UiO : Department of Technology Systems
University of Oslo

Digital Transformation for Holistic and Inclusive Development Conference, Gondar (ET), 4-6Apr2022

The Need for Digital Inclusion in Digital Transformation

Josef Noll,
Professor, University of Oslo, Department of Technology Systems
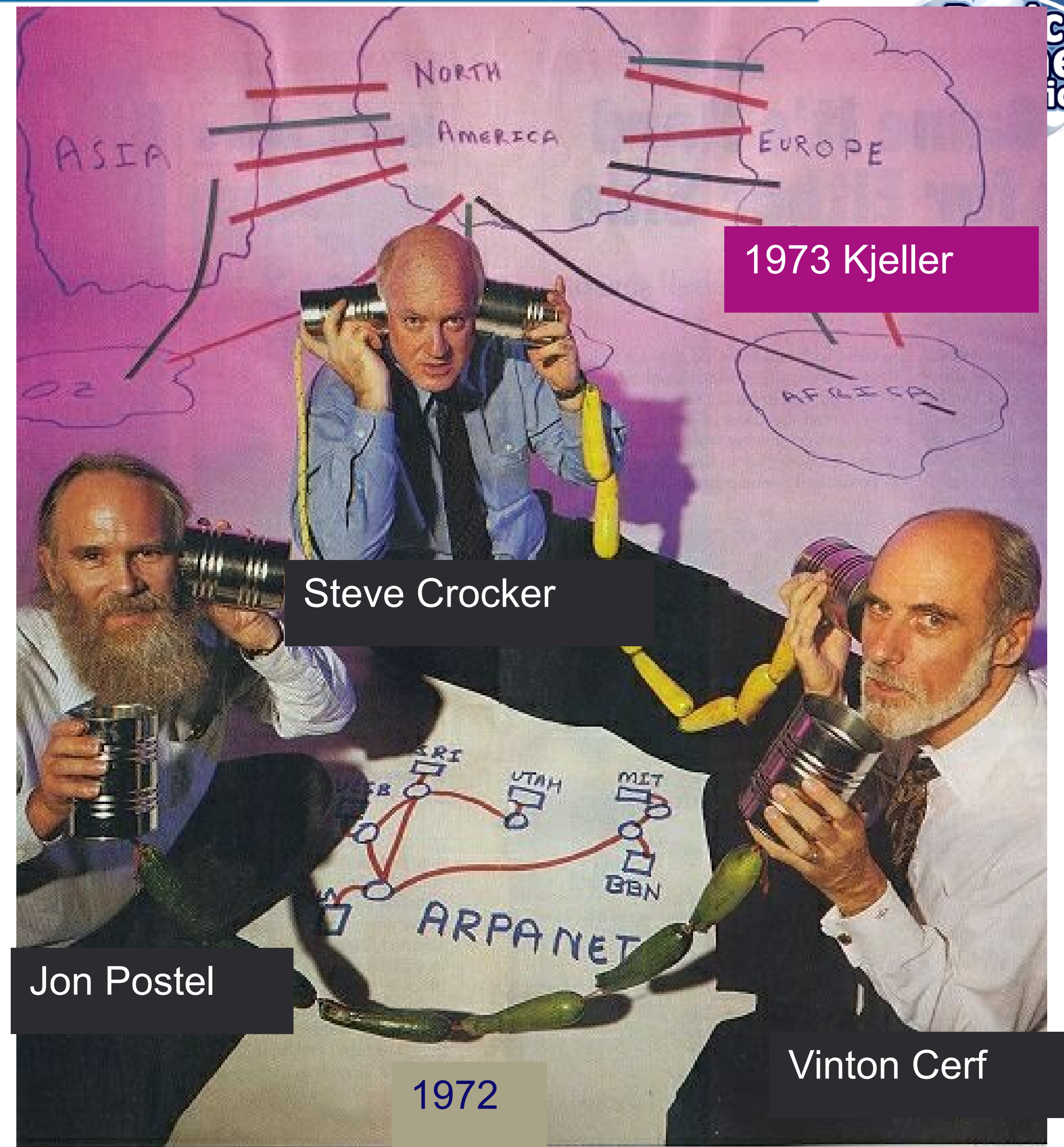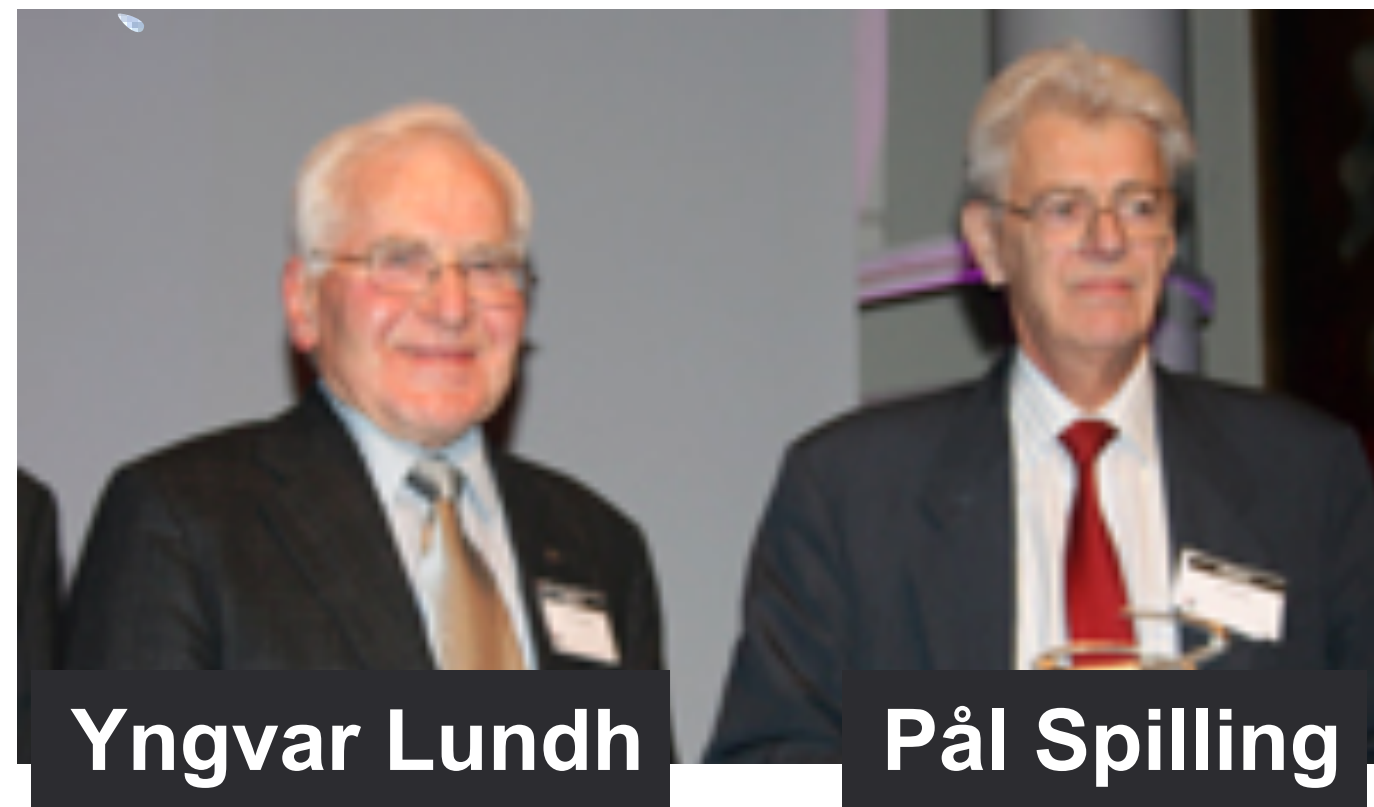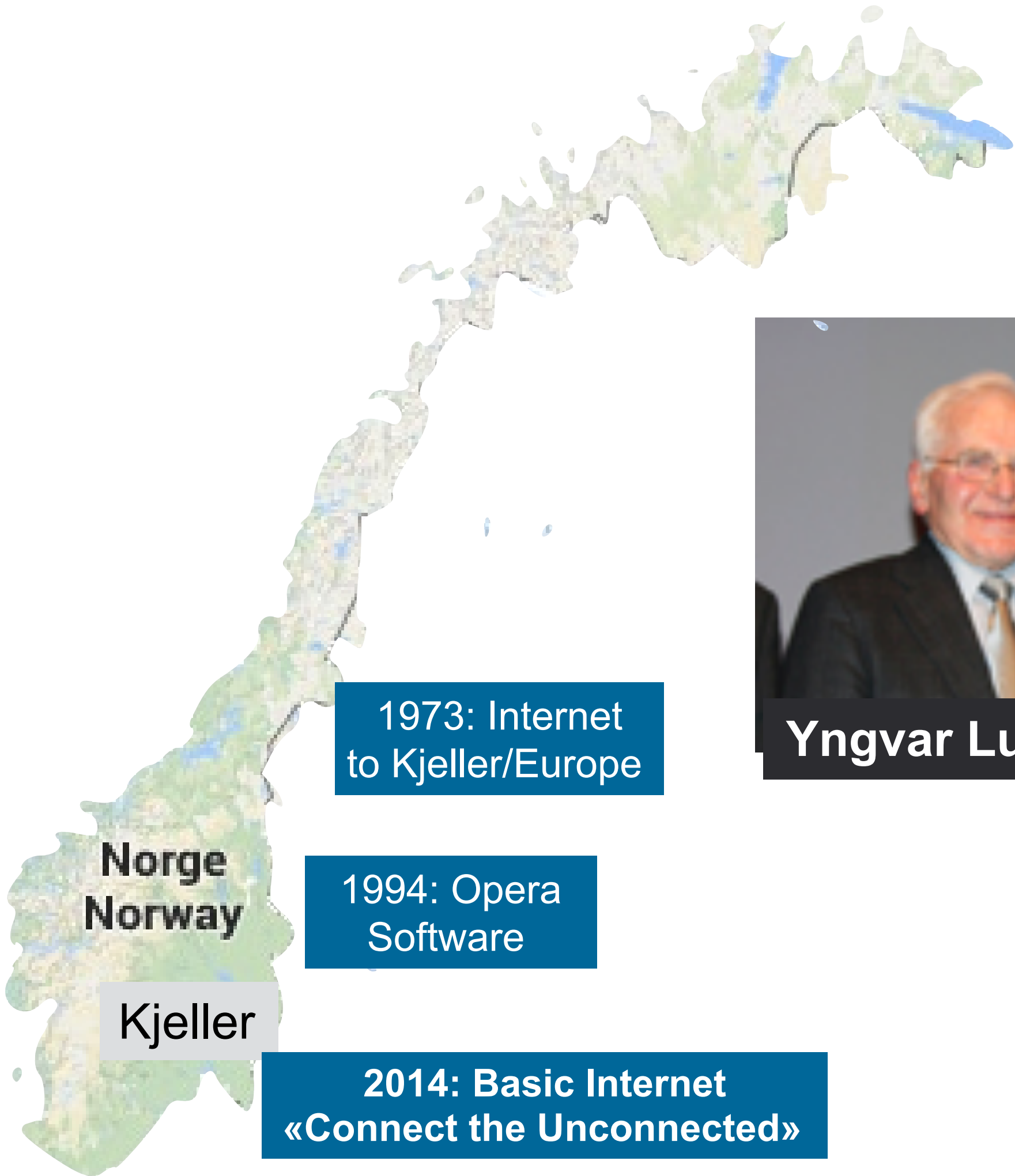Lead: Digital Global Health, Centre for Global Health, UiO
Secretary General, Basic Internet Foundation
Kjeller, Norway, m: +47 9083 8066

Next Generation Internet as basis for empowerment and trust

1973 Kjeller

1973: Internet to Kjeller/Europe

Yngvar Lundh   **Pål Spilling**

1994: Opera Software

Norge Norway

Kjeller

2014: Basic Internet «Connect the Unconnected»

Steve Crocker

Jon Postel

Vinton Cerf

1972

Source: http://www.michaelkaul.de/History/history.html

Why Inclusion?

