# Introduction to Community Networks

# About the Association for Progressive Communications (APC)


International network of CSO  founded in 1990 dedicated to ICTs for social justice: 62 organisational members and 29 individual members active in 73 countries.

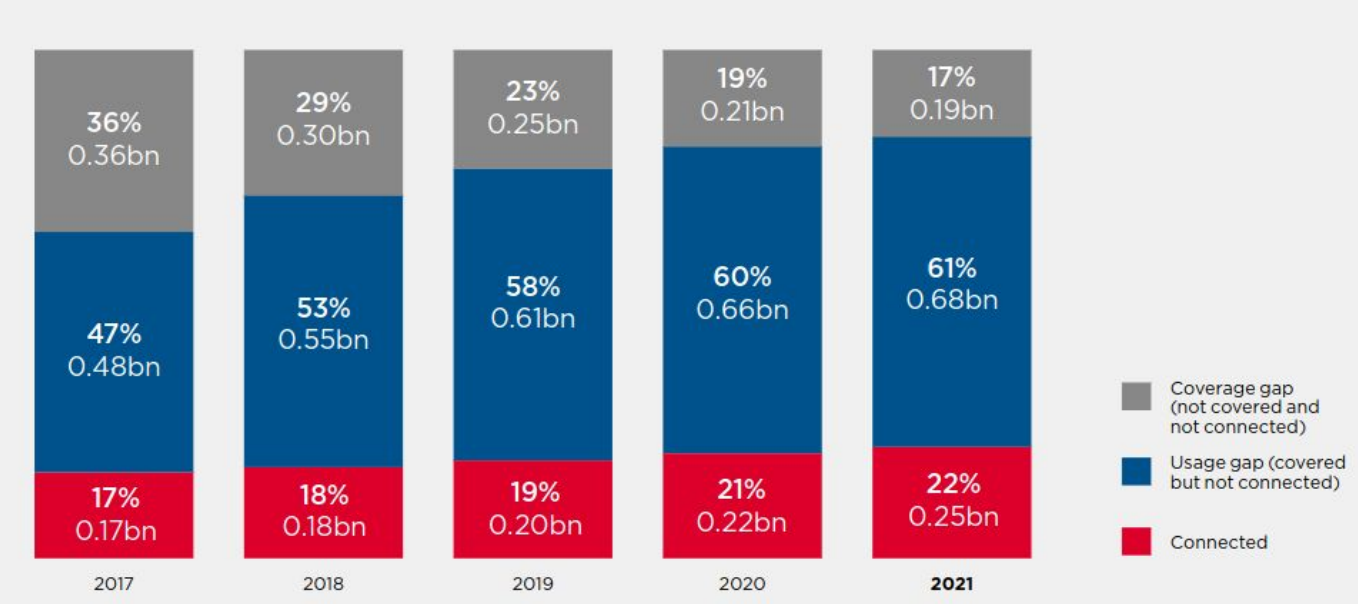
Since 2017, actively supporting community network development in 16 countries from the Global South. Currently supporting 30 organizations.

Policy training (CRASA, EACO, WATRA, African Union Commission) and research.

Participation in policy processes: Global (IGF, UN, ITU's WTDC, GSR, CWG-Internet and SG Qs), Regional (AU's  STC –CICT-3), National (Public Consultations and Technical Assistance).

# Growth and gaps in mobile users

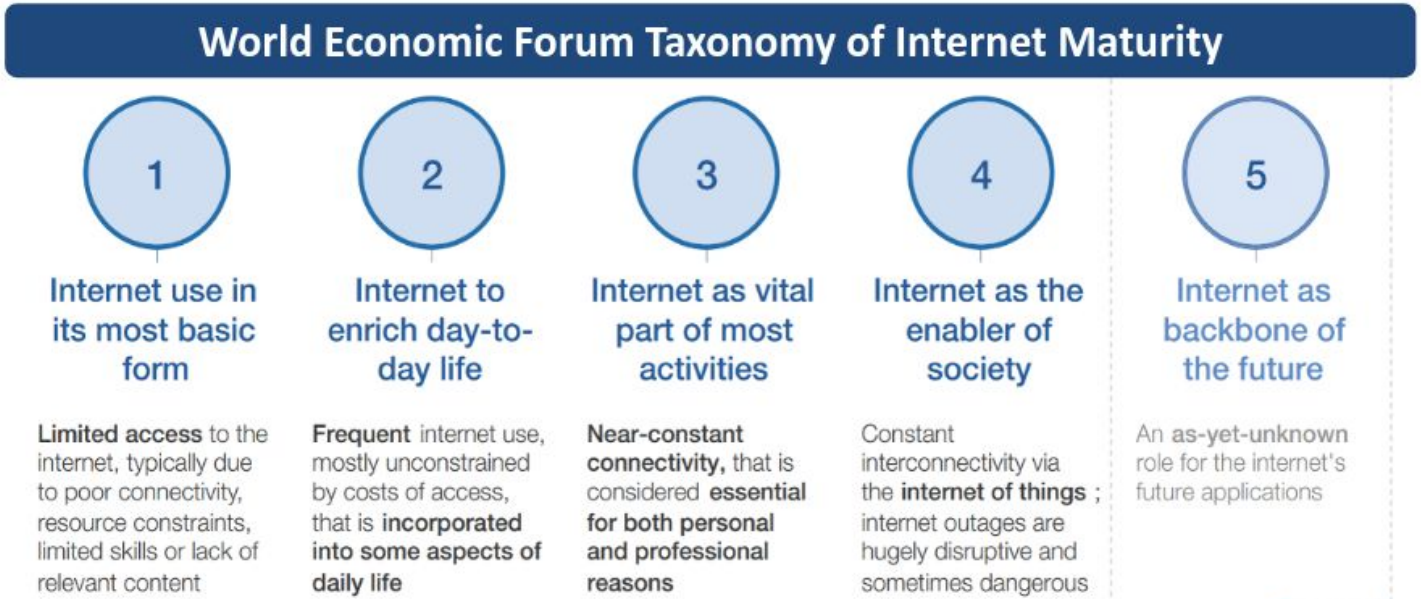
## Mobile connectivity in Sub Saharan Africa




GSMA's The State of Mobile Internet Connectivity 2022: Sub Saharan Africa Key Trends - https://www.gsma.com/r/wp-content/uploads/2022/10/State-of-Mobile-Internet-Connectivity-2022-Sub-Saharan-Africa.pdf

