ISSN 2347-4289

Analysis Of Multimode Radio For Wireless Comunication Applications

Patil Amrit T., Bendre Pallavi G.

Post Graduate Department of Electronics & Telecommunication, Savitribai Phule Pune University, Pune, India
Post Graduate Department of Eletrical, Rajarambapu Institute of Technology, Sakharale, Islampur, India
Email:patil.amrit90@gmail.com

ABSTRACT: A multimode radio communication technology that is based on software defined wireless communication protocols instead of hardware implementations. It means that, modulation technique, air interface protocol and functionality can be upgraded with software download and update instead of a total hardware substitution. It provides an efficient and protected solution to the difficulty of building multi-mode and multifunctional wireless communication devices. A multimode radio is able to being re-programmed or reconfigured to operate with different waveforms and protocols through dynamic loading of novel waveforms and protocols. These waveforms and protocols can contain several different parts, including modulation techniques and performance characteristics explained in software as part of the waveform itself. A multimode radio is mostly used basic digital modulation techniques. This is achieved by combining basic modulation techniques together. The global wireless communication application requires a flexible and updated radio system. A Multimode radio is steps towards future wireless communication technology.We have suggested a new multimode wireless radio. We have analyzed the performance of this new multimode radio. We have considered important performance metrics of multimode radio such as SNR, BER and signal constellation. This simulation is done by using the MATLAB.

Keywords: Multimode Radio (MMR); Bit Error Rate (BER); BPSK; QPSK; MPSK;

1. Introduction

1.1 Wireless Communication Systems

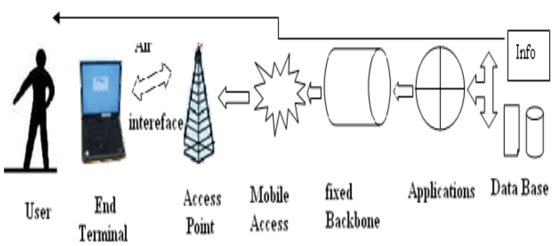


Fig.1 *Wireless Communication System*

Present Generation wireless systems are on its way to capitalize the wireless telecom market. The expectations from next generation wireless systems are as follows:

1. Seamless roaming 2. High spectral efficiency
3. High data rates 4. Integrated services
5. Inter operability6. Low cost

It concentrates on integrating all the existing technologies so that user can easily roam from one service provider area to another. While the roll-off of 3G systems is under progress, research activities on the 4G have already started. Using the multimode radio methodology can fulfils not all but maximum possible of these expectations. Multimode radio is identifiably working as Software Defined Radio. A multimode is *a* radio in which the software manages and controls the radio's waveform properties and applications. Furthermore, it is flexible, interoperable, reprogrammable, and reconfigurableand may be upgraded in the field with new capabilities shown in figure 1. In our perspective, multimode radio technology is not but also implementation guideline.

1.2 Problem Motivation

Most current conventional radios uses the hardware e.g. FPGA for the physical layer. Where, the reconfigurability is defined for different modulation and demodulation techniques. Most of times, these conventional radios takes more time to response the signal so that delay has increased in communication system. A commonly observed misbehavior is latency. Practically, in a Conventional radio, most devices have more response time. The main problem in Wireless radio system is still, the Bit Error rate and Signal to Noise Ratio. In the literature one can find many different approaches which try to handle this problem, but there is no modulation algorithm which fits in all cases. In this thesis we present a new approach for a multimode algorithm, which is based on software defined radio. The multimode algorithm has been analyzed the different parameters and prove that it is better than any conventional radio present till today. Several algorithms which are based on modulation and demodulation problems were introduced in recent years to solve different problems, e.g. BER, SNR, and Latency. To address these design requirements several design strategies for a multimode radio has been proposed and each having its fair share of advantages and limitations. Multimodal algorithms should be self-configured, self-built algorithm.

