Device Test Application Specification

for NFC Forum Analog,
NFC Forum Digital Protocol,
NFC Forum LLCP,
NFC Forum SNEP,
and NFC Forum Type 1/2/3/4 Tags

NFC Forum™

NFCForum-CS-DeviceTestApplication_v2.1.01

2013-12-23

RESTRICTIONS ON USE

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1 Introduction

1.1 Scope

This specification describes the Device Test Application (DTA) that a vendor can integrate in an NFC Forum Device to ensure that the Implementation Under Test (IUT) can be tested against the NFC Forum Technical Specifications [ANALOG], [DIGITAL], [T1TOP], [T2TOP], [T3TOP], [T4TOP], [LLCP], and [SNEP].

The Test Laboratory uses the DTA to configure the IUT for NFC Forum Certification Testing. The DTA, together with the Technical Specifications, provides all the information vendors need in order to implement in their devices the functionalities that are required to pass the NFC Forum Certification. The DTA has been designed to maximize automation with minimal human intervention and to minimize the resources needed when running the NFC Forum test cases.

For NFC Forum Certification Testing at Analog and Digital levels, the DTA is based on Profiles, which are explained in NFC Activity Technical Specification [ACTIVITY]. A Profile is a set of activities (i.e., a sequence of commands and responses) with a set of configuration parameters. The combination of Activities and Profiles defines a predictable, deterministic behavior for an NFC Forum Device, which is utilized by the DTA to guarantee that the test cases can be reliably reproduced and to reduce the resources (in term of memory space) needed by the DTA itself.

This document specifies a Test Profile and Listen Mode Execution based on the NFC Activity Specification. The Test Profile and Listen Mode Execution are integrated into the DTA together with transaction functionalities, which are specific command sequences or well-known Type Tag operations that are under test.

For NFC Forum LLCP and SNEP Certification Testing, the DTA uses a different approach, but again with the aim of optimizing automated test coverage.

1.2 Audience

This document is intended for use by vendors that want to certify an NFC Forum Device.

1.3 Applicable Documents or References

This document complements NFC Forum Digital Test Cases.

[ACTIVITY]	Activity Technical Specification, Version 1.0, NFC Forum
[ANALOG]	Analog Technical Specification, Version 1.0, NFC Forum
[ANALOG_TC]	Test Cases for Analog Technical Specification, Version 1.0.02, NFC Forum
[DIGITAL]	Digital Protocol Technical Specification, Version 1.0, NFC Forum

[DIGITAL_TC]	Test Cases for the Digital Protocol and Activity Technical Specifications, Version 1.0.05 NFC Forum
[ICS]	Implementation Conformance Statement (ICS) for Digital Protocol, LLCP, and SNEP Version 1.0.09, NFC Forum
[ICS_A]	Implementation Conformance Statement (ICS) for Analog, Version 1.0.08 NFC Forum
[ICS_I]	Instructions for Completing the Implementation Conformance Statement (ICS), Version 1.0.09, NFC Forum
[ISO/IEC_9646]	ISO/IEC 9646, Open Systems Interconnection – Conformance testing methodology and framework, 1995, ISO/IEC
[ISO/IEC_9646-1]	ISO/IEC 9646-1: Information Technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts 1994, ISO
[ISO/IEC_9646-2]	ISO/IEC 9646-2: Information Technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 2: Abstract Test Suite specification 1994, ISO
[ISO/IEC_14443]	Identification cards – Contactless integrated circuit cards – Proximity cards Includes: [ISO/IEC 14443-1:2008], Identification cards – Contactless integrated circuit cards – Proximity cards – Part 1: Physical characteristics [ISO/IEC 14443-2:2010], Identification cards – Contactless integrated circuit cards – Proximity cards – Part 2: Radio frequency power and signal balance [ISO/IEC 14443-3:2001], Identification cards – Contactless integrated circuit cards – Proximity cards – Part 3: Initialization and anti-collision

	[ISO/IEC_14443-3:2001/Amd.1], Identification cards -- Contactless integrated circuit(s) cards -- Proximity cards -- Part 3: Initialization and Anti-collision, 1 February 2001 with Amendment 1: Bit rates of fc/64, fc/32 and fc/16, 15 June 2005; Amendment 3: Handling of reserved fields and values, 22 March 2006; and Corrigendum 1: Amendment 1 - Corrigendum, 29 August 2006
	[ISO/IEC 14443-4:2008], Identification cards – Contactless integrated circuit cards – Proximity cards – Part 4: Transmission protocol
	ISO/IEC
[IXIT]	Implementation eXtra Information for Testing (IXIT) for Digital Protocol, Version 1.0.09, NFC Forum
[IXIT_A]	Implementation eXtra Information for Testing (IXIT) for Analog, Version 1.0.04 NFC Forum
[IXIT_I]	Instructions for Completing the Implementation eXtra Information for Testing Version 1.0.09, NFC Forum
[LLCP]	Logical Link Control Protocol (LLCP) Technical Specification, Version 1.1, NFC Forum
[RFC2119]	Key words for use in RFCs to Indicate Requirement Levels, RFC 2119, S. Bradner, March 1997, Internet Engineering Task Force
[SNEP]	Simple NDEF Exchange Protocol (SNEP) Technical Specification, Version 1.0, NFC Forum
[SNEP_TC]	Test Cases for SNEP Version 1.0.02, NFC Forum
[T1TOP]	Forum Type 1 Tag Operation Specification Version 1.1, NFC Forum
[T2TOP]	Forum Type 2 Tag Operation, Version 1.1 NFC Forum
[T3TOP]	Forum Type 3 Tag Operation, Version 1.1, NFC Forum
[T4TOP]	Forum Type 4 Tag Operation, Version 2.1, NFC Forum

[T1T_TC]	Test Cases for the Type 1 Tag Operation, Version 1.1.01, NFC Forum
[T2T_TC]	Test Cases for the Type 2 Tag Operation, Version 1.1.01, NFC Forum
[T3T_TC]	Test Cases for the Type 3 Tag Operation, Version 1.1.01, NFC Forum
[T4T_TC]	Test Cases for the Type 4 Tag Operation, Version 1.0.05, NFC Forum

1.4 Administration

The Device Test Application Specification is an open specification supported by the Near Field Communication Forum, Inc., located at:

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Wakefield, MA, 01880

Tel.: +1 781-876-8955
Fax: +1 781-610-9864

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

The NFC Forum, Inc. maintains this specification.

1.5 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.

1.6 Intellectual Property

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

1.7 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].

1.8 Requirement Numbering

Requirements in this document are uniquely numbered, with the number appearing next to each requirement. Requirements can include informative statements. In this case, the statement is formatted with italics and MAY instead of MUST is used. For example:

Table 1: Sample Requirement

1.8.1.1	A car MUST have four wheels.
A car MAY have five wheels.	

A figure that is labeled “flow chart” illustrates the behavior given by the corresponding requirements tables. Figures are informative if not otherwise stated. Figure 1 shows an example.

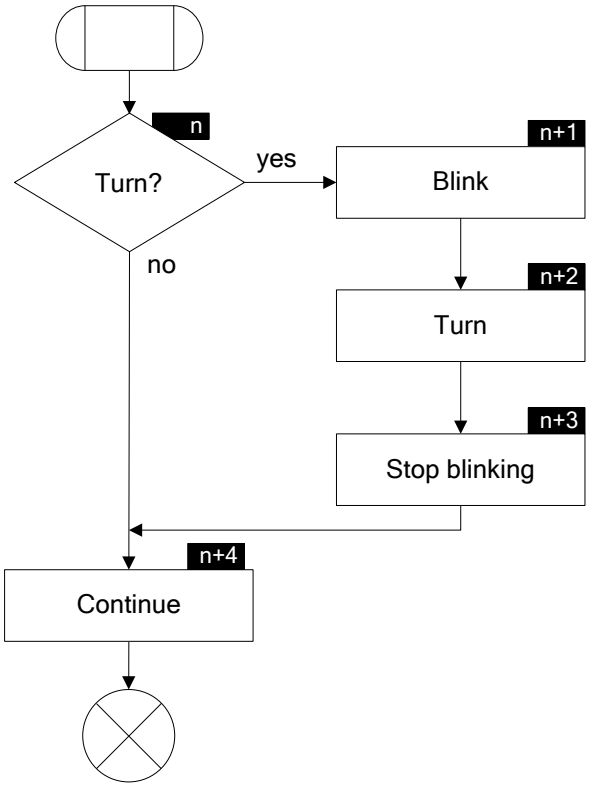


Figure 1: Example Flow Chart

A requirement can be labeled as a symbol when referring to a flow chart, indicating a particular sequence. If the current requirement is labeled "Symbol *n*", then the next requirement in the sequence is "Symbol *n*+1", unless explicitly stated differently.

Table 2: Example Requirements

1.8.1.2	Symbol *n* If a car wants to turn left or right, it MUST proceed to Symbol *n+1*. Otherwise, the car MUST proceed to Symbol *n+4*.
1.8.1.3	Symbol *n+1* The car MUST blink.
1.8.1.4	Symbol *n+2* The car MUST turn.
1.8.1.5	Symbol *n+3* The car MUST stop blinking.
1.8.1.6	Symbol *n+4* The car MUST continue to drive straight ahead or stop.

1.9 Notational Conventions

1.9.1 Notations

Table 3 defines the notational conventions used in this document.

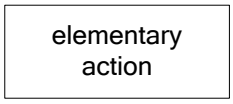
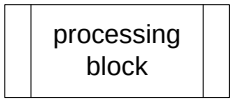
Table 3: Notational Conventions

Notation	Description
XYh	Hexadecimal notation. Values expressed in hexadecimal form are followed by a lower case “h”. For example, 27509 decimal is expressed in hexadecimal as 6B75h.
xyb	Binary notation. Values expressed in binary form are followed by a lower case “b”. For example, 82h hexadecimal is expressed in binary as 10000010b.
[…]	Optional part
xx	More than one value possible
STATE	Written in **COURIER FONT** and in bold to distinguish them from the text.
PARAMETER	Written in CAPITAL LETTERS to distinguish it from the surrounding text.
CON_	Prefix for Configuration Parameters; e.g., CON_DEVICES_LIMIT.
INT_	Prefix for variables used in the Activities; e.g., INT_COLL_PEND.
GRE_	Prefix for variables used in the Greedy Collection; e.g., GRE_POLL_A.

1.9.2 Figures

Table 4 defines the graphical notation used in the figures of this document.

Table 4: Figure Notation

Symbol	Meaning
	Activity
	Start of a flow chart
	Connection point with dedicated label. Used when a flow chart is split into multiple figures
	End of a flow chart
	Test block with one input branch and several output branches
	Elementary action block
	Processing block that can be decomposed in elementary action blocks and/or other processing blocks
	Connecting element with processing flow indicated by the direction of the arrow

1.10 Abbreviations

Table 5: Abbreviations

Abbreviation	Description
APDU	Application Protocol Data Unit
C-APDU	Command APDU
DUT	Device Under Test
IUT	Implementation Under Test
n.a.	Not Applicable
NDEF	NFC Data Exchange Format
NFC	Near Field Communication
NFC-A	Near Field Communication – Type A Technology
NFC-B	Near Field Communication – Type B Technology
NFC-F	Near Field Communication – Type F Technology
NFCID0	NFC-B identifier. NFCID0 is always 4 long.
NFCID1	NFC-A identifier of the NFC Forum Device in the Passive Communication mode. NFCID1 can be 4, 7, or 10 bytes long (simple, double, or triple size).
NFCID2	NFC-F identifier of the NFC Forum Device in the Passive Communication mode. NFCID2 is always 8 bytes long.
NFCID3	NFCIP-1 identifier of the NFC Forum Device. NFCID3 is always 10 bytes long.
PDU	Protocol Data Unit
R-APDU	Response APDU
RF	Radio Frequency (RF field = magnetic field)
SAP	Service Access Point
SC	System Code, NFC-F
SDU	Service Data Unit
SDP	Service Discovery Procedure
SN	Service Name
T1T	Type 1 Tag Platform
T2T	Type 2 Tag Platform
T3T	Type 3 Tag Platform

Abbreviation	Description
T4AT	Type 4A Tag Platform
T4BT	Type 4B Tag Platform
T4T	Type 4 Tag Platform

1.11 Glossary

Device Test Application (DTA)

Test application developed by the Vendor. It allows control and observation of the exchanges between the IUT and the Lower Tester.

Device Under Test (DUT)

NFC Forum Device that contains the Implementation Under Test (IUT).

Digital Certification Testing

A defined set of tests that checks the software responsible for the data exchange between an NFC Forum Device and another NFC Forum Device or tag. The tests check the [DIGITAL] and [ACTIVITY].

Implementation Under Test (IUT)

Part of the DUT that is used for the NFC Forum Certification Test. In digital testing, IUT is the layer that corresponds to the [DIGITAL] and [ACTIVITY] specifications, embedded in an NFC Forum Device provided for NFC Forum Digital Certification Testing.

- In analog testing, IUT is the layer that corresponds to the [ANALOG] specifications, embedded in an NFC Forum Device provided for NFC Forum Analog Testing.
- In LLCP testing, IUT is the layer that corresponds to the [LLCP] specifications, embedded in an NFC Forum Device provided for NFC Forum LLCP Testing.
- In SNEP testing, IUT is the layer that corresponds to the [LLCP] and [SNEP] specifications, embedded in an NFC Forum Device provided for NFC Forum SNEP Testing

ISO-DEP

Half-duplex block transmission protocol defined in [ISO/IEC_14443], with [EMV_CLESS] as implementation option. See [DIGITAL].

LLCP Certification Testing

A defined set of tests that checks the software that is responsible for the data exchange between an NFC Forum Device and another NFC Forum Device. The [LLCP] shall be checked.

Lower Tester (LT)

The representation of the means of providing, during test execution, indirect control, and observation of the lower service boundary of the IUT via the underlying service-provider [ISO/IEC_9646].

NFC-DEP Protocol

The half-duplex block transmission protocol as defined in [DIGITAL].

Profile

The combination of a Resolution Process managing a set of Activities, an Initialization that chooses a set of values as Configuration Parameters, and Clean-up.

Test Environment

Test environment required to perform NFC Forum Certification Testing. It includes the Device Test Application, Implementation Under Test, and the Lower Tester.

Test Functionalities

Functionalities to be implemented by the vendor following the requirements specified in this document, and to be implemented in the Device Test Application to allow the Test Laboratory to proceed to NFC Forum Certification Testing.

Test Laboratory

A facility approved by the NFC Forum to perform NFC Forum Certification Testing.

Vendor

The entity that submits the NFC Forum Device for NFC Forum Certification Testing.

2 Test Architecture Overview

NFC Forum requires that devices implementing [DIGITAL], [ANALOG], [LLCP], [SNEP], and [ACTIVITY] and submitted for NFC Forum Certification are tested against the relevant specifications.

To test the compliance of the implementation against [DIGITAL], [ANALOG], [LLCP], [SNEP], and [ACTIVITY], NFC Forum Devices have to be tested in a defined Test Environment. See Figure 2.

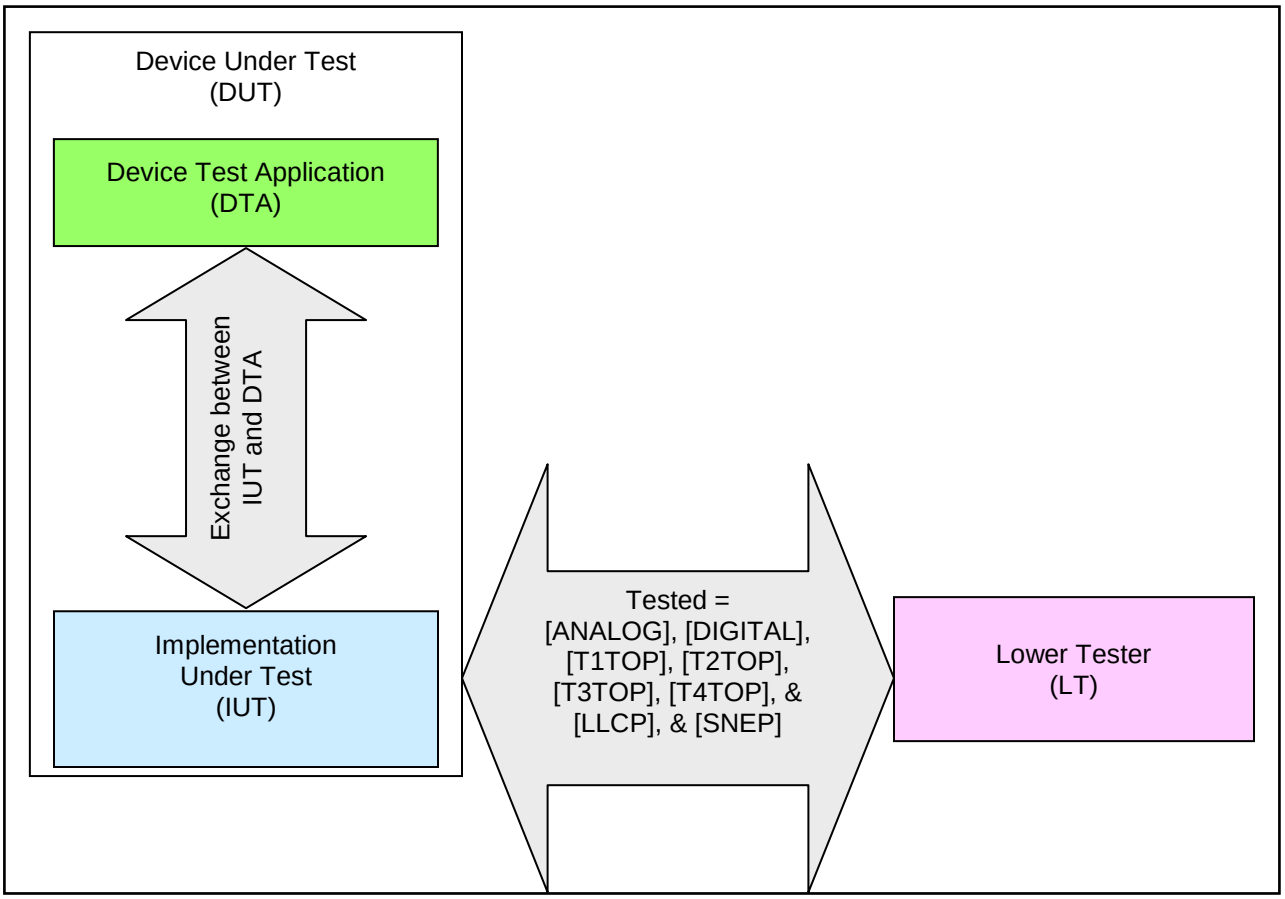


Figure 2: Schematic View of the Test Environment (Informative Image)

The Test Environment is composed of two parts:

- LT: Lower Tester
- DUT with Device Test Application or DUT connected to the external Device Test Application (e.g., PC with DTA connected to the NFC Forum Device)

This document describes the requirements the Device Test Application must comply with and is structured as described below:

- Section 3: General Requirements for Device Test Application
- Section 4: Test Profile and Listen Mode Execution
- Section 5: Test Transaction Functionalities in Poll Mode

- Section 6: Test Transaction Functionalities in Listen Mode
- Section 7: Device Test Application for LLCP
- Section 8: Device Test Application for SNEP

3 General Requirements for Device Test Application

The Device Test Application complies with the following general requirements.

