

**Report of the Conference on African Research and Education Network
Infrastructure**

Held in Tunis, November 14 and 15, 2005

Convened by the African Association of Universities (AAU)

**Financed by the International Development Research Centre (IDRC) in the
context of its PAREN Program: Promoting African Research and Education
Networking**

**Sponsored by IDRC, the Partnership for Higher Education in Africa, OSISA,
SIDA and the World Bank Institute**

Executive Summary

The Conference on African Research and Education Network Infrastructure convened by the Association of African Universities and supported by IDRC, the Partnership for Higher Education and other sponsors, is part of a process aimed at linking African scientists, academics and students to their peers by building and connecting research and education networks in the region.

This report gives a brief summary of the issues and the processes leading up to the Conference, summarises the proceedings and concludes with the road map towards increased research and education networking developed by participants prior to and during the Conference.

The Conference addressed the issue of network infrastructure at four levels – campus, national, regional and Pan-African. It identified actions to be taken at all levels to overcome the high costs of connectivity, shortages of skilled staff and overall lack of infrastructure and to stimulate the development and interconnection of national and regional R&E networks.

The establishment of bandwidth consortia able to drive prices down through economies of scale was identified as a key strategy at national and regional levels. Another promising approach involves mapping existing fibre networks and working collectively on ways to open them up for research and education applications.

Africa-wide approaches are needed to promote information exchange and learning, to advocate in favour of policies aimed at open access and lower costs and to encourage more coordinated and sustainable funding strategies.

AAU as the representative body in Africa for universities was identified as the appropriate organisation to take on the regional role if it could be reinforced with additional staff and skills. IDRC and the Partnership for Higher Education in Africa will consider supporting AAU as it takes up the challenge of research and education networking.

IDRC also indicated willingness to support the implementation of an African universities network operators stream within the regular training sessions provided by AFNOG, the African Network Operators Group.

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Chapter 1 Conference Background

1.1 The Issue

In African universities life is being squeezed from research and higher education by the high cost of bandwidth which inhibits communication and collaboration.

More bandwidth is needed in tertiary institutions in Africa to expand research collaboration regionally and globally, provide access to the wealth of scholarly information available online and facilitate African contributions to global research on important issues of the day. It would encourage skilled educators and researchers to stay and work in their own countries – or return to them. It would increase the chances for the development of African solutions to African development problems.

There are a number of reasons why bandwidth is orders of magnitude more expensive in Africa than elsewhere.

Fibre optic cable which provides a cheaper option than satellite is scarce in Africa. Where it is available costs are kept high by monopolistic ownership structures whose main goals are commercial rather than developmental.

More expensive satellite seems therefore often to be the only option. While the bandwidth consortium supported by the Partnership for Higher Education in Africa has established that universities can drive prices down by acting together the costs are still much higher than elsewhere. While economies of scale can be found through collaborative action there is also a need for regulators to promote open access and lower cost models as well as to acknowledge the contribution universities make to national development through special licensing arrangements that provide bandwidth at concessionary prices.

A number of events in 2005, in Africa, Europe and North America, have explored different approaches and strategies for linking African universities, among themselves and to global academic and research networks, and bringing down the costs of bandwidth.

1.2 The Process

Cape Town, January 2005: the Association of African Universities (AAU), at its Annual General Meeting, resolved that bandwidth was a priority issue and was mandated to set up a Working Group to examine how it could best support bandwidth needs for research and education networking in Africa. The World Bank/AVU African Tertiary Institution Connectivity Survey (ATICS) and the initial IDRC PAREN report were also both launched at the event.

Washington, DC, May 2005: the Internet2 brought together a group of donors and technical specialists promoting African networking mainly from outside the continent.

Maputo, May 2005: the Open Access Conference reviewed the results of two IDRC-funded studies describing African initiatives in research and education networking and donor and related investment in university connectivity.

Philadelphia, September 2005: Internet2 convened a 1 day session of African networking specialists at its fall meeting to consider Progress and Challenges in Building National Research and Education Networks in Africa: A View from the Field.

Geneva, September 2005: CERN, ITU and UNU convened an International Workshop on African Research and Education Networking with more European representation aimed at facilitating scientific and medical collaboration.

Through this series of events over 9 months in 2005 many African, North American and European scientists, academics and development specialists have discussed ways to expand the bandwidth resources available to African universities.

The AAU-convened and IDRC-supported Conference on African Research and Network Infrastructure reported on here was intended to build on the results of earlier events and shape them into an action plan to be implemented under African leadership.

1.3 The Conference

The Conference had three objectives:

- To promote a more integrated approach among international partners supporting national research and education networking in Africa through the development of a regional road map focused on improving connectivity for African tertiary education and research institutions;
- To provide an opportunity for knowledge sharing; and
- To help identify and catalyse new initiatives.

Expected outcomes were:

- a coherent and catalytic AAU ICT program targeted at exploiting promising opportunities to advance networking at campus, national, regional and continental levels; and
- commitment of key players to partnerships in support of access to increased bandwidth for education, research and outreach within the region.

The program was structured around panel presentations and plenary discussion on initiatives at four levels: campus, national, regional and continental. Panels were followed by working groups to consolidate findings and recommendations and their integration into a road map identifying the direction of future actions. In the final session, international partners were invited to respond to the road map.

Over 100 participants attended the Conference. More than half of the participants were from African institutions, mainly universities or organisations working closely with them.

Chapter 2 Conference Discussions and Outcomes

2.1 Opening session

Steve Song, Director of the Connectivity Africa and Acacia programs in IDRC and Akilagpa Sawyerr, Secretary-General of AAU opened the Conference. The Keynote speech was delivered by Venancio Massingue, Minister of Science and Technology, Mozambique.

African universities championed the Internet in Africa in the late 80s and early 90s....

Steve Song's comments drew attention to the historic role of African universities in introducing Internet to the continent. In the late 1980s and early 1990s the Internet in Africa was born in universities; the energy and skill of a few champions in Zambia, Mozambique, Senegal and Uganda, to name just a few countries, led to experimentation with e-mail systems to satisfy a pent-up demand for communications. Donors like IDRC and stakeholders like the Economic Commission for Africa recognized the importance of these initiatives in the context of research and education in the region and began to develop programs of support. As the Internet spread globally and penetrated deeper into societies everywhere content providers developed services to take advantage of its reach. INASP, eIFL, HINARI and AGORA are four examples of international programs that facilitate online access by developing countries to the best global, scientific literature. By the late 90s it had become clear that while there had been a huge increase in the availability of information there had been very little increase in the bandwidth available to deliver it to users in Africa. African universities were being starved of information by the scarcity and high cost of the bandwidth needed to link their campuses to international networks.

There were many reasons for the bandwidth problem including the lack of regulatory dispensation for academic institutions, the ownership structure of the fibre networks being put in place around the continent, the limited penetration of terrestrial networks outside metropolitan areas and the high cost of satellite access.

Collaborative initiatives are now emerging among universities that use their collective weight to negotiate reduced bandwidth costs and there is a growing interest within the academic community as a whole to tackle the bandwidth issue.

This interest was manifested concretely at the January 2005 annual general meeting of the AAU which set up a working group to identify the role it could play in helping its university members access more bandwidth. AAU is the most representative body of African universities and is therefore a logical partner for donors supporting bandwidth initiatives and encouraging universities to once again take up the challenge of making the Internet work for Africa.

African universities have a special role to play in African development...

