Location Services

Location Services - Feature Description

The Location Services (LCS) feature enables the EPC MME and the GPRS/UMTS SGSN to use the SLg (MME) or Lg (SGSN) interface which provides the mechanisms to support specialized mobile location services for operators, subscribers, and third party service providers. Use of this feature and the SLg/Lg interface is license controlled.

The location information is reported in standard geographical co-ordinates (longitude and latitude) together with the time-of-day and the estimated errors (uncertainty) of the location of the UE. For external use, the location information may be requested by and reported to a client application associated with the UE, or a client within or attached to the core network. For internal use, the location information can be utilized by the SGSN for functions such as location assisted handover or to support other features.

Location information is intended to be used for

- location-based charging (e.g., home-location billing, roaming-location billing),
- location-based services (e.g., lawful interception, emergency calls),
- positioning services offered to the subscribers (e.g., mobile yellow pages, navigation applications on mobiles), and
- by the operator for service provider services such as network planning and enhanced call routing.

How Location Services Works

The SGSN LCS responsibilities center around UE subscription authorization and managing LCS positioning requests. The LCS functions of the SGSN are related to charging and billing, LCS co-ordination, location request, authorization and operation of the LCS services.

When using the Iu interface, before the SGSN can request location information of a target UE from the radio access network (RAN), an Iu signaling connection must have been established between the SGSN and the RAN. The SGSN sends a Location Request message to the RAN. The RAN determines the location of the target UE related to this Iu signaling connection and sends a Location Report to the SGSN over the same Iu

signaling connection. On the Iu interface, only one location request for a geographic location estimate can be ongoing at any time.

Only one location request can be ongoing at any time.

The operation begins with a LCS Client requesting location information for a UE from the LCS server. The LCS server will pass the request to the LCS functional entity (SGSN) in the core network. The LCS functional entitiy (SGSN) in the core network then:

1. verifies that the LCS Client is authorized to request the location of the UE or subscriber
2. verifies that location services are supported by the UE
3. establishes whether it (the MME/SGSN) is allowed to locate the UE or subscriber, for privacy or other reasons
4. establishes which network element in the radio access network (GERAN or UTRAN or E-UTRAN) should receive the Location Request
5. requests the access network (via the A, Gb, Iu or S1 interface) to provide location information for an identified UE, with indicated QoS
6. receives information about the location of the UE from the Access Network and forward it to the Client
7. sends appropriate accounting information to an accounting function.

Relationship to Other SGSN Functions

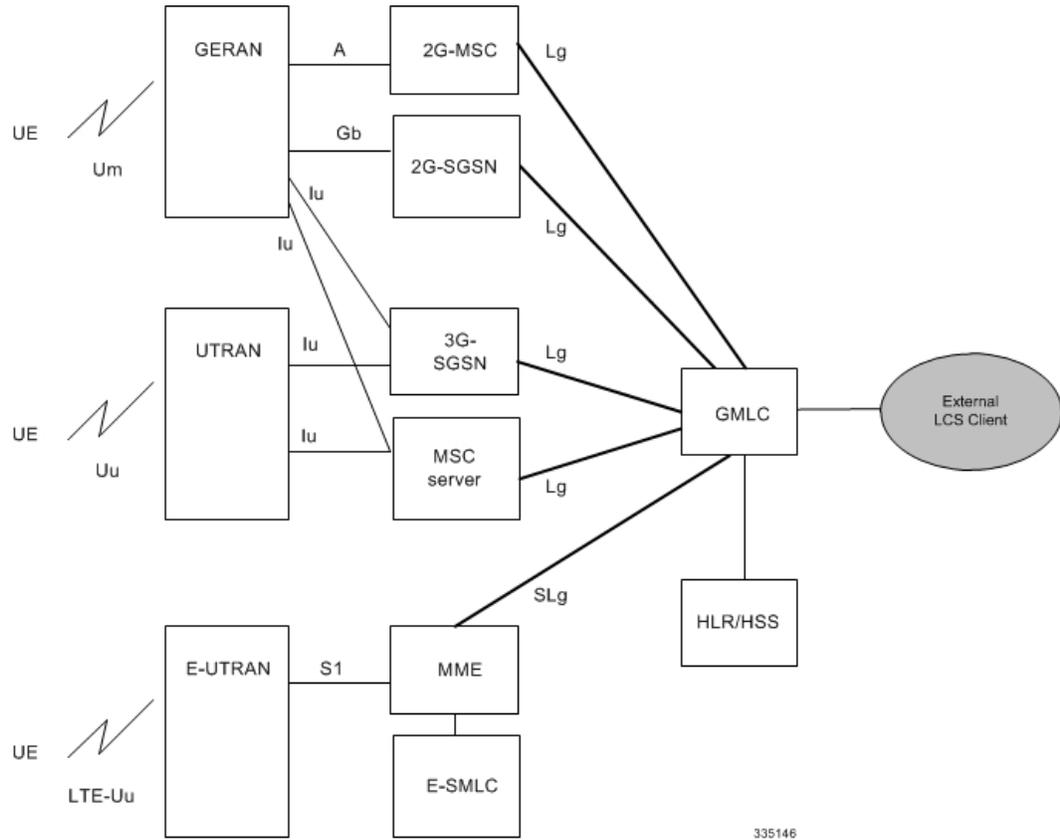The Location Services feature utilizes several of the existing SGSN functionalities:

