Devices Requirements

High Level Conformance Requirements

Version 3.4.00

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[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 2.3, NFC Forum
[ANALOG]	NFC Analog Technical Specification, Version 3.0 NFC Forum
[DIGITAL]	NFC Digital Protocol Technical Specification, Version 2.4, 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 3.1, NFC Forum
[LLCP]	NFC Logical Link Control Protocol (LLCP) Technical Specification, Version 1.2, NFC Forum
[NCI]	NFC Controller Interface Technical Specification Version 2.3, 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

[T2T] NFC Forum Type 2 Tag Specification
Technical Specification,
Version 1.2,
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 1.2,
NFC Forum

[T5T] NFC Forum Type 5 Tag Specification
Technical Specification,
Version 1.2,
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
[WLC]	Wireless Charging Specification Technical Specification, Version 2.0 NFC Forum
[WPC Ki RP]	Ki Reference Poller Documentation Version 1.0 Wireless Power Consortium

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 and maintained by the Near Field Communication Forum, Inc., located at:

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1.4 Intellectual Property

This document conforms to the Intellectual Property guidelines specified in the NFC Forum's *Intellectual Property Rights Policy* (NFC-Forum-IPR-Policy.pdf), as outlined in the NFC Forum *Rules of Procedure* (NFC-Forum-Rules-of-Procedure.pdf).

1.5 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].

1.6 Abbreviations

Table 1: Abbreviations

Abbreviation	Description
ACM	Active Communication Mode
APDU	Application Protocol Data Unit
CCC	Car Connectivity Consortium®
CMD	Command
CE	Card Emulation
DTA	Device Test Application
IEC	International Electrotechnical Commission
ICCE	Intelligent Car Connectivity Industry Ecosystem Alliance
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
NMD	NFC Mobile Device
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
USI	Universal Stylus Initiative
WLC	Wireless Charging

1.7 Glossary

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

Normal Power Mode

The Device is sufficiently powered to operate all functions in the device including all functions supported by the NFC interface.

Reduced Power Mode

The Devices power supply is insufficient to operate all its functions (e.g., the Battery has reached a threshold to indicate low Battery). In this case most functionalities of the Device are automatically switched off. The device however has sufficient power to support the NFC controller to execute all the functions for the card emulation mode.

NOTE In this mode the supply voltage available to the NFC controller may be reduced and other inputs like the system clock of the device may not be available.

NOTE In the *Reduced Power Mode,* it is assumed that no other mode than the card emulation mode is available. Therefore, only this mode will be in the scope for certification testing.

NOTE In other standards the *Reduced Power Mode* is also known as *Battery Low Mode*.

Communication

Process of transferring data (information) between two NFC Devices.

Charging

Process of transferring power from an NFC WLC Reader to an NFC WLC Tag using the magnetic field of the Operating Field.

Power Harvesting Guard Time

The time of an Unmodulated Carrier after which the WPC Ki Tag Device is ready to receive an ALL_REQ or SENS_REQ Command, specified as 22.5ms.

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.

NFC Forum distinguishes between two categories of Device Classes. The first category, as detailed in section 3.1, defines Device Classes ensuring interoperability between all Device Classes. This category ensures interoperability in an open ecosystem across all Device Classes and therefore is strongly recommended by NFC Forum. The second category of Device Classes, as detailed in section 3.2, is defined to meet requirements of specific market segments and is denoted as specific market ecosystem. The Device Classes defined for a specific market ecosystem are interoperable within that market segment. However, those specific Device Classes do not interoperate in the open ecosystem since not all interoperability modules mandatory for the open ecosystem are implemented. NFC Forum introduces this second category to address application needs of specific market segments. Specific market ecosystem devices are to be implemented only for the designated market segments, and not available for other market segments.

NOTE This definition of an NFC Forum Device deviates from the definition of an NFC Forum Device contained in the previous versions of the Devices 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 defined in sections 3.1 or 3.2).

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 sub-features 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. However, an NFC Forum Device is allowed to support multiple NFC Forum Device classes.

Some tables below contain Gray colored fields or cells to indicate that for the device class or interoperability module the property is undefined.

3.1 Open ecosystem Device Classes

This section defines the Device Classes dedicated to the open ecosystem ensuring use case independent interoperability. Table 2 defines the Device Class to interoperability module mapping.

Table 2: Open ecosystem NFC Forum Device Classes to interoperability module mapping

NFC Forum Device / Module		RF Collision Avoidance	Reader / Writer					Initiator		Target		Card Emulation Mode			Type 2 Tag Module	Type 3 Tag Module	Type 4A Tag Module	Type 4B Tag Module	Type 5 Tag Module	WLC Poller	WLC Listener
			T2T OP	T3T OP	T4AT OP	T4BT OP	T5T OP	PCM	ACM	PCM	ACM	T3T Platform	T 4A T Platform	T 4B T Platform							
NFC Universal Device		M	M	M	M	M	M	M	O^1	M	O^1	O	O	O						O^3	
NFC Mobile Device		M	M	M	M	M	M					M	M	M						O^3	
NFC Reader Device		O	M	M	M	M	M													O^3	
NFC Card Emulation Device												O^2	O^2	O^2		$C^{1,2}$	$C^{1,2}$	$C^{1,2}$			O^3
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		
WLC Reader Device		O	M	O^3	O^3	O^3	M													M	
WLC Tag Device															O^2	$O^{2,3}$	$O^{2,3}$	$O^{2,3}$	$O^{2,3}$		M

NOTE O^1: None or all options marked as O^1 for a Device Class SHALL be selected.
O^2: It is mandatory for a device to select at least one of the listed options.
C^1: If the feature is selected the respective platform must also be selected.
C^2: At least one module must be selected if the optional WLC Listener module is supported.

O^3: Please check the NFC Forum webpage if this feature is already available for certification.

From this version of Devices Requirements onwards the T1T OP interoperability module is removed.

Appendix B analysis which Devices Classes are contained in another Device Class.

3.2 Specific market ecosystem Device Classes

This section defines the Device Classes dedicated to specific market segments to enable a single particular use case, called, specific market ecosystem.

Table 3 defines the Device Class to interoperability module mapping.

To serve the specific needs of the automotive industry the following automotive Device Classes are defined: CCC Digital Key Reader Device, CCC Digital Key CE Device, ICCE Digital Key Reader Device and ICCE Digital Key CE Device.

Table 3: Specific market ecosystem devices to interoperability module mapping

NFC Forum Device / Module	RF Collision Avoidance	Reader / Writer								Initiator		Target		Card Emulation Mode			Type 2 Tag Module	Type 3 Tag Module	Type 4A Tag Module	Type 4B Tag Module	Type 5 Tag Module	WLC Poller	WLC Listener
		T2T OP	T3T OP		T4AT OP		T4BT OP		T5T OP	PCM	ACM	PCM	ACM	T3T Platform	T4AT Platform	T4BT Platform							
			Platform	NDEF support	Platform	NDEF support	Platform	NDEF support															
CCC Digital Key Reader Device	O		O	O[1]	M	O	O	O[1]															
CCC Digital Key CE Device														O	M	O							
ICCE Digital Key Reader Device	O		O	O[1]	M	O	O	O[1]															
ICCE Digital Key CE Device														O	M	O							
USI WLC Reader Device	O	M																				M	
WPC Ki Reader Device	O	M			M																		
WPC Ki Tag Device																	O[2]		O[2]				

It is mandatory for CCC Digital Key CE and ICCE Digital Key CE Devices to support *Normal Power* and *Reduced Power Mode* for each supported Tag Platform.

NOTE O[1]: If the feature is selected the respective platform must also be selected.
O[2]: It is mandatory for a device to select at least one of the listed options.

NOTE No USI WLC Tag Device Class is defined because it is implicitly covered by the WLC Tag Device implementing Type 2 Tag and claiming support for WLC OV 7.

3.3 Interoperability assessment of Device Classes of both categories

The interoperability on communication level between different Device Classes is analyzed in Table 4. This table contains the Device Classes defined for the open ecosystem as well as for the specific market ecosystem. Green colored cells indicate interoperability between the combination of Device Classes. Yellow colored cells indicate that interoperability between the Device Classes is only provided if an optional feature is implemented. Red colored cells indicate non-interoperability between the combination of Device Classes.

The interoperability analysis of Table 4 shows that interoperability is provided only for open ecosystem Device Classes. Interoperability between specific market ecosystem Device Classes and open ecosystem Device Classes is only provided for specific Device Classes and not in general. No interoperability can be assumed for specific market ecosystem Device Classes not belonging to the same ecosystem segment.