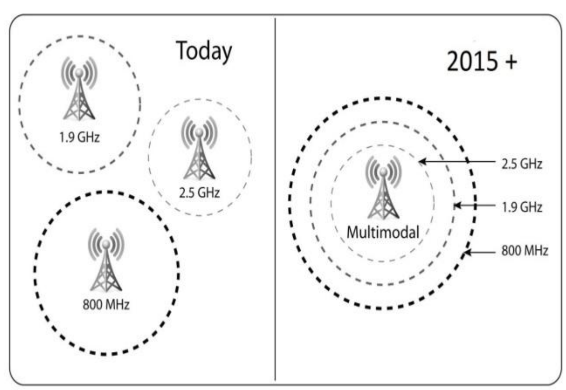


Fig.2 *MMR Future*

2. Multimode Radio Architecture

The MMR has an appropriate trans-receiving system. The transceiver in a software radio based wireless communication system for GPP hardware will be as depicted in figure 3 & figure 4.

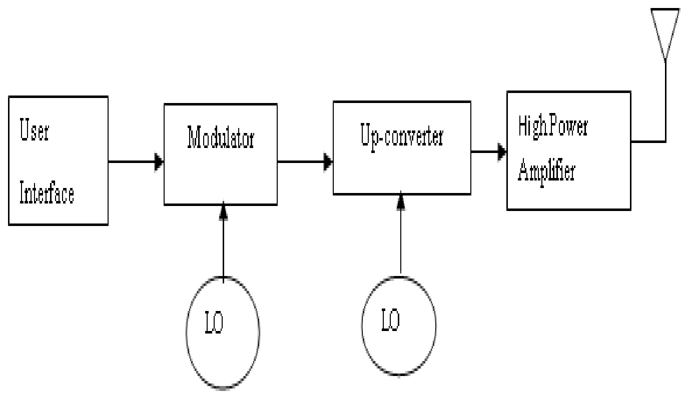


Fig.3 *MMR Transmitter*

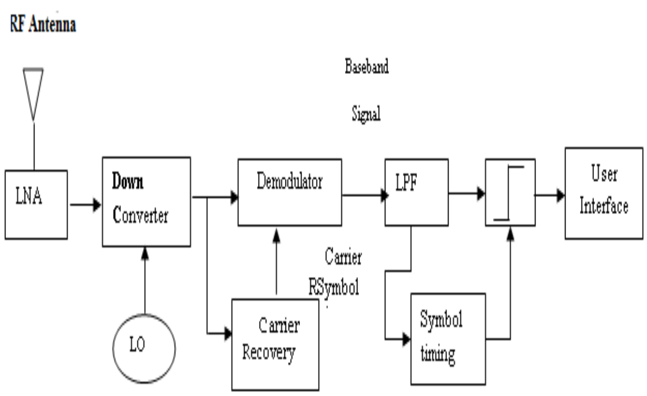


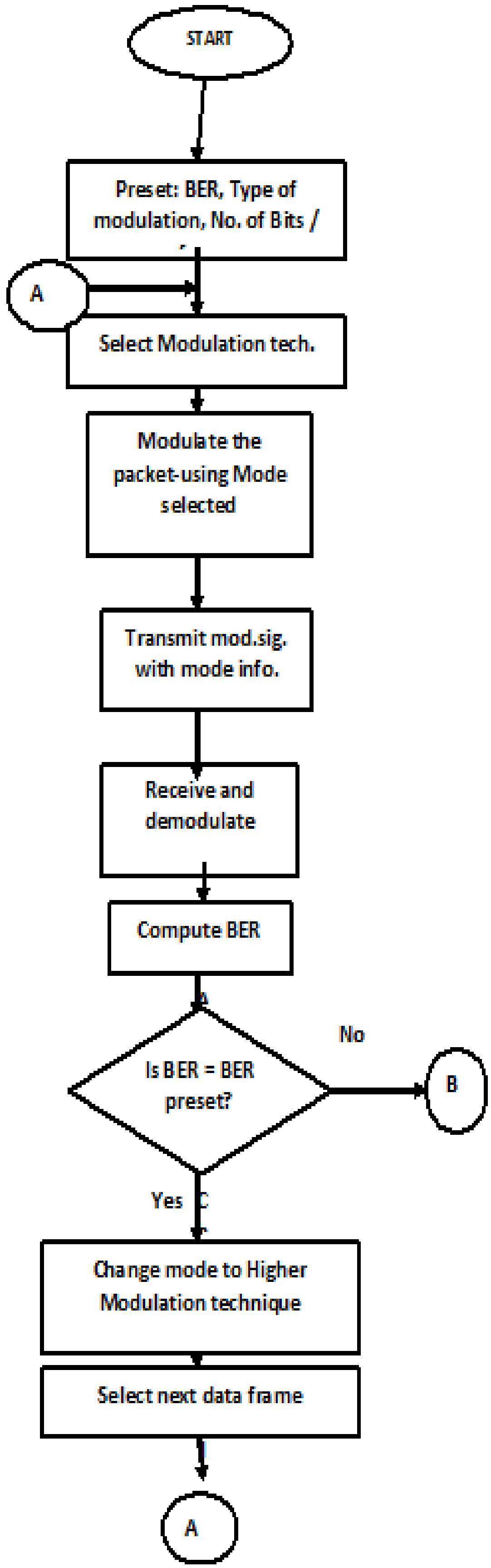
Fig.2 *MMR Receiver*

As per above architecture, the original digital signal is modulated as digital modulation scheme with high frequency from Local Oscillator. The Up Converter and High power Amplifier increases the strength of signal. Then modulated signal transmitted through a high quality RF antenna. During the transmitting of signal, noise has been added into it. The noisy signal received by RF antenna. This signal might be weak and noisy so it goes through the Low Noise Amplifier. At next step signal is down converted and added with frequency so that it could be demodulate. The received signal becomes original modulated signal when the carrier frequency removed from it. But at both transmitter and receiver modulation and demodulation scheme must be same. Otherwise result will be unpredictable. The noise will be removed with help of low pass filter. The LPF is useful while noisy particles are included in the signal. With help of symbol timing the digital signal regains in original form.

3. Flow Chart of the system

The system starts with preloading of BER, Modulation technique, Bit rate etc. Now “A” is the signal which to be transmitted is modulated with predefined modulation technique e.g. 16 PSK. At receiver signal will demodulated and compare the BER. If BER of received signal is less than or equal to preset BER then higher modulation technique will be select by the transmitter. If BER of received signal is greater than preset BER then lower modulation technique will be select by transmitter. If both conditions failed then next data frame will be transmitted by same modulation technique.

