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# **5G Network Slicing for Digital Inclusion**

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[BasicInternet.org](http://BasicInternet.org), [@Basic4all](https://twitter.com/Basic4all)



# Outline

***“The last time I was connected by wire was at birth”***

- Kjeller and the Internet
- My mission
  - from 3G to 5G
  - “always online, always connected”?
- Web and network development
  - the network responsive Web design
- Vision: “Internet light for all”
  - Free access to information for all
  - Technology
  - Open issues
- Ongoing activities
  - Europe, Africa (Tanzania, DR Congo)
  - Why India? - The Global InfoInternet standard

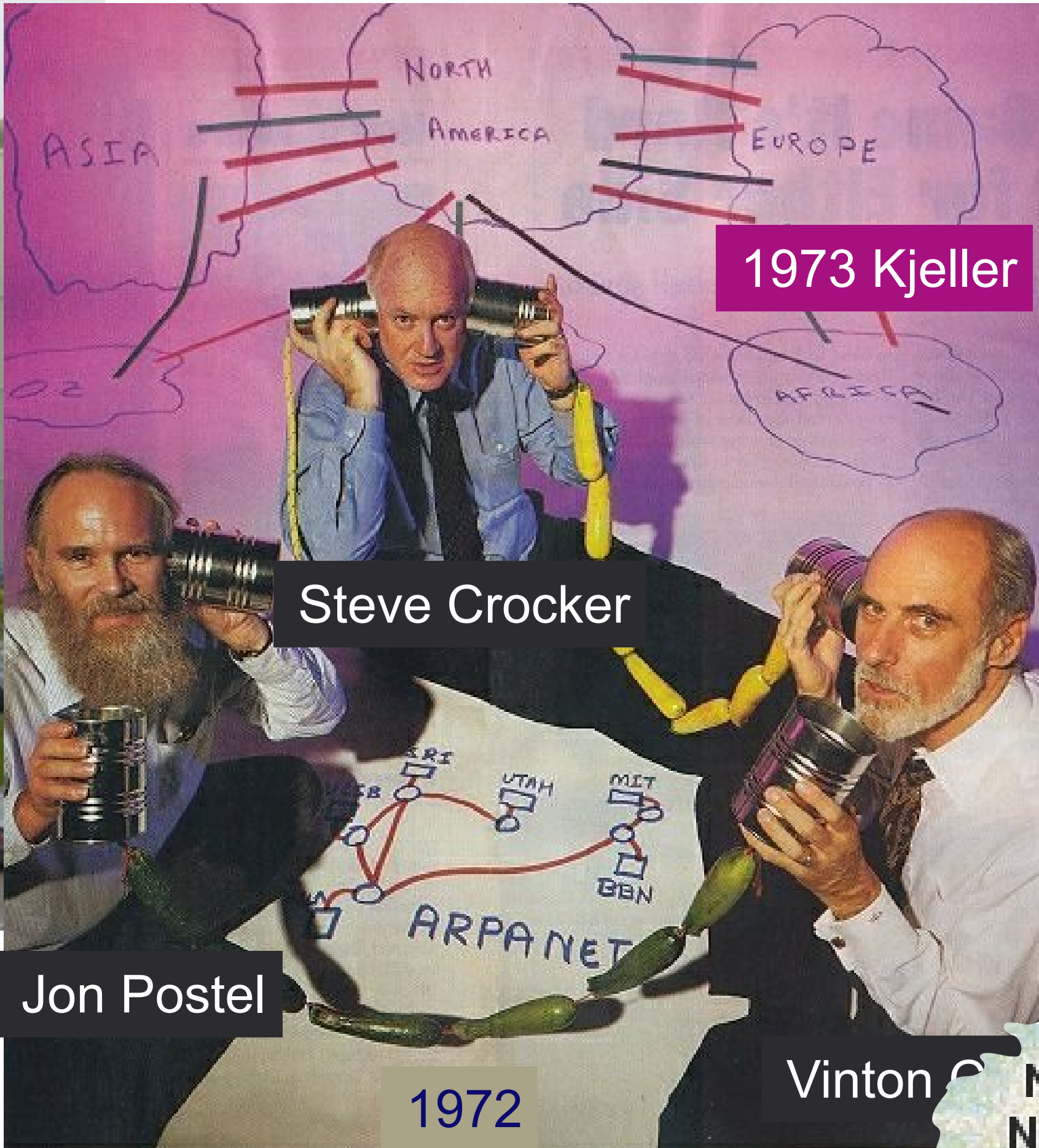




# Kjeller: Internet, 2G, 3G, ...



## Norsar/UiO at Kjeller

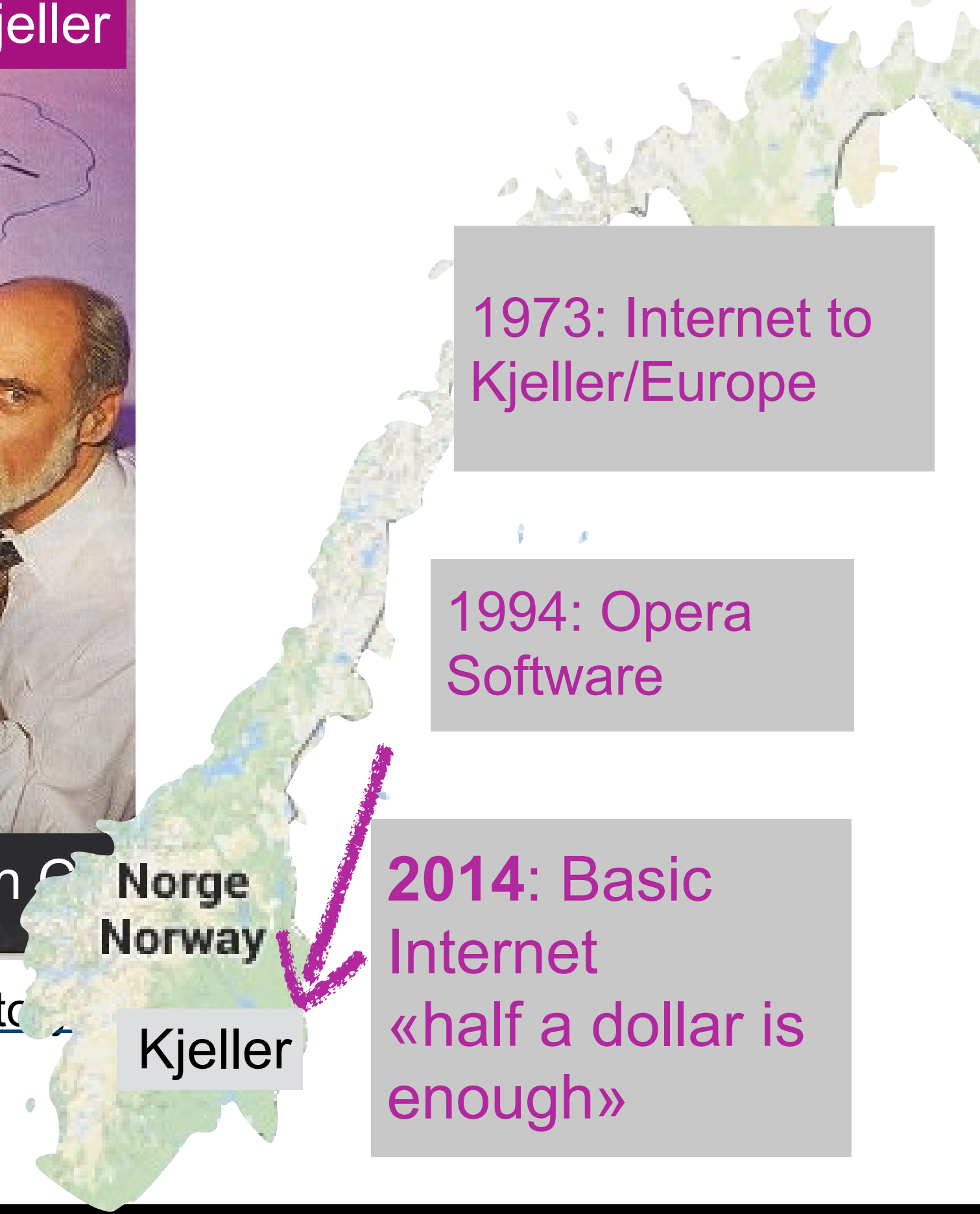


1973 Kjeller

1973: Internet to Kjeller/Europe

1994: Opera Software

2014: Basic Internet «half a dollar is enough»



- The building where the Internet (Arpanet) came to Europe in June 1973

Source: <http://www.michaelkaul.de/History/histo>

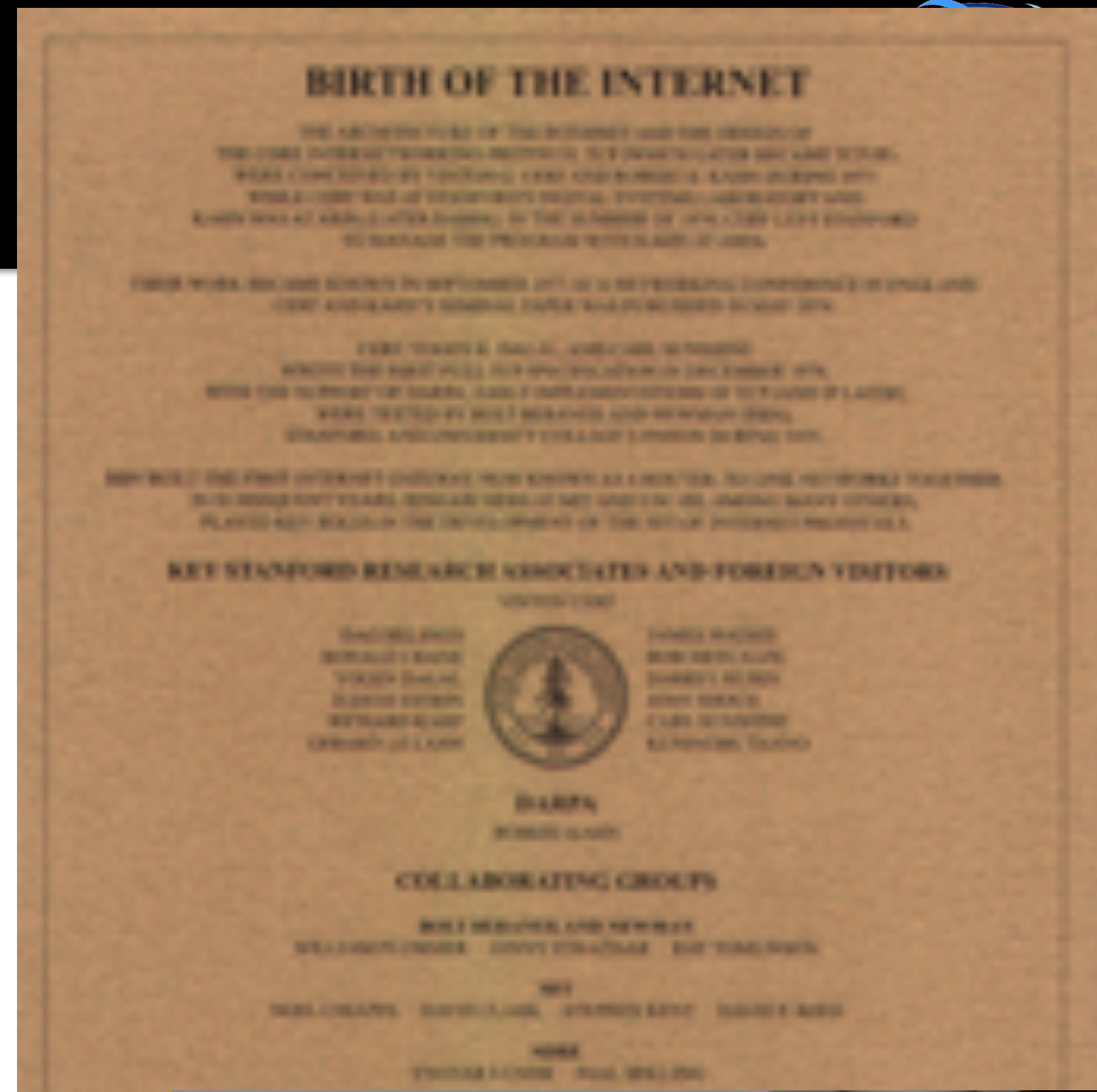
1971 (at which point 23 hosts, at universities and government research centers, were connected to the ARPANET); 29 by August, 1972, and 40 by September, 1973.