Professor Sawyerr highlighted the special role that universities play in African development. It is only by empowering Africa's knowledge institutions through access to communications and information that they will be able to produce leaders to define and implement African development policies and strategies. Access to bandwidth is important as the means to support African research which

contributes to the broader development agenda. It is not access itself which is important but the uses to which it is put.

Many organisations are working to improve access within the African university community – research institutions and the universities themselves, governments, donors and other international partners. There are clear benefits to be gained by a more cooperative approach. AAU, which is the main instrument for collaboration among African universities, is well placed to bring institutions together and to serve as a focal point and clearinghouse to help identify emerging activities in need of support and to promote the sharing of knowledge and experience.

This should be a Conference with a difference. It should move beyond discussion of the problems and challenges to outline a plan of action and the processes for delivering it. Participants include policy makers and practitioners. Together they must provide the broad lines of action which will allow for forward movement in the battle for increased connectivity in Africa's universities.

The Internet has become the main tool of collaboration through which researchers and educators in African universities can engage with their peers in industry and government, forge global relationships while remaining in their own countries and contribute an African perspective to global science...

The keynote address by Minister Massingue placed the bandwidth issue within the broader context of African higher education, science and technology and development policy.

African university networks – on campuses and at national, regional, and continental levels – are a necessary precondition for quality education and research, science and technology and thus for the identification of made-in-Africa solutions to Africa's development challenges.

Education and research must be integrated within the broader context of African development. Scientists need to break out of the confines of their own work to engage with their peers in other sectors. They need to collaborate with industry as well as with government.

But collaboration is difficult without access to information and communication facilities, The Internet has become the main tool for collaboration. When it is not available and researchers are unable to share ideas and work jointly with colleagues elsewhere they are likely to migrate from the south to the north. They become part of the brain drain and the investment made in their education pays little return to the country in which it was made. Africa needs leaders who are aware of the local as well as the global aspects of the challenges facing them. The world needs access to African knowledge of problems of global import - malaria and deforestation are two examples.

The digital divide is seen in its most extreme form in the research and education community in Africa. In today's world, fostering exchanges of knowledge and experience across regions in the interests of all requires that African universities be better able to access and use the Internet. This is an issue of increasing concern to African Ministers of Science and Technology working together at the continental level through the African Union and NEPAD and sub regionally through organisations like SADC.

2.2 Panel discussions and breakout groups

Panel 1: Campus level networks

Panel 1: Building campus level capacity and infrastructure

Chair: Isatou Secka Jah, MRC Labs Jahara, Gambia

Rapporteur: Americo Muchanga, CIUEM, Mozambique

Panelists:

Bob Hawkins, WBI: ATICS – Lessons for the future of campus networks in Africa

Albert Nsengiyumva, National University Rwanda: NUR network from the perspective of NREN development in Rwanda

Ibrahim Niang, UCAD, Dakar: Capacity and infrastructure requirements

Emmanuel Tonye, Cameroon University Network: Challenges in building the Cameroon University Network

Martin Belcher, INASP: Bandwidth Management Optimisation

The African Tertiary Institutions Connectivity Survey

This panel opened with an overview of the state of connectivity in African universities based on the Africa Tertiary Institutions Connectivity Survey (ATICS) carried out by the African Virtual University in 2004. This study established that most African universities have access to the same amount of bandwidth as the average household in North America but at a much higher cost (on average \$5.46 per kilobyte). By collaborating within consortia and knowing what to demand, universities have a better chance of accessing better quality bandwidth at a lower cost but in only a few countries are universities collaborating within national research and education networks - and where these NRENs do exist few universities are connected to them.

The challenges facing universities in Rwanda, Senegal and Cameroon were then presented along with the strategies developed to address them.

National University of Rwanda

Major challenges at NUR include inadequate infrastructure and facilities for students, shortage of human resources, poor quality of education, limited research and administrative capacity and inadequate funding.

The ICT policy calls for ICT infrastructure development, the design of an instructional technology platform, research on ICT and ICT extension programs (for example for GIS).

Capacity to implement the policy is constrained by power shortages, problems of staff retention, the high cost of internet connectivity, the low level of ICT use both within the curriculum and for teaching,

Ways to move forward include participating in a consortium to negotiate bandwidth, training both technical and teaching staff and putting in place a Steering Committee to address ICT issues within the university.

University Cheikh Anta Diop, Senegal

UCAD's network was built in 2000 with WBI funding. It uses 6 km of fibre, running at 200Mbps with 2 Mbps for Internet access. The network was designed for 300 PCs and now has 3000 connected. Total bandwidth is saturated and the infrastructure is not appropriate for new applications like video-conferencing, VOIP and remote training.

UCAD is not in a position to respond to projects being promoted by government to provide students and professors with one PC each.

The network needs to be redesigned to address the shortcomings of the current backbone. NREN development could bring benefits through resource optimization and the sharing of research results but it is important to get good connectivity in place at the campus level first.

Inter-University Network in Cameroon

The purpose of the Inter-University Network in Cameroon is to improve the quality of education in each of the participating universities and expand their capacity to deliver programs. Implementation in each university is guided by a master plan with five chapters:

- building ICT infrastructure
- implementing technologies for open and distance learning
- publication and dissemination of scientific and technological knowledge and information
- research and development
- decision support systems.

The 7 universities making up the network (6 state and 1 private) are presently linked by satellite. The centre of the network is in the University of Yaounde.

Main challenges are high Internet costs and the inadequacy of the ICT infrastructure to support distance learning.

The challenges could be met through national and regional collaboration to reduce satellites costs, the use of wireless technologies and regional training programs.

INASP

The final presentation described the bandwidth management approach and training tools developed by INASP; the ATICS study identified bandwidth management as the easiest way to improve the quantity and quality of bandwidth available for educational purposes. Bandwidth management involves:

- the monitoring and management of available resources; and
- the optimization of resources to ensure value for money and fitness of purpose.

To be successful bandwidth management strategies need the support of executive management within the university, implementation management at a senior level and day-to-day technical support. NRENs are ideally placed to lead the drive for more effective bandwidth management.

In general access to the Internet is limited and the cost is high; satellite is the main access technology. Fibre is being used in the core campus networks but the networks are not always dimensioned to cater for bandwidth intensive applications such as video-conferencing, tele-learning and VOIP. All universities faced the problem of retaining trained staff in the face of market demand.

Strategies were identified to address the main challenges.

Strategies to address human resource issues:

- involve students in network management and trouble shooting and give them a leadership role;
- develop continuous training programs that incorporate both work and study programs;
- train users so that they can service themselves to the extent possible;
- establish and nurture communities of practice;
- provide incentives to retain skilled staff.

Strategies to address infrastructure issues:

- focus on infrastructure for local network access as the main connectivity building block;
- build understanding of fibre versus wireless implications for campus networking;
- address the issue of power shortages;
- establish communities of practice to share expertise and knowledge about local area network development and share the lessons learned among universities.

Strategies to address the bandwidth issue:

- form bandwidth consortia;
- form NRENs to share bandwidth and other resources (eg libraries);
- deploy bandwidth management to increase the amount of campus traffic that is dedicated to education and research purposes;
- bring the bandwidth issue to the attention of senior university leadership.

