



**The Eleventh International Conference on Wireless and  
Mobile Communications  
ICWMC 2015, 11-16 October 2015, St. Julians, Malta**

**Digital Inclusion for Sustainable  
Developments**

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Internet Foundation**

**Prof. at University Graduate Studies  
(UNIK), University of Oslo (UiO)**

**Head of Research at Movation AS**

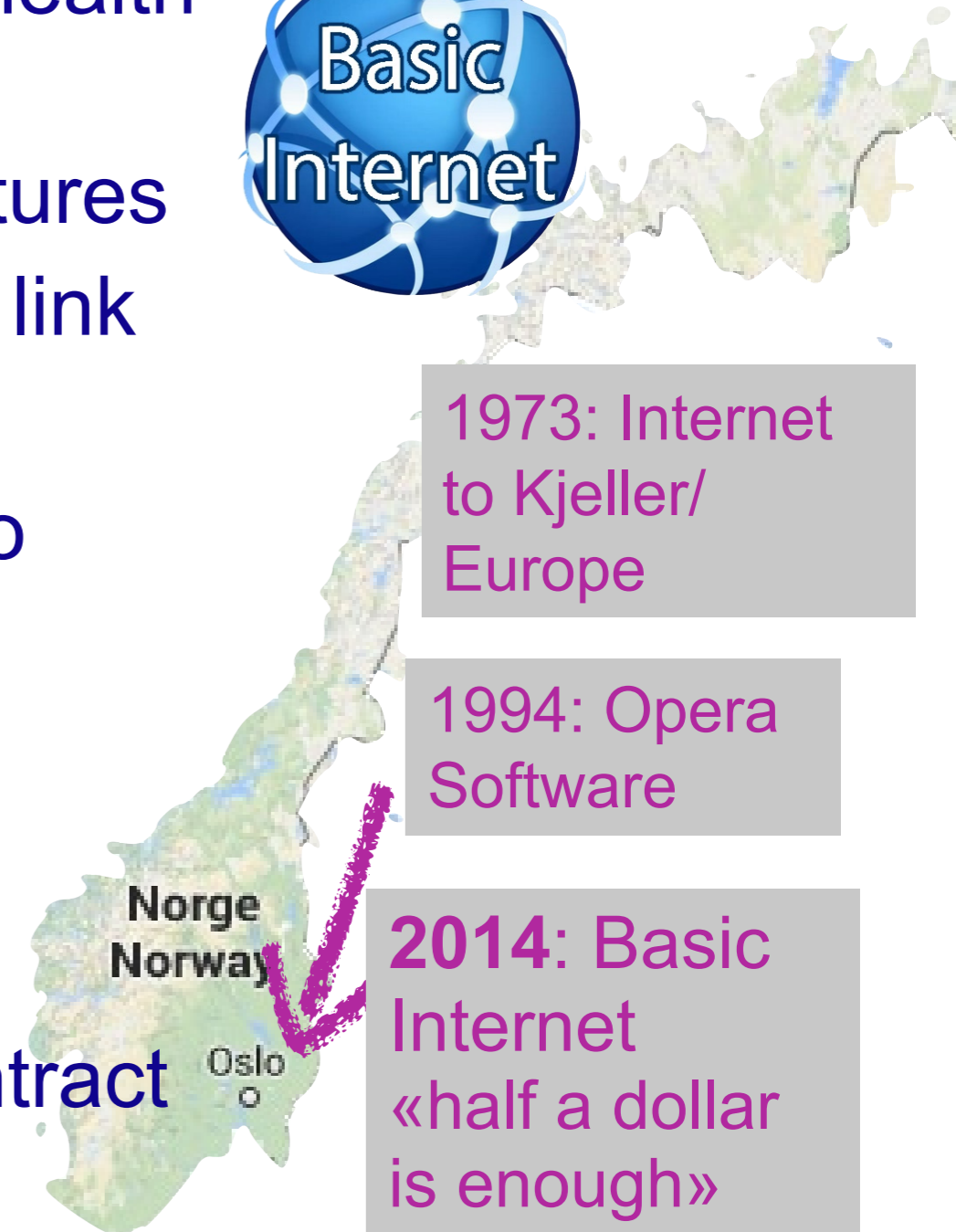
**Oslo Area, Norway**



# Executive Summary



- Knowledge is the basis for education, health and entrepreneurship
- Basic Internet is access to text and pictures
  - for 300-400 people on a thin satellite link
  - no need for broadband
- develops the market, complementary to market actors
- roll-out through local partners
- Foundation by experienced people
- Now:
  - Norwegian Development Agency contract with Orange for pilot in Mali





# Outline



- History and Motivation
- Knowledge is the basis for education, health and entrepreneurship
- Digital Inclusion
  - Basis for Innovation
  - United Nations Sustainability Goals
- Basic Internet is access to text and pictures
  - for 300-400 people on a thin satellite link
  - no need for broadband
- Economy
- Technology challenges
- Conclusions

The screenshot shows the Basic Internet website homepage. At the top left is the Basic Internet logo. To its right is the text ': Internet' and a search bar with 'Go' and 'Search' buttons. Below this is a navigation menu with links for Home, Projects, Solutions, Impact Research, Opportunities, and About us. The main content area features a photograph of three young girls in school uniforms. Below the photo is the heading 'The Basic Internet Foundation' followed by a paragraph: 'Envision a world of free access to basic information on health care, education or development. Join our quest to make this vision a reality!'. Below this is another paragraph: 'The Basic Internet Foundation aims at optimised content delivery on capacity-limited networks:'. This is followed by a bulleted list: '• The Foundation will offer free access to low capacity Internet as a carrier of digital content to people in areas with low admission and / or no internet coverage.' and '• The Foundation will assist organisations and companies to adapt and disseminate information for the affected recipients should be able to help themselves.'. On the right side of the page, there is an 'About us' section with a 'People' sub-section listing: '• Josef Noll', '• Gunnar Nilsson', '• Tor Blomseth', '• Vidar Sannerhaugen', '• Stian Løvold', and '• Linda Firveld'. Below this is a 'Founding Partners' section listing: '• UNIK' and '• Kjeller Innovation'.

- Research and Education at Kjeller
- Close relation to FFI, IFE, NILU,...
- Professors from UiO (Oslo) and NTNU (Trondheim)



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

Source: Wikipedia

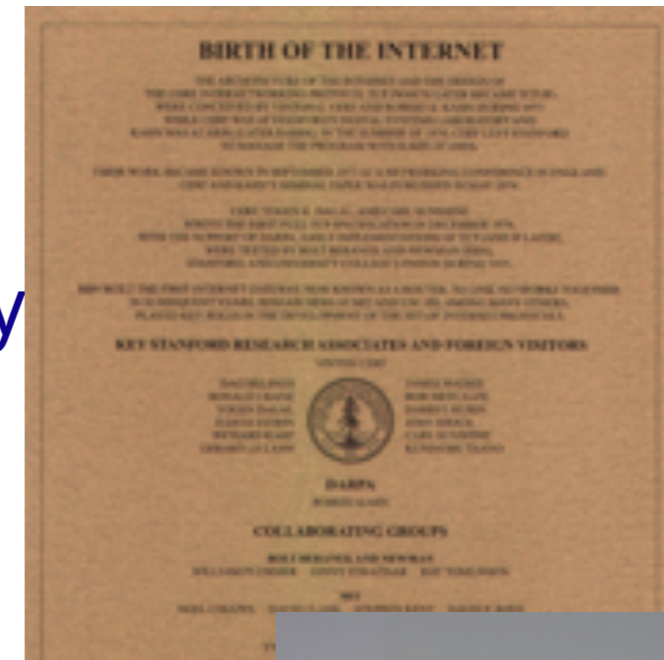
1971 (at which point 23 hosts, at universities and government research centers, were connected to the ARPANET); 29 by August, 1972, and 40 by September, 1973.

