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Impact of Reciever Systems'and Channel's Parameters on Distributed Computing Power Ratio in OFDMA based Wireless Distributed Computing Network

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Abstract: In present days, high data rates transmissions and their manipulations are almost completing by wireless distributed computing (WDC) network, generally for minimize the time consumption. But we are unable to minimize the distributed computing power ratio (DCPR) in much manner for same network. The parameters, which are influencing on this DCPR, are network size, bandwidth, computing density, and switching frequency. In this paper, the main objective is to minimize the DCPR with proper allocation of mentioned parameters for a WDC network. I propose OFDMA based WDC system, to achieve the very less interference and to satisfy the above specified objective. This paper uses soft and evolutionary computing algorithm, called the particle swarm optimization (PSO). This algorithm gives global optimum solution to above specified objective. The performance of proposed system with specified algorithm is analyzed using computer MATLAB simulation.

Keywords*:* Wireless Distributed Computing Network, OFDMA, DCPR.

I. INTRODUCTION

Basic WDC networkcontains single transmitter and multi receivers are used. All these receivers can share information and to completean enormous tasks with in very less finite amount of time. But WDC network faces interference by fading and noise channel conditions.

Due to this disadvantage of WDC system, orthogonal frequency division multiplexing (OFDMA) scheme deploys into WDC system to achieve the very less amount ofinter symbol and inter carrier interferences. OFDM comes under the physical layer. OFDM based WDC system employs to accomplish the required task in less amount of signal to noise ratio (SNR) and without interference. But this scheme contain adaptively in its subcarriers allocation.

Generally subcarriers allocation in OFDM based wireless distributed computing (WDC) network is main issue. This allocation efficiently achieved by an evolutionary algorithm, called the particle swarm optimization (PSO), presented in [1]. With the help of PSO, resource allocation for OFDM based wireless communication system presented in [7].

However in all the above works, no one has been performed on DCPR withnetwork size, bandwidth, computing density, and switching frequency.

In this paper, I proposeminimization or optimization of DCPR with network size, bandwidth, computing density, and switching frequency. This paper is organized as follows: In section II, the problem statement is presented. In section III, the problem is formulated. In section IV, present the proposed system model. In section V, I present the simulation results. Finally, the paper is concluded by the section VI.

II. PROBLEM STATEMENT

In this paper, minimization or optimization of DCPR with network size, bandwidth, computing density, and switching frequency is considered as anobjective.This objective is analyzed in with and without channel variances (noise, fading and etc.) between transmitter and all different receivers.

III. PROBLEM FORMULATION

As noted in previous paragraph, the objective of OFDMA based WDC network isto achieve the required quality of service (QoS) (optimization of DCPR). For this task, we need to formulate the required objective in a mathematical manner. In this section, I present mathematical equations that relate various WDC network parameters. [2]

One of the important resources in a WDC network is the total computing power. It is defined as the total power required for a receiver to perform a certain computational task.In digital circuits computing power consumption is mainly classified as static and dynamic power consumptions [2]. The computing power consumed by the i^{th} receiver is given by [2].

$$P_{co}^{(i)} = P_s^{(i)} + P_d^{(i)} \text{watts} \qquad (5)$$

Where 'P_{co}' is the computing power, 'P_S' is the static power and 'P_d' is the dynamic power.

Here static power is indicating that how much power isleaking in processor.

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Dynamic power is about computing task. It is expressing in below as [2]:

$$P_d^{(i)} = a \times C_L \times V_{cc}^2 \times N_{SW} \text{watts} \quad (6)$$

In this paper, above specified dynamic power consumption is considered in two locations. One is at the input side and other one is at the output side. The dynamic power consumption at the input side is called the transient dynamic power consumption, at the output side is called the load dynamic power consumption.

$$P_{dtr}^{(i)} = a \times C_{pd} \times V_{cc}^2 \times N_{SW} \text{watts} \quad (7)$$

$$P_{dl}^{(i)} = a \times C_L \times V_{cc}^2 \times N_{SW} \text{watts} \quad (8)$$