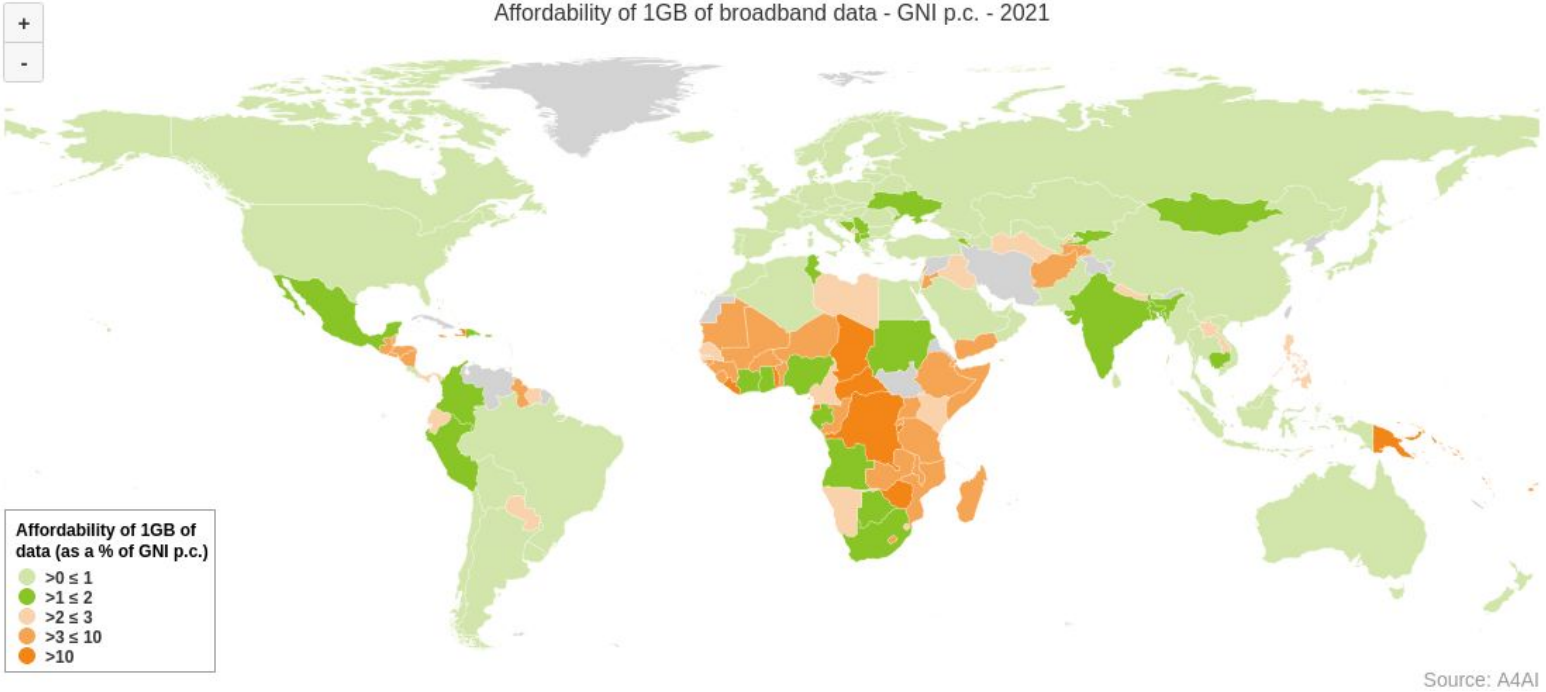
# Most of the "connected" are Level 1

## Mobile connectivity in East Asia & Pacific

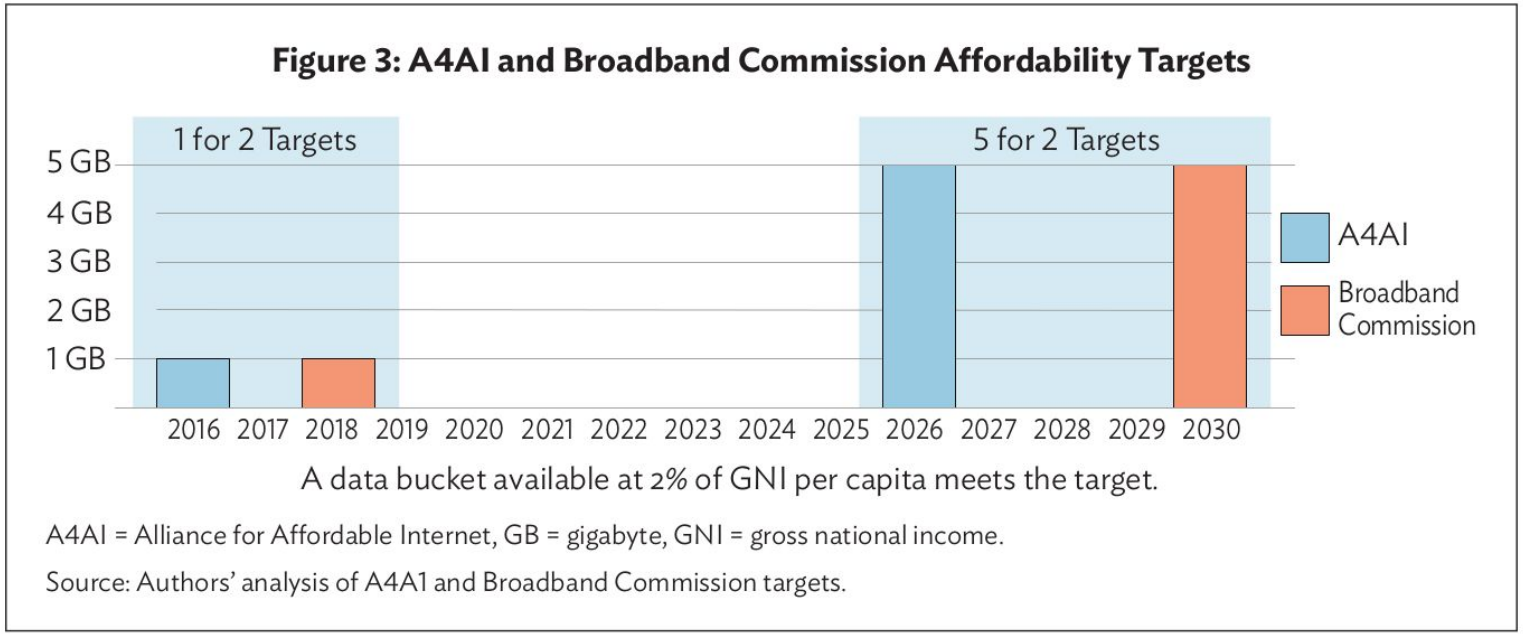



World Economic Forum - Financing a Forward Looking Internet for All (2018):
https://www3.weforum.org/docs/WP_Financing_Forward-Looking_Internet_for_All_report_2018.pdf

# Mobile Broadband Affordability: 1GB below 2% monthly income

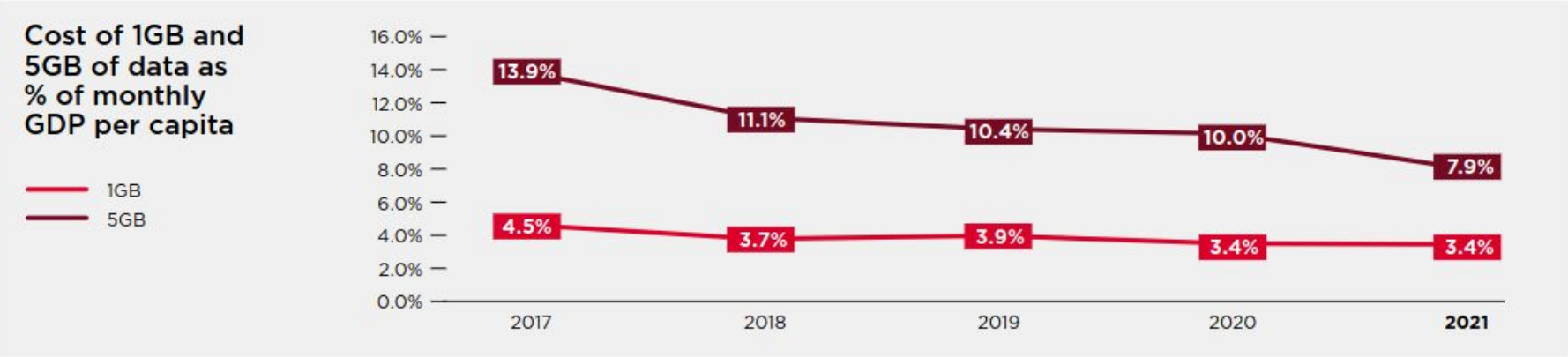


# Mobile Broadband Affordability: From 1GB to 5GB below 2% monthly income




Source https://www.adb.org/sites/default/files/publication/847626/sdwp-083-last-mile-connectivity-affordability-frontier.pdf

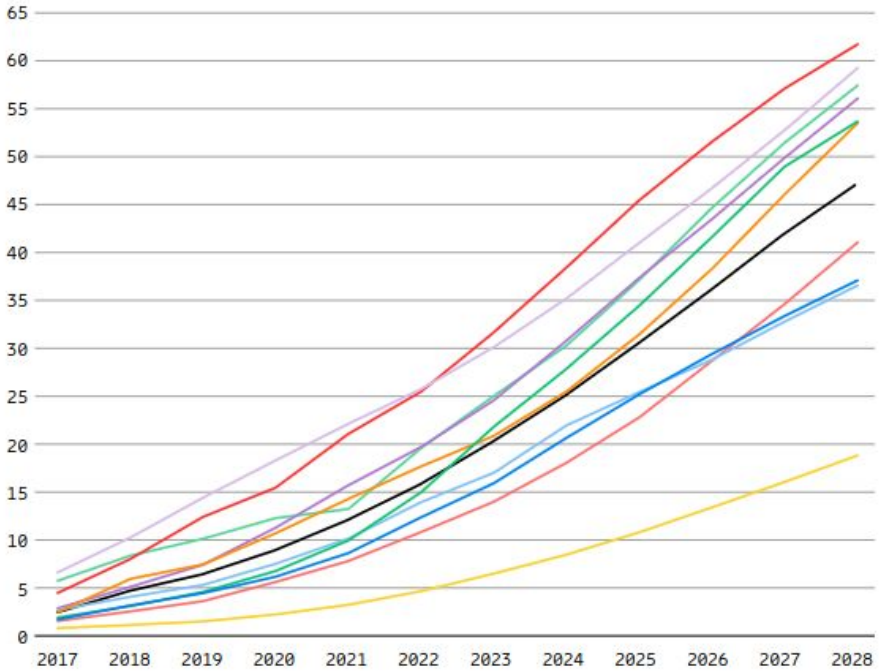
# Mobile Broadband Affordability: 1GB and 5GB below 2% monthly income




GSMA's The State of Mobile Internet Connectivity 2022: Sub Saharan Africa Key Trends - https://www.gsma.com/r/wp-content/uploads/2022/10/State-of-Mobile-Internet-Connectivity-2022-Sub-Saharan-Africa.pdf

# Mobile broadband Actual and Projected Usage

**Figure 20: Mobile data traffic per smartphone (GB per month)**




| Regions | 2022 | 2028 | CAGR 2022–2028 |
|---|---|---|---|
| India, Nepal, Bhutan | 26 | 62 | 16% |
| GCC | 26 | 59 | 15% |
| North America | 20 | 58 | 20% |
| Western Europe | 20 | 56 | 19% |
| North East Asia | 18 | 54 | 20% |
| South East Asia and Oceania | 15 | 54 | 24% |
| Global average | 16 | 47 | 20% |
| Latin America | 11 | 41 | 25% |
| Middle East and North Africa[1] | 12 | 37 | 20% |
| Central and Eastern Europe | 14 | 37 | 18% |
| Sub-Saharan Africa | 4.7 | 19 | 26% |

Source https://www.ericsson.com/49dd9d/assets/local/reports-papers/mobility-report/documents/2023/ericsson-mobility-report-june-2023.pdf

# Why Growth is Slowing

## We've Connected the Easy Half

| Billions of People on Earth | Average Annual Income | Affordable Monthly Communication Spend |
|---|---|---|
| 1st Billion | $29,206 | $205 |
| 2nd Billion | $12,702 | $53 |
| 3rd Billion | $5,540 | $23 |
| 4th Billion | $2,987 | $12 |
| 5th Billion | $1,771 | $7 |
| 6th Billion | $1,065 | $4.4 |
| 7th Billion | $540 | $2.25 |

Source: Richard Thanki, University of Southhampton from UN & ITU data

# State of Connectivity


**COVID-19 pandemic illuminated a long-standing issue: The many low-income communities around the world that lack reliable and / or affordable access to connectivity are being left further behind.**

# Elements of a conducive environment


"Connecting the first 53% wasn't so hard. Connecting the remaining 47% is a different ball-game, and 'business as usual' will not work."

- Ms. Doreen Bogdan-Martin
  ITU Secretary General

# ITU WTDC 2022 Report

RESOLUTION 37 (Rev. Kigali, 2022)

**Bridging the digital divide**

The World Telecommunication Development Conference (Kigali, 2022),

15 to encourage innovation and accelerate the use and adoption of emerging digital technologies and the development of business models or other innovative ways to help telecommunication operators, as well as telecommunications/ICTs complementary access networks and solutions in reducing costs, overcoming geographic obstacles that leads to acceleration of digital inclusion to bridge the digital divide;

17 to continue supporting Member States, in the case where it is requested, in developing policy and regulatory frameworks that could expand and support the engagement of telecommunications/ICTs complementary access networks and solutions in bridging the digital divide;

*invites Member States*

5 to consider inclusive and innovative policies to close the digital divide, taking into account national initiatives and telecommunications/ICTs complementary access networks and solutions,

# ITU Plenipotentiary 2022 Report

RESOLUTION 139 (REV. BUCHAREST, 2022)

**Use of telecommunications/information and communication technologies to bridge the digital divide and build an inclusive information society**

The Plenipotentiary Conference of the International Telecommunication Union (Bucharest, 2022),

*instructs the Director of the Telecommunication Development Bureau, in coordination with the Directors of the other Bureaux, within their respective mandates*

7 to support sharing national experiences and information, such as case studies, and support enabling environments for the use of affordable technologies for bridging the digital divide, such as current and emerging telecommunication/ICT infrastructure, including telecommunication/ICT complementary access networks and solutions;

*invites Member States*

4 to consider facilitating an environment for sharing national experiences for bridging the digital divide, as appropriate, using affordable technologies, such as current and emerging telecommunication/ICT infrastructure, including telecommunication/ICT complementary access networks and solutions, according to national regulations;

# What are community networks?

# Definition


13
TIC
14
Colnodo
Coolab
15
11
Instituto Bem Estar Brasil
12
AlterMundi
CITAD
5
BOSCO Uganda
1
2
La Difference
6
Tunapanda
4
CYD
3
Zenzeleni
BAIF
7
9
Servelots
Asorcom
8
Common Room
10

# Community Connectivity Provider

What makes a Community Connectivity Provider (CCP)?

