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A Survey on Dynamic Path Restoration techniques In Mesh Networks

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ABSTRACT

Mesh is a network topology in which devices are connected with many redundant interconnections between network nodes. In a true mesh topology every node has a connection to every other node in the network. We present the investigations on mesh networks and its types. The optical mesh networks are upcoming topology in Now a day's simulations are available to all network topology even mesh also. We considering the mesh with dynamic mechanisms in path restorations. And also shows the IP restorations.

Key words: mesh networks, dynamic path , restoration, optical mesh,

I. INTRODUCTION

There are two types of mesh topologies: full mesh and partial mesh. Full mesh topology occurs when every node has a circuit connecting it to every other node in a network. Full mesh is very expensive to implement but yields the greatest amount of redundancy, so in the event that one of those nodes fails, network traffic can be directed to any of the other nodes. Full mesh is usually reserved for backbone networks.

Partial mesh topology is less expensive to implement and yields less redundancy than full mesh topology. With partial mesh, some nodes are organized in a full mesh scheme but others are only connected to one or two in the network. Partial mesh topology is commonly found in peripheral networks connected to a full meshed backbone. The concept of a mesh network architecture is being adopted increasingly in the field in the development and Deployment of new networks or in the replacement, migration, or evolution of existing networks. In a generic mesh network, a set of nodes is interconnected with links following an arbitrary topology. The routes of end-to-end "paths" (i.e., end-to-end physical or virtual circuits) over the links can be arbitrary. The routes of backup or protection paths can also be arbitrary and even be generated dynamically. This generality is in contrast to traditional network architectures that are typically more rigid in form with fault tolerance provided using, for example, rings, extra dedicated protection links, or pre established protection connections. Advantages of mesh networking include the enabling of more general routing schemes, more flexible traffic engineering, simplification of network operations and management functions, more cost-effective use of redundant network capacity, the enabling of more general self-configuration and self-healing mechanisms, and potentially higher levels of service availability. The mesh networking concept is also general in scope, so it can be applied physically in different physical parts of networks as well as logically in different logical layers.

Mesh networking (topology) is a type of networking where each node must not only capture and disseminate its own data, but also serve as a *relay*for other nodes, that is, it must collaborate to propagate the data in the network.

A mesh network can be designed using a *flooding* technique or a *routing* technique. When using a routing technique, the message is propagated along a path, by *hopping* from node to node until the destination is reached. To ensure all its paths' availability, a routing network must allow for continuous connections and reconfiguration around broken or blocked paths, using *self-healing* algorithms. A mesh network whose nodes are all connected to each other is a fully connected network. Mesh networks can be seen as one type of ad hoc network. Mobile ad hoc networks (MANET) and mesh networks are therefore closely related, but MANET also have to deal with the problems introduced by the mobility of the nodes.

The self-healing capability enables a routing based network to operate when one node breaks down or a connection goes bad. As a result, the network is typically quite reliable, as there is often more than one path between a source and a destination in the network. Although mostly used in wireless situations, this concept is also applicable to wired networks and software interaction.

Advantages

- Point to point line configuration makes identification and isolation of faults easy.
- Messages travel through a dedicated line meaning that only the intended recipient receives the message: privacy and security is thus ensured,
- In the case of a fault in one link, only the communication between the two devices sharing the link is affected.
- The use of dedicated links ensures that each connection carries its own data load thus ridding of traffic problems that would have been encountered if a connection/link was shared.

Disadvantages

- If the network covers a great area, huge investments may be required due to the amount of cabling and ports required for input and output devices. It is a rare choice of a network connection due to the costs involved.

Optical mesh networks are a type of telecommunications network.

Transport networks, the underlying optical fiber-based layer of telecommunications networks, have evolved from DCS (Digital Cross-connect Systems)-based mesh architectures in the 1980s, to SONET/SDH (Synchronous Optical Networking/Synchronous Digital Hierarchy) ring architectures in the 1990s. Technological advancements in optical transport equipment in the first decade of the 21st century, along with continuous deployment of DWDM systems, have led telecommunications service providers to replace their SONET ring architectures by mesh-based architectures. The new optical mesh networks support the same fast recovery previously available in ring networks while achieving better capacity efficiency and resulting in lower capital cost.

Optical mesh networks today not only provide trunking capacity to higher-layer networks, such as inter-router or inter-switch connectivity in an IP, MPLS, or Ethernet-centric infrastructure, but also support efficient routing and fast failure recovery of high-bandwidth services. This was made possible by the emergence of optical network elements that have the intelligence required to automatically control certain network functions, such as fault recovery.

