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Design of SC-FDMA in OWPIC Algorithm using Optical communication

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Abstract: In communication, multi user detection is placed a vital role in 5G communication network. Now, design the SC-FDMA using DFT(discrete Fourier transform),IDFT(inverse discrete Fourier transform),cyclic prefix, constellation modules. SC-FDMA is mostly preferred in 5G networks flush a piece of convalescing low down power consumption in low down peak to average power ratio of RF transmission signal. The regeneration of transmission signal is similar to be the method of multi user SC-FDMA. Multi user SC-FDMA is necessary conventional to the serial and parallel communication interfacing cancellation algorithm. It's intended to achieve the outcome be large. This algo is to be compulsive the low power consumption. toward eradicate multiple access RF communication, In this mode proposed algorithm is introduce in optical weighted parallel interference cancellation (OWPIC).these yield results are implemented in the SC-FDMA among high precession than traditional parallel interference cancellation (PIC) .along with multi user SC-FDMA using, the OWPIC algorithm and also the code is written using VHDL, simulation on Modelsim for DFT-OFDM architecture and synthesis in Xilinx. Finally we analysed the leakage power, input out power, source voltage, dynamic current, on chip clocks.

Keywords: SC-FDMA, OFDM-Uplink, Downlink, Xilinx, Modelsim.

I. INTRODUCTION

In Earlier days inside the cellular communication, they used some of the technics like as TDMA, FDMA, CDMA, IFDMA, UTMS, EDGE, Wi-Max etc. Now Mainly Focus on SC-FDMA, The SC-FDMA is nothing but inner part of the DFT-OFDMA (Discreet Fourier Transform-Orthogonal Frequency Division Multiple Access). SC-FDMA is a Frequency Division Multiple Accesses is also called as linearly precoded orthogonal frequency division multiple accesses. In multiusers to share the information to the multiple communication resource channel.

A. SC-FDMA

SC-FDMA uses an additional N-point DFT stage at transmitter and an N-point IDFT stage at receiver. The Basic block diagram of SC-FDMA transmitter is shown in figure 1.1. The input to transmitter is a stream of modulated symbols.

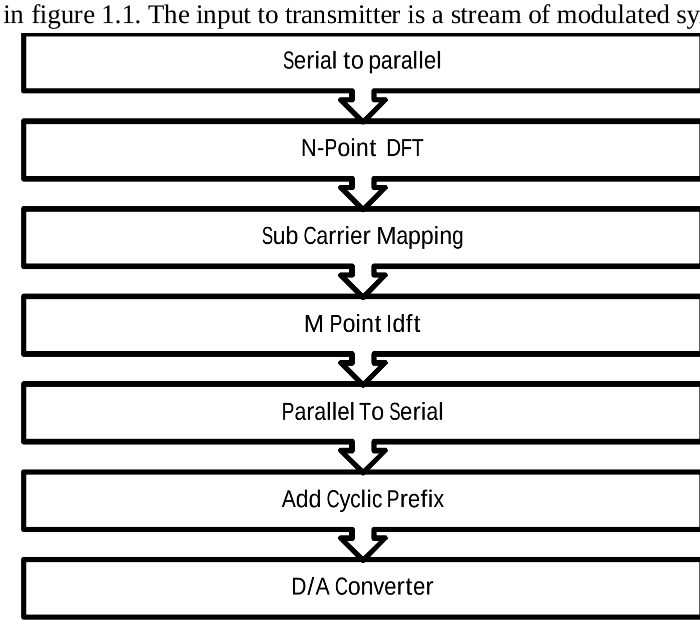

Figure: 1.1 SC-FDMA Transmitters

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The N-Point DFT is output of N-sub carrier channels, and M is the total amount of bandwidth in sub carrier mapping to follow these two techniques, they are localized sub carrier channel and distributed sub carrier channel.in sub carrier channels are regularly spaced across the total channels bandwidth. The localized sub carrier channel be also call as local SC-FDMA(LFDMA) where as distributed sub carrier channel is also call as distributed SC-FDMA(DFDMA).

