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and Zilog Z-80, were installed in 8-bit computers such as the Apple II, the MSAI 8080, and the Commodore 64.

800 The first "area code" for what AT&T originally called In-WATS service. See 800 Service and 8NN.

800 Portability 800 Portability refers to the fact that you can take your 800 number to any long distance carrier. A case example, once I had 1-800-LIBRARY. For many years, that number was provieded by AT&T. When portability came along, we were able to change it from AT&T to MCI and still keep 1-800-LIBRARY, which is 800-542-7279. 800 Portability is provided by a series of complex databases the local phone companies, under FCC mandate, have built. 800 Portability started on May 1, 1993. See 800 Service.

800 Service A toll call paid for by the called party, rather than the calling party. A generic and common term for In-WATS (Wide Area Telecommunications Service) service provided by a phone company, whether a LEC (Local Exchange Carrier) or an IXC (IntereXchange Carrier). In North America and in order of their introduction, all these In-WATS services have 800 (1967), 888 (1996), 877 (1998), 866 (2000), or 855 (2001) as their "area code." (Note: Future 800 numbers will follow the convention 8NN, where NN are specific numbers which are identical. Such 800 service is typically used by merchants offering to sell something such as hotel reservations, clothes, or rental cars. The idea of the free service is to entice customers to call the number, with the theory being that if the call was a toll call and therefore cost the customer something, he or she might be less inclined to call. Suppliers of 800 services use various ways to configure and bill their 800 services.

800 Service works like this: You're somewhere in North America. You dial 1-800, 1-888, 1-877, 1-866 or 1-855 and seven digits. The LEC (Local Exchange Carrier, i.e., the local phone company) central office sees the "1" and recognizes the call as long distance. It also recognizes the 8NN area code and queries a centralized database before processing the call further, with the query generally taking place over a SS7 (Signaling System 7) link. The centralized database resides on a Service Management System (SMS), which is a centralized computing platform. The database identifies the LEC or IXC (InterExchange Carrier) providing the 8NN number. Based on that information, and assuming that the toll-free number is associated with an IXC, the LEC switch routes the call to the proper IXC. Once the IXC has been handed the call, it processes the 800 number, perhaps translating it into a "real" telephone number in order to route it correctly. Alternatively, the IXC translates the 800 number into an internal, nonstandard 10-digit number for further routing to the terminating Central Office (CO) and trunk or trunk group.

As a real-life example, the publisher of this book has an 800 number, 800-LIBRARY (or 800-542-7279). When you call that number, MCI routes that number to the first available channel on the dedicated T-1 circuit which leased from MCI's, and connecting the MCI New York City POP (Point Of Presence) to the CMP New York City office.

Because 800 long distance service is essentially a database lookup and translation service for incoming phone calls, there are endless "800 services" you can create. You can put permanent instructions into the company to change the routing patterns based on time of day, day of week, number called, number calling. Some long distance companies allow you to change your routing instructions from one minute to another. For example, you might have two call centers into which 800 phone calls are pouring. When one gets busy, you may tell your long distance company to route all the 800 inbound phone calls to the call center, which isn't busy. See Eight Hundred Service and One Number Calling for more, especially all the features you can now get on 800 service.

In May of 1993 the FCC mandated that all 800 (and by extension all 8NN) numbers became "portable." That means that customers can take their 800 telephone number from one long distance company to another, and still keep the same 800. See also 800 Portability.

800 Services are known internationally as "Freefone Services." In other countries the dialing scheme may vary, with examples being 0-800 and 0-500. Such services also go under the name "Greenfone." In June 1996, the ITU-T approved the E.169 standard Universal International Freefone Number (UIFN) numbers, also known as "Global 800." UIFN will work across national boundaries, based on a standard numbering scheme of 800, 888 or 877 plus an 8-digit telephone number. See also UIFN and Vanity Numbers.

802 See 802 Standards.

802 Standards The 802 Standards are a set of standards for LAN (Local Area Network) and MAN (Metropolitan Area Network) data communications developed through the IEEE's Project 802. The two most important standards are 802.11b and 802.11a. The standards also include an overview of recommended networking architectures, approved in 1990. The 802 standards follow a unique numbering convention. A number followed by a capital letter denotes a standalone standard; a number followed by a lower case letter denotes either a supplement to a standard, or a part of a multiple-number standard (e.g., 802.1 & 802.3). The 802 standards segment the data link layer into two sublayers:

1. A Media Access Control (MAC) layer that includes specific methods for gaining access to the LAN. These methods — such as Ethernet's random access method and Token Ring's token passing procedure — are in the 802.3, 802.5 and 802.6 standards.

