PacNOG37
Suva, Fiji

Warren Finch

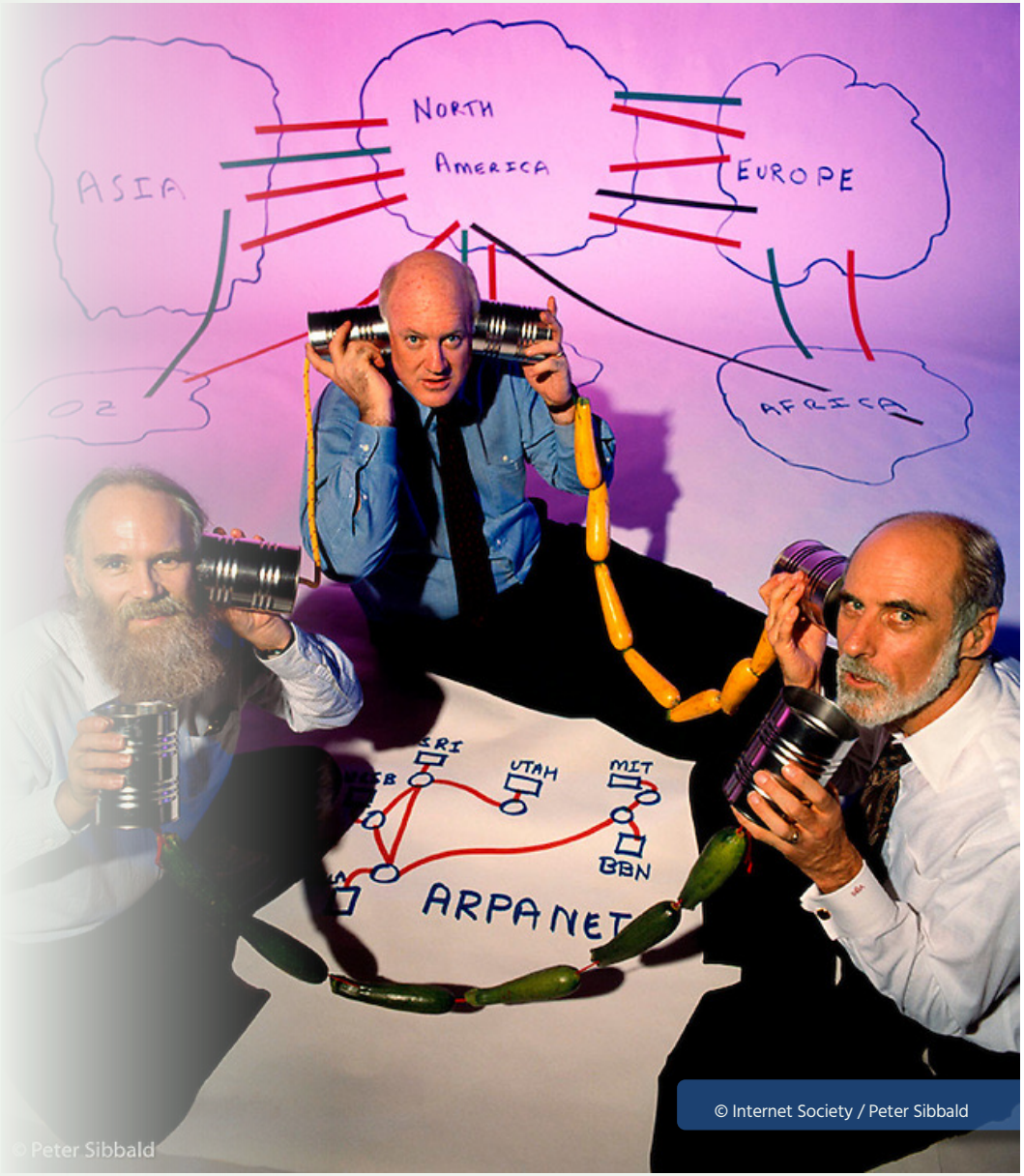
finch(at)isoc(dot)org

Our History

The Internet Society was founded in 1992 by early Internet pioneers, including Vint Cerf and Bob Kahn, who helped shape the technical foundations of the global Internet.

Among our leadership and members are many of the Internet's innovators, advocates, and champions dedicated to advancing its continued growth and development.

Learn more: ISOC History



Strategic Goals

People everywhere have access to an affordable, reliable, and resilient Internet.

- Reduce barriers to access and make the Internet faster and more affordable.
- Empower communities to build and defend the Internet.
- Protect the open and interoperable Internet so everyone can create, innovate, and connect freely.

People everywhere have an Internet experience that is safe, secure, and protects them online.

- Defend the Internet against decisions that weaken online security.
- Advocate for policy, technology, and commercial decisions that put people's safety, security, and privacy first.
- Empower people to make safe choices to protect themselves online

Global Presence

Our global community consists of 80+ organization members, 100+ Chapters, 5 Special Interest Groups, 3 Standing Groups, and 100,000+ individual members spanning over 200+ countries, territories, and areas of geographic

General Funding Opportunities

BOLT Grant Program

The Building Opportunities/Leveraging Technologies (BOLT) Grant Program supports technical and social innovations that promote Internet connectivity.

Connecting the Unconnected

The Connecting the Unconnected funding program supports communities and local organizations working to build and expand Internet infrastructure for people living in rural, remote, and low-income areas.

Encryption Day

This funding supports efforts to defend strong encryption through the annual Global Encryption Day and other events. Learn how you can apply for funding for activities that support and celebrate Global Encryption Day 2024.

Internet Governance Forum Events

The Internet Governance Forum (IGF) funding program supports the organization of IGF events at the local, national, regional and global levels, as well as Schools of Internet Governance. The goal of the IGF is to encourage an open and inclusive multi-stakeholder dialogue on policy issues related to Internet governance. The goal of Schools of Internet Governance is to ensure that diverse actors have the skills to participate in Internet governance structures and shape the future of the Internet.

Resiliency Grant Program

The Resiliency Grant Program provides support for communities to be prepared for and reconnect to the Internet quickly after climate-related disasters strike.

SCILLS Grant Program

The Strengthening Communities/Improving Lives and Livelihoods (SCILLS) Grant Program expands economic growth and increases educational opportunities by supporting individuals and communities to more knowledgeably and skillfully use the Internet.

Sustainable Peering Infrastructure

The Sustainable Peering Infrastructure funding program supports local communities to build or enhance IXPs and further develop organizations and communities that support peering and interconnection

Sustainable Technical Communities

The Sustainable Technical Communities funding program supports the organization of technical events, in order to enable strong and sustainable technical communities that help the Internet thrive.

Learn more: Funding Areas

Global Encryption Day 2026

A global day of action to promote, protect and defend strong encryption.