ISSN 2347-4289



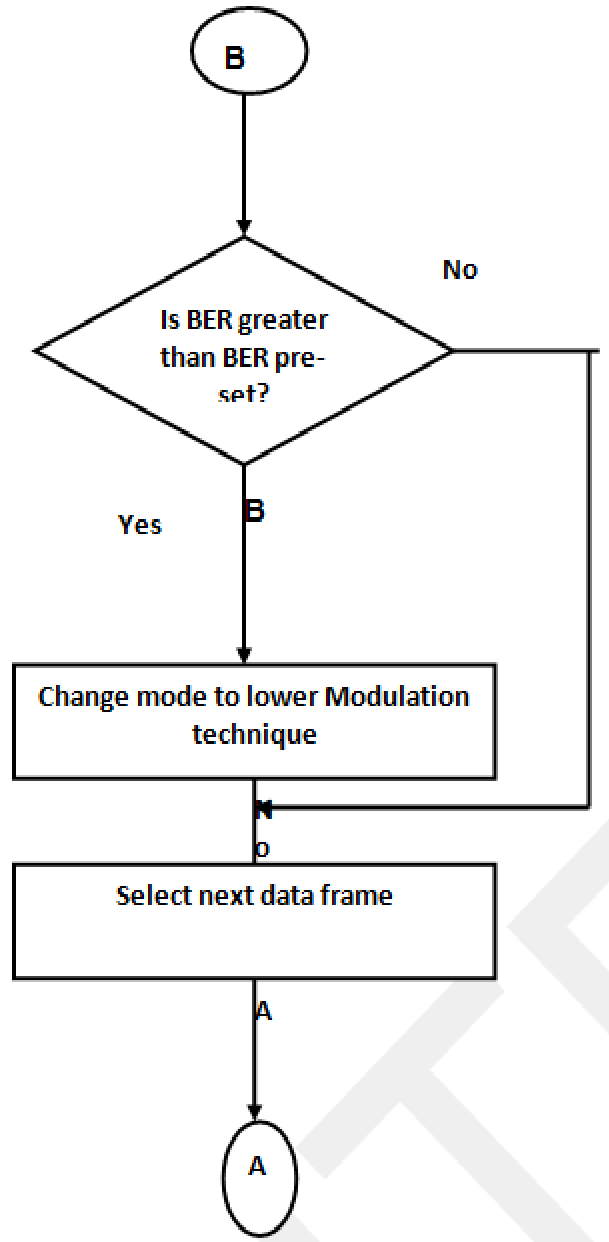


Fig. 5 *Flow chart*

4. Multi Mode Radio Algorithm

I. One out of five modulation techniques, viz. BPSK, QPSK, 8 PSK, 16 PSK and 32 PSK is switched as channel SNR changes.

II. That is, if current modulation is 16 PSK and channel condition improves so that BER will get improved. But it will not utilize the improved channel condition with the help of 16 PSK.

III. Then modulation technique is switched to 32 PSK. This will give moderate BER, but the throughput will be increased from 4 BPS to 6 BPS.

IV. Further, if the channel condition degrades then modulation technique can be reverted back to the 16 PSK or to 8 PSK.

V. The algorithm simulation for independent distance i.e. SINR has been also proved to be attractive. The distance ranges in the cell site are considered 50-500 meters, 500-1500 meters and 1500-3000 meters.

ISSN 2347-4289

5. Results

Here, one out of four modulation techniques, viz. BPSK, QPSK, 8PSK, 16PSK, 32 PSK are switched, as channel SNR changes. That is, if current modulation is QPSK and channel condition i.e. SNR improves so that BER gets improved. But it does not utilize the improved channel conditions with the help of QPSK. Therefore, the modulation technique is switched to 8PSK. This switching in modulation results in moderate BER, but due to the higher number of constellations the throughput increases from 4 bits per symbol to 6 bits per symbol. Further if the channel condition degrades then modulation technique can be reverted back to the BPSK or QPSK. The most reliable channel quality estimate is the BER, since this metric reflects the channel quality, irrespective of source or the nature of quality degradation. In the proposed system both mode selection probability, latency for one simulation run. Latency is computed using MATLAB “Profiler” utility. For outdoor communication the results show that the system performance is improved considerably for five modes in AWGN environment. The latency is decrease with increase in number of packets. For multipath communication, the results show that the system performance is improved comparatively less than in AWGN environment. SNR and SINR are estimated using BER values calculated from the packet for AWGN and multipath environments respectively. The simulation is carried-out for 10,000 packets. The computed parameters are average BER, average throughput, From the results obtained, it is concluded that the multimode system simulated has shown improvement in its performance. The parameters used for performance evaluation are Bit Error Rate (BER) and throughput (bits per symbol). The modulation switching algorithm proves to be significant in case of average bit error rate and throughput. The algorithm simulation for independent distance i.e. SINR has been also proved to be attractive. The distance ranges in the cell site are considered 50-500 meters, 500-1500 meters and 1500-3000 meters.

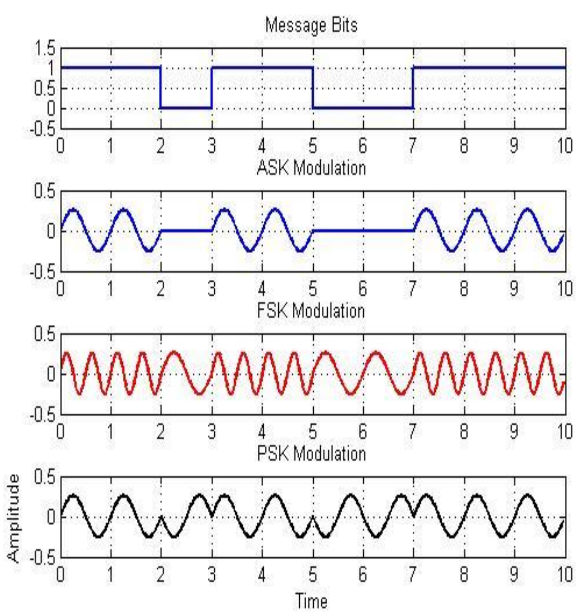


Fig.6 *Modulation scheme*

The digital signal modulation scheme has shown above. Three modulations ASK, FSK and PSK are given. The digital message having 1101100111 bits, are transmitted with different modulation techniques. We can see that the modulated signals are typically different.

