

CDMA

**Enabling WLL Services and
Bridging the Digital Divide**

December 2002

***CDMA is growing rapidly in
the mobile environment***

***But its value is also growing
as an affordable WLL alternative
for wireline voice
and Internet access services***

Current WLL Market Drivers

To offer toll-quality telephony at a relatively low cost basis

To provide universal telephone access

To provide universal Internet access

An affordable alternative to wireline for low teledensity areas

To add a second and third phone line

A temporary service prior to providing wireline services

***CDMA Wireless Local Loop
best satisfies these demands***

and

***lays the foundation for a
smooth migration to new enhanced services
using exciting new devices
(ala 3G)***

CDMA

Has emerged as the Global WLL Standard

"CDMA for WLL is now deployed on every major continent and is emerging as the global WLL standard,"

Wireless Week, August 1999

"CDMA is very good for local access service, the voice quality is excellent... and the coverage is much better than we initially thought."

McClelland, OrangeOne, Australia (majority owned by Hutchinson), July 11, 2000

"Of the various WLL technologies, CDMA is being increasingly deployed in India. This is due to the fact that it scores on the capacity front and the coverage is also much better to the other competing technologies. In fact, with the impending third generation revolution, CDMA, which is emerging as the third-generation digital wireless standard, migration will be much smoother, faster and simplified."

Sudhir Chowdhary, Computers Today (India), Nov. 30, 2000

"[BSNL] has identified the CDMA system as most suitable for WLL connections"

P.P. Ramachandran, Chief General Manager, Kerala Telecom, October 14, 2002

CDMA WLL Operators

More than 50 trials and commercial operations worldwide

North America

Frontier Cellular (U.S.)
Nebraska Wireless Telephone Co. (U.S.)
Unefon (Mexico)
Pegaso PCS (Mexico)
Centennial (Puerto Rico)
Bell Mobility (Canada)

Latin America

Vesper (Brazil)
Empresas Publicas de Medellin (EPM) (Colombia)
SmartCom PCS (Chile)
Tricom (Dom. Republic)
Telgua (Guatemala)
Haitel (Haiti)

Africa

Intercellular (Nigeria)
Starcomms (Nigeria)
Reliance Telecom (Nigeria)
Cellcom (Nigeria)
African Telecommunications Inc. (Dem.Rep. of Congo)
Mauritius Telecom (Mauritius)

Europe

RomTelecom (Romania)
ITC (Ukraine)
Velton Telecom (Ukraine)

Russia

Bashinformsvyaz
Electrosvyaz
JSC Chelyabinsk -- Sviazinform
JSC Electrosvyaz -- Rostov
Kodotel
Kubtelcom
Metrosvyaz
Tech Info Bellum
Tumentelecom

India

Tata Teleservices
Bharti Telenet
Essar/HFCL
Shyam/Hexacom
BSNL/MTNL
Reliance Infocom

Middle East

Kazakh Telecom (Kazakhstan)
Ministry of Communications (Kuwait)
Public Telecommunications Corporation (Yemen)

