Glossary

Introduction

This Glossary contains an alphabetical listing of the common terms used in the cellular industry. The terms listed are either defined directly or the reader is referred to another term listed herein.

Terms and Definitions

Definitions for this Glossary come from a variety of sources. Where there is a difference in a terms' definition, the definition is numerically separated.

Access Channel

1. A type of control channel over which the cell site is more or less constantly transmitting its overhead message stream.

2. A reverse CDMA channel used by mobile stations for communicating to the base station. The access channel is used for short signaling message exchanges such as call originations, responses to pages, and registrations. The access channel is a slotted random access channel.

Advanced Mobile Phone System (AMPS)	The cellular signaling protocol developed by Bell Labs, adopted by the entire Western Hemisphere and several other locations worldwide.
American Standard Code for Information Interchange (ASCII)	American Standard Code for Information Interchange.
Analog	Continuous, lacking discrete points. Examples of analog applications are clocks that use hands, the electro-magnetic spectrum (also called a continuum), and AMPS signaling.
Analog-to-Digital Converter (ADC)	The ADC converts the intermediate frequency (IF) signal from the Test Set into discrete time data for analysis.
Antenna	A device that converts electrical energy to radiant energy (radio frequency or RF), or RF to electrical energy. Most cellular antennas use stacked elements, coupled by a phasing coil, to increase the gain or directivity. See also Phasing Coil and Gain.
Base Station	1. An RF transmitter and receiver pair (constituting a single channel) used to communicate with subscriber equipment. A base station provides the means to relay data and voice communications between subscriber equipment and base site controllers.
	2. A station in the Domestic Public Cellular Radio Telecommunications Service, other than a mobile station, used for communicating with mobile stations. Depending upon the context, the term base station may refer to a cell, a sector within a cell, an MTSO, or other part of the cellular system.

Baud Rate   The reciprocal of the shortest transmission pulse duration (time). Baud is
                         equivalent to the bit rate in binary transmission. Therefore, 1200 baud is a
                         transmission rate of 1200 bits per second.

Binary Number   A number system that makes use of only two numbers: 0 and 1 (hence the name).
System   The binary number system is preferred for computer applications and for digital
                         cellular.

Bit   A single binary digit, either a 1 or a 0.

Bits per second   Bits per second.
(BPS)

Byte   8 bits.

Carrier   The center frequency which is modulated with intelligence when transmitted, then
Frequency   demodulated by the receiver. The carrier frequency is so named because it carries
                         the intelligence (voice, tones, music, et.c.).

Cell   The area served by a single cell site. The entire Cellular Geographic Service Area
                         (CGSA) is divided into many cells.

Cell Site   The antennas, transmitter, receiver, and other equipment necessary to establish a
                         connection between the cellular system and the customer's cellular radio-
                         telephone.

Cellular   Refers to the technology providing radio-telephone service by dividing an area
                         into "cells" and establishing a radio link between the "cellular telephone: and a
                         nearby "cell site."

Cellular Carrier   A cellular system operator or service provider. Two carriers are permitted in each CGSA, by law. The carrier owns the equipment that makes up the cellular system.

Cellular Geographic Service Area (CGSA)   A cellular concept which involves a geographic organization of frequency assignments so that virtually any number of subscribers can be served with a fixed number of allocated frequencies. There is no theoretical capacity limitation due to lack of radio voice paths.

Channel   1. A particular set of one transmit frequency and one receive frequency in the RF band.

2. A transmission path between two points. It is usually the smallest subdivision of a particular transmission system by means of which a single type of communication service is provided.

Co-Channel Interference   When a cellular telephone is first assigned a voice channel it is concurrently assigned a SAT. Since channels may be re-used in cellular (co-channels), it is the SAT which determines that the correct channel is being monitored. Otherwise, there could be co-channel interference, a form of crosstalk.

Code Channel   A subchannel of a forward CDMA channel. A forward CDMA channel contains 64 code channels. Code channel zero is assigned to the pilot channel. Code channels 1 through 7 may be assigned to either the paging channels or the traffic channels. Code channel 32 may be assigned to either a sync channel or a traffic channel. The remaining code channels may be assigned to traffic channels.

