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Implementation of Traffic Engineering in MPLS Networks by Creating TE Tunnels Using Resource Reservation Protocol and Load balancing the Traffic

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ABSTRACT: Today Internet Plays an important role in our day-to-day life. Basically, WAN connections are expensive in ISP's budget and it is most important to deliver the services with QoS to its customers. Traffic Engineering is one of the solution when routers are overloaded. Generally, all routers in the network uses the shortest path. By this all routers are overloaded and traffic occurs.This results in packet delay or dropping in the network. The main objective of this project is to forward the packets using tunnels, when the traffic occurs. The headend router uses Resource Reservation protocol to reserve the bandwidth to forward the packets. And finally the enhanced Quality of Service (QoS) is achieved by this project.

KEYWORDS: MPLS, RSVP, IGP, OSPF

I.INTRODUCTION

Over the last few years, the Internet has evolved into a ubiquitous network and inspired the development of a variety of new applications in business and consumer markets. These new applications have driven the demand for increased and guaranteed bandwidth requirements in the backbone of the network. In addition to the traditional data services currently provided over the Internet, new voice and multimedia services are being developed and deployed. The Internet has emerged as the network for providing these converged services. However, the demands placed on the network by these new applications and services, in terms of speed and bandwidth, have strained the resources of the existing Internet infrastructure. This transformation of the network toward a packet-and cell-based infrastructure has introduced uncertainty into what has traditionally been a fairly deterministic network.

In addition to the issue of resource constraints, another challenge relates to the transport of bits and bytes over the backbone to provide differentiated classes of service to users. The exponential growth in the number of users and the volume of traffic add another dimension to this problem. Class of service (CoS) and QoS the issues must be addressed to in order to support diverse requirements of the wide range of network users. In sum, despite some initial challenges, MPLS will play an important role in the routing, switching, and forwarding of packets through the next-generation network in order to meet the service demands of the network users.

In a traditional IP forwarding paradigm, packets are forwarded on a per-hop basis where a route lookup is performed on each router from source to destination. As cited earlier, the destination-based forwarding paradigm leads

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to suboptimal use of available bandwidth between a pair of routers in the service provider network. Predominantly, the suboptimal paths are under-utilized in IP networks. To avoid packet drops due to inefficient use of available bandwidth and to provide better performance, TE is employed to steer some of the traffic destined to follow the optimal path to a suboptimal path to enable better bandwidth management and utilization between a pair of routers. TE, hence, relieves temporary congestion in the core of the network on the primary or optimal cost links. TE maps flows between two routers appropriately to enable efficient use of already available bandwidth in the core of the network. The key to implementing a scalable and efficient TE methodology in the core of the network is to gather information on the traffic patterns as they traverse the core of the network so that bandwidth guarantees can be established.

TE tunnels are, thus, data flows between a specific source and destination that might have properties or attributes associated with them. The attributes associated with a tunnel, in addition to the ingress (headend) and egress (tailend) points of the network, can include the bandwidth requirements and the CoS for data that will be forwarded utilizing this tunnel. Traffic is forwarded along the path defined as the TE tunnel by using MPLS label switching. Hence, TE tunnels are assigned specific label switched paths (LSPs) in the network from source to destination, which are usually PE routers. MPLS LSPs have a one-to-one mapping with TE tunnels, and TE tunnels are not bound to a specific path through the SP network to a destination PE router. Unless configured explicitly, TE tunnels can reroute packets via any path through the network associated with an MPLS LSP. This path might be defined by the IGP used in the core, which are discussed in the section on MPLS TE extensions

The primary reason for the implementation of MPLS TE is to control paths along which traffic flows through a network. MPLS TE also lends itself to a resilient design in which a secondary path can be used when the primary path fails between two routers in a network. Data plane information is forwarded using label switching; a packet arriving on a PE from the CE router is applied labels and forwarded to the egress PE router. The labels are removed at the egress router and forwarded out to the appropriate destination as an IP packet.

OSPF or IS-IS with extensions for TE is used to carry information pertaining to the tunnel configured on a router. The extensions carry information on available resources for building a tunnel, like bandwidth on a link. As a result, a link that does not have the requested resources (like bandwidth) is not chosen to be a part of the LSP tunnel or TE tunnel. Signaling in an MPLS TE environment uses resource reservation protocol (RSVP) with extensions to support TE tunnel features.

