FEAST Project

FEAST Feasibility Study for the AU-EU AfricaConnect initiative

Deliverable D2C : Roadmap

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1 Introduction

The mid-term review of the work so far carried out by the FEAST study indicated that it was time to deepen the analysis and work out a detailed and tailor-made roadmap for the issues that needs to be dealt with between now and the end of the FEAST study (October 2009). It was decided (by the FEAST team, the EC, and the external expert) that this analysis should include the very precise and specific points identified during Phase A and B of FEAST that can be addressed at this stage, rather than deal with a generic roadmap.

This document is the result of that analysis. It is a precise roadmap of the work to be carried out and the issues to be dealt with in establishing a sub-Saharan regional research and education network (REN) between the NRENs of the countries identified to be in a position to participate in such a regional network (namely Ethiopia, Kenya, Malawi, Mozambique, Rwanda, South Africa, Sudan, Tanzania and Uganda).

It is encouraging to note that the regulatory environment in most of the countries being considered is very good and many of the national telecommunications regulators have strong working relationships with the NREN. A summary of the regulatory environment in the region is provided in Appendix B.

This document is divided into three parts and a summary of the action items for each is provided in Appendix C Project Planning Overview.

- Procurement planning.
- Technical and operational planning.
- Risk mitigation.

The following wording is used throughout this document:

- **Implementation project**: The project financed by DG AidCo that will lead to the creation of a regional African R&E network and its interconnection to GÉANT.
- **REN**: The regional African R&E network to be implemented.
- **Identified African NRENs**: The NRENs in Ethiopia, Kenya, Malawi, Mozambique, Rwanda, South Africa, Sudan, Tanzania and Uganda.
- **Connected African NRENs**: The subset of the identified African NRENs that have chosen to participate in the implementation project.
- **FEAST team**: KTH, DANTE and TERENA.
- **EU NRENs**: Those EU NRENs that are engaged in FEAST and will take on a partner role in the implementation project.

2 Procurement Planning

2.1 Introduction

The Request for Information (RFI) for Connectivity within sub-Saharan Africa and between sub-Saharan Africa and Europe carried out by the FEAST team between March and June 2009 resulted in very little response from the connectivity providers. Deeper engagement with the connectivity providers is therefore needed to ensure that the objectives of FEAST and a subsequent implementation project are fully understood in the market place. It is also necessary to start engaging with relevant equipment suppliers.

Following that, the procurement of connectivity and equipment will have to be prepared to ensure that the procurement process can be launched as early as possible in a subsequent implementation project. To ensure the success of connectivity and equipment procurement a strong recommendation to the European Commission as to the procurement process needed is made.

2.2 Key Players

The procurement planning requires an alliance between European and sub-Saharan African organisations to ensure that it can be successfully carried out. These organisations are:

- KTH.
- DANTE.
- UbuntuNet Alliance.
- Identified African NRENs.
- AfNOG
- TERENA.

2.3 FEAST D2B Request For Information

A RFI was sent to 37 African, European and Global connectivity providers in March 2009. The list of suppliers was constructed from the output of “Activity A.4 Supplier Survey” of the FEAST

project, and from the database of European and international connectivity providers maintained by DANTE.

A number of connectivity providers acknowledged the RFI and promised responses by the closing date (mid-April). However by the end of April only three viable responses were received.

Reminders were sent to the suppliers before the closing date, and a subsequent request was made to the non-responding companies to confirm whether they were or were not interested in making a submission. This elicited a small number of confirmations that the companies could not provide services in the region mostly due to their lack of involvement in Africa.

Subsequently, a number of suppliers responded that they were interested in providing information but were not in a position to do so in the short term. This is probably a response to the market opening up in the region as the sea cables materialise.

Details of the three viable responses are described below, but it is an indication of the underdeveloped state of the market that there have been so few responses. Many of the multi-national companies state that they did not have their own infrastructure in place in Eastern Africa and consequently were not going to respond. However, it is surprising that some connectivity providers that have large investments in some of the African countries did not respond to the RFI. It is possible that these companies would react more readily to a formal tender process.

2.3.1 Summary of the RFI Results

As stated above, there were three viable responses to the RFI process:

- **"Company A"** offered a sea-cable connection from several of the European GÉANT Points of Presence (PoPs) to Djibouti where onward sea-cable connections could be made. This solution would require negotiations with other suppliers at Djibouti and could also be used to connect the Université de Djibouti.
- **"Company B"** offered direct terrestrial connectivity between most of the capital cities of the African NRENs and London. This connectivity could be split into connections at a variety of data rates. The service would involve the purchase of an Indefeasible Right of Use (IRU) for a 20 year period with a small annual maintenance charge.
- **"Company C"** offered services on the physical infrastructure provided by "Company B"' but at less advantageous rates.

It should be noted that none of the companies offered any terrestrial connectivity for one of the identified African NRENs, the NREN in landlocked Malawi.

The RFI process remains open in the expectation that new offers are likely to be provided by the local connectivity providers over the coming half year. While this information may arrive later in the FEAST study, it will be very valuable to the subsequent implementation project.

2.4 Engagement with relevant connectivity providers and equipment suppliers

2.4.1 Engagement with relevant connectivity providers

It is evident from the RFI process so far that the connectivity market has responded to the RFI in a poor manner. This could be due to a number of causes, for example:

- The FEAST partners may have posted the RFI to the wrong contact people within the connectivity provider organisations (however, this is less likely for the contact details taken from the DANTE procurement database).
- The lack of connectivity infrastructure led to the organisations not responding.
- Lack of interest or knowledge as how to respond to such an RFI.
- A possible REN in sub-Saharan Africa is seen as a competitive infrastructure by the local connectivity providers, and therefore a decision was taken not to respond to the RFI. Local effort will be required to ensure that Telecom operators do not view the academic and research networks as competitors, but as a separate class of closed user group service providers.

In order to improve the RFI results and to ensure that a possible procurement activity receives responses from well educated connectivity providers, it is essential that the FEAST team re-engages with the African connectivity marketplace. It needs to be ensured that the contacts for the RFI are validated to ensure they are the appropriate contacts, or whether different departments in the organisation are better placed to respond to the RFI.

This process should be supported by the UbuntuNet Alliance, representing NRENs in the region, as well as the individual identified African NRENs. It could also be worthwhile to engage with AfNOG as the African Operators Association.

If it is found that the contacts were appropriate, why they did not respond to the RFI needs to be determined, as well as what needs to be done to remove obstacles to a response. In collaboration with the UbuntuNet Alliance and the identified African NRENs, the objectives of the FEAST study and an implementation project should be further disseminated to raise awareness.

2.4.2 Engagement with Equipment Suppliers

Informal discussions have taken place over the last months with relevant equipment suppliers. These have mainly focused on the major networking suppliers such as Alcatel, Cisco, Huawei and Juniper.

Depending on the chosen REN topology, one or several core PoPs will need to be established in sub-Saharan Africa, which will need both core routing equipment and Local Area Network (LAN) equipment for the measuring and monitoring of network traffic.

Before any equipment procurement can commence it is essential to understand the details of how equipment is to be imported, installed, ware-housed and maintained. It is also necessary to involve the equipment providers in the process of the creation of new NREN infrastructures within the identified African NRENs. How far the equipment providers would be able to donate all or a subset of the necessary equipment (as they have done in the ALICE and EumedConnect projects) should be explored, as well as how much interest or how able they are to provide training for the installed equipment.

2.5 Required Tender Procedure

It is required that the tender procedure for the connectivity and the equipment tender of the implementation project will follow either EC" Negotiated Procedure" or the "Competitive Dialogue Procedure".

As the RFI has proven, the market for fibre and leased lines connectivity in Eastern and Southern Africa is poorly developed and also less open in comparison to other, more developed world regions. Eastern Africa has been very poorly served by under-sea fibre optic cables. Competition is scarce: In the second half of 2009, there will be only two possible cable options for connectivity within Africa and towards Europe and the world. A further cable may be in place in the second half of 2010.

Generally, the under-sea fibre optic cables mentioned above are built by consortia and then are sold to individual operators and investors, who then resell capacity on the cables in a variety of ways. It is possible to purchase long term ownership of a portion of the cable, known as an Indefeasible Right of Usage (IRU). An IRU is usually purchased for the life of the cable (about 20 years), and comes with an obligation to pay an annual maintenance fee as well as the purchase cost.

A number of the developers of the cables, as well as the individual shareholders, may be able to sell short- or long-term capacity on one or more of the cables. In fact, the operators will be selling capacity on the cables in a competitive manner, with prices changing as new cables are installed and as the market develops.

It is expected that the budget for an implementation project will be limited to €15M, and it will be a requirement on the connectivity and equipment tender processes to acquire the most economical and technically advantageous network configuration in a fluid, but also rapidly evolving marketplace. It will not be possible to define a network topology ahead of time, as might be possible in a more traditional procurement in a stable and developed marketplace.

In a dynamic market such as Africa is today (even more so in 2010), the connectivity providers are installing cross links between their services in the countries on a fast-moving basis, and may not be advertising these links widely. It may not be possible to identify appropriate links ahead of time. The most appropriate ones may only be presented during a tender process, which allows for negotiations and engagement with the providers.

