ISO/IEC 14443 Overview

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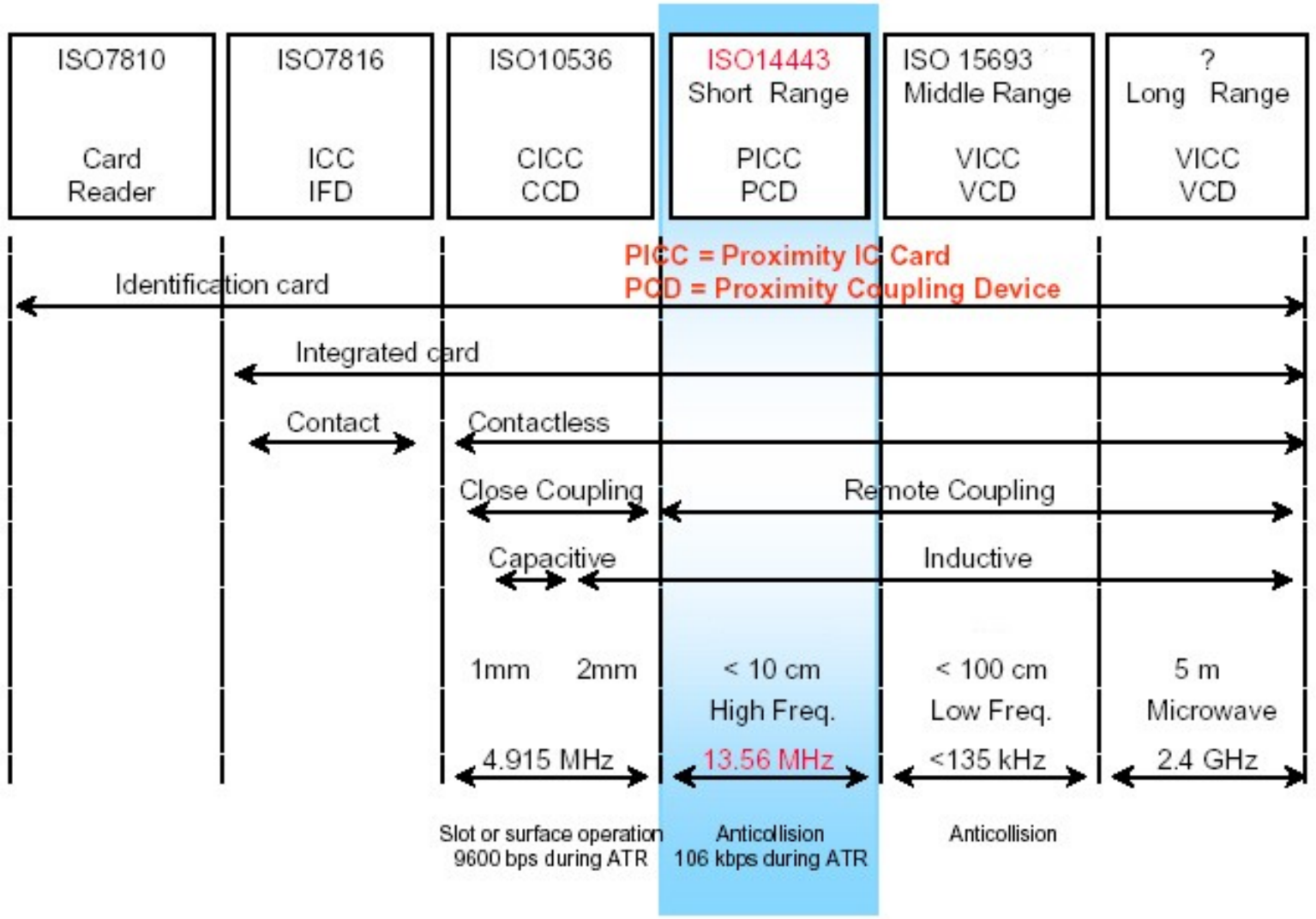
Standards Overview