## COMMUNITY

- **'Community'**
  - People-built around a common interest or goal
- **Participation**
  - Build, maintain, operate or simply benefit from the infrastructure
- **Local Ownership & Governance**
  - Locally owned as a common-pool resource

## CONNECTIVITY

- **Nodes**
  (points of redistribution or delivery)
  - Routers
  - Clients & Servers
- **Backhaul**
  (interconnection within & between network)
  - Links (Wireless or Fiber) & Backbone
  - Gateway to the Internet

**Community connectivity providers refer to a wide variety of efforts by local communities to build and manage all or parts of the infrastructure required to enjoy and co-create the internet.**

# The Role of CCPs

CCPs come in a variety of different sizes, setups, purposes, governance models and levels of professionalism

## 1. Purpose

- Gain access
- Improve affordability
- Local ownership
- Greater openness
- Autonomy & self-determination

## 2. Governance

- Non-profits
- Community networks
- Cooperatives
- Small businesses
- Projects & partnerships
- NGOs
- Network operators
- Academia

## 3. Infrastructure & Services

- Voice / SMS only
- Mobile Data
- Fixed Wireless (Licensed or Unlicensed)
- Fiber
- Local Content
- Skill Development

## 4. Size

- Geographic coverage
- Users: 50 to 500,000
- Backhaul (upstream):
- 100 Mbps - 10 Gbps

# The Role of CCPs

Defining features & characteristics: CCP vs Traditional Operators

## COMMUNITY CONNECTIVITY PROVIDER

- Socially focused & purpose-driven
- Community-led
- Open and carrier-neutral networks
- Decentralised nature
- Localised - locally owned or operated
- Not for profit / cost-recovery model
- Grassroots / bottom-up
- Collective ownership
- Self-deterministic

**VS.**

## TRADITIONAL OPERATOR

- Profit-driven
- Commercially-minded
- Centralized infrastructure
- Privately or state-owned
- Profit-extraction
- Professional and top-down
- Knowledge concentration / specialization
- Investment from traditional sources
- No / minimal user participation in network governance (design, deployment, operation)

# Three broad categories of community connectivity providers

## Community Connectivity Providers (CCPs)

***Main Objective:***

Deliver affordable broadband connectivity to underserved urban, rural, and remote communities

***Key Criteria:***

- Local ownership structure (reinvestment criteria)
- Accountability to the social mission (measurement)

*Community-owned*

### Community Networks (CNs)

CNs are owned by the local community of users and any returns are reinvested into the community or returned to members

*Publicly-owned*

### Municipal Networks

Municipal networks are owned by the government within defined jurisdictions and any returns are used to service financial obligations or returned to government

*Privately-owned*

### Social Enterprises

Social enterprises are double bottom line businesses that seek both financial and social returns, and any returns are reinvested for growth or returned to shareholders

# The Role of CCPs

Community connectivity providers are often complementary - filling gaps and providing access where traditional commercial networks do not

**The large-scale, commercial, telco network model has done wonders for coverage but, on its own, is insufficient to connect everyone affordably.**

- **Traditional solutions are showing signs of having reached their limits**: Mobile network operators, who have been efficient in high-income & urban areas, are struggling to find viability in markets with subsistence-level incomes and/or in sparsely populated regions, where ROI is scarce.

- **Varied attempts to address this problem**, through universal service strategies/ funds, private sector initiatives or philanthropy, **have met with limited success**.

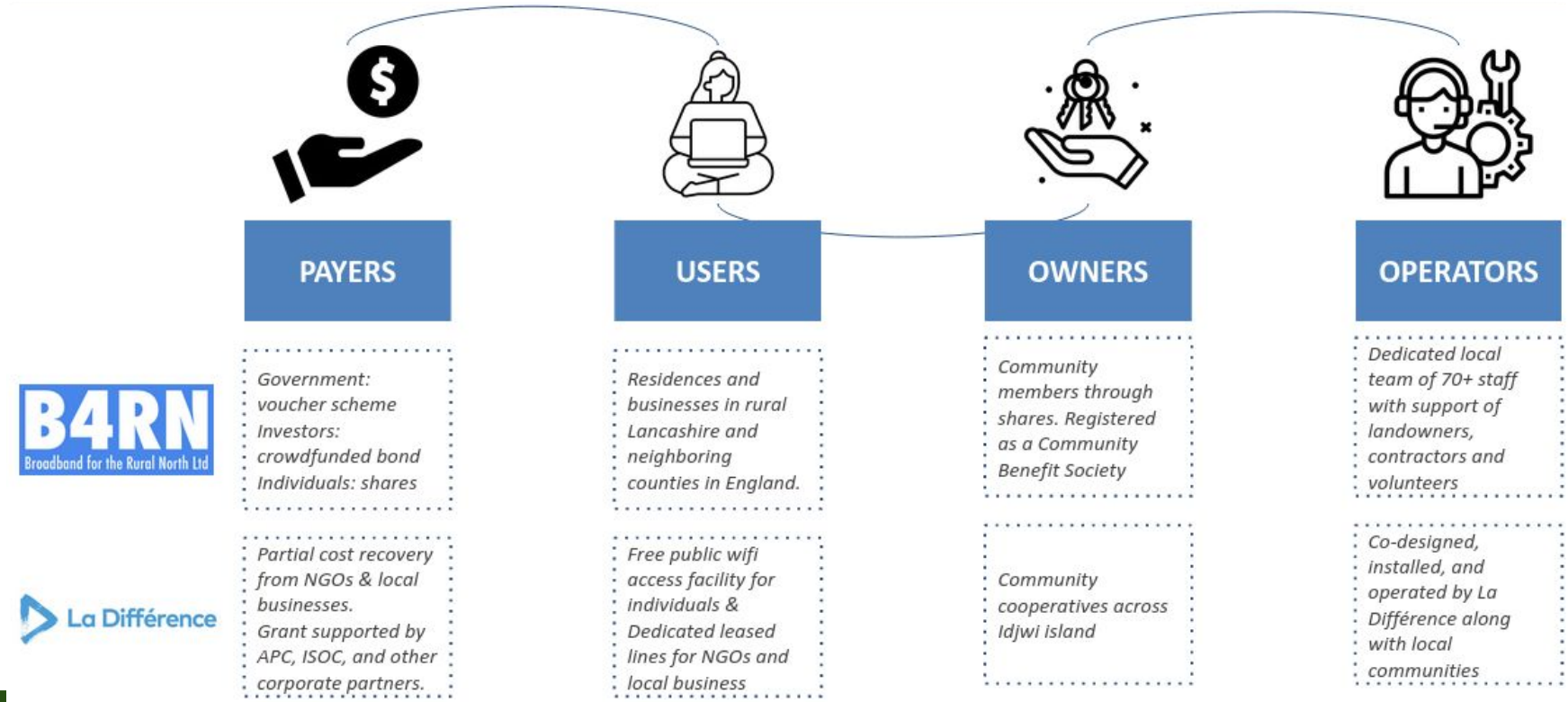
**CCPs are feasible alternative solutions in environments where traditional networks fail or are reluctant to operate.**

- **CCPs can move towards closing connectivity gaps:** They often service unconnected areas that are not profitable for commercial operators or precede other forms of internet development.
- **CCPs also bring connectivity to those otherwise excluded:** Either because of geography, topography, size, or income level, and enable local development, lead to local business development, and encourage civic participation.
- **CCPs help keep profits local**: Generally reinvest any proceeds in the local community and its network.

# Different networks at different stages

| | Stage 1: Starting | Stage 2: Sustaining | Stage 3: Growing | Stage 4: Maturing |
|---|---|---|---|---|
| **Key Goal** | **Operational**<br>● Plan and get equipment<br>● Find initial customers<br>**Financial**<br>● Seek seed funding - grants or support to help maintain the network | **Operational**<br>● Understand economics to reach sustainability<br>**Financial**<br>● Getting to operating break-even (EBITDA) | **Operational**<br>● Grow into new regions<br>**Financial**<br>● Getting to total cost & financial break-even (EBIT) | **Operational**<br>● Scheduled CapEx upgrades<br>**Financial**<br>● Moving beyond break-even to reinvesting |
| **Core Activities** | ● Identified local community network champions "Digital Stewards" to manage network<br>● Identified need and coverage network area<br>● Established community partners that will develop, plan, and maintain the network<br>● Procured resources (fiber, active and passive infrastructure)<br>● Installation in key locations in a community (anchor institutions) | Network<br>● Increase node or fiber deployed<br>Customers<br>● Generate enough revenue to sustain the initiative; grow customer base<br>Finance<br>● Explore business monetization models<br>● Cost saving or cost recovery strategies | Identify adjacent areas to provide service coverage<br>● Assess needs<br>● Skill sharing related to maintenance and sustainability of community network implementation<br><br>Explore more granular cost savings<br>● Local content cache | ● Adding network in new locations<br>● SLOs around network performance |
| **Examples** | ● Mamaila, South Africa<br>● Chak 26 S/P, Pakistan<br>● Murambinda Works, Zimbabwe<br>● Tusheti Community Network, Georgia<br>● Suusamyr, Kyrgyzstan | | | |

# Diversity in Financial Models



# Benefits of Community Networks

*"In Africa, a community network is not simply telecommunications infrastructure deployed and operated by citizens to meet their own communication needs; it is a tool to improve what a community is already doing in terms of their growth and development, by contributing to a local ecosystem that enhances the daily lives of those staying in the community."*

- More local control over how the network is used and the content that is provided over the network.
- Greater potential for attention to the needs of marginalised people and the specific populations of rural communities, including women and older people.
- Lower costs and retention of more funds within the community.
- Increased potential to foster a sense of agency and empowerment among users and those involved in the network



Source: Understanding Community Networks in Africa
https://www.internetsociety.org/resources/doc/2017/supporting-the-creation-and-scalability-of-affordable-access-solutions-understanding-community-networks-in-africa/

# Diversity in the service provided

- Support local businesses to reach a wider customer base by providing platforms for marketing, e-commerce that products or services contributing to economic growth and entrepreneurship in the community.
- Empower community members to effectively and take advantage of the opportunities offered by the internet through offering digital skills training programs
- Encourage digital adoption by tailoring content and applications to cater to the unique needs and interests of the community. This involves developing local news platforms, educational resources, health information, agricultural tips, and cultural content that resonate with the community members.


