Devices Requirements

High Level Conformance Requirements

Version 2.1.02

2020-11-12

[DEVREQS]

NFC Forum™

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1 Overview

The NFC Forum publishes a set of technical specifications for Near Field Communications technology. The purpose of this document is to define which high level features of the NFC Forum specifications are necessary to be implemented by a device for it to be eligible to receive the NFC Forum Certification Mark. These high level features are identified as requirements (marked by 'SHALL' statements) in this document.

1.1 Objectives

The objective of this requirements document is to specify the sets of functionalities and features that need to be supported by NFC-Forum-compliant devices to ensure basic interoperability. The term "basic interoperability" requires conformance to the specifications listed in Section 1.2.

1.2 Applicable Documents or References

The documents listed below contain provisions that are referenced in this specification. Unless a publication date is explicitly stated, the latest version of each document, including all published amendments, applies.

[ACTIVITY]	NFC Activity Technical Specification, Version 2.1, NFC Forum
[ANALOG]	NFC Analog Technical Specification, Version 2.1, NFC Forum
[DIGITAL]	NFC Digital Protocol Technical Specification, Version 2.2, NFC Forum
[GLOSS_CC]	Compliance Committee Glossary (available at http://nfc-forum.org) NFC Forum
[GLOSS_TC]	Technical Acronyms and Glossary NFC Forum
[DEVINFO]	Device Information Record Type Definition Technical Specification NFC Forum
[DTA]	Device Test Application Specification, Version 2.2.02, NFC Forum
[LLCP]	NFC Logical Link Control Protocol (LLCP) Technical Specification, Version 1.2, NFC Forum
[NCI]	NFC Controller Interface Technical Specification NFC Forum
[NDEF]	NFC Data Exchange Format (NDEF) Technical Specification, Version 1.0, NFC Forum

[PERF]	Tag Performance Requirements Version 1.0, NFC Forum
[RFC2119]	Key words for use in RFCs to Indicate Requirement Levels, RFC 2119, S. Bradner, March 1997, Internet Engineering Task Force
[RTD]	NFC Record Type Definition, Technical Specification, Version 1.0, NFC Forum
[SNEP]	NFC Simple NDEF Exchange Protocol (SNEP) Technical Specification, Version 1.0, NFC Forum
[SIGNATURE]	Signature Record Type Definition Technical Specification NFC Forum
[SMARTPOSTER]	Smart Poster Record Type Definition Technical Specification NFC Forum
[T1T]	NFC Forum Type 1 Tag Specification Technical Specification, Version 1.0, NFC Forum
[T2T]	NFC Forum Type 2 Tag Specification Technical Specification, Version 1.1, NFC Forum
[T3T]	NFC Forum Type 3 Tag Specification Technical Specification, Version 1.1, NFC Forum
[T4T]	NFC Forum Type 4 Tag Specification Technical Specification, Version 1.1, NFC Forum
[T5T]	NFC Forum Type 5 Tag Specification Technical Specification, Version 1.1, NFC Forum
[TEXT]	Text Record Type Definition Technical Specification, NFC Forum
[URI]	Universal Resource Identifier (URI) Record Type Definition Technical Specification, NFC Forum

[VERB] Verb Record Type Definition
Technical Specification,
NFC Forum

If the manufacturer decides to implement a device based on a newer version of the NFC Forum specifications, that device remains eligible to receive NFC Forum Certification, assuming the manufacturer confirms functional compliance of the device to the specifications listed above. This confirmation is given as part of the application for NFC Forum Certification for the device.

1.3 Administration

This document is supported by the Near Field Communication Forum, Inc., located at:

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The NFC Forum, Inc. maintains this document.

1.4 Name and Logo Usage

The Near Field Communication Forum's policy regarding the use of the trademarks NFC Forum and the NFC Forum logo is as follows:

- Any company MAY claim compatibility with the authorized version of an NFC Forum specification, whether a member of the NFC Forum or not.
- Permission to use the NFC Forum logo is automatically granted to designated members only as stipulated on the most recent Membership Benefits list, during the period of time for which their membership dues are paid.
- Member's distributors and sales representatives MAY use the NFC Forum logo in promoting member's products sold under the name of the member.
- The logo SHALL be printed in black or in color as illustrated on the Logo Page that is available from the NFC Forum at the address above. The aspect ratio of the logo SHALL be maintained, but the size MAY be varied. Nothing MAY be added to or deleted from the logo.
- Since the NFC Forum name is a trademark of the Near Field Communication Forum, the following statement SHALL be included in all published literature and advertising material in which the name or logo appears:

  NFC Forum and the NFC Forum logo are trademarks of the Near Field Communication Forum.

1.5 Intellectual Property

This document conforms to the Intellectual Property guidelines specified in the NFC Forum's *Intellectual Property Rights Policy* (http://nfc-forum.org/wp-content/uploads/2013/11/NFC-Forum-IPR-Policy.pdf), as outlined in the NFC Forum *Rules of Procedure* (http://nfc-forum.org/wp-content/uploads/2013/11/NFC-Forum-Rules-of-Procedure.pdf).

1.6 Special Word Usage

The key words “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, and “MAY” in this document, with the exception of the RESTRICTION ON USE section, are to be interpreted as described in [RFC2119].

1.7 Abbreviations

Table 1: Abbreviations

Abbreviation	Description
ACM	Active Communication Mode
APDU	Application Protocol Data Unit
CMD	Command
DTA	Device Test Application
IEC	International Electrotechnical Commission
ICS	Implementation Conformance Statement
ISO	International Organization for Standardization
LLCP	Logical Link Control Protocol, as defined in [LLCP]
NDEF	NFC Data Exchange Format, as defined in [NDEF]
NFC	Near Field Communication
OSI	Open Systems Interconnection
P2P	NFC Forum Peer Mode, based on peer-to-peer communication
PCM	Passive Communication Mode
RW	Read / Write
RF	Radio Frequency
RTD	Record Type Definition
SMS	Short Message Service
URI	Universal Resource Identifier

1.8 Glossary

For the definitions of Glossary terms see [GLOSS_CC] and [GLOSS_TC].

2 Technology Definitions

In this document the terms NFC-A, NFC-B, NFC-F and NFC-V are used when referring to NFC Forum Devices. The terms ISO/IEC 14443A, ISO/IEC 14443B, JIS X 6319-4 (also known as FeliCa) and ISO/IEC 15693 are used for the equivalent technologies that are not defined by the NFC Forum.

3 NFC Forum Devices

An NFC Forum Device consists of one or more interoperability modules, as defined in Section 4. Section 3 defines classes of NFC Forum Devices by mapping the interoperability modules to the implementation requirements of specific NFC Forum Devices. Then this section shows the interoperability between NFC Forum Devices.

NOTE This definition of an NFC Forum Device deviates from the definition of an NFC Forum Device contained in the previous versions of the Device Requirements document up to version 1.5 (when only one class of NFC Forum Device existed). The term 'NFC Forum Device' changed from describing a specific device implementation to a general term that can be replaced by any defined NFC Forum device class.

An NFC Forum Device SHALL implement at least one specific class of NFC Forum Device (as listed in

Table 2).

This document uses the following requirement levels:

- Mandatory (M) – for features that SHALL be implemented
- Optional (O) – for features that MAY be implemented
- Conditional (C) – for subfeatures that SHALL be implemented if the parent optional feature is implemented or the parent feature is mandatory.

A device that implements a certain class of NFC Forum Device SHALL implement all modules that are marked as mandatory for that class.

A device that implements a certain class of NFC Forum Device MAY implement any or all modules that are marked as optional for that class.

A device that implements a certain class of NFC Forum Device SHALL implement every module that is marked as conditional for that class when the condition related to that module is set true.

A device that is claimed to implement one or more classes of NFC Forum Device SHALL not support modules (requirements) that are not part of the claimed NFC Forum Device classes.

In Table 2 the gray colored fields indicate undefined modules for the NFC Forum Device. However, an NFC Forum Device is allowed to support multiple NFC Forum Device classes.

Table 2: NFC Forum Devices to interoperability module mapping

NFC Forum Device / Module		Reader / Writer					Initiator		Target		Card Emulation Mode								Comment
		T1T OP	T2T OP	T3T OP	T4AT and T4BT OP	T5T OP	PCM	ACM	PCM	ACM	Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Type 2 Tag Module	Type 3 Tag Module	Type 4A Tag Module	Type 4B Tag Module	Type 5 Tag Module	
NFC Universal Device		O	M	M	M	M	M	M	M	M	O	O	O						
NFC Mobile Device		O	M	M	M	M					M	M	M						
NFC Reader Device		O	M	M	M	O	O	O											
NFC Tag Device	**NFC Type 2 Tag**													M					
	NFC Type 3 Tag														M				
	NFC Type 4A Tag															M			
	NFC Type 4B Tag																M		
	NFC Type 5 Tag																	M	

Table 3 describes the interoperability between the different classes of NFC Forum Devices (marked with an 'X').

Table 3: NFC Forum Device interoperability

Device Name		NFC Universal Device	NFC Mobile Device	NFC Reader Device	NFC Tag Device					Comment
					NFC Type 2 Tag	NFC Type 3 Tag	NFC Type 4A Tag	NFC Type 4B Tag	NFC Type 5 Tag	
NFC Universal Device		X	X	X[1]	X	X	X	X	X	
NFC Mobile Device		X	X	X	X	X	X	X	X	
NFC Reader Device		X[2]	X		X	X	X	X	X	
NFC Tag Device	**NFC Type 2 Tag**	X	X	X						
	NFC Type 3 Tag	X	X	X						
	NFC Type 4A Tag	X	X	X						
	NFC Type 4B Tag	X	X	X						
	NFC Type 5 Tag	X	X	X						

NOTE X[1]: If an NFC Reader Device supports the optional P2P Initiator, it can communicate with an NFC Universal Device that is in P2P Target.

NOTE X[2]: An NFC Reader Device can communicate with an NFC Universal Device that supports the opional CE Mode.

4 Interoperability Modules

A number of interoperability modules have been defined for devices implementing NFC Forum specifications. Each of these modules has an associated set of requirements.

4.1 Interoperability Modules Overview

This section lists and defines the modules that serve as the foundation for interoperability between NFC Forum Devices.

The defined interoperability modules are:

- Reader/Writer Module
    - Type 1 Tag Operation
    - Type 2 Tag Operation
    - Type 3 Tag Operation
    - Type 4A Tag Operation
    - Type 4B Tag Operation
    - Type 5 Tag Operation
- Initiator Module
- Target Module
- Card Emulation Modules
    - Type 3 Tag Platform Module
    - Type 4A Tag Platform Module
    - Type 4B Tag Platform Module
- Tag Modules:
    - Type 2 Tag Module
    - Type 3 Tag Module
    - Type 4A Tag Module
    - Type 4B Tag Module
    - Type 5 Tag Module.

4.1.1 Reader/Writer Module

The Reader/Writer Module covers the behavior of an NFC Forum Device implementing Poll Mode behavior in combination with the Reader/Writer functionality, as defined by [DIGITAL] and [ACTIVITY]. This includes the ability to read and/or write to a Type 1 Tag, Type 2 Tag, Type 3 Tag, Type 4A/B Tag and Type 5 Tag.