At that point, two satellite links, across the Pacific and Atlantic Oceans to Hawaii and Norway (NORSAR) had been added to the network. From Norway, a terrestrial circuit added an IMP in London to the growing network.



# The Internet and Scandinavia

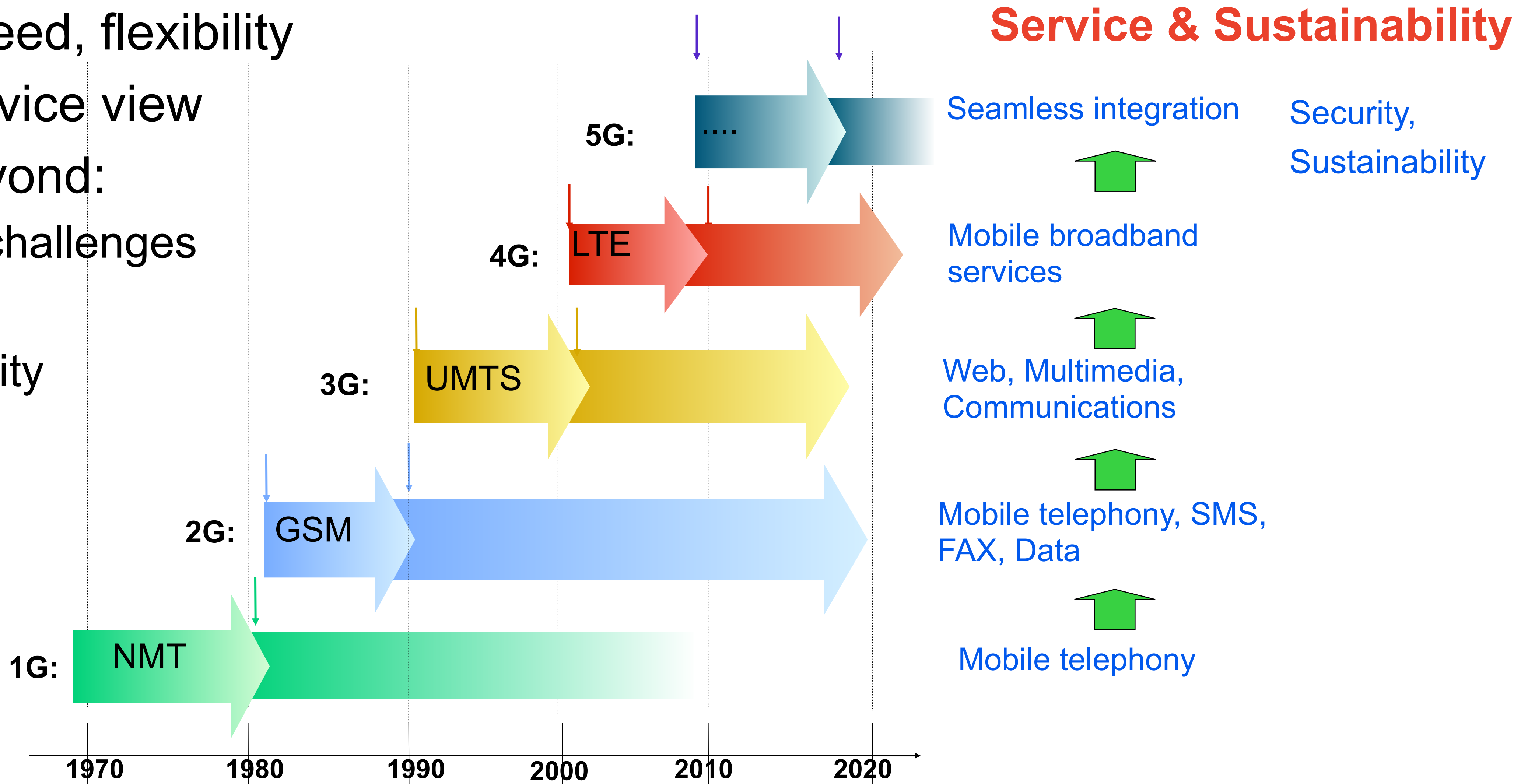
- The first connection of Arpanet outside of the USA (and Hawaii) was to **Scandinavia** (Kjeller, June 1973)
- List\_of\_Internet\_pioneers [Wikipedia]
  - Yngvar Lundh, Paal Spilling
- Application development
  - .php, OpenSource, Linux, Skype, Spotify
  - OperaSoftware, FAST Search
  - Nokia, Ericsson
  - Telenor, Telia
- Mobile Internet:
  - GSM
  - Service adaptation





# 5G: Speed, Bandwidth, latency and **much more**

- 1G-3G: Speed, flexibility
- 3G-4G: service view
- 5G and beyond:
  - ➔ Business challenges
  - ➔ ownership
  - ➔ sustainability



[adapted from Per Hjalmar Lehne, Telenor, 2000]



# 5G Research Topics

## R&D and business

- (i) massive mobile broadband,
  - ➔ social networks for things
- (ii) billions of devices and
  - ➔ Internet of Things (IoT)
  - ➔ automated processes
  - ➔ Edge computing
- (iii) ultra-reliable and ultra-low latency networks.
  - ➔ industrial automation
- (iv) societal: digital inclusion
  - ➔ free access to information for all



except 

IIT Bombay, C-DOT

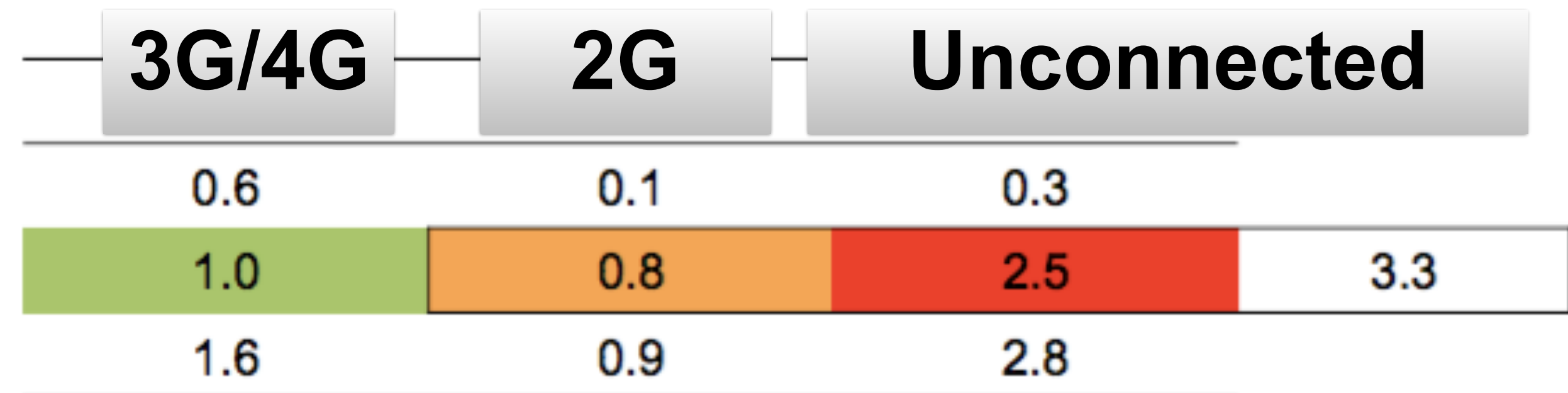




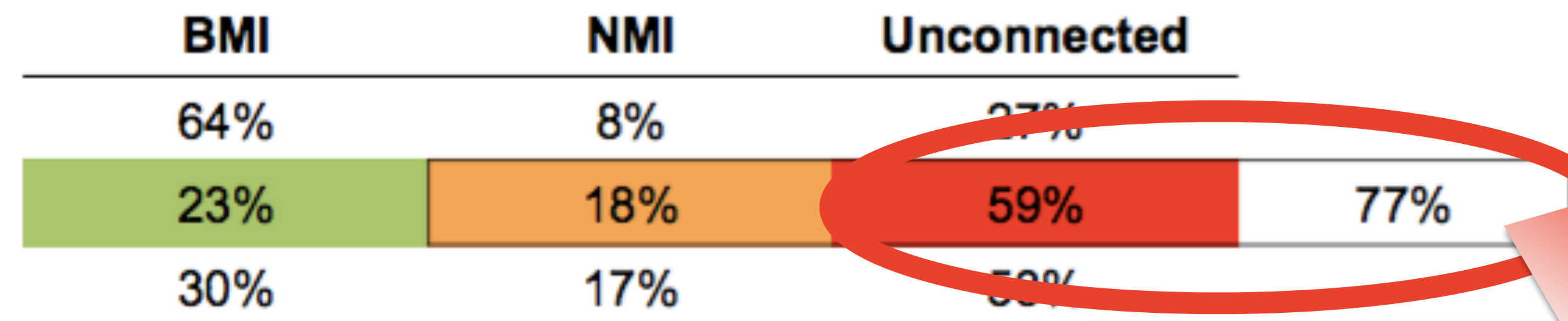
## The Unconnected Market Landscape

### Unique Mobile Internet Users

Population 15+ (bn)	Total
Developed World	0.9
Developing World	4.3
Total	5.2



Penetration 15+ (%)	Total
Developed World	100%
Developing World	100%
Total	100%



77% don't have decent access

Source: GSMA Intelligence; figures reflect position at end of 2014  
 BMI = Broadband Mobile Internet (3G/4G); NMI = Narrowband Mobile Internet (<3G)

