Distributed process control by smart containers

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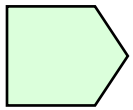
Distributed process control by smart containers

Topics



- **Problem**
- **Solution ideas**
- **Technical Aspects**
- **Communicational Aspects**
- **Modern Information Processing**
- **Future Work**

Automation in logistics

Existing concepts:

- Improvements for each process step
- Significant costs reduction
- Only few value enhancements for the customer

challenges :

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- Individualisation of customer needs
- More flexibility (transported material, Layout, capacity)
- Value-added services
- Improving the service levels
- Intelligent handling of goods
- Information needed because of new regulatory framework

Problems

- Various information systems
  - For example port information management systems (e.g. BHT or Dakosy), customs information systems (e.g. ATLAS), dangerous goods information systems or carrier's systems
  - All these have to have different information and views on the state of each container

- Still less automation in data collecting

- More information are needed because of regulatory framework, like ISPS for the United States and similar legal restrictions that will be made for the EU

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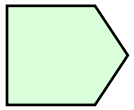

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Requirements concerning the Information management

- Reduction of the complexity
- Simplification and transition to more flexible processes
- Expandability
- Ability to integration

Solution concepts

- Capability of the goods to communicate with the system (Autonomy)
- Flexibility of the complete system by new processes (Adaption)
- Shifting operative decisions nearer to the goods (Delegation)

Solution Approaches

- Combining the physical object and the information technology on a lower level
- Similar mapping of the real world to the data world

Implementation

- Decomposing complex problems into many small resolvable subtasks
- Decentralisation of the IT- and control architecture to solve the tasks near to the material/ good
- Simple communication between IT and transportation good and packaging

according to Schönbeck, 2003

Solution ideas

- Therefore three points can be identified
  - The automation of the data collecting must be increased
  - Semantic enriched standardised communication
    (Web Services, Ontology)
  - Intelligent information processing to avoid information overflow
    (possibly Planning, Data Mining, Decision Support)

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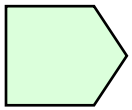


Problem

Solution ideas

Technical Aspects

Communicational Aspects

Modern Information Processing

Future Work

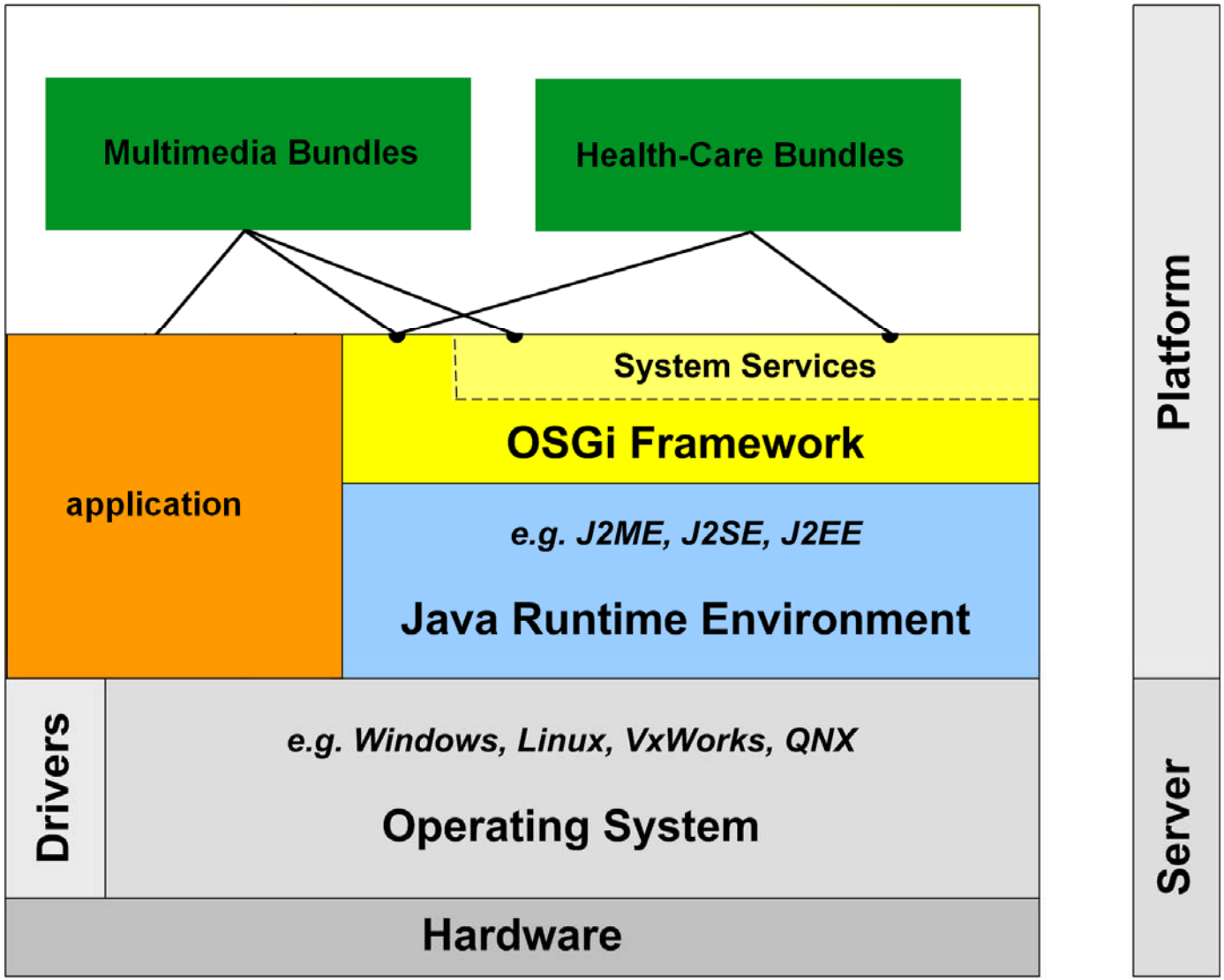
Technical aspects (1/2)