China

China Telecom
China Unicom (Chengdu)
Shanghai PTA

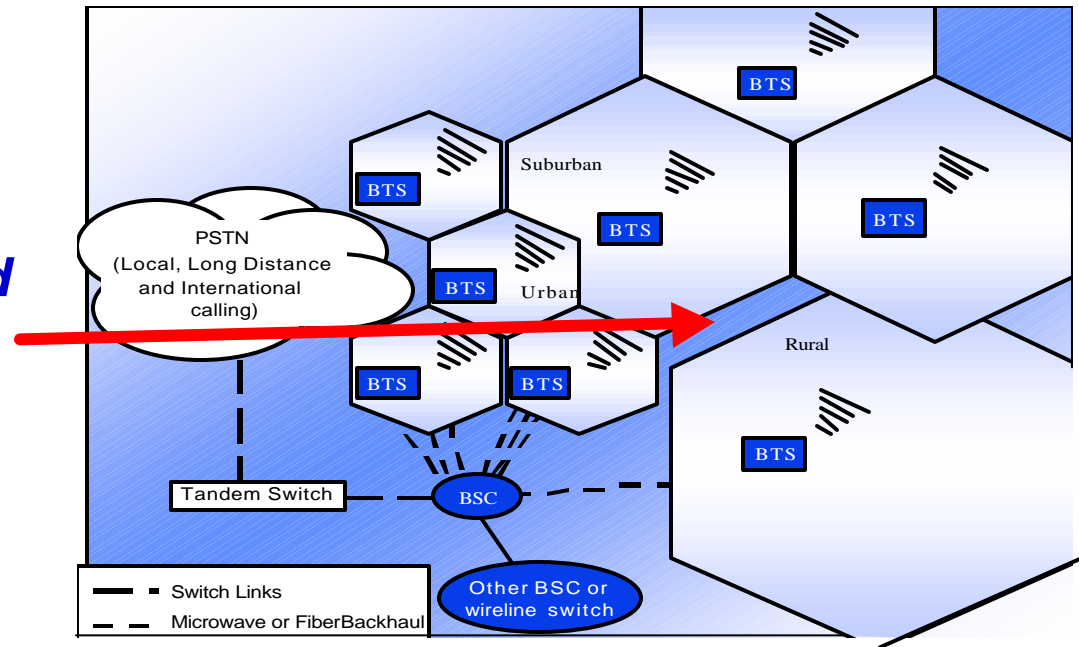
Asia

Indosat (Indonesia)
Konselindo (Indonesia)
Telesera (Indonesia)
Metrosele (Indonesia)
PT Telekom (Indonesia)
Ratelindo (Indonesia)
Telekom Malaysia
Mongol Telecom (Mongolia)
Mobicom (Mongolia)
Myanmar Telecom (Myanmar)
Telstra (Australia)
VNPT (Vietnam)

