

Backhaul: From Fibre to Satellite

Session 2.4

Fibre Optic Infrastructure

Satellite Dependency

2009

Total design capacity
of undersea cables

2Tbps



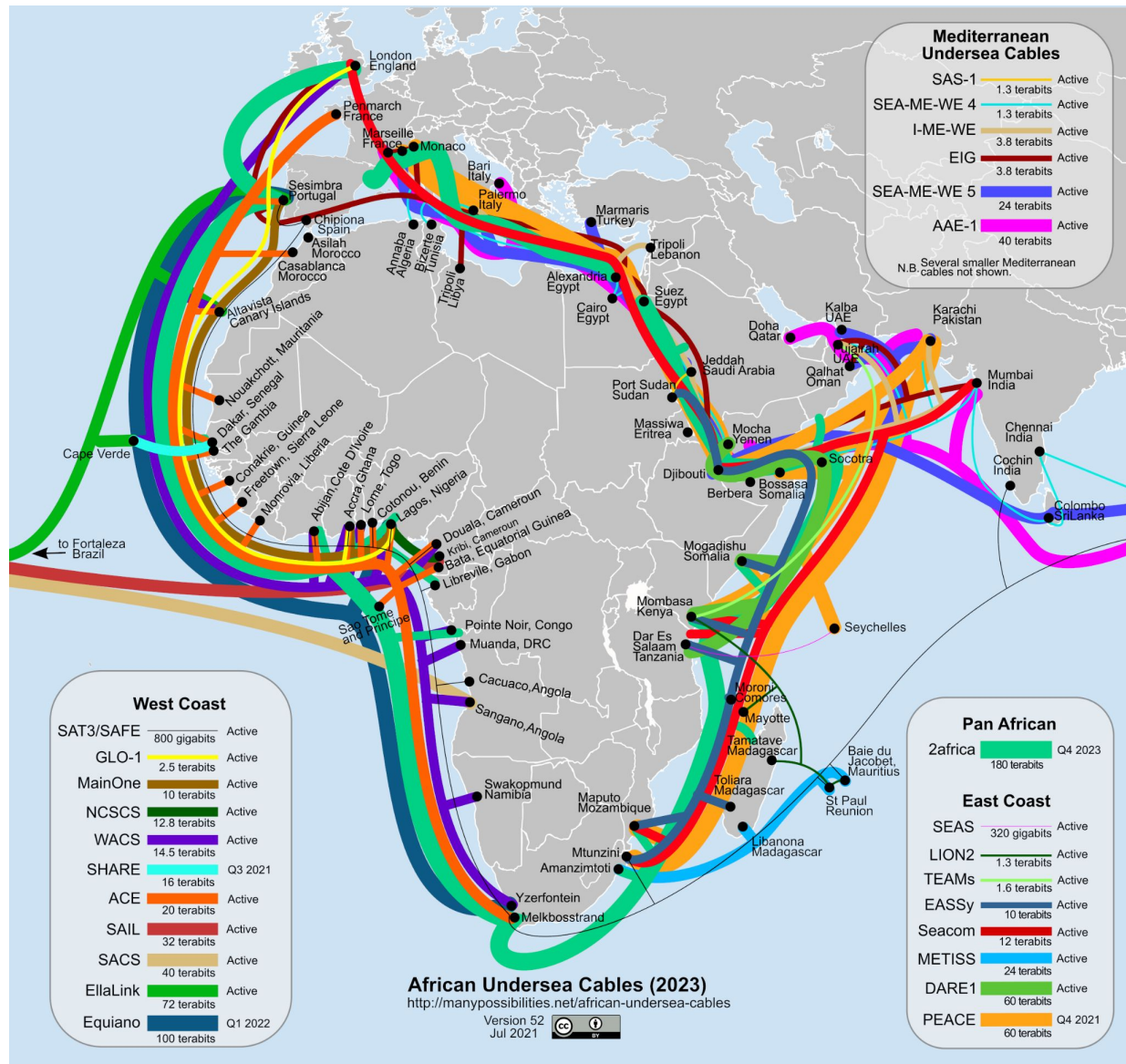
Fibre Optic Connectivity

2023

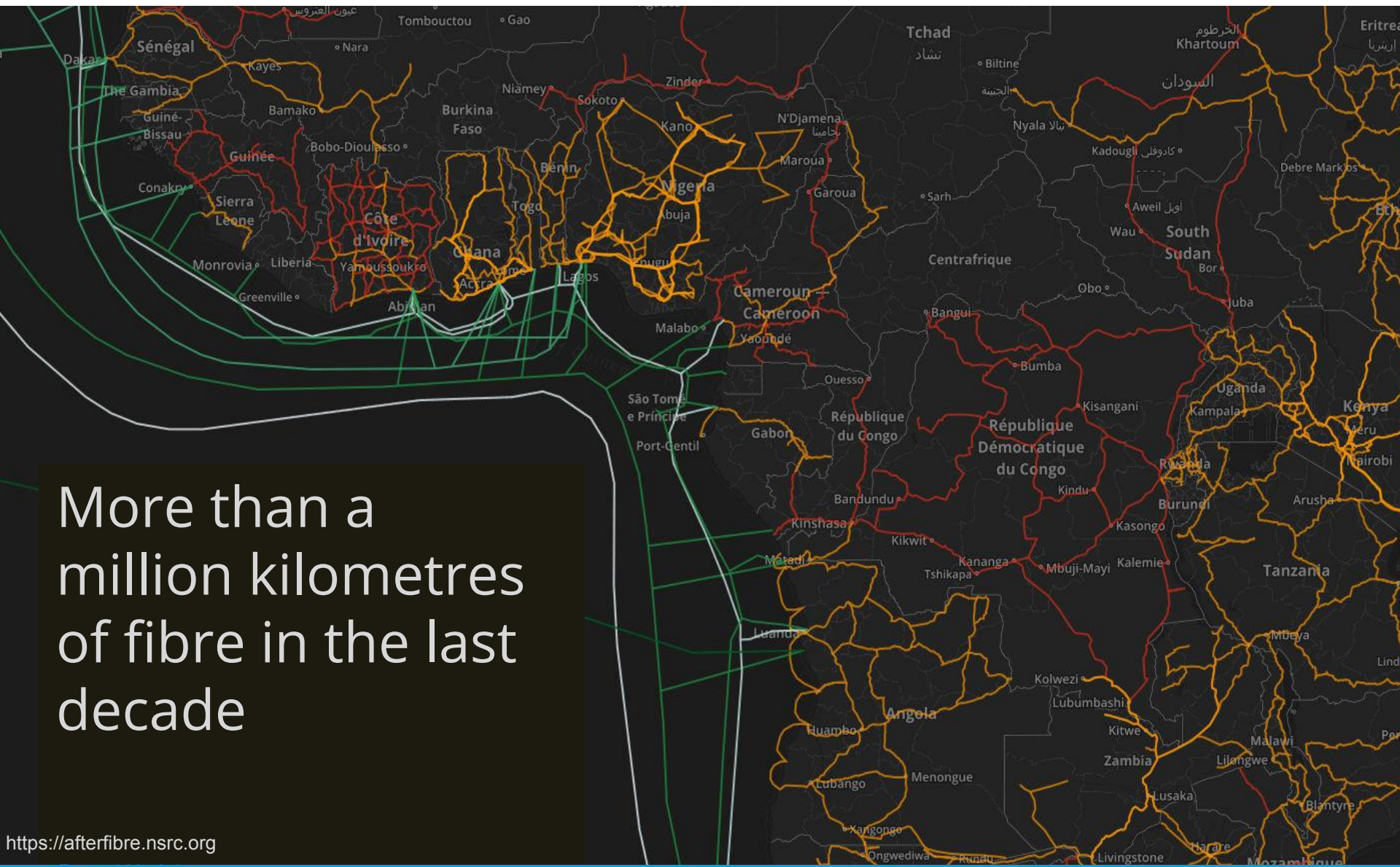
Expected total design capacity of undersea cables