4.1.2 Initiator Module

The Initiator Module covers the behavior of an NFC Forum Device implementing Poll Mode behavior using either ACM or PCM in combination with the Initiator functionality, as defined by [DIGITAL] and [ACTIVITY]. The Initiator Module using ACM generates an Operating Field only when it sends a frame to a peer device, as defined by [DIGITAL] and [ACTIVITY].

4.1.3 Target Module

The Target Module covers the behavior of an NFC Forum Device implementing Listen Mode behavior in combination with the Target functionality, as defined by [DIGITAL] and [ACTIVITY]. The Target Module uses PCM in case the Initiator uses PCM and uses ACM in cases the Intiator uses ACM. The Target Module using ACM generates an Operating Field only when it sends a frame to a peer device, as defined by [DIGITAL] and [ACTIVITY].

4.1.4 Type 3 Tag Platform

The Type 3 Tag Platform Module covers the behavior of an NFC Forum Device implementing Listen Mode behavior in combination with the Type 3 Tag Platform functionality, as defined by [DIGITAL] and [ACTIVITY].

4.1.5 Type 4A Tag Platform

The Type 4A Tag Platform Module covers the behavior of an NFC Forum Device implementing Listen Mode behavior in combination with the Type 4A Tag Platform functionality, as defined by [DIGITAL] and [ACTIVITY].

4.1.6 Type 4B Tag Platform

The Type 4B Tag Platform Module covers the behavior of an NFC Forum Device implementing Listen Mode behavior in combination with the Type 4B Tag Platform functionality, as defined by [DIGITAL] and [ACTIVITY].

4.1.7 Type 2 Tag Module

The Type 2 Tag Module covers the behavior of an NFC Forum Device implementing Type 2 Tag Platform and Type 2 Tag functionality, as defined by [T2T], [DIGITAL] and [ACTIVITY].

4.1.8 Type 3 Tag Module

The Type 3 Tag Module covers the behavior of an NFC Forum Device implementing Type 3 Tag Platform and Type 3 Tag functionality, as defined by [T3T], [DIGITAL] and [ACTIVITY].

4.1.9 Type 4A Tag Module

The Type 4A Tag Module covers the behavior of an NFC Forum Device implementing Type 4A Tag Platform and Type 4A Tag functionality, as defined by [T4T], [DIGITAL] and [ACTIVITY].

4.1.10 Type 4B Tag Module

The Type 4B Tag Module covers the behavior of an NFC Forum Device implementing Type 4B Tag Platform and Type 4B Tag functionality, as defined by [T4T], [DIGITAL] and [ACTIVITY].

4.1.11 Type 5 Tag Module

The Type 5 Tag Module covers the behavior of an NFC Forum Device implementing Type 5 Tag Platform and Type 5 Tag functionality, as defined by [T5T], [DIGITAL] and [ACTIVITY].

4.2 Interoperability of Modules

This section provides an overview of the interoperability between the defined modules.

Interoperability is defined so that two NFC Forum Devices are able to interact and communicate with each other. This means that certain modules implemented in the two NFC Forum Devices are interoperable.

Table 4 defines the interoperability between modules in a matrix. No interoperability is defined for the gray colored (both dark and light gray) fields.

NOTE Type 2 Tag and Type 5 Tag are not emulated on a device.

Table 4: Modules - Interoperability

			Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Type 2 Tag Module	Type 3 Tag Module	Type 4A Tag Module	Type 4B Tag Module	Type 5 Tag Module
				PCM	ACM	PCM	ACM								
Reader/Writer								X	X	X	X	X	X	X	X
Initiator	**PCM**					X									
	ACM						X								
Target	**PCM**			X											
	ACM				X										
Type 3 Tag Platform			X												
Type 4A Tag Platform			X												
Type 4B Tag Platform			X												
Type 2 Tag Module			X												
Type 3 Tag Module			X												
Type 4A Tag Module			X												
Type 4B Tag Module			X												
Type 5 Tag Module			X												

4.3 Requirements to Modules Mapping

Table 5 maps the individual defined requirements to the NFC Forum interoperability modules.

Table 5: NFC Forum Interoperability Modules

Number			Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Type 2 Tag Module	Type 3 Tag Module	[illegible]	Type 4B Tag Module	Type 5 Tag Module	Comment
				PCM	ACM	PCM	ACM									
REQ-1.A				M	M	M	M									Peer to peer (P2P)
REQ-1.B			M													Read/Write (RW)
REQ-1.C								C	C	C						Card Emulation
REQ-2.A			M	M												Poll Mode
REQ-2.B						M		C	C	C						Listen Mode
REQ-3.A			M													NFC Tag detection
	REQ-3.1A		M													5 second NFC Tag detection
REQ-3.B				M	M											NFC Universal Device Detection
	REQ-3.1B			M	M											5 second NFC Universal Device detection
REQ-4.A			M	M												Poll for NFC-A Technology
REQ-4.B			M													Poll for NFC-B Technology
REQ-4.C			M	M												Poll for NFC-F Technology
REQ-4.D			C													Poll for NFC-V Technology
REQ-5																VOID
REQ-6			M	M												Multiple Device/Tag detection
REQ-7			M	M	M	M	M									NDEF forming
REQ-8			M	M	M	M	M									NDEF accepting
REQ-9.A1			M													RATS
REQ-9.A2									C				O			ATS
REQ-9.B1			M													ALLB_REQ, SENSB_REQ, ATTRIB

Number			Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Type 2 Tag Module	Type 3 Tag Module	[illegible]	Type 4B Tag Module	Type 5 Tag Module	Comment
				PCM	ACM	PCM	ACM									
REQ-9.B2										C				O		SENSB_RES
REQ-RF-1			M	M	M	M	M	C	C	C	M	M	M	M	M	Operating Volume
REQ-P2P-1				M	M	M	M									P2P communication
	REQ-P2P-1.1.1			M	M											Data exchange in PCM as Initiator
	REQ-P2P-1.1.2			M	M											Data exchange in ACM as Initiator
	REQ-P2P-1.2.1					M	M									Data exchange in PCM as Target
	REQ-P2P-1.2.2					M	M									Data exchange in ACM as Target
	REQ-P2P-1.3			M	M	M	M									Payload
REQ-P2P-2				M	M	M	M									LLCP
	REQ-P2P-2.1			M	M	M	M									LLCP service class
	REQ-P2P-2.2			M	M	M	M									Protocol bindings
REQ-P2P-3				M	M	M	M									SNEP
	REQ-P2P-3.1			M	M	M	M									SNEP Server
REQ-RW-1			M													NDEF read
	REQ-RW-1.1		C													T1T NDEF read
	REQ-RW-1.2		M													T2T NDEF read
	REQ-RW-1.3		M													T3T NDEF read
		RW-1.3.1	M													Payload
	REQ-RW-1.4		M													ISO DEP
		RW-1.4.1	M													T4T NDEF read
		RW-1.4.2	M													Payload
		RW-1.4.3	M													APDU MV 2.x

Number			Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Type 2 Tag Module	Type 3 Tag Module	[illegible]	Type 4B Tag Module	Type 5 Tag Module	Comment
				PCM	ACM	PCM	ACM									
		RW-1.4.4	M													APDU MV3.x
	REQ-RW-1.5		C													Reading NDEF
		RW-1.5.1	C													1 byte command support
		RW-1.5.2	C													2 byte command support
		RW-1.5.3	C													Read Payload
		RW-1.5.4	C													Mapping Version
REQ-RW-2			M													NDEF write
	REQ-RW-2.1		C													T1T NDEF write
	REQ-RW-2.2		M													T2T NDEF write
	REQ-RW-2.3		M													T3T NDEF write
		REQ-RW-2.3.1	M													Payload
	REQ-RW-2.4		M													T4T NDEF write
		REQ-RW-2.4.1	M													Payload
		REQ-RW-2.4.2	M													APDU MV 2.x
		REQ-RW-2.4.3	M													APDU MV3.x
	REQ-RW-2.5		C													T5T NDEF write
		RW-2.5.1	C													1 byte command support
		RW-2.5.2	C													2 byte command support
		RW-2.5.3	C													Write Payload
		RW-2.5.4	C													Mapping Version
REQ-TAG-1.A									C		M		M			NFC-A Technology support

Number			Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Type 2 Tag Module	Type 3 Tag Module		Type 4B Tag Module	Type 5 Tag Module	Comment
				PCM	ACM	PCM	ACM									
REQ-TAG-1.B										C				M		NFC-B Technology support
REQ-TAG-1.C								C				M				NFC-F Technology support
REQ-TAG-1.D															M	NFC-V Technology support
	REQ-TAG-1.2										M					T2T Platform support
	REQ-TAG-1.3							C				M				T3T Platform support
	REQ-TAG-1.4A								C				M			T4AT Platform support
	REQ-TAG-1.4B									C				M		T4BT Platform support
	REQ-TAG-1.5														M	T5T Platform support
REQ-T2T-1											M					T2T CMD set
	REQ-T2T-1-1										M					READ CMD
	REQ-T2T-1-2										C					WRITE CMD
	REQ-T2T-1-3										C					SECTOR_SELECT
REQ-T2T-2											M					Life Cycle State
REQ-T2T-3											M					CC and NDEF
REQ-T2T-4											M					Mapping Version
REQ-T3T-1												M				T3T CMD set
	REQ-T3T-1-1											M				CHECK
	REQ-T3T-1-2											C				UPDATE
REQ-T3T-2												M				Life Cycle State
REQ-T3T-3												M				NDEF storage service
REQ-T3T-4												M				Attribute Information Block

Number			Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Type 2 Tag Module	Type 3 Tag Module		Type 4B Tag Module	Type 5 Tag Module	Comment
				PCM	ACM	PCM	ACM									
REQ-T3T-5												M				Mapping Version
REQ-T4T-1													M	M		T4T Mapping Version
REQ-T4T-2													M	M		CMD set
	REQ-T4T-2-1												M	M		ReadBinary
	REQ-T4T-2-2												C	C		UpdateBinary
	REQ-T4T-2-3												C	C		Mapping Version 3.x ReadBinary and ODO
	REQ-T4T-2-4												C	C		Mapping Version 3.x UpdateBinary and ODO and DDO
REQ-T4T-3													M	M		Short Field coding
REQ-T4T-4													C	C		Extended Field coding
REQ-T4T-5													M	M		Life Cycle State
REQ-T4T-6													M	M		Application, CC, NDEF
REQ-T5T-1															M	T5T: generic requirement on CMDs
	REQ-T5T-1-1														M	Minimum required CMDs
	REQ-T5T-1-2														C	EXTENDED_READ_SINGLE_BLOCK
	REQ-T5T-1-3														C	WRITE_SINGLE_BLOCK support
	REQ-T5T-1-4														C	EXTENDED_WRITE_SINGLE_BLOCK support
	REQ-T5T-1-5														O	SELECT CMD support
	REQ-T5T-1-6														O	LOCK_SINGLE_BLOCK
	REQ-T5T-1-7														O	EXTENDED_LOCK_SINGLE_BLOCK
	REQ-T5T-1-8														O	READ_MULTIPLE_BLOCK CMD support
	REQ-T5T-1-9														O	EXTENDED_READ_MULTIPLE_BLOCK CMD support

