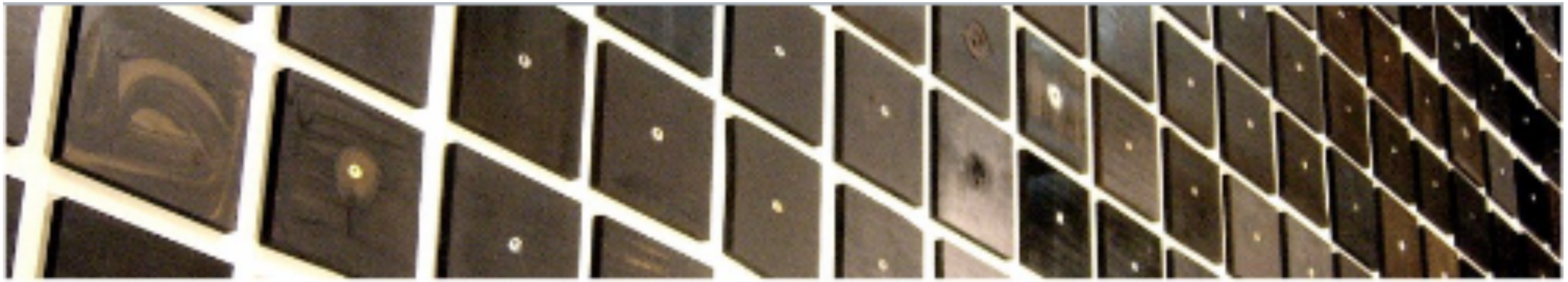


UiO : Universitetet i Oslo

Mobility 2016, 22-26May2016, Valencia

Basic Internet Access: Capacity and Traffic Shaping

Elin Sundby Boysen[1], Iñaki Garitano[2,3], Josef Noll[1,3]

[1]University of Oslo, Norway
[2]Mondragon Unibertsitatea, Spain
[3]Basic Internet Foundation, Norway

Overview

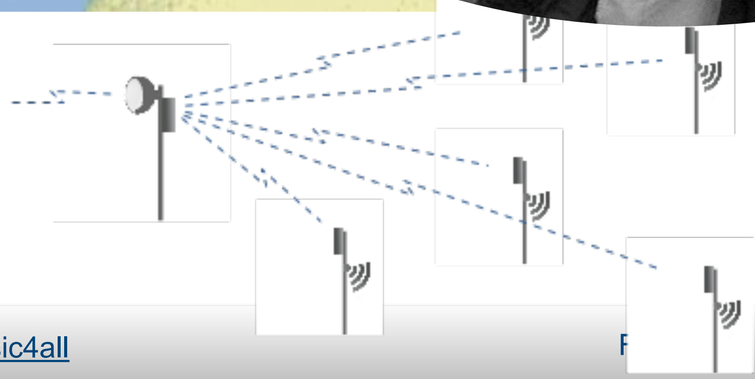
- “The Network is the Computer” [John Gage, SUN Microsystems]
- Coverage and Capacity
- Basic Information Access
  - Free Basic by Facebook
  - Airtel Free
  - Basic Internet Foundation
- Capacity and Traffic Shaping
  - “developed” perspective: tariffs
  - “development” perspective: digital equality
- Status and Future Work

