

Efficient Bandwidth Utilization in DOCS

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Abstract

Taking into consideration the significance of multi domain dynamic optical circuit switching (DOCS) over other optical switching technologies, we compare the potential viability of DOCS and other optical circuit switching technologies for multi domain traffic exchange thus showing an enhanced algorithm that can be used for efficient bandwidth utilization in DOCS. In this paper we make an effort to boost the use of DOCS in e-science technologies by utilizing bandwidth much more efficiently. Immediate request and scheduled request are the two features that our algorithm is covering.

Keywords: Multidomain DOCS, Bandwidth utilization on request priority, Immediate request, Scheduled request

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INTRODUCTION

Today, Internet is fairly considered as an imperative reserve of firsthand and most recent information for research organizations, industrial and academic researchers, governmental and non-governmental agencies and for SME's and large enterprises. In addition to that, Internet is also providing an influential role of communication and has thus become an exciting part of life. Internet is a network of thousands of independently administered networks known as Autonomous Systems (AS). These Autonomous Systems are owned and managed by organization such as telecom operators, Internet service providers etc. Exchange of traffic among autonomous systems is vital to the operational connectivity of the global Internet. It is therefore, interdomain traffic exchange play decisive role in the global Internet and thus plays a significant role in the decentralized global Internet, because the entire Internet, which is made up of AS's is interconnected.

From a simple means of communication among computers, the Internet, coupled with the uptake of broadband, has emerged as a fundamental part of modern society in most countries. New applications emerge everyday and some have become cultural icons, such as YouTube and Facebook. Its

hierarchy has been extended from international, national and campus networks to include networks for businesses, homes, cars, and individuals. The Internet has gone mobile, as devices on cellular networks have been enabled for the Internet Protocol (IP), already used by several millions of individuals and potentially several billions. On top of these networks and devices lies a vast array of applications for e-commerce, e-government, e-education and e-health, together comprising the Internet of Services (IOS). In order to fulfill these demands Optical network efficiency is under research for a long time. Efficient utilization of bandwidth is major area of concern.

Research Challenges in Dynamic Optical Circuit Switching:

As the same protocol has been used by optical layer that were used in IP layer so it has inherited that same problems (Fernandez 2009). Some are listed in table 1. Some more challenges that has been identified by (Mukherjee 2007) What architectural solutions should be developed to efficiently "groom" (i.e., pack, unpack, and switch at intermediate nodes) sub-wavelength granularity connections of diverse bandwidth (including IP flows, multi-protocol label switching (MPLS) tunnels, etc.) on to high-capacity wavelength channels in an optical

network? How can DOCS technologies be used to create Lambda Grids for various e-science and other applications?

S.No	IP layer	Optical Layer
1	Scalability	Scalability
2	Security	Security
3	Convergence	Convergence Properties
4	Number of messages (chattiness)	Number of messages (chattiness)
5	Location and ID separation	Interaction with Protection and Restoration
6	Expressiveness of routing policies	Expressiveness and enforcement of RWA policies
7	Traffic Engineering	Efficient Engineering of RWA

Applications like online video streaming, e-science and conferencing require that they must be allocated network resources within a particular duration, so in a way they carry info about their starting and ending time. Such requests that have a certain deadline for their completion are called Deadline Driven Requests (DDR).

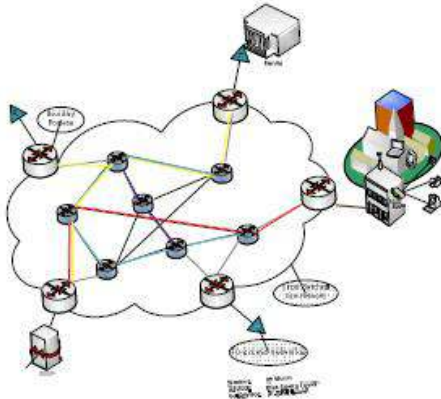


Figure 1: Dynamic optical circuit switched network

Sometimes applications like server Backup or video conferencing has information about the holding time of these requests, which can increase the efficiency of the network. Such requests differ from DDRs in a way that these requests have certain duration for which they need network resources but they do not have any fixed starting and ending time. These have been described as Holding Time Aware (HTA) Requests. In [4] some work has been done on provisioning of these requests with respect to shared path protection for resiliency purpose. They have proposed an algorithm for dynamic provisioning of shared-path-protected connections in WDM mesh networks. In advance reservation requests

we have the knowledge of requests in advance so major issue in this case is request scheduling. According to (Tornatore, 2008) Network requests with advance reservations can be divided into following three types: (i) *specified starting time and specified duration* (STSD), (ii) *specified starting time and unspecified duration* (STUD), (iii) and *unspecified starting time and specified duration* (UTSD). But we can see that there can be requests that do not have specific information about their *starting time and duration* such requests are called UTUD in [6]. DDR and HTA based architectures can be considered to be a special cases of the AR architecture.

