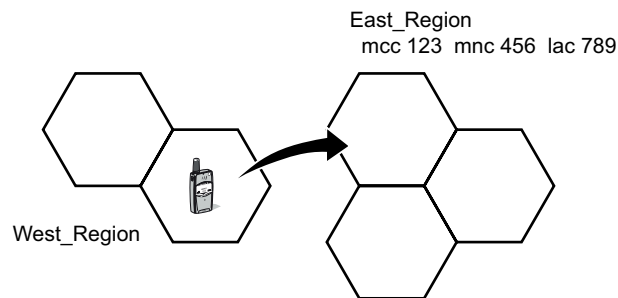


Figure 3 Configuring Roaming Restrictions Based on IMSI Number Series in an LA

In Figure 3, each hexagon represents an LA where the Roaming Restrictions Based on IMSI Number Series functionality can be configured in the SGSN-MME(s) serving it. When the MS tries to access a new LA by performing an attach, RAU, or Handover procedure, the SGSN-MME checks if there are any Roaming Restrictions. If the new LA has Roaming Restrictions for the IMSI number series to which the MS belongs, access to the new LA is denied.

Note: The MS may be denied access to the RAT or new LA based on other restrictions checked by the SGSN-MME before roaming restrictions are checked. For more information see [GSM Mobility Management](#) and [WCDMA Mobility Management](#).

In Figure 3, the MS moves from West Region to East Region. The SGSN-MME checks if the Roaming Restrictions Based on IMSI Number Series functionality is configured for the MS that belongs to IMSI number series 654321.

Configure the Roaming Restrictions Based on IMSI Number Series functionality for East Region by performing the following instructions:

1. Create the RrCauseCodes.

```
create_rr_cause_code -rc East_Region_gw_cc13 -cc 13
```

```
create_rr_cause_code -rc East_Region_gw_cc15 -cc 15
```

2. Map the created RrCauseCodes to the LA to be configured with the Roaming Restrictions Based on IMSI Number Series functionality.

```
create_rr_cause_code_la -rc East_Region_gw_cc13 -mcc 123 -mnc 456 -lac 789
```

```
create_rr_cause_code_la -rc East_Region_gw_cc15 -mcc 123 -mnc 456 -lac 789
```

3. Map the IMSI number series to the created RrCauseCodes.

```
create_rr_cause_code_imsins -rc East_Region_gw_cc13 -imsi 123456
```



```
create_rr_cause_code_imsins -rc East_Region_gw_cc15 -imsi
654321
```

4. Check and activate the configuration, see Section 6 on page 7.

The SGSN-MME restricts the LA with Mobile Country Code (MCC) 123, Mobile Network Code (MNC) 456, and LA Code (LAC) 789 for IMSI number series 654321 and 123456.

- If an MS that belongs to IMSI number series 123456 tries to perform a RAU or attach to the LA with MCC 123, MNC 456, and LAC 789, the SGSN-MME sends a reject message with cause code #13 to the MS.
- If an MS that belongs to IMSI number series 654321 tries to perform a RAU or attach to the LA with MCC 123, MNC 456, and LAC 789, the SGSN-MME sends a reject message with cause code #15 to the MS.

For more information on cause codes, see *GSM Mobility Management*, and *WCDMA Mobility Management*.

7.2.2

Roaming Restrictions Based on IMSI Number Series with Once Cause Code for Each LA

Figure 4 shows an overview of how the Roaming Restrictions Based on IMSI Number Series functionality can be used to send different cause codes based on LAs.

