LIQUID
INTELLIGENT TECHNOLOGIES

Cost models for data services and International Internet Connectivity: Lessons learned and best practices from different regions

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CTIO

Liquid Intelligent

Technologies

4th October 2023

Liquid Intelligent Technologies Overview

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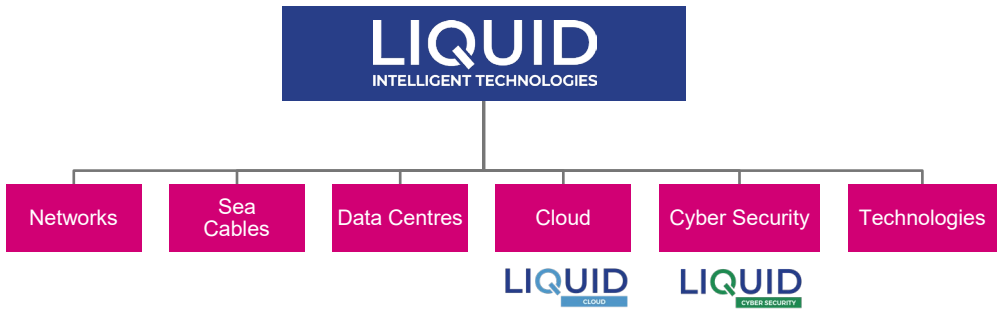
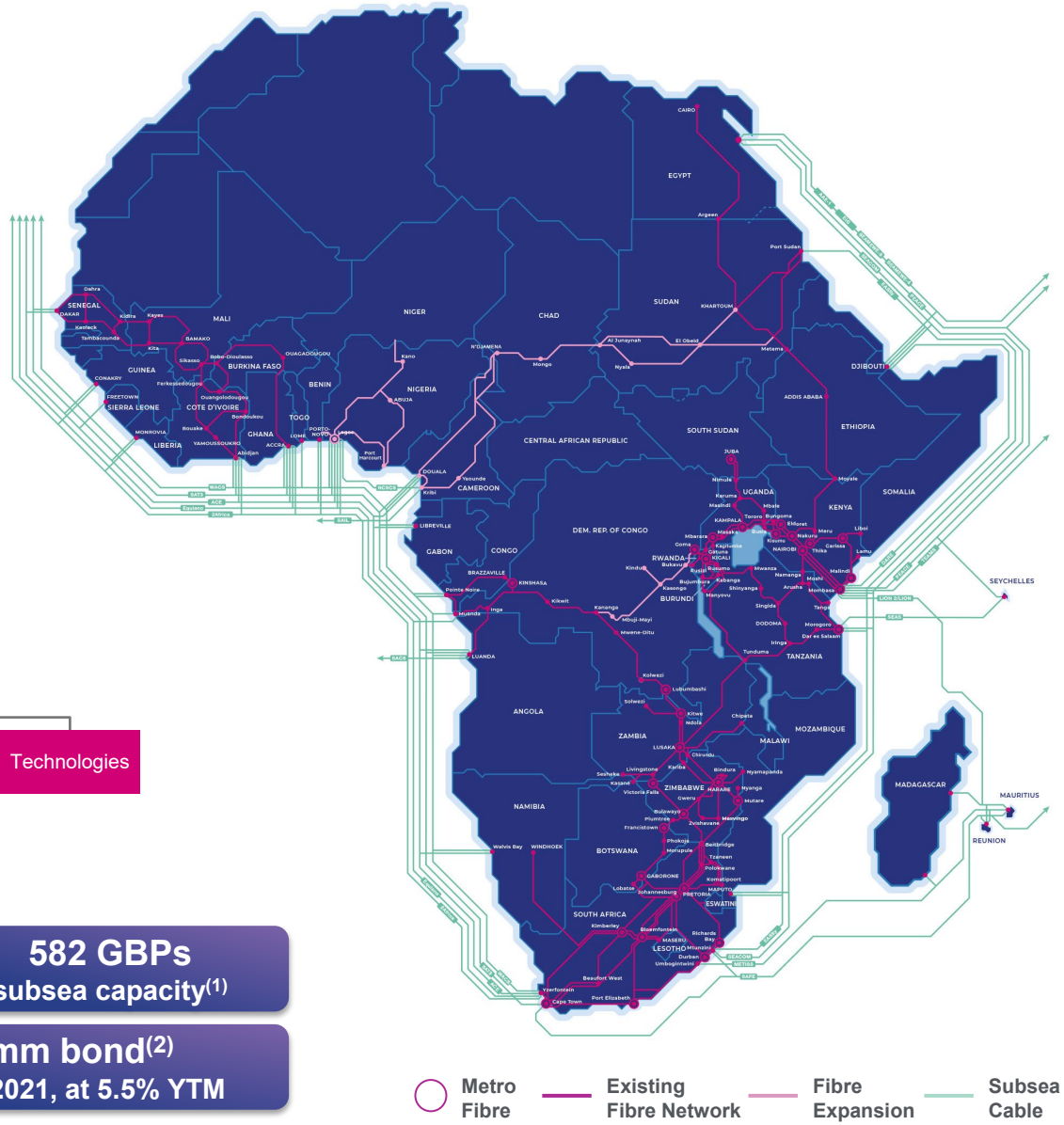
- The leading cross-border communications and cloud solutions provider with owned proprietary network across 11 countries in SSA and 3 countries outside SSA
- Bringing high-speed and reliable **connectivity**, **colocation**, **cloud**, **cybersecurity** and **digital services** to mobile carriers and blue-chip enterprise customers
- Extensive **metropolitan and last mile access networks**





100,000+ km fibre network

14 countries in Africa

582 GBPs subsea capacity(1)

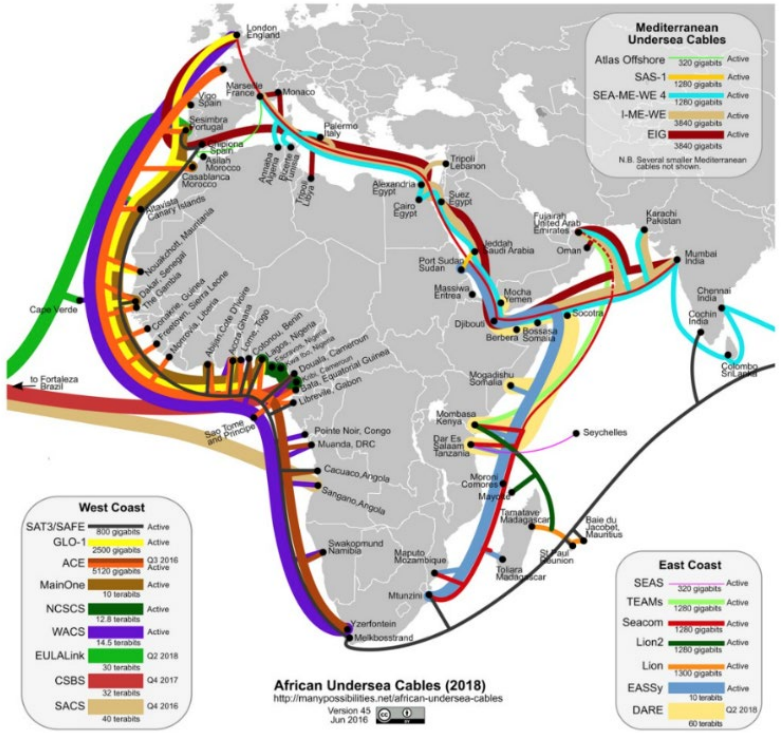
250,000 cloud seats

US$840mm bond(2) refinanced in 2021, at 5.5% YTM

Source: Company information.
Note: (1) As of February 28, 2021. (2) Consists of $620mn bond and $220mn variable ZAR term loan.

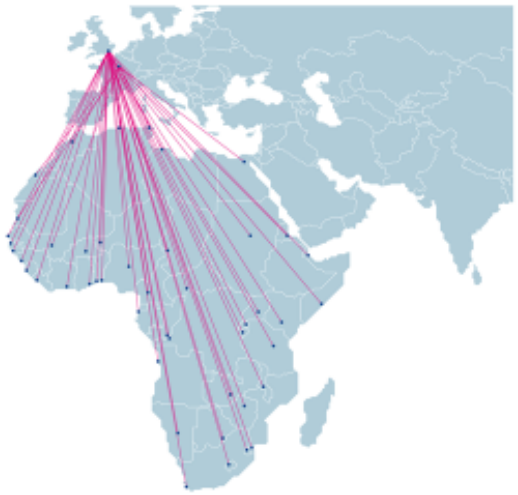
History – Transition of Satellite to Fibre First mile Backbone in Africa

"By 1993, 70% of Africans had never heard a phone ring"



African Internet 2012

Artists Impression...