Places without Mobile Coverage

- Yes, they exist, even in Norway

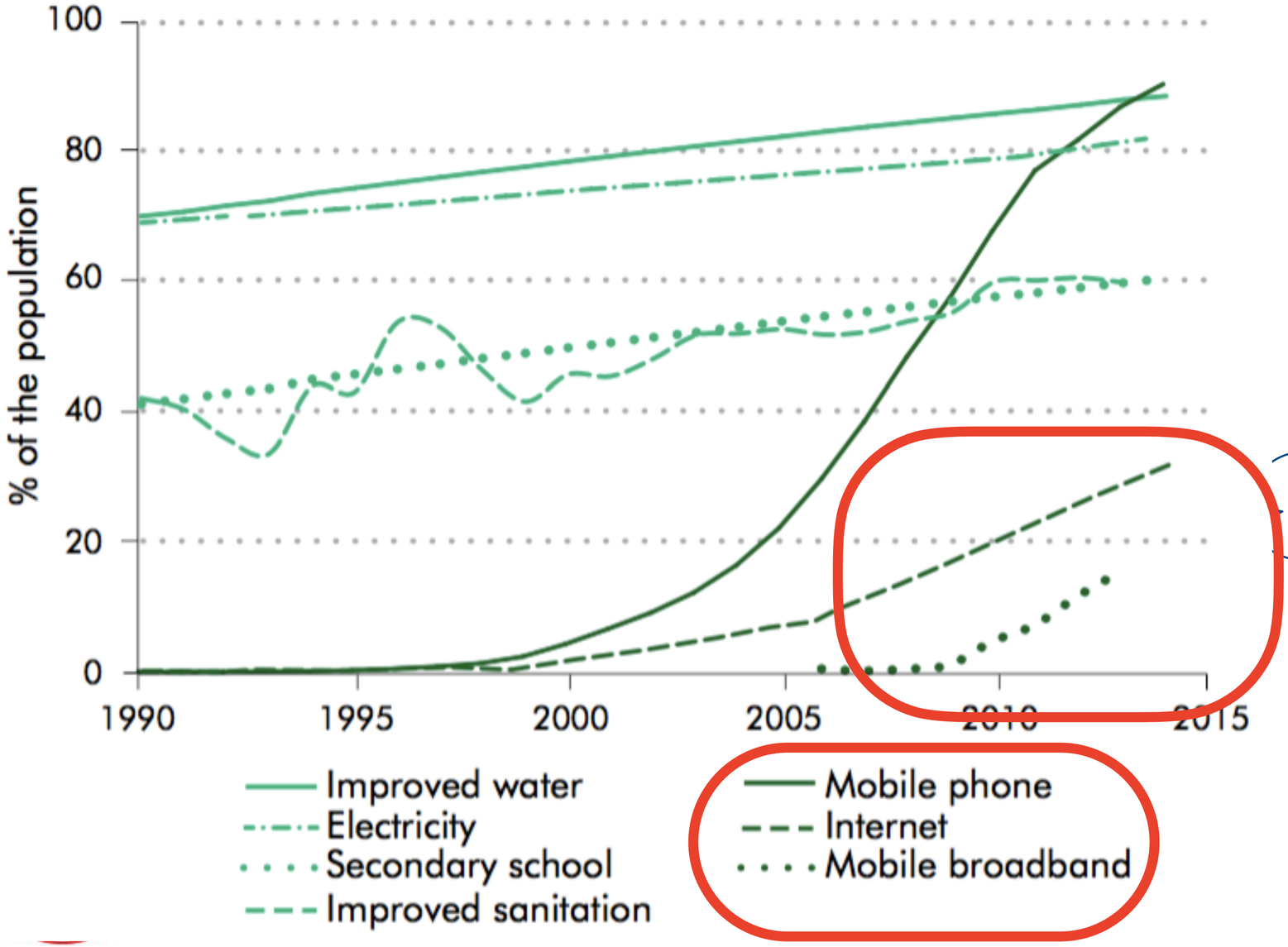
But the need is more stringent …

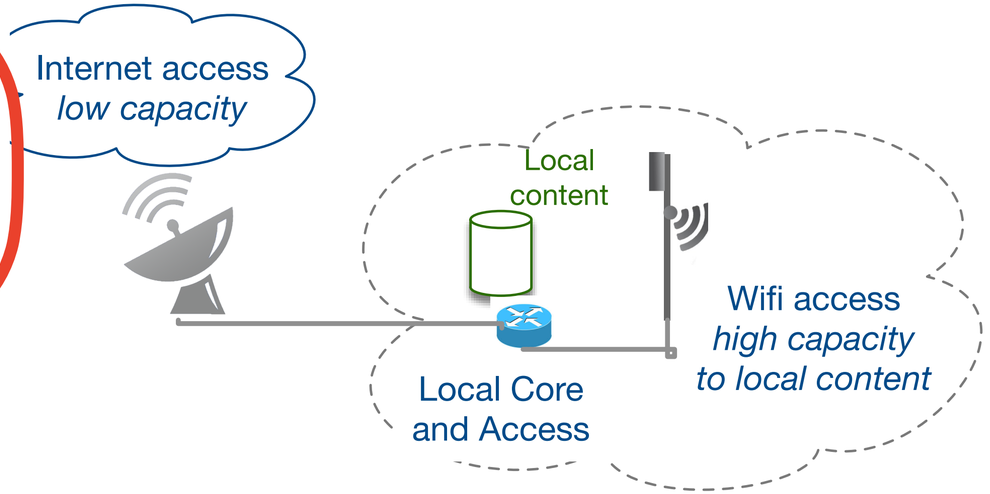
- Internet provision to various parts of DRC
  - operations since 2011
- Connection to a.o. University of Lisala
- Experiences from Internet provision
  - Expensive access: 2000 US$/month for 1 Mbit/s
    Note: 80 Mbit/s for 66 US$ (NO), factor: **2.420 or 0.04%**
  - Requirement for self-sustainable infrastructure
- Developed network infrastructure
  - low-cost establishment of local hot-spots
  - remote core infrastructure (in Norway)
  - based on experiences from Internet history at UiO/UNIK



[Source: World Development Report 2016]

a. Digital technologies are spreading rapidly in developing countries





Connectivity & Affordability

- Mobile supported development
- Affordability (costs of data)
- industrial perspective (Ind4.0)

The Unconnected Market Landscape

Unique Mobile Internet Users

Population 15+ (bn)	Total	BMI	NMI	Unconnected	
Developed World	0.9	0.6	0.1	0.3	
Developing World	4.3	1.0	0.8	2.5	3.3
Total	5.2	1.6	0.9	2.8	

Penetration 15+ (%)	Total	BMI	NMI	Unconnected	
Developed World	100%	64%	[illegible]	27%	
Developing World	100%	23%	18%	59%	77%
Total	100%	30%	17%	53%	

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

[Source: GSMA, Nov2015]

Three trends
changing industry and society

Internet of Things and Big Data

- economy is data-driven
- digital revolution
  - cars -> Tesla, Google
  - health care -> Fitbit, Google/Apple watch
  - home automation -> Google

Industrie4.0

- cheap sensors
- data-driven production
- service-oriented manufacturing

Digital Divide

- 59% unconnected in the developing world
- Inequality in education
- basic industry

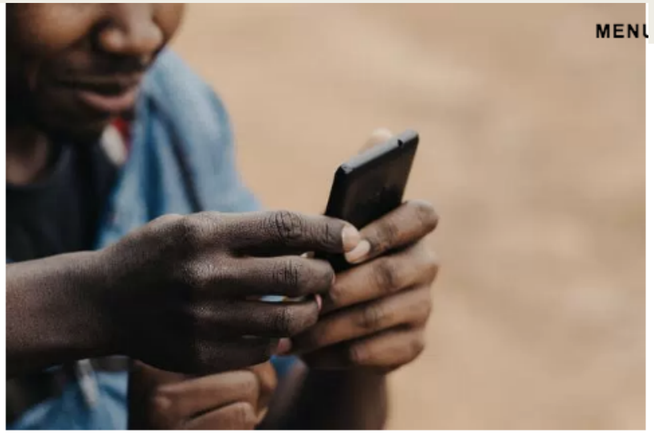
Common challenges:
Connectivity, Affordability, Scalability & Education

internet.org by facebook

Free Basic and Express Wi-Fi

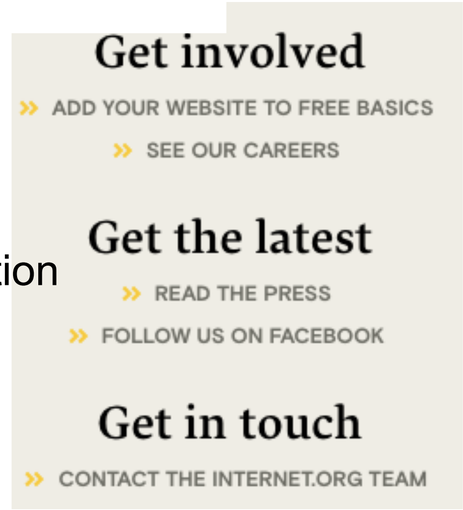
- Free Basic addresses: accessibility, affordability and relevance
  - ➡ social network thinking
  - ➡ novel business, own education
- Provided through >40 mobile operators
  - ➡ zero-rated content
  - ➡ 40% conversion to payed services 1 month, 3 month ROI
- Express Wi-Fi
  - ➡ local entrepreneurs
  - ➡ integrated value chain (AMOS-6 sat, VSAT)
  - ➡ goal: 200 US$/1Mbit/s

Challenge:
Connectivity Data (Data Retention Directive)



Free Basics by Facebook provides people with access to basic websites for free – like news, job postings, health and education information, and communication tools like Facebook.

India: refused to operate: connection data
Egypt: refused to operate: governmental surveillance [theverge.com]



Airtel Zero

- Customer free access to mobile apps
  - ➡ Apps signed up with ‘Airtel Zero’
- Marketing
  - ➡ App providers pay for customers’ data charges,
- India National Agenda on “Digital Inclusion”
  - ➡ Digital Inclusion and ‘Make in India’

How will ‘Airtel Zero’ work?