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, TeliaSonera
- Mobile Internet:
  - GSM
  - Adaptation
  - ‘

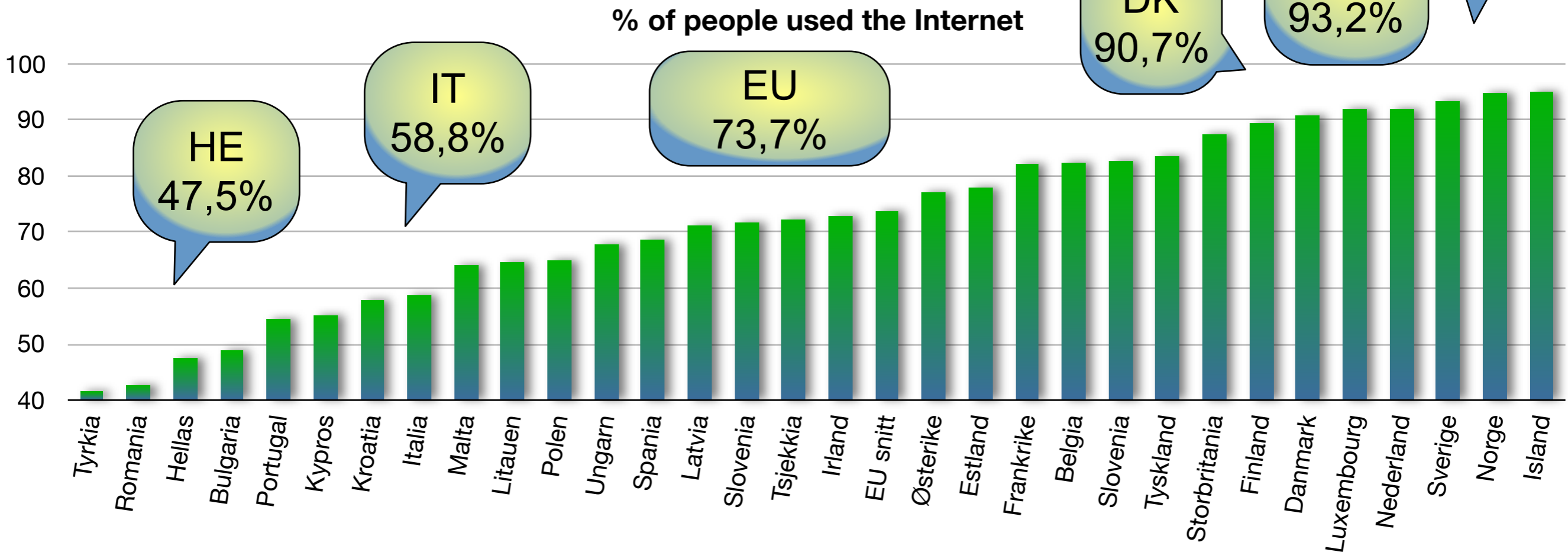


# Internet usage in Scandinavia

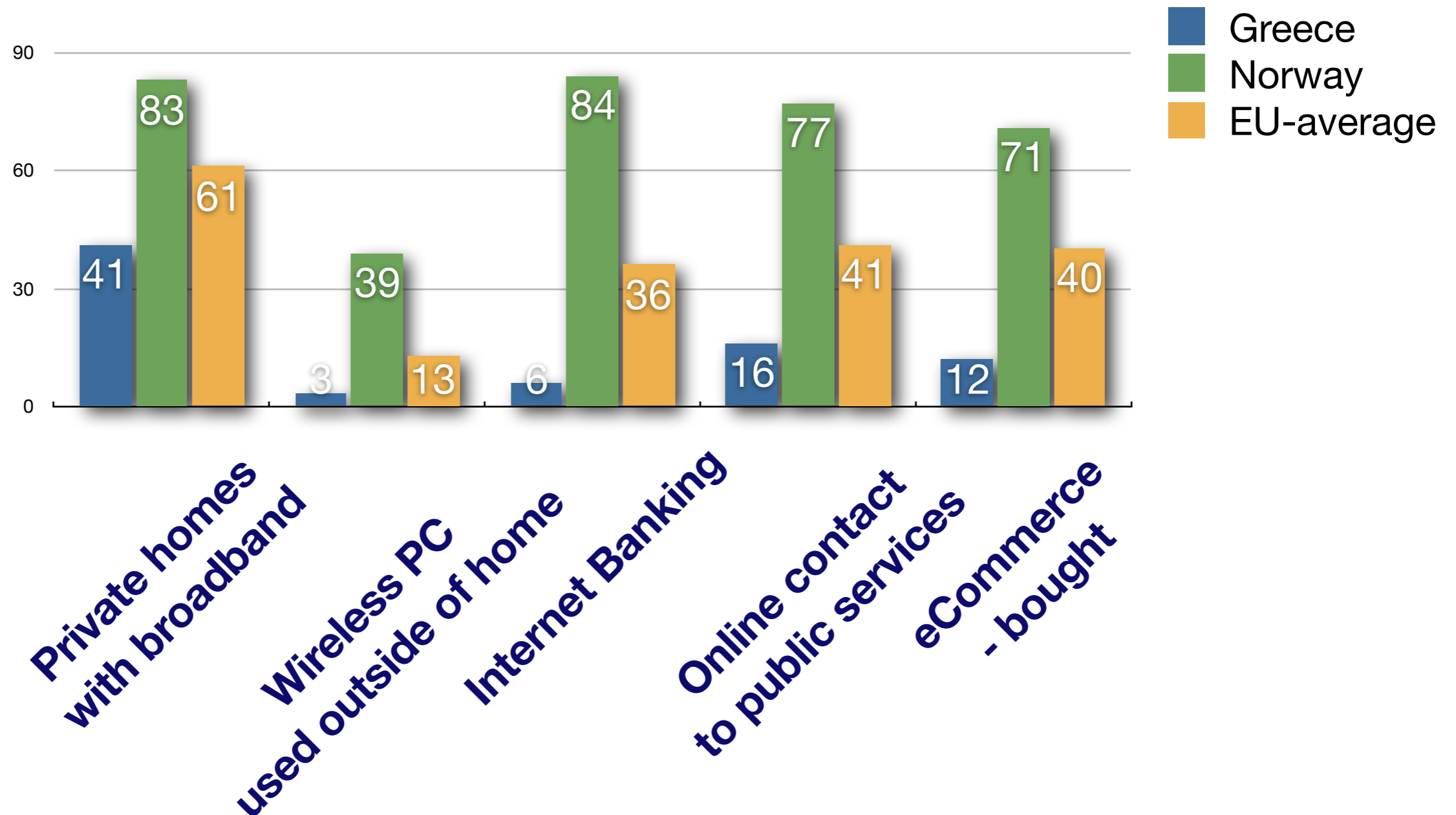


[Robert Madelin, Directorate-General for Information Society and Media, EU commission, Aug 2011]

