Performance Evaluation of Digital Modulation Techniques in a WCDMA-based Radio-over-Fiber Communication System

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Abstract—The demand of mobile communications in the modern world is increasing day by day and subscribers for the mobile communication technologies are growing rapidly. The data transfer rate should be maximum for uninterrupted communication. Therefore, the Radio over fiber system along with wireless communication, is used for the high speed data transfer. This combination will increase the capacity for the cellular base stations to change dynamically and meet the traffic requirements. To better understand the M-ary PSK system, a Simulink-based simulation system is designed for M-ary PSK for M=64 using communication toolbox in Simulink. In this paper we propose the suitability of 64 PSK Digital Modulation Technique for transmission and the results are analyzed on the basis of BER, scatter plot and eye diagram like performance measures.

Index Terms—Digital Modulation Techniques, Eye Diagram, Scatter Plot and 64 psk using rof.

I. INTRODCTION

Radio over fiber (RoF) is an analog optical link transmitting modulated RF signals. It serves to transmit the RF signal downlink and uplink, to and from central station (CS) to base station (BS) called also radio ports. The main requirements of radio over fiber Link architecture are duplex operation (i.e. downlink-uplink), reasonable length (a few tens of kilometers), and need a few millimeter-wave components only in the base stations and also need of only few high-performance Optical components. RoF systems are now being used extensively for enhanced cellular coverage inside buildings such as offices, shopping malls and airport terminals.

Fig. 1: Block Diagram for WCDMA using RoF

The combination of wireless and optical networks is a potential solution for increasing capacity and mobility as well as decreasing costs in the access network. The concept of RoF means to transport information over optical fiber by modulating the light
with the radio signal. This modulation can be done directly with the radio signal or at an intermediate frequency. Radio-over-Fiber (RoF) system is a fiber-fed distributed antenna network which is expected to be a fundamental supporting technique for 3G development. Greater end user demand for improved 3G services. It provides wider coverage & better indoor broadband quality. It supports high data rate transmission. The goal for the next generation with mobile communication system is to seamlessly integrate a wide variety of communication services such as high speed data, video & multimedia traffic as well as voice signals. This was a topic of investigation Khasjori and H.S A.I Raweshidy. Description of the MATLAB simulation of multiuser detection in code division multiple access (CDMA) Hailil Tanyer Eyyuboglu. To reach low bit error rate (BER) levels within reasonable computation times, the method of sampling is utilized. Sonia Aissa and Martin Maier demonstrated the ultimate goal of networks providing access to information when needed, wherever needed and in whatever format it is needed. The vision of technological convergence of wireless and optical networks is not only becoming a necessity but also plays a key role in future communications networks.

II. DIGITAL MODULATION TECHNIQUES

To meet the explosive demands of high-capacity and broadband wireless access, radio over fiber (RoF) technology has been proposed to be the best solutions for the implementation of the reduced cell size and cost-effective system. For the high speed data rate like 10 GB/s or 40 GB/s per channel linear and nonlinear degrading effects will be severe. The Performance Evaluation of Digital Modulation Techniques for WCDMA using Radio over fiber selection of a suitable optical modulation format is a key issue to ensure optimum system performance[1]. An optimal modulation format which is more tolerant to linear and nonlinear impairments can improve dramatically the capacity of light wave system, bit rate-distance product.[2] To combat both the linear and the nonlinear impairments over the transmission fiber, an optimal modulation format is desired. The advanced modulation schemes with other key technologies, like low noise optical amplifiers, new advanced optical fibers and forward error correction techniques, can realize high spectral efficient, high-capacity optical transport networks [3]. Several advanced optical digital modulation techniques have proposed in recent years for ultra long distance digital optical transmission. Because of it’s easy to modulate and demodulate.

III. PSK

Phase shift keying is another form of angle modulated, constant amplitude digital modulation. Psk is an M-ary digital modulation scheme. 64-psk is an M-ary encoding technique where M=64; there are 64 different output phases possible. With 64-psk six bits are combined, producing 32 different output phases. With 64-PSK, n=6 and M=64; therefore, the minimum bandwidth and baud equal one-sixth the bit rate (fb/6).

