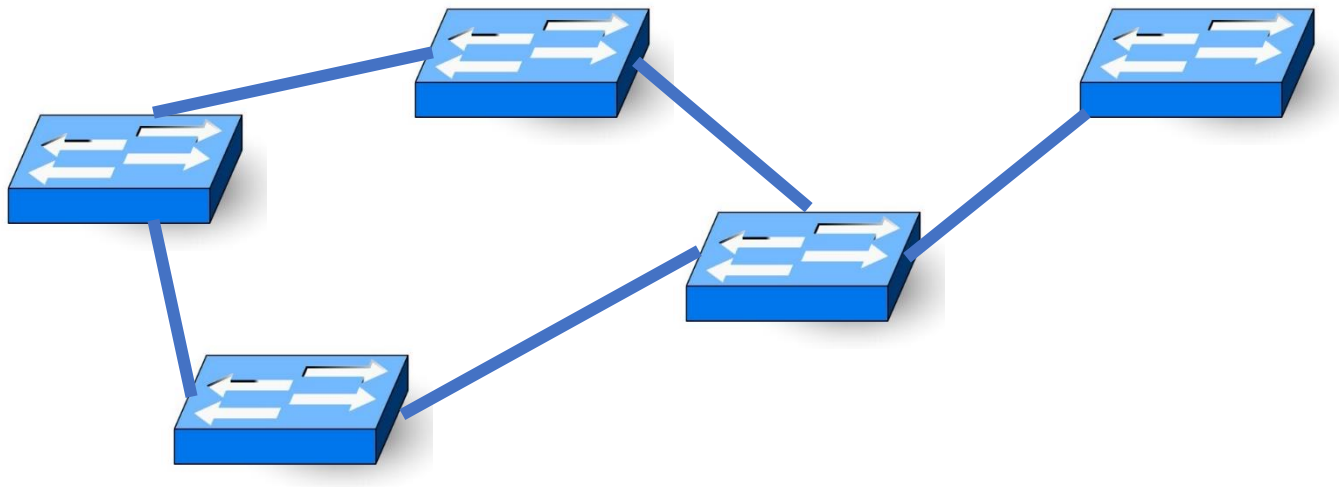
Introduction to SDN and NFV

Uzzam Javed

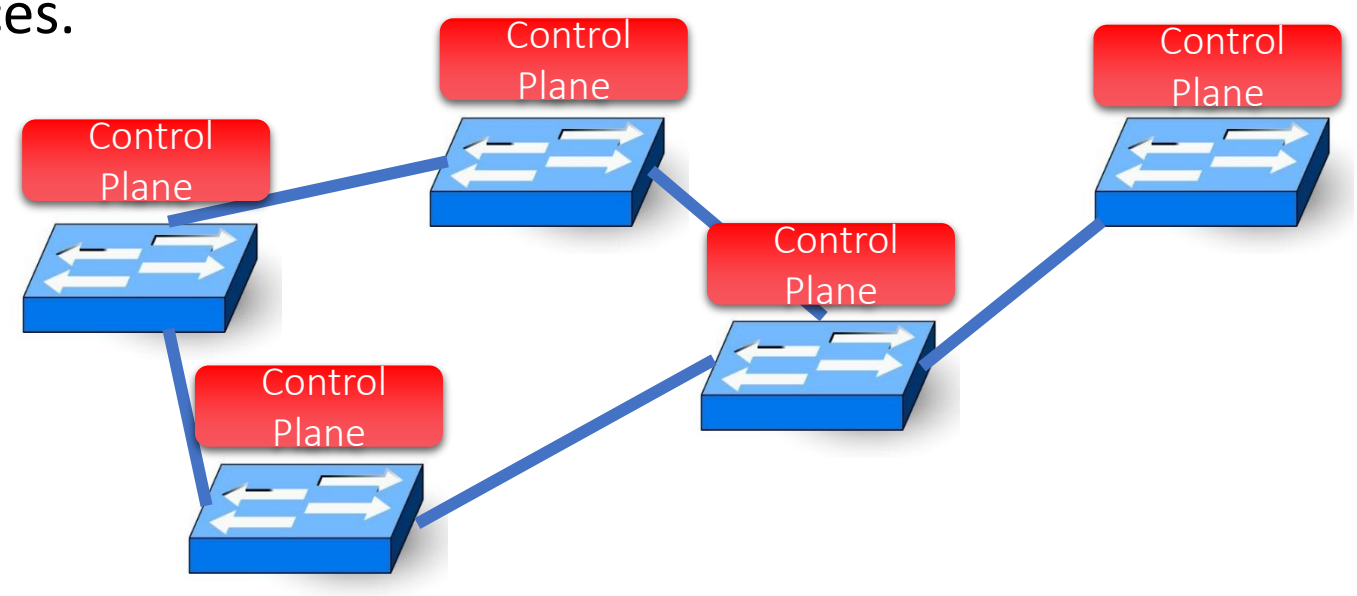
Planes in Networking

- **Data Plane**
  - Forward traffic according to the logic implemented at the control plane.



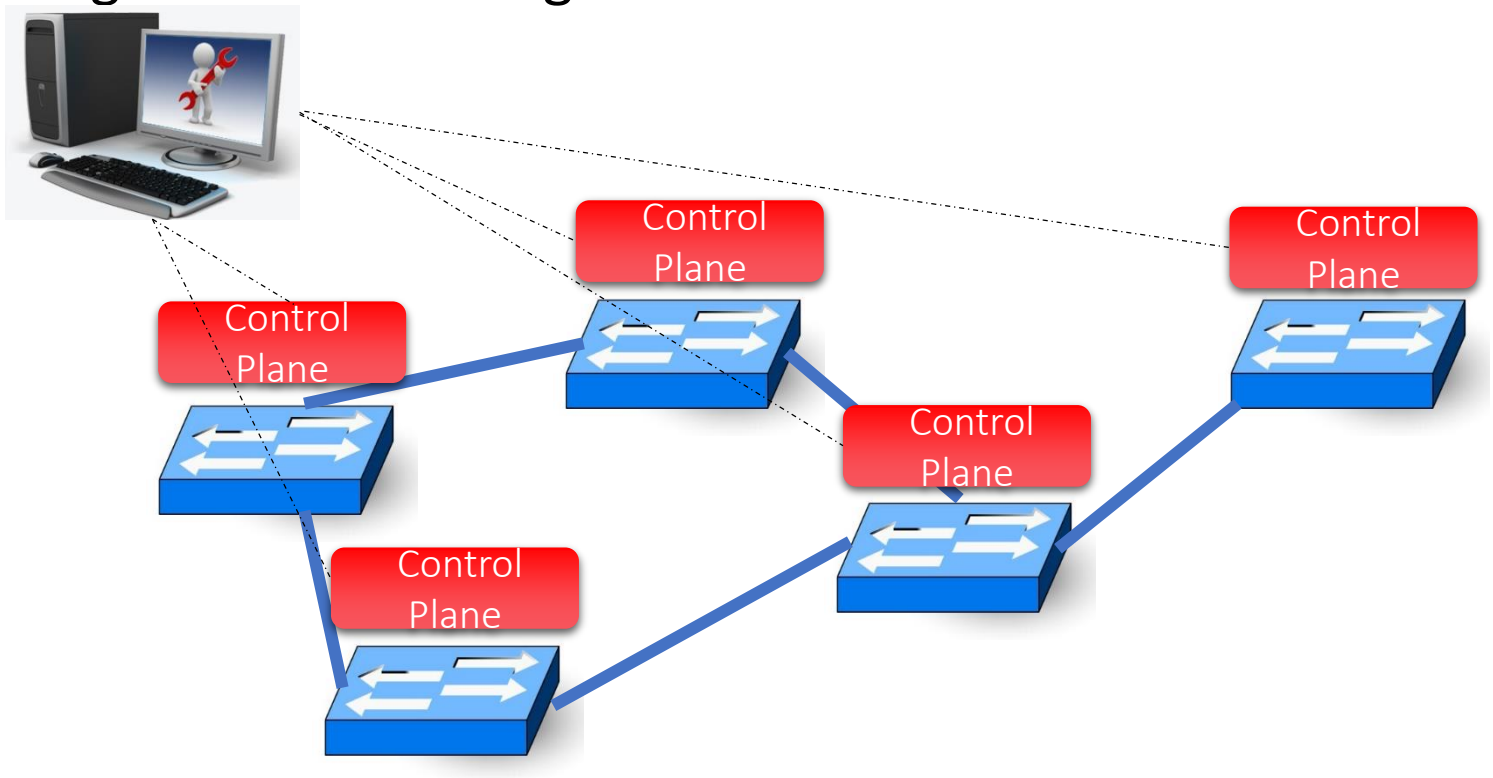
Planes in Networking

- **Control Plane**
  - Control plane is the brain of the network, providing logic for the forwarding plane.
  - It learns about the structure of the network by communicating to its peers in other devices.



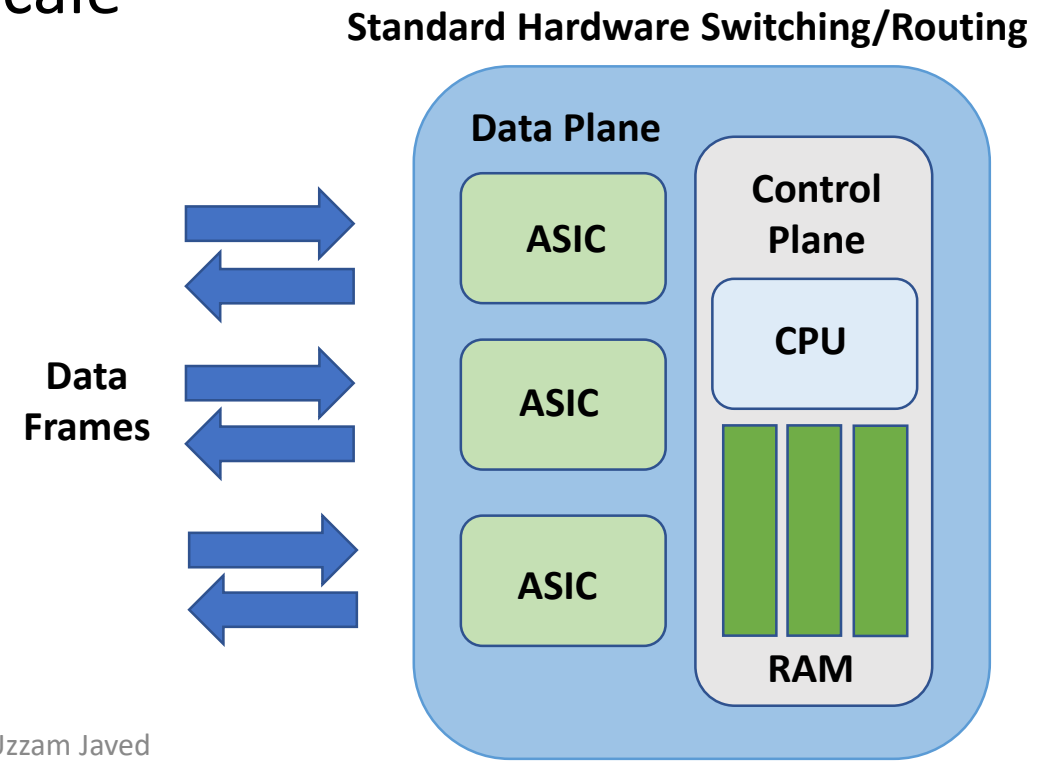
Planes in Networking

- **Management Plane**
  - For management and configuration of the network devices.



