Radio Network Tuning and Optimization for WCDMA
Agenda

- Tuning Process Flow
- Tools used for Tuning Activity
- Pilot Analysis
- UE Analysis
- Final Words
Tuning or Optimization, What is the difference!

- **During Tuning**
  No traffic in the network, No subscribers
  Network tuned only based on drive test data
  Labor intensive with repeated drive test
  All is about Pre-launch activities

- **During Optimization**
  Commercial traffic, subscribers using the network
  Statistics used widely to monitor network performance
  Drive testing just in case
  All is about Post–launch activities
Agenda

- Tuning Process Flow
- Tools used for Tuning Activity
- Pilot Analysis
- UE Analysis
- Final Words
Radio Network Initial Tuning for WCDMA

- Preparations
- Parameter Audit
- Drive Testing & Post Processing
- Analysis & Change Proposals
- Change Verification & Reporting

Commercial Launch
Tuning Process Flowchart

1. Initial Drive test
2. Drive test analysis
3. Change proposal
4. Change implemented (verification)
5. Drive test analysis
6. Drive test verification
7. Any Changes?
   - Yes: Move to next cluster
   - No: Cluster Report

Flowchart shows the process from initial drive test to verification and assessment of changes, leading to the next cluster.
Agenda

- Tuning Process Flow
- **Tools used for Tuning Activity**
- Pilot Analysis
- UE Analysis
- Final Words
Tools For Tuning/Optimization & Data Post Processing

- **TEMS Investigation for WCDMA (Data Collection – Route Analysis)**
  - Scanner (Software + HW)
  - External GPS
  - User Equipment (UE)

- **GPEH (neighbours optimization)**

- Statistics counters

- **NeXplorer**

- **MCOM**

- **MapInfo**
TEMs Investigation Overview

- Support for multiple technologies
  - GSM/GPRS/EDGE/WCDMA in one tool
- Data collection
  - New terminals and equipment
  - Analysis functions
- Post-Processing and reporting
  - New Route Analysis
  - RAN tuning report
- Data collection, real-time analysis and Post-Processing all in one tool
User Activities and Tools

- Drive Testing and real time troubleshooting
  - Data collection

- On-screen Post-Processing
  - Data collection (single logfile replay)
  - Route analysis (multiple logfile replay/statistics)

- Reporting
  - WCDMA RAN Tuning report
  - HTML report generator

- Access Measurements with other applications
  - Export logfiles to various open formats
TEMS Investigation Data Collection
Support for Multiple Technologies

- The Data Collection module in TEMS Investigation supports data collection and analysis of data from WCDMA and GSM network

- More different technology options
  - GSM/GPRS/EDGE
  - WCDMA/GSM/GPRS/EDGE
  - HSDPA/HSUPA
  - CDMA
  - WiMAX
TEMS Investigation Data Collection

Introduction

- TEMS Investigation supports more than 130 devices from all major vendors across multiple technologies
- Simple and effective data collection
  - Automatic detection of devices
  - Customizable workspaces that can be shared between users
  - Device control functionality
  - Powerful command sequences to control and automate data collection
  - Event audio indications
  - Real-time data presentation
- Multiple devices can be connected and can run simultaneously
  - Minimize the time spent collecting data.
- In addition to traditional RF data, L2/L3 messages, and IP information collection, TEMS Investigation supports testing of CS and PS services.
TEMS Investigation Data Collection

Sources of data

- Phones and UEs
- Scanners
- PC cards and USB modems
- Fixed Wireless Terminals
- AQM module
- In-building positioning
- GPS receivers
- Cell definition files
- Logfiles
TEMS Investigation  Data Collection

Auto detection of equipment

- All phones are normally auto-detected
- Certain data cards functioning as user terminals are auto-detected, whereas others are not
- Scanners are not auto-detected
- GPS units that use the NMEA protocol are auto-detected
TEMŞ Investigation Data Collection

Devices supplied by Ericsson

- **Sony Ericsson**
  - C702
  - W760i
  - Z750i
  - K790i
  - K790a

- **Nokia**
  - N96
  - N95 US
  - 6120
  - 6086

- **Motorola**
  - MOTORAZR2 V9

- **Option**
  - Option GlobeTrotter EXPRESS HSUPA

- **PCTEL**
  - WCDMA/GSM
    - PCTEL SeeGull EX and EX-Mini
    - PCTEL SeeGull LX*
  - CDMA/EVDO
    - PCTEL SeeGull LX and PCTEL LX Basic*

- **DRT**
  - WiMAX
    - DRT 4301A WiMAX
  - LTE
    - DRT 4301A LTE SISO

* HW passed LTB is not supplied
Terminals and equipment
Sony Ericsson Z750i

- Supported networks
  - GSM/EDGE 850/900/1800/1900
  - WCDMA 850/1900/2100 MHz
  - HSDPA 850/1900/2100 MHz