Table 4: NFC Forum Device interoperability

Device Name		NFC Universal Device	NFC Mobile Device	NFC Reader Device	NFC CE Device	NFC Tag Device: NFC Type 2 Tag	NFC Tag Device: NFC Type 3 Tag	NFC Tag Device: NFC Type 4A Tag	NFC Tag Device: NFC Type 4B Tag	NFC Tag Device: NFC Type 5 Tag	WLC Reader Device	WLC Tag Device	CCC Digital Key Reader Device	CCC Digital Key CE Device	ICCE Digital Key Reader Device	ICCE Digital Key CE Device	USI WLC Reader Device	WPC Ki Reader Device	WPC Ki Tag Device
NFC Universal Device		X	X	X[1]	X	X	X	X	X	X	X[1]	X	X[1]	X	X[1]	X			
NFC Mobile Device		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
NFC Reader Device		X[1]	X		X	X	X	X	X	X		X		X		X			
NFC CE Device		X	X	X							X		X[4]		X[4]				
NFC Tag Device	**NFC Type 2 Tag**	X	X	X							X		X[5]		X[5]		X		
	NFC Type 3 Tag	X	X	X							X		X[3]		X[3]		X[6]		
	NFC Type 4A Tag	X	X	X							X		X		X		X[6]		
	NFC Type 4B Tag	X	X	X							X		X[3]		X[3]		X[6]		
	NFC Type 5 Tag	X	X	X							X						X[6]		
WLC Reader Device		X[1]	X		X	X	X	X	X	X		X		X		X			
WLC Tag Device		X	X	X							X		X[4]		X[4]		X[2]		
CCC Digital Key Reader Device		X[1]	X		X[4]	X[5]	X[3]	X	X[3]			X[4]		X		X			
CCC Digital Key CE Device		X	X	X							X		X		X				
ICCE Digital Key Reader Device		X[1]	X		X[4]	X[5]	X[3]	X	X[3]			X[4]		X		X			
ICCE Digital Key CE Device		X	X	X							X		X		X				
USI WLC Reader Device						X	X[6]	X[6]	X[6]	X[6]		X[2]							
WPC Ki Reader Device																			X
WPC Ki Tag Device																		X	

NOTE X[1]: A device can communicate with an NFC Universal Device if the optional CE Mode is supported.

X[2]: USI WLC Reader Device can communicate with a WLC Tag Device implementing the Type 2 Tag Module.

X[3]: CCC Digital Key Reader and ICCE Digital Key Reader Device can communicate with a NFC Tag Device if supporting the optional Type 3 Tag or Type 4B Tag Platform.

X[4]: CCC Digital Key Reader and ICCE Digital Key Reader Device can communicate with a WLC Tag Device or CE Device implementing T4AT or if both are supporting the optional Type 3 Tag or Type 4B Tag Platform.

X[5]: CCC Digital Key Reader and ICCE Digital Key Reader Device can activate a T2T Platform.

X[6]: USI WLC Reader Device can communicate with an NFC Tag if the according optional Tag Type is supported.

NOTE Devices supporting Listen Mode, having an ISO/IEC 14443-1 Class 6 antenna and supporting *Comms OV5* might not be interoperable with devices in Poll Mode supporting *Comms OV20*. Support of *Comms OV5* and *Comms OV20* are defined in 5.13.

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 Modules
  - Type 2 Tag Operation
  - Type 3 Tag Operation
  - Type 4A Tag Operation
  - Type 4B Tag Operation
  - Type 5 Tag Operation
- Peer Modules:
  - 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.
- RF Collision Avoidance Module
- Wireless Charging Poller Module
- Wireless Charging Listener 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 2 Tag, Type 3 Tag, Type 4A Tag, Type 4B Tag and Type 5 Tag. Specific market ecosystem device classes may support only a subset of this functionality.

4.1.2 Peer Modules

4.1.2.1 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].

4.1.2.2 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 Initiator 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].

4.1.3 Card Emulation Modules

The Card Emulation Mode is offered for 3 different Tag Platforms, the Type 3 Tag, Type 4A Tag and Type 4B Tag Platforms.

4.1.3.1 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].

4.1.3.2 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].

4.1.3.3 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].

4.1.4 Tag Modules

The Tag Module is offered for 5 different Tag Types, the Type 2 Tag, Type 3 Tag, Type 4A Tag, Type 4B Tag and Type 5 Tag.

4.1.4.1 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].

4.1.4.2 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].

4.1.4.3 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].

4.1.4.4 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].

4.1.4.5 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].

4.1.5 RF Collision Avoidance Module

The RF Collision Avoidance Module covers the behavior of an NFC Forum Device implementing the Listen before Talk approach in Poll mode as defined in [ACTIVITY].

4.1.6 Wireless Charging Poller Module

The Wireless Charging Module covers the behavior of an NFC Forum Device implementing the wireless charging functionality for the Poll mode as defined in [WLC].

4.1.7 Wireless Charging Listener Module

The Wireless Charging Module covers the behavior of an NFC Forum Device implementing the wireless charging functionality for the Listen mode as defined in [WLC].

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 5 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.

NOTE RF Collision Avoidance ensures that two NFC Forum Devices are not in Poll mode at the same time and therefore enables basic interoperability (Listen before Talk). The below interoperability analysis applies once RF collision avoidance was already successfully performed. Therefore RF Collision Avoidance will not be shown in Table 5.

Table 5: Modules – Interoperability

PRIMARY / REPLICA		Initiator		Reader/Writer					WLC Poller				
		PCM	ACM	Type 2 Tag Operation	Type 3 Tag Operation	Type 4A Tag Operation	Type 4B Tag Operation	Type 5 Tag Operation	Type 2 Tag Operation	Type 3 Tag Operation	Type 4A Tag Operation	Type 4B Tag Operation	Type 5 Tag Operation
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					
WLC Listener	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 6 to Table 11 map the individual defined requirements grouped by functionality to the NFC Forum interoperability modules and indicates its applicability. If no requirement of a group applies to an NFC Forum interoperability modules, for simplicity such interoperability modules are not shown.

Table 6: Generic requirements to modules mapping

Number			RF Collision Avoidance	Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform	Comment
					PCM	ACM	PCM	ACM				
REQ-1.A					M	M	M	M				Peer mode
REQ-1.B				M								Read/Writer (RW)
REQ-1.C									C	C	C	Card Emulation
	REQ-1.1C								C[1]	C[1]	C[1]	CE support in Normal Power Mode
	REQ-1.2C								C[2]	C[2]	C[2]	CE support in Reduced Power Mode
REQ-2.A				M	M							Poll Mode
REQ-2.B							M	M	C	C	C	Listen Mode
REQ-2.C			C									RF Collision Avoidance
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				C[3]								Poll for NFC-B Technology
REQ-4.C				C[3]	M							Poll for NFC-F Technology
REQ-4.D				C[4]								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-RF-1				M	M	M	M	M	C	C	C	Operating Volume See 5.13

NOTE C[1]: If Card Emulation for a Tag Platform is supported then the according condition for *Normal Power Mode* MUST be selected.
C[2]: If Card Emulation for a Tag Platform is supported then the according condition for *Reduced Power Mode* in addition MAY be selected. For the CCC Digital Key CE Device and ICCE Digital Key CE Device the support of the *Reduced Power Mode* is mandatory.

NOTE C[3]: For any Device Classes that is not a WPC Ki Reader Device Class, a CCC Digital Key Reader Device Class or a ICCE Digital Key Reader Device Class, the feature is Mandatory. For a WPC Ki Device Class, CCC Digital Key Reader Device Class and ICCE Digital Key Reader Device Class, it is optional.

NOTE C[4]: For any Device Classes that is not a WPC Ki Reader Device Class, a CCC Digital Key Reader Device Class or a ICCE Digital Key Reader Device Class, the feature is Mandatory. For a WPC Ki Device Class, it is optional. For a CCC Digital Key Reader Device Class and a ICCE Digital Key Reader Device Class, the feature cannot be supported.