The algorithms proposed so far in the literature utilize type of requests, routing policy and wavelength selection strategy as key components for provisioning requests in optical networks.

MULTICAST HOLDING TIME ALGORITHM:

Once it's decided what has to be done at each phase we can formulate our algorithm as follows:

Input: $R(s, d, A, B, h)$; Current network state.

Output: Path for R, NULL if no eligible solution is found.

Initialization: Construct the auxiliary graph G according to the initial network state.

1. Routing Phase:

When a connection request R arrives

1.1. Compute the shortest path p from the source to the destinations of R on graph G using DCSP, if path not found block the traffic demand; otherwise, continue with the following steps.

1.2. If p contains free wavelengths, set up light-paths using the wavelength selected in wave length selection phase.

1.3. Groom R along the pre-existing light-paths on p or setup a new light-path on path p.

2. Wavelength assignment phase:

2.1. If C_{req} free, p then provision C_{req} , update free capacities. Provisioning successful.

2.2. Wavelength index is selected using following relation:

$D_{link} = (CapacityFree * Link\ Popularity * Holding\ TimeResidual)$

$W_{select} = link, m \text{ where } m=0,1,2...$

Where CapacityFree is the available capacity on the link, link popularity is how many connections are provisioned on that link and residual holding time is the time remaining for which resources on that link will be used.

- 2.3. If capacity is not available on any single wavelength then proceed to following steps.
- 2.4. Search for the highest capacity available on the light-path and save index one.
- 2.5. Find another wavelength with $C_{find} = C_{req} - C_{found}$, if found reserve C_{found} on index one and C_{find} on index two, else block the request.

3. Update graph G as follows:

- 3.1. Update the capacity and cost of edges. For the light-paths carrying traffic R, capacities are decreased by the amount of the bandwidth demanded. Modify the cost of the edges of the auxiliary graph according to this rule:

$$\text{Costupdate} = (\text{BWreq} * \text{HTreq}) / (\text{BWreq} + \text{HTreq})$$

Whereas we have used normalized values of the required (req) bandwidth (BW) and holding time (HT).

- 3.2. Update the popularity of each link that occurs in the path p from s to d.

4. When a connection terminates:

- 4.1. Remove the traffic from the network.
- 4.2. Update G by applying the reverse of steps defined in above section

Existing Bandwidth Allocation Algorithm for DOCS

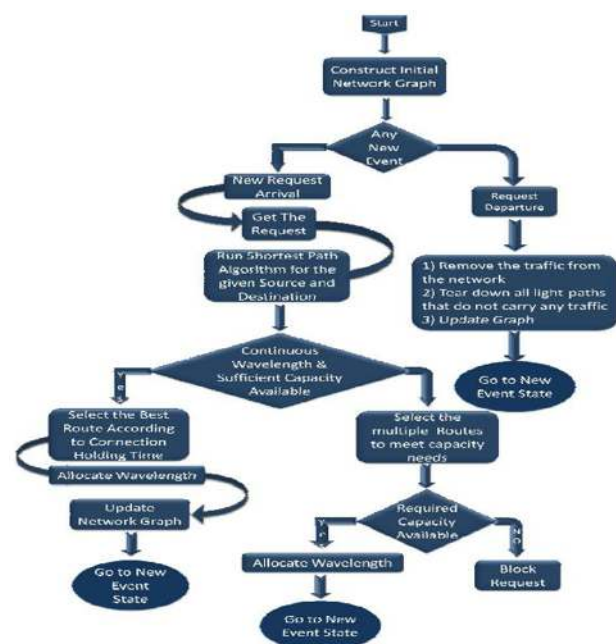


Figure 2: Existing Bandwidth Allocation Algorithm Flow

According to some algorithms for multicast requests provisioning by considering the special case of *specified starting time and specified duration* STSD requests. We have used existing DCSP algorithm for routing purpose and defined our own wavelength selection and links cost update expressions. After comparison of our algorithm performance in terms of call blocking and bandwidth blocking for on demand and advance reservation scenarios, we observe that advance reservation is better in performance than on demand. However, there is a major drawback in this method that is, the author has just dealt with advance reservation, which is not dealing with scheduled requests.