As the procurement process will involve the connectivity providers as well as the identified African NRENs or partners in the countries who will be paying a contribution to the national links, the following points need to be taken into account:

- Physical connections are dynamic, new ones being implemented over time.
- Competition on different sea cables.
- Competition between connectivity providers on a single sea cable.
- Competition on links from sea cables to capital cities.
- Competition on links to landlocked countries.
- Need to negotiate with multiple vendors and partners on links.

Most of the above points are unique to Africa, due to the low level of availability of telecommunications infrastructure. This is being remedied with the sea and land based fibre optic cables.

For these reasons it is a requirement that connectivity and equipment procurement of the implementation project will follow either the negotiated or the competitive dialogue procedure. The FEAST team, specifically the European coordinator of the implementation project, will need to collaborate with the European Commission closely to ensure that the implementation project contract reflects this firm requirement. Failing to do so will certainly lead to a failed implementation project.

2.6 "Rule of Origin"

It is expected that during the implementation project a variety of equipment, services and consulting functions will have to be acquired or contracted. Most of these items are highly specialised and are generally only manufactured or provided by a single niche supplier/provider in the world. This is fairly typical of the ICT market worldwide.

In any procurement, the best options should be procured on a worldwide basis; purchasing equipment that is solely manufactured in Europe or Africa would certainly lead to the implementation of a sub-standard network or would lead to serious delays in the implementation of the REN. In terms of software and consultancy, the best possible services should be acquired irrespective of whether they are manufactured in the beneficiary region, Europe or outside. There are specialist consultancy groups that can facilitate the start-up of the network that are based outside of Europe or Africa, but it should still be possible to contract their assistance in the implementation project.

Consequently, an exception to the AIDCO "Rule of Origin" must be provided in the contract between the EC and the European Coordinating partner, as has been granted previously in ALICE, EUMEDCONNECT and TEIN2.

The following is a list of possible equipment and services that an implementation project may require to procure. Some of these may actually be supplied by European of African branches of multinational companies who may have manufacturing or research bases in either Europe or Africa but perform little true manufacturing in the regions. It may be possible to purchase servers, desktop computers and laptops that are nominally manufactured in Europe or Africa, but which actually contain components that are manufactured around the world and have their final assembly in Europe or Africa. This is what is referred to as "Badge Engineering" below. Most internal components, however, have a single point of manufacture in the world.

Type of Equipment/Service	Comment on Sourcing
Network Routers	Specialist, limited suppliers worldwide
Network Switches	Specialist, limited suppliers worldwide
Fibre Optic Equipment	Specialist, limited suppliers worldwide
Server Computers	May be available in EU, “badge engineered”
Desktop Computers	May be available in EU, “badge engineered”
Laptop Computers	May be available in EU, “badge engineered”
Personal Digital Assistants (PDA)	Specialist, limited suppliers worldwide
Software – network monitoring	Specialist, limited suppliers worldwide
Software – server applications	Specialist, limited suppliers worldwide
Software – desktop applications	Specialist, limited suppliers worldwide
Services – Telecoms Consultancy	Must source world leaders
Services – NREN start-up consultancy	Must source world leaders
Services – Operational Consultancy	Must source world leaders
Telecoms Services	Source both in Africa and Europe

Table 2.1: Sources of equipment and services

2.7 Procurement preparation

As in other implementation projects, it is advised that the procurement that will lead to a sub-Saharan Africa REN between the identified African NRENs and towards Europe, should commence as early as possible at the start of the project. The FEAST study should therefore take the advantage of the time now available to start the actual preparatory work for the procurement process. In consultation with technical experts at EU NRENs and identified African NRENs, the FEAST partners should commence the writing of the connectivity and equipment invitation to tender (ITTs). These documents should be based on the findings of the RFI and the parallel discussions with the connectivity providers and equipment suppliers. In addition to the preparation of the ITTs, there is also a need to work early on the evaluation documents and to bring together a team of experts with appropriate local knowledge to evaluate the offers made. In the case of experts coming from the UbuntuNet Alliance or any of the identified African NRENs, this could mean that some preparatory training will be needed.

At the same time, the EU Official Journal entry for both procurements should be prepared and a timeline for the procurement taking into account the necessary timings associated with the negotiated procedure or the competitive dialogue procedure.

2.8 Summary of main task and key partners

- Deepen engagement of connectivity suppliers
  - Leave RFI open for further submissions
  - Check connectivity providers contact details correct
  - Engage with AfNOG
  - Lead discussions with connectivity providers
  - Disseminate objectives of FEAST and implementation project
  - Key partners: KTH, DANTE
  - Support needed from identified African NRENs, UbuntuNet Alliance
  - Dissemination support needed from TERENA
- Deepen engagement of equipment providers
  - Equipment import, installation, ware-housing and maintenance
  - Possibility of donations
  - Possibility of supporting the creation of NRENs
  - Key Partner: DANTE
  - Support needed from identified African NRENs, UbuntuNet Alliance
- Required Tender procedure and derogation from Rule of Origin
  - Discuss with DG AidCo the need for the negotiated procedure or the competitive dialogue procedure
  - Discuss with DG AidCo the need for a derogation from the rule of origin for services and supplies
  - Ensure that the EC contract reflects the requirements
  - Key Partners: DANTE, KTH
  - Support needed from DG INFSO
- Prepare the Connectivity and Equipment procurement
  - Write the ITT for the connectivity procurement
  - Write the ITT for the equipment procurement
  - Decide on evaluation criteria
  - Assemble a team of experts from EU and Africa for the evaluation of the connectivity and equipment tender responses
  - Train African experts on the evaluation of the tender responses (if needed)
  - Key Partner: DANTE
  - Support needed from EU NRENs and identified African NRENs, UbuntuNet Alliance

3 Engineering and Operational Planning

While the tasks described in section 2 “Procurement Planning” are tasks that the FEAST team and its supporters, EU NRENs and others, should start carrying out immediately, there is less urgency to start the detailed planning for the engineering and the operational planning of the REN that is to be implemented. However, the FEAST team members (and specifically technical experts coming from the EU NRENs) should begin thinking about what is necessary to ensure a successful implementation and subsequent operations of the REN to be established in sub-Saharan Africa. Some general design, engineering and operational aspects need to be taken into account early on, and certainly there are engineering and operational training requirements in the identified African NRENs and the UbuntuNet Alliance.

Specifically, the technical capacity building and training are areas where a committed engagement from the EU NRENs is needed to ensure the success of an implementation project.

3.1 Key players

The technical engineering and operational planning will need a strong alliance between DANTE, the EU NRENs, the more advanced African NRENs and the UbuntuNet Alliance, as well as experienced staff from organisations such as the Network Startup Research Centre (at the University of Oregon). The key players are:

- DANTE.
- Committed technical experts from EU NRENs.
- Technical experts from advanced African NRENs (South Africa, Kenya).
- Technical experts from the UbuntuNet Alliance.
- Network Startup Resource Centre in the University of Oregon.

3.2 Development of regional NOC and NEG functions

It is clear that the sub-Saharan REN will only be a success if there is a sense of clear ownership by the connected African NRENs and the UbuntuNet Alliance. To achieve this sense of ownership, the REN cannot be managed and operated from Europe, but must be managed and operated from within the African R&E community. This approach has worked very successfully

in the Latin American arena, where the technical responsibility for the engineering and operation of RedCLARA have, from the very beginning, been with CLARA directly.

It is therefore essential that a sub-Saharan Africa REN Network Operations Centre (NOC) and a regional Network Engineering Group (NEG) are developed.

From the experience in Latin America, the way the CLARA NOC and NEG functions were developed should be studied. In the very beginning of the ALICE project, a subset of Latin American engineers wrote a document on the requirements of a CLARA NOC and NEG functions. This document was then turned into a tender document for a tender of the two functions among the advanced Latin American NRENs. A team of experts from around the world, and led by DANTE, evaluated the technical merit and the commercial affordability of the responses and subsequently recommended to CLARA to award the CLARA NOC function to the Mexican NREN and the CLARA NEG function to the Brazilian NREN. The process was repeated for the CLARA NOC function in 2008 and led to the NOC responsibilities being handed over to the Chilean NREN.

Having the engineering and operational responsibility of RedCLARA made the network a Latin American responsibility, even if the major part of the funding came from Europe and the coordinating partner of the ALICE project was a European organisation.

3.3 Development of the Operational Model

In parallel with the development of the NOC function, there is a need to look at the principles of the potential operational model for the REN and its interaction with the connected African NRENs and the GÉANT network in Europe. There is ample material available in Europe which African engineers with operational experience could use as a base for the operational planning. An example of this material may be found in Appendix D.

The following sections are basic requirements that a regional NOC in Africa will have to fulfil and could form the basis for a tender for a regional NOC function in sub-Saharan Africa.

3.3.1 Development of Fault Handing Procedures

In any major network faults will always arise amongst the myriad of components that make up the system. Procedures need to be put in place to formalise the actions that need to be taken in order to inform other networks of the faults, take appropriate action to remedy the faults, and to document each incident.

Fault reporting will have to be managed for all upstream networks and service providers, for NOC provision and services, and all the downstream-connected NRENs. A formal trouble-ticketing and reporting system should be put in place and should be rigidly adhered to.

