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Research Article

Software-Defined Network Controller & Flow Setup Latency

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Abstract

Software-defined networking (SDN) delivers a high level of preoccupation to the network engineers to control the traffic of networks and manage the connected network resources. As it is a traditional switch controller sequence, generating or operating a network becomes more manageable for the engineers. On the performance of the network flow process, this approach is capable of providing a measurable result. In the internet platform, day by day, the connectivity of devices has increased in a wide range across the world. In addition to this, networking applications also continuously grow each year to balance the entire procedure.

In addition to internet users, networking fundamentals also expand to be more composite at a quick rate. In various early studies, researchers proposed the different layers of Software-defined networking (SDN) to identify its impact on controlling the setup of the internet network. This process is capable of providing flexible, dynamic, and climbable management and management for networks. Accompanied with the SDN approach, the networking site operating process can be 100% better than other traditional cycles. A single controller due to the heavy load in the internet accessing process can cause a serious issue and cause traffic for the users.

The researcher in this study adopted the mixed method of data collection and mixed method of data analysis. Several research methods have also been used to collect and analyze relevant data in this research study. The result of this research procedure shows the advantage along with the benefits of this cycle. In addition, the result highlights the other traditional network traffic to identify the effectiveness of the distributed nature of SDN. It highlighted successfully that the given solutions in this study could reduce latency and similarity with existing hardware design and protocol. The study is expected to qualify a wide range of distribution of Software-defined networking (SDN) hypotheses in order to provide a flexible flow of hardware modifications.

Keywords:

1. Introduction

The software-defined network is a framework, and this is based on three specific concepts. The concepts are data planning, control separation, and ephemeral management. Therefore, software-defined networking controllers are significant and play an important role in the specific framework. (Parihar, A and Tiwari, N 2021)

In the present era, the number of users is rapidly increasing on the internet; due to this requirement, a dynamic network is required to fulfill such types of demands.

After that, it can be said that the controllers of Software-defined networking are the embodiment of the software-defined networking framework (Hamdan *et al.* 2020). The reflection of the controllers of Software-defined networking can be noticed in the specific Framework for Software-defined networking. Apart from that, the Controller of Software-defined networking helps provide several services for control plane distribution centralization and the state management of ephemeral networks. The three concepts of Software-defined networking are essential, and the controllers of Software-defined networking help to analyze these three concepts in the framework. The usage of these controllers of Software-defined networking is analyzed in this particular research study.

On the other hand, latency is another important part of Software-defined networking. Therefore, latency is the process of measurement of the time off the network, and latency is measured by using MS (Bennis *et al.* 2018). Apart from that, four particular aspects majorly impact the network latency, which is analyzed below for this specific research study. The usage of latency is another description of this research study's full stop; in addition to that, the flow setup latency and its uses in the Software-defined networking framework are also analyzed in this particular research study significantly. Furthermore, the connection between Software-defined networking and flow setup latency is another description of this research study.

Apart from that, this particular research study aims to analyze the importance of flow setup latency in Software-defined networking. Along with that, there are some objectives that the researcher has set to achieve and create a remarkable research study. Therefore, the objectives are to analyze the usage of the controllers of Software-defined networking, to investigate the beneficial sites of the framework of a software-defined network. In addition to that, analyzing the importance of latency is another objective of this particular research study. Apart from that, identifying the connection between flow setup latency and software-defined networks is also an objective of this specific research study. Therefore, the usage of flow setup in the framework of the software-defined network is analyzed in this particular research study.

In this section, the author proposes a dehazing based image on dynamic optimization technique. (Singh, K and Parihar, A 2021)The hazy appearance is useful to capture the information about transmission map in the term of haze and object details present in it.

On the other hand, the researcher has used some research questions to understand the basic concept of the research topic. Along with that, some methods and techniques are used by the researcher for creating a remarkable research study. The researcher uses some data collection techniques to collect proper and accurate data for this particular research study. Apart from that, some data analysis techniques are also used to analyze the collected data correctly and make the study readable for the readers. Thus, the methods that the researcher has adopted are effective and efficient and were helpful to make a significant research study.

2. The usage of the software-defined network controller

There are lots of controllers of software-defined networks, and all the controllers are equally essential for the framework. Therefore, the controllers of software-defined networks help to control the framework of software-defined networks, and it is also helpful to analyze the framework properly. Apart from that, some windows provide the facilities of giving software-defined network controllers. After that, the vendors that provide the controllers of the software-defined network are essential. Some of the vendors are Cumulus Networks, Juniper Networks, Pluribus Networks, Nuage Networks, VMware, Cisco, Big Switch Networks, Hewlett Packard Enterprise, Pica8, and others (Bhushan *et al.* 2019). Along with that, the controllers of the software-defined network are the essential elements of the software-defined network framework full stop in addition that the controllers play a significant role in the making of software-defined network framework. Therefore, the substantial role in the controllers of the software-defined network is analyzed in this particular study.

