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Code division multiple access pdf

How to use a channel by different radio communication technologies This article is about how you use a channel. CdMA technology is hereinafter referred to as cdmaOne and CDMA2000. Multiplexia analoguulation AM FM PM QAM SM SSB Circuit mode (standard bandwidth) TDM FDM / WDM SDMA Polarization Spatial OAM Statistical multiplexing (variable bandwidth) Package change Dynamic TDMA FHSS DSSS OFDMA SC-FDM MC-SS Related Topics Channel Uses Medium Access Control vte Code Sharing Multifunction (CDMA) is a channel access method used by different radio communication technologies. CDMA is an example of multiple user skills where multiple transmitters can transmit data simultaneously through a single communication channel. This allows multiple users to share the frequency band (see bandwidth). CdMA uses diffuser technology and a special encoding system (where a code is assigned to each transmitter) to avoid undue interference between users. [1] [2] CDMA is used as a use in many mobile phone standards. IS-95, also called CDMAOne, and its 3G evolution cdma2000 are often referred to only as CDMA, but UMTS, the 3G standard used by GSM operators, also uses broadband CDMA or W-CDMA, as well as TD-CDMA and TD-SCDMA as radio technologies. History The technology of the code department's multifunctional channels has long been known. In the Soviet Union (Soviet Union), the first work dedicated to this subject was published in 1935 with Dmitri Ageev. [3] Linear methods provide three types of signal separation: frequency, time and compensating method. [clarification required] CDMA's technology was used in 1957 when leonid Kupriyanovich, a young military radio engineer in Moscow, made an experimental model of a wearable automatic mobile phone, which he called an LK-1 with an access point. [4] LK-1 weighs 3 kg, operating distance 20-30 km and battery life 20-30 hours. [5] [6] The base station described by the author could serve several customers. In 1958, Kupriyanovich made a new experimental pocket model of a mobile phone. This phone weighed 0.5kg. To serve more customers, Kupriyanovich suggested a device he called a correlator. [7] [8] In 1958, the Soviet Union also began developing the Altai National Car Civil Telephone Service in accordance with the Soviet MRT-1327 standard. The telephone system weighed 11 kg. It was placed in the trunk of vehicles of high-ranking officials and used a standard handset in the cabin. The main developers of the Altai system were the VNIIS (Voronezh Science Research Institute of Communications) and the State Specialized Project Institute (GSPI). In 1963, this service began in Moscow, and in 1970 the Altai service was used in 30 SNT cities. [9] Uses CDMA2000 mobile phone Synchronous CDM (code-division early generation of CDMA) was implemented in the Global Positioning System (GPS). This is before that and differs from its use on mobile phones. Qualcomm standard IS-95, marketed as cdmaOne. The Qualcomm standard IS-2000, known as CDMA2000, is used by several mobile phone companies, including the Globalstar network. [nb 1] UMTS 3G mobile phone standard using W-CDMA. [nb 2] CDMA has been used in the OmniTRACS satellite system for transport logistics. CdMA modulation CDMA steps are a diffuse multifunctional technology. Diffaging spectrum technology spreads the bandwidth of the data evenly over the same transmitted power. A propagation code is a pseudo-random code with a narrow ambiguity function, unlike other narrow pulse codes. In CDMA, locally generated code works much faster than the data provided. Data transfer data is combined with bitwise XOR (exclusive OR) and faster code. The image shows how the diffication spectrum signal is generated. A data signal with a pulse duration of T b {\displaystyle T_{b}} is an XORed with a code signal pulse duration of T c {\displaystyle T_{c}} (chip sequence). (Note: bandwidth is equal to 1 / T {\displaystyle 1/T} with T {\displaystyle T} = bit time.) Therefore, the data signal has a bandwidth of 1 / T b {\displaystyle 1/T_{b}} and a difficon signal bandwidth of 1 / T c {\displaystyle 1/T_{c}} . Because T c {\displaystyle T_{c}} is much smaller than T b {\displaystyle T_{b}} , the bandwidth of the diffication signal is much greater than the bandwidth of the original signal. The ratio T b /T c {\displaystyle T_{b}/T_{c}} is called a propagation factor or processing gain and to a certain extent specifies the upper limit of the total number of users supported by the access point at the same time. [1] [2] Creating a CDMA signal Each CDMA user uses a different code to convert their signal. Selecting the codes used to modulate the signal is very important for the performance of CDMA systems. The best performance occurs when there is a good difference between the signal of the desired user and those of other users. The signals are separated by correlation of the received signal with the