21 October 2026

Held online, worldwide

A Global Day of Action

Promoting, protecting & defending strong encryption

350+ Coalition Members

Global Encryption Coalition, founded in 2020

Strengthen, Don't Weaken

The Coalition's call to governments everywhere

https://www.globalencryption.org

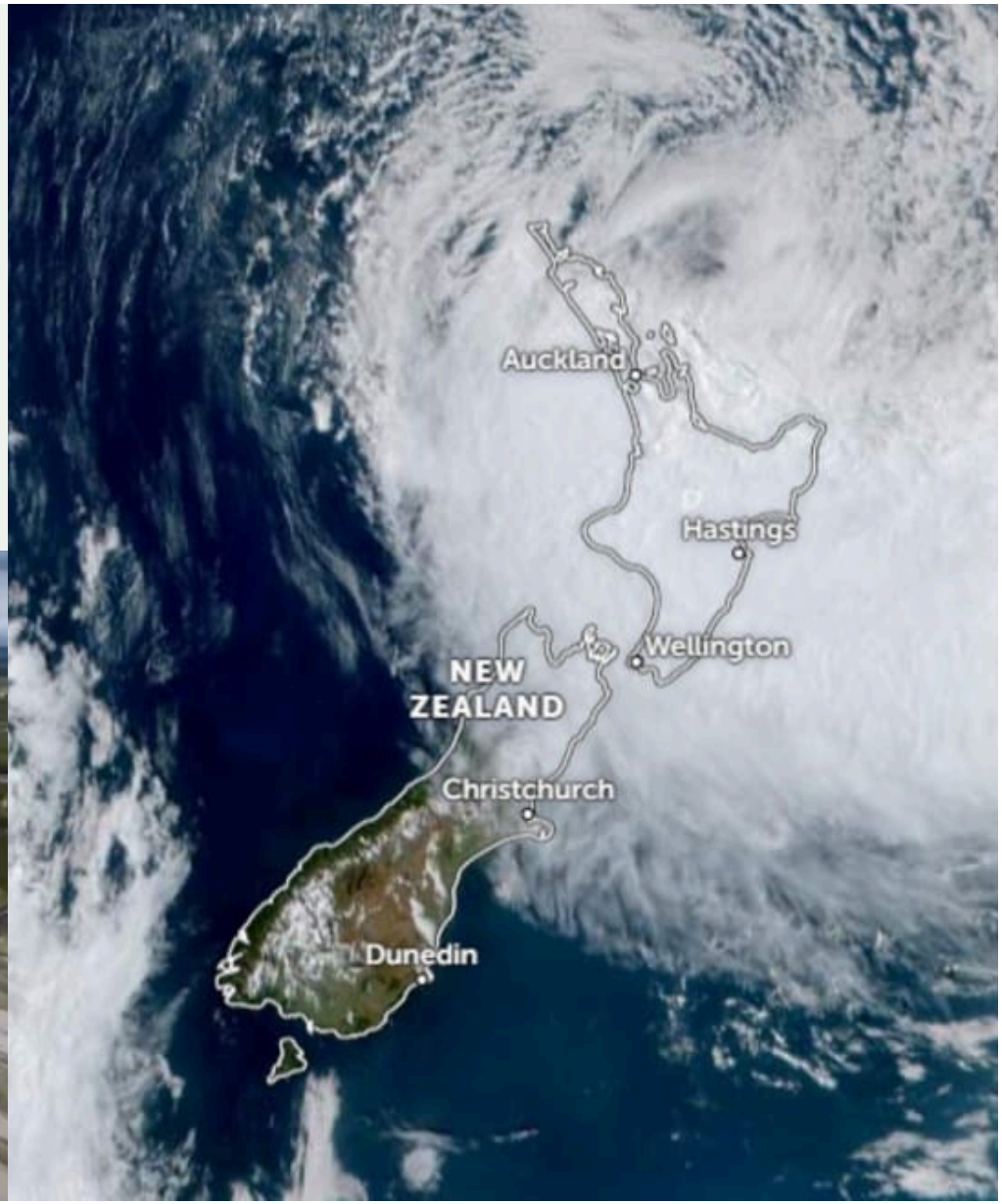
Internet Society

Open Fibre Data Standard

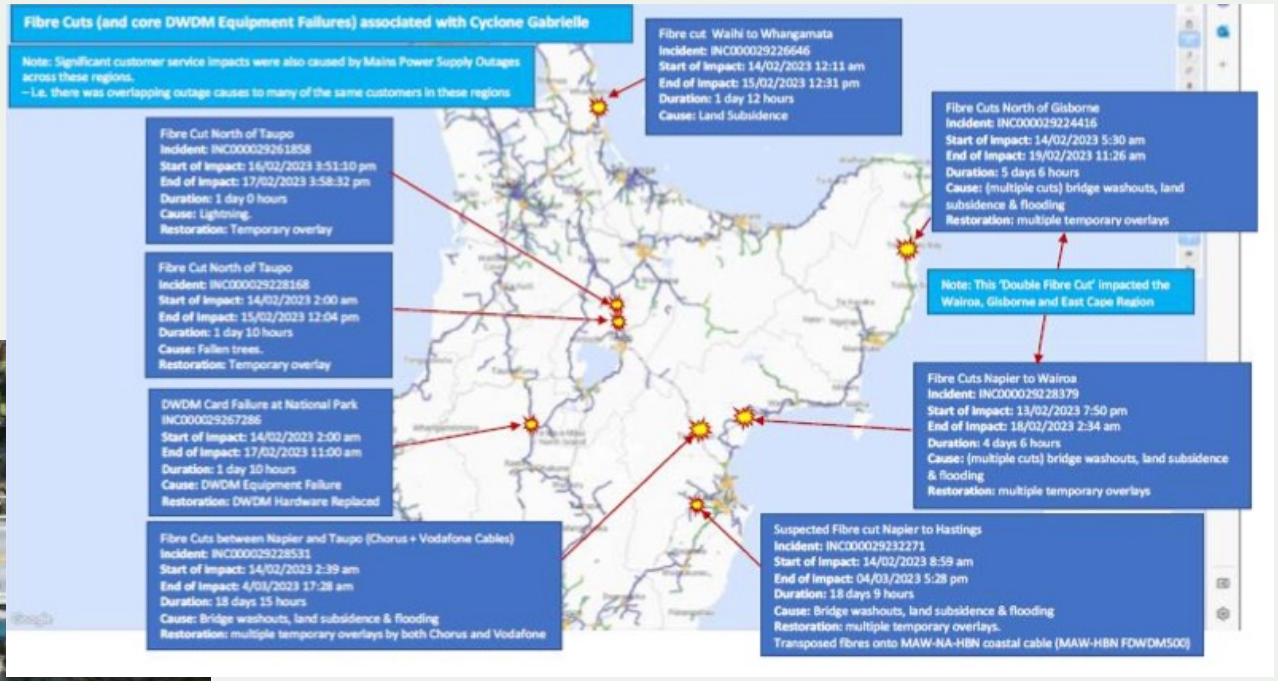
Warren Finch

Jul 2026

Why do this?


Auckland
Hastings
Wellington
NEW
ZEALAND
Christchurch
Dunedin

Cyclone Gabrielle Post Incident Report



DOWN BUT NOT OUT: Hikuwai Bridge No 1 collapsed in Cyclone Gabrielle in February, taking with it critical fibre connection for the East Coast. A fibre bypass has been completed. Picture by Rory O'Sullivan, Chorus

https://www.tcf.org.nz/wp-content/uploads/TEF-Incident-Report-Cyclone-Gabrielle-11-May-2023.pdf

Improving Telecommunications Resilience

HAWKE'S BAY REGIONAL RECOVERY AGENCY

Hawke's Bay Regional Economic Development Agency

Recommendations

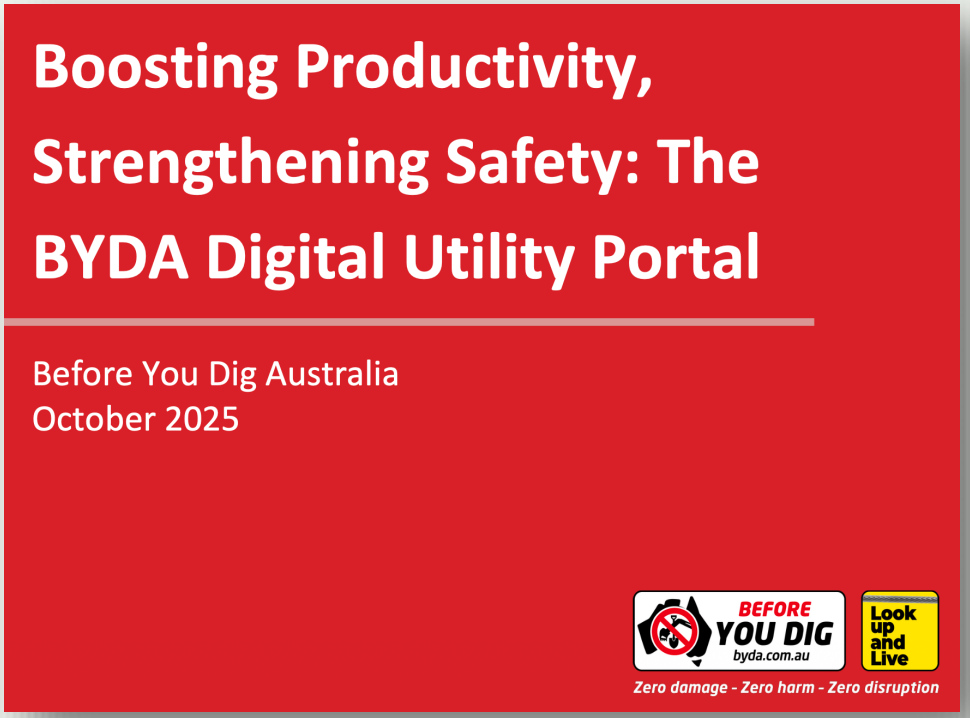
- Enhance battery capacity at key cellular sites
- Alternative energy or grid-scale backup for critical sites
- **Diverse fibre optic backbone path**
- Stable Terrestrial Clock Source
- Improve Physical Site Security at Remote Locations

https://www.hawkesbayrecovery.nz/assets/Uploads/Communications-Resilience-Report-July-24.pdf

Why do this?

Global movement towards digital utility registers

- Hong Kong - Underground Utility Information System
- United Kingdom - National Underground Asset Register
- Australia - BYDA Digital Utility Portal
- Netherlands - KLIC



https://portal.byda.com.au/wp-content/uploads/2025/10/Boosting-productivity-strengthening-safety-The-BYDA-Digital-Utility-Portal.pdf

Why infrastructure mapping matters

Policy frameworks increasingly depend on spatial evidence about networks.