\* “use of IT in a proper way can increase effectiveness with 30-40%”  
 \* “we are good in technology development. But access to venture capital is bad in Europe as compared to the USA”.  
 [Aftenposten, 3. October 2011] [gunhild@aftenposten.no](mailto:gunhild@aftenposten.no)



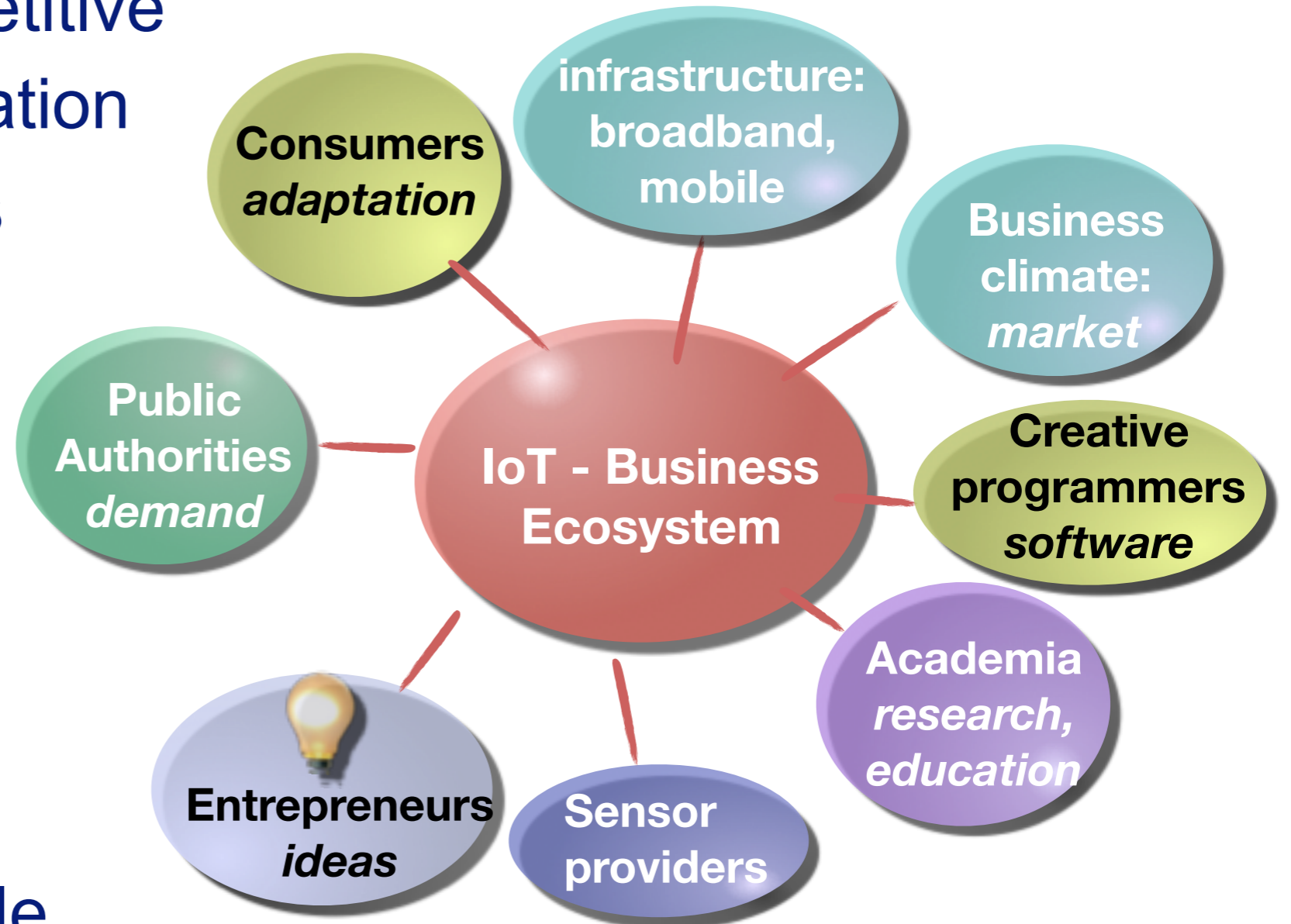
# Internet service usage



# Human perspective in The IoT ecosystem



- **Creating business**
  - openness, competitive
  - climate for innovation
- **Public authorities**
  - trust, confidence
  - demand
- **Consumers**
  - (early) adapters
  - education
- **Infrastructure**
  - broadband, mobile
  - competition





# Internet-driven services



- App economy
  - «All services» come through mobile devices
  - from «parts» to services
- Ambient Assisted Living (AAL)
  - Sensors supporting care information
  - Proactive Health professionals
    - call if you have not taken your medicine
    - call if your blood pressure is too high
- Hospital access
  - BasicInternet at 5 hospitals
- Producing sensors vs analysing data
  - sensor producers don't see the use of their sensors
- Information providers (Google)
  - become industry suppliers

«Free basic access for low capacity services»  
The Basic Internet Vision @Basic4all



# MIT and the global GDP

- 50% of U.S. economic growth after 1945 attributed to technological innovation

## MIT alumni startups (2011 numbers)

- 25,800 active companies
- 3.3 million people employed
- \$2 trillion gross domestic product
- 10th world rank in GDP
- 19% higher per capita income than Canada (19% higher than USA)

## Role of education

- 75% of the world's GDP growth in developing countries

25 largest economies by GDP (PPP) in 2015 in Billions

1	 <b>China</b>	18,976
2	 <b>United States</b>	18,125
3	 <b>India</b>	7,997
4	 <b>Japan</b>	4,843
5	 <b>Germany</b>	3,815
6	 <b>Russia</b>	3,458
7	 <b>Brazil</b>	3,259
8	 <b>Indonesia</b>	2,840
9	 <b>United Kingdom</b>	2,641
10	 <b>France</b>	2,634