Panel 2: National Research and Education Networks

Panel 2: Exploiting the potential of National Research and Education Networks in Africa

Chair: Duncan Martin, TENET, South Africa

Rapporteur: Aouaouche El-Maouhab, CERIST, Algeria

Panelists:

Margaret Ngwira, MALICO, Malawi: The logic of library-driven NRENs

Victor Kyalo, KENET: Forming an NREN in Kenya

Aminu Ibrahim, Ahmedu Bello University: Networking steps in Nigeria

Ahmedou Ould Haouba, NIC, Mauritania: Towards an NREN in Mauritania

Enrique Pelaez, CEDIA, Ecuador: Comments from an Ecuadorean NREN Perspective

This panel illustrated four different African approaches to NREN development; a presentation from Ecuador demonstrated the benefits of moving quickly to implement national research and education networks.

Malawi

The first example was of an incipient NREN in Malawi driven by a consortium of libraries which recognized early the importance of bandwidth to the delivery of information service. Many of the reasons why bandwidth was a vital tool for universities are linked to libraries. By 2002 the University of Malawi library community had sourced excellent e-content through INASP and eIFL and had set up vigorous e-content training programs for faculty, students and researchers; the University was considering developing its own digital repositories and had established an on-line public access catalogue (OPAC). But all these initiatives were limited by the bandwidth bottleneck. MALICO (the Malawi library and information consortium) was established to consolidate the purchasing power of libraries. To achieve its objectives it needed expanded access to bandwidth and had to rely on its own resources and initiative to get it. In the process it became, in effect, an incipient NREN promoting the bandwidth needs of the dispersed campuses of the University, procuring VSATs, negotiating with the regulator and servicing the academic community. MALICO is now assisting with the development of MAREN – the Malawi Academic and Research Network; while it is looking forward to handing over the bandwidth responsibility to the ICT sector it will become an active member of MAREN.

Kenya

The second example, KENET, is one of the more established NRENs in sub-Saharan Africa. KENET's goal is to establish communication and networking among educational and research institutions in Kenya to facilitate wide use of ICTs in teaching, learning, research and sharing of other information resources by the general public at an affordable cost. It established a fully functional institutional framework in 2001 and now has 51 member institutions in four clusters in different regions of the country. All universities in Kenya – both public and private – have been connected since 2003. It is currently working on its 3rd generation network architecture to allow for connectivity scaling and efficient delivery of content. The network has piloted a collaboration model to deliver content for shared teaching between faculties of member institutions; it has trained over 55 technical support staff in member institutions in routing technology, systems administration and network management and trained some faculty members in e-learning systems. KENET operates in partnership with its member universities and research institutes which provide leadership to its research and development section and with the Government of Kenya, the regulator, the telcom provider, the Kenya Internet exchange point and Kenya data network. International partners include the Partnership for Higher Education in Africa, Tufts University, USAID and NSRC at the University of Oregon.

Nigeria

Between 1992 and 2004 there have been more than a dozen projects to create NRENs in Nigeria. Most of these projects resulted in positive feasibility studies and were based on stakeholder inputs. They did not however result in the establishment of a Nigerian research and education network.

What went wrong?

- The focus was on NREN creation rather than evolution;
- The process was not organic and project schedules were not sufficiently thought through;
- There was too much emphasis on money, equipment and buildings and not enough on human capacity and social engineering;

- Training was mainly for technicians and not for users or professional staff;
- Ownership was equated with control and resulted in territoriality and turf wars.

These failures have eroded confidence in NREN processes which the Nigerian Forum of Partnership Organisations is now attempting to overcome.

The Forum is a not-for-profit NGO conceived in September 2004. It is the first collaborative project to be wholly initiated and owned directly by Nigerian higher education institutions in more than 30 years. The Forum has 6 member universities and will serve as a platform from which to nurture the growth of an NREN; its secretariat has one full time project officer. Its objectives focus on the sharing of resources and skills and joint programs. It is a grantee of the Carnegie and MacArthur Foundations and has incorporated both international and Nigerian advisory groups. The Forum will move forward through partnerships and synergies that respond to NREN requirements.

Mauritania

At the moment Mauritania has three separate Internet connections via satellite with France, Morocco and Germany. By the end of 2005 these connections will have been replaced by a MAURITEL link of 50 megabytes through the Sat3 landing point in Senegal. MAURITEL is the only Internet access provider in the country – the University of Nouakchott has negotiated a 50% reduction in access costs from MAURITEL.

The Science and Technology Faculty of the University manages the Mauritania top level .mr domain. It is working towards the goal of a national education network by linking other institutions to its Internet node – 10 institutions have been linked to-date. It provides a distance education platform in cooperation with AVU and Laval University. With international partners it is providing training in network administration and content development. The University is interested in seeking partnerships to reduce the costs of Internet access and access to scientific content.

Ecuador

CEDIA, the research and education network in Ecuador, is young but has some impressive achievements. First discussions were held with both national and international partners in March 2002. CEDIA was officially created by the country's President in September 2002 with a membership of 7 Universities, 2 Research Institutions and 2 Government Agencies. Agreements with Internet2 and CLARA were signed shortly afterwards and CEDIA also started negotiation with Transelectric to get access to the country's fibre optic network. A first version of the network was deployed in March 2004 – its fibre national network will start operation in 2006.

CEDIA's mission is to: promote and coordinate the development of advance research networks focus in academic, scientific and technology development and innovation of Ecuador. By August 2005 it had 24 members throughout the country and was connected to the CLARA network through the Pan-American cable.

Through a joint national tender CEDIA has achieved an average reduction of 69% in bandwidth costs. It is providing training in advanced networks, administration, security, operations and applications. It

is identifying interest groups to work on applications development. Considerable progress has been made in a short period of time.

Discussions focused on actions to promote NRENs nationally and implement them effectively.

Strategies to promote NREN development:

- Get NREN issues onto the agendas of the regulator and the national ICT policy body;
- Get NRENs onto the agendas of national science and technology and higher education bodies;
- Build a database on fibre resources and keep it up-to-date;
- Develop a consortium to negotiate for bandwidth;
- Develop a financial plan and business model leading to sustainability;
- Identify criteria for membership;
- Develop a strategy for accessing and sharing content among network members;
- Develop a joint strategy for human capacity development;
- Participate in regional initiatives;
- Develop good relations with donors.

Panel 3: Overcoming Constraints to multi-country collaboration

Panel 3: Overcoming Constraints to multi-country collaboration – geographic and interest-based networks

Chair: John Dyer, TERENA

Rapporteur: Ben McGarry, SARUA

Panelists:

Sandra Aluoch, AVU: The bandwidth consortium – what next?

Bjorn Pehrson, KTH, Sweden: SARUA: Results of and lessons from the fibre study in Southern Africa

Doug Hull, Connectivity Partners Int'l: Results of and lessons from the fibre study in North Africa

David West, Dante: EUMEDConnect – a stimulus to the development of NRENs in North Africa

African Virtual University

AVU was requested by the Partnership for Higher Education in Africa to survey the needs of its partner universities in Ghana, Nigeria, Kenya, Uganda, Tanzania and Mozambique. Among other things the survey revealed that VSAT was the viable solution in the short to medium term, that significant costs reduction could be realized when full transponder loading was achieved and that longer term commitments can reduce costs. It also revealed that African universities have a poor payment record and providers therefore require large guarantees and that regulatory issues hamper VSAT licensing.

Following the study, the Partnership asked AVU to act as the sole agent for bandwidth negotiation for the universities it supported. AVU prepared a tender which resulted in a winning bid by Intelsat for 93 MB at \$2.40 – delivered through two satellites. The contract was signed and became effective on November 1, 2005.

AVU is committed to consolidating existing networks to benefit from economies of scale. It will provide bandwidth not only to Partnership supported universities but also to members of its own network and institutions in the orbit of the African Development Bank. Partnership universities are committed to 51 MB.