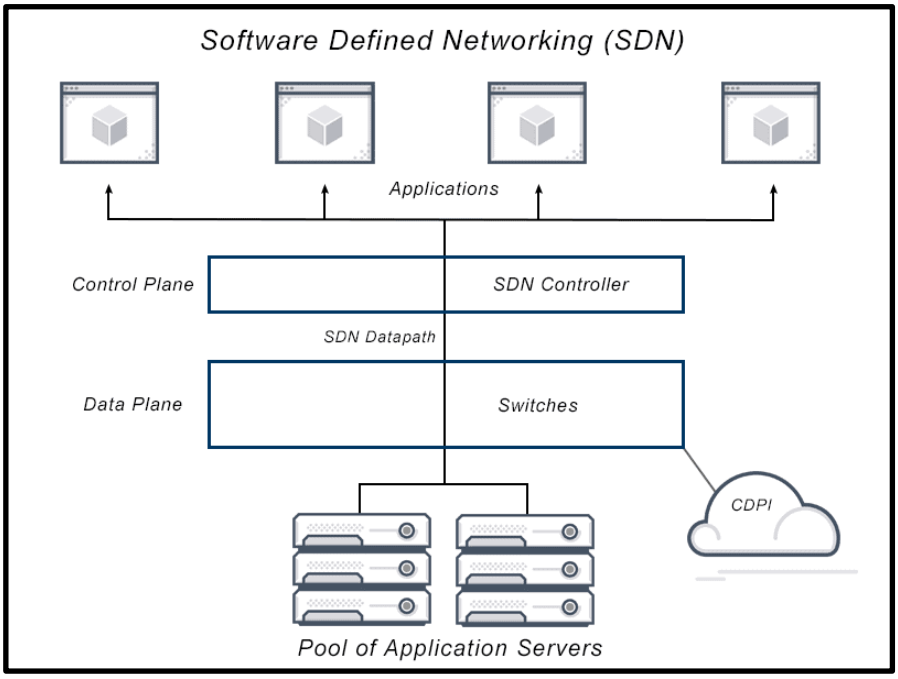

Figure 1: "software-defined network"

(Source: Chaudhary *et al.* 2018)

On the other hand, some open sources provide the controllers of Software-defined networks. Those specific open sources are OpenContrail, OpenDaylight, Floodlight, and others. The controllers of Software-defined networking are essential because it helps to provide the network all over the world. Multinational companies that provide this type of network use the controllers mostly (Chaudhary *et al.* 2018). Therefore, it is essential to provide services to the people of the world. It is necessary to make a large international company. For the more forgiving the connection among the people of other countries, the controllers are vital. The controllers of Software-defined networking help to provide their services to the people and community of other countries, which helps them establish their company in the global market. Apart from that, the advantages of software-defined networking controllers are analyzed below in this particular research study.

3. Advantages of Software-defined network

There are lots of benefits of the controllers of Software-defined networking, and those beneficial sides are analyzed in this part of this particular research study. Therefore, the controllers of Software-defined networking help simplify the operations that are one of these controllers' most critical beneficial sites (Li *et al.*, 2018). It helps to reduce the network's complexity and separate the data planes and control during the making of automation and increase the scalability. Apart from that, it helps to achieve all the goals of an organization and along with that helps to get good growth in the international market.

