Major Industry Initiatives

- **Open Market Handsets (OMH)**
  Creates devices that can be used across multiple operators without hardware or software changes by storing all user, network and service configuration data onto an OMH-capable R-UIM removable card. Simplifies handset upgrades, enables handset exchanges, increases economies of scale and reduces inventory costs.

- **International Roaming Team (IRT)**
  Provides support resources and develops technical solutions for CDMA voice, SMS and data roaming. Develops solutions for inter-standard roaming, known as: World Mode.

- **Device Strategy Council (DSC)**
  Provides strategic direction on all issues concerning CDMA device availability and testing.

- **Global Handset Requirements for CDMA (GHRC)**
  Develops common requirements for CDMA devices to improve economies of scale and ensure ease of interoperability and roaming.

- **CDMA Certification Forum (CCF)**
  An independent body that focuses on the efficient testing and certification of CDMA devices globally. www.globalccf.org

- **Evolution Team**
  Defines requirements and standards for the evolution of CDMA technologies.

- **Global Strategy Team (GST)**
  Executes the CAC’s marketing plan through events, papers and PR activities.

- **CMO Council**
  Develops and executes strategic marketing initiatives to promote the success and value of CDMA2000.

- **CDG Advocacy Council (CAC)**
  Develops a marketing plan to promote the global adoption and growth of CDMA2000.

- **PR Council**
  Guides CDG’s PR activities through collective and proactive media efforts.

- **IP-Based Over-the-Air Device Management Team (IOTA DM)**
  Develops requirements and capabilities for IP-based OTA standards for CDMA Handset Configuration Management.

- **CDMA450 SIG**
  To support the specific needs of CDMA450 operators globally.

- **CDMA University**
  Offers public, private and self-paced training on a broad range of wireless industry topics, including business professional and technical training. www.cdmauniversity.com

- **Regional Interest Groups**
  Work with government officials and wireless operators to help in their selection and deployment of CDMA2000 in specific geographic regions.
CDMA: 475 Million Global Subscribers

More than 300 operators in 108 countries/territories have deployed or are deploying CDMA2000®

Most leading CDMA2000 operators intend to deploy LTE
CDMA Subscribers as of September 2008

<table>
<thead>
<tr>
<th>Region</th>
<th>Subscribers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia Pacific</td>
<td>251,010,000</td>
</tr>
<tr>
<td>North America</td>
<td>145,800,000</td>
</tr>
<tr>
<td>Caribbean &amp; Latin America</td>
<td>52,150,000</td>
</tr>
<tr>
<td>Europe</td>
<td>3,280,000</td>
</tr>
<tr>
<td>Middle East</td>
<td>4,900,000</td>
</tr>
<tr>
<td>Africa</td>
<td>17,620,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>474,760,000</strong></td>
</tr>
</tbody>
</table>

- **Asia Pacific** 52.9%
- **North America** 30.7%
- **Caribbean & Latin America** 11.0%
- **Europe, Middle East, Africa** 5.4%
United States: Carrier Market Share

**CDMA2000 is the dominant technology in the U.S. wireless services market**

**U.S. Subscriber Market Share (Q3 2008)**

- **Verizon**: 32%
- **Sprint**: 28%
- **AT&T**: 19%
- **T-Mobile**: 12%
- **Others**: 9%

*CDMA Market Share is more than 52%*

Source: Chetan Sharma Consulting, August 2008
Global CDMA2000 3G Subscriber Forecast

CDMA2000 Subscribers Worldwide (Cumulative)

<table>
<thead>
<tr>
<th>Year</th>
<th>Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001*</td>
<td>3.7</td>
</tr>
<tr>
<td>2002*</td>
<td>33.1</td>
</tr>
<tr>
<td>2003*</td>
<td>85.4</td>
</tr>
<tr>
<td>2004*</td>
<td>146.8</td>
</tr>
<tr>
<td>2005*</td>
<td>225.1</td>
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<tr>
<td>2006*</td>
<td>325.1</td>
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<tr>
<td>2007*</td>
<td>417.5</td>
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<tr>
<td>2008**</td>
<td>483.5</td>
</tr>
<tr>
<td>2009**</td>
<td>539.5</td>
</tr>
<tr>
<td>2010**</td>
<td>584.8</td>
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<tr>
<td>2011**</td>
<td>630.5</td>
</tr>
<tr>
<td>2012**</td>
<td>669.8</td>
</tr>
<tr>
<td>2013**</td>
<td>700.5</td>
</tr>
</tbody>
</table>

*Source: Actual CDMA Development Group

Global EV-DO Broadband Subscriber Forecast

EV-DO Subscribers Worldwide (Cumulative)