# Industrie 4.0 vision



Source: Trumpf / Forschungsunion  
Wirtschaft & Wissenschaft

# EU Commission activities

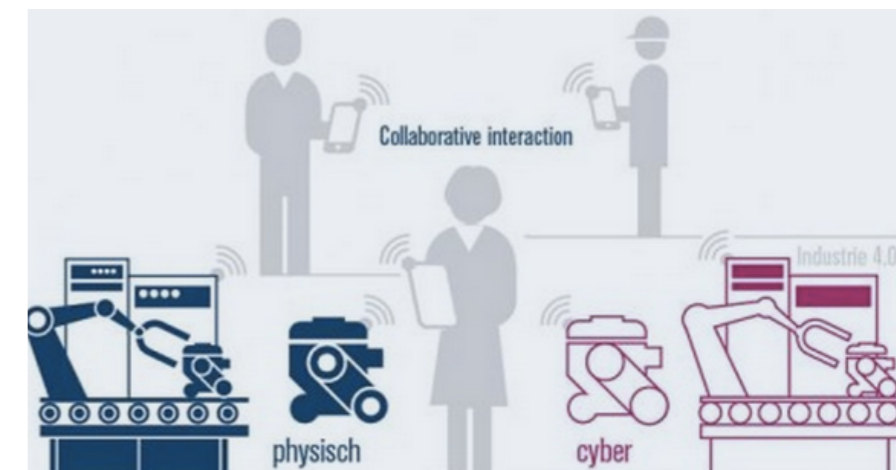


- Four focus areas for Industrie 4.0
  - Digital Innovation Hubs
  - Leadership in digital platforms
  - **Closing the digital divide gap**
  - Providing framework conditions
- Collaboration with regional/structural funds (ESIF) and Juncker package (EPIF)
- Connectivity is the challenge both in terms of
  - Availability/Security and
  - Affordability

# Digital Divide & Digital Inclusion



- Basic school in education
  - 3 basics: read, write, mathematics,
  - +2 innovation drivers: express, ICT
- University education
  - basics: analysis, problem solving, evaluation
  - innovation by: english writing, innovation management
- the Global World perspective for beyond 2050
  - Human-Bond-driven systems
  - Knowledge-, sustainability-driven economy



# 2/3 of the World's population have no access

- Knowledge is the basis for health, education and entrepreneurship
- Provide access to basic information, means
  - access to education
  - access to health information
  - opportunity for entrepreneurship

Today, the Internet isn't accessible for two thirds of the world. Imagine a world where it connects us all.

[Internet.org]  
Oct 2013



# United Nations Sustainable Development Goals



**GOAL 1**  
**Poverty**  
 END POVERTY IN ALL ITS FORMS EVERYWHERE

**GOAL 5**  
**Empower Women**  
 ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS

**GOAL 9**  
**Infrastructure & Innovation**  
 BUILD RESILIENT INFRASTRUCTURE, PROMOTE INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION

**GOAL 13**  
**climate change**  
 TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS\*

**GOAL 17**  
**Sustainable development**  
 STRENGTHEN THE MEANS OF IMPLEMENTATION AND REVITALIZE THE GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT

**GOAL 2**  
**Hunger & Food**  
 END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE

**GOAL 6**  
**Water**  
 ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

**GOAL 10**  
**Inequalities**  
 REDUCE INEQUALITY WITHIN AND AMONG COUNTRIES

**GOAL 14**  
**marine resources**  
 CONSERVE AND SUSTAINABLY USE THE OCEANS, SEAS AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT

**GOAL 3**  
**Health**  
 ENSURE HEALTHY LIVES AND PROMOTE WELL-BEING FOR ALL AT ALL AGES

**GOAL 7**  
**Energy**  
 ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL

**GOAL 11**  
**inclusive cities**  
 MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

**GOAL 15**  
**biodiversity**  
 PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS, SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION, AND HALT AND REVERSE LAND DEGRADATION AND HALT BIODIVERSITY LOSS

**GOAL 4**  
**Education**  
 ENSURE INCLUSIVE AND EQUITABLE QUALITY EDUCATION AND PROMOTE LIFELONG LEARNING OPPORTUNITIES FOR ALL

**GOAL 8**  
**Growth & Employment**  
 PROMOTE SUSTAINED, INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, FULL AND PRODUCTIVE EMPLOYMENT AND DECENT WORK FOR ALL

**GOAL 12**  
**sustainable consumption**  
 ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS

**GOAL 16**  
**inclusive societies**  
 PROMOTE PEACEFUL AND INCLUSIVE SOCIETIES FOR SUSTAINABLE DEVELOPMENT, PROVIDE ACCESS TO JUSTICE FOR ALL AND BUILD EFFECTIVE, ACCOUNTABLE AND INCLUSIVE INSTITUTIONS AT ALL LEVELS

Bas

# #Basic4All

## The Role of Free Access



**GOAL 4**



ENSURE INCLUSIVE AND EQUITABLE QUALITY EDUCATION AND PROMOTE LIFELONG LEARNING OPPORTUNITIES FOR ALL

**Education & Lifelong**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

reas  
ad

**GOAL 3**



ENSURE HEALTHY LIVES AND PROMOTE WELL-BEING FOR ALL AT ALL AGES

**Health & Well-Being**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

**GOAL 5**



ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS

**Empower Women & Girls**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

**GOAL 8**



PROMOTE SUSTAINED, INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, FULL AND PRODUCTIVE EMPLOYMENT AND DECENT WORK FOR ALL

**Growth & Employment**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

**GOAL 9**



BUILD RESILIENT INFRASTRUCTURE, PROMOTE INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION

**Infrastructure & Innovation**

**GOAL 10**



REDUCE INEQUALITY WITHIN AND AMONG COUNTRIES

**Inequalities**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

**GOAL 16**



PROMOTE PEACEFUL AND INCLUSIVE SOCIETIES FOR SUSTAINABLE DEVELOPMENT, PROVIDE ACCESS TO JUSTICE FOR ALL AND BUILD EFFECTIVE, ACCOUNTABLE AND INCLUSIVE INSTITUTIONS AT ALL LEVELS

