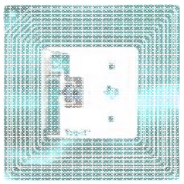
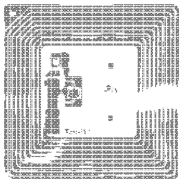
Fraunhofer Institut Materialfluss und Logistik

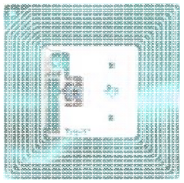
ECCL 2008
»The challenge for autoID-systems in logistics «

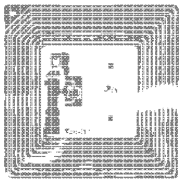
Christian Meiß

Agenda









1. **RFID - Basic Technology**
2. RFID at Fraunhofer IML
3. RFID in industry
4. Research on RFID

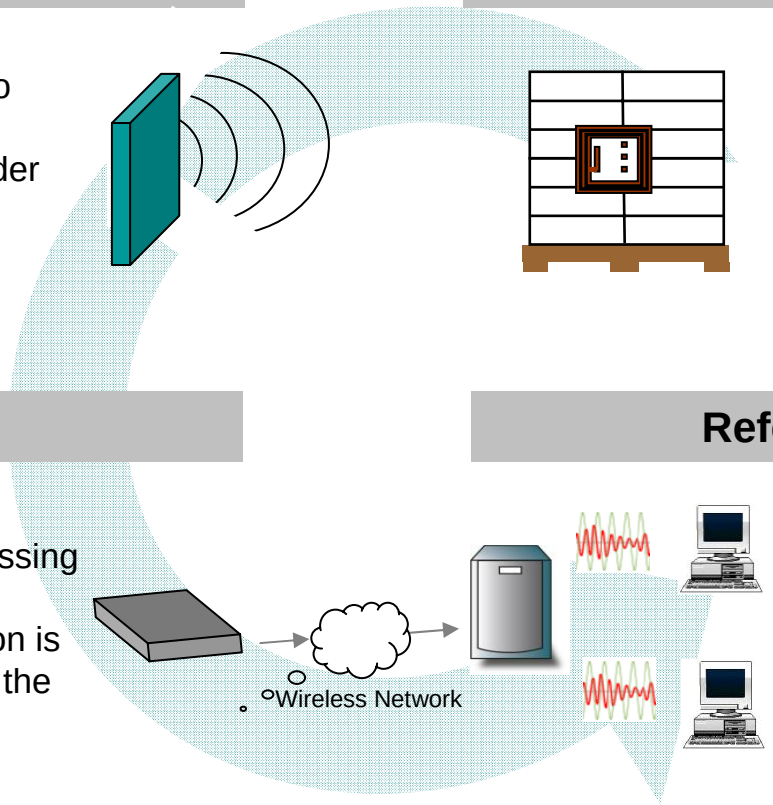
Schematic view of an RFID System

RFID Antenna

- Triggers/generates an electro magnetic field
- Supplies energy to transponder
- Points/directs field towards expected location of tag

RFID Tag / Transponder

- Simple IC with antenna
- Passive transponder needs to receive energy to communicate
- Different frequencies do exist: for FMCG UHF 868
- Transponder stores information (in case of FMCG = EPC)



Reader

- Controls antenna
- Interface towards data processing
- Especially for UHF readers, significant technical innovation is expected to hit the market in the next 12 months

Referencesoftware

- ONS (Object Name Service)
- Local application (e.g. WMS)

Source: Fraunhofer IML,»RFID 2004 Logistiktrends für Industrie und Handel«; CCG, »Mit dem Transponder in die Zukunft«, Management Informationspapier