- Mostly sub sea Trunk Routes
- Multiple sub sea routes and competition leading to lower pricing
- Internet hubbing mostly in Europe
- IXP of choice for Africa is LINX
- Some cross border connections, mostly selling commercial transit to countries with no landing stations
- Nearly all countries have local IXP. Many of these have participation from local incumbent Telco
- Cheaper than before
- Latency to Europe about 50% less, inter Africa Latency still about the same as a direct satellite

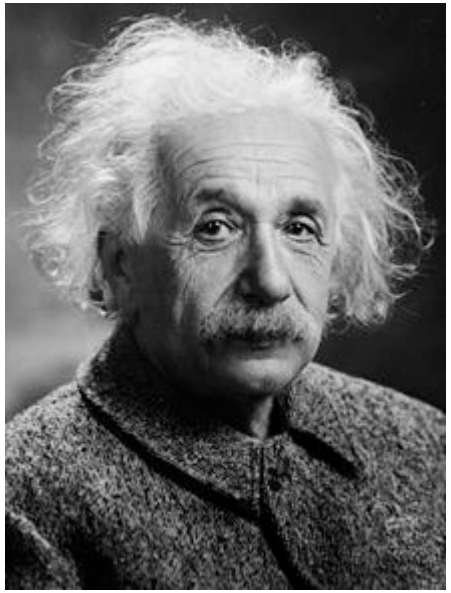
Physics – Latency is a Factor of Distance

Theories
- Speed of light in a medium = c / refractive index
- Velocity= Distance/Time

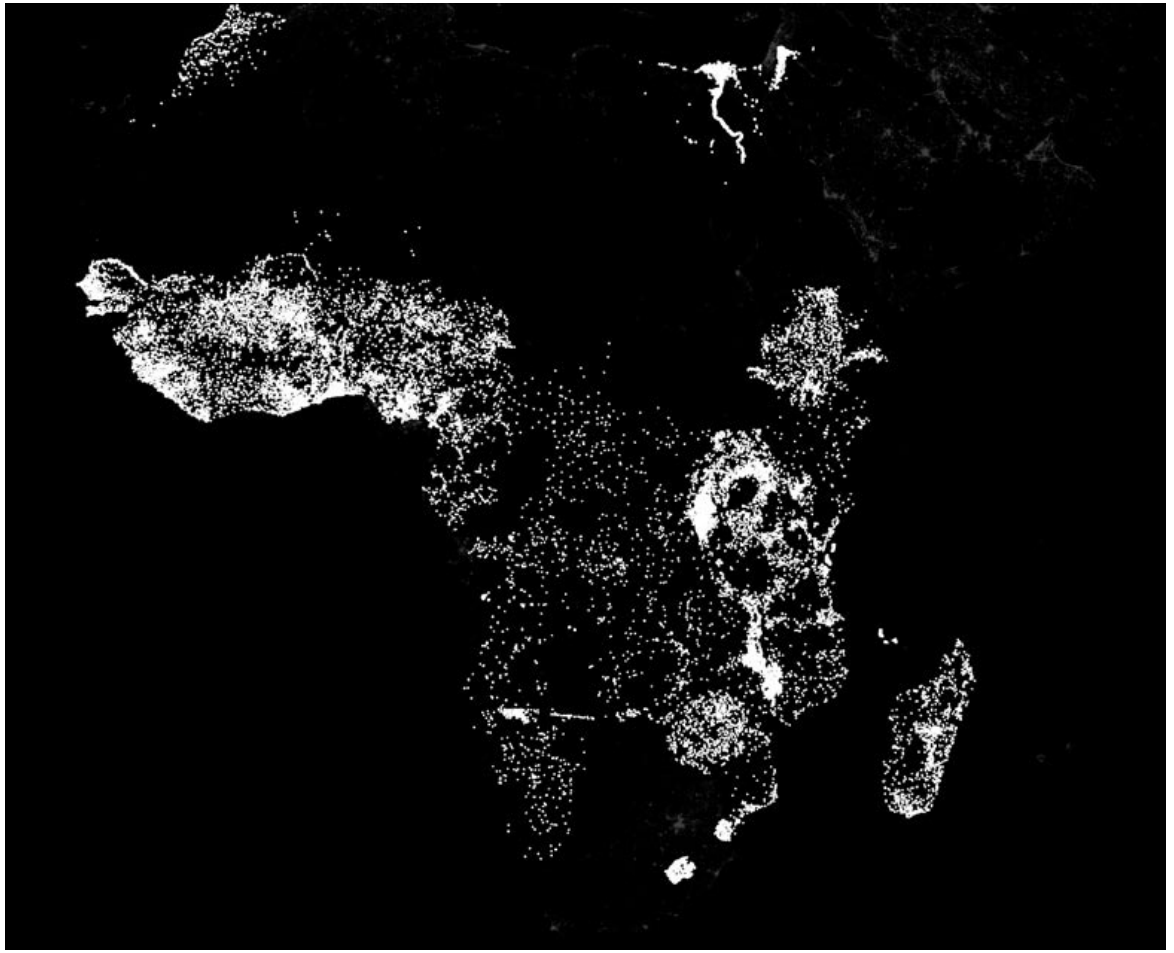
UoM
- 1 ms = 1 second /1000
- RTT = Round trip delay – Time taken there and back
- 1 km = 1000 m

Universal Constants
- Speed of light in a vacuum (c) is 2.99 x 10^8 m/s
- Refractive index of doped silica with an index around 1.4475
- Speed of light in fibre = 2.06 x 10^8 m/s

RTT (ms) = 1000 x 2 x Distance(m) / 2.06 x 10^8 m/s



Geography – Africa is REALLY Big with Large Uninhabited Zones



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Economics – CAPEX, OPEX, Fill the Pipes!

- Build to Last to global standards
- Built to grow with the needs of the customer/consumer
- Network Operations and design and design to maintain reliability
- Sustainable Business Model
- CAPEX and OPEX are a factor of distance
- Infrastructure sharing with complimentary Infrastructure owners
- Wayleave charges – complex negotiations and unregulated
- 10G to 100G (to 400 and more) wavelength technology shift
- Financing Models
- Differentiated Data Products, Wholesale, Enterprise, Retail
- Digital Services to ‘fill the pipe’
- IXPs, Caching, Peering, Cloud OnRamps

