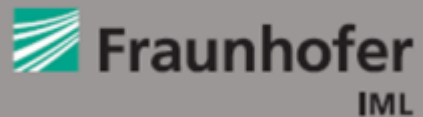


Internet of Things in Logistics



Schuster Architekten Düsseldorf

EPoSS Annual Forum 2012



Andreas Nettsträter

THE FRAUNHOFER IML



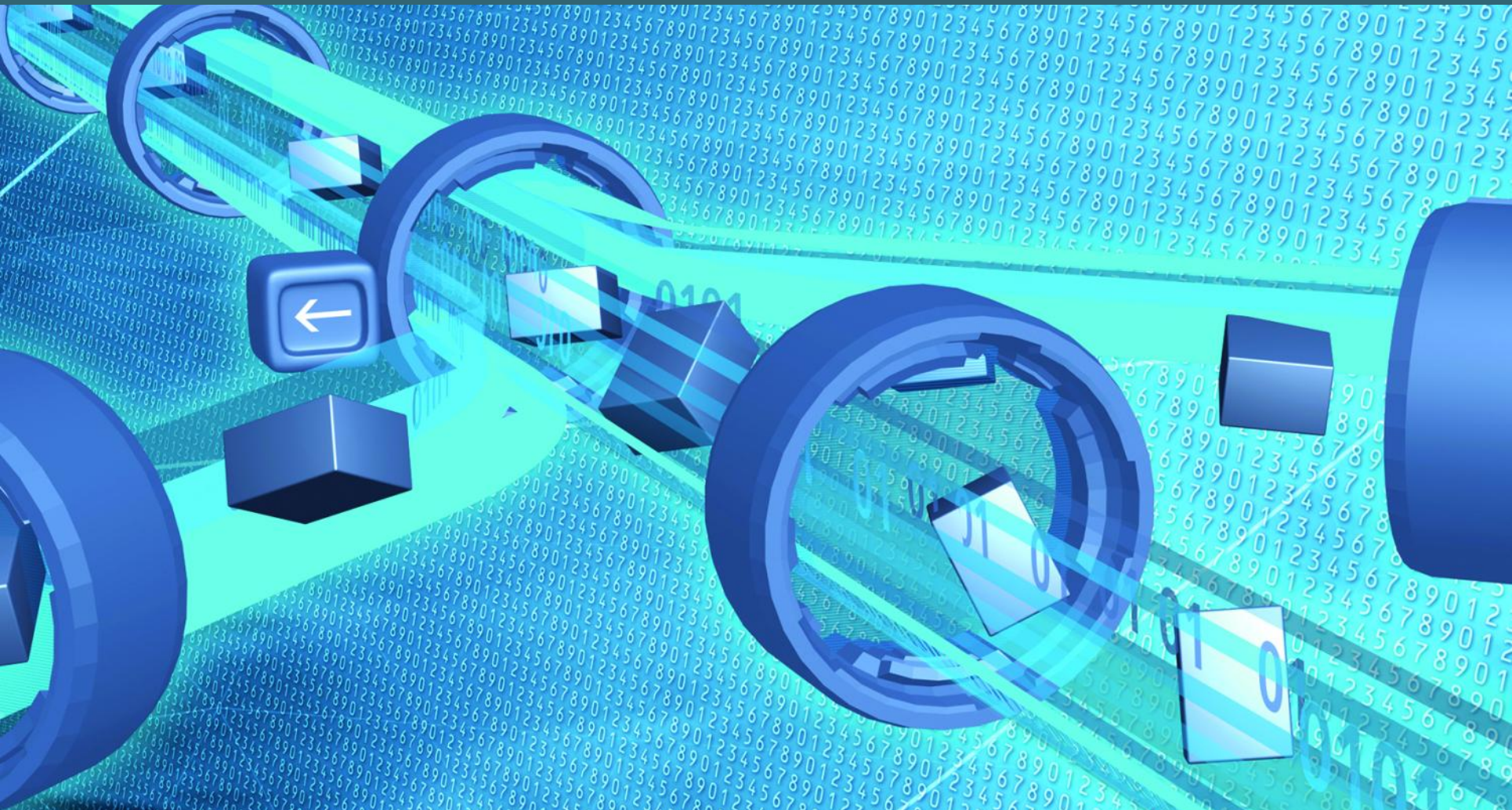
The Fraunhofer IML

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

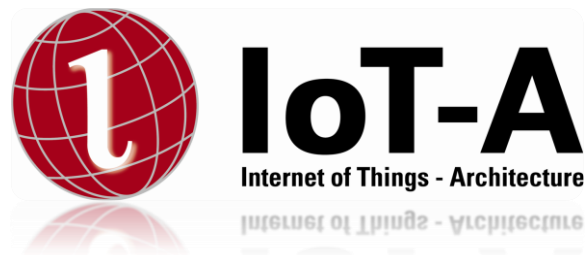


- Distribution of central control to a multiplicity of small self-organized units
- Decentralized material flow control
- Automatic adaption to environmental changes (no reprogramming)
- Smart Items and Services are enablers for the IoT in logistics