Requirements 1: Control of the IUT

3.1.1.1	The Device Test Application MUST execute the Test Profile and Listen Mode Execution (see Section 4) and the Test Functionalities (see Section 5 and Section 6) as indicated in [IXIT] and in accordance with the Implementation Conformance Statement (see [ICS]).
3.1.1.2	The Test Application MUST permit the Test Profile and Listen Mode Execution to select, start, and stop (see Section 4). The DTA MUST permit the Test Functionalities to select, start, and stop (see Section 5 and Section 6).

4 Test Profile and Listen Mode Execution

The Test Profile defines a sequence of Activities to be performed by the NFC Forum Device. The Test Profile consists of an initialization, a Resolution Process (called Poll Mode Resolution Process), Configuration Parameters, Activities, the Greedy Collection, and a Clean-up (see [ACTIVITY], Section 8).

During Test Profile initialization, the Configuration Parameters as needed by the included Activities are set and RF Collision Avoidance takes place (see [ACTIVITY], Section 7, Poll Mode – RF Collision Avoidance).

The Test Profile Clean-up erases the Greedy Collection and the Operating Field is turned to the Operating Field Off state (see [ACTIVITY], Section 6, Requirement 6.1.1.1).

The Poll Mode Resolution Process consists of an algorithm that is controlled by the DTA and determines the next Activity to call, depending on the outcome of the previous Activity. For each possible Activity to call next, the Resolution Process provides the necessary input parameters.

In the DTA, the Test Profile enables the NFC Forum Device to connect to the LT and to establish the transport communication protocols: NFC-DEP transport protocol, Type 4A and 4B Tag Half-duplex protocol, and Type 1-3 Tag platform protocol. Eventually, the transport communication protocol is used by the transaction functionalities described in Section 5 and Section 6 and by the test cases related to [T1TOP], [T2TOP], [T3TOP], and [T4TOP].

The Test Profile is combined with Listen Mode to create the Test Profile and Listen Mode Execution, which is part of the functionality of the Device Test Application (DTA).

The Test Profile and Listen Mode Execution has been designed to allow maximum automation of the testing process and minimum human intervention when running the test cases, and also to allow the flexibility needed to support different implementation options as indicated in the ICS (see [ICS]).

Depending on which devices are discovered, the Test Profile allows an NFC-DEP communication to be established to the LT executing either the Poll Mode Digital Protocol Test Cases [DIGITAL_TC] or the NFC Forum Type Tag Test Cases [T1T_TC], [T2T_TC], [T3T_TC], and [T4T_TC].

Listen Mode is the counterpart for Poll Mode. Listen Mode assumes the NFC Forum Device has activated support for NFC-DEP, ISO-DEP (on NFC-A and NFC-B), and Type 3 Tag emulation. If only a subset of this functionality is supported, the corresponding part of the Listen Mode state machine is deactivated.

The Test Profile and Listen Mode Execution for [DIGITAL_TC], [T1T_TC], [T2T_TC], [T3T_TC], and [T4T_TC] can be used for [ANALOG_TC].

4.1 Test Profile and Listen Mode Execution – Main Loop

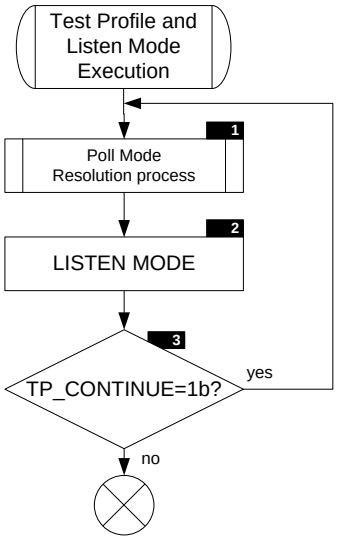


Figure 3: Test Profile and Listen Mode Execution Flow Chart – Main Loop

Requirements 2: Test Profile and Listen Mode Execution – Main Loop

4.1.1.1	Symbol 1: The NFC Forum Device MUST enter Poll Mode according to [ACTIVITY] (see [ACTIVITY], Sections 6, 8, and 9) and MUST proceed to Section 4.3.
4.1.1.2	Symbol 2: After a time equal to $\mathbf{T_{TRANSITION\_PM \rightarrow LM}}$ from when the Operating Field is switched to the Operating Field Off state, the NFC Forum Device MUST enter Listen Mode according to the [ACTIVITY] (see [ACTIVITY], Sections 3, 4, and 5) and MUST proceed to Section 4.4.
4.1.1.3	Symbol 3: If the NFC Forum Device is configured to continue (i.e., TP_CONTINUE has a value equal to 1), then the NFC Forum Device MUST proceed to Symbol 1. Otherwise, the NFC Forum Device MUST exit.

NOTE $\mathbf{T_{TRANSITION\_PM \rightarrow LM}}$ value is indicated in [IXIT]. After the $\mathbf{T_{TRANSITION\_PM \rightarrow LM}}$, the LT can switch the Operating Field to the Operating Field On state to communicate with the NFC Forum Device.

4.2 Configuration Parameters

The Test Profile and Listen Mode Execution have a set of configuration parameters. The parameters belong either to the activities, to the Test Profile itself, or to Listen Mode. The settings of these parameters depend on the involved activities (see [ACTIVITY], this document, [IXIT], and [ICS]).

[ANALOG_TC] and [DIGITAL_TC] have different [ICS] and [IXIT].

Table 6, Table 7, Table 8, Table 9, and Table 10 show the Activity and the Test Profile and Listen Mode Execution parameters and their settings related to a PATTERN_NUMBER equal to ‘0000’. With a PATTERN_NUMBER different from ‘0000’, the configuration parameters can change as indicated in Section 5 and Section 6.

If a parameter depends on information from [IXIT] or [ICS], this is directly indicated. All of these parameters concern the [DIGITAL_TC]. For [ANALOG_TC], the ICS is sufficient.

Table 6: Listen Mode – Configuration Parameters

Name	Value	Format	Size	Description
CON_LISTEN_DEP_A	1b	Binary	1 bit	This parameter controls whether to listen for NFC-A Technology with NFC_DEP support or not. 1b: Listen for NFC-A Technology with NFC-DEP support 0b: Do not listen for NFC-A Technology with NFC_DEP support
CON_LISTEN_DEP_F	0b or 1b, see Appendix C	Binary	1 bit	This parameter controls whether to listen for NFC-F Technology with NFC_DEP support or not. 1b: Listen for NFC-F Technology with NFC-DEP support 0b: Do not listen for NFC-F Technology with NFC-DEP support
CON_LISTEN_T3TP	0b or 1b, see Appendix C	Binary	1 bit	This parameter controls whether to listen for NFC-F Technology with Type 3 Tag Platform support or not. 1b: Listen for NFC-F Technology with Type 3 Tag Platform support 0b: Do not listen for NFC-F Technology with Type 3 Tag Platform support

Name	Value	Format	Size	Description
CON_LISTEN_T4ATP	0b or 1b , defined in [ICS]	Binary	1 bit	This parameter controls whether to listen for NFC-A Technology with Type 4 Tag Platform support or not. 1b: Listen for NFC-A Technology with Type 4 Tag Platform support 0b: Do not listen for NFC-A Technology with Type 4 Tag Platform support
CON_LISTEN_T4BTP	0b or 1b , defined in [ICS]	binary	1 bit	This parameter controls whether to listen for NFC-B Technology with Type 4 Tag Platform support or not. 1b: Listen for NFC-B Technology with Type 4 Tag Platform support 0b: Do not listen for NFC-B Technology with Type 4 Tag Platform support
CON_ADV_FEAT	0b	Binary	1 bit	1b: Support advanced protocol features 0b: Do not support advanced protocol features
CON_SYS_CODE [2]	CON_SYS_CODE [0] = ‘FFFF’ CON_SYS_CODE [1] = ‘12FC’	Array of byte Sequences	2 bytes x 2 = 4 bytes	If configured for Type 3 Tag Platform, an ordered list of *N* system codes is maintained by the adjacent upper layer (N>0). Otherwise, the list contains a single system code of value FFFFh as a default

Name	Value	Format	Size	Description
				value (N=1).
CON_SENSF_RES [2]	CON_SENSF_RES [0] = ’01FE UUUUUUUUUUUU(NFCID2)’ + ‘UUUU(PAD0)’ + ‘UUUUUU(PAD1)’ + ‘UU(**$MRTI_{CHECK}$**)’ + ‘UU(**$MRTI_{UPDATE}$**)’ + ‘UU(PAD2)’ CON_SENSF_RES [1] = ’02FE UUUU UUUUUUUU(NFCID2)’ + ‘UUUU(PAD0)’ + ‘UUUUUU(PAD1)’ + ‘UU(**$MRTI_{CHECK}$**)’ + ‘UU(**$MRTI_{UPDATE}$**)’ + ‘UU(PAD2)’ with ‘UUUU’ Any value	Array of byte Sequences	16 bytes x 2 = 32 bytes	See SENSF_RES format in [DIGITAL]. In particular: • NFCID2 must be configured if the NFC Forum Device cannot generate random numbers • If configured for Type 3 Tag Platform, then PAD1, **$MRTI_{CHECK}$**, **$MRTI_{UPDATE}$** and PAD2 must be configured as per [DIGITAL]. Otherwise, these data elements can have any value.
CON_ATR_RES	NFCID3 = ‘U…U’ Any value, **BS_T**=’00’, **BR_T**=’00’, **TO**=(‘0000uuuu’)b, **PP_T**=(‘00uu00u0’)b	Array of byte Sequences	variable	See ATR_RES Format in [DIGITAL]. In particular: • NFCID3**$_T$** must be configured if the NFC Forum Device cannot generate random numbers • **BS_T**, **BR_T**, **TO**, **PP_T** need to be configured • General bytes (**G_T0**…**G_Tn**) need to be configured if the upper adjacent layer wants to indicate some

Name	Value	Format	Size	Description
				information such as LLCP support.
CON_ATS	TL = (number of Historical bytes + 5) and (‘05’)h ≤TL ≤ (‘14’)h T0 = (“0111 aaaa”)b with (“aaaa”)b = FSCI TA(1) = (‘00’)h or (‘80’)h TB(1) = (“XY”)h with • X = FWI where X ≤ (‘7’)h • Y = SFGI where Y ≤ (‘8 ’)h TC(1) = (“0000 00uu”)b where the bits indicated as ‘u’ may take any value. Historical bytes = up to 15 bytes (k ≤ 14) that may take any value.	Array of byte Sequences	variable	See ATS format in [DIGITAL].
CON_SENSB_RES	Byte 1 of Protocol Info (Byte 10 of SENSB_RES) = (‘00’)h or (‘80’)h Byte 2 of Protocol Info (Byte 11 of SENSB_RES) = • most significant nibble = Max_Frame_Size where (‘2’)h ≤ Max_Frame_Size ≤ (‘8’)h • least significant	Array of byte Sequences	variable	See SENSB_RES format in [DIGITAL].

Name	Value	Format	Size	Description

	nibble = (‘1’)h
	Byte 3 of Protocol Info (Byte 12 of SENSB_RES) =
	• most significant nibble = FWI where FWI≤ (‘7’)h
	• least significant nibble (ADC and FO) where
	  • bit 4=0
	  • bit 3, bit 2, bit 1 = any value			

CON_ATTRIB_RES	‘00’	Array of byte Sequences	variable	See ATTRIB Response in [DIGITAL], in particular MBLI
CON_BITR_F	‘06’	integer	1 byte	b2=1: 212 kbps b3=1: 424 kbps At least one bit of these must be set.

Table 7: Technology Detection Activity – Configuration Parameters

Name	Value	Format	Size	Description
CON_POLL_A	1b	binary	1 bit	1b: Poll for NFC-A Technology 0b: Do not poll for NFC-A Technology
CON_POLL_B	0b or 1b, see Appendix C	binary	1 bit	1b: Poll for NFC-B Technology 0b: Do not poll for NFC-B Technology
CON_POLL_F	1b	binary	1 bit	1b: Poll for NFC-F Technology 0b: Do not poll for NFC-F Technology
CON_POLL_P	0b	binary	1 bit	1b: Poll for Proprietary Technology 0b: Do not poll for Proprietary Technology
CON_BAIL_OUT_A	1b	binary	1 bit	1b: Bail-out after NFC-A 0b: No Bail-out after NFC-A
CON_BAIL_OUT_B	1b	binary	1 bit	1b: Bail-out after NFC-B 0b: No Bail-out after NFC-B

Table 8: Collision Resolution Activity – Symbol 2 – Configuration Parameters

Name	Symbol 2 Value	Format	Size	Description
CON_DEVICES_LIMIT	UU, defined in [ICS]	Hexadecimal	1 byte	CON_DEVICES_LIMIT = 00h: No identifier has to be resolved when a collision is detected. CON_DEVICES_LIMIT > 00h: Number of resolved NFCIDx device identifiers beyond which the collision resolution process can stop resolving when collisions are still pending.
CON_ADV_FEAT	0b	Binary	1 bit	0b: Advanced protocol features not activated 1b: Advanced protocol features activated
CON_ANTICOLL	1b	Binary	1 bit	0b: Do not use Anti-collision 1b: Use Anti-collision

Table 9: Device Activation Activity – Configuration Parameters

Name	Values	Format	Size	Description
CON_ATR	‘00’ + ‘00’ + (‘00uu00u0’)b	Hexadecimal	3 bytes	ATR_REQ Command parameter Refer to [DIGITAL] (Byte 14 of ATR_REQ) for the coding of byte 1. Refer to [DIGITAL] (Byte 15 of ATR_REQ) for the coding of byte 2. Refer to [DIGITAL] (Byte 16 of ATR_REQ) for the coding of byte 3.
CON_GB	‘U…U’ 0 or more bytes	Hexadecimal	n bytes	General bytes of the ATR_REQ or Higher Layer INF of ATTRIB Refer to [DIGITAL]. Byte 17+*n* of ATR_REQ) and [DIGITAL]. Byte 10+*n* for ATTRIB For the ATR_REQ, these bytes contain the General Bytes (**G_T0**…**G_{Tn}**) as information for LLCP. For ATTRIB, these bytes contain High Layer INF.
CON_RATS	8’ + (‘uuuu’)b	Hexadecimal	1 byte	RATS Command Parameters Refer to [DIGITAL] (Byte 2 of RATS Command) for the coding of byte 1.
CON_ATTRIB	‘00 08 01’	hexadecimal	3 bytes	ATTRIB Command Parameters Refer to [DIGITAL] (Byte 6 of ATTRIB Command) for the coding of byte 1. Refer to [DIGITAL] (Byte 7 of ATTRIB Command) for the

Name	Values	Format	Size	Description
				coding of byte 2. Refer to [DIGITAL] (Byte 8 of ATTRIB Command) for the coding of byte 3
CON_BITR_NFC_DEP	0 (default value) 3	Integer	1 byte	Desired bit rate: 0: maintain the bit rate 1: 106 kbps 2: 212 kbps 3: 424 kbps Refer to Appendix C.

Table 10: Test Profile – Configuration Parameters

Parameters	Values
PATTERN_NUMBER	0000h (default value)
T4AT_NFC-DEP_PRIORITY	Values 0b or 1b, defined in [IXIT]
NFC-F_BITRATE	0b: 212 kbps (default value) 1b: 424 kbps
REACTIVATION	Values 0b or 1b, defined in [IXIT]

4.3 Poll Mode Resolution Process

The Poll Mode Resolution Process uses subroutines to improve readability. All routines and subroutines described in the following sections include:

- The flow chart describing the routine or subroutine
- The requirement table related to the routine or subroutine

Each activity is indicated with its name and the related symbol in the flow chart.

4.3.1 Poll Mode Resolution Process – Main Flow

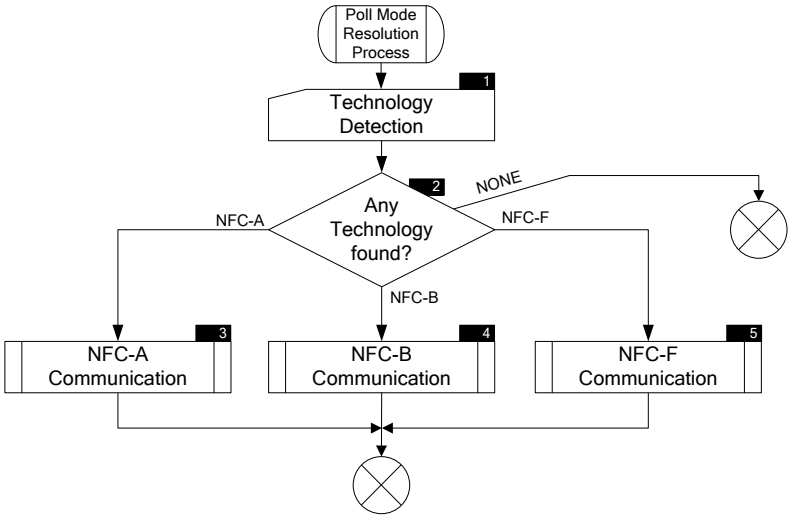


Figure 4: Test Profile – Poll Mode Resolution Process Flow Chart – Main Flow

Requirements 3: Test Profile - Poll Mode Resolution Process – Main Flow

4.3.1.1	Symbol 1: The NFC Forum Device MUST execute the Technology Detection Activity using the parameters in Table 7 (see [ACTIVITY]). The NFC Forum Device MUST send NFC-F frames using the bit rate indicated in Appendix C.
4.3.1.2	Symbol 2: If the NFC Forum Device has detected a Technology, then: • If NFC-A Technology (i.e., FOUND_A has a value equal to 1), then the NFC Forum Device MUST proceed to Symbol 3. • If NFC-B Technology (i.e., FOUND_B has a value equal to 1), then the NFC Forum Device MUST proceed to Symbol 4. • If NFC-F Technology (i.e., FOUND_F has a value equal to 1), then the NFC Forum Device MUST proceed to Symbol 5. In any other case, the NFC Forum Device MUST exit.
4.3.1.3	Symbol 3: The NFC Forum Device MUST execute the NFC-A Communication (see Section 4.3.2).
4.3.1.4	Symbol 4: The NFC Forum Device MUST execute the NFC-B Communication (see Section 4.3.3).
4.3.1.5	Symbol 5: The NFC Forum Device MUST execute the NFC-F Communication (see Section 4.3.4).