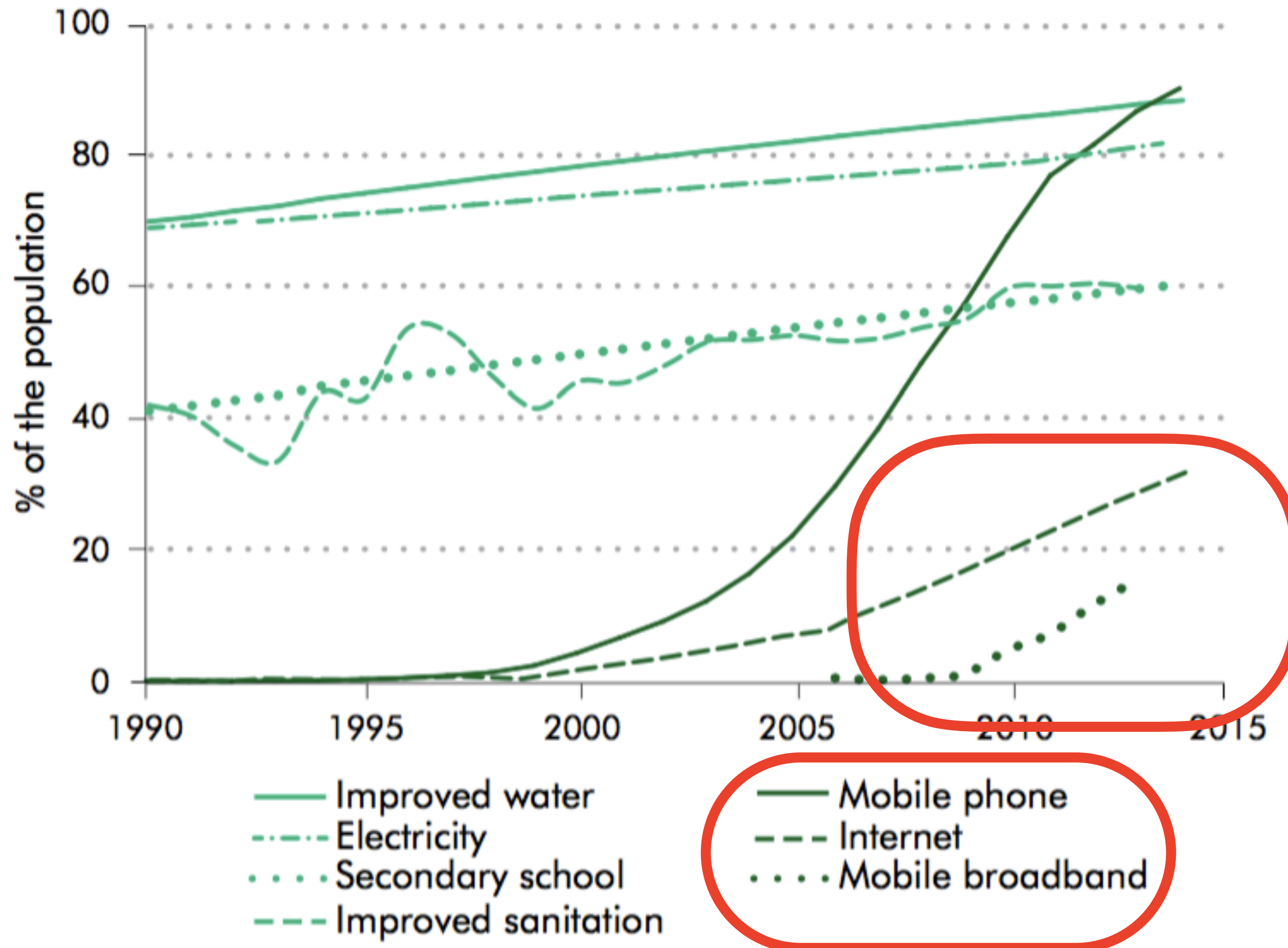
[Source: GSMA, Nov2015]





[Source: World Development Report 2016]

a. Digital technologies are spreading rapidly in developing countries

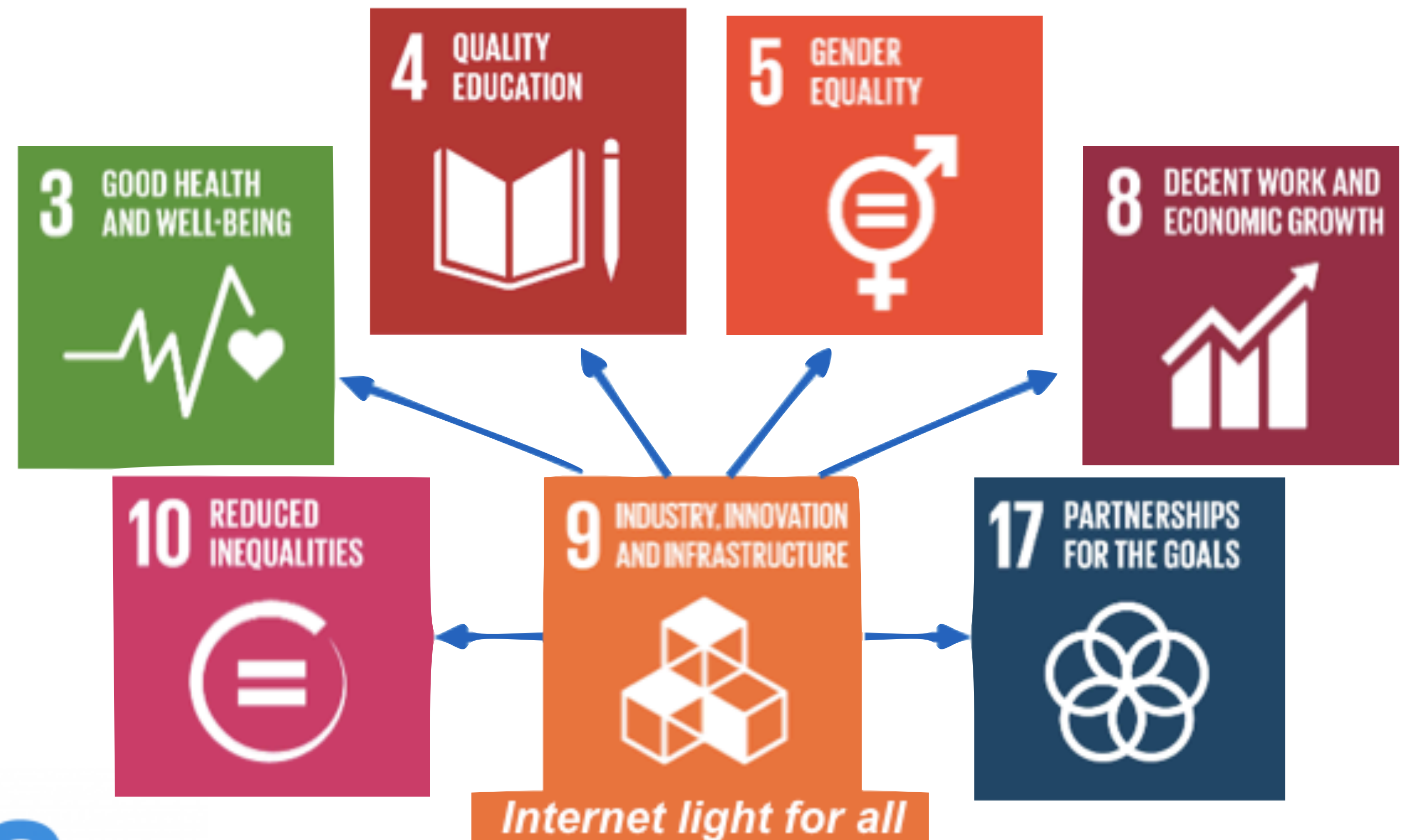


- ➔ Digital Economies/Societies
- ➔ Internet of Things (IoT)



# (iv) Societal: Sustainability and Digital Society

- Combat the Digital Divide
- Support the Sustainable Development Goals (SDGs)
- (iv) provide free access to information for all
- India specific
  - ➔ health knowledge: food, nutrition, birth/newborn
  - ➔ basic IT education
  - ➔ increase agriculture productivity





# TelCos have the wrong investors

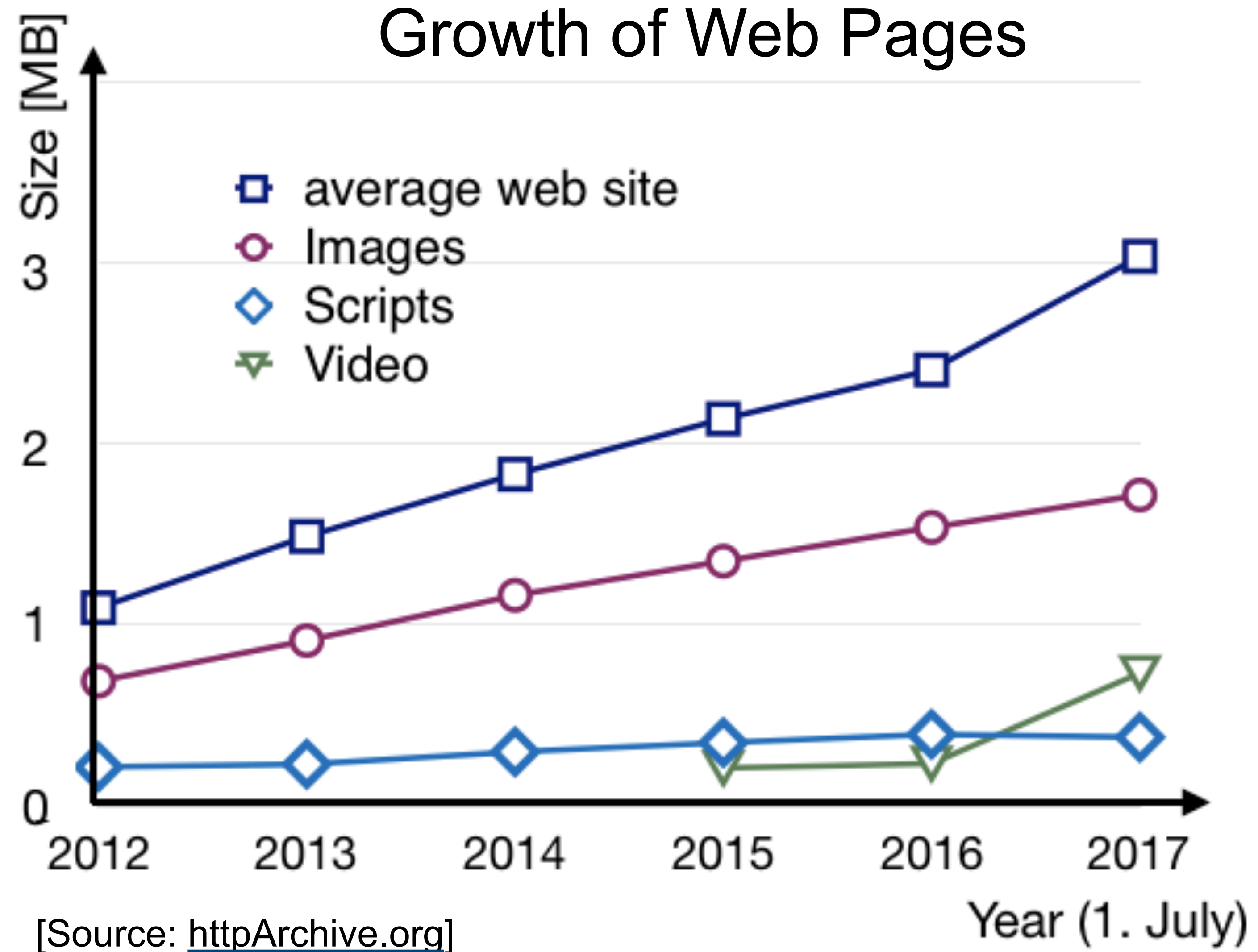
- Revenue driven
  - ➔ roll-out in urban
  - ➔ focus on voice (GSM)
  - ➔ Mobile Broadband for Premier League, Bollywood, ....
  