Proposed Scheme

We had incorporated two features in our algorithm one is immediate request and another one is scheduled request, how to allocate bandwidth to these two cases.

Immediate Request: is that which needed to be fulfilled on the same time.

Scheduled Request: scheduled request is the one which can be fulfilled when it is scheduled, but DDR must be defined for it.

The basic flow of our algorithm is as follows it is dealing with two types of request which are really needed in DOCS, IR and SR. so it is named as Dynamic optical Circuit Switching for Immediate and Scheduled Request (DOCS-ISR).

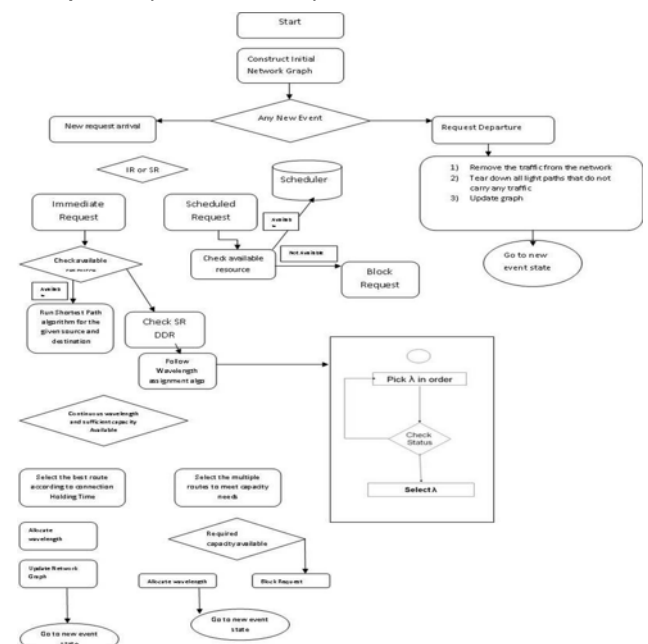


Figure 3: Flow of Algorithm for DOCS-ISR

As e-science, webinars and conferences demand for scheduled request but there is no such mechanism to cop with that request this algorithm will be catering with immediate and on demand requests.

Pseudo Code

1. Start
2. Construct initial tree graph. (ST)
3. Check if there is new request then go to (4) else (17)
4. Check the request is IR or SR
5. If request is IR go to (6) else (20)
6. Check availability of recourses. If available go to (7) else (18)
7. Run shortest path algorithm from source to destination.
8. Check if sufficient capacity is available if yes then go to (9) else (13).
9. Select the best route according to connection holding time.
10. Allocate wavelength.
11. Update network group.
12. Go to new event.
13. Select multiple routes to meet capacity need.
14. Check request capacity if yes (15) else (16). Block request
15. Go to new event
16. Check Scheduled request Dead Line Driven Request (DDR) (if the current DDR can be accommodated before that utilizing that)
17. Follow wavelength according to algorithm
18. [First Fit , Best Fit]
19. Check if the request is schedule check available resources if available (21) else (22).
20. Check the schedule (which will check if the request can be accommodated by comparing DDR)
21. Block request
22. Request Departure
23. Remove traffic from all request
24. Tear Done all light paths that do not carry any traffic
25. Update graph
26. Go to new event state
27. End

RESULTS AND DISCUSSION

The DOCS-ISR (Proposed algorithm) is ideal in a situation when you need to fulfill immediate and scheduled requests. Previously all algorithms were just dealing with immediate requests.

CONCLUSION

In this paper we discussed various algorithms for the utilization of the bandwidth in DOCS. We highlighted the pros and cons of various algorithms. We also showed our proposed algorithm and showed that the proposed scheme has achieved a significant improvement as compared to the approaches existing in the literature.

Algorithm name	Support for IR	Support for SR	Support for DDR
Previous Algorithm[8]	Yes	No	Yes
Proposed Algorithm	Yes	Yes	Yes

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