The impact of remote hosting on Internet performance

POLICY ISSUE

Although a considerable investment in broadband infrastructure has improved broadband speeds across many African countries, the reliability and performance that users ultimately receive is determined also by the interconnection between networks and Internet Service Providers (ISPs) and by where the content, services and applications are hosted. Often, high latencies to remote destinations introduce significant performance bottlenecks, suggesting that, in addition to investments in higher throughput links, effort should be devoted to improving interconnection between ISPs and locating content closer to the users.

RECOMMENDATIONS

Most of the public policy strategies on improving local content in Africa focus on demand-side interventions, such as the creation of content in local languages, and on developing skills on web content production and consumption. While these policies are important, we recommend to bodies in charge of the governance of the internet to identify ways of facilitating local markets for content hosting, access and distributions by focusing on:

Incentivising investments on data centres and web farms in Africa, to stimulate economies of scale for the local web hosting market.

Encouraging local news websites to move the content closer to the users in Africa, by incentivising the use of Content Delivery Network (CDN)-enabled networks and by reducing prices for local hosting.

Facilitating peering relationships between ISPs and investing in local exchange points to reduce latency.

Incentivising ISPs to peer in local exchange points by regulation.

THE RESEARCH

I LITERATURE/PRIOR WORK

As a result of new investments in backbone, backhaul and notably wireless access infrastructure (Song, 2017), Internet availability has outpaced adoption in Africa (Kende and Quast, 2017), raising questions of why adoption is lagging behind. The majority of the African population continues to be offline due to high data costs (RIA, 2017; A4AI, 2017) lack of local content (Amos, 2016), and poor network performance (Chetty et al., 2013; Fanou et al., 2015), despite a number of investments and projects to expand and upgrade undersea cables, and new investments in terrestrial fibre network capacity. While this significant investment in broadband infrastructure in Africa has improved throughputs across the continent, the average Round-Trip Times (RTT or latency) is still high, due to poor Internet peering infrastructure (Chavula et al., 2017). Not only is the peering fabric of the continent uneven, but also content infrastructure in Africa requires significant development. Studies suggest that content is a dominant component of network traffic, but local content is a major bottleneck to African connectivity (Bruegge et al., 2011).

Research conducted by Fanou et al., (2016), which explored the deployment of web infrastructure in Africa by surveying 18 African websites, showed that a large number of regional websites in Africa have their hosting servers outside Africa. Even though the number of data centers across African countries is increasing (Booth, 2014; Jones, 2014), together with a growing number of Internet eXchange Points (IXPs) to exchange local traffic, along with international content providers and Content Delivery Networks (CDNs) beginning to install nodes in Africa, most content, even local websites, are hosted and are delivered from overseas (Bram, 2015).

II PROPOSED METHOD

The study makes use of active Internet measurements and individual and household surveys on ICT access and use. In order to measure what type of content

people in Africa consume, the study draws on #AfterAccess survey, which delivers nationally representative results for households and individuals. Internet measurements were conducted to gather information regarding where Africa's web content is hosted, as well as to assess the associated performance.

Active measurements, in the form of Traceroute, were conducted from a distributed set of vantage points in each country to the respective websites, to determine the countries and networks in which they are hosted, as well as the attendant packet delays between users in the country and websites.

III DATA SOURCES

Primary and secondary data were used. #AfterAccess survey data was used as primary source as well as Traceroute data. Ripe Atlas platform was used to collect Traceroute data. The list of local news websites for every African country was compiled from ABYZ News Links, an online directory of links to online news sources from around the world organized on a geographical basis.

The geographical location of each web-hosting server was determined using the MaxMind geolocation database which provides network information including the networks' Autonomous System Numbers (ASNs) and network names.

IV RESEARCH RESULTS

1. *Internet users' perspective*

In terms of barriers to internet use, data cost has been reported as the main obstacle in all countries under investigation (i.e. South Africa, Mozambique, Rwanda, Tanzania, Kenya, Ghana, and Nigeria). For a number of respondents to the #AfterAccess surveys, internet is considered a time-consuming activity, as it seems that lack of time is another relevant barrier to internet use. In Tanzania (28.36%), South Africa (24.22%), and Mozambique (36.5%), instead, the users perceive that internet speed is not sufficient for a seamless internet access. Lack of content in local language, on the other hand, and in contrast to previous studies on local content in Africa, is not considered one of the main obstacles to internet use, except in Rwanda, where 8,49% of the respondents expressed some concern related to lack of content in local languages.

