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PERFORMANCE EVALUATION OF RANDOM ACCESS METHODS FOR WIRELESS SYSTEMS

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ABSTRACT

This paper falls within the scope of the ever increasing demand on the spectrum of frequencies, as much for the wireless telephony as for the networks. This demand will continue to grow and it is therefore increasingly important to find new methods to improve the efficiency of use of the frequency spectrum. There is a great deal of research being done to try to find solutions and new approaches. The GSM mobile radio system is now known to the general public throughout the European continent and is a world-wide reference point both in terms of concepts and vocabulary. Although evolutionary, the GSM relies on a relatively rigid TDMA multiplexing technique. The flow rates are limited. The GPRS, General Packet Radio Service, will improve the achieved bit rates but the rise of multimedia services requires more and more high bit rates, in the order of several hundred kbps.
Keywords: *Access methods, OFDMA, CDMA, TDMA, FDMA, CSMA, ALOHA.*

1. INTRODUCTION:

The radio channel is basically a broadcast medium. Therefore, a signal transmitted by a user may potentially be received by all other users in the area covered by the transmitter. Although this possibility is very interesting for certain applications, such as radio or television broadcasting, it requires strict control of access to mobile communications. The goal of mobile communications is to provide communication channels on demand between a mobile terminal and a base station that connects the user to the fixed network infrastructure. The design criteria of such systems include capacity, complexity and quality of service [1]. All these criteria are influenced by the method used to provide multiple access. In any case, the reverse is true: access methods must be carefully chosen in the light of the relative importance of design criteria and the characteristics of the systems. There are several types of multi-user communication systems. A first type is a multiple access system with which a large number of users share a common communication channel for transmitting information to a receiver.

A second type of mobile communication is a broadcast network in which a single transmitter sends information to multiple receivers. The multiple access technologies in mobile radio system are based on the isolation of the various signals used in various connections. The support parallel transmissions in uplink or downlink are called multiple access. The areas commonly used to provide the following access [2]:

Spatial domain: all mobile communication systems use the fact that radio signals are attenuated during propagation. This implies that distant transmitters produce interference that is negligible compared to the power of the desired signal. Directional antennas can be used to ensure separation of the signals. The technique corresponding to this treatment is called SDMA (Space Division Multiple Access).

Frequency domain: signals occupying non-overlapping frequency bands can be easily

separated. Signals can be transmitted without interfering with each other. This method is called FDMA (Frequency Division Multiple Access).

Time domain: signals can be transmitted over time periods that do not overlap. The signals thus occupy the same frequency band, but can easily be separated by their arrival times. This method is called TDMA (Time Division Multiple Access).

Code domain: In the CDMA (Code Division Multiple Access) method, the different users transmit signals that are not very correlated with one another. Correlators can therefore be used to extract individual signals from a mixture of signals transmitted at the same time and on the same frequency band.

The preference that we have a method over another depends largely on the overall characteristics of the system design. No multiple access method is universally preferable to others.

2 .THE MULTIPLE ACCESS TECHNIQUES:

In a multi-user wireless communication system, system resources, including bandwidth and power, must be shared by the different users. The sharing of these resources can be done on several dimensions: frequency, temporal,....,etc. This resource allocation is called multiple access [3]. Several multiple access techniques have been proposed in the literature and the performance of each of them differ depending on the type of multi-user channel and link status. In this section, we present the different multiple access techniques by focusing on the multiple access code division (CDMA), which is a main concept for our work. A multi-user system in which the base station and / or different users are equipped with multiple antennas is called MIMO multi-user system. This type of system introduces a new dimension for performing resource sharing: the spatial dimension. In this paper, we discuss the performance of OFDMA systems and transmission techniques to such systems. The benefits of multi-user diversity, exploiting the natural variation in time connections of different users are also detailed. There are two different types of multi-user channel: an uplink channel and a downlink channel. The first type, also known as multiple access channel (multiple access channel MAC) is assigned to several users transmitting to a single receiver [4]. While the second type of channel, often referred to as broadcast channel (broadcast channel BC), is dedicated to a single transmitter sending data to multiple users. Thus, the power available at the transmitter and the bandwidth of the wireless link must be shared by different users. In the remainder of this paper, the study will focus on the diffusion channel. Bandwidth is a resource both limited and very expensive; an efficient allocation of this resource is an important aspect in the design of a multi-user channel. The majority of wireless applications require dedicated channels to ensure reliable transmission and continuously. These dedicated channels are obtained via a line method (channelization) dividing the system resources into three main axes (see Figure 1: the time axis, the frequency axis and the code axis. Multiple access technique is to divide the previous axes orthogonal channels that can or not to assign and thereafter each channel to a specific user. According to the available axes, three types of multiple access techniques exist: the time division multiple access (TDMA) multiple access and frequency division (FDMA), which are both orthogonal channeling methods while the multiple access code division (CDMA) can represent, according to the design code, an orthogonal or non-orthogonal method [2].

