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Retraction

Retracted: Dynamic Wavelength Scheduling by Multiobjectives in OBS Networks

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] V. K. A. Kumar, M. R. Kumar, N. Shribala et al., "Dynamic Wavelength Scheduling by Multiobjectives in OBS Networks," *Journal of Mathematics*, vol. 2022, Article ID 3806018, 10 pages, 2022.

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Research Article

Dynamic Wavelength Scheduling by Multiobjectives in OBS Networks

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The burst dropping ratio is witnessed in the contemporary literature as a considerable constraint of optical burst switching (OBS) networks that attained many researchers' efforts in the recent past. Among the multiple practices endeavoring to reduce the burst drop ratio, the optimal burst scheduling is one dimension in this regard. The transmission channel scheduling and appropriate wavelength allocation are critical objectives to achieve optimal burst scheduling in regard to minimal burst drop ratio. Many of the scheduling models depicted in the contemporary literature aimed to achieve the optimum scheduling by electing the channels, which depend on optimum utilization of idle time. Some of the studies tried to select channels by any metrics of quality, and significantly minimal amount of studies focused on wavelength allocation for lowering BDR. Moreover, in regard to this, this study tried to achieve optimum wavelength allocation beneath manifold objective QoS metrics, which is identified as "multi-objective dynamic wavelength scheduling (DyWaS)." The experimental study carried through the simulations evinced that the proposed model DyWaS escalated the optimality of burst scheduling through wavelength allocation compared with other existing methods represented in the contemporary literature.

1. Introduction

Growing Internet access and penetration rate across the world is resulting in high traffic congestion among system networks. Further, the increase in multi-media applications is causing further load over existing bandwidth. Accordingly, the need for additional traffic rates, which have already crossed the maximum capacity limits of networks, is on the rise. As these traffic rates focus more on backbone networks, the impact is largely felt on core networks. To overcome these limitations, highly effective and optimal resource distribution to clients must be designed [1]. Most of the network programmers rely on the optical-switching model to address the congestion issues in networks [2].

In commercial networks, circuit switching is the most common optical-switching model. Light can travel a longer distance through the circuit-switching model. It is known as the "WR network" because of the light paths it allows to pass through the fibres. The projected wavelengths of these rays also influence their trajectories. It is true that the traditional WR model is not as effective in high-traffic situations, and its performance can change over time. WR light paths are bandwidth-assured tunnels, resulting in insufficient or unused bandwidth due to information transmission inefficiency, which is the case here.

The OBS model [3–11] has emerged as a reliable option for next-generation optical networking to efficiently handle heavy congestion scenario along with dynamically varying traffic conditions. The model [12] integrates the optimal optical circuit with packet switching in order to explore large bandwidth. Hence, this approach is regarded as a preferred option for managing high-speed backbone networks. It incorporates burst assembly, where data packets are integrated into bursts at the ingress-edge nodes and then disintegrates these bursts at the egress. The model considers a burst as the primary switching granularity consisting of a cluster of data packets transmitted between nodes. Together with the burst, a control message is also transmitted through the pre-determined path to construct the fabrics of every in-between node before the delivery of burst to the particular node. These guarantees cut-through at every in-between node for the burst, which is open to the control layer. The duration of the transmission of the control message and the delivery of related burst is termed as offset duration.

Though the approach has multiple pros, it also involves certain challenges, hindering QoS of the network like buffering lags, occasional burst conflicts arousing from single-way signaling norms, and regular retro-blocking of bursts. Packet dropping is the major challenge observed in higher layers, mandating redelivery of the dropped packets and thereby adding to overall transmission lags.

There are a number of possible explanations for this burst reduction in the OBS environment, including data contention, path congestion, and ineffective resource reservation coding or retro-blocking. Numerous studies in the current literature focus on burst-based models and the switching framework associated with them. Another intriguing area of study in the context of OBS is data contention [13]. Environmental factors can complicate multiplexing and switching.

As a result, these issues can result in a decrease in network efficiency, particularly when a transmission request consumes nearly all of the available bandwidth capacity. In these networks, a more nuanced version of unfairness is observed, with a higher probability of bursts dropping.

1.1. Motivation. The OBS default transmission model does not support burst buffering during transmission. As a result, burst drop is frequently observed as the default loss class constraint for networks. This is because buffering based on burst transmission reduces the QoS in OBS when compared to IP networks. Typically, for OBS network provisioning of QoS, wavelength contention occurs when two or more data bursts attempt to achieve identical output at the same time using the same wavelength. In this case, for OBS networks, the possibility of burst loss is minimized by lowering the level of wavelength contentions during data bursts.

1.2. Problem Statement. Scheduling an OBS network can be defined as the process of allocating or reserving resources in anticipation of a burst entering the network. The primary goal of scheduling is to minimize any idle spaces created by the burst and schedules. Unlike the traditional Internet, there is little support for optical buffers for temporary storage and forwarding in the event of a contention in OBS networks. Thus, bursts are typically forwarded to the next node in the destination direction within a short turnaround time, or the burst is dropped.

