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Content

Foreword

This Technical Specification has been produced by the 3GPP.

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Introduction

UMTS will build on the success of GSM and is likely to become even more widespread. In addition, the continued growth of international travel for business and leisure means that the number of roaming UMTS and GSM subscribers is set to increase significantly.

Every time a subscriber moves to a location area served by a different MSC/VLR or SGSN, the subscriber data must be downloaded from the HLR in the home PLMN to the new entity serving the user and deleted in the old MSC/VLR or SGSN. If the location areas associated with these entities are small or the subscriber frequently moves between location areas the subscriber will represent a large signalling load. This is equally applicable to subscribers moving within their home network and roaming subscribers except in the latter case international signalling costs are incurred.

The Super-Charger uses spare capacity in the MSC/VLR or SGSN and modifies subscriber data handling to reduce the signalling load associated with roaming. The reduction in signalling load is achieved without introducing a new node but does require new functionality within the network.

1 Scope

This Technical Report describes the use of Super-Charger mechanism within UMTS to reduce the signalling traffic associated with mobility. This document provides a technical proposal and example uses of the Super-Charger concept but also identifies issues that require further study. Finally, this document highlights the advantages and disadvantages, and identifies the UMTS Technical Specifications that would require enhancing to support this functionality.

2 References

The following documents contain provisions, which through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] 3G TS 21.905: "3G Vocabulary".

[2] 3G TS 23.008: "Organisation of Subscriber Data@.

[3] 3G TS 23.016: "Subscriber Data Management; Stage 2".

[4] 3G TS 23.060: "General Packet Radio Service (GPRS); Service Description; Stage 2".

[5] 3G TS 29.002: "Mobile Application Part (MAP) Specification".

[6] 3G TS 33.102: "3G Security, Security Architecture".

3 Definitions and Abbreviations

3.1 Definitions

Super-Charged Network	A UMTS network in which the Super-Charger mechanism is being used to optimise mobility management signalling.

3.2 Abbreviations

The abbreviations reported in this document can be found in [1].

4 General Description

The aim of the Super-Charger concept is to reduce the mobility management costs associated with inter-VLR and SGSN location updates.

The Super-Charger constitutes a change to the subscriber data management to reduce mobility management costs. However, the proposed enhancement does not require significant modifications of the GSM/UMTS standards.

The current subscriber data management philosophy is to cancel the subscriber data at the old MSC/VLR when the subscriber moves to a location area served by a different MSC/VLR. An alternative philosophy is to leave the subscriber data at the old MSC/VLR, which removes the need to use the cancel location procedure, figure 1. The HLR performs the normal insert subscriber data at the new MSC/VLR. The subscriber data at the old MSC/VLR is not maintained in any way. Therefore, no additional signalling is required.

The network benefits from this new philosophy when the subscriber roams to a previously visited MSC/VLR where the user's subscription data is already present. In this case, provided the subscription data is still valid then the need to perform the insert subscriber data procedure is removed, figure 2. Consequently, this philosophy reduces mobility management cost by reducing the volume of location update signalling.

The new philosophy is of most benefit in metropolitan areas where the density of MSC/VLRs is high to cope with the large number of subscriber and subscribers regularly commute between location areas served by different MSC/VLRs. Assuming the subscriber data has not been deleted or changed since the subscriber was last attached in the location area then the MSC/VLR has the option to use the subscriber data previously downloaded. However, the HLR will ultimately control data retention and updates in the MSC/VLR.