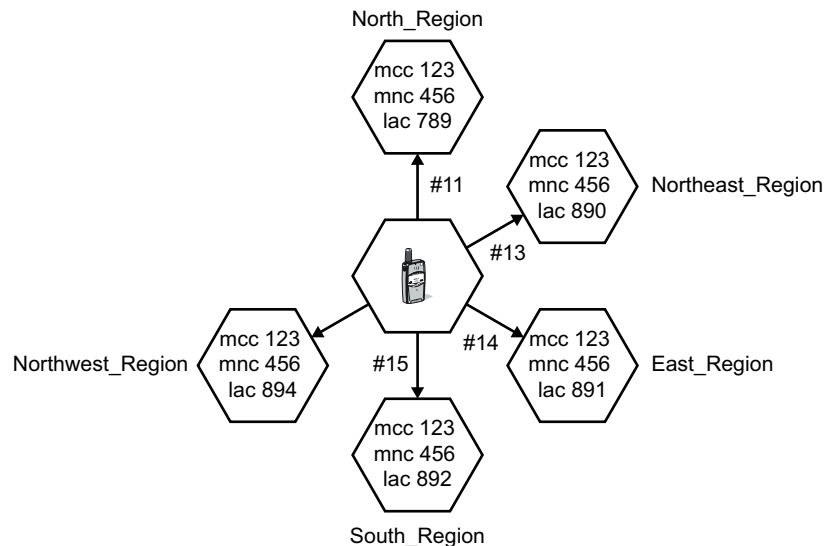


Figure 4 Configuring Roaming Restrictions Based on IMSI Number Series with One Cause Code for Each LA

In the scenario in Figure 4, five different possibilities are presented. The MS moves to one of the five different LAs. Except for Northwest_Region, all LAs have the



Roaming Restrictions Based on IMSI Number Series functionality configured for the MS that belongs to IMSI number series 654321.

In this case, for each LA, except Northwest_Region, the SGSN-MME sends a reject message with a different cause code to the MS. Configure this scenario by performing the following instructions:

1. Create the RrCauseCodes.

```
create_rr_cause_code -rc North_Region_cc11 -cc 11
```

```
create_rr_cause_code -rc Northeast_Region_cc13 -cc 13
```

```
create_rr_cause_code -rc East_Region_cc14 -cc 14
```

```
create_rr_cause_code -rc South_Region_cc15 -cc 15
```

2. Map the created RrCauseCodes to the LAs to be configured with the Roaming Restrictions Based on IMSI Number Series functionality.

```
create_rr_cause_code_la -rc North_Region_cc11 -mcc 123 -mnc 456  
-lac 789
```

```
create_rr_cause_code_la -rc Northeast_Region_cc13 -mcc 123 -mnc 456  
-lac 890
```

```
create_rr_cause_code_la -rc East_Region_cc14 -mcc 123 -mnc 456  
-lac 891
```

```
create_rr_cause_code_la -rc South_Region_cc15 -mcc 123 -mnc 456  
-lac 892
```

3. Map the IMSI number series to the created RrCauseCodes.

```
create_rr_cause_code_imsins -rc North_Region_cc11 -imsi 654321
```

```
create_rr_cause_code_imsins -rc Northeast_Region_cc13 -imsi  
654321
```

```
create_rr_cause_code_imsins -rc East_Region_cc14 -imsi 654321
```

```
create_rr_cause_code_imsins -rc South_Region_cc15 -imsi 654321
```

4. Check and activate the configuration, see Section 6 on page 7.

The SGSN-MME restricts roaming for four LAs for IMSI number series 654321.

- If the MS tries to perform a RAU or attach to the LA with MCC 123, MNC 456, and LAC 789, the SGSN-MME sends a reject message with cause code #11 to the MS.



- If the MS tries to perform a RAU or attach to the LA with MCC 123, MNC 456, and LAC 890, the SGSN-MME sends a reject message with cause code #13 to the MS.
- If the MS tries to perform a RAU or attach to the LA with MCC 123, MNC 456, and LAC 891, the SGSN-MME sends a reject message with cause code #14 to the MS.
- If the MS tries to perform a RAU or attach to the LA with MCC 123, MNC 456, and LAC 892, the SGSN-MME sends a reject message with cause code #15 to the MS.

In this example, the MS is allowed to perform a RAU or attach to the LA with MCC 123, MNC 456, and LAC 893, since no Roaming Restrictions Based on IMSI Number Series functionality is configured for this LA.

For more information on cause codes, see [GSM Mobility Management](#) , and [WCDMA Mobility Management](#).

7.3

Configuring Roaming Restrictions Based on IMSI Number Series for GSM, WCDMA, and LTE

The Roaming Restrictions Based on IMSI Number Series functionality can be configured in the SGSN-MME for LTE, GSM, and WCDMA access types simultaneously. The example in Figure 5 shows the flexibility of configuring the Roaming Restrictions Based on IMSI Number Series functionality.

