# Evolving Technologies

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# SD-WAN Software Defined Wide Area Network – What is SD-WAN ?

- SD-WAN is an acronym for software-defined networking in a wide area network (WAN)
- SD-WAN simplifies the management and operation of a WAN by decoupling the networking hardware from its control mechanism
- This concept is similar to how software-defined networking implements virtualization technology to improve data center management and operation

### **SD-WAN Market and Estimated Market Size**



#### Market Opportunity: SD-WAN

#### Market Situation:

- Transition to SD-WAN is happening
- SD-WAN is replacing the market for traditional branch routing solutions



IDC worldwide SD-WARLForecard, 2017 202.

Gartner Forecast: SD-WAN and Its Impact on Traditional Router and MPLS Services Revenue, Worldwide, 2016-2020

# SD-WAN – Why SD-WAN ?

 A key reason of SD-WAN is to allow companies to build higher-performance WANs using lower-cost and commercially available Internet access, enabling businesses to partially or wholly replace more expensive private WAN connection technologies such as MPLS

# **SD-WAN - Forward Error Correction**

• For some applications it is necessary to have good error protection

 Sometimes, it will be impossible for the receiver to communicate back with the sender to check for errors in the received packages

# **SD-WAN - Forward Error Correction**

 Some algorithms are made for this kind of situation as for example in a multiple receiver communication

• They use a forward error correction, which is based on the addition of redundant bits over the bit stream of data

# **SD-WAN - Forward Error Correction**

A simple example of forward error correction is (3,1) repetition code. In this example, each bit of data is sent three times
and the value or meaning of the message is decided upon majority vote. The most frequently sent bit is assumed to be the
value of the message (see table below)

Triplet received	Interpreted as
000	0 (error free)
001	0
010	0
100	0
111	1 (error free)
110	1
101	1
011	1

# **Cisco SD-WAN Cloud Scale Architecture**



# **Component and Architecture of Cisco SD-WAN**

- The Cisco SD-WAN solution is a clouddelivered Wide Area Network (WAN) overlay architecture that extends the principles of software-defined networking (SDN) into the WAN
- Cisco SD-WAN is broken into four parts:
  - Data Plane
  - Control Plane
  - Management Plane
  - Orchestration Plane



# **Cisco SD-WAN Viptela Control Plane**

# OMP (Overlay Management Protocol)

- OMP Works as BGP in Traditional Routing
- Exchanges Routing Information via vSmart
- vSmart acts like BGP RR
- All WAN Edge builds up the OMP Session with vSmart only



# **TLOC (Transport Locator)**

- TLOC is Transport Locator use to identify transport path
- TLOC replaces the next-hop information
- One WAN Edge can be configured up to 8 colors
- TLOC Entry consist of following items:
  - System IP
  - Color
  - Encapsulation Protocol
    - GRE
    - IPSEC



# **Cisco SD-WAN Viptela Management Plane**

# **Device Templates**

- vManage is used for management plane and pushing configuration to the WAN Edges
- Device templates is the combination of multiple feature templates
- Feature templates are used to enable specific global configuration to the WAN edge device
- The other half of the configuration is policy other than templates

# Type of Policy in SD-WAN

- Centralized Control Policy
- Centralized Data Policy
- Localized Control Policy
- Localized Data Policy

# **Centralized Control Policy**

- It's a Central policy and defined on vSmart
- It defines how routing (Route learning and Advertisement ) will take place in SD-WAN through vSmart
- Similar like Route-map in traditional routing
- It also defines the topology between the WAN edges (by default it's full mesh)



# **Cisco SD-Access**

# **Cisco SD-Access**

- An Automated, Programmable Campus Network Fabric Solution
- First Intent Based Network Solution
- Provide Automated end-to-end segmentation to separate users, devices and applications
- Contextual insight for fast issue resolution and capacity planning
- Open programmable interfaces for integration with third party solutions

# **Cisco SD-Access**



# Why SD-Access

- Network deployment
  - Setup or deployment of a single network switch can take several hours due to scheduling requirements and the need to work with different infrastructure groups. In some cases, deploying a batch of switches can take several weeks
  - Disparate networks are common in many organizations, as different systems are managed by different departments. The main IT network is typically operated separately from building management systems, security systems and other production systems

# **SD-Access Components**



# **Fabric Components**

Below are the Fabric Components:

- Fabric Control Plane Node
- Fabric Border Node
- Fabric Edge Node
- Fabric Intermediate Node
- Fabric Wireless LAN Controller (WLC)
- Fabric-Enabled Access Point
- Endpoint
- Cisco Identity Service Engine (ISE)
- Cisco DNA Center

# Fabric Control Plane Node

• The fabric control plane node serves as a central database, tracking all users and devices as they attach to the fabric network, and as they roam around

 The fabric control plane allows network components (switches, routers, WLCs, etc) to query this database to determine the location of any user or device attached to the fabric, instead of using a flood and learn mechanism

# **SD-Access Transit**



# SD-WAN Transit



# IP Transit – MPLS VPN Transport



# Cloud Computing, Edge Computing and FOG Computing

# **Cloud Computing**

 Cloud computing is the delivery of computing services including servers, storage, databases, networking, software, analytics, and intelligence over the Internet to offer faster innovation, flexible resources, and economies of scale

 Cloud computing is the delivery of on-demand computing services from applications to storage and processing power typically over the internet and on a pay-as-you-go basis!

