Aalto University
School of Science

ControlThings
Excellence Embedded

BIM-IoT (Internet of Things

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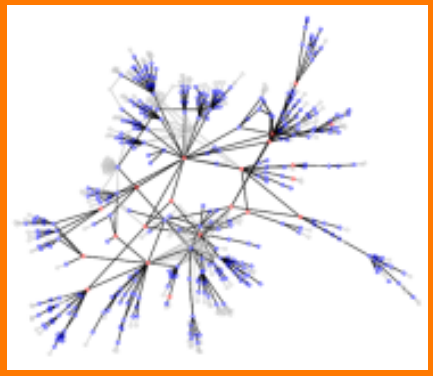


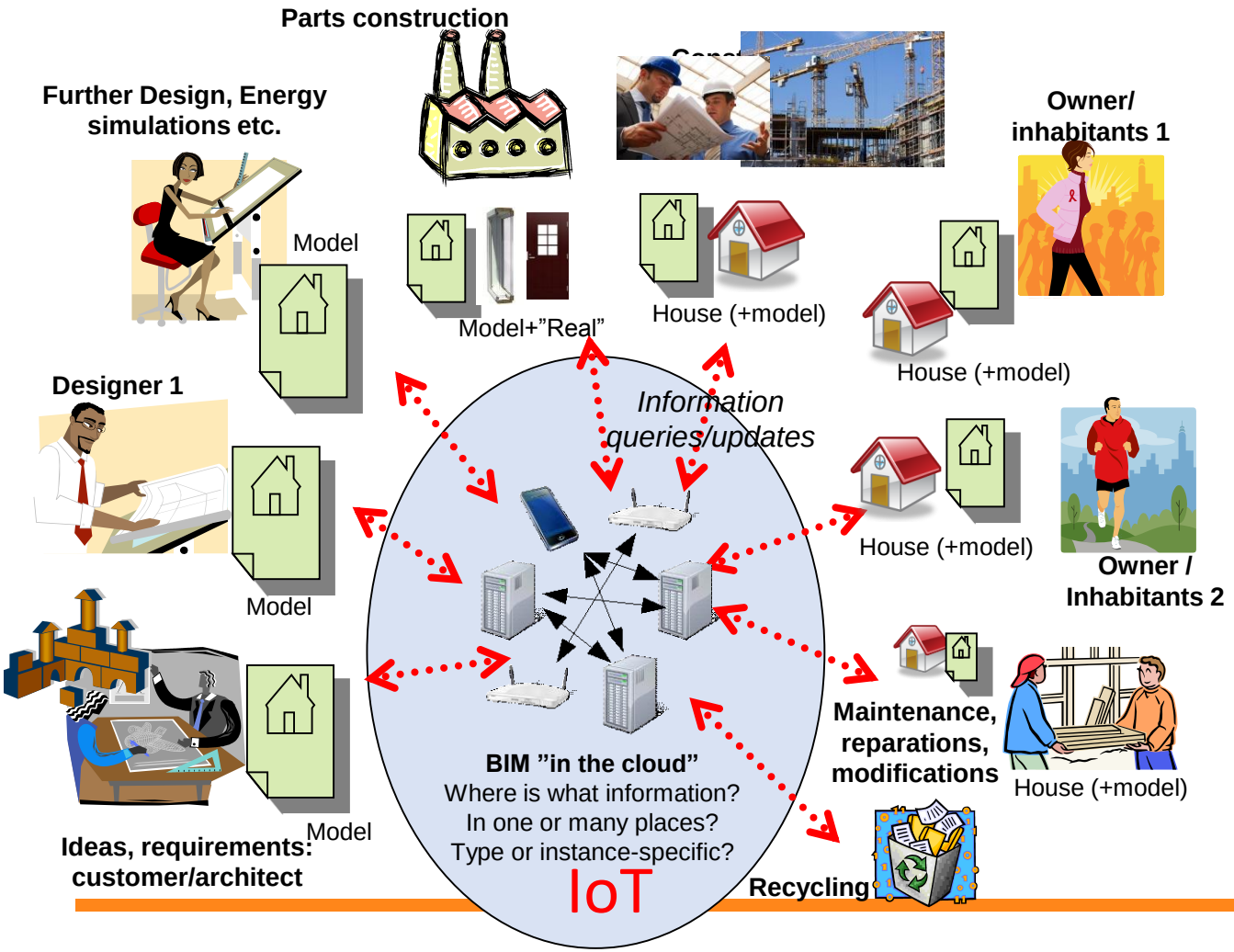
IoT @ Aalto & The Open Group

- ***DIALOG*** platform: **first IoT implementation** in the world (Aalto University, 2001), described in first research articles on IoT in 2002*
- ***PROMISE EU project***: **10 industrial IoT cases** in different application domains (2004-2008)