Photo Credit: Mamaila CN

# Diversity in the service provided

- Offer financial literacy programs and resources to educate community members about digital financial services
- Facilitating access to government services and information through digital platforms
- Promoting environmental awareness and sustainability through eco-friendly practices, conservation initiatives, renewable energy solutions, and recycling programs
- Using digital platforms to preserve and promote local culture, traditions, and heritage such as showcasing local arts, music, traditional knowledge, storytelling, and cultural events hence fostering a sense of identity within the community

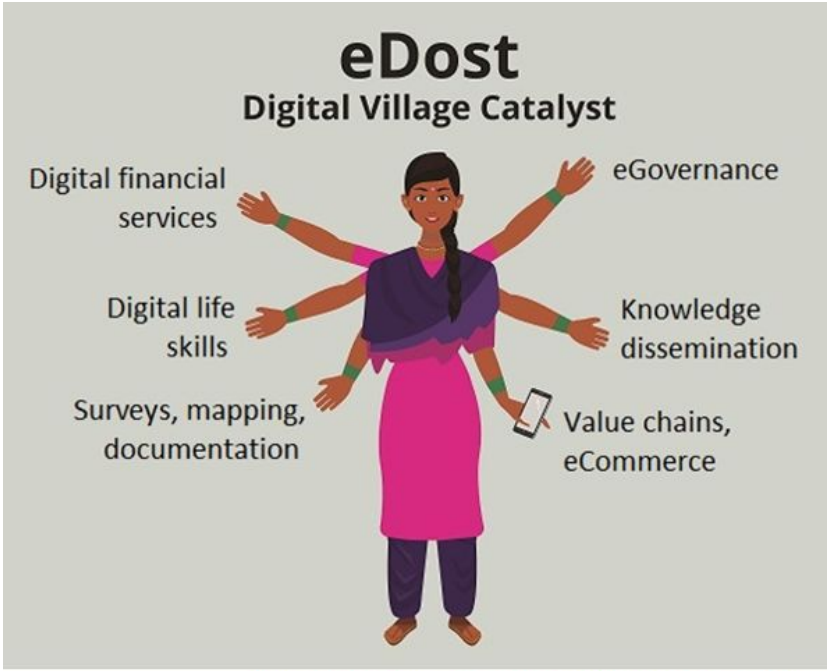



*Figure 1: A schematic depicting the roles of an eDost*

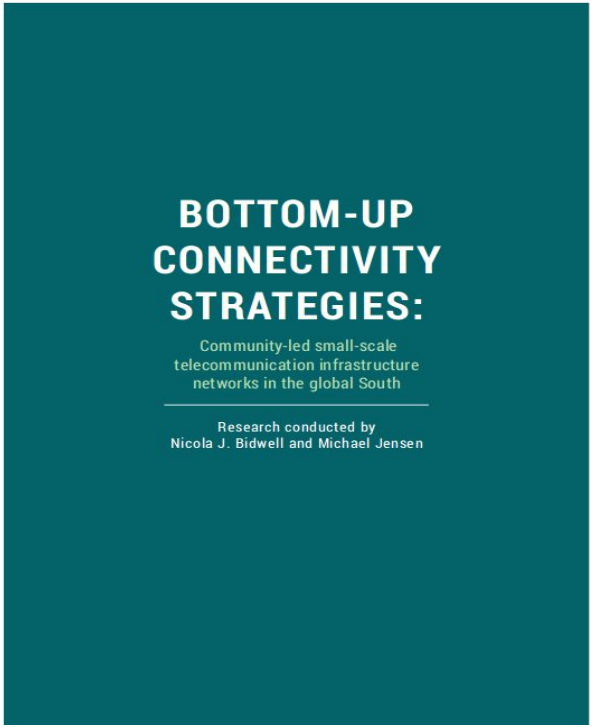
# CN Resources and Benefits


Local control over how the network is used and the content that is provided over the network.

Attention to the needs of marginalised people, including women and older people.

Lower costs and retention of more funds within the community (contribution to sustainable livelihoods)

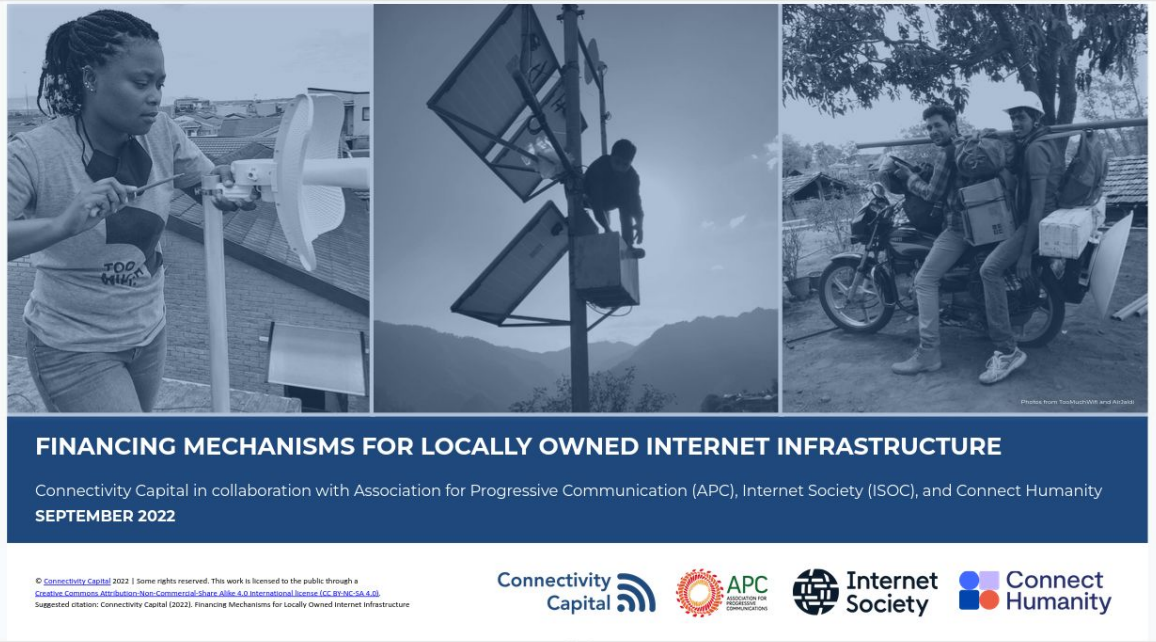
Foster a sense of agency and empowerment




Source: https://giswatch.org/community-networks

Source: https://www.apc.org/connectivitystrategies

# CN Resources and Benefits




- The state of global internet access and how community connectivity providers (CCPs) can expand broadband access
- The economics and the unique challenges of operating CCPs
- Options for ownership and operating models, with case studies of successful networks
- Finance mechanisms to sustainably fund community connectivity providers
- Recommendations for policymakers, funders, and network builders to support the ecosystem

Financing mechanisms for locally-owned internet infrastructure; https://connecthumanity.fund/report-financing-ccps/

# Technological Change

# Connectivity in Emerging Markets

The market is primed for a new fourth wave of internet infrastructure delivered by non-incumbent community connectivity providers

## Major waves of investment in connectivity infrastructure

### 1 Mobile Networks *(1990s – present)*

- Remains the largest with continuous investment by operators every year
- 4G and 5G expansion will drive further required investment

### 2 Submarine cables *(2009 - present)*

- Investment continues and is quite similar in scale to mobile network investment *(2Africa, Equiano)*

### 3 Data Centers & National Backbone *(2013 - present)*

- Pan-continental transactions and investment commitments of $2B in 2021 *(Equinix-MainOne, WIOCC-Open Access Data centers, Digital Realty, Liquid-Africa Data centers etc.)*

### 4 Uncapped Fixed Broadband

Delivered by community connectivity providers

- **Uncapped connectivity is a prerequisite to a full potential, digital economy**
- Landed fiber capacity needs to be distributed to homes, SMEs, and businesses via fiber and high-capacity fixed wireless links

