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Performance Parameter of Spectrum Sensing MIMO- OFDM based LTE Technique

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Abstract - *Orthogonal Frequency Division Multiple Access has been adopted in emerging broadband wireless access networks such as 3GPP UMTS/LTE and IEEE 802.16x (WiMAX) due to its inherent immunity to inter-symbol interference and scheduling flexibility in resource allocation. 3GPP LTE (Long Term Evolution) is the evolution of the UMTS which will make possible to deliver next generation high quality multimedia services according to the users expectations. For the LTE performance evaluation and Radio Resource Management in 4G, needs, system level simulations, different algorithms to simulate the LTE Downlink based on OFDM technology with Schedulers are presented in this thesis. These show that proportional fair and resource fair schedulers deliver a good trade-off between throughput and fairness.*

Key Words: *Long Term Evolution (LTE), OFDM, 4G, MIMO- OFDM*

1. INTRODUCTION

Mobile communication of these days is inherently extra more complex than fixed factor communication. Consequently, the overall potential of radio communication is far being found out. In December 1947, Douglas H. Ring and W. Rae younger, Bell Labs engineers, proposed hexagonal cells for cellular phones in cars. In 1969 Amtrak geared up commuter trains alongside the 225-mile.

The big apple Washington course with special pay telephones that allowed passengers to vicinity telephone calls while they teach changed into moving. The gadget re-used six frequencies in the 450 MHZ band in 9 websites, a precursor of the idea later applied in mobile phones. On December 1971, AT&T submitted a suggestion for mobile carrier to the Federal Communications commission (FCC). In 1971's they constructed the primary community in Chicago and had 1300 customers at the machine by the stop of 1978. After years of hearings, the FCC accepted the thought in 1982 for an advanced cell phone system (AMPS) and allotted frequencies in the 824–894 MHz band. Analog AMPS become subsequently superseded by way of virtual AMPS in 1990.

In 1979 cell communities (1G) become launched in Japan by using NTT. The subsequent 1G network to release became the Nordic mobile phone (NMT) system in Denmark, Finland, Norway and Sweden in 1981. NMT changed in the primary cellular smartphone network to characteristic worldwide roaming. With the creation of 1G phone, the mobile market confirmed the annual boom fee of 30 to 50 according to cent, rising to almost 20 million subscribers by means of 1990 [1]. The 2G systems designed in the Nineteen Eighties have been nevertheless used specifically for voice applications however have been based totally on virtual era, which includes virtual sign processing techniques [2]. 2G cellular systems include GSM, digital AMPS (D-AMPS), code-division a couple of get right of entry to (CDMA), and private virtual communication (percent). GSM is the maximum a hit own family of mobile requirements. It includes GSM900, GSM-railway (GSM-R), GSM1800, GSM1900, and GSM 400 [3].

3G mobile telecommunication is a technology of requirements for cell phones and cellular telecommunication offerings fulfilling the international mobile Telecommunications-2000 (IMT-2000) specs via the ITU. Utility services include huge- vicinity wireless voice phone, cellular internet access, video calls and mobile TV, all in a cell environment [4]. To fulfill the developing demands in network ability, charges required for high speed statistics switch and multimedia packages, 3G standards started evolving. The 3G era lets in video, audio, and pix applications. Over 3G phones, you'll be able to watch streaming video or have video telephony.

In telecommunications, 4G is the fourth generation of cellular wireless requirements. It's miles a successor to the 3G and 2G households of requirements. In 2009, the ITU-R company designated the IMT-superior (global cellular Telecommunications superior) requirements for 4G requirements, placing top velocity necessities for 4G carrier at a hundred Mbit/s for high mobility, communication (including from trains and automobiles) and 1 Gbit/s for low mobility verbal exchange (such as pedestrians and stationary customers) [5]. IMT-superior compliant versions of LTE and WiMAX are under development and called "LTE superior" and "Wi-Fi man-advanced" respectively. ITU has determined that LTE superior and Wi-Fi man-advanced must be accorded the official designation of IMT-advanced. ITU identified that modern-day variations of LTE, WiMAX and other advanced 3G technology that don't fulfill "IMT-advanced" requirements may want to dispute the fact that be considered "4G", furnished them constitute forerunners to IMT-superior and an extensive degree of development in performance and abilities with appreciate to the initial 1/3 generation systems now deployed [6].

