CDMA 2000 and CDMA 450

Colin Chandler
Vice Chairman
International 450 Association
Presentation Summary

• Introduction to the International 450 Association (IA 450)
• Spectrum and Standards for CDMA 450
• Industry commitment to CDMA 450
• Summary
International 450 Association
International 450 Association History

• NMT MoU was an operator only organization with the roles of maintaining the analog NMT Specifications and facilitate roaming between NMT operators
• In 1998 NMT MoU started the Digital Interest Group to consider future digital standards for use in the NMT frequency band
• Selected CDMA and GSM as the standards to develop at a memorable meeting in New York
• NMT Association formed in 1999 from membership of the NMT MoU, plus additional members from suppliers and other organizations interested in NMT
• IA 450 launched in St Petersburg in September 2003 focusing on digitalization of 450 MHz band
## International 450 Association Membership

- Membership of 25
  - 10 Operator members,
    - EuroTel Praha, Iberiatel, PTK Centertel, RTC MOBIKOM, Skylink, SOTEL, Telemobil S.A., Telenor Mobile AS, Telia Sonera, Mobisil
  - 14 Supplier members
- Observers
  - Douglas C Lane and Associates
IA 450 Mission Statement

Support the members in developing their cellular business in the 450 MHz band including migration to the digital standard, and to maintain the analogue NMT Standard.
Regulatory

• Promote 450MHz band for cellular services
• Represent the IA 450 at ITU to ensure that CDMA 450 is considered in ITU committees
• Represent the IA 450 in CEPT on 450 MHz band
• Support members in influencing National Authorities for use of 450MHz band in Europe and worldwide for cellular applications
Technology

• Provide operators considering using CDMA with the technical information required to implement CDMA including migration from NMT
• Provide support to operators already using CDMA with additional technical information to improve CDMA 450 networks
• Encourage Network and Terminal vendors to develop, manufacture and market products for use with CDMA 450
Services

- NMT Association will support members in developing services including
  - Mobile telephony (voice)
  - Mobile data communications
  - PAMR Services
  - Wireless Local Loop
Public Relations

• Promote the continued use of cellular telephony in the 450 MHz band
• Cooperate with CDMA Development Group and other relevant industry groups
• Market the use of 450 MHz frequency band for CDMA 450
Operational considerations

- Ensure Roaming can be established between CDMA 450 Operators
- Ensure Roaming can be established between CDMA 450 and other technologies
- Ensure Roaming can be established with other frequency bands using CDMA
- Migration from Circuit switched to Packet switched protocols
- Prepare common recommendations for billing and customer care
Business cases

• Provide current NMT operators and other operators using 400 to 500 MHz with a business case model for migrating to digital CDMA

• Provide new operators with a business case model for considering to use CDMA 450

• Assist network and terminal vendors to assess the market potential
NMT Analogue

• Continue support of NMT Standard and Reference Documents including
  – NMT Specifications
  – Security
  – International Roaming
  – Numbering Plans
  – Billing
IA 450 Organisation

IA 450 Plenary

NMTA Board

Working Groups

Chair: Yuri Dombrovsky, Skylink
Vice Chair: Colin Chandler, QUALCOMM
Secretary: Dorota Inkielman, PTK Centertel
Spectrum and Standards for CDMA 450
CDMA2000 1x at 450 MHz NMT ‘A’ Band

• Preferred CDMA450 Frequency bands

Mobile Transmit

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Description</th>
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<tbody>
<tr>
<td>452.5 MHz</td>
<td>Guard Band</td>
</tr>
<tr>
<td>453.99 MHz</td>
<td>FIRST CARRIER</td>
</tr>
<tr>
<td>455.22 MHz</td>
<td>SECOND CARRIER</td>
</tr>
<tr>
<td>456.45 MHz</td>
<td>THIRD CARRIER</td>
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<tr>
<td>457.475 MHz</td>
<td>Guard Band</td>
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BTS Transmit

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<tr>
<td>463.99 MHz</td>
<td>FIRST CARRIER</td>
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<tr>
<td>465.22 MHz</td>
<td>SECOND CARRIER</td>
</tr>
<tr>
<td>466.45 MHz</td>
<td>THIRD CARRIER</td>
</tr>
<tr>
<td>467.475 MHz</td>
<td>Guard Band</td>
</tr>
</tbody>
</table>
Comparing CDMA2000 Coverage At 450MHz

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Cell radius (km)</th>
<th>Cell area (km²)</th>
<th>Relative Cell Count</th>
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<tbody>
<tr>
<td>450</td>
<td>48.9</td>
<td>7521</td>
<td>1</td>
</tr>
<tr>
<td>850</td>
<td>29.4</td>
<td>2712</td>
<td>2.8</td>
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<tr>
<td>950</td>
<td>26.9</td>
<td>2269</td>
<td>3.3</td>
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<tr>
<td>1800</td>
<td>14.0</td>
<td>618</td>
<td>12.2</td>
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<tr>
<td>1900</td>
<td>13.3</td>
<td>553</td>
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<tr>
<td>2100</td>
<td>12.0</td>
<td>449</td>
<td>16.2</td>
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</table>

*QUALCOMM ITU contribution, June 11, 2001
Spectrum Requirements for IS-2000-1x in 450 MHz NMT Bands