ISO/IEC 14443 Overview

History

- The development of the standard was assigned to SC17/WG8 in 1994.
- A task force was established comprising several companies.
- The 1st task was to determine what the market wanted in a contactless card.
- The task force studied various applications, that were in use at the time and projected for the foreseeable future.
- Compatibility with application layers of existing contact smart card (ISO/IEC 7816) standards was also taken into consideration for the ease of integration and deployment.
- In the end, the task force defined four parts to the standard:
  1. ISO/IEC14443-1 Physical characteristics
  2. ISO/IEC14443-2 Radio Frequency Power and Signal Interface
  3. ISO/IEC14443-3 Initialization and anticollision
  4. ISO/IEC14443-4 Transmission Protocol

ISO/IEC 14443 Overview

History - Modes of Operation

- The task force felt that a standard must also be capable of defining a card that uses a microprocessor as this offers the flexibility to easily update the application through software.
- After a year of debate a consensus was reached by defining two ‘modes of operation’ in ISO/IEC 14443-2 (the power and signal interface). These are referred to as ‘Type A’ and ‘Type B’.
- In 1998 a third signal interface mode was proposed by Sony (Type C) but rejected as this did not add anything new to the standard.
- All four parts of the ISO/IEC14443 standards were completed by 2001.

- In mid 2001, a number of companies proposed an amendment that would add five additional modes to ISO/IEC14443-2. (Type C > G).

  An SC17 ballot (ISO/IEC JTC1/SC17 N2051) on 11th Jan 2001 eventually concluded to keep only the two modes A and B.

ISO/IEC 14443 Overview

History - Modes of Operation

Annex:	NORMATIVE		INFORMATIVE				
TYPE	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Advocate	Philips	TI	Sony				
PCD to PICC							
Modulation	100%	10%	10%	100%	10%	100%	10%
	ASK	ASK	ASK	ASK	ASK	ASK	ASK
Bit coding	Modified Miller	NRZ	Manchester	Bit width	NRZ - L	PPM	NRZ - L
Data rate	~ 106 kbps	~ 106 kbps	~106 kbps or more	T0	115,2 kbps	12,5 kbps	~ 106 kbps
PICC to PCD							
Modulation	Load	Load	Load	Load	Load	Load	Load
	OOK	BPSK	ASK		ASK		OOK
Subcarrier	fc/16	fc/16	None	None	None	~ 21 kHz	None
Bit coding	Manchester	NRZ - L	Manchester	bit width	NRZ - L	100 us	Manchester
Data rate	~ 106 kbps	~ 106 kbps	~ 106 kbps	T1	115,2 kbps	~ 10 kbps	~ 106 kbps

NOT 'Standard'

Acronyms

There are a vast amount of acronyms used in the standard. These are summarized in the ‘Symbols and Abbreviated Terms’ section at the front of all parts 1 > 4 of the standard.

Primary acronyms are:

PICC – Proximity Integrated Circuit Card (Transponder)

PCD – Proximity Coupling Device (Reader)

Also, many of the commands referenced in Parts 3 and 4 are formatted XXXA or XXXB. This identifies them as a Type A or Type B command.

