Anritsu

Must-Have Reference

For Wireless Communication

The Must-Have Reference for Wireless Communication

This reference will help you understand the terminology associated with wireless telecom and data communications to let you make more informed decisions about new technology, products, and services. In addition, it shows which Anritsu products provide test and measurement solutions in each area.

Wireless Telecom Technology (Part 1)

Wireless Technology	**CDMA IS-95**	**cdma2000® 1xRTT**	**cdma2000 1xEV-DO**	**cdma2000 1xEV-DV**	**TDMA**
Wireless Standard	TIA/EIA/IS-95A, TIA/EIS IS-95B	TIA/EIA/IS-2000 www.3gpp2.org	TIA/EIA/IS-856 www.3gpp2.org	TIA/EIA/IS-2000 Releases C & D www.3gpp2.org	TIA/EIA-136 www.tiaonline.org
US Operators	Verizon Wireless Sprint PCS	Verizon (“National Access”) Sprint PCS Leap Wireless	Verizon (“Broadband Access”)	Sprint (planned)	AT&T Cingular T-Mobile
Upgrade Path	cdma2000 1xRTT	cdma2000 1xEV-DO			GSM GPRS EDGE
Frequency Range	824-925 MHz 1750-1990 MHz	411-493 MHz 824-925 MHz 1750-1990 MHz	(same as 1xRTT)	(same as 1xRTT)	824-894 MHz 1850-1990 MHz
Channel Bandwidth	1.23 MHz or 1.25 MHz	1.23 MHz or 1.25 MHz	1.23 MHz or 1.25 MHz	1.23 MHz or 1.25 MHz	30 kHz
Data Rate	14.4 kbps	144-307 kbps	700-2.4 Mbps	3.09 Mbps max	9.6-19.2 kbps
Generation	2G (IS-95A) 2.5G (IS-95B)	2.5G	3G	3G	2G
Relevant Anritsu Test and Measurement Products					
Mobile Unit or Base Station	MS8608A MS8609A MS2681A/83A/87B MS2721A MS2711D MT8212B S332D	MS8608A MS8609A MS2681A/83A/87B MS2721A MS2711D MT8212B S332D	MS8608A MS8609A MG3681A ML2480A MS2681A/83A/87B MS2721A MS2711D MT8212B S332D	MS2721A MS2711D MT8212B S332D	MS8608A MS8609A MS2681A/83A/87B MS2721A MS2711D MT8212B S332D
Mobile Unit Only	MT8801C MT8802A MT8820A CRCA Software MA8120A	MT8801C MT8802A MT8820A MA8120A	MT8820A MA8120A	MA8120A	MT8801C MT8802A CRCA Software MA8120A

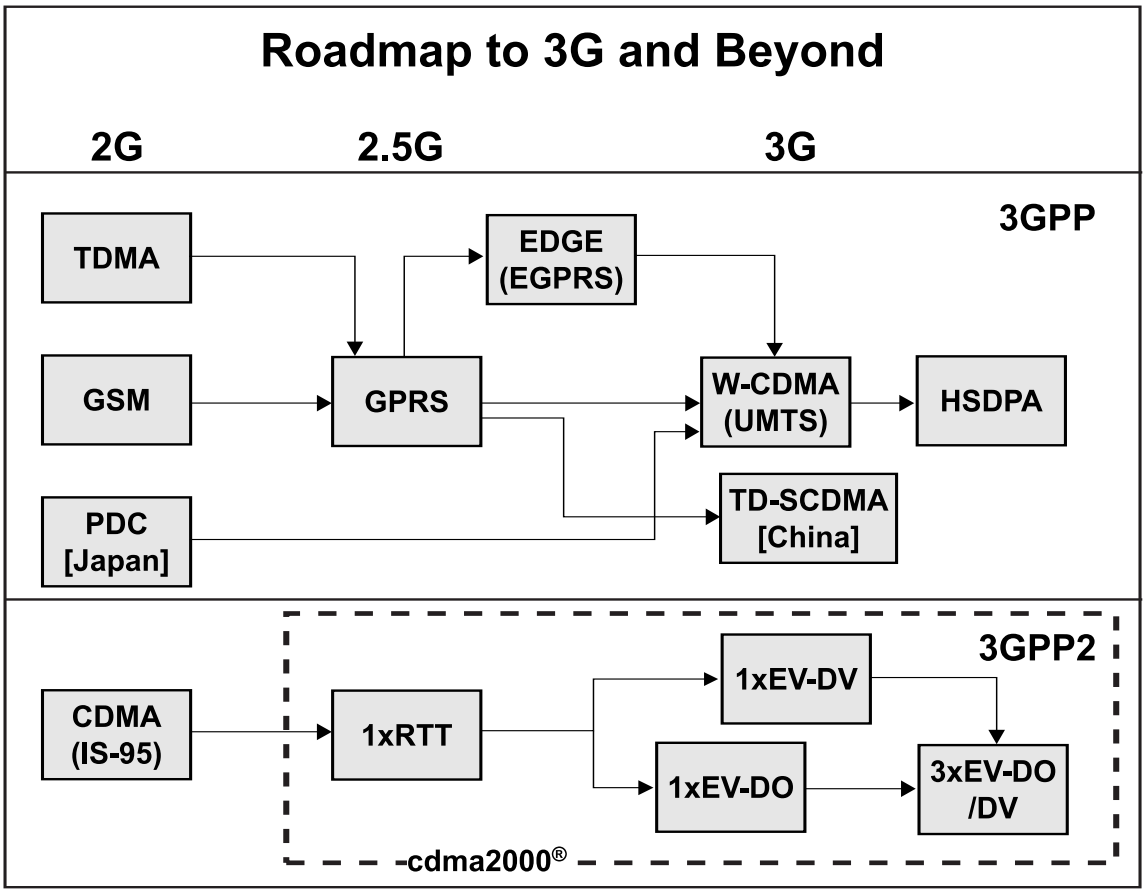
cdma2000® is a registered trademark of the Telecommunications Industry Association (TIU-USA).
When applied to goods and services, the cdma2000® mark certifies their compliance with cdma2000® standards.