2. A Logical Link Control (LLC) Layer, described in the 802.2 standard, that provides for connection establishment, data transfer, and connection termination services. LLC specifies three types of communications links:

* An Unacknowledged Connectionless Link, where the sending and receiving devices do not set up a connection before transmitting. Instead, messages are sent on a "best effort" basis, with no provision for error detection, error recovery, or message sequencing. This type of link is best suited for applications where the higher layer protocols can provide the error correction and functions, or where the loss of broadcast messages is not critical.

* A Connection-Mode Link, where a connection between message source and destination is established prior to transmission. This type of link works best in applications, such as file transfer, where large amounts of data are being transmitted at one time.

* An Acknowledged Connectionless Link that, as its name indicates, provides for acknowledgement of messages without burdening the receiving devices with maintaining a connection. For this reason, it is most often used for applications where a central processor communicates with a large number of devices with limited processing capabilities.

802.1 IEEE standard for overall architecture of LANs and internetworking. See all the following definitions.

802.11a 802.11a is actually an updated, bigger, better, faster version of 802.11b (also called WiFi), which is now commonly installed in offices, airports, coffee shops, etc. Many laptops now come with 802.11b built-in. The newer 802.11a, also an IEEE standard for wireless LANs, supports speeds up to 54 Mbps. 802.11a runs in a 300-MHz allocation in the 5 GHz range, which was allocated by the FCC in support of UNII (the Unlicensed National Information Infrastructure). Specifically, 200 MHz is allocated at 5.15-5.35 MHz for in-building applications, and 100 MHz at 5.725-5.825 MHz for outdoor use. This allocated spectrum is divided into three working domains. At 5.15-5.25 MHz, maximum power output is restricted to 50mW (milliWatts), 5.25-5.35 to 250mW, and 5.725-5.825 to 1 Watt. 802.11a has been dubbed Wi-Fi5 (Wireless Fidelity 5 MHz) by the Wireless Ethernet Compatibility Alliance (WECA).

802.11a uses Coded Orthogonal Frequency Division Multiplexing (COFDM) as the signal modulation technique. COFDM sends a stream of data symbols in a massively parallel fashion, with multiple subcarriers (i.e., small slices of RF, or Radio Spectrum, within the designated carrier frequency band. Each carrier channel is 20 MHz wide, and is subdivided into 52 subcarrier channels, each of which is approximately 300 KHz wide; 48 of the subcarrier channels are used for data transmission, and the remaining four for error control. Through the application of a coding technique, each symbol comprises multiple data bits. The specified coding techniques and data rates specified, all of which must be supported by 802.11-compliant products, include BPSK (Binary Phase Shift Keying) at 125 Kbps per channel for a total of 6 Mbps across all 48 data channels, QPSK (Quadrature Phase Shift Keying) at for 250 Kbps per channel for a total of 12 Mbps, and 16QAM (16-level Quadrature Amplitude Modulation) at 500 Kbps per channel for a total of 24 Mbps. The standard also allows more complex modulation schemes, that offer increased data rates. Currently, the most complex and fastest is 64QAM (64-level QAM), at 1.125 Mbps per channel for a total of 54 Mbps.

The symbol rate is slowed down enough that each symbol transmission is longer than the delay spread. The delay spread is the variation in timing between receipt of the signals associated with a given symbol, with the delay spread caused by multipath fading. Multipath fading is the phenomenon whereby the RF signals carrying a given data symbol arrive at the receiver at slightly different times. This is because the signal spreads out from the transmitter, with certain portions of the signal reaching the receiver more or less directly, while other portions of the signal bounce around off of walls, furniture, your co-worker's pointy head, and such. Now, each of the symbols contains multiple bits, which are imposed on it through the coding processes identified above. As the multiple symbols reach the receiver, they are sorted out and decoded, with the decoding process providing some additional time for the receiver to adjust for the delay spread and to get ready to receive the next symbol. Both 802.11a and 802.11b are designed to be compatible with Ethernet LANs, using the MAC (Media Access Control) technique of CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance).