i.e. REQA - Request Type A PICC Command

REQB - Request Type B PICC Command

ISO/IEC 14443 Overview

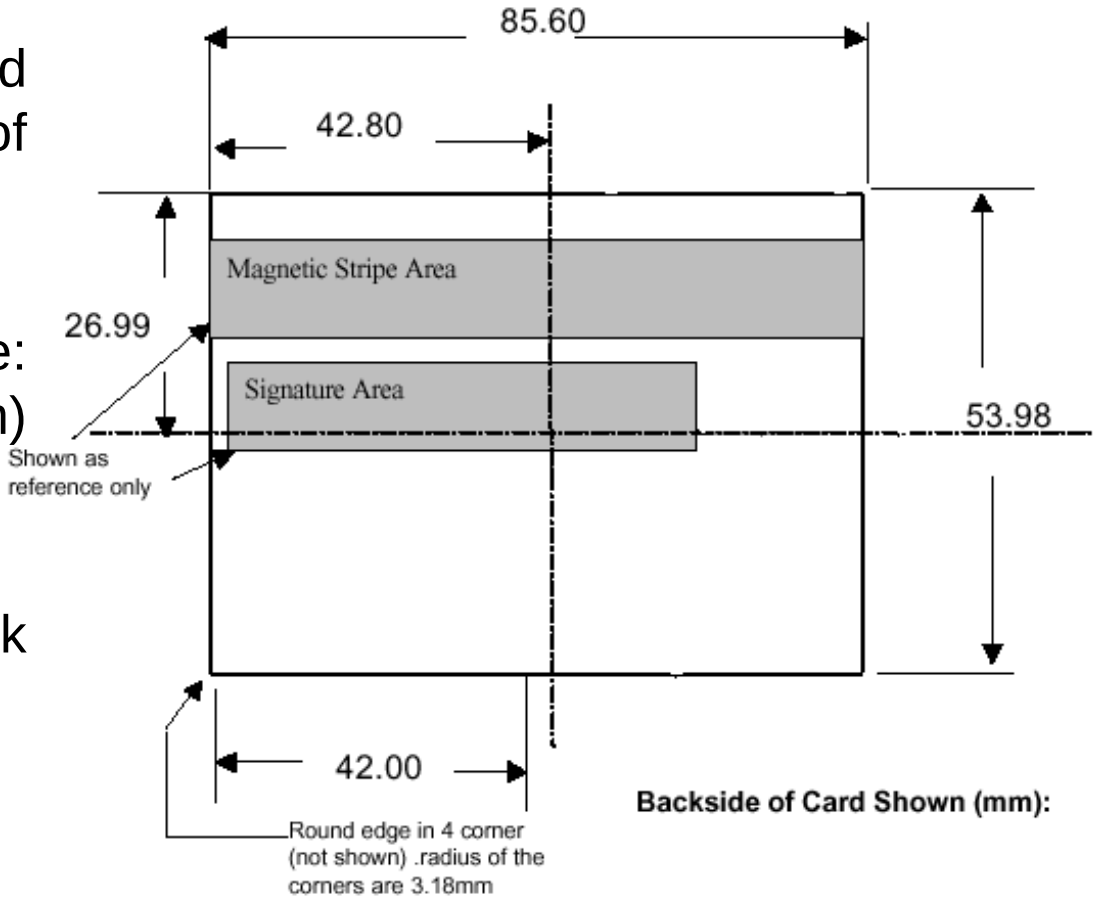
- **Standard Structure**

ISO/IEC14443-1 Physical Characteristics

This part of the standard specifies the physical size of the smart card.

The card is the following size: (85.6mm x 54.0mm x .76mm) referred to as ID-1 size.

This is the size of a bank credit card.



ISO/IEC 14443 Overview

Standard Structure

ISO/IEC1443-2 Power and Interface

The ISO/IEC14443-2 standard has two modes with the following features:

