Unique Word based DFT-S-OFDM Waveforms without cyclic prefix

[1] Potluri Sreenivasulu , [2]Chekuru Vinay kumar , [3]Madduri Hari Babu , [4]Nara Lavanya, [5]Donthireddy Harshitha , [6]Annem Sireesha

[1]Associate professor, [2,3,4,5,6] Student, [1]Dept.of ECE, [2]Dept.of ECE, [3]Dept.of ECE, [4]Dept.of ECE, [5]Dept.of ECE, [6]Dept.of ECE

PBR Visvodaya Institute Of Technology and Science, Kavali, Nellore District ,India

Abstract:

This work examines extended discrete Fourier transform-spread-orthogonal frequency division multiplexing (G-DFT-s-OFDM) waveforms, which use an internal guard period to replace the cyclic prefix of classic OFDM/DFT-s-OFDM. Flexibility, spectral confinement, and a low peak-to-average power ratio are all advantages of such waveforms. Aspects of reference sequence design. A new estimator for the special zero-tail DFT-s-OFDM situation is proposed, and aspects relating to reference sequence design and mapping for channel estimation are thoroughly explored. We also discuss the prospect of using the internal guard period at each symbol for frequent channel state information updates, allowing for the tracking of rapidly changing propagation conditions.

I.INTRODUCTION

In Orthogonal Frequency Division Multiplexing (OFDM) - based systems, the usage of a Cyclic Prefix (CP) allows to convert the linear convolution with the fading channel to a circularconvolution, leading to a simple one-tap frequency domain equalization at the receiver. Thanksto its capability of efficiently counteracting the multipath, CP-OFDM has been accepted as basic waveform for several radio access technologies, including Long Term Evolution (LTE).It has recently been agreed that also 5th Generation (5G) new radio (NR) will be adopting CP-OFDM, at least for enhanced mobile broadband (EMBB) and ultra-reliable low latencycommunication (URLLC) services at below 40 GHz carriers. The Discrete Fourier Transform -spread- OFDM (DFT-s-OFDM) waveform is meant at reducing the peak-to-average power ratio (PAPR) of OFDM by emulating a single carrier transmission, and can be obtained as a simple add on over OFDM. Already adopted in LTE uplink, DFT-s-OFDM will also be supported by 5G NR, targeting uplink coverage-limited cases.

II.LITERATURE SURVEY

[1] L. Hanzo, M. Munster, B.J. Choi and T. Keller: Orthogonal frequency-division multiplexing (OFDM) is a method of digital modulation in which a signal is split into several narrowband channels at different frequencies. CDMA is a form of multiplexing, which allowsnumerous signals to occupy a single transmission channel, optimizing the use of available bandwidth. Multiplexing is sending multiple signals or streams of information on a carrier at the same time in the form of a single, complex signal and then recovering the separate signalsat the receiving end. Multi-Carrier (MC) CDMA is a combined technique of Direct Sequence (DS) CDMA (Code Division Multiple Access) and OFDM techniques. It applies spreading sequences in the frequency domain.

[2] [2] H. Holma and A. Toskala, Eds.,: From the editors of the highly successful LTE for UMTS: Evolution to LTE-Advanced, this new book examines the main technicalenhancements brought by LTE-Advanced, thoroughly covering 3GPP Release 10 specifications and the main items in Release 11. Using illustrations, graphs and real-life scenarios, the authors systematically lead readers through this cutting-edge topic to provide anoutlook on existing technologies as well as possible future developments. The book is structured to follow the main technical areas that will be enhanced by the LTE-Advanced specifications. The main topics covered include: Carrier Aggregation; Multi-antenna MIMO.

Transmission, Heterogeneous Networks; Coordinated Multipoint Transmission (CoMP); Relay nodes; 3GPP milestones and IMT-Advanced process in ITU-R; and LTE-Advanced Performance Evaluation.

[3] p.Roshan and j. Leary: Master the basics in designing, building, and managing a Cisco Aironet WLAN. Master the basics of Wireless LANs with this concise design and deploymentguide Understand implementation issues for a variety of environments including vertical, SOHO, and enterprise networks Learn design and troubleshooting advice from real-world casestudies 802.11 Wireless LAN Fundamentals gives networking engineers and IT professionals the knowledge they need to design, deploy, manage, and troubleshoot their own wireless local-area networks (WLANs). Starting with an overview of the technology and architecture of WLANs, the book goes on to explain services and advanced features that such applications canprovide. Most importantly, it provides practical design guidance and deployment recommendations.