The scheduling algorithm must effectively handle bursts while also ensuring that any existing voids are filled in an efficient manner. A void can be defined as the space between two consecutive bursts scheduled for a channel that is left unused or idle.

2. Related Research

In JET models, the probability of burst loss varies with each hop in the OBS environment. This is because the duration of the offset decreases with each hop. As a burst approaches its final node, the likelihood of it dropping increases. This concept results in a decrease in both throughput and resource consumption. Additionally, it may result in a great deal of injustice [14].

A bi-state Markov chain approach was proposed in [15] for managing burst drops in the JET context. It used the FF-VF filling context for path sequencing. In [16], a tool for estimating the probability of an FDL buffering granularity-specific loss was developed. Researchers in [17, 18] developed an estimation tool by utilizing retransmission and deflection models. The authors proposed a more advanced form of JET signaling, dubbed VFO, in their study [19]. The VFO's time sequencer takes the burst's arrival time into account. S-JET, a new JET signaling variant, was proposed in [20] as a means of increasing JET processing speed by registering at the end of the list. The authors in [21] developed an asymptotic scenario for the possibility of a null burst drop at various projected wavelengths. This assists in identifying areas with a remote possibility of a burst drop.

The researchers in [22] paid greater attention to the effect of offset duration. They devised a method for supplying the patterns of offset time distribution seen in control frame headers. The researchers demonstrated that the variance of the pattern can affect the total burst loss. Because the burst loss is less dependent on reservation coding in the header span, a lower threshold value is required. Barakat and Darcie [6] conducted a study to determine the effect of control frame dispensation on the throughput of a channel. A new technique was been developed in order to better understand the effect of the control-header sequencing procedure on primary nodes. According to the researchers' findings, high-speed control message transmission is not required to achieve superior performance in OBS networks. According to another study, the mean control delay on existing long-haul routes can be significantly longer than the delay in the header sequences.

The researchers in [23] developed a probabilistic method for determining the likelihood of burst loss when channel usage convertor sharing is used. To manage traffic distributions, the method employs the Markovian arrival procedure, which views the burst onset as the burst's onset. The burst volume appears to disperse rapidly. According to [24], this study developed an optimal burst sequencing code. The code makes use of invariant time burst rescheduling. The primary purpose of this method is to eliminate any offset duration errors. As a result, duration-based priority mechanisms are prohibited. The possibility of data contention and loss is examined in the context of multiple routing codes [25]. The model in [26] is a lower load fixed-point method for determining the likelihood of data loss. For both JIT and JET concepts, the method utilizes data segmentation and path-based priorities. According to the theory, data segmentation reduces the risk of data loss the least, while path-based priority theory also reduced losses more significantly, but the difference was not statistically significant.

Pre-emption is the most frequently used technique for ensuring fairness in OBS networks [27]. The LHP mechanism as a means of redressing environmental injustices is another contemporary model [28]. The researchers discovered that if the total number of hops exceeds a predetermined threshold, it is possible to prevent a second burst at the final hop. However, in OBS, the method fails because pre-emption occurs only once, at the very end of the network path. The authors in [29] proposed an alternative to this solution. This concept is founded on two pre-determined threshold levels. Additionally, Gao et al. [30] proposed a fair FPP model. This calculation is based on the first offset duration, the mean burst volume, the successful hops, and the leftover hops. In the context of data contention, the FPP method of pre-emption is used to balance network fairness and throughput. In an experimental study, the FPP model outperformed the approaches proposed in [27, 28].

As suggested by the authors in [31], the FCSA sequencing program can be used to strike a balance between fairness and blocking efficiency. The algorithm incorporates a dynamic priority into each burst. The critical characteristics of a burst are determined by the priority assigned by the appropriate authority. In the context of data contention, this approach uses these priorities to select a desirable burst and ignore another. The researchers in [32] considered the role of a subcarrier in path capacity.

The study in [33] employed sequencing mechanisms in order to accommodate a large number of participants. As part of this effort to ensure short-term fairness, bandwidth is weighted. The model in [34] proposes the use of the DPCC system, which is designed to ensure equitable distribution of traffic and resources. Additionally, the method modifies the message transmission's speed and reliability. It adjusts these parameters based on data from traffic congestion, pricing, and user feedback. The model is based on feedback data, which can be scarce. As a result, when input flows are limited, certain bursts experience a high rate of loss. This can result in an asymmetrical network utilization. A route based on an ant scenario, a wavelength, and a time-slot distribution program was proposed [35] for lowering the burst drop ratio and achieving a high overall efficiency.

The preceding studies concentrated on reducing the likelihood of burst loss and increasing network throughput as a result. However, these contributions were limited to determining the channel's optimal idle time. The purpose of this paper is to propose a new model for increasing efficiency that can be used with both JIT and JET. It considers multiple quality metrics at the channel level, such as data offset duration and burst transmission realization time, in addition to traffic inference resolution methods. In this model, burst segmentation can also be used to optimize scheduling.