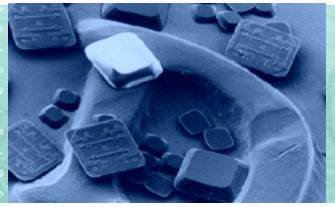
Frequency characteristics

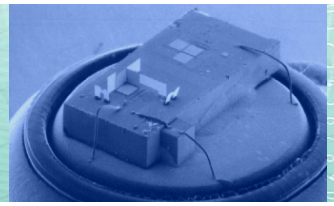
	LF (125 / 134 KHz)	HF (13,56 MHz)		UHF (860 - 950 MHz)			SHF (2,45 GHz)	
Mode	passive	passive (usual)	semi-passive	passive (usual)	semi-passive	active	passive	active (usual)
Reading distance	< 20 cm	< 1m		< 6m	< 30m	< 100m	< 6m	> 100m
Influence of metal	low	high		very high (reflection)			very high (reflection)	
Influence of humidity	no influence	low		very high (absorption)			very high (absorption)	
Bulk reading	not realized	< 30 tags		< 150 tags			at present impossible	n.s.
Data communication	load modulation (near field)			backscatter (far field) / load modulation (near field)	backscatter (far field)		backscatter (far field)	
Data storage	RO / RW	most common RW up to 64kBit (FRAM)		RO and RW normally 96 / 512 Bit			RO / RW	
Common Standards	ISO 10536, ISO 18000-2	ISO 14443, ISO 15693, ISO 18000-3		ISO 18000-6, EPC Gen2, EPC Gen1			ISO 18000-4	
Data transfer rate	low	high		very high			very high	
Costs per transponder	0.5 - 1€	0.3 - 1€	< 10 €	0.1 – 0.8€	< 10€	approx. 50€	n.s.	approx. 50€

IT and data structure in terms of RFID

Data-on-Network

Data-on-Tag





EPC Tags

- Central data management
- One to one product identification
- Uniform data standards
- Simple and low priced transponder
- Write once, read multiple

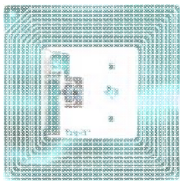
Information
(Data Warehouses)

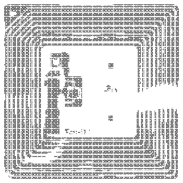
Smart Tags + Aware Objects

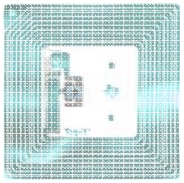
- Decentral data management
- Information quantity > 1 KByte
- Extra functionalities
- Redundancy
- Multiple writing, multiple reading

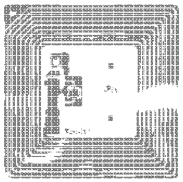
Control
(Realtime Logistics)

Agenda









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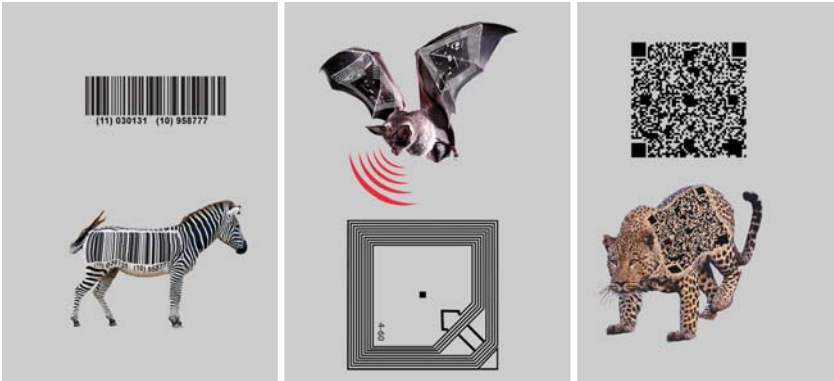
Capacity overview RFID at Fraunhofer IML



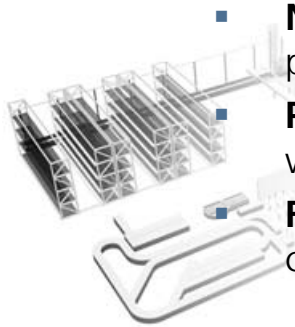
Capacity overview RFID

- Analysis and monetary evaluation of current ident-systems
- **Feasibility Study**
- **Evolution of RFID-scenarios**
- Cost-benefit calculation
- Requirements specification for ident-systems

Economic + technical feasibility

I II III IV

Pre-test at openID-center



- **Neutral** tests of RFID-devices for products and packaging
- **Pre-tests** with conveyer and warehouse devices
- **Recommendation** for tuned components and frequency band