Code Division Multiple Access (CDMA)   1. One of the possible methods of providing digital cellular. CDMA imposes several digital signaling patterns, one pattern per communication link, on a single carrier. The communication link (conversation) is kept separated from other links by the ability of the telephone to recognize only its assigned signaling pattern.

CDMA is attractive because it provides for a large number of communication links, but the drawback is that as more links are established, distortion and interference increases. In other words, CDMA call quality is not expected to match current analog call quality.

2. A technique for spread-spectrum, multiple-access digital communications that creates channels through the use of unique code sequences.

CDMA Channel   The set of channels transmitted from the base station and the mobile stations on a given frequency. See also forward CDMA channel and reverse CDMA channel.

CDMA Frequency Assignment   A 1.23 MHz segment of spectrum centered on one of the 30 kHz channels of the existing analog system.

CDMA Generator   A functional block in the CDMA Cellular Adapter that generates pilot PN sequences with externally or internally applied channel data. A noise generator is also incorporated that is capable of generating calibrated E_b/N_o signals.

Code Domain Analyzer   An instrument that measures individual Walsh Channel characteristics in a CDMA channel.

Compander   A combination of a compressor at one point in a communication path used for reducing the amplitude range of signals, followed by an expandor at another point used for a complementary increase in the amplitude range.

Control Channel   A channel used for the transmission of digital control information from a land station to a mobile station or from a mobile station to a land station. There are two types of control channels: Access Channels and Paging Channels.

Crosstalk   Unwanted sound in a voice channel resulting from cross coupling to another voice channel.

dB   Decibel. A relative unit stating the logarithmic ratio between two values of power. 10 dB is ten times the reference. 3 dB is approximately twice the reference. For instance, an antenna that exhibits 3 dB of gain will have an effective radiated power of 6 watts if its input signal is 3 watts.

dBm   A precise measure of power, based upon the decibel scale, but referenced to the milliwatt; i.e., 1 dBm = .001 Watt.

dBμ   A measure of electrical field strength in term of its ratio (in dB) to one microvolt/meter.

dBm/Hz   A measure of power spectral density. dBm/Hz is the power in one Hertz of bandwidth, where power is expressed in units of dBm.

dBW   1. A precise measure of power, based upon the decibel scale, but referenced to the watt; i.e., 1 dBW = 1 Watt.

2. A measure of power expressed in terms of its ratio (in dB) to one Watt.

Deviation   In frequency modulation, the modulation type used in cellular, when the carrier frequency is modulated, it deviates from its center frequency by some amount. This is the deviation, expressed as a plus or minus number in Hz because the deviation is both above and below the center frequency. For instance, in cellular SAT deviation should be ±2 kHz.

Digital

The use of numbers to represent discrete samples of a complex entity. A digitized document uses numbers to represent the letters that make up the words of the document. A digitized photograph uses numbers to represent the pixels that comprise the photograph. And digitized voice uses numbers to represent discrete samples of the voice. Any number system may be used, but binary is most typically preferred. See also Binary Number System.

Digital Cellular   A signaling technique designed to increase the number of communication links in the available allocated spectrum. Three signaling methods are under consideration: CDMA, FDMA, and TDMA. NAMPS has been compared to digital cellular because it too, increases the number of communications links. See also CDMA, FDMA, NAMPS, and TDMA.

Digital SAT   (D)SAT. A digital equivalent of Signaling Tone used in NAMPS protocol. Unlike ST, which is a single tone, NAMPS users the complement of the currently assigned (D)SAT.

Digital ST   (D)ST. A digital equivalent of Signaling Tone used in NAMPS protocol. Unlike ST that is a single tone, NAMPS uses the complement of the currently assigned (D)SAT.

Discontinuous Transmission   A battery saving system feature which senses lack of activity on a voice channel (except for SAT), and instructs the cellular telephone to power back two power steps until voice is detected through a VOX circuit, or the switch instructs the telephone to return to its original power level. See also VOX.

Diversity   When enabled, this programming bit allows the use of an optional switched second antenna.

Dual Tone Multi-Frequency (DTMF)   A method of sending numerical address information from a telephone by simultaneously sending a combination of two tones out of a group of 8. This is called *Touch-Code* dialing by Motorola and *Touch Tone* by AT&T.

