Static connection handover

Use case guide

About this document

Scope and purpose

This document outlines the setup process of the OPTIGA™ Authenticate NBT to enable a static connection handover use case. It demonstrates the steps through which the end user can operate and explore the seamless connection handover to other carriers such as Bluetooth or Wi-Fi.

Intended audience

This document is primarily intended for solution providers, system integrators, application developers and product marketers who want to evaluate and test the OPTIGA™ Authenticate NBT within the scope of a static connection handover use case.

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1 Introduction

This use case guide assists users in understanding the key features of the OPTIGA™ Authenticate NBT that enable the static connection handover use case. It also provides a high-level overview of how the device needs to be configured for this use case and the steps required to realize real-world use case scenarios.

Chapter 2 describes the use case in general and the specific features of the OPTIGA™ Authenticate NBT.

Chapter 3 describes how the use case will be enabled on the OPTIGA™ Authenticate NBT, beginning with its personalization and guiding through the implementation of the use case.

The Appendix A section provides generic information about the OPTIGA™ Authenticate NBT like its product architecture, the supported interfaces and the command set. Furthermore, this section contains a comprehensive description of the product delivery condition, which summarizes all the relevant details to enable the preparation of the device for its intended use.

***Note**: For a collection of all available support material for the product, refer to its product page [7].*

1.1 NFC I2C bridge tags

NFC Bridge Tags are dual-interface tags that enable contactless features for IoT devices via an I2C controller interface, allowing for a touch-and-go experience with a mobile phone. On one side, the NFC Bridge Tags include a contactless passive NFC interface and on the other side, a contact-based I2C target interface that connects to the MCU of the IoT device.

The OPTIGA™ Authenticate NBT harnesses the Integrity Guard 32 security architecture to provide an option for the end-user with symmetric and asymmetric cryptographic operations, as well as password-based data protection schemes. As a result, the device is ideal for security demanding applications.

This product includes device authentication, pass-through and asynchronous data transfer modes, which can be used for variety of applications such as:

- Keyless access and activation of shared mobility vehicles
- Controlled access to personal electronic devices such as HDD
- Theft prevention for electronic goods by authenticated activation

This tag can also be used in healthcare and industrial applications. The OPTIGA™ Authenticate NBT, in combination with healthcare sensors, enables access to information through an NFC-enabled mobile phone or reader. Furthermore, the device is an ideal product for industrial applications such as headless configuration and parametrization of devices, assembly line programming and fault diagnostics.

2 Use case overview

The following chapter illustrates the use of OPTIGA™ Authenticate NBT to facilitate static connection handover use cases. To accomplish this use case, the device is expected to hold the credentials of a Bluetooth or Wi-Fi connection which will be passed on to the user's mobile phone via the NFC interface.

2.1 General information

The OPTIGA™ Authenticate NBT supports connection handover from NFC to alternative carriers such as Bluetooth or Wi-Fi and is used in embedded environments. The intuitive nature of close distances allows for easy establishment of an NFC connection. However, NFC is not suitable for persistent connections or large data transfers. This is a case, switching to alternative carriers such as Bluetooth or Wi-Fi can provide the best user experience.

2.2 Methodology

In order to enable users to adopt the solution, connection handover requires a standardized behavior of NFC devices. For this reason, NFC Forum develops a number of specifications. In addition to the technical specifications for the Analog, Digital Protocol and NDEF application layers, the NFC Forum provides a dedicated application specification for implementing connection handover to alternative carriers such as Wi-Fi or Bluetooth. This specification defines static and negotiated variations. While negotiated connection handover allows for more flexibility related to available carriers, static connection handover is often more suitable. For more information, please refer to [5].

Specific records in the tag's NDEF message indicate the device's ability to support connection handover to alternative carriers. Both, Android and iOS NFC-enabled devices provide services for automatically detecting NFC tags and reading their NDEF message. The mobile phone may choose one of the alternative carriers to continue data transmission with the host device (for example, a host MCU).

2.3 Static connection handover use case example

An NFC-enabled mobile phone is utilized for the purpose of communicating with the embedded system consisting of the OPTIGA™ Authenticate NBT and a host. As the connection information is stored statically in the NDEF file of the T4T application, the device used for static connection handover does not require a connection to a host.

