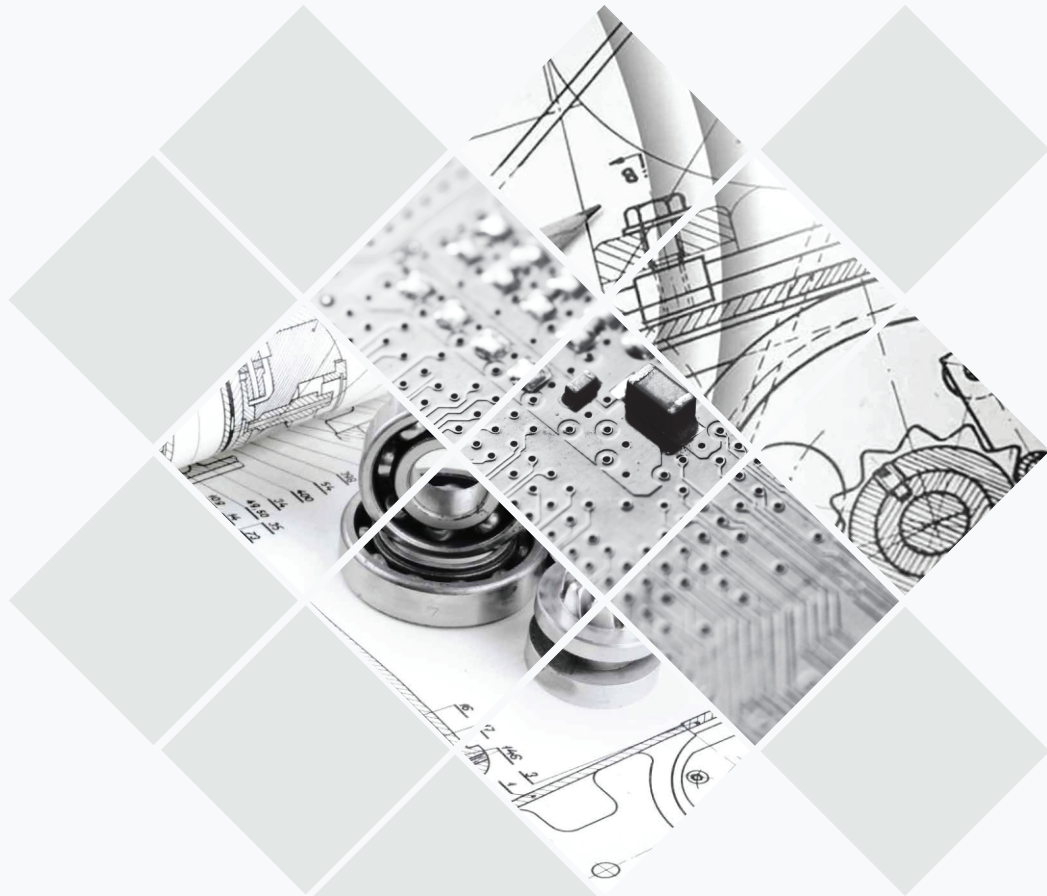


# software defined networking

Software Defined Networking is an emerging trend in the networking and communication industry and it promises to deliver enormous benefits, from reduced costs to more efficient network operations.



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## Software Defined Networking - Virtualization of Traffic Engineering

### Abstract

This white paper presents concept and solutions for virtualization of networks using Software Defined Networking.

Software Defined Networking is an emerging trend in the networking and communication industry and it promises to deliver enormous benefits, from reduced costs to more efficient network operations.

It is an architecture that allows network administrators to easily manage and introduce new network services. This is done by decoupling the management and control planes that makes decisions about where traffic is sent from (the control plane) the underlying hardware that forwards data traffic to the selected destination (the data plane).

In this paper we are describing the virtualization of Traffic Engineering (TE) using SDN, which will cover the followings,

- Traditional network architecture
- Limitations of today's networking technologies
- Why this transformation in networking architecture is required.
- Case Study - Virtualization of Traffic Engineering
- Use cases and Challenges
- Conclusion

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## Software Defined Networking - Virtualization of Traffic Engineering

### Introduction

SDN is a new approach to networking that gives network operators and owners more control of the infrastructure, allowing optimization, customization and virtualization that enable the creation of new types of network services. Such new network services will have the ability to generate new business models, products & services, which reduce capital & operational costs.

