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A Novel Scheduling Algorithm for Wireless Optical Network

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Abstract- **With the increasing of the business carried by the wireless private network and the continuous development of the new network technology, the problems in the traditional mode of wireless private network are becoming more and more obvious. So optical wireless channel were scheduled by observing the packets requirement and available channels. In this work two renowned scheduling algorithm First come First Serve and Shortest data first were compared. Scheduling of optical wireless channel obtained from WDM were done in same environment of data packets delivery. Experiment and results shows that proposed optical wireless channel scheduling by SDF was better than FCFS algorithm on various evaluation parameters.**

Index Terms- **Channel Utilization, genetic algorithm, Load balancing, Optical Data Computing, WDM.**

I. INTRODUCTION

In today's cellular networks, the design and choice of schedulers is left to the operator. As a consequence, the significant impact of scheduling algorithms on network performance made them a popular research topic. The current implementations of schedulers do not utilize the advanced features of physical layer and users are often scheduled regardless of their channel conditions. On one hand, fourth generation cellular technologies mostly operate on multiple subcarriers. Commonly adopted schedulers operate regardless of user's channel condition, e.g.:

- Round Robin, that serves users in a circular manner without any other consideration,
- earliest deadline first (EDF), which schedules the packet that will be expired the soonest,
- weighted fair queueing (WFQ), that allocates the resources with respect to the weights associated with every user [6].

In contrast, schedulers have been proposed, but not fully implemented yet, that take advantage of physical layer information, such as the user channel state. This type of schedulers are called opportunistic schedulers. As an example, some vendors deploy simplified opportunistic schedulers which follow the proportional fair strategy [7]. Proportional fair schedulers consider the current channel state of the users and the history of received throughput of each user.

Unfortunately, the implementation accuracy of proportional fair schedulers is commonly limited by scarce memory and processing resources deployed at base station. A WDM technology has the enormous amount of bandwidth available in fiber cable. As fiber cable can provide large amount of bandwidth by using WDM technology. In fiber optics use of WDM provide different wavelength to each channel where collection of channels was done by a carrier. In WDM system, each carries multiple communication channels and each channel operating on different wavelength. Such an optical transmission system has a potential capacity to provide Tera bytes of bandwidth on a single fiber. WDM technology has the capability to provide the bandwidth for the increase in the huge on traffic demand of various applications like audio, video and multimedia, which needs the QoS over the network [1].

II. RELATED WORK

In [2] In this paper, we investigate multiple access scheduling methods for downlink orthogonal frequency division multiplexing in diffuse optical wireless networks. Unlike the radio frequency channel, the DOW channel has low-pass filter characteristics and so requires different scheduling methods than those developed for the RF channel. Multi-user diversity orthogonal frequency division multiple access systems nominate a cluster of subcarriers with the largest signal-to-noise-ratio for transmission.

In [4] author investigates for hybrid optical wireless networks. In particular, we explore the scheduling of traffic transmission in such heterogeneous environment. Targeting to improve the hybrid network performance as well as guarantee the QoS requirement of diverse applications, we focus on the network throughput and transmission delay.

In [5] author have discussed the optical and wireless access networks architectures and their convergence as an effective solution for ever increasing bandwidth and quality of services. Different convergence architectures and related work have been discussed, with main attention to Fi-WSN architecture, in particular the Fi-WSN gateway and its design issues. Three gateway design issues have been mentioned while one of them the 'Message Prioritization' have been discussed in great detail with respect to the class of service priority queues and the delays that the high priority queue experiences.

In [6] dynamic uplink resource scheduling algorithm is proposed on the basis of Software Defined Optical Network. By studying the business characteristics of the uplink transmission of power wireless network, the priority of the service is evaluated before the resource scheduling is carried out. According to the characteristics of OFDM resource allocation and the numerical control separation and programmable feature of SDON, different scheduling methods are designed for different services.

