An Overview of Load Balanced IP Routing in Communication Network

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ABSTRACT
Load Balancing is partitioning the quantity of traffic load that a router needs to do between two or additional terminals so additional quantity of load gets wiped out a similar amount. Load Balancing is the process of redistributing the work load among nodes of the distributed system to improve resource utilization and job response time and also avoiding a situation where some nodes are heavily loaded while others are idle or doing some work[1][2][3]. Therefore, all users get served quicker. This paper provides an overview of such load balanced routing protocols. It provides comparative study of all the protocols like OSPF, S-OSPF, MPLS and TPR for IP Routing and choose for the best based on some of the important factors like congestion control, shortest path, packet loss etc.

General Terms
Load Balancing and Routing Protocols.

Keywords
OSPF, S-OSPF, MPLS, TPR, Congestion, Load Balancing.

1. INTRODUCTION
On the Internet, companies whose Websites get a good deal of traffic typically use load balancing. Our main aim is to balance the load and send the load through shortest path using one of the best protocols. Load Balancing is dividing quantity of load that a laptop needs to do between two or additional computers so additional quantity of load gets wiped out a similar amount of your time and, in general, all users get served quicker. It enhances the availability and scalability of server applications [1][2].

Modern extremely loaded traffic websites ought to serve many thousands , if not millions, of synchronous requests from users and come back the right text, images, video or application knowledge during a quick and reliable manner. Load Balancing acts because the "traffic cop" before the servers and routing client requests across all servers to meet those requests in some way that maximizes speed and capability utilization and certify that none of the server is overladen, which may reduce the performance. If a one server is down, the load balancer directs traffic to the remainder of the on-line servers. If in case a new servers is additional to the network the load balanced automatically sends requests to it.

In this manner, a load balanced performs the following functions:

1. Distributes client requests or network load efficiently across multiple servers.
2. Makes certain high handiness and responsibility by causing requests solely to servers that are on-line.
3. Provides the flexibleness to feature or take off servers as demand dictates.

2. OVERVIEW OF LOAD BALANCED IP ROUTING ALGORITHMS
All the algorithms provide different benefits; the choice of load balancing algorithms depends on our need and Load Balancing Algorithms are designed by using following criteria consideration.

1. Round Robin
   Requests are distributed across the cluster of servers in order.
2. Least connections
   A new request is shipped to the server with fewest current connections to client. The relative capacity of every server is factored into deciding that which one has the least connections.
3. IP Hash
   The IP address of the consumer is employed to work out that server receives the request.

Further we have studied various routing protocols as mentioned earlier. OSPF works on the link state routing based on Dijkstra's Algorithm. It helps in finding out the best shortest path available throughout the networks with low cost. S-OSPF stands for Smart OSPF and is the extension of OSPF having the same concept but works with more flexibility[4]. MPLS stands for Multi-protocol Label Switching. The main concept of it is to label the packets and further transfer it to the destined node[1][5][7]. TPR stands for two phase Routing protocol which is having two phase and mainly having LSP tunnels while transferring of traffic[6][11][12].

2.1 The Routing Algorithms
2.1.1 OSPF
OSPF stands for Open shortest path first. OSPF is a routing protocol[8]. It works on link state routing protocol. OSPF is a dynamic routing protocol that specifies however routers communicate with one another. OSPF works on a big network because there is no limitation of the amount of cops within the network. In OSPF, traffic is forwarded on and split equally between equal cost shortest paths.

A. Working
OSPF works on link state routing protocol. In link state protocol the links are the interface on the router whereas the state is however it relates to its neighbors, which might include its address and network information. There are some terminologies we should be known before going further:

- **Link State Advertisements (LSA)**: It simply provides an update on a router's link status, so that data will be sent when link is connected, disconnected or otherwise changed.

- **Topological Database**: Router maintains a table in its memory that contains all the links information about all known routers.
- **SPF algorithm**: In SPF algorithm it uses Dijkstra's algorithm to find out the shortest path to destination.
- **SPF tree**: It provides a list of all the routes to any destination with an order of preference.

Every router that has been organized for an OSPF area sends out a Link State Advertisements (LSA) at regular intervals. All of this link state data is stored in a topological database, after which an SPF rule is applied to the data in the database. This methodology generates an SPF tree listing all of the routes to any destination with an order of preference. The preferred order is then kept within the table, giving the router the best routing available paths. The process is illustrated in following figure 2.1.1(a)

Routers in exchange link –state data start the process.