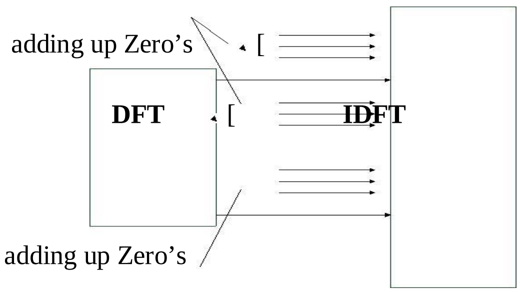

Figure 1.2 (a): Spread FDMA

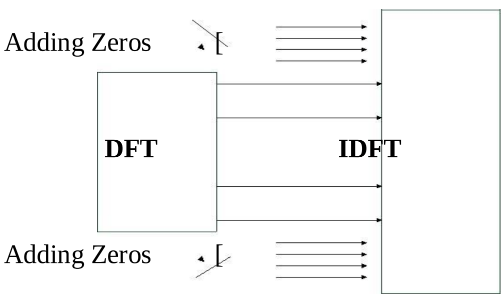

Figure 1.2 (b): Localize FDMA

SC-FDMA receiver be shown here figure 1.2(c). It is almost similar as conventional OFDMA by additional slab of subcarriers demapping, IDFT with optional seminal filter. This sieve corresponds towards the ethereal shaping worn into the transmitter. The subcarrier duct demapping of M-map subcarrier canal result N-distinct signals. During the end, IDFT convert the SC-FDMA signal towards the signal compilation.

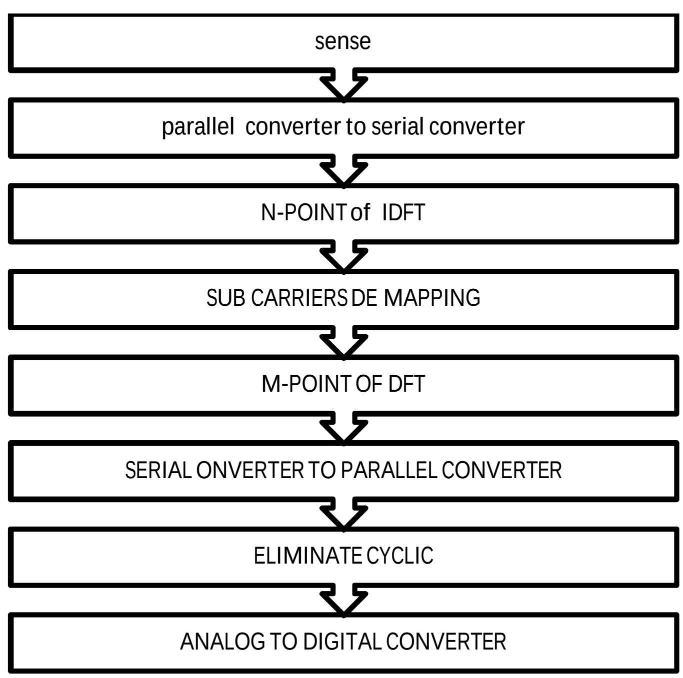

Figure: 1.2(c) Receiver of SC-FDMA

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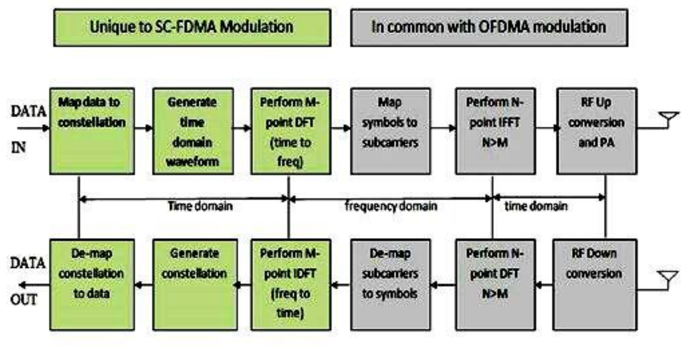
Inside uplink of LTE, There are various extra information carrying signals such as; position signal, random entrée preamble as well as control signal etc. These signals be considered as string signalling and also have constant amplitude with zilch autocorrelation. during disparity through data carrying signals, in these signals are not part of SC-FDMA tone scheme.



SC-FDMA VS OFDMA

B. SC-FDMA VS OFDM

Inside the SC-FDMA one extra unit DFT spirit live added by the IFFT unit in the aerial and IDFT is also additional in the receiver side.it's generally having low PAPR gap in OFDM systems.in the configaration process of SC-FDMA systems having less frequency offset poise to OFDM systems.in it's often frayed in LTE carrier terminals inside the transmitline and different OFDM systems are used in the e Node B downlink.lots of broadband technologies like as wi-max,W-LAN are used in the OFDM systems

1) Merits of OFDM

a) Frequency selective waning to be change the sub channels/subcarriers and not whole band

b) The cyclic prefix to eliminates ISI and IFI.