2014: Basic Internet «Connect the Unconnected»

Kjeller

➡ "The German coming to the Nordics"

▪ Radio, Communications, Remote Sensing

▪ Siemens, European Space Agency (ESA)

▪ Telenor: 3G development (Kjeller)

➡ The Nordics & Baltics

▪ Internet to Europe (1973), Pioneers: Vint, Paal, Yngvar

▪ .php, OpenSource, Linux, Skype, Spotify

▪ OperaSoftware, FAST Search

▪ Nokia, Ericsson

▪ Telenor, TeliaSonera

➡ "Internet to Africa" (2012)

▪ Basic Internet Foundation (2014)

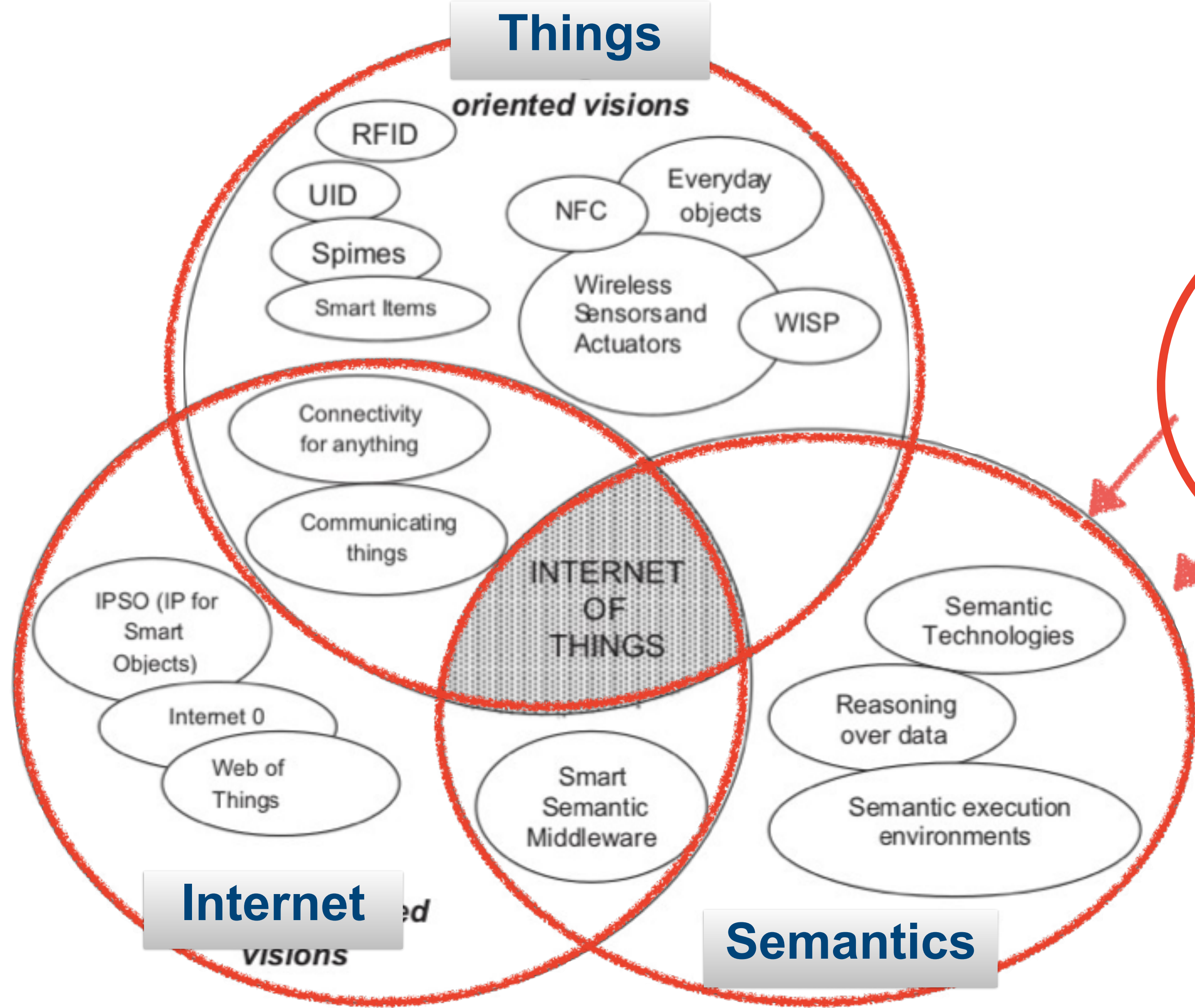**Internet of Things (IoT)**

5G (6G)

Digital Inclusion

Sustainable Development Goals

The Internet of Things (IoT)

➡ IoT =
- Things +
- Internet +
- **Semantics**

➡ Things that communicate
- with Things: computer,
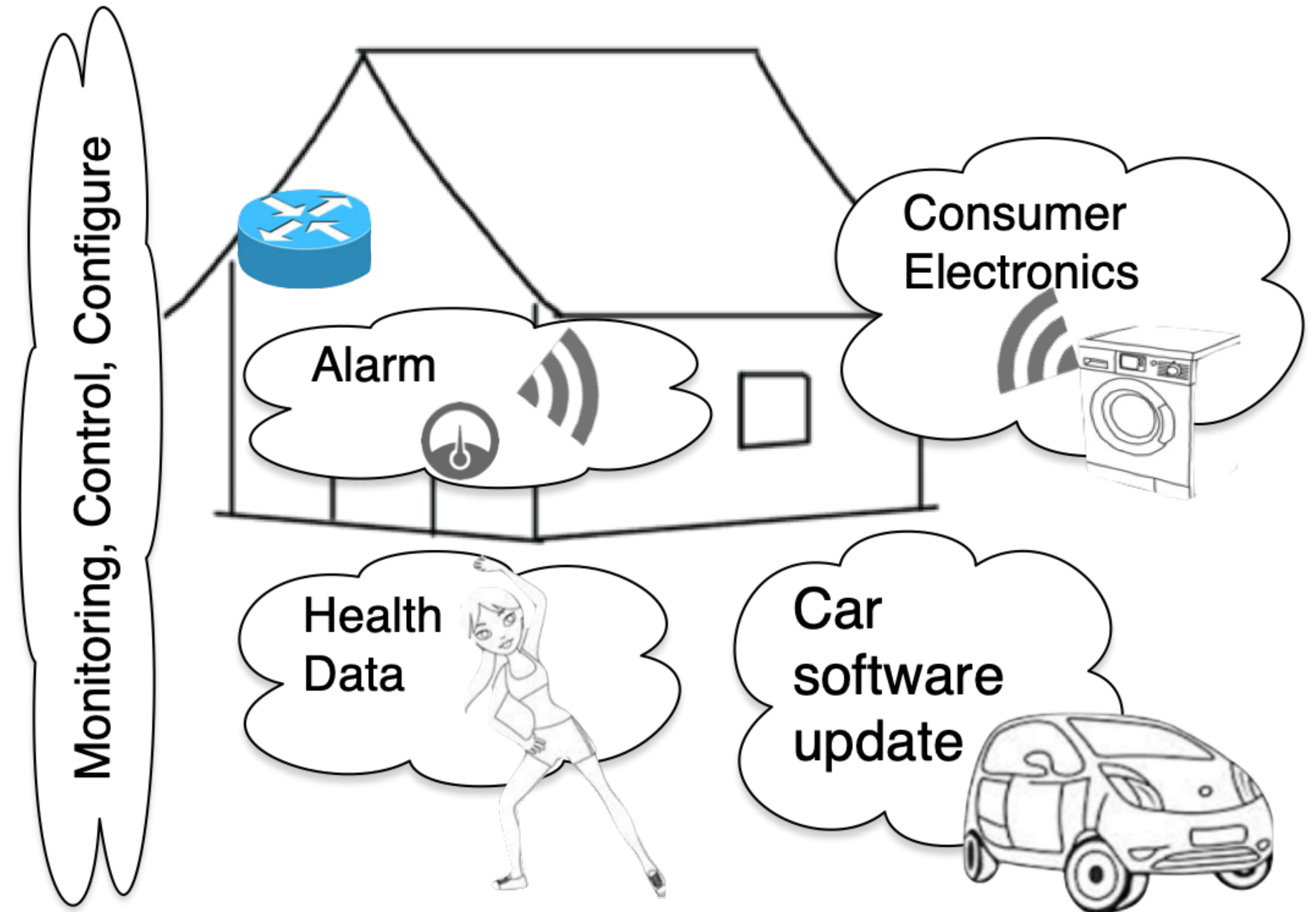- understand the meaning,
- takes own decisions