A NOC function must maintain an up to date database of all of the points of contact for fault reporting as well as a complete inventory of all equipment and connectivity links.

The following is a non-exhaustive list of fault handling processes and procedures that need to be covered by a NOC function:

- Problem Localisation and Service Restoration Procedures.
- Fault Reporting Methods:
  - Who may report problems.
  - Hours of cover and out of hours cover.
  - Contact Information.
- Types of Enquiry:
  - Getting Help.
  - Reporting Faults.
  - DOS Attacks.
  - Getting Status Information.
  - Updating the NOC with information.
- NREN Maintenance and Outages.
- Trouble Ticket System.
- Escalation and Complaints Procedures.
- Task Force.

3.3.2 Liaison between the NOC and African NRENs

At a formal level, the NOC function will have to set up a number of mechanisms for communicating with the connected African NRENs, its underlying connectivity providers, and its upstream networks (such as GÉANT). While it is important to learn from the procedures used by established NRENs around the world, it is absolutely vital to work with the locally connected African NRENs to establish local best practice and to take account of the special requirements of the region. There will be many such local factors that will be novel in the Eastern and Southern Africa NRENs, and these factors need to be shared locally and internationally.

In general, however, the upstream suppliers will communicate using mechanisms agreed in their service level agreements. For the downstream NRENs, the following list can help identify the main communication methods:

- Communication and Information Flow, according to Service Level Agreements (SLAs):
  - Access Point Managers (APMs):
    - Each connected African NREN will nominate at least one person to act as a liaison person between the NREN and the regional NOC. These nominated people will be the main point of contact between the regional NOC and the connected African NREN.
  - Mailing Lists:
    - Technical mailing lists amongst APMs.
    - Trouble ticket mailing list.
  - Web Server:
    - General AfricaConnect web site with a public area and an area restricted to members, the restricted area will have more confidential information such as monthly reports, operational procedures etc.

- APM Meetings:
  - At least annually, the regional NOC will arrange a meeting of the APMs of the connected African NRENs to meet with the NOC and NEG staff and discuss issues and provide feedback to the NOC.
- Reporting by the regional NOC:
  - The NOC will have to provide monthly service reports to the APMs of the connected African NRENs.

3.4 Network design

The final design of a REN in sub-Saharan Africa will most likely not be the result of choice but of the market conditions and the affordability of the offers received. However, it is essential that some basic design principles are being respected. In order to be able to jump start the implementation of the REN in Africa, a regional NEG function will need to consider these initial networking principles and will also be needed to define the IP routing policies to be adopted by the regional NOC. The following sections outline the principles and look at the main IP routing needs.

3.4.1 Network and Engineering principles

In looking at the construction of a REN in Eastern and Southern Africa, ideally the following engineering principles should apply:

- National academic traffic remains within the respective connected African NREN and does not traverse any other network.
- National traffic stays in the country and is exchanged at a national internet exchange point.
- Traffic among African connected NRENs in the region is exchanged through the REN.
- The connected African NRENs are connected into a network mesh through regional PoPs.
- Commodity internet peering is carried out as locally as possible.
- Peering between the REN and GÉANT occurs in either Europe or Africa.

GÉANT will allow for peering and global transit to R&E networks globally.

An ideal design for the connection of the identified African NRENs is a series of interconnected rings. To cover the whole of East Africa three rings would seem ideal: one in the North, one Central and one in the South of the region:

- **North:** Sudan, Ethiopia, Djibouti and a link to the EUMEDCONNECT2 network (in Egypt)
- **Central:** Kenya, Uganda, Rwanda, Burundi, Tanzania
- **South:** Mozambique, Malawi, South Africa, (Zambia, Zimbabwe, Botswana, Namibia)

Based on the findings of the RFI, a sub-optimal infrastructure appears to be the only solution at present. This sub-optimal solution, available at the end of the first half of 2009, is a star network with an interconnection point in London and point-to-point links to the capital cities of Kenya, Uganda, Rwanda, South Africa, Tanzania and Mozambique. Other countries, such as Burundi,

could potentially be added to this at a later stage. To date, the RFI has not offered a suitable solution to connect land-locked Malawi.

It is clear that the point-to-point connection from the various African NRENs to a GÉANT or UbuntuNet Alliance PoP London breaks many of the above outlined regional networking and engineering principles. Such topology leads to the fragmentation of R&E networking in Africa and would in the long term harm R&E networking progress in sub-Saharan Africa. It is therefore necessary. as described in 2 “Procurement Planning”, to deepen the involvement of the connectivity providers and to ensure that by the time the connectivity procurement has started a true regional African network topology will emerge.

3.4.2 IP Routing Rules and Procedures

As well as the design task of a regional NEG function, the regional NEG will have to develop the IP routing rules and procedures that are to be implemented by the regional NOC. The REN, along with its connected African NRENs, has an obligation to ensure efficient routing to its upstream networks such as GÉANT. It needs to be ensured that other networks are not adversely affected by errors or misconfigurations in the network. In particular there are a number of issues that need to be closely monitored, such as the number of routes advertised, the frequency of announcements, and the announcement of bogus routes.

Policies must be developed by the regional NEG in conjunction with AfriNIC, GÉANT and the connected African NRENs to ensure that international best practice is adhered to in the operation of the REN and the connected African NRENs.

There are many topics that need to be considered. The following list is an overview of the main items that should be covered by policy and procedures. As technologies change, it is likely that the list will vary in quite a dynamic manner and should be updated accordingly:

- REN Obligations:
  - General routing policies.
  - Routing Protocol and Route Aggregation.
- Route Filtering:
  - Autonomous System Path Filtering.
  - IP Prefix Filtering.
  - Installation and Updates.
  - BGP Communities.
  - Loose Source Routing.
- Route Dampening Policy.
- REN Routing Registrations:
  - Network Registration.
  - Routing Policy Changes.
- Multicast:
  - Configuration.
- IPv6.
- Access to the Routers:
  - REN SSH Access to AfricaConnect Backbone Routers.
  - REN SNMP Access to AfricaConnect Backbone Routers.

3.5 Engineering and Operational Training and Capacity building

The engineering and operations tasks to be covered by the regional NEG and NOC, and also by the identified African NRENs, need sound engineering and operational skills. Drawing on the Latin American experience again, it can be expected that the advanced African NRENs will have these engineering and operational skills already available to their respective organisations. However, it is also expected that several of the still developing and emerging identified African NRENs will need to receive support for capacity building and specific training to be able to manage the national NREN connectivity, as much as their regional connection to the REN. It is therefore advised to develop a training and capacity building plan early on in the project, and make it tailor-made for each of the identified African NRENs.

3.5.1 Staff Development, Recruitment and Retention

In most areas of the world there are continued difficulties in recruiting and retaining staff in the areas of networking and system administration. It is to be expected that there will be even greater problems in areas where the network is underdeveloped and there is not a ready pool of trained staff in the community.

Local action needs to be taken to put in appropriate staffing programmes to ensure that there is sufficient continuity to maximise the efficiency of NREN operations.

The NRENs should work with their local institutions to encourage them to run appropriate courses that will lead to the development of a stream of suitably trained engineers for the expected demand in networking staff.

Programmes that will allow internships in the NRENs for students in the academic institutions would encourage potential staff to consider the advantages of working in an NREN environment.

In addition to organising specific training and capacity building courses, the idea of “twinning” the identified African NRENs with interested NRENs could provide long term support for both parties, with staff from each organisation spending some time in the counterpart organisation. This way it should be possible for the identified African NRENs to see how things are done in Europe, and to adopt and adapt the best practices that fit the African environment. The converse is also true, as the African NRENs will have avoided many of the mistakes that have been made in the development of the European networks, and possible feedback for the European NRENs from such interactions is likely.

The following gives a generic, three level overview of the possible areas that will need to be covered. These should be tailored to the needs of each of the respective identified African NRENs.

- Foundation level networking topics.
- Intermediate level networking topics.
- Advanced level networking topics.

A brief description of the topic areas is given below: The number of topics that can be offered will depend on the level of demand from African NRENs and the training media used to deliver them (using less expensive media, such as distance learning, more topics can be delivered). It would be expected that a number of trainers would be also trained during these programmes so that the course could be provided locally for other NRENs and for the connected institutions.

3.5.2 Foundation Level NREN Technical Training

- An Introduction to LAN and WAN technologies
  To include the fundamentals of Ethernet, ISDN, ATM, PDH and SONET/SDH paying particular attention to how they are used to build IP networks.
- Introduction to the Internet Protocol suite
  To include a review of the structure of the IP (v4) packet, common link-layer encapsulation schemes, IP addressing, ICMP, TCP, UDP.
- IP Network Monitoring I
  Using SNMP polling, MIBs and open source-tools like MRTG, Cricket, etc to display traffic statistics.
- Internet Services
  DNS (fundamentals, configuration and operation), FTP, telnet, e-mail (SMTP, POP, IMAP).