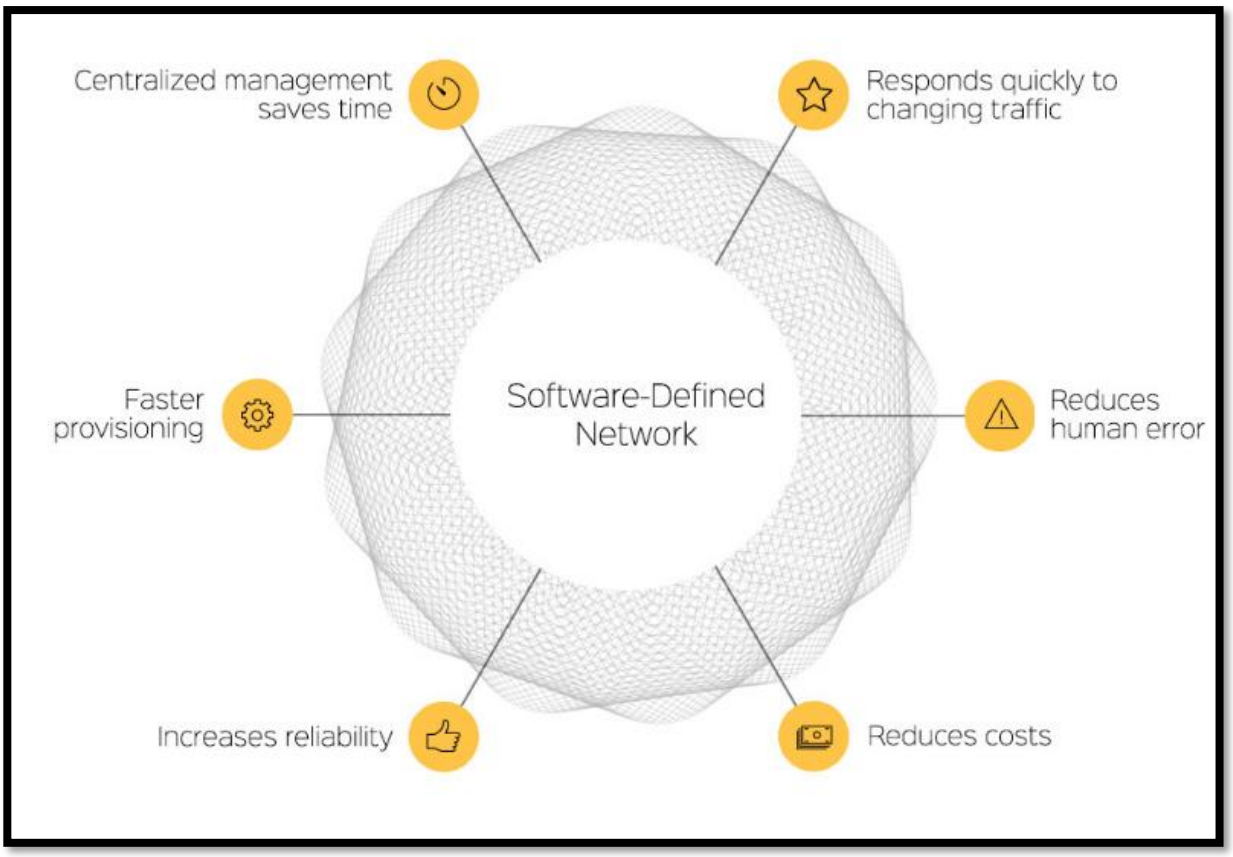

Figure 2: Advantages of Software-defined network

On the other hand, the controllers of Software-defined networking help build up a programmable network that is helpful to provide services all over the world. In addition to that, the controllers of Software-defined networking provide more features and facilities, such as helps to eliminate the manual configuration. Therefore, that is helpful to build up a programmable network (Rehmani*et et al.*, 2019). Furthermore, controllers of Software-defined networking help in many factors such as cloud automation, control monitoring, management, centralization, configuration, and service delivery. It can be said that the controllers of Software-defined networking take an essential part in the software-defined network model.

Challenges of SDN and comparison with traditional network

While considering the positive impacts of SDN, there are also some of the challenges that might negatively impact the organization's performance. However, in this part of the research study, a comparison will be provided on the advantages and challenges of SDN. As per the words of (Alsaeedi *et al.*, 2019) SDN is suitable prevention for IT and cloud implementation and performance.

4. Latency

Latency is a process to measure the delay of time between the cause and effect of some changes. Apart from that, the network latency is used to measure the speed of the network. Latency is a term used in computer networking to describe the amount of time it takes for a data packet to transit from one point to another. In an ideal world, latency will be as low as possible as the round-trip time (RTT) for a packet of data traveling to and from a destination can be used to determine network latency. Network capacity latency can make it difficult to load WebPages, disrupt audio feeds, and make an app unworkable. Based on the location, sometimes, a tiny increase in delay can destroy the user experience.

On the other hand, Geographical location is one of the key causes of delay. Highly spread Internet Protocol (IP) networks span large distances, increasing transmits power and potentially delaying an application. Good network latency is important for any Software-defined networking, and a good latency supports low latency. The network latency is based on the time the data needs to travel between the resources and the destination. Therefore, it is identified the ping rate of a good latency is needed to be below ***150 MS*** (Bennis *et al.*,2018). In addition to that, the ping rate of ***20 MS*** is considered a significant network latency. Thus, the use of flow setup latency in Software-defined networking is analyzed in this research study.

