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An Overview: OFDM Technology an Emerging Trend in Wireless Communication

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ABSTRACT: With the expansion of information interchanges innovation, the interest for Higher Data Rate Services, for example, interactive media, voice, and information over both wired and remote connections is likewise expanded OFDM is transmission strategy created to take care of the expanding demand for higher information rates in interchanges, which can be utilized as a part of both wired and remote situations. New strategies to enhance data rates are required to exchange the broad measure of information which existing procedures can't bolster. These strategies must have the capacity to give high Data rate, bit error rate (BER), maximum delay. In this paper, We have presented a survey of QoS in OFDM wireless networks along with resource allocation and scheduling algorithms, its impact and how this modulation scheme can be utilised to enhance the performance of data transmission in the future of wireless networks.

KEYWORDS: Bit Error Rate (BER), Orthogonal Frequency Division Multiplexing (OFDM), Quality of Service (QoS), Resource allocation, Scheduling

I. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) is a digital transmission modulation scheme developed to meet the increasing demand for higher data rates in the field of communications, which can be used in both wired and wireless environment [6]. It has become the basis of many telecommunications standards including Wireless Local Area Networks (WLANs), Digital Terrestrial Television (DTT) and digital radio broadcasting and many transmission application all over the world.

With the increase in traffic data in a network beyond the network capacity, the service degrades. While most applications can cope up with such degradations, real-time or multimedia traffic cannot [15]. Network administrators cannot keep pace with the proliferation in computer network traffic simply by adding more and more capacity (increasing bandwidth). Instead, it is far better to optimize the available bandwidth.

The quality of Service (QoS) mechanisms offers improved services to the end user, while reducing upgrades to the network capacity.QoS allows for optimized use of the existing network infrastructure. QoS can provide the means to manage the network resources in an efficient manner. In a technical sense, QoS can be implemented as a set of factors that governand molds the network traffic like bandwidth, throughput, delay, jitter and loss [12].

A wireless network is susceptible to all the parameters mentioned above. These parameters might bring on some diversity in bandwidth, latency in the delivery of data; error rates and jitter. The adverse circumstances prevailing in a WLAN network begs for QoS guarantees. An adaptive QoS solution could be the answer to the unpredictable nature of the medium, leading to better utilization of the network resources [4].

II. OFDM TECHNOLOGY: AN EMERGING TREND

In contrast to conventional Frequency Division Multiplexing (FDM), the spectral overlapping among subcarriers is allowed in OFDM since orthogonality will ensure the subcarrier separation at the receiver, providing better spectral efficiency [7].OFDM transmission system offers possibilities for alleviating many of the problems encountered with single carrier systems. It offers efficient modulation and demodulation, High spectral efficiency, Lower multi-path distortion, flexibility, easy equalisation. Hence OFDM is a multi-carrier technique that fulfils the demand for high data rate wireless communication [3].

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A. ***PRINCIPLE OF OFDM***

In digital communications, information is expressed in the form of bits. The term symbol refers to a collection of bits, in various sizes, OFDM data are generated by taking symbols in the spectral space using M-PSK, QAM, etc., and converts the spectra to the time domain by performing the Inverse Fast Fourier Transform (IFFT) [6].

B. ***HOW OFDM WORKS?***

- Source data is converted to symbols by applying modulation technique such as interleaving and mapping of bits, and then symbols are modulated onto orthogonal sub-carriers using IFFT.
- Orthogonality is maintained during channel transmission. This can be achieved by adding a cyclic prefix to the OFDM frame to be sent. The cyclic prefix consists of the last samples of the frame, which are copied and placed at the beginning of the frame.
- Synchronization: Cyclic prefix can be used to detect the start of each frame. This is achieved by using the fact that the first and last samples are the same and therefore correlated
- Channel Equalization: The channel can be estimated either by using a training sequence or sending known so-called pilot symbols at predefined sub-carriers.
- Demodulation of the received signal by using FFT.
- Decoding and de-interleaving.