>814 Tbps

An increase of over 400 times.



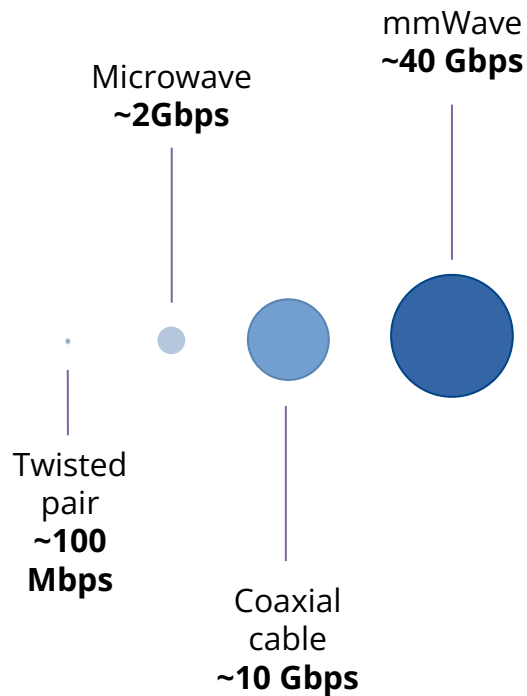
Growth of Terrestrial Fibre



More than a million kilometres of fibre in the last decade

<https://afterfibre.nsrc.org>

How Fibre Differs From Other Access Technologies



**Fibre Optic
Infrastructure
~25 Tbps**

Fibre vs Wireless Economics



The capital cost of fibre deployment is significantly higher than wireless technologies but the combination of its massive capacity and significantly longer lifespan (20+ years vs 3-5 years) make it a more affordable technology overall.

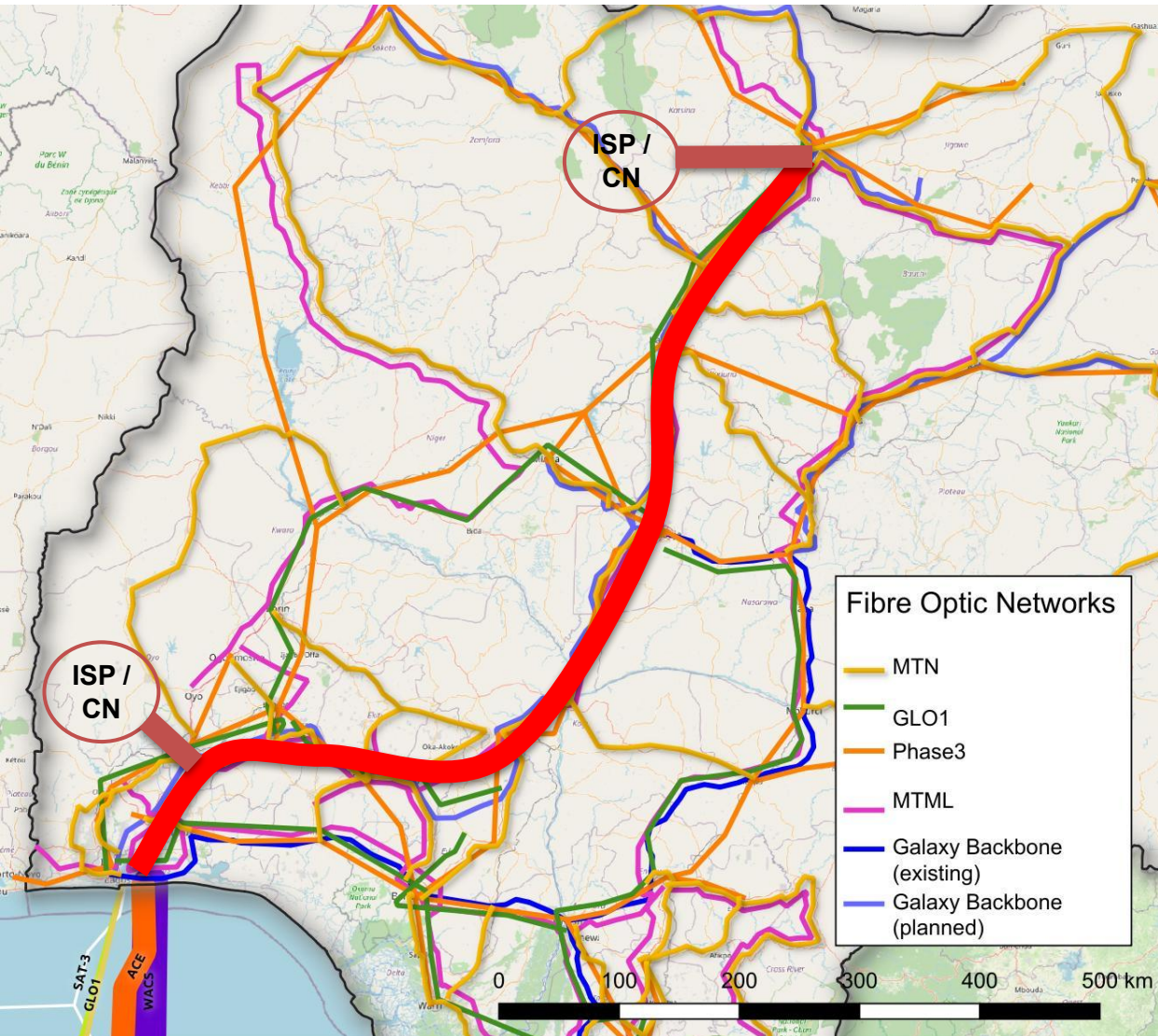
Rural Fibre is More Expensive

Ongoing network costs are often the single biggest sustainability factor for small operators.