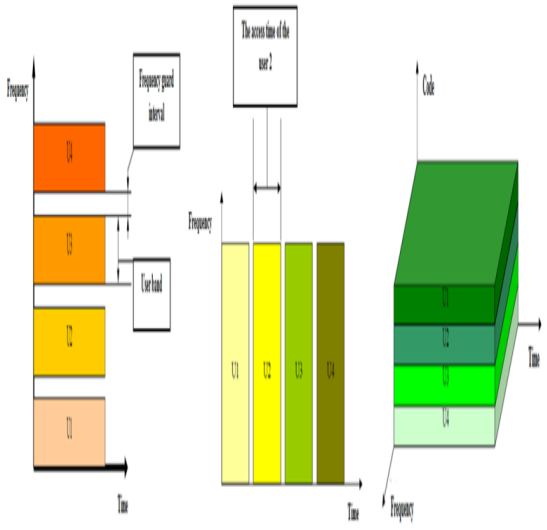

Figure 1: *Multiple Access techniques: FDMA, TDMA, CDMA*

This section presents the main multiple access techniques used in wireless communications. These media access methods are part of the protocol of the layer 2 in the OSI model. Although these access methods take most often originate in wired communications, they had to be adapted to wireless communication [1].

The first part presents techniques used in voice - oriented communications (GSM, UMTS, DECT), namely:

- Frequency Division Multiple Access (FDMA);
- Time division multiple access (TDMA);
- Code Division Multiple Access (CDMA).

The second part presents the techniques used in data communication (WLAN, packet radio, etc ...). These are mainly:

- ALOHA and its variants.
- CSMA and its variants
- Quality of Service (QoS) issues, which arise mainly when data and multimedia applications are mixed (voice + moving picture)....

2.1 The static access techniques for wireless systems:

Systems without son oriented voice GSM and DECT use fixed access techniques. In these techniques, at the time of connection establishment, radio resources are allocated to the connection and no longer vary during the connection. These resources can be a frequency band, a portion of time or a spread spectrum code. The choice of access scheme (FDMA, TDMA, CDMA, or combination) can have a significant impact on performance, QoS and system capacity. This choice is so dominant (at least in the minds of designers), often denominated systems based on multiple access [5].

The GSM is a TDMA system, while the UMTS a CDMA system. It can be shown that the choice of an access technique is a preponderant factor for the performance of wireless systems. In the case of cellular systems, this choice has made and is still debated between CDMA and TDMA / FDMA for example. Indeed, depending on the cellular organization and signal processing techniques used, one and the other techniques promise different capacities. Note also that we speak of fixed access techniques to the main part of the connection (during connection), while for the establishment of the connection it uses the random access techniques that we see in the second part [6].

The GSM and UMTS systems use a random access technique (the slotted ALOHA) during the phase of establishing the communication between the base station and the mobile. However, these two systems, mainly intended for voice transmission, use the TDMA to GSM and CDMA for UMTS. Another very important parameter is the duplex, that is to say the technique will allow distinguishing between senses of connection. In an uplink cellular system, it will generally be referred to as the transmission of the mobile to the base station and downlink for transmission from the base station to the mobile. We will begin by detailing these techniques and the reasons for the choices made and then we will detail the techniques of multiple access. Media access protocols regulate access to physical media and its duration of use in order to manage potential conflicts [3]. These protocols play an important role in the distribution networks, where all users may send and receive at any time. The access protocols are based on two allocation mechanisms: static and dynamic. A static allocation mechanism allocates a definitively communication channel, while the dynamic mechanism is able to adapt to the environment.

The main medium access techniques FDMA modes, TDMA and CDMA that we present now. The media access protocols regulating access to the physical medium and duration of use in order to manage potential conflicts. These protocols play an important role in the distribution networks, where all users may send and receive at any time [4]. The access protocols are based on two allocation mechanisms: static and dynamic. A static allocation mechanism allocates a definitively communication channel, while the dynamic mechanism is able to

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the modes FDMA, TDMA and CDMA that we present now.

2.1.1Duplexing techniques:

There are two techniques of duplexing:

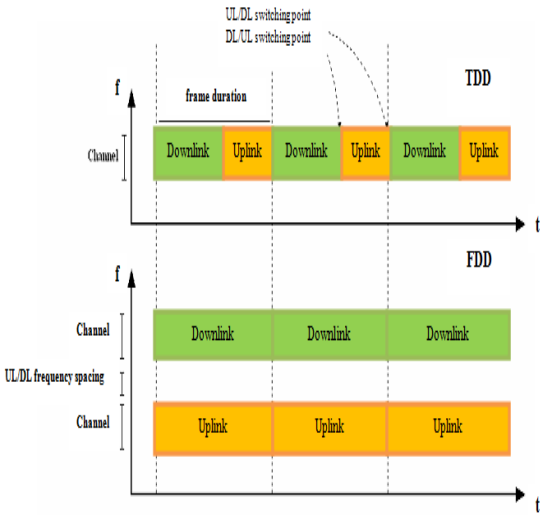


Figure 2: Duplex Transmission, Duplexing Allows To Separate The Upstream And Downlink Communications

FDD: Frequency Division Duplexing. In this mode, the uplink and downlink channels are on distinct frequencies. This is the choice of GSM and UMTS [7].

TDD: Time Division Duplexing. In this mode, the uplink and downlink channels are on the same frequency, but alternatively use the channel (typically the first downlink and then uplink. This is the choice in the case of wireless local systems [8]. This is also the case for a second phase of UMTS for urban environments organized in micro-cells. The two main advantages of TDD are [4]:

- A greater simplicity of the RF part, since it works only on one frequency at a time (against two for the FDD, one on the uplink, one on the downlink.
- The channel is reciprocal (i.e. that the base station sees the same transmission channel as the terminal).Therefore, the power adjustment is simple. (The power adaptations adapt its transmission power to have good power (and thus the good signal / noise ratio at the receiver).

