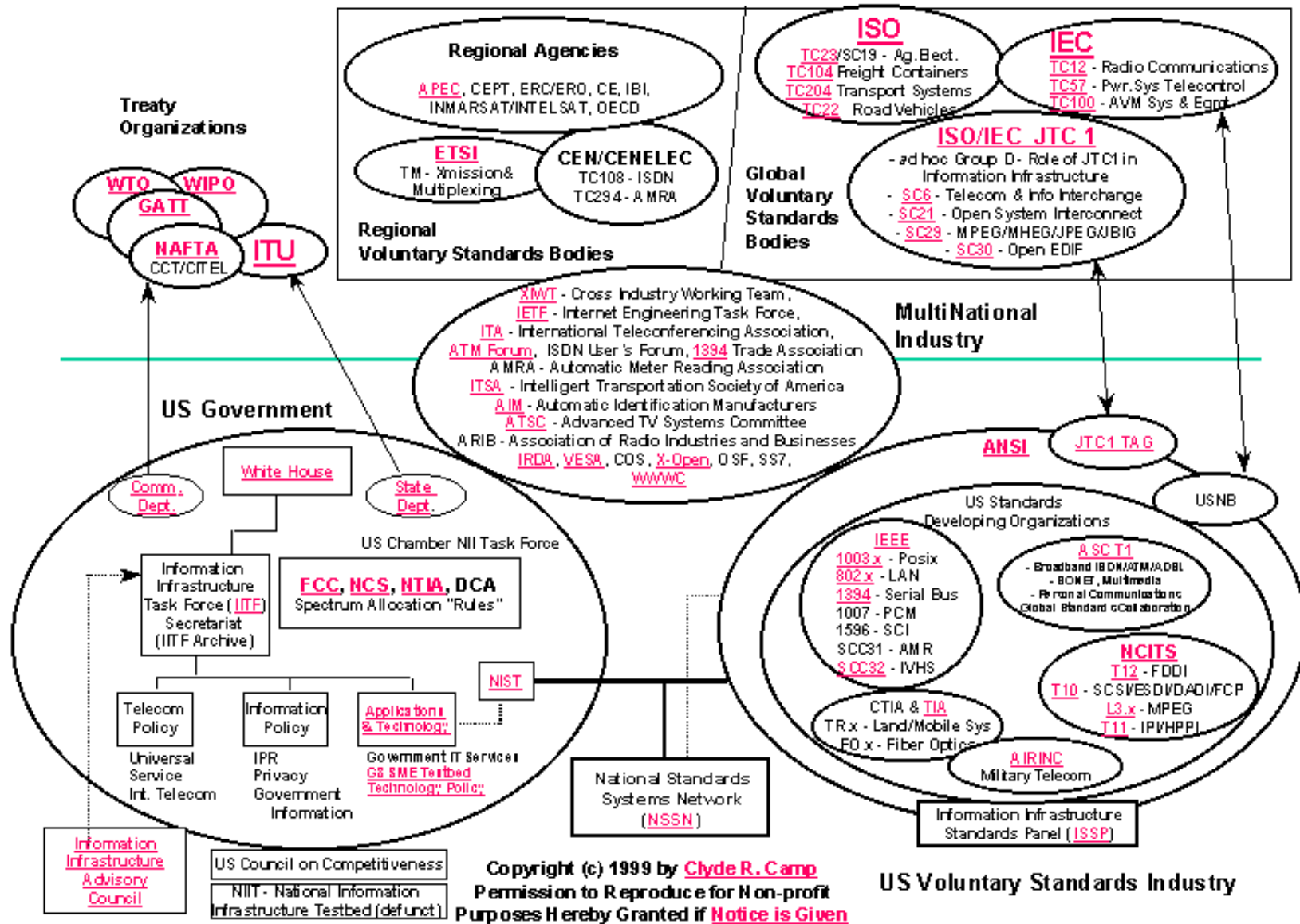# PHILIPS

ISO/IEC 14443 Contactless Interface Introduction

CAS – 2006

- **International Card Standards**
- **ISO/IEC 14443 Standard**
  - **Abbreviations**
  - **Parts 1 – 4**
  - **PICC States**
  - **Type A & B**
  - **Coding & Modulation**
- **ISO Card Activation Sequence**
- **Comparison ISO7816 & ISO14443 Standards**
- **Regulations**

www.crcamp.com/standards/sdos.htm

Joint Technical Committee (JTC) 1

Other Subcommittees

Subcommittee (SC) 17 "ID-Cards"

