

Telecommunications and Information Exchange Between Systems

ISO/IEC JTC 1/SC 6

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Contribution for 14443/NFC Harmonization SC 6 Study Group Meeting

Japan National Body of SC6

2009-03-05

Motivation of Harmonization

- Original intention of 14443 and 18092
 - 14443 was designed for contact-less IC Card, employing inductive coupling communication technology on 13,56 MHz ISM band
 - 18092 (NFCIP-1) was PHY/MAC protocol designed for computer peripherals (including the handsets), employing inductive coupling communication technology on 13,56 MHz ISM band
- New intention of the market
 - Expected to use 14443-2,-3,-4 for Objects in addition to Cards
 - Expected to use 18092 for the Card applications in addition to 18092 peer-to-peer applications
- Overlapping application areas
 - Expected to use existing 14443 and 18092 applications on a mobile handset
- Critical requirements for the overlapping application areas
 - Existing major applications are bound to a single technology
 - 14443-A application
 - 14443-B application
 - 18092-212kbps-passive-mode application
 - And it is very difficult to change the existing applications in the countries/areas, because those are already installed into IT social infrastructure
 - Therefore both full 14443 and full 18092 passive mode compatibility are required in the market
 - And users also expect to use mobile handset all over the world beyond home country

* **PHY**: Physical Layer, **MAC**: Medium Access Control Layer, **ISM**: Industry Science Medical

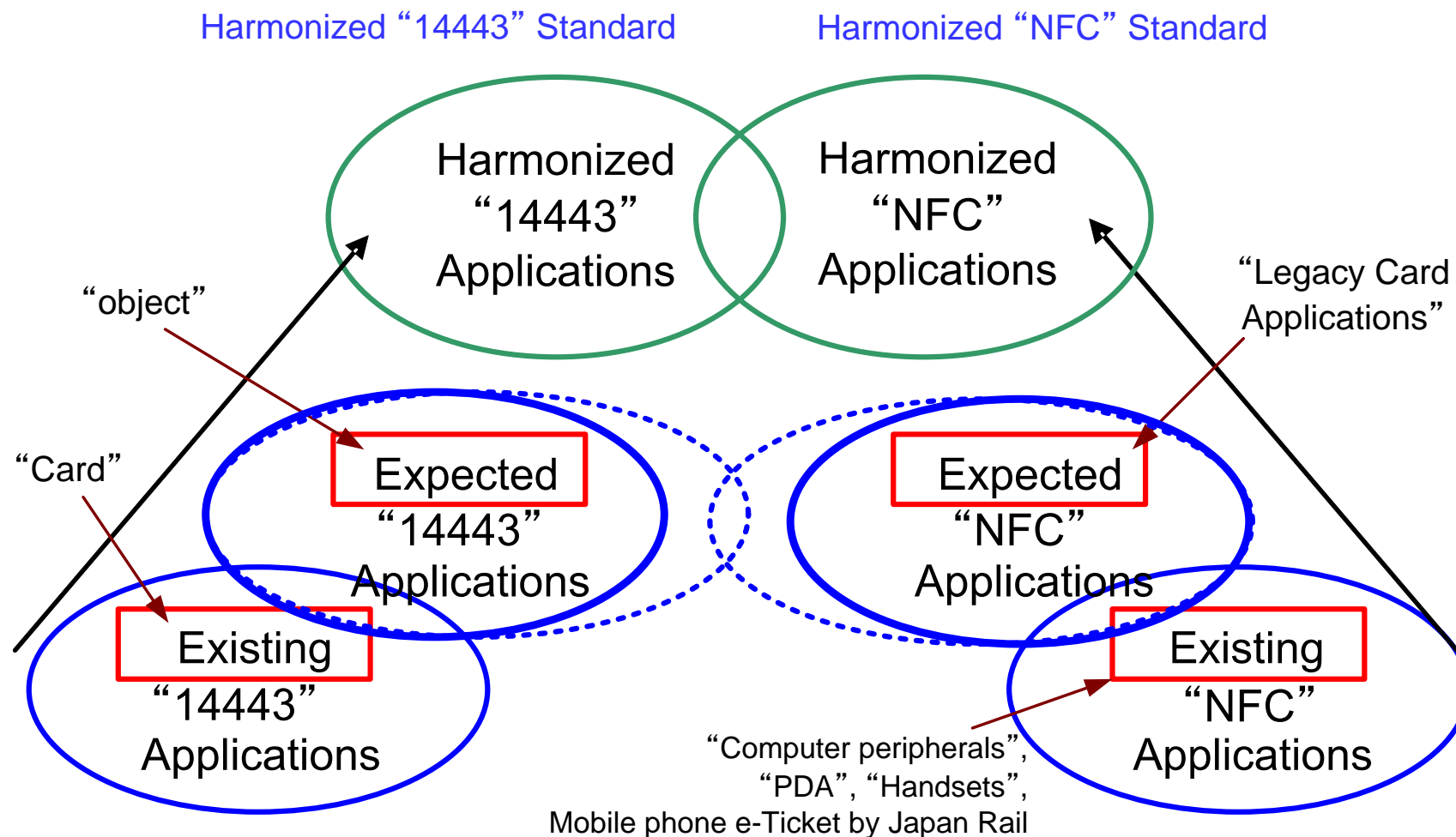
International Standard should:

- **Not give preference to characteristics or requirements of specific countries or regions when different needs or interests exist in other countries or regions**

Overlapping application areas

(Market needs)

Further study on 6N13701



Contactless IC Cards

Inductive coupling communication

International Standard should: Not distort the market

Photos of the commercial examples for **6N13701**:
“National Body Contribution to the Ad Hoc Meeting of
ISO/IEC JTC 1/SC 17 and JTC 1/SC 6 on the
harmonization of the NFC standards and ISO/IEC
14443” of the Annex A



20 August 2008
Rev1: 24 Jan 2009

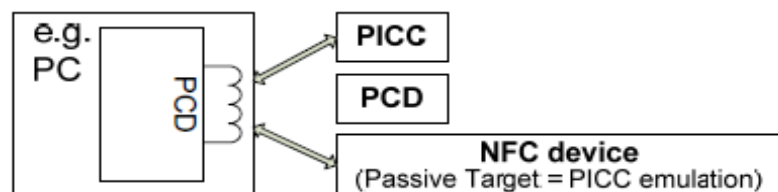


Figure A.3

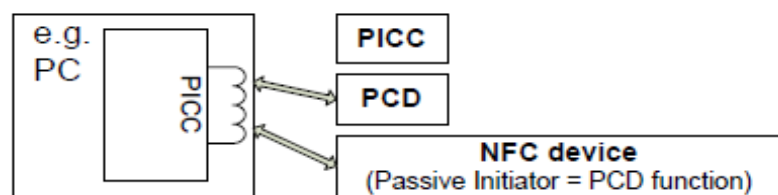
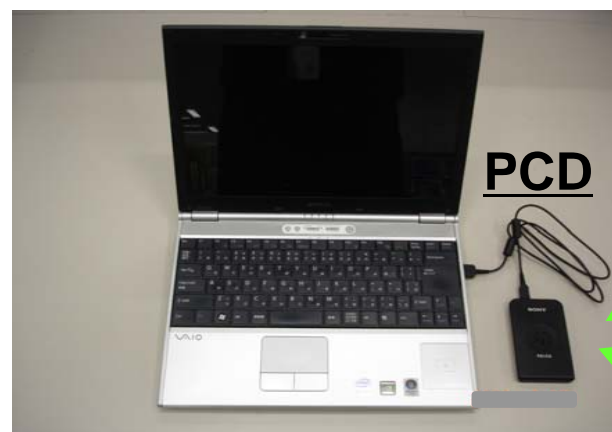


