

U-1 (SDN)

DOMS

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- * Challenges of traditional network -
- Scalability (not)
 - Flexibility & Performance ~~not~~ bottleneck
 - Security
 - Interoperability
 - Manual setup
 - security gaps
 - limited visibility
 - Vendor lock in (restrict choice & flexibility).



Traditional

SDN

Control plane

Distributed across network devices

Centralized SDN controller -

Configuration

Manual configuration on each device

Programmable configuration through SW

• Protocols for working

• APIs to configure as per need

Scalability

difficult & requires physical changes

• Flexible & scalable through SW control.

limited visibility

improved visibility

Isolation

control plane & data plane are integrated

decouples control plane from data plane

Security

perimeter based defense, limited dynamic control

centralized control & programmable security policies adapts to threats

Vendor lock in

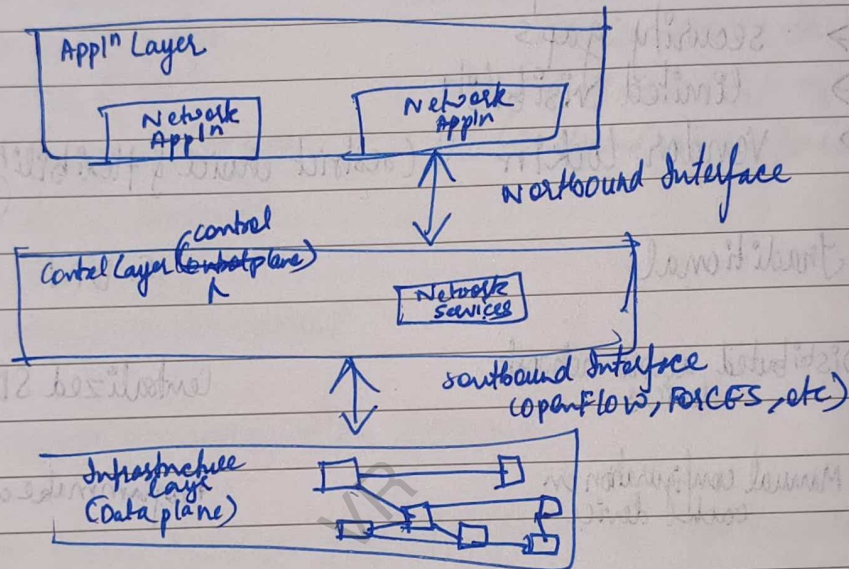
• proprietary protocol limit flexibility

• open interface enables multiple vendor compatibility

* SDN working -

* → SDN is a network architecture approach that enables network to intelligently & centrally controlled or programmed using \neq w appⁿ.

SDN architecture separates control & data planes of network stack.



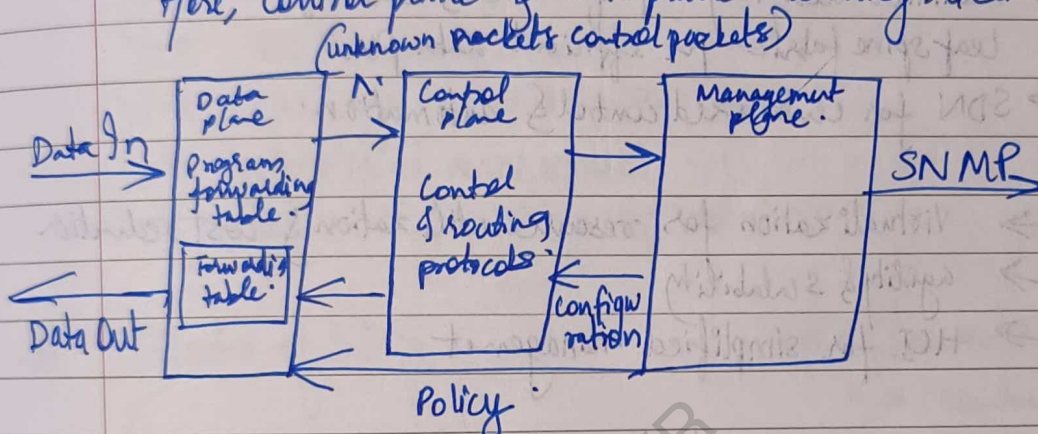
SDN components :

- 1) Data Plane - physical network devices (switches, routers) forward data based on controller instructions
- 2) Control Plane - Central SDN controller makes intelligent routing decisions
- 3) Southbound Interface - Appⁿ (OpenFlow), controller talks to switches using this protocol (like a secret handshake)
- 4) Northbound APIs → Appⁿ interaction with control to program network
- 5) Appⁿ Plane → controls appⁿs at appⁿ layer.
→ SDN appⁿ communicate behaviors & needed resources with SDN controller.
- 6) Control Layer → manages policies & traffic flow.
- 7) Infrastructure layer → consists of physical switches in network

Traditional switch architecture with diagram -

core of switch based on → custom silicon, either on ASIC, FPGA, NPU. These hardware devices can forward packets based on layer 2 & layer 3. input at requisite "wide speed". The control plane handles routing funcⁿ & handles calculates packet forwarding rules.

Here, control plane & data plane are integrated.



SDN data plane → forwards data packets
 → comprises switches & routers
 → receives instructions from control plane
 → implements packet forwarding

SDN control plane → centrally manages network
 → decoupled from dataplane
 → uses software controller
 → determines network policies.

SDN management plane → handles network management tasks
 → supports configuration & monitoring
 → interfaces with SDN controller
 → enables centralized management.

* Architecture of modern data center.

- Physical ~~Architecture~~
 - Modular design for faster Deployment & scaling
 - high density racks for space optimization
 - efficient cooling system for heat management
 - Redundant power & network for continuous operation
- Network
 - Multitier design for performance & security
 - Leaf spine fabric for efficient data flow
 - SDN for centralized control & automation.
- Compute
 - Virtualization for resource utilization & cost reduction
 - agility & scalability
 - HCI for simplified management
- Storage
 - SAN → high performance & block level storage
 - NAS → file level network storage
 - SDS → disaggregated/virtualized storage.
- security
 - Defense in depth approach with layered control
 - Microsegmentation for workload isolation.
 - Zero trust security for continuous verification.
- Management
 - Infrastructure as Code for automation
 - monitoring & analytics tool for real time analysis.
 - cloud integration for hybrid & multi cloud deployments.

* Adv of SDN

- centralized Control
- Programmable
- Scalable
- security
- Vendor Independence
- Better Visibility
- enhanced network performance
- simplified management
- traffic engineering optimization

* Disadv of SDN

- Complexity
- Security Risks
- Potential Vendor lockin
- Maturity
- Performance overhead
- single point of failure
- dependency on controller
- performance bottlenecks

* Characteristics of SDN

- centralized Control
- Programmability
- Abstraction
- Virtualization
- open standards
- Automation
- Dynamic Resource Allocation
- Agility & scalability

* SDN works with Distributed ~~Control~~ ^{Control plane}

- each network element has its own logic.
- make local decision based on network state.
- offers scalability & fault tolerance
- data plane → network device autonomously packets.
→ provides decentralized forwarding decisions & improved fault tolerance.

Centralized

~~Distributed~~ Control

- control plane → ~~each element~~
managed by centralized controller.
global decisions → entire network.
simplifies management → policy enforcement

Data plane

- data plane → openflow switches forward packets based on controller instructions.
- offers simplified forwarding logic & consistent policy enforcement.