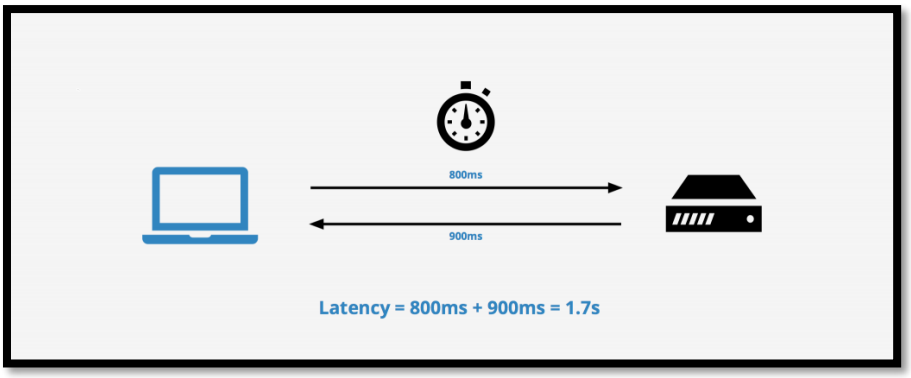

Figure 3: Network latency

(Source: Bennis, 2018)

5. Methods and techniques

Research techniques and methods are essential for any research study, and the use of several techniques and methods in a research study is helpful to create a remarkable and readable research study. There are many techniques and methods for doing research papers, and among them, the researcher has adopted some accurate research techniques for this particular research study. There are several types of methods and techniques, such as research philosophy research approach, research design techniques, data collection techniques, and data analysis (Ryan, 2018). The researcher adopts all the research methods for doing an appropriate research study. First of all, the researcher has adopted ***a hybrid proactive and reactive*** approach, one of the significant research philosophies to analyze genuine information about the research topic (Rzepka*et et al.* 2020). Apart from that, positivism research philosophy is helpful to gain knowledge about some objective, reliable general data based on the research topic full stop; this is why the researcher has adopted the positivism research philosophy.

The prevalent method is used to perform well for low-light intensity images, which is termed retinex. (Parihar *et al.* 2020) In this article, the author proposes a new application for simultaneous estimation of reflectance and illumination for “low-light image enhancement."

Apart from that, the researcher has adopted a descriptive research design for designing a remarkable research study. Therefore, the descriptive research design is one of the efficient research designs that help to descriptively analyze the topic's concept in the study. In addition to that, ***the descriptive research design*** helps to gain knowledge about the when, where, how, and what questions about the research topic (Atmowardoyo, 2018). However, the descriptive research design cannot get the answers to the why questions, but it is beneficial to know the basic ideas about the research topic. This is the primary reason to adopt the descriptive research design as a research technique in this research study also; the researcher has used the ***deductive approach*** to mitigate the research objectives. The reasoned inclusion approach is helpful to evaluate the concept of the research topic in a simple way, and that is helpful to make a readable research study.

There are various types of methods used for the classification of network traffic (Parihar *et al.* 2021) with the help of evaluation of congestion and performance in Software-defined networking.

In addition to that, the researcher has used proper techniques of data collection that are important to analyze appropriate information about the research topic. There are generally two types of data collection techniques: the primary technique of data gathering and the secondary technique of data gathering. Both techniques are very efficient and effective in collecting accurate and proper data about the research topic. Therefore, the researcher has adopted ***the PARD method of data collection*** in this particular research study. There are many resources for secondary data collection methods, such as books, magazines, newspapers articles, journals, public records, government records, and many more published resources (Längler, 2019). By using the resources of the secondary method of data, collection research has gained a lot of accurate data for this research paper. Apart from that, there are a lot of resources for primary methods of data collection, such as interviews, surveys, and other real-life experiences.

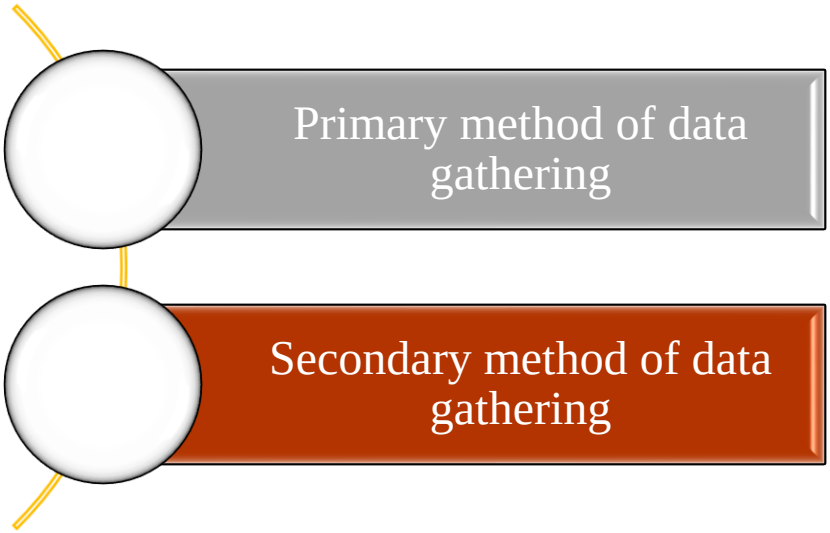

Figure 4: techniques of data gathering

(Source: Längler, 2019)

The primary method of data collection is based on the experiences that a person gains from real-life expertise, and it is helpful to collect some genuine data about the research topic. On the other hand, the researcher has also used proper data analysis methods, which is another essential part of any research study (Geldhof *et al.*, 2018). There are mainly two types of data analysis techniques such as quantitative analysis of data and qualitative analysis of data. Both of the techniques of data analysis are important and efficient to analyze the data collected in a significant way. Therefore, the quantitative analysis of data methods is used to analyze the data that are gathered by using the primary method of data collection.