Wireless Telecom Technology (Part 2)

Wireless Technology	GSM	GPRS	EDGE (EGPRS)	W-CDMA (UMTS)	HSDPA
Wireless Standard	GSM 01.01 version 8.0.0 Release 1999 www.3gpp.org	GSM 01.60 version 6.0.0 www.3gpp.org	3GPP TS 43.051 version 5.9.0 Release 5 www.3gpp.org	3GPP Release 99 www.3gpp.org	3GPP Release 5 www.3gpp.org
US Operators	AT&T Cingular T-Mobile	AT&T Cingular T-Mobile	AT&T Cingular T-Mobile	AT&T (planned for late 2004)	
Upgrade Path	GPRS EDGE W-CDMA	EDGE W-CDMA	W-CDMA	HSDPA	
Frequency Range	450-486 MHz 824-894 MHz 876-960 MHz 1710-1880 MHz 1850-1990 MHz	450-486 MHz 824-894 MHz 876-960 MHz 1710-1880 MHz 1850-1990 MHz	450-486 MHz 824-894 MHz 876-960 MHz 1710-1880 MHz 1850-1990 MHz	824-894 MHz 830-885 MHz 1710-1880 MHz 1710-2155 MHz 1850-1990 MHz 1920-2170 MHz	824-894 MHz 830-885 MHz 1710-1880 MHz 1710-2155 MHz 1850-1990 MHz 1920-2170 MHz
Channel Bandwidth	200 kHz	200 kHz	200 kHz	5 MHz	5 MHz
Data Rate	9.6-19.2 kbps	44-171.2 kbps	384 kbps max; 120 kbps typ eff throughput	144 kbps-2 Mbps max; 384 kbps typ	14 Mbps max; 10.8 Mbps max eff throughput
Generation	2G	2.5G	2.5G+	3G	3.5G
Relevant Anritsu Test and Measurement Products					
Mobile Unit or Base Station	MS8608A MS8609A MS2681A/83A/87B MS2721A MS2711D MT8212B S251C S332D	MS8608A MS8609A MS2681A/83A/87B MS2721A MS2711D MT8212B S251C S332D	MS8608A MS8609A MS2681A/83A/87B MS2721A MG3681A ML2480A MS2711D MT8212B S251C S332D	MS8608A MS8609A MS2681A/83A/87B MS2721A MG3681A ML2480A ML8721B (BS only) MS2711D MT8212B S332D	MS8608A MS8609A MG3681A MS2721A
Mobile Unit Only	MT8801C MT8802A CRCA Software MT8820A MA8120A	MT8820A MA8120A	MT8820A MA8120A	MT8820A PTS Software RTD Software MD8480B MA8120A	MA8120A

Wireless Datacom Technology

Wireless Technology	IEEE 802.15 Bluetooth	IEEE 802.11a Wi-Fi	IEEE 802.11b Wi-Fi	IEEE 802.11g Wi-Fi	IEEE 802.16a WiMax
Wireless Standard	www.bluetooth.org	www.ieee.org/11	www.ieee.org/11	www.ieee.org/11	www.ieee.org/16
Frequency Range	2.4 GHz	5.150-5.825 GHz	2.4 GHz	2.4 GHz	2-11 GHz
Channel Bandwidth	1 MHz	20 MHz	10-30 MHz	25 MHz	1.25-20 MHz
Max Link Length	10 m	60-100 ft	150-300 ft		31 mi
Data Rate	1 Mbps	54 Mbps max; 1-2 Mbps throughput common	11 Mbps max; 8-10 Mbps throughput common	54 Mbps max	70 Mbps
Relevant Anritsu Test and Measurement Products					
Mobile Unit or Base Station	MS2681A/83A/87B ML2480A MT8850A MT8852A ME7865A MA8120A	MT8860A MS8608A MS8609A MS2681A/83A/87B MS2721A ML2480A S332D+FCN4760 MS2711D+FCN4760	MT8860A MS8608A MS8609A MS2681A/83A/87B MS2721A ML2480A MS2711D MT8212B S332D	MT8860A MS8608A MS8609A MS2681A/83A/87B MS2721A ML2480A MS2711D MT8212B S332D	MS2721A
Mobile Unit Only	[Not applicable]		MA8120A	MA8120A	MA8120A



Terms and Mnemonics

Note: Some of the terms referenced in these explanations are not limited to wireless applications, and thus are explained in Anritsu Company's "Must-Have Reference For IP and Next Generation Networking", which you can download at www.us.anritsu.com/musthave.

