Networking in ICTD

Some history and current trends

Matt Johnson & Esther Jang 2018

What is a network?

Many kind of networks

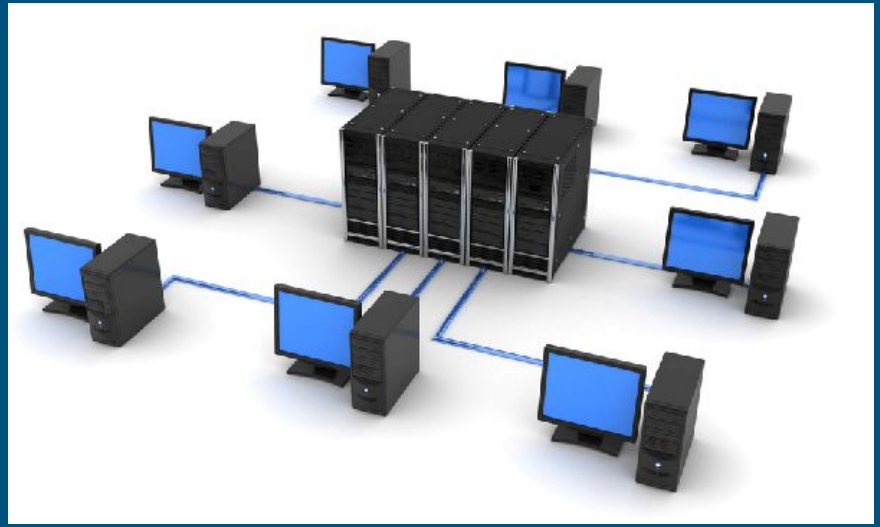
Biological Networks

Social Networks

Computer Networks

Cellphone Networks

Internet Networks



quora.com

Many kind of networks

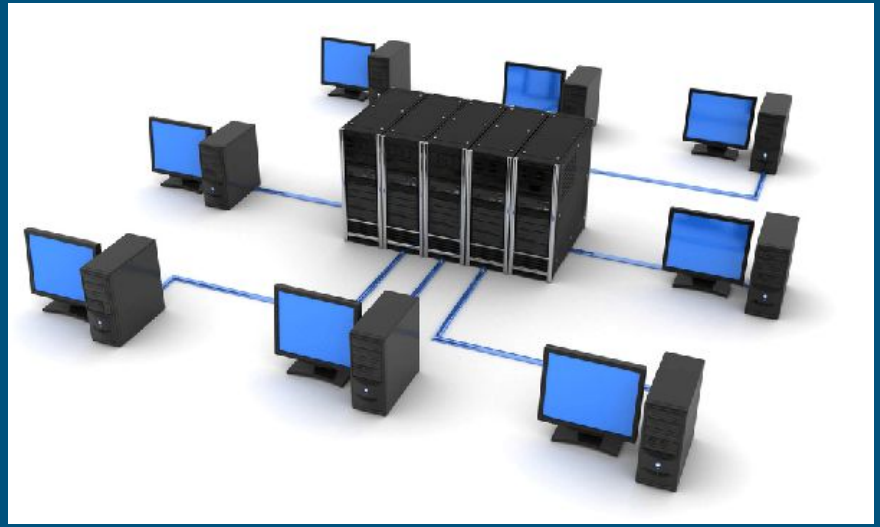
Biological Networks

Social Networks

Computer Networks

Cellphone Networks

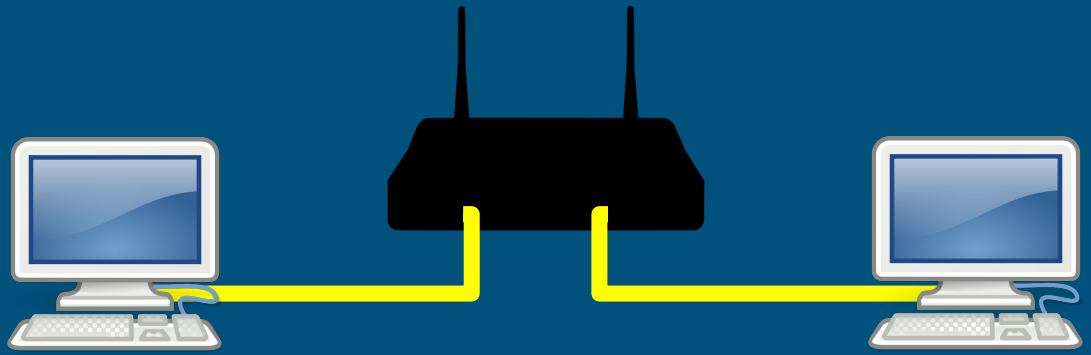
Internet Networks



quora.com

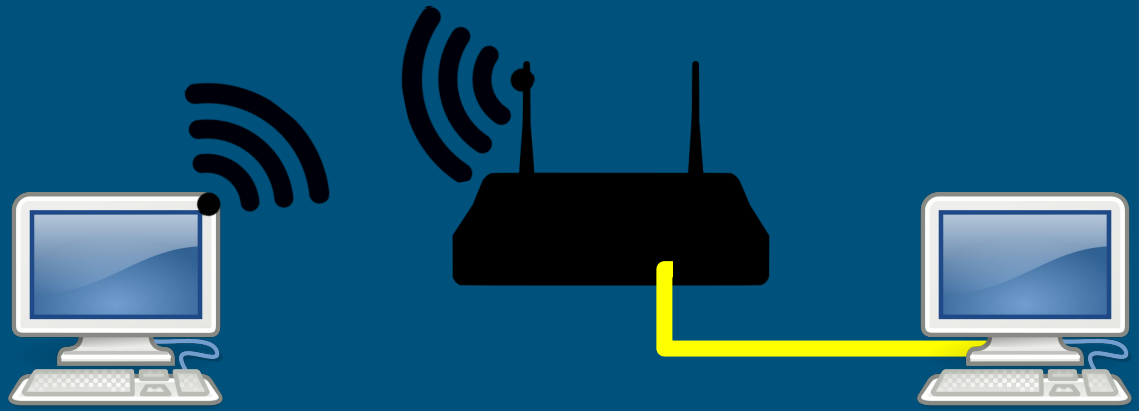
Computers connected to other computers...

