

Impact of NRENs in Universities – The ZAMREN Experience.

Bonny KHUNGA

Zambia Research and Education Network, Lusaka, Zambia,
khungab@zamren.zm or khungab@gmail.com

Douglas KUNDA

Mulungushi University, Centre for ICTE, Kabwe, Zambia,
dkunda@mu.ac.zm or douglas.kunda@yahoo.com

Received:06.03.2017; Accepted: 06.07.2017

Abstract:

African universities are confronted with a tirade of challenges such as insufficient and still declining funding from governments, limited infrastructure, lack of advanced labs for teaching and research, high cost of best publications and databases, high student-lecturer ratios, global competition brought about by cyber space, research financing, scarce availability of academic staff, and high cost of ICT Services. Research and Education Networks (NRENs) are organizations defined as not-for-profit whose mandate is to create organizational and technical environment to support and enhance collaboration and sharing of education and research resources among universities, locally, regionally and globally.

This paper examines some of the key needs and challenges the universities and research institutes confront and how NRENs can assist in addressing them. It also looks at how NRENs can create synergies with local telco's and services providers to lower the cost of ICT services and products. It also discusses the impact of the introducing ZAMREN on the Research and Education Institutions in Zambia

Keywords:

NREN Services, eduroam, FID, Sci-GaIA, Magic (Global Science Communities), Direct Research Assistance, High Performance Computers, ZAMREN, End-to-end Connectivity, Training and Support, Big Data, Public and Private Partnerships.

1. INTRODUCTION

African universities are confronted with a tirade of challenges such as insufficient and still declining funding from governments, limited infrastructure, lack of advanced labs for teaching and research, high cost of best publications and databases, high student-lecturer ratios, global competition brought about by cyber space, research financing, scarce availability of academic staff, and high cost of ICT Services. Education and research is fundamental to the development of any nation. Thus, most countries have recognized the need for a different support strategy for the relevance and sustenance of their universities and research institutes to survive in the 21st Century.

Research and Education Networks (NRENs) are organizations defined as not-for-profit whose mandate is to create organizational and technical environment to support and enhance collaboration and sharing of education and research resources among universities, locally, regionally and globally. NRENs have different forms of governance and ownership models, some solely owned by universities and research institutes, others by governments with universities and research institutes in the governance structures.

This paper examines some of the key needs and challenges the universities and research institutes confront and how NRENs can assist in addressing them. It also looks at how NRENs can create synergies with local telco's and services providers to lower the cost of ICT services and products. ZAMREN, the NREN in Zambia, has been operational for the past 4.5 years. The paper examines ZAMREN's formation, and growth path as a case study and assesses the impact of the NREN on research and education in the country. NRENs also have inherent operational challenges, the paper also highlights some of the challenges ZAMREN encountered and how they were addressed.

This paper discusses the impact of the introducing ZAMREN on the Research and Education Institutions in Zambia. For example, reduction on the bandwidth costs [4]. At the launch of ZAMREN, the starting Bandwidth tariff was US\$900 per 1Mbps per month. This was considered to be a huge reduction compared to what the commercial provider's tariff were at that time which ranged from US\$4,500 to US\$5,000 per 1Mbps per month. Progressively ZAMREN has been reducing its tariffs on Bandwidth as it procured more capacity through UbuntuNet Alliance and as at 30th December, 2016, ZAMREN tariffs were US\$140 per 1Mbps.

2. CHALLENGES FACING HIGHER EDUCATION INSTITUTIONS (HEI)

Researchers have identified the common challenges faced by Higher education institutions especially those related in the use of ICTs into teaching and research [1]. For example identified lack of appropriate physical environment and ICT infrastructure as one of the challenge faced by Higher education institutions. The following are some of the challenges faced by Higher education institutions:

2.1 Lack of advanced laboratory for teaching and research

In most developing countries, higher education institutions lack advanced laboratory to conduct certain specialized experiments for teaching and research. The introduction of NRENs provides opportunities to share some of these advanced laboratory facility and undertake joint research.

