Adaptive Channel Estimation by Optimizing the Prior of Noise with Flower Pollination Method

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Abstract **-** The channel estimation is effective research because it will be able to predict noise from variable noise. How to predict, that noise distribution is challenge in SCFDMA channel. In this paper proposed flower pollination algorithm is used which is globally accepted optimization algorithm in optimizing problems to predict and optimize noise for adaptive filters .In experiment shows BER is significantly reduced when use FPA compare to Werner filter.

Keywords - Werner filter, BER, FPA, OFDM, Mean Squared Error

I. INTRODUCTION

The wireless applications have now developed much quickly. There is a prime requirement of high throughput of data in wireless communication applications. To take into account of it, International Mobile Telecommunication (IMT) union proposed third Generation Partnership Project (3GPP) for developing LTE framework. The components of LTE framework are as under:

1. To give End-to-End quality of service (QoS).
2. To give high download rates of around 300Mbps and uplink rates of 75Mbps.
3. To extend the limit of cell in order to oblige 200 dynamic clients.
4. To help client portability of around 350Km/hr.

To deliver these components, 3GPP Long Term Evolution framework has embraced OFDMA for its down transmission and SC-FDMA for its Uplink transmission as multiple access techniques. OFDM is a powerful and effective modulation strategy utilized in wireless frameworks. OFDM utilizes orthogonal subcarriers to pass on data to the receiver. OFDMA or Orthogonal Frequency Division Multiple Access is an OFDM based multiple access technique which empowers different clients to get to the channel at the same time. OFDMA technique is favoured as it gives high information rate and can overcome the issue of Inter Symbol Interference (ISI). It uses spectrum productively and furthermore gives power towards different multipath blurring channel. A critical issue of an OFDMA based framework is its transmitted signal Peak-to-Average-Power Ratio (PAPR). In OFDMA superposition of many time-domain information subcarriers brings about high PAPR requirements. These substantial peaks of signal require power amplifiers of high power. The peaks in the level of the signal causes different nonlinear distortions which prompts wasteful operation of power amplifiers. In this way, OFDMA has a drawback of high PAPR which causes high power requirement of client terminal and in this manner causes increment in general cost of the system. In Long term evolution (LTE) framework OFDMA is used just for downlink transmission. As a substitution to the issue of high PAPR requirement, 3GPP LTE had proposed SCFDMA framework for its uplink transmission. SCFDMA based communication frameworks give low Peakto-Average-Power Ratio, which thus uses power amplifiers more productively and spares battery power of User Equipment and hence cost of the user equipment.

Single Carrier- Frequency Division Multiple Access (SC-FDMA): Single carrier frequency division multiple access is a multiple access technique employed for transmitting signal in uplink and is employed in 3rd generation partnership project (3GPP) Long Term Evolution system. SC-FDMA is basically linearly precoded OFDMA. SC-FDMA signal is basically an OFDM signal in which data symbols in time-domain are transformed into frequency-domain by using discrete Fourier transform process. At the SCFDMA transmitter, a baseband modulator maps the info bits stream into a succession of complex numbers by utilizing different modulation schemes like BPSK, QPSK, 16QAM, 64QAM and so on. Modulation scheme is chosen dynamically by the transmitter based upon radio conditions of the channel. After this, the transmitter will gather the modulation symbols into squares which contain N diverse symbols. The transmitter at that point performs N-point DFT operation toward change of signal into its frequency domain interpretation. An M-point IDFT operation at that point changes these subcarrier amplitudes into a time domain signal.

Channel Estimation: Keeping in mind the end goal to accomplish great execution a correspondence recipient has to know the effect of channel on got flag. This is called channel

estimation. A vital variable for any remote correspondence framework is estimation of its channel and channel parameters. The thought process of a channel estimation prepare is to limit Mean Squared Error (MSE) between wanted flag and got flag. Diverse channel estimation algorithm had been outlined in order to accomplish elite. Utilizing channel estimation algorithm motivation reaction of a channel and its conduct can be approximated. By utilizing channel estimation techniques, coherent demodulation method can be actualized at the beneficiary. In correspondence framework for channel estimation a known flag succession called pilot signals are embedded at particular area inside the data flag. These image successions enable beneficiary to remove channel lessenings and stage turn gauges for each got image. By recognizing channel parameters error in the got flag can be diminished. The point of most channel estimation algorithms is to limit the mean squared error (MSE), while using minimal computational assets in the estimation procedure.

