Part 5

IC cards
with synchronous transmission

Part 1: ATR and data sections

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1. Scope

This specification describes the Answer-to-Reset (ATR) and the arrangement and structure of the data sections in the data memory of IC cards with synchronous transmission (usual name: memory IC cards):

- ATR
- ATR data section
- Directory data section
- Application data section

Structure and coding of possible additional memory sections for security mechanisms when accessing the memory are out of scope of this specification.

2. Normative references

ISO 3166: 1994
Codes for the representation of names of countries

ISO/IEC 7816-3: 1988
Identification cards - Integrated circuit(s) cards with contacts, Part 3 - Electronic signals and transmission protocols

ISO/IEC 7816-4: 1995
Identification cards - Integrated circuit(s) cards with contacts, Part 4 - Inter-industry commands for interchange

ISO/IEC 7816-5: 1994
Identification cards - Integrated circuit(s) cards with contacts, Part 5 - Numbering system and registration procedure for application identifiers

ISO/IEC 7816-6: 1995
Identification cards - Integrated circuit(s) cards with contacts, Part 6 - Inter-industry data elements

ISO 8825: 1990
Information technology - Open systems Interconnection - Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1)

3. Definitions und abbreviations

3.1 Definitions

3.1.1 Data section: logical data zone in the memory, which complies with a file according to ISO/IEC 7816-4

3.1.2 Data unit: the smallest set of bits which can be unambiguously referenced (usual size: 8 bits = 1 byte)

3.1.3 Data object: Information seen at the interface which consists of a tag, a length and a value (i.e a data element).

3.1.4 Data memory: physical medium with sequential arrangement of data units. The address of the first unit (begin of the data memory) has the value 0.

3.1.5 Tag: data object identifier for BER-TLV encoded data objects.

3.1.6 Template: constructed data object representing a frame for a logically connected number of BER-TLV-encoded data objects.

3.2 Abbreviations

AID = Application identifier
APP = Application
ASN.1=Abstract syntax notation one
ATR = Answer-to-Reset
BER = Basic encoding rules
DIR = Directory
DO = Data object
DS = Data section
FID = File identifier
IC = Integrated circuit
ICC = Integrated circuit(s) card
ICCF= ICC fabricator
ICM = IC manufacturer
ICT = IC type
PIX = Proprietary application id extension
RFU = Reserved for future use
RID = Registered application provider id
TLV = Tag, length, value

3.3 Other conventions

A byte consists of 8 bits designated b1 to b8, from the least signifanct bit (lsb, b1) to the most significant bit (msb, b8)
Logically connected bytes (e.g. offset) are named B1 to Bn. The least significant byte is named B1.

In this specification only the logical structure of the data is described and not the order in which the bits appear during transmission.

4. Encoding technique

4.1 Data objects

The encoding technique for data objects used is the Basic Encoding Rules (BER) of the ISO-Encoding convention ´Abstract Syntax Notation One (ASN.1)´.

Thus a data object consists of

- a tag
- a length and
- a value.

Fig. 1 shows the general structure of a BER TLV encoded data object.

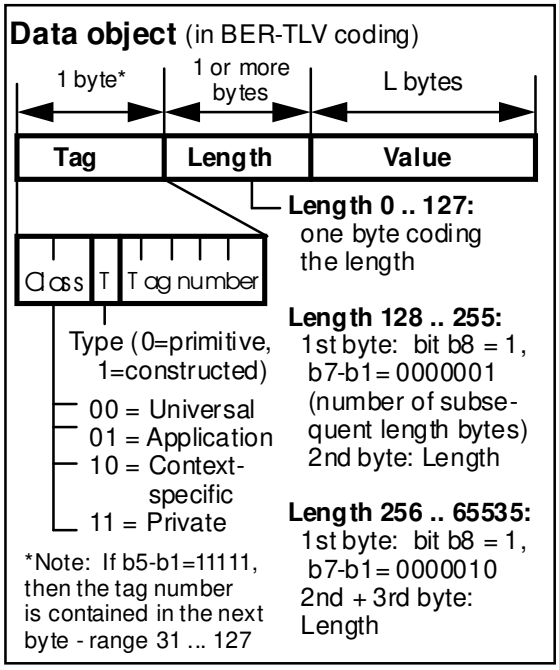


Fig.1: General structure of a BER-TLV encoded data object

4.2 Data sections

With the exception of the ATR all data sections contain BER-TLV encoded data objects. Each data section consists either of a single or constructed data object, i.e. the length of the data section is encoded in the length of this data object. The following variants are to be distinguished:

- The data section consists of one data object of the type primitive. The data object, identifiable by its tag, belongs to those data objects applicable for this data section**.**

- The data section consists of one constructed data object (template). The template and the nested data objects belongs to those data objects applicable for this data section.

- The data section begins with the constructed data object 'sequence' (standardised data object of the universal class with the tag '30') and contains a sequence of data section specific templates and/or other data section specific data objects, that are not integrated in a template.

Fig. 2 shows the variants in the structure of a data section

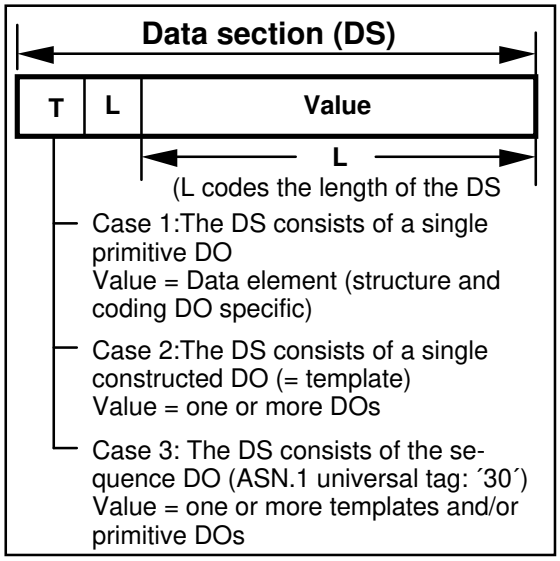


Fig 2: Structure variants for a data section

4.3 Data memory

The whole data memory can be seen logically as a sequence of bytes. The first byte has as byte address the value 0. The general arrangement of the data sections in the data memory are shown in Fig. 3

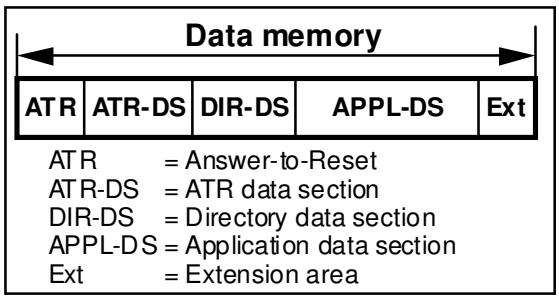


Fig. 3: ATR and data sections in the data memory

5. ATR

According to ISO/IEC 7816-3 the ATR of an ICC with synchronous transmission consists of

- Byte H1: Protocol type
- Byte H2: Protocol parameter
- Bytes H3, H4: Historical bytes.

The ATR is stored in the first four bytes of the data memory (byte addresses ´00´ - ´03´).

5.1 H1 - Protocol type

The byte H1 (in ISO/IEC 7816-3 only functionally defined) indicates the transmission protocol and the ATR structure.

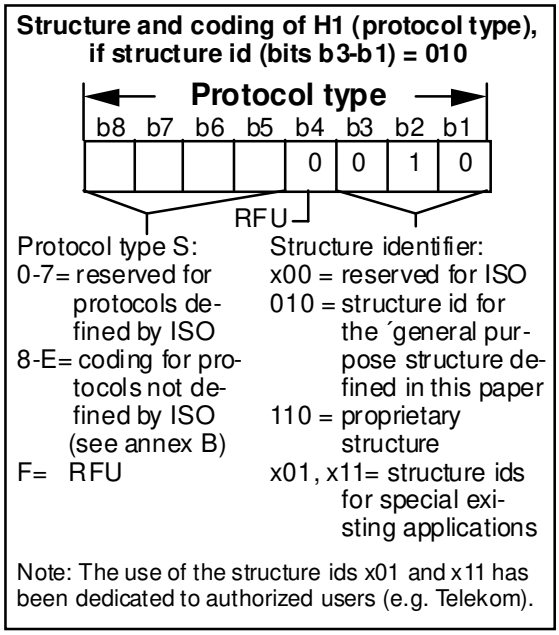


Fig. 4: Protocol type

The ATR structure id characterizes the structure of the complete ATR and is encoded in the bits b3 - b1. The protocol type S of the transmission protocol supported by the card is indicated in the bits b8-b5.

