13- Software-Defined Networking (SDN)

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Software-Defined Networking Concepts

- SDN was developed following the growing need to automate, scale, and optimize networking that can facilitate application diversity and agility.
- SDN lets you design, build, and manage networks, while separating the control and forwarding planes.
- As a result, the control plane is directly programmable, and it abstracts the underlying infrastructure for applications and network services.

Software-Defined Networking Concepts (cont.)

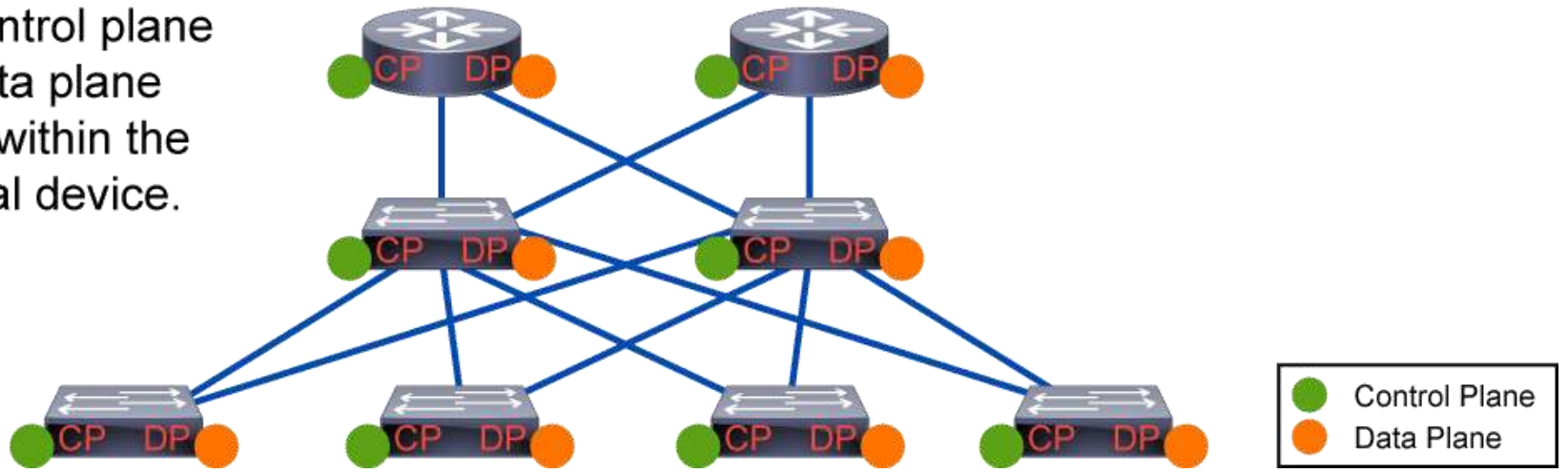
Traditional versus Software-Defined Networks

- In the traditional networks, the control plane of the network devices processes the traffic that is paramount to maintain the functionality of the network infrastructure.
- It consists of applications and protocols between the network devices, which are used to learn and compute forwarding decisions on a device.
- The data plane manages data packet flow.
- It acts on the forwarding decisions while forwarding traffic through the network device.

Software-Defined Networking Concepts (cont.)

Traditional versus Software-Defined Networks (cont.)

The control plane and data plane reside within the physical device.