C. ***Block Diagram of OFDM***

The basic principle of OFDM is depicted as a block diagram showing a simplified configuration of an OFDM transmitter and receiver are given in Figure 1 and Figure 2

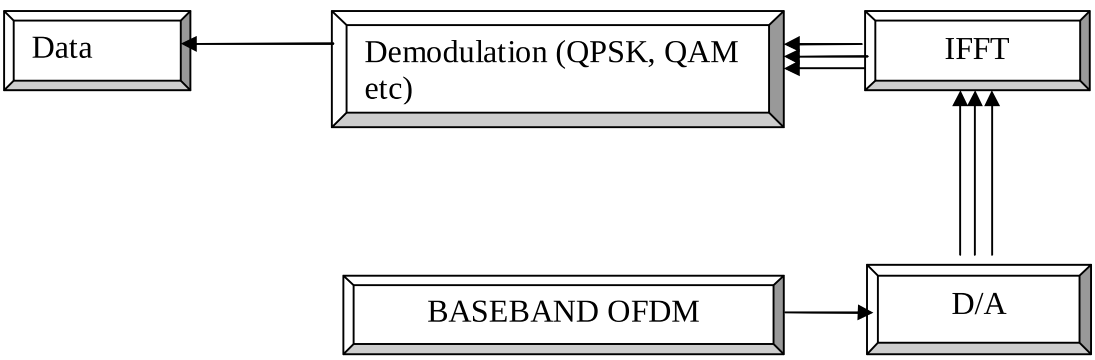

Figure 1 OFDM Signal Transmitter

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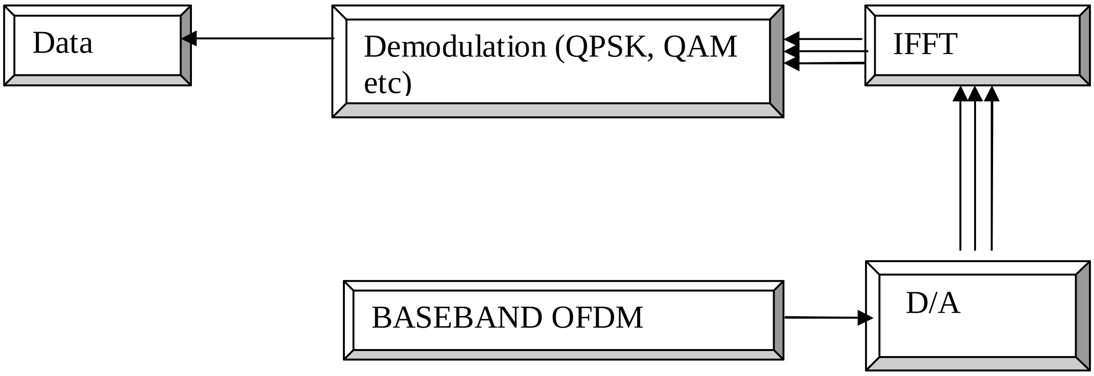

Figure 2OFDM Signal Receiver

Significant advantages of OFDM systems are [3]

- High spectral efficiency
- Simple digital realization by using the FFT operation.
- Less complex receivers due to the avoidance of Inter Symbol Interference (ISI).
- Different modulation schemes can be used on individual sub-carrier

D. ***Cons of OFDM***

Though all over the world OFDM has its acceptance, still have some drawbacks [2]:

- Accurate frequency and time synchronization is required
- More sensitive to Doppler spread than single-carrier modulation schemes.
- PAPR problem in OFDM is used to characterize the envelope fluctuation of the OFDM signal. It is the ratio of the maximum instantaneous power to its average power. PAPR occurs when in a multi carrier system the different sub carriers are out of phase with each other.

III. QOS IN OFDM WIRELESS NETWORK

QoS refers to the quality as perceived by the user/application while in the networking community; QoS is acknowledged as a measurement of the service of the quality that the network provides to the users. For instance, RFC 2386 characterisesQoS as a set of service requirements to be met when transporting a packet stream from the sink to its destination.

