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Study of different types of noise and their effects on digital communications

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Abstract: During propagation between a transmitter and a receiver, the transmitted signal is often subjected to several phenomena related to the propagation environment. It result during reception, a signal comprised of multiple elementary signals. These elementary signals take different paths and therefore have different propagation times and amplitudes. They thus exhibit phase shifts that may lead to recombination of constructive and destructive ways thus causing a complete disappearance of the signal. The latter phenomenon commonly known as 'fading' may affect the performance of mobile communication systems. The fading amplitude of the received signal may follow several statistical distributions such as Rayleigh, Nakagami. In this context, the evaluation of performance of these systems is therefore essential to develop highly efficient systems. As the measures in real environments are very tedious, several methodologies will emulate realistic propagation channels multi paths have been proposed. This in order to characterize the performance of mobile communication systems.

Keywords: fading, noise, channel, Rayleigh, Rice, digital fingerprint.

1. INTRODUCTION

In wireless communication systems, the mobility of the transceiver assigns the communication channel and provides fundamental limitations to this kind of systems. The transmission path between the transmitter and the receiver can change from direct spread unobstructed severely obstructed by buildings, mountains, foliage, etc [1]. In contrast to wireline channels that are predictable and steady, the radio channels used in the mobile communication systems are extremely randomized and therefore difficult to analyze. Thus the speed of movement of the transmitter or receiver affects the speed of the fading signal. The modeling of the channel has historically been one of the most difficult parts of a mobile system design. Typically, this model is based on a statistical model based on measurements made for a communication system having a specific allocation of spectrum [2].

Wave propagation mechanisms are diverse, but can generally be attributed to reflection, diffraction and dispersion. Most systems operate in urban areas, there is no propagation path-sight between transmitter and receiver and the presence of high buildings causes severe losses due to diffraction. Due to multipath reflections on various obstacles, the waves travel along different paths with varying amplitudes. The interaction between these waves then causes fading at a specific position and amplitude of the wave decreases as the distance between the transmitter and the receiver increases [1].

Propagation models have traditionally interested in the prediction of the average amplitude or the signal received at a given distance from the transmitter, as well as the variability of the amplitude of the signal in close proximity with obstacles. The propagation models that predict the average amplitude of the signal at a given distance between the transmitter and the receiver are useful for the estimation of the coverage of a transmitter and are called "large- scale models"[3]. They characterize the signal amplitude at distances of separation of the transceiver of several hundreds or thousands of meters. On the other hand, propagation models characterizing the rapid fluctuations in the amplitude of the received signal at very short distances or very short transit times are called "small-scale models" .

When the mobile moves over short distances from the base station, the instantaneous amplitude of the received signal may vary quickly, thereby causing fading at small scales. The received signal is a sum of contributions from different directions and whose phases are uncertain, it changes significantly; for example by obeying a Rayleigh distribution. In case of small scale fading, the instantaneous power of the received signal may change from three to four orders of magnitude for a receiver moved only a fraction of the wavelength [2]. If the mobile moves away from the transmitter at much greater distances, the average of the received local signal will gradually decrease. Mobile communication channels are represented by multipath time varying. Knowing that the performance of the digital system is strongly affected by multipath propagation in the form of dispersion, reflection and refraction, it is necessary to study the behavior of these paths [4].

The choice of the propagation channel is critical during transmission. It depends on the expected transmission quality and constraints including the transmission [3]. Indeed, in the presence of reflection, refraction or diffraction, the wave can take different paths. At the reception, the signal can be attenuated or at worst, completely destroyed since the different versions of the signal can be added or canceled [5]. In this case, it is

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called fading. In this article, Part 2 treats multipath propagation, explaining the basis for a communication system and the mechanisms of multi-path propagation, Part 3 presents the physical aspects of the propagation channel .The characterization fainting are reserved for Part 4. Part 5 explains the modeling propagation channels .The simulations and analysis of results are in part 6.The conclusions are given in Part 7.

2. THE MULTI-PATH PROPAGATION

The propagation channel induces fundamental limitations on the performance of wireless communication systems. It can vary between any transmitter and receiver of a simple transmission where the transmitter and the receiver are in the same field of vision to a transmission, more complex, severely hampered by barriers of all kinds [6]. Thus, the signal received by the receiver is composed of several waves having the different paths followed. These waves can be reflected, transmitted, or distributed, diffracted by the propagation environment and the dielectric properties of the obstacles [7].