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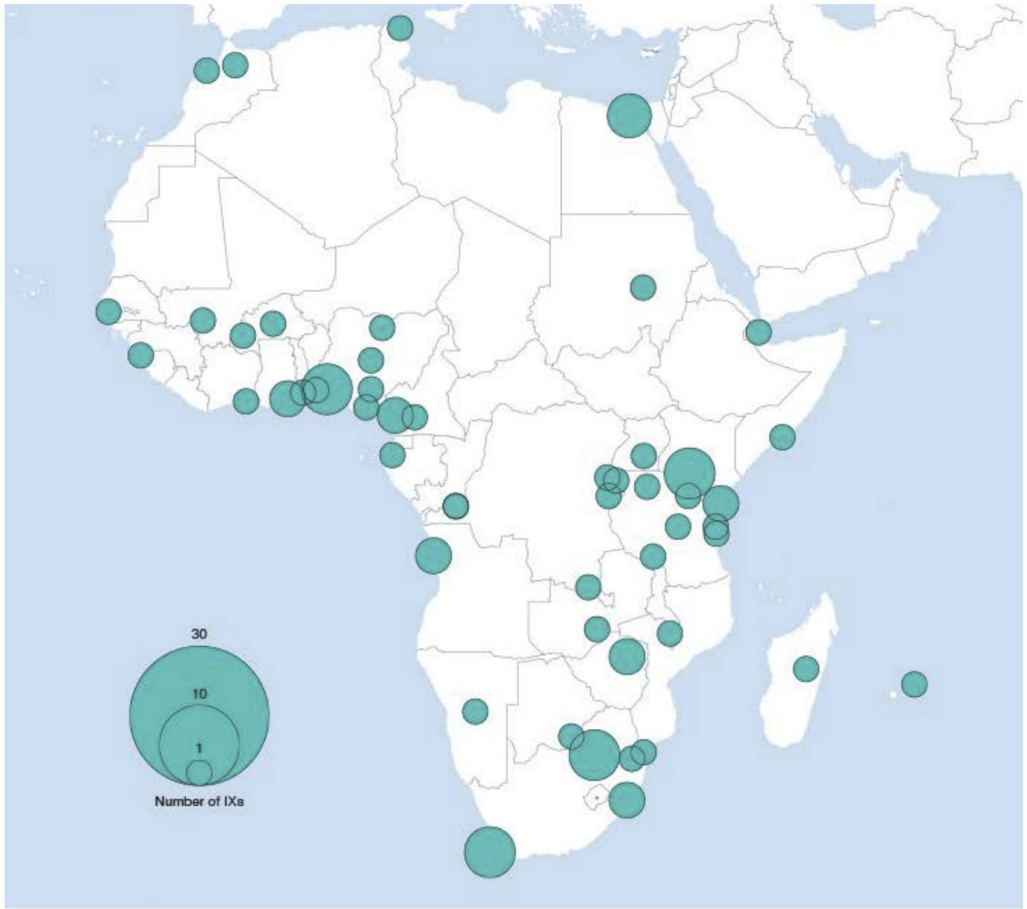
Growth of Internet Exchanges

Our digital future starts here.

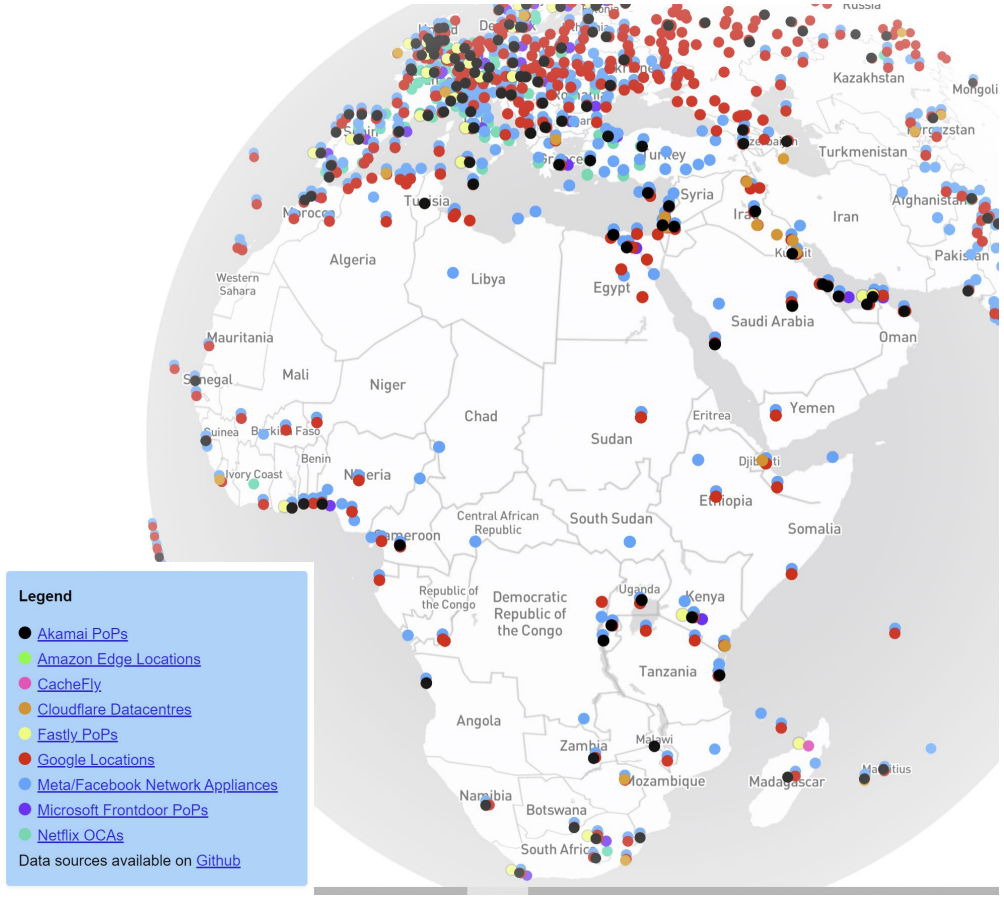


- IXPs help localize traffic and content connecting networks and content providers
- Lowering costs (less IPT) and enhances performance (lower latencies)
- Essential element of creating hubs and their ecosystems
- Sourced from IXPDB & Peeringdb

Emergence of Content Delivery Networks

Our digital future starts here.