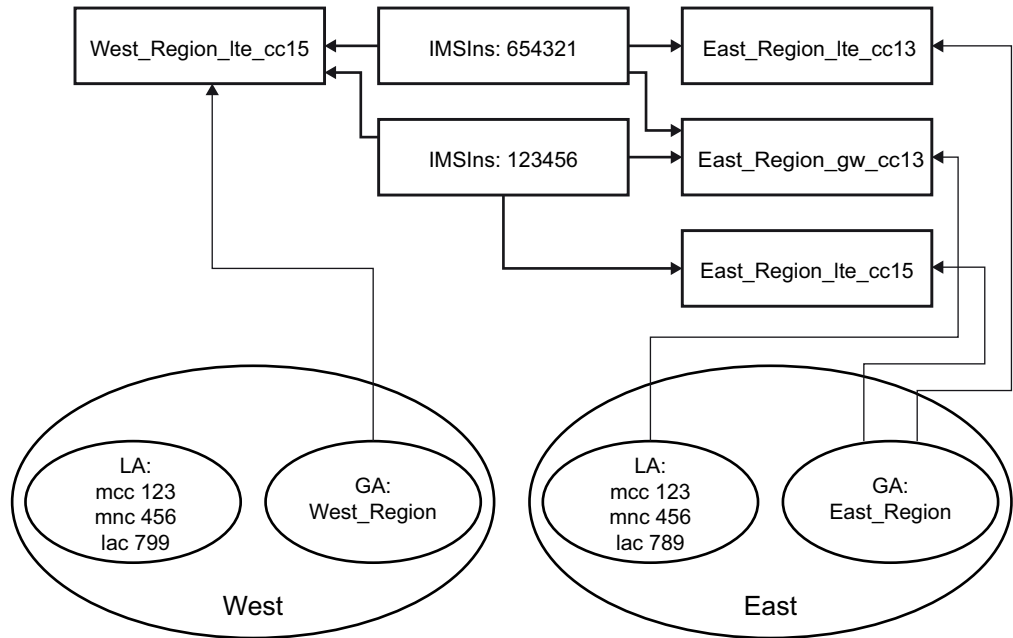


Figure 5 Configuring Roaming Restrictions Based on IMSI Number Series for GSM, WCDMA, and LTE Simultaneously

West_Region is configured as a hot spot within a PLMN. The East area is on the border to a different PLMN. The neighboring operators have agreements to compel UE to roam in their respective home PLMNs. Both the West and East area have geographically overlapping coverage of GSM, WCDMA, and LTE. The East area also has geographically overlapping coverage with a neighboring PLMN.

The high bandwidth in the hot spot in West_Region is reserved for privileged subscribers. IMSI number series 123456 and 654321 represent less privileged subscribers. They are not allowed in West_Region for the LTE access type, but it is desirable that they stay with the same operator. To achieve this, cause code #15 is used. Upon receiving this cause code, the UE or MSs that belong to IMSI number series 123456 and 654321 search for another TA or LA in the same PLMN. They are likely to find the LA offering GSM or WCDMA access in the West area.

IMSI number series 654321 represents roaming subscribers belonging to the neighboring PLMN. UE belonging to this series visits the East area. According to agreements, the Roaming Restrictions Based on IMSI Number Series functionality is configured to make the UE search for its home PLMN in this area. To achieve this, cause code #13 is used for all access types (both the LA and GA in the East area). When rejected with this cause code, the UE searches for its home PLMN.

Different IMSI number series can be configured with different cause codes in the same area. An IMSI number series can also have different cause codes



in co-located LAs and GAs. This is illustrated by configuring the Roaming Restrictions Based on IMSI Number Series functionality for IMSI number series 123456 in the East area.

UE belonging to IMSI number series 123456 are prevented from using LTE services in East_Region, but remaining in the operators PLMN, they can use LTE services in other GAs nearby. This is achieved through the configuration of cause code #15. However, when these MSs try to access the GSM or WCDMA services in the East LA, they are denied access with cause code #13.