1G – First Generation Cellular Wireless

The first generation of cellular wireless (1G) was based on analog technology. The systems were designed only to carry voice technology.

1xEV-DO – 1x Evolution Data Only

1xEV-DO (cdma2000) is a 3G mobile standard that delivers a peak data rate of 2.4 Mbps using just 1.25 MHz of spectrum. This is the next Evolution of cdma2000, intended to provide powerful data transmission capabilities for mobile phones. This upgrade to cdma2000 requires a second 1.25 MHz channel that is used exclusively for data. Most cdma2000 network operators are expected to combine 1x and 1xEV-DO channels in their systems to provide varying voice and data capacities as required by customer demand. Qualcomm is driving this standard. Verizon began deploying 1xEV-DO service trials in late 2003.

1xEV-DV – 1X Evolution Data and Voice

1xEV-DV (cdma2000) is a 3G mobile standard that promises to provide data-rate speeds of 1.2 Mbps for mobile users, with peak data speeds up to 5.2 Mbps for stationary users. This standard will integrate voice and simultaneous high-speed packet data multimedia services. Nokia and Motorola are backing this standard. Sprint has proposed this service for 2005-2006.

1xRTT

1xRTT (cdma2000), the next generation of standard CDMA, offers between 1.5 and 2 times the number of voice channels as a standard CDMA system, peak data rates of 153 kbps and backwards compatibility with cdmaOne networks. 1x stands for one times 1.25 MHz carrier, as used in 2G CDMA. RTT stands for Radio Transmission Technology. cdma2000 1x is 21 times more efficient than analog cellular and 4 times more efficient than TDMA networks.

2G – Second Generation Cellular Wireless

2G cellular wireless technology converts voice to digital data for transmission over the air and then back to voice. Most 2G systems provide 9.6-14.4 Kbps circuit-switched data service.

2.5G – Second Generation + Cellular Wireless

2.5G refers to technology that is added to a 2G network to provide packet-data service. In practice, 2.5G is synonymous with the GPRS technology that has been added to GSM networks.

3G – Third Generation Cellular Wireless

3G systems have been designed for both voice and data. By International Telecommunications Union (ITU) definition, 3G systems must provide a minimum of 144 kbps packet-data service.

3GPP – Third Generation Partnership Project

3GPP is a global body dedicated to developing 3G specifications. In 1997-98, Nokia was active in establishing 3GPP as the organization for developing global 3G standards based on W-CDMA technology. Specifications for W-CDMA radio access networks were rapidly established and in 2000, Nokia promoted the transfer of GSM/EDGE standardization to 3GPP. The first commercial W-CDMA products were released based on the 3GPP Release99. Standardization continues with Releases 4, 5 and 6.

3GPP2 – Third Generation Partnership Project 2

3GPP2 is a collaborative Third Generation (3G) telecommunications specification-setting project comprising North American and Asian interests on the development of the next generation cdma2000 wireless communications. 3GPP2 is largely based on Qualcomm cdma2000 product standards.

3GSM

3GSM is another name for the W-CDMA 3G standard. (See 3G.)

3GSP – 3G Service Provider

A mobile operator that has a 3G license to provide 3G services to customers.

3xEV-DO/DV – 3X Evolution Data Only/Data and Voice

Enhanced versions of 1XEV-DO or 1xEV-DV with three channels of data/voice. The details of 3xEV are unclear, and this service is likely 4-5 years in the future.

802.11 – Wireless LANs (Wi-Fi)

802.11, known as Wi-Fi, define standards for wireless LANs (WLANs) and was approved in July '97. WLANs provide half-duplex (not simultaneous bidirectional) connections that are shared, not switched. IEEE 802.11a and 802.11b (standardized in September '99) and 802.11g (standardized in mid-2003) define different physical layer standards for WLANs, and the 802.11 standard offers no provisions for interoperability between these physical layers. Microsoft certification applies to both 802.11a and 802.11b. The IEEE 802.11 Working Group page has helpful information. Toshiba said it shipped the industry's first laptop PC with built-in dual 802.11a/b connectivity in December '02. By the end of 2003, unit shipments of 802.11g interfaces surpassed shipments of 802.11b and continue to grow while 802.11b shipments decline.

The Wi-Fi Alliance (www.wi-fi.org), previously known as WECA, promotes the standard, tests products for interoperability, and awards the "Wi-Fi" mark to those that past. Wi-Fi Alliance certified over 500 products by November '02.

Security is one of the biggest issues with wireless LANs - see WPA and WEP, as well as 802.11i.

802.11a

802.11a operates at 5 GHz and provides data rates up to 54 Mbps using OFDM (Orthogonal Frequency Division Multiplexing) modulation, like European digital TV. 802.11a supports a maximum of 24 unique connections per access point, far more than the three connections supported by 802.11b and 802.11g. Compared to 802.11b, 802.11a offers higher (2X-5X) theoretical throughput, more available frequencies, avoiding multipath echoes, but shorter range (60-100 feet). Actual throughput at typical operating distances is often only 1-2 Mbps. 802.11a products did not become available from most U.S. vendors until early 2002.