Number			Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Type 2 Tag Module	Type 3 Tag Module		Type 4B Tag Module	Type 5 Tag Module	Comment
				PCM	ACM	PCM	ACM									
	REQ-T5T-1-10														O	Special Frame support
REQ-T5T-2															M	Valid Life Cycle State
REQ-T5T-3															M	CC and NDEF
REQ-T5T-4															M	Mapping Version
REQ-Tag-Perf-1											M	M	M	M	M	Tag Performance in compliance operating volume
REQ-Tag-Perf-2											M	M	M	M	M	Tag Performance in performance operating volume
REQ-TST-1.A			M													[DTA] support in RW mode
REQ-TST-1.B				M	M											[DTA] support as P2P Initiator
REQ-TST-1.C						M	M									[DTA] support as P2P Target
REQ-TST-1.D								C								[DTA] support as T3T Listener
REQ-TST-1.E									C	C						[DTA] support as T4T Listener

5 NFC Forum Requirements

The NFC Forum Devices requirements are listed in the following subsections:

- 5.1 Requirements Terms (see Table 6): Defines capabilities of NFC-Forum-compliant devices.
- 5.2 RF Requirements (see Table 7): Defines common performance requirements (for example, Operating Volume).
- 5.3 Requirements for NFC Forum Peer Mode (see Table 8): Defines in detail the capabilities of NFC-Forum-compliant devices in NFC Forum Peer Mode.
- 5.4 Requirements for NFC Forum Reader/Writer Mode (see Table 9): Defines in detail the capabilities of NFC-Forum-compliant devices in NFC Forum Reader/Writer Mode.
- 5.5 Requirements for NFC Forum Tag Platform and Module (see Table 10): Defines generic capabilities of NFC Forum Universal Devices in CE Mode and NFC Tag Devices.
- 5.6 - 5.9 Tag Module Requirements (see Table 11 to Table 14): Defines in detail the capabilities of NFC Tag Devices.
- 5.10 Tag Performance Requirements (see Table 15): Defines generic requirements on performance for NFC Tag Devices.
- 5.11 Requirements for NFC Forum Certification (see Table 16): Defines requirements for certification of NFC Universal and NFC Reader Devices.

NOTE Requirements terms are specific to each class of devices.

5.1 Requirements Terms

Table 6: Requirements Terms

Number	Requirements Terms	Remark
REQ-1.A	The ability to communicate in Peer Mode.	See Section 5.3.
REQ-1.B	The ability to communicate in NFC Forum Reader/Writer Mode.	See Section 5.4.
REQ-1.C	The ability to communicate in NFC Forum Card Emulation Mode.	See Section 5.5.
REQ-2.A	The ability to operate in Poll Mode.	
REQ-2.B	The ability to operate in Listen Mode.	
REQ-3.A	The ability to detect any NFC Forum Tag (potentially containing an NDEF message).	
REQ-3.1A	The ability in Poll Mode to detect an NFC Tag Device within 5 seconds after the tag or device enters the Operating Volume.	This is not a requirement to force a device to poll all the time. However, when the device is polling, this requirement applies. This requirement applies to the digital protocol layer and defines an upper limit to detect a Tag.
REQ-3.B	The ability to detect an NFC Forum Universal Device.	
REQ-3.1B	The ability in Poll Mode to detect an NFC Forum Device in Peer Mode within 5 seconds after the device enters the Operating Volume.	This is not a requirement to force a device to poll all the time. However, when the device is polling, this requirement applies. This requirement applies to the digital protocol layer and defines an upper limit to detect a peer device.
REQ-4.A	The ability to poll for Technology: NFC-A	
REQ-4.B	The ability to poll for Technology: NFC-B	
REQ-4.C	The ability to poll for Technology: NFC-F	
REQ-4.D	The ability to poll for Technology: NFC-V	
REQ-5	Void	

Number	Requirements Terms	Remark
REQ-6	The ability to detect whether multiple NFC Forum Devices and/or NFC Tag Devices respond to a poll command. There is no requirement to identify each responding device.	
REQ-7	The ability to generate NDEF data, as defined by [NDEF].	
REQ-8	The ability to accept an NDEF message, correctly formatted according to [NDEF].	
REQ-9.A1	In NFC-A, the ability to set the parameters to disable the support of advanced protocol features, as follows: • In the RATS command, the ability to set FSDI to at least 8h.	Poll mode requirement on RATS command
REQ-9.A2	In NFC-A, the ability to set the parameters to disable the support of advanced protocol features, as follows: • In response to the RATS command, the ability to set the following to 0b: • Bits b7 to b5 and b3 to b1 of TA(1)	Listen mode requirement on RATS response
REQ-9.B1	In NFC-B, the ability to set the parameters to disable the support of advanced protocol features, as follows: • In the ALLB_REQ and SENSB_REQ commands, the ability to set bit b5 of PARAM to 0b. • In the ATTRIB command, the ability to set bits b8 to b3 of Param 1 to 0b. • In the ATTRIB Command the ability to set bits b4 to b1 (FSDI) of Param 2 to at least 8h.	Support for the advanced protocol features as described in [DIGITAL] will be allowed when the necessary specifications are developed.

Number	Requirements Terms	Remark

REQ-9.B2	In NFC-B, the ability to set the parameters to disable the support of advanced protocol features, as follows:
	• In the SENSB_RES response, the ability to set the following to 0b:
	  • Bits b7 to b5 and b3 to b1 of the Bit_Rate_Capability field
	  • Bits b3 and b2 of the Protocol_Type field.	

5.2 RF Requirements

Table 7: RF Requirements

RF Number	RF Requirement	Remark
REQ-RF-1	The ability to exchange data with another compliant NFC Forum Device in the Operating Volume, as defined in [ANALOG].	

5.3 Requirements for NFC Forum Peer Mode

Table 8: Requirements for NFC Forum Peer Mode

REQ-P2P Number	P2P Requirement	Remark
REQ-P2P-1	In Peer Mode the ability to communicate with another device in Peer Mode to exchange data.	
REQ-P2P-1.1.1	In Peer Mode the ability to exchange data as initiator in passive communication mode using at least one of the following bit rates: 106, 212 or 424 kbit/s.	PCM Initiator
REQ-P2P-1.1.2	In Peer Mode, the ability to exchange data as initiator in active communication mode using at least one of the following bit rates: 106, 212, or 424 kbit/s.	ACM Initiator
REQ-P2P-1.2.1	In Peer Mode the ability to exchange data as the target in passive communication mode at 106, 212 and 424 kbit/s.	PCM Target
REQ-P2P-1.2.2	In Peer Mode, the ability to exchange data as the target in active communication mode at 106, 212, and 424 kbit/s.	ACM Target
REQ-P2P-1.3	In Peer Mode the ability to support payload sizes up to and including 254 bytes.	The definition of payload is according to NFC-DEP Protocol as defined in [DIGITAL].
REQ-P2P-2	In Peer Mode the ability to support LLCP as defined in [LLCP].	
REQ-P2P-2.1	In Peer Mode the ability to support LLCP link service class 3 as defined in [LLCP].	
REQ-P2P-2.2	In Peer Mode the ability to support protocol bindings for NFC Forum Registered Protocols (LLCP or SNEP or both).	
REQ-P2P-3	In Peer Mode the ability to communicate with another device in Peer Mode to exchange NDEF Data as defined in [SNEP].	
REQ-P2P-3.1	In Peer Mode the ability to support a Default SNEP Server as defined in [SNEP].	

5.4 Requirements for NFC Forum Reader/Writer Mode

Table 9: Requirements for NFC Forum Reader/Writer Mode

REQ-RW Number	Reader/Writer Mode Requirement	Remark
REQ-RW-1	The ability to read NDEF data structures from all NFC Tag Types when a single tag is present in the Operating Volume.	
REQ-RW-1.1	The ability to read NDEF data structures of an NFC Type 1 Tag [T1T].	
REQ-RW-1.2	The ability to read NDEF data structures of an NFC Type 2 Tag [T2T].	
REQ-RW-1.3	The ability to read NDEF data structures of an NFC Type 3 Tag [T3T].	
REQ-RW-1.3.1	The ability to read payload sizes up to 254 bytes at a bit rate of at least 212 kbit/s from a NFC Type 3 Tag. Payload is defined according to [DIGITAL] for the Type 3 Tag Platform.	
REQ-RW-1.4	The ability to support ISO-DEP for communicating to NFC Type 4A and 4B Tag [T4T].	
REQ-RW-1.4.1	The ability to read NDEF data structures of an NFC Type 4A and 4B Tag.	
REQ-RW-1.4.2	Reading an NFC Type 4A and 4B Tag, the ability to support a payload size of 254 bytes and a bit rate of 106 kbit/s. Payload is defined according to [DIGITAL].	
REQ-RW-1.4.3	Reading an NFC Type 4A and 4B Tag implementing Mapping Version 2.x, the ability to support 256 data bytes in the response APDU. The definition of data bytes is used in accordance with [T4T].	256 bytes is the maximum amount of data that can be read by a command APDU.
REQ-RW-1.4.4	Reading an NFC Type 4A and 4B Tag implementing Mapping Version 3.x, the ability to support at least 32 kB data within the response APDU. The definition of data bytes is used in accordance with [T4T].	
REQ-RW-1.5	The ability to read NDEF data structures of an NFC Type 5 Tag.	
REQ-RW-1.5.1	The ability to support 1 Byte Commands for reading NDEF data structures of an NFC Type 5 Tag as defined in [T5T].	

REQ-RW Number	Reader/Writer Mode Requirement	Remark
REQ-RW-1.5.2	The ability to support 2 Byte Commands for reading NDEF data structures of an NFC Type 5 Tag as defined in [T5T].	
REQ-RW-1.5.3	The ability to read payload sizes up to 256 bytes at a bit rate of 26 kbit/s from a NFC Type 5 Tag. The definition of payload is according to [DIGITAL] for Type 5 Tag Platform.	
REQ-RW-1.5.4	Reading NDEF data from an NFC Type 5 Tag implementing Mapping Version 1.x as defined in [T5T].	
REQ-RW-2	The ability to write NDEF data structures to all NFC Tag Types when a single tag is present in the Operating Volume.	
REQ-RW-2.1	The ability to write NDEF data structures to an NFC Type 1 Tag [T1T].	
REQ-RW-2.2	The ability to write NDEF data structures to an NFC Type 2 Tag [T2T].	
REQ-RW-2.3	The ability to write NDEF data structures to an NFC Type 3 Tag [T3T].	
REQ-RW-2.3.1	Writing NDEF data to an NFC Type 3 Tag, the ability to support payload sizes up to 254 bytes and SHALL support a bit rate of at least 212 kbit/s. Payload is defined according to [DIGITAL] for Type 3 Tag Platform.	
REQ-RW-2.4	The ability to write NDEF data structures to an NFC Type 4A and 4B Tag [T4T].	
REQ-RW-2.4.1	Writing NDEF data to an NFC Type 4A and 4B Tag, the ability to support a payload size of 254 bytes and a bit rate of 106 kbit/s. Payload is defined according to [DIGITAL].	
REQ-RW-2.4.2	Writing NDEF data to an NFC Type 4A and 4B Tag implementing Mapping Version 2.x, the ability to support 255 data bytes in the command APDU. The definition of data bytes is used in accordance with [T4T].	255 bytes is the maximum amount of data that can be written by a command APDU.

