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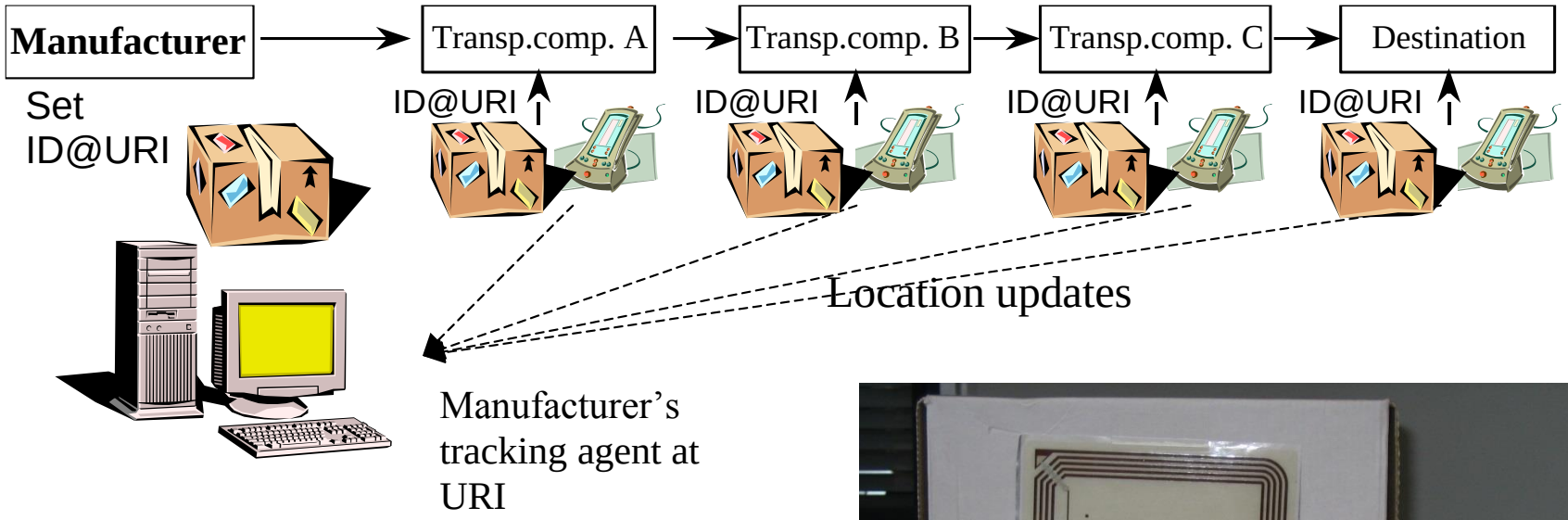
Beginning in IoT: Tracking with ID@URI



Industrial pilots performed 2002, 2003 in multi-organisational and international context