- Infrastructure Investors
  - ➔ min 13% revenue
  
- **Not suitable** for
  - ➔ Digital literacy
  - ➔ low income segment
  - ➔ non-profit content: EDU, health, agriculture, eGov

Telecom
revenue-driven
voice & mobile broadband
subscription based (SIM)
mobile network: coverage (voice) & capacity (data)
operator cost model



# Internet light: Demand for information only

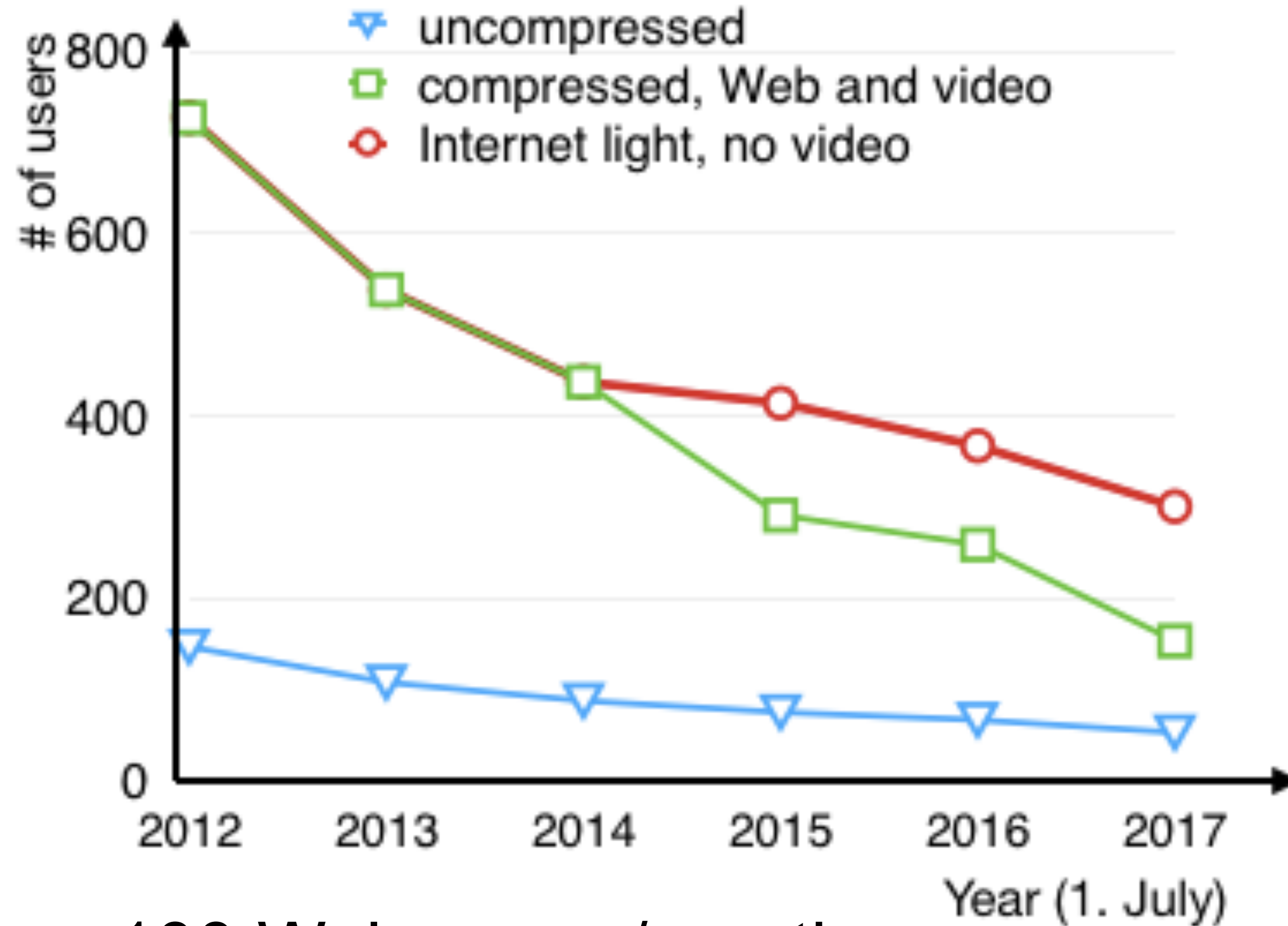
- Average Web Pages
  - ➔ growth: 1 to 3 MB within 5 years
  - ➔ images: ~3x
  - ➔ video: ~5x
- Web page growth counteracts network development



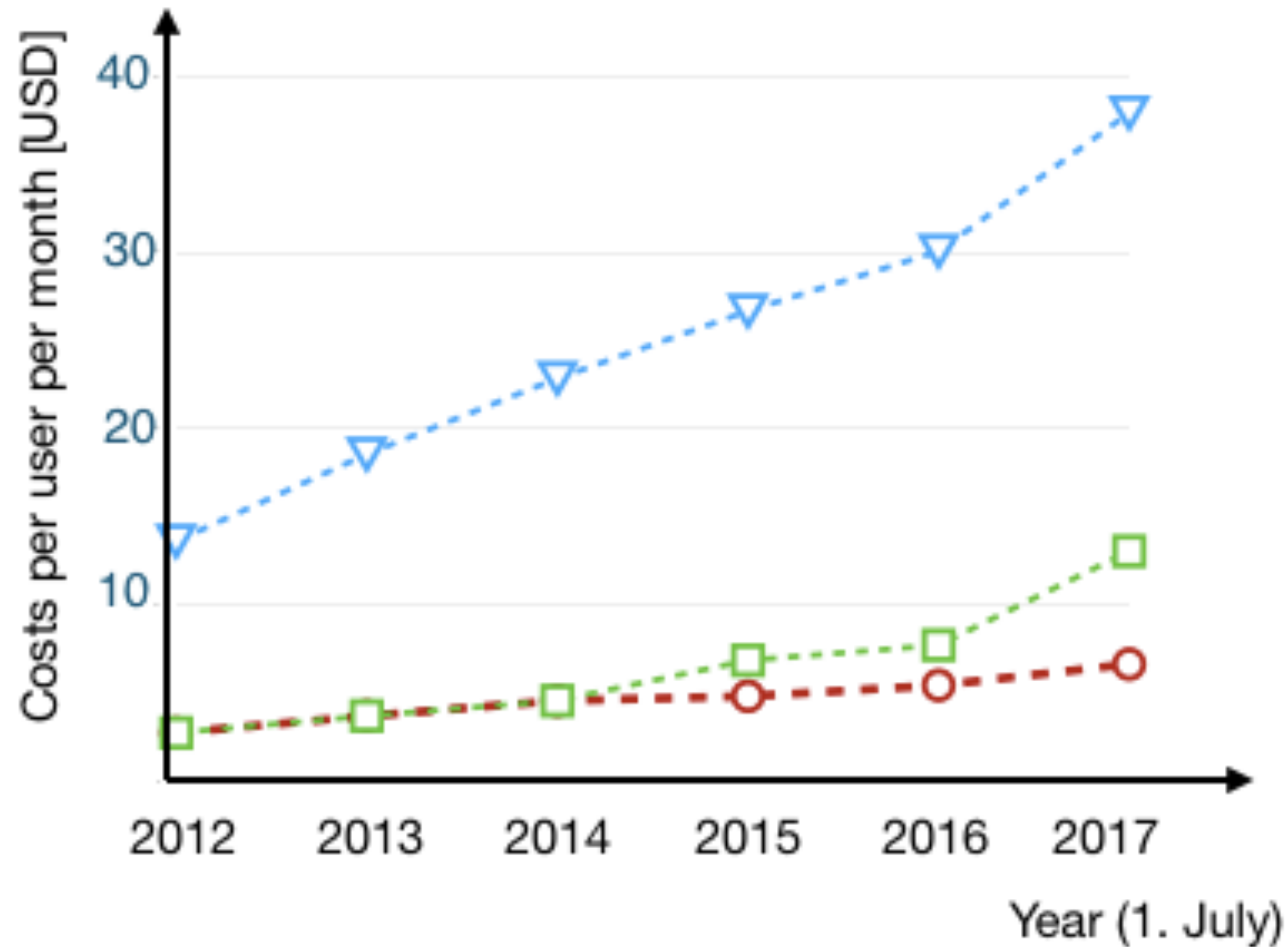


# Impact of Web Page size

## # of users supported



## Cost per month per user



- ➔ 100 Web pages/month
- ➔ using 1 Mbit/s satellite link

[derived from: [httpArchive.org](http://Archive.org)]



# The Network Responsive Web

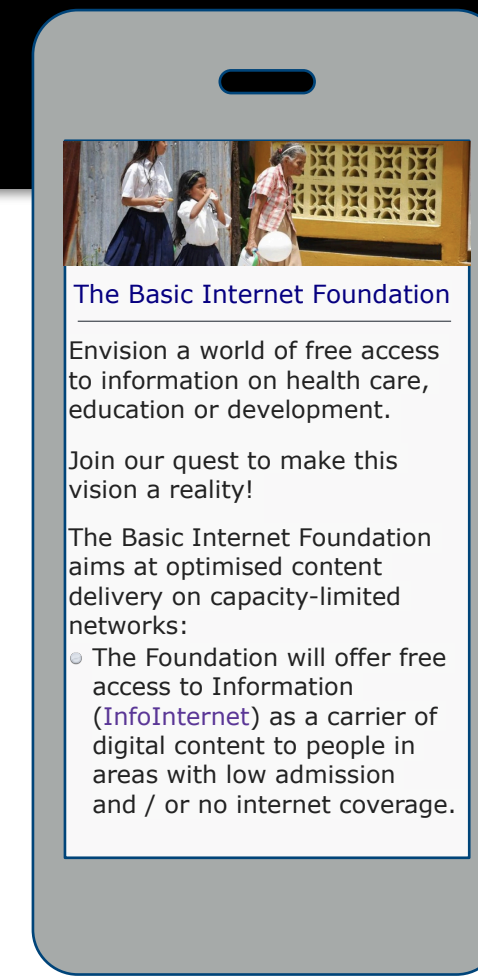
- Network responsive Web
  - ➔ Adapt to network capabilities
    - ▶ Car queue in remote areas
    - ▶ Mobile tethering (Wifi)
  - ➔ Server-side adaption of content