Computers connected to other computers… with other things in the middle

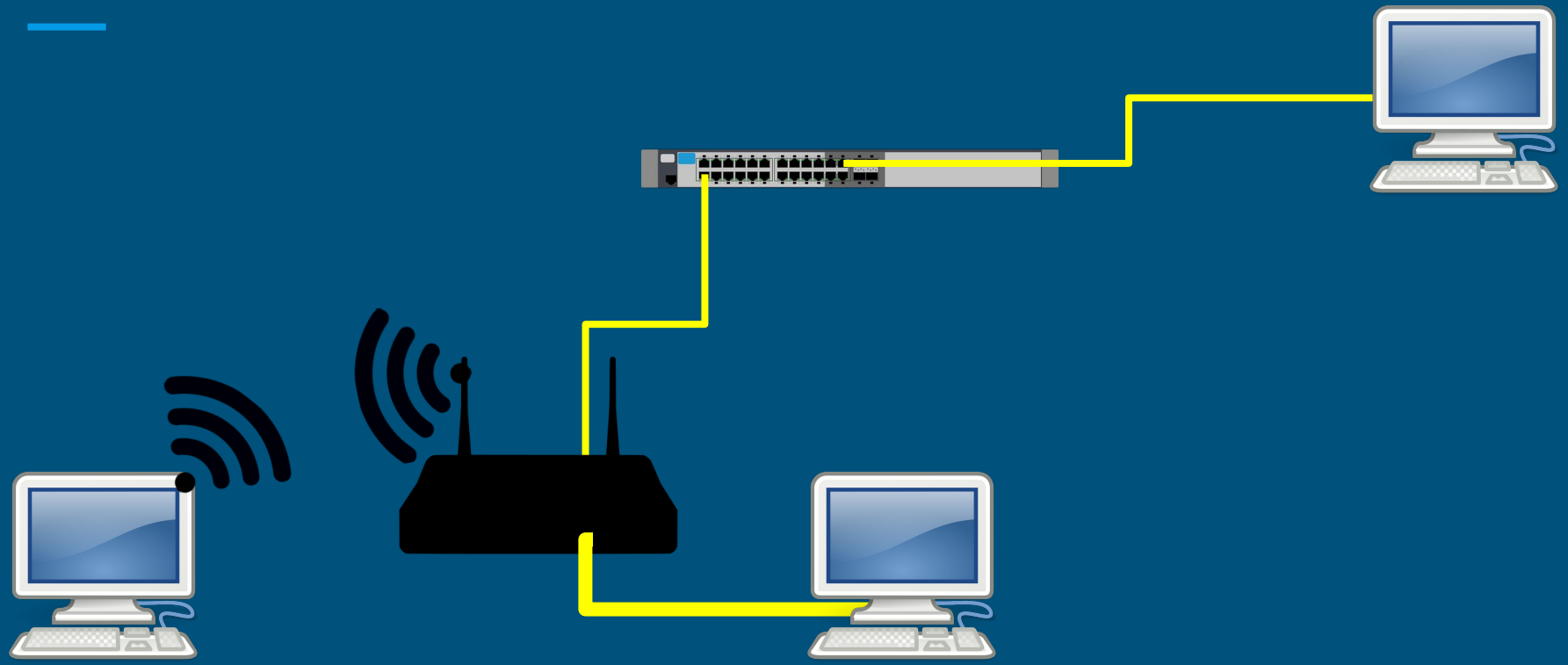


Computers connected to other computers… with “radios” instead of wires

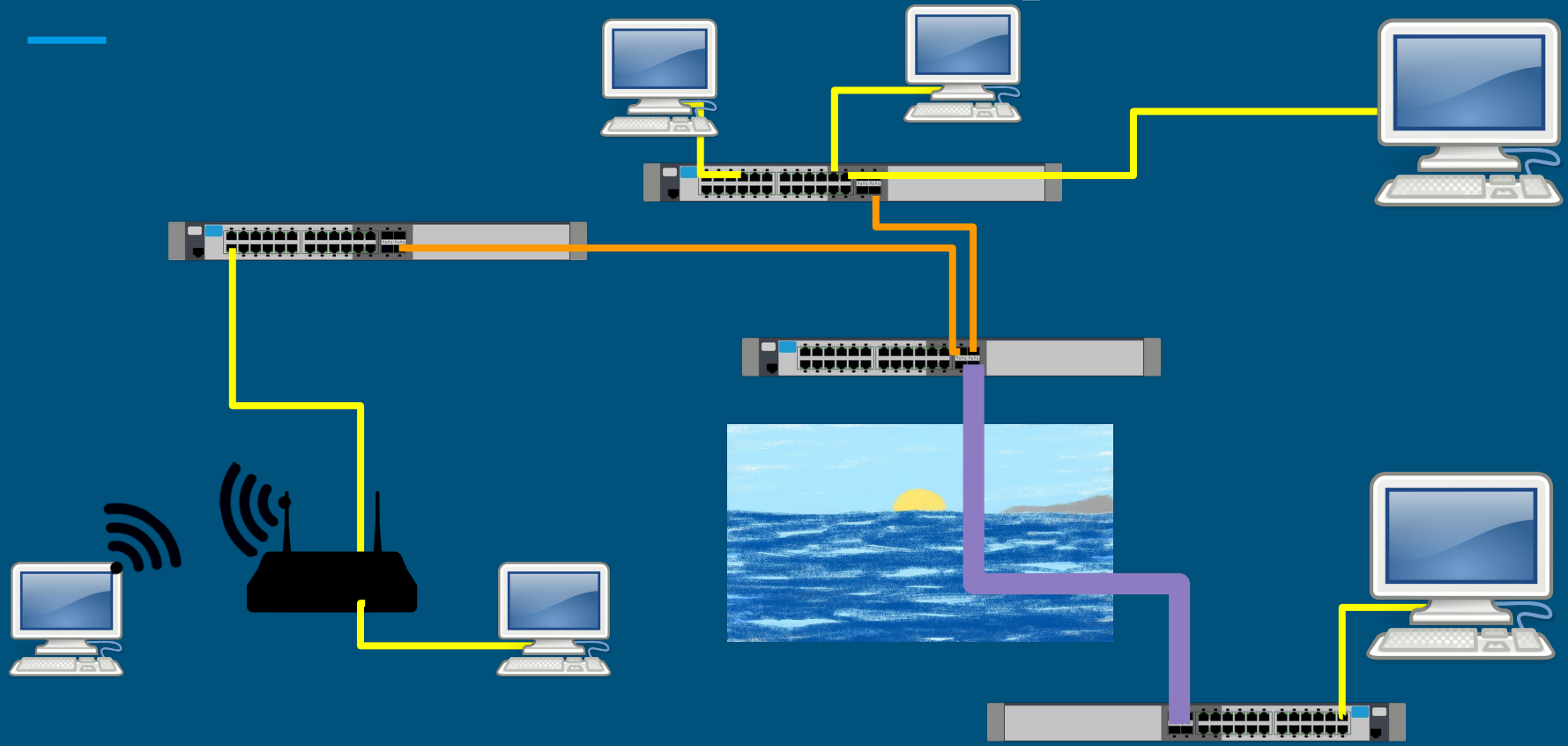
Computers connected to other computers… with a mix of radios and wires