II.RELATED WORKS

A. Designing of MPLS TE Using GNS3

Generally the router uses the shortest path solution from source to destination, so if at the same time all routers are looking for shortest path, their might be possibility of overloading and delay. So MPLS not just rely on shortest path. It utilized the underutilized paths, when all shortest paths are over utilized. The main objective of this work is to simulate the workings of MPLS with Traffic Engineering in a network and to perform analysis of the advantages provided by MPLS as opposed to other commonly used network protocols .In this paper they performed simulation of various network topology protocol like IS-IS, OSPF and tunneling using GNS3 simulation environment. In general, existing network topologies determines the shortest path from source to destination by calculating the distance. But some time the lowest path is overloaded; hence network flow is affected. The MPLS reduced the possibility of routing overloading by added extra layer of packet labeling. Hence the underutilized resources are now fully optimized. MPLS TE is applicable in ISP maintenance, router only networks and also those networks where virtual circuits are used as an interconnection between routers

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B. Performance Analysis of Signaling Protocols

MPLS enhance the performance of the network by using signaling protocols for traffic engineering. Through the signaling protocol, traffic engineering selects the network paths for forwarding the packets to the routers in a balanced manner. This paper explains the study of performance analysis of Constraint-Based routed LDP signaling protocol and Resource Reservation Protocol -TE signaling protocol. This paper has demonstrated that the MPLS system using CR-LDP TE signal convention has a visible execution favorable position contrasted with the MPLS system using RSVP TE signal convention as far as the quantity of got voice packets and the quantity of kept up calls with both GSM and PCM codecs. This is for the most part because of the poor adaptability of RSVP convention came about because of the additional activity prerequisites for intermittent refreshment of movement, high LSP disappointment recuperation movement and RSVP messages to keep up the positions in all LSR.

C. An approach to Traffic Engineering in MPLS Networks using Class for different Classes

This paper provide a variety of services through multiple service classes where each service class will provide a different performance in terms of response time. These service classes will be designed to provide appropriate levels of service to user applications. Different classes of services and the packets between different classes are classified as per the application request and study and analysis of the traffic is made in GNS3 simulator to show how traffic management is done for large traffic in MPLS network. Based on the traffic flow the different services like HTTP,FTP,TELNET,SNMP,ICMP can prioritise the traffic based on applications and thus prioritize the traffic and enhances the higher priority traffic in terms of latency,jitter,drops and throughput.

III.DESIGN & IMPLEMENTATION

Here ,MPLS TE is configured by GNS3 Software.Here the forwarding is done by the label which is 20 bit value.The label is simply attached to the packet and must be forwarded destination routers. The structure of the packet will be,

Label	TC	S	TTL
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An MPLS label consists of the following parts:

- 20-bit Label value
- 3-bit Experimental field
- 1-bit Bottom-of-Stack indicator
- 8-bit Time-To-Live field

Traffic Engineering

MPLS Traffic Engineering (MPLS TE) is a growing implementation in today's service provider networks. MPLS adoption in service provider networks has increased manifold due to its inherent TE capabilities. MPLS TE allows the MPLS-enabled network to replicate and expand upon the TE capabilities of Layer 2 ATM and Frame Relay networks. MPLS uses the reachability information provided by Layer 3 routing protocols and operates like a Layer 2 ATM network. With MPLS, TE capabilities are integrated into Layer 3, which can be implemented for efficient bandwidth utilization between routers in the SP network.

TE is the process of steering traffic across to the backbone to facilitate efficient use of available bandwidth between a pair of routers. Prior to MPLS TE, traffic engineering was performed either by IP or by ATM, depending on the protocol in use between two edge routers in a network. Though the term "traffic engineering" has attained popularity and is used more in the context of MPLS TE today, traditional TE in IP networks was performed either by IP or by

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ATM.