2.1.2 Frequency Division Multiple Access (FDMA):

In a pure FDMA system, all users can transmit their signals simultaneously and are distinguished by their transmission frequency. The FDMA is based on the oldest known multiplexing technique: frequency multiplexing used to transmit TV signals over the cable, or on conventional Hertzian and satellite channels [9]. The main problem that the FDMA poses to the transceiver designer is that of the adjacent channel. Indeed, it is absolutely necessary to avoid derating power outside its band, on pain of generating significant interference on the channel occupying the neighboring frequency as shown in Figure 3. This problem is particularly important on the uplink. Indeed, the signal received at the base station by a mobile away is significantly lower than the signal received at the base station by the near mobile. Therefore, if the nearest mobile generates significant interference, the signal distant signal may be completely embedded in the interference generated by nearby mobile [1].

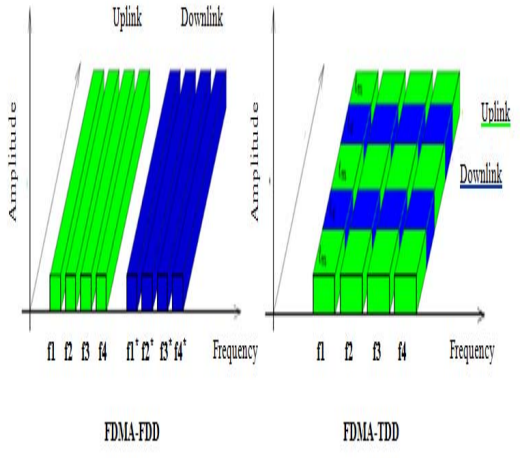


Figure 3: Examples Of Pure Systems.

The FDMA mode is to perform frequency division of the spectrum. This results in several carriers contained in the allocated frequency band. Each of these receives a communication carrier (and only one simultaneously). Generally, the physical channel uses two frequency bands (a rising and a descending).

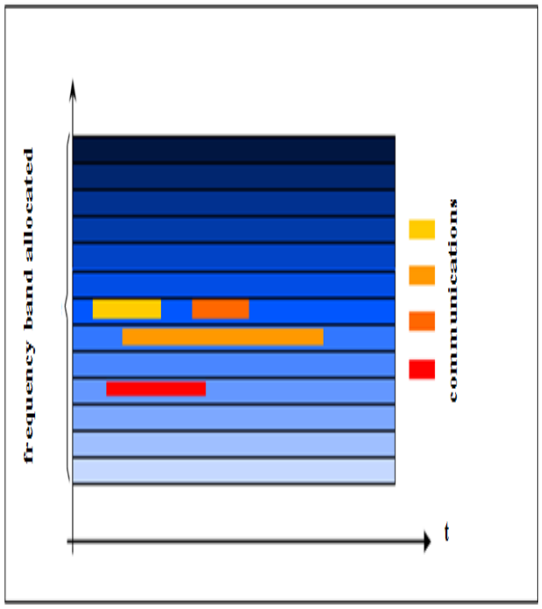


Figure 4: Fdma Access Mode

This mechanism has some disadvantages:

- Each user monopolizes a carrier and that even during silence phases.
- If a frequency range presents shadow areas, the client loses its communication.

2.1.3 Time division multiple access (TDMA):

In a TDMA system, users use the same frequency and take possession of the channel each in turn (it is the system of a civilized conversation with several). TDMA is based on time division multiplexing used for example in telephony, concentration (digital) connections between telephone exchanges. The main benefit of TDMA is that it is easy for a user to take possession of multiple slots of the time multiplex, and it is therefore easy to have users using different data rates as shown in figure 5.

"The" main standard using this technique is the GSM, which uses a mix of TDMA and FDMA, on a TDD duplexing technique. DECT (Digital European Cordless Telephone) also uses TDMA / FDMA, but with technical TDD (since DECT is for microcells of approximately 300 meters in diameter). The same manner as in FDMA, the signal received on the uplink (i.e. the base station) may be very different in power for a remote user and a near-end user. It is therefore necessary also to perform power control [10].

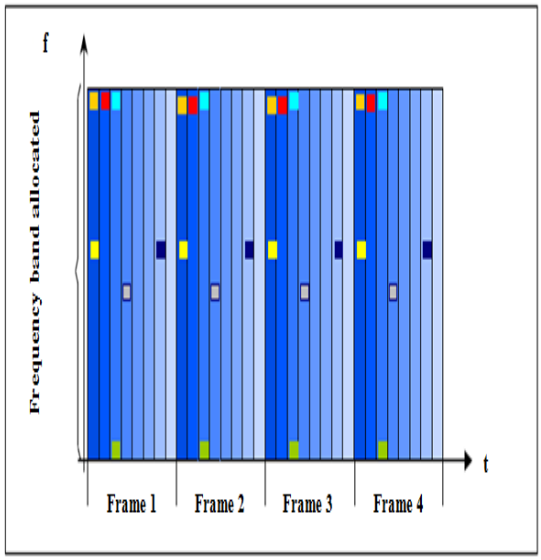


Figure 5: Tdma Access Mode

This access mode works on a shared physical resource in time: each carrier is divided into elements called time slots. The TDMA frame is defined as being equal to eight slots. When a client accesses the network, a slot is assigned (fixed carrier and slot number from 1 to 8 in the frame). The client retains that slot on this frequency for the duration of its communication.

When two clients simultaneously transmit on the same slot (same carrier and the same slot number in the frame), there is a collision, and packets are lost and must be reissued. This technique is much more interesting than FDMA in terms of channel utilization (8 times passing more customers on a frequency in FDMA) [6]. It was used by the GSM

until 2000 (now in the new GSM standard, clean packet communication change frequency at each frame, ensuring a better quality of services mean: every user benefits from the entire frequency range).