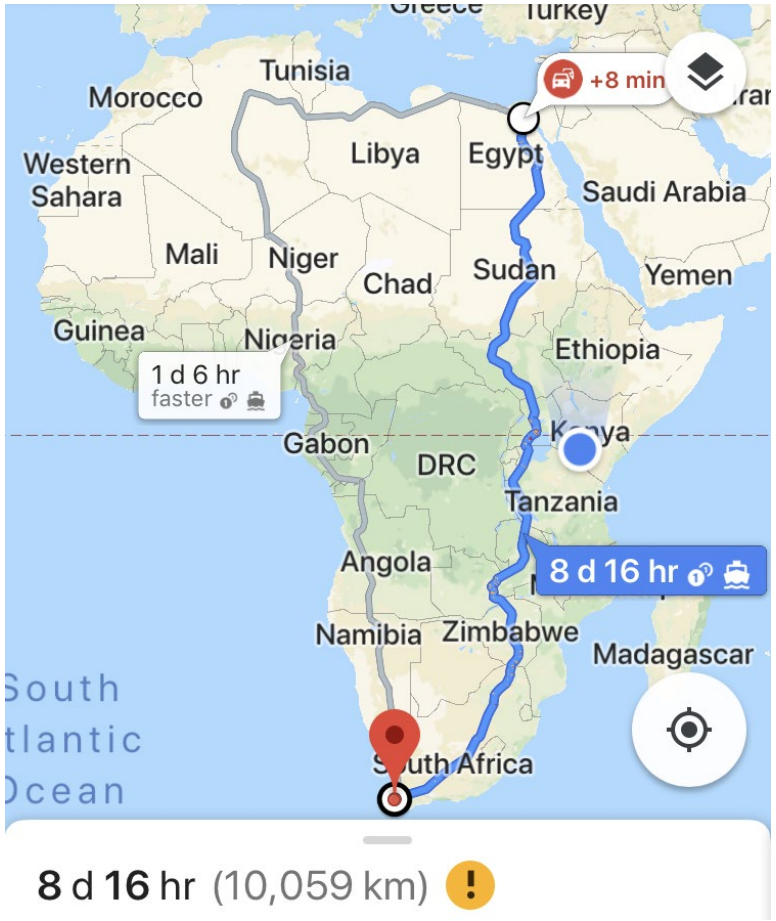
https://opentelecomdata.org/cdns/



Observations

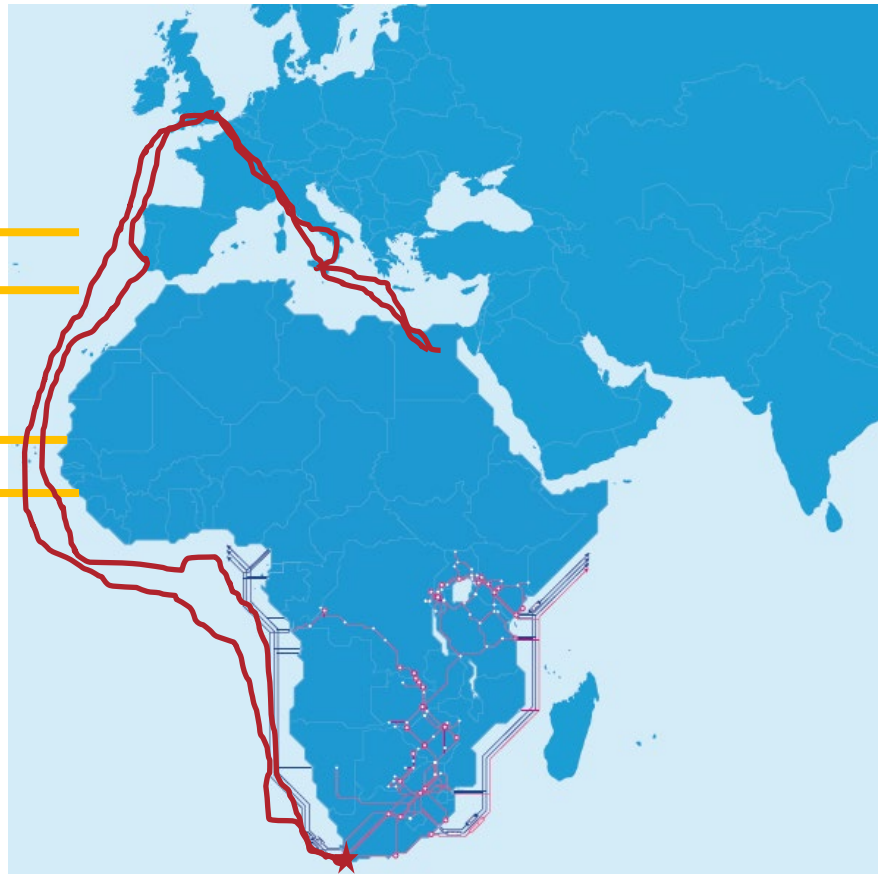
- Every country has at least one CDN cache
- ‘Hub Cities’ have all/most CDNs
- Mix of operator caches and IXP hosted
- Physical density is sparse
- Only a few countries have density of caches in tier 2 cities
- Google and Meta have the most caches

“Boomerang Routing”
2017 Cape to Cairo – 97 ms?

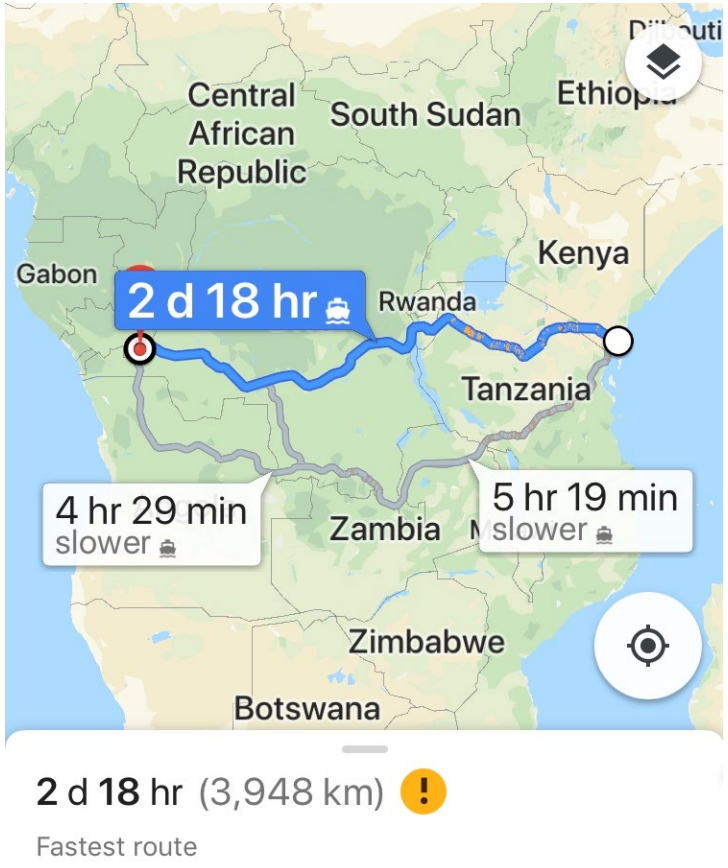


LZA-PE1-CPT#traceroute 41.209.193.1
1 teng0-1-0-1.luk-pe1-gsw.liquidtelecom.net
2 be5.luk-pe1-tho.liquidtelecom.net
3 xe2-1-6.londra32.lon.seabone.net
4 be3.palermo16.pal.seabone.net
5 telecom-egypt.palermo16.pal.seabone.net

209 msec

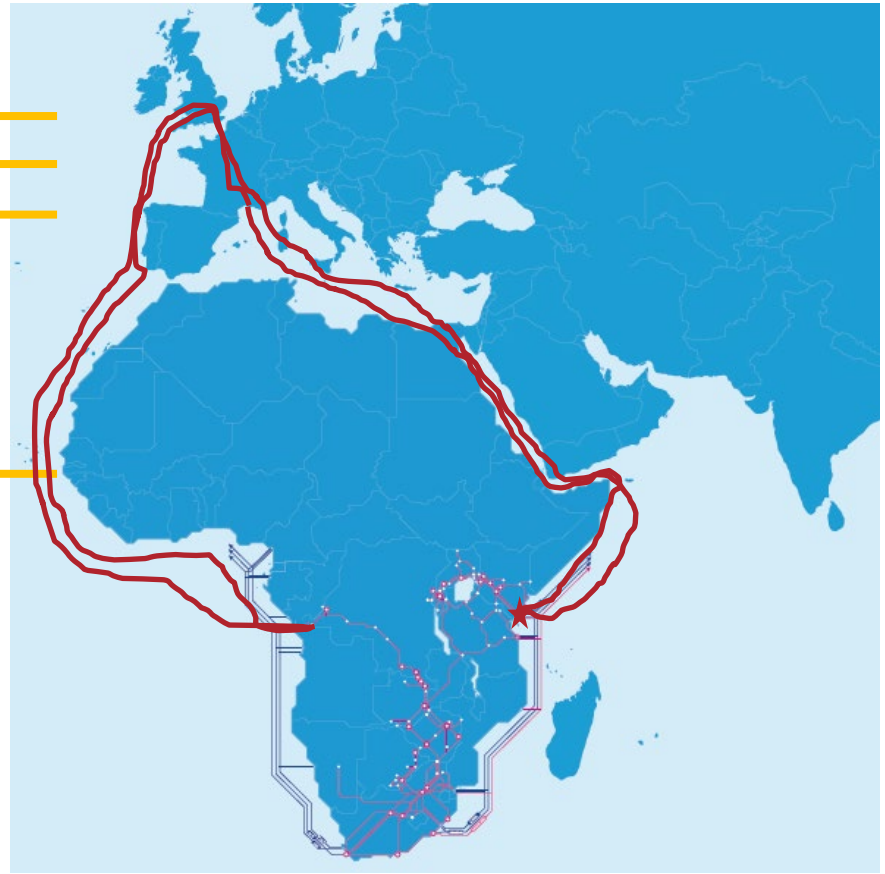


2017 - Mombasa to Kinshasa – 38 ms?



LKE-P1-MSA#traceroute 41.243.13.1
1 teng0-0-1-0-0-lfr-pe1-mrs.liquidtelecom.net
2 te0-0-0-0.luk-pe1-gsw.liquidtelecom.net
3 be5.luk-pe1-tho.liquidtelecom.net
4 5.11.10.95 145
5 195.66.226.204 131
6 182.79.222.165
7 125.62.187.189
8 dsl-del-static-078.45.246.61.airtelbroadband.in
9 41.243.13.1 302