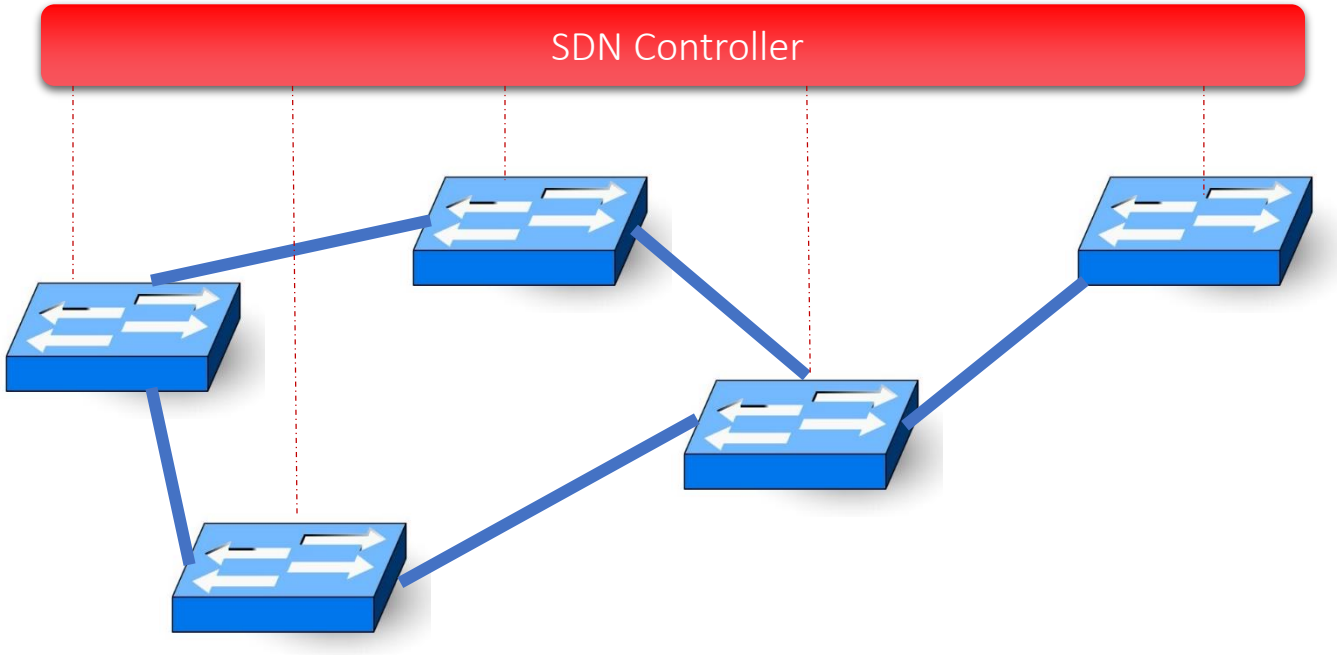
Traditional Networks

- In traditional networks all three planes reside within the firmware of switches and routers.
- Making the management of large scale networks difficult.



Software Defined Networking (SDN)

- Software Defined Networking (SDN) decouples control plane from data plane.
- Providing a control plane abstraction for the whole network.

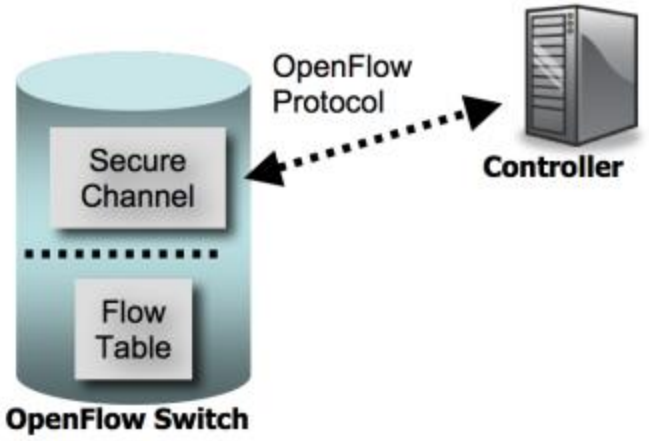


SDN Controller

- It is a software that provides a centralized view of and control over the entire network.
- Used to enforce policies that dictate network behavior.
- Makes the management of the network simple that is more uniform and consistent.
- Examples: POX, NOX, OpenDaylight

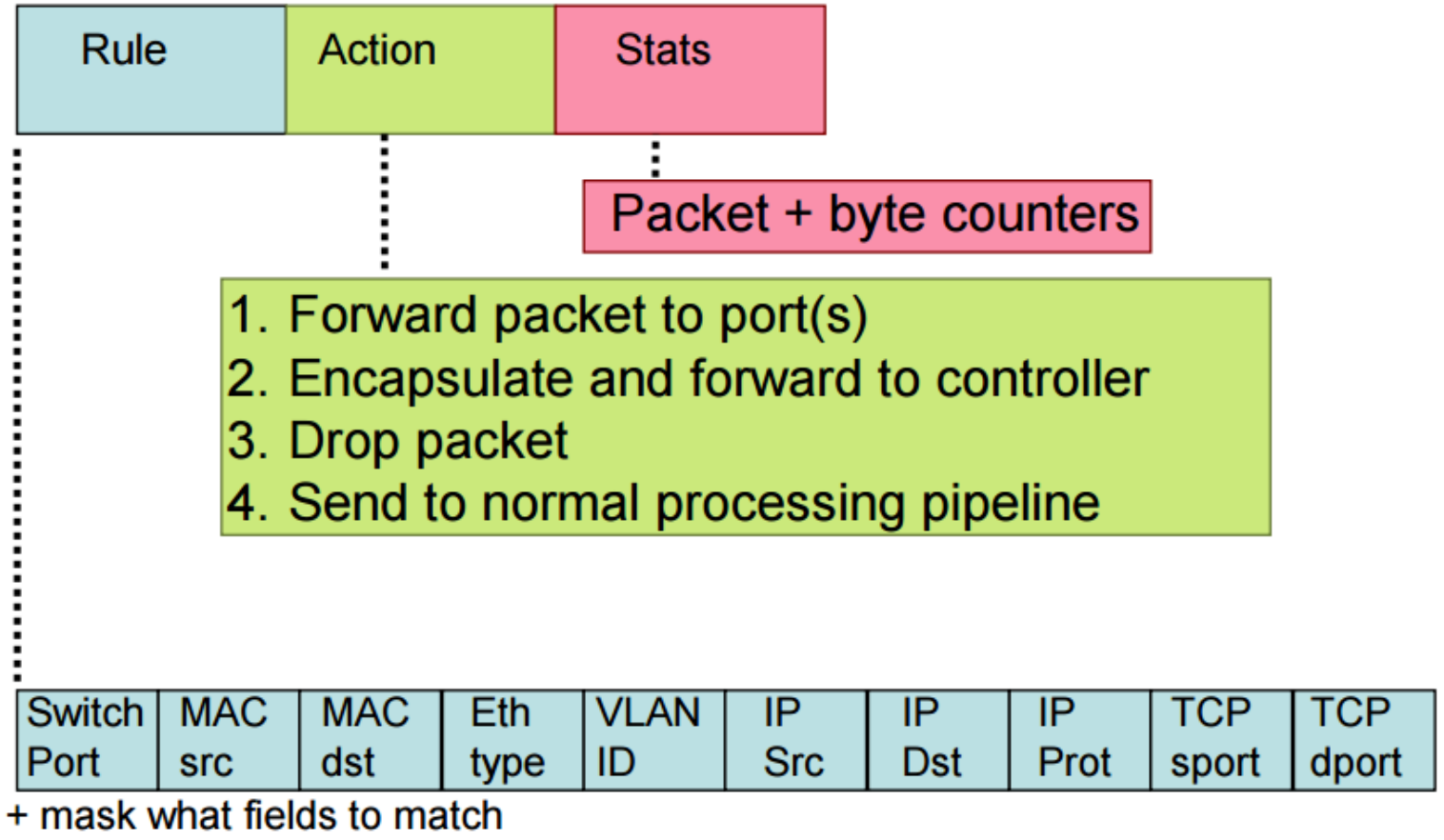
OpenFlow

- Virtually separated planes interact through different APIs (interfaces).
- OpenFlow is an interface to communicate between the control plane and the data plane promoted by Open Networking Foundation (ONF).



https://www.opennetworking.org/images/stories/downloads/sdn-resources/onf-specifications/openflow/openflow-spec-v1.0.0.pdf

