Using NREN capacities to extend and enhance UbuntuNet

Duncan H MARTIN, B.Sc.(Hons), Ph.D, MBL
CEO and Director of TENET
Non-Executive Director of the UbuntuNet Alliance
TENET, P.O. Box 18094, Wynberg 7824, South Africa
Tel: + 27 21 763 7141, Fax: + 27 21 763 7227, Email: ceo@tenet.ac.za

Abstract

As the regional REN for Eastern and Southern Africa, the primary purpose of the UbuntuNet Alliance is to provide its member NRENs with regional and global interconnectivity with other NRENs and with the Internet generally. However, fulfilment of the task can be greatly facilitated and its cost significantly reduced if the member NRENs, each within its own country, provide network capacities and services to the Alliance.

Although this insight is present in the "patchwork backbone"concept that can be found in early strategy documents of the Alliance, its first practical realisation is the connection of the Zambian NREN, ZAMREN, to the UbuntuNet network not in London, but in South Africa.

The paper tells how ZAMREN connects to UbuntuNet and uses this as an example to explore and illustrate three of four ways in which NRENs can extend the reach and enhance the effectiveness of the UbuntuNet Network. These three have NRENs providing capacities of different sorts within their local infrastructures for use as part of the UbuntuNet network. The fourth has NRENs arranging UbuntuNet's peering interconnections with local commodity networks in their countries.

The UbuntuNet Alliance is willing to contract formally with NRENs for the provision of such services at specified service levels and to pay for such services at negotiated rates that compensate the NREN for any additional costs incurred or that are based on the cost-recovering service charges that the NREN's own member institutions pay.

Keywords

NREN, regional REN, UbuntuNet, local commodity peering

1. Opening remarks

This paper concerns the *organisation* named the UbuntuNet Alliance for Research and Education Networking, referred to in the sequel as "the Alliance" (UbuntuNet Alliance, 2012); the *network* operated by the Alliance, which is known as "the UbuntuNet network" or just as "UbuntuNet"; and the national research and education networks, or "NRENs" that are members of the Alliance ('member NRENs"). The paper explores ways in which the member NRENs, besides using and benefitting from the Alliance's Internet services, can assist the Alliance to extend the reach and enhance the effectiveness of the UbuntuNet network.

ZAMREN is the NREN of Zambia. Some aspects of ZAMREN's connection to UbuntuNet are described and used to introduce and illustrate the main points of this paper. However the author does not presume to tell the full ZAMREN story – how the Zambian universities overcame the institutional independence and other difficulties that bedevil attempts to build NRENs; how the universities came to trust ZAMREN and how they govern ZAMREN; how ZAMREN set about

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getting connected. But ZAMREN's story is one that should be documented and told, for it speaks of willingness to collaborate and of the initiative, leadership and courage of ZAMREN's CEO, Mr Bonny Khunga and ZAMREN's Board.

The South African NREN, TENET (TENET, 2012) also plays a role in the story of ZAMREN's connection to UbuntuNet.

This is not a research paper. It is not even a learned article. It is perhaps something of a practice note of interest to research and education networking practitioners in Africa.

2. UbuntuNet as a network

The Alliance was founded in 2006 as a non-profit association of the NRENs of countries in Eastern and Southern Africa to serve them as their regional REN. Its first services were available only to member NRENs that had their own intercontinental circuits to London. There, the Alliance could provide those NRENs with global Internet transit, including both REN transit via the famous European research network, GÉANT, and commodity Internet transit via interconnections with commercial networks at LINX (the London Internet Exchange) (LINX, 2012).

Thus UbuntuNet, the network operated by the Alliance, launched not in Africa but in London. Its beginning in 2008 was a router kindly donated by Cisco Systems and co-located free of charge within the Telecity Exchange, and with interconnects to GÉANT, LINX and certain commodity transit providers. Both the European Commission's GÉANT Policy Committee and operator of GÉANT, DANTE (Delivery of Advanced Networking Technology to Europe) (DANTE, 2012), were and have continued to be very supportive of the Alliance's efforts.

Today, the Alliance has a second routing hub in Amsterdam, where it peers at the Amsterdam Internet Exchange (AMS-IX) (AMS-IX, 2012) and purchases alternative commodity transit. Five member NRENs connect to one or both of the Amsterdam and London UbuntuNet hubs ("U-HUBs") and rely on UbuntuNet as their major upstream REN and commodity transit provider. They are KENET (Kenya), TENET (South Africa), TERNET (Tanzania), MoRENet (Mozambique) and SudREN (Sudan).