Working Group (WG) 4 "Chip Cards"

Working Group (WG) 8 "Contactless IC Cards"

Task Force (TF) 1 "Close Coupling"

Task Force (TF) 2 "Remote Coupling"

Task Force (TF) 3 "Vicinity Coupling"

ISO 7810

"Contact" ISO 7816

ISO 10536

Not used anymore

ISO 14443

mifare

ISO 15693

iCODE
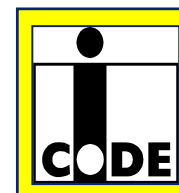
Part 1: Physical characteristics

- **Physical size of the ISO14443 card**

Part 2: RF signal & power interface

- **RF-interface (13.56 MHz, modulation, min. field-strength)**
  - **Type A: 100% modulation, Miller bit-coding**
  - **Type B: 10% modulation, NRZ bit-coding**

Part 3: Initialization & anti-collision

- **Start of communication (request, anti-collision, select card)**
  - **Type A: Bit-wise arbitration**
  - **Type B: Time-slot Method**

Part 4: Transmission protocols

- **Describes data exchange between reader and cards**

The ISO14443 does not specify any specific application, security or encryption.

ATQA	Answer to Request		ADC	Application Data Coding
BCC	Block Check Character		AFI	Application Family Identifier
CRC_A	Cyclic Redundancy Check		ATQB	Answer to Request
HLTA	Halt command, type A		ATTRIB	PICC selection command
ID	Identification number		CRC_B	Cyclic Redundancy Check
PCD	Proximity Coupling Device (reader/writer device)		EGT	Extra Guard Time
			EOF	End Of Frame
PICC	Proximity Card		HLTB	Halt command
REQA	Request command		INF	INFormation field belonging to higher layer
SAK	Select Acknowledge			
SELECT	Select command		N	Number of anti-collision slots
UID	Unique card Identifier		PUPI	Pseudo-Unique PICC Identifier
WUPA	Wake-up command		R	Slot number chosen by PICC
			REQB	Request command
			SOF	Start Of Frame
			TR0	Guard Time
			TR1	Synchronization Time
			WUPB	Wake-up command

To purchase ISO14443 standard documents please go to: *http://www.ISO.ch*

PHILIPS

This part of the ISO/IEC 14443 specifies the PICC physical characteristics.

⇨ Physical Dimensions

⇨ Ultra-violet light, X-rays

⇨ Dynamic bending and torsion stress

⇨ Alternating magnetic and electric field

⇨ Static electricity and Static magnetic field

⇨ Operating temperature

This part of the ISO/IEC 14443 specifies the RF power and signal interface for Type A and Type B cards.

⇨ Electrical Dimensions

⇨ Initial dialogue for proximity card – Reader Talk First

⇨ Frequency (13.56MHz $\pm$ 7kHz)

⇨ Operating magnetic field strength range: H_{min} and H_{max}
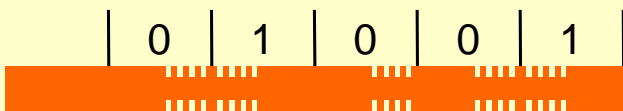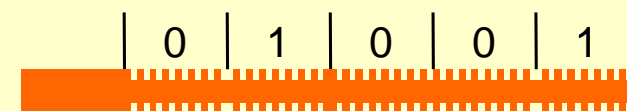
⇨ Communication signal for Type A and Type B

Type A

Type B

**PICC ➜ PCD
(Uplink)**

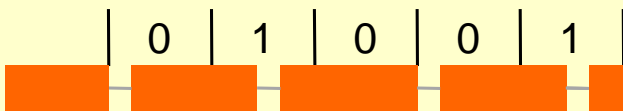Load Modulation
Subcarrier fc/16, 106kbit/s
ASK-Manchester

| 0 | 1 | 0 | 0 | 1 |

Load Modulation
Subcarrier fc/16, 106kbit/s
BPSK-NRZ

| 0 | 1 | 0 | 0 | 1 |

**PCD ➜ PICC
(Downlink)**

ASK 100%
Modified Miller, 106kbit/s
Fieldgap 40 cycles

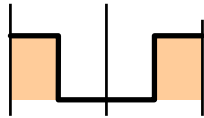| 0 | 1 | 0 | 0 | 1 |

ASK 10%
NRZ, 106kbit/s

| 0 | 1 | 0 | 0 | 1 |
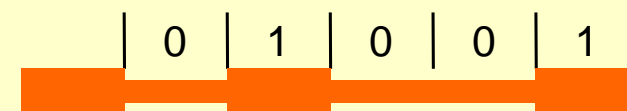
PCD …   Proximity Coupling Device (Reader)
PICC … Proximity Integrated Circuit Card