Where 'P_{dtr}' is the computing power at the input side, 'P_{dl}' is the computing power at the output side, 'P_s' is the static power and 'P_d' is the dynamic power. 'a' is the parameter relating to computing density, 'C_{pd}' is the power dissipation capacitance, 'C_L' is the loading capacitance, 'V_{cc}' is the supply voltage for digital circuits. The parameter 'N_{SW}' means number of bits changes is required, it relates to the computational burden. Higher 'N_{SW}' means more number of bits changes are required and hence capacitors are to be charged and discharged. Therefore more energy is required. The parameter 'a' is also known as the processor parameter. Higher 'a' means, the processor has higher capacitance and hence more energy is required to charge them. The total power is required for computation is [1]

$$P_{co} = \sum_{i=1}^{K} P_{co}^{(i)} \text{watts} \quad (9)$$

Where 'K' indicates total number of destination nodes or receivers.Another important resource in WDC is total communication power consumed. As the name suggests, it is the total power required for a source node to communicate the computational task to the destination nodes. It depends on factors like bandwidth, data rate required and channel variance [2].

The relationship between the above factors and communication power required is given by Shannon's theorem where 'B' indicates the total bandwidth is available, 'd' is the maximum possible data rate, 'P_{cm}' is the communication power required and 'σ^2' is noise power in the channel [2].

$$d = W \times \log\left(\frac{P_{cm}}{\sigma^2}\right) \text{(bits/sec)} \quad (10)$$

If the channel variance of the 'i^{th}' receiver is σ_i^2then relationship between communication power required and data rate achieved is given by [2]

$$d_i = W_i * \log\left(1 + \mathrm{P}_{\mathrm{cm}}^{(\mathrm{i})}/\sigma_i^2\right) \text{ (bits/sec)} \quad (11)$$

Where '$P_{cm}^{(i)}$' is the communication power required to achieve a maximum data rate of 'd_i' for the 'i^{th}' receiver. Therefore the total powers utilized for communication will [1]

$$P_{cm} = \sum_{i=1}^{K} P_{cm}^{(i)} \text{watts} \quad (12)$$

Where 'K' indicates the total number of receivers.

The total power consumed for communication and computation is [1]

$$P_{tc} = P_{cm} + P_{co} \text{watts} \quad (13)$$

IV. PROPOSED SYSTEM MODEL

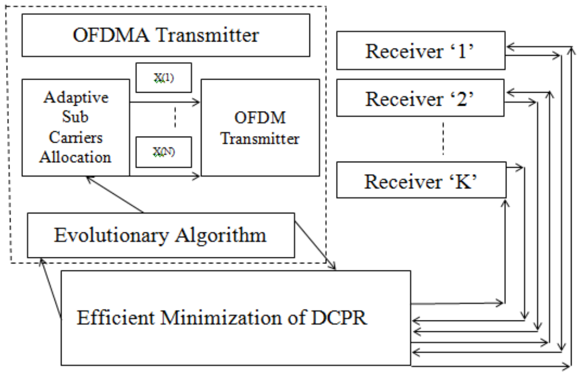

Fig. 1. Block diagram of the Proposed System Model

The objective of this paper are to produce:
Minimize: .distributed computing ratio (DCPR)

The resource (time, number of subcarriers, elements or devices and number of manipulations) allocate to a particular receiver in an efficient manner, it indicates the communication power and computation burden allocated to each node based on the quality of service (QoS)requirements and resource constraints. The QoS for common WDC network are less power consumption, assurance in reliable communication, high transmission data rate withan efficient and adaptivebandwidth (number of sub carriers) allocation.

The block diagram of the proposed system is shown in Fig. 1. In the proposed system, initially transmitter allocated to all receivers with equalnumber of subcarriers, amount of load and number of operations. Here one controllerblock is used. This controller block estimate the parameters relate todevice (internal) and channel(outside) from an every receiver. These parameters are completelydepending on channel characteristics and receivers capabilities and their densities (loads). The transmitter collects the data from controller block, after then it analyzes about the DCPR and its related parameters (specified). After this analysis,it adaptively changes the number of subcarriers allocation, network size, load and operations. Again controller block will observe the device (internal) and channel (outside) parameters or factors. This analysis is done by evolutionary or nonlinear optimization algorithm. This optimization algorithmgives efficient solution for specified objective. In this paper, PSO is used as nonlinear minimization algorithm and it helpful to achieve the better global minimum solution [8].

