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ICTF and Genetic Algorithm Based on PTS Technique for Paper Reduction in OFDM System

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ABSTRACT:

The main drawback in the system OFDM factor is the ratio of peak to average power (PAPR), whichLeg overall system performance. We suggest genetic imitator steel algorithm (GSAA) with the sequence of partial transfer technology (PTS) (GSAA-PTS) to reduce the peak to average Power ratio (PAPR) of orthogonal frequency division Dual system (OFDM). PTS based genetic algorithm Method (GA-PTS) is a new and optimized to reduce PAPR Approach, which has reduced the burden of calculating the original PTS Way. However, the researchers focused on how to improve follows PAPR performance. The proposed method has GSAA-PTS The advantages of genetic algorithm and simulation steel Algorithm to find the best stage PTSTo factors triggered this factor a lot of techniques, depending on the system, such as A cat, a partial sequence of transmission, the selective method of appointment, and turn-expansion etc. there. Outside this technique of compression-expansion technique is a simple methodology to press or COMPAND input signal on the basis of As to limit the PAPR at the point of order. While decompander is a method in which the receiver operates Opposite to expand the companded signal in the OFDM transmission section. Using specially Interior design iteration, ICTF is able to obtain any improvement in the bit error rate (BER) and reducing out of Band Intervention (PE), while reducing PAPR significantly. destruction complete theoretical analysis, and Some important results as the profit to be made PAPR, the effect of distortion and compression-expansion, and selection criteria for derivatives-expansion parameters and the number of repetitions Ooqsy. In particular, it is shown that the ICTF without de companding In the recipient to give a good performance from the mainland. Simulations show that compared to the classic iterative filter technology (ICF) Capture and ICTF can significantly reduce the number of iterations required to reach the PAPR requires low complexity. In addition, the OFDM companded codes by the proposed technique has ICTF Least in the range of distortion, and less than one spectral band re-growth of traditional schemes and Companding.

Keywords:OFDM, PAPR, Companding Transform and Filtering (CTF), Out of Band Interference (OBI), Signal Attenuation Factor (SAF), GA

INTRODUCTION:

Multiplexing orthogonal frequency division (OFDM) technology and more expected in the field of mobile telephony Communications. The purpose of the efficient use of spectrum and highly efficient transfer to support high-speed Internet, multimedia and high-quality high-definition video streaming with the transfer of a multicarrier technology.OFDM adopted on a large scale in many of the technologies of wireless mobile communications and wireless communication standards.It is adjustable in the frequency division multiplexing (FDM) The only difference is all orthogonalality. It is maintained orthogonal by maintaining the phase difference between the signals on the right Angle. With great advantages and disadvantages as the bit error rate (BER), the peak power to average power ratio (PAPR), carrier frequency offset voltage and time. Shalom and peak power compared to average power and peak power ratio to average (PAPR). practically power Amplifier linear region limited and after additional peaks is created duplication and forcing these power peaks Amplifier to operate in the saturation region. additional height of the existence of additional energy and outside the linear region of the amplifier. Therefore, it is necessary that this effective technique for interrogation to operate the power amplifier in the linear region by reducing The PAPR familiarize ration the number of OFDM approach technique. A within a few years, such as selective mapping (SLM) [3], part of the transmission process (PTS) [4], the tone reservation (TR) [5], the tone injection (TI) [5] The extension of the active galaxy

(ACE) [6], a snapshot [7] and companding and [8] - companding conversion [15] and .Aiterativefiltering scheme provides compression distortion effects on the continent. It is clear that the BER performance can be effective Improved by reducing companding and distortion. Based on the analysis results, and companding new iterative transformation and

Filter (ICTF). -Expansion Of the proposed transfer, and signals with the capacity of more than a certain peak companded the ability to limit electricity during the summer, and amplitude signals near the peak of a certain amplitude companded is linearly scale to offset the energy is cut. With careful design and peak amplitude companded linear adaptation of size, and the proposed transfer can effectively reduce overexpansion and accurate design distortion.WithMaximum conversion scheme companded and linear scale conversion familiarize achieve improved BER spectral density and performance while reducing PAPR effectively.