On-Site Test, installation and trainings

- **Single- and bulk reading under real conditions**
- Installation and tuning of the Ident-Systems
- Evolution of **Middleware**
- Monitoring **starting phase**
- Employee training

openID-center

Automated high bay warehouse

Rack feeder

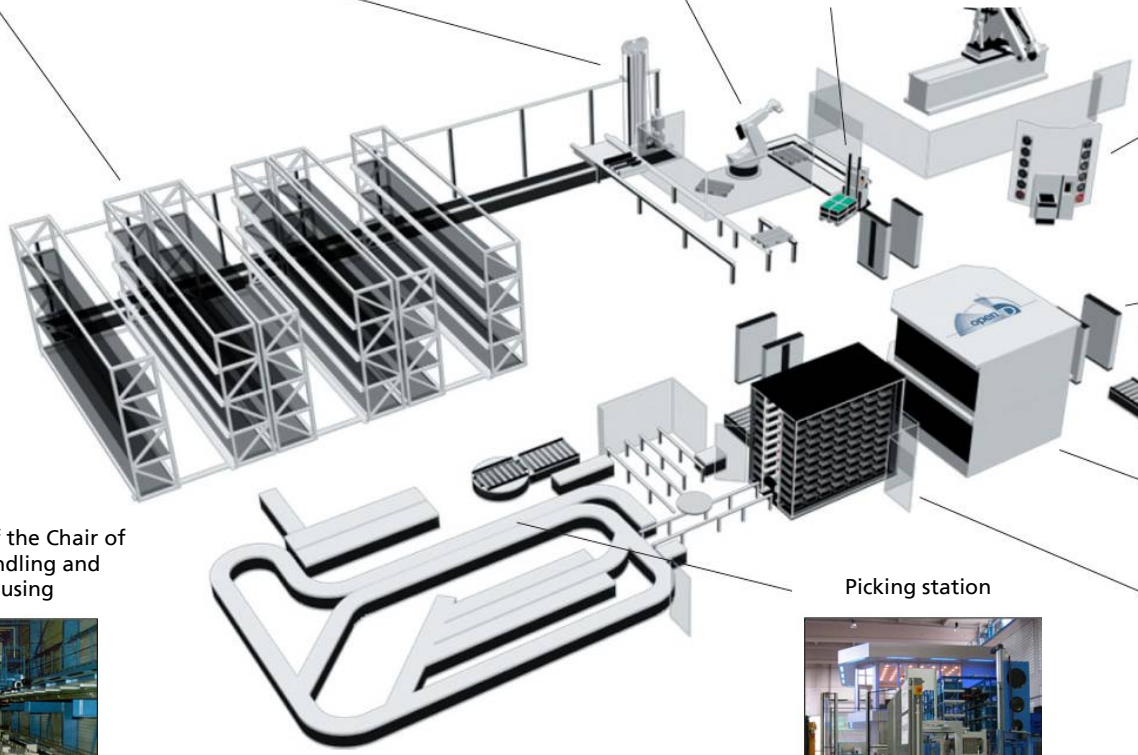
Pallet robot

Automated guided vehicle

Automated guided vehicle

Tower24®

RFID gate

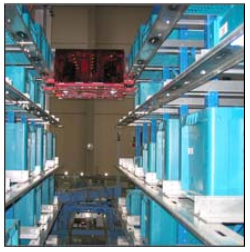


Reusable depot

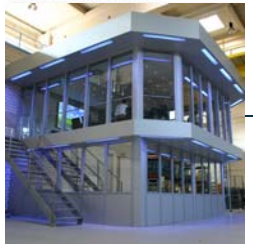
Testing field of the Chair of Material Handling and Warehousing

Picking station

Multishuttle warehouse



Conference room



Cooperation partners and sponsors

Performance portfolio – Focus performance tests

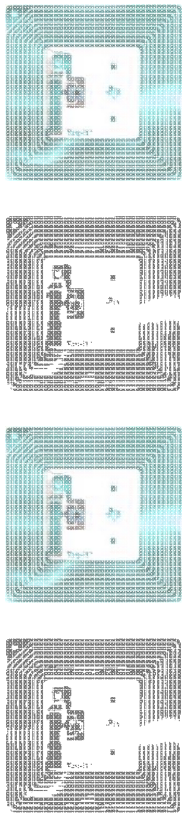
Control commands

Performance on test device

[redacted]