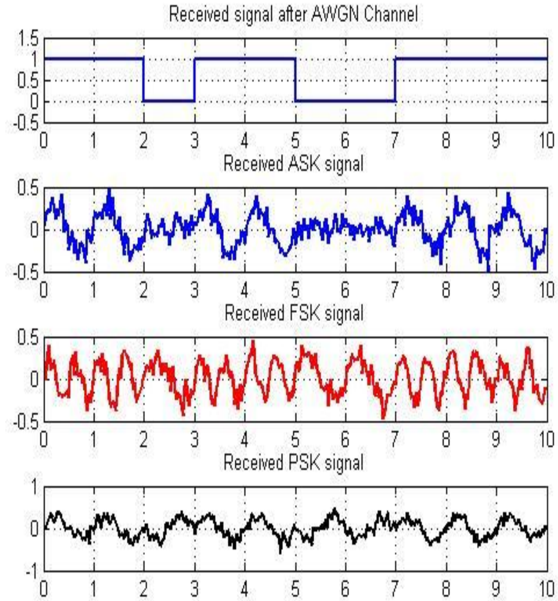


Fig.7 *Demodulation scheme*

This received signal by RF receiver having Additive White Gaussian Noise. Amplitude of signal is not change but pattern changed. The Signal to Noise Ratio is 0:20. Received signal are disturbed so the transmitted signals information mis-matched. These digital modulated signals having channel interference as well as noise. These will increase as increase in the transmitting distance. The multi path fading can also disturb the signal information.

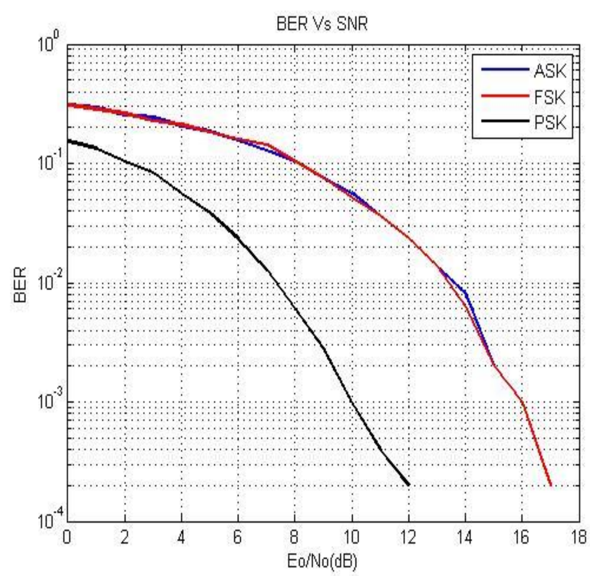


Fig.8 *BER vs. SNR*

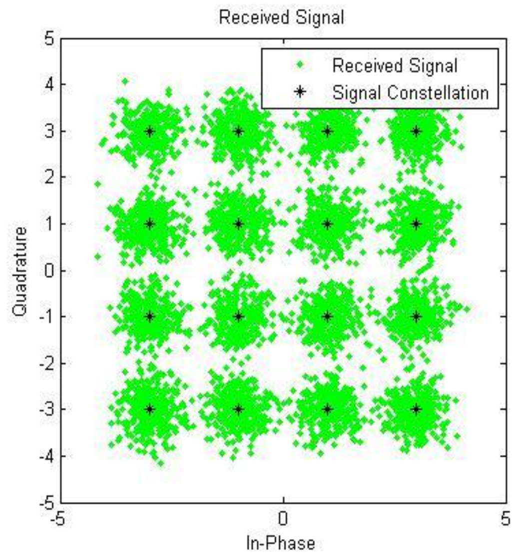


Fig.9 *Constellation diagram*

These show the BER as a function of the Energy per Bit to Noise Ratio (Eb/No). This is a measure of the energy efficiency of a modulation scheme. If a higher Eb/No is needed to transfer data for a given modulation scheme, then it means that more energy is required for a bit transfer. Low spectral efficiency modulation schemes, such as PSK, require a lower Eb/No, and hence are more energy efficient. For a power limited system, with unbounded bandwidth, the maximum data rate could be achieved using PSK. The PSK is more reliable and more confident modulation technique than other ASK and FSK modulation techniques.

