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Software Defined Network for Internet of Things

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Abstract - *In the era of Internet of things, managing data over the network with respect to scalability is the challenging thing. Managing cost with respect to performance and productivity of the network solutions to handle such challenges is also important. With advent of SDN or software defined network has provided a de facto solution for scaling devices over network. SDN controller is open source platform that is cost effective and great community support. The controller is responsible for dividing the data plane that manages traffic over network and control plane that handles the various routing program respectively. Nowadays the traditional routing devices are replaced with IOT devices. We need a reliable study on overall integration of SDN and IOT devices. This paper focuses on software defined network with internet of things with respect to scalability and performance. We have used Cooja a simulating tools that provides an environment for managing a variety of routing devices also called as dummy motes and a main controller in the software defined network. The main controller queries each node in the network and finds the shortest path to pass the information in vicinity. We can also monitor our activity in Cooja and can use the log file to analyze the data using Splunk. The Splunk tool provides various operations like search, monitor, analyze and visualize the data*.

Key Words: Software Defined Network, Internet Of Things, Cooja, Splunk.

1. INTRODUCTION

In last few years, SDN has emerged to a next big thing in an information technology sector .Now what SDN actually is? To know this, we are going to first learn about why SDN came into existence. Here we are going to study about the traditional networks moving towards a whole new virtualization called as software define networks. With the advent of SDN, all the devices connected in a network are managed by a simple building block of this new technology called as control plane. Here, we will study about SDN in more details followed by its applications in Internet of things or IOT. Moving further we are going to brainstorm on existing internet routing protocols and whether they are capable of handling IOT.

1.1 Traditional networks

Conventionally, the networking worked with respect to connecting hardware like routers and switches backed with a basic software program that used to define a configuration for all the connected devices in a network[1]. This can be observed from the following diagram.

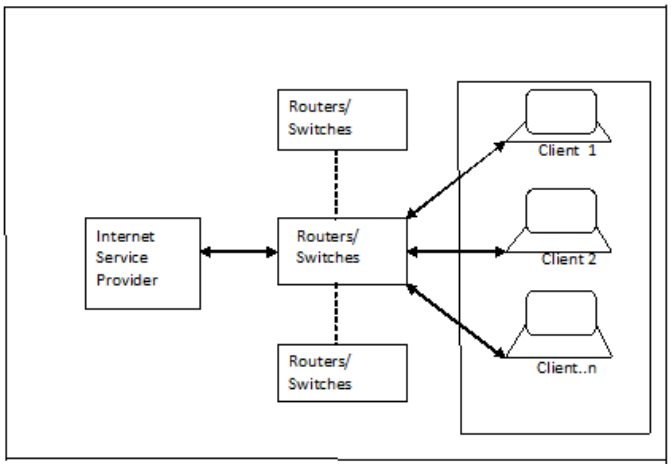

Fig-1: Traditional Network

Even today traditional networks are used extensively world wide. With some help of networking skills a network administrator manages to architect the whole components of network. Though the above diagrams looks simple, the overall size of network goes on increasing with respect to usage and requirement over the time. As, the complexity of network increases it becomes difficult to add a program for every new devices and to reconfigure the whole new system each time. This scenario becomes an extra overhead for network management.

To manage the complexity of network it was figured out that it would be better if we divide the network flow into something that manages the network and data differently. This was the use case of introducing virtualization in networking which we are going to study in the upcoming section.

1.2 Virtualization

In the process of virtualization the control plane manages the network and data plane manages the network traffic. Here the traffic means all the data that flows to and fro in any network .The division of control plane and data plane was handled by a smart controller running a specialized software that manages all the network traffic .This smart controller is situated on a server that has internet connectivity on one side and is connected to different devices like routers and switches on another side.

Let us modify the traditional network so as to visualize the virtualization in network.

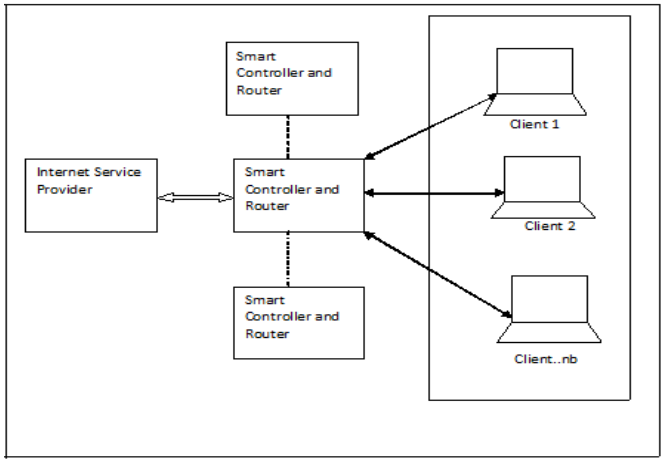

Fig-2: Virtualization

Virtualization brought the following advantages to the network.

