Animal Radio Frequency Identification: Low Frequency Advanced Transponder with flexible memory organization

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Use of Low Radio Frequency Identification (RFID) systems

- Developments started already in the 1960ies
- Symposium 1976: Cow Identification Systems and their Applications
  - ✓ Results reported from UK, Germany, The Netherlands & USA
  - ✓ Commercial systems for (dairy) animal identification
- Nowadays compulsory traceability systems based upon RFID
  - ✓ Farm animals & companion animals
- Need of standards was recognized
  - ✓ 1991 First ISO animal RFID meeting
  - ✓ 1994 Standard for all categories of animals
  - ✓ 1996 Standards published

ISO 11784 Animal RFID Code structure

Bit no	Information	
1	Animal bit	
2-4	Retag counter	R
5-9	User information (ADDITIONAL INFORMATION)	UU (EU sheep & goat 04)
10-14	Reserved field (for future use)	AAA
15	RUDI bit	
16	Data block flag	
17-26	Manufacturer/Country code (ISO 3166, Denmark 208)	CCC
27-64	Identification code	XXXX XXXX XXXX

Standard provides a means to enable unique ID codes

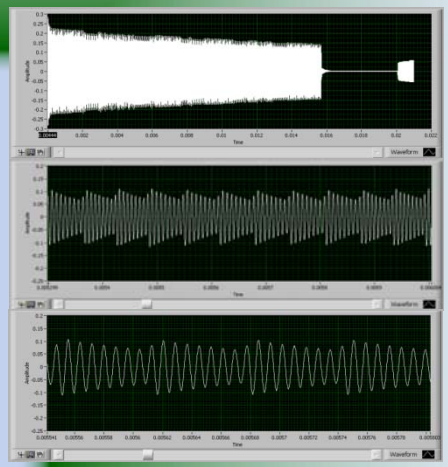
Registration authority: ICAR (www.icar.org)

- Granting of (shared) manufacturer codes & product codes

ISO 11785 Technical concept

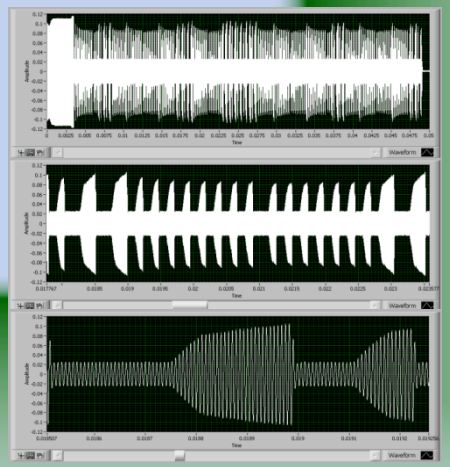
Two protocols are accepted:

- HDX => Separate energy & data transfer
- FDX-B => Simultaneous energy & data transfer



Activation frequency 134.2 kHz

- Signal transmitted in noisy environment
- Signal transmitted through live animals
- Optimal reading performance



- Communication rather slow
- No anti collision

Low Frequency (LF) RFID with additional features

Additional features:

- Storing (locking) information on transponder
- Possibility of password protection
- Anti collision (readable with several transponders in field)
- Compatible with NON advanced LF transponder

ISO 14223

Radiofrequency identification of animals - Advanced transponders

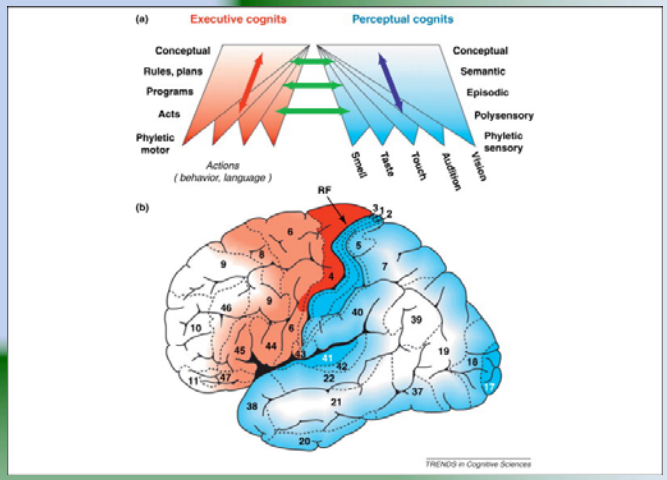
- Part 1: Air interface (2010)
- Part 2: Code and command structure (2009)
- Part 3: Applications (under development)

