A Study on MPLS Vs SD-WAN

S. Rajagopalan

Abstract Internet service providers and techno enterprises evolved with CISCO IOS called MPLS built a strong and diligent network for succeeding generations to utilize all sorts of full-fledged amnesties over a solitary structure. MPLS is considered as a routing method, and it is not a facility or a service. MPLS can be encased with any prevailing infrastructures, namely digital subscriber line, asynchronous transfer mode, frame relay, and IP. MPLS is not platform dependent. It can work seamlessly without making any change in the current environment of these technologies. But implementing MPLS is quite expensive, so with the support of SD-WAN, ISPs and enterprises are attempted to enhance its usages using inexpensive Internet connection. This survey articled aimed to compare the pros and cons of both the technologies MPLS and SD-WAN.

Keywords SD-WAN (software-defined wide area network) · MPLS (multi-protocol label switching) · LSP (label-switched path) · TE (traffic engineering) · ATM (asynchronous transfer mode) · FEC (forwarding equivalence class)

1 Introduction

MPLS is a WAN-based system launched to foredetermine the well-established and extremely effective routes to forward data from one node to another node by using short bit sequences called labels instead of lengthy network addresses. A routing method selects a route to direct traffic from source to destination [1]. All the real-time traffic can be handled easily by this method. MPLS technology has been ruling private-based connectivity for the past 20 years. Internet protocols IPv4, IPv6, frame relay, ATM and IPX are all supported by MPLS [2]. SD-WAN is evolved from MPLS technology. SD-WAN guarantees the secured, smooth and secluded connectivity [3]. But MPLS has few issues such as security and backup link. WAN backbone

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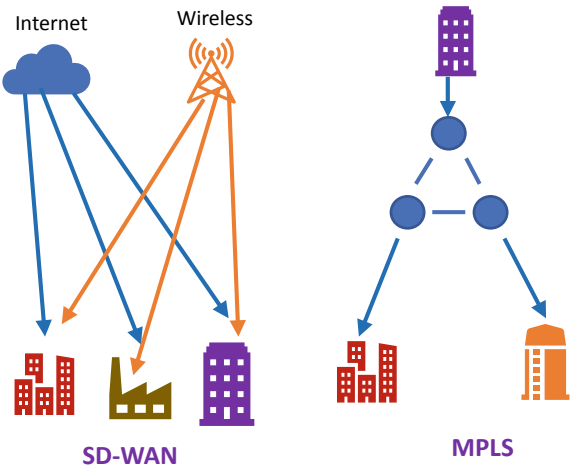

Fig. 1 SD-WAN and MPLS network. *Source* https://www.fieldengineer.com/sd-wan/sd-wan-vs-mpls-vs-sdn

architecture is completely integrated by the SD-WAN and also drives online traffic by using a centralized strategy. This issue could not be handled properly due to incongruent fragments of its structure and approach. This article discusses those issues in detail in the upcoming sections.

MPLS works alike a router or switch in layer 2.5. Here, data will be forwarded by the decisions of the packet forwarding methods. SD-WAN employed certain WAN connections, namely LTE and 5G which connect large enterprises located in remote places all over the world. Figure 1 illustrates the network connections of MPLS and SD-WAN.

2 MPLS

MPLS works independently, and it is not tangled with any of the existing fundamental technologies. The simple MPLS architecture with two sections, namely forwarding (data plane) and control (control plane) is shown in Fig. 2. In MPLS, once a packet arrives, it will be allotted to a forwarding equivalence class (FEC) which is specified by the labels. In the network, every router has a table about neighboring node. So, router will not try to find the header rather the succeeding routers utilize the labels as an index in order to provide new FEC. The job of these path labels is to find out the effective path to destination node instead of finding out endpoints [4]. It was designed to improve the drawbacks in frame relay and ATM [5]. MPLS resides on enterprises and on carrier's infrastructural backbone to support campuses, offices and its branch offices, enterprises and Ethernet-based services in order to achieve QoS for the reliable real-time traffic. The MPLS infrastructure could not fix itself properly with OSI layers. So, it is considered as 2.5 layer [6]. MPLS can establish forwarding tables for any protocol. A label-switched path (LSP) will be established to route

