A

Project Report on

OFDM (Orthogonal Frequency Division Multiplexing)

Simulation Applying Matlab

Submitted in partial fulfillment of the

requirement for the award of the

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in

ELECTRONICS AND COMMUNICATION ENGINEERING

by

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DECLARATION

We declare that the work presented in this report titled "OFDM (Orthogonal Frequency Division Multiplexing) Simulation Applying Matlab", submitted to the Department of Electronics and Communication Engineering, Galgotias University, Greater Noida, for the Bachelor of Technology in Electronics and Communication Engineering is our original work. We have not plagiarized unless cited or the same report has not submitted anywhere for the award of any other degree. We understand that any violation of the above will be cause for disciplinary action by the university against us as per the University rule.

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Date:

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CERTIFICATE

This is to certify that the project titled **"**OFDM (Orthogonal Frequency Division Multiplexing) Simulation Applying Matlab**"** is the bonafide work carried out by Shreyam Chaurasia, Abhijit Kumar , during the academic year 2018-22. We approve this project for submission in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering, Galgotias University.

Name of the project mentor
Dr. Himanshu Parashar

The Project is Satisfactory / Unsatisfactory.

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Internal Examiner (s) External Examiner

Approved by

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ABSTRACT

This document describes the layout and application of OFDM (OFDM is a standard measurement for enabling the high data rates required by today's various data operations) modems applied in wireless communication. We have mapped on sending precompiled and notes files applying OFDM with protocols and system parameters. This technique has the potential to become a promising technology for 4thgeneration (4G) mobile phones due to its high transmission speeds over wired and wireless channels that are protected from multipath fading. Digital communication, digital audio broadcasting, and digital video broadcasting are all examples of bandwidth intensive applications that can benefit from this technology. Bit error rates and ISIs in classic multipath technologies like QAM are extremely high; however they can be decreased by using OFDM technology. The study also included simulation findings, future work and conclusions.

Each data bit is transmitted repeatedly or consecutively one after the other in a simple single modulation system. Within the independent sub stream channels in OFDM, different pieces can be sent in equal even simultaneously. As an outcome, the data rate of each sub channel can be lower than that of a single channel with similar frequency. This reduces the chances of interference and makes for more efficient transmission bandwidth.

The standard behind on which the OFDM is built is FDM, that distributes the available bandwidth into a number of sub-streams with various frequencies. Chang at Bell Labs introduced OFDM in 1966, and Weinstein and Ebert improved this in 1971.

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GLOSSARY

OFDM	Orthogonal Frequency Division Multiplexing
ISI	Inter Symbol Interference
FDM	Frequency Division Multiplexing
IFFT	Inverse Fast Fourier Transform
FFT	Fast Fourier Transform
DFT	Discrete Fourier Transform
PAPR	Peak To Average Power Ratio
FGPA	Field Programmable Gate array

1. INTRODUCTION

The study and simulation for Orthogonal Frequency Division Multiplexing is the emphasis of this project. Chang PATANG was the first one to investigate OFDM in 1966. Because OFDM is sensitive to ISI(Inter Symbol Interference) is a big occurrence in high-speed transmission (ISI) , it is highly suitable to high-speed transmission. Inter Symbol Interference takes place when the gearbox Interferes itself, and the acceptor cannot correctly resolve the gearbox because the signal displays massive gadgets including mountains and homes, the recipient looks at multiple copies of the signal. This means multipathing of communication terms. Indirect paths require a lot of time to reach the recipient, so the delay copy of the signal disturbs the signal that causes ISI to disturb the signal. Whenever the communication networks improve the speed at which information is exchanged every communication definitely become shorter in frequency because Inter Symbol Interference because the postpone time as a result of multipath remains steady, ISI will become a trouble in excessive records price verbal exchange. OFDM prevents such kind of problem by delivering a large number of slow transmissions at the same time. Figure 1 shows both methods for transferring the same four binary facts. Assume that this communication takes 4seconds then each information lasts one second on the left side of the image. However, as illustrated on the right side of the image the OFDM will transport all four bits at the same time with each piece of information lasting four seconds. This long period alleviates ISI issues. Another reason to use OFDM reduced execution at high-speed structures as compared to standard single-service methodologies.