[4] ETSI TR 138 913 V14.2.0 (2017-05): The justification of the Study Item was that a fully mobile and connected society is expected in the near future, which will be characterized by a tremendous amount of growth in connectivity, traffic volume and a much broader range of usage scenarios. Besides the market requirements, the mobile communication society itself alsorequires a sustainable development of the eco-system, which produces the needs to further improve system efficiencies, such as spectrum efficiency, energy efficiency, operational efficiency and cost efficiency. To meet the above ever-increasing requirements from market and mobile communication society, next generation access technologies are expected to emerge in the near future. A study item to identify typical deployment scenarios for next generation access technologies and the required capabilities in each corresponding deploymentscenarios should be considered.

[5] H. G. Myung, J. Lim, and D. J. Goodman: Single carrier frequency division multiple access (SCFDMA) which utilizes single carrier modulation at the transmitter and frequency domain equalization at the receiver is a technique that has similar performance and essentiallythe same overall structure as those of an OFDMA system. One prominent advantage over OFDMA is that the SC-FDMA signal has lower peak-to-average power ratio (PAPR). SC- FDMA has drawn great attention as an attractive alternative to OFDMA, especially in the uplink communications where lower PAPR greatly benefits the mobile terminal in terms of transmit power efficiency. SC-FDMA is currently a working assumption for the uplink multiple.

[6] H. G. Myung, J. Lim, and D. J. Goodman: Single carrier frequency division multiple access (SCFDMA) which utilizes single carrier modulation at the transmitter and frequency domain equalization at the receiver is a technique that has similar performance and essentiallythe same overall structure as those of an OFDMA system. One prominent advantage over OFDMA is that the SC-FDMA signal has lower peak-to-average power ratio (PAPR). SC- FDMA has drawn great attention as an attractive alternative to OFDMA, especially in the uplink communications where lower PAPR greatly benefits the mobile terminal in terms of transmit power efficiency. SC-FDMA is currently a working assumption for the uplink multiple access scheme in 3GPP Long Term Evolution (LTE). In this paper, we give an in-depthoverview of SC-FDMA with focus on physical layer and resource management aspects.

[7] F. Schaich and T. Wild: This paper deals with generalized discrete Fourier transform— spread—orthogonal frequency division multiplexing (G-DFT-s-OFDM) waveforms, which replace the cyclic prefix of traditional OFDM/DFT-s-OFDM with an internal guard period. Such waveforms feature significant benefits in terms of flexibility, spectral containment, and low peak-to-average power ratio. Aspects related to reference sequence design and mapping for channel estimation are thoroughly addressed, and a new estimator for the specific zero-tailDFT-s-OFDM case is proposed. Furthermore, we address the opportunity of exploiting the internal guard period at each symbol for frequent channel state information updates, thus enabling the possibility of tracking rapidly varying propagation condition.

III.Existing System:

CP-DFT-S-OFDM:

➨ In Orthogonal Frequency Division Multiplexing (OFDM) - based systems, the usage of a Cyclic Prefix (CP) allows to convert the linear convolution with the fading channel to a circular convolution, leading to a simple one-tap frequency, its capability of efficiently counteracting the multipath, CP-OFDM has been accepted as basic waveform for several radio access technologies, including Long Term Evolution (LTE) and IEEE 802.11 . It has limited flexibility , poor spectral containment and High PAPR .To overcome the dis advantages of CP-DFT-S-OFDM we proposed a new method called UW DFT-S-OFDM.

