Software-Defined Networks
SDN

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software-defined network

A network organizing technique that has come to recent prominence is the software-defined network (SDN).

In essence, an SDN separates the data and control functions of networking devices, such as routers, packet switches, and LAN switches, with a well-defined application programming interface (API) between the two.

Evolving Network Requirements

Before looking in more detail at SDNs, let us examine the evolving network requirements that lead to a demand for a flexible, responsive approach to controlling traffic flows within a network or internet.

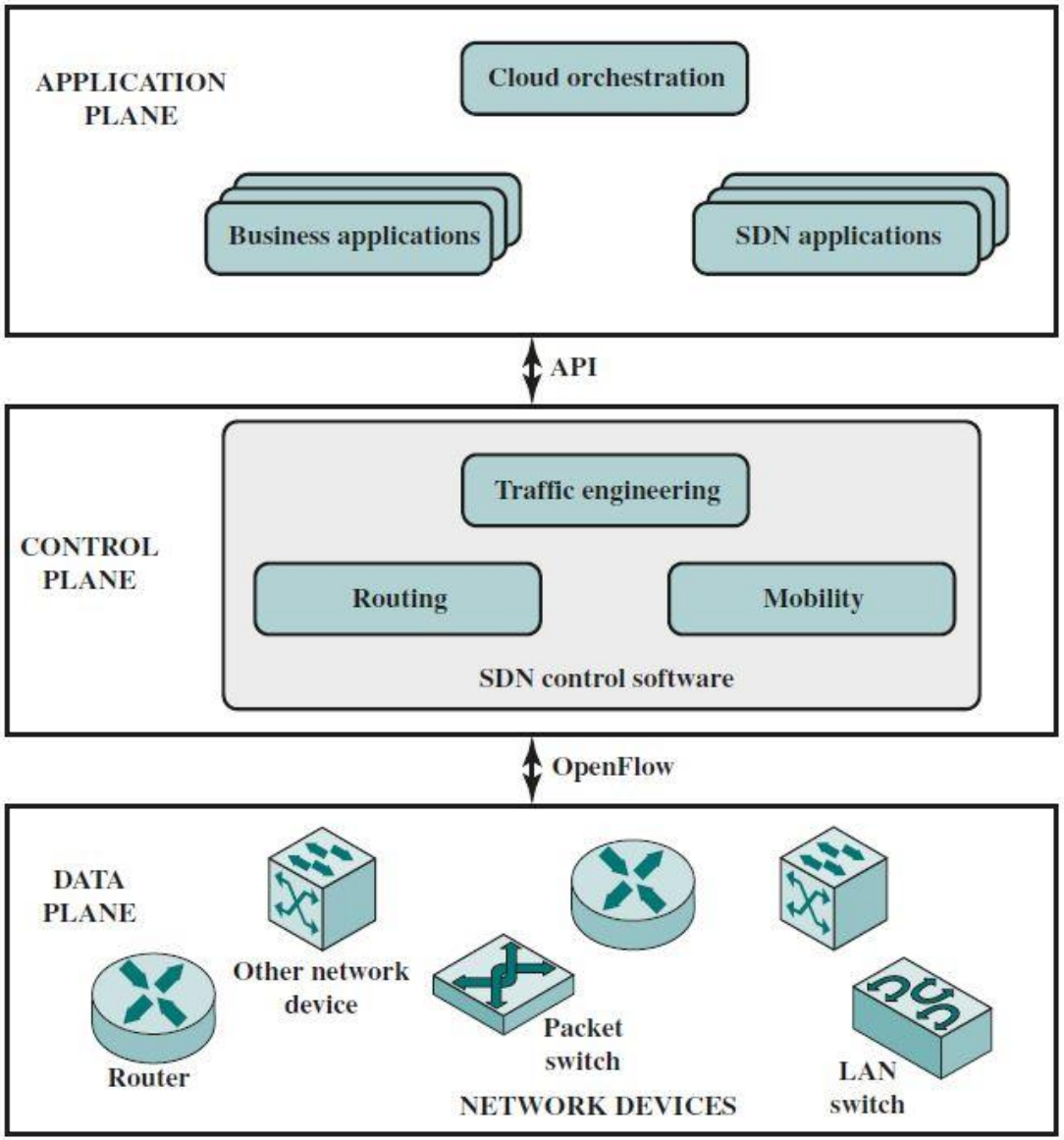
- **First factor is the increasingly widespread use of server virtualization.** In essence, server virtualization masks server resources, including the number and identity of individual physical servers, processors, and operating systems, from server users.