REQ-RW Number	Reader/Writer Mode Requirement	Remark
REQ-RW-2.4.3	Writing NDEF data to an NFC Type 4A and 4B Tag implementing Mapping Version 3.x, the ability to support 32kB data within the command APDU. The definition of data bytes is used in accordance with [T4T].	
REQ-RW-2.5	The ability to write NDEF data structures to an NFC Type 5 Tag [T5T].	
REQ-RW-2.5.1	The ability to support 1 Byte Commands for writing NDEF data structures to an NFC Type 5 Tag.	
REQ-RW-2.5.2	The ability to support 2 Byte Commands for writing NDEF data structures to an NFC Type 5 Tag.	
REQ-RW-2.5.3	The ability to write payload sizes up to 32 Bytes at a bit rate of 26 kbit/s to an NFC Type 5 Tag. The definition of payload is according to [DIGITAL] for Type 5 Tag Platform.	
REQ-RW-2.5.4	Writing NDEF data to an NFC Type 5 Tag implementing Mapping Version 1.x as defined in [T5T].	

5.5 Requirements for NFC Forum Tag Platform and Module

Table 10: Requirements for NFC Forum Tag Platform and Module

Tag Number	Tag Mode Requirement	Remarks
REQ-Tag-1.A	The ability to support NFC-A in listen mode.	T2T, T4AT
REQ-Tag-1.B	The ability to support NFC-B in listen mode.	T4BT
REQ-Tag-1.C	The ability to support NFC-F in listen mode.	T3T
REQ-Tag-1.D	The ability to support NFC-V in listen mode.	T5T
REQ-Tag-1.2	Compliant with the Type 2 Tag Platform as defined in [DIGITAL] and [ACTIVITY].	T2T
REQ-Tag-1.3	Compliant with the Type 3 Tag Platform defined in [DIGITAL], and [ACTIVITY].	T3T
REQ-Tag-1.4A	Compliant with the Type 4A Tag Platform and ISO-DEP Protocol as defined in [DIGITAL], and [ACTIVITY].	T4AT
REQ-Tag-1.4B	Compliant with the Type 4B Tag Platform and ISO-DEP Protocol defined in [DIGITAL] and [ACTIVITY].	T4BT
REQ-Tag-1.5	Compliant with the Type 5 Tag Platform defined in [DIGITAL] and [ACTIVITY].	T5T

NOTE In Card Emulation Mode no requirements are specified for tag emulation to exchange NDEF data between NFC Universal Devices.

5.6 Requirements for NFC Forum Type 2 Tag Module

Table 11: Requirements for NFC Forum Type 2 Tag Module

T2T Number	Tag Mode Requirement	Remarks
REQ-T2T-1	The ability to support the command set defined in [T2T].	CMD set
REQ-T2T-1-1	The ability to support the READ command.	CMD needed to read data
REQ-T2T-1-2	If in INITIALIZED or READ/WRITE life cycle state, the ability to support the WRITE command.	CMD needed to write data
REQ-T2T-1-3	If the T2T_Area exceeds Sector Number 0, the ability to support the SECTOR_SELECT command.	
REQ-T2T-2	Compliant with at least one of the Life Cycle states, as defined in [T2T].	Tag access
REQ-T2T-3	The ability to contain at least the Capability Container and the NDEF TLV, as defined in [T2T].	A T2T contains at least the CC and the NDEF TLV.
REQ-T2T-4	The ability to support Mapping Version 1.x, as defined in [T2T].	Valid versions: 1.0 – 1.9

5.7 Requirements for NFC Forum Type 3 Tag Module

Table 12: Requirements for NFC Forum Type 3 Tag Module and Platform

T3T Number	Tag Mode Requirement	Remarks
REQ-T3T-1	The ability to support the command set defined in [T3T].	CMD set
REQ-T3T-1-1	The ability to support the CHECK command.	CMD needed to read data
REQ-T3T-1-2	If in INITIALIZED or READ/WRITE life cycle state, the ability to support the UPDATE command.	CMD needed to write data
REQ-T3T-2	Compliant with at least one of the Life Cycle States, as defined in [T3T].	Tag access
REQ-T3T-3	The ability to contain the Service with the Service Number 0, as defined in [T3T].	NDEF storage service
REQ-T3T-4	The ability to contain at least the Attribute Information Block, as defined in [T3T].	
REQ-T3T-5	The ability to support Mapping Version 1.x, as defined in [T3T].	Valid versions: 1.0 – 1.9

5.8 Requirements for NFC Forum Type 4A and 4B Tag Modules

Table 13: Requirements for NFC Forum Type 4A and 4B Tag Modules

T4T Number	Tag Mode Requirement	Remarks
REQ-T4T-1	The ability to implement either Mapping Version 2.x or Mapping Version 3.x, as defined in [T4T].	Valid versions: 2.0 – 2.9 or Valid versions: 3.0 – 3.9
REQ-T4T-2	The ability to support the command set for Mapping Version 2.x or Mapping Version 3.x, as defined in [T4T].	CMD set
REQ-T4T-2-1	The ability to support the Select and ReadBinary commands.	Needed to read NDEF
REQ-T4T-2-2	If in INITIALIZED or READ/WRITE Life Cycle State, the ability to support the UpdateBinary command.	Needed to write NDEF
REQ-T4T-2-3	If implementing the Mapping Version 3.x the ability to support ReadBinary with ODO.	Needed to read NDEF from T4T Mapping Version 3.x
REQ-T4T-2-4	If in INITIALIZED or READ/WRITE life cycle and implementing the Mapping Version 3.x, the ability to support UpdateBinary with ODO and DDO.	Needed to write NDEF to T4T Mapping Version 3.x
REQ-T4T-3	The ability to support Short Field coding.	Mandatory
REQ-T4T-4	If MLc is larger than a Data field length of 255 bytes and/or MLe is larger than an expected response length of 256 bytes, the ability to support Extended Field coding.	Conditional
REQ-T4T-5	Compliant with at least one of the Life Cycle states, as defined in [T4T].	Life Cycle State
REQ-T4T-6	The ability to contain at least the NDEF Tag application, Capability Container and the NDEF file, as defined in [T4T].	

5.9 Requirements for NFC Forum Type 5 Tag Module

Table 14: Requirements for NFC Forum Type 5 Tag Module

T5T Number	Tag Mode Requirement	Remarks
REQ-T5T-1	The ability to support the defined subset of commands, as defined in [T5T].	Generic requirement on command set
REQ-T5T-1-1	The ability to support the INVENTORY, READ_SINGLE_BLOCK and SLPV_REQ commands.	Minimum set of CMDs to be supported by a T5T (need to read content).
REQ-T5T-1-2	If 2-byte address mode is supported, the ability to support the EXTENDED_READ_SINGLE command.	Additional minimum required CMD in case 2-byte address mode is supported (need to read content).
REQ-T5T-1-3	If in INITIALIZED or READ/WRITE life cycle states, the ability to support the WRITE_SINGLE_BLOCK command.	For READ/WRITE Tags, the write CMD is supported.
REQ-T5T-1-4	If 2-byte address mode is supported and if in INITIALIZED or READ/WRITE life cycles state, the ability to support the EXTENDED_WRITE_SINGLE_BLOCK command.	For READ/WRITE Tags and, if 2-byte address mode is supported, additionally the write CMD is supported.
REQ-T5T-1-5	The ability to support the SELECT command.	Optional feature.
REQ-T5T-1-6	The ability to support the LOCK_SINGLE_BLOCK command.	Optional feature, to move the Tag from READ/WRITE to Read-Only Life Cycle State.
REQ-T5T-1-7	If 2-byte address mode is supported, the ability to support the EXTENDED_LOCK_SINGLE_BLOCK command.	Optional feature, to move the Tag from READ/WRITE to Read-Only Life Cycle State.
REQ-T5T-1-8	The ability to support the READ_MULTIPLE_BLOCK command.	Optional feature.
REQ-T5T-1-9	If 2-byte address mode is supported, the ability to support the EXTENDED_READ_MULTIPLE_BLOCK command.	Optional feature.

T5T Number	Tag Mode Requirement	Remarks
REQ-T5T-1-10	The ability to support the special frame during Write-Alike command execution.	Optional feature.
REQ-T5T-2	Compliant to at least one of the Life Cycle states, as defined in [T5T].	Life Cycle State.
REQ-T5T-3	The ability to contain at least the Capability Container and the NDEF TLV, as defined in [T5T].	A T5T contains at least the CC and the NDEF TLV.
REQ-T5T-4	The ability to support Mapping Version 1.x, as defined in [T5T].	Valid versions: 1.0 – 1.9

5.10 Tag Performance Requirements

Table 15: Tag Performance Requirements

Tag-Perf Number	Tag Mode Requirement	Remarks
Tag-Perf-1	The ability to successfully transmit an NDEF message in the compliance operating volume (see [ANALOG]), as defined in [PERF].	Applies to T2T, T3T, T4T and T5T.
Tag-Perf-2	Measuring the maximum distance of successful NDEF message transmission in the performance operating volume, as defined in [PERF].	Applies to T2T, T3T, T4T and T5T.

5.11 Requirements for NFC Forum Certification

Table 16: Test Requirements

REQ-TST Number	Test Requirement	Remark
REQ-TST-1.A	Implementation of the Device Test Application for Reader/Writer mode, as defined in [DTA] for use during NFC Forum certification testing.	Besides NFC Forum certification testing, the management of the presence and visibility of the DTA during the lifetime of the NFC Forum Device is out of scope.
REQ-TST-1.B	Implementation of the Device Test Application for Initiator, as defined in [DTA] for use during NFC Forum certification testing.	In DTA Initiator is referred to Poll mode. Besides NFC Forum certification testing, the management of the presence and visibility of the DTA during the lifetime of the NFC Forum Device is out of scope
REQ-TST-1.C	Implementation of the Device Test Application for Target, as defined in [DTA] for use during NFC Forum certification testing.	In DTA Target is referred to Listen mode. Besides NFC Forum certification testing, the management of the presence and visibility of the DTA during the lifetime of the NFC Forum Device is out of scope.
REQ-TST-1.D	Implementation of the Device Test Application for Type 3 Tag Platform Listen mode, as defined in [DTA] for use during NFC Forum certification testing.	Besides NFC Forum certification testing, the management of the presence and visibility of the DTA during the lifetime of the NFC Forum Device is out of scope.
REQ-TST-1.E	Implementation of the Device Test Application for Type 4 Tag Platform Listen mode, as defined in [DTA] for use during NFC Forum certification testing.	Besides NFC Forum certification testing, the management of the presence and visibility of the DTA during the lifetime of the NFC Forum Device is out of scope.

A. Specification Cross Reference

(Informative)

Table 17 shows the cross references between the requirements in this document and the relevant set of NFC Forum Technical Specifications.