2.1. The basics of a communication system:

A communication system enables the transmission of digital information from a source that generates the information to one or more destinations, point-to-point communication or point-to-multi-point. The transmitted signals are in digital or analog form originally, but scanned at some stage. In order to increase the reliability of the transmission, each signal is represented by a sequence of bits that ideally should be the least redundancy possible. In fact a source coding can perform data compression operations and minimizing bandwidth use. Given that the transmission channel is not perfect, disturbances may alter the transmitted signal. One solution is to use an error correction coding (eg convolutional coding, block coding, etc.)[6].

In general, the error correction coding consists to introduce in a controlled manner, redundancy bits in the sequence of information bits. The destination, knowing the channel coding used, is capable of correcting errors that occur during transmission. This technique increases the reliability of communication, but also the bandwidth required. Once the bit sequence to be transmitted is ready, after source coding and channel coding, it must be adapted to the physical transmission medium. This operation, called modulation consists in associating a particular signal to a particular sequence of bits [7].

The modulation is often encountered M-QAM (Quadrature Amplitude Modulation). The resultant signal is finally transmitted in the channel. This signal is corrupted due to attenuation and distortion by many factors such as noise, interference and delay. At the reception, all operations done find an equivalent. Therefore, the received signals are demodulated and the decoded bit sequence to recover the bit sequence information originally sent.

Figure 1 illustrates a communication system with the operations described above [8].

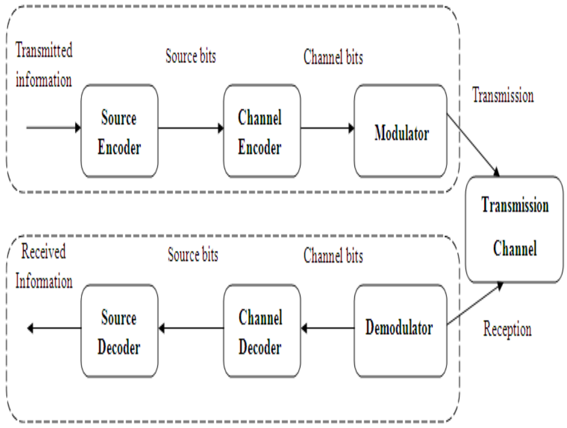

Figure 1: Diagram of a transmission chain.

2.2. The mechanisms of multi-path propagation:

The physical processes of propagation are twofold: the distortion of the electromagnetic wave and overlay of unwanted signals, designated as either noise [8]. The four main mechanisms governing the interaction of the wave with the environment are explained in the following paragraphs. Moreover, the distortions due to the wave interaction with the environment are observed at two different levels, as their impact is visible on a large or small scale [9].

2.2.1. The Noise:

The noise includes all signals not carrying useful information and affect the desired signal from Figure 2. This is a disturbance whose origins are the propagation channel (external noise), and electronic devices used in the receiver (internal noise). External noise may be extraterrestrial or terrestrial origin [9]. The first category, returning into account that in the space link or in the upstream channels to satellite, terrestrial only are noise sources. They include noise due to atmospheric interference, those from the various radiations of the environment, any interference between users of the propagation channel or the noise of industrial origin and due to human activity in general [10]. As to the internal noise, it originates from the Brownian motion of the electrons present in the electronic components of the receiver [11].

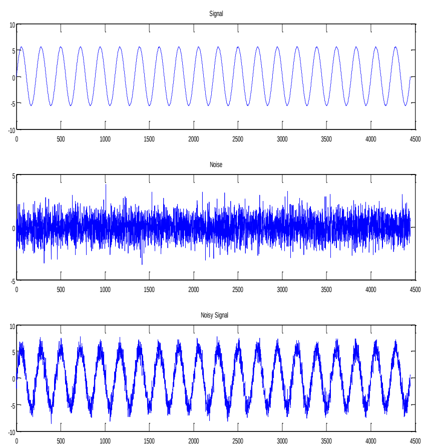

Figure 2: The effect of noise on the transmission of a signal.

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2.2.2. Propagation mechanisms:

In the ideal case of propagation in free space, there is nothing outside the transmitting and receiving antennas, so there is the direct path [9]. In an environment where obstacles are present, to give the direct path between the transmitter and the receiver, the extent of which varies with the wavelength and the distance between the transmitter and the receiver, is clear of obstructions [12]. In reality, apart from the direct path between transmitter and receiver, each trip as a contribution at the receiver has encountered at least one obstacle, it is called multipath propagation. The four phenomena governing the interaction of the wave with the environment are well known phenomena of reflection, refraction, diffraction and scattering [13]. They are considered the basic physical mechanisms of propagation in the context of wireless communications. The main propagation phenomena are illustrated in Figure 3.