* security
* privacy
* dependability
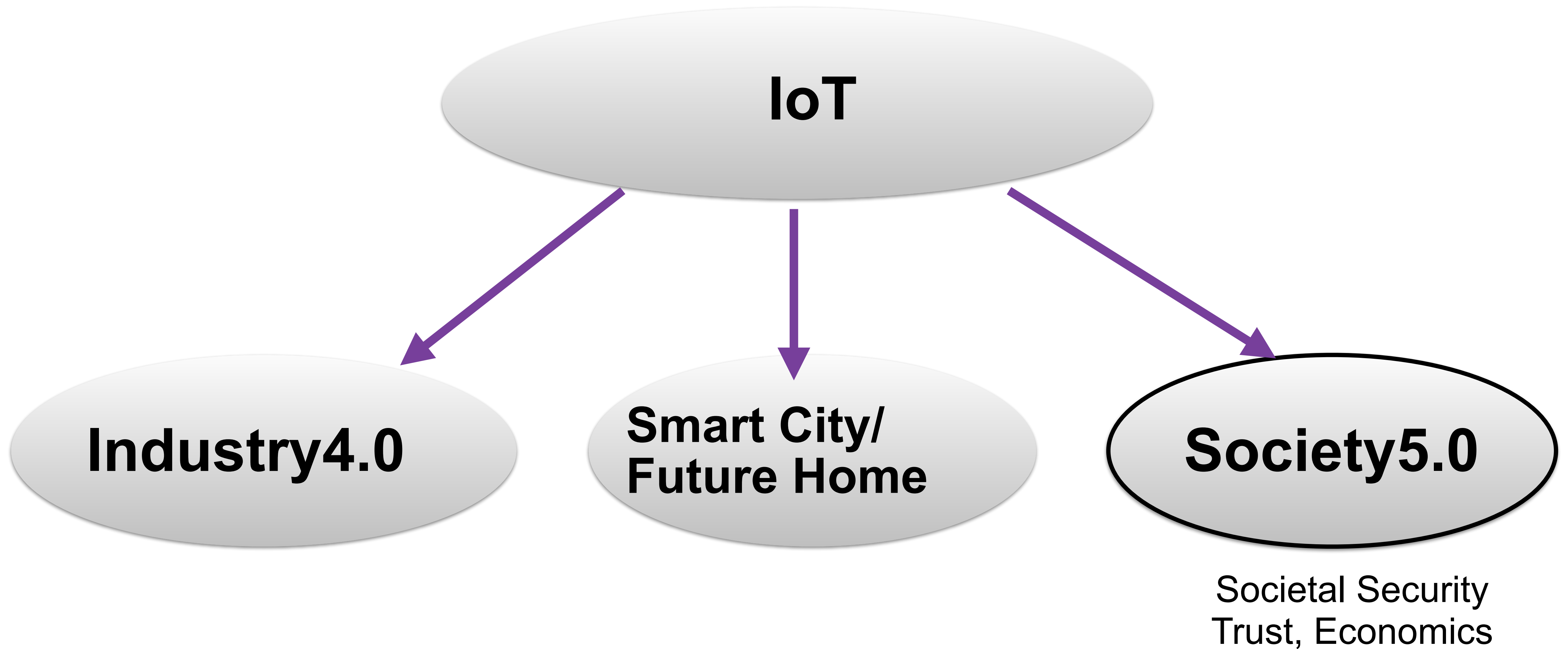* context-aware
* personalised

Fig. 1. "Internet of Things" paradigm as a result of the convergence of different visions.

Internet of Things (IoT)

➡ Interconnected power systems

▪ measure:
  ‣ Voltage,
  ‣ Frequency variation
▪ automatic control

➡ Controlling home appliances

▪ Power consumers:
  ‣ heat pump, water heater
  ‣ car charger
  ‣ washing machine, dish washer
▪   Convenience & Security

Monitoring, Control, Configure

Alarm

Consumer Electronics

Health Data

Car software update

Internet of Things (IoT)

IoT

Industry4.0

Smart City/
Future Home

Society5.0

Societal Security
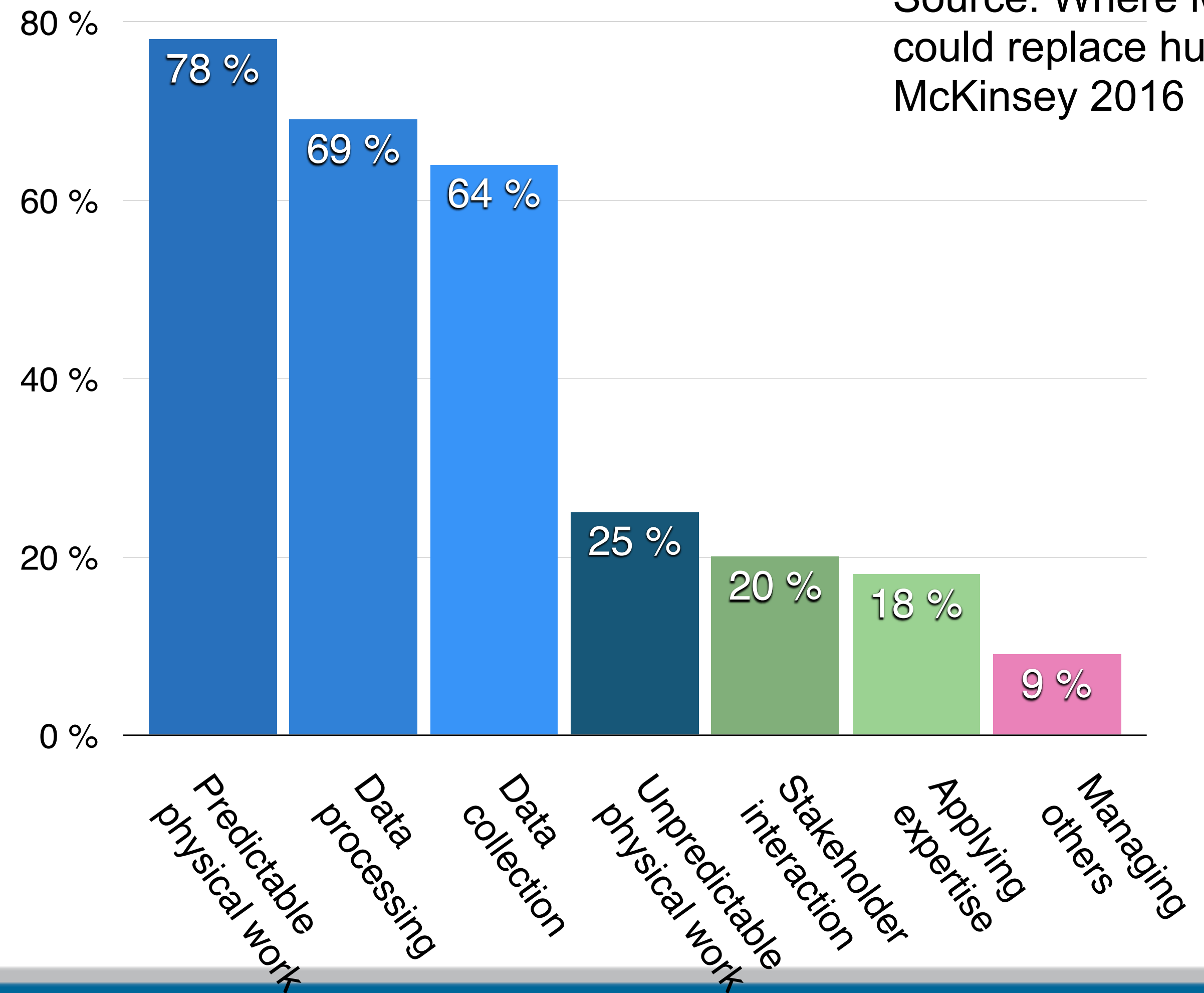Trust, Economics

Automation will come

USA work force time spent [%]

- ● Predictable physical work
- ● Data collection
- ● Stakeholder interactions
- ● Managing others
- ● Data processing
- ● Unpredictable physical work
- ● Applying Expertise
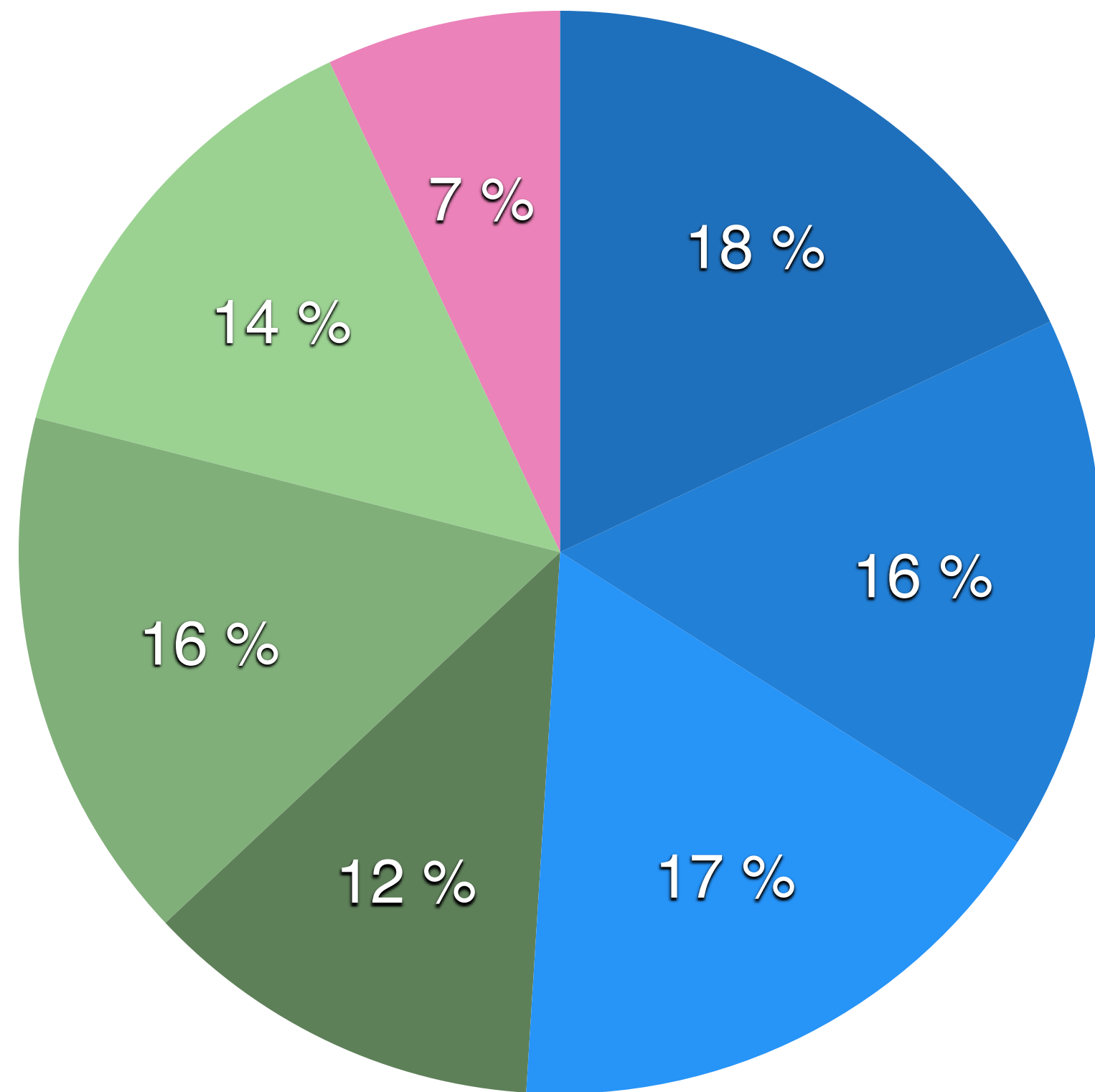
Technical automation potential **2016** [%]

