

V-NM: Network Management Using NFV

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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 on set of virtual machines.

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 software running on servers. The main concept behind project V-NM is to replace the traditional network management by modern approach using the abovementioned techniques. OpenFlow protocol and OpenStack framework are used in the implementation of this project, which allows to manage SDN and NFV with great flexibility [3].

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.

Problem

Implementation of a virtual network management system using modern technologies is required to eliminate the manual configuration and customization of the infrastructure in order to improve the performance and efficiency.

Hypothesis

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

Goal

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

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.

Deliverables and deliveries

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

- Implementation of following five network functions:
 - Load Balancer
 - Firewall
 - NAT/Routing
 - Tunneling/Slicing
 - Monitoring/Metering
- Traffic generation module to inject network traffic and test various functions.
- A module will be programmed for communication between the ODL (OpenDayLight) controller and OpenStack controller.
- Visualization on OpenStack and OpenDayLight web-based GUI's.
- Three big scenarios to isolate the clients, and to propose redundant solution on generation of errors in network
- Project report
- Peer review report
- Weekly progress reports

- Project poster
- Lessons learned document
- PowerPoint Presentation
- Video
- KTH social group webpage

Approach

This project consists of implementing various critical network utilities in a virtualized environment by abstracting a physical topology by means of virtual tenant network to augment the network resiliency. A traffic generation module will be implemented to inject the traffic in the network and to test the various designed functionalities. The following set of tools and frameworks will be utilized during the project.

- OpenStack
- OpenDayLight
- OpenVSwitch
- Mininet
- Wireshark
- Virtual Machines

Tasks

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

- Examine and study the Mininet Stanford Backbone topology
- Understand and study the layers including the functionality of OpenDayLight and Openstack.
- Design the virtual tenant network topology
 - Discuss various possibilities of network design
 - Finalize the design and document the topology
- Design the network functions
 - Document the functionality, and argue why particular set of functions has been chosen to implemented in a specific way.
 - Come up with the pseudo code
- Write the network functions

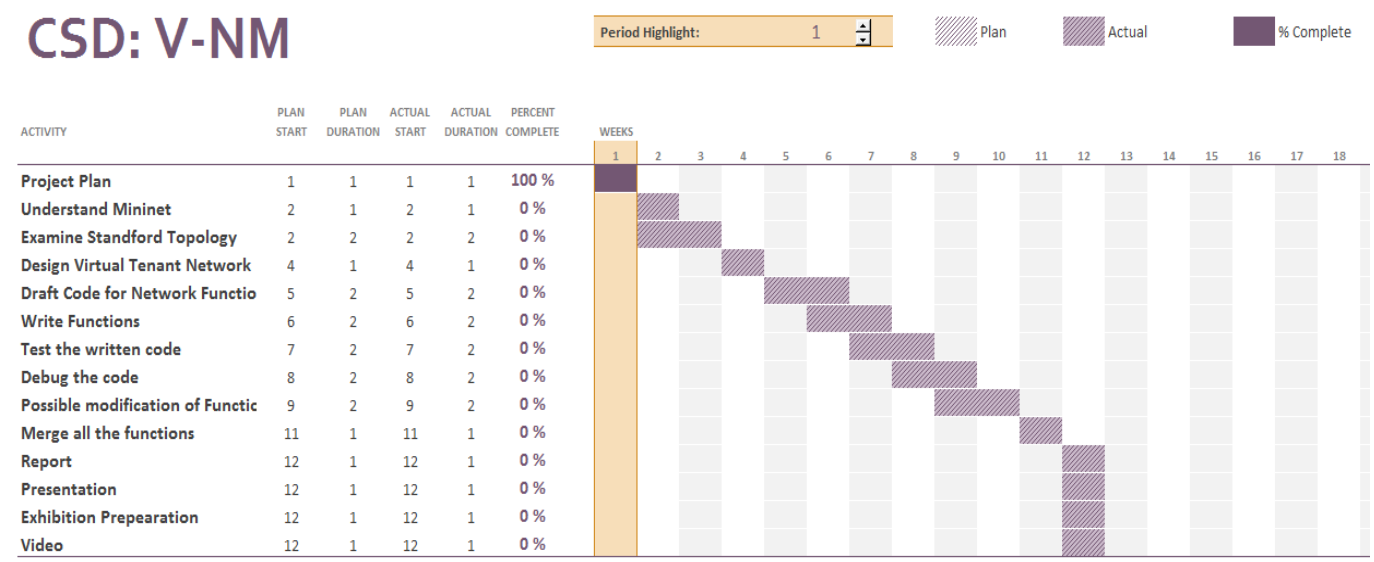
- Test the written code
- Debug the functions if required
- Design and test scenarios using traffic generator
- Possible modification of functions (Buffer Period)
- Prepare for the final Exhibition (Posters, etc.)
- Finalize report
- Create Presentation
- Create a video

Method

In this project we are going to use the applied research method [4] as following this research approach we can answer specific questions or solve known and practical problems. 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.

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.



Risk Analysis

Software Defined Networking and Network Function Virtualization are fairly new concepts, so getting familiar with these concepts might take longer than expected. The team members belong to Communication systems, thus possessing very extensive networking background and basic programming skills, which might need some further study to implement the networking functions. As, the team comprises of all international students, so some members might travel to their countries for Christmas vacations, which can result in some delay in the planned proposal. To mitigate these risks, the team members need to spend more time than required and work together to help and assist each other. The members need to work rigorously prior to Christmas vacations, to make-up in advanced for the times lost during Christmas.

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.

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.

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.
- [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.