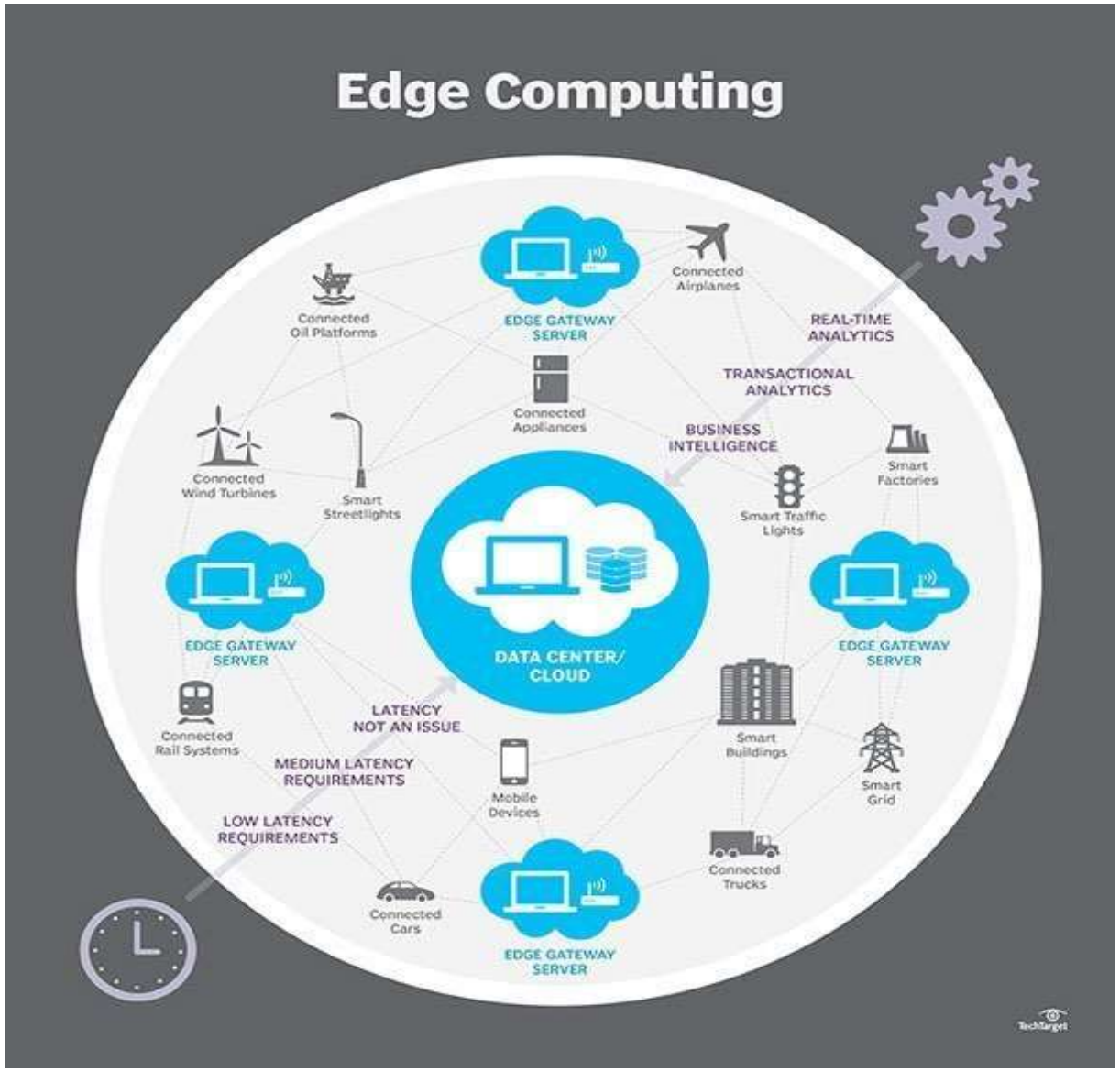
# Current and future networking solutions

# Edge computing

- Edge computing
  - distributed computing paradigm
  - brings computation and data storage closer to the location where it is needed
  - applications and data closer to devices — and their users.
  - improve response times and save bandwidth
  - use of micro data centers
- vs cloud computing
  - huge data centers
  - massive data storage and processing
  - edge computing complements cloud computing


