BER analysis of Wireless regional area network in Rican fading environment

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***Abstract*- To fulfill the need of data communication various wireless standard are employed and this process is continuing to give more and more comfort to user. The standard IEEE 802.22 is in the research area to find various aspect of this standard. The uses of this standard allow using more than 1000 user simultaneously hence this is called as wireless regional area network. In this paper, the simulation of this system has been carried out for Rician channel. The BER vs SNR graphs are given in this paper for different modulation.**

***IndexTerms* – WRAN, QPSK, QAM, FEC code, BER, etc.**

I. INTRODUCTION

Wireless communication becomes a fundamental need of the personal daily life. The need of high speed communication and accurate communication is required more and more research in the field of the wireless communication. There are various generation of wireless communication due to this requirement. Recently fourth generation is in use for the communication. The communication standards with generation are given in the table-1.

Table 1 Standards with Generation

Generation	Wireless standard	Maximum speed
1	NMT,AMPS, TACS	N/A
2	GSM,CDMA,D-AMPS,GPRS	>0.5Mbps
3	CDMA2000/EV-DO, WCDMA/HSPA+, TD-SCDMA	<63Mbps
4	WLAN,WPAN,LTE,WIMAX	<300Mbps

In this paper, IEEE 802.22, its requirements and applications. Also discuss the main design challenges and new features of the upcoming the IEEE 802.22 standard (WRAN) wireless that will address the wireless broadband standard problem in rural communities and emerging markets. In particular, we discuss the new cognitive radio features such as spectrum sensing and frequency agility that allows for efficient and reliable sharing of the TV band spectrum with primary users. In Wireless regional area network (WRAN) is fixed point to multi-point (PMP) system and its connectivity between the base station and the Consumer premise Equipments is possible in both line-of-sight and non-line-of-sight situations. In the standard typical support range is 30 km (kilometre). meeting the demands of rural areas, but based on propagation conditions it may cover up to 100 km (kilometre).

II. WRAN (IEEE STANDARD 802.22) OVERVIEW

The idea behind 802.22 is that there are considerable unused frequencies between Very high frequency (VHF) and Ultra high frequency (UHF) broadcast channels between 54 and 862 MHz [3]. This is possible by using cognitive radio capabilities. In these include dynamic spectrum access, incumbent database access, accurate geolocation techniques, spectrum sensing (SS), spectrum etiquette, and coexistence for optimal use of the available spectrum. Essentially this means that it will be possible to send wireless broadband access without interfering with TV signals. The CR base station covers an area between 33 km to 100 km and the network is designated to provide the minimum throughput of 1.5 Mbps for the downstream and 384 kbps for the upstream. In additional to conventional PHY and MAC layer functionalities, new features have been included in IEEE 802.22standard network.

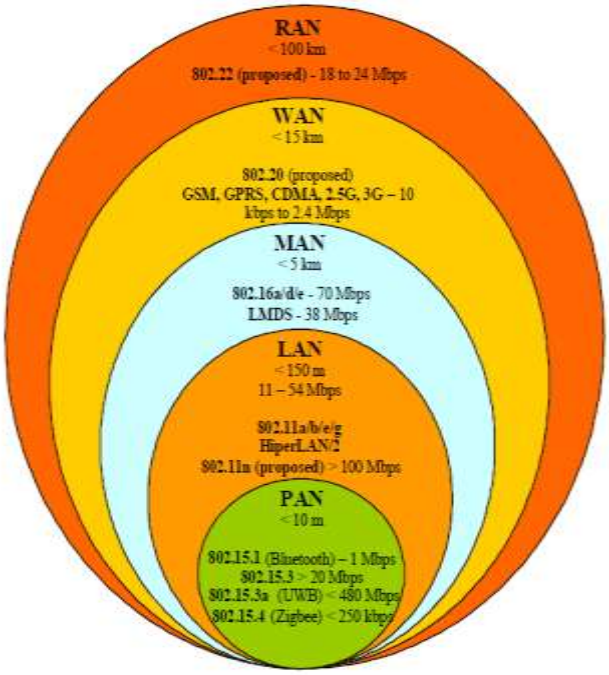

Fig: 1 802.22 wireless RAN classification as compared to other popular wireless standards