5.2 H2 - Protocol parameter

The byte H2 ´Protocol Parameter´ - only functionally described in ISO/IEC 7816-3 - contains additional parameters relevant for the continuation of the communication with the IC card:

- Length of the data units
- Size of the data memory
- Specification of options for read commands

Fig. 5 shows the structure of byte H2.

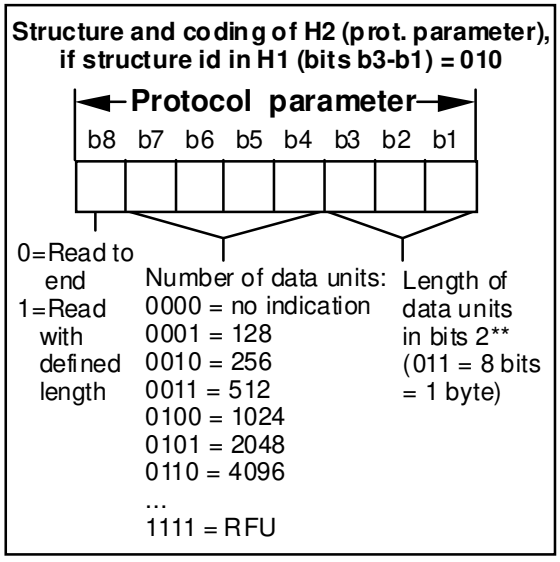


Fig. 5: Protocol parameter

5.3 Historical bytes

The bytes H3 and H4 contain according to ISO/IEC 7816-3 information similar to the historical bytes in IC cards with asynchronous transmission. Historical bytes are defined in ISO/IEC 7816-4.

5.3.1 H3 - Category indicator

In accordance with ISO/IEC 7816-4 historical bytes begin with the category indicator, which

characterizes the structure of the historical bytes. The value provided for IC cards with synchronous transmission (see table 78 in ISO/IEC 7816-4) is ´10´. This value indicates that the following byte will be a DIR data reference. The structure and coding of the DIR data reference is, however, not defined in ISO/IEC 7816-4, but specified in 5.3.2.

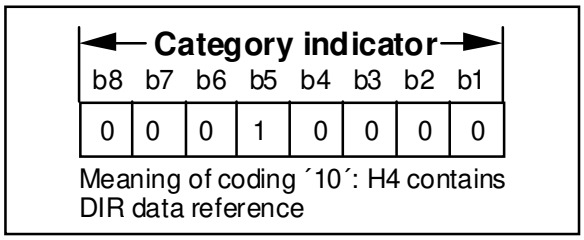


Fig. 6: Category indicator according to ISO/IEC 7816-4

5.3.2 H4 - DIR data reference

Byte H4 contains the DIR data reference, a pointer (byte address) to the first byte of the directory section. The exact structure of this byte is shown in fig. 7.

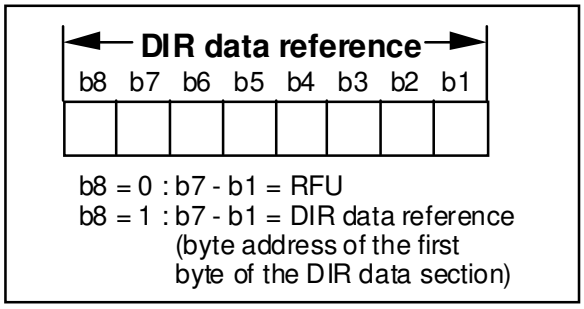


Fig. 7: DIR data reference according to ISO/IEC 7816-4 (structure and coding according to the memory layout defined in this specification)

6. ATR data section

The ATR data section is an optional data section and is comparable to the ATR file in microprocessor cards (see ISO/IEC 7816-4). It contains when present, a data object with manufacturer specific information. In the memory it follows immediately after the ATR. The ATR data section is empty when the pointer 'DIR data reference' has the value '84', which means that the DIR data section follows immediately after the ATR header.