- A networked microsystem node consists of a small computer with wireless communication and integrated peripheral devices such as sensors.
- Container equipped with an (ISO 10374) RFID transponder and reader to scan container contents.
- We identify three major challenges regarding these sensor knots;
  - the establishment of ad hoc networks of containers,
  - the location of containers within such a network,
  - and especially the composition and utilisation of emergent properties of the network.

Technical aspects (2/2)

- We want to establish an ad hoc network based on the LEACH (Low Energy Adaptive Clustering Hierarchy) [2] routing protocol, using 802.15.4 (ZigBee base) on the physical layer allowing for a medium range of 500m.
- Location services would be facilitated through signal propagation delays - thus enabling a continuous location in the port with a maximum offset of 2m at 100m reach.
- We are building prototypic sensor knots that allow the usage of embedded OSGi to enable dynamic loading of software components. This enables each knot to react not only on its own perception but also on the perception of those knots surrounding it, by loading different behaviours based on the state of the network.

Platform Open Service Gateway Initiative



according to OSGi, 2006

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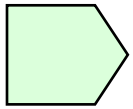

Problem

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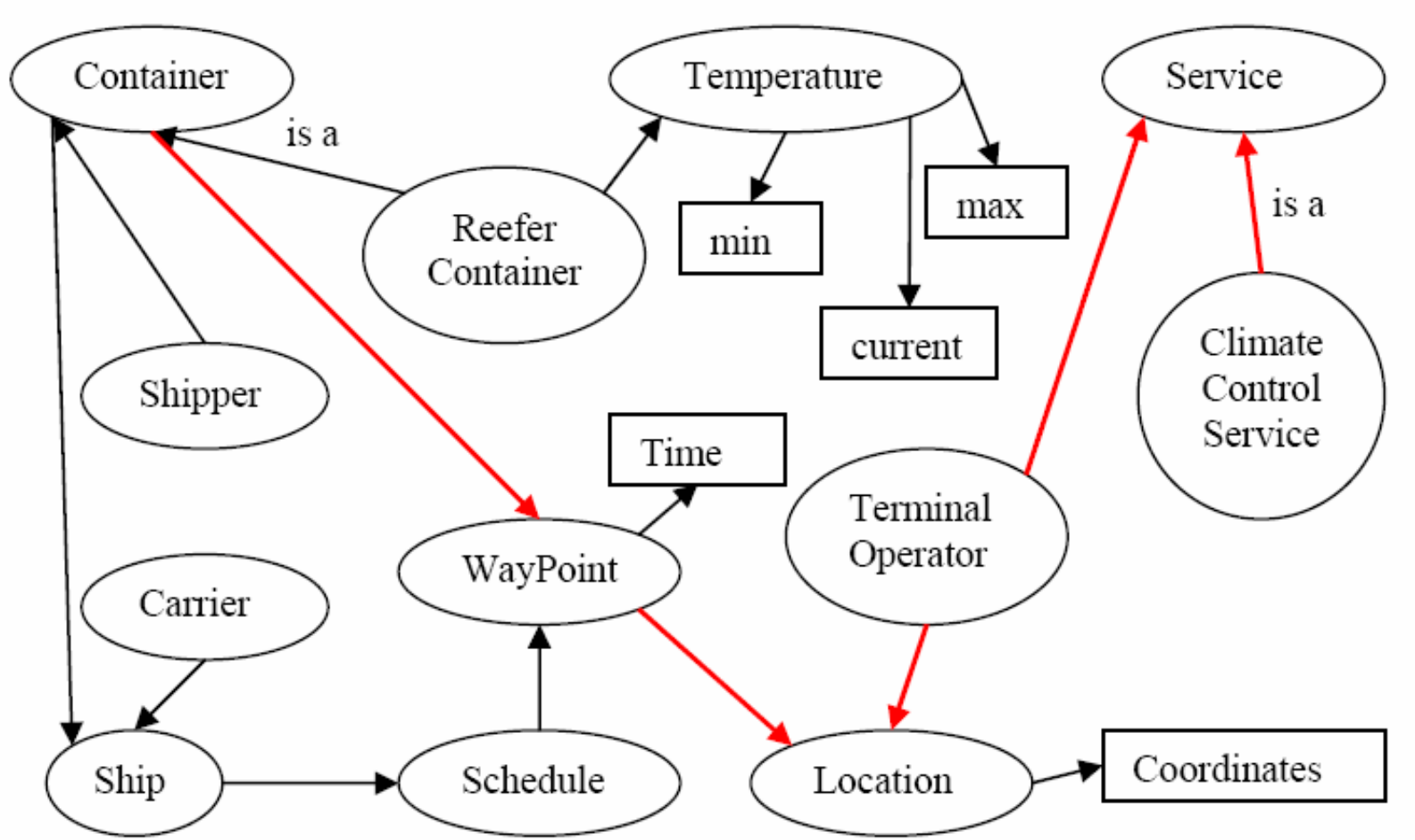
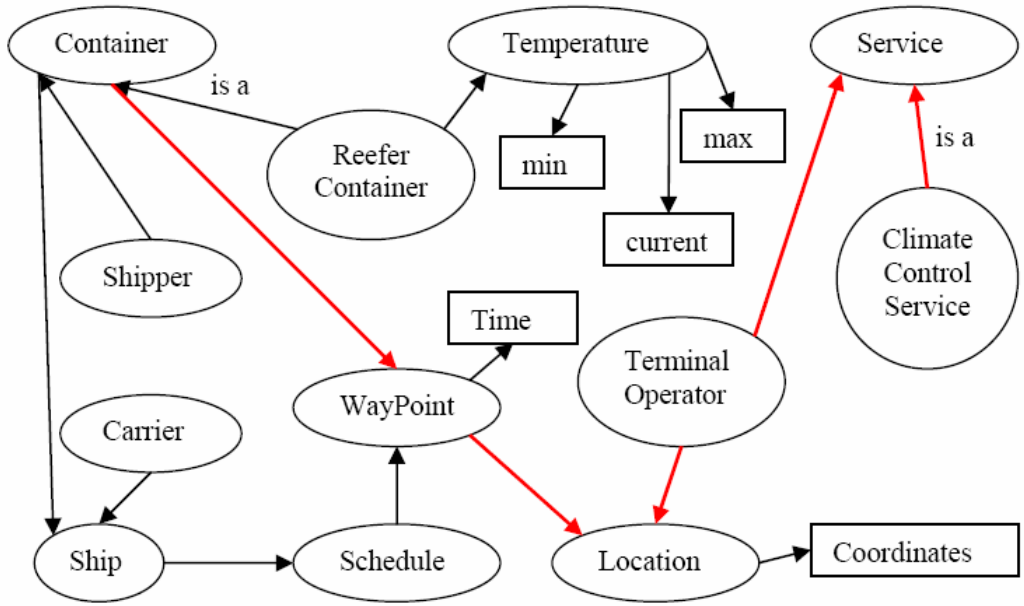
Port Communication Ontology