Computers connected to other computers… with some other other computers far away

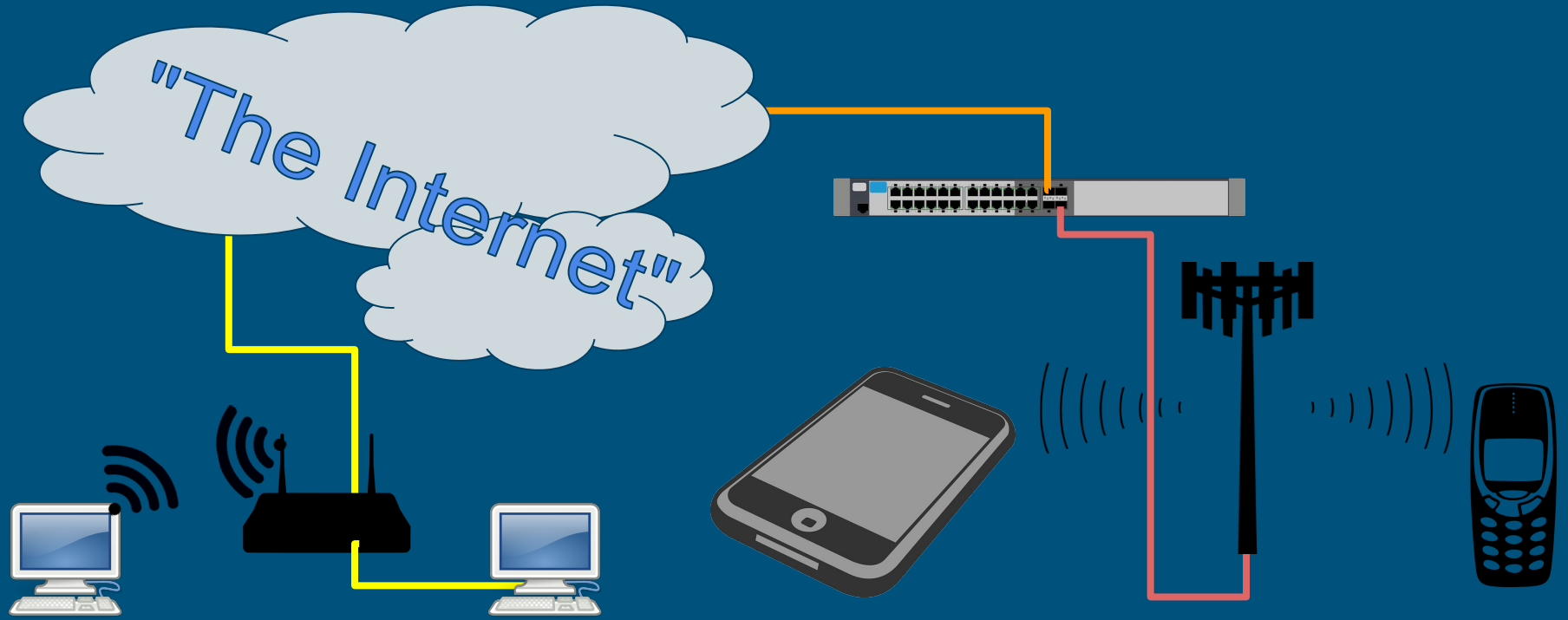


Computers connected to other computers…
Connected to most of the computers

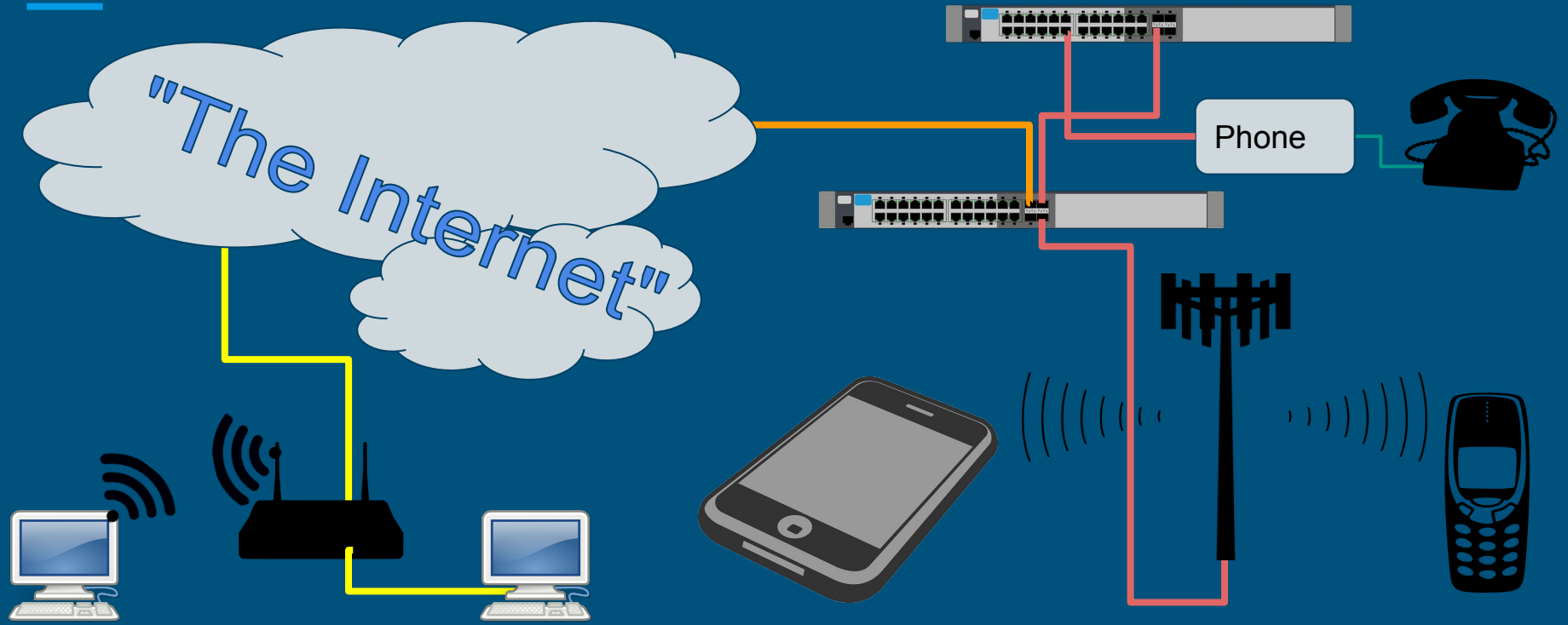


Computers connected to other computers…
Connected to most of the computers

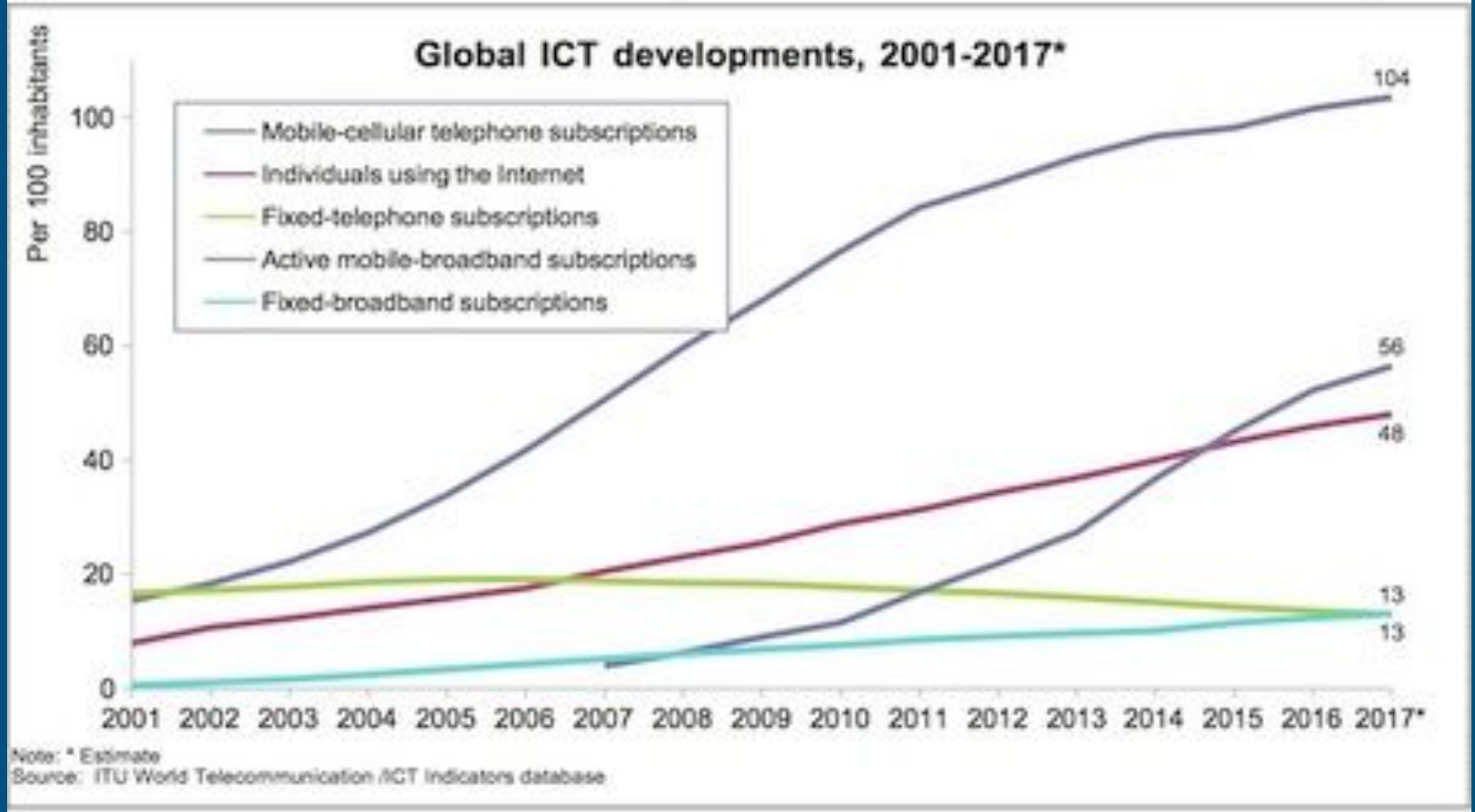
Computers connected to other computers… and some different kinds of computer



