



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

Ben Roberts

CTIO

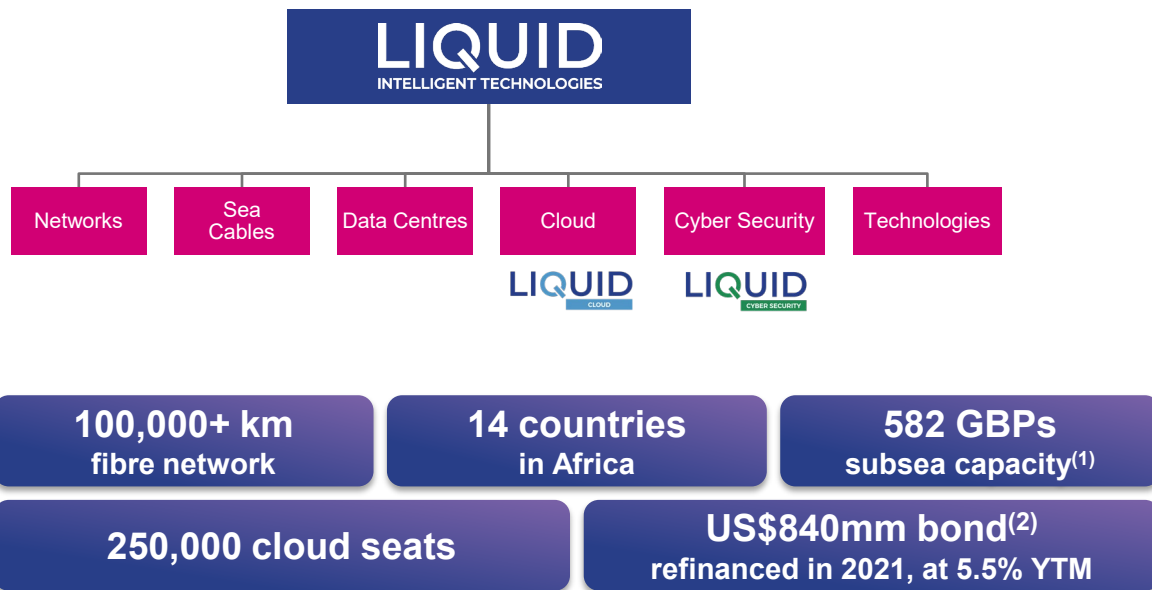
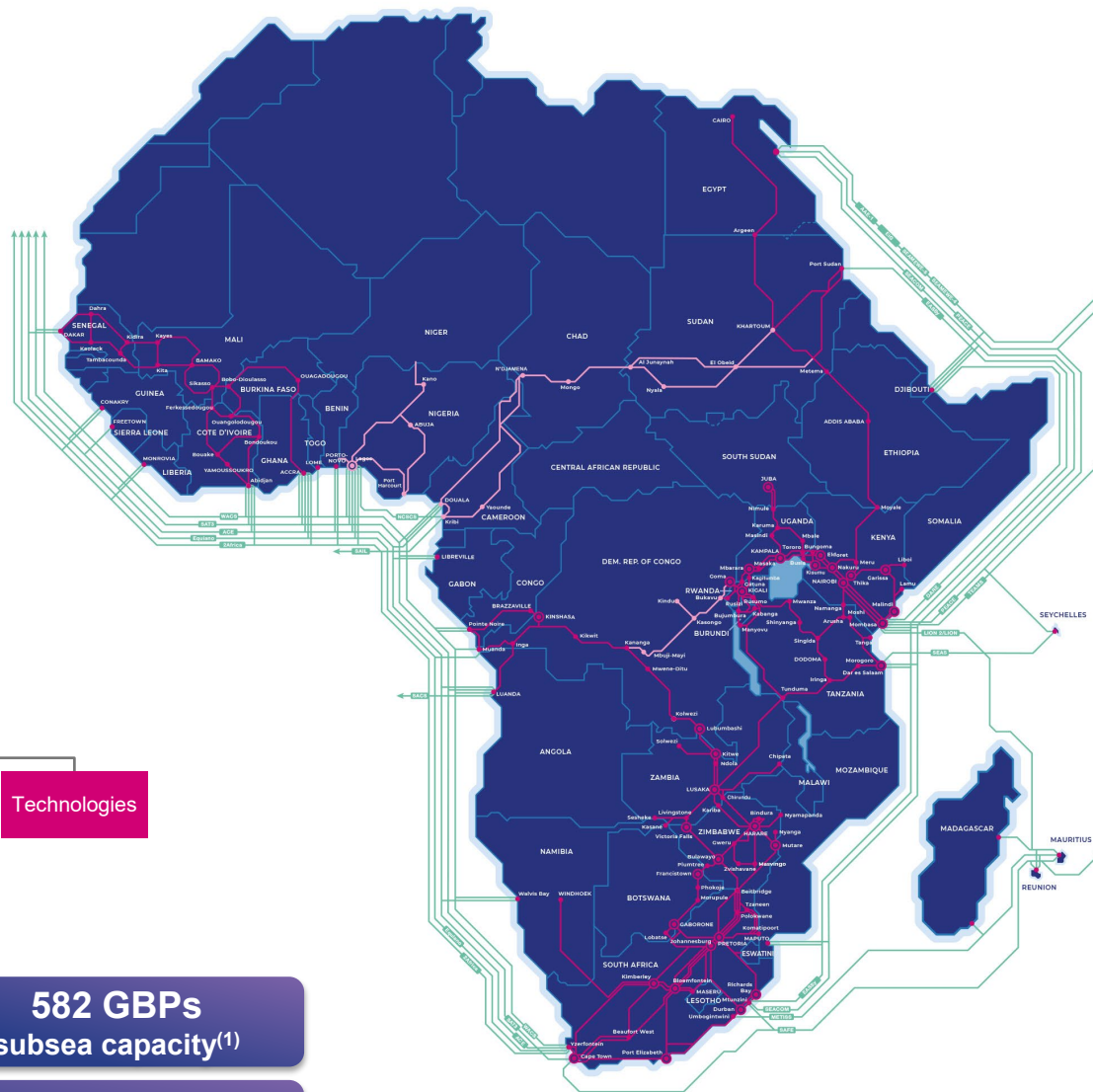
Liquid Intelligent
Technologies