AVU will encourage growth of education networking within the region:

- from a technological perspective through the development of campus and regional networks, technical training, bandwidth management and equipment procurement consortium; and
- from a human perspective by promoting the sharing of knowledge and research, addressing policy and advocacy issues and establishing for a for discussion among partners.

The SARUA Fibre Study

The SARUA fibre study seeks ways of providing broadband Internet access to African universities through optical fibre initially in Malawi, Mozambique, Kenya, Rwanda, Tanzania and Zambia. While VSAT will be required in the foreseeable future the study seeks to establish a parallel track that would identify and exploit existing fibre infrastructure. Through this approach the study hopes to foster a significant increase in bandwidth available to African universities, the spread of NRENs within Southern and East Africa and a regional backbone.

The study is supported by IDRC and the World Bank Institute and one of its outputs is a fibre database identifying existing resources. Fibre does exist and more is being rolled out constantly through power grids, pipelines and transport networks. Policy and regulation may get in the way of its use, it may be expensive and suitable business models may be lacking but these are all problems that can be addressed with political will.

Because it is a horizontal infrastructure fibre is well suited to support the sharing of resources (caching servers, super computers, the national grid) and access costs that are key components and benefits of NRENs. A regional fibre backbone can facilitate Internet access procurement by a consortium of all NRENs and both trans-border and global academic peering.

Universities in countries covered by the study have come together within the Ubuntunet Alliance in order to consolidate their resources to develop a regional network drawing on existing and planned fibre networks.

Pan Arab University Research and Education Network (PAN)

The Pan Arab Network is the result of a feasibility study undertaken by a Canadian consulting company and championed by the Government of Jordan.

The concept describes an:

- Integrated, dedicated broadband network linking Arab universities in 22 countries;
- Modeled on Jordan's University Broadband Network;
- Under collaborative Arab university management;
- Accessing and leveraging existing and interconnected power grid dark fibre;
- with eventual links to hundreds of Arab research and education institutions; and
- with initial sites located at universities currently serving as network hubs.

There is strong support for the concept as an Arab League initiative and no major regulatory obstacles if PAN is structured as a private network; the main technical issue is the 1100 km fibre gap through Libya.

There are three main challenges to implementation:

- Structuring an implementation consensus that includes all 22 Arab states;
- Raising resources estimated at between \$33 and \$42 million, creating a formula for sharing costs and identifying private sector partners;
- Engaging the user community and identifying content and applications.

There are synergies between PAN and EUMEDConnect which is a supporter of the concept.

EUMEDConnect

Building Geant2, the 7th generation European research and education network infrastructure, is a four year project (2004 – 2008) with a cost of 200 million euros. Project partners are 30 of Europe's NRENs, Dante and TERENA. The network connects 34 countries, over 3500 research institutes and 30 million users to partners all over the globe.

EUMEDCONNECT links Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Palestinian Authority, Syria, Tunisia and Turkey to Geant2. 80% of the 10 million cost of EUMEDCONNECT is funded by the EC – 20% by beneficiaries.

The increased connectivity provided to the 4 North African countries through EUMEDCONNECT has enabled the connection of major project sites to be shifted from commercial Internet providers, the hosting of project databases in the connected countries, GRID computing, bandwidth intensive real time applications (tele-medicine, video-conferencing) and the introduction of IPv6. It has also served as a stimulus to the development of NRENs in North Africa and their linkage with European partners.

Within countries, the North African NRENs provide connectivity between users and EUMEDCONNECT, they take full responsibility for funding, building and operating the national network, they represent national requirements within EUMED decision-making bodies and they promote the network concept to national partners. EUMEDCONNECT has stimulated the development of national networks by:

- Providing users with an international connectivity opportunity;
- Creating a forum for best practise and friendly competition between NRENs;
- Enhancing the external visibility of NREN performance; and
- Helping justify internal business cases for NREN development

Participants considered that both national and continent-wide bodies had a role to play in stimulating regional networking.

Strategies to promote regional networks:

- As a prerequisite to stimulate multi-country collaboration:
 - Build local and regional consensus
 - Establish political leadership

- Work towards policy and regulatory harmonization
- Seek both donor incentive funding and funding from national governments
- Encourage AAU to develop or support regional associations of universities as a vehicle to promote national and regional research and education networking
- Encourage AAU to make use of its political weight within the region and globally to advocate for and promote the role of both national and regional education and research networks.

Panel 4: Pan-African options

Panel 4: Pan-African options – capturing synergies among different initiatives

Chair: Lishan Adam

Rapporteur: Mike Jensen

Panelists:

Mavis Ampah, WB/GICT: The prospects for terrestrial fibre networks in Africa

Don Riley, IEEAF: The NSF Study: links between the West Coast of Africa and the US

Harald Holt, UNU/GVUGRID-Arendal: AFUNet: Global Connectivity for the African R&E Community

F. F. Tusubira, Makerere University: AAU: Strategic framework and road map: a proposal

Harry de Backer, Union European: Accessing EU support for university networking in Africa¹

NSF/IEEAF Study of feasibility of high speed links to West Africa

In terms of connectivity, developing regions such as India and Africa are 5-10 years behind Europe, North America and some parts of Asia. This issue is not just about bandwidth but about enabling network activities that may not be commercially viable and building collaborative university communities.

NSF has funded IEEAF to carry out a feasibility study on options for NSF-funded links from the US to Africa to enable collaboration between US and African researchers. The IEEAF strategy involves partnerships between the R&E community and the private sector to build a global quilt of networks – it has already obtained 10 Gbps of donated capacity. It is targeting a proposal of US\$ 2 million annually for 5 years to connect with West Africa (Senegal and Ghana) and to expand the network both within these countries and regionally. It will extend the networks locally through a WiMax donation.

National partners have been identified and the IEEAF aims to leverage its international telecommunications knowledge, relationships with multinational operators, experience with public/private partnerships and its success in obtaining bandwidth donations to strengthen the case for NSF funding.

¹ Mr de Backer was unable to participate in the international partners panel on November 15 because of other obligations; his intervention was foreseen for that session and is reported on with other interventions there.

AFUNET

AFUNET is the working name for a proposal under development by UNU in collaboration with ITU and CERN. AFUNET is intended to support the growth of network infrastructure for the African research and education community. It will build on and supplement other initiatives.

Under present thinking, AFUNET would be a membership association made up of NRENs; its secretariat would be hosted by a Pan African organisation to be selected by members – AAU is one possibility. Funding would initially come from donors but in the long run external funding would be replaced by membership fees.

AFUNET would aim to interconnect networks at three levels: the continental level represented by AFUNET; the national level, represented by NRENs; and the campus level. It would also establish infrastructure, promote collaboration, support capacity building and promote joint educational programs.

The infrastructure strategy is to rely initially on satellite to quickly establish interconnectivity but to use fibre as it becomes available. Members would cooperate with PTOs and ISPs in developing infrastructure. The strategy would promote open market approaches.

The AFUNET study (www.gvu.unu.edu) will be circulated widely for discussion and comment.

The World Bank strategy

Access to telecommunications infrastructure in Africa is constrained by monopolistic business models which control access and prices. Exclusivity arrangements force non-owners to buy capacity from owners (national operators) at many times the price that the latter pay. Small consortium members pay many times the price of large members. The Bank is currently focusing on East Africa (Com-7, Comtel and EASSY) in an attempt to encourage non-discriminatory access, fair pricing, maximization of traffic development potential, fair financial return for investors and development impact for end users.