2) Existing System

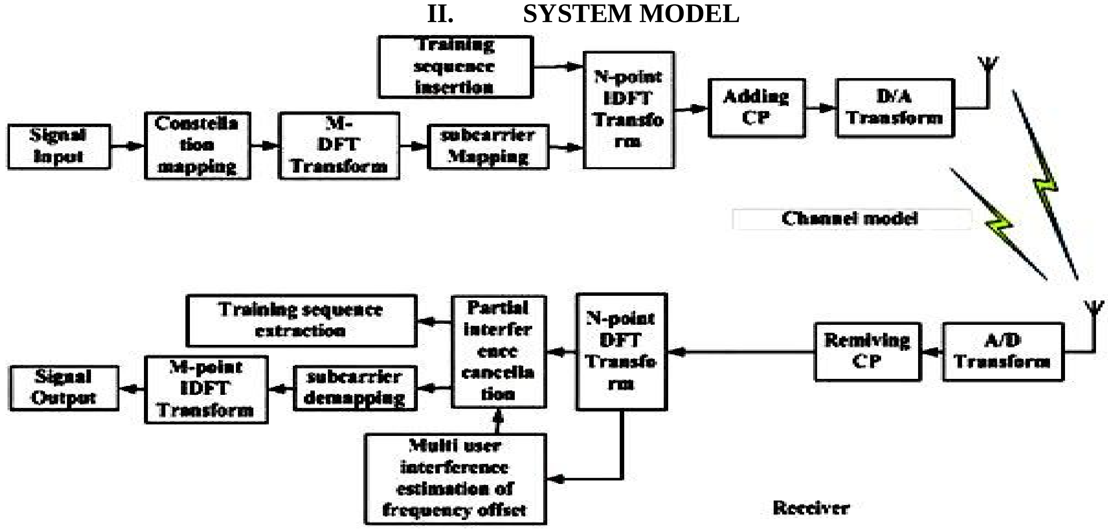
In uplink multi user accessing scheme, the sub carrier channel allocation technique is used in the IFDMA. In sub carrier channel allocation, all sub carriers are do not overlap each other. That's why they do not effect on the each super imposed disturbance of each user signal. Carrier signal mapping method is used to separate the multi user signal. The instantaneous of the offset current frequency same as the normalized shifting factor is same.

3) Drawbacks

a) Architectural design Area and Power Consumption is High.

b) Noise based signal.

II. SYSTEM MODEL



Multi user acessing model for SC-FDMA Uplink communication system

Presume to be distinct the regularity equalize pro user *i*, as *T* be the digit of uplink user. Once the variation of *N* sub-carrier, *S*(*k*) be distinct of the conventional rate signal. Pro a canal by *L*-path, the instant area pointer *yi* (*m*) tin subsist uttered as,

$$y_i(m) = \frac{1}{N}\sum_{k=0}^{N-1} S(k) \sum_{l=0}^{L-1} h(m,l)\exp(j2\pi k(m-l)/N) \cdot \exp(j2\pi \xi^i m/N) + z(k) \quad (1)$$

wherever, *z* (*k*) be preservative flaxen Gaussian noise by dissent _2.

$$Y_i(k') = \frac{1}{N}\sum_{k=0}^{N-1}\sum_{m=0}^{N-1} S(k)H(k)\exp(j2\pi mk/N) \cdot \exp(j2\pi\xi^i m/N)\cdot\exp(-j2\pi mk'/N) + Z(k') \quad (2)$$

past *N*-DFT alteration on top of expression, then we get,

Where, Y_i(k) be the indication regularity equalize pro user i. through unraveling the nosiness, as follow to,

$$\begin{aligned} Y_i(k') &= \frac{1}{N}\sum_{k=0}^{N-1}\sum_{m=0}^{N-1} S(k)H(k)\exp(j2\pi mk/N)\exp(j2\pi\xi^i m/N) \\ &\quad \cdot\exp(-j2\pi mk'/N) + Z(k'), \\ &= \frac{1}{N}\sum_{m=0}^{N-1}\sum_{k=0}^{N-1} S(k')H(k')\exp(j2\pi\xi^i m/N) \\ &\quad + \sum_{\substack{k=0,\\ k\neq k'}}^{N-1} X(k)H(k')\frac{\sin\pi(k-k'+\xi^i)}{N\sin\frac{\pi}{N}(k-k'+\xi^i)} \\ &\quad \cdot\exp(j\pi(k-k'+\xi^i)(N-1)/N \\ &\quad + Z(k'), \quad k' = 0,1,\cdots,N-1, \end{aligned} \quad (3)$$

wherever, the _rst element be the presumption introduce in ISI, the instant element be the meddling introduced by ICI. The next element be the meddling introduce in AWGN.

