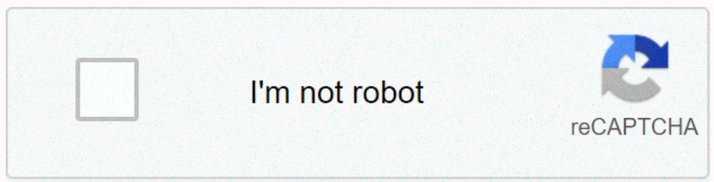


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# Cdma tdma fdma pdf

>> electronic design resources .. >> Library: Article Series .. .. >>: What's the difference: Communication 101 Download this article in . PDF Access methods are multiplex techniques that provide communication services to multiple users in wired or wireless media with one bandwidth. Communication channels, be they wireless spectrum segments or wired connections, are expensive. Communication service providers must engage multiple paid users through limited resources in order to earn money. Access methods allow many users to share these limited channels to provide the economy of the scale needed for a successful communications business. There are five basic access methods or multiplexes: multiple frequency division access (FDMA), multiple time-splitting access (TDMA), multiple code division access (CDMA), multiple orthogonal frequency division (OFDMA) access, and multiple spatial division access (SDMA). Contents of FDMA TDMA CDMA OFDMA SDMA Other methods of FDMA FDMA reference is the process of dividing a single channel or bandwidth into multiple individual strips, each for use by one user (Fig. 1). Each individual band or channel shall be wide enough to meet the signal spectrums of the transmissions to be distributed. The data to be transmitted shall be modulised on each subcarrieri and all shall be linearly mixed. 1. FDMA divides the shared medium bandwidth into individual channels. Subcarriers modulated information to be transmitted occupy each subchannel. The best example is the cable TV system. The medium is a single coaxing cable that is used to broadcast hundreds of video/audio programming channels to homes. The coax cable has useful bandwidth from 4 MHz to 1 GHz. This bandwidth is divided into 6 MHz wide channels. Initially, one TV station or channel used one 6 MHz band. But with digital techniques, multiple TV channels can share one band today thanks to compression and multiplex techniques used in each channel. This technique is also used in optical communication systems. One optical cable has a huge bandwidth that can be divided to FDMA. Each of the different data sources or information shall be assigned a different frequency of light for transmission. Light in general is not referred to by frequency, but by its wavelength (λ). As a result, optical FDMA is called wavelength division multiple access (WDMA) or wavelength-only multiplexing division (WDM). One of FDMA's older systems is the original analog telephone system, which used a hierarchy of frequency multiplex techniques to make multiple phone calls on a single line. Analog voice signals 300-Hz to 3400-Hz were used to modulate sub-transmitters in 12 channels from 60 kHz to 108 kHz. Modulators/mixers have created signals with one side band (SSB), upper and lower side bands. These subcarriers were then frequency multiplexed to subcarriers in the range 312-kHz to 552-kHz using the same same Methods. At the receiving end of the system, the signals were resolved and restored by filters and demodulators. The original aeronautical telemetry systems used the FDMA system to place multiple sensor data on a single radio station. Early satellite systems shared individual 36-MHz band transponders in the range of 4 GHz to 6 GHz with multiple voice, video or data signals via FDMA. Today, all these applications use TDMA digital techniques. TDMA TDMA is a digital technique that divides a single channel or band into time intervals. Each time slot is used to transmit one or the other digital segment of each signal in serial format. This technique works well with slow voice data signals, but is also useful for compressed video and other high-speed data. A good example is the widely used T1 transmission system, which has been used in the telecommunications industry for years. T1 lines transmit up to 24 individual voice calls per line (Fig. 2). Each voice signal typically covers 300 Hz to 3,000 Hz and is digitized at a speed of 8 kHz, which is little more than nyquist's minimum rate twice the highest-frequency component needed to maintain all analog content. 2. This T1 digital telephone frame is illustrated by TDM and TDMA. Whenever a time period is allocated to one user. High data speed makes the user unaware of the lack of simultaneity. The digitized voice is displayed as individual serial bytes that occur at a speed of 64 kHz, and 24 of these nozzes are moved, creating a single frame of T1 data. The frame occurs at a speed of 1,536 MHz (24 at 64 kHz) for a total of 192 bits. One sync bit is added for timing purposes for a total data speed of 1,544 Mbits/s. At the receiving end, individual voice bytes are restored at 64 kHz and transferred via a digital analog converter (DAC) that reproduces the analog voice. The basic GSM (Global System of Mobile Communications) mobile phone system is TDMA-based. It divides the radio spectrum into 200 kHz bands and then uses time-division techniques to throw eight voice calls into a single channel. Figure 3 shows one GSM TDMA signal frame. Eight time intervals can be voice signals or data, such as texts or emails. The frame is transmitted at a speed of 270 kbit/s using gaussian minimum displacement keying (GMSK), a form of frequency displacement key modulation (FSK). 3. This GSM digital cell method shows how up to eight users can share a 200 kHz channel over different periods of time within 1248

