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DEVELOPING NETWORK TOPOLOGY TO PROVIDE AUTOMATION IN A VIRTUAL ENVIRONMENT BASED ON PYTHON

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Abstract - Due to the rising number of networking devices, opportunity arises for automation to come in handy. In this project, our focus is to generate various automation scripts for day to day tasks such landing and configuring new switches/routers, generating new vlans, subnets, and also doing some baseline configurations. We will be creating a virtual environment using GNS3 to run these scripts and check their authenticity. GNS3 is mounted on VM Ware for better functionality. Python is used in majority of the area. The output of this project is a ready to use interface to generate various automation scripts.

***Key Words*:** Automation, GNS3, Python.

1.INTRODUCTION

In current times, due to the exponential increase in number of networking devices, it is difficult to manage and operate all of them with the old school method. Hence, several methods were introduced in order to create a better management method of the devices. One of the most common way is a management tool that is used to monitor and maintain a set of devices. The scope of such tool can be from one data centre to all the data centers of that company around the globe. Such management tools can be a boon for network engineers but only till some extent. Most of the devices run on scripts. For every functionality, there is a script running behind it. This script differs for every device and functionality. Hence, it is difficult to maintain a record of all its type.

There are several network simulators available such as Cisco Packet Tracer, NS3, Microsoft Visio, EVE, and GNS3. The motive behind choosing GNS3 in our project is due to its adapting functionalities, easy to use UI and compatibility features for all the types of networking devices. GNS3 also overcomes certain drawbacks faced in the other network simulators, thereby coming up as an ideal choice.

In this project, we have generated and used various scripts to automate some of these everyday tasks in order to achieve higher efficiency and less probability of any human error. To virtually create a data centre environment, we have used GNS3 loaded on top of VM Ware and for automation scripts we have used Python.

2.CHALLENGES

A data centre consists of hundreds of devices. It can also vary from different companies to different capacities. On an average, millions of data packets travel through this devices in order to keep the business running. So, it is crucial to make sure that these devices are up and running with correct configurations and connections. In every field, probability of human errors always exists and it is always tried to reduce it to much possible extent but it can never ensure a zero error ecosystem. It is observed that automation can take this quality up a notch and ensure our environment to be almost error free. While setting up the automation scripts, it is important to check its correctness before launching it in the production devices or else even a small error in the script can lead into major disasters.

3. STATE OF ART

Network Automation has been a trend since a long time and there have been many positive breakthroughs in the field. The fundamental objective of this upshift is to increase the efficiency and decrease the possibilities of human errors. Various methods have been proposed to achieve the same. To achieve the desired throughput, we need a strong framework with ease of operation and flexibility.

The need of automation and its boon is explained very well in “Design and implement Automated Procedure to upgrade remote network devices using Python” [10]. The authors have elaborated on how automation reduces human interventions, thereby decreasing the scope of human errors. They have used various types of Automation Procedures (AP) to illustrate and support their theory.

Along with correctness, automation also leads to cost saving as elaborated in “Optimal Distribution Network Automation Considering Earth Fault Events” [11] stated how the experts are believing in network automation as an investment for better service reliability in future. This paper also provides the analysis on the cost benefits over a long run for an establishment by introducing optimal automation solutions,

In “Analytic Calculus of Response Time in Networked Automation Systems” [13], the authors have thrown light on the time-saving perspective of automation by giving a method

of modeling the system architecture into Timed Event Graphs (TEGs). Based on such graphs, various analysis are done on each of these models and Max-Linear equations are obtained that helps in reaching further conclusions.