- Standardisation **Work Group** established with The Open Group in 2010 under name Quantum Lifecycle Management (QLM), changed into IoT Work Group in 2014
- **Open Messaging Interface** (O-MI) and **Open Data Format** (O-DF) published in 2014

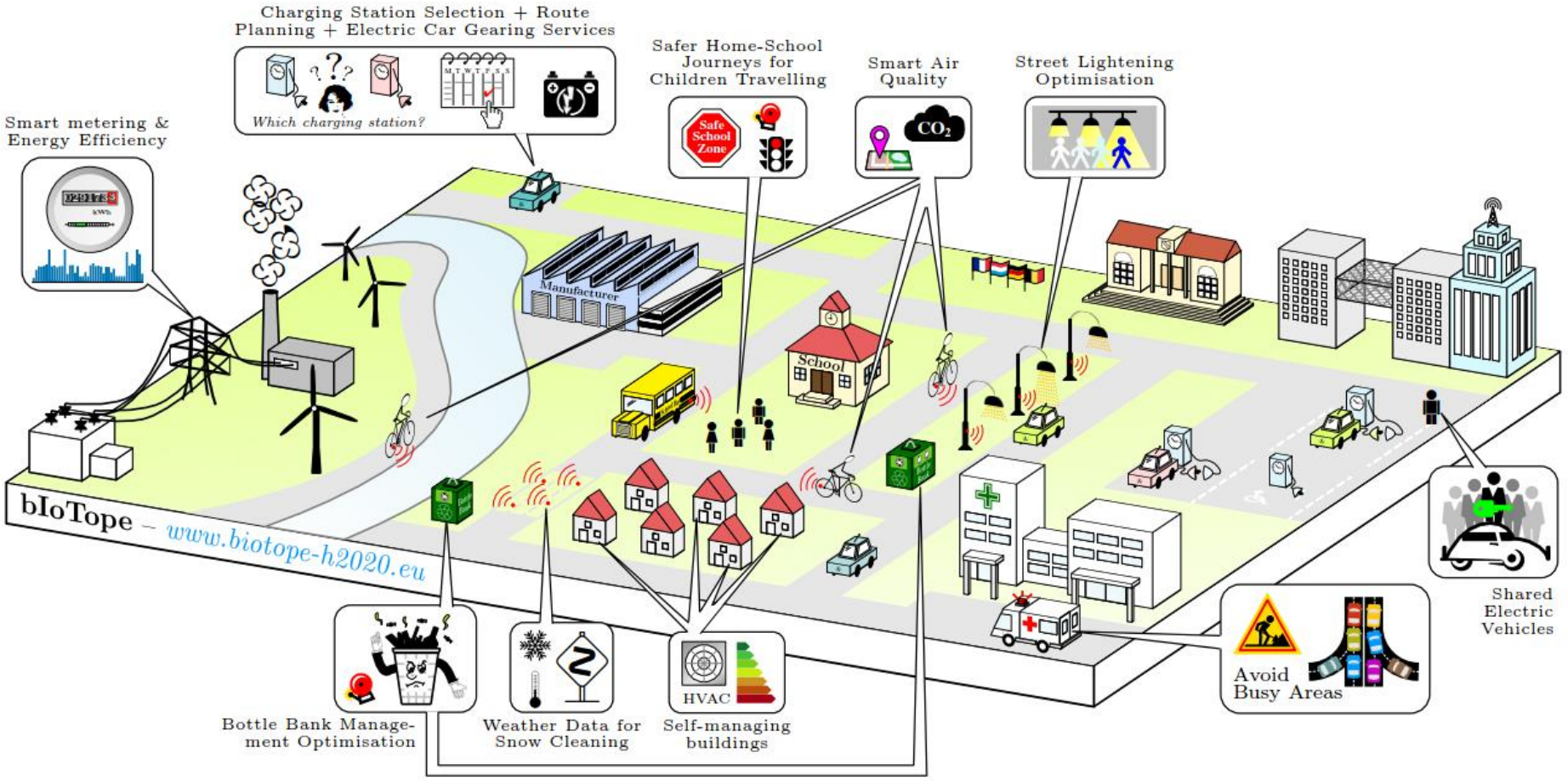
* FRÄMLING, Kary. Tracking of material flow by an Internet-based product data management system (in Finnish). *Tieke EDISTY magazine, No. 1, 2002*, Finland. pp. 24-25.