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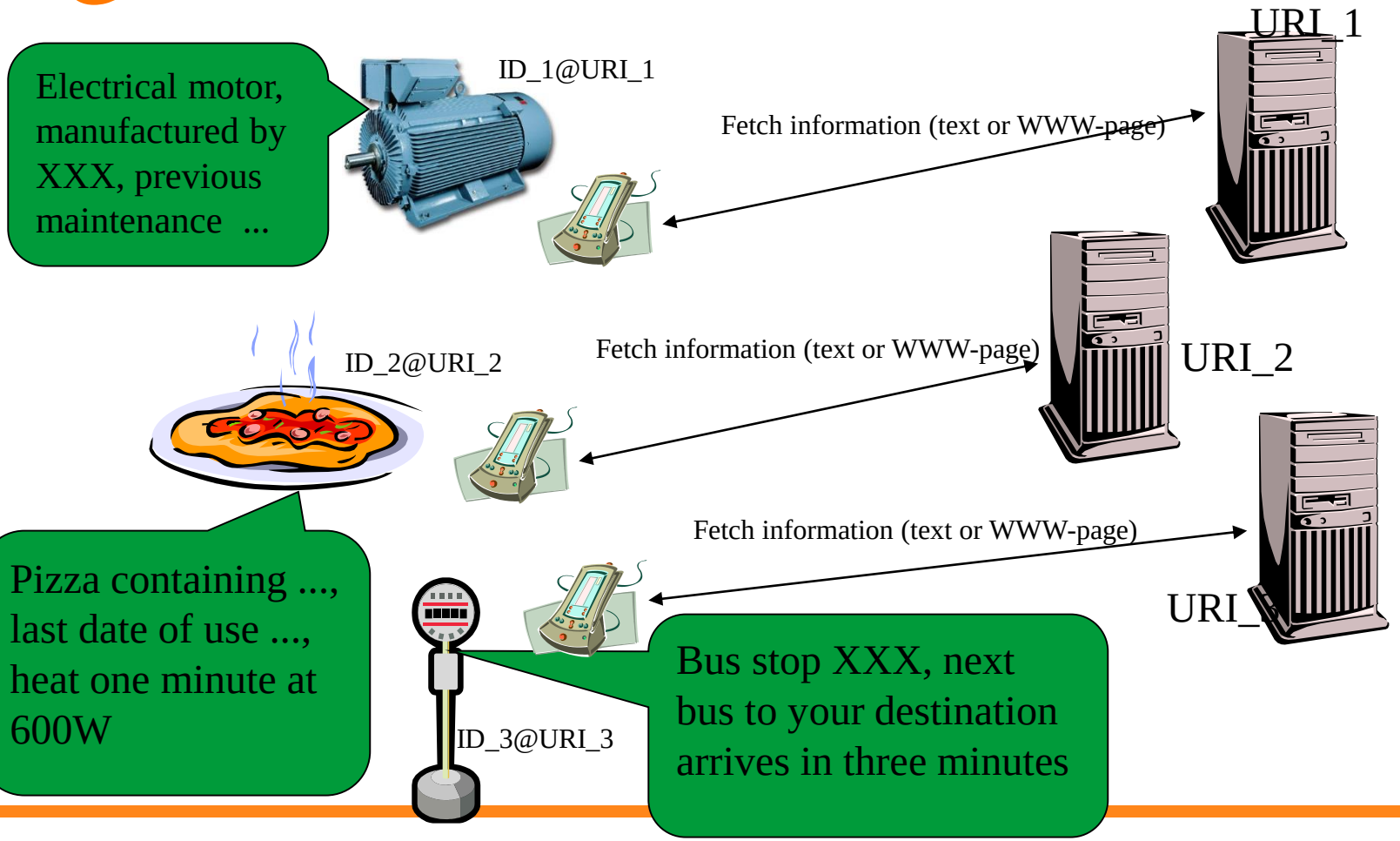
School of Science

HUVIO, Eero, GRÖNVALL, John, FRÄMLING, Kary. Tracking and tracing parcels using a distributed computing approach. In: SOLEM, Olav (ed.) Proceedings of the 14th Annual Conference for Nordic Researchers in Logistics (NOFOMA'2002), Trondheim, Norway, 12-14 June 2002. pp. 29-43.