Figure A.3



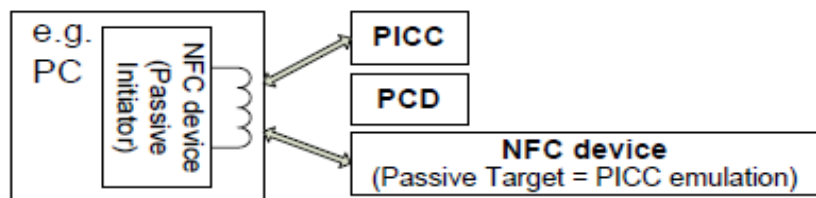


Figure A.4

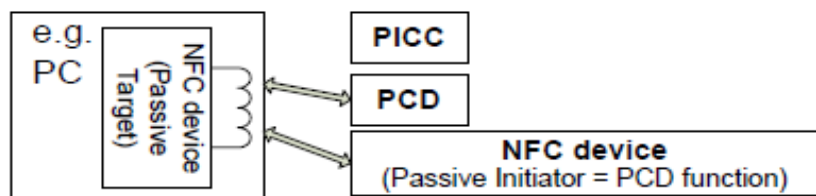


Figure A.4



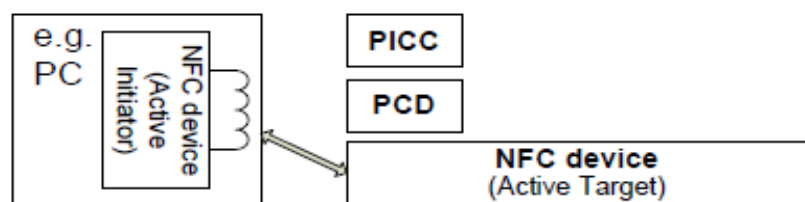


Figure A.5

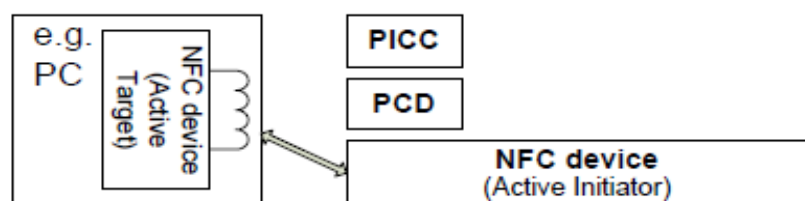
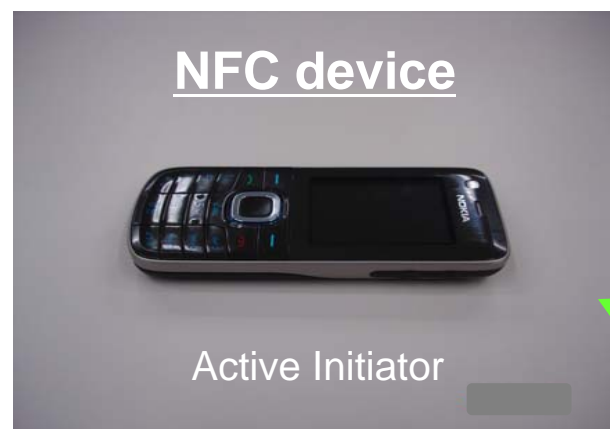
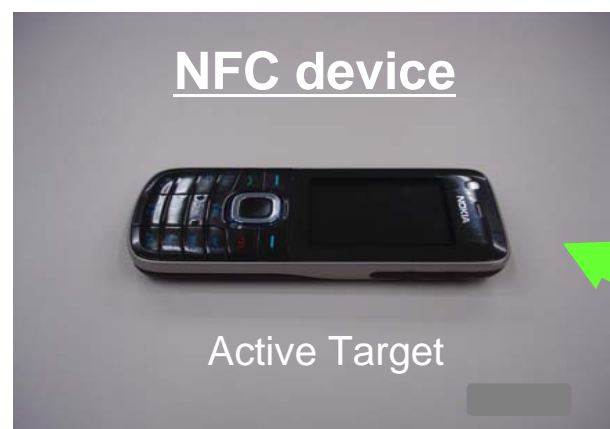


Figure A.5



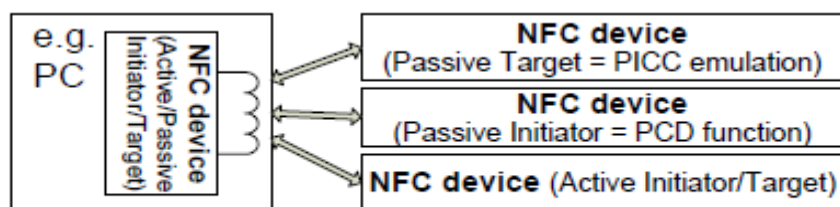
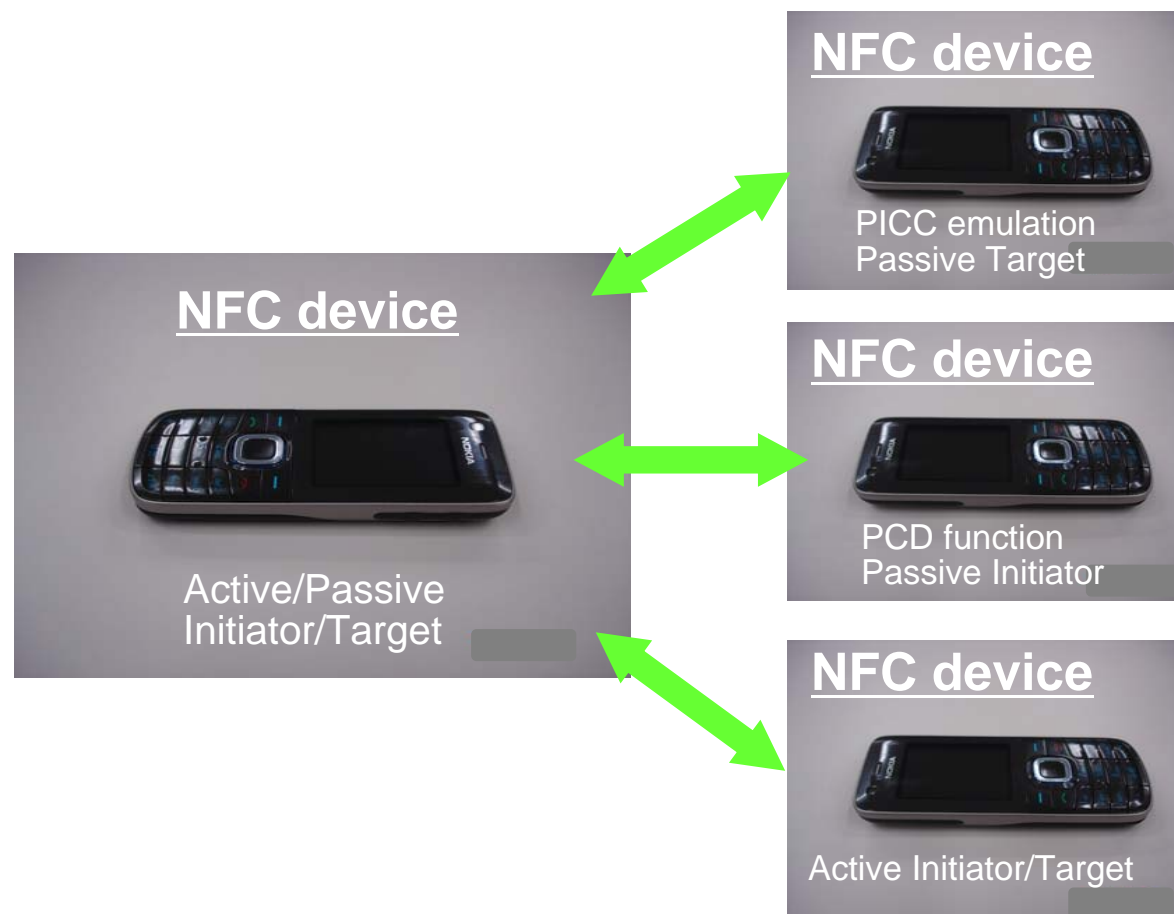


Figure A.6



Overlapping application areas

Market needs (Example use-cases)

- 1 Contactless IC Card Emulation by Handset
- 2 Read and write contactless IC card by Handset
(Contactless IC Card Reader/Writer Emulation by Handset)
- 3 Bi-directional communication between computer peripheral and PICC
- 4 Bi-directional communication between PCD and Handset
(Read and Write Contactless IC Card Reader by Handset)

* The word “Handset” represents computer peripherals, mobile phone, PDA, et cetera.