105 million people use EV-DO broadband data services offered by over 120 service providers worldwide

EV-DO created the business case for mobile broadband data services

*Source: Actual CDMA Development Group
**Source: Net growth average of Strategy Analytics (Jun 2008), ABI (Aug 2008), Wireless Intelligence (Jul 2008), WCIS+ (Jul 2008), iGR (Mar 2008) and Yankee Group (Jun 2008) for subscriber forecasts (2008 and beyond) summed with CDG actual numbers of 2008
CDMA2000: The Largest Selection of 3G Devices

Over 2050 CDMA2000 devices have been introduced to the market

- Entry-level Voice-centric Handsets
- Personal Messaging Mobile Phones
- Fixed Wireless Phones
- PDAs
- EV-DO Fixed Wireless Terminals
- Interactive Multimedia CE Devices
- EV-DO PC Cards
- EV-DO USB modems
- WorldMode™ Global Roaming Phones
- Television Phones
- EV-DO PCexpress Embedded Modules for PC Notebooks

More than 625 EV-DO broadband data devices have been commercialized by more than 55 device suppliers

* CDMA450
# EV-DO Rev. A Networks Worldwide

The first IP-based, low-latency, advanced broadband network to be commercialized

<table>
<thead>
<tr>
<th>Company</th>
<th>Location/Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprint</td>
<td>New Zealand</td>
</tr>
<tr>
<td>Telecom New Zealand</td>
<td></td>
</tr>
<tr>
<td>KDDI</td>
<td></td>
</tr>
<tr>
<td>verizon wireless</td>
<td></td>
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<tr>
<td>Chinaunicom</td>
<td></td>
</tr>
<tr>
<td>LG TeleCom</td>
<td></td>
</tr>
<tr>
<td>Bell Mobility (Canada)</td>
<td></td>
</tr>
<tr>
<td>IUSACELL (Mexico)</td>
<td></td>
</tr>
<tr>
<td>Movistar (Venezuela)</td>
<td></td>
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<tr>
<td>Movilnet (Venezuela)</td>
<td></td>
</tr>
<tr>
<td>Bermuda Digital Communications</td>
<td>BDC</td>
</tr>
<tr>
<td>Leap Wireless (USA)</td>
<td></td>
</tr>
<tr>
<td>Bell Mobility (Canada)</td>
<td></td>
</tr>
<tr>
<td>Broadband Everywhere (Philippines)</td>
<td></td>
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<tr>
<td>Itisaluna (Iraq)</td>
<td></td>
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<tr>
<td>MyCell Company Ltd. (Tanzania)</td>
<td></td>
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<tr>
<td>Telesystems or Ukraine</td>
<td></td>
</tr>
<tr>
<td>Arobase Telecom (Cote d'Ivoir)</td>
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<tr>
<td>Mobilkom (Czech Rep)</td>
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<tr>
<td>EOCG</td>
<td>Aruba, Cayman, Netherland Antilles</td>
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<tr>
<td>Sudatel (Sudan)</td>
<td></td>
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<tr>
<td>Telefonica O2 (Czech Rep)</td>
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<tr>
<td>Tatem Telecom (Dem. Rep. of Congo)</td>
<td></td>
</tr>
<tr>
<td>Telesur</td>
<td>Suriname</td>
</tr>
<tr>
<td>Benson Infomatics Ltd. (Tanzania)</td>
<td></td>
</tr>
<tr>
<td>Packet Communications (USA)</td>
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<tr>
<td>Starcomm of Nigeria</td>
<td></td>
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<tr>
<td>Saudi Telecom Company</td>
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<tr>
<td>Telesur (Suriname)</td>
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<tr>
<td>PT Smart Telecom (Indonesia)</td>
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<tr>
<td>Movicel (Angola)</td>
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<tr>
<td>G-Mobile (Mongolia)</td>
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<tr>
<td>NTELOS (USA)</td>
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<tr>
<td>Telkom Kenya Ltd.</td>
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<tr>
<td>Delta Telecom (Russia)</td>
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<tr>
<td>Neotel (South Africa)</td>
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<tr>
<td>Ukrainian Mobile Communications</td>
<td>UMC</td>
</tr>
<tr>
<td>AirVell (USA)</td>
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</tr>
<tr>
<td>Sferia (Poland)</td>
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</tr>
<tr>
<td>Speednet (Belize)</td>
<td></td>
</tr>
<tr>
<td>Visafone (Nigeria)</td>
<td></td>
</tr>
<tr>
<td>Itsaluna (Iraq)</td>
<td></td>
</tr>
<tr>
<td>Itsaluna (Iraq)</td>
<td></td>
</tr>
</tbody>
</table>