IV.Proposed System:

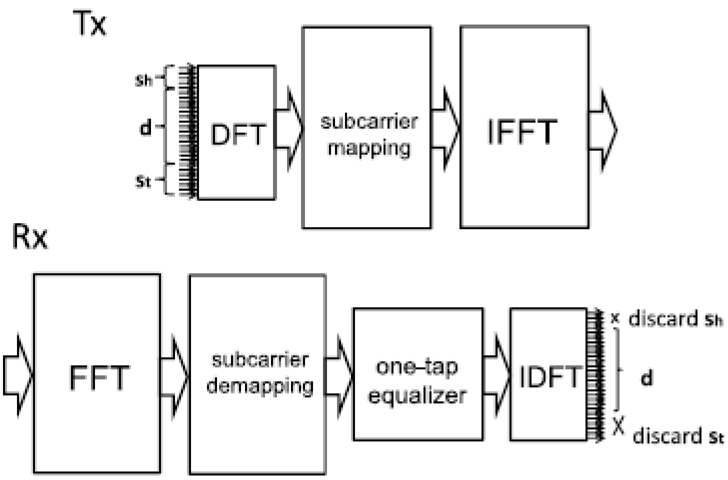
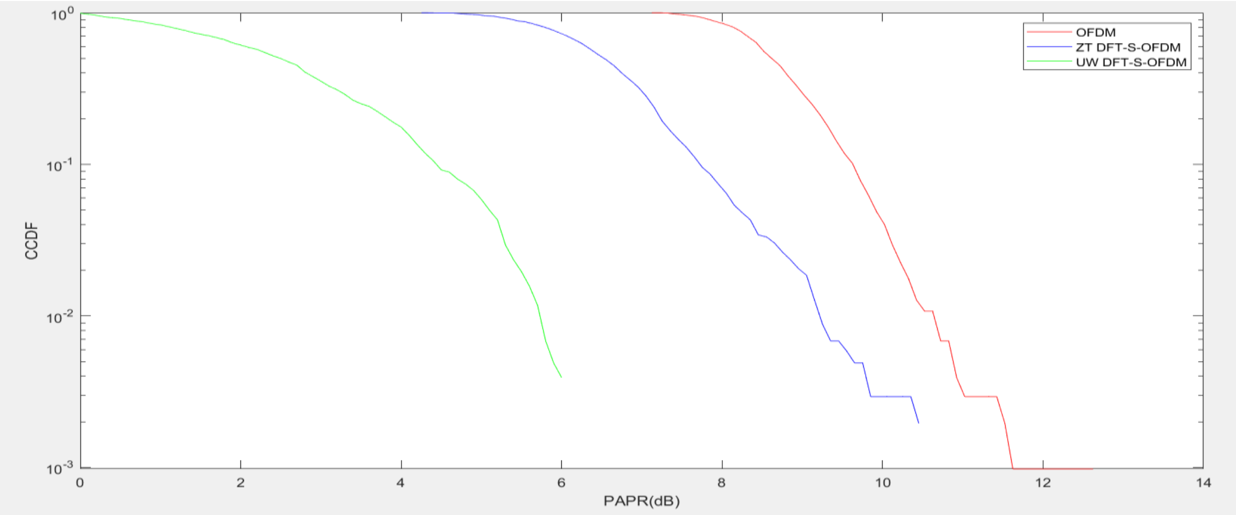


Fig: Block Diagram of Proposed Method

- UW DFT-S-OFDM replace the CP with an internal guard interval whose length can be set dynamically according to the delay spread of the channel rather than being hardcoded in the system numerology.
- Eases scalability as well as coexistence among cells operating over channels with diverse dispersion characteristics.
- The usage of the same signal tail at each symbol also allows to track fast channel variations even without additional overhead.
- Reduction of PAPR.
- Good spectral containment.

