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1 Introduction

1.1 Objectives
This document outlines the set of functionalities and features which are required to be supported by NFC Forum-compliant devices to ensure basic interoperability.

1.2 Purpose
The NFC Forum is publishing a set of technical specifications around the NFC technology. The purpose of this document is to define which high level features of the NFC Forum specifications must be implemented by a device in order to be eligible to receive the NFC Forum Compliance Mark. These are identified as requirements in this document.

The document provides the terminology and definitions, followed by a description of the extent of the NFC Forum Brand Promise to NFC Forum Peer Mode, NFC Forum Reader/Writer Mode, and NFC Forum Card Emulation Mode.

It outlines which parts of the NFC Forum protocol stack need to be present in order to reach the interoperability requirements to support the NFC Forum Brand Promise.

The criteria and use cases considered for determining the features are provided in appendices.

1.3 Audience
This document is intended for use by manufacturers wanting to implement an NFC Forum Device.

1.4 Applicable Documents or References
The following documents contain provisions that are referenced in this specification. The latest version including all published amendments applies unless a publication date is explicitly stated.


1.5 Administration

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

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http://www.nfc-forum.org/

The Minimum Level of Interoperability Compliance Working Group maintains this document.

1.6 Special Word Usage

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in RFC 2119.
1.7 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 NFC Forum specifications, whether a member of the NFC Forum or not.
- Permission to use the NFC Forum logos is automatically granted to designated members only as stipulated on the most recent Membership Privileges document 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 logos.
- 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.

1.8 Intellectual Property


1.9 Glossary

*APDU*

Application Protocol Data Unit

*ICS*

Implementation Conformance Statement: A document indicating which features are implemented by a product.

*IIEC*

International Electrotechnical Commission

*ISO*

International Organization for Standardization

*Listen Mode*

Initial mode of an NFC Forum Device when it does not generate a carrier; in this mode, the NFC Forum Device listens for the Remote Field of another device, as defined in [ACTIVITY].
**Introduction**

**LLCP**
Logical Link Control Protocol, as defined in [LLCP]

**NDEF**
NFC Data Exchange Format, as defined in [NDEF]

**NFC**
Near Field Communication

**NFC Forum Card Emulation Mode**
When in NFC Forum Card Emulation Mode, the NFC Forum Device (emulating either an NFC Forum Tag or a contactless card) cannot start the communication on its own. The Master/Slave Communication is initiated by a reader/writer terminal. The communication for this mode is abbreviated as CE.

**NFC Forum Device**
A device that supports the following Modus Operandi: Initiator, Target and Reader/Writer. It may also support Card Emulation Mode.

**NFC Forum Peer Mode**
In NFC Forum Peer Mode, the initiator starts the communication, and the target responds to it. Both NFC Forum Devices have the capability to be either initiator or target. It uses the NFC-DEP Protocol as described by [DIG PROT]. The communication for this mode is abbreviated as P2P.

**NFC Forum Reader/Writer Mode**
In NFC Forum Reader/Writer Mode, the NFC Forum Device starts the Master/Slave Communication and sends commands to an NFC Forum Tag or contactless card. The communication for this mode is abbreviated as RW.

**NFC Forum Tag**
A contactless tag or (smart) card supporting NDEF.

**NFC-A**
The Technology based on the modulation scheme, bit level coding, and frame format as defined in [DIG PROT].

**NFC-B**
The Technology based on the modulation scheme, bit level coding, and frame format as defined in [DIG PROT].

**NFC-F**
The Technology based on the modulation scheme, bit level coding, and frame format as defined in [DIG PROT].

**NFC-DEP Protocol**
Half-duplex block transmission protocol defined in [DIG PROT].
**Operating Volume**

The three-dimensional space, as defined by the NFC Forum, (see [ANALOG]), in which an NFC Forum Device in Poll Mode can communicate with an NFC Forum Device in Listen Mode or has to be able to communicate with a responding device.

**Poll Mode**

Initial mode of an NFC Forum Device when it generates a carrier and polls for other devices, defined in [ACTIVITY].