In Figure 5, the following LAs already exist:

- MCC 123, MNC 456, and LAC 799
- MCC 123, MNC 456, and LAC 789

The following GAs already exist:

- West_Region
- East_Region

Each of these areas is to be connected to one or more RrCauseCodes:

- West_Region_lte_cc15
- East_Region_lte_cc13
- East_Region_gw_cc13
- East_Region_lte_cc15

These RrCauseCodes are to be connected to one or more IMSI number series:

- 123456
- 654321

Configure the Roaming Restrictions Based on IMSI Number Series functionality for this scenario by performing the following instructions:

1. Create the RrCauseCodes.

```
create_rr_cause_code -rc West_Region_lte_cc15 -cc 15
create_rr_cause_code -rc East_Region_lte_cc13 -cc 13
create_rr_cause_code -rc East_Region_gw_cc13 -cc 13
create_rr_cause_code -rc East_Region_lte_cc15 -cc 15
```

2. Map the created RrCauseCodes to the GAs to be configured with the Roaming Restrictions Based on IMSI Number Series functionality (LTE only).



```
create_rr_cause_code_ga -gan West_Region -rc West_Region_lte_c
c15
```

```
create_rr_cause_code_ga -gan East_Region -rc East_Region_lte_c
c13
```

```
create_rr_cause_code_ga -gan East_Region -rc East_Region_lte_c
c15
```

3. Map the created RrCauseCode to the LA to be configured with the Roaming Restrictions Based on IMSI Number Series functionality.

```
create_rr_cause_code_la -rc East_Region_gw_cc13 -mcc 123 -mnc
456 -lac 789
```

4. Map the IMSI number series to the created RrCauseCodes.

```
create_rr_cause_code_imsins -rc West_Region_lte_cc15 -imsi
123456
```

```
create_rr_cause_code_imsins -rc West_Region_lte_cc15 -imsi
654321
```

```
create_rr_cause_code_imsins -rc East_Region_lte_cc13 -imsi
654321
```

```
create_rr_cause_code_imsins -rc East_Region_gw_cc13 -imsi
123456
```

```
create_rr_cause_code_imsins -rc East_Region_gw_cc13 -imsi
654321
```

```
create_rr_cause_code_imsins -rc East_Region_lte_cc15 -imsi
123456
```

5. Check and activate the configuration, see Section 6 on page 7.

The Roaming Restrictions Based on IMSI Number Series functionality displayed in Figure 5 are now configured. View the configuration details by performing the following instructions:

1. View the parameters for RrCauseCode West_Region_lte_cc15.

```
get_rr_cause_code -rc West_Region_lte_cc15
```

Parameter	Active Data	Planned Data
timestamp	20101008092422	-
planState	-	-
cc	15	-

2. List all RrCauseCodes.

**list_rr_cause_code**

```
rr_cause_code -rc East_Region_gw_cc13
```

```
rr_cause_code -rc East_Region_lte_cc13
```

```
rr_cause_code -rc East_Region_lte_cc15
```

```
rr_cause_code -rc West_Region_lte_cc15
```

3. List all RrCauseCodes for all GAs (LTE only).

list_rr_cause_code_ga

```
rr_cause_code_ga -gan East_Region -rc East_Region_lte_cc13
```

```
rr_cause_code_ga -gan East_Region -rc East_Region_lte_cc15
```

```
rr_cause_code_ga -gan West_Region -rc West_Region_lte_cc15
```

4. List all LAs for all RrCauseCodes.

list_rr_cause_code_la

```
rr_cause_code_la -rc East_Region_gw_cc13 -mcc 123 -mnc 456 -lac  
789
```

5. List all IMSI number series for RrCauseCode West_Region_lte_cc15.

list_rr_cause_code_imsins -rc West_Region_lte_cc15

```
rr_cause_code_imsins -rc West_Region_lte_cc15 -imsi 123456
```

```
rr_cause_code_imsins -rc West_Region_lte_cc15 -imsi 654321
```

6. List all RrCauseCodes for IMSI number series 654321.

list_rr_cause_code_imsins-imsi 654321

```
rr_cause_code_imsins -rc East_Region_lte_cc13 -imsi 654321
```

```
rr_cause_code_imsins -rc East_Region_gw_cc13 -imsi 654321
```

```
rr_cause_code_imsins -rc West_Region_lte_cc15 -imsi 654321
```

8 Example of Configuring Roaming Restrictions Based on IMEI TAC

This section describes how to configure the Roaming Restrictions Based on IMEI TAC functionality. Two roaming restrictions based on IMEI-TAC and IMEI-TAC SV configuration examples are presented.

8.1 Roaming Restrictions Based on IMEI TAC

In Figure 6, TAs are grouped into GAs FDD_Region and TDD_Region, which support the Frequency Division Duplexing (FDD) technology and the Time Division Duplexing (TDD) technology respectively.

Figure 6 shows an overview of how the Roaming Restrictions Based on IMEI TAC functionality can be used to send different cause codes based on IMEI TAC in a GA.