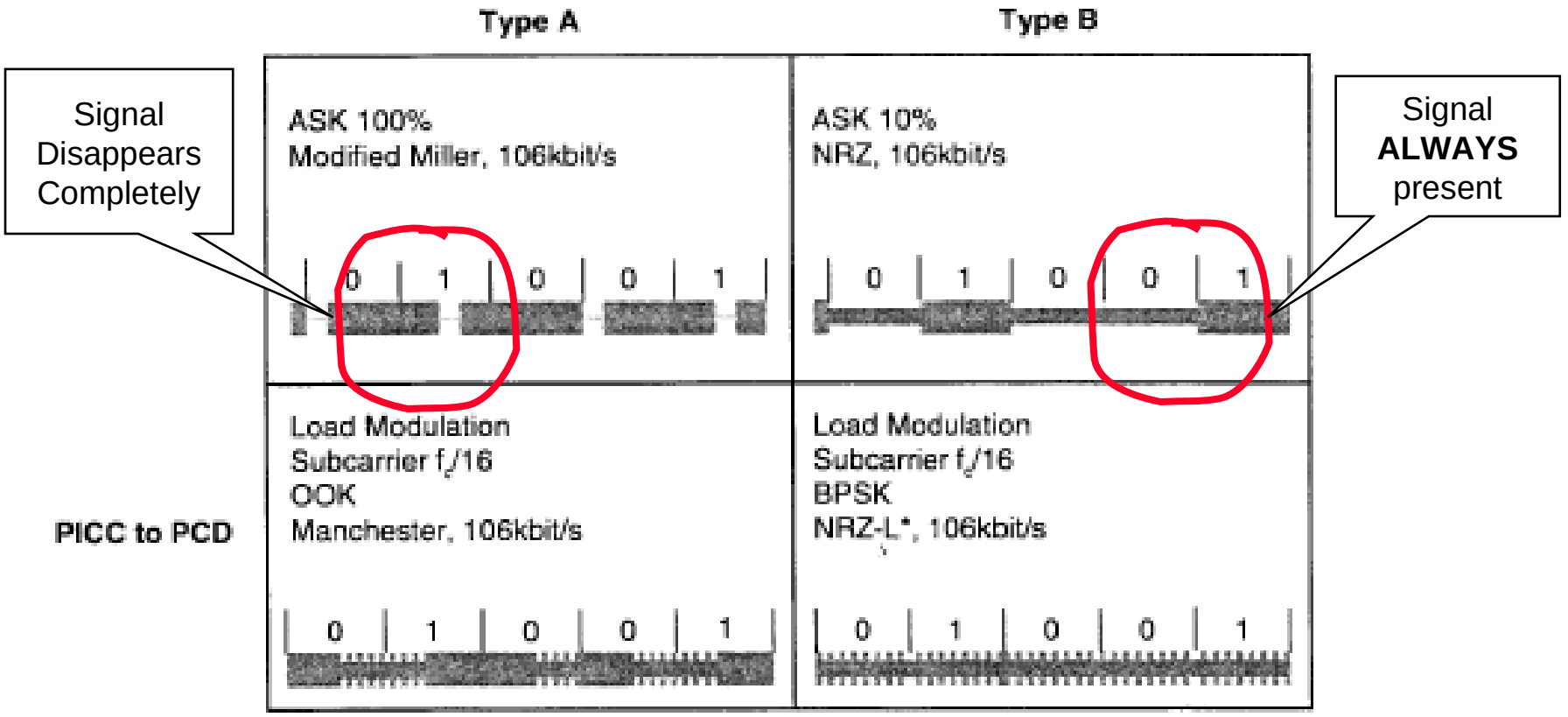
Reader to Card (PCD > PICC)	Type A	Type B
Frequency	13.56 MHz	13.56 MHz
Modulation	100% ASK	10% ASK
Bit coding	Modified Miller	NRZ
Data rate	106 kb/s	106 kb/s
Card to Reader (PICC > PCD)		
Modulation	Load	Load
Bit coding	OOK	BPSK
Subcarrier	847kHz	847kHZ
Bit coding	Manchester	NRZ
Data rate	106 kb/s	106

These features allow the reader to power and communicate with the card over a targeted range of operation of approximately 10 cm.

ISO/IEC 14443 Overview

- **Standard Structure**

  ISO/IEC1443-2 Power and Interface



* Inversion of data is also possible

ISO/IEC 14443 Overview

Standard Structure

ISO/IEC14443-3 Initialization and Anticollision

- Part three of the standard enables the reader to identify the cards in the magnetic field and establish communications with a specific card. It specifies the byte format, frames and timing used during the 2 initial phases of communication.

- The initialization process includes the commands between the reader and the card that activates the card to the ‘READY’ state.

- This anticollision process follows to identify all PICC’s in the PCD field .

  Part 3 defines 2 anticollision processes for the 2 different modes:

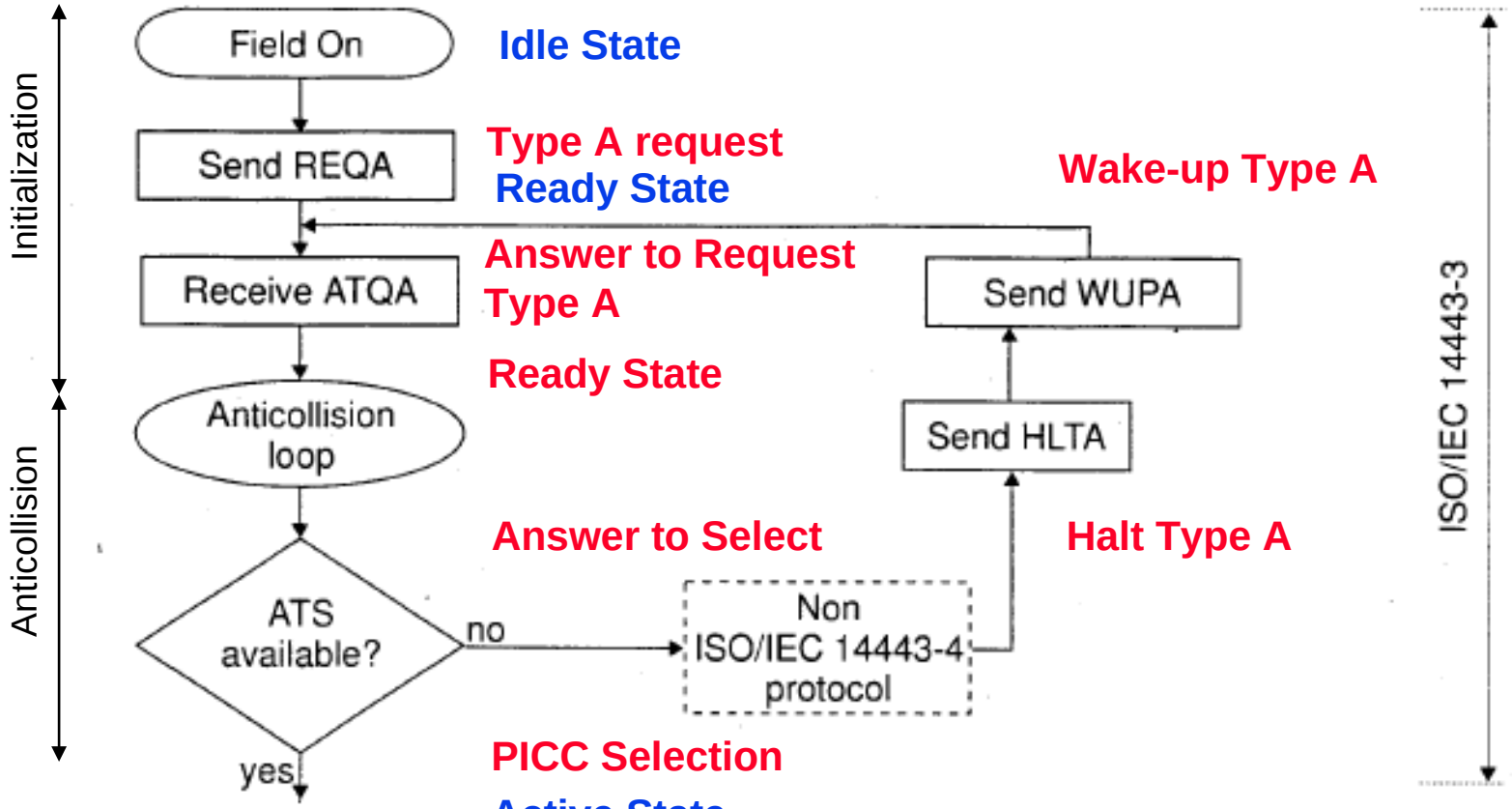
  Type A > Bit-collision detection protocol

  Type B > Slotted ALOHA with dynamic slot adaptation.