1. Mobile app makers register with ‘Airtel Zero’ to give customers toll-free access to their apps
2. Airtel informs customers about these toll-free apps
3. Customers download and access these apps at zero data charges – and enjoy their favorite online tasks (e.g. entertainment, shopping) for free – even at zero mobile balance

Motivation:
"Need to close the digital gap"

- The Global Goals:
  Norway is the secretariat for Quality Education
- Internet history
  - ➡ 1973 Europe through Kjeller
  - ➡ 1994 Opera Software
  - ➡ 2014 Basic Internet Foundation

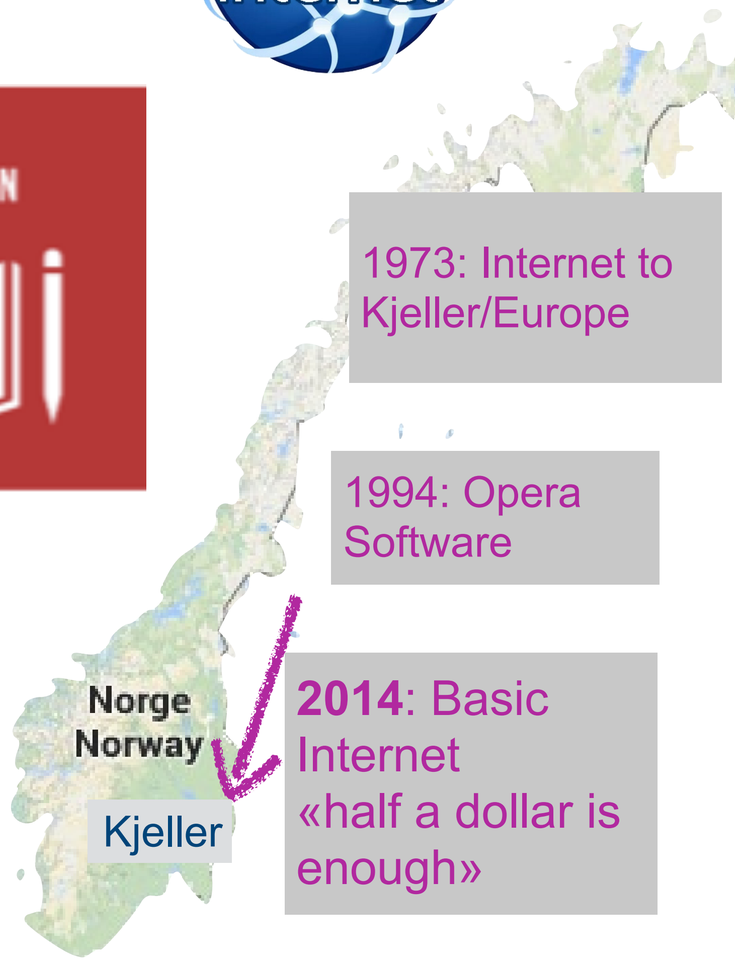
THE GLOBAL GOALS
For Sustainable Development

4 QUALITY EDUCATION

Basic Internet

"Internet is my teacher"

"I'm currently learning Python and HTML, so I can make a website for my parents' business"