### Why SDN?

In the traditional networks, protocols are tightly coupled with network equipment, which is based on the principles of autonomous systems. Even as a proven networking model, simple and scalable, Network engineers have to manually configure a large number of devices individually, which quickly becomes unmanageable.

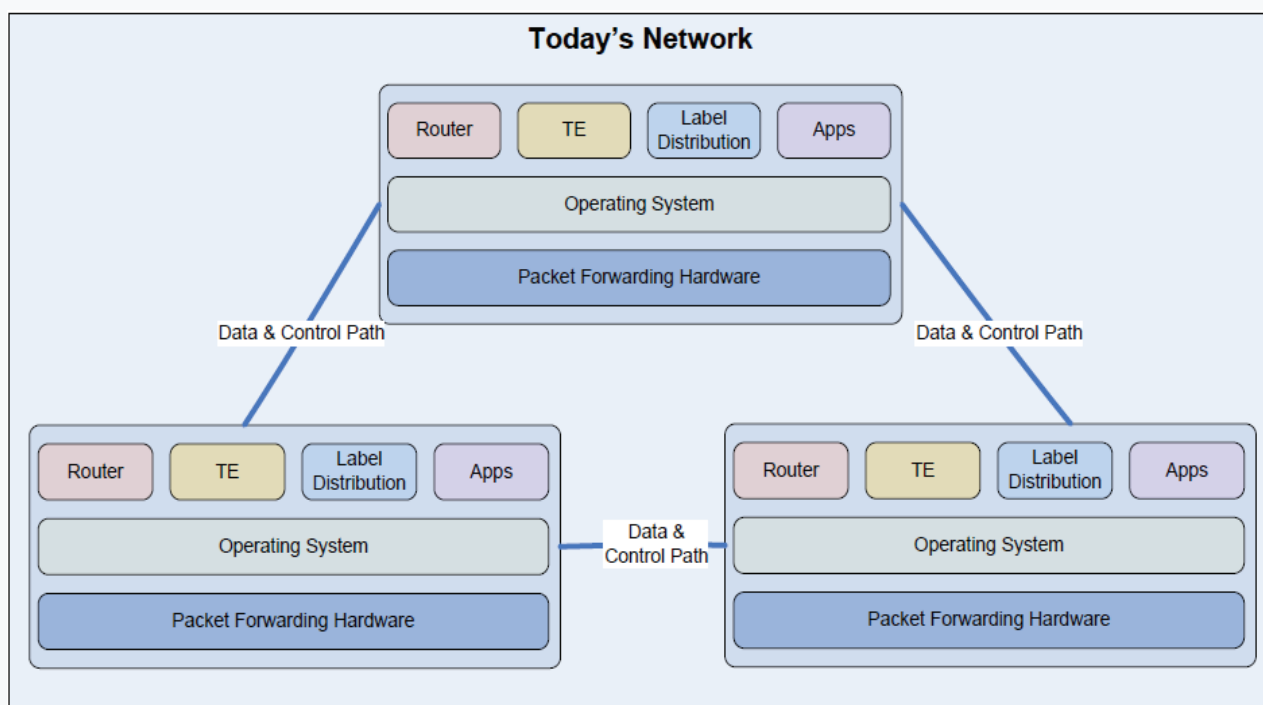


Figure 1 Traditional Network

Also, since networking software is embedded with the networking equipments, moving equipment from one location to other requires a lot of reconfiguration in the network by making the changes in the networking elements such as router, switch or firewall.

A modern network requires the ability to adjust dynamically based on application needs such as traffic patterns and volume of data flowing. Policy changes have to automatically propagate to the entire network for configuration thus manual work and error can be avoided. New features have to be integrated with minimal disruption of the network operations.



## Software Defined Networking - Virtualization of Traffic Engineering

### Next Generation Networks using SDN

SDN addresses most of the concerns that network administrators and designers of modern networks face. SDN provides centralized programmability and management of networks, by separating the control and data planes of network switching. An SDN controller with complete knowledge of networking components and behavior can instruct devices how to handle traffic flows by software messaging. The behavior of the network is then configured by software in contrast to each individual device being independently configured by command-line interface or user interface.