**Sustainable development**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

**GOAL 17**



STRENGTHEN THE MEANS OF IMPLEMENTATION AND REVITALIZE THE GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT

**inclusive societies**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

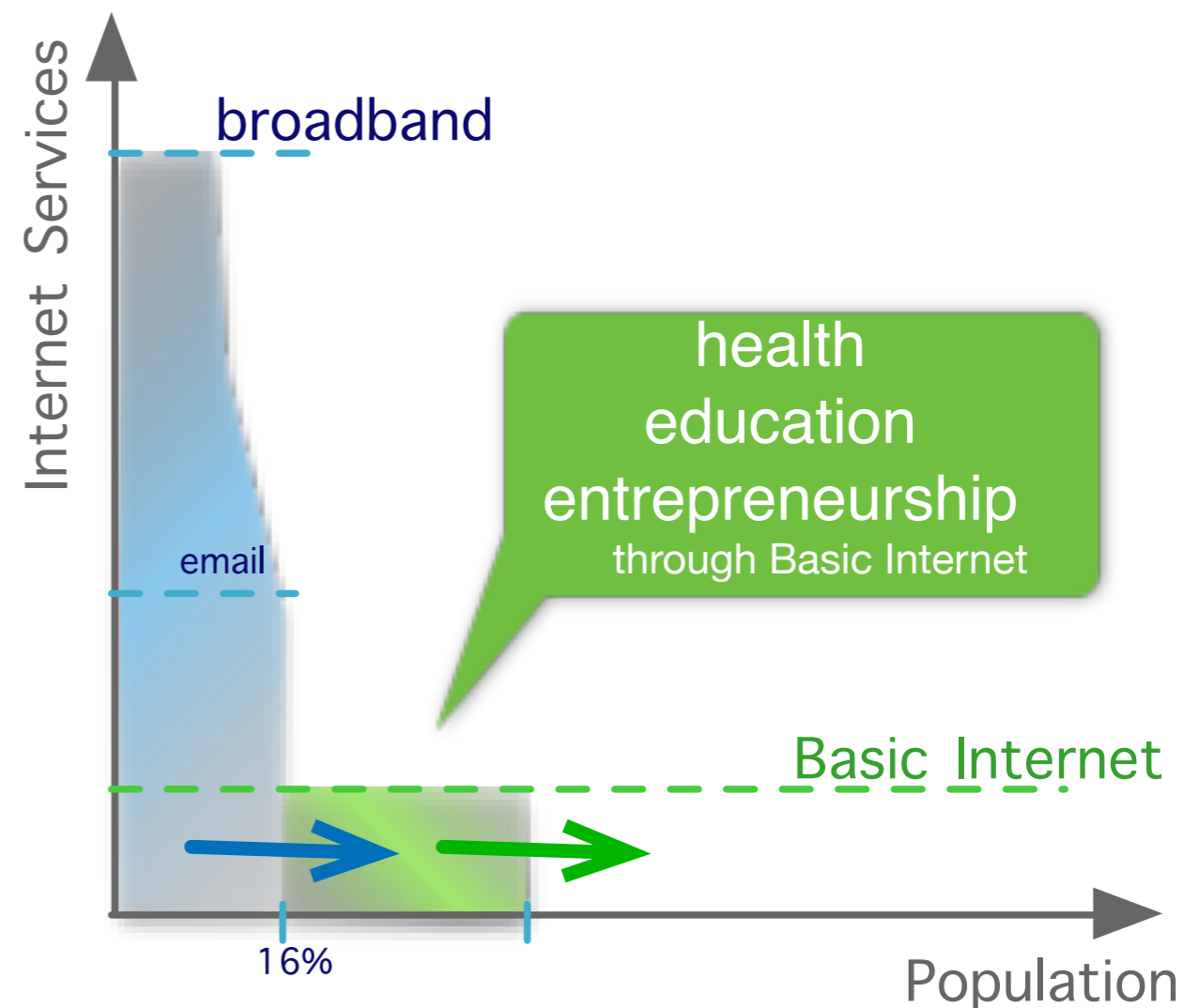


# #Basic4All

## Access to basic information to everyone



- A typical situation in Africa
- Need for
  - those who don't have Internet coverage
  - those who don't have income for access
  - those who don't have rich parents
- We develop the market
  - Basic Internet is complementary to traditional industry
- The World
  - Internet access spammed by video and gaming
  - Roaming (3G/4G) - affordability
  - Authentication (WLAN) - availability



# The role of information



**Information**  
- knowledge that you get about someone or something  
- facts or details about a subject  
[source: merriam-webster.com/dictionary]

- Net Neutrality
- Basis for economic development
- «Children are good in using IT»
  - video, gaming, snapchat,...
- «Children are bad in retrieving information»

R. GOSCINNY **Asterix** A. UDERZO

Asterix *and*  
the **MISSING SCROLL**

Written by Jean-Yves FERRI

Illustrated by Didier CONRAD



# #Basic4All Development Focus



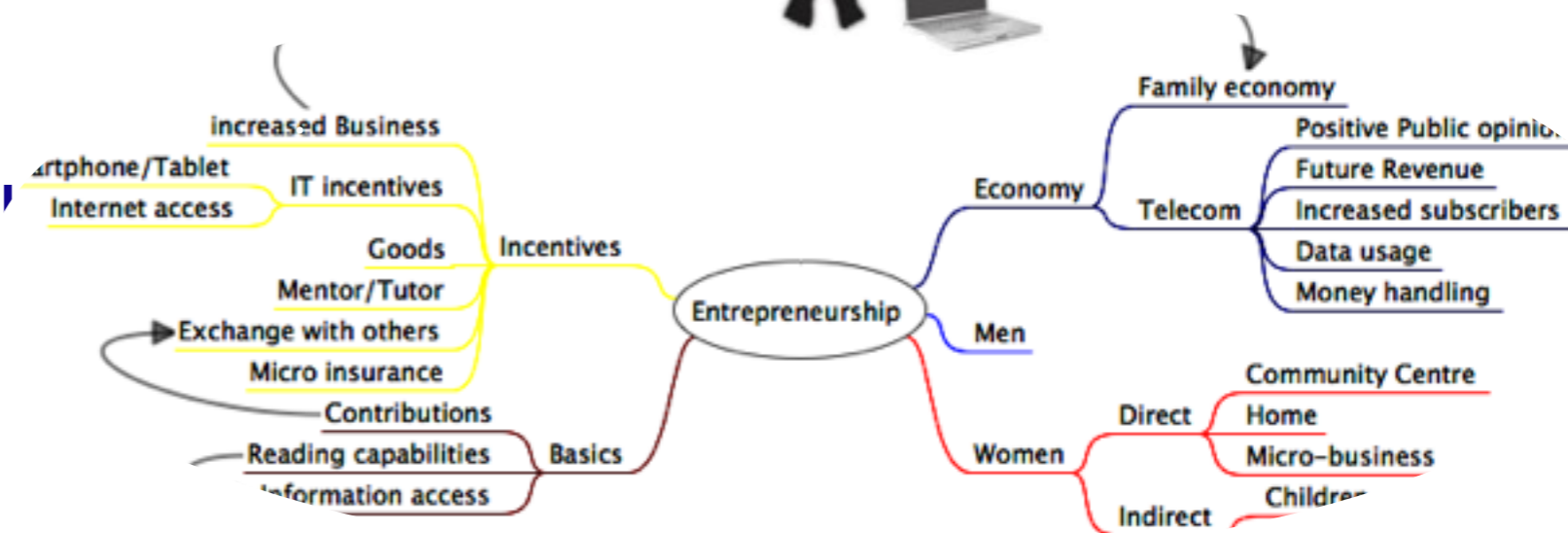
- Education
  - Digital Inclusion
  - Free access to Basic Information



- Health
  - sensor/app supported health informatics
  - new role of health professionals



- Innovation
  - Women entrepreneurs
  - Knowledge-based



# Free Information access: Removing the digital divide



- Societal aspects
  - everyone has access to information
  - on all WLAN (&mobile) networks
- Technical requirements
  - browser with just text & picture
  - compressed content to be transmitted over radio
  - proxy-based splitting of information