ISO/IEC 14443 Overview

- **Standard Structure**

ISO/IEC14443-3 Initialization and Anticollision



Note: Type A process illustrated

ISO/IEC 14443 Overview

- **Standard Structure**

ISO/IEC14443-4 Transmission protocols

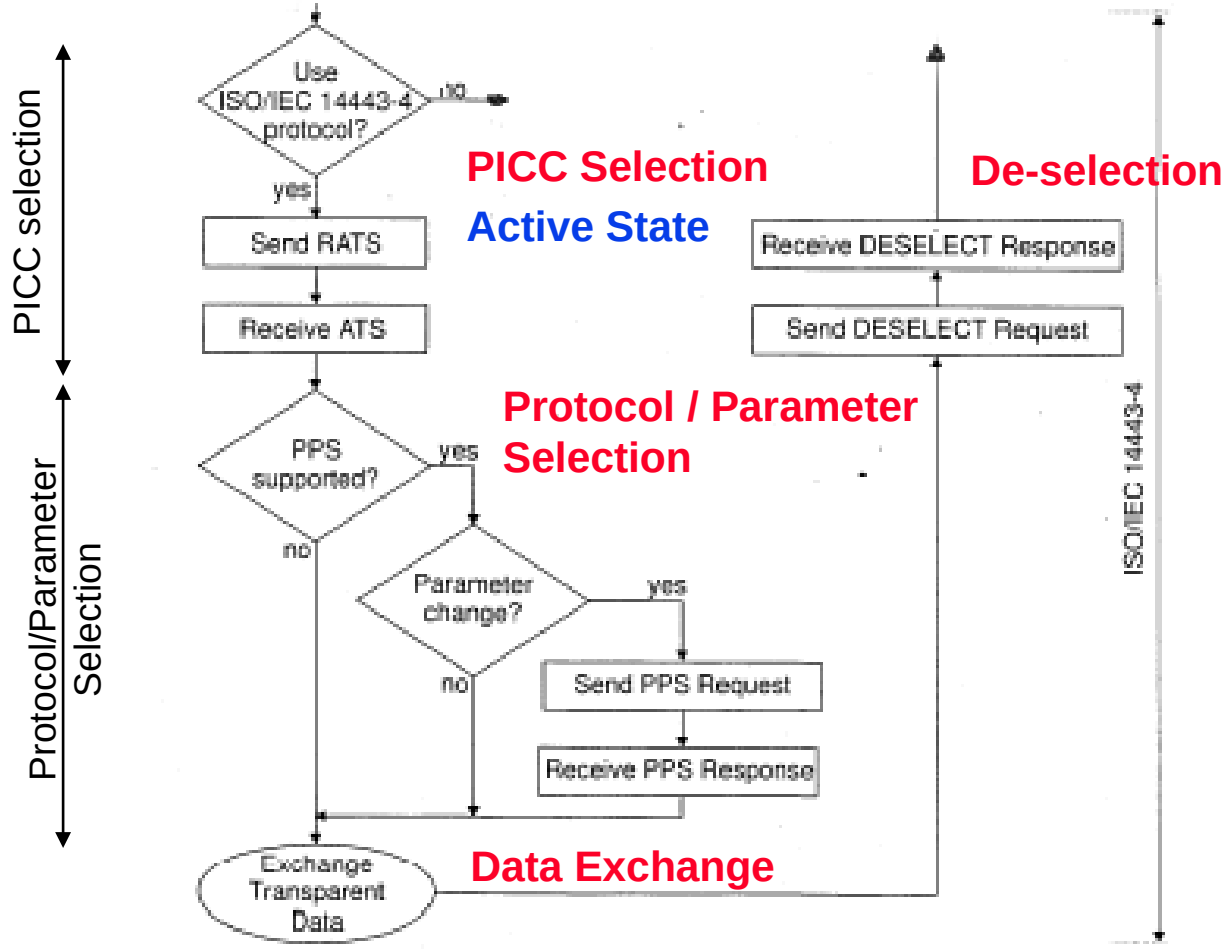
- Part four of the standard defines the half-duplex block transmission protocol. In particular, it defines the activation and deactivation sequences of the protocol.
- The activation sequence is concluded through the Protocol and Parameter Selection (PPS) process, upon which data can be exchanged.
- Upon completion of data exchange, the PICC can be disabled through the de-selection process.

- This standard has been developed with functionality and flexibility in mind.

