CDMA2000: Delivering on 3G

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To lead the rapid evolution and deployment of CDMA-based systems, based on open standards and encompassing all core architectures, to meet the needs of markets around the world in an emerging, information-intensive environment.
The CDG is a consortium of over 110 member companies from around the world. Members are involved in many aspects of CDMA system deployment and support.
CDG Membership

- Agilent Technologies, Inc.
- Aicent, Inc.
- Airbiquity, Inc.
- Airvana Inc.
- ALACEL Corp.
- ALLTEL Communications, Inc.
- Alpine Electronics, Inc.
- Anritsu
- AnyDATA Corporation
- ArrayComm, Inc.
- Asia Pacific Broadband Wireless
- Audiovox Communications Corp.
- Bell Mobility
- BellSouth International
- Berkana Wireless, Inc.
- Bitfone Corp.
- Celerica, Inc.
- Celletra Ltd.
- China Unicom
- CIBERNET Corporation
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- Conductus, Inc.
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- Gemplus Corporation
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- Grayson Wireless
- GTRAN, Inc.
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- Multimedia Limited
- Hutchison Telecom (HK) Ltd.
- Hyundai CURITEL, Inc.
- InnoviCs Corporation
- iSCO
- IUSACELL
- KDDI
- Komunikasi Selular Indonesia
- (Komselindo)
- Korea Telecom Freetel, Inc. (KTF)
- Kyocera Corporation
- Leap
- LG Electronics, Inc.
- LG Telecom, Ltd.
- Lightbridge, Inc.
- Logica
- Lucent Technologies, Inc.
- Metawave Communications
- Motorola, Inc.
- NEWS IQ Inc.
- Nextel Communications
- Nokia Corporation
- Nortel Networks
- Openwave
- Pacific Bangladesh Telecom Limited
- Pele-Phone Communications Ltd.
- PT Wireless Indonesia
- QUALCOMM, Inc.
- QuickSilver Technology
- Qwest
- Racal Instruments
- Reliance Infocom Limited
- Research In Motion
- RITT
- Rohde & Schwarz
- Samsung Electronics Co. Ltd.
- Sanyo Fisher Company
- Schema Ltd.
- SchlumbergerSema
- Sharp Laboratories of America
- Sierra Wireless, Inc.
- SK Telecom
- SmartCom PCS
- SmartServ Online, Inc.
- SmartTrust
- Sony Electronics
- Spirent Communications
- Sprint
- Starent Networks Corporation
- Tata Teleservices Limited
- Telecom Mobile Limited
- Telefonica Moviles
- Telespree Communications
- Telstra Corporation Ltd.
- Telus Mobility Cellular, Inc.
- Texas Instruments
- TSI
- UNEFON
- U.S. Cellular
- Verizon Wireless
- Via Telecom, Inc.
- WaterCove Networks
- Wavecom, Inc.
- WAVS, Inc.
- Western Wireless
- Wherify Wireless, Inc.
- Willtech, Inc.
- Willtek Communications, Inc.
- Winphoria Networks, Inc.
- Wireless Test Systems
- ZTE Corporation
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<th>CDMA Development Group</th>
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<td>CDMA Worldwide</td>
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<td>CDMA2000: Delivering on 3G</td>
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CDMA is the present and future of advanced wireless services

Code Division Multiple Access (CDMA) is a spread spectrum technology used in second and third generation wireless networks.

cdmaOne™ identifies 2G and 2.5G cellular, PCS and wireless local loop (WLL) services based on the IS-95A and IS-95B CDMA air interface standards. IS-95A supports data delivery up to 14.4 kbps while IS-95B offers up to 115 kbps.

CDMA2000 is an ITU-approved, IMT-2000 (3G) standard.
CDMA2000 1X can double voice capacity and delivers data rates up to 307 kbps.
CDMA2000 1xEV is optimized for high-speed data:
  - CDMA2000 1xEV-DO uses a designated channel for data at speeds of up to 2.4 Mbps in a single carrier.
  - CDMA2000 1xEV-DV integrates voice and data on a single channel with speeds of up to 4.8 Mbps.
As the most advanced digital technology, CDMA offers significant benefits to operators and their subscribers.