Duplexer   An electronic device used in the antenna circuit to protect the receiver's front end from the output of the transmitter. The duplexer also serves to eliminate unwanted received signals (for instance, in cellular we only want to receive in the 800 MHz range), and to suppress harmonics.

E-AMPS   See Expanded Spectrum.

Eb   The energy in an information bit.

E_b/N_o   The ratio between the energy of each information bit (E_b) and the noise spectral density (n_o). This ratio is usually expressed in dB.

Effective Radiated Power (ERP)

Effective Radiated Power.

Electrically Erasable Programmable Read Only Memory (EEPROM)

Memory type that does not require UV light for erasing or updating. Hence, easier to use.

Electronic Industries Association (EIA)

Electronic Industries Association.

Electronic Serial Number (ESN)

A unique serial number, stored in the cellular telephone in hexadecimal code, not accessible by the customer or through programming. Each functioning cellular telephone has a unique ESN.

Erasable Programmable Read Only Memory (EPROM)

A form of machine readable memory which may be erased (normally using ultraviolet light) and updated (again using UV light).

Even-Second Clock

A clock that occurs every two seconds.

Expanded Spectrum

In 1988 the FCC expanded the electromagnetic spectrum allocation to cellular from 666 channels to 832 channels. Otherwise the AMPS signaling protocol remained unchanged.

Finite Impulse Response (FIR) Filter

This is a filter for which the output, in response to an impulse input, totally dies away after a finite time interval. The term is usually used in reference to a digital filter.

Forward CDMA Channel

A CDMA channel from a base station to mobile stations. The forward CDMA channel contains one or more code channels that are transmitted on a CDMA frequency assignment using a particular pilot PN offset. The code channels are associated with the pilot channel, sync channel, paging channels, and traffic channels. The forward CDMA channel always carries a pilot channel and may carry up to 1 sync channel, up to 7 paging channels, and up to 63 traffic channels, as long as the total number of channels, including the pilot channel, is no greater than 64.

Forward Control Channel (FOCC)

A control channel used from a cell site to a cellular telephone.

Forward Link

The link direction from the base station to the mobile station. Also referred to in satellite communications technology as the downlink.

Forward Traffic Channel

A code channel used to transport primary traffic, secondary traffic, and signaling traffic from the base station to the mobile station.

Forward Voice Channel (FOVC)

A voice channel used from a cell site to a cellular telephone.

Frame

A basic timing interval in the system. For the Access channel, paging channel, and traffic channel, a frame is 20 ms long. For the sync channel, a frame is 26.666…ms long.

Frequency   Rate of repetition. In electronics, frequency is measured in Hertz (abbreviated Hz). One Hz is one cycle per second. Alternating current available at a wall outlet is typically rated at 120 volts AC, 60 Hz. This means that the voltage varies at a sinusodial rate from a positive to a negative voltage 60 times per second. Cellular channels are in the 800 MHz range, meaning that cellular carrier frequencies repeat (or oscillate) at the rate of 800 million cycles per second.

Frequency Division Multiple Access (FDMA)   One of the possible methods of providing digital cellular. With FDMA, the carrier frequency is not directly modulated. Instead, the intelligence (voice, music, etc.) is mixed with a secondary frequency lower than the carrier frequency, then two or more of these secondary frequencies simultaneous modulate the carrier frequency. In this way, two or more communication links (conversation) can be imposed on the same carrier frequency. FDMA is not being seriously considered for cellular because, even though it increases the communication links, it also requires a very wide bandwidth.

Frequency Modulation (FM)   See Deviation. See also Modulation.

Full Duplex   Refers to a communication system, or equipment capable of transmission simultaneously in two directions.

Gain   A measure of increase in power. The gain of a circuit is the measure of the increase in voltage at the output over the circuit's input signal voltage. When applied to an antenna, gain takes on a slightly different meaning. Antennas are either omni-directional or directional. An omni-directional antenna is usually considered to have no gain. But a directional antenna is said to have gain because the effective radiated power is concentrated and therefore apparently higher than the input power (when compared to the output from an omni-directional antenna).

Group ID Mark   This is a number (9 - 15) which specifies how many of the most significant bits of the System ID are compared when processing local control orders.