4th October 2023

Liquid Intelligent Technologies Overview



- 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**



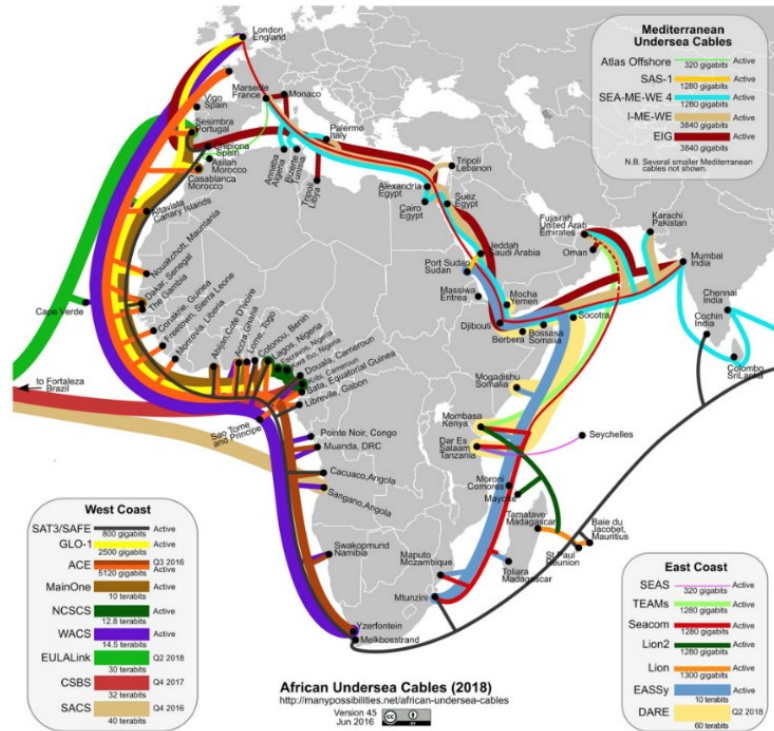
○ Metro Fibre — Existing Fibre Network — Fibre Expansion — Subsea Cable

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



- 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

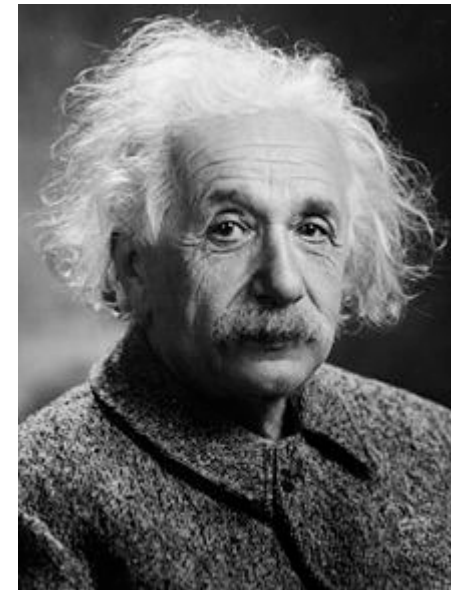
Universal Constants

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

$$\text{RTT (ms)} = 1000 \times 2 \times \text{Distance(m)} / 2.06 \times 10^8 \text{ m/s}$$



www.fromoldbooks.org



Geography – Africa is REALLY Big with Large Uninhabited Zones



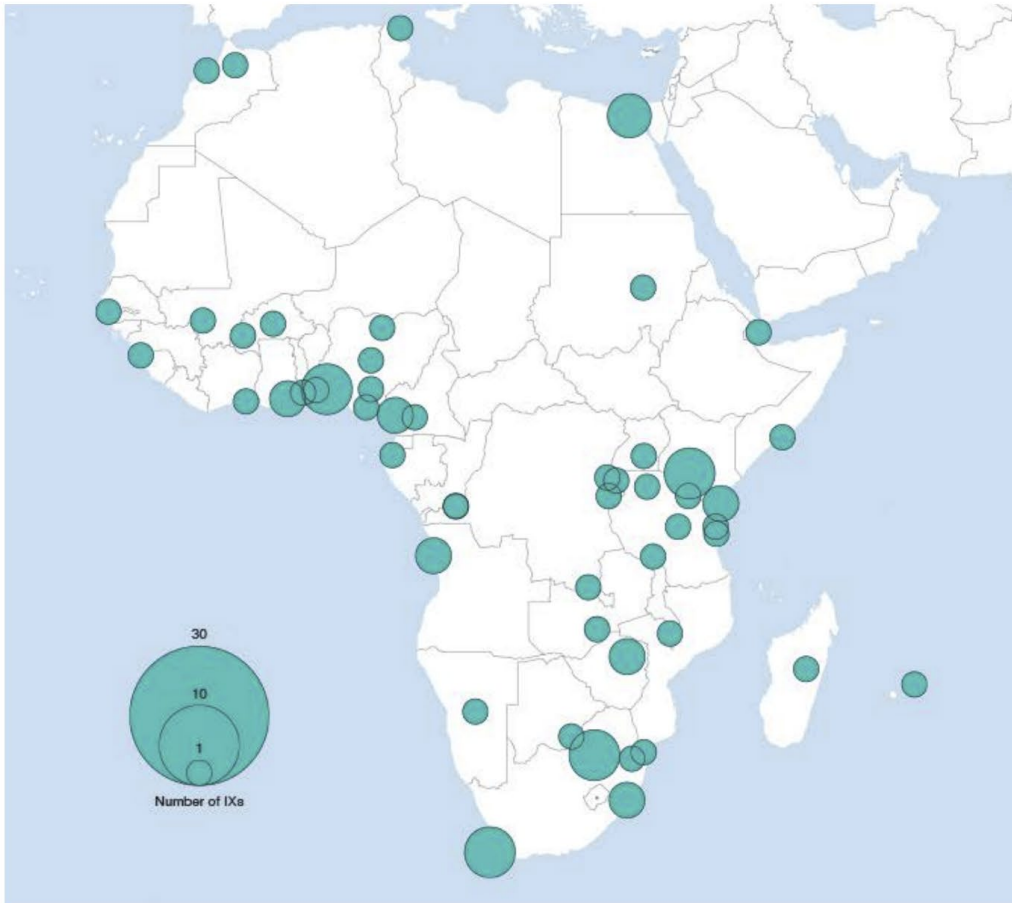
Economics – CAPEX, OPEX, Fill the Pipes!

- 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



Growth of Internet Exchanges

Our digital future starts here.

