Regulatory policies and spectrum requirements for use of CDMA in the 450 MHz band

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Overview

• What is CDMA450?

• Spectrum requirements for migration to CDMA in the 450 MHz band

• Regulatory policies and initiatives concerning use of CDMA in the 450 MHz band around the world

• Use of the 450 MHz band for IMT-2000 in developing countries
What is CDMA450?
What is CDMA450?

• First and foremost, it is a cost-effective, highly-flexible, spectrally efficient, commercially viable and available digital wireless technology platform for 450-470 MHz band

• In Western Europe, as well as CDMA450 for public cellular services, a modified version known as CDMA-PAMR is being used to offer advanced digital trunking services, known as Wideband PAMR
CDMA in the 450 band provides a platform for a number of services

- **Services & Market**
  - Public Cellular
  - Mobile data
  - Wireless access in rural areas
  - Next-generation PAMR

- **Technology & Standards**
  - CDMA450-family of technologies
    - High Spectrum Efficiency
    - Maximum site capacity use
    - Ubiquitous coverage
    - Efficient data transmission

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Economies of scale already exist for network equipment and terminals
Technical harmonisation of frequency use on an international level
CDMA450 can viably target niche markets that are not being addressed by the major players

• Clear differentiation from major operators
  – True nation-wide coverage
  – Up to 2.4 Mbps data throughput per user

• Focus on niche markets for rural users and special applications
  – PAMR services
  – Wireless Internet access in rural areas
  – Rural telephony
  – Nationwide mobile computing
  – Machine-to-Machine communication
**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>
</tr>
</thead>
<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>
</tr>
<tr>
<td>950</td>
<td>26.9</td>
<td>2269</td>
<td>3.3</td>
</tr>
<tr>
<td>1800</td>
<td>14.0</td>
<td>618</td>
<td>12.2</td>
</tr>
<tr>
<td>1900</td>
<td>13.3</td>
<td>553</td>
<td>13.6</td>
</tr>
<tr>
<td>2100</td>
<td>12.0</td>
<td>449</td>
<td>16.2</td>
</tr>
</tbody>
</table>

*QUALCOMM ITU contribution, June 11, 2001*
Spectrum requirements for migration to CDMA in the 450 MHz band
### IS-2000 NMT-450 Band (Band Class 5) Frequency Plan

<table>
<thead>
<tr>
<th>System Designator</th>
<th>Band Subclass</th>
<th>Mobile Station</th>
<th>Base Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>A*</td>
<td>0</td>
<td>452.500-457.475</td>
<td>462.500-467.475</td>
</tr>
<tr>
<td>B*</td>
<td>1</td>
<td>452.000-456.475</td>
<td>462.000-466.475</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>450.000-454.800</td>
<td>460.000-464.800</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>411.675-415.850</td>
<td>421.675-425.850</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>415.500-419.975</td>
<td>425.500-429.975</td>
</tr>
<tr>
<td>F</td>
<td>5</td>
<td>479.000-483.480</td>
<td>489.000-493.480</td>
</tr>
<tr>
<td>G</td>
<td>6</td>
<td>455.230-459.990</td>
<td>465.230-469.990</td>
</tr>
<tr>
<td>H*</td>
<td>7</td>
<td>451.310-455.730</td>
<td>461.310-465.730</td>
</tr>
</tbody>
</table>

* Current Product support
Carrier Overlay on NMT Standard Band with 4.45 MHz

- **FIRST CARRIER A**
  - Frequency: 453.995 MHz
- **SECOND CARRIER B**
  - Frequency: 455.225 MHz
- **THIRD CARRIER C**
  - Frequency: 456.455 MHz

- **GUARD**
  - Width: 0.38 MHz

- **3.69 MHz**

- **1.23 MHz**

- **453 MHz** to **457.45 MHz**
Spectrum Requirements for CDMA in 450 MHz NMT Bands

• Minimum clearing requirement 1.8 MHz for first 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
  – 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
Digital Transition Frequency Plan

NMT Analog Only

Dual-mode: One CDMA Carrier

Dual-mode: Two CDMA Carriers

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

Freq (MHz) 410 420 430 440 450 460 470 480 490

Subclass
A
B
C
D 411.675 415.850 421.675 425.850 452.500 457.475 462.500 467.475

Croatia, Slovenia

Mobile Tx (Home)
Base Tx (Home)

Baltics, Belarus, China Daging, Moldova, Romania, Russia, Scandinavia, Tunisia, Ukraine, Bulgaria, Poland