- Mobility Management module
- MAP Service module

Architecture

The MME is accessible to the Gateway Mobile Location Center (GMLC) via the SLg interface.

The SGSN is accessible to the GMLC via the Lg interface.

Figure 1: LCS Architecture

The SGSN informs the HLR/HSS regarding the LCS capabilities of UE in GPRS (2G) or UMTS (3G) networks. The SGSN may include the IP address of the V-GMLC associated with the SGSN in the MAP_UPDATE_GPRS_LOCATION message during Attach and ISRAU procedures.

Limitations

Currently, SGSN support is limited to:

1. A single location request at a time for the target UE. Concurrent location requests are not supported.
2. Only Provide Subscriber Location messages with the id as IMSI are supported.
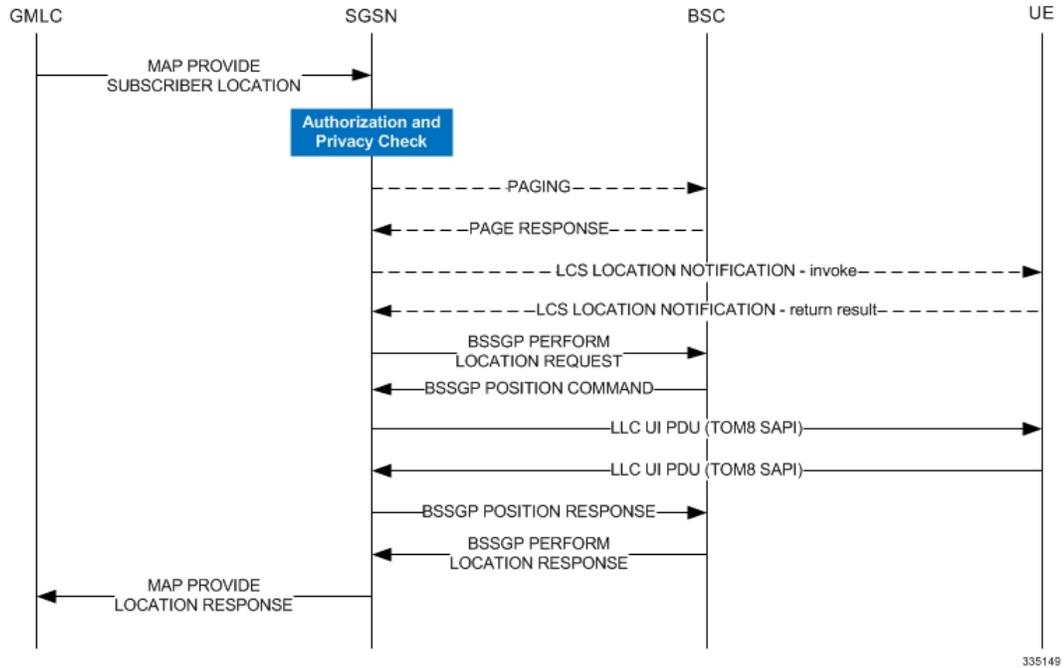
Flows