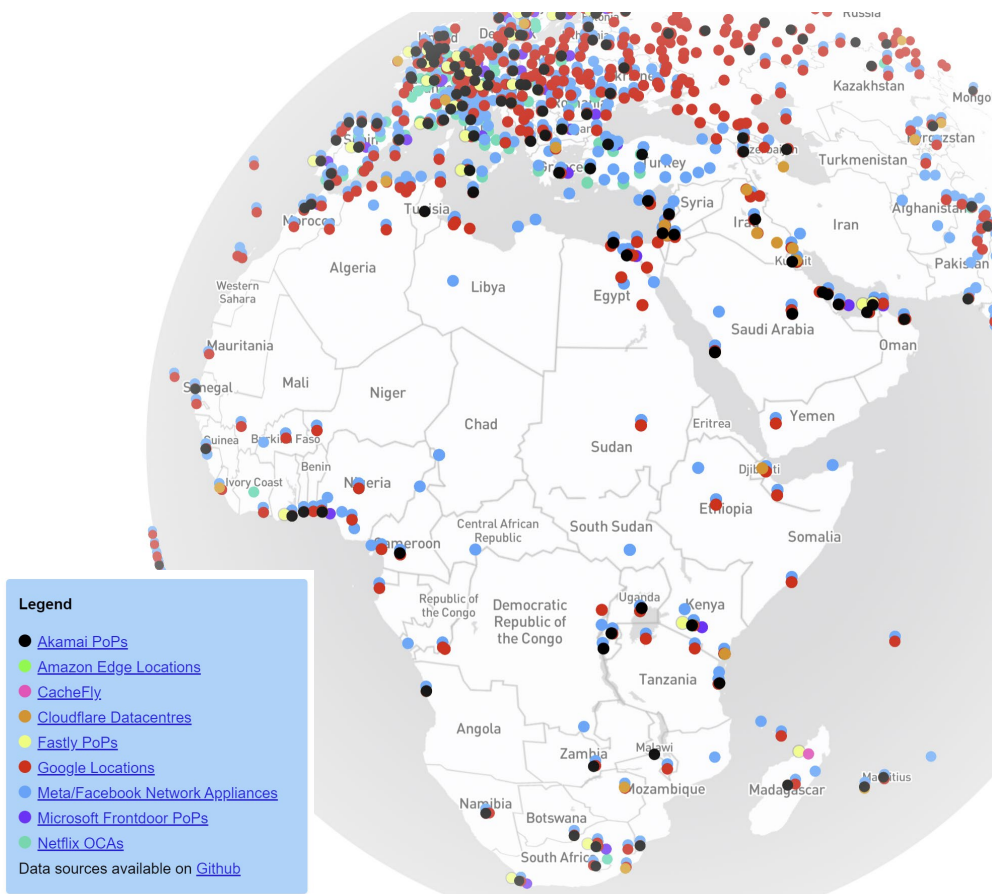


- IXP help localize traffic and content connecting networks and content providers
- Lowering costs (less IPT) and enhances performance (lower latencies)
- Essential element of creating hubs and their ecosystems
- Sourced from IXPDB & Peeringdb

Emergence of Content Delivery Networks

Our digital future starts here.

<https://opentelecomdata.org/cdns/>

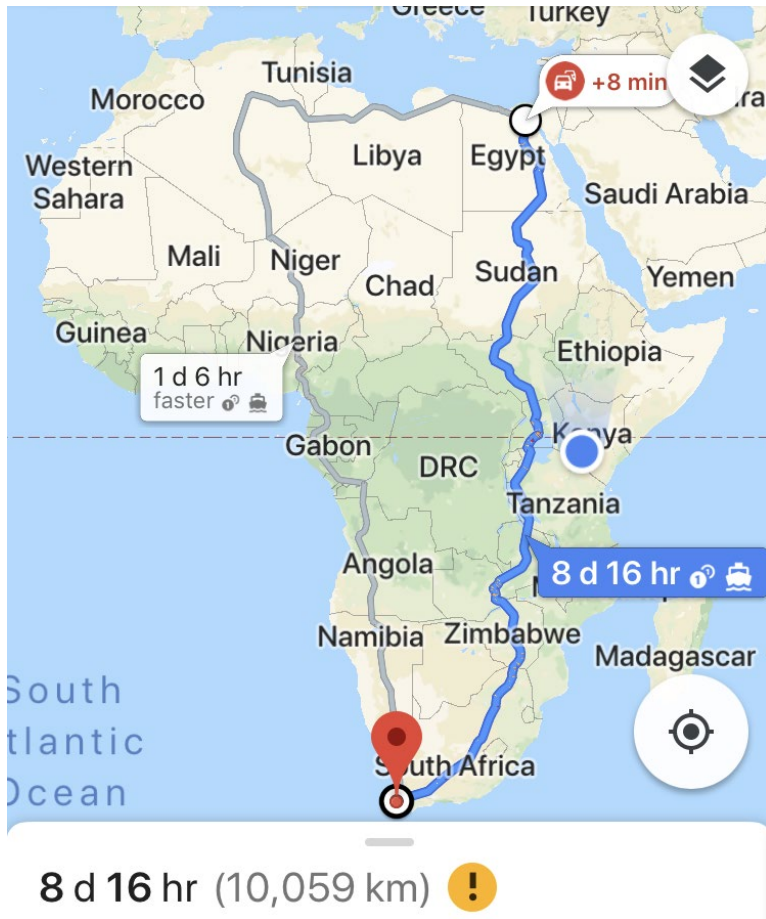


Observations

- 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

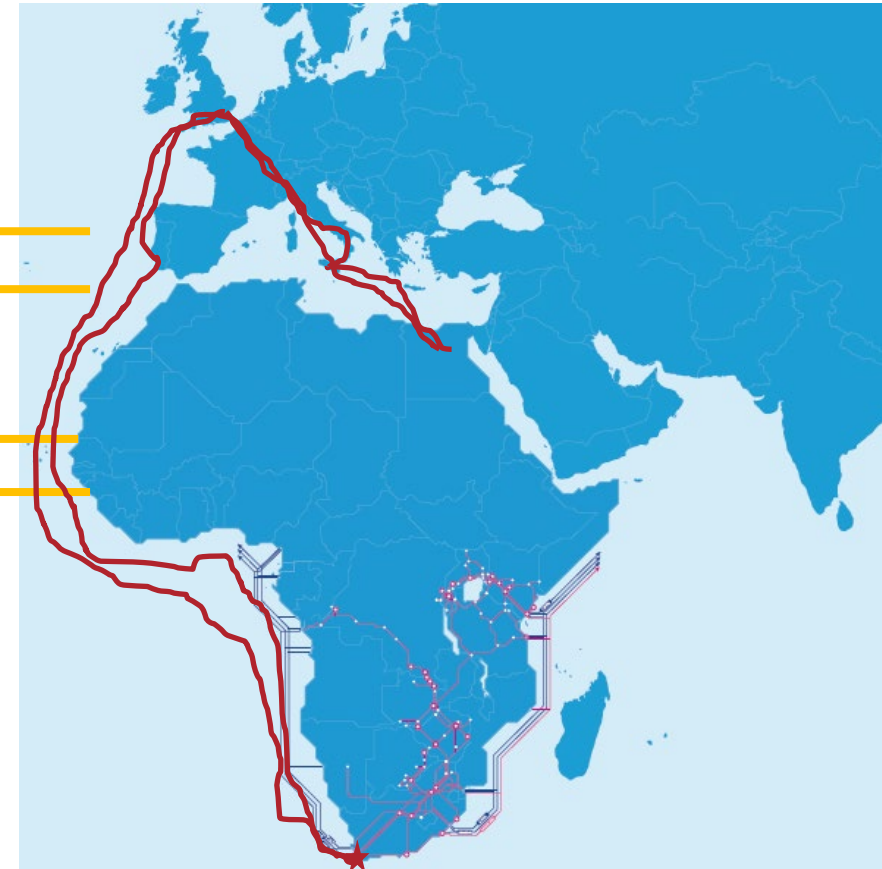
“Boomerang Routing”