2.1.4 Multiple access by frequency division (CDMA):

CDMA is based on the technique of spread spectrum, where each user is allocated a PN code (random code) different, and is identified with that code. Besides Viterbi, one of the strongest (and rich) advocates CDMA for mobile telephony, and the first standard developer, (tried to) demonstrate that CDMA enabled increased capacity; one of the reasons CDMA success is its flexibility. Two arguments in favor of the CDMA are [11]:

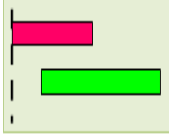
The absence of frequency planning. As noted in the section on the spread spectrum, if two signals have different codes, it is possible to separate them from each other.

It is therefore sufficient to ensure that the users of the adjacent cells have different codes to distinguish them, and therefore there is no need for different frequencies for each cell.

Spread spectrum, it is sufficient to use signals with different spreading factors, which is made, for example, by the OVSF codes (Orthogonal Variable Spreading Factors) in UMTS .This mechanism optimizes the use of bandwidth by two improvements [7]:

- By multiplexing code messages that simultaneously occupy a channel. By adding an identification code to frames of a message, it is possible to combine them into a single signal. In reception, it is possible to extract from the signal the different messages in the majority of the cases with an antagonistic algorithm of code decoupling. The coding / extraction of messages relies on combinatorial mathematical techniques (Walsh Hadamard matrices, "gold sequences"). Compared with TDMA, CDMA therefore avoids most collisions with the exception of the case or two messages are sent strictly at the same time, in which case there will be a collision and therefore retransmission. So there is more concept of sharing of bandwidth (frequency or time) between users. Everyone has a certain way all the band at its disposal.

Table 1: Comparison Of Access Methods

Type of collision	TDMA	CDMA
	Collision	Collision (but packages not necessarily all lost)
	Collision	No collision

- By issuing the message before a small package called "power preamble" following the pure ALOHA protocol with an initial transmission power p watts. At each failure of the transmission of the preamble, it is re-transmitted but with an incremented power (within the limit of the number of attempts granted, if it is exceeded there is failure of the transmission). When the preamble is acknowledged, the message is in turn transmitted to the power reached. In the event of a collision between messages, the higher power message will be transmitted (unlike the pure ALOHA) and the lower packet will be re-transmitted without increasing its power. Of course, a packet must be significantly more powerful than the others (delta of 2 steps of power) in order to be "distinguished" from the others. Thus in the type of collision 1 in the

table above, a message more powerful than the other one (s) will not be lost.

2.1.5 Notes on comparative performance of TDMA / FDMA / CDMA:

As a first approximation (that is to say, regardless of intervals and / or guard bands), TDMA and FDMA systems have the same performance. Indeed, the implications of interference, and thus in the cellular frequency planning, is the same. It is then possible to rely simply on the spectral efficiency in a single cell, and if the data is to be divided into frequencies or times, it will not change [12].

In CDMA, things are a little more subtle, since you can use the same frequencies in all cells. On the other hand, it is not possible to obtain orthogonal codes for users of different cells (all the more so because it would require synchronizing the cells between them, which is very complicated).Therefore, a complete (and statistical) analysis of the interferences must be carried out, depending on the quality of the codes used. Depending on all this, some argue that CDMA allows for greater capacity. Without going into detail, this statement is correct only if very powerful algorithms are used in the receivers, which is not the case at the moment [8].

2.2 Random access methods for wireless systems:

In the previous section, it has come fixed multiple access methods. These are very efficient in terms of spectral efficiency, but completely neglect [13]:

- The problem of random access to the channel to ensure the establishment of communication;
- The random access problem to ensure data communications. These are by nature intermittent and subject to great variations in flow. Moreover, they require a settling time of much lower connection in the case of voice communication.

To solve these problems, we must appeal to the random access techniques are:

- ALOHA (and its variations)
- CSMA (and its variations)

2.2.1 ALOHA for wireless communications:

Aloha is a random access method for access to the transmission channel. An access method is seen on a level other than an access technique (FDMA, TDMA and CDMA) but it will be presented at the same level to emphasize its interest in improving performance. A source uses the channel only when needed, so when it has information to send. The source then waits for the recipient's response to report a bad or good reception [14]. This technique is adapted to the case of a large number of users who are often inactive. In the case where several sources try to send at the same time, a collision is caused and the packets in collision are lost, which requires a retransmission.
In satellite networks, this technique can be used to resource demand, and therefore in the control plan. The major disadvantages of this technique are instability and low throughput (18%).The sliced aloha gives better performance, since the transmitters are synchronized by a discretization of time [15].

In the case of the terrestrial network the duration of a time slot is the return RTD (Round Trip Delay) maximum between two network points. The stations are synchronized and experiencing the beginning of a slot. A station cannot issue at the beginning of a slot. A flow rate of 36% is achieved by this technique. Several variants of Aloha have been studied [12]:

- Aloha with contention resolution.
- Aloha with carrier sense.
- Aloha with collision detection.
- Aloha with collision resolution.

2.2.1.a The pure ALOHA protocol:

Works with TDMA (no / little collision avoidance mechanism). In Hawaiian, "Aloha" means "Hello". This summarizes the operation of this somewhat barbaric protocol which consists for the client to send his message on the channel without worrying about whether the one is already busy transmitting or not data as shown in figure 6. If the transmitter does not receive an acknowledgment for its transmission during a given time interval, it re-transmits the same in the same way. If no acknowledgment has been received beyond a certain number of attempts, there is a failure of the transmission ("saturated network") [16].