<table>
<thead>
<tr>
<th>Operators</th>
<th>Subscribers</th>
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<tbody>
<tr>
<td>• Greater voice capacity</td>
<td>• Better voice quality</td>
</tr>
<tr>
<td>• Simplified system planning through the use of the same frequency in every sector</td>
<td>• Longer talk time</td>
</tr>
<tr>
<td>• Improved coverage characteristics resulting in fewer cell sites</td>
<td>• Improved privacy and security</td>
</tr>
<tr>
<td>• Data ready; uses standard IP commands and protocols</td>
<td>• Advanced data services</td>
</tr>
<tr>
<td>• The platform for 3G</td>
<td></td>
</tr>
</tbody>
</table>
CDMA technologies deliver superior capacity for voice and data

*Number of users per 5MHz of spectrum*

- **AMPS**: 8
- **GSM**: 21-23
- **TDMA**: 24
- **GSM FFR w/AMR**: 34 - 53
- **cdmaOne IS-95A**: 51-66
- **CDMA2000 1X**: 105-120
- **WCDMA**: 62-95

**CDMA is the most spectrally efficient technology**

- cdmaOne delivers 14x increase in voice capacity over analog and more than 2x more than GSM and TDMA
- CDMA2000 doubles voice capacity of cdmaOne systems making it the most spectrally efficient technology available today

*Source: Deutsche Bank, May 2002*
CDMA is the fastest growing technology, serving more than 135 million subscribers worldwide...

Source: CDMA Development Group
...and it will continue to be the fastest growing technology platform

Technology Share 2001

- iDEN: 4%
- TDMA: 10%
- Analog: 4%
- CDMA/CDMA2000: 12%
- GSM: 70%

Technology Share 2005E

- Analog: 1%
- CDMA/CDMA2000: 20%
- TDMA: 10%
- iDEN: 1%
- GSM/WCDMA: 68%

Source: EMC, Morgan Stanley, 2002
CDMA is one of the leading technologies with presence across all continents.

- **North America**: 58 million subscribers
  - Dominant technology

- **Europe, Middle East and Africa**: 2 million subscribers
  - The first 3G technology launched in Europe

- **Asia Pacific**: 49 million subscribers
  - Birthplace of 3G
  - Now deployed in China

- **Caribbean and Latin America**: 26 million subscribers
  - 20% market share
  - Subscriber base growing at 40% per year

As of September, 2002
The dominant 3G standards are based on CDMA

Although there are five terrestrial standards, most of the attention and energy in the industry has been directed toward the CDMA standards.
CDMA Development Group

CDMA Worldwide

CDMA2000: Delivering on 3G
Delivers services to consumers and revenues to operators

Dominates the 3G market

Offers significant lead time and service differentiation

Key success factors
33 CDMA2000 1X commercial networks (first deployed Oct 2000)
19 CDMA2000 1X networks scheduled to be deployed
4 CDMA2000 1X trial networks
3 CDMA2000 1xEV-DO commercial networks (first deployed Jan 2002)
4 CDMA2000 1xEV-DO networks scheduled to be deployed
4 CDMA2000 1xEV-DO trial networks
CDMA2000 dominates the 3G market today...

- Over 25 million CDMA2000 subscribers as of October 2002
- More than 2 million are being added every month

Source: CDMA Development Group
... and will continue to lead throughout the decade
CDMA2000 delivers greater value to the end users…

### Applications
- MMS
- Streaming Video
- Broadcasts
- GPS/Telematics

### Data Rates

<table>
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<tr>
<th></th>
<th>CDMA2000 1X</th>
<th>CDMA2000 1xEV-DO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peak</strong></td>
<td>144-153 kbps</td>
<td>2.4 Mbps</td>
</tr>
<tr>
<td><strong>Throughput (mobile)</strong></td>
<td>60-100 kbps</td>
<td>490-600 kbps</td>
</tr>
<tr>
<td><strong>Throughput (fixed)</strong></td>
<td>N/A</td>
<td>980-1200 kbps</td>
</tr>
</tbody>
</table>

Source: Asia and North America operators
... and incremental revenue for operators

CDMA2000 delivers a nearly five-fold increase in data revenue and more than 50% higher total revenue per subscriber

Source: Morgan Stanley, June 2002
More than 250 CDMA2000 terminals are available in the market
• cdmaOne phone prices will continue to decline and will reach $53 by 2005
• CDMA2000 1X phone prices will decline at a faster rate to reach $58 by 2005
• UMTS phones, especially dual mode, will remain at least 3 times more expensive than CDMA2000

Source: Shosteck, 2002
CDMA2000’s spectrum flexibility

| CDMA2000 can be deployed in any existing cellular, PCS and IMT-2000 spectrum |
| CDMA2000 can be deployed in a small amount of spectrum |

CDMA2000 is not constrained to only the IMT-2000 band. It is defined to operate in existing and IMT-2000 spectrum:

- 450 MHz
- 700 MHz
- 800 MHz
- 900 MHz
- 1700 MHz
- 1800 MHz
- 1900 MHz
- 2100 MHz

<table>
<thead>
<tr>
<th>Spectrum Type</th>
<th>Current Spectrum</th>
<th>Or New Spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog</td>
<td>1X</td>
<td>1X 1X 1X</td>
</tr>
<tr>
<td>cdmaOne</td>
<td>1X</td>
<td>1X 1X 1X</td>
</tr>
<tr>
<td>TDMA</td>
<td>1X</td>
<td>1X 1X 1X</td>
</tr>
<tr>
<td>GSM/GPRS</td>
<td>1X</td>
<td>1X 1X 1X</td>
</tr>
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1.25 MHz

5 MHz
Offers a direct migration path to 3G

Source: CDMA Development Group
Requires only minor enhancements to the existing cdmaOne network…

The network architecture is designed to deliver Internet and advanced services seamlessly, and without the need to build-out a new packet network.
...and relatively small capital investment

<table>
<thead>
<tr>
<th>Country</th>
<th>Carrier</th>
<th>Technology/Service</th>
<th>Total CapEx (US$ billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>SKT</td>
<td>CDMA2000 1X and 1xEV-DO</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>KTF</td>
<td>CDMA2000 1X and 1xEV-DO</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>LGT</td>
<td>CDMA2000 1X</td>
<td>0.4</td>
</tr>
<tr>
<td>Japan</td>
<td>KDDI</td>
<td>CDMA2000 1xEV-DO</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>DoCoMo</td>
<td>W-CDMA</td>
<td>10.9</td>
</tr>
<tr>
<td>U.S.</td>
<td>Sprint PCS</td>
<td>CDMA2000 1X and 1xEV-DO</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>AT&amp;T Wireless</td>
<td>GSM/GPRS/EDGE/WCDMA</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Sprint PCS will spend $8 per POP to migrate to CDMA2000. Recently, Moody’s estimated that cdmaOne carriers could upgrade to CDMA2000 1X for $3 to $5 per POP.

Source: Morgan Stanley, June 2002
TDMA to CDMA2000: One step evolution to 3G

- **TDMA Network**
- **BTS**
- **Modem Pool**
- **PSTN**
- **BSC**
- **MSC**
- **PDSN**
- **IP Backbone**
- **WWW**
- **VPN**
- **Enterprise Network**

*Usually co-located with TDMA equipment, requires separate interface protocols*

**New off-the-shelf CDMA2000 Terminals**

**New Equipment with 1X Channel Card**

**As with AMPS, benefits of this path include:**
- Re-use of the core network
- Ability to deploy 3G in-band, without the cost of buying new spectrum
- Ability to deploy 3G in only a small amount of spectrum

**Software Update**
A number TDMA operators around the world have deployed or are in the process of upgrading their networks to CDMA2000.
AMPS to CDMA2000: One step evolution to 3G

- **AMPS to CDMA2000 1X**
  - **BTS**
  - **CDMA2000 BTS**
  - **BSC**
  - **PDSN**
  - **MSC**

**Software Update**

**Modem Pool**

**IP Backbone**

- **PSTN**
- **WWWW Enterprise Network**
  - **VPN**

**New off-the-shelf CDMA2000/AMPS Terminals**

**New Equipment with 1X Channel Card**

- **This path is particularly compelling due to:**
  - Re-use of the core network
  - Ability to deploy 3G in-band, without the cost of buying new spectrum
  - Ability to deploy 3G in only a small amount of spectrum

* Usually co-located with AMPS equipment, requires separate interface protocols
GSM to CDMA2000: One step evolution to 3G through GSM 1X
“CDMA2000 is designed to build a simple and cost-effective network evolution…the first phase of CDMA2000, known as 1X, is already in commercial operation, offering double the voice capacity of second-generation (2G) networks.”

SEC Filing S1-A 11/28/01 – “Our CDMA network positions us to meet the growing voice and data needs of our customers…Upon full deployment of our 1XRTT network and 1XRTT handsets we expect that this technology will effectively double our network's voice capacity compared to the current version of CDMA.”

William Esrey, Chairman – "Essentially, we're spending zero additional dollars to convert our network to 3G."
CDMA2000 – analysts perspective

“The power of the platform is unlike anything the wireless industry has ever seen. The handset is no longer a simple device for voice communications as it is throughout most of the world, but is a multimedia platform in the truest sense of the word.” - ABN AMRO

“...only CDMA 1x comes with affordable and attractive handsets and applications, matched with half the capex per pop of W-CDMA.” - Morgan Stanley