In this paper, we are simulation a new standard IEEE 802.22, which is considered as a fifth generation standard. The basic parameter of this standard as below

Table 2 Basic IEEE 802.22 standard specification parameters

Parameter name	Specification value
Typical cell radius (km)	30 - 100 km
Methodology	Spectrum sensing to identify free channels
Modulation	OFDM
Channel capacity	18 Mbps
Channel bandwidth (MHz)	6, (7, 8)

III. OVERVIEW OF THE IEEE 802.22 STANDARD

The IEEE 802.22 Wireless regional area network (WRAN) standard define PHY and MAC layer specifications for operation in the TV frequency bands in the range among 54 MHz, avoiding harmful interference to incumbents. Standard is currently under development, and its draft includes new cognitive radio (CR) features which are discussed in the rest of this section [1].

Application

The main goal of the IEEE 802.22 is to provide a cost effective wireless alternative to wired broadband access, and especially in sparsely populated areas. IEEE 802.22 WRAN is a point to multipoint system where the Base Station provides connectivity to static Consumer Premise Equipments with its coverage area (cell).

The IEEE 802.22 PHY

The IEEE 802.22 PHY will support typical data rates of 1.5Mbit/s in the downstream (DS) direction and 384 Kbit/s in the upstream (US). According to the IEEE 802.22 draft, given .The adaptive modulation parameters and the operating constraints, and assuming. A 6 MHz TV channel bandwidth the system is expected to support up to 255 CPEs per BS per TV channel.

Spectrum sensing

In addition to the PHY modem, every CPE will also be equipped with a spectrum sensing system, which should meet the regulatory requirements for sensing (TABLE I). Although the particular algorithm used is implementation dependent, the IEEE 802.22 standard describes several sensing techniques with corresponding evaluation results (based on simulation) that can be algorithms discussed in the IEEE 802.22 draft [5] that achieved best performance result.

IV. MODULATION TECHNIQUE

Modulation and channel coding are fundamental components of a digital communication system. Modulation is the process of mapping the digital information to analog form so it can be transmitted over the channel .In this paper are using two modulation techniques.

Quadrature Amplitude Modulation

The QAM is popular modulation technique used in various wireless standards communication. It combined with ASK and PSK which has two different signals sent concurrently on the same carrier frequency but one should be shifted by 90º with respect to the other signal. The principle equation 4 is.