■ Cost of reaching a fibre Point of Presence e.g. PtP wireless

■ Cost of fibre internet increases with distance from Lagos

International transit/peering available in Lagos



Lessons from History



Rowland Hill and the Penny Black Stamp

In the early 1800s postage was charged by distance and number of sheets

Rowland Hill, a school teacher, was convinced a single price stamp that would guarantee postage anywhere in the UK would transform the postal system

In 1839, **76M** letters posted in UK

In 1840, after the introduction of the Penny Post, **168M** letters

Ten years later **347M** letters

Democratised access to the postal system

New Zealand

National Wholesale Fibre Network Operator



EdgeConnect | Chorus x +
https://sp.chorus.co.nz

CHORUS Products & services Tools Processes Training Login

Overview Price & Offers Tech Specs Resources

Networks connectivity > EdgeConnect

EdgeConnect

Peer with your favourite Internet Exchange

Overview

Peering is fundamental for you, your end customers, and the providers of the content that your customers view and enjoy every day. We're working with New Zealand's Internet Peering Exchanges to make peering possible over your existing UFB handovers, making it easier than ever before.

Chorus EdgeConnect is a collaboration between NZIX and Chorus which enables Chorus customers to reach NZIX exchanges (currently only AKL-IX) over Chorus UFB handovers.

By establishing a special VLAN (SVID/CVID combination) on your Chorus UFB Handover you will be able to communicate with other NZIX members on the same exchange, whether they are physically on NZIX exchange

Quick find
Product be
Product fe
Updates
Price & Off
FAQs

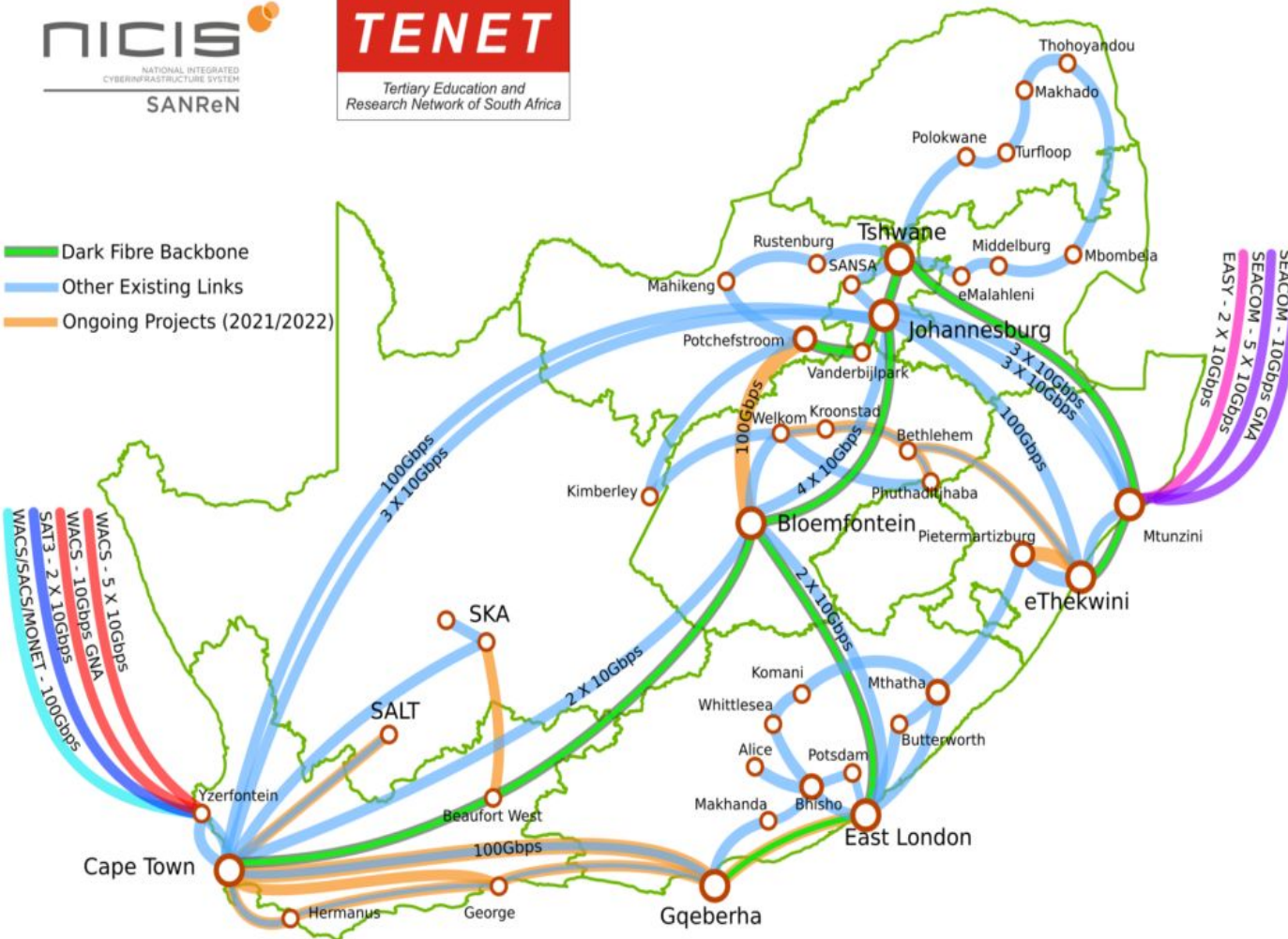
Product pricing
Click to get a
product rate



CHORUS

South Africa

National Research and Education Network



Historic investment in 2009 in the new Seacom cable.

Pricing the same regardless of distance for all universities and research institutions.

South African NREN - 2021-04-07 (John Hay)

United Kingdom

Broadband for the Rural North (B4RN)



- rural cooperative
- > 7,000 connected
- 1 (and now 10) Gbps symmetric service
- > 50 local staff
- hundreds of volunteers
- 65% of all properties
- > £7m in local investment
- > 2,300 shareholders

Fibre Optic Backbone Networks

Commodity or Infrastructure

- Treating fibre investments the same way we think about other infrastructures like road or rail will lead us to different decisions about investment.
- The private sector is better at managing the asset but cannot be relied on to push prices down.
- Government-run networks tend to be inefficient and less responsive to the market



Alternative Approaches

Diversifying Investment and Ownership

Could the EASSy/WIOCC model work for state-owned terrestrial networks?