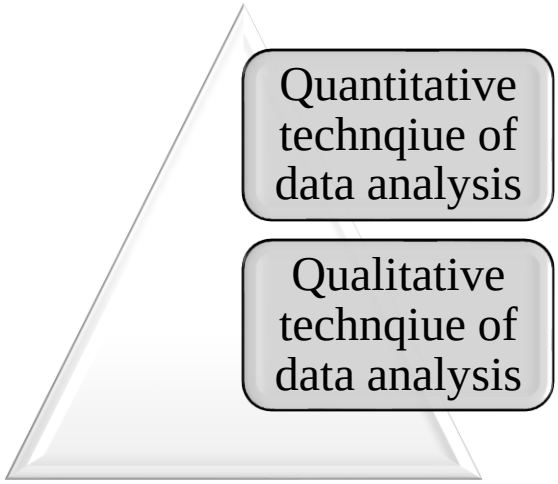

Figure 5: Mixed method of data analysis

(Source: Riazi, 2018)

Along with that, the qualitative analysis of data method is used to analyze the data that are gathered by using the secondary method of data collection as the researcher utilized the Proactive method of data collection similarly, the researcher proposed to adopt the proactive method of data analysis (Riazi, M. and Emami, A., 2018). The ***PARD method of data analysis*** was helpful to analyze the data that the research has collected and was quite willing to create a remarkable research study. After that, the data that are collected by the research are analyzed below in this research study significantly.

6. Result and discussion

Flow setup latency in Software-defined networking controller

The typical switch-controller cycle in " software-defined networking " isn't a quick procedure from creating a network event notification at the Controller to implementing flow rules at the switches; the typical switch-controller cycle in "software-defined networking" isn't a quick procedure. Researchers found that "flow setup latency" in networks of around 500 switches is 50 milliseconds, with 99th percentile latencies ten times greater. The software setup latency proposes path aggregation techniques to minimize both latency and variation in flow setup. Using the study technique, additional user-initiated flows require just a small number of switches to be changed. Comparable conditions showed average and 99-percentile lateness dropping to 5.9 and 7 milliseconds, correspondingly.

