3rd Generation Mobile Wireless

A Presentation on the Opportunities and Challenges of Delivering Advanced Mobile Communications Services

August 7, 2001
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Market Summary
A number of factors are driving the wireless Internet and wireless information...

**Societal trends**
- Emerging computer literate society
- Increasing travel and mobility
- Desire for entertainment
- Need for enhanced productivity

**Technology enablers**
- High speed, cost effective mobile systems
- Integrated multimedia applications
- Small, powerful, application-rich user devices

**Market trends**
- Rapid growth in mobile
- Rapid Internet adoption
- Accelerating pace of electronic commerce (aka M-commerce)
- Rapid growth of portable and palmtop computers
…enabling exciting vertical and horizontal applications

**Enterprise Workgroup**
- Specific IT Applications
- Business Verticals
- Group Chat, Email, Instant Messaging
- Wide Area Intranet
- Mobile Workforce Management (dispatch), Telematics

**Mobile Professional**
- Business General
- Horizontal Business
- Internet / Intranet
- Email, Chat, Instant Messaging
- Personal Information Management

**Consumer**
- Personal Interest
- Horizontal Consumer
- Internet
- Entertainment, Infotainment, Lottery, Sports
- Navigation, Map Search
- Electronic Cash (M-Commerce)

*Email, Intranet Access, Legacy Applications
Access, Vertical Applications
Weather, Travel, News, Gaming, Stock Quotes*
Data indicates that this convergence is creating enormous opportunity for the wireless industry.

**Wireless Data Users**

- Source: The ARC Group, Wireless Internet Report, 2000

**Worldwide Wireless Subscribers**

- Source: EMC Database, 2001
Looking more closely at wireless technologies, CDMA continues to grow share and is becoming a key enabler of the wireless Internet.

CDMA in the Americas accounted for 30% of the wireless marketplace while GSM was just 7%.

Worldwide, CDMA will account for 22% of the wireless marketplace.

Source: EMC Database, June 2001

CDMA (2G and 3G) will very likely be the predominant global wireless technology.
Going forward, addressable population will be a key driver of technology market share.

Countries able to deploy CDMA2000 in existing cdmaOne networks represent over 4.18 billion pops.

Countries announcing CDMA2000 deployments represent 806.5 million pops.

Countries that have awarded UMTS spectrum represent only 672 Million pops:

- J-WCDMA = 175 million (Japan, Korea)
- UMTS = 497 million (Western Europe/Asia)

Sources: CIA World Factbook, EMC World Cellular Database June 2001, CDG 2001, Public Announcements
3G Drivers and Key Considerations
Certain factors are critical for making 3G a success

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>✓</td>
<td>Solutions that are globally recognized and meet adopted, international standards</td>
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<tr>
<td>✓</td>
<td>Solutions that work, enable quick time-to-market and meet industry expectations</td>
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<tr>
<td>✓</td>
<td>Spectrum flexibility, efficiency and cost</td>
</tr>
<tr>
<td>✓</td>
<td>Capacity to meet future demand</td>
</tr>
<tr>
<td>✓</td>
<td>Seamless and cost effective migration from today’s systems</td>
</tr>
<tr>
<td>✓</td>
<td>Broad range of competitively-priced devices for end users (consumers, enterprises)</td>
</tr>
<tr>
<td>✓</td>
<td>Broad range of applications for end users</td>
</tr>
</tbody>
</table>

This section addresses each of these success factors
The ITU formed the IMT-2000 program to coordinate standards to meet these needs.

**IMT-2000 Terrestrial Radio Interfaces**

- **IMT-2000 CDMA Direct Spread**
  - WCDMA (UMTS)
- **IMT-2000 CDMA Multi-Carrier**
  - CDMA2000
- **IMT-2000 CDMA TDD**
  - UTRA TDD & TD-SCDMA
- **IMT-2000 TDMA Single Carrier**
  - UWC-136/EDGE
- **IMT-2000 FDMA/TDMA**
  - DECT

Although there are five terrestrial standards, most of the attention and energy in the industry has been toward the CDMA standards.
Although 2G systems may be coming from different starting points, future systems will largely be based on CDMA.
More importantly, 3G services are available today with CDMA2000