The Bank engages at all levels with intergovernmental organisations, governments, development partners and private operators; the NEPAD E-Commission is a particularly important interlocuteur in Africa. The Bank also works through its sister agency the IFC which funds detailed feasibility studies and advises on the structuring of commercial options. At the moment it is working with partners on a set of principles to support open infrastructure and non-discriminatory access in order to build awareness within governments of the benefits of open access models. It would rather promote lower costs for all than support preferential pricing for universities.

Negotiations are on-going on the funding of the EASSY consortium – it is unlikely that governments will commit the total amount (\$300 million for EASSY and \$100 million for backhaul to landlocked countries) and they will most likely seek funds from the WB and other multilateral lending institutions (DBSA, for example). The Bank may therefore be able to influence the consortium in the direction of open access – it has already made countries aware of the minimum terms for Bank involvement which

include open access. There appears to be a convergence on a common understanding of what is required.

The AAU strategic framework and roadmap for the bandwidth initiative

In the face of many different bandwidth initiatives in Africa there is a need for a regional cooperative mechanism that can filter proposals based on knowledge of ongoing programs and needs, catalyze initiatives, mobilize resources, initiate policy reform and promote the sharing of experiences.

With this in mind AAU has engaged African stakeholders in an attempt to identify the profile of the organisation that could take on the role of regional cooperation mechanism and champion the issue of bandwidth and ICT support for education and research networking. The stakeholder survey also sought input on the scope and priorities of regional collaboration.

Priorities include not only national and regional education and research networking but also a host of other ICT issues starting with ICT policy and planning.

The ideal champion would:

- Have a continental position and mandate;
- Have international higher education experience and a track record of leadership within the African academic environment;
- Have experience and credibility as a facilitator of stakeholder processes;
- Be a credible and trusted partner.

The AAU meets some of these requirements (continental positioning, mandate, credibility as THE representative body for universities in the region, committed leadership) but at present it lacks the human and financial resources to take advantage of the opportunities inherent in increased awareness of the importance of national and regional research and education networking and to face the challenges of developing a truly Africa-wide program. There are indications that resources might be forthcoming from the donor community to build AAU capacity to address networking issues through strategic planning, capacity building, the exchange of ICT expertise and the development of a knowledge management system on research and education networking aimed at all its members.

Strategies to promote continent-wide networking:

- Information exchange and learning
 - Develop and maintain a current web site on all activities and actors
 - Synthesize information and identify gaps and needs
 - Develop outreach programs to engage stakeholders not yet involved – for example the Working Group on Higher Education and ADEA
 - Organise annual or more frequent stakeholders meetings to continue information sharing
- Policy reform: awareness raising and lobbying activities to push agenda of open access and low cost bandwidth
 - AAU to develop continent-wide lobbying strategies
 - Regional networks to develop regional lobbying strategies
 - Where no RRENs exist AAU to lobby for their formation

- NRENs to develop national lobbying strategies
- Capacity building directed at all levels: tool kits, information sheets or briefing notes, information sharing, training workshops
- Fund raising
 - Develop a concrete business plan responding to clearly identified needs and with sustainability strategy built in;
 - Hold a donor forum involving all stakeholders including local and national stakeholders;
 - Build understanding of the processes of different donors – for example EU and JICA funds must be channeled through governments or regional governmental organisations (eg AU, ECOWAS).
- Designate AAU to facilitate these activities
- Engage support to build a small team within AAU with appropriate skills and experience

2.3 The response of international partners

The Chairman, Prof. Silas Lwakabamba, introduced the panel of nine representatives of development and international organizations and invited them to give their views on the processes leading up to the Conference and the activities presented during the previous sessions; he invited them to indicate where they saw African Research and Education initiatives going and what the next steps should be following the Conference.

John Butler Adam, Partnership for Higher Education in Africa

The Partnership is not primarily interested in bandwidth but in broader programs of support to higher education in Africa. It became engaged in bandwidth at the request of universities in the region who found the high cost of bandwidth an impediment to the implementation of effective research and teaching programs; it responded by supporting the bandwidth Consortium currently managed by AVU. Its current program focuses on the establishment of national research and education networks (in Kenya, Mozambique and Nigeria) and on efforts aimed at improving bandwidth management among the partnership supported universities in 7 countries through the South African TENET.

In closing, the Partnership representative:

- Affirmed the Partnership support of the processes and outcomes of the Conference;
- Reiterated the Partnership's belief in working with all stakeholders and its desire to establish a way to work with all stakeholders to pool the benefits;
- Encouraged all stakeholders to work together.

Bob Hawkins, World Bank Institute

Following the increased debate on African research and education networking over the past year the time is ripe to pool experience into a coherent and focused plan of action. A regional body such as the AAU could play an important role in this regard. Mr. Hawkins encouraged all stakeholders to continue with established processes of transparency and experience and information sharing which could considerable benefit the development of NRENs.

The World Bank works mostly at the country level and responds to requests from national bodies, often governments. Mr. Hawkins agreed to raise the African research and education network issue with his colleagues working on higher education programs with universities and ministries of higher education.

Regionally the WBI supports ongoing efforts to identify bandwidth demand and usage as well as available fibre resources.

In May 2006 the Bank will host a meeting in South Africa on the knowledge economy which would provide a good venue for a review of progress made on networking following this conference.

Thierry Amoussougbo, Economic Commission for Africa (ECA)

Mr Amoussougbo represented Ms Aida Opoku-Mensah who apologized for the fact that she was unable to attend. He drew attention to the Economic Commission for Africa's long history of supporting African higher education and research of which the initiation of the inter university council in East Africa was one example. The ECA was interested in promoting local languages and in helping universities to interpret indicators for good planning; the ECA's Education Sector is active in supporting education policies.

He concluded by affirming support for what had been decided by the Conference participants and stakeholders and indicated that he saw a need for the AAU to influence policies and encourage research in education.

Pierre Dandjinou, UNDP

UNDP is not actively involved in education and network infrastructure development but does have a strong belief in research. Its ICT program focuses on ICT for the poor with about 60% of its resources going to e-governance, e democracy and e- parliament related activities.

Any approach made to UNDP for support to research networking should be founded on development goals and not on ICT for its own sake and should come as a "package", probably as part of a Poverty Reduction Strategy Plan (PRSP) or some other national development program. UNDP could also provide some support for example by leveraging its good relationships with the private sector to foster partnerships and by helping with capacity building for example through the exchange of expertise between Africa and Asia.

In concluding, he noted that African countries and governments, and in particular their Ministers of Finance, did not raise the issue of ICT and that it was difficult to provide support without demand from the countries themselves.

Finally, he noted that UNDP may be able to support the AAU at the regional level, but reiterated that any requests should come as part of a "package".

Hans-Falk Hoffman, European Center for Nuclear Research (CERN)

Mr. Hoffman started off by noting that CERN was very interested in African research and education networking and had consequently hosted a meeting on the subject in September, 2005 organized jointly with the International Telecommunications Union (ITU) and UNU.

He noted that education and research networks needed champions in African countries to promote them and governments that understood that science and technology offers the best return on investment.

He urged participants to remember that neighbors such as Europe were willing to help share experiences and that an expanded Europe had some similar conditions as those faced by Africa which could make the experiences relevant and helpful.

He concluded by informing participants that CERN was not a funding agency but could help in other ways, for example:

- CERN could accept post doctoral students and fellowships and help find funding for them; and
- CERN could help in executing projects jointly with AAU, AVU or other such entities.