DILEMMA Standardized ← → Flexibility

ISO 14223-3 Splits transponder memory

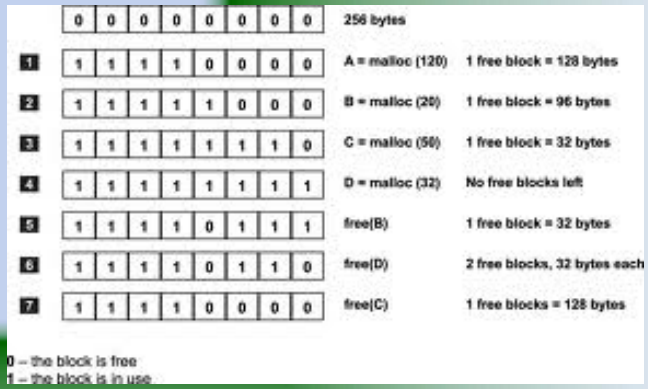
ISO 14223-3 Four different memory parts accessible

- ISO 11784 ISO 11785 information (ANIMAL ID)
- Data Format IDentifier (DFID) information
- Defined information with fixed allocation
  - ✓ E.g. Date of birth
- Flexible content object identifiers (OID) based
  - ✓ E.g. Amount of concentrate eaten



Overview of the ISO 14223-3 memory

- ISO 11784 ISO 11785 defined part
- Data Format IDentifier (DFID) information (one block of 4 bytes)
  - ✓ 2 Bytes reserved for future use (RFU)
  - ✓ 2 bytes for the DFID [00000..65535]
- Single Access Memory (SAM)
  - ✓ Defined information with fixed allocation
  - ✓ Use is optional
- Data Directory Memory (DDM)
  - ✓ Flexible content OID based
  - ✓ Use is optional



Data Format Identifier (DFID) Agency ➔ defines memory

- DFID code is the link to the memory composition
  - ✓ All transponders with certain DFID have same memory organization
  - ✓ DFID codes are granted to DFID agencies
    - o Company
    - o User group
    - o Governmental competent authority
    - o .....
  - ✓ One organization responsible for
    WorldWide Registering of Registry Agencies (WWRRA)
    (e.g. ICAR)

- The DFID code informs reader about interpretation of the memory
  - ✓ Template shall be available for reader manufacturers (e.g. internet)

To be defined by the DFID Agency

- Size of memory to be reserved for the SAM section (start position DDM)
- Content of the (non proprietary) SAM part
- (Non proprietary) OID's that can be used in the in the DDM part

THE AGENCY

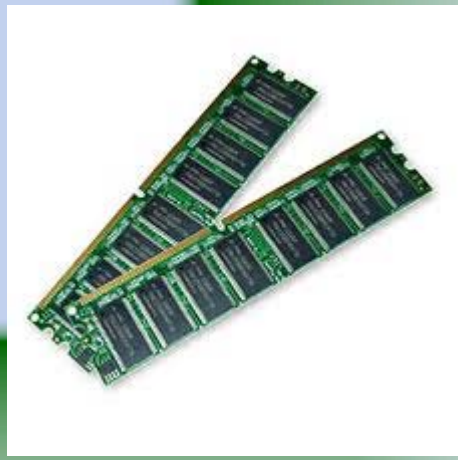


Table memory organization ISO 14223 transponder

Section	Mandatory	Block #	Byte 0	Byte 1	Byte 2	Byte 3	Lock bit
ISO 11784 / ISO 11785 defined							
DFID link	Yes	0	RFU	RFU	DFID	DFID	Yes
SAM	No	1	DAD	DAD	DAD	DAD	Yes
		..					
		N	DAD	DAD	DAD	DAD	Yes
DDM	No	N + 1	DAD	DAD	DAD	DAD	Yes
		..					
		N + M	DAD	DAD	DAD	DAD	Yes

DFID = Data Format Identifier

SAM = Single Access Memory

DDM = Data Directory Memory

RFU = Reserved for Future Use

DAD = DFID Agency Defined

Examples of SAM (I)

Species		dogs/cats/ferrets	protected animals	Ornamental fish	Horse
Item 1	Examples	Date of birth	Date of birth		Date of birth
Item 2		Injection site	Place of birth	Place of birth	Place of birth
Item 3		Country of origin	Country of origin	Country of origin	Country of origin
Item 4		Sex	Sex	Sex	Sex
Item 5		Breed	Breed	Breed	Breed
Item 6		Home veterinary	Cites code	Farm reg. Number	Medical Risk
Item 7		DB registration	DB registration	DB registration	Vaccination
Item 8		Vaccination	Vaccination		Specian medication
Item 9		Mother's ID		Mother's ID	Father's ID
Item 10		Farther's ID		Farther's ID	Check database