**RF**

Radio Frequency

**Record Type Definition (RTD)**

A definition of type names and their associated NDEF payload data format. An NFC Forum RTD defines NDEF payload data formats and their associated type names.

**SC**

Smart Card is a contactless tag or smart card 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).

**Technology**

A group of transmission parameters that make up a complete communication protocol. These parameters include carrier frequency, bit rate, modulation scheme, bit level coding, frame format, protocol, and command set. They use the same carrier frequency (13.56 MHz), but use a different modulation scheme, bit level coding, and frame format, and may share the protocol and command set.

**Type X Tag**

A contactless tag or smart card supporting NDEF, which can be accessed by a device implementing the tag operation specifications. Note: When used in a document, ‘X’ must be replaced by ‘1’, ‘2’, ‘3’, ‘4’, ‘4A’ or ‘4B’.

**Type Y Tag Platform**

The underlying communication protocol of a Type X Tag according to [DIG PROT]. Note: When used in a document, ‘Y’ must be replaced by ‘3’, ‘4A’ or ‘4B’.
2 Terminology and Definitions

2.1 The NFC Forum Brand Promise

The NFC Forum certification program provides a level of assurance that a certified device implements a certain level of functionality and that this functionality is compliant with the NFC Forum specifications. This is referred to in this document as the NFC Forum Brand Promise. In other words, it is the promise of functionality and interoperability which is conveyed by the NFC Forum Compliance Mark (the brand).

2.2 Technology Definitions

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

This section details the extent to which the Brand Promise of NFC Forum Certification applies to the different modes of operation. A mentioning of a layer or a reference to a specification in this section does not mean that all features of a particular layer or specification are mandatory.

3.1 Primary Mode of Operation

An NFC Forum Device shall be able to operate in Listen Mode as the default mode, and also in Poll Mode, as defined in [ACTIVITY].

3.2 Brand Promise for NFC Forum Peer Mode

An NFC Forum Device in NFC Forum Peer Mode shall support:

- Physical Layer (NFC-A, NFC-F) as defined by [ANALOG]
- Digital Layer (NFC-A, NFC-F) up to the device selection as defined by [DIG PROT] and [ACTIVITY]
- INITIATOR of NFC-DEP Protocol as defined by [DIG PROT]
- TARGET of NFC-DEP Protocol as defined by [DIG PROT]
- Logical Link Control Protocol as defined by [LLCP]
- Service Discovery Protocol
- Simple NDEF Exchange Protocol
- Capabilities to parse NDEF messages as specified in [NDEF]

![Device Architecture – NFC Forum Peer Mode](image-url)

Figure 1: Device Architecture – NFC Forum Peer Mode
In Figure 1, the Applications block includes NDEF applications. NDEF applications may use the Simple NDEF Exchange Protocol [SNEP] to exchange NDEF data or may use one of the other protocols for this purpose.

3.3 Brand Promise for NFC Forum Reader/Writer Mode

An NFC Forum Device in NFC Forum Reader/Writer Mode shall support

- Physical layer as defined by [ANALOG]
- All three technologies (NFC-F, NFC-A, NFC-B) up to the device selection as defined by [DIG PROT] and [ACTIVITY]
- Capabilities to read and write NFC Forum Types 1-4 Tags as defined by [T1T OP], [T2T OP], [T3T OP] and [T4T OP]
- Capabilities to parse NDEF messages as specified in [NDEF]

![NFC Architecture Diagram](image)

Subject to NFC Forum brand promise

3.4 Brand Promise for NFC Forum Card Emulation Mode (Optional)

The NFC Forum Card Emulation Mode is optional for an NFC Forum Device. However, where NFC forum Card Emulation Mode is supported, the NFC Forum Device shall provide RF and protocol functionality (as defined in [ANALOG], [DIG PROT] and [ACTIVITY]) which enables the emulation of contactless card products.