2.2 Industry's high demand of best academicians

Higher education institutions face brain drain because industry's high demand for best academicians and ability to attract them because they can pay them higher salary and also provide laboratory with up to date equipment. Therefore higher education institutions are faced with difficulties on how to attract and retain best academics.

2.3 Limited physical infrastructure

Lack of appropriate physical environment and ICT infrastructure, [1,2] is one of the major challenges for higher education institutions. New technologies are Bandwidth hungry, for example application for capturing high quality video lectures and podcasting require large Bandwidth. Therefore, this requires investment in ICT infrastructure and this can be a challenge in some Universities in developing countries.

Furthermore, higher education institutions lack classroom space and limited library facilities. ICT with high bandwidth capacity can facilitate students to learn from their rooms without necessary going into the class room or lecture rooms.

2.4 Limited education and research resources

In most developing countries in Africa, higher education institutions have limited education and research resources due to lack funding. For example, most of the books in the library are outdated and students and researchers do not have access to journals. Limited access to research resources leads to low quality research outputs and fewer publication in international journals. NRENs open doors for sharing educational and research resources.

3. NREN's ROLE IN RESEARCH AND EDUCATION

We can reiterate some general functions played by NRENs. Paramount, is developing of necessary communication protocols and finding innovative ways of using the network to support education and research [3]. Collaboration and initiatives have emerged such as Sci-GaIA, Magic, enabling grid computing to share computing resources, sharing of labs and other academic resources via dedicated networks supporting VoIP. This has lead to proliferation of NRENs worldwide.

4. ZAMREN AS A CASE STUDY

ZAMREN begun as a consortium when three public Universities (University of Zambia, Copperbelt University and Mulungushi University) came together to collaborate and set up a team of ICT Directors to spearhead the formation of the ZAMREN (the Zambian Educational and Research Network). The Vice Chancellors from the three public universities met several times to provide policy directions, solicit for support from government and quasi-government institutions, and to provide resources necessary to initiate the setting up of ZAMREN Office. The Committee of ICT Directors from three public universities were responsible for technical and administrative tasks of setting up ZAMREN and outlining project specification. In order for an NREN to be set up you need two or more universities and research institutions to come together to spearhead the formation of an NREN. Alternatively if the country has National Council for Higher Education and Research, the National Council can be used to initiate the process of setting up an NREN.

ZAMREN has embraced the Public and Private Partnership strategy in its operations. The drivers and catalyst that made ZAMREN successful include the following [5].:

4.1 Collaboration among founding universities to setup an NREN

The synergies demonstrated by the Vice Chancellors of the three public universities and ICT Directors, as outlined in the paragraph above, had a spiral effect in attracting other education and research institutes to join ZAMREN.

4.2 NICHE Project Support

In 2010 the three public universities submitted a project proposal to the Netherlands Government through NUFFIC. The Government of the Netherlands approved a total budget of Euro 2,249,767 for the ZAMREN/NICHE Project. The main objective of the project was “To improve the quality of Higher Education and to enhance research and resource sharing among research and education institutes in Zambia through ICT capacity building and strengthening of the Zambia Research and Education Network”.

The outcome of this project were: Investment that enabled the building of an operational Network Operating Centre for ZAMREN; Technical and organizational capacity building for ICT and University Administration staff on various aspects of National Research and Education Networks; A four-year business model which lay a foundation for creating a self sustaining ZAMREN as an NREN organization. The project was successfully closed in June 2015 having met its objectives.

4.3 Support from Ministry responsible for ICT to use Universal Access Funds

Zambia Information Communication Technology Authority (ZICTA) manages the Universal Access funds for Zambia and was able to apply these funds to support last mile connectivity of some institutions to ZAMREN. ZICTA funded the last mile connectivity for University of Zambia, Copperbelt University and Mulungushi University to ZESCO fiber grid backbone. ZICTA also assisted other public colleges and secondary schools to be connected to ZAMREN fiber network.

4.4 Support from Regulatory body for preferential licensing (ZICTA)

ZICTA also facilitated a license to ZAMREN as closed user group of education and research institutions.