OpenFlow Switch Flow Table

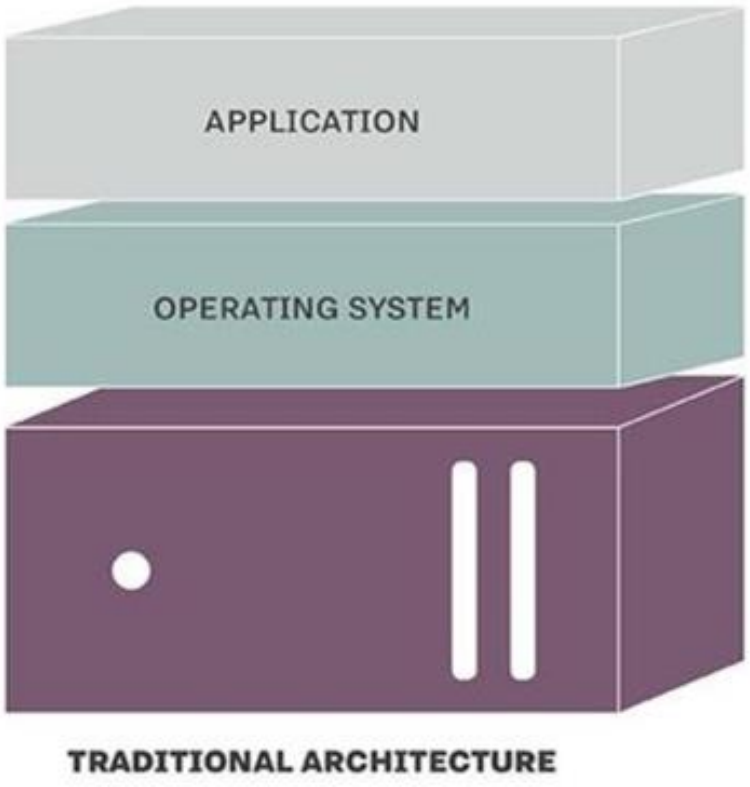


http://www.slideshare.net/Cameroon45/ppt-4515906

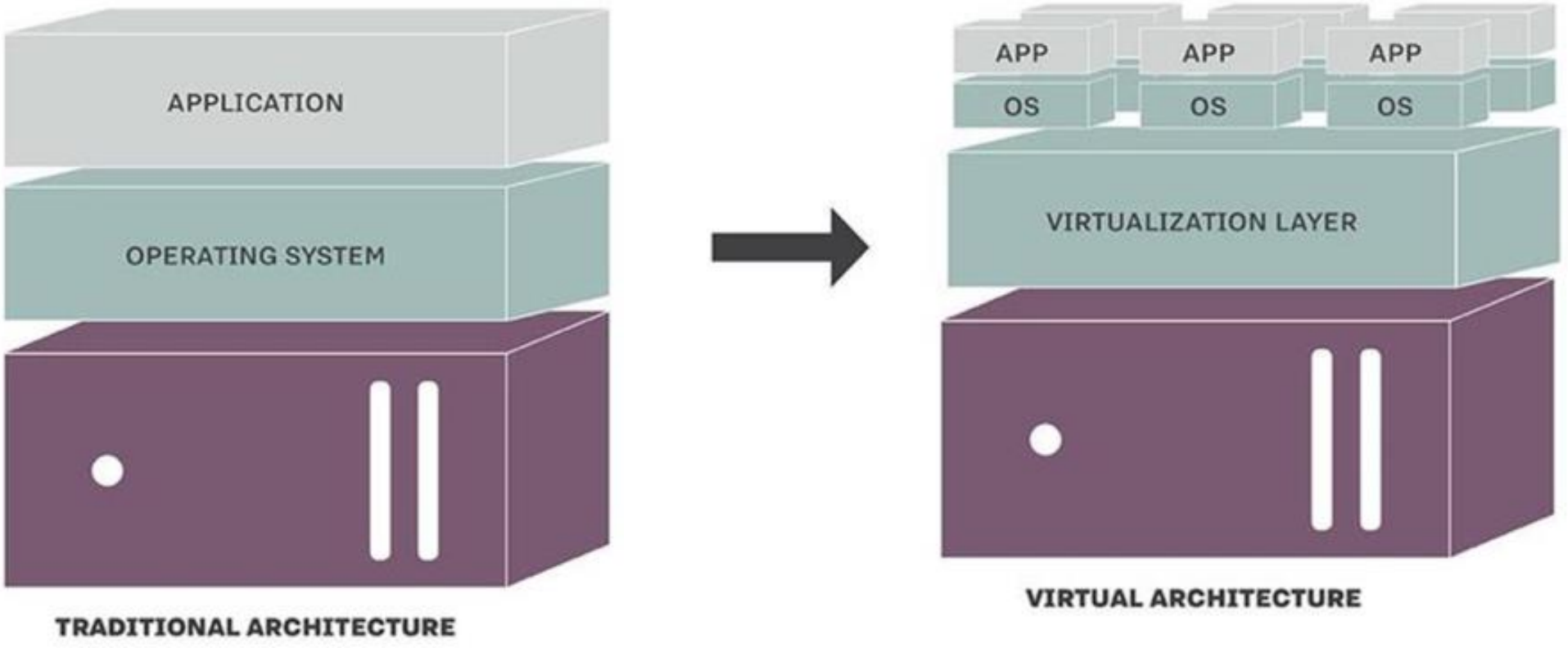
SDN Benefits

1. Direct programmability
2. Centralized management
3. Reduced CAPEX
4. Reduced OPEX
5. Agility and flexibility

What is Virtualization?



What is Virtualization?

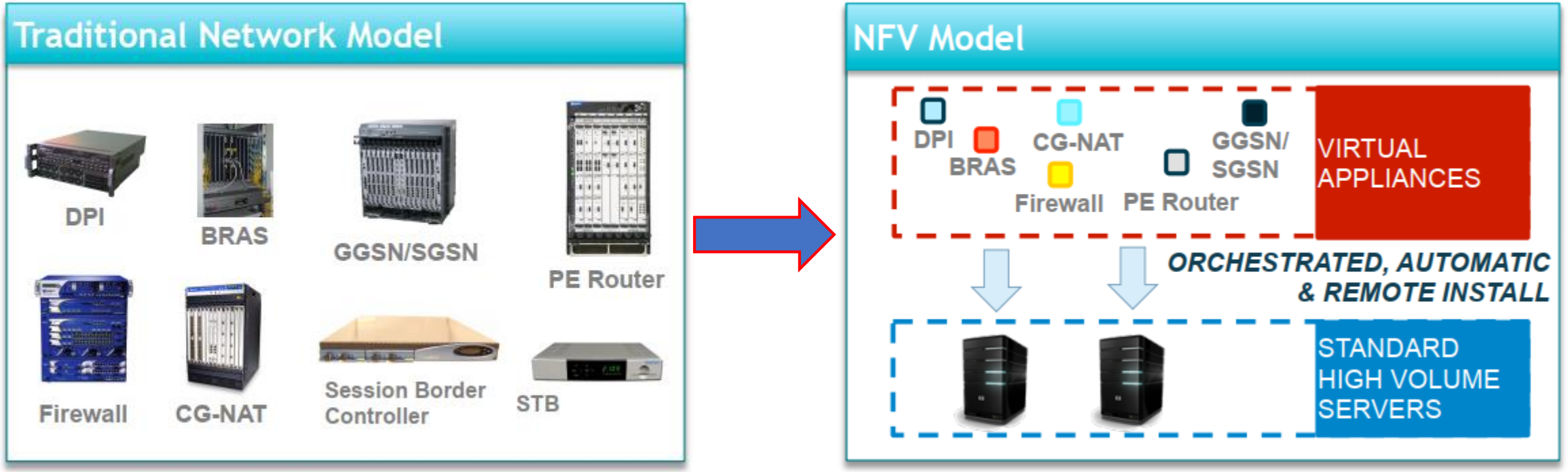


Network Function Virtualization (NFV)

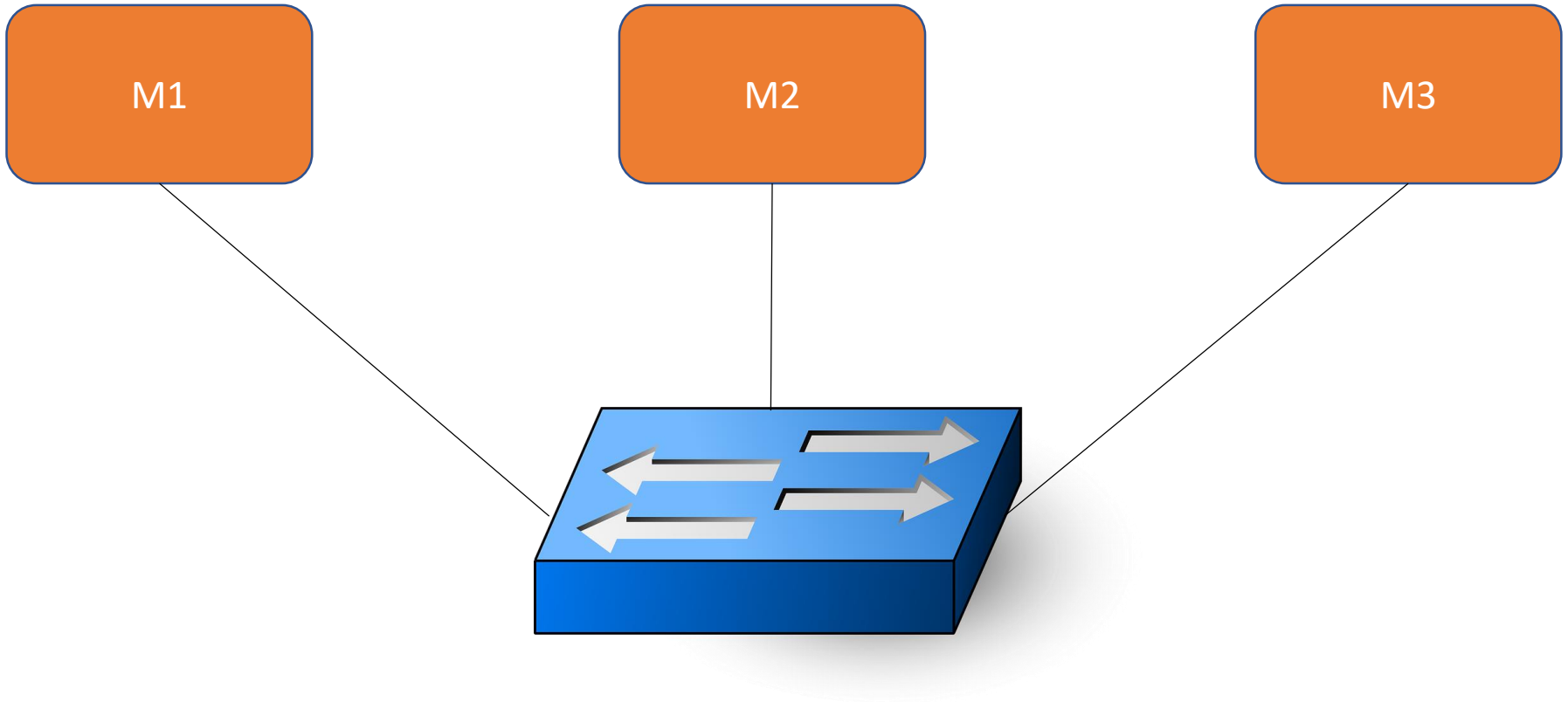
- NFV decouples network functions from the hardware.
- Those network functions are called virtual network functions (VNFs).
- VNFs run in virtual machines on commercial off-the-shelf (COTS) hardware.
- This makes adding new network functions or applications easier and faster.

NFV Model

NFV Model



How does a physical switch work?