Connectivity
Identify underserved and disconnected areas

Investment
Target public and private funding

Resilience
Understand redundancy, risks and dependencies

Sharing
Coordinate deployment and infrastructure use

The policy problem

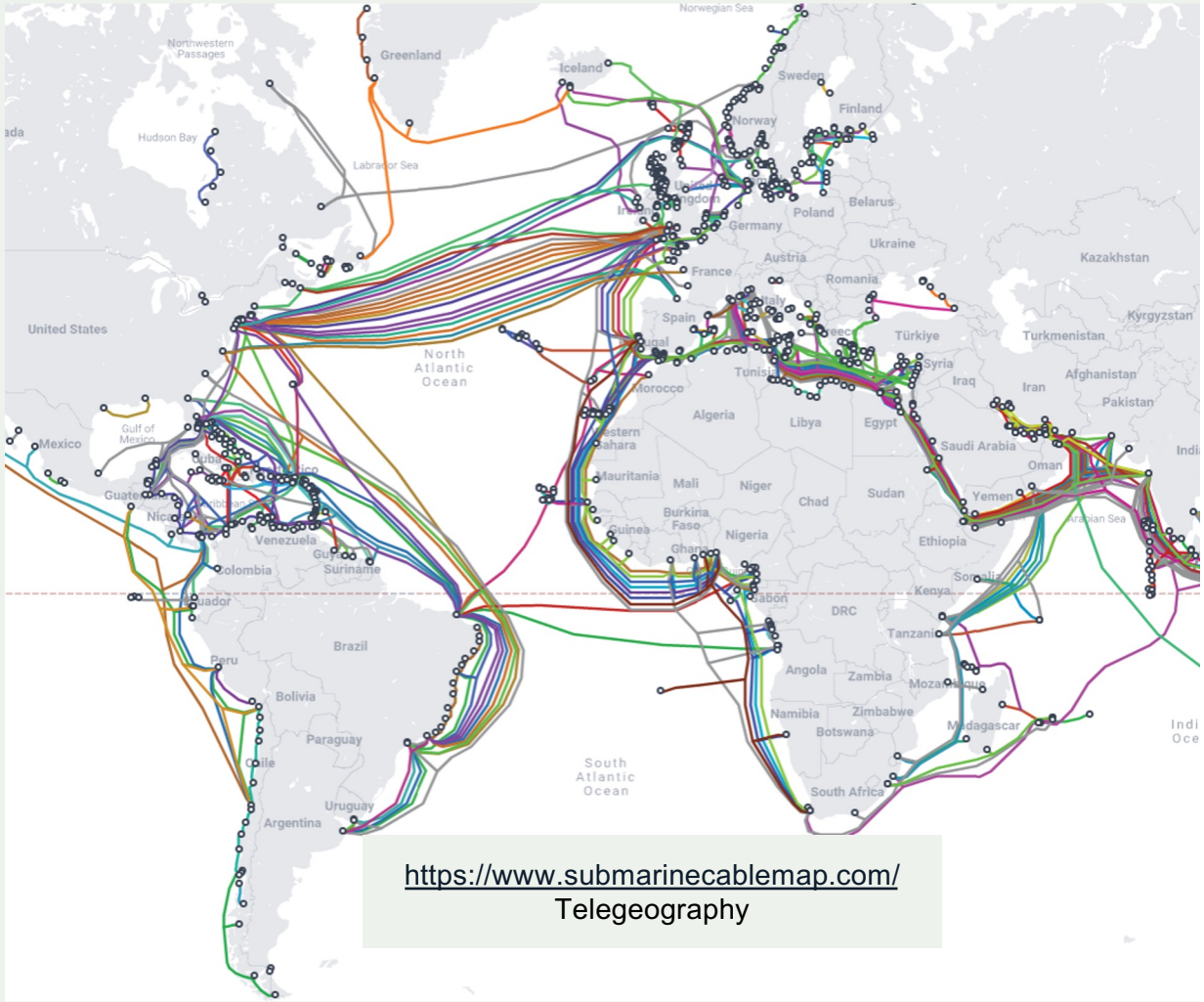
Most countries need better information about where terrestrial infrastructure exists and where gaps remain.

The challenge is not only mapping. It is also data structure, data confidence and interoperability.

This creates a practical role for complementary standards and platforms.

Mapping fibre networks

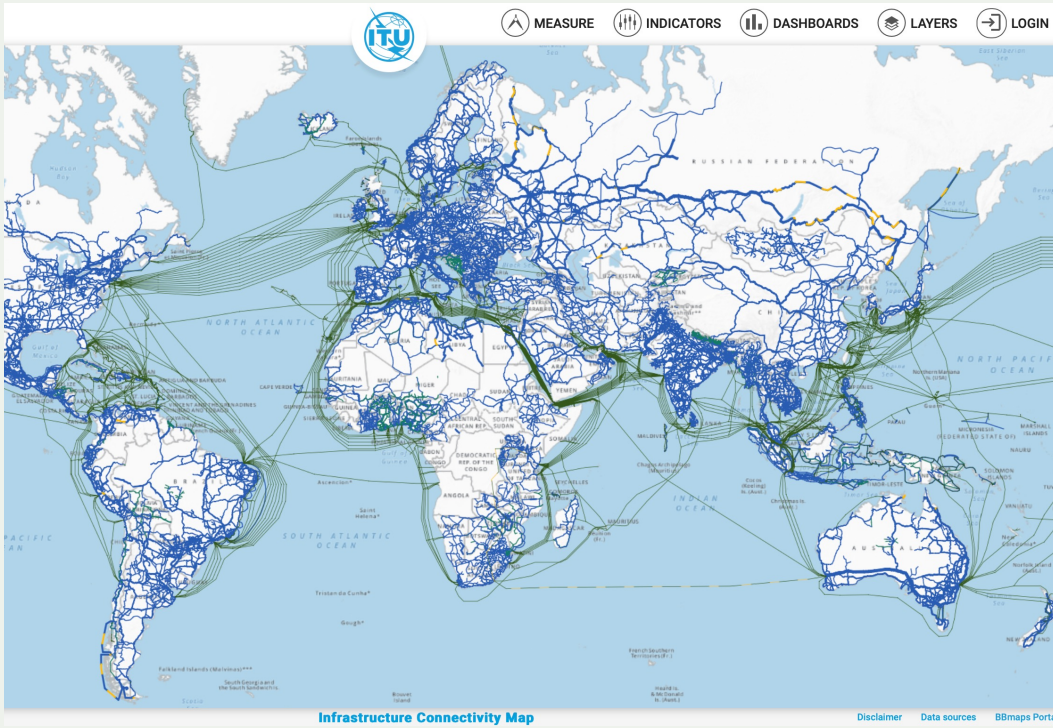
- Undersea cable maps are readily available.
- When it comes to terrestrial fibre networks, much less information is available. Some operators publish network maps, but many do not.
- Some terrestrial operators do provide detailed, public maps and options to download publish them in different formats.
- But there are no norms regarding publishing and what is shared



https://www.submarinecablemap.com/
Telegeography

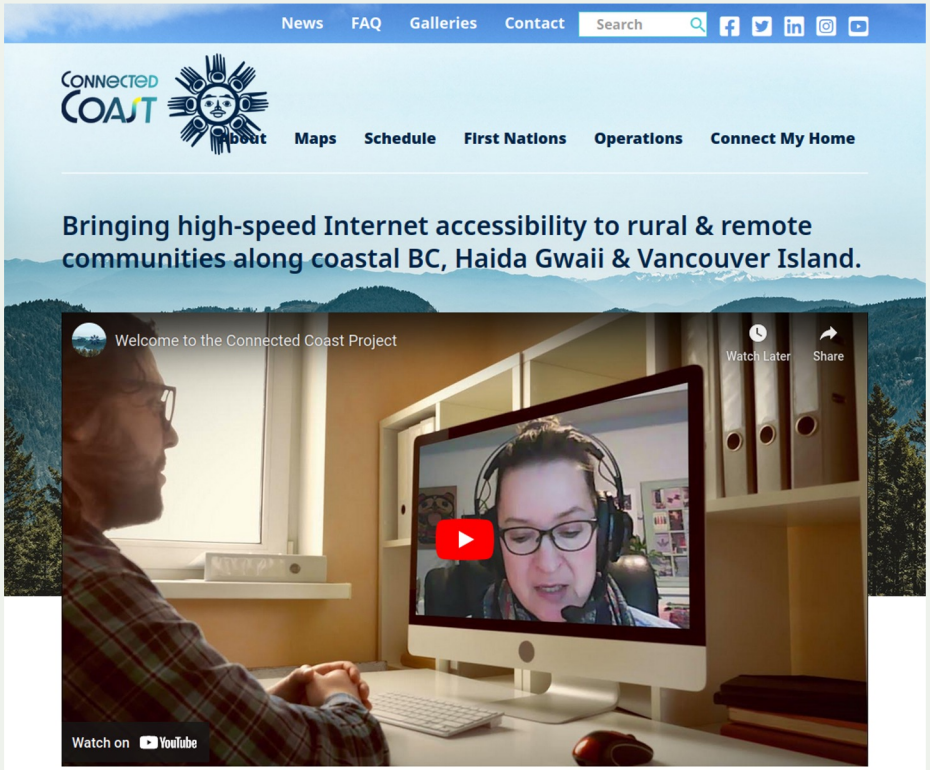
State of terrestrial fibre maps

- Institutions that track terrestrial fibre collect data from various sources, some of which is dated.
- Undersea cable maps are readily available.
- When it comes to terrestrial fibre networks, much less information is available. Some operators publish network maps, but many do not.
- Some terrestrial operators provide detailed interactive maps and options to download publish them in different formats (KMZ, PDF)



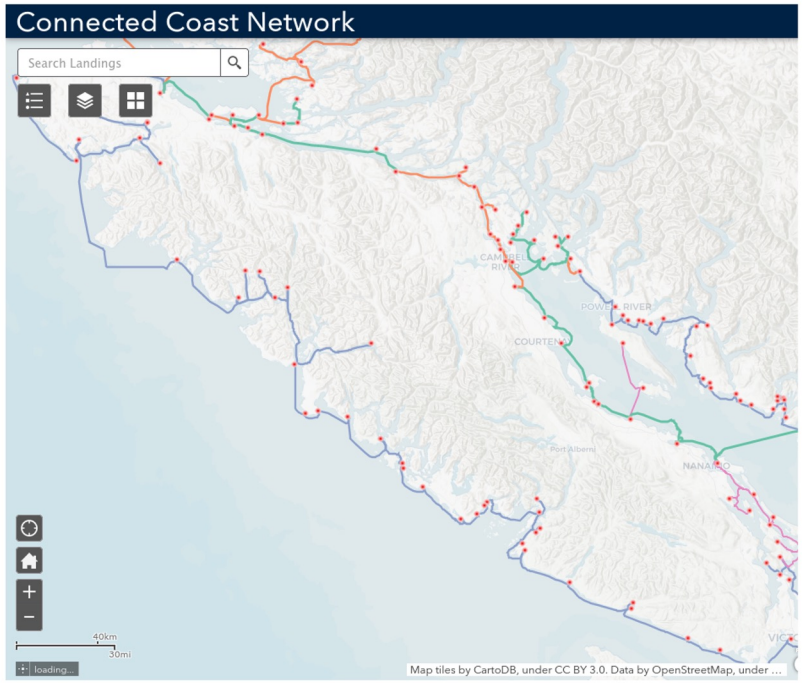
https://bbmaps.itu.int/bbmaps/

Canada: Connected Coast



The Connected Coast project will bring new or improved high-speed internet accessibility to 139 rural and remote coastal communities, including 48 Indigenous communities – representing 44 First Nations – along the BC coast from north of Prince Rupert, to Haida Gwaii, south to Vancouver, and around Vancouver Island.

https://connectedcoast.ca/map/



Build Status Map – PDF

View/Download PDF Here.