Accessing product information with ID@URI



Slide presented by Kary Främling at Tekes e-Logistics seminar, 22 May 2002

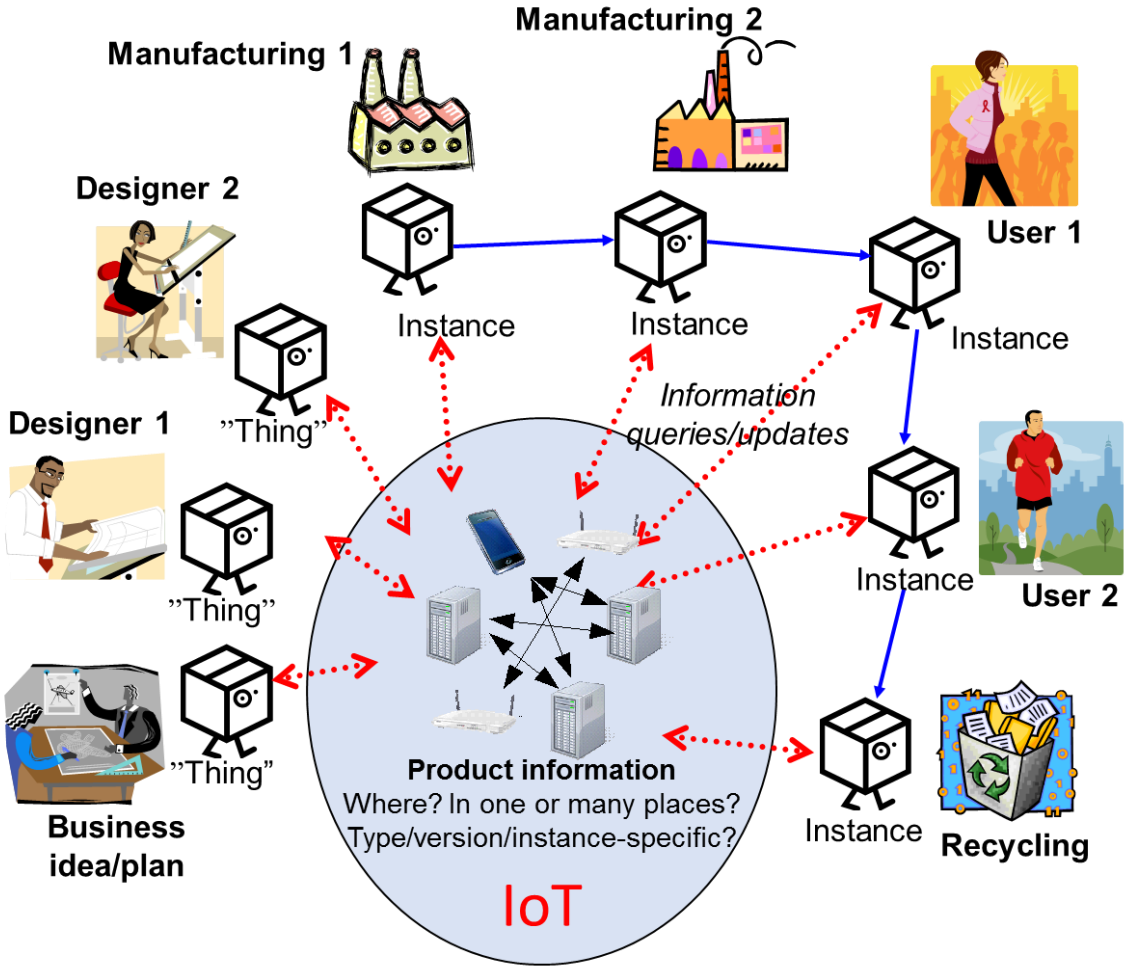
Underlying ideas

- Every ”**physical object**” should possess a ”**virtual counterpart**” (**agent**) during its whole life-cycle
- ”Physical objects” can be goods, shipments, machines, vehicles, homes, humans, ...
- Agent handles:
  - Information about its physical counterpart (location, user instructions, service records etc.)
  - Service lookup (transport, assembly, maintenance, …)
  - Other transactions (payment, access control, …)

K.Främling 7/5/2002 TAI RESEARCH CENTRE 3

FRÄMLING, Kary, HOLMSTRÖM, Jan, ALA-RISKU, Timo, KÄRKKAINEN, Mikko. *Product agents for handling information about physical objects* . Report of Laboratory of Information Processing Science series B, TKO-B 153/03, Helsinki University of Technology, 2003. 20 p.

IoT and Closed-Loop PLM



- **PLM**: Product Lifecycle Management
- IoT should manage **all PLM information** about **any product/Thing**
- Information is **Distributed over Systems** (devices, servers, clouds, ...)
- Information is **Distributed over Organizations** (companies, individuals, authorities, …)
- **Linked Data** is core technology

