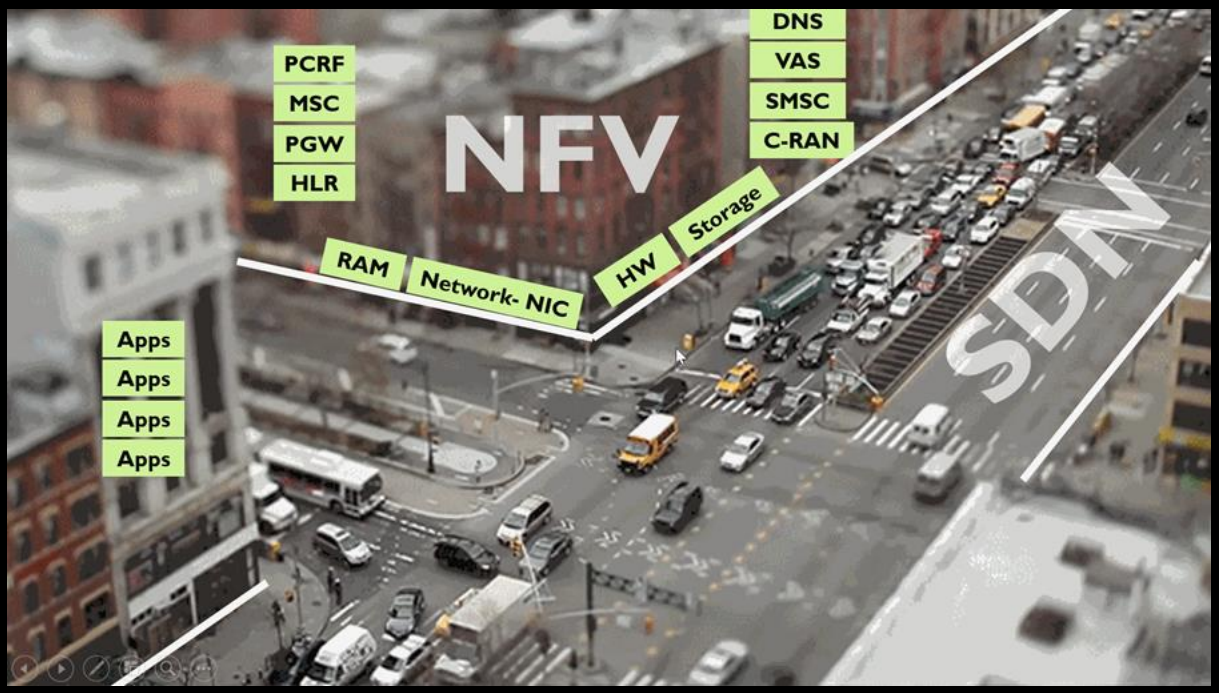
Telco Cloud Series
Module – 03

Introduction to SDN – Software defined network

Covering Introduction & Tutorial for SDN (Software defined network) and OpenFlow Architecture in Telco Networks. Covering Difference between NFV & SDN or How they work. Both architectures use network abstraction, they do so differently. SDN forwards data packets from one network device to another. SDN's networking control functions are used for flexible routing of data / IP packets

1. Introduction & Basics
2. Why we need SDN & Features of SDN
3. SDN Role in Data and Forwarding Plane, Control Plane & Management Plane
4. SDN Framework & Architecture
5. OpenFlow Architecture (High Level)
6. Need of SDN