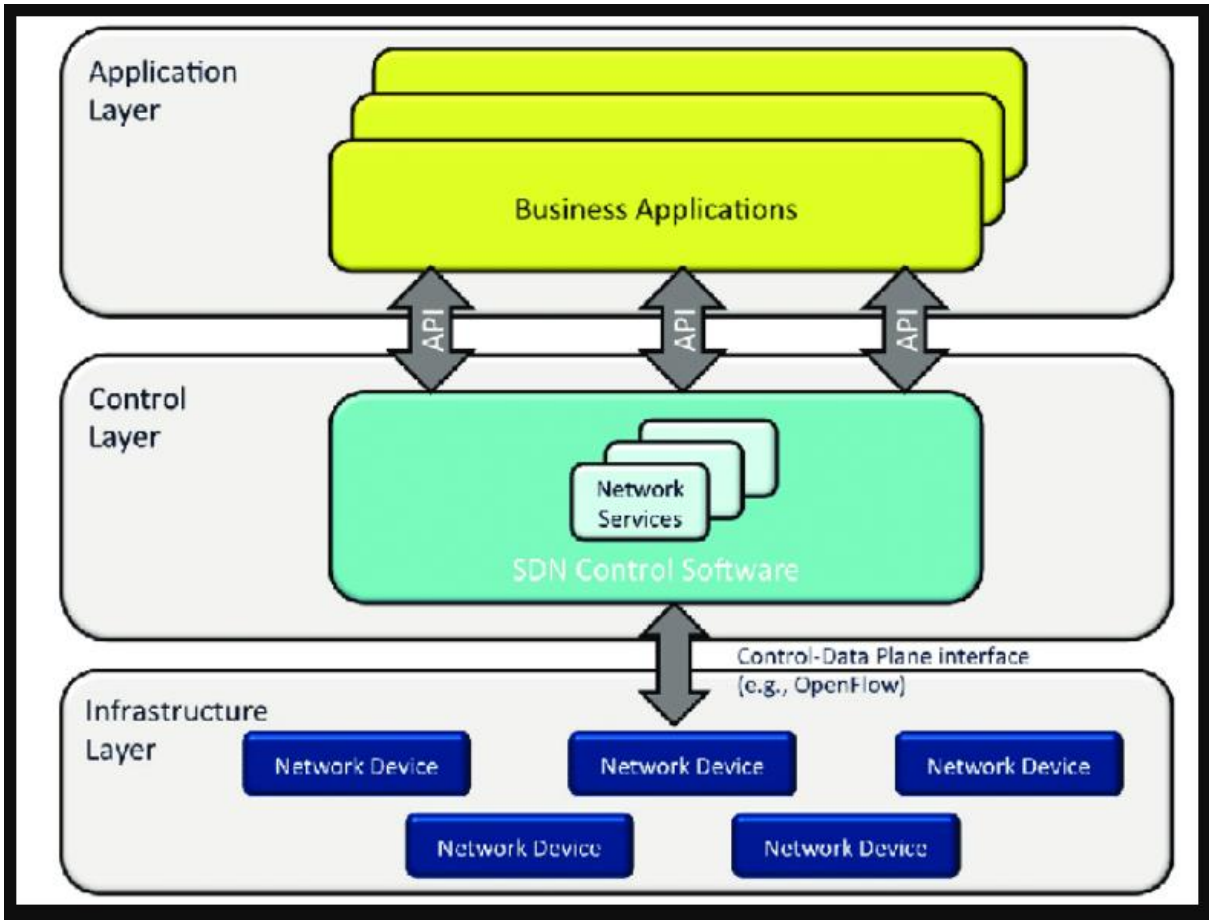

Figure 6: Software-defined network

(Source: Asadollahi *et al.* 2017)

Traditionally, network devices have proprietary software and long, expensive evolution cycles (Asadollahi *et al.*, 2017). Complex choices must be made while designing such devices. As a result of SDN, the "network logic" is executed in a logically centralized software platform called Controller, while network devices are reduced to programmable "flow-forwarding machines" called Switches. A control application that makes forwarding choices uses the state of the network, whereas the former encodes and saves the decision as flow rules to apply to incoming traffic. Researchers have focused on the design and performance of SDN controllers and switches so far in their study on SDN so far (Hohlfeld *et al.*, 2018). However, an examination of the complete system, including the controller and switch network, is still awaiting completion.

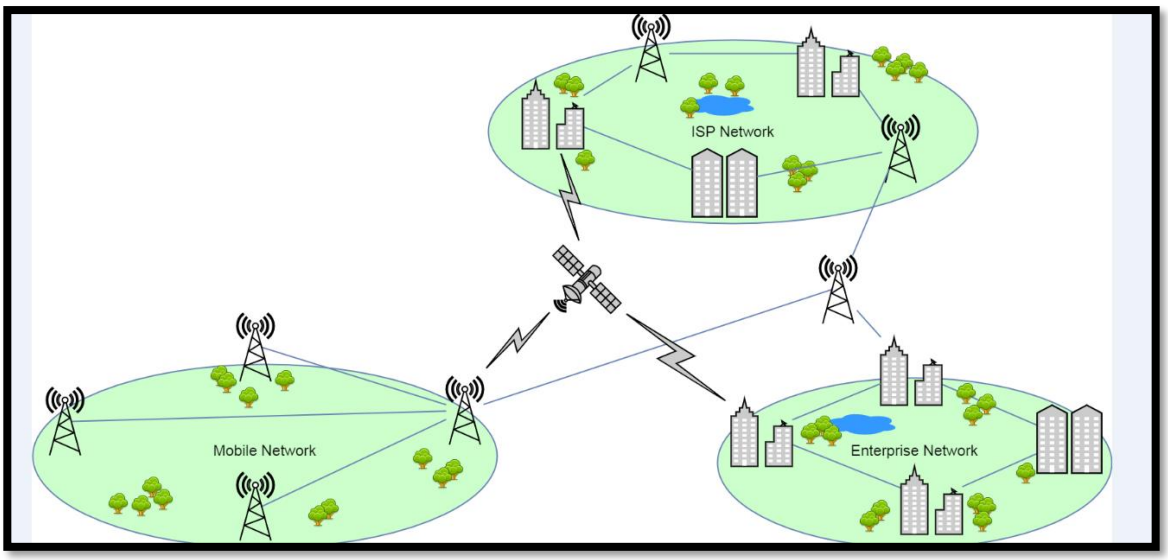

Figure 7: Flow setup latency

These tests were conducted to examine the function of SDN networks from end to end, and this article fills that vacuum. Although researchers examine Open Flow SDN in the context of operator networks, the results are generic and apply to SDN as a paradigm. As shown, the Controller must set up all N switches along the path in order to create a flow. When S1 receives a "ping request," it creates and delivers a packet in the message to the Controller if no "flow rule" matches "the packet."The Controller calculates essential rules for each change along the way and pushes them to the changes according to those rules (Akbar Neghabi*et et al.* 2019). The “ping request” will be sent to “the destination” as a result. The ping-reply will be handled similarly. Accordingly, the Controller performs switch configurations in parallel; thus, latency should be equivalent to that of a single switch configuration.