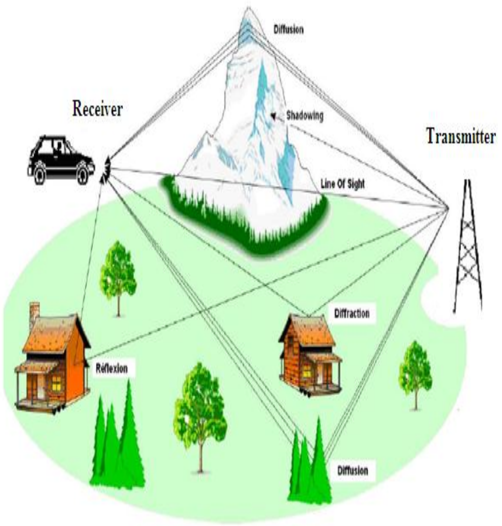

Figure 3: The principal propagation mechanisms

2.2.2. a. Reflection / Refraction:

Reflection and refraction are involved when the wave interacts with an obstacle whose dimensions are very large and very small irregularities to the wavelength [13]. When the object is perfectly conducting, all the incident energy is reflected. Otherwise, a part of the energy penetrates the object, according to the refraction phenomenon [14]. The amount of energy carried by the refracted wave depend on the absorption capacity of the material. For a flat surface, incident angles, reflection and refraction are related by Snell -Descartes and, in particular, the angles of incidence and reflection are equal. Since the surface has a certain roughness with respect to the wavelength, the incident wave is reflected in several directions and is called diffuse reflection [15].

2.2.2. b.Diffraction:

Diffraction occurs when the propagation path is blocked by an obstacle having small dimensions to the wavelength or having sharp edges [13]. According to the Huygens principle, each point of the wavefront acts as a secondary source [14]. The energy transmitted by these sources allows the signal to propagate in areas which would be considered as shadows by geometrical optics, as well as explaining the waves arrive at the receiver in the absence of direct visibility or the intervention of other types of interaction [15].

2.2.2. c.Diffusion:

The spread of a wave appears if it exists on the wave path a dense package of dimensions of objects of the same order of magnitude or less than the wavelength [13]. In this case, the wave is redirected in all directions with different attenuations. The same phenomenon is observed with a rough surface having dimensions of asperities near the wavelength [14]. We find this type of phenomena in the wave propagation in the presence of trees, for example [15]. These propagation mechanisms explain the possibility of communication for mobile connections where the transmitter and receiver are not necessarily line of sight.

2.2.3. The effects of multipath propagation:

The multipath propagation provides a continuity of the coverage by allowing communication in case the transmitter and receiver are not in direct view. However, the multitude of paths creates difficulties for the receiver. In fact, the received signal is a combination of several instances of the signal with amplitudes, phases and different time arrivals [16]. Fading of a multipath channel are categorized into two types: slow fading and fast fading. The slow fading or large scale, such as attenuation and shadowing, attenuation translate the power of the signal due to the distance between the transmitter and receiver or due to obstacles encountered. The attenuation appears like an overall decrease in received power depending on the distance transceiver [17]. This process can be modeled by a simple equation representing the attenuation due to propagation in a given environment. As for shadowing, it undergoes more rapid changes than attenuation up to 20 dB at a distance of hundreds of meters. The shadowing is caused by obstacles between the transmitter and the receiver such as high buildings or dense vegetation. The fast fading or small scale have amplitude variations on a scale equal to a half wavelength and can achieve up to 40 dB [18]. This results in constructive and destructive interference between the waves reaching the multipath receiver.

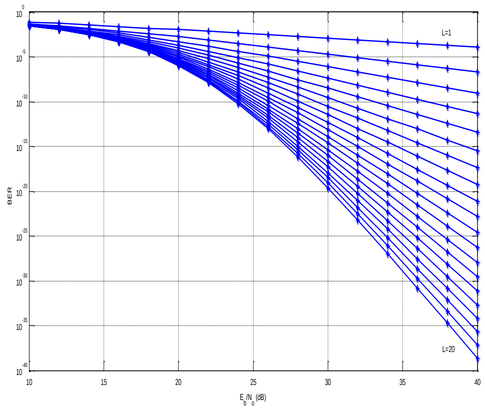

Figure 4: Quadrature amplitude modulation through a fading channel with order of diversity varying from 1 to 20.