Optical mesh networks enable Quality-of-Service protection and a variety of dynamic services such as bandwidth-on-demand, Just-In-Time bandwidth, bandwidth scheduling, bandwidth brokering, and optical virtual private networks that open up new opportunities for service providers and their customers alike.

II. IP RESTORATION:

Assumptions:

1) Fiber failure is detected by the destination nodes of all failed lightpaths.WDM hardware is tightly coupled with IP layer . Thus the time to detect a fiber failure is dominated by the time it takes for the service interrupt. F=10 ms.

2) The destination nodes of all the failed lightpaths broadcast link-state update message over the network.

3) The routing tables stabilize after all the nodes in the network receive all the link-state update messages.

4) Transmission time for the link-state update messages can be neglected in comparison to the propagation delay.

5) The processing time for the link state update messages is dominated by the time it tales to run the broadcast algorithm. D=1 ms.

6) The propagation delay on a fiber P=400 µs.

7) R: The time required to recompute the routing table at a node. R=200 ms.(representative of the time for recomputing the routing tables of the IP routers.

8) h_d: The number of hops from the failed fiber to the destination node of the failed lightpath.

9) n: The number of hops from the destination node of the failed lightpath to the most distant node in the network.

Total Time for IP Restoration:

F + hd x P + n x P + (n + 1) x D + R

III. DYNAMIC PATH RESTORATION

The failure of a particular link results in the failure of all circuits that use the link. The failure of a circuit can lead to the possible failure of a path. When a path experiences a circuit failure, the dynamic mesh network will attempt to reroute the affected path over circuits that are operational. The process of rerouting a failed path in response to a failed circuit is called *dynamic path restoration*. The type of restoration method assumed here is quite general. It may be one that finds the next shortest route in terms of working circuits, subject to the prevailing circuit bandwidth constraints. It may be one that finds a route that maximizes the minimum remaining capacity over all working circuits in the network. The restoration method could also reroute some or all paths in the network ("network repacking") to maximize some objective function. The method could also reroute paths in response to the completion of link repairs. The dynamics of the path restoration algorithm are defined generally as follows. Let the state of the bandwidth of the circuits at time be defined by the vector . As already defined, the path routing matrix at time is given by . Now, suppose that at time there is a link failure or repair event that causes the new state of the circuits to become . The general function of the path restoration algorithm is then to determine a new path routing matrix based on , subject to the circuit bandwidth state , i.e., . If a path is affected by a failure event and the path cannot be rerouted, then is set to 0, and the path routing matrix entries for path become irrelevant. It is to be noted that the routes of rerouted paths can depend upon the previously realized ordered sequence of link failure and repair events. When all links return back to an operational state, the path routing matrix could be different from . However, we assume in the formulation developed here that the dynamic path restoration method is such that all paths return to their initial routes once all links become operational, i.e., if , then . This reflects what may be seen typically, though not necessarily, in practice since there are usually some established desired routes under normal operating conditions. It is also to be noted that, in the above defined path restoration dynamics, we do not account for the time that paths may not be operational while the path restoration algorithm is finding new path routes to use. However, this rerouting time is, in practice, typically orders of magnitude smaller than the time to repair links (e.g., cable cuts), and therefore, the main contribution to path unavailability is the time to repair physical links themselves. Today's optical mesh networks can have restoration times of the order of seconds or less [1]. The average repair time of cable cuts is, in practice, typically of the order of several hours.

IV. Design considerations

1. Choice of objective function: The objective function determines what is to be optimized by the algorithm. One of the possibilities is to minimize the sum of costs of the working and protection paths allocated for the incoming request [7]. The objective function might also be a weighted sum of factors working and backup path bandwidth consumption [9].

The cost of a link may be defined in different ways. It might just be a hop count, or might include other factors like length of the link [6], available bandwidth, sharing of backup link, or whether the link lies on or straddles a cycle (in the case of p-cycle based algorithms).

2. Restorability: Restorability refers to the percentage of failures for which backup paths can be found. As a significant amount of resources are being invested in the protection scheme, it is generally expected that 100% restorability is provided.

3. Wavelength conversion: Wavelength converters are used to switch data from one wavelength to another. However, they are very expensive and hence it is often impractical to place wavelength converters at all the nodes.

4. Centralized/distributed: We may either have a central server that coordinates the request admission control and Routing and Wavelength Assignment (RWA) of incoming requests, or run a distributed algorithm at each of the nodes that handles requests independently. Distributed control is more scalable a centralized approach, but it may be more complicated as all nodes need to aware of the entire network state. This could be achieved by flooding Link State Updates on the network [13].