If governments sold off a percentage of capacity to an SPV with financing support for small investors

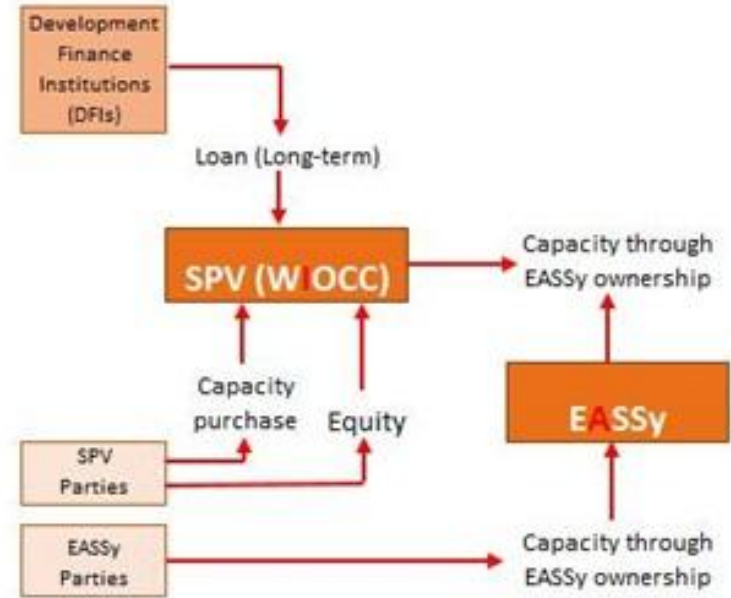


Figure 6 - WIOCC Financing Structure2



IXPs and CDNs

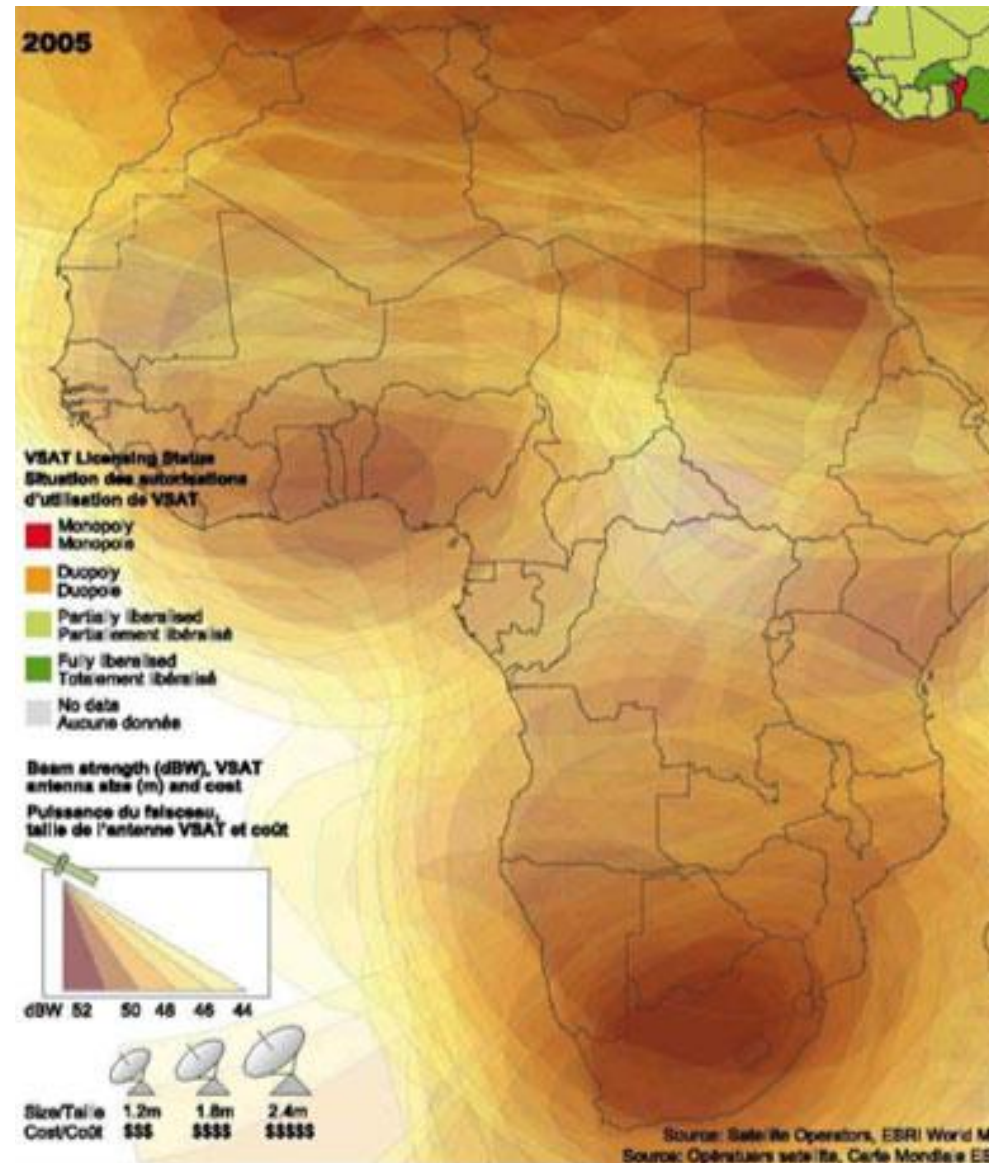
		2012	2020
Data Centers	Carrier-neutral		Excelsimo Galaxy Backbone ICN ipNX Layer3 Madallion Comm MDXi data centers (2) Rack Centre
Content Delivery Networks	International	Google Global Cache	Akamai Amazon Web Services Cloudflare Facebook Google Caches Google Edge PoP Limelight Microsoft Netflix
IXPs	IXPN nodes (2006) Number of peering networks: Peak traffic: WAF-IX nodes (2018) Number of members: Peak traffic:	Lagos 30 300 Mbps	Lagos (4), Abuja, Port Harcourt, Kano 71 125 Gbps Lagos 15 ~11 Gbps