Vehicle Fleet Management

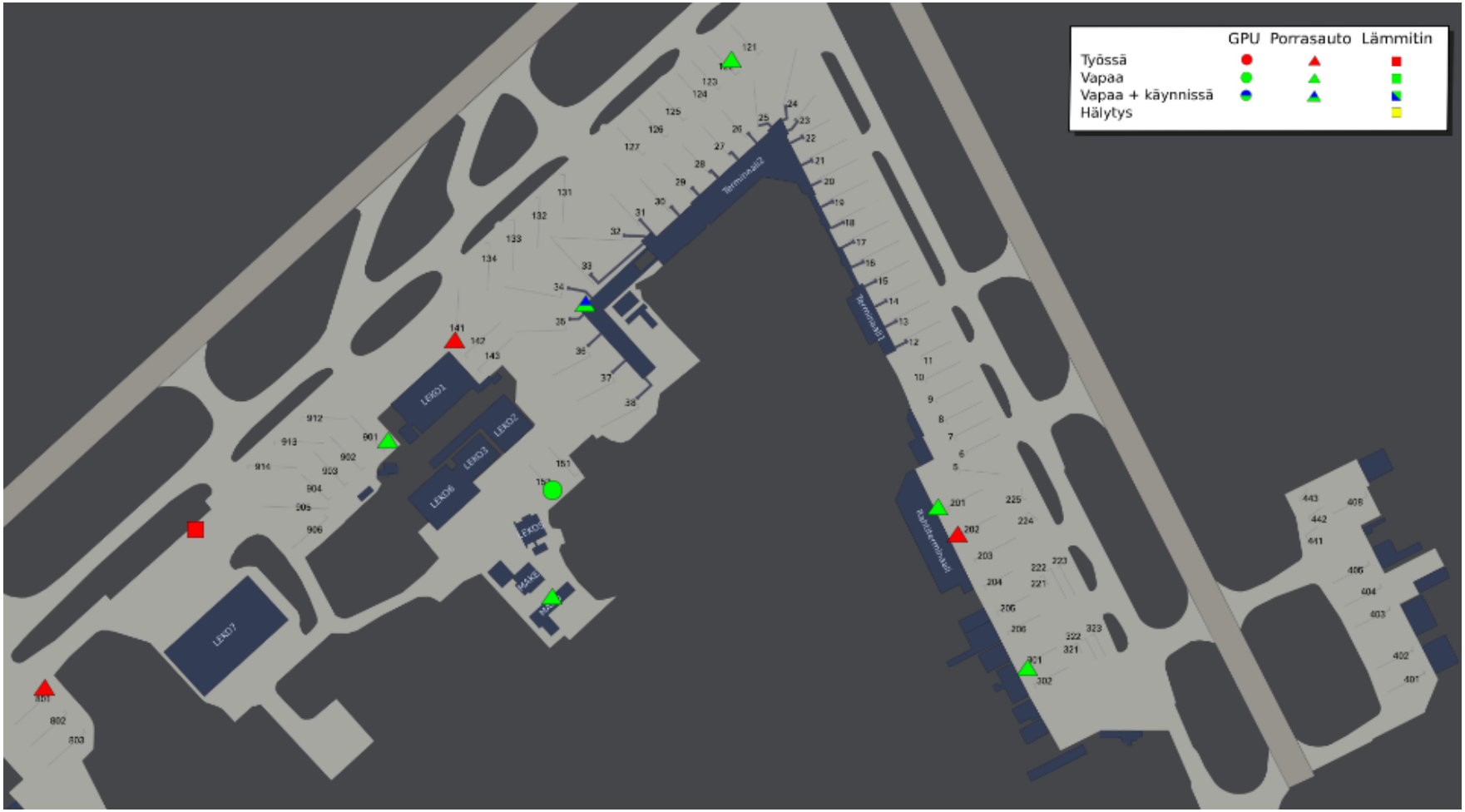
Current system

- Pilots implemented for Helsinki airport and former Finnish Post
- Objectives:
  - Condition-based maintenance
  - Fleet-level optimization
  - Driver behavior analysis and feedback
  - Reduced idling, promoting”green” values
  - Reducing Total Cost of Ownership
- All products are mobile
- Mobile data transfer using proprietary protocols
- All other data transfer by O-MI & O-DF