Source: Where Machines could replace humans, McKinsey 2016

Significance

IoT security challenges

➡ Mirai attack

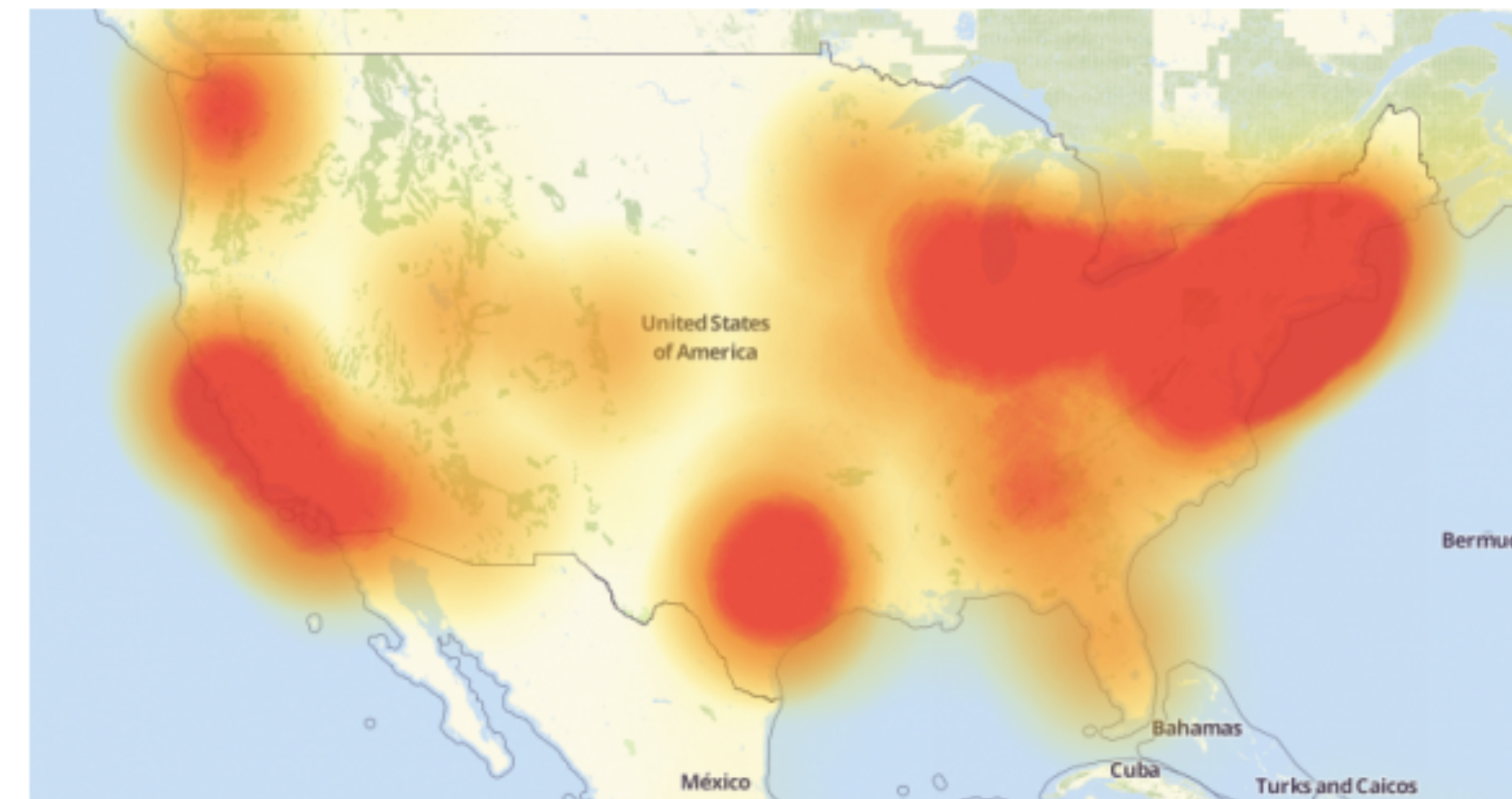- "security by obscurity"
- different security viewpoint

➡ "it is just the beginning"

- 4x increase in capability in 2018

21 Hacked Cameras, DVRs Powered Today's Massive Internet Outage

16Oct2016

A massive and sustained Internet attack that has caused outages and network congestion today for a large number of Web sites was launched with the help of hacked "Internet of Things" (IoT) devices, such as CCTV video cameras and digital video recorders, new data suggests.

Earlier today cyber criminals began training their attack cannons on **Dyn**, an Internet infrastructure company that provides "critical technology services to some of the Internet's top destinations. The attack began creating problems for Internet users reaching an array of sites, including Twitter, Amazon, Tumblr, Reddit, Spotify and Netflix.

[Source: https://krebsonsecurity.com/2016/10/hacked-cameras-dvrs-powered-todays-massive-internet-outage/]

Trust for IoT

Wireless Train Coupling

https://www.youtube.com/watch?v=pMQ0CWzOKTI

"Building Trust in the Internet of Things"

SECURITY

USABILITY

PRIVACY

SCOTT DEMONSTRATOR BOOKLET
SCOTT USE CASE BOOKLET

What is SCOTT?
SCOTT RESULTS

Publications
YouTube

SAFETY

TRUSTABILITY

SCOTTproject.eu

Internet of Things (IoT)

5G (6G)

Digital Inclusion

Sustainable Development Goals

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

Service & Sustainability

5G: .... → Seamless integration

Security, Sustainability

4G: LTE → Mobile broadband services

3G: UMTS → Web, Multimedia, Communications

2G: GSM → Mobile telephony, SMS, FAX, Data

1G: NMT → Mobile telephony

1970 1980 1990 2000 2010 2020
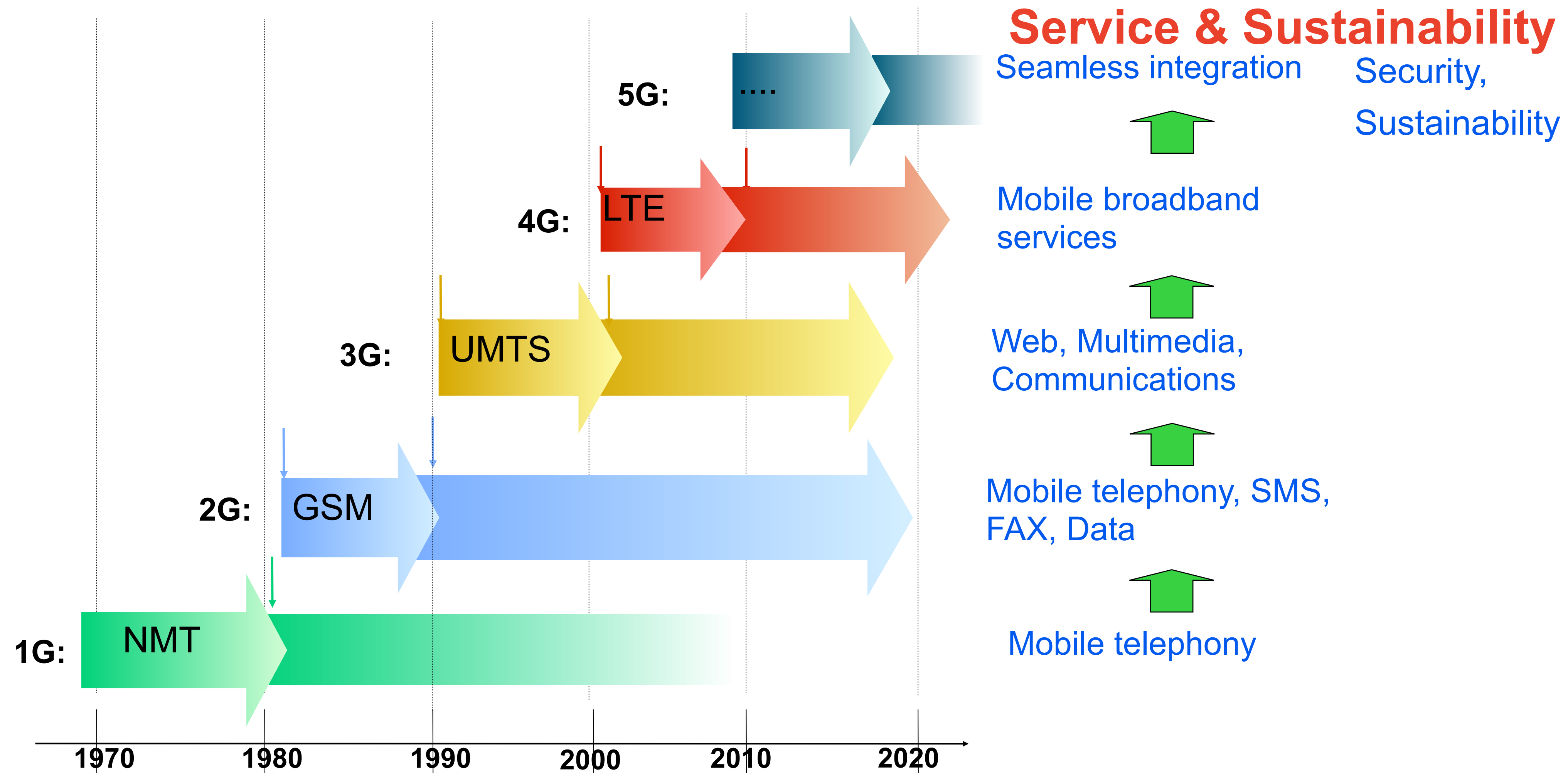
[adapted from Per Hjalmar Lehne, Telenor, 2000]

5G: Industrial Challenges

eMBB

➡ enhances Mobile Broadband

➡ massive IoT

➡ ultra Reliable, Low Latency communication

>10 Gbps peak data rates

100 Mbps whenever needed

10 000 x more traffic

10-100 x more devices

M2M ultra low cost

10 years on battery

<1 ms radio latency

Ultra reliability

"Unlimited experience"

Extreme Mobile Broadband

5G

Massive machine communication

Critical machine communication

"For everything"