<table>
<thead>
<tr>
<th>Operator</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
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<tbody>
<tr>
<td>Telstra (Australia)</td>
<td>Trial 3Q 2000</td>
<td>Trial 3Q 2000</td>
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<tr>
<td>Telus Mobility (Canada, incl. Clearnet)</td>
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<td>SK Telecom (Korea, incl. Shinsegi)</td>
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<tr>
<td>Telcel (Venezuela)</td>
<td>Oct. 1, 2000</td>
<td></td>
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<tr>
<td>LG Telecom (Korea)</td>
<td>Trial 1H 2001</td>
<td>May 1, 2001</td>
<td>May 2, 2001</td>
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<tr>
<td>KT Freetel (Korea, incl. Hansol PCS)</td>
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<tr>
<td>Verizon Wireless (USA)</td>
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<tr>
<td>ALLTEL (USA)</td>
<td></td>
<td></td>
<td>2H 2001</td>
<td>2H 2001</td>
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<tr>
<td>Sprint PCS (USA)</td>
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<td>KDDI (Japan)</td>
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<tr>
<td>Bell Mobility (Canada)</td>
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<tr>
<td>Global Telecom (Brazil)</td>
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<tr>
<td>Telesp (Brazil)</td>
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<tr>
<td>Vesper (WLL, Brazil)</td>
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<tr>
<td>Pegaso PCS (Mexico)</td>
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<td></td>
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<tr>
<td>Telecom Mobile Limited (New Zealand)</td>
<td></td>
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</tr>
</tbody>
</table>

Sources: Company Press Releases and Statements, News Articles and Analyst Reports

Launch dates for other 3G technologies are much less clear:

- Japan WCDMA has been postponed from May 2001 to at least October 2001
- Europe WCDMA (UMTS) won’t likely be deployed until after 2004
- EDGE deployment is an uncertainty

SK Telecom (Korea) launched the world’s first commercial IMT-2000 3G system in October 2000. LG Telecom and KT Freetel (Korea) launched CDMA2000 service in May 2001. 4700 CDMA2000 base stations are deployed in Korea, allowing more than 400,000 users to realize data rates of over 150 kbps.
Spectrum flexibility is a key consideration for any technology...

CDMA2000 3G services operate in a small amount of spectrum

- Effective use of spectrum, significant to ALL operators
- Effective both in overlay or greenfield deployments

**CDMA2000 is not constrained to only the IMT-2000 band.**

**Defined to operate in existing and IMT spectrum:**

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

**Current Spectrum** | **Or New Spectrum**
---|---
**Analog** | 1x | 1x | 1x | 1x
**cdmaOne** | 1x | 1x | 1x | 1x
**TDMA** | 1x | 1x | 1x | 1x
**GSM/GPRS** | 1x | 1x | 1x | 1x

5 MHz
...which can be a decisive factor for operators wanting to move to 3G

Americas: Countries that can potentially deploy Europe WCDMA*

*1900 MHz band [required for Europe WCDMA] not already occupied

Americas: Countries that can deploy CDMA2000 in existing spectrum

Source: EMC World Cellular Database, 2001
The CDMA2000 evolution path is flexible and future-proof...

- Voice
- Data up to 14.4 kbps
- Voice
- Data up to 115 kbps
- 2x increases in voice capacity
- Up to 307 kbps packet data on a single (1.25 MHz) carrier
- First 3G system for any technology worldwide
- Optimized, very high-speed data (Phase 1)
- Up to 2.4 Mbps packet data on a single (1.25 MHz) carrier
- Integrated voice and data (Phase 2); up to 4.8 Mbps
...providing significant spectral efficiency benefits for operators

2 x 5 MHz spectrum available:
1 WCDMA (5 MHz) Carrier or
3 CDMA2000 (1.25 MHz) Carriers

Data Throughput / sector (Mbps)

Voice (Erlangs)