• Minimum clearing requirement 1.8 MHz for one carrier
• 2\textsuperscript{nd} and 3\textsuperscript{rd} carriers require additional 1.25 MHz each
  – 3.05 MHz for two carriers
  – 4.3 MHz for three carriers
• Significant flexibility in carrier placement within allocated band
  – FA’s (available carrier frequencies) are spaced on a raster of 20 or 25 kHz, depending on IS-2000 Band Class 5 Band sub-class
    • Carrier frequencies can be chosen to avoid known interference issues
    • Carrier spacing can be modified somewhat, with minimal impact on performance
Band Class 5/Band Subclass A Example

• Channel numbers shown in figure are (non-standard) interleaved analog 12.5 kHz channel numbers, where $f = 453.000 + (n-1)\times0.0125 \text{ MHz}$

• CDMA carriers introduced are the preferred carriers specified in IS-2000 standards documents for Band Class 5 Band subclass A
  – Band Class 5 channel numbers 160, 210, and 260
  – Correspond to carrier frequencies: 453.975, 455.225, and 456.475 MHz \((f = 450.000 + (N-1)\times0.025 \text{ MHz})\)
Digital Transition Frequency Plan

21 Analog Control Channels (262.5 kHz)

338 Analog Voice Channels (4225 kHz)
16.1 Voice Channels/Sector

2nd CDMA RF Carrier
35 Voice CH/Sector

1st CDMA RF Carrier
35 Voice CH/Sector

21 Analog Control Channels (262.5 kHz)

185 Analog Voice Channels (2312.5 kHz)
8.8 Voice Channels/Sector

1st CDMA RF Carrier
35 Voice CH/Sector

2nd CDMA RF Carrier
35 Voice CH/Sector

21 Analog Control Channels (262.5 kHz)

85 Analog Voice CH (1050 kHz)--4 Voice CH/Sector

2nd CDMA RF Carrier
35 Voice CH/Sector

1st CDMA RF Carrier
35 Voice CH/Sector

3rd CDMA RF Carrier
35 Voice CH/Sector

4300 kHz

3050 kHz

279 kHz Guard Bands

1250 kHz

NMT Analog Only

Dual-mode: One CDMA Carrier

Dual-mode: Two CDMA Carriers

All-digital: Three CDMA Carriers
## CDMA 450 Band Class and Subclasses

<table>
<thead>
<tr>
<th>Freq (MHz)</th>
<th>410</th>
<th>420</th>
<th>430</th>
<th>440</th>
<th>450</th>
<th>460</th>
<th>470</th>
<th>480</th>
<th>490</th>
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<td>D</td>
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3 December 2003 IA 450 Presentation, ITU-BDT Sub-Regional Seminar, Ljubljana
CDMA2000 Family of Standards

• 1xEV-DO and 1xEV-DV technologies fit seamlessly into IS-95/CDMA20001x networks:
  – Same chip rate, link budget, power requirements, and coverage area
  – Same network architecture and elements as CDMA2000
  – 1X/1xEV-DO together only use two 1.25 MHz carriers to offer services that exceed ITU 3G requirements, versus other technologies that require 5 MHz of spectrum

Can flexibly mix 1x, 1xEV-DO, 1x EV-DV in the spectrum allocation
Industry commitment to CDMA 450
Infrastructure Vendors for CDMA 450

- Lucent Technologies
- Huawei
- ZTE
- Nortel
Handset Vendors for CDMA 450

• Available today
  – Synertek
  – Hyundai Curitel

• Future terminals
  – Compal
  – AnyDATA (terminal and data card)
  – Giga
  – GTRAN
  – Huawei
  – ZTE

• Other vendors are also showing interest in developing CDMA 450 terminals
CDMA 450 Operators - 1

• Zapp Mobile (Telemobil), Romania
  – Opened service December 2001
  – 150,000 subscribers, October 2003
  – Expect 200,000 subs by end of 2003
  – 85% corporate users, ARPU $33-$34

• SkyLink, Russia
  – Currently comprising Delta, St Petersburg and Moscow Cellular Communications
CDMA 450 Operators - 2

- Delta
  - Opened December 2002 when Russian Ministry of Telecommunications granted CDMA450 federal status
  - 30,000 subscribers October 2003
  - ARPU $67 per month, 64 % using data, with speeds in excess of 80 kbps

- MCC
  - Opened 1 November 2003
CDMA 450 Operators - 3

- BelCel, Belarus
  - Launched February 2003
  - Anticipate 100,000 subs by end of Q3 2004

- Iberiatel, Georgia
  - Currently operates NMT 450 WLL system
  - Launching CDMA 450 WLL system before end of 2003

- Uzbektelecom, Uzbekistan
  - Received licence for cdma450 in 2002 for WLL services and is operational
Future developments in CDMA 450

- Serious consideration of the technology in China
- Further expansion in CES
- PAMR and PPDR
Summary

- CDMA 450 is a commercially and technically viable technology in operation today providing cellular voice data and WLL services
International 450 Association
Contact details

• For more information on the International 450 Association please visit the International 450 Association web site at www.450world.org

• For membership information contact the International 450 Association Secretary at dorota.inkielman@centertel.pl