Table 7: Peer Mode requirements to interoperability modules mapping

Number			Peer Mode				Comment
			Initiator		Target		
			PCM	ACM	PCM	ACM	
REQ-P2P-1			M	M	M	M	P2P communication
	REQ-P2P-1.1.1		M				Data exchange in PCM as Initiator
	REQ-P2P-1.1.2			M			Data exchange in ACM as Initiator
	REQ-P2P-1.2.1				M		Data exchange in PCM as Target
	REQ-P2P-1.2.2					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

Table 8: Reader/Writer Mode requirements to module mapping

Number			Reader/Writer								Comment
			Type 2 Tag Operation	Type 3 Tag Operation		Type 4A Tag Operation		Type 4B Tag Operation		Type 5 Tag Operation	
				Platform	NDEF support	Platform	NDEF support	Platform	NDEF support		
REQ-9.A1						M					RATS
REQ-9.B1								M			ALLB_REQ, SENSB_REQ, ATTRIB
REQ-RW-1			M		M		M		M	M	NDEF read
	REQ-RW-1.2		M								T2T NDEF read
	REQ-RW-1.3			M							T3T Platform
		RW-1.3.1		M							Payload
		RW-1.3.2			M						T3T NDEF read
	REQ-RW-1.4					M		M			ISO DEP
		RW-1.4.1					M		M		T4T NDEF read
		RW-1.4.2					M		M		Payload
		RW-1.4.3					M		M		APDU MV 2.x
		RW-1.4.4					M		M		APDU MV3.x
	REQ-RW-1.5									M	Reading NDEF
		RW-1.5.1								M	1 byte command support
		RW-1.5.2								M	2 byte command support
		RW-1.5.3								M	Read Payload
		RW-1.5.4								M	Mapping Version
REQ-RW-2			M								NDEF write
	REQ-RW-2.2		M								T2T NDEF write
	REQ-RW-2.3			M							T3T send payload size
		REQ-RW-2.3.1			M						T3T NDEF write
	REQ-RW-2.4						M		M		T4T NDEF write
		REQ-RW-2.4.1					M		M		Payload

Number			Reader/Writer									Comment
			Type 2 Tag Operation	Type 3 Tag Operation		Type 4A Tag Operation		Type 4B Tag Operation		Type 5 Tag Operation		
				Platform	NDEF support	Platform	NDEF support	Platform	NDEF support			
		REQ-RW-2.4.2					M		M			APDU MV 2.x
		REQ-RW-2.4.3					M		M			APDU MV3.x
	REQ-RW-2.5										M	T5T NDEF write
		RW-2.5.1									M	1 byte command support
		RW-2.5.2									M	2 byte command support
		RW-2.5.3									M	Write Payload
		RW-2.5.4									M	Mapping Version
REQ-RW-3	REQ-RW-3.0		C^1	C^1		C^1		C^1			C^1	Support of various options of minimum NDEF Message sizes
	REQ-RW-3.1		C^2	C^2		C^2		C^2			C^2	Support of 130KB of minimum NDEF Message size
REQ-RW-4	REQ-RW-4.0		C^3			C^3						Support for NFC-A Guard Time
	REQ-RW-4.1		C^4			C^4						Support for Power Harvesting Guard Time

NOTE C^1: REQ-RW-3.0 SHALL be selected for all Device Classes supporting Reader/Writer mode except the NFC Mobile Device. Otherwise not applicable.

C^2: REQ-RW-3.1 SHALL be selected for the NFC Mobile Device Class. Otherwise not applicable.

$C^{3:}$ REQ-RW-4.0 SHALL be selected for all Device Classes expect WPC Ki Reader Device.

$C^{4:}$ REQ-RW-4.1 SHALL be selected for WPC Ki Reader Device

Table 9: Card Emulation and Tag Mode requirements to module mapping

Number			CE Mode			Tag Mode					Comment
			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	
REQ-TAG-1.A				C		M		M			NFC-A Technology support
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.E				M		C[1]		C[1]			NFC-A Guard Time (GT_A)
REQ-TAG-1.F						C[2]		C[2]			Power Harvesting Guard Time
	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 and ISO-DEP support
	REQ-TAG-1.4B				C				M		T4BT Platform and ISO-DEP support
	REQ-TAG-1.5									M	T5T Platform support
REQ-9.A2				C				O			ATS
REQ-9.B2					C				O		SENSB_RES
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

Number			CE Mode			Tag Mode					Comment
			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	
REQ-T3T-3							M				NDEF storage service
REQ-T3T-4							M				Attribute Information Block
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
	REQ-T5T-1-10									O	Special Frame support

Number			CE Mode			Tag Mode					Comment
			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	
REQ-T5T-2										M	Valid Life Cycle State
REQ-T5T-3										M	CC and NDEF
REQ-T5T-4										M	Mapping Version
REQ-RF-1			M	M	M	M	M	M	M	M	Operating Volume. See 5.13
REQ-Tag-Perf-1						C[3]	M	C[3]	M	M	Requirements for Tag compliance operating volume
REQ-Tag-Perf-2						C[3]	M	C[3]	M	M	Requirements for Tag performance operating volume

NOTE C[1]: REQ-TAG-1.E SHALL be selected for all Device Classes supporting any of the Type Tag Module and MAY be selected for the WPC Ki Tag Device.

NOTE C[2]: REQ-TAG-1.F SHALL be selected for WPC Ki Tag Devices if REQ-TAG-1.E was not selected.

NOTE C[3]: REQ-Tag-Perf-1 and REQ-Tag-Perf-2 SHALL be selected for all Devices except WPC Ki Tag Devices. WPC Ki Tag Devices are not required to be tested for Tag Conformance or Performance operating volume.

Table 10: DTA requirements to module mapping

Number			RF Collision Avoidance	Reader/Writer	Initiator		Target		Type 3 Tag Platform	Type 4A Tag Platform	Type 4B Tag Platform			Comment
					PCM	ACM	PCM	ACM						
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

Table 11: WLC Mode Requirements to module mapping

Number			WLC Poll Module	WLC Listen Module	Comment
REQ-WLC-P-1			M		WLC protocol support
REQ-WLC-P-2			M		Power Class support
REQ-WLC-L-1				M	WLC protocol support
REQ-WLC-L-2				M	To be charged from any power class
REQ-RF-2.1			C[1]	C[1]	WLC OV6 Operating Volume
REQ-RF-2.2			C[1]	C[1]	WLC OV7 Operating Volume

NOTE C[1]: At least one of REQ-RF-2.x must be selected by a module.

5 NFC Forum Requirements

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

- 5.1 Requirements Terms (see Table 12): Defines capabilities of NFC-Forum-compliant devices.
- 5.2 RF Requirements (see Table 13): Defines common performance requirements (for example, Operating Volume).
- 5.3 Requirements for NFC Forum Peer Mode (see Table 14): 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 15): Defines in detail the capabilities of NFC-Forum-compliant devices in NFC Forum Reader/Writer Mode.
- 5.5 Requirements for NFC Forum Card Emulation and Tag Mode (see Table 16): Defines generic capabilities of NFC Forum Universal Devices in CE Mode and NFC Tag Devices.
- 5.6 - 5.9 Tag Module Requirements (see Table 17 to Table 20): Defines in detail the capabilities of NFC Tag Devices.
- 5.10 Tag Performance Requirements (see Table 21): Defines generic requirements on performance for NFC Tag Devices.
- 5.12 Requirements for NFC Forum Certification (see Table 23): 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 12: 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-1.1C	The ability to operate in Card Emulation Mode when in *Normal Power Mode*.	
REQ-1.2C	The ability to operate in Card Emulation Mode when in *Reduced Power Mode*.	
REQ-2.A	The ability to operate in Poll Mode.	
REQ-2.B	The ability to operate in Listen Mode.	
REQ-2.C	In Poll Mode the ability to perform RF Collision Avoidance.	
REQ-3.A	The ability to detect any NFC Forum Tag (potentially containing an NDEF message).	

Number	Requirements Terms	Remark
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 an NDEF message, 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.

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 13: 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 [section 5.13..	
REQ-RF-2.1	The ability to exchange data and to be charged in the Operating Volume WLC OV 6, as defined in [WLC].	
REQ-RF-2.2	The ability to exchange data and to be charged in the Operating Volume WLC OV 7, as defined in [WLC].	