Serving the world's fastest growing WLL subscriber base

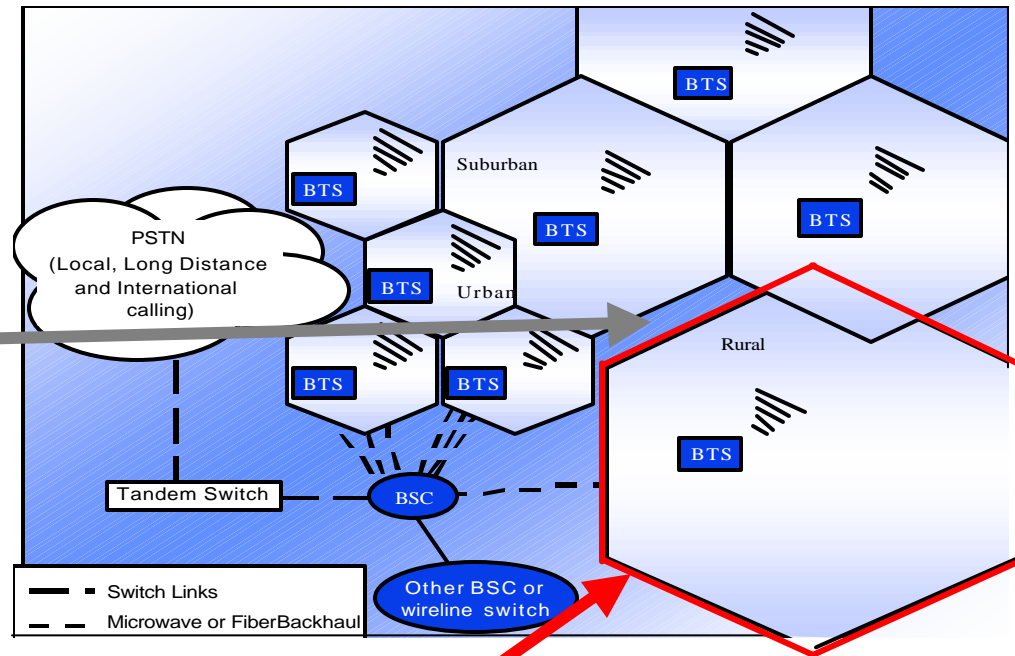
CDMA WLL Network Flexibility

Coverage does *not* need to be contiguous in a CDMA WLL network



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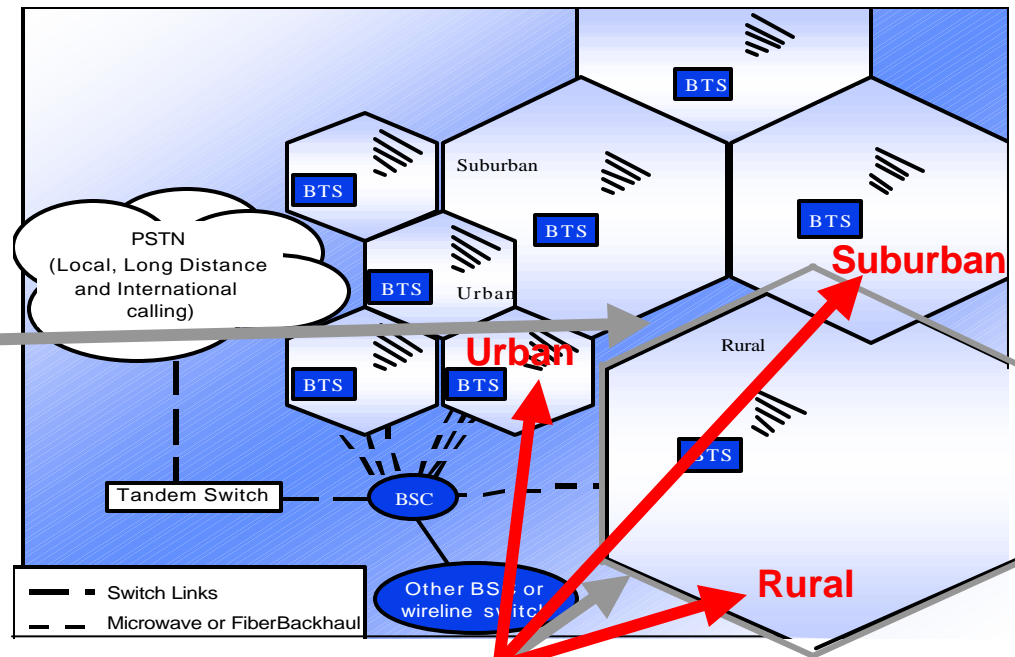


To support regulatory requirements, CDMA WLL services can be "limited" to geographical areas by creating User Zones:

- **Broadcast User Zones:** per sector or cell
- **Mobile Specific User Zones:** per SID, NID, Base-ID, Base LAT or Base LONG

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- *Mobile Specific User Zones: per SID, NID, Base-ID, Base LAT or Base LONG*

CDMA WLL supports both small and large coverage areas

Topology	Antenna Height	Cell Radii	No. of Sectors
Urban	40 m	4.92 km	6
Suburban	40 m	9.38 km	6
Rural	50 m	26.68 km	3

1. Cell Radii is based on using 800 MHz spectrum
2. Nortel's Metro Cell (Boomer Cell) is capable of 100+ km of range

Advantages of Macrocellular CDMA WLL



Lower network costs

- Cost of wireless is dropping precipitously
- Cost of digging trenches for fiber & cable isn't



Lower operating costs

- Cost of maintaining a wireless network is less than a fiber, cable or copper line network

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Enhanced Performance

- Excellent voice quality and security
- Rapid access to Internet
- Low output power
- Improved system reliability
- Less sensitive to environmental disasters
- Optimum spectral efficiency



Rapid user hookup

- Connecting a wireless user is fast & simple
- Self installation is possible
- No truck roll is necessary

Advantages of Macrocellular CDMA WLL

Economies of scale



- Open Standard - not proprietary
- A standardized air interface allows cost reductions due to “off-the-shelf” component availability and mass produced silicon circuits

Economies of scope



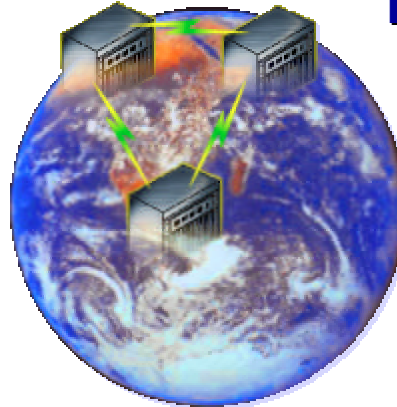
- Mobile/fixed services convergence: easy expansion of WLL network to enable limited and full mobile services
- WLL network equipment and sites are compatible with mobile network equipment
- Easy transition to mobility

Advantages of Macrocellular CDMA WLL



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Flexible network planning

- Increased coverage and capacity
- Flexible (modular) approach to expanding capacity
- N=1 spectrum reuse allows for unexpected growth in demand
- Indifferent to topography and distance



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Faster deployment and quicker ROI

- Dramatically reduced right-of-way approvals
- Shorter per loop installation time

Advantages of Macrocellular CDMA WLL

Toll quality voice



- Enhanced Voice Rate Vocoder EVRC offers highest quality voice at a low 8 kbps rate
- Selectable Mode Vocoder SMV will enhance MOS