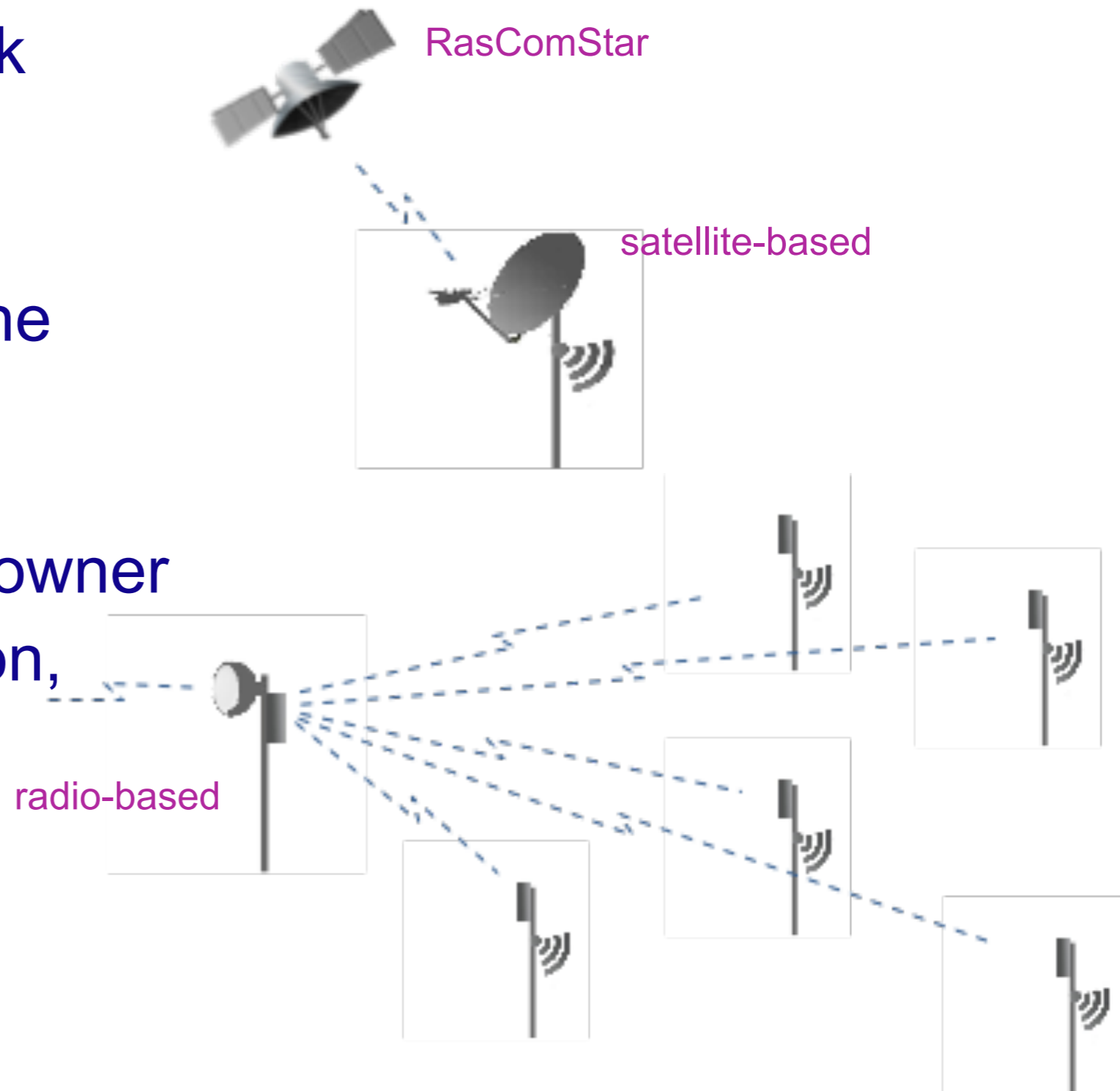
- Example: Opera Mini
  - encrypted request from Opera Mini browser
  - Opera access Web page, removes animations, and compresses the page
  - Compressed page is sent to device
  - typical 80% reduction
- Usage results
  - 4 MByte average user
  - 20 MByte max user/month

[Opera Software, Nigeria, 2011]

# Basic Internet provision through Partners



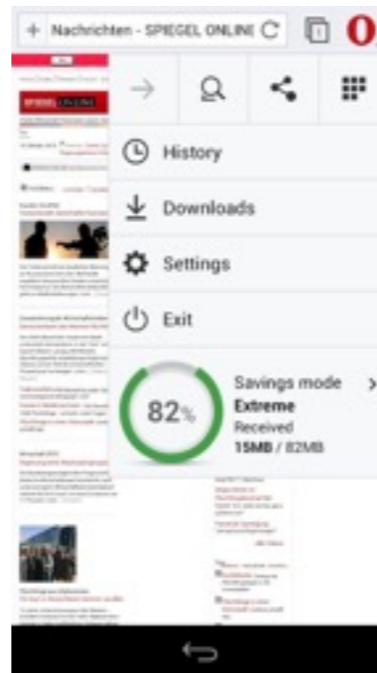
- Satellite, radio or mobile link
  - local roll-out
  - with partners in Africa
- Mobile Operators: extend the reach, prepare the market
- CSR: increase innovation
- Own deployment: hot-spot owner
- AID organisations: education, health information
- Sponsored access
- Higher education: educate teachers



# Technological challenges



- Goal: free information to everyone
  - compressed text
  - low/medium-size pictures
- Information type filtering
  - filter dynamic elements
  - Web browser
    - Opera Mini
    - http2 standard
  - Basic Internet App Store
    - traffic amount, capacity
- Network protocol
  - signalling versus data amount
  - mobile network load
- Centralised management
  - open protocols, e.g. TR-069
  - Customer premise equipment (CPE) and Auto-configuration server (ACS)
    - auto-configuration
    - software management, modules
    - status and performance
    - diagnostics
- IoT extension
  - set-up, configuration of communication
  - secure (encrypted) communication
  - update/revoke security certificates



# Technology High-level challenges



#Basic4All  
let us know your interest to  
become part of  
BasicInternet

v3.0 Business Extensions: IoT, App  
v2.5 IoT and App extension  
v2.0 Technology extensions  
v1.5 Market agreements Africa  
v1.2 Market agreements Pilot markets  
v1.1 Operational Kjeller Innovation  
v1.0 Operational Demonstration Kongo  
v0.9 Technology demonstration at UNIK

