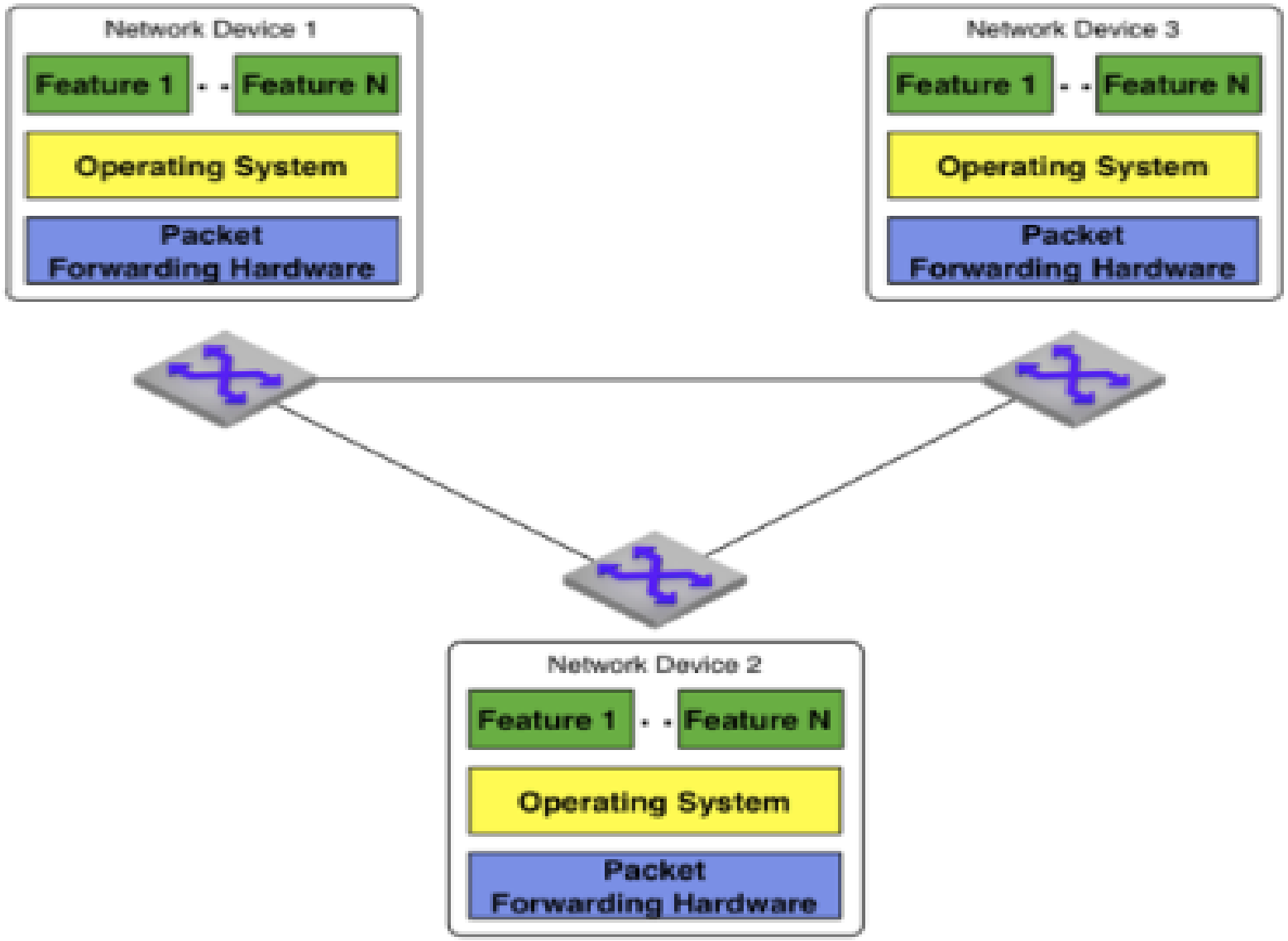
Software Defined Networking

Traditional Scheme



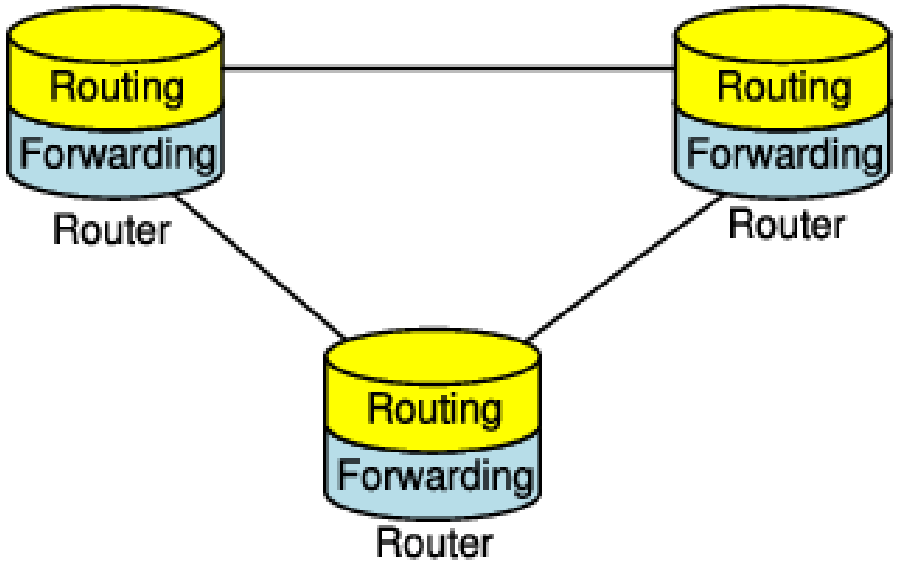
- Software-Defined Networking (SDN) is a networking architecture that **separates the control plane** from the **data plane and centralizes the network controller**.
- Network devices in conventional network architectures are getting exceedingly **complex** with the **increasing number of distributed protocols** being implemented and the use of **proprietary hardware and interfaces**.
- In the conventional network architecture the control plane and data plane are coupled.
- **Control plane** is the part of the network that carries the **signaling and routing message** traffic while the **data plane** is the part of the network that carries the **payload data traffic**.

