Chapter 7 Conclusion

The development of the MPLS VPN simulator components has provided several valuable insights into the methodology of network simulations, as the development process has been a journey of discovery and exploration. This chapter will begin with the discussion of the objective achieved during the development process followed by the discussion on the goals achieved for the project.

The third section will discuss the development outcome. This section will detail the strengths and the limitation of the MPLS VPN simulator. It is then followed by a discussion on future enhancement for the MPLS VPN simulator. This section will describe some of the new functionalities that can be implemented for future purposes.

7.1 Objectives Achieved

This section will briefly discuss the objective achieved during the development process.

The first of which is the acquisition of knowledge. During the development process, different kinds of experiences and knowledge were gained. A thorough survey was carried out on most of the available literature on the subject of the latest networking technologies such as MPLS, VPN, MP-iBGP and MPLS VPN. These leads to a good understanding of these network technologies. The understanding of the core nature of these technologies is most essential even before the first step is undertaken to simulate the operation of these technologies within an artificial environment.

The second objective achieved is the understanding of the whole concept of network simulation. A deep study has been made on most current network simulators in order to gain a better insight into the workings of a network simulator. This has provided the solution to the problem of simulation and the development of the network simulator. Furthermore, the experience gained in solving problems during the design, implementation and testing of the simulator is really invaluable.

The third objective achieved through this project is the complete development of the MPLS VPN simulator based on object-oriented approach. The object-oriented approach endows the simulator design with flexibility, modularity, extensibility and reusability. Furthermore, the MPLS VPN simulator has unique features that give it strength not seen in other simulators.

All these objectives, both knowledge-oriented and development can be achieved. The development process has provided many opportunities for the study of the latest networking technologies. It also given the chance to prove the ability to create a simulator with all the desired features that were put forward right from the beginning.

7.2 Goals Achieved

The goal of this project is to ultimately develop the MPLS VPN simulator. These developed simulators are used to simulate the operation of MPLS VPN. Having achieved the goal of developing MPLS VPN components, the components can be integrated into the current MPLS simulator.

The testing and verification of the MPLS VPN simulator components had proven that the goals were achieved. These components have been completed and fully functional according to the system design. The following are the components' capabilities that have been achieved:

- The simulator provides the user a user-friendly environment to configure the VPN for each site.
- The simulator allows the user to view the VPN detail.
- The simulator is able to generate BGP_OPEN, BGP_KEEPALIVE and BGP_UPDATE message.
- The simulator is able to import the route into the correct VRFs based on the import and export policies configured in each PE-Router.
- The IP packet can reach the destination based on VPN label and IGP label.
- The end system is able to support three types of MPLS VPN topologies such as Intranet topology, Intranet and Extranet Integration topology and Central Services topology.

7.3 Development Outcome

The development process has produced a simulator that contains the system strength as well as the system limitation. This section will discuss about the development outcome of the MPLS VPN simulator.

7.3.1 System Strength

The simulator possesses a variety of strength as compared to other simulator products. The major strengths of the simulator are listed as below:

- Platform independent - The developed simulator using Java Programming Language enables it to be cross-platform. Thus, the simulator works well in Windows, Unix or Linux environment.
- Simplicity - The GUI and the user-friendly environment allow the users in creating different network topologies on the workspace. Besides that, VPN can be configured easily by using the step-by-step guideline provided by the simulator.
- Object Oriented - The simulator is fully developed in object-oriented approach. All methods and modules are built in classes. Thus, creation or modification of components can be done easily.
- Analysis of Simulation result - The simulator provides the log file for the simulation process. This lets the user analyze the result of different network topologies after the simulation. This method enables the user to perform further analyses.

7.3.2 System Limitation

The limitations of the simulator components that were developed during this project were due to the limited scope of the project. Besides that, the development process needed to be simplified in order to meet the time and effort constraints. The system limitation are listed as below:

- The simulator works based on Java application, thus it is not web-enabled yet.
- The simulator requires large resources to simulate.

- The simulator only supports the common functionality of the MPLS VPN.

7.4 Future Enhancements

The open-ended nature of the UMJaNetSim allows much space for improvements. It is foreseeable that further work can be put into the simulator development to add more features to increase its usefulness. The followings are some of the future enhancements for the simulator:

- Development of further visualization components can greatly enhance the usefulness of the simulator, both as an education and a research tool.
- The non-ATM based MPLS LSR components can be added to the simulator.
- The route reflector can be implemented in the current MPLS VPN simulator to provide scalability.
- The MD-5 encryption can be implemented for the routing protocol to enhance the security feature in MPLS VPN.
- The access control list can be implemented in the current MPLS VPN simulator.

7.5 Chapter Summary

To summarize the entire project, the development process of this project has been a journey of discovery and acquisition of experience. This project managed to achieve overall project objectives and requirements as a MPLS VPN network simulator, as determined during the system analysis. The simulator-testing phase has proven that the project was implemented successfully and managed to support three most common types of topologies.

This project also showed that the object-oriented approach using Java programming language to network simulation is an extremely beneficial approach to the development of network simulator.