Ecological transition in ICT: A role for open hardware?

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Recent climate change model update

Source: CNRS, CEA & Météo-France, 17/9/2019
Outline

• Context:
  global socio-ecological crisis
• What about ICT?
• Socio-ecological transition
Growth in Internet data traffic

Global growth rate 2016-2021: + 24% / year

Source: CISCO, VNI, 2017

Growth rate:
for smartphone communications: + 48% / year
for M2M (IoT) communications: + 70% / year
# Internet energy consumption model

<table>
<thead>
<tr>
<th>2018 status</th>
<th>0.35-1 kWh/GB</th>
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<tr>
<td>Change rate</td>
<td>~ -10% / year</td>
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GHG emissions from online video

2018 data

Source: The Shift Project
Trend in IoT device market

The edge will eat the cloud [...] the edge is coming and it’s going to be big

– Thomas Bittman, Gartner Blog Network
Energy footprint – Home camera

• 10 HD cameras always-on:
  – 3900 GB / month
  – Generates 50% of the household electrical energy consumption in the cloud

• Engineering solutions:
  – local event detection though AI/ML inference ➔ Edge computing
  – More efficient network ➔ 5G
Moore’s law

Increasing transistor density by shrinking the feature size

- Better performance and energy efficiency
- More complex manufacturing: more energy and more material

Source: Intel
Energy footprint of chip fabrication

Chip unit sale: +9%/year (thanks Steve!)

× Chip unit fab energy: +8%/year (thanks Gordon!)

= Global chip fabrication energy footprint: +17% per year

Source: IC insights, 2019
It’s not only about energy

Coltan mine in North Kivu (Congo)
Copyright: Stefano Stranges

E-waste informal recycling area in Guiyu (China)
Impact of financial economy on ICT innovations

- Pitfall #1: buzz-word driven innovation
Impact of financial economy on ICT innovations

- Pitfall #1: Buzz-word driven innovation
- Pitfall #2: KPI-driven innovation
What will we use 5G for?
The case of AV and 5G

- A lot of sensor data \(\rightarrow\) a lot of power in the cloud
- A lot of ICs and batteries \(\rightarrow\) a lot of rare metal
- Rebound effect: how to say no to 100-km commuting
- Systemic effect: driver becomes a consumer
The technological illusion

Total = 42 GTCO$_2$/year

- **2020**
  - ICT
  - Other

- **2050**
  - ICT
  - Other (+2°C IPCC plan)

24 GTCO$_2$/year

The digital Tower of Babel

5G, blockchain, deep-learning, self-driving cars
No exponential is forever ... but forever can be delayed.

– Gordon E. Moore
Socio-ecological transition

• [...] Transition initiative [...] refers to grassroot community projects that aim to increase self-sufficiency to reduce the potential effects of peak oil, climate destruction, and economic instability. [Wikipedia]

• The social-ecological transition answers environmental change with social progress.
  – Prof. E. Laurent, 2015
How do we apply these principles to ICT engineering?
1. Focus innovation on fundamental needs
Requires human interaction with the rest of the world (i.e. non engineers)
Socio-ecological transition in ICT

2. Replace KPI by reduction in carbon / resource footprint (caution: ≠ efficiency !!!)
Socio-ecological transition in ICT

3. Appropriate technology (low/mid tech is cool)
Socio-ecological transition in ICT

4. Resiliency is a key target
A role for open hardware?

- Open-source code
- Open-source hardware
- Open-source EDA tools
- + open semiconductor fabs
= resilient ICT
Sobriety in academic research

A Tsunami of paper – Dr M. Pelgrom, 2015
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Sobriety in the use of ICT

- Do not waste data traffic
- Consume data locally
- Fight electronic obsolescence (protect, repair, question the replacement)