WHITE PAPER

CDMA2000 FOR WIRELESS IN LOCAL LOOP NETWORKS

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T A B L E O F C O N T E N T S

1. Introduction

Wireless technologies have been deployed in different parts of the world to provide local loop telecommunication services. Compared to traditional wireline (copper) local loop, Wireless Local Loop (WLL) technology solutions can be deployed much faster and at lower cost. In developing countries there has always been strong interest in using WLL technologies to bridge the 'digital divide'.

Choosing the best WLL technology can be a challenging task, given the multiplicity of technologies available in different frequency bands. Many WLL technologies are proprietary, limited to a specific frequency band or only available from a few manufacturers, making it difficult to achieve the economies of scale that will lead to subsequent equipment cost reductions. Moreover, a challenge for WLL technologies is meeting the increasing demand for Internet access and broadband data applications. Not all fixed wireless technologies have been able to deliver Internet access in a cost effective manner, which has led to a limited set of viable WLL options.

Although an operator's choice of a WLL technology may often depend on frequency band allotments, other factors such as infrastructure and handset availability, cost (which mainly depends on volume), spectral efficiency and data services capabilities of the technology also matter. CDMA2000®[1], a 3G mobile communications technology, has been chosen by many operators as a preferred solution for their WLL requirements. The WLL operation is an alternative configuration of this full mobility technology that is in compliance with the regulatory requirements of the country in which it is deployed. The majority of WLL networks in the world are based on CDMA2000 at either 450 MHz or 850 MHz. By offering CDMA2000-based WLL services, the subscriber gets both toll-quality voice and high-speed, broadband data capabilities at the same time.

This white paper is intended to provide a high-level analysis of how CDMA2000 mobile technology and its features can be leveraged successfully in the wireless local loop environment. A region-specific update has been included for all the WLL-based CDMA2000 deployments around the world.

[1] CDMA2000 is a registered mark of the Telecommunications Industries Association (TIA)

2. WLL Technology Selection

Wireless technologies in the local loop can be broadly categorized as cordless (low-range), mobility (macro cellular) or proprietary. Each one of these categories can be positioned for a specific market niche. Cordless-based technologies are basically intended for high-density urban areas due to their short range. Since they require extensive backhaul infrastructure outlays, they have not been very successful in the present-day marketplace. Mobility-based technologies are traditionally positioned for the macro cellular environment, which are well suited for rural areas. They are also used extensively for providing umbrella coverage in urban and suburban scenarios. Proprietary technologies are typically country specific and are intended for service within urban and suburban areas. Some proprietary WLL technologies are positioned for "toll-quality" voice services using low delay ADPCM (adaptive differential pulse code modulation) codecs, while others for high-speed data. But these solutions are “Near Line of Sight” limited, addressing the specialized market niche for a second POTS (Plain Old Telephone Service) line with data rates greater than those available on a typical dial-up line.

The following set of selection guidelines addresses the complex decision making process that WLL operators face when choosing a WLL technology. They are taken from the ITU’s Radio Communication Bureau publication titled “Wireless Access Local Loop (Volume 1) – Handbook on Land Mobile (including Wireless Access),” Chapter 5 (p. 22). These guidelines specifically address the following key factors affecting the technology choice:

- Maturity of the technology
- Scope for knowledge transfer
- Availability of local skills for installation and maintenance
- Ongoing maintenance cost
- Expected level of ongoing support
- Sensitivity to network planning errors and amendments
- Cost of interworking with existing technologies
- Avoidance of being "locked-in" to particular suppliers of technologies
- Extent of "future proofing" provided by the technology

Operators should look at the level of vendor support, competitive pricing, availability of equipment as well as the ability and flexibility of the system to offer both fixed and mobile services (if required) for voice and data. Another important area that both regulators and

consumers have acknowledged is high-speed Internet access. Many studies have shown that access to the Internet is a vital factor in the socio-economic development of any country.

A common myth, especially within markets of low GDP per capita, is that there is no demand for data services. However, we have all seen the emergence of cyber-cafes, tele-centers or Internet parlors in both developing and advanced economies, where any person can pay a nominal fee to use a 'shared' PC to surf the web. (This is very similar to having public call offices for voice). It is obvious that Internet access and data services are transitioning from being an optional service to becoming a mandatory consumer requirement. WLL operators therefore feel the pressure to provide data speeds at least equal to or greater than dial-up services.

In other words, apart from the coverage requirement, WLL networks must meet at least two minimum requirements: sufficient voice capacity to accommodate higher-usage patterns from the local user and data transmission requirements. The ability to provide higher speeds for broadband services, commercial data applications for small and medium-sized enterprises, schools and/or smaller-sized government agencies, such as local police stations and fire stations, places the WLL service provider on a level playing field with advanced telecommunications offerings, such as ISDN, satellite, cable modems or DSL services.