Source: Connectivity Capital Analysis

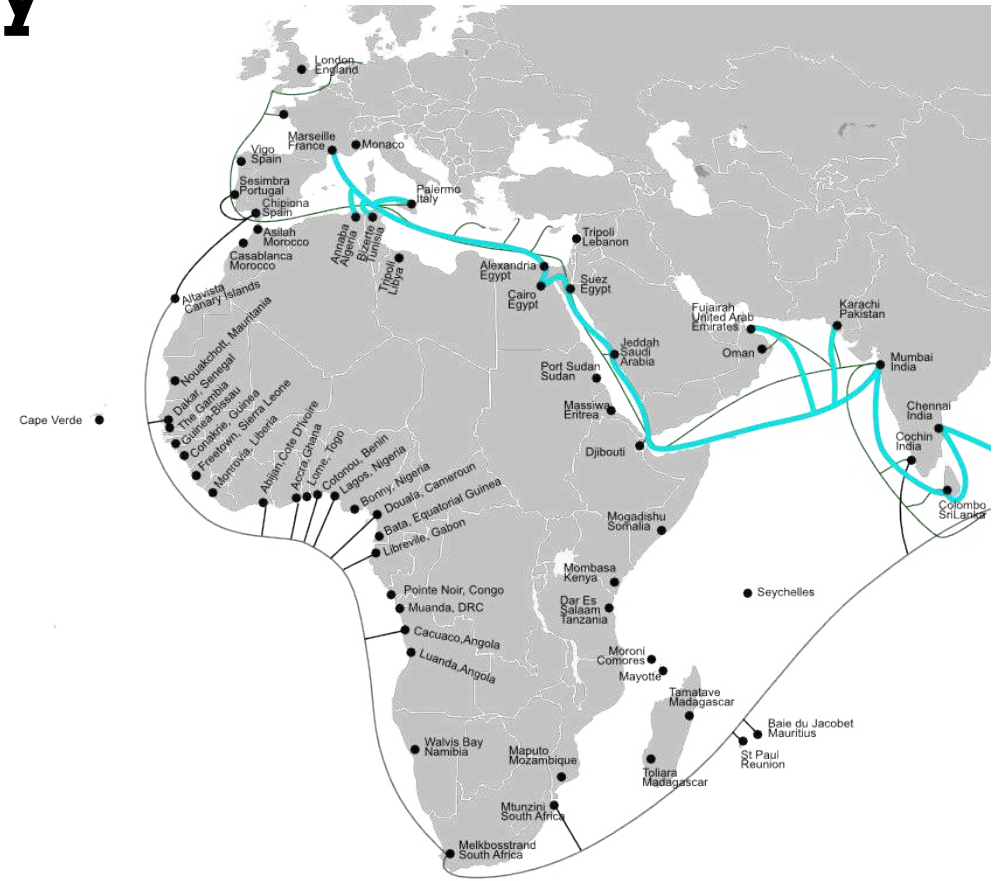
# Satellite Dependency

as recently as early

2009

total African undersea cable design capacity was less than

2Tbps



# Fibre Optic Connectivity

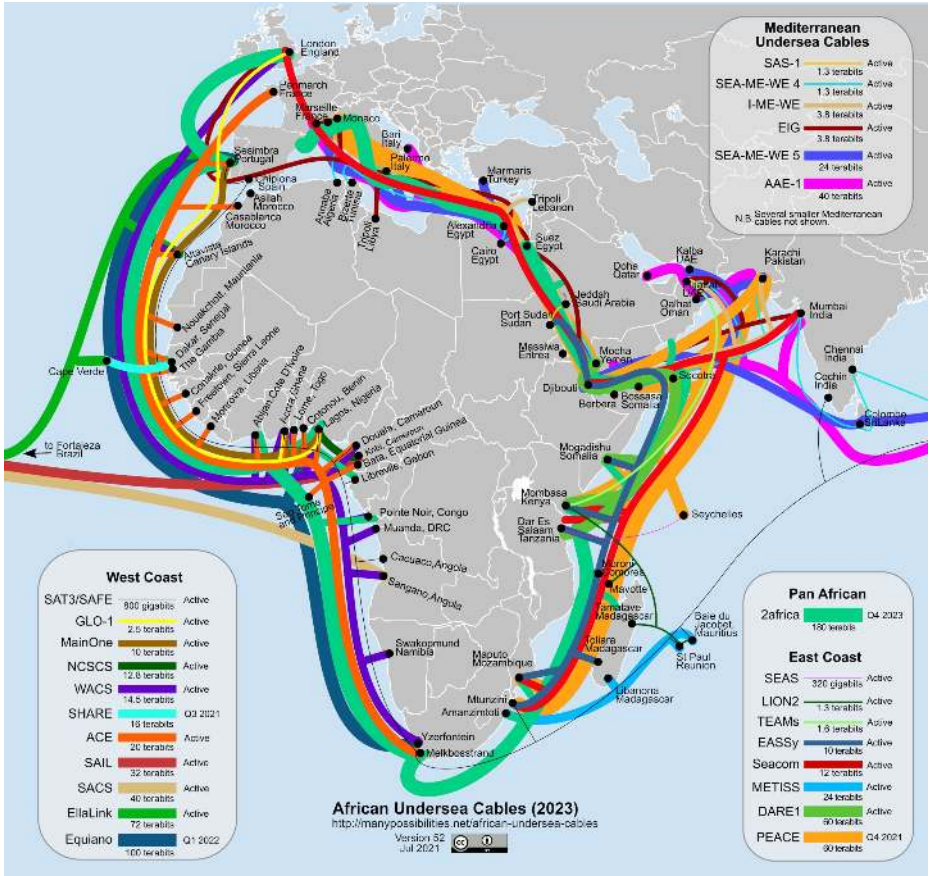
by

2024

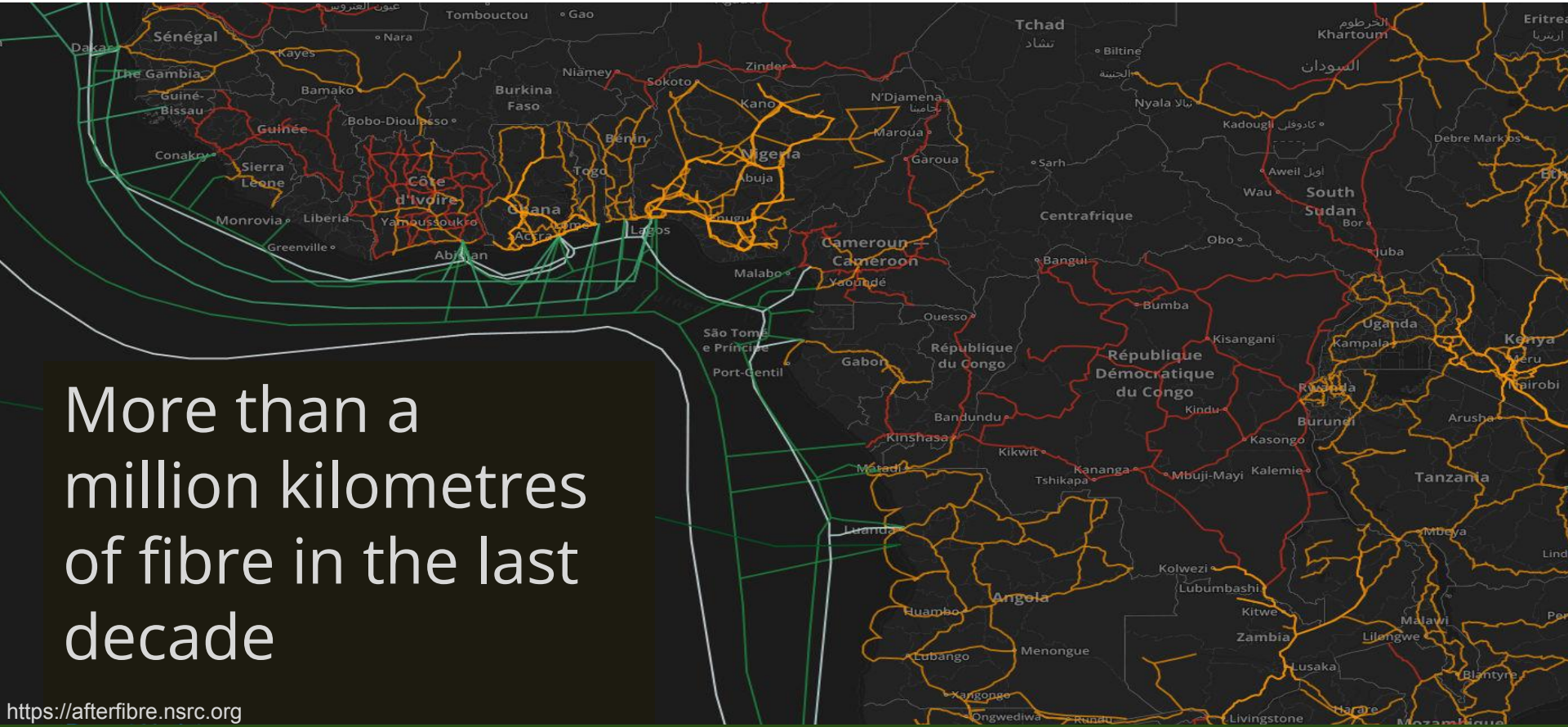
the expected total design capacity of undersea cables will be greater than

814 Tbps

an increase of over 400 times.