IoT-A as the EU FP7 IoT flagship project



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

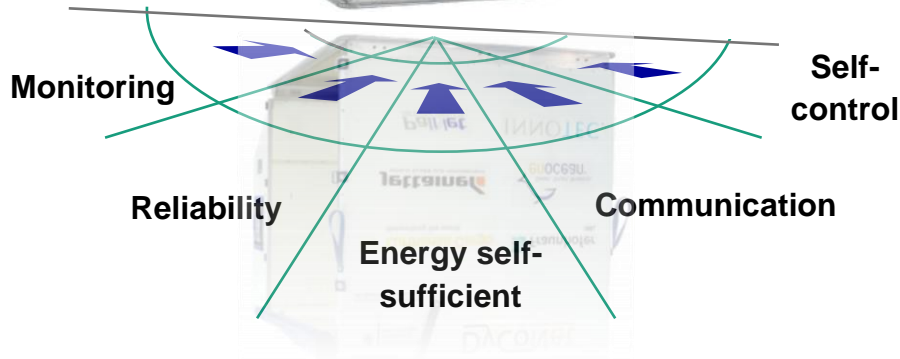


The intelligent Box



- 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

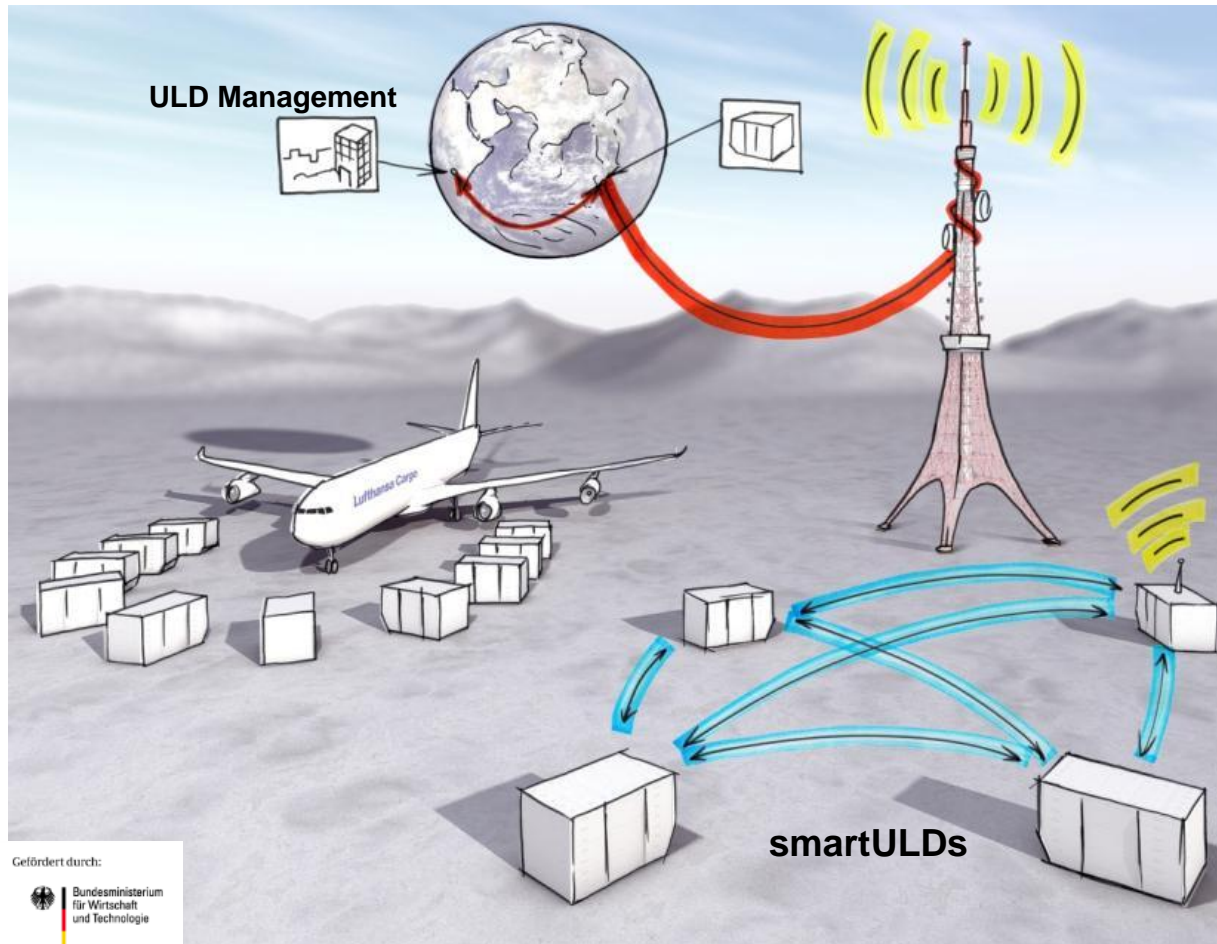
- Components with self-sufficient energy source
- High-performance Sensors
- Synchronized information and material flow through process in realtime

Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages

DyCoNet – Smart air freight containers (smartULD)



- **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

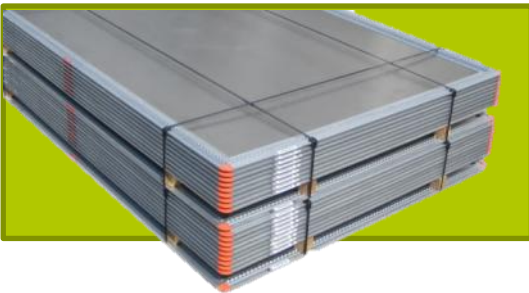
SmaRTI – Smart objects control logistic processes