3. Dynamic Wavelength Scheduling (DyWaS)

Dynamic wavelength scheduling (DyWaS) is an extension of our previous work, proximate optimal channel selection via void filling (POCS-VF) [36]. When it comes to wireless networks, the POCS-VF is an adaptive channel scheduling system that maximizes the utilization of data bursts by utilizing idle time between channel schedules (pools of packets). POCS-VF is a scheduling strategy for data bursts that prioritizes them based on available bandwidth and the possibility of utilizing idle time. However, other aspects of quality of service (QoS) are ignored when channel scheduling is determined. As a result, it frequently performs below average at public access points. In comparison to POCS-VF, the proposed DyWaS evaluates the effect of multiple transmission quality objectives on the transmission quality of proposed wavelengths. The wavelength optimality ratio (wor) has been proposed as a new scale for examining the application of various channel quality metrics in this context. The greater the wavelength optimality ratio is, the more critical that particular communication channel is. The DyWaS strategy is as follows.

Each access point's controller buffers packets to ensure consistent transmission latency. When a transmission session is created, the collection of packets is divided into bursts and information about each burst is passed to a scheduler. This information sharing can be determined using a burst transmission control packet. Arrival time is the time required for a burst to arrive at an access point and the time required to share information about that burst, which is commonly referred to as offset time.

For simplicity, we will use $p(cf_i)$ as the processing time, $\tau(cf_i)$ as the time it takes for control frame cf_i to attain the scheduling system after it leaves the assembler, and$\tau(b_i)$ as an estimate of how long it will take to send burst bi from the assembler to the scheduler. The total estimated transmission time $ett(b_i)$ is calculated as follows:

$$ett(b_i) = p(cf_i) + \tau(cf_i) + \tau(b_i). \tag{1}$$

Here in equation (1), the representation could be the entire expected time consumed by burst for reaching towards scheduler. Table 1 describes the annotation used to describe the equations.

3.1. DyWaS Strategy. The scheduler starts the scheduling procedure if the control frame has arrived. In this regard, the scheduler introduces the essential properties of transmission called optimum wavelength, which requires the existence of wavelength time. Moreover, wavelength allocation procedure under DyWaS is discussed in the following.

Primarily, the abovesaid method evaluates the shown wavelength transmission values of entire available presented

Table 1: Notations for DyWaS.

Wavelength optimality ratio	(wor)
Processing time	$p(cf_i)$
Control frame	cf_i
Estimated transmission time	$ett(b_i)$
Wavelength arbitration rate	$arr(w_i)$
Elapsed schedules of the wavelength	$es(w_i)$
Total number of schedules	$ts(w_i)$
Nanometers and the representation	$nw(i)$
Deserted schedules	$\mathrm{d}s(w_i)$
Inference threshold	irt
Wavelength existence span	wes
Existence span threshold	est
Residual life span	$rls(w_i)$
Transmission realization rate	(trr)
Inference rate	(ir)
Wavelengths possessing primary score	W_{ps}

wavelengths and sequences these wavelengths as per the one of shown quality metrics, which is deliberated as main transmission quality requirement. The planned method for evaluating the opportunity of every transmission metric quality, projected in respect to available estimated wavelengths, is discussed in the following segment.

The scheduler transmission controller receives the DPs from manifold consumers and buffers as per their arrival time latency, and later bursts are the buffered DP pool. Moreover, these bursts are scheduled by the access points towards optimal shown wavelengths, which transfer data towards target. This paper's objective is to attain maximum quality of transmission.

The projected wavelengths are scheduled and controlled by the scheduler (set of wavelengths). Therefore, the wavelength allocation under the scheduler is from the sets, which indicates the available wavelengths.

The wavelength scheduling towards burst is required for transmitting the particular quality. The wavelength, which is scheduler, is not often optimal under entire considered quality metrics. The priority sequence in respect to chosen metrics quality could be the contextual position. Here, wavelength that is highly rated under 1 metric of quality is not optimal often under other metrics of quality. Therefore, it is evident for choosing the wavelength, which is reasonably rated under many of the most preferable quality metrics for scheduling.

The selection of wavelength by the optimality rate of wavelength scheduled towards respective burst is suggested. The metric quality is adapted for evaluating optimality ratio of wavelength in the following way:

(i) Wavelength arbitration rate: this metric signifies ratio of wavelength elapsed schedules in averse to count of times where the wavelength is scheduled. This could be measured in the following equation:

$$arr(w_i) = \frac{es(w_i)}{ts(w_i)}. \quad (2)$$

(a) The notation $arr(w_i)$ in equation (2) is the wavelength arbitration rate, which is the ratio of elapsed schedules $es(w_i)$ of the wavelength w_i against total schedules $ts(w_i)$.