2017 Cape to Cairo – 97 ms?

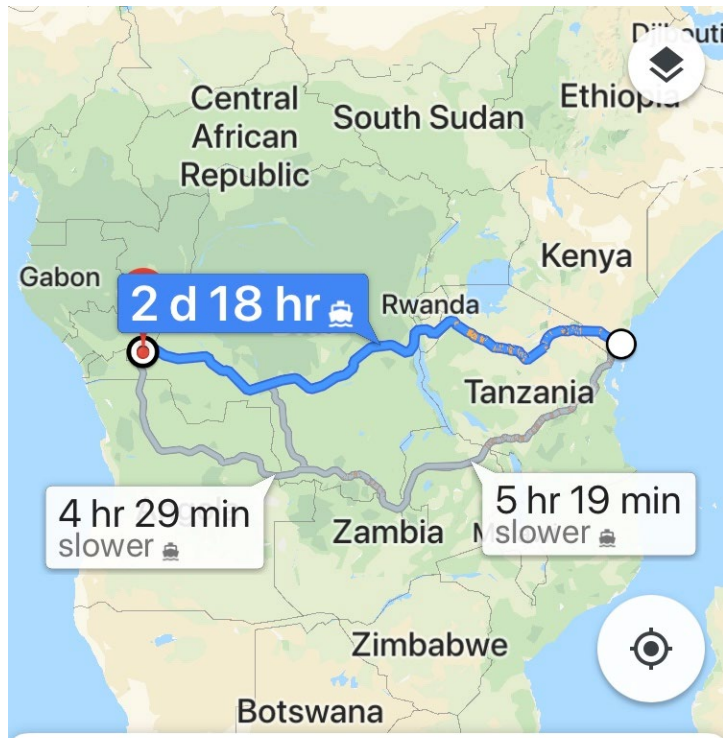


- LZA-PE1-CPT#traceroute 41.209.193.1
- 1 teng0-1-0-1.luk-pe1-gsw.liquidtelecom.net
 - 2 be5.luk-pe1-tho.liquidtelecom.net
 - 3 xe2-1-6.londra32.lon.seabone.net
 - 4 be3.palermo16.pal.seabone.net
 - 5 telecom-egypt.palermo16.pal.seabone.net

209 msec



2017 - Mombasa to Kinshasa – 38 ms?

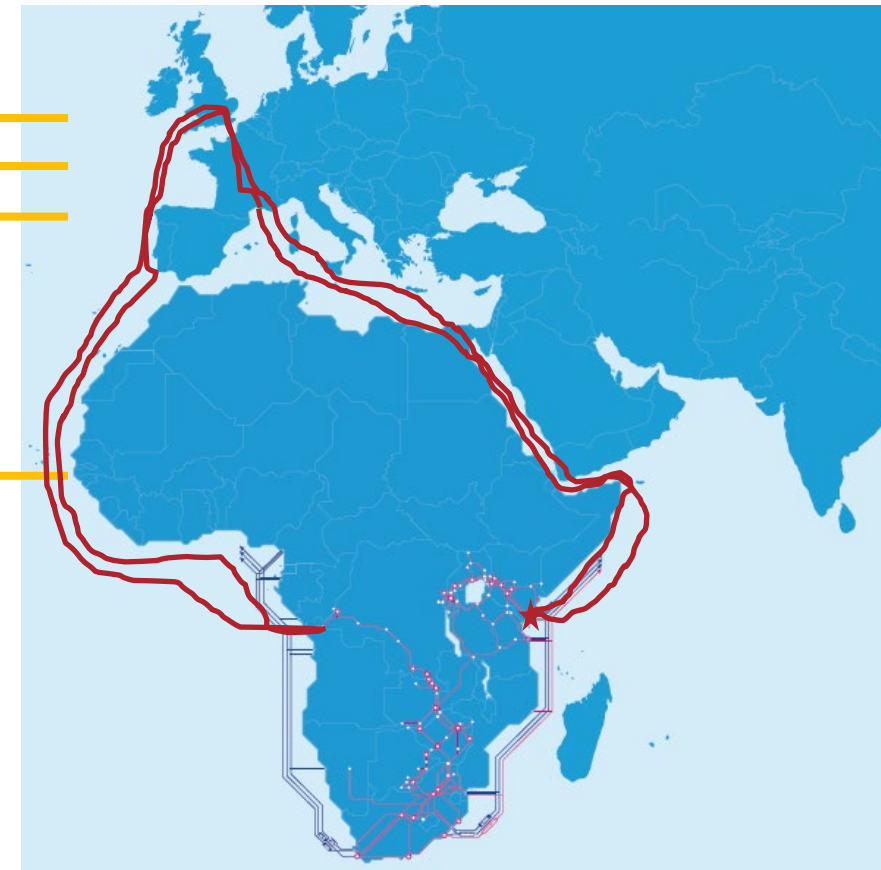


2 d 18 hr (3,948 km) !