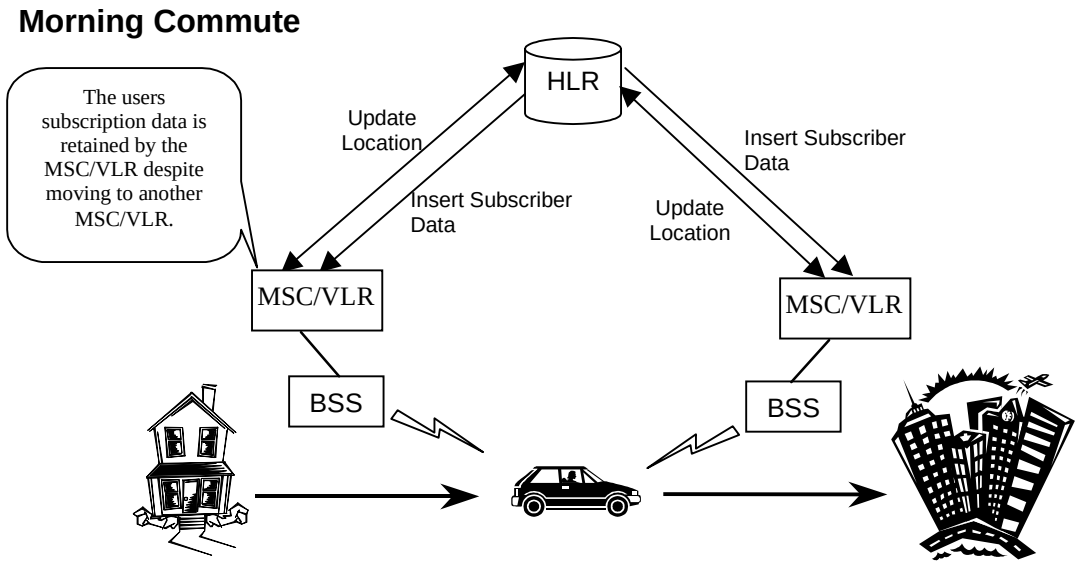

Figure 1: Morning Commute in a Super-Charged Network

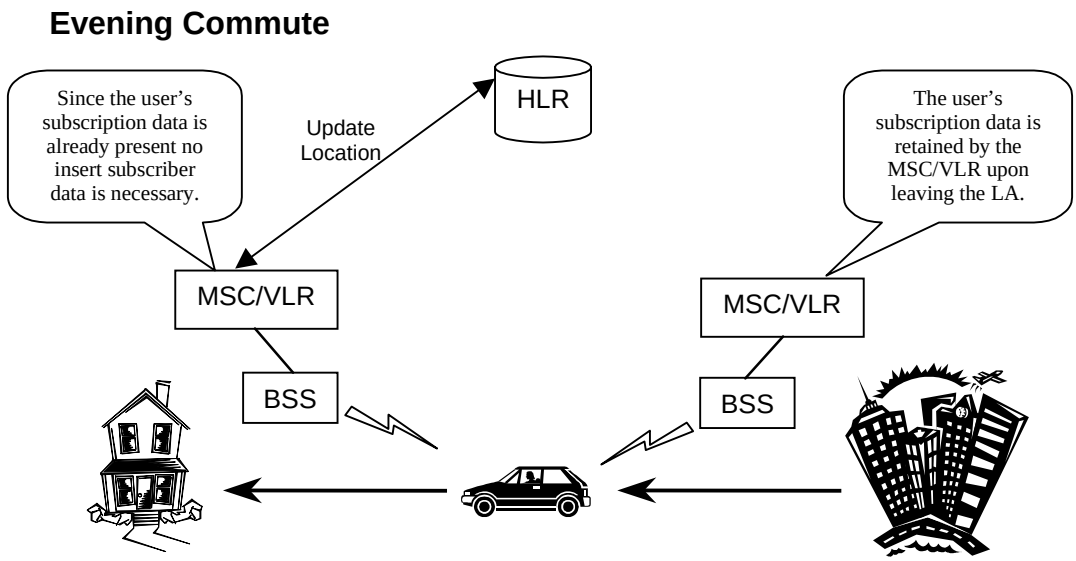

Figure 2: Evening Commute in a Super-Charged Network

In a Super-Charged network subscriber information is no longer deleted from the VLR database when a mobile station leaves the area served by the MSC/VLR, using spare capacity available in the VLR to store the subscription data. This results in the continuous growth of the VLR database size. Consequently, a new VLR data management system is required so that the VLR can handle newly arrived mobile stations. Two options are envisaged. Old subscriber data may either be deleted periodically using a VLR audit system or deleted dynamically to make room for the newly arrived subscribers.

The Super-Charger concept is equally applicable to packet services.

5 Functional Description

The Super-Charger mechanism modifies the Location Update procedures to reduce the cost of Inter-VLR and SGSN mobility.

Specifically, the Super-Charger mechanism proposes the modification of the following aspects of Inter-VLR and SGSN Location Updates:

- Addition of a new optional parameter to each of the MAP UPDATE LOCATION and MAP UPDATE GPRS LOCATION messages, which indicates whether the VLR and SGSN support the Super-Charger concept and provides the date/time at which the subscription data was last modified in the HLR before the subscription data was provided to the VLR or SGSN.
- Addition of a new optional parameter to the insert subscriber data message to communicate the date/time at which the subscription data was last modified.
- The MAP CANCEL LOCATION message is no longer sent by Super-Charged HLRs to MSC/VLRs and SGSNs that support the Super-Charger functionality.
- The MAP MS PURGE message is no longer sent when inactive subscription data is removed from the VLR or SGSN databases during Database Management procedures.
- Diagnostic information is added to the MAP PROVIDE ROAMING NUMBER response, which is used in response to a request for a roaming number to indicate that the subscriber's data was removed from the VLR during Database Management procedures.
- Database Management system.