(ii) Desertion rate: this metric indicates the failure transmissions noticed in averse to entire amount of times the respective wavelength is scheduled. Equation (3) represents the metric assessment:

$$dr(w_i) = \frac{\mathrm{d}s(w_i)}{ts(w_i)}. \quad (3)$$

(a) The notation $dr(w_i)$ in equation (3) depicts the ratio of abandoned transmissions $\mathrm{d}s(w_i)$ against the total number of schedules $ts(w_i)$ of respective wavelengthw_i.

(iii) Transmission realization rate: this metric denotes transmission realization ratio in averse to count of times, in which wavelength is the scheduler that could be measured in the following way:

$$trr(w_i) = \frac{ts(w_i) - \mathrm{d}s(w_i)}{ts(w_i)}. \quad (4)$$

(a) The notation $trr(w_i)$ in equation (4) claims the transmission realization rate of wavelength w_i, and the difference between total schedules $ts(w_i)$ and the deserted schedules $\mathrm{d}s(w_i)$ depicts the total number of successful schedules.

(iv) Inference rate: adequate amount of wavelength is required for performing transmission with less assurance. The wavelength that is available needs to be compatible towards respective transmission of burst, so that at bottom side, the attenuation needs to be overcome, and at top side, it should not enable noise inference. When wavelength is lower than essential level or higher than level that allows noise inference, then it depicts that respective wavelength could not be optimal, and when it is in between pre-requisite levels, then respective wavelength needs to be considered. The wavelength in the specified level is divergent at the specified threshold from other shown wavelengths, which is scheduled as per the wavelength compatibility measuring using the following equation:

$$ir(w_i) = \sqrt{(w(i) - nw(i))^2}. \quad (5)$$

(a) The notation $ir(w_i)$ in equation (5) finalizes the distance of resulting wavelength distance from its neighbor wavelength, the representation $w(i)$ signifies respective wavelength in the nanometers, and the representation $nw(i)$ denotes the neighbor wavelength in the nanometers.

(b) This $ir(w_i)$ must be greater than the given inference thresholdirt, since $ir(w_i) < irt$ indicates that wavelengthw_i causes inference with wavelengthw_j for current scheduling requirement.

(v) Wavelength data rate: this parameter is the main QoS aspect since data rate acts as crucial role for attaining less assured delivery of burst at destination. When rate of data is lower than needed or more than cumulative of pre-requisite data rate and residual data rate of threshold, then it represents that corresponding wavelength could not be optimal for scheduling; if they are in between requisite rate of data and residual threshold data rate, then respective wavelength could be optimal. Here, data rate measuring compatibility is given in the following:

$$wdr(w_i) = dra(w_i) - drr(w_i). \quad (6)$$

(a) Here notation $w\ dr(w_i)$ in equation (6) finalizes the data rate of wavelength w_i, $dr\ a(w_i)$ is indicating the data rate available at wavelengthw_i, and "$dr\ r(w_i)$" is the data rate required at w_i for corresponding burst to be scheduled.

(b) This $dr\ c(w_i)$ needs to be lower than the specified "residual data rate threshold" $r\ dr\ t$, as $dr\ c(w_i) > r\ dr\ t$ denotes that w_i wavelength is large for present scheduling requirement data rate that could be reserved for further scheduling with maximum requirement of data rate.

(vi) Wavelength existence span (*wes*): if the "wavelength existence span" is more than residual life time of respective burst, then corresponding wavelength is not suitable for scheduling as span existence is more than residual life time of burst and absolute variance of *est* (existence span threshold). When the absolute variance among "wavelength existence span" and residual life time of burst is more than $r\ dr\ t$, then it could be infeasible for scheduling because the respective wavelength could be reserved aimed at future load, which required more wavelength existence span. This could be measured in the following way:

$$wes(w_i) = aes(w_i) - rls(b). \quad (7)$$

(a) The notation $wes(w_i)$ in equation (7) evinces the wavelength existence span of wavelength w_i, the notation $aes(w_i)$ signifies the available existence span of w_i wavelength, and representation $rls(w_i)$ signifies the residual life span of b burst for transmitting the required burst.

(b) If $0 < wes(w_i) \leq est$, then the wavelengthw_i is optimal; otherwise, it is infeasible for scheduling.

3.2. Evaluation Strategy of Optimality Ratio of Projected Wavelengths. Let wavelength arbitration rate (*arr*), desertion rate (*dr*), transmission realization rate (*trr*), inference rate (*ir*), wavelength data rate (*w dr*), and wavelength existence span (*wes*) be a set of QoS metrics $M = \{[arr(w_i), dr(w_i), trr(w_i), ir\ (w_i), w\ dr(w_i), wes(w_i)] \forall i = 1 \ldots x\}$ of available projected wavelengths $W = \{w_1, w_2, \ldots w_x\}$ under scheduler s_j.

The QoS factors $w\ dr(w_i)$, $wes(w_i)$ are primary metrics, which are main metrics that are utilized for detecting every wavelength compatibility scope. This prime score is utilized for sequencing the presented wavelengths that are evaluated in the following way.