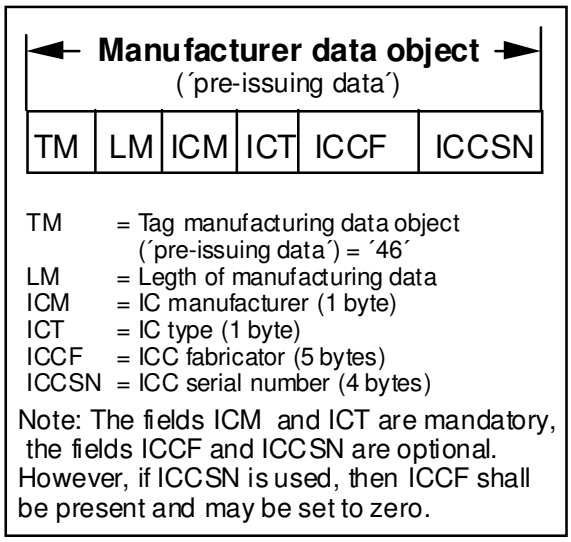


Fig. 8: Manufacturer data object

The information about the IC type in connection with IC manufacturer may play a role at the application level as it characterizes functional differences in chips with the same transmission protocol.
The values for ICM and ICCF are issued by a Registration Authority (see Annex B). The values for ICT are issued by the manufacturers and listed by the Registration Authority. The values for ICCSN are issued by the manufacturer and are not centrally registered.

7. DIR data section

The DIR data section shall always be present and contains according to ISO/IEC 7816-5 data objects for application selection. The following variants are possible:

- The IC card is a mono application card and only the data object 'application identifier' (tag '4F') is present in the DIR data section.

- The IC card is a mono application card with the data object 'application template' (tag '61') in the DIR data section. The application template can contain along with the application identifier (tag '4F') further data objects

(e.g. application label - tag '50' or discretionary data - tag '53').

- The IC card is a multi-application card. In this case the DIR data section begins with the data object 'sequence - tag '30'. In the value part of the sequence data object there are at least two application templates - tag '61' - to be found. These application templates shall contain along with the application identifier - tag '4F' - the data object 'path - tag '51'. The data object 'path' contains in the value field the pointer (physical address) to the first byte of the application data section of the corresponding application (the usage of the DO path is logically equivalent).

The general structure of an application identifier of the category 'national registration' is shown in Fig. 9

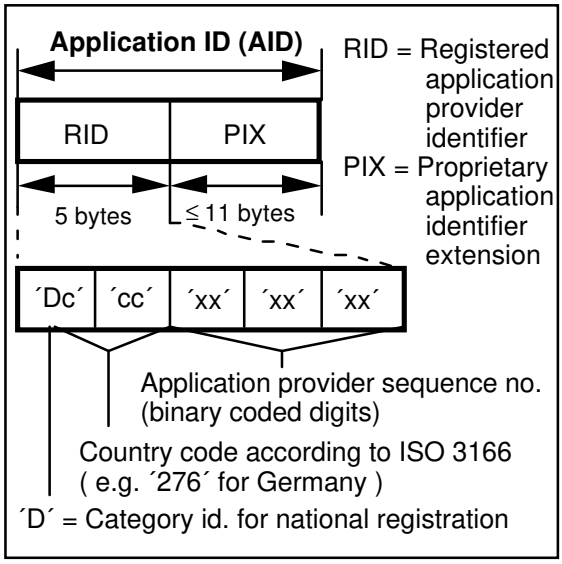


Fig. 9: Structure of an ISO/IEC 7816-5 conform 'application identifier' of the category 'national registration'

Note:
For assignment of an RID, an application provider shall contact the national standardisation body or its agent.

8. Application data section(s)

In mono-application cards (see annex A, fig. 1 and annex C) the application data section begins immediately after the DIR data section and starts either with

- tag ´40´ (= tag of the 'primitive' application data object), if the application data have no TLV structure, or

- tag ´60´ (= tag of the application data template), if the application data are BER-TLV coded DOs.