Open Network Foundation (ONF) is take lead in standardization of SDN and defined SDN architecture as shown in the figure 2. Application layer contains business application which consumes SDN services provided by control layer. Control layer- which is called SDN controller provides logically centralized control functionality to application layer and well defined open south API which communicates with infrastructure layer. Infrastructure layer contains networking switches provides switching and forwarding functionalities. Here standard OpenFlow protocol is used to communicate control layer with infrastructure layer. The networking elements used in infrastructure layers should support OpenFlow protocol.

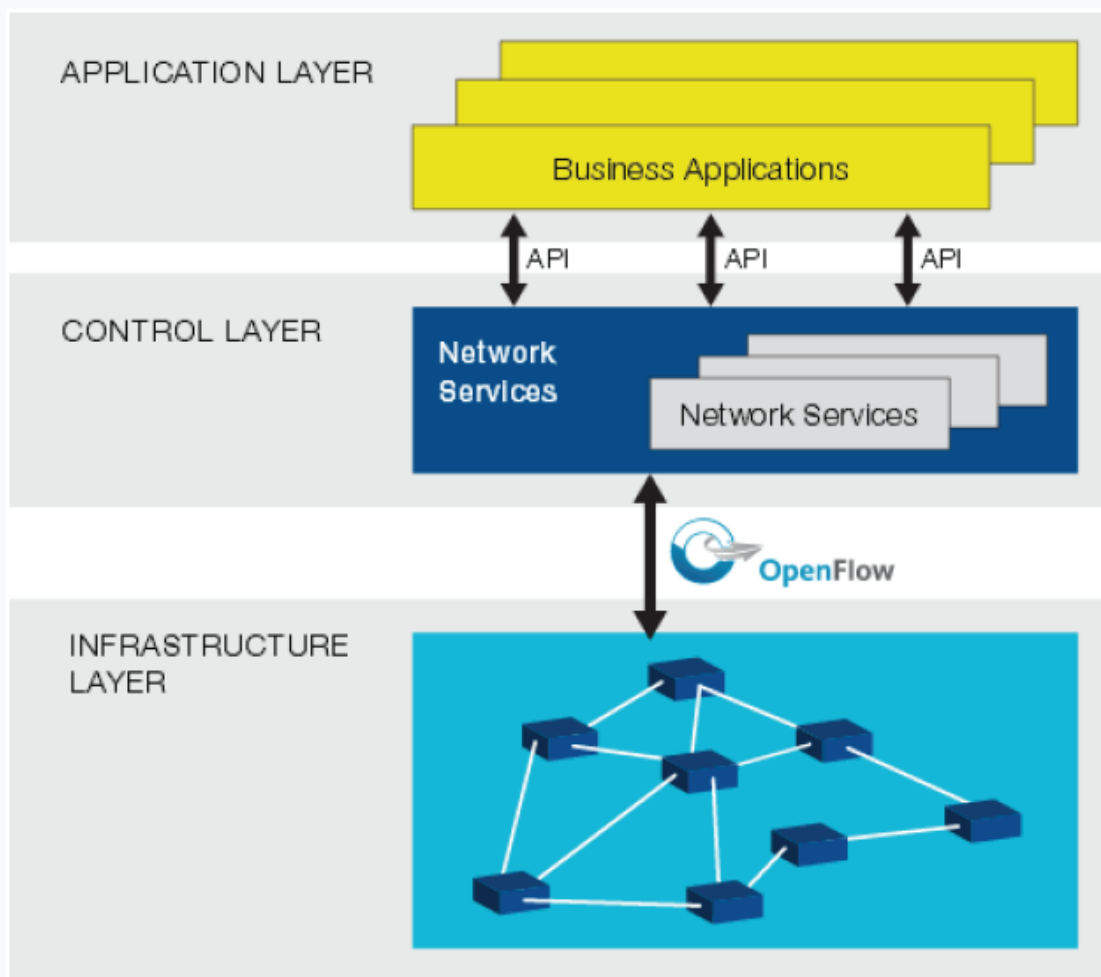


Figure 2 ONF SDN Architecture



## Software Defined Networking - Virtualization of Traffic Engineering

### Market Drivers



Figure 3 Global Data Center IP Traffic Growth

As shown in the above figure according to “Cisco Visual Networking Index Study”, global data center IP traffic to increase three-fold by 2017 and global cloud traffic crossed the zettabyte threshold in 2012, and by 2017, over two-thirds of all data center traffic will be based in the cloud. These data highlight the use of SDN which logically centralize the control plain which improves the programmability and management of dynamically varying network.

