TSG-RAN Working Group 3
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Agenda Item: **8.4**
Source: **Alcatel**
Title: **Common Channels on the Iur (revised version)**
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Common Channels on Iur

1 Introduction

At SMG2 UMTS ARC meeting #7 at Chicago, the possibility for the Iur to support Common Channels became a working assumption. The common channels refer to FACH, RACH and DSCH.

Two further contributions try to reverse this working assumption [2] and [3]. The main reason invoked is the complexity of the implementation in the UTRAN.

This contribution first aims to clarify the working assumption:
Even if Iur is able to support common channels, it is still possible for a UTRAN manufacturer not to support this feature. It is not contrary to the working assumption. The working assumption supports both approaches i.e. support if CCH on Iur, and no CCH on Iur.

In the first approach, inter-RNS cell update and inter-RNS hard handover are performed via Iur without the help of the Core Network.

In the second approach, a SRNS relocation is performed each time a cell reselection under a new RNS is initiated by the UE (a cell update procedure is required if the UE cannot send periodic measurements to the UTRAN). If the UE is able to send measurements to the UTRAN a Hard Handover via CN will be performed.

This contribution is also intended to point out the potential problems induced by the dropping of the working assumption. These problems were already tackled in [4] and [5].

2 Discussion

Following issues are discussed:

- Break in transmission
- Reliability
- Multimedia UE
- Ping-pong effect
- Channel switching

2.1 Duration of the break in transmission when Iur does not support of CCH

In the FACH/RACH state, the UE will probably not be able to send measurements to the UTRAN because there is no uplink channel for that purpose (RACH is not sufficient). Therefore, the UE in the "cell connected state" initiates a cell update procedure each time it changes cell.

In the DSCH state, there should be an uplink DCH associated to the DSCH. In this case,

measurements can be sent by the UE to the UTRAN, and a classical hard handover procedure can be performed.

The handover procedure induces a shorter break in transmission than the cell reselection procedure: In the hard handover procedure, the UE can continue to communicate a short time under the old cell as long as it does not receive the Handover Command from the UTRAN. This means that the processing time for the preparation of the handover in the UTRAN and in the CN is hidden to the user. However, the hard handover procedure should not be too long since the UE is going away from the current cell.

In the cell reselection procedure, the UE immediately tries to communicate under the new cell. The processing time for the preparation of the new path is not hidden to the user in the cell reselection procedure. The break in transmission will be much longer than with the hard handover procedure.

These differences are described in the following figures. The figure 1 describes a possible solution for inter-RNS cell update with immediate SRNS relocation. This figure makes the assumption that Iur exists and is used for RNSAP messages (not for the transfer of data). The figure 5 in the annex describes the cell update procedure when there is no Iur. The figure 2 describes a possible solution for the hard-handover procedure via the Core Network.

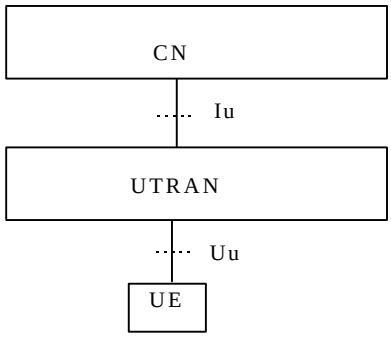

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Figure 1: Example of Inter-RNC cell update with immediate SRNS Relocation procedure (Iur is used for signalling only)

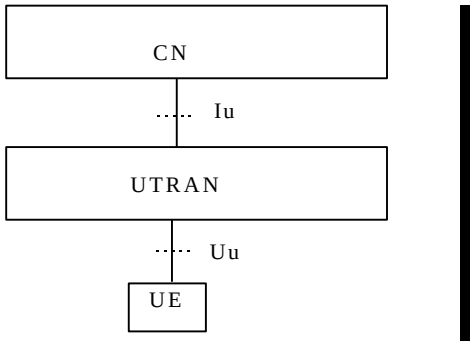

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Figure 2: Example of Inter-RNS Hard Handover via CN

2.2 Break in transmission when Iur supports CCH

Figures 3 and 4 show the inter-RNS cell update procedure and the inter-RNS hard handover procedure via Iur, when Iur supports CCH. These figures use Iur messages defined in [7].