The NFC Brand Promise covers only emulation of Type 3 Tag Platform, Type 4A Tag Platform and Type 4B Tag Platform as defined in [DIG PROT] and [ACTIVITY]. Tag Platform means the
underlying communication protocol of the associated tag. In the scope of this document this is referred to as an emulation platform. The emulation platform and therefore NFC Forum Card Emulation Mode, excludes the application level (software and data).

Emulation of any other cards or tags is outside the scope of the NFC Forum Brand Promise.

With the emulation platform as defined above, the Brand Promise for NFC Forum Card Emulation Mode covers the device activation functionality and half-duplex communication. This functionality comes in addition to the device detection and collision detection already covered under [DIG PROT] and [ACTIVITY] in Listen mode.

An NFC Forum Device supporting NFC Forum Card Emulation Mode must implement at least one emulation platform and may implement more than one emulation platform.

For each of the emulation platforms implemented and declared in the Implementation Conformance Statement (ICS), the NFC Forum ensures interoperability of the following functions:

- Physical layer as defined by [ANALOG]
- Device detection as defined by [DIG PROT] and [ACTIVITY]
- Collision detection and resolution as defined by [DIG PROT] and [ACTIVITY]
- Device activation as defined by [DIG PROT] and [ACTIVITY]
- Half-duplex communication as defined by [DIG PROT] and [ACTIVITY]
- Device de-activation, if applicable and as defined by [DIG PROT] and [ACTIVITY]

<table>
<thead>
<tr>
<th>NDEF Reference Applications</th>
<th>Third Party NDEF Applications</th>
<th>Non-NDEF Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tag Operation Emulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Protocol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subject to NFC Forum brand promise

NFC Forum Specifications  External Specifications

Figure 3: Device Architecture – NFC Forum Card Emulation Mode (Optional)
4 Requirements for NFC Forum Compliant Devices

The requirements for an NFC Forum Device are listed in the following sections:

- **General Requirements**: Defines general capabilities of NFC Forum compliant devices.
- **RF Requirements**: Defines common performance requirements; for example, Operating Volume.
- **Requirements for NFC Forum Peer Mode**: Defines in detail the capabilities of NFC Forum compliant devices in NFC Forum Peer Mode.

### 4.1 General Requirements

**Table 1: General Requirements**

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEN</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>GEN-1</td>
<td>An NFC Forum Device SHALL be able to communicate in NFC Forum Peer Mode and SHALL be able to communicate in NFC Forum Reader/Writer Mode and MAY be able to communicate in NFC Forum Card Emulation Mode.</td>
<td>See Section 4.3, 4.4 and 4.5.</td>
</tr>
<tr>
<td>GEN-2</td>
<td>An NFC Forum Device SHALL have a Poll Mode and a Listen Mode.</td>
<td></td>
</tr>
<tr>
<td>GEN-3</td>
<td>An NFC Forum Device SHALL be capable to detect any NFC Forum Tag (potentially containing an NDEF message) or another NFC Forum Device.</td>
<td></td>
</tr>
<tr>
<td>GEN-3.1</td>
<td>An NFC Forum Device in Poll Mode, SHALL detect an NFC Forum Tag or an NFC Forum Device in Peer Mode within 5 seconds of the tag or device being brought into the Operating Volume.</td>
<td>This is not a requirement to enforce a device to always poll but in the case the device is polling this requirement applies. The requirement applies to digital protocol layer.</td>
</tr>
<tr>
<td>GEN-4</td>
<td>An NFC Forum Device SHALL be able to poll for all technologies—NFC-A, NFC-B, and NFC-F.</td>
<td></td>
</tr>
<tr>
<td>GEN-5</td>
<td>An NFC Forum Device SHALL achieve a minimum operating range.</td>
<td>See Section 4.2.</td>
</tr>
<tr>
<td>GEN-6</td>
<td>An NFC Forum Device SHALL detect if multiple NFC Forum Devices and NFC Forum Tags respond to a poll command. There is no requirement to identify each responding device.</td>
<td></td>
</tr>
<tr>
<td>GEN-7</td>
<td>NDEF data produced by an NFC Forum Device</td>
<td>according to [NDEF]</td>
</tr>
<tr>
<td>No.</td>
<td>Requirement</td>
<td>Remark</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>GEN</td>
<td><strong>General</strong></td>
<td>“Consuming” means that the upper layers of the stack, or the application itself, will process the data (message in the NDEF message) and use it if it is meaningful, or if not meaningful (content or size-wise), either ignore it or generate some kind of error message. The error message to the user should indicate that the information is meaningless to the application, for example, &quot;not valid content&quot;.</td>
</tr>
<tr>
<td>GEN-8</td>
<td>An NFC Forum Device which is capable of consuming particular NDEF data SHALL accept the same NDEF data in any well-formed NDEF message.</td>
<td>Support for the advanced protocol features as described in [DIG PROT] publication will be allowed when the necessary specifications are developed.</td>
</tr>
<tr>
<td>GEN-9</td>
<td>An NFC Forum Device must set the parameters to disable the support of advanced protocol features, as follows:</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NFC-A</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• In the RATS command, the NFC Forum Device in Poll Mode MUST set FSDI equal to 8h.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• In response to the RATS command, the NFC Forum Device in Listen Mode MUST set to 0b:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ bits b7 to b5 and b3 to b1 of TA(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ bit b5 of TC(1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NFC-B</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• In the ALLB_REQ and SENSB_REQ command, the NFC Forum Device in Poll Mode MUST set bits b5 and b6 to 0b.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• In the SENSB_RES response, the NFC Forum Device in Listen Mode MUST set to 0b:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ bits b7 to b5 and b3 to b1 of the Bit_Rate_Capability field</td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ bits b3 and b2 of the Protocol_Type field</td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ bit b4 of the ADC field</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In the ATTRIB command, the NFC Forum Device in Poll Mode must set bits b5 to b8 and b3 to b4 of Param 1 to 0b.</td>
<td></td>
</tr>
</tbody>
</table>
4.2 RF Requirements