Technical aspects of interface

	Type A	Type B
Downlink Modulation (PCD to PICC)	100% ASK modified Miller code	10% ASK NRZ code
Signal/noise ratio	Very high (30% noise tol.)	Low (3% noise tolerance)
Uplink Modulation (PICC to PCD)	Load modulation, ASK Manchester code	Load modulation, BPSK NRZ code
Anti Collision	Binary Search method	Time slot method
Product Portfolio	µC and hardwired logic	µC
Speed	no difference between Type A and Type B	
Security	no difference between Type A and Type B	
Power (energy eff.)	no difference between Type A and Type B	
Large scale experience	Extensive; 500M cards, 5M readers components	Limited <30M cards, 20K readers
Interoperability experience (within one project)	Extensive, multi suppliers for cards and readers	Limited, no multiple vendors known

Manchester Coding

data "1" "0"

PCD

Anticollision

Synchronous answer of all PICCs in the field

UID form PICC 1

| 1 | 0 | 1 | 0 | |

UID form PICC 2

| 1 | 0 | 0 | 0 | |

FDT

"1" "0" "1" "0" **PICC 1**

"1" "0" "0" "0" **PICC 2**

"1" "0" "?" "0" **PCD**

S F G #ghwhfw#froolvlrq

PHILIPS
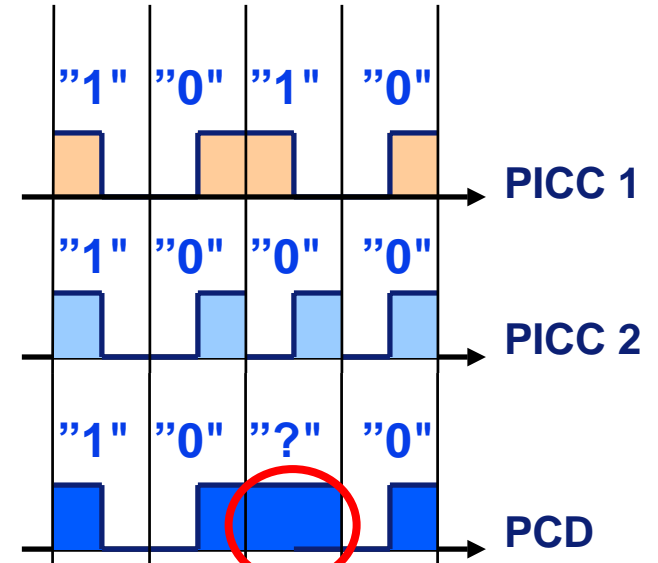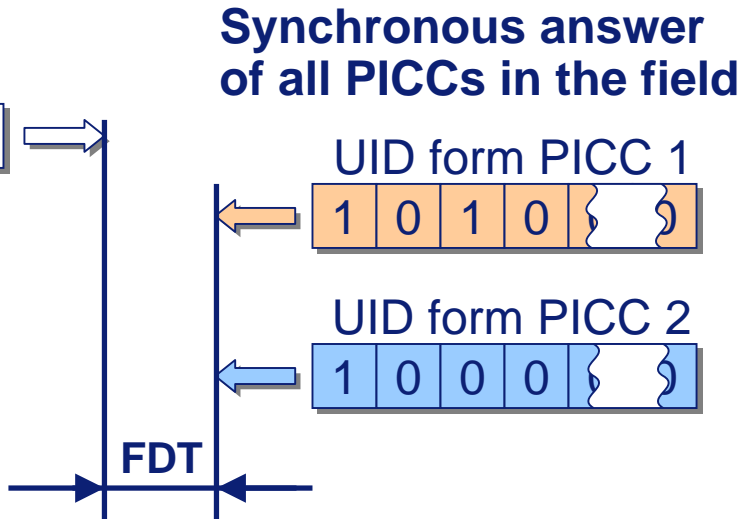
Unique <u>identifier / serial number</u> (UID) is basis for bitwise arbitration ...