Every router stores the link-state information into the routers table.

The Router processes all information within the topology table and makes use of the Dijkstra's rule to work out all routes to any or all networks, likewise because the least-cost routes. All this data is stored in the SPF tree with preferred sequence. The routing information is propagated to the routing table.

OSPF uses link state routing protocol which works on Dijkstra's algorithm which is a shortest path routing algorithm. By using OSPF as a routing protocol in IP networks packets are been send through the shortest path with respect to some parameters. The parameters with protocol is concerned with are links available between the source and destined nodes, congestion ratio, and updation in topology database. On basis of all this it chooses for the best shortest path available and sends packet to the destination

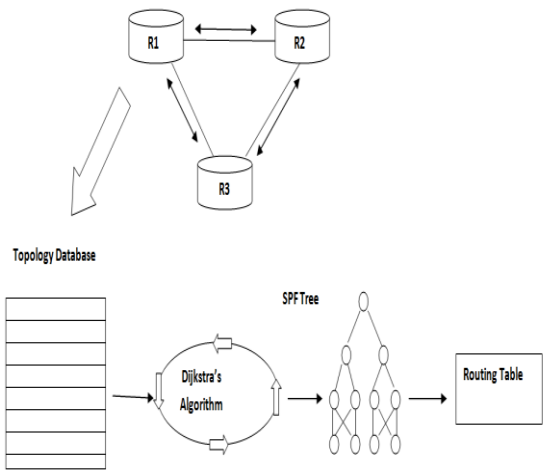


FIG 2.1.1 (a) OSPF Protocol

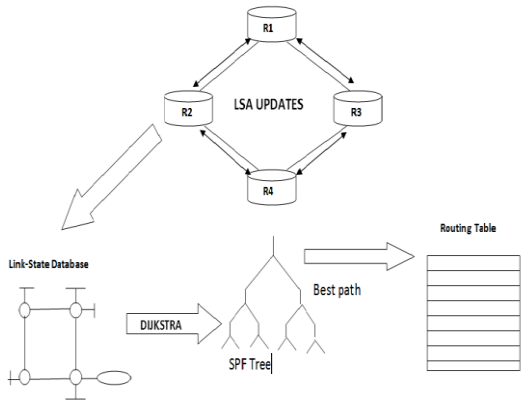


FIG 2.1.1 (b): Working of OSPF Protocol

B. Summary

PARAMETER 1: Shortest Path

It goes for the shortest paths whatever are available for that path.

PARAMETER 2: Maintain database

OSPF maintains a database which gives information about all the links that are available into the network. It updates the table as soon as changes occurs.

Protocol 3: Congestion control

It controls the congestion but not to a very great extent. Some more protocols are being found to overcome and increase the congestion control

2.1.2 S-OSPF

Open Shortest Path First (OSPF) is one among the foremost wide used intra-domain routing protocol[1][4]. It's documented that OSPF protocol doesn't offer flexibility in terms of packet forwarding to attain any network optimization objective because of the high value of network assets and industrial and competitive nature of net service provisioning, service suppliers have an interest in performance improvement of their networks. This helps in reducing congestion hot-spots and rising resource utilization across the network, which, in turn, ends up in Associate in Nursing multiplied revenue assortment. A technique of achieving this is often through Traffic Engineering presently traffic engineering is usually done by mistreatment MPLS.

However bequest networks running OSPF would wish to be upgraded to MPLS to attain higher resource utilization while not upgrading OSPF network to MPLS may be a challenge during this paper we tend to gift a straightforward however effective rule, referred to as sensible OSPF (S-OSPF) to produce traffic engineering resolution in Associate in Nursing OSPF primarily based best effort network we tend to formulate Associate in Nursing optimisation downside supported the traffic demand to reduce the utmost link utilization within the network. Routing of the traffic demand is achieved mistreatment OSPF we've got simulated S-OSPF on real networks of 2 service suppliers. Simulation results show that S- OSPF primarily based traffic engineering resolution performance terribly closely follows the best resolution. Only sender edge nodes distribute traffic to the neighbour nodes, as shown in Fig 2.1.2(a), with optimum

ratios that are obtained by implementing a Linear Programming (LP) problem. After the traffic reaches the neighbour nodes, it is routed according the OSPF protocol. The scheme is termed as the Smart OSPF scheme (S-OSPF)[1][4]. In S-OSPF, the source node distributes IP packets only to the neighbour nodes.