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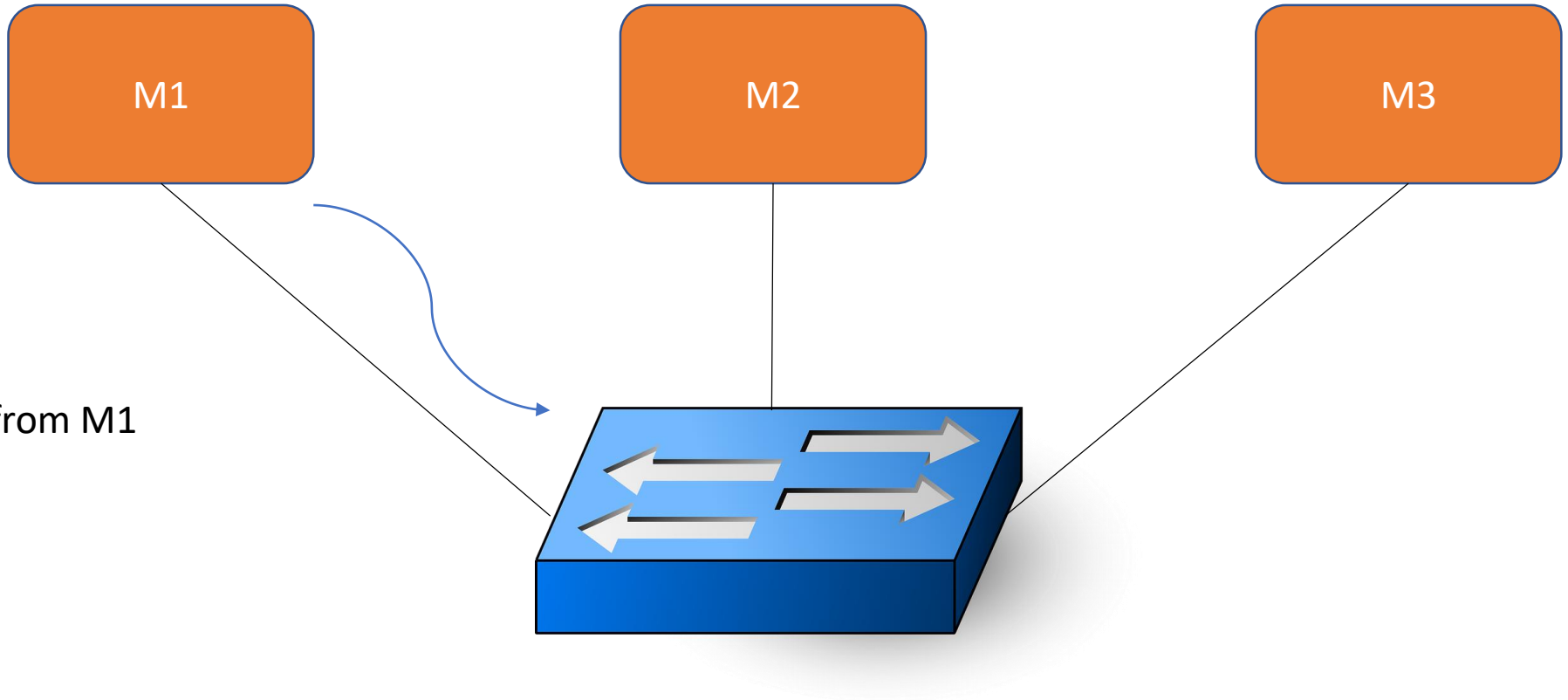
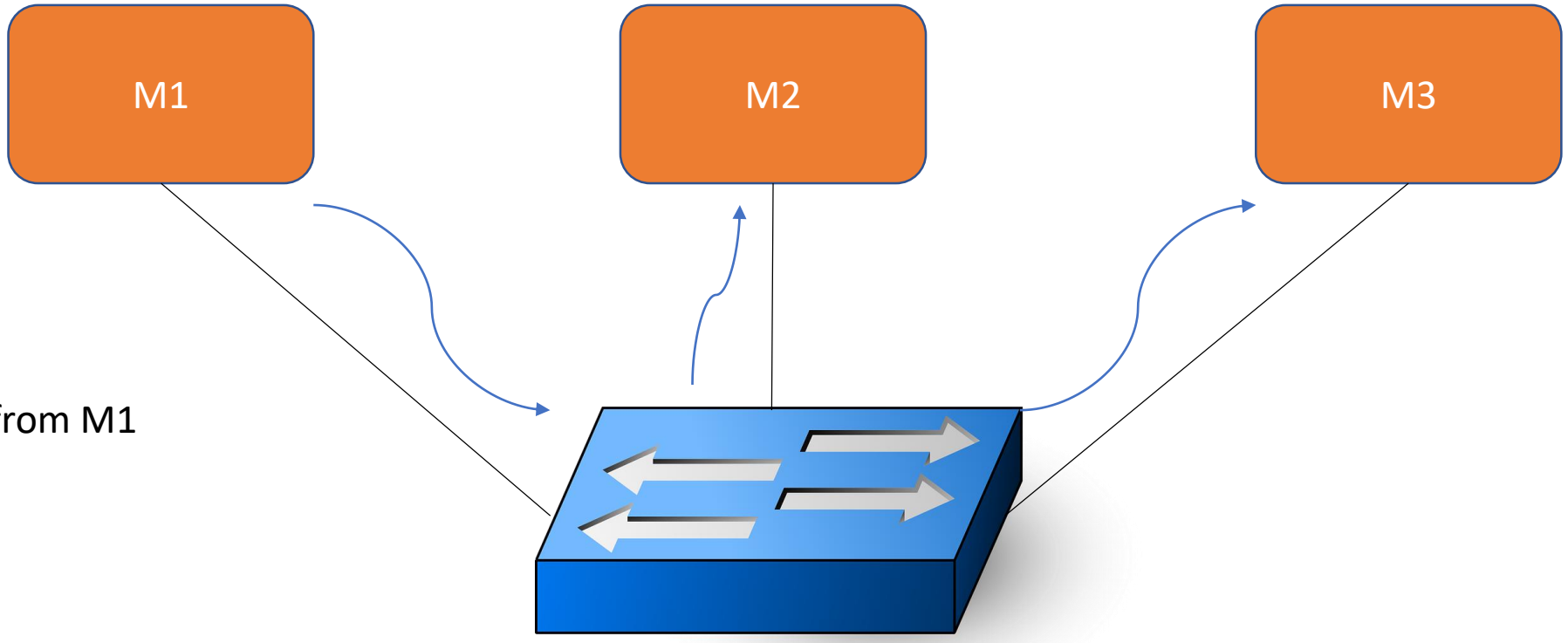


1. Packet from M1 for M3

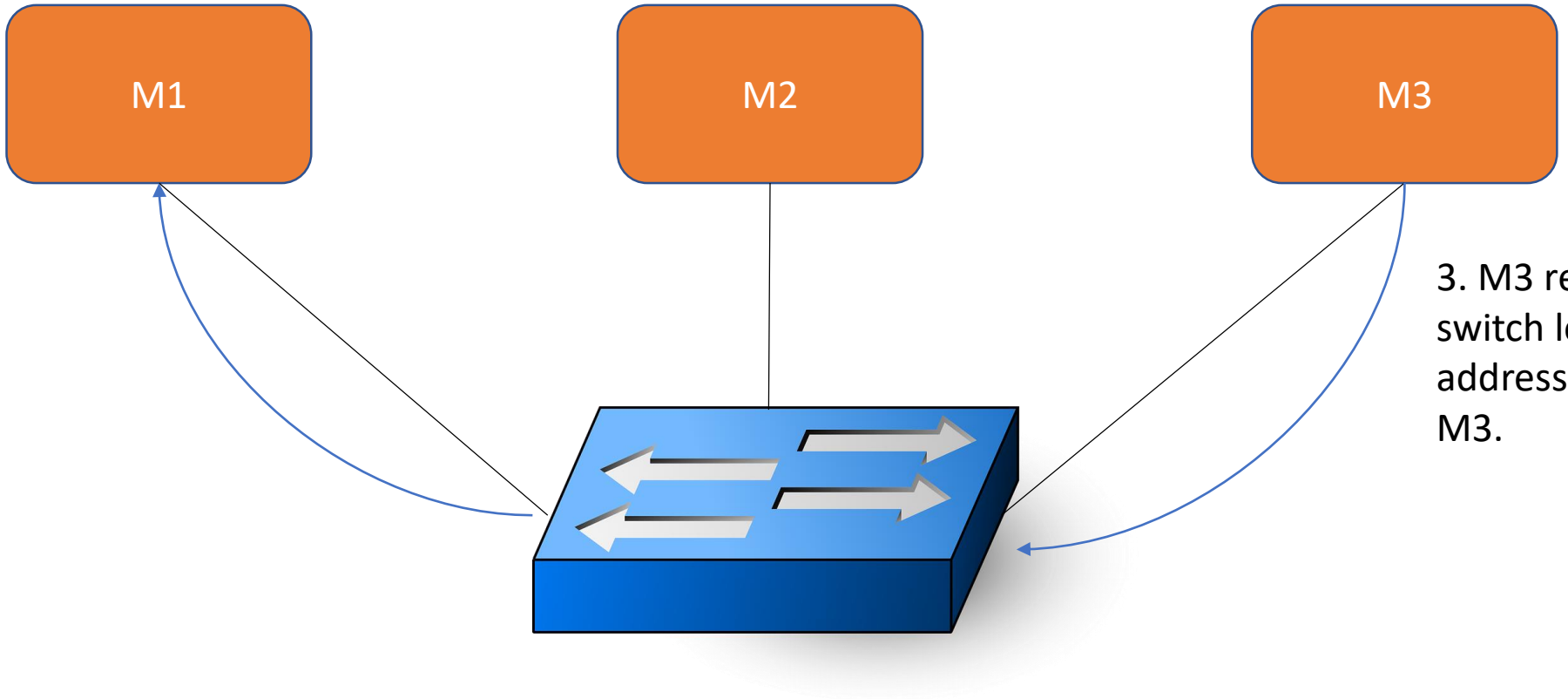
How does a physical switch work?



1. Packet from M1 for M3

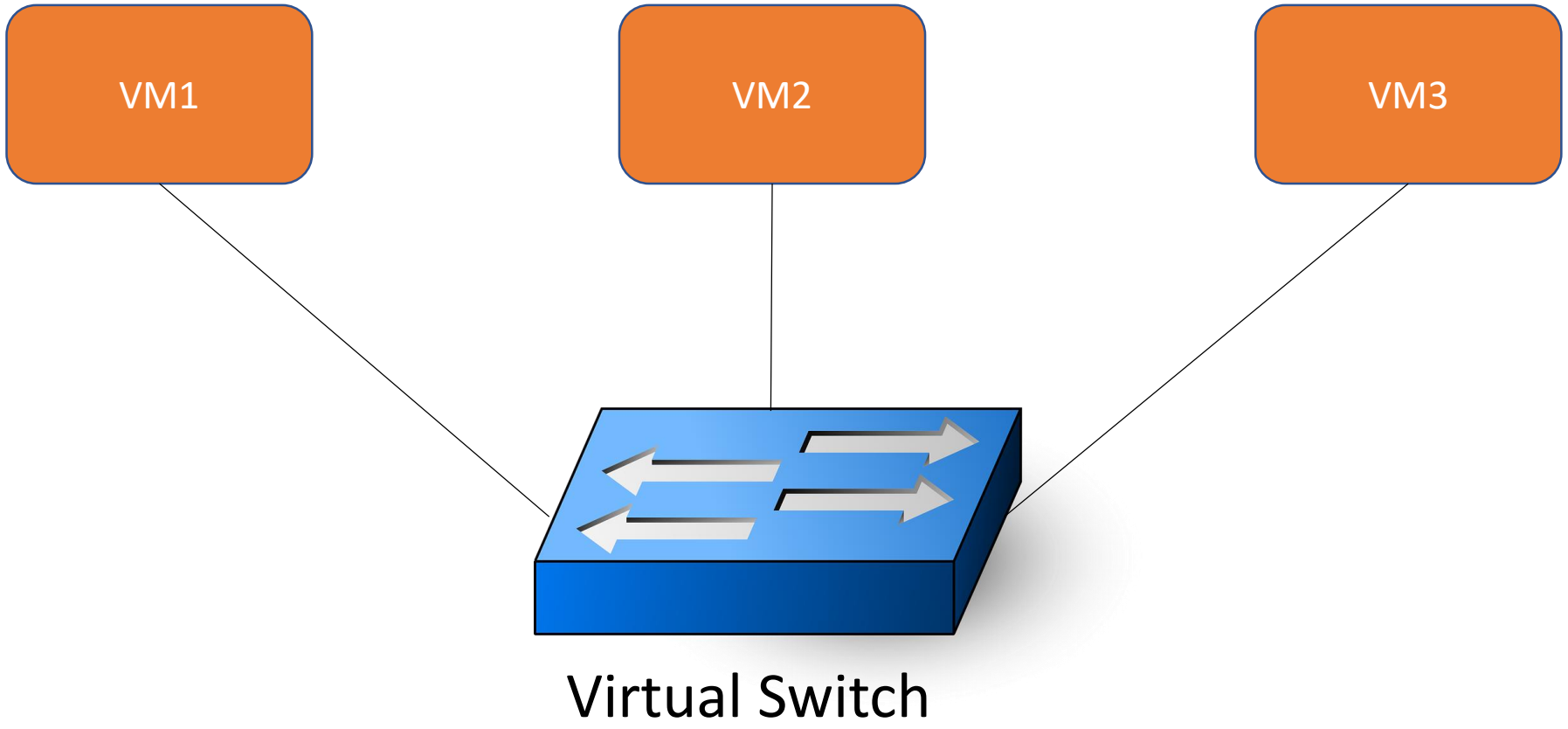
2. Switch doesn't know where M3 is connected, so it floods on all ports.

How does a physical switch work?



3. M3 responds and switch learns the MAC addresses of M1 and M3.

How a virtual switch works?



