

Inter and Intra Networks Analysis of the African Continent

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*Code can be found at
https://github.com/freckles98/Internet_Systems_Assignment/settings*

ABSTRACT

The African continent is fairly underdeveloped within the networking world [1] due to economic disadvantage, expensive bandwidth and poor infrastructure [2]. (more here)

1 Introduction

The African continent is fairly underdeveloped within the networking world [1], due to economic disadvantage, expensive bandwidth and poor infrastructure [2]. Improvements in internet performs have been seen over the years, however packet loss is still a major problem, where it remains the highest in the world [2].

This paper aims to study the relationship between how interconnected and intraconnected African countries are by assessing end-to-end delays, AS-level hops and country level-hops.

This paper is structured in 5 sections. Section 2 covers the background and experimental setup. Section 3 provides the results and analyses for inter-country analyses. Section 4 embarks on a discussion around the intra country results and what findings can be drawn from them. Section 5 contains comparison of the inter and intra country results. Finally, section 6 concludes the paper.

2 Background and setup

Background

A brief discussion about the internet speeds and the importance behind them.

Experiment conditions

All experiments were run on a laptop with 8GB random access memory. A Intel(R) Core(TM) i5-4200U processor was used. A solid-state drive was used, along with a 64 bit operating system. Windows 10 is run on the operating system and all experiments were run through the terminal in Visual Studio Code.

Experimental Setup

A ping and traceroute was sent to 21 different universities 3 times a day over a period of 3 days. Each ping and traceroute was sent from 5 different probes – one

measurement within the country and another measurement within Africa. Three different traceroutes were sent at each measurement over the different protocols (ICMP, TCP and UDP).

3 Inter Country Results

Preliminary results are displaying that ..
(place bar graph showing the different rtt for each university on each day)
Then looking at the traceroute results
(number of hops graph per country) and (graph the average delay) and (graph number of hops between countries)

Focus on three specific universities showing the map and the traceroute within that. Discuss around this. Compare the differences between TCP, ICMP and UDP

4 Intra Country Results

Preliminary results are displaying that ..
(place bar graph showing the different rtt for each university on each day)
Then looking at the traceroute results
(number of hops graph per country) and (graph the average delay) and (graph number of hops between countries)

Focus on three specific universities showing the map and the traceroute within that. Discuss around this. Compare the differences between TCP, ICMP and UDP

5 Comparison between Inter and Intra Country Results

Produce table looking at number of hops, rtt and delays. Explain final findings about the network situation in Africa.

6 Conclusion

Conclude paper. Discuss profound findings.

REFERENCES

APPENDIX

| | Country | Country Code | University | IP Address |
|----|--------------|--------------|--|-----------------|
| 1 | South Africa | ZA | University of Cape Town | 137.158.154.230 |
| 2 | South Africa | ZA | University of Pretoria | 137.215.6.94 |
| 3 | South Africa | ZA | Rhodes University | 146.231.128.43 |
| 4 | Ghana | GH | University of Ghana | 197.255.125.213 |
| 5 | Ghana | GH | University of Cape Coast | 156.38.96.0 |
| 6 | Ethiopia | ET | Jimma University | 197.154.187.0 |
| 7 | Kenya | KE | University of Nairobi | 41.89.94.20 |
| 8 | Kenya | KE | Kenyatta University | 41.89.10.241 |
| 9 | Uganda | UG | Makerere University | 196.43.135.170 |
| 10 | Uganda | UG | Uganda Christian University | 102.220.200.167 |
| 11 | Algeria | DZ | Universite de Jijel | 193.194.69.172 |
| 12 | Morocco | MA | Université Ibn Zohr | 196.200.181.122 |
| 13 | Morocco | MA | Al Akhawayn University | 196.12.203.30 |
| 14 | Sudan | SD | Sudan University of Science and Technology | 41.67.52.0 |
| 15 | Rwanda | RW | University of Rwanda | 41.222.245.0 |
| 16 | Tanzania | TZ | University of Dar es Salaam | 196.44.160.0 |
| 17 | Zambia | ZM | University of Zambia | 41.63.1.33 |
| 18 | Zimbabwe | ZW | University of Zimbabwe | 196.4.80.0 |
| 19 | Mauritius | MU | University of Mauritius | 202.60.7.12 |
| 20 | Namibia | NA | University of Namibia | 41.205.129.157 |

| | | | | |
|----|---------|----|---|----------------|
| 21 | Namibia | NA | Namibia University of Science and Technology | 196.216.167.71 |
|----|---------|----|---|----------------|

References (to do):

[1] <https://www.internetsociety.org/internet/history-of-the-internet-in-africa/>

[2] <https://spectrum.ieee.org/how-bad-is-africas-internet>

ACM Reference format:

FirstName Surname, FirstName Surname and FirstName Surname. 2018. Insert Your Title Here: Insert Subtitle Here. In *Proceedings of ACM Woodstock conference (WOODSTOCK'18)*. ACM, New York, NY, USA, 2 pages. <https://doi.org/10.1145/1234567890>

Structure

Number of Universities failed ping and traceroute

Average delay

AS-level hops

Country level hops

Introduction

geo-topology and performance between at least 20 universities in Africa.

You will select universities' web-servers as targets for your measurements (you can only select a maximum of 3 universities from each country).

You will choose at least 3 probes as vantage points from each of the countries selected (select countries where you can find at least 3 Ripe probes).

You should repeat ping and traceroute measurements from each probe to every target server - from each probe to repeat 3 times a day for 3 days. It is recommended to automate the Ripe Atlas measurements, e.g using Atlas-Cousteau. You can use Maxmind database to determine the ASN and country of each IP in the traceroute data.

Analysis Task-1: intra-country measurements - analyse ping and traceroute results from vantage points and target servers within each country.

Analysis Task 2: intercountry measurements - analyse ping and traceroute between probes and web servers that are in different countries.

For both Task-1 and Task-2, you will need to analyse the following:

1) end-to-end delays;

2) AS-level (Autonomous Systems) hops (number of ASN(autonomous system) hops, and what ASNs are traversed between source and destination);

3) country-level hops (which countries are traversed between source and destination).

In the end, you will write a report to: **(1) discuss your observations, particularly in terms of Internet delays and geo-location of paths;**

2) draw and discuss a geo-topology map that combines the results from the two tasks.

What to submit: Submit a report of 3-5-pages (including the graphs and topologies). The report should include discussion of the tasks undertaken, the results and discussion of the results. You will submit a zip-folder containing the report, as well as measurement/analysis scripts and data.