A received multiuser sign be able to uttered as,

$$\begin{aligned} Y(k') &= \frac{1}{N}\sum_{i=1}^{T-1}\sum_{m=0}^{N-1}\sum_{k=0}^{N-1} S(k)H(k)\exp(j2\pi mk/N)\exp(j2\pi\xi^i m/N) \\ &\quad \cdot\exp(-j2\pi mk'/N) + w(k'), \end{aligned}$$

$$= \frac{1}{N}\sum_{m=0}^{N-1}\sum_{k'=0}^{N-1} X(k')H(k')\exp(j2\pi\xi^{i}m/N)$$

$$+ \sum_{\substack{i\in M\\ j\neq i}}\sum_{\substack{k=0,\\ k\neq k'}}^{N-1} X(k)H(k)\frac{\sin\pi(k-k'+\xi^{i})}{N\sin\frac{\pi}{N}(k-k'+\xi^{i})/N}$$

$$\cdot\exp(j\pi(k-k'+\xi^{i})(N-1)/N + \sum_{\substack{j\in T\\ j\neq i}}\sum_{\substack{j=0,\\ j\neq k'}}^{N-1} X(j)H(j)$$

$$\times\frac{\sin\pi(j-k'+\xi^{j})}{N\sin\frac{\pi}{N}(j-k'+\xi^{j})}\cdot\exp(j\pi(j-k'+\xi^{j})(N-1)/N$$

$$+Z(k'), k' = 0, 1, \cdots, M-1, \quad (4)$$

where, Y $(k0)$ represents all user signals received. The _nal term corresponds to multiple access interference introduced by the frequency offset. since the over psychiatry, several entrée nosiness tin be introduce via regularity offset difference, thus the recipient wants to remove it in arrange to develop the signal diffusion performance.

III. OWPIC ALGO PRO UPLINK & DOWNLINK ENTRANCE INTERVENTION

Here instruct close to shrink the manifold uplink entrée interfacing cause via dissimilar haulier regularity offset pro diverse users. Also intrusion cause with flanking pair of user, the SIC as well as PIC algo's be normally used. The consecutive interfering cessation algo be base on subcarrier intrusion cessation, to increase the beneficiary dispensation setback also ease the pointer synchronized dispensation performance; going on the previous dispense, the PIC algo tin be apply on top of the entire sub-carriers by the equal time and reduce intrusion, but its exactitude is limited. hence, the Optimal Weight Parallel Interference Cancellation (OWPIC) algo is proposed inside this rag to remove manifold entrée interfering introduced in regularity offsets, in instruct to get better accuracy of the similar interference cancellation algo's and reduce iterations. The intention is to be optimizing SIR, also to take the finest SIR consequent near the best weights pro PIC interfering cessation. From the overall analysis, the various entrée interfering signals tin be uttered as,

$$Y(k') = \frac{1}{N}\sum_{m=0}^{N-1}\sum_{k'=0}^{N-1} X(k')H(k')\exp(j2\pi\xi^{i}m/N)$$

$$+ \sum_{\substack{i\in M\\ j\neq i}}\sum_{\substack{k=0,\\ k\neq k'}}^{N-1} X(k)H(k)\frac{\sin\pi(k-k'+\xi^{i})}{N\sin\frac{\pi}{N}(k-k'+\xi^{i})/N}$$

$$\cdot\exp(j\pi(k-k'+\xi^{i})(N-1)/N$$

$$+ \sum_{\substack{j\in T\\ j\neq i}}\sum_{\substack{j=0,\\ j\neq k'}}^{N-1} X(j)H(j)\frac{\sin\pi(j-k'+\xi^{j})}{N\sin\frac{\pi}{N}(j-k'+\xi^{j})}$$