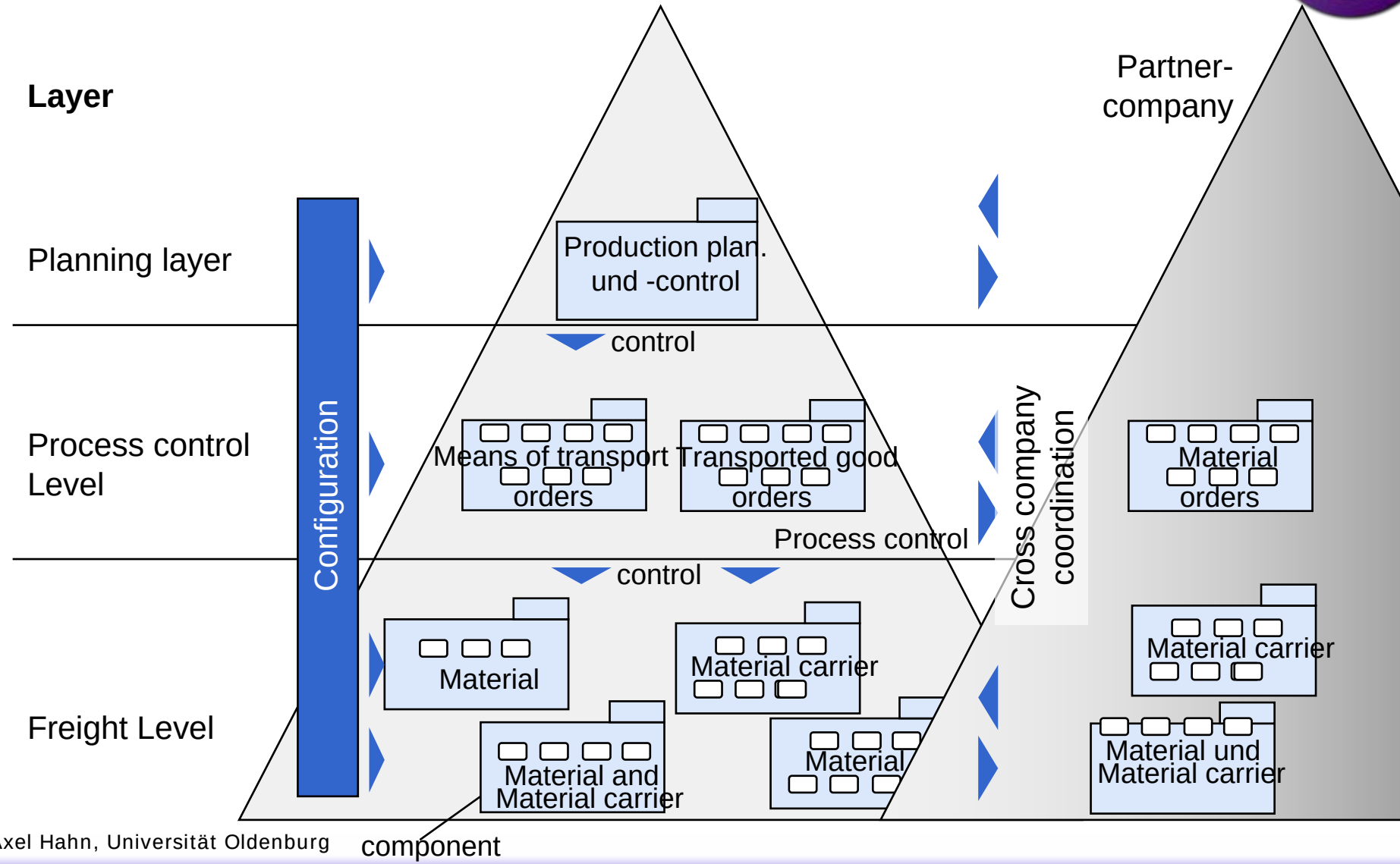


Ontology Example



- A malfunctioning reefer container would know its current 'WayPoint'
- then it asks the associated terminal operator for assistance
- receives a list of all instances of the '*ClimateControlService*' class, choosing one of them (probably after exchanging further data)
- then finally ordering its assistance.

Transfer to Component architecture



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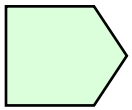


