Implementing of Virtual Router Redundancy Protocol in a Private University

Joseph Ng Poh Soon and Shaaban Hassan Ramadhan Abdulla
School of Information Technology, SEGi University, No 9 Jalan Technology,
Kota Damansara Petaling Jaya, Selangor, Malaysia
Email: josephng@segi.edu.my, ahluha@yahoo.com

Choo Peng Yin, Wong See Wan, Phan Koo Yuen, and Lim Eng Heng
Faculty of Information Technology, University Tunku Abdul Rahman, 31900 Kampar, Perak, Malaysia
Email: {choopy, wongsw, phanky, limeh}@utar.edu.my

***Abstract*—Network high availability is one of the common problems faced by many university institutions that contribute to operation cost to increase, slow down working speed and increased student's attrition. Virtual Router Redundancy Protocol provides a better way to business continuity and high availability. The main objectives on implementation of VRRP is to create an alternative path, applying virtual routers, implementation of single IP with multiple IP, together with load balancing technique so as to become healthier and not to be overwhelmed by heavy load during operation. VRRP implementation going to be a preeminent success for private university, this new finding is going to be very useful to overcome an existing problem and leads to the improvement of services and great benefit to business. To prove workability of VRRP, entirely environment will be simulated using GNS3 network simulator, this will be able to emulate the existing problems hence it can demonstrate the aim and defend the expected objectives.**

***Index Terms*—high availability, redundancy, load balancing, business continuity, virtual router redundancy protocol, university**

I. Introduction

The potential benefits from network enabled transformation of university institution are enormous. Increasing competition in education business together with globalization contributed in making network service to become more important. It is very difficult to run an university institution without having high availability of network services, this will result to increasing of running cost, slow communication within and outside campus and also lead to scarcity of customers. One factor that determine the university quality is a good services especially in networking facilities such as LMS (Learning Management System), online result and studies schedule, this gives the university as well as countries itself good image to outside world and contributed to economic growth of that countries hence a lot of students worldwide can be attracted and become interested to join the university.

Absence of better network high availability contributed to the poor performance in daily routine within university, such as high operation cost in term of distribution of study materials to students such notes, secondly time wasting whereby preparing printed notes for large number of students takes more time comparing with self-service online. Apart from that it will also cause a problem to students where by every time they have to carry notes around, through high availability of network give them opportunity to access anywhere any time and reduce heavy burden of carry papers around every time hence it's flexible. In order to achieve this condition there are very important criteria that are required to be meat, these are high availability of resources, redundancy and load balancing.

II. Literature Review

A fault in a network system will prevent users from accessing very important information. Within university students depend on network for different uses, that makes high availability is one of the first criteria. High availability helps to achieve and sustain the objectives or situation which going together with business goal that is 99.9% availability [1]. This shows that service 24/7 given a high priority in a university, high network availability result to all network based services operation to perform efficiently and reduce chance for downtime that might be caused by human error. Through high availability tools bring smooth operation by enabling system administrator to control a greater number of serves with less effort. With poor network availability students is a number on victims, they depend on network service for their daily activities such as downloading different materials needed for their studies and increase knowledge by studying online, apart from students lecturer as well also fall in this category where they need to upload different study material for student to access at any time.

In general, redundant network provide a significant value in business, due to little or no maintenance, self-healing system, fast recovery times also business save

Manuscript received July 29, 2013; revised October 20, 2013.

doi: 10.12720/jiii.1.4.255-259

money over the long term. Cable breaking and miss configuration of network devices is always causes of failure in network operation, at the same time the process for searching for errors it become more expensive and difficult, hence little carelessness of the risk cost production stoppages and economically relevant outages. The using of redundant real time networking make the routers cable separate [2]. Using of redundant as shown in Fig. 1, help to avoid single point of failure in network, switch and routers are connected with more than one cables. With the simultaneous transmission of data packets in two lines, when single line fail within a network is no longer have effect in disruption of communication and therefore automation play it's role.