II. LITERATURE REVIEW

In [1] had exhibited a study on various regulation plans which have higher execution for use in uplink communication. The creators had analyzed OFDM conspire as a decision for high information rate wireless communication system. OFDM system gives resilience towards multi-way postpone spread and it is additionally powerful to channel dispersions. One of the real impediments of OFDM considered is the vast variety in flag adequacy which gives it a high estimation of PAPR. So the OFDM signals with high PAPR experience the ill effects of issue of nonlinear contortion due to non-perfect conduct of High Power amplifiers. Likewise it is unfavorable for battery powered gadgets like cell phones which are power restricted. Be that as it may, SC-FDMA system gave preferred PAPR diminishment over OFDMA system and had turned into a balance decision for uplink communication in Long Term Evolution (LTE).

In [2**]** gave a review of SC-FDMA based framework. The creators clarified the entire SC-FDMA handle. It gave a detail knowledge of the diverse procedures utilized by SCFDMA transmitter and receiver. The creator gave PAPR attributes of SCFDMA based framework and additionally channel subordinate resource scheduling plan of SC-FDMA framework.

In [3] exhibited a procedure which utilizes M-ary pulse shaping in SC-FDMA framework. The creators looked at integral combined dissemination work for various M-ary flagging procedures. The creators presumed that by expanding the request M in M-ary flagging, the PAPR of the flag can be decreased. The creators had considered that Localized subcarrier mapping gives higher execution regarding PAPR. The creators had made examination of execution of 8-DPSK, 8-QAM, 8-PSK conspires and had presumed that 8-PSK plot conveys better execution contrasted with others as far as PAPR.

In [4] depicted distinctive sub-carrier mapping schemes like IFDMA (Interleaved FDMA), and LFDMA (Localized FDMA) for LTE-SCFDMA frameworks. Through reenactments the creator had demonstrated that IFDMA sub-carrier mapping scheme gives bring down PAPR when contrasted with LFDMA by a level of 1dB. Encourage the creators had demonstrated that IFDMA sub-carrier mapping scheme enhances framework execution essentially when contrasted with LFDMA mapping scheme.

In [5] had done investigation of SCFDMA framework utilizing Partial Transmit Sequence (PTS) conspire. The creators had proposed SCFDMA framework in light of Wavelet for breaking down PAPR execution of framework utilizing PTS conspire. The creators had completed investigation utilizing diverse wavelets and with various number of transporters. The examination had demonstrated that there is change in the execution of wavelet based SCFDM by utilizing PTS plot. So the creators had presumed that SCFDMA in light of wavelet gives us better execution contrasted with a SCFDMA framework in view of DFT.

In [6] spoken to an investigation of MIMO-OFDM based framework and its Bit Error Rate execution. The creators had accomplished change in the execution of MIMO-OFDM framework by utilizing Forward Error Correction (FEC) codes. The creators had analyzed diverse codes in Additive White Gaussian Noise (AWGN) channel and Rayleigh fading channel. After examination the creators had proposed three appropriate codes for MIMO-OFDM framework ie Reed Solomon-Convolution Code (RS-CC), Convolutional Turbo Code (CTC) and Low Density Parity Check code (LDPC). The creators had discovered that CTC give a coding increase of 0.2dB in AWGN channel and pick up of 0.25dB in Rayleigh fading channel.

In [7] examined distinctive sub-carrier mapping techniques, for example, IFDMA (Localized FDMA), DFDMA (Distributed FDMA) and IFDMA (Interleaved FDMA) for SCFDMA framework. The creators had dissected DFT SCFDMA plot for enhanced execution with various sub-carrier mapping and modulation techniques. The creators had contrasted these outcomes and that of traditional OFDMA framework. The correlation had demonstrated that the DFT-SCFDMA framework incredibly decreases the PAPR and enhances SER for LTE uplink transmission in contrast with the traditional OFDMA.