5.3 Requirements for NFC Forum Peer Mode

Table 14: 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 Number	P2P Requirement	Remark
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 15: Requirements for NFC Forum Reader/Writer Mode

REQ-RW Number	Reader/Writer Mode Requirement	Remark
REQ-RW-1	The ability to read an NDEF message from all NFC Tag Types when a single tag is present in the Operating Volume.	
REQ-RW-1.2	The ability to read an NDEF message of an NFC Type 2 Tag [T2T].	
REQ-RW-1.3	The ability to send Type 3 Tag Platform Commands and receive Type 3 Tag Platform Responses as defined for Type 3 Tag Platform in [DIGITAL] and [ACTIVITY].	
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 an NFC Type 3 Tag. Payload is defined according to [DIGITAL] for the Type 3 Tag Platform.	
REQ-RW-1.3.2	The ability to read an NDEF message of an NFC Type 3 Tag [T3T].	
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 an NDEF message 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 Number	Reader/Writer Mode Requirement	Remark
REQ-RW-1.4.4	Reading an NFC Type 4A and 4B Tag implementing Mapping Version 3.x, the ability to support at least 256B data within the response APDU. The definition of data bytes is used in accordance with [T4T].	
REQ-RW-1.5	The ability to read an NDEF message of an NFC Type 5 Tag.	
REQ-RW-1.5.1	The ability to support 1 Byte Commands for reading an NDEF message of an NFC Type 5 Tag as defined in [T5T].	
REQ-RW-1.5.2	The ability to support 2 Byte Commands for reading an NDEF message 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 an NDEF message to NFC Tag Types when a single tag is present in the Operating Volume.	
REQ-RW-2.1	VOID	
REQ-RW-2.2	The ability to write an NDEF message to an NFC Type 2 Tag [T2T].	
REQ-RW-2.3	The ability to write payload sizes up to 254 bytes at a bit rate of at least 212 kbit/s to an NFC Type 3 Tag. Payload is defined according to [DIGITAL] for the Type 3 Tag Platform.	
REQ-RW-2.3.1	The ability to write an NDEF message to an NFC Type 3 Tag [T3T].	
REQ-RW-2.4	The ability to write an NDEF message 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 Number	Reader/Writer Mode Requirement	Remark
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-2.4.3	Writing NDEF data to an NFC Type 4A and 4B Tag implementing Mapping Version 3.x, the ability to support 256B data within the command APDU. The definition of data bytes is used in accordance with [T4T].	
REQ-RW-2.5	The ability to write an NDEF message to an NFC Type 5 Tag [T5T].	
REQ-RW-2.5.1	The ability to support 1 Byte Commands for writing an NDEF message to an NFC Type 5 Tag.	
REQ-RW-2.5.2	The ability to support 2 Byte Commands for writing an NDEF message 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].	
REQ-RW-3.0	The ability to read or write an NDEF message size of at least one of the following options from any NFC Forum defined Tag Type: 1.6kB, 8kB, 16kB, 32kB, 130kB NOTE The Tag Type may impose further limits on the maximum NDEF message size.	Minimum limit on max NDEF message size
REQ-RW-3.1	The ability to read or write an NDEF message size of 130kB. NOTE The Tag Type may impose further limits on the maximum NDEF message size.	
REQ-RW-4.0	The ability to supply the NFC-A Guard Time	
REQ-RW-4.1	The ability to supply a Power Harvesting Guard Time	

5.5 Requirements for NFC Forum Card Emulation and Tag Mode

Table 16: 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.E	The ability to support the NFC-A Guard Time as defined in [DIGITAL]	T2T, T4AT
REQ-Tag-1.F	The ability to support the NFC-A Guard Time defined to Power Harvesting Guard Time (specified as 22.5ms)	T2T, T4AT
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 Devices.

5.6 Requirements for NFC Forum Type 2 Tag Module

Table 17: 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 18: 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 19: 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 20: 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.
REQ-T5T-1-10	The ability to support the special frame during Write-Alike command execution.	Optional feature.

T5T Number	Tag Mode Requirement	Remarks
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 21: 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 Wireless Charging Mode Requirements

Table 22: Wireless Charging Mode Requirements

WLC Number	Wireless Charging Requirement	Remarks
REQ-WLC-P-1	The ability to support the static and negotiated protocol as defined in [WLC].	
REQ-WLC-P-2	The ability to provide the power level for the supported power class as defined in [WLC].	
REQ-WLC-L-1	The ability to indicate and support either the static or negotiated mode as defined in [WLC].	
REQ-WLC-L-2	The ability to support to be charged independent of the power class of the WLC-P as defined in [WLC].	

5.12 Requirements for NFC Forum Certification

Table 23: 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.

5.13 Operating Volume and Reference Equipment

NFC Forum defines different operating volumes, two for generic use cases [ANALOG], one to assess the Tag performance [PERF] and two for wireless charging [WLC]. The five distinct operating volumes are denoted as *Comms OV5, Comms OV20, Perf OV, WLC OV6 and WLC OV7*. Basic interoperability between devices having a different coil size is covered by NFC Forum certification. Each device will be tested using a reference equipment having different coil sizes as defined in [ANALOG], [WLC] and [WPC Ki RP]. The different coil sizes of the reference equipment cover the span of device form factors targeted by NFC Forum use cases.

NFC Forum defines the following reference equipment to test communication related parameters:

- Reference Poller 0 - Coil:
    - Shape: round, outer diameter 60mm

- Reference Poller 3 – Coil:
    - Rectangular, outer dim: 47.5mm x 33.5mm
- Reference Poller 6 – Coil:
    - Rectangular, outer dim: 24.5mm x 19.5mm
- Reference Listener 1 – Coil:
    - Rectangular, outer dim: 71.6mm x 41.5mm
- Reference Listener 3 – Coil:
    - Rectangular, outer dim: 46.0mm x 32.0mm
- Reference Listener 6 – Coil:
    - Rectangular, outer dim: 24.7mm x 19.7mm

NFC Forum defines the following reference equipment to test wireless charging related parameters:

- Reference WLC-P6 – Coil:
    - Rectangular, outer dim: 27.5mm x 22.5mm
- Reference WLC-P7 – Coil:
    - Rectangular, outer dim: 10.5mm x 5.5mm
- Reference WLC-L6 – Coil:
    - Rectangular, outer dim: 24.7mm x 19.7mm
- Reference WLC-L7 – Coil:
    - Rectangular, outer dim: 9.0mm x 4.0mm

NFC Forum refers to [WPC Ki RP] to test communication related parameters for WPC Ki Tag Device class:

- WPC Ki RP – Coil:
    - larger than Reference Poller 0 Coil

Table 24 lists the reference equipment to be mandatorily and optionally used for certification testing depending on the Device Class and operating volume. The Tag performance operating volume (*Perf OV)* is only defined for Tag devices and therefore is only shown for this Device Class. If an Operating Volume does not apply for a particular Device Class it will not be shown.

Table 24 Reference Equipment and Operating Volume definition per Device Class

Device Class	Operating Volume	Ref Pol 0	Ref Pol 3	Ref Pol 6	Ref Lis 1	Ref Lis 3	Ref Lis 6	Ref WLC-P6	Ref WLC-P7	Ref WLC-L6	Ref WLC-L7	WPC Ki RP
NFC Universal Device	Comms OV20	M	M	M	M	M	M					
	WLC OV 6									O		
	WLC OV 7										O	
NFC Mobile Device	Comms OV20	M	M	M	M	M	M					
	WLC OV 6									O		
	WLC OV 7										O	
NFC Reader Device	Comms OV20				M	M	M					
	WLC OV 6									O		
	WLC OV 7										O	
Card Emulation Device	Comms OV20	M	M	M								
	WLC OV 6							O				
	WLC OV 7								O			
NFC Tag Device	Comms OV5	O^2	O^1	O^1								
	Comms OV20	O^2	O^1	O^1								
	Perf	O	M	M								
WLC Reader Device	WLC OV 6				O	O	M			M		
	WLC OV 7					O	M				M	
WLC Tag Device	WLC OV 6		O	M				M				
	WLC OV 7		O	M					M			
CCC Digital Key Reader Device	Comms OV5				O^1	O^1	O^1					
	Comms OV20				O^1	O^1	O^1					
CCC Digital Key CE Device	Comms OV20	M	M	M								
ICCE Digital Key Reader Device	Comms OV5				O^1	O^1	O^1					
	Comms OV20				O^1	O^1	O^1					
ICCE Digital Key CE Device	Comms OV20	M	M	M								
USI WLC Reader Device	WLC OV 7					O	M				M	
WPC Ki Reader Device (3)	Not defined				O^3	O^3	O^3					
WPC Ki Tag Device (3)	Not defined											O^3

NOTE O^1: It is mandatory for a device to select one of the listed OV per Reference Equipment and need to be the same OV for all Reference Equipment.

NOTE O^2: If selected the same OV for Reference Pollers 3 and 6 must have also been selected.

NOTE O^3; (^{3}): For the WPC Ki device classes, NFC Forum does not mandate yet any Analog testing for communication parameters and therefore not any Operating Volume. For Digital testing, WPC Ki RP is recommended for WPC Ki Tag device and NFC Forum Ref L1, L3 or L6 for WPC Ki Reader device.

For the WPC Ki device classes, please check the NFC Forum webpage if the WPC Ki device classes Operating Volume is already available for certification.

NOTE Interoperability is ensured in the smallest Operating Volume subset supported by the two devices.

A. Use Cases (Informative)

Three 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 the communication and charging protocols are defined by 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.