NFV & SDN Together



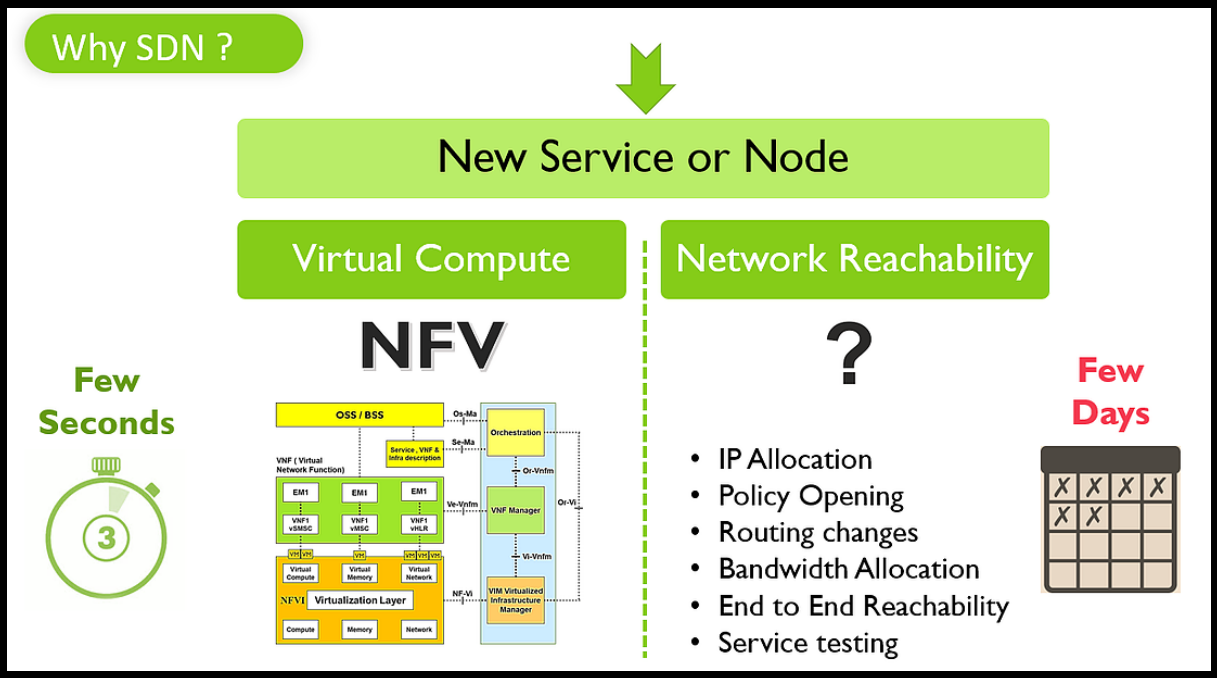
Till now, we have covered NFV which helps us building the agile and flexible Compute resources. Since NFV is all about Three main Concepts: Softwarization, Virtualization & Orchestration. SDN is all about networking control functions for routing & policy definition in automated way for ensuring IP / Network reachability well in Time. Both SDN & NFV architectures use network abstraction, they do so differently

SDN provides a new level of programmability and abstraction to Network layer which is playing phenomenal role in Automated networks of Future. Let's take deep dive on SDN & Its working

Just see the Building blocks which represents the NFV & host multiple Applications. Just like you can remove, replace or keep new tenant in Build, similarly you can host applications in NFV as well

You can see traffic on road representing SDN whose main responsibility is to carry traffic to right destination in Automated way

Why SDN?



First thing First, Let's understand why we need SDN & How it is helping

Well, we have seen NFV helps in Virtualizing networks which help us in rapid deployment & ultimately reduces New Service / New Node Creation time to few seconds. For example, we can create vMSC or vMME in few seconds & make it ready with help of Orchestrator & Automation