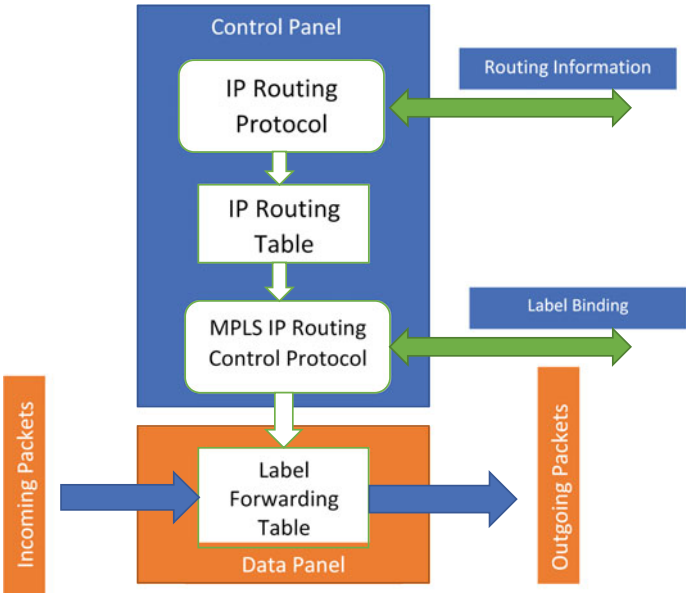

Fig. 2 MPLS architecture

traffic between foredetermined path in MPLS networks. A unidirectional LSP must be established before the communication starts. Based on this, forwarding would take place. When a user wants to communicate in MPLS network, then MPLS label will be added at the ingress node of the MPLS router. Each MPLS label consists of four parts, namely label, QoS experimental bits, stack bottom and TTL [7]. A label consists of all the details for the MPLS routers to identify the destination of the packet forwarding. Experimental bits are meant for QoS to assure the precedence of the labeled packet. Stack bottom informs MPLS router that the label reaches the egress router, i.e., it reaches the destination.

2.1 Boon and Bane

There are few paybacks in using MPLS, namely bandwidth optimization, congestion reduction, scalability and improved performance. Congestions could be minimized by finding optimal routes [8]. MPLS is not so susceptible to denial of service attack. MPLS is considered to be secured and private transfer mode [9]. MPLS is considered being an expensive mode of transfer because this service must be obtained from a carrier. There is very few MPLS service providers giving global coverage. So, if a company wants to extend its service to its branch office, MPLS communication will be costly and branch office communication to the headquarters will be troublesome

unless they start using clouds. Clouds provide anywhere and anytime services for their users in a cost-effective way [10].

2.2 MPLS Future

ISPs need lot of infrastructural assets to manage the emerging amount of users and applications [11]. MPLS is an essential part of the WAN environment. Nowadays, industries are gradually passing on to a hybrid landscape which has both MPLS and basic Internet service. Point-to-point services still be provided by MPLS for branch offices of big firms, retailers and other data centers. MPLS is very expensive, dependable and consistent but Internet connection is very cheap and reliability is very low. Moreover, incorporation of MPLS-TE with SDN has improved the resource usage and load balancing of a network.

3 SD-WAN

Conventional WAN's distinct job is to allow employers in a branch or an institution's campus to link and access the applications installed in their servers. Usually, MPLS's dedicated LSP is used to maintain a secured and authentic connection. This cannot be applied in the present cloud-based scenario. Industries and enterprises started using SaaS and IaaS applications in numerous cloud environments. Present-day IT has lot many contests to be addressed. So IT realizes that the user's application proficiency is complicated and deprived. WAN was intended for the past decades, and it could not handle the current traffic explosion due to the clouds. This caused applications' unreliability, traffic issues and insecured data. Evolution of SD-WAN overpowers these issues.

The era of clouds transmuted backbone of firms. SD-WAN rapidly improves the performance of a business, diminishes budget and provides vigorous security [12]. The SD-WAN architecture is shown in Fig. 3. SD-WAN architecture clearly separated the data plane and control plane and its services. The SD-WAN architecture is cloud scope and protected, flexible and programmable. SD-WAN improves the users' proficiency. It can route IP packets through the most efficient paths, but once it reaches Internet, pursuance is not guaranteed.

3.1 Challenges and Benefits

In the present-day enterprise scenario, over 50% traffic is through clouds but the network available is not at all a cloud serviceable network. SaaS works very pathetically. It has to manage very complicated data flow. The working charges of bandwidth

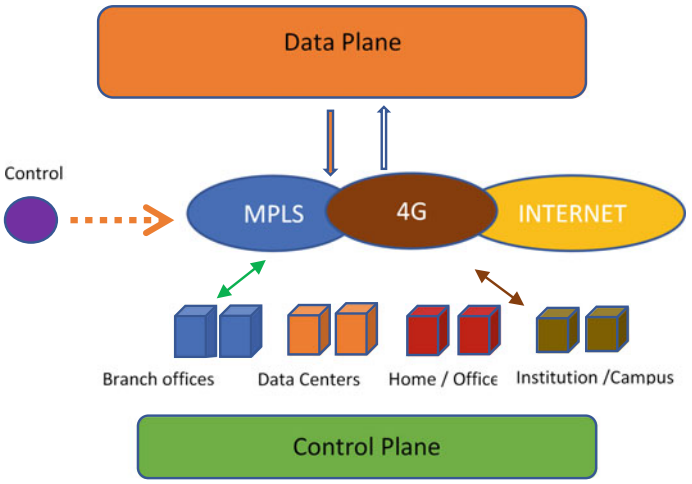

Fig. 3 Architecture of SD-WAN

will be elevated. Every year, the network traffic flow is increased by 30%. A small architectural change will take months to complete it. User application experience is quite unpredictable, and more than 70% of application disruption is due to network problems. Enterprises' another significant challenge is to implement security. Hybrid architecture's susceptibility leads to many other issues.