WLL systems can be separated into two main groups: systems operating above 2.4 GHz and systems operating below 2.4 GHz. The technologies that use frequencies above 2.4 GHz are usually able to support data speeds matching ISDN / Cable / DSL services, due to the availability of greater bandwidths. Some of the commonly used frequencies for these technologies are in the 2.4 GHz, 2.5 GHz 3.4-3.6 GHz, 10.5 GHz and higher bands. Multimode Multipoint Distribution Services (MMDS) come under this group of technologies. Technologies operating above 20 GHz include those denominated as Local Multipoint Distribution Services (LMDS). Some of these solutions are available in the market today and are exclusively geared towards data services. In certain cases they can support several Mbps data transmission rates. However the radio coverage, equipment cost and availability are key limitations of these services.

Common air-interface technologies operating below the 2.4 GHz spectrum band include mobile service technologies such as AMPS, TDMA IS-136, GSM, EIA/TIA-95A/B (cdmaOne™), CDMA2000 and WCDMA. These systems are deployed in the 450, 800, 900, 1700, 1800, 1900 and 2100 MHz frequency bands. The other known technologies which have been used are PHS (Personal Handy Phone Service) and DECT (Digital Enhanced Cordless Telecommunication). PHS operates in the 1895-1918 MHz band whereas DECT operates in the 1880-1900 MHz band.

DECT started out as a cordless telephony specification designed for cordless PBXs, used for a company's private communication requirements. DECT is a low-power system and has limited range, typically with 0.25 km cell radius.

PHS systems were also designed for limited mobility or fixed cellular applications. These systems are characterized by low power base stations which makes them better suited to

highly dense urban environments. These systems use the 32 kbps ADPCM vocoder that offers voice quality comparable to wireline and data speeds ranging typically from 32 kbps to 128 kbps.

Cellular technologies are often identified by the wireless generation to which they belong. AMPS, being a first generation technology and used in commercial systems since 1983, has a long history in the industry, but is being phased out of the market. Second generation technologies such as IS-54/IS-136, GSM and EIA/TIA-95 A/B (cdmaOne) have been deployed successfully in different areas around the globe, but have had limitations in terms of voice capacity, voice quality and data capabilities.

Until the deployment of third generation (3G) systems, the above mentioned WLL technology groups were positioned at two different extremes, higher frequency systems with high-data speeds but without mobility, and lower frequency systems with limited data capabilities but with full mobility. 3G technologies, such as CDMA2000 1X and CDMA2000 1xEV-DO (1X Evolution Data Optimized), have combined the flexibility of mobile communication services and high-speed broadband services typically offered by the higher frequency systems, but without the associated deployment complexities.

These 3G technologies bring in a slew of options in the form of CDMA2000 1X and 1xEV-DO that are able to provide WLL services for residential, business and SOHO (Small Office Home Office) customers. CDMA2000 (covered in detail in Section 3) is fully compliant with ITU recommendations and has emerged as the leading option for WLL services among the various possible mobile / fixed wireless technologies (DECT, PHS, TDMA and GSM).

CDMA2000, evolved from EIA/TIA-95 technology, introduces major improvements in the reverse link and implements enhanced vocoding and power control techniques that enable WLL solutions which match or even surpass wireline solutions in terms of capability and life cycle costs. CDMA2000's evolutionary path includes CDMA2000 1xEV-DO Release 0 and Release A as well as CDMA2000 1X Releases C & D, which can deliver 3.1 Mbps on the downlink and 1.8 Mbps on the uplink. Market availability of these new releases is expected by mid-2006. By choosing to deploy CDMA2000, a WLL operator can reap the benefits offered in terms of price, performance, features, evolutionary path, and flexibility in network deployment alternatives.

3. CDMA2000: The Technology-of-Choice for WLL

There is strong and immediate need for readily available and state-of-the-art WLL systems in several developing regions because of the pressures on national governments to fulfill social, economic and political obligations related to tele-density objectives in rural and less developed areas. Providing Internet access through wireline-based dial-up, cable and DSL service, especially in undeveloped or sparsely populated areas, is costly and time consuming. Incumbent and competitive local exchange carriers (LECs), as well as mobile service providers, can provide voice and data services to the subscriber using WLL systems at relatively lower costs and in a shorter period of time.

In emerging markets where PC penetration is low, the ability to support tele-centers or cyber-cafes can constitute an additional revenue source for the operator. This evolution of services from simple dial-up to higher speed (ISDN, cable and/or DSL) has raised the bar at which WLL services are expected to perform. At present, ITU approved and 3G-based CDMA2000 1X and 1xEV-DO networks are the only NLOS WLL / Limited Mobility/ Full Mobility networks that meet the coverage requirements for voice services, while providing comparable or even better data rates than wireline, cable or DSL services.