- New UE capability
  - WCDMA scanning
  - HSDPA support

- Control functionality
  - Lock to RAT
  - PLMN selection
  - Access Class Control
  - Control of Layer 3, Discard message
  - WCDMA Cell Selection/Barred Control
  - Modify BLER target (WCDMA)
  - HS Capability Control
  - GSM Voice Codec Control
  - GSM – EDGE Capability Control
  - GSM Cell Selection/Barred Control
  - TX Power setup (GSM)

- Other features
  - C/I per TS
  - C/A (+2,+1,0,-1,-2)
    - GSM and WCDMA scanning
    - AQM/PESQ compatible
    - GSM channel verification
    - TEMS Pocket option
    - External antenna option
Terminals and equipment
Sony Ericsson Z750i enhancements

- New configuration of Sony Ericsson Z750i
  - Can be used together with an external antenna
- External antenna adaptor available as an option for Sony Ericsson Z750i
  - Requires HW modification
  - The antenna adaptor is fixed and can’t be removed by the user
Terminals and equipment

WCDMA terminal scanning

- Sony Ericsson C702, W760i and Z750i include a high-performance scanner, capable of monitoring CPICH channels and finding networks!
- CPICH (RSSI, RSCP, Ec/No, path information)
  - 12 UARFCN
  - TOP N or LIST mode (Up to 40 SCs)
- BCH Decoding
  - Collect system Information on the selected cells
  - SIB mask to filter unwanted SIBs
- Network Search
  - Used to search for active networks on user defined UARFCN intervals
  - Up to three UARFCN intervals per request
Terminals and equipment
Option GlobeTrotter EXPRESS HSUPA

- Option GlobeTrotter EXPRESS HSUPA
  - GSM/EDGE 850/900/1800/1900
  - HSDPA/HSUPA/WCDMA 850/1900/2100
Drive test tools configuration

Drive Test Equipments for Voice, CS64 & PS call

- Short/Long call Speech
- Short/Long call CS64
- PS
- GPS
- Scanner WCDMA
- Scanner WCDMA
TEMS Investigation Route Analysis

Overview

- Support for multiple logfiles
  - TEMS Investigation, TEMS Automatic and TEMS DriveTester data
  - Data selector for snapshot statistics on logfiles or cells
  - Project view for fast drill-down in logfiles
  - Map views
  - Binned data in map view
    - Time
    - Distance
    - Area

- Ease-of-use
  - TEMS logfiles, no export/import needed
  - Cell view in Data Selector
  - Multiple views (Master/Slave)
  - Event representation
  - Zoom in line charts
  - Task oriented

- Examples of pre-defined tasks:
  - Coverage analysis
  - Handover analysis (intra-frequency, inter-RAT)
  - Call analysis (PI’s)
Post-Processing in TEMS Investigation
Route Analysis – Workflow

- In data selector:

- Filter on Performance Indicators
  (Task = Call Analysis)
Post-Processing in TEMS Investigation
Route Analysis – Workflow

- Load the selected logfiles in the Project view for fast drill down on error events
Post-Processing in TEMS Investigation
Route Analysis – Workflow

- From the Project, “drag & drop” the logfiles into a map window for geographic analysis
Post-Processing in TEMS Investigation
Route Analysis – Workflow

...or view the selected logfiles directly in the map window
Post-Processing in TEMS Investigation
Route Analysis – Workflow

- Change Task in the Map to change analysis focus
- Create views in the map
Post-Processing in TEMS Investigation
Route Analysis – Workflow

- In the Project view, select a specific dropped call and utilize the full synchronization
Post-Processing in TEMS Investigation
WCDMA RAN Tuning Reports

- Report tool for TEMS Investigation data
  - On paper/map reports
- RF Engineering reports
- PS and CS Reports
- Batch job possibility
Post-Processing in TEMS Investigation
WCDMA RAN Tuning Reports - Highlights

- Highlights – RAN tuning report
  - Fast, easy creation of WCDMA tuning report in Word format
  - Produces plots in MIF format
  - Provides flexibility to customize the report template
  - Supports both TEMS Investigation scanner and UE measurements
  - Supports long call (Retainability) and short call (Accessibility) categorization
  - Provides close to 40 charts/tables and 140 text objects
    - Potential Neighbor Candidate table to find missing neighbor
    - Pilot coverage information
    - Voice, CS and PS KPI statistics
Post-Processing in TEMS Investigation
Accessibility, Mobility, Coverage, and Retainability

- Provides an unbiased view on RAN performance
- Flexibility to customize report
- Supports scanner, PS and CS UE measurements
- Engineering report with detailed call classification
- Management reports with KPIs
- Plots also available in MapInfo Interchange Format
- Event trapping and classification
Post-Processing in TEMS Investigation

WCDMA RAN Tuning Reports

- Support both Scanner and CS/PS UE Measurement
Post-Processing in TEMS Investigation
WCDMA RAN Tuning Reports