<https://www.internetsociety.org/resources/doc/2020/ixp-report-2020/>

Satellite

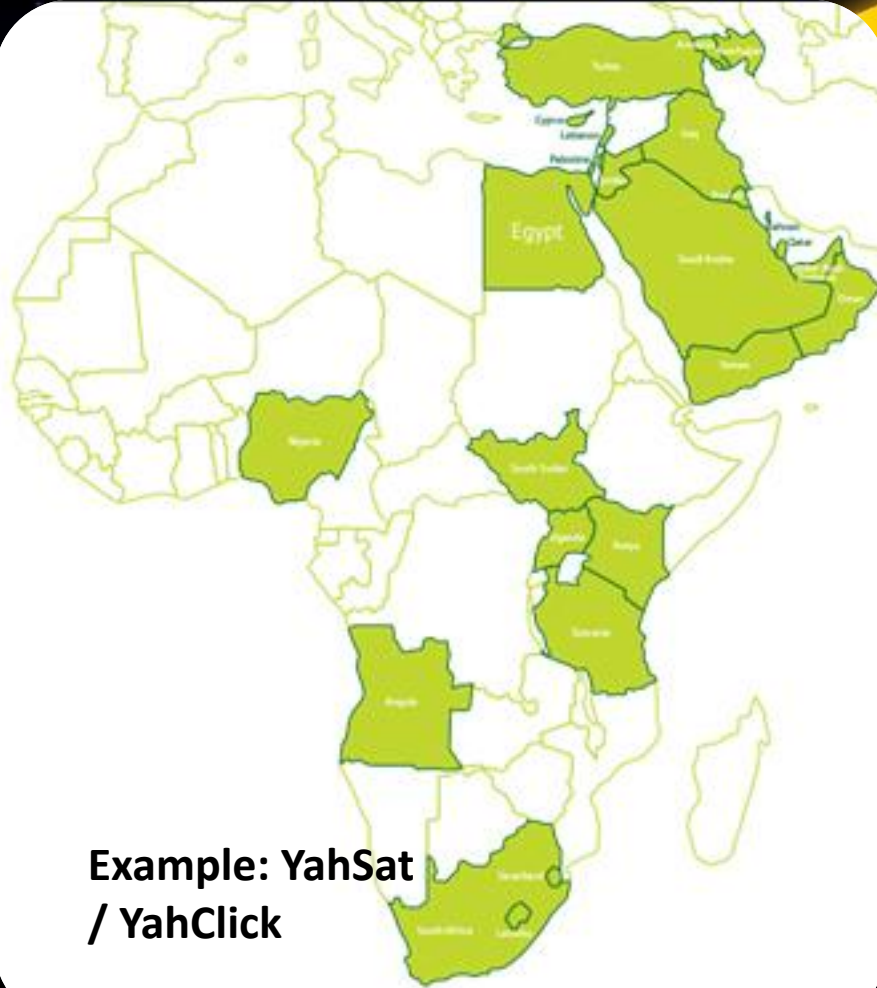
Satellite Yesterday

- C-Band
 - Large dish required
 - Lower power
 - Expensive installation
- Ku-Band
 - Smaller dish
 - Higher power
 - Less expensive installation but OPEX still high



Satellite Today

High Throughput Satellites (HTS)