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3. THE PHYSICAL ASPECTS OF PROPAGATION

The physical phenomena that alter the transmission at a spread can be classified into two categories [19]. According to the observation time of the events we encounter phenomena known large and small scale [20].

3.1. Large-scale phenomena:

The large-scale phenomena are the phenomena that affect the transmission from the transmitter to the receiver and during the entire program. We meet in the first place the signal attenuation due to free-space propagation caused by the isotropic dispersion of energy and growing according to the frequency and distance [21]. Secondly, there is the attenuation called masking effect or "Shadowing" which is due to the presence of obstacles such as buildings, forests between transmitter and receiver. For the latter, the attenuation varies depending on the nature of the material crossed. On a large scale, the propagation channel is characterized by attenuation and shadowing [22]. While the attenuation is global average variability, shadowing represents a local average variability.

3.1.1. The attenuation:

Attenuation is expressed by the ratio between the power received by the receiver and the one emitted by the transmitter. The main parameters that can be included in the different attenuation models are parameters related to the environment and antennas [22]. The parameters related to the environment may include information on the type of connection, the region, the average height of buildings, vegetation [23]. The parameters for the antennas contain information about their investments and their types. Often, these models do not explicitly depend on the frequency, but a frequency range in which the model is valid is set.

3.1.2. The shadowing:

At a fixed distance from the transmitter, the received signal will not be constant, it varies with respect to an overall average [22]. The shadowing is often caused by the presence of large obstacles like buildings and trees between the transmitter and receiver [23]. This large-scale source characteristic is the slow variation compared to global average power, these variations can be described by a log-normal distribution including standard deviation depending on the frequency and the environment [24].

3.2. A small scale phenomena:

Small scale phenomena are the phenomena that affect the signal transmitted over a short time interval. It is observed that the reflections, refractions and diffractions caused by the presence of objects creating several instances of the transmitted signal. They can add constructively or destructively at the receiver, in particular according to their respective phases. In this case we speak of "fading" of the signal. Small scales of the channel parameters describe the rapid fluctuations in the amplitude of a radio signal over a short period or for a little distance [25].

These fluctuations are due to interference between different signal paths which reach the receiver at different times. The combination of these multipath signals to the receiver results in a signal that may vary widely in amplitude and phase [26]. It depends on the power, phase and propagation time relative to each version of the signal and the bandwidth of the transmitted signal. The factors affecting small-scale fluctuations are:

3.2.1. The multi-path propagation:

In a multipath channel, the received signal is a combination of several instances of the signal with amplitudes, phases and different time arrivals [26]. This can cause distortion or rapid fluctuations of the received signal. The multipath propagation often increases the time dispersion of the signal causing intersymbol interference [27].

3.2.2. The mobility of the receiver:

The mobility of the receiver relative to the transmitter will cause a random frequency shift of the Doppler Effect applied to each of the various paths [27]. This frequency offset can be positive if the receiver is approaching the transmitter or negative in the opposite case.

3.2.3. The mobility of environmental objects:

If the objects in the environment are moving, they will produce a Doppler shift varying in time on each of the multiple paths. In the case where the objects and the receiver are in motion, there are two cases: if the object is moving faster than the receiver, its effect will dominate [28]. By against if the movement of the objects is lower than the receiver, its effect will be ignored and only the receiver of the movement will be considered.

4. CHARACTERIZATION OF FADING CHANNELS

The propagation of the signal through the wireless channel generates variations in the signal amplitude and the phase. For coherent modulation which is considered as M-QAM, the variations of the signal phase degrade performance unless they are compensated in the receiver, since the information is transmitted by the phase and amplitude of the carrier [29]. It is assumed in the literature the use of an ideal coherent receiver, wherein the phase variations are perfectly compensated. We consider later that the receiver performance is consequently completely determined by the statistics of the amplitude of the signal envelope.

4.1. Channel fast fading and slow fading:

Temporally encountered two propagation channel categories. We observe the channels fast fading and slow fading which distinction is linked to the concept of Doppler spread and coherence time of the channel. These features refer to the short-term effects mentioned above [29]. They are very important for the mathematical modeling of the channel and the system performance evaluation operating in these channels. The classification of a fast fading or slow fading channel is connected to the notion of coherence time T_{coh} channel which is a measure of the minimum time separation for which the impulse responses of the channel on transmission of a pure frequency are considered decorrelated [30].