# **Cloud Computing**

 Rather than owning their own computing infrastructure or data centers, companies can rent access to anything from applications to storage from a cloud service provider

 One benefit of using cloud computing services is that firms can avoid the upfront cost and complexity of owning and maintaining their own IT infrastructure, and instead simply pay for what they use, when they use it

# What is IPTV?

- Delivering digital TV services over IP networks by using copper, fiber, wireless and HFC infrastructure
- SP IPTV service is delivered over SP's private network
  - This includes FTTx , xDSL , Wireless , HFC and so on

# **IPTV Network Architecture**

#### **IPTV Network Architecture**



1-2 SHE, 10-100 VHO, 100-1000 VSO

# Content Delivery Networks - CDN

# CDN – Content Delivery Networks

- Content Delivery Network companies replicate content caches close to large user population
- They don't provide Internet access or Transit Service to customers or ISPs, but distribute the content of the Content Providers
- Let's first understand some fundamental businesses such as Content Provider and OTT (Over the Top) Providers

# CDN – What does Content Provider do?

 Content Providers are defined as companies that provide actual content to consumers

- There are two types of Internet sources: Eyeballs and Content
  - Eyeballs: refers to actual users
  - **Content**: refers to data which the users are interested in
- These two terms are used in the networking communities in the standard bodies (IETF, IEEE etc.) and at the events such as NOG, RIPE and IETF meetings

### CDN – What does Content Provider do?

 Search companies (Bing, Google, Yandex, Baidu), TV stations (ABC News, BBC, CNN), video providers (YouTube, Netflix), online libraries and E-Commerce websites all are Content Providers. Content Providers are commonly referred as OTT (Over the Top) Providers

# Wireless Local Area Network Design

# WLAN Architecture

#### **There are three different WLAN Architecture:**

- Autonomous WLAN architecture
- Centralized WLAN architecture
- Distributed WLAN architecture

### WLAN Architecture - Autonomous WLAN Architecture

- For many years, the conventional access point was a standalone WLAN device where control, data and management planes of operation existed and operated on the edge of the network architecture
- These APs are often referred to as fat APs or standalone Aps
- However, the most common industry term for the traditional access point is autonomous AP

### WLAN Architecture - Autonomous WLAN Architecture

 All configuration settings exist in the autonomous access point itself, and therefore, the management plane resides individually in each autonomous AP

 All encryption and decryption mechanisms and MAC layer mechanisms also operate within the autonomous AP

# Artificial Intelligence Machine Learning and Deep Learning

# What is AI, ML and DL

• Artificial intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks

• Machine Learning and Deep Learning are subset of Artificial Intelligence

# **Artificial Intelligence**



# What is AI, ML and DL



ML and DL are subsets of AI

You perform AI using ML and DL technology

# Segment Routing

# **Segment Routing Basics**

- Segment Routing (SR) leverages the source routing paradigm. A node steers a
  packet through an ordered list of instructions, called ' segment '
- State is kept in the packet header, not on the router, with Segment Routing
- Resources such as the CPU and Memory are saved
- If you have 100 Edge Routers in your network and if you enable MPLS Traffic Edge to Edge, you would have 100×99/2 = 4950 LSP states on your Midpoint LSR. This is prevalent in many MPLS TE enabled network

# Segment Routing – Why Segment Routing?

- If you enable Segment Routing and if you evaluate the same midpoint case (since you assign a Prefix/Node SID for every Edge router), Midpoint LSR would have 110 entries instead of 4500 entries
- As for the scalability, everything is perfect. However, there is a caveat
- Segment list can easily get big if you use explicit routing for the purpose of OAM. If you do that, you may end up with 7-8 segments. In that case, it is pertinent that you check the hardware support

# Segment Routing – Why Segment Routing?

 Cisco claims that they have performed the tests on a number of service provider networks and that their findings show that two or three segments would be enough for the most explicit path scenarios

 You can use Segment Routing to provide MPLS VPN service without using LDP for the transport label distribution

# Segment Routing (SRv6) SR IPv6 Dataplane

### Segment Routing (SRv6) – SR IPv6 Dataplane

- Segment Routing works based on Source Routing
- Two dataplane is defined for Segment Routing : MPLS and IPv6
- MPLS has been deployed in many networks
- Segment routing is applied to an IPv6 data plane by encoding IPv6 segments into new routing extension header (SRH)

### Segment Routing (SRv6) – SR IPv6 Dataplane

- SR brings Scalability , removes some protocol requirements such as LDP, RSVP , NSH
- Can provide 50msec FRR coverage in any topology with TI-LFA
- Can be used as unified control plane for DC, WAN and Metro Networks
- SR MPLS in DC can be used but generally hosts don't deploy MPLS, thus SRv6 is seen as better candidate to be deployed towards up to the Host as IPv6 in the host is supported by every vendor

### Segment Routing (SRv6) – SR IPv6 Dataplane

 SR MPLS is used for Transport purpose, SRv6 can be used not only for Transport, but also for Service signaling, so much more protocol can be eliminated in the network



Additional Protocol and State

Additional Protocol just for tenant ID

Simplification, FRR, TE, SDN