Due to these advantage OFDM (orthogonal frequency division multiplexing) has been adopted as a standard for various wireless communication system such as digital audio broad casting(DAB),terrestrial digital video broad casting(DVB-T),wireless local area network(WLANs) . The main disadvantage of OFDM is its large peak-to-average power radio (PAPR) which results in significant inter-modulation and undesirable out-of band radiation .When an OFDM signal passes through high power amplifier (HPA), which is a nonlinear device [1]. OFDM has been considered as a promising candidate to achieve high rate data transmission in a mobile environment. The OFDM systems significantly increase bandwidth efficiency by allowing overlapping of the sub channel, while maintaining orthogonality between them. Moreover, robustness against frequency selective fading channels can be easily achieved [2]. In general to reduce the distortion caused by the non-linearity of HPA, it requires a large back-off from the peak power due to which the power efficiency get degrades .The complexity of the digital-to-analog converter (DAC) also get increased due to the large value of PAPR[3]. Therefore in OFDM system the PAPR reduction is one of the most important research areas. There are several PAPR reduction techniques which can be classified according to some specific criteria .These PAPR techniques can be categorized as additive and multiplicative schemes with respect to the computational operation. The examples of multiplicative schemes are PTS (partial transmit sequence) and SLM (selected mapping technique) [4]. On the other hand clipping and peak cancelling are deterministic schemes and tone reservation is the example of additive scheme. The low complexity PAPR reduction schemes may be applicable to mobile communication systems [5] .Comparison of PAPR reduction techniques is based on average power increase, BER degradation, computational complexity and data rate loss Orthogonal frequency-division multiplexing (OFDM),

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essentially identical to coded OFDM (COFDM) and discrete multi-tone modulation (DMT), is a frequency-division multiplexing (FDM) scheme used as a digital multi-carrier modulation method. A large number of closely-spaced orthogonalsub-carriers are used to carry data. The data is divided into several parallel data streams or channels, one for each sub-carrier. Each sub-carrier is modulated with a conventional modulation scheme (such as quadrature amplitude modulation or phase-shift keying) at a low symbol rate, maintaining total data rates similar to conventional single-carrier modulation schemes in the same bandwidth. OFDM has developed into a popular scheme for widebanddigital communication, whether wireless or over copper wires, used in applications such as digital television and audio broadcasting, wireless networking and broadband internet access. The primary advantage of OFDM over single-carrier schemes is its ability to cope with severe channel conditions (for example, attenuation of high frequencies in a long copper wire, narrowband interference and frequency-selective fading due to multipath) without complex equalization filters. Channel equalization is simplified because OFDM may be viewed as using many slowly-modulated narrowband signals rather than one rapidly-modulated wideband signal. The low symbol rate makes the use of a guard interval between symbols affordable, making it possible to eliminate inter symbol interference (ISI) and utilize echoes and time-spreading (that shows up as ghosting on analogue TV) to achieve a diversity gain, i.e. a signal-to-noise ratio improvement. This mechanism also facilitates the design of single frequency networks (SFNs), where several adjacent transmitters send the same signal simultaneously at the same frequency, as the signals from multiple distant transmitters may be combined constructively, rather than interfering as would typically occur in a traditional single-carrier system.

Example of applications

The following list is a summary of existing OFDM based standards and products. For further details, see the Usage section at the end of the article.

Cable

- ADSL and VDSL broadband access via POTScopper wiring.
- DVB-C2, an enhanced version of the DVB-C digital cable TV standard.
- Power line communication (PLC).
- ITU-TG.hn, a standard which provides high-speed local area networking over existing home wiring (power lines, phone lines and coaxial cables).
- Trail Blazertelephone line modems.
- Multimedia over Coax Alliance (MoCA) home networking.

Wireless

- The wireless LAN (WLAN) radio interfaces IEEE 802.11a, g, n and HIPERLAN/2.
- The digital radio systems DAB/EUREKA 147, DAB+, Digital Radio Mondiale, HD Radio, T-DMB and ISDB-TSB.
- The terrestrial digital TV systems DVB-T and ISDB-T.
- The terrestrial mobile TV systems DVB-H, T-DMB, ISDB-T and Media FLO forward link.

- The wireless personal area network (PAN) ultra-wideband (UWB) IEEE 802.15.3a implementation suggested by Wi Media Alliance.