$$\cdot\exp(j\pi(j-k'+\xi^{j})(N-1)/N$$

$$+Z(k'), k' = 0, 1, \cdots, N-1, \quad (5)$$

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Assent toward think to the receiver signals track IFDMA haulier allocation, interference owing to compound user signals separation. We identify as *m* is integer of PIC eliminate, as well as weights for the PIC elimination algorithm. later than PIC take useful in earlier times, the *i*-th addict signal tin be uttered as,

$$y^i(k)_{(m)} = y^i(k)_{(1)} - w \sum_{\substack{l=0\\ l\neq k}}^{N-1} \sum_{l\in j} \rho(k,l)\, y^j(l)_{(m-1)} \qquad (6)$$

wherever_(*k*; *l*) be the obstruction caused during the *l*-th subcarrier used for abuser *j* as well as the *k*-th subcarrier pro user *i*, which flask be articulated as,

$$\rho(k,l)=\frac{\sin\pi(l-k+\xi^j)}{N\sin\frac{\pi}{N}(l-k+\xi^j)}\cdot\exp(j\pi(l-k+\xi^j)(N-1)/N \qquad (7)$$

_ (*k*; *l*) *yj* (*l*) *m*-1 be the _rst obstruction part, *yi*(*k*) *m* be signal later than the *m*-th recognition, along with *yi*(*l*)*m*-1 is the signal subsequent to detection (*m* -1). substitute Eq.(7) keen on Equation PIC conclusion, it follows that,

$$y^i(k)_{(2)} = X(k)H(k)\left(1 - w \sum_{\substack{l=0\\ l\neq k}}^{N-1} \sum_{l\in j} \rho^2(k,l)\right) + I + \Upsilon \qquad (8)$$

Here, ***I*** is the prying introduce in the subsequent detection,7 is the clatter introduced by the subsequent detection, *yi*(*k*)(2) be the conventional signal pass through the next PIC cancellation.then,

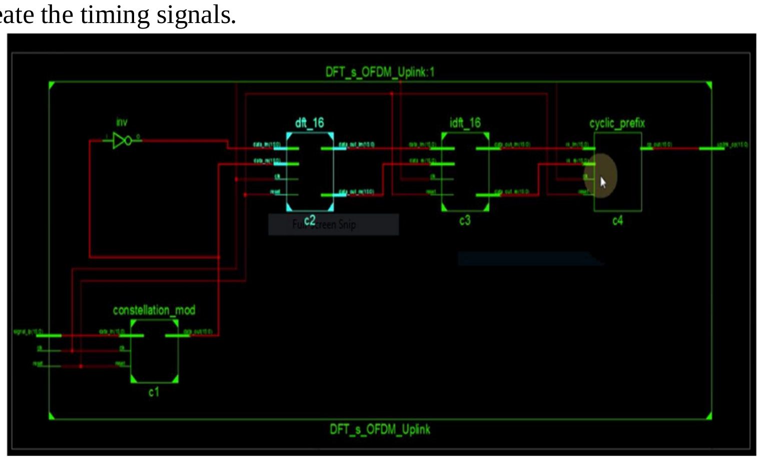
$$I = \sum_{\substack{l=0\\ l\neq k}}^{N-1} \sum_{l\in j} X(l)H(l)(\rho(k,l)(1-w) - w \sum_{\substack{l=0\\ l\neq k}}^{N-1} \sum_{l\in j} \rho^2(k,l)) \qquad (9)$$

$$\Upsilon = Z(k) - w \sum_{\substack{l=0\\ l\neq k}}^{N-1} \sum_{l\in j} \rho(k,l) z(l) \qquad (10)$$

Eq. (10) be use in the direction of the sign SIR following the resultant PIC cessation.

IV. DFT'S-OFDM UPLINK

The RTL graphical representation of the designinterlocks between the dissimilar blocks. It is technology liberated schematic of the DFT'S.OFDM Uplink's of the methods are connected to transposedIDFT.and transfers the digitalized data into equal samples are connected cyclic preface to create the timing signals.