4.3.2 NFC-A Communication

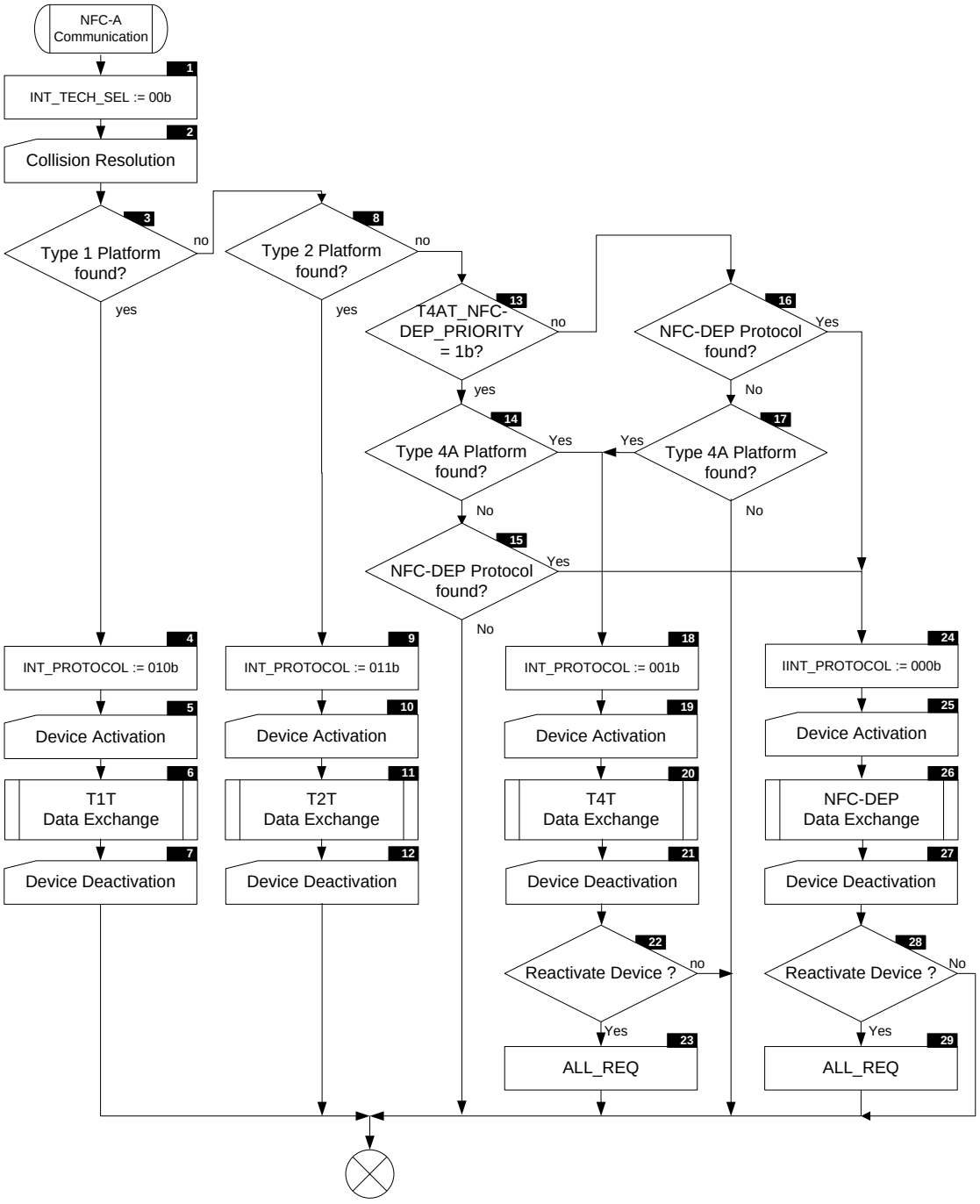


Figure 5: Test Profile – Poll Profile Resolution Process Flow Chart – NFC-A Communication

Requirements 4: Test Profile – Poll Profile Resolution Process – NFC-A Communication

4.3.2.1	Symbol 1: The NFC Forum Device MUST set INT_TECH_SEL to 00b.
4.3.2.2	Symbol 2: The NFC Forum Device MUST execute the Collision Resolution Activity using the parameters in Table 8 (see [ACTIVITY]).
4.3.2.3	Symbol 3: If the NFC Forum Device has found a Type 1 Platform, then the NFC Forum Device MUST proceed to Symbol 10. Otherwise, the NFC Forum Device MUST proceed to Symbol 4. The NFC Forum Device has found a Type 1 Platform when the SENS_RES is a Valid Response and indicates Type 1 Tag platform with b5-b1 of byte 1 equal to 00000b.
4.3.2.4	Symbol 4: The NFC Forum Device MUST set INT_PROTOCOL to 010b.
4.3.2.5	Symbol 5: The NFC Forum Device MUST execute the Device Activation Activity using the parameters in Table 9 (see [ACTIVITY]).
4.3.2.6	Symbol 6: The NFC Forum Device MUST execute the T1T Data Exchange (see Section 4.3.5).
4.3.2.7	Symbol 7: The NFC Forum Device MUST execute the Device Deactivation Activity (see [ACTIVITY]).
4.3.2.8	Symbol 8: If the NFC Forum Device has found a Type 2 Platform, then the NFC Forum Device MUST proceed to Symbol 11. Otherwise, the NFC Forum Device MUST proceed to Symbol 5. The NFC Forum Device has found a Type 2 Platform when the SEL_RES Response is a Valid Response and indicates Type 2 Tag platform with b7-b6 equal to 00b.
4.3.2.9	Symbol 9: The NFC Forum Device MUST set INT_PROTOCOL to 011b.
4.3.2.10	Symbol 10: The NFC Forum Device MUST execute the Device Activation Activity using the parameters in Table 9 (see [ACTIVITY]).
4.3.2.11	Symbol 11: The NFC Forum Device MUST execute the T2T Data Exchange (see Section 4.3.6).

4.3.2.12	Symbol 12: The NFC Forum Device MUST execute the Device Deactivation Activity (see [ACTIVITY]).
4.3.2.13	Symbol 13: If the NFC Forum Device gives priority to Type 4A Platform (i.e., T4AT_NFC-DEP_PRIORITY has a value equal to 1b), then the NFC Forum Device MUST proceed to Symbol 7. Otherwise, the NFC Forum Device MUST proceed to Symbol 6.
4.3.2.14	Symbol 14: If the NFC Forum Device has found a Type 4A Platform, then the NFC Forum Device MUST proceed to Symbol 12. Otherwise, the NFC Forum Device MUST proceed to Symbol 9. The NFC Forum Device has found a Type 4A Platform when the SEL_RES Response is a Valid Response and indicates Type 4A Tag platform compliant with [ISO/IEC_14443] with b6 equal to 1b.
4.3.2.15	Symbol 15: If the NFC Forum Device has found NFC-DEP, then the NFC Forum Device MUST proceed to Symbol 13. Otherwise, the NFC Forum Device MUST exit. The NFC Forum Device has found an NFC-DEP Protocol when the SEL_RES Response is a Valid Response and indicates NFC-DEP Protocol with b7 equal to 1b.
4.3.2.16	Symbol 16: If the NFC Forum Device has found NFC-DEP, then the NFC Forum Device MUST proceed to Symbol 13. Otherwise, the NFC Forum Device MUST proceed to Symbol 8. The NFC Forum Device has found an NFC-DEP Protocol when the SEL_RES Response is a Valid Response and indicates NFC-DEP Protocol with b7 equal to 1b.
4.3.2.17	Symbol 17: If the NFC Forum Device has found a Type 4A Platform, then the NFC Forum Device MUST proceed to Symbol 12. Otherwise, the NFC Forum Device MUST exit. The NFC Forum Device has found a Type 4A Platform when the SEL_RES Response is a Valid Response and indicates Type 4A Tag platform compliant with [ISO/IEC_14443] with b6 equal to 1b.
4.3.2.18	Symbol 18: The NFC Forum Device MUST set INT_PROTOCOL to 001b.
4.3.2.19	Symbol 19: The NFC Forum Device MUST execute the Device Activation Activity using the parameters in Table 9 (see [ACTIVITY]).

4.3.2.20	Symbol 20: The NFC Forum Device MUST execute the T4T Data Exchange (see Section 4.3.8).
4.3.2.21	Symbol 21: The NFC Forum Device MUST execute the Device Deactivation Activity (see [ACTIVITY]).
4.3.2.22	Symbol 22: If REACTIVATION is equal to 1b and PATTERN_NUMBER indicates reactivation (see Appendix C), then the NFC Forum Device MUST proceed to Symbol 28. Otherwise, the NFC Forum Device MUST exit.
4.3.2.23	Symbol 23: The NFC Forum Device MUST send an ALL_REQ Command and it MUST wait for a Response afterward as defined in [DIGITAL].
4.3.2.24	Symbol 24: The NFC Forum Device MUST set INT_PROTOCOL to 000b.
4.3.2.25	Symbol 25: The NFC Forum Device MUST execute the Device Activation Activity using the parameters in Table 9 (see [ACTIVITY]).
4.3.2.26	Symbol 26: The NFC Forum Device MUST execute the NFC-DEP Data Exchange (see Section 4.3.9).
4.3.2.27	Symbol 27: The NFC Forum Device MUST execute the Device Deactivation Activity (see [ACTIVITY]).
4.3.2.28	Symbol 28: If REACTIVATION is equal to 1b and PATTERN_NUMBER indicates reactivation (see Appendix C), then the NFC Forum Device MUST proceed to Symbol 29. Otherwise, the NFC Forum Device MUST exit.
4.3.2.29	Symbol 29: The NFC Forum Device MUST send an ALL_REQ Command and it MUST wait for a Response afterward as defined in [DIGITAL].

4.3.3 NFC-B Communication

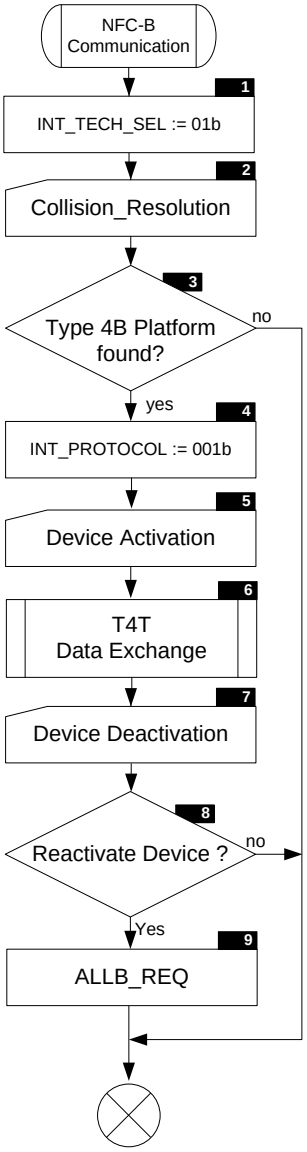


Figure 6: Test Profile – Poll Profile Resolution Process Flow Chart – NFC-B Communication

Requirements 5: Test Profile – Poll Profile Resolution Process – NFC-B Communication

4.3.3.1	Symbol 1: The NFC Forum Device MUST set INT_TECH_SEL to 01b.
4.3.3.2	Symbol 2: The NFC Forum Device MUST execute the Collision Resolution Activity using the parameters in Table 8 (see [ACTIVITY]).
4.3.3.3	Symbol 3: If the NFC Forum Device has found a Type 4B Platform, then the NFC Forum Device MUST proceed to Symbol 4. Otherwise, the NFC Forum Device MUST exit. The NFC Forum Device has found a Type 4B Platform when the SENSB_RES Response is a Valid Response and indicates support for [ISO/IEC_14443] by setting bit b1 of Protocol_Type to 1b.
4.3.3.4	Symbol 4: The NFC Forum Device MUST set INT_PROTOCOL to 001b.
4.3.3.5	Symbol 5: The NFC Forum Device MUST execute the Device Activation Activity using the parameters in Table 9 (see [ACTIVITY]).
4.3.3.6	Symbol 6: The NFC Forum Device MUST execute the T4T Data Exchange (see Section 4.3.8).
4.3.3.7	Symbol 7: The NFC Forum Device MUST execute the Device Deactivation Activity (see [ACTIVITY]).
4.3.3.8	Symbol 8: If REACTIVATION is equal to 1b and PATTERN_NUMBER indicates reactivation (see Appendix C), then the NFC Forum Device MUST proceed to Symbol 9. Otherwise, the NFC Forum Device MUST exit.
4.3.3.9	Symbol 9: The NFC Forum Device MUST send an ALLB_REQ Command and it MUST wait for a Response afterward as defined in [DIGITAL].

4.3.4 NFC-F Communication

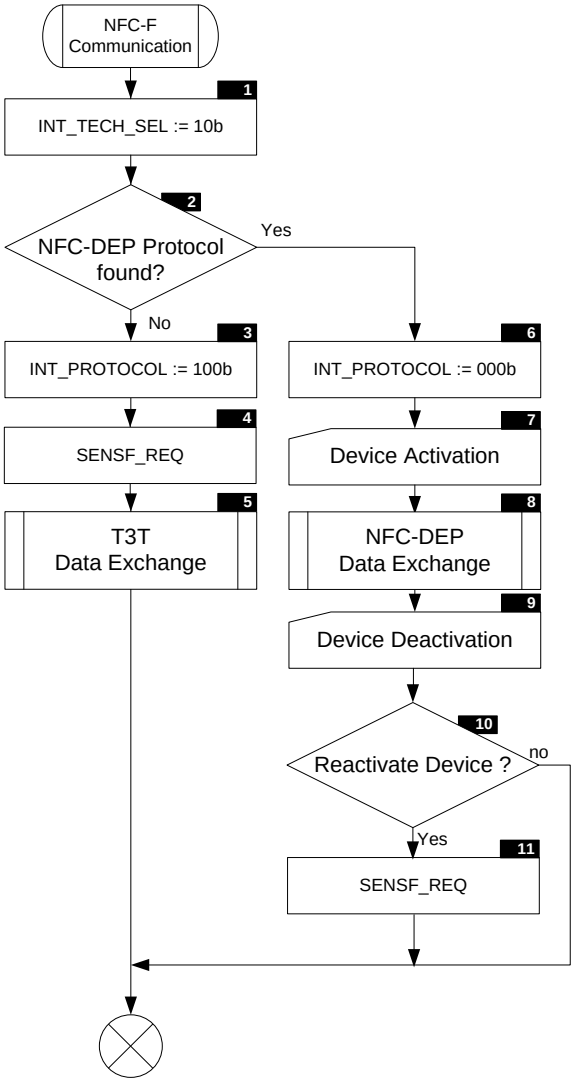


Figure 7: Test Profile – Poll Profile Resolution Process Flow Chart – NFC-F Communication

Requirements 6: Test Profile – Poll Profile Resolution Process – NFC-F Communication

4.3.4.1	Symbol 1: The NFC Forum Device MUST set INT_TECH_SEL to 10b.
4.3.4.2	Symbol 2: If the NFC Forum Device has found NFC-DEP, then the NFC Forum Device MUST proceed to Symbol 6. Otherwise, the NFC Forum Device MUST proceed to Symbol 3. The NFC Forum Device has found an NFC-DEP Protocol when the SENSF_RES Response is a Valid Response and indicates support for NFC-DEP Protocol by setting Bytes 1-2 of NFCID2 to 01FEh.
4.3.4.3	Symbol 3: The NFC Forum Device MUST set INT_PROTOCOL to 100b.
4.3.4.4	Symbol 4: The NFC Forum Device MUST send a SENSF_REQ Command using the parameters in Appendix C and it MUST wait for a Response afterward as defined in [DIGITAL].
4.3.4.5	Symbol 5: The NFC Forum Device MUST execute the T3T Data Exchange (see Section 4.3.7).
4.3.4.6	Symbol 6: The NFC Forum Device MUST set INT_PROTOCOL to 000b.
4.3.4.7	Symbol 7: The NFC Forum Device MUST execute the Device Activation Activity using the parameters in Table 9 (see [ACTIVITY]).
4.3.4.8	Symbol 8: The NFC Forum Device MUST execute the NFC-DEP Data Exchange (see Section 4.3.9).
4.3.4.9	Symbol 9: The NFC Forum Device MUST execute the Device Deactivation Activity (see [ACTIVITY]).
4.3.4.10	Symbol 10: If REACTIVATION is equal to 1b and PATTERN_NUMBER indicates reactivation (see Appendix C), then the NFC Forum Device MUST proceed to Symbol 11. Otherwise, the NFC Forum Device MUST exit.
4.3.4.11	Symbol 11: The NFC Forum Device MUST send a SENSF_REQ Command using the parameters in Appendix C, and it MUST wait for a Response afterward as defined in [DIGITAL].

4.3.5 T1T Data Exchange

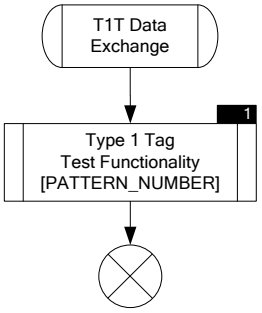


Figure 8: Test Profile – Poll Profile Resolution Process Flow Chart – T1T Data Exchange

Requirements 7: Test Profile – Poll Profile Resolution Process – T1T Data Exchange

4.3.5.1	Symbol 1: The NFC Forum Device MUST execute the Type 1 Tag Test Functionality related to the PATTERN_NUMBER value (see Section 5.3).

4.3.6 T2T Data Exchange

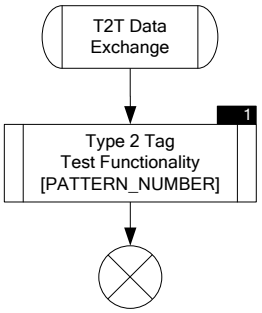


Figure 9: Test Profile – Poll Profile Resolution Process Flow Chart – T2T Data Exchange

Requirements 8: Test Profile – Poll Profile Resolution Process – T2T Data Exchange

4.3.6.1	Symbol 1: The NFC Forum Device MUST execute the Type 2 Tag Test Functionality related to the PATTERN_NUMBER value (see Section 5.3).

4.3.7 T3T Data Exchange

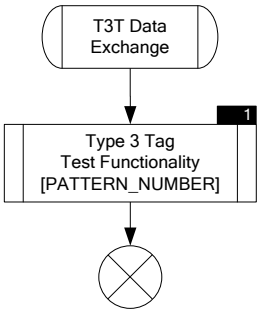


Figure 10: Test Profile – Poll Profile Resolution Process Flow Chart – T3T Data Exchange

Requirements 9: Test Profile – Poll Profile Resolution Process – T3T Data Exchange

4.3.7.1	Symbol 1: The NFC Forum Device MUST execute the Type 3 Tag Test Functionality related to the PATTERN_NUMBER value (see Section 5.5).