## v2.5 IoT and App extension [\[edit\]](#)

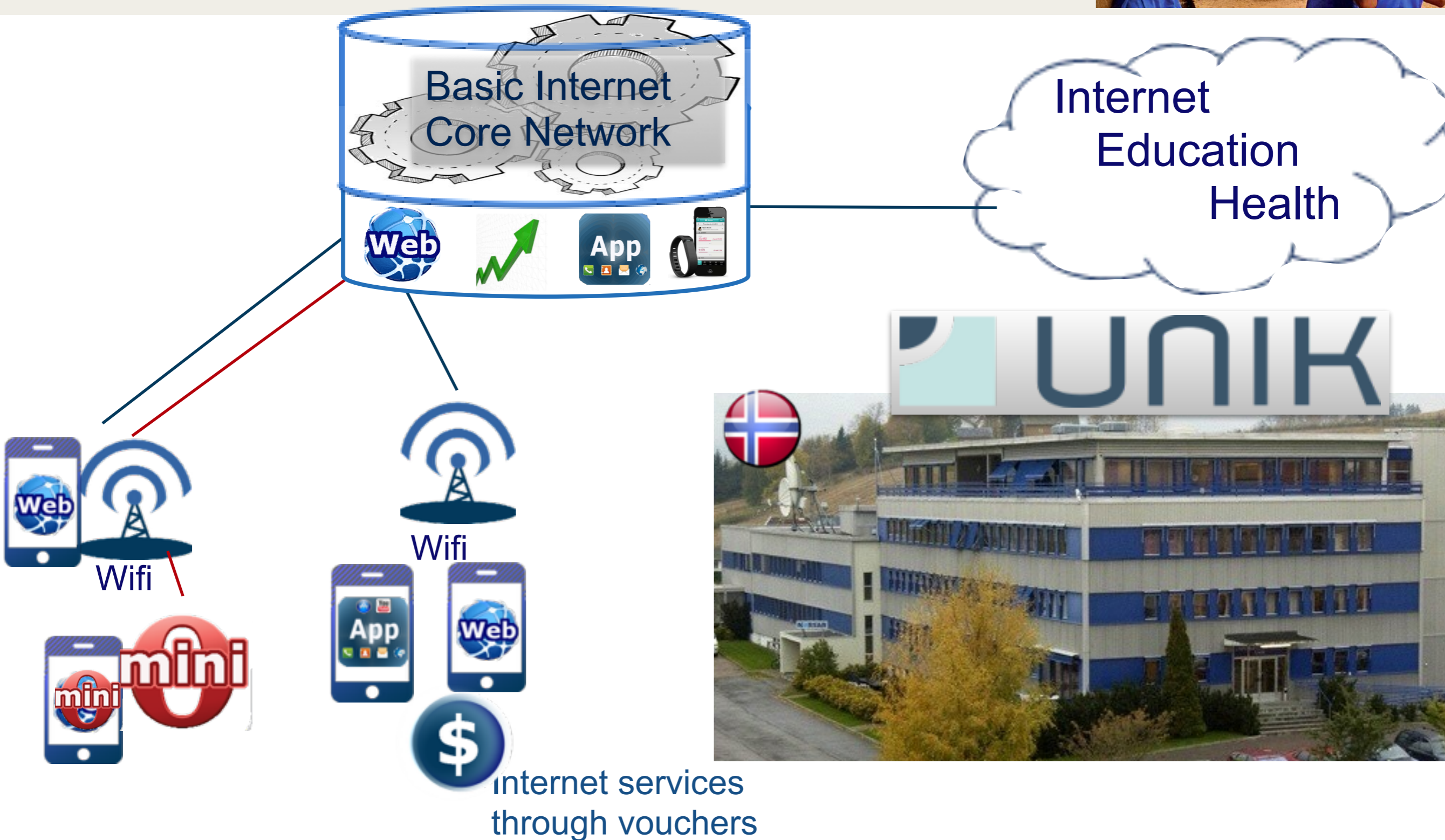
- Define App requirements to be able to use "Basic Internet"
- Define use-case IoT
- IoT-app (Summary low-cost application for IoT sensor supply, - [New](#), - v2.7)
- Basic Internet App requirements (Summary business for Apps with own proxy access, - [New](#), - v2.7)
- PowerConsumption Links (Summary Provide documentation on Power Consumption of e
- AP monitoring through Mikrotik (Summary Add local monitoring on the «client side» of the solution is that we in the Mikrotik a «monitoring» of IP addresses who provide traffic. No set-up allowing us to provide a «busy hour» and other measures., - [Open](#), [Answer](#), - v2.5)
- Cache for Base Stations (Summary Add a cache at our base stations to increase "virtual

## v2.0 Technology extensions [\[edit\]](#)

- TR-069 on MikroTik RouterOS (Summary TR-069 protocol implemented on MikroTik RouterOS)
- Video in Opera Mini redirected to accounting unit (Summary Currently Opera Mini does not requested video should point to an accounting page, - [New](#))
- Own infrastructure for Basic Internet (Summary Customers provide their own infrastructure)



# Basic Internet Core Network at Kjeller



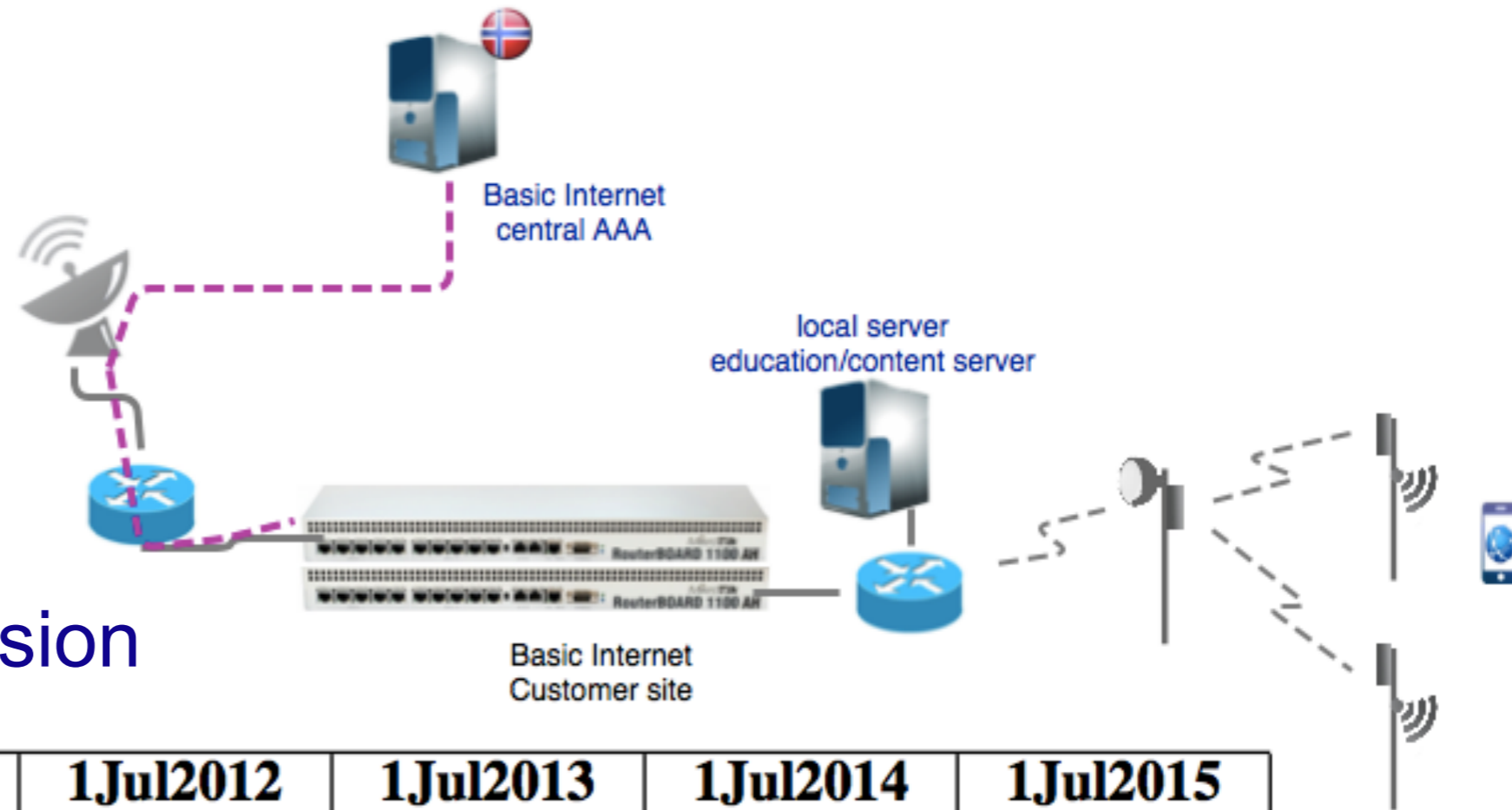


# Examples of challenges

## Network infrastructure



- DHCP lease time
  - IP addresses
  - 20.000 students
  - mobile network



- Intelligent compression

	<b>1Jul2012</b>	<b>1Jul2013</b>	<b>1Jul2014</b>	<b>1Jul2015</b>
<b>av. web site [kB]</b>	1090	1485	1829	2135
<b>Images [kB]</b>	684	909	1159	1348
<b>Scripts [kB]</b>	210	225	293	344
<b>Video [kB]</b>				204