Schematic Diagram of DFT-OFDM Uplink System

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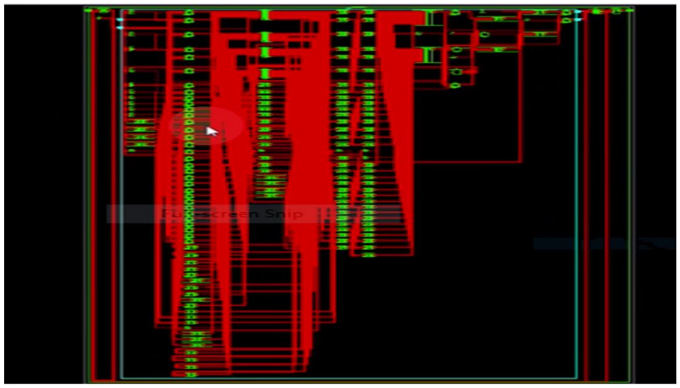
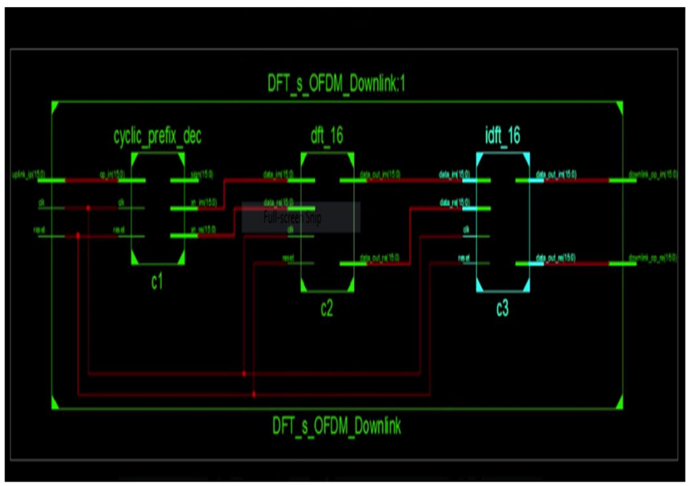


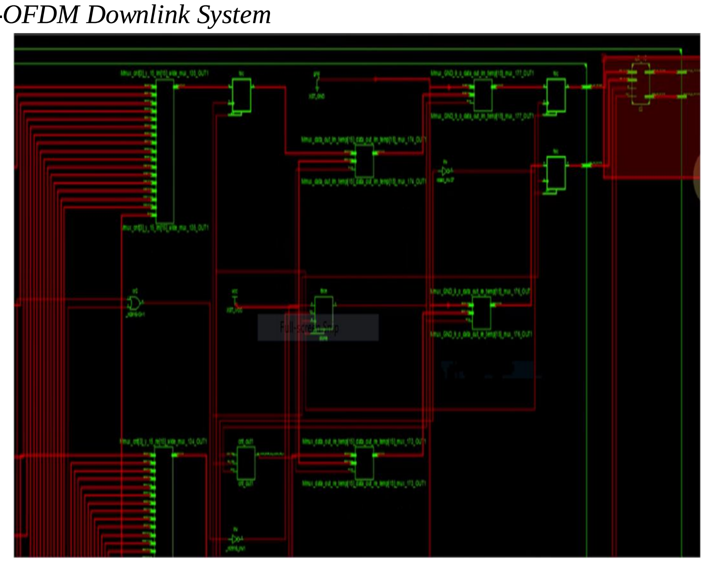
Design Objectives of Top Level Block

A. DFT'S- OFDM Downlink

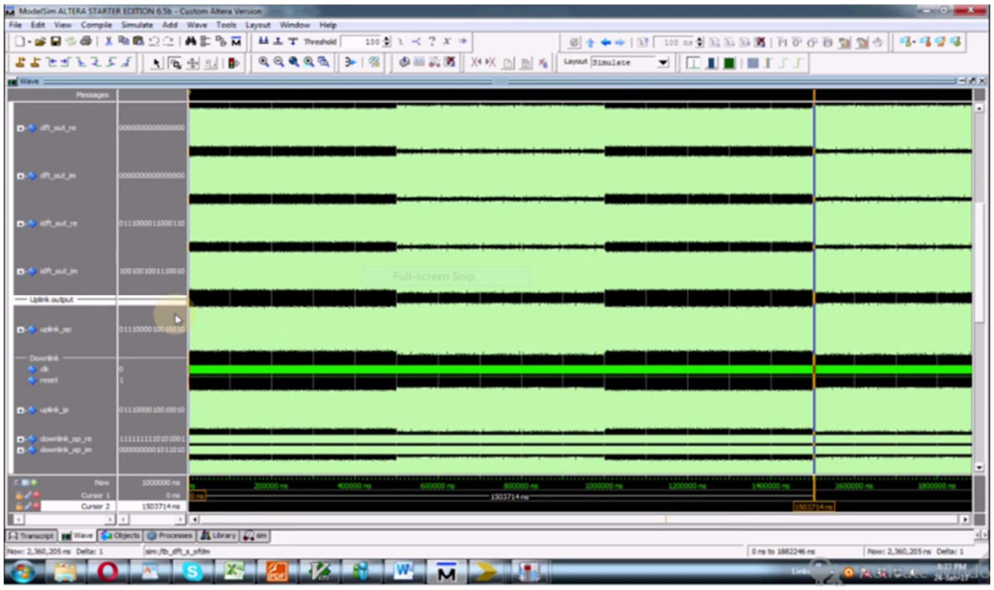
OFDM requires more transmissionpower, whereas SC-FDMA require less power, along withhigher power cannot be processed using UE(mostly mobile phones (or) CPE'S) due to battery size limitations therefore SC-FDMA is used for uplink by UE'S. Other remains also include high data rates achievable using OFDMA than other one.



