

NFC Multi Protocol for Interoperability
Version 1.0
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1 Introduction

1.1 Purpose of the document

This document makes recommendations to handset manufacturers and to Proximity Coupling Device (PCD) manufacturers to ensure their interoperability.

The Near Field Communications (NFC) paradigm is built upon the multi-application concept. The NFC mobile handset and UICC combination needs to be compliant with several infrastructures (e.g. payment, access control, public transportation, etc.) whereas a contactless card is compliant with only a single infrastructure.

ISO/IEC 14443 [2], [3], [4] standards are composed of a set of parameters and options. The main objective of this document is to define a configuration in line with these standards that allows the Universal Integrated Circuit Card (UICC) to host all types of data and applications (e.g. Mifare Classic, Mifare DESFire, payment applications compatible with EMVCo, all standard TYPE A and B applications).

Note that standard TYPE A application is an application that is addressable by a PCD using ISO/IEC 14443-4 TYPE A protocol. The same way, a TYPE B application is addressable using ISO/IEC 14443-4 TYPE B protocol.

This document sets out requirements for the PCD that interacts with the NFC handset and the UICC.

It also attempts to align and harmonise the co-existence of different contactless technologies on one platform in an evolving eco-system. With this first version, the proposed Radio Frequency (RF) protocol parameters are more restrictive than may be necessary. This is done intentionally in order to ensure that initial implementations work correctly.

1.2 Scope

This document is limited to the card emulation mode and peer-to-peer mode of contactless interaction.

This document does NOT define any new parameter that is not compliant with ISO 14443 standards.

This document is built upon the objective that usage of NFC compatible devices shall be as simple as possible for the end user. All contactless services that this latter has subscribed to shall be compatible. No activation/deactivation operations due to contactless parameters conflict is requested to the user. This hypothesis leads to make the decision to exclude, for this version of the document, the compatibility with some deployed technologies (e.g.: Mifare 4bytes UID length). Please refer to Table 2 for a complete description of targeted protocols.

1.3 Definition of Terms

Term	Description
1K or 4K	1K or 4K bytes for Mifare Classic
AFI	Application Family Identifier.

AFSCM	Association Française du Sans Contact Mobile
ADC	Application Data Coding
ATQA	Answer To reQuest, TYPE A
ATQB	Answer To reQuest, TYPE B
ATS	Answer To Select, TYPE A
ATTRIB	PICC Selection Command, TYPE B
CID	Card Identifier
CLF	Contactless Front End
CRC	Cycling Redundancy Check
DR	Divisor Receive (PCD to PICC)
DS	Divisor Send (PICC to PCD)
EOF	End Of Frame
FO	Frame Option
FSCI	Frame Size for proximity Card Integer
FSD	Frame Size for proximity coupling Device
FSDI	Frame Size for proximity coupling Device Integer
FWI	Frame Waiting time Integer
GP	GlobalPlatform
LSB	Least Significant Bit
MBLI	Maximum Buffer Length Index
MNO	Mobile Network Operator
MS	Mobile Station
MSB	Most Significant Bit
NA	Not Applicable
NAD	Node Address
NFC	Near Field Communication
OS	Operating System
P2P	Peer To Peer
PCD	Proximity Coupling Device
PICC	Proximity Integrated Circuit Card
PPS	Protocol and Parameter Selection
RATS	Request for Answer to Select, TYPE A
REQA	REQuest command, TYPE A
REQB	REQuest command TYPE B
RF	Radio Frequency
RFU	Reserved for Future Use ISO/IEC
SAK	Select AcKnowledge, TYPE A
SFGI	Start-up Frame Guard time Integer
SFGT	Start-up Frame Guard Time

SOF	Start Of Frame
S(WTX)	S-block request for Waiting Time Extension
T=CL	Transport layer protocol = Contact Less; defined in ISO/IEC 14443-4
T0	Header Byte, TYPE A
TA(1)	ATS : First byte Interface Character, TYPE A
TB(1)	ATS : Second byte Interface Character, TYPE A
TC(1)	ATS : Third byte Interface Character, TYPE A
TR2	Timing before PCD Start-of-Frame
UICC	Universal Integrated Circuit Card (usually known as SIM card)
UID	Unique Identifier
UID0	Unique Identifier byte 0