locally generated code of the desired user. If the signal matches the code of the desired user, the correlation function is high and the signal can be picked up by the system. If the desired user code has nothing in common with the signal, the correlation should be as close as possible to zero (in which case the signal is removed); This is called a cross-correlation. If the code correlates with the signal at any time other than zero, the correlation shall be as close as possible to zero. This is called an automatic correlation and is used to disqualify multipathic disorders. [14] [15] Analogy access is a room (canal) where people want to talk to each other at the same time. To avoid confusion, people can alternately speak (time distribution), speak in different fields (frequency sharing), or speak in different languages (code sharing). CDMA is comparable to the last example where people who speak the same language can understand each other, but other languages are considered noise and rejected. Similarly, on CDMA radio, a shared code is assigned to each user group. Many codes have the same channel, but only users associated with a specific code can communicate. In general, CDMA belongs to two basic categories: synchronous (orthogonal) and asynchronous (pseudorandom codes). Multiplexification of the code distribution (synchronous CDMA) The digital modulation method is similar to that of simple radio transmitters. In an analog case, a low-frequency data signal is multiplied by a time factor with a high-frequency clean sine-wave carrier and transmitted. In practice, this is the frequency convoretion of these two signals (Wiener-Khinchin theorem), which leads to a carrier operating in a narrow side band. In the digital case, the blue-shaped claimant is replaced by Walsh functions. These are the binary square waves that make up the perfect set of ortonor paint. The data signal is also binary and time multiplicing is achieved by a simple XOR function. This is usually in Gilbert's cell mixture circuit. Synchronous CDMA utilizes the mathematical properties of the orthrogonality between vectors representing data strings. For example, binary string 1011 is represented by a vector (1, 0, 1, 1). Vectors can be told by bringing together their flap product by bringing together the products of their components (e.g. if = (a, b) and v = (c, d), then their dot product u·v = ac + bd). If the point product is zero, the two vectors are said to be orthogonal to each other. Some features of the dot product help you understand how W-CDMA works. If vectors (a) and (b) are orthopaedic, then · b = 0 {\displaystyle \mathbf {a} \cdot \mathbf {b} =0} and: a · (a + b) = ‖ a ‖ 2 because · a + a · b = ‖ a ‖ 2 + 0 , {\displaysylet \mathbf {a} \cdot (\mathbf {a} +\mathbf {b})=\|\mathbf {a} \|^{2},\ {\text{since}}\ \mathbf {a} \cdot \mathbf {a} +\mathbf {a} \cdot \mathbf {b} =\|\mathbf {a} \|^{2}+0 ,} · (− a + b) = − ‖ a ‖ 2 because − · a + a · b = − ‖ a ‖ 2 + 0 , {\displaystyle \mathbf {a} \cdot (-\mathbf {a} +\mathbf {b})=-\|\mathbf {a} \|^{2},\text{since}\\ {-\mathbf {a} }\cdot \mathbf {a} +\mathbf {a} \cdot \mathbf {b} =-\|\mathbf {a} \|^{2}+0.} b · a + b) = ‖ b ‖ 2 because b · a + b · b = 0 + ‖ b ‖ 2 , {\displaystyle \mathbf {b} \cdot (\mathbf {a} +\mathbf {b})=\|\mathbf {b} \|^{2},\ {\text{since}}\ \mathbf {mathbf {b} \|^{2},\ {\text{since}}\ \mathbf {mathbf b} \cdot \mathbf {a} +\mathbf {b} \cdot \mathbf {b} =0+\|\mathbf {b} \|^{2},} b · (a − b = − ‖ b ‖ 2 because b · a − b · b = 0 − ‖ b ‖ 2 . {\displaystyle \mathbf {b} \cdot (\mathbf {a} -\mathbf {b})=-\|\mathbf {b} \|^{2},\ {\text{since}}\ \mathbf {b} \cdot \mathbf {a} -\mathbf {b} \cdot \mathbf {b} =0-\|\mathbf {b} \^{2}.} Each user of synchronous CDMA uses the code ortochonal to other people's codes to change their signal. The following illustration shows an example of 4 mutual ortgogonal digital signals. The cross-correlation of orthomegonal codes is zero; in other words, they do not bother each other. In the case of IS-95, a 64-bit Walsh code is used to encode the signal to distinguish between different users. Since each of Walsh's 64 codes is orthopaedic to everyone else, the signals are channeled into 64 orthogonal signals. The following example shows how to encode and decode each user's signal. Example example of example 4 mutually orthonous digital signals Start with a vector series that is mutually ortonial. (Although mutual orthopaedicity is the only condition, these vectors are usually built to facilitate decoding, such as columns or rows in Walsh matriles.) The image next to it shows an example of an orthopaedic function. These vectors are assigned to individual users and are called code, chip code, or chipping code. For shortness, this example uses codes v with only two bits. Each user is associated with another code, such as v. One bit represents positive code v and 0 bits of negative code −v. For example, if v = (v0, v1) = (1, −1) and the information the user wants