Landing Sites Map – PDF

View/Download PDF Here.

Open Data

Cable Location Map – KMZ FILE

As-built cable location files in KMZ (Google Earth file format) & GPX (navigation file) are available.
To receive a copy and future file updates, please fill out the form on our Operations page.

Terrestrial Fibre Mapping Challenges

Accuracy – Maps are compiled via official maps (from some operators), shareholder reports, World Bank studies, and other 'informal' sources.

Completeness - Most maps are not complete and many need updating.

Limited information – Most map data lacks sufficient information to inform policy and development.

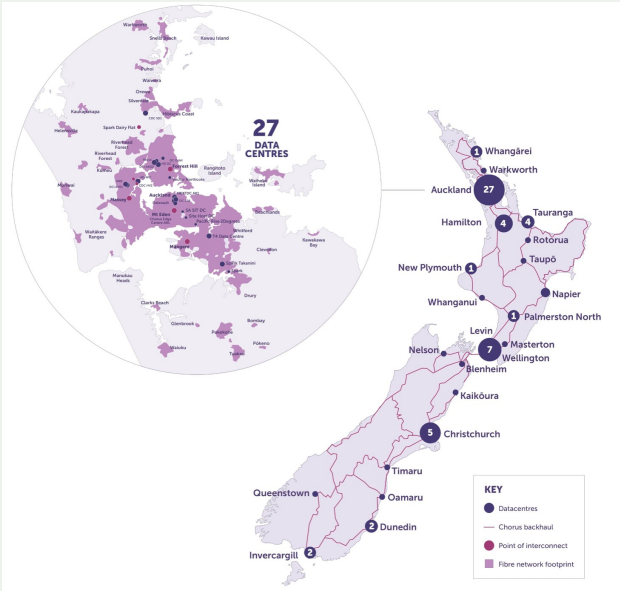
Publication Format – Operators that publish map data are limited in the ways that they can publish - interactive webpages, PDF or KML

Validation – Mapping providers have difficulty verifying and keeping their data current.

Typical resources

- Most public sources of terrestrial fibre networks are dated, unauthoritative, and in formats that are a challenge to integrate with other sources.

https://opendata-christchurchcity.hub.arcgis.com/



https://www.chorus.co.nz/enterprise/data-centre-connectivity

Searching for Resources: Google-Fu Techniques

Advanced search techniques for locating maps and open internet resources.

Master the Operators
site: filetype: intitle: inurl:

Hunt for Map Files
filetype:pdf, kml & kmz coverage maps

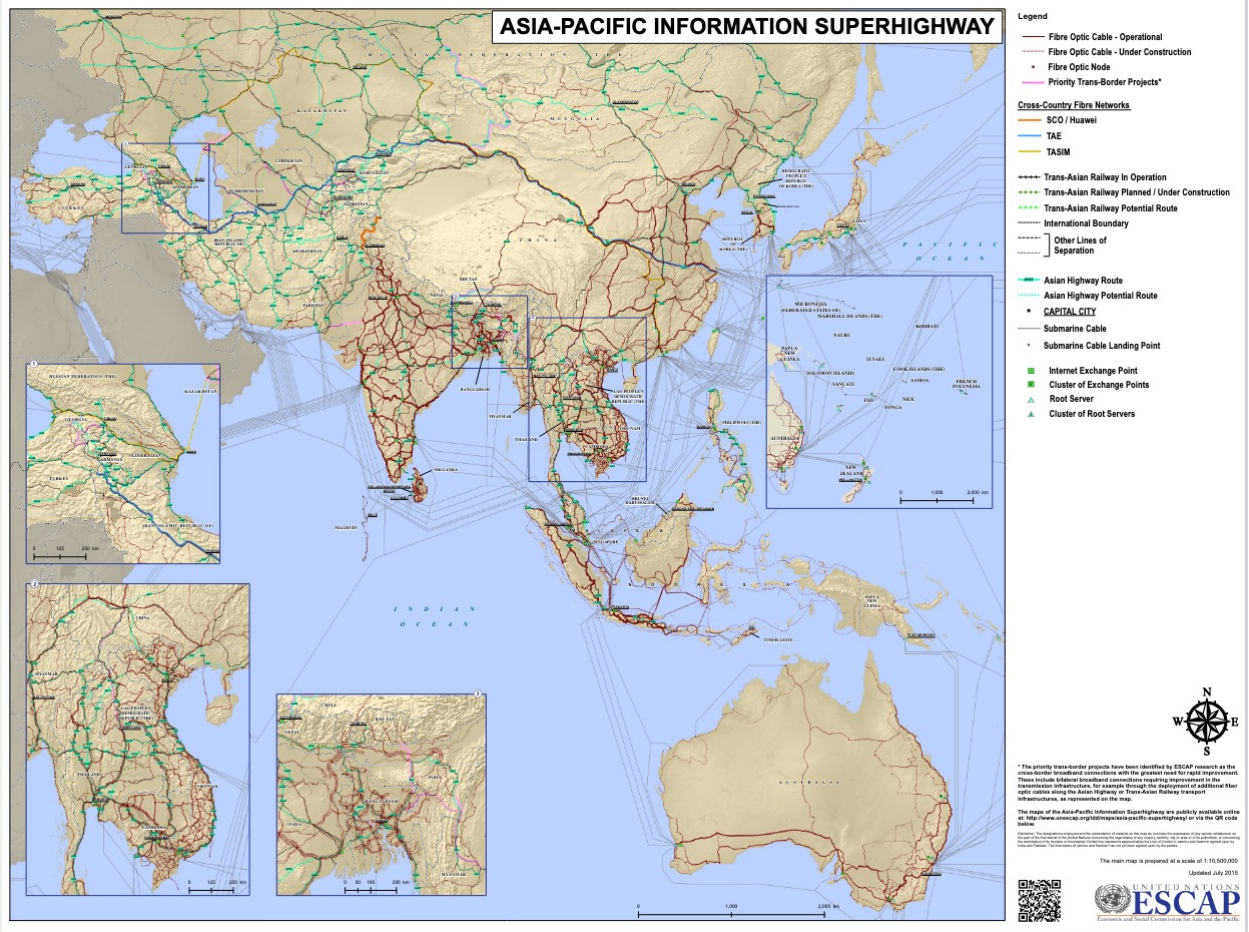
Target Trusted Sources
Regulators, gov sites & open-data portals

Refine & Combine
Quotes, OR and minus (-) to cut the noise

Full hands-on guide: github.com/waz-here/ISOC/blob/main/OFDS/OFDS-Google-Fu-Workshop-Guide.md

From Static Resource to Living Document

- In 2015, UNESCAP published a map of the Asia-Pacific Information Superhighway
- The Open Fibre Data Standard could enable this map to become a living document of infrastructure development in the region.



https://unescap.org/resources/escap-investment-maps

The Importance of a Common Language

OFDS is both an **Open Data** initiative and an **Open Standards** initiative.

Whether network maps are shared publicly or not, having an Open Standard, in essence a common language, to describe them is essential to understanding network resilience and making effective investments in infrastructure.

