Internet of Things in Logistics

EPoSS Annual Forum 2012

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THE FRAUNHOFER IML
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Data and Facts

- Founded in 1981
- More than 200 scientists
- 250 student assistants
- Turnover of 23,5 million €, 40% of that from industry, trade and services
- Branches and project centers in Frankfurt (Main), Prien (Chiemsee), Hamburg
- Cooperation with HSG St. Gallen (Switzerland), Georgia Tech (USA), Lisbon (Portugal), Shanghai (China), Rio de Janeiro (Brazil)
The Internet of Things in Logistics
The Internet-of-Things in Logistics

- Distribution of central control to a multiplicity of small self-organized units
- Decentralized material flow control
- Automatic adaption to environmental changes (no reprogramming)
- Smart Items and Services are enablers for the IoT in logistics
IoT-A as the EU FP7 IoT flagship project

- Establish and evolve an Architectural Reference Model for the Future Internet of Things
The intelligent Box

- Communicates with people and machines
- Energy self-sufficient
- Controls logistic processes
- Manages the whole picking process
- Supervises its environmental conditions
- Maintenance free
- Modular construction to adapt to almost every logistics process
- Self-locating
Smart and energy self-sufficient air freight containers (ULD)

Application Requirements
- Worldwide, decentralized self-control of air freight containers
- Sensor data to monitor shipment status
- Reliability and Robustness upon application use

Innovative Challenges
- Components with self-sufficient energy source
- High-performance Sensors
- Synchronized information and material flow through process in real time
DyCoNet –
Smart air freight containers (smartULDs)

- **Sensor monitoring**, trigger alarms autonomously (Temperature, GPS, …)
- **Internet** connected (GSM based)
- **ad-hoc networks** of ULDs (e.g. 802.15.4)
- **energy harvesting** enabled (e.g. solar, vibrations)
- Integrated **RFID-based** identification of goods
- Ground-handler interaction (NFC)
- Vehicle-ordering
SmaRTI –
Smart objects control logistic processes

- **Smart post boxes** for German postal letter network,
  - which communicate with multi-frequency transponder and different protocols and route themselves through networks

- **Smart air freight pallets**, 
  - send data on position, shipment and environment in world-wide network of Lufthansa Cargo with energy self-sufficient systems

- **Smart wooden pallet with innovative radiofrequency (RF)- and IT-infrastructure**, 
  - controls autonomously the material-flow of REWE's supply chain to the customer within Germany
Cellular Transport Systems

- Swarm of 50 autonomous transport vehicles:
  - Autonomous behavior of every single shuttle, e.g. collision avoidance, safety tasks
  - Swarm is responsible for the task of transportation, e.g. scheduling is done in the group

- Increase flexibility and changeability
  - Simple scale-up and scale-down
  - Replace inflexible conveying systems by autonomous transport vehicles
Cellular Transport Systems

- One drive, two gears
  - Rail guided inside storage rack
  - Free navigation on floor
- Unit loads up to 40 kg and 600mm x 400mm
- Load handling device for single or double-deep storage
- Multi energy supply concept for different battery technologies
  - Lead-acid
  - Lithium-iron-phosphate
  - Lithium-ion
LivingLabs at Fraunhofer IML

Cellular Transport Systems

“Swarm intelligence” for logistics and supply chains

- Size / floor area: 1,000 m²
- Opened: Mid 2011
- Largest experiment for artificial intelligence in logistics
LivingLabs at Fraunhofer IML

openID-Center
- An open platform for logistics software and autoID systems
  - Size / floor area: 1,500 m²
  - Opened: 2006 / modern. 2011
  - Open integration platform for autoID technologies

Energy Efficiency Test Facility
- MF system with belt and roller conveyors, RFID readers and light barriers
  - Energy measurement of 140 drives
  - Evaluation system for decentralized control strategies
Modeling a new world

Internet of Things
Operational level
Real time capabilities
Self-control
Shuttles & Smart Items

Internet of Services
Normative level
Batch execution
Self-organization
Logistics Mall
Logistics-as-a-Service
Logistics Mall – Cloud Computing for Logistics

- Virtual marketplace for logistics and IT apps
- The way from application-centric processes (like MES, WMS and ERP) to service-oriented processes
Fields of innovation

- **Logistics-by-Design (Standards)**
  Standardized structures called Business-Objects for the definition and modeling of logistics services and objects
  → Allowing easy integration of business processes and services

- **Logistics-on-Demand (Tools)**
  Cloud-based tools for the integration and development of logistics services
  → Support for the creation of flexible business processes

- **Logistics-as-a-Product (Marketplace)**
  Virtual marketplace for custom-made logistics processes ranging from single services to complete software solutions
  → Logistics processes as tradable goods
Our expertise in R&D for Europe

Smart items
- Electronics and electrical design
- Micro Energy Harvesting
- Communication structure
- AutoID technologies

Smart transport systems
- Mechanical design and engineering
- Navigation and sensor fusion
- Swarm Intelligence and Multi Agent Systems
- E-Mobility

Cloud Computing
- Software engineering
- App development
- System modelling
- Business models
- Enterprise ontology

Applications in logistics and manufacturing
Internet of Things in Logistics

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