Proactive Security Approaches for Web 3.0 and IoT Networks through SLM Based Chaos

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Abstract— **The emergence of Web 3.0, which emphasizes decentralization and interoperability, presents new and complex security challenges that demand thorough examination. It is crucial to tackle the security concerns linked to the development of the Semantic Web in this particular situation. Blockchain technology, which is a fundamental aspect of Web 3.0, brings about security problems due to the implementation of decentralization. Although blockchain improves transparency and resistance to tampering, it is not impervious to weaknesses. Specific security issues that need to be addressed to ensure the strength of decentralized systems include smart contract vulnerabilities, weaknesses in consensus algorithms, and the potential for 51% assaults on decentralized networks. A significant obstacle faced by such networks is the elevated Peak to Average Power Ratio (PAPR), which diminishes their level of security. A high peak-to-average power ratio (PAPR) results in a significant amount of detectability and compromised security. Therefore, it is imperative to decrease the peak-to-average power ratio (PAPR) of the systems. Various methods have been utilized thus far to decrease the Peak-to-Average Power Ratio (PAPR) in systems. The proposed work uses a modified selective mapping technique and attains lower PAPR compared to previously existing work.**
*Keywords***:-
Web 3.0, Security, PAPR-, High Power Amplifier, Clipping, Filtering SLM,**

I. INTRODUCTION

Web 3.0 and interconnected networks have become one of the most important areas of current research for several applications.

Fig.1 Visualization of Web 3.0

This is an ecosystem of connected physical objects that are accessible through the internet. The major challenges of web 3.0 based systems are:

- Increasing number of users, so need for more bandwidth.
- Limited Bandwidth availability.
- One of the techniques to address the above problems is using Orthogonal Frequency Division Multiplexing (OFDM) in IoT Based Systems.

II. Multiplexing in Web 3.0

Orthogonal Frequency Division Multiplexing or OFDM is a technique that works on the principle of orthogonality. The carriers or signals are mutually orthogonal and hence create no overlap. Using OFDM in place of FDM helps in accommodating more users or devices in the same available bandwidth.
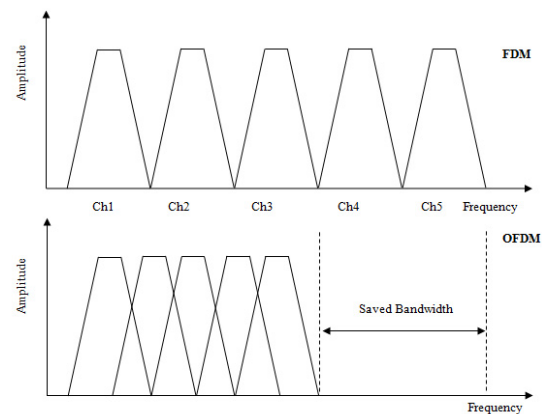

Fig.2 Comparative Analysis of FDM and OFDM.

The major advantages of this technique are high spectral efficiency and efficient digital implementation. The drawback lies in the fact that the amplitude variations of OFDM signals is large , which requires large back-off in the transmitter amplifier and hence High Power Amplifiers (HPAs) are not efficiently used. In order to reduce the distortion caused by a HPA without setting it to large back-offs, several techniques have been introduced that limit the peak of the envelope of the signal (clipping)[1],[5], a problem that is usually referred to as peak-to-average power ratio (PAPR) reduction. These

techniques have varying PAPR-reduction capabilities, power, and bandwidth and complexity requirements. PAPR is a very well-known measure of the envelope fluctuations of a multicarrier (MC) signal and plays a decisive role in the adoption of any particular technique. So the major problem with OFDM is high peak to power ratio or PAPR
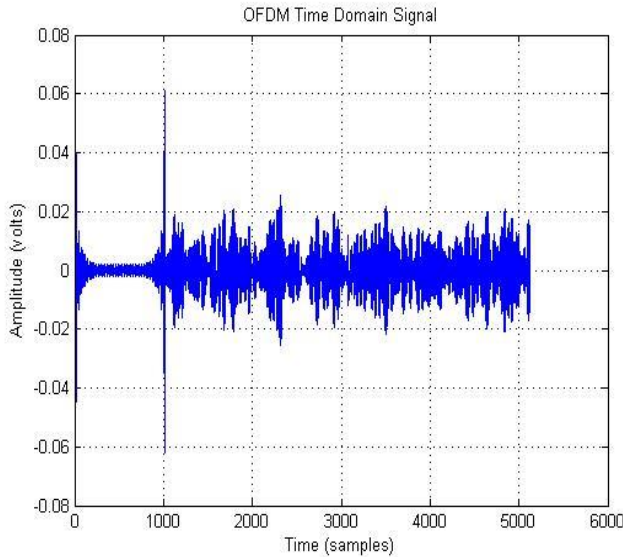