802.11b

802.11b operates at 2.4 GHz (along with cordless phones and microwave ovens) and provides theoretical data rates up to 11 Mbps over links of 150-300 feet using Direct Sequence Spread Spectrum (DSMM) modulation. Actual throughput is typically never more than 5 Mbps. 802.11b supports a maximum of three unique connections per access point, and 802.11b-compatible products were the first ones to become available in the U.S. Regarding 802.11a vs. 802.11b, Wi-Fi Planet has a helpful paper on making choices and Linksys has helpful information on the technical differences.

802.11e

Provides QoS (Quality of Service) that will be important for voice and multimedia transmission by describing error correction and bandwidth management to be used in 802.11a and 802.11b. There are two versions. EDCA (Enhanced Digital Control Access) mode, called WME (Wireless Multimedia Extensions), will become available first with certification testing planned starting September '04. WME defines eight levels of access priority and provides more access to higher priority packets than to lower-priority packets but provides no bandwidth guarantees, and is probably best suited for one-way audio. HCCA (HCF Coordinated Channel Access), also known as WSM (Wireless Scheduled Multimedia), is a polled access method that includes WME and provides guaranteed bandwidth scheduling reservations. WSM, with certification testing planned starting December '04, is probably best suited for two-way streaming voice and video. The IEEE now expects to ratify 802.11e in early 2005.

802.11g

802.11g is an extension to 802.11b to provide data rates up to 54 Mbps while operating at 2.4 GHz like 802.11b but using OFDM modulation like 802.11a. Products are expected to have RF interference problems similar to 802.11b. Like 802.11b, 802.11g supports a maximum of three unique connections per access point. The IEEE approved the specification in June '03, and the first products claiming compatibility with the draft standard shipped in January '03. In July '03 the Wi-Fi Alliance completed successful interoperability testing of the first products. 802.11 Planet has a helpful tutorial comparing 802.11a with 802.11g.

802.11h
Defines processes that 802.11a systems can use to comply with ITU recommendations for avoiding conflict with other users of the 5 GHz spectrum such as military radar systems. These processes include DFS (Dynamic Frequency Selection), for using channels uniformly and avoiding channel conflict; and TPC (Transmit Power Control), for reducing the radio transmit power of Wi-Fi devices.

802.11i
A standard approved in June '04 that provides security enhancements based on WPA, TKIP, and AES. AES is the new U.S. Government data encryption standard and is far more secure than WPA, the previous 802.11 security mechanism. 802.11i incorporates key management and authentication, and may eventually replace WEP and WPA for WLAN security. The Wi-Fi Alliance planned to start certifying 802.11i products in September '04 under the name "WPA2", indicating that the security is enhanced relative to WPA.

802.11n
A standard in development to provide WLANs with at least 100 Mbps throughput, measured at the interface between the 802.11 media-access control (MAC) and higher layers. The IEEE began debating various proposals in September '04 with likelihood of ratifying a standard in 2006 or 2007. 802.11n is expected to be founded on Multiple-Input Multiple-Output technology (see MIMO). TGn Sync and WWiSE are alliances of major companies with proposals for this standard; see WWiSE and TGn Sync.

802.11p
A working group that is developing extensions applicable to automobiles in the 5.9 GHz spectrum allocated to vehicles. Considerations include better security, mobile operation, identification, and a more sophisticated handoff system. 802.11p will be the basis of DSRC (Dedicated Short Range Communications), a system intended for communications from one vehicle to another or to a roadside network. See DSRC.

802.15 – Wireless Personal Area Networking (WPAN)

The IEEE Wireless Overview Web site is helpful to explain what is happening in this area.

802.15.1 - Bluetooth
A standard defining wireless networking with a 1 Mbps data rate that operates at 2.4 GHz over a range of up to 10 meters. Bluetooth is intended for short-range links between computers, personal digital assistants, mobile phones, printers, digital cameras, keyboards, and other PC peripherals. The 1 Mbps data rate is a serious limitation that prevents this technology from acting as a USB replacement except for very low-speed peripherals such as keyboards. The Bluetooth.com and Bluetooth.org sites have helpful information.

802.15.3 and .3a
Project group planning high rate WPANs with 10-500 Mbps data rates. Ultra wideband is a key technology being considered here (see UWB).

802.15.4 - ZigBee
This addresses the low cost and low power needs that remote monitoring and control and sensory network applications have, including the ability to run for years on standard batteries. These products, first expected in early 2005, operate with rates up to 250 Kbps in the unlicensed bands that include 2.4 GHz globally, 915 MHz in the Americas, and 868 MHz in Europe. The ZigBee Alliance is promoting this technology.