Flows

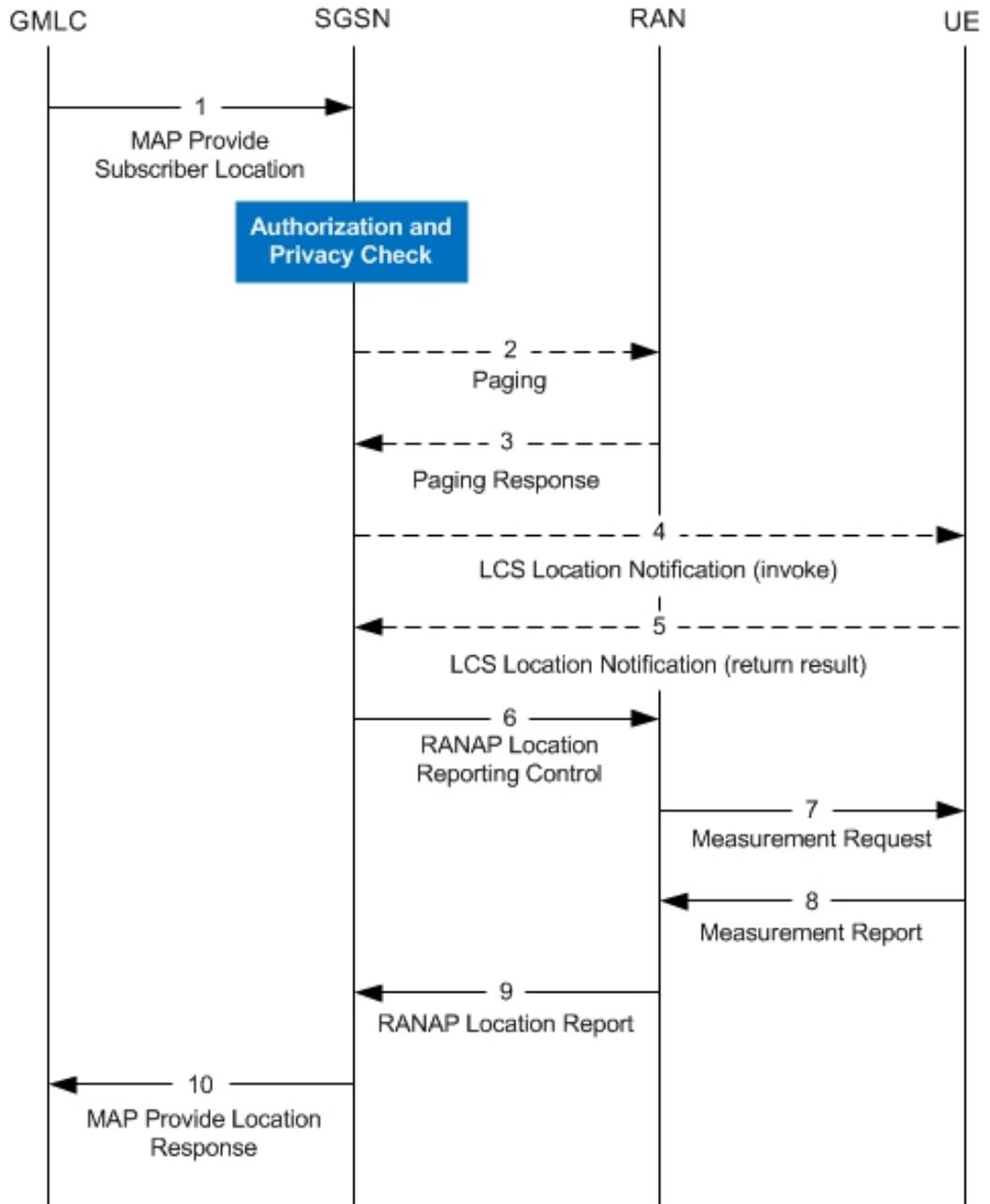Location Services call flows are standards compliant for the SGSN.

