A Comparative Study On Software Defined Network Vs Traditional Network Approach

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Abstract—A digital civilization has emerged as a result of the Internet, in which practically everything is connected and accessible from anywhere. Now traditional networks and IP addressed were complicated and hard to operate.As a result, it is difficult to configure the network in accordance with the established protocols and respond to changes in the load and defects by re configuring the network. current networks are vertically incorporated with controlled and data plane which make it more complicated.An emerging idea called Software-Defined Networking (SDN) seeks to remedy this problem by fostering logical network control centralization, breaking vertical incorporation, decoupling the network control logic from the fundamental switches and routers, and enabling network programming.To provide the necessary flexibility, it is necessary to separate the issues between the network policy concept, their implementation in hardware switching, and data forwarding. By breaking down the problem of network control into manageable components, SDN makes it easier to create and implement new concepts in networking, simplifies network management, and helps in the evolution of the network.This paper explores SDN, explaining its fundamental ideas, how it is different from traditional networking, and its basic architectural principles.We also discussed the key benefits and difficulties of SDN security, flexibility, and performance. A succinct summary of SDN is revised at the end. (Abstract)

Index Terms—SDN, traditional, transform, architecture, control panel(key words)

I. INTRODUCTION

As networks are growing in real world the availability of hardware, switches and hubs are becoming a problem. Also setting network for software is from switches is complicated and time consuming for the users or companies which have the high virtual systems and need continuous network. Now here is we can say SDN helps[1,2].

SDN allows network operators to programmatically set up, monitor, modify, and control network functioning through open interfaces like the OpenFlow protocol[3].

The SDN modifies how network infrastructures are used, managed, and configured.

The foundation of the SDN's approach is the division of the control plane from the data plane [4]. SDN proposes to separate the data packet forwarding mechanism (data plane) from the routing process in order to focus network intelligence on a single network component (control plane). For visual example refer **Fig. 1**

Now as introduction is over so this page will now discuss about comparison between SDN architecture and Traditional networking also we will discuss about what are the benefit of SDN and also explore some tool that are used in SDN.

II. THEORIES ON TRADITIONAL NETWORKING AND SDN

Comparison of Traditional and SDN

Now first we see how traditional networking works it is divided in different pattern depend on device few are ARP,STP, OSPF, EIGRP, BGP, and others operate independently [8] also as we can see traditional networks protocol is dependent on devices so they do connect with each other but they don’t have centralized machine to control network.

Devices in traditional network connect with each other directly[9,10].Here comes the biggest difference that is traditional network is mostly hardware based where SDN is mostly software based.

Hardware based means if we have to change network or configure router then we have to visit to that router to perform operation on the other hand software based means we can configure router or machine by any web page or application that can automatically configure that machine.

As we discussed hardware based model in traditional networks uses most of switches, hubs, router and other hardware like wires, connecting clips etc. On the other hand in SDN APIs are used to do all operation due to this connectivity, device manufacturers instead of using the protocols necessary for traditional networking, network can be manually programmed [9,20]. All mounting is done through conventional networks. control aircraft and data planes in one physical enhance the capacity of each unit before sharing them traffic volume, CPU load, and other factors two processes that use memory [21–23].

SDN is recognized as a well-liked replacement for traditional networking since it enables IT managers to add additional physical infrastructure services and bandwidths without incurring additional costs [25]. Traditional networking calls for new hardware in order to increase network power [26,27].

For visual example of SDN vs Traditional Networking Architecture Refer **Fig. 2**

Need of SDN

SDN is classified as a current model that is quickly evolving as a replacement for networks that cannot eliminate the shortcomings of traditional networking by separating software from hardware [28,29]. In SDN, a centralised software application provides management and control for the hardware.

An open source framework standard and layered architecture are the primary needs of SDN. Software is more effective, more flexible in terms of programming, and more friendly to innovation in computer networking since it is easily generated by different vendors [7,32]. SDN must solve a number of difficulties, including scalability issues, virtualization, connectivity continuity, controller location, and more [33,34].

Reliability is one of the major issues faced by SDN. For large-scale networks, reliability is a prime concern [22,35].Practically speaking, the SDN controller is a unified control feature since it frequently represents a single point of failure. Therefore, measures must be done to guarantee that the dependability of contemporary technical solutions is at least as good as or higher than before [36,37]. One of the key developments for building the network architecture of the new economy is SDN. The digital economy cannot, however, be built on shaky networks [38,39].