So below are the main Market Drivers for next generation SDN.

- Increasing need for mobility
- Growing of cloud services
- Need for efficient network infrastructure
- Consumerization of information technology
- Changing traffic pattern to P2P communication and surging of video traffic
- Intelligent adaptive network for Big Data analytics

### Typical Applications

- Data Center and Cloud – Better scalability, server utilization, centralized control and efficient utilization of bandwidth
- Carriers and internet service providers for efficient utilization of bandwidth

In this paper we are describing the virtualization of networking functions with the help of a specific solution in Traffic Engineering. Here virtualization of Traffic Engineering implemented using SDN and OpenFlow. Enterprise data centers, cloud service providers, long-haul telecom providers and internet service providers can use this solution where TE Capabilities are centralized using SDN and OpenFlow.



## Software Defined Networking - Virtualization of Traffic Engineering

### Virtualization of Traffic Engineering using SDN

#### - A Case Study

Traffic Engineering (TE) is an essential for enterprise data centers, cloud service providers, long-haul telecom providers and internet service providers. Such backbones must support a high use of transmission capacity so that they can withstand link or node failures.

Traffic Engineering optimizes the performance of backbone networks by analyzing the real time data traffic, topology and bandwidth demands.

In today's network TE capabilities can be achieved using TE capable Switches/Routers where complex protocols are replicated in each and every switch as shown in the figure 1.

In SDN based approach as shown in figure below, control plane is decoupled from data plane. Control plane forms SDN controller which contains open source routing stacks; here we are using Quagga routing

framework and OpenFlow 1.1 server. Switches/Routers are OpenFlow 1.1 capable.

Open source routing stack Quagga will act as a Router with Traffic Engineering capability. Currently, Quagga supports common unicast routing protocols, that is BGP, OSPF, RIP, IS-IS and MPLS. Quagga with TE capable routing protocol forms the control plane for the SDN controller.

As part of this solution we made the Switches/Network elements OpenFlow 1.1 capable by porting open source OpenFlow implementation.

DN controller collects the real time data from the underlying network and with the other connected SDN controller. With this data, it computes the path assignments for traffic flows and then programs the paths into the switches using OpenFlow. In the case of changing demand or network events, the service recomputes path assignments and reprograms the switches.