4.5 Collaboration with Optic Fibre Infrastructure Owners

Within the country, there is fibre laid or being laid by various organizations, most prominently Commercial ISP Providers and Power Utility Companies. Collaboration with these organizations for use of their infrastructure can result in a quick and efficient way of deploying NREN services [7].

4.5.1 Collaboration with Power Utility company (ZESCO)

A memorandum of understanding was signed between ZAMREN and ZESCO to use their inland cross-town fibre for free, as long as, it was used for education and research purposes. This has been one of the biggest support initiative in ZAMREN operations. ZESCO’s fibre

coverage is wide in the country, hence the only cost that ZAMREN incurs is the provision of Last-mile connectivity from the ZESCO’s PoPs to the member institution.

4.5.2 Collaboration with Commercial ISP

It is understandable that some ISPs consider NRENs as competitors because they see the NRENs take their clients (research and education institution) and provide them with Internet services at lower tariffs. But however, the commercial ISPs need to be convinced that by NRENs providing these services to education and research institutions, the NRENs are creating a huge customer base for commercial ISPs which emerges when the students graduate, are in industry and are no longer accessing NREN services which they were used to. Through collaboration, some commercial ISPs support ZAMREN by offering discounted rates for lease of metro fibre circuits, for example CEC-Liquid, HAI and SmartNet.

Prior to the procurement of the regional circuit under UbuntuNet Alliance, from Lusaka to Johannesburg, CEC-Liquid leased capacity to ZAMREN on concessionary rates.