Key facts about CDMA2000 (Source: www.cdg.org, November 2004):

- 100 operators in 52 countries on 6 continents
- 97 1X and 17 1xEV-DO commercial networks
- Additional twenty 1X and thirteen 1xEV-DO networks scheduled for deployment by the end of 2004
- 700 devices manufactured by 56 vendors
- More than 127 million CDMA2000 (3G) subscribers worldwide by 3Q 04
- More than 226 million CDMA (2G and 3G) subscribers worldwide by 3Q 04

3.1. Technical Superiority of CDMA2000

Many of the shortcomings experienced with traditional WLL networks can be avoided through the use of CDMA2000 WLL technologies. In wireless systems, cell coverage is governed by the law of physics, more specifically by the propagation of the RF signal. PHS and DECT systems located in the 1800/1900 MHz band use spectrum bands similar to PCS systems. But, their relatively low-powered base stations support a smaller coverage area. The PHS standard specifies a maximum base station power output of up to 500mW which is

equivalent to the micro-cell range of a regular mobile system. The typical radius of coverage for a PHS/DECT base station is in the order of 500 meters and the maximum range is in the order of 1.5 km. As a result, the large number of cells and the associated backhaul required for coverage, especially in rural areas, leads to substantial capital and operating costs. Some fixed wireless systems deployed in the 3.4 to 3.6 GHz band can provide cell coverage up to several kilometers by utilizing directive receive antennas on high masts. However, one big drawback of these systems is the line of sight (LOS) requirement which ultimately impacts the number of base stations required and the associated capital and operating costs.

In contrast to these technologies, CDMA2000 WLL systems support a variety of base stations depending on the coverage need. Macro, micro and pico cell sites, which can be deployed in any market (rural, suburban, urban, and dense urban areas), can provide coverage ranging from 10 m to 100 kms. Line-of-sight (LOS) requirement is not an issue given the frequencies at which CDMA2000 operates. In the end, operating in NLOS conditions and also at lower frequencies leads to the deployment of fewer cell sites. This results in faster deployments and lower capital and operating costs.

3.1.1. Competitive Advantages

In addition to the coverage and capacity advantages mentioned in earlier sections and covered in detail in the next two sub-sections of this white paper, CDMA2000-based WLL systems have many other competitive advantages.

Greater Spectral Efficiency: CDMA2000 1X systems offer more than 35 voice channels per sector per 1.25 MHz carrier, making it the most spectrally efficient technology deployed today. Through the use of transmit and receive antenna diversity techniques, the voice capacity can be doubled. Enhanced capacity directly translates to increased spectral efficiency, fewer dropped calls and fewer blocked calls.

Superior Voice Clarity: Based on mean opinion score (MOS) listening tests, CDMA systems offer the best voice clarity. The vocoders used in CDMA systems (13 kbps QCELP, 8 kbps QCELP, EVRC and SMV) are rated better in voice quality tests than the vocoders used by other competing technologies.

Fewer Dropped Calls: Soft and softer handoff techniques and multi-path rake receivers improve the signals received at the Mobile as well as at the Base Station; which significantly lowers the probability of dropped calls in CDMA systems.

Lower Transmission Power: The inherent nature of CDMA spread spectrum technology and its dynamic power control capabilities allows CDMA mobile devices to transmit at lower RF power levels than the mobiles designed for other wireless technologies. This results in enhanced system capacity and longer battery talk time.

Higher Data Throughput Speeds: With CDMA2000 1X systems, users can get peak data rates of 153 kbps with Release 0 and up to 307.2 kbps with Release A . Typical average user

throughput is in the range of 60-100 kbps. With the introduction of presently available 1xEV-DO (Data Optimized) systems, users can receive higher down-link peak data rates of up to 2.4 Mbps with average user throughput of 300-600 kbps and a sector data throughput of 800-1100 kbps per carrier.

Enhanced Global Roaming Capability: With the availability of multi-mode, multi-band CDMA handsets, roaming between CDMA and GSM networks has become feasible. Qualcomm has already developed a multi-technology chipset that supports IS-95 A/B, CDMA2000 1X and GSM / GPRS all in a single baseband chipset. In the near future, these multimode chipsets will include CDMA2000 1xEV-DO, EDGE and WCDMA.

Inherent Voice Security: In CDMA systems, the use of an ESN-based Long code mask (2^ 41 length PN sequence) for voice scrambling provides greater over-the-air privacy and eliminates cloning, cross-talk and eavesdropping.

Data Integrity: Secure data transactions, essential for Corporate VPN access, M-commerce, messaging, etc., are assured using advanced encryption techniques as defined in the standards.