*Logo Not Shown: Broadband Everywhere (Philippines), Itisaluna (Iraq) and MyCell Company Ltd. (Tanzania)*

56 commercial Rev. A networks, with 34 in deployment

Most CDMA operators are expected to upgrade to Rev. A

www.cdg.org
EV-DO Rev. A: Value Proposition

Enabling IP-based “advanced” mobile broadband and delay-sensitive services

Increased speeds
- Average download speeds of **600-1400 kbps** with bursts up to **3.1 Mbps**
- Average upload speeds of **350-500 kbps** with bursts up to **1.8 Mbps**

Increased capacity
- Highest spectral efficiency available in the industry – enabling a lower total cost of ownership

Greater bi-directional symmetry

Reduced latency
- Average latency below 50 msec (RTT) – enabling delay sensitive applications, such as VoIP

Low connection set-up times

Advanced Quality of Service (QoS)
- User and Flow-based prioritization to enable different grades of service based on subscription and application

IP-based network connectivity
- Greater service flexibility, network control and seamless service connection
- Increased efficiency driving down total cost savings (up to 30%)

Platinum multicasting
- 1.5 Mbps capacity with > 98% coverage

Backward compatible
EV-DO Rev B: Value Proposition

Higher performance multicarrier solution with greater spectrum flexibility

Aggregates multiple EV-DO channels for higher performance
- Software upgrade to existing Rev A channel cards
- Allows deployment in “hot-zones” with high data demand

Higher broadband data rates
- Peak data rates are proportional to the number of carriers aggregated
  - 2 RFs = 6.2 Mbps, 3 RFs = 9.3 Mbps
- Typical carrier bandwidth is 5 MHz (standard supports up 20 MHz)

Increased (wider) bandwidth
- To support more users per sector or lower cost per megabyte
- To encourage longer usage

Network flexibility
- Allocation of bandwidth for new devices depends on application needs and network availability

Higher capacity
- Improved spectral efficiency on both FL and RL due to multi-carrier transmissions
- Better user experience throughout the cell coverage area

Backward compatibility
- Co-existence of 1X, Rel. 0, Rev. A and Rev. B devices in the same network
- 1xEV-DO Rev A channel cards can be re-utilized
Migration to Mobile Broadband is Accelerating

Migration to EV-DO is being driven by consumer demand and affordable devices

Sources: Net growth average of Strategy Analytics (Jun 2008), ABI (Aug 2008), Wireless Intelligence (Jul 2008), WCIS+ (Jul 2008), iGR (Mar 2008) and Yankee Group (Jun 2008) for subscriber forecasts (2008 and beyond) summed with CDG actual numbers of 2008
LTE Subscriber Forecast

LTE Subscribers by Region
(Forecast: 2010 to 2013)

Sources: ABI Research, January 2009
Evolution of CDMA2000 Roadmap
Mobile Services Evolution

The introduction of mobile technologies is driven by the demand for new services

Adoption of new services drives technological innovation and investments

Source: CDMA Development Group, August 2008
CDMA2000 Roadmap with Next Generation

CDMA2000 will continue to be enhanced to introduce new features

**3G CDMA Evolution Path**

- **CDMA2000 1X**
  - DL: 153 kbps
  - UL: 153 kbps

- **1xEV-DO Rel. 0**
  - DL: 2.4 Mbps
  - UL: 153 kbps

- **1xEV-DO Rev. A**
  - DL: 3.1 Mbps
  - UL: 1.8 Mbps

- **EV-DO Rev. B**
  - DL: 9.3 Mbps
  - UL: 5.4 Mbps

- **EV-DO Enhancements**
  - DL: 14.7 Mbps
  - UL: 5.4 Mbps

- **VoIP**
  - e.g., More than doubles voice capacity

**OFDMA Evolution Path**

- **LTE**
  - DL: 36-147 Mbps
  - UL: 14-72 Mbps

- **Mobile WiMAX (802.16e)**
  - FFR = 1/3/1
  - DL: 35 Mbps
  - UL: 8.2 Mbps

- **Mobile WiMAX (802.16m)**
  - FFR = 1/3/1
  - DL: up to 100 Mbps
  - UL: up to 20 Mbps