Computers connected to different kinds of computers… with some legacy standards



Computers connected to different kinds of computers… with some legacy standards

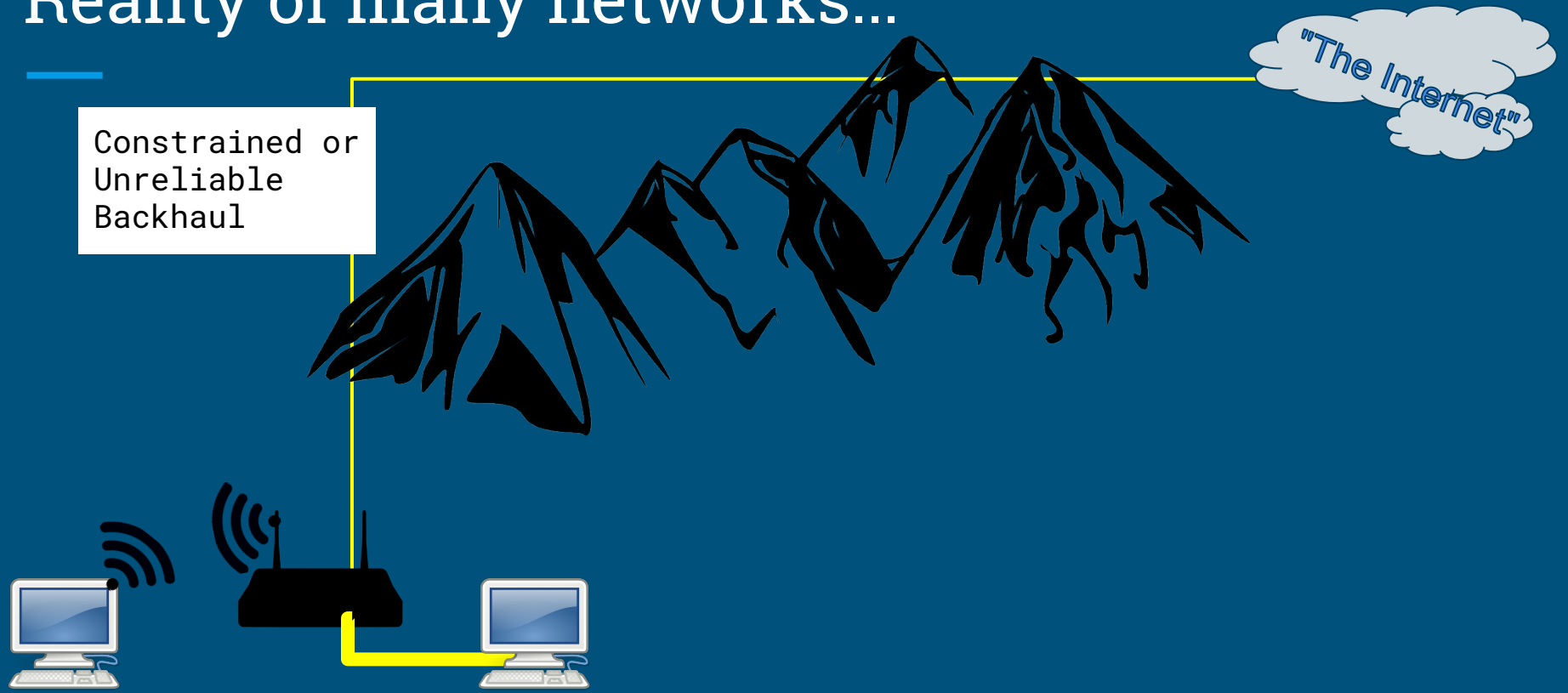


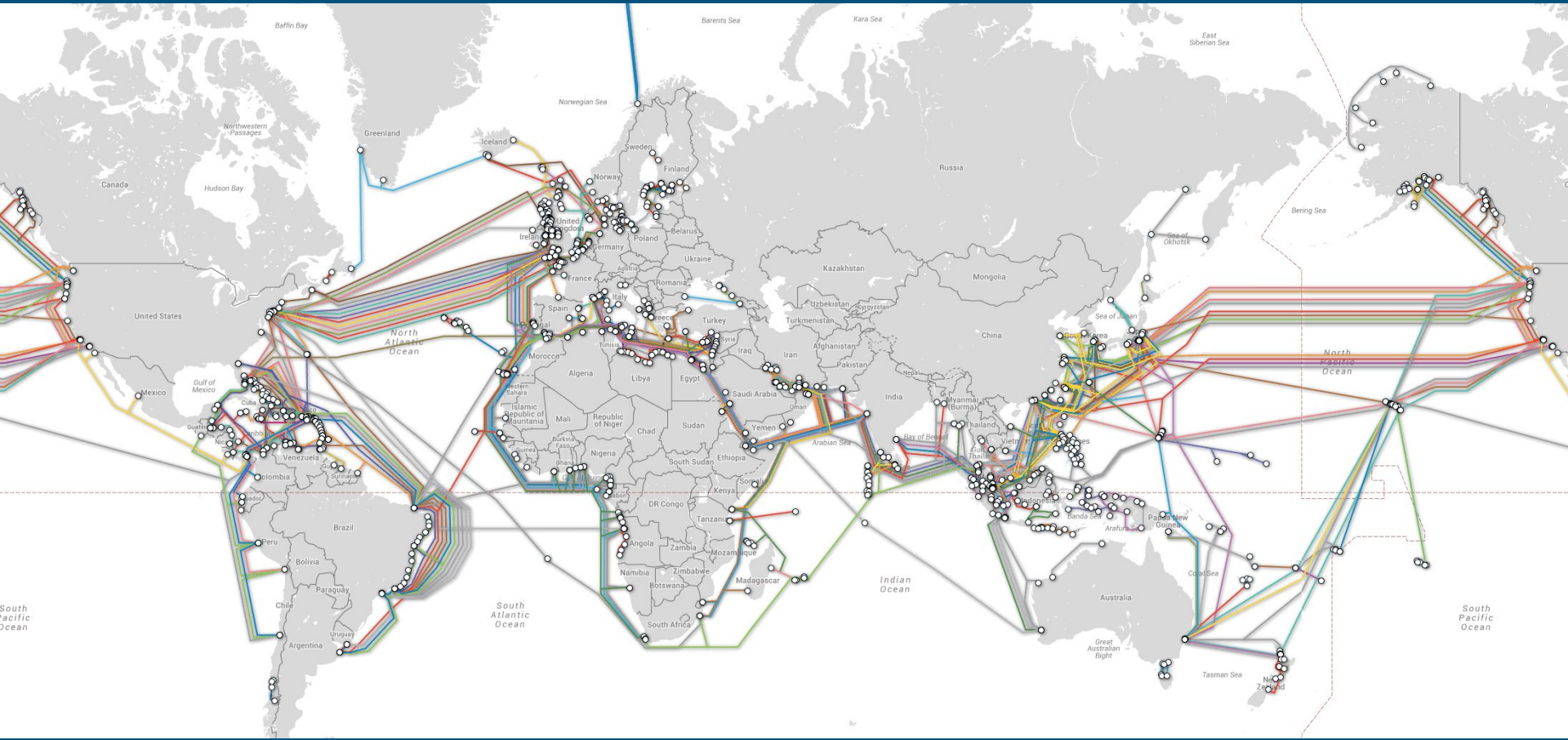
theregister.co.uk

What does this have to do with ICTD???