3.1.2. Coverage Advantages

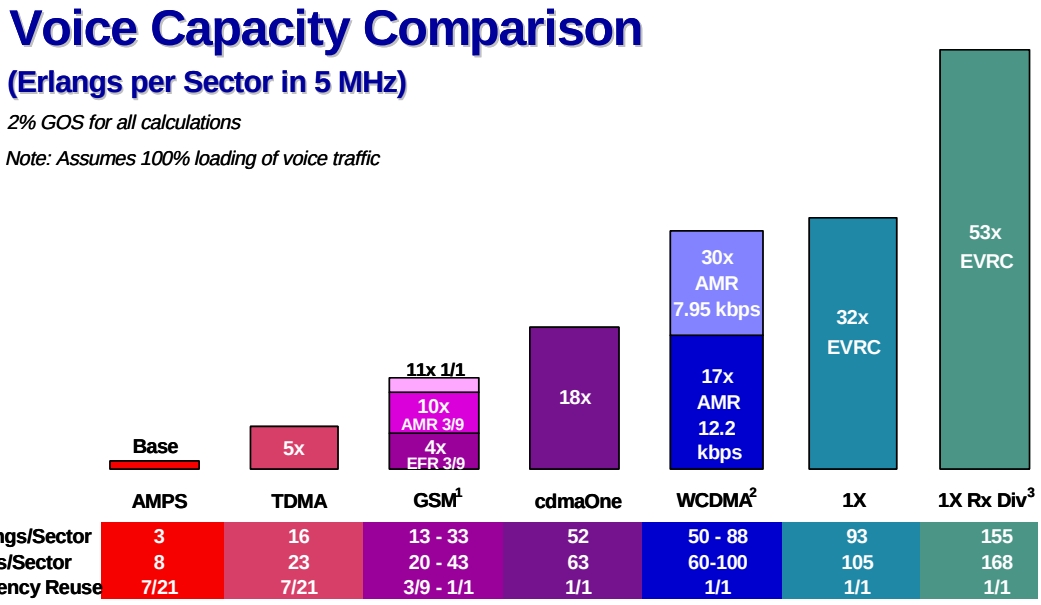
CDMA2000-based WLL systems are readily available in various frequency bands (450, 850, 1700 and 1900 MHz) in the market today. As per the laws of physics, the RF propagation loss is less at the lower frequencies and hence a CDMA2000 WLL base station operating at 450 or 850 MHz can serve a greater coverage area compared to a system operating at 1800/1900/2100 MHz.

Another lesser known coverage advantage of CDMA systems is that the signals are usable even across large distances. In traditional TDMA based systems, as the name denotes, time is used as the multiple access mechanism where traffic and control information is separated into time slots. When signals travel long distances from the BTS to the subscriber terminal, synchronization issues arise. In CDMA systems, the multiplexing of channels is achieved through the use of Walsh codes. These digital codes are not dependent on a time synchronization scheme and permit the encoded signals to travel over longer distances. This allows, with proper planning, the signals to propagate over much larger areas than in TDM-based networks, such as D-AMPS and GSM. Commercial systems in Australia have deployed CDMA cell sites in rural areas whose radii exceed 100 Km. More importantly, this has been achieved without any special modifications to the user terminals. There are several manufacturers who support this type of configuration in their CDMA2000 base station equipment.

3.1.3. Voice and Data Capacity Advantages

Since radio spectrum is a valuable and limited resource, regulators and operators favor spectrally efficient technologies that increase a cellular system's capacity without requiring additional spectrum. Capacity is a critical issue for operators especially when they start introducing data services. CDMA2000 offers significant capacity improvements over existing 2G networks without requiring additional spectrum or deploying additional base stations. Better vocoding and antenna diversity (at both base station and mobiles) techniques provide a cost effective and practical solution that can double the capacity of 3G CDMA systems. With the introduction of advanced vocoders and other receive diversity techniques; one could expect more than 45 Erlangs of voice capacity per sector per 1.25 MHz carrier with CDMA2000 WLL systems.

WLL operators deploying CDMA2000 systems have roughly doubled the voice capacity offered by their EIA/TIA-95 A/B systems and achieved at least 3 to 5 times more voice capacity than that offered by GSM systems. Figure 1 compares the voice capacity between various mobile wireless technologies within a 5 MHz bandwidth.



1. "GSM AMR VOCODERS: FACTS ABOUT INCREASED VOICE CAPACITY", QUALCOMM Internal Paper: Rao Yallapragada
2. "Comparing HSDPA vs R99 Capacity v7", QUALCOMM Internal Paper: Thomas Klingenbrunn
3. "Further Capacity Improvements in CDMA Cellular Systems", QUALCOMM Inc, Roberto Padovani (Calculations based on 1% Blocking)