3.5.3 Intermediate Level NREN Technical Training

- Interior Routing Protocols
  Introduction to OSPF and IS-IS.
- Exterior Routing Protocols
  Concentrating on BGPv4 and its use in Internet Routing (including the notion of Autonomous Systems and the use of Routing Registries).
- Multicast
  Fundamentals of multicasting, terminology, addressing, IGMP, PIM, multicast extensions to BGP, MSDP, SSM, common multicast-enabled applications.
- IP Network Monitoring II
  Alarms, SNMP traps, syslog, Netflow statistics, network performance monitoring (e.g. RIPE TTM boxes / AMPlets from NLANR).

3.5.4 Advanced Level NREN Technical Training

- Security
  Establishing a CERT, configuring and using IDS & Firewalls, security evaluation techniques, NATs, VPN technologies, etc.
- IP Quality of Service
  DiffServ, Premium IP, less than best efforts, etc.

- IPv6
- MPLS
- Optical Networking
  Transmission in optical fibre (types of fibre, light sources, attenuation, dispersion), WDM transmission systems, optical ADMs and cross-connects, IP/WDM, GMPLS, OBGP.

3.6 Summary of main tasks and key partners

- Development of a regional NOC function:
  - Development of NOC function requirements document.
  - Preparation for a tender for a regional NOC function (among the advanced African NRENs).
  - Development of an operational model to be followed.
  - Key partners: DANTE.
  - Support needed from: African and EU NREN engineers with operational experience, NSRC, AfNOG, CLARA NOC.
- Development of a regional NEG function:
  - Development of regional NEG requirements document.
  - Preparation for a tender for a regional NEG function (among the advanced African NRENs).
  - Development of regional network engineering principles document.
  - Development of IP routing rules and procedures document.
  - Key partners: DANTE.
  - Support needed from: African and EU NREN engineers with experience in network engineering and planning, NSRC.
- Training and capacity building for engineering and operations:
  - Development of tailor made training courses for each of the identified African NRENs and the UbuntuNet Alliance.
  - Key partners: TERENA, EU NRENs that are interested to take “twinning” responsibilities.

4 Risk Mitigation

There are substantial risks involved in implementing a project for a REN in sub-Saharan Africa. From the information gathered in FEAST D2A and the analysis carried out in D2B, it is evident that the identified African NRENs are not as strong a group as were (for example) the NRENs that joined the Latin American ALICE project. Latin America benefited from the Brazilian participation as beneficiary country with a very strong NREN, and also from the long standing experience of the NRENs in Chile, Mexico and Argentina. Similar experience today is only available in South Africa.

The state of development of the majority of the identified African NRENs can be compared to that of (for example) Guatemala or Nicaragua at the beginning of the ALICE project. Guatemala today is a strong member of the ALICE2 project and connected to RedCLARA at high speed. Nicaragua, on the contrary, failed to benefit from the ALICE project and dropped out during its second year.

From this experience, it is realistic to say that the implementation project in sub-Saharan Africa will be successful for a subset of the identified African NRENs, who will be able to connect to the REN. But it is also realistic to suggest that some of the African NRENs may require extra time or resources to successfully connect.

To ensure that such risk is mitigated as much as possible, it is necessary to conjointly work on a risk analysis to ensure the early commitment of the identified African NRENs, as well as the interested EU NRENs. It is also evident that to minimise the financial risk of the project, the FEAST team will have to seek the close collaboration of relevant philanthropic organisations, NGOs active in the region, and other donating agencies.

This is probably the most important and the most immediate activity to be carried out by the FEAST team and its supporters.

4.1 Key Players

The risk mitigation of the implementation project will need strong collaboration between the stakeholders in the project. These are

- The European Commission.
- The African Union Commission.
- ACP Secretariat.
- The UbuntuNet Alliance.

- The identified African NRENs.
- The European Coordinating partner.
- EU NRENs and TERENA.
- Connectivity providers and suppliers.

It will also need the close involvement of NGOs active in the arena and the region, as well as philanthropic organisations and donating agencies.

Only if all these stakeholders and institutions can be brought to provide a joint effort will the implementation project succeed. Each institution will have to contribute to their full potential, and will have to demonstrate good will, commitment and eagerness to collaborate. Any activity that would lead to a division of the main stakeholders would construe a serious risk to the activity as a whole.

4.2 Engaging the identified African NRENs

The FEAST team has identified the NRENs in Ethiopia, Kenya, Malawi, Mozambique, Rwanda, South Africa, Sudan, Tanzania and Uganda as most likely to be in a position to benefit from an implementation project. Appendix A gives an overview of the respective readiness of these identified African NRENs and the state of the current NREN infrastructure and organisation.

As a next step, it is essential that these identified NRENs understand the rules, processes, procedures, benefits, responsibilities and duties of being a partner in an EC project. It will be essential to ensure that the identified African NRENs have a clear understanding of the steps that are to be taken towards the implementation process. It has to be stated that for a newcomer to EC projects, the list of administrative steps can be quite discouraging and it is therefore necessary that the identified African NRENs are carefully walked through the process in detail. See the detailed information in Appendix E.

The following is a list of steps that would need to be explained in detail as they lay the foundation of the initial procurement phase of an implementation project:

- The proposal writing process.
- The need to register their organization in an EC database and obtain a beneficiary number.
- The need to sign a “Principle of Good Membership” agreement.
- The need for a letter of intent entering the procurement phase of the project.
- The need to pay an initial 20% share of the cost of the procurement phase of the project.
- The way travel and per diems are reimbursed during the procurement phase of the project.
- The need for a bank account that can handle Euro transfers.
- The NREN involvement during the connectivity and equipment procurement process.
- The fact that the European Coordinating partner will make an offer of connectivity that will need to be accepted by the NREN before implementation can start.

The cost sharing model adopted based on shared costs and access costs and the way a connected African NREN would have to contribute to the 20% African contribution to the project (signature of a bilateral contract and the Service Confirmation Form).

The information on the points above should be made available to the identified African NRENs in writing, as well as in a face-to-face meeting organised in Africa. The face-to-face meeting should address the identified African NRENs as a group rather than individually. Such a meeting could be organised during the time of the FEAST study, and could also be used to deepen the understanding of the respective training needs of the NRENs, as well as further work on identification of ongoing projects and applications. It is to be noted that the meeting would need to be attended by the right people from the identified African NREN organisations, and should only focus on the identified African NRENs and the UbuntuNet Alliance. It would need to be a real working meeting to achieve results and ensure that the African partners understand the processes and benefits.

4.3 Engaging the interested EU NRENs

A key to the success of the implementation project for Africa will be the support and commitment from the EU NREN partners. The FEAST team is already supported by several EU NRENs (most notably DFN). However, further and deeper involvement, specifically in training and capacity building and potentially through the means of “twinning”, will be needed.

Ideally, the implementation project should be backed by the entire European GÉANT community. It is essential that the EU NRENs not only involve their managerial staff but also allow committed engineers to dedicate manpower to the various activities. It will need to be discussed with the EU NRENs, both individually and as a group, where their contribution should be. It seems at this stage that the easiest way of ensuring effective support is through the means of “twinning” where each respective EU NREN would work to meet the specific needs and requirements of its “twinned” African NREN.

It is recommended that the FEAST partners organise a workshop for the interested EU NRENs to discuss the task ahead, ensure communication between those EU NRENs that are already playing an active role, make use of maximum synergies, and to form a strong European support team for implementation. This workshop should take place in a European location and should make use of the funding still available to FEAST. As it is more essential to meet with the identified African NRENs, the workshop for EU NRENs should be organised towards the end of the FEAST study.

4.4 Engaging Relevant Philanthropic Organisations and Donating Agencies

It is uncertain in how far the identified African NRENs and the UbuntuNet Alliance will be able to actively contribute their required 20% share of the funding for the implementation project. It has been seen in other regional projects that the collection of the 20% share is not a straightforward task and constitutes a real financial risk to the European Coordinating partner.

The FEAST activity D2A has identified several philanthropic organisations and donating agencies that are already working in similar fields in the respective region. Examples are the

World Bank, the African Development Bank, the Bill and Melinda Gates Foundation, the Open Society Institute, the Shuttleworth Foundation, Carnegie Mellon, PHE, ISOC, IDRC, SIDA, etc.

The established dialogue with these organisations and agencies will need to be strengthened over the coming months, and it should be explored in detail in how far they would be able to contribute financially to the 20% share required from the African partners.

In a parallel discussion, the FEAST partners should determine with the EC whether the 20% share from the African partners is a hard requirement, or whether it could be changed to smaller percentage if it becomes clear that 20% will not be met.

4.5 Risk Analysis

A detailed Risk Analysis has been undertaken. This section describes the major factors in this analysis, and refers to the detailed mitigation analysis in Appendix F.

4.5.1 Major Stake holders in Project

- European Commission.
- African Union Commission.
- ACP Secretariat.
- Regional Network, UbuntuNet Alliance.
- NRENs in region.
- European Coordinating Partner.
- TERENA.
- Suppliers.
- Other Contributors.

4.5.2 Risk activities

The following activities were identified to carry out the risk analysis:

- Risk identification.
- Risk assessment, severity/likelihood.
- Risk treatment, avoidance, reduction, treatment and transfer (pass on).

4.5.3 Risk Analysis

The detailed analysis of the risks identified in this project are given in Appendix F. This orders the risks and describes potential mitigations for each risk.

4.5.4 Strengths Weaknesses Opportunities and Threats (SWOT) Analysis

The following, non exhaustive, list identifies the strengths, weaknesses opportunities and threats posed by this project.