The map below depicts existing and planned fibre infrastructure layout in Zambia

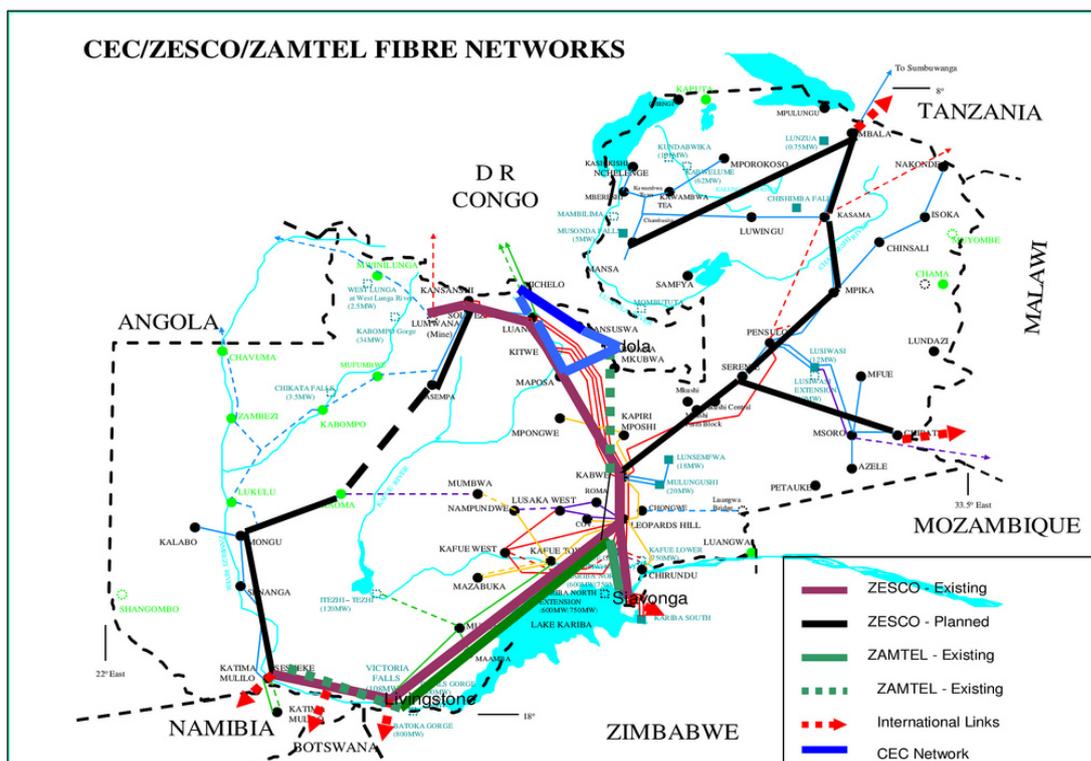


Figure 1. CEC/ZESCO/ZAMTEL Fibre Networks

4.7 Being part of the Regional Network, UbuntuNet Alliance

ZAMREN joined the UbuntuNet Alliance (UA) as part of regional and international collaboration. The Alliance exists to provide regional and international connectivity and Internet services to its member NRENs in Eastern and Southern Africa (“the Region”), on a non-profit basis. The Alliance provides specialized interconnections with other research and education networks worldwide – interconnections that are available only to bona-fide NRENs – and also connectivity to the general “commodity” Internet worldwide. The cost of Global

Transit Services for a land-locked country in Africa is a major factor in the pricing of Internet based services. Therefore being part of UA, which has been able to procure big volume of international transit at a reduced cost for the region has had a tremendous impact on ZAMREN operations.

5. FINANCIAL MODEL

The ZAMREN Business model is designed on a not-for-profit principle, that is, the costing of services is designed solely to cover operating expenses. This model does allow for the organization to have surplus derived from its operations in order to support recapitalization. ZAMREN is allowed to retain up to 50% of its revenue operating as surplus. Major source of income is through provision of Bandwidth capacities to member institutions. A small percentage through provision of services such as web and e-mail hosting, DNS and backup services.

The Bar Chart below depicts the financial performance from 2013 to 2016.

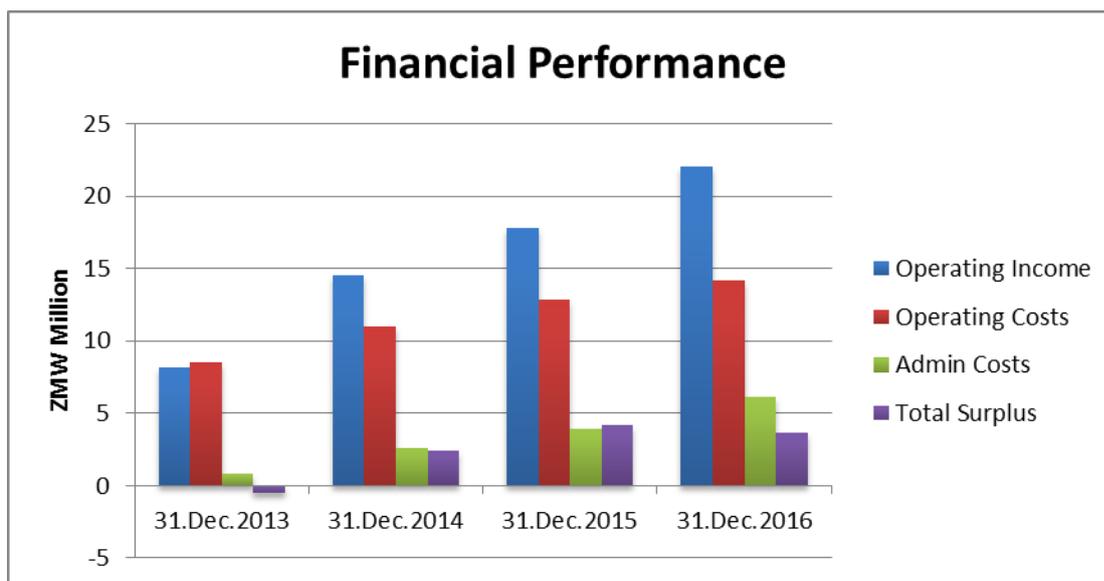


Figure 2. The financial performance from 2013 to 2016

6. ZAMREN GOVERNANCE MODEL

ZAMREN is a membership based organization. All registered education and research institutions as well as professional communities of practice that have research and education as anchor core business are eligible for membership. At the close of the year, the number of member institutions stood at 78. ZAMREN has three organizational levels:

Annual General Meeting:

The Annual General Meeting is the supreme decision making assembly. It comprises Institutional Heads of all ZAMREN Member Institutions. It elects members that seat on the ZAMREN Board from Institutional Heads of Member Institutions. Its role is to give strategic policy guidance that sustains Member Institution’s collective will to collaborate within Zambia.