Table 17: Cross Reference

Number			ANALOG	ACTIVITY	DIG PROT	LLCP	SNEP	NDEF	TxT	Performance	Comment
REQ											
REQ-1			X	X	X						P2P RW CE (Opt.)
REQ-2				X							Poll/Listen mode support.
REQ-3				X							Tag and Device Detection
REQ-4				X	X						Technology Detection Activity for NFC-A, -B, -F and -V
REQ-5											VOID
REQ-6				X							Multiple Device/Tag Detection
REQ-7								X			NDEF forming
REQ-8								X			NDEF accepting
REQ-9.A					X						RATS/ATS restrictions
REQ-9.B					X						ALLB_REQ, ATTRIB, SENSB_RES restrictions
REQ-RF-1			X								Operating Volume
REQ-P2P-1	REQ-P2P-1.1				X						Combination of Technology Detection, Collision Resolution and Data Exchange Activities for PCM and ACM.
	REQ-P2P-1.2			X	X						
	REQ-P2P-1.3				X						
REQ-P2P-2	REQ-P2P-2.1					X					LLCP support

Number			ANALOG	ACTIVITY	DIG PROT	LLCP	SNEP	NDEF	TxT	Performance	Comment
	REQ-P2P-2.2					X					
REQ-P2P-3	REQ-P2P-3.1						X				SNEP support
REQ-RW-1				X							Combination of Technology Detection, Collision Resolution and Data Exchange Activities for NDEF read
	REQ-RW-1.1				X				X		
	REQ-RW-1.2				X				X		
	REQ-RW-1.3				X				X		
		REQ-RW-1.3.1			X				X		
	REQ-RW-1.4				X				X		
		REQ-RW-1.4.1			X						
		REQ-RW-1.4.2			X				X		
		REQ-RW-1.4.3							X		
		REQ-RW-1.4.4							X		
	REQ-RW-1.5				X				X		
		REQ-RW-1.5.1			X				X		
		REQ-RW-1.5.2							X		
		REQ-RW-1.5.3							X		
		REQ-RW-1.5.4							X		
REQ-R				X							

Number			ANALOG	ACTIVITY	DIG PROT	LLCP	SNEP	NDEF	TxT	Performance	Comment
	REQ-RW-2.1				X				X		Combination of Technology Detection, Collision Resolution & Data Exchange Activities for NDEF write
	REQ-RW-2.2				X				X		
	REQ-RW-2.3				X				X		
		REQ-RW-2.3.1			X				X		
	REQ-RW-2.4				X				X		
		REQ-RW-2.4.1			X						
		REQ-RW-2.4.2							X		
		REQ-RW-2.4.3							X		
	REQ-RW-2.5				X				X		
		REQ-RW-2.5.1			X				X		
		REQ-RW-2.5.2							X		
		REQ-RW-2.5.3							X		
		REQ-RW-2.5.4							X		
Tag-1	Tag-1.A			X	X						NFC-A Tech Support
	Tag-1.B			X	X						NFC-B Tech Support
	Tag-1.C			X	X						NFC-F Tech Support
	Tag-1.D			X	X						NFC-V Tech Support
	Tag-1.2				X				X		T2T Platform
	Tag-1.3				X				X		T3T Platform

Number			ANALOG	ACTIVITY	DIG PROT	LLCP	SNEP	NDEF	TxT	Performance	Comment
	Tag-1.4A			X	X						T4AT Platform
	Tag-1.4B			X	X						T4BT Platform
	Tag-1.5				X				X		T5T Platform
T2T-1									X		CMD set
T2T-2									X		Life Cycle
T2T-3									X		CC and NDEF
T2T-4									X		Mapping Version
T3T-1									X		CMD set
T3T-2									X		Life Cycle
T3T-3									X		NDEF
T3T-4									X		AIB presents
T3T-5									X		Mapping Version
T4T-1									X		Mapping Version
T4T-2									X		CMD set
T4T-3									X		Short Field
T4T-4									X		Extended Field
T4T-5									X		Live Cycle
T4T-6									X		APP, CC, NDEF
T5T-1									X		CMD Set
T5T-2									X		Live Cycle
T5T-3									X		CC and NDEF
T5T-4									X		Version Number
Tag-Perf										X	
REQ-TST-1											Certification testing requirements, see [DTA]

B. Use Cases

(Informative)

Two broad categories of use cases were considered in identifying the requirements:

- Those in which the communication protocols are wholly defined by the NFC Forum
- Those in which an NFC Forum Device communicates with another device using compatible legacy protocols.

The use cases are described in the sections below and illustrated in the accompanying figures.

Figure 1 describes the conventions used in the figures below to indicate the roles of the different actors in the use cases. This usage is confined to the illustrations of the use cases in this document and does not indicate the general usage of the marks.

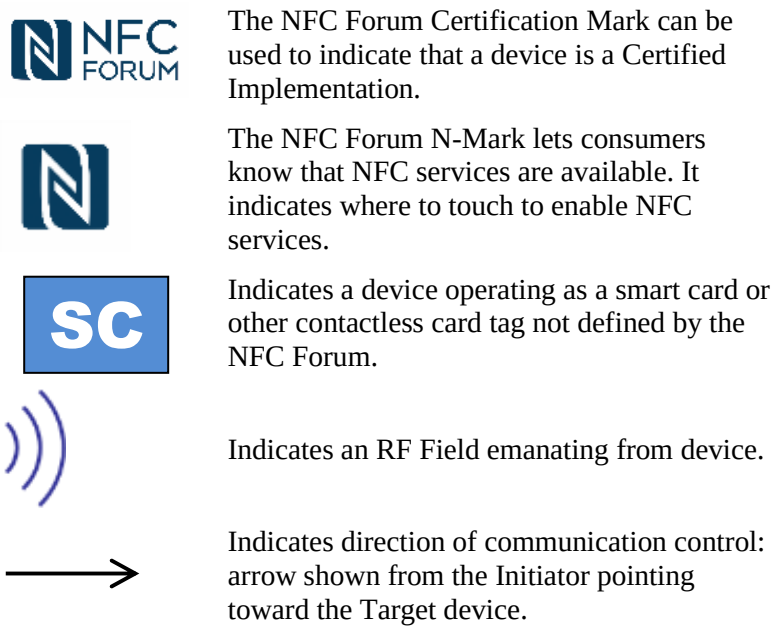

Figure 1: Conventions for Use Case Diagrams

B.1 NFC Forum Communication Use Cases

The use cases defined in this section deal with communication between an NFC Forum Device and another actor, as defined below. Interoperability on the communication level is ensured by the NFC Forum Certification Program.

1. An NFC Forum Device is able to communicate with another NFC Forum Device in NFC Forum Peer Mode. This is illustrated in Figure 2.

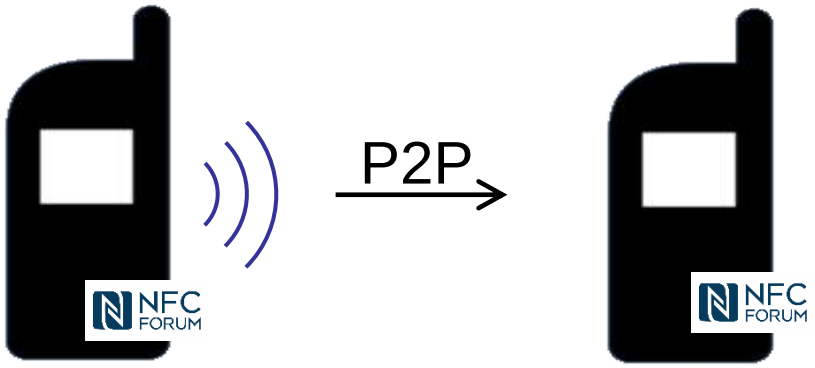

Figure 2: Two NFC Forum Devices Communicating in NFC Forum Peer Mode

2. An NFC Forum Device in NFC Forum Reader/Writer Mode is able to communicate with an NFC Forum Tag. The NFC Forum Tags were specified by the NFC Forum and specifications on how to operate these tags have been made available. This is illustrated in Figure 3.

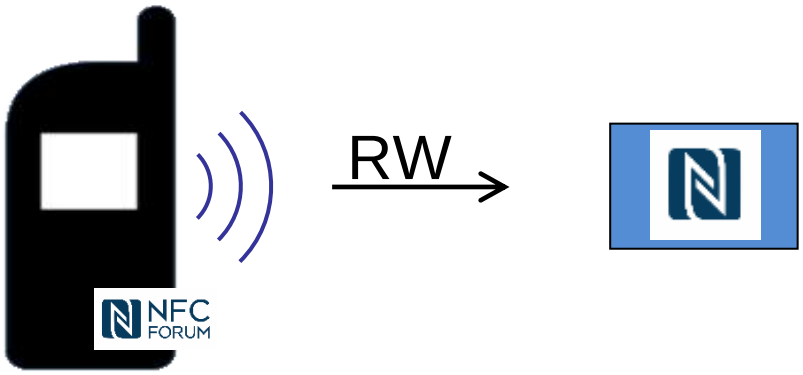

Figure 3: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with an NFC Forum Tag

3. An NFC Forum Device in NFC Forum Reader/Writer Mode is able to communicate with an NFC Forum Device emulating an NFC Forum Tag. This is illustrated in Figure 4.

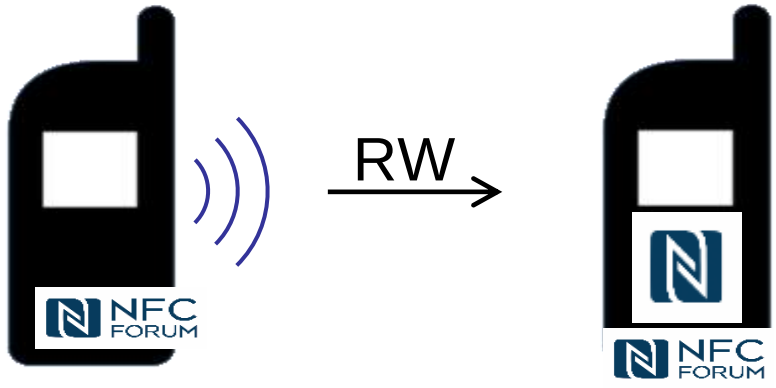

Figure 4: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with an NFC Forum Device in NFC Forum Card Emulation Mode

B.2 Legacy Communication Use Cases

The use cases defined in this section deal with communication between an NFC Forum Device and legacy systems that are not defined by the NFC Forum. However, parts of the implementation of an NFC Forum Device, such as the RF layer or lower layer protocols, are also used by legacy infrastructure.

The NFC Forum takes into account the possibility that requirements for some parts of the protocol stack might impact the usability of NFC Forum Devices within existing contactless infrastructure. Therefore the NFC Forum takes the needs of legacy systems into consideration when it specifies tests that involve parts of the protocol stack that are also relevant for legacy systems.

An NFC Forum Device in Reader/Writer Mode can communicate to an external smart card (SC) or other contactless card or tag that is supporting applications and protocols defined outside the NFC Forum. The smart card system is based on one of the technologies (ISO/IEC 14443A, ISO/IEC 14443B, and/or JIS X 6319-4) that is compatible with the technologies defined by the NFC Forum (NFC-A, NFC-B, and/or NFC-F). This is illustrated in Figure 5.

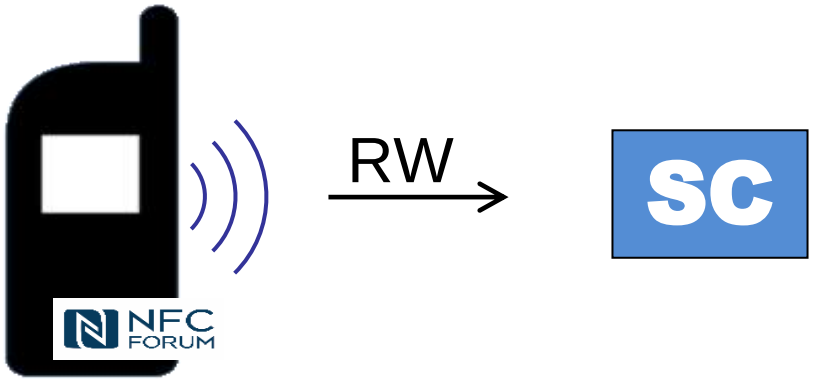

Figure 5: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with a SC

4. An NFC Forum Device in Reader/Writer mode can communicate with another NFC Forum Device emulating a smart card (or other contactless card or tag) that supports applications and protocols defined outside of the NFC Forum. The smart card system is based on a technology defined by the NFC Forum (NFC-A, NFC-B, and/or NFC-F). This is illustrated in Figure 6.