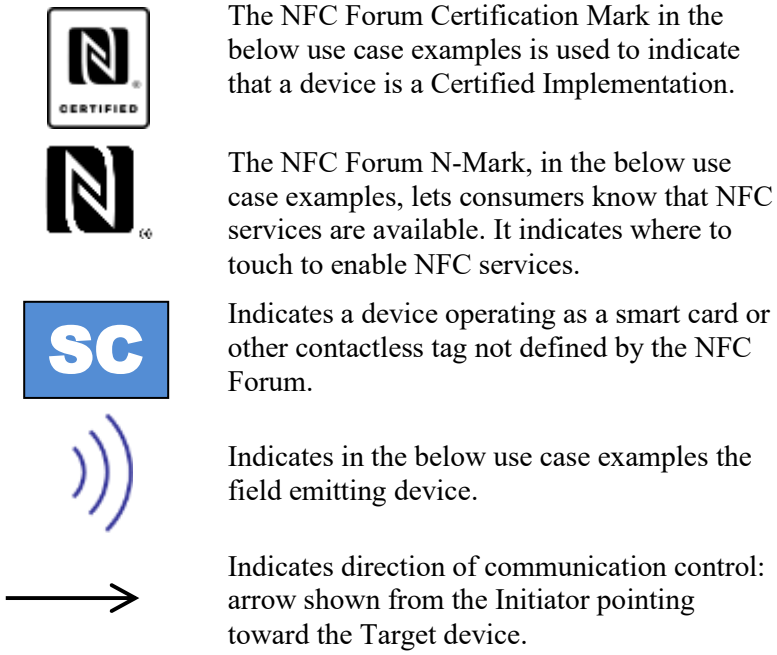

Figure 1: Conventions for Use Case Diagrams

A.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.

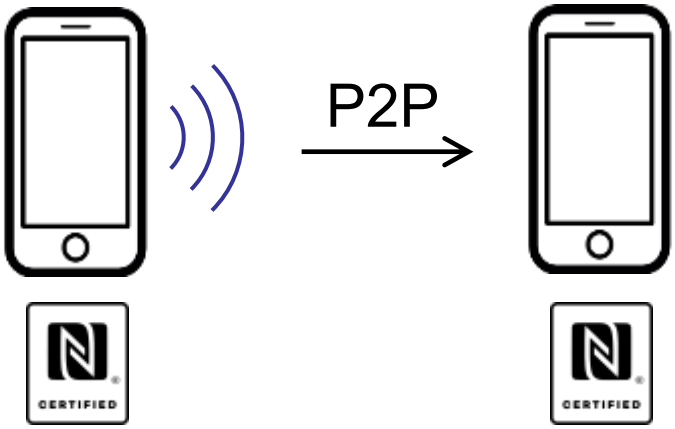

Figure 2: Two NFC Forum Devices Communicating in NFC Forum Peer Mode

2. An NFC Forum Device in NFC Forum Reader/Writer Mode is able to communicate with an NFC Forum Tag. The NFC Forum specifies the requirements for NFC Forum Tags as well as how to operate these tags. This is illustrated in Figure 3.

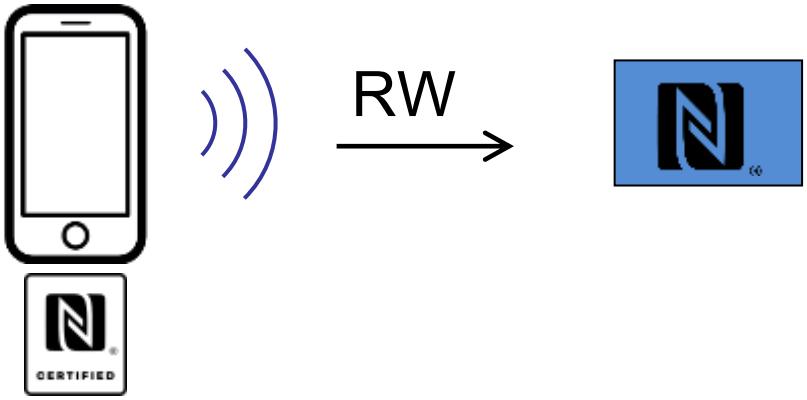

Figure 3: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with an NFC Forum Tag

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.

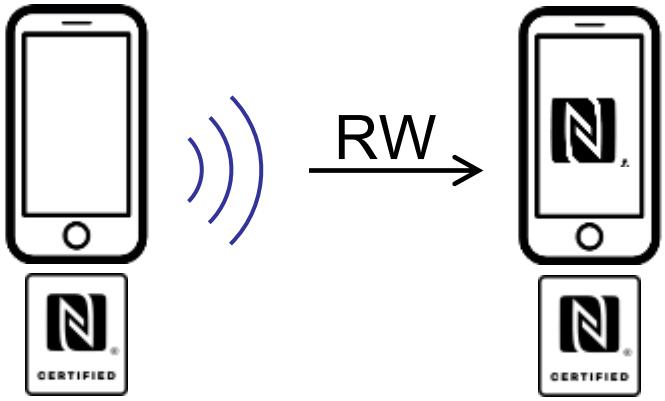

Figure 4: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with an NFC Forum Device in NFC Forum Card Emulation Mode

4. An NFC Forum Device in NFC Forum Reader/Writer Mode is able to communicate with an NFC Forum Device emulating an NFC Card Emulation Device. This is illustrated in Figure 5.

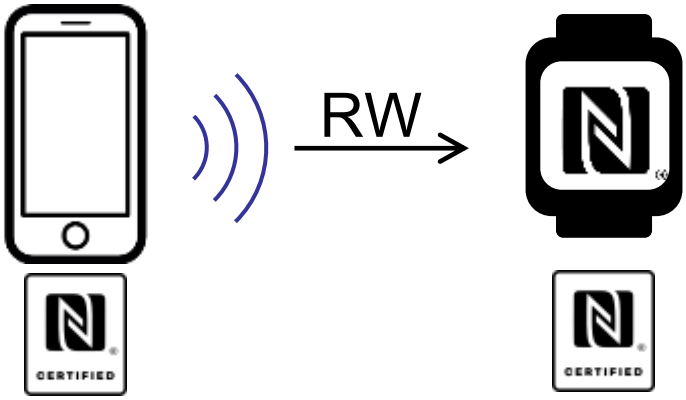

Figure 5: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with an NFC Forum Card Emulation Device

A.2 NFC Forum Wireless Charging Use Case

The use case defined in this section deals with the charging of an NFC WLC Tag Device by an NFC WLC Reader Device. In order to enable the wireless charging use case the two devices communicate to optimize the charging process. Figure 6 shows an use case example for wireless charging.

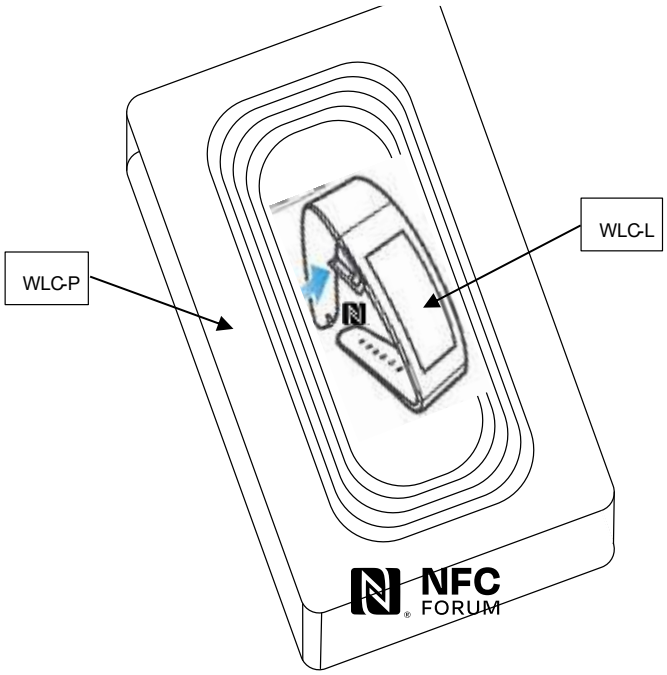

Figure 6: NFC WLC Poller (WLC-P) is communicating and charging a NFC WLC Listener (WLC-L)

A.3 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 7.

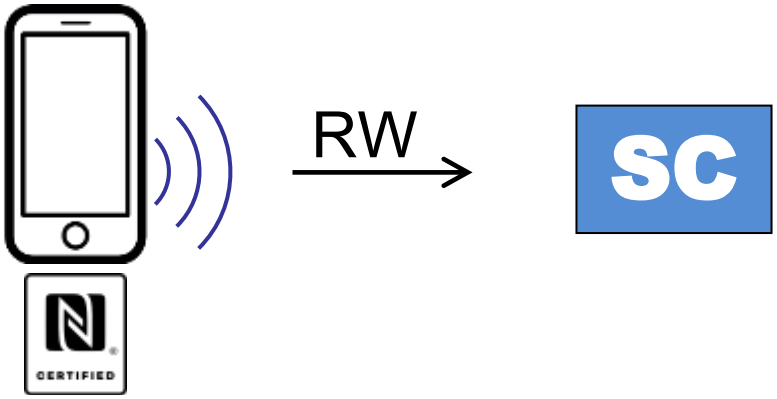

Figure 7: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with a SC

5. 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 8.