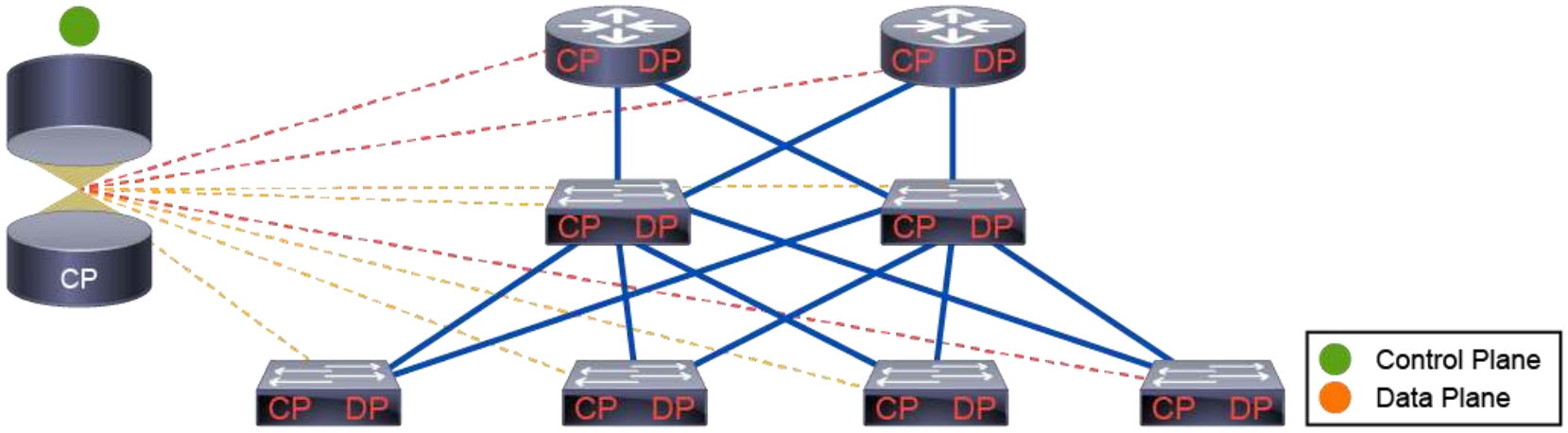
Software-Defined Networking Concepts (cont.)

Traditional versus Software-Defined Networks (cont.)

- As SDN first emerged, there was the thought that the control plane must be removed from each device and that the control plane must be centralized into what is called an SDN controller.
- It is a classic SDN concept of strict separation between the control plane and the data plane.
- In this model, a controller makes all the decisions about how network devices function, while the network device is considered to be "dumb," that is, it has no control capability.

Software-Defined Networking Concepts (cont.)

Traditional versus Software-Defined Networks (cont.)



Software-Defined Networking Concepts (cont.)

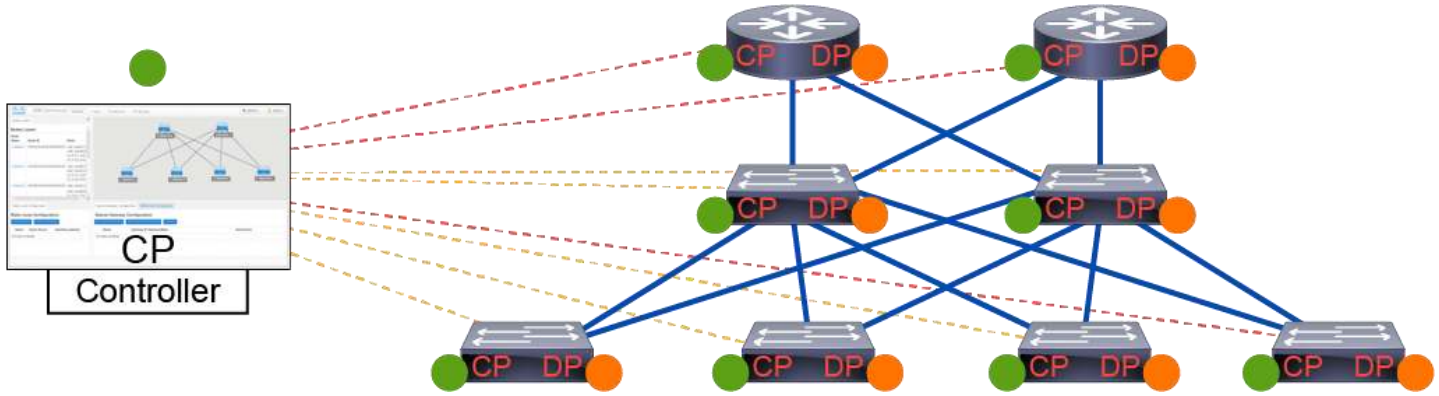
Traditional versus Software-Defined Networks (cont.)

