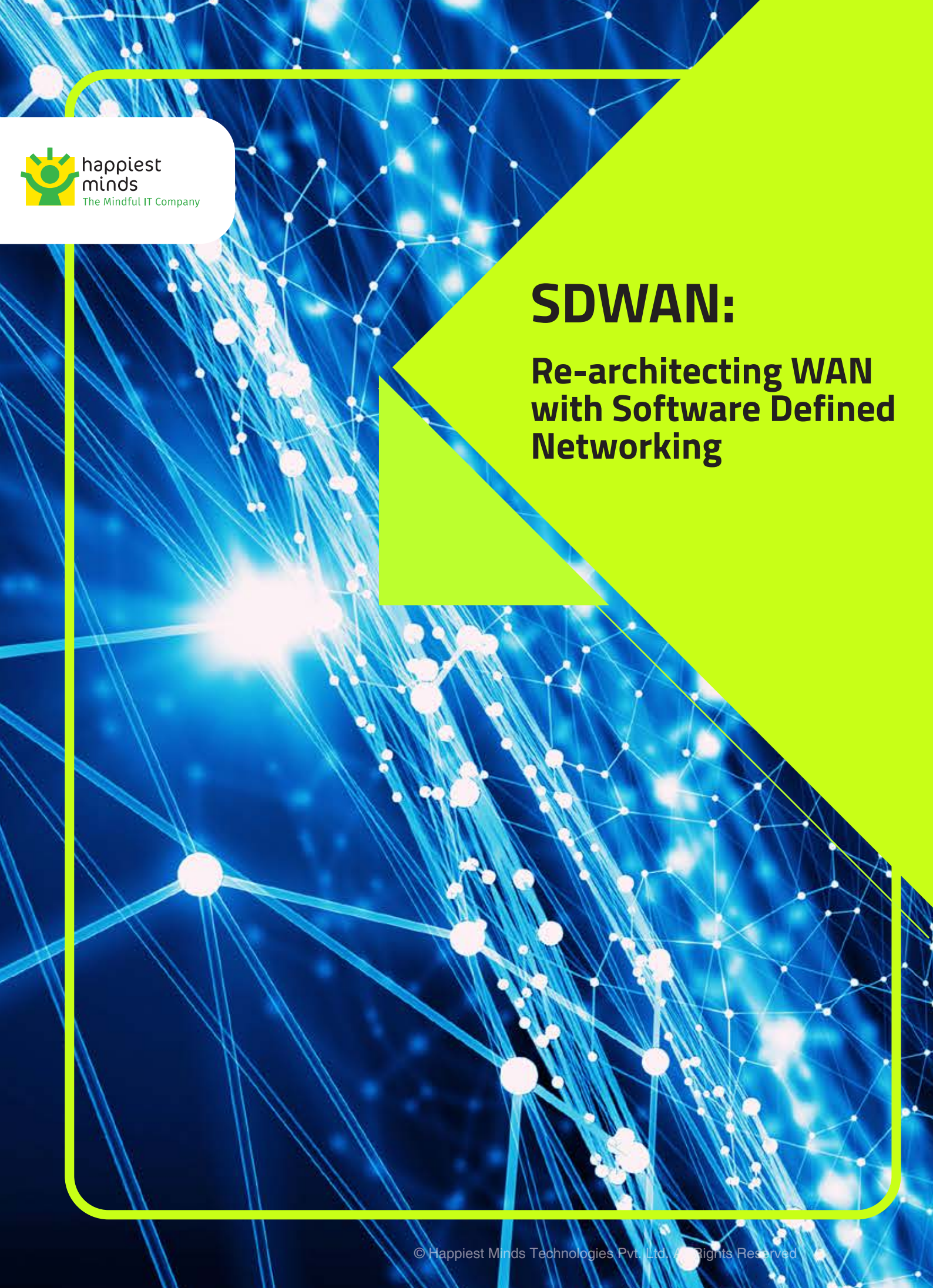

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SDWAN:

Re-architecting WAN with Software Defined Networking

Introduction

SDN (Software Defined Networking) is an emerging focus area in the world of networking. This architectural approach of decoupling the software(Control-plane) from the Hardware (Forwarding plane) is opening opportunities towards network programmability and flexibility in network construction from the legacy vendor-locking ecosystem.