Subscriber Equipment



Lower capital expense and financing requirements

- Wireless networks reach break-even point sooner than wireline networks
- Wireline networks will have excess capacity
- Price of subscriber equipment is driven by mobile device market

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High Speed Data

- 3G CDMA enables data rates up to 2.4 Mbps
- Capable of providing wireless ISP services



Subscriber Equipment

Lowest capital expense and financing requirements

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- Wireline networks will have excess capacity
- Price of subscriber equipment is driven by mobile device market

Provides 3G migration path



Backward compatible evolution to 3G services

- Allows multiple 1.25 MHz channel migration to CDMA2000 1x/1xEV
- Migration to IMT-2000 on a common ANSI-41, IP or GSM/MAP platform

CDMA WLL Terminal Vendors



LGIC
LSP-200/2001



Hyundai
HWP-120/221



Synertek
SCW-200W

- **Axesstel**
 - Samsung design
- **Hyundai Curitel**
 - Westech



Telular



Westech
DTP-810/1910



Samsung
SCW-F200

- **Kison**
- **LGIC**
- **Motorola**
- **NEC**



LGIC
LSP-230/2301



Hyundai
HWT-120/220



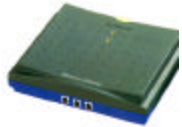
Synertek
HSW-310-s/3100-s



Telular
Phonecell SX4e



Westech
DTT-810/1910



Samsung
SCW-R5000

- **Synertek**
 - Standard Telecom
 - Sewon (Maxom)



LGIC



Hyundai



Synertek
SSW-300-s/3000-s

- **Telular**



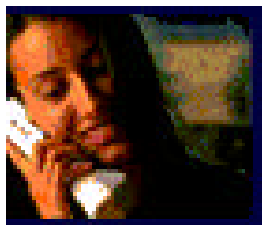
Motorola
FX800C



Motorola
TX800C



NEC



Axesstel
ACW-P800/P1900



Axesstel
ACW-T800/t901



CDMA WLL Connections



Connecting the home and office to the world!



A CDMA WLL Case Study

Telcel (BSI) – WLL Operator in Venezuela

elcel (BSI) - Venezuela



TelcelFijo: Fixed wireless telephony on their 800 MHz network:

- Terminal is financed in 4/5 installments (US\$97-117)
 - 2 terminal models – LG & Hyundai
 - 2 adapters - Motorola & Hyundai
- Prepaid: Local calls US\$0.06/min – no monthly fee.
- With monthly fee: \$15/month, \$0.04/min plus unlimited nights and weekends
- No subsidies



elcel (BSI) - Venezuela



Lessons learned:

- Over 300,000 units sold in 6 months
- Access to a new and different market segment by using fixed wireless terminals
- Prepaid and limited mobility services increased revenues
- Leveraged the investment and capacity of their CDMA network – nationwide coverage
- Upgrading network to CDMA2000 to offer data services



TELCEL

@ BELL SOUTH

Su conexión digital confie



A CDMA “Limited Mobility” Market

CDMA Operators in India

BSNL

MTNL

Tata Teleservices

Reliance Infocomm

BSNL - India



Tarang: Universal Telephone Service

- Launched popular “Tarang” services
 - A big hit with users – very affordable!
- Network: CDMA IS-95A
 - Upgrading to CDMA2000 1X in 2003 – Adding 1.5M lines
- Sales: Adding one phone per minute (per the Ministry)
 - Every village postman to carry a BSNL “limited mobility” phone
- Terminal rental: US\$4.12/month
 - US\$100 deposit
 - 1 year contract
- Cost per Call: US\$0.025 per call (3 minutes)
- Free in-coming calls
- Decision: Expanding service to 80 more cities
- Future: Launching CDMA2000 1X early in 2003 to offer more voice and data services

tarang



Tata Teleservices - India



Mobitel: Mobile wireless in local loop (WLL-M) Service

- Began offering “Mobitel” CDMA2000 1X services in November 2002:
 - Launched service in Karnataka
 - Expanding service to Delhi, Gujarat, Haryana, Punjab, Kerala, Tamil Nadu, Bangalore, Managlore, Hubli, and Dharwad
 - Andhra Pradesh – cdmaOne to be upgraded to 1X
 - Growing WLL-M coverage to 25 cities (50 SDCAs) by mid-2003
- Network: cdmaOne upgrading to CDMA2000 1X
 - Upgrading to CDMA2000 1xEV-DO by end of 2003
- Terminal Rental: US\$4.14/month
 - Activation Fee: US\$20
 - Refundable deposit: \$50 to \$91 (depending on plan)
 - 1 year contract
 - Manufacturers: LG, Samsung, Kyocera, Motorola (Initial order qty. 40,000)
- Cost per Call: US\$0.025 per call (3 minutes)
- Free in-coming calls