Setting's flow setup latency	**values**	**MS**
Single switch	4 and 8. N =4, N = 8	1.22 MS and 1.8 MS
Median Latencies	99 Percentile	3.7 MS and 12 MS

Table 1: setting's flow setup latency

However, the flow setup delay of this configuration is substantially higher than that of a single switch, especially near the conclusion. Both 4 and 8 are acceptable N values. For “N = 4” and “N = 8,” the results indicate “median latencies” of “1.22ms” and “1.8ms,” respectively, with 99-percentile values of “3.7m” and “12ms,” respectively. When using more than one switch, calculating a path in the controller application requires more sophisticated calculations than when using only one switch. Sweetens, the Controller sends N flow setup commands, which increases control plane delay (Ahmed *et al.*, 2018). Floodlight's processing of incoming picketing; TCP's scheduling of tiny flaming messages. The device manager and other “Floodlight” modules also communicate with the application to determine the control plane's latency.

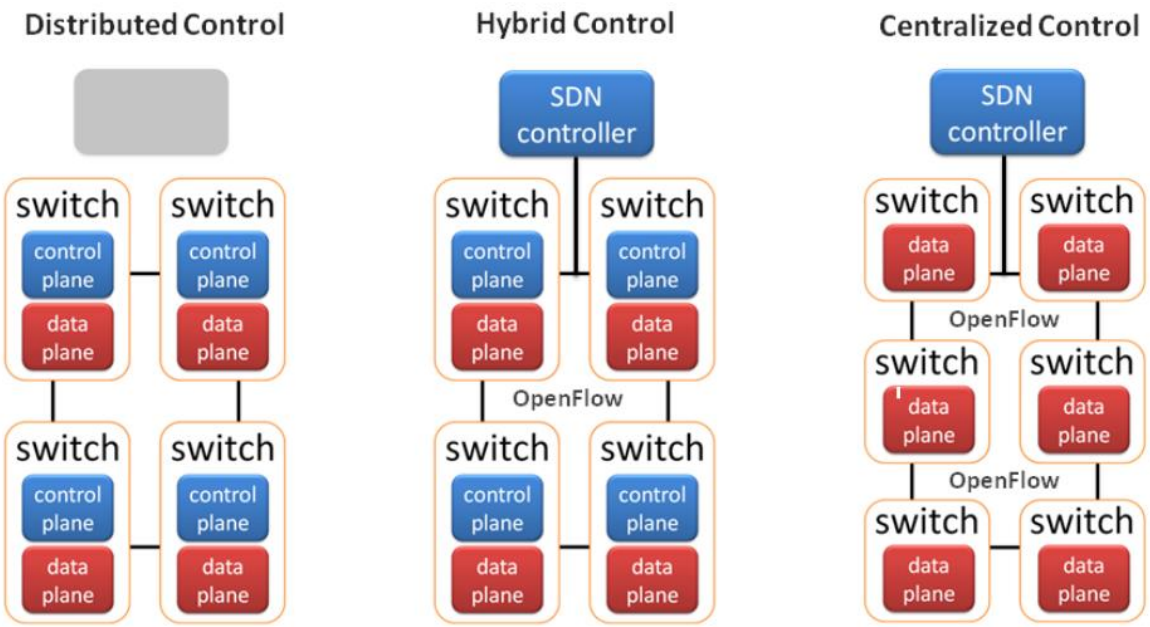

Figure 8: Software-defined networking

(Source: Ahmed *et al.* 2018)

First packets of a flow can be delayed if a partly constructed route is present. The Controller may try to predict how long it will take for all of the paths to be set up and postpone transmission of the initial packet by this amount of time. However, it is impossible to acquire a real-time assessment of this delay period. Open Flow bundles, for example, can be used to deliver the route commands in the reverse direction, resulting in explicit confirmations from switches. Except for the initial requestor, the Controller may send flow setup to all switches and wait for confirmations before setting up the first switch and sending the original packet from there. Both approaches are unappealing to researchers because they penalize all flows, which is especially harmful to short or single packet flows. This section's default paths are similarly reversed, although they don't employ OF packages. As an alternative, the Controller can disregard packets coming in from intermediary switches. Switches do not store the original user packet once they deliver it to the Controller, resulting in packet loss (Abdelaziz *et al.*, 2017). Adding packet buffering to a switch adds a significant amount of complexity, and it is not guaranteed to function.