"Instant action"

mIoT

URLLC

[source: Nokia https://networks.nokia.com/5g/get-ready]
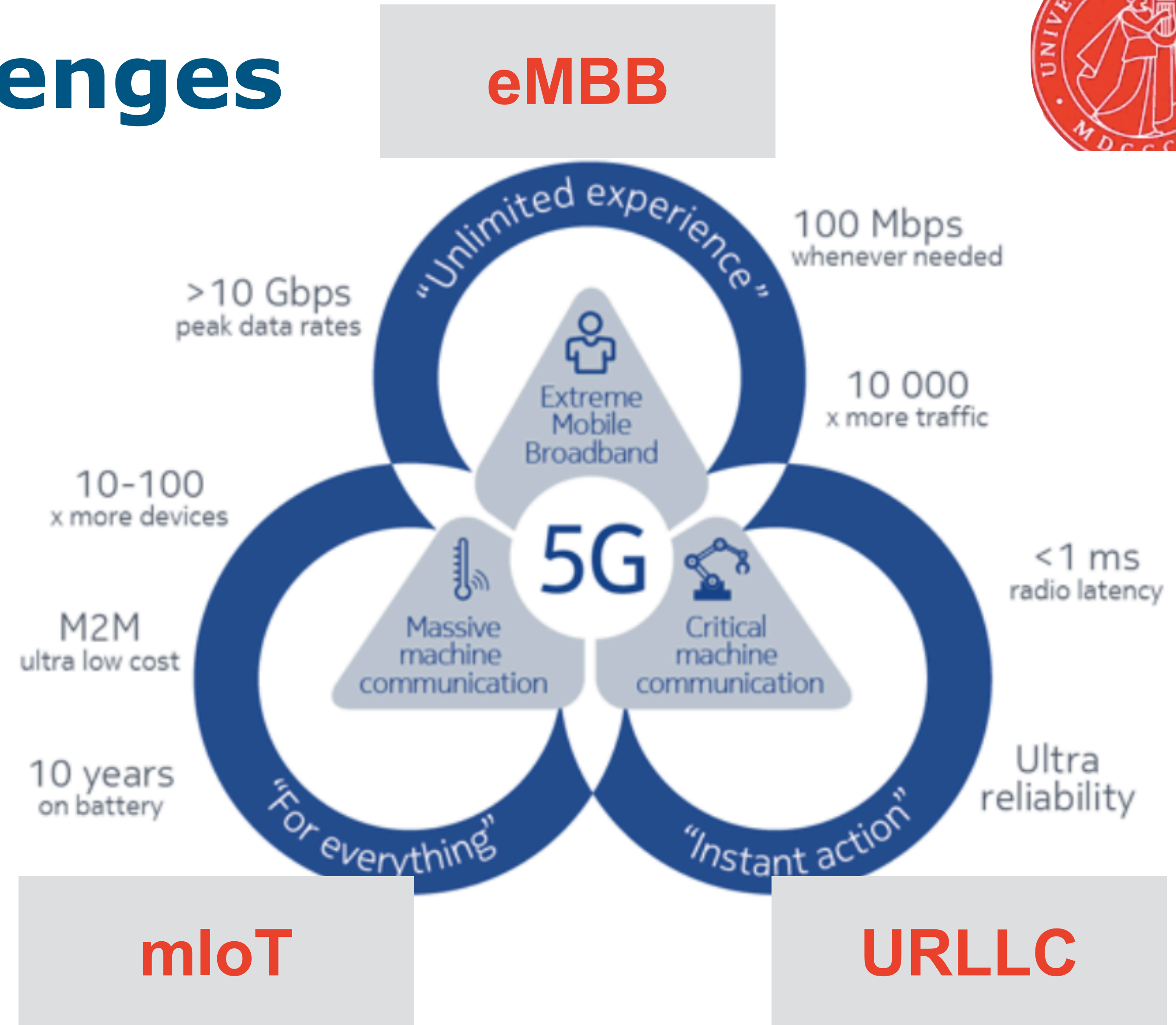
5G – hva mangler vi

➡ #5GforAll

▪ radio interface: Large cell,
low mobility sites (low density rural areas)

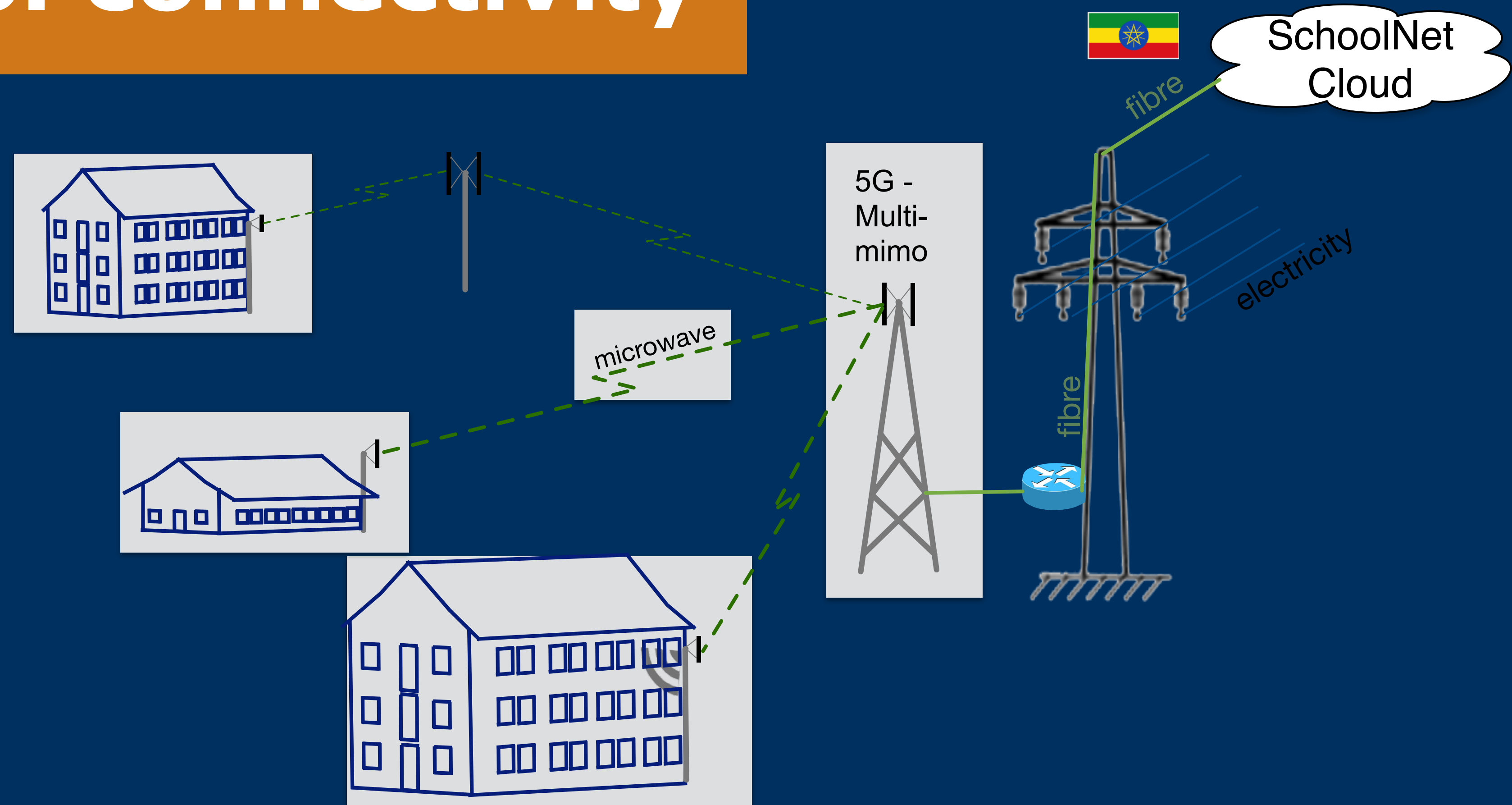▪ freemium model for access
(freemium = free + premium)

➡ Missing aspects in 5G

▪ interface mobile-home network

  ‣ we become network operators

▪ application-specific routing (service quality)

▪ interference with unlicensed technologies
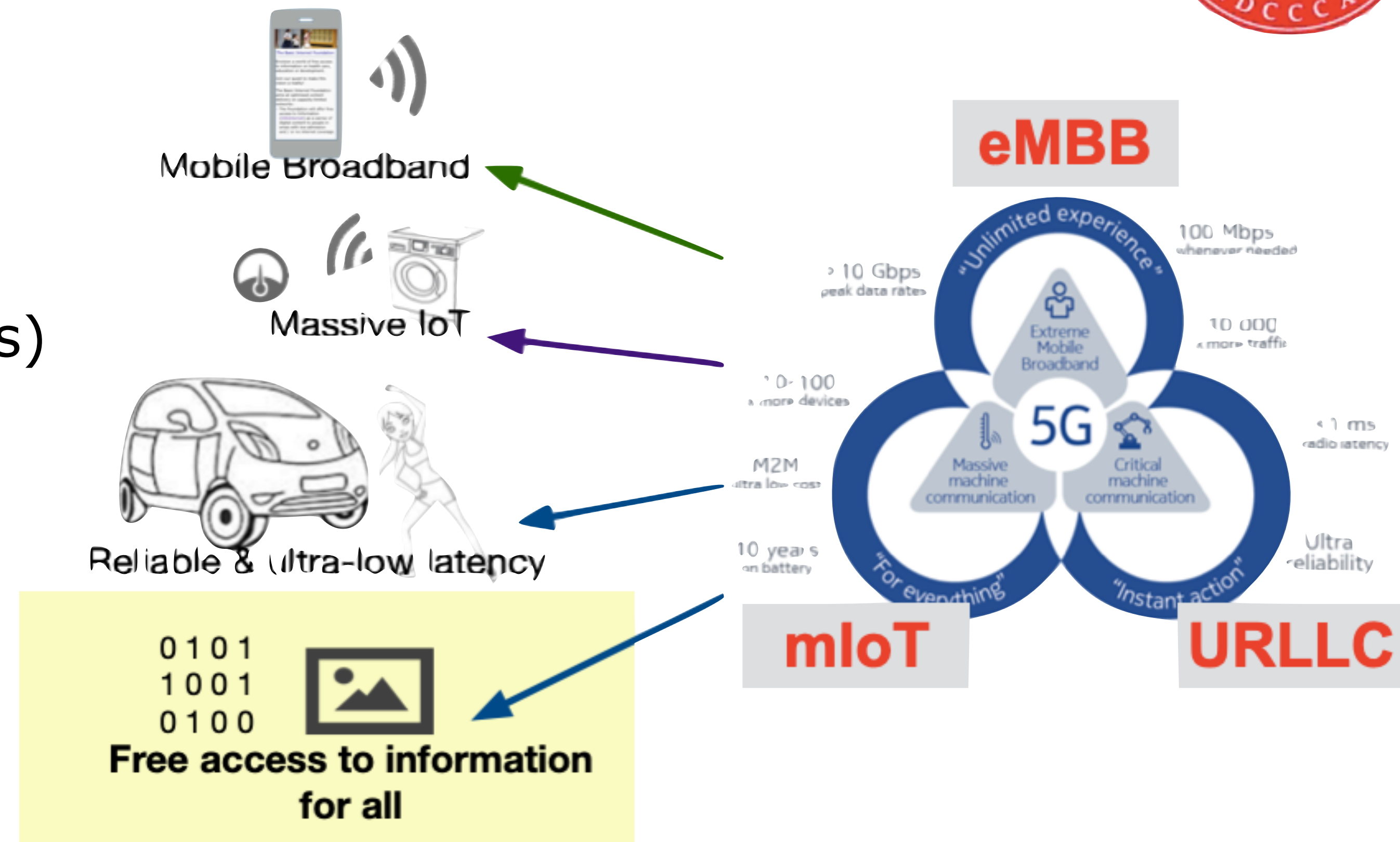
5G for reaching the villages