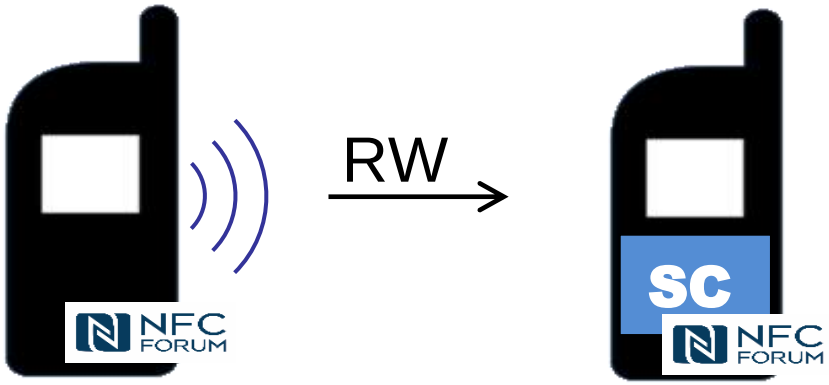

Figure 6: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with an NFC Forum Device Emulating a SC

5. An NFC Forum Device emulating a smart card (or other contactless card or tag) can be accessed by an external reader/writer terminal. The smart card system is based on one of the technologies (ISO/IEC 14443A, ISO/IEC 14443B, and/or JIS X 6319-4) compatible with those defined by the NFC Forum (NFC-A, NFC-B, and/or NFC-F). This is illustrated in Figure 7.

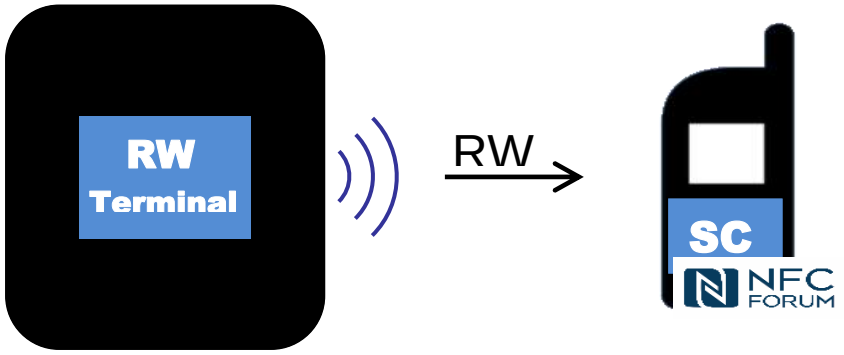

Figure 7: Reader/Writer Terminal and NFC Forum Device Emulating a SC

C. NFC Forum Architecture

(Informative)

C.1 NFC Forum Device

The NFC Forum defines an NFC Forum Device, which is within the scope of the NFC Forum. An NFC Forum Device supports at least one of the classes of NFC Forum Device defined in this document. The properties of each class are specified in this chapter.

Each class of NFC Forum Device complies with at least one of the sets of NFC Forum Interoperability Modules. These modules are defined in the main text of this document. Independent of the class of device, the NFC Forum Device can also include additional protocols and applications not defined by the NFC Forum. Currently the NFC Forum defines three classes of NFC Forum Device: NFC Universal Device, NFC Reader Device and NFC Tag Device.

C.1.1 NFC Universal Device

An NFC Universal Device is a device that implements at least the parts of the NFC Forum Protocol Stack that are relevant for the mandatory NFC Forum Interoperability Modules. It can additionally support optional parts of the stack.

The NFC Universal Device supports NFC Forum Reader/Writer Mode, NFC Forum Peer Mode, and may also support NFC Forum Card Emulation Mode.

The NFC Universal Device architecture is capable of being configured both for Polling and for Listening. It implements the following NFC Forum Interoperability Modules:

- Mandatory NFC Forum Interoperability Modules
    - Initiator Interoperability Module
    - Target Interoperability Module
    - Reader/Writer Interoperability Module
- Optional NFC Forum Interoperability Modules
    - Type 3 Tag Platform Interoperability Module
    - Type 4A Tag Platform Interoperability Module
    - Type 4B Tag Platform Interoperability Module.

C.1.2 NFC Reader Device

An NFC Reader Device is a device that implements at least the parts of the NFC Forum Protocol Stack that are relevant for the mandatory NFC Forum Interoperability Modules. It can additionally support optional parts of the stack.

The NFC Reader Device supports the NFC Forum Reader/Writer Mode and may support the NFC Forum Peer Mode (Initiator component). It does not implement the NFC Forum Peer Mode (Target component) or the NFC Forum Card Emulation Mode.

The NFC Reader Device architecture is capable of being configured for Polling but not for Listening.It implements the following NFC Forum Interoperability Modules:

- Mandatory NFC Forum Interoperability Modules
    - Reader/Writer Interoperability Module
- Optional NFC Forum Interoperability Modules
    - Initiator Interoperability Module.

C.1.3 NFC Tag Device

An NFC Tag Device is a device that does not implement the NFC Forum Protocol Stack. It does not support any of the NFC Forum Operation Modes (as are defined in Section C.3).

The NFC Tag Device architecture is capable of being configured for Listening but not for Polling.

The term *NFC Tag Device* is used when describing properties that are common to all NFC Tag Devices. But a given NFC Forum Device will normally be specific to a single type of tag, and will be named accordingly:

- NFC Type 1 Tag
- NFC Type 2 Tag
- NFC Type 3 Tag
- NFC Type 4A Tag
- NFC Type 4B Tag
- NFC Type 5 Tag.

An NFC Type 1 Tag implements components supporting all requirements defined in [T1T].

NOTE NFC Forum does not offer certification for the NFC Type 1 Tag.

An NFC Type 2 Tag implements the following NFC Forum Interoperability Modules:

- Mandatory NFC Forum Interoperability Modules
    - Type 2 Tag Interoperability Module.

An NFC Type 3 Tag implements the following NFC Forum Interoperability Modules:

- Mandatory NFC Forum Interoperability Modules
    - Type 3 Tag Platform Interoperability Module
    - Type 3 Tag Interoperability Module.

An NFC Type 4A Tag implements the following NFC Forum Interoperability Modules:

- Mandatory NFC Forum Interoperability Modules
    - Type 4A Tag Platform Interoperability Module
    - Type 4A Tag Interoperability Module.

An NFC Type 4B Tag implements the following NFC Forum Interoperability Modules:

- Mandatory NFC Forum Interoperability Modules
    - Type 4B Tag Platform Interoperability Module
    - Type 4B Tag Interoperability Module.

An NFC Type 5 Tag implements the following NFC Forum Interoperability Modules:

- Mandatory NFC Forum Interoperability Modules
    - Type 5 Tag Interoperability Module.

C.2 NFC Forum Protocol Stack

The NFC Forum Protocol Stack applies to an NFC Universal Device and an NFC Reader Device but not to an NFC Tag Device.

The NFC Forum Protocol Stack includes the communication protocols:

- between an NFC Universal Device in NFC Forum Peer Mode and
    - another NFC Universal Device in NFC Forum Peer Mode.
- between an NFC Universal Device in NFC Forum Reader/Writer Mode and
    - an NFC Tag Device
    - a technology-compatible contactless smart card
    - optionally another NFC Universal Device in NFC Forum Card Emulation Mode.
- optionally between an NFC Universal Device in NFC Forum Card Emulation Mode and
    - another NFC Universal Device in NFC Forum Reader/Writer Mode
    - an NFC Reader Device in NFC Forum Reader/Writer Mode
    - a technology-compatible reader/writer terminal.
- optionally between an NFC Reader Device in NFC Forum Peer Mode (Initiator) and
    - an NFC Universal Device in NFC Forum Peer Mode (Target).

This NFC Forum Protocol Stack design includes no assumptions about the implementation or overall architecture of an NFC Forum Device.

Table 18 maps the NFC Forum terminology used to define layers within the protocol stack in relation to the ISO/OSI defined protocol layers.

Table 18: OSI Protocol Stack Mapping

ISO/OSI Layer	NFC Universal Device	NFC Reader Device	NFC Tag Device
L4 and up: Transport, Session, Presentation, Application	Type X Tag Operation, SNEP, NDEF, RTDs, Applications	Type X Tag Operation, SNEP, NDEF, RTDs, Applications	Type X Tag, NDEF, RTDs
L3: Network	None	None	None
L2: Data Link	LLCP	LLCP	None
	Digital Protocol, Activity	Digital Protocol, Activity	Digital Protocol, Activity
L1: Physical	Analog	Analog	Analog

C.2.1 L1 and L2 - Analog and Digital Protocol Layers

The NFC Forum specifications that cover the analog [ANALOG] and digital protocol [DIGITAL] layers are based on several other specifications, including:

- ISO/IEC 14443 standard series
- ISO/IEC 18092
- JIS X 6319-4
- ISO/IEC 15693 standard series.

[ACTIVITY] defines a listen state machine and polling operations for all four Technology types.

Together, these specifications define how an NFC Forum Device communicates with other devices in the following ways.

- When in NFC Forum Peer Mode:
    - Communication with an NFC Universal Device or NFC Reader Device using NFC-DEP running on either NFC-A or NFC-F Technology using either PCM or ACM.
- When in NFC Forum Reader/Writer Mode:
    - Communication with an NFC Universal Device using the appropriate Type X Tag Platform running on NFC-A (Type 4A Tag), NFC-B (Type 4B Tag) or NFC-F (Type 3 Tag) Technology
    - Communication with an NFC Tag Device using the appropriate Type X Tag Platform running on NFC-A (Type 1, Type 2, or Type 4A Tag), NFC-B (Type 4B Tag), NFC-F (Type 3 Tag) or NFC-V (Type 5 Tag) Technology
    - Communication with an ISO/IEC 14443 smart card using Type X Tag Platform and ISO-DEP running on either NFC-A or NFC-B Technology
    - Communication with a JIS X 6319-4 (FeliCa) smart card running on NFC-F Technology
    - Communication with a ISO/IEC 15693 Tag running on NFC-V Technology.

- When in NFC Forum Card Emulation Mode:
    - Communication, using ISO-DEP running on either NFC-A or NFC-B Technology, with an NFC Universal Device, NFC Reader Device or a reader/writer that supports that capability
    - Communication, using NFC-F Technology, with an NFC Universal Device, NFC Reader Device or a reader/writer that supports that capability.

C.2.2 L2 - Logical Link Control Protocol

The Logical Link Control Protocol (LLCP) data link layer of the NFC Forum protocol stack [LLCP] allows the upper protocol layers to have a reliable bidirectional data link over NFC-DEP and hides the target-initiator model from these upper layers.

LLCP is only used for P2P Communication using both, PCM and ACM. It provides an interface to NFC applications, but it can also be used as a foundation for network layers in existing protocol stacks, such as OBEX or TCP/IP.

C.2.3 L4 and Up – Type X Tag Operation

This transport layer includes the command sets needed to read from, or write to, the mandatory NFC Tag Device technologies and the NDEF Mapping that defines how the NDEF data are mapped within these command sets for the different types of NFC Tag Device. The command sets and NDEF data mappings are defined in [T1T], [T2T], [T3T], [T4T] and [T5T].