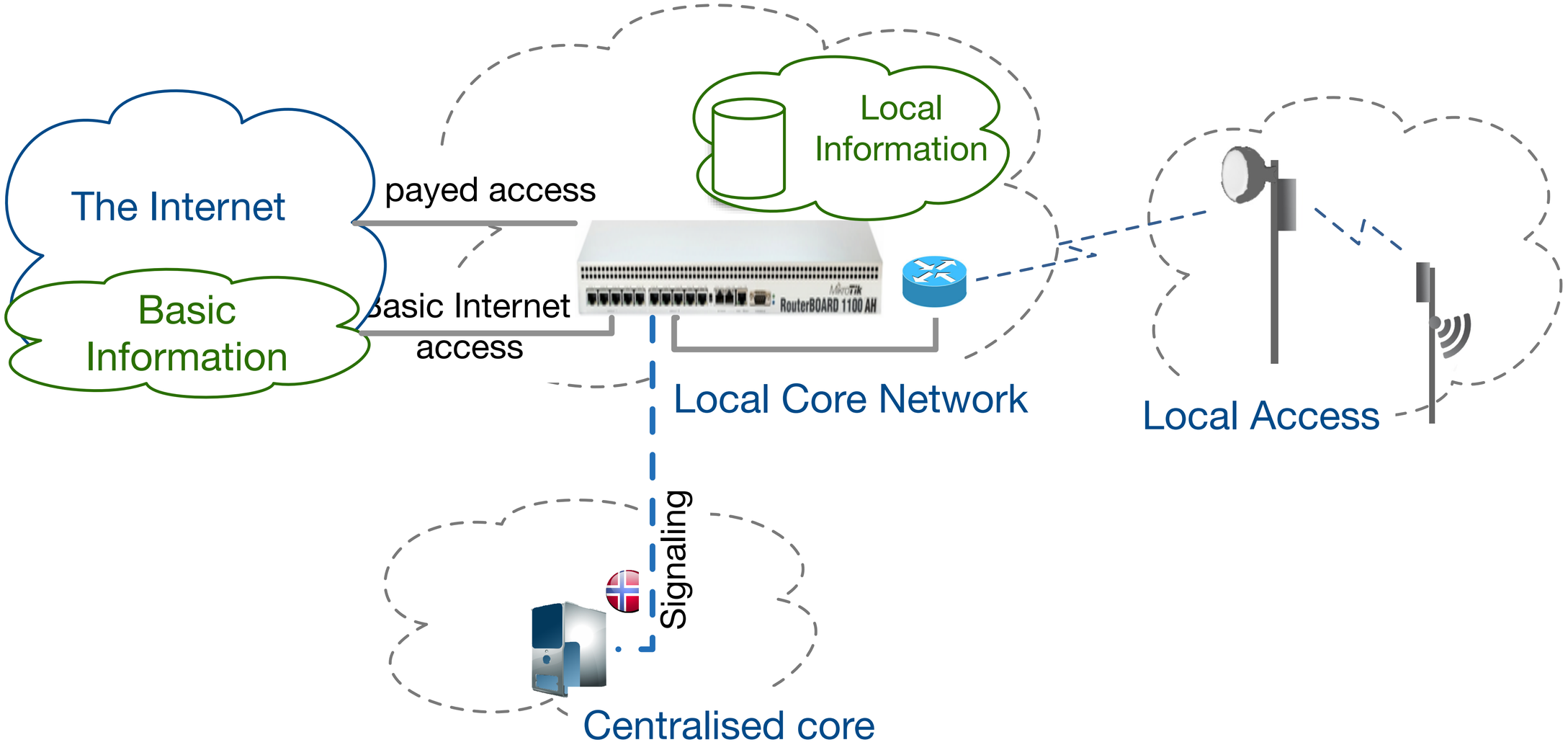


1973: Internet to Kjeller/Europe

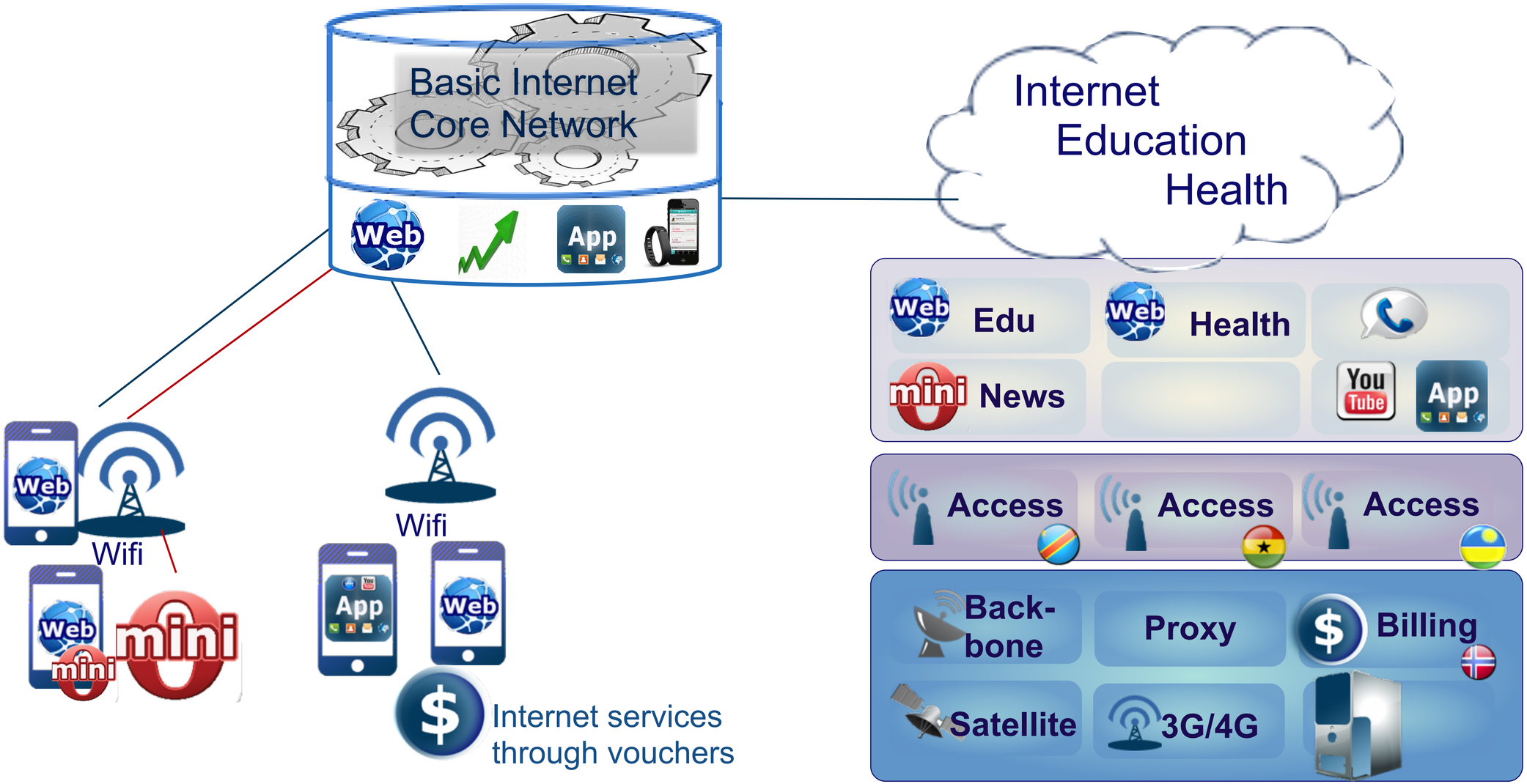
1994: Opera Software

2014: Basic Internet «half a dollar is enough»

