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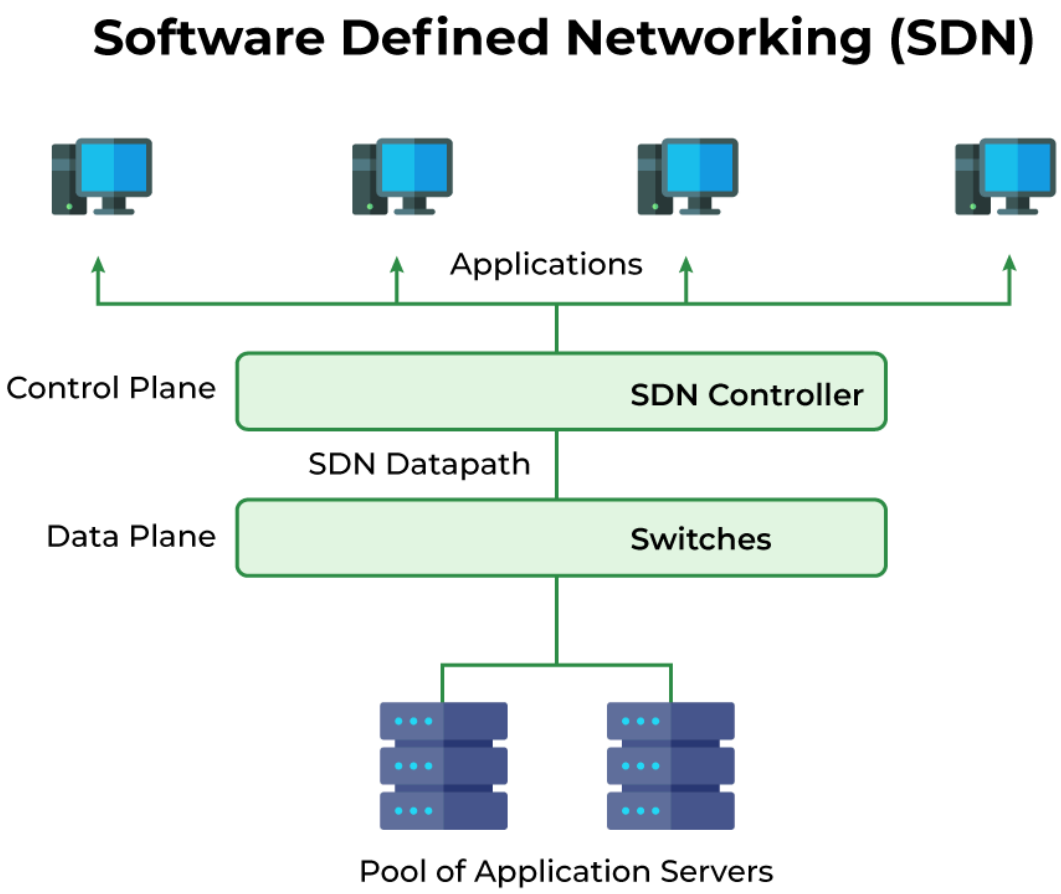
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What is Software Defined Networking (SDN)?

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Software defined networking (SDN) is an approach to network management that enables dynamic, programmatically efficient network configuration to improve network performance and monitoring. It is a new way of managing computer networks that makes them easier and more flexible to control.

In traditional networks, the hardware (like routers and switches) decides how data moves through the network, but SDN changes this by moving the decision-making to a central software system. This is done by separating the **control plane** (which decides where traffic is sent) from the **data plane** (which moves packets to the selected destination).