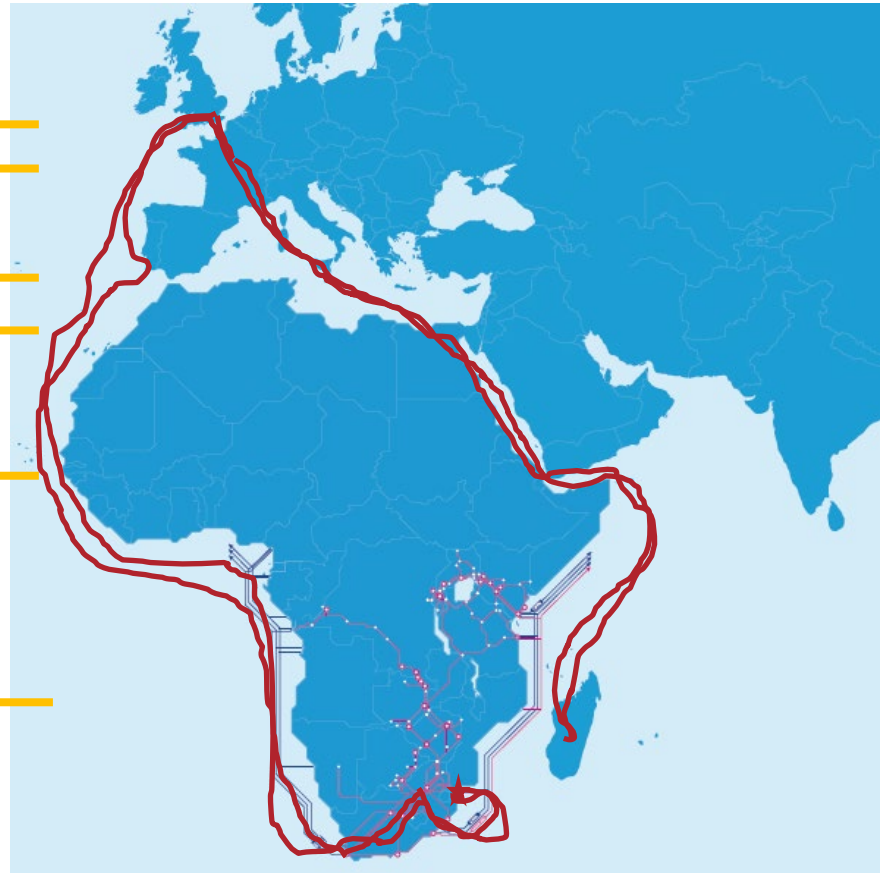
296 ms



Maputo to Madagascar – Packets eventually find a way there even if Google and Lonely Planet Can Not

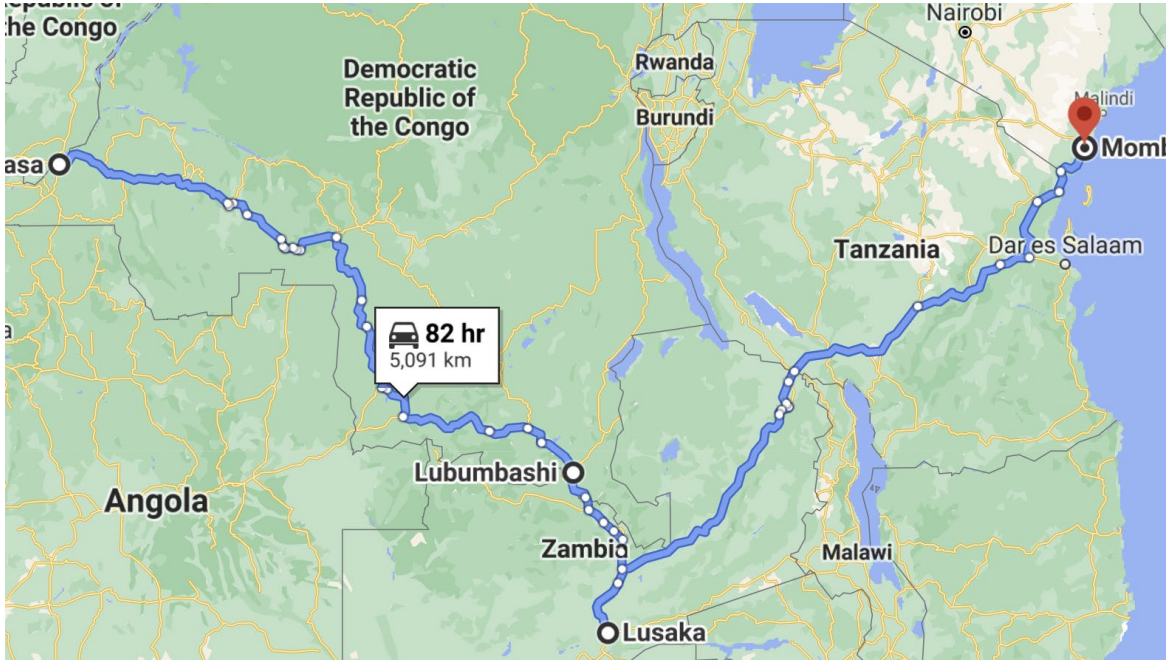
- No Direct Flights
- No passenger boats
- Lonely Planet advises that the only way is to ask around in Maputo harbour and hitchhike a freighter

LMZ-PE1-MPT#traceroute 41.204.120.154
1 41.60.134.226 pos8-2-2-lza-p2-jhb.liquidtelecom.
2 bundle-eth10-p4-jhb.liquidtelecom.net
3 tengig0-3-0-7-pe1-cpt.liquidtelecom.net
4 ten0-0-0-7.luk-p1-tho.liquidtelecom.net
5 bundle-eth1.luk-pe1-tcy.liquidtelecom.net
6 10ge3-10.core1.lon2.he.net
7 100ge1-2.core1.par2.he.net
8 gulfsat.par.franceix.net
9 pe-th2-2-po2.malagasy.com
10 rtr-ixp-3-te4-0-0-3752.malagasy.com
11 mainrouter-3-bond0.malagasy.com
12 mainrouter-3-bond0.malagasy.com
13 bwmgr-tc-3-eth9.malagasy.com
14 pe-andranoabo-1-tengiga3-2.malagasy.com
15 * * *
16 corporate-portal.malagasy.com



589 msec

2023 - Mombasa to Kinshasa -63 ms and 40 ms Routes are LIT



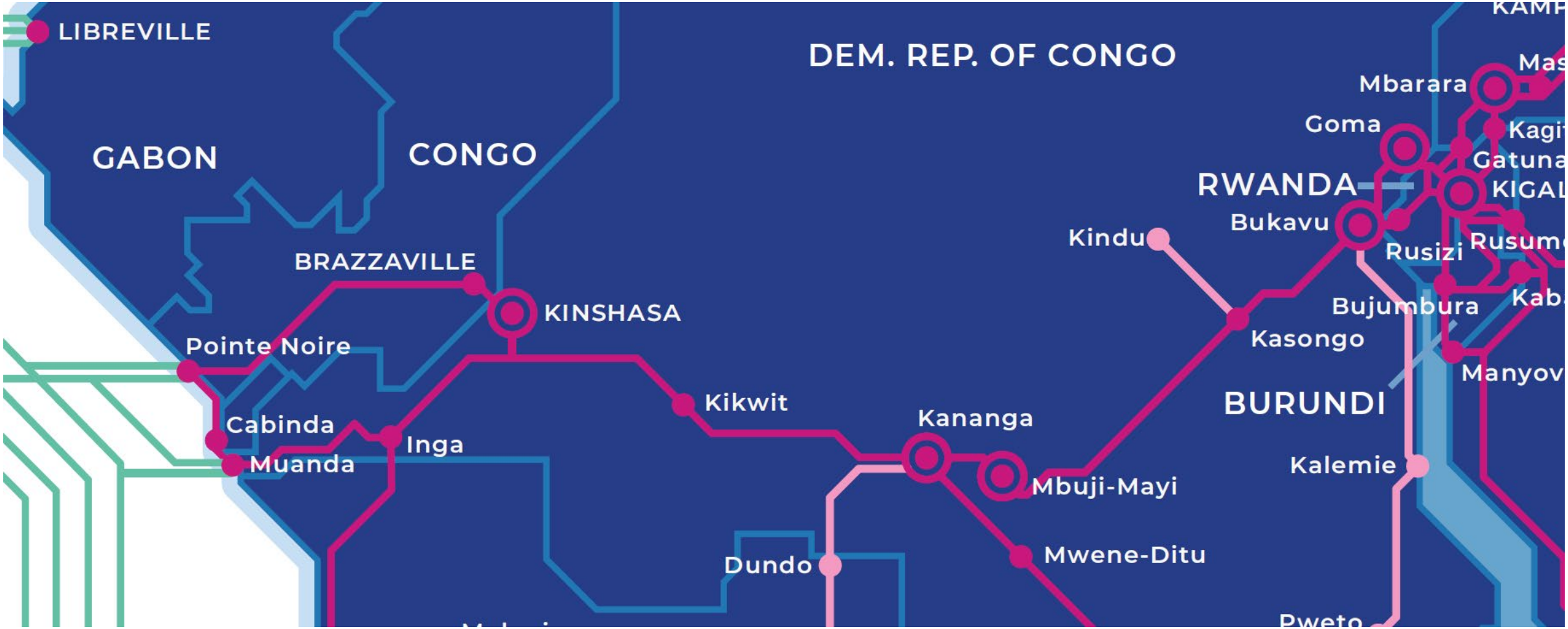
PE1-FIH> traceroute
197.155.86.231.liquidtelecom.net