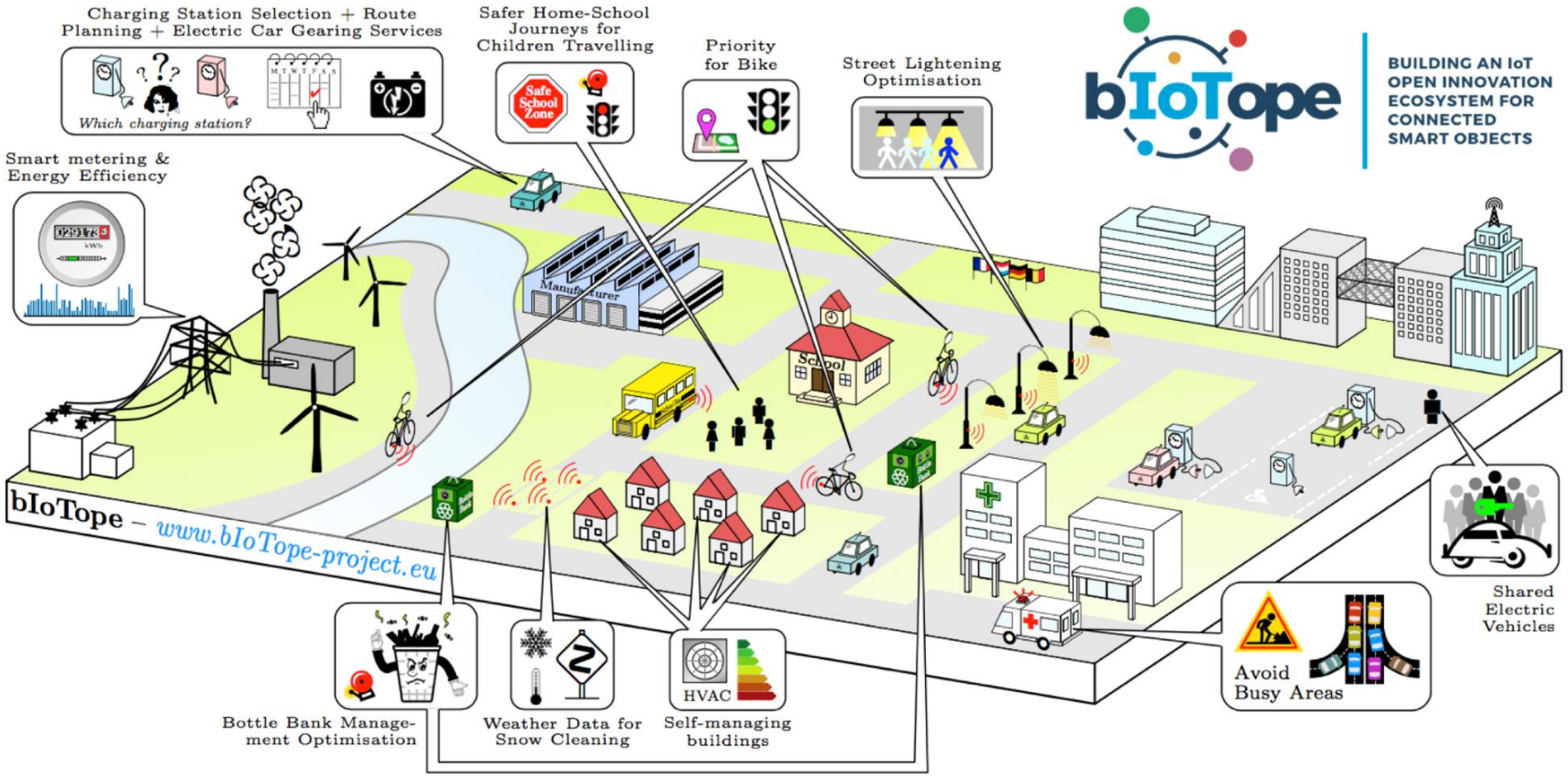
In the future

- Objectives:
  - All-covering Fleet management based on collected information and optimization of different functions
- Many different organizations/users need different data from different devices
- **Standard protocol needed!** O-MI & O-DF do the job

Remote monitoring of vehicles: airport

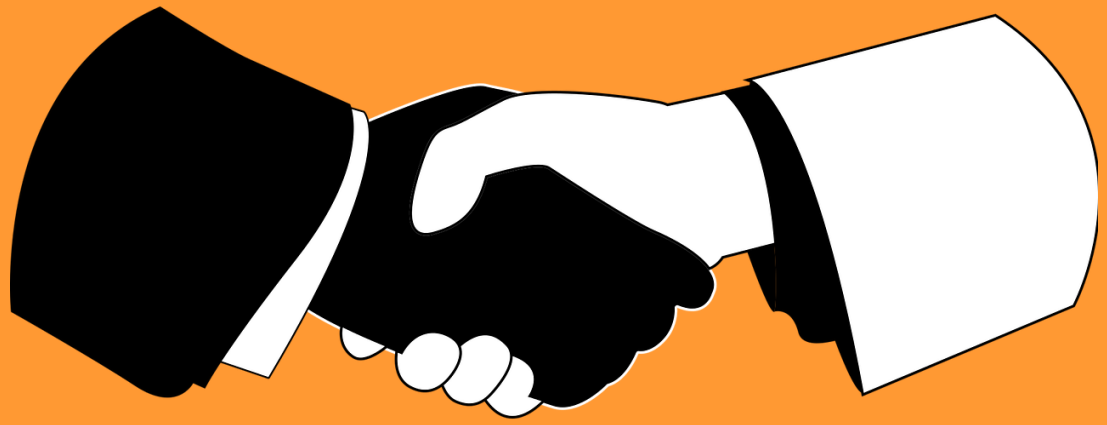


Smart City: bIoTope use cases



bIoTope: *Building an IoT OPen innovation Ecosystem for connected smart objects*
H2020 project, ICT-30 *Internet of Things and Platforms for Connected Smart Objects*, started January 2016