2. *Geolocation of African news content hosting*

The hosting and geolocation analysis indicates that about 85% of the news websites are hosted outside the countries in which they belong, i.e. the website is owned and it is local to one country, but is hosted in another country.

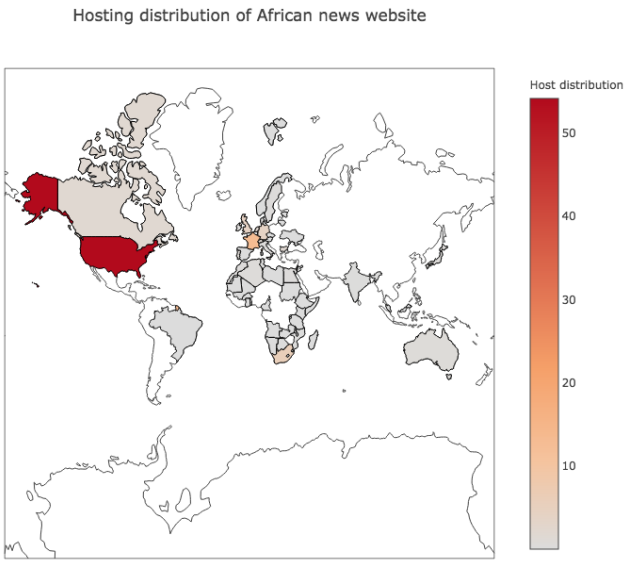

Figure-1: *Map of the world showing countries where the African news websites are hosted; the color intensity reflects the percentage of websites hosted in the country.*

The US takes the lion's share in hosting African content, with about 58% of all the websites being hosted by American companies (Figure 1). Within Africa, South Africa leads in the content hosting business, hosting about 14% of all of Africa's remotely hosted news websites (i.e minus those that belong to South Africa). The rest of the websites, about 20% are hosted in various countries in Europe (notably, 9% in France, 4% in Germany, and 3% in Great Britain).

3. *Network-level analysis of Africa's news sites*

Similar to the geo-location analysis, network-level analysis shows that most of the websites are hosted by foreign companies. Chart in Figure 4 below shows the distribution of websites among the networks. Taking into consideration all the sampled African news websites, Cloudflare Inc (US) takes the biggest share of the market, hosting about 22% of the websites. Following in the far distance is OVH SAS (France) with 8%, OPTINET (South Africa) at 6%, Google LLC and GoDaddy.com (both US) at 5% each, and Unified Layer (US) at 4%, and HETZNER (South Africa) at 3%. Regarding the hosting market share of only remotely hosted websites, Cloudflare take an even bigger share of 26%, followed by OVH SAS (9%), Google LLC (6%), GoDaddy.com (5%) and Unified Layer (5%). What is interesting to note is that the leading providers for Africa's remote hosted news websites are largely based on Cloud infrastructure and make use of content distribution networks.

4. *Delay Analysis (Round Trip Times) to access locally and remotely hosted content*

The median RTTs for locally hosted websites is about 50ms (Figure 2), whereas for remote hosted websites, the median RTTs range between 100ms and 300ms (Figure 3). This shows that there are significant performance implications for geo-location of website hosting.

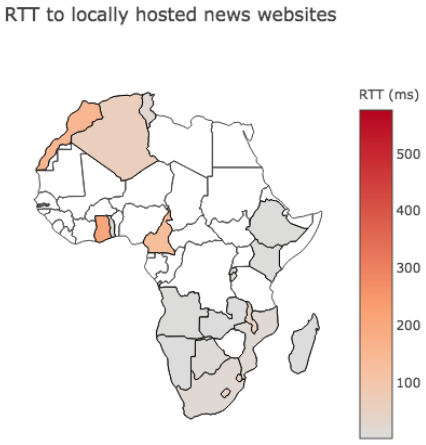

Figure 2: *National median RTTs to locally hosted websites*

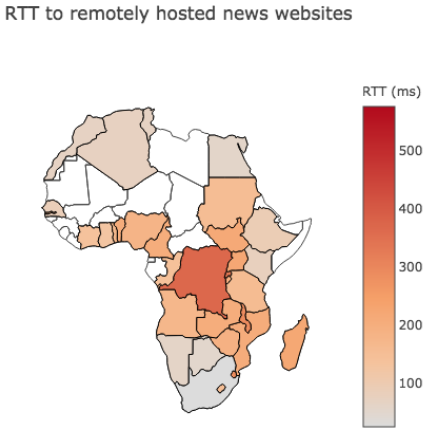

Figure 3: *National median RTTs to remotely hosted websites*

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