- ➔ Reality is networks in many regions are highly constrained or non-existent
  - ◆ Economic reasons, logistical reasons, corruption/justice reasons
- ➔ Addressing networking issues is an attractive problem because...
  - ◆ It's (at least somewhat) technological in many cases
  - ◆ Connectivity and information is seen as an enabling technology for other development
  - ◆ It's easy to measure and see progress
    - "There was no Internet here, now there's Internet, huzzah!"
- ➔ Generally high demand from people on the ground
  - ◆ People tend to want to be connected, often know exactly how far and where to go to get connectivity otherwise
  - ◆ "Unconnected people" is largely a myth (maybe deep Amazon...), ICTD networking work is making connectivity more convenient and cost effective, usually not first exposure

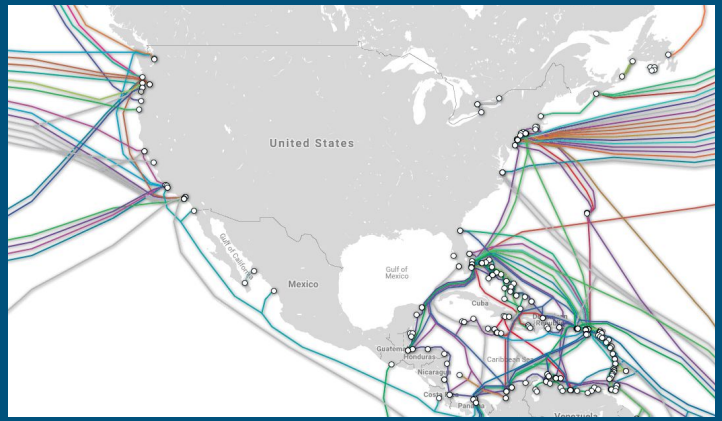
Reality of many networks...