- This approach enables you to evolve the control plane protocols independently of the hardware, while having a central point of control that can control multiple data-plane elements.
- Still, the complete separation of the entire control plane from the data plane in the classic SDN model, is a radical departure from the design and operation of most networks today.
- Besides the benefits that this approach provides, it introduces potential challenges in scalability, availability, and performance, The controller must be able to scale to very large networks, with thousands of nodes, as well as must be highly available with sufficient performance to meet the rapid requests and extreme load conditions on the network.

Software-Defined Networking Concepts (cont.)

Traditional versus Software-Defined Networks (cont.)

- Another option is a combination of the best of both worlds, referred as hybrid SDN, where both traditional networking and SDN operate in the same environment.
- This can be accomplished without a complete decoupling of the control plane and the data plane.



Software-Defined Networking Concepts (cont.)

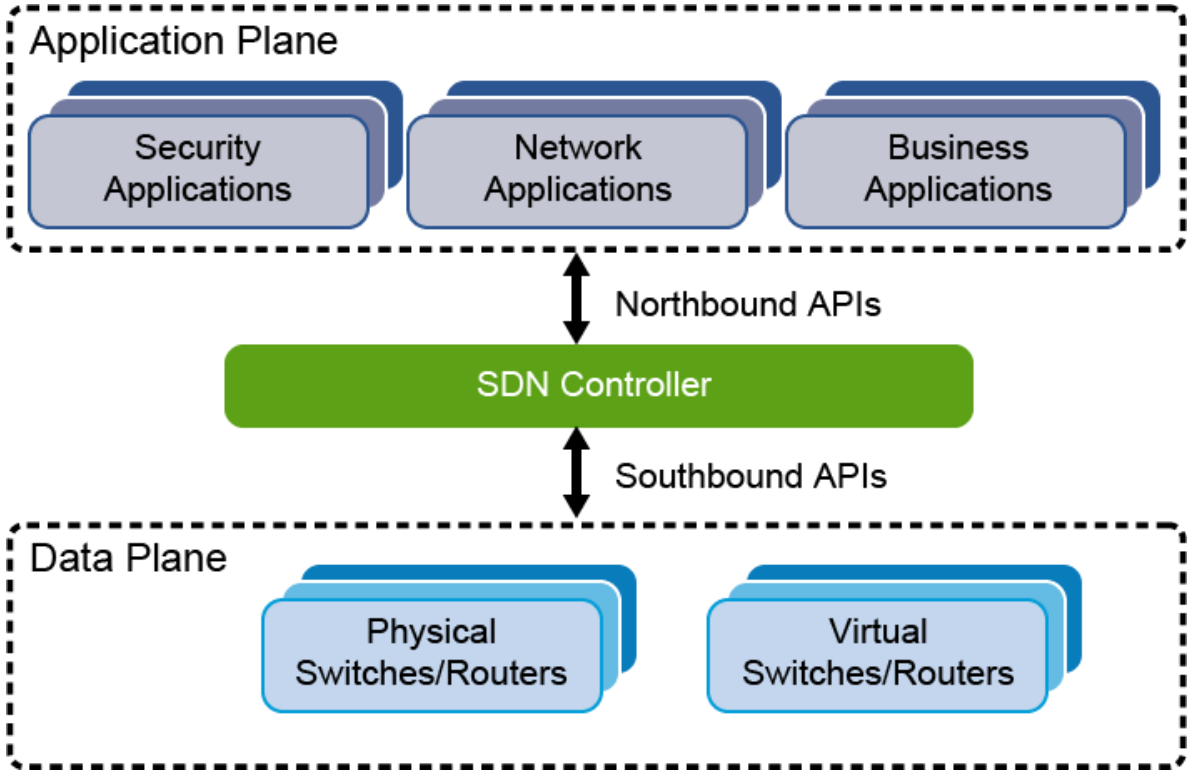
- The SDN movement was started to re-architect packet forwarding techniques, but later realized that real improvement was needed in network operations.
- In traditional networks, network engineers typically use manual, CLI or GUI, through device-by-device approach, which is inefficient.
- There is a drive to eliminate access to CLI (and GUI) to minimize touch-points on the network, as well as utilize programmatic interfaces that allow faster and automated execution of processes and workflows with reduced errors, while working with structured objects such as XML or JavaScript Object Notation (JSON).

