CHAPTER 6

GUIDELINES, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

VOMS is an essential part of any mobile operator’s PrePaid offering. The design and implementation thereof are important; if these are not done properly, it may lead to revenue loss or damage to a mobile operator’s reputation.

In this research report the functions of a VOMS system have been discussed, as well as proposed methods to improve an existing architecture and render VOMS a system with higher service availability. This chapter will provide guidelines on how to proceed to implement such a new architecture. The proposed new VOMS topologies will be described and recommendations will be provided on how to migrate existing services from a current VOMS to the new architecture with a view to contributing to the effectiveness of a VOMS offering.

6.2 HIGH SERVICE AVAILABILITY FOR A SINGLE SITE

Figure 6.1 illustrates what the recommended topology would look like. There are five VMs for the application service and three VMs for the database. Note the redundant network paths that have been available for the clients. The clients would connect to the network infrastructure of a mobile operator, which would then be routed to the load balancers that form part of the new VOMS architecture. Only one load balancer will be active; the other load balancer will be on hot standby. This may be achieved by the Cisco function, HSRP, which allows the secondary load balancer to receive a health check from the primary load balancer; if after a period of time there has been no health check, and the secondary load balancer would begin consuming traffic. The application and database contexts shown in Figure 6.1 are the ACE configurations for the front-end application servers and back-end database servers respectively. Appendix A shows the ACE configuration for the experiment. To implement the architecture in Figure 6.1, it would be require adding the IP addresses of the application and database servers to the ACE configuration.
Traffic would be routed to the five application VMs as per the defined algorithm scripted in the running configuration of the load balancers. There are various configurations that could be configured on the load balancers. Round robin was chosen, meaning that incoming client traffic would be routed in sequence to each of the application VMs. An example would be that as traffic arrives at the load balancer, the first request will be sent to the first defined application server within the configuration on the load balancer. The second request will be sent to the second application server that has been configured within the load balancer, and so forth. Round robin was a simplistic approach according to which load should be evenly distributed. The five application VMs were configured identically. They would all have the same application port numbers configured and would function independently. The strength of this configuration is found in the parallelism that would be achieved, that is, the ability to process a client’s request over multiple application servers instead of one application.

After the application servers have processed the request, it might need to perform a database request before responding back to the client. This request is passed back out to the load balancers to be directed to the database back-end VMs.

In this configuration, there were three database VMs. The load balancers performed the same round robin action as was done when traffic entered from the clients. The traffic would be assigned to any of the three databases. The implementation of a clustered database would be required. The replication was setup in such a manner that the latency between the databases was minimal and less than a second. Once the database had performed its task the response was sent back to the application VMs and then back to the client.

The architecture shown in Figure 6.1 would be an ideal structure for a single site. The concern with single sites would always be a natural disaster. This architecture would need to be expanded to achieve true availability.
FIGURE 6.1: An ideal architecture for the newly proposed VOMS system
6.3  HIGH SERVICE AVAILABILITY FOR AN ORGANISATION

Taking the concept further and expanding on Figure 6.1, it needs to be said that while this topology would be considered to have high service availability, it too would not be immune to a natural disaster. Therefore, the topology would need to make use of cluster computing to mitigate natural disasters.

Figure 6.2 depicts a construction of a VOMS topology that would provide such high application service availability. This configuration, is based on an MTR of four hours, and will have application service availability of eight 9’s and above [39].

Transactions from clients would be sent to both sites. Traffic would be distributed by means of network routing to both sites. The load balancers would be configured to distribute traffic over these two sites. An important consideration was the latency incurred by using clustered computing. If there were sufficient bandwidth it should not have a significant impact on the client response times, if the distance between the primary and secondary site was not excessively long. Lastly, a Quality of Service (QoS) should be configured on this network, so as to provide VOMS traffic a higher priority.

It would be possible to create a MySQL cluster and expand the replication over both sites. Bandwidth again would be an important consideration.

This topology will provide extremely high service availability for a mobile operator in the event of a natural disaster, and with the loss of a single site, there would be no impact to the clients and connectivity to VOMS will still remain available.