ZAMREN Board

The Board constitutes the appointed and elective members. Appointed members are from the three founding universities (UNZA, CBU and MU), ZESCO, ZICTA, and CEO as Ex-Officio.

The Board supervises ZAMREN Management and provides policy guidance.

The tenure of office for the elective Board Members is two years with a maximum of two consecutive terms.

ZAMREN Committees of the Board

The Board appoints three committees to assist in ZAMREN operations namely Audit and Risk Committee, Technical Research and Education Committee and Finance and Administration Committee.

ZAMREN Administration

The team, consitute Full Time Employee (FTE), with the Chief Executive Officer as its head, the Chief Technical Officer in charge of Operations and Finance Officer in charge of financial affairs. The team manages the day-to-day administrative and operations functions of ZAMREN.

7. IMPACT

The introduction of ZAMREN has brought significant impact on research and education institutions in Zambia. Currently there are 78 research and education institutions that are members of ZAMREN. The impact of ZAMREN on higher education institutions include increased access to ICT services and products through bigger Bandwidth allocated to more education and research institutions.

The graphs below depict the growth in the number of connected institutions and ZAMREN’s Internet Traffic from member institutions.

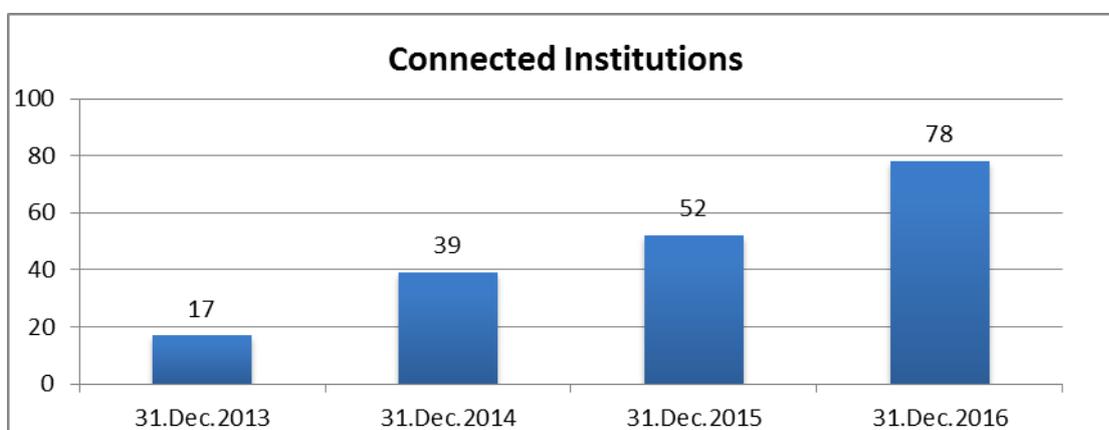


Figure 3. Conected Institutions

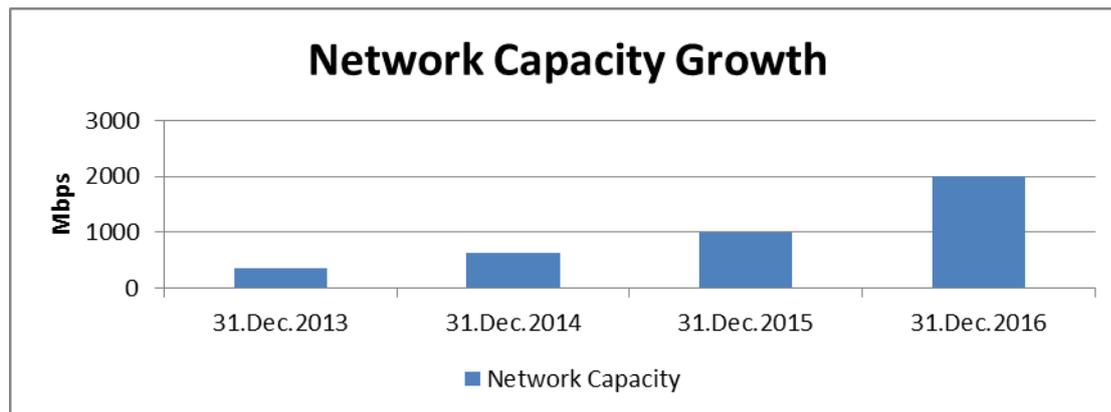


Figure 4. Network Capacity Growth

7.1 Cost Reduction