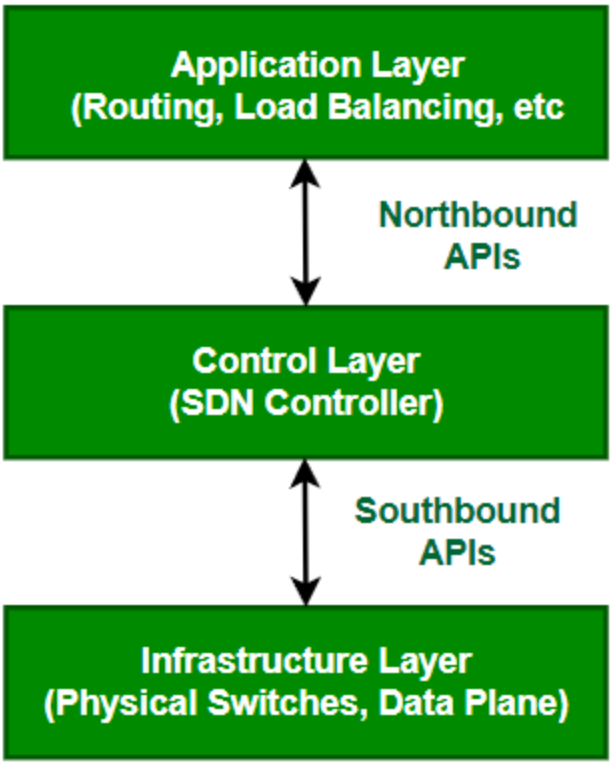


Software Defined Networking

SDN Architecture

In a traditional network, each switch has its own control plane and data plane. Switches exchange topology information to build a forwarding table that decides where to send data packets. In Software-Defined Networking (SDN), the control plane is removed from switches and assigned to a centralized SDN controller. This allows network administrators to manage traffic from a single console instead of configuring each switch individually.

The data plane remains in the switch, forwarding packets based on flow tables set by the controller. These tables contain match fields (like input port and packet header) and instructions (forward, drop, or modify packets). If a packet doesn't match any entry, the switch contacts the controller, which provides a new flow entry to decide the packet's path. A typical SDN architecture consists of three layers.



SDN Architecture

- **Application Layer:** It contains the typical network applications like intrusion detection, firewall, and load balancing.
- **Control Layer:** It consists of the SDN controller which acts as the brain of the network. It also allows hardware abstraction to the applications written on top of it.
- **Infrastructure Layer:** This consists of physical switches which form the data plane and carries out the actual movement of data packets.

The layers communicate via a set of interfaces called the north-bound APIs(between the application and control layer) and southbound APIs(between the control and infrastructure layer).

What is a Data Plane?

All the activities involving and resulting from data packets sent by the end-user belong to this plane. Data Plane includes:

- Forwarding of packets.
- Segmentation and reassembly of data.
- Replication of packets for multicasting.

What is a Control Plane?

All activities necessary to perform data plane activities but do not involve end-user data packets belong to this plane. In other words, this is the brain of the network. The activities of the control plane include:

- Making routing tables.
- Setting packet handling policies.

What are the Components of Software Defining Networking (SDN)?

The three main components that make the SDN are:

- **SDN Applications:** SDN Applications relay requests or networks through SDN Controller using API.
- **SDN Controller:** SDN Controller collects network information from hardware and sends this information to applications.
- **SDN Networking Devices:** SDN Network devices help in forwarding and data processing tasks.

Where is Software Defined Networking Used?

- Enterprises use SDN, the most widely used method for application deployment, to deploy applications faster while lowering overall deployment and operating costs. SDN allows IT administrators to manage and provision network services from a single location.
- Cloud networking software-defined uses white-box systems. Cloud providers often use generic hardware so that the Cloud data center can be changed and the cost of CAPEX and OPEX saved.

Why Software Defined Networking is Important?

- **Better Network Connectivity:** SDN provides very better network connectivity for sales, services, and internal communications. SDN also helps in faster data sharing.

- **Better Deployment of Applications:** Deployment of new applications, services, and many business models can be speed up using Software Defined Networking.
- **Better Security:** Software-defined network provides better visibility throughout the network. Operators can create separate zones for devices that require different levels of security. SDN networks give more freedom to operators.
- **Better Control With High Speed:** Software-defined networking provides better speed than other networking types by applying an open standard software-based controller.

How Does Software-Defined Networking (SDN) Works?

In Software-Defined Networking (SDN), the software that controls the network is separated from the hardware. SDN moves the part that decides where to send data (control plane) to software, while the part that actually forwards the data (data plane) stays in the hardware.

This setup allows network administrators to manage and control the entire network using a single, unified interface. Instead of configuring each device individually, they can program and adjust the network from one central place. This makes managing the network much easier and more efficient.

In a network, physical or virtual devices move data from one place to another. Sometimes, virtual switches, which can be part of either software or hardware, take over the jobs of physical switches. These virtual switches combine multiple functions into one smart switch. They check the data packets and their destinations to make sure everything is correct, then move the packets to where they need to go.