TE with IP was mostly implemented by manipulation of interface cost when multiple paths existed between two endpoints in the network. In addition, static routes enabled traffic steering along a specific path to a destination. The inspiration behind MPLS TE is *Constraint Based Routing (CBR)*, which takes into account the possibility of multiple paths between a specific source/destination pair in a network. With CBR, the operation of an IP network is enhanced so the least cost routing can be implemented as well as variables to find paths from a source to destination. CBR requires an IGP, like OSPF or IS-IS, for its operation. CBR is the backbone of the TE tunnel definition and is defined on the ingress routers to the MPLS domain when implementing MPLS TE. Resource availability and link status information are calculated using a *constrained SPF* calculation in which factors such as the bandwidth, policies, and topology are taken into consideration to define probable paths from a source to destination.

V. SIMULATION RESULTS

For simulation, we use GNS3 simulator. It is the great graphical tool with enriched with multiple features to simulate the protocols like OSPF, BGP, EIGRP etc.,

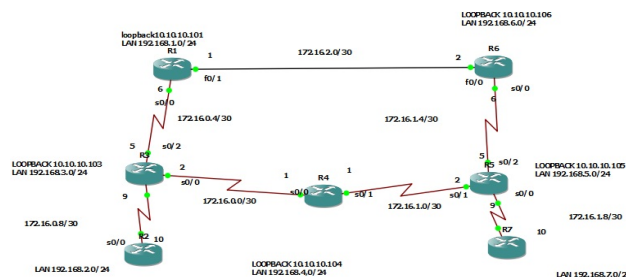


Figure A: MPLS network

```

R12#sh mpls traffic-eng tunnels
Name: R12_t2 (Tunnel2) Destination: 172.16.0.4
Status:
Admin: up Oper: up Path: valid Signalling: connected
path option 1, type dynamic (Basis for Setup, path weight 50)
Config Parameters:
Bandwidth: 500 kbps (Global) Priority: 7 7 Affinity: 0x0/0xFFFF
Metric Type: TE (default)
AutoRoute: enabled LockDown: disabled Loadshare: 500 bw-based
auto-bw: disabled
InLabel : -
OutLabel : Serial0/0, 38
RSVP Signalling Info:
Src 192.168.0.12, Dst 172.16.0.4, Tun_Id 2, Tun_Instance 52
RSVP Path Info:
My Address: 192.168.0.12
Explicit Route: 192.168.92.9 192.168.19.14 192.168.114.1 172.16.13.1
172.16.13.3 172.16.34.4 172.16.0.4
Record Route: NONE
Tspec: ave rate=500 kbits, burst=1000 bytes, peak rate=500 kbits
RSVP Resv Info:
Record Route: NONE
Fspec: ave rate=500 kbits, burst=1000 bytes, peak rate=500 kbits
History:
    
```

Figure B: MPLS traffic-eng tunnels

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```
R3#sh mpls interfaces
```

Interface	IP	Tunnel	Operational
Serial0/0	Yes (ldp)	Yes	Yes
Serial0/2	Yes (ldp)	Yes	Yes
Serial0/3	Yes	No	No
Tunnel1	No	No	Yes
Tunnel2	No	No	Yes

Figure C:MPLS interfaces

```
R3#sh mpls ldp bindings
```

tib entry: 10.10.10.101/32, rev 14	local binding: tag: 301	remote binding: tsr: 10.10.10.104:0, tag: 400	remote binding: tsr: 10.10.10.101:0, tag: imp-null
tib entry: 10.10.10.103/32, rev 10	local binding: tag: imp-null	remote binding: tsr: 10.10.10.104:0, tag: 401	remote binding: tsr: 10.10.10.101:0, tag: 100
tib entry: 10.10.10.104/32, rev 16	local binding: tag: 302	remote binding: tsr: 10.10.10.104:0, tag: imp-null	remote binding: tsr: 10.10.10.101:0, tag: 101
tib entry: 10.10.10.105/32, rev 18			

Figure D:MPLS LDP bindings

V. CONCLUSION

Traffic engineering is the solution, when routers are overloaded. In this paper, we implement the traffic engineering in MPLS networks by creating the TE tunnels with the help of Resource Reservation protocol .RSVP reserves the bandwidth for forwarding and the reservation is retained after the forwarding is over. By this we can achieve enhanced QoS. We also calculate the number of packets .The redundant path is also specified. By this the probability of failure is reduced.

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