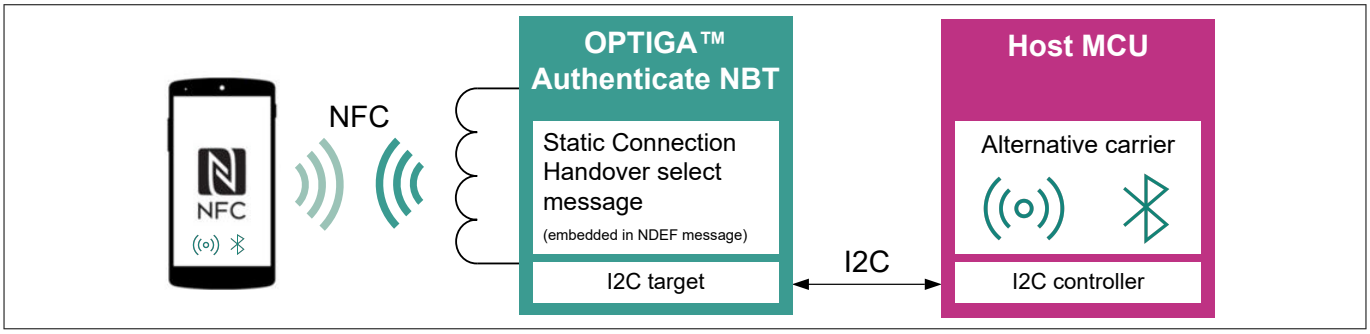


Figure 1 Static connection handover components

On the other hand, if the OPTIGA™ Authenticate NBT is connected to a host MCU via the I2C bus interface, an "in-field update" of connection information is enabled. In this case, the host can modify the Wi-Fi credentials of a Wi-Fi router by changing the connection information such as the SSID or the passphrase.

3 Use case integration

This chapter describes how to use the OPTIGA™ Authenticate NBT for static connection handover use cases. This includes the steps required to configure the product as well as interactions with the product during the OPERATIONAL state.

***Note**: Infineon Technologies provides host libraries to support the integration of OPTIGA™ Authenticate NBT into custom applications on different platforms. Multiple example applications demonstrate how these libraries can be utilized for interactions with the device during personalization and operation in different use cases. For more information, refer to product website [7] or the Software Integration Guide [10].*

The connection handover is demonstrated using the alternative Bluetooth carrier of the PSoC microcontroller. The example shown in this section covers the flow to configure the OPTIGA™ Authenticate NBT. These steps correspond to the example applications provided for this use case which contain a basic example of how the device can be integrated for this document's use case.

A comprehensive summary of the OPTIGA™ Authenticate NBT's technical details, relevant for the implementation of this use case, is presented in Appendix A.1.

3.1 Prerequisites

The OPTIGA™ Authenticate NBT is shipped in its device delivery condition (see Appendix A.2).

The device must be physically connected to an NFC antenna via its L_A and L_B pins allowing to operate the OPTIGA™ Authenticate NBT from an NFC-enabled phone (Figure 2).

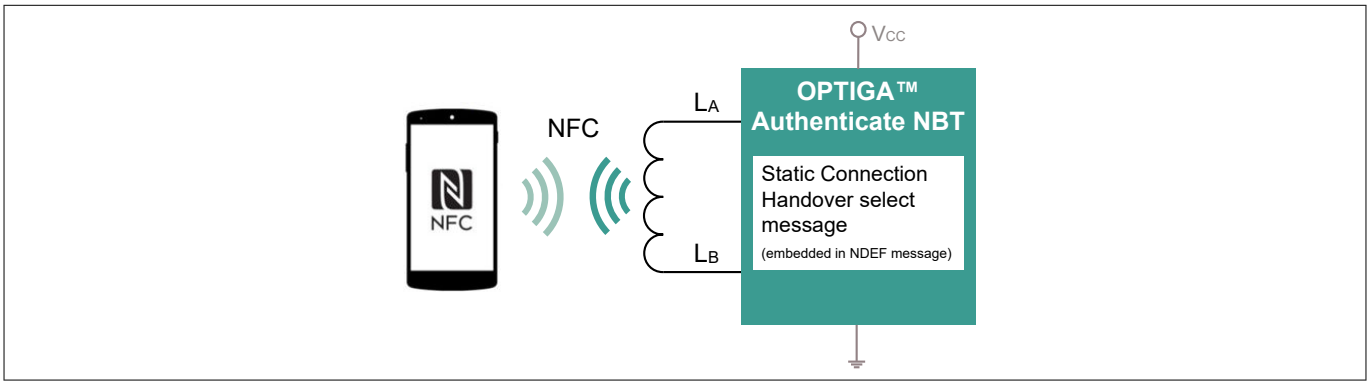


Figure 2 NFC-only tag - static connection handover

In some application scenarios, a connection to a host MCU via the I2C pins may also be necessary (Figure 3).