Note that the above-mentioned five NRENs are all maritime NRENs that connect to the Alliance's European U-HUBs using submarine cable capacities that they have purchased or rented individually.

The founders of the Alliance envisaged that someday, too, UbuntuNet would include high speed circuits to London and other major centres, and would deliver affordable, high speed regional and global connectivity services to a local hub of each member NREN via a high speed regional backbone network within Africa. The AfricaConnect Project (AfricaConnect, 2012) is a great first step towards realising this dream.

3. The first African U-HUB at Mtunzini

In late 2007 TENET executed an agreement with SEACOM Ltd (SEACOM, 2012) for the purchase of an indefeasible right of use of an STM-64 (almost 10 Gbps) circuit between the SEACOM Cable Station at Mtunzini, South Africa and Telecity, London. TENET secured a backhaul link from the Cable Station to the Durban node on the 10 Gbps SANReN national backbone network. SANReN (South African National Research Network) (SANReN, 2012) is being deployed by the Meraka Institute of the CSIR ("Meraka"), under contract to the South African Department of Science and Technology. TENET's SEACOM circuit and the SANReN national backbone came into use in January 2010, both being operated by TENET, which began the dramatic and continuing propulsion of South African research and education networking into the era of affordable gigabits.

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Some months later the Alliance and TENET agreed in principle that NRENs of other countries could purchase capacity within TENET's SEACOM circuit at the same cost-recovering tariff that TENET charges its own participating institutions. To facilitate this and enable such NRENs to exchange BGP route announcements directly with UbuntuNet, it was agreed that TENET's routing hub within the SEACOM Cable Station would be configured as part of the UbuntuNet network. In this way, the Alliance secured its first U-HUB in Africa within the SEACOM Cable Station at Mtunzini.

Importantly, Meraka agreed that TENET might further facilitate connections by allowing other NRENs to connect to any SANReN node and using transport capacity within SANReN to extend the connection to the SEACOM Cable Station.

4. ZAMREN's connection to UbuntuNet

4.1 Description of the connection

The Zambian NREN, ZAMREN was first (and is still the only) land-locked NREN to connect to UbuntuNet. It did so by consciously and courageously deciding to adopt the TENET-UbuntuNet scheme described in the previous section, and accordingly to arrange a link from Lusaka, not to London or Amsterdam, but to the U-HUB at Mtunzini. This fact that Zambia and South Africa are not direct neighbours makes this even more remarkable.

To achieve this ZAMREN rented an STM-1 circuit between its main hub in Lusaka and a SANReN node in Johannesburg. The circuit passes right through Zimbabwe, crossing Zimbabwe's borders with Zambia and South Africa on the way.

TENET regards the port at which ZAMREN connects in Johannesburg as effectively being an UbuntuNet point-of-presence ("U-POP") and has provisioned layer 2 capacity within the SANReN network to interconnect that U-POP with the Mtunzini U-HUB. Via this extended layer 2 circuit ZAMREN's router exchanges route announcements and traffic directly with the Mtunzini U-HUB.

Finally, the Alliance orders from TENET such bandwidth on the SEACOM circuit to London as it requires for use by ZAMREN.

4.2 The contractual position

These arrangements permit the Alliance, as befits a regional REN, to function fully as ZAMREN's upstream provider of worldwide REN and commodity transit. They ensure that TENET is in no sense an upstream service provider to ZAMREN, and no contract exists between TENET and ZAMREN.

TENET provides the services described above at cost-recovering tariffs to the Alliance, which, in turn, provides its services to ZAMREN at cost-recovering tariffs.

4.3 The cost of the long access circuit

Of course ZAMREN bears the rental cost of the access circuit all the way from Lusaka into South Africa. ZAMREN's provider is Econet Liquid Telecom ("Liquid"), which is based in Zimbabwe, and is systematically rolling out an important regional optical fibre network in Southern Africa. Currently Liquid's fibre does not extend further south than Musina, and Liquid subcontracts the South African company Broadband Infraco to provide the ZAMREN circuit between Musina and Johannesburg.

However, Liquid is steadily trenching its way further south, and Meraka is extending the SANReN into rural areas. Early in 2013 both Liquid and SANReN will have reached Makhado, which will enable ZAMREN to connect to a (new) U-POP in Makhado. This shortening of the circuit will eliminate the need for the sub-contracted segment into Johannesburg and so substantially reduce ZAMREN's costs.