- Networks can be spun up and down dynamically.
- It can be configured for specific application use case.
- Security policies can be installed on each and every clusters of network or even on specific devices.
- It is cost effective solution and even saves time by providing dynamic configuration.

Community support from strong competitors like IBN, MICROSOFT and VMWare etc

2. Routing Concepts

To understand the need of the emergence of the SDN in our current networking topologies, we need to know how current networking routing mechanism works. We are going to use a practical scenario shown as follows to get the networking concepts.

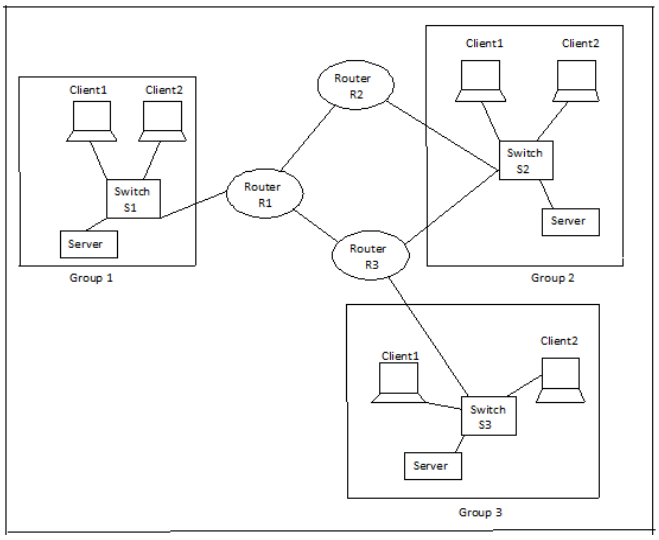

Fig-3: Existing Routing Protocol

In above diagram, there are three clusters of network connected with each other via router[2]. Let us assume they follow a simple routing protocol algorithm. For illustration, client 1 of group 1 wants to access the data from group 3 server. in this case the routing path will be Router R1 -> Router R2 -> Switch S2->server and vice versa for receiving the response.

Now In cases of network failure, consider if the link between R2 and S2 switch is accidently not working due to any issue. The router R1 will receive the failure response while navigating from Router R2. Next time, whenever a request arises from group1 the router will take a different path i.e via Router R3.

This is simple routing path algorithm which is ideally followed in present days system.

Let us note some important inferences from above scenario.

- Now until the issue is fixed by a network administrator and the routers are reconfigured manually the group 1 request won't be routed through Router 2.

- The router did the job of rebuilding the network via other links but it doesn't know if it was done better or if it selects the best path.

In any complex network the above points can get converted into real disadvantages of current networking system.

3. Proposed Systems

As a solution to handle the scenario CISCO designed an amazing router technology that has powerful software's in the routers. The router was designed so as to grab the packets from network and send them wherever desired. So all the routers in network are provided with some intelligence. This intelligence is nothing but pre-processing of packets before they are send. This pre-processing introduced some latency too. As the packets takes time to read, configure and navigate. Moreover the cost of implementation was too expensive to handle. A single CISCO device cost around 27000$. There was need of some optimal solution that can reduce the cost so that small group to medium scale organization could also afford to implement the strategy for networking. It was also essential that the all the inferences listed above are also considered for such single solution.
Software defined networking proved to be the perfect solution. Not only in aspect of routing solutions but also with respect to cost effectiveness. In next section let us study how it worked so well as compared to other solution.

3.1 SDN as a solution

In above section we have understood the purpose of SDN. Now let us take an overview of software defined network as a remedy to the problem. The SDN routers has virtually no

software on it. They are dumb devices or routers that are control by a special management server. In case of CISCO routers, Involving software brings pre-processing into picture, further resulting as slowing the speed of data on the network. This was particularly avoided by SDN as it had very low software configuration. In SDN the software that controls the data plane is pulled out and placed on a whole new unit[3]. Lets us call this unit as SDN controller or SDN server. Now only minimal software is present on SDN routers.

Now lets us have a visual regarding the SDN implementation on a simple network we implement above.