802.16 – WiMax (Worldwide Interoperability for Microwave Access)

This IEEE standard defines broadband wireless for the metropolitan area to address the "last mile" problem of providing connections to individual homes and offices. The initial version, approved in December '01, operates in the 10-66 GHz frequency band with line-of-sight towers to fixed locations. The 802.16a extension, ratified in January '03, does not require line-of-sight transmission and allows use of lower 2-11 GHz frequencies for both fixed and portable applications. 802.16a claims up to a 30-mile range and 75 Mbps data transfer (at 20 MHz channelization) that can support thousands of users, plus improved latency and per-connection QoS features. 802.16a provides selectable channel bandwidths from 1.25 to 20 MHz with up to 16 logical sub-channels. A typical cell radius is probably 3-5 miles. Interoperability forums have been held, and the first commercial products are expected to ship in 2H 2004. Also see MIMO.

WiMax was planned from the beginning to be compatible with European standards. The WiMax Forum of over 100 companies was established in 2001 by Nokia, Ensemble Communications, and the Orthogonal Frequency Division Multiplexing Forum and now works to promote deployment of broadband wireless access networks based on 802.16 and to certify product interoperability. Intel and Alcatel announced that they are working together on this technology in an effort to deliver products by 2H 2005.

802.16d, planned for Q3 2004, will update 802.16a to incorporate the many amendments associated with it. 802.16e, planned for late 2005, will regional roaming for broadband wireless applications up to 15 Mbps (at 5 MHz channelization) with a typical cell radius of 1-3 miles.

AFH – Adaptive Frequency Hopping

Adaptive Frequency Hopping improves resistance to radio interference from other unrelated communication devices or from microwave ovens or cordless phones. For example, when two Bluetooth devices connect under normal circumstances, they establish a frequency hopping scheme across 79 frequency channels in the 2.4 GHz ISM band. AFH aims to improve the performance of a Bluetooth connection by identifying channels with high error rates and excluding the use of these channels.

AMR – Adaptive Multi Rate

A system used in W-CDMA and GSM to adapt the data rate based on demand.

AN – Access Node

A point on a network that allows subscribers to access the network.

AP – Access Point

See the Must-Have Reference for IP and Next Generation Networking.

AT – Access Terminal

A cdma2000 1xEV-DO handset used in data-only mode.

BLER – Block Error Rate

Bluetooth

See 802.15.1.

BS – Base Station

The location of the radio equipment for one or more cells. In 3GPP2, a Base Station comprises a Base Station Controller and one or more Base Transceiver Stations (see BTS).

BTS – Base Transceiver Station

The termination of a radio interface in a cellular system.

CCDF – Complementary Cumulative Distribution Function

CCDF of envelope power is used in digital communications test equipment and shows the cumulative probability of a particular peak-to-average power occurring.

CDMA – Code Division Multiple Access

CDMA is a spread-spectrum technology that spreads multiple conversations across a wide segment of the spectrum as opposed to splitting a channel into time slots. With CDMA, unique digital codes are used to differentiate subscribers that are simultaneously using the same spectrum. The CDMA Development Group Web site has helpful information about CDMA generally.

cdma2000

cdma2000 represents a family of technologies that includes cdma2000 1X and cdma2000 1XEV. cdma2000 1XEV includes 1XEV-DO and 1xEV-DV. cdma2000 services are being implemented in North America and Asia, but not in Europe.

cdmaOne – IS-95

cdmaOne is the brand name for IS-95 CDMA technology and was introduced by Qualcomm. cdmaOne provides a family of related services including cellular, PCS and fixed wireless (wireless local loop). See IS-95.

CDP – Code Domain Power

Measuring Code Domain Power means verifying the distribution of power in the code channels. This verifies that the various channels are at expected power levels and determines when one code channel is leaking energy into the other channels. The correctness of the transmitted code channel numbers, their powers, and their code lengths should be verified.

DCCH – Digital Control Channel

A channel for communications between a mobile phone and the network.

DECT – Digital Enhanced Cordless Telecommunications

DECT is a digital wireless technology that originated in Europe for cordless telephones when ETSI defined the DECT standard in January 1988. DECT is seeing increasing adoption worldwide, including use in wireless offices and wireless telephone lines to homes. It is a radio access technology, not a complete system architecture. DECT interoperates with other network types such as the PSTN, ISDN, and GSM. The DECTWeb and DECT Forum Web sites have helpful information.

DL – Downlink

DMR – Digital Mobile Radio

DSRC – Dedicated Short Range Communications

A system intended for communications between two vehicles, or from one vehicle to a roadside network. The IEEE and the Armstrong Consulting Web sites have helpful information. See 802.11p.

EDGE – Enhanced Data Rates for Global Evolution

EDGE is a 2.5G technology being promoted by the TDMA and GSM communities that is capable of both voice and 3G data rates. It extends the GPRS 10-50 Kbps service to 100 Kbps or more. Cingular promised a full deployment by around mid-2004, and AT&T is expected to install EDGE technology in 6500 U.S. cities in 2004.

EGPRS – Enhanced General Packet Radio Service

See EDGE.

EV-DO or EV-DV

See 1xEV-DO, 1xEV-DV, and 3xEV-DO/DV.

EVM – Error Vector Magnitude

Used to determine errors and their causes. Error Vector = Measured Vector (actual signal magnitude and phase) – Reference Vector (the ideal signal).