Enterprises who would like to migrate to SD-WAN will harvest few benefits. Firstly, they will get optimized cloud and SaaS accessibility and reply times. Any public clouds can be accessed impeccably. Operating cost will be reduced by 50%. Any structural changes will not take long. Any applications SLA will be manageable and easily foreseeable. A rigorous security will be implemented for hybrid networks.

3.2 Features

SD-WAN has lot of features regarding the security, cloud environment, user application experience and cost. User application experience will be very active with hybrid links. In the cloud environment, very vibrant optimization can be done. A data center, cloud and local offices can be connected in single overlay. It can be combined with MPLS and less priced broadband. Due to the base elements of the cloud architecture, it is more vulnerable for any sort of attacks [13]. Cloud security can be provided for hybrid networks when SD-WAN is used. Centralized server system feature is available in SD-WAN. An integrated SD-WAN requires a minimum IT workforce for WAN computerization and segmentation [14].

3.3 SD-WAN Load Balancing

Dynamic routing method to find optimum route is automatically done in SD-WAN. When SD-WAN finds the burdened MPLS, it will shift the traffic automatically to the Internet. This makes less congested network route in an inexpensive way [15].

4 SD-WAN or MPLS

It is very difficult to determine whether SD-WAN is better than MPLS. Any company routes real-time traffic over WAN, and then the company must need MPLS. SD-WAN utilizes common Internet to connect other Web sites. If an IP packet reaches this common Internet, then there will not be any guarantee of delivery because latency, loss of packet and jitter may affect it. If a company only uses traffic that does not involve real-time applications, namely resource sharing, file sharing, email, file transfer, etc., then SD-WAN would fetch many benefits over MPLS.

4.1 High Bandwidth

SD-WAN can assure high-speed Internet through an inexpensive way. It grants a company to use high bandwidth Internet connections. SD-WAN groups several connections to achieve high-speed bandwidth at inexpensive manner.

4.2 Better Uptime

Numerous WAN connections can be combined in SD-WAN in order to provide seamless uptime. Cloud services must be always available for the users [16]. MPLS sometimes faces failure to handle this issue.

4.3 Increased Performance

SD-WAN regulates the traffic in the fastest way through the circuit. MPLS does not perform any action unless specific settings are made.

Table 1 SD-WAN and MPLS differences

	SD-WAN	MPLS
Types of connections	5G, LTE and MPLS amalgamation	Twofold MPLS
Cloud admittance	Straight and shortest access to clouds	Cloud takes from datacenters
Security	Lines are dedicated	Entrenched security
Elasticity	Capacity can be increased	Delay in adding the capacity
Quality	Business policy based traffic routing	Dedicated lines for Internet traffic

Source https://www.riverbed.com/blogs/sdwan-vs-mpls.html

4.4 No More ISP

SD-WAN does not bump into ISP issue so that it can join or eliminate ISP at anytime without much difficulties. It has the ability to do vibrant link selection [17]. MPLS is struck with same service providers that creates lot of hassle in packet forwarding.

Table 1 focuses on significant differences between the SD-WAN and MPLS.

4.5 SD-WAN and Cloud

If an enterprise uses many cloud-based applications, SD-WAN is the game changer. There are various users who need various services in the cloud environment, and integrating those services is a difficult task in clouds [18]. SD-WAN directs network traffic to a facilitated cloud gateway, and this will connect it to the cloud applications and keep the connection alive [19]. When network flow reaches SD-WAN providers' closest gateway, then it can be straightaway connected to a cloud provider. So the latency, jitter and packet loss will be less comparatively. This will improve the user experience considerably. Secured direct internet access allows branch offices to connect to the cloud applications without any attacks.

5 Conclusion

SD-WAN is an upcoming alternative for MPLS, and it makes wide area network connections more adaptable and secured. Any sort of policies can be easily implemented without much changes across the WAN but MPLS always needs a predetermined route. If non-real-time traffic is handled by WAN, then SD-WAN is a perfect choice. If real-time traffic is handled by WAN, then the MPLS must be used. But MPLS connections are quite expensive. Anyway, both kinds of traffic have some

benefits such as high bandwidth, performance improvement, increased uptime, low cost and better performance. SD-WAN can replace MPLS with its centralized trafficking system and gives a more secured and flexible network. Nowadays, nearly 40% of enterprises embraced SD-WAN and 83% of companies attempting to adopt SD-WAN. These numbers may grow in the upcoming years.

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