MAIL



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

AIR



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

FMCG



- **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



Bundesministerium
für Bildung
und Forschung


 **Lufthansa Cargo**

MARS
deutschland

 **CHEP**
Logistics

 **Infineon**
technologies

REWE

 **Deutsche Post**

 **GS1**
Germany

Cellular Transport Systems

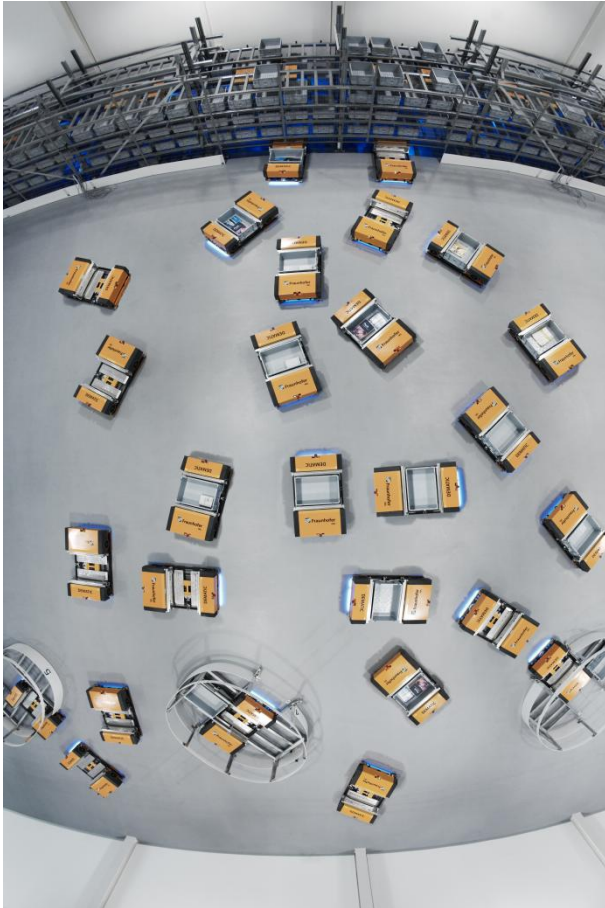


Ministerium für Innovation,
Wissenschaft, Forschung und Technologie
des Landes Nordrhein-Westfalen