A channel is called slow fading if the channel coherence time is much larger than the symbol duration. In other words, the realization of the channel is the same for several transmitted symbols. Therefore a very low level of signal can be observed over the duration of several

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consecutive symbols, leading to a series of errors. Note that in this case, the fading can be superimposed on the longer-term effects [31].

4.1.1. Doppler Spread:

The Δ_d Doppler spread represents the difference between the largest and smallest frequency shift inherent multipath [32].

4.1.2. The coherence time:

The coherence time T_{coh} is defined as the minimum time required for the impulse responses of the channel on transmission of a frequency are decorrelated. It is defined by:

$$T_{coh} \approx \frac{1}{\Delta_d} \qquad (1)$$

If two transmitted signals are separated by a temporary interval of less than T_{COH} then their amplitudes are attenuated similarly as the impulse responses of the system to its two inputs are decorrelated [33]. A slow fading channel is a channel whose duration Ts of a symbol verify $T_s \square T_{coh}$. In this type fading low noise level is observed on several consecutive symbols because the channel response changes more slowly than the signal. On the other hand, a channel is said fast fading if $T_s \square T_{coh}$. The channel response changes faster while during the duration of a symbol. Fainting is then on each symbol.

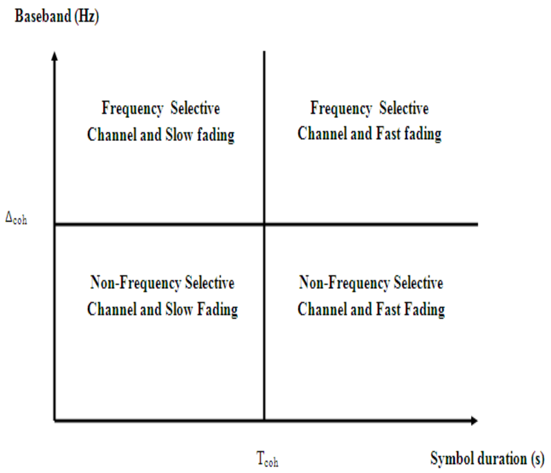

Figure 5: Classification of multipath channels

4.2. Selective channel and non-frequency selective:

On the frequency level we find two propagation channel categories. We observe selective and non-selective channels in frequency whose distinction is related to the concept of multi-channel spread and coherence bandwidth. The frequency selectivity is another extremely important parameter of the propagation channels [34]. This characteristic is related to the coherence bandwidth of the channel B_{coh}, dual parameter coherence time. It is the measure of the minimum frequency separation for which the responses at two different pure frequencies channel are considered decorrelated. If the amplitude and phase of all the spectral components of a signal are affected in the same way by the channel (the bandwidth of the signal is less than or equal to the coherence bandwidth), it is considered non-selective frequency, also known as flat channel [35]. Otherwise, when the spectral components of the signal are affected inhomogeneously by the propagation channel, it is said frequency selective: some frequency components are subjected to different attenuations and phase distortions of a frequency in the other. Note also, that the selectivity of a channel is still on the characteristics of a communication system.

4.2.1. Spreading multipath:

The multipath spreading T_m is the time delay or gap in which the response of the channel when facing a multipath is constant [35].

4.2.2. Coherence bandwidth:

The coherence bandwidth represents Δ_{coh} the frequency range over which the channel response is considered as being nearly constant [36].
It is defined by:

$$\Delta_{coh} \approx \frac{1}{T_m} \qquad (2)$$

A channel is frequency selective if for bandwidth Bs of the signal was $\Delta_{coh} \square B_s$ or equal way to the duration T_s of a symbol; $T_s \square T_m$. Otherwise, the channel is said flat channel or nonselective [37]. The disadvantage of a frequency selective channel is based on the existence of intersymbol interference. Since $T_s \square T_m$ while the second symbol is already issued while the first is still temporally spread.