BIM, IoT and the Lifecycle



- Over lifetime, BIM information becomes **distributed** over many computer, organisations, individuals, ...
- Models may **not be accessible** when needed
- Building and its parts are **unique instances** as soon as it has been built
- Models tend **not to correspond to real building** as building gets older

Smart City: bIoTope use cases



Example: Car arriving in town

Find parking place close to …

Need to charge my EV battery, N kWh…

I'm driving in street xxx, location yyy

Street temperature is…

ESP system activated, slippery!!

Just drove into hole in the street!

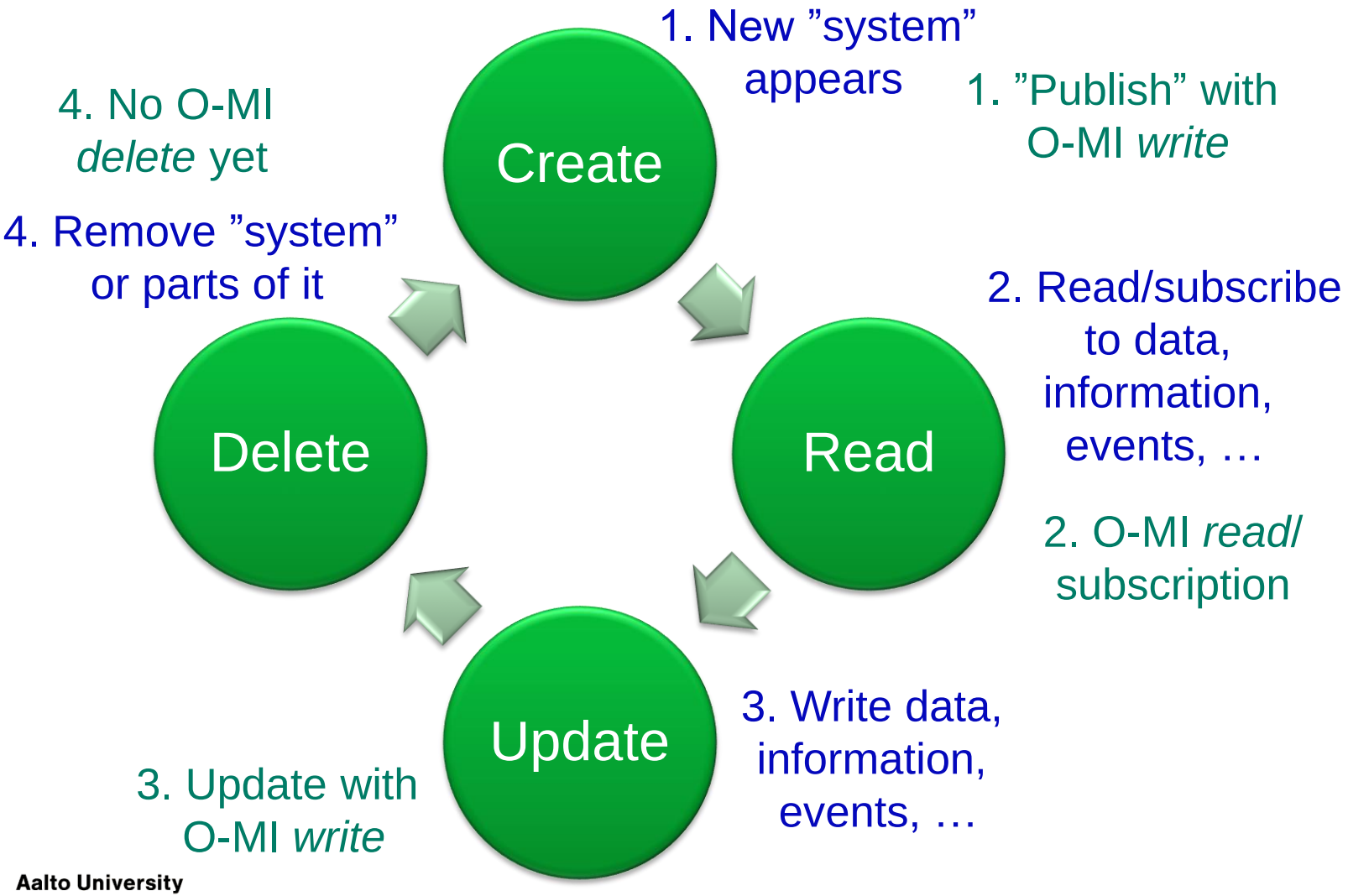
Parking/ EV charging place reserved…

Hole in road 100 meters ahead!

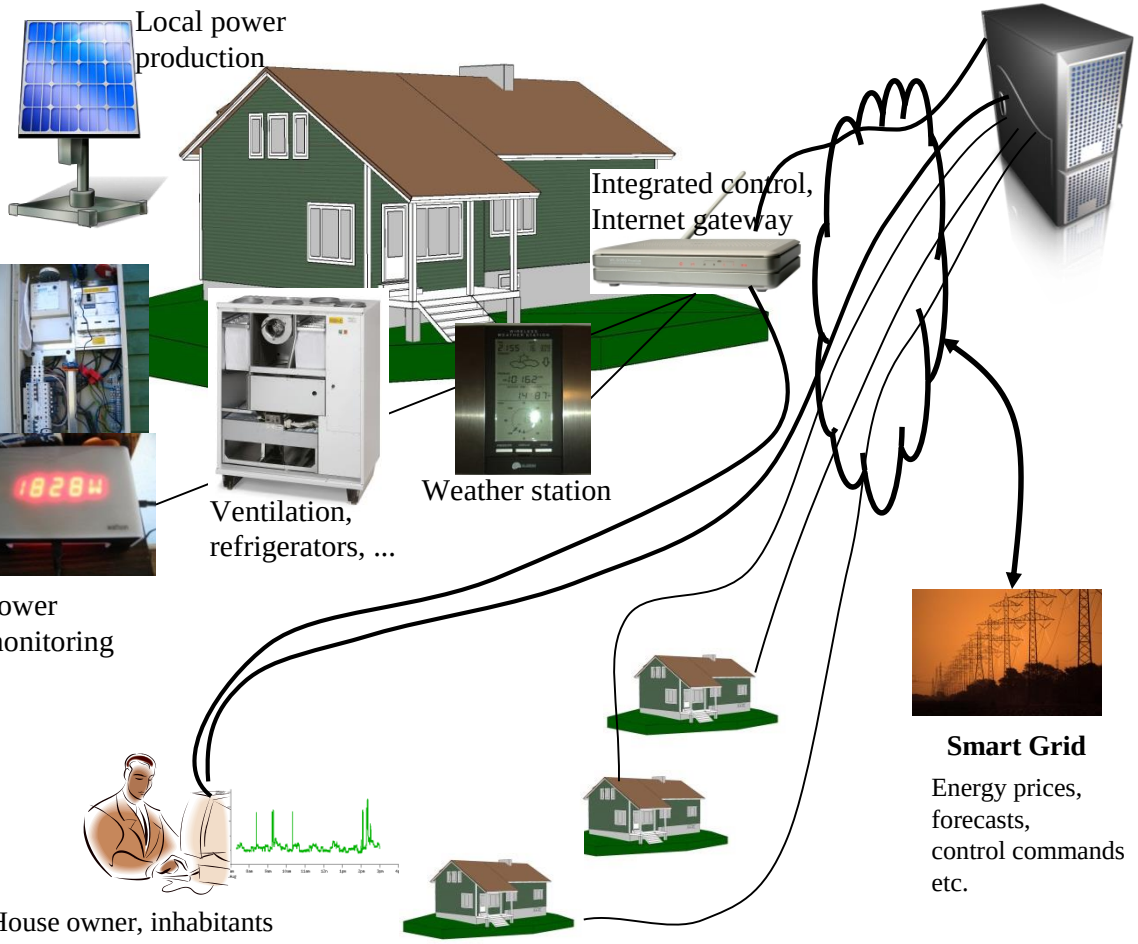
Slippery 100 meters ahead!