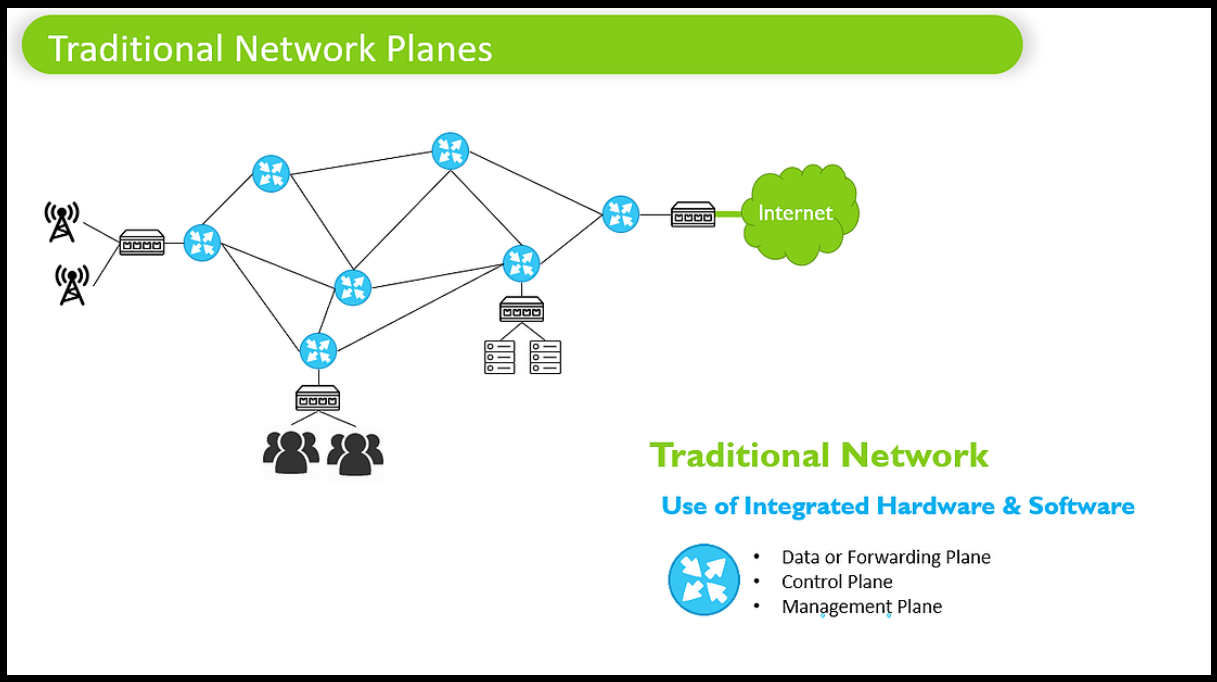
But the Another problem is Network connectivity. For any new Node or New Service, we need multiple things such as IP Allocation, Bandwidth Allocation, Policy Opening, Routing changes to achieve End to End Reachability and proceed with Service testing. All this is not automated & it takes lot of time to prepare design, perform changes in every router / switch & make it thru

In typical scenarios, this make take few days or week to finish IP Routing & enabling end to end reachability of all required links. SDN helps us here by making this routing / switching network flexible & programmable

Pls benefits & Features of SDN based networks: -

1. Directly Programmable
2. Flexible, Dynamic & Agile
3. Centrally Managed
4. Abstracts Network
5. De-Couples Control & Forwarding plane
6. Based on Open Standards & Vendor Neutral

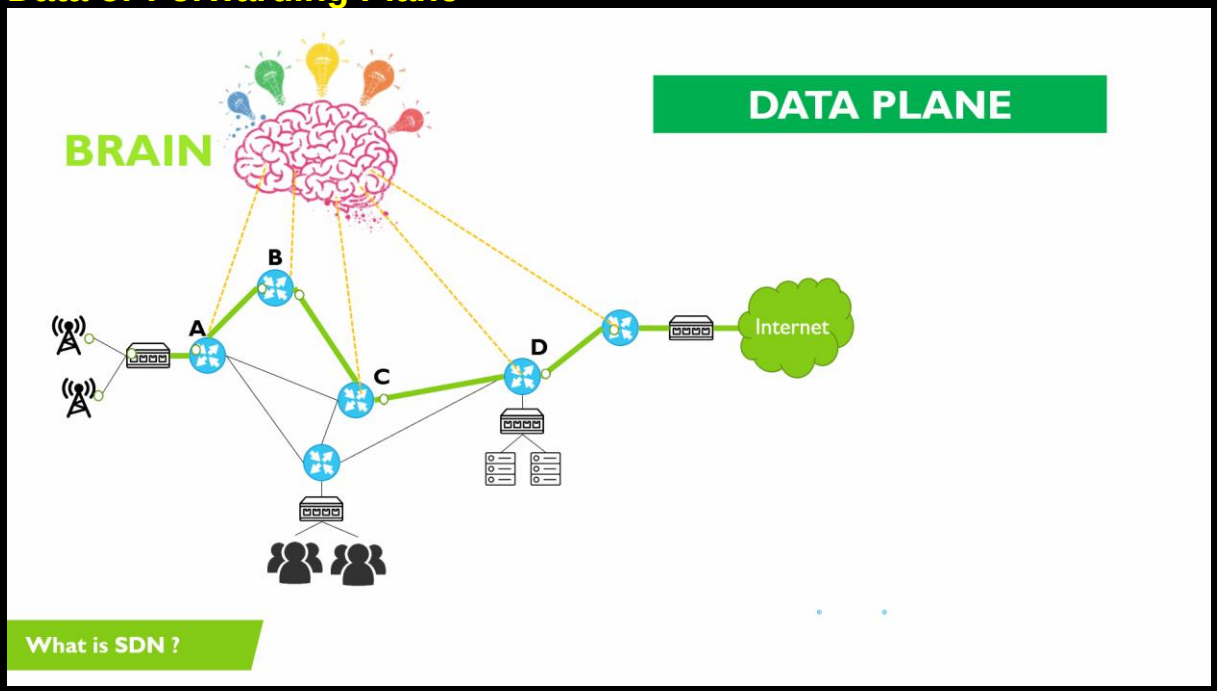
What is SDN (Software-Defined Networking)