International Standard should:

- Effectively respond to regulatory and market needs (in the global marketplace)
- Not stifle innovation and technological development

Products/Systems supporting more than one standard developed by manufacturer's effort

- “NXP” released their NFC device; ‘**PN511**’ and ‘**PN531**’ are conformant to ISO/IEC 18092. And NXP also released the NFC chip ‘**PN512**’ that is conformant to ISO/IEC 18092 and ISO/IEC 14443 Type B. “INSIDE Contactless” released their NFC device; ‘**MicroRead**’ is complying with the ISO/IEC 14443 A/B/B’, ISO/IEC 15693, ISO/IEC 18092, NFC forum specifications. “Innovision” released their ‘**Topaz NFC/RFID** Reader Writer IC family’ those are complying with ISO/IEC 14443-2, -3, ISO/IEC 18092 and ISO/IEC 21481.
- Above three companies had developed their specification for integrating 14443 and 18092, so that they can provide 14443/NFC harmonized device as their original implementation. Therefore, interoperability between those 14443/NFC devices is of concern. And a few years later from now, the number of these 14443/NFC devices will be increasing in the global market. The behavior between 14443 and NFC of these 14443/NFC devices may be different, because its specification is originally designed by each company.
- To avoid fragmented and incompatible solutions, a harmonized standard is required. This standard must take into account existing and widely adopted contactless technologies. The vast majority of existing adopted contactless technologies are compatible to either ISO/IEC 14443 or ISO/IEC 18092. A harmonized standard that is backwards compatible with ISO/IEC 14443 and ISO/IEC 18092 will lead to further market growth of the contactless technology. A harmonized standard is required enabling interoperable implementations that are compatible with the existing deployed infrastructure.

International Standard should:

- Not stifle innovation and technological development

(Example)

Existing major applications in Japan

- 14443-A
 - Tobacco card
- 14443-B
 - Basic Resident Register card
 - Driver's License
- 18092-212kbps-passive-mode
 - Japan Rail e-Ticket card
 - Japan Rail mobile e-Ticket infrastructure
 - Interoperable Fare Management System (IFMS) for the public transport infrastructure

International Standard should:

- **Have no adverse effects on fair competition**
- **Respond to scientific and technical developments in various countries**

information exchange and existing application

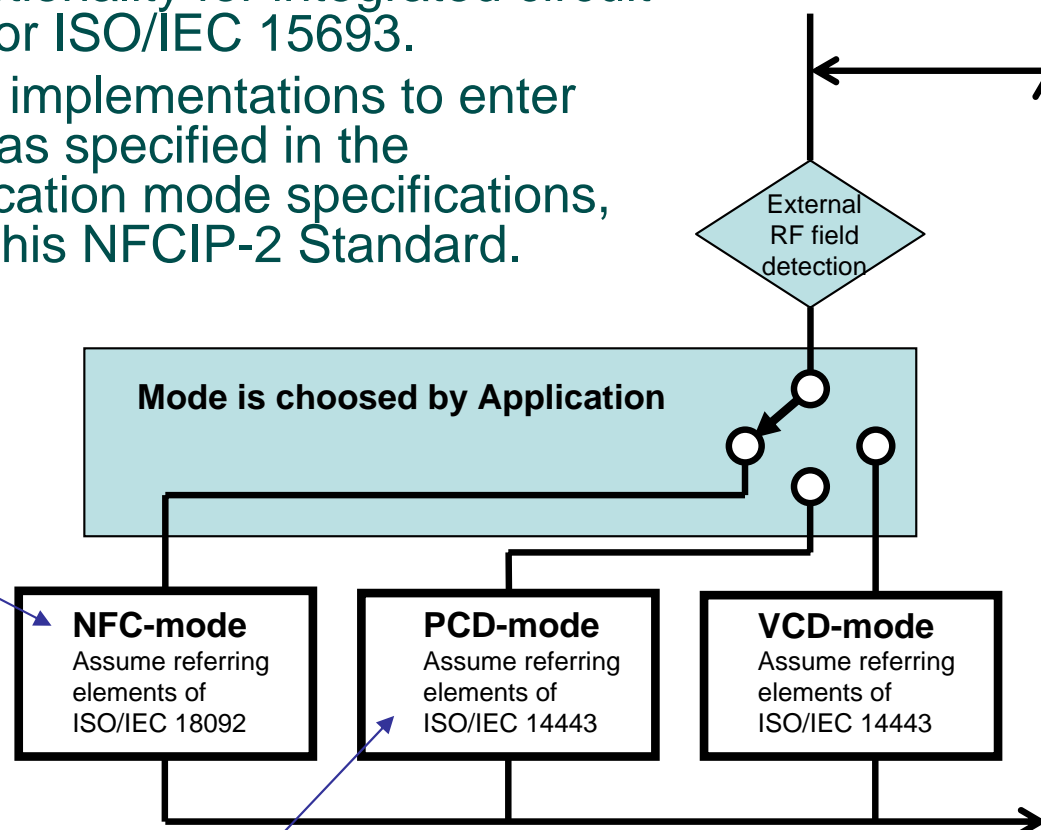
- Information exchange between 18092 and 14443
 - **OK:** between 18092 Device and 14443 PCD
 - If 14443 PCD make a polling by Type A technology then 14443 PCD can detect 18092 Passive Mode Target by 106 kb/s, and information exchange is possible by 106 kb/s.
 - **OK:** between 18092 Device and 14443 Type A PICC
 - If 18092 Passive Initiator make a polling by 106 kb/s technology then 18092 Passive Initiator can detect 14443 Type A PICC, and information exchange is possible by 106 kb/s.
 - **N/A:** between 18092 Device and 14443 Type B PICC (existing application)
- Overlapping applications area (existing application)
 - 18092 does not have 14443 Type B technology
 - 14443 PCD doesn't recognize Coding of 212 kbps and 424 kbps for 18092
- Requires further study
 - Comparison between “18092 Active Communication Mode” and “Power saving mechanism for 14443 PCD although it is not specified”

ISO/IEC 21481 Architecture

- ISO/IEC 21481 (NFCIP-2) specifies the communication mode selection mechanism, designed to not disturb any ongoing communication at 13,56 MHz, for devices implementing ISO/IEC 18092 and the reader functionality for integrated circuit cards compliant to ISO/IEC 14443 or ISO/IEC 15693.
- ISO/IEC 21481 (NFCIP-2) requires implementations to enter the selected communication mode as specified in the respective standard. The communication mode specifications, however, are outside the scope of this NFCIP-2 Standard.

14443 Type B compatibility is not available if the application's control stay inside the NFC-mode.

18092's 212kb/s and 424 kb/s compatibility is not available if the application's control stay inside the 14443 PCD-mode



