International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 06 | June -2020 ISSN: 2582-3930

Why OFDM Is Not The Waveform For 5G

Deepak Kumar Ray[1], Amul Jaiswal[2], Ankit Singh[3], Abhishek Roy[4]

[1]Assistant Professor of Electronics and Telecommunication Department, BVDUCOEP
[2]Student of Electronics and Telecommunication Department, BVDUCOEP
[3]Student of Electronics and Telecommunication Department, BVDUCOEP
[4]Student of Electronics and Telecommunication Department, BVDUCOEP

Abstract -Due to the rise of wireless devices plus the need for higher data rates requires an upsurge on bandwidth. The OFDM technique helps us to give the required data rates for wireless devices. Simple OFDM has its own limitations,so in order to break the limitations variants of OFDM are used in 5g network. The variants of OFDM are: Cyclic prefix OFDM. Filtered OFDM, MIMO OFDM, Coded OFDM, flash OFDM, vector OFDM, wideband OFDM. In the research paper we have discussed the introduction of OFDM, Its block diagram, variants, advantages, disadvantages, limitations,key indicators, applications,etc…

1.INTRODUCTION *(OFDM)*

OFDM, Orthogonal Frequency Division Multiplexing is a procedure of data encoding into multiple carrier frequencies. Chang of Bell Labs in 1966 introduced OFDM.

OFDM has large number of closely spaced modulated subcarrier signals with overlapping spectra property are transmitted to data in parallel. The frequency channels are orthogonal to each other and because of that there is no interference. OFDM was further enhanced by Weinstein and Ebert in 1971 with introduction of a guard interval that helps us to provide better use of orthogonal property in-transmission of channels i.e. affected by the multipath.Guard intervals are used to ensure that different transmissions do not interfere with one another or can cause overlapping transmissions. Orthogonal frequency-division multiplexing isa frequency division multiplexing technique. The carrier spacing is reciprocal to the symbol period. The signal transmission is close to one another and must be separated by spaces called guard bands.

2.BLOCK DIAGRAM OF OFDM

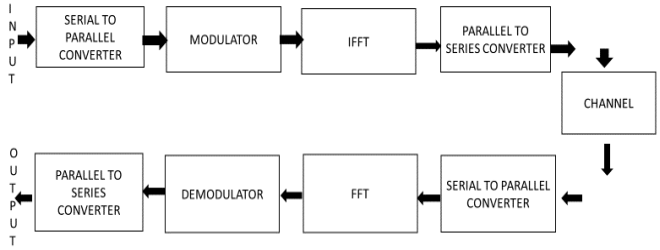

Fig.2.Block Diagram

The block diagram of OFDM is shown above:-

- First, the input is applied on the OFDM system which is FEC coded i.e. convolution code. The gain which is obtained from it is called diversity gain. The points, called constellation points are grouped together which convert data into serial i.e. represented by complex numbers.
- A Serial to Parallel converter block is used now. We have used a Mapping Technique i.e. pilot mappedalso. When data goes from the Serial to Parallel converter and IFFT is applied on it. In each block of data CP is entered and data is divided into the serial type. Now this data is Modulated and it converts thedigital data into the analog by using different types of modulations. Then, that signal is gone to all the wireless channels.
- The receiver side doing opposite of sender and change the signal into again digital by using Synchronization and Analog-Digital converter which perform exactly opposite of Digital-Analog converter.
- The input signal also called as OFDM signal is demodulated with the help of demodulator block. Again that signal is converted into serial by using Parallel to Series Converter.
- Finally, we receive an output data as shown by the diagram.

3. KEY INDICATORS OF 5G

5G KPIs are categorized into following :-

- e-MBB (Enhanced mobile broadband)
- URRLC (Ultra-reliable and low latency) communications.
- m-MTC (Massive machine type communications).

The Characteristics we need in 5g network are as follows:-

- The mobile data volume per geographical area is 1000 times higher.
- The lower energy consumption is 10 times.
- The connected devices are 10-100times more.
- The typical user data rate 10-100 times higher.
- In low density areas 5g is accessible.

The high performance, new network will be handled via scalable management framework which will enable fast deployment of novel applications, which will include sensor -

based applications.The security and authentication metrics will be light weight but robust for the new generation.
Multi domain networks and services will be provided.