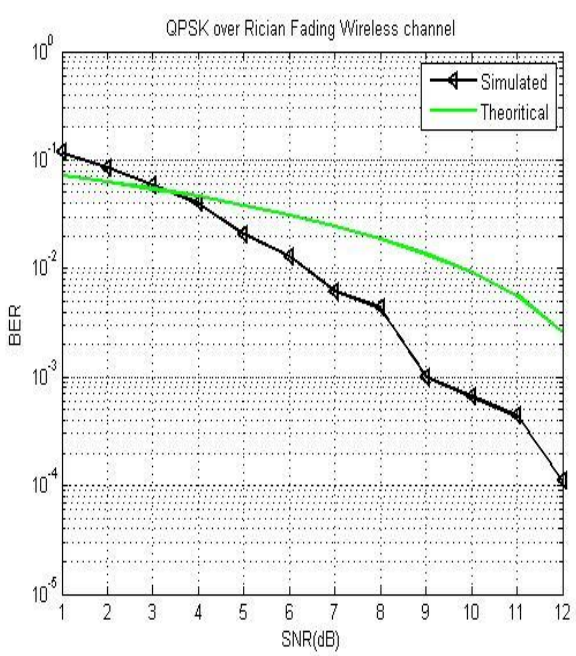


Fig. 10 *QPSK over Rician Wireless channel*

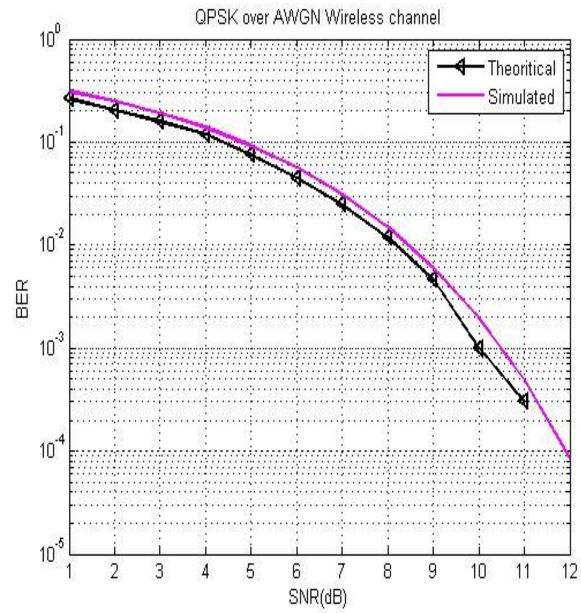


Fig.11 *QPSK over AWGN Wireless channel*

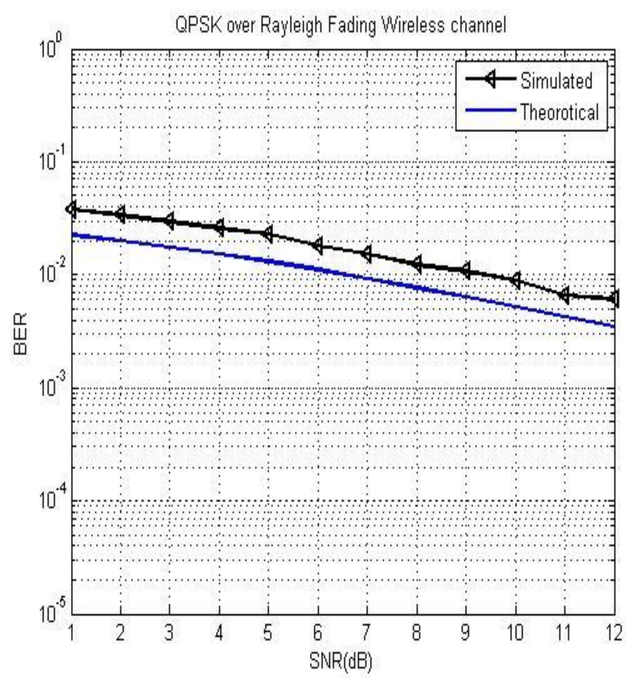


Fig.12 *QPSK over Rayleigh fading Wireless channel*

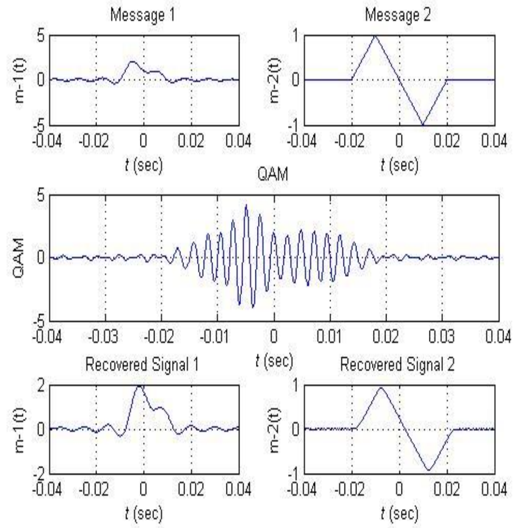


Fig.13 *Time Domain Response of QAM*

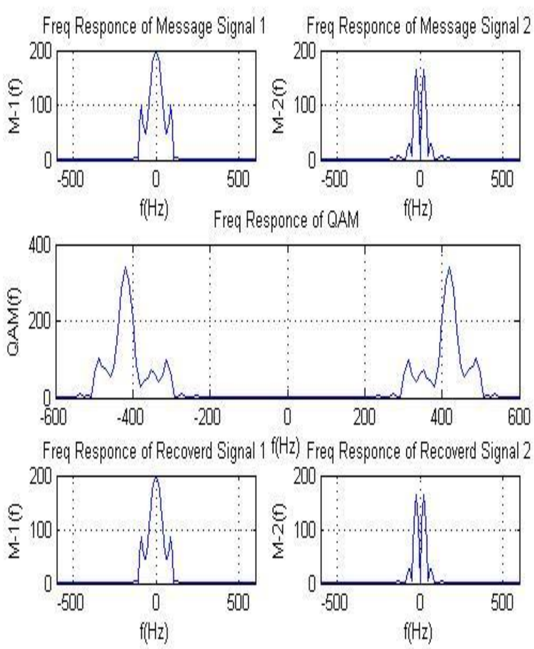


Fig.14 *Freq. Domain Response of QAM*

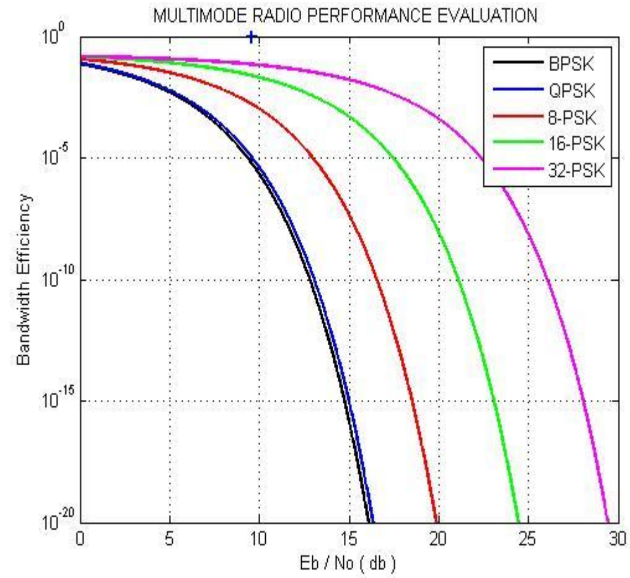


Fig.15 *Multimode radio performance evaluation*

6. Conclusions

Models for MMR based wireless communication system invariably rely on simplifications with respect to reality in order to achieve mathematical tractability or speed in simulation of Rake receiver BER performance. To enable better reflection of real-world conditions, a fast, semi-analytical BER prediction method was used in this project. Examples show significant results based on the use of common channel. It can be concluded therefore, that existing methods and simplified channel models are not adequate for software radio use in the design of future systems, where high data rates dictate the use of low sampling factors, and design error margins must be reduced to ensure greater spectral efficiencies. The multimode Radio cellular mobile system has improved performance on the basis of BER and constellation size for different modulation algorithms. Thus, the mode may improve the throughput without sacrificing system QoS using estimated *Eb to N0* ratio to meet preset BER target. Channel conditions vary depending on the transmitter-receiver distance and the level of interference. Here the QoS constraints are dependent on the type of application and user requirements. The effects of adapting modulation algorithms under various channel conditions to meet QoS criteria are explored. The goal is to improve overall BER and data rate.