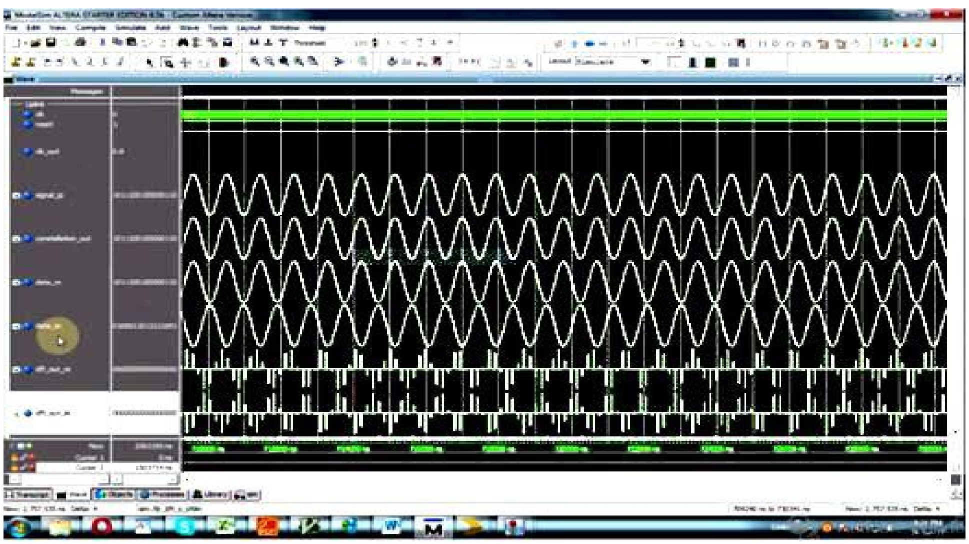
B. Schematic Diagram of DFT-OFDM Downlink System



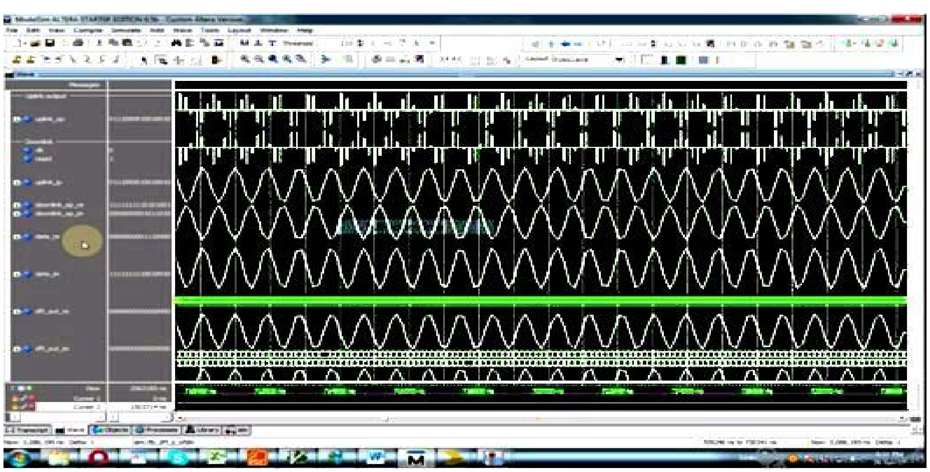
Top Level Blocks of aDFT-OFDM Downlink System Design



