

RFID: Addressing, Event Management and Network Services

RFID Addressing

Overview

- Identifiers in RFID
- A brief history of object numbering schemes
- Object identifiers
 - EPCglobal Electronic Product Code
 - Ubiquitous ID
 - Other object numbering schemes
- Addressing objects
- The Internet of Things

Identifiers in a Gen2 tag

- Tag identification (TID) memory bank
 - An 8-bit ISO 15963 allocation class identifier
 - For EPCglobal Tags it is 0xE2
 - A 12-bit Tag mask-designer ID
 - A 12-bit Tag model number.
 - Manufacturers can also include other information if required e.g. tag serial number
- EPC in EPC memory bank
- User memory bank may contain additional application specific IDs

ISO 14443 IDs

- ISO 14443-A requires fixed Card Identifier (CID)
- CID uniquely related to tag chip
 - Application Family Identifier (AFI) defines separate spaces for CID
- Used by reader to address a specific card
 - Also used in groups to keep specific cards in a particular state
- In ISO 14443-B can be pseudo –random number
- Application layer identifiers are contained in user data space
 - e.g. Oyster card customer number different from ISO ID

Addressing objects

- User-space object ID
- Generally no additional context data on tag
- Characteristics
 - Universally unique
 - Sub-domain structure
 - Registrar
 - Ownership
 - Mechanisms for mapping to metadata
- There are already some candidates!

Numbering Systems for Objects

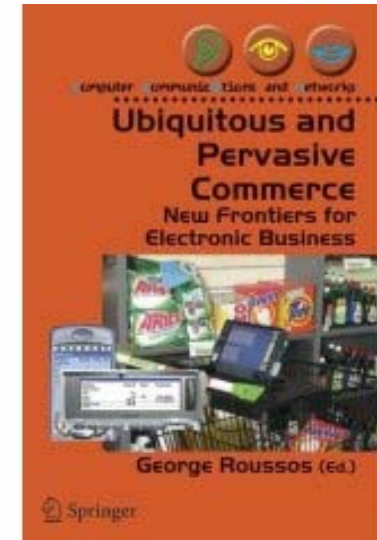
- Barcodes
 - many different types!
- IPv6 addressing
 - too much functionality for objects in many cases
 - requires superior processing capability and >100KB stack)
- Internet 0
 - reduced IP stacks with ISO-1800/IRDA etc link layer
 - Asymmetric, no end-to-end
- Other MAC addresses
 - embedded Zigbee, Bluetooth



UCC/EAN-128, EAN-13, EAN-8, ITF 14.

Multiple identifiers

- Objects can have multiple IDs in different schemes
 - 658.05 UBI (Dewey Classification Scheme)
 - 1846280354 (ISBN)
 - 9781846280351 (EAN)
 - 6602940 (LIBRI)



Objects are also products

- Object manufacturer well positioned to embed ID
- Has been done before at global scale
- Major perceived business benefits in the supply chain
 - logistics, inventory, anti-counterfeiting, demand forecasting, shrinkage
- Possible consumer applications
 - smart things, smart selves, product recalls
- Major technology investment

Barcodes and the SG1 system

- UPC created in 1973 the first American 10-digit barcode standard (uniform and then Universal product code)
- European Article Numbering introduced in 1977 extended the scheme to the needs of a global market
 - first to separate the data from the data carrier
- Two systems became interoperable in 2005 as EAN.UCC and later SG1 (One Global Standard)
- Under SG1 a variety of standardization activity including RFID within EPCglobal
 - ebXML, Global Data Synchronization Network, Global Standards Management Process, Global Product Classification

EPC Identifiers

- A global identifier scheme is needed
 - Address allocation, coordination of address space, address semantics, resolution
- EPC is part of SG1 and so has to accommodate existing EAN and related identifiers
- Management of the scheme is via a SG1 subsidiary called EPCglobal Inc
- Protocols are developed in the Auto-ID network of research laboratories

EPC structure

- EPC tag data standards define “pure identifiers” which are abstract object addresses
- Pure identifiers are stored following the related “physical realization” and “encoding” protocols on the tag
- *Header data* identifies the particular scheme employed in a specific EPC and thus the semantics of the digits
- Current schemes are specific to SG1 and DoD requirements and there is also a general ID