ISO/IEC 14443 Overview

- **Standard Structure**

ISO/IEC14443-4 Transmission protocols



Note: Type A process illustrated

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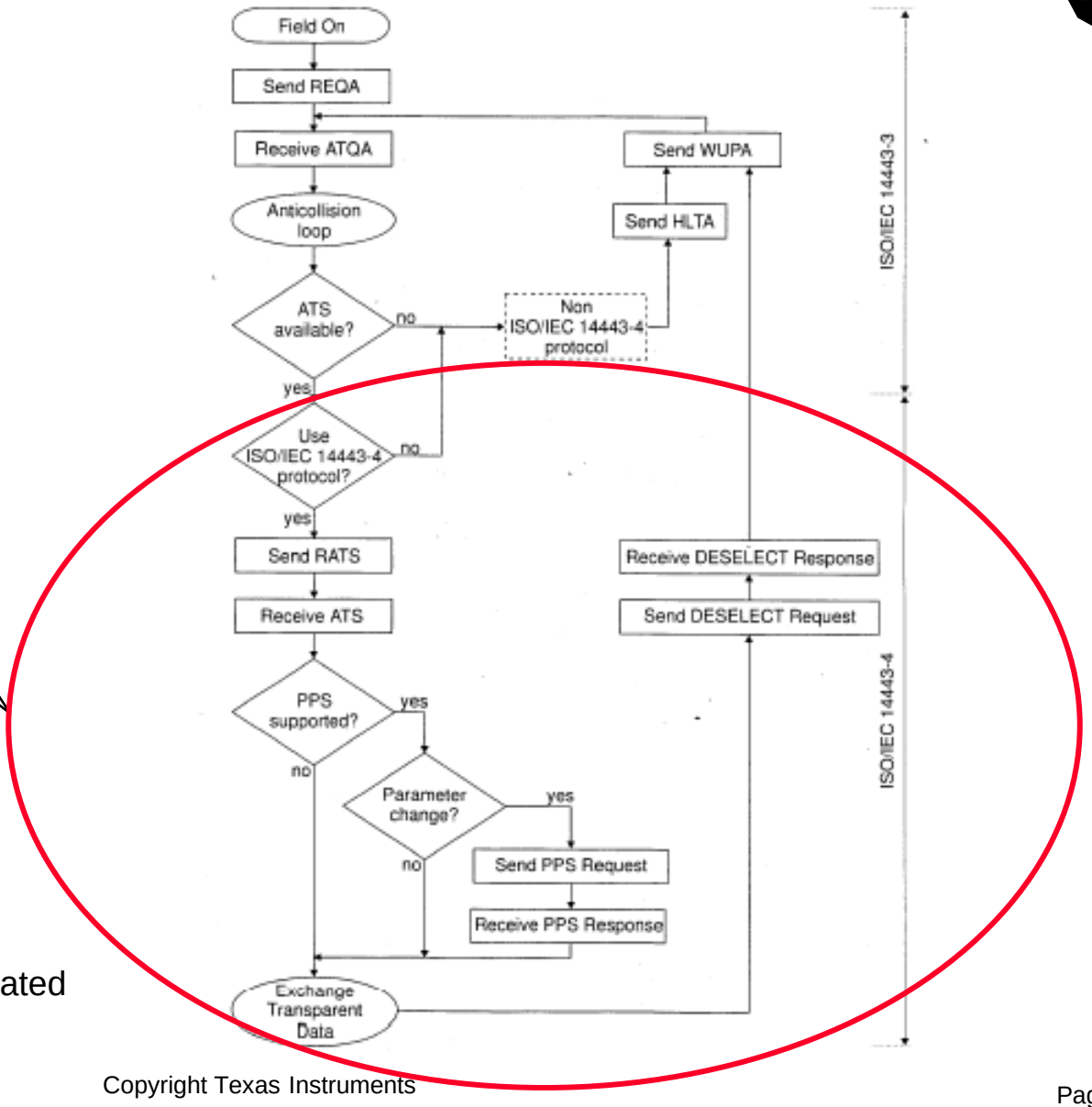
- **Complete Operation**

MIFARE is NOT the same as 'Type A'.

It is not compliant to ISO/IEC 14443-4, Type A illustrated. It uses it's own transmission protocol.