In [8] tackle the problem of scheduling in a multi-carrier wireless system. Their paper is dedicated to adapt the MaxWeight algorithm for multi-carrier scenarios for which they define three objective functions that emulate the MaxWeight behavior. The first objective function simply maximizes the product of queue size and feasible rate for each user over all subcarriers. The second and third objective functions are NP-hard problems that account for the ignorance of MaxWeight algorithm towards users with small queue and bad channel quality.

In [9] state that throughput-optimal algorithms in single channel wireless networks are not necessarily throughput-optimal in multi-channel wireless networks. Hence, they propose a joint channel-assignment and workload based scheduler (CA-WS), which is throughput-optimal in multi-channel wireless networks. In [20], flows are classified into two groups, namely, transient and resident and every flow is associated with a file transfer from source to destination. A transient flow is a flow whose file is not fully buffered at the base station, while a resident flow has fully transmitted the file to the base station. Every flow starts from a source and crosses the base station to reach the destination. Let’s assume that all flow sources try to transmit a file to the base station.

III.PROPOSED METHODOLOGY

1.Develop Environment

In order to perform a true experiment data packets were randomly generate where size and arrival time of the packets were different. Although header, footer of the packets take fix size but as per message bits size of packet may vary.

2. Optical Wireless Channel

As wirless optical channel can communicate in nano meter range of wavelength so for better utilization WDM (Wire less division multiplexing) was done. Here this paper has divide optical channel into 8 sub-channels. NRZ modulation and De-modulation technique was used for the data packet communication. Here whole process of scheduling was done at sender end so Fig. 1 and Fig. 2 explain whole working, where each block diagram was explained by the various sub section of this proposed methodology section.

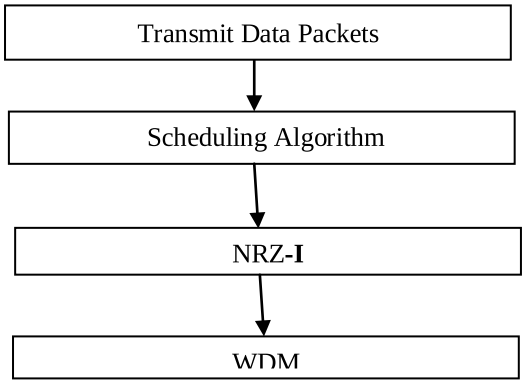

Fig. 1 Transmitter Side optical wireless Block diagram.

3.First Come First Serve (FCFS) has the principle of a queue processing technique or servicing conflicting demands by ordering process by First-Come, First-Served (FCFS) behavior, what comes in first is handled first, what comes in next waits until the first is finished.

Data Packets obtained are queue as per arrival time of the packet. Here all channels have equal data transmission capacity. So FCFS scheduling algorithm find the blank available channel to transmit next packet in the queue. In this algorithm computation time was very less at the same time none of data packet get into starvation condition which is known as undefined waiting time.

4. First Come First Serve

- Input Data Packets with Arrival Time
- Short data packets in increasing order as per Arrival time
- Assign Shorting Sequence to Channel Queue
- For Each Data Packet in queue
- Apply NRZ modulation
- Transmit Corresponding Optical Signal to OWDM
- Loop End

5. Shortest Data First in this scheduling approach small size data packet were scheduled first. So other packets have to wait for their turn to get shortlist in the channel queue. This can be understand as data packets are pipelined or queued in the channel as per size of the message. So all input packets are short as per there packet size in increasing order. Hence packets have small message bits get first chance to transmit while higher message packets get later. In this algorithm computation time was less as shorting was done on available packets. Here none of packet get under starvation as preemptive algorithm was consider. Preemptive means once queue position was assigned to the packet than it can't be rollback even small size packet is available.

6. Shortest Data First

- Input Data Packets with Arrival Time, Packet Size
- For T to T+1 arrival time duration
- Short data packets in increasing order as per Packet Size
- Assign Shorting Sequence to Channel Queue
- For Each Data Packet in queue
- Apply NRZ modulation
- Transmit Corresponding Optical Signal to OWDM
- Loop End
- Loop End

IV.EXPERIMENT AND RESULTS

So as to perform analysis and measure assessment results MATLAB tool was adapt. This segment of paper show experimental setup and results. The tests were performed on a machine outfitted with 4 GB of RAM, 2.27 GHz Intel Core i3 and running under Windows 7 Professional. In this work total 8 channel are considered. Laser beam of 193.1nm wavelength was consider where AWGN channel was used for communication from sender to receiver. Wave length division multiplexing was used with LRZ encoding.