5.1 New Update Location Parameter

It is proposed that as part of the Super-Charger feature an optional parameter is added to the Update Location and Insert Subscriber Data messages. In the examples this information element takes the name "ageOfSubscriberData". The purpose of this information element is;

- to indicate that the VLR, SGSN and HLR supports the Super-Charger functionality and;
- to indicate the date/time at which the subscription was last modified in the HLR before the subscription data was provided to the VLR orSGSN.

This parameter could be added after the ellipsis notation to avoid an application context upgrade.

Figure 3: Example ASN.1 encoding of Update Location Argument

The HLR uses the presence of this parameter to determine whether the originator of the update location message supports the Super-Charger feature and whether it is necessary to send subscription data.

If the parameter is present the HLR shall set a flag in the HLR to show that the originating entity supports the Super-Charger functionality.

If the parameter is not present in the Location Update request message the HLR shall not set the Super-Charger support flag and shall provide subscription data as described in the GSM standards.

This flag is subsequently used to determine whether the HLR shall send the cancel location message when the subscriber roams to another VLR or SGSN. If the Super-Charger supported flag is set the HLR shall not send the cancel location message, whereas if the Super-Charger supported flag is not set the HLR shall send the cancel location message.

The "ageOfSubscriberData" parameter includes the date and time at which the subscription data was last modified in the HLR before the subscription data was sent to the VLR or SGSN. However, if the VLR or SGSN contains no subscription data for the subscriber the date and time shall indicate a default value.

Upon receipt of the "ageOfSubscriberData" parameter the HLR shall compare the received date/time against the date/time stored against the subscription data in the HLR and;

- If the date/time stamp provided by VLR or SGSN is older than the date/time stamp stored by the HLR, then the HLR shall use the insert subscriber data procedures to provide the requesting entity with the subscription data stored in the HLR including the updated date/time stamp.
- If the date/time stamp provided by the VLR or SGSN is the default value the HLR shall use the insert subscriber data procedures to provide the requesting entity with the subscription data stored in the HLR including the date/time stamp.
- If the date/time stamp provided by the VLR or SGSN is the same as the date/time stamp stored by the HLR, then the HLR shall not send subscription data to the requesting entity.

5.2 Purge MS message removal

In the normal GSM mode of operation when a VLR or SGSN deletes a subscriber's data because it has been inactive for an extended period the VLR or SGSN sends a PURGE MS message to the HLR indicating that the corresponding subscriber was removed.

In a Super-Charged network, the PURGE MS message is not sent as a result of Database Management procedures, section 8.4. Instead, the subscription data is silently discarded. Subsequently subscriber activity

is indicated to the HLR using the update location procedure, which shall include the "ageOfSubscriberData" parameter containing the default value and consequently the HLR shall initiate the normal GSM Location Update procedures

A drawback to the removal of the PURGE MS exists during mobile terminations. Since the HLR is not notified when a subscriber is removed from a particular VLR or SGSN, it will continue to route calls and packets to the respective entities where the subscriber information was deleted assuming that was the last reported location of the subscriber. This will cause extra work for the MSC/VLR and SGSN if the subscriber cannot be reached.

The occurrence of this drawback is small since it is likely that the subscriber has location updated in another VLR or SGSN. However, the deployment of Super-Charger in conjunction with Pre-Paging will limit the impact of this disadvantage.To further limit the impact of this drawback it is proposed to modify the VLR restoration procedure as follows:

Upon receipt of a request for a roaming number, if there is no subscriber data record in the VLR the VLR shall distinguish two cases:

a) the subscriber data record was lost due to VLR restart

b) the subscriber data record was removed by the Super-Charger database management function described in section 8.4.

In the first case the normal restoration procedure is started. In the second case the VLR returns an AbsentSubscriberError with the new diagnostic information "MS purged". The HLR then sets the MS purged flag and further terminated calls will not be routed to the VLR/MSC.

The means by which the VLR distinguishes the two cases a) and b) is considered implementation dependent and is not detailed further.