At the onset of operationalizing ZAMREN in July 2012, the total connectivity for universities and research institutes, in the country was less than 35Mbps. The amalgamated cost for this connectivity was above US\$160,000 per month.

The cost of bandwidth by commercial provider in 2012 when ZAMREN became operational ranged from US\$4,500 to US\$5,000 per 1Mbps per month. ZAMREN starting Bandwidth tariff was US\$900 per 1Mbps per month. At that time, this was considered to be a huge cost reduction compared to the commercial provider's tariffs.

Progressively ZAMREN has been reducing its tariffs on Bandwidth as it procured more capacity through UbuntuNet Alliance and as at December, 2016, ZAMREN tariffs were US\$140 per 1Mbps [4].

Through the process, ZAMREN has been a game-changer in reducing the cost of Bandwidth in the country. Commercial providers have followed the trend set by ZAMREN and respectively reduced their tariff which as at December 2016, ranged between US\$200 to US\$400 per 1Mbps per month. Inasmuch as the cost the cost of Bandwidth significantly dropped, it is still very high compared to what is obtaining in Europe and is considered by member institution as being a significant budget line item on operating costs.

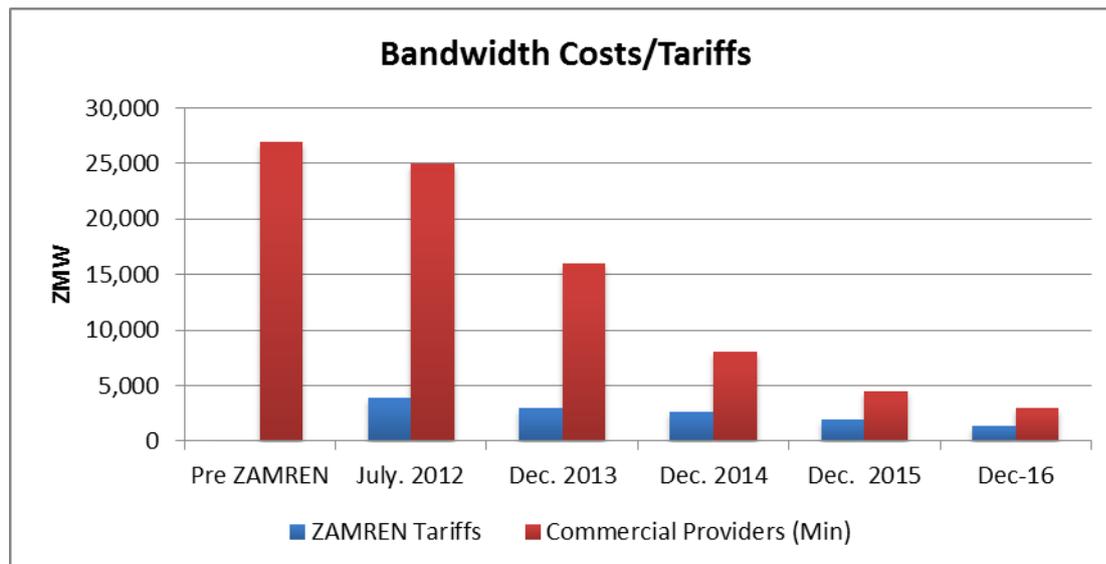


Figure 5. Bandwith Costs/Tariffs

The low cost of Bandwidth has been a major attraction for member institution to get connectivity services from ZAMREN, however as depicted above, the commercial providers have been also lowering their tariffs and the difference between ZAMREN and Commercial tariffs, though significant is no longer staggering.