5G for school connectivity

SchoolNet Cloud

fibre

electricity

5G - Multi-mimo

microwave

fibre

Internet of Things (IoT)

5G (6G)

Digital Inclusion

Sustainable Development Goals

Starting Point:

"Our vision is
to improve the life of **every human**
through **free access to information** on the
Internet…."
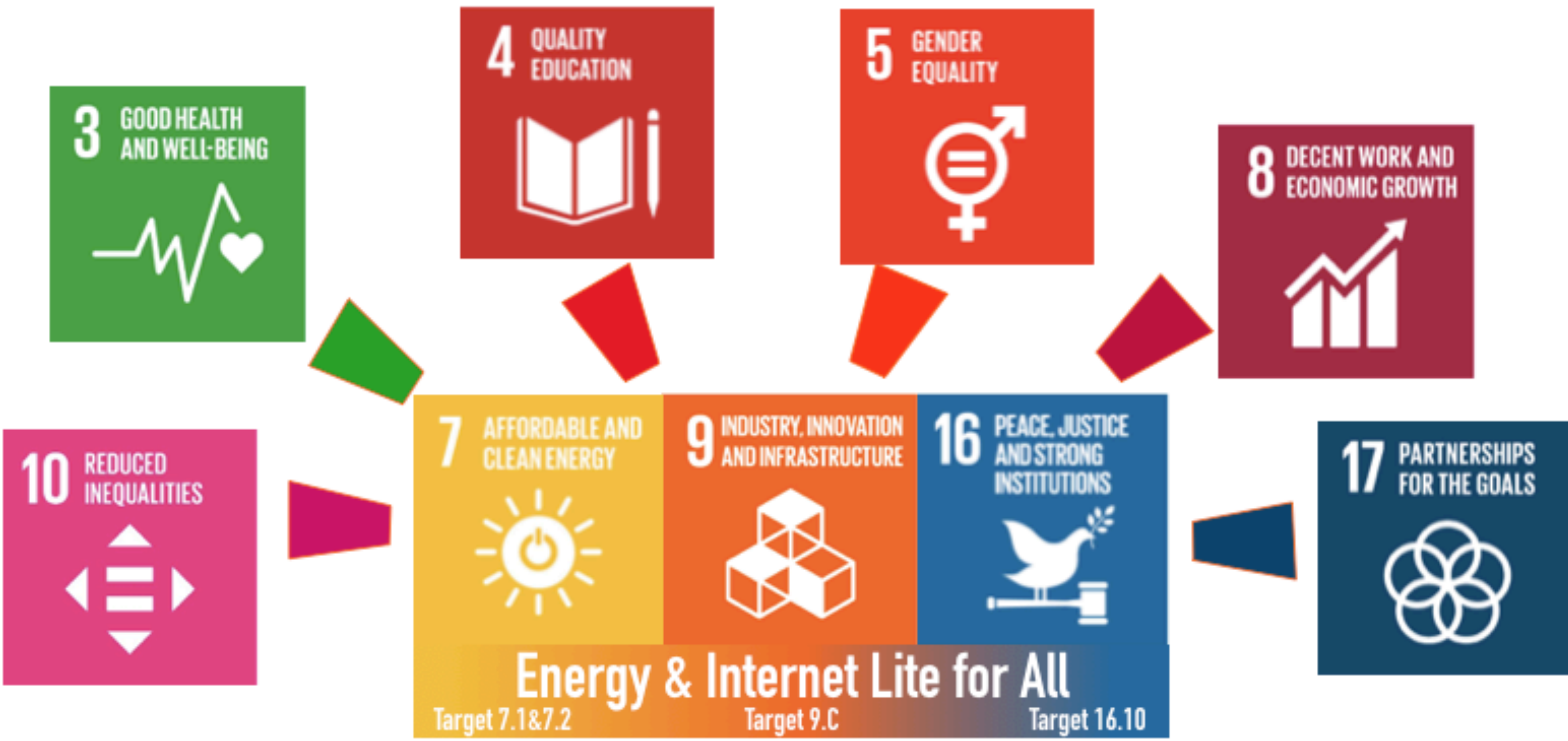
Proof of concept

➡ Koye Secondary and Preparatory School

- connected as part of African Innovation Week 2019
- using mobile network

Ethiopia did it!

➡ COVID-19 response

- "free access to health & education"

- "zero rating"
  - ‣ Health (MoH): MoH.gov.et
  - ‣ Ephi.gov.et & Covid19.et
  - ‣ Education: National Digital Library
    NDL.ethernet.edu.et

➡ follow-up from discussions after African
Innovation Week (AIW2019)

ethio telecom

ግንቦት 24 ቀን 2012 ዓ.ም

ኢትዮ ቴሌኮም የከፍተኛ ትምህርት ተቋማት ተማሪዎች እና መምህራን
ትምህርታዊ መረጃዎችን ከ http://ndl.ethernet.edu.et/
በነፃ ማግኘት እንዲችሉ አደረገ

በአገራችን የኮሮና ቫይረስ (COVID-19) ወረርሽኝን ለመከላከል በመንግሥት በኩል
በርካታ እርምጃዎች እየተወሰዱ ሲሆን ከነዚህም መካከል የገፅ ለገፅ ትምህርት
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ተቋማት መምህራን እና ተማሪዎች ከትምህርት ጋር ተያያዥነት ያላቸውን አጋዥ
መረጃዎች ከ **http://ndl.ethernet.edu.et/ በነፃ ማግኘት** እንዲችሉ
በማድረግ የመማር ማስተማሩ ሂደት እንዲቀጥል የበኩሉን አስተዋፅኦ ማድረጉን በደስታ
ይገልፃል::

በተመሳሳይ ሁኔታ ኩባንያችን ስለወረርሽኙ ወቅታዊ መረጃ ለህብረተሰቡ እየሰጡ
የሚገኙትን የጤና ሚኒስቴር **http://www.moh.gov.et** ፣ የኢትዮጵያ ህብረተሰብ
ጤና ኢንስቲትዩት **http://www.ephi.gov.et** እንዲሁም የተቋቋመ የኮቪድ **19**
መቆጣጠሪያ ስርዓት ድረ-ገፅን **http://www.covid19.et** በነፃ እያቀረበ መሆኑ
ይታወቃል::

Public Opinion on SDGs ([afrobarometer.org]( ))

➡ Priorities by people in Africa

- ▪ decent work
- ▪ zero hunger
- ▪ good health
- ▪ ...

SDG	Priority	%
8 DECENT WORK AND ECONOMIC GROWTH	decent work	57%
2 ZERO HUNGER	zero hunger	31%
3 GOOD HEALTH AND WELL-BEING	good health	27%
16 PEACE AND JUSTICE STRONG INSTITUTIONS	peace & jus	26%
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	industry	24%
6 CLEAN WATER AND SANITATION	clean water	24%
1 NO POVERTY	no poverty	22%
4 QUALITY EDUCATION	qual. edu	21%
7 AFFORDABLE AND CLEAN ENERGY	clean energy	13%
11 SUSTAINABLE CITIES AND COMMUNITIES		4%
13 CLIMATE ACTION		3%
10 REDUCED INEQUALITIES		2%
5 GENDER EQUALITY		1%

need to have

nice to have

# Summary
"Access, Skills, Regulations & Inclusion"

- Technology meets global challenges
  - ➡ Billions of sensors <=> electronic waste
  - ➡ Cyber-/IoT-security <=> Trust and Societal Security
  - ➡ Automation, Industry4.0 <=> Trust and Transparency

- Digital Cooperation
  - ▪ "Free access to information on the Internet"
  - ▪ Internet & technology for the society
  - ➡ Project 1: IoT (AI, ML) for Ethiopia
  - ➡ Project 2: School Connectivity