Edge Computing
EDGE GATEWAY SERVER
Connected Airplanes
Connected Oil Platforms
REAL-TIME ANALYTICS
TRANSACTIONAL ANALYTICS
Connected Appliances
BUSINESS INTELLIGENCE
Connected Wind Turbines
Smart Streetlights
Smart Factories
Smart Traffic Lights
EDGE GATEWAY SERVER
DATA CENTER/ CLOUD
EDGE GATEWAY SERVER
Connected Rail Systems
LATENCY NOT AN ISSUE
MEDIUM LATENCY REQUIREMENTS
Smart Buildings
Smart Grid
Mobile Devices
LOW LATENCY REQUIREMENTS
Connected Trucks
Connected Cars
EDGE GATEWAY SERVER
TechTarget

# Edge computing

- Where?
  - Edge data centers
  - IoT
  - Application domains: retail, healthcare, transportation, etc. (*can you give examples*)

- Why?
  - regulatory compliance around location and data privacy
  - Performance
    - lower latency
    - higher bandwidth
    - Low levels of congestion and reliability

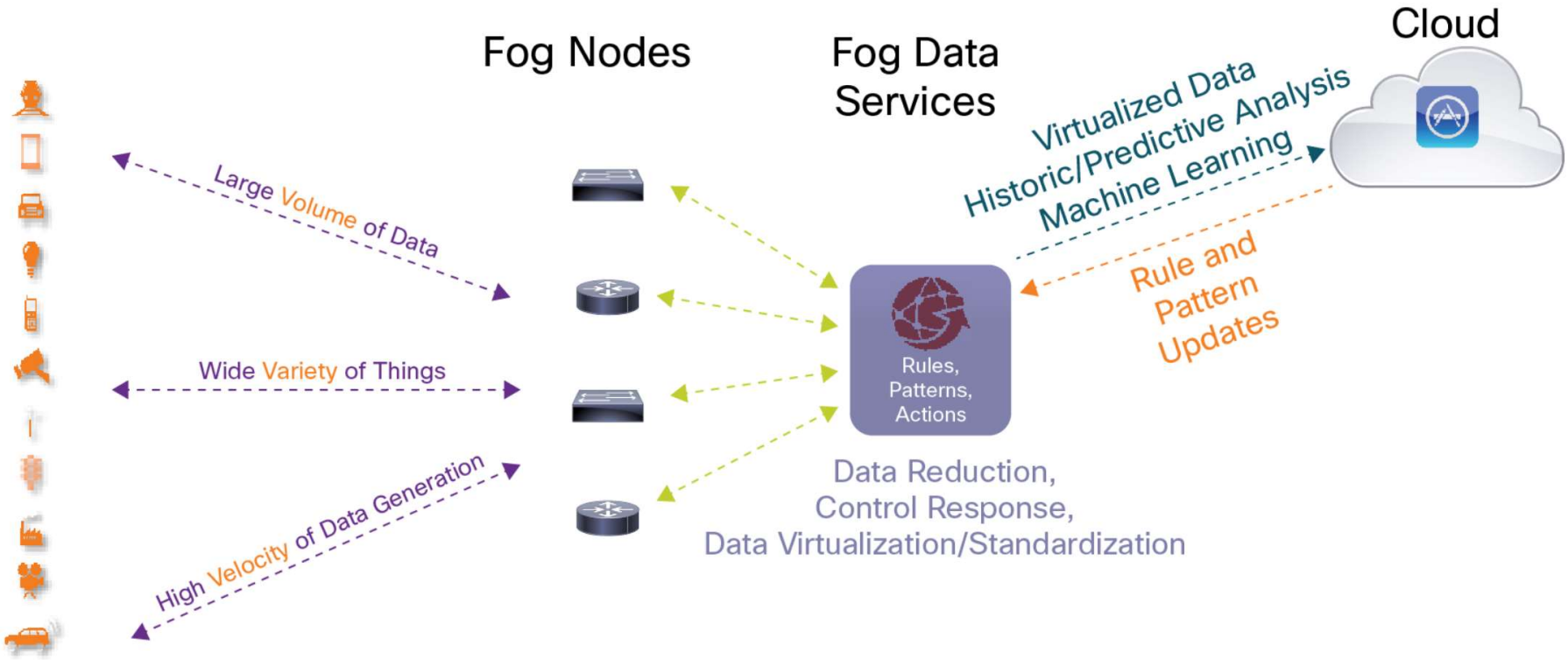
# Edge computing

- **Micro data centers** help IT professionals install and manage edge networking and computing simply, reliably, and predictably by combining power, cooling, physical security, and management software and services into prepackaged rack solutions that can be deployed globally in any environment.