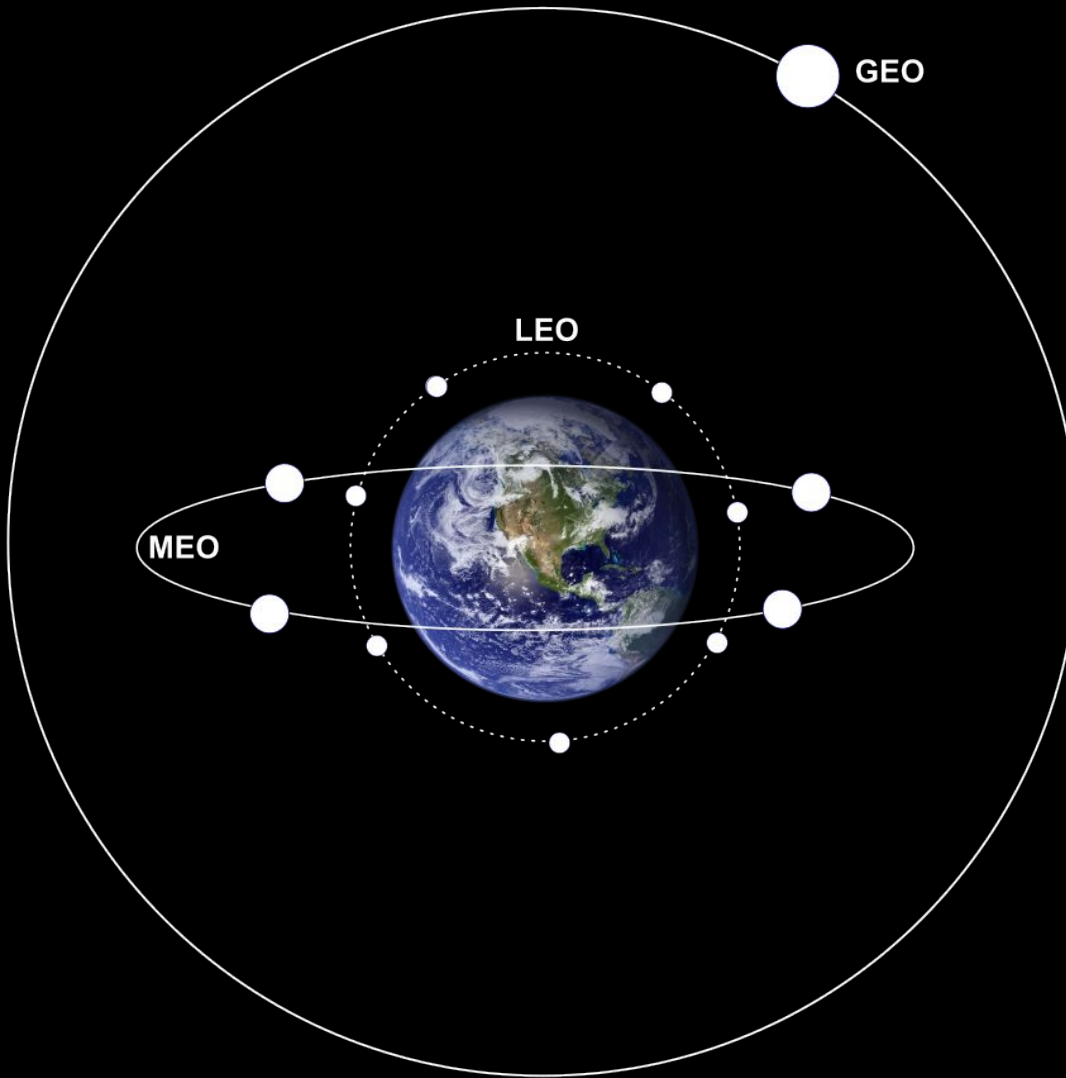


Example: YahSat
/ YahClick



Steerable
Spot
Beams

Satellite Technologies

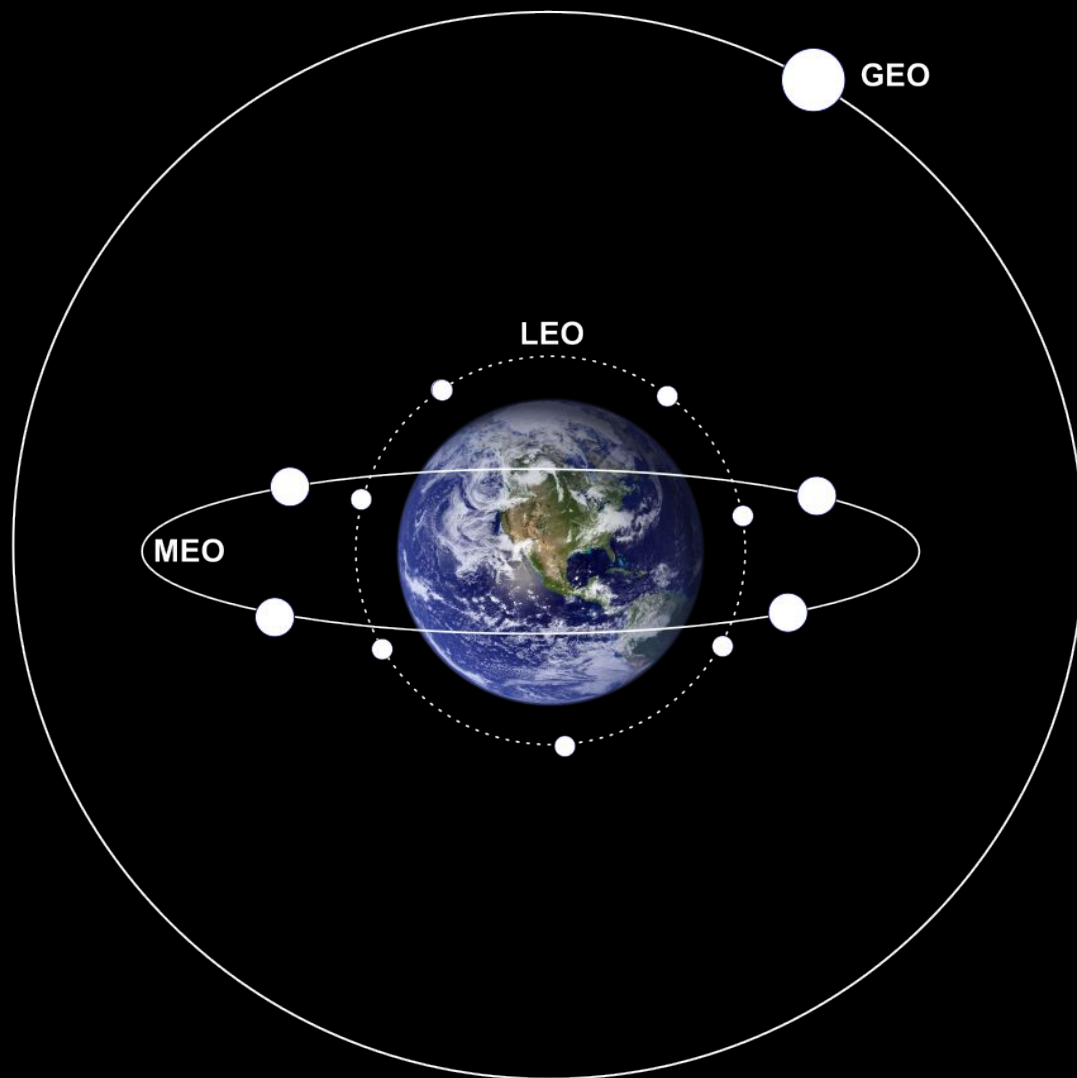


Geo-stationary
(GEO)

Middle Earth
Orbit (MEO)

Low Earth Orbit
(LEO)

Latency



GEO

Altitude: 35K km

Latency: > 500ms

MEO

Altitude: 5-12K km

Latency: > 120ms

LEO

Altitude: 8-16K km

Latency: > 30ms

Comparison

	LEO	MEO	GEO
Satellite Size	Small	Medium	Large
Satellite Cost	Low	Medium	High
Communication Latency	Low	Medium	High
Number needed for global coverage	> 100	6	3
Antenna Tracking	Fast	Slow	Fixed
Ground Station Density	High	Medium	Low
Lifespan	5 years	12 years	15 years
Application	Consumer / corporate broadband	GPS, Navigation, MNO backhaul	Broadcast TV, Weather, light data users e.g. banking