6.4  STUDY SUMMARY

PrePaid services are a growing market. It has continued to grow over the years and now outnumbers Post-Paid subscribers. While a preferred method in non-First World countries, PrePaid has become a vital offering to many subscribers who either do not want or do not qualify for Post-Paid contracts. The stability of any network and the network elements within a mobile operator are very important to the reputation of mobile operators. Reputation is crucial in a competitive market. It therefore is important that mobile operators make an effort to improve their service offerings. This could be achieved by enhancing existing architectures.
FIGURE 6.2: Eight 9’s application service availability architecture
This study focused on VOMS, which is an integral component of PrePaid. The research that was conducted was aimed at proving that an existing VOMS architecture could be enhanced and the application service availability of VOMS made to have an extremely high availability.

A laboratory was set up and configured to resemble the network elements that constitute a PrePaid system. The downstream IN systems were required to process transactions from VOMS. The new VOMS architecture was then tested by means of emulations. The new VOMS architecture was put through rigorous testing using different fault conditions.

The results of the emulations proved that the new VOMS architecture would provide high application service availability, which is a significant improvement over an existing architecture.

A cost comparison was conducted between an existing VOMS architecture and the newly proposed VOMS architecture to determine the feasibility of the new system. Based on the research undertaken, the new VOMS architecture would be more cost effective than an existing VOMS system.

6.5 LIMITATIONS OF THE STUDY

The following limitations of the study are recognised: The emulations that were conducted could have been run from a system that was within the laboratory network and not from an outside network. The pool of test subscribers used for the emulations could all be made to exist on the downstream IN, thus it could have been seen how many failures would occur during a failure. These aspects will be addressed when publications are prepared.

6.6 CONTRIBUTION OF THE RESEARCH

The research has contributed in a modest way toward new knowledge. A knowledge gap was bridged by completing this study. The quality, validity and reliability of the study were ensured by thorough research and a sound methodological approach. The completed research report will provide a platform for further research. The overall aim of the research was to contribute to high application service availability for a VOMS system.
6.7 RECOMMENDATIONS

The following recommendations will permit this study to produce valuable results:

- Articles on the research results should be published.
- The research results should be presented at national and international conferences.
- Further research should be conducted with more services on the new architecture so that the emulations would be similar to the live environment.
- Further research should be conducted on various other hardware systems.
- Further research on various other Virtual Machines software should be conducted.

6.8 CONCLUSION

The findings of the study indicate that the project has been completed successfully, as answers and solution were found to the research questions.

Question 1 required that VOMS be described and contextualised. VOMS and the components that constitute the makeup of a VOMS system were described in detail. Further details were provided on the functionality that VOMS provided, and the discussion of the findings put the importance of the newly developed VOMS in context.

Question 2 required of the researcher to determine whether it was possible for VOMS to achieve a near 100% application service availability. In chapter 5, the results of the tests that were run had been discussed. These results indicated that the application service remained available during the failure conditions. Clients that connect to such a system will not lose their connectivity and may be oblivious of a failure occurring. While an application service availability of 100% was achieved during the experimentation, the duration of the emulations was for a short period. The experimental configuration proved to have a better service availability when compared to an existing VOMS architecture, but it could be enhanced further as the experiment architecture only catered for 100% capacity. The architecture could be enhanced to achieve an eight 9’s application service availability. To achieve this extremely high service availability, additional capacity would need to be provided according to Holenstein et al. [39], as described in this chapter.

In research question 3 it was asked whether it would be economically feasible to build such architecture. The overall cost of developing a new VOMS system was presented in Chapter 4,
and it was found that it would be economically feasible to build such a new system if the cost is compared to that of the installation of an existing proprietary VOMS system.

It therefore may be stated that the goal of the study was achieved, namely to evaluate how a specific mobile operator implemented its VOMS installation and to determine whether there were better methods to do this in order to improve its availability. The results of this research, therefore, can serve as groundwork for assembling guidelines and to make a contribution to the effectiveness of the telecommunications industry.

6.9 CONCLUSIVE REMARK

A specific network element was chosen to be examined to determine if it was possible for an existing high availability system to be developed further to create a new architecture with a service availability of eight 9’s or more.

The network element chosen was VOMS; this system was described in detail to provide context to the use of VOMS and the importance thereof. It was important to investigate the concepts that would be required to increase the high availability of such an element. Research was done and a new architecture was proposed and constructed. It was proven that this new system would be economically feasible to construct and implement. Furthermore, the new architecture was proven to have higher service availability as compared to an existing architecture.

While the research was undertaken to improve a specific network element for telecommunications, the idea behind the high availability architecture could be further expanded to all sectors of ICT and IT.