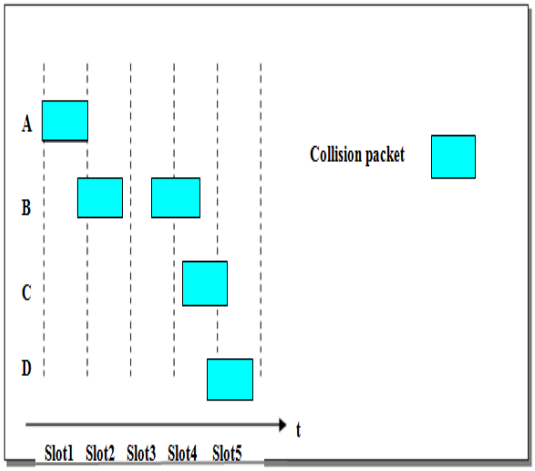


Figure 6: ALOHA

2.2.1.b The slotted ALOHA protocol:

This protocol inherits the ALOHA protocol. It improves it by discretizing time into elements called "slots", intervals with a duration of 577 µs. The discretization of time means that the transmitters and the base with which they communicate as shown in figure 7, are synchronized to the same external clock: each station knows exactly when a slot begins. Two packets collide if they are ready to be sent in the same slot. Depending on the selected type of transmission (CDMA ...), processing different collisions [17].

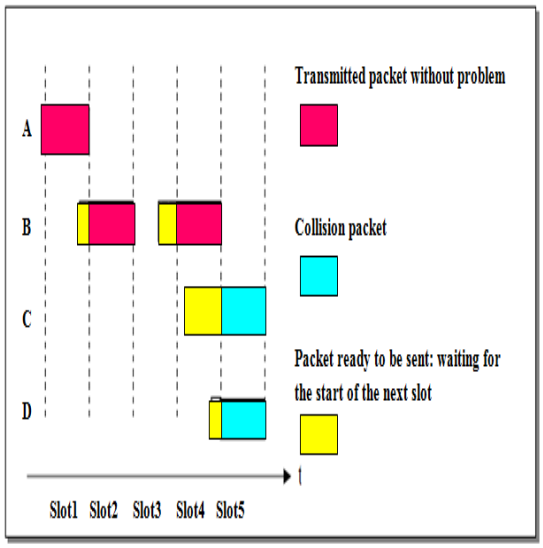


Figure 7: Slotted Aloha

2.2.2 Carrier Sense Multiple Access (CSMA):

The main defect of ALOHA is its lack of spectral efficiency. In ALOHA, users do not take into account the activity of their peers and there is no mechanism to prevent collisions. A simple way to avoid collisions is to simply listen to the channel before transmitting a packet. If the channel is used, the terminal will wait before transmitting. The protocols that use this principle are called CSMA (Carrier Sense Multiple Access) and LBT (Listen Before Talk) [18].

Figure 8 illustrates the operation of CSMA: User1, after checking that the channel was free, sent two frames. User 2 finds that the channel is being used and delays its emissions for a certain period of time. At the time when it sends its packet, users 1 and 3 want to transmit a packet, find that the channel is used and also delay their transmission with a random delay. The delays are such that there is still collision between the packets and that a retransmission is necessary. The CSMA protocol reduces the collision probability significantly compared to ALOHA, however, these collisions may occur. In particular, if the propagation time between terminals is large, the probability of collision will be high. Therefore, CSMA is used instead for local networks, while ALOHA is used in large cells [19].

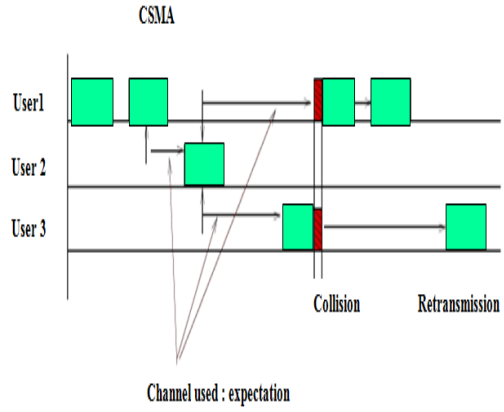


Figure 8: Basic Principle Of The CSMA

Medium Access Controller (MAC) is the physical implementation of the protocol defined for the media access control that is used in the case of shared networks with multiple nodes available for communication using a single physical medium. The advanced methods from the Ethernet ALOHA and two varieties have been defined to deal with different scenarios. Among them CSMA / CD and

CSMA / CA are widely deployed in many networks such as Ethernet. Carrier Sense defined here is the situation where the physical layer listens to ethernet wire before transmitting data across the network [14].

2.2.2.a CSMA/CD :

This multiple access method is used in wired networks because it is possible to detect a collision and then proceed with so much used in LAN and WAN. It is used by IEEE 802.3 standard Ethernet in which each node monitors the traffic on the line and if no traffic is available, a particular node can transmit. But at the same time if two attempt to transmit then it is known as a collision. This situation is detected by all nodes in the given network. After the stations that had the collision will try to send data after a certain random time interval that are vary for each node. If again a collision occurs the random time undergone is increased and waits again. This is the procedure used in CSMA / CD networks and the method has no deterministic capability [20].