- **Another factor** leading to the need for rapid response in allocating network resources **is the increasing use by employees of mobile devices,** such as smart phones, tablets, and notebooks to access enterprise resources.

SDN Architecture

- **SDN control plane:** A central controller performs all complex functionality, including routing, naming, policy declaration, and security checks. It consists of one or more SDN servers.
- **SDN data plane:** The SDN controller defines the data flows that occur in the SDN data plane. Each flow through the network must first get permission from the controller, which verifies that the communication is permissible by the network policy.

The SDN architecture is remarkably flexible; it can operate with different types of switches and at different protocol layers.



SDN Logical Structure

Functions of Switch in SDN

In an SDN architecture, a switch performs the following functions:

1. The switch encapsulates and forwards a flow's first packet to an SDN controller, enabling the controller to decide whether the flow should be added to the switch's flow table.

2. The switch forwards incoming packets out the appropriate port based on the flow table. The flow table may include priority information dictated by the controller.

3. The switch can drop packets on a particular flow, temporarily or permanently, as dictated by the controller. Packet dropping can be used for security purposes, or traffic management requirements.

In simple terms, the SDN controller manages the forwarding state of the switches in the SDN.

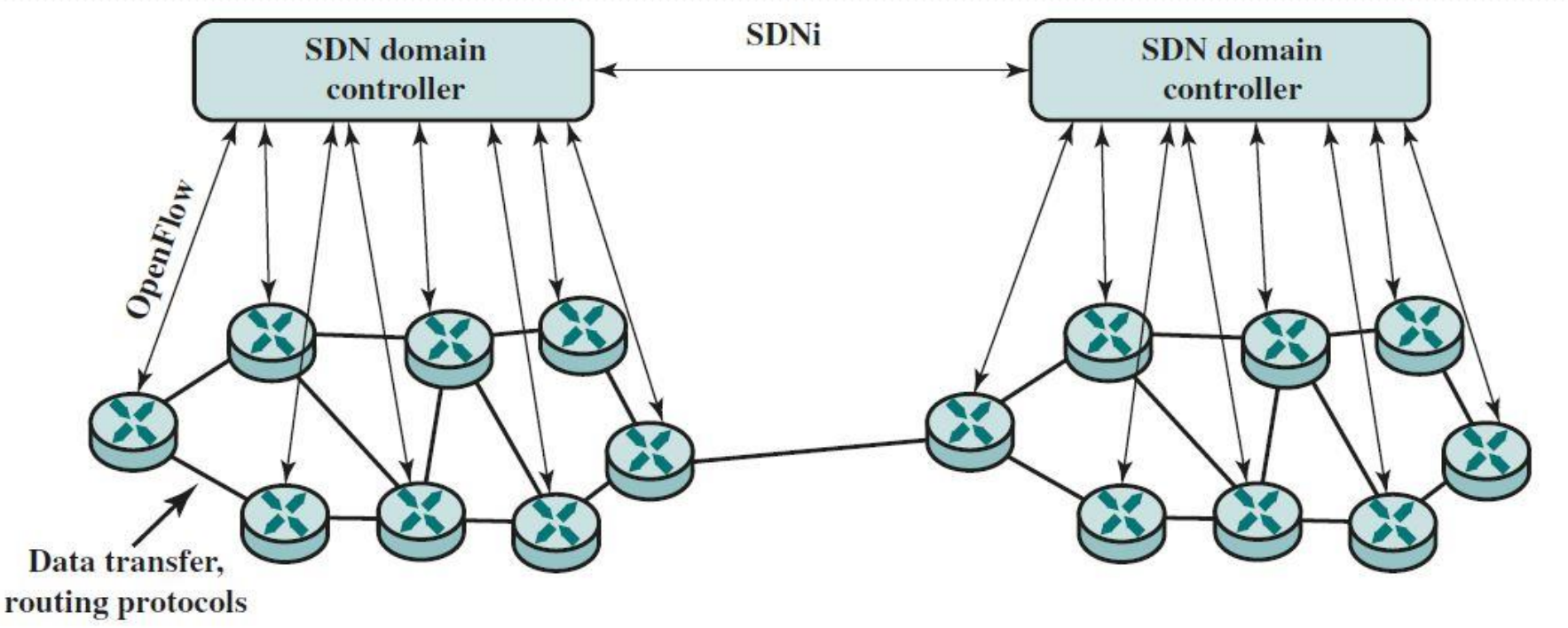
SDN Domains

The operator of a large enterprise network divides the whole network into a number of non-overlapping SDN domains.

Reasons for using SDN domains include the following:

- **Scalability:** The number of devices an SDN controller can manage is limited. Thus, a reasonably large network may need to deploy multiple SDN controllers.
- **Privacy:** A carrier may choose to implement different privacy policies in different SDN domains.
- **Incremental deployment:** A carrier's network may consist of parts of legacy and non-legacy infrastructure. Dividing the network into multiple, individually manageable SDN domains allows for flexible incremental deployment.

SDN Domain Structure



SDN Protocols

The existence of multiple domains creates a requirement for individual controllers to communicate with each other via a standardized protocol, to exchange routing information. IETF (*Internet Engineering Task Force*) developed a protocol, called SDNi, for interfacing SDN domain controllers.

SDNi

SDNi functionality includes the following:

- Coordinate flow setup originated by applications, containing information such as path requirement, QoS, and service level agreements across multiple SDN domains.
- Exchange reachability information to facilitate inter-SDN routing. This will allow a single flow to pass through multiple SDNs and have each controller select the most appropriate path when multiple such paths are available.

SDNi cont..

The message types for SDNi include the following:

- Reachability update
- Flow setup/tear-down/update request (including application capability requirement such as QoS, data rate, latency, etc.)
- Capability update (including network-related capabilities, such as data rate and QoS, and system and software capabilities available inside the domain)

OpenFlow

To turn the concept of SND into practical implementation, two requirements must be met.

- First, there must be a common logical architecture in all switches, routers, and other network devices to be managed by an SDN controller.
- Second, a standard, secure protocol is needed between the SDN controller and the network device.

Both of these requirements are addressed by OpenFlow.

OpenFlow

The OpenFlow protocol enables the controller to manage the logical structure of a switch, without regard to the details of how the switch implements the OpenFlow logical architecture.

Flow Table Components

The basic building block of the logical switch architecture is the flow table. Each packet that enters a switch passes through one of more flow tables.

Each flow table contains entries consisting of six components:

- **Match fields:** Used to select packets that match the values in the fields.
- **Priority:** Relative priority of table entries.
- **Counters:** Updated for matching packets. include the number of received bytes and packets per port, per flow table, and per flow table entry; number of dropped packets; and duration of a flow.

Flow Table Components Coun..

- **Instructions:** Actions to be taken if a match occurs.
- **Time-outs:** Maximum amount of idle time before a flow is expired by the switch.
- **Cookie:** different data value chosen by the controller. May be used to filter flow statistics, flow modification and flow deletion

Conclusions

- It is clear that the virtualization and software defined technologies are the way of the future.
- In fact, we are already see a concept described as Software Defined Anything (SDx) arise. Companies are striving to apply these concepts to all areas of computeing, networking, storage, and security.
- SDN's promise of an open sourced, centralized, and programmable software controlled network is certainly enough to get anyone excited about the possibilities and changes such a solution could bring.

Thank You

ÖNEMLİ

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