ISHO – Intersystem handover from WCDMA to Enhanced GPRS

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Agenda

1. EGPRS and WCDMA networks
   • Architecture
   • Routing Area and Location Area Update
   • PDP context

2. ISHO – Intersystem handover
   • General
   • ISHO Decision

3. Measurements
   • Test Cases
   • Tools and Environment

4. Test results
   • Delays
   • Throughput

5. Conclusions and Future Research

6. Extras
WCDMA - EGPRS Network Architecture

Focus on the packet switched network
- SGSN controls the packet switched network
- GGSN is only a gateway to the external networks i.e. Internet
- RNC and BSC are responsible for the radio access network (RAN)

Most important interfaces
- In GERAN and UTRAN
  - Uu, Um and Abis, Iub
- In the Core Network
  - Iu-PS, Gb
Routing Area/Location Area Update

- Relationship between Location Area (LA) and Routing Areas (RA)
- Location Area / Routing Area update is performed, when moving from one RA/LA to another

- Separated RA/LA update (Network mode of operation (NMO) II)
  - LA is updated to the circuit switched network (to the MSC/VLR)
  - After that RA is updated to the packet switched network (to the SGSN)
  - Gs interface is not used

- Combined RA/LA update (NMO I)
  - Only RA is updated to the packet switched network (to the SGSN)
  - SGSN updates the location to the MSC/VLR via the Gs interface
ISHO – Intersystem handover

The basic functionality:

1. Routing Area Update
   - After moving under EGPRS coverage

2. Location change information
   - 3G-SGSN is resolved by using old RAI (Routing Area Identity)

3. Downlink packet buffer forwarding
   - RNC buffers IP packets

4. PDP context update
   - GGSN is able to route IP packets to the correct SGSN

5. Location Update and Iu-PS release
ISHO Decision - EGPRS

- Mobile is able to measure WCDMA frequencies during the time slots that are not used for data transmission

- Mobile Controlled Cell Reselection
  - Mobile reselects a WCDMA cell, if the WCDMA signal quality (CPICH Ec/No) is good enough

- Intersystem Network Controlled Cell Reselection (IS-NCCR)
  - BSC makes the decision based on the measurement reports received from the mobile
  - Mobile is measuring WCDMA quality
**ISHO Decision - WCDMA**

- Network Controlled Cell Reselection
  - RNC makes the decision based on the measurement reports received from the mobile
  - Compressed Mode should be used to measure EGPRS frequencies
Test Cases

TCP causes extra delays because of its behavior --> both TCP and UDP used
  • TCP Retransmission timeout, slow start etc.

  • FTP DL 100 MB file from ftp server (TCP is used)
    • ISHO repeated 10 times, 5 times in both directions

  • UDP Streaming
    • Streaming with UDP traffic generator and Helix server
    • ISHO repeated 10 times, 5 times in both directions

  • Different cases (WCDMA network always separated RA/LA update):
    1. Separated RA/LA update
    2. Combined RA/LA update
    3. IS-NCCR and Separated RA/LA update
    4. IS-NCCR and Combined RA/LA update
Tools and Environment

- In the terminal
  - Nemo Outdoor
  - CommView 5.0
  - UDP generator
  - Real One player

- Green route
  - Speed 0-5 km/h

- Blue route
  - Speed 50 km/h
ISHO Data Outage Time

The advantage of using the combined RAU/LAU is really clear

The longer the delay, the bigger the impact on application level

IS-NCCR causes extra delay before sending the RRC connection setup to the WCDMA network.

On the application level the extra delay of IS-NCCR is even longer

Data Outage Time WCDMA -> EGPRS, TCP vs. UDP

Data Outage Time EGPRS -> WCDMA, TCP vs. UDP
UDP streaming

- UDP streaming during ISHO
  - Key frame interval 5 seconds
- Problems 20 seconds after ISHO
  - Packet were buffered
- Problems were over after 12 seconds
Throughput – WCDMA vr. EGPRS

Link adaptation causes the variation in Modulation and Coding Schemes.

CCO from UTRAN

WCDMA 384 kbit/s

Data outage

EGPRS

40 seconds

MCS

~350 kbit/s

~210 kbit/s

CM starts, first measurement report

MSC-9 in use

40 seconds
Throughput - pingponging

- Poor WCDMA quality may cause downgrade 384 kbit/s -> 128 kbit/s in the RAB.
- EGPRS throughput may be better than WCDMA
- Bad network optimization may cause pingponging
Conclusions and Future Research

Conclusion

• Data outage time is remarkable for the end user
• Proper parametrization needed
• WCDMA is not always better than EGPRS
  • ISHO strategy should be planned

Future Research

• ISHO between Outdoor 3G cell and indoor 2G cell
  • Parameter optimization on cell border -> How to prevent pingponging?
    • Ec/No is fluctuating a lot indoors
• IS-NCCR development
• 2G -> 3G trigger development, (specified but not implemented)
  • RSCP trigger should be implemented
    • A too weak WCDMA cell with low RSCP and fluctuating Ec/No can be selected
Questions and comments?

Thank you!
Enjoy the summer!
Extras, KPIs

- Delays
- Throughput
- Success rates
Extras, parameters

- Only Ec/No trigger was used
  - WCDMA quality is the reason for performing ISHO from EGPRS to WCDMA and vice versa
  - Ec/No levels are really good in the test network
  - Parameter optimization not possible

- CPICH Ec/No
  - Ec/No Threshold = -8 dB

- WCDMA cell
  - Ec/No level
  - FDD_Qmin = -6 dB

- Reselect WCDMA cell

- Reselect EGPRS cell

- Reselect EGPRS cell

- time
Extras, EGPRS -> WCDMA in general

IS-NCCR causes extra delay
Extras, WCDMA -> EGPRS in general

Extra delay caused by separated RAU/LAU can be seen really well

Time before sending channel request is really long ~3300 ms
Extra, delays TCP - EGPRS -> WCDMA

TCP Application delay EGPRS -> WCDMA

Bearer delay EGPRS -> WCDMA
Extra, delays TCP - WCDMA -> EGPRS

TCP Application delay WCDMA -> EGPRS

Inter-SGSN intersystem change time WCDMA -> EGPRS
Extra, delays UDP - WCDMA -> EGPRS

UDP Application delay WCDMA -> EGPRS

Inter-SGSN intersystem change time WCDMA -> EGPRS
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Bearer delay EGPRS -> WCDMA

Data outage time [ms]

Bearer delay [ms]

#Intersystem handovers