Prozessanalyse + Modellierung → Kosten- Nutzen Analyse → **Tests** + Implemen-tierung → IT-Integration → Anlaufbeglei-tung + Schulung

Agenda



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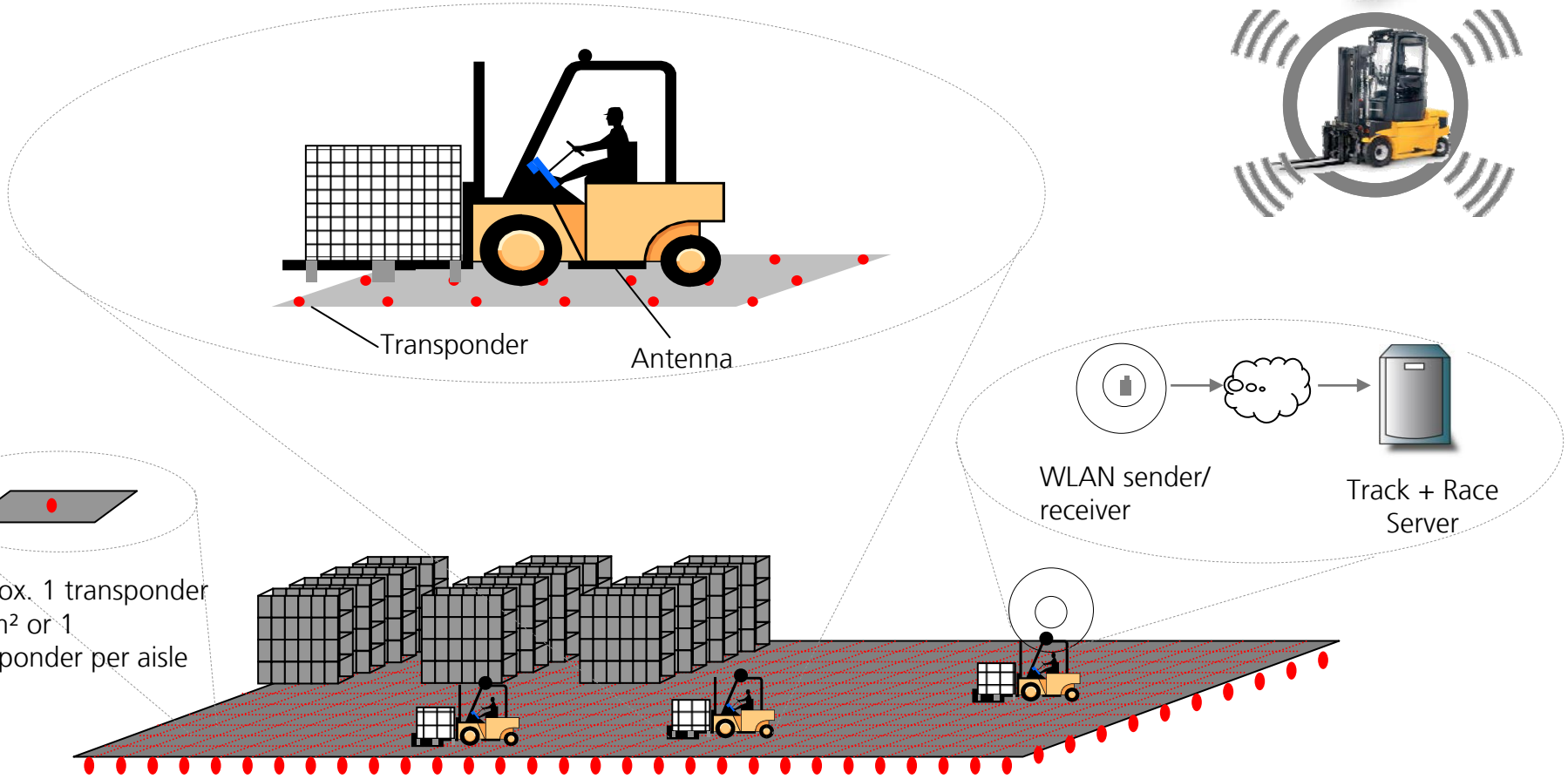
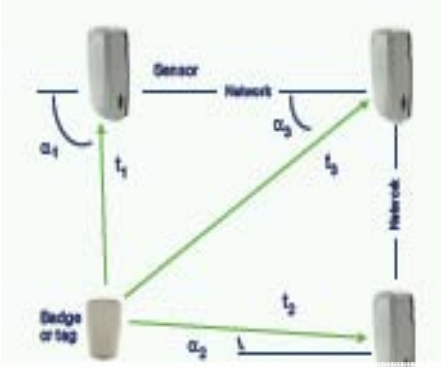
RFID applications
Transponders for vehicle control