This service orchestration capability of an SDN architecture can enable providers to

- **Design newer ways to monetize their services**
- **Introduction of new services.**

This paper discusses SD-WAN (Software Define Wide Area Networks) architecture and its overall capabilities towards re-architecting current WAN architecture in the backdrop of ever increasing internet traffic and adoption of cloud enabled applications.

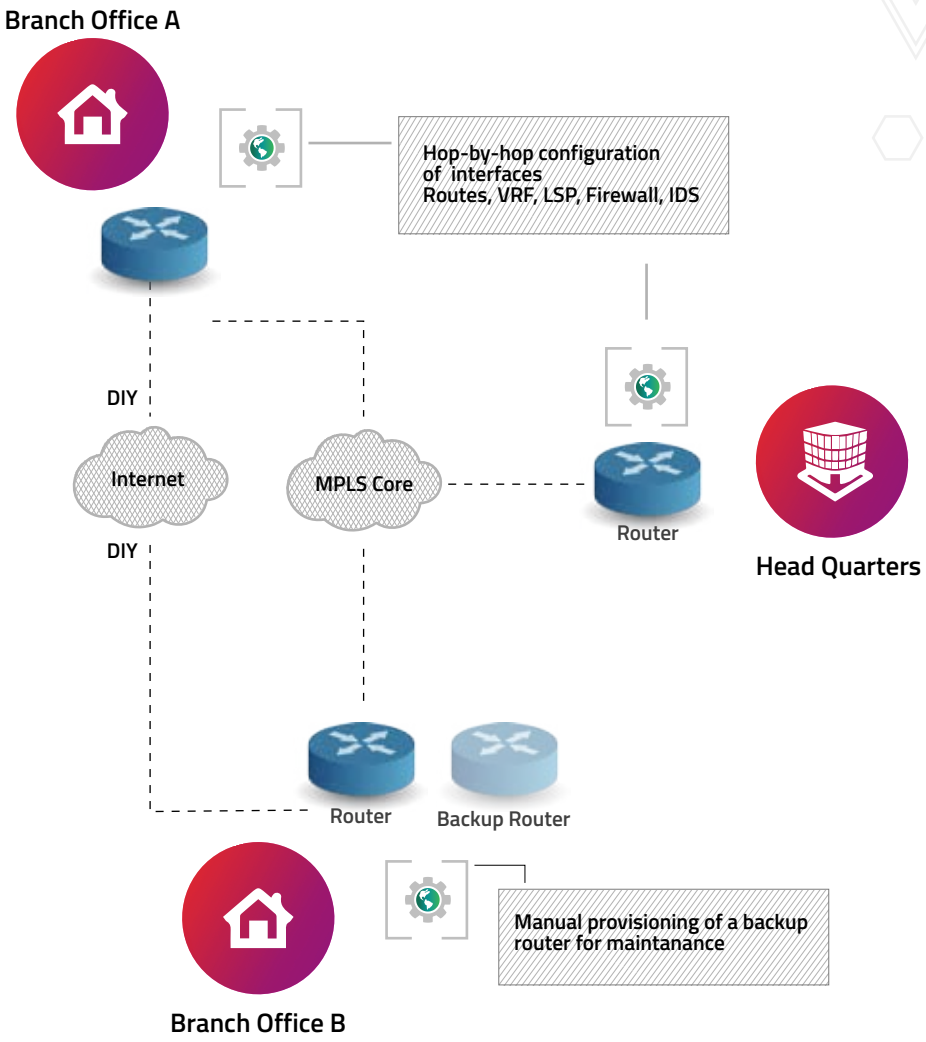
Simply put, SD-WAN aims to refine the approach towards provisioning, management and optimization of WAN connecting enterprise networks in a software-centric way and bringing cost-effectiveness and simplicity in managing these connections. Let us look at the past deployment architecture and factors driving this software-centric way that is expected to achieve 30% adoption in the next three years among WAN users.