- 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

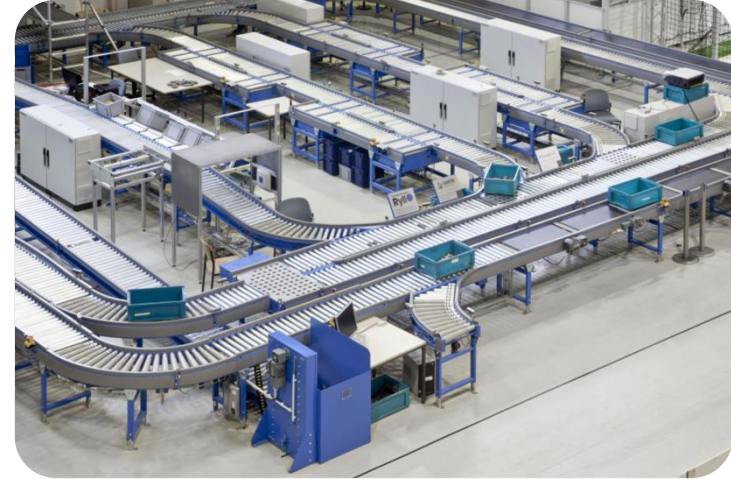


LivingLabs at Fraunhofer IML



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

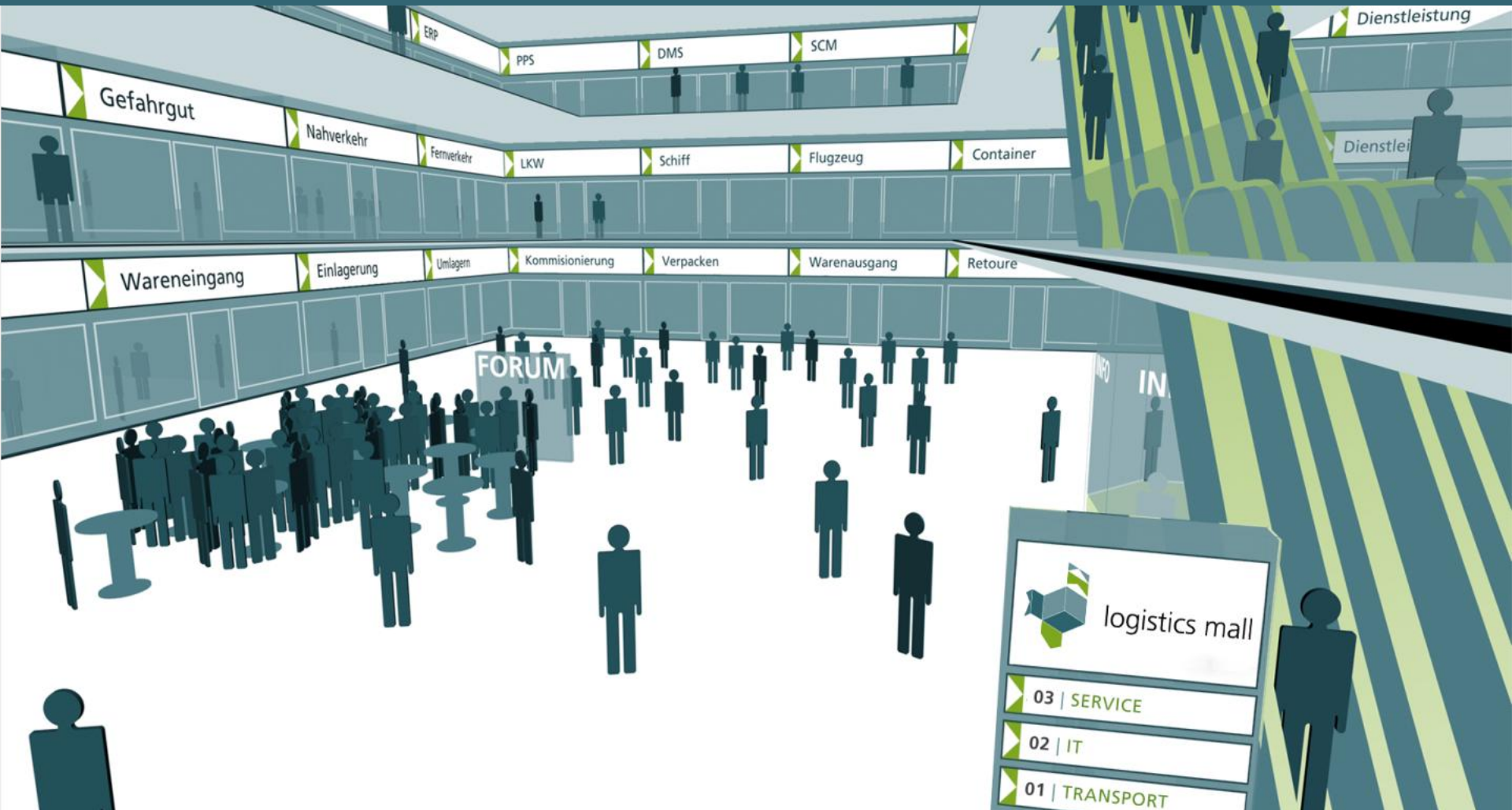
Operational level
Real time capabilities
Self-control
Shuttles & Smart Items



