

13 Network Virtualization

13.1 Cloud Computing

- Cloud Services
 - Software as a Service (SaaS): Anwendungen: Office 365
 - Platform as a Service (PaaS): OS, Entwicklungstools
 - Infrastructure as a Service (IaaS): CPU, Speicher, Netzwerk
- Cloud Models
 - Public clouds: MS Teams, ...
 - Private clouds: nur für eine Organisation
 - Hybrid clouds: Aufteilung der Daten
 - Community clouds: wie private, aber von mehreren Unternehmen gemeinsam genutzt
- Cloud computing vs. Data center
 - Data Center: physical facilities: compute, network, and storage
 - Cloud computing: off-premise service

13.2 Virtualization

- Abstraction Layers
 - Services
 - OS
 - Firmware
 - Hardware
- Type 2 Hypervisor
 - Hardware, Host OS, Hypervisor, Guest-OS
 - VMWare Workstation, VirtualBox, Parallels
- Type 1 Hypervisor (bare metal)
 - Hardware, Hypervisor, Guest-OS
 - require management console (e.g. Cisco UCS Manager)
 - server over allocation: VMs haben insgesamt mehr RAM als Hardware
 - Hyper-V, KVM, VMware ESXi

13.3 Virtual Network Infrastructure

- Wenn VMs zwischen Servern verschoben werden, müssen VLANs angepasst werden
- East-West-Traffic: innderhalb des Data Center zwischen VMs
- North-South-Traffic: distribution - core - offsite
- virtual routing and forwarding (VRF)

13.4 Software-Defined Networking (SDN)

3 Schichten

- Management Plane: SSH, TFTP, SFTP, HTTPS, SNMP
- Control Plane: Routing-Protocols, Routing-Tables, STP, ARP-Table
- Data Plane (Forwarding Plane): forward traffic flows

Traditional Architecture

- Jedes Gerät hat eigene Control Plane und Data Plane
- Cisco Layer-3-Switch: CEF (Cisco Express Forwarding)
 - Control Plane: Routing Table, ARP Table pre-populate ⇒
 - Data Plane: FIB (Forwarding Information Base), adjacency table

Network Virtualization Technologies

- SDN Architecture
 - Centralized Control Plane im SDN Controller
 - OpenFlow: Protocol, Southbound-API (SDN-Controller - Data-Plane)
 - OpenStack: virtualization and orchestration platform, IaaS solution
- ACI (Cisco Application Centric Infrastructure)

13.5 Controllers

Elements of OpenFlow Switch

- flow: sequence of packets
- Flow Table: incoming packets → flow → Group Table
- Group Table: triggers actions
- Meter Table: triggers performance-related actions

Cisco ACI (Application Centric Infrastructure)

- Hardware Solution
- Integrates cloud computing and data center management
- policy element is removed from data plan
- Application Network Profile (ANP): end-point groups (EPG), policies
- Application Policy Infrastructure Controller (APIC)
 - centralized software controller
 - translates the application requirements into a network configuration
- Cisco Nexus 9000 Series switches: application-aware switching fabric
- two-tier spine-leaf topology
 - Spine: Cisco Nexus 9500 Series switches
 - Leaf: Cisco Nexus 9300 Series switches → APIC, Network devices

SDN Types

- Device-based SDN: (z.B. Cisco OnePK) Application → Data plane device
- Controller-based SDN: Application (OpenDaylight) → centralized controller (Cisco Open SDN) → Data plane device
- Policy-based SDN: Application (Cisco APIC-EM) → Policy layer → SDN controller → Data plane device