Long term Evolution (LTE) network guarantees better facts, charges, one hundred Mbps within the downlink and 50 Mbps in the uplink; similarly to that, LTE have guided for scalable bandwidth, from 1.25 MHz to twenty MHz. A majority of these features is making LTE a totally attractive generation of operators in addition to the subscribers [7].

2. LONG TERM EVOLUTION (LTE)

LTE is popularly referred to as a 4G era. It's miles an all-IP era primarily based on orthogonal frequency-division multiplexing (OFDM), that is more spectrally green and can deliver greater bits per Hertz. LTE also brings subscribers a "proper" cell broadband that allows a excellent video to enjoy and media mobility. it is predicted that out of about 2 billion people, who may be having broadband via 2012, a few 1/3 can be mobile broadband customers and majority customers might be served with the aid of high pace Packet access (HSPA) and longtime Evolution (LTE). 3GPP LTE is the evolution of the 0.33-technology of mobile communications [8]. LTE is designed to growth records costs and mobile facet bit fees. Radio aid control draws outstanding attention while utilizing available resources to offer customers with better device throughput. Radio resources management consists of transmission strength management, mobility management, and scheduling of radio assets. A smart radio useful resource management is at the heart of LTE to make it a strong generation to satisfy the broadband mobility desires of upcoming years. This could schedule the to be had resource in a quality manner and offer to the customers with the enough transmission functionality to attain the decided QoS.

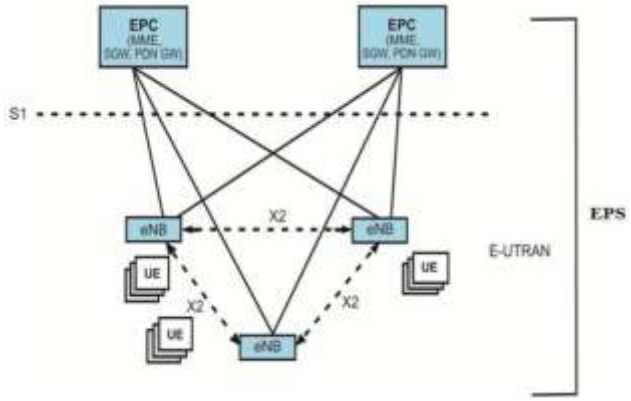

Fig -1: LTE Architecture

While they move freely and will also make certain that these assigned sources could not intervene with already assigned resources. 3GPP advanced Packet gadget (EPS) framework consists of evolved Packet Cores (EPCs) and developed UMTS Terrestrial Radio access Networks (E-UTRAN) as shown in determine 1. EPCs talk with each different and with E-UTRANs. EPC incorporates a mobile control Entity (MME) and device architecture Evolution Gateway (SGW) together with a Packet facts network Gateway (PDN GW).

Table -1: LTE Performance metrics

LTE Performance Metrics	
Peak Data Rate	DL/UL: 100/50 Mbps for 20 MHz
Full Mobility	Up to 500 km/h
Latency in Control/user plane	< 100 ms (idle to active) /<5 MHz
Capacity	200 users per cell (5 MHz)
Cell Sizes	5-100 km
Spectrum	1.25, 2.5, 10, 15 and 20 MHz