Note: Type A process illustrated

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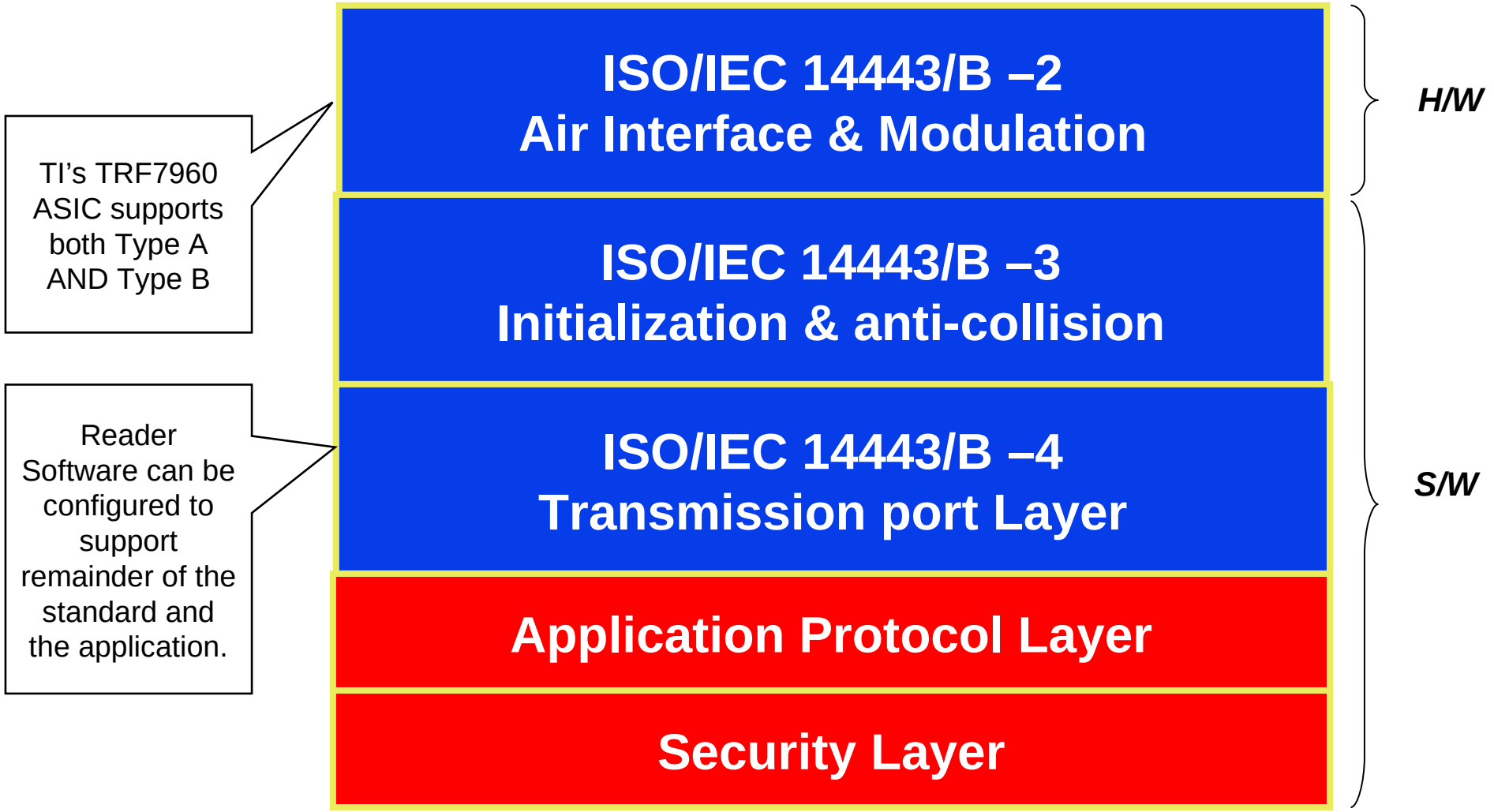
- **Communication Protocol Stack**



ISO/IEC 14443 Overview

Mode Conclusion

Technical Aspect	ISO14443A	ISO14443B	ISO15693	General Comments (For more specific feedback, pls request further info)
Origins	~1990	~1995	~2001	Type B was derived at a much later date than Type A, so has a number of advantages.
Data Rate	106 Kbs	106 up to 847 Kbs	1.65/26.4 kbs	Type B is adaptable to application speed requirements. 14443-3 supports negotiation of higher data-rates with Type B.
Anti-Collision	Medium Binary-search-tree with inefficiencies	Excellent Slotted-ALOHA with dynamic slot adaptation by reader	Excellent Slotted deterministic concept	Type B Slotted ALOHA is the more efficient and sophisticated anti-collision mechanism compared to binary tree search.
Multi-Applications	Yes - Medium	Yes - Fast	Yes - Slow	No clock recovery required with Type B for multi-applications.
Modulation Depth	100% (NO data processing DURING off pulses)	10% (Data processing DURING off pulses)	100% and 10%	100% modulation may offer greater noise immunity for long read-range applications >0.5-1m , but no difference for small read-range applications <.1m.
Air-Interface Complexity	Low (only 100%)	Low (only 10%)	Medium (10% and 100%)	Limited differences in air-interface complexity when using fixed depths of modulation.

Type B is a more recent, advanced, flexible and efficient Mode of Operation.