This is our traditional network where traffic is moving between various Switches & Router in order to reach its final destination

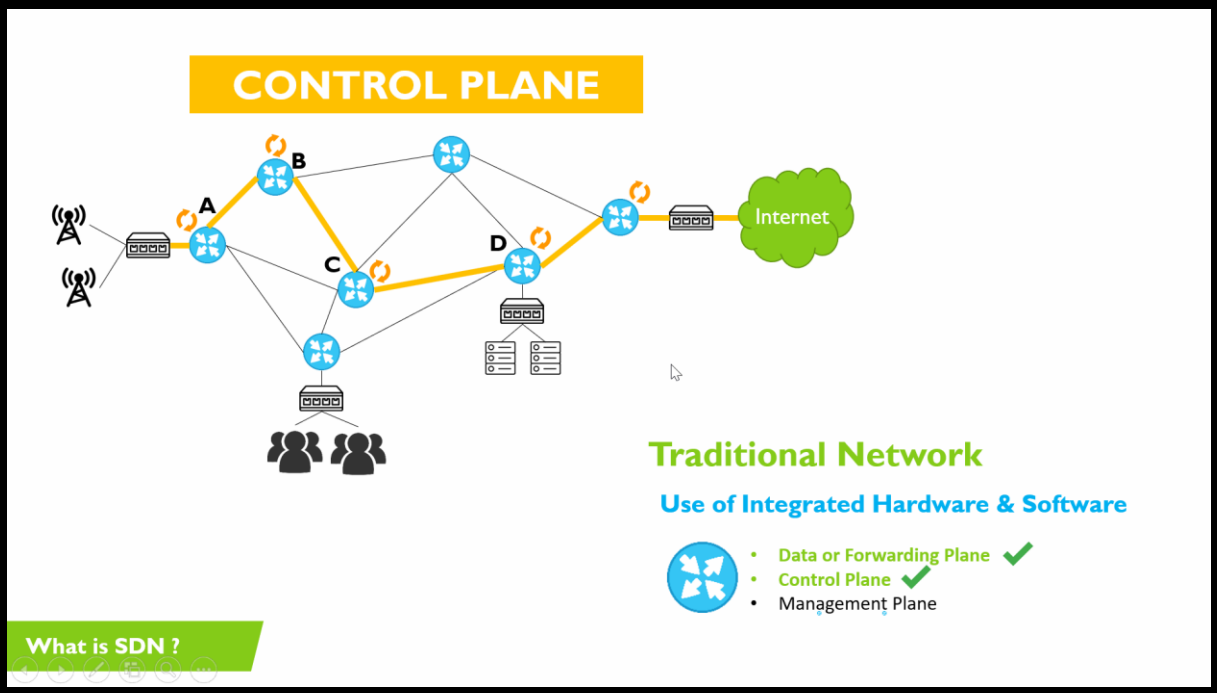
SDN changes how networking is fundamentally done. Instead of having network intelligence distributed across every device, SDN aims to centralize command and control in a master device (or a few of them for redundancy) and to split networking into three planes. Let's understand what are 3 Planes which we are going to deal with

Data or Forwarding Plane



Let's First see how Data Plane works, in traditional network, there multiple switches & Routers having links connected to each other via line cards carry this traffic. This is where the data is actually moved from one device to another, as visible on-screen traffic is going all the way from Router A to Router B to Router C to Router D.