C.2.4 L4 and Up – NDEF and RTDs

This presentation layer includes the NFC data exchange format [NDEF], record type definition [RTD], [URI], [TEXT], [SMARTPOSTER], [SIGNATURE], [VERB] and [DEVINFO].

Together these specifications describe a data format that is used to exchange information between two NFC Forum Devices that supports that capability, or between a NFC Forum Device and a reader/writer, tag, or smart card that supports that capability.

An RTD specifies the way NDEF is used by specific applications. For example, a smart poster application on a NFC Forum Device that supports that capability retrieves a universal resource identifier (URI) or a short message service (SMS) message. Therefore, [SMARTPOSTER] defines how the URI or SMS content is stored in an NDEF Message.

C.2.5 Protocol Partitioning

To assist with the implementation of some classes of NFC Forum Device, [NCI] defines an interface between a Device Host and an NFC Controller. The mechanisms defined in NCI allow the Device Host to manage an NFC Controller at different levels in the OSI Protocol Stack. NCI applies to an NFC Universal Device and an NFC Reader Device, but not to an NFC Tag Device.

C.3 Operation Modes

The NFC Forum Protocol Stack supports three different operation modes:

- The NFC Forum Peer Mode, which is used to communicate with an NFC Universal Device or optionally with an NFC Reader Device (Initiator).
- The NFC Forum Reader/Writer Mode, which reads from, and potentially writes to, an NFC Universal Device that is acting as a card emulator, or an NFC Tag Device. This mode also allows for communication with existing technology compatible smart cards.
- The NFC Forum Card Emulation Mode, which emulates the behavior of a smart card or tag. This optional mode allows for communication with an NFC Universal Device that is acting as a reader/writer, an NFC Reader Device, or with existing technology-compatible reader/writer terminals.

Section C.1 identifies which operation modes are implemented by each class of NFC Forum Device.

The following three sections and figures depict the protocol stack for each Operation Mode. The analog layer and digital protocol layer are common for all three modes. While the digital protocol layer of the stack is depicted as a single layer, it is defined in two separate specifications, [DIGITAL]and[ACTIVITY].

C.3.1 NFC Forum Peer Mode

A Peer Mode capable NFC Forum Device is able to communicate with another Peer Mode capable NFC Forum Device using NFC-DEP using either PCM or ACM, as defined in [DIGITAL]. The device uses the procedures defined in [LLCP] to establish and manage the link. Figure 8 shows the NFC Forum Peer Mode architecture.

The service discovery protocol defined in [LLCP] is used to identify the common services supported by both NFC Forum Devices.

The simple NDEF exchange protocol defined in [SNEP] is a protocol for exchanging NDEF Messages between peer applications on different NFC Forum Devices.

Upper-level protocols registered with the NFC Forum can be bound to LLCP using bindings defined by the NFC Forum. Upper-level protocols not registered with the NFC Forum can also be bound to LLCP using proprietary bindings.

All peer applications will communicate with peer applications on another NFC Forum Device using one of these underlying protocols.

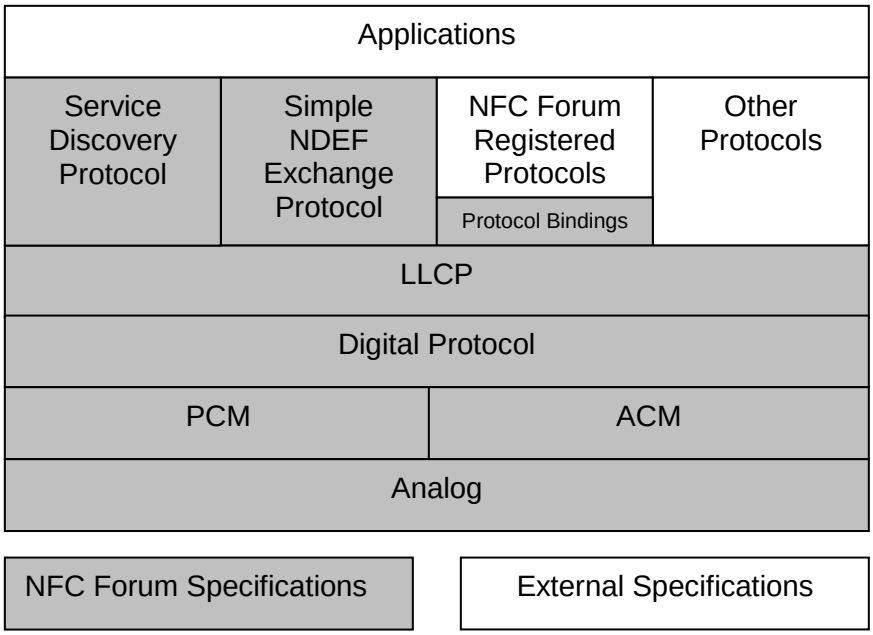

Figure 8: Peer Mode Architecture

C.3.2 NFC Forum Reader/Writer Mode

A Reader/Writer Mode capable NFC Forum Device is able to communicate with an NFC Tag Device. In this mode the Tag Operation parts of all five mandatory Type X Tag specifications are supported. Figure 9 shows the NFC Forum Reader/Writer Mode architecture.

If the device supports an NDEF Application, it can exchange data with an NFC Tag Device using the NFC Forum-defined message coding format.

If the device supports third-party NDEF applications, it can exchange data with an NFC Tag Device using the third-party defined message coding format.

The device can also support non-NDEF reader/writer applications that can use the underlying layers to communicate with a variety of components (smart cards, memory cards, tags, etc.) that are compliant with one of the contactless Technology types.

An NFC Forum Device supports the RF interfaces (NFC-A, NFC-B, NFC-F and NFC-V) defined in [ANALOG] and [DIGITAL]. It establishes communication using the poll mode operations in [ACTIVITY], then performs application level communication using the Tag Operation defined in [T1T], [T2T], [T3T],[T4T] and [T5T].

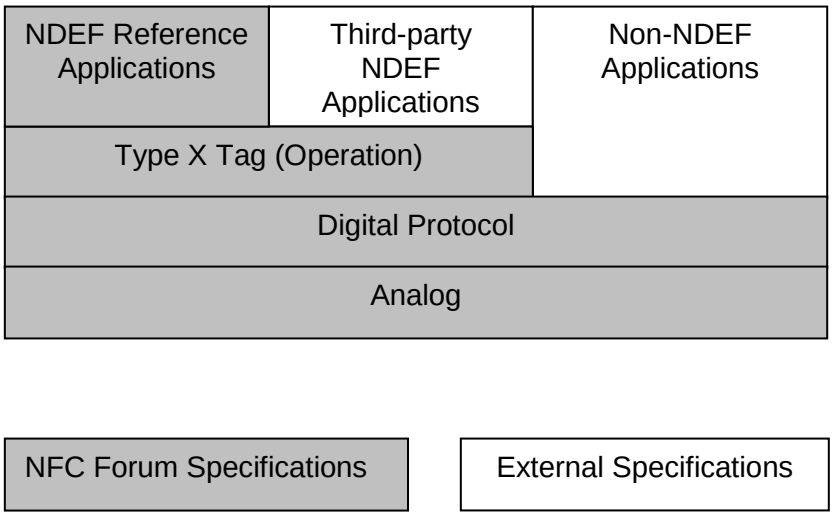

Figure 9: Reader/Writer Mode Architecture

C.3.3 NFC Forum Card Emulation Mode

An NFC Forum device that is NFC Forum Card Emulation Mode capable behaves as a smart card or tag in front of either another NFC Forum Device that implements the Reader/Writer Mode or a conventional technology-compatible reader/writer. This mode includes the emulation of memory cards, tags and smart cards. The emulation of smart cards is intended mainly for portable devices that can be conveniently presented to reader/writers.

Using this mode, existing technology-compatible terminal infrastructures (e.g., for payment and ticketing) can communicate with an NFC Forum Device that supports NFC Forum Card Emulation Mode. Figure 10 shows the architecture of the Card Emulation Mode.

The behavior of an NFC Forum Device in NFC Forum Card Emulation Mode is described using a state machine defined in [ACTIVITY].

If the device supports an NDEF Application, it can exchange data with a reader/writer using the NFC Forum-defined message coding format.

If the device supports third-party NDEF applications, it can exchange data with a reader/writer using the third-party defined message coding format.

The device can also support non-NDEF smart card applications that can employ the underlying layers to communicate with a reader/writer using the application-specific messages.

Since NFC Forum Card Emulation Mode is an optional feature, it will not necessarily be supported by an applicable NFC Forum Device.

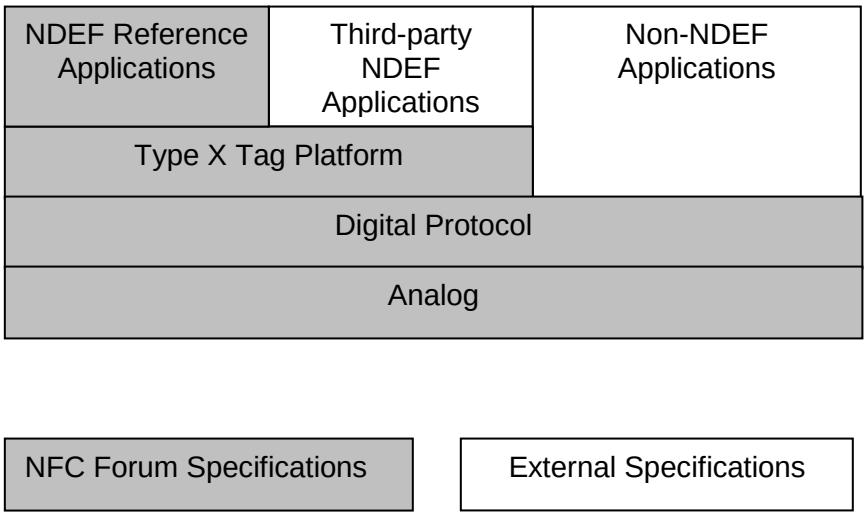

Figure 10: Card Emulation Mode Architecture

C.4 Device Architecture

Figure 11 and Figure 12 show the architecture of an NFC Forum Device when the device is Polling (Figure 11) or Listening (Figure 12) at the point when another device is detected in its proximity. Each block identifies an activity to be performed, and the activities depend on the behavior of the device(s) in the proximity of the NFC Forum Device.

Section C.1 describes which configurations are possible for each class of NFC Forum Device.

NOTE Before starting an activity, the adjacent activity listed below has to be completed.

NOTE All P2P Communication uses LLCP.

All NFC Tag Device applications are based on NDEF. If a device also supports proprietary non-NDEF applications, these are out of scope of the NFC Forum.