Handoff   A process of maintaining a radio link between a cellular radio-telephone and the cellular system. The handoff occurs when the radio-telephone moves out of range of one cell site and comes within range of another, relying on Received Signal Strength Indication (RSSI) to determine when handoff is necessary.

Harmonic   An image frequency of a fundamental frequency located some multiple of the fundamental frequency above the fundamental frequency. For instance, if a frequency of 800 MHz is transmitted, harmonics might be found at 1,600 MHz (1.6 GHz), 3.2 GHz, etc. Harmonics should be suppressed because, even though their power is minuscule compared to the fundamental frequency, they can interfere with other radio applications.

Hexadecimal (HEX)   A way of representing binary data (bits), grouping data into base 16 representing decimal equivalents of 0 thought 15 using characters 0 - 9 and A- F.

Long Code   A PN sequence with period 2_{42}-1 that is used for scrambling on the forward CDMA channel and spreading on the reverse CDMA channel. The long code uniquely identifies a mobile station or mobile station user (MIN) on both the reverse traffic channel and the forward traffic channel. The long code provides limited privacy and prevents the accidental reception of signals transmitted to another mobile station. The long code also separates multiple Access channels on the same CDMA channel.

Long Code Mask   A 42-bit binary number that contains system and mobile station dependent values such as the mobile station electronic serial number (ESN), mobile station

identification number (MIN), paging channel number, and access channel number. The long code mask creates the unique identities of the long code.

Mcps

Megachips per second (one million chips per second).

Mobile Identification Number (MIN)

The 34-bit binary number that is a digital representation of the 10-digit directory telephone number assigned to a cellular telephone.

Modulation

The method of imposing intelligence (voice, music, etc.) onto a carrier frequency, allowing the intelligence to be broadcast as RF over great distances. There are several modulation types. Analog cellular uses FM (frequency modulation). See also Deviation. CDMA cellular and PCS use QPSK and Offset QPSK.

Modulation Symbol

The output of the data modulator before spreading. On the reverse traffic channel, 64-ary orthogonal modulation is used and six code symbols are associated with one modulation symbol. On the forward traffic channel, each code symbol (when the data rate is 9600 bps) or each repeated code symbol (when the date rate is less than 9600 bps) is one modulation symbol.

Narrow AMPS

NAMPS. The cellular signaling protocol developed by Motorola to provide for a further expansion of cellular voice channels. NAMPS uses a 10 kHz bandwidth for NAMPS voice channels, leaving a 30 kHz bandwidth for AMPS channels and dynamically re-designating channels as NAMPS or AMPS as required.

Non-Wireline

See Wireline.

Number Assignment Module (NAM)

The physical location of the subscriber customer's programmed information, such as MIN, SID, etc.

Offset Quadrature Phase Shift Keying (OQPSK)

A form of modulation that applies different data sequences to two carriers separated by 90°. The two different data sequences are staggered by half a modulation symbol time.

Orthogonal Spreading

The application of Walsh functions to baseband CDMA signals. On the forward channel, Walsh functions provide channelization. On the reverse channel, Walsh codes provide a 64-binary modulation symbol set.

Oscillator

In electronics, an oscillator produces alternating high and low voltages at some frequency. A crystal oscillator vibrates at some rate depending on how it is cut when voltage is applied to it. A synthesizer is an oscillator whose output is some multiple of its input.

Page

A message which is broadcast to a cellular phone notifying of an incoming call. When the phone receives a page message addressed to it, it rings to alert the user.

Paging Channel   A code channel on the forward link used for paging mobile stations. CDMA: Of the 64 Walsh functions used for channelization on the forward link, one through seven (inclusive) are used for paging channels. AMPS/TACS: A 30 Hz FM channel that the phones are directed to monitor for paging signals.

Phase Lock Loop (PLL)   An electronic circuit which takes the alternating current outputs from two sources and makes one output the slave of the other so that both frequencies are the same. When using a PLL, if the output of one circuit is off frequency by some amount, the slaved output will be off frequency by exactly the same amount.

Pilot Channel   An unmodulated, direct-sequence, spread-spectrum signal transmitted continuously by each CDMA base station. The Pilot channel allows a mobile station to acquire the timing of the forward CDMA channel, provides a phase reference for coherent demodulation, and provides a means for signal strength comparisons between base stations for determining when to handoff.