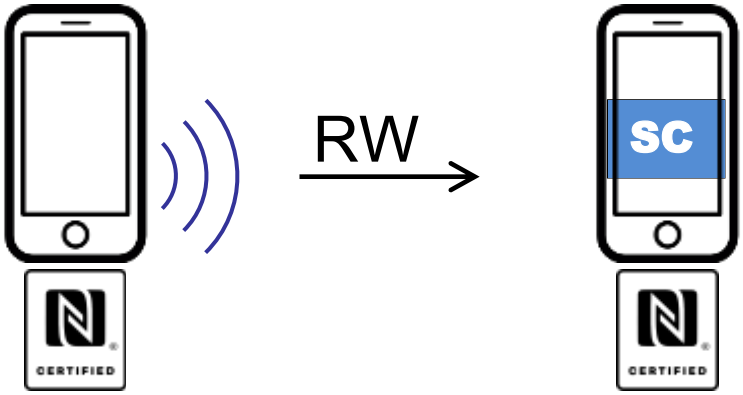

Figure 8: NFC Forum Device in NFC Forum Reader/Writer Mode Communicating with an NFC Forum Device Emulating a SC

6. 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 9.

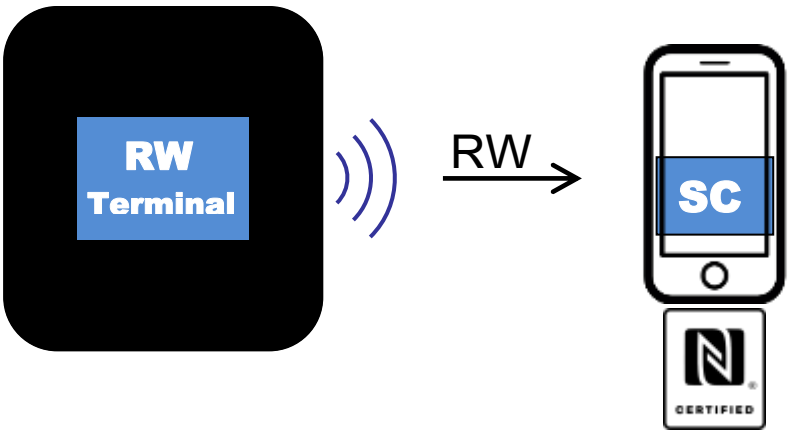

Figure 9: Reader/Writer Terminal and NFC Forum Device Emulating a SC

B. List of Device Classes containing other Device Classes

This section analysis which Device Classes implicitly contain other Device Classes as a function of mandatory and optional supported interoperability modules. Table 25 shows for the Parent Device Class which Child Device Classes are contained. For Device Class combinations not shown in the Parent Device Class section no Child Device Class exists.

Table 25: Device Class coverage of other Device Classes

			Parent Device Class				
			Open ecosystem NFC Forum Device Classes				
		Parent Device classes (in this row) cover the Child Device classes selected (in the column):	NFC Universal Device	NFC Mobile Device	NFC Reader Device	WLC Reader Device	NFC Card Emulation Device
Child Device Class	Open ecosystem Device Classes	NFC Universal Device	X				
		NFC Mobile Device	X[1]	X			
		NFC Reader Device	X	X	X	X	
		NFC Card Emulation Device	X[1]	X			X
		NFC Type 2 Tag					
		NFC Type 3 Tag					X[4]
		NFC Type 4A Tag					X[4]
		NFC Type 4B Tag					X[4]
		NFC Type 5 Tag					
		WLC Reader Device	X[3]	X[3]	X[3]	X	
		WLC Tag Device					X[4]
	Specific market ecosystem devices	CCC Digital Key Reader Device	X	X	X	X	
		CCC Digital Key CE Device	X[2]	X[2]			X[2]
		ICCE Digital Key Reader Device	X	X	X	X	
		ICCE Digital Key CE Device	X[2]	X[2]			X[2]
		USI WLC Reader Device	X[3]	X[3]	X[3]	X[5]	
		WPC Ki Reader Device	X[6]	X[6]	X[6]	X[6]	
		WPC Ki Tag Device					X[4]

X[1] : only if the NFC Universal Device supports Card Emulation Mode for T3T, T4AT, and/or T4BT Platform

X[2] : only if the NFC Universal, NFC Mobile Device or the NFC CE Device support Card Emulation Mode for T4AT Platform in normal and reduced Power mode

X[3]:Only if the optional WLC Poller Module is supported by the Parent Device.

X[4]: Only if the Tag Platform and Tag Module for the Tag Type are supported by the Parent Device.

X[5]: Only if the WLC Reader Device supports the Ref WLC-L7 operated in the WLC OV 7 (see section 5.13).

X[6]: Only if the Parent Device complies to REQ-Tag-1.F (Power Harvesting Guard time instead of the standard NFC-A Guard time)

NOTE Other coverage of Child Device classes by Parent Devices classes is not possible as some options are not foreseen in the Parent device class, but are mandatory in the Child Device Class

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 Devices defined in this document. The properties of each class are specified in Section 3.

Each class of NFC Forum Device complies with at least one of the sets of NFC Forum Interoperability Modules as defined in Section 3. 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 seven classes of NFC Forum Devices: NFC Universal Device, NFC Mobile Device, NFC Reader Device, NFC CE Device, NFC Tag Device, NFC WLC Reader and NFC WLC Tag Device. Section 3 defines which interoperability modules are mandatory or optional for a specific device class. A detailed assessment on interoperability between defined device classes is provided in Section 3.3.

C.2 NFC Forum Protocol Stack

The NFC Forum Protocol Stack contains all interoperability modules defined in Section 3:

- Peer Mode to enable communication with another device implementing the peer mode
- Reader/Writer Mode which interoperates with a device implementing either the Type X Tag Module or the CE Mode
- CE Mode enables the communication with devices implementing the Reader/Writer Mode or a technology-compatible reader/writer terminal
- Type X Tag Module enables the communication with devices implementing the Reader/Writer Mode or a technology-compatible reader/writer terminal
- Wireless Charging Module enabling the use case of NFC based charging. The WLC Poll Module uses the Tag Operation Mode to execute the WLC protocol. The WLC Listen Mode enables to be charged supporting one Tag Platform for the WLC protocol.

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

Table 26 maps the NFC Forum protocol stack components of NFC Forum defined interoperability modules in relation to the ISO/OSI defined protocol layers.

Table 26: OSI Protocol Stack Mapping

ISO/OSI Layer	Reader Writer Module	Peer Module	CE Module	Tag Module	WLC Poll Module	WLC Listen Module
L5 and up: Session, Presentation, Application	NDEF, RTDs, Applications	SNEP, NDEF, RTDs, Applications	Applications	NDEF, RTDs, Applications	WLC protocol, NDEF, RTDs	WLC protocol, NDEF, RTDs

L4: Transport	Type X Tag Operation, Type X Tag Platform		Type Y Tag, Type Y Tag Platform	Type X Tag, Type X Tag Platform	Type X Tag Operation, Type X Tag Platform	Type X Tag, Type X Tag Platform
L3: Network	None	None	None	None	None	None
L2: Data Link	None	LLCP	None	None	None	None
	Digital Protocol, Activity, ISO-DEP[1]	Digital Protocol, Activity, NFC-DEP	Digital Protocol, Activity, ISO-DEP[1]	Digital Protocol, Activity, ISO-DEP[1]	Digital Protocol, Activity, ISO-DEP[1]	Digital Protocol, Activity, ISO-DEP[1]
L1: Physical	Analog	Analog	Analog	Analog	Analog	Analog

NOTE 1: ISO-DEP transport protocol is defined for T4AT and T4BT communication.

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 Technologies.

Together, these specifications define how NFC Forum Devices communicate with other devices in the following ways.