4.3.8 T4T Data Exchange

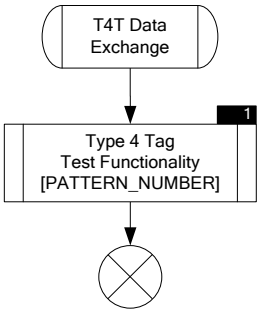


Figure 11: Test Profile – Poll Profile Resolution Process Flow Chart – T4T Data Exchange

Requirements 10: Test Profile – Poll Profile Resolution Process – T4T Data Exchange

4.3.8.1	Symbol 1: The NFC Forum Device MUST execute the Type 4 Tag Test Functionality related to the PATTERN_NUMBER value (see Section 5.6).

4.3.9 NFC-DEP Data Exchange

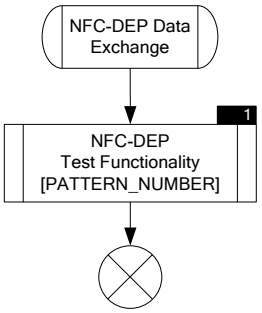


Figure 12: Test Profile – Poll Profile Resolution Process Flow Chart – NFC-DEP Data Exchange

Requirements 11: Test Profile – Poll Profile Resolution Process – NFC-DEP Data Exchange

4.3.9.1	Symbol 1: The NFC Forum Device MUST execute the NFC-DEP Test Functionality related to the PATTERN_NUMBER value (see Section 5.2).

4.4 Listen Mode

Requirements 12: Listen Mode

4.4.1.1	If the NFC Forum Device remains in the **NO_REMOTE_FIELD** State (see [ACTIVITY]) for time t_{LM}, then the NFC Forum Device MUST exit from Listen Mode.
4.4.1.2	If the NFC Forum Device enters into the **CARD_EMULATION_4A** State (see [ACTIVITY]), then the NFC Forum Device MUST execute the Type 4 Tag Test Functionality in Listen Mode (see Section 6.4).
4.4.1.3	If the NFC Forum Device enters into the **CARD_EMULATION_4B** State (see [ACTIVITY]), then the NFC Forum Device MUST execute the Type 4 Tag Test Functionality in Listen Mode (see Section 6.4).
4.4.1.4	If the NFC Forum Device enters into the **CARD_EMULATION_3** State (see [ACTIVITY]), then the NFC Forum Device MUST execute the Type 3 Tag Test functionality in Listen Mode (see Section 6.3).
4.4.1.5	If the NFC Forum Device enters into the **TARGET_A** State (see [ACTIVITY]), then the NFC Forum Device MUST execute the NFC-DEP Test Functionality in Listen Mode (see Section 6.2).
4.4.1.6	If the NFC Forum Device enters into the **TARGET_F** State (see [ACTIVITY]), then the NFC Forum Device MUST execute the NFC-DEP Test Functionality in Listen Mode (see Section 6.2).
4.4.1.7	After the NFC Forum Device has concluded the state machine due to No Remote Field Sensed and not in state **NO_REMOTE_FIELD**, the NFC Forum Device MUST stay in Listen Mode and set the state machine to **NO_REMOTE_FIELD** for at least t_{RLM}. Refer to Appendix B for the value of t_{RLM}.
4.4.1.8	If CON_LISTEN_DEP_F=1 and CON_LISTEN_T3TP =1, the NFC Forum Device MUST respond with multiple SENSF_RES in response to a SENSF_REQ.

NOTE t_{LM} value is indicated in [IXIT].

4.5 Exception Processing

Requirements 13: Exception Processing

4.5.1.1	If not otherwise specified in this document, [ACTIVITY], or [DIGITAL], if there is a Protocol Error, Timeout Error, Transmission Error, or PROTOCOL EXCEPTION, the NFC Forum Device MUST exit the Poll Mode Resolution Process (see Section 4.1).

5 Test Transaction Functionalities in Poll Mode

The NFC Forum Digital Test method is based on the [ISO/IEC_9646] remote test method (see [ISO/IEC_9646-1] and [ISO/IEC_9646-2]), where the existing protocol between the IUT and the Lower Tester (i.e., the protocol to be tested) also conveys the TMPDU (Test Management PDU).

5.1 Test Architecture in Poll Mode

For Poll Mode Testing, a Lower Tester (LT) is presented to the IUT (see Figure 2). The LT stores a set of predefined responses to the commands of the Poll Mode Resolution Process (see Section 4) for each test scenario. The LT sends the responses of the set to the IUT according to the running test scenario. These responses are sent using parameters and timings defined for each Test Case scenario in the Test Case description.

During the execution of a test scenario, the DTA-IUT sends Commands as indicated in the Poll Mode Resolution Process (see Section 4).

When the Poll Mode Resolution Process is running, the LT sends test-specific responses to the DTA-IUT according to the applied test scenario.

As soon as the DTA enters a Test Functionality (see Section 4.3.6, Section 4.3.7, Section 4.3.8, and Section 4.3.9), the DTA-IUT sends commands as described in Section 5.2, Section 5.3, Section 5.4, Section 5.5, and Section 5.6.

The following sections describe Poll Mode functionality.

5.1.1 Loop-back Test Functionality in Poll Mode

Loop-back Functionality is used for testing Type 4A and 4B Tag Half-duplex Protocol and NFC-DEP Protocol (see [DIGITAL]). Loop-back Functionality is used with slight variations in Section 5.2.2 and Section 5.6.2.

This Loop-back Functionality converts each received response into the next command and sends this command back to the LT via the IUT.

1. The following steps and Figure 13After the DTA enters the Loop-back Test Functionality, the DTA sends the 1st Command Payload.
2. The 1st Command Payload is encapsulated by the transport communication into command(s) sent from the DTA-IUT to the LT.
3. After receiving the command(s), the LT answers with Response(s) to the DTA-IUT.
4. Responses are decapsulated into Response Payloads and sent from the IUT to the DTA.
5. The DTA collects one or more Response Payloads and converts them into one or more Command Payloads to be sent by the IUT encapsulated as Commands to the LT.

Steps 2 to 5 are repeated continuously until the LT indicates with a specific Response to quit Loop-back Test Functionality or until the LT stops responding.

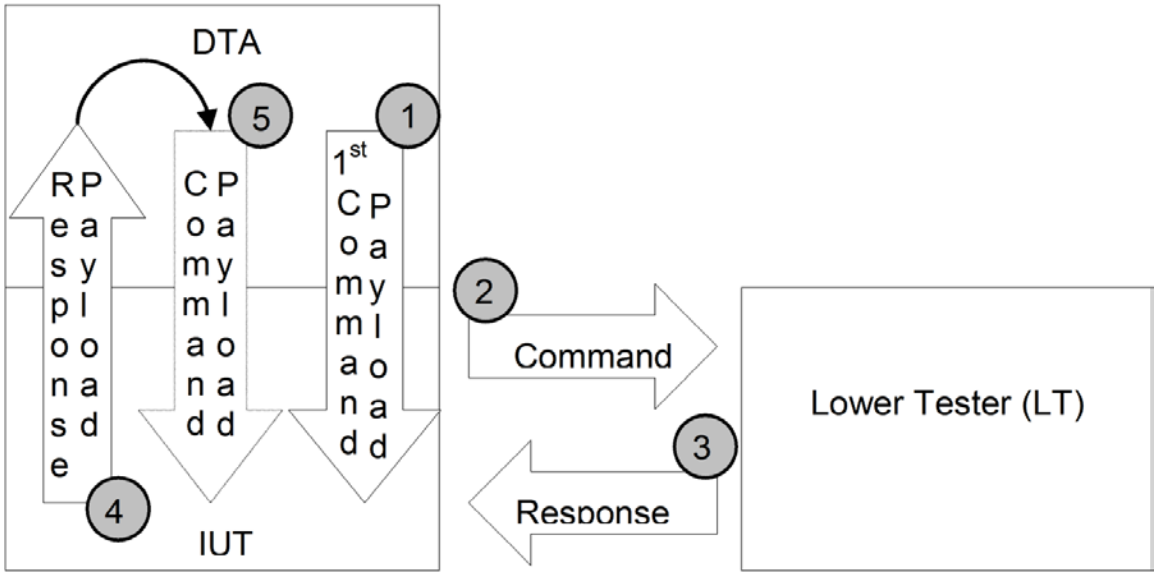


Figure 13: Loop-back Test Functionality in Poll Mode

5.1.2 Type Tag Platform Test Functionality in Poll Mode

Type Tag Platform Test Functionality is used for testing the Type Tag Command Set (see [DIGITAL]). In particular, the Type Tag Platform Test Functionality is used with slight variations in Section 5.4.2, Section 5.5.2, and Section 5.5.3.

Type Tag Platform Test Functionality stores test scenarios that are described by predefined commands sets. When the Type Tag Platform Test Functionality is executed, DTA-IUT sends the commands, one after the other, to the LT. The LT sends responses using parameters and timings defined for each Test Case scenario in the Test Case description.

The following steps and Figure 14 describe Type Tag Platform Test Functionality.

1. After the DTA enters the Type Tag Platform Test Functionality, the DTA sends a Command according to the stored Test Scenario to the IUT.
2. The Command is sent from the IUT to the LT.
3. After receiving the Command, the LT answers with a Response to the DTA-IUT according to the applied Test Scenario.
4. The Response is sent to the DTA.

Steps 1 to 4 are repeated continuously until either the Test Scenario stored in the DTA is brought to an end or the LT stops responding.

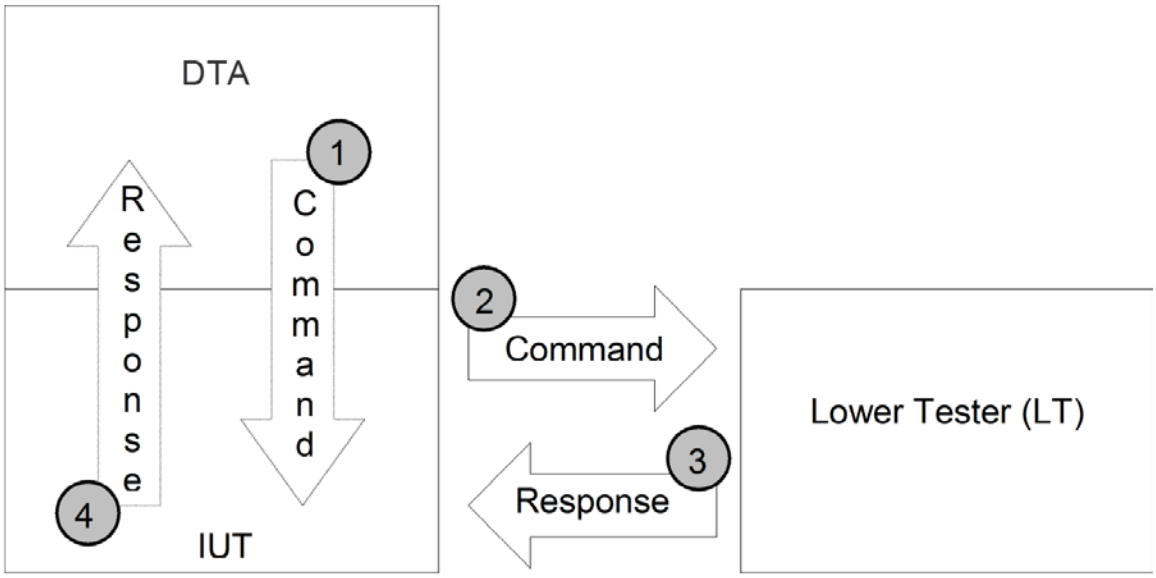


Figure 14: Type Tag Platform Test Functionality in Poll Mode

5.1.3 Type Tag Operation Test Functionality in Poll Mode

Type Tag Operation Test Functionality is used for testing the Type Tag Operation Technical Specifications (see [T1TOP], [T2TOP], [T3TOP], and [T4TOP]). In particular, the Type Tag Test Functionalities are used in Section 5.3.3, Section 5.3.4, Section 5.3.5, Section 5.4.3, Section 5.4.4, Section 5.4.5, Section 5.5.5, Section 5.5.6, Section 5.6.3, and Section 5.6.4.

Type Tag Test Functionality is called from the DTA to the IUT. Three Type Tag Test Functionalities are defined:

- NDEF Read Test Functionality
- NDEF Write Test Functionality
- Transition from READ/WRITE to READ-ONLY Functionality (only applicable to Type 1 Tag Operation and Type 2 Tag Operation)

The following steps and Figure 15 describe the Type Tag Operation Test Functionality.

1. After the DTA enters the Type Tag Operation Test Functionality, the DTA calls a Type Tag Operation Test Functionality.
2. The IUT sends a Command from the IUT to the LT according to the specified Type Tag Operation Test Functionality.
3. After receiving the Command, the LT answers with a Response to the DTA-IUT according to the applied Test Scenario.

Steps 2 to 3 are repeated until Type Tag Operation Test Functionality is completed or the LT stops responding.

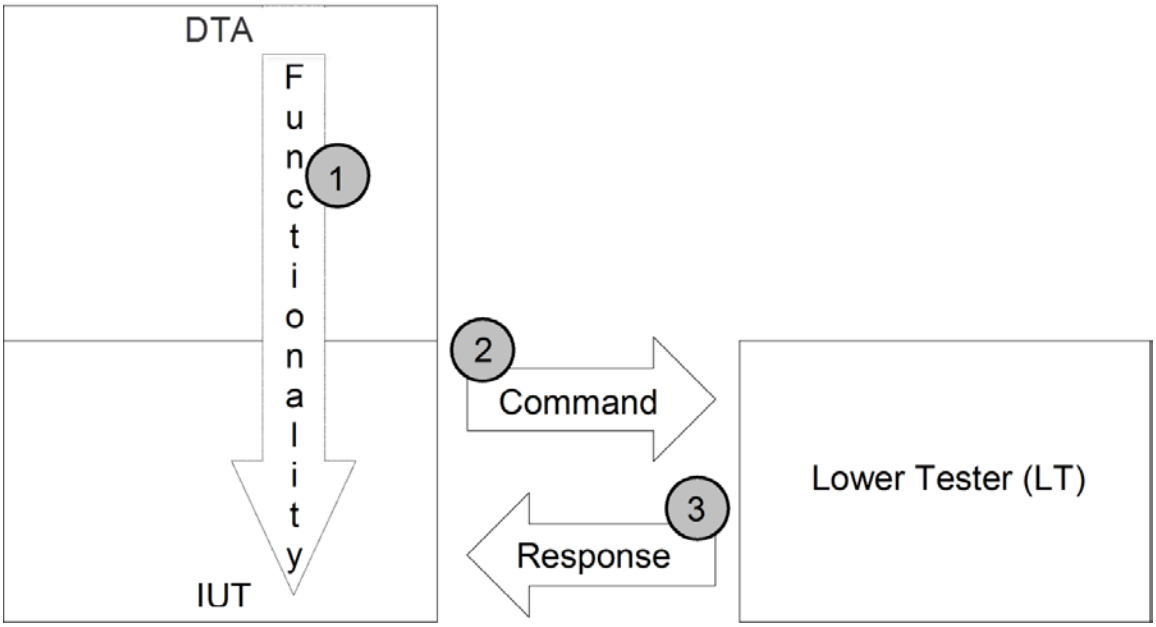


Figure 15: Type Tag Operation Test Functionality in Poll Mode

5.2 NFC-DEP Test Functionality in Poll Mode

This section describes the different NFC-DEP Test Functionalities.

5.2.1 NFC-DEP Test Functionality PATTERN_NUMBER Value

Requirements 14: Type 2 Tag Test Functionalities

5.2.1.1	The NFC Forum Device MUST execute NFC_DEP Test Functionality according to the PATTERN_NUMBER value in Appendix C.

For example, if the PATTERN_NUMBER value is equal to 0000h, the NFC Forum Device executes the NFC-DEP Loop-back Functionality (see Section 5.2.2 and Appendix C).

5.2.2 NFC-DEP Loop-back Functionality in Poll Mode

The NFC-DEP Loop-back Functionality exchanges Application Data with the LT. The Application Data is encapsulated in the Transport Data Bytes of the Data Exchange Protocol Requests/Responses (DEP_REQ/DEP_RES) when transmitted between DTA-IUT and LT.

The Application Data can be transported in two or more chained DEP_RES or DEP_REQ by using a Chaining mechanism (see [DIGITAL] for details on the Chaining mechanism).

NOTE If the IUT reports a failure at the protocol level (protocol error or excess of transmission or time-out errors), see Section 4.5.

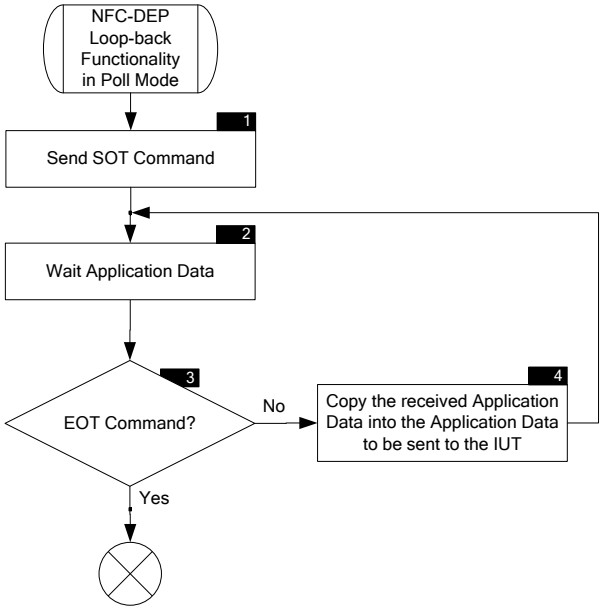


Figure 16: NFC-DEP Loop-back Functionality in Poll Mode Flow Chart

Requirements 15: NFC-DEP Loop-back Functionality in Poll Mode

5.2.2.1	Symbol 1: The NFC Forum DTA MUST send the Start Of Test Command (SOT), which is the first Application Data. The Start Of Test Command is '00 40 00 01 10 02 01 0E' (Parameter Exchange PDU of LLCP).
5.2.2.2	Symbol 2: The NFC Forum DTA MUST wait for Application Data sent by the LT in the DEP_RES Response.
5.2.2.3	Symbol 3: The NFC Forum DTA MUST check the received Application Data. • If the Application Data is an End Of Test (EOT) Command encoded as 'FF FF FF 01 01', then execute Device Deactivation Activity with DSL_REQ Command (see [ACTIVITY]). • If the Application Data is an End Of Test (EOT) Command encoded as 'FF FF FF 01 02', then the NFC Forum DTA MUST end the NFC-DEP Loop-back Functionality and execute Device Deactivation Activity with RLS_REQ Command (see [ACTIVITY]). • Otherwise, the NFC Forum DTA MUST proceed to Symbol 4.
5.2.2.4	Symbol 4: The NFC Forum DTA MUST copy the received Application Data into the next Application Data to be sent to the IUT.

