Tdoc WHS-99012

3GPP Joint Meeting on GSM-UTRAN handover and SRNS relocation

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Agenda item	**:**	GSM/UTRAN handover (PS services)
Source	**:**	**Lucent Technologies**
Title	**:**	**Discussion on common Routing Areas**
Document for	**:**	**Discussion**

Introduction

During the introduction of UMTS (3G), its radio coverage may be patchy resulting in pockets (such as in-building) where 3G coverage may not be available and the mobile must revert to 2G.
There has been discussions in SA2 before on the issues of having a common location/routing area for 3G and 2G [1]. There is a clear advantage in having common areas in order to reduce signalling (LAU/RAU) load, but some issues were also identified if the mobile was not to perform a RAU when it moved between 2G and 3G. This contribution discusses one possible way of reducing the RAU load while avoiding the issues.

- The working assumption is that an LA/RA cannot span more than one MSC/SGSN. This implies that a common 2G/3G MSC/SGSN is required to support a common LA/RA. This is not much of an issue for the MSC side, since an Iu/A interface IWF is relatively straightforward and can be expected to be standardised. The SGSN side when the UE has a PDP context active is, however, more complex and is the main topic of this contribution.
- This contribution only considers non-real-time services for reasons explained later.

Issues to be addressed when a UE has a PDP context active:

- Separate 2G and 3G SGSNS with separate RAs:
  Consider a UE in GPRS STANDBY state with a PDP context active. When it moves into 3G coverage area[1] then the UE will select the 3G cell. If the 2G and 3G are served by different SGSNs, this will result in a RAU towards the 3G. The HLR will have to be updated and a new GTP tunnel set up with the GGSN. A similar case arises when the UE is in URA connected mode in 3G and hits a blind spot without 3G coverage. This is especially wasteful if the transition is caused by patchy 3G coverage and the UE "reverts" back to its previous access technology after a certain time without having sent any data.

- URA connected state
  Even with common RAs, under the current WAs, a UE in URA connected mode will need to perform a RAU when it moves out of 3G coverage. This is required to remove the UE context and connections in the UTRAN and also set up an access towards the 2G. An SGSN that supports Iu-ps and Gb with common RAs will thus still lead to RAU traffic when the mobile crosses between 2G and 3G. This can lead to significant signalling load for a long packet session.

From the above discussion and the issues discussed in [1] , it is seems that a RAU is required when the UE moves between 2G and 3G with the PDP context active. For a UE in active communication, a couple of additional signalling messages of a RAU will not add significantly compared to the data traffic carried. However, for UEs not in active communication, these RAUs may be comparable with the traffic being sent and must be minimised.

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[1] It is assumed here that the cell selection mechanism is set to choose 3G where available.

Proposal

Delayed RAU

One possible way to reduce the signalling associated with non-active mobiles is to delay the RAU until there is data to send. Thus a UE which goes out of 3G coverage area temporarily and comes back into 3G in the same URA, without having sent any data would not perform any updates. If, out of 3G coverage (i.e., it is in 2G), and the UE needs to send any data, it must first perform a RAU before sending any data.

Two network architectures are possible:

- Same RA covers 2G and 3G. The UE identifies a change in radio access network to differentiate between 2G and 3G.
  - Allows operator to use same SGSN for 2G and 3G to save MAP traffic to HLR and setting up a new GTP tunnel.
- Have different RAs for 2G and 3G; UE must maintain the previous RA for 2G and 3G to identify a change in RA for the respective access technology.

Paging

STANDBY state

Without a RAU when moving between 2G and 3G, it is necessary to page the mobile in both 2G and 3G cells of the RA(s) in order to either to deliver a packet in STANDBY mode (or to request a session start up for a network initiated session). If the UE has moved from where it had last sent any data, it must respond to the page with a RAU. The appropriate path via 2G or 3G will then be set up accordingly and the old paths torn down.

URA connected state

URA connected state requires special attention. A UE in URA connected state should also be allowed to move between 2G and 3G without generating RAUs. This requires that type[2] 2 paging messages originating at the RNC and using RNTI as the UE identifier, will need to be sent to all of the RA – covering 2G and 3G. This can be achieved using:

- A RANAP paging message across Iu-ps from the UTRAN to the CN. The CN can then translate this paging message to P-TMSI before sending it to all the BSSs in the RA. If the 2G and 3G are served by different SGSNs, then the paging message will have to be carried over Gn. Or,
- An interface between the BSC and RNC to carry this paging message. Also requires a new paging message over the air to use RNTI or the RNC should also maintain the P-TMSI of the UE to send a type 1 paging request to the BSSs. It also implies that the RNC has knowledge of the cells that belong to the 2G RA that the URA overlaps.

Other issues/optimisations

This procedure will increase delay to start communication if out of the cell in which it was last in active communication. . Since this is only applicable for best effort services, the additional delay may be acceptable compared to the saving in RAU traffic. The network configuration may be broadcast to enable or disable this configuration.

This requires some interaction of 2G and 3G MMs in the UE to accept paging messages, and to retain old RAs. This is true whenever a RA spans 2G and 3G.

[2] Here Type 2 refers to RAN type 2 paging message.

It creates additional paging load. This is an unavoidable consequence of reduction of RAU signalling. Note that this depends on the operator configuration. If the operator does not foresee any problems with patchy coverage, then this procedure need not be used. There are several optimisations possible to reduce the impact of this additional paging load. For e.g., the paging message can first be sent to the 2G cells that overlap the patchy 3G coverage area and on no response, the paging area can then be widened to the entire 2G RA.

If the UE happens to be in "other" coverage area while the Periodic Routing Area update timer ran out, if should perform RAU and will then be considered as registered in that access network.

It may be required to identify whether the user was last registered in 2G or 3G from the RAI and P-TMSI. Normally, the RAI provides this distinction. If the same RAI is used for both 3G and 2G, then the P-TMSI address space for 2G and 3G can be made disjoint to provide this distinction. This is an operator configuration issue.

UEs not in active communication in patchy coverage areas do not generate RAU traffic. It allow operators to have common or separate SGSNs and RAs for 2G and 3G.

The proposed procedures can be summarised as follows:

- A RA is allowed to span both 2G and 3G coverage.
- A UE in STANDBY moving between 2G and 3G within the same RA does not perform a RAU.
- When the terminal wants to send any data:
  - if it is in the same access network as it was when it last sent data, the procedures to be followed is exactly as defined in 2G or 3G.
  - if it is in the other access network than the one from which it sent data last, a RAU must be performed before sending the data. For example, a terminal in STANDBY state in 2G will not perform a RAU when it crosses into 3G, but will do so when it has any data to transmit.
- While in the STANDBY state in 2G, if the SGSN receives data to be sent to the mobile, it must page the entire RA, which includes both 2G and 3G coverage.
  - If the terminal is in the same access network as it was when it last sent data, the rest of the procedures to be followed is exactly as defined in 2G or 3G.
  - If the terminal has changed between 2G and 3G between the time it last sent any data and the page message, it performs a RAU instead of a paging response. The network then accepts this RAU as a paging response.
- If the UE was in URA connected state and the UTRAN receives data to be sent to the UE:
  - The UE must be paged in both URA and the 2G RA. In this case it is the UTRAN that originates the paging message, and there is no existing link between the RNC and BSC. Hence this paging message must be carried by RANAP to the SGSN from the RNC via the Iu-ps. The SGSN will then page the mobile using the P-TMSI over the entire RA.

Reference:

[1] 23.920 Evolution of the GSM platform towards UMTS