

Internet Performance to Africa

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Overview

- We report the first results ever for real-time Internet performance to Africa using the PingER methodology.
- Multiple monitoring hosts were used to enable comparisons with performance from different parts of the world.
- Africa is shown to be far from the Internet performance in industrialized nations due to the poor infrastructure in place today.
- These monitoring efforts
 - can provide valuable information to analyse the relative rates of future improvement ,
 - today they help us to quantify the digital divide ,
 - can provide quantitative information to policy makers.

Introduction

Following the proposal on *real-time network monitoring in Africa* discussed at the Open Round Table carried out in 2002 in Trieste, efforts have been made to quantify the digital divide realities in Africa.

The motivation to carry out this actual monitoring of the African Internet performance is to help to create further awareness of the lack of infrastructure and facilities.

This monitoring is also essential to enable “*Virtual Laboratories*”, to catalogue and understand critical needs, set expectations, provide trouble shooting abilities, and to allocate resources to optimize/improve performance.

In turn this will imply a better distribution of money resources.

Methodology / Setup

The methodology used is PingER.

For the results, we utilized multiple monitoring hosts at CERN in Geneva Switzerland, SLAC in California USA, TRIUMF in Vancouver Canada, and the University of Wisconsin in Madison Wisconsin.

(This enables to ensure there were no pathologies associated with a given monitoring host and also to enable comparisons with performance from different parts of the world).

We utilised the Abdus Salam-eJDS network for monitoring real-time connectivity patterns among research and educational institutions in developing countries, including Africa.

Once we had potential contacts we sent e-mail to them explaining our purpose, our needs, and the possible impact on the network and hosts at the site.

(Sometimes these e-mails required extended explanations).

Once we had a host to monitor, we then checked that the host was accessible to pings and then entered it into the relevant PingER databases.

(Typically about 75% of the contacts eventually resulted in a remote host to monitor successfully. In some cases pings were blocked and were outside the control of the remote site personnel (e.g., if a service provider blocked the pings)).

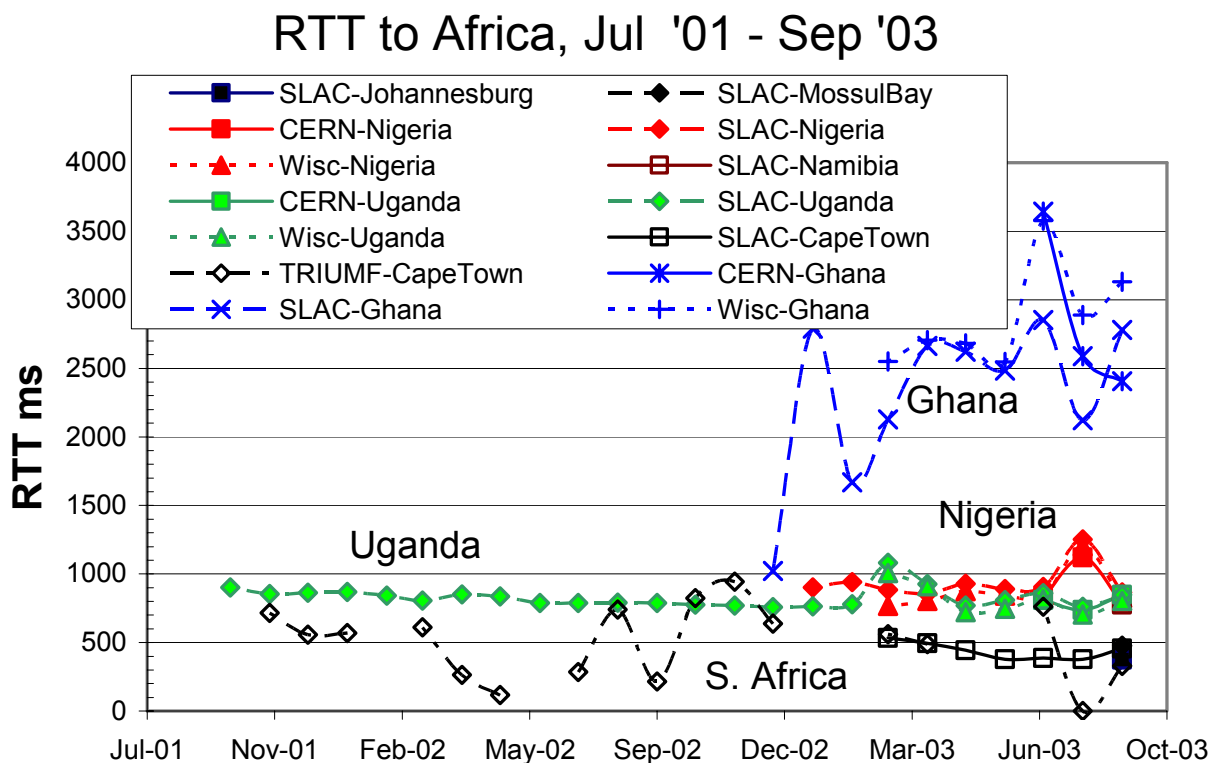
Preliminary Results for Africa

Currently we monitor hosts in:

- the Biotechnology and Nuclear Agricultural Research Institute of the Ghana Atomic Energy Commission in Accra Ghana,
- Obafemo Awolowo University in Ife-Ife Nigeria,
- Makerere University of Kampala Uganda,
- Schoolnet in Windhoek Namibia,
- the University of Cape Town S. Africa, Mussel Bay South Africa and Johannesburg S. Africa.