  https://www.apc.com/gr/en/solutions/business-solutions/micro-data-centers/overview.jsp

# Fog computing

- Defined by Cisco (similar to edge computing)



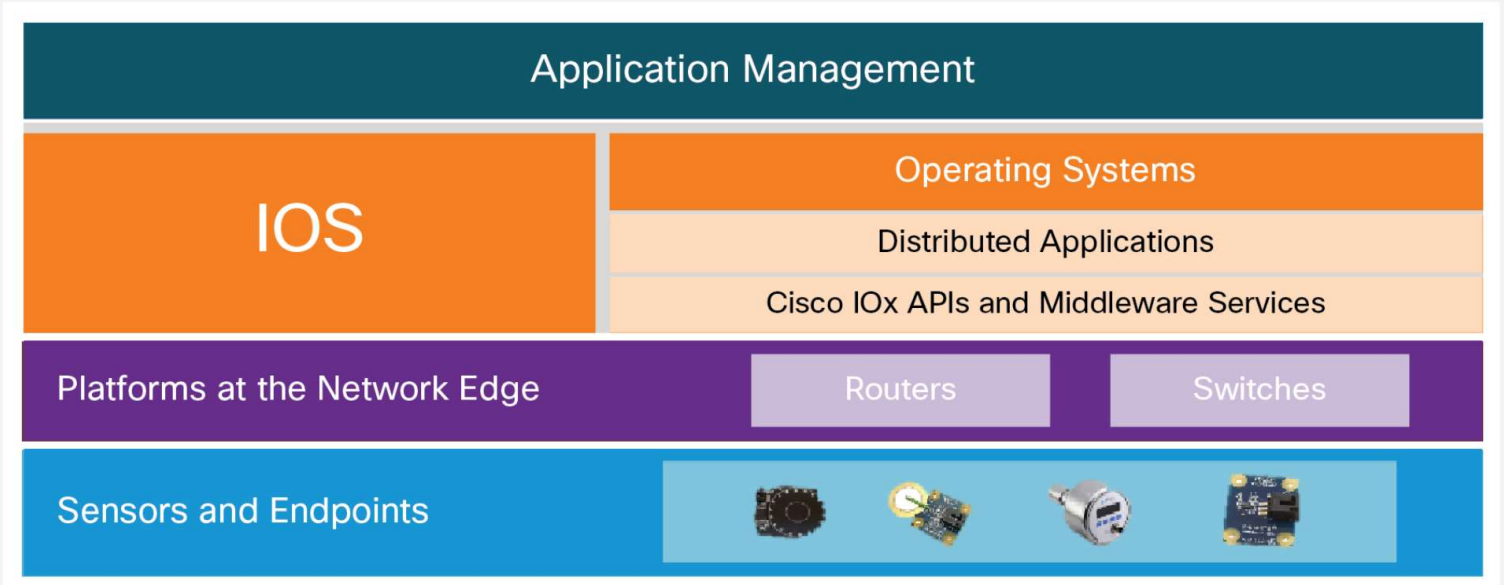
# Fog computing

- Cisco offers software as a service (SaaS) built on PaaS and IaaS
- **Plus** Machine as a Service
- (MaaS)

**How Cisco IOx Works**

Cisco IOx hosts applications in a Guest Operating System (GOS) that runs on a hypervisor on a Cisco fog node (Figure 1). Cisco IOx comes with Yocto Linux, but developers can use any operating system.