Standards



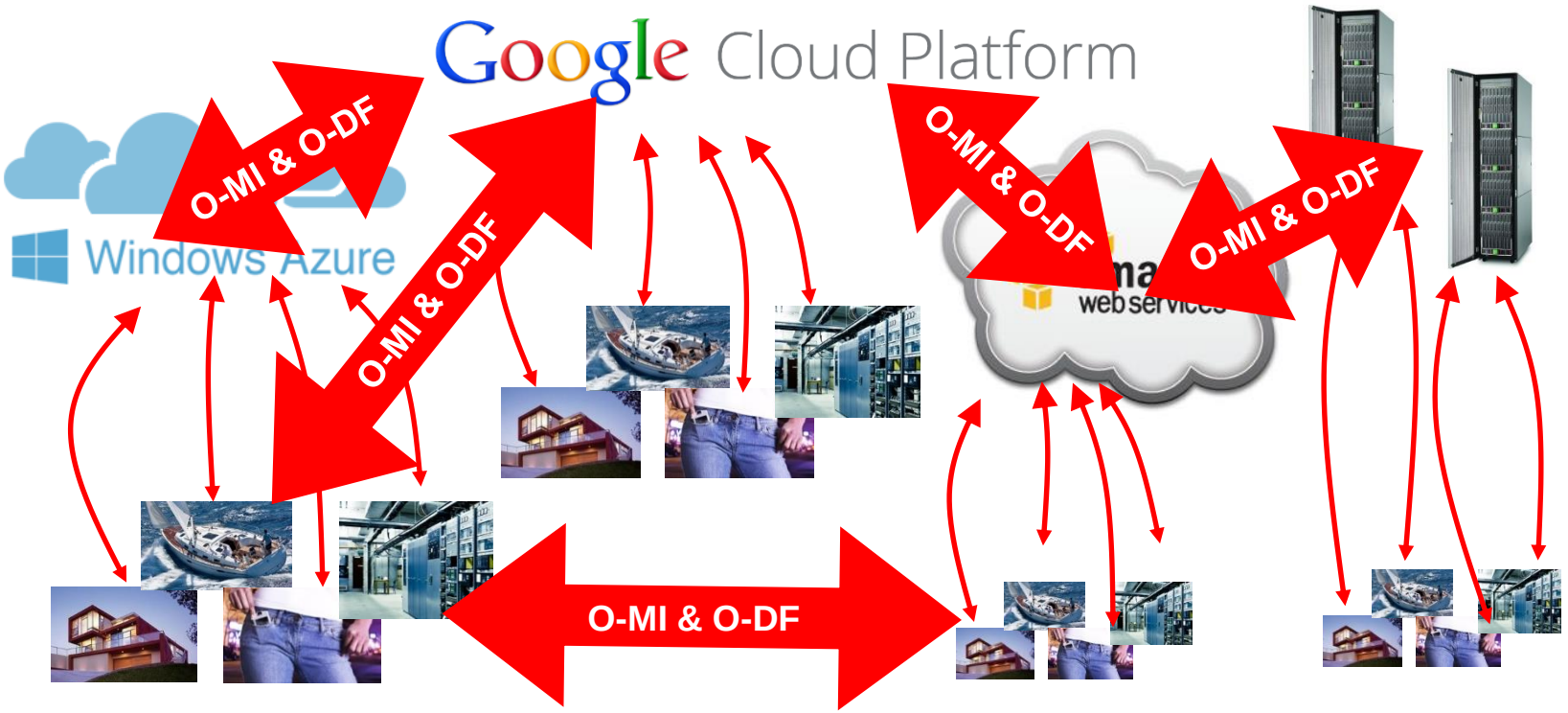
IoT @ The Open Group

- ***DIALOG*** platform: Helsinki University of Technology, 2001[1,2]
- ***PROMISE EU project***: Closed-Loop Product Lifecycle Management for 10 industrial cases in different application domains (2004-2008)
- **Standardisation** with **The Open Group** since 2010

- **Open Messaging Interface** (O-MI) and **Open Data Format** (O-DF) published in 2014
- IoT for **Closed-Loop PLM** and **Systems of Systems**