Then, identify primary score in the following way.

Initial procedure normalizes the compatibility of bandwidth and span existence.

Step 1. $\forall_{i=1}^{x}\{w_i \exists w_i \in W\}$, begin.

Step 2. diff$\leftarrow r\ dr\ t - w\ dr(w_i)$: the set diff comprises the variance among the residual data rate $w\ dr(w_i)$ of each wavelengthw_i in averse to $r\ dr\ t$ residual bandwidth threshold.

Step 3. diff$_{abs}\leftarrow abs(\text{diff}\{w_i\})$ //the set diff$_{abs}$ comprises the absolute entries values in diff.

Step 4. End.

Step 5. $\forall_{i=1}^{x}\{w_i \exists w_i \in W\}$, begin.

Step 6. $w\ dr(w_i) = 1 - (1/(\text{diff}\{w_i\} + \max(\text{diff}_{abs}) + 1))$: normalize the data rate of wavelength so that optimal wavelength in respect to data rate might possess greater value that is between 0 and 1.

Step 7. End.

Step 8. $\forall_{i=1}^{x}\{w_i \exists w_i \in W\}$, begin.

Step 9. diff$\leftarrow est - wes(w_i)$//the set diff comprises the variance among the residual existence span$wes(w_i)$ of the probable wavelengths in averse to residual *est*.

Step 10. diff$_{abs}\leftarrow abs(\text{diff}\{w_i\})$ //the set diff$_{abs}$ comprises the absolute entry values in diff.

Step 11. End.

Step 12. $\forall_{i=1}^{x}\{w_i \exists w_i \in W\}$, begin.

Step 13. $wes(w_i) = 1 - (1/(\text{diff}\{w_i\} + \max(\text{diff}_{abs}) + 1))$ //normalizing "wavelength existence span" so that the optimal wavelength existence span might possess greater value that is in between 0 and 1.

Step 14. End.

Step 15. $\forall_{i=1}^{x}\{w_i \exists w_i \in W\}$, begin.

Step 16. $ps(w_i) = 1 - (w\ dr(w_i) \times wes(w_i))$//product of 2 decimal fractions gives the minor decimal fraction. Therefore, product of represented data rate $w\ dr(w_i)$ and $wes(w_i)$ is deducted from 1 to achieve higher product value.

Step 17. End.

Moreover, these probable wavelengths could be indexed as per the metric values of QoS, so that every probable wavelength could have diverse indices for divergent QoS metrics, and greater than 1 wavelength might possess similar index regarding 1 of QoS. The wavelength index in respect to QoS might be achieved by arranging the presented wavelengths in increasing sequence of corresponding metrics of QoS that is optimal through higher values. When metric QoS is optimal by lesser values, then probable wavelengths could be arranged in decreasing sequence of corresponding metric values of QoS. In respect to any of QoS, the index greater than 1 wavelength in sequenced list could be same, when corresponding QoS metric values for respective wavelengths were identical. As per the description,

(i) These projected wavelengths are deliberated as W_{ps} set, which are arranged in increasing sequence of their main score.

(ii) These projected wavelengths are deliberated as W_{arr} set, which are arranged in decreasing sequence of arbitration rate of wavelength.

(iii) These projected wavelengths are deliberated as W_{dr} set, which are arranged in decreasing sequence of ratio of desertion.

(iv) These projected wavelengths are deliberated as W_{trr} set, which are arranged in increasing sequence of ratio of transmission realization.

(v) These projected wavelengths are considered as W_{ir} set, which are arranged in decreasing sequence of inference ratio.

Moreover, the method represents the "wavelength optimality rate" for every projected wavelength in the following way.

$\forall_{i=1}^{x}\{w_i \exists w_i \in W\}$, Begin for each projected wavelength.

$$\mu(w_i) = \frac{\{W_{ps}\{w_i\} + W_{arr}\{w_i\} + W_{dr}\{w_i\} + W_{trr}\{w_i\} + W_{ir}\{w_i\}\}}{|Q|}. \tag{8}$$

Equation (8) evaluates the projected indices' mean for manifold wavelength metrics w_i. The representations $W_{ps}\{w_i\}$, $W_{arr}\{w_i\}$, $W_{dr}\{w_i\}$, $W_{trr}\{w_i\}$, $W_{ir}\{w_i\}$ denote the wavelength index w_i in corresponding sets.

$$d(w_i) = \sqrt{\frac{1}{|Q|}\left\{\begin{array}{c}(\mu(w_i) - W_{ps}\{w_i\})^2 + (\mu(w_i) - W_{arr}\{w_i\})^2 + \\ (\mu(w_i) - W_{dr}\{w_i\})^2 + (\mu\{w_i\} - W_{trr}\{w_i\})^2 + \\ (\mu(w_i) - W_{ir}\{w_i\})^2\end{array}\right\}}. \tag{9}$$

Equation (9) expressed from statistical metric is known as "root mean square deviation" of indices assigned towards respective wavelength over diverse metrics of QoS. The representation $\mu(w_i)$, which is utilized in the equation, finalizes the index average of respective w_i wavelength attained for diverse metrics of QoS.

$$wor(w_i) = \frac{1}{d(w_i)}. \tag{10}$$

Then, equation (10) selects optimal entry sets W_{ps} that are probable wavelengths possessing primary score more than specified threshold. Moreover, arrange these chosen wavelengths in decreasing sequence of *wor*, and similar sequence is recommended for selecting the probable wavelength in respect to schedule respective burst.