WCDMA*

CDMA2000 1X


Erlangs per sector and data throughput per sector

Other Sources: Qualcomm
Capacity is a key consideration for 3G services

Scenario 1: 100% Voice

- **WCDMA**
  - 50.8 Erlangs*
  - 5 MHz

- **CDMA2000**
  - 100 Erlangs
  - 3 x 1X Channels
  - 5 MHz

- 97% more capacity in 1X

Key:
- **Voice**

---

** per Sector

Other Sources: Qualcomm
Capacity for mixed voice and data traffic

*Scenario 2: 50% Voice, 50% Data*

**WCDMA**
- 25.4 Erlangs*
- 415 Kbps*

5 MHz

**CDMA2000**
- 50 Erlangs
- 525 Kbps

3 x 1X Channels

5 MHz

- 62% more total capacity with 1X

---

** per Sector
Other Sources: Qualcomm
CDMA2000 1xEV further improves the capacity of the 3G network

_Scenario 3: 50% Voice, 50% Data_

**Capacity**

<table>
<thead>
<tr>
<th>Channel Configuration</th>
<th>WCDMA</th>
<th>CDMA2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 MHz 2x1X, 1x1xEV</td>
<td>25.4 Erlangs*</td>
<td>50 Erlangs</td>
</tr>
<tr>
<td></td>
<td>415 Kbps*</td>
<td>1,090 Kbps</td>
</tr>
</tbody>
</table>

>130% more total capacity with 1X/1xEV

** per Sector

Other Sources: Qualcomm
Operators are faced with a few migration alternatives to 3G

1G /2G

- cdmaOne (IS-95A) (IS-95B)
- AMPS/Analog
- TDMA (IS-136)
- GSM
- NMT
- New 3G Operator

3G

- Japan WCDMA
- CDMA2000
- EDGE
- Europe WCDMA (UTMS)

The next few slides will illustrate why the path to CDMA2000 is most beneficial for analog, TDMA, GSM and new (3G) operators by addressing:
- Basic network architecture
- Ease of migration
- Cost of migration
The architecture for CDMA2000 is quite clean.

- Solutions that are globally recognized and meet adopted, international standards.
- Solutions that work, enable quick time-to-market and meet industry expectations.
- Spectrum flexibility, efficiency and cost.
- Capacity to meet future demand.
- Broad range of compatible, priced devices for end users (consumers, enterprises).
- Broad range of applications for end users.
Whereas that for GSM/GPRS/EDGE/WCDMA requires a parallel network of service nodes.
As does the architecture for TDMA/GPRS/EDGE/WCDMA

- Solutions that are globally recognized and meet adopted, international standards
- Solutions that work, enable quick time-to-market and meet industry expectations
- Spectrum flexibility, efficiency and cost
- Capacity to meet future demand
- Seamless and cost effective migration from today’s systems
- Broad range of competitively-priced devices for end users
- Broad range of applications for end users

Cell Phones
Smartphones and PDAs
Laptops with Cell Phones

BSC
RCU
MSC
3G Core Elements
GMSC
PNR
136
SGSN
GGSN
HGR/ANSI-41
GPRS Register

PSTN
Internet

Solutions

Packet Traffic
Circuit Switched Traffic
Evolving cdmaOne to CDMA2000 1X is a logical proposition

Evolving to CDMA2000

MSC

PSTN

IP Backbone

Enterprise Network

BTS

New 1X Channel Card

New Software

BSC

Software Upgrade

New Terminals (backward compatible)

www VPN

Software Upgrade

IWF

MSC

PDSN

Solutions that are globally recognized and meet adopted, international standards

Solutions that work, enable quick time-to-market and meet industry expectations

Spectrum flexibility, efficiency and cost

Capacity to meet future demand

Solutions and cost effective migration from today’s systems

Broad range of competitively-priced devices for end users (consumers, enterprises)

Broad range of applications for end users
AMPS to 3G: Practical solution to CDMA2000

AMPS to CDMA2000 1X

BTS

CDMA2000 BTS*

New Equipment with 1X Channel Card

BSC

PDSN

New Equipment

MSC

Software Update

Modem Pool

PSTN

IP Backbone

WWW

VPN

Enterprise Network

New Off-the-shelf CDMA2000/AMPS Terminals

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

- Solutions that are globally recognized and meet adopted, international standards
- Solutions that work, enable quick time-to-market and meet industry expectations
- Spectrum flexibility, efficiency and cost
- Capacity to meet future demand
- Successful and cost-effective migration from today’s systems
- Broader range of competitively-priced devices for end-users
- Broader range of applications for end users
TDMA to 3G: Practical solution to CDMA2000