1.4 Document Cross-References

Ref	Title	Document Reference	Version
[1]	NFCForum-TS-DigitalProtocol-1.0	Digital 1.0 (17 November 2010)	1.0
[2]	ISO/IEC 14443-2	ISO/IEC 14443-2 (2010)	2010
[3]	ISO/IEC 14443-3	ISO/IEC 14443-3 (2011)	2011
[4]	ISO/IEC 14443-4	ISO/IEC 14443-4 (2008)	2008
[5]	ETSI TS 102 622	ETSI TS 102 622 Release 9	v9.4.0
[6]	MIFARE ISO/IEC 14443 PICC Selection	NXP AN 10834 (26 June 2009)	Revision 3.0
[7]	MIFARE Type Identification Procedure	NXP AN10833 (29 August 2011)	Revision 3.2
[8]	GlobalPlatform Card Specification V2.2 Amendment C	GPC_SPE_025 (February 2012)	v1.0.1
[9]	EMVCo specifications	EMV Contactless Communication Protocol Specification	V2.1
[10]	ISO/IEC 14443-2	ISO/IEC: Amendment 2	2011
[11]	EMVCo handset requirements	EMVCo Handset Requirements for Contactless Mobile Payment:	Version1.0 (June 2010)
[12]	EMVCo Test Equipment Specifications	Level 1 Test Equipment Specifications - PICC Manual, PCD Manual, CMR Manual, Gerber Files	v2.0

2 Technical Backgrounds

2.1 Supported technologies

The handset shall be compliant with all the following RF protocols without any action from the end user (no switch between two configurations/applications by the user):

ISO14443-3: Mifare Classic 1K, 4K

ISO14443-4: TYPE A (including Mifare DESFire EV1),

ISO 14443-4 TYPE B

2.2 Initialization and anti - collision

Both TYPE A (including Mifare Classic and Mifare DESFire) and TYPE B products shall support initialization and anti-collision as defined by ISO/IEC 14443-3.

2.3 Supported configurations

For TYPE A, the default contactless profile of the UICC (or any other Secure Element) is the profile compliant with EMVCo requirements (cf §3.1.2.2).

Further, some MNOs may wish to support Mifare Classic and Mifare DESFire applications. In that case the UICC shall support one of the following configurations:

EMVCo + Mifare DESFire EV1

EMVCo + Mifare classic 1K and 4K

EMVCo + Mifare Classic 1K/4K + Mifare DESFire EV1

For more details, please refer to §3.1.2.2

For TYPE B, there shall be one and only one configuration whatever are the activated applications on the UICC. . This configuration is compliant with EMVCo recommendations and all fully standard applications (e.g.: Calypso release 3.1).

2.4 PCD-handset Interface

2.4.1 Polling

In order to detect the handset, and the UICC that holds card emulation applications, a PCD shall send repeated Request Commands. :REQA and REQB.

The REQA or REQB has to be sent only after the carrier is switched off and on; waiting time before starting the transmission is at least equal to 5 milliseconds.

The minimum required time between a REQA and a REQB or REQB and REQA is 5 milliseconds.

The PCD must stop the communication protocol, if no associated application is answering…

Please refer to standards ISO/IEC 14443-3 and ISO/IEC 14443-4 for more information