FDD – Frequency Division Duplex

See UTRA (Universal Terrestrial Radio Access).

FOMA – Freedom of Mobile Multimedia Access

The Japan NTT DoCoMo brand name for 3G services based on W-CDMA.

GCF – Global Certification Forum

GCF (gcf.gsm.org) is a partnership between network operators and terminal manufacturers that provides an independent process to ensure global interoperability and other functionality of 2G and 3G mobile wireless terminals. A GCF-certified terminal has been tested to a suite of test cases based on criteria developed by the global standards-making community and validated through the GCF Agreement Group.

GPRS – GSM Packet Radio Service or General Packet Radio Service

GPRS is an upgrade to a GSM network that adds packet data to the voice network. GPRS uses the same time slots as voice calls and each time slot is capable of approximately 9.6 Kbps of data throughput. A GPRS network that offers 28.8 Kbps down to the phone and 9.6 Kbps from the phone back to the network is using three time slots down and one up.

GSM – Global System for Mobile Communications

GSM is a TDMA digital technology deployed first in Europe. Today 65-70% of all wireless voice networks use GSM technology. GSM uses a combination of Frequency Division Multiple Access (FDMA) and Time Division Multiple Access (TDMA). In FDMA, the 25 MHz band is divided into 125 frequencies of 200 kHz each. One or more of those frequencies are assigned to each base station. In TDMA, each of those frequencies uses 8 time slots. A list of GSM US operators can be found at www.gsmworld.com/roaming/gsminfo/cou_us.shtml. The GSM World Web site has helpful information about GSM generally.

HiperLAN2 – High Performance Radio LAN

A 3GPP standard specifying a broadband wireless LAN that supports data rates of 25 to 54 Mbps on a carrier frequency of 5 GHz.

HiSWANa – High Speed Wireless Access Network Type a

An ARIB standard “ARIB STD-T70” that uses the 5.15 to 5.25 GHz band with a variable transmission rate from 6 to 36 Mbps. This system guarantees bandwidth usage and can manage bandwidth for each user.

HSDPA – High Speed Downlink Packet Access

HSDPA, part of the 3GPP Release 5 W-CDMA specification, is a packet-based data service in a W-CDMA downlink with data transmission up to 8-10 Mbps (and 20 Mbps for MIMO systems) over a 5MHz bandwidth in a W-CDMA downlink. For users who are close to the base station with good connections, it creates an improvement for W-CDMA similar to that which EDGE does for GSM, providing a 2X increase in air interface capacity and a 5X increase in downlink data speeds. Such a fast service could ultimately reduce the appeal of 802.11 Wi-Fi by providing equivalent speed with much more widespread deployment. Some service providers are planning 2005-2006 roll outs – NTT DoCoMo, for example, has stated a plan for providing HSDPA service by 2H 2005. ARCchart has a helpful HSDPA overview.

iDEN

iDEN is a Motorola proprietary version of TDMA with a unique “push-to-talk” two-way radio capability. Nextel Communications is the largest iDEN operator in the U.S. Anritsu products currently do not support iDEN.

IMT-2000 – Third Generation Mobile Systems

A global standard for third generation (3G) wireless communications linking terrestrial and satellite networks, and defined by a set of interdependent ITU recommendations. IMT-2000 is the result of collaboration between groups inside the ITU (ITU-R and ITU-T) and outside the ITU (such as 3GPP, 3GPP2, TIA). The IMT-2000 Web site has more information.

I/Q – In-Phase and Quadrature

I/Q modulators are 90 degrees out of phase with each other. I/Q modulation combines two channels of information into one signal and then separates them later.

IS-136 – Interim Standard 136

IS-136, an evolved version of IS-54, is the U.S. standard for TDMA for both the cellular (850 MHz) and PCS (1.9 GHz) spectrums. Unlike IS-54, IS-136 utilizes time division multiplexing for transmitting both voice and the control channel. The Digital Control Channel (DCCH) is a key element of IS-136. privateline.com has a helpful reference explaining IS-136.

IS-95

A TIA/EIA standard that was the first widely used CDMA system, and is heavily installed in North America. The initial specification, known as IS-95A, was later upgraded to IS-95B. IS-95B combines cellular and PCS systems. In addition to voice, IS-95A is able to carry data at rates up to 14.4 kbps, and IS-95B supports data rates up to 115 kbps. Radio-Electronics.com has a helpful explanation of IS-95.

Mcps – Million Chips Per Second

The number of million bits (chips) per second in the spreading sequence of a direct sequence spreading code. Each user's voice or data information is separated by multiplying the information by pseudo-random bits called chips.

MIMO – Multiple-Input Multiple-Output

A process in which information is sent over two or more antennas. The signals reflect off objects and create multiple paths that cause interference and fading in conventional radios. MIMO uses these paths to carry more information, which is recombined on the receiving side based on MIMO algorithms. MIMO is expected to greatly increase performance and range but handle existing 802.11a/b/g radios with only a slight cost increase. Some form of MIMO may be used by the IEEE 802.11n Task Group, which is creating a specification for WLANs having at least 100 Mbps throughput (see 802.11), and for WiMax/802.16 wireless “last mile” access. Airgo Networks was the first company to produce chipsets supporting MIMO (see 802.11n and 802.16).

