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Comparison of Routing Techniques in Optical Network: A Survey

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Abstract

We consider large optical networks in which nodes employ incorporate user-specific conditions when traverse the search path. The problem of routing is critically important for increasing the efficiency of all optical networks. Routing techniques are used to allow the optical network to be completely self organizing and self configuring. In this paper several routing techniques have been considered which are used in wired and as well as wireless networks. These routing techniques are Adaptive Alternate Routing, Dynamic Routing, Ad-Hoc On-Demand Distance vector (AODV) Routing, Destination sequenced distance vector (DSDV) routing protocol, Dynamic Source Routing (DSR). We also highlight the advantages and performance issues of each routing technique. Performance metrices are used such as packet delivery ratio, routing overhead etc.

Keywords: Optical Network; Routing; Overhead.

1. Introduction

Optical network is a key technology in a communication network and a very quickly developing new area of research. The important applications include high speed supercomputing, scientific visualization, real time medical imaging video conferencing [20]. All optical networks must be fault tolerant order to avoid services interruptions. To deployed the ever increasing bandwidth demand of network users and applications wavelength-division multiplexing (WDM) optical networks has been considered the most suitable and reliable technology. Network survivability is an important requirement for any optical networks due to their ultra-high capacity. Network survivability means network's ability to continue functioning correctly in the presence of failures of any network components [19]. So the survivability of a network becomes the challenging issue in optical network. Also the routing in wireless and wired networks has been an active area of research for many years. Routing is the process of selecting best path in network and it is performed for many kinds of networks including Telephone networks, Electronics data networks and transportation networks. Routing techniques are constantly being improved in order to handle the constant changes in the traffic, link bandwidth, and the required quality of service in today's Internet [21]. The network simulator 2 (NS2) is an object-oriented simulator and provides substantial support for simulation of TCP, routing, multicast protocols over wired and wireless (local and satellite) networks, etc. The simulator is event-driven and runs in a non-real time

fashion [15,22]. The various performances metrics like average delay, packet delivery ratio and routing overhead etc are analyzed in literature survey to calculate the effective routing techniques.

2. Literature Review

Nirmala L Devi1 et al. [1], studied the reduction of blocking probability using alternate path routing and wavelength converter in protected optical network. To increase reliability of protection, have proposed shared protection against failures required to establish all the connections present in shared protection network. In SP networks blocking probability is reduced than the DPP network, placing three wavelength converters at the same position.

A.V. S. Xavier et al. [2] has proposed an adaptive-alternative routing algorithm for all-optical networks, named NrPSR. The algorithm finds the Nr routes with minor cost for a given source-destination pair according to a cost function expanded in a power series (PSR) in which the coefficients are determined by a Particle Swarm Optimizer.

Franco Callegati et al. [3] investigated an overview of routing techniques that may be adopted in an optical packet-switched backbone is presented, showing the effects of adaptive multi-path routing strategies on the network performance. Furthermore, performance differentiation based on different routing and contention resolution strategies is proposed and analyzed in a simple QoS-aware scenario

M. R. I Mat Jusoh et al. [4] have studied that two fundamental things first is routing techniques for optical network planning and optimization and second is routing issues and problems in static, incremental and dynamics. Also compared the characterstics of different routing on their performance analysis.

Rodrigo C. Frietas et al. [5] has proposed two strategies to increase the link or subpath restoration and found the subpath restoration is better than link when compared the both. The performance of three different restoration schemes for all-optical networks (link, subpath and path) upon a single link failure considering physical layer impairments also compared.

S. Suryanarayana et al. [6] presented an adaptive methodology towards developing routing scheme in optical network based on queue based mechanism at wavelength router for comparatively higher quality of services. In optical network the data are transmitted from various nodes to reach the destination through optical router. These offer heavy traffic congestion due to non-linear traffics resulting in degraded quality services.

Kungmeng Lo et al.[7] investigate a class of adaptive routing called Dynamic Wavelength Routing (DWR), in which wavelength converters (WCs) are not utilized in the network. The objective is to maximize the wavelength utilization and reduces the blocking probability in an arbitrary network. Two sub-algorithms are also considered Least Congestion with Least Nodal-degree Routing algorithm (LCLNR) and Dynamic Two-end Wavelength Routing algorithm (DTWR).

Raman kumar et al. [8] presented a restorable routing algorithm that reduces blocking probability and compares the proposed work with the conventional algorithms. He also considered quick and efficient heuristic for restorable routing. A low-complexity mathematical model has been developed which is used for the calculation of the blocking probability of network and this model does not require any simulation statistics.

Wilson Ramirez et al. [9] has proposed a promising routing scheme Hybrid Prediction-based Routing (HPBR). HPBR combines prediction strategies with a novel method to select the most suitable routing metric, aiming at reducing both the dissemination of network state information and the blocking probability. He proposed scheme significantly reduces the blocking probability compared with other routing schemes, while avoiding the need to periodically disseminate network state information

Carmelo J.A. Bastos Filho et al. [10] has analyzed the performance of an impairment aware routing algorithm (IA-RWA) for all optical network. He considered two metrices physical distance and the wavelength availability that is based on the Ant colony optimization technique (ACO). Two approaches is also analyzed for ACO and compared the performances to classical RWA algorithms in terms of blocking probability.

David B. Johnson et al. [11] the two mechanisms of Route Discovery and Route Maintenance, which allow nodes to discover and maintain *source routes* to arbitrary destinations in the ad hoc network. The Dynamic Source Routing protocol (DSR) provides excellent performance for routing in multi-hop wireless ad hoc networks. DSR has very low routing overhead and is able to correctly deliver almost all originated data packets, even with continuous, rapid motion of all nodes in the network.