# Growth of Terrestrial Fibre

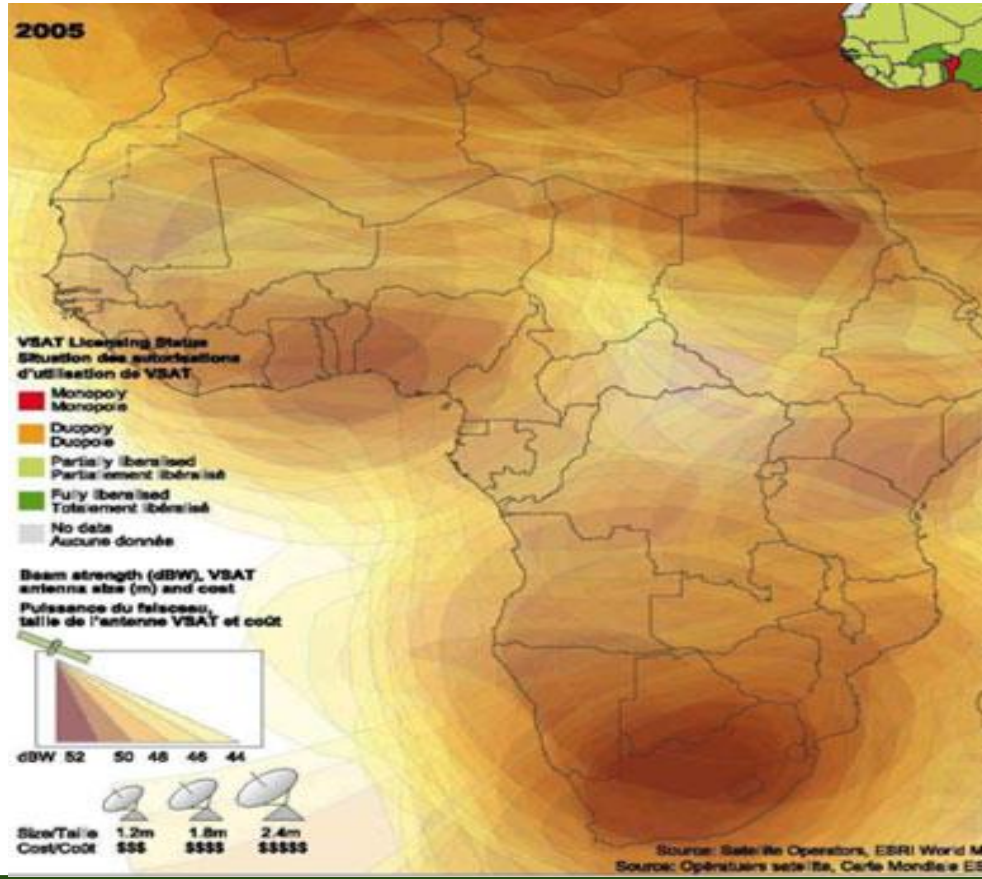



More than a million kilometres of fibre in the last decade

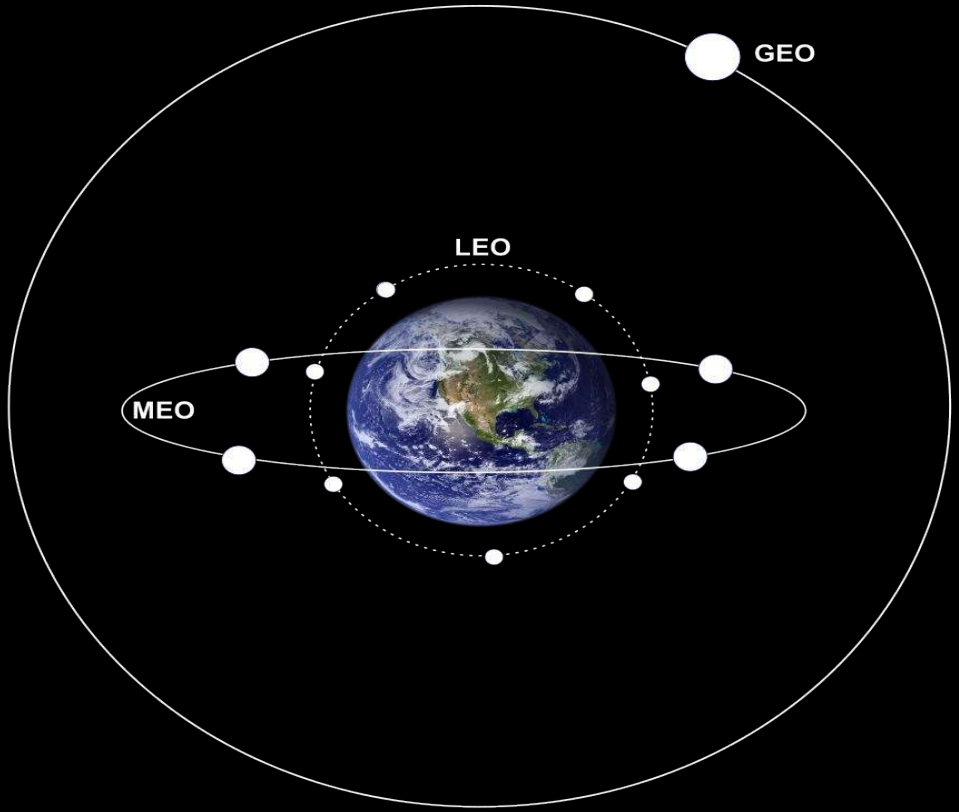
https://afterfibre.nsrc.org

# 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

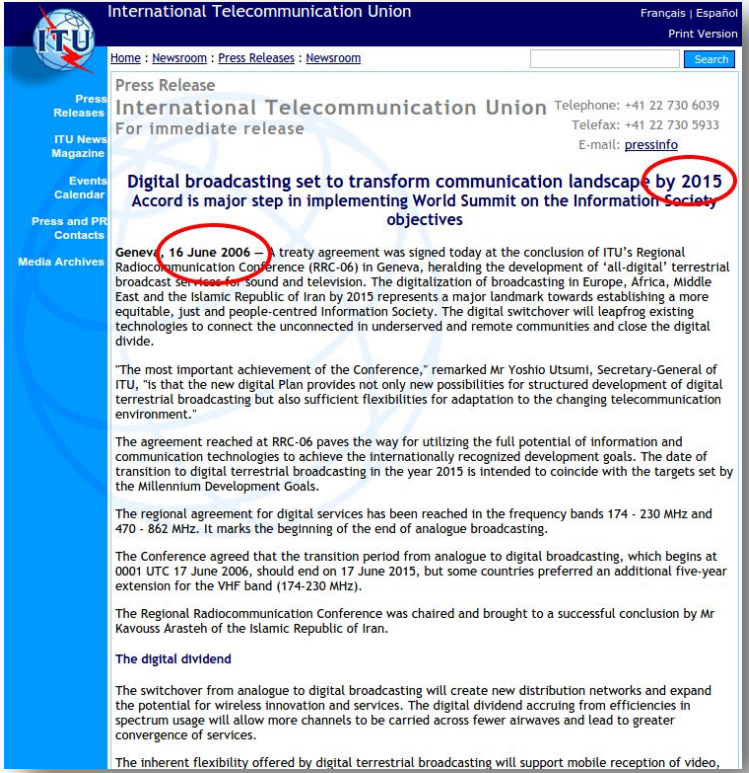



Geo-stationary (GEO)

Middle Earth Orbit (MEO)

Low Earth Orbit (LEO)

# Regulatory Change vs Tech Change



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**Digital broadcasting set to transform communication landscape by 2015**

**Accord is major step in implementing World Summit on the Information Society objectives**

**Geneva, 16 June 2006** – A treaty agreement was signed today at the conclusion of ITU's Regional Radiocommunication Conference (RRC-06) in Geneva, heralding the development of 'all-digital' terrestrial broadcast services for sound and television. The digitalization of broadcasting in Europe, Africa, Middle East and the Islamic Republic of Iran by 2015 represents a major landmark towards establishing a more equitable, just and people-centred Information Society. The digital switchover will leapfrog existing technologies to connect the unconnected in underserved and remote communities and close the digital divide.

"The most important achievement of the Conference," remarked Mr Yoshio Utsumi, Secretary-General of ITU, "is that the new digital Plan provides not only new possibilities for structured development of digital terrestrial broadcasting but also sufficient flexibilities for adaptation to the changing telecommunication environment."

The agreement reached at RRC-06 paves the way for utilizing the full potential of information and communication technologies to achieve the internationally recognized development goals. The date of transition to digital terrestrial broadcasting in the year 2015 is intended to coincide with the targets set by the Millennium Development Goals.

The regional agreement for digital services has been reached in the frequency bands 174 - 230 MHz and 470 - 862 MHz. It marks the beginning of the end of analogue broadcasting.

The Conference agreed that the transition period from analogue to digital broadcasting, which begins at 0001 UTC 17 June 2006, should end on 17 June 2015, but some countries preferred an additional five-year extension for the VHF band (174-230 MHz).

The Regional Radiocommunication Conference was chaired and brought to a successful conclusion by Mr Kavouss Arasteh of the Islamic Republic of Iran.

**The digital dividend**

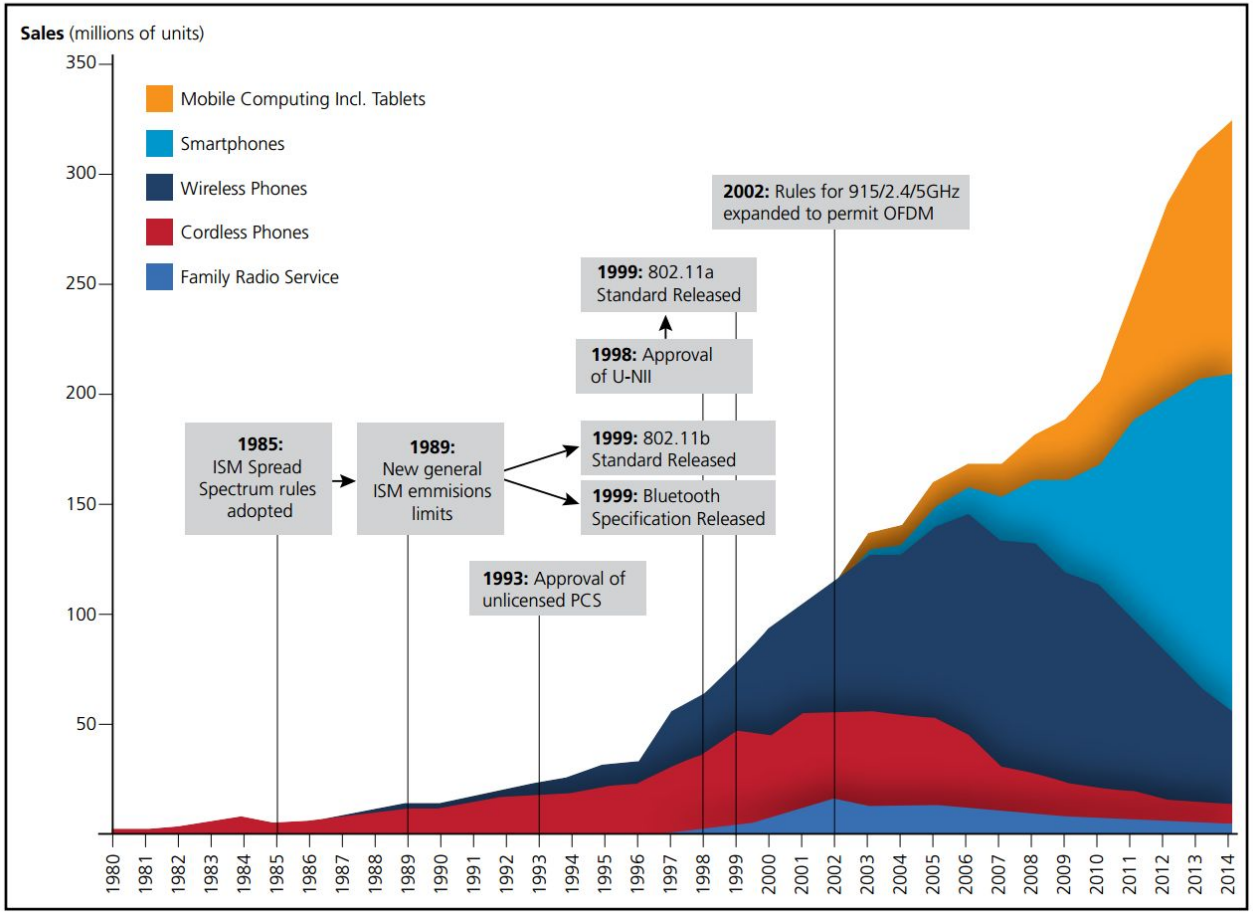
The switchover from analogue to digital broadcasting will create new distribution networks and expand the potential for wireless innovation and services. The digital dividend accruing from efficiencies in spectrum usage will allow more channels to be carried across fewer airwaves and lead to greater convergence of services.

