Performance Assessment of Digital Modulation Methods for 3G Using Hybrid Fiber Radio

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Abstract
The growing demand for high-capacity multimedia services in real-time demands wireless broadband access. In order to meet this demand, a fiber based wireless access using Hybrid Fiber Radio (HFR) technology can be used. This Hybrid Fiber Radio technology uses both radio and fiber in amalgamation. Fiber based wireless access schemes effectively combine the high capacity of optical fiber with the flexibility of wireless networks. So WCDMA HFR systems will have an impression not only on several-user interference but also on intermodulation distortion and clippingnoise power. In this paper we suggest and show the relative examination and fitness of 32 PSK digital modulation techniques for communication. The relative results are analyzed for 32 PSK and correctness of the digital modulation technique is based on various performance measures such aseye opening, BER.

Keywords
BER, Eye Diagram, Signal Trajectory and Digital Modulation Techniques, Scatter Plot.

I. Introduction

Wideband CDMA (WCDMA) air interface with the Hybrid fiber Radio technology is one of the most favorable approaches for 3G technology. Numerous suggestion supporting WCDMA were submitted to the International Telecommunication Union (ITU) and its International Mobile Telecommunications forthe year 2000 (IMT2000) initiative for 3G. All these proposals try to take advantage of the WCDMA radio techniques. The standard that has emerged is based on ETSI's Universal Mobile Telecommunication System (UMTS) and is commonly known as UMTS Terrestrial Radio Access Network (UTRAN). In WCDMA, conversion of electrical to optical signal and signal modulation happens in central station. After transmission through various length of fiber, the receiver signal is analysed. PIN photo diode is used to detect the optical signal & convert it back to electrical signal. Afterwards Demodulation is performed. BER analyzer is used to analysis the results. Fig. 1 shows the Block diagram of Hybrid Fiber Radio System.

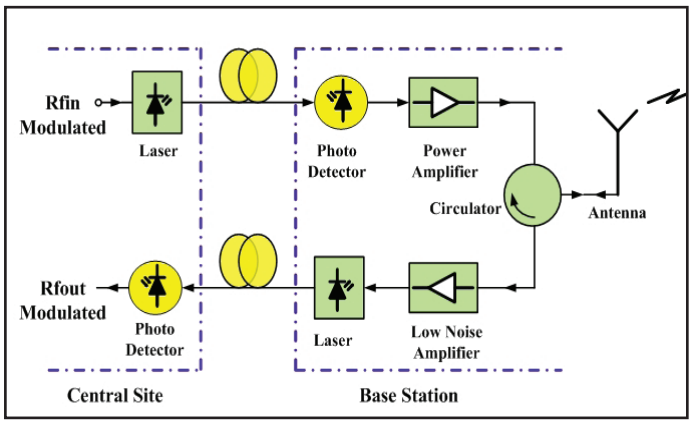

Fig. 1: Hybrid Fiber Radio System

W-CDMA is a spread-spectrum modulation technique, one which uses channels whose bandwidth is much greater than that of the data to be transferred. Instead of each connection being granted a dedicated frequency band just wide enough to accommodate its envisaged maximum data rate, W-CDMA channels share a much larger band. The modulation technique encodes each channel in such a way that a decoder, knowing the code, can pick out the wanted signal from other signals using the same band, which simply appear as so much noise. UMTS uses a core network derived from that of GSM, ensuring backward compatibility of services and allowing seamless handover between GSM access technology and WCDMA.The mixture of wireless and optical networks is a possible 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. Hybrid Fiber Radio (HFR) system is a fiber-fed distributed antenna network which is expected to be a fundamental supporting technique for 3G development. Description of the MATLAB simulation of multiuser detection incode division multiple access, to reach low bit error rate (BER) levels within realistic computation times, the way of sampling is used. The eventual goal of networks providing access to information when needed, wherever needed and in whatever format it is needed. The visualization 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. Phase Shift Keying (PSK)

Phase-Shift Keying (PSK) is a digital modulation scheme that conveys data by changing (modulating) the phase of a reference signal (the carrier wave). The modulation is impressed by varying the sine and cosine inputs at a precise time. In an M-ary signaling scheme, two or more bits are grouped together to form symbols and one of M possible signals, s1 (t), s2 (t)… SM (t) is transmitted during each symbol period of duration Ts. Usually, the number of possible signals is $M = 2^n$ where n is an integer . M-ary modulation schemes have better bandwidth efficiency but they have less power efficiency. With 32-psk five bits are combined, producing 32 different output phases. With 32 PSK, n=5 and M=32; therefore, the minimum bandwidth and baud equal one –fifth the bit rate(fb/5).

III. Digital Modulation Techniques

A. Direct Modulation

Digital signals consist of logical 1s and 0s, which readily corresponds to electrical ON and OFF states, or to two discrete voltages (or current) levels. The typical optical communications light source is a laser diode, which is easily modulated by controlling its current. Several factors limit the upper frequency at which a laser diode can be modulated. These include the time constants (frequency response) of the driving circuitry, the physics of the diode itself, and the characteristics of the transmission medium, which is typically an optical fiber.

B. Indirect Modulation

Modulation of a continuous light beam removes the laser diode-related problems at the cost of greater complexity. It also eliminates the signal-to-noise problems of applying a modulated subcarrier. The stable light source allows maximum transmission distance for a given amount of dispersion in the fiber. Established methods include delivering the data to electrically modulated crystalline materials such as lithium niobate. These devices can rapidly switch the light beam between a direct signal path, or split the beam into two paths with 180-degree phase shift, which cancel when recombined. This provides electrically controlled on-off transitions that do not affect the light source.