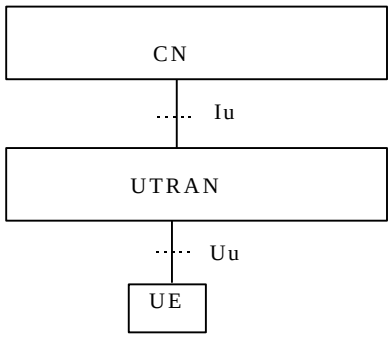

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Figure 3: Example of Inter-RNS cell update via Iur

When comparing figures 1 and 3, which could correspond to the scenarios for FACH/RACH, it can be noticed that:

- The break in transmission is much longer when SRNS relocation is synchronized with the cell update.
- The procedure involves 3 or 4 nodes instead of only 2 nodes when CCH are supported by the Iur.

- The SRNS relocation procedure has to be as fast as possible. Therefore, this solution imposes real-time constraints in the Core Network for SRNS relocation. These constraints do not exist in the solution with CCH on Iur.
- The Core Network may also be overloaded with these additional procedures.

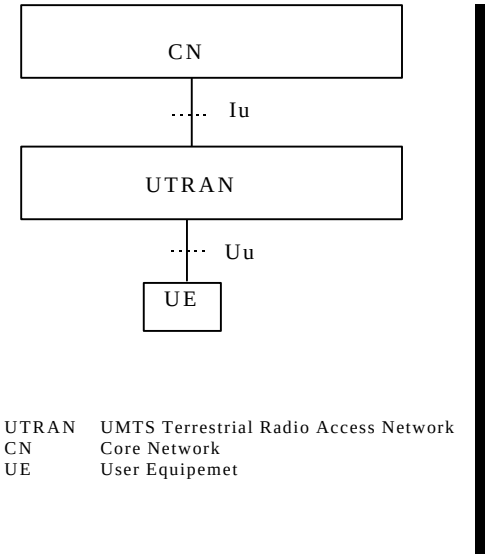

Figure 4: Example of Inter-RNS Hard Handover via Iur

When comparing figures 2 and 4, which may correspond to the scenarios for DSCH/DCH, it can be noticed that:

- The break in transmission is shorter when handover is performed via Iur because there is no RRC/RLC connection to re-establish.
- The procedure involves 3 or 4 nodes instead of only 2 nodes when CCH are supported by the Iur.
- The Core Network may be overloaded with these additional procedures.

2.3 Reliability

Common channels will be used for the transfer of non real time data. The QOS requirements in terms of loss of data must be met in the whole network (CN plus UTRAN).
Several cases have to be considered:

- SRNS relocation.
- Inter-UTRAN handover,
- GSM/GPRS <=> UMTS handover,
- Inter-RNS handover,

In the IP domain, the reliability of user data in SRNS relocations, GSM/UMTS handovers and inter-UTRAN handovers (no Iur interface), is guaranteed by the TCP layer or by the combination of the LLC layer at SGSN and the complex "Inter-SGSN update" procedure (GGSN being the anchor point).
The re-transmission by TCP layer must be infrequent since IP frames can be long and leads to a waste of radio resources.

The contribution SMG12 tdoc C-99-232 from Ericsson presented at Walnut Creek proposes to remove the LLC layer in the SGSN for IP flows. In particular, it says:

"If an interrupt in the radio service lasts too long for RLC to recover, TCP is able to recover the lost packets.[…]. If it is assumed that long interruption of the radio service is infrequent, this drawback can be regarded as acceptable."

GSM/UMTS handovers, inter-UTRAN handovers (no Iur interface) will be relatively infrequent.
Pure SRNS relocations (those not being a consequence of inter-RNS hard handovers within a UTRAN).should also be infrequent
Whereas inter-RNS hard handovers and cell updates within a UTRAN could be relatively frequent.