Table 2: RF Requirements

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF</td>
<td>RF requirements</td>
<td></td>
</tr>
<tr>
<td>RF-1</td>
<td>An NFC Forum Device SHALL be capable of</td>
<td>The Operating Volume will be defined by [ANALOG]. The intention is that</td>
</tr>
<tr>
<td></td>
<td>exchanging data with another NFC Forum Device</td>
<td>the definition of the Operating Volume will provide an operating range of</td>
</tr>
<tr>
<td></td>
<td>or an NFC Forum Tag within a well-defined</td>
<td>at least 15mm. The conformance to this requirement is intended to be</td>
</tr>
<tr>
<td></td>
<td>Operating Volume.</td>
<td>determined using reference equipment with a design specified in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>relevant specification.</td>
</tr>
</tbody>
</table>

4.3 Requirements for NFC Forum Peer Mode

Table 3: Requirements for NFC Forum Peer Mode

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2P</td>
<td>NFC Forum Peer Mode</td>
<td></td>
</tr>
<tr>
<td>P2P-1</td>
<td>Two NFC Forum Devices SHALL be able to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>communicate in Peer Mode to exchange application</td>
<td></td>
</tr>
<tr>
<td></td>
<td>data.</td>
<td></td>
</tr>
<tr>
<td>P2P-1.1</td>
<td>An NFC Forum Device in Peer Mode SHALL be able</td>
<td></td>
</tr>
<tr>
<td></td>
<td>to exchange data as initiator in passive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>communication mode using at least one of the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>following bit rates: 106, 212, and 424 kbit/s.</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Requirement</td>
<td>Remark</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>P2P</td>
<td><strong>NFC Forum Peer Mode</strong></td>
<td></td>
</tr>
<tr>
<td>P2P-1.2</td>
<td>An NFC Forum Device in Peer Mode SHALL be able</td>
<td></td>
</tr>
<tr>
<td></td>
<td>to exchange data at 106, 212, and 424 kbit/s as</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the target in passive communication mode.</td>
<td></td>
</tr>
<tr>
<td>P2P-1.3</td>
<td>An NFC Forum Device SHALL support payload sizes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>up to and including 254 bytes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The definition of payload is according to NFC-DEP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protocol as defined by [DIG PROT].</td>
<td></td>
</tr>
<tr>
<td>P2P-2</td>
<td>An NFC Forum Device in Peer Mode SHALL support</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LLCP.</td>
<td></td>
</tr>
<tr>
<td>P2P-3</td>
<td>In Peer Mode, two NFC Forum Devices SHALL be</td>
<td></td>
</tr>
<tr>
<td></td>
<td>capable of exchanging NDEF Data.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This functionality is intended to be</td>
<td></td>
</tr>
<tr>
<td></td>
<td>provided by the Simple NDEF Exchange Protocol</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[SNEP].</td>
<td></td>
</tr>
</tbody>
</table>
## 4.4 Requirements for NFC Forum Reader/Writer Mode