Basic Internet infrastructure:
Technology Solution

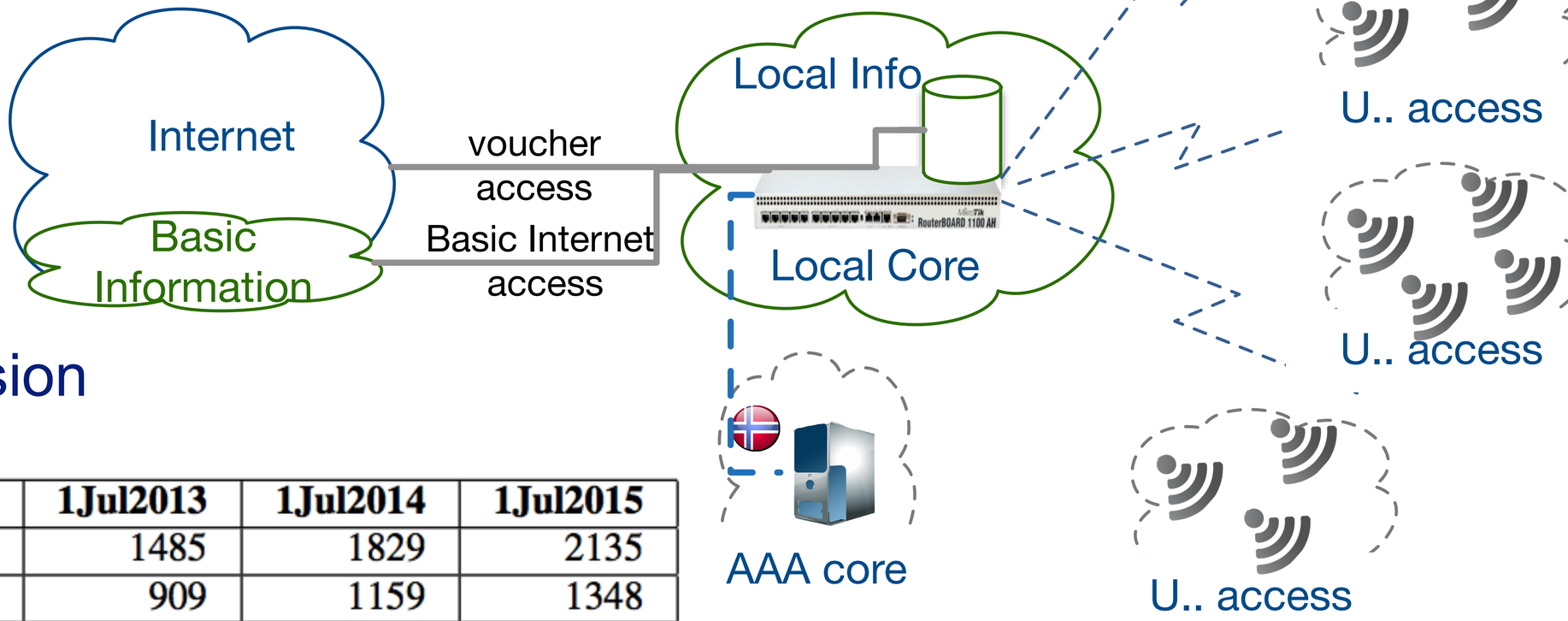


Public-Private Partnership
Basic Internet Core Network



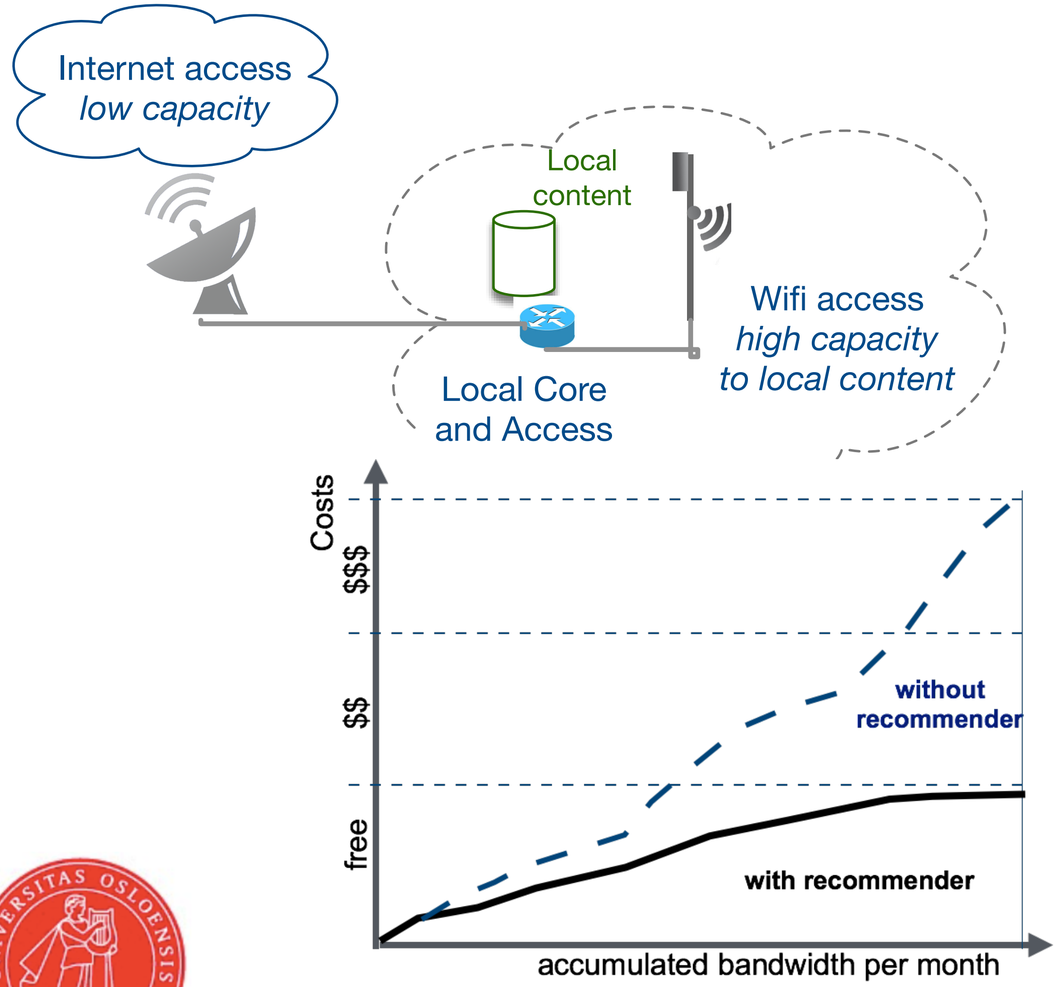
Examples of challenges
Network infrastructure (Kinshasa)

- DHCP lease time
  - ➡ IP addresses
  - ➡ 50.000 students
  - ➡ http2 server side compression
  - ➡ IP filtering
  - ➡ mobile network
- Intelligent compression



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

Traffic shaping (goals)



- Addressing connectivity challenges
  - ➡ “everything connects”
  - ➡ limited backhaul connectivity
- adhere to network conditions
  - ➡ overcrowded network (“car queue”)
  - ➡ bad coverage: 3G cell breathing, 2G network, Wifi congested
- adhere to user data limits
  - ➡ 1 GB (or volume steps)
- access from Wifi or Mobile Broadband
  - ➡ Wifi “everything is downloaded”

Development: Traffic recommender

- 50% of network traffic initiated from browsers [Morgan Stanley Research]
  - ➡ adaptation of browser functionality (server processing)
- 80% of screen time usage related to apps
  - ➡ priority of app usage
  - ➡ average 26 apps per mobile (average user overload)
- Implementation: App recommender

TABLE II. NORMAL BANDWIDTH USAGE FOR TYPICA APPILCATIONS

Service	Traffic
Web browsing	2.5 MB/min
Social Networks (1 Hour)	90MB
Video Streaming(i.e.YouTube) (1 Hour)	1125MB (720p)
Online Music, i.e. Spotify, 1 h	43.2MB (96kbps)
Mobile MMS with Video	100KB
Mobile SMS (1 message)	0.13KB

Results

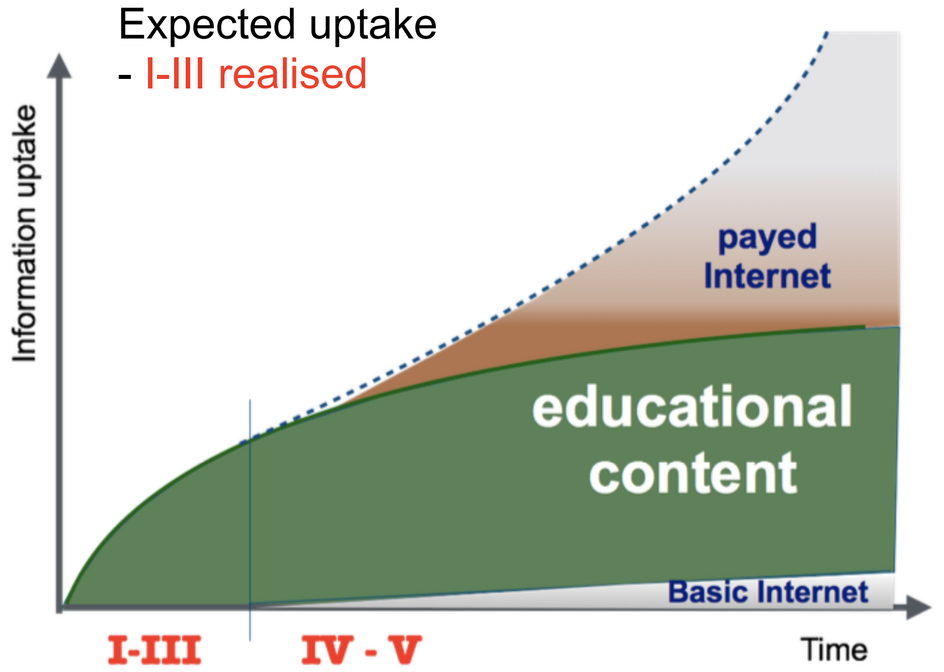
- Implementation work
  - ➡ Android framework established
  - ➡ Network probing successful
    - basis for proactive handover (earlier work)
    - provides network quality factors (ping, network capacity estimation)
  - ➡ App listing priorities (simple on/off)
- Identified challenges
  - ➡ App config access not supported by Android
  - ➡ Link personal preferences (apps; app usage) to network quality
    - from on/off to optimisation (priority handling)
    - proactive connectivity map