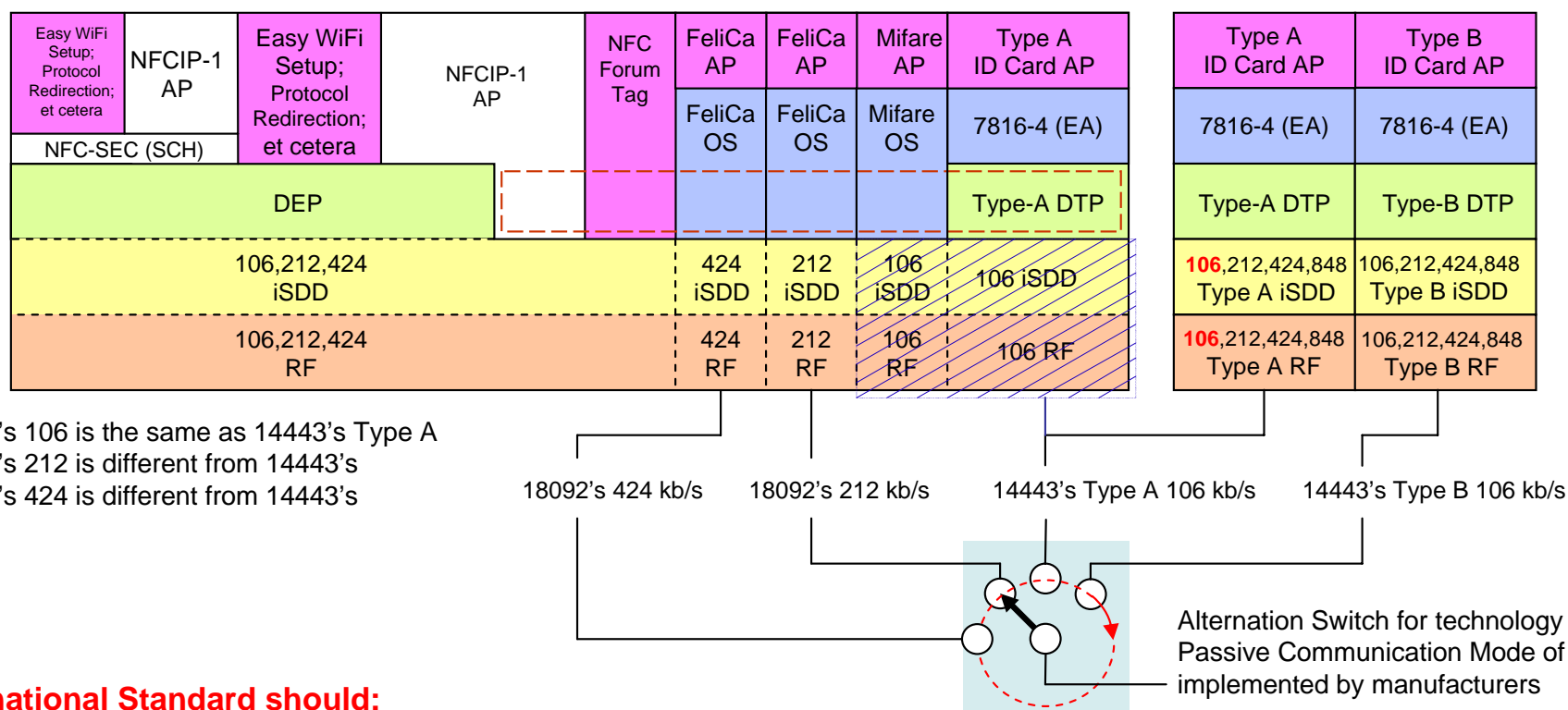
International Standard should:

- Effectively respond to regulatory and market needs (in the global marketplace)
- Be performance based as opposed to design prescriptive

Commercial example of “14443” and “18092 passive communication mode” protocol stack

• Use-case

- Contactless IC Card Emulation by Handset
- NFC Forum Tag emulation by Handset
- Read and write contactless IC card by Handset
- Read and write NFC Forum Tag by Handset



International Standard should:

- Effectively respond to regulatory and market needs (in the global marketplace)

ISO/IEC 21481 (NFCIP-2)

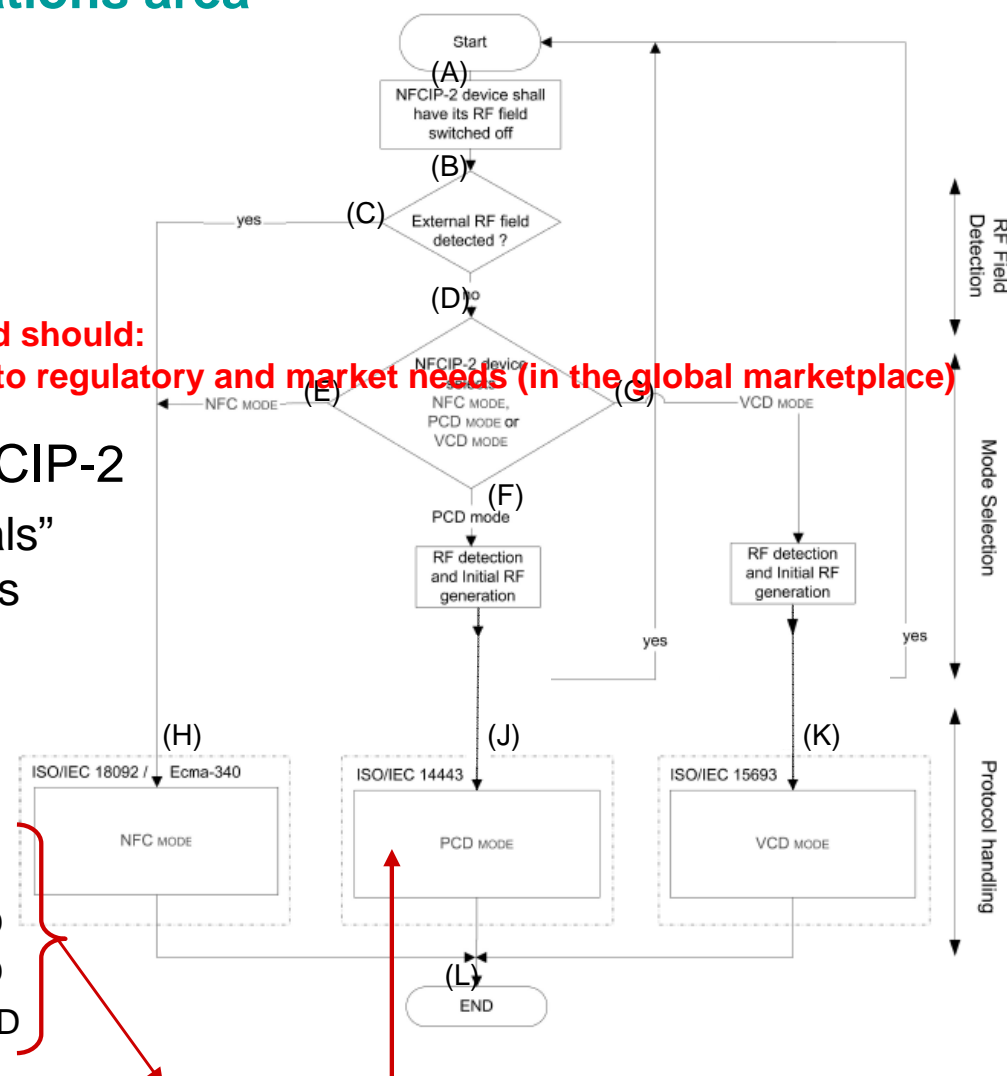
Commercial Example (major implementation in the market)

Solution for the overlapping applications area
using NFCIP-2 architecture
by individual manufacturers

- 3 technologies detection
 - 18092 passive mode 212kb/s polling
 - 14443 Type A polling
 - 14443 Type B polling
- Implementation for polling 3 technologies by NFCIP-2
 - Application defines the “polling order” and “intervals” (e.g. intervals are set to x, y, z; and polling order is “-x- Type A -y- Type B -z- NFC212”)
 - While idle, before detecting a technology, do 1 to 5 repeat 3 to 5 as follows:
 - External RF detection
 - If no External RF then turn the RF detection function off
 - Wait x, then invoke PCD-mode with Type A polling once, and END
 - Wait y, then invoke PCD-mode with Type B polling once, and END
 - Wait z, then invoke NFC-mode with NFC212 polling once, and END
 - If detect a technology then stay in the mode and process a transaction, then END
 - Go to START

International Standard should:

- Effectively respond to regulatory and market needs (in the global marketplace)



This is possible, but Standard specification for PCD-mode to meet the requirements of 15 the marketplace is required.