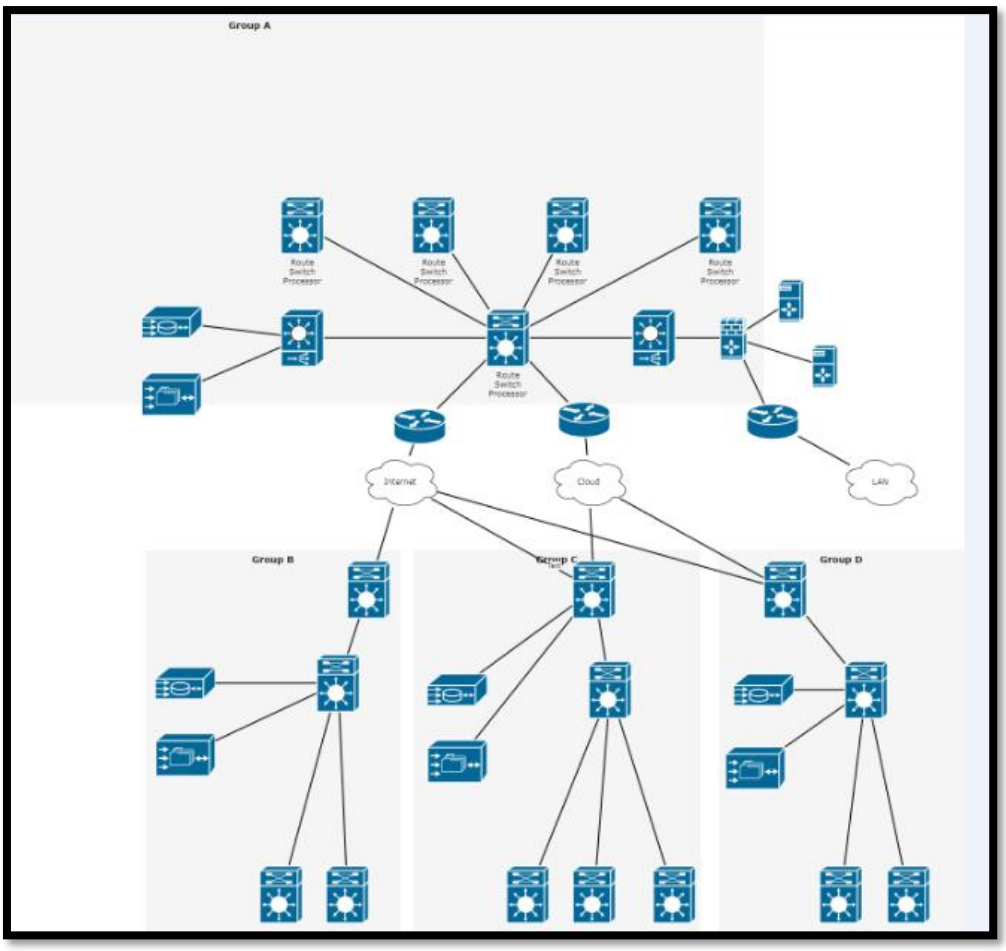

Figure 9: PARD method

These types of packet losses can be recovered by utilizing retransmission techniques such as TCP. As a result, the effect of partly constructed routes is not eliminated but instead delegated to the end-users. Apart from that, these methods can only reduce the performance difficulties produced by R3, but not those caused by R1 or R2. A tight separation of topology and flows is required to provide minimal latency. Many innovative applications, such as machine-to-machine or V2X communications, rely on these components. Flow configuration in SDN may be simplified by separating control of edge and core switches. This method grows well in large settings. In addition to supporting fine-grained flow control for end users, researchers proved that the suggested approach could support more complicated situations relating to the dynamics of a network.

As part of this, researchers showed and assessed the support for data movement and dynamic network alterations. This problem is expected to be exacerbated when the network is made of a varied collection of hardware switches since the "flow rule installation" latencies in hardware switches are more variable than in software switch installations (Nayak *et al*., 2017). This is because switches from various vendors may have varying performance characteristics, which increases the influence of R2 and R3. To make this system even more scalable, developers want to explore how they may adapt the hierarchical control to the approach (Luizelli*et al*., 2017). On the other hand, according to IV-B results, the suggested approach effectively mitigates the issues and performs substantially better than the current state of the situation. In addition, the proposed approach is scalable, both in terms of fabric configuration and in terms of software.

7. Conclusion

It is identified that Software-defined networking is very important, and the Controller of Software-defined networks is more important. The controllers help to provide the services of networks is not only one country but also several countries. From that, the software-defined network controllers make it simple to provide the services in other countries. Apart from that, the flow setup latency is also essential for the Controller of Software-defined networking to measure and set up the delivery time of services. A control application that makes forwarding choices uses the state of the network, whereas the former encodes and saves the decision as "flow rules" to apply to incoming traffic. The Controller calculates essential rules for each change along the way

and pushes them to the changes according to those rules. Therefore, this particular research study analyzes the importance of slow setup latency in the controls of Software-defined networking..

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