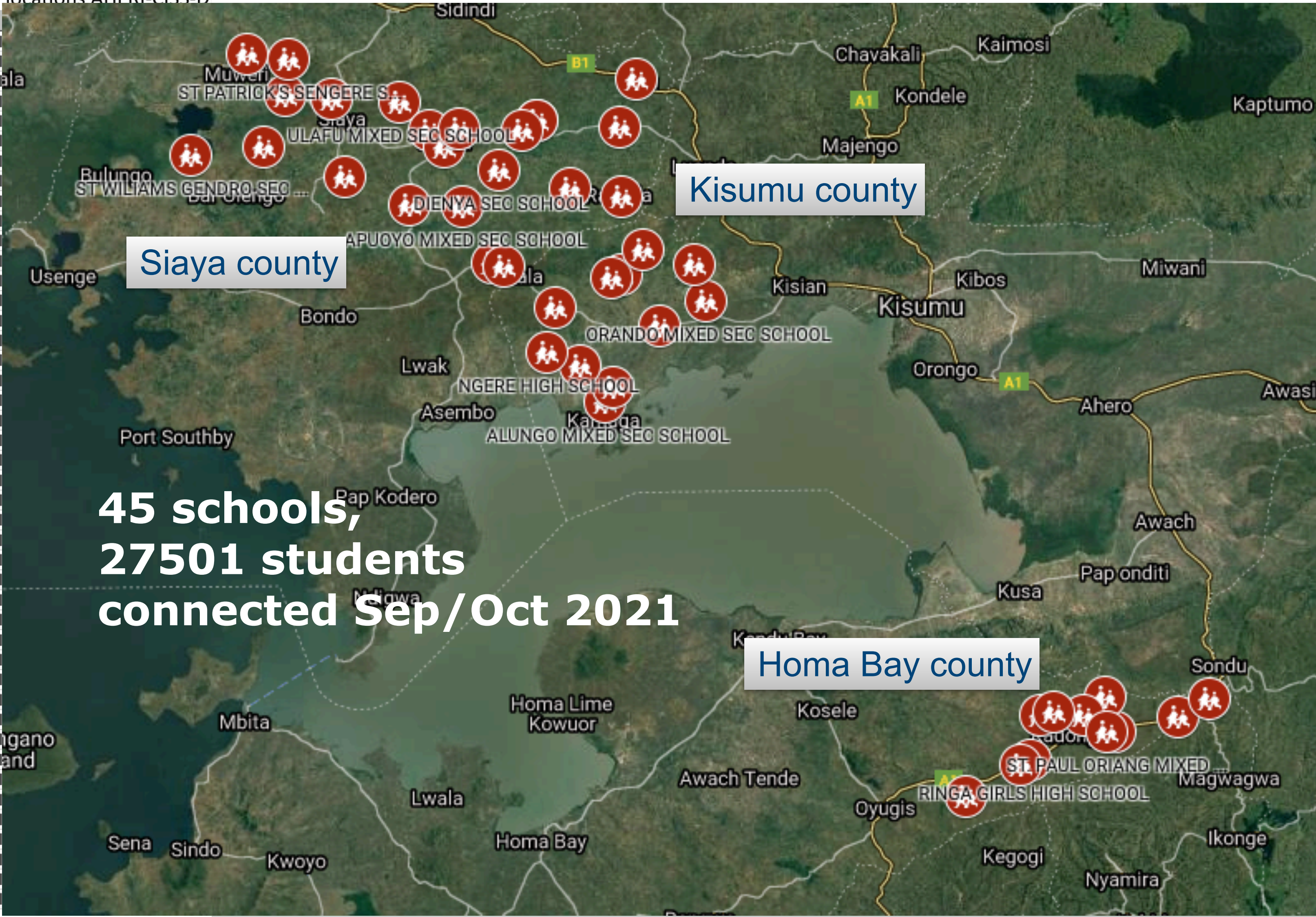**Where can IoT help us?**

5G for school connectivity

SchoolNet Cloud

fibre

5G - Multi- mimo

electricity

microwave

fibre
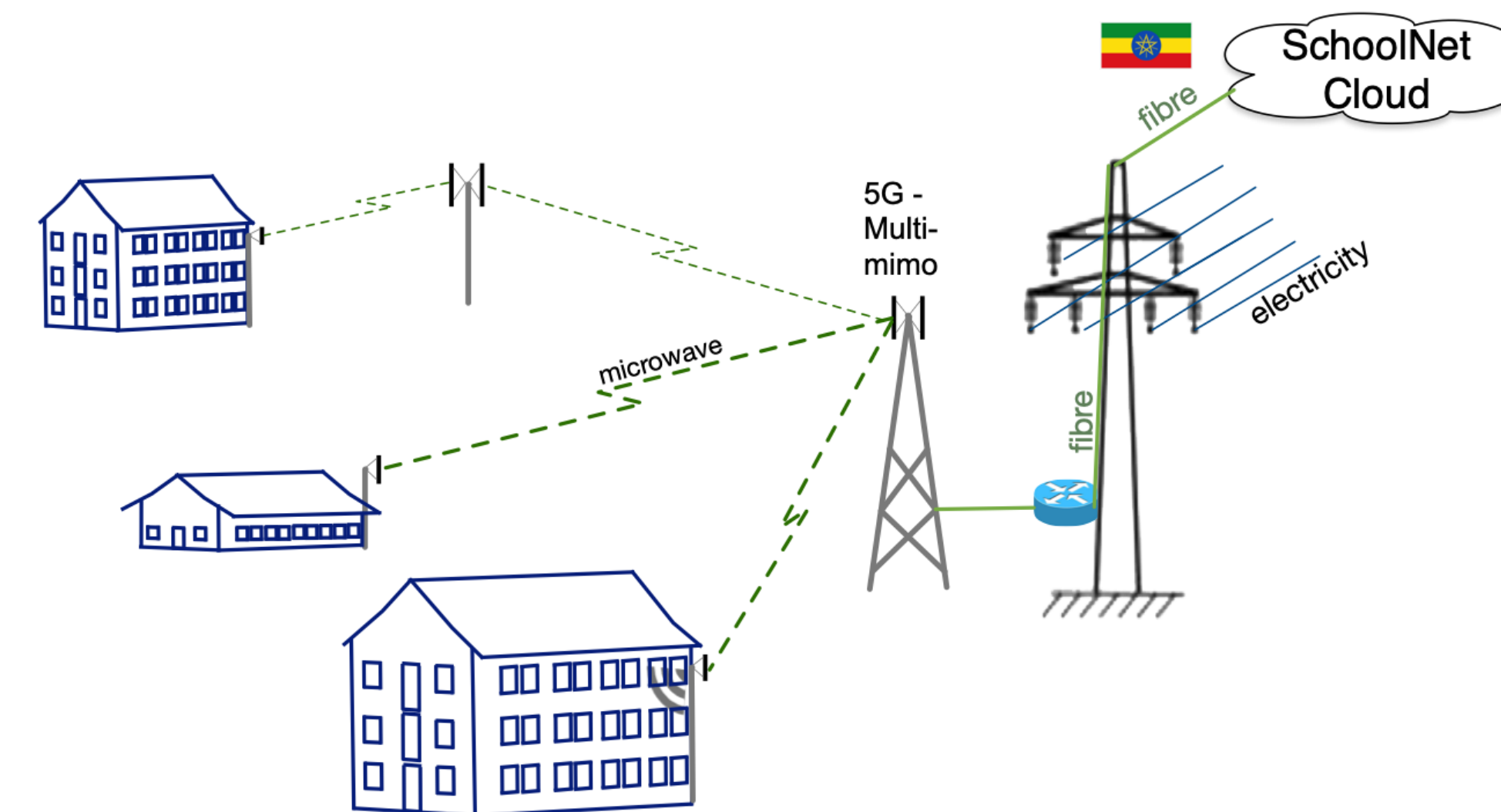
Background Slides

School locations AHERI-CISS-D

#	name	location
1	ST. PAUL ORIANG MIXED SCHOOL	http://p
2	ORANDO MIXED SEC SCHOOL	http://p
3	MALELE MIXED SEC SHOOL	http://pala
4	ULAFU MIXED SEC SCHOOL	http://p
5	BISHOP OKOTH GIRLS MBAGA SEC SC	http://p
6	PALA MIXED SEC SCHOOL	http://p
7	KOLWENY KINGSWAY SEC SCHOOL	http://p
8	KIT MIKAYI MIXED SEC SCHOOL	http://p
9	NDURU MIXED SEC SCHOOL	http://p
10	DANIS OBARA SEC SCHOOL	http://p
11	ATELA MIXED SEC SCHOOL	http://p
12	WANG'APALA BOYS HIGH SCHOOL	http://p
13	APUOYO MIXED SEC SCHOOL	http://p
14	AGORO OYOMBE SEC SCHOOL	http://p
15	RINGA GIRLS HIGH SCHOOL	http://p
16	ORERA MIXED SEC SCHOOL	http://p
17	DUDI GIRLS SEC SCHOL	http://p
18	BORO MIXED SEC SCHOOL	http://p
19	ST BARNABAS SEC SCHOOL	http://p
20	SINAGA GIRLS SEC SCHOOL	http://p
21	DIENYA SEC SCHOOL	http://p
22	RAMULA MIXED SEC SCHOOL	http://p
23	DHENE MIXED SEC SCHOOL	http://p
24	ST WILIAMS GENDRO SEC SCHOOL	http://p
25	ST PATRICK'S SENGERE SEC SCHOOL	http://p
26	ST MAR'YS YALA SCHOOL	http://p
27	NGIYA MIXED SEC SCHOOL	http://p
28	OBAMBO MIXED SEC SCHOOL	http://p
29	SENATOR OBAMA SEC SCHOOL	http://p
	ST MATHEW NYASIDHO MIXED SCHO	http://p
		p://p
		p://p
		p://p
		p://p
35	ST	http://p
36	AL	http://pngano
37	ST	OL http://pand
38	AL	http://p
39	MA	http://p
40	RI	http://p
41	NC	http://p
42	ST	http://p
43	BIS	CH http://p
44	AK	http://p

Kisumu county

Siaya county

Homa Bay county

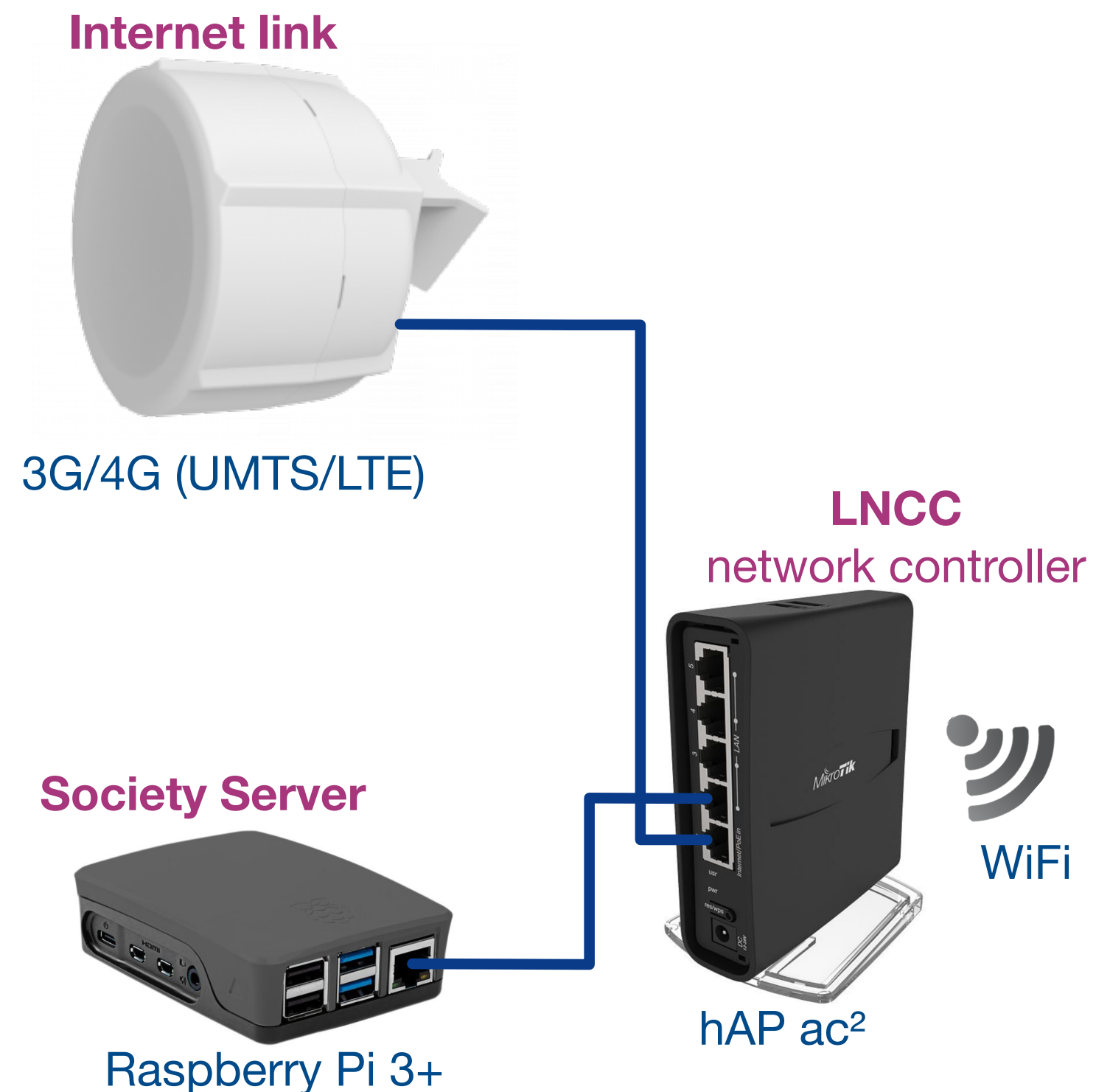**45 schools,
27501 students
connected Sep/Oct 2021**

sponsored by our premium partner

DENT

Safaricom

- parallel to GIGIconnect first phase
- **5 Mbit/s over LTE** (dedicated SIM cards)
- 58 USD/month

Solving the challenge of access

➡ wireless information spot (InfoSpot)

➡ Reaching out >20 km to mobile network

➡ Affordable solution: OPEX <20 USD/ month

Internet link

3G/4G (UMTS/LTE)

LNCC
network controller

Society Server

WiFi

Raspberry Pi 3+

hAP ac²

"Connect the Unconnected"
Izazi

Basic Internet Foundation

Antenna

Village office

Installation time: 1,5 h
catching the signal from the Vodacom tower in Migoli (~10km away)

The mobile phone has
replaced the machete
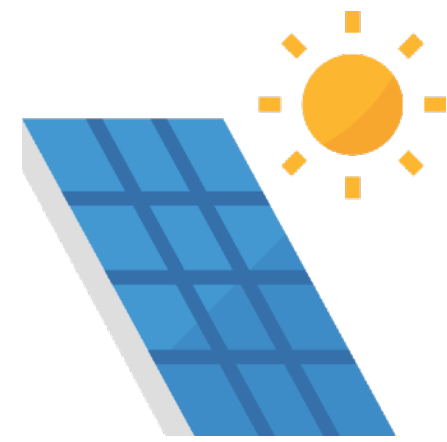(even in places without Mobile Broadband)

What is SESA?