5.3 Retrieving IMSI from MS instead of Old VLR (Optional)

When a subscriber returns to a previously visited MSC/VLR the authentication vectors are already available in the VLR that is serving the mobile station. Consequently, communication of the authentication vectors from the old VLR is not necessarily required. Therefore, optionally a further reduction in the real-time cost of Inter-VLR Location Updates can be achieved if the subscriber's IMSI is retrieved from the mobile station using DTAP IDENTITY REQUEST/RESPONSE procedures instead of requesting the information from the old VLR. However, this option has associated security impacts since the IMSI is communicated over the air interface unciphered.

Alternatively, it may be possible to enhance the MAP Send Identification procedure such that the old VLR does not provide the authentication vectors as part of this procedure. However, the MAP Send Identification procedures would have to be modified in a backward compatible manner but even then the requirement to use authentication vectors in sequence may preclude the use of this option.

The appropriateness of these further enhancements is for further study.

These additional optimisations are not possible in the context of packet services because the inter-SGSN signalling is essential to establish a temporary data connection between the two SGSNs for the transfer of packets.

5.4 Database Management

In a Super-Charged network subscriber's information is no longer deleted from the VLR or SGSN databases when the MS (Mobile Station) leaves the served area. Instead, the information is kept for future use, using spare capacity available in the VLR or SGSN. This is essential for reducing the real-time cost of an Inter-VLR or SGSN Location Update transaction. This results in a continuous growth of the database size. If not managed properly, the VLR and SGSN databases will eventually become full and unable to handle newly arrived MSs. Hence a new strategy to manage the VLR and SGSN database content is required.

The database management scheme is an implementation option. Possible mechanisms are:

- Utilisation of a larger database,
- Periodic audit scheme,
- Implementation of a strategy to make room for new users by removing old subscriber information from the associated database.

5.4.1 Utilisation of a larger database

The implementation of larger databases may be used to limit the need for other mechanisms to ensure that sufficient database capacity is available to service new subscribers. However, the need for an alternative mechanism such as Periodic Audits and Dynamic Subscription Data Deletion is not removed.

Implementing larger databases such that subscription information is retained for an increased number of subscribers can increase the benefit from a Super-Charged network. However, the optimal database capacity will be network specific. Furthermore, the implementation of a larger database is not a requirement for this feature.

5.4.2 Periodic Audit

This scheme periodical removes inactive subscription data from the VLR and SGSN databases. The volume of subscription data deleted should by based on an estimation of the growth of the database size during the audit cycle. Since the estimated growth will be network specific it is recommended that the standards do not capture a specific percentage. However, it is recommended that the audit process is performed once every 24 hours during a quite period.

Exactly which subscriber's data is deleted should be based on the "age" of the data or the period of time elapsed since the last Iu interface activity. Before removing a particular subscriber's data it is essential to check for any CS or PS activity.

The deletion of inactive subscriptions should not result in the use of the Purge MS procedure towards the HLR. Instead the data is discarded silently.

5.4.3 Dynamic Subscription Data Deletion

This scheme allows the run-time removal of subscription if the associated database is full. In this case, the oldest subscription data is deleted to make room for the newly arrived subscriber. This mechanism may be used in conjunction with the other scheme detailed above or as the only method by which to create available capacity within a database.

The criterion for removal is the 'age' of the subscriber's information in the database. The age of a subscriber's information in the database is defined as the elapsed time since the last Iu-interface activity for the MS occurred. The oldest subscriber is removed first. Circuit Switched and Packet Service activity of the subscriber shall be checked before any deletion.

5.5 Data Consistency

Normal GSM operation ensures that subscriber data is only maintained in the HLR. When a subscriber enters a service area served by a particular database (i.e. VLR or SGSN), the HLR temporarily provides the database with the data related to that particular subscriber. If the subscriber happened to move to a new service area served by a different database, the subscriber data is sent to the new database and removed from the old database.

In a Super-Charged Network, subscription data is retained in numerous databases around the network. Each database provided with subscription data will retain this information when the subscriber roams to a different service area. In order to ensure data consistency the HLR shall record the date/time at which the subscription data was last modified and this date/time stamp is downloaded to the VLR or SGSN with the

subscriber data . If the subscription data is changed in the HLR the copy of the data in each database will become outdated, except the current database(s) since they will be automatically updated. At location updating the VLR or SGSN shall provide the date/time at which the subscriber data was last modified then by comparing this value with the date/time stored in the HLR the HLR can determine whether the subscription data in the requesting entity is valid. Only if the data is not valid shall the HLR download the current subscription data.

Furthermore, to prevent the HLR containing inconsistent subscriber location information if radio contact with the mobile station is lost during a location update procedure, a cancel location message is sent to the subscribers 'old' or 'previous' MSC/VLR or SGSN.