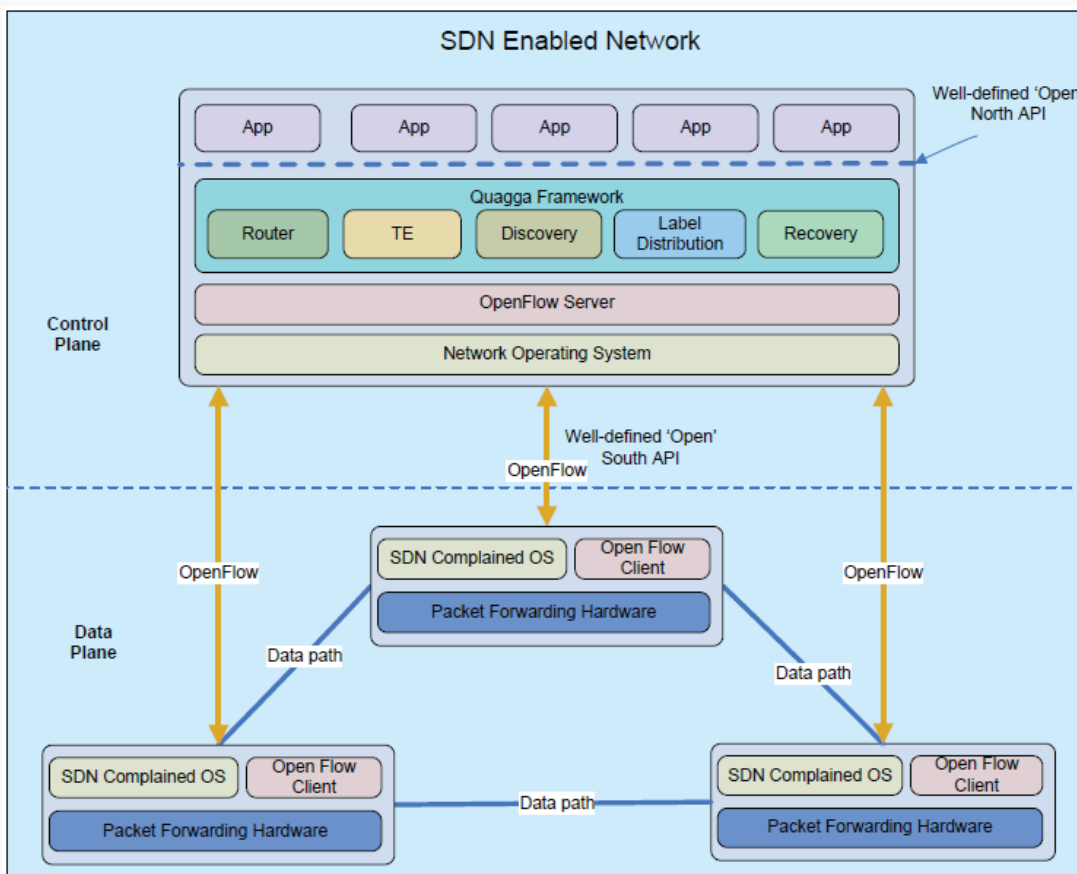


Figure 4 SDN Enabled Traffic Engineering Network



## Software Defined Networking - Virtualization of Traffic Engineering

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#### Benefits of SDN Approach

- **Centralized Control** – SDN allows the centralized control of multi vendor switches because it will inter operate through the OpenFlow protocol.
- **Improves Failover Behavior** – Reduced failures due to simplifying or centralizing configuration, management and provisioning

- **High utilization** - Centralized traffic engineering provides in high utilization of the links.
- **Faster failure handling** - Failures can be identified are handled faster because the functionality are split and divided between SDN controller and Switch/Routers.
- **Maintainability** – SDN splits the control plane from the forwarding/data plane enables us to perform upgradation of SDN controllers or Switches/Routers without much disruption of network.
- **Algorithm Upgradation** - Compute capability of network devices is no longer a limiting factor as control/management plane resides on external servers/controllers.

#### Constraints

- Lack of standardization and awareness among buyers
- OpenFlow protocol is not mature
- Interoperability challenges
- To support co-existence with existing devices, the existing technologies must have additional enhancement

#### Scope for Improvement

Providing redundancy for the SDN controller will be a real challenge in the proposed solution. Since SDN is a centralized solution, failure in the SDN controller will block the entire functionality of the network. To overcome this, a redundant SDN controller, which would be acting as a secondary SDN controller, has to be configured. Communication between primary and secondary SDN controllers has to be addressed in the proposed solution.

SDN also creates concern to network engineers that require understanding to effectively manage security issues. In the traditional networks, engineers understand where each physical device is located and can manage the environment to protect the most valuable assets. In SDN, even though the same security management may be possible, the physical location of the device is less important because the controls are implemented in the abstraction layer. To improve security, engineers need to maintain close surveillance of valuable assets within the environment and track the assets that are being protected. Location enabled asset tracking applications could alleviate such concern of day to day management





## Software Defined Networking - Virtualization of Traffic Engineering

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vof network administration.

### Conclusion

Increasing need for mobility and growing of cloud based services introduce rapid change in network demand which cannot be handled by today's traditional networking architecture. SDN transform today's networks into scalable, programmable platforms which can control multi-vendor switches using OpenFlow protocol. SDN allows IT staff to manage networks with common approach and tool set. Because of control plane running externally in SDN architecture, computing capability of network devices is no longer a limiting factor. It has created a lot of excitement in the networking industry for possibly using low cost hardware in high end network infrastructure which reduces capital expenditure and operational costs.

With its many advantages, SDN is expected to transform today's static network into flexible and programmable platforms of the future networks. While worlds' leading network equipment vendors are getting geared up to embrace this transformation, QuEST is building the expertise and solutions to provide expert level engineering services in SDN technology.

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### Author

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