- **TDMA to CDMA2000 1X**

  - **BTS**
  - **CDMA2000 BTS**
  - **BSC**
  - **PDSN**

  **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

- **Solutions that are globally recognized and meet adopted, international standards**
  - Spectrum flexibility, efficiency and cost
  - Capacity to meet future demand
  - Seamless and cost effective migration from today’s systems
  - Broad range of competitively-priced devices for end users
  - Broad range of applications for end users

- **Solutions that work, enable quick time-to-market and meet industry expectations**

- **Capacity to meet future demand**

- **Broad range of competitively-priced devices for end users**

- **Broad range of applications for end users**

* Usually co-located with TDMA equipment, requires separate interface protocols
GSM to 3G: Practical solution to CDMA2000

Adding CDMA2000 1X

New Terminals (GSM/GPRS)

GSM/ GPRS BTS

CDMA2000 BTS*

1X Channel Card

Upgrade

A/lu Interface

MSC

GSM/ GPRS BSC

Upgrade

New Equipment

PDSN

CDMA2000 BSC*

New Terminals (CDMA2000 1X or multimode GSM/GPRS/CDMA2000 1X)

SGSN

GPRS and CDMA2000 are Complementary

GPRS Backbone

Non-standard router

SGSN

New Equipment

IP Backbone

WWW

VPN

GGSN

Commercial IP Router Packaged by Vendor

Modem Pool

Commercial Server

RADIUS Server

Solutions that are globally recognized and meet adopted, international standards
Solutions that work, enable quick time-to-market and meet industry expectations
Spectrum flexibility, efficiency and cost
Capacity to meet future demand
Simplicity and cost effective migration from today’s systems
Broad range of competitively-priced devices for end users
Broad range of applications for end users

* Usually co-located with 2G/2.5G equipment, requires separate interface protocols

Enterprise Network
Migrating from GSM to CDMA2000 is an attractive evolution to 3G

GSM operators need new spectrum to deploy UMTS

- Many GSM carriers will not have access to new UMTS spectrum

GSM carriers can use CDMA2000 1X-MAP (IS-833) in existing spectrum

- 1X-MAP (IS-833) applies the CDMA2000 radio interface to GSM-MAP networks
  - Allows GSM operators to retain international roaming capability
- 1X-MAP is an ITU standard, developed by 3GPP2 with support from 3GPP
- 3GPP also included changes in Release 99 for 1X-MAP support

CDMA2000 for GSM:

- CDMA2000 1X-MAP (IS-833)
  - CDMA2000 1X lower layers using GSM signaling

Developed by 3GPP2 with support from 3GPP
**Effort to upgrade GSM to GPRS/WCDMA is quite significant**

<table>
<thead>
<tr>
<th></th>
<th>2G GSM</th>
<th>2.5G GPRS</th>
<th>3G WCDMA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Software</strong></td>
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</tr>
<tr>
<td>User Interface</td>
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<td>Protocol</td>
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<td><strong>Handset</strong></td>
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<td>RF</td>
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<tr>
<td>Baseband</td>
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<tr>
<td>Manufacture and Testing</td>
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<tr>
<td><strong>Base Station</strong></td>
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<td>RF</td>
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<td>Channel Cards</td>
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<td><strong>Network</strong></td>
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<td>Backhaul</td>
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</tbody>
</table>

**TDMA and analog operators following the GSM path will have to pay the price of this investment**

- Generation Independent
- Upgrade Required
- New Equipment Required
On the other hand, effort to go from cdmaOne to 3G CDMA2000 is modest.

<table>
<thead>
<tr>
<th></th>
<th>2G cdmaOne (95A)</th>
<th>2.5G cdmaOne (95B)</th>
<th>3G CDMA2000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Handset</strong></td>
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<tr>
<td>Software</td>
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<td>Hardware</td>
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<td>Manufacture and Testing</td>
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<td><strong>Base Station</strong></td>
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<td>Backhaul</td>
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</tbody>
</table>

TDMA and AMPS operators maintain the same core network as cdmaOne operators, and therefore realize the same migration benefit.
Multiple CDMA2000 terminal products are already available in the market

- Samsung SCH-X100
- Samsung SCH-X120
- Samsung SCH-X110
- SK TeleTech IM-2400
- Samsung SCH-X130
- Samsung SCH-X200
- Samsung SPH-X1000
- LG Cyber X-1
- Samsung SCH-X2000
- SK TeleTech IM-2300
- Motorola V671C
- GTRAN DotSurfer 1X

Solutions that are globally recognized and meet adopted, international standards
Solutions that work, enable quick time-to-market and meet industry expectations
Spectrum flexibility, efficiency and cost
Capacity to meet future demand
Seamless and cost-effective migration from today’s systems
Broad range of competitively-priced devices for end users (consumers, enterprises)
Broad range of applications for end users
CDMA terminals are reaching price parity with GSM

In a recent study comparing phones from the top tier vendors, CDMA is reaching price parity with GSM and achieving lower prices in some price tiers.