Source: adapted from Ciena Corporation

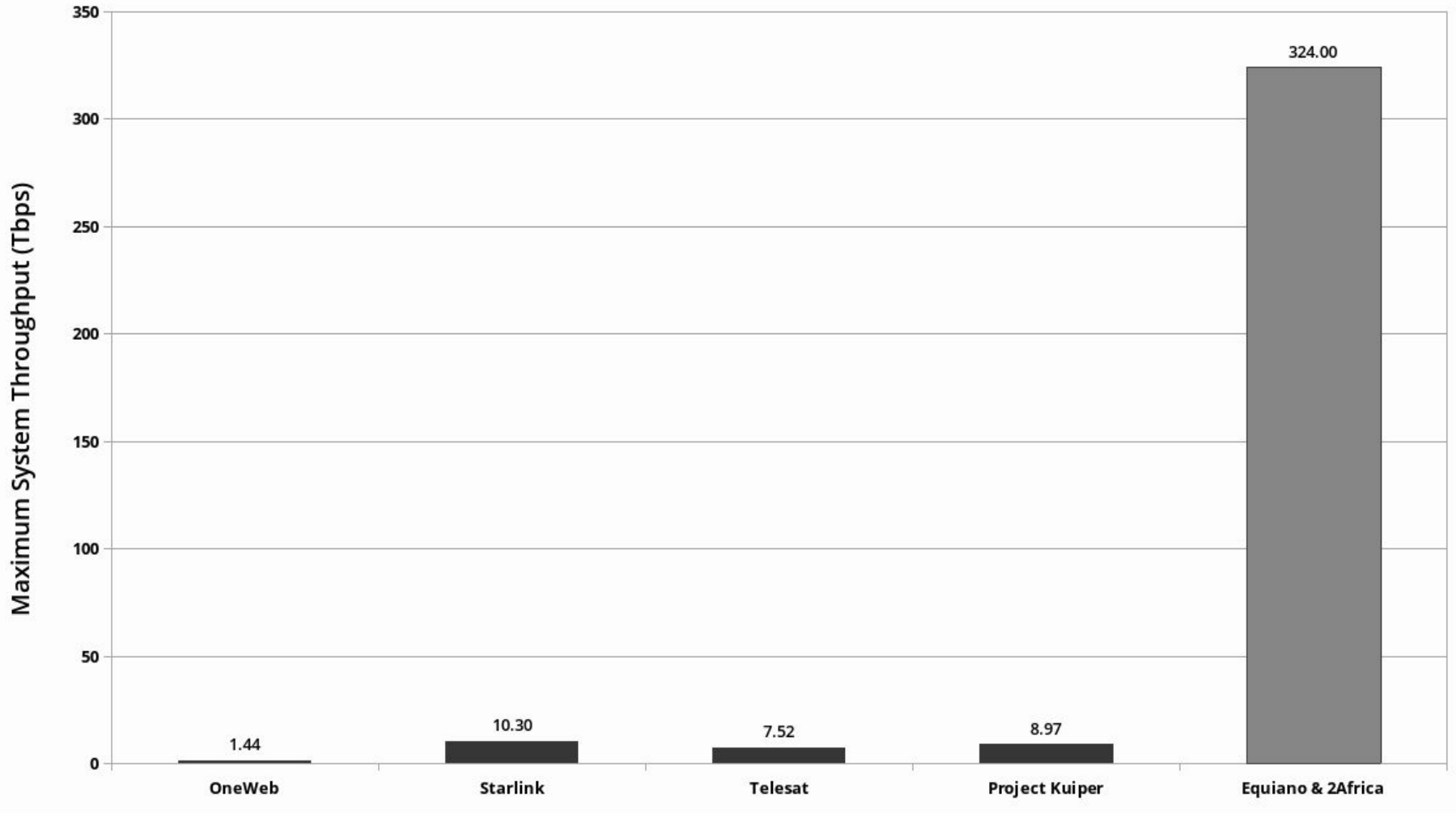
LEO Satellite Initiatives



Initiative	Major Investor	Launch Partner	Number of Satellites	Max System Throughput (Tbps)	Altitude (km)
OneWeb	Bharti, Eutelsat, UK Government, SoftBank	Arianespace (soyuz rockets)	716	1.44	1200
Starlink	Elon Musk (Lead), Google	SpaceX	4408	10.3	550
Telesat	Loral Space & Communications	Blue Origin (Amazon)	188	7.52	1015-1325
Project Kuiper	Amazon	Blue Origin (Amazon)	3,236	8.97	630

Source: <https://ieeexplore.ieee.org/abstract/document/9473799>

Capacity: Satellite vs Fibre



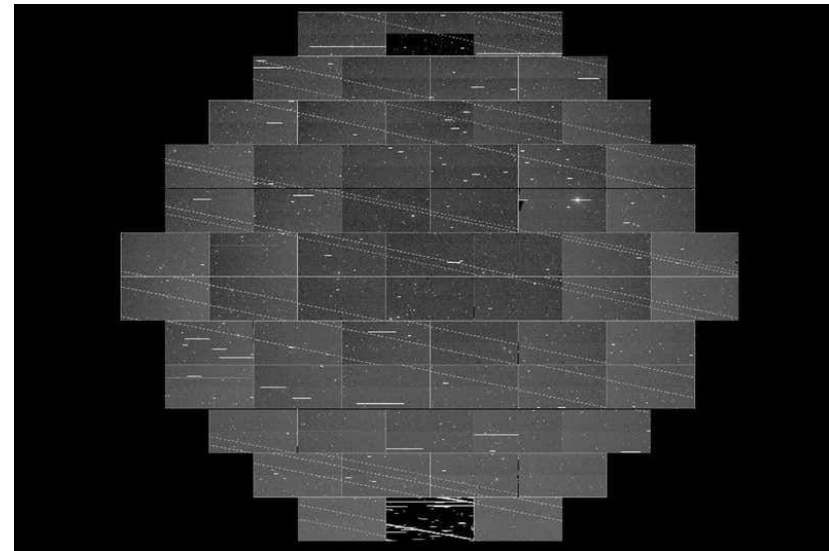
Date source: <https://ieeexplore.ieee.org/abstract/document/9473799>

Other LEO concerns

- There are an unprecedented number of satellites planned for launch in the coming years, increasing the risk of a “Kessler Syndrome”; a runaway chain reaction of satellite debris collisions
- Obscuring of the night sky for astronomers. LEO satellites produce streaks across astronomical images.



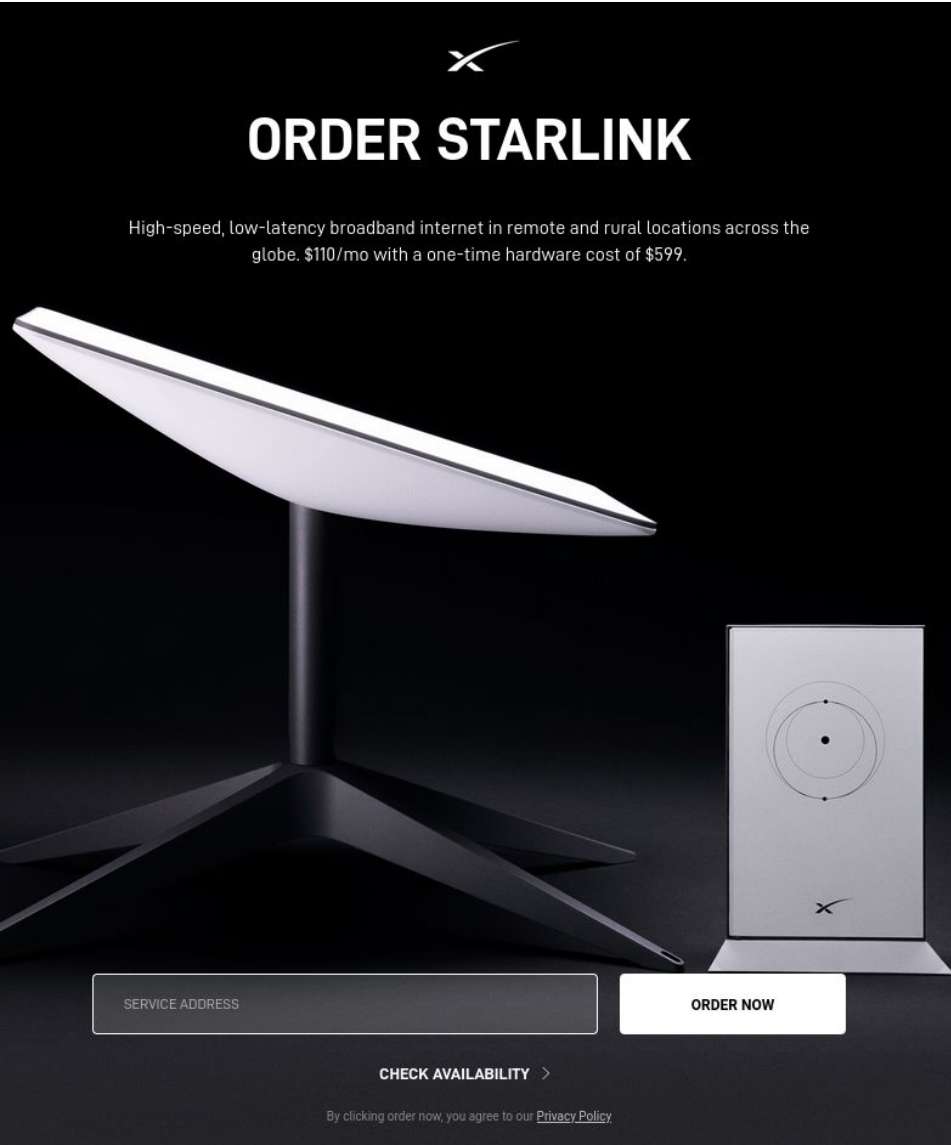
<https://trustmyscience.com/qu-est-ce-que-le-syndrome-de-kessler/>