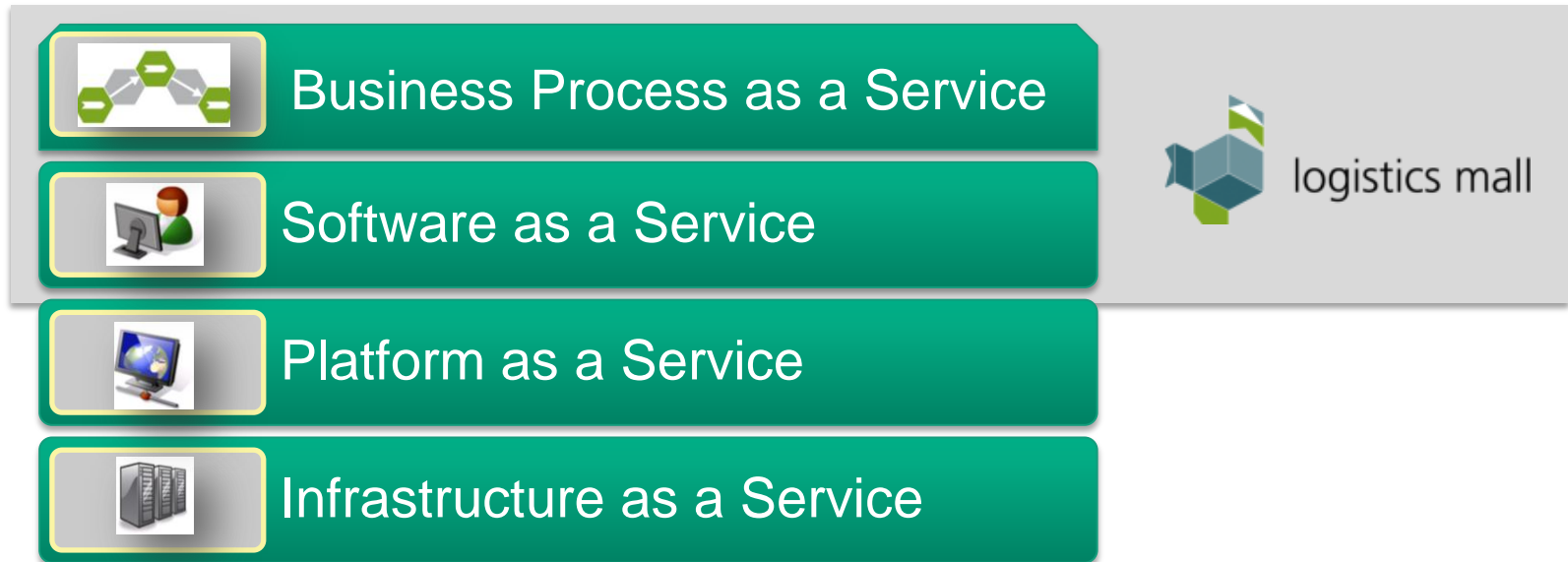
Internet of Services

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)

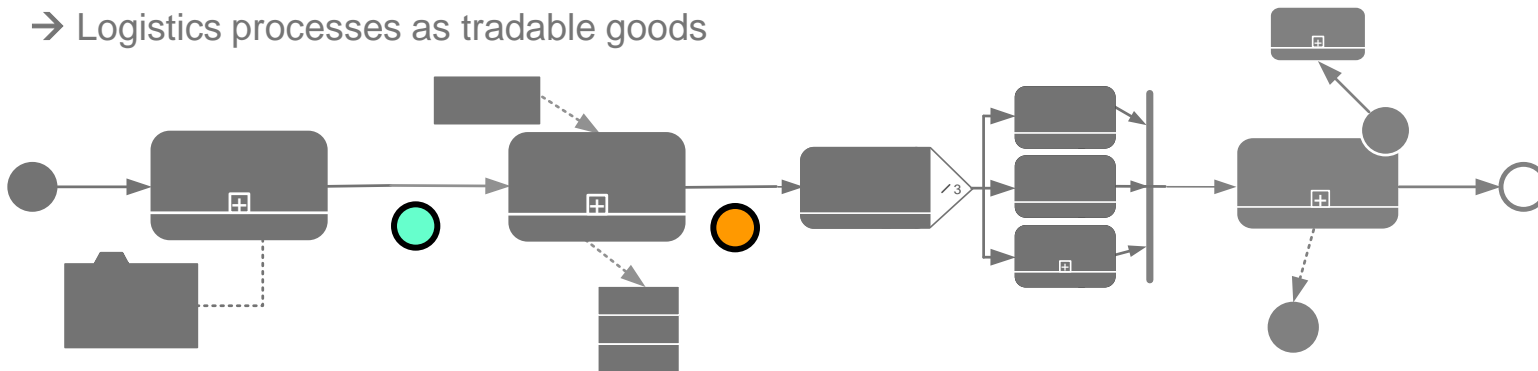
Cloud-based tools for the integration and development of logistics services

→ Support for the creation of flexible business processes

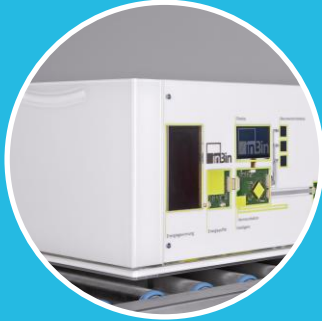
■ Logistics-as-a-Product (Marketplace)

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

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