A. Working:

Smart-OSPF (S-OSPF) is associate degree extended theme from OSP this is often that every edge nodes distribute traffic by causing to some neighbour nodes. Alternative intermediate nodes adapt OSPF rules to send knowledge. S-OSPF can transfer knowledge by gathering those distributed traffic at destination node with decreased whole network congestion quantitative relation to reduce whole network congestion quantitative relation, we must always calculate and confirm however many quantitative relation ought to send every neighbour nodes on the network topology. It makes less congestion quantitative relation than usual OSPF on simulation. Wide existing networks, however, don't have enough house to implement those schemes by user as a result of routers functions area unit confirm beforehand by vendors. If you need new routing function, you need to wait to unharness from some vendors. Those reason cause to arduous realizing perform of S-OSPF on existing networks. Consequently, we tend to focus for SDN and Open Flow. SDN is that the one conception of networking construction. SDN evolved from work done at UC Berkeley and Stanford around 2008. This enables network-administrators to manage network services through abstraction of lower level practicality. This concept separates network to data-plane and control-plane knowledge plane transfer some knowledge, and control plane manage those data-plane systems. This makes easier to construct versatile networks by administrator.

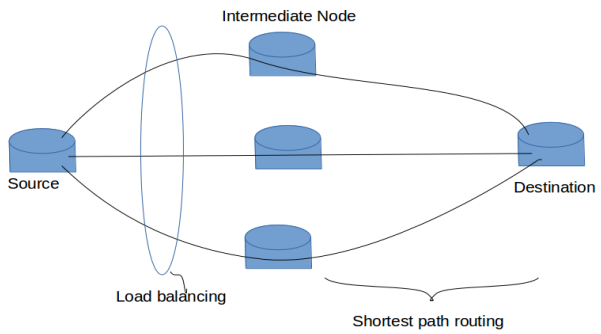


FIG 2.1.2 (a): Smart OSPF

B. Summary

Parameter 1: Reduce Congestion

Using S-OSPF results indicate that the network congestion ratios with the traffic matrix are lower than those with the hose model and as OSPF is doesn't offer flexibility in terms of packet forwarding we use smart OSPF.

2.1.3 MPLS

MPLS stands for Multi-protocol Label Switching. The main aim of MPLS is labeling of packets[1][5][7][10]. In an exceedingly ancient routed informatics network, every router makes AN freelance forwarding call for every packet primarily based entirely on the packet's network-layer header. MPLS also has the capability to handle traffic tunnel by minimizing congestion and making use of all available bandwidth with an efficient manner. MPLS allows maximum packet to be forwarded at switching layer rather than routing level. As soon as the packets enter into the network or service provider each packet gets labeled by the ingress (entrance) router. All the intermediate routers perform packet forwarding based only on those labels. Finally the exit router removes the label and forwards the original IP packet toward the destination.

The label determines which route the packet will follow. The paths, which are called Label Switched paths (LSPs), allow service provider to decide what will be the best path for certain traffic to flow into public of private network.

A. Working

MPLS is best described as "Layer 2.5 networking protocol". MPLS works on the advantage of the fastest switching mechanism of (data link layer) network combined with high scalability, availability and manageability of network layer. Instead of using IP address based packet forwarding MPLS uses its unique labels for each packet. As a packet enters entrance router, MPLS labels the packet for data transmission across the network. The labels in MPLS header are inserted into data packet that has to be transformed. These fastened length labels carry the knowledge, which permit every change router on a way to method and forward packets to destination. As every node forwards the packet, it exchange current label for the foremost acceptable label to the following node to route the packet. When a packet reaches the exit router, the labels area unit removed and also the packet is forwarded to destination IP network. These mechanisms enable very high speed packet switching.

In fig 2.1.3 (a) it has been shown that we have created a simulation network for the traffic flow. Node 0 and Node 1 are used as source node and Node 6 and Node 7 are used as destination Nodes. Node 2,3,4,5 are used as The information table 1 of node LSR2 act as Label Edge Router (LER) shown below, where exit router characterize FEC, label and LSP ID. Labels of this table area unit distributed supported the management mode that's chosen to be dead at node LSR2.