School class crossing street in 5 minutes, change route!

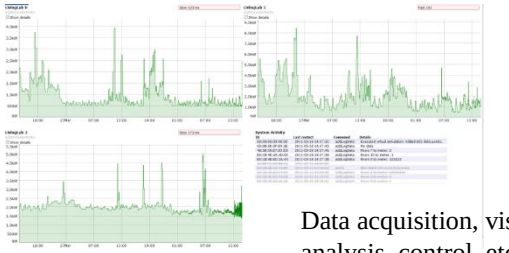
IoT CRUD with O-MI and O-DF



Smart House



Manufacturers, maintenance and service companies, electricity providers, ...



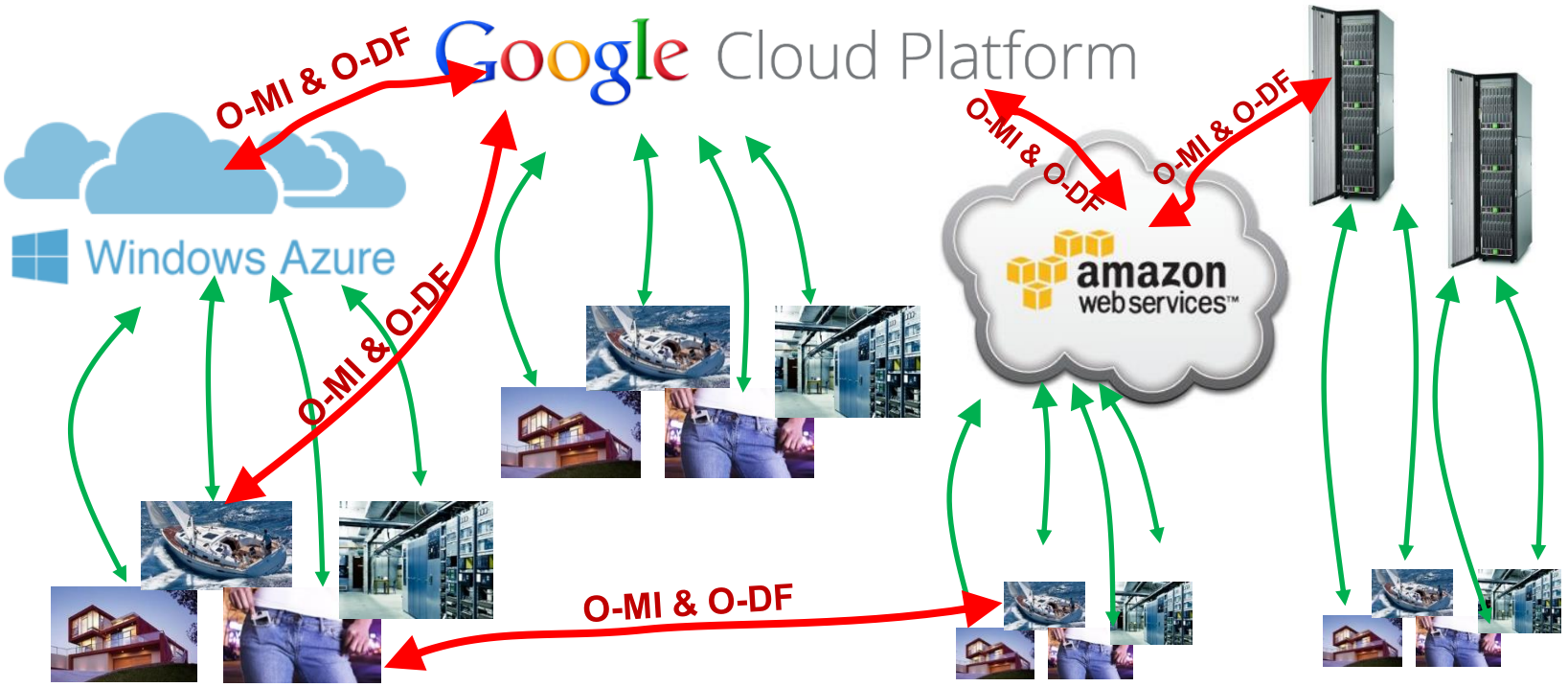
Data acquisition, visualisation, analysis, control, etc. (server/cloud)