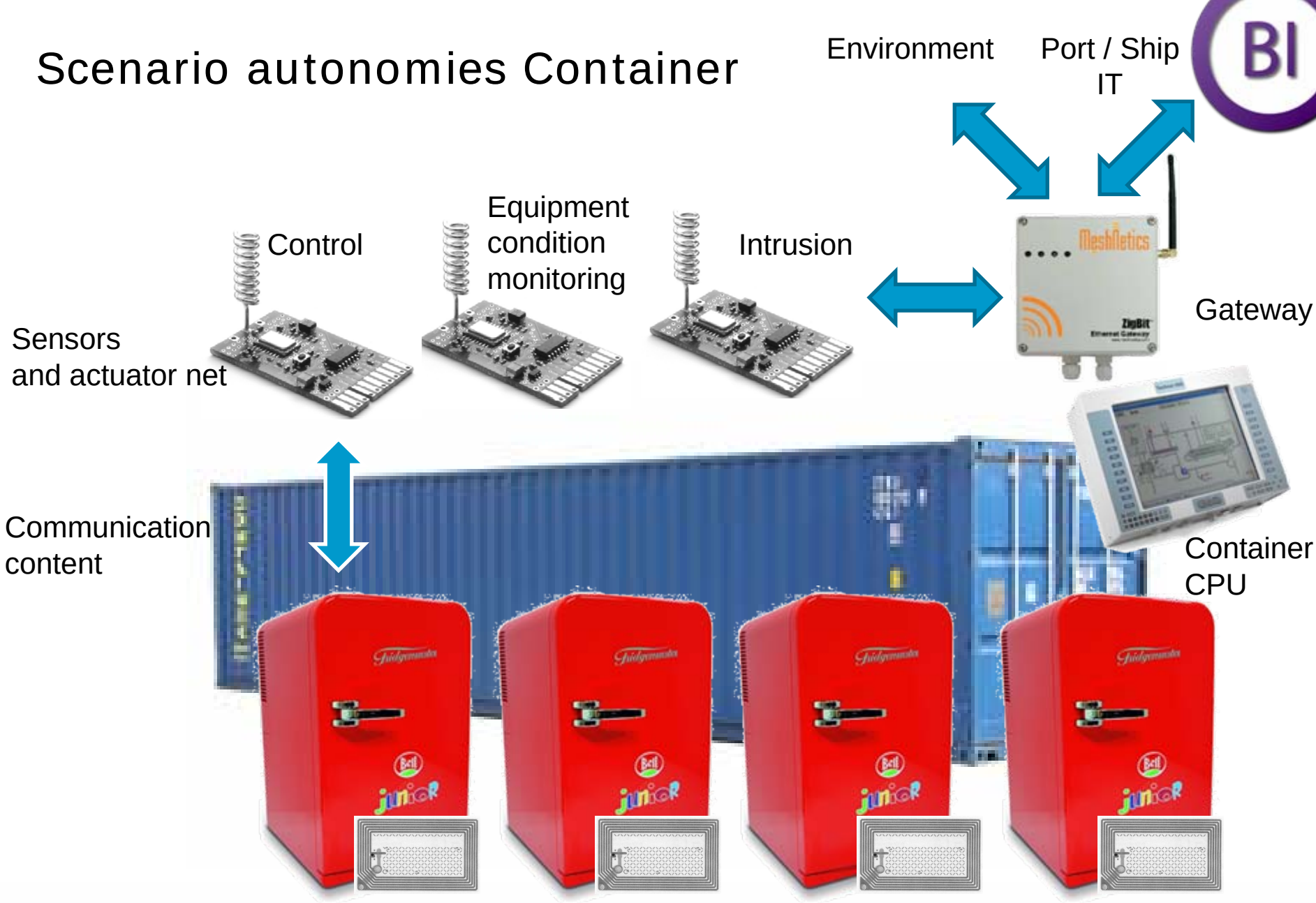
Modern Information Processing

Future Work

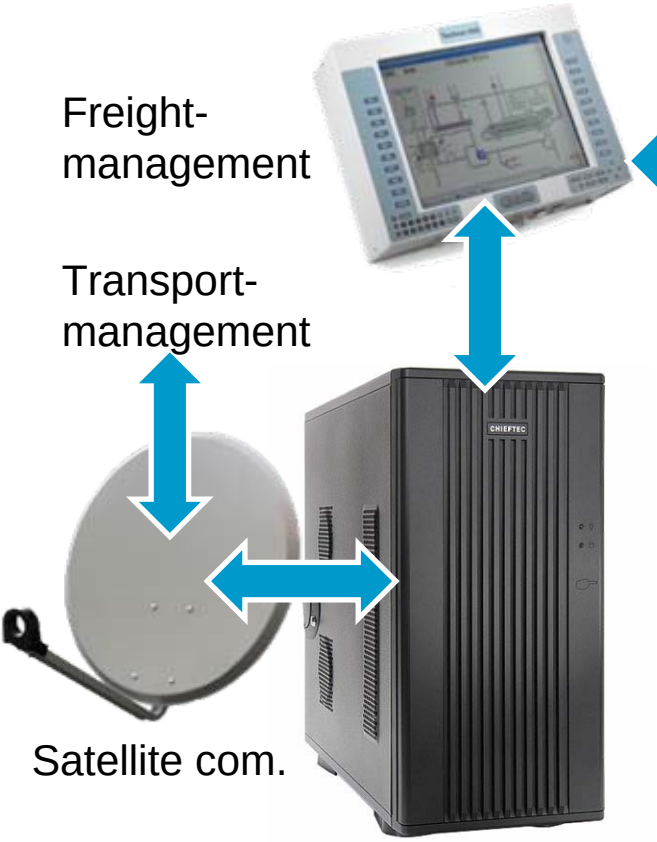
Modern Information Processing

- As the process of information gathering can be completely automised, it can be expected that the amount of collected data grows significant.
- The number of participating information systems and their abilities will not grow that fast.
- The availability of information makes it necessary to clarify which information is needed in which system and in what granularity.
- The actual systems here developed for centralised computing running on mainframe computers.
- To handle the challenges the information processing (and so decision taking), has to be decentralized.

Scenario autonomies Container



Transport



Freight-management

Transport-management

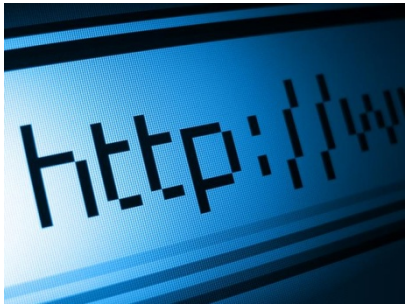
Satellite com.

Ship-Hostsystem
for container Management components

Upload Software

Communication with the surrounding

Stock and handling



Communication with
the container and goods

Transportation control and
-management (Reeder, …)

Container-
specific
Web Service

Upload Software

Communication
with the
surrounding

Ship-Hostsystem
for container Management Components

Integration Port IT

Port Management

Port IT
BHT / Dakosi /
Atlas …

Transport-
management

Container-
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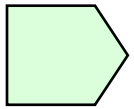

Future Work

Future Work

- The technical aspects are in work.
- Building a testbed and a reference implementation of the aforementioned architecture. That a prove of concept can be done.
- Further work into the development of a prototype capable of working in real world environment has to be done in cooperation with partners.