4.5.4.1 *Strengths:*

- National ICT plan in place.
- National fibre plan implemented.
- Experiences in Latin America, Asia etc.
- European NREN skills.
- GÉANT.
- Three sea cables arriving shortly
- Existence on the UbuntuNet Alliance
- Current investment in infrastructure
- Existing cash to purchase VSAT technology by institutions
- New technologies such as LEO satellites.

4.5.4.2 *Weaknesses:*

- Lack of funding by African beneficiaries.
- Lack of political will.
- Mistrust of neighbours by African politicians.
- Lack of Infrastructure in Africa to allow adjacent countries connect.
- Lack of infrastructure to some landlocked countries.
- Lack of cohesiveness in UbuntuNet Alliance.
- Lateness of delivery of AfricaConnect funding.
- NRENs may become fragmented due to individual national plans.

4.5.4.3 *Opportunities:*

- Greenfield network implementation.
- Enthusiastic staff.
- Development of Higher education in Africa.
- Fulfilment of national development aid aims by Europe.
- Enhance research cooperation with Africa.
- Model for other regions in Africa.
- Economic gain in both Africa and Europe.
- Coordination with other donors to Africa.
- Support from the AAU and AUC.
- Delivery of AfricaConnect funding.

4.5.4.4 *Threats: (Challenges):*

- Competition from India, China, USA.
- Economic downturn diverts national efforts elsewhere.
- Political instability in some countries.
- Unsatisfactory response to tender procedures.
- Sub optimal solution for REN due to high telecommunication costs.

4.6 Summary of main task and key partners

- Deepening of relations with identified African NRENs:
  - Development of information pack for identified African NRENs.
  - Organization of workshop in Africa (Kampala, November 2009).
  - Meeting between UbuntuNet Alliance and DANTE Management (July 2009).
  - Key partner: DANTE.
  - Support needed by KTH, TERENA, UbuntuNet Alliance, African NRENs.
- Deepening engagement of EU NRENs:
  - Promoting “twinning” and furthering commitment of EU NRENs.
  - Organization of an EU NREN meeting (October 2009, Berlin, Dublin, Amsterdam).
  - Key partner: TERENA.
  - Support needed by KTH, DANTE, DFN, interested EU NRENs.
- Engaging philanthropic organizations and donating agencies:
  - Key partners: KTH.
  - Support needed from DANTE, TERENA, IRNC, SIDA, World Bank etc…
- Discussion with DG AidCo on potential scenario that identified African NRENs will not be able to meet the 20% contribution required:
  - Key partner: DANTE.
  - Support needed from KTH, TERENA, UbuntuNet Alliance, identified African NRENs, DG INfSo.
- Risk Analysis and Mitigation Plan:
  - Develop a detailed risk analysis document for the implementation project.
  - Develop a financial risk analysis with respect to 20% African contribution and possible mitigation plan.
  - Key players: DANTE, KTH, TERENA.
  - Support needed from UbuntuNet Alliance, identified African NRENs.

Appendix A State of Readiness of the identified African NRENs

While all of the African countries were studied in the FEAST activity D2A – Information Gathering, it was only possible to make a detailed study of, and visits to, a much smaller grouping of Eastern and Southern African countries that D2A had identified. Throughout the second Phase of the FEAST study, a series of "Readiness" criteria were developed by the partners in order to assess which African NRENs could profit from an implementation project.

The Readiness Criteria are:

- Organisation and human resources: Are there sufficient staff employed by the NREN?
- Acceptable use and connection policies: Have these been developed and published?
- Interconnected campus networks of member institutions: Is there more than one institution connected to the NREN?
- Number plan from AfriNIC: Have public IP addresses and AS numbers been allocated?
- Lighthouse Demonstrators: Have projects been identified that would benefit from improved and coordinated connectivity?

The table below groups the identified African NRENs into four categories of readiness.

The first are the "really ready" countries. South Africa is included in this list as an example of one such country. The second group are countries that are nearly ready and where only some small remedial action is needed to ensure their readiness.

The third category are NRENs whose state of development is more problematical and an early investment in training and capacity building should remediate the situation and bring these countries up to a level of readiness that would allow them to participate in the implementation project.

The fourth grouping contains a number of countries with easy sea cable-access that could take advantage of the cable landing points to connect their NRENs with a small degree of effort.

Further analysis of the positions of these three NRENs should be undertaken during the remaining time of the FEAST project.

		Organisation, Human Resources	Acceptable Use Policies	Interconnected Networks	IP Numbers from AfriNIC	Applications Demonstrators
Ready Group	Kenya	√	√	√	√	√
	South Africa	√	√	√	√	√
Nearly Ready	Rwanda	√	**?**	√	√ **(?)**	√
	Mozambique	√	**?**	√		√
Require Remediation	Uganda					√
	Tanzania					√
	Malawi	√ **(?)**	√			√
Cable Opportunities	Djibouti					
	Ethiopia					
	Sudan					

Table A.1: State of readiness of identified African NRENs

The following summarises the immediate actions that need to be taken to bring the respective NREN into a state of full readiness:

Rwanda: Publish Acceptable Use Policy/Consumer Policy (AUP/CP) and acquire IP numbers and Abstract Syntax Notation (ASN) from AfriNIC, though the National University of Rwanda already has the required numbers.

Mozambique: Publish AUP/CP and acquire IP numbers and ASN from AfriNIC.

Uganda: Publish AUP/CP and acquire IP numbers and ASN from AfriNIC, recruit staff, connect other institutions to the network (currently only Makerere University is connected).

Tanzania: Publish AUP/CP and acquire IP numbers and ASN from AfriNIC, recruit staff, connect other institutions to the network, formalise official sponsorship on a national basis.

Malawi: Publish AUP/CP and acquire IP numbers and ASN from AfriNIC, recruit staff, ensure international terrestrial connectivity.

The readiness table above shows that a number of the identified African NRENs have a physical network in place in their country. However, with the exception of Kenya and South Africa, most of the other countries have restricted national networks or have networks in the planning phase.

The following list describes briefly the situation in the countries under study:

Kenya: An extensive national network is being implemented under contract with a national data supplier. This network is based on fibre connections largely, but there are a few Synchronous Digital Hierarchy (SDH) links where fibre is not possible.

Rwanda: While the two main universities are already connected on fibre, the national fibre plan proposes connectivity to all the public universities. At the moment, the severe shortage of staff does not allow for the implementation of this plan.

Mozambique: An extensive metropolitan area network (MAN) exists in Maputo, based on a combination of fibre and wireless links. However, little production traffic is carried on this network. However, once MoRENet (the NREN in Mozambique) is connected to the sea cable, this MAN will become the conduit for the connected institutions. Plans are underway to connect the institutions outside Maputo, but the scale of the country provides some special challenges.

Uganda: Currently, only Makerere University in Kampala is connected to RENU and most activity takes place in Makerere, however the CEO of RENU is from another university close to Kampala, so there is some approach to expanding the network.

Tanzania: Internal structural problems between TERNET and a number of government ministries mean that there is little real networking activity in Tanzania. There is scope for a metropolitan area network to connect a large number of institutions in Dar es Salaam and several fibre plans exist to connect the rest of the country.

Malawi: Several institutions are connected together by fibre in Blantyre already and there are plans to connect Lilongwe and Mangochi by wireless and fibre.

The NREN readiness table above identifies the development issues in the identified African NRENs. Clearly, Kenya is the only NREN that has a high level of development and is in an immediate position to deploy the facilities that could be provided by an implementation project in the short term.

All of the other NRENs have severe developmental requirements that need to be tackled and resolved before they will be able to benefit from any implementation project. Training and capacity building is required at all levels: Strategic, Management, Technical and Operational.

At present, most institutions in the African countries are paying for their own VSAT services directly to the VSAT suppliers. Generally, there are no direct connections between the institutions or between the institutions and the NREN. The funding that currently is used for the VSAT services will be required to build and maintain the national networks and may not be sufficient to fund the 20% co funding requirements as well.

As most of the countries involved in the study are at the very bottom of the GDP world league (see D2B for an overview), there is a concern that these countries will not be in a position to take over the full burden of the costs of the regional network in a three- to five-year timeframe while building up their knowledge economies in a satisfactory manner. It is unlikely that the NRENs will be able to self-sustain an African REN in the near future.

Appendix B National Licensing Programmes

All of the countries in which the identified African NRENs are located have the appropriate licenses and enjoy the support of their Telecommunications Regulators. In general, there is a very good relationship between the Regulators and the NRENs. The following table summarises the licensing position in the countries:

Country	Market Officially Liberalised	Market State	NREN License Issued
Djibouti	No	State Incumbent	No NREN
Ethiopia	No	State Incumbent	NREN working as state agency
Kenya	Fully	Competitive	Yes, License issued to NREN, including international Gateway licence
Malawi	Fully	De-facto Duopoly	Yes, License issued to NREN
Mozambique	Fully	Monopoly	None Required and confirmed in writing by Regulator
Rwanda	Fully	De-facto Duopoly	May be required when NREN has infrastructure
Tanzania	Fully	Competitive	None Required
South Africa	Fully	Competitive	Yes, License issued to NREN, including international Gateway licence

Country	Market Officially Liberalised	Market State	NREN License Issued
Sudan	No	Private Incumbent	NREN working as state agency
Uganda	Fully	Competitive	None Required

Table B.2: Overview of regulatory environment

It is interesting to note that the two most ready NRENs to provide support for a possible regional NOC (Kenya and South Africa) both have full international licenses.

