UMTS Inter-RAT Handover Monitoring

MasterClaw UMTS provides a full set of applications and KPIs for UMTS

Introduction

This short technical note introduces the concept of Inter Radio Access Technology (RAT) handover over UMTS networks and shows how these procedures can be monitored proactively using MasterClaw and UMTS Circuit Access KPI application.

Inter RAT handovers are extremely interesting procedures, both because they involve different technologies and because they represent the only way to ensure high coverage combining the well proven and diffused GSM technology with the forthcoming UMTS. So far UMTS is deployed in many countries but 3G coverage is provided mainly over the main city centers. When users move towards the country sides usually move from 3G to 2G coverage. In these scenarios, operators want to make sure that the two technologies coexist and ensure continuous network access to the customers.

When a user is performing a voice call and is moving between 2G and 3G coverage zones, sophisticated procedures take place in order to ensure the continuity of the service avoiding annoying call drops.

Handover from UTRAN to GSM

Figure 1 shows an example of handover from UTRAN to GSM. In this case the User Equipment is leaving a 3G cell and finds better coverage under a 2G cell. This triggers an RRC measurement report message to the serving RNC that shall activate the inter technology handover from UMTS to GSM.

Upon detection of this message, the RNC sends a ***RANAP message Relocation Required*** to the 3G MSC-S. The UMTS Core Network will forward this request to the GSM MSC over the MAP/E interface (*MAP message Prepare Handover*). At this point the normal GSM procedures follow in the 2G domain (not shown for simplicity). Once initial procedures are completed in the 2G domain, the MSC returns the MAP/E message *Prepare Handover Response* to the 3G domain.

Benefits

- Helps securing high end-user service quality by ensuring seamless handovers between 2G and 3G access networks
- Gives instant indications of Inter-RAT Handover problems
- Helps you making the most out of your existing 2G network infrastructure, while extending out the UTRAN network

Features

- Combines real-time monitoring and historical reports for trend and diagnostic analysis
- Powerful KPIs allows for detailed root-cause analysis related to Iu CS procedures and UTRAN performance
- Based on UTRAN and UMTS core signaling

Application Note

This takes the 3G MSC-S to respond to the initial request from the RNC by sending a ***RANAP message Relocation Command***. The existing RRC connection between the RNC and UE is used by the RNC to send the *RRC message Handover from UTRAN command***.** One or several message from GSM domain can be included in this message.

Normal GSM procedures (not shown here) follow up, and the UE is detected within the GSM coverage. Once the UE is controlled by the 2G network, the 2G-MSC sends a MAP/E message *Send End Signal Request* to the 3G domain.

At this point the UMTS network initiates release of resources allocated by the former RNC using the ***Iu Release Command***, and previously allocated bearer resources are released within the UMTS domain (e.g. using RANAP and ALCAP protocols and completing with an ***Iu Release Complete***. The procedure is then completed by the UMTS CN by sending MAP/E message *Send End Signal Response*.

The described procedure is a typical example of handover from UMTS to GSM. All the listed procedures can be traced in real time by MasterClaw and proper counters can be enabled to provide statistical performance indicators on all relevant interfaces. Furthermore, all RANAP messages/procedures, here highlighted in bold, are collected and processed by the UMTS circuit access KPI.

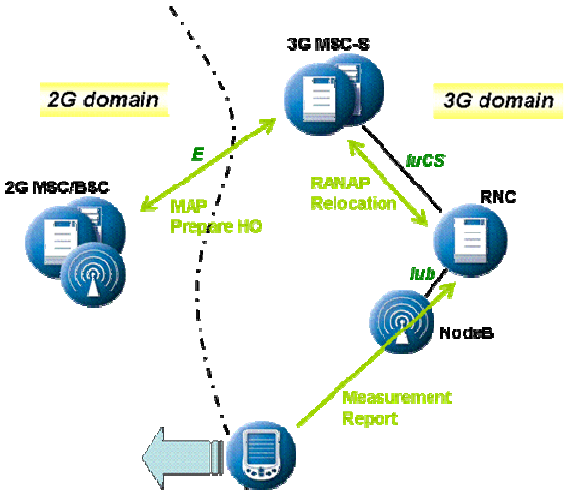

Figure 1: Inter System Handover: UMTS to GSM example (from UTRAN)

Handover from GSM to UMTS

Figure 2 shows an example of handover from GSM to UTRAN. In this case the User Equipment is leaving a 2G cell and finds better coverage under the 3G domain. Once the BSC and/or UE find the preconditions for the handover, the BSC sends the *Handover Required* message to the 2G MSC. This takes the 2G MSC to send the MAP/E message *Prepare Handover* to the UMTS core network.

Once this MAP message is received by the 3G MSC-S, this sends a ***RANAP message Relocation Request*** to the Target RNC. A RANAP response ***Relocation Request Acknowledge*** is returned to the MSC-S by the target RNC and a MAP/E message *Prepare Handover Response* is sent by the UMTS core network to the 2G MSC.

At this point normal GSM procedures follow up (not shown) and the target RNC detects the UE. A ***Relocation Detect*** message is sent to the 3G MSC-S node. When the RRC connection is established and the necessary radio resources have been allocated, the UE sends the *RRC message Handover to UTRAN Complete* to the target RNC. The target RNC sends a ***RANAP message Relocation Complete*** to the 3G MSC-S.