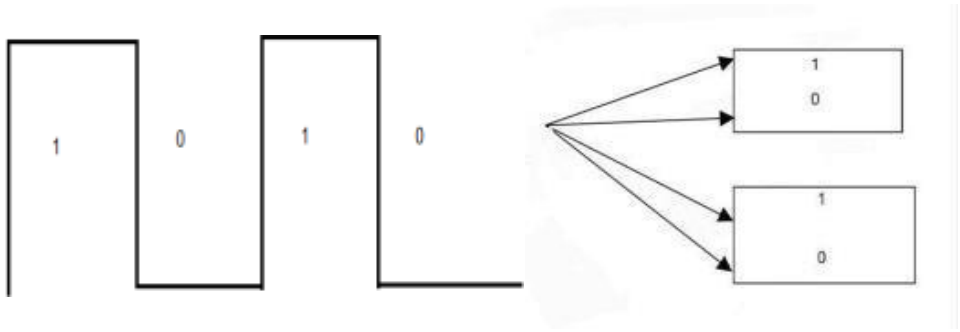

Fig.1 Custom against OFDM transmission

1.1 RECEIVING SIGNALS AND CREATION OF OFDM

Because it is hard to create a large bank OFDM frequencies are frequently created electronically, instead of using conventional receivers and phase lockedoscillators. A common OFDMtransceiver is seen in the diagram below in Figure2. In the transmitter part, digital data is converted to subcarrier amplitude and phase image. The Inverse Fast Fourier Transform (IFFT) is a slightly more computationally efficient form used in all hands on real systems to turn this spectrum presentation of the data set into the time domain. To convey the average time and frequency domains signals are converted to the appropriate frequency using the OFDM signal. The receiver inverts its transmitter function, converting the RF signal towards baseband enabling explanation and analysis utilizing of the frequency domain signal's by applying Fast Fourier Transform (FFT).The subcarriers amplitude and stage (phase) are then reestablished and changed over it into a computerized information. And mass applicable word turn on whetherthe signal is being collected or createdthus IFFTs and FFTs are complementing features. The terms FFT and IFFT are interchangeable when the signal does not require this differentiation.