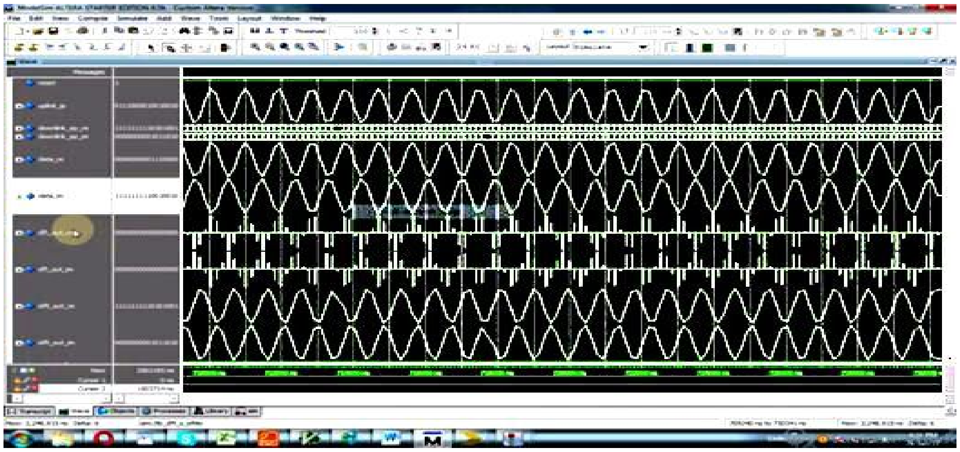
Wave Forms of DFT-OFDM System



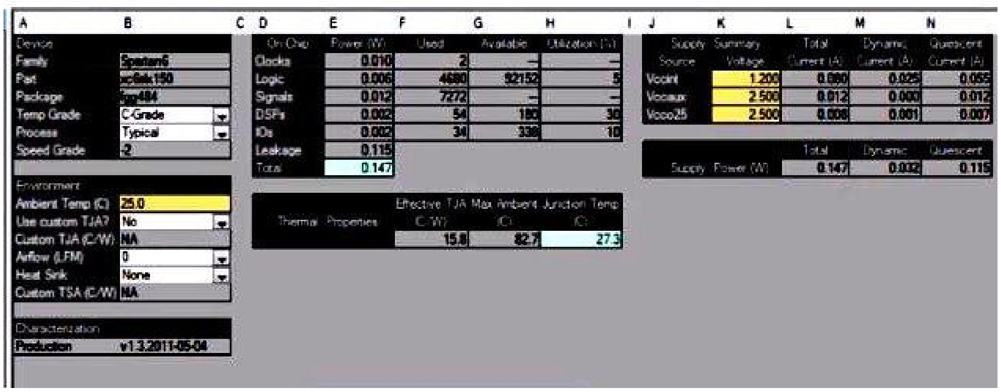
Wave Form Signals of DFT-OFDM System



Wave Form Signals of DFT-OFDM Uplink System



Wave Form Signals of DFT-OFDM Downlink System



Power Report of DFT-OFDM of Uplink & Downlink System

V. CONCLUSION

The HDL co-simulation of a design performed using OWPIC Algorithm base OFDM is ruling importance due to its concertstipulations of ISI and bandwidth compatibility over DFT based OFDM. However, calculation complexity of DFT restricts, use of DFT for OFDM due to its hardware requirements on VLSI platform. In this work, lifting based DFT is modified and a new architecture is derived that can compute DFT in less than 2.458 ns, utilization power is 0.147 and consumes power of less than 20 mw. The performance of DWT architecture can be further enhanced by introducing parallel processing and pipelining to improve throughput and latency.

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S.V.A.V. Prasad as completed M.Tech, Ph.D. presently working as professor and Dean(academic affairs), Dean(R&D), sir has developed various products like High voltage tester, VHF Wattmeter, standard signal, generator with AM/FM modulator, wireless Becom, high power audio amplifier, wireless microphone and many more in the span of 25 years(1981-2007).sir has awarded for excellence in R&D in year 1999,2004 and national quality award during the year 1999,2000,2004 and 2006.sir is fellow member of IEEE and life member of ISTE,IETE and society of audio& video system. sir has published more than 155 papers in various national & international conferences and journals, sir research area includes wireless communication, satellite communication & acoustics, antenna, neural networks & artificial intelligence. Reviewer for various national and international journals.