bits. CDMA CDMA is another pure digital technique. It is also known as spectrum propagation because it takes a digitized version of an analog signal and spreads it through wider bandwidth at a lower power level. This method is also called the Direct Sequence Distribution Spectrum (DSSS) (Figure 4). The digitised and compressed voice signal in serial data form is transmitted by processing in XOR together with the chip signal at a much higher frequency. The CDMA IS-95 IS-95 The 1,2288-Mbit/s chipping signal is transmitted by a digitized compressed voice at 13 kbits/s. 4. Spectrum propagation is a CDMA technique. The compressed and digitised voice signal is processed in a logical XOR circuit together with a high frequency coded chipping signal. As a result, the digital voice is spread over much wider bandwidth that can be shared with other users using different codes. Chipping signal is derived from pseudorandom code generator, which assigns a unique code to each user's channel. This code distributes a 1.25 MHz voice signal. Many such signals can occupy the same channel at the same time. For example, the use of 64 unique chip codes allows up to 64 users to occupy the same channel at a frequency of 1.25 MHz simultaneously. On the receiver, the correlation circuit finds and identifies the specific calling code and resets it. Third-generation mobile phone technology (3G) called wideband CDMA (WCDMA) uses a similar method with compressed voice and 3.84 Mbit/s 5 MHz channel chip codes so that multiple users can share the same band. OFDMA OFDMA is an access technique used in Long-Term Evolution (LTE) mobile systems to accommodate multiple users in a given bandwidth. Orthogonal multiplexing frequency division (OFDM) is a modulation method that divides a channel into several narrow orthogonal bands that are positioned so that they do not interfere with each other. Each band is divided into hundreds or even thousands of 15-kHz wide subcarriers. The data to be transmitted is divided into many lower-speed bitstreams and modulated into subcarriers. The time intervals within each subcharal data stream are used to package the data to be transmitted (Fig. 5). This technique is very spectrally efficient, so it provides a very high data rate. It is also less affected by multipath spread effects. 5. OFDMA shall assign a group of subcarriers to each user. Subcarriers are part of a large number of subcarriers used to implement OFDM for LTE. The data can be voice, video, or something else, and it's compiled into time segments that are then transmitted through some of the associated subcarriers. Each user is assigned a subchanel group and associated time intervals to implement OFDMA. The smallest group of subchanels assigned is 12 and is called a resource block (RB). The system assigns a number of RBs to each user as needed. SDMA SDMA uses physical separation methods that allow sharing of wireless channels. For example, one channel can be used simultaneously if users are deployed far enough apart to avoid interference. Known as frequency reuse, the method is widely used in cellular radio systems. Cell sites are spaced apart to minimize interference. In addition to spacing, directional antennas are used to prevent interference. Most three antennas to create 120° sectors that allow frequency sharing (Fig. 6a). 6a). technologies such as smart antennas or adaptive arrays use dynamic beam shaping to reduce signals to narrow beams that can be targeted at specific users, except for everyone else (Fig. 6b). 6. SDMA separates users on shared frequencies by isolating them using directional antennas. Most cellular sites have three antenna arrays to separate their coverage into isolated 120° sectors (a). Adaptive fields use beam shaping to identify the users you want, ignoring others at the same frequency (b). One unique variation of SDMA, the polarizing multiple access division (PDMA), separates signals using different antenna polarizations. Two different signals can then use the same frequency, one sends a vertically polarized signal and the other sends a horizontally polarized signal. The signals will not interfere with each other even if they are at the same frequency because they are orthogonal and the antennas will not respond to the opposite polarized signal. Separate vertical and horizontal antennas of the receiver are used to restore two orthogonal signals. This technique is widely used in satellite systems. Polarization is also used for multiplexes in optical systems. The new 100 Gbit/s systems use dual-polarised four-step shift keys (DP-QPSK) to achieve high speeds on a single thread. High-speed data is divided into two slower data streams, one using vertical light polarization and the other horizontal polarization of light. Polarization filters separate the two signals on the transmitter and receiver and merge them back into high-speed current. Other methods A unique and widely used method of multiple access is the carrier sense of multiple access with collision detection (CSMA-CD). This is a classic method of access that is used on local Area Networks (ETHERNET). Allows multiple network users to access a single cable for transmission. Listen to all network nodes continuously. When they want to send data, they listen first and then transmit if there are no other signals on the line. For example, a single packet or frame will be transmitted. Then the process is repeated. If two or more transmissions occur simultaneously, a collision occurs. Network interface circuits can detect a collision, and then nodes wait a random time before re-transferring. Variations of this method are called carrier sense multiple approach with collision avoidance (CSMA-CA). This method is similar to CSMA-CD. However, a special scheduling algorithm is used to determine the appropriate time to transmit over a shared channel. While the CSMA-CD technique is most commonly used in wired networks, CSMA-CA is the preferred method in wireless networks. >> electronic design resources .. >> Library: Article Series .. .. >>: What's the Difference: Communication 101 References Frenzel, Louis E., Principles of Electronic Communications Systems, 3rd Edition, McGraw Hill, 2008. Gibson, Jerry D., Editor, Communication Manual, CRC Press, 1997. Skylar, Bernard, Communication, 2. Tomasi, Wayne, Advanced Electronic Communication Systems, 4. 1998.