MS – Mobile Station

The term used in GSM to describe a mobile phone.

Multicall

A supplementary service developed in 3GPP to dynamically control parallel network connections. The specification is available on the 3GPP Web site.

Node B – Base Station

A 3G term for the base station transceiver system.

OBW – Occupied Bandwidth

Occupied Bandwidth is a measure of the bandwidth containing 99% of the total integrated power of the transmitted spectrum, centered on the assigned channel frequency. Interference to other channels or to other systems can occur if OWB is too large.

OCNS – Orthogonal Channel Noise Simulation

OTA – Over The Air

PDC – Personal Digital Cellular

PDC is a version of TDMA technology used exclusively in Japan.

PHS – Personal HandyFone System

PHS is a Japan-only TDMA technology. Originally, the difference between PDC and PHS systems was that PDC was true cellular while PHS provided voice and data access but did not support moving from one cell to another.

PSTN – Public Switched Telephone Network

The original international public telephone system based on switched connections of copper wiring carrying analog voice data.

RC – Radio Configuration

Radio Configuration (RC) in cdma2000 systems indicates the channel data rate. RC1 (9600 bps) and RC2 (14440 bps) are backward compatible with IS-95B. RC3 and above use cdma2000 coding for higher capacity. The Spreading Rate (SR) indicates the multiples of 1.2288 Mcps (see Mcps), where SR1 is 1.2288 Mcps and SR3 is 3.6864 Mcps:

RC	Forward Channel	Reverse Channel
1	1200-9600 bps (SR1)	1200-9600 bps (SR1)
2	1800-14,400 bps (SR1)	1800-14400 bps (SR1)
3	1500-153,600 bps (SR1)	1500-153,600 bps (SR1)
4	1500-307,200 bps (SR1)	1800-230,400 bps (SR1)
5		1500-614,400 bps (SR3)
6		1800-1,036,800bps (SR3)

RFID – Radio Frequency Identification

An RFID system uses radio frequencies to retrieve stored identification information from a tiny object called an RFID Tag that is typically attached unobtrusively to a product, an animal, or some other item. A Passive RFID Tag derives all its operation and response power from the signal it receives on its antenna, typically operates over ranges of 10 mm to 5 m, and responds with just an ID number. An Active RFID Tag has its own power source such as a small battery, a greater range, and the ability to respond with much more information. RFID systems use a wide variety of frequencies, including 125-135 kHz, 6.7 MHz, 13.5 MHz, 902-928 MHz, and 2.4 GHz. The AIM Web site has a helpful summary of information about RFID.

ROF – Radio On Fiber

A system where an optical signal modulated with a radio signal is transmitted via optical fiber to roadside receiver stations, where it is then converted back to a radio signal for broadcasting from antennas. This technique can be used to transmit wideband wireless signals with relatively low noise.

RRM – Radio Resource Management

The methods used in a digital cellular network to manage the allocation of radio channels, frequencies, and characteristics to match the requirements of the users on the network.

RBW – Resolution Bandwidth

For spectrum analyzers, a narrow band filter is swept across a frequency span to create the spectrum display. The filter bandwidth (RBW) determines the frequency resolution across the frequency axis.

SHO – Soft Handoff

A process in which a mobile phone communicates simultaneously with base stations in two or more overlapping cell sites while the call is being passed from one cell site to another.

SR – Spreading Rate

See RC (Radio Configuration).

SPA – Spectrum Analyzer

TDD – Time Division Duplex

See UTRA (Universal Terrestrial Radio Access).

TDMA – Time Division Multiple Access

TDMA is an air interface that allows mobile stations to use the same frequency separated by time slots. TDMA uses its spectrum by assigning each user on a channel a different “slot” in time. IS-136 and iDen have 3 slots per channel, while GSM has 8 slots per channel.

TD-SCDMA – Time Division - Synchronous Code Division Multiple Access

TD-SCDMA is a 3G technology developed by Siemens Mobile in conjunction with partners in China, and became part of 3GPP UMTS Release Phase 4 in March 2001. Using the Time Division Duplex (TDD) UMTS transmission mode, traffic is sent and received in different time slots over the same frequency band; see UTRA. The synchronous aspect of TD-SCDMA means that it can handle synchronous circuit-switched services such as speech and video as well as asynchronous packet-switched services such as Internet access. It will be deployed initially in China. The China TD-SCDMA Web site provides more information.

TGn Sync

A consortium of companies (TGnSync.org) including Agere Systems, Atheros, Intel, Nokia, Philips, and Sony developing a proposal for high-performance wifeless networks in conjunction with IEEE 802.11n. Some key technical features include use of MIMO technology to support 315 Mbps with two antennas and seamless Interoperability with 802.11a/b/g products. See 802.11n; MIMO; WWiSE.

TRX – Tx/Rx or Transceiver

TTCN – Tree and Tabular Combined Notation

Tree and tabular combined notation is an ISO/IEC standard (9646-3) for specifying communication systems conformance tests. Anritsu's MX785201A W-CDMA (UMTS) Protocol Test System (PTS) provides an environment that supports TTCN.