Appendix C Project Planning Overview

The following lists summarise the key points made in this document.

C.1 Procurement Planning

- Deepen engagement of connectivity suppliers:
  - Leave RFI open for further submissions.
  - Check connectivity providers contact details correct.
  - Engage with AfNOG.
  - Lead discussions with connectivity providers.
  - Disseminate objectives of FEAST and implementation project.
  - Key partners: KTH, DANTE.
  - Support needed from identified African NRENs, UbuntuNet Alliance.
  - Dissemination support needed from TERENA.
- Deepen engagement of equipment providers:
  - Equipment import, installation, ware-housing and maintenance.
  - Possibility of donations.
  - Possibility of supporting the creation of NRENs.
  - Key Partner: DANTE.
  - Support needed from identified African NRENs, UbuntuNet Alliance.
- Required Tender procedure and derogation from Rule of Origin:
  - Discuss with DG AidCo the need for the negotiated procedure or the competitive dialogue procedure.
  - Discuss with DG AidCo the need for a derogation from the rule of origin for services and supplies.
  - Ensure that the EC contract reflects the requirements.
  - Key Partners: DANTE, KTH.
  - Support needed from DG INfSo.
- Prepare the Connectivity and Equipment procurement:
  - Write the ITT for the connectivity procurement.
  - Write the ITT for the equipment procurement.
  - Decide on evaluation criteria.
  - Assemble a team of experts from EU and Africa for the evaluation of the connectivity and equipment tender responses.
  - Train African experts on the evaluation of the tender responses (if needed).
  - Key Partner: DANTE.
  - Support needed from EU NRENs and identified African NRENs, UbuntuNet Alliance.

C.2 Engineering and Operational Planning

- Development of a regional NOC function:
  - Development of NOC function requirements document.
  - Preparation for a tender for a regional NOC function (among the advanced African NRENs).
  - Development of an operational model to be followed.
  - Key partners: DANTE.
  - Support needed from: African and EU NREN engineers with operational experience, NSRC, AfNOG, CLARA NOC.
- Development of a regional NEG function:
  - Development of regional NEG requirements document.
  - Preparation for a tender for a regional NEG function (among the advanced African NRENs).
  - Development of regional network engineering principles document.
  - Development of IP routing rules and procedures document.
  - Key partners: DANTE.
  - Support needed from: African and EU NREN engineers with experience in network engineering and planning, NSRC.
- Training and capacity building for engineering and operations:
  - Development of tailor made training courses for each of the identified African NRENs and the UbuntuNet Alliance.
  - Key partners: TERENA, EU NRENs that are interested to take “twinning” responsibilities.

C.3 Risk Mitigation

- Deepening of relations with identified African NRENs:
  - Development of information pack for identified African NRENs.
  - Organization of workshop in Africa (Kampala, November 2009).
  - Meeting between UbuntuNet Alliance and DANTE Management (July 2009).
  - Key partner: DANTE.
  - Support needed by KTH, TERENA, UbuntuNet Alliance, African NRENs.
- Deepening engagement of EU NRENs:
  - Promoting “twinning” and furthering commitment of EU NRENs.
  - Organization of an EU NREN meeting (October 2009, Berlin, Dublin, Amsterdam).
  - Key partner: TERENA.
  - Support needed by KTH, DANTE, DFN, interested EU NRENs.
- Engaging philanthropic organizations and donating agencies;
  - Key partner: KTH.
  - Support needed from DANTE, TERENA, IRNC, SIDA, World Bank etc…
- Discussion with DG AidCo on potential scenario that identified African NRENs will not be able to meet the 20% contribution required:
  - Key partner: DANTE.
  - Support needed from KTH, TERENA, UbuntuNet Alliance, identified African NRENs, DG INfSo.
- Risk Analysis and Mitigation Plan:

- Develop a detailed risk analysis document for the implementation project.
- Develop a financial risk analysis with respect to 20% African contribution and possible mitigation plan.
- Key players: DANTE, KTH, TERENA.
- Support needed from UbuntuNet Alliance, identified African NRENs.

Appendix D NREN Services and Activities

The following is a detailed list of tasks and activities that need to be taken into account by a developing NREN. This list was produced by Koen Schelkens from the Belgian NREN (BELNET) and is part of the work of the TERENA Management of Service Portfolios Task force. It can act as a checklist for any developing or emerging NREN and as a benchmark for more developed NRENs.

D.1 Network & connectivity services

1. Basic IP-connectivity services: commercial internet vs. research & educational networks
2. Customer connections to the NREN-backbone: type of connections +specific routing configurations (BGP, VRRP …)
3. Carrier/telco -service between NREN<-> "customer" managed circuits or dark fibre
4. Bandwidth on demand
5. End-to-End connectivity for end users groups (incl. Lightpaths - wavelengths)
6. Access@home - for end users – Student rooms…
7. Wireless access (WLAN services from NREN – WIMAX- WIFI)
8. VPN-services (incl. Lightpaths, MPLS-VPNs, VPN- encryption & IP-tunnels) 1.9.DNS services
9. NTP-service
10. IPv6 (enabled network, experiment & promotion)
11. IP-Multicast (enabled network, experiment & promotion)
12. Network Support services:
    a. 7*24 Helpdesk
    b. 7*24 Network Monitoring (customer connection: for ex. including real-time & periodic reporting services- bandwidth usage – SLA measurement etc.)
    c. Performance Enhancement Response Team (PERT)
    d. Detective –tool (SURFNet, Internet2 detective)
13. IP & DNS Registration services:
    a. IP-address allocation (AFRINIC LIR for IPv4, IPv6, Multicast IP)
    b. Domain name registration (National TLD + other: .eu, .org…)
    c. ENUM registration (Phone number -> internet domain name)

D.2 Security services

1. CSIRT - CERT: Computer Security Incident/Emergency Response Team
2. Anti-virus control: (+ Anti spam?)
3. Intrusion prevention
4. NETFLOW monitoring tool
5. Vulnerability testing tool (Network & web services)

D.3 Authentication & "Mobility" services

1. Authentication & Authorisation Infrastructure (single sign on for all applications/services)
2. Identity management systems
3. PKI certificate service
4. Server Certificate Service
5. Inter-(W)LAN/network access: EDUROAM

D.4 Housing - Storage – hosting – content delivery services

1. Housing /co-location facilities
2. Webhosting /Hot standby
3. Mail relay / back up services
4. Disaster recovery – off site back up services
5. Storage Area Network (SAN) – infrastructure
6. Netnews/Usenet server
7. Academic/educational software distribution: frame agreements & clearing (see also 4.4)
8. FTP & Mirroring services (Proprietary & non proprietary software, Wiki…-)
9. Hosting services/applications for research and educational community (for. Ex. Scientific databases, WIKIs, administration tools ...)
10. Media storage and –streaming facilities
    a. Media portals
    b. Streaming facilities (streaming server, podcasting, p-to-p facilities)
    c. Media conversion services

D.5 Network communication tools & conferencing

1. (Video) conferencing tools/application + MCU & gatekeepers service
2. VoIP / IP-Telephony and/or IP-Voice gateway service (VoIP <-> PSTN)
3. Instant Messaging (IRC, JABBER etc..-)
4. Mailing List services
5. E-Mail gateway services (e-mail < -> fax, sms, pager.)
6. Search Engines
7. Anti-spam services

D.6 Network computing resources

1. GRID computing (for ex. Co-ordination within NREN community, offering CPU, gatekeeper…)

D.7 E-Learning / Tele-teaching /e-research

1. Virtual Learning Environments (VLE's)
2. Digital Repositories

D.8 User interaction - knowledge dissemination

1. Consultancy and advice
2. Training: workshops, seminars
3. Support &User Portals
4. User (advisory) groups /forums
5. User BLOG's (Per user category / thematically)
6. User conferences
7. NREN publications:
   a. Newsletters
   b. Magazines
   c. Cookbooks / user manuals

D.9 NREN side activities / services (not NREN-users specific)

1. Registry for national domains
2. National Internet Exchange

D.10 Other criteria for service classification/categories:

D.10.1 Target group / scope

1. Focus on connected Institutions (wholesale) or end users (retail)?
2. Focus on specific user segment: research/education/ICT-dept/…

D.10.2 Basic, Optional or Advanced…

1. Basic/standard Service (included in standard package -for example. Connectivity, IP-assignment, news services…)
2. Optional service (charged extra – on customer request)
3. Advanced Service (technology push/ R&D/ high end service for research)

D.10.3 Functional order (~ relation with NREN organisational structure):

1. Network operations services
2. R&D services
3. Security services
4. Middleware services
5. Registration services ("HOSTMASTER"- function)
6. User support & communication

Appendix E Information for African NRENs

As a result of the FEAST review that took place in Malaga in June 2009, it was decided by the FEAST partners that closer dialogue needs to be sought with the Southern and Eastern African NREN community and the UbuntuNet Alliance to ensure that early information is shared about the process and procedures involved regarding the collaboration in an implementation project for connectivity among Southern and Eastern African NRENs and towards GEANT.