(All the hosts, apart from the last two are at Academic and Research (A&R) sites. The last two are commercial sites that we obtained through TomWare).

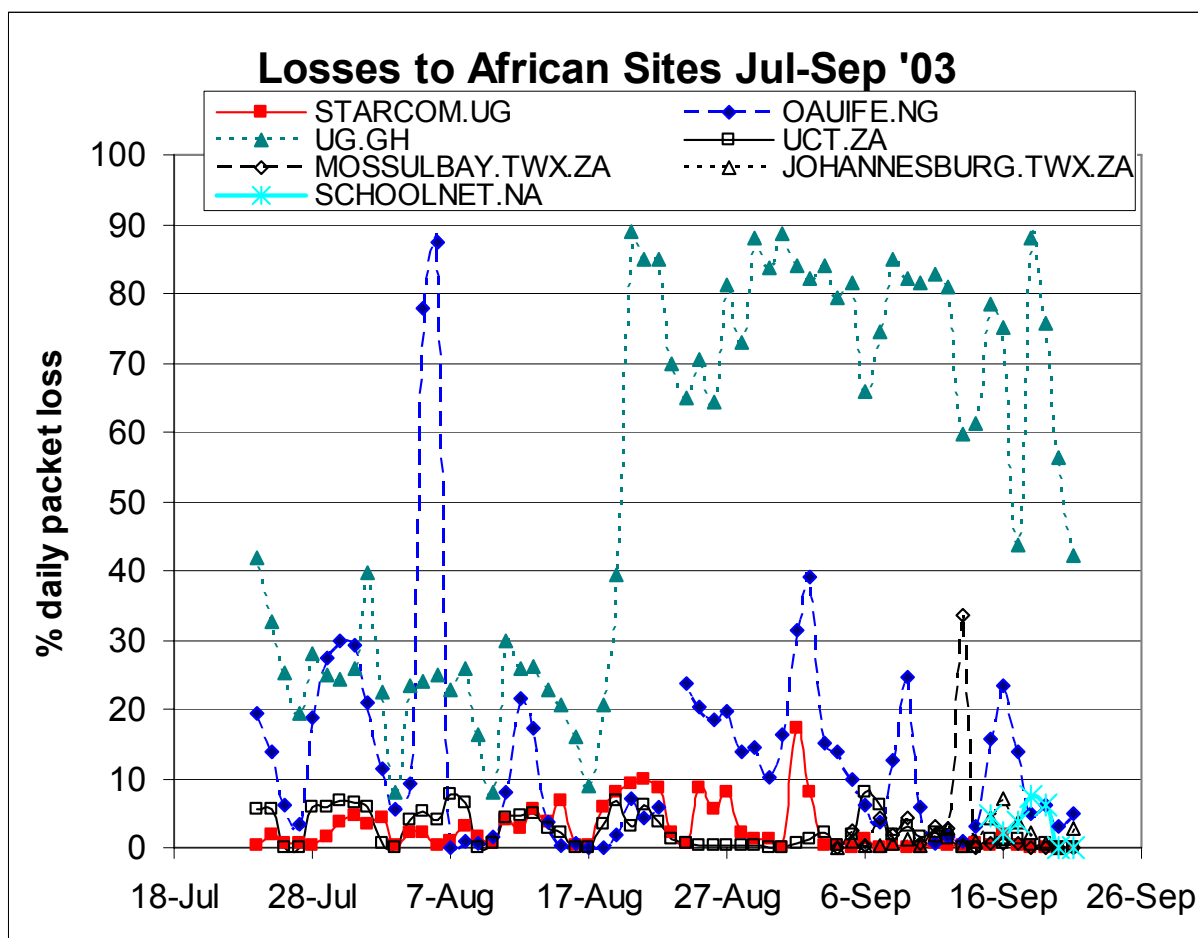
RTTs from N. America and European monitoring hosts to remote hosts in various African countries



The average monthly *Round Trip Times* (RTT) to the various remote hosts in Africa from the monitoring sites in N. America and Europe implies that

- for a given remote host there is little difference between the monitoring sites. This may indicate that the common bottleneck in most cases is closely associated with the remote site.
- It is also seen that the routes to Ghana, Nigeria and Uganda have RTTs of over 600ms. and thus probably include a satellite hop.