V. SIMULATION RESULTS

In this section I analyze the performance of proposed method using MATLAB simulation. Optimization of DCPR with respect to different parameters (considered) as performance issue.

For the simulation, I consider one main node and number of destination nodes are 20. The channel between

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the transmitter and the particular receiver is considered to be additive white Gaussian noise (AWGN), whose SNR is taken from 20 to 35 in an uniform and random manner. The total network power is considered as 20 watts. The distance between the transmitter and the particular receiver is taken from 2 to 20 k.m. in random manner.

The average power constraint on each receiver is taken as 1 watt. The static power consumption, for the particular receiver is taken from 0.01 to 0.10 watt in an uniform and random manner. The maximum number of subcarriers in one OFDMA block is taken as 1024.

Here Monte Carlo simulation is used, for this simulation transmission bits are taken as up to10^6 bits and its mapping scheme as binary phase shift keying (BPSK). Maximum values of computing density (system's load), switching frequency are denoted as 'a_M', 'N_{swM}'.

In below simulations I study the effect of computing density (system's load) and switching frequency on bandwidth (number of sub carriers) consumption, total timeconsumption.

The DCPR is defined by the ratio of dynamic networkcomputing power consumption to the total available network power to complete this task [1].

In Fig.1 and Fig.2, DCPR increases when computing density (load) and switching frequency (operations) increases. Compared to Fig.2, Fig.1 shows more effect on DCPR. It means receiver system's load will more effect on DCPR.

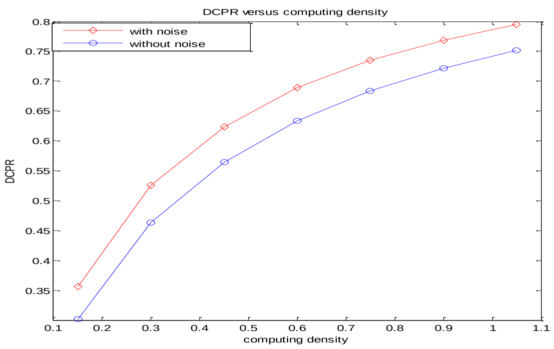

Fig.1. Effect of fixed computing density (load) on DCPR [1]

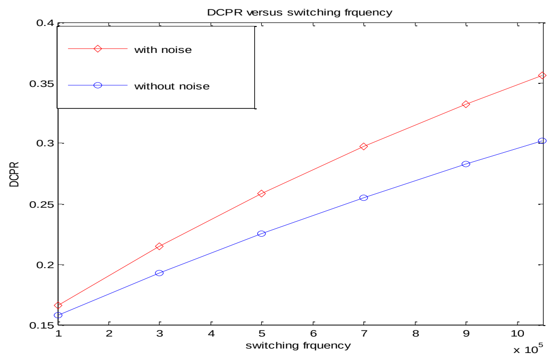

Fig.2. Effect of fixed switching frequency (operations) on DCPR [1]

In Fig.3 and Fig.4, DCPR almost remains constant whenswitching frequency (operations) is adapted and fixedcomputing density (load) and vice versa. Compared to Fig.4, Fig.3 shows more effect on DCPR. It means receiver system's load will more effect on DCPR.

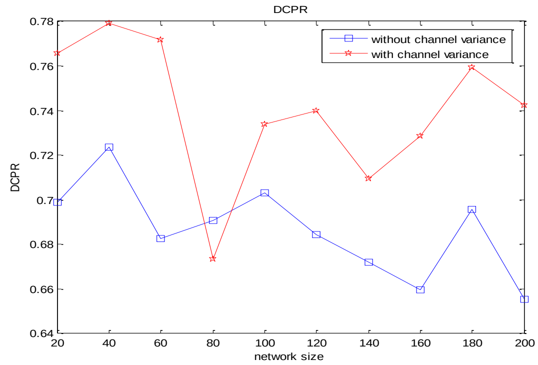

Fig.3. Effect of only adaptive switching frequency (operations) on DCPR [2]