DANTE would therefore like to start this dialogue by providing some Questions and Answers (Q&As) that we have seen as being important in EC regional projects that DANTE has led in the past.

Note

It has to be made clear at this stage that there is no contract yet for an implementation project, which means that the precise details are not known. Therefore, these questions and answers represent an overview of the issues that have been experienced in regional activities in the past.

Q: What is the likely form of the project?

A: It is likely that the implementation project will be divided into two phases. Phase A would be the planning and procurement phase. Phase B would be the implementation and operational phase. Phase A would last around 8-12 months, followed by approximately 24 to 36 months of Phase B.

Q: How would African NREN partners join the project?

In all past projects it has been an EC requirement that the beneficiary partners provide the following documentation:

- Letter of intent and financial commitment to Phase A of the project.
- Letter of Endorsement from relevant Ministry, stating that the organisation is driving the NREN effort within the country.
- Agreement to “Principles of Good Partnership”.
- Possibly also the completion of a registry with EC database to obtain a beneficiary number.

In addition to this, for Phase A the European Coordinating Partner requires signatures on a bilateral agreement that lays out the relationship between the Coordinating partner and the

beneficiary NREN. In addition, there is the need for a financial contribution to Phase A (see below).

For Phase B there would be the need to sign a bilateral agreement which contains also the definition of the connectivity services to be delivered and their payment schedule (Service Confirmation Form).

Q: What happens during Phase A?

A: During Phase A the European Coordinating partner will carry out the procurement for the connectivity and equipment required. At the same time the African NREN partners will have to look towards the establishment of a regional NOC and regional NEG.

Q: What is the African financial contribution to Phase A?

A: In all projects that have been carried out so far, there has been the need for a 20% overall contribution to be collected from the beneficiary countries. This would be the same for Phase A. The African NRENs would be required to contribute 20% of the costs of Phase A. The costs of Phase A will be manpower and travel only and the timing limited, therefore the 20% contribution should likely be between Euro 5000 and 15000 per African partner (the amount depends on the number of beneficiary countries to join Phase A).

Q: What happens after Phase A?

A: Phase A will end with offers to be made by the European Coordinating partner to the African NRENs. These offers will be based on the outcome of the connectivity and equipment procurement process (approved by the EC) and will follow a pre-agreed cost-sharing model. The African NRENs will be presented with an offer that will lay out precisely the connectivity service they will receive and what their share of the 20% contribution would need to be. Only when the African NREN signs the Phase B contract with the European Coordinating Partner will the NREN be participating in Phase B of the project.

Q: What happens if only a few African NRENs wish to join Phase B?

A: In the past, the contract between the EC and the European Coordinating partner fixed the number of NRENs that had to enter Phase B for the project to continue. It is suggested that this would also form part of the contract in the case of an African project.

Q: What would the project provide to the African partners?

A: Those African NRENs that chose to participate in Phase B of the project (under the terms offered to them in the project) would ideally see the interconnection of their NRENs with each other and to the European GEANT network. There would be regular project meetings (in the African region) and also capacity building and training workshops organized for the NRENs participating. The EC funding would cover 80% of the costs of the infrastructure, the equipment, the manpower for running the project and the infrastructure, as well as for the training and capacity building costs. The remaining 20% would be covered via the participating NRENs contribution to Phase B.

Q: How would the project be managed?

A: The EC rules require that a European coordinating partner will be responsible for all the contracting that is done within the project. This also includes the financial administration. It would be hoped that the African partners would share the general project management and the

day-to-day work. All the manpower required to do manage the project would be paid for via the project's budget.

Q: Who would be responsible for the project reporting to the EC?

A: The European Coordinating partner would be responsible to ensure that project deliverables are submitted to the EC in a timely fashion. The responsibility for the writing of the reports and deliverables would ideally be shared between the European coordinating partner and the project partners. The detail of the share would be agreed between all the partners when the project proposal is drafted.

Q: What has been a major hurdle to NRENs in the past?

A: It has been observed that some NRENs struggle with the administrative side of entering a project. This might involve the signature on letters or contracts. But also quite mundane matters such as obtaining a bank account that can handle Euro transfers. Another major hurdle has been the regular payment of Phase B 20% contribution.

Q: What are the next steps at this point in time (June 2009)?

A: The EC will need to finalise their internal discussions that will lead to contract negotiations between the EC and the European Coordinating Partner. This should be carried out between Q4/2009 and Q1/2010. If DANTE is to be the Coordinating Partner a formal approval from the DANTE Board is needed before DANTE can enter the negotiations with the EC. In parallel, the FEAST team will continue their work on the roadmap and the final report. It is essential that closer conversations take place between the European and African partners. It is hoped that the UA will visit DANTE at the end of July 2009. Further discussions where the points made above will be discussed in detail will take place in Addis Abeba in September 2009.

Appendix F Risk Register

The following pages contain tables of all identified risks for this project. Each risk is identified by a **Risk Number** for ease of discussion. Note also the **Severity**, **Likelihood** and **Risk Level** parameters.

Risk Number	Category	Description	Severity (1-5)	Likelihood (1-5)	Risk Level (Severity * Likelihood)	Mitigation or Action to be taken	Primary Action By	Secondary Action By
1	Financial	Restrictive equipment purchasing restrictions in the contract with the EC leading to late or suboptimal networking solutions	5	5	25	Negotiate contract with EC to allow a derogation to the AIDCO "Rule of Origin"	EC	
2	Financial	Restrictive conditions of hiring of consultants in the contract with the EC leading to delayed or suboptimal solutions	5	5	25	Negotiate contract with EC to allow a derogation to the AIDCO "Rule of Origin"	EC	
3	Financial	Inability of some NRENs to purchase appropriate equipment due to national or international trade barriers	5	5	25	May eliminate the relevant NRENs from the first phase of AfricaConnect until issues can be resolved through political efforts	African NRENs	AAU, AUC, EC
4	Financial	Failure of African partners to finance the network after the grant period	5	4	20	UbuntuNet Alliance to work with members NRENs to ensure that funding is available, pass funding through UbuntuNet Alliance to consolidate its central role	African NRENs	EC
5	Financial	Cash Flow problems due to slowness or inability of NRENs to pay their 20% share	4	5	20	Seek assurance from EC of ability to use up to 100% of the EC funds allocated in the event of a shortfall in receipts from NRENs. Bill ahead for up front membership fee plus 15% of annual charge. Letters of Credit confirmed on a European bank	EC	African NRENs, European Implementation Body
6	Financial	Credit Worthiness of NRENs, (inability to pay their 20% share)	4	5	20	Seek assurance from EC of ability to use up to 100% of the EC funds allocated in the event of a shortfall in receipts from NRENs. Bill ahead for up front membership fee plus 15% of annual charge. Letters of Credit confirmed on a European bank	EC	African NRENs, European Implementation Body
7	Financial	Rigid enforcement of EC "Rule of Origin" in sourcing required equipment and services	5	3	15	Negotiate contract with EC to allow a derogation to the AIDCO "Rule of Origin"	EC	
8	Financial	Inability of some NRENs to pay euro denominated invoices to the European Implementation Body	5	3	15	May delay the relevant NRENs from the first phase of AfricaConnect until arrangements can be made to transfer funds to a European clearing bank	African NRENs	AAU, AUC, EC
9	Financial	Lack of finance/facilities in NREN to connect user institutions in the country to the national networking infrastructure	3	4	12	Political action in country to convince the potentially connected members that the NREN is the most efficient route for network connectivity in the long run	African NRENs	

Risk Number	Category	Description	Severity (1-5)	Likelihood (1-5)	Risk Level (Severity * Likelihood)	Mitigation or Action to be taken	Primary Action By	Secondary Action By
10	Financial	Inability to arrange reimbursement of personal expenses of NREN staff working on the project resulting in staff being unable to attend or participate	1	3	3	Special financial arrangements may need to be put in place to ensure reimbursement of participants	European Implementation Body	
11	Operational	Failure of UbuntuNet Alliance to recruit and retain appropriate full time staff	5	5	25	Enhance the capacity building programme	UbuntuNet Alliance	
12	Operational	Lack of key staff in connected institutions leading to problems in connecting and maintaining appropriate connections to the NREN	5	5	25	Early capacity building programmes to be initiated by the NRENs with the assistance of the AfricaConnect funding for Capacity Building.	African NRENs	
13	Operational	Unacceptably high staff turnover in REN and NRENS	5	5	25	Enhance the capacity building programme, ensure that NREN managers have suitable HR training to ensure that their staff are suitably trained and motivated	UbuntuNet Alliance	European Implementation Body and EC
14	Operational	Unavailability of trained staff in NREN and REN	4	5	20	Enhance the capacity building programme, ensure that NREN managers have suitable HR training to ensure that their staff are suitably trained and motivated	UbuntuNet Alliance	European Implementation Body and EC
15	Operational	Uncontrolled security incidents in either the REN, the NREN or connected sites leading to international incidents	4	5	20	Enhance the capacity building programme, technical training of the NREN engineers, frequent seminars, conferences. Close contact with developed NRENs around the world.	African NRENs	
16	Operational	Electrical power supply availability and quality problems at NREN and REN sites	4	4	16	Ensure local backup power supply (generators) and appropriate supplies of fuel stored close to generator	UbuntuNet Alliance	African NRENs
17	Operational	Sea cable does not live up to expectations	5	2	10	Fall back to using other sea-cables, VSAT or the new LEO satellite services	Sea Cable Suppliers	
18	Operational	Inability to deployment of lighthouse demonstrators programmes that could threaten subsequent phase of AfricaConnect funding	3	3	9	calls for proposals/tenders for capacity building by education, training and deployment of applications that can serve as lighthouse demonstrators	African NRENs	European Implementation Body and EC
19	Political / Strategic	Over commitment by African NREN leaders performing several tasks and duties other than just managing the NREN	5	5	25	Document staffing requirements and the need for dedicated professional staff	African NRENs	UbuntuNet Alliance
20	Political / Strategic	Sea cable not terminated in landlocked countries	5	5	25	All participants to take whatever political action that is required to ensure that the landlocked countries have appropriate connectivity. Seek help of AAU, AUC, EC	EC, AUC, AAU, NRENs and project teams	