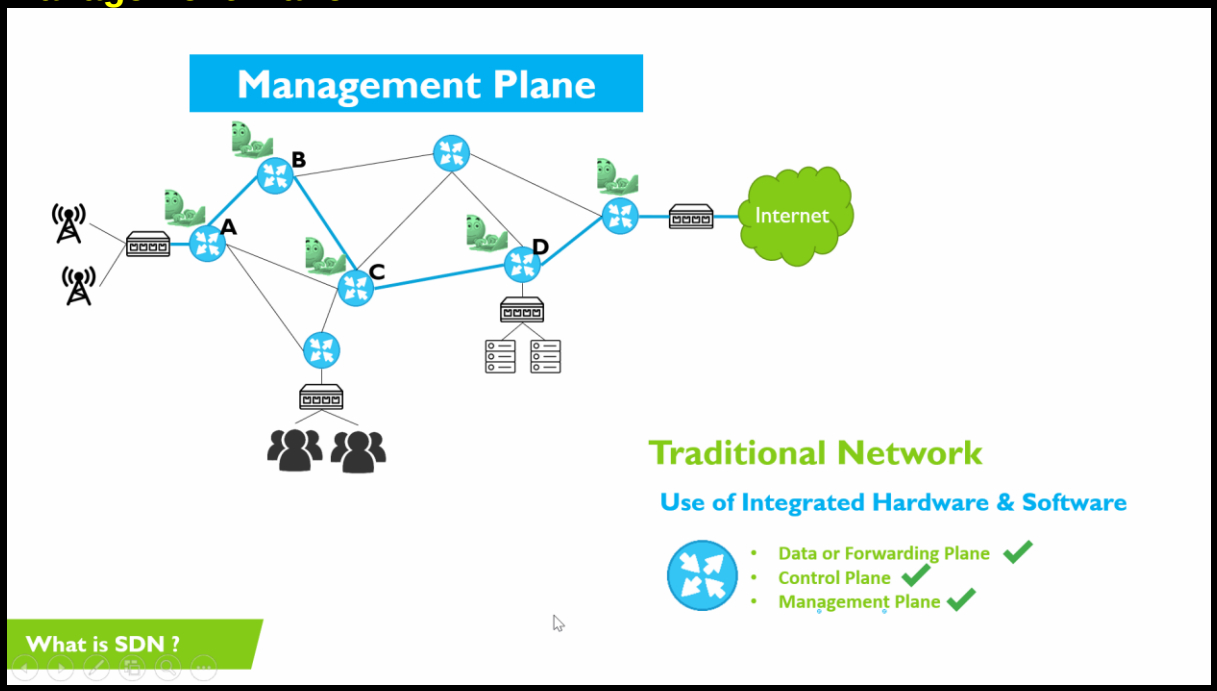
Control Plane



This is control plane. In traditional network, the role of control plane to take routing decisions. Every router is having its own brain to decide best path to route the traffic. These routing decisions are taken on basis of routes configured in router and routes learned from adjacent routers

For example, in traditional network, Router A decides to route traffic to router B on basis of Brain applied by itself i.e. Router A. Since Router A doesn't know what's happening in life of subsequent routers such as C or D, this can be point of concern in case there is problem in network such as link failures or congestion. There has to be someone who is keeping end to end eye on complete network and take holistic decision