5. RWA: Routing and wavelength assignment may be done jointly or sequentially. In the case of joint RWA, routing and wavelength assignment may be formulated as a single ILP. Another approach is to do the routing first, and then reserve a wavelength on each link over which the connection is routed. Different strategies for wavelength assignment such as first fit and first fit in descending order of wavelength might be used.

6. Type of failure: Failures may occur at nodes or at links. Link failures are much more common than node failures for two reasons. Links are more exposed and prone to damage as it is difficult to protect the entire length of fiber which may span thousands of miles. Secondly, node failures may be transparently restored by node redundancy. On the other hand, complete link redundancy using a mechanism like 1+1 APS is not feasible. Even if there is link redundancy, the links will need to be routed over different conduits to avoid the backhoe effect.

7. Number of failures: Protection may be provisioned for a single failure or groups of nodes that in the same Shared Risk Link Group (SRLG). The single failure assumption may be justified because the probability of failure is so low that no more than one failure is expected to occur at the same time with high probability. However, when different fibers are routed over the same geographic path, they may be susceptible to simultaneous failures. Nodes that are likely to fail together are grouped together into SRLG's. The backup paths of working paths that belong to the same SRLG are not shared.

V. EXISTING SYSTEM:

1. The concept of mesh network architecture is being adopted increasingly in the field in the development and deployment of new networks or in the replacement, migration, or evolution of existing networks.

2. Existing link sharing between a primary path and backup path(s) in order to achieve better capacity utilization, a connection can share some highly reliable links in common among its primary and backup paths.

3. Multiple backup paths are provided to an availability-stringent connection, compared to the traditional scheme which may have to block some high-availability connections.

VI. PROPOSED SYSTEM:

We consider the general problem of analyzing path availability in mesh networks with dynamic path restoration, where failover paths are determined dynamically, “on the fly,” by an algorithm in real-time based on the current state of the network. In this general problem, the size of the state-space and the structural complexity of the system generally preclude the use of analytical modeling techniques. Direct simulation can also be very challenging, or even impractical, when the sets of network element failure events that lead to loss of end-to-end path service occur very rarely.

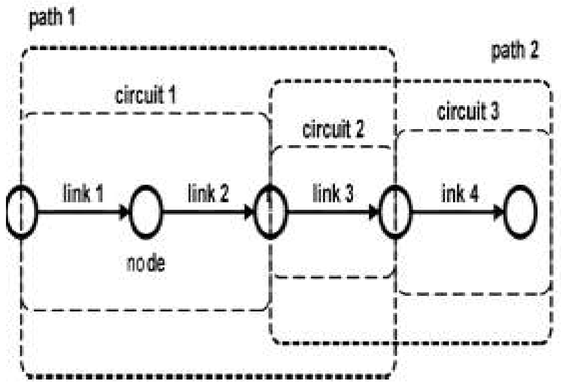

Fig. 1. Model structure in terms of nodes, links, circuits, and paths.

We develop a fast efficient Markov Monte Carlo simulation technique for the analysis of service availability in a general mesh network model with a general dynamic path restoration method. In the model, it is assumed that there is a given set of initial end-to-end paths that carry end-to-end traffic demands.

One or more network element failures, the affected paths are rerouted dynamically by a given rerouting algorithm that generates alternate routes to use. As element repairs are made and the initial routes become available again for use, the rerouted paths may revert to their respective original routes.

The model also uses the concept of a "*failure equivalence group*" (FEG), consisting of failure event sources and pools of repair personnel, to account for multiple in-series link cuts, optical amplifier failures along each link, as well as bidirectional link failures, node failures, or more general geographically distributed failure scenarios.

The DPFS simulation technique developed here is a practical and effective method for estimating service availability in mesh networks with dynamic path restoration. It enables one to obtain useful confidence interval widths on path service availabilities in reasonable simulation run times. The developed failure and repair modeling with FEG is sufficiently general so that it can be used to faithfully represent many of the types of failure and repair mechanisms that appear in practice.

VII. CONCLUSITION

We present the collected information of mesh networks with all considerations. The method for estimating service availability in mesh networks with dynamic path restoration. The assumed path restoration algorithm is sufficiently general to accommodate almost any algorithm, at least ones that return paths to their initial paths once all element repairs have been made. There are several directions in which the present work can be extended. The formulation of the simulation could be recast in terms of independent replications to accommodate restoration algorithms that do not necessarily return paths to their initial paths.

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