Starlink's dotted line trails photobombing the Dark Energy Camera's view (Cliff Johnson/Clara Martínez-Vázquez/DELVE Survey)
<https://www.sciencealert.com/spacex-just-launched-a-third-batch-of-its-starlink-satellites>

Starlink

- Operational since 2021
- Currently > 500,000 subscribers
- African service announcements:
 - Mozambique: no operational date
 - Nigeria: service to commence late 2022
- Initial pricing USD
 - USD599 for terminal plus monthly subscription costs USD110
- Nigeria: Terminal to cost USD99 but monthly cost unknown
- In France, Starlink have offered capped services at a lower cost
- Power consumption may be a factor in rural areas





ORDER STARLINK

High-speed, low-latency broadband internet in remote and rural locations across the globe. \$110/mo with a one-time hardware cost of \$599.

SERVICE ADDRESS

ORDER NOW

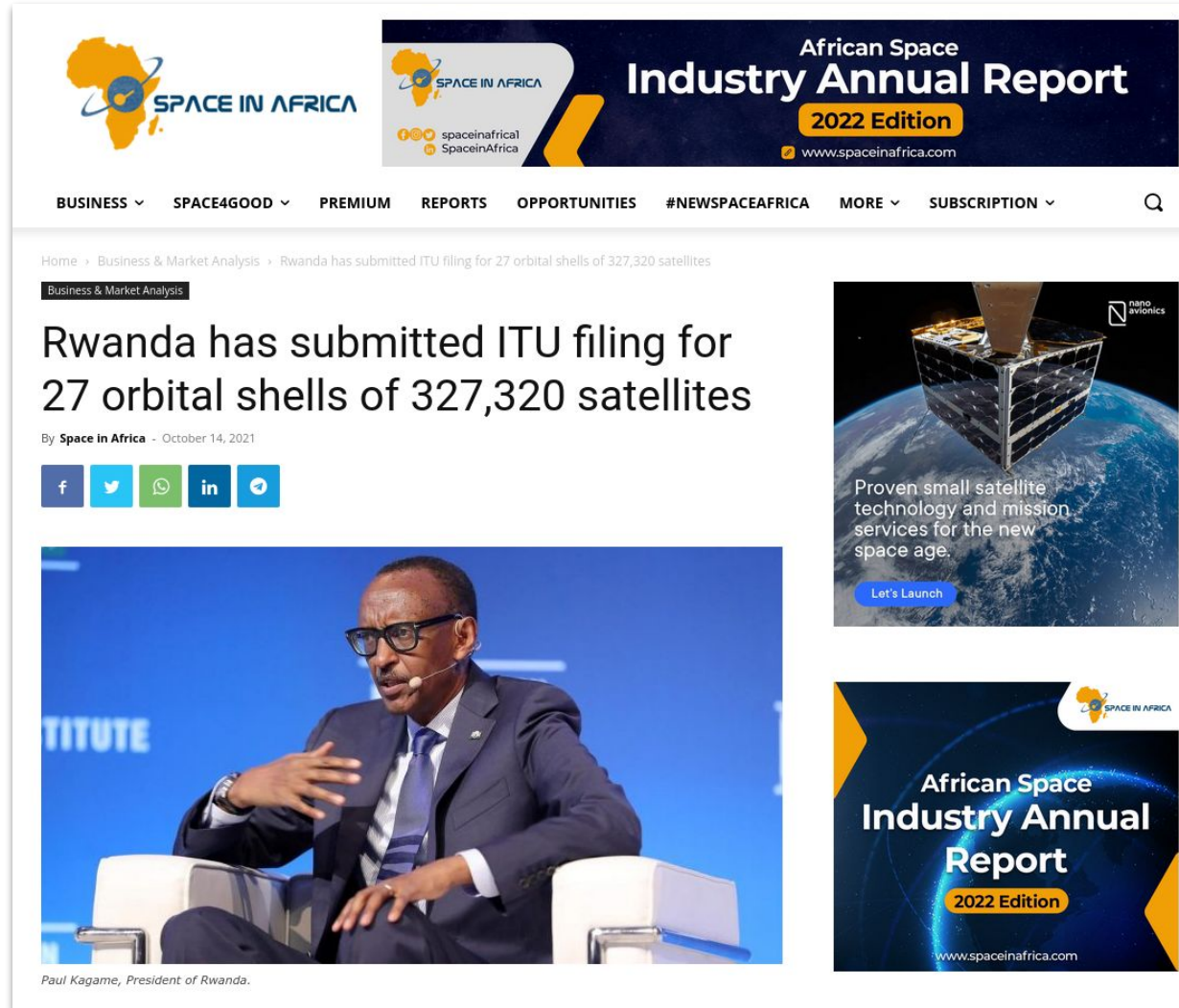
CHECK AVAILABILITY >

By clicking order now, you agree to our [Privacy Policy](#)

Global regulatory issues

LEO satellite decisions are taken nationally but with global consequences.

The rush to launch LEO constellations in the absence of global regulation is partly an attempt to create de facto regulation.



Home › Business & Market Analysis › Rwanda has submitted ITU filing for 27 orbital shells of 327,320 satellites

Business & Market Analysis

Rwanda has submitted ITU filing for 27 orbital shells of 327,320 satellites

By **Space in Africa** - October 14, 2021

[f](#) [t](#) [w](#) [in](#) [o](#)

Paul Kagame, President of Rwanda.

African Space Industry Annual Report
2022 Edition
www.spaceinfrica.com

Proven small satellite technology and mission services for the new space age.
[Let's Launch](#)

Thank you!