Italy

Malaysia

Hungary

Czech, Slovakia, Austria, Belgium, Netherlands, Germany, Portugal

Turkey

Indonesia, Thailand

Malaysia

Italy

Hungary

Czech, Slovakia, Austria, Belgium, Netherlands, Germany, Portugal

Mobile Tx (Home)
Base Tx (Home)
Regulatory policies and initiatives concerning use of CDMA in the 450 MHz band
Current status on use of CDMA in Europe

• ECC Decision adopted harmonising use of spectrum in Europe in 410, 450 or 870 frequency bands for systems with 1.25 MHz carrier width (i.e. including CDMA)

• Recognition by CEPT that some countries will (and may) deploy CDMA in these bands for ordinary cellular purposes although a number of regulators prefer the frequencies to be used primarily for PAMR services

• ETSI in process of preparing Harmonised Standards (ENs) for both CDMA-PAMR and CDMA450 which will ease the entry into some markets

• Many European countries have licensed, are in the process of licensing or plan to license spectrum for CDMA systems
Current status on use of CDMA in Europe (2)

• ECC Decision adopted in March 2004
  – ECC decision covers systems with 1.25 MHz channel width (i.e. CDMA) or 200 kHz channel width (i.e. TETRA 2 TAPS)
  – Decision “harmonizes” (effectively permits the usage of) spectrum in the 410, 450 and 870 frequency bands for use by any wideband system covered by the decision
  – Decision adopted after it had been established in CEPT (WG SE) that CDMA was an efficient system for use in these frequencies and that it was technically compatible with existing:
    • PMR/PAMR systems in 400 MHz bands
    • GSM systems below 915 MHz
    • UIC systems above 876/921 MHz
    • short range devices below 870 MHz
• In parallel, Footnote EU34 inserted into CEPT/ERC Report 25 (European Common Allocation Table) stating that: “Parts of the bands 450 to 457,5 / 460 to 467,5 MHz may also be used for existing and evolving public cellular networks on a National basis”.
Current status on use of CDMA in Europe (3)

• Strategic Plan on PMR/PAMR adopted as ECC Report 25 in May 2003:
  
  – Documents the shift that is underway from analogue to digital and from narrowband digital to wide band digital systems (including CDMA)
  – Defines PAMR as “Operator provided, commercially open networks designed for business professional users, dedicated user groups but no limitation on the nature or type of the user groups and no need for these to be related. Not generally intended for these groups to communicate with each other.”
  – Notes that the ability to interconnect with other public networks (e.g. PSTN) is a standard feature of PAMR
  – Encourages administrations to make frequencies available for wideband systems in 410, 450 and/or 870 MHz bands
CDMA licensing in Europe

• In the EU to date, Czech, Denmark, Latvia, Portugal and Norway have licensed 450 spectrum for nationwide public cellular services as too have Belarus, Georgia, Romania and Russia in Eastern Europe

• Germany held a licensing process earlier this year for Wideband PAMR in the 450 band

• Sweden plans to auction 450 spectrum for nationwide public cellular services in the near future

• A number of other EU countries plan to license 450 spectrum for either PAMR or cellular services in the near future including Austria, Finland and the Netherlands

• Other EU countries such as France are studying whether demand exists to license the frequencies but have already signalled their intention to issue a full public licence
Regulatory developments in Asia

• A commercial CDMA450 mobile network has been launched in Indonesia pursuant to a modification of the former NMT operator’s licence

• A number of CDMA450 licences have been issued in the Asia-Pacific region with commercial WLL networks already deployed in Cambodia, Vietnam and some regions of China

• In addition, WLL licences have been awarded and deployments are planned in Laos and Pakistan by year end 2004

• In Central Asia, a commercial CDMA450 public cellular network has been launched in Uzbekistan with similar networks planned in Afghanistan and Turkmenistan

• The Indian regulator, TRAI, recently held a consultation on the use of CDMA in the 450 MHz band

• An initiative is expected to commence within APT soon to seek regional harmonisation of the 450 frequencies
Regulatory developments in Africa

- A number of CDMA450 WLL licences have been issued in Africa with a commercial network already deployed in Uganda.
- CDMA450 WLL licences have been awarded and deployments are underway in Ethiopia, Nigeria, Mozambique and Kenya.
- Further CDMA450 WLL deployments are planned in Benin and Zimbabwe with commercial launch envisaged in 1Q 2005.
- South Africa and Namibia have both held consultations on possible use of the 450 band for CDMA.
- There has been long-standing interest from a number of African countries in the use of the 450 MHz band for IMT-2000 services, led by Cameroon, and it is expected that this will lead to an initiative within the Africa Telecom Union in the near future to seek regional harmonisation.
Regulatory developments in the Americas