Sub-$100 phones are available for cdmaOne and GSM.

cdmaOne cost curves and economies of scale directly benefit CDMA2000

Comparison of average unsubsidized wholesale terminal prices from Tier One and Tier Two manufacturers. Grouped by product tier.

<table>
<thead>
<tr>
<th></th>
<th>Average*</th>
<th>High-End Smartphone</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM</td>
<td>$186</td>
<td>Nokia 9210 $1407**</td>
</tr>
<tr>
<td>CDMA</td>
<td>$188</td>
<td>Kyocera QCP-6035 $499***</td>
</tr>
</tbody>
</table>

*Average Price - Source: Nokia

Tier 1 vendors: Perceived by the market as supplying the best overall quality for a specified product at a particular price point. The most important characteristic of a Tier 1 vendor is market share. Since Tier 1 vendors normally have a strong brand, they are typically able to levy a premium for their products.

Tier 2 vendors: Regarded as providing mediocre quality for a specified product at a particular price point. Tier 2 vendors do not obtain a premium for their products and will sell them for a price less than that charged by a Tier 1 vendor, even if product specification were similar.

**Retail Price - Source: Orange:
http://www.the_order.co.uk/orange_contract/Orange_nokia_9210_contract.asp

***Retail Price - Source: Verizon Wireless
CDMA2000 terminals have a time-to-market advantage...

Sources: EMC World Database, June 2001 and Marcus Evans, March 2001
...that will translate to better economies and pricing

Notes:

- Average Q4 wholesale pricing for CDMA2000 is based on 300,000 unit shipments.
- WCDMA pricing is based on smaller volume shipments since Gartner does not expect volume order for WCDMA until after 2003.
- WCDMA pricing represents single mode 2.1 GHz and multimode dual band terminals for W. Europe and Asia.
- GSM/GPRS pricing represents 900 MHz and 900/800 MHz terminals for W. Europe and Asia, plus GSM 1900 MHz terminals for N. America.
- CDMA2000 1X pricing represents 800 MHz and 1.9 GHz, single mode, dual mode and tri-mode handsets for Asia and N. America.

Source: Gartner Group, April 2001
Handset pricing and availability

By 2002, the difference in the average wholesale price for entry-level CDMA and GSM handsets will be approximately $10.

The difference between the average wholesale price for mid-tier and high-tier CDMA and GSM handsets is negligible.

In 2001, users will be able to purchase 3G CDMA2000 handsets at an average wholesale price that is less than 2.5G GSM/GPRS handsets.

In 2001, users will be able to purchase CDMA2000 handsets at an average wholesale price significantly less than WCDMA handsets.

Low-end 3G capable CDMA2000 handsets will be available more than four years ahead of mid-tier and low-end WCDMA handsets.

Source: Gartner Group, April 2001
Handset migration is another key consideration in the success of 3G

GSM roadmap is discrete with no forward and backward compatibility

CDMA terminals are fully forward and backward compatible

- IS-95A
- IS-95B
- CDMA2000 1X
- CDMA2000 1xEV
- GSM
- GPRS
- EDGE
- WCDMA
CDMA enables the kind of capabilities needed to realize significant advancements in services...

<table>
<thead>
<tr>
<th>Data Transmission Speed - kbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G Analog</td>
</tr>
<tr>
<td>2G CDMA</td>
</tr>
<tr>
<td>3G CDMA</td>
</tr>
</tbody>
</table>

- Voice
- Voice Mail
- Fax
- Weather, Traffic, News, Sports, Stock updates

Solutions that are globally recognized and meet adopted, international standards
- Spectrum flexibility, efficiency and cost
- Capacity to meet future demand
- Seamless and cost effective migration from today’s systems
- Broad range of competitively-priced devices for end users (consumers, enterprises)
- Broad range of applications for end users
CDMA enables the kind of capabilities needed to realize significant advancements in services (cont.)