QoS is the capability of a network element (e.g. an application, host or router) to have quite some degree of assurance that its traffic and service requirements will be satisfied [9]. The term "QoS" is used in different meanings, ranging from the users' perception of the service to a set of connection parameters essential to achieve particular service quality [10].The QoS provisioning is performed in two quality domains, namely, reliability and timeliness [10]. Multiple QoS levels are being provided in the timeliness domain by guaranteeing manifold packet delivery speed options. In the reliability domain, various reliability requisites are endorsed by probabilistic multipath forwarding [8]. Following are some essential components of QoS architecture summarised in the form of a table below:

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Components in QoSarchitecture	
Components	***Description***
Traffic Specification	***Helps in specification of source traffic characteristics and desired QoS.***
QoS Routing	***Provides routes between source and destination with adequate support for the requested QoS***
Call Admission Control	***Determines whether a connection request should be admitted or refused, based on the requisite QoS and the status of the given network.***
Resource Reservation	***Allocates resources such as buffers, bandwidth, and power, wireless channel at the network elements, which are called for to satisfy the QoS guarantees.***
Packet Scheduling	***To schedule, packets that have to be transmitted according to the QoS requirements of the connections***
Wireless Channel Characterization	***Specifies the statistical QoS measure of a wireless channel e.g. delay rate, and delay-bound violation probability triplet, data rate.***

A. MAJOR ISSUES IN QOS

The main parameters characterising the data transmission in wireless networks are: delay, jitter, reliability and bandwidth. These parameters together determine the QoS [1]. QoS requirements depend on the application and its nature. These parameters are explored in the following section:

- ***Jitter***-The variation in time between the packets arriving at the destination is called jitter. Network congestion and change in route may cause jitter. Real-time applications such as audio or video conferences are not tolerable to jitter due to the sensitive nature of this type of traffic.
- ***Delay***-The time interval elapsed between the departures of data from the source to its arrival at the destination is labelled as Delay. In the communication system, delay points to the time lag between the departure of a signal from the source and its arrival at the destination.
- ***Reliability***-Reliability of a network is its ability to continue providing the service that a client requires for successful operation during network system failures or systematic attacks. Reliability is a multiplicative metric.
- ***Bandwidth***-- Bandwidth is a network resource affecting QoS, refers to the data rate supported by a network connection or interface. Real-time applications usually require high bandwidth as compared to other general applications.

IV. RESOURCE ALLOCATION AND SCHEDULING ALGORITHM

Resource Allocation algorithm is essential to assure the inherent capabilities of the OFDM System. Scheduling and resource allocation are vital components of wireless data systems. By scheduling we mean the problem of predicting which clients are going to be dynamically active in a given time-slot; resource allocation refers to the problem of assigning physical layer resources such as power and bandwidth among these active users [13]. Within OFDMA framework, the resources allocated to the users come in three dimensions: time, frequency and power. This requires the scheduler to operate with a more prominent level of freedom but also makes the rationale of resource fairness obsolete and makes the problem even bigger. There are three primary issues that need to be dealt in multiple access resource allocation, which are spectral efficiency, fairness and QoS.

Scheduling in resource allocation can be vividly elaborated with the help of an example given above in figure 3, is shown that freshly arrived packets are put in the schedule queue to wait for the scheduling and assigned the highest security level. The real-time controller gets all the packets and sort according to Earliest Deadline First (EDF) policy. Then from the sorted list of data packets, ‘n' number of packets will be selected for the first time. If the packet can be accepted the real-time controller will place the packet into the accepted queue.

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Real-time controller only considers the new packets in schedule queue, real-time controller notifies the security-level controller to increase or decrease the security level of each packet. If a new packet cannot be accepted it will be rejected by the real-time controller and placed in the rejected queue. The security-level controller will decrease the security level of a packet to improve the Schedulability [5].