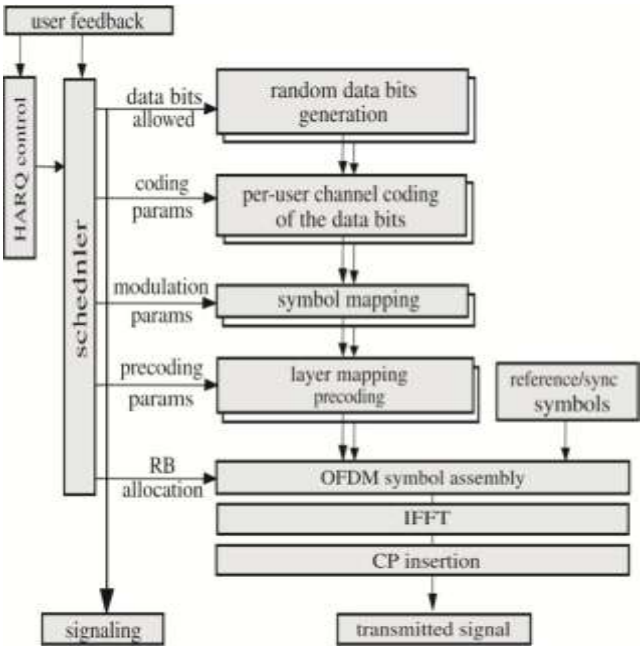

Fig -2: LTE downlink transmitter structure

Within the first step of the transmitter processing, the consumer facts is generated relying on the preceding Acknowledgement (ACK) signal. If the preceding consumer records delivery Block (TB) changed into now not mentioned, the stored TB is retransmitted the usage of a Hybrid computerized Repeat request (HARQ) scheme. Then a Cyclic Redundancy check (CRC) is calculated and appended to every user's TB. The records of every consumer is independently encoded the usage of a faster encoder. Every block of code bits is then interleaved and rate matched with a target rate depending on the obtained Channel pleasant Indicator (CQI) person comments. In addition to HSDPA, the fee-matching method in LTE already consists of the HARQ technique.

A.LTE Downlink Receiver

LTE receiver is proven in determine Figure 3. Every UE receives the sign transmitted by the anode and performs the reverse physical-layer processing of the transmitter. First, the receiver has become aware of the RBs that bring its special information. The estimation of the channel is finished using the reference indicators available inside the time-frequency useful resource grid. Based totally on this channel estimation, the high-quality of the channel may be evaluated and the suitable remarks facts calculated. The channel information is likewise used for the demodulation and tender-damping of the OFDM signal.

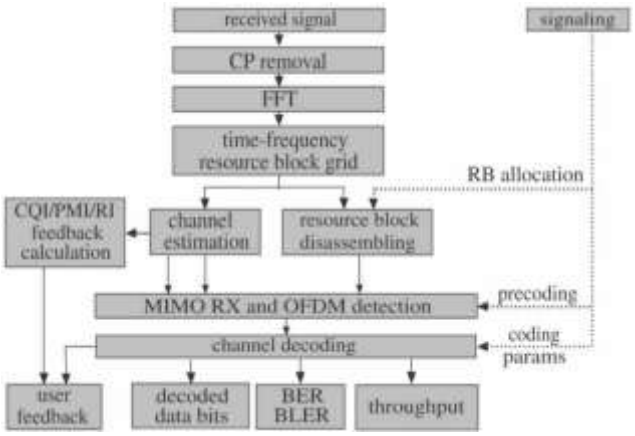

Fig -3: LTE downlink receiver structure

Sooner or later, the UE performs HARQ combining and channel interpreting. So as to reduce down processing time, at each rapid generation a CRC test of the decoded block is performed and if accurate, deciphering is stopped. The impact of the additional CRC tests is negligible, as the rapid decoder iteration requires a computation time three orders of significance bigger than the CRC check.