- Provides Key Performance tables & charts for management

### Cluster Level Key Performance Indicators

<table>
<thead>
<tr>
<th>Cluster Level Key Performance Indicators</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS Call Set-up Success rate</td>
<td>77.7%</td>
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<tr>
<td>Total Dropped Calls</td>
<td>6</td>
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<tr>
<td>Call Time between Drop (s)</td>
<td>1737.7 sec</td>
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<tr>
<td>Total Cluster Retainability</td>
<td>94.2%</td>
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<td>Handover Success Rate</td>
<td>98.0%</td>
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<table>
<thead>
<tr>
<th>Coverage Class</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Level 1</td>
<td>91.60</td>
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<tr>
<td>Level 2</td>
<td>1.44</td>
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<tr>
<td>Level 3</td>
<td>0.94</td>
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<tr>
<td>Level 4</td>
<td>6.03</td>
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<td>Total</td>
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<table>
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<tr>
<th>Cluster</th>
<th>RSCP &gt;= -92</th>
<th>-92&gt; RSCP &gt;= -95</th>
<th>-95&gt; RSCP &gt;= -107</th>
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<th>Coverage Class</th>
<th>Percentage</th>
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<td>0.61</td>
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<td>0.90</td>
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Post-Processing in TEMS Investigation
WCDMA RAN Tuning Reports

- Provides engineering-level call classification and coverage analysis on a cell level for verification and troubleshooting

**Call Setup Failure Distribution**

- **Total Call Setup Failure**
- **Total Call Attempts**

**Cell Name (SC)**

- Alert or Connect not received
- Call Proceeding not received
- Measurement Control not received
- Random Access Failure
- RRC Connection Complete not sent
- RRC Connection Reject
- RRC Connection Setup not received
- Total Attempts

**Dropped Call Classification**

- 33.5%
- 27.8%
- 2.8%
- 2.8%
- 33.3%
Post-Processing in TEMS Investigation
WCDMA RAN Tuning Reports

- Plots (Binned Scanner, Binned UE and Event)
Post-Processing in TEMS Investigation
WCDMA RAN Tuning Reports

- Potential neighbor candidates

### Potential Neighbor Scrambling Code (Sample Count)

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<thead>
<tr>
<th>Cell</th>
<th>SC</th>
<th>CI</th>
<th>SC1</th>
<th>SC2</th>
<th>SC3</th>
<th>SC4</th>
<th>SC5</th>
<th>SC6</th>
<th>SC7</th>
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<th>SC9</th>
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<th>SC11</th>
<th>SC12</th>
<th>SC13</th>
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</tr>
</tbody>
</table>

- Neighbor OK!
- Not in the Neighbor List → Potential to be added
- In the Neighbor List but Not Measured → Potential to be removed
Post-Processing in TEMS Investigation
WCDMA RAN Tuning Reports

- KPI information and call statistics

### Key Performance Indicator Cluster Table

<table>
<thead>
<tr>
<th>Cluster Level Key Performance Indicators</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS Call Set-up Success rate</td>
<td>86.7%</td>
</tr>
<tr>
<td>Total Dropped Calls</td>
<td>8</td>
</tr>
<tr>
<td>Call Time between Drop (s)</td>
<td>60.8 min</td>
</tr>
<tr>
<td>Total Cluster Retainability</td>
<td>97.9%</td>
</tr>
<tr>
<td>Handover Success Rate</td>
<td>99.8%</td>
</tr>
</tbody>
</table>

### Key Performance Indicator Cell Table

<table>
<thead>
<tr>
<th>Cell</th>
<th>SC</th>
<th>Total Call Attempt</th>
<th>Total Call Setup Failure</th>
<th>Total Dropped Call</th>
<th>Total SHO Attempt</th>
<th>SHO Success Rate</th>
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<td>CELL11</td>
<td>0</td>
<td>16</td>
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<td>36</td>
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<td>145</td>
<td>100%</td>
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<td>1</td>
<td>22</td>
<td>95.5%</td>
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<td>123</td>
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<td>0</td>
<td>0</td>
<td>32</td>
<td>96.5%</td>
</tr>
</tbody>
</table>

### Dropped Call Classification

- DL Poor Coverage
- DL Poor Coverage (Next Event: Registration)
- High DL BLER

### Retainability

- 87.4%

### Accessibility

- 0.6%
- 0.5%
- 0.4%
- 0.3%
- 0.2%
- 0.1%
- 0.05%
- 0.01%
- 0.005%
- 0.0005%
Licensing

- **Data Collection - as today!**
  - No license is required to start the data collection application
  - A valid license is required to connect equipment
  - No license is required for post-processing of single logfiles
  - No license is required to export logfiles
  - No license is required to create HTML or KPI reports

- **Route Analysis/RAN Tuning**
  - A valid license is required to start the Route Analysis application

---

**TEMS Investigation up to 6.x**

- **Data Collection**
  - Drive Testing Mode
- **Route Analysis**
  - Analysis Mode (Multiple logfiles)
  - Analysis Mode (Single logfile)
  - Logfile Export
  - HTML Report
  - KPI Report
  - WCDMA RAN Tuning Report
General Performance Event Handling recording

- Besides RANAP, RRC, RNSAP e NBAP protocol messages for group of cells or RNCs, with GPEH it is possible to record also internal node events (RNC o RBS) regarding the triggering events for UTRAN algorithms (channel switching, Capacity management, Soft Handover, IRAT Handover, Supervision) with the relative measurements.