2.2.2.b *CSMA/CA :*

This is the multiple access scheme used in the layer 2 access method wherein the following method is used when the nodes try to transmit simultaneously in a shared network. Here the node that wishes to transmit first must listen to the channel for a predetermined period before evaluating the state of the channel. If the channel is free then the node is capable of transmitting. Otherwise the channel is said to be busy and the node must wait until the channel is in standby mode [21].
This is implemented in local networks IEEE 802.11 wireless and other wireless networks and this is preferred because wireless networks can not detect a collision while transmitting as wired networks. Thus, the implementation of CSMA / CA will improve the packet fell in wireless networks.

- CSMA CD is used in wired LANs and CSMACAs used in wireless LANs and other types of wireless networks.
- CSMA CD is standardized in IEEE 802.3 CSMA and CA is standardized in the IEEE 802.11 standard.
- CSMA CD will not take steps to prevent transmission collision until it is taken up for CSMA CA will take steps to not take place at any collision since it has no way of knowing whether a collision occurred.

2.2.3 The performance of random access methods:

Aloha is a simple communication system to be used for satellite communication. In the Aloha process, each source in a communication network transmits data each time there is a frame to be transmitted. If the frame successfully reaches the destination, the next frame is transmitted. If the frame is not received at the destination, it will be transmitted again. CSMA (Carrier Sense Multiple Access) is a Media Access Control (MAC) protocol, where a node transmits data on a shared transmission medium only after verifying the absence of any other traffic [22].

As mentioned earlier, Aloha is a simple communication protocol in which each source in the network transmits data every time it has a frame to be transmitted. If the frame is successfully transmitted, the next frame will be transmitted. If the transmission fails, the source will resend the same frame. Aloha works well with wireless broadcast systems or half-duplex bidirectional links. But when the network becomes more complex, such as an Ethernet with multiple sources and destinations that uses a common data path, problems arise due to a collision of data frames. When the communication volume increases, the problem of collision becomes worse. This can reduce the efficiency of a network since frame collision will result in data loss in both frames. Slotted Aloha is an upgrade to the original Aloha protocol, where discrete time slots have been introduced to increase maximum throughput while reducing collisions. This is achieved by allowing sources to transmit only at the beginning of a time interval [23].
CSMA protocol is a probabilistic MAC protocol in which a node checks whether the channel is free before transmitting on a shared channel, such as an electrical bus. Before transmitting, the transmitter tries to detect the existence of a signal from another station in the channel. If a signal is detected, the transmitter waits until the current transmission is completed before starting transmission again. This is the "Carrier Sense" part of the protocol. "Multiple Access" defines several stations that send and receive signals on the channel and a transmission by a single node is generally received by all other stations using the channel. Carrier Sense Multiple Access with collision detection (CSMA / CD) and

Carrier Sense Multiple Access with Collision Avoidance (CSMA / CA) are two modifications to the CSMA protocol. CSMA / CD improves CSMA performance by stopping a transmission as soon as a collision is detected and CSMA / CA improves CSMA performance by delaying transmission by a random interval if the channel is detected busy [24].

The main difference between Aloha and CSMA is that the Aloha protocol does not attempt to detect whether the channel is free before transmitting the CSMA protocol but verifies that the channel is free before transmitting data. Thus the CSMA protocol avoids conflicts before they occur while the Aloha protocol detects that a channel is busy only after a conflict occurs. For this reason, CSMA is more appropriate for Ethernet networks where multiple sources and destinations use the same channel.

3. SIMULATION AND ANALYSIS OF RESULTS :

It can be shown that the choice of an access technique is a preponderant factor for the performance of wireless systems. In the case of cellular systems, this choice has made and is still debating between CDMA and TDMA / FDMA for example.

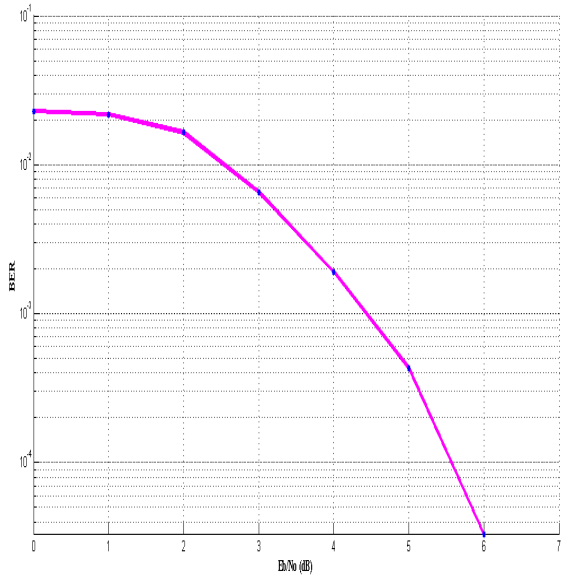


Figure 9: CDMA Ber Plots

Indeed, depending on the cellular organization and signal processing techniques used, one and the other techniques promise different capacities (figure 9).