Examples of SAM (II)

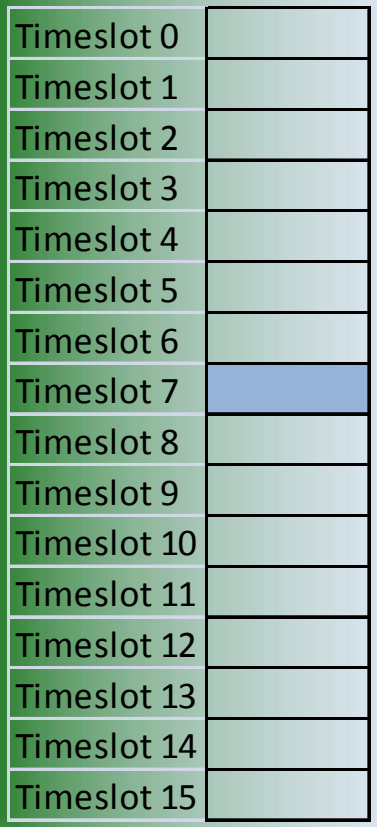
Species		Cattle	Sheep	Pig	Horse
Item 1	Examples	Date of birth	Date of birth	Date of birth	Date of birth
Item 2		Place of birth	Place of birth	Place of birth	Place of birth
Item 3		Country of origin	Country of origin	Country of origin	Country of origin
Item 4		Sex	Sex	Sex	Sex
Item 5		Breed	Breed	Breed	Breed
Item 6		Farm reg. Number	Farm reg. Number	Farm reg. Number	Farm reg. Number
Item 7		DB registration	DB registration	DB registration	DB registration
Item 8		Production type	Production type	Production type	Production type
Item 9		Mother's ID	Mother's ID	Mother's ID	Mother's ID
Item 10					

Example of DDM

Field	Identifier	Code	Length of data (# bytes)
Species	SPC	Hex01	1
Date of Birth	DOB	Hex02	3
Country of origin	COO	Hex03	2
Sex	SEX	Hex04	1
…	…	Hex…	…
…	…	Hex…	…
Medication date	MD	Hex50	3
RFU		Hex51 – Hex98	tbd
End of Data	EOD	Hex99	

Possibilities of communicating with ISO 14223 transponders

1. ID-reading (ISO 11784 ISO 11785)
   - ✓ Animal passing antenna in raceway
   - ✓ Anti collision mechanism (time consuming)
     (reading several transponders at “same” time)
2. DFID block access (reading / writing / locking)
   - ✓ E.g. Check if animal registered by DFID Agency
   - ✓ Time efficient
3. Access SAM information (reading / writing / locking)
   - ✓ Access one / several block(s) of 32 bits of information
   - ✓ Time efficient
4. Access DDM information (reading / writing / locking)
   - ✓ Information has to be read sequentially (time consuming)



ISO 14223-3 has predefined pre defined DFID's

- To start use of the ISO 14223 technology ISO has predefined DFID's

DFID code	Definition	Owner	Comment
00000	RFU	ISO	
00001	No additional Memory defined	User	
00002	Proprietary	User	Open format
00003	DDM only	ISO	Continuous stored data using the index for every item prior to the data. Standardized DDM Format
00004-01000	RFU	ISO	
01001	ISO Pre-defined DFID, General Animal	ISO	Fixed defined data agreed and managed by the ISO group
01002-02000	RFU for Pre-defined DFID's	ISO	
02001-65535	User DFID's	User	To be granted and published by WWRRA

Data storage with Object Identifiers

- OID look up table defining content and format
- Preferred situation:
  - ✓ OID's are worldwide defined
  - ✓ OID's are relevant for all species
  - ✓ New elements may be added when requested from user group
- Difficult to organize
- DFID Agency defines OID's to be used in combination with their DFID
- A combination of both is possible

Concluding remark

- ISO 14223 part 3 is under development
- Expected to be published in 2015
- Transponder manufacturers & reader manufacturers made first trails
- Compatibility with ISO 11784 ISO 11785 allows smooth introduction
- Robust LF frequency characteristics
- Memory organization as defined in ISO 14223-3
  - ✓ Flexibility by using DFID's
  - ✓ Fast data access of the SAM section
  - ✓ Flexibility of the DDM section by using OID's
- Challenge for companies will be to find applications
  - ✓ Livestock
  - ✓ Companion animals

Thank you!