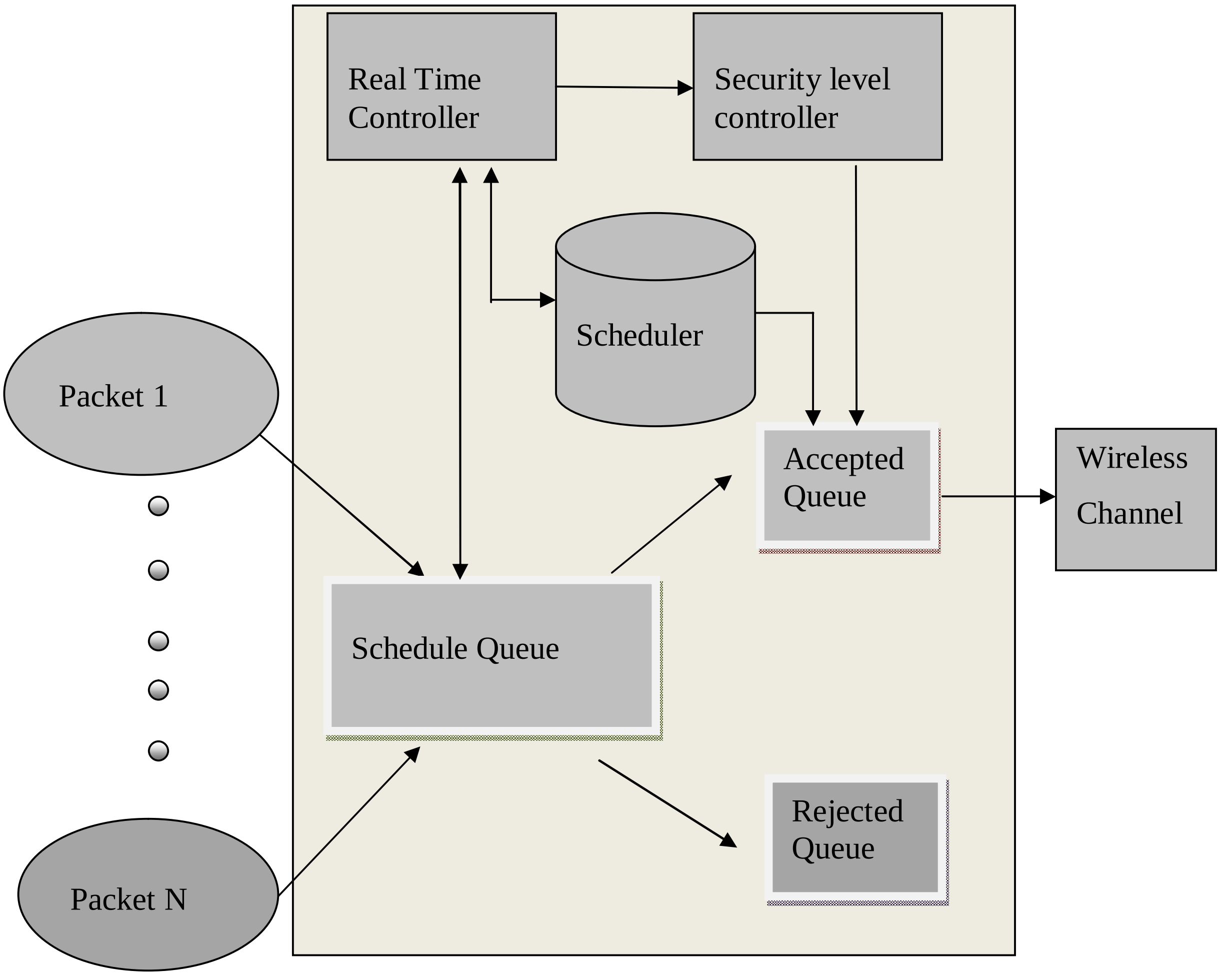

Fig.3. Scheduler Model

V. DIFFERENT QOS LEVELS

QoS is influenced by various elements, which can be divided into "human" and "technical" elements. Human components include: stability of service, availability of service, delays, user information. The technical component comprises: reliability, scalability, effectiveness, maintainability, grade of service, etc. Four types of QoS service levels are as follows:

- Provisioning: The first step is ensuring that the correct transport is selected. Appropriate allocation of bandwidth ensures the proper start point for network design. Understanding application characteristics are key to what they will use regarding network bandwidth, delay, jitter, latency.
- Best-effort Service: The majority of application data flows fit this service level. Best-effort service provides basic connectivity with no guarantee for packet delivery and handling

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- Differentiated Service: Traffic at this service level can be classified into classes based on their individual requirements. Each class is then regarded as per its configured QoS mechanism.
- Guaranteed Service: Guaranteed service requires absolute allocation of specific resources to ensure that the traffic profiled to receive this service has its specific necessities met.

VI. CONCLUSION AND FUTURE WORK

Hence this paper presents a survey of OFDM technology, how this technology is different from past ones and it's potential to improve the efficiency of networking capacity to meet the Demands for future wireless communication networks are to ensure high data rates with better QoS. OFDM is an advanced technology which is suitable for fast data transmission due to its expertise in handling the multipath propagation problem and bandwidth efficiency. Hence improving QoS in OFDM-based wireless networks constitutes a significant research challenge in the field of computer networks. OFDM technology promises a better network efficiency to deal with high demanding data rates of consumers

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