1. Evaluation Parameter

1.1Peak Signal to Noise Ratio

$$PSNR = 10\log_{10}\left(\frac{Max\_pixel\_value}{Mean\_Square\_error}\right)$$

1.2Signal to Noise Ratio

$$SNR = 10\log_{10}\left(\frac{Signal}{Noise}\right)$$

1.3 Bit Error Rate

$$\eta = \frac{n_c}{n_a} \times 100$$

Here n_c is number of bits which are true.
Here n_a is total number of pixels present in Data.

2.Channel Utilization Rate

$$CU = \left(\frac{CS - PS}{CS}\right) \times 100$$

Here CU is Channel Utilization, CS is Channel Size, PS is Packet Size.

V.RESULTS AND DISCUSSION

Table 2 Average Packet PSNR value for Scheduling algorithm.

Distance	SDF	FCFS
400 Km	54.1514	49.3802
550 Km	51.1411	50.172
700 Km	54.1514	51.1411

From table 2 it was obtained that Shortest data first has higher average PSNR value as compared to first come first serve. As shortest data first find small slots in channel to fot first so PSNR at receiver end get improved. So communication in this channel with wireless optical data increases data accuracy at receiver side.

Table 3 Average Packet SNR value for Scheduling algorithm.

Distance	SDF	FCFS
400 Km	10.5531	10.2241
550 Km	10.3455	10.2787
700 Km	10.5531	10.3455

From table 3 it was obtained that Shortest data first has higher average SNR value as compared to first come first serve. As shortest data first find small slots in channel to fot first so SNR at receiver end get improved. So communication in this channel with wireless optical data increases data accuracy at receiver side.

Table 4 Average Packet Channel Utilization value for Scheduling algorithm.

Distance	SDF	FCFS
400 Km	45.991	9.01968
550 Km	45.991	9.01968
700 Km	45.991	9.01968

From table 4 it was obtained that Shortest data first has higher average channel utilization value as compared to first come first serve. As shortest data first find small slots in channel to fit first so Channel Utilization at receiver end get improved. So communication in this channel with wireless optical data increases data accuracy at receiver side. Here use of AWGN channel for communication gives strength to SDF algorithm as well.

Table 5 % Average Packet Q-Factor value for Scheduling algorithm.

Distance	SDF	FCFS
400 Km	0.705969	0.327165
550 Km	0.209122	0.107739
700 Km	0.686712	0.613739

From table 5 it was obtained that Shortest data first has higher average Q-Factor value as compared to first come first serve. As shortest data first find small slots in channel to fit first so Q-Factor at receiver end get improved. So communication in this channel with wireless optical data increases data accuracy at receiver side.

Table 6 Average Packet BER value for Scheduling algorithm.

Distance	SDF	FCFS
400 Km	0.25	0.75
550 Km	0.5	0.625
700 Km	0.25	0.5

From table 3 it was obtained that Shortest data first has lower average BER value as compared to first come first serve. As shortest data first find small slots in channel to fot first so BER at receiver end get improved. So communication in this channel with wireless optical data increases data accuracy at receiver side.

VI. CONCLUSION

As demand of digital communication increases day by day, so channel utilization plays an important role. Communication media get higher bandwidth in optical wireless channel to transmit data packets of text, audio, video files. This paper proposed a wireless optical channel scheduling algorithm with implementation on different packet size arrival. It was found that shortest data first has better channel utilization as compared to first come first serve algorithm. Results shows that SDF has improved values of SNR, SNR, Q-Factor, BER parameter as compared to FCFS in AWGN channel. In future researcher can improve scheduling algorithm by involving other fitness parameter for channel selection.

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