Historical WAN deployments

Historically WAN deployment were carried out following a uniform static policy based on the type of connections:

- Connections to a branch-offices/data-center: Dedicated connections to geographically distributed offices, email servers, ERP, CRM systems. In most of the cases this is a primary WAN connection using MPLS.
- External Connections: Dedicated Internet Access(DIA) as a fallback link for the MPLS link or for the transport of non-critical services.

Figure 1: Traditional Hybrid-WAN Architecture



The overall idea was to create a hybrid-WAN approach where there are multiple WAN connections MPLS, DIA, DSL or Wireless.
This traditional approach continued to get adopted in spite of operational complexities and high costs. However, with ever increasing WAN traffic coupled with natural adoption of different kind of services (Cloud, Social Media) put significant pressure to manage WAN cost whereas the enterprise WAN budgets has been mostly flat. So a strategic focus is required to identify points of improvements in current & future deployments leveraging revolutionary concepts, in this case, SDN.
It is interesting to note current disadvantages that call for elimination in the existing deployments that can create an opportunity for reducing costs of a) Configuration b) Management.

- **Complex Provisioning:**
  Hop-by-Hop multiple configuration of nodes for routing policy and the multiple steps performed to confirm every configuration done.
  No standard procedures to rollback as most of the time it is just complete repetition of all the steps from the beginning.

- **Complex Management:**
  - Requires unique skill.
  - Unpredictable turn-around-time to recover from failures.
  - High uptime introducing new services.

- **No Bandwidth management.**
  - The absence of application specific policy for dynamic traffic steering.
  - Lack of run-time visibility of WAN utilization. Loss of ERP, CRM connections due to excessive use of VoIP and VDI applications
  - Inefficient use of expensive MPLS link: For e.g. The Internet traffic would use the MPLS transport all the way to the datacenter or the headquarter before branching out to the web.

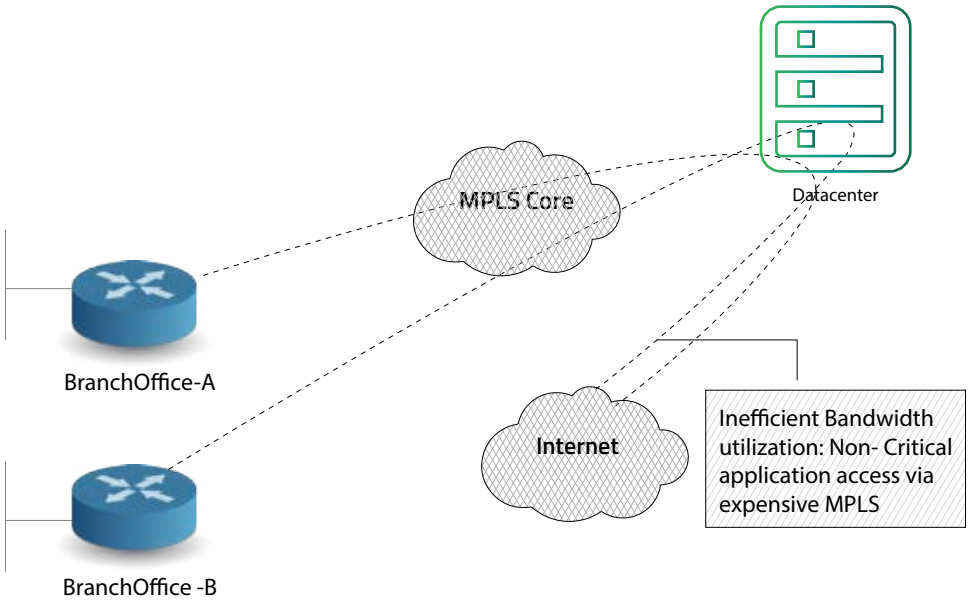


Figure 2:Legacy WAN with Inefficient Bandwidth utilization

WAN improvement opportunities with SDN

The standard way of implementing an SDN is by the Open-Flow protocol. It enables a controller software to communicate with Open-Flow enabled switches and routers so that the forwarding and routing logic in these devices can be programmed based on the business application running on top of the controller.