5.3 Type 1 Tag Test Functionality in Poll Mode

This section describes the different Type 1 Tag Test Functionalities.

5.3.1 Type 1 Tag Test Functionality PATTERN_NUMBER Value

Requirements 16: Type 1 Tag Test Functionalities

5.3.1.1	The NFC Forum Device MUST execute Type 1 Tag Test Functionality according to the PATTERN_NUMBER value in Appendix C.

For example, if the PATTERN_NUMBER value is equal to 0001h, the NFC Forum Device executes the functionality suitable for both the Type 1 Tag Platform Test Functionality (see Section 5.3.2) and the Type 1 Tag Operation NDEF Read Test Functionality (see Section 5.3.3 and Appendix C).

5.3.2 Type 1 Tag Platform Test Functionality

Use the Type 1 Tag Operation NDEF Read Test Functionality (Section 5.3.3) for the Type 1 Tag Platform in Poll Mode Digital Tests.

5.3.3 Type 1 Tag Operation NDEF Read Test Functionality

Requirements 17: Type 1 Tag Operation NDEF Read Test Functionality

5.3.3.1	The NFC Forum Device MUST execute NDEF Read Procedure according to the Type 1 Tag Operation (see [T1TOP], Section 6).
5.3.3.2	The NFC Forum Device MUST keep the NDEF Message read using the NDEF Read Procedure.
This requirement is related to Requirement 5.3.4.2 to allow a kind of loopback in the Type Tag Operation doing an NDEF Read test and an NDEF Write test sequentially. This allows testing that an NDEF message is correctly read and written.	

The command sequence expected from the IUT during the NDEF Read Procedure is described in [IXIT].

The command sequence starts after the response to the RID command is correctly received by the IUT:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.
3. Etc.
4. See [IXIT] for last command.

5.3.4 Type 1 Tag Operation NDEF Write Test Functionality

Requirements 18: Type 1 Tag Operation NDEF Write Test Functionality

5.3.4.1	The NFC Forum Device MUST execute NDEF Write Procedure according to the Type 1 Tag Operation (see [T1TOP], Section 6).
5.3.4.2	The NFC Forum Device MUST write the NDEF Message previously read using the Type 1 Tag Operation NDEF Read Test Functionality (see Section 5.3.3).

The command sequence expected from the IUT during the NDEF Write Procedure is described in [IXIT]. The command sequence starts after the response to the RID command is correctly received by the IUT:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.
3. Etc.
4. See [IXIT] for last command.

5.3.5 Type 1 Tag Operation Transition from READ/WRITE to READ-ONLY Functionality

Requirements 19: Type 1 Tag Operation Transition from READ/WRITE to READ-ONLY Functionality

5.3.5.1	The NFC Forum Device MUST execute the Transition from READ/WRITE to READ-ONLY according to the Type 1 Tag Operation (see [T1TOP], Section 6).

The command sequence expected from the IUT during the Transition from READ/WRITE to READ-ONLY Procedure is described in [IXIT].

The command sequence starts after the response to the RID command is correctly received by the IUT:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.
3. Etc.
4. See [IXIT] for last command.

5.4 Type 2 Tag Test Functionality in Poll Mode

This section describes the different Type 2 Tag Test Functionalities.

5.4.1 Type 2 Tag Test Functionality PATTERN_NUMBER Value

Requirements 20: Type 2 Tag Test Functionalities

5.4.1.1	The NFC Forum Device MUST execute Type 2 Tag Test Functionality according to the PATTERN_NUMBER value in Appendix C.

For example, if the PATTERN_NUMBER value is equal to 0000h, the NFC Forum Device executes the T2T Platform Test Functionality (see Section 5.4.2 and Appendix C).

5.4.2 T2T Platform Test Functionality

Requirements 21: Type 2 Tag Platform Test Functionality

5.4.2.1	The NFC Forum Device MUST execute NDEF Write Procedure according to the Type 2 Tag Operation (see [T2TOP], Section 6.4.3).
5.4.2.2	The NFC Forum Device MUST write the default NDEF Message.
5.4.2.3	The NFC Forum Device MUST generate a default NDEF message with a number of bytes bigger than 1004.

The command sequence expected from the IUT during the NDEF Write Procedure is described in [IXIT].

The command sequence starts after the response to the SEL_RES command is correctly received by the IUT:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.
3. Etc.
4. See [IXIT] for last command.

NOTE Use the same Type 2 Tag Operation NDEF Write Test Functionality for the Type 2 Tag Platform in Poll Mode Digital Tests.

5.4.3 Type 2 Tag Operation NDEF Read Test Functionality

Requirements 22: Type 2 Tag Operation NDEF Read Test Functionality

5.4.3.1	The NFC Forum Device MUST execute NDEF Read Procedure according to the Type 2 Tag Operation (see [T2TOP], see Section 6.4.2).
5.4.3.2	The NFC Forum Device MUST keep the NDEF Message read using the NDEF Read Procedure. *This requirement is related with the Requirement 5.4.4.2 to allow a kind of loopback in the Type Tag Operation doing sequentially an NDEF Read test and an NDEF Write test. This allows testing that an NDEF message is correctly read and written.*

The command sequence expected from the IUT during the NDEF Read Procedure is described in [IXIT].

The command sequence starts after the response to the SEL_RES command is correctly received by the IUT:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.
3. Etc.
4. See [IXIT] for last command.

5.4.4 Type 2 Tag Operation NDEF Write Test Functionality

Requirements 23: Type 2 Tag Operation NDEF Write Test Functionality

5.4.4.1	The NFC Forum Device MUST execute NDEF Write Procedure according to the Type 2 Tag Operation (see [T2TOP], Section 6.4.3).
5.4.4.2	The NFC Forum Device MUST write the NDEF Message previously read using the Type 2 Tag Operation NDEF Read Test Functionality (see Section 5.4.3),

The command sequence expected from the IUT during the NDEF Write Procedure is described in [IXIT].

The command sequence starts after the response to the SEL_RES command is correctly received by the IUT:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.

3. Etc.
4. See [IXIT] for last command.

5.4.5 Type 2 Tag Operation Transition from READ/WRITE to READ-ONLY Functionality

Requirements 24: Type 2 Tag Operation Transition from READ/WRITE to READ-ONLY Functionality

5.4.5.1	The NFC Forum Device MUST execute Transition from READ/WRITE to READ-ONLY according to the Type 2 Tag Operation (see [T2TOP], Section 6.4.4.2).

The command sequence expected from the IUT during the Transition from READ/WRITE to READ-ONLY Procedure is described in [IXIT].

The command sequence starts after the response to the SEL_RES command is correctly received by the IUT:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.
3. Etc.
4. See [IXIT] for last command.

5.5 Type 3 Tag Test Functionality in Poll Mode

This section describes the different Type 3 Tag Test Functionalities.

5.5.1 Type 3 Tag Test Functionality PATTERN_NUMBER Value

Requirements 25: Type 3 Tag Test Functionalities

5.5.1.1	The NFC Forum Device MUST execute Type 3 Tag Test Functionality according to the PATTERN_NUMBER value in Appendix C.

For example, if the PATTERN_NUMBER value is equal to 0003h, the NFC Forum Device executes the Type 3 Tag Operation Command Test with Minimum Number of Blocks (see Section 5.5.2 and Appendix C).

5.5.2 Type 3 Tag Operation Command Test with Minimum Number of Blocks

For the T3T Platform in Poll Mode Digital Tests, the Type 3 Tag Operation Command Test with Minimum Number of Blocks can be used.

In this case, the IUT sends the commands (called command sequences) one after the other to the LT using the 2-Bytes Block List Format (see [T3TOP], Section 5.5). The LT sends responses using parameters and timings as defined for each Test Case scenario in the Test Case description.

The interface between DTA and IUT depends on the device, and one or more exchanges may be performed.

The Type 3 Tag Operation Command Test with Minimum Number of Blocks requires a specific command sequence between IUT and LT. The command sequence starts after the IUT correctly receives the response to the SENSF_RES command (see Section 4.3.4).

1. The IUT sends the UPDATE Command with the 2-Bytes Block List format:

   '08' + 'XX XX XX XX XX XX XX XX'(IDm) + '01'(Number of Services) + '09 00'(Service Code List) + '01'(Number of Blocks) + '80 01'(Block List) + ‘XX…XX’(16 bytes of Block Data)

2. The LT replies with the UPDATE Response. See [IXIT], Section 4.8.1.

3. The IUT sends CHECK Command with 2-Bytes Block List format:

   ’06’ + 'XX XX XX XX XX XX XX XX'(IDm) + ‘01’(Number of Services) + ‘09 00’(Service Code List) + ‘01’(Number of Blocks) + ‘80 01’(Block List)

4. The LT replies with the CHECK Response. See [IXIT], Section 4.8.1.

5. The IUT sends the EOT Command. See [IXIT], Section 4.8.1.

The Commands related to items 2, 4, and 5 are indicated in detail in [IXIT].

EOT Command is the UPDATE Command with the specific parameter defined in the scenario. The purpose of EOT Command is to acknowledge to LT that the test has correctly finished.

NOTE If the LT received the EOT Command, the LT should decide that the test has correctly finished.

5.5.3 Type 3 Tag Operation Command Test with Maximum Number of Services

For the T3T Platform in Poll Mode Digital Tests, the Type 3 Tag Operation Command Test with Maximum Number of Services can be used.

In this case, the IUT sends the commands (called command sequences) one after the other to the LT using the 2-Bytes Block List Format (see [T3TOP], Section 5.5). The LT sends responses using parameters and timings as defined for each Test Case scenario in the Test Case description.

The interface between DTA and IUT depends on the device, and one or more exchanges may be performed.

The Type 3 Tag Operation Command Test with Maximum Number of Services requires a specific command sequence between IUT and LT. The command sequence starts after the IUT correctly receives the response to the SENSF_RES command (see Section 4.3.4).

1. The IUT sends the UPDATE Command with 2-Bytes Block List format:

   '08' + 'XX XX XX XX XX XX XX XX'(IDm) + '0C'(Number of Services) + '09 00 49 11 89 22 C9 33 09 44 49 55 89 66 C9 77 09 88 49 99 89 AA C9 BB'(Service Code List) + '0C'(Number of Blocks) + '80 00 81 00 82 00 83 00 84 00 85 00 86 00 87 00 88 00 89 00 8A 00 8B 00'(Block List) + 'XX…XX' (192 Bytes of Block Data)

2. The LT replies with the UPDATE Response. See [IXIT], Section 4.8.2.

3. The IUT sends CHECK Command with 2-Bytes Block List format:

   ’06’ + 'XX XX XX XX XX XX XX XX'(IDm) + '0F'(Number of Services) + '0B 00 4B 11 8B 22 CB 33 0B 44 4B 55 8B 66 CB 77 0B 88 4B 99 8B AA CB BB 0B CC 4B DD 8B EE'(Service Code List) + '0F'(Number of Blocks) + '80 00 81 00 82 00 83 00 84 00 85 00 86 00 87 00 88 00 89 00 8A 00 8B 00 8C 00 8D 00 8E 00'(Block List)

4. The LT replies with the CHECK Response. See [IXIT], Section 4.8.2.
5. The IUT sends the EOT Command. See [IXIT], Section 4.8.2.

The Commands related to items 2, 4, and 5 are indicated in detail in the [IXIT].

EOT Command is the UPDATE Command with the specific parameter defined in the scenario. The purpose of EOT Command is to acknowledge to LT that the test has correctly finished.

NOTE If the LT received the EOT Command, the LT should decide that the test has correctly finished.

5.5.4 Type 3 Tag Operation Command Test with Maximum Number of Blocks

For the T3T Platform in Poll Mode Digital Tests, the Type 3 Tag Operation Command Test with Maximum Number of Blocks can be used.

In this case, the IUT sends the commands (called command sequences) one after the other to the LT using the 2-Byte and 3-Bytes Block List Format (see [T3TOP], Section 5.5). The LT sends responses using parameters and timings as defined for each Test Case scenario in the Test Case description.

The interface between DTA and IUT depends on the device. One or more exchanges may be performed.

The Type 3 Tag Operation Command Test with Maximum Number of Blocks requires a specific command sequence between IUT and LT. The command sequence starts after the IUT correctly receives the response to the SENSF_RES command (see Section 4.3.4).

1. The IUT sends the UPDATE Command with 2-Bytes Block List format:

   '08' + 'XX XX XX XX XX XX XX XX'(IDm) + '04'(Number of Services) + '09 00 49 11 89 22 C9 33'(Service Code List) + '0D'(Number of Blocks) + '80 00 80 01 80 02 81 00 81 01 81 02 82 00 82 01 82 02 83 00 83 01 83 02 83 03'(Block List) + 'XX…XX’(208 Bytes of Block Data)

2. The LT replies with the UPDATE Response. See [IXIT], Section 4.8.3.
3. The IUT sends CHECK Command with 2-Bytes Block List format:

   ’06’ + 'XX XX XX XX XX XX XX XX'(IDm) + ‘05’(Number of Services) + ‘0B 00 4B 11 8B 22 CB 33 0B 44’(Service Code List) + '0F'(Number of Blocks) + '80 00 80 01 80 02 81 00 81 01 81 02 82 00 82 01 82 02 83 00 83 01 83 02 84 00 84 01 84 02'(Block List)

4. The LT replies with the CHECK Response. See [IXIT], Section 4.8.3.
5. The IUT sends the UPDATE Command with 3-Bytes Block List format:

   '08' + 'XX XX XX XX XX XX XX XX'(IDm) + '07'(Number of Services) + '09 00 49 11 89 22 C9 33 09 44 49 55 89 66'(Service Code List) + '0C'(Number of Blocks) + '00 00 00 00 01 00 01 00 00 01 01 00 02 00 00 02 01 00 03 00 00 03 01 00 04 00 00 04 01 00 05 00 00 06 00 00'(Block List) + 'XX…XX’(192 Bytes of Block Data)

6. The LT replies with the UPDATE Response. See [IXIT], Section 4.8.3.
7. The IUT sends the CHECK Command with 3-Bytes Block List format:

’06’ + 'XX XX XX XX XX XX XX XX'(IDm) + '05'(Number of Services) + '0B 00 4B 11 8B 22 CB 33 0B 44'(Service Code List) + '0F'(Number of Blocks) + '00 00 00 00 01 00 00 02 00 01 00 00 01 01 00 01 02 00 02 00 00 02 01 00 02 02 00 03 00 00 03 01 00 03 02 00 04 00 00 04 01 00 04 02 00'(Block List)

8. The LT replies with the CHECK Response. See [IXIT], Section 4.8.3.
9. The IUT sends the EOT Command. See [IXIT], Section 4.8.3.

The Commands related to items 2, 4, 6, 8, and 9 are indicated in detail in [IXIT].

EOT Command is the UPDATE Command with the specific parameter defined in the scenario. The purpose of EOT Command is to acknowledge to LT that the test is correctly finished.

NOTE If the LT received EOT Command, the LT should decide that the test has correctly finished.

5.5.5 Type 3 Tag Operation NDEF Read Test Functionality

Requirements 26: Type 3 Tag Operation NDEF Read Test Functionality

5.5.5.1	The NFC Forum Device MUST execute NDEF Read Procedure according to the Type 3 Tag Operation (see [T3TOP], Section 6.4.2).

The command sequence expected from the IUT during the NDEF Read Procedure is described in the [IXIT].

The command sequence starts after the IUT correctly receives the response to the SENSF_RES command:

1. The IUT sends the CHECK Command for reading Attribute Information

   ’06’ + 'XX XX XX XX XX XX XX XX'(IDm) + '01'(Number of Services) + '0B 00'(Service Code List) + '01'(Number of Blocks) + '80 00'(Block List)

2. See [IXIT] for changing the command sequence to read 240 Bytes NDEF Data.

5.5.6 Type 3 Tag Operation NDEF Write Test Functionality

Requirements 27: Type 3 Tag Operation NDEF Write Test Functionality

5.5.6.1	The NFC Forum Device MUST execute NDEF Write Procedure according to the Type 3 Tag Operation (see [T3TOP], Section 6.4.3).

The command sequence expected from the IUT during the NDEF Write Procedure is described in the [IXIT].

The command sequence starts after the UIT correctly receives the response to the SENSF_RES command:

1. The IUT sends the CHECK Command for reading Attribute Information:

   ’06’ + 'XX XX XX XX XX XX XX XX'(IDm) + '01'(Number of Services) + '0B 00'(Service Code List) + '01'(Number of Blocks) + '80 00'(Block List)

2. The LT replies to the CHECK Response. See [IXIT], Section 4.8.5.
3. The IUT sends the UPDATE Command for writing Attribute Information:

’08’ + 'XX XX XX XX XX XX XX XX'(IDm) + '01'(Number of Services) + '09 00'(Service Code List) + '01'(Number of Blocks) + '80 00'(Block List) + ' XX XX XX XX XX XX XX XX XX 0F XX XX XX XX XX XX'(Attribute Information block)

4. The LT replies UPDATE Response. See [IXIT], Section 4.8.5.
5. See [IXIT] for changing the command sequence to write 192 Bytes NDEF Data.
6. The IUT sends the UPDATE Command for writing Attribute Information

   ’08’ + 'XX XX XX XX XX XX XX XX'(IDm) + '01'(Number of Services) + '09 00'(Service Code List) + '01'(Number of Blocks) + '80 00'(Block List) + ' XX XX XX XX XX XX XX XX XX 00 XX 00 00 C0 XX XX'(Attribute Information block)

5.6 Type 4 Tag Test Functionality in Poll Mode

This section describes the different Type 4 Tag Test Functionalities.

5.6.1 Type 4 Tag Test Functionality PATTERN_NUMBER Value

Requirements 28: Type 4 Tag Test Functionalities

5.6.1.1	The NFC Forum Device MUST execute Type 4 Tag Test Functionality according to the PATTERN_NUMBER value in Appendix C.

For example, if the PATTERN_NUMBER value is equal to 0000h, the NFC Forum Device executes Type 4A Tag and Type 4B Tag Loop-back Functionality (see Section 5.6.2 and Appendix C).

5.6.2 Type 4A Tag and Type 4B Tag Loop-back Functionality in Poll Mode

The Type 4A Tag and Type 4B Tag Loop-back Functionality exchanges Application Data with the LT. The Application Data can be divided into Responses (called Response-Application Protocol Data Unit or R-APDU) and Commands (called Command-Application Protocol Data Unit or C-APDU). R-APDU and C-APDU are exchanged between the IUT and the LT and are encapsulated in I-Blocks.

C-APDU and R-APDU can be transported in two or more chained I-Blocks using a Chaining mechanism (see [DIGITAL] for details on the Chaining mechanism).