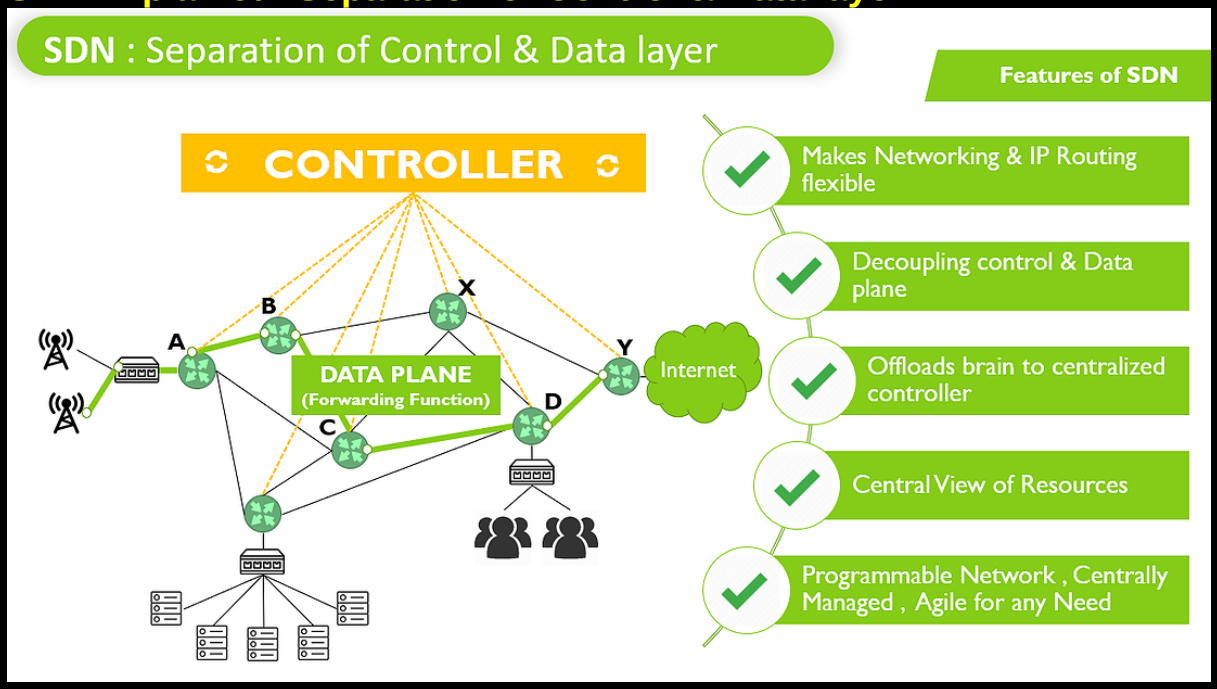
Management Plane



Now, Let's understand the Management Plane. In traditional network, this is used for performing Operation & maintenance of network. For example, we use Management plane to fetch reports, Perform Configurations, Get Alerts and Alarms

If you have to Open new route, eventually we need to login into every router and this is quite tedious task which takes lot of time & prone to errors due to manual configuration involved

SDN Explained: Separation of Control & Data layer



Separation of Control & Data layer

This is SDN Powered network where controller or brain of network is separated from data or forwarding plane. SDN will change dramatically the way we design, manage & run our networks

Before we discuss this, Let's understand What is SDN? SDN stands for Software-Defined Networking (SDN). This is an emerging architecture of Network that is fully programmable, dynamic, manageable, cost-effective, and adaptable, making it ideal for dynamic & random requirements for day to day stuff

This works on 4 key principles of SDN Networks

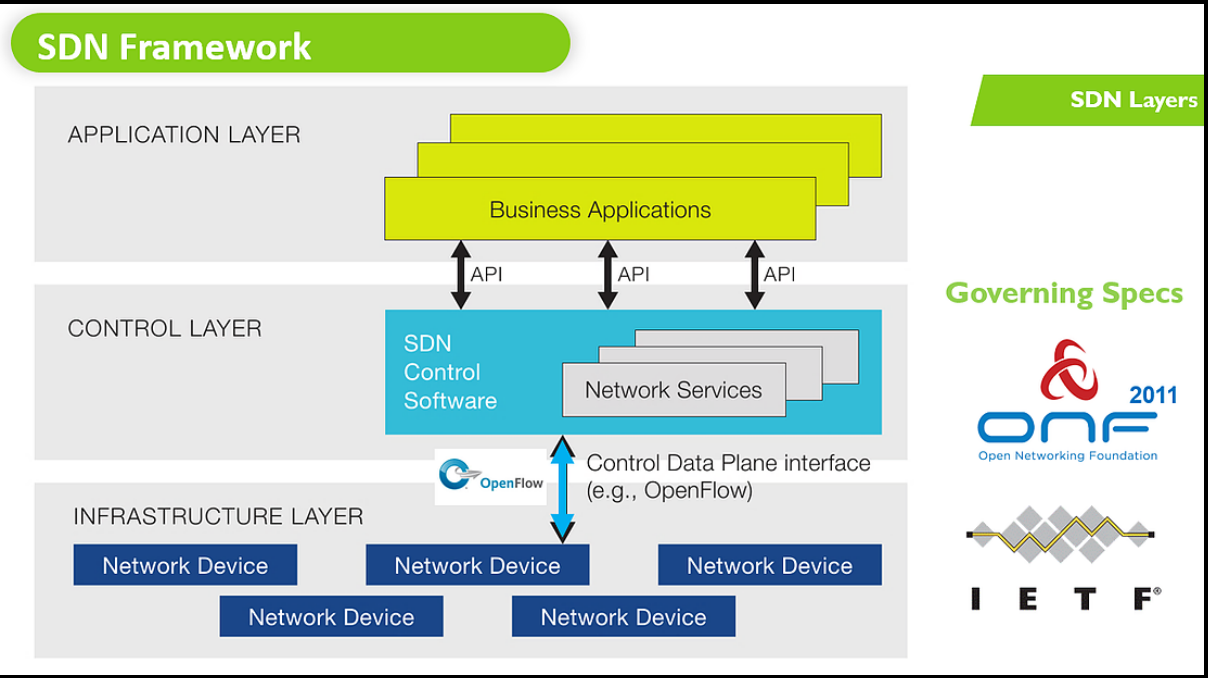
- **Makes Networking & IP Routing flexible:** SDN ultimately enable packets or traffic to reach its destination, it does same with help of software & dynamic algorithms with full flexibility & Agility. Instead of wasting many days in performing manual routing for enabling reachability, SDN does this in much better way that requires far less time