Fig.3 OFDM Time Domain Signal

The graph above shows the time domain OFDM signal. It can be seen that the signal has high peaks leading to high peak to average power ratio defined by:

$$PAPR = \max \{x^2(t)\} / mean\{x^2(t)\} \quad (1)$$

Where $x(t)$ denotes the time domain OFDM signal.
The Complementary Cumulative Distribution Function (CCDF) is often used to analyze the magnitude of PAPR in an OFDM system, which is mathematically defined as:

$$\text{Probability (PAPR \{x\} > Y)} = 1 - (1-e^{-y})^N \quad (2)$$

Here N is the number of sub-carriers,
Y is any arbitrary value of PAPR above which the possibility of attaining PAPR is evaluated. The CCDF plot clearly indicates the possibility of attaining PAPR greater than a particular PAPR value. Since the user data is random in nature, hence the modulated version of the OFDM signal is also random in nature. Hence probabilistic approaches need to be used for the analysis of PAPR.

III. SELECTIVE MAPPING

Selective mapping is the most fundamental and highly efficient technique to reduce PAPR. It provides a high performance as compared to normal OFDM. In this method set of m different symbols are generated of the same signal X and out of these m symbols the symbol with minimum PAPR is transmitted, which is given by:

$$\text{Min}\{PAPR(x(t)^m\} \quad (3)$$
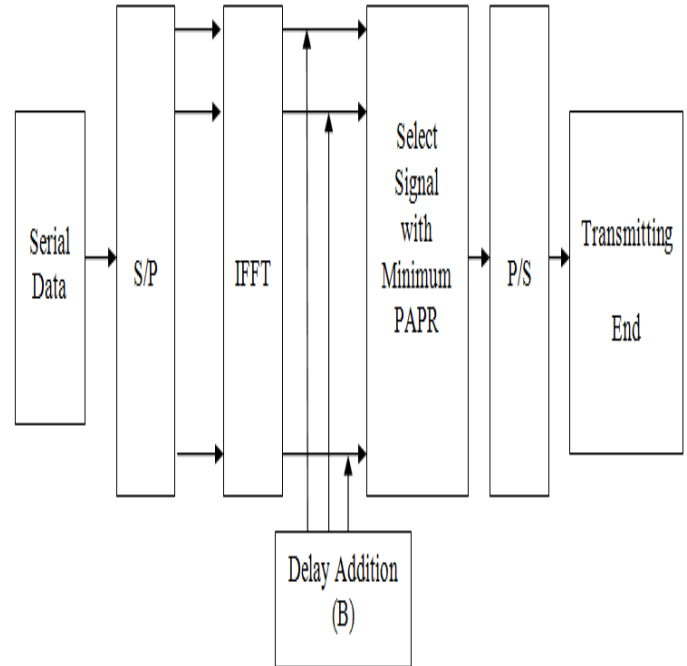
The block diagram of the SLM technique is given below:

Fig, 4 Block Diagram of SLM Technique

The only disadvantage of SLM can be thought to be the increase in complexity in case more delay vectors are added which eventually increases the searching complexity. Each X block contain N wide variety of binary information, and those blocks are improved by means of one-of-a-kind phase sequence. These exclusive segment collection are termed as M. After multiplying with M distinctive stages a very changed information movement is acquired. This changed statistics circulate is implemented to the IDFT block which generates mutually orthogonal sub carriers and those sub carriers are modulated via the records movement. With out the IDFT blocks, N nearby oscillators could be wanted for generating N together orthogonal sub carriers which might in turn boom the complexity and electricity consumption of the gadget whilst making it cumbersome. The larger the wide variety of levels introduced, i.e. the bigger the period of the segment vector, extra is the PAPR discount capability.