5. MODELING THE PROPAGATION CHANNELS

For a non-selective channel, the signal transmission can be achieved without modulation or baseband. Fading is realised in a homogenous way since it affects all frequencies in a similar way. After identifying the different physical involved phenomena in wave propagation, it is necessary to model the propagation channel by giving a mathematical representation conforms to reality [38]. Three approaches are possible to model the propagation channel:

- The theoretical approach based on the calculation of the field by solving the Maxwell equations leads to the deterministic model. With this approach, the Maxwell equations solving requires knowledge of several information such as the position and nature of the sources, the electromagnetic characteristics of propagation media, the boundary conditions on the surfaces, etc [38]. This information is generally difficult to know especially in the case of spread within the buildings. In this environment, a priori knowledge of many of factors such as the dimensions of the parts, materials, building architecture, the mobility of people, and the presence of various objects is not obvious.
- The developed approach from results of propagation measurements is called statistical model because the

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channel parameters are characterized by statistical processing. This approach rapidly gives the order of magnitude of the propagation channel parameters without using the knowledge of the surrounding environment [39]. In order to achieve a more realistic representation of the channel, it is necessary to make a large number of measurements. In this, the channel sounder is used to determine these parameters.

- Another called semi-deterministic approach is based on the combination of the two models. In this approach, the statistical model can be used to correct the data of the deterministic model for a template more approached actual conditions [40].

5.1. Channel propagation time invariant:

The propagation channel is viewed as a system that transforms the input signal in another output signal. It can be modeled by a linear filter whose characteristics do not change with time and space. This statement is due to the fixed position of transmitter and receiver and lacks any moving hand in our environment [41].

Therefore, the channel is time invariant. The multipath phenomenon can be modeled by a complex impulse response which includes alleviation of the delay wave and the phase of the signal on all versions of the signal received at the receiver; each path has a different version of the signal.

When the propagation channel is time invariant, it can be expressed in the field of late by its impulse response baseband $h(\tau)$ [42]:

$$h(\tau)=\sum_{p=0}^{P-1}\alpha_p \exp(i\theta_p)(\tau-\tau_p) \qquad (3)$$

This impulse response, here representing a channel having P paths amplitude α_p and phase θ_p, binds the received signal r(t) to the transmitted signal s(t) by the following relationship:

$$r(t)=(h*s)(t)+n(t)=\int_{-\infty}^{+\infty}\sum_{p=0}^{P-1}\alpha_p(\exp(i\theta_p))\delta(\tau-\tau_p)s(t-\tau)d\tau+n(t)$$

(4)

$$=\sum_{p=0}^{P-1}\alpha_p \exp(i\theta_p)s(t-\tau_p)+n(t) \qquad (5)$$

Where n(t) is the term additive white Gaussian noise.

All the propagation channel time invariant is also characterized in the frequency domain by the transfer function expressed by [43]:

$$H(f)=TF[h(\tau)] \qquad (6)$$

The Fourier transform of the received signal r (t) is given by the following relationship:

$$R(f)=H(f).S(f)+TF[h(\tau)] \qquad (7)$$

Where S(f) represents the Fourier transform of the transmitted signal s (t).

5.2. Propagation channel varying in time:

When the transmitter or receiver is moving or when the propagation environment evolves, the propagation channel model described previously will not exist. In effect, the functions $h(\tau)$ and $H(f)$ are changed over time and the propagation channel said varying in time [43].

To take into account the temporal variations of the channel impulse response $h(\tau)$ varying over time of the propagation channel is a two-dimensional function $h(\tau.t)$ where τ corresponds to the axis of delays, while t corresponds to the axis time.

Assuming that the position and the number of paths do not vary through time, the latter is expressed in the time-space delay in the form:

$$h(\tau,t)=\sum_{p=0}^{P-1}\alpha_p(t)e^{i\theta_p(t)}\delta(\tau-\tau_p) \qquad (8)$$

Based on central limit theorem, assuming that micro-paths are sufficiently large, $\alpha_p(t)$ follows a Rayleigh law whose probability density is defined by:

$$p_{\alpha_p}(\alpha_p)=\frac{2\alpha_p}{\sigma^2_{\alpha_p}}\exp(-\alpha_p{}^2/\sigma^2{}_{\alpha_p}) \qquad (9)$$

The $\theta_p(t)$ phase follows, in turn, a uniform law on $[0,2\pi]$:

The Rayleigh channel is the distribution that is used to model the fading due to multipath incoherent when the transmitter and receiver are not in direct view. This is one of the most difficult propagation channels, but fairly common in dense urban environments.

The Rayleigh channel model multipath implies that there is no dominant path. Otherwise, $\alpha_p(t)$ follows a law Rice characterized in particular by the ratio between the power of the dominant path, and the total mean power without the contribution of the dominant path.