SESA is a collaborative project between the **European Union and nine African countries** (Kenya, Ghana, South Africa, Malawi, Morocco, Namibia, Tanzania, Rwanda and Nigeria) that aims at **providing energy access technologies and business models** that are easily replicable and generate local opportunities for economic development and social cohesion in Africa.

Smart Energy Solutions for Africa

Morocco
Ghana
Nigeria
Kenya
Rwanda
Tanzania
Malawi
Namibia
South Africa

https://sesa-euafrica.eu

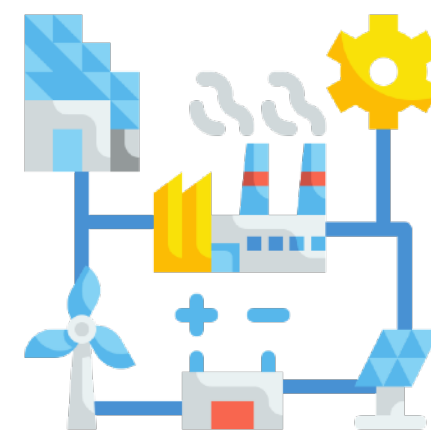# The technologies on focus

Decentralised renewables
(Solar PV)

Second life electric vehicle (EV)
batteries for stationary energy
storage

Waste/Biogas-to-energy
systems

Climate-proofing,
resilience and adaptation

Smart micro-grids

Rural internet access &
free Energy information

our
contribution

SESA

Basic
Internet
Foundation

Nextcloud.BasicInternet.org
open documentation (registration)

Readme for LTE antenna configuration

Download Winbox.exe from Mikrotik and connect your antenna. Make sure to

- connect the power over ethernet (PoE) adapter such that "data+power" goes to the antenna.

- *cable connects to port 1 (PoE in), see https://vimeo.com/354375901*

SIM card is inserted (make sure to remove the PIN)
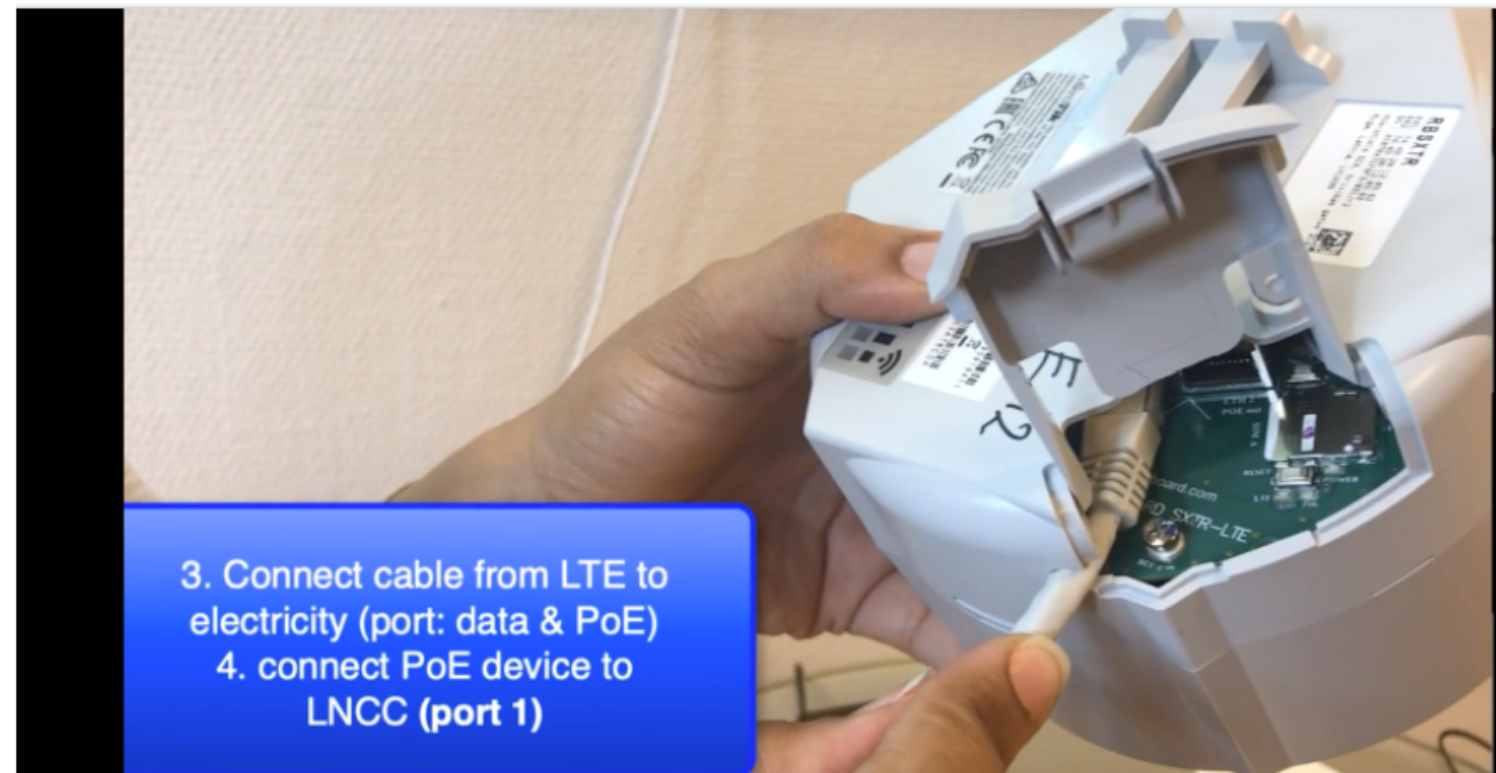

How_to_connect_BasicInternet.png

First, check if you see two green diodes (power & SIM). If you only see one light, it means that the antenna is not working with the Operator network (Vodacom, Tigo, MTN,...). If your antenna is configured, go directly to 01Control.md and check for errors - if not configured, follow the steps below to install the software.

Once you are connected reset the device and **remove the old configuration**. Goto System = Reset Configuration (if you don't do that, we will end up with two configurations conflicting with each other)
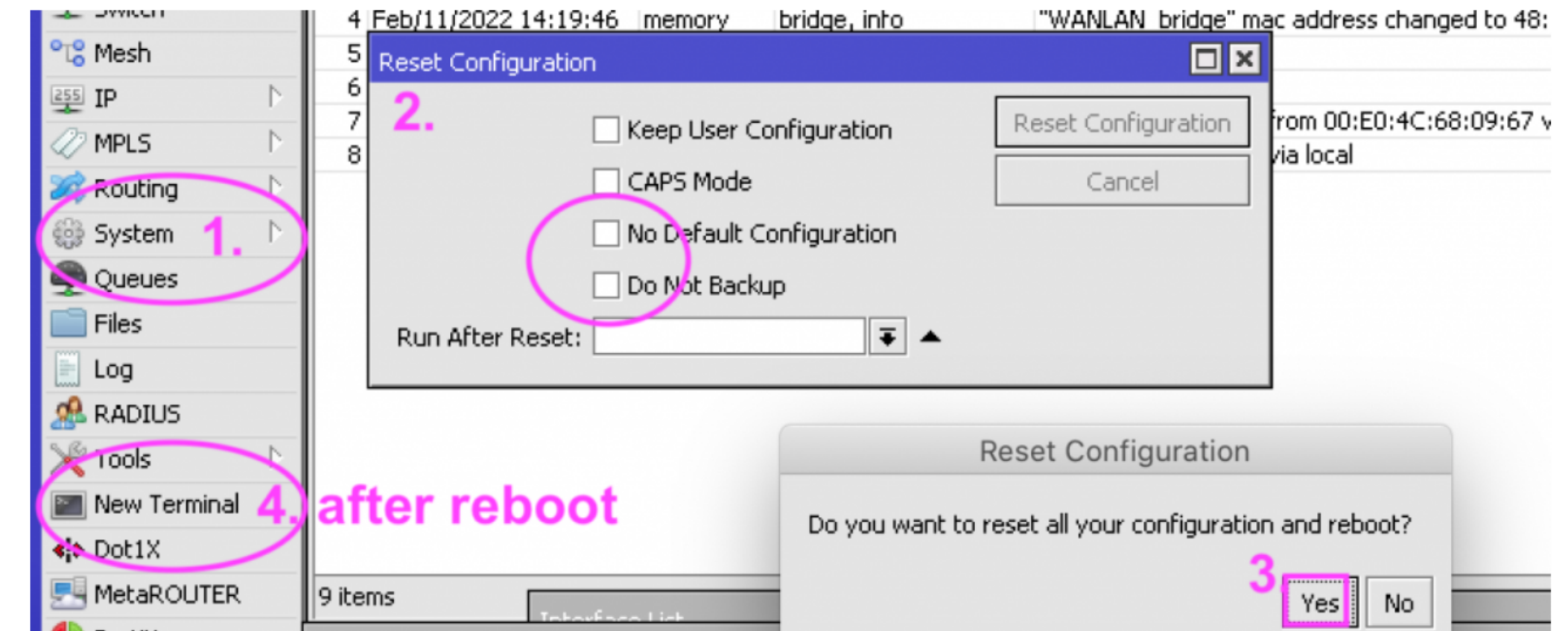
System_ResetConfiguration.png

The device will reboot. After, reboot, connect again using Winbox, and open terminal "New Terminal"

Paste the following code into the terminal (in Winbox)

```
/interface lte
set [ find ] mac-address=AC:FF:FF:00:00:00 mtu=1500 name=lte1 network-
mode=3g,lte

/interface bridge
add comment="Bridge WAN(LTE) to LAN through Ether2" name=WANLAN_bridge
```