III. Architecture of SDN

As we have how traditional network is different from SDN and its architecture lets discuss architecture of SDN it explains that how SDN really works. To create software defined network there are three primary layers that are needed 1)Application plane 2) Data Plane 3) control plane[7,28,40]. SDN consists of two interfaces, one connects the southbound APIs and the other between the control layer of the Northbound API and the application layer of the API.The SDN contains 2 layer[41]. for visual example refer **Fig. 3**

As we discussed that how API's are connecting to all three plane lets know about all plane and how they work in SDN.

Application Plane:

Each program at the application layer has exclusive control over one or more SDN controllers that are available to a user combination of resources that is a component of the SDN architecture, which is made up of software that delivers network services to users and devices [46, 47].Applications link with the SDN controller using APIs (northbound interface) to achieve an abstract global picture of the network they are utilising and to describe the network activities they need at the time [44].

Control layer:

It includes several software-based SDN controllers that offer centralised control via a well defined API to manage network forwarding operations through an open interface[42,43]. The device layer, the network operating system layer, and the network abstraction layer are the three main layers that make up the control plane [44,45].

Infrastructure Plane:

The infrastructure plane is sometimes referred to as the data layer or data plane [44]. Like the physical layer of the OSI architecture, it comprises network components like actual and virtual computers that interact with data flow. From its entrance to its exit interface, an SDN forwarding plane is in responsible of physically transmitting packet frames utilising the control plane's protocols [7,49].

Now as we know about all planes are present in SDN architecture. Now we are going to know about how they are connected to each other and what API to they use.

There are two API named as 1) Northbound API and 2) Southbound API

Northbound API

The northbound APIs are the link between the apps and the SDN controller. Applications should inform the network of their needs so that the network can provide those services or communicate what it already provides. [41,48]

Southbound API

SDN southbound APIs are used to establish connections with the SDN controller, network switches, and routers. The OpenFlow protocol is the most used one in this interface [10,41].

Here we have fully discussed the architecture of SDN and it s layers API etc. SDN is so useful and helpful in terms of cost efficiency, time consumption, so lets take a look on how SDN is provide benefits that traditional network.

IV. Benefits of using SDN in real life

Platform

It provides the platform for virtualinzation, promote data-insensitive software, instance etc.

Centralized and place for network management

As we have already seen in traditional network there wast any one place to control network. SDN provides centralized and stable place to access control network using Software.By this security of network and fair use of network is easily recognizable. If any terms or policy violation happens it can be communicated to all organization easily

Hardware cost reduction :

SDN utilizes organisational performance and the virtualization idea to improve network utilisation while building a network with the least amount of hardware possible [16, 26], eliminating the need for manual help and the cost of setup and reducing network usage.

Data abstraction from cloud:

There will always be cloud computing, and an uniform architecture is starting to take shape. By leveraging SDN to abstract cloud infrastructure, cloud services can be more easily unified. All of the networking components that large data centre systems contain are controllable [53,54].

Security approach

When there is a single management panel for networking, it makes it simpler to monitor and administer the security features. [54,55].It might not have to deal with numerous programmes that are part of the system or rely on them. It is simple to manage from a single central location and offers a better security strategy [56]. The same console may be used to broadcast information in the event of a security-related alarm.

Automation

In contrast to previous networks, today's network is not concerned with internet access. The automatic responses of the cloud can also be modified using SDN. The procedure functions well in settings like enterprise-wide SD-WAN networks [38].

V. CHALLENGES USING SDN

SDN is still in its existence, despite being recognised as the fundamental solution to the issues that the infrastructure of the developing network is confronting. In addition to many additional benefits, advantages like improved functionality, decreased cost, and increased efficiency have been listed. However, a number of obstacles also need to be taken into consideration.

As SDN becomes more widely adopted and new alternatives are proposed, difficulties develop [62].