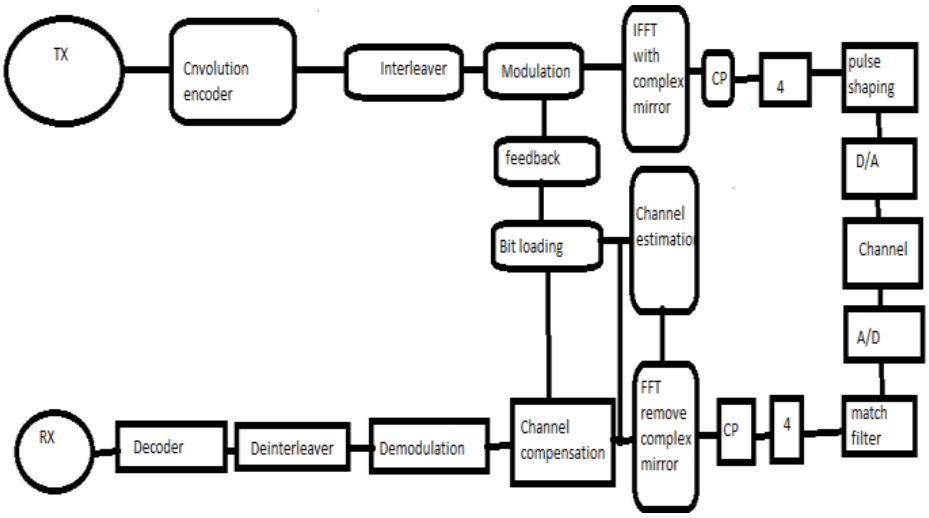

Fig.2 BLOCK DIAGRAM OFOFDM SYSTEM

1.2 SHIELDING AGAINST ISI

To ensure the subcarriers orthogonal in OFDM transmissions, then amplitude and phase of the subcarriers should always remain consistent during the symbol period. When they're not in order, it indicates the subcarriers spectral shapes aren't in rhythm, which means nulls aren't at the desired frequency, causing in inter-carrier interference. Both amplitude and phase change drastically at the symbol's boundary to the new numbers required for the following data symbol. Inter Symbol Interference disperses energy between symbols inside a multipath environment, generating a transient variation in subcarrier amplitude and phase at the start of said mark. The duration of all these momentary processes corresponds for the execution time of the radio stations. The sporadic signals are the output of each multipath parts arriving with minute difference of times and varying the received subcarrier vector Because implementing a guard phaselessens the signal's temporal component, FFT is taken from the symbol's static portion. This removes the effects of ISI if the propagation delay of the radio channel is shorter than the guard time. Channel equalization analyzes any leftover effects due by multipath, like phase rotation and amplitude scaling.

2. OVERVIEW

The project's goal is to research and develop an OFDM communication system. Diagram of MATLAB simulation is given below.

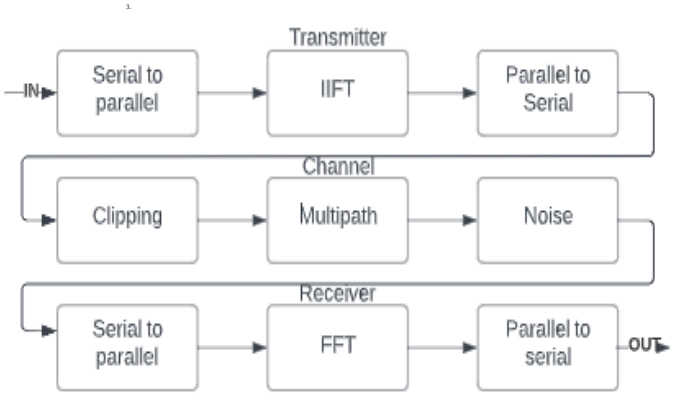

Fig.3 The OFDM simulation block diagram.

The data is first changed from a serial channel to parallel set by the transmitter. Each channel is defined by a number in each set of data. A four-data combination is represented by Si. This example set of data is stored on the y axis in the waveform before using the Opposite Fast Fourier Transform (IFFT), as can be seen in Figure 3.

The IFFT requires this symmetric structure around the vertical line in order to change the data. An inverse Fourier transform is used to convert the frequency response data set into samples of the matching time domain representation. The IFFT is useful for OFDM because it creates samples of a waveform with frequency components that satisfy orthogonality constraints. The OFDM signal is then formed by generating time domain samples periodically in the parallel to serial block.

The channel simulation can be used to explore noise, multipath, and peaking, which are all frequent wireless channel features. To create simple noise, random data is added to the output channel. Multipath

simulation should be about adding weaker and delayed duplicates of the delivered signal to the source. This mimics the wireless issue.

A signal is said to communicate when it travels down numerous paths. A receiver, for example, may pick up a signal both directly and via a house. Finally, clipping simulates the problem of amplifier saturation. In OFDM application, this solves the issue of a high peak to average power ratio. The receiver copies the transmitter's activities. OFDM data is first divided into parallel sets from a serial input. Time signal is changed into frequency-domain information by using Fast Fourier Transform (FFT). The frequency parts have the same magnitudes as the sample signal. Finally, the similar to serial block converts information signal into a serial input allowing for faster data processing.

3. LITERATURE REVIEW

3.1 To pass on the data DFT is employed through FDM.

Approach that modulates and demodulates by applying Discrete Fourier Transforms is a frequency division multiplexing explanation of The Fourier transform data transmission system. A totally computerized approach can be planned around a particular reason PC that does the quick Fourier change as differentiation the cots of subcarrier oscillators as well as synchronized demodulators which are generally required within FDM devices are abolished.

3.2 Building of OFDM modulator on ground of Field Programmable Gate array (FPGA).

To accommodate high baud rates and low inter symbol interference, OFDM systems are used in current and future communication techniques wired less firewall, universal serial bus is also wireless, satellite broadcasting and Mobile CDMA are some further examples. The terminology SDR "SOFTWARE DEFINED RADIO" is created by Joe Mitola it generally refers to increasingly advanced signal processing setups including FFT, to address new developing devices, slow standard adoption, and inefficient spectrum use.