SGSN

Figure 2: 2G Mobile Terminating Location Request

Figure 3: 3G Mobile Terminating Location Request

Standards Compliance

The SGSN's Location Services feature complies with the following standards:

- TS 3GPP 23.271, v9.6.0
- TS 3GPP 24.030, v9.0.0

- TS 3GPP 24.080, v9.2.0
- TS 3GPP 25.413, v9.8.0 (sections 8.19.2 and 8.20.2)
- TS 3GPP 29.002, v9.7.0

Configuring Location Services (LCS) on the SGSN

This section provides a high-level series of steps and the associated configuration examples to configure Location Services on the 2G or 3G SGSN -- or for both.

The commands could be issued in a different order, but we recommend that you follow the outlined order for an initial LCS configuration. All listed configuration steps are mandatory unless otherwise indicated.

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Important For all the required configuration commands to be available and to implement the configuration, the SGSN must have loaded the license for the Lg interface.

Step 1 Enable Location Services on the SGSN.

Step 2 Identify the GMLC (in the MAP service) to which the SGSN connects for LCS access to the external LCS client.

Step 3 Configure the MAP service's M1 timer.

Important Step 3 is not mandatory but it is recommended.

Step 4 Create a location services configuration and associate the MAP service.

Step 5 Fine-tune LCS configuration per UE by defining LCS-related restrictions.

Step 6 Associate the location services configuration with the appropriate SGSN - GPRS (2G) service and/or UMTS (3G) service.

Step 7 Associate the location services configuration with an operator policy.

Step 8 Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode command **save configuration**. For additional information on how to verify and save configuration files, refer to the *System Administration Guide*.

Step 9 Verify the configuration for each component by following the instructions provided in the *Verifying the Feature Configuration* section.

Enabling LCS

Location Services functionality is enabled globally for the SGSN.

```
config
    sgsn-global
        location-services
        end
```

Notes:

- This command enables and 'starts' LCS on the SGSN.
- This command also enables support for the Lg interface on the SGSN.

• Using the 'no' keyword stops LCS.

Identifying the GMLC

Use the MAP service configuration to identify the GMLC to which the SGSN connects for LCS access to the external LCS client. We recommend that you also configure the MAP service's M1 timer, however, this is option.

```
config
     context context_name
          map-service map_service_name
                gmlc { isdn E.164 | point-code point_code } gsn-address
ipv4_address [ source-ssn ssn ]
                timeout m1 seconds
                end
```

Notes:

• Only one GMLC can be configured per MAP service.

• SGSN includes the configured GMLC address as the value for the v-GMLC (an optional IE) in Update-GPRS-Location messages to the HLR. It is possible to configure the SGSN to exclude the GMLC address in Update-GPRS-Location messages, see *Configuring Exclusion of GMLC Address from Update-GPRS-Location Messages* below.

• **isdn** is the 1-15 digit E.164 number that identifies the GMLC.

• **point-code** is the address for the GMLC in dotted-decimal or decimal SS7 point-code format

• **gsn-address** is the IPv4 address for the GMLC

• **source-ssn** optionally identifies the source SSN value to be used.

Configuring Exclusion of GMLC Address from Update-GPRS-Location Messages

By default, the SGSN includes the GMLC address, configured in the MAP service, in all Update-GPRS-Location (UGL) messages going to the HLR. Some HLRs do not recognize the v_GMLC field or value when it arrives in the UGL. As a result, the HLRs reject the calls. This prevents roaming-in subscribers from using some networks where LCS is enabled.

Beginning with Release 19.4, it is possible to configure the SGSN to exclude the GMLC from the UGL message. This is done with a new keyword, **exclude-gmlc**, added to the **map** command in the Call-Contol Profile configuration mode. Use the following configuration, illustrated below, to exclude the GMLC from the UGL message:

```
config
   call-control-profile profile_name
      map message update-gprs-location exclude-gmlc
      end
```

Notes:

- **exclude-gmlc** - This keyword configures the SGSN to exclude the GMLC address in the Update-GPRS-Location (UGL) messages sent to the HLR.