63.188 msec

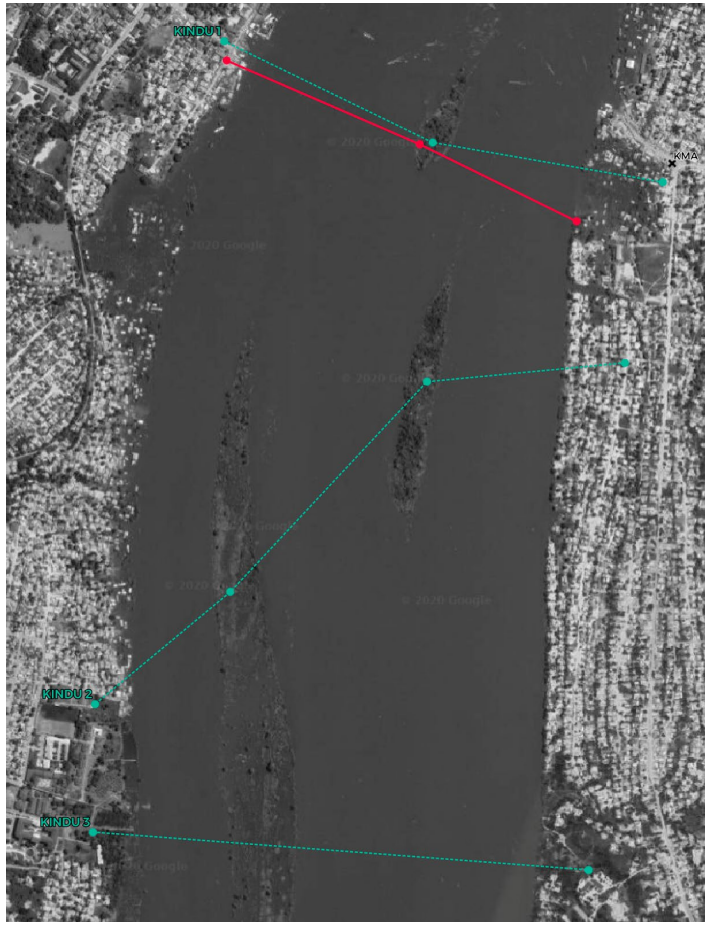
PE1-MSA > traceroute
197.155.86.230.liquidtelecom.net

62 msec

Impacting millions of Africans by addressing gaps in First and Middle Mile



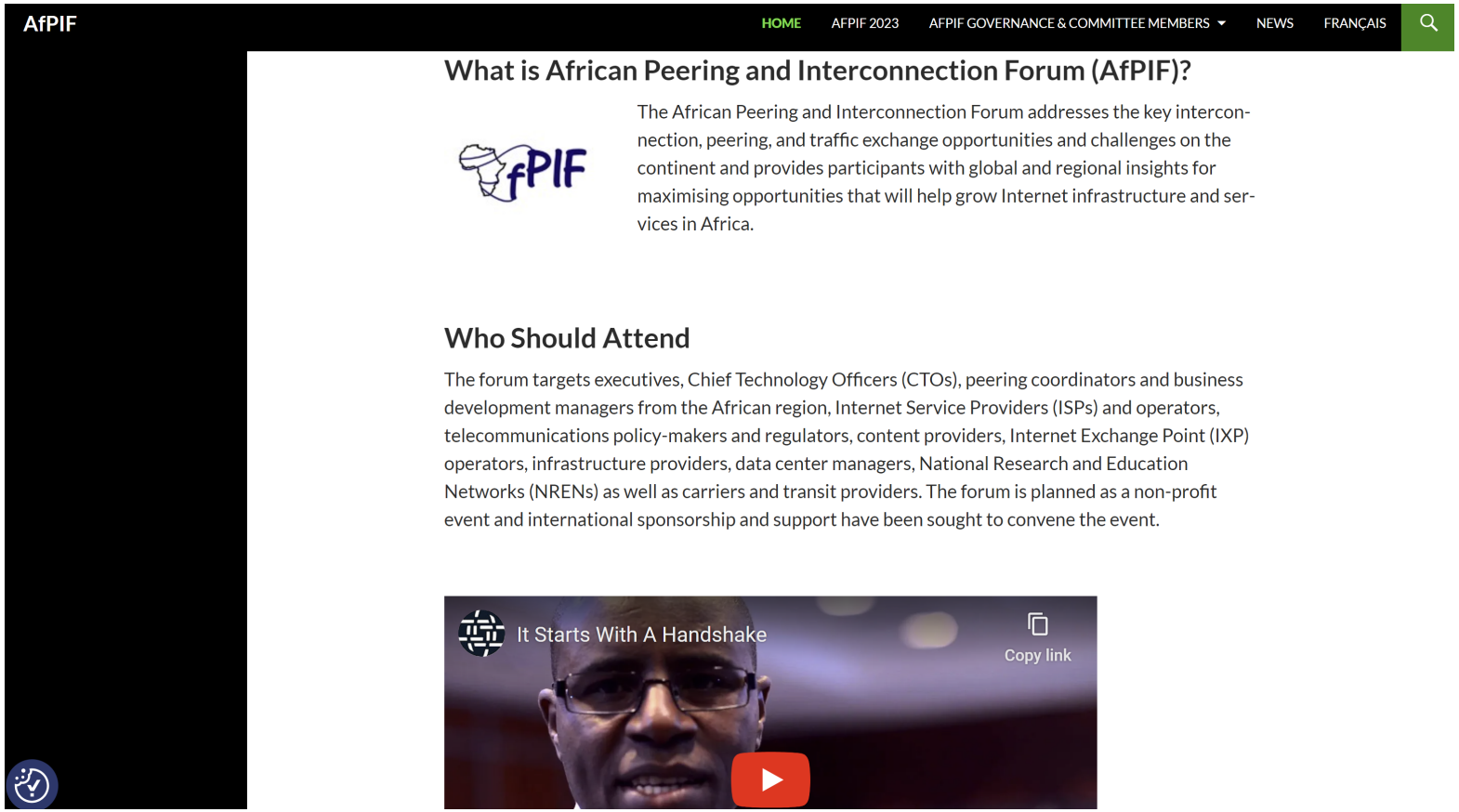
Technology and Civil Engineering Challenges to Solve



What else are we doing About it Besides building Fibre? Collaboration with ISOC, Industry.

Our digital future starts here.