The length field of the application data object respective the application data template indicates the length of the application data section.

In multi-application cards (see annex A, fig. 2) the byte address of the first byte of the associated application data section is given in the data object 'path' of the related application template (see ISO/IEC 7816-5) contained in the DIR data section.

9. Extension areas

Behind an application data section an ´extension area´ may follow. The default value of the bytes in an extension area is the 'logical erased state' of the chip (e.g. 'FF').

Annex A (normative)

Data sections in mono - and multi-application cards

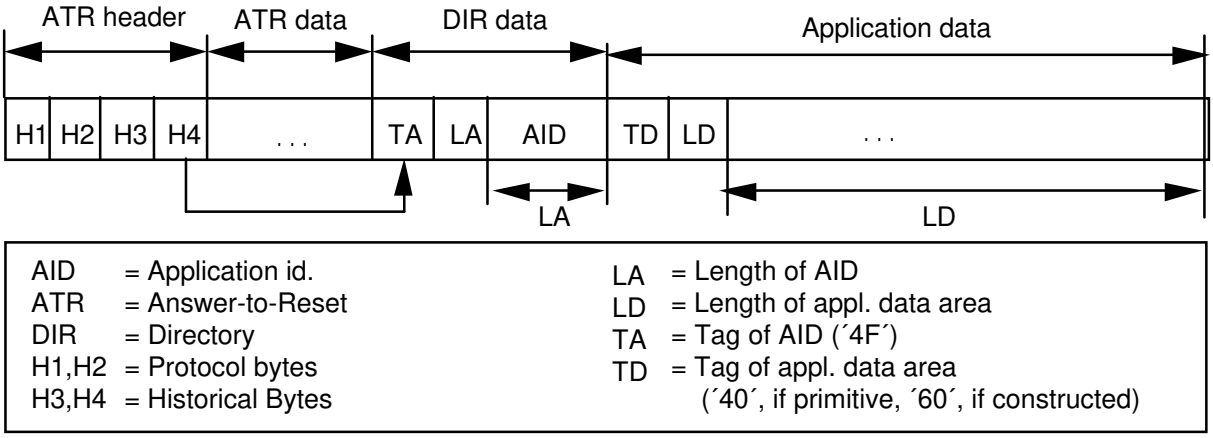


Fig. 1: General arrangement of a mono-application memory card with simple DIR structure