Risk Number	Category	Description	Severity (1-5)	Likelihood (1-5)	Risk Level (Severity * Likelihood)	Mitigation or Action to be taken	Primary Action By	Secondary Action By
21	Political / Strategic	Political instability at a national level in NREN countries	5	4	20	European Implementation Body to maintain vigilance	EC, European Implementation Body	
22	Political / Strategic	Commercial interests by public-sector staff in NRENs, possible conflict of interest	4	4	16	Assess the risks in the local NREN and establish a register of commercial interests.	African NRENs	
23	Political / Strategic	Corruption on a national basis	4	4	16	Awareness programme	European Implementation Body	
24	Political / Strategic	Inability to establish AfricaConnect NOC & NEG	4	4	16	Outsource the NOC or NEG to an individual NREN in Africa or elsewhere if not possible in Africa	European Implementation Body	
25	Political / Strategic	Lack of understanding of role of NREN in country	3	5	15	Political action in country by the NREN by frequent communications with the potential members, seminars, meetings, conferences etc.	African NRENs	
26	Political / Strategic	NRENs purchasing connectivity to UbuntuNet router in London independently of AfricaConnect	3	5	15	UbuntuNet Alliance to take political action with their members to ensure that the UA Router in London is not used to replace or supplant a "real" African network. Allow connections to London of a short term (1 year) basis only	UbuntuNet Alliance	
27	Political / Strategic	Lack of competitive markets for procurement of links for the regional backbone	3	4	12	targeted awareness raising to increase the political will on the national level in the countries of the beneficiaries	European Implementation Body	
28	Political / Strategic	Existing and future direct connections to London could be seen as diminishing the requirements for an African NOC	3	4	12	UbuntuNet Alliance to take political action with their members to ensure that the UA Router in London is not used to replace or supplant a "real" African network. Allow connections to London of a short term (1 year) basis only	UbuntuNet Alliance	
29	Political / Strategic	NRENs lose support of connected institutions – fragmentation of user base in the NREN country	3	4	12	NRENs to communicate the benefits of the NREN system to the potentially connected institution, newsletters, seminars, conferences etc	African NRENs	

Risk Number	Category	Description	Severity (1-5)	Likelihood (1-5)	Risk Level (Severity * Likelihood)	Mitigation or Action to be taken	Primary Action By	Secondary Action By
30	Political / Strategic	Failure of African partners to deliver on expectations	3	3	9	Arrange formal communications channels between the UbuntuNet Alliance and the European Implementation Body to ensure that expectations are documents, understood on both sides and met	UbuntuNet Alliance	
31	Political / Strategic	Failure of UbuntuNet Alliance as a cohesive organisation	3	3	9	Political action UbuntuNet Alliance to raise its recognition in the African NREN countries and in Europe, conference presentations etc	UbuntuNet Alliance	
32	Political / Strategic	Key countries not taking an active part in UbuntuNet Alliance	3	3	9	Political action required by the UbuntuNet Alliance to encourage the non-cooperating countries to take an active part in the UbuntuNet Alliance, seek help from the AAU NREN unit.	UbuntuNet Alliance	
33	Political / Strategic	Lack of national political acceptance of NREN cooperation	3	3	9	Political action in country by the NREN by frequent communications with the potential members, seminars, meetings, conferences etc.	African NRENs	
34	Political / Strategic	Loss of faith by African countries due to delay in the implementation of the AfricaConnect project	3	3	9	Political action by the EC to show that action is being taken and that a grand plan is in progress.	EC	
35	Political / Strategic	Loss of momentum at the end of FEAST and before AfricaConnect	3	3	9	Request EC to commit to AfricaConnect in a timely manner and to facilitate an early Capacity Building programme in the designated NRENs.	EC	
36	Political / Strategic	Ministerial endorsement of the NREN lacking	3	3	9	UbuntuNet Alliance to assist the African NRENs in getting the required ministerial endorsement, Possibly with the assistance of the AAU	UbuntuNet Alliance	
37	Political / Strategic	Not enough "Ready" NRENs to enable AfricaConnect project to be viable and funded by EC	2	4	8	Immediate capacity building programmes targeted at the NRENs that do not fall into the immediately ready group, ahead of the contract start of AfricaConnect	UbuntuNet Alliance	
38	Political / Strategic	Failure to live up to national aid goals and programmes of EU countries	2	2	4	EC to demonstrate support for aid goals by contribution and support of AfricaConnect project in all its phases	EC	

Appendix G Acronyms

AAU	Association of African Universities
ADM	Add/Drop Multiplexer
AfNOG	The African Network Operators' Group
AfriNIC	African Network Information Centre, the Regional Internet Registry for Africa.
ALICE	America Latina Interconectada Con Europa Project to develop the RedCLARA network
APM	Access Point Manager
ASN	Abstract Syntax Notation
ATM	Asynchronous Transfer Mode
AUC	African Union Commission
AUP	Acceptable Use Policy
BLOG	Contraction of the term "weblog", online report
BGP	Border Gateway Protocol
CERT	Computer Emergency Response Team
CLARA	Cooperación Latino Americana de Redes Avanzadas Latin American Advanced Networks Cooperation
CPU	Central Processing Unit
CSIRT	Computer Security Incident Response Team
DiffServ	Differentiated Services, a computer networking architecture
DNS	Domain Name System
EC	European Commission
eduroam	Education Roaming, a secure international roaming service for users in Higher Education
ENUM	Telephone number mapping in IP networks
EU	European Union
EUMEDCONNECT	Project to establish and operate an IP-based network in the Mediterranean region
FTP	File Transfer Protocol
GMPLS	Generalised Multi-Protocol Label Switching
ICMP	Internet Control Message Protocol
ICT	Information and Communications Technologies
IDS	Intrusion Detection System
IGMP	Internet Group Management Protocol
IMAP	Internet Message Access Protocol
IP	Internet Protocol
IRC	Internet Relay Chat
IPv6	Internet Protocol version 6
IRU	Indefeasible Right of Use

ISDN	Integrated Services Digital Network
IS-IS	Intermediate System to Intermediate System
ITT	Invitation To Tender
JABBER	Extensible Messaging and Presence Protocol
LEO	Low Earth Orbit (satellites)
LIR	Local Internet Registry
MAN	Metropolitan Area Network
MIB	Management Information Base
MPLS	Multiprotocol Label Switching
MSDP	Multicast Source Discovery Protocol
NAT	Network Address Translation
NETFLOW	Network protocol for collection of traffic information
NEG	Network Engineering Group
NLANR	National Laboratory for Applied Network Research (US)
NLANR AMPlet	NLANR Active Measurement software
NOC	Network Operations Centre
NREN	National Research and Education Network
NSRC	Network Startup Resource Centre, University of Oregon
OBGP	Optical Border Gateway Protocol
OSPF	Open Shortest Path First
PDH	Plesiochronous Digital Hierarchy
PERT	Performance Enhancement and Response Team
PIM	Personal Information Manager
PKI	Public Key Infrastructure
PoP	Point of Presence
POP	Post Office Protocol
PSTN	Public Switched Telephone Network
RedCLARA	CLARA's network in Latin America
REN	Research and Education Network
RFI	Request For Information
RIPE	Réseaux IP Européens, the Regional Internet Registry for Europe
RIPE TTM	RIPE Test traffic Monitoring
SAN	Storage Area network
SDH	Synchronous Digital Hierarchy
SLA	Service Level Agreement
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SONET	Synchronous Optical Networking
SSH	Secure Shell
SSM	Source-Specific Multicast
SURFNet	Netherlands NREN
SWOT	Strengths, Weaknesses, Opportunities and Threats
TCP	Transmission Control Protocol
TLD	Tope Level Domain
TEIN	Trans-Eurasia Information Network
UDP	User Datagram Protocol
VLE	Virtual Learning Environment
VOIP	Voice Over IP
VPN	Virtual Private Network
VRRP	Virtual Router Redundancy Protocol

WDM	Wavelength Division Multiplexing
WiFi	Wireless computer networking
Wiki	Website used in knowledge management
WIMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless LAN wireless network connect