NOTE If the IUT reports a failure at the protocol level (protocol error or excess of transmission or time-out errors), see Section 4.5.

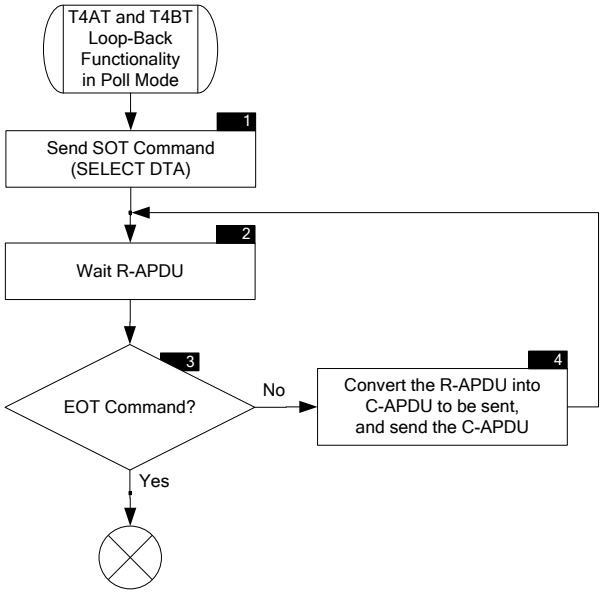


Figure 17: Type 4ATag and Type 4B Tag Loop-back Functionality in Poll Mode Flow Chart

Requirements 29: Type 4A Tag and Type 4B Tag Loop-back Functionality in Poll Mode

5.6.2.1	Symbol 1: The NFC Forum DTA MUST send the Start Of Test Command (SOT), which is the first C-APDU from DTA to IUT. The Start Of Test Command (also called SELECT DTA) is: ‘00 A4 04 00 0E’ + “2NFC.SYS.DDF01” + ‘00’ (in hexadecimal format ‘00 A4 04 00 0E’ + ‘32 4E 46 43 2E 53 59 53 2E 44 44 46 30 31’ + ‘00’)
5.6.2.2	Symbol 2: The NFC Forum DTA MUST wait for R-APDU from the IUT.
5.6.2.3	Symbol 3: The NFC Forum DTA MUST check the R-APDU. If the R-APDU is an End Of Test Command (EOT Command) encoded as 'FF FF FF 01 01’+ ’90 00’, then the NFC Forum DTA MUST end the Type 4A Tag and Type 4B Tag Loop-back Functionality. Otherwise, the NFC Forum DTA MUST proceed to Symbol 4.
5.6.2.4	Symbol 4: The NFC Forum DTA MUST convert the R-APDU into the C-APDU to be sent to the IUT and format the C-APDU. Format the R-APDU as Data_R + ’90 00’ by setting Data_R to a sequence of one or more bytes, up to 256 bytes. Format the C-APDU as Data_C by setting Data_C to a sequence of one or more bytes equal to Data_R in the received R-APDU.

5.6.3 Type 4 Tag Operation NDEF Read Test Functionality

Requirements 30: Type 4 Tag Operation NDEF Read Test Functionality

5.6.3.1	The NFC Forum Device MUST execute NDEF Read Procedure according to the Type 4 Tag Operation (see [T4TOP], Section 6.4.2).
5.6.3.2	The NFC Forum Device MUST keep the NDEF Message read using the NDEF Read Procedure.
This requirement is related with the requirement 5.6.4.2 to allow a kind of loopback in the Type Tag Operation doing sequentially an NDEF Read test and an NDEF Write test. This allows testing that an NDEF message is correctly read and written.	

The command sequence expected from the IUT during the NDEF Read Procedure is described in [IXIT].

The command sequence starts after the IUT correctly receives the response to the ATS command:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.
3. Etc.
4. See [IXIT] for last command.

5.6.4 Type 4 Tag Operation NDEF Write Test Functionality

Requirements 31: Type 4 Tag Operation NDEF Write Test Functionality

5.6.4.1	The NFC Forum Device MUST execute the NDEF Write Procedure according to the Type 4 Tag Operation (see [T4TOP], Section 6.4.3).
5.6.4.2	The NFC Forum Device MUST write the NDEF Message previously read using the Type 4 Tag Operation NDEF Read Test Functionality (see Section 5.6.3).

The command sequence expected from the IUT during the NDEF Write Procedure is described in [IXIT].

The command sequence starts after the IUT correctly receives the response to the ATS command:

1. See [IXIT] for next command.
2. See [IXIT] for command sequence.
3. Etc.
4. See [IXIT] for last command.

6 Test Transaction Functionalities in Listen Mode

6.1 Test Architecture in Listen Mode

For Listen Mode Testing, a Lower Tester (LT) is presented to the IUT (see Figure 2). The LT stores a set of predefined commands for each test scenario and sends the commands of the set to the IUT according to the running test scenario. These commands are sent using parameters and timings as defined for each Test Case scenario in the Test Case description.

During the execution of a test scenario, the DTA-IUT sends Responses as indicated in Listen Mode (see Section 4).

When in Listen Mode, the LT sends test-specific commands to the DTA-IUT according to the applied test scenario.

As soon as the DTA enters a Test Functionality in Listen Mode (see Section 4.4), the DTA-IUT sends commands as described in Section 6.2, Section 6.3, and Section 6.4.

The following sections describe Listen Mode functionalities.

6.1.1 Loop-back Test Functionality in Listen Mode

Loop-back Functionality is used for testing Type 4A and 4B Tag Half-duplex Protocol and NFC-DEP Protocol (see [DIGITAL]). Loop-back Functionality is used with slight variations in Section 6.2.2and Section 6.4.2.

Loop-back Functionality converts each received command into the next response and sends this response back to the LT via the IUT.

The following steps and Figure 18 describe Loop-back Test Functionality.

1. The LT sends a Command to the IUT.
2. Commands are decapsulated into Command Payloads and sent from the IUT to the DTA.
3. The DTA collects one or more Command Payloads and converts them into one or more Response Payloads to be sent by the IUT encapsulated as Responses to the LT.
4. The IUT sends the Response to the LT.

Steps 1 to 4 are repeated continuously until the LT stops sending Commands.

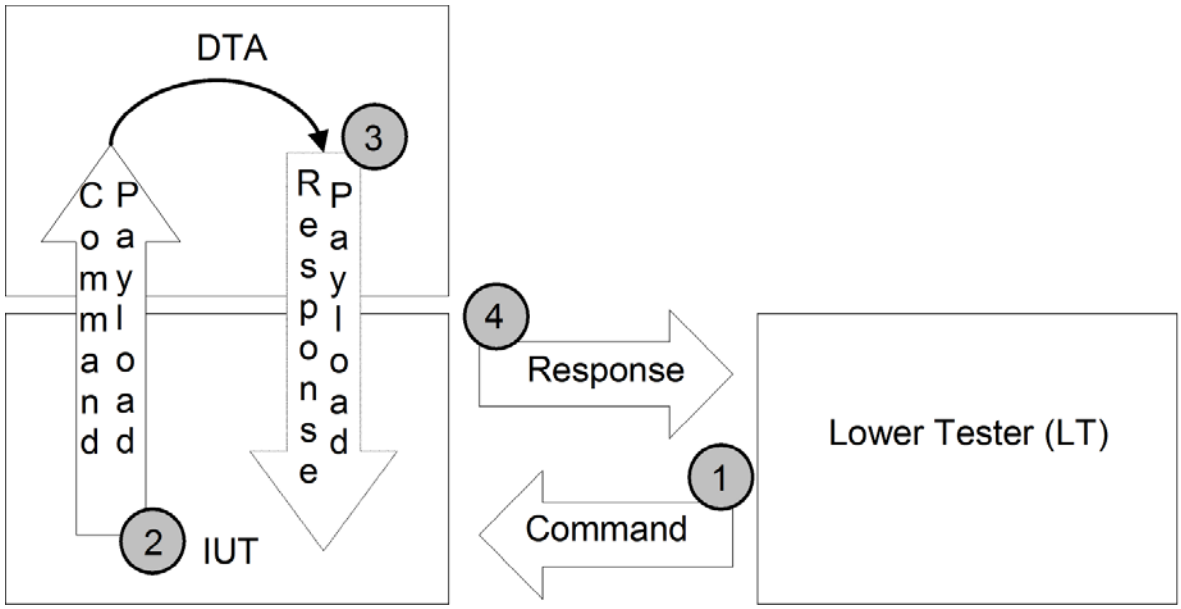


Figure 18: Loop-back Test Functionality in Listen Mode

6.1.2 Type Tag Platform Test Functionality in Listen Mode

Type Tag Platform Test Functionality is used for testing the Type Tag Command Set (see [DIGITAL]). Type Tag Platform Test Functionality is used in Section 6.3.2.

Type Tag Platform Test Functionality stores test scenarios that are described by predefined responses sets. When the Type Tag Platform Test Functionality is executed, DTA-IUT sends the responses, one after the other, to the LT. The LT sends commands using parameters and timings as defined for each Test Case scenario in the Test Case description.

The following steps and Figure 19 describe Type Tag Platform Test Functionality.

1. The LT sends a Command according to the Test Scenario to the IUT.
2. The Command is sent from the IUT to the DTA.
3. After receiving the Command, the DTA answers with a Response to the IUT according to the stored Test Scenario.
4. The Response is sent to the LT.

Steps 1 to 4 are repeated continuously until the LT stops sending Commands.

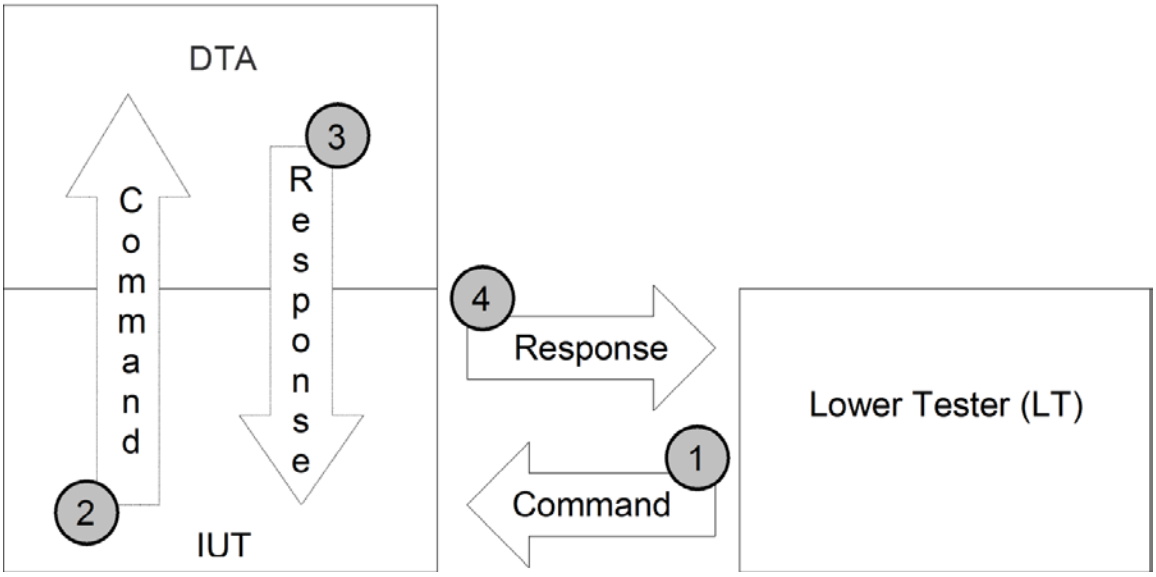


Figure 19: Type Tag Platform Test Functionality in Listen Mode

6.2 NFC-DEP Test Functionality in Listen Mode

This section describes NFC-DEP Test Functionality in Listen Mode.

6.2.1 NFC-DEP Test Functionality Requirement

Requirements 32: NFC-DEP Test Functionality in Listen Mode

6.2.1.1	The NFC Forum Device MUST execute the NFC-DEP Loop-back Functionality in Listen Mode (see Section 6.2.2).

6.2.2 NFC-DEP Loop-back Functionality in Listen Mode

The NFC-DEP Loop-back Functionality exchanges Application Data with the LT. The Application Data is encapsulated in the Transport Data bytes of the Data Exchange Protocol Requests/Responses (DEP_REQ/DEP_RES) when transmitted between DTA-IUT and LT.

The Application Data can be transported in several chained DEP_RES or DEP_REQ by using a Chaining mechanism (see [DIGITAL] for details on the Chaining mechanism).

NOTE If the IUT reports a failure at the protocol level (protocol error or excess of transmission or time-out errors), see Section 4.5.

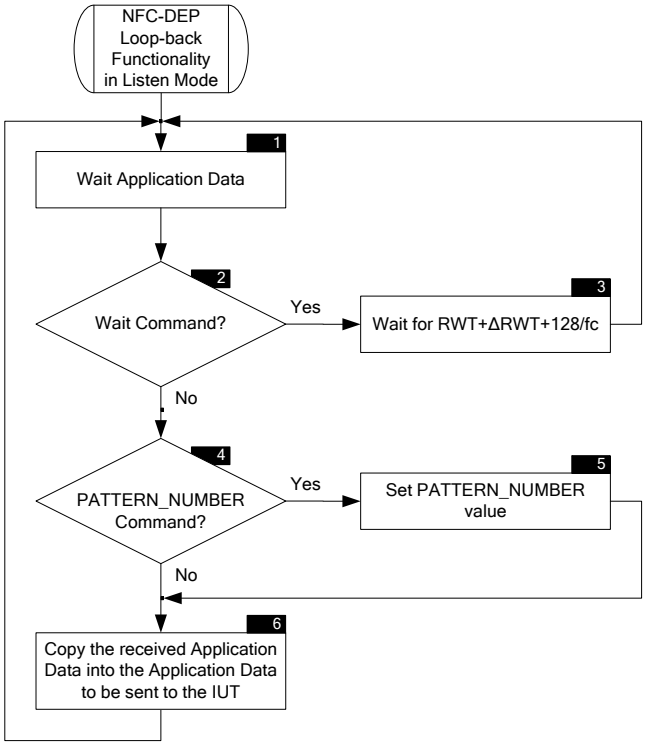


Figure 20: NFC-DEP Loop-back Functionality in Listen Mode Flow Chart

Requirements 33: NFC-DEP Loop-back Functionality in Listen Mode

6.2.2.1	Symbol 1: The NFC Forum DTA MUST wait for Application Data from the IUT (i.e., data received by the IUT in the DEP_REQ Request).
6.2.2.2	Symbol 2: If the Application Data is a Wait Command encoded as 'FF FF FF 01 03', then the NFC Forum DTA MUST proceed to Symbol 3. Otherwise, the NFC Forum DTA MUST proceed to Symbol 4.
6.2.2.3	Symbol 3: The NFC Forum DTA MUST copy the received Application Data into the next Application Data to be sent to the IUT.
6.2.2.4	Symbol 4: The NFC Forum DTA MAY check the received Application Data. If the NFC Forum DTA does not check the Application Data, then the NFC Forum DTA MUST proceed to Symbol 6. Otherwise NFC Forum DTA MUST perform the following: • If the Application Data is a PATTERN_NUMBER Command encoded as 'FF00 0000 XXXX', then the NFC Forum DTA MUST proceed to Symbol 5. • Otherwise, the NFC Forum DTA MUST proceed to Symbol 6.
6.2.2.5	Symbol 5: The NFC Forum DTA SHALL set the PATTERN_NUMBER value equal to 'XXXX' (last 2 bytes of the received PATTERN_NUMBER Command).
6.2.2.6	Symbol 6: The NFC Forum DTA MUST copy the received Application Data into the next Application Data to be sent to the IUT.

6.3 Type 3 Tag Test Functionality in Listen Mode

This section describes the Type 3 Tag Test Functionality in Listen Mode.

6.3.1 Type 3 Tag Test Functionality Requirement

Requirements 34: Type 3 Tag Test Functionality in Listen Mode

6.3.1.1	The NFC Forum Device MUST execute the Type 3 Tag Basic Command Exchange Test Functionality in Listen Mode (see Section 6.3.2).

6.3.2 Type 3 Tag Basic Command Exchange Test Functionality in Listen Mode

For the Type 3 Tag in Listen Mode Digital Tests, the IUT in Listen Mode SHALL send the response when it receives the command from the LT in Poll Mode.

For UPDATE command with 2-byte Block List:

‘09’ + ‘XX XX XX XX XX XX XX XX’(NFCID2) + ‘00’ + ‘00’

For CHECK command with 2-byte Block List:

‘07’ + ‘XX XX XX XX XX XX XX XX’(NFCID2) + ‘00’ + ‘00’ + ‘01’ + ‘XX...XX'(16 bytes of Block Data)

For UPDATE command with 3-byte Block List:

‘09’ + ‘XX XX XX XX XX XX XX XX’(NFCID2) + ‘00’ + ‘00’

For CHECK command with 3-byte Block List:

‘07’ + ‘XX XX XX XX XX XX XX XX’(NFCID2) + ‘00’ + ‘00’ + ‘01’ + ‘XX...XX'(16 bytes of Block Data)

NOTE The Functionality to execute is selected by the LT as indicated in [IXIT].

6.4 Type 4 Tag Test Functionality in Listen Mode

This section describes the Type 4 Tag Test Functionality in Listen Mode.

6.4.1 Type 4 Tag Test Functionality Requirement

Requirements 35: Type 4 Tag Test Functionality in Listen Mode

6.4.1.1	The NFC Forum Device MUST implement either Type 4A Tag and Type 4B Tag Loop-back Functionality in Listen Mode (see Section 6.4.2) or Type 4A Tag and Type 4B Tag Proprietary Functionality in Listen Mode (see Section 6.4.3). The NFC Forum Device MAY implement both the Type 4A Tag and Type 4B Tag Loop-back Functionality in Listen Mode (see Section 6.4.2), or the Type 4A Tag and Type 4B Tag Proprietary Functionality in Listen Mode (see Section 6.4.3).

NOTE The Functionality to be executed is selected by the LT as indicated in [IXIT].

6.4.2 Type 4A Tag and Type 4B Tag Loop-back Functionality in Listen Mode

The Type 4A Tag and Type 4B Tag Loop-back Functionality exchanges Application Data with the LT. The Application Data can be divided into Responses (called Response-Application Protocol Data Unit or R-APDU) and Commands (called Command-Application Protocol Data Unit or C-APDU). R-APDU and C-APDU are exchanged between the IUT and the LT and are encapsulated in I-Blocks. APDU and R-APDU pairs can be transported in several chained I-Blocks using a Chaining mechanism (refer to [DIGITAL] for details on the Chaining mechanism).

NOTE If the IUT reports a failure at the protocol level (protocol error or excess of transmission or time-out errors), see Section 4.5.

The Type 4A Tag and Type 4B Tag Loop-back Functionality is applied when testing the chaining of the Type 4A and 4B Tag Half-duplex Protocol (see [DIGITAL]).