Software-Defined Networking Concepts (cont.)

Software-Defined Networking Concepts (cont.)

- SDN offers a centralized, programmable network that consists of the following building blocks:

1. SDN controller
2. Northbound APIs
3. Southbound APIs



Software-Defined Networking Concepts (cont.)

1. SDN Controller

- Is a body of software that replaces, or enhances, the control functions that are traditionally part of the embedded operating system in a network device.
- SDN controllers are the brains of the network, offering a centralized view of the overall network.
- The controller is an active part of the distributed network control plane, rather than a means to configure the network control plane behavior in devices.

Software-Defined Networking Concepts (cont.)

2. Northbound APIs

- Used for communication with the applications and services running over the network.
- For example, the controller supports northbound Representational State Transfer (REST) APIs, which can enable application integration to the network.
- REST is an architectural style that abstracts architectural elements within a distributed hypermedia system.
- REST APIs, based on HTTP and JSON, are becoming a common way of programming infrastructure.

Software-Defined Networking Concepts (cont.)

3. Southbound APIs

- Relay information to the switches and routers in network.
- Hence, the controller uses these APIs to dynamically make changes according to real-time needs, as well as retrieve information for the state of the devices.
- These APIs provide connection to virtual and physical network elements.
- For example, OpenFlow, which was developed by the Open Networking Foundation (ONF), is a southbound interface that can enable the SDN controller to manipulate the forwarding plane of network devices, so it can be adapted to changing business requirements.

Software-Defined Networking Concepts (cont.)

Cisco SDN Solutions

- The SDN solutions enable you to design, provision, and manage highly secure networks that provide access to any application.
- SDN provides choice in automation and programmability across data centers, campuses, and wide-area networks.
- Cisco portfolio has different SDN solutions

Software-Defined Networking Concepts (cont.)

Cisco SDN Solutions (cont.)

1. **Cisco Digital Network Architecture (DNA) Center:**
   - Represents the network management and command center for Cisco DNA, the intent-based network for the enterprise.
   - Cisco DNA is extensible, software-driven architecture that accelerates and simplifies your enterprise network operations, while lowering costs and reducing risks.
   - Cisco DNA Center is an SDN controller, which enables you to provision and configure all your network devices in minutes.
   - It activates features and capabilities on network devices using Cisco DNA software, while everything is managed from the Cisco DNA Center dashboard.

Software-Defined Networking Concepts (cont.)

Cisco SDN Solutions (cont.)

2. Cisco Software-Defined (SD) Access:

- An intent-based networking solution for the Enterprise built on the principles of Cisco DNA.
- It provides automated end-to-end segmentation to separate user, device and application traffic without redesigning the network.
- It enables you to automate user policy access and a single network fabric across wired, wireless, IoT environments, and also extends to the Cisco ACI data center.
- It uses Cisco DNA Center, which provides policy enforcement, workflow-based automation, and analytic into users and application behavior.

Software-Defined Networking Concepts (cont.)

Cisco SDN Solutions (cont.)

3. Cisco SD-WAN:

- A cloud-delivered architecture that enables you to securely connect any user and any application over WAN using a single management console (Cisco vManage), as well as connect them to cloud platforms with greater speed, reliability, and efficiency, without compromising the security.
- You can quickly establish an SD-WAN overlay fabric to connect data centers, branches, campuses, and colocation facilities to improve network speed, security, and efficiency.

Software-Defined Networking Concepts (cont.)

Cisco SDN Solutions (cont.)

4. Cisco SD-Branch:

- Enables you to deploy, monitor, and optimize network services with software and hardware that's purpose-built for branch deployments.
- The Cisco DNA Center enables you to manage the SD-Branch solution and automate provisioning of network services on any hardware or virtual platform across your entire network.
- With centralized orchestration and management for SD-WAN and traditional routing infrastructures, Cisco SD-Branch delivers on-demand network services, makes adding new services and changes easy without visits to remote branches, which enables you to deploy business-critical services in minutes.