IV. MODIFIED SELECTIVE MAPPING

In the proposed selective mapping technique, the signal received after the selective mapping technique is analysed and residual peaks are found. The residual peaks are multiplied with an inverse sync function so as to reduce the residual peaks. The flowchart of the proposed system is shown below.
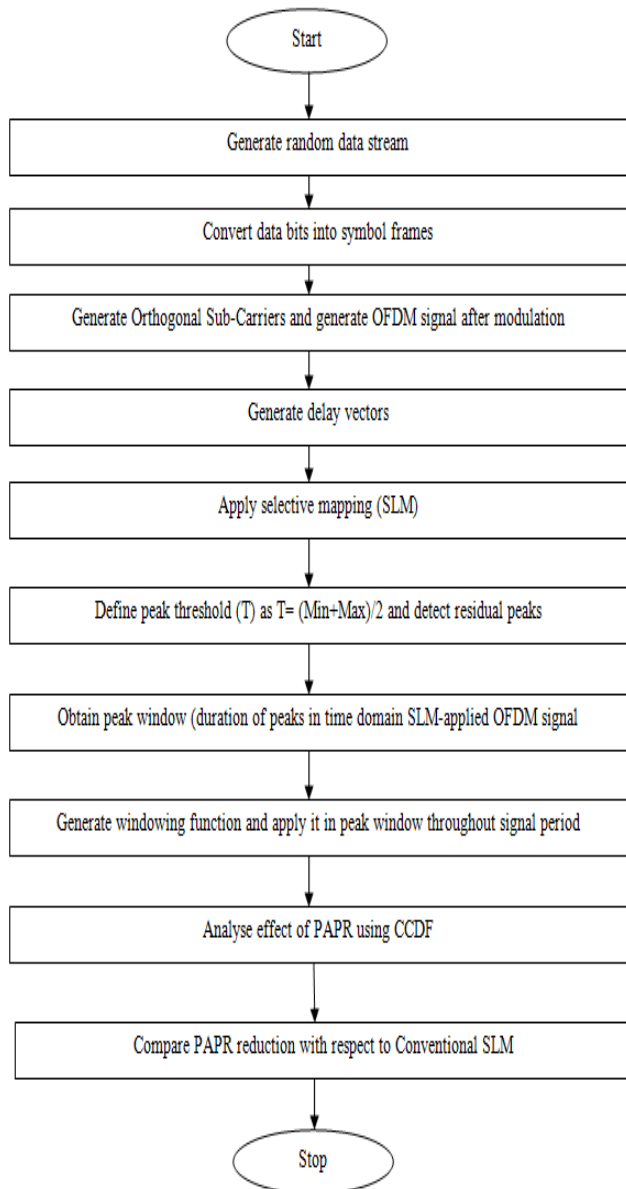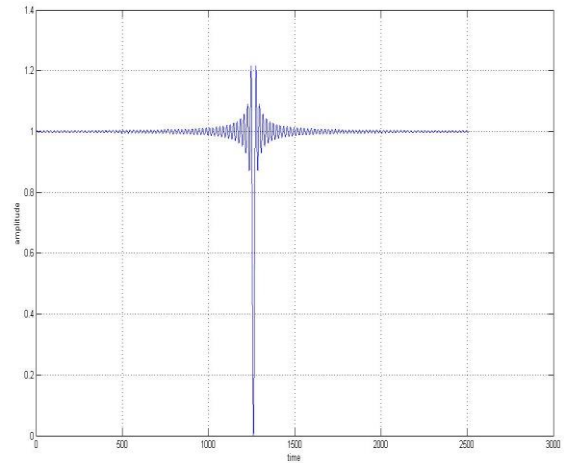
Fig.6 Inverted sync windowing function.

V. RESULTS

The results are analyzed using the CCDF curve and an earlier plummet or fall in the CCDF curve among two systems indicates that the PAPR has been reduced in the one with an earlier fall of CCDF or PAPR.
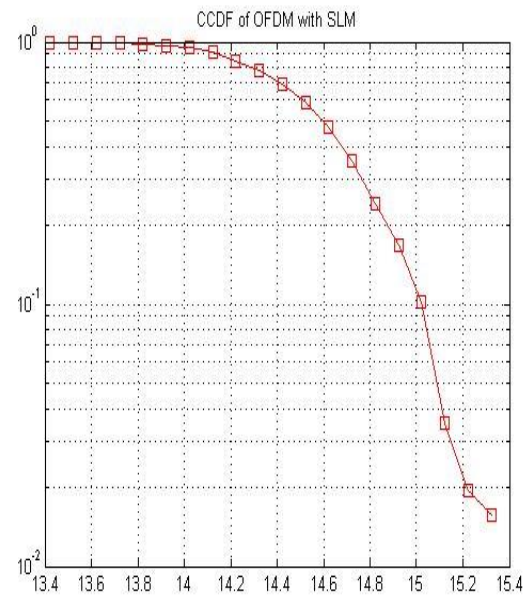
Fig.7 CCDF of Conventional SLM

Fig.5 Flowchart of Proposed Technique

In the proposed scheme, an inverse sync window is multiplied with the residual peaks of the signal after SLM is applied. The inverted sync is chosen since it resembles the inverted peaks of a typical time domain OFDM signal. The inverted sync function is defined as:

$$W = 1 - \text{sinc}(m)/\pi^2 . m^2 \qquad (4)$$

The inverted sync function is shown in the figure below:

Fig.8 CCDF Proposed Technique

Table.1 Comparative Results Analysis

Approach	PAPR
Plain Text	21.5
Plain Text + SLM	15.2
Previous Work [1]	10
(Proposed Work)	3.3

It can be observed that the proposed work attains lesser PAPR compared to previous work thereby enhancing the security of the system.

CONCLUSION

It can be concluded from the previous discussions and supporting results that the proposed technique is effective in reduction of OFDM based data transmission for Web 3.0. A modification to the selective mapping technique has been proposed so as to reduce the PAPR of the system. The CCDF has been used for the analysis of the PAPR of the system. It can be seen from the results that the proposed system attains extremely low values of PAPR for Web 3.0 systems thereby enhancing their security.

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