Pilot PN Sequence   A pair of modified maximal length PN sequences with period 2^{15} used to spread the forward CDMA channel and the reverse CDMA channel. Different pilot PN sequence offsets.

Pilot PN Sequence Offset Index   The PN offset in units of 64 PN chips of a pilot, relative to the zero offset pilot PN sequence.

PN Chip   The time duration of one binary bit in the PN sequence, which is equal to the reciprocal of the frequency at which the PN sequence generator operates. For example, if the PN generator operates at 1.2288 MHz, then a PN chip is 813.802…ns.

PN Sequence Literally

"pseudo-noise sequence." A periodic binary sequence (with "0" mapped to 1, and "1" mapped to - 1). Typically a PN sequence has good autocorrelation which (when normalized) equal 1 for zero shift between the two sequences, and -1/N, where N is the period, for all other shifts.

PN Sync Pulse

A signal to the CDMA Generator that initiates pilot PN sequence generation. The start of each pilot PN sequence is synchronized at the Test Set's RF IN/OUT connector to the 27 millisecond frame clock.

Portable

A small cellular telephone, with the transceiver, handset, antenna, and battery contained in a single handheld unit. A portable unit is typically small enough to fit into an overcoat pocket, or into a purse or brief case.

Programmable Read Only Memory (PROM)

A form of memory which can only be programmed once, cannot be erased, and cannot be updated.

Quadrature Spreading

Frequency spreading performed using pilot PN sequences at a 1.2288 Mcps rate. Also referred to as "short sequence spreading."

Radio Frequency (RF)

Energy that is radiated through space. Radio waves.

Random Access Memory (RAM)

A type of memory in which information can be sorted, retrieved, and modified. This type of memory is generally volatile (i.e., its contents are lost if power is removed).

Read Only Memory (ROM)

Memory that can only be read and not written to; normally non-volatile storage (i.e., when power is removed the memory is not lost).

Received Signal Strength Indicator (RSSI)

Provides a signal for logic circuit processing that is a function of received RF signal strength. RSSI is used both by the switch and the mobile or portable.

Reference Signal

A replica of the ideal CDMA waveform. The reference signal resides on the Cellular Adapter's DSP analyzer and is correlated with a signal-under-test to determine waveform accuracy and timing offset.

Reverse CDMA Channel

The CDMA channel from the mobile station to the base station. From the base station's perspective, the reverse CDMA channel is the sum of all mobile station transmissions on a CDMA frequency assignment.

Reverse Control Channel (RECC)

The control channel used from a cellular telephone to a cell site. This is used when the cellular telephone initiates a call.

Reverse Link

The link direction from the mobile station to the base station. Also referred to in satellite communications technology as the uplink.

Reverse Traffic Channel

A reverse CDMA channel used to transport primary traffic, secondary traffic, and signaling traffic from a single mobile station to one or more base stations.

Reverse Voice Channel (REVC)

The voice channel used from a cellular telephone to a cell site.

Root Means Square (RMS)

Used in mathematics as a measure of alternating current (AC).

Sidetone

An attenuated portion of the transmit audio returned to the originator.

Signaling Tone (ST)   A 10 KHz tone transmitted by an AMPS or TACS mobile or portable on a voice channel to: 1) confirm orders [50msec.], 2) signal flash requests [400 msec.], 3) signal release requests [1.8 sec.], and 4) indicate ringing [65 sec.].

Spectrum   An increasing or decreasing continuum. The visible spectrum is generally shown as the color red on the left and the color blue on the right. Infra-red, which is invisible, is shown to the left of the spectrum and ultra-violet, which is also invisible, is shown to the right. Red is shown on the left because it has the lowest frequency (longest wavelength), and blue is shown on the right because it has the highest frequency (shortest wavelength). The visible spectrum is actually a subset of the electromagnetic spectrum. When the electromagnetic spectrum is shown, audio frequencies are typically shown on the left, and light is shown toward the right. Infra-red frequencies (also called microwave) are used by radar and some other radio applications. Cellular frequencies (in the 800 MHz range) are slightly below infra-red.

Station Class Mark   This is a number (0 - 15) which specifies the power class, VOX capability, and type of the cellular telephone equipment.