Genie: Nationwide Limited Mobility Service

- Launching WLL services in 18 circles by end of December 2002
- Network: CDMA2000 1X
 - Currently 2,550 BTSs and 67 MSC/BSCs
 - Growing to 3,972 BTSs and 83 MSC/BSCs
- Handset Cost:
 - From US\$41.36 to \$82.76 (subsidized)
 - GSM handsets are currently selling for ~ US\$93; replacing GSM phones with free CDMA2000 phones
 - Initial order placed for 3M handsets from LG and Samsung (local manufacturing)
- Potential Growth:
 - Cellular Telephony expected to grow from 8M to 44M subs by 2006
 - 46% CAGR
- **Cost Per Call:** (400 out-going calls): US\$0.008 per call (15 sec pulses)
- **Free incoming calls**
- **Long distance calls at local rates**



Other “Limited Mobility” Operators India & Bangladesh



HFCL

Operating in 4 major cities in India

- Adding 4,000 subs per month
- Upgrading to CDMA2000 1X in 2003



SHYAM TELELINK

Shyam Telelink

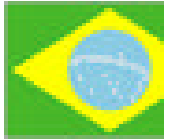
- Private Operator in state of Rajasthan, India
- Operates wire-line, corDECT, GSM & CDMA
 - Upgrading to CDMA2000 1X
 - Investing US\$230M in next 5 years
- Expanding CDMA coverage from 18 to 36 cities in 2003



Pacific Bangladesh Telecom Limited

PBTL

- Operating CDMA in Bangladesh
- Expanding coverage to 28 districts
 - 96K subs as of October 2002
- Upgrading to CDMA2000 1X in 2003



A CDMA WLL Case Study

Vésper – “Mirror” Operator in Brazil



Vésper – Mirror Operator in Brazil

Overview



Operating in 80+ cities, including São Paulo & Rio de Janeiro (high & low density areas)

- Awarded 1.9 GHz WLL spectrum licenses (10 x 10MHz) in 1999, with a challenging deployment timeline
- Purchased mobile licenses in 2002 covering 65 million POPs. Plans to introduce “full-mobility” services leveraging its existing CDMA WLL network → convergence of fixed and mobility services.

Considered various technologies to meet its aggressive deployment requirements:

- Chose cdmaOne: A superior “non-proprietary” solution from Lucent, Nortel and Ericsson. Technology was widely available, standardized, easy to upgrade to 3G, and experiencing the price benefits of scale.

Met aggressive regulatory timeline for basic service with quick CDMA deployment

- From time of license award to contract signing to deployment to commercial operations was ~9 months
- Adopted “plug & play” and retail distribution approach to simplify & quicken subscriber provisioning

Serving approximately 500,000 subscribers - mostly consumer voice services

Began selling WLL terminals (~\$250 FOB each), then introduced “restricted mobility” selling portable/mobile terminals that are much less expensive (~\$95 FOB)

CDMA Enabling WLL Services

Vésper – Brazil

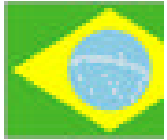
Largest WLL Operator in the World



- STFC license covering over 135 million POPs its two license regions
- Operating in 80+ cities with population of over 200,000, including São Paulo & Rio de Janeiro
- Network was built to capitalize on future converged services with little incremental cos
 - Fixed & mobile
 - Voice & data

Vésper Is a Low-Cost Converged Telecommunications Provider offering Value-Based Services to the Consumer and Corporate Markets

Vésper – Brazil



Executed an Aggressive Deployment Strategy in 1st year

	January 2000		January 2001	
	Residential	Business	Residential	Business
Services¹	<ul style="list-style-type: none"> ◆ POTS ◆ Long distance 	<ul style="list-style-type: none"> ◆ POTS ◆ Long distance 	<ul style="list-style-type: none"> ◆ POTS ◆ Dial up IP ◆ Long distance 	<ul style="list-style-type: none"> ◆ POTS ◆ Dial up and dedicated IP ◆ Long distance ◆ Centrex ◆ Digital trunks ◆ Audio conferencing
Operations¹	<ul style="list-style-type: none"> ◆ Paying subscribers: 0 ◆ 44 cities (ready for service prior to launch) ◆ 45mm pops covered ◆ 23 switches ◆ 371 BTS's (installed within 6 months) ◆ 1,840 employees ◆ 2 NOC's ◆ 2 call centers ◆ 15 warehouses 		<ul style="list-style-type: none"> ◆ Paying subscribers: 275,213 ◆ 80 cities ◆ 68mm pops covered ◆ 32 switches ◆ 850 BTS's ◆ ~1,500 employees ◆ 2 NOC's ◆ 2 call centers ◆ 15 warehouses 	