In [8] proposed a changed plan called as Hadamard SCFDMA which takes the benefit of Hadamard based spreading orthogonal CDMA code to bring down PAPR in uplink transmission. The creators had analyzed the execution of heartbeat formed Hadamard SCFDMA frameworks and heartbeat molded SCFDMA frameworks. The creators had demonstrated that Hadamard based SCFDMA frameworks have bring down PAPR when contrasted with the heartbeat molded SCFDMA frameworks and OFDMA frameworks. Likewise the creators had presumed that in Hadamard SCFDMA with IFDMA subcarrier mapping the PAPR change lessens as the move off component α expands, which is same as on account of SCFDMA. SER execution for the proposed plot is tried in multipath channels. The outcomes had demonstrated that the Hadamard SCFDMA conspire accomplished lessening in PAPR as well as has SER points of interest at bring down framework many-sided quality.

In [9] looked at execution for changed subcarrier mapping schemes in MIMO-SCFDMA framework utilizing STBC (Space Time Block Code).The creators had thought about Bit Error Rate execution for various number of transmitters. In STBC, spatial assorted qualities system signals are coded through the transmit radio wire which makes excess and along these lines decreases blackout likelihood. The creators had demonstrated that IFDMA is superior to LFDMA regarding Bit Error Rate.

In [10] examined the issue of mutilation in correspondence framework which are caused by fading, delay spread and multipath effect. The creators had outlined different channel estimation and evening out methods to give change in execution of an OFDM based framework. The creators had proposed the utilization of wiener channel for channel estimation. The reproduction consequences of the proposed plans demonstrate that wiener channel gives better channel estimation. Additionally OFDM performs preferred under AWGN channel over fading channels. The creators finish up by plotting SER bends that wiener performs preferred in AWGN over fading channels and accomplish better SER.

In [11] they mostly dissect the relations between peak-to-average power ratio (PAPR) lessening, spectrum efficiency (SE), and vitality efficiency (EE) in orthogonal frequency division multiplexing (OFDM) frameworks, separately. Through PAPR lessening, the efficiency of high power amplifier (HPA) could be considerably enhanced, and the nonlinear distortion noise caused by the HPA could likewise be fundamentally decreased. Thus, the SE and EE are expanded with a total transmit power imperative over additive white Gaussian noise (AWGN) channel. Also, we determine the quantitative relations between PAPR lessening, SE, and EE, separately. Reenactment comes about demonstrate that the OFDM framework with PAPR diminishment could accomplish higher SE and EE than the framework without PAPR diminishment.

In [12] This letter considers a direct current-one-sided optical orthogonal frequency division multiplexing (DCO-OFDM) with intensity-modulated direct-detection (IM/DD) regulation for visible light communication (VLC) frameworks. The high peak-to-average power ratio (PAPR) is a basic execution restricting factor for the DCO-OFDM framework. To decrease the PAPR, exhibit a PAPR decrease strategy by applying semi-unequivocal unwinding way to deal with Tone Injection (TI). With the proposed strategy, accomplish a noteworthy PAPR decrease as extensive as 5 dB, which adds to a discernible BER execution pick up as prove by reenactment comes about considering the light transmitting diode (LED) nonlinearities.

In [13] a novel segmental partial transmit sequence (S-PTS) plot is proposed for the peak-to-average power ratio (PAPR) decrease in counterbalance quadrature plentifulness balance based orthogonal frequency-division multiplexing (OQAM-OFDM) frameworks. The key thought of the S-PTS plot is to isolate the covered OQAM-OFDM signals into a number of sections, and afterward some disjoint subblocks are separated and increased with various stage pivot factors in each portion. Contrasted and the regular PTS conspire straightforwardly utilized in OQAM-OFDM systems, the S-PTS plan could offer better PAPR diminishment with bring down computational unpredictability.

In [14] proposed another PAPR reduction procedure by consolidating the Iterative Clipping method and the SLM method. In the first place, the info information is sustained, to decrease the PAPR handle utilizing the Iterative Clipping method, the PAPR is at that point registered for each subsequent grouping and this flag arrangement is encouraged into the SLM method, the SLM strategy is then helpful to enhance the BER execution of the framework. In this manner utilizing these two methods in mix, the reproduction result appears the change in PAPR, and superior of BER investigation.