$$s(t) = d_1(t)\cos 2\pi f_c t + d_2(t)\sin 2\pi f_c t \qquad (1)$$

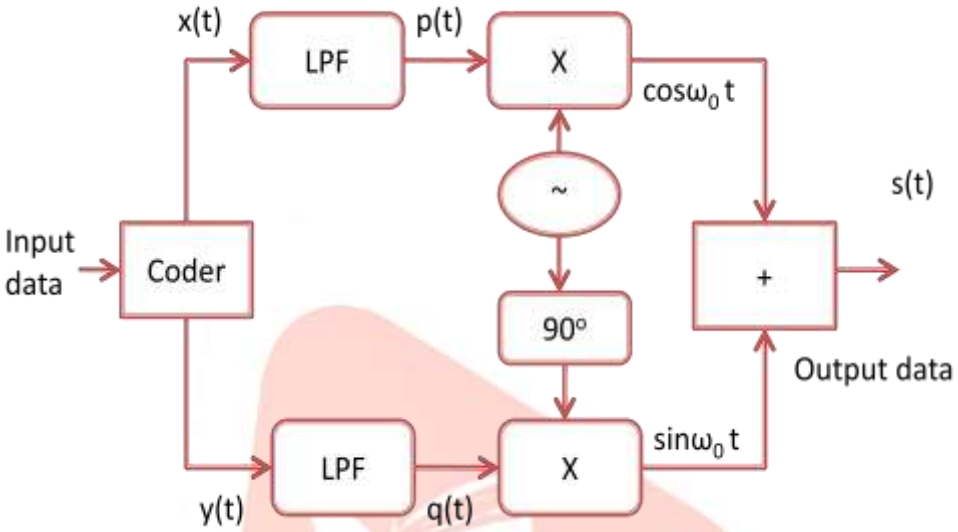

Fig: 2 QAM System

Quadrature Phase Shift Keying (QPSK)

This is also known as four-level PSK where each element represents more than one bit. In the each symbol contains two bits and it uses the phase shift of π/2, which means 90º instead of shifting the phase 180º. The principle equation 5 is.

$$s(t) = \begin{cases} A\cos\left(2\pi f_c t + \frac{\pi}{4}\right) & \text{for binary 11} \\ A\cos\left(2\pi f_c t + \frac{3\pi}{4}\right) & \text{for binary 01} \\ A\cos\left(2\pi f_c t - \frac{3\pi}{4}\right) & \text{for binary 00} \\ A\cos\left(2\pi f_c t - \frac{\pi}{4}\right) & \text{for binary 10} \end{cases} \qquad (2)$$

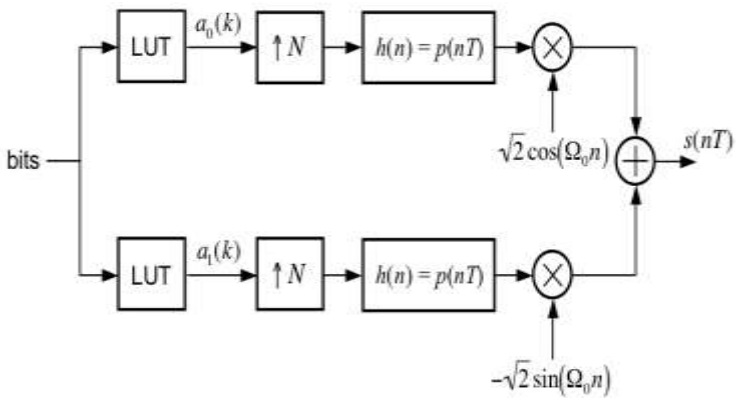

Fig: 3 QPSK System

The constellation consists of four points but the decision is always made in two bits. This mechanism can ensure the efficient use of bandwidth and higher spectral efficiency.

V. RICIAN CHANNEL

Rician fading best describes a situation where a dominant non-fading, line-of-sight (LOS), component is present in addition to a number of indirect multipath signals. The fading envelope of this model is described by Rician probability density function (PDF). Additive white Gaussian noise (AWGN) and Rician channels provide fairly good performance corresponding to an open country environment, while Rayleigh channel, which best describes urban environment fading, provides relatively worse performance. Line-of-sight path is introduced into the Rayleigh fading environment, the fading turns into Rice-distributed fading. It is also a small scale fading.

The Rician distribution is given by

$$p(r) = \frac{r}{\sigma^2} e^{-\frac{(r^2+A^2)}{2\sigma^2}} I_0\left(\frac{Ar}{\sigma^2}\right) A \leq 0, r \geq 0 \qquad (3)$$

Where $I_0(x)$the modified Bessel function of the first kind and zero order is $k_r = \frac{Ar}{\sigma^2}$is the rice factor.