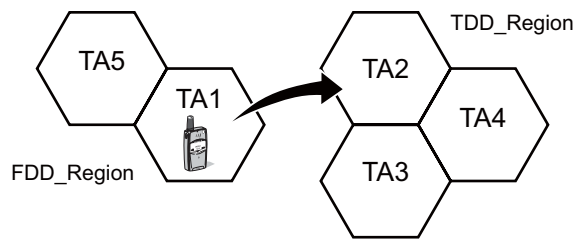


Figure 6 Configuring Roaming Restrictions Based on IMEI TAC in a GA

In this example, the UEs with IMEI-TAC of 12345678 are configured so they cannot access the GA TDD_Region, which includes TA2, TA3, and TA4. When the UEs try to access a TA in the GA TDD_Region by performing the attach or TAU procedure, the UEs receive cause code #15 in the attach or TAU reject message.

1. Create the UE device type `iphone6`, which maps the IMEI-TAC 12345678.

```
create_ue_device_type -dn iphone6 -dv apple -dc smart -dos ios
create_ue_device_type_imei_tac -dn iphone6 -tac 12345678
```

2. Create the UE device type group `iphone`, which includes the UE device type `iphone6`.

```
create_ue_device_group -dgn iphone
create_ue_dg_device_type -dgn iphone -dn iphone6
```

3. Create the GA `TDD_Region`, which includes TA2, TA3, and TA4.

```
create_ga -gan TDD_Region
```



```
create_ga_ta_range -gan TDD_Region -tan TDD_TA2_4 -mcc 123 -mnc
456 -first 2 -last 4
```

4. Create the RR Cause Code #15.

```
create_rr_cause_code -rc TDD_CC15 -cc 15
```

5. Map the RR cause code #15 to the GA TDD_Region.

```
create_rr_cause_code_ga -rc TDD_CC15 -gan TDD_Region
```

6. Map the RR Cause Code #15 to the UE device group iphone, which is restricted to user services in the GA TDD_Region.

```
create_rr_cause_code_imei_tac_list -rc TDD_CC15 -dgn iphone
-itlr blacklist
```

8.2 Roaming Restrictions Based on IMEI TAC SV

In this example, the UEs with IMEI-TAC 87654321 and SV 01 are configured so they cannot access the GA RR_Region, which includes TA5, TA6, and TA7. When the UEs try to access a TA in the GA RR_Region by performing the attach or TAU procedure, the UEs receive cause code #13 in the attach or TAU reject message.

1. Create the UE device type blackberry9700, which maps the IMEI-TAC 87654321 with SV 01.

```
create_ue_device_type -dn blackberry9700 -dv rim -dc smart -dos
other
```

```
create_ue_device_type_imei_tac_sv -dn blackberry9700 -tac
87654321 -sv 01
```

2. Create the UE device type group blackberry, which includes the UE device type blackberry9700.

```
create_ue_device_group -dgn blackberry
```

```
create_ue_dg_device_type -dgn blackberry -dn blackberry9700
```

3. Create the GA RR_Region, which includes TA5, TA6, and TA7.

```
create_ga -gan RR_Region
```

```
create_ga_ta_range -gan RR_Region -tan RR_Region_5_7 -mcc 123
-mnc 456 -first 5 -last 7
```

4. Create the RR Cause Code #13.

```
create_rr_cause_code -rc RR_CC13 -cc 13
```

5. Map the RR cause code #13 to the GA RR_Region.



```
create_rr_cause_code_ga -rc RR_Region -rc RR_CC13
```

6. Map the RR Cause Code #13 to the UE device group blackberry, which is restricted to user services in the GA RR_Region.

```
create_rr_cause_code_imei_tac_list -rc RR_CC13 -dgn blackberry  
-itlr blacklist
```

9 Example of Verifying the Roaming Restriction Feature

This example verifies that the Roaming Restriction Based on IMEI TAC functionality works.

```
./ebm_counters.pl -f A20140703.1100+0200-20140703.1115+0200_1_ebs.  
7 -e l_attach -n sub_cause_code -v 848
```

Event ID : l_attach

Filters On This Event

Parameter Name : sub_cause_code

Parameter Value : 848

Occurance : 1

Note: 848 is the sub-cause code value for ROAMING_RESTRICTION_BASED_ON_IMEI_TAC.