In [15] explore a low-density parity-check (LDPC)- coded orthogonal frequency-division multiplexing (OFDM) framework with a peak-to-average power ratio (PAPR) diminishment utilizing the partial transmit sequence (PTS), which does not transmit PTS side data about the phase factors. They see the PTS handling as a phase of coding also, call the came about code of LDPC coding and PTS preparing a connected LDPC-PTS code. At that point, infer the parity-check framework of the connected LDPC-PTS code. With the parity-check framework, the LDPC code and phase factors can

be together decoded utilizing conviction proliferation calculations. Neither transmission of PTS side data (phase factors) nor phase factor estimation before deciphering is required by the proposed plot.

III. PROPOSED METHODOLOGY

The proposed system simulation consists of three parts:

1. Transmitter system
2. Channel
3. Receiver system

The block diagram in the fig shows design of proposed system:

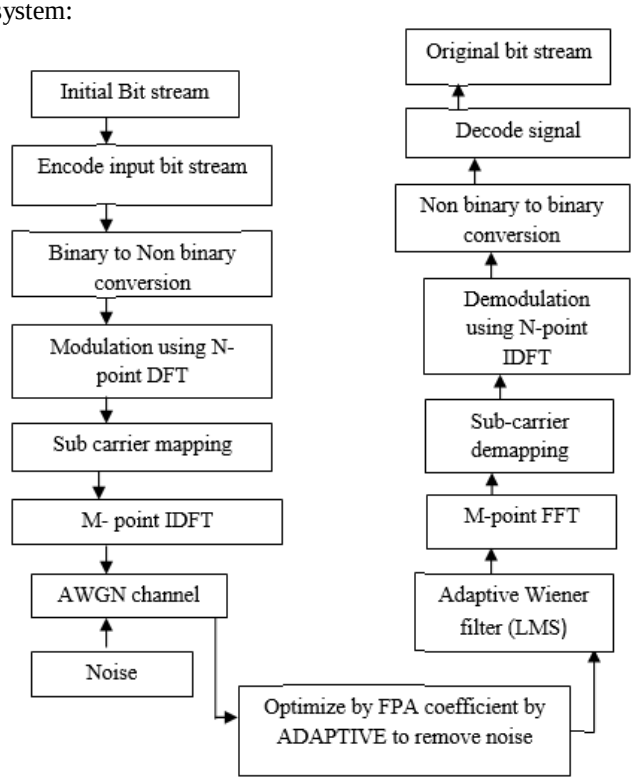

Fig.1: Flow Chart for Adaptive Channel Estimation

A. Transmitter

At SCFDMA transmitter various modulation schemes like BPSK, PSK, 16QAM, QPSK are employed. In the proposed system model, a randomly generated bit stream is encoded. This encoded bit stream is modulated using any of these modulation techniques: BPSK, 16QAM or QPSK in various proposed system designs. The transmitter groups the modulation symbols into blocks each containing N symbols. The discrete Fourier transform (DFT) is used to convert a finite sequence of equally spaced samples of a function into list of coefficients of a finite combination of complex sinusoids, ordered by their frequencies, that has those same sample values.

The next step maps each of the N-DFT outputs to one of the (M>N) orthogonal sub carriers that can be transmitted by a radio channel mapping. A **subcarrier** is a sideband of a radio frequency carrier wave, which is modulated to send additional information.

B. Channel

The transmitted signal in the system model suffers from fading because of path loss as well as interference due to multipath signals. So it is required to select a proper channel model so as to make simulations near to real one. Many different channel models are employed like Rayleigh, Rician and AWGN channel. Randomly generated noise is the part of system. The amount of noise present in the system is measured by Signal to Noise Ratio (SNR). SNR is defined as ratio of received power P_r to the power of noise present within the transmitted signal bandwidth.

For Gaussian noise which has uniform power spectral density,

$$PSD=N_o/2 \quad (3.1)$$

$$\text{Total Bandwidth}=2B \quad (3.2)$$

$$\text{Received SNR}=Pr/N=Pr/NoB \quad (3.3)$$

Another important term with regard to proposed system design is Bit Error rate or BER. Bit Error rate is defined as the number of bits in error divided by the total number of transferred bits during a particular time interval. BER for AWGN channel is defined as

$$BER=1/2erfc \quad \{sqr(E_b/N_o)\} \quad (3.4)$$

Where, E_b/N_o=Normalized carrier to noise ratio

BER of communication system is affected by transmission channel noise, distortion, attenuation, multipath fading phenomenon etc. In the proposed system design, performance of the system is observed in both Rayleigh and AWGN channel in terms of SNR and BER of the system. The Gaussian noise added to signal while passing through channel is removed using adaptive wiener filter. The parameters of Adaptive filter are optimized using Meta heuristic optimization technique ie Particle swarm optimization.