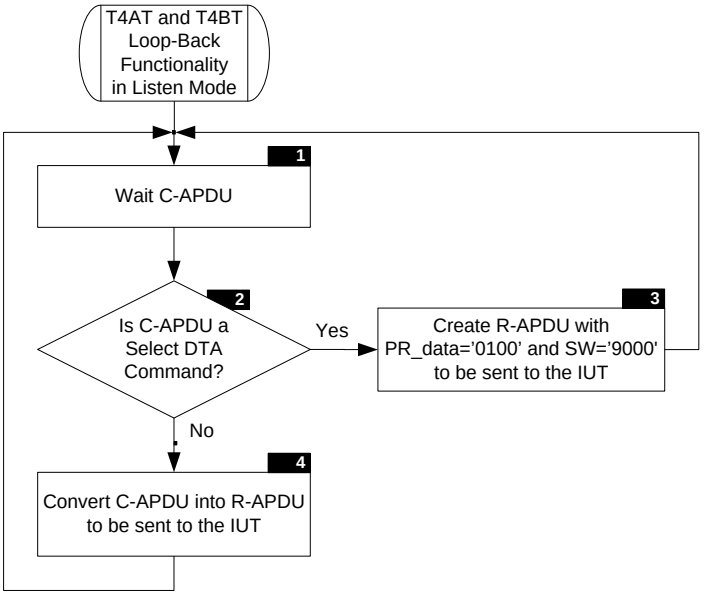


Figure 21: Type 4A Tag and Type 4B Tag Loop-back Functionality in Listen Mode Flow Chart

Requirements 36: Type 4A Tag and Type 4B Tag Loop-back Functionality in Listen Mode

6.4.2.1	Symbol 1: The NFC Forum DTA MUST wait for C-APDU from the IUT (i.e., data received by the IUT)
6.4.2.2	Symbol 2: The NFC Forum DTA MUST check the received C-APDU. • If the C-APDU is a Select DTA encoded as '00 A4 04 00 0E' + "1NFC.SYS.DDF01" + '00' (in hexadecimal format '00 A4 04 00 0E' + '31 4E 46 43 2E 53 59 53 2E 44 44 46 30 31' + '00'), then the NFC Forum DTA MUST proceed to Symbol 3. • Otherwise, the NFC Forum DTA MUST proceed to Symbol 4.
6.4.2.3	Symbol 3: The NFC Forum DTA MUST create an R-APDU encoded as'01 00 90 00' (PR_DATA (Proprietary Response Data) equal to '01 00' and SW (Status Word) equal to '90 00') to be sent to the IUT.
6.4.2.4	Symbol 4: The NFC Forum DTA MUST convert the received C-APDU into the R-APDU to be sent to the IUT. Format the C-APDU as '80 EE 00 00' + Lc + Data_C + '00' with: • Lc 1-byte value that depends on Data_C length • Data_C Command Data sequence of one or more bytes up to 250 Format the R-APDU as Data_R + '90 00' with: • Data_R Response Data, sequence of one or more bytes equal to the Data_C in the received C-APDU

6.4.3 Type 4A Tag and Type 4B Tag Proprietary Functionality in Listen Mode

Type 4A Tag and Type 4B Tag Proprietary Functionality exchanges Application Data with the LT. The Application Data can be divided into Responses (called Response-Application Protocol Data Unit or R-APDU) and Commands (called Command-Application Protocol Data Unit or C-APDU). R-APDU and C-APDU are exchanged between the IUT and the LT and are encapsulated in I-Blocks. APDU and R-APDU pairs can be transported in several chained I-Blocks using a Chaining mechanism (see [DIGITAL] for details on the Chaining mechanism).

NOTE If the IUT reports a failure at the protocol level (protocol error or excess of transmission or time-out errors), see Section 4.5.

Requirements 37: Type 4A Tag and Type 4B Tag Proprietary Functionality in Listen Mode – Generic Requirements

6.4.3.1	The Type 4A Tag and Type 4B Tag Proprietary Functionality SHALL have a P_AID (Proprietary Application IDentifier). The P_AID is contained in the first I-block of the protocol exchange in a Select DTA command with the format of '00 A4 04 00' +Lc + P_AID + Le.
6.4.3.2	The Type 4A Tag and Type 4B Tag Proprietary Functionality SHALL allow and support a sufficient number of command-and-response pairs to complete the relevant Listen Mode test cases. The minimum number of command- response pairs is three, excluding the Select DTA command.

The expected response to the Select DTA command and further C-APDU and R-APDU exchange requirements is defined by the IUT manufacturer and can be entered into [IXIT]. This allows the test tool to be pre-configured for a test session performing the required command exchanges and validating the IUT responses. There is no requirement for the P_AID and data for the Proprietary Application in this version of the document.

The example below shows the proprietary command-response exchanges and data that shall be submitted by [IXIT]. In the example, the proprietary application supports minimum requirements such as:

- Responds to a Select Application Command with P_AID
- One initial command-response with two additional command–and-response pairs is also supported (command-and-response data below is not shown but shall be completed in the [IXIT] form).

  P_AID (proprietary application Identifier): XX XX XX XX XX XX XX XX XX XX (**n** bytes)

  Lc: 0**n** , Le:00

  R-APDU for Select Application command: xx……xx (hex bytes)

  C-APDU-init: 80 A8 00 00 XX XX XX XX

  R-APDU-init: XX……XX (hex bytes)

  C-APDU-1:00 B2 01 0C 00

  R-APDU-1: XX……XX (hex bytes)

  C-APDU-2:00 B2 02 0C 00

  R-APDU-2: XX……XX (hex bytes)

NOTE The hex bytes as well as the 'xx' presentation in the example above may be any value based on the product application supported. Commands and responses can contain the same data value (one command supported by multiple repetitions) in all exchanges above following the Select Application command.

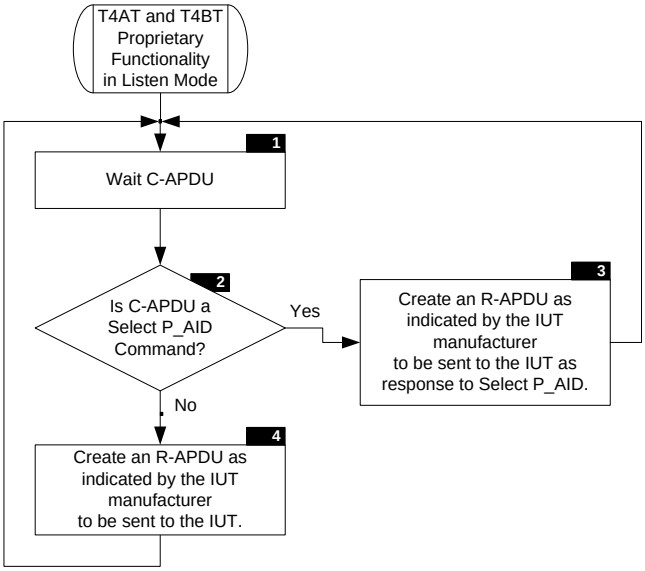


Figure 22: T4AT and T4BT Proprietary Functionality in Listen Mode Flow Chart

Requirements 38: T4AT and T4BT Proprietary Functionality in Listen Mode

6.4.3.3	Symbol 1: The NFC Forum DTA MUST wait for C-APDU from the IUT (i.e., data received by the IUT).
6.4.3.4	Symbol 2: The NFC Forum DTA MUST check the received C-APDU. • If the C-APDU is a Select P_AID encoded as'00 A4 04 00' +Lc + P_AID + Le, then the NFC Forum DTA MUST proceed to Symbol 3. • Otherwise, the NFC Forum DTA MUST proceed to Symbol 4.
6.4.3.5	Symbol 3: The NFC Forum DTA MUST create an R-APDU as indicated by the IUT manufacturer in [IXIT] to be sent to the IUT as response to Select P_AID.
6.4.3.6	Symbol 4: The NFC Forum DTA MUST create an R-APDU as indicated by the IUT manufacturer in [IXIT] to be sent to the IUT.

7 Device Test Application for LLCP

7.1 General Requirements for Device Test Application

This section describes the different LLCP Device Test Application Functionalities.

7.1.1 LLCP Test Functionality Activation

To make a distinction between Digital Protocol testing and LLCP testing, the LLCP magic number SHALL be used in the ATR_REQ and ATR_RES commands (octet sequence ‘46 66 6D’, see [LLCP]).

If the LT is the Initiator, the ATR_REQ SHALL be sent with the LLCP magic number to indicate the activation of the LLCP test functionality. The IUT SHALL consequently start the LLCP DTA. The IUT SHALL reply with the ATR_RES containing the LLCP magic number.

If the LT is the Target, the IUT SHALL send the ATR_REQ with the LLCP magic number. The LT SHALL reply with the ATR_RES containing the LLCP magic number.

7.1.2 LLCP Test Functionality PATTERN_NUMBER Value

7.1.2.1	The NFC Forum Device MUST execute LLCP Test Functionality according to the PATTERN_NUMBER value in Appendix C.

PATTERN_NUMBER values in the range of 1000h-12FFh are assigned to LLCP functionalities.

If PATTERN_NUMBER needs to be changed by LT, this SHALL be done using a dedicated service. The Service Name (SN) is urn:nfc:sn:dta-pattern-number. The SAP for this service is fixed to 10h.

The LLCP assigned PATTERN_NUMBER SHALL be sent as a payload of UI PDUs from LT to IUT.

The UI PDU shall be encoded as '010000b’ (SAP) + 0011b + ‘xxxxxxb’ (SAP) + ‘FF00 0000 XXXX’ (Data) (XXXX: PATTERN_NUMBER).

7.2 LLCP Echo Test Application

The LLCP Echo Test Application (also referred to as the LLCP DTA) is an application running on the IUT and that uses functionalities like Service Discovery, implemented by the LLCP stack.

In case of the Connection-less mode only, in order to indicate to the DTA on the IUT that an LLCP test sequence starts, an UI PDU containing a fixed payload of ‘53 4F 54’ (Start Of Test Command) is sent in the Information field.

To allow for automated testing, the test cases have been designed to work with both an extended connection-less mode echo test application and an extended connection-oriented mode echo test application. Per echo test application, two services are required on the IUT and on the LT. One will be referred to as *inbound service*, and the other one will be referred to as *outbound service*. The inbound and outbound directions are defined from the IUT perspective. The use of the services will be defined below.

Table 11 lists the name of the local services as they shall be registered with the local service environment, and the Service Access Point (SAP) value notation as will be used in the test cases.

Table 11: LLCP DTA Services

Service	Service Name (SN)	SAP on LT	SAP on IUT
Inbound connection-less mode echo service	urn:nfc:sn:dta-cl-echo-in	**$SAP_{LT,CL-IN-SRC}$**	**$SAP_{IUT,CL-IN-DEST}$**
Outbound connection-less mode echo service	urn:nfc:sn:dta-cl-echo-out	**$SAP_{LT,CL-OUT-DEST}$**	**$SAP_{IUT,CL-OUT-SRC}$**
Inbound connection-oriented mode echo service	urn:nfc:sn:dta-co-echo-in	**$SAP_{LT,CO-IN-SRC}$**	**$SAP_{IUT,CO-IN-DEST}$**
Outbound connection-oriented mode echo service	urn:nfc:sn:dta-co-echo-out	**$SAP_{LT,CO-OUT-DEST}$**	**$SAP_{IUT,CO-OUT-SRC}$**

Figure 23 gives an overview of the Connection-less Mode services.

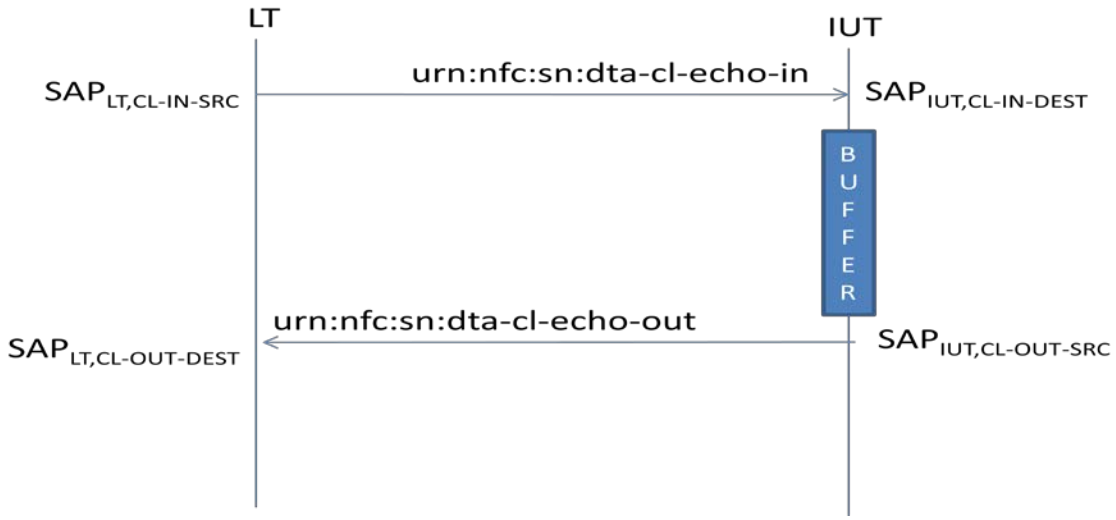


Figure 23: Connection-less Mode Test Application

Figure 24 gives an overview of the Connection-Oriented Mode services.

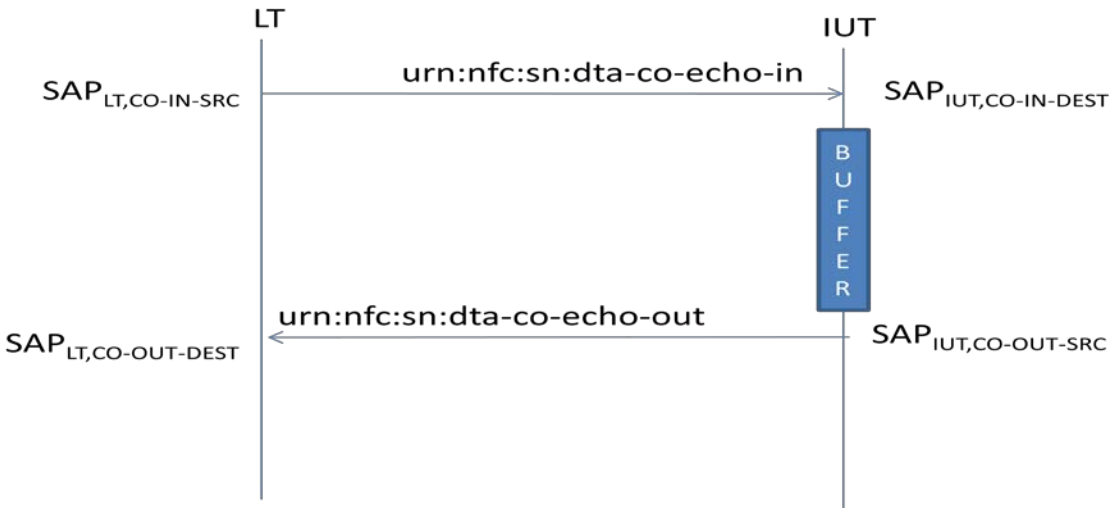


Figure 24: Connection-Oriented Mode Test Application

For the inbound service, the LT initiates the service name lookup. For the outbound service, the IUT initiates the service name lookup

Based on these roles, the SAP are named: **$SAP_{ww,xx-yy-zz}$**, where

- ww is identifying the device
  - LT - Lower Tester
  - IUT - Implementation under test)
- xx is identifying the mode
  - CL – Connection-less
  - CO - Connection-oriented
- yy is indentifying the service
  - IN - inbound service
  - OUT - outbound service
- zz is identifying the origin.
  - SRC - Source
  - DEST - Destination

The SAP values of the two services on the lower tester are presented in Table 12.

Table 12: SAP Values on LT

SAP on LT	Range
$SAP_{LT,CO-IN-SRC}$	20h
$SAP_{LT,CO-OUT-DEST}$	12h
$SAP_{LT,CL-IN-SRC}$	21h
$SAP_{LT,CL-OUT-DEST}$	11h

The IUT SHALL use Service Discovery Procedure (SDP) to retrieve the SAP values.

Table 13: SAP Value Ranges on IUT

SAP on IUT	Range
$SAP_{IUT,CL-IN-DEST}$	11h-1Fh
$SAP_{IUT,CL-OUT-SRC}$	20h-3Fh
$SAP_{IUT,CO-IN-DEST}$	11h-1Fh
$SAP_{IUT,CO-OUT-SRC}$	20h-3Fh

The SAP values $SAP_{IUT,CL-IN-DEST}$ and $SAP_{IUT,CO-IN-DEST}$ values MAY be part of the LLCP part of [IXIT]. If the values are dynamically assigned, the LT SHOULD use the Service Discovery Procedure to retrieve the SAP values in the LT configuration phase.

7.2.1 Extended Connection-less Mode Echo Test Application

The extended connection-less mode echo test application consists of two services. The inbound connection-less mode echo service SHALL accept connection-less transport mode PDUs on the $SAP_{IUT,CL-IN-DEST}$. Service data units MAY have any size between zero and the maximum information unit size announced with the LLCP Link MIU parameter. Inbound service data units SHALL enter a linear buffer of service data units. The buffer SHALL have a capacity of exactly $N_{BUFFER,CL}$ service data units. The first service data unit entering the buffer SHALL start a $T_{DELAY,CL}$ delay timer. Expiration of the delay timer SHALL cause service data units in the buffer to be sent back over the outbound echo service using $SAP_{IUT,CL-OUT-SRC}$ until the buffer is completely emptied. The buffer empty condition SHALL then re-enable the delay timer start event for the next service data unit.

Table 14: Default parameters for the Connection-less Mode Echo Test Application

Parameter	Description	Value
$T_{DELAY,CL}$	Connection-less mode echo delay timer	$T_{DELAY,CL}$ = 3 s
$N_{BUFFER,CL}$	Connection-less mode buffer capacity	1 SDU

PATTERN_NUMBER values in the range of 1100h-11FFh are assigned to Connection-less Mode functionalities.

7.2.2 Extended Connection-oriented Mode Echo Test Application

Connection Establishment

The connection-oriented mode echo test application SHALL wait until a first CONNECT request from the LT is received on the inbound connection-oriented mode echo service. As soon as the CONNECT / CC PDU pair is exchanged over the inbound connection-oriented mode echo service, the IUT SHALL either first perform a Service Discovery Procedure or immediately send a CONNECT PDU over the outbound connection-oriented mode echo service to $SAP_{LT,CO\text{-}OUT\text{-}DEST}$. The IUT shall start a timer of $T_{CO,\ CONNECT\text{-}OUT}$. A Pattern Number is linked to the selection of the sequence.