A PurgeMS message is sent when the MSC/ VLR or SGSN detects that radio contact has been lost.

Finally, in the event of an HLR restart the date/time stamp for each subscriber is updated to reflect the restart. HLR restarts will result in a temporary decrease in the benefit from Super-Charger.

5.6 Subscriber Deactivation

When a subscriber is deactivated, the cancel location message is sent to the current VLR and/or SGSN of the subscriber.

Subsequently, when the subscriber attempts to register at a MSC/VLR or SGSN, which has data for the subscriber, the HLR will return an error of 'Unknown Subscriber' and therefore prevent the subscriber from obtaining service.

6 Specific Examples

This section describes the operation of a Super-Charged network. This mechanism primarily impacts the D and Gr interface signalling as shown below.

6.1 Circuit Switched Domain

6.1.1 Location Update Procedures

Figure 4 provides the message flow for an inter-VLR Location Update in a current GSM network. In this case, the receipt of a location update request containing a LAI served by the previous MSC/VLR from the mobile station triggers the new MSC/VLR to retrieve the authentication triplets from the old MSC/VLR using the Send Identification request message. The new MSC/VLR subsequently requests a location update from the HLR, which causes the cancellation of the location information in the old MSC/VLR and insertion of subscriber data in the new MSC/VLR. The new MSC/VLR then confirms the location update request to MS and may perform TMSI reallocation.

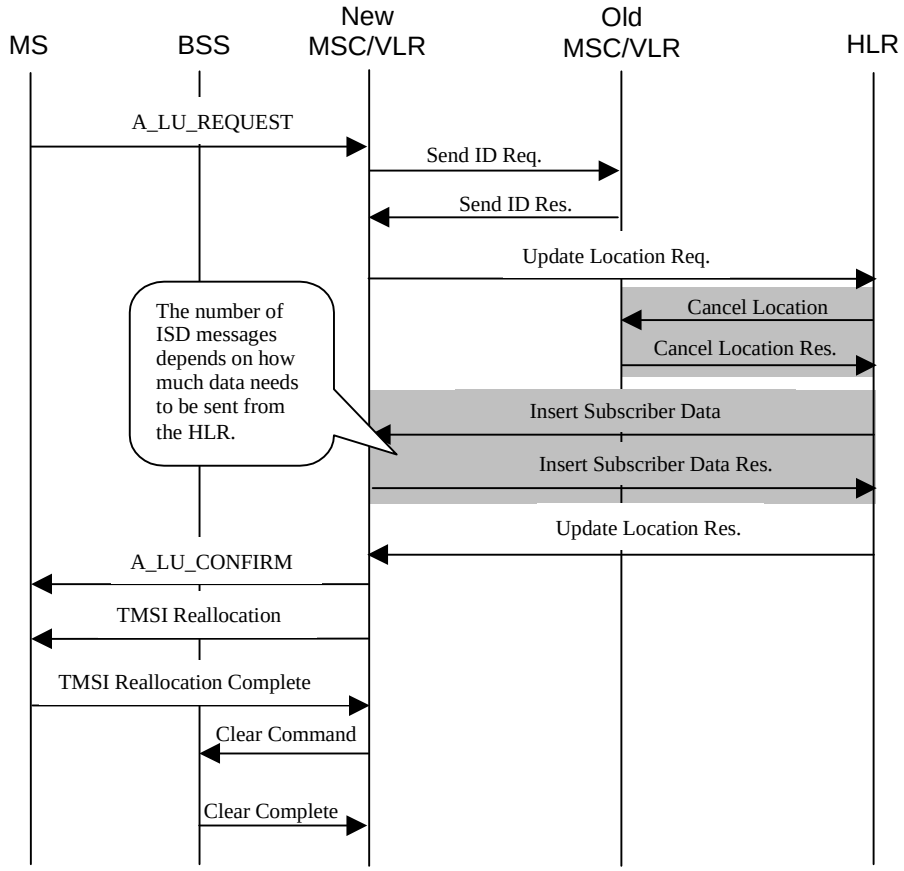

Figure 4: The message flow for an inter-VLR location update in a current GSM network.