Reader (R/W) Device

| Anticollision command | 1xxx…. | 1011xxx... | Select   1011..... |

MIFARE cards

A) 1011.......   1011.......   1011.......

B) 1010.......   1010.......

C) 0101.......

→ time
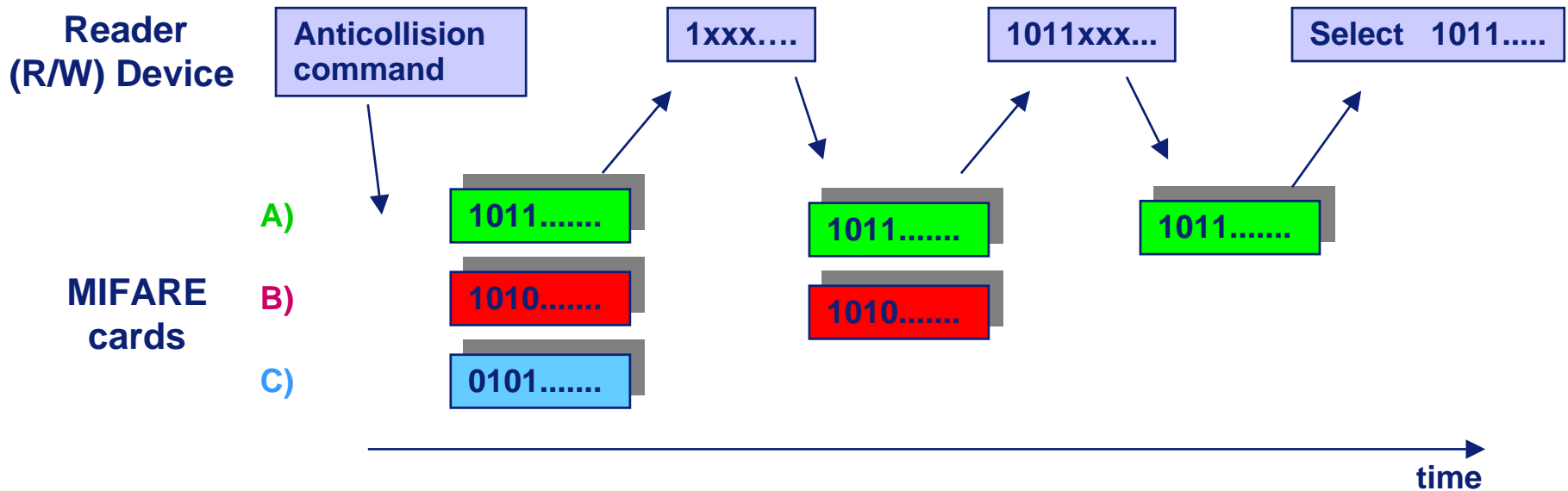
Single remaining (selected) card can be authenticated for R/W operation ...

14443A-3

Type A Card
State Diagram

```
                              ┌─────────────┐
                              │  POWER OFF  │
                              │    State    │
                              └─────────────┘
                                     │
                                Power on Reset
                                     │
                                     ▼
    ┌─────────────┐             ┌─────────────┐
    │    HALT     │             │    IDLE     │
    │    State    │             │    State    │
    └─────────────┘             └─────────────┘
                                     │
              WAKE-UP             REQA Command
              Command                │
                       ╲             ▼
                        ╲      ┌─────────────┐      Anticollision
                         ╲     │   READY     │ ◄──     Loop
                          ╲    │    State    │
                               └─────────────┘
                                     │
                                SELECT Command
      HALT                           │
      Command                        ▼
                               ┌─────────────┐
                               │   ACTIVE    │ ◄──   Application
                               │    State    │
                               └─────────────┘
```

- **Request**
- **Anti-Collision**
- **Select**

Card Activation Sequence flowchart:

- PCD / PICC diagram, ISO 14443-3 A
- **Start** → REQA → PICC
- ATQA ← PICC
- **Bit frame ant collision supported?**
  - NO → Proprietary frames and protocol
  - YES → Anticollision Loop * → PICC; UID + SAK ←
- **SAK bit 6 = 1?**
  - NO → MIFARE® Classic
  - YES → ISO 14443-4 (T=CL)

* see next slide

* The CT (= Cascade Tag, Type A) byte indicates that the UID is not received completely yet. It indicates that another anticollision loop on the next higher cascade level is required to get the complete UID.