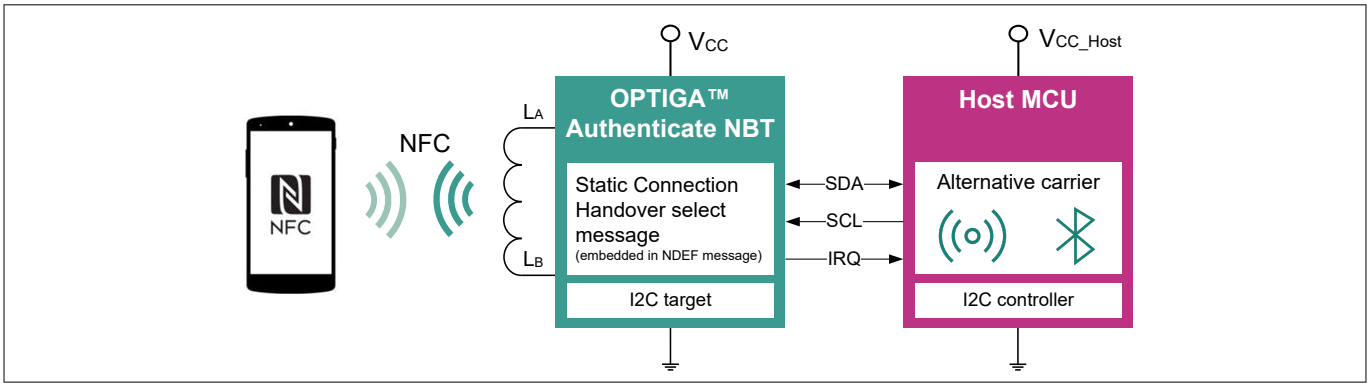


Figure 3 Embedded tag - static connection handover

The procedures to enable the device for the use case and to update OPTIGA™ Authenticate NBT's NDEF message to contain a dedicated connection handover record are explained in the following sections.

3.2 Operation modes

Connection handover is a method used in the NFC technology to connect mobile and multimedia devices quickly and seamlessly to exchange data. The functionality may be integrated into a consumer device to enable the highest level of convenience during connection establishment, especially for applications such as file exchange or streaming.

3.3 Personalization

The following chapter describes how to configure the OPTIGA™ Authenticate NBT for static connection handover use cases.

3.3.1 Device target state

The following interface configurations can be used to operate the OPTIGA™ Authenticate NBT in static connection handover use cases:

- In the embedded tag setup, both interfaces must be enabled (NFC and I2C)
- In the NFC-only tag setup, the NFC interface must be enabled while the setting of the I2C interface has no influence (as the device is not connected to a host MCU, the I2C interface is not utilized)

Interface settings	I2C interface	Enabled
	NFC interface	Enabled
IRQ settings	I2C-IRQ	Disabled
	PT-IRQ	Disabled
	NFC-IRQ	Disabled

Figure 4 Example interface configuration for static connection handover

In both hardware setups, the Type 4 Tag application's NDEF file carries a static connection handover record. NFC-enabled mobile phones, based on Android, are natively accessing and interpreting the NDEF file's content.

***Note**: As of 2024, iOS devices do not yet support this functionality.*

The example device target settings for static connection handover use cases in an embedded tag hardware setup are depicted in Figure 5.