Subscriber Equipment   Mobile, portable, or transportable cellular telephones or their accessories.

Supervisory Audio Tone (SAT)   One of three tones in the 6 KHz region that are transmitted by the cell site and transponded (returned) by a cellular telephone in the AMPS protocol.

Sync Channel   A code channel in the forward CDMA channel that synchronizes the mobile station with the base station.

Synthesizer

An electronic circuit used to increase or change the frequency from a reference oscillator, providing a synthesized frequency.

System ID (SID)   The SID is a 15 bit binary number (entered and displayed as a 5-digit decimal number in programming) which identifies the customer's "Home" system. This number is transmitted by the base site and compared by the cellular telephone to determine if the telephone is in its home system. An "even" SID indicates a B-Side (wireline) carrier, and an "odd" SID indicates a non-wireline (A-Side) carrier.

System Time   The time reference used by the system. System time is synchronous to Universal Coordinated Time (except for leap seconds) and uses the same time origin as Global Positioning Satellite (GPS) time. All base stations use the same System Time (within a small error). Mobile stations use the same System Time, offset by the propagation delay from the base station to the mobile station. See also Universal Coordinated Time.

Time Division Multiple Access (TDMA)   One of the possible methods of providing digital cellular. With TDMA, several communication links (conversations) can occur on the same carrier frequency. For instance, if you wish to impose three communication links on a carrier then you would assign each link to a time slot. Those time slots would repeat 1, 2, 3, 1, 2, 3, 1…continuously at some rate or speed. Samples of each link would be taken at the same rate and mixed with the carrier frequency, each in its turn. On the receiving end, the receiver would pick off only the time slots of its assigned communication link, then filter them to provide a good representation of the original intelligence (voice, music, etc.). TDMA is attractive because it requires no increase in bandwidth and eventually it is hoped as many as six communication links will be possible on a single carrier.

Traffic Channel

A communication path between a mobile station and a base station, used primarily for communicating service-option related traffic. The term traffic channel implies a forward traffic channel and reverse traffic channel pair. See also forward traffic channel and reverse traffic channel.

Traffic Channel Preamble

A sequence of all-zero frames that is sent at the 9600 bps rate by the mobile station on the reverse traffic channel. The traffic channel preamble is sent during initialization of the traffic channel when the mobile station is in the traffic channel initialization substate of the mobile station control on the traffic channel state.

Transportable

A cellular telephone that is larger than a portable with a larger battery. A transportable cellular telephone may be approximately the size of a briefcase, although size and shape will vary greatly from model to model.

Voice Channel

A channel on which a voice conversation occurs and over which brief digital messages may be sent between the cell site and the cellular telephones operating within its boundaries.

Voice Operated Transmit (VOX)

This is a two-way term that refers to the capability of a radio to sense modulation activity from a microphone to key or not key a transmitter. VOX in cellular is more properly termed Discontinuous Transmission. See also Discontinuous Transmission.

Walsh Chip

The shortest identifiable component of a Walsh function. There are 2^N Walsh chips in one Walsh function where N is the order of the Walsh function. On the forward CDMA channel, one Walsh chip equals 1/1.2288 MHz, or 3.255…us.

Walsh Cover

A coding method that uses Walsh functions to create a set of mutually orthogonal CDMA signals. In the CDMA system, a code channel is formed by a Walsh cover.

Walsh Function   One of 2^N time-orthogonal binary functions (note that the functions are orthogonal after mapping "0" to 1, and "1" to -1).

Walsh Symbol   The time necessary to transmit one Walsh function on the reverse CDMA channel.

Wireline

Wireline and Non-Wireline are terms used to distinguish between the two cellular carriers in a CGSA. Originally the "wireline" carrier was an affiliate of a telephone company providing conventional landline telephone service within the area of the CGSA; the "non wireline" carrier was the other cellular operator. In recent years the terms simply denote whether the carrier uses the "A" block of cellular frequencies (non-wireline) or the "B" block (wireline). All cellular telephones sold in the United States must be able to use both A and B block cellular channels.

Zero Offset Pilot PN Sequence

A pilot PN sequence aligned with System Time such that the first chip on every even-second mark is the "1" following the fifteen consecutive "0"s.