---

1. Capacity increase of more than double 35 calls/sector is primarily due to new EVRC-B codec, UL and DL interference cancellation and mobile receive diversity
2. Peak rate for 3 EV-DO carriers with software upgrade; full mobility. Standard supports up to 15 aggregated Rev. A carriers
3. Peak rate for 3 EV-DO carriers with 64QAM in the DL; full mobility. Standard supports up to 15 aggregated Rev A carriers
4. EV-DO Enhancements include Femtocell support, MIMO and 64QAM in the DL and 16 QAM in the UL to enable peak data rates shown within 4 EV-DO carriers; full mobility
5. Based on Reuse = 1/3/1 FFR within 10 MHz TDD channel 2x2 MIMO; DL/UL = 2:1; full mobility
6. Based on baseline requirements; Reuse = 1/3/1 FFR within 20 MHz TDD channel 2x2 MIMO and 64QAM in DL and 1x2 MIMO and 16QAM in UL; DL/UL = 2:1; full mobility
7. Initial baseline requirements are based on 5-20 MHz of bandwidth using OFDMA in the DL and SC-FDMA in the UL, FDD, 64QAM, 2 TX MIMO in DL, and single TX stream in UL; full mobility
Proposed CDMA2000 1X Enhancements

The voice capacity of CDMA2000 1X can be quadrupled by implementing cost effective software upgrades and selectively upgrading to a new radio configuration.

- An EVRC-B vocoder
- Rx Diversity antennas
- Quasi-Linear Interference Cancellation (QLIC)
- Reverse Link Interference Cancellation (RL IC)
- Quasi-Orthogonal Functions (QoF)
- Forward and reverse link early termination
- A reduced power control bit rate
- Efficient closed loop power control
- Smart blanking of 1/8 rate frames

Note: The above is not an all inclusive list of the enhancements that are being considered by 3GPP2.
Proposed EV-DO Enhancements

*EV-DO will be enhanced by implementing cost effective and selective upgrades*

- **Smart Networks:**
  - *Sector load balancing* to increase network capacity
  - *Spatial, frequency* and *time domain load balancing* to achieve spatial isolation
  - *Dynamic resource management* to adapt network resources to fulfill demand
  - *Self-tuning* to dynamically adjust network resources to reduce network operating costs

- **Smart Antennas**
  - *MIMO* and *RL Tx Diversity* to provide higher data rates, improved cell coverage and increased sector capacity
  - *Higher-order Rx Diversity* and *receiver enhancements* designed for burst loading and interference to improve cell edge performance and sector capacity

- **Heterogeneous Network Deployments**
  - Unified operation of macro cells, *picos*, *relays* and *femtocells* to provide low cost network capacity and coverage

- **Control Channel Capacity Enhancements**
  - *New channel cards* for increased spectral efficiency and multi-carrier operations

Note: The above is not an all inclusive list of the enhancements that are being considered by 3GPP2 WG 3
CDMA and OFDM are complementary technologies

Wider-bandwidth OFDM-based broadband networks will complement 3G CDMA

- Backhaul: WiMAX 802.16d
- Broadcast: MFLO, DVB-H, ISDB-T, TDMB, S-DMB, CMMB
- Additional Broadband Capacity: LTE, Mobile WiMAX, WiFi

CDG is enabling interoperability between all these technologies to ensure a seamless user experience.
CDMA2000 and LTE
Network Interoperability
Requirements for Mobility and HO

CDMA2000 and LTE connected systems...

- Shall support terminals with single radio and dual radio solutions.
- Shall support voice service continuity between access networks.
- Shall support bidirectional service continuity between access networks to enable both best effort and real-time applications.
- Shall minimize impact on service quality, e.g. Quality of Service (QoS), reduce interruption times.
- Should minimize the coupling between access networks (e.g. by using transparent signaling through the source system) allowing independent protocol evolution in each access.
- Shall be based on the principles of network controlled radio access mobility.
Core Network Architecture

The Interworking architecture must cover:

- Mobility
- Authentication / Security
- Policy and Charging
- Fixed / Mobile convergence

Current agreed architectures for OFDM-CDMA Interworking

- EV-DO (HRPD) ↔ LTE: based on 3GPP Evolved Packet Core (EPC) (agreed in 3GPP and 3GPP2)

Common Reference Architecture to Accommodate Performance Requirements and Deployment Models for all Technology Pairings
Inter-system Functionalities

**Loose coupling**

a) “Break Before Make” (MBB)

- Little or no inter-system functionalities
- UE-centric L3 mobility based on (P)MIP
- Resources are released in the source system prior to Handover execution
- Service break is significant
- Resources in target system are obtained prior to HO execution directly over target radio interface - “seamless mobility”
- Requires dual radio capability, simultaneous transmit.

b) “Dual-radio MBB”