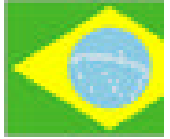
Source: Vésper

Note 1: As of January 1, 2000 to January 1, 2001



Vésper – Brazil

Refining its Strategy to Drive Profitability



Restructured for greater focus and cost management

- In November 2001 QUALCOMM restructured and recapitalized Vésper – leading to an increase in its ownership stake from 16% to 86%
- New management team with restructuring and wireless telecom experience installed
- Reduced operating costs reduced to position the company as a low cost provider of simple telecom solutions

Began offering lower-cost mobile terminals within a “restricted mobility” environment

- In 2002, the regulator approved Vésper petition for low cost “mobile” handsets – allowing the company to support a commercially viable business based on offering portable services that are unique to the market

Migrating to CDMA2000 1X & 1xEV-DO to double voice capacity and offer high-speed data services (up to 2.4 Mbps). Leverage CDMA platform to extend from voice to data



Vésper – Brazil

User Terminal Migration



Vésper Portable
and Vésper Mobile

Vésper Express



Vésper Portable



Restricted Mobility
2002 & Beyond



Mobile
2003 & Beyond



Fixed (WLL)
Through 2001



CDMA Enabling WLL Services

Vesper – Brazil

1xEV-DO: A World of Opportunity



Fixed Broadband Wireless Access

- Dial-up killer: always on high-speed connection
- Targeted coverage
- Easy, self- installation (no cables)
- Portability advantage



Mobile Broadband Access

- Portable Internet access
- e-mail anywhere
- VPN/ Intranet access
- Notebook
- PDA



Handsets

- Richer interactive multimedia services
- TV/ Video on demand
- Video conferencing
- wMoney



Corporate Applications

- Sales Force Automation
- Field Service (i.e. installation, logistics)
- Secure Messaging



wPOS (Point of Sales)

- Credit card/ debit card
- Check verification
- Lottery terminals
- Anywhere with infrastructure limitations



Remote Monitoring

- Vending machines
- Utility meters
- Vehicle tracking
- Inventory tracking
- Alarm systems



Financial Service

- Wireless ATMs
- Home Banking
- Insurance Claims Administration

Fully Functioning, Cutting-Edge 1xEV-DO Commercial Network Operating by End of 2002

Other Considerations

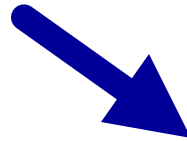
CDMA WLL Experiences Elsewhere

- CDMA is adequately supporting the global objective of *increasing teledensity*
- Governments are realizing that CDMA can support the “*poor man’s phone service*”
- Basic service costs in India are lower than *\$0.01 per minute* using CDMA
- *Significant competition* between North American and Korean vendors is continuing drive costs down... Competition from China is inevitable
- “*Limited mobility*” is being permitted in India... and, is being watched by others
- New and existing operators are deploying *CDMA2000* this year to increase voice capacity (or lower per-minute costs) and meet the demand for data services
- CDMA2000 1xEV-DO allows operators to become a *wireless ISP*

Market Trend: Convergence of WLL and Mobility Networks

Although CDMA WLL offers universal telephony service reliably and affordably, the desire to offering limited mobility services (using mobile devices) will increase as the cost of these competing feature rich mobile devices drop

Fixed environment



Limited mobility

***CDMA WLL offers operators an economical and flexible platform...
and, if permitted, the option to transform their fixed telephony business into
a limited mobility telephony service
as well as a high-speed wireless ISP data service***

The obvious impetus for future growth in WLL

Being able to offer CDMA portable handsets, which are plentiful and affordable!



