V-NM: Network Management Using NFV

Members

- Epameinondas Kontothanasis ekon@kth.se
- Sikandar Khan sikkha@kth.se
- Maria Haider mariahai@kth.se
- Ganapathy Raman grma@kth.se
- Peiyue Zhao peiyue@kth.se
- Jing Jin jji@kth.se

This project will be structured as a six-person project, where each member will be responsible for a set of tasks to be carried out in conjunction and coordination with other members of the team. Towards the end of the project all functionality will be combined and output will be presented.

1.Background

This project builds on the idea of emerging concept of Software Defined Networking (SDN) [1] and Network Function Virtualization (NFV) [2]. The basic notion of SDN is separation of Data and Control plane whereas the NFV is to interchange dedicated network appliances with the software running on servers. The main concept behind project V-NM is to replace the traditional network management by modern approach using the said techniques. OpenFlow protocol and OpenStack cloud manage software and OpenDaylight are used in the implementation of this project, which allows to manage SDN and NFV with great flexibility [3].

2.Problem statement

In the current era of networking, an introduction of a new service requires deployment of infrastructure across the network. Each of the networking devices need to be manually customized to deliver its purpose and it is not easy to reconfigure them without the risk of producing inconsistencies and inaccessibility in the network. The traditional approach is also not cost efficient where new devices need to be added to reflect any changes in the network.

3.Problem

Nowadays an increased internet usage is leading big enterprises to spend money and time in their infrastructure. The cost of building and maintaining Data centers is increasing year by year. Alongwith the increased operational cost, maintenance cost and the increased power consumption are the driving forces in pushing the big vendors in to find new solutions.
Other problems that companies are facing are the difficulties managing remote infrastructure, especially when it is the time for changes and maintenance of the remote sites. All the above problems plus the vendor specific solutions with hard-wired networks with boxes dedicated to single functions drive the IT community to find new solutions.

4.Hypothesis

It is possible to build a virtualized environment over commodity physical infrastructure to simplify the management of network functions.

5.Goal

Setup a Virtual Network Management system that consists of a virtual topology and implementing functionalities to test and monitor the network. Use various scenarios to see how the topology would respond in different settings.

6.Measurable objectives

The measurable objectives are to isolate the clients while guarantying QoS and security, and to handle the traffic in different load scenarios and to counter errors by providing redundant solutions.

7.Deliverables and deliveries

The following items have been decided upon to be delivered by the end of this project.

- Traffic generation/injection module to inject the traffic network traffic and stress test various network functionalities
- Virtualization of following network functions on OpenStack:
    - Load Balancer
    - Firewall
    - NAT/Routing

    - Tunneling/Slicing
    - Monitoring/Metering
- Connectivity of OpenStack with Mininet via br-ex (OpenVSwitch)
- Visualization of OpenStack and OpenDayLight on web-based GUI's
- Two OpenStack compute nodes with at least two different tenants to isolate clinents
- Traffic logs
- Project Plan
- Midterm Presentation
- Midterm Peer Review
- Weekly progress reports
- Final Report
- PowerPoint Presentation
- Video
- KTH Social Group webpage
- Exhibition
- Lessons Learned Report

8.Approach

This project is going to use Software Defined Networking along with Network Virtualization Functions to be implemented on the mini stanford topology. The work will commence with background research on SDN and NFV, along with understanding the architecture and functionality of OpenStack and OpenDayLight, followed by the implementation of functions on a small test topology which will later be moved to the mini stanford topology. Tools to be used:

- OpenStack
- OpenDayLight
- OpenVSwitch
- Mininet
- Wireshark
- VMware

9.Tasks

The project has been divided into following tasks and subtasks which must be performed in order for the project to reach the completion stage.

1. Study the physical topology (Mininet Stanford Backbone)
2. Design the virtual topology on paper

- Discuss network design
- Design and document topology

3. Design Functions
   - Document functionality. Build the logical architecture of the functions, e.g the firewall rules
   - Write Draft code.
   - Review code
4. Deploy Functions
   - Test and debug code
5. Design and test scenarios using traffic generator
6. Prepare for the final Exhibition
   - Write the final report
   - Create Presentation
   - Create a video

10.Method

In this project we are going to use the Applied research method as following this research approach we can answer specific questions or solve known and practical problems [4]. Following this method we aim to examine specific circumstances of network functions. As it is mentioned in [4] this "method examines a set of circumstances and the results are related to a particular situation." This method builds on existing knowledge and applies this to solve the mentioned problems.

11.Gantt diagram and milestone chart (time schedule)

The timeline for the project is shown below. The chart shows all the major steps, which will result towards the completion of the project.

See Gantt Diagram

12.Risk Analysis

Software Defined Networking and Network Function Virtualization are fairy new concepts, so getting familiar with these concepts might take longer than expected. As it is a new technology, we expect to

come across with bugs in the software releases. We expect that the documentation of new releases will be pure. In advance we expect problems due to hardware limitations. Running a number of virtual machines in a single host can cause poor performance of the hardware, as are not as powerful as it should.
Platform like OpenStack is new and is under continuous development, so it might result in lot of instability issues, to mitigate such risk, the team members need to review the documentation with utter detail and use forums like askopenstack (https://ask.openstack.org/) and Stack Overflow (http://stackoverflow.com/) to share the doubts and seek help from the professionals in the feild.

The team UnnA comprises of six people, certainly with different time schedules, so there is a high possibility of conflicts in the team meetings, and discussions. To overcome these risks, meetings and tasks will be planned in advance using tools like Trello (https://trello.com) and Facebook group.
Nevertheless, To mitigate these and various other risks with functionality issues, the team needs to spend more time than required and work together in out-of-work hours, to help and assist each other.

13.Unique contribution of the team members

The team members combine knowledge and expertise in different areas. Different members combine knowledge of programming while others have deep knowledge of network architecture and design.

14.Dissemination of results and expected impact

The results and findings of this project will be disseminated by press-release and online medium including the video. The project will also be showcased at an exhibition to attract the interested audiences. This project is expected to fascinate the individuals working and studying in the field of networking and interested in emerging concepts of software defined networking. It is hoped that the findings will motivate individuals to carry out further work and research in the similar domain.

15.References

[1] Software-Defined Networking: The New Norm for Networks, ONF White Paper, April 13, 2012.

[2] Network Function Virtualization (NFV); Use Cases, ETSI Industry Specification Group.

[3] Mark Leary's, SDN, NFV, and open source: the operator's view, Gigacom Research, March 19, 2014.

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[4] A. Håkansson, Portal of Research Methods and Methodologies for Research Projects and Degree Projects. WORLDCOMP'13 - The 2013 World Congress in Computer Science, Computer Engineering, and Applied Computing, 22-25 July, 2013 Las Vegas, Nevada; USA.