- In the User Description General Performance Event Handling (45/1551-AXD 105 03/1 Uen Rev D) there are listed all messages and events that are is possible to record with the relative information about the fields and subfields they consist of.
GPEH recording from RANOS

- Choose profile
- Name and Comments of the measurements
- Select the Network Element Type (RNC, RBS)
- Select specific nodes
- Select RNC/cells
- Select specific event (RANAP, RRC, NBAP, RNSAP, GPEH Internal)
- Select the fraction of user (\%)
- Setting of Measurement scheduling

Select specific event (RANAP, RRC, RNSAP, NBAP, GPEH Internal)
GPEH: Neighbour Cell Optimization Service

The service has the aim to suggest new neighbor relations to be added or deleted, based on field information retrieved from GPEH files:

“INTERNAL_SOFT_HANDOVER_EXECUTION” (Event_ID:408)

Triggered by the RNC Handover Execution function: the event is used to log any active set change during an executed HO

→ HO Matrix

“INTERNAL_SOHO_DS_MISSING_NEIGHBOUR” (Event_ID:427)

Triggered at reception of a measurement report for event 1a/c where the triggering cell is not included in neighbor set

→ Missing Neighbor Matrix
Existing Tools for GPEH analysis

- **GHT (General Handover Tool)**
  - Internal /// developed tool
    - Neighbour optimizer
    - Pilot pollution detector

- **TEMS Visualization**
  - **WCDMA Module**
    - Call event analyzer
    - Neighbour Optimizer
    - Pilot pollution detector
  - **GSM Module**
    - Call Event Analyzer
    - Cell Timeslot Monitor
  - **Tracing Module**
    - IRAT trace possibility
GHT: Post-Processment Methodology

RNC dump → Cell DB → MS SQL server Database → Output Matrix → Selector → Neighbor Change Proposal

Process steps:
1. RNC dump
2. Cell DB
3. GPEH Logs
4. Formatter and Merger
5. MS SQL server Database
6. Output Matrix
7. Selector
8. Selection Criteria
9. Neighbor Change Proposal
GHT: CELL-Info format

TXT file tab delimited containing:

• Cell name

• CID

• Latitude in decimal format (41.93908333)

• Longitude in decimal format (12.62544422)

• Azimuth

• Scrambling Code associated

• Neighbour list for each cell (RM10U3    RM10U2….)

• ....
NCells optimization: Technical Background

RNC sends UE, radio network and cell parameters to be used in measurements evaluations.

RNC makes the proposal on which cells add, delete or replace in the Active Set and attempts to allocate and/or deallocate resources according to the proposal.

UE necessarily performs measurements on Monitored Set and Active Set and it can perform measurement on Detected set, based on remaining time (UE implementation).

If Soft/Softer Handover is executed, Active Set and Monitored set is updated.
Considered events in HO Executed:

Event 1a

<table>
<thead>
<tr>
<th>Measurement Quantity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_CPICH best cell</td>
<td></td>
</tr>
<tr>
<td>P_CPICH 2</td>
<td></td>
</tr>
</tbody>
</table>

Reporting range1a

Reporting range1b
Considered events in HO Executed: Event 1c
Technical Background: Phase 1

1st “bridge neighbour” relation case

Defined Neighbor

A ↔ C

B

D ↔ C

Soft Handover D → C

D → B

D → A

D is added in AS because of bridge relation with C
Technical Background: Phase 1
1st “bridge neighbour” relation case

D is a detected cell
Technical Background: Phase 1

- From Handover executed between each couple of cells, even if they are not declared as neighbors, we can find out the detected cells that have to be added as neighbors.
2nd “bridge neighbour” relation case

Bridge relation that optimize neighbour lists. D and C relation has no need to be declared.
Technical Background: Phase 1

- Not all Handover executed between two cells not defined as neighbors need a relation addition. It depends on overlapping regions.
- By applying proper filtering criteria we can find out the relation that are really needed to add.
Technical Background: Phase 2
Missing Neighbour

Cell D is a missing neighbour for Cell A and Cell B

Defined Neighbor

A B

A B

A

B

D

Technical Background: Phase 2
Missing Neighbour

Cell D is a missing neighbour for Cell A and Cell B

Defined Neighbor

A B

A B

A

B

D
Technical Background: Phase 2

- From UE Measurement Reports (MR) on detected cells we can find out overlapping cells that are not declared as neighbours.
- UE MRs on detected cells depend on UE supplier implementation.
- According to 3GPP MRs on detected cells must always be reported, but is left to UE suppliers how much time is dedicated on detected cell measurements.
Service based on GHT