to send is (1, 0, 1, 1), then the transmitted symbols would be (v, −v, v, v) = (v0, v1, −v0, −v1, v0, v1) = (1, −1, −1, −1). For this article, we call this built vector a relayed vector. Each sender has a different, unique vector v selected from this series, but the method of building the transmitted vector is identical. Now, due to the physical characteristics of the interference, if the two signals in the phase are in the phase, they add to give a double amplitude for each signal, but if they are out of phase, they are subtracted and give a signal, which is the difference between amplitudes. Digitally, this behavior can be modeled using transport vectors, component at a time. If sender0 has a code (1, −1) and data (1, 0, 1, 1) and sender1 has a code (1, 1) and data (0, 0, 1, 1) and both consignors send simultaneously, then this table describes the encoding steps: Step Encode sender1 0 encoding0 = (1, −1), data0 = (1, 0, 1, 1) code1 = (1, 1), data1 = (0, 0, 1, 1) 1 encoding = 2(1) , 0, 1, 1) − (1 , 1, 1, 1) = (1, −1, 1, 1) encode1 = 2(0, 0, 1, 1) − (1, 1, 1, 1) = (−1, −1, 1, 1) 2 signal0 = encoded ⊗ code0= (1, −1, 1, 1) (1, −1)= (1, −1, −1, −1, −1, 1, −1) signal1 = encoding1 ⊗ code1= (−1, −1, 1, 1) ⊗ (1, 1)= (−1, −1, −1, −1, 1, 1, 1, 1) Because signal0 and signal1 are transmitted simultaneously to the air, they add a raw signal (1, −1, −1, 1, 1, −1, 1, −1) + (−1, −1, −1, −1, 1, 1, 1, 1) = (0, −2, −2, −0, 2, 0, 2, 0). This raw signal is called a disturbance pattern. The receiver then extracts an understandable signal to all known transmitters by connecting the sender's code to a glitch pattern. The following table explains how this works and shows that the signals do not interfere with each other: Step Decode from 10 code0 = (1, −1), signal = (0, −2, −2, 0, 2, 0, 0, 2.0) code1 = (1, 1), signal = (0, −2, −2, 0, 2, 0, 2, 0) 1 decode0 = pattern.vector0 decode1 = pattern.vector1 2 decode0 = ((0, −2), (−2,0), (2,0) , (2, 0)) · (1, −1) decode1 = ((0, −2), (−2, 0), (2, 0), (2, 0)) · (1, 1) 3 decode0 = ((0 + 2), (−2 + 0), (2 + 0), (2 + 0)) decode1 = ((0 − 2), (−2 + 0), (2 + 0), (2 + 0)) 4 data0=(2), −2, 2, 2), which means (1, 0, 1, 1) data1=(−2, −2, 2, 2), i.e. (0, 0, 1, 1) In addition, after decoding, all values greater than 0 are interpreted as 1, while all values are interpreted as 1, while all values are less than zero is interpreted as 0. For example, after decoding, the data is (2, −2, 2, 2), but the recipient interprets this as follows (1, 0, 1, 1). Exactly 0 values indicate that the sender has not passed on data, as shown in the following example: Assume that signal0 = (1, −1, −1, 1, 1, −1, 1, −1, −1) is sent alone. The following table shows the receiver decompression code: Step Decode sent to 10 code0 = (1, −1), signal = (1, −1, −1, −1, 1, 1, 1, −1, −1, 1, −1) code1 = (1,1), signal = (1, −1, −1, 1, −1, −1) 1 decode0 = pattern.vector0 decode1 = pattern.vector1 2 decode0 = ((1, −1), (−1, 1), (1, −1), (1, −1)) · (1, −1) decode1 = ((1, −1), (−1, 1), (1, −1), (1, −1)) · (1, 1) 3 decode0 = ((1 + 1), (−1 − 1), (1 + 1), (1 + 1)) decode1 = ((1 − 1), (−1 + 1), (1 − 1), (1 − 1)) 4 data0 = (2, −2, 2, 2) i.e. (1, 0, 1, 1) data1 = (0, 0, 0, 0), which means no data When the receiver tries to decode the signal with the sender code1, the data is all zero, so the cross-correlation is zero and it is clear that sender1 has not passed any information. Asynchronous CDMA See also: Direct sequence spread spectrum and almost distant problem When mobile base links cannot be closely coordinated, especially due to handset mobility, a different approach is needed. Since it is not mathematically possible to create signature sequences that are both ortochonal arbitrarily for random entry points and use code mode in full, asynchronous CDMA systems use unique pseudo-random or pseudo-melu sequences called spread sequences. Distribution is a binary sequence that appears random but can be repeated deterministically by intended receivers. These propagation sequences are used to encode and decode the user's signal in asynchronous CDMA in the same way as the orthophanal codes of synchronous CDMA (see example above). These dissemination sequences are statistically irreparable, and the sum of several distribution sequences leads to multifunctional disturbances (MAI) caused by an approximate Gaussian noise process (according to the centralised limit eorem of statistics). Gold codes are an example of the distribution order that is appropriate for this purpose because the correlation between the codes is small. If all users are received at the same power level, the MAI variance (e.g. noise output) increases directly in relation to the number of users. In other words, unlike synchronous CDMA, other users' signals appear to a signal of interest and interfere with the slightly desired signal relative to the number of users. All forms of CDMA use a diffuser spread factor to allow receivers to partially discriminate against unwanted signals. Signals