- Examples

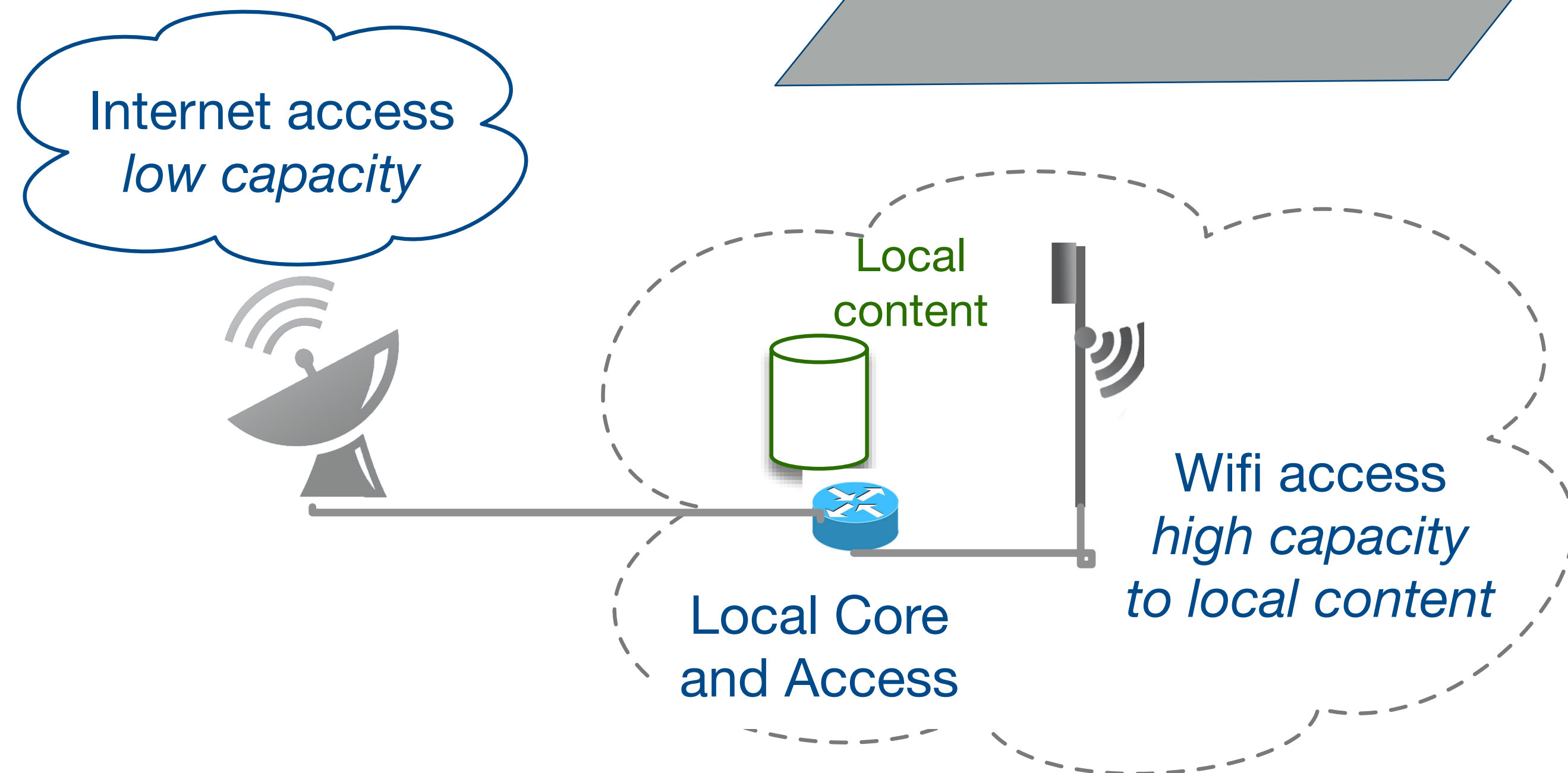
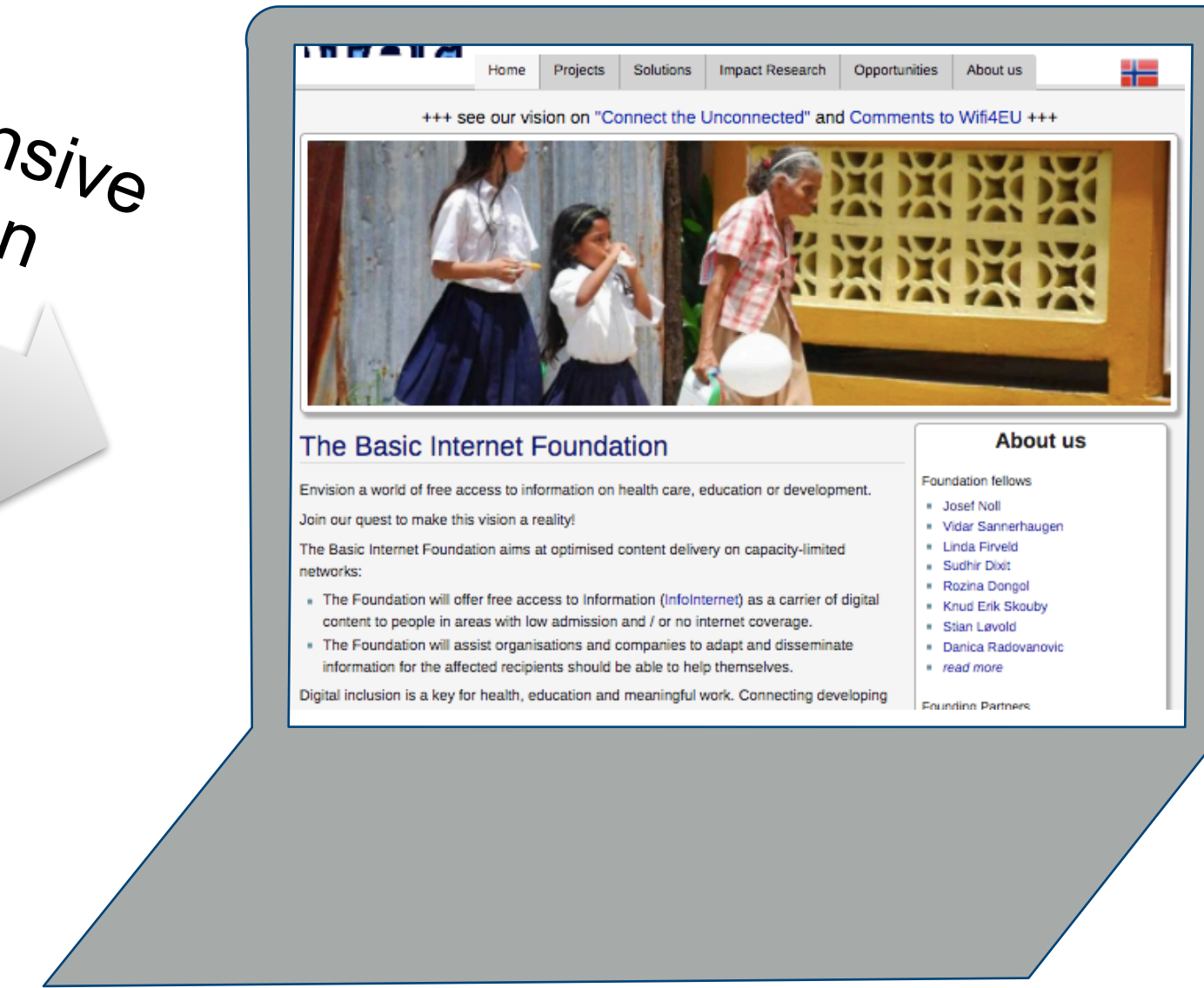
- ➔ Opera Mini (proxy)
- ➔ Chrome (compression)

- Internet light

- ➔ text and pictures
- ➔ local video



Responsive design



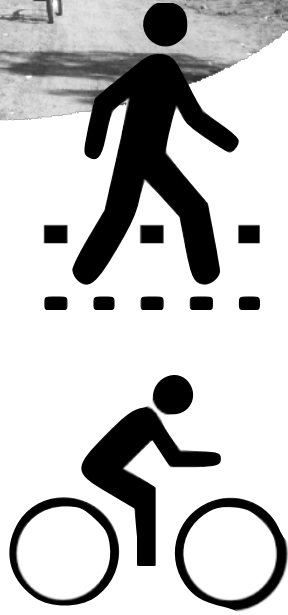


# “Internet light for all”

*free access to information for all*



## Road Infrastructure



- “Walk on Roads”
  - free usage for pedestrians & cyclists

- Speed & toll roads
  - Car: number plate
  - speed & comfort
  - often privately managed



- Successful complementarity

## “Internet light” Infrastructure



- “Walk on the Internet”
  - free access of information
  - local societies

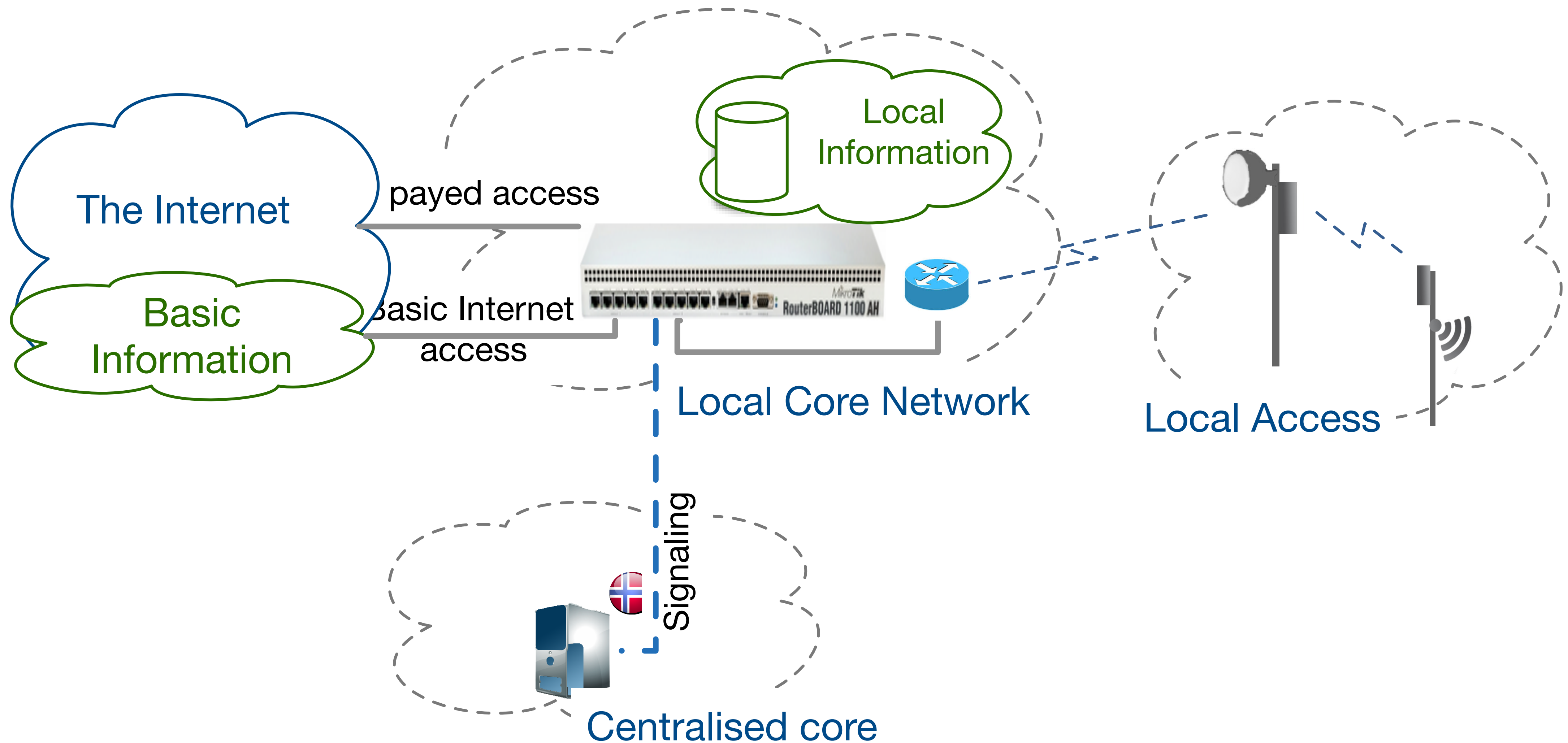
- Broadband and Mobile services
  - Voice, video & games
  - speed & comfort
  - privately managed