Rice channel is often used to characterize a propagation environment having a large specular component due to a direct view between the transmitter and the receiver, and a plurality of incoherent paths caused broadcasters to the environment [43].

The model allows Rayleigh, despite its simplicity, to effectively examine the robustness and performance of a system simulation. Furthermore, its use is widely used, the results obtained are qualitatively valuable because they can be easily compared with other systems performance.

The Nakagami-m channel, The Law of Nakagami-m was proposed by the author of the same name to cover a wide range of severity of fading. The probability density of a law Nakagami is given:

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$$p_{\alpha_p}(\alpha_p) = \frac{2m^m \alpha_p^{\,2m-1}}{\sigma_{\alpha_p}^{\,2m}\Gamma(m)} \exp\left(-\frac{m\alpha_p^{\,2}}{\sigma_{\alpha_p}^{\,2}}\right), \alpha_p \geq 0 \quad (10)$$

With the fading parameter m distribution. It can vary between ½ and $+\infty$ and can therefore characterize a mono-lateral Gaussian fading channel (m = 1/2) to the perfect channel without fading, $(m \to +\infty)$ passing through the Rayleigh channel $(m = 1)$

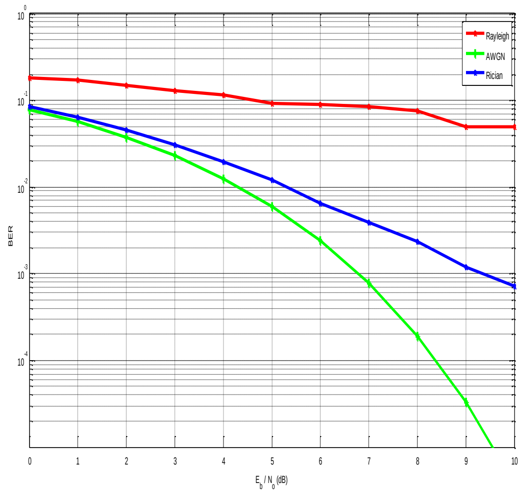

Figure 6: bit error rate in a Gaussian channel, Rayleigh channel and Rice channel.

A wireless communication channel is generally characterized by random temporal variations in the phase and amplitude of the received signal. These variations may be attributed to the relative spatial movement of the transmitter and receiver or the movement of the signal propagation environment [44].

It was shown that in practice, these random fainting may follow a distribution that is similar to Rayleigh, in the case of a non-line of sight communication, and distribution Rice for communications with direct line of sight. Other statistical distributions may also be used to represent fading. The Rayleigh fading models and Rice, however, are still the most used for evaluation of the performance of wireless communication systems. The signal waveform suffers under many insights, particularly in urban areas and the receiver receives a series from echoes in various and unpredictable sources. These echoes of variable amplitudes introduce variable delays.

For a Rayleigh channel system performance are degraded compared with those of a AWGN channel because of the strong influence of the channel. The signal in a Rayleigh channel is affected by fading over white Gaussian noise for low SNR which gives us a high BER, this decreases with increasing SNR depending on the parameter Rayleigh [44].

6. SIMULATION AND ANALYSIS OF RESULTS

All images contain some visual noise. Noise presence gives the image a mottled, grainy texture or a snowy one. Image noise Figure comes from a variety of sources. No imaging method is free of noise, but the noise is much more prevalent in certain types of imaging procedures in others.

The analog representation of a physical quantity is generally provided by an electrical signal, that is to say a current or a voltage varying with time.

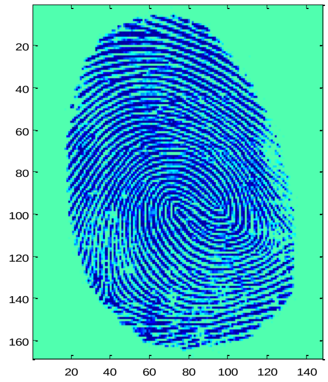

Figure 7: original image of a scanned fingerprint.

However it is possible to replace the continuous signal by a series of measures which we note the results as numbers is scanning. The contrast characterizes the light distribution of an image. Visually it is possible to interpret it as a spreading of the image brightness histogram.

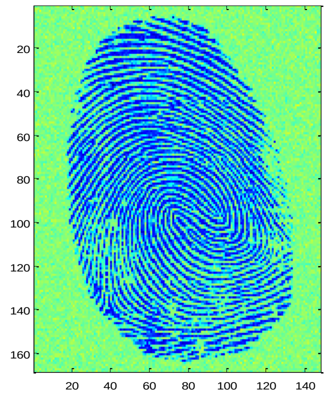

Figure 8: noisy digitized image by a Gaussian noise and Rayleigh noise.