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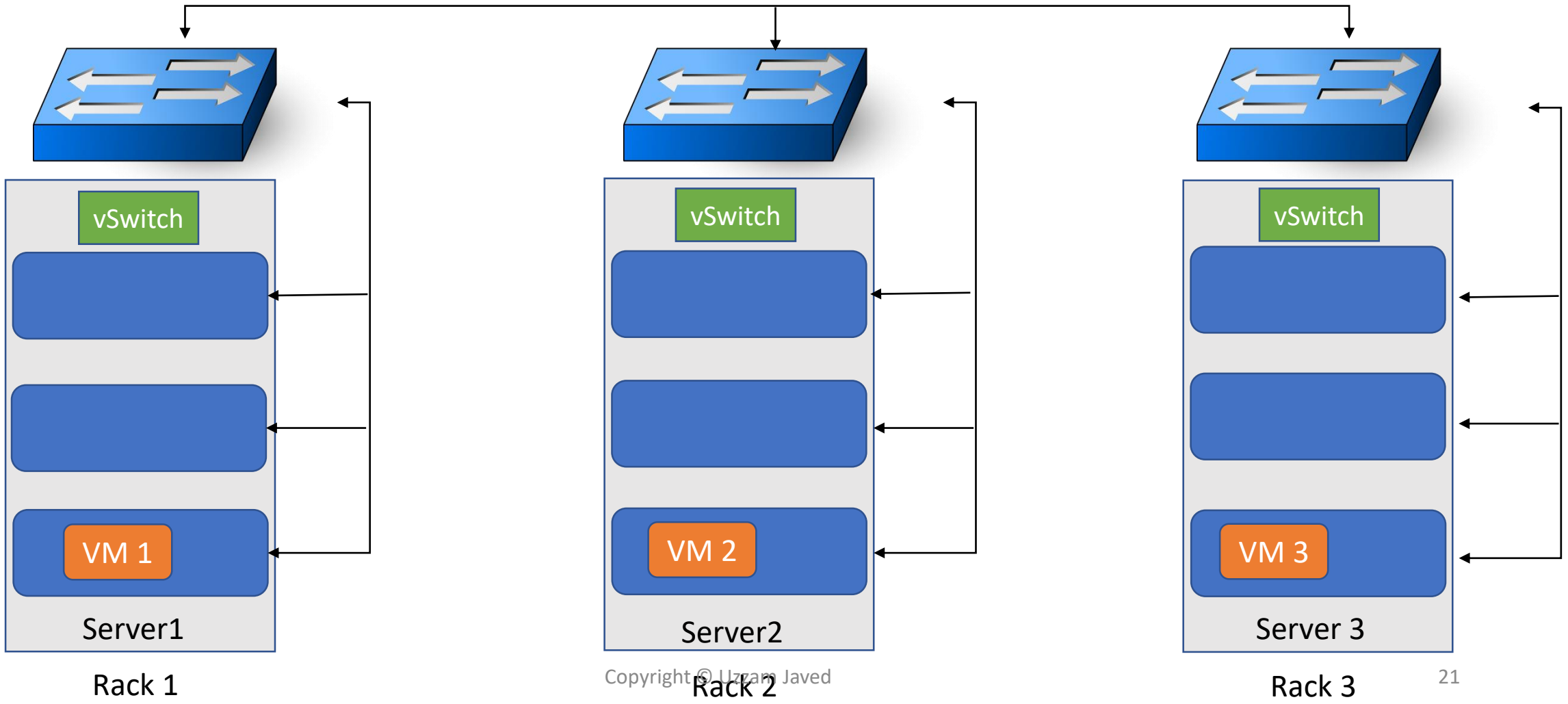

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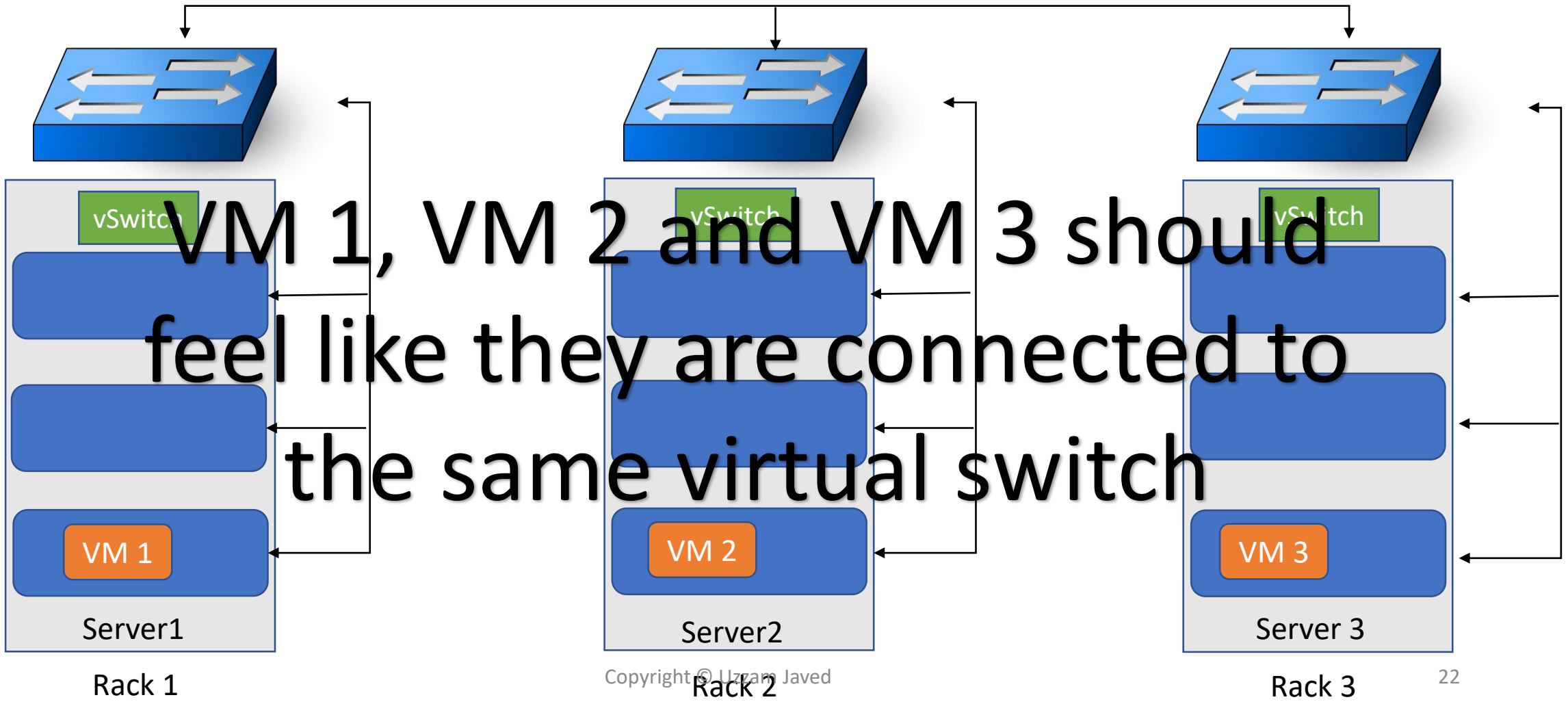
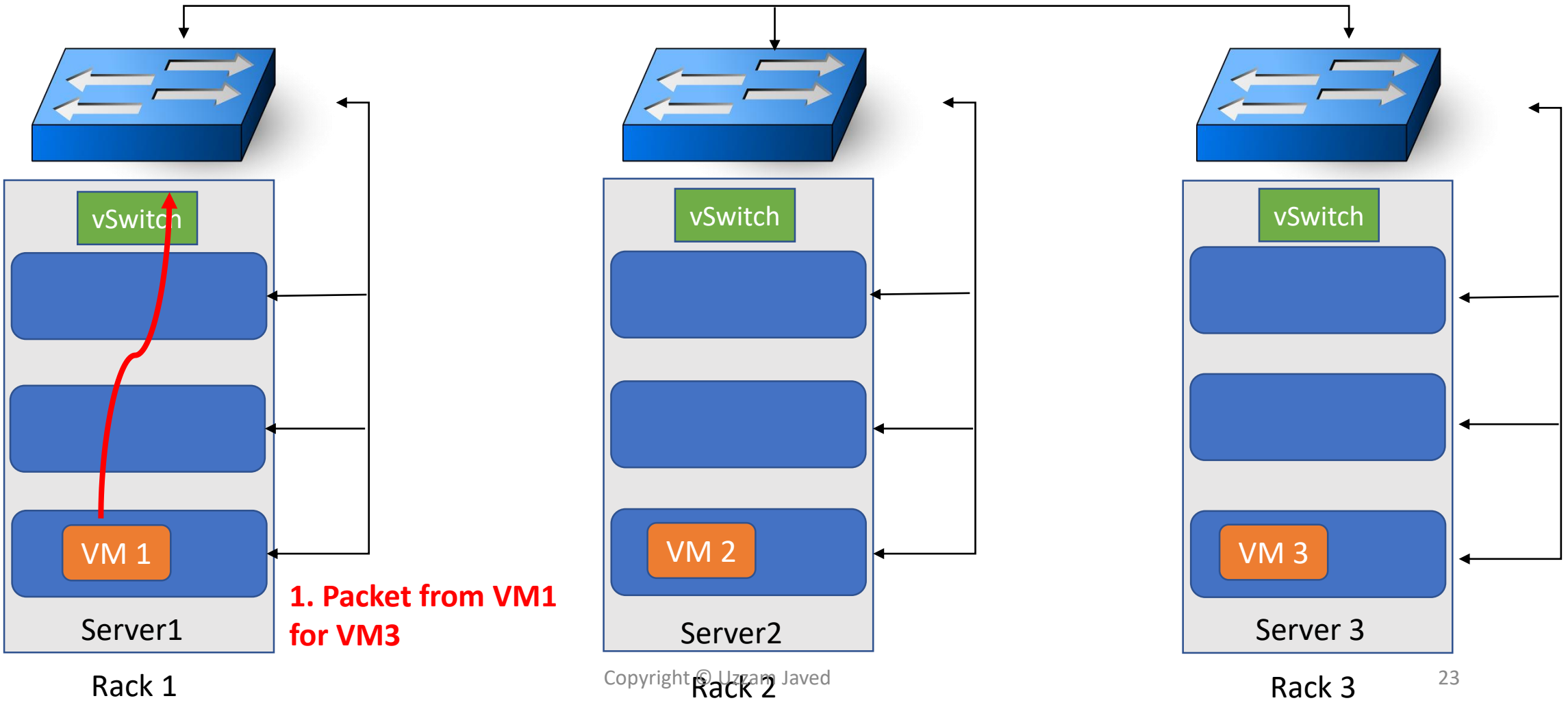