The OFDM based multiple access technology OFDMA is also used in several 4G and pre-4G cellular networks and mobile broadband standards:

- The mobility mode of the wireless MAN/broadband wireless access (BWA) standard IEEE 802.16e (or Mobile- Wi MAX).
- The mobile broadband wireless access (MBWA) standard IEEE 802.20.
- The downlink of the 3GPPLong Term Evolution (LTE) fourth generation mobile broadband standard. The radio interface was formerly named High Speed OFDM Packet Access (HSOPA), now named Evolved UMTS Terrestrial Radio Access (E-UTRA).

Key features

The advantages and disadvantages listed below are further discussed in the Characteristics and principles of operation section below.

Summary of advantages:

- Can easily adapt to severe channel conditions without complex time-domain equalization.
- Robust against narrow-band co-channel interference.
- Robust against inter symbol interference (ISI) and fading caused by multipath propagation.
- High spectral efficiency as compared to conventional modulation schemes, spread spectrum, etc.
- Efficient implementation using Fast Fourier Transform (FFT).
- Low sensitivity to time synchronization errors.
- Tuned sub-channel receiver filters are not required (unlike conventional FDM).

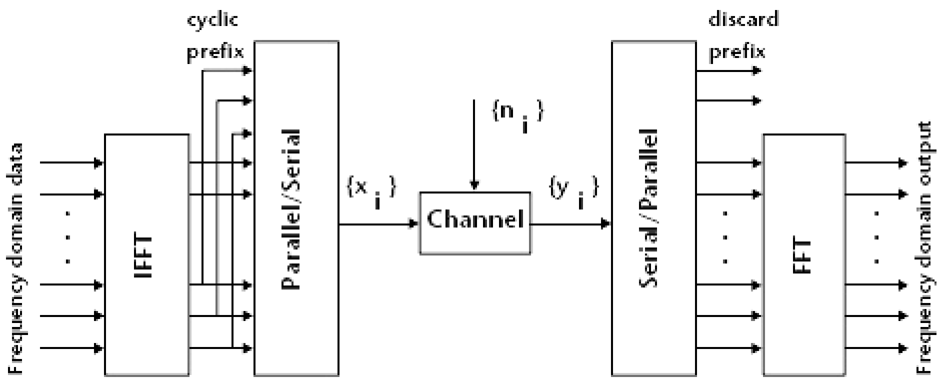
- Facilitates single frequency networks (SFNs); i.e., transmitter macro diversity.

2.ORTHOGONALITY

In OFDM, the sub-carrier frequencies are chosen so that the sub-carriers are orthogonal to each other, meaning that cross-talk between the sub-channels is eliminated and inter-carrier guard bands are not required. This greatly simplifies the design of both the transmitter and the receiver; unlike conventional FDM, a separate filter for each sub-channel is not required.

The orthogonality requires that the sub-carrier spacing is $\Delta f = \frac{k}{T_U}$ Hertz, where $T_U$seconds is the useful symbol duration (the receiver side window size), and k is a positive integer, typically equal to 1. Therefore, with N sub-carriers, the total pass band bandwidth will be $B \approx N \cdot \Delta f$ (Hz).

The orthogonality also allows high spectral efficiency, with a total symbol rate near the Nyquist rate for the equivalent baseband signal (i.e. near half the Nyquist rate for the double-side band physical pass band signal).



The discrete time baseband OFDM signal, are transformed in to continuous time baseband OFDM signals by a low pass filter called DAC, where the peak power can be increased while maintaining constant average power. Usually , the PAPR of continuous time baseband OFDM signals is larger than that of discrete time baseband OFDM signals by 0.5 – 1.0dB.