- Solutions that are globally recognized and meet adopted, international standards
- Solutions that work, enable quick-to-market and meet industry expectations
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- Broad range of applications for end users

<table>
<thead>
<tr>
<th>Data Transmission Speed - kbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000</td>
</tr>
<tr>
<td>1,440</td>
</tr>
<tr>
<td>960</td>
</tr>
<tr>
<td>640</td>
</tr>
<tr>
<td>320</td>
</tr>
<tr>
<td>192</td>
</tr>
<tr>
<td>96</td>
</tr>
<tr>
<td>64</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

1G Analog | 2G CDMA | 3G CDMA

- Text Messaging
- Audio Streaming
- Voice
- Voice Mail
- Electronic Newspaper
- E-Mail
- Mobile Radio
- Data
- Weather, Traffic, News, Sports, Stock updates
- Electronic Publishing
CDMA enables the kind of capabilities needed to realize significant advancements in services (cont.)

CDMA enables the kind of capabilities needed to realize significant advancements in services (cont.)

Solutions that are globally recognized and meet adopted, international standards
Solutions that work, enable quick time-to-market and meet industry expectations
Spectrum flexibility, efficiency and cost
Capacity to meet future demand
Scalability and cost effective migration from today’s systems
Broad range of competitively-priced devices for end users
Conformance, certification
Broad range of applications for end users

<table>
<thead>
<tr>
<th>Data Transmission Speed - kbps</th>
<th>1G Analog</th>
<th>2G CDMA</th>
<th>3G CDMA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Voice</td>
<td>Text Messaging</td>
<td>Video Streaming</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audio Streaming</td>
<td>High-speed Internet</td>
</tr>
<tr>
<td>Telephone (Voice)</td>
<td></td>
<td>Electronic Newspaper</td>
<td>Mobile Radio</td>
</tr>
<tr>
<td>Voice Mail</td>
<td></td>
<td>Fax</td>
<td>M-Commerce</td>
</tr>
<tr>
<td>Electronic Publishing</td>
<td></td>
<td>Data</td>
<td>Video Conference</td>
</tr>
<tr>
<td>Voice Mail</td>
<td></td>
<td>E-Mail</td>
<td>(High quality)</td>
</tr>
<tr>
<td>Weather, Traffic, News, Sports, Stock updates</td>
<td></td>
<td>Electronic Publishing</td>
<td>Mobile TV</td>
</tr>
<tr>
<td>Electronic Publishing</td>
<td></td>
<td>Mobile TV</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Video Streaming</td>
<td></td>
<td>Mobile TV</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Remote Medical Service</td>
<td></td>
<td>M-Commerce</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>(Medical image)</td>
<td></td>
<td>M-Commerce</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Video Conference</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>(High quality)</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Capacity to meet future demand</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
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<td>Solutions that are globally recognized and meet adopted, international standards</td>
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<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
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<tr>
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<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Spectrum flexibility, efficiency and cost</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
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<tr>
<td>Capacity to meet future demand</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Scalability and cost effective migration from today’s systems</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Broad range of competitively-priced devices for end users</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Conformance, certification</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
<tr>
<td>Broad range of applications for end users</td>
<td></td>
<td>Video Conference</td>
<td>Video Surveillance, Video Mail, Travel</td>
</tr>
</tbody>
</table>
...and significantly enhances the user’s wireless experience