**Figure 1.** Cisco IOx Makes It Possible to Offer Fog Infrastructure as a Service



# Software defined networks (SDNs)

- What is SDN? – decoupling of data and control planes

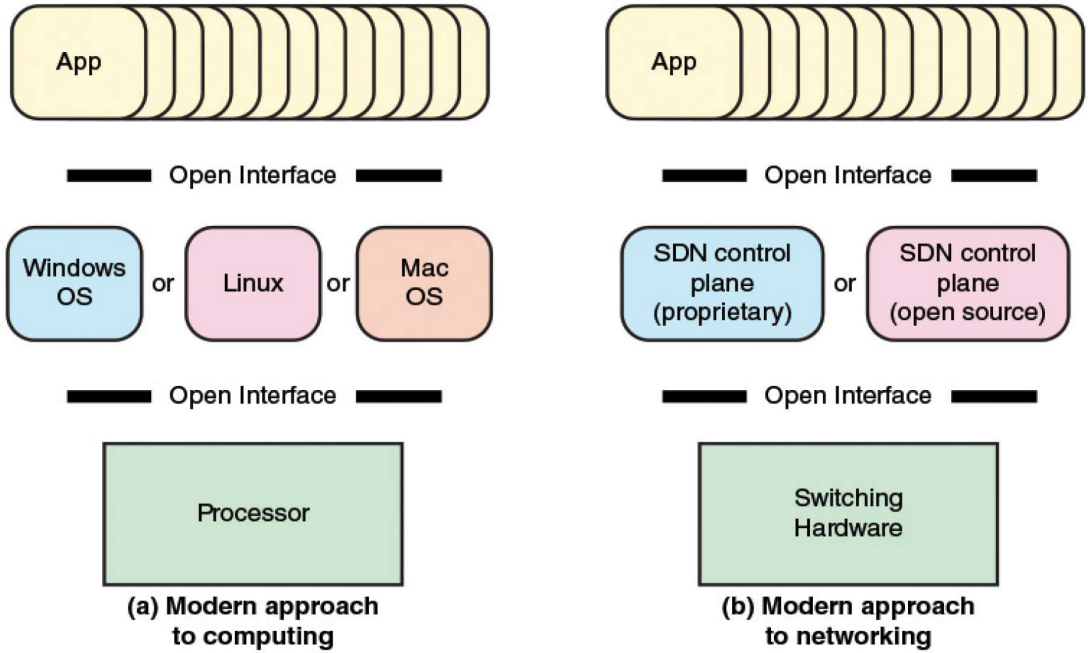



FIGURE 3.1 The Modern Approach to Computing and Networking

W. Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", Ed. Addison-Wesley Professional, 2015

# Software defined networks (SDNs)

- Why?
  - Traditional Network Architectures are Inadequate
  - Demand is Increasing
    - Cloud computing, Big data, Mobile traffic, The Internet of Things (IoT)
  - Supply is increasing
    - 4G, 5G, fiber, virtualization etc
  - Traffic Patterns Are More Complex
    - “horizontal” traffic between servers as well as “vertical” traffic between servers and clients; Unified communications (UC); BYOD; Classical C/S shifted towards virtualization

# Software defined networks (SDNs)

- How?
  - decoupling of data and control planes
  - modular
  - adding new features
  - use of open interfaces and APIs
  - custom features not device custom built