Type 4 Tag application file	File Access Policy file				Capability Container file				NDEF message file				FILE_1				FILE_2				FILE_3				FILE_4			
File usage/content	Type 4 Tag application file access settings				References to Type 4 Tag files				Connection Handover record				<emtpy>				<emtpy>				<empty>				<empty>			
Operation	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update
Access condition value for emb. CH	N	N	N	N	A	N	A	N	A	A	A	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Access conditions: A = ALWAYS; N = NEVER; P = PASSWORD REQUIRED

Figure 5 Example target configuration: Static connection handover - embedded tag setup

- The NDEF file contains the records to handover the connection to an alternative carrier and can be read from both interfaces
- After the personalization, the NDEF file cannot be written via the NFC interface anymore
- I2C settings remain unchanged and allow full access to the NDEF file
- Proprietary files (FILE_1, FILE_2, FILE_3 and FILE_4) are not used, no reading or writing is permitted

The example for a target configuration in the NFC-only tag setup is shown in Figure 6. With these settings applied, access to the NDEF file is restricted to the NFC interface, and any attempts to access it via the I2C interface will be blocked. Therefore, the static connection handover record cannot be altered.

Type 4 Tag application file	File Access Policy file				Capability Container file				NDEF message file				FILE_1				FILE_2				FILE_3				FILE_4			
File usage/content	Type 4 Tag application file access settings				References to Type 4 Tag files				Connection Handover record				<emtpy>				<emtpy>				<empty>				<empty>			
Operation	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update
Access condition value for CH	N	N	N	N	A	N	A	N	N	N	A	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Access conditions: A = ALWAYS; N = NEVER; P = PASSWORD REQUIRED

Figure 6 Example target configuration: Static connection handover - NFC-only tag setup

3.3.2 Utilized interfaces

In PERSONALIZATION life cycle state, the OPTIGA™ Authenticate NBT can be configured via both interfaces, I2C and NFC.

3.3.3 Personalization procedure

Figure 7 depicts the standard personalization procedure.

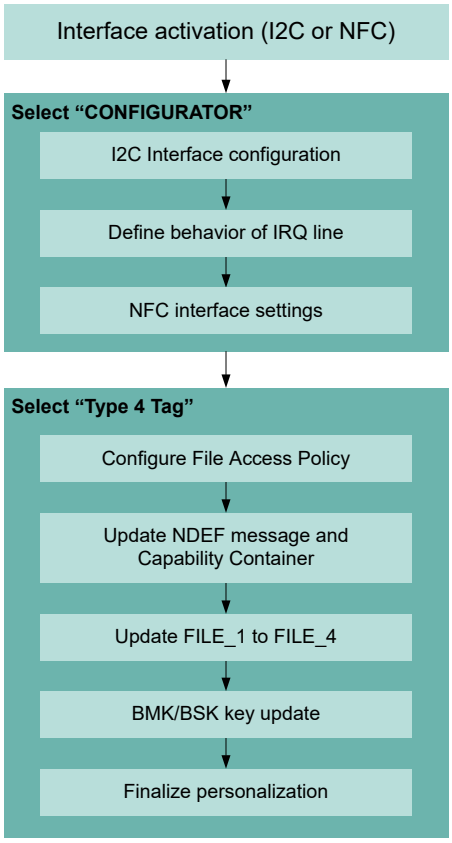


Figure 7 Standard personalization procedure

3 Use case integration

The personalization of OPTIGA™ Authenticate NBT can be executed via the I2C interface (from a host MCU) or the NFC interface (from an NFC-enabled mobile phone). It is recommended to perform interface-related configurations via the CONFIGURATOR application once the preferred interface is activated.

Subsequently, the Type 4 Tag application's file contents (for example, application-related data in the NDEF file) should be changed, file access conditions (in the EF.FAP file) can be updated accordingly and key values must be exchanged to application- and/or customer-specific values.

The last step in this sequence is to activate the OPERATIONAL state to finalize the preparation of OPTIGA™ Authenticate NBT for the usage in the field.

An example personalization sequence is illustrated in Figure 8, where a mobile phone personalizes the OPTIGA™ Authenticate NBT in an NFC-only tag operation mode.