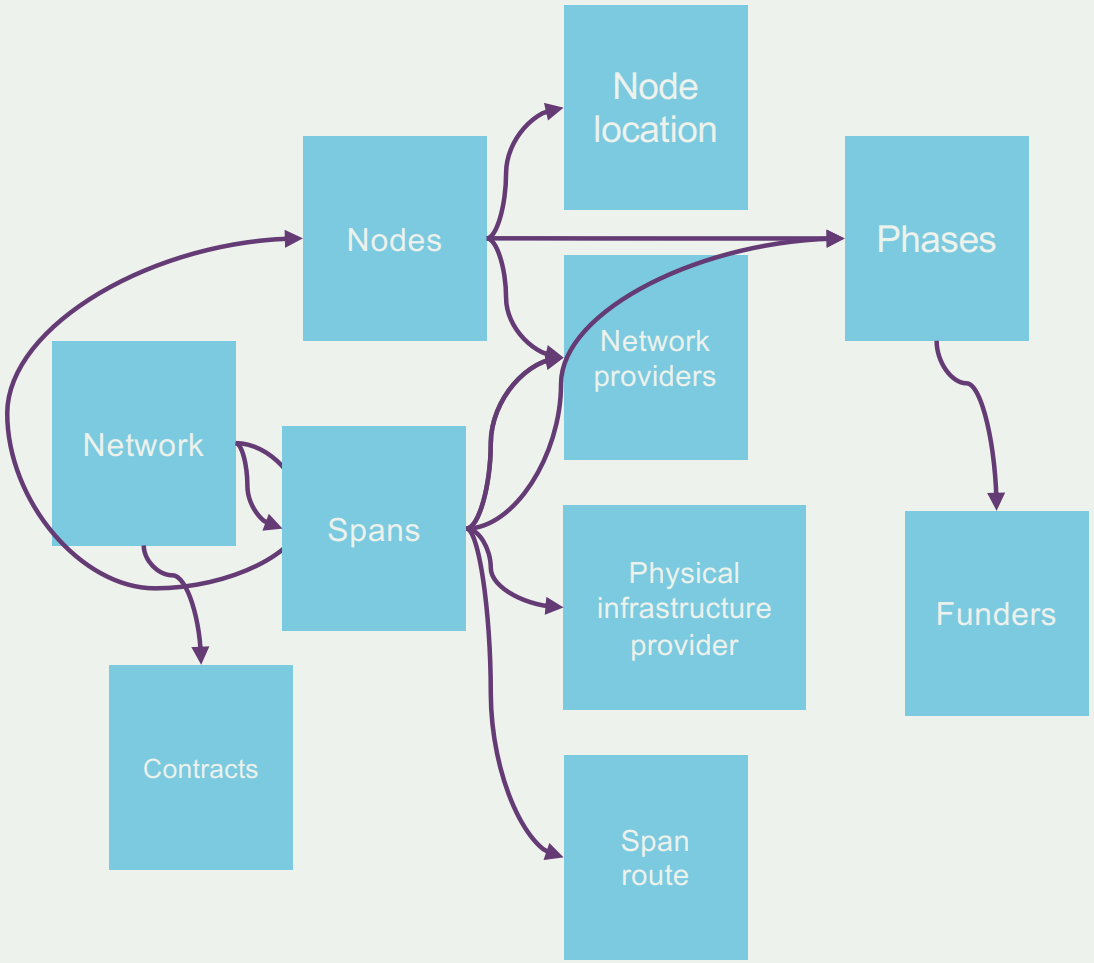
Open Data

+

Open Standard

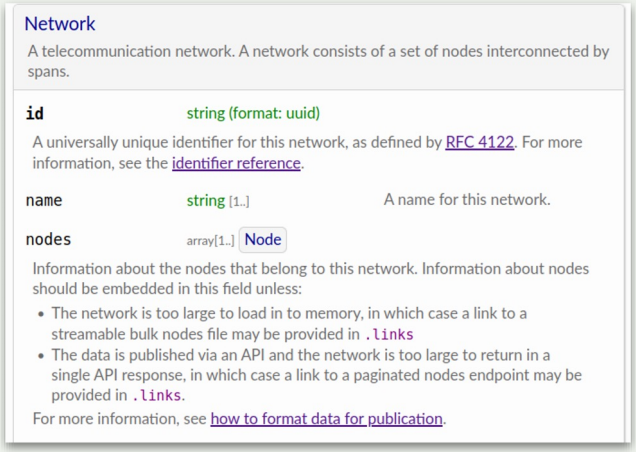
Open Fibre Data Standard

- Describes what data to publish about fibre networks
- Provides a vocabulary and structure for fibre network data
- Offers guidance and software tools for publishers and users

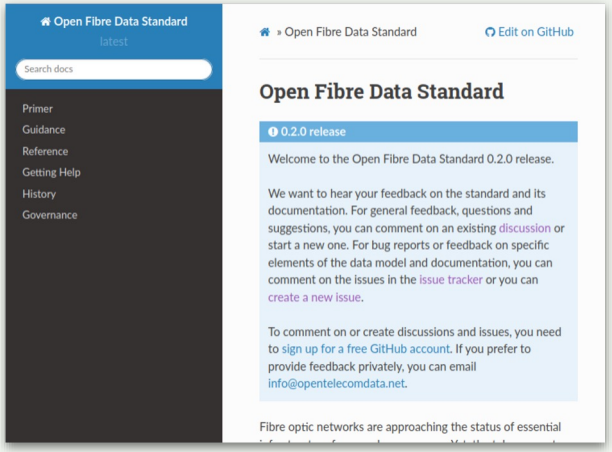


Components

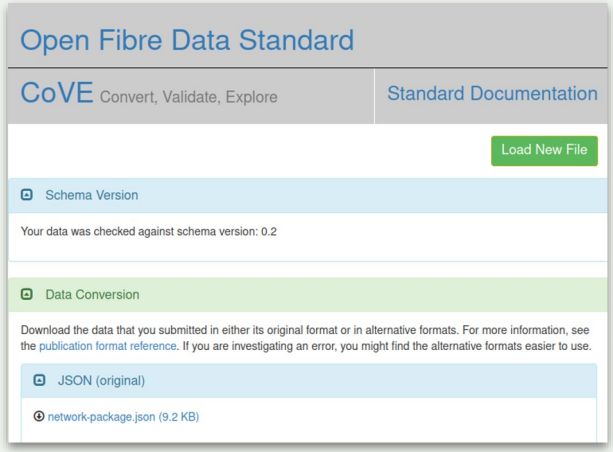
Schema and codelists	Documentation	Open source tools
Define the structure and format of OFDS data, the meaning of each field, and the rules that must be followed to publish OFDS data.	A primer, guidance and reference documentation covering how to publish and use OFDS data.	Software tools for converting, validating and exploring OFDS data. CoVE (Convert, Validate, Explore)



https://open-fibre-data-standard.readthedocs.io/en/latest/reference/schema.html



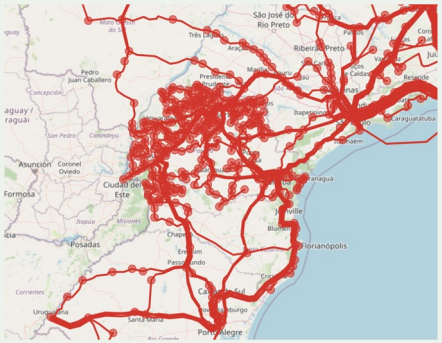
https://open-fibre-data-standard.readthedocs.io/en/latest/

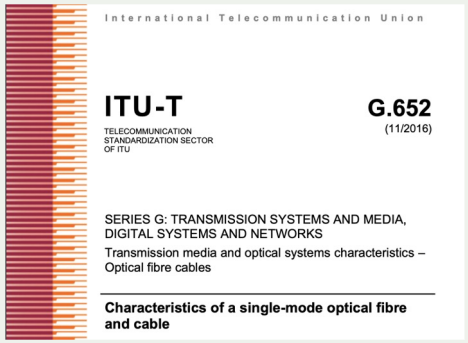


https://ofds.cove.opendataservices.coop/

Categories of Data

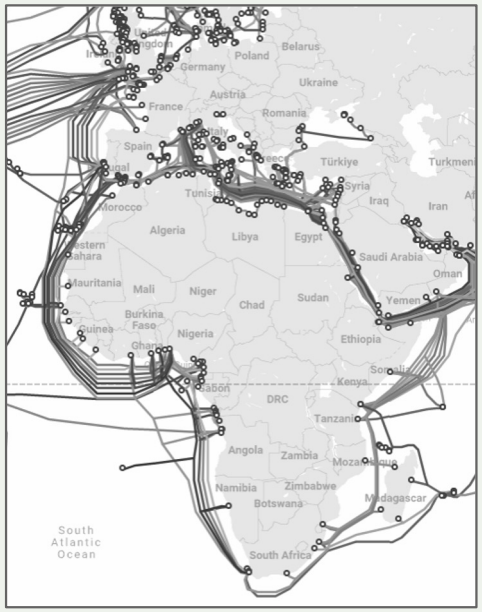
Location data	Technical data	Administrative data
The route of fibre cables, the coordinates of PoPs, towers and IXPs.	Capacity, ITU fibre standards, power availability.	The organisations that own and operate infrastructure, the status of infrastructure, dark fibre availability.

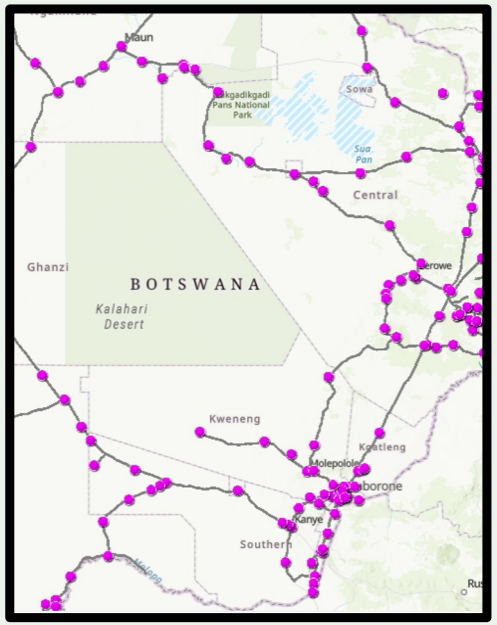


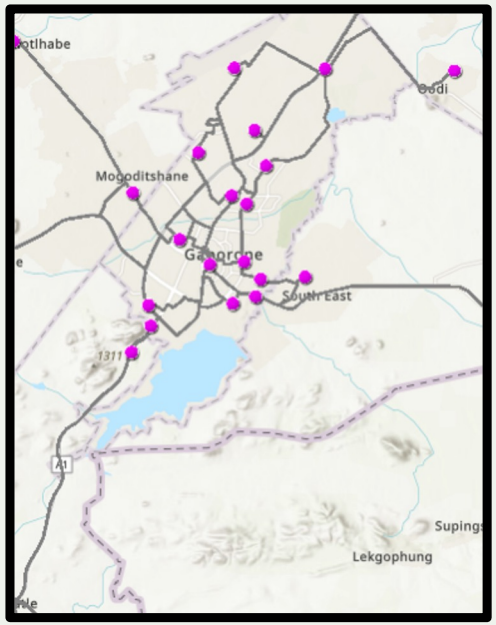


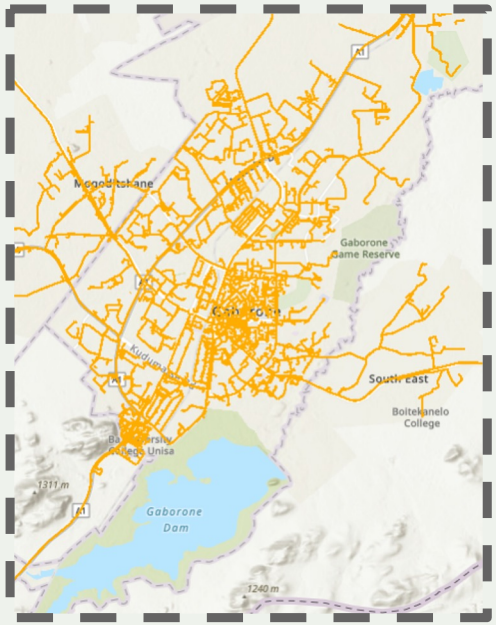
Reach

The initial focus of OFDS lies in describing **national and middle mile** networks but will ultimately encompass **last mile** networks.