VI. RESULTS AND DISCUSSION

System description

IEEE 802.22 WRAN System is simulated over physical layer using Rician channel in MATLAB 7.14. For the simulation random data is generated consisting of 10 Symbols. After converting Serial data into parallel form convolution coding is used as FEC code. In this section, BER (Bit Error Rate) analysis of WRAN system with Modulation techniques

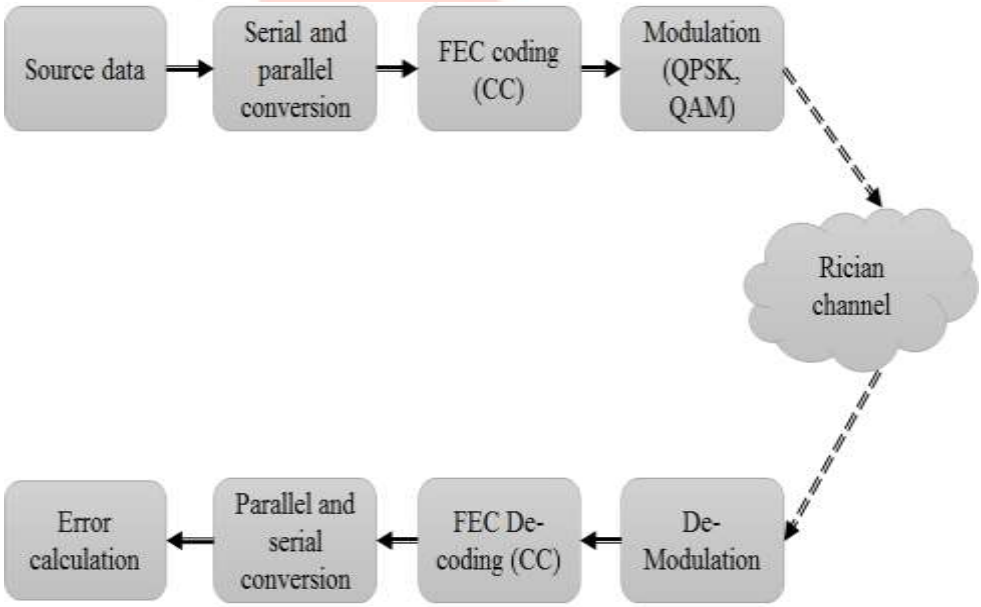

Fig: 4 System block of WRAN communication using modulation technique

Table 3 Simulation parameter

S. No.	Parameter	values
1	No. of symbol	10
2	Modulation	QPSK, QAM-16
3	Channel	Rician, AWGN
4	SNR	0-12
5	Factor	K=10, k=1