www.afpif.org Africa Peering and Interconnection Forum



Open Fibre Mapping – With ITU

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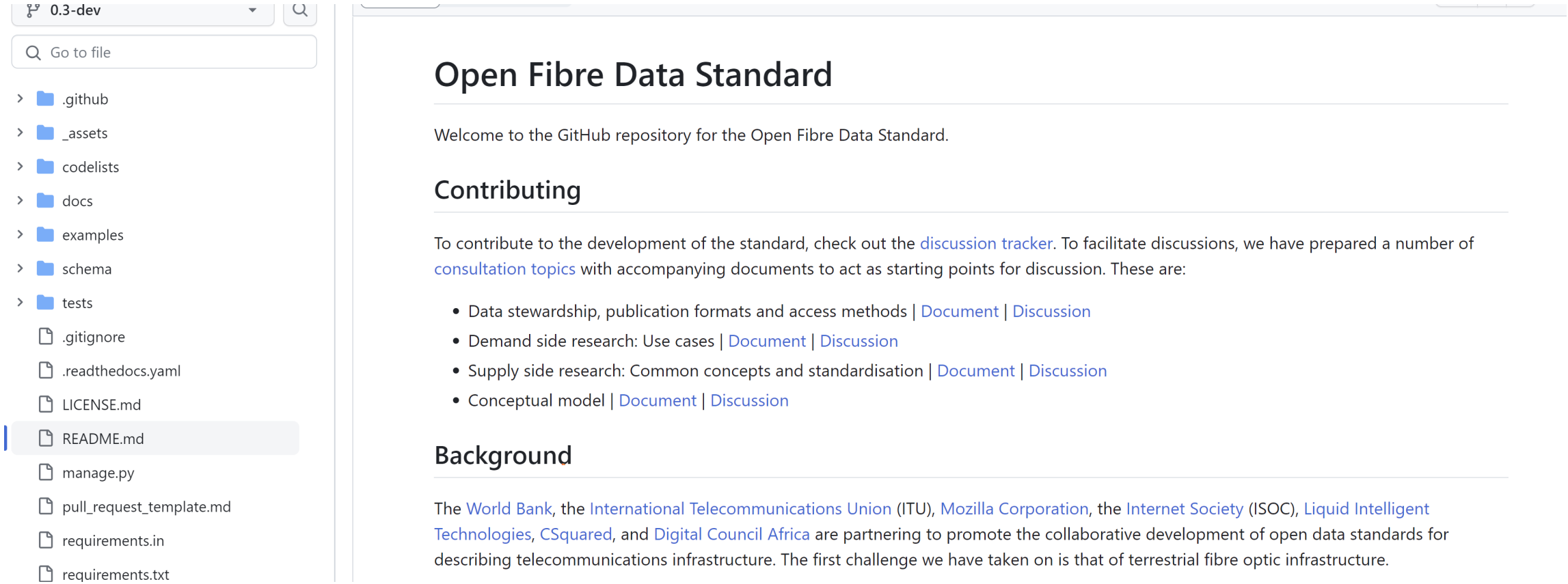
https://github.com/Open-Telecoms-Data/open-fibre-data-standard



With IETF - Pioneering Segment Routing

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“There have also been some key developments in IP packet routing and segment routing that are enabling us to route traffic based on where it has come from as well as where it is going to. We at Liquid Telecom were one of the first globally to deploy segment routing as well as one of the first in Africa to deploy IPV6 to the last mile customer endpoint – and it was great to receive an award recognising that in London at the end of 2018. We are also looking to the future and getting involved with standards development, especially where segment routing and IPv6 converge, in order to ensure the standards of tomorrow cater for the needs of Africa and its customers.”

https://www.afpif.org/2019/08/ten-years-of-supporting-africas-tech-community/

Workgroup:	SPRING Working Group
Internet-Draft:	draft-bonica-spring-sr-mapped-six-04
Published:	27 September 2021
Intended Status:	Standards Track
Expires:	31 March 2022

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G. Chen, *Baidu*

Aligning our Investments to Regional Integration Initiatives and Mega Projects

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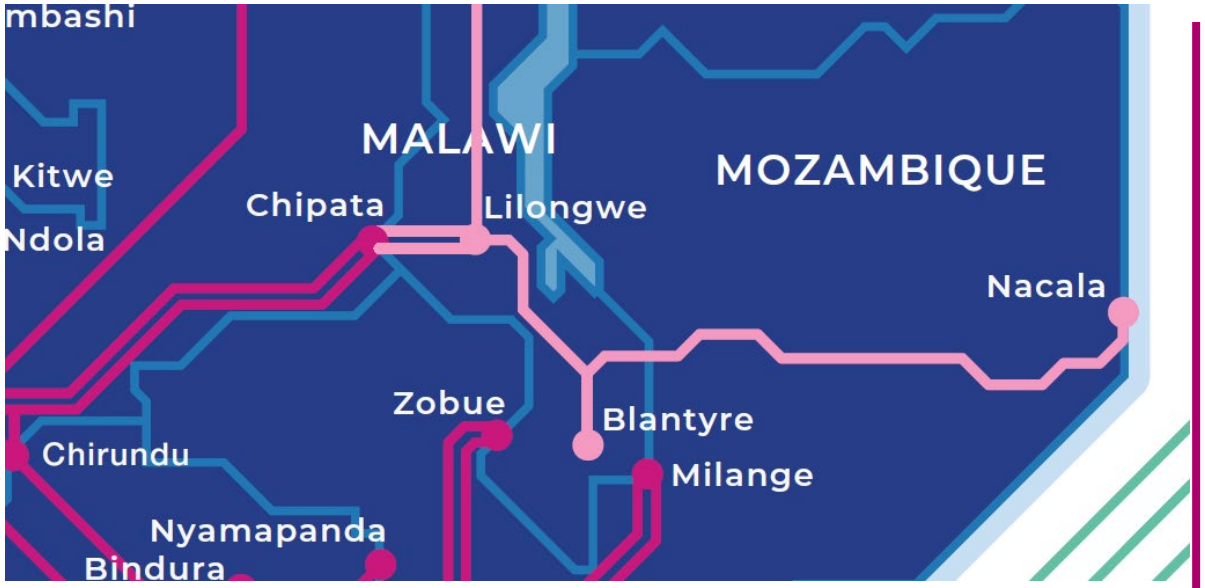


Malawi launches Diplomatic Data Corridors project

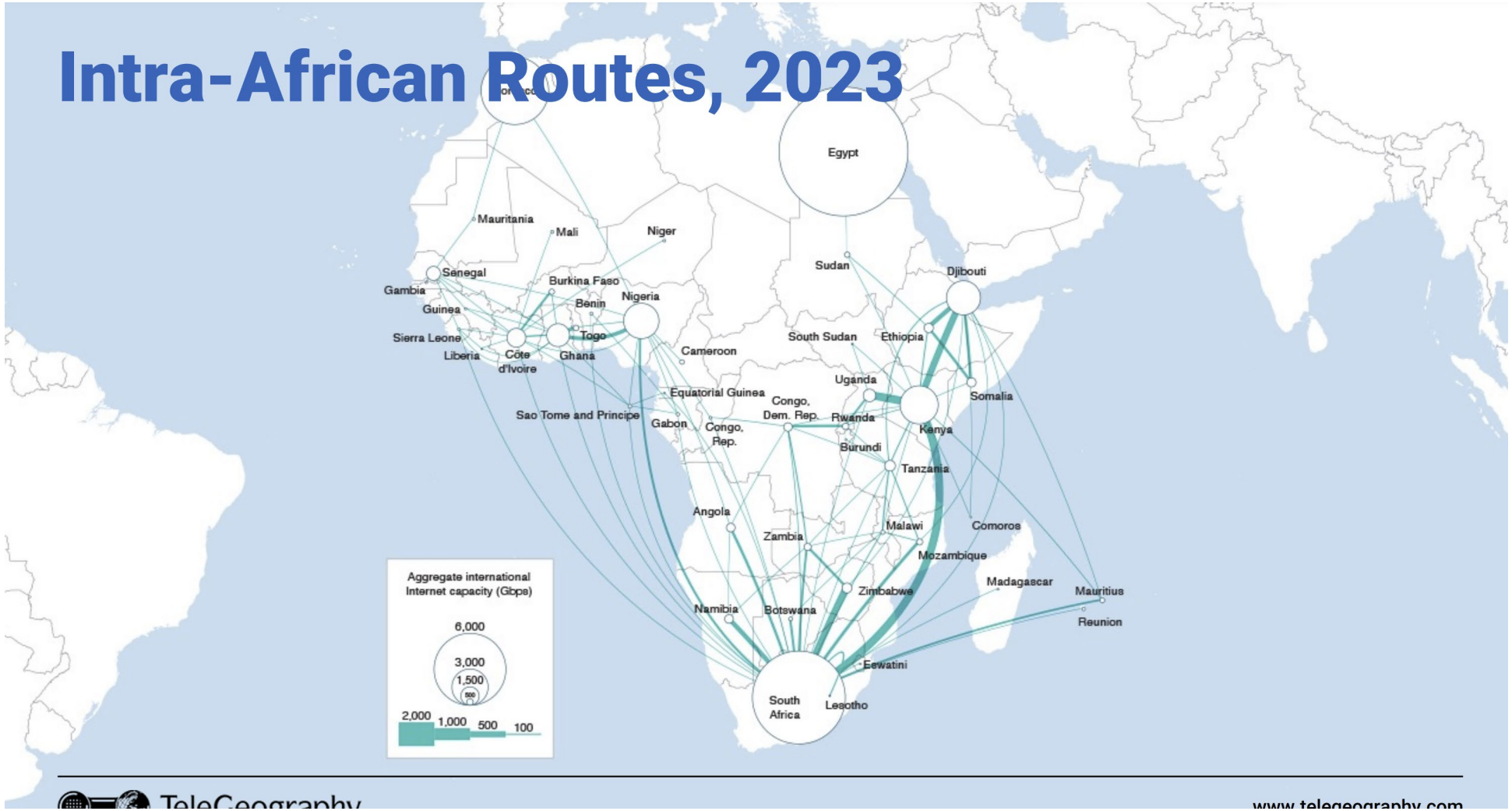
06 March 2023

Malawi has launched the Diplomatic Data Corridors project to address the high cost of internet and data services, as well as the country's low internet penetration.