3.PAPR IN OFDM

However, OFDM is not without drawbacks. One critical problem is its high peak-to-average power ratio (PAPR). High PAPR increases the complexity of analog-to-digital (A/D) and digital-to-analog (D/A) converters, and lowers the efficiency of power amplifiers. Over the past decade various PAPR reduction techniques have been proposed, such as block coding, selective mapping (SLM) and tone reservation, just to name a few . Among all these techniques the simplest solution is to clip the transmitted signal when its amplitude exceeds a desired threshold. Clipping is a highly nonlinear process, however. It produces significant out-of-band interference (OBI). A good remedy for the OBI is the so-called companding. The technique 'soft' compresses, rather than 'hard' clips, the signal peak and causes far less OBI. The method was first proposed in, which employed the classical μ-law transform and showed to be rather effective. Since then many different companding transforms with better performances have been

Published. This paper proposes and evaluates a new companding algorithm. The algorithm uses the special airy function and is able to offer an improved bit error rate (BER) and minimized OBI while reducing PAPR effectively. The paper is organized as follows. In the next section the PAPR problem in OFDM is briefly reviewed.

PAPR IN OFDM

- OFDM is a powerful modulation technique being used in many new and emerging broadband communication systems.

Advantages:

Robustness against frequency selective fading and time dispersion.

Transmission rates close to capacity can be achieved.

Low computational complexity implementation (FFT).

Drawbacks:

Sensitivity to frequency offset.

- Sensitivity to nonlinear amplification.

- Compensation techniques for nonlinear effects
  - Linearization (digital predistortion).
  - Peak-to-average power ratio (PAPR) reduction.
  - Post-processing.
- PAPR-reduction techniques:
  - Varying PAPR-reduction capabilities, power, bandwidth and complexity requirements.
  - The performance of a system employing these techniques has not been fully analyzed
  - PAPR is a very well known measure of the envelope fluctuations of a MC signal
  - Used as figure of merit.
  - The problem of reducing the envelope fluctuations has turned to reducing PAPR.
  - In this paper we ...
  - present a quantitative study of PAPR and NL distortion
  - simulate an OFDM-system employing some of these techniques

Motivation: evaluate the performance improvement capabilities of PAPR-reducing methods.

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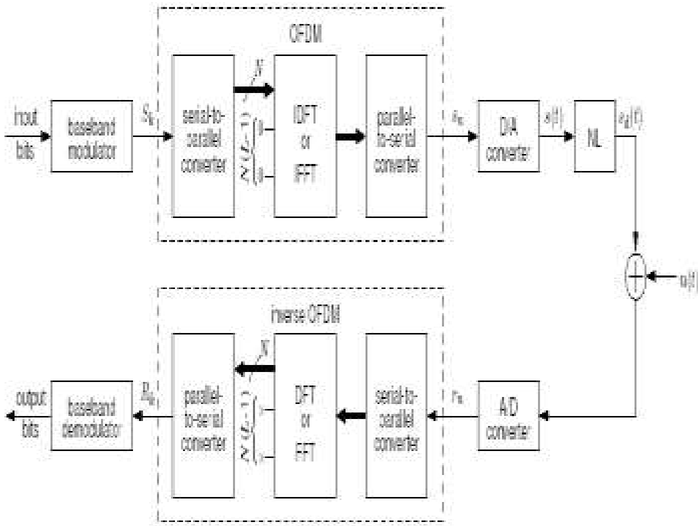
4.Orthogonal Frequency Division Multiplexing



- An OFDM signal can be expressed as

s_k complex baseband modulated symbol

N number of subcarriers

If the OFDM signal is sampled at , the complex samples can be described as

$$s_n = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} S_k e^{j2\pi kn/N}, \quad n \in [0, N-1]$$

Peak-to-average power ratio

- Let be the *m*-th OFDM symbol, then its PAPR is defined as
- $$\text{PAPR}_m = \frac{\left\| \mathbf{s}^{(m)} \right\|_\infty^2}{E\left[\left\| \mathbf{s}^{(m)} \right\|^2 \right] / N}$$

The CCDF of the PAPR of a non-oversampled OFDM signal is

$$\Pr(\xi > \xi_0) = 1 - (1 - e^{-\xi_0})^N$$

- CCDF of PAPR increases with the number of subcarriers in the OFDM system.