If this sounds great, that's because it is great. If this sounds too good to be true, that's because it gets a little more complicated. While the 5 GHz spectrum is pretty clear in the US, it's not so readily available elsewhere. Military and government installations use portions of this band overseas. In Japan, only the 5.15-5.25 MHz spectrum is available. In Europe, the 5.725-5.825 MHz spectrum is already allocated for other uses. In Europe, ETSI (European Telecommunications Standards Institute) requires that two additional protocols be used in conjunction with 802.11a in order to protect incumbent applications and systems running over previously allocated shared spectrum. DFS (Dynamic Frequency Selection) allows the 802.11a system to dynamically shift frequency channels and TPC (Transmission Power Control) reduces the power level. In combination, these protocols serve to eliminate interference issues with incumbent signals. See also 802.11b, 802.11g, BPSK, CSMA/CA, MAC, OFDM, QAM, QPSK, WECA and Wi-Fi.

802.11b 802.11b is now the most common wireless local area network. 802.11b (also called WiFi) is now commonly installed in offices, airports, coffee shops, etc. Many laptops now come with 802.11b built-in. 802.11b has been dubbed Wi-Fi (Wireless Fidelity) by the Wireless Ethernet Compatibility Alliance (WECA). 802.11b defines both the Physical (PHY) and Medium Access Control (MAC) protocols. Specifically, the PHY spec includes three transmission options — one Ir (Infrared), and two RF (Radio Frequency). 802.11b uses DSSS (Direct Sequence Spread Spectrum) modulation.for digital communication. DSSS involves the transmission of a stream of one's and zero's, which is modulated with the Barker code chipping sequence. Barker code is an 11-bit sequence (e.g., 10110111000) that has advantages in wireless transmission. Each bit is encoded into an 11-bit Barker code, with each resulting data object forming a "chip." The chip is put on a carrier frequency in the 2.4 GHz range (2.4-2.483 GHz), and the waveform is modulated using one of several techniques. 802.11 systems running at 1 Mbps make use of BPSK (Binary Phase Shift Keying). Systems running at 2 Mbps make use of QPSK (Quaternary Phase Shift Keying). Systems running at 11 Mbps make use of CCK (Complementary Code Keying), which involves 64 unique code sequences, which technique supports six bits per code word. The CCK code word is then modulated onto the RF carrier using QPSK, which allows another two bits to be encoded for each 6-bit symbol. Therefore, each 6-bit symbol contains eight bits. Power output is limited by the FCC to 1 watt EIRP (Equivalent Isotropically Radiated Power). At this low power level, the physical distance between the transmitting devices becomes an issue, with error performance suffering as the distance increases. Therefore, the devices adapt to longer distances by using a less complex encoding technique, and a resulting lower signaling speed, which translates into a lower data rate. For example, a system running at 11 Mbps using CCK and QPSK, might throttle back to 5.5 Mbps by halving the signaling rate as the distances increase and error performance drops. As the situation gets worse, it might throttle back to 2 Mbps using only QPSK, and 1 Mbps using BPSK. Also to be considered in this equation is the fact that the 2.4 GHz range is in the unlicensed ISM (Industrial, Scientific and Medical) band, which is shared by garage door openers, microwave ovens, bar code scanners, cordless phones, Bluetooth LANs, and a wide variety of other devices. As a result, this slice of spectrum can be heavily congested at times, and performance can drop considerably. 802.11 divides the available spectrum into 14 channels. In the US, the FCC allows the use of 11 channels. Four channels are available in France, 13 in the rest of Europe, and only one in Japan. There also is overlap between adjacent channels (e.g., channels one and two), which fact further affects performance; therefore, any given system must maintain maximum channel separation from other systems in proximity.

Both 802.11a and 802.11b are designed to be compatible with Ethernet LANs. 802.11b uses a variation of the MAC (Media Access Control) technique of CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance), which is used in some wired Ethernets, as well. A device seeking to transmit over the shared medium (in this case, a shared RF channel) listens to the network. If it senses no activity over the carrier frequency for a minimum period of time known as the DIFS (DCF (Distributed Coordinated Function) InterFrame Spacing), it requests access by first transmitting a RTS (Request To Send) packet. The RTS packet includes both the source (i.e., transmitter) and destination (i.e., intended receiver) addresses, the duration of the intended session (i.e., transmission), and the ACK (ACKnowledgement) associated with it. If the network is available, the destination device responds with CTS (Clear To Send), repeating both the duration and the ACK. All other devices back off the network until the session is concluded. If the network, on the other hand, is busy, the device waits a period of time equal to the DIFS, plus a random number of slot times, as calculated with several back-off timers. The "listening" process takes several forms. CAM (Constant Access Method), the default method, involves constant monitoring of the network. Since CAM creates a power consumption issue for battery-powered devices, PAM (Polled Access Mode) can be substituted. PAM calls for all client devices to go into sleep mode, all awaking at regular intervals, at the exact same time, to listen for network activity. On January 3, 2000 the 802.11 technology got another boost when Microsoft and Starbucks announced that they were to join forces to offer wireless access, using 802.11b among other standards, in most of Starbucks' coffee outlets over the next two years. The deal, some analysts say, is a further sign that 802.11b could become a serious competitor to better known wireless technologies such as Bluetooth, HomeRF, or even next-generation cellular networks. Apple was the first to launch an 802.11b product line (called AirPort). All Apple computers now include a built-in antenna which, in conjunction with a networking card, can exchange data with a small base station plugged into a broadband Internet connection up to 45 metros (150 feet) away. Although some PC laptops now come pre-equipped with wireless hardware, most users buy a PCMCIA card, or PC card, that serves as a wireless modem and antenna. See also 802.11a, 802.11g, Bluetooth, BPSK, Chip, CSMA/CA, DSSS, EIRP, Ethernet, HomeRF, MAC, QPSK, Spread Spectrum, WECA and Wi-Fi.

