An Evaluation of Peering and Traffic Engineering in the Pan-African Research and Education Network

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Outline

- Introduction and Background
- Network measurements
- Simulation
- AIX, Peering and SDN
- Results
- Conclusion

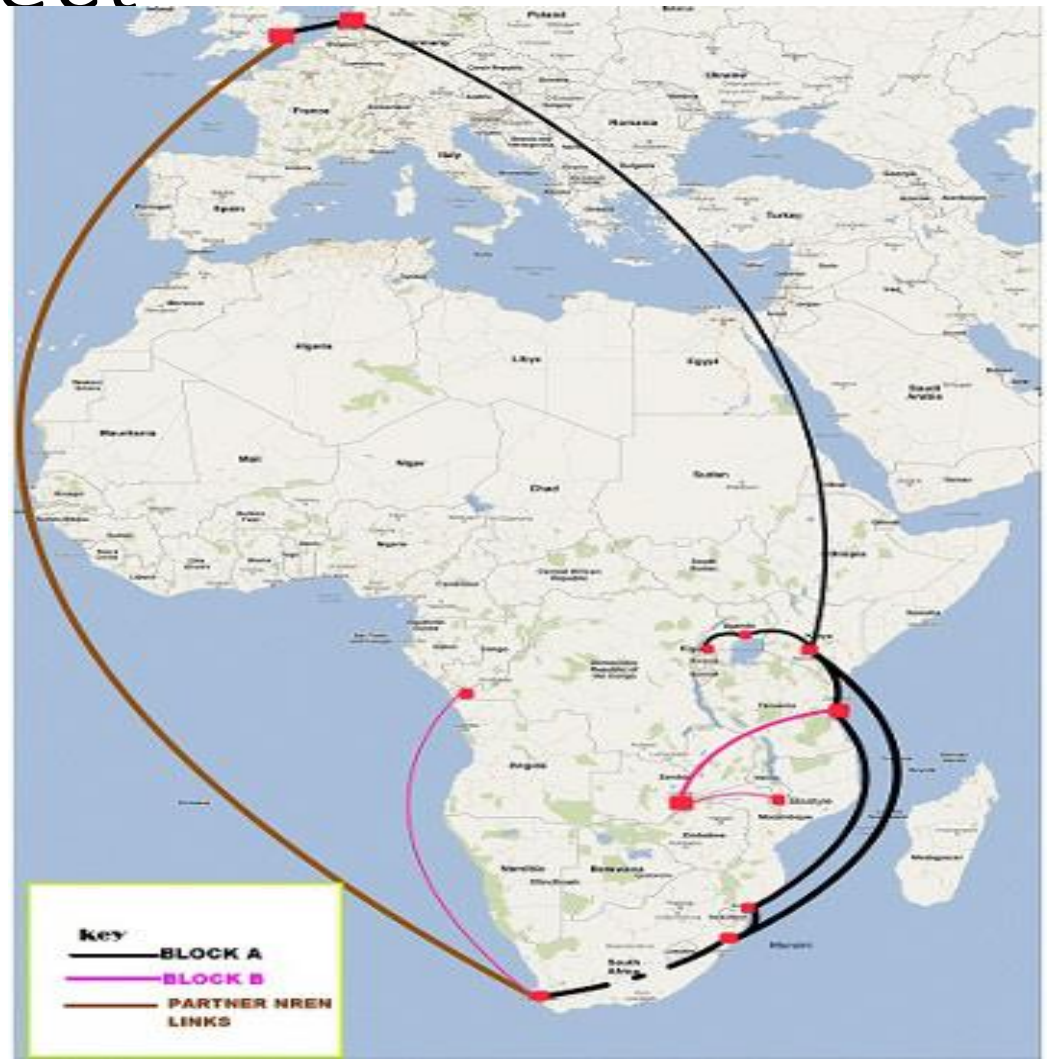
Introduction

- Despite an increase in the amount of Internet bandwidth in Africa, together with the proliferation of submarine and terrestrial fibre optic cable systems, a large proportion of Internet traffic exchanged among Africa's Internet users is still exchanged through higher tier transit providers at IXPs in other continents . e.g. Europe.
- Our work attempts to quantify this problem and its impact on intra-Africa Internet performance, especially with regard to end-to-end latency.
- The recent developments in technology such as the Software Defined Network offer Africa and the developing world a chance to implement optimal traffic engineering solutions for NRENs at lower deployment and maintenance costs.
- Our paper makes a contribution in two ways; first through active topology measurements, it provides an assessment of traffic routing and its impact on latency.
- Secondly, through simulation, it shows performance benefits of implementing an African Internet exchange, and discusses possible software defined mechanisms that could be used to manage traffic in such a setting.