In fig 2.1.3(b) we have shown the traffic flow without MPLS. Here because the packets are passed to the Nodes the packets n ancient network path (via node 2-4-5) don't have any load, whereas path (via node 2-3-5) is over loaded. Packets are lost because of congestion at node 2 and we have seen same situation when no traffic engineering is applied for MPLS network.

In fig 2.1.3(c), the traffic flow is shown by using MPLS. In MPLS network, node 2 to node 5 is described as LSR nodes. We have studied LSR2 as entrance router and LSR5 as exit router wherever the trail through node 2-3-5 thought of as shortest path. Because of congestion at node 2, traffic engineering is applied for MPLS network. Traffic follows the through alternate path (via node2-3-5).

The need for implementing MPLS technology to beat a number of the restrictions concerned in traditional based mostly routing. The label based uniqueness of MPLS simplifies IP based traffic routing from source to destined node without affecting the IP packets. Due to this it also focus on the security aspect of MPLS networks. By using MPLS networking congestion over the network is controlled on very large scale. MPLS also has the capability of utilizing available bandwidth in efficient manner.

B. Summary

Parameter 1: Congestion Control on implementing MPLS; it finds or has the record of alternative shortest path available throughout the network. Rather than going through the

shortest path it always prefer going for the less congested path and forwards the traffic from source to destination.

Parameter 2: Packet Loss
Packet loss is prevented on a great extent. As MPLS has its unique labels for each packet it follows the path provided and reaches the destine node which prevents the packet loss.