- The neighbor cell list is currently optimized based on Drive Test Campaign – well established approach and easily implemented but with some major limitations:
  - **Limited Cost and Time effectiveness:**
    - RAN Tuning Round-Trip-Delay (Data Collection-Analysis-Reporting-Implementation) is long and the process affects only the area under measurement
  - **Limited Accuracy and Limited Sample Number:**
    - Not straightforward implementation of neighbor “deletion” and “re-prioritization”; strong dependency on the selected Drive Routes
  - **Limited information-gathering capability in specific environments** (indoor, train station and tracks, any other area where is not possible to drive)

- It’s difficult to optimize UMTS neighbours only with counters
  - Relation counters only for best cell (no bridge neighbour concept)
  - No availability of measurements (Av. RSCP, Av Ec/No)
Service based on GHT

- This service provides an easy and efficient way to keep the neighbor relations in the WCDMA Radio Network optimized in the most effective way from a time, cost and quality perspective.
- This service will enable to find missing neighboring cells that should to be defined as neighbors, and identify currently defined neighbor relations that can be removed.
- This service can also help to (re-)prioritize the current neighbor plan (truncation).
Service Delivery Phases

- **Preparation**
  - Methodology Agreement
  - Tool Customization
  - Data Gathering

- **Phase 1**
  - "Bridge Neighbors"
    - Initial Neighbor Clean-up based on GPEH_Profile1 and Post Processing_Module1

- **Phase 2**
  - "Missing Neighbour"
    - Neighbor Optimization based on GPEH_Profile2 and Post Processing_Module2
Service Delivery Phases – Phase 1

Based on INTERNAL_SOFT_HANDOVER_EXECUTION (GPEH profile_1)

Phase 1

Validation

GPEH Profile_1

Post_Process Module_1

Data Collection

Analysis

Start

2^ Neigh. Proposal

Validation

End

Final Neigh. Implem.

Analysis

Data Collection

GPEH Profile_1

Post_Process Module_1

Analysis

+/-

1^ Neigh. Proposal & Implem.

Based on INTERNAL_SOFT_HANDOVER_EXECUTION (GPEH profile_1)
Service Delivery Phases – Phase2

Based on INTERNAL_SOHO_DS_MISSING_NEIGHBOUR and INTERNAL_SOFT_HANDOVER_EXECUTION (GPEH profile_2)
Methodology: Phase 1

- For every RNC:
  - Activate 1st GPEH Measurement session on event `INTERNAL_SOFT_HANDOVER_EXECUTION (GPEH profile_1)`; the session duration is set so to get enough statistical accuracy (load dependent)
  - GPEH file Post-Process (`module_1`) to derive **HO matrix**
  - Fine-tuning of decision-criteria (**#occurrences, % Handover, ranking, distance, av. RCSP/EcNo**)
## Methodology: Phase 1

### HO matrix

<table>
<thead>
<tr>
<th>AS Cell</th>
<th>Neighbor CID</th>
<th>Cell Type</th>
<th>Evaluated Cell</th>
<th>Neighbor CID</th>
<th>Cell Type</th>
<th>Average RSCP</th>
<th>Max RSCP</th>
<th>Average EC/I</th>
<th>Max EC/I</th>
<th>OCCURRENCES ASCell</th>
<th>OCCURIENCES TCell</th>
<th>NEIGHBOR RELATION</th>
<th>DISTANCE</th>
<th>USAGE %</th>
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</tr>
</tbody>
</table>

Prep: TEI/RDN: M. Guagliardi
Appr: Rev: PA1
Checked: Date: 2009-03-16
60 (115) Ericsson Internal
Output: INTERNAL_SOFT_HANDOVER_EXECUTION Matrix

Fields description:

• **AS cell**: Best Server cell in AS
• **NEIGHnr**: number of the neighbours defined for the best server
• **CID**: Cell identity
• **CELLTYPE**: (Macro/Micro)
• **EVALUATED CELL**: TG neighbour measured
• **NEIGHnr**: number of the neighbours defined for the best server
• **CID**: Cell identity
• **CELLTYPE**: (Macro/Micro)
• **Average RSCP**: neighbour measured radio condition
• **Max RSCP**: neighbour measured radio condition
• **Average EC/N0**: neighbour measured radio condition
• **Max EC/N0**: neighbour measured radio condition
• **OCCURRENCES AS cell**: number of events recorded for the current pair of cells (AS cell->TG cell)
• **OCCURRENCES TG cell**: number of events recorded for the current pair of cells (TG cell->AS cell)
• **Neighbour relation**: (declare/not declared)
• **DISTANCE**: site to site distance (Km)
• **% USAGE**: normalized to the sum of the values of the column: OCCURRENCES for the same AS cell
Methodology: Phase 1