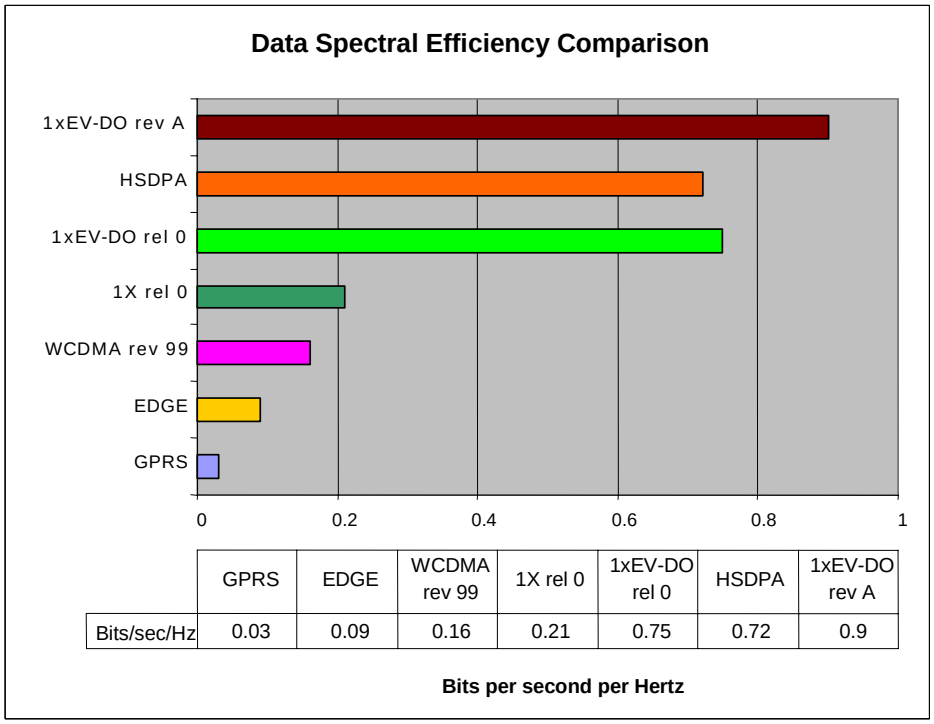
Figure 1: Voice capacity comparison of various cellular technologies

High-speed broadband data capabilities have now become a baseline requirement for WLL networks, and broadband access solutions based on 1xEV-DO are being deployed in the U.S., Eastern Europe, Asia and Australia.

While it has been possible to provide high-speed 'data-only' type services with systems positioned at higher frequencies, such as 2.4 to 2.8 GHz and 3.4 to 3.6 GHz, the commercial success of these systems has been limited due to their lack of voice services and costly deployments in terms of infrastructure and customer premises equipment. In contrast, the business case for Eurotel's fixed wireless 1xEV-DO data only network at 450 MHz showed that this solution could compete successfully in the market place because of the Capex and Opex advantage it had over other systems.

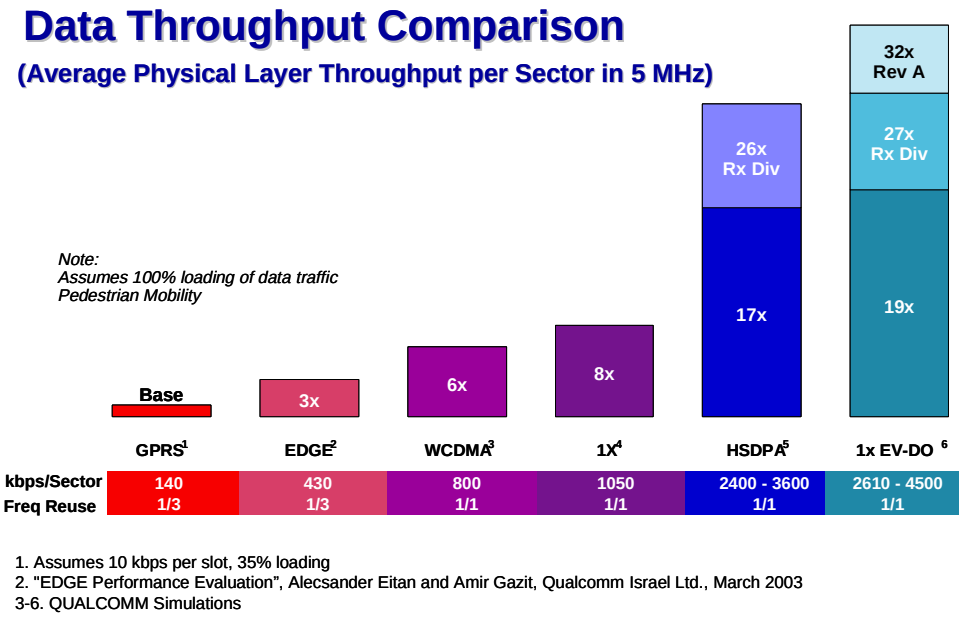
With DECT and PHS systems, it is possible to achieve 64 to 128 kbps data rates by aggregating time slots, but this is achieved by sacrificing voice capacity.

Figure 2 compares the data spectral efficiency and Figure 3 compares the sector throughput capacity for various cellular technologies within a 5 MHz bandwidth.