6. Future Research

I. This research effort creates several opportunities for future investigations. The single channel radio design that was implemented as a part of this research could be extended to a multi-channel design to boast the data rates of the system. The signal generation facilities available in the latest software radio transceivers could be exploited in order to make a multiple access system capable of handling more than one user simultaneously.

II. The BER performance of the radio could be improved significantly by implementing complex but more effective channel encoding and decoding schemes. The partial reconfiguration capabilities of the GPPs could be further exploited by moving more parts of the radio from static to reconfigurable sections, thus making the architecture more flexible and user controllable. The SDR based radio structure presented in this thesis could be used to

ISSN 2347-4289

implement various digital signal processing systems for industry level applications.

III. The digital modulation-demodulation algorithm topics include AGC, Channel waveform coherence, coding/decoding and spreading /dispreading of the spectrum used. As the present case study is focused on the modulation switching, therefore, AGC, coding and spreading are not discussed.

IV. Adaptive error control coding and power control are well-known techniques in cellular mobile wireless communication systems. A comprehensive analysis for the advantage of applying these techniques in cellular wireless communication systems should be conducted.

V. Simulations are used for the evaluation in the downlink direction. A non line-of-sight system, represented by a propagation exponent of 4, is assumed to approximate a real system.

8. References

[1] Software Defined Radio Forum- http://www.sdrforum.org/public/approved/07

[2] Vanu Inc., “The Software Radio Solution to Public Safety Interoperability. http://www.vanu.com/publications/TheSRSolutiontoPublicSafety /

[3] Mitola, Joseph. (n.d.). Software Radio – Cognitive Radio: Wireless Architectures for the21st Century. http://ourworld.compuserve.com/homepages/jmitola/

[4] J. G. Proakis, Digital Communications, 3rd edition. New York: McGraw Hill, 1995.

[5] R. Prasad, Universal Personal Communications. Boston: Artech house, 1998.

[6] R. van Nee and R. Prasad, OFDM for Wireless Multimedia Communications. Boston: Artech House, 2000.

[7] O. Edfors, Low-complexity algorithms in digital receivers, Ph.D. Thesis, Luleå University of Technology, Sept. 1996.

[8] S. B. Weinstein and P. M. Ebert, “Data Transmission by Frequency-Division Multiplexing Using the Discrete Fourier Transform,” IEEE Trans. Commun. Techn., vol. COM-19, no. 5, pp. 628–634, Oct. 1971.

[9] [9] A. Peled and A. Ruiz, “Frequency Domain Data Transmission Using Reduced Computational Complexity Algorithms, “ in Proc. IEEE Int. Conf. Acoust. Speech, Signal Processing, Denver, CO, 1980, pp. 964–967.

[10] P. A. Bello, “Characterization of randomly time-variant linear channels,” IEEE Trans. on Commun. Systems, vol. CS-11, pp. 360–393, Dec. 1963.

[11] R. Steele, Mobile Radio Communications. New York: John Wiley & Sons, 1992.

[12] W. C. Jakes Jr., Microwave Mobile Communications. New York: John Wiley & Sons, 1974.

[13] X. Dong, T. T. Tjhung, and F. Adachi, “Error Probability Analysis for 16 STARQAM in Frequency-Selective Ricean Fading with Diversity Reception,” IEEE Trans. on Veh.Techol., vol. 47, no. 3, pp. 924–935, Aug. 1998