Encoding schemes

- General Identifiers (GID-96)
- System Identifiers
 - GS1 Global Trade Item Number (GTIN) SGTIN-96 SGTIN-198
 - GS1 Serial Shipping Container Code (SSCC) SSCC-96
 - GS1 Global Location Number (GLN), SGLN-96 SGLN-195
 - GS1 Global Returnable Asset Identifier (GRAI) GRAI-96 GRAI-170
 - GS1 Global Individual Asset Identifier (GIAI) GIAI-96 GIAI-202
- DoD construct (DoD-96) cf. www.dodrfid.org

Types of data

- Serialized Global Trade Item Number (SGTIN) -On item packaging for items where a serial number is used for the unique identification of trade items worldwide within the UCC.EAN System.
- Global Returnable Asset Identifier (GRAI)-On item packaging for items (reusable package or transport equipment).
- Global Individual Asset Identifier (GIAI) -On item packaging for items (used to uniquely identify an entity that is part of the fixed inventory of a company -GIAI can be used to identify any fixed asset of an organization).
- Serialized Shipment Container Code (SSCC)-Items shipped as either pure or mixed case, pallet, (SSCC can be used by all parties in the supply chain as a reference number to the relevant information held in computer database or file).

Electronic Product Code

016.37000.123456.1000000000			
Header	EPC Manager	Object Class	Serial Number

- *Header*: identifies the length, type, structure, version and generation of EPC
- *Manager Number*: which identifies the company or company entity (today: same as EAN)
- *Object Class*: similar to a stock keeping unit or SKU
- *Serial Number*: which is the specific instance of the Object Class being tagged

ucode

- Not specifically related to supply chain applications
- ucode is a 128-bit number
- It is a meta-ID because it can incorporate other numbering schemes
 - provides bindings for JAN, UPC, EAN.UCC, ISBN
- It can be abbreviated for use with low-capacity carriers
 - uses context code
- Distinct domain levels, managed independently
- Registrar is Ubiquitous ID Centre
 - T-Engine Forum, University of Tokyo

uID technologies

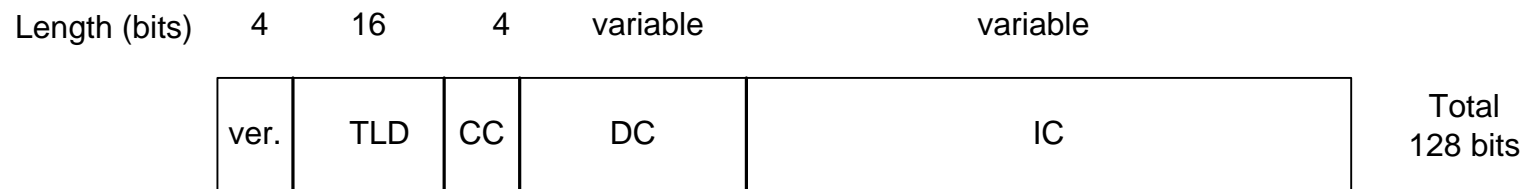
- Defines specific tag classes
 - also incorporates barcodes
 - microwave, HF and UWB tags
- Defines reader device called the uID Communicator
- Defines software platform
 - Based on TRON
- Address resolution points to uTAD record with object details

```
<rdf:RDF
  xmlns:rdf="http://www.w3.org/2002/22/99-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:utad="urn:utad:schema:utad:base:0.0.0#"
  xmlns:pc="urn:utad:schema:pc:example:0.0.0#"
  <rdf:Description rdfabout="ucode:0123....cdef">
    <rdf:type rdfresource="urn:utad:schema:pc:example:0.0.0#pc"/>
    <utad:version>0.0.0</utad:version>
```



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ucode structure



- version
- Top Level Domain code
- Class Code specifies the boundary between DC and IC
- Domain Code specifies the type of IC
 - e.g. JAN, ISBN, EPC etc
- Identification Code is the actual object identifier

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