	GPRS	EDGE	WCDMA rev 99	1X rel 0	1xEV-DO rel 0	HSDPA	1xEV-DO rev A
Bits/sec/Hz	0.03	0.09	0.16	0.21	0.75	0.72	0.9

Figure 2: Data Spectral Efficiency Comparison



1. Assumes 10 kbps per slot, 35% loading
2. "EDGE Performance Evaluation", Alecsander Eitan and Amir Gazit, Qualcomm Israel Ltd., March 2003
3-6. QUALCOMM Simulations

Figure 3: Data Throughput comparison of various cellular technologies

3.2. 3G Services Available Today

CDMA2000 is delivering on the 3G promise today. It has created new opportunities and revenue streams for operators and the entire wireless industry around the world, with more innovation to come in the near future. The acceptance of CDMA2000 by over 140 million subscribers today in Asia, Australia, Europe, North America and Latin America within just three years clearly indicates the demand for new services, devices, and enhanced applications. A broad range of color LCD phones and fixed wireless devices are entering the market. These include Camera phones, Camcorder phones, Video on Demand (VoD) phones, gpsOne enabled phones, Push-to-Talk (PTT) phones and multimedia enabled devices for full and limited mobility use, in addition to intelligent WLL phones for fixed wireless purposes. These new devices, combined with high-speed packet data access, are opening the doors for a broad array of services that deliver greater choice for consumers and enhance the operators' competitive advantage. The wireless consumers' usage and demands have changed dramatically.

The Korean experience demonstrates the increased capabilities of CDMA2000 networks which can enhance the consumer experience and lead to a different business model for the operators. Color screens, synthesized sounds, MP3, cameras, USB connectivity and GPS location are now becoming standard features in user devices. New data-centric applications such as messaging (SMS, EMS and MMS), e-commerce and other financial services,

Internet browsing, navigational assistance and entertainment are becoming increasingly popular.

Although voice services and SMS are still the dominant components of the average revenue per user (ARPU), profits usually increase with the introduction of data services. For example, when Delta Telecom in Russia upgraded their NMT network to CDMA2000, their ARPU jumped from US $10 to US $70. Figure 4 shows data from April 2004 showing the increase in ARPU in KDDI's CDMA network over the previous four years. With the introduction of CDMA2000 1X and BREW, the ARPU jumped from $ 37.53 to $ 72.93. Another jump in the ARPU from $ 72.93 to $ 104.54 happened with the deployment of CDMA2000 1xEV-DO which made hundreds of data-centric applications available to consumers.

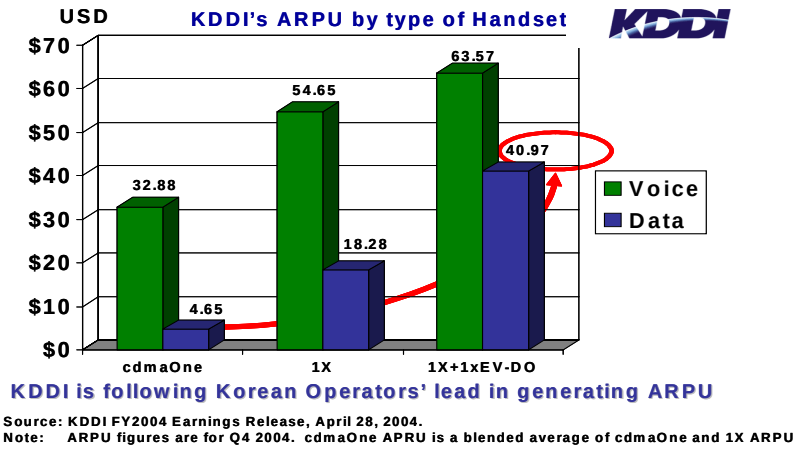


Figure 4: ARPU trend of KDDI, Japan

3.3. Handset / FWT Availability

It has been very difficult to attain economies of scale for most WLL technologies because a large majority of these systems are proprietary in nature. This has had a direct impact on the availability of infrastructure from multiple vendors and selection of subscriber terminals. In contrast to other WLL technologies, CDMA started out as a mobile technology. Since the infrastructure equipment used in mobile and WLL systems is the same and the core components used in CDMA mobile and WLL handsets are common to both, the economies of scale, generated by the large mobile infrastructure equipment and subscriber terminal market, directly benefit WLL operators.

Terminals are an important consideration in technology selection. Depending on the type of customer they plan to serve, operators have to decide whether portable or desktop (or both) will be offered to consumers. Portable or limited mobility units are the equivalent of readily available mobile devices. Desktop units are desk or wall mounted devices that can

plug in multiple regular landline phones and/or a fax. A computer can also be interfaced to the desktop or wall unit via data port or USB interface.

Other types of devices include:

- Data Only devices: PCMCIA cards which can be used in laptops or desktop PCs via adapters.
- Public Payphones: Typically manufactured by the WLL device vendors or sold as kits to retrofit regular landline payphones.

There are many CDMA-based FWT (Fixed Wireless Terminal) manufacturers in the market today. These include Audiovox, Axesstel, Dowtel, Huawei, Hyundai-Curitel, Kison, Kyocera, LG, Motorola, NEC, Synertek, Telular, Westech, ZTE and many other small and medium scale CDMA handset manufacturers. Figure 5 shows the variety of FWTs available in the market.