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5. NRENs as capacity providers to UbuntuNet

5.1 The idea

The membership region of the UbuntuNet Alliance includes, apart from Madagascar and other island countries in the western reaches of the Indian Ocean, no fewer than 20 countries on the African continent. Each country subjects telecommunication operators to its own unique set of laws, regulations and practices regarding the roles of the regulator, the roles of the historically advantaged incumbent, and the construction and use of border-crossing circuits.

Not surprisingly, from an early stage the Alliance encouraged the emerging NRENs to seek international gateway licenses from their national regulators and conceived the strategy of realising its regional backbone as a "patchwork backbone" comprised to some extent of segments provided by its member NRENs (see, for example, (Kyalo, 2006)). Thus the Alliance has long entertained the idea that its member NRENs would not only receive services from the Alliance, but would use their own capacities to enable and assist the Alliance to extend its reach and enhance its services to the NRENs.

The realisation of ZAMREN's connection provides examples of the types of services by NRENs to the Alliance that are identified in the following subsections.

5.2 NRENs can host U-HUBs and U-POPs

A U-HUB is a router that is operated by UbuntuNet or its appointed UbuntuNet Operator as part of the UbuntuNet network. At the time of writing there are U-HUBs in Amsterdam, London and Mtunzini, as described above. However, within a year, the AfricaConnect Project will deploy at least five new U-HUBs in Africa, and more will follow in subsequent years.

The Alliance can contract to host a U-HUB in a commercial exchange (as it did in Amsterdam); or in an upstream provider's rack (as for the London U-HUB in DANTE's rack within Telecity); or in a member NREN's rack (as for the Mtunzini U-HUB in TENET's rack within the SEACOM Cable Station).

Depending on the requirements and the circumstances attending the deployment of each new U-HUB, the Alliance may well want to contract with other member NRENs to accept the co-location of further U-HUBs within their facilities.

A U-POP is a layer 2 port on an NREN's router or switch that the NREN makes available to the Alliance, together with layer 2 backhaul capacity to some U-HUB, for use by the Alliance and operation by the UbuntuNet Operator as part of the UbuntuNet network. This concept allows one NREN to facilitate and enable the connection of another NREN to the UbuntuNet Network, as the case of ZAMREN illustrates.

Hosting U-HUBs and U-POPs within their facilities is a key way that an NREN may assist the Alliance, and many member NRENs will have opportunities to do so.

5.3 Provision of point-to-point capacity

The ZAMREN story illustrates that an NREN can provide UbuntuNet with point-to-point capacity at layer 2 for operation and use as part of the UbuntuNet Network to interconnect U-HUBs and U-POPs within the NREN's country.

The provision of layer 2 point-to-point bandwidth within its network is another key way that an NREN may assist the Alliance to extend its reach and benefits new-comers.

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5.4 Provision of submarine cable capacity

NRENs that have access to submarine cable capacity may well be in a position to contract to provide the Alliance with specified bandwidths on specified circuits on a cost-recovery basis, for use by the Alliance as it sees fit and for the benefit of one or more other member NRENs.

This sharing model has potential not only for enabling the Alliance to provision a new NREN with its primary intercontinental connection capacity, but also to enable the Alliance to offer a restoration service to member NRENs that provides alternative intercontinental connectivity when primary submarine cable circuits fail.

5.5 Peering with local commodity networks

The fourth way in which a member NREN can empower the Alliance is to arrange direct peering between UbuntuNet at a local U-HUB and local commodity networks. Traffic in either direction that flows across such a local peering link is traffic that would otherwise flow from Africa to a U-HUB in Europe and back to Africa. Consequently local peering links will dramatically reduce latencies and so enhance the Alliance's commodity peering service to every Member NREN.

The member NREN's role is to use its knowledge of the local Internet industry and its relationships with local ISPs, industry associations and Internet exchange operators to facilitate and enable UbuntuNet to peer with local commodity networks as envisaged above.

In South Africa, TENET peers with many commodity networks at Internet exchanges in Cape Town and Johannesburg, which are operated by the local Internet Service Providers Association (ISPA), of which TENET is a member. With ISPA's and the Alliance's permission, TENET will negotiate the replacement of each of these peering interconnections with TENET by peering with UbuntuNet.

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Biography

Duncan H Martin is an executive manager who trained originally as a mathematician. In 1977 he left Natal University to join the National Research Institute for Mathematical Sciences of the CSIR, and directed the Institute from 1980. In 1987 he switched to ICT management, and in 1991 joined UCT as Director of Information Technology. When TENET replaced UNINET in 2001, Duncan was a founding director and was appointed as TENET's first CEO. He is a non-executive director of the UbuntuNet Alliance, of which he is a founder, and of three other non-profit companies concerned in some way with the Internet.