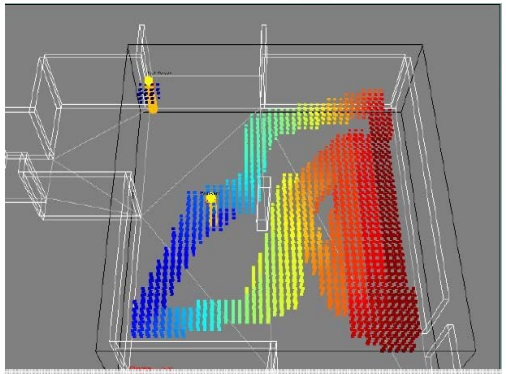
Source: VLB 2005

Ultra Wide Band Realtime-Positioning-System

- Active tags with UWB-Senders
- Preciseness of 15cm in 3D
- Range of more than 100m
- Especially capable for logistics- and assembly-environments
- Has been installed in March 2007 in the openID-center in Dortmund

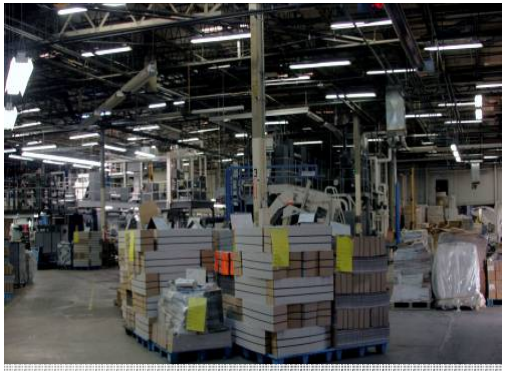


Locating over „Time Difference of Arrival“ and „Angel of Arrival“



Visualization in 3D

Locating employees in danger-zones



Reducing loss during assembly

Ubisense
Precise Real-time Location

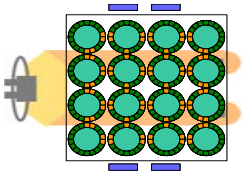
RFID application in the chemical industry

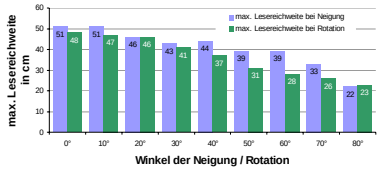
Customer: Münzing Chemie

Task

- Transponder application to identify barrels and IBCs
- Difficult reading conditions due to metal barrels and fluids
- Group reading of up to 32 metal barrels

I II III IV





Approach and test accomplishment

- Determination **„sweet spot“**
- Reading rate for **bulk readings** and orientation of units
- **Data concept** and **process integration**
- **Cost estimation**

Results and recommendation

- Reading rate dependant on number, orientation of transponders and surface of units
- 1,5 mm minimum distance of transponders for metal barrels
- High reading rate for transponders attached on the outside

Daimler Chrysler AG – Feasibility analysis

DAIMLERCHRYSLER

RFID-based inventory recording of usage in a central empties warehouse

Customer: Daimler Chrysler AG, Sindelfingen

I II III IV

Task

- Optimizing the reusable container management
- Goals of the optimization are higher transparency of container movements and diminished shrinkage
- Manufacturer neutral screening tests on selected RFID systems

Approach

- **Laboratory tests**:

  - Selection of hardware, transponder type, frequency
  - Determination of the maximum conveying speed
  - Forklift test with antenna configuration
  - Handheld test