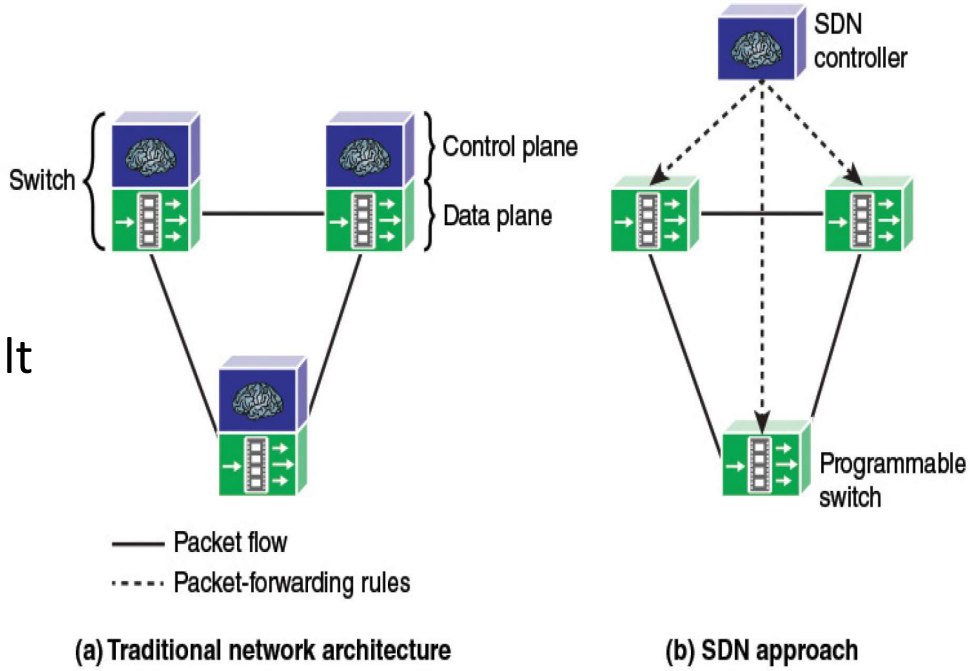
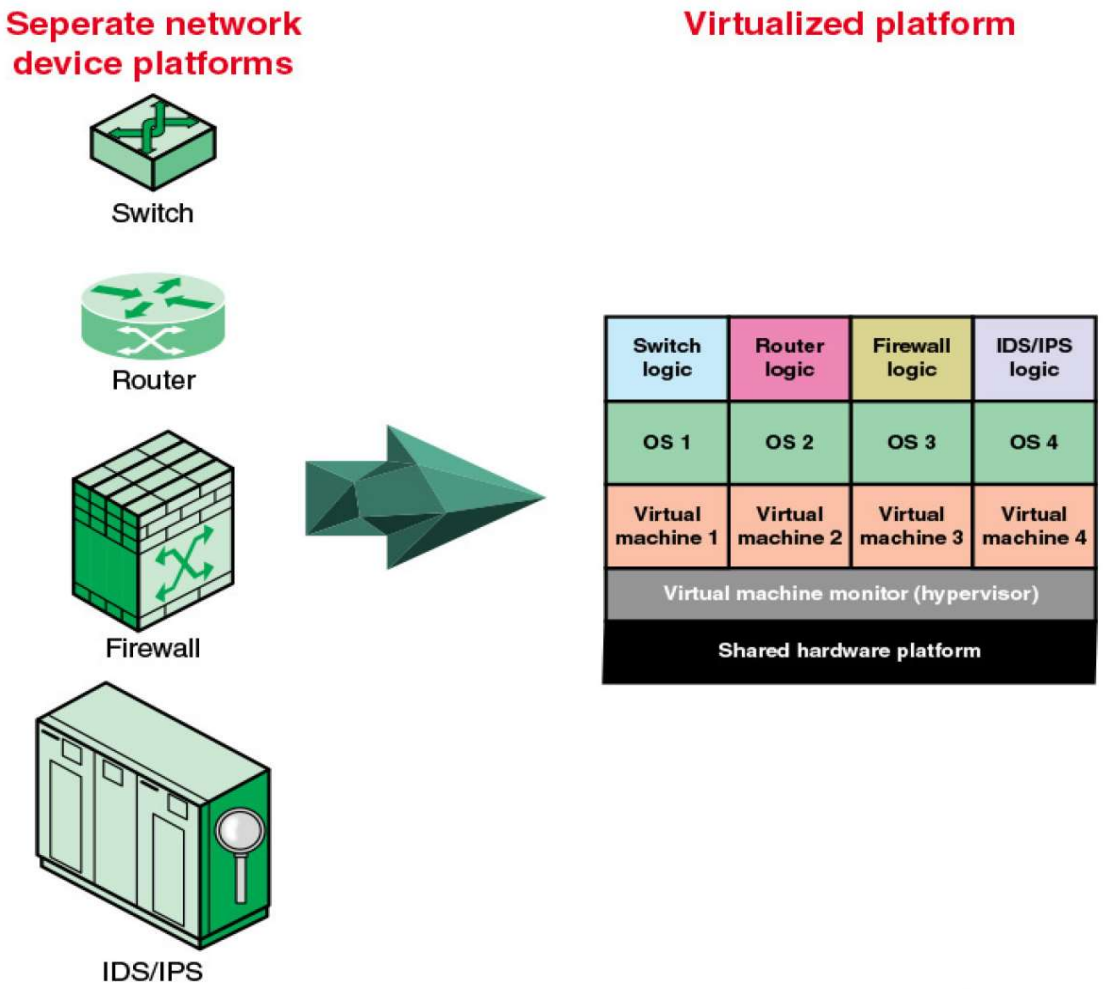



FIGURE 3.2 Control and Data Planes

W. Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", Ed. Addison-Wesley Professional, 2015

# Network function virtualization (NFV)




W. Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", Ed. Addison-Wesley Professional, 2015

**FIGURE 2.16** Network Functions Virtualization