- Never Used neighbor-relation list (deletion)
- Customer validation/approval for neighbor addition/deletion/re-prioritization and network implementation (via scripts)
- **Validation re-run** Activate 2nd GPEH Measurement session on event INTERNAL_SOFT_HANDOVER_EXECUTION (GPEH profile_1) and Post-Process (module_1)
- Optional Tuning Change Proposals (down tilt for overshooting, re-orientation)
Methodology: Phase 2

- For every RNC:
  - Activate GPEH Measurement session on event INTERNAL_SOHO_DS_MISSING_NEIGHBOUR and INTERNAL_SOFT_HANDOVER_EXECUTION (GPEH profile_2); session duration same as Phase 1
  - GPEH file Post-Process (module_2) based on UE_Context and cell info (position and azimuth) to determine Cid from SC Target cells in a “detected-cell” condition
Methodology: Phase 2

- Derivation of *Missing Neighbor Matrix*

<table>
<thead>
<tr>
<th>AS CELL</th>
<th>NEIGHr CELL TYPE</th>
<th>DETECTED CELL</th>
<th>NEIGHr CELL TYPE</th>
<th>Average RSCP</th>
<th>Max RSCP</th>
<th>Average ECN0</th>
<th>Max ECN0</th>
<th>OCCURRENCES</th>
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<td>0.25</td>
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<tr>
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<td>31 MACRO</td>
<td>RM131U3</td>
<td>26 MACRO</td>
<td>-96</td>
<td>-91</td>
<td>-14</td>
<td>-12</td>
<td>5</td>
<td>1.97</td>
<td>M</td>
<td>0.25</td>
</tr>
</tbody>
</table>

- Fine-tuning of decision-criteria
- Customer validation/approval of proposed neighbor addition and network implementation
- Optional Tuning Change Proposals (tilt for overshooting, re-orientation)
Output: INTERNAL_SOHO_DS_MISSING_NEIGHBOUR Matrix

Fields description:

- **AS cell**: Best Server cell in AS
- **NEIGHnr**: number of the neighbours defined for the best server
- **CELLTYPE**: (Macro/Micro)
- **DETECTED CELL**: neighbour detected
- **NEIGHnr**: number of the neighbours defined for the best server
- **CELLTYPE**: (Macro/Micro)
- **Average RSCP**: neighbour detected radio condition
- **Max RSCP**: neighbour detected radio condition
- **Average EC/N0**: neighbour detected radio condition
- **Max EC/N0**: neighbour detected radio condition
- **OCCURRENCES**: number of events recorded for the current pair of cells
- **DISTANCE**: site to site distance (Km)
- **TYPE**: missing
- **% USAGE**: normalized to the max value of the column: OCCURRENCES
NexPlorer

Supported input format:

- Accepted formats for GSM
  GSM command log files
  CNAI
  CNAIv2
- Accepted formats for WCDMA
  BulkCM
  Ranos Mom
  MoShell
WCDMA input files – Bulk CM file

- Quite difficult to understand its format
- There are several versions
- XML based file, it can be exported by OSS
- Its size might go up to 1Gbyte for a larger network
- NeXplorer supports reading from Bulk CM file
WCDMA input files – RMO file

- RMO is a self-created XML file
- RANOS has an interface that can be queried by a Python script to retrieve data from the network
- The retrieved data comes from the mirrored database in OSS
- The Python script is provided in the install package of NeXplorer
- It is more compact than Bulk CM, it is filtered only to the interesting information from the OSS model
- If an error occurs while saving the RMO file, the caught exception is included in the file as an extra parameter and NeXplorer gives a warning while processing the file
WCDMA input files – MoShell file

- a simple log text file
- the user has to log into an RNC or RBS
- there is a command to list object parameters from the node: “kget”
- the log has to be saved
- it contains the least information from all three supported formats
Parsing WCDMA Bulk CM files

Only the checked object types are loaded into the model (Bulk CM files contain many objects that are not used by NeXplorer).

If checked then only the selected RNCs are loaded into the model: again to save memory.
How to interpret the main window

Red background: the command was not analysed
Salmon background: the command was analysed but an optional parameter was not set
Red foreground: the given parameter is not equal to the Ericsson recommended/default value
Main window is customizable

- View menu helps customize the main window
  - Show NOT SET parameters
  - MO Types on separate sheets
- The table with the parameter values can be sorted by any columns
- The sorting and the width of the columns are remembered
- Show NOT SET parameters
  - The tool contains much more parameters than are usually set by the input files
  - It might be disturbing to see parameters that are not set – e.g. parameters that don’t exist anymore in this release
NeXplorer tools

- Consistency checks
- Parameter checks
- Parameter export
- Parameter summary
- GSM RN Executive summary (SW Audit)
- Compare with history
- Export/import site locations
- Export in TEMS format
Consistency check - 1

- **Flexibility:**
  - no hard coded rules
  - users can define their own rules
  - rules can be password protected to hide their source code

- Own “language” for the rules, so-called pre-evaluation rules

- The rule in the end is an Excel formula to return a Boolean value

- The evaluation is done by Excel running in the background
Consistency check - 2