- Devices in Peer Mode use the NFC-DEP transport to exchange information. NFC-DEP can be executed on either NFC-A or NFC-F Technology using either PCM or ACM.
- A Device in Reader/Writer Mode communicates with:
    - Devices supporting CE Mode. The CE Mode implements a Type X Tag Platform running on NFC-A (Type 4A Tag), NFC-B (Type 4B Tag) or NFC-F (Type 3 Tag) Technology
    - NFC Tag Devices supporting the Tag Module. The Tag Modules provides the NDEF application using the appropriate Type X Tag Platform running on NFC-A (Type 2, or Type 4A Tag), NFC-B (Type 4B Tag), NFC-F (Type 3 Tag) or NFC-V (Type 5 Tag) Technology. For Type 4A and Type 4B Tag the ISO-DEP transport facilitates the data exchange.
    - ISO/IEC 14443 smart cards using Type 4A/B Tag Platform and ISO-DEP running on either NFC-A or NFC-B Technology
    - JIS X 6319-4 (FeliCa) smart cards running on NFC-F Technology
    - ISO/IEC 15693 Tags running on NFC-V Technology.

- Devices supporting CE Mode:
    - If supporting Type 4A or 4B Tag Platform, communication using ISO-DEP running on either NFC-A or NFC-B Technology, with Devices supporting Reader/Writer Mode or a legacy reader/writer that supports that capability
    - If supporting Type 3 Tag Platform, communication using NFC-F Technology, with Devices supporting Reader/Writer Mode or a legacy reader/writer that supports that capability.
- Devices supporting Tag Mode:
    - Communicates and exchanges NDEF messages with a device supporting Reader/Writer Mode.
- Devices supporting WLC Poll Mode:
    - Communicates with and charges a device supporting WLC Listen mode using the Tag Platform and Module/Tag Operation supported by both devices.
- *Devices supporting* WLC Listen Mode:
    - Communicates with and will be charged by a device supporting WLC Poll mode using the Tag Platform and Module supported by both devices.

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, NFC Tag Devices 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 [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 can be mainly split into four different operation modes:

- The Peer Mode, which defines the communication between an Initiator and a Target. The Peer Mode is implemented in a NFC Universal Device or optionally in an NFC Reader Device (Initiator).
- The Reader/Writer Mode, which reads from, and potentially writes to, devices implementing the Card Emulation Mode or the Tag Mode. This mode also allows for communication with existing technology-compatible smart cards.
- The Card Emulation Mode, which emulates the behavior of a smart card or tag. This mode allows for communication with devices implementing the Reader/Writer Mode. It also enables the communication with existing technology-compatible reader/writer terminals. The Card Emulation Mode enables the communication to the Reader/Writer Mode but does not define the application to be executed like the NDEF application.
- The Tag Mode enables the communication with devices implementing the Reader/Writer Mode. It also enables the communication with existing technology-compatible reader/writer terminals. The Tag Mode provides a previously written NDEF message which also may be updated during its lifetime.
- The WLC Poll Mode enables charging of a device implementing WLC Listen mode using the same Tag Platform and Module.
- The WLC Listen Mode enables to be charged by a device implementing the WLC Poll mode using the same Tag Operation.

Section 3 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 six 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 10 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.

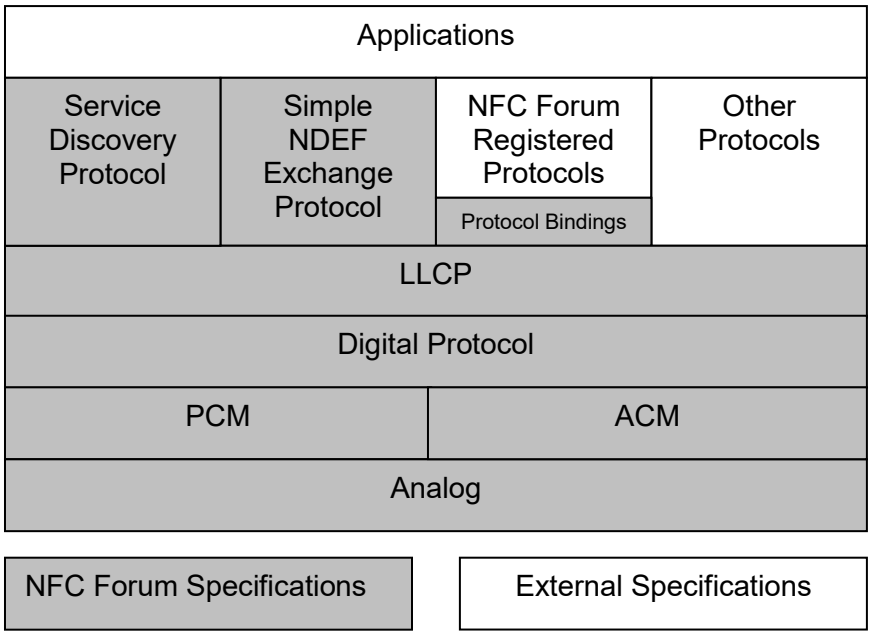

Figure 10: Peer Mode Architecture

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 or a device supporting CE Mode. In this mode the Tag Operation parts of the Type X Tag specifications are supported. Figure 11 shows the Reader/Writer Mode architecture.

If the device supports the 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 Technologies.

An NFC Forum Device implementing the Reader/Writer Mode 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 NDEF application level communication using the Tag Operation defined in [T2T], [T3T],[T4T] and [T5T].

Figure 11 shows the architecture for the Reader/Writer Mode following the OSI layer structure.

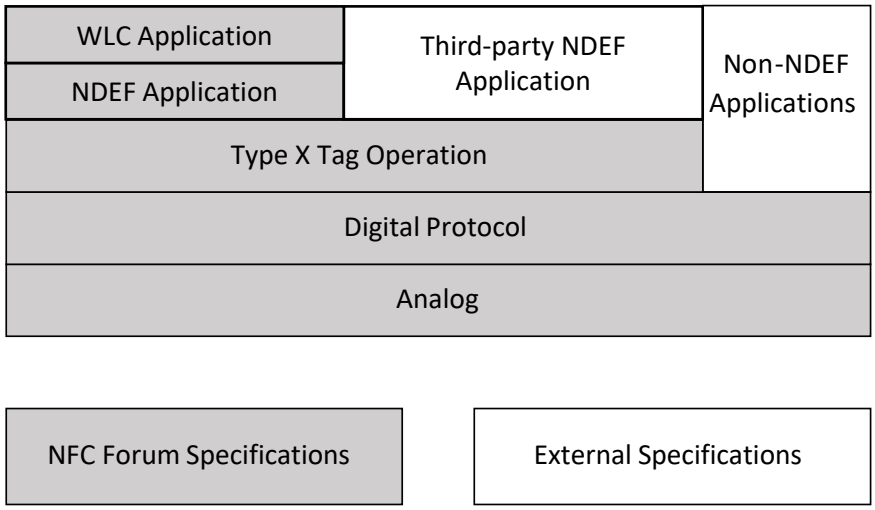

Figure 11: Reader/Writer Mode Architecture

NOTE The WLC Poll Mode is not shown as a dedicated mode since it can be regarded as an application using the entire stack of the Reader/Writer protocol stack.

C.3.3 NFC Forum Tag Modes

An NFC Forum device that is CE 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. The Tag mode is typically implemented in NFC Tag Devices and serve the same purpose as devices supporting CE Mode.

An NFC Forum Device that supports one of these modes enables communication to existing technology-compatible terminal infrastructures (e.g., for payment and ticketing). Figure 12 shows the architecture of the Tag and CE Mode.

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

The Tag Mode independent on the implemented Tag Type supports the NDEF application, the CE Mode may contain the NDEF application.

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.

Devices supporting either of both modes can also support non-NDEF applications that can employ the underlying layers to communicate with a reader/writer using the application-specific messages.

Figure 12 shows the architecture for the CE and the Tag Mode. The CE Mode is available for the Type 3 Tag, Type 4A Tag and Type 4B Tag Platforms. The Tag mode is available for all NFC Forum defined Tag Types.

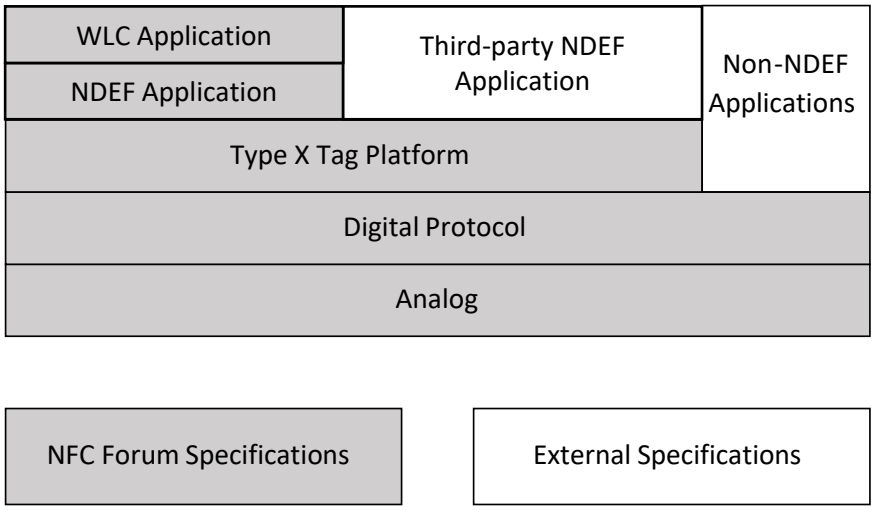

Figure 12: Tag Mode Architecture

NOTE The WLC Listen Mode is not shown as a dedicated mode since it can be regarded as an application using the entire stack of the Tag protocol stack.