C. Receiver

The process carried at SCFDMA receiver is reverse to the process carried at SCFDMA transmitter. A SCFDMA receiver has to perform function of Inverse Discrete Fourier Transform, demodulation of modulated signal, frequency domain equalization etc.

The flow chart of adaptive channel estimation is given below:

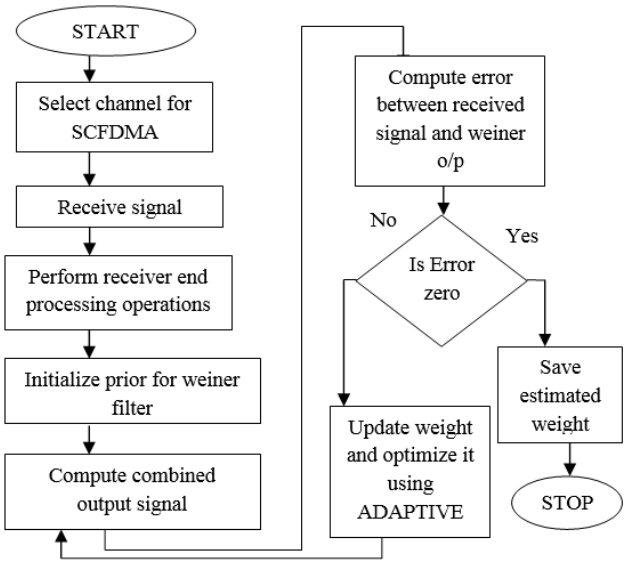

Fig.2: Flow chart for adaptive channel estimation

Step1: Start

Step2: In this step, for SCFDMA select the channel.

Step3: When channel is selected then receive the signal.

Step4: In this step when signal is receiving then perform receiver end processing operations.

Step5: For the weiner filter initialize the prior.

Step6: In this step, Compute combined output signal.

Step7: In this step, the error between received signal and weiner o/p is computed.

Step8: After computing the error a condition is applied, if error is zero then save the estimated weight and STOP program. If error is not zero update the weight and optimize it using ADAPTIVE and go to the step6.

Proposed Algorithm:

Flower Pollination Algorithm: In nature, the primary motivation behind the flowers is reproduction by means of pollination. Blossom pollination is identified with the exchange of dust, which is finished by pollinators, for example, creepy crawlies, flying creatures, bats, different creatures or wind. Some blossom sorts have exceptional pollinators for effective pollination. The four tenets of pollination have been defined in view of the motivation from flowering plants and they shape the fundamental refreshing conditions of the bloom pollination calculation.

1. Cross-pollination happens from the dust of a bloom of various plants. Pollinators comply with the standards of a Lévy distribution by hopping or flying inaccessible steps. This is known as global pollination handle.

2. Self-pollination happens from the dust of a similar bloom or different flowers of the same plant. It is local pollination.

3. Blossom steadiness is the relationship of pollinators and bloom sorts. It is an improvement of the bloom pollination handle.

4. Local pollination and global pollination are controlled by likelihood between 0 and 1, and this likelihood is called as the switch likelihood.

IV. RESULTS

Global pollination:

$$x_i^{t+1} = x_i^t + (x_i^t + g^*)$$

g^* = current best solution
L= length of the pollination

x_i^t = a solution in the present optimization problem

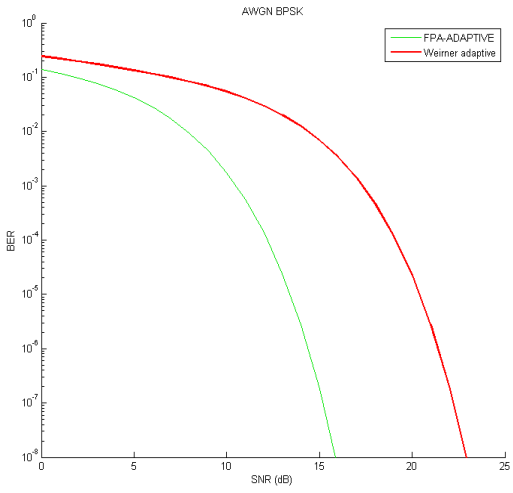

Fig.3: AWGN BPSK modulation

In Figure 3 show the BPSK modulation on SCFDMA channel on AWGN noise. In this figure comparison between wiener filter and FPA optimize Adaptive Filter which optimize the

prior of adaptive that's why reduce the BER more than Weirner Filter.