- Following trials of CDMA450 in Brazil conducted by the national regulator, ANATEL (see http://projetoscd.isat.com.br/), it launched an initiative within the regional frequency body for the Americas, CITEL, calling for pan-American harmonisation of both the 410-430 and 450-470 MHz bands for use by CDMA

- CITEL issued a questionnaire to its constituent regulators to gather information on current use of the bands, the results of which will be discussed in forthcoming meeting

- Jamaica held a public consultation on possible use of the 450 band for a new public cellular licence

- It is anticipated that further studies will follow and there appears to be considerable interest in the region following a national consultation by ANATEL and a trial in Peru
Use of the 450 MHz band for IMT-2000 in developing countries
IMT-2000 standards and spectrum

The ITU has approved five radio air interface standards and has identified multiple frequency bands for IMT-2000:

- The IMT-2000 technologies are frequency agnostic
- The dominant IMT-2000 standards, CDMA2000 and WCDMA, are being deployed in multiple frequency bands
- The CDMA2000 standard is defined for twelve different frequency bands, of which the 800 MHz and 1900 MHz are most widely used
- The WCDMA standard is defined for the 1800, 1900 and 2100 MHz
- The decision in which bands IMT-2000 technologies are first deployed depends on regulatory decisions, the marketplace, and political considerations
Coverage Advantages of Lower Frequency Bands for IMT-2000 in Developing Countries

• Several developing countries, including Cameroon and Cote d’Ivoire, have indicated that they would like to explore the advantages of lower frequencies bands, such as the 450 MHz band, for the delivery of IMT-2000 services

• Due to the favorable propagation characteristics of lower frequencies and their associated coverage benefits, there may be significant cost advantages associated with deploying an IMT-2000 system in the 450 MHz band

• These cost advantages will be important considerations for developing countries, which may have several different frequency bands available, but may not have the resources to deploy nationwide systems in the higher frequency ranges identified by the ITU for IMT-2000 and do not have the same copious spectrum requirements for such services as developed countries
Identification of the 450-470 MHz band for IMT-2000

Several ITU resolutions support identification of lower frequency bands for IMT-2000:

• Administrations have the flexibility to use IMT-2000 technologies in any band allocated to the mobile service (ITU-R Resolution 223, recognizing c), and some administrations have deployed or are planning to deploy in frequency bands other than those identified for IMT-2000 (Resolution 228 recognizing f);

• The identification of several bands for IMT-2000 allows administrations to choose the best band or parts of bands for their circumstances (ITU-R Resolution 223, noting i);

• Developing countries have particular needs that should be met (ITU-R Resolution 223, emphasizing b) and where cost considerations warrant the installation of fewer base stations, such as in sparsely populated areas, bands below 1 GHz are generally suitable for implementing mobile systems including IMT-2000 (ITU-R Resolution 224, considering e, ITU-R Resolution 228, considering e);

• The evolution of first and second-generation systems to IMT-2000 is an ITU objective that can be facilitated if those systems are permitted to use their current frequency bands (ITU-R Resolution 224, recognizing).
World Radio Conference 2003 Developments and ITU-R WP8F Studies

• The World Radio Conference 2003 (WRC-03) approved plans for the future development of IMT-2000, and created a new item for attention on IMT-2000 for WRC-07 (Agenda Item 1.4):
  – “To consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 taking into account the results of ITU-R studies in accordance with Resolution 228. (Rev. WRC-03)”
  – Res. 228 (Rev.WRC-03) invites further studies of lower frequency bands for IMT-2000 in ITU-R WP8F

• Currently ITU-R WP8F has created a survey on potential candidate bands for future development of IMT-2000:
  – Includes language that recognizes the need, in many developing countries and countries with large areas of low population density, for the cost-effective implementation of IMT-2000 and notes the possibility to identify additional terrestrial bands below those already identified (below 806 MHz in Region 2 and 3, below 862 MHz in Region 1)”
    • Question: “If additional spectrum is needed to support extended and cost-effective coverage of mobile service in developing countries and countries with large areas of low population density, which frequency bands below those currently identified for IMT-2000 (i.e. below 806 MHz), could potentially be considered and studied?”
    • Question: Please provide a list of potential candidate bands and their current uses in your country?
  – Opportunity for countries to comment on the 450-470 MHz as an optimal band for IMT-2000 technologies and services. Contributions can be submitted to the ITU by January 25th 2005