Figure 5: CDMA2000 1X WLL Terminals

Currently, the price of CDMA-based WLL terminals may vary from US $80 to US $150 depending on the features supported. A feature-rich CDMA2000 1X WLL phone usually includes a USB/RS232 port for Internet and data capabilities, speaker phone for full-duplex hands-free calling, a 3-line dot matrix LCD screen and phonebook capability. Three-way calling, call waiting, call forwarding and 2-way SMS messaging are supported on these phones. Cordless (portable) FWTs are already available (e.g., LG's LSI-110 phone model) and they typically offer about 72 hours of standby time and more than 2 hours of talk time.

4. CDMA WLL Deployments around the World

As of 4Q 2004, more than seventy CDMA-based networks were in commercial operation worldwide. These networks are either fixed wireless, limited mobility or full mobility in nature. Chinese manufacturers Huawei and ZTE have developed low cost CDMA WLL systems for customers in Africa, Asia and Latin America. The cost of FWTs and other related WLL terminals has dropped, encouraging CDMA-based WLL deployments in developing regions. In 2005, we could see more than a dozen new CDMA2000-based Mobile/Limited Mobility/WLL network deployments in Asia, Africa and Latin America.

Until a few years ago, telephones were rare and priced beyond the reach of most people in many developing nations. In these countries, the affordability of a telephone service is still limited to a house and not to an individual. Generally, people in the low and middle income groups prefer fixed wireless service, one for their entire household, compared to a single mobile phone owned by the head of the household. The desktop phone is well suited for use by the entire family, which is another reason why WLL phones are popular in developing countries. A growing number of operators are looking to wireless technologies to rapidly provide thousands of new subscribers with high-quality telephone service at a reasonable price. Existing landline operators can easily extend their network with WLL services. Cellular operators can capitalize on their current network to deliver residential service with WLL. New service providers can quickly deploy WLL solutions to meet a community's telephony and Internet needs.

4.1. Asia / Pacific Region

The Asia Pacific region accounts for a significant portion of the CDMA-based WLL pie. More than two-thirds of the total WLL subscribers are based in this region. India alone accounts for more than 3 million CDMA-based fixed wireless subscribers, and this number continues to grow. The Indian CDMA operators Reliance Infocomm (RIL) and TTSL (Tata Tele Services Limited) are considered to be the top CDMA WLL operators in the world. Each operator has a WLL subscriber base exceeding one million.

Several governments in Asia, and in some cases the regulators as well, encourage mobile wireless operators, especially state-owned telecom operators, to develop rural telecommunications by offering incentives to operators who provide telecom services to rural areas. In India, a special allotment of money through the Universal Services Obligation (USO) funding scheme has been the key enabler in the deployment of a nationwide CDMA WLL network by the state-owned Indian operator BSNL (Bharat Sanchar Nigam Ltd.). BSNL is now upgrading their EIA/TIA-95A network to CDMA2000 in order to provide Internet access and

other data services to their rural subscribers. In the Tibet region of China, mobile as well as fixed wireless phone services are provided through CDMA450 networks.

The table below lists the operators in the Asia- Pacific region who have chosen CDMA for their WLL networks.

CDMA-based WLL Networks in Asia-Pacific Region

India

Bharti Telenet
(Madhya Pradesh)
BSNL
HFCL
MTNL
Reliance Infocomm
Shyam Telecom
Tata Teleservices

Indonesia

Indosat
Mobile 8
MSI 450
PT Telkom
PT WIN
Ratelindo

Greater Asia

Telstra (Australia)
Caspian American Telecom
(Azerbaijan)
Telecom Fiji
Kazakh Telecom (Kazakhstan)
Telkom Malaysia
Mongol Telecom (Mongolia)
Mobicom (Mongolia)
Myanmar Telecom UTL (Nepal)
PTCL (Pakistan)
Telecard (Pakistan)
S Telecom (Vietnam)
Uzbek Telecom (Uzbekistan)
VNPT (Vietnam)

4.2. Latin America

In the last six years, Latin America has made major strides in telecommunications policy and service delivery. A wave of privatization and deregulation across the region has led to a substantial increase in the number of fixed and mobile subscribers. After the Latin American privatization efforts, significant competition in the telecommunication field ensued, particularly in the long distance and mobile wireless arenas. Nevertheless, the region still has a way to go in order to meet the goal of 20 main lines per 100 inhabitants set forth by the ITU in 1992.

Latin America's fixed line teledensity averages around 16%. Three countries (Brazil, Mexico and Argentina) in this region have the bulk of the installed lines, while a majority of the countries are below the regional average. Vivo, Brasil Telecom, Tmais and Vesper provide CDMA-based fixed and mobile wireless services in Brazil. Haitel (in Haiti), EPM Bogotá (in Colombia), Smartcom PCS (in Chile), Tricom (in Dominican Republic) and Bellsouth (in Guatemala & Venezuela) are the other CDMA-based WLL operators in Latin America.