List of technical points 1/2

(18092 and 14443 common concerns)

- Since 14443 PCD has no external RF detection mechanism, radio interference must be happened
- The RF characteristics of the Handsets with a small antenna is very different from the Card with nominal size of antenna
- Low consumption and longer battery life is a very important feature for the Handsets

International Standard should:

- **Not distort the market**
- **Not stifle innovation and technological development**

List of technical points 2/2

- Standard RF test methods for Handset/ PICC/ PCD used for the overlapping applications area
- ISO/IEC 21481 (NFCIP-2) to meet the requirements of the marketplace
 - External RF Detection for mobile use of 14443 PCD
 - for not disturbing other 13,56 MHz ISM band applications
 - Mechanism of the all technologies detection for the overlapping application areas for 14443 and 18092
 - 14443 Type A of 106 kb/s & 14443 Type B of 106 kb/s
 - 18092 Coding of 106 kb/s, 212 kb/s, 424 kb/s
 - 18092 Coding of 212 kb/s and 424 kb/s are different from 14443

International Standard should:

- **Not distort the market**
- **Not stifle innovation and technological development**

Available ISO/IEC specifications on the harmonization table

- NFC
 - ISO/IEC 18092
 - Information technology — Telecommunications and information exchange between systems — Near Field Communication — Interface and Protocol (NFCIP-1)
 - ISO/IEC 21481
 - Information technology — Telecommunications and information exchange between systems — Near Field Communication Interface and Protocol -2 (NFCIP-2)
 - ISO/IEC 22536
 - Information technology — Telecommunications and information exchange between systems — Near Field Communication Interface and Protocol (NFCIP-1) — RF interface test methods
 - ISO/IEC 23917
 - Information technology — Telecommunications and information exchange between systems — NFCIP-1 — Protocol Test Methods
- 14443
 - ISO/IEC 14443
 - Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 1: Physical characteristics
 - Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 2: Radio frequency power and signal interface
 - Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 3: Initialization and anticollision
 - Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 4: Transmission protocol
 - ISO/IEC 10373-6
 - Identification cards — Test methods — Part 6: Proximity cards

Information technology — Telecommunications and information exchange between systems — Near Field Communication — Interface and Protocol (NFCIP-1)

- 18092:2004
 - This International Standard defines communication modes for Near Field Communication Interface and Protocol (NFCIP-1) using inductive coupled devices operating at the centre frequency of 13,56 MHz for [interconnection of computer peripherals](#). It also defines both the [Active and the Passive communication modes](#) of Near Field Communication Interface and Protocol (NFCIP-1) to realize a [communication network](#) using Near Field Communication devices for networked products and also for consumer equipment. This International Standard specifies, in particular, [modulation schemes, codings, transfer speeds, and frame format of the RF interface, as well as initialization schemes and conditions required for data collision control](#) during initialization. Furthermore, this International Standard defines a [transport protocol](#) including protocol activation and [data exchange methods](#).
 - Information interchange between systems also requires, at a minimum, agreement between the interchange parties upon the interchange codes and the data structure.

**Information technology —
Telecommunications and information exchange between systems —
Near Field Communication Interface and Protocol -2 (NFCIP-2)**

- 21481:2005
 - ISO/IEC 18092, ISO/IEC 14443 and ISO/IEC 15693 standards specify the RF signal interface, initialisation, anti-collision and protocols for wireless interconnection of closely coupled devices and access to contactless integrated circuit cards operating at 13,56 MHz.
 - This International Standard specifies the communication mode selection mechanism, designed to not disturb any ongoing communication at 13,56 MHz, for devices implementing ISO/IEC 18092 and the reader functionality for integrated circuit cards compliant to ISO/IEC 14443 or ISO/IEC 15693. This International Standard requires implementations to enter the selected communication mode as specified in the respective standard. The communication mode specifications, however, are outside the scope of this NFCIP-2 Standard.

Information technology — Telecommunications and information exchange between systems — Near Field Communication Interface and Protocol (NFCIP-1) — RF interface test methods

- **22536:2005**
 - This International Standard is part of a suite of standards that specify tests for ISO/IEC 18092. It defines test methods for the RF-interface. This International Standard specifies RF-test methods for NFC devices with antennas fitting within the rectangular area of 85 mm by 54 mm.
 - This test standard, the first of two parts, specifies compliance tests for the RF interface of ISO/IEC 18092 devices. The companion test standard specifies protocol tests for ISO/IEC 18092.
 - Ecma purposefully aligned this International Standard with ISO/IEC 10373-6 to allow testing laboratories to reuse equipment and expertise.

Information technology — Telecommunications and information exchange between systems — NFCIP-1 — Protocol Test Methods

- **23917:2005**
 - This International Standard specifies protocol test methods for ISO/IEC 18092 in addition to those specified in ISO/IEC 22536.

Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 1: Physical characteristics

- 14443-1:2000
 - This part of ISO/IEC 14443 specifies the physical characteristics of proximity cards (PICC). It applies to identification cards of the card type ID-1 operating in proximity of a coupling device.
 - This part of ISO/IEC 14443 shall be used in conjunction with later parts of ISO/IEC 14443.
- 14443-1:2008
 - This part of ISO/IEC 14443 defines the physical characteristics of proximity cards (PICCs).
 - It is to be used in conjunction with other parts of ISO/IEC 14443.

Identification cards — Contactless integrated circuit(s) cards — Proximity cards —

Part 2: Radio frequency power and signal interface

- 14443-2:2001
 - This part of ISO/IEC 14443 specifies the characteristics of the fields to be provided for power and bi-directional communication between proximity coupling devices (PCDs) and proximity cards (PICCs).
 - This part of ISO/IEC 14443 **is intended to be used in conjunction with** other parts of ISO/IEC 14443.
 - This part of ISO/IEC 14443 does not specify the means of generating coupling fields, nor the means of compliance with electromagnetic radiation and human exposure regulations which can vary according to country.
- CD 14443-2R3:2008
 - This part of ISO/IEC 14443 specifies the characteristics of the fields to be provided for power and bidirectional communication between proximity coupling devices (PCDs) and proximity cards (PICCs).
 - This part of ISO/IEC 14443 **shall be used in conjunction with** other parts of ISO/IEC 14443.
 - This part of ISO/IEC 14443 does not specify the means of generating coupling fields, nor the means of compliance with electromagnetic radiation and human exposure regulations which can vary according to country.

Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 3: Initialization and anticollision

- 14443-3:2001
 - This part of ISO/IEC 14443 describes:
 - polling for proximity cards (PICCs) entering the field of a proximity coupling device (PCD);
 - the byte format, the frames and timing used during the initial phase of communication between PCDs and PICCs;
 - the initial Request and Answer to Request command content;
 - methods to detect and communicate with one PICC among several PICCs (anticollision);
 - other parameters required to initialize communications between a PICC and PCD;
 - optional means to ease and speed up the selection of one PICC among several PICCs based on application criteria.
 - Protocol and commands used by higher layers and by applications and which are used after the initial phase are described in ISO/IEC 14443-4.
 - This part of ISO/IEC 14443 is applicable to PICCs of Type A and of Type B (as described in ISO/IEC 14443-2).
 - NOTE Part of the timing of data communication is defined in ISO/IEC 14443-2.
- CD 14443-3R3:2008
 - This part of ISO/IEC 14443 describes:
 - polling for proximity cards (PICCs) entering the field of a proximity coupling device (PCD);
 - the byte format, the frames and timing used during the initial phase of communication between PCDs and PICCs;
 - the initial Request and Answer to Request command content;
 - methods to detect and communicate with one PICC among several PICCs (anticollision);
 - other parameters required to initialize communications between a PICC and PCD;
 - optional means to ease and speed up the selection of one PICC among several PICCs based on application criteria.
 - Protocol and commands used by higher layers and by applications and which are used after the initial phase are described in ISO/IEC 14443-4.
 - This part of ISO/IEC 14443 is applicable to PICCs of Type A and of Type B (as described in ISO/IEC 14443-2).
 - NOTE 1 Part of the timing of data communication is defined in ISO/IEC 14443-2.
 - NOTE 2 Test methods for this standard are defined in ISO/IEC 10373-6.

Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 4: Transmission protocol

- 14443-4:2001
 - This part of ISO/IEC 14443 specifies a half-duplex block transmission protocol featuring the special needs of a contactless environment and defines the activation and deactivation sequence of the protocol.
 - This part of ISO/IEC 14443 is intended to be used in conjunction with other parts of ISO/IEC 14443 and is applicable to proximity cards of Type A and Type B.
- 14443-4:2008
 - This part of ISO/IEC 14443 specifies a half-duplex block transmission protocol featuring the special needs of a contactless environment and defines the activation and deactivation sequence of the protocol.
 - This part of ISO/IEC 14443 is intended to be used in conjunction with other parts of ISO/IEC 14443 and is applicable to proximity cards **or objects of** Type A and Type B.

Identification cards — Test methods —

Part 6: Proximity cards

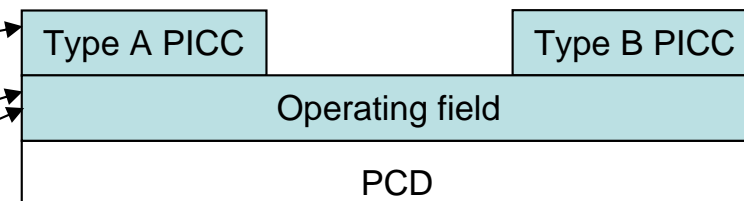
- 2nd CD 10373-6:2008 (17n3628)
 - This International Standard defines test methods for characteristics of identification cards according to the definition given in ISO/IEC 7810. Each test method is cross-referenced to one or more base standards, which may be ISO/IEC 7810 or one or more of the supplementary standards that define the information storage technologies employed in identification cards applications.
 - NOTE 1 Criteria for acceptability do not form part of this International Standard but will be found in the International Standards mentioned above.
 - NOTE 2 Test methods described in this International Standard are intended to be performed separately. A given card is not required to pass through all the tests sequentially.
 - This part of ISO/IEC 10373 deals with test methods which are specific to contactless integrated circuit(s) card technology (Proximity cards). Part 1 of the standard, General characteristics, deals with test methods which are common to one or more ICC technologies and other parts deal with other technology-specific tests.
 - Unless otherwise specified, the tests in this part of ISO/IEC 10373 shall be applied exclusively to Proximity cards defined in ISO/IEC 14443-1, ISO/IEC 14443-2, ISO/IEC 14443-3 and ISO/IEC 14443-4.

Difference of Scope

- ISO/IEC 14443

- Scope

- Type A PICC and Type B PICC
 - Communication protocol between PICC and PCD
 - Characteristics of the fields to be provided for power



- Elements of specification

- Power and communication protocol between PCD and two type of PICCs
 - Polling, byte format, the frames and timing used during the initial phase of communication between PCDs and PICCs; the initial Request and Answer to Request command content; anticollision; initialize communications between a PICC and PCD; speed up the selection of one PICC among several PICCs based on application criteria.
 - A half-duplex block transmission protocol.

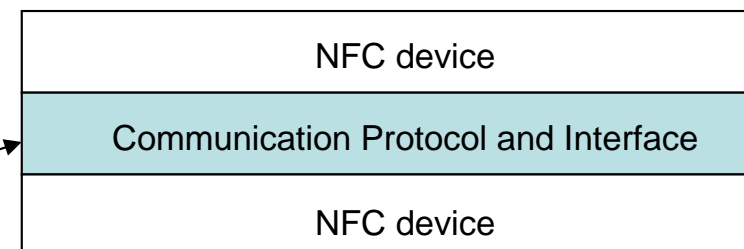
- ISO/IEC 18092

- Scope

- Communication protocol and interface for computer peripherals; networked products; consumer equipment

- Elements of specification

- Inductive coupled (Active and Passive) communication mode at the 13,56 MHz for interconnection
 - modulation schemes, codings, transfer speeds, and frame format of the RF interface; initialization schemes and conditions required for data collision control during initialization.
 - A transport protocol including protocol activation and data exchange methods.



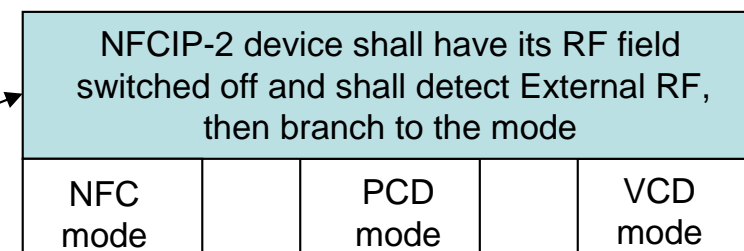
- The white paper (Ecma/TC32TG19/2005/012) introduces:

- Transfer of content
 - Set up of communication for other protocols

- ISO/IEC 21481

- Scope

- Communication mode selection mechanism for NFCIP-1, 14443PCD, 15693VCD



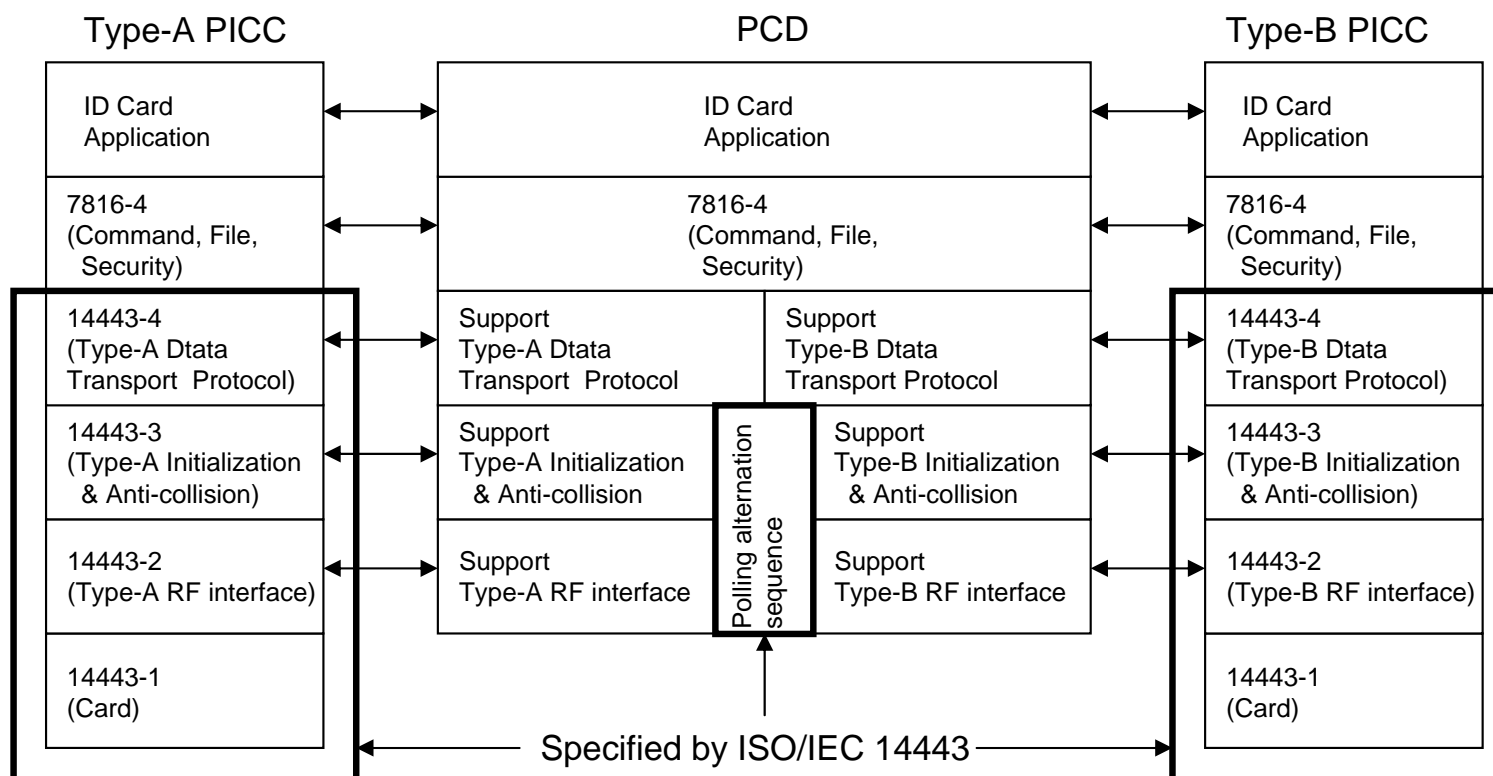
- Elements of specification

- Listen before talk mechanism for PCD mode and VCD mode

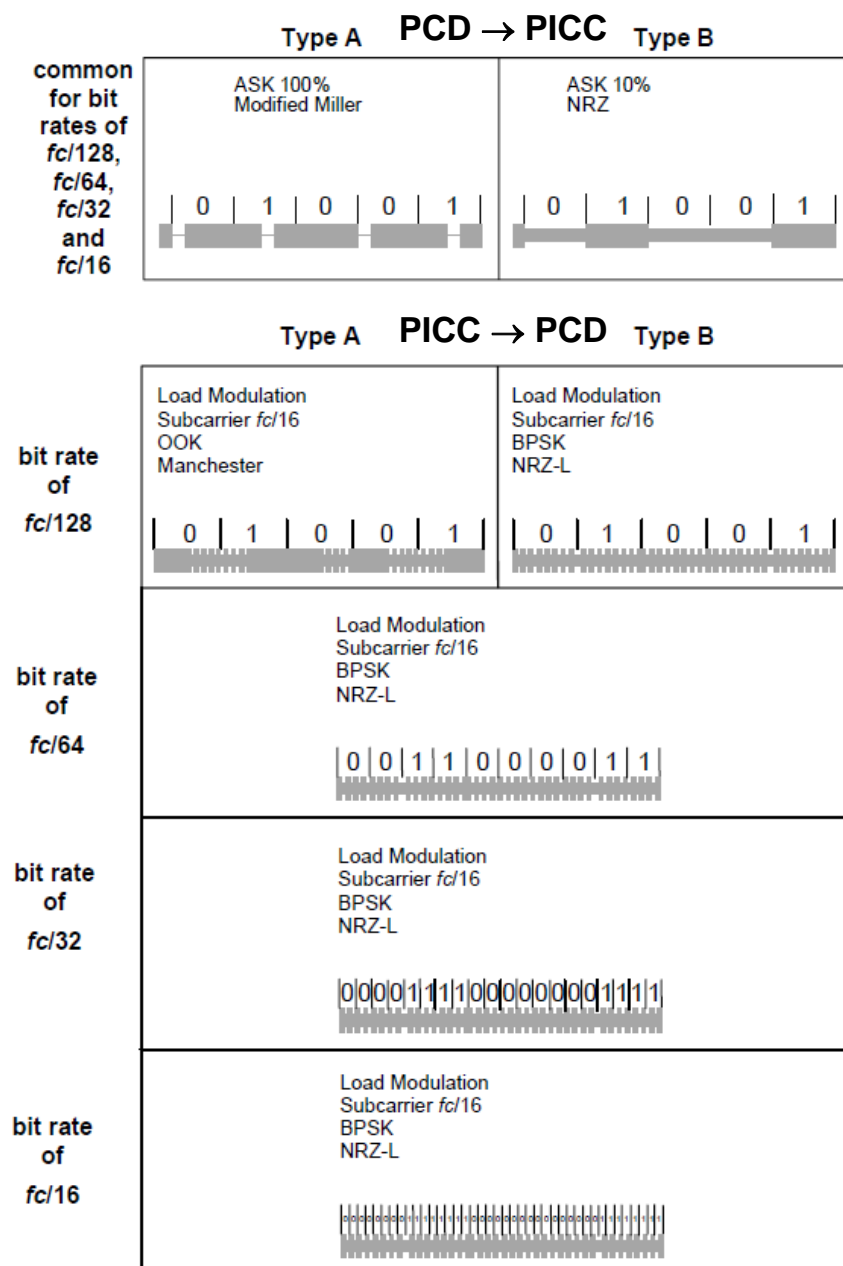
14443 protocol stack

- 14443 Part 1 to Part 4 specify “Contactless Proximity IC cards (PICC)”
- 14443 Part 2 to Part 4 shall be used in conjunction with other Part
 - Completely different Type-A and Type-B of PICC (single technology A or B)
 - Data rate is 106 kbps for both type of initialization and anti-collision
 - Beyond 106 kbps, bit coding for PICC to PCD is only Type-B
 - Higher data rate is negotiated on 14443-4
- 14443-2,-3 slightly mentions about PCD
 - Type A and B for every data rate for PCD
 - Polling alternate technology between Type A and B
- PCD specification is not available

PCD specification is not contained in 14443, but indirectly via the test methods for PCDs in 10373-6.



3rd CD 14443-2 specification



- PCD → PICC
 - Type A and Type B signal interfaces
 - PCD alternate between A and B before detecting a PICC
 - Anti-collision shall be 106 kb/s
 - Higher Bit-rate negotiate on 14443-4
 - No external RF detection
 - No small antenna test methods
 - No power saving specification for PCD
- PICC → PCD
 - 106 kb/s of data rate
 - Bit coding is Type A & B
 - Initialization & Anti-collision is Type A & B
 - Data Transport Protocol is Type A & B
 - Beyond 106 kb/s of data rate
 - Bit coding is only Type B
 - Initialization & Anti-collision is Type A & B
 - Data Transport Protocol is Type A & B

Commercial example of 18092 protocol stack

Passive Communication Mode

- Use-case
 - Contactless IC Card Emulation by Handset
 - Read and write contactless IC card by Handset
 - NFC Forum Tag emulation, and Reader/Writer emulation
 - Easy WiFi setup, Protocol Redirection, et cetera
- 18092 specifics
 - One coding system for one data rate
 - Coding of 106 kb/s is Mifare compatible technology
 - Coding of 212 kb/s and 424 kb/s are JIS X 6319-4 compatible technology
 - The switching mechanism between Initiator and Target
 - Only Initiator generates RF
 - RF is not switched off after sending a command every time

Communication Mode

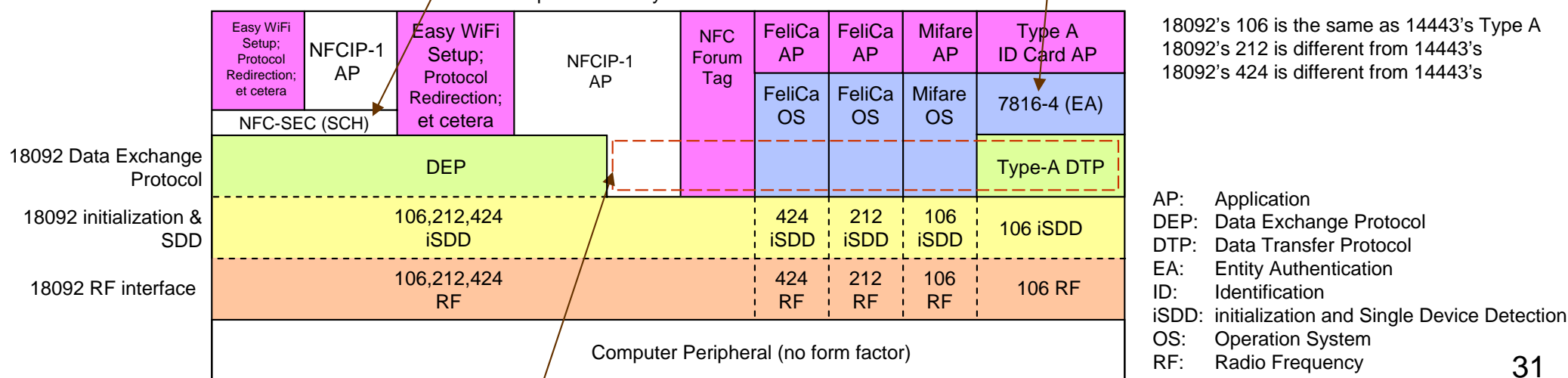
- NFCIP-1 device shall detect external RF at first
- NFCIP-1 device shall be Target-role as the first behavior
- Turn to Initiator-role by application's demand
- If Initiator send ATR_REQ and RF-off then **Active Mode**
- If Initiator send ATR_REQ and keep RF-on then **Passive Mode**

These are completely different use-case.