Evaluation: effect on battery, user experience

TABLE III. INFORMATION PROVISIONING COSTS

Usage [MB]	Users/1 Mbps	costs/user [US$/month]
4	3996	0.5
20	799	3
50	320	6

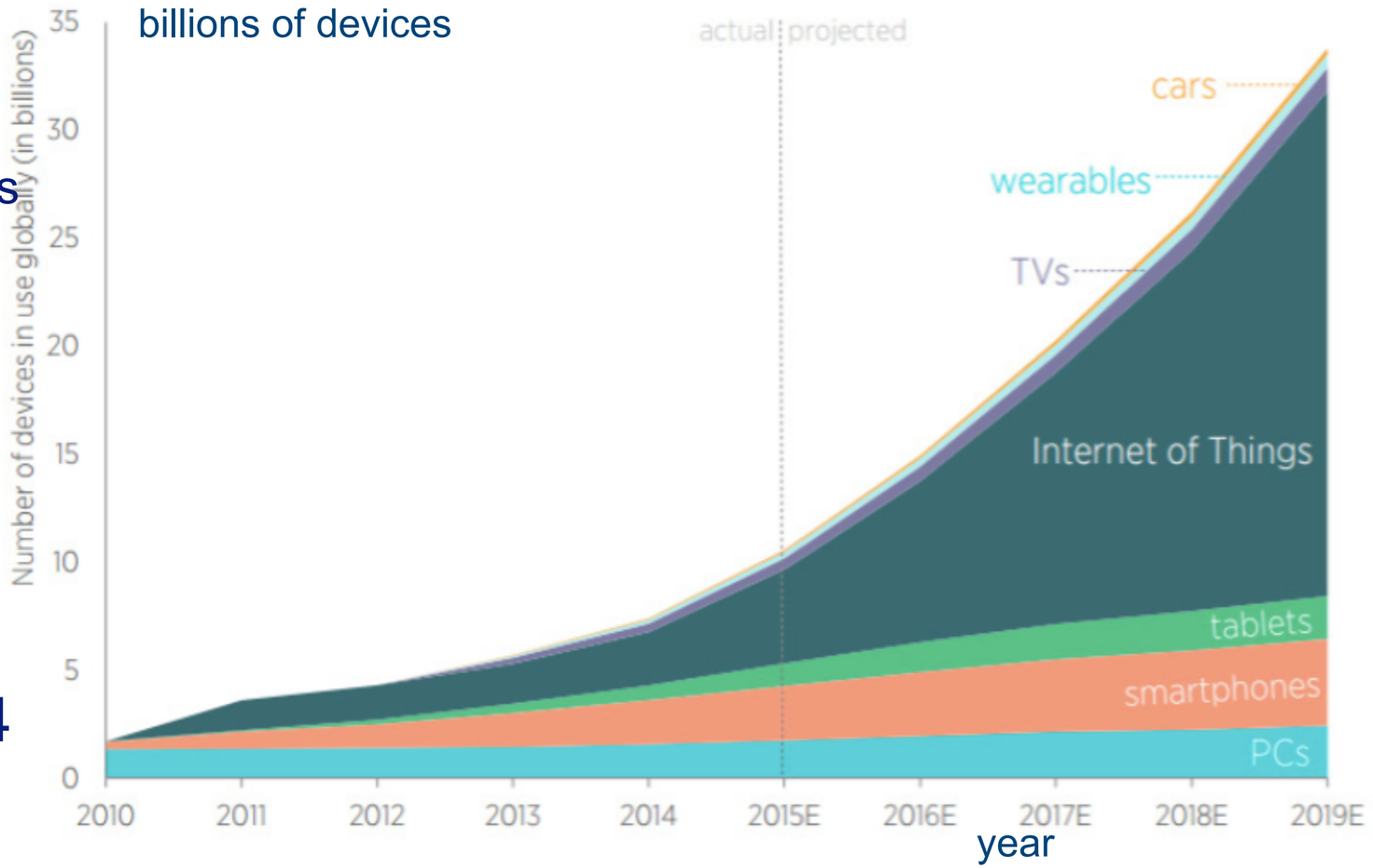
given1 Mbit/s satellite cost of 2000 US$/month



Basic Internet: Traffic shaping

Basic Internet challenge: IoT inclusion

- DNV-GL:
  - ➡ sensors will drive automated data management
  - ➡ from passive data to automated decisions
  - ➡ automated decision tools by 2020
- Smart home appliances, “wearables”, smart metering, autonomous vehicles,…
- 10 billion (2013) -> 19 - 40 billion (2019)
- total global impact: US$ 2.7 - 14.4 trillion by 2025
- **~3/4** of devices from IoT++
  ~1/4 from tablet, mobile…

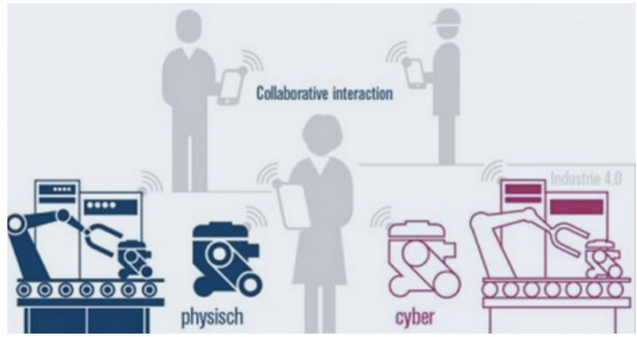


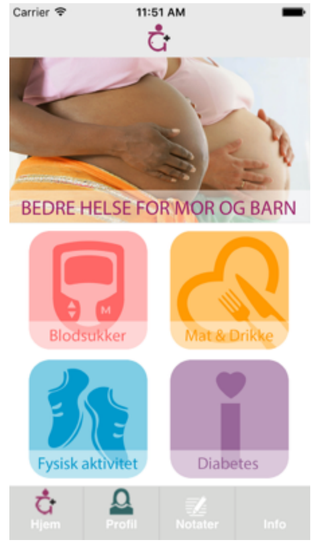
[Source: A. Thinner and A. Castillo, 2015]

Source: John Greenough, “The Internet of Everything 2015,” *Business Insider Intelligence*. Produced by Adam Thierer and Andrea Castillo, Mercatus Center at George Mason University, 2015.

Conclusions

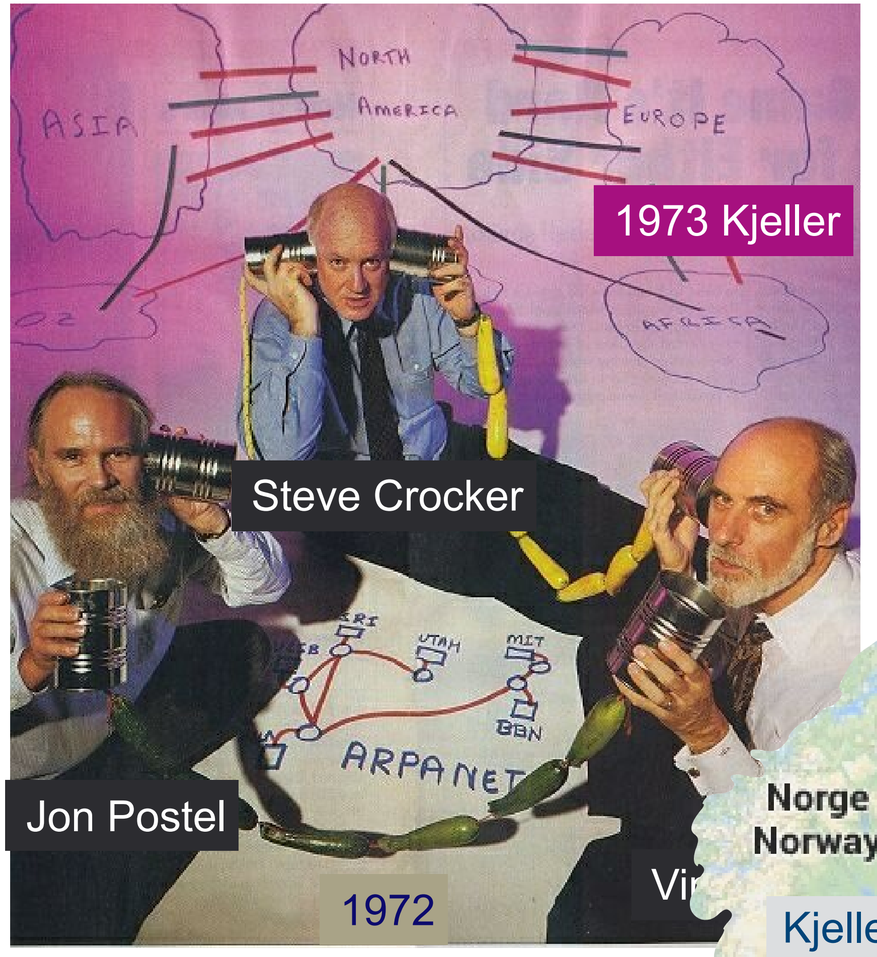
- Digital inclusion includes IoT
  - ➡ Development aid needs to become digital
  - ➡ Access is the main challenge: cost factor 2.400 more expensive Internet
  - ➡ Data driven societies
- Basic Internet Foundation
  - ➡ Connectivity -> novel business models
  - ➡ Scalability -> open wifi for IoT
  - ➡ Affordability -> LTE-band sharing (NL, SE)
  - ➡ Education -> addressing the digital gap
- Traffic shaping
  - ➡ efficient use of bandwidth (network probing)
  - ➡ adjusted to tariff models