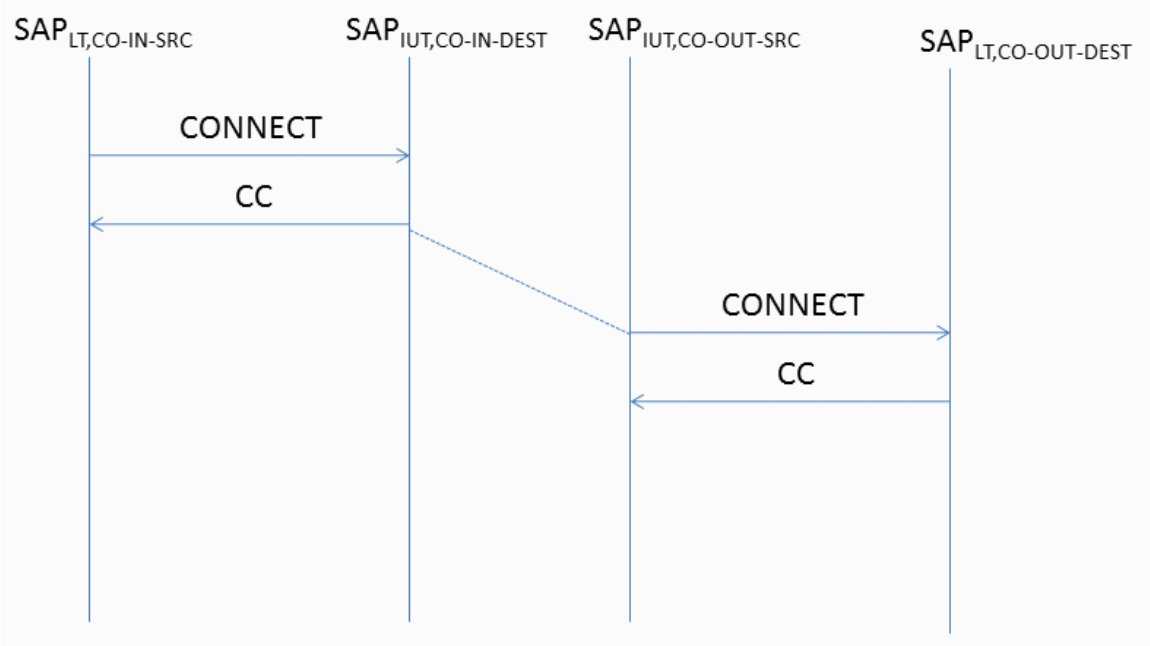


Figure 25: Connection Establishment Sequence for Inbound and Outbound Services (with Connection Establishment by Name)

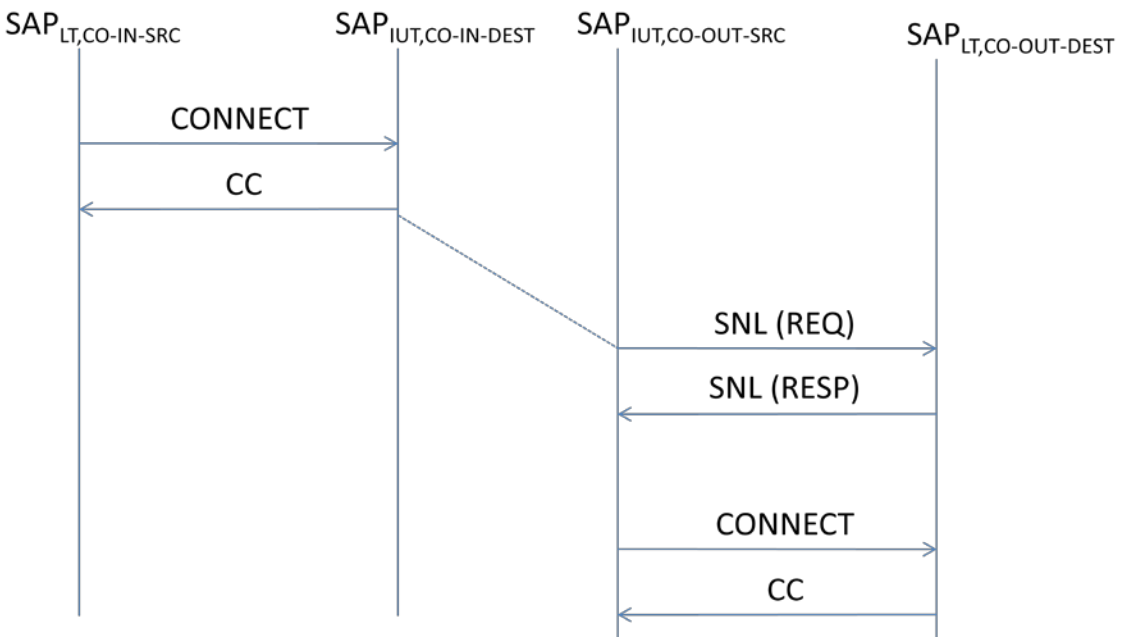


Figure 26: Connection Establishment Sequence for Inbound and Outbound Services (with Service Discovery Procedure)

If the IUT can't establish the outbound connection with the LT before the timer expires, the IUT SHALL terminate the inbound connection.

Once these connections are established, the IUT can process connection-oriented transport mode PDUs. Further connect requests shall then be denied.

In the CONNECT PDU on the outbound echo service, and the CC PDU on the inbound echo service, the IUT SHALL send the parameters (MIUX, RW,…) as defined [IXIT].

Information Transfer

The connection-oriented mode echo test application SHALL operate such that inbound service data units are stored in a linear buffer of service data units. The buffer SHALL have a capacity of exactly $\mathbf{N_{BUFFER,CO}}$ service data units. The first service data unit entering the buffer SHALL start a delay timer of $\mathbf{T_{DELAY,CO}}$. Expiration of the delay timer SHALL cause service data units in the buffer to be sent back to the LT over the outbound echo service until the buffer is completely emptied

The buffer empty condition shall then re-enable the delay timer start event for the next service data unit. The echo service shall determine itself as being in the receiver busy condition if it is unable to accept further incoming service data units. IUT shall send an RNR PDU on a data link connection when it is temporarily unable to dispatch service data units to the echo service. While in the receiver busy condition, IUT shall continue to accept and buffer I PDUs. When the receiver busy condition clears, IUT shall send an RR PDU on the data link connection.

Table 15: Default parameters for the Connection-oriented Mode Echo Test Application

Parameter	Description	Value
$T_{DELAY,CO}$	Connection-oriented mode echo delay timer	$T_{DELAY,CO}$ = 3 s (max LTO = 2.55 s)
$N_{BUFFER,CO}$	Connection- oriented mode buffer capacity	2 SDU
$T_{CO,\ CONNECT\text{-}OUT}$	Outbound connection establishment timer	3 s

PATTERN_NUMBER values in the range of 1200h-12FFh are assigned to Connection-oriented Mode functionalities

Connection Termination

Termination of the data link connection SHALL cause the echo server to further accept a new connection request on the inbound service. The termination of the data link connection SHALL also empty the buffer.

If on the outbound service, the IUT receives a DM PDU, instead of a CC PDU, the IUT SHALL terminate the connection on the inbound service immediately.

If on the inbound connection the IUT receives DISC PDU, IUT shall terminate the outbound connection after sending DM PDU on inbound connection.

If on the inbound connection the IUT receives or sends FRMR PDU, IUT shall terminate the outbound connection immediately.

8 Device Test Application for SNEP

8.1 General Requirements for Device Test Application

The Device Test Application complies with the following general requirements.

Figure 27 provides an overview of the different components in the DUT in its two roles: DUT as SNEP client and DUT as SNEP server.

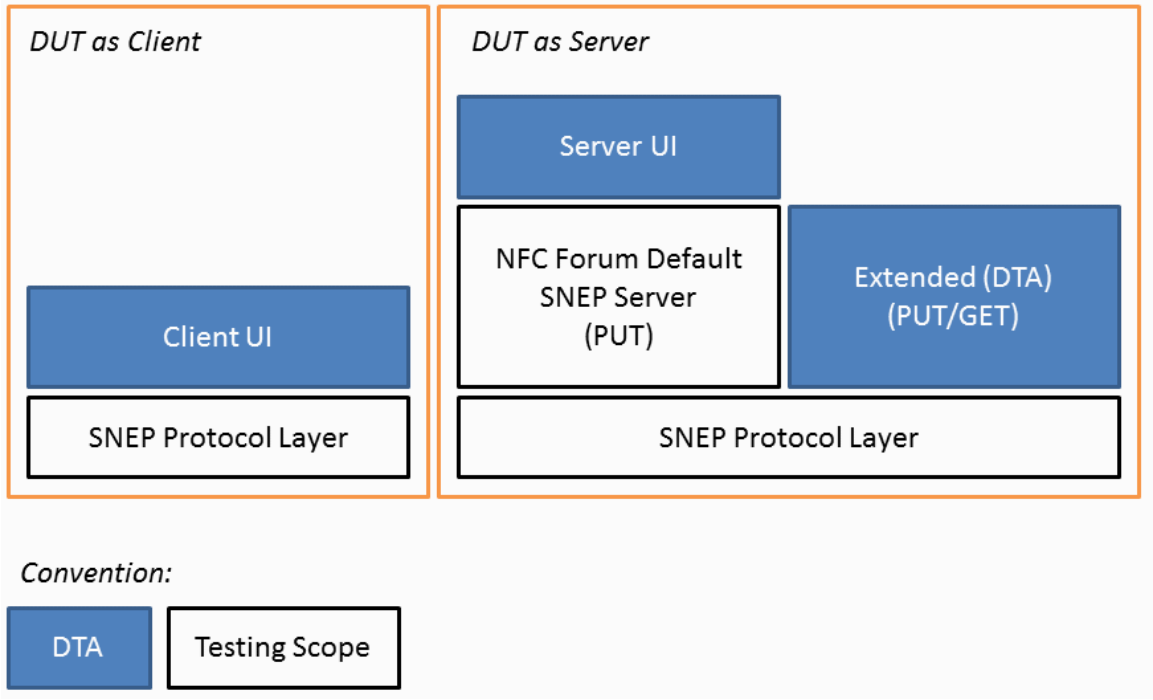


Figure 27: Overview of DTA Functionalities (Informative Image)

The Figure distinguishes the parts in scope for SNEP testing, as well as DTA functionalities.

Parts in scope are:

- The SNEP protocol layer as defined in Sections 1 to 5 of [SNEP]
- The NFC Forum Default SNEP Server as defined Section 6 of [SNEP]

For the DTA, we can identify 3 functionalities:

- For a DUT as Client - A Client GUI
- For a DUT as Server - A Server GUI and an Extended DTA Server functionality

The DUT may implement one or more functionalities, depending on the SNEP features supported.

8.2 DUT as a Client

8.2.1 Client GUI

The Client GUI shall support

- A means to set-up LLCP connection-oriented communication.
- A means to trigger the request messages (PUT/GET) with NDEF data as defined in the SNEP test cases document [SNEP_TC]. This may include setting up and terminating the LLCP connection-oriented communication.
- A way to display Text RTD content. The Text RTD content contains Plain ASCII and no special characters.

8.3 DUT as a Server

8.3.1 Server GUI

The Server GUI runs on top of the NFC Forum Default SNEP server. It shall support a way to display Text RTD content. The Text RTD content contains Plain ASCII and no special characters.

8.3.2 Extended DTA Server

The Extended DTA Server runs on top (and uses the SNEP protocol layer). This server is included to allow testing of both PUT and GET Request Code messages

On the extended DTA server it shall be possible to define a URN to identify the service.

Upon reception of a PUT request, the extended DTA server shall store the payload in memory until the next disconnection, or until it receives a new PUT request message.

Upon reception of a GET request, the extended DTA server shall analyze the NDEF structure in the message (that shall only contain the RTD type requested) and shall return the NDEF data of the RTD type available in memory. If no message of the requested RTD type is available, the application shall send an appropriate Response Field Code (e.g. ‘C0” – Not found)

The memory size of the Extended DTA Server shall be more than 512 bytes, and shall be able to store one NDEF message.

A. Exhibit A

No items have been included in Exhibit A.

B. Values

Throughout this document, symbols are used to identify the values of Parameters. The actual values of the Parameters are listed in this appendix. For some of the Parameters, a minimum and maximum value is defined. Other Parameters are defined by a single value.

Parameters have a value for the NFC Forum Device in Poll Mode and for the NFC Forum Device in Listen Mode. Unless otherwise specified, the value for Poll Mode has to be used when the parameter is referenced in a Poll Mode requirement. The value for Listen Mode has to be used when referenced in a Listen Mode requirement.

B.1 Timing Value

Parameter	Poll Mode Value			Listen Mode Value			Units
	Min	Nominal	Max	Min	Nominal	Max	
t_{RLM}				6.0			ms

C. PATTERN_NUMBER

The table below indicates the functionality or the parameter to be used or to be executed in conjunction with the PATTERN_NUMBER value set at the moment in the DTA for Digital Protocol.

PATTERN_ NUMBER	CON_POLL_B	CON_ BITR_ NFC_ DEP1	NFC-F_ BIT RATE2	CON_LISTEN_ DEP_F	CON_LISTEN_T3TP3	SESNF_REQ	SENSF_REQ Reactivation4	Reactivation	Test Transaction Functionality in Poll Mode					Listen Mode
									NFC-DEP	Type 1 Tag	Type 2 Tag	Type 3 Tag	Type 4 Tag	Type 3 Tag5
0000h	1	0	0	1	[ICS]	-	-	No	Loop-back, Section 5.2.2	-	Platform, Section 5.4.2	-	Loop-back, Section 5.6.2	Command Exchange, Section 6.3.1
0001h	1	0	0	1	[ICS]	12FC,00,00	-	No	-	NDEF Read, Section 5.3.3	NDEF Read, Section 5.4.3	NDEF Read, Section 5.5.5	NDEF Read, Section 5.6.3	Command Exchange, Section 6.3.1
0002h	1	0	0	1	[ICS]	12FC,00,00	-	No	-	NDEF Write, Section 5.3.4	NDEF Write, Section 5.4.4	NDEF Write, Section 5.5.6	NDEF Write, Section 5.6.4	Command Exchange, Section 6.3.1
0003h	1	0	0	1	[ICS]	12FC,00,00	-	No	-	Transition to READ-ONLY, Section 5.3.5	Transition to READ-ONLY, Section 5.4.5	Min Number of Block, Section 5.5.2	-	Command Exchange, Section 6.3.1
0004h	1	0	0	1	[ICS]	12FC,00,00	-	No	-	-	-	Max Number of Service, Section 5.5.3	-	Command Exchange, Section 6.3.1
0005h	1	0	0	1	[ICS]	12FC,00,00	-	No	-	-	-	Max Number of Block, Section 5.5.4	-	Command Exchange, Section 6.3.1
0006h	1	0	1	1	[ICS]	12FC,00,00	-	No	Loop-back, Section 5.2.2	-	-	Min Number of Block, Section 5.5.2	-	Command Exchange, Section 6.3.1
0007h	1	0	0	1	[ICS]	FFFF,01,0F	FFFF,00,03	Yes	Loop-back, Section 5.2.2	-	-	Min Number of Block, Section	Loop-back, Section 5.6.2	Command Exchange, Section 6.3.1

1 Desired bit rate: 0: maintain the bit rate, 1: 106 kbps, 2: 212 kbps, 3: 424 kbps

2 0b: 212 kbps (default value), 1b: 424 kbps

3 1b in case the [ICS] indicates support for “Listen for T3T platform”, 0b otherwise

4 SC,RC,TSN: System Code (SC), Request Code (RC), Time Slot Number (TSN)

5 The Type 3 Tag Test Functionality is applicable if CON_LISTEN_T3TP=1

PATTERN_ NUMBER	CON_POLL_B	CON_ BITR_ NFC_ DEP1	NFC-F_ BIT RATE2	CON_LISTEN_ DEP_F	CON_LISTEN_T3TP3	SESNF_REQ	SENSF_REQ Reactivation4	Reactivation	Test Transaction Functionality in Poll Mode					Listen Mode
									NFC-DEP	Type 1 Tag	Type 2 Tag	Type 3 Tag	Type 4 Tag	Type 3 Tag5
												5.5.2		
0008h	1	0	1	1	[ICS]	FFFF,01,0F	FFFF,00,03	NFC-F only	Loop-back, Section 5.2.2	-	-	Min Number of Block, Section 5.5.2	-	Command Exchange, Section 6.3.1
0009h	1	3	0	1	[ICS]	-	-	No	Loop-back, Section 5.2.2	-	-	-	-	Command Exchange, Section 6.3.1
000Ah	0	0	1	1	[ICS]	-	-	No	-	-	-	-	-	Command Exchange, Section 6.3.1
000Bh	0	0	0	1	[ICS]	-	-	No	-	-	-	-	-	Command Exchange, Section 6.3.1
000Ch	1	0	0	0	[ICS]	-	-	No	-	-	-	-	-	Command Exchange, Section 6.3.1
000Dh	1	0	0	1	0	-	-	No	-	-	-	-	-	-

The table below indicates the functionality or the parameter to be used or to be executed in conjunction with the PATTERN_NUMBER value set at the moment in the DTA for LLCP.

PATTERN_ NUMBER	Test Functionality
1200h	LLCP Connection Oriented Functionality setting up by SAP or Connection-less Functionality
1240h	LLCP Connection Oriented Functionality setting-up by name or Connection-less Functionality
1280h	LLCP Connection Oriented Functionality setting up by using SNL or Connection-less Functionality

D. Revision History

The following table outlines the revision history of Device Test Application Specification.

Table 16: Revision History

Document Name	Revision and Release Date	Status	Change Notice	Supersedes
Device Test Application Specification	Version 1.0, July 21, 2010	Final		All drafts
Device Test Application Specification	Version 1.1, September 9, 2010	Final	Editorial changes, moved Pattern number tables to Appendix B to avoid editorial inconsistencies	Version 1.0
Device Test Application Specification	Version 1.2, October 4, 2010	Final	Added PATTERN_NUMBERs 000Ah and 000Bh for Guard Time Testing	Version 1.1
Device Test Application Specification	Version 1.21, December 1, 2010	Final	Added PATTERN_NUMBERs 000Ch and 000Dh for single SENSF_RES Corrected CON_SENSF_RES format. Modified PATTERN_NUMBER 0006h according to CR#49.	Version 1.2
Device Test Application Specification	Version 2.0	Final	Merge Device Test Application, Device Test Application for LLCP, and Device Test Application for SNEP.	Version 1.21
Device Test Application Specification	Version 2.1, April 19, 2013	Final	Editorial Corrections Modifications to LLCP DTA functionalities	Version 2.0
Device Test Application Specification	Version 2.1.01, December 23, 2013	Final	Editorial corrections Modifications for CR#128, CR#160, CR#168, CR#169, CR#222	Version 2.1