4.3. Rest of the World

CDMA WLL networks have also been deployed in several African countries such as Algeria, Nigeria, Ethiopia, Egypt and the Congo. The table below lists CDMA WLL networks deployed in Africa, the Middle East, Europe, Russia and North America.

CDMA-based WLL networks in Rest of the World

Europe
JSC Interdnestrcom (Moldova)
OSP Polpager (Poland)
TPSA (Poland)
RomTelecom (Romania)
ITC (Ukraine)
Telesystems (Ukraine)
Velton Telecom (Ukraine)

Russia
Bashinformsvyaz
Electrosvyaz
JSC Chelyabinsk -- Sviazinform
JSC Electrosviaz – Rostov
Elikson, Ivtelecom
Kodotel, Kubtelcom
Metrosvyaz
Metrotel
Orskintersvyaz
Pcomm, Petrosvyaz
Rubicon Wireless
Rus SDO, Sibchallenge
Tumentelecom

Africa
Algeria Telecom
Egypt Telecom
Ethiopia Telecommunications Corp.
Bourdex (Nigeria)
Intercellular (Nigeria)
Multi-Links (Nigeria)
Starcomms (Nigeria)
Reliance Telecom (Nigeria)
Cellcom (Nigeria)
AfriTel (Dem.Rep. of Congo)
Mauritius Telecom

North America
Bell Canada
Centennial de Puerto Rico
Telefonica Moviles (Mexico)
Unefon (Mexico)

Middle East
Ministry of Communications (Kuwait)
PTC (Yemen)
Yemen Telecom

5. Conclusions

CDMA2000 WLL networks are rapidly gaining acceptance as one of the most efficient ways to provide telecommunication services. There are numerous advantages when deploying CDMA2000-based systems for WLL services:

- Mature technology with flexible network planning
- Same network can provide full mobility, limited mobility and fixed wireless type of WLL services
- Economies of scale in terms of infrastructure and terminals
- Propagation advantage in terms of frequencies / spectrum being used
- Data services with broadband facility available through evolutions such as CDMA2000 1xEV-DO
- High capacity networks that allow efficient use of the available spectrum
- Availability of equipment in many frequency bands by many vendors
- Availability of excellent outdoor as well as indoor coverage
- Open standards and 3G compliant per the ITU's IMT-2000 standards
- Lower cost for interworking with other existing mobile technologies
- Smooth evolutionary path with "future proofing" and preservation of Capex

With more than seventy CDMA-based WLL networks commercially operating in many countries, these networks are being recognized for their excellent coverage, voice quality, high data rates and wide variety of handsets. The growth of these networks in developing nations has increased their tele-density, provided Internet access and offered "state-of-the-art" telecom facilities to underserved consumers in rural and remote areas.

6. References

[1] "Recommended Minimum Performance Standards for Base Stations Supporting Dual- Mode Wideband Spread Spectrum Cellular Mobile Stations," TIA/EIA IS-97

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Glossary

1xEV-DO	1X Evolution Optimized
1xEV-DV	1X Evolution Data and Voice
3G	Third Generation
ADPCM	Adaptive Differential Pulse Code Modulation
AMR	Adaptive Multi Rate
ARPU	Average Revenue Per User
BREW	Binary Run time Environment for Wireless
BTS	Base Station Transceiver
BWA	Broadband Wireless Access
CDMA	Code Division Multiple Access
CT-2	Cordless Telephony-2
D-AMPS	Digital Advanced Mobile Phone Service
DECT	Digital Enhanced Cordless Telecommunications
DSL	Digital Subscriber Line
EDGE	Enhanced Data Rates for GSM Evolution
EMS	Enhanced Messaging Services
ESN	Electronic Serial Number
EVRC	Enhanced Variable Rate Codec
FWA	Fixed Wireless Access
FWT	Fixed Wireless Terminal
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile
HSDPA	High Speed Downlink Packet Access
IS	Interim Standard
ISDN	Integrated Services Digital Network

ITU	International Telecommunications Union
LEC	Local Exchange Carrier
LMDS	Local Multi-point Distribution Service
LOS	Line Of Sight
MMDS	Multi-channel Multi-point Distribution Service
MMS	Multimedia Messaging Service
MOS	Mean Opinion Score
MS	Mobile Station
NLOS	Non Line Of Sight
OTD	Orthogonal Transmit Diversity
PCMCIA	Personal Computer Memory Card International Association
PCS	Personal Communication Service
PHS	Portable Handy phone System
POTS	Plain Old Telephone Service
PTT	Push To Talk
QCELP	Qualcomm Code Excited Linear Prediction
RF	Radio Frequency
SOHO	Small Office Home Office
SMS	Short Message Service
SMV	Selectable Mode Vocoder
STS	Space Time Spreading
TDMA	Time Division Multiple Access
UMTS	Universal Mobile Telecommunications System
USO	Universal Services Obligation
VOD	Voice On Demand
VPN	Virtual Private Network
WCDMA	Wideband CDMA
WLL	Wireless in Local Loop