Undersea | **National** | **Middle mile** | Last mile

Sources: submarinecablemap.com, BoFiNet GIS portal

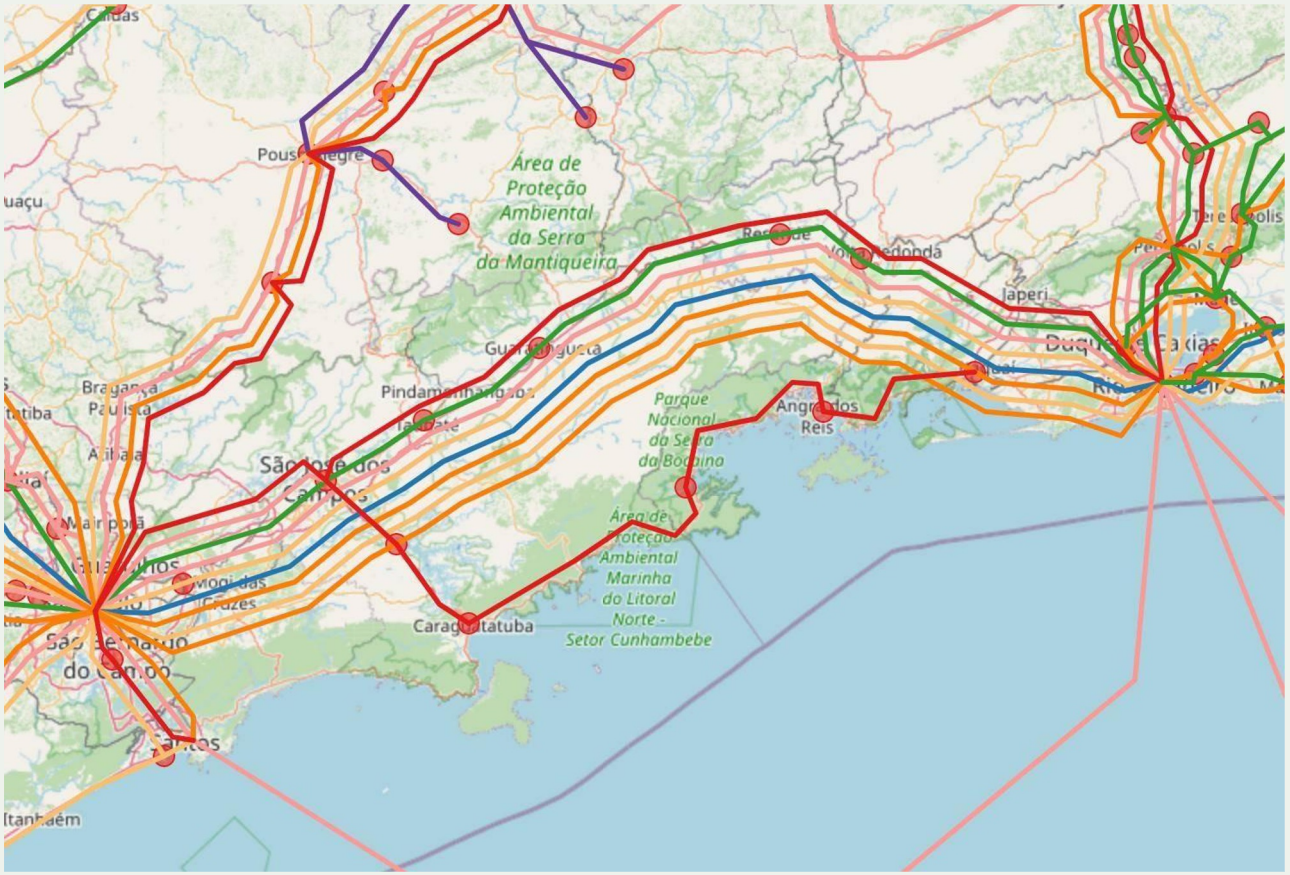
Benefits of an Open Fibre Data Standard (OFDS)

Governments	Network Operators	Researchers
• More strategic investment in fibre • Better understanding of national and regional network resiliency • Improved coordination across sectors • Reduction of physical network interruption • Tracking policy impact	• Better targeting of investments to reach the unserved and underserved • Better targeting of investments to improve network resiliency • Trust building among operators	• Evidence of the socio-economic impact of of fibre investments • Better network analysis and visualization tools • Informed advocacy and interventions such as cross-border interconnection issues • More civil society engagement in bridging the digital divide

Benefits of an Open Fibre Data Standard (OFDS)

- Understanding the true extent of national fibre infrastructure
- Benefits to cyber security. Redundancy is key to network resilience.

Resilience has less to do with failsafe networks than networks that are safe when they fail.



Map of fibre networks from Sao Paulo to Rio de Janeiro

Standard Development and Maintenance

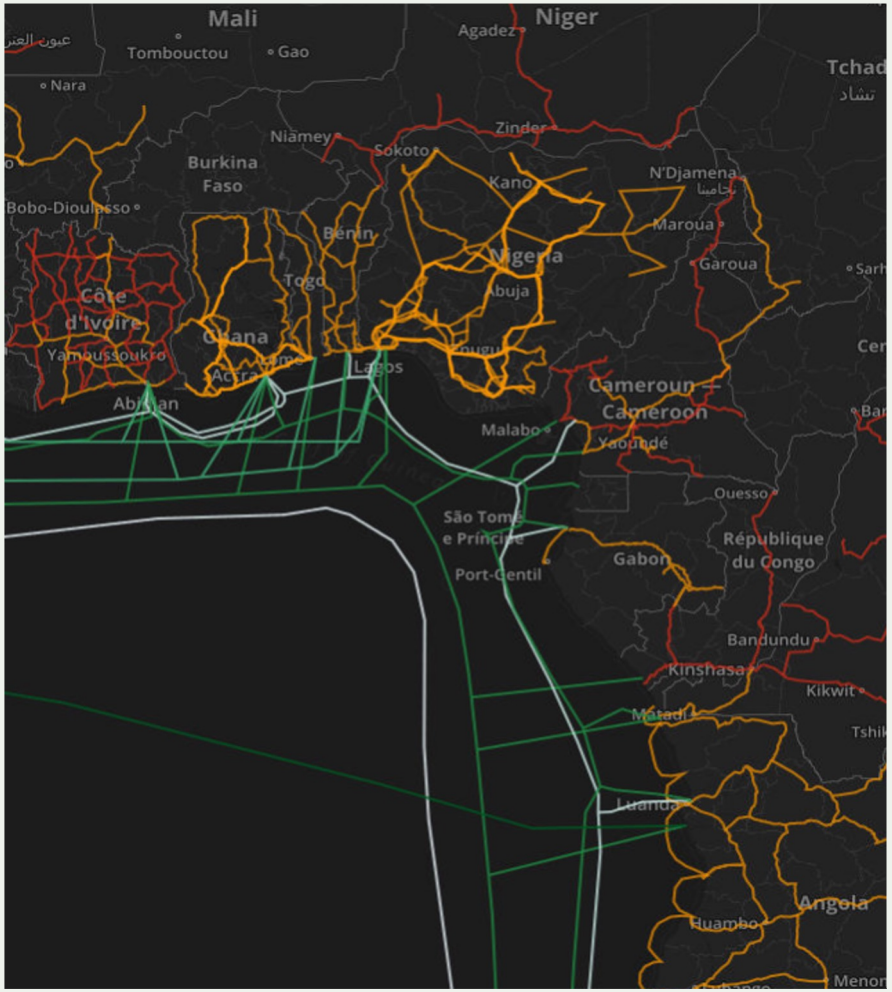
We are facilitating the establishment of a multistakeholder governance structure for the Open Fibre Data Standard (OFDS), originally funded by the World Bank.