The procedure continues with the UMTS core network sending a MAP/E message *Send End Signal Request* to the 2G MSC and following standard GSM procedures take place in the 2G domain. Once the operations on the 2G domain are completed the 2G MSC sends a MAP/E message *Send End Signal Response* to the UMTS core network to conclude the procedure.

Once again the listed procedures can be traced in real time by MasterClaw and proper counters can be enabled to provide statistical performance indicators on all relevant interfaces. Furthermore, all RANAP messages/procedures, here highlighted in bold, are collected and processed by the UMTS circuit access KPI.

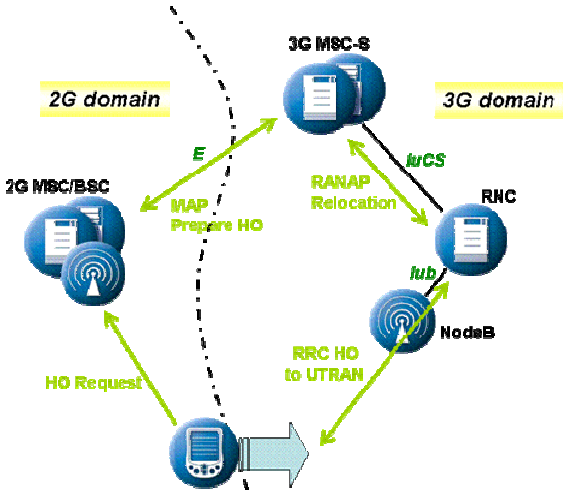

Figure 2: Inter System Handover: GSM to UMTS example (to UTRAN)

UMTS Circuit Access KPI to Monitor Inter-RAT Handovers

MasterClaw UMTS Circuit Access KPI is a powerful application designed to provide statistical information related to Iu CS procedures. The application contains a

large set of reports targeting the various procedures and scenarios taking place in the UMTS domain.

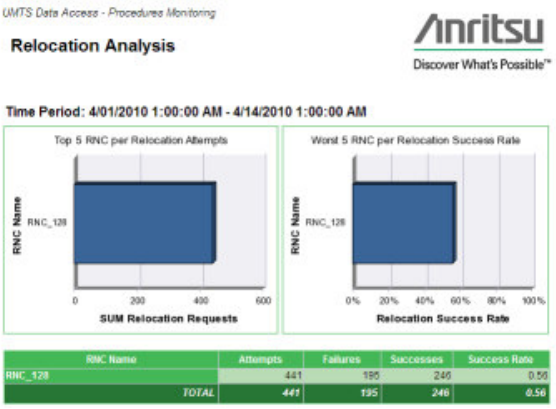

Figure 3: Relocation Analysis report example

The report named *Relocation Analysis* provides statistical KPIs that are also related to the *Iu* procedures described in the previous sections. Referring to handover from 3G to 2G the target *RNC id* field contains the *GSM Cell Id* allowing the evaluation of failure and success rates per 2G cells or group of cells.

Link and Message Statistics and Inter-RAT Handovers

Link and Message Statistics is a counter based application that can provide reports on any supported interface and protocol. Data is collected and processed every 5 minutes. As described in the previous sections, inter RAT handovers trigger RRC messages over the *Iub* interface (see Figure 4). Typical reported KPIs include UTRAN failure rates versus links and linksets.

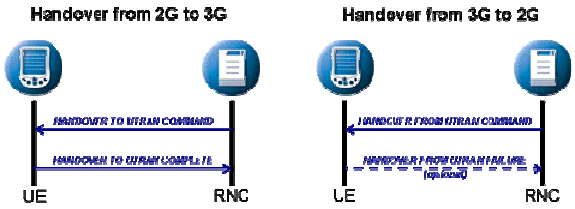

Figure 4: RRC procedures over Iub interfaces

Traffic Observer and Inter-RAT Handovers

Traffic Observer is real-time monitoring application providing counter based data views on any supported interface and protocol. The data view described here is evaluating the handover from UTRAN failure rate as ratio between the number of *RRC handover from UTRAN failure* and number of *RRC handover from UTRAN command*. A similar approach can be followed for the 2G to 3G case.

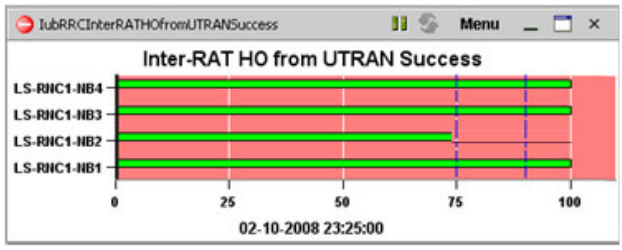

Figure 5: Inter RAT Handover from UTRAN chart in Traffic Observer

Summary

MasterClaw provides tools for monitoring and troubleshooting inter RAT handovers. This application note introduces typical inter technology handover examples and provides a short description of what can be analyzed and traced using MasterClaw KPI applications.

Troubleshooting applications and full coverage of the 2G domain are other key features of MasterClaw. These tools and qualities have not been discussed in this technical note, as well as the application of counter based KPIs to fast troubleshooting with Traffic Observer. For further details and information please refer to the MasterClaw solution overviews and application notes.

References

1. 3GPP TR 25.931 *"UTRAN functions, examples on signaling procedures"*, http://www.3gpp.org/ftp/Specs/html-info/25931.htm

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