UE – User Equipment

Refers to a mobile phone, PDA, or other user device. “UE” is a 3G term normally used only in connection with W-CDMA, and typically only in Europe. (See MS.)

UL – Uplink

UMTS – Universal Mobile Telecommunications System

UMTS is a part of the International Telecommunications Union's IMT-2000 vision of a global family of third-generation (3G) mobile communications systems. This version of 3G is a W-CDMA technology being developed primarily by Europe's GSM community; UMTS is synonymous with W-CDMA in Europe. UMTS is the planned 3G technology for GSM networks worldwide.

UTRA – Universal Terrestrial Radio Access

UTRA is the radio interface defined by 3GPP for 3G W-CDMA communication between user equipment (UE) and a base station. UTRA has two operation modes: Frequency Division Duplex (FDD) and Time Division Duplex (TDD). TDD handles asymmetric traffic well and can be implemented in an unpaired frequency spectrum. FDD requires paired frequency bands, making its implementation more difficult when there is limited frequency availability. The world's first commercial FDD networks were launched in Japan and Europe in late 2001.

UWB – Ultra Wideband

As applied to local area networking, UWB is a wireless technology that uses narrow (picosecond or nanosecond) pulses at very low power to transmit high data rates over distances up to approximately 10-100 m across all frequencies at once. UWB uses spread spectrum technology spread over about 7.5 GHz with such low power that it does not interfere with other wireless transmission. Current product data rates are around 50 to 500 Mbps. This communications technology, also called digital pulse wireless or carrierless, can carry data through doors and other obstacles that obstruct other signals. UWB could be an alternative to Bluetooth (see 802.15). First products will probably appear in early 2005, based on proprietary chipsets in advance of standards still in development by the IEEE.

W-CDMA – Wideband CDMA

W-CDMA is a version of CDMA that uses 10 MHz of wireless spectrum: a 5-MHz uplink from the mobile terminal and a 5-MHz downlink to the mobile terminal. The version of W-CDMA used by NTT DoCoMo in Japan is called FOMA or J-W-CDMA; the European version is referred to as UMTS or E-W-CDMA. AT&T and Cingular are planning W-CDMA service in the U.S.

WEP – Wired Equivalent Privacy

A security protocol for wireless LANs that is part of the 802.11 Wireless LAN standard - see 802.11. It uses 40 or 104-bit encryption. WEP has been criticized for its relatively weak RC4-type encryption and lack of user authentication. The "Security of the WEP algorithm" paper by UC Berkeley addresses some of the security concerns with WEP. A near-term improvement to WEP is Wi-Fi Protected Access (see WPA); other current alternatives include 802.1x, TKIP, and VPN technology (see 802.1x, TKIP, and VPN). The 802.11i standard is expected to provide a long-term solution (see 802.11i).

Wi-Fi – Wireless Fidelity

Originally referred to the 802.11b standard, but now usually refers to the 802.11 wireless LAN standards generally - see 802.11.

Wi-Fi5 – Wi-Fi In 5 GHz Band

Originally signified the 5 GHz band used by 802.11a, as opposed to the 2.4 GHz band of 802.11b. Official use of Wi-Fi5 has been discontinued to avoid confusion and maintain the integrity of the "Wi-Fi" name.

WiMax – Worldwide Interoperability for Microwave Access

See 802.16.

WLL – Wireless Local Loop

Any of several kinds of systems using radio signals instead of copper wiring to connect telephone subscribers to the public switched telephone network (PSTN).

WME – Wireless Multimedia Extensions

See 802.11e.

WPA – Wi-Fi Protected Access

The WPA specification was developed by the Wi-Fi Alliance and some members of the 802.11i task group to significantly enhance Wi-Fi security. WPA was designed to be a software upgrade forward compatible with the 802.11i standard - see 802.11. WPA is standard in 802.11i. WPA includes data encryption via TKIP using RC4 WEP, a 128-bit encryption key, and 802.1x authentication. Products supporting WPA began shipping in 2H'03 and by mid-2004 over 400 products using WPA were certified by the Wi-Fi Alliance. The Wi-Fi Alliance site has helpful information about WPA. WPA is an upgrade to the original Wired Equivalent Privacy protocol - see WEP.

WPA2 The Wi-Fi Alliance certified the first 802.11i products in September '04 under the name "WPA2", indicating that the security is enhanced relative to the original WPA. WPA2 uses AES encryption.

WPAN – Wireless Personal Area Network

See the Must-Have Reference for IP and Next Generation Networking.

WSM – Wireless Scheduled Multimedia

See 802.11e.

WWiSE – Worldwide Spectrum Efficiency

A consortium of semiconductor and consumer electronics companies (WWiSE.org) spearheaded by Airgo Networks, Bermai, Broadcom, Conexant Systems, STMicroelectronics, and Texas Instruments developing a proposal for IEEE 802.11n high-speed WLANs. The proposal is based on a combination of OFDM and MIMO (Multiple-Input, Multiple-Output) technologies and achieves up to 540 Mbps data rate. See 802.11n; MIMO; TGn Sync.

ZigBee – Wireless Personal Area Networking

See 802.15.4.

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