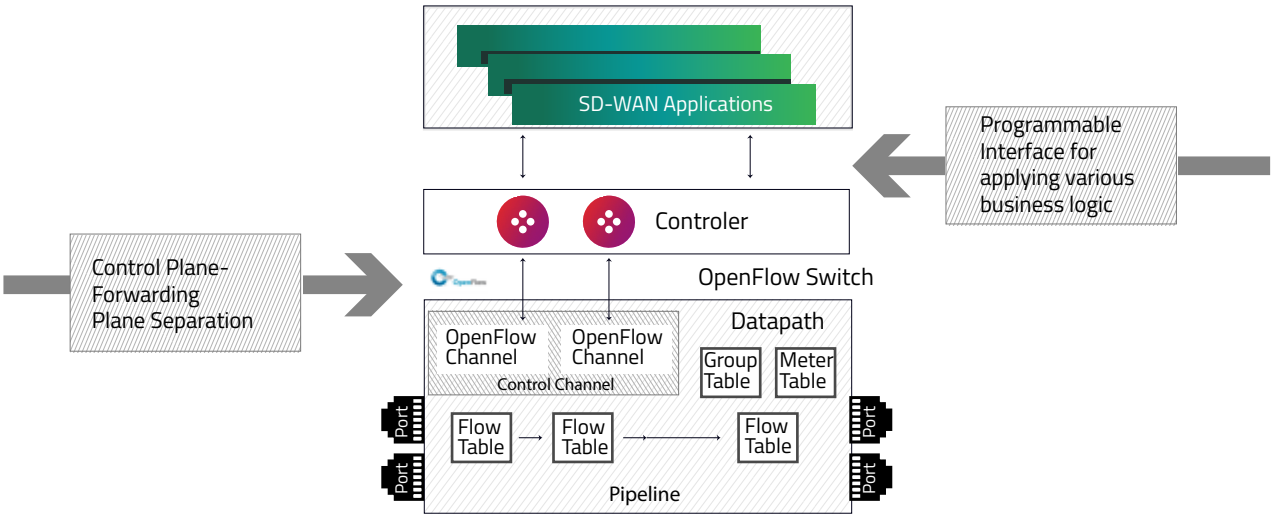
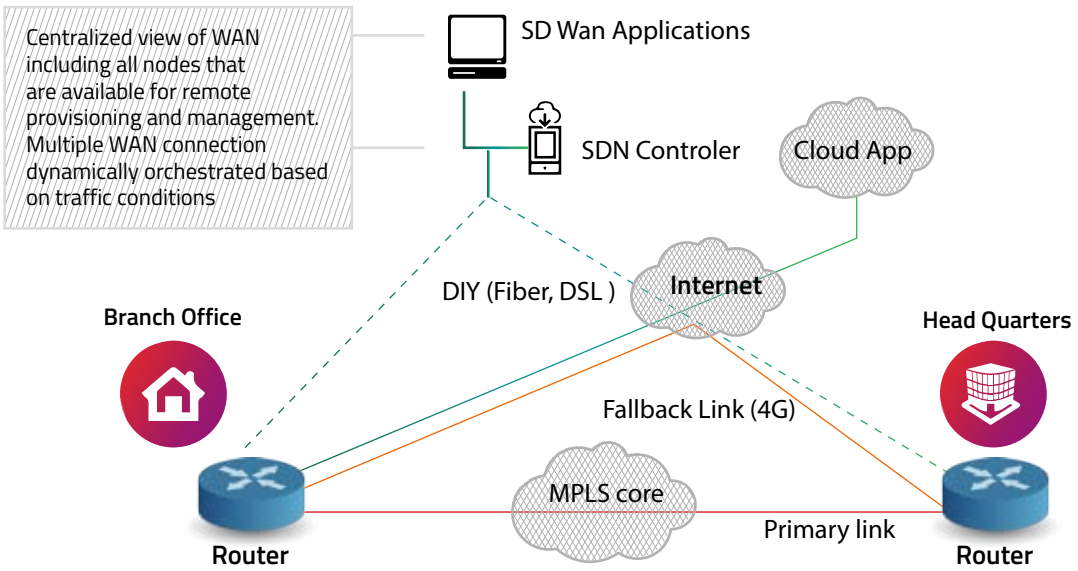


Figure 3: SDN Components: Open-Flow Switch, SDN Controller and SDN Application

The key components of an SD-WAN architecture are SD-WAN routers located at geographically distributed enterprise branch offices, headquarters, data centers, etc. along with other SDN-enabled nodes like PE/CE Routers and Gateways connected to a centralized Controller. Controllers also have capabilities to communicate with traditional non-SDN devices. However, in such scenarios, they must have appropriate southbound interface plugins to interface with those devices currently managed with SNMP or other proprietary NMS interface protocol. The connectivity from these SD-WAN routers could be multiple WAN links based on deployment view similar to that of a hybrid-WAN for e.g.