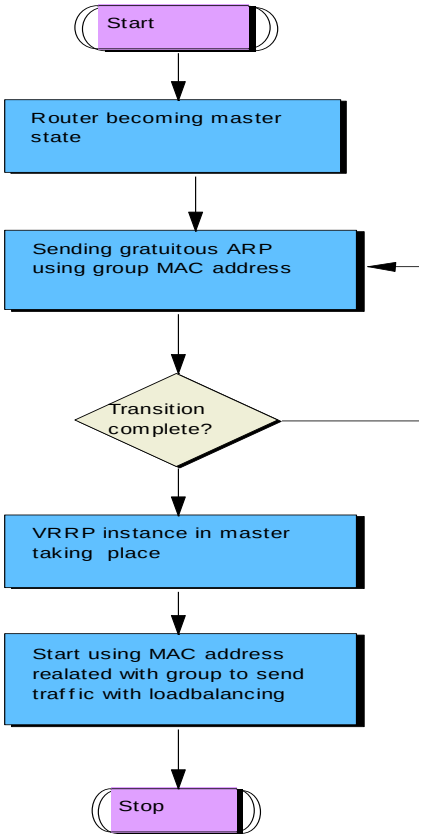

Figure 1. VRRP flowchart

Absence of balancing in university network will result into poor performance in devices and no resilience in network, this will result network with less fault tolerance. Load balancing applies multiplayer switch which is evenly distribute the network among the devices processing function therefore during heavy network traffic, load can be distributed among devices, this help on increasing the availability and scalability of network resources for example business-critical information and applications [3]. This solution has ability to scale critical applications transparently and ensure the service level agreement and availability objectives in line with the requirement of business.

III. Current Challenges

It is important for every university to go together with next generation of internet community that mostly based on E-Student and E-resource's, this will enable students to complete registration process online as well as getting all study resources. Therefore 100% availability cannot be achieved by conventional methods [4]. This is shown in Fig. 2 below.

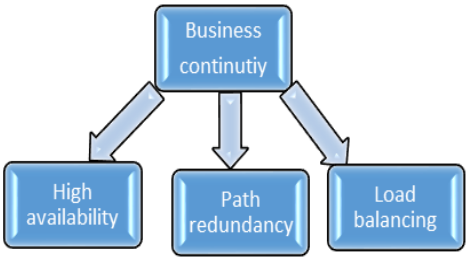

Figure 2. Challenges in network availability

Redundancy it play role of increasing of devices and the network size and cost, hence network redundancy is partially provided in actual cases. In this case the internet is following a set of large number of network that based in mesh structure topology [5]. High congestion cause a lot of problem such as packet delivery to be very poor, long packet latency, routing overload and high signal interface [6]. In most of the current load balancing techniques is either use a dynamic router in order to avoid congestion and balance the real time traffic load or another current technique is multipath routing a path which lead to the extra overload.

IV. Technology Operation

VRRP technology switch can determine their roles in a VRRP group by priority. The master switch is always of high priority, that forward packets to outside network and the backups is one with lower priority. Master switch always send VRRP advertisement periodically show it normal operation. Backup receives advertisement and compare with its own priority; when advertisements are high will remain as backup otherwise then it became master. A backup starts the advertisement interval timer while is waiting the next one from the master, if does not receive VRRP advertisement from master after time expires, then it will regarded as master fails and start election process to elect new master for forwarding packets.

Network management solution is very important issue where by some computer and users as well are trying to ignore until the fault occurs. But now a day's business is highly depend on reliable, secure and highly available networking infrastructure that that serve a very wide area and multitude of management domain [7]. In maintaining high availability network the technical operation are mostly based on the followings

- Fault management , in fault management it based on detecting as well as avoiding network problems, which result to the increasing of network availability , that keep network downtime at the minimum rate as well as improving network

performance. Performance management, enable a network administrator to visualize, manage as well as improve performance of complex network, reducing the time it takes in performing routine management and maintenance task by automating tasks.

- Configuration/Inventory management, it is process of organizing and maintains the information required about all components of the computer network. When computer need repair, expansion upgrade or modification, configuration management database is always determine the best course of action.
- Availability monitoring, this is a prime factor for high availability, the function of this is to transmit and receive up or down the polling information, in many time emulating mission-critical traffic to measure availability and latency.
- Accounting: in high availability is require accounting or usage statistics which is rolled back in to performance management. This will help in providing redundant solution as requires an ability to manage duplicate entries.

Redundant protocol is of two types this is standards-based or proprietary. The standard based is providing slower recovery proprietary which provide faster recovery time. In redundancy some time there is overlapping features and functionality of redundancy protocols, but in most of the application they use hybrid protocols which is more common [8]. The two most popular standard based redundancy protocols are as follows:-

- Link aggregation, this is providing path to multiple link in virtual link, for example in time where number of link is up to eight established between two locations. Here if eight 100-megabit connections are in place therefore will make them one 800-Megabits connection.
- Rapid spanning tree protocol (RSTP), this is the one which uses an algorithm methodology where by the path is used for the primary communication. This is redundant which is most reliable. It is best in mesh network which have multiple redundant link as well in ring network topology.

Load balancing existing for long time there is different appliance of load balancing that is used such as the one Cisco, Barracuda and F5. All this application use the same characteristics in which the devices present "Virtual server" IP address together with other services such as HTTP to the outside where user wanted to connect, normally use to forward the connection to most suitable real server by doing bio directional address translation for the purpose of increasing application availability. In basic network load balancing operates in such way as:

- The first the user is connecting to the internet so as to request service such as website.
- The second step in DNS then the user connected to a specific IP address at specific destination
- Then the user is connected to load balancer
- In a load balancer after accepting connection then here is deciding on which server to accept to connection according to the load that server changes have also the destination IP in order to match with the service of selected host.
- Once the server accept the connection the respond back to source, client , using its default route, the load balancer
- Then the load balancer capture packets that are returned from the host at this time changes the source IP in order to match with server IP and port before forwarding the packet back to the client.
- On the client side received the return packet, knowing that it came from virtual server and displays it contents.