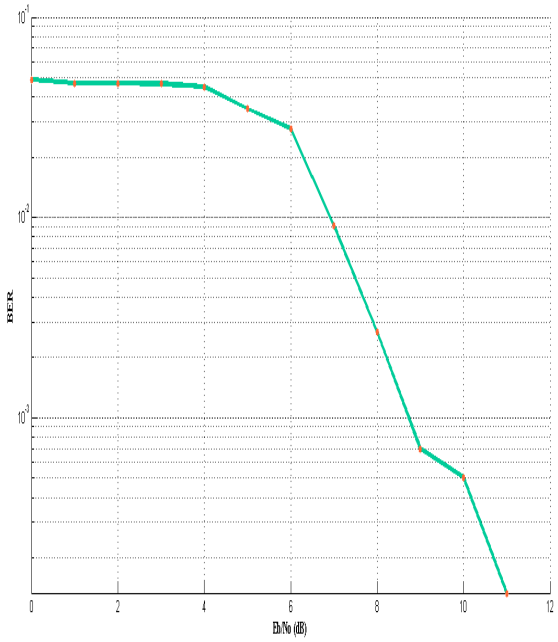


Figure 10:*FDMA ber plots*

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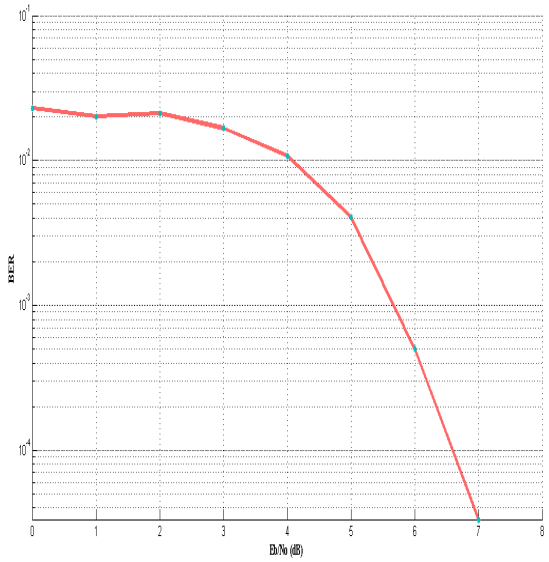

Figure 11: TDMA Ber Plots

The principle of this protocol is simple: each node at the same time sharing the same frequency band to communicate (figure11). There is no synchronization mechanism between nodes or previews of the channel. This implies that there is no resource allocation for one or more network nodes. So the nodes transmit regardless of the state

of the channel, there is no acknowledgment indicated to the sender that the transmitted frame is badly received.

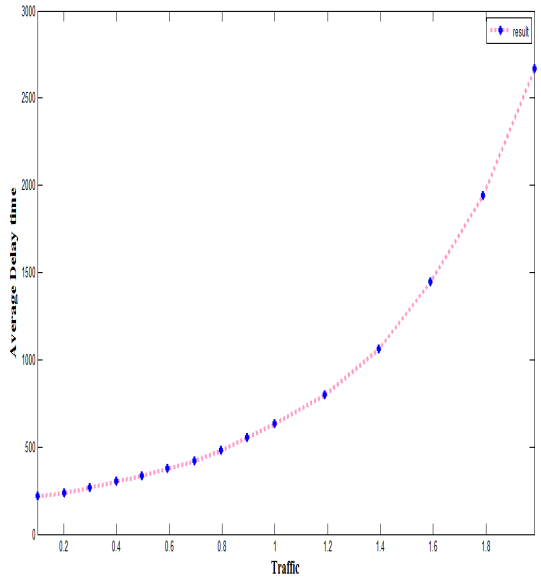

Figure 12: Average Delay Time Of Pure ALOHA System

The recovery is therefore by using the ARQ (Automatic Repeat ReQuest). The ALOHA protocol exists in two versions, a slotted version (Slotted ALOHA (Figure 12)) and a non-slotted version (UnSlotted ALOHA (Figure 13)). As described in the transition diagram in Figure 13, when a node wishes to transmit a PDU, it transmits it directly to the radio interface if it is not already present. Used in transmission. .After sending a retransmission timer is triggered. Thus begins a receipt acknowledgment wait state of the transmitted PDU. If the acknowledgment of the current PDU is received before the expiration of the timer, it is off then checks whether the packet queue from the network layer for this interface is not empty.

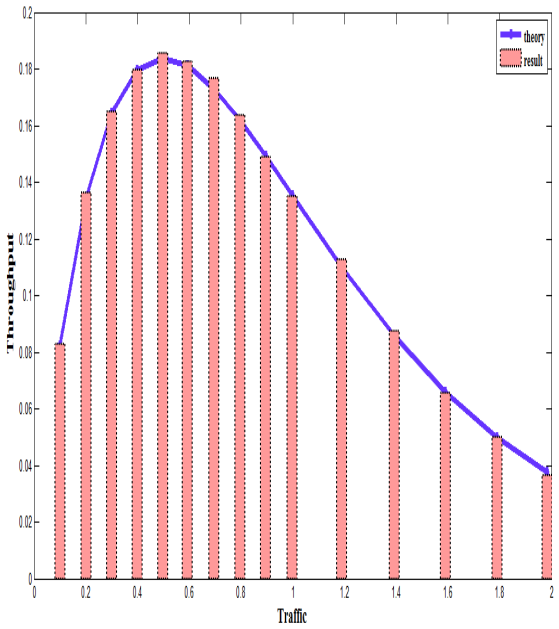

Figure 13: Throughput Of Pure ALOHA System

If this is the case, is selected the first packet in the lead, and then encapsulated in a MAC-PDU that is transmitted. The priority is thus first-come first-served. Otherwise, we wait for packet transmission. At the end of the total reception of a PDU received by the radio interface, the disencapsulation process is performed: removing the MAC header, and transmission of the PDU to the network layer if it is addressed. In the case of the expiration of the retransmission timer before receiving the acknowledgment issued the PDU it transmits. Maximum retransmission terminal has been defined to avoid indefinitely transmitting the same PDU. Once this terminal is reached, the current PDU is deleted and one passes to the next one in the queue.