Related Work

- Many universities still obtain their Internet connectivity from commercial Internet service providers (ISPs) that have no peering relationships amongst themselves [(B. Barry et al, 2010 IST Africa), (R. Steiner et al, 2005 IDRC)].
- The level of direct interconnectivity and peering among NRENs remains low, and the traffic that is exchanged among NRENs in sub-Sahara Africa continues to be exchanged at long distance Internet eXchange Points (IXP) in Europe and North America, resulting in high data transmission costs[(J. Gilmore et al, 2007 SATNAC)] and sub-optimal performance (e.g. high latency).
- Work on the African internet topology [(A. Gupta et al, 2014 PAM Conf)] shows that about 66% of traffic between South African Internet users and Google cache servers located in Africa is routed outside the continent. The same work also characterizes the IXP peering situation in Africa and shows that most African ISPs do not peer among themselves
- Projects and Implementations – UbuntuNet Alliance, WACREN, ASREN and Africa Connect

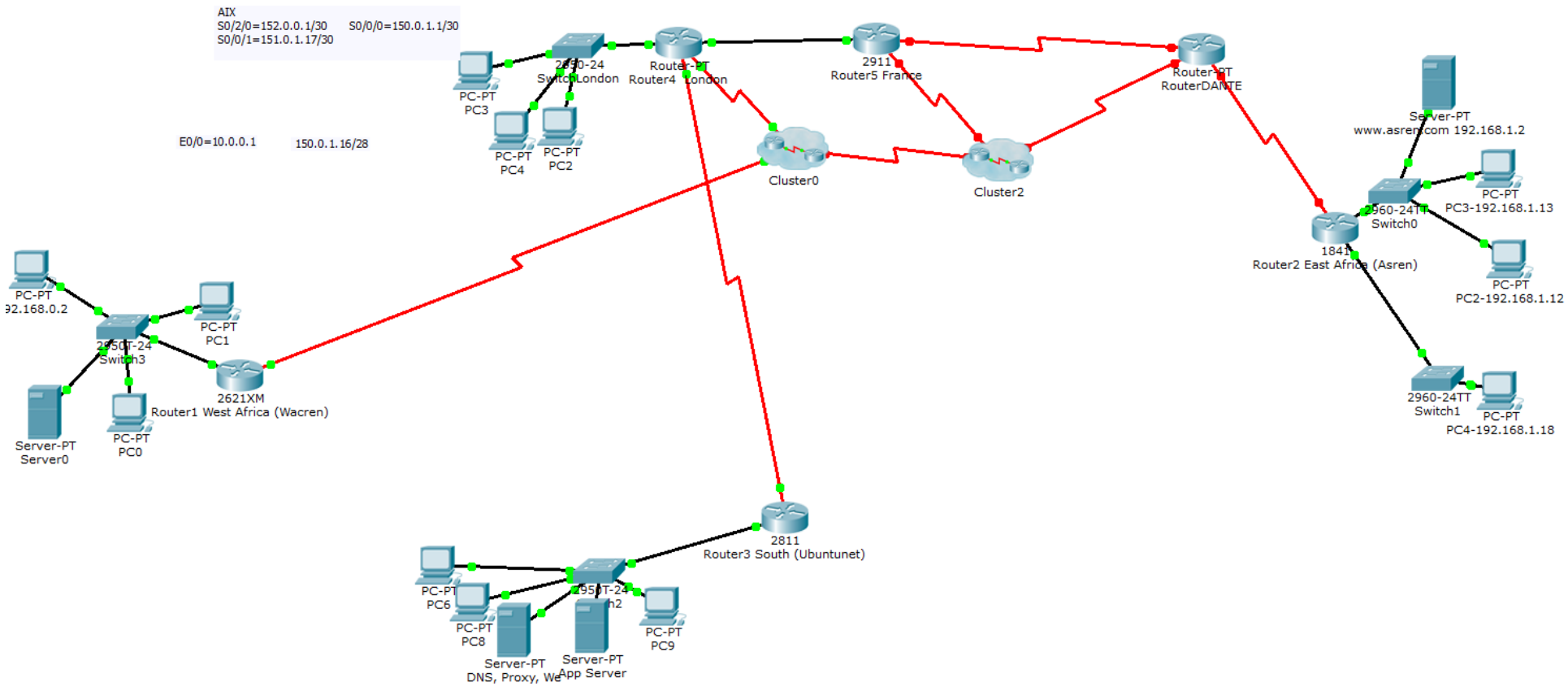
Africa Connect



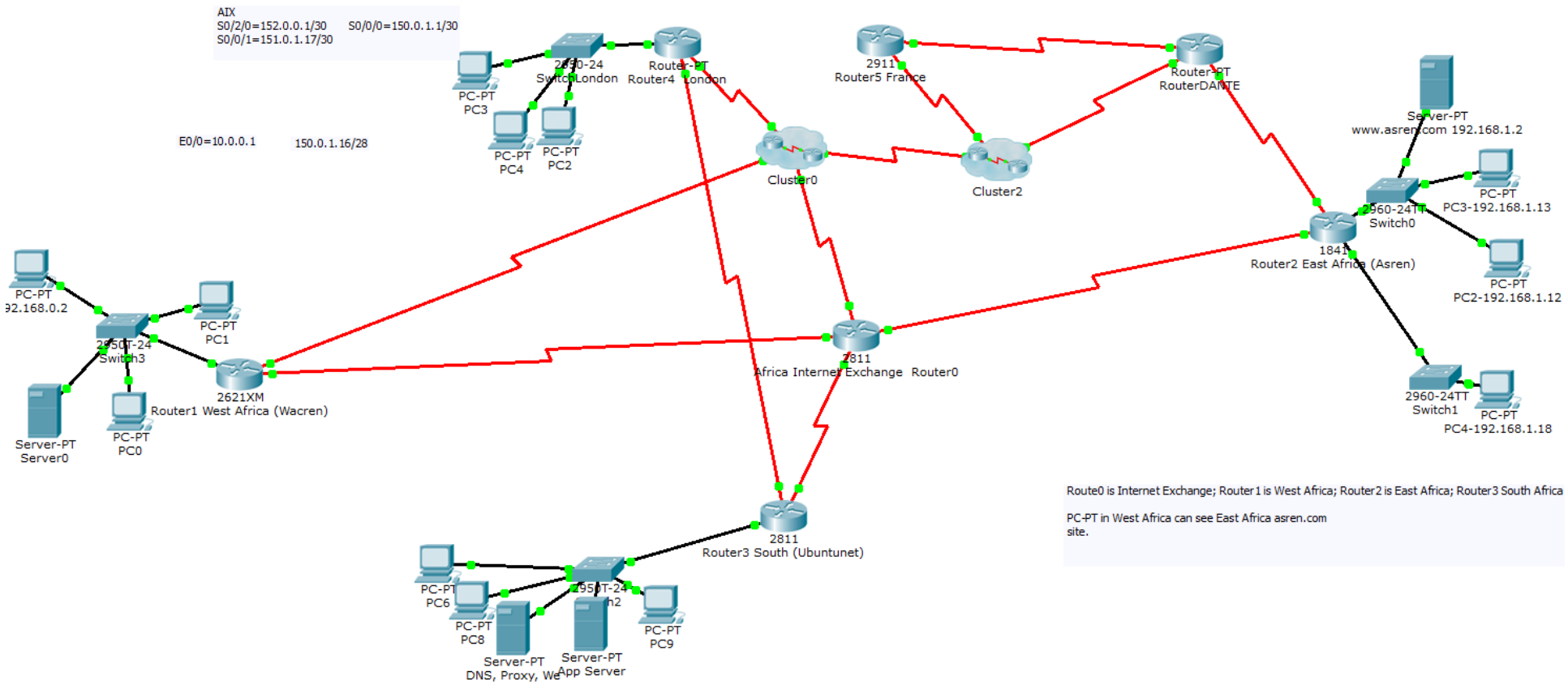
Network Measurements

- Active measurement techniques attempt to exploit network management to solicit responses from a set of network destinations, and then use such responses to infer topological characteristics such as route paths, RTTs and packet loss.
- Common active measurement techniques make use of Traceroute, a tool for discovering IP paths between a host and some destination. The tool works by sending IP packets with increasing time-to-live (TTL) values, in such a way that packets continually expire on their way and cause routers to respond with ICMP time-exceeded messages.
- To assess performance of traffic exchange among the African Research and Education Networks, a two (2) week experiment was conducted to probe IP paths to 35 universities across 12 countries. The target universities are within the UbuntuNet Alliance area.
- Using Scamper network tool, Internet probes were performed every day to each address for 14 days, using ICMP-based Ping and Traceroute network probes from two main vantage points, in South Africa (SA) and Malawi. Further probes were conducted from vantage points in West Africa (Senegal), and East Africa (Rwanda).