Results

- Determination of appropriate transponders and modification of pallets
- Pilot phase using forklifts and handhelds
- Identification of restrictions and potentials

RFID in construction I

Construction-machines-locating

Starting postion

- Lasting for weeks, vehicles are on inadequate secured and unsupervised building sites.
- Key / core importance:
  - Protection against theft and fraud
  - Supervision of operation and control of operating hours

I II III IV

Requirements

- Alarm signal if movements outside defined working hours
- GPS-locating to find the stolen machine
- Supervision of operation via sensors
- Battery-powered power supply with a long lifetime
- Resistant, waterproof and non-breakable box

Result

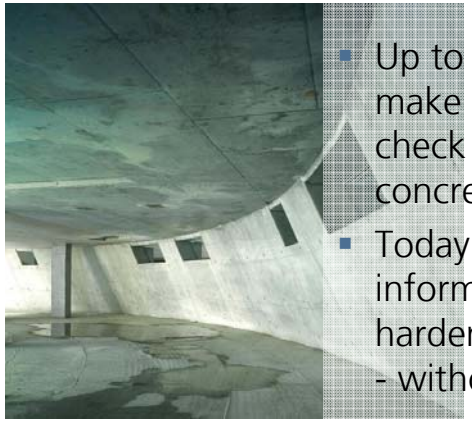
Westfälische Rundschau 06.03.2008:

"At the weekend it was possible to regain a stolen wheel-type loader with the help of the positioning system "TrackCube".

RFID in construction II

IDENTEC SOLUTIONS Visibility Delivered.

„New World Trade Center“



- Up to now it was necessary to make drillings in concrete to check the hardness of the used concrete
- Today active transponder inform about the ideal hardening of the used concrete - without drilling

Starting position

I II III IV

Requirements

- Tags are used in the whole building (fundament, supporting walls, lift shafts, stairwells, machine rooms)
- In the process of the hardening RFID-Tags collect, save and transfer wireless temperature data to the monitoring system.

Result

- Reduction in construction time
- Cut in construction / building costs
- Increased static security / safety

RFID in construction III

HOCHTIEF AG, inhaus2

I II III IV

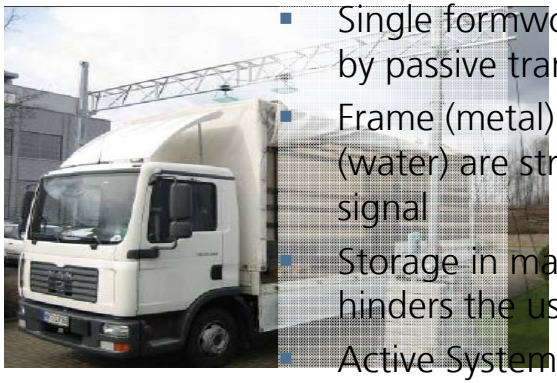
Task

- Testing of 868-RFID technology to identify formwork on trucks

Approach

- Testing different RFID tags and reader on formwork in the Fraunhofer IMS
- Assembling a testing environment in the Fraunhofer IML for best position and range measurement
- Conversion of best-suited technologies under real conditions on a truck

Results



- Single formworks can be identified by passive transponders
- Frame (metal) and Formwork facing (water) are strongly disturbing the signal
- Storage in many layers on the truck hinders the usage of passive RFID
- Active Systems must be used to fulfil the task

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RFID-Knowledgebase

THE RFID KNOWLEDGEBASE

The world's largest collection of RFID Case Studies

Case Studies	3052
Companies	4151
Company slideshows & audio	526
Countries	100
Last Updated	19 Nov

Airlines and Airports

113 case studies in section.

Animals and Farming

134 case studies in section.

Books, Libraries, Archiving

110 case studies in section.

Military

79 case studies in section.

Financial, Security, Safety

569 case studies in section.

Healthcare

280 case studies in section.

Land and Sea Logistics, Postal

327 case studies in section.

Retail, Consumer Goods

502 case studies in section.

Laundry

13 case studies in section.

Leisure, Sports

396 case studies in section.

Manufacturing

202 case studies in section.

Passenger Transport, Automotive

405 case studies in section.