Scalability

Scalability issues are the main challenges SDN faces.Two related problems can be deduced from this one main problem: (a) controller scalability and (b) network node scalability.Up to 6 million flows per second can be handled by a single controller [63]. Thus, this indicates that only one controller, or several controllers, can manage the required control plane services for a large number of data forwarding nodes [64,65]. The conceptually centralised controller should be physically distributed to increase scalability rather than running peer-to-peer [66].It doesn't matter if the controller network is dispersed or peer-to-peer; the issues the controller encounters when interaction occurs will be shared by all network nodes [38]. Scalability is frequently attained with the help of Hyper Flow and Onix. Onix operates by assigning and dividing network status to unique, physically separated controllers. Using the HyperFlow programme, OpenFlow networks that are each under a user-controlled control can be connected [67].

Flexibility

One of the core issues with SDN is how to effectively handle high-level packet processing flows. Flexibility and performance are the two primary criteria to be taken into account in this regard [69].

Security challenges

Networks' flexibility is its capacity to adapt to novel and cutting-edge features in software and network infrastructure. The performance is concerned with how quickly data is delivered from the control plane through data-plane network nodes [70].You will need to protect and secure the device, rely on each component's SDN, ensure that the controller complies with your requirements, and, in the event of a malfunction, the architecture should be able to recognise, address, and disclose the issue [41]. Security flaws and SDN safety hazards are made possible by the separation of the data and control aircraft. The best location for SDN controllers, switches, and other devices influences the performance and security of the entire network [73,74]. Because of SDN's flat design, which requires compliance from monitoring systems and defensive solutions to increase overall performance, energy savings, and network security [5,75], its integration presents additional security issue.

Data plane layer security challenge:

Flood tables in the data plane are space constrained, and storage flow entries on flow tables cause overhead, which results in high costs and subpar performance [75,76]. This issue can be solved by storing several high-performance, low-cost rules using clever flow table control approaches [41]. Network activity can be interrupted by switches or access points when malicious users launch a Denial of Service (DoS) attack, which causes the disruption or network loss [70].

Control plane layer security challenge

Although controllers are essential to SDN, their centralised decision-making, which can activate networking in a security compromise, makes them a single point of weakness [77]. The control layer's transparent environment makes it a desirable target for security threats. How many switches are connected to the controller, and how many requests are issued to the controller while waiting for a response, is another issue. Your controller may crash as a result of the load it is under if you add a lot of switches to it [41, 78].

Application plane layer security challenge

To monitor a network node that has the potential to infect other connected network nodes, the hacker can flood the application layer with malicious data [79].

The attacker may gain unauthorised access to the network node by introducing malicious code to track the flow of network packets and steal important data [1].

VI. IMPLEMENTATION TOOLS FOR SDN

To evaluate the performance of SDN, numerous simulation tools, such OMNET++ and Mininet, have been created. The other modelling tools are Estinet and Ns-3. These techniques have their advantages. You may see in Table.2 [9] a comparison of the various simulation tools. The review of SDN's definition, architecture, advantages, and difficulties was offered in this work. Additionally, we looked at the architecture of the SDN networking paradigm in relation to the relevant open research issues and amended part of the work done for each challenge, including scalability, security, dependability, and performance. Additionally, a number of specific SDN concerns, such as standardising the SDN modules and adding fresh, specially built SDN procedures, still call for additional research in order to minimise problems inherited from legacy networks.

So after discussing whole structure of SDN and its architecture here is final conclusion

VII. CONCLUSION:

A standardized programming capacity to regulate network behaviour is made possible by the SDN networking paradigm, which is still in development. Since SDN is a contemporary method of networking, many traditional network challenges have been redesigned using this architecture, while some problems still pose difficulties. Due to the network's growing complexity as well as that of many other software domains, SDN offers effective and automatic network control.This paper reviewed part of the work done with each issue, including scalability, security, reliability, and performance, and compared the SDN networking paradigm design with the corresponding open research problems. Additionally, numerous specific SDN challenges, such as standardizing the SDN modules and establishing new special SDN procedures, still need further research to minimise problems brought about by legacy networks. The study has to focus more on the control plane in order to generate creative ideas for the controllers that serve as the SDN design's brains. Several security precautions should be taken into consideration because the control plane is a potential point of failure for the entire network. As a result, SDN is crucial in creating numerous fixes for traditional network concerns, while some problems still pose a challenge. Additionally, it offers effective and autonomous network control that fulfils the demands of the network's growing complexity as well as those of many other software fields.