C.4 Device Architecture

Figure 13 and Figure 14 show the generic architecture of an NFC Forum Device when the device is Polling (Figure 13) or Listening (Figure 14) 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. Depending on the Interoperability Modules supported, a Device Class may only implement parts of the Poll and/or Listen architecture.

Section 3 describes which configurations are possible for each class of NFC Forum Device.

NOTE Before starting an activity, the adjacent activity listed below must 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 Generic Polling Architecture

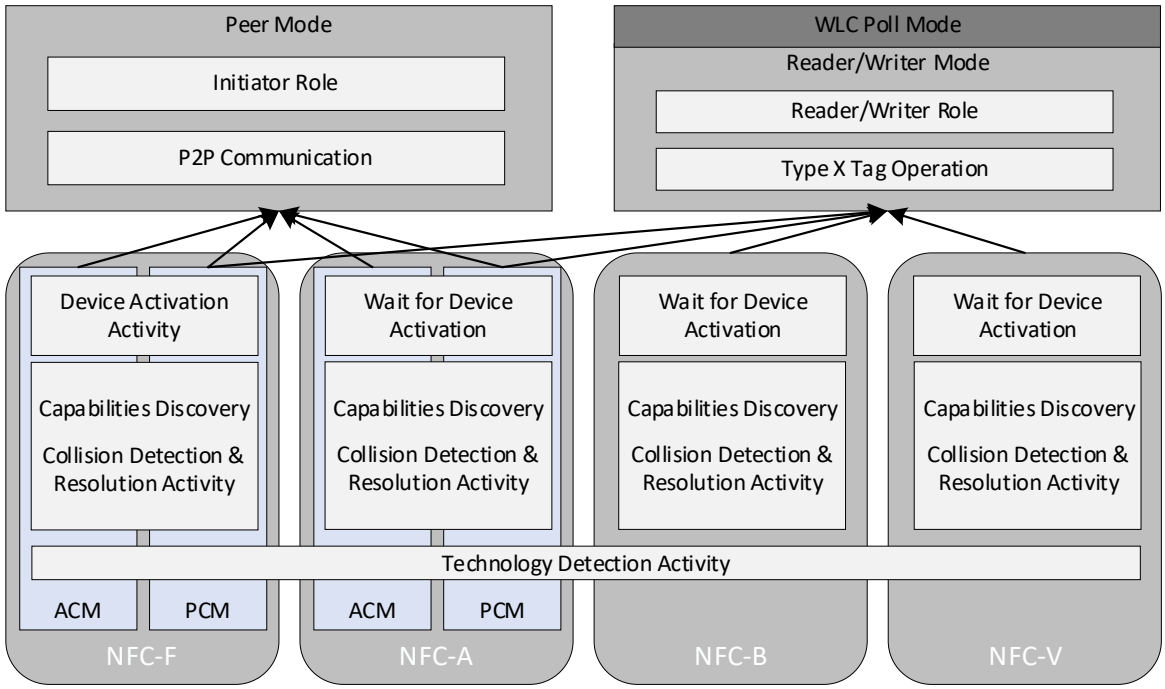

Figure 13: Generic Polling Architecture

Starting from the bottom, Figure 13 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. In case the WLC Poll mode is supported and the received NDEF message contains the WLC Capability record the WLC mode can be used to charge the device in proximity. At this point the device is a WLC Reader.

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 Generic Listening Architecture

This section describes the generic listen mode architecture. An NFC Forum defined Device Class may only implement parts of this architecture. Still it can be derived from this generic listen mode architecture.

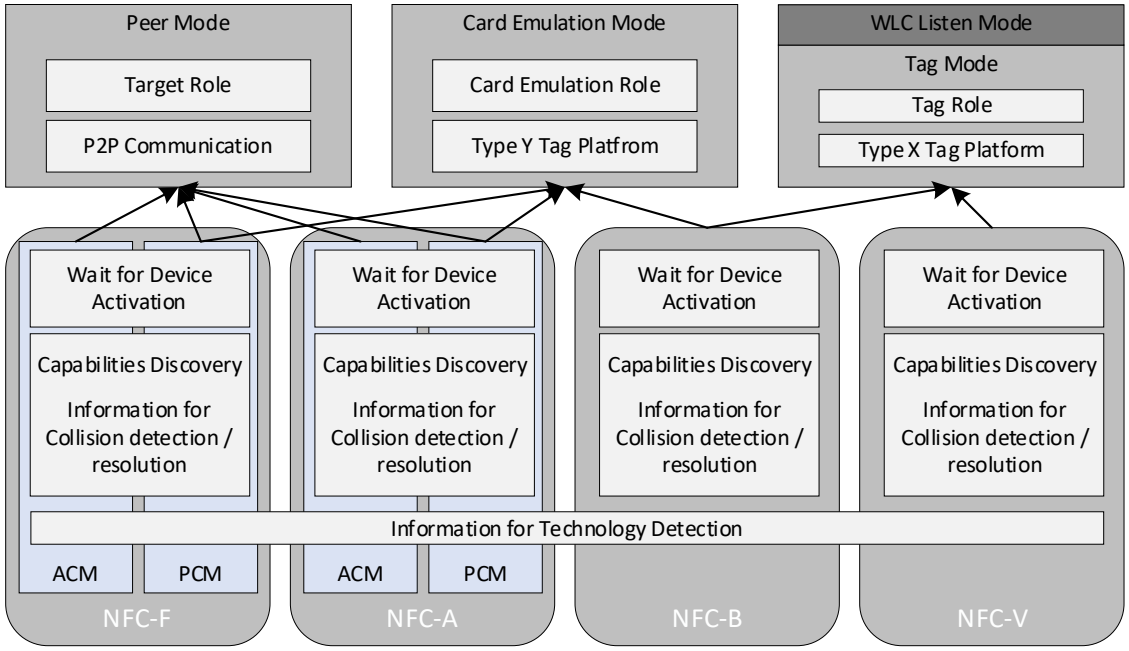

Figure 14 Generic Listening Architecture

Starting from the bottom, Figure 14 shows four different contactless technologies: NFC-F, NFC-A, NFC-B, and NFC-V.

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 for the selected Technology.

Depending on the supported modes and 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 Device supports Card Emulation Mode or the Tag Mode, 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 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 CE Mode, the Type X Tag Platform is shown in the top middle side of the figure. The activities of a Device in CE Mode comprise the use of the appropriate commands for the Platform. At this point, the device is emulating a Type Y 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 and the NDEF application. In case the WLC listen mode is supported the device provides in its NDEF

message the WLC Capability record. If the WLC poll mode is supported by the counterpart the WLC protocol is used to charge the device. At this point the device is a WLC Tag Device.

D. Revision History

Table 27 outlines the revision history of the "Devices Requirements" document.

Table 27: 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 requirements 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 Added [ARCHITECTURE] in section 1.4. Changed http link in Appendix C.	Version 1.4.01, March 2016
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	Version 2.0.00, August 2017

Document Name	Revision and Release Date	Status	Change Notice	Supersedes
			- 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.	
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 3.0 September 2021	Final	- RF Collision Avoidance Req. Extended - T1T OP removed - Specific market ecosystem addition - CCC Device Classes addition - Operating Volume and Reference Equipment section addition - Appendix B, device class compatibility analysis for certification	Version 2.1.01
Devices Requirements	Version 3.1 November 2021	Final	- WLC feature and device classes addition - USI WLC reader device addition - CE Device addition	Version 3.0
Devices Requirements	Version 3.2 March 2022	Final	- Update requirement for T4T MV3.0 APDU size - Add minimum requirement on maximum NDEF message size	Version 3.1 November 2021
Devices Requirements	Version 3.3 August 2024	Final	- Added WPC Ki Device Classes - Editorial updates	Version 3.2 March 2022
Devices Requirements	Version 3.4 September 2025	Final	- Added ICCE Dig-Key Reader and CE device. - Added Comms OV5 and Comms OV20 in chapter 5.13 - Editorial updates	Version 3.3 August 2024