When Iur is used for inter-RNS hard handovers for CCH, the Serving RNS remains and can be considered as an anchor point for the UTRAN. The re-transmission of lost user data is assured by RLC in the SRNC.
When Iur is not used for inter-RNS hard handovers for CCH, RLC cannot be used to avoid the loss of data. The re-transmission of lost data has to be performed by the TCP layer.
This will occur rather frequently:

- At each inter-RNS hard handover in packet data communications,
- At each DCH => CCH channel switching when the UE is in soft handover on DCH.

Furthermore, in the FACH/RACH case, the break in transmission can be long when Iur is not used as shown in figure 1. If there is no LLC in SGSN, the data are systematically lost (no retrieve of data stored in the old SGSN) and TCP layer will have to retransmit them.
If LLC layer exists, ~~S~~since there is no flow control between the GGSN and the SGSN, data sent by the GGSN are stored in the SGSN. The long break in transmission may lead to an overflow in SGSN and a retransmission by the TCP layer.

Need of LLC layer in SGSN
It should also be noted that if Iur is not used for the transfer of CCH data, then the data cannot be retrieved from the old SRNC to the new SRNC via the Iur. It means that the cell update is seen by the CN and data are retrieved from old SGSN to new SGSN, like in GPRS. And this implies that LLC layer is required. Furthermore, cell level is seen by the CN and this is contrary to the idea that mobility at cell level should be hidden to the CN.
This is not the case if Iur can transfer CCH data.

2.4 Multimedia UE

When a UE has a real-time connection on a DCH (e.g. speech). The QOS requirements (low transfer delay and low frame loss rate) are guaranteed by soft handover. The Serving RNS remains the anchor point as long as SRNS relocation is not performed.

If a non real time packet data connection is established in addition to the real-time connection, the approach using Iur for the transfer of CCH data does not imply a change of Serving RNS: the QOS is guaranteed for the real-time connection.

If CCH are not supported by Iur, a SRNS relocation will be performed when the UE is on a drift RNS and no cell under the SRNS is in the active set: there will be a break in transmission on the real-time connection.
Then, all along the multimedia call, a SRNS relocation will be performed each time the UE moves to another RNS, and will induce a break in transmission.

Furthermore, the SRNS relocation procedure can be very complex even in the UTRAN since

the UE can be in soft handover under both the SRNS and a DRNS: the DRNS will become SRNS and the SRNS will become DRNS. Then the Iur user plane has to be reversed and Macro Diversity Combiner moved. It has to be noticed that the only agreed precondition for a SRNS relocation procedure is that the active set must not include cells under the SRNS (see [6] section 9.2.2.1). Other cases are for further study.
It should be noted that this precondition can be kept if the Iur supports CCH. This simplifies the implementation of the UTRAN.

Furthermore, this case may occur frequently since there is a ping-pong effect due to the low hysteresis in W-CDMA. It also increases the number of SRNS relocations with real-time constraints.

2.5 Ping-pong effect

Due to W-CDMA, the hysteresis in hard handovers is very low. This is because all channels are on the same frequency. This is the reason why soft handover has been introduced in W-CDMA: No soft handover would lead to very frequent hard handovers.

On common channels, soft handovers are not possible because these channels are shared by several users. The low level of hysteresis remains as long as the channels are on the same frequency.

If the Iur is not used for the support of CCH, the number of SRNS relocations (and CN hard handovers) will increase drastically. It increases the load in the CN. And this is in contradiction with the above requirement on the infrequent use of TCP re-transmissions.

2.6 Channel switching

If DCH is used for packet data transfer at a high rate, and if the data rate decreases, it will be necessary to switch to a common channel in order to save radio resources.
If the UE is under a drift RNS,

- If Iur is not used for CCH, a SRNS relocation is performed even if the UE does not move.
- If Iur is used for CCH, no SRNS relocation has to be performed.

2.7 Proposed solution for guaranteeing real-time QOS and non real-time QOS

Real-time QOS consists in a low transfer delay and no (or at least very short) break in transmission.
Non real-time QOS consists in less stringent constraints on transfer delay but in no loss of data.