Source: www.idtechex.com/knowledgebase

ak3

Reihenfolge:
1.Books
2. Consumer
3. Health Care
4. Manufactoring
5. Automotive
6. Reusable (2 Folien, auf 2. Folie zuück in Mitte)
7. Laundry (dann Ende)

Ann-Kristin Klas; 30.05.2005

Agenda

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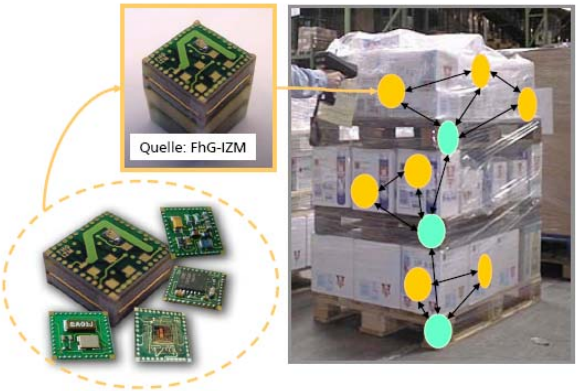
4. **Research on RFID**

Research Topics at Fraunhofer IML

Self-routing

Networking



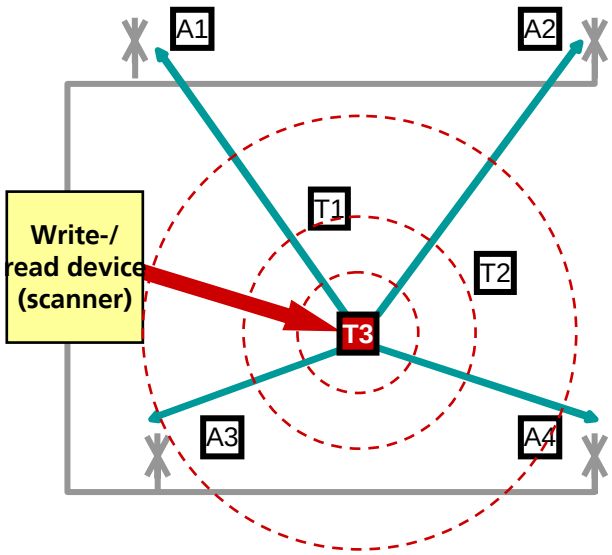
Localization

Load unit scan and protection

Several objects in one structure can build an entity and network.

- Spatial bondage of reading processes as well as coverage, penetration and shadowing problems of RFID-systems can be cleared out
- The position of objects in a structure gets definable thanks to intermeshed radio networks with sufficient speed
- A removing or manipulation of objects can be detected and registered directly in the structure.

Locating of objects with passive RFID



Antenna arrangement to position passive tags

Potential methods

- Gates
- Grip-mapping method
- Operation time rating
- Phase difference rating (appropriate to RFID)

Characteristics

- IT support necessary
- High spatial resolution (1 cm)
- In progress

Thank you for your attention!

Christian Meiß

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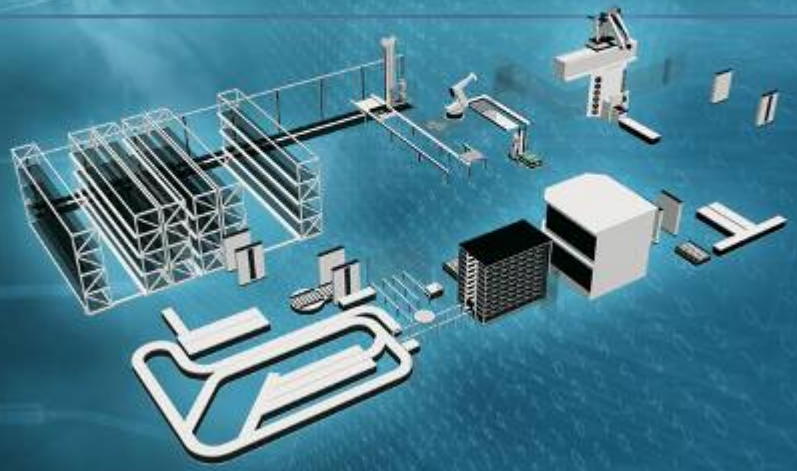
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