V. Research Methods

Research methodologies help to guides researchers to involve and to active in certain field of enquiry [9-10]. Most of the time aim of the research and research topic are not going to be the same at all time it differ from its objectives and flow of the researcher by using suitable methodology make it to easily achieved, from choosing the topic and carrying out till recommendations research methodology lead the research in required way; therefore whole research plan is mostly based on the concept of right research methodology as shown in Table I below.

TABLE I. Research Methodology Summary [11]

Research Dimension	Explanatory Sequential Design
Research Validation	1. Content Validity - Domain distribution - Language - Depth - Jargon 2. Concurrent Validity - Focus Group 3. Construct Validity - Lecturer - (IT, Engineering, Business) - Industry Peers - Industry Experts
Research Methods	Phase 1 : Literature review
	Phase 2 : Simulation Testing

In order to prove the strength of VRRP and workability, the powerful tools GNS3 can be used to emulate the problem to show the absence of using VRRP and the presences for the purposes to reach the expected goals. In performing testing, first normal protocol can be used to show its operation where by different test will be conducted such as to terminate cable so as to see how impossible to choose alternative due to the lack of using VRRP. The second test will be conducted with same network configured with VRRP protocol with same technics of testing to show suitable VRRP is to overcome the problems such as downtime and traffic congestion in university network.

As mentioned earlier the university network facing number of problems such as lack of high availability,

redundancy network, load balancing and failover. After successful simulated the network environment with effective performance of VRRP, the expected aim will be very clear as well as will be the reason behind for appointing this protocol to be applied in private university. VRRP will reduce network downtime in very minimal rate in such it is hard for the users to notice, this will result for little lost in business. Congestion avoidance or reduction is another aim where by VRRP that can be controlled through load balancing technique in order to make devices healthier and not to be overwhelmed by heavy load. Improving availability of resources is another aim of choosing VRRP; the improvement can be done through using of VLAN technology that increases performance.

VI. Business Advantages

In many of today networks require a deployment of network uptime of 99.999% this is commonly referred as five 9s the network availability, if the network has a stringent requirements which approaching an uptime of 99.99999% also known as 9s availability[12].The high availability has a lot of advantages, the common one is lower cost. When network availability is reliable and maintained to maximum the business flowing will be constant and reducing running cost, this is because the university will save a lot on using paper works and will migrate to the online resources system. This is due to the high availability and will enable students to access material any time hence save cost for university operation. This is shown in Fig. 3 below.

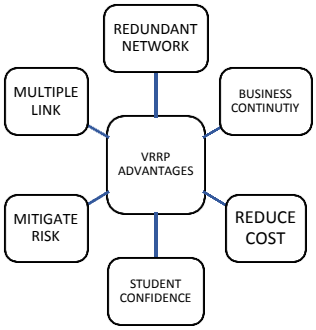

Figure 3. VRRP business advantages

Redundancy network bring a bulk of advantages in business, the best one is response to any downtime or disaster which can be put into disparate risk management into single, integrated strategy this will help in university institution to adapt and respond rapidly during any fault that may occur. Continuity central describe the advantages of business continuity itself as, will help to keep the business to the place where would probably failed due to an incident also allow what would otherwise be unacceptable risk to be insured. Due to this fact there are a lot of advantages when there is redundancy in network.

The use of multiple ISP link this will increase the university with maximum uptime in it network connectivity in such a way that even one or other ISPs fail as there will be still services available . Therefore this will enable the key service such as web surfing, VPN access and voice traffic will remain available end ensure the constant operation all the time. When there is network redundancy in private university will lead to increasing of performance and production. This is due to increasing of throughput for upload and download activities, students will able to access material in easy way and make the university to be more active in its business. Maintaining continuity service delivery, this is deal in protecting service for the university in case of failure also it give chance to IT officer in university to identify the cause of disruption and enable to make right decision very quickly.

VII. Conclusion

High availability network is very important aspect, especially within the private university, this lead us to find solution on how this condition can be achieved.From the recommendation and clear explanation of VRRP technology will enable private university with effective network services, this is essential in achieving eStudent services which determine feature prosperity of university and students in general. VRRP is best protocol that has solution for all the problems above mentioned and make network efficiency and effective all the time. VRRP will also provide disaster recovery technique and maintain business continuity within the university hence business growing by attracting number of students to join in private university hence contributed to the growth of business. This paper also recommend for other researchers to conduct a deep research in the other protocol which similar like VRRP such as HSRP (Hot Standby Router Protocol). This will give a private university to make a right decision petering which protocol is best to be applied within the campus area to improve the performance on network services and get ride from traditional way of single link.

