LTE
mobile networks evolution goes on!

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Mobile Monday, Fribourg
Wireless Technology...
Current Status of Mobile Network Coverage & Bandwidth

Mobile Voice and Data Coverage

GSM-EDGE
>99% of the population

Mobile Broadband Coverage

UMTS-HSPA
93% of the population

basically HSPA 7.2/14.4 Mbps up to HSPA+ 21 or 42 Mbps in cities and hotspots

Swisscom is the clear market leader and offers the best mobile network coverage and performance.

EDGE: enhanced data rates for GSM evolution
HSPA: high-speed packet access
Mobile Data is a strong Customer Need
Volume Growth continues

- the mobile data traffic volumes are doubling every 8 months
- mobile broadband with PCs and mobile internet access with smartphones are the main drivers

Mobile Data Traffic Evolution

HSDPA: high-speed downlink packet access
About LTE

Expectations on HSPA’s successor

More powerful than UMTS-HSPA

- Higher data rates → Downlink 150 Mbps / Uplink 50 Mbps (Rel. 1)
- Higher spectral efficiency
- Shorter delays → Roundtrip Time < 10 ms

Higher spectral efficiency

- Flexible bandwidth, of 1.4, 3, 5, 10, 15 à 20 MHz makes it possible to use new frequency bands and refarming of already used spectrum
- FDD (frequency division duplex) and TDD (time division duplex) modes

Lower cost per bit

- «flat» IP architecture
- No circuit Switch voice services → Mobile VoIP
- Simplified operations, less manual configuration efforts (SON: self-organizing network)
- Cost effective migration from HSPA to LTE

A Proof of Concept doesn’t answer all those questions, but gives the necessary indications to correct expectations
Applications examples

› Voice and Video on LTE
› High bandwidth (upload and downloads), for cloud based services
› Reduced delays, for online gaming
› Enhanced web surfing user experience
› Video conferences, security, QoS for professional usage

QoS: Quality of Service

Images: google.com
Field Trial
Test cases

> Coverage measurements
  – With /o load
  – With /o interferences
  – Single/multiple users
  – Range
> Mobility: handovers
> MIMO (multiple input, multiple output) performance
> Self Optimizing Network (SON)
  – Automatic neighbor planning
  – Self healing tests (turn off/on LTE Sites)
> HSPA and LTE performance comparisons
> High speed (up to 300km/h according to the standard)
> Vendors comparison (Ericsson and Huawei)

Radio access was at the center of the tests, rather than core network
Pictures

Huawei’s hardware

Core network:
› Mobility management
› Subscribers management

Radio access:
› eNodeB

Remote Radio units

Test «Natels »
Pictures
Ericsson’s hardware

Radio access:
> eNodeB

ILE (IMS)

Core network:
> Mobility management
> Subscribers management
> Policy enforcement
LTE Devices tendencies: development faster than expected

- Current development focused on the US market
- LTE Devices types:
  1. USB Dongles
  2. Mobile hotspots
  3. Smart phones
  4. Tablets
  5. Machine-to-machine

- Leading chipsets: Samsung, Qualcomm, ST-Ericsson
- Leading devices manufacturers: HTC, LG, Samsung
LTE Device: many challenges

- Power consumption issues at the beginning
- LTE deployments worldwide so far on the following frequencies: 700, 800, 1'700, 1'800, 2'100, 2'600 MHz
  - Fragmentation
  - Difficulties to implement devices with so many bands
  - Roaming issues

- First LTE VoLTE compliant handsets
- Multimode LTE USB dongles
- First LTE Handset and tablets in Japan
- European LTE handsets (2.6GHz)
- Mature ecosystem on main LTE bands

Source: idate
Sites for the LTE test in Granges (SO)
3 sites with 3 sectors each
Antennas at 2.6 GHz for LTE
Located in Granges (Field Trial Site)

Remark
The antennas used for the tests were not wide-band and not meant to be used for longer than the tests duration.
Field Trial Granges
Coverage (theoretical)

- 55 Mbps
- 45 Mbps
- 35 Mbps
- 22.5 Mbps
- 10 Mbps
- 3 Mbps
Field Trial Granges
Test measures with Ericsson: throughput (DL) in kbit/s
Ericsson tests results

- According to predictions
- Throughput changes with channel bandwidth (5, 15, and 20 MHz)

<table>
<thead>
<tr>
<th>Throughput Changes with Channel Bandwidth</th>
<th>20 MHz Bandwidth, 96 downlink RBs, 48 UL RBs</th>
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<tbody>
<tr>
<td>Peak Throughput</td>
<td>93 Mbps (DL)</td>
</tr>
<tr>
<td></td>
<td>21 Mbps (UL)</td>
</tr>
<tr>
<td>Multi-user Cell Throughput</td>
<td>70 Mbps with 3 users per cell (DL)</td>
</tr>
</tbody>
</table>

Latency:

- 32 Byte Mid Cell
- 1000 Byte Mid Cell
- 1472 Byte Mid Cell
- 32 Byte Drive
- 1000 Byte Drive
- 1472 Byte Drive

DL Throughput vs CINR:

- 20 MHz
- 10 MHz
- 5 MHz
- 20 MHz EVA70
- 10 MHz EVA70
- 5 MHz EVA70
Frequencies

- Current 2G bands are technology neutral for GSM and UMTS, LTE has just been approved by OFCOM on those bands. *Reframing* needed.
- All current bands auctioned, plus 800 and 2’600 MHz during first quarter 2012.

ORNÍ/NISV

- Rules still very restrictive (10x lower levels than WHO and UE).
- Reaching power limits on some sites leads to using other network architectures (e.g. *Metro cells*)
Conclusions

Performances as expected!

- **Expectations** generally reached during the tests
- **Technology** already very mature, compared to the starts of GSM and UMTS
- **First LTE deployments** took place in countries facing specific challenges (e.g. operators without 3G spectrum)
- LTE worldwide acknowledged as THE technology succeeding to UMTS/HSPA
- In a first phase, LTE will exclusively be used to increase Mobile Broadband’s data throughput (data only)

**Next steps**
- Integration in existing Core network
- Commercial launch
- Improvements with future Releases
More surprises to come

Source: google.com
Questions and Answers
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