The inherent flexibility offered by digital terrestrial broadcasting will support mobile reception of video,


NETFLIX
2007


# Growth of Unlicensed Spectrum

**Figure 1: Unlicensed Spectrum Milestones and Selected Device Categories – Growth Over Time**



# Unlicensed Spectrum Growth

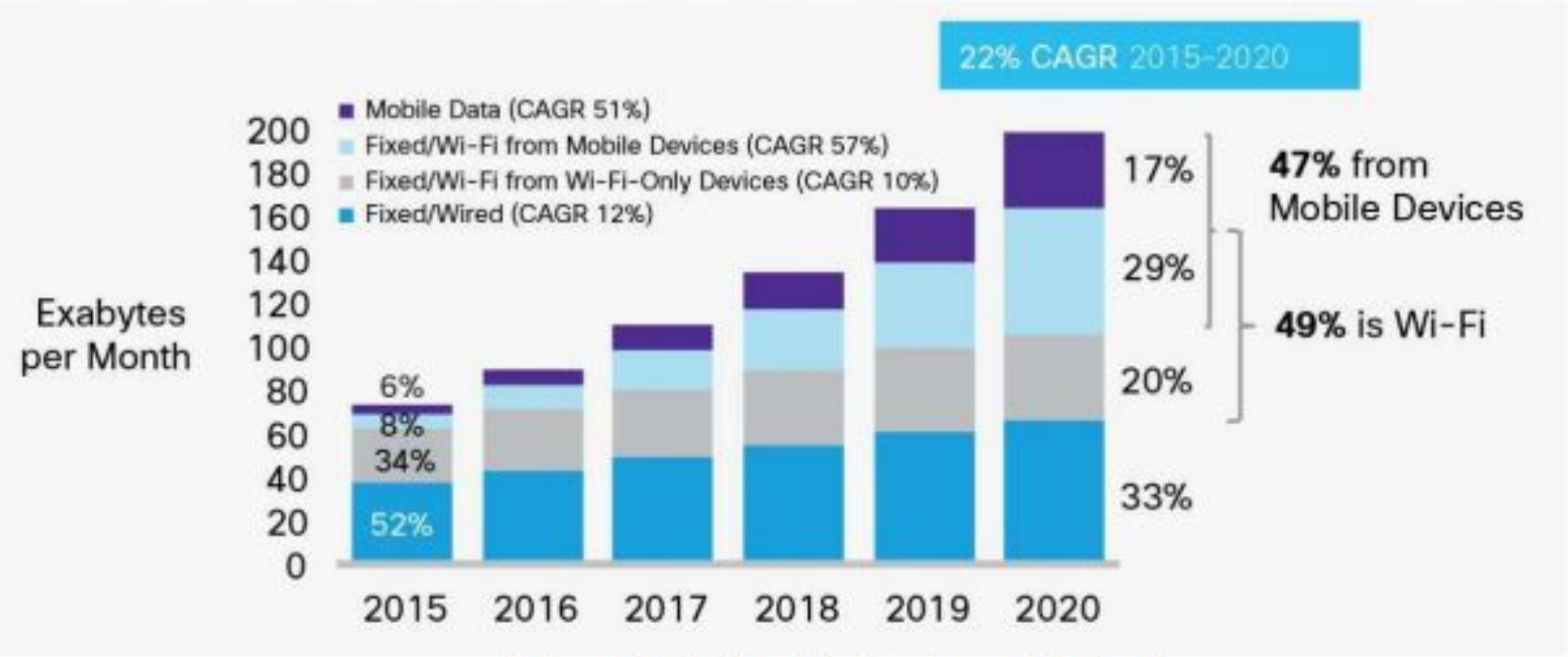
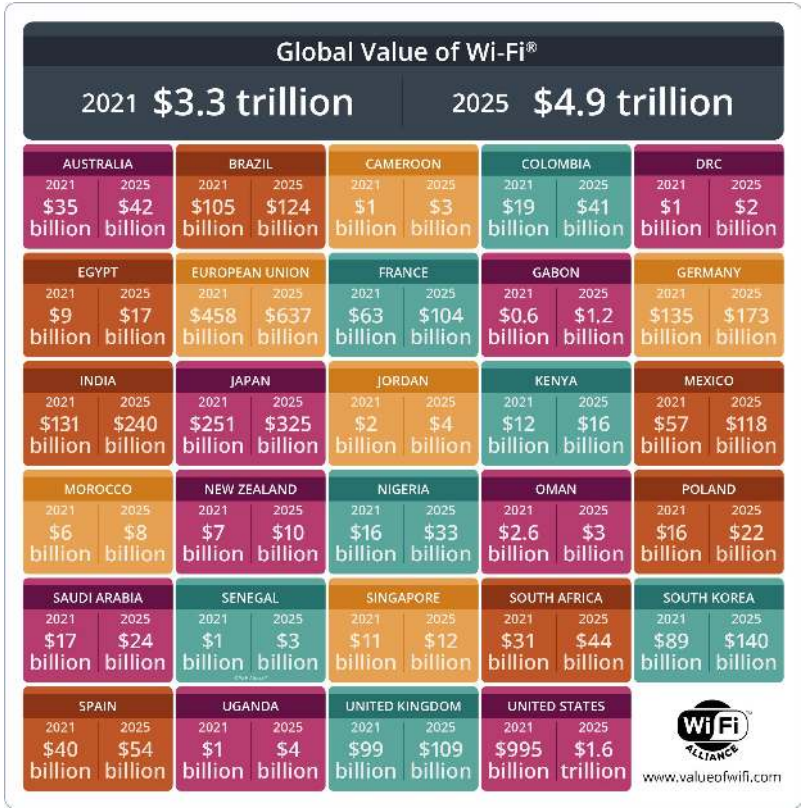



*Figure 1: IP Traffic By Access Technology*
*Cisco Visual Networking Index*

Source: CISCO Visual Networking Index - https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html

# The Economic Value of WiFi

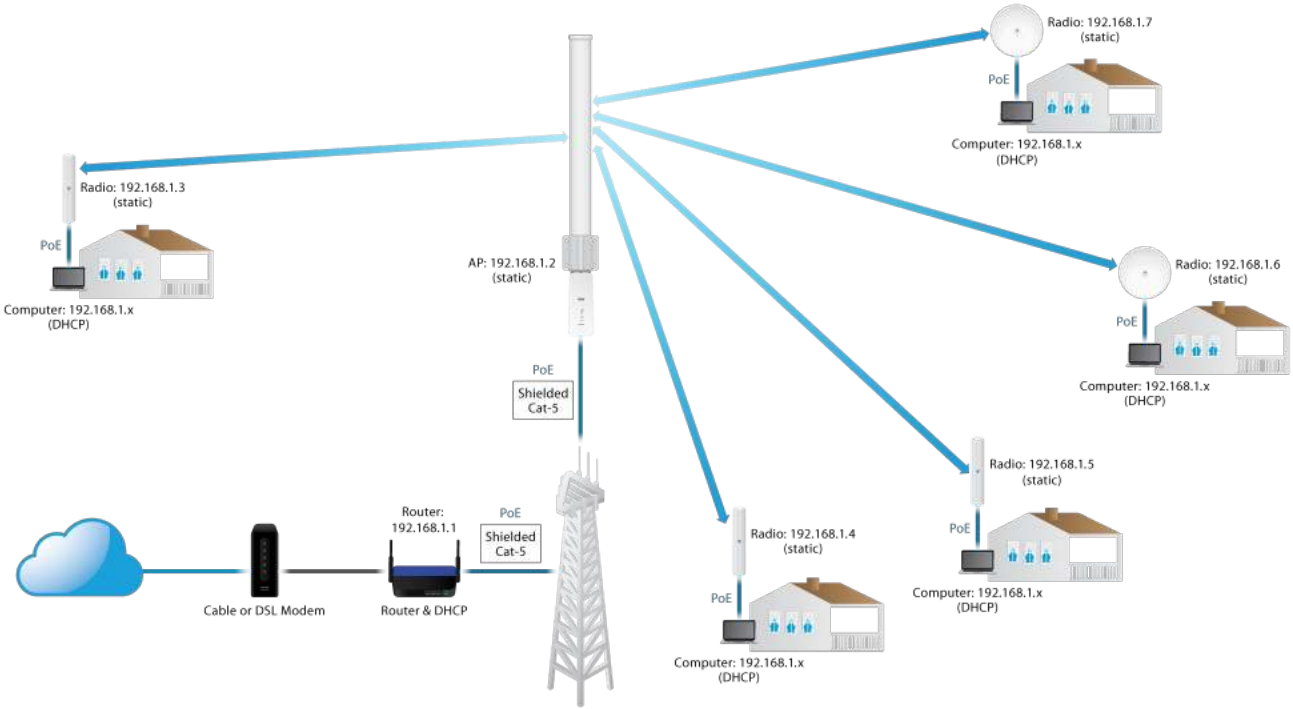
The license-exempt nature of WiFi combined with its extreme affordability has enabled its meteoric growth as both an access and a backhaul technology.