### Table 4: Requirements for NFC Forum Reader/Writer Mode

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>RW</td>
<td><strong>NFC Forum Reader/Writer Mode</strong></td>
<td></td>
</tr>
<tr>
<td>RW-1</td>
<td>An NFC Forum Device SHALL be capable of reading NDEF data structures from all NFC Forum Tag Types when a single tag is present in the Operating Volume.</td>
<td></td>
</tr>
<tr>
<td>RW-1.1</td>
<td>An NFC Forum Device SHALL be capable of reading NDEF data structures of an NFC Forum Type 1 Tag.</td>
<td></td>
</tr>
<tr>
<td>RW-1.2</td>
<td>An NFC Forum Device SHALL be capable of reading NDEF data structures of an NFC Forum Type 2 Tag.</td>
<td></td>
</tr>
<tr>
<td>RW-1.3</td>
<td>An NFC Forum Device SHALL be capable of reading NDEF data structures of an NFC Forum Type 3 Tag.</td>
<td></td>
</tr>
<tr>
<td>RW-1.3.1</td>
<td>An NFC Forum Device reading an NFC Forum Type 3 Tag SHALL support payload sizes up to 253 bytes and SHALL support a bit rate of 212kbit/s. The definition of payload is according to [DIG PROT] for Type 3 Tag platform.</td>
<td></td>
</tr>
<tr>
<td>RW-1.4</td>
<td>An NFC Forum Device SHALL be capable of reading NDEF data structures of an NFC Forum Type 4 Tag.</td>
<td></td>
</tr>
<tr>
<td>RW-1.4.1</td>
<td>An NFC Forum Device reading an NFC Forum Type 4 Tag SHALL support 256 data bytes within the response APDU, a payload size of 254 bytes, and a bit rate of 106kbit/s. The definition of data bytes is used in accordance with [T4T OP] and payload is used in accordance with [DIG PROT].</td>
<td></td>
</tr>
<tr>
<td>RW-2</td>
<td>An NFC Forum Device SHALL be capable of writing NDEF data structures to all NFC Forum Tag Types when a single tag is present in the Operating Volume.</td>
<td></td>
</tr>
<tr>
<td>RW-2.1</td>
<td>An NFC Forum Device SHALL be capable of writing NDEF data structures to a NFC Forum Type 1 Tag.</td>
<td></td>
</tr>
<tr>
<td>RW-2.2</td>
<td>An NFC Forum Device SHALL be capable of writing NDEF data structures to a NFC Forum Type 2 Tag.</td>
<td></td>
</tr>
<tr>
<td>RW-2.3</td>
<td>An NFC Forum Device SHALL be capable of writing NDEF data structures to a NFC Forum Type 3 Tag.</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Requirement</td>
<td>Remark</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>RW</td>
<td><strong>NFC Forum Reader/Writer Mode</strong></td>
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</table>
| RW-2.3.1 | An NFC Forum Device writing NDEF data to an NFC Forum Type 3 Tag SHALL support payload sizes up to 253 bytes and SHALL support a bit rate of 212kbit/s.  
The definition of payload is according to [DIG PROT] for Type 3 Tag platform. |                                                                                                                                        |
| RW-2.4 | An NFC Forum Device SHALL be capable of writing NDEF data structures to an NFC Forum Type 4 Tag. |                                                                                                                                        |
| RW-2.4.1 | An NFC Forum Device writing NDEF data to an NFC Forum Type 4 Tag SHALL support 255 data bytes within the command APDU, a payload size of 254 bytes, and a bit rate of 106kbit/s.  
The definition of data bytes is used in accordance with [T4T OP] and payload is used in accordance with [DIG PROT]. |                                                                                                                                        |
4.5 Requirements for NFC Forum Card Emulation Mode (Optional)