2.4.2 Sequence chart of 14443-4 TYPE A

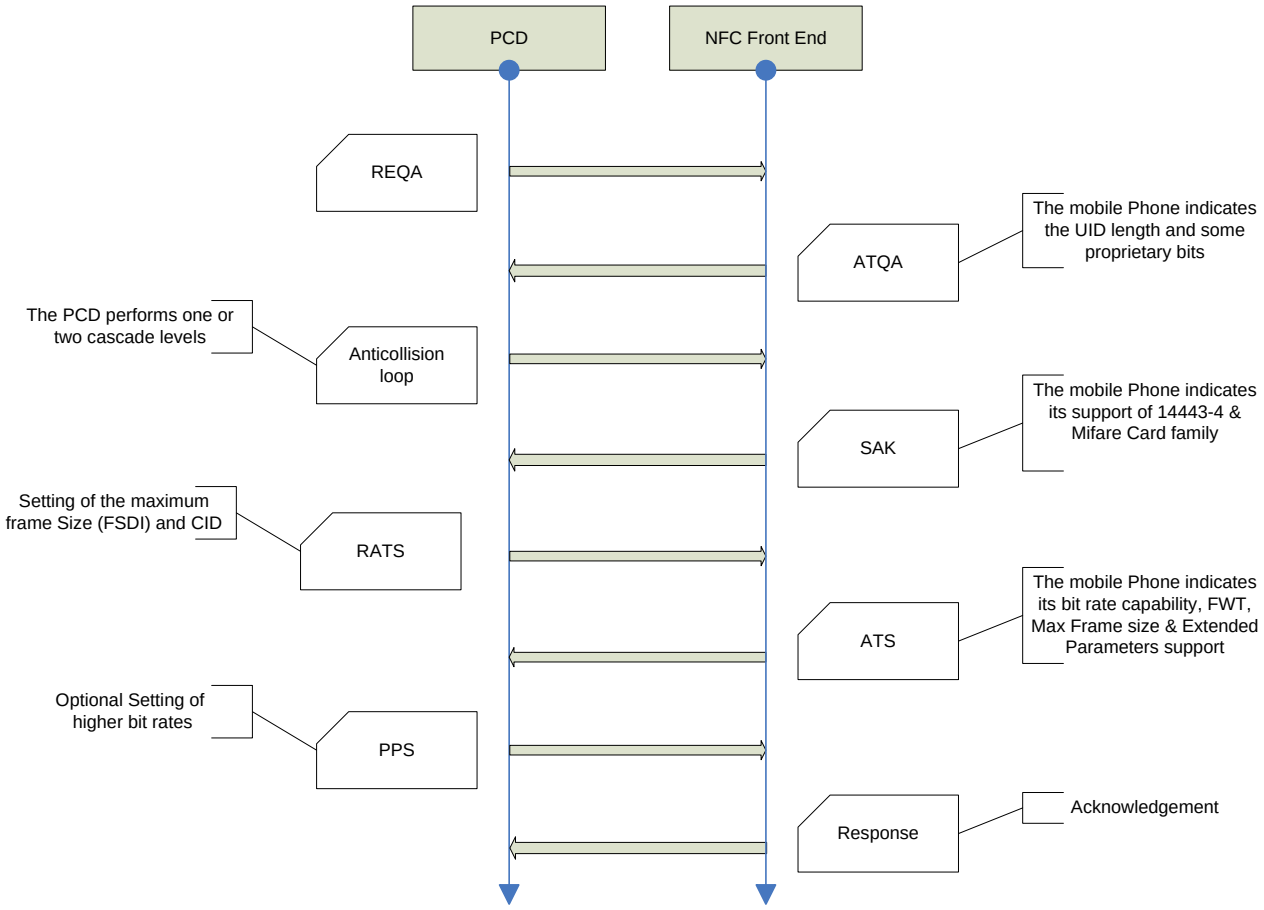
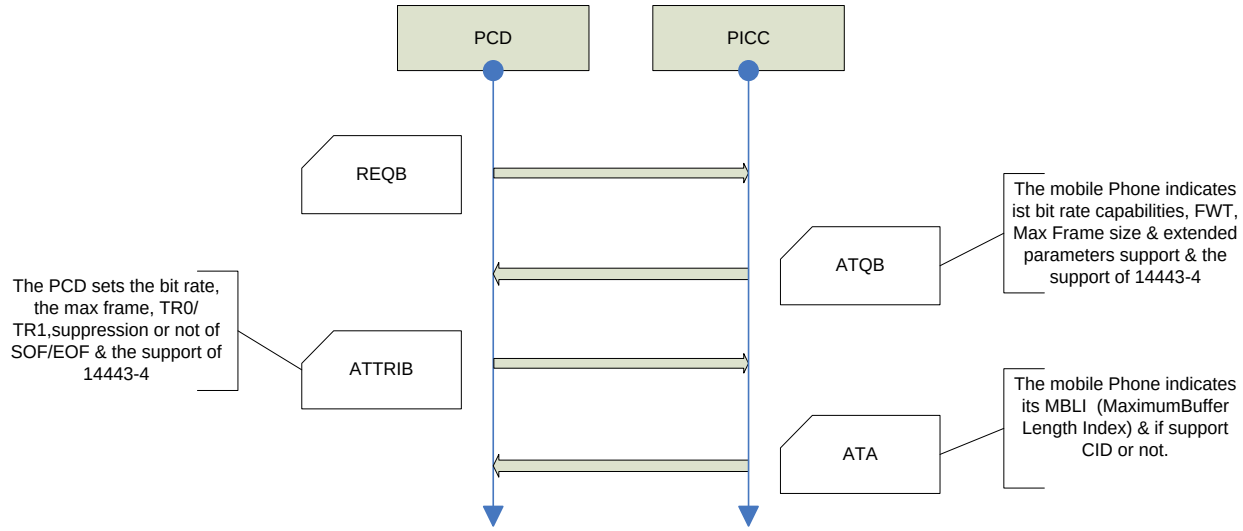


Figure 1 **SO 14443-4 TYPE A**

Sequence chart of 14443-4 TYPE B



ISO 14443-4 TYPE B

Figure 2

3 Contactless Parameters

This part of the document describes the standard parameters for the supported protocols.