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Figures and Tables

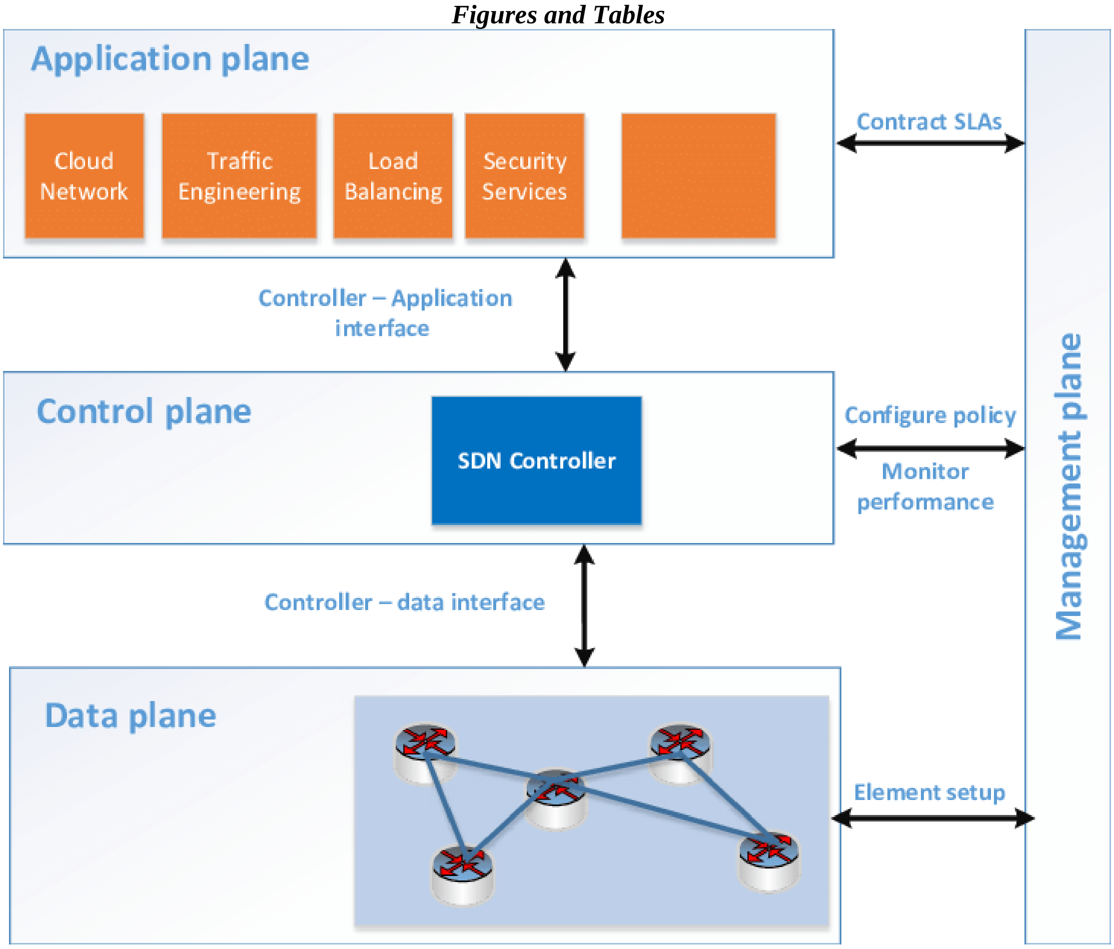

Fig. 1

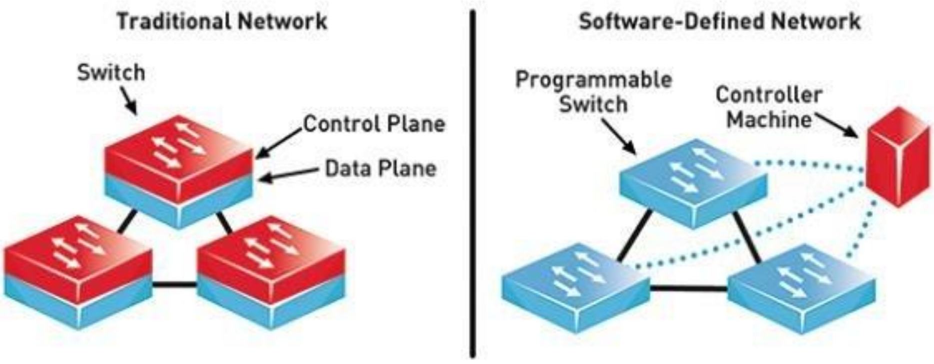