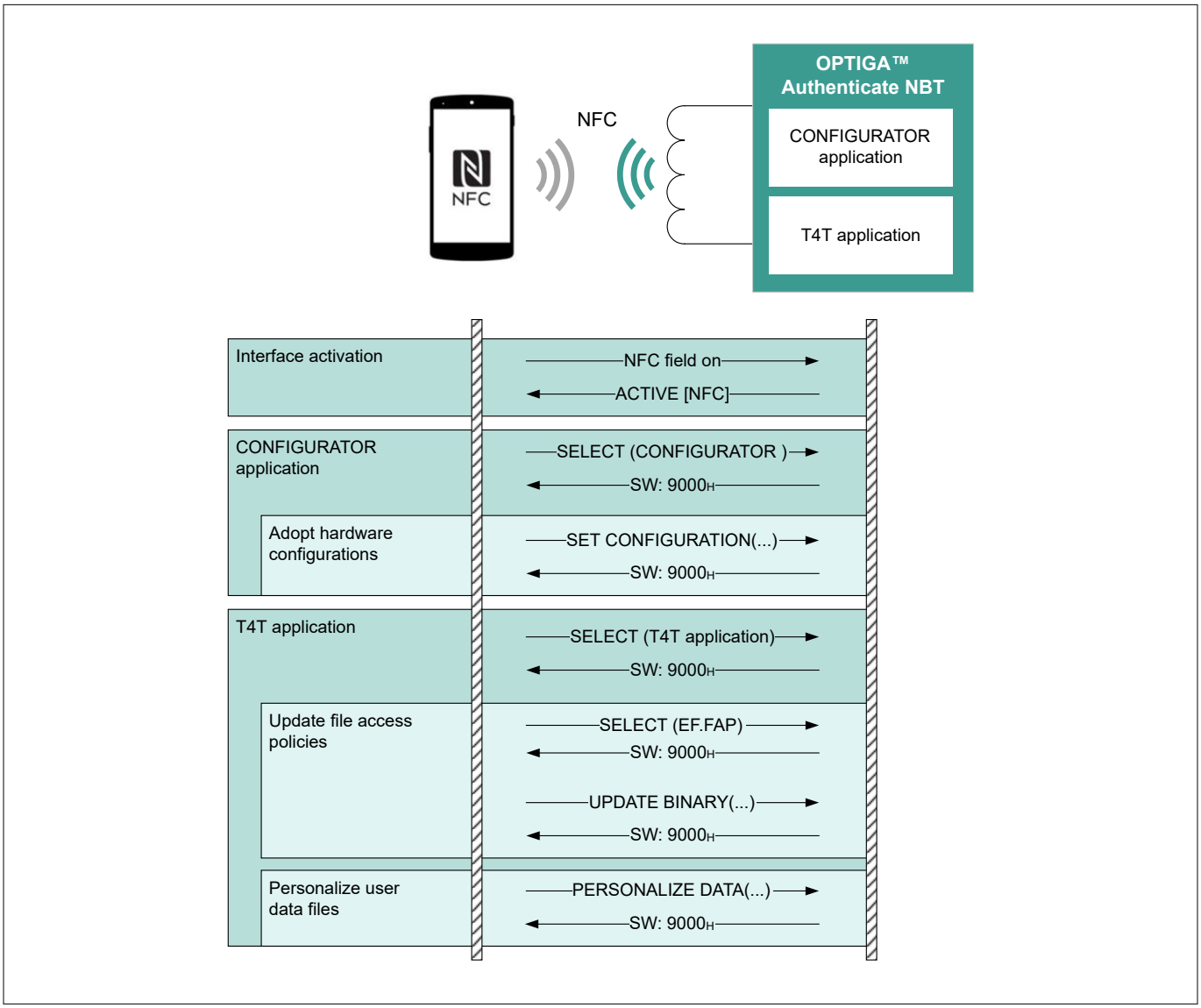


Figure 8 Personalization procedure example via NFC interface using a mobile phone

***Note**: Infineon Technologies provides the implementation of example applications for mobile phones (iOS and Android) to personalize the OPTIGA™ Authenticate NBT for certain use cases. As these applications are shared as full source code, they can be easily modified and extended to custom personalization schemes [7].*

3.3.3.1 Interface configurations

Upon delivery, the OPTIGA™ Authenticate NBT is configured with interface settings that are suitable for static connection handover applications in the embedded tag as well as in the NFC-only tag setup.

The implementation of the GP T=1' I2C protocol in the device relies on an interrupt line to notify the host that data is available. Hence, the IRQ-I2C option should be configured for the OPTIGA™ Authenticate NBT's IRQ, since the IRQ functionality is disabled by default upon delivery.

3.3.3.2 Type 4 Tag application's file configurations

After selecting the Type 4 Tag application of the OPTIGA™ Authenticate NBT, there are two ways to personalize the application's files. The implementer may select the preferred method that is most efficient in the development and/or production environment.