3.1 TYPE A

3.1.1 Definitions

All parameters, needed for a better understanding of the current document, already defined in ISO/IEC 14443-4 TYPE A, are listed in the table below.

Parameter	**Comment**
MODE	TYPE A card emulation enabled indicator
UID	UID as defined in ISO/IEC 14443-3 [3] for TYPE A
SAK	Preformatted SAK as defined in ISO/IEC 14443-3 [3] for TYPE A
ATQA	ATQA coded as defined in ISO/IEC 14443-3 [3] for TYPE A.
APPLICATION_DATA	The historical bytes as defined in ISO/IEC 14443-4 [4] for TYPE A
FWI, SFGI	Frame Waiting time and Start-up frame guard Time as defined in ISO/IEC 14443-3 [4] for TYPE A
CID_SUPPORT	support for CID as defined

	ISO/IEC 14443-4 [4]
CLT_SUPPORT	Support of tunnelling mode for ISO/IEC 14443-4 [7] non compliant protocols
DATARATE_MAX	Maximum data rate supported

Registry entries for TYPE A

Table 1

3.1.2 Mandatory parameters for TYPE A

3.1.2.1 NFC parameters and associated mask

The table below indicates the parameters used by each contactless technology. This table lists all recommended values for all listed protocols (the column headings in the first row of the table). This table does not define any new configuration or parameters.

N.B.: Please note that for ATQA, byte 1 contains bits from 1 to 8 and byte 2 contains bits from 9 to 16 as defined by [5] and [8]

			Basic profile (compatible with EMVCo applications)		**Mifare classic parameters (7 bytes UID)**		**DESFire EV1 (7 bytes UID)**	
GP Tag	**Label**	**Length**	**NFC param Value (hex)**	**Mask Value (hex)**	**NFC param Value (hex)**	**Mask Value (hex)**	**NFC param Value (hex)**	**Mask Value (hex)**
80	LV UID UID	1 0,4,7,10	00 (random)	00	07 (fixed value)	FF	07 (fixed value)	FF
81	SAK	1	20	C7	08	CF	20	C7
82	ATQA[1]	2	0400	B9FC	4400	FFFC	4403	FFFF
83	LV ATS ATS	1 0 to 15	00	00	00	00	00	00
84	FWI/SFGI	1	78	FF	78	FF	78	FF
85	CID support	1	01	FF	01	FF	01	FF
86	Data_Rate_Max	3	000000	FFFFFF	000000	000000	030300	000000

Table 2

Contactless parameters

The recommended value for ‘CID support’ is 1. There may be certain scenarios where the UICC may not support CID, as allowed for in [4] and [9]. This configuration may lead to some interoperability issues when a PCD which does not fully comply with ISO/IEC 14443 and EMV, is used.

[1] ATAQ is coded on two bytes as specified in ETSI TS 102 622

3.1.2.2 Mobile Station implementation

The contactless parameters required for TYPE A of an NFC handset and UICC (Mobile Station – MS) are dependent on the contactless applications to be supported

If the MS does not support any Mifare applications and supports only standard TYPE A applications, it shall be compliant with the profile number 1, also called the default profile, as described in the table below.

If, additionally, the MS supports Mifare Classic data, the MS shall be compliant with the profile number 2 as described in the table below.

If in addition to the profile 1, the MS supports Mifare DESFire EV1 applications, the MS shall be compliant with the profile number 3 as described in the table below.

If the MS supports standard TYPE A, Mifare Classic data and Mifare DESFire EV1 applications, the MS shall be compliant with the profile number 4 as described in the table below.