802.12 Standard for 100VG-AnyLAN. Addresses 100 Mbps demand-priority access method physical-layer and repeater specifications. Approved in 1995.

802.15 A developing IEEE standard for Wireless Personal Area Networks (WPANs), the 802.15 Working Group (WG) comprises four Task Groups (TGs). TG1 is deriving a WPAN standard based on the Bluetooth specifications. TG2 is developing recommended practices to facilitate the coexistence of 802.15 WPANs and 802.11 WLANs (Wireless Local Area Networks). TG3 is chartered to draft a new standard for high-rate WPANs running at 20 Mbps or better. Development is focusing on the 2.4 GHz band, using OQPSK (Orthogonal Quaternary Phase Shift Keying) as the modulation technique. TG4 is charged with investigating a low data rate WPAN solution running at no more than 200 Kbps in support of applications such as wireless interactive toys, sensors, automation, and smart tags and badges.

802.16 A developing IEEE standard for broadband wireless access. The 802.16 Working Group (WG) is working on a variety of fixed wireless standards intended to serve high-speed applications.

802.1B Standard for LAN/WAN management, approved in 1992; along with 802.1k, became the basis of ISO/IEC 15802-2.

802.1D IEEE standard for interconnecting LANs through MAC bridges (specifically between 802.3, 802.4, and 802.5 networks). The standard was approved in 1990, and was incorporated into ISO/IEC 10038. Works at the MAC level.

802.1E IEEE standard for LAN and MAN load protocols. Approved in 1990, formed the basis for ISO/IEC 15802-4.

802.1F Standard for defining network management information specified in 802 umbrella standards. Approved in 1993.

802.1G A developing standard for remote bridging at the MAC layer.

802.1H IEEE practices recommended for bridging Ethernet LANs at the MAC layer. Approved in 1995.

802.1I IEEE standard for using FDDI (Fiber Distributed Data Interface) as a MAC-layer bridge. Approved in 1992, the standard was incorporated into ISO/IEC 10038.

802.1J IEEE standard for LAN connectivity using MAC-layer bridges. A supplement to 802.1D, it was approved in 1996.

802.1K IEEE standard for the discovery and dynamic control of network management information. Approved in 1993. In conjunction with 802.1B, was the basis for ISO/IEC 15802-2.

802.1M A conformance statement for 802.1E, it addresses definitions and protocols for system load management. Approved in 1993, it was incorporated into ISO/IEC 15802-4.

802.1P IEEE extension of 802.1D. Specification for the use of MAC-layer bridges in filtering and expediting multicast traffic. Prioritization of traffic is accomplished through the addition of a 3-bit, priority value in the frame header. Eight topology-independent priority values (0-7) are specified, with all eight values mapping directly into 802.4 and 802.6. Switches that support 802.1P and 802.1Q provide a framework for bandwidth prioritization. Essentially what all these words mean is that you can assign a priority to the type of traffic with IEEE 802.1p class-of-service (CoS) values and these allow network devices along the way to recognize and deliver high-priority traffic in a predictable manner. When congestion occurs, QoS drops low-priority traffic to allow delivery of high-priority traffic. See also 802.1Q.

802.1Q IEEE specification for implementation of VLANs in Layer 2 LAN switches, with emphasis on Ethernet. Similar to 802.1P, prioritization of traffic is accomplished through an additional four bytes of data in the frame header. Most data fields in this addition to the header are specific to VLAN operation. Also included is a field which provides the same 3-bit priority flag specified in 802.1P's priority-mapping scheme. In addition to conven-