IV. PERFORMANCE MEASURES

The right choice of the performance evaluation criteria for the characterization of optical transmission links represents one of the key issues for an effective design of future long-haul optical systems. The evaluation criteria should provide a precise determination and separation of dominant system limitations, making them crucial for the suppression of propagation disturbances and a performance improvement. The most widely used performance measures for performance evaluation are the BER and eye opening.

A. EYE DIAGRAM

The Discrete-Time Eye Diagram Scope block displays multiple traces of a modulated signal to produce an eye diagram. In telecommunication, an eye pattern, also known as an eye diagram, is an oscilloscope display in which a digital data signal from a receiver is repetitively sampled and applied to the vertical input, while the data rate is used to trigger the horizontal sweep. It is so called because, for several types of coding, the pattern looks like a series of eyes between a pair of rails. Several system performance measures can be derived by analyzing the display. If the signals are too Long, too short, poorly synchronized with the system clock, too high, too low, too noisy, or too slow to change, or have too much undershoot or overshoot, this can be observed from the eye diagram. An open eye pattern corresponds to minimal signal distortion. Distortion of the signal waveform due to intersymbol
interference and noise appears as closure of the eye diagram.

B. BIT ERROR RATE (BER)

In digital transmission the number of bit errors is the number of received bits of a data stream over a communication that have been altered due to noise, interference Distortion bit or synchronization errors. The BER can be estimated from following equation. The BER gives the upper limit for the signal because some degradation occurs at the receiver end.

BER is

\[
BER = \frac{1}{2} \text{erfc}\left(\frac{Q}{2}\right) \approx \frac{\exp(-Q^2/2)}{Q\sqrt{2\pi}}
\]

The bit error rate or bit error ratio (BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval. BER is a unit less performance measure, often expressed as a percentage. The bit error probability \( p_e \) is the expectation value of the BER. The BER can be considered as an approximate estimate of the bit error probability. This estimate is accurate for a long time Interval and a high number of bit errors. In a communication system, the receiver side BER may be affected by transmission channel noise interference, distortion, bit synchronization problems, attenuation, wireless multipath fading, etc. In a noisy channel, the BER is often expressed as a function of the normalized carrier-to-noise ratio measure denoted \( \frac{E_b}{N_0} \) (energy per bit to noise power spectral density ratio), or \( \frac{E_s}{N_0} \) (energy per modulation symbol to noise spectral density).

C. SIGNAL TRAJECTORY

The Discrete-Time Signal Trajectory Scope displays the trajectory of a modulated signal in its signal space by plotting its in-phase component versus its quadrature component. The Discrete-Time Signal Trajectory Scope block has one input port. The input signal must be complex. The block accepts signal of type double, single, base integer, and fixed-point for input, but will cast it as double. The input signal must be a sample-based scalar in sample-based mode. The input must be a frame-based column vector or a scalar in frame-based mode.

D. SCATTER PLOT

The Discrete-Time Scatter Plot Scope block displays scatter plots of a modulated signal, to reveal the modulation characteristics, such as pulse shaping or channel distortions of the signal. The Discrete-Time Scatter Plot Scope block has one input port.

V. SYSTEM DESCRIPTION AND RESULTS

In this system we will use matlab Simulink. Fig2. Shows the Matlab simulation model of the 64 PSK digital modulation technique. The Performance of 64 PSK is measured and Eye diagram, signal trajectory, scatter plot and BER graph for 64 PSK is evaluated.

Fig 2.Simulink Model for 64 PSK Digital Modulation Technique using WCDMA and RoF.

Fig 3.Signal Trajectory Scope for 64 psk
VI. CONCLUSIONS

This paper describes the performance of 64 psk Digital Modulation Technique using the WCDMA and RoF. The Results are carried out using Matlab Simulink. The results include the Eye Diagram, scatter plot, Signal trajectory and BER graph for 64 psk Digital Modulation Technique.

REFERENCES


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