1. Standardized method using the UPDATE BINARY command
   - The targeted file needs to be selected before its content can be accessed (SELECT file command)
   - Even in the PERSONALIZATION state, file access conditions as set in EF.FAP must be satisfied
     - Setting of a proper FAP may be required in advance, otherwise updating may be denied
   - BMK and BSK keys cannot be updated with this method
   - Updates of file access conditions within the EF.FAP file need to be done for each of the application's file separately
2. Proprietary method using the PERSONALIZE DATA command
   - No dedicated file selection required
   - Exclusive method for updating BMK/BSK keys
   - The update of the file access conditions for all application files is possible with a single command

The file access policy should be updated to define the per-file and the per-interface access rights for the application files. It is essential that the access right settings for the NDEF file (via the NDEF-File_CTRL_TLV) and the proprietary files (via the Proprietary-File_CTRL_TLV(s)) in the EF.CC file match the FAP configuration for the respective files. The OPTIGA™ Authenticate NBT keeps these setting in sync for the NDEF-File_CTRL_TLV, but application developers need to update these values for the Proprietary-File_CTRL_TLVs. If the data is not matching, this may result in non-compliance with the NFC Forum T4T Specification [1].

***Note**: The EF.CC settings only impact access from the NFC interface, while the FAP settings affect access from both interfaces supported by OPTIGA™ Authenticate NBT.*

The following tables provide details about the access rights settings for the application files of OPTIGA™ Authenticate NBT in an embedded tag setup and the NFC-only tag example for the static connection handover use case. Table 1 contains the access right settings an NFC reader (for example, NFC-enabled mobile phone) needs to consider. The example settings in the EF.CC file only allow reading the NDEF file and block any update operation on all files.

Table 1 EF.CC (relevant for access via the NFC interface)

Tag	Length	FileID	Size	READ	WRITE	Description
04_H	06_H	$E104_H$	1000_H	00_H	FF_H	NFC read: Yes; NFC write: No
05_H	06_H	$E1A1_H$	0400_H	FF	FF_H	No NFC access at all (no read, no write)
05_H	06_H	$E1A2_H$	0400_H	FF_H	FF_H	No NFC access at all (no read, no write)
05_H	06_H	$E1A3_H$	0400_H	FF_H	FF_H	No NFC access at all (no read, no write)
05_H	06_H	$E1A4_H$	0400_H	FF_H	FF_H	No NFC access at all (no read, no write)

The settings shown in Table 2 govern access to all application files for the embedded tag example. In this case, full access to the NDEF file (FileID: $E104_H$) is permitted through the I2C interface. From the NFC interface, read access is granted; however, the update of data is blocked. Access to the proprietary files (FileIDs: $E1A1_H$, $E1A2_H$, $E1A3_H$, and $E1A4_H$) is prohibited as they are not used in the application.

Table 2 EF.FAP (example FAP settings when used in embedded tag setups)

FileID	I2C_Read	I2C_Update	NFC_Read	NFC_Update	Description
$E103_H$	40_H	00_H	40_H	00_H	No NFC update; no I2C update
$E104_H$	40_H	40_H	40_H	00_H	No NFC update; full I2C
$E1A1_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access
$E1A2_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access
$E1A3_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access
$E1A4_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access
$E1AF_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access

Compared to the settings for the embedded tag setup Table 3 additionally blocks access rights to the NDEF file from the I2C interface.

Table 3 EF.FAP (example FAP settings when used in NFC-only tag setups)

FileID	I2C_Read	I2C_Update	NFC_Read	NFC_Update	Description
$E103_H$	40_H	00_H	40_H	00_H	No NFC update; no I2C update
$E104_H$	00_H	00_H	40_H	00_H	No NFC update; no I2C access
$E1A1_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access
$E1A2_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access
$E1A3_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access
$E1A4_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access
$E1AF_H$	00_H	00_H	00_H	00_H	No NFC access; no I2C access

***Note**: For the static connection handover use case, there is no need to update the BMK and BSK keys. However, if an update is necessary, the PERSONALIZE DATA command should be utilized.*

3.3.3.3 Personalizing a Bluetooth simple pairing record

In order to customize the OPTIGA™ Authenticate NBT for a connection handover application, a dedicated record needs to be loaded into its NDEF message file. This record must hold the relevant details about the alternative carrier, such as its type (for example: Bluetooth or Wi-Fi). Figure 9 depicts the basic structure of a Bluetooth simple pairing record.