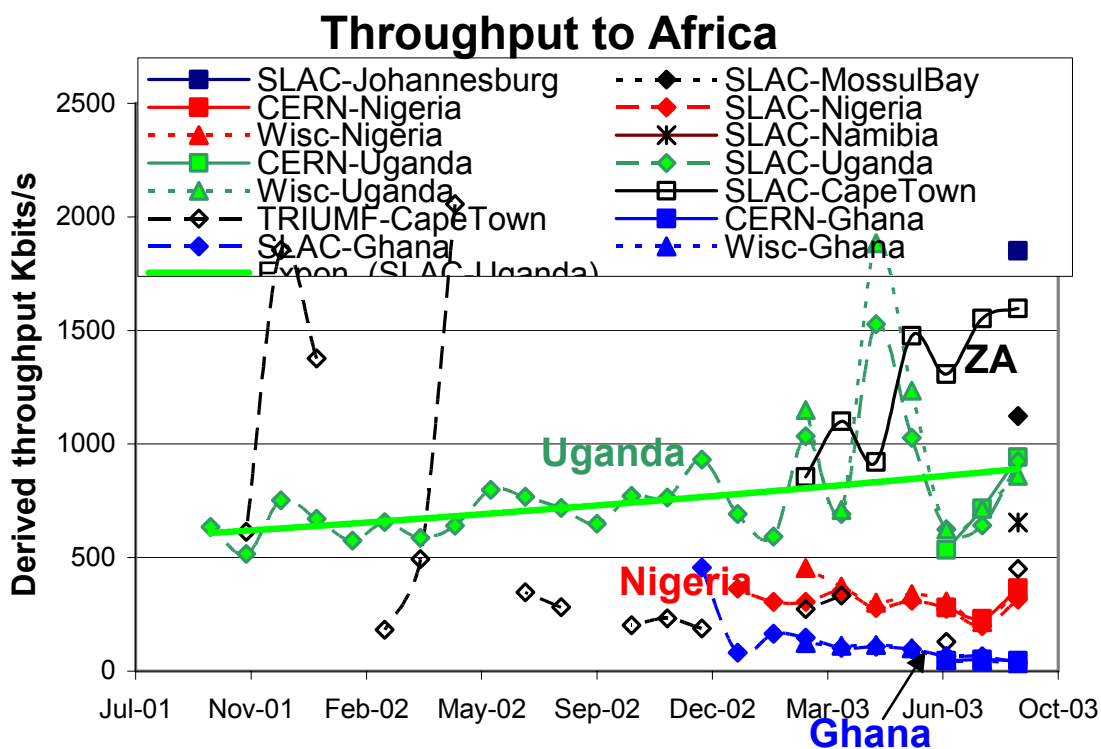
Losses averaged over a day from SLAC to African countries Jul-Sep 2003



- A noticeable step change in the losses to Ghana is seen starting around August 18. This does not appear to be due to ping rate limiting. The losses occur on the last two hops in Ghana. This losses to Ghana are making the link almost unusable.
- Losses to Nigeria although better are still categorized as bad (> 12%) most of the time.
- Uganda, Namibia and South Africa have monthly average losses of between 1 and 3% (acceptable to poor).

Derived throughput from N. America and Europe to some African countries

Combining the losses and RTTs using the Mathis formula we derive the maximum TCP throughput, i.e. *Derived throughput* $\sim MSS/(RTT*\sqrt{loss})$ and plotting the monthly averages from July though September 2003 for monitoring hosts in N. America and Europe to hosts in Africa.



- derived throughput is best to S. Africa, followed by Uganda and Nigeria with Ghana the lowest.
- There is over an order of magnitude difference between S. Africa and Ghana.

- The derived throughput for Nigeria is close to that of broadband DSL and cable to the home in the U.S., and for Ghana the derived throughput is close to that for a dial up modem.
- The solid line through the Uganda points is a fit to an exponential to help guide the eye. It appears that the performance for Cape Town and Uganda is improving while Ghana and Nigeria are holding steady or getting worse. There is insufficient data for Namibia to detect trends.

Conclusions

1. Much work needs to be done to extend the monitoring to more regions within Africa.
2. Even for the countries already monitored, more sites are needed to help avoid anomalous results associated with a single site.
3. Unfortunately it often appears that with all the other challenges in the region, Internet monitoring may not be very high on peoples' agendas.
4. We encourage to provide contacts for new countries and sites.

From these preliminary results, it is apparent that

5. Ghana in particular and Nigeria have poor to bad connectivity (the former is almost unusable).
6. Of great concern is the lack of improvement with time for both Ghana and Nigeria.
7. Comparing the performance to Africa with other regions of the world, Africa performance is a factor of 30 below that of say Europe, -Uganda (one of the better performing African countries) is at the same state Europe was at in 1995.