3.3 Multichannel data transmission using orthogonal signals

This is an orthogonal multiplexing method for sending large numbers of data messages at maximum data rates over bandwidth-limited linear communication media without inter-symbol or inter-channel interference. The most basic technique is applied for synchronizing a large number classes of band limited orthogonal time mechanism is seen within the compact frequency domain.

3.4 Kineplex is a high-speed, low- latency binary communication technology.

Thousands of medium and large-scale scientific and business data-processing computers have been placed in use by the government and industry since world war 2

.The unavoidable connection of computing hardware from the radio communication systems and wires has taken place as a outcome of this development.

4. Advantages and Disadvantages

Advantages

1. Spectrum efficiently can be used by enabling overlap. OFDM has additional resistant to interference because of the limited band shallow fading sub channel rather than definite carrier systems frequency selective fading is applied.
2. Since OFDM delivers modulation and demodulation functions using FFT technology, it is fast and accurate.
3. Provides protection against shocking parasitic noise as well as extremely similar channel interference.
4. OFDM also has several advantages over standard timedivision multiplexing. In OFDM, the RF receiver is simpler because the entire signal is received by a single frequency-selective filter and can be software-separated using the Fast Fourier Transform, but in an FDM system, a separate RF band pass filter for each channel is required. It also improves overall bandwidth efficiency. One consequence of greater overall peak to average power ratio (PAPR) is that they necessitate sluggish linear transmission circuits.

Disadvantages

1. The OFDM signal have a large and wide dynamic range, noise amplitude, requiring an RF power amplifier including an extremely high ratio of peak power to average power of a signal (PARP).
2. Because of dropping of the Discrete Fourier Transform, it is delicate to porter frequency offsets and drifts than one porter systems.
3. The two significant impediments of OFDM by contrasting it with a solitary channel frameworks .OFDM frame works require precisely the matching transmitters and the receivers.

It thus necessitates the signal modulators and demodulators timing being precisely coordinated and built to specified tolerances. Also, the system becomes more sensitive to Doppler shifts and is therefore less effective for fast moving vehicles.

5. MATLAB SIMULATION AND RESULTS

Binary data and text file inputs are supported in MATLAB simulation. After that, simulate a channel that has authorized to OFDM transmission, modeling the channel attempting to recover data input, and do analysis to determine the transfer margin of error. To evaluate an experimentof 16 QAM can be performed using OFDM on a classic old mono signal communications system. Such experiments are dynamical, granting for modification of factors in determining the communication device's features. As a report on the completed scan an OFDMsimulation, you'll get a graph.

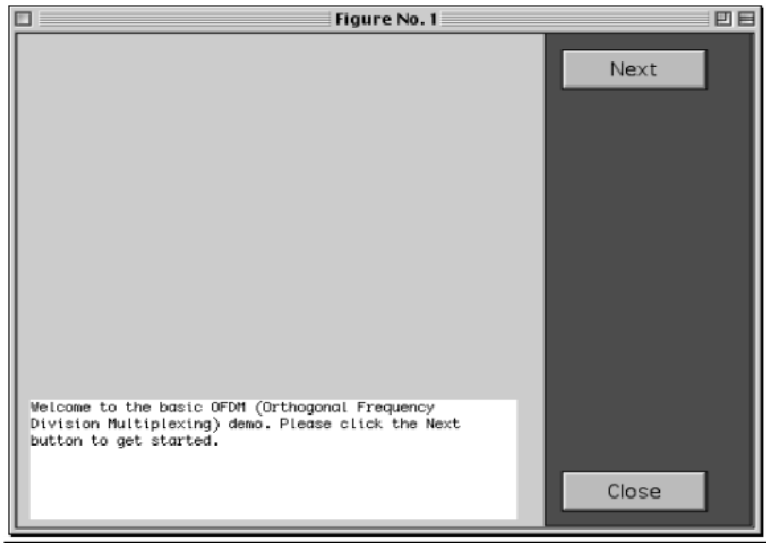

Fig 4. Basic OFDM (Orthogonal FrequencyDivision Multiplexing) demo. Please click the Next button to get started.