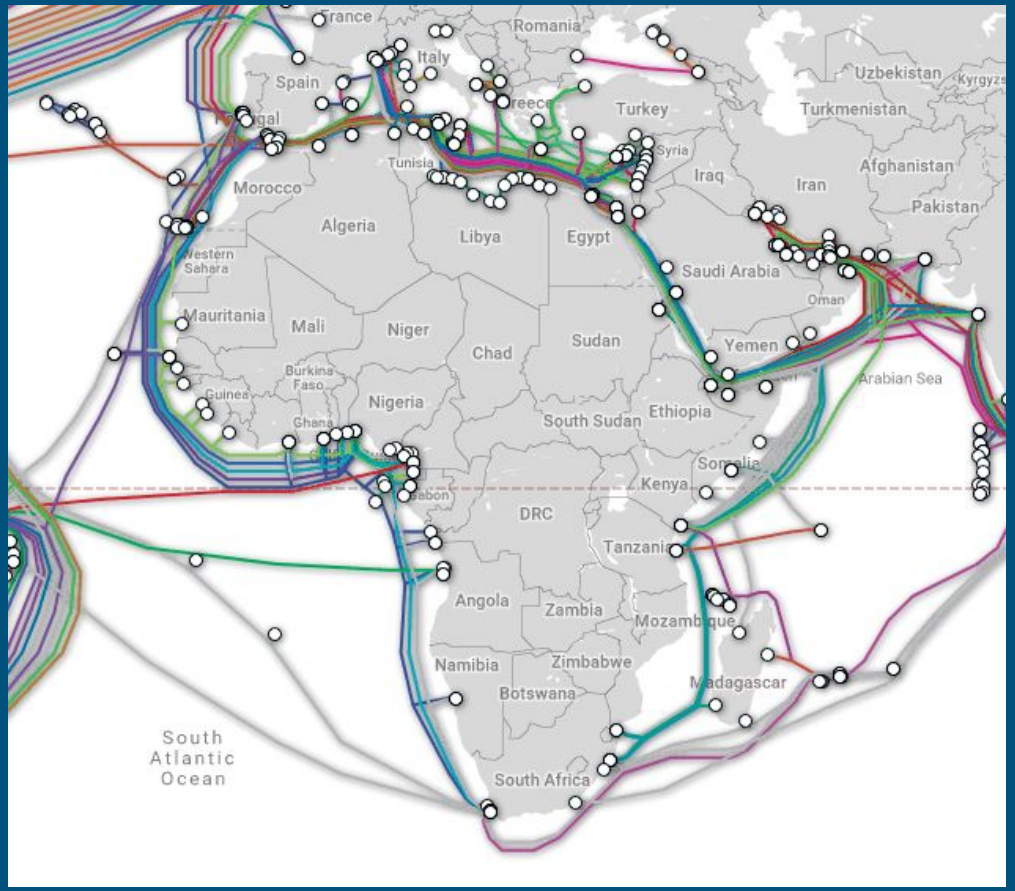




https://www.submarinecablemap.com/

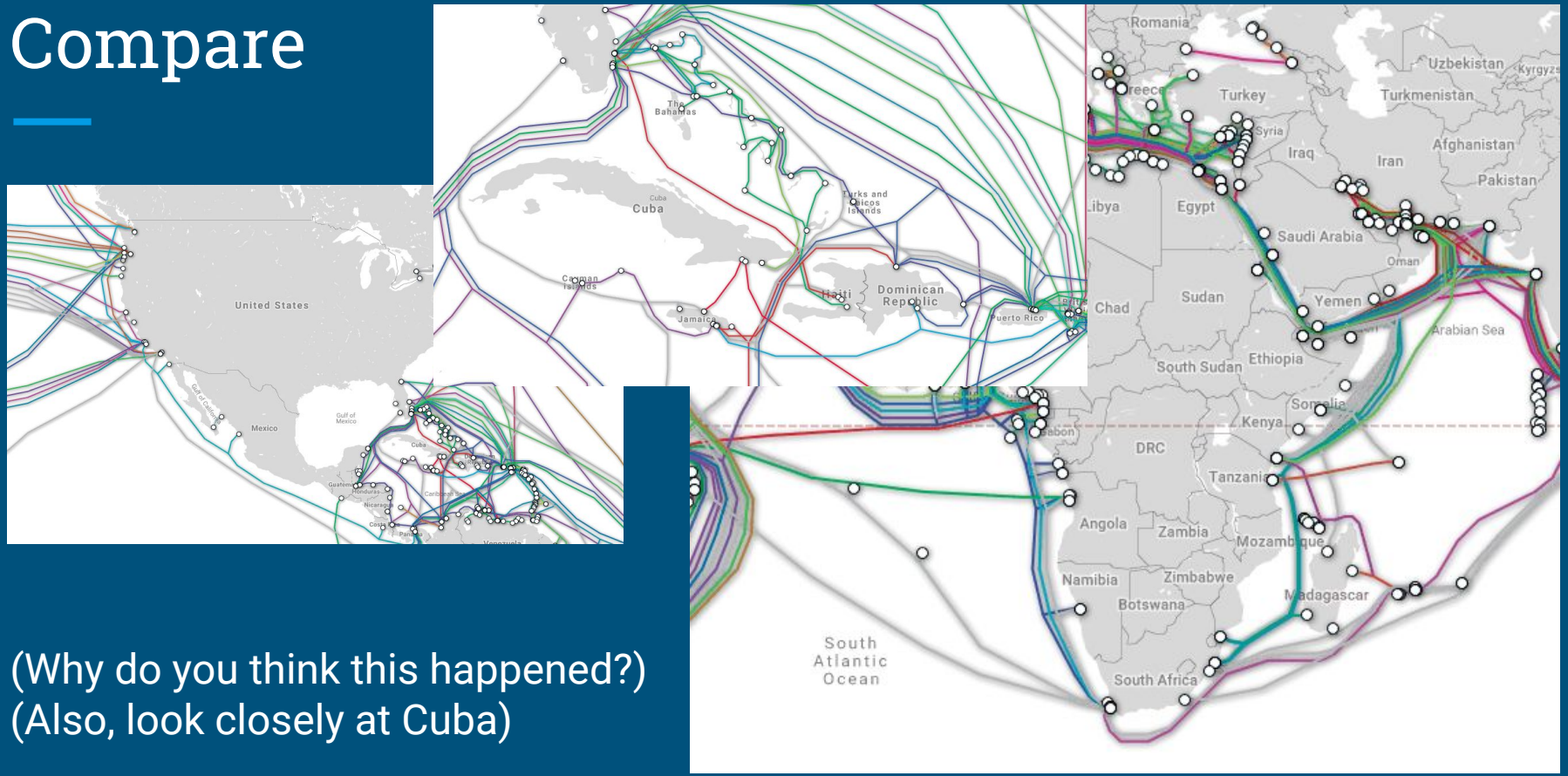
Compare





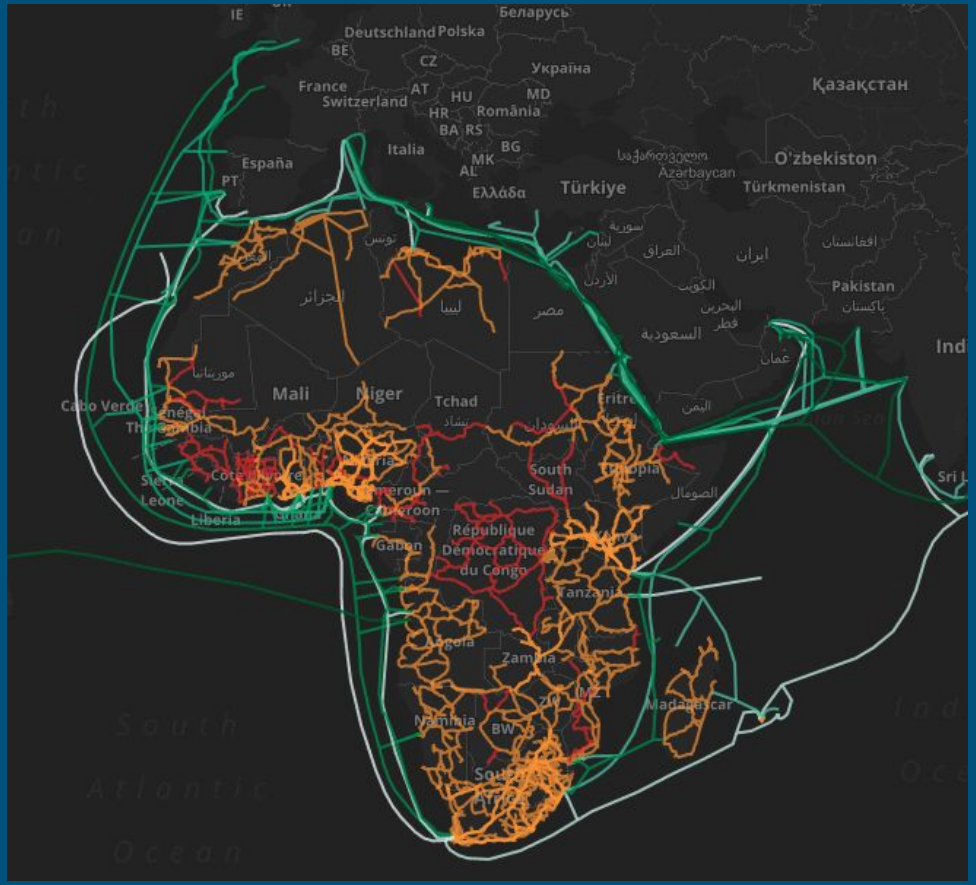
(Why do you think this happened?)
(Also, look closely at Cuba)

Compare



(Why do you think this happened?)
(Also, look closely at Cuba)

Compare

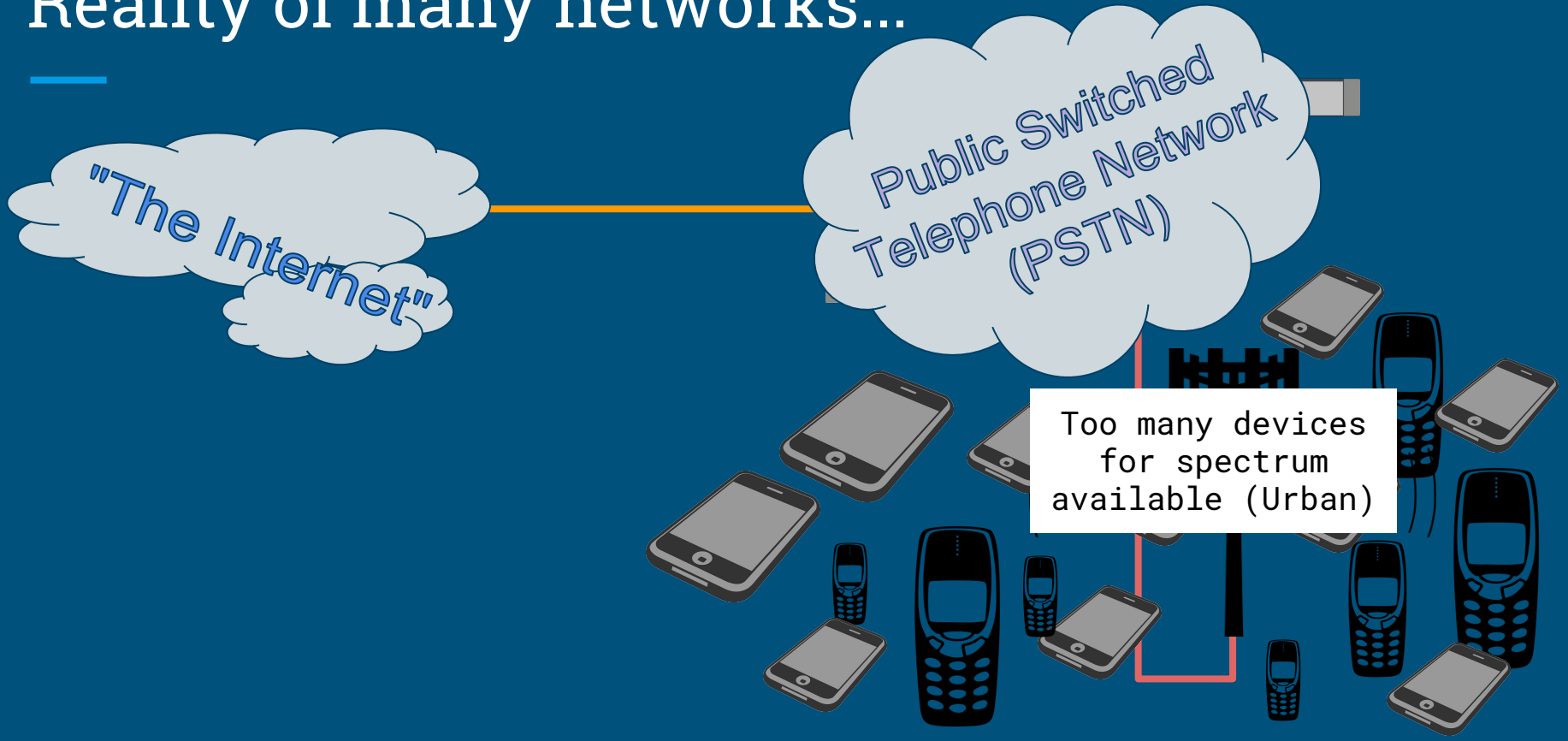


Orange: live, Red: under construction

https://afterfibre.nsrc.org/

Reality of many networks...