NFC-SEC provides two services:

1. Secure Channel
2. Shared Secure
3. Does not provide "Entity Authentication"

ISO/IEC 7816-4 specifies security mechanism for ID Card:
7816 specifies Entity Authentication



The proprietary protocol that is specified by 18092 General Protocol Flow

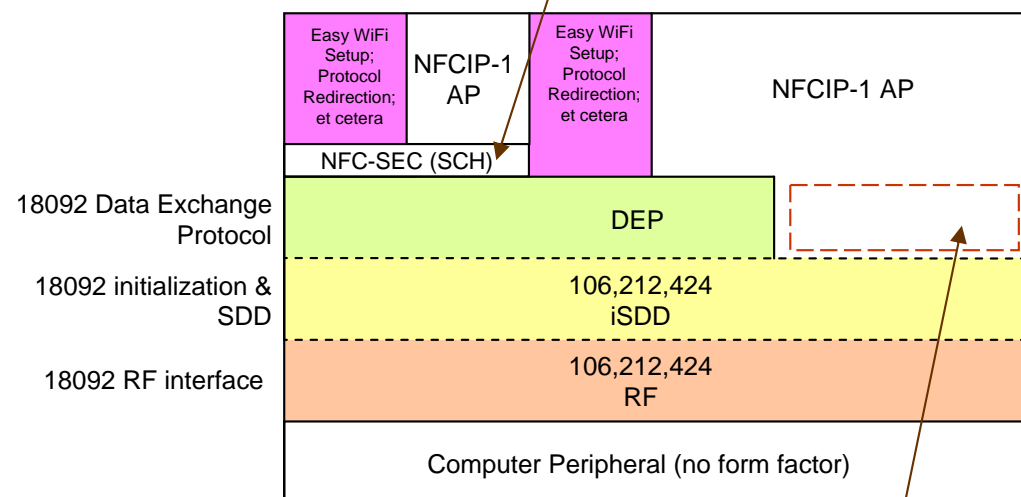
Commercial example of 18092 protocol stack

• Active Communication Mode

- Use-case
 - Small data exchange
 - Easy WiFi setup, Protocol Redirection, et cetera
- 18092 specifies
 - One coding system for one data rate
 - Coding of 106 kb/s is Mifare compatible technology
 - Coding of 212 kb/s and 424 kb/s are JIS X 6319-4 compatible technology
 - The switching mechanism between Initiator and Target
 - Both Initiator and Target generate RF
 - RF is switched off after sending a command every time

NFC-SEC provides two services:

1. Secure Channel
2. Shared Secure
3. Does not provide “Entity Authentication”



Communication Mode

- NFCIP-1 device shall detect external RF at first
- NFCIP-1 device shall be Target-role as the first behavior
- Turn to Initiator-role by application's demand
- If Initiator send ATR_REQ and RF-off then **Active Mode**
- If Initiator send ATR_REQ and keep RF-on then **Passive Mode**

AP: Application
 DEP: Data Exchange Protocol
 DTP: Data Transfer Protocol
 EA: Entity Authentication
 ID: Identification
 iSDD: initialization and Single Device Detection
 OS: Operation System
 RF: Radio Frequency

The proprietary protocol that is specified by 18092 General Protocol Flow

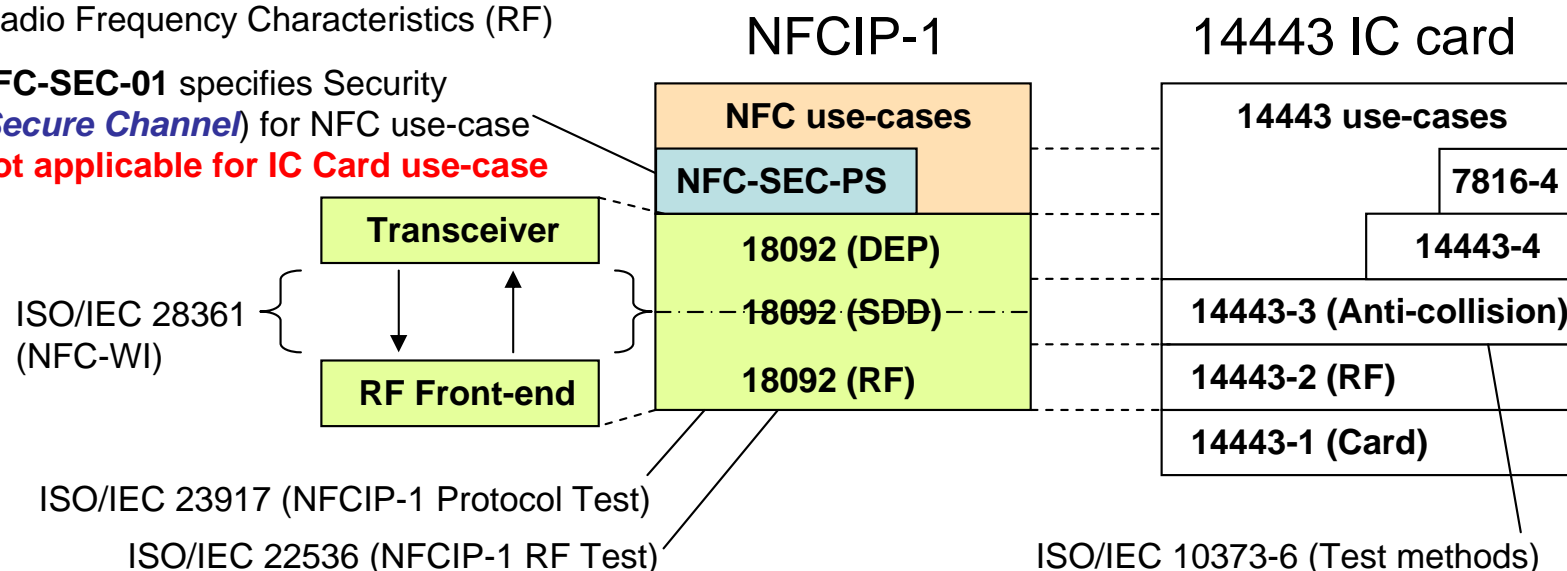
NFC/14443 layer comparison

• ISO/IEC 18092:2004, clause 10

- The General Protocol flow between NFCIP-1 devices shall be conducted through the following consecutive operations:
 - Any NFCIP-1 device shall per default be in Target mode.
 - When in Target mode, it shall not generate an RF field, and shall wait silently for a command from the Initiator.
 - The NFCIP-1 device may switch to Initiator mode only if required by the application.
 - The application shall determine either Active or Passive communication mode and transfer speed.
 - Initiator shall test for external RF field present and shall not activate its RF field if an external RF field is detected. See clause 8.3.
 - If an external RF field is not detected, the Initiator shall activate its RF field.
 - The Target shall be activated by the RF field of the Initiator.
 - Transmission of a command by the Initiator either in the Active communication mode or in the Passive communication mode at a selected transfer speed.
 - Transmission of a response by the Target either in the Active communication mode or in the Passive communication mode. The communication mode and the transfer speed shall be the same as the Initiator communication mode and the transfer speed.

Data Exchange Protocol (DEP)
Single Device Detection (SDD)
Radio Frequency Characteristics (RF)

NFC-SEC-01 specifies Security
(*Secure Channel*) for NFC use-case
Not applicable for IC Card use-case



• ISO/IEC 14443-2:2001, clause 7

- The PCD shall alternate between modulation methods when idling before detecting the presence of a PICC of Type A or Type B.
- Only one communication signal interface may be active during a communication session until deactivation by the PCD or removal of the PICC. Subsequent session(s) may then proceed with either modulation method.

14443-1 Physical characteristics

14443-2 Radio frequency power and signal interface

14443-3 Initialization and anticollision

14443-4 Transmission protocol

7816-4 title is

"IC cards with contacts Interindustry commands for interchange"

7816-4 specifies Security (*Entity Authentication*) for ID Card