The real-time QOS is guaranteed in the UTRAN as long as there is no SRNS relocation: making the assumption that all real-time connections are supported by DCH channels, soft-handovers guarantee that there is no break in transmission. Since the real-time calls are not very long, the UE may not be too far from its initial SRNS and SRNS relocations may be avoided because there will be no major gain in transmission resources.

In the packet data domain, a PDP context may be activated for a very long time in GGSN and SGSN. Therefore, the UE can be very far from the SGSN where it activated the PDP context. SRNS relocations must be done in order to optimize the transmission path.
When using CCH on the Iur, SRNS relocation is not immediately performed in case of inter-RNS hard handover, and the SRNS remains an anchor point for packet data: RLC guarantees that no data is lost.

A possible solution for minimizing the TCP retransmissions and optimizing the transmission path would be:

- To avoid SRNS relocation when the UE is in the Cell Connected state (equivalent to Ready state in GPRS).
- To perform SRNS relocation when the transmission path can be optimized only if the UE is in the URA Connected state (equivalent of the Standby state in GPRS).

3 Conclusion

The approach with no CCH on Iur leads to a number of issues both in UTRAN and Core Network that should be taken into account.
Furthermore, the increased complexity of the Iur interface and associated functions (RLC, MAC-D, MAC-C) when the Iur supports CCH is to be compared with the increased complexity in SRNS relocation procedure in the UTRAN due to the removal of the agreed precondition for SRNS relocation (see [6] section 9.2.2.1).

The present working assumption allows for both approaches. The removal of the Chicago working assumption would remove one possibility.

The advantages and drawbacks of both approaches have to be studied more in detail. Since both Core Network and UTRAN are impacted, 3GPP System Architecture WG2 should be involved in this study.

4 Proposal

1. It is proposed to keep the working assumption as it is, i.e. the Iur standard can support CCH data streams. This assumption does not force the UTRAN manufacturers to implement it.

2. It is proposed to include figure 1 in [7] section 7.2.13.2, figure 3 in a new section 7.2.13.3 in [7] called "Inter-RNS cell update via Iur", and figure 4 in [7] section 7.2.12.2.1.

3. It is also proposed to send a liaison statement to 3GPP SA WG2 with the present contribution plus contribution [1] to [5] attached, asking for there advice.

5 References

[1] SMG2 UMTS ARC Tdoc 194/98, Common Channels in Iur interface, Ericsson
[2] SMG2 UMTS ARC Tdoc 380/98, Common Channels in Iur interface, Nokia
[3] TSG-RAN WG3#1 99-044, Drawbacks of Common Channels on Iur, Siemens
[4] SMG2 UMTS ARC Tdoc 246; Radio Access Anchor Point, Alcatel
[5] SMG2 UMTS ARC Tdoc 251; Comparison between proposals, Alcatel
[6] UMTS ZZ.11 V.0.1.0, Description of Iu interface
[7] TSGW3#1(99)033, CCH Procedures over Iur, Nortel Networks

6 Annex

This annex describes a possible solution for Cell Update procedure when the Iur does not exist e.g. between two UTRANs.
The drawback of such a procedure is that the Cell Update is seen by the CN and this is contrary to the idea which supports that mobility at URA and cell levels are handled only by the UTRAN.

- If this is between two UTRANs, a possible solution could be that the UTRAN border is also a Routing Area border. Then the UE would initiate a RA update procedure.
- If the Iur is not used for CCH data transfer, the previous solution cannot apply and the mobility at cell level will be seen by the CN.

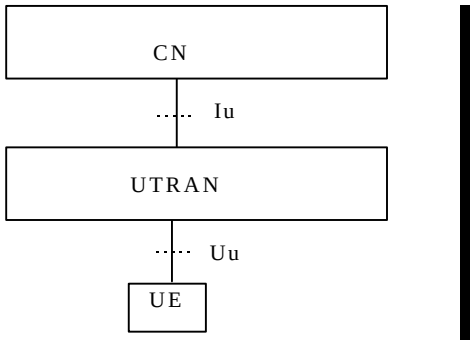

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Figure 5: Cell Update procedure when there is no Iur e.g. between two UTRANs