Asenath Mpatwa, ITU

Ms. Mpatwa detailed the workings of ITU's Department of Development and noted that the department hosts a world summit every 4 years that sets and agrees on plans for action. The next meeting will be held in Doha in 2006.

The ITU believes in collaboration and information sharing and on the need for a focal point to coordinate activities. It stands willing to help build capacity in this context if time-bound and phased action plans can be developed.

She concluded by saying that she believed that leadership at the pan-African level was probably the most important factor for success.

Banji Oyeyinka, United Nations University

Mr. Oyeyinka was in agreement with the outcomes of the Conference and the proposed role of the AAU. He however cautioned that five key elements would have to be taken into careful consideration if success was to be realized:

- Engagement and inclusion of governments in the process especially as universities in Africa were often controlled by governments;
- Avoidance of duplication of efforts already underway at all levels;
- Taking into account the wide diversity of African organizations and social institutions;
- Seek activities and initiatives that add value to already existing initiatives; and
- Carefully consider the issue of ownership of the network at all levels.

Johan Paardekooper, CISCO

Mr. Paardekooper informed participants of CISCO's long time support for higher education and indicated that CISCO was supportive of the efforts of African research and education networking initiatives.

Harry de Backer, The European Union

The EU is the largest ODA contributor; it will make use of ICTs particularly as a development tool in support of MDGs. Funding for education and research networking could come from a number of sources: eg the \$30 million ACP Science and Technology Program or the \$35 million higher education program. The EU will also support the NEPAD infrastructure strategy for Africa. The EU would be open to proposals for the development of telecommunications infrastructure paired with applications, for example NRENs or regional networking initiatives, as long as they come from African governments and have NEPAD support.

Steve Song, International Development Research Center (IDRC)

Mr. Song started off by summarizing the events leading up to the conference and noted that tremendous progress had been made.

He detailed the importance of working at the four levels- the university campus, the national (NREN) level, the regional or multi-country level and the continental level.

He noted that IDRC working in concert with the other partners and stakeholders had supported the process throughout this period and would continue to do so by expanding the university network stream in AFNOG training programs, by supporting individual NRENs, by working with regional efforts to access bandwidth, for example the newly formed Ubuntunet, and by strengthening AAU capacity to address network issues.

He concluded by urging all the stakeholders to stay the course to realize the creation of African research and education networks and their subsequent contribution to knowledge generation and utilization.

In discussion from the floor a representative from the **Swedish International Development Agency** noted that SIDA had worked mainly with individual universities and had also supported the AAU at the continental level. He concluded that while SIDA was currently not actively engaged in supporting African education and research networking, the conference presented an opportunity to consider their support going forward.

2.4 Closing Remarks

In his closing comments Professor Sawyerr drew attention to the tacit agreement throughout the Conference that the discussion goes beyond connectivity and bandwidth to the importance of collective action. It is only through collective action that African universities will be able to connect

globally and move forward. Bandwidth is in this sense a proxy for a larger debate but a key one in that connectivity is an important enabler of collaboration in education and research.

Leadership, action and innovation will be required at all four levels of activity considered during the Conference: campus, national, regional and continental.

National institutions bear primary responsibility for progress at the campus and national levels although there are regional organisations that can catalyse action at these levels as well as regionally. The biggest gap is at the continental level and the Conference identified a number of areas where useful actions could be undertaken:

- A clearinghouse function to promote information sharing and learning across countries and sub-regions;
- Advocacy in favour of policy reform to promote an open-access agenda; and
- Funding issues, to develop strategies for using donor support more effectively.

AAU is ready to work with other stakeholders and groupings along the lines identified above to spread African research and education networking beyond the current list of ‘high flyers’ to all parts of the continent.

Chapter 3 Road Map: Promoting African Research and Education Networking

The road map integrates the reports of the four panels and breakout groups and highlights actions that can be taken at campus, national, regional and continental levels to move the bandwidth agenda forward. It identifies actions to be taken by universities, NRENS, regional networks and national research and science and technology bodies. It also suggests specific responsibilities that could be taken on at the continental level by a strengthened AAU to build knowledge resources on connectivity issues, develop advocacy programs and promote more coordinated approaches to funding.

1. Campus level actions	Who is Responsible?
<p>Building human capacity and staff retention</p> <ul style="list-style-type: none"> • involve students in network management and trouble shooting and give them a leadership role; • develop continuous training programs that incorporate both work and study programs; • train users so that they can service themselves to the extent possible; • establish and nurture communities of practice; • provide incentives to retain skilled staff. <p>Infrastructure:</p> <ul style="list-style-type: none"> • focus on deploying infrastructure for local network access as the main connectivity building block; • build understanding of fibre versus wireless implications for campus networking; • address the issue of power shortages; • establish communities of practice to share expertise and knowledge about local area network development and share the lessons learned among universities. <p>Bandwidth:</p> <ul style="list-style-type: none"> • form bandwidth consortia; • establish NRENS to share bandwidth and other resources (eg libraries) and act on behalf of members when negotiating for national and international telecommunications services; • deploy bandwidth management to increase the amount of campus traffic that is dedicated to education and research purposes. 	<p>University ICT managers in close cooperation with University HRD managers and senior university management</p> <p>University ICT managers in cooperation with university HRD and facilities management</p> <p>University ICT managers in cooperation with peers in other universities and senior management</p>
2. National level actions	Who is Responsible?
<p>Promoting NREN development:</p> <ul style="list-style-type: none"> • Get NREN issues onto the agendas of the regulator and the national ICT policy body; • Get NREN issue onto agenda of national research coordination body – if one does not exist, build support for establishing one 	<p>AAU to promote among its members and partners (NEPAD, EU, donors, national higher education bodies, S&T</p>

<p>NREN tasks</p> <ul style="list-style-type: none"> • Build a fibre database and keep it up-to-date; • Develop a consortium to negotiate for bandwidth; • Develop a financial plan and business model leading to sustainability; • Identify criteria for membership; • Develop a strategy for accessing and sharing content among network members; • Develop a joint strategy for human capacity development; • Participate in regional initiatives; • Develop good relations with donors. 	<p>ministries etc) ICT managers from all potential members of the NREN with support from their University leadership</p> <p>NREN management</p>
<p>3. Regional level actions</p>	<p>Who is responsible?</p>
<p>Promoting regional networks:</p> <ul style="list-style-type: none"> • As a prerequisite to stimulate multi-country collaboration on R&E networking: <ul style="list-style-type: none"> ○ Build local and regional consensus ○ Establish political leadership ○ Work towards policy and regulatory harmonization ○ Seek both donor incentive funding and funding from national governments • AAU to develop or support regional associations of universities as a vehicle to promote national and regional research and education networking • AAU to make use of its political weight within the region and globally to advocate for and promote the role of both national and regional education and research networks. 	<p>Where appropriate regional university bodies do not exist or do not have R&E networking on their agendas push must come from both national level: (university leadership and national S&T leadership) and from AAU</p> <p>Regional collaboration should be along functional lines</p> <p>NRENs can take action themselves to exploit economies of scale and share resources on a regional basis (Ubuntunet)</p>
<p>4. Pan Africa actions</p>	<p>Who is responsible</p>
<p>Strategies to promote continent-wide networking:</p>	