The implementation of Card Emulation Mode is optional. However, if Card Emulation Mode is implemented and claimed in the ICS, then it must conform to the following requirements.

Table 5: Requirements for NFC Forum Card Emulation Mode (Optional)

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<th>No.</th>
<th>Requirement</th>
<th>Remarks</th>
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<td>CE</td>
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<td>CE-1</td>
<td>If Card Emulation Mode is implemented on an NFC Forum Device, at least one out of the following technologies SHALL be supported: NFC-A (PICC), NFC-B (PICC), or NFC-F (PICC).</td>
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<td>CE-1.1</td>
<td>If card emulation according to NFC-A (PICC) is implemented, the NFC Forum Device SHALL be compliant to the Type 4A Tag platform as per [DIG PROT] and [ACTIVITY].</td>
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<td>CE-1.2</td>
<td>If card emulation according to NFC-B (PICC) is implemented, the NFC Forum Device SHALL be compliant to the Type 4B Tag platform as per [DIG PROT] and [ACTIVITY].</td>
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<td>CE-1.3</td>
<td>If card emulation according to NFC-F (PICC) is implemented, the NFC Forum Device SHALL be compliant to the Type 3 Tag platform as per [DIG PROT] and [ACTIVITY].</td>
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</table>

**NOTE** In NFC Forum Card Emulation Mode, no requirements are specified for tag emulation to exchange NDEF data between NFC Forum Devices.
A. 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 4 describes the conventions used in the figures below to indicate the roles of the different actors in the use cases. Note that this usage is confined to the illustrations of the use cases in this document, and does not indicate the general usage of the marks.

![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 which has been defined by the NFC Forum. Interoperability up to a certain 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 5.

![Figure 5: 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 external NFC Forum Tag. NFC Forum Tags are selected by the NFC Forum and specifications on how to operate these tags are made available. This is illustrated in Figure 6.

Figure 6: 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 a NFC Forum Tag. This is illustrated in Figure 7.

Figure 7: NFC Forum Device in NFC Forum Reader/Writer Mode communicating with an NFC Forum Device in NFC Forum Card Emulation Mode

A.2 Legacy Communication Use Cases

The use cases defined in this section deal with communication between an NFC Forum Device and legacy systems which are not defined by the NFC Forum. However, parts of the implementation of an NFC Forum Device, like the RF layer or lower layer protocols, are also used by legacy infrastructure. The NFC Forum takes into account that requirements for some parts of the protocol stack may impact the usability of NFC Forum Devices within existing contactless infrastructure, and therefore NFC Forum takes requirements of legacy systems into consideration when testing parts of the protocol stack that are also relevant for legacy systems.

1. An NFC Forum Device in Reader/Writer mode can communicate to an external smart card (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) compatible with those defined by the NFC Forum (NFC-A, NFC-B and/or NFC-F). This is illustrated in Figure 8.
2. An NFC Forum Device in Reader/Writer mode can communicate to 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 9.

3. 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 10.
B. Requirements and Technical Specifications Cross Reference (Informative)

Table 6 shows the cross reference between the requirements in this document and the relevant set of NFC Forum technical specifications.

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<th>No.</th>
<th>Relation</th>
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<th>ACTIVITY</th>
<th>DIG PROT</th>
<th>LLCP</th>
<th>SNEP</th>
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C. Revision History

The following table outlines the revision history of the NFC Forum Device Requirements document.

Table 7 Revision History

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<th>Revision and Release Date</th>
<th>Status</th>
<th>Change Notice</th>
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<td>Final Draft</td>
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