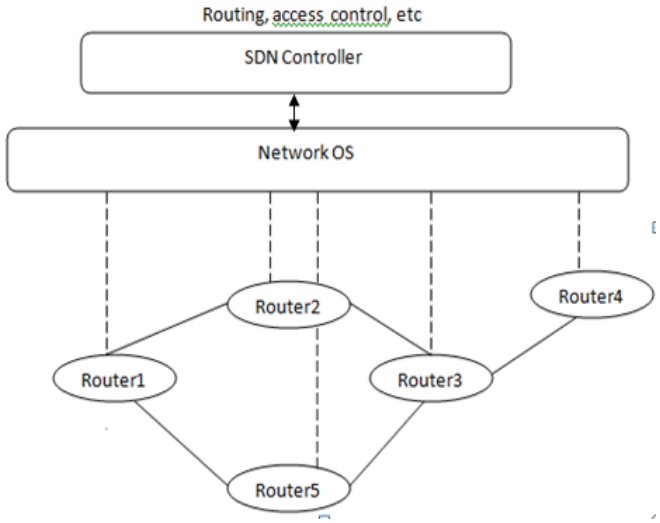

Fig-4:SDN Controller

In the above diagram we removed the groups connected to routers. On implementing SDN, we observe that a new network operating layer is introduced. This layer controls the dumb routers. The network operating system will communicate with every single dumb router in the network. The networking system constructs a logical network view and provides the algorithm to route every single data packet in a network. In such cases a network administrator has control over such routing mechanism as those algorithms can be totally programmed. There can be n number of programs for example they can be security programs, routing programs or network management programs etc.

The interesting thing is the software that controls the data planes across all the routers or SDN controllers are open sourced. Thus reducing the cost tremendously.

4 . Design Methodology

The structured design is implemented in 4 steps:

4.1 Configure

Here we configure the tools required for simulation. We require Contiki Operating System along with Cooja simulation tools especially used for IOT simulation. Further, the data visualization is done using a Splunk tool which is a software that is used for searching, analyzing and monitoring machine generated big data via a web style interface.

4.2 Simulate and Test

The diagram below represents the Cooja Simulation Environment.

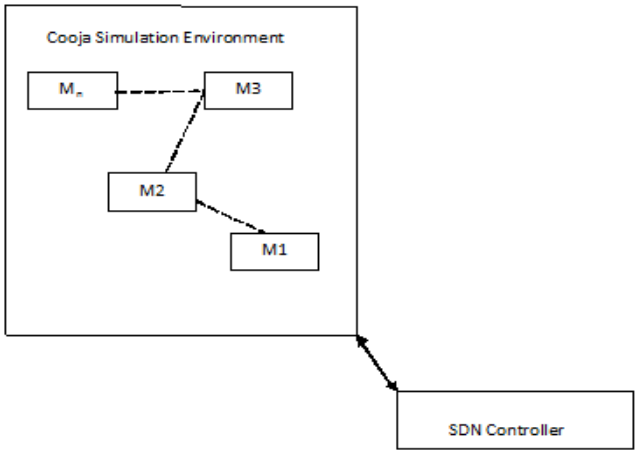

Fig-5: Cooja Simulation Environment

Cooja Simulation Environment provides a network environment for motes.SDN queries the motes and sends the data. We can use any protocol like REPL,COAP etc. for establishing a connection to simulation network.

4.3 Monitoring

Further the network is monitored by Cooja inbuilt tool. In the above diagram, we connect Radio Messages Log to the Cooja simulation to monitor the data.

4.4 Logging and Analyzing

The analyzing of such data can be complex. To avoid complexity, we need a tool that can accept any machine data and provide a query based visualization. Consider the following diagram:

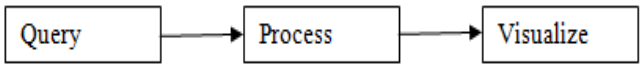

Fig-6: Visualization in Splunk

The query format mentioned above is as shown below:

Eg: <Splunk query format>

The visualization is the process required to analyze the data with respect to search patterns and data usage and future predictability.

5 . Results

Let us divide the results in three sections:

5.1Simulation log

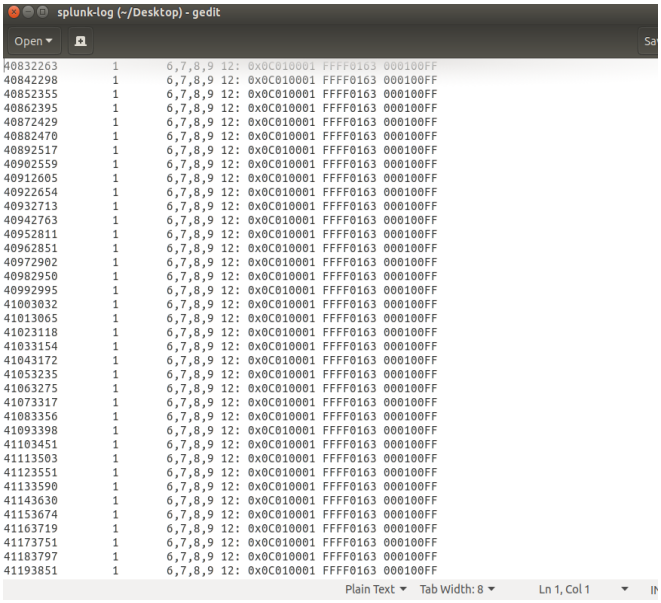

Fig-7: Cooja simulation log

5.2Splunk Tabular log

As we can see that the data displayed in the above screenshot provides a raw output of nodes in simulation and communication between them.We will present the data in tabular format using the Splunk tool.

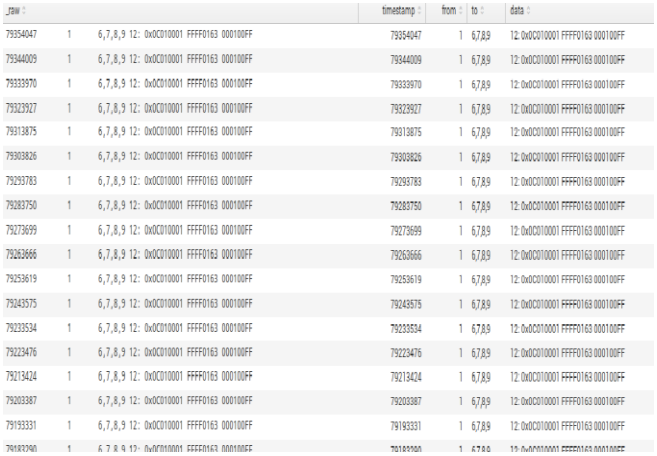

Fig-8: Splunk tabular log

5.3 Splunk visualization according to data query

Next we need to visualize the simulation data Using Splunk query.

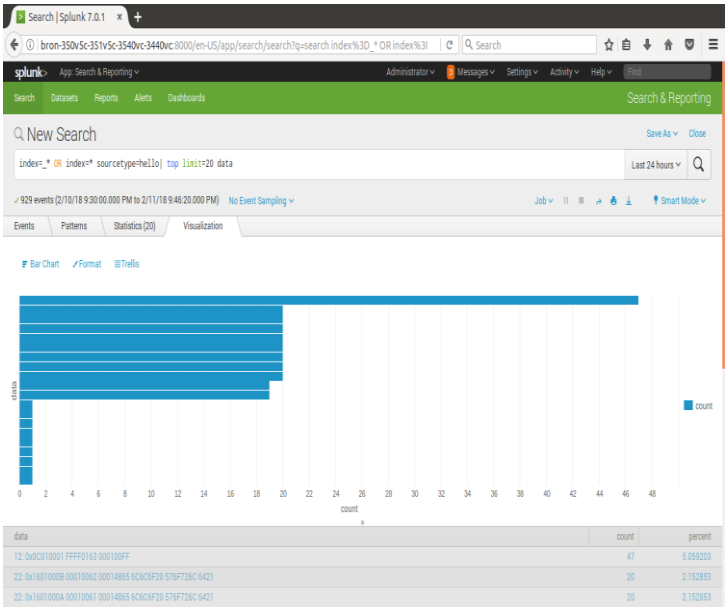

Fig-9: Graphical data visualization in splunk

6. Conclusion

Traditionally, the networking architecture used various hardware devices viz routers and switches which had some programming that handled the devices and provided a layout for it. But, in case of complex network, it became difficult to add programs every time for each new device which resulted in difficulty to manage the network. Hence, a new method of SDN was developed to overcome the existing problem which divided the control plane and data plane using a smart controller situated on a server. This method also proved to be cost effective method. IOT devices are integrated with SDN. The scalability and performance of routing devices in a network is optimal with SDN controller. The data traffic is analyzed as well as monitored using tools like plunk. The data is visualized for better predictability with respect to future changes or data mining purposes.

REFERENCES

[1] Samaresh Bera, Sudip Misra, Sanku Kumar Roy, Mohammad S. Obaidat , "Software-Defined WSN Management System for IoT Applications", 1937-9234 © 2016 IEEE

[2] Akram Hakiri, Pascal Berthou and Aniruddha Gokhale, "Publish/Subscribe-enabled Software Defined Networking for Efficient and Scalable IoT Communications".

[3] Antonio JARA,"A Novel Distributed SDN-Secured Architecture for the IoT ",2016 International Conference on Distributed Computing in Sensor Systems.