<ul style="list-style-type: none"> • Information exchange and learning <ul style="list-style-type: none"> ○ Develop and maintain a current web site on all activities and actors ○ Synthesize information and identify gaps and needs ○ Develop outreach programs to engage stakeholders not yet involved – for example the Working Group on Higher Education and ADEA ○ Organise annual or more frequent stakeholders meetings to continue information sharing • Policy reform: awareness raising and lobbying activities to push agenda of open access and low cost bandwidth <ul style="list-style-type: none"> ○ AAU to develop continent-wide lobbying strategies ○ Regional networks to develop regional lobbying strategies ○ Where no RRENs exist AAU to lobby for their formation ○ NRENs to develop national lobbying strategies ○ Capacity building directed at all levels: tool kits, information sheets or briefing notes, information sharing, training workshops • Fund raising <ul style="list-style-type: none"> ○ Develop a concrete business plan responding to clearly identified needs and with sustainability strategy built in ○ Hold a donor forum involving all stakeholders including local and national stakeholders ○ Build understanding of the processes of different donors – for example EU and JICA funds must be channeled through governments or regional governmental organisations (eg AU, ECOWAS). 	AAU in collaboration with NRENs and RRENs
5. Actions for all university stakeholders	Who is responsible?
<ul style="list-style-type: none"> • Designate AAU to facilitate continent-wide activities 	AAU to consult its membership
6. Actions for international partners	Who is responsible?
<ul style="list-style-type: none"> • Support a small team within AAU with appropriate skills and experience 	International partners

Annex 1 Conference Program

<p>Conference on African Research and Education Networking Infrastructure</p> <p>On the occasion of the World Summit on the Information Society - Tunis November 14 and 15, 2005</p> <p>Convened by the Association of African Universities</p> <p>Sponsored by: International Development Research Centre (IDRC) Partnership for Higher Education in Africa (PHEA) Open Society Initiative for Southern Africa (OSISA) Swedish International Development Agency (SIDA) World Bank Institute (WBI)</p>	
<p>Day 1: November 14, 2005 8.30 – 18.00 Sidi Bou Said Room, Corinthia Hotel</p>	
8.30	Welcome and Introduction: The antecedents of the conference – Steve Song, Connectivity Africa, IDRC
8.40	Welcome and Introduction: Towards a roadmap to increased bandwidth resources for African universities – Akilagpa Sawyerr, Secretary General, AAU
8.50	Keynote: Bandwidth in the context of national education, science and technology and development policy – Venancio Massingue, Minister of Science and Technology, Mozambique
9.15	Coffee break
9.45	<p>Panel 1: Building campus level capacity and infrastructure Chair: Isatou Secka Jah, MRC Labs Jahara, Gambia Rapporteur: Americo Muchanga, CIUEM, Mozambique</p> <p>Panelists:</p> <p>Bob Hawkins, WBI: ATICS – Lessons for the future of campus networks in Africa Albert Nsengiyumva, National University Rwanda: NUR network from the perspective of NREN development in Rwanda Ibrahim Niang, UCAD, Dakar: Capacity and infrastructure requirements Emmanuel Tonye, Cameroon University Network: Challenges in building the Cameroon University Network Martin Belcher, INASP: Bandwidth Management Optimisation</p>
11.15	<p>Panel 2: Exploiting the potential of National Research and Education Networks in Africa Chair: Duncan Martin, TENET, South Africa Rapporteur: Aouaouche El-Maouhab, CERIST, Algeria</p>

	<p>Panelists:</p> <p>Margaret Ngwira, MALICO, Malawi: The logic of library-driven NRENs Victor Kyalo, KENET: Forming an NREN in Kenya Aminu Ibrahim, Ahmedu Bello University: Networking steps in Nigeria Ahmedou Ould Haouba, NIC, Mauritania: Towards an NREN in Mauritania Enrique Pelaez , CEDIA, Ecuador: Comments from an Ecuadorean NREN Perspective</p>
12.45	Lunch - Buffet – Cascade Restaurant
14.00	<p>Panel 3: Overcoming Constraints to multi-country collaboration – geographic and interest-based networks Chair: John Dyer, TERENA Rapporteur: Ben McGarry, SARUA</p> <p>Panelists:</p> <p>Sandra Aluoch, AVU: The bandwidth consortium – what next? Bjorn Pehrson, KTH, Sweden: SARUA: Results of and lessons from the fibre study in Southern Africa Doug Hull, Connectivity Partners Int’l: Results of and lessons from the fibre study in North Africa David West, Dante: EUMEDConnect – a stimulus to the development of NRENs in North Africa</p>
15.30	Coffee break
16.00	<p>Panel 4: Pan-African options – capturing synergies among different initiatives Chair: Lishan Adam Rapporteur: Mike Jensen</p> <p>Panelists:</p> <p>Mavis Ampah, WB/GICT: The prospects for terrestrial fibre networks in Africa Don Riley, IEEAF: The NSF Study: links between the West Coast of Africa and the US Harald Holt, UNU/GVUGRID-Arendal: AFUNet: Global Connectivity for the African R&E Community F. F. Tusubira, Makerere University: AAU: Strategic framework and road map: a proposal Harry de Backer, Union European: Accessing EU support for university networking in Africa</p>
18.00 – 20.00	Reception Restaurant Le Bistro Corinthia Hotel

Day 2 November 15 2005 8.30 – 12.30 Sidi Bou Said Room, Corinthia Hotel

8.30	Breakout sessions chaired by the panel chairs/rapporteurs to present and review conclusions of the four panel discussions
9.30	Coffee break
10.00	Road Map/Way Forward: Presentation and integration of the panel reports into regional road map Chair: F.F. Tusubira, Makerere University Rapporteur: Heloise Emdon, IDRC Panelists : Day 1 Panel rapporteurs or others selected by breakout groups
11.15	Response by Stakeholders and International Partners: issues and activities to be addressed by future programs Chair: Silas Lwakabamba, KIST, Rwanda Rapporteur: Alex Twinomugisha, GESCI Panelists: Partnership for Higher Education in Africa – John Butler-Adam World Bank Institute – Bob Hawkins Economic Commission for Africa – Aida Opoku-Mensah UNDP – Pierre Dandjenou CERN – European Centre for Nuclear Research – Hans-Falk Hoffman International Development Research Centre – Steve Song International Telecommunications Union – Asenath Mpatwa United Nations University – Banji Oyeyinka CISCO – Johan Paardekooper
12.15	Summing Up and Closing Akilagpa Sawyerr, Secretary General, AAU