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- It is widely believed that the more subcarriers are used in a OFDM system, the worse the distortion caused by the nonlinearity will be.
- In-band and out-of-band distortion

- If N is large enough, the OFDM signal can be approximated as a complex Gaussian distributed random variable. Thus its envelope is Rayleigh distributed

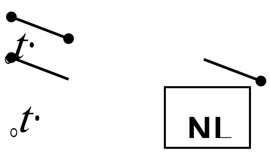
$$f_X(x) = \frac{2x}{\sigma^2} e^{-\frac{x^2}{\sigma^2}}$$

with $E[X] = \sigma\frac{\sqrt{\pi}}{2}$ and $var[X] = \sigma^2\left(1 - \frac{\pi}{4}\right)$,

where the variance of the real and imaginary parts of the signal is

- Buss gang theorem

$$R_{x_1x_2}(\tau) \quad \begin{cases} x_1(t) \\ x_2(t) \end{cases}$$



$$\begin{cases} x_1(t) \\ y_2(t) \end{cases} R_{x_1y_2}(\tau) \qquad \text{where } R_{x_1y_2}(\tau) = \alpha R_{x_1x_2}(\tau)$$

$$x_1(t) = x_2(t) \qquad R_{xy}(\tau) = \alpha R_{xx}(\tau)$$

An interesting result is that the output of a NL with Gaussian input (OFDM) can be written as:

$$y(t) = \alpha x(t) + d(t), \qquad \text{where } \alpha = \frac{R_{xy}(\tau_1)}{R_{xx}(\tau_1)}$$

Considerations on PAPR reduction

- In order to improve the system performance, PAPR should predict the amount of distortion introduced by the nonlinearity
  - PAPR increases with the number of subcarriers in the OFDM signal.
  - The distortion term and the uniform attenuation and rotation of the constellation only depend on the back-off.

The effect of a nonlinearity to an OFDM signal is not clearly related to its PAPR

- The effective energy per bit at the input of the nonlinearity is
- where E_o is the average energy of the signal at the input of the nonlinearity, K is the
- number of bits per symbol and η_p is the power efficiency.

- There will only be aa BER performance improvement when the effect of reducing the in-band distortion becomes noticeable and more important than the loss of power efficiency.
- This is not taken into account in the majority of the PAPR reducing methods.

Let (0),(1), ⋯,$X(N-1)$ represent the data sequence to be transmitted in an OFDM symbol with Nsubcarriers. The baseband representation of the OFDM symbol is given by:

$$x(t) = \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} X(n) e^{\frac{j2\pi nt}{N}} \qquad 0 \le t \le T,$$

where$T$is the duration of the OFDM symbol. According to the central limit theorem, when $N$is large, both the real and imaginary parts of $x(t)$ become Gaussian distributed, each with zero mean and a variance of E[$|x(t)|$2]/2, and the amplitude of the OFDM symbol follows a Rayleigh distribution. Consequently it is possible that the maximum amplitude of OFDM signal may well exceed its average amplitude. Practical hardware (e.g. A/D and D/A converters, power amplifiers) has finite dynamic range; therefore the peak amplitude of OFDM signal must be limited. PAPR is mathematically defined as:

$$\textbf{PAPR} = 10\log_{10} \frac{\max[|x(t)|^2]}{\frac{1}{T}\int_0^T |x(t)|^2\, dt} \quad (\textbf{dB}).$$

It is easy to see from above that PAPR reduction may be achieved by decreasing the numerator max[$|x(t)|$2], increasing the denominator (1/T) ·∫ T0 $|x(t)|$2 dt, or both.

The effectiveness of a PAPR reduction technique is measured by the complementary cumulative distribution function
(CCDF), which is the probability that PAPR exceeds some threshold, i.e.:

CCDF = Probability (PAPR >p0), where p0 is the threshold.

5.PAPR reduction methods

PAPR reduction methods have been studied for many years and significant number of methods has been developed. These methods are discussed below:

- Clipping: Clipping naturally happens in the transmitter if power back-off is not enough. Clipping leads to a clipping noise and out-of-band radiation. Filtering after clipping can reduce out-of-band radiation, but at the same time it can cause “peak regrowth”. Repeated clipping and filtering can be applied to reduce peak regrowth in expense of complexity. Several methods for mitigation of the clipping noise at the receiver were proposed: for

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example reconstructing of the clipped sample, based on another samples in the oversampled signal.