Fastest route

- 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

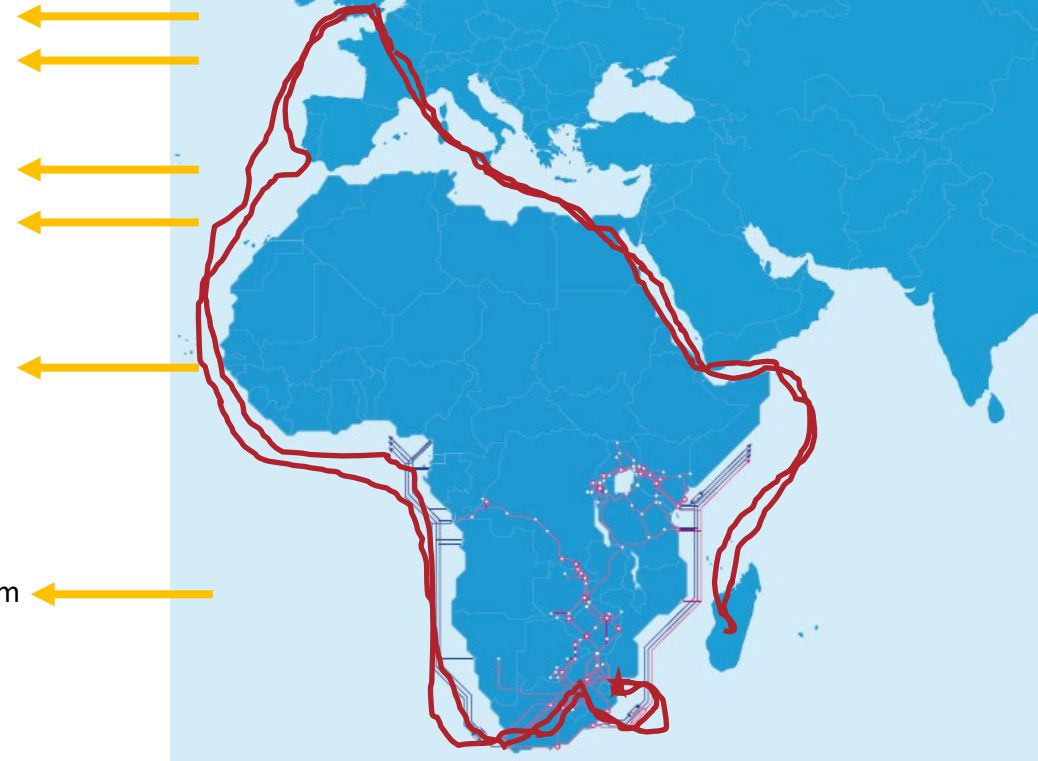


Can't find a way there



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

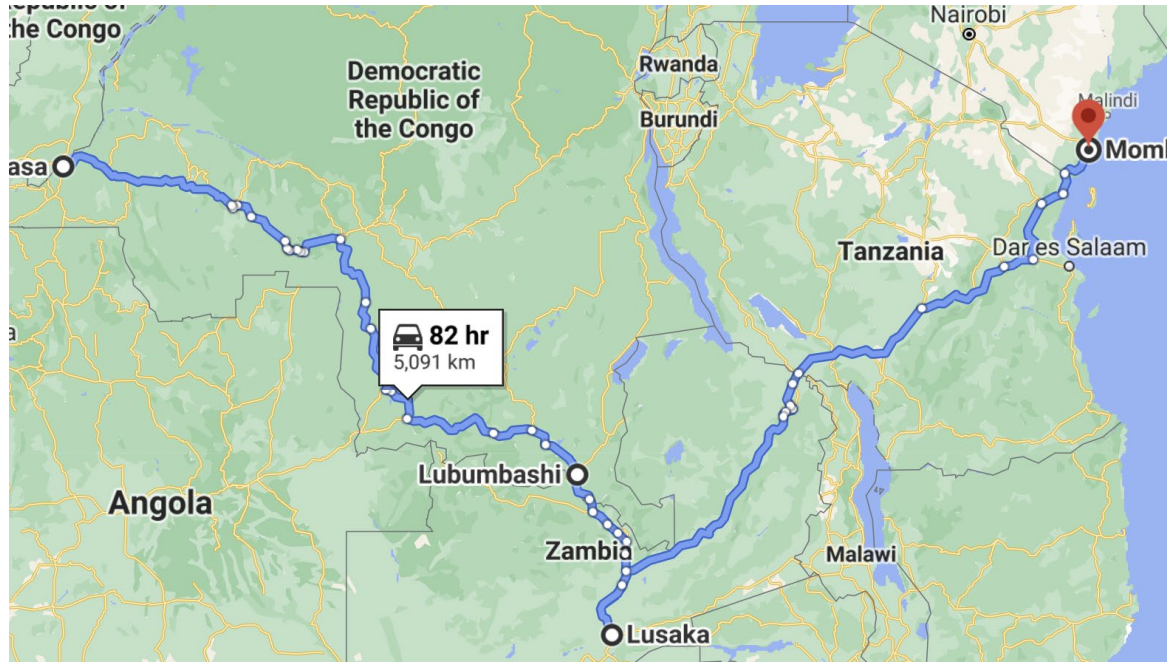
```
LMZ-PE1-MPT#traceroute 41.204.120.154
1 41.60.134.226 pos8-2-2-lza-p2-
  jhb.liquidtelecom.
2 bundle-eth10-p4-jhb.liquidtelecom.net
3 tengig0-3-0-7-pe1-cpt.liquidtelecom.net
4 ten0-0-0-7.luk-p1-tho.liquidtelecom.net
5 bundle-eth1.luk-pe1-tcy.liquidtelecom.net
6 10ge3-10.core1.lon2.he.net
7 100ge1-2.core1.par2.he.net
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

Public

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

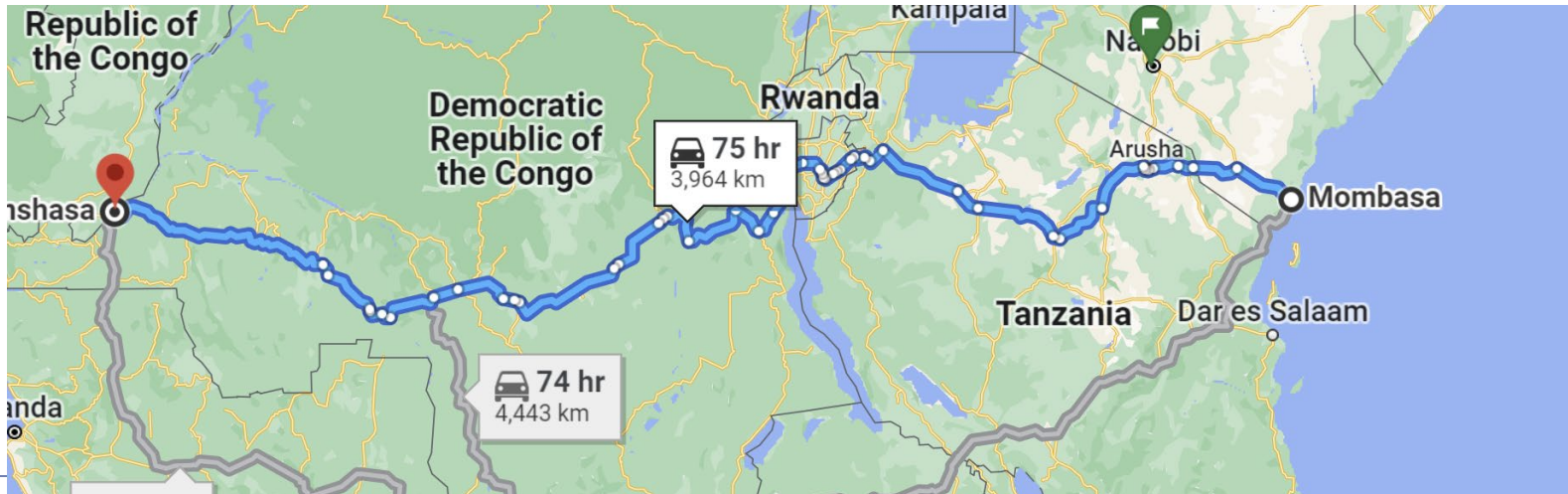


PE1-FIH > traceroute
197.155.86.231.liquidtelecom.net

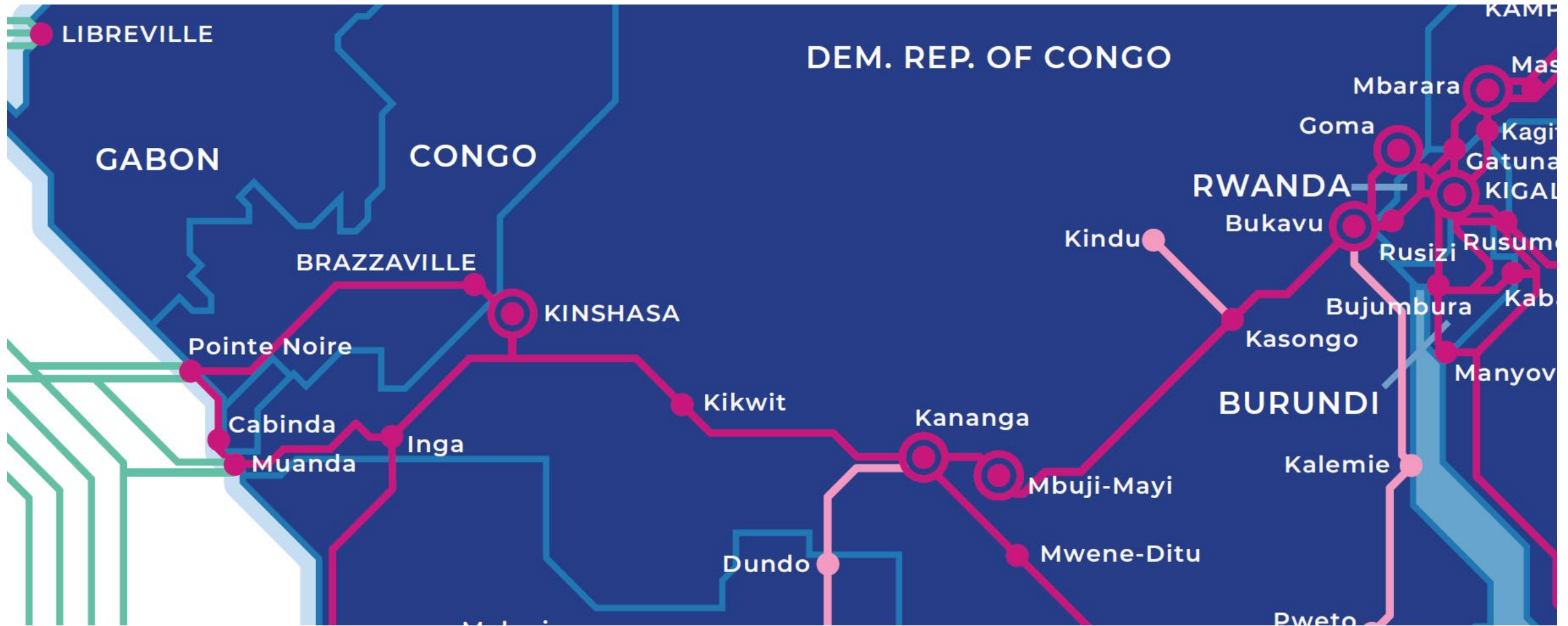
63.188 msec

PE1-MSA > traceroute
197.155.86.230.liquidtelecom.net

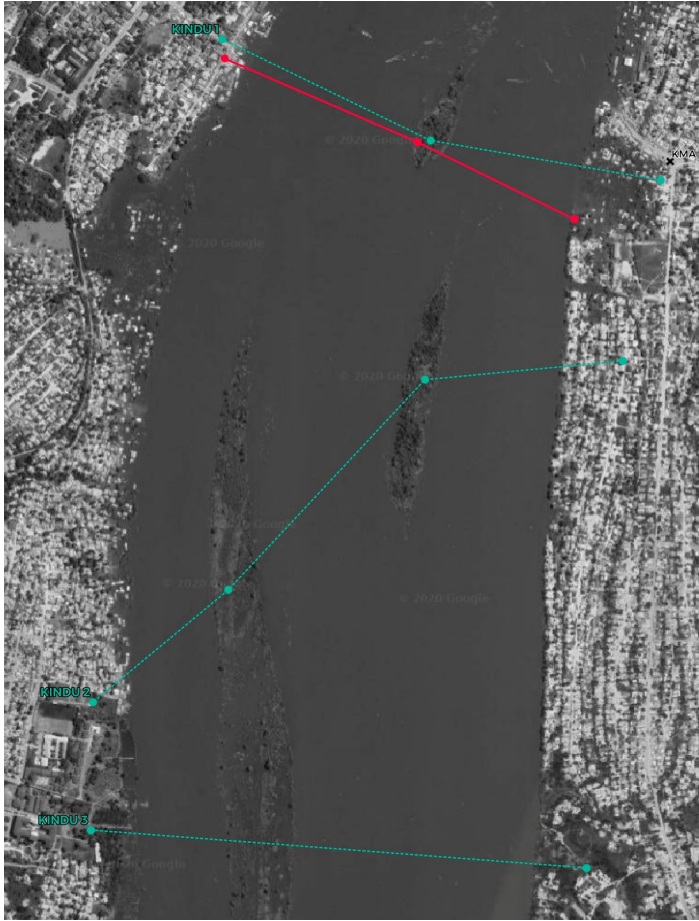
62 msec



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



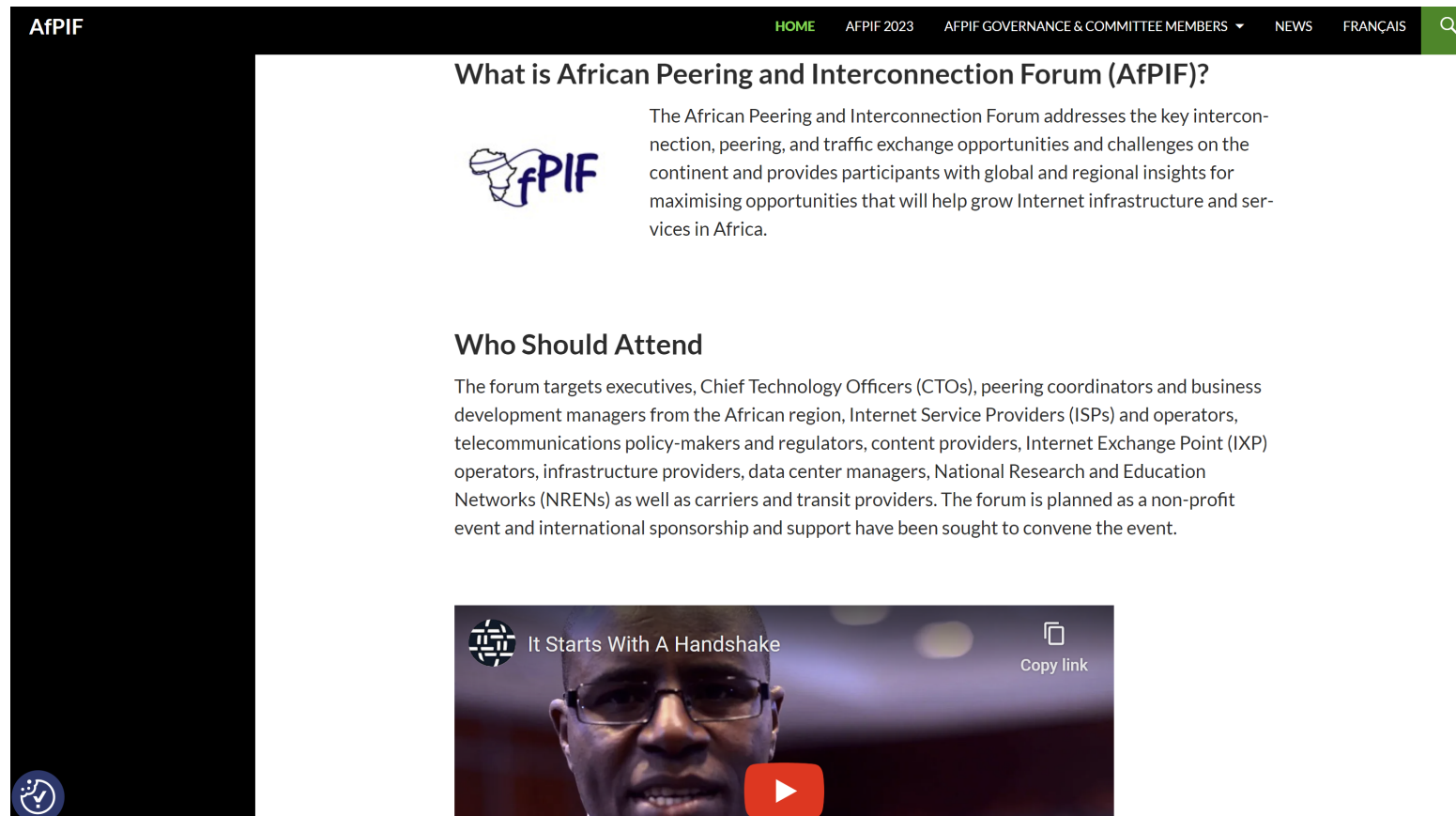
Technology and Civil Engineering Challenges to Solve



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



The screenshot shows the AfPIF website homepage. The navigation bar includes links for HOME, AFPIF 2023, AFPIF GOVERNANCE & COMMITTEE MEMBERS, NEWS, FRANÇAIS, and a search icon. The main content area features a section titled "What is African Peering and Interconnection Forum (AfPIF)?" with