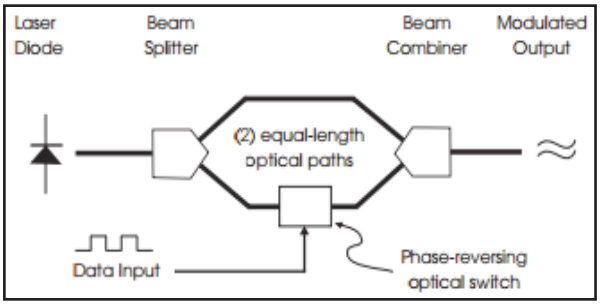

Fig. 2: Functional Diagram of Optical Modulator

IV. Performance Analysis

A. Scatter Plot

A scatter plot (also called a scatter graph, scatter chart, or scatter diagram is a type of plot or mathematical diagram using Cartesian coordinates to display values for typically two variables for a set of data. If the points are color-coded you can increase the number of displayed variables to three. The data is displayed as a collection of points, each having the value of one variable determining the position on the horizontal axis and the value of the other variable determining the position on the vertical axis.

B. Eye Diagram

The Discrete-Time Eye Diagram Scope block shows multiple traces of a modulated signal to produce an eye diagram. In telecommunication, 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. 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.

C. Bit Error Rate

The bit error rate (also BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval. The bit error probability is the expectation value of the bit error ratio. The bit error ratio 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.

$$\mathrm{BER} = \frac{1}{2}\,\mathrm{erfc}\left(\sqrt{E_b/N_0}\right) \qquad (1)$$

BER curves to describe the performance of a digital communication system. In optical communication, BER (dB) vs. Received Power (dBm) is usually used; while in wireless communication, BER (dB) vs. SNR (dB) is used.

D. Signal Trajectory

A signal trajectory is a continuous plot of a signal over time. A signal trajectory differs from a scatter plot in that the latter displays points on the signal trajectory at discrete intervals of time.The Discrete-Time Signal Trajectory Scope block has one input port. The input signal must be complex. The block receives 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.

V. Results and Discussions

In this system we will use matlab Simulink. Fig. 3 shows the Matlab simulation model of the 32 PSK digital modulations Technique. Performance of 32 PSK is measured. Eye diagram,signal trajectory, scatter plot and BER graph for 32 PSK isevaluated.

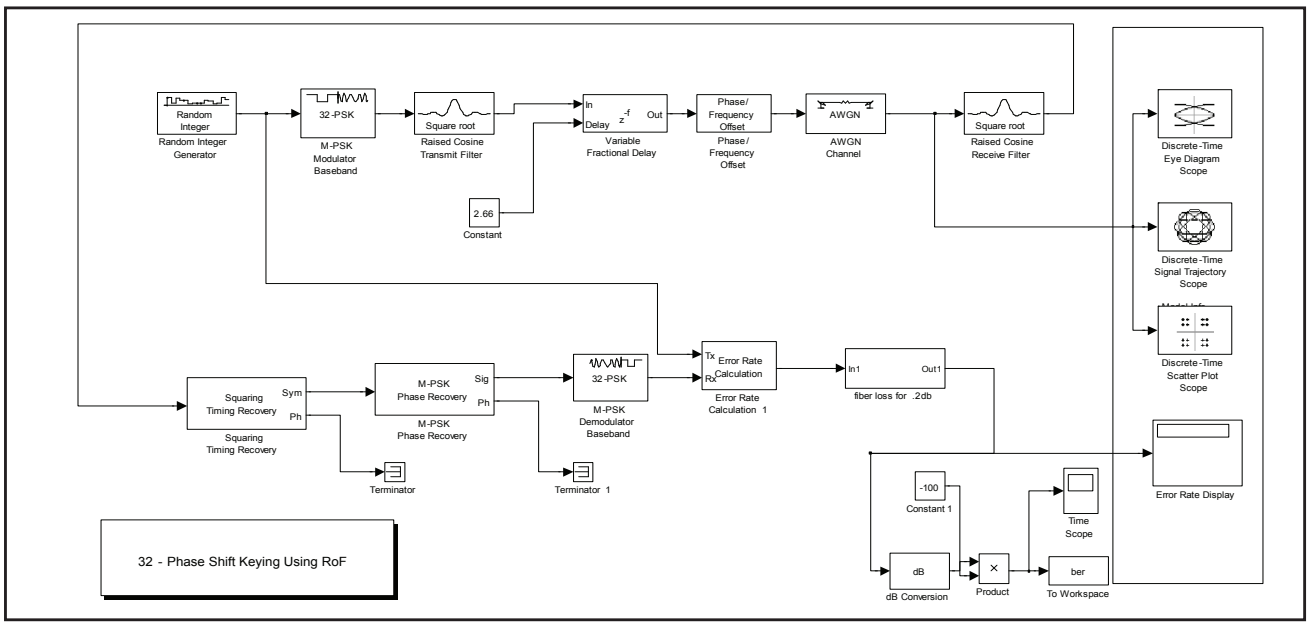

Fig. 3: Block Diagram for 32 PSK

This study is further in continuation and the departmental research committee has not allowed publishing the complete/partial results of the test(s) except model/diagram.

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