Approximate transfer times for a 3 minute MP3 song file

<table>
<thead>
<tr>
<th>Tx Standard</th>
<th>Data Rate</th>
<th>Download Time</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM</td>
<td>9.6 kbps</td>
<td>2466 (41 minutes) ouch!</td>
<td>Commercial</td>
</tr>
<tr>
<td>cdmaOne (IS-95A)</td>
<td>14.4 kbps</td>
<td>1852 (31 minutes)</td>
<td>Commercial</td>
</tr>
<tr>
<td>GPRS</td>
<td>45 kbps</td>
<td>526 (8.8 minutes)</td>
<td>Commercial</td>
</tr>
<tr>
<td>cdmaOne (IS-95B)</td>
<td>56 kbps</td>
<td>417 (7 minutes)</td>
<td>Commercial</td>
</tr>
<tr>
<td>WCDMA phase 1</td>
<td>56 kbps</td>
<td>417 (7 minutes)</td>
<td>??</td>
</tr>
<tr>
<td>CDMA2000 1X</td>
<td>307 kbps</td>
<td>77 (1.3 minutes)</td>
<td>Commercial</td>
</tr>
<tr>
<td>WCDMA phase 2</td>
<td>306 kbps</td>
<td>77 (1.3 minutes)</td>
<td>2004+</td>
</tr>
<tr>
<td>CDMA2000 1xEV</td>
<td>2-5 Mbps</td>
<td>13-6 (0.2-0.1 minutes)</td>
<td>2002</td>
</tr>
</tbody>
</table>
Myths and Facts
Some common myths and facts about 3G

<table>
<thead>
<tr>
<th>Myth</th>
<th>Fact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WCDMA will experience far better economies of scale (compared to CDMA2000)</strong></td>
<td>CDMA2000 economies will be significant, yielding comparable benefits of scale</td>
</tr>
<tr>
<td><strong>CDMA2000 will be limited to the US</strong></td>
<td>CDMA2000 has already been deployed in Korea, and will be deployed in Japan, the US, Canada, Mexico and Brazil in 2001</td>
</tr>
<tr>
<td><strong>GSM/GPRS/WCDMA is the default migration path for TDMA operators</strong></td>
<td>TDMA operators, since they use the same core network as CDMA operators, can migrate much more easily to CDMA2000 from TDMA today</td>
</tr>
<tr>
<td><strong>CDMA2000 1X is 2.5G</strong></td>
<td>CDMA2000 1X is an approved, IMT-2000 3G standard</td>
</tr>
<tr>
<td><strong>CDMA2000 can only be deployed by current CDMA operators</strong></td>
<td>CDMA2000 can be deployed by any operator</td>
</tr>
<tr>
<td><strong>CDMA2000 deployments will be “islands” of service</strong></td>
<td>Today’s CDMA networks have full roaming capability, and CDMA2000 will be compatible with current and future systems to connect worldwide systems</td>
</tr>
</tbody>
</table>
Some common myths and facts about 3G (cont.)

<table>
<thead>
<tr>
<th>Myth</th>
<th>Fact</th>
</tr>
</thead>
<tbody>
<tr>
<td>3G is still some time off</td>
<td>CDMA2000 is commercially deployed; UMTS will likely not be deployed until 2004</td>
</tr>
<tr>
<td>3G systems can only be deployed in the 2GHz band</td>
<td>CDMA2000 can be deployed in any band, including the IMT band</td>
</tr>
<tr>
<td>Korea, a cornerstone of 2G CDMA, is going to WCDMA</td>
<td>Korea has already commercially deployed CDMA2000, and will have deployments in PCS, cellular and IMT bands</td>
</tr>
<tr>
<td>Japan will deploy a fully capable, WCDMA system in May 2001</td>
<td>NTT DoCoMo has delayed their deployment of WCDMA from May to October, but will likely roll out a 64 kbps service. KDDI, using cdmaOne, has had 64 kbps packet data service since early 2000.</td>
</tr>
<tr>
<td>All flavors of WCDMA are the same</td>
<td>WCDMA for Japan and Europe have different technical parameters, impacting roaming, interoperability, etc.</td>
</tr>
</tbody>
</table>
Summary
Summary

The wireless industry is on the verge of enabling applications and services never before imagined.

Operators are faced with different alternatives for enabling these capabilities with 3G systems.

In the end, certain factors are critical to determining which alternative is most beneficial, including:

- Global recognition of the technology
- Viability of the technology, and ability to deliver
- Flexibility in solutions
- Cost competitive solutions
- Broad range of products and applications