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2. MIMO-OFDM SYSTEM

One major breakthrough in wireless communications is the invention of the systems with multiple antennas at the transmitters and the receivers, [8] called multiple-input multiple-output (MIMO) system, which could show a considerable increase in the channel capacity. In a multipath wireless channel environment, the deployment of MIMO systems which enhances the channel capacity enormously has led to the achievement of high rate data transmission without increasing the total transmission power or bandwidth. Using multiple antennas at both the source (transmitter (TX)) and the destination (receiver (RX)) is referred to as spatial multiplexing [15]. The use of MIMO in wireless systems has several advantages such as:-

- Significant increase in data throughput and spectral efficiency
- Reduced fading because of antenna diversity
- Increased user capacity
- Greater immunity to interference

MIMO combined with OFDM provides significant improvement in the performance of wireless LANs, enabling them to serve existing applications more cost-effectively, as well as making new and more demanding applications possible [9].

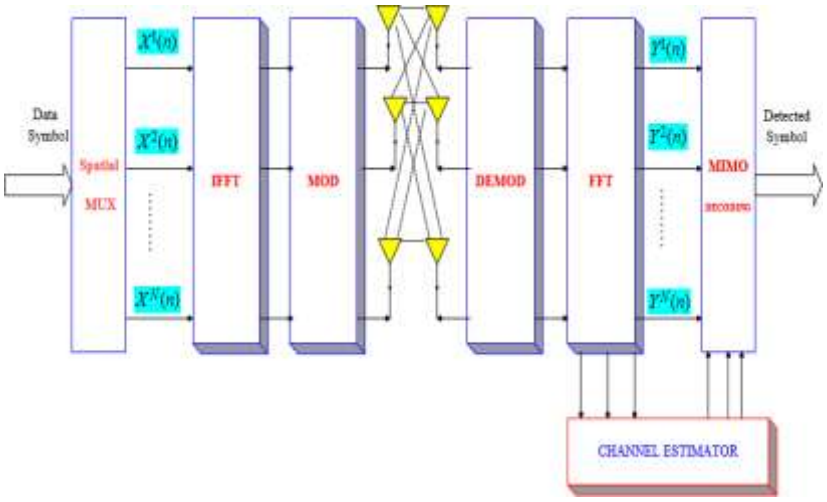

Fig -4: MIMO – OFDM Model

The spectral efficiency of MIMO is achieved by transmitting different symbols on different transmit antennas simultaneously as shown in Figure 4, in such a way that the information can be recovered from the parallel streams of data arriving at different antennas in the receiver under suitable channel conditions (i.e. Sufficiently rich multipath scattering). This requires of advanced signal processing algorithms, which also ensures adequate BER performance [10].

3. SIMULATION RESULTS

In this section will present the simulation result and performance analysis of the proposed architecture. In figure 5, show the graph of the probability of spectrum detection versus different SNR with different number of active subcarriers. In this case we are using 2 transmit antennas and 2 receive antennas in our model.

