CHAPTER 6: CONCLUSION

The main objective of this project is to fulfil the purpose of improving the efficiency in performing computer network simulation studies. Hence, the project is specifically designed as an object-oriented ATM network simulator with emphasis on congestion control mechanism.

It has been designed to be portable and at the same time allows component developed to be shared in order to have reusability and flexibility. Thus, it has made possible to add or remove any portions of the simulator accordingly. The use of Java programming language makes it all possible. Development of additional objects to assimilate into the system for other purpose of simulation study could also be achieved.

6.1 Objectives Achieved

The objectives for this project have been achieved and they are discussed in greater details.

A thorough survey has made on most of the current network simulators, to gain a proper insight into the working of a network simulator. Special attention is given to the methods currently being used to overcome congestion in a network environment. This knowledge is put to good use in designing the ATM network simulator. Therefore, through an extensive study made on existing available simulators, the project could integrate the best possible congestion control mechanism and traffic management.

It is also highly desirable to make the ATM network simulator to be portable that can be executed on any platform. It is for this very reason that a suitable programming language must be found. It must be simple and yet powerful enough to perform up to the task. That is the reason why object-oriented technique programming is much preferred.

The prefect language for this particular project is none other the ever-popular Java Programming Language. It really fulfils or rather satisfies all the conditions needed to construct the ATM network simulator. Java is easy to use as it employs the simple object-
oriental approach. Furthermore, this object-oriented approach could drives the classes developed into the resource-executor model.

And one of the most attractive features of Java programming, is the portability of its applets. Its applets can be post on the World Wide Web and the Internet Servers. From there, the simulator could be executed on any computer platform, making it a multi-platforms simulator.

Another great benefit of Java is its multithreading technique, which will enable computer programs to run in parallel. As the ATM network simulator is highly sensitive to global clock, the executor classes could depend on the language to do concurrent process at one specific period. The period for the simulator to execute each object is not the same.

Observations have shown that this project has successfully achieved the desirable objectives.

6.2 Goals Achieved

Based on the goals as laid out in this project, the simulator must be an object-oriented ATM network simulator. With creativity and innovations, the various components are successfully written and tested to produce the expected results. When all the components of the ATM network simulator are properly grouped together in packages, it can be ported in with additional features without changing the whole programming structure of the simulator.

In the link management system, the simulator must be able to simulate the resource class object to transmit the ATM cells into the input buffer. These cells are then transferred to another output buffer for transition into another object, which is better known as TCP end system or the switch’s buffer. Signals are executed before the cells are passed out from the link.

In the buffer management section, it must be able to perform the process of sending and fetching ATM cells from the link object. The process is based on the signals provided by the link object. Congestion control mechanism is based primarily on early packet discard and fair buffer allocation. It is tested and found to function in a proper manner. The performance of
ABR traffic flow control mechanism using a forward RM cells is done. Value for explicit rate is also tested to observe the change during the simulation period.

### 6.3 Development Outcome

From this project, the most valuable experience gained is the understanding of early packet discard congestion control method for ATM ABR service. Needless to say, the experience gained from designing and testing the outcome of this project is really invaluable.

The emphasis on link and buffer management also gives valuable understanding on congestion control. At the same time, objectives and goals of this project are satisfied with the successful completion of object-oriented components for an ATM network simulator. The congestion control mechanism is mainly based on early packet discard using fair buffer allocation, as well as ABR rate control feedback mechanism. The development is successfully built with the use of Java programming language and its tool – Borland JBuilder Enterprise version 3.0.

### 6.4 Simulator Strength

The major strengths of this simulator are listed as below:

- Object-oriented modelled approach
- Multithreaded
- Web enable using Java Applet
- Portable, extensible and modular

The Java programming language could handle object-oriented programming approach. Therefore, it holds the all the advantages of an object-oriented approach. It includes, modularity, portability, extensibility, as well as simplicity.

With the benefit of using Java, one of the major advantages is the portability of Java applets into the World Wide Web and Internet server. From the web browser, the simulator could be executed on any computer platform, which means it can be a multi-platforms simulator.
Besides, another great benefit of Java is the multithreading technique, which is able to write programs with parallel activities. An ATM network simulator is highly dependent to a global clock. The executor classes could depend on it to do concurrent process at one specific period. The period for a simulator to execute for each executor object is mainly different. Therefore, one could need to wait for another object to complete its task before executing the next job. So, a global clock is used to synchronise the jobs in between objects.

### 6.5 Simulator Limitation

The simulator is limited to certain features:

- Queue on FIFO discipline
- Congestion control using early packet discard with fair buffer allocation
- ABR rate control feedback mechanism using RM cells

### 6.6 Future Enhancement

The simulator model can be enhanced easily. More features can be added to the functions or additional object can be created without the change or minor change in other existing objects. Besides, it can easily be made more portable with the addition of major components or be made more advance and features rich.

### 6.7 Summary

This project which has taken us on a journey full of experiences both memorable and meaningful. Object-oriented programming approach is proven to be a successful approach and powerful as well. The Java programming language and its companion - the Jbuilder have really stood up to the task in creating the ATM network simulator. With creativity and innovations, this simulator can really make to perform. With its complete set of features like web-enable, multithreading and multi-platform oriented, this simulator could be a successful ATM network simulator.