4.TABLE OF WORK

Work done	Sacrosanct knowledge
Nitesh Jain, Harshika Shrivastava, Asmita A. Moghe in [1]: Streaming using HTTP and FFmeg.	Implementing Ansible for lesser human intervention.
Sriniketan Mysari, Vaibhav Bejgam in [2]: CI/CD using Jenkins Ansible	Ansible - YAML format for time saving.
Divyansh Mahajan, Swarali Patil, Wagh Vipul Shashikant, Mohit Dangayach, P. Veda Bhanu, J Soumya in [3]: The automation process used in the synthesis of an optimized Network-on-Chip (NoC) design.	Using automation for faster design process and resource utilization analysis.
Jay Shah, Dushyant Dubaria, John Widhalm in [4]: DevOps tools for networking.	Abstracting the configuration needed to launch server instances with specific configurations.
Takuya Tojo, Shingo Okada, Yoshiyuki Hirata, Seisho Yasukawa in [5]: Integrated control of IP and Optical network for Multi-grade Virtualized network	On demand provisioning of a Virtualized network with a provisioning tracker.
Xia Zhen, Lanlan Rui, Xuesong Qiu, Biyao Li, Peng Yu in [6]: Network Optimization Algorithm: PNGA (Primary Nodes Group Algorithm)	Network modelling and three-tier power grid in Network Virtualization Environment.

Table -1: Table of work

5.PROPOSED WORK

The proposed system comprises of two parts. Both of these parts combine to make one working environment that supports automation script generation and verification.

A. Script generation

The web page has various input fields in drop-down list format. It contains two major fields

i. Type of device

ii. Function of the script

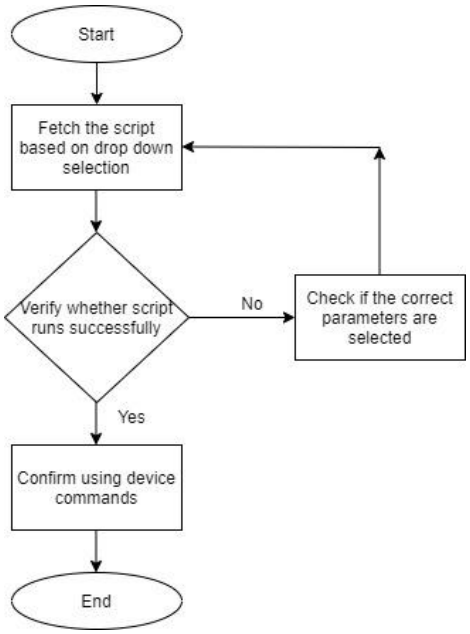

Fig -1: Flowchart of script generation

All these scripts will be stored in the back-end and will reflect on the web page once user hits “OK”. If the type of script for a particular device is not prepared then it will display an error message stating that it is currently unavailable. The steps of these procedure are displayed in Fig -1. The scripts generated from the web page can be pasted in the configuration panel of the device in GNS3 to verify its correctness. Once the script runs successfully, we can run certain sh commands to check whether all the work is done as needed or not.

B. GNS3 Virtual Environment

In order to achieve a virtual environment similar to a data centre we have used GNS3. GNS3 stands for Graphical Network Simulator. As the name suggests, it helps in creating complex network environments and also in emulating, configuring and troubleshooting the devices present in it.

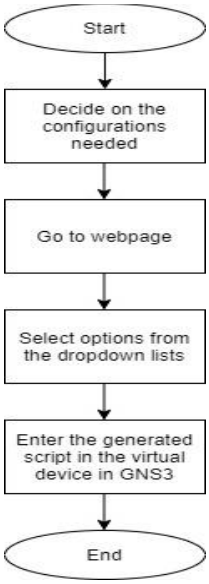

Fig -2: Workflow

6.RESULTS

To achieve the proposed system layout, we have used the following software:

1. VM Ware Workstation

2. GNS3

3. Visual Studio Code

VM Ware Workstation allowed us to create a Virtual Machine upon which we could install GNS3, making it faster and more efficient. It also balances the load of the laptop and utilizes only a fixed number of cores that are assigned to it.

GNS3 aids in making a virtual environment supporting plenty devices that we were able to use in creating a mini data centre on our systems and run those scripts. Fig -3 displays one such example of the entire network topology that can be virtually created in our simulator software.