- **High-Cost, Reliable MPLS-Link**
- **Fixed Broadband Internet (Fiber, DSL, etc.)**
- **Wireless(4G)**

Figure 4: SD-WAN Architecture



Flow rules persist in network nodes in spite of SDN Controller failure, Clustering of controller along with HA is one of the many ways to handle this situation

Here are the key characteristics of this approach creating a motivating business case for SD-WAN deployment.

Centralized Management:

As opposed to device specific provisioning and monitoring, the SD-WAN architecture has a Centralized Management having complete visibility of all the network nodes along with the services provisioned. Operational procedures like the addition of a new service chain (Firewall, IPS, SPAN, Tunnels) is simplified with a rich GUI interface of an SDN application developed over the controller.

Some of the common and complex operational procedures in a hybrid-WAN getting highly simplified and also bringing down WAN operational costs are:

- **Service Instantiation based on the type of outgoing WAN link. For e.g.**
  - **Firewall Instance for External-> Internal Traffic but not for MPLS traffic.**
  - **IPS only for Web traffic but not for MPLS traffic**
  - **Disabling DIA if firewall or IPS is down**
- **Centralized and remote configuration of VRFs, LSP in edge routers for configuring MPLS link**
- **Dynamic application of various policies via Open-Flow rules on traffic characteristics. For e.g.**
  - **Office365, Facebook, YouTube traffic via DIA**
  - **Datacenter, Lync traffic via MPLS link**

Efficiency in Bandwidth Management:

Open-Flow protocols enable to gather statistics from all network nodes to determine the overall health of the WAN. A centralized controller would be able to get various traffic counters, flow counters which can be utilized to gather analytics for dynamic programming to optimize bandwidth costs and to apply different policies.

- **Determine the percentage of overall DIA or MPLS traffic** consumed by various applications. There could be an observed poor performance of a particular application, so the user can add rules to steer the corresponding traffic to the MPLS link.
- **Anomaly Detection: Configuring pre-defined action against**
  -Abnormal Rx(Received) and Tx(Transmitted) Traffic counters over a given period against its defined threshold
  -Deviation of Source & Destination IP pair ranges for an interface or application.
- **Dynamic Traffic Steering for capacity utilization: Depending upon bandwidth usage** the SD-WAN application can program to steer the traffic dynamically to alternate links or apply policies to enforce optimized use of the service. For e.g.
  -Configuring a particular time of the day to reset the threshold of Facebook usage based on monthly usage reports. This action enables freeing of bandwidth for UC application during this period.
  -Freeing up MPLS bandwidth by moving Email, Lync to DIA in a branch office during a bulk transfer to/from data-center.
- **Using Internet as a WAN by optimizing the use of DSL, Fiber, Wireless at the same time dynamically to reduce the reliability factor of an internet connection.**

Challenges with SD-WAN

Our ongoing study of various equipment vendors show that there is no single vendor offering a complete SD-WAN solution in a branch or in the service provider network. The overall market is currently segmented in terms of the options available and key features like zero-touch provisioning is in its nascence.
Key motivating factors for the adoption a SD-WAN solution would be in terms of

- **Initial CAPEX**
- **Availability of on field performance test result of various services c) Accessibility to legacy network nodes and WAN interfaces E1/T1**
- **Unified orchestration capability with multiple controller platforms.**

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Author

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Purnendu is responsible for developing solution and products around SDN & NFV technologies for global customers. He has been instrumental in leading the research and development along with developing different proof of concepts around this space for Happiest Minds. He has around 13+ years of experience and has extensively worked developing products/features/solutions around in GSM, 3G, LTE, Routing & Switching domains.

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