encoded with specified propagation sequences are received, while signals with different sequences (or the same sequences, but different timing lines) are displayed as broadband noise reduced by the propagation factor. Because each user creates a MAI, signal strength management is an important problem with CDMA transmitters. CdM (synchronous CDMA), TDMA or FDMA receiver may theoretically arbitrarily reject strong signals using different codes, time gaps or frequency channels due to the orthogonality of these systems. This does not apply to asynchronous CDMA. rejecting unwanted signals is only partial. If something or all unwanted signals are much stronger than the desired signal, they will take it over. This results in the general requirement of any asynchronous CDMA system roughly equivalent to the signal power levels seen on the receiver. In a CDMA cell, the access point uses a fast closed-cycle power management system to tightly control the transmission power of each mobile phone. Advantages of asynchronous CDMA up to other technologies Effective use of the fixed frequency spectrum Theoretically, CDMA, TDMA and FDMA have exactly the same spectral efficiency, but in practice both have their own challenges – power management in the case of CDMA, timing in the case of TDMA and frequency production/filtration in the case of FDMA. TDMA systems must carefully synchronize transmission times for all users to ensure that they are received at the right time and do not cause interference. Since this cannot be completely managed in a mobile environment, each time slot must have a security time, reducing the likelihood that users will interfere but reduce the spectrum Similarly, FDMA systems must use a protective band between adjacent channels, as the signal spectrum has shifted unpredictably due to user mobility. Protective lanes reduce the likelihood that adjacent channels will interfere, but reduce spectrum usage. Flexible allocation of resources Asynchronous CDMA provides a key advantage in the flexible allocation of resources, i.e. the allocation of distribution sequences to active users. For CDM (synchronous CDMA), TDMA and FDMA, the number of concurrent orthonal codes, time gaps and frequency intervals is fixed, so capacity for the number of concurrent users is limited. CDM, TDMA and FDMA systems may be allocated a fixed number of orthopaedic codes, time gaps or frequency bands that are still underrepresented due to the outbreak of phone and parcel data transfers. The number of users supported in asynchronous CDMA is not strictly, only the policy limit, which is controlled by the desired probability of bit error because sir(signal-glitch) varies inversely depending on the number of users. In a congested traffic environment such as mobile communications, asynchronous CDMA has the advantage of allowing performance (bit errors) to vary randomly, and the average value is determined by the number of users that is greater than the utilization rate. For example, for example, there are 2N users who speak only half the time, 2N users can be accommodated with the same average bit error probability as N users who talk all the time. The main difference here is that the likelihood of N users having a bit error talking all the time is constant, while that's the random number (similarly) for 2N users who talk half the time. In other words, asynchronous CDMA is ideal for a mobile network where a large number of transmitters generate relatively little traffic at irregular intervals. CDM systems (synchronous CDMA, TDMA and FDMA systems cannot restore malnourished resources related to unloading traffic due to the fixed number of orthonous codes, time gaps, or frequency channels of individual transmitters. For example, if TDMA has N-time slots and 2N users who talk half the time, half the time is more than N users have to use more than N timelines. In addition, it would require significant overheads to allocate and distribute orthopaedic code, time or frequency channel resources continuously. By comparison, asynchronous CDMA transmitters simply send when they have something to say and go off the air when they don't, keeping the same signature order as long as they're connected to the system. CDMA's diffication spectrum capabilities Most modulation systems try to minimize CDMA bandwidth because bandwidth is a limited resource. However, difficer spectral techniques use a bandwidth of the transmission several magnitudes greater than the required minimum signal bandwidth. One of the first reasons for this was military applications such as control and communication systems. These systems were designed using a diffication spectrum for its safety and durability of jamming. Asynchronous CDMA has some privacy because the signal is spread by pseudo-random code. This code makes difficon spectral signals appear random or has noise-like properties. The recipient cannot downgrade this submission without knowing the pseudo-random sequence