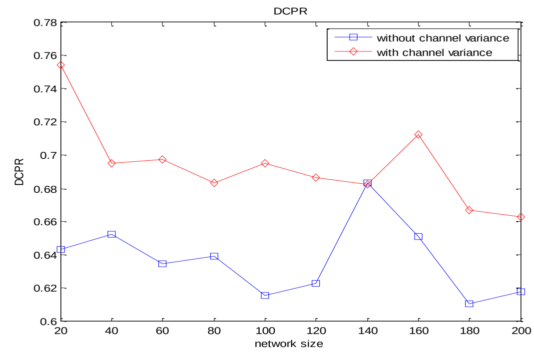

Fig.4. Effect of only adaptive computing density (load) on DCPR [2]

Compared to Fig.1, Fig.4 shows less effect on DCPR. It means receiver system's load will more effect on DCPR.

Compared to Fig.2, Fig.3 shows less effect on DCPR. It means receiver system's load will more effect on DCPR.

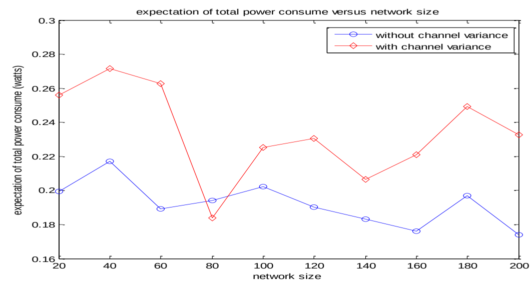

Fig.5. Effect of both computing density (load) and switching frequency (operations) on DCPR [2]

In Fig.5, DCPR almost remains constant (in less amount) whenboth computing density (load) andswitching frequency (operations) are adapted.

Compared to Fig.1,2,3,4, Fig.5shows less effect on DCPR. It means receiver system's load will more effect on DCPR.

In Fig.6 and Fig.7, DCPR decreases, whenswitching frequency (operations) is adapted and fixedcomputing density (load), vice versa and also subcarriers (bandwidth) increases. Compared to Fig.6, Fig.5 shows more effect on DCPR. It means receiver system's load will more effect on DCPR.

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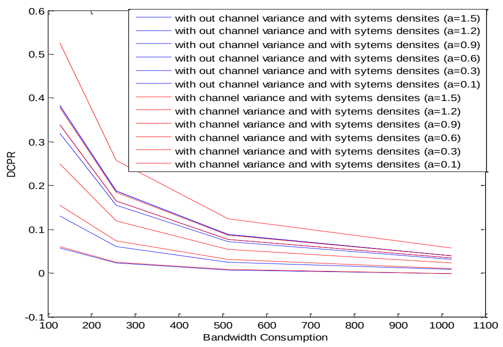

Fig.6. Effect of variation in computing density (load), fixed switching frequency (operations) and variation in number of subcarriers on DCPR

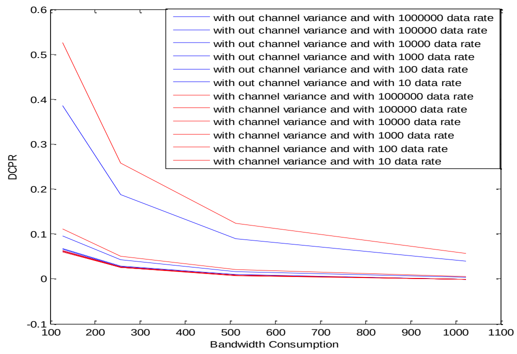

Fig.7. Effect of variation in fixed switching frequency (operations), computing density (load) and variation in number of subcarriers on DCPR

Compared to Fig.6, Fig.7 shows less effect on DCPR. It means receiver system's load will more effect on DCPR

VI. CONCLUSION

In this paper, I proposed a new allocation scheme for OFDMAbased WDC system. This proposedallocation scheme given the good balance betweencomputing density (load), switching frequency (operations) and bandwidth (number of sub carriers) consumption. The performance of the proposed scheme is studied using computersimulations. The simulation results shown that compared with fixed internal and fixed outside parameters, adapted internal and adapted outside parameters are given less effect on specified objective.

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BIOGRAPHIES

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