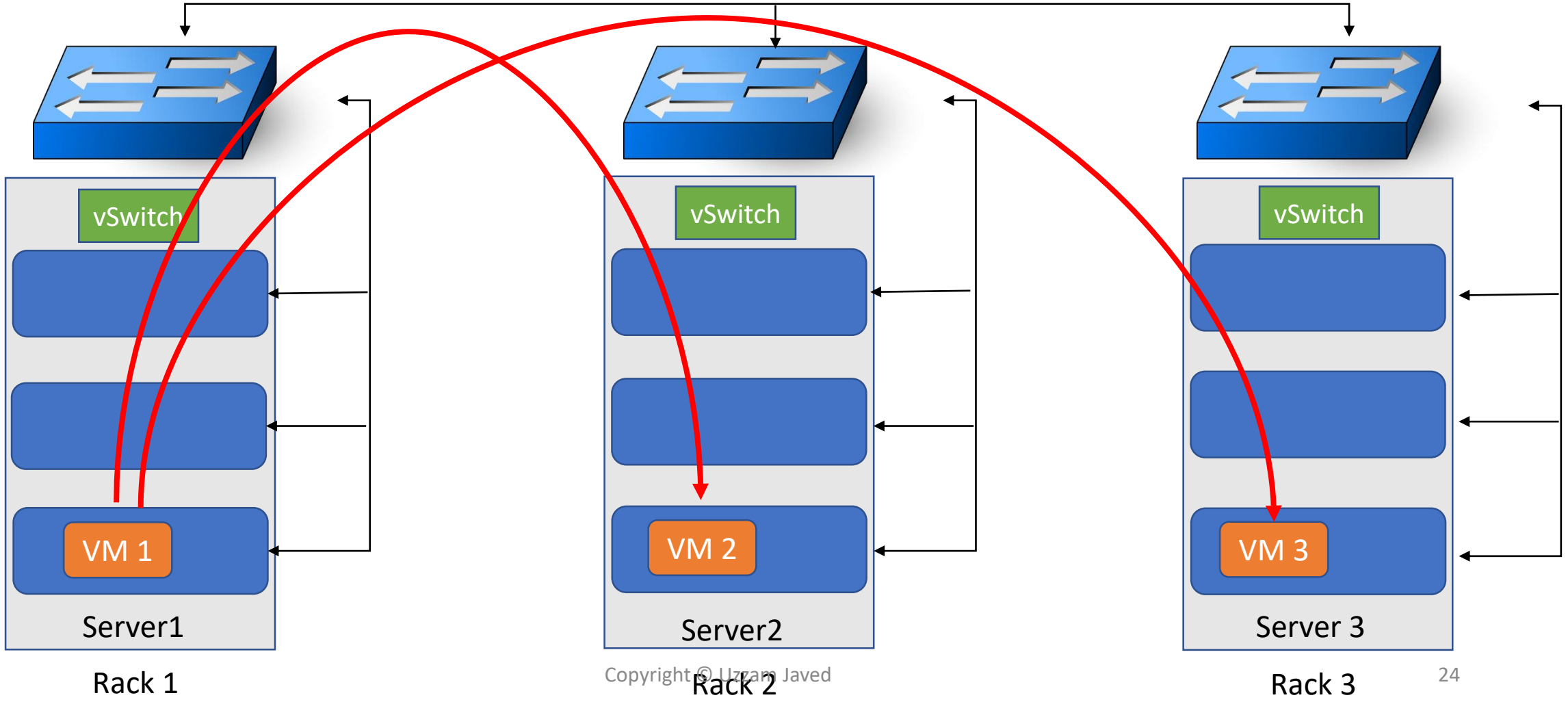
VM 1, VM 2 and VM 3 should feel like they are connected to the same virtual switch

How a virtual switch works?

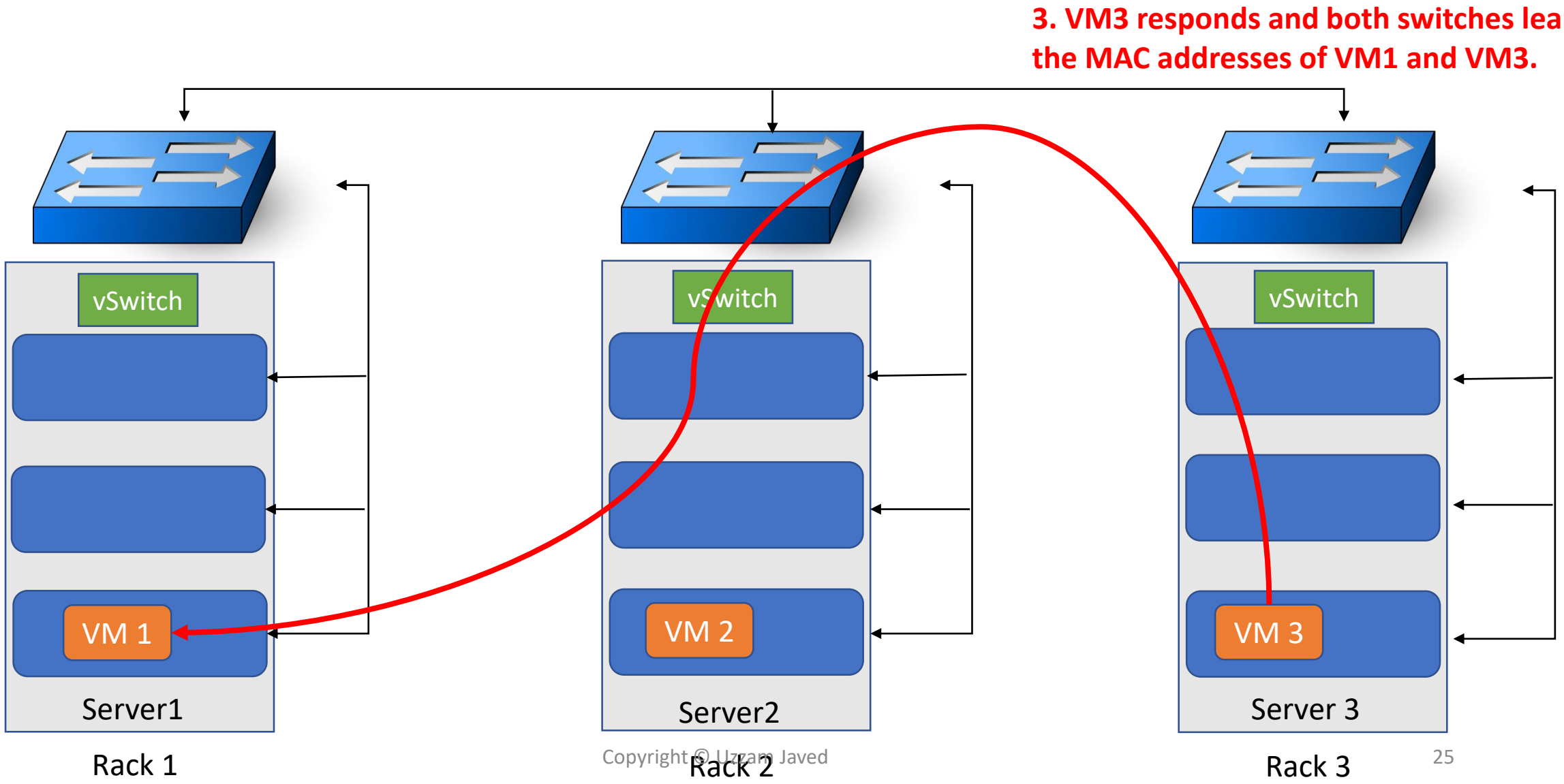


How a virtual switch works?

2. Switch doesn't know where VM3 is connected, so it unicasts to all the VMs.



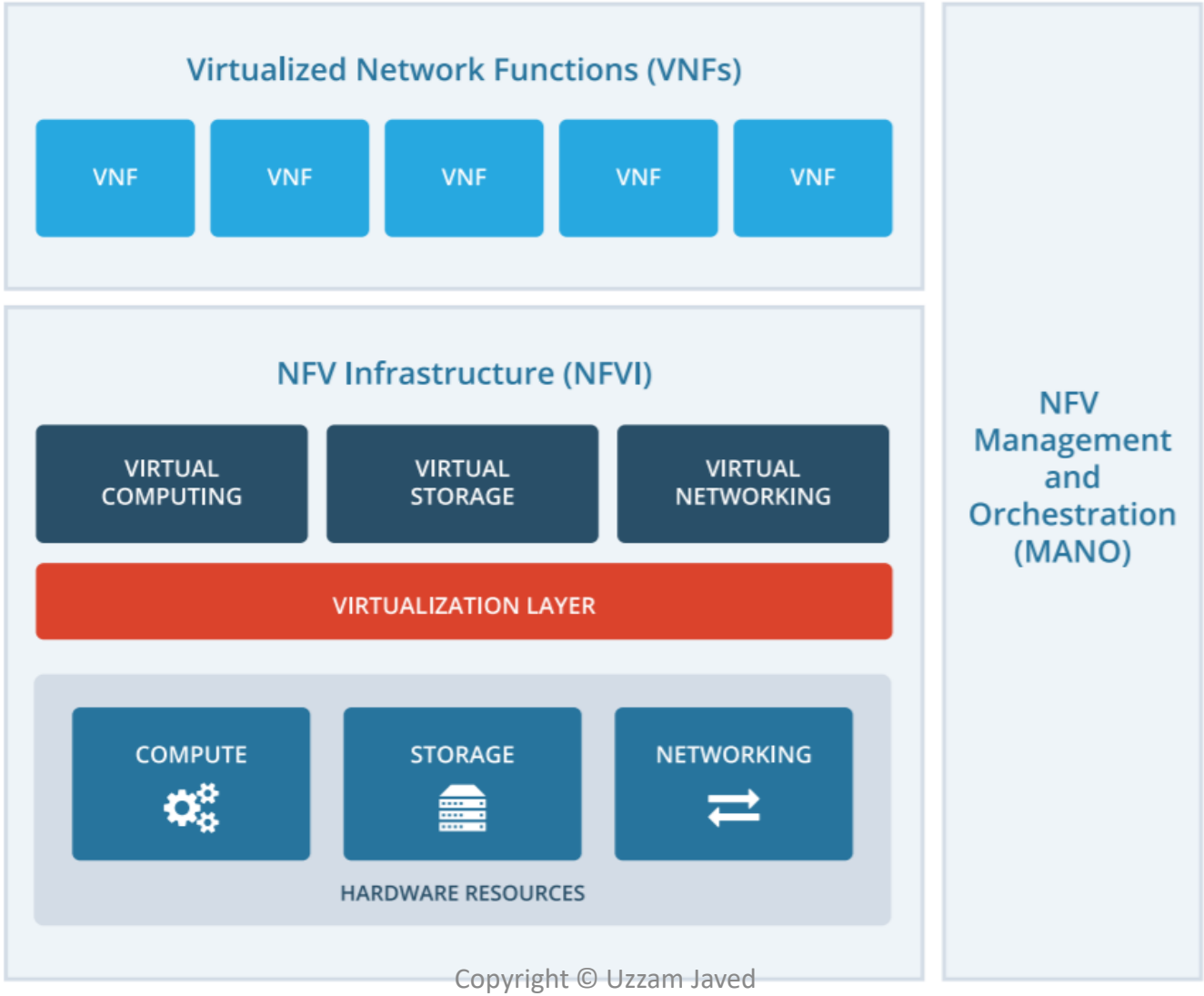
How a virtual switch works?



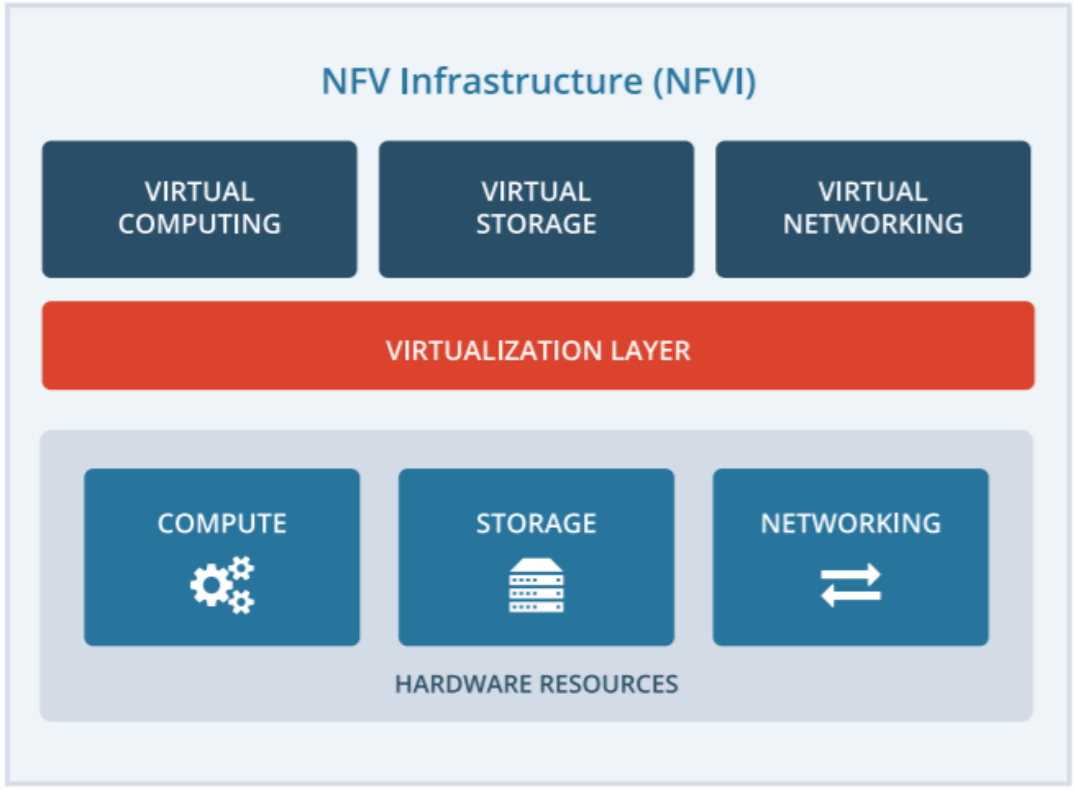
History

- Concept and collaborative work on NFV was born in October 2012.
- Number of leading Telecom service providers authored a white paper calling for industrial and research action.
- In November 2012 seven of these operators selected European Telecommunications Standards Institute (ETSI) to be the home of the Industry Specification Group for NFV (ETSI ISG NFV).