The negative parameters like (a) no availability of wavelength with required values of QoS metrics and (b) threshold lapses of burst incoming time could be managed under DyWaS in the following way.

If projection of required wavelength is not occurred, when delay identified in arrival of burst that exhibits in wavelength utilization arbitration or if manifold burst competent towards respective wavelength then restructuring of burst into manifold bursts could be done & scheduling of DyWaS would be recursively done till the scheduling procedure is succeeded.

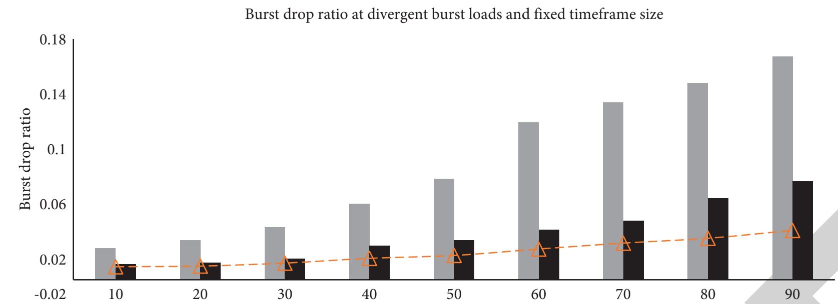
Here, in the DyWaS procedure, it endeavors initially for tracking the optimal wavelength under the influence of diverse metrics of QoS; when scheduling procedure is unsuccessful in connecting burst with respective wavelength, then corresponding burst is restructured into two bursts so that one will definitely be suitable for contemporary wavelength. Nevertheless, repeat the represented method on other burst part till it is scheduled towards optimum wavelength.

4. Simulation Result

The results of the staged experiment are discussed in this section. Through JAVOBS integration, connecting 38 senders via a one-way communication path enables two-way order [37]. Each burst volume is limited to 1,024 data packets of 64 bytes each. The experimentation process utilizes sixteen communication paths, each with a unique time and bandwidth constraint. Each experiment lasted an average of ten minutes. Along with standard approaches, the simulation was conducted using the DyWaS method. POCS-VF [36] and MSBFVF [38–40] are two well-established techniques that share a common concept but differ in their implementation.

The burst drop rate against variable loads and non-variable time periods; the drop rate against variable time periods and non-variable load; the transmission path usage ratio against variable loads and non-variable time periods; the transmission path usage ratio against variable period and non-variable load; and the mean scheduling duration are all parameters used to assess the efficiency of the tested models. The burst drop rate is the total number of bursts that were scheduled for transmission divided by the total number of scheduled bursts. The utilization rate of transmission paths is calculated by dividing the number of active paths by the total number of paths. On average, scheduling each of the sequenced bursts takes the same amount of time as the total number of bursts considered. The simulation's burst load volume ranged from ten to ninety, and the study's time durations ranged from ten to fifty milliseconds.

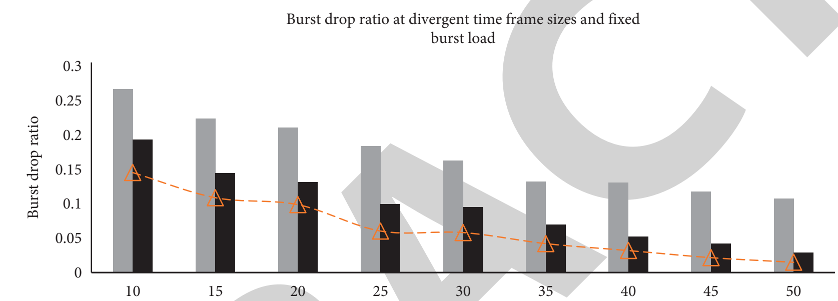
4.1. Performance Assessment. The experimental results established that the proposed sequencing model DyWaS outperformed the industry-standard MSBFVF. In comparison to POCS-VF, it solved the scheduling optimization problem at a higher level. The preceding paragraph detailed the metrics used to evaluate the performances. As illustrated in Figure 1, the burst dropping rate is 2% smaller than that of



	10	20	30	40	50	60	70	80	90
MSBFVF	0.024	0.03	0.04	0.058	0.077	0.12	0.135	0.15	0.17
POCS-VF	0.012	0.013	0.016	0.026	0.03	0.038	0.045	0.062	0.075
DyWas	0.0099	0.0104	0.0127	0.0163	0.0185	0.0234	0.0279	0.0316	0.0376