Available rulesets

Selected ruleset

Rules within the ruleset: checked items will be executed

Log window with incosistencies
Consistency check - 3

- The user can create new rule set
- Add/delete rules
- Edit rules if he/she knows the password
Consistency check – edit rule

- Pre-evaluated rules editor
- Details of one pre-evaluated rule
- Parameter selector for easier formula editing
- The formula that will be evaluated in Excel
- Message editor
Parameter check - 1

- Checks every object in the model
- Lists one parameter per row
- The parameter is listed if its value is not either the Ericsson recommended or default value
- The parameters that appear here are marked with red foreground in the main window
Parameter check - 2

- Parameter comparison files are included in the install package, e.g.:
  - R10_parameter_comparision.txt
  - ran6_0_ga_parameter_comparision.txt
Parameter export - 1

- The same flexibility as for consistency check rules
- The result is an Excel workbook where different sheets contain different parameter groups of the model
- One rule lists parameters from several object levels, e.g.: BSC, Cell, Neighbour relation
- One rule describes one sheet in the workbook
- There is a selected object type of the model that the rule applies to. Every other object type must be accessed via the selected type, e.g. child/parent of the selected object or the selected object refers to it.
Parameter export - 2

Each checked rule creates one sheet in the result table. The workbook is represented as tabbed panes in the tool and can be exported to Excel.
Parameter summary - 1

- a summary of every parameter of the model
- one parameter takes one row
- it lists the used values and their occurrence frequency in one Excel sheet
In the example parameter CELLSTATE has two different values in the model:
• ACTIVE (with 162 occurrences)
• HALTED (with 4 occurrences)
Agenda

- Tuning Process Flow
- Tools used for Tuning Activity
- **Pilot Analysis**
- UE Analysis
- Final Words
Drive Test Routes
Pilot Analysis

The basic measurements of scanner are

- **CPICH_RSCP** (received signal code power)
- **CPICH_Ec/No** (received energy per chip divided by the power density in the band)
- Pilot Pollution

What can you achieve with scanner?

- Crossed feeder issues (DL)
- Coverage verification
- Interference problems (overshooting cell, pilot pollution)
- Missing neighbours
COVERAGE VERIFICATION - Primary Common Pilot Channel

Verify P-CPICH detection to minimize coverage holes

- P-CPICH RSCP
- P-CPICH Ec/No

<table>
<thead>
<tr>
<th>Coverage level</th>
<th>$RSCP$ [dBm]</th>
<th>$E_c/N_0$ [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sufficient</td>
<td>$RSCP \geq -100$</td>
<td>$E_c/N_0 \geq -12$</td>
</tr>
<tr>
<td>Poor</td>
<td>$-115 \leq RSCP &lt; -100$</td>
<td>$-16 \leq E_c/N_0 &lt; -12$</td>
</tr>
<tr>
<td>No coverage</td>
<td>$RSCP &lt; -115$</td>
<td>$E_c/N_0 &lt; -16$</td>
</tr>
</tbody>
</table>
Critical Area Definition

- Red Polygon: Low RSCP (<-100 dBm)
- Blue Polygon: Low Ec/Io (-12 dB)
- Green Polygon: Pilot Pollution (Ec/No_{nth cell SC} >= Ec/No_{Best serving cell SC} - 5 dB)
Crossed feeder

swapped feeder sector 1 and 2 of the RBS RM292U Olgiata
Best Server Signal Strength (RSCP)

- Green is good
- Violet can generate problems
- Blue is bad
Pilot Ec/No Measurements

- Green is good
- Ochre can generate problems
- Violet is bad
INTERFERENCE

By correlating low Ec/No with high RSCP, areas with high interference can be detected.
Primary Common Pilot Channel (P-CPICH) – PILOT POLLUTION

High CPICH reception levels from many Cells, (more than MAX_ACTIVE_SET)

- Threshold = 5 dB
- AS size max = 3

\[
Pilot\ count\left(\frac{E_c}{N_0} \geq \frac{E_c}{N_0} \text{ serving} \right) - \text{threshold} > AS_{\text{size}}
\]
Pilot Pollution
Pilot Pollution
Change Proposal: RM114U2 SC391, Antenna Down-tilt from 2 to 4 Degrees
Overshooting
Change Proposal: RM189U1 SC246, Antenna Down-tilt from 2 to 4 Degrees
Agenda

- Tuning Process Flow
- Tools used for Tuning Activity
- Pilot Analysis
- **UE Analysis**
- Final Words
UE Analysis

- Voice /Video/PS calls
  - Long calls
  - Short calls

- Identify problem areas
  - Accessibility
  - Dropped calls
  - Interference
  - Throughput
Short Calls Analysis

Set-up a call and maintain it for a pre-defined time duration (for 60-90 s)

Call set-up failure and drops during short calls can be mainly used to analysis Accessibility failure due to:

- UE Failure
- Unsuitable Parameters Setting
- Coverage Problem
- Interference
- Others
Long Calls Analysis

Set-up a call and maintain it until it is drop (used for the analysis of Retainability performace)

Drops during long call can be used to identify:

- Missing Neighbour Relation
- Coverage Problem
- UE Problems
- Network Characteristics
- Best Parameter Setting
- Others
KEY PERFORMANCE INDICATORS

- Accessibility (Call set-up success rate)
- Retainability (Dropped calls)
- Mobility (Handover success rate)
- Integrity (BLER and throughput)
Case 1: Drop due to missing neighbor

Problem: Detected Neighbor (DN)

- UE sends a Measurement Report that contains an event1a means adding a new RL (cell) to Active Set
- If the reported cell is not in the current neighbor cell list and the reported Ec/No is better than the best serving cell Ec/No in AS by some dBs (set by a RNC parameter)
- If for any reason the new cell can not be added to AS, call will be released(`releaseConnOffset` range -30..250 unit 0.1dB)
Case 1: Drop due to missing neighbor

"DN" cell better than the serving cell
Case 2: Drop due to Poor Coverage (low RSCP)

Problem: Poor DL coverage

- When UE gets to an area with low RSCP ( < -105 dBm) regardless Ec/No values there is high risk for drop.
- UE will likely ramp up the transmitted power and reach its max power.
- The DL BLER will probably increase and SIR target cannot maintain anymore, finally the call drops.
Case 2: Drop due to Poor Coverage (low RSCP)
Case 3: Drop due bad environment

Problem: bad environment

- Every drop that occurs when Best Server is Missing (Mostly in good CPICH RSCP conditions). The UE active set update cannot follow the quick coverage changes. In this case Pilot Pollution situations are included as well (3 cells in AS and more than 1 strong SCs is interfering the connection within a range of 5 dB - Ec/No basis evaluation).
Case 3: Drop due bad environment

"Best server" is not present
Case 4: Drop due to HW problems – RBS fault no SHO

Event 1a for RM126U1
PS: Session Error due to Poor DL Coverage

UE enters a very low coverage area (RSCP < – 105 dBm). The packet connection is carried on a 64/64 DCH Channel as consequence of the low coverage conditions. The UE will likely ramp up its power to the maximum, goes to Idle Mode and the Application and RLC throughputs go to zero. At this point the RAS application will start the Session Timeout timer, if the throughput is not resumed the Session Error event is triggered with cause “session timeout”.
PS: Session Error due to Poor DL Coverage

"RSCP" is very low

"Throughput < 64 kbps"
Interference UL – compressed mode

- During compressed mode, there is an UL interference increase due to UE_Tx_power increase because UE measures GSM neighbours.
- If IRAT HO is not present after compressed mode because the Ec/No > Ec/No_{event 3a}, then consider a possible shift of 2d event threshold on a cell basis in order to delay compressed mode.
Interference UL – compressed mode

- A possible settings for cells parameters are:

  **timeToTrigger2dRSCP** from 5000 to 1280 (RNC basis RM01RNC)
  Time in milliseconds (ms) between detection of event 2d and sending of the measurement report, when the measurement quantity is CPICH RSCP. When the value 5000 is set, the measurement report will not be sent at all.

  **usedFreqThresh2dEcno** from -11 to -12 (cell basis)
  Threshold for event 2d for the used frequency when the measurement quantity is Ec/No.
  This parameter is also used for calculation of a threshold value for the used frequency for 2f events. The calculated value is sent to the UE in a RRC Measurement Control message. If the sum of the calculation (usedFreqRelThresh2fEcno + usedFreqThresh2dEcno) exceeds the maximum 3GPP value 0dB, the value sent to the UE will be 0dB.

  **usedFreqThresh2dRscp** from -112 to -105 (cell basis)
  Threshold for event 2d for the used frequency when the measurement quantity is RSCP.
  Note: This parameter is also used for calculation of a threshold value for the used frequency for 2f events. The calculated value is sent to the UE in a RRC Measurement Control message. If the sum of the calculation (usedFreqRelThresh2fRscp + usedFreqThresh2dRscp) exceeds the maximum 3GPP value -25dBm, the value sent to the UE will be -25dBm.
Interference UL – compressed mode

Before Parameter changes  After Parameter changes
FINAL WORDS

- For network tuning, we need to relay on field measurements which require extensive drive tests.
- Finding the best possible configuration for antenna heights, tilts, azimuths and parameter setting for all the present cells/sectors in the network and also for any new sites that might be needed to improve coverage.
- Power adjustment can also be used for network tuning but can become complicated and result in poor network performance.
- Neighbour definition is of prime importance in UMTS network (Soft handover gain and interference reduction). Keep neighbour list up to 20.
- Automated tools are needed that could suggest the best possible neighbour relations, antenna heights and tilts by using both the field measurements and the propagation models & simulations.
- Skilled people, right methods and advanced tools are needed to perform 3G tuning and optimisation.