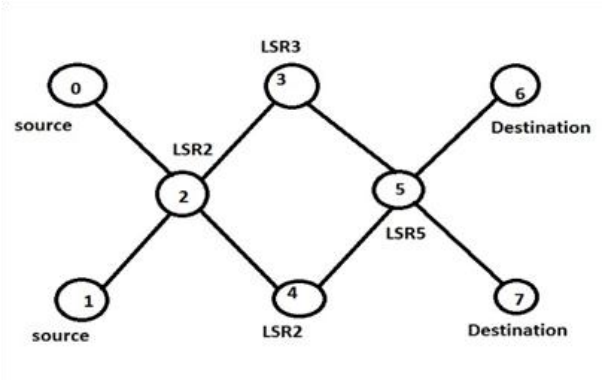


Fig 2.1.3 (a): Simulation Topology

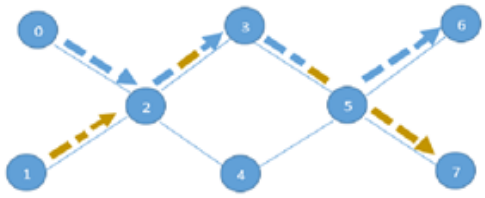


Fig 2.1.3 (b): Symmetric Network without MPLS

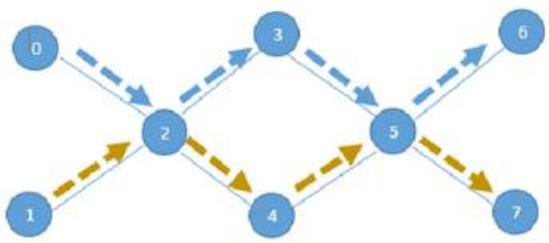


Fig 2.1.3 (c): Symmetric Network with MPLS

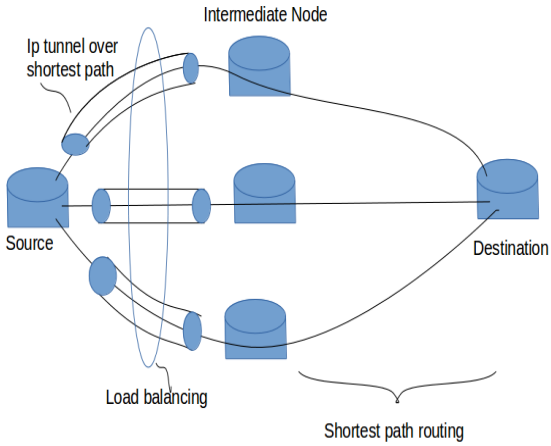
2.1.4 TPR

TPR stands for Two Phase Routing Protocol[1][11][12]. One helpful approach to enhancing routing performance is to minimize the at most link utilization rate, conjointly referred to as the network congestion quantitative relation, of all network links. Minimizing the network congestion quantitative relation results in a rise in admittable traffic. Several routing ways are extensively studied Wang et al. formulates a general traffic engineering downside, wherever traffic demands square measure assumed to be flexibly split among provide and destination nodes. This sophisticated operation is implemented by the Multi-Protocol Label Switching (MPLS) Traffic-Engineering (TE) technology .However, gift networks in the main use shortest-path-based routing protocols like Open Shortest Path First (OSPF) and Intermediate System to Intermediate System (IS-IS). This implies that already deployed information processing routers within the gift networks would need to be upgraded, which might considerably increase capital expenditures.

A. Working
Two-phase routing (TPR) performs load reconciliation and every flow is routed in sequence with the shortest-path-based OSPF protocol, in 2 stages across intermediate nodes. TPR effectively relaxes network congestion. In TPR, packets at the supply node aren't directly routed to the destination node over the shortest path. TPR consists of 2 phases as follows, within the first section, packets square measure directed to intermediate nodes and labor under IP tunnels, like IP-IP and Generic Routing Encapsulation (GRE) tunnels. The tunnels square measure created by encapsulating the initial IP packets with further IP headers that indicate the intermediate node. Associate degree encapsulated IP packet in associate degree IP tunnel is additionally routed over the shortest path (to the intermediate node) within the second section, associate degree encapsulated IP packet is DE-encapsulated to yield the initial IP packet at the intermediate node, so sent to the destination node over the shortest path. For an oversized network, the amount of doable routes is high as a result of their square measure several intermediate nodes which will be used because the target of the distributed IP tunnels. However, the protocol needs the configuration of IP tunnels, between all edge nodes and intermediate nodes within the network. As is true within the case of MPLS-TE, the amount of tunnels will increase in proportion to N2 that weakens quantifiability from the network operation purpose of read.

B. Summary:
Parameter1 :Minimizing Network Congesion
As a results of the routing in section one, every node receives traffic destined for various destination that it routes to their respective destination in phase. TPR relaxes the network congestion.

Parameter 2: Packet Loss: It prevents packet loss in the network to some extent.



3. COMPARISON TABLE OF PROTOCOLS

	Parameters	OSPF	S-OSPF	MPLS	TPR
1	Work	In OSPF it goes only through the shortest path even if it is traffic loaded.	S-OSPF first splits the load to the neighbors and then applies OSPF.	MPLS uses label for forwarding packets.	TPR goes through two phase and more flexible than S-OSPF for traffic distribution
2	Congestion	More congestion	Less congestion than OSPF	Less congestion	Minimize the congestion
3	Tunnels	Not required	Not required	LSP tunnels	IP tunnels or GRE tunnels Required
4	Packet Loss	More packet loss	Less packet loss than OSPF	Less packet loss	Less packet loss
5	Label	No need of labels.	No need of labels.	Required	Required.
6	Efficient	Less Efficient as compared to others.	More Efficient than OSPF	More efficient than S-OSPF	Less efficient
7	Routing	Shortest path	Combination of source distribution and shortest path from neighbor node	Explicit Routing	Combination of two shortest path

4. CONCLUSION

This paper proposes for an overview of IP routing Load Balancing protocols. It has been seen that OSPF has more congestion, packet loss and less efficient as compared to all the protocols. S-OSPF is better than OSPF Protocols in terms of congestion control, packet loss and efficiency. MPLS is best among all working on the parameters like congestion control, packet loss and efficiency. It only uses LSP tunnels and packet labels. TPR is less efficient as compared to others.

Also it tries to solve various issues like,Traffic Information Systems are most prominent use,Mapping(Map Quest,Google Maps),where multiple ways are available for same destination. Load Balancing is a concept which is still under research. Everyday frameworks,algorithms and models are being developed and existing models are updated. There is a vast scope for future enhancement. For example,the users are sending arbitrary data as a query on the web, and hence web-centric queries can be optimized at server level to reduce server load to improve the server performance. Further, implementation of our work is pending and hence an improvement may be recommended in the same.

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