Additional information

How come these guys didn't think of security?



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

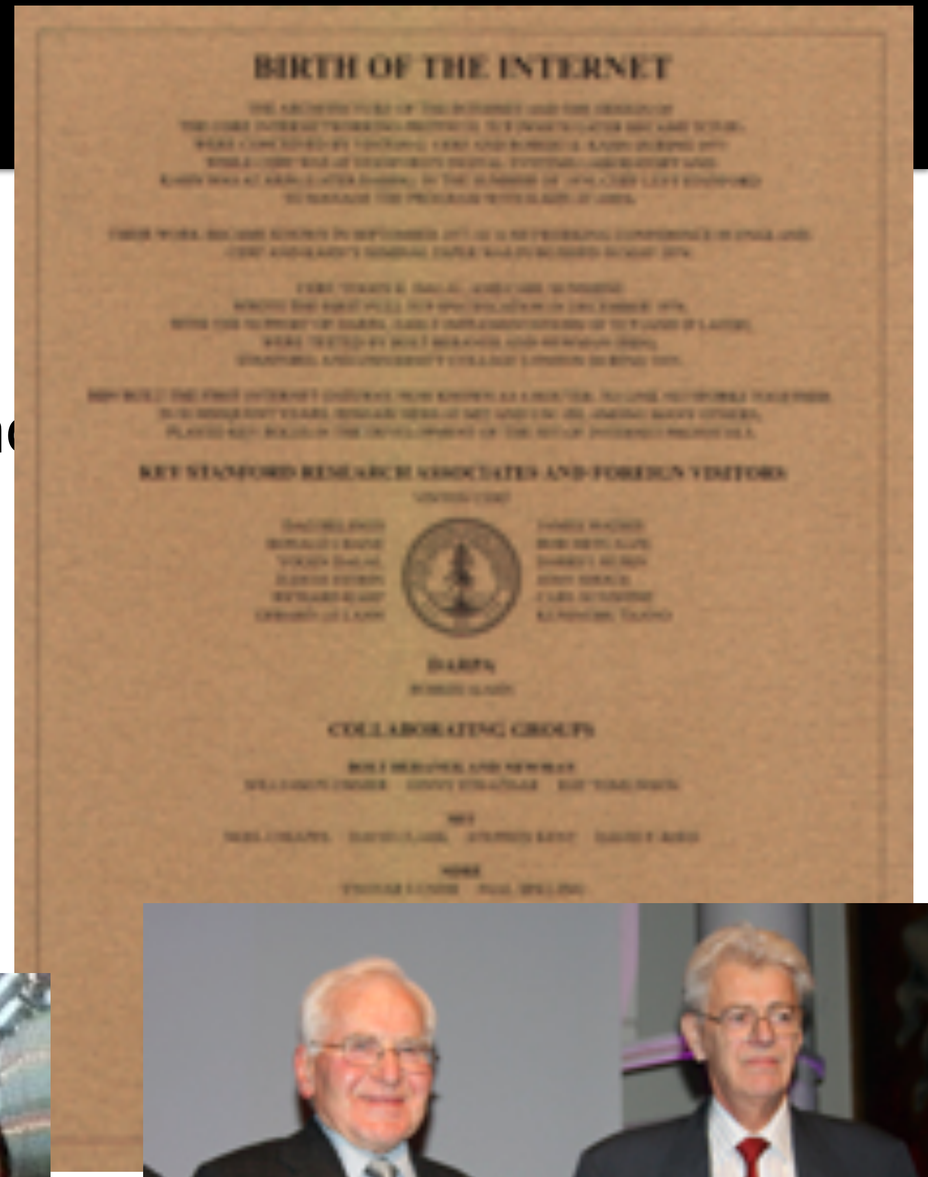
1971 (at which point 23 hosts, at universities and government research centers, were connected to the ARPANET); 29 by August, 1972, and 40 by September, 1973.

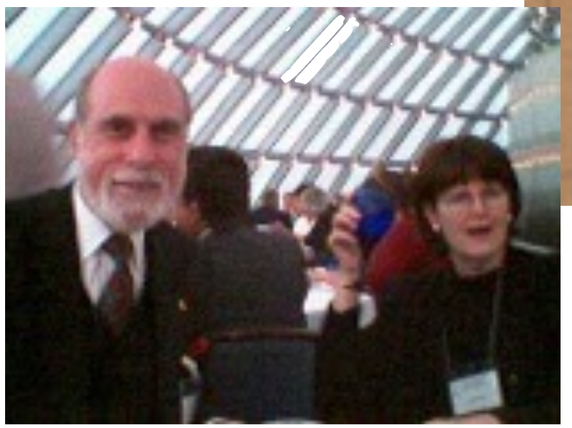
At that point, two satellite links, across the Pacific and Atlantic Oceans to Hawaii and Norway (NORSAR) had been added to the network. From Norway, a terrestrial circuit added an IMP in London to the growing network.

Source: http://www.michaelkaul.de/History/h...

The Internet and Scandinavia

- The first connection of Arpanet outside of the USA (an **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
  - Service adaptation