a sub-header and a paragraph describing the forum's purpose. Below this is a section titled "Who Should Attend" with a paragraph listing the target audience. At the bottom, there is a video player with the title "It Starts With A Handshake" and a "Copy link" button.

AfPIF HOME AFPIF 2023 AFPIF GOVERNANCE & COMMITTEE MEMBERS NEWS FRANÇAIS

What is African Peering and Interconnection Forum (AfPIF)?

The African Peering and Interconnection Forum addresses the key interconnection, peering, and traffic exchange opportunities and challenges on the continent and provides participants with global and regional insights for maximising opportunities that will help grow Internet infrastructure and services in Africa.

Who Should Attend

The forum targets executives, Chief Technology Officers (CTOs), peering coordinators and business development managers from the African region, Internet Service Providers (ISPs) and operators, telecommunications policy-makers and regulators, content providers, Internet Exchange Point (IXP) operators, infrastructure providers, data center managers, National Research and Education Networks (NRENs) as well as carriers and transit providers. The forum is planned as a non-profit event and international sponsorship and support have been sought to convene the event.

It Starts With A Handshake Copy link

Public

Open Fibre Mapping – With ITU

Our **digital future**
starts here.

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

0.3-dev

Go to file

- > .github
- > _assets
- > codelists
- > docs
- > examples
- > schema
- > tests
- .gitignore
- .readthedocs.yaml
- LICENSE.md
- README.md
- manage.py
- pull_request_template.md
- requirements.in
- requirements.txt

Open Fibre Data Standard

Welcome to the GitHub repository for the Open Fibre Data Standard.

Contributing

To contribute to the development of the standard, check out the [discussion tracker](#). To facilitate discussions, we have prepared a number of [consultation topics](#) with accompanying documents to act as starting points for discussion. These are:

- Data stewardship, publication formats and access methods | [Document](#) | [Discussion](#)
- Demand side research: Use cases | [Document](#) | [Discussion](#)
- Supply side research: Common concepts and standardisation | [Document](#) | [Discussion](#)
- Conceptual model | [Document](#) | [Discussion](#)

Background

The [World Bank](#), the [International Telecommunications Union \(ITU\)](#), [Mozilla Corporation](#), the [Internet Society \(ISOC\)](#), [Liquid Intelligent Technologies](#), [CSquared](#), and [Digital Council Africa](#) are partnering to promote the collaborative development of open data standards for describing telecommunications infrastructure. The first challenge we have taken on is that of terrestrial fibre optic infrastructure.

Public

With IETF - Pioneering Segment Routing