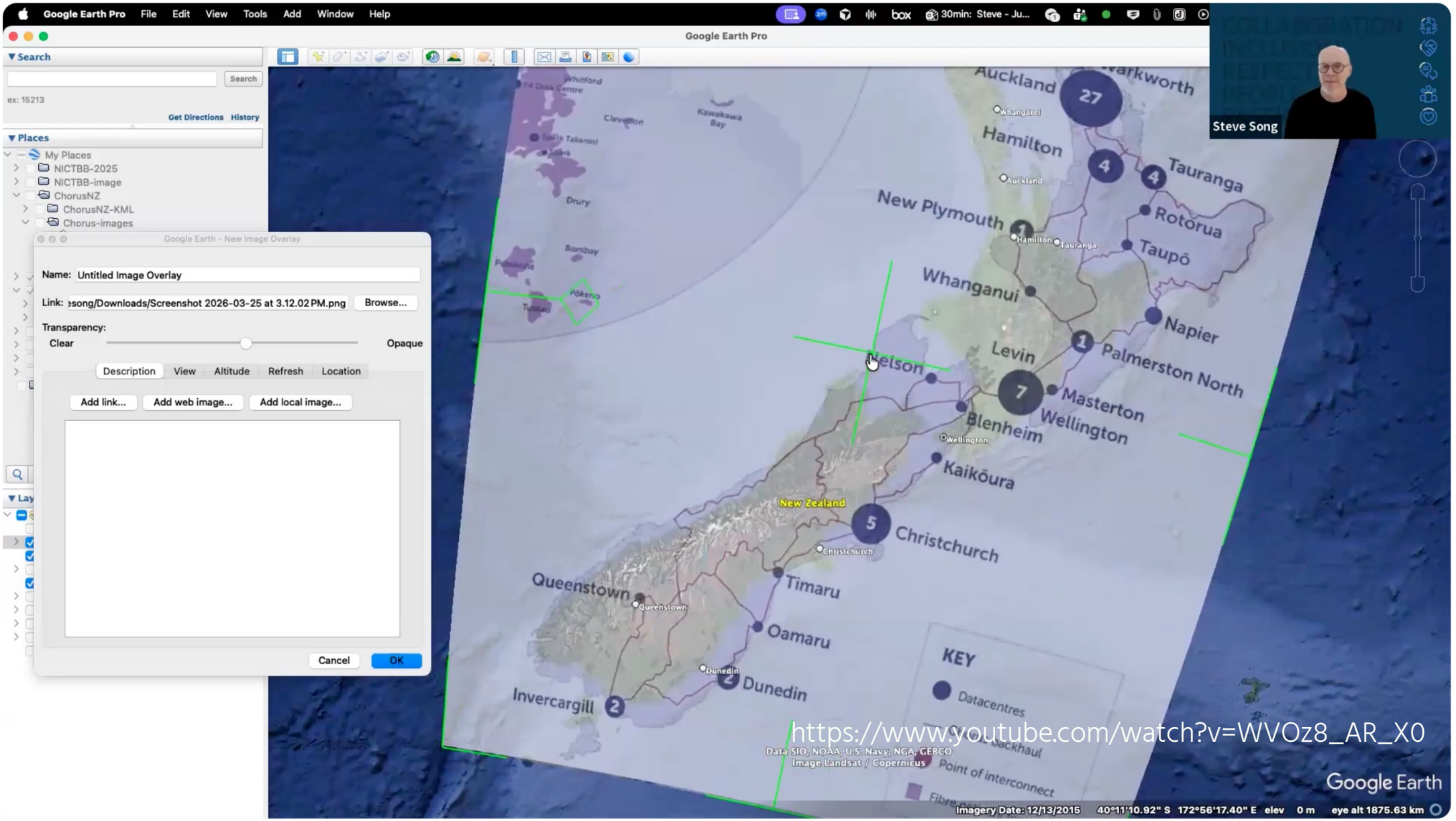
At a recent workshop in Geneva, an Interim Governance Committee for the standard was established, consisting of members listed here.

An Advocacy Initiative – Open Fibre Data

Drawing on past experiences and leveraging our global network and convening power, the Internet Society is developing a strong and diverse community around the standard.

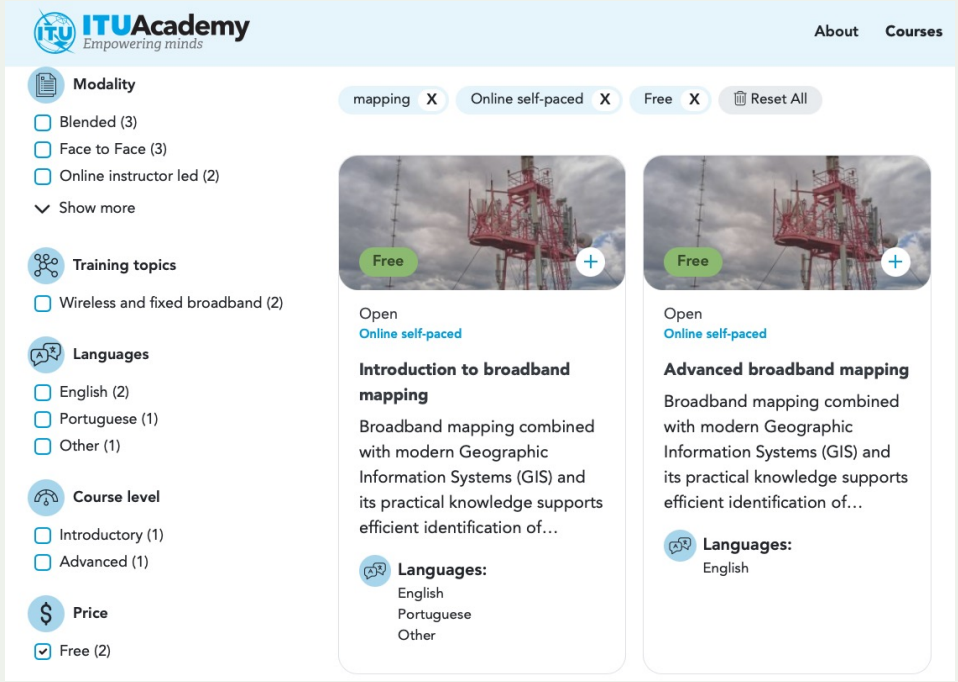
Understanding the true reach and overlap (or lack thereof) of fibre optic backbone infrastructure contributes to ISOC's goal understanding of network resilience and promoting a truly inclusive internet.




Google Earth Pro File Edit View Tools Add Window Help
Google Earth Pro
Search
Get Directions History
Places
My Places
NICTBB-2025
NICTBB-image
ChorusNZ
ChorusNZ-KML
Chorus-images
Google Earth - New Image Overlay
Name: Untitled Image Overlay
Link: esong/Downloads/Screenshot 2026-03-25 at 3.12.02 PM.png
Browse...
Transparency:
Clear
Opaque
Description View Altitude Refresh Location
Add link... Add web image... Add local image...
Cancel OK
Steve Song
Auckland
Hamilton
Tauranga
Rotorua
Taupō
New Plymouth
Whanganui
Napier
Palmerston North
Levin
Nelson
Masterton
Wellington
Blenheim
Kaikōura
Christchurch
Timaru
Oamaru
Dunedin
Invercargill
Queenstown
New Zealand
KEY
Datacentres
Point of interconnect
https://www.youtube.com/watch?v=WVOz8_AR_X0
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Google Earth
Imagery Date: 12/13/2015 40°11'10.92" S 172°56'17.40" E elev 0 m eye alt 1875.63 km

Getting Started

- Read the Docs
  - https://ofds.info/en/getting-started/
- Training
  - https://academy.itu.int/training-courses/full-catalogue?search_api_fulltext=mapping&field_taxon_type%5B152%5D=152
- Tools
  - OFDS Sample Datasets
  - https://github.com/stevesong/OFDS-datasets
  - The OFDS Demo Map
  - https://ofds-demo.opentelecomdata.org/
  - Use the OFDS Data Validation Tool
  - https://ofds.cove.opendataservices.coop/
  - The OFDS Consolidation Tool
  - https://github.com/Open-Telecoms-Data/ofds_consolidation_tool
  - KML2OFDS python script
  - https://github.com/stevesong/kml2ofds/



Internet Society plans for 2025 / 2026

Outsource the maintenance and development of OFDS to a professional standards consultancy/organisation as an interim measure.

Provide a secretariat function with online collaboration tools and resources to support the Open Fibre Data Standard governance group and working groups.

Conduct an advocacy campaign through community building, stakeholder engagement, and content development.

Fundraise for the ongoing development and adoption of the Open Fibre Data Standard

Get involved!

Please get in touch if you are interested in:

- Learning more about OFDS
- Hosting an OFDS workshop
- Participating in standard development and governance

Thank you!

Warren Finch
finch(at)isoc(dot)org

Further Reading

Articles

World Bank - Making it Possible for the World to Log On

Internet Society - A Standard to Increase Availability, Accessibility of Terrestrial Fiber Infrastructure Data

Internet Society - Mapping Terrestrial Fibre Optic Networks is Essential for Measuring Internet Resilience

Open Data Services Cooperative - Open Fibre Data Standard: opening up fibre optic broadband infrastructure

Mozilla - Open Fibre Data Standard: Understanding the True Extent of the Internet

The State of Open Data - Telecommunications and the State of Open Data

Canonical sources

Documentation
https://open-fibre-data-standard.readthedocs.io/en/latest/reference/schema.html

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

Thank you


Open Infrastructure Map
about | stats | exports
Tavua Town
Ba
Lautoka
Nadi
Levuka
Nausori
Suva
Sigatoka
10 km
https://openinframap.org/#8.67/-17.7907/178.9531

Appendix:

Addressing questions regarding the security of publishing network maps

The Cost of Obscurity

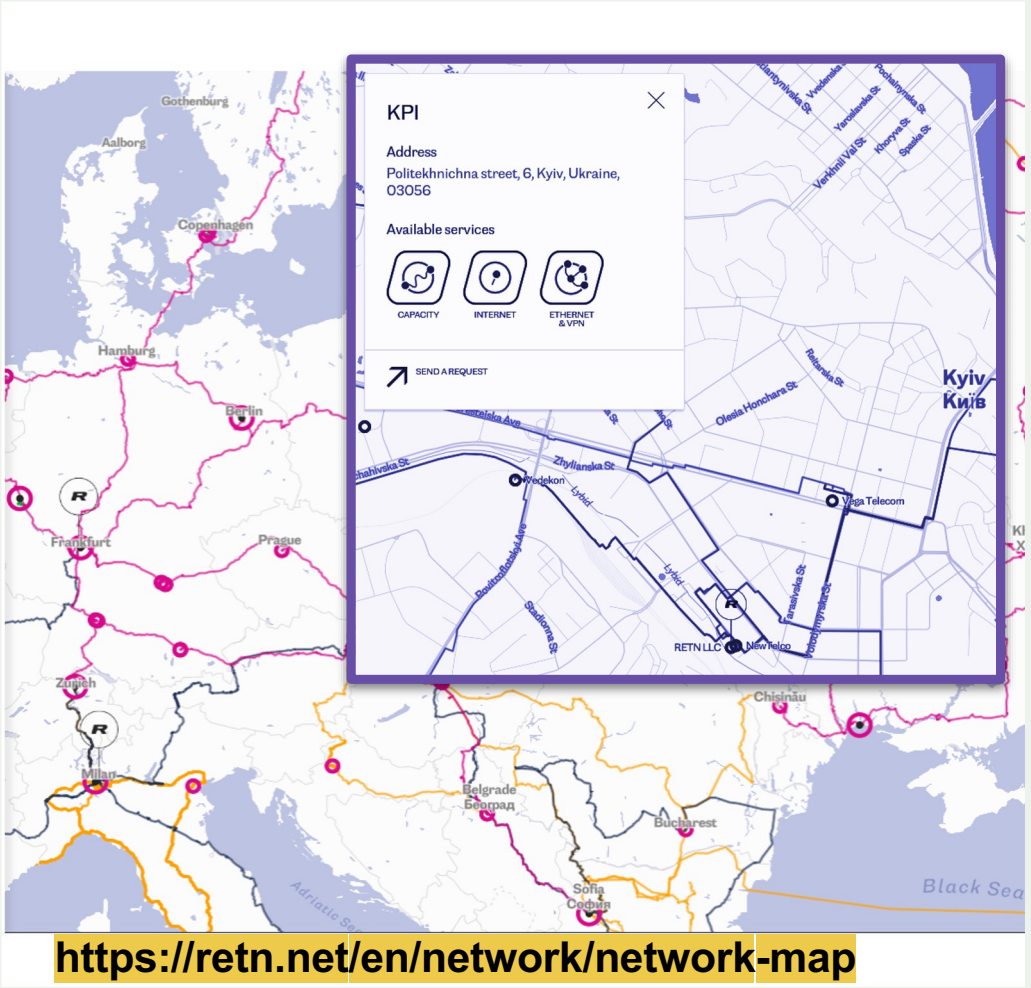
Evidence suggests that the cost and risks of obscurity outweigh those of transparency:

- A 2021 study with MTN Ghana estimated the cost of cuts like this would amount to a loss of USD750,000 in the 5 month period.
- This does not include the economic losses from the cut to enterprises that depend on that infrastructure.

Evidence from Existing Operators

Evidence from operators who currently share detailed maps of their fibre network infrastructure suggest that publicly available maps are not a critical point of security vulnerability.

RETN in Ukraine is a dramatic case in point. They are one of the largest fibre network operators and continue to maintain, in 2025, a detailed online map. If online network maps were a security concern, it likely this would have been taken down long ago.



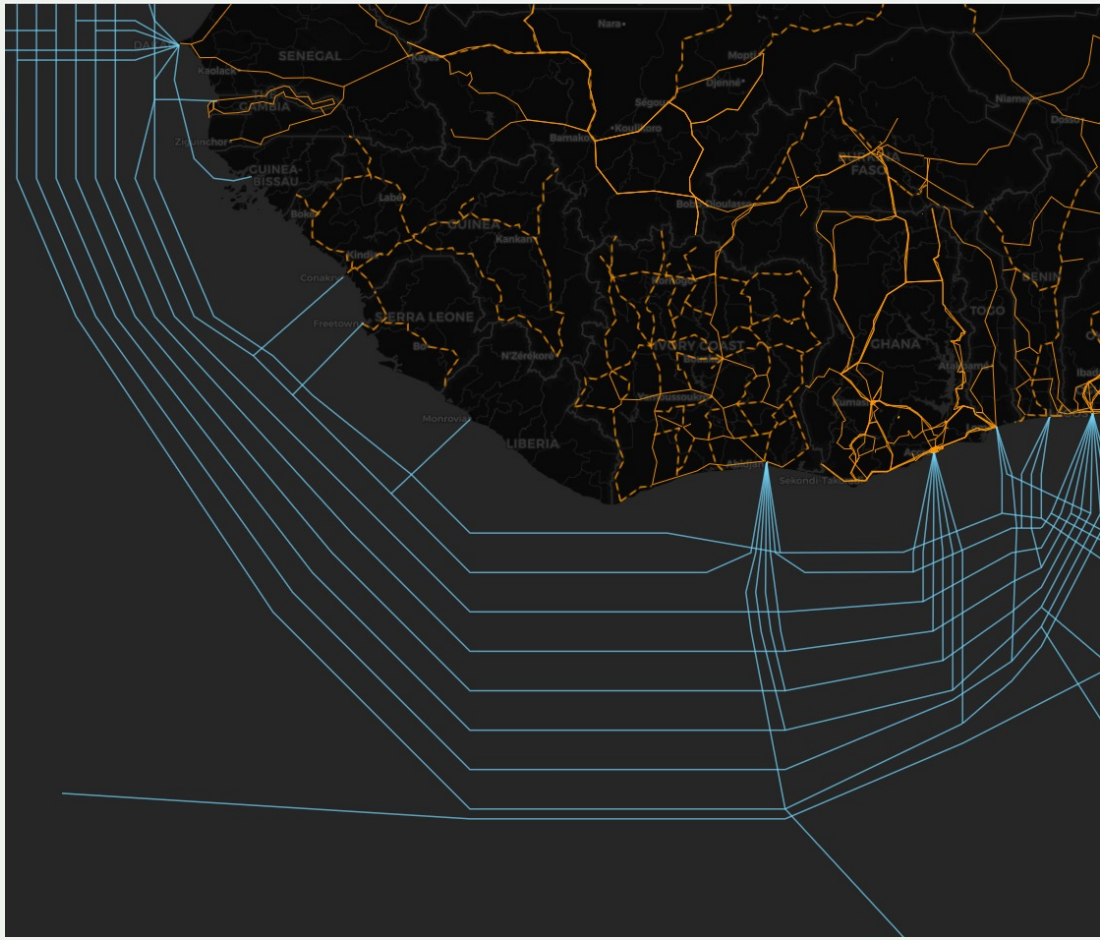
Undersea and Terrestrial Interdependence

In 2024/2025 undersea cables have come into prominence as a result of significant cable disruptions. African countries suffered particularly with cuts on both the east and west coast of the continent in 2024.

In response, the ITU has convened an international committee to discuss undersea cable resilience. However, considering undersea cables independently of terrestrial fibre optic infrastructure is only looking half of the problem.

In the case of the undersea cable cuts off the coast of Cote d'Ivoire in 2024, terrestrial fibre networks played an essential role in the restoration of services.

Terrestrial fibre data is as important as undersea cables in understanding global network resiliency.



Data Obfuscation in Public Maps

Terrestrial fibre network maps can be published in a manner that is useful to researchers, but which also provides sufficient obfuscation of map data to allay operator concerns regarding security.

There are a number of technical approaches to achieving this.

Bokeh: Obfuscating Physical Infrastructure Maps

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University of Wisconsin-Madison

Jeremy Koritzinsky
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University of Wisconsin-Madison

Meenakshi Syamkumar
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University of Wisconsin-Madison

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University of Wisconsin-Madison

Ramakrishnan Durairajan
ram@cs.uoregon.edu
University of Oregon

Joel Sommers
jsommers@colgate.edu
Colgate University

ABSTRACT

Physical infrastructures that facilitate *e.g.*, delivery of power, water and communication capabilities are of intrinsic importance in our daily lives. Accurate maps of physical infrastructures are important for permitting, maintenance, repair and growth but can be considered a commercial and/or security risk. In this paper, we describe a method for obfuscating physical infrastructure maps that removes sensitive details while preserving key features that are important in commercial and research applications. We employ a three-tiered approach: tier 1 does simple location fuzzing, tier 2 maintains connectivity details but randomizes node/link locations, while at tier 3 only distributional properties of a network are preserved. We implement our tiered approach in a tool called *Bokeh* which operates on GIS shapefiles that include detailed location information of infrastructure and produces obfuscated maps. We describe a case study that applies Bokeh to a number of Internet Service Provider maps. The case study highlights how each tier removes increasing amounts of detail from maps. We discuss how Bokeh can be generally applied to other physical infrastructures or in local services that are increasingly used for e-marketing.

CCS CONCEPTS

• **Security and privacy → Data anonymization and sanitization**.

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Geographic Information System; Shapefile Obfuscation; Network Map Obfuscation; Internet Physical Infrastructure Maps

1 INTRODUCTION

Accurate maps of the geographic characteristics and features of physical infrastructures such as power, water and communication systems are routinely generated and maintained by both public and private entities. These maps are important for a wide range of applications including inventory management, risk assessment, permitting, maintenance, repair and growth. These maps are also important in a wide variety of research contexts that seek to assess complex combinations of characteristics or capabilities and/or make fundamental and longer term improvements to infrastructure.

Our study is concerned with maps that convey characteristics of physical infrastructure. Such maps typically include details of locations of key components (*e.g.*, buildings), which we refer to as *nodes*, and connectivity between components (*e.g.*, various forms of rights of way, wires, conduits, etc.), which we refer to as *links*. Representations of such infrastructure appear as a graph or network on a map. Moreover, they are often instantiated in a standard GIS format such as ESRI's shapefile or Google's KML/KMZ so that they can be easily visualized, analyzed and combined with other data. We argue that there are two fundamental features of such maps that define their accuracy. *Location accuracy* is the correspondence between the represented geographic locations of individual nodes/links in a map with their actual (ground truth) locations. *Graph accuracy* is the correspondence between individual nodes and links in a map and their actual physical connectivity in the network. In each case an exact match between the map and the true physical infrastructure would mean the map is 100% accurate.

Unfortunately, there are risks in publishing 100% accurate physical maps. First is the risk of attack on the physical infrastructure locations identified in the maps. These attacks seek to damage nodes and/or links causing outages that could have broader impact. Examples of such attacks (which were

https://ix.cs.uoregon.edu/~ram/papers/LocalRec-2019.pdf

The Importance of a Common Language

OFDS is both an **Open Data** initiative and an **Open Standards** initiative.

Whether network maps are shared publicly or not, having an Open Standard, in essence a common language, to describe them is essential to understanding network resilience and making effective investments in infrastructure.

Open Data

+

Open Standard