Fig. 2

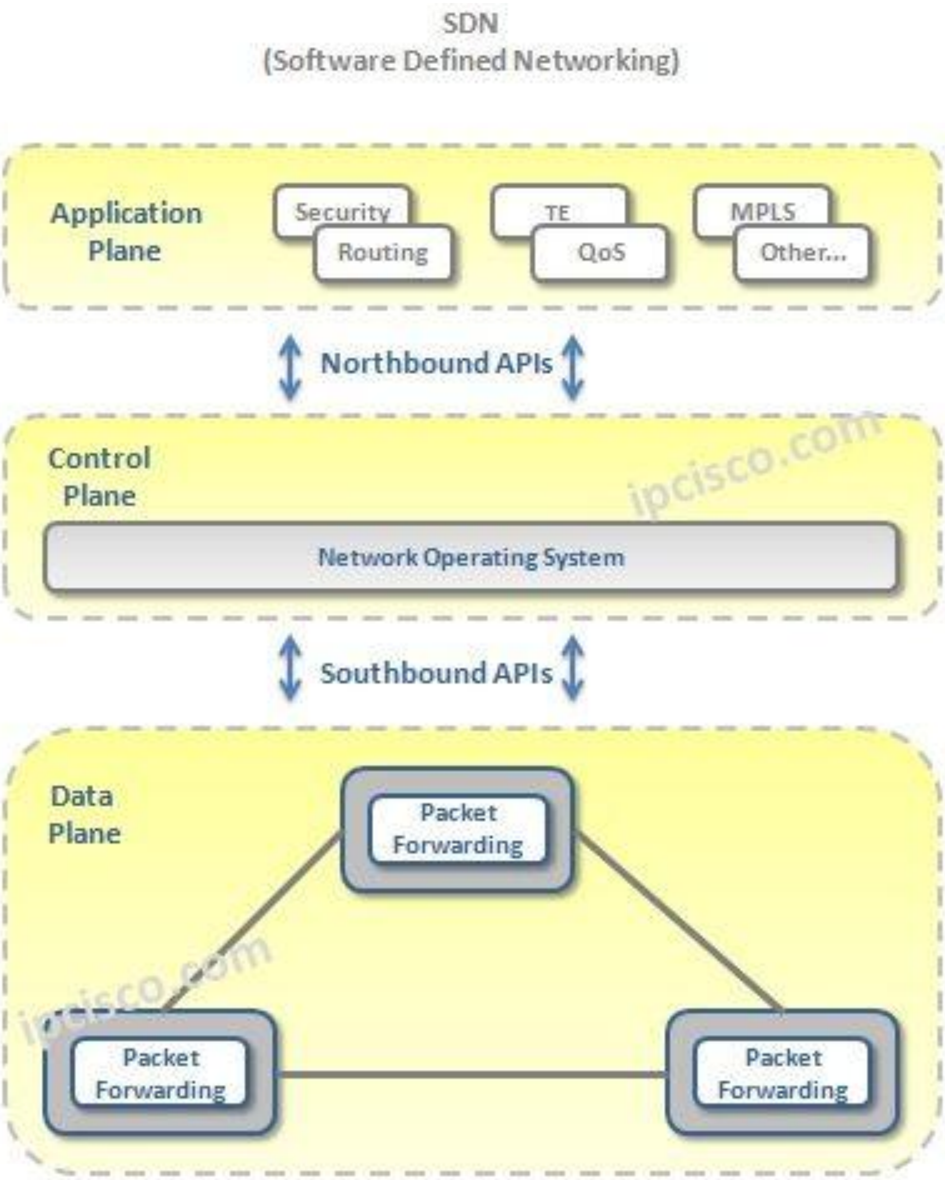

Fig. 3

VI. ACKNOWLEDGMENT

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