Reality of many networks...



ICTD Focuses on Rural Areas (for now)

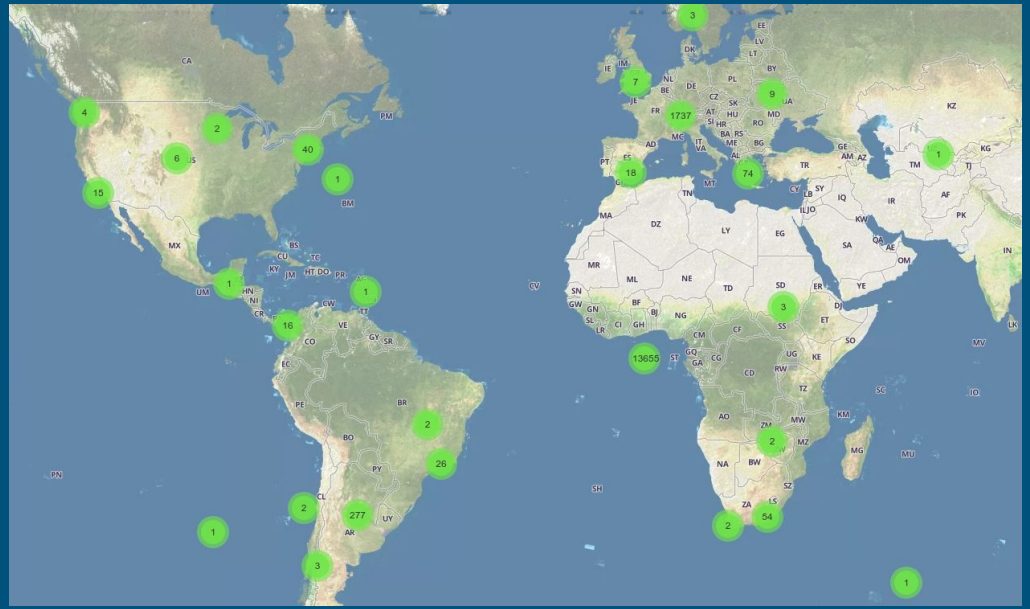
- ➔ Long Tail of Connectivity
- ➔ Telecoms want to make money!
  - ◆ Will naturally deploy networks where they can profitably!
- ➔ ~1B users in rural areas where density is too low to serve with current methods
  - ◆ Site costs, legal costs, land costs, all too high... Revenue per user is low
- ➔ Alternative connectivity paradigms

Community Networks

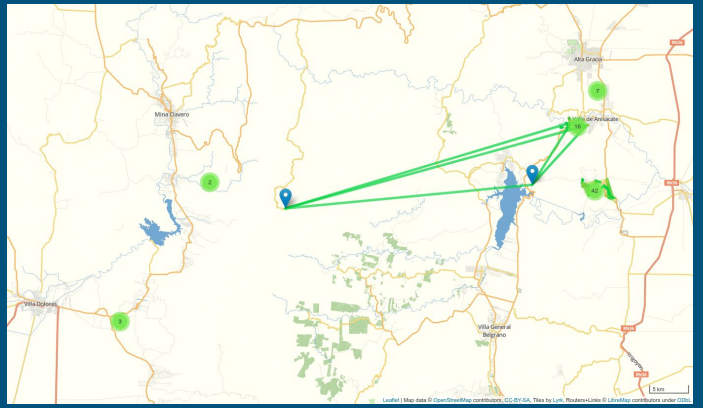
- Some existing WiFi based
- New deployments of cellular based
- Important difference from telco: owned and operated by people in the community
  - No/low site costs (existing structures and land)
  - Local maintenance and security
- Challenge in sustainability
  - Tech and knowledge transfer
  - Backhaul funding


guifi·net
The Telecommunications
Network
Free, Open and Neutral

LibreMap: Map of CNs around the world



http://libremap.net/



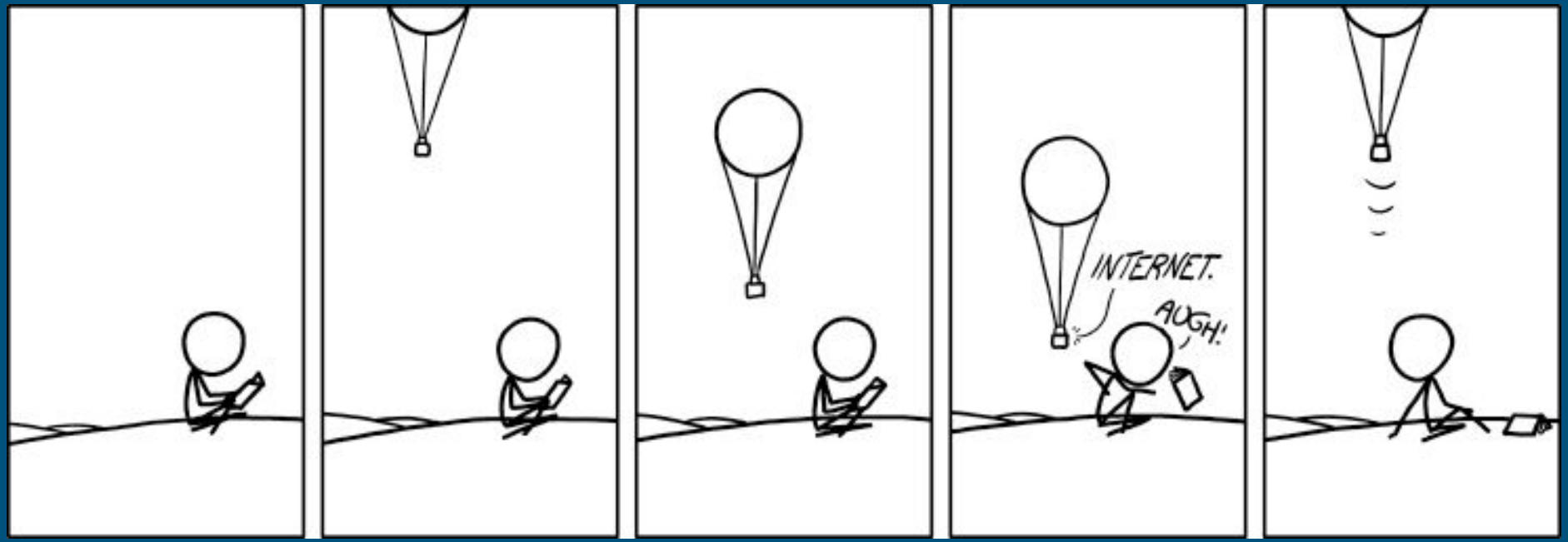
^ Some small towns using mesh networks near Cordoba, Argentina