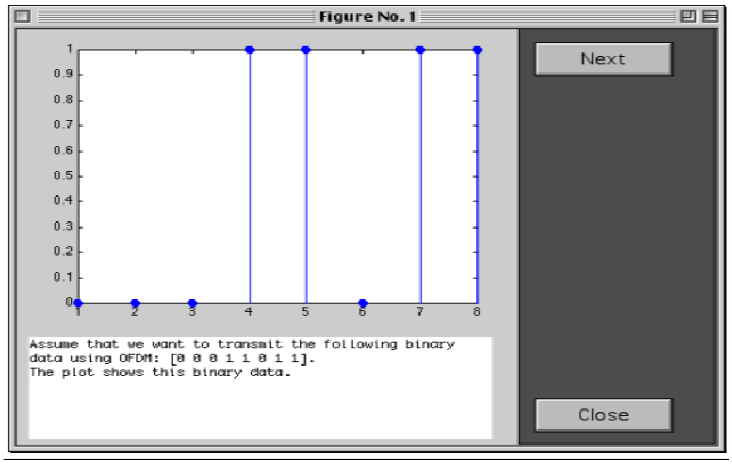

Fig 5.If we have to send the following binary datausing OFDM: [0 0 0 1 1 01 11].
Plot shows this binary data.

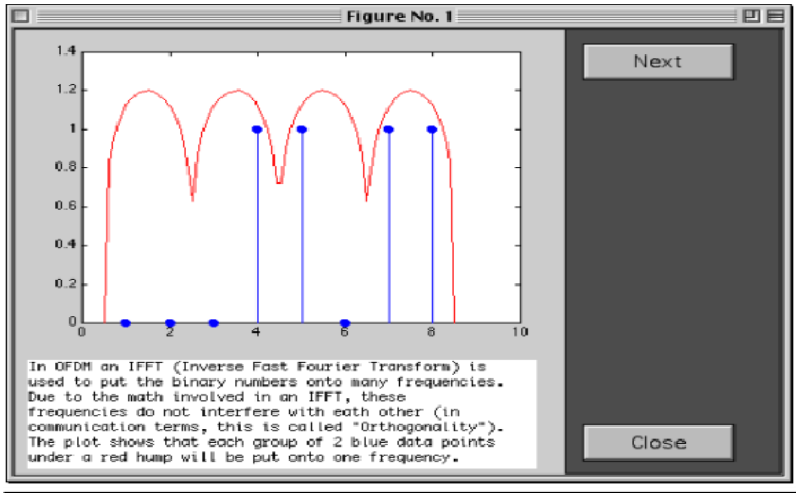

Fig 6.The binary numbers are put onto numerous frequencies using an IFFT (Inverse Fast Fourier Transform) in OFDM. Thesefrequencies do not conflict with each other due to the arithmetic involved in IFFT (in communication terms, this is called " Orthogonality "). Each set of two blue data points under a red hump will be assigned to one frequency, as seen in the graph.

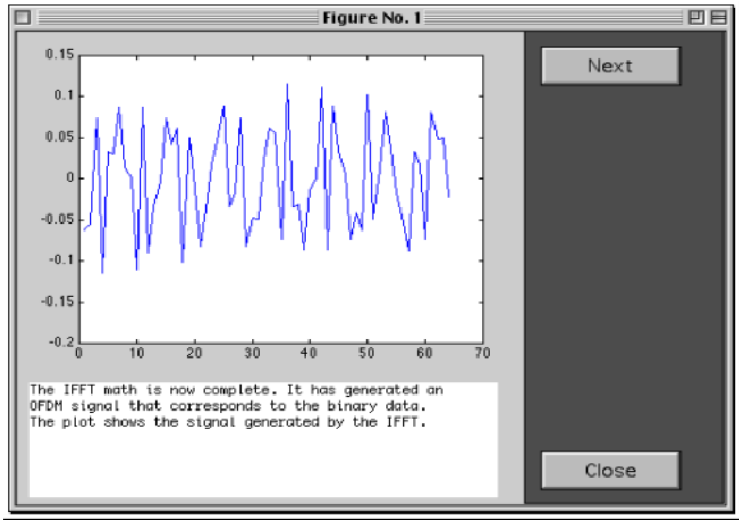

Fig 7.The IFFT math is finished. It has produced an OFDM signal that matches the binarydata. The signal created by the IFFT is depicted in the graph.