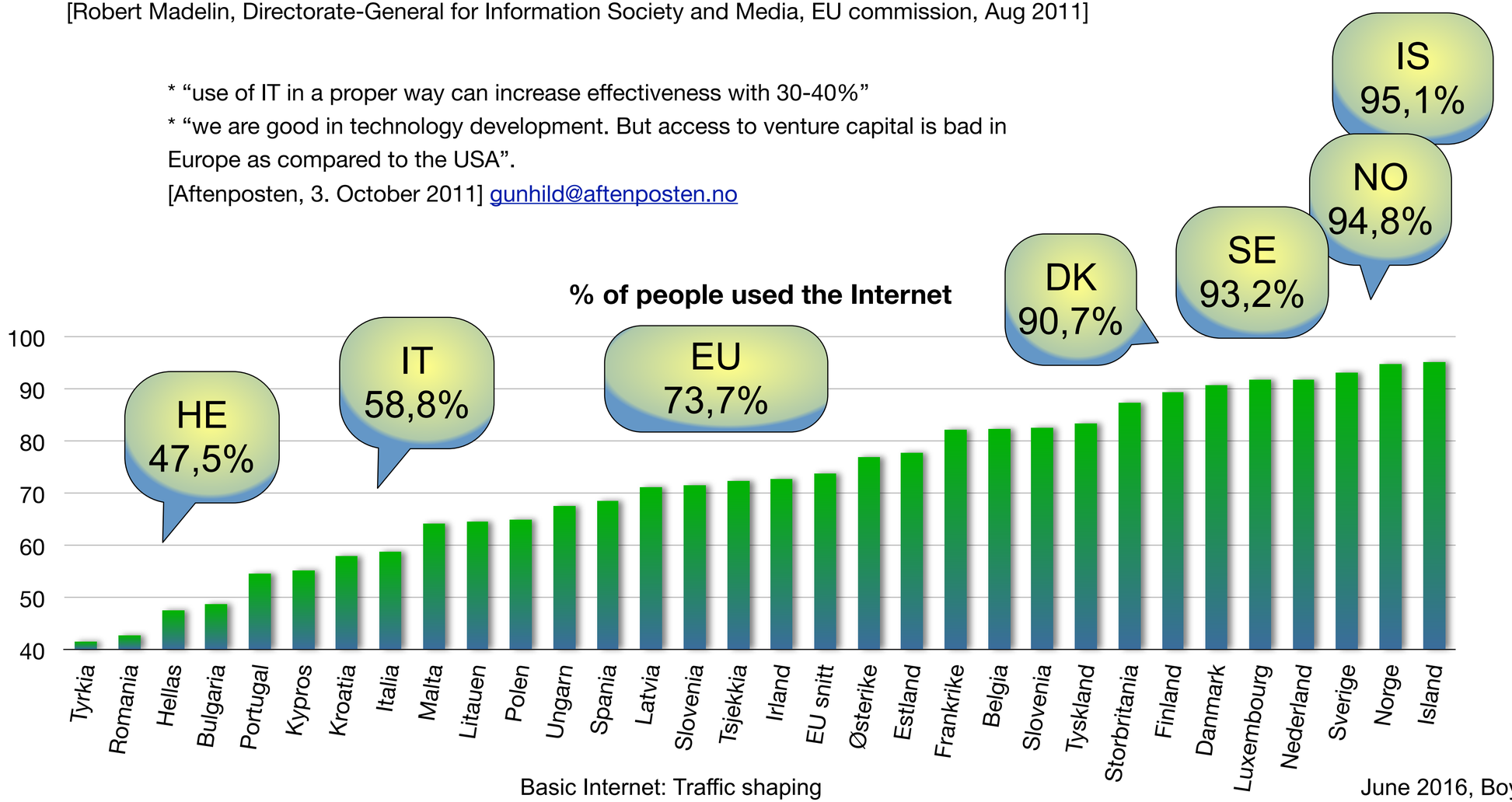


Internet usage in Scandinavia

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

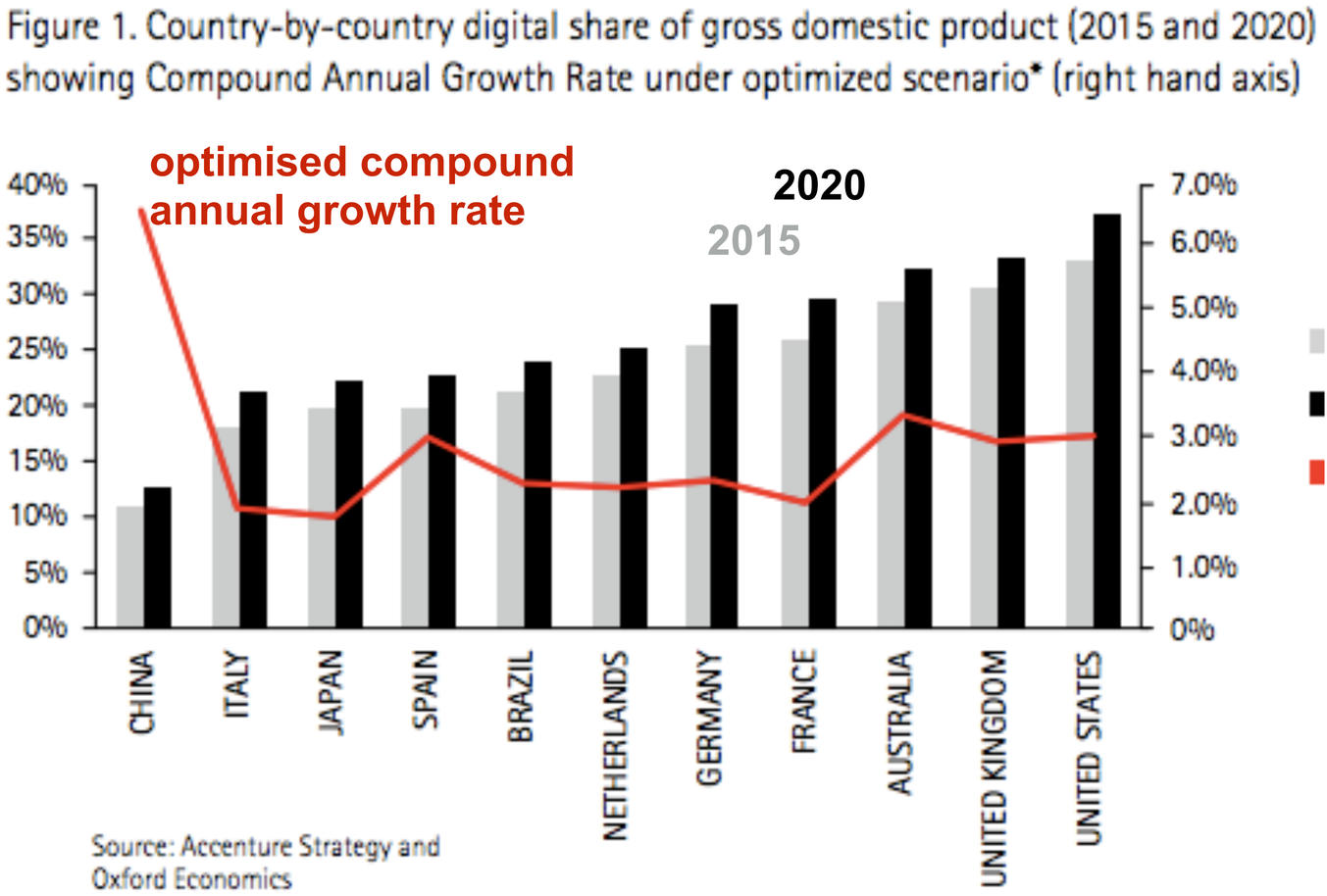
* “use of IT in a proper way can increase effectiveness with 30-40%”
* “we are good in technology development. But access to venture capital is bad in Europe as compared to the USA”.

[Aftenposten, 3. October 2011] gunhild@aftenposten.no



Digital share of GDP (2015 - 2020)

- Accenture Strategy & Oxford Economics, 2016
- Today: USA, 33% og GDP due to digital
- Financial Services 57% digital
  Business Services 54%
  Communications 47%
- 22% of global retail from digital,
  28% in health,
  20% in consumer goods
- digital achievements: *technology, skills, accelerators*



[Source:Accenture, “Digital Disruption Growth” 2016]