Latency Effects on Broadband Performance in South Africa

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Introduction

Few countries in Africa are regulating broadband performance, and there are few studies of broadband quality of service overall on the continent. To fill this gap in our knowledge, we conducted a pilot study of broadband performance in South Africa. Our results were surprising: not only are speeds generally poor in the country—particularly on fixed lines—latency plays a significant role in degraded broadband performance. In this position paper, we describe the study details and main results on latency as well as policy implications for South Africa.

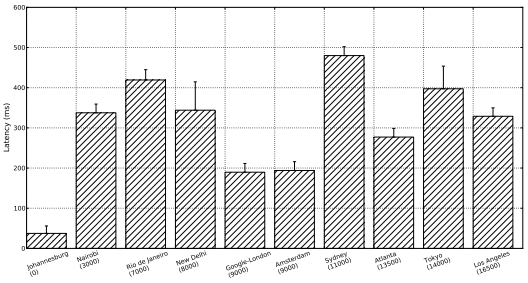
Study Details

Our pilot study of broadband quality of service took place between Feb-April 2013 in South Africa. We deployed routers equipped with our measurement firmware, BISmark (Broadband Internet Service Benchmark[1]) at 16 sites across all nine provinces (separately governed regions) of the country. During this period, we collected continuous measurements on broadband throughput, packet loss, jitter, and latency. We performed our latency measurements to servers both within the country as well as to locations in Africa, Asia, America, Australia, and Europe. In addition to our South Africa deployment, we have deployed more than 300 routers in nearly 30 countries around the world and have been collecting continuous performance data since June 2010[2].

Study Results

Latency to locations around the world from South Africa:

The figure below shows the average latencies to Measurement Lab servers around the world from South Africa as measured from our 16 fixed line testing sites. In the figure, we have sorted the bars from left-to-right in order of increasing distance in kilometers from Johannesburg, South Africa. Contrary to what we expected, we observed *network latency does not correlate with geographic distance.* We were surprised to find, for instance, that network paths to Nairobi, Kenya on the African continent are almost twice as high network latencies to London and Amsterdam. This is despite the fact that these European cities are approximately three times further geographically from Johannesburg than Nairobi.



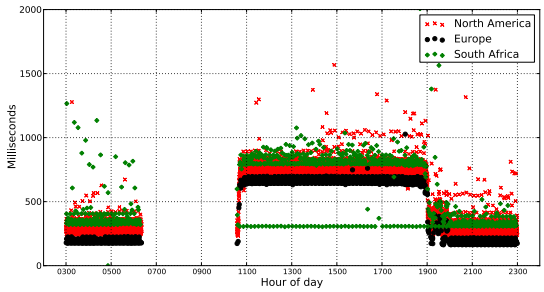
We measured these paths using `traceroute`, and learned that this result arises because network paths between South Africa and Kenya go through Internet exchange points in Europe as opposed to going directly to Kenya. A similar situation arises with the high latency observed between South Africa and Brazil, and between South Africa and India. Once again, because the paths are not direct to these regions, latency is higher. The underlying cause of these circuitous routing is the way Internet Service Providers (ISPs) peer with each other and the high cost of connecting more directly through closer Internet exchange points. If ISPs do not have direct peering arrangements in place, data must travel further (often off of the African continent entirely, via Europe), resulting in higher latencies.

Latency to popular websites. We measured the performance that users achieved in the country to the "Top 100" websites in South Africa as rated by Alexa[3]. Our goal was to determine whether any specific popular sites performed poorly. On average, users experienced round-trip latencies

[1] http://projectbismark.net
[2] The performance data from the testbed is continually uploaded to http://uploads.projectbismark.net/.
[3] http://www.alexa.com

exceeding 200 ms to five of the ten most popular websites in South Africa: Facebook (246 ms), Yahoo (265 ms), LinkedIn (305 ms), Wikipedia (265 ms), and Amazon (236 ms). Previous work in this area has shown that these latencies are high enough to adversely affect user experience. These latencies also suggest that the content for these sites is hosted far away from South Africa. In fact, many of these services, such as Facebook.com, report only having data centers in Europe and North America. Our data suggests that poor performance in this instance is because there are no web caches close to the South African users for these popular services and because of the often-indirect connectivity paths between ISPs.

Reliability to services. When undersea cables were cut off the coast of Egypt on 27 March 2013, we observed an increase in latency to measurement servers from many global destinations for fixed-line users in our wider BISmark deployment, particularly Nairobi. The Renesys blog states that the cable cut occurred at 06:20 and that our server in Nairobi was completely unreachable from *any* location from 06:20:45 to 10:34:38. In the figure to the left, we show the timeline of events corresponding to the fibre cut. The figure shows performance measurements to Nairobi from BISmark deployments in South Africa and in other geographic regions, as baselines for comparison. We found that all locations saw interrupted connectivity to Nairobi during the "gap" in the plot. Surprisingly, when connectivity was restored, all clients in the global deployment saw higher latency to Nairobi except for the Neotel clients in South Africa (AS 36937, Neotel)—Neotel being a South African ISP.



This result implies that Neotel in South Africa may have better connections to destinations within Africa than other ISPs. From our research, we know Neotel has shares in three undersea cables to Africa: SEACOM cable, West African Cable System (WACS), and EASSy cable. Since SEACOM alone was affected by the cut, Neotel's access to alternate fiber paths may have allowed its users to sustain better performance after the fiber cut. This result implies that measuring latency can provide information about the reliability of connections from South Africa to the rest of the world. It also illustrates that peering arrangements can be highlighted by continuous latency measurements.

Policy Implications

Our results imply that regulators in Africa should be monitoring broadband quality of service on a regular basis and that latency plays a significant role in broadband performance in South Africa. For this reason, a focus on improving broadband speeds on the continent alone will not improve performance because this will not address the issue of high latency to popular sites and services. Instead, our results imply that to properly address the effects of latency on broadband performance, the South African and other African governments need to focus on:

1. Facilitating peering relationships between ISPs and investing in local exchange points to reduce latency; reducing costs for ISPs to peer in local exchange points.
2. Encouraging popular websites and servers to host content closer to users in Africa
3. Hosting local servers for popular services such as Dropbox to reduce latency (and, hence, improve performance) for end users, and also reduce costs for providers

We intend to expand our deployment to other locations in Africa and to further assess how IP traffic is routed in Africa by mapping ISPs' peering at Internet exchanges points[4].

[4] For further reading, see http://projectbismark.net and http://www.researchictafrica.net.