Visual Studio Code was used for the web page developed that is used to fetch those scripts. Most of these scripts are written in python. However, some are commands that are used directly in the device.

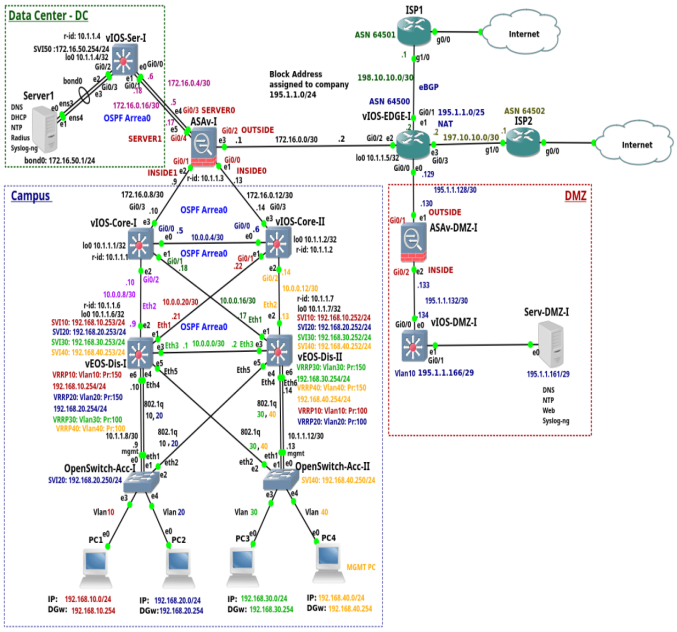

Fig -3: Sample network technology

Now, let us say that we want to fetch the script of port configuration on an Extreme device. Let us assume that port to be configured is 25 and the VLAN name is v138. Then the port configuration in this case will include the following commands shown in Fig -4.

```
configure vlan v138 add ports 25 untagged stpd S138 dot1d
configure stpd S138 ports link-type edge 25 edge-safeguard enable bpdu-restrict
disable flow-control rx-pause ports 25
show port 25 no-refresh
```

Fig -4: Port configuration commands

7.CONCLUSION

In this paper, a different approach towards network automation is proposed. The system is backed by a strong and reliable infrastructure that can be easily expanded to a broader horizon by adding more number of configuration scripts in the same tool. It can run in a virtual environment, same can be taken into consideration in a live data centre environment. Apart from this, it can be also used for testing new scripts before pushing it directly in production environment. Fig -5 shows the increase in the traffic flow within data centre over the years. Hence, we can conclude that we need automation to support the increasing demand of data centric ventures.

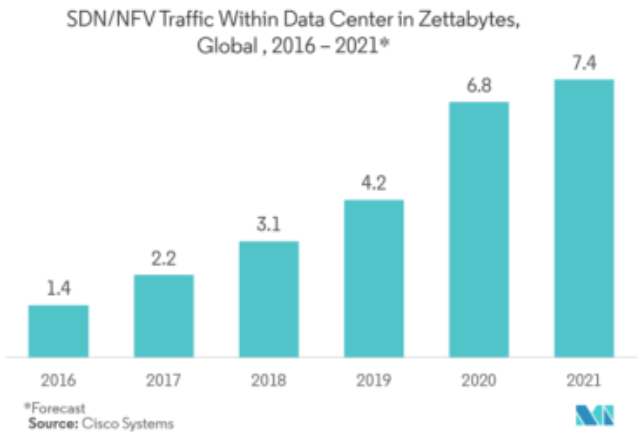

Fig -5: Rise in SDN/NFV traffic

8. FUTURE WORK

The proposed system can be further upgraded as a network monitoring tool by creating a dashboard displaying the health details of all the devices and also include statistics like packets transferred, packets dropped, uplinks, downlinks, etc. In addition to this, various Research and Development teams can make the use of the same to get a better idea and functionalities of the devices and its layers in proper depth.

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