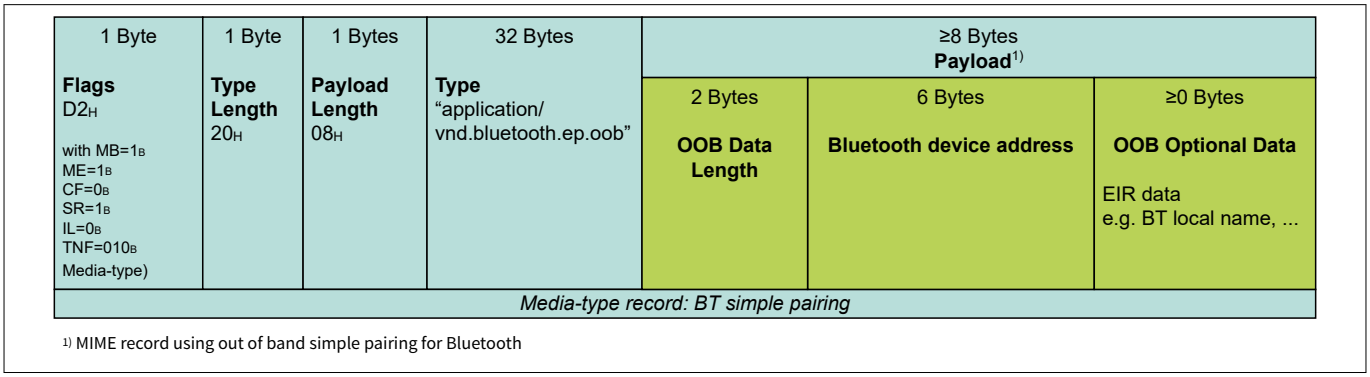


Figure 9 NFC simple pairing record

The pairing record can offer supplementary data to identify the device by integrating the information into the OOB (Out Of Band) Optional Data field. It's important to note that this is optional information that is not required for the device identification process.

3.3.3.4 Activating the OPERATIONAL life cycle state

The OPTIGA™ Authenticate NBT state transition from the PERSONALIZATION to the OPERATIONAL life cycle state is triggered by the following sequence:

- Selecting the CONFIGURATOR application
- Sending the DGI "FINALIZE PERSONALIZATION" embedded either into a SET CONFIGURATION or a PERSONALIZE DATA command (refer to Extended Datasheet [8])

***Note**: This step may be skipped during the development phase to allow the developer to make several optimization attempts.*

3.4 Operational use case

Once the OPERATIONAL life cycle state is activated, the connection handover application can be executed in either an NFC-only tag or embedded tag setup. In this life cycle state, administrative commands are disabled (see Table 6) and product configuration functions are blocked. The configured file access policies govern operations on the file (based on the settings within the EF.FAP).

When using the NFC-only tag setup, the OPTIGA™ Authenticate NBT is connected to an NFC antenna only. In this scenario, it provides static connection information to an NFC-enabled mobile phone via the NFC interface.

In the embedded tag setup, the OPTIGA™ Authenticate NBT is integrated into a host system and connected to a host MCU through the I2C interface. This allows the host to update the NDEF message containing the latest connection information, which is provided to the NFC-enabled mobile phone.

The following components are required:

- An NFC antenna connected to the device
- An NFC-enabled mobile phone
- Embedded tag setup: The device is additionally interconnected into host system via I2C interface

***Note**: Optionally, the NDEF message may contain additional records (for example, URL, pointing to the website to the OEM) beside the handover record.*

3.4.1 Operational flow example: Host configuration

Figure 10 depicts a typical NFC communication sequence between a mobile phone and the OPTIGA™ Authenticate NBT to initiate a handover to a Bluetooth connection.

This example of an operational flow uses OPTIGA™ Authenticate NBT in an embedded tag configuration. The device hosts the connection handover-specific NDEF message. An NFC-enabled mobile phone is used without a dedicated mobile application to exchange data (for example, the device configuration) with a host.

After reading the NDEF message, the mobile phone can extract, parse and interpret the contained connection handover record. This media-type record contains the Bluetooth simple pairing information data of the alternative carrier. The carrier data (for example, Bluetooth device address, OOB optional data) is then applied to establish the connection between the host and the mobile phone.