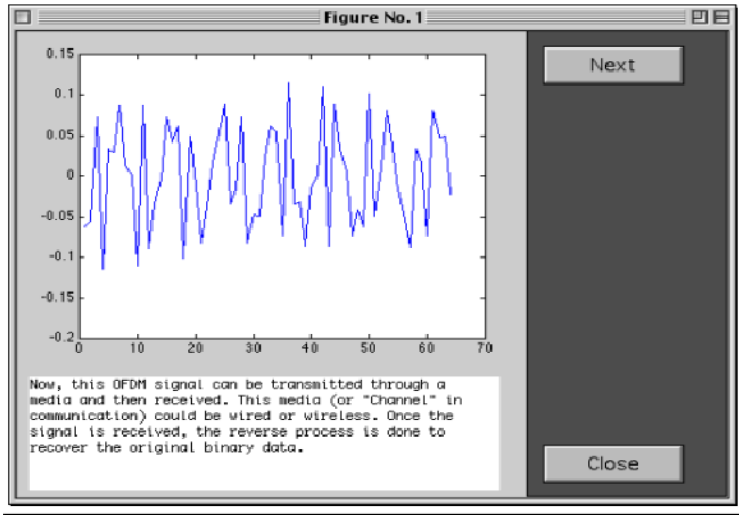

Fig 8. This OFDM signal must now be broadcast through a medium and then received. This communication media Channel could be wired or wireless. The technique of retrieving the actual original binary data is reversed just after the signal is detected.

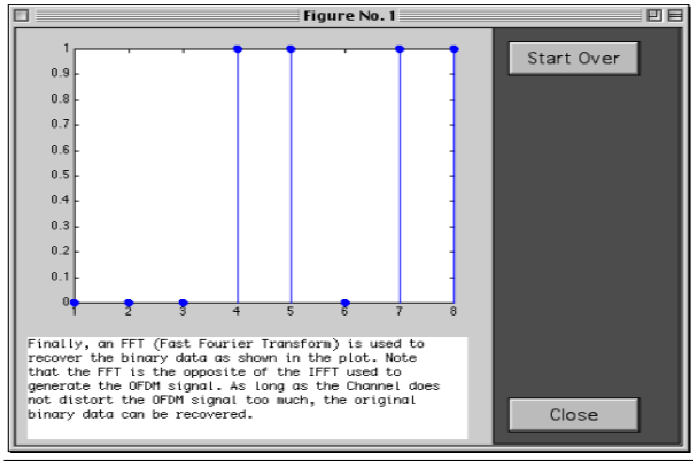

Fig.9.Subsequently the binary data is retrieved by using the Fast Fourier Transform as shown in the figure above. The inverse of the IFFT, which was utilized to generate the FFT, is the FFT. The original binary data can be recovered as long as the channel does not distort the OFDM signal excessively.

6. CONCLUSION AND FUTURE WORKS

6.1 Conclusions

We have done this paper to show that OFDM is more appropriate and sensible for multipath channels than single transporter transmission methods on MATLAB recreation.The major goal with this experiment is to be able to shift signals frombottom to top frequency, as well as from top to bottom frequency and vice versa. This means that the same signal can be used in more than one frequency range. This means that if a frequency range is not available, you can move it to another frequency range. An OFDM framework has been used to implement this. At the same moment, it helps in determining the bit error rate and peak to average power ratio. This research can be used as a foundation for future research. Code error correction, Implementation of DSP, Peak to average power ratios, correction and detection of channel phase shift and efficient adaptive transmission are examples of these extensions.

6.2 Future Works

Demand for high rate data communication own surged in recent years due to speedy increase of digital transmission. To keep up with the demand for multiple communication bandwidth, new spread spectrum modulation schemes such as OFDM are constantly being used. Current digital signal transmitter have rise in processing power toward the matter where OFDM is now viable as well as cost-effective. Looking at the documents, publications, and records on OFDM, it's definite that such technology had a significant effect on communication in the upcoming years.

Terrestrial Digital video broadcasting, Digital audio broadcasting, Cellular radio, Broadcasting of HDTV, Digital subscriber lines, Asymmetric Digital Subscriber Line, and a very high performance local area network standards and all wireless networking technology are all examples of these technologies.

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