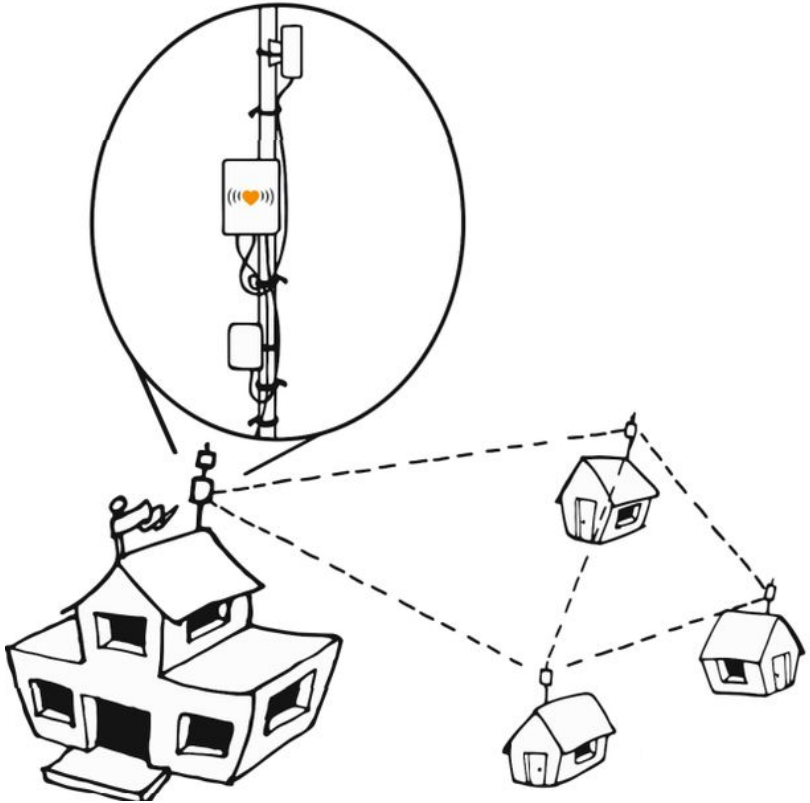

Source: https://www.wi-fi.org/news-events/newsroom/economic-value-of-wi-fi-forecast-in-africa-middle-east-and-india

# Fixed Wireless

WiFi has emerged as a powerful technology for both access and backhaul around the world.
Yet the way in which it is regulated varies from country to country.



# Mesh Networks



# Spectrum Sharing Technologies





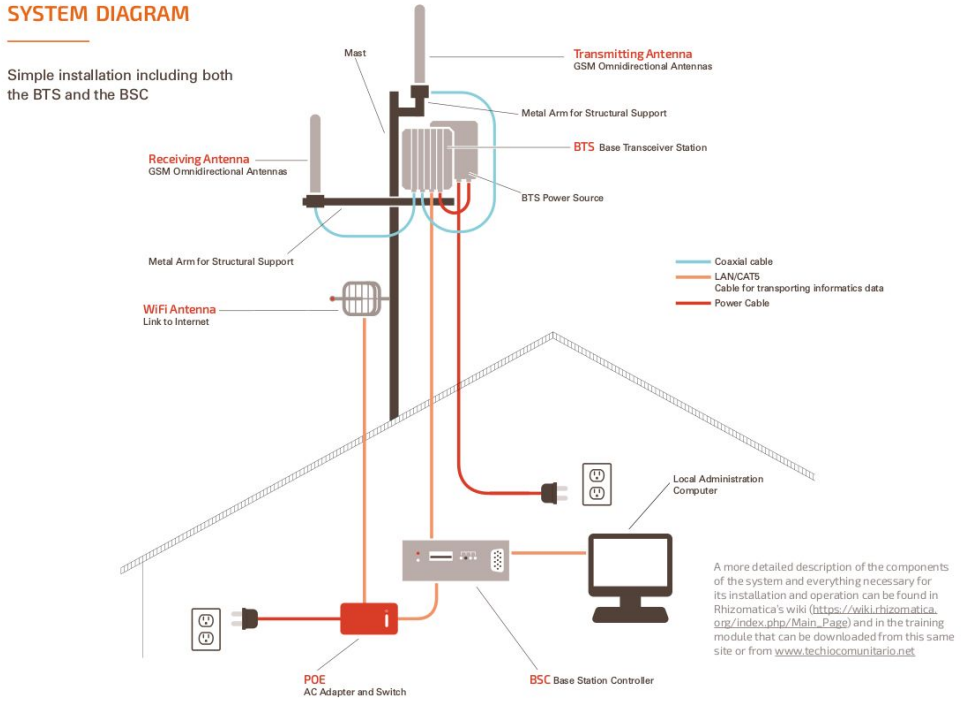




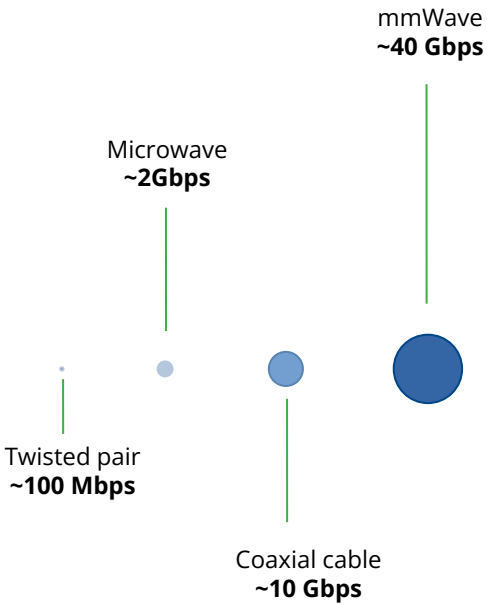


# Mobile Spectrum

- Low Power
- Low-cost GSM & LTE
- Simple Graphic Interface for Local Management
- VoIP for Call Termination
- Open Source platform reduces cost, increases flexibility
- Licensed spectrum for backhaul
- Satellite failover backhaul



# Fiber Optic




## Fibre Optic Infrastructure

## ~25 Tbps



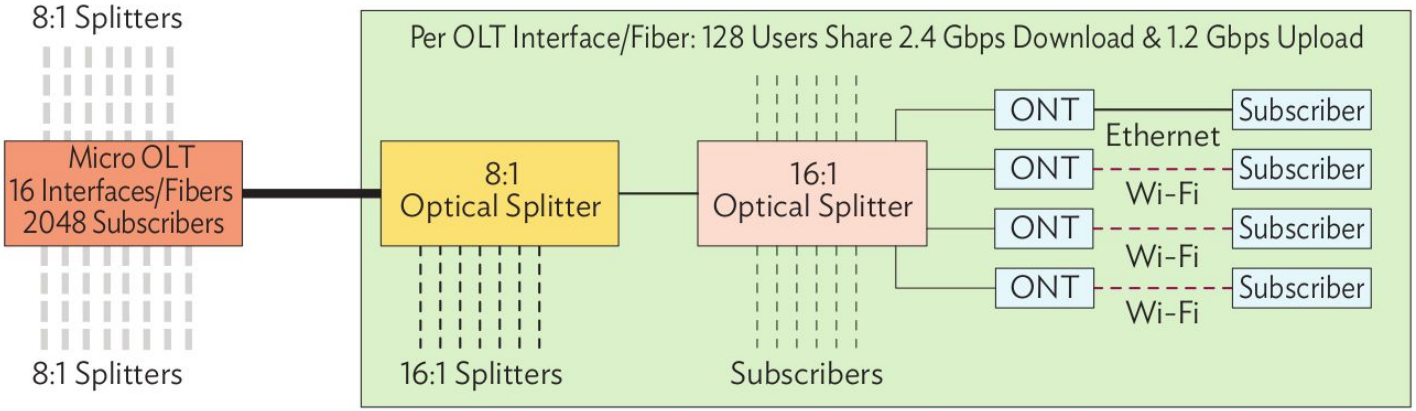
Source: https://engineering.fb.com/connectivity/aerial-fiber-deployment/

# 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.

# Gigabit Passive Optical Network (GPON)

**Figure 14: Gigabit Passive Optical Network System Topology**




OLT = optical line terminators, ONT = optical network terminators

Source: Adapted from Mirandilla-Santos, Mary Grace, Jonathan Brewer, and Jaie Faustino. *From Analog to Digital: Philippine Policy and Emerging Internet Technologies.* The Asia Foundation, October 2018.

Source https://www.adb.org/sites/default/files/publication/847626/sdwp-083-last-mile-connectivity-affordability-frontier.pdf

# Bamboo Towers

# Network Software

- Not only hardware, a lot of progress in affordable software:
  - Network Design
  - Monitoring
  - Provision
  - Voucher Management
  - Billing

# Connectivity in Emerging Markets

Confluence of positive developments over the last decade make this the right time to invest in community connectivity providers

**Trends accelerating growth of connectivity across emerging markets are driven by secular supply and demand factors**

Supply factors

## Landed international bandwidth

Several submarine cables arrived on the African continent from 2009 to 2012. New cables are expected to increase capacity further

Image: NBER, Jay Fitzgerald

## Falling capex

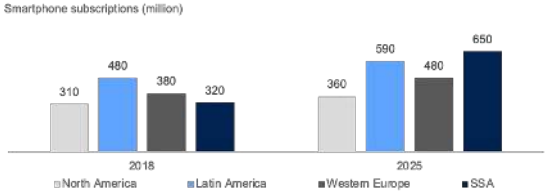
The price of fiber and high-capacity wireless equipment (radios, antennas, etc.) has fallen significantly. The total CapEx for network build out is decreasing. However, this is fairly offset by persistent high labor costs to implement new infrastructure


Source: Hjort, et. al. (2019), TeleGeography (2021), Ericsson Mobility Report

Demand factors

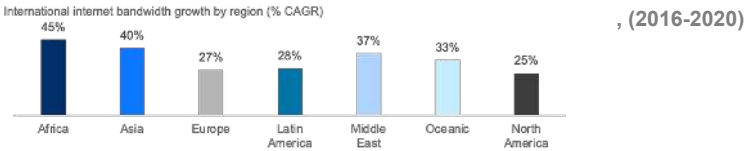
## Device penetration

The cost of smartphone devices has fallen significantly, dramatically increasing ownership and demand for more data




## Explosion of applications and content

New apps, including VoIP (voice over internet protocol), mobile money, and social media, provide considerable value to customers; driving demand for connectivity



# Barriers for growth for Community Networks

# Barriers for growth of community networks

- Licensing frameworks - Non existent frameworks for non profit operators in the current frameworks. Beyond this the financial, technical, and reporting requirements are also often beyond the reach and capacity of community network operators.
- Access to backhaul capacity remains the largest expense for community networks. The cost of minimum volume purchases for wholesale fiber backbones is costly and limits the communities' ability to obtain affordable backbone capacity.
- The available radio frequency spectrum for Wi-Fi is limited and shared with other wireless technologies. As the demand for wireless connectivity grows, there is a challenge in managing spectrum allocation and minimizing interference with other wireless services.
- High cost of licensed spectrum
- Unreliable electricity especially in rural areas results in service disruptions forcing the community networks to invest in solar panels and batteries to power equipment
- Limited access to financing

# Stay tuned

Podcast: Routing for Communities

- https://www.apc.org/en/podcasts/routingforcommunities

CN Newsletter - APC - 59th Edition

- https://www.apc.org/en/news/community-networks-newsletter-women-connecting-village

# Introduction to Community Networks

**With the support of**



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