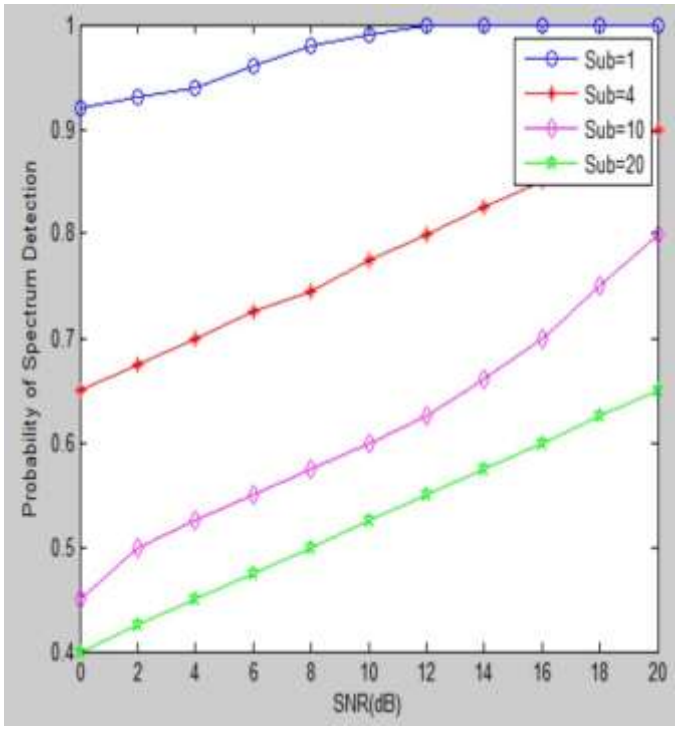

Fig -5: Probability of spectrum detection versus different SNR in 2 × 2 MIMO system

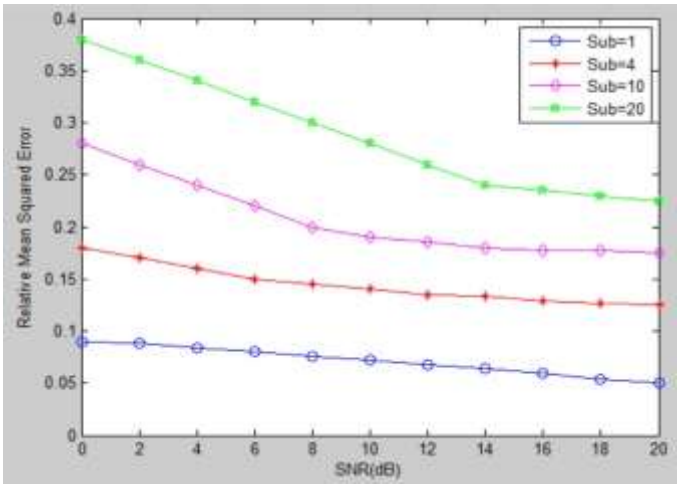

Fig -6: Probability of relative mean square error versus different SNR in 2×2 MIMO system

In figure 6, show the graph of the relative mean squared error versus different SNR in 2×2 MIMO system with different number of active subcarriers. From the figure, we can see when less relative mean squared error is less number of subcarriers. The increase subcarriers are active in the system, the mean square error will increase.

In figure 7, show the bit error rate versus different SNR under a different number of subcarriers in 4×4 MIMO system. From the figure, it is clear that the less active subcarriers will lead to lower bit error rate (BER).

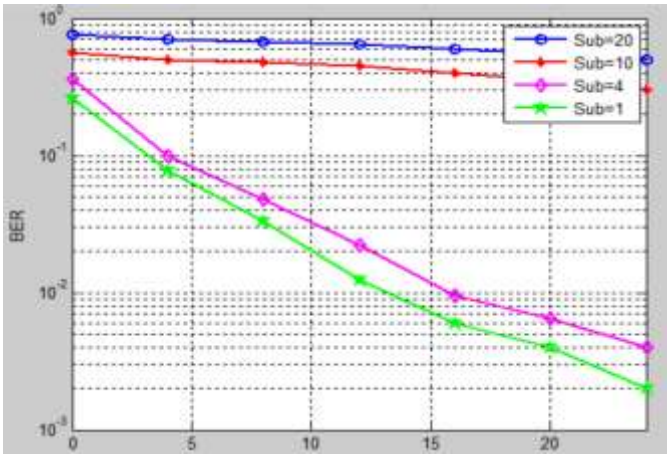

Fig -7: Probability of bit error rate versus different SNR in 4×4 MIMO system

4. CONCLUSION

In this research work, we proposed an iterative receiver for MIMO-OFDM systems. Based on this receiver, solutions to two of the most important problems in OFDM systems have been provided, namely, inter carrier interference cancellation and inter symbol interference cancellation over long term evolution (LTE) transmitter and receiver system. Furthermore, the spectrum sensing algorithm introduced in this paper can efficiently estimate the spectrum usage but without the prior information of sparsity, which makes it suitable for the application in the real wireless environment.

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