Burst Load

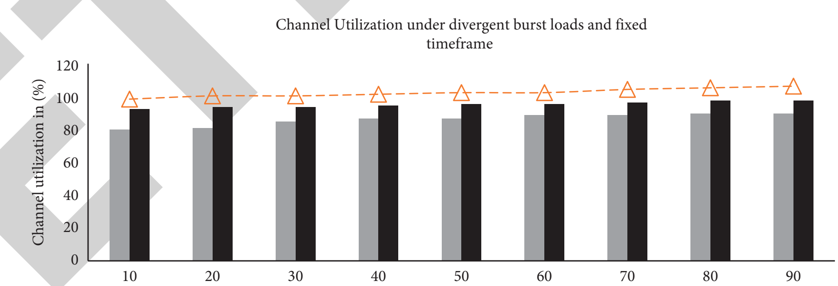
Figure 1: Ratio of burst drop to divergent burst load for a fixed timeframe of 35 μs.



	10	15	20	25	30	35	40	45	50
MSBFVF	0.26609	0.22313	0.21042	0.18347	0.16263	0.13189	0.12999	0.11717	0.10719
POCS-VF	0.19273	0.14385	0.13096	0.09936	0.09512	0.06915	0.05226	0.04193	0.02892
DyWas	0.145023	0.108573	0.09846	0.060217	0.057998	0.041964	0.031886	0.021582	0.01488

Time frame size in

Figure 2: Burst drop ratio changing with the change of size of the timeframes and the burst size staying the same.



	10	20	30	40	50	60	70	80	90
MSBFVF	81	82	86	88	88	90	90	91	91
POCS-VF	94	95	95	96	97	97	98	99	99
DyWas	100	102	102	103	104	104	106	107	108

Burst Load

Figure 3: The ratio of channel utilization when a constant timeframe of 35 μs and a varied burst load are used.

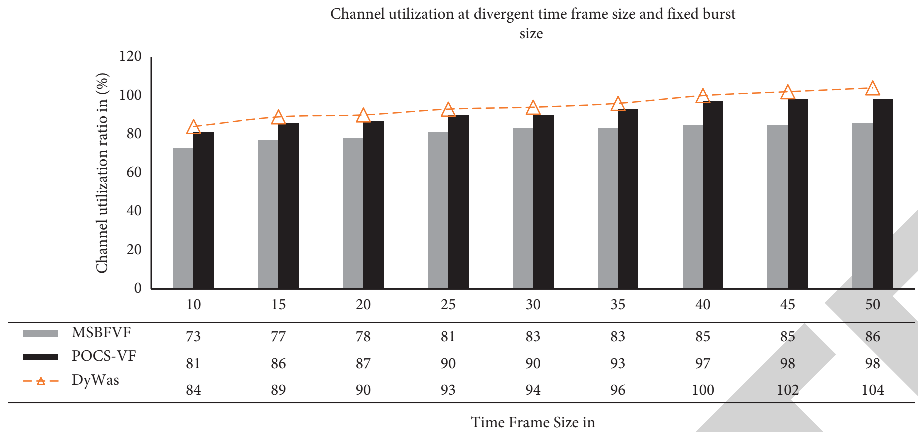
POCS-VF and 8% narrower than that of MSBFVF strategy under various loads and a constant timeframe of 35 μs.

Figure 2 illustrates the burst drop ratio for non-variable load burst models with varying timeframes. The ratios are shown for burst drops of 35 and 840 and various other models. The proposed model's burst dropping was found to be 2.5% and 7.5% less than that of POCS-VF and MBSFVF, respectively.

As shown in Figure 3, the transmission path usage ratio for the DyWaS model is 3% higher than that of the PCS-VF approach and 7% higher than that of the MSBFVF approach for burst sizes that are both variable in size but not in duration.

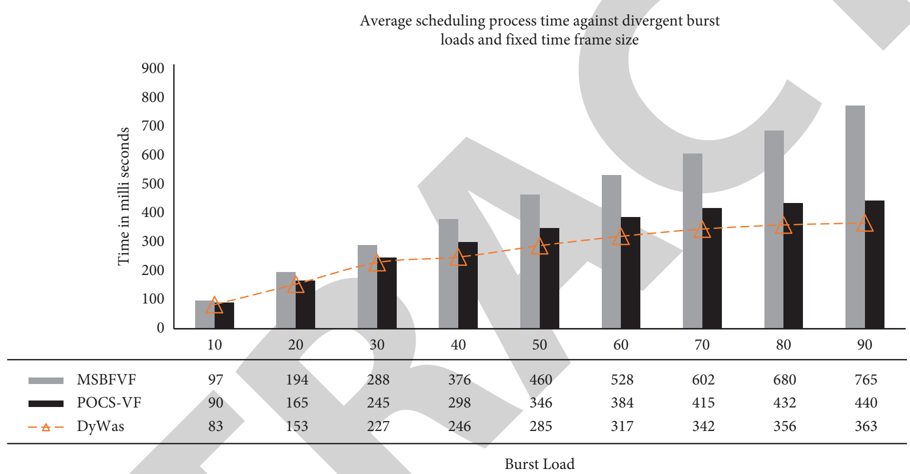
As shown in Figure 4, the proposed DyWaS model had a transmission path utilization ratio that was 2% higher than that of POCS-VF and 8% higher than that of MSBFVF under burst load as constant and variable time duration conditions.