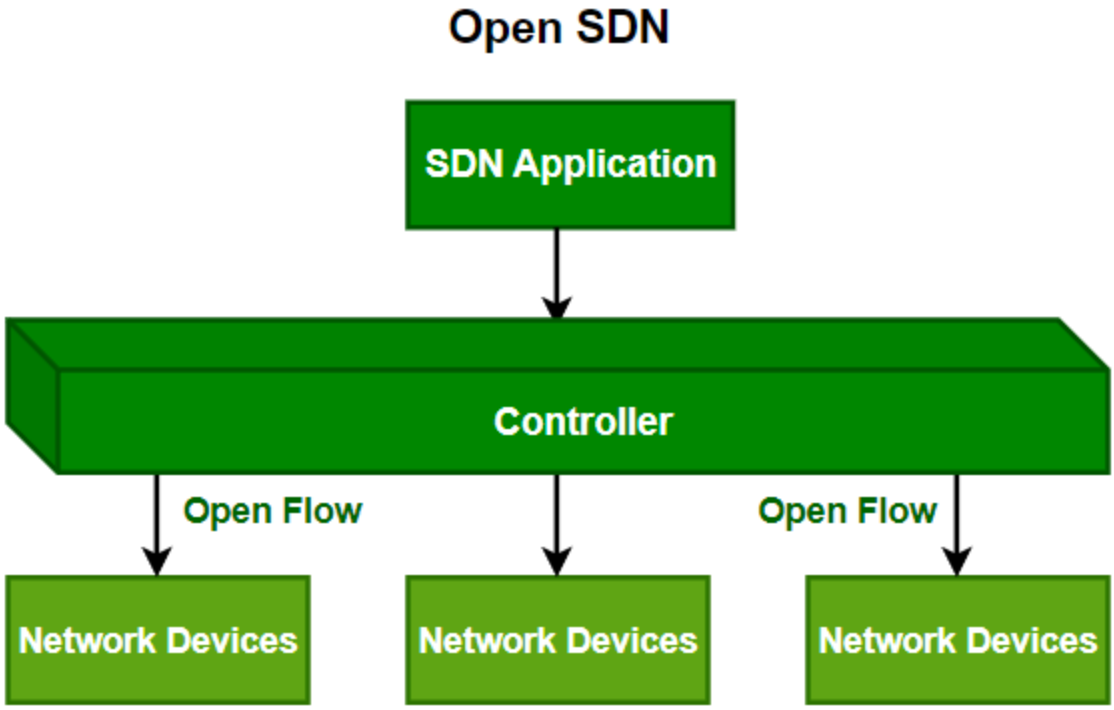
What are the Different Models of SDN?

There are several models, which are used in SDN:

- Open SDN
- SDN via APIs
- SDN via Hypervisor-based Overlay Network
- Hybrid SDN

Open SDN

Open SDN is implemented using the OpenFlow switch. It is a straight forward implementation of SDN. In Open SDN, the controller communicates with the switches using south-bound API with the help of OpenFlow protocol.