Figure 5 provides the message flow for an inter-VLR Location Update in a Super-Charged UMTS Network. This example assumes that mobile subscriber has previously visited the area served by the entity marked “New 3G-MSC/VLR” and that the subscription data has been retained by the New 3G-MSC/VLR and is still valid. In this case, the receipt of a location update request containing a LAI served by the previous MSC/VLR from the mobile station triggers the new 3G-MSC/VLR to retrieve the authentication vectors from the old MSC/VLR using the Send Identification request message. The new 3G-MSC/VLR then requests a location update from the HLR, indicating the date/time at which subscription data was last modified in the HLR before the data was provided to the MSC/VLR. Since both the old 3G-MSC/VLR support Super-Charger no cancel location message is sent to the old 3G-MSC/VLR. The HLR compares the date/time stamp received in the location update request with the date/time stamp stored in the HLR. Assuming the subscription data has not changed then the HLR shall not insert subscriber data in the new 3G-MSC/VLR.

The HLR responds with a positive Update Location response and the new 3G-MSC/VLR confirms the location update request to MS and may perform TMSI reallocation.

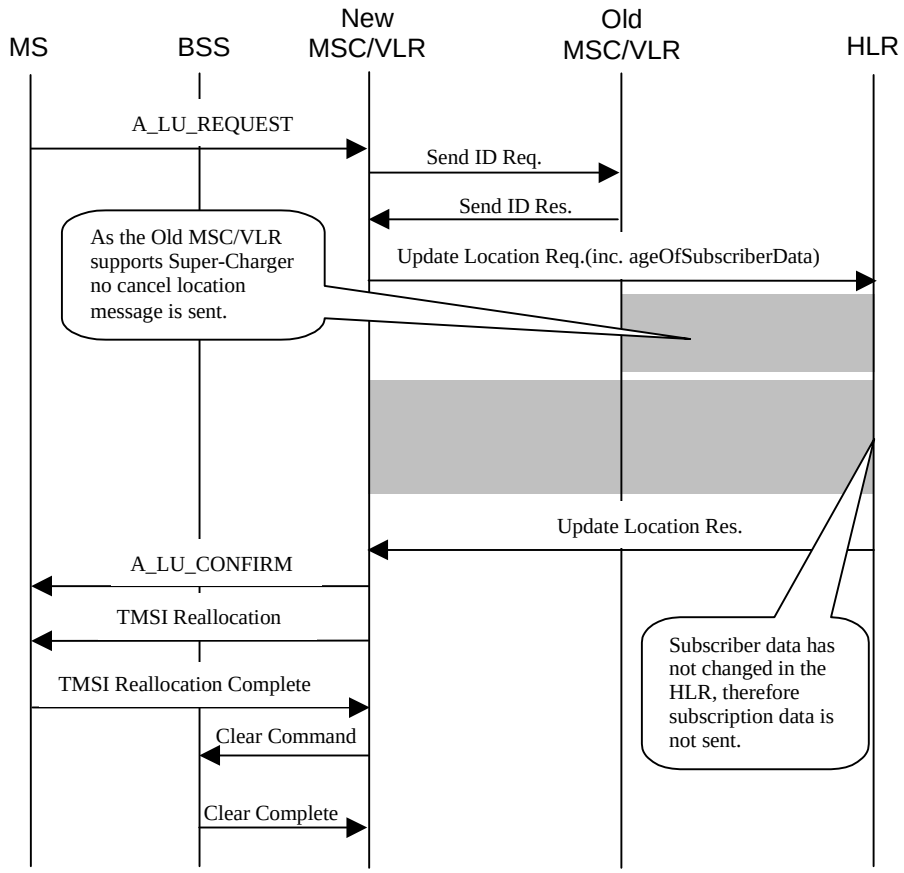

Figure 5: The message flow for an inter-VLR location update in a Super-Charged UMTS Network.

6.1.2 Modification of Subscription Data

The Insert Subscriber Data is enhanced to transport the date/time at which the subscription data in the HLR was last modified. However,the Delete Subscriber Data procedures are not impacted by the Super-Charger concept.

6.1.3 Cancel Location

The MAP CANCEL LOCATION procedures are not required within and between Super-Charged networks except in the event of the loss of radio contact, section 8.5. However, Super-Charged networks are required to support the cancel location procedure to support GSM/UMTS standard mobility management procedures in roaming scenarios. This is achieved by recording whether the VLR or SGSN supports the Super-Charger functionality at location updating.

If a subscriber roams to a VLR or SGSN that does not support the Super-Charger functionality the HLR shall not set the flag indicating that Super-Charger is supported. Consequently, during the location update since this flag is not set the HLR shall send the cancel location message to the previous VLR or SGSN as described in TS 29.002.

6.1.4 Reset

Super-Charger has a minimal affect on the restoration procedures in the VLR and SGSN.