Our digital future starts here.

“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.”

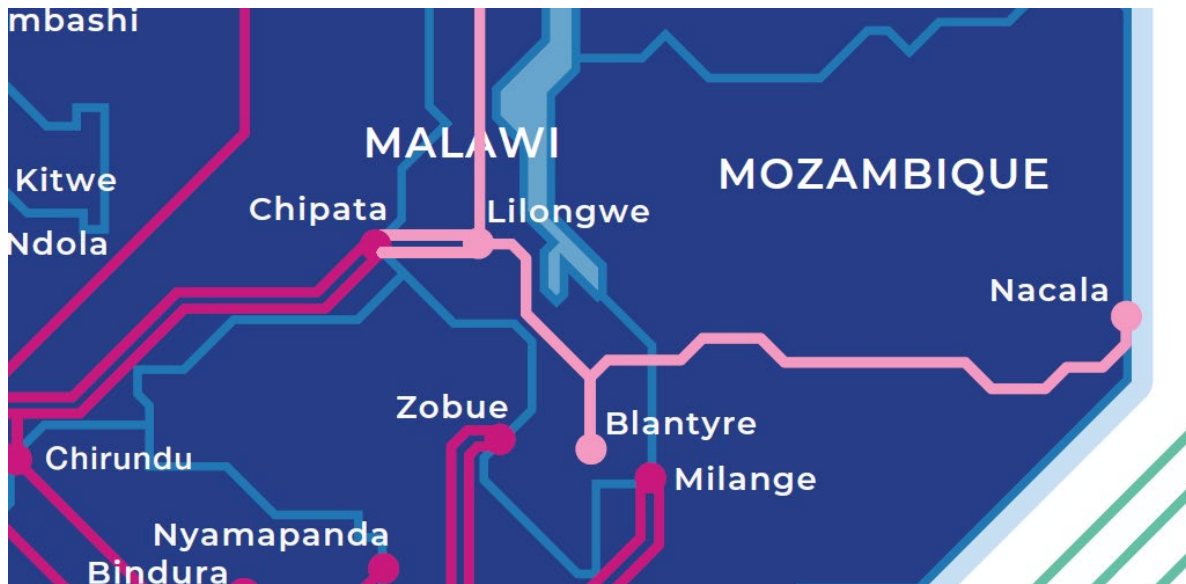
<https://www.afpif.org/2019/08/ten-years-of-supporting-africas-tech-community/>

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
Authors:

R. Bonica	S. Hegde	Y. Kamite	A. Alston	D. Henriques
<i>Juniper Networks</i>	<i>Juniper Networks</i>	<i>NTT Communications Corporation</i>	<i>Liquid Telecom</i>	<i>Liquid Telecom</i>
L. Jalil	J. Halpern	J. Linkova	G. Chen	
<i>Verizon</i>	<i>Ericsson</i>	<i>Google</i>	<i>Baidu</i>	

Aligning our Investments to Regional Integration Initiatives and Mega Projects

Our digital future starts here.



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.

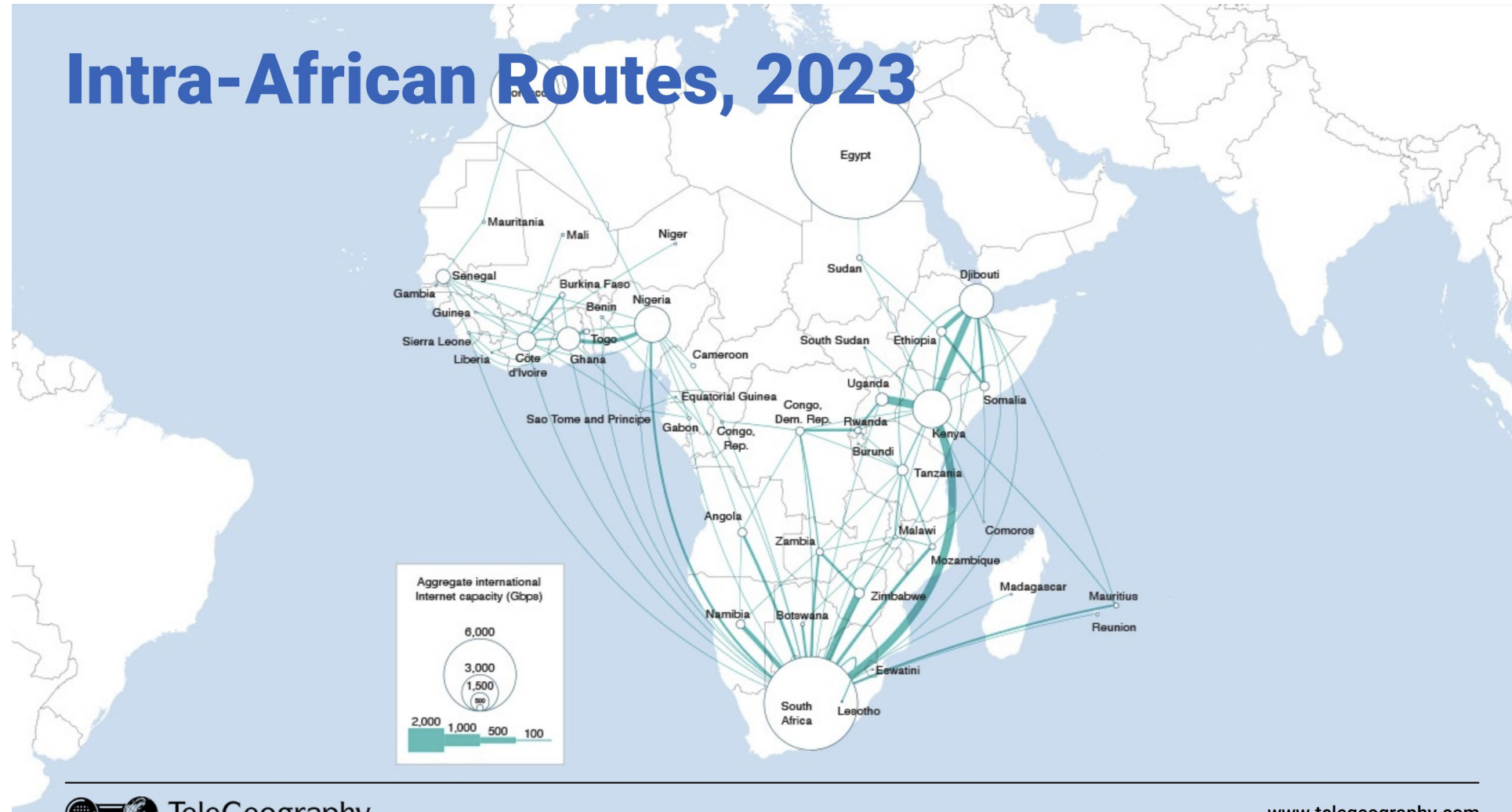
Malawi's government has entered negotiations with Mozambique, Tanzania, and Zambia to consider directing their internet traffic into Malawi.

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

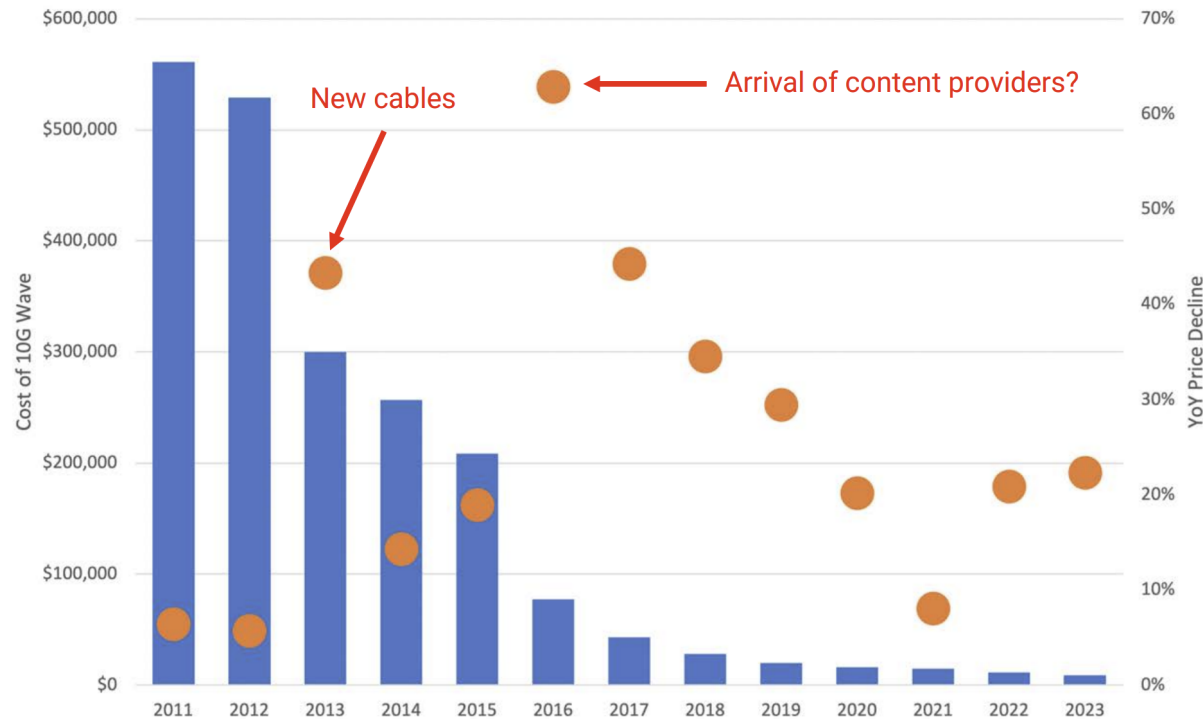
Intra-African Routes, 2023



Data on Price Decline of Wholesale Internet in South Africa

Price Decline After New Cables in South Africa

10G Wavelength Prices on Johannesburg-London Route



- 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

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



LIQUID
INTELLIGENT TECHNOLOGIES

Thank You

Ben.roberts@liquid.tech

<https://www.linkedin.com/in/ben-roberts-9085592/>