Future WLL Market Drivers

***In the future...
where **convergence** is fast becoming a key driver...***

***Being able to go beyond voice services
and offer high-speed Internet access,
and (potentially) streaming video
through WLL infrastructure
will become essential to the operator***

CDMA2000 WLL for Voice and Data in a Fixed Environment

CDMA2000 1x & 1xEV WLL will:

- **Double voice** capacity over existing IS-95 systems (~34 Erl/sec/carrier)
- Offer up to **2.4 Mbps** peak data rates for Internet access
- Support a **lower cost per bit** served to compete with:
Cable modems, MMDS/LMDS, xDSL
- Increase **battery standby times** by 50%
- Offer the **highest spectral efficiency** combination possible
- Permit **dynamic allocation of spectrum** to serve different busy hours for voice and data
- Remain totally **backward compatible** with today's IS-95-A/B networks
- Upgradable to provide **mobility** (not possible with cable, xDSL & MMDS/LMDS)
- Continue to provide a **mix** of fixed and mobile solutions

Fixed



Voice

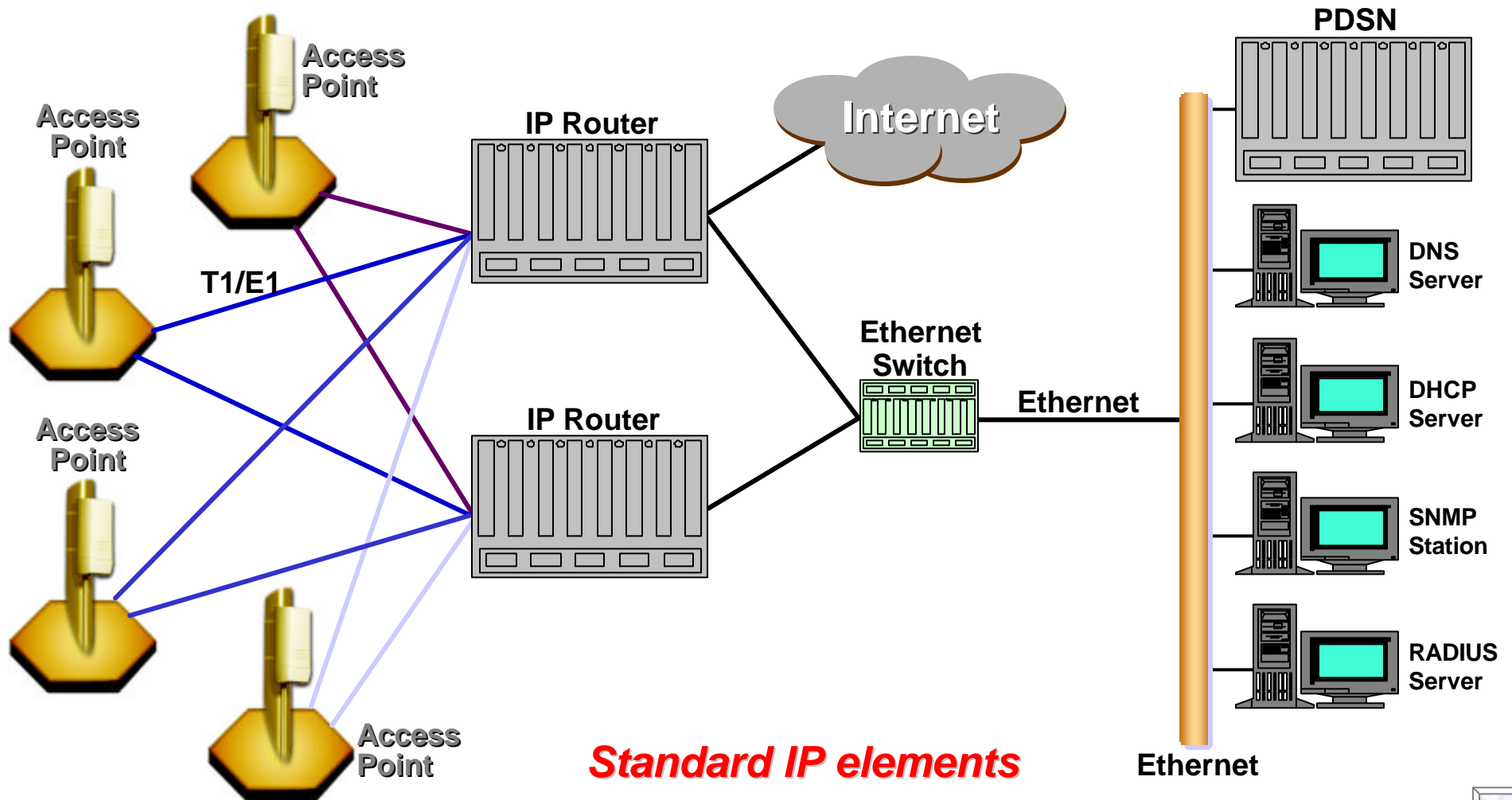


Data



***CDMA2000 1xEV-DO
offers an opportunity to become a
Wireless ISP***

Wireless ISP Network Configuration



Wireless ISP Network Scenario

**1xEV-DO @ 1900 MHz
5 + 5 MHz
Over 10 Years**

Nationwide Coverage: Service area of 45,000 Sq. Km.