multimedia++

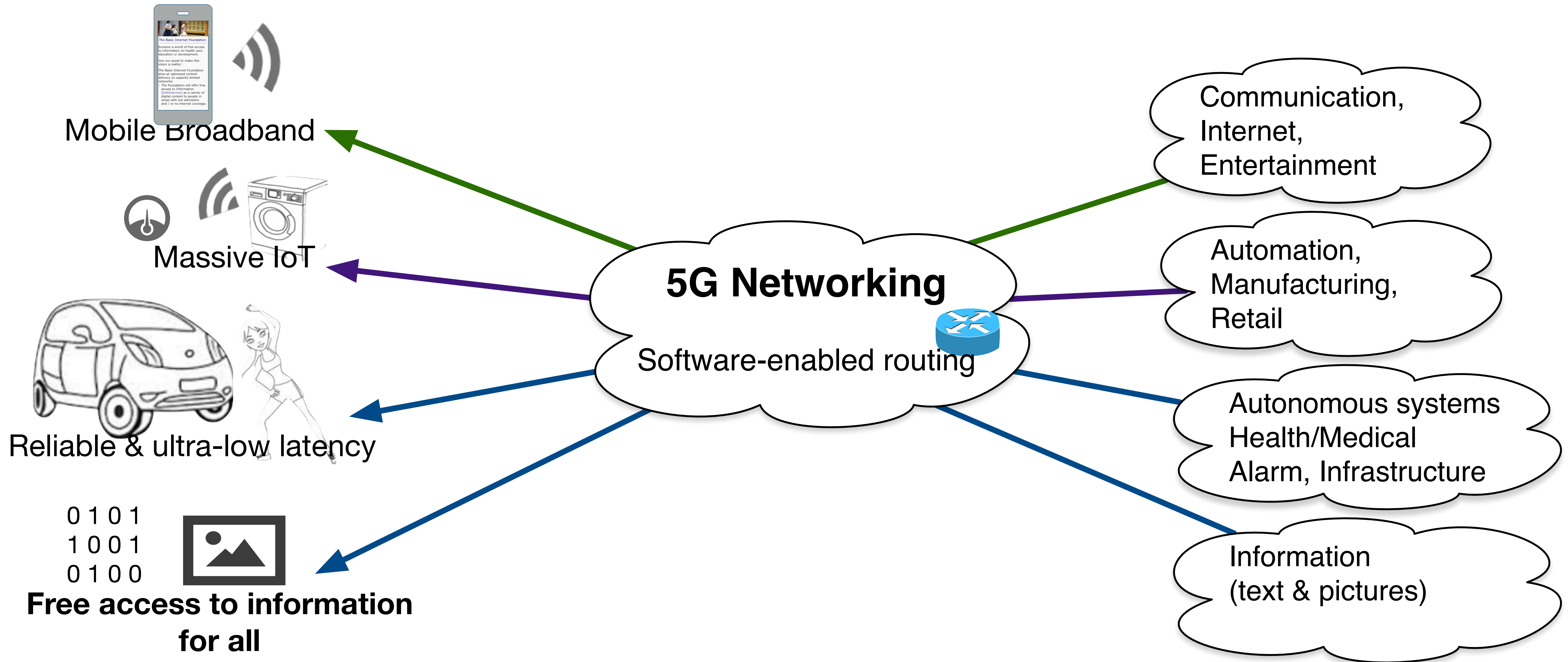
- Complementarity

# Basic Internet infrastructure: Technology Solution





# 5G network slicing for Free Access to Information for All

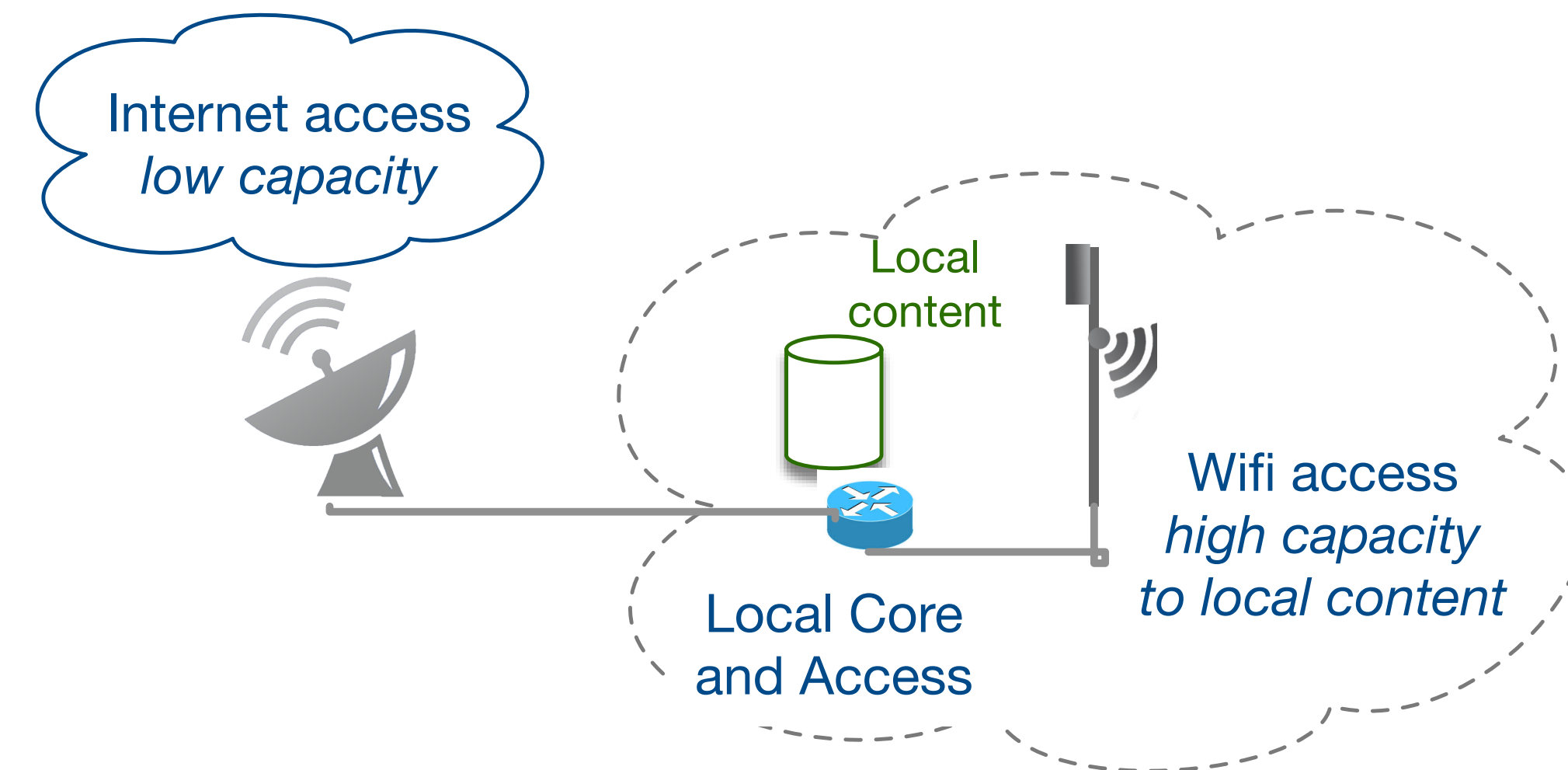


# Business in Internet light for all

Goal: Include people with 1 USD/month for communications



- **Reality** in Tanzania (as an example for Africa)
  - 49 Million people, 69% living in villages
  - over **4.000 villages are unconnected**, accounting for **13 M People**
  - **35% of people** without access to mobile data
- **Internet light for all** is sustainable
  - free access to **text, pictures** and **local video**
  - requires 2-2,5% of bandwidth, **>97%** available for **commercial use**
  - 10 min with video - or - 10 month with information
  - >300 people with free access = 1 commercial use

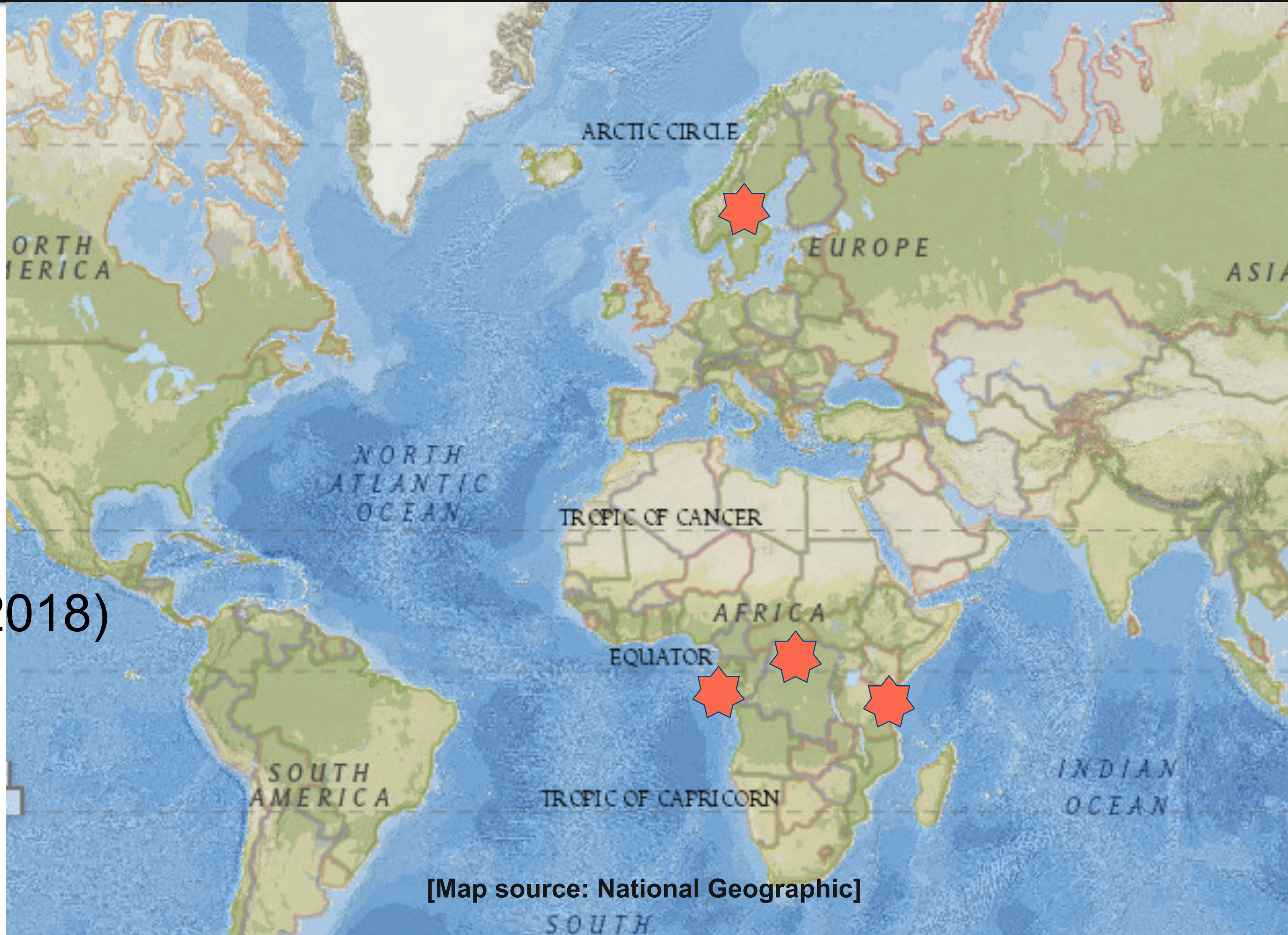




# Connect the unconnected - our projects



- Lisala, Kinshasa++ (2011)
  - ➔ Internet
- Kinshasa
  - ➔ Hot-spot, local content
- Oslo og Bærum, (2014)
  - ➔ Health "GravidPluss.no"
- Tanzania (2017)
  - ➔ Digital Health
- Congo (2017)
  - ➔ Digital Economy
- 21 Health stations in Norway (2018)
  - ➔ "TrygtSvangerskap.no"
- Pilot in India (2018?)
  - ➔ Global InfoInternet Standard
- Showcase Tanzania (2018?)