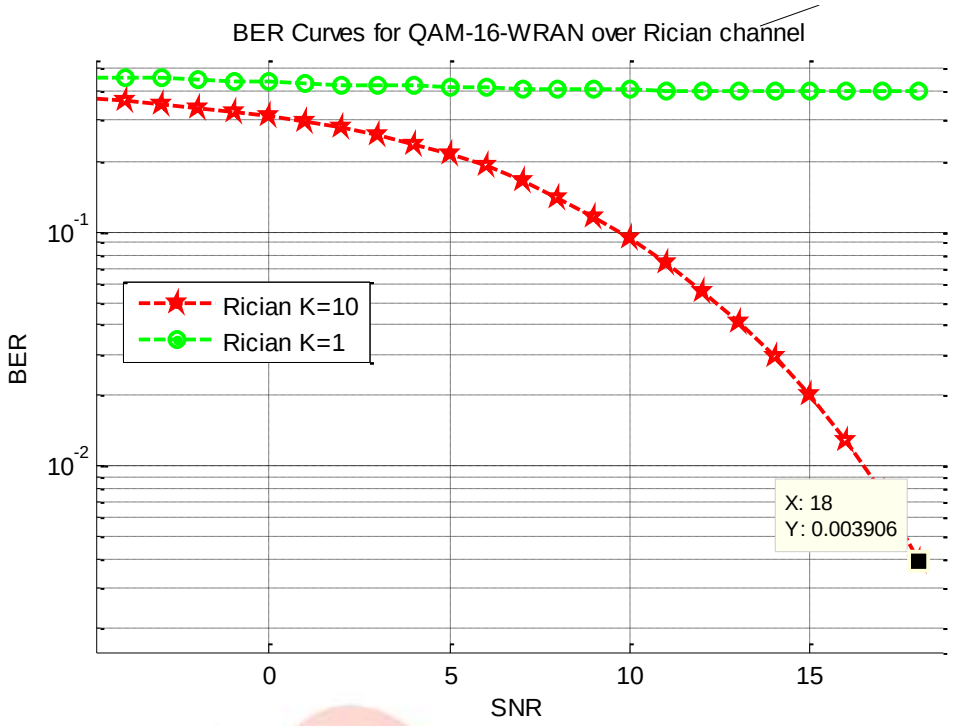

Fig: 5 Performance of SNR to BER

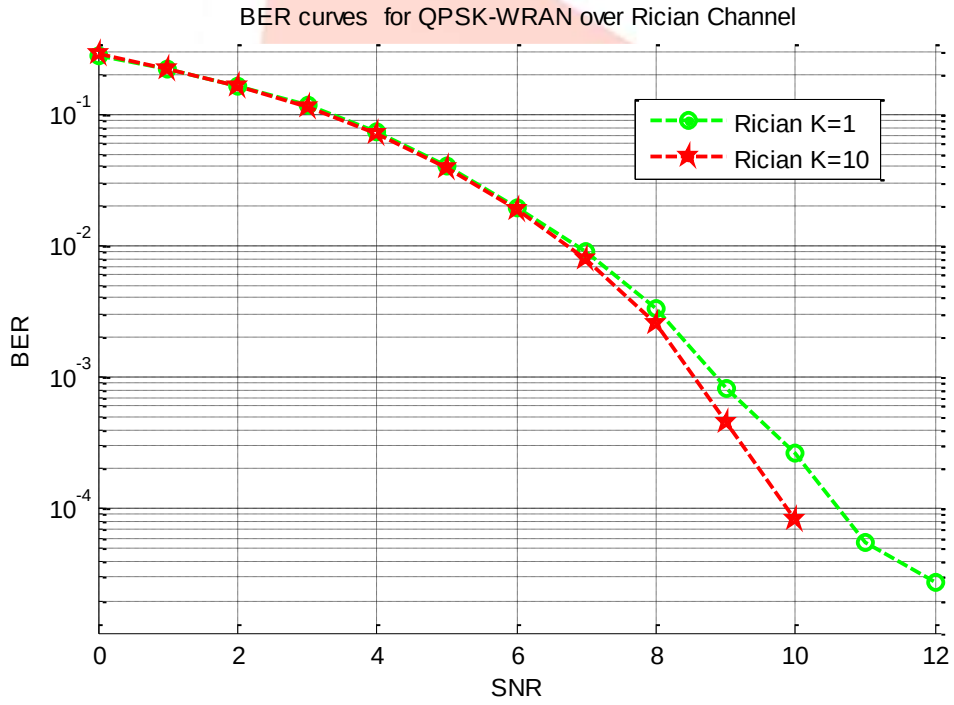

Fig: 6 Performance of SNR to BER

Table 4 Performance parameter value

S. no.	SNR	QAM -16		QPSK	
		BER			
		K=10	K=1	K=10	K=1
1	0	0.3121	0.4384	0.2856	0.2779
2	4	0.2388	0.4208	0.07024	0.074
3	8	0.1403	0.4102	0.002569	0.003306
4	12	0.05601	0.4048	0	2.778e-05

VII. CONCLUSION

In this paper, performance enhancement of WRAN communication system is done with Modulation technique. Modulation technique used is QPSK and QAM for RICIAN channel. A graph of BER versus SNR is obtained which shows that k-10 factor is more efficient than k-1 for RICIAN channel. Future work includes comparison of BER versus SNR for QAM and MIMO.

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