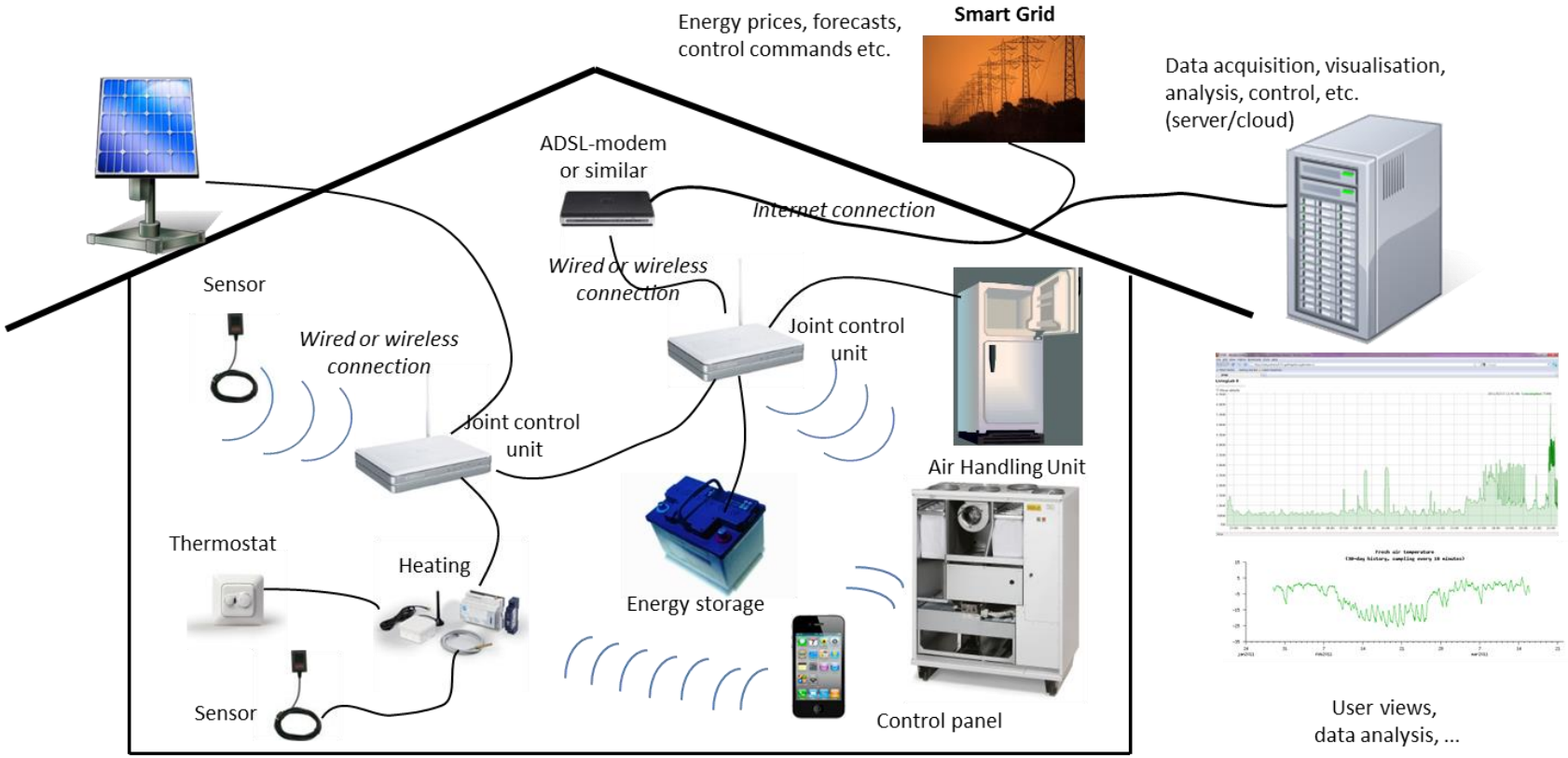
[1] Främling, Kary. *Tracking of material flow by an Internet-based product data management system* (in Finnish). Tieke EDISTY magazine, 2002, Finland. pp. 24-25. http://www.cs.hut.fi/~framling/Publications/TiekeArtikkeli.pdf
[2] Främling, Kary, et al. *Guiding Initial State-space Exploration by Action Ranking and Episodic Memory.* Helsinki University of Technology, 2003. 19 p. http://www.cs.hut.fi/Publications/Reports/B152.pdf