Simulation – Cisco Packet Tracer



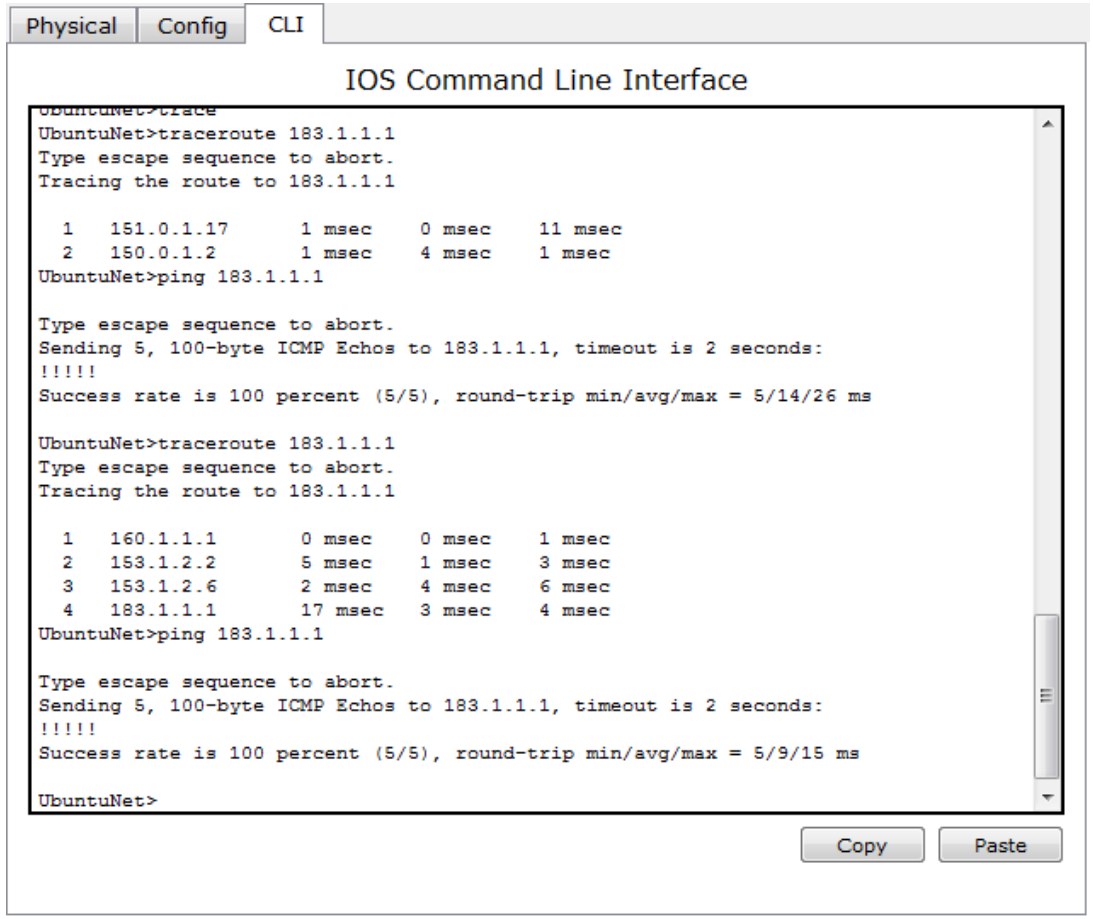
Scenario 2 with AIX and Peering



Peering on African NRENs and SDN technology

- A possible way of achieving optimal traffic exchange is through collaborative routing and traffic engineering among NRENs.
- A pair of NREN may dynamically [re]route the traffic between them with the aim of minimising latency for certain types of traffic such as video conferencing, while minimising transit cost for non delay sensitive traffic.
- This can be achieved with mechanisms for dynamic end-to-end path reconfiguration, and performing collaborative and dynamic load balancing using network metrics.
- For example, an NREN may want to dynamically [re]distribute its traffic with the aim of minimising latency for certain types of traffic, while minimising transit cost for the rest of the traffic.
- This can be achieved if NRENs have mechanisms for dynamic path re-configuration, which can be achieved through peering and local Internet switching on Software Defined Network platforms

Simulation Results



Conclusion

- Our paper discusses performance challenges, in terms of latency, for Africa's NREN traffic to be exchanged in Europe.
- Internet probes from different locations in Africa show that on average, over 75% Africa's NREN traffic originating and destined for Africa is routed outside the continent.
- Using simulation, it is shown that latency for Africa's inter-NREN traffic could be reduced by 50% by implementing a central exchange entity and introducing peering for the African NRENs.
- Further, the paper discussed the potential for improving the pan-African NRENs traffic exchange through traffic engineering and the use of software defined networking.