- Coding: Coding methods include Golay complementary sequences, block coding scheme , complementary block codes (CBC) , modified complementary block codes (MCBC) etc. An application of the Golay Complementary sequences is limited by the fact that they can not be used with M-QAM modulation. Simple scheme, proposed in , relies on lookup tables containing sequences with lower PAPR. This method doesn't attempt to utilize those sequences for error correction/detection. CBC utilizes complement bits that are constructed from the subset of the information bits. MCBC is a modification of CBC suitable for large number of sub-carriers. Coding methods have low complexity but PAPR reduction is achieved in expense of redundancy causing data rate loss.

- Partial Transmit Sequences (PTS): a set of sub-carriers of an OFDM symbol is divided into non-overlapping sub-blocks . Each sub-block undergoes zero-padding and IDFT resulting in p(k), k=1…V, called PTS. Peak value optimization is performed over linear combination of PTSs: $\sum_{k=1}^{V} p(k)b(k)$, where b(k) is optimization parameter. The optimization parameter is often limited to four rotation factors: $b(k) \in \{\pm 1, \pm j\}$.

- Selected mapping (SLM) : a set of sub-carriers of an OFDM symbol is multiplied sub-carrier wise by U rotation vectors b.Then all the rotated U data blocks are transformed into the time-domain by IDFT and then the vector with the lowest PAPR is selected for transmission.

- Interleaving : The same data block is interleaved by K different interleavers. K IDFTs of the original data block and modified data blocks are calculated. PAPR of K blocks is calculated. The block with minimum PAPR is transmitted.

- Tone Reservation (TR) : L sub-carriers are reserved for peak reduction purposes. The values of the signals to insert on peak reduction sub-carriers are computed by suitable Linear Programming algorithm.

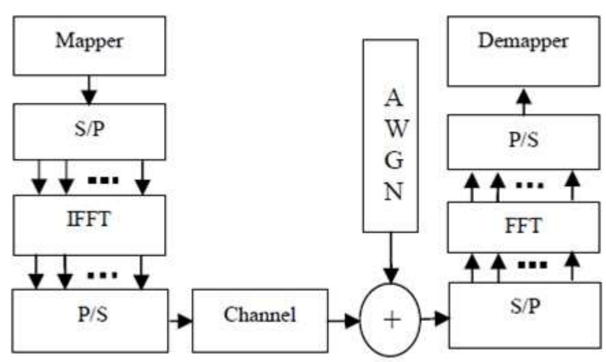

Fig. 1 A Conventional OFDM system

- Tone Injection (TI) : TI maps one constellation point of the original constellation (for example QPSK) to several constellation points of the expanded constellation (for example 16QAM). PAPR redaction is achieved by choosing constellation points of the expanded constellation.

- Active Constellation Extension (ACE) : ACE modifies original constellation by moving nominal constellation points located on the outer constellation boundaries in the directions that don't decrease Euclidean distances between constellation points.

Nonlinear Companding Transform (NCT) :NCT compand original OFDM signal using strict monotone increasing function. Companded signal can be recovered by the inverse function at the receiver

COMPANDING DISTORTION ANALYSIS In this section, the impacts of the companding distortion on The BER performance in ICTF procedure is investigated. A. Companding Noise. Based on Bussgang theorem for real and complex Gaussian Signal [6], the companded signal can be approximately decomposed into two parts: the attenuated signal component And companding noise

CONCLUSION:

In this paper, we have proposed a new way to embed operator simulation steel genetic algorithm, which the advantages of both genetic algorithm is needed and imitator And the steel algorithm to find the best stage of factors. As the The simulation results, it is clear that the proposed GSAAPTS Scheme can only be overcome disadvantages GA-PTS Way, but also to prevent this phenomenon mature. At the same time, You can also achieve better performance of PAPR, compared to Way GA-PTS, and PAPR of GSAA-PTS scheme can be It is improved by 0.13dB to 0.26dB.An-expansion and the frequency converter and filtering scheme regarding PAPR reduction, the performance of the mainland and The study of the results of the numerical simulation of OFDM systems. It can also be applied in the algorithm presented WiMAXStations with the largest number of OFDM subcarriers. In the simulation, synchronized perfection, and the channel It is to obtain an estimate of the future. ICTF technology has provided not only able to reduce significantly with the PAPR Improve the performance of the mainland and I, but also drastically reduces the number of iterations

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