SoS & IoT with Open Group Standards



- Bidirectional, secure connectivity when and as needed, based on context/situation
- Open standards: Open Messaging Interface (O-MI) and Open Data Format (O-DF)

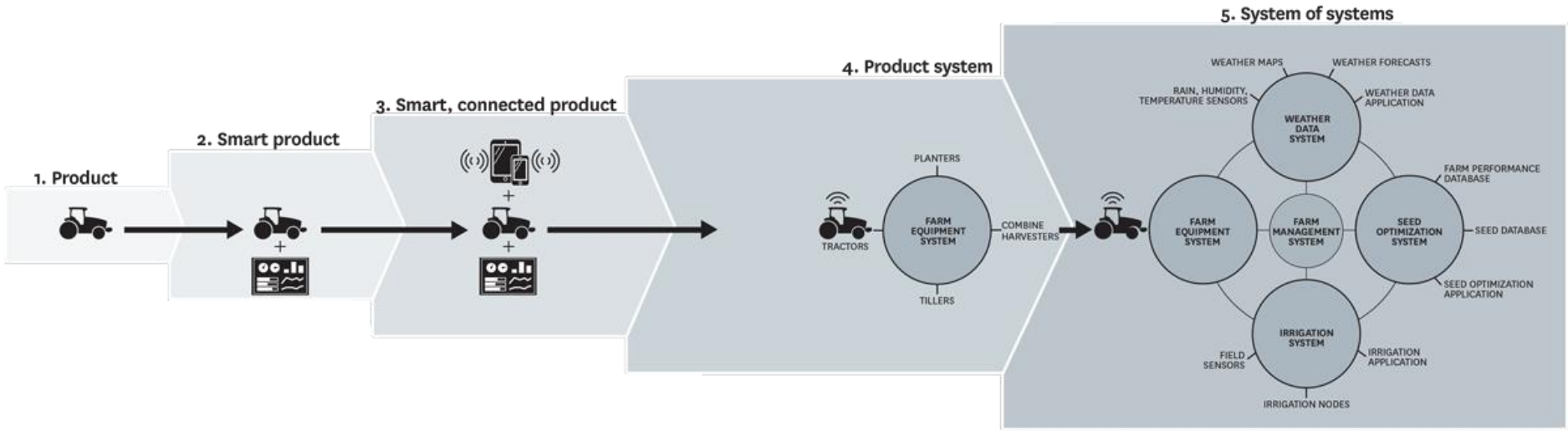
Energy management in buildings, smart grid, distributed energy production



FRÄMLING, Kary, HOLMSTRÖM, Jan, LOUKKOLA, Juha, NYMAN, Jan, KAUSTELL, André. Sustainable PLM through Intelligent Products. Engineering Applications of Artificial Intelligence , Volume 26, 2012. pp. 789-799.

Systems of Systems in Acriculture

- M. Porter, J. Heppelmann: *How Smart, Connected Products Are Transforming Competition*. Harvard Business Review, November 2014.



Open Platform 3.0 of The Open Group: Systems of Systems

Social behavior analytics
Lifestyle behavior analytics

Customer preferences and behavior analytics
Usage and viewing preferences and behavior data aggregation and analytics

Buyer and seller history analytics
Apparel sales

Customer buying behavior analytics
Business supply chain

Data feeds collection and data aggregators (Data Fabric).
Visualization Analytics

Performance analytics
Marketing Analytics

Citizen activity and preferences analytics
Event and crowd behavior analytics
Real-time event analysis

Patient and Medical Data aggregation and analytics

Multi-channel (Closed loop) data collection and processing
Real-time analytics response
Energy usage pattern analytics

Medical data analytics
Medical History-Patient Statistical analysis
Medical Research Analytics

Semantic Linked Open Data (W3C)
Master Data Management (MDM)

Vehicle driver usage analytics

Citizen, crowd, corporate activity and behavior analytics

forecast behavior analytics
Financial stock trading Analytics
Financial Market social behavior analytics

Conclusions

- Solar and wind power are becoming cheaper and more efficient, as well as energy storage
- This could make it possible to create distributed ”energy communities” that do not need power grid
- Internet of Things provides means for optimizing such ”fleets of power sources”
- On a Systems of Systems level it becomes possible to optimize food production on a larger scale, while taking both local and global environmental impact into account