How does a passive tag auto id system work (really)?

Electronic labelling. Read/Write features.
The ISO Standards. The ISO-RFID-TAG-X.

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Contents

• RF-ID Tags
  • Readers
    • Physics, Anti-collision
  • Tag data for returnable container
    • AFI tag data structure
  • Where are we now?
    • Conclusions

RF-ID Tag technology is engineering
RF-ID Tag

Data storage media with radio connection and radio power transmission

4 functions of an RF-ID Tag:

- Data Storage
- Power reception
- Data reception (write to tag)
- Data emission (read from tag)
Components of the RF-ID Tag

Focus now: 898MHz foil RF-ID Tags – ISO18000-6

Antenna

Dipole
Backscatter -> electromagnetic field
Serves 3 purposes:
  • Energy transmission
    • Data reception
    • Data emission

• IC – Integrated Circuit
  • both ends of antenna connected to IC
    • Size < 1mm²
    • All functions included

Tag inlay covered with paper (smart label)
Tag reader

Communication partner of RF-ID tags.

- Establishes a stationary field of fix frequency 980MHz (energy).

- Reads and writes Data to/from RF-ID tag.

Main visible component: Antennas
Tag Function 1: Energy reception
Tag function 2: Data reception

Cmd: Send memory block 2, bit 0 to 64

Date rate: up to 40kBit/s
Data transmission to all tags in field simultaneously
Tag function 3: Data emission

Cmd reply: Sending memory block2, bit 0 to 64

Reflecting the wave (Sending)

Tag to reader: 160 kBit/s max

Oscillator in short-circuit state:
  • no energy consumption (reflection) of the tag
  • Reader receives reflected wave
  • Reception only possible, if only one tag talks -> Anti-Collision
Anti-Collision

Capability to communicate with multiple tags in the reader field.

All tags receive power and commands simultaneously.

Problem to solve
If multiple tags are sending data:
- reader detects only collision
- reader does not receive any data.

→ Anti-Collision methods
(a) ALOHA, (b) Binary Tree,
(c) slotted random
**Anti-Collision – unique tag ID**

### Necessary to address tag directly

If reader knows tag ID it may communicate only with this tag

**Tag ID: ISO 15963**

Technology-Independent tag-id standard:

<Org><Manufacturer><Serial number>

**Tag ID example:**

E0170B01AA000CD8

### Organisation:

**E0: ISO/IEC7816-6/AM1**

**E2: EPCglobal**

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Anti Collision – Example Overview

Tag 1
ID: 1000h

Tag 2
ID: 1002h

Tag 3
ID: 1012h

Reader

Last Digit = ?

1000 % Collision % % % % % % % % % % %

Last Digit = 2
For last Digit = ?

1002 1012 % % % % % % % % % % % % % %
Anti-Collision – Pre-selection on application family (AFI)

Pre-select group of RF-ID tags

EPC/AFI

Example: Flight baggage
⇒ Ignore any other tags like goods

Advantage: Faster Anti-Collision

AFI: Application family identifier
Byte which composes into two sub-fields:
• Application family
• Application Subfamily

• 1 Transport
• 2 Financial
• 3 Identification (Access control)
• 4 Telecommunication
• 5 Medical
• 6 Multimedia
• 7 Gaming
• 8 Data Storage
• 9 EAN.UCC System (AI's) (Retail)
  • 9-? ?EPC?
• 10 ASC (DI's)
  • 10-1 Items
  • 10-2 Transport units
  • 10-3 Returnable containers
• 11 UPU (Universal Postal Union)
  • 11-1 Items
  • 11-2 Transport units
  • 11-3 Returnable containers
• 12 IATA
  • 12-1 IATA Baggage Tag
Summary:

• Standards: ISO/IEC18000-6c

• Anti-Collision using Unique ID for up to 200 tags.

  • Reading distance: up to 8m, may be restricted by local power limitations.

  • Spot-light shaped reading zone: stack of readers to increase performance
Tag data for returnable container

- **Unique ID:** Composed of: Issuer, container
  - Container Type: **KLT1521**
  - Additional data: current contents

**How?**
- Compatible to present Bar Code to be compatible to present infrastructure

  **ISO15459-5 Returnable Container**
  - 25B**ODABCDQQD184AC+B**KLT1521
    (registered Odette issuer)
  - 25B**UN123456789QQD184AD+B**KLT1521
    (registered DUNS issuer)
  - **FNC1800312345671234567QQD184AE**
    (registered GS1 issuer using EAN128 data structure (Global Returnable Asset ID))
RFID Data Structure

AFI Structure

- All Bar-Code versions may be represented
  - Additional data welcome
  - (Use tag as portable data base)

EPC Structure

- Tag data is a database pointer (GRAI)
  (Only some GRAI can be represented)
- Other data should be held in the EPC framework (set of worldwide data bases)

Data on Tag

Data on Network
ISO (AFI) RFID tag data structure

- RFID tags advanced features:
  - Writeable
  - Big memory
  - Read without view
- How to extend present systems with RFID tags?
  - Compatible RFID data structure
  - ISO/IEC15961
ISO/IEC15961 & ISO/IEC15962 Overview

Application

Reader

Radio Link

RF-ID tag

Cmd: Write field
Data: JLHEDMG12
Ok
Serial Line etc.

Memory Map

Unique ID

AFI

DSFID

tag image (partly known)

Application Interface

Data Formatting/Extraction

ISO 15961

ISO/IEC 15962

Air Interface

ISO 18000-X

Tag memory with formatted data
ISO/IEC15961 & ISO/IEC15962

Features

• Compatible to other material handling data structures
• Treats ASC/EAN128 transparently
• Defines commands read/write
• Select tags suited to my application quickly
• Fast access on key fields "What is your transport unit?"
• Fast access on arbitrary fields
ISO/IEC15961: Conversion to Abstract Syntax Notation One (ASN.1)

- Definition of commands: write field, read field,...
  Commands and data on one wire
- Identifiers are organised in a tree covering ASC, EAN128, ...
- Example:
  ASC 1H → (40 248 74 6) 39
  40 248 74 6: ISO15434-6
  39: 1H

ASN.1 identifier tree (OID)
**ISO/IEC15962: - Memory organisation**

### Sequential

1. ID 1
2. Data 1
3. ID 2
4. Data 2
5. ID n
6. Data n
7. Free space for additional fields

### Directory

1. ID 1
2. Link 1
3. ID 2
4. Link 1
5. ID n
6. Link n
7. Free for fields
8. Data n

- **Very quick access on first field**
- **Access speed decreases for each field**
- **Less memory usage than directory method**

Quick access on any field
- **Directory may be buffered or fix for the application**
Where are we today?

ISO17364: Supply chain applications of RFID – Returnable transport items (RTIs)

Next Step: CEN TC225 3th of may in Brussels
Conclusions

→ Data structures of automatic-identification: ASC, EAN128, Transfer Syntax, ISO-RFID Tag

• Type information is added to the data for the information system
• World wide uniqueness is achieved using labeler IDs.
• ISO Standards guarantee communication within branches.
• Data structures may be transmitted by different media independent of the data structure.

→ RF-ID Tag data structures establish compatibility within tags and to barcode.

• Usable standard 15961/15962 ready for use.
• Complex ? That’s normal, it is RF-ID !