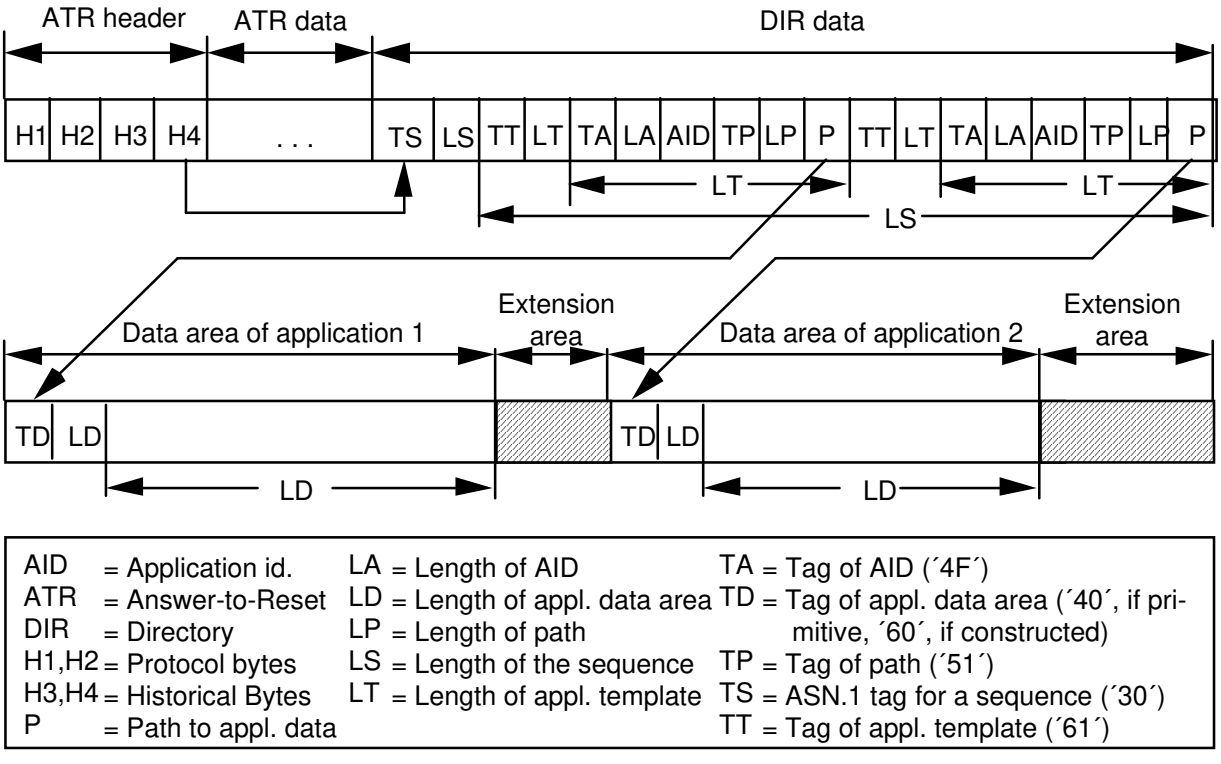


Fig. 2: General arrangement of a multi-application memory card (example)

Note: A pointer (e.g. in H4 or in a path DO) contains a byte address, i.e. the n-th byte in the data memory has as its byte address the value n-1, as the address value count begins with 0.

Annex B (informative)

Protocol types and other identifiers

The following protocol type identifiers (bits b8-b5 in H1) are in use:

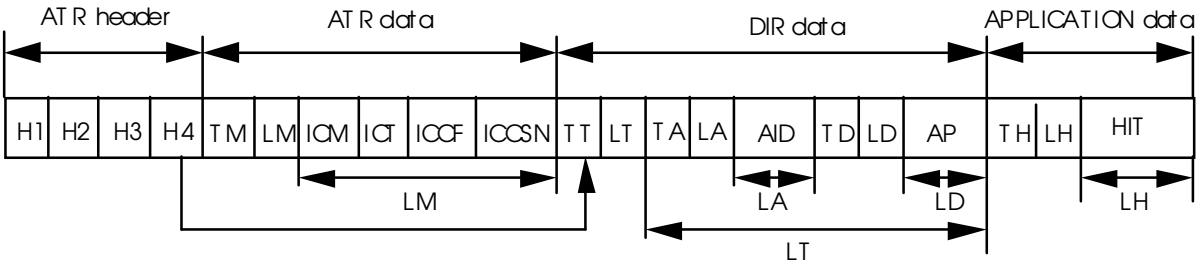
´8´ = Serial Data Access Protocol (SDA Protocol)
´9´ = 3-Wire Bus Protocol (3WB Protocol)
´A´ = 2-Wire Bus Protocol (2WB Protocol)

A registration should be undertaken for the following identifiers

- ICM (IC Manufacturer)
- ICCF (ICC Fabricator)
- ICT (IC Type)

Annex C (informative)

Example of a memory layout



AID = Application Identifier of health insurance application	HIT = Health insurance template	LM = Length of manufact. data
	ICCF = IC Card Fabricator Id.	LT = Length of appl. template
AP = Application Personalizer Identifier	ICCSN = IC Card Serial Number	TA = Tag of AID = ´4F´
	ICM = IC Manufacturer Id.	TD = Tag of discretionary data = ´53´
ATR = Answer-to-Reset	ICT = IC Type	TH = Tag of health insurance template = ´60´
DIR = Directory	LA = Length of AID	
H1,H2 = ATR protocol bytes	LD = Length of dicretionary data	TM = Tag of manufacturer data = ´46´
H3,H4 = ATR Historical bytes	LH = Length of health insurance template	TT = Tag of application template = ´61´

Fig. 1: Data sections of the German health insurance card (an extension area follows behind HIT)