Annex 2 List of Participants

FULL NAME	INSTITUTION	COUNTRY
Adam, Lishan	University of Stellenbosch	Ethiopia
Adera, Edith	IDRC	Kenya
Akorli, Felix Korbla	National University of Rwanda	Rwanda
Aluoch, Sandra Atieno	African Virtual University	Kenya
Amoussougbo, Thierry H.	Economic Commission for Africa, DISD	Ethiopia
Asior, Hubert	University of Education Winneba	Ghana
Augustin, Gaschignard	Project SIST	France
Bagula, Bigomokero	KTH	
Oyeyinka, Banji	UNU INTECH	The Netherlands
Belanger, Paul	UN	Ethiopia
Belcher, Martin	INASP	United Kingdom
Ben Ghezala, Henda Hadjami	Centre de Calcul el Khawarizmi	Tunisie
Beutler, Afton	WOW	USA/Switzerland
Beutler, Robert	WOW	USA/Switzerland
Beyene, Tsegereda	Cisco Systems	United States
Bothma, Theo	University of Pretoria	South Africa
Boyles, Heather	Internet 2	United States
Brendan, Barrett	UNU	Japan
Butler-Adam, John	The Ford Foundation	South Africa
Camara, Aliane	IDRC	Senegal
Chikumbi, Godfrey	KTH	Sweden
	Korea Advanced Institute of Science & Technology	
Chon, Kilnam		Korea
Constedt, Anders	KTH	Sweden
Dakubu, Mumuni	University of Ghana	Ghana
Danofsky, Samuel	United Nations	United States
Dosenjh, Manjit	CERN	
Dyer, John	Terena	Netherlands
Dzidonu, Clement Kwaku	INIIT/VVU	Ghana
Dzvimbo, Kuzvinetsa P.	African Virtual University	Kenya
Eberhardt, Mike	Sun Microsystems	
El-Maouhab, Aouaouche	CERIST	Algeria
Emdon, Heloise	IDRC	South Africa
Eshun, Benjamin	Association of African Universities	Ghana
Eujayl, Imad	IFPRI-ISNAR	Ethiopia
Farouk, Kaoun	Ecole Nationale des Sciences de	Tunisie
Frempong, Godfred Kwasi	CSIR- Science and Technology Policy	Ghana
Fritelli, Claudia	World Education Corps	United States
Greaves, Duncan	Tertiary Education Network, South Africa	South Africa
Hawkins, Bob	World Bank	United States
Hoffman, Hans-Falk	CERN	Switzerland
Hull, Doug	Connecting Partners Int'l	Canada
Ibrahim, Aminu	Nigeria ICT Forum	Nigeria
Imen, Awari	La Presse	Tunisie
Jaimes, Alejandro	Fuji Xerox	Japan

Jensen, Mike	IDRC	South Africa
Johnson, Andrea	Carnegie Corporation of New York	United States
Keats, Derek	University of Western Cape	South Africa
Koubaa, Kheled	Tunisian Internet Society Chapter	Tunisie
Krtaz, Mary Helen	TATRC	United States
Kyalo, Victor	KENET	Kenya
Lisbeth Levey	Partnership for Higher Education	United States
Lwakabamba, Silas	Kigali Institute of Science, Technology	Rwanda
Mabila, Francisco	UFM	Mozambique
Macanze, Jamo	MICTI	Mozambique
Mack, John	Society for SSS	United States
Martin, Duncan	TENET	South Africa
Massingue, Venancio Simao	Ministry of Science and Technology	Mozambique
McGarry, Ben	Sarua	South Africa
Merrouch, Redouane	CNRST- Marwan	Maroc
Missen, Cliff	University of Iowa	United States
Moroney, Sean	AITEC Africa	United Kingdom
Mpatwa, Asemath	International Telecommunication Union	Switzerland
Muchanga, America	CIVEM	Mozambique
Nana Nzepa, Olivier	University Younde	Cameroon
Ngwira, Margaret	University of Malawi	Malawi
Niang, Ibrahima	Université Cheikh Anta DIOP de Dakar	Senegal
Njovu, Simon Kamilus	Mzumbe University	Tanzania
Nsengiyumva, Albert	National University of Rwanda	Rwanda
Oberger, Bengt	SIDA	Sweden
Olivier, Nana	Université YOÉ	Cameroun
Oluleye, Ayodeji	Univeristy of Ibadan	Nigeria
Osiakwan, Eric	AFRISPA	Ghana
Oyeyinka, Banji	UNU INTECH	The Netherlands
Paardekooper, Johan	Cisco Systems	Netherlands
Pawlowski, Jennifer	The Rockefeller Foundation	United States
Pehrson, Bjorn	KTH	Sweden
Peláez Jarrin, Enrique	CEDIA nad ESPOL	Ecuador
Priestley, Carol	INASP	United Kingdom
Purbo, Onno		Indonesia
Quaynor, Nii	UNICT Task Force	Ghana
Riley, Donald	Univ of Maryland	United States
Roberge, Stéphane	IDRC	Canada
Robertine, Tankeu	RIA	Cameroun
Roy, Isabelle	Canadian International Development Agency	Canada
Rukeratabaro, Kasole Didier	Supranet	Congo (DRC)
Saied, Mohamed	United Nations University HQ	Japan
Saliah-Hassane, Hamadou	TELUQ/UQAM	Canada
Sami, Nezar	Enstinet	Egypt
Sarhan, Ebada	Helwan University	Egypt
Sawyerr, Akilapga	Association of African Universities	Ghana
Sebusang, Sebusang Enele Mophuti	University of Botswana	Botswana
Sebysang, Sebusang	Univeristy of Botswana	Bostwana

Shettima, Kole
Song, Stephen
Stavrou, Aki
Tankeu, Robertine
Tonye, Emmanuel
Torres, Danilo
Treffgame, Carew
Trond, Skjesol
Tusubira, F.F.
Twinomugisha, Alex
Uhlir, Paul
Utreras, Florencio
van Dongen, Wim
Victor, Ciza
West, David
Wild, Kate

MacArthur Foundation
IDRC
LINK Wits
University Yaounde
Ministère de l' Enseignement Supérieur
SCO Tome et Principe
Dept for International Development
UNINETT
Makerere University
GeSCI
The National Academies
CLARA
Centre for International Cooperation
CBINET
DANTE
Information for Development

Nigeria
Canada
South Africa
Cameroon
Cameroun
United Kingdom
Norway
Ireland
United States
Chile
The Netherlands
Burundi
United Kingdom
Canada

Annex 3 Glossary

AAU – African Association of Universities
AFNOG – African Network Operators Group
AFUNET – working title for a UNU/ITU/CERN Africa R&E networking initiative
AGORA – Access to Global On-line Research in Agriculture
ATICS – African Tertiary Institution Connectivity Survey
AU – African Union
AUF – Agence Universitaire de la Francophonie
AVU – African Virtual University
CEDIA – Research and Education Network of Ecuador
CLARA – EU supported Latin American research network
COMESA – Common Market for Eastern and Southern Africa
COMTEL – planned communications network in Eastern and Southern Africa
DANTE – Delivery of Advanced Network Technology to Europe – management agency for GEANT
EASSy – East African Submarine Cable System
eIFL – Electronic Information for Libraries
EUMEDConnect – EU program to network the Mediterranean countries
GEANT – Collaborative project and network among 26 National Research and Education Networks in Europe (EU program)
GDLN – Global Development Learning Network (World Bank)
GICT – Global Information and Communication Technologies Department – World Bank
HINARI – Health Internetwork Access to Research Initiative
HRD – Human Resource Development
ICT – Information and Communication Technologies
IDRC – International Development Research Centre
IEEAF – Internet Educational Equal Access Foundation
INASP – International Network for the Availability of Scientific Publications
ITU – International Telecommunications Union
KENET – Kenya Education Network
NEPAD – New Partnership for Africa’s Development
NORAD – Norwegian Agency for Development Cooperation
NREN – National Education and Research Network
NSF – National Science Foundation
NSRC – Network Start-Up Resource Center
OSISA – Open Society Institute in Southern Africa
PAREN – Promotion of African Research and Networking (IDRC Program)
PHEA – Partnership for Higher Education in Africa
PPP – Public, Private Partnerships
R&E – Research and Education
RIA – Research ICT Africa
RREN – Regional Research and Education Network
SARUA – Southern Africa Regional Universities Association
SIDA – Swedish International Development Agency
S&T – Science and Technology
TENET – Tertiary Education Network – South Africa

UEM – Eduardo Mondlane University, Mozambique

UNU – United Nations University

VSAT – very small aperture terminal for satellite communications

WB – World Bank

WBI – World Bank Institute

WGHE – Working Group on Higher Education (of Association for the Development of Education in Africa)