References

[1] Cisco ASR 1000 series aggregation services router high availability: Delivering “Carrier-Class” services to midrange router systems. [Online]. Available: http://www.cisco.com/en/US/prod/collateral/routers/ps9343/solution_overview_c22-450809.pdf

[2] Network redundancy. [Online]. Available: http://www.bachmann.info/fileadmin/media/Produkte/Steuerungssystem/Produktblaetter/Network_redundancy_en.pdf

[3] An introduction to load balancing applications. [Online]. Available: http://www.radware.com/Resources/load_balancing_introduction.aspx?terms=load+balancing

[4] M. Hayasaka and T. Miki, “A network architecture with high availability for real-time premium traffic over the internet," *Journal of Network and Systems Management*, vol. 16, pp. 201-221, 2008.

[5] P. Gill, N. Jain, and N. Nagappan, “Understanding network failures in data centers: Measurement, analysis, and implications," in *Proc. SIGCOMM*, Toronto, Ontario, Canada, vol. 41, no. 4, 2011, pp. 350-361.

[6] K. Salchow. (2012). Load balancing 101: Nuts and bolts. [Online]. Available: http://www.f5.com/pdf/white-papers/load-balancing101-wp.pdf

[7] J. Ding, "Basic concept of network management," in *Advances in Network Management*, Boca Raton: Taylor & Francis, 2010, pp. 43-48.

[8] Network redundancy reduces risk, downtime, control engineering. (2011). [Online]. Available: http://www.controleng.com/single-

article/network-redundancy-reduces-risk-downtime/fbb380911a5b1769eb01347fdc8c30c7.html
[9] J. William. (November 24, 2011). What is research methodology. [Online]. Available: http://www.howtodo.dissertationhelpservice.com/what-is-research-methodology
[10] N. P. S. Joseph, *et al.*, "Battles in volatile information and communication technology landscape: The malaysia small and medium enterprise case," *International Journal of Business Information System*, vol. 13, no. 2, pp. 217-234, 2013.
[11] N. P. S. Joseph, *et al.*, "IaaS cloud optimization during economic turbulence for Malaysia small and medium enterprise," *International Journal of Business Information System*, 2013.
[12] S. Snedaker, "Business continuity and disaster recovery planning for IT professionals," in *Business Continuity and Disaster Recovery Plan*, Burlington: Syngress Publishing, Inc., Ch. 2, 2011, pp. 113-114.

Joseph Ng Poh Soon is an evangelist of his birth place, Kuala Lumpur, Malaysia. He graduated as an Associate Charted Secretary (UK), with a Masters in Information Technology (Aus) and a Masters in Business Administration (Aus). He also holds a CCNA, HCDA, CEI, CEH, 3CE, MCP professional certification and is a member of MAICSA and IAENG. With his blended mix of both business and technical skills, he has held senior management position in many MNC and leads numerous mission critical systems.

Shaaban Hassan Ramadhan Abdulla is a final year student reading his Bachelor of Information Technology (Hons) at SEGi University Malaysia. His passions for computer networking have made great transformation for his internship at an international telecommunication enterprise.

Assistant Professor Dr Choo Peng Ying was born in Kampar, Malaysia. He graduated from University of Arizona (US) with two bachelor degrees in Electrical Engineering and Computer Engineering, a Master and PhD in Electrical & Computer Engineering. His current research interest and concern is the impact of long term energy shortage on IT infrastructure, economy and society.

Wong See Wan was born in Ipoh, Malaysia. She received her Bachelor degree in Information Technology from UUM and Master of Science in Computer Science USM. In year 2007, she joined University Tunku Abdul Rahman (UTAR) and is currently a Lecturer in the FICT. She currently focuses on supply chain disruption from long term energy shortage for her doctoral research.

Phan Koo Yuen was born in Ipoh, Malaysia. He is currently a lecturer in FICT at University Tunku Abdul Rahman, Malaysia. He received his Master of Science with Information Studies from Nanyang Technological University, Singapore. In his 13 years experience in teaching computing and IT courses, he has obtained the Best Lecturer Award (2000 and 2001) and Unit Leader Award (2000). He now looks into integrating augment reality for future mobile competitive for his PhD research.

Lim Ean Heng was born in Ipoh, Malaysia. He received a Bachelor in Finance and Master of Science in Information and Communication Technology from the University Utara Malaysia (UUM). Having in charge of the IT department during his stint with multinational company, he liaises, oversees and provides professional audit, budgeting, financial management and accounting services in support of the Finance department. His doctoral researches are on multimedia solution that will leap frog the industry.