NFV Architecture

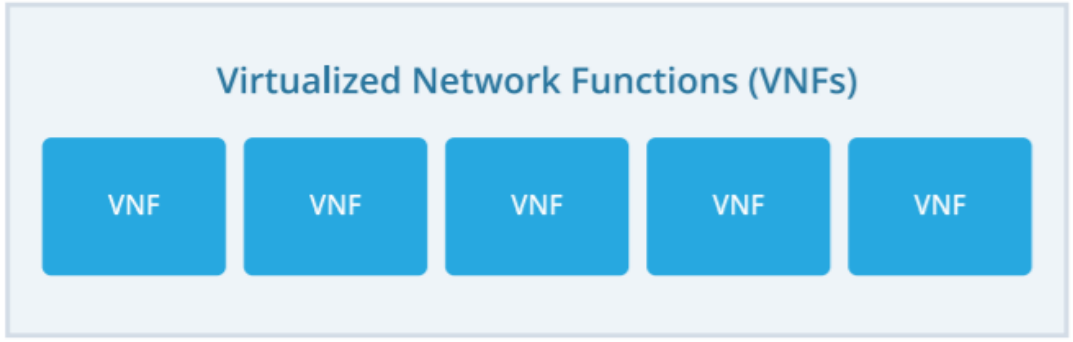


NFVI



- Manages the physical resources
- Virtualization layer (Hypervisor) is responsible for abstracting the physical resources into virtual resources.

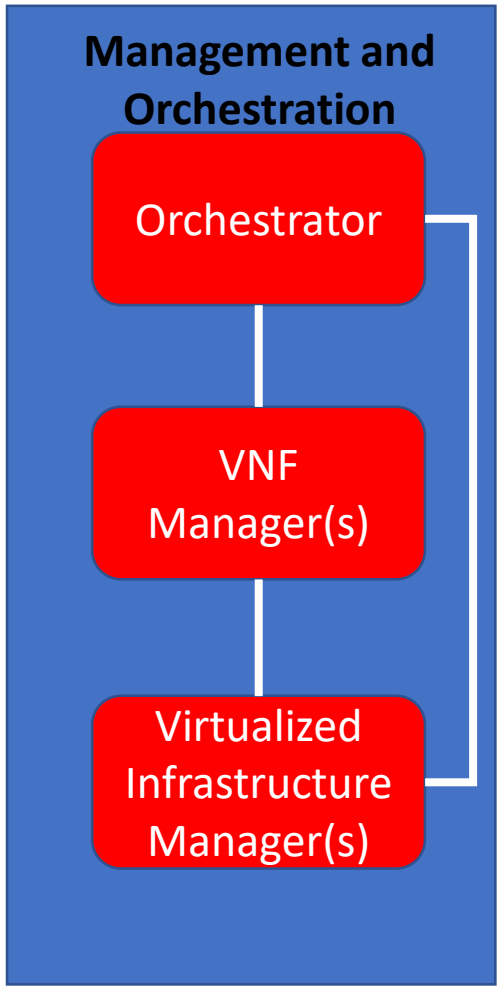
VNF



- A VNF is the basic block in NFV architecture.
- They run on virtual resources on top of the hardware networking resources.
- VNFs handle specific network functions like load balancing or firewalls.

NFV Management and Orchestration

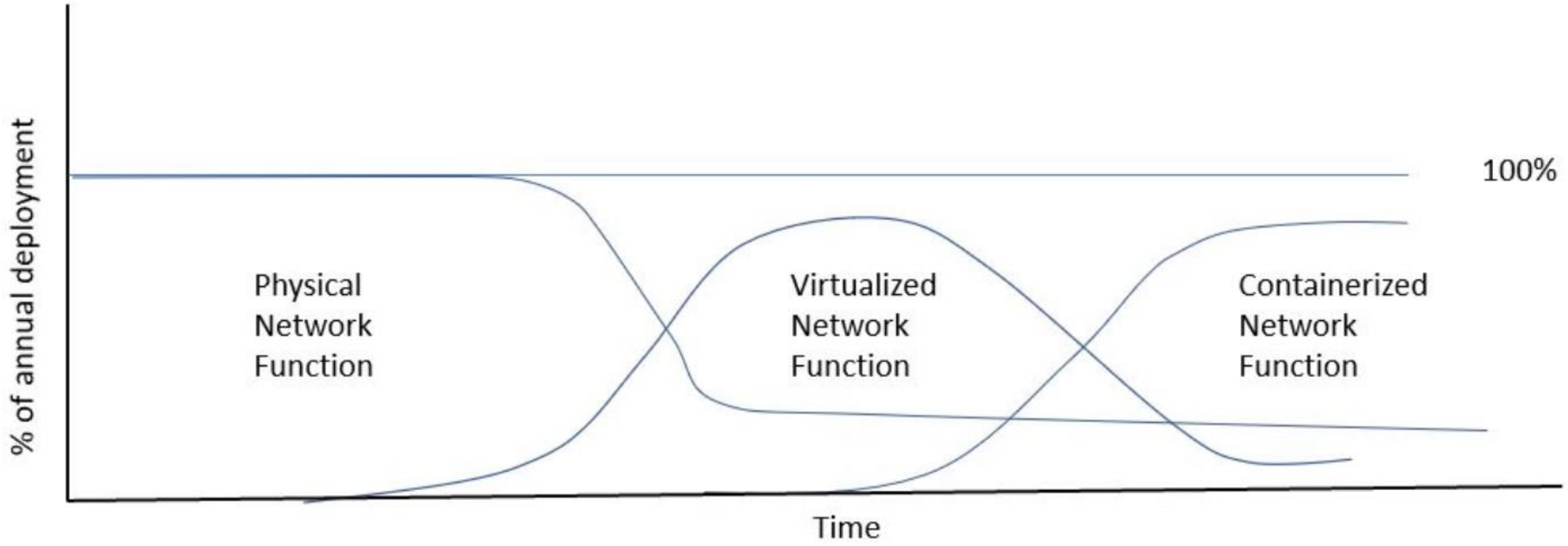
- Automation of resources and network services.
- Global resource management of NFVI resources.
- Allocating and scaling of resources.



Benefits of NFV

1. Less Vendor Lock-in
2. Greater Resource Efficiency
3. Flexibility

Network Function Evolution

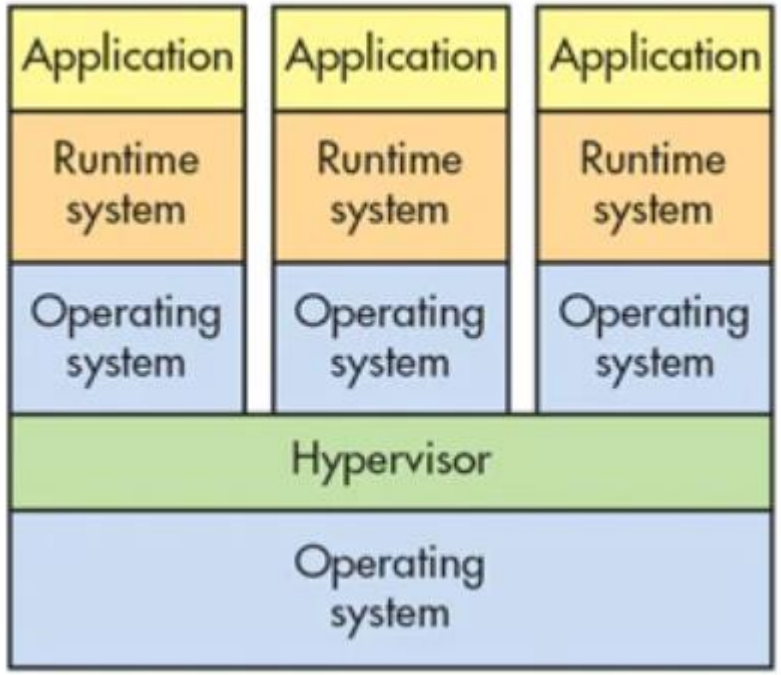


Source: RedHat

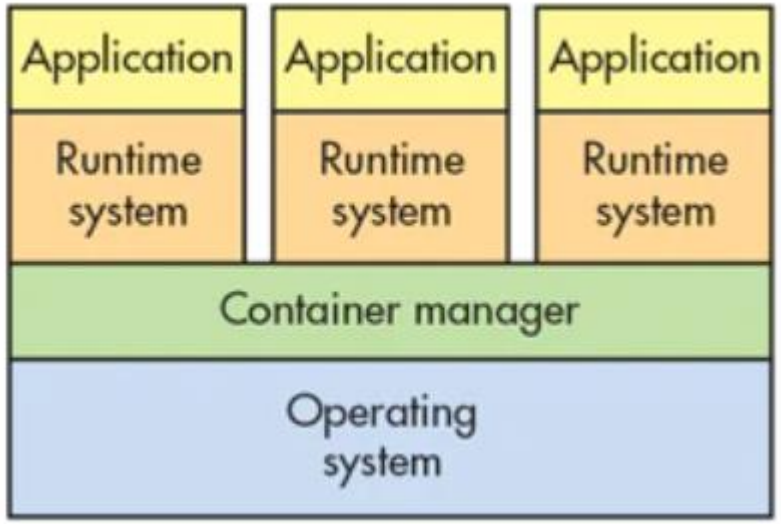
Note: Physical, Virtualized and Containerized network functions will coexist for some time

VM vs. Container

- **VM**



- **Container**



SDN vs. NFV

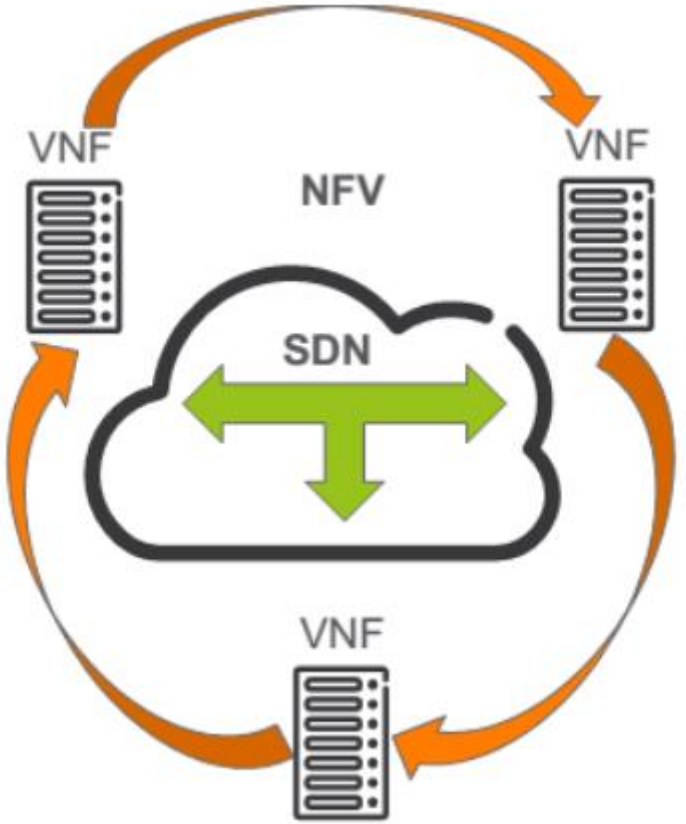
- **SDN** – flexible forwarding & steering of traffic in a physical or virtual network environment.