Silicon Valley Approaches

Google Loon

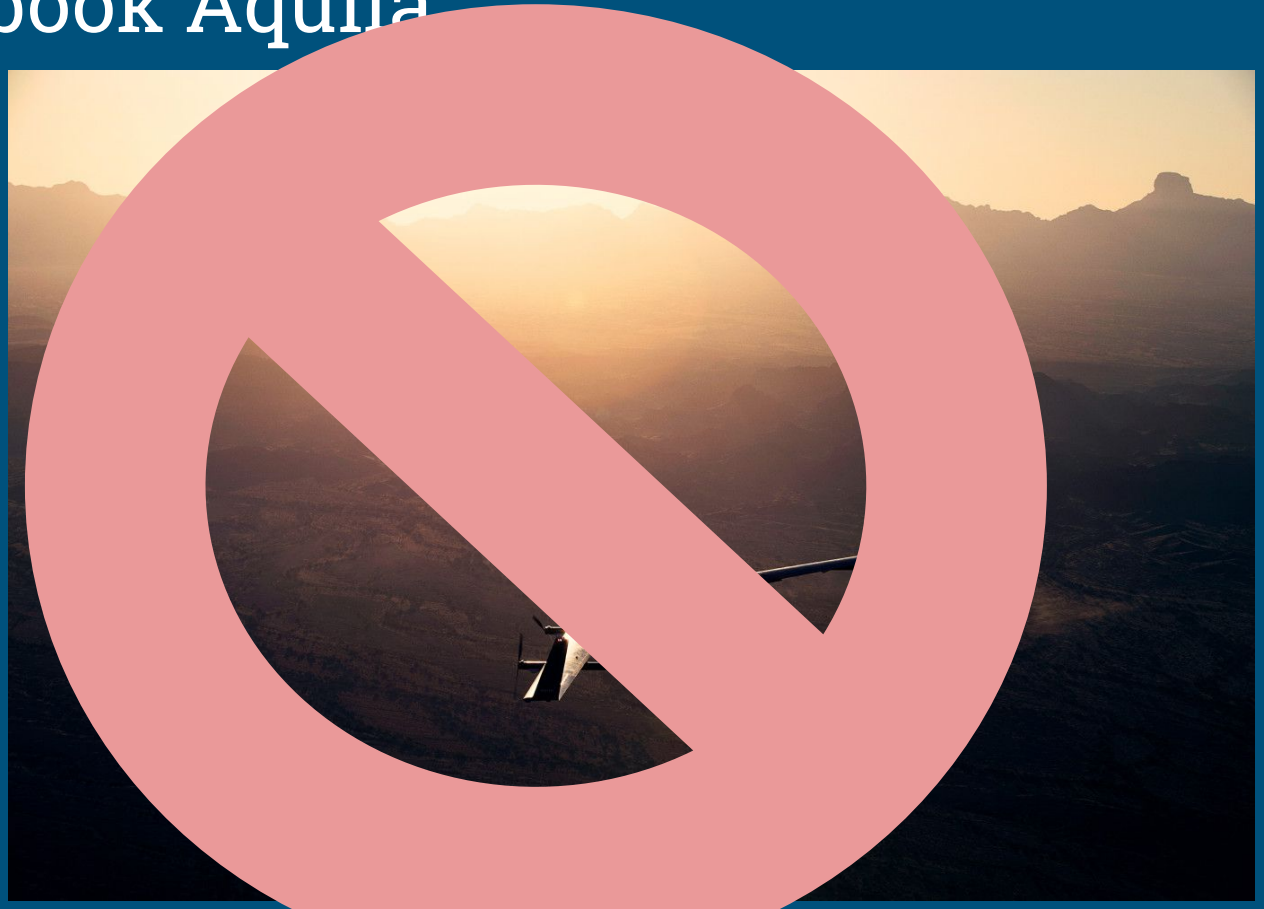
Use a High Altitude Platform to increase users/tower

XKCD #1226: Baloon Internet



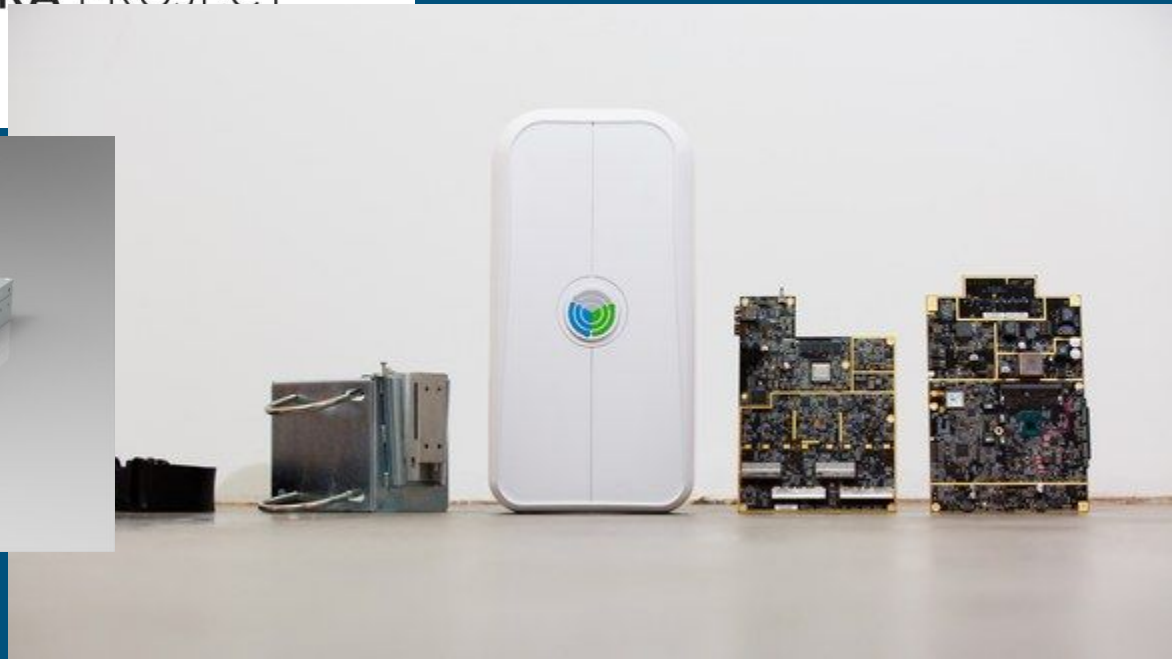
xkcd.com

Facebook Aquila



New Approach: address infrastructure costs

TELECOM INFRA PROJECT



What does this matter to me?

Not all networks are created equal

- Key performance metrics
  - Bandwidth/Rate: How much information can flow (Bytes/S)
  - Latency: How far away is the destination (ms)
  - Loss: How much information gets there (%)
  - Availability: Is the connection always on (%)
- If you only test as an urban user in the US, the things you develop will only be useful for urban users in the US!

Tools Demonstration!

1. How to read a ping

Tools Demonstration!

1. How to read a ping
2. Firefox & Chrome network emulation tools

Tools Demonstration!

1. How to read a ping
2. Firefox & Chrome network emulation tools
3. Firefox & Chrome mobile resolution emulation tools

Tools Demonstration!

1. How to read a ping
2. Firefox & Chrome network emulation tools
3. Firefox & Chrome mobile resolution emulation tools
4. Limiting connections on mobile phones
    a. Disable LTE-- Live the 3G life
    b. You used to be able to disable 3G to live the 2G-GPRS life, but GPRS networks are actually shutting down in the US (insecure…)

Tools Demonstration!

1. How to read a ping
2. Firefox & Chrome network emulation tools
3. Firefox & Chrome mobile resolution emulation tools
4. Limiting connections on mobile phones
    a. Disable LTE-- Live the 3G life
    b. You used to be able to disable 3G to live the 2G-GPRS life, but GPRS networks are actually shutting down in the US (insecure…)
5. Linux `netem` traffic control-- not enough time to discuss today
    a. https://wiki.linuxfoundation.org/networking/netem

Policy: discuss blog post

Thank you!

If you’re interested in this area, my lab does research building real networks. I’m also always down for questions!

Outline

Learning objectives:

Students should be able to articulate why spectrum and backhaul are important aspects of network access

Students should know how to develop and test applications for limited network scenarios.

Students should be familiar with the terms community network, community cellular network, wifi mesh network, and network neutrality.