**CDMA2000 is delivering on 3G, and addresses these factors.**
Appendix
### Abbreviations and acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>3G-GGSN</td>
<td>Gateway GPRS Support Node + UMTS upgrade</td>
</tr>
<tr>
<td>3G-SGSN</td>
<td>Serving GPRS Support Node + UMTS upgrade</td>
</tr>
<tr>
<td>3GPP</td>
<td>3rd Generation Partnership Project</td>
</tr>
<tr>
<td>3GPP2</td>
<td>3rd Generation Partnership Project 2</td>
</tr>
<tr>
<td>AAA Server</td>
<td>Authentication, Authorization, and Accounting Server</td>
</tr>
<tr>
<td>A-bis</td>
<td>Interface between BSC and BTS</td>
</tr>
<tr>
<td>A Interface</td>
<td>Interface between GSM MSC and BSS</td>
</tr>
<tr>
<td>AMPS</td>
<td>Advanced Mobile Phone System</td>
</tr>
<tr>
<td>BSC</td>
<td>Base Station Controller</td>
</tr>
<tr>
<td>BTS</td>
<td>Base Transceiver Station</td>
</tr>
<tr>
<td>CDMA</td>
<td>Code Division Multiple Access</td>
</tr>
<tr>
<td>DECT</td>
<td>Digital European Cordless Telecommunications</td>
</tr>
<tr>
<td>EDGE</td>
<td>Enhanced Data Rates for Global Evolution</td>
</tr>
<tr>
<td>FDMA</td>
<td>Frequency Division Multiple Access</td>
</tr>
<tr>
<td>Gb Interface</td>
<td>Interface between SGSN and BSS</td>
</tr>
<tr>
<td>GGSN</td>
<td>Gateway GPRS Support Node</td>
</tr>
<tr>
<td>Gi+ Interface</td>
<td>Interface between 3G-GGSN and Data Networks</td>
</tr>
<tr>
<td>Gn Interface</td>
<td>Interface between SGSN and GGSN</td>
</tr>
<tr>
<td>Gn+ Interface</td>
<td>Interface between 3G-SGSN and 3G-GGSN</td>
</tr>
<tr>
<td>GPRS</td>
<td>General Packet Radio Service</td>
</tr>
<tr>
<td>GSM</td>
<td>Global System for Mobile Communications</td>
</tr>
<tr>
<td>HLR/AUC</td>
<td>Home Location Register/Authentication Center</td>
</tr>
<tr>
<td>IP-Router</td>
<td>Internet Protocol Routers</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunications Union</td>
</tr>
<tr>
<td>IWF</td>
<td>Interworking Function</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>kbps</td>
<td>Kilobits per second</td>
</tr>
<tr>
<td>Iu-bis</td>
<td>Interface between RNC and Node B</td>
</tr>
<tr>
<td>Iu CS</td>
<td>Interface between 3G-MSC and RNC for Circuit Switched traffic</td>
</tr>
<tr>
<td>Iu PS</td>
<td>Interface between 3G-SGSN and RNC for Packet Switched traffic</td>
</tr>
<tr>
<td>Mbps</td>
<td>Megabits per second</td>
</tr>
<tr>
<td>MAP</td>
<td>Mobile Access Protocol</td>
</tr>
<tr>
<td>MSC</td>
<td>Mobile Switching Center</td>
</tr>
<tr>
<td>Node B</td>
<td>Group of WCDMA cells (~BTS)</td>
</tr>
<tr>
<td>NMT</td>
<td>Nordic Mobile Telephone</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
</tr>
<tr>
<td>PDSN</td>
<td>Packet Data Serving Node</td>
</tr>
<tr>
<td>PSTN</td>
<td>Public Switched Telephone Network</td>
</tr>
<tr>
<td>RF</td>
<td>Radio Frequency</td>
</tr>
<tr>
<td>RNC</td>
<td>Radio Network Controller (~BSC)</td>
</tr>
<tr>
<td>R-P Interface</td>
<td>Interface between Radio Access Network (RAN) and PSDN</td>
</tr>
<tr>
<td>SGSN</td>
<td>Serving GPRS Support Node</td>
</tr>
<tr>
<td>TDMA</td>
<td>Time Division Multiple Access</td>
</tr>
<tr>
<td>TD-SCDMA</td>
<td>Time Division - Synchronous Code Division Multiple Access</td>
</tr>
<tr>
<td>UMTS</td>
<td>Universal Mobile Telephone System</td>
</tr>
<tr>
<td>UTRA TDD</td>
<td>Universal Terrestrial Radio Access Time Division Duplex</td>
</tr>
<tr>
<td>VPN</td>
<td>Virtual Private Network</td>
</tr>
<tr>
<td>WCDMA</td>
<td>Wideband Code Division Multiple Access</td>
</tr>
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</table>