When a MSC/VLR restarts after a failure, all IMSI records affected by the failure are erased. This may include affected inactive subscription data present in the VLR as part of the Super-Charger process.

Consequently, there will be no subscription data or location information stored for an affected mobile station until after the VLR has received either a "Provide Roaming Number" request or an "Update Location" request for that mobile station.

In the former case, on receipt of a "Provide Roaming Number" request restoration of subscriber data in the VLR is triggered individually for each IMSI record using the “Restore Data” procedure. This procedure is not affect by the Super-Charger functionality.

In the case of a “Update Location” request from a mobile station following a VLR restart, since the VLR will not have subscription data for the mobile station the Update Location message shall include the “ageOfSubscriberData” parameter containing the default value. Consequently, the HLR will initiate the normal GSM “Insert Subscriber Data” procedure and update the Super-Charger supported flag..

When an SGSN restarts after a failure, the SGSN deletes all MM and PDP contexts affected by the restart. Optionally, the SGSN may broadcast a Reset message within the SGSN routeing area. This causes the mobile stations that are located in the SGSN routeing area to reinitiate Attach and Activate PDP context procedures. The broadcast Reset message does not target specific mobile station based on the content of the SGSN database. Therefore, no additional signalling is incurred as a result of inactive subscription data present in the SGSN as part of the Super-Charger process.

Each mobile station shall perform a re-attach after a random calculated time in each MS to avoid network congestion. At the next Roueting Area Update from the MS the SGSN performs an Update Location to the HLR as in the Attach or Inter-SGSN RA Update procedures. The update location message shall not contain the “subscriberDataNotRequired” flag. Consequently, the HLR will initiate the normal “Insert Subscriber Data” procedure and enter the SGSN address into the Roaming History, if it is not already present.

6.1.5 Short Message Service

The Short Message Service is not impacted by the Super-Charger concept.

6.2 Packet Switched Service

No further requirements have been identified to support Super-Charger in the Packet Switched domain

7 Benefits and Drawbacks

7.1 Example Signalling Scenario

Consider the network configuration in Figure 6, which shows a network of five MSC/VLRs within a metropolitan area. The diagram also shows the area covered by each VLR. Without Supercharger there are a total of eight imbedded Insert Subscriber Data dialogues and eight imbedded Cancel Location messages sent by the HLR for a total of eight Inter VLR Update Locations (marked by crosses), as a subscriber moves from X to Y and back to X again.

If all the MSC/VLRs in Figure 6 can retain subscriber information (i.e. they have Supercharger capability) then going from X to Y will still result in four imbedded ISD dialogues but no imbedded Cancel Location messages. However, going back to X will result in no ISD dialogues since all the MSC/VLRs visited by the subscriber in going to Y have retained the subscriber’s data. In addition to this, there are no imbedded Cancel Location messages. This assumes that the user’s subscription data has not been modified in the HLR or deleted in the MSC/VLRs.

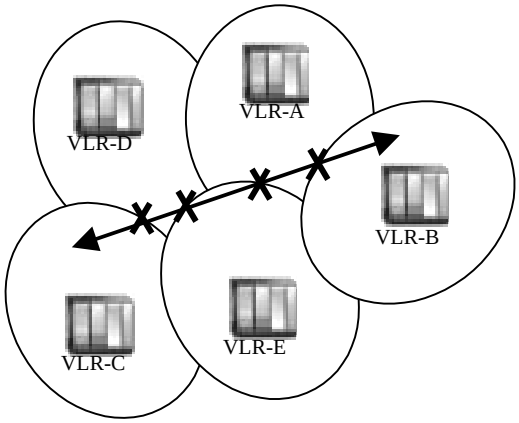

Figure 6: An example network configuration demonstrating the benefit from Super-Charger.

Consequently, in this example Super-Charger provides a reduction in the total number of imbedded Insert Subscriber Data dialogues and Cancel Location messages being sent.

In a non-Super-Charged network, the total real-time cost of an Inter VLR Update Location in the above example is:

8*(Cost of UL + Cost of ISDs + Cost of CL)

Whereas in a Super-Charged network, the total real-time cost of an Inter VLR Update Location in the above example is:

4*(Cost of UL + Cost of ISDs) + 4*Cost of UL

The “Cost” of each procedure will consist of the sum of the signalling, which is externally visible and the processing load, which is implementation specific. If this calculation is restricted to the signalling benefit and an assumption is made that 3 insert subscriber data messages are required per location update procedure then the number of single MAP messages exchanged on the D-interface is:

In a non Super-Charged network: 40

In a Super-Charged network: 20

Consequently, an estimated 50% reduction in signalling can be achieved in the above example.