- To re-enable the default behavior to include the GMLC address in the map message, enter the following configuration command:

  remove map message update-gprs-location exclude-gmlc

- For information about the other keywords available for the **map** command, refer to the *Command Line Interface Reference*.

Creating the Location Service Configuration

This set of configuration commands creates a location service configuration and associates the MAP service with the location service. Up to 16 separate location services can be created.

config
    context *context_name*
        location-service *loc_serv_name*
            associate map-service *map_serv_name*
            end

Notes:

- The SGSN supports a maximum of 16 location service configuration. It should be noted that this number, 16, is not part of the SGSN's service configuration limit of 256.
- Associate the MAP Service configuration in which the GMLC is defined.

Fine-tuning the Location Service Configuration

Fine-tune the location service configuration per UE by defining LCS-related restrictions. The following commands will be used to configure the LCSN timer (location notification invoke procedures timer). Configuring the timer value is optional.

config
    context *context_name*
        location-service *loc_serv_name*
            timeout lcsn *seconds*

Notes:

LCSN timer range is 10 - 20 with a default of 15. seconds.

The following command is used to configure the UE available guard timer. Configuring this timer is optional.

config
    context *context_name*
        location-service *loc_serv_name*
            timeout ue-available-guard-timer *ueagtimer_seconds*

Notes:

This timer, set in seconds, is used to guard the packet-switched deferred location request (UE available event) procedures. It is an integer from 10 to 600. Default is 600.

The following command is used to configure area event invoke procedure timer. Configuring this timer is optional.

```
config
    context context_name
        location-service loc_serv_name
            timeout area-event-invoke-timer aietimer_seconds
```

Notes:

This timer, set in seconds, is used to guard the area event invoke procedure. It is an integer from 10 through 20. Default is 15.

The following command is used to configure periodic event invoke procedure timer. Configuring this timer is optional.

```
config
    context context_name
        location-service loc_serv_name
            timeout periodic-event-invoke-timer peitimer_seconds
```

Notes:

This timer, set in seconds, is used to guard the period location invoke procedure.. It is an integer from 10 through 20. Default is 15.

Associating the Location Service Config with the SGSN

Location service functionality can be associated with either the 3G SGSN via commands in the SGSN Service configuration mode or with the 2G SGSN via commands in the GPRS Service configuration mode.

The following associates the location service configuration with a 3G SGSN:

```
config
    context context_name
        sgsn-service service-name
            associate location-service loc_serv_name
```

Notes:

- To associate with a 2G SGSN, enter the GPRS service configuration mode in place of the SGSN service configuration mode.

Associating the Location Service Config with an Operator Policy

Location service functionality can be associated with an operator policy to provide granular control.

The following associates the location service configuration with a call-control profile by IMSI and these CLIs will disable/enable Mobile Terminating, Mobile Originating and/or Network Induced location requests by access-type.

```
config
    call-control-profile ccprofile_name
            lcs-mt { allow | restrict } access-type { gprs | umts }
```

Notes:

- **lcs-mt** enables mobile-terminating location requests.

- replace **lcs-mt** with **lcs-mo** to enable the mobile-originating location requests, **lcs-ni** is not supported by SGSN.
- Default for the 3 **lcs** commands is **allow**

Verifying the LCS Configuration for the SGSN

View the location service configuration to verify the configurations created for the Location Service functionality, by using the following commands:

```
show location-service service { all | name loc_serv_name
```

View the MAP configuration to verify the MAP configurations created for the Location Service functionality, by using the following commands:

```
show map-service { all | name map_serv_name }
```

View the call-control profile configuration to verify the configurations created for the Location Service functionality, by using the following commands:

```
show call-control-profile full name ccprof_name
```

Monitoring and Troubleshooting the LCS on the SGSN

Use the commands listed below to monitor and/or troubleshoot the operation of the Location Services on the SGSN.

- **show map statistics name** *map-service-name*
- **clear map statistics name** *map-service-name*
- **show gmm-sm statistics**
- **show subscribers sgsn-only summary**
- **show subscribers gprs-only summary**
- **show location-service service {all | name** *location-service-name* **}**