To further evaluate DyWaS's scheduling performance, the study compared it to two other benchmark approaches



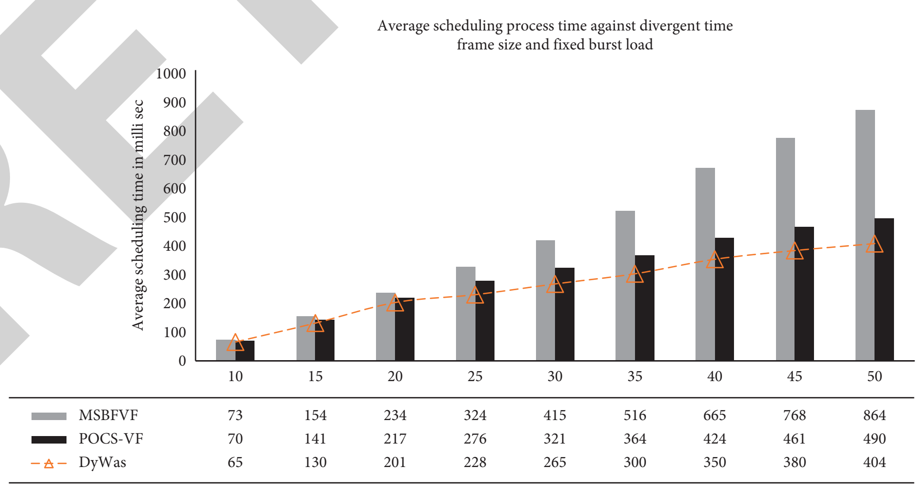
	10	15	20	25	30	35	40	45	50
MSBFVF	73	77	78	81	83	83	85	85	86
POCS-VF	81	86	87	90	90	93	97	98	98
DyWas	84	89	90	93	94	96	100	102	104

Figure 4: A depiction of how many bytes each channel uses under a wide range of timeframes and a burst load of 35680 bytes.



	10	20	30	40	50	60	70	80	90
MSBFVF	97	194	288	376	460	528	602	680	765
POCS-VF	90	165	245	298	346	384	415	432	440
DyWas	83	153	227	246	285	317	342	356	363

Figure 5: Depiction of average time to schedule burst: divergent burst loads with the fixed time frame of size 25.



	10	15	20	25	30	35	40	45	50
MSBFVF	73	154	234	324	415	516	665	768	864
POCS-VF	70	141	217	276	321	364	424	461	490
DyWas	65	130	201	228	265	300	350	380	404

Figure 6: Average time depiction for scheduling of bursts: diversified sizes of timeframes and constant 35680 bytes of burst load.

in terms of scheduling time. Figure 5 depicts a system with a constant duration of 35 μs and a wide range of burst sizes. Figure 6 shows a non-varying burst size of 35,680 bytes with a variable time duration. DyWaS scheduling times were comparable to POCS-VF scheduling times and significantly less than MSBFVF scheduling times in both conditions.

Figure 5 illustrates the average time required to schedule bursts for disparate burst loads with a specific timeframe of 35 μs.

5. Conclusion

The novel proposal and objective of this paper can be regarded as a new approach for scheduling bursts in OBS networks using wavelength allocation. In contrast to other contemporary models, the proposed model is a multi-objective dynamic wavelength scheduling strategy (DyWaS) that evaluates the wavelength's competence in relation to the burst to be scheduled using multiple quality metrics. The proposal's core competency is to achieve the lowest burst drop ratio possible under volatile burst sizes and timeframes, as demonstrated by an experimental study conducted in a simulation environment. Performance analysis was conducted using a variety of different performance statistics, and the proposed model was compared with other contemporary models. The performance metrics burst drop ratio, transmission channel utilization ratio, and time required for scheduling were used to evaluate performance. The proposed model DyWaS outperformed the contemporary models MSB-FVF and POCS-VF by 2.5% and 8%, respectively, in terms of burst drop ratio. When compared to MSB-VF, the model DyWaS required the least amount of processing time; however, when compared to POCS-VF, the model DyWaS required approximately the same amount of processing time. The proposal's results motivate us to extend further by utilizing the depicted metrics as fitness functions in evolutionary strategies to construct an end-to-end route with optimal wavelength allocation between source and destination via multiple nodes.

Data Availability

The processed data are available upon request from the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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