1. Asemo internals (seecc+ webkeruudlogsender)
2. Temperature & humidity sensors
3. Enervent Pandion

Reference Implementation

- Currently running at https://otaniemi3d.cs.hut.fi/omi/node/
- Published as Open Source
- Plan: disseminate through iot.eclipse.org
- Implements:
  - URL-based discovery and read operations
  - Web GUI for more advanced operations
- Source Code in Github : https://github.com/AaltoAsia/O-MI
- Implementations in several languages exist
- Data publication and acquisition for instance with simple Unix Shell Script

IoT with Open Group Standards



- **Systems** rather than sensors
- **Horizontal integration** as easy as vertical integration
- Connections created **without programming as needed**
- Establish **two-way**, **time-limited** information flows between trusted entities

Conclusions

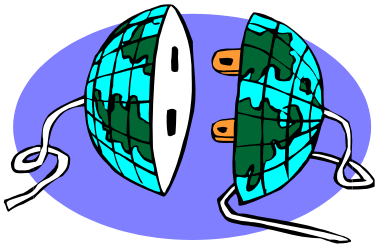
- **O-MI & O-DF** is the same for **IoT** as **HTTP & HTML** for the **Web**
- IoT is about **Systems of Systems**
- **Keep it simple!** O-MI: 21 pages, O-DF: 10 pages
  - O-MI & O-DF are **mature**: the result of a long process and many iterations involving numerous people, organizations, domains and applications
  - *I didn't have time to write a short letter, so I wrote a long one instead.*
- **Questions for everybody** to think about
  - What if HTTP&HTML would not have been universally accepted and we would have 10-1000 incompatible Webs?
  - What would that ecosystem look like?
  - What would it mean to business?
  - What would it mean to developers?

Interoperability challenge

Think this is difficult?

Internet of Things,

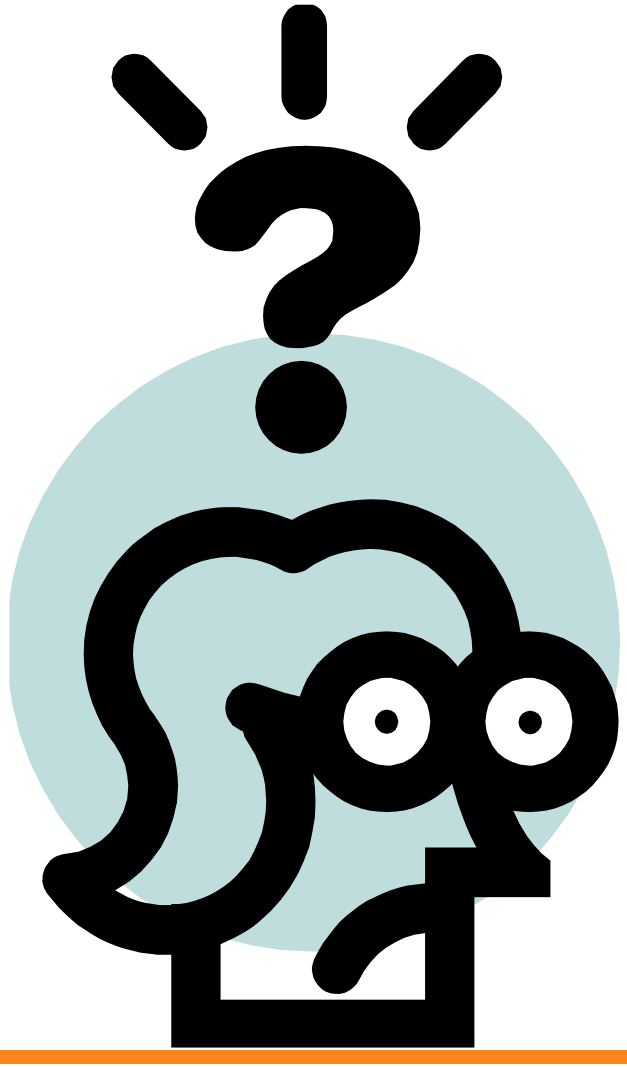
Cyber-Physical Systems



Open Messaging Interface (O-MI)
Open Data Format (O-DF)
Open Group Standards for the Internet of Things (IoT)

Things, money, languages, ...

Questions?



Thank You!