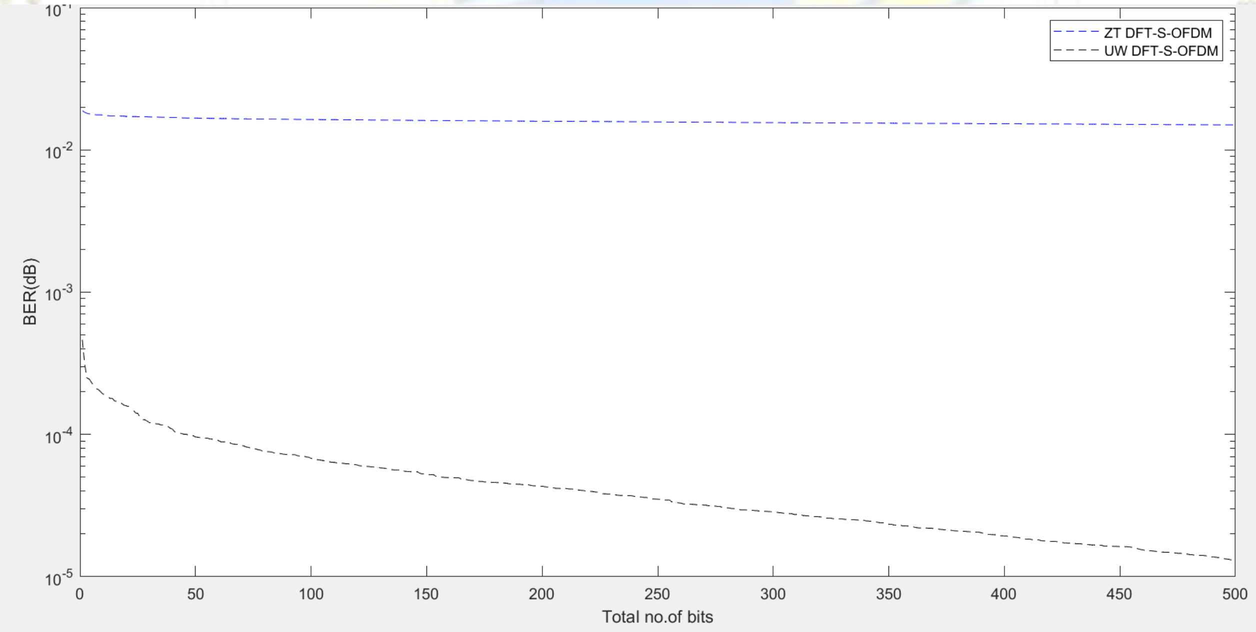
V.Result :



The above graph shows UW DFT-S-OFDM has less PAPR because that uses a DFT spreading matrix instead of a typical FFT matrix to spread the data symbols in the frequency domain. This spreading matrix ensures that the signal has a constant envelope, which helps to reduce the PAPR compared to other OFDM methods.

In conventional OFDM systems, the PAPR is high because of the inherent orthogonality of the subcarriers. When the subcarriers add constructively, they can create a large peak, resulting in high PAPR. However, in DFT-S-OFDM, the use of a DFT spreading matrix ensures that the subcarriers do not add constructively, reducing the possibility of high peak values and thus lowering the PAPR.

Therefore, Unique word DFT-S-OFDM has a lower PAPR than other OFDM methods, making it more suitable for high-speed data transmission and reducing the distortion caused by signal peaks.



Bit Error Rate is the ratio between Error bits and total number of bits. In UW DFT-s-OFDM BER reduces when increasing total number of bits increases because when more bits are transmitted Efficient utilization of bandwidth is possible and SNR also good when bandwidth is more

VI.Conclusion

In this article, we have described the properties of Generalized DFT-s-OFDM (G-DFT-s-OFDM) waveforms without CP, with the particular emphasis on challenges and opportunities related to channel estimation and tracking. Both Zero Tail (ZT) DFT-s-OFDM and Unique Word (UW) DFTs-OFDM solutions are presented and analyzed. G-DFT-sOFDM replace the CP with an internal guard interval whose length can be set dynamically according to the delay spread of the channel rather than being hardcoded in the system numerology. This eases scalability as well as coexistence among cells operating over channels with diverse dispersion characteristics. Such waveforms are particularly suited for TDD mode given the opportunity of embedding the guard period in the symbol itself, as well as for fast beam switching at mm-wave frequencies. G-DFT-s-OFDM also features attractive properties in terms of PAPR and spectral containment even without additional filtering/windowing, thus supporting asynchronous access and coexistence of flexible numerologies in the same carrier. Channel estimation requires specific arrangements either on the frame design (for UW DFT-s-OFDM) or at the receiver processing (for ZT DFT-sOFDM) in order to fully exploit the nominal properties of the used reference sequences. The usage of the same signal tail at each symbol also allows to track fast channel variations even without additional overhead.

VII.Future Scope

Future work will address the performance of such waveforms with additional windowing and filtering operations, especially for the case of ZT DFT-s-OFDM whose low power head and tail makes it particularly suited for tolerating edge distortions. Future analysis will also focus to detailed performance assessment of G-DFT-s-OFDM for small bandwidth allocations, which may suffer from non-negligible energy leakage in the signal tail. The usage of ICI cancellation receivers and enhanced channel estimators is also to be considered for the sake of improving the capability of tracking fast channel variations.

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