The limitations of the conventional network architectures

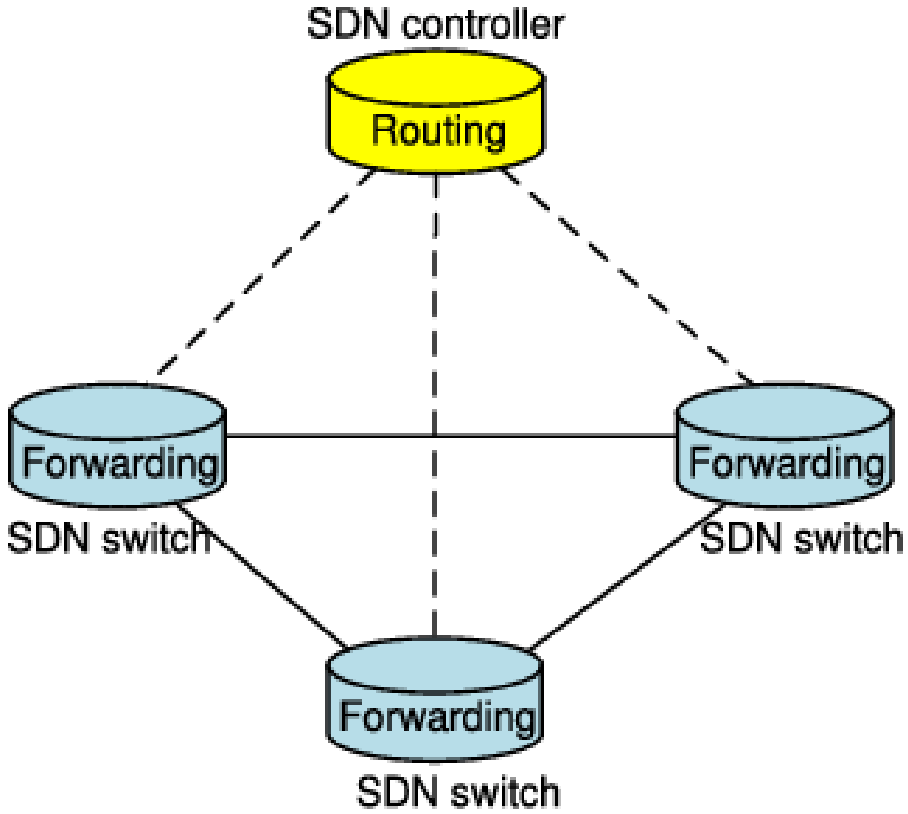
- **Complex Network Devices**: Conventional networks are getting increasingly complex with **more and more protocols** being implemented to improve link speeds and reliability.
- **Limited Interoperability**: Interoperability is limited due to the lack of standard and open interfaces. Network devices use proprietary hardware and software and have slow product life-cycles limiting innovation.
- **Dynamic Traffic pattern:** The conventional networks were well suited for static traffic patterns and had a large number of protocols designed for specific applications. For IoT applications which are deployed in cloud computing environments, the traffic patterns are more dynamic. Due to the complexity of conventional network devices, making changes in the networks to meet the dynamic traffic patterns has become increasingly difficult.
- **Management Overhead:** Conventional networks involve significant management overhead. Network managers find it increasingly difficult to manage **multiple network devices and interfaces** from multiple vendors. Upgradation of network **requires configuration changes in multiple devices** (switches, routers, firewalls, etc.)
- **Limited Scalability:** The virtualization technologies used in cloud computing environments has increased the **number of virtual hosts requiring network access**. IoT applications hosted in the cloud are distributed across multiple virtual machines that require exchange of traffic. The analytics components of lot applications run distributed algorithms on a large number of virtual machines that require huge amounts of data exchange between virtual machines. Such computing environments require highly scalable and easy to manage network architectures with **minimal manual configurations,** which is becoming **increasingly difficult with conventional networks.**

SDN:

- SDN attempts to create network architectures that are simpler, inexpensive, scalable, agile and easy to manage.
- In SDN, control and data planes are **decoupled and the network controller is centralized**.
- Software-based SDN controllers maintain a **unified view** of the network and make configuration, **management and provisioning simpler.**
- The **underlying infrastructure** in SDN uses simple **packet forwarding hardware** as opposed to specialized hardware in conventional networks.



Traditional network
(Routing and forwarding are coupled)



SDN network
(Routing and forwarding are decoupled)

SDN

- Network devices become simple with SDN as they do not require implementations of a large number of protocols.
- Network devices receive instructions from the SDN controller on how to forward the packets.
- These devices can be simpler and cost less as they can be built from standard hardware and software components.

Key elements of SDN are as follows:

Centralized Network Controller:

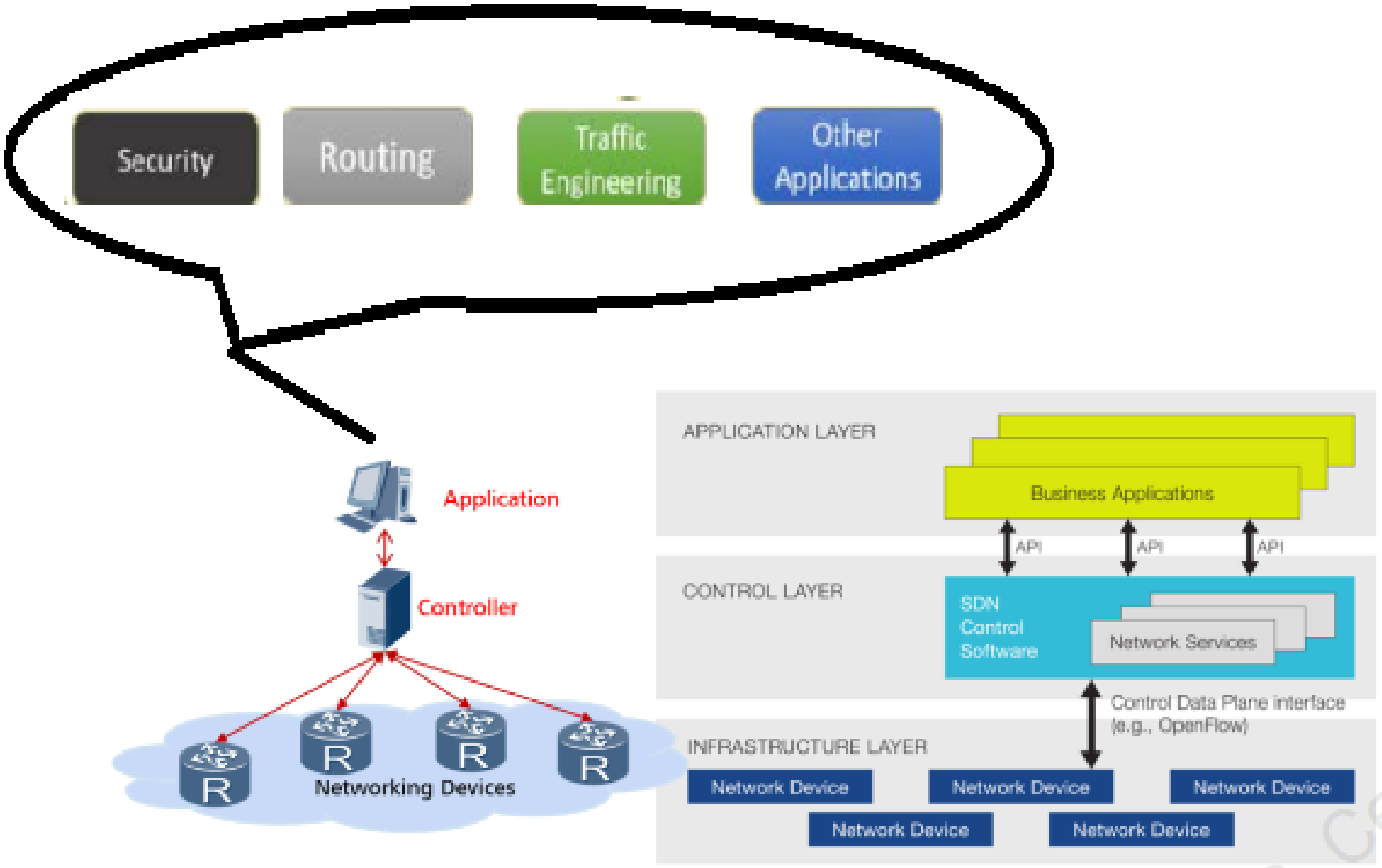
- With decoupled control and data planes and centralized network controller, the network administrators can rapidly configure the network.
- SDN applications can be deployed through programmable open APIs. This speeds up innovation as the network administrators no longer need to wait for the device vendors to embed new features in their proprietary hardware.

Programmable Open APIs:

- SDN architecture supports programmable open APIs for interface between the SDN application and control layers (Northbound interface).
- With these open APIs various network services can be implemented, such as routing, quality of service (QoS), access control, etc.

Standard Communication Interface (OpenFlow):

- SDN architecture uses a standard communication interface between the control and infrastructure layers (Southbound interface).
- OpenFlow, which is defined by the Open Networking Foundation (ONF) is the broadly accepted SDN protocol for the **Southbound interface**.


Security
Routing
Traffic Engineering
Other Applications
Application
Controller
Networking Devices
APPLICATION LAYER
Business Applications
API
API
API
CONTROL LAYER
SDN Control Software
Network Services
Control Data Plane interface (e.g., OpenFlow)
INFRASTRUCTURE LAYER
Network Device
Network Device
Network Device
Network Device
Network Device