			1 - Basic profile (compatible with EMVCo applications)		**2 - Basic profile + Mifare classic activated application**		**3 - Basic profile + Mifare DESFire activated application**		**4 - Basic profile + Mifare + DESFire activated applications**	
GP Tag	**Label**	**Length**	**NFC param Value (hex)**	**Mask Value (hex)**	**NFC param Value (hex)**	**Mask Value (hex)**	**NFC param Value (hex)**	**Mask Value (hex)**	**NFC param Value (hex)**	**Mask Value (hex)**
80	LV (UID) UID	1 0,4,7,10	00 (random)	00	07 (fixed value)	FF	07 (fixed value)	FF	07 (fixed value)	FF
81	SAK	1	20	E7	28	E7	20	E7	28	EF
82	ATQA	2	0400	BFFC	4400	FFFC	4403	FFFF	4403	FFFF
83	LV ATS ATS	1 0 to 15	00	00	00	00	00	00	00	00
84	FWI/SFGI	1	78	FF	78	FF	78	FF	78	FF
85	CID support	1	01	FF	01	FF	01	FF	01	FF
86	Data_Rate_Max	3	000000	FFFFFF	000000	FFFFFF	000000	FFFFFF	000000	FFFFFF

Table 3

Mandated contactless parameters

The recommended value for ‘CID support’ is 1. There may be certain scenarios where the UICC may not support CID, as allowed for in [4] and [9]. This configuration may lead to some interoperability issues when a PCD which does not fully comply with ISO/IEC 14443 and EMV, is used.

3.2 Type B

3.2.1 Definitions

All parameters needed for a better understanding of the current document and already defined in ISO/IEC 14443-4 TYPE A are listed in the table below.

Identifier	Parameter	Comment
'01'	MODE	TYPE B card emulation enabled indicator
'02'	PUPI	PUPI as defined in ISO/IEC 14443-3 [3] for TYPE B.
'03'	AFI	Application family identifier as defined in ISO/IEC 14443-3 [3] for TYPE B
'04'	ATQB	Additional data for ATQB
'05'	HIGHER_LAYER_RESPONSE	Higher Layer response in answer to ATTRIB command as defined in ISO/IEC 14443-3 [3] for TYPE B
'06'	DATARATE_MAX	Maximum data rate supported

Defines the registry entries for a TYPE B RF technology card

3.2.2 Mandatory parameters for TYPE B

Table 4

3.2.2.1 NFC parameters and associated mask

			Fixed profile	
GP Tag	**Label**	**Length**	**NFC param Value (hex)**	**Mask Value (hex)**
80	LV PUPI PUPI	1 4	00 (Random)	00
81	AFI	1	00	FF
82	ATQB GP	4	00000071	0xFFFFFFFF
83	LV ATTRIB Hlresp ATTRIB	1 0 to 15	00	00
84	DATA_Rate_max	3	000000	FFFFFF

Table 5

Mandated Contactless parameters for TYPE B

4 NFC Peer to Peer Mode

If Peer to Peer (P2P) is supported, the device shall work in P2P with a bit rate equal or higher than 212 Kbits/s (bigger values are allowed) in order to avoid interoperability problems with contactless readers up to 106 Kbits/s in TYPE A.

5 Proximity Coupling Device (PCD)

5.1 Requirements

The PCD must be compliant with the ISO/IEC 14443-2 and ISO/IEC 14443-3 standard. The Classes 1, 2, 3 shall be supported as described in the ISO/IEC 14443-2: AMD2 [10] Additional PICC class.

In addition it shall support the EMV Contactless Communication Protocol Specifications [9].

5.2 EMV Contactless Specifications for Payment Systems

The PCD shall be compliant with EMV Contactless Communication Protocol Specification V2.1 [9]

5.2.1 Contactless Mobile Payment (PICC)

Reference specification: EMVCo Handset Requirements for Contactless Mobile Payment: Version1.0 June 2010 [11]

5.2.2 Terminal (PCD)

The PCD shall be compliant with EMVCo Contactless Level 1[12]

Annex A Document Management

A.1 Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
0.9	March 2012	Document pre-submitted to PSMC for appointing reviewers	PSMC	Ahmad Saif, Orange
1.0	September 2012	Submitted to DAG and PSMC for approval	NFC, PSMC	Ahmad Saif & Gael Gerard, Orange
1.0	January 2015	This PRD is transfered from 2012 Near Field Communications Project (Fast Track) to Digital Commerce B2B Wallet Interfaces Programme Global Interest Group	N/A	Veselina Mihovska, GSMA
1.0	January 2015	This PRD is transfered from 2012 Near Field Communications Project (Fast Track) to SIM Group	N/A	Cassandra Watson, GSMA

Other Information

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