	2002	2004	2007	2011
Population	81,980,082	81,819,480	81,579,166	81,259,846
Broadband Penetration	4.4%	13.6%	35.3%	42.0%
Wireless ISP Market Share	3.0%	9.0%	14.3%	15.8%
Subscribers	109,197	998,910	4,106,486	5,392,403
Monthly ARPU	\$45	\$41	\$38	\$35
Data Volume (MB/User/Month)	200	248	337	400

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cumulative 1.25 MHz RF carriers per sector per site	1	1	2	3	3	3	3	3	3	3
Network Site Count	773	995	1,649	2,424	3,216	5,285	5,573	5,790	5,911	6,037

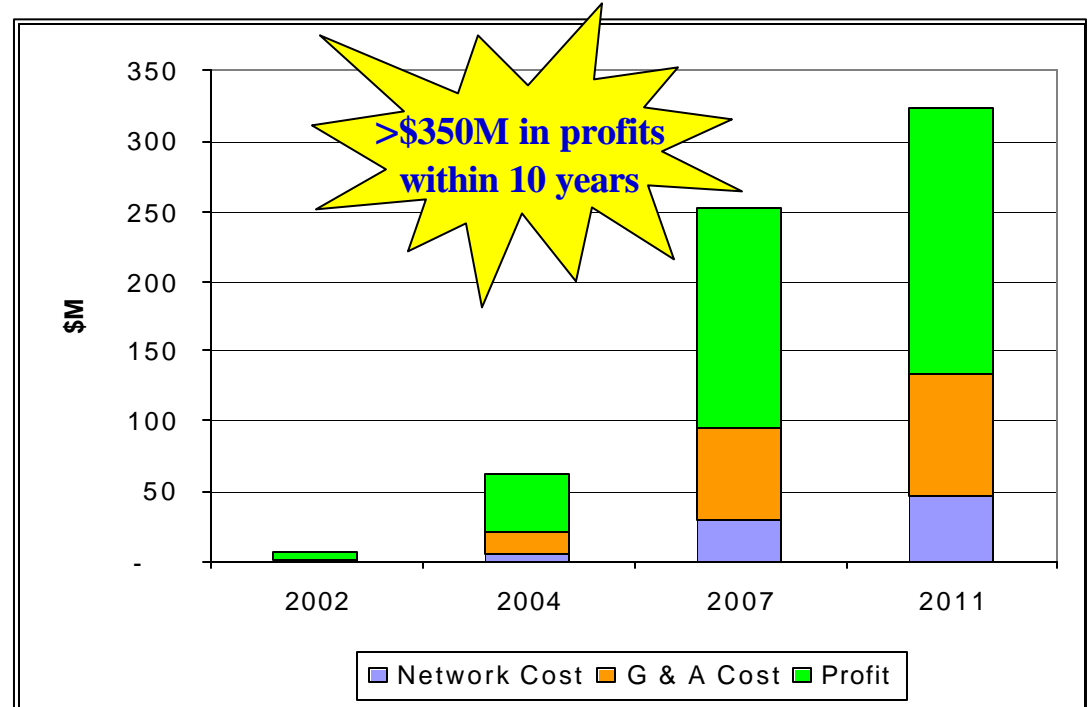
Final Year Economic Results

Wireless ISP Business
CDMA2000 1xEV-DO @ 1900 MHz
5+5 MHz
5.4M Subs paying \$35/mo in year 10

Year 2011

Cumulative Free Cash Flow	\$2,608M
Break Even Point	5 years
Peak Financing	\$139M
Cumulative Capital Expenditures	\$1,701M
Cumulative CAPEX per Sub	\$316
OPEX	\$267M
EBITDA Margin	48%
NPV	\$2,409M
IRR	71%

Year 2011



A CDMA2000 1xEV-DO wireless ISP business is capable of creating more profit than a DSL or Cable Modem business