As any physical measuring device, the data is tainted by noise. It comes from both the patient, thermal motion of the protons at the origin of spurious emissions and the measuring chain, analogue to digital converters, antenna, etc. Noise is the random signal from the environmental system, it is still present.

Note that the noise in the imaging is not a parasite. It is generally desirable for the brightness of the image to be uniform, except where it passes to form an image. There are, however, factors that tend to produce variations in the luminance of a displayed image even if no image detail is present. This variation is generally random and has no particular model. In many cases, it reduces the quality of the image that is especially important when the objects are being imaged, small and low contrast.

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This random variation in the picture brightness is designated as noise. Noise is generally defined by the signal to noise ratio (SNR).

The SNR is used to evaluate the influence of the signal to noise ratio in the image, which can be measured in several ways: either between two regions of interest, or from two identical acquisitions, or pixel by pixel in the as an SNR of the pixel map.

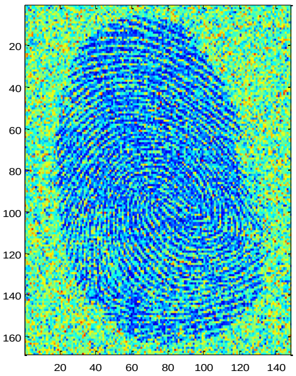

Figure 9: digitized image noisy with a noise of Rice.

To know the nature of the noise in digital images, we search to know its statistical distribution. It has been shown that the noise present in digital images follow a Rice distribution, also known as Rician distribution. The cause of the noise in the amplitude images is the presence of noise in the frequency plan for the acquisition. In the frequency domain, the noise present in both the real and imaginary parts of the signal is assumed to be uncorrelated Gaussian noise with zero mean. The variance of this noise is the same in real and imaginary parts.

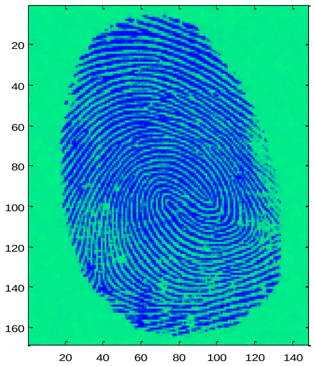

Figure 10: digitized image denoised.

Noise is a phenomenon consisting of color noise pixels, which are superimposed on the image. They appear during long exposures or when you go up the sensitivity. Digital Compact is particularly sensitive to the phenomenon, with noisy images, some as lower sensitivities.

The noise removal of an image is a major problem in image processing. Indeed it happens that during a continuous image capture phenomena such as noise, blurring, poor quality ... appear. The model we present here aims to reduce the noise to approximate a more authentic image.

7. CONCLUSION

By definition, noise is a random signal superimposed on the useful signal. According to the noise amplitude relative to that of the signal, the noise will cause a random fluctuation in the signal amplitude or a corruption of the binary content in the case of a digital signal. In addition, the channel introduces an attenuation of the transmitted signal which will restrict its scope. Therefore, the "information" carried by the signal is degraded or lost, in the presence of noise. The purpose of this paper is to present the different types of noise in a transmission channel, to present models and sizes to characterize the (SNR) and to link the amount of noise to the degradation of a signal digital, relationship between the signal to noise ratio and bit error rate. From concepts of noise and minimum signal to noise ratio to avoid an erroneous transmission, it will be possible to dimension the power to issue in the channel, the signal characteristics, gains and losses of the various elements of the channel. The digital signals are susceptible to noise, but are not as sensitive as analog signals. Unlike an analog signal, the quality of a digital signal cannot be measured to the signal distortion, but the possibility for a digital circuit correctly detecting the transmitted binary state. While the main constraint of an analog communication is the signal to noise ratio which is directly connected to the signal distortion that of a digital communication is the bit error rate. As requirements in terms of signal to noise ratio for the analog communication are very high, they are much lower for digital communications. Noise levels needed to induce a bit error should be very large and the same as the signal amplitude.

The noise is not a parasite, it is a random signal from the system and it is always present. Our source image contains mostly high frequency, which brings us to add Gaussian noise because its pulse type, so high frequencies. Then we will attempt to delete it using filters with reference to signal to noise ratios denoised images by these different filters, as we shall see in the next job.

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