[Map source: National Geographic]





# Digital Health Spot for 300 €

Creating digital access for the unconnected



Digital inclusion  
The catalyst for sustainable development

300 € digital health hotspot

60.000 € connecting a village in TZ

250.000.000 € connecting all villages in TZ

89.000.000.000 € EU border control per year



Digital society



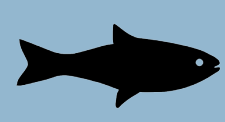
Agricultural and rural development



Education



Health



Food, water and shelter



80 € Solar panel



30 € Regulator



50 € Hotspot



20 € USB-charger



50 € Tablet



15 € LED light



20 € Battery



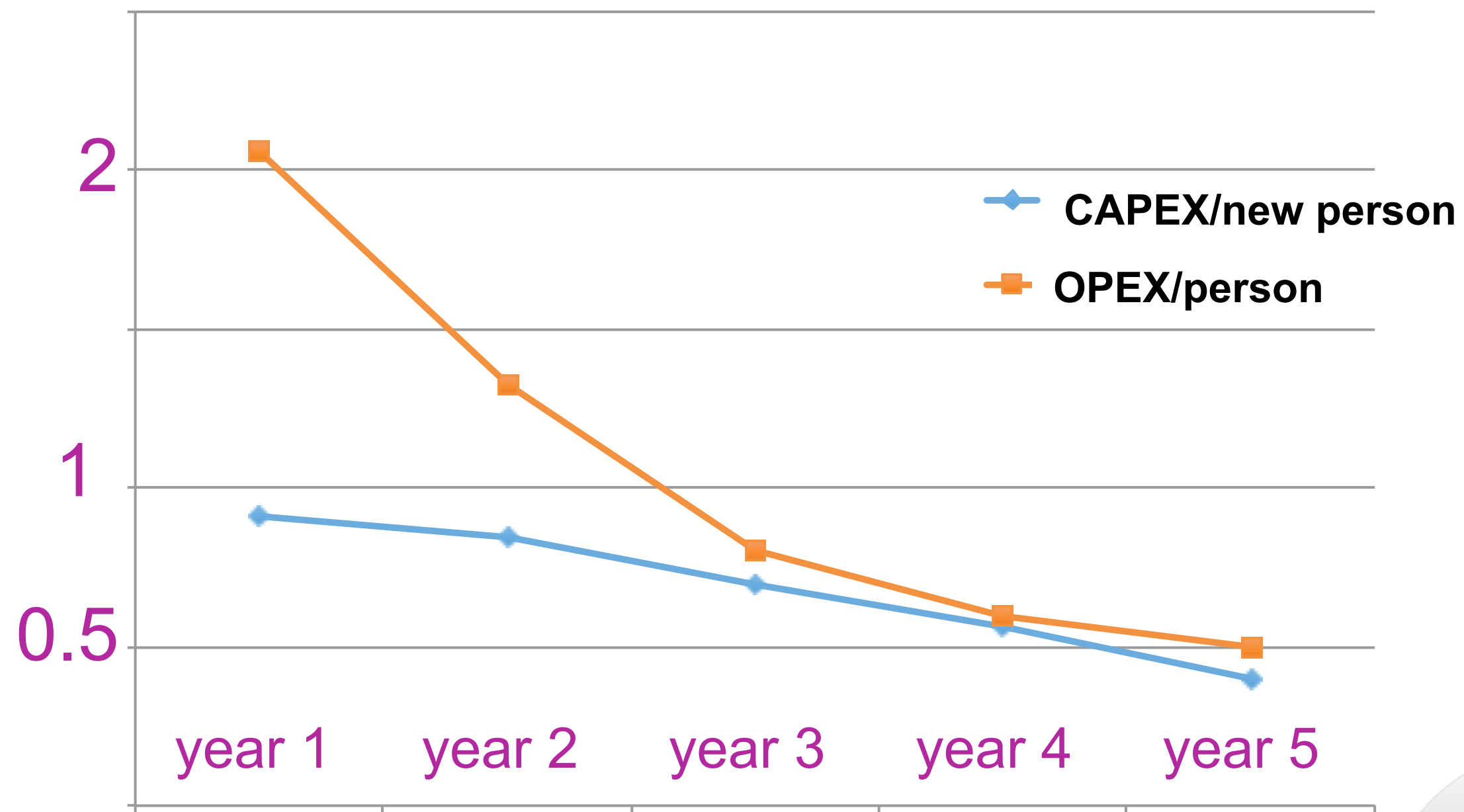
20 € Materials



# Estimation Cost of ICT development



## InfoInternet Costs/user/month [US\$]



- local Wifi spots
- based on Satellite connectivity

half a  
dollar is  
enough\*



## Comparison - societal costs



Source: UK GOVERNMENT UNIT COST DATABASE  
[www.data.gov.uk/sib\\_knowledge\\_box/toolkit](http://www.data.gov.uk/sib_knowledge_box/toolkit)



# Internet light for all



- **5G** development
  - (i) Massive mobile broadband,
  - (ii) billions of devices and
  - (iii) ultra-reliable and ultra-low latency networks
  - **NEW**: (iv) the free access to information for all.
- **Net neutrality**
  - access to information, compressed text and pictures through **Internet light for all**
- **Catalyst** for Sustainable Development Goals (SDGs)
- Pilots for **Digital Inclusion** through *Internet light for all*
  - Focus in **Tanzania** on **health**
  - Focus in **DRC** on education/**work**
  - **Global Standard** through India Pilot(?)





# Background slides



# Partnership for Digital Africa

<http://www.aftenposten.no/meninger/debatt/Kronikk-Som-gjesteland-pa-G20-toppmotet-ma-vi-bidra-til-a-endre-verden--Erna-Solberg-614076b.html>



Google translate

## Comment: As a guest country at the G20 summit, we must help to change the world | Erna Solberg

ERNA SOLBERG (H), PRIME MINISTER

UPDATED: 30.JAN.2017 9:39 P.M. | PUBLISHED: 30.JAN.2017 7:58 P.M.



DEBATE



In July last year was Erna Solberg invited by Angela Merkel for this year's G20 meeting. Here from a meeting between the German Chancellor and the Norwegian Prime Minister in Berlin in November, where Norway's participation as guest country at the economic summit were among issues discussed.

### 1. UN sustainability goals and Agenda 2030:

Germany has chosen this agenda as a backdrop for their entire program for the presidency, and I lead a group at the United Nations that will drive towards implementation.

We will work to ensure that the G20 goes ahead with its own specific commitments to help achieve sustainability goals.

### 2. Migration and partnership with Africa:

The world is experiencing the greatest influx of refugees since World War II. Europe, and especially Germany, have seen the consequences of that.

**It is necessary to improve the situation where people break up close.** Germany will use its chairmanship to do something about the problems which people belong. There is no minimum job creation and private investment. There are agreements with African countries wishing to achieve it.

G20 can therefore help the countries and international organizations use their resources more on measures which create growth and job creation.

### 3. Health and education.

Norway has long had a heavy international involvement. Education and health are associated with economic growth.



# 2. Migration and Partnership with Africa

- Example: Digital Tanzania
  - ➔ Unconnected: 13 Million people in 4.000 villages
  - ➔ Combined effort of
    - ➔ IT industry,
    - ➔ World Bank,
    - ➔ Telecom and
    - ➔ **Industry**