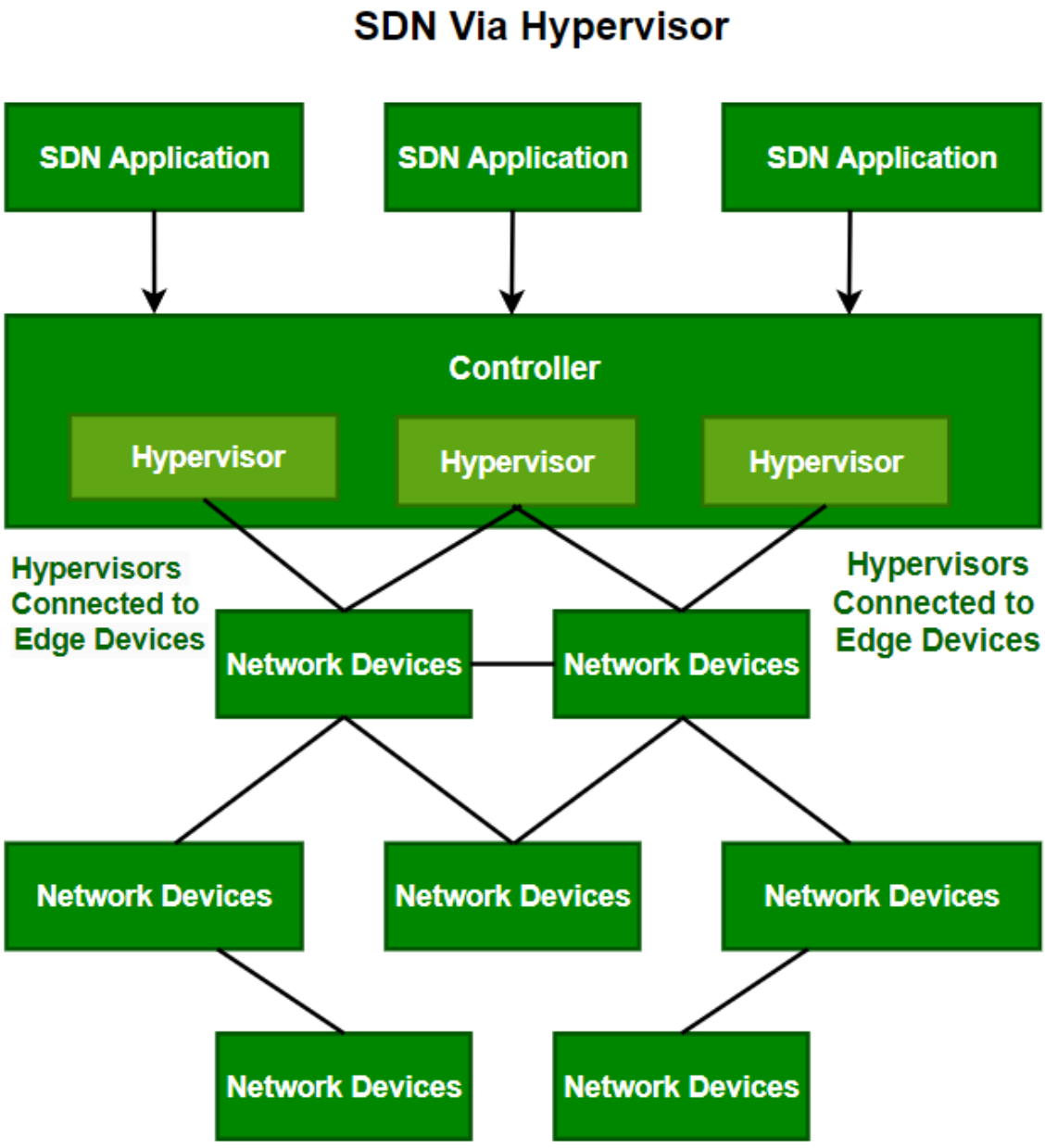
Open SDN

SDN via APIs

In SDN via API, the functions in remote devices like switches are invoked using conventional methods like SNMP or CLI or through newer methods like Rest API. Here, the devices are provided with control points enabling the controller to manipulate the remote devices using APIs.

SDN via Hypervisor-based Overlay Network

In SDN via the hypervisor, the configuration of physical devices is unchanged. Instead, Hypervisor based overlay networks are created over the physical network. Only the devices at the edge of the physical network are connected to the virtualized networks, thereby concealing the information of other devices in the physical network.



SDN via Hypervisor

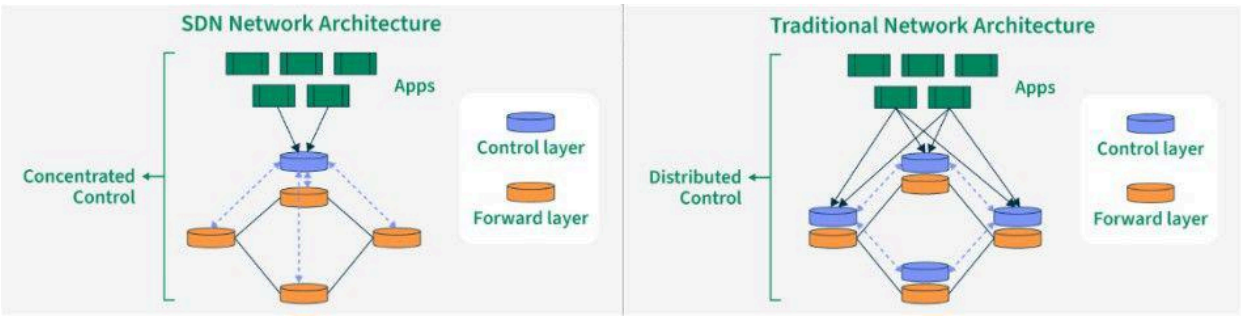
Hybrid SDN

Hybrid Networking is a combination of Traditional Networking with software-defined networking in one network to support different types of functions on a network.

Difference Between SDN and Traditional Networking

Software Defined Networking	Traditional Networking
Software Defined Network is a virtual networking approach.	A traditional network is the old conventional networking approach.
Software Defined Network is centralized control.	Traditional Network is distributed control.
This network is programmable.	This network is nonprogrammable.
Software Defined Network is the open interface.	A traditional network is a closed interface.
In Software Defined Network data plane and control, the plane is decoupled by software.	In a traditional network data plane and control plane are mounted on the same plane.

For more details you can refer to the article differences between SDN and Traditional Networking.



SDN vs Traditional Network Architecture

Advantages of SDN

- The network is programmable and hence can easily be modified via the controller rather than individual switches.
- Switch hardware becomes cheaper since each switch only needs a data plane.
- Hardware is abstracted, hence applications can be written on top of the controller independent of the switch vendor.
- Provides better security since the controller can monitor traffic and deploy security policies. For example, if the controller detects suspicious activity in network traffic, it can reroute or drop the packets.

Disadvantages of SDN

- The central dependency of the network means a single point of failure, i.e. if the controller gets corrupted, the entire network will be affected.
- The use of SDN on large scale is not properly defined and explored.

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