7.2 Ability to access and share education resources

The introduction of ZAMREN has enabled higher education institutions to access and share education resources, for example through Zambia Library Consortium (ZALICO) the three public universities are able to access Elsevier publications far much more efficiently through the ZAMREN network that before.

7.3 Increased research collaboration within Zambia

ZAMREN has promoted collaboration among higher education institutions in Zambia. For example, the three public universities have started to undertake joint research and are using the ZAMREN network to collaborate. The three public university with the local IEEE representatives are planning to host jointly an international conference on ICT in September 2017 and are using the ZAMREN network to conduct planning meetings through video conferencing.

7.4 Increased ICT Skills

In Zambia most research and educational institutions did not have highly qualified technical staff to support and manage ICT services and products. This is due mainly to budget constraints, and in some cases institutional policies, where there are no full time staff establishments for ICT operations. ZAMREN undertakes various technical capacity building programmes to ensure effective service delivery and management of ICTs in member institutions. These programmes have been supported through, the Nuffic Project, AfricaConnect2 (through UbuntuNet Alliance), Network Startup Resource Centre (NSRC) and International Network for the Availability of Scientific Publications (INASP).

ZAMREN has contributed to improving ICT skills uptake in the country through its technical capacity building programmes.

7.5 Ability to undertake Big Data research

ZAMREN has been providing special value added services rather traditional services such as webhosting that commercial ISP provide. For example ZAMREN provides eduroam to its members. This service provides connectivity to Internet based services wherever the service was deployed within the country and outside the country at no cost to the user of the network [6]. This service distinguishes ZAMREN from other ISPs. Other services that ZAMREN has been providing is capacity building through trainings and technical support to its member institutions at shared cost.

ZAMREN is offering Cloud Computing (CC) and High Performance Computing (HPC). ZAMREN is helping facilitate use of Big Data research and Internet of Things as educational institutions are able to download and upload data at high speeds.

7.6 Universities able to provide better services

ZAMREN has facilitated universities to provide better services to their staff and students. For example, most of the Universities have introduced on-line student management systems and learning management system such as moodle. Universities are now able to provide better services to Open Distance Learning (ODL) students because of the ZAMREN network.

8. CONCLUSION

The introduction of an NREN in Zambia has had a positive impact on higher learning institutions by lowering cost of bandwidth, provision of value added services and increase research collaboration among the Universities locally and regional level. The launching of ZAMREN has been a game changer for internet tariffs and provision of ICT services and products in Zambia.

References

- [1] Bingimlas K., Barriers to the successful integration of ICT in teaching and learning environments: a review of the literature, *Eurasia Journal of Mathematics, Science & Technology Education*, 5 (3), (2009), 235–245
- [2] Dionys D., Introduction of ICT and multimedia into Cambodia's teacher training centres, *Australasian Journal of Educational Technology*, 28 (6), (2012), 1068–1073.
- [3] Dyre J., The Case for National and Research Education Networks, TERENA, (2009)
- [4] Khunga B. and Kunda D, Research and Education Networks: putting values into links, Proceedings and reports of the 8th UbuntuNet Alliance annual conference, Maputo, Mozambique, (2015).
- [5] Kunda D., Implementing National Research and Education Networks (NRENs) in Land Locked African Countries: Critical Success Factors, Proceedings of TERENA TNC15 Conference, Porto, Portugal, (2015).
- [6] Mkandawire, S., Survival of National Research and Education Networks (NRENs) in a competitive market of Africa: A Case Study of the Zambia Research and Education Network (ZAMREN), Proceedings and reports of the 6th UbuntuNet Alliance Annual Conference, (2013), 185-192,

- [7] Khunga B., NREN and Telecom Companies Synergies: A Case of ZAMREN, Proceedings of IST-Africa Conference-2016, Durban, South Africa, (2016).