SDN vs. NFV

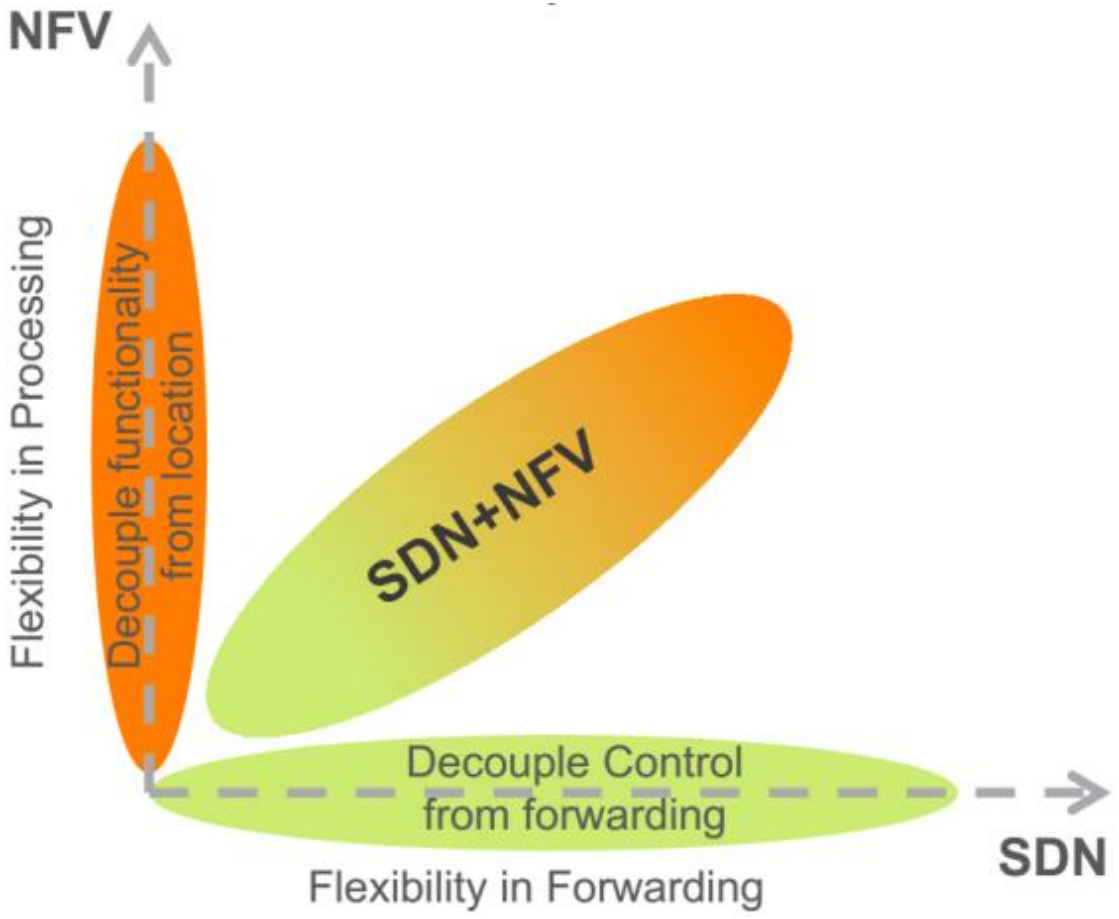
- **SDN** – flexible forwarding & steering of traffic in a physical or virtual network environment.
- **NFV** – flexible placement of virtualized network function across the network.

SDN vs. NFV

- **SDN** – flexible forwarding & steering of traffic in a physical or virtual network environment.
- **NFV** – flexible placement of virtualized network function across the network.
- **SDN & NFV** – are complementary tools for achieving full network programmability.



Flexibility with SDN & NFV



Source: Ahmad Rostami, Ericsson Research (Kista)

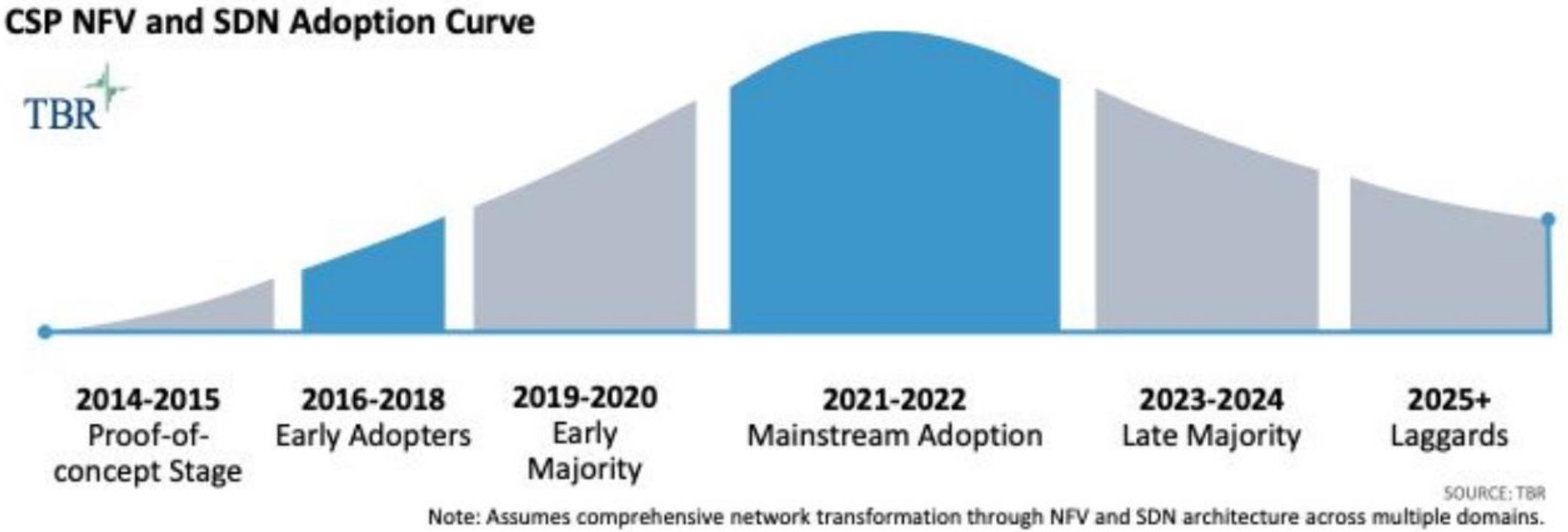
Simple Equation to define Network Virtualization:

Network Virtualization

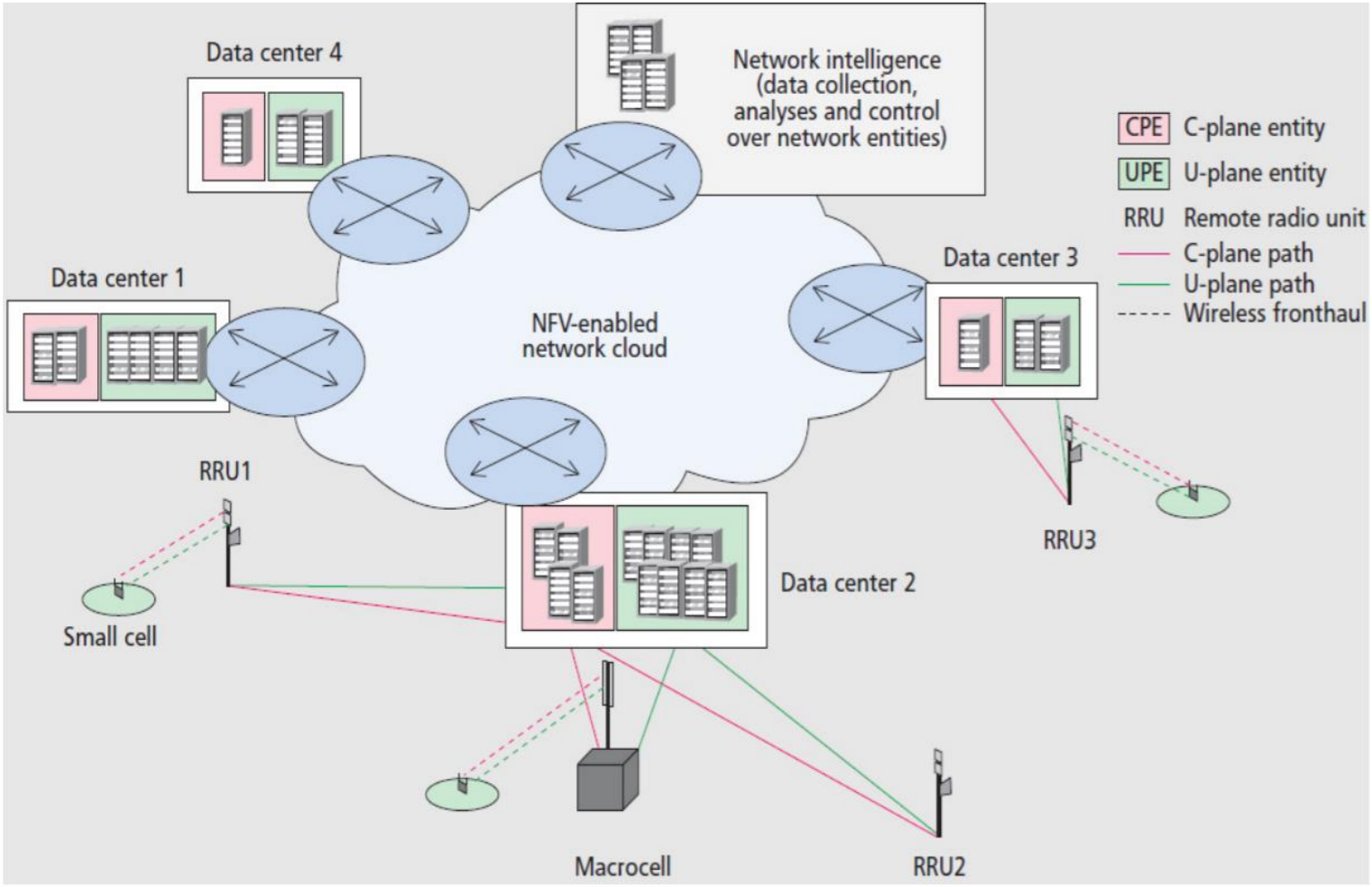
Simple Equation to define Network Virtualization:

Network Virtualization = SDN+NFV

Have we reached NFV and SDN maturity?



SDN/NFV Use Case: 5G



Additional Resources

- European Telecommunications Standards Institute - ETSI (https://www.etsi.org/technologies/nfv)
- Open Networking Foundation - ONF (https://www.opennetworking.org/sdn-definition/)
- Open Platform for NFV - OPNFV (https://www.opnfv.org/)

Questions?

Contact:

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Teaser For Next Week's Talk!