**Tight coupling**

- Requires inter-system functionalities
- Network-controlled; L3 mobility based on (P)MIP (S101)
- Ability to configure and report measurements of the target system
- Inter-system interface for establishing resources in target system prior to HO execution
- Possibility of data forwarding
- Suitable for single radio devices, but also applicable to dual radio devices
EV-DO is considered a Trusted Non-3GPP Access Technology
# DO (HRPD) and LTE Interworking

<table>
<thead>
<tr>
<th>Responsible Groups</th>
<th>E-UTRAN (LTE)/HRPD - Work item 195</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSG-S</td>
<td>HRPD/1xRTT and LTE Interworking and Inter-Technology Handoff-Stage 1 S.R0129-0 v1.0 (Published)</td>
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<tr>
<td>TSG-A</td>
<td>E-UTRAN to HRPD Handoffs-IOS (A.S0022) (TIA-1142)-expected to be approved in December/January</td>
</tr>
<tr>
<td>TSG-X</td>
<td>X.P0057 in V&amp;V</td>
</tr>
<tr>
<td>TSG-C</td>
<td>Interworking of 1X, HRPD and LTE - C.S0087 in V&amp;V</td>
</tr>
</tbody>
</table>
Principles for Optimised Handovers

Inspired from the A21 interface defined for EV-DO => 1X voice call continuity

Terminal interacts directly with target system (LTE or EV-DO) to perform handover preparation

Source system provides “tunneling” capability (S101) for terminal to interact with target system

In the LTE => EV-DO direction there are two distinct steps

1) **Pre-registration**: when conditions are such that a handover to HRPD may be required, the source system provides the UE with sufficient information to perform pre-registration with the target HRPD access and core network, over the S101 tunnelling interface

2) **HO execution**: if conditions subsequently warrant that a handover should occur, the handover signalling will also be performed over the S101 tunnelling interface, whereas data forwarding takes place on S103

Similar logic applies in the EV-DO => LTE direction

- Except that, pre-registration also triggers the HO execution
Voice Continuity with Legacy CS Domain: OFDM to Circuit Switch (CS) Handoff (HO)

EPC/LTE is Packet Switched (PS) only system

Voice continuity between LTE and 1X Circuit Switched (CS) domain requires a transformation of a VoIP (on IMS) call into CS session and vice versa

Requirement is that there should be minimum impact on the CS domain

The solution to the problem falls in the Voice Call Continuity (VCC) with “single radio hybrid terminal” category

- VCC = Voice Call Continuity between CS domain and PS via IMS
- Because of the similarities with 3GPP2 VCC and 3GPP Rel-7 VCC, the problem is referred to as Single Radio VCC
- Single Radio VCC for LTE-1X is specified in 3GPP TS 23.216
Graceful CDMA to LTE Evolution

Standards alignment, driven by service providers

CDMA2000 core networks with IMS and VCC will play a key role in expanding 3G and 4G deployments

- e.g. Seamless call handoffs between 2G, 3G and 4G networks
- e.g. EV-DO and LTE femtocells

CDMA2000 operators are among the first to deploy wider-bandwidth OFDM solutions:

- Broadcast – DVB-H, MFLO, ISDB-T, T-DMB, CMMB, etc.
- Additional broadband capacity – LTE, Wi-Fi, etc.

CDMA Ecosystem will ensure service continuity will exist between these complementary solutions

IP Core Networks and VCC Bridge Multiple Technologies, including Wi-Fi, Femto, LTE and Mobile WiMAX
CDMA2000 and LTE Device Interoperability
Next Generation Multimode Devices

Next generation mobile broadband devices will leverage the learning curve of CDMA2000 WorldMode™ devices

CDMA2000 operators will be among the first operators to offer next generation mobile broadband services

* WiMAX is enabled using a separate chipset
** MDM 9800 and MDM 9600 chipsets will support FDD and TDD duplex modes and different carrier bandwidths. RF links included will be dependent upon the carrier’s requirements
**Conclusion**

- **EV-DO Rev. A** is creating and validating the business case for next generation mobile broadband technologies.

- **CDMA2000** networks will be complemented by and interoperate with LTE to provide additional broadband access capacity and performance.

- **CDMA2000** interworking with LTE will be enabled by:
  - Common Core Network Architecture – 3GPP/3GPP2 Evolved Packet Core
  - Hand-off control and Voice Call Continuity with CDMA2000 1X
  - CDMA2000 and LTE WorldMode™ devices

- **EV-DO Rev. A/B** will provide a seamless user experience as LTE networks are built-out over time.

- **CDMA2000** operators will among the first to deploy LTE
  - Without having to deploy a GSM/WCDMA network

- **CDMA2000** learning curve will drive LTE penetration with affordable WorldMode devices.