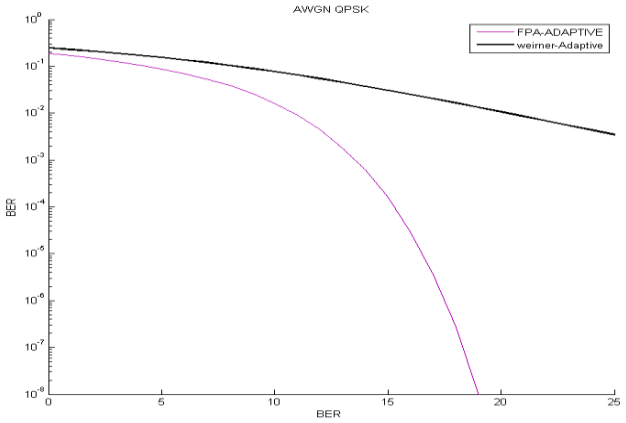

Fig.4: AWGN QPSK modulation

In Figure 4 show the QPSK modulation on SCFDMA channel on AWGN noise.In this figure comparison between wiener filter and FPA optimize Adaptive Filter which optimize the prior of adaptive that's why reduce the BER more than Weirner Filter. But if we compare with figure 1 and figure 2 BPSK reduce BER but QPSK increase SNR.

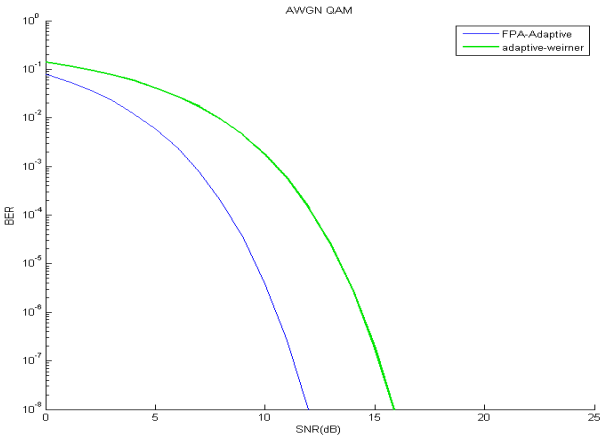

Fig.5: AWGN QAM

In Figure 5 show the QAM modulation on SCFDMA channel on AWGN noise.In this figure comparison between wiener filter and FPA optimize Adaptive Filter which optimize the prior of adaptive that's why reduce the BER more than Weirner Filter. Which is better perform than QPSK and BPSK modulation.

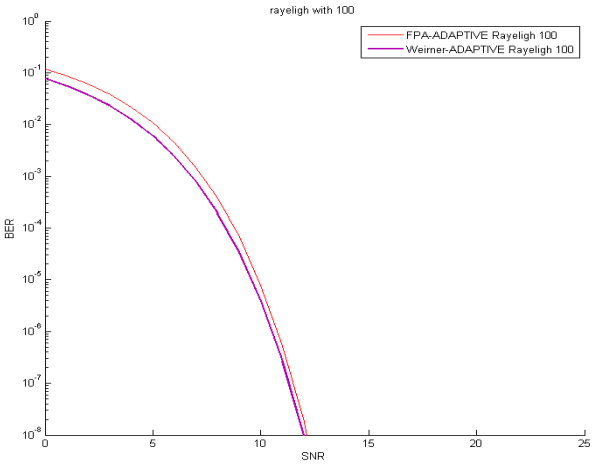

Fig.6: Rayeligh with 100

In Figure 6 show the SCFDMA channel on Rayleigh noise. In this figure comparison between wiener filter and FPA optimize Adaptive Filter which optimize the prior of adaptive that's why reduce the BER more than Werner Filter. But Rayleigh channel not significant increase performance of FPA because of Rayleigh channel highly variable noise.

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