- **Decoupling control & Data plane:** In traditional network, Where Both Brain & Data forwarding layer sits on same router, here we can see centralized controller whereas Data forwarding plane still resides on Router. Here, centralized Controller decides traffic Routing, Data Plane only used for forwarding Payload to destination. We call this as De-Coupling of control & Data plane

- **Offloads brain to centralized controller & Central View of Resources**: SDN provide a central view for more efficient resource allocation and running of network services. This facilitates centralized monitoring of entire network. The control plane is taking decision considering end to end topology. While routing traffic from Router-A, it does consider what's happening in life of Router-D. In case there is some outage or link congestion or degradation happened with Router-D, All the routers are told to route traffic via Router-X

- **Programmable Network, Centrally Managed, Agile for any Need**: Centralized control plane means network control to become directly programmable and the underlying infrastructure to be abstracted for applications and network services. SDN makes networks programmable so that operators can support multiple applications such as dynamic provisioning of bandwidth, Auto Scale out, Scale In, Building protection paths etc. There are upper layer applications which can flexibly manage the controller such as exposing Controller directly to user on Web portal where End user can provision or De-Provision bandwidth himself. The true power of SDN is Abstraction, the whole logic flow is so automated that network applications can make requests SDN controller which in turn will adjust the network resources, changing configuration. All of this happens within few Seconds

SDN Framework



In SDN Architecture, OpenFlow protocol is key to entire topology. The group of few Intellects started working on OpenFlow specification in Stanford University & thereafter, in year 2011, The Open Networking Foundation also called as ONF was founded to promote SDN and OpenFlow. There are several workgroups created which started standardizing this OpenFlow protocol

Most of OEMs & Vendor are supporting this OpenFlow protocol now. Here SDN Controller can belong from One OEM where Data / Forwarding plane may belong to another vendor. SDN Controller can also communicate with many types of network elements from different vendors with help of OpenFlow Protocol

This OpenFlow protocol provides unified method or southbound interface for the control plane to communicate with the data plane. This is followed by all vendors such as Cisco, Juniper, HP etc. OpenFlow works on standard API defined between the control and the Data or forwarding plane. With help of OpenFlow the Brain or Controller can manipulate or change the routing tables, routing Algorithm used by forwarding plane. This allows remote configuration of packet forwarding tables by adding, modifying and removing packet matching rules and actions. This Open Flow needs to be supported by both Controller and Forwarding routers used in network. The existing devices can be also evolved to support Open Flow, for example, All Existing Traditional Switches Routers etc. can become Data Forwarding plane can receive instructions from 3rd Party Controller. Here we can transform our existing network to support SDN

Since controller is exposed to Business applications with help of APIs, this gives us opportunity to innovate multiple features & functionalities in the network as per customer requirements