# Internet provision International Activities

- Latvia - «free Wifi European capital»
- Germany - Government vs Freifunk
- Romania - E-NET
- Wireless Cities
  - Bologna, Bristol, Dublin, ,...
  - [Municipal\\_wireless\\_network](#) [[wikipedia.org](#)]
- IT-industry
  - Google, Microsoft, Yahoo - Wifi
  - Internet.org
  - zero rated content



[tagesschau.de, 2015]

Regierung will WLAN-Netz in Deutschland ausbauen  
tagesthemen 22:15 Uhr, 12.03.2015, Kirsten Rulf, WDR

- Access
  - Google Loom
  - Facebook Solar Aircrafts
  - Thales/Alenia Zepelin
  - Satellite
  - Fibre/Virtual Fibre

# Our extended partner network: Business Ecosystem



**ASHOKA**  
Everyone A Changemaker™

<b>Edu</b>	<b>Health</b>	
<b>News</b>		<b>App</b>

<b>Access</b>	<b>Access</b>	<b>Access</b>
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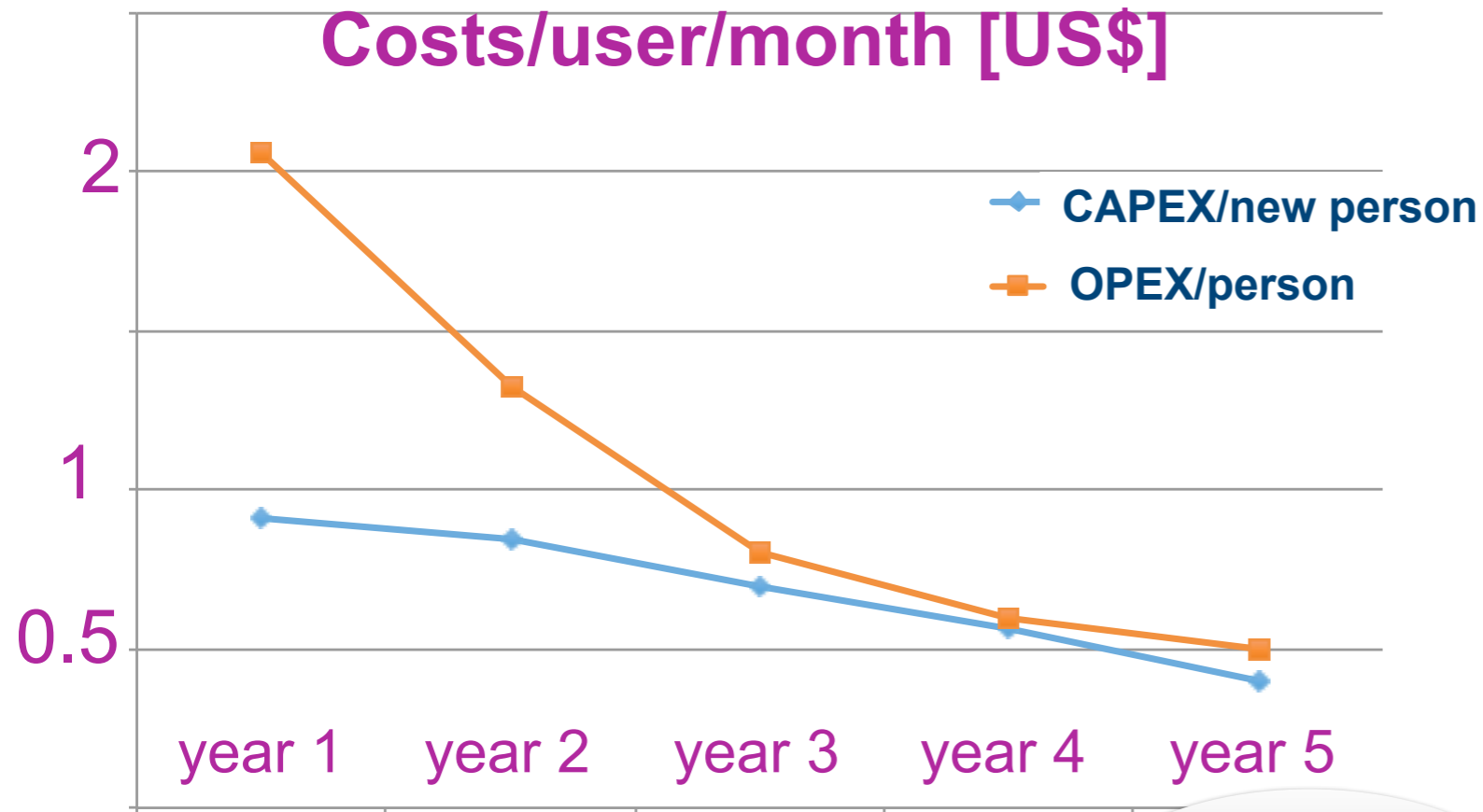
<b>Backbone</b>	<b>Proxy</b>	<b>Billing</b>
<b>Satellite</b>	<b>3G/4G</b>	

# Society costs

## Cost of ICT development



### Basic Internet Costs/user/month [US\$]



**Child Protection**  
Child taken into care  
average cost per year

**£64,819**

**Unemployment**  
Job Seekers Allowance  
per claimant per year

**£10,025**

**Care for the Elderly**  
Residential care for older  
person per year

**£28,132**

**exclusion**  
**Education**  
Exclusion from school  
per pupil per year

**£11,192**

half  
a dollar is  
enough\*

- local Wifi spots
- based on Satellite connectivity



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

# Activities - DRC (Congo) Implementation



- Internet access
  - University of Lisala
  - Deployment at 4 other universities in Kinshasa (DRC)
  - 10 additional implementations
- IPXextenso, Orange
  - 2 successful pilots
  - 570 planned installations
  - expected: 2000 villages
- upcoming pilots in Mali++



# #Basic4All Conclusions



- Digital Inclusion is the key for sustainable development
  - Complementary to traditional industry
  - Relevant for Africa (and the World)
- Net neutrality
  - access to information, compressed text and pictures
  - reach of 300-400 people on a 1 Mbit/s thin satellite link
- Technology challenges
  - Information type filtering
  - Network load (DHCP, data vs signalling)
  - Remote maintenance (TR-069)
  - Browser development (http2)
  - IoT extension (App store)
- A collaborative foundation from Kjeller (Norway)