Hiroaki Harai et al. [12] have proposed a new class of alternate routing method in all–optical switching networks.It is shown that Alternate routing method can improve overall blocking probability as well as fairness among connections with different numbers of hop counts. In all–optical switching networks, the connection
with more hops encounters more call blocking, so alternate routing has been introduced with limited trunk reservation. He also investigated dynamic routing method showing that the dynamic routing method is efficient when traffic load is low or many wavelengths are prepared on the link.

Elizabeth M. Royer [13] provides descriptions of several routing schemes proposed for ad hoc mobile networks with a classification of these schemes according to the routing strategy (i.e., table-driven and on-demand. He has presented a comparison of these two categories of routing protocols, highlighting their features, differences, and characteristics. Finally applications and challenges facing ad hoc mobile wireless networks has been identified.

Charles E. Perkins [14] has compared the performance of DSR and AODV, two prominent on-demand routing protocols for ad hoc networks. Both DSR and AODV use on-demand route discovery, but with different routing mechanics. DSR uses source routing and route caches, and does not depend on any periodic or timer-based activities. AODV, on the other hand, uses routing tables, one route per destination, and destination sequence numbers, a mechanism to prevent loops and to determine freshness of routes. The performance differentials are analyzed using varying network load, mobility, and network size.

Yinfei Pan [15] has made the use of NS2 easy and fast do the work of network post simulation and more practical. This paper also tells the performance evaluation method on the comparison of two on-demand source routing protocols AODV and DSR. These protocols were designed for reducing the routing loading in networks. It also shows DSR is somewhat suitable for sensor work applications.

Jamal N. Al-Karaki, [16] has presented the routing techniques in wireless sensor network.. The routing techniques are classified based on the network structure into three categories: flat, hierarchical, and location-based routing protocols. Furthermore, these protocols are classified into multipath-based, query-based, negotiation-based, and QoS-based routing techniques depending

on protocol operation. He also highlight the design trade-offs between energy and communication overhead savings in some of the routing paradigm, as well as the advantages and disadvantages of each routing technique.

Dhritiman Banerjee et al. [17] proposed a practical approach to solve routing and wavelength assignment (RWA) of light paths in large optical networks. A large RWA problem is partitioned into several smaller sub problems, each of which may be solved independently and efficiently using well-known approximation techniques. The objective was to minimize the number of wavelengths needed, given a set of light path requests. The problem was studied for the static case (where all light path requests are available in advance) as well as the dynamic case (where light path requests arrive and need to be established one by one).

Josh Broch et al. [18] contributed in two areas firstly provides an accurate simulation of the MAC and physical layer behavior using modifications to the *ns* network simulator. This new simulation environment provides a powerful tool for evaluating ad hoc networking protocols and other wireless protocols and applications. Second, using this simulation environment, we present the results of a detailed packet-level simulation comparing four recent multi-hop wireless ad hoc network routing protocols. These protocols, DSDV, TORA, DSR, and AODV, cover a range of design choices, including periodic advertisements vs. on demand route discovery.

3. Discussion and Analysis

In today era, Routing in wireless and wired networks has been an active area of research for many years. The selection of routing techniques is based on geographical position on packet's destination, network parameters, routes, nodes etc. Table 1 shows comparison of routing techniques which is used in this survey paper for wireless and wired network and estimates the better performance over one another.

Table1: comparison of Routing Techniques

Paper	Routing techniques/ Protocol	Comparison parameters	Results
Design Routing Protocol Performance Comparison in NS2:AODV comparing to DSR as Example [15]	AODV and DSR	Packet delivery ratio, average delay, routing overhead	DSR is better in sensor networking. For packets delivery rate and delay, DSR should be better than AODV.
Performance of Alternate Routing Methods in All Optical switching Networks [12]	Dynamic routing and alternate routing technique	Blocking probability with random policy and blocking probability with first-fit policy	Alternate routing improves the blocking probability and fairness among connection and as the wavelength is limited so it is better than dynamic routing in terms of limited wavelength
An Hybrid Prediction-based Routing	Hybrid Prediction-based	Blocking probability and scattering of	HPBR performs the better performance in

Approach for Reducing Routing Inaccuracy in Optical Transport Networks [9]	Routing	network state information	terms of blocking probability as it not affected by update period than other prediction routings.
Dynamic Routing Scheme in all optical network using resource Adaptive Routing Scheme [6]	Resource adaptive routing, Dynamic routing scheme,	Throughput Overhead	By applying queuing model route overhead is less in Resource adaptive routing and also throughput is less when compared to dynamic routing
A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks [13]	AODV, DSR TORA	Route metric, routes table, Multiple route possibilities	AODV follows the fresest and shortest path while DSR and TORA follows shortest path. DSR having routes in route cache while others have route table.
A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols [18]	DSR, DSDV, AODV	Packet delivery ratio, routing overhead	AODV offers 100% packet delivered than DSR And AODV. AODV requires 5% higher overhead than others.
Routing Techniques in Optical Packet-Switched Networks.[3]	Adaptive routing	Packet loss rate	Adaptive routing is better to show less packet loss when a failure occurs

4. Conclusion

The successful comparison of routing techniques shows that our performance evaluation is very effective for optical network. It can also be used for measuring the network routing protocols performance. Overall in this survey paper some of routing techniques like AODV, DSR, and DSDV has been discussed. A key reason of this paper is to calculate the network performance metrices like packet delivery ratio, routing overhead, blocking probability etc which selects the best routing technique over one another.

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