Implementing CDMA in TDMA Networks

Leveraging the success of CDMA

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2G/3G Market Evolution

1999
- CDMA IS95B (64 kbps)
- Commercial Deployments in Japan, Korea, Peru

2000
- CDMA Industry commercializes 1X (up to 153 kbps) service
- GSM Industry commercializes GPRS (20-64 kbps) service

2001
- EDGE trials up to 120 kbps
- CDMA Industry commercializes QNC (14 kbps) service
- CDMA Industry trials 1xEV-DO (2.4 Mbps) service

2002
- 2002
- CDMA Industry commercializes 1X (up to 153 kbps) service
- KDDI 1X commercialized

2003
- 2003
- CDMA Industry trials 1xEV-DO (2.4 Mbps) service
- 2003
- CDMA2000 1xEV-DV (up to 3.1 Mbps) chips available
- NTT DoCoMo FOMA commercialized

2004
- 2004
- CDMA2000 1xEV-DV (up to 3.1 Mbps)
- HSDPA
- GSM Industry commercializes WCDMA (~2 Mbps) service

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Value Drivers for Migrating from TDMA to CDMA2000 1X

- Investment Protection
- "Future Proof"
- Backward Compatible to IS-95A/B
- Subscriber Feature Transparency
- Network Migration
- Customer Commitment
- Revenue Generation
- Cost of Ownership
- Operability
- Quality of Service
- Capacity & Coverage
- CAPEX
- OPEX
- Value Drivers

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• CDMA migration path offers:
  • Efficiency – 2X voice capacity increase lowers CAPEX/OPEX (69% fewer BTS – 5MHz)
  • Reduction in number of sites installed to serve the same traffic
  • In areas of the world in which spectrum must be purchased, these efficiency advantages provide a higher Return On Investment
# Spectral Efficiency Comparison

<table>
<thead>
<tr>
<th></th>
<th>HSDPA</th>
<th>WCDMA</th>
<th>cdmaOne (IS-95B)</th>
<th>CDMA2000 1X</th>
<th>CDMA2000 1xEV-DO</th>
<th>CDMA2000 1xEV-DV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spectrum Occupancy</strong></td>
<td>5 MHz</td>
<td>5 MHz</td>
<td>1.25 MHz</td>
<td>1.25 MHz</td>
<td>1.25 MHz</td>
<td>1.25 MHz</td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td>Voice + Data</td>
<td>Voice + Data</td>
<td>Voice + Data</td>
<td>Voice + Data</td>
<td>Data Only</td>
<td>Voice + Data</td>
</tr>
<tr>
<td><strong>Connection Mode</strong></td>
<td>Circuit + Packet</td>
<td>Circuit + Packet</td>
<td>Circuit + Packet</td>
<td>Circuit + Packet</td>
<td>Packet Only</td>
<td>Circuit + Packet</td>
</tr>
<tr>
<td><strong>Max Data Rate per User</strong></td>
<td>F/L</td>
<td>8.0 Mbps</td>
<td>384 kbps (up to 1.92 Mbps)</td>
<td>64 kbps</td>
<td>153.6 kbps (up to 307 kbps)</td>
<td>2.4 Mbps</td>
</tr>
<tr>
<td></td>
<td>R/L</td>
<td>384 kbps</td>
<td>64 kbps (up to 384 kbps)</td>
<td>14.4 kbps</td>
<td>153.6 kbps (up to 307 kbps)</td>
<td>153 kbps</td>
</tr>
<tr>
<td><strong>Sector Throughput (F/L)</strong></td>
<td></td>
<td>2800 kbps</td>
<td>1000 kbps</td>
<td>75 kbps</td>
<td>180 kbps</td>
<td>644 kbps</td>
</tr>
<tr>
<td><strong>Spectral Efficiency (bps/Hz)</strong></td>
<td></td>
<td></td>
<td>0.56</td>
<td>0.20</td>
<td><strong>0.06</strong></td>
<td>0.14</td>
</tr>
</tbody>
</table>

|                  |              |              | 0.50             | 0.80        |
Simplified Network Migration
TDMA to CDMA2000 1X

<table>
<thead>
<tr>
<th>Spectrum</th>
<th>Ease of Migration</th>
<th>Investment Protection</th>
<th>Time to Market</th>
<th>Terminal Devices</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

### Terminal Devices
- Time to Market
- Investment Protection
- Ease of Migration

### Revenue Generation
- OPEX
- CAPEX

<table>
<thead>
<tr>
<th>Feature</th>
<th>OPEX</th>
<th>CAPEX</th>
<th>Revenue Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less Steps</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Less Complicated</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>No Subscriber Impact</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Equipment Leverage</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Backward Compatible</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Fewer BTS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Increased Capacity</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Re-Use Existing Core

- TDMA and CDMA2000 systems are **ANSI-41 based** switching core networks.

- **Simplified migration** leveraging existing core network from TDMA.

- **Reduction in operator CAPEX and OPEX** leveraging existing CDMA2000 core network.
CDMA Network Migration
Beyond 1X

<table>
<thead>
<tr>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>1X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2X Voice Capacity Over IS-95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Data Rate: 153 kbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-4X Data Capacity Over IS-95A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1xEV-DV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2X Voice Capacity Over IS-95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Data Rate: 3.1 Mbps</td>
<td></td>
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<tr>
<td>12-14X Data Capacity Over IS-95A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1X → 1xEV-DV</td>
<td></td>
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<tr>
<td>1xEV-DO</td>
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1xEV-DV Characteristics

• Support of Interactive, Streaming, and Real-Time/2-Way Services
• Peak Data of 3.1 Mbps with Unmatched Data Capacity of 1.0 Mbps within 1.25 MHz
• Backward Compatible with IS95A/B/1X
• Voice and Data Services in a Single CDMA Carrier
CDMA2000 1X: Platform for New Applications

Mobile Office
- E-Mail
- E-Downloads
- Internet Access
- Web Browsing

Information and News
- Financial Info
- Weather
- Sports
- News
- Restaurants

Personalized Services
- Instant Messaging
- Online Chat
- Location Services
- Home Page

Enterprise Apps
- Calendar
- M-Commerce
- Stock Trading/Banking

Financial Info
- Local Events
- Movies
- Gaming
- Music

Terminal Devices
Spectrum
Investment Protection
Ease of Migration
Timing

Motorola General Use
Version # 6    Date: 04/17/02
3G is Here and CDMA is Ready
Today CDMA2000 1X Provides…

• Support of CDMA2000 1X Air Interface
  – Enables new revenue generating features
  – Enables high voice capacities
  – Lower Cost/Channel compared to IS-95

• Introduction of IP Components
  – Packet Data Routing
  – Packet Data Service Node
  – Authentication, Accounting, and Authorization Server
  – Higher Capacity and Reduced Operating Costs

• Orderly Migration Path to 1xEV
  – Maximizes re-use of existing equipment
  – Maximizes revenue generating data service opportunities
  – Minimizes risk to existing voice services
  – Simplified BTS upgrades