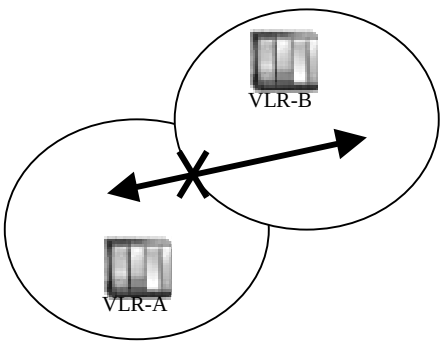

Figure 7: An example network configuration demonstrating the benefit from Super-Charger for the simple case of roaming between two VLRs.

Furthermore, if a simple case of roaming between two service areas is considered (Figure 7) then by a similar calculation.

In a non-Super-Charged network, the total real-time cost of an Inter VLR Update Location in Figure 7 is:

3*(Cost of UL + Cost of ISDs + Cost of CL)

Whereas in a Super-Charged network, the total real-time cost of an Inter VLR Update Location in Figure 7 is:

2*(Cost of UL + Cost of ISDs) + Cost of UL

The equivalent number of MAP messages exchanged on the D-interface is:

In a non Super-Charged network: 15

In a Super-Charged network: 9

Consequently, an estimated 40% reduction in signalling can be achieved for the example in Figure7, based on the assumption that neither VLR initially contained the subscriber's subscription data and that the subscription data was not modified or deleted before the subscriber returned to the area served by the first VLR. Subsequently roaming between the same two VLRs assuming that the subscription data is not modified or deleted in the VLRs results in an estimated 80% reduction is signalling each time the subscriber moves between these two VLRs.

7.2 Advantages

- Super-Charger reduces the volume of signalling traffic associated with mobility. In particular, the Cancel Location procedure is no longer used and the Purge MS and ISD procedures are significantly reduced.
- Super-Charger benefits both the home and visited network in reducing mobility management signalling. In roaming scenarios this mechanism also reduces the volume of inter-PLMN signalling.
- In the circuit switched domain, Super-Charger can additionally remove signalling between the old and new entities in inter-VLR location updates.
- Super-Charger does not require the addition of new network entities.
- The impact on GSM/UMTS standards is low since the majority of the Super-Charger concept refers to internal functionality. However, three MAP messages would require minor enhancements.

7.3 Disadvantages

Removal of the PURGE MS means that the HLR is not notified when a subscriber is removed from a particular VLR or SGSN. Consequently, the HLR will continue to route calls and packets to the respective entities where the subscriber information was deleted assuming that that was the last reported location of the subscriber. This will increase mobility related signalling traffic, and cause extra work for the GMSC, HLR, MSC/VLR and SGSN if the subscriber cannot be reached. However, the enhancement of the provide roaming number response message and the optionally the deployment of Super-Charger in conjunction with Pre-Paging will limit the impact of this disadvantage.

The super-charger does not reduce the mobility related signalling traffic for subscribers whose subscriber data is modified in HLR or deleted from MSC/VLR, before their return to a given VLR area. The amount and share of such subscribers are likely to increase with growing deployment of location and time based services.

7.4 Open Issues

- The option to use the standalone ISD procedures to update the subscription data in the visited MSC/VLR or SGSN in the event of a change to subscription data in the HLR when the MS roams to a previously visited MSC/VLR or SGSN is for further study. See section 8.1.
- The possibility of using the Pre-Paging concept to reduce the impact of removing the Purge MS as described in section 8.2 is for further study.
- The option to retrieve the IMSI from the MS instead of the old VLR in inter-VLR location updating or enhance the send identification message as described in section 8.3 is for further study.

8 Impact on Release 99 Specifications

The following specification will need to be enhanced to support the Super-Charger concept:

TS 23.008	Specification of the Super-Charger supported flag and date/time stamp.
TS 23.016	Specify the option to use Super-Charger.
TS 23.060	Specify the option to use Super-Charger
TS 29.002	Super-Charger requires the addition of a new optional parameter in the Update Location and insert subscriber data operations and the enhancement of the Provide Roaming Number response message. In addition, the Location Update procedures would require modifying with this optional functionality.

9 Conclusions

Super-charger is a feasible approach to reduce inter-PLMN mobility management traffic and work should continue to include the feature in release 99.

History

Document history		
V3.0.0	January 2000	Publication