C.4.1 Polling Architecture

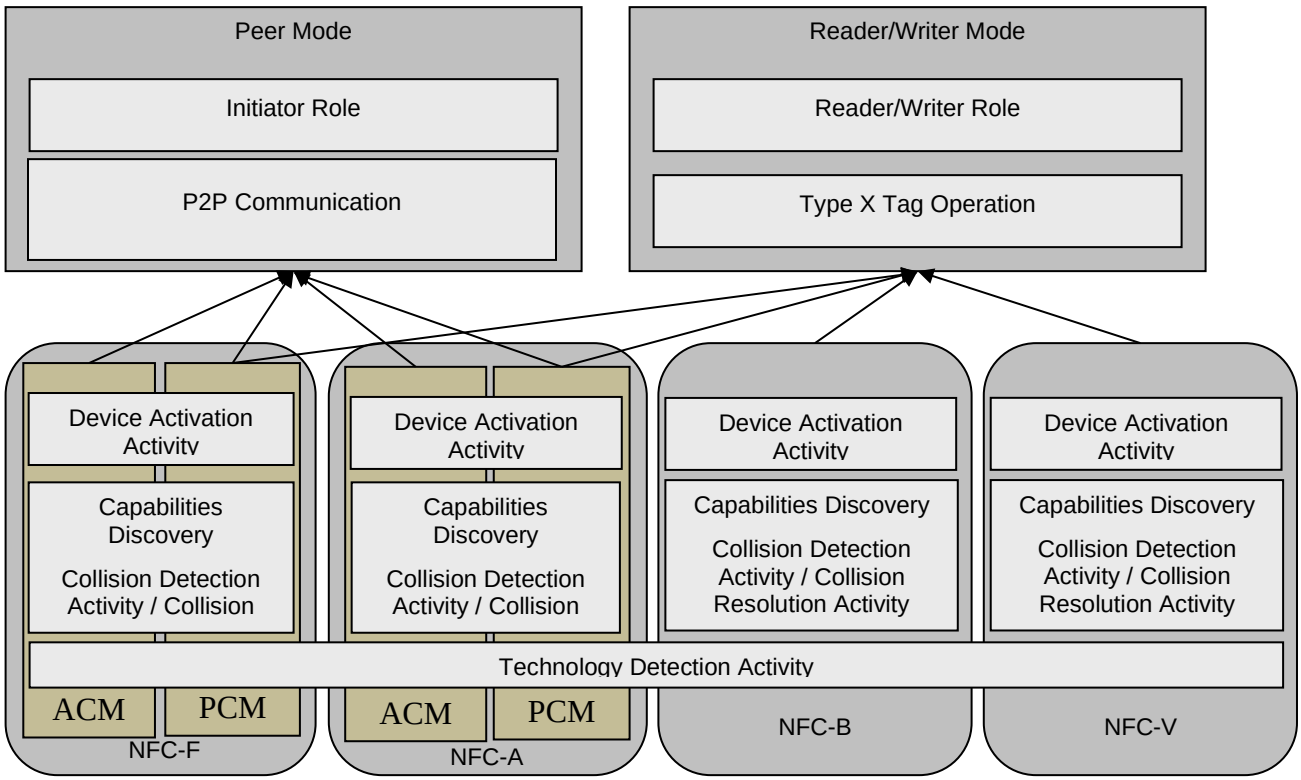

Figure 11: Polling Architecture

Starting from the bottom, Figure 11 shows four different contactless technologies: NFC-A, NFC-B, NFC-F and NFC-V.

The Technology Detection Activity determines which Technology is supported by the listening device(s) in the proximity of the NFC Forum Device.

Each Technology has its own Collision Resolution Activity and capability discovery activities, which provide similar functionality using technology-specific commands. The Device Activation Activity which establishes the communication link is protocol-specific.

After setting all communication parameters, the device either engages with another NFC Forum Device in direct P2P Communication (note that P2P Communication is not possible with the NFC-B or NFC-V Technology), or it engages with an NFC Tag Device.

The P2P Communication using PCM or ACM is shown on the top left side of the figure. The activities in NFC Forum Peer Mode comprise the use of NFC-DEP data exchange and LLCP. Application-specific activities on top of LLCP are not displayed. At this point, the device is an NFC-DEP Initiator.

The Tag Operation part of the Type X Tag is shown on the top right side of the figure. The activities in NFC Forum Reader/Writer Mode comprise the use of the appropriate tag commands and NDEF applications. Application specific activities on top of NDEF are not displayed. At this point, the device is a Reader/Writer.

Reader/Writer Communication is allowed with devices other than one of the Type X Tag Platforms and whose data is not formatted according to NDEF (for example, communicating with payment or transit contactless smart cards), although out of scope of the NFC Forum.

In all cases, the protocol-specific Device Deactivation Activity can be used to close the link to the remote device.

C.4.2 Listening Architecture

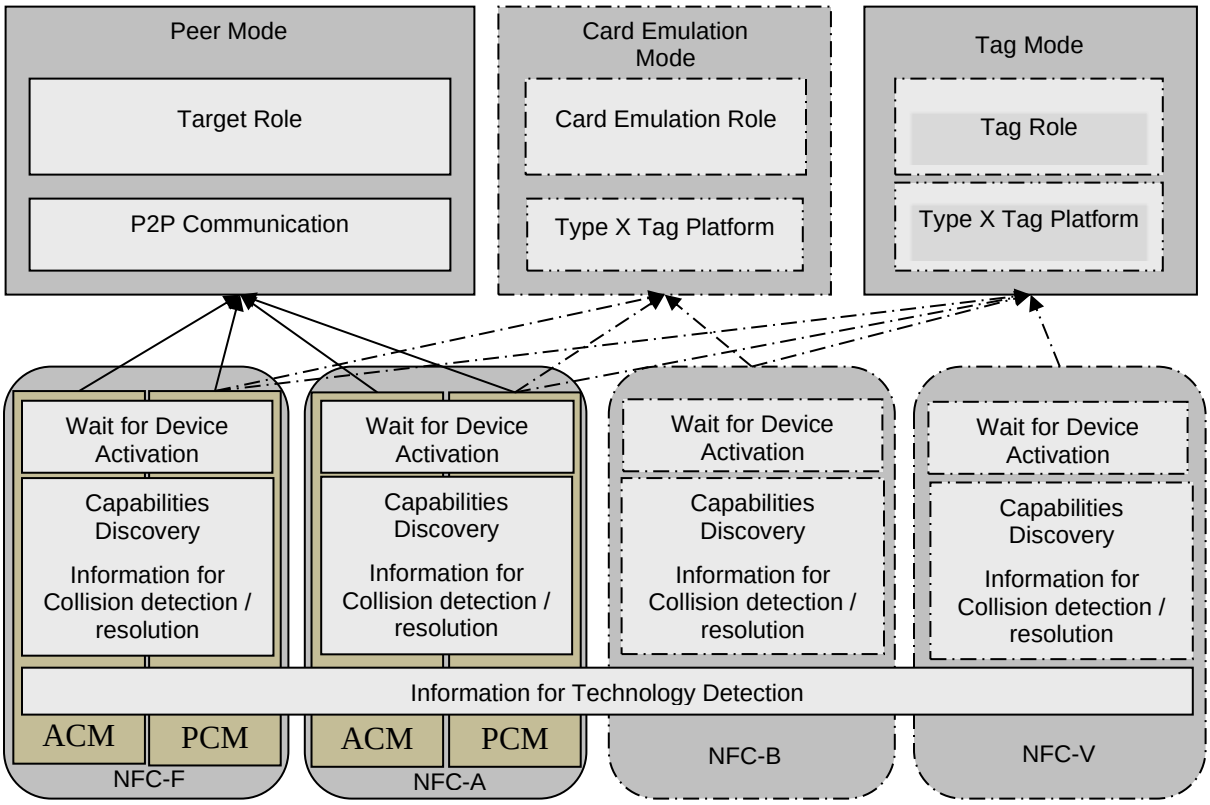

Figure 12: Listening Architecture

Starting from the bottom, Figure 12 shows four different contactless technologies: NFC-F, NFC-A, NFC-B, and NFC-V.

NOTE An NFC Universal Device will not listen for NFC-V technology, and an NFC Universal Device that does not support NFC Forum Card Emulation Mode, or that supports NFC Forum Card Emulation Mode but not the NFC-B based Technology, will not listen for NFC-B Technology.

The configuration of the Listener determines whether it responds to poll commands sent during the Technology Detection Activity, and the parameters sent in the responses. The response to further commands during the Technology Detection, Collision Resolution, and Device Activation activities proceeds according to the Listen State Machine.

After setting all communication parameters, the device either engages with another NFC Forum Device in direct P2P Communication using either PCM or ACM, or, if the NFC Universal Device supports NFC Forum Card Emulation Mode or if it is a NFC Tag Device, it engages with a Reader/Writer and will respond to the Tag Operation part of the Type X Tag.

The P2P communication using either PCM or ACM is shown on the top left side of the figure. The activities in NFC Forum Peer Mode comprise the use of the NFC-DEP data exchange protocol and LLCP. Application-specific activities on top of LLCP are not displayed. At this point, the device is an NFC-DEP Target.

For a device that supports NFC Forum Card Emulation Mode, the Type X Tag Platform is shown in the top middle side of the figure. The activities of an NFC Universal Device in NFC Forum Card Emulation Mode comprise the use of the appropriate commands for the Platform. At this point, the device is emulating a Type X Tag.

An NFC Tag Device supports the Tag mode for at least one technology and Type X Tag Platform, as shown on the top right side of the figure. The activities of a NFC Tag Device comprise the use of the appropriate commands for the supported Type X Tag Platform.

D. Revision History

Table 19 outlines the revision history of the "Devices Requirements" document.

Table 19: Revision History

Document Name	Revision and Release Date	Status	Change Notice	Supersedes
Device Requirements	Version 1.0, April 2012	Final	Initial Publication	-
Device Requirements	Version 1.1, May 2012	Final	Update references to latest available NFC Forum specifications, add clarification on specific specification versions listed, updated figure of NFC Forum Card Emulation Mode, added more precise requirements for the NFC Forum Peer Mode, NFC Forum N-Mark related text update, applied some minor text clarifications	Version 1.0, April 2012
Device Requirements	Version 1.2, July 2012	Final	Removed Section 1.3 with the Interim Exceptions; High level requirments for ANALOG added; Added the reference to the RTD; Minor editorial corrections.	Version 1.1, May 2012
Device Requirements	Version 1.3, December 2013	Final	Added requirement for the support of DTA and updated the DTA version	Version 1.2, July 2012
Device Requirements	Version 1.4.01, March 2016	Final	v1.4.00, July 2015 Addition of high level requirements for version 1.1 of DIGITAL and ACTIVITY 1.4.01, Feb 2016 - new logo included in all occurences - editorial improvements	Version 1.3, December 2013
Device Requirements	Version 1.5.02, February 2017	Final	v1.5.01, September 2016 Update to incorporate ANALOG v2.0 for Certification Release 10 v1.5.02, February 2017	Version 1.4.01, March 2016

Document Name	Revision and Release Date	Status	Change Notice	Supersedes
			Added [ARCHITECTURE] in section 1.4. Changed http link in Appendix C.	
Devices Requirements	Version 2.0.00, August 2017	Final	Addition of NFC Tag and Reader Device classes as well as Tag Performance requirements.	Version 1.5.02, February 2017
Devices Requirements	Version 2.1, June 2018	Final	Addition of the following features: - P2P ACM - T4T OP MV3.0 - T5T OP - for T4ABT OP, frame size larger than 256B may be supported The support of the T1T OP has been made optional for the NFC Universal and Reader Devices.	Version 2.0.00, August 2017
Devices Requirements	Version 2.1.01 January 2020	Final	Changes version number of several Technical Specifications in the Reference documents	Version 2.1, June 2018
Devices Requirements	Version 2.1.02 November 2020	Final	Addition of the NFC Mobile Device class	Version 2.1.01 January 2020