GSM Evolution towards a 3G Environment
GSM Evolution towards a 3G Environment

AGENDA

• Introduction
  – GSM Position & Vision
• System Evolution
• Performance Enhancements
• Conclusion
GSM Evolution towards a 3G Environment

GSM - a world-wide success

- North America: 800/1900 MHz
- Europe & CEMA: 900/1800 MHz
- Latin America: 800/1800/1900 MHz
- APAC: 900/1800 MHz

GSM & WCDMA
Dominant Global Standards

Technology Share of Digital Subscribers - March 2003

- GSM & WCDMA: 72%
- PDC: 5%
- TDMA: 10%
- CDMA: 13%

Source: EMC
Introduction

GSM Evolution towards a 3G Environment

New subscriber market share

GSM has increased its market share of new subscribers*, which is the highest since 1997

Source: EMC database Q1 2003

Introduction

GSM
The way forward

• Continuous voice growth
• Services beyond voice take-off
• Operational efficiency
• Seamless evolution
GSM/GPRS/EDGE/WCDMA

*GSM has increased its market share of new subscribers, which is the highest since 1997.
GSM Evolution towards a 3G Environment

AGENDA

- Introduction
  - GSM Position & Vision
- System Evolution
- Performance Enhancements
- Conclusion

Two main evolution paths

<table>
<thead>
<tr>
<th></th>
<th>2G</th>
<th>3G</th>
<th>Evolved 3G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First Step into 3G</td>
<td>768 Kbps - 2 Mb/s</td>
<td>768 Kbps - 10 Mb/s+</td>
</tr>
<tr>
<td>TDMA</td>
<td>28.8 Kb/s</td>
<td>64 - 144 Kbps</td>
<td></td>
</tr>
<tr>
<td>GSM</td>
<td></td>
<td>384 Kbps - 2 Mb/s</td>
<td></td>
</tr>
<tr>
<td>PDC</td>
<td></td>
<td>384 Kbps - 10 Mb/s+</td>
<td></td>
</tr>
<tr>
<td>cdmaOne</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDMA 2000 1X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDMA 2000 1XEV</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One Family

WCDMA/HSDPA

Time

GSM Evolution towards a 3G Environment

GSM Evolution to WCDMA and Beyond

- **Content, 3-party applications**
- **Communication Services (SMS/MMS, Browsing/Streaming,...)**
- **GSM/GPRS/EDGE Core Network**
- **Data**
- **Internet/Intranet (0.4B+ subscribers)**
- **Radio Network**
  - GSM/GPRS/EDGE (800/900/1800/1900 MHz)
  - WCDMA/HSDPA 3G Spectrum (2 GHz, 1900 MHz)
- **Dual Mode Terminals**

Seamless networks

- **Common Network Management**
- **Applications**
- **Connectivity**
- **Node re-use**
  - One combined radio resource
  - 10 to 50% spectrum efficiency gain
  - All packet (IP/ATM) transmission
  - Up to 40% savings (GSM)
  - Site sharing
  - 80% of WCDMA RBS
  - User service transparency
  - End-to-end QoS
Mature GSM operators going WCDMA

Roll-out options

Service Continuity (GSM-WCDMA)

128kbps

WCDMA

EDGE

~120kbps*

GSM/GPRS

~40kbps*

* 3 slot handset

Coverage

Performance

13 14

GSM Evolution towards a 3G Environment

GSM Evolution towards a 3G Environment
GSM Evolution towards a 3G Environment

AGENDA

- Introduction
  - GSM Position & Vision
- System Evolution
- Performance Enhancements
- Conclusion

GSM Capacity Road Map - Voice

Voice capacity in Erlang/sector/10 MHz spectrum

- EFR 4/12
- EFR 1/1
- AMR FR
- IRC & Net Sync
- SAIC
- AA

2 x 10 MHz Spectrum

- FL>100% through CHAT*

- FL=100%

* CHAT, Channel Allocation Tiering. A concept for GSM allowing a frequency reuse < 1

Numbers show technology potential.
### Performance Enhancements

#### GSM/GPRS/EDGE Capacity Road Map - Data

Spectrum efficiency in kbps/sector/MHz for packet data in 2x10 MHz spectrum (calculated for an average packet bitrate of 50 kbps)

<table>
<thead>
<tr>
<th>Technology</th>
<th>Efficiency (kbps/sector/MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPRS</td>
<td>0</td>
</tr>
<tr>
<td>EGPRS</td>
<td>200</td>
</tr>
<tr>
<td>Net Sync</td>
<td>300</td>
</tr>
<tr>
<td>SAIR</td>
<td>500</td>
</tr>
<tr>
<td>AA</td>
<td>700</td>
</tr>
</tbody>
</table>

**Legend:**
- Very preliminary numbers!
- Simulations not completed!
- Numbers show technology potential.

#### Summary of GSM Capacity Roadmap

- **GSM voice capacity can be increased**
  - More than 16 times compared to EFR in 4/12 reuse
  - More than 8 times compared to EFR in 1/1 reuse
  By the introduction of AMR, synch and IRC, SAIR and AA
  With CHAT good performance in reuse <1
- **EGPRS data capacity can be increased**
  - More than 2 times with AA
  - Around 50% with SAIC when interfered by GMSK
- **EGPRS performance in a full CHAT concept is currently being investigated.**
GSM Evolution towards a 3G Environment

**WCDMA Capacity Road Map – Voice (Downlink)**

![Graph showing WCDMA capacity roadmap for voice (downlink)]

- **Numbers show technology potential.**
- **2 x 10 MHz Spectrum**

**WCDMA Capacity Road Map - Data**

![Graph showing WCDMA capacity roadmap for data](image)

- **Numbers show technology potential.**
- **2 x 10 MHz Spectrum**
Summary of WCDMA Capacity Roadmap

- **WCDMA voice capacity can be increased**
  - More than 5 times compared first release
    By the introduction of lower AMR rates, Txdiv, Advanced Receiver and AA

- **WCDMA data capacity can be increased**
  - 2-3 times with Release 5 (HSDPA)
  - 2-3 times with AA

- **WCDMA peak rate is enhanced to 14 Mbps with Release 5**
  - Even higher peak rate is possible with MIMO

- **Further evolution of WCDMA is ongoing**
  - Improved uplink
  - Reduced latency

AGENDA

- **Introduction**
  - GSM Position & Vision
- **System Evolution**
- **Performance Enhancements**
- **Conclusion**
Conclusion

- GSM/WCDMA will stay world’s leading standard in mobile communications
- System evolution is based on synergy of GSM and WCDMA
- GSM and WCDMA guarantee further performance improvements in the future