1 USD/month for Telecom



**GSM + Wifi**

- 200W
- MicroBTS

Cost: 70 kUS\$/village

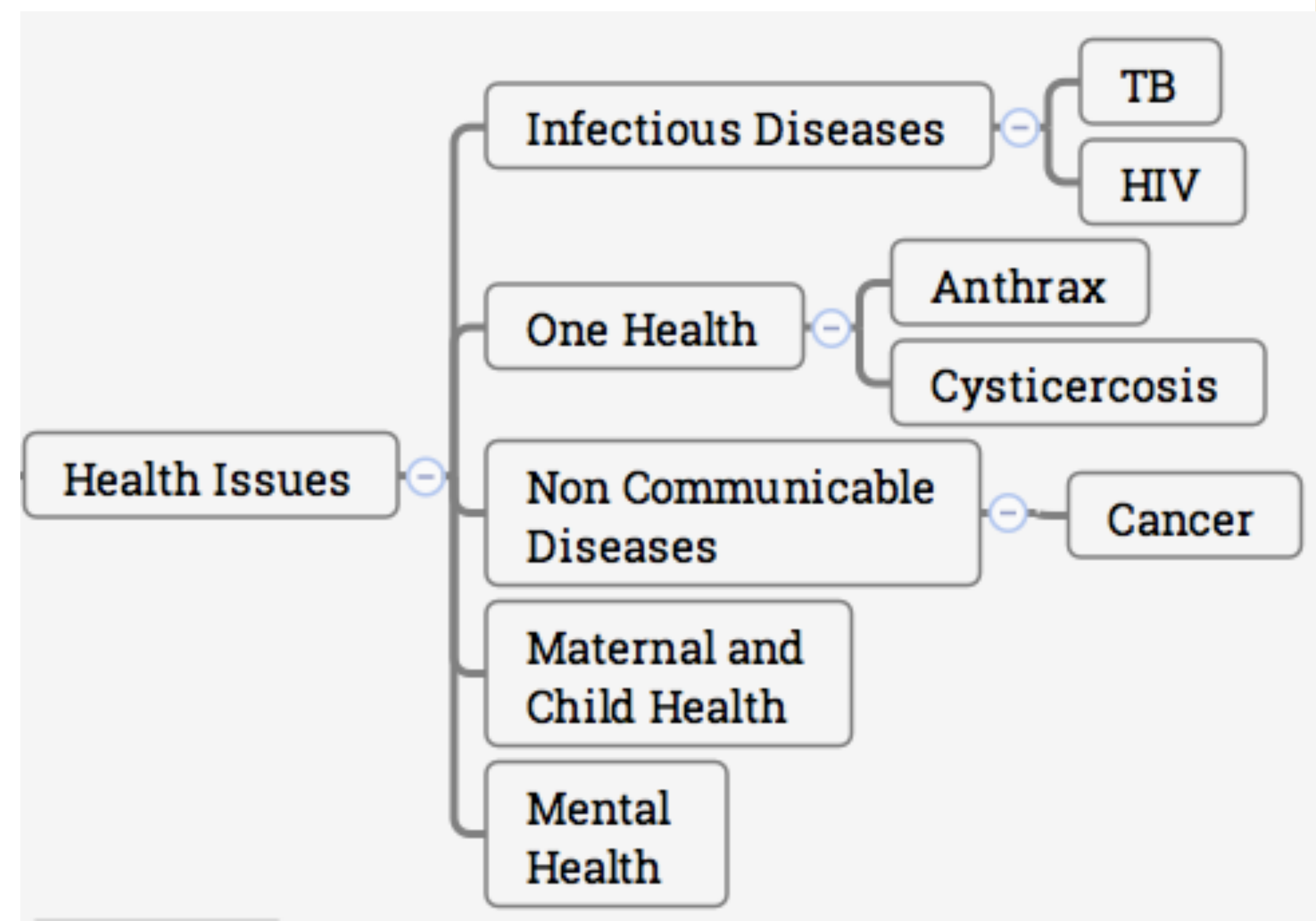


# Tanzania – Digital Health

2017



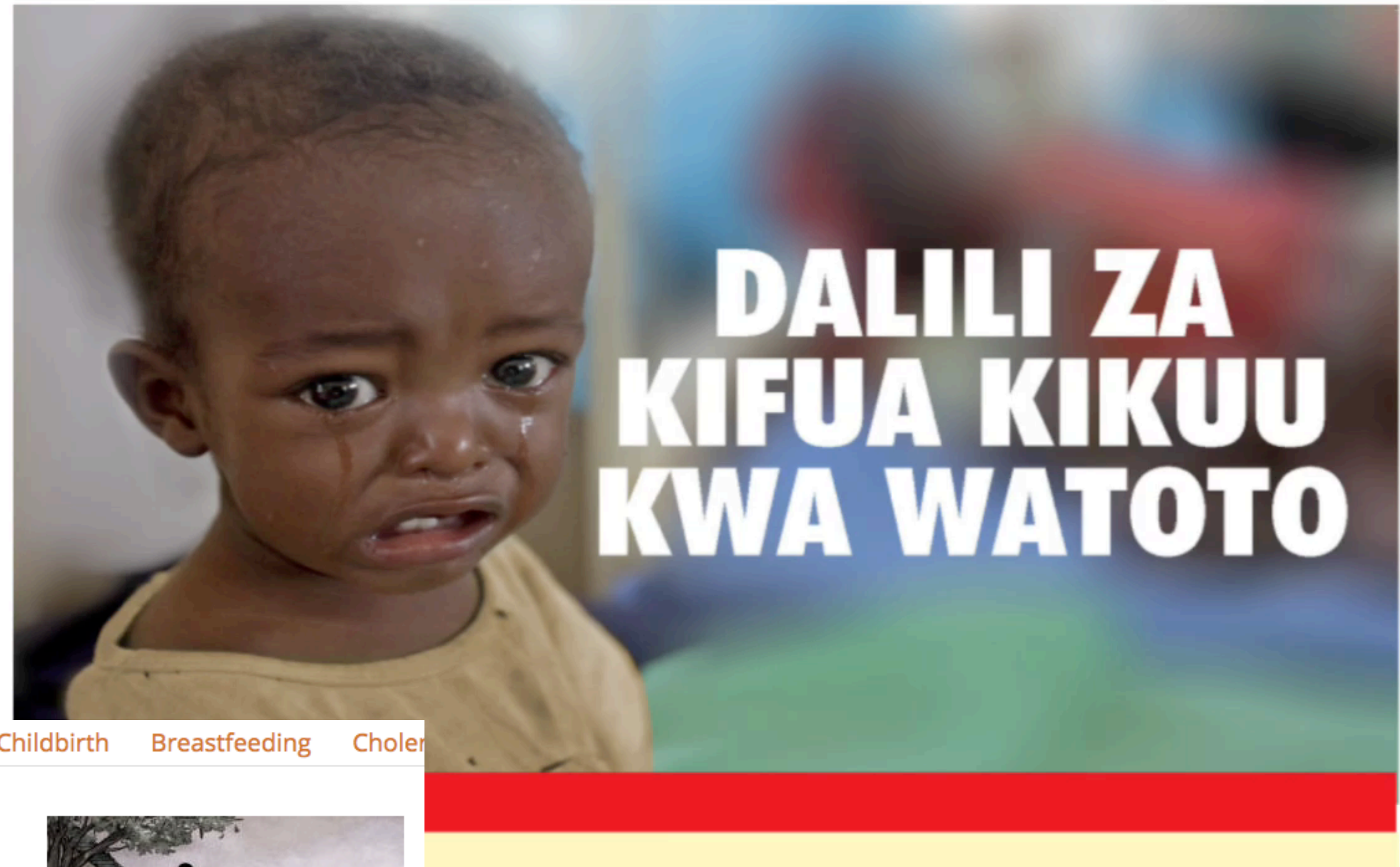
- Digital Health Information
  - ➔ 4 villages with health spots in Tanzania
  - ➔ Focus on TB, HIV, Anthrax and Cysticercosis
  - ➔ Health videos





# Digital Global Health Involvement, participation and sharing

- **Catalyst** for Agenda 2030 and S
- **Entry point** for the **Digital Socie**



All Small Baby Newborn Childbirth Breastfeeding Cholera



The Story of Ebola, English



The Story of Ebola, Swahili

<https://globalhealthmedia.org/videos>

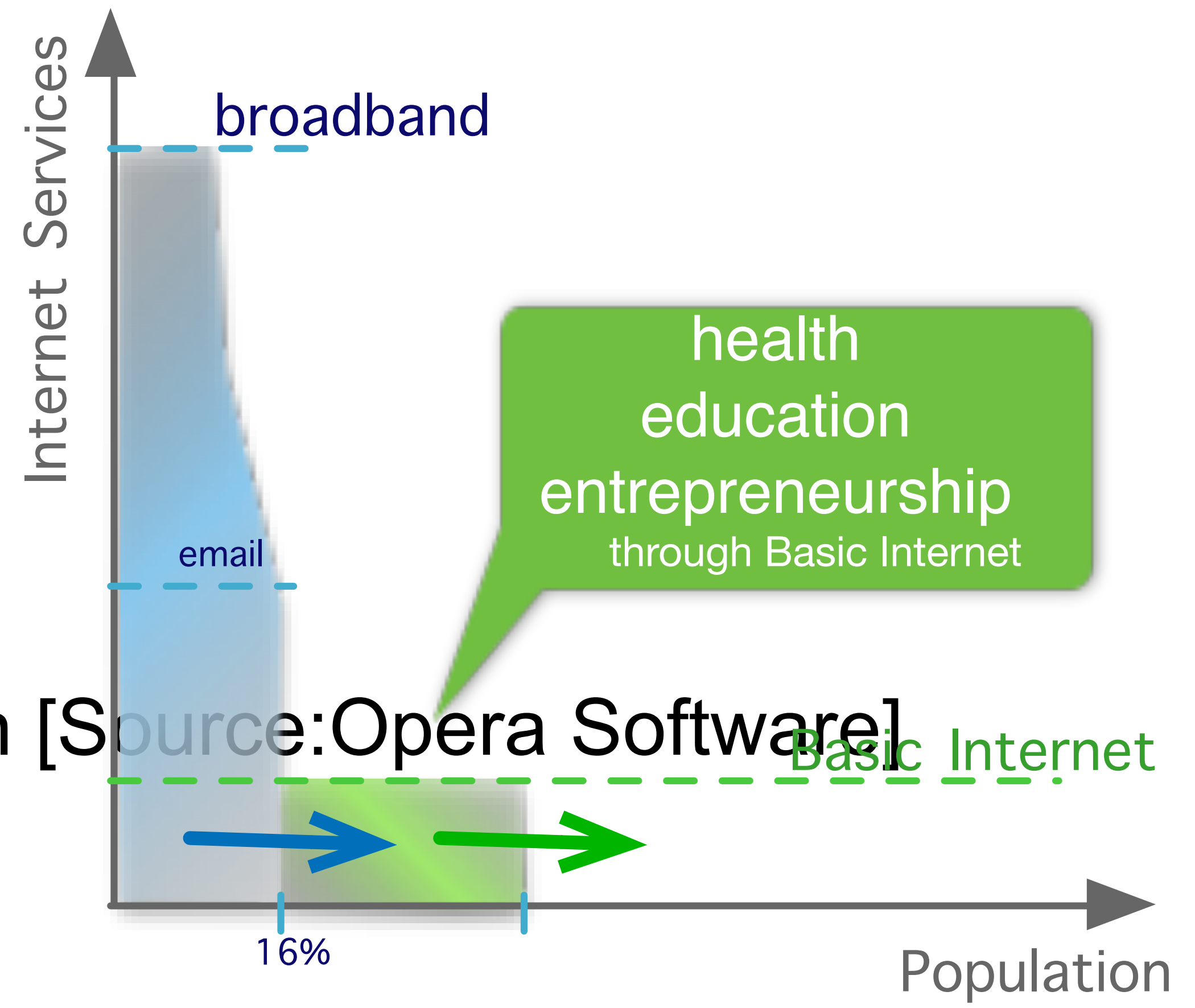




# “a dollar is enough”



- “nobody pays for a health video”
  - ➔ requires new business model
- *Internet light*: text & pictures
  - ➔ Free access to information
  - ➔ Local content: health video, education
  - ➔ Voucher access to entertainment
- 10 min video = 10 months of information [Source:Opera Software]
  - ➔ Information: 2-2.5% bandwidth
  - ➔ 1 paid user + 300-400 “Internet light”





# Partners



FR



ES



Ministry of Health, TZ



UiO



TZ



USA



TZ



UK





# Sustainability Goals (SDGs) and Agenda 2030



Goal: Include people with 1 USD/month for communications

Free local info  
📖 health  
📖 education

## 1. UN sustainability goals and Agenda 2030:

Germany has chosen this agenda as a backdrop for their entire program for the presidency, and I lead a group at the United Nations that will drive towards implementation.

We will work to ensure that the G20 goes ahead with its own specific commitments to help achieve sustainability goals.

## Our contribution:

- Information for all (**InfoInternet**)
  - **free access** to text and pictures
    - the “**walk** on the Internet”
  - paid access to amusement
    - “Toll Roads”
- The **catalyst** for the SDGs





# Work in DRC

- Addressing Internet as enabler for Digital Society
  - ➔ existing mobile (GSM only) network
  - ➔ existing entry through ongoing collaborations
- Potential services:
  - ➔ voucher-sales for digital services,
  - ➔ electrical lights,
  - ➔ programs and mentoring for education and health
- Sustainability
  - ➔ operated by commercial actor
  - ➔ service continuity (free InfoInternet)
    - ➔ only 2-2,5% of bandwidth needed