Malawi's government has entered negotiations with Mozambique, Tanzania, and Zambia to consider directing their internet traffic into Malawi.

Daud Suleman, director general of the Malawi Communications Regulatory Authority (Macra), said that the country wants to double the current internet penetration rate to 40% in three years and leverage connections from undersea cables into Malawi to

Current Network Data Regarding Intra African Data Flows



https://www.afpif.org/wp-content/uploads/2023/08/AfPIF23_Patrick_Christian_Ghana_TG.pdf

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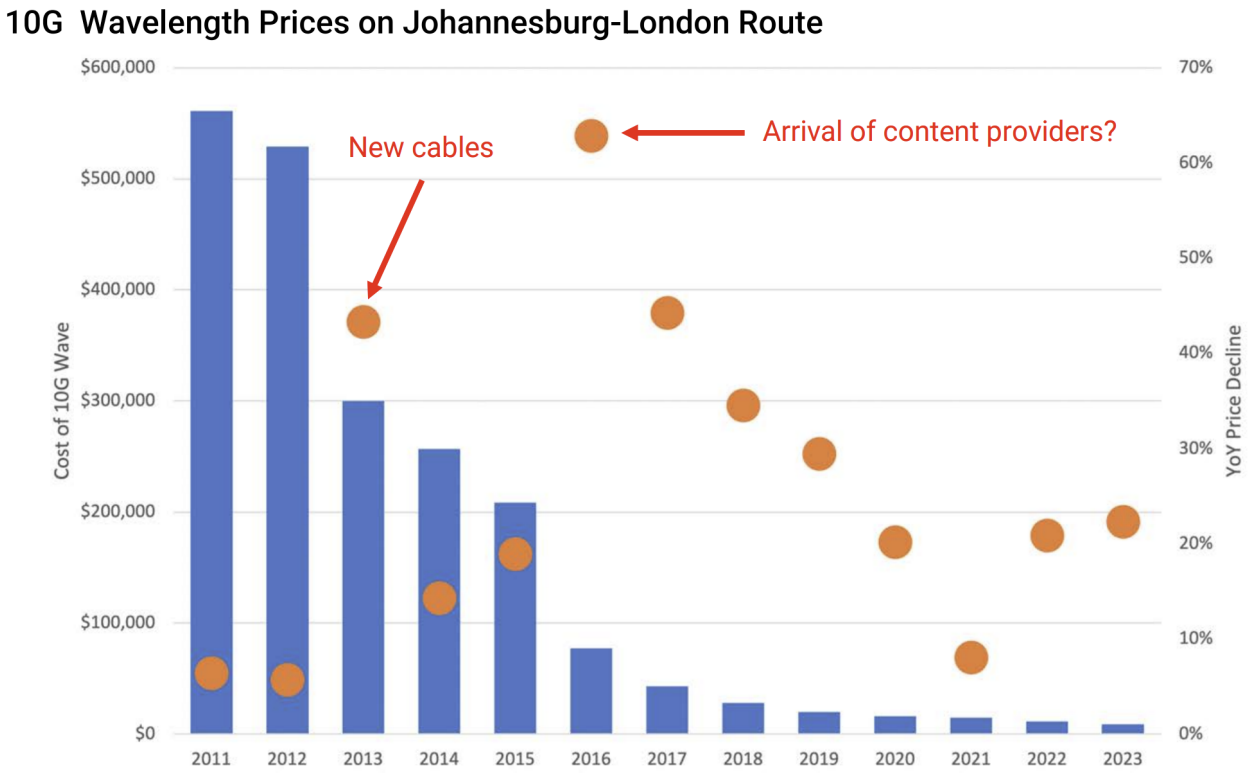
Data on Price Decline of Wholesale Internet in South Africa

Price Decline After New Cables in South Africa



- Pre-2013 a 10G Wave between London and Jo'burg was more than a half million dollars.
- Pre-2012 cables, growth rate steady at below 10%
- By 2013 40%+ drop, then in 2016 another large drop 60%
- Since then has dropped to between 15-20% annual drop past 4 years

TeleGeography

www.telegeography.com

https://www.afpif.org/wp-content/uploads/2023/08/AfPIF23_Patrick_Christian_Ghana_TG.pdf

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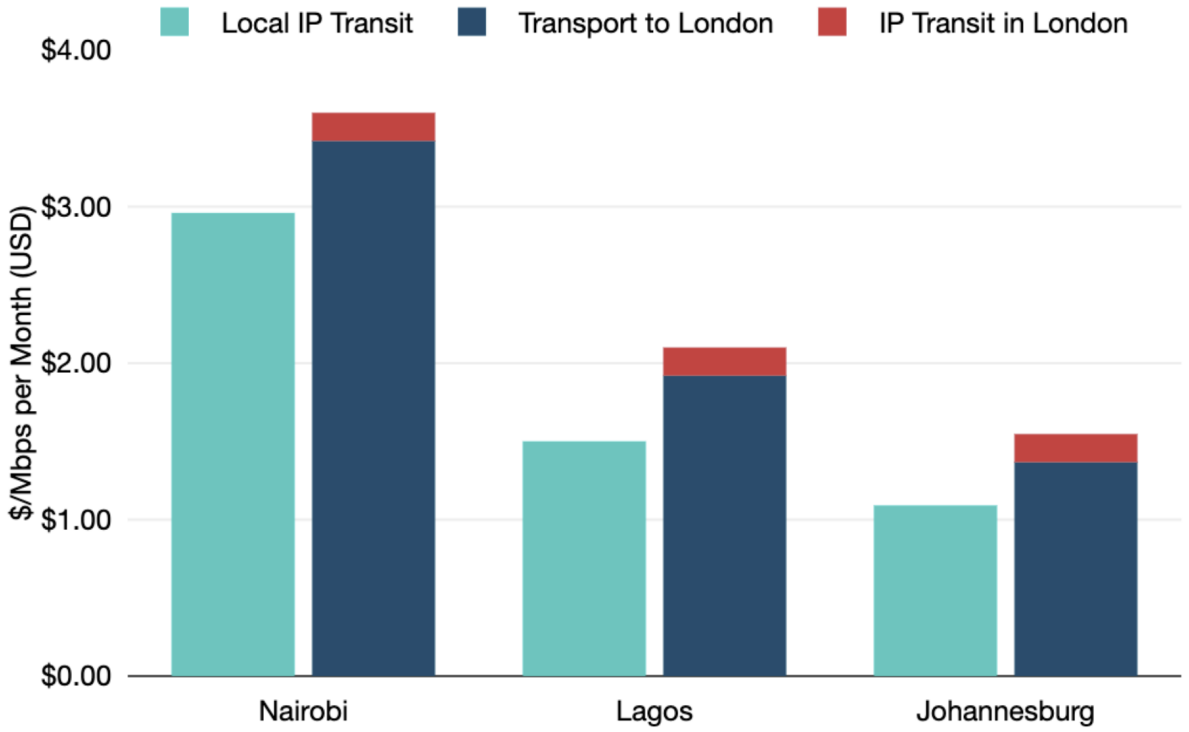
Comparing IP Transit vs Intercontinental Trunks in Hub Cities

Pipe and Port versus Local IP Transit Prices

Weighted Median 10 & 100 Gbps Wavelength Prices & Price Multiples in Africa



- All 3 cities local IP transit was 25% cheaper than pipe and port.
- 5 years ago it was ~25% more expensive to purchase local IPT

TeleGeography

www.telegeography.com

https://www.afpif.org/wp-content/uploads/2023/08/AfPIF23_Patrick_Christian_Ghana_TG.pdf

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Thank You

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