CHARACTERISTICS	VALUES
Peak Date Rate	DL-20 Gbps UL-10 Gbps
Spectral Efficiency	DL-30bits/Hz UL-15bits/HZ
Latency	C-Plane-10ms U-Plane 0.5ms
Area Traffic Capacity	1oMbits/m2
Mobility	500km/h
Bandwidth Support	Upto-1GHz
Coverage	mMTC-164db
Connection Density	! million devices/km2
Reliability	1 packet loss out of 100 packets
UE Battery Life	mMTC-15years

Table -1: Characteristic of 5G

4. ADVANTAGES AND DISADVANTAGES OF OFDM

ADVANTAGES:

- Due to overlapping, OFDM makes efficient use of spectrum.
- OFDM divides the channel into narrowband flat sub channels therefore making it resistant.
- Use of FFT techniques to implement the modulation and demodulation functions is efficient.
- It's takes less sampling timing offsets compare to the single carrier systems.
- It gives good security against interference and parasitic noise.
- With the use of FFT techniques we may implement demodulation and modulation functions.
- Recovery of lost symbols can be done by channel coding and interleaving.

DISADVANTAGES:

- Requirement of RF amplifiers because of noise in OFDM.
- Tricky to carrier frequency and drift- frequency as compare to the single carrier system are due to the leakage of DFT.
- It requires time offset and frequency offset correction algorithms as it is prone to Inter symbol Interference (ISI) and Inter Carrier Interference (ICI).
- Requirement of guard bands to avoid ISI errors due to timing offsets.
- Local oscillators and DFT leakage results in high carrier frequency offset.

5. OFDM VARIANTS

1) CYCLIC PREFIX OFDM

The CP-OFDM features a guard interval that has a special property which eliminates inter symbol interference (ISI)which is present in the previous transmitted symbol. The reiteration of the upper part by itself therefore with the help of the linear convolution property of a frequency-selective multipath channel are seldom demonstrated as like circular convolution, which successfully can transform to the frequency domain via discrete Fourier transform. Each OFDM symbol is headed by a replica of the top a part of that very same symbol.

Advantages:

- It reduces inter symbol interference.
- It offers robustness.

Disadvantages:

- It decreases data capacity.
- The reason is retransmission of data and it takes up system capacity.

2) FILTERED OFDM

Filtered-OFDM is a one of the variant of the OFDM. It is used to generate the waveform which is spectrally-localized. Filter of different kinds used by 5G waveform. The difference is occurred between kind of Filter and how we use the filter. Basically f in OFDM doesn't provide any special meaning. In f-OFDM, a frequency band can be divided into multiple-sub bands .Each one have their own bandwidth. Another point is that each sub band is made-up of multiple subcarriers. By increasing the length of filter or we called filter length exceed the CP length of OFDM which is helpful in design the filter correctly.

3) CODED OFDM

COFDM uses multiple carriers for signal data transmission. It offers resistance to multipath effects. In the signal there is correction of error technique or code for error correction present.

COFDM is best suited for single frequency networks**.**

4) VECTOR OFDM

VECTOR OFDM is being developed and monitored by CISCA. It uses multiple input multiple output (MIMO)

technology. There are multiple antennas for transmitting and receiving signals of a range of frequencies .The multipath effects enhances the signal and improves the speed of transmission of data over a signal. It is uses in broadband services.

5) WIDEBAND OFDM

In wideband OFDM there is a degree of spacing between the channels that is large. The large distances between channels results in no effect of error on the transmitting signal. It is used in Wi-Fi Systems and radio networks and 4G devices. The bandwidth of WOFDM is 2.9 GHz.

6.CONCLUSIONS

In this research paper we have given information about Orthogonal Frequency Division Multiplexing in detail. The OFDM technology has a promising future in mobile communication and wireless networks. OFDM is already used in WLAN and it will soon be used MAN also. OFDM has high spectral efficiency. We still don't know whether it will be cost effective or not. OFDM is used in various modulation systems with the help of new signal processing techniques.

REFERENCES

1. [SIOHAN,2002] P.Siohan , C.Siclet and N. Lacaille, "Analysis and style of OFDM/ OQAM systems supported filter-bank theory," in IEEE Transactions on Signal Processing.
2. [FETTWEIS,2009] G. Fettweis, M. Krondorf and S. Bittner, "GFDM –Generalized Frequency Division-Multiplexing,"IEEE-Vehicular TechnologyConference,Barcelona,2009.
3. [ABDOLI, 2015] J.Abdoli, M. Jia and J. Ma, "Filtered OFDM: a replacement waveform for future wireless systems," 2015 IEEE 16th International Workshop on Signal Processing Advances in Wireless Communications (SPAWC), Stockholm, 2015.
4. [VAKILIAN, 2013] V.Vakilian, T.Wild, F. Schaich, S.ten Brink and J.F.Frigon, "Universal-filtered multi-carrier technique for wireless systems beyond LTE, "2013 IEEE Globecom Workshops (GC Wkshps).