used to encode the data. CDMA can also withstand harassment. The jamming signal has only a limited amount of power to jam the signal. Jamming can either spread its energy to the entire bandwidth of the signal or jam only part of the entire signal. [14] [15] CDMA can also effectively combat narrowband interference. Since narrowband interference affects only a small part of the difficion spectrum signal, it can be easily eliminated by filtering without losing much data. Convosion encoding and forwarding can be used to recover this lost data. CDMA signals can also withstand multipath fade. Because the diffication spectrum signal has a high bandwidth, only a small part of this is weakened by multipath at any time. Like narrowband harassment, this only leads to a small loss of data and can be overcome. Another reason why CDMA can withstand multipath interference is that the delayed version of the submitted pseudo-random codes has a bad correlation with the original pseudo-random code, and thus appears as another user bypassed on the receiver. In other words, as long as the multipath channel causes at least one delay in the chip, multipath signals will arrive at the receiver so that they move in time with at least one chip from the intended signal. The correlation characteristics of pseudo random codes are such that this small delay makes the multipath seem correlated with the intended signal, so it is ignored. Some CDMA devices use a rake receiver that utilizes multipath delay components to improve system performance. The Rake receiver combines data from multiple correlators, each tuned to a different route delay and producing a stronger version of the signal than a simple receiver with a single correlation tuned to the route delay of the strongest signal. [1] [2] Frequency reuse is the ability to reuse the same radio frequency at other cellular locations in the cellular system. In FDMA and TDMA systems, frequency planning is an important aspect. Frequencies used in different cells shall be designed to: ensures that the signals from different cells do not interfere with each other. In CDMA, the same frequency can be used in each cell because channeling is done using pseudo-random codes. Reusing the same frequency in each cell eliminates the need for frequency planning in CDMA. However, different pseudo-random sequences shall be designed to ensure that the signal received from a single cell is not correlated with that of a nearby cell. [1] Because adjacent cells use the same frequencies, CDMA systems can perform soft donations. Soft donations allow a mobile phone to communicate simultaneously with two or more cells. The best signal quality is selected until the handover is complete. This differs from those used in other cell systems with hard donations. In a harsh situation of donation, as the mobile phone approaches the hand, the signal strength can vary abruptly. CdMA systems, on the other hand, use a soft output that cannot be detected and provides a more reliable and high-quality signal. [2] CdMA's cooperation has been explored A new type of shared multi-user transmission and detection system, known as CDMA cooperation[16], has been investigated as it exploits differences between users' waning channel signatures to increase users' capacity well beyond the length of spread of the MAI-limited environment. The authors show that it is possible to achieve this growth with low complexity and high error rates for flat waning channels, which is a major research challenge for overloaded CDMA systems. In this approach, the authors grouped a small number of users to share the same distribution order and allow group propagation and propagation functionality instead of using a single set per user, as in traditional CDMA. The new multi-user multi-user receiver consists of two steps: a multi-user group detection phase (MUD) that blocks a MAI between groups and a low complexity maximum probability detection phase, where the data of parallel-spread users can be recovered together using the minimum euchloride distance and the user channel rise factors. The improved CDMA version, known as interleave division multiple access (IDMA), uses orthopaedic intermediate tissue as the only means of user separation instead of the signature order used in CDMA. See also CDMA Spectrum Efficiency CDMA2000 Comparison of mobile phone standards cdmaOne Ortogonal variable spread factor (OVSF), CDMA Pseudo-random noise Quadrature-division multiple access (QDMA) implementation, CDMA Rise over thermal Spread W spectrum-CDMA Notes ^ Globalstar uses elements of CDMA, TDMA and FDMA that combine satellites [10] ^ UMTS networks and other CDMA-based systems are also known as a type of interference-glitch-gliding systems. [11] [12] This relates to the characteristics of CDMA technology: features: users operate in the same frequency band that affects SINR and thus reduces coverage and capacity. [13]

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