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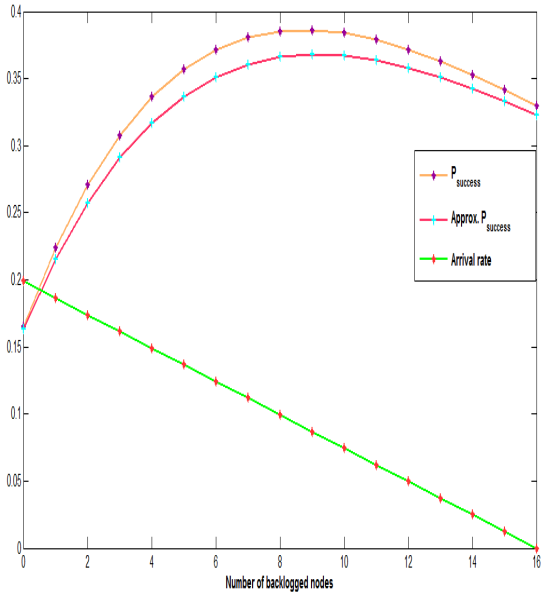

Figure 14: S-Aloha

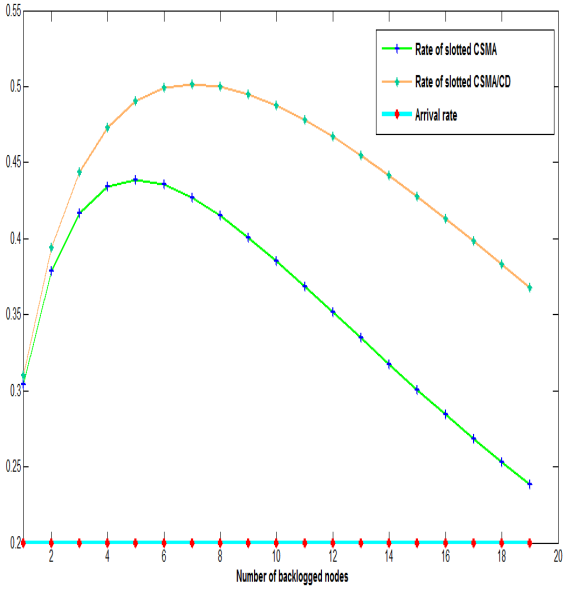

Figure 15: Number Of Successfully Transmitted Packets By Backlogged Nodes Versus Arrival Rate

In Slotted ALOHA, the carrier is divided into slices without super frame structure, and a transmitter can transmit at the beginning of a slice. The idea is to ensure that the same frame does not partially collides with several frames as in the ALOHA protocol UnSlotted. In this method, each station periodically transmits to a slot using the access code. A slot consists of a certain number of bits so frames, the transmitter sends one bit of each frame of slot according to its code.

As can be seen, various parameters can influence the behavior of this method: slot size, slot interval, management technique etc. If at the arrival of the next slot, the transmitted PDU is still not acknowledged, it is retransmitted. The retransmission delay is thus equal to the size of the PDU minus the duration of the slot in this case. As in the previous method, a maximum retransmission boundary is set and the accused have priority over other types of PDUs. In the present method, since transmission is not immediate, it is necessary to introduce two waiting states which represent the state of the MAC layer before the arrival of the next slot (see Figure 14): wait for the slot to appear and wait for the first chip to be used.

In UnSlotted ALOHA, so that there is no possibility of collision, it is important that no frames are transmitted by a nearby sensor during a period equal to said vulnerable period $2t$ (see Figure 14), or t is the duration of a frame. Taking G the average number of frames sent by time frames and assuming that the number of frames sent over the duration of transmission of a frame follows the Poisson law, then the probability that k frames are issued during the duration of a frame is equal to:

$$P(k) = \frac{G^k * e^{-G}}{k!}$$

Also the probability of having 0 frame is of the form e^{-G}.

In an interval of duration equal to 2 " frame times ",the average number of generated frames is equal to $2G$ .The probability that no additional traffic is generated during the entire period of vulnerability is given by $P_0 = e^{-2G}$ .By positing $S = G * P_0$ we obtain :

$$S = G * e^{-2G}$$

The maximum traffic is obtained for $G = 0.5$ with $S_{max} = 1/(2e)$ whose value is about

$0.184(18\%)$. The introduction of respective intervals of constant duration will double the transmission capacity $S_{max} = 1/e$.

As can be seen in figure 14, Slotted ALOHA has a maximum for $G = 1$,with an elapsed traffic of $S_{max} = 1/e$ whose value approximately $0.368(36.8\%)$. In this method , which has become the ALOHA or Slotted ALOHA ,a station must wait for the start of a time interval to start broadcasting .As shown in Figure 15 , the period of vulnerability is limited to the duration of a frame (t) which leads us to $S = G * e^{-G}$.

4. CONCLUSION:

We have presented in this article the most multiplexing methods used in the field of radio frequencies: frequency division multiplexing (FDMA), time (TDMA) or code (CDMA).We gave then the principle of spread spectrum and in particular that using direct sequences. At the receiver, extracting information signal requires synchronization between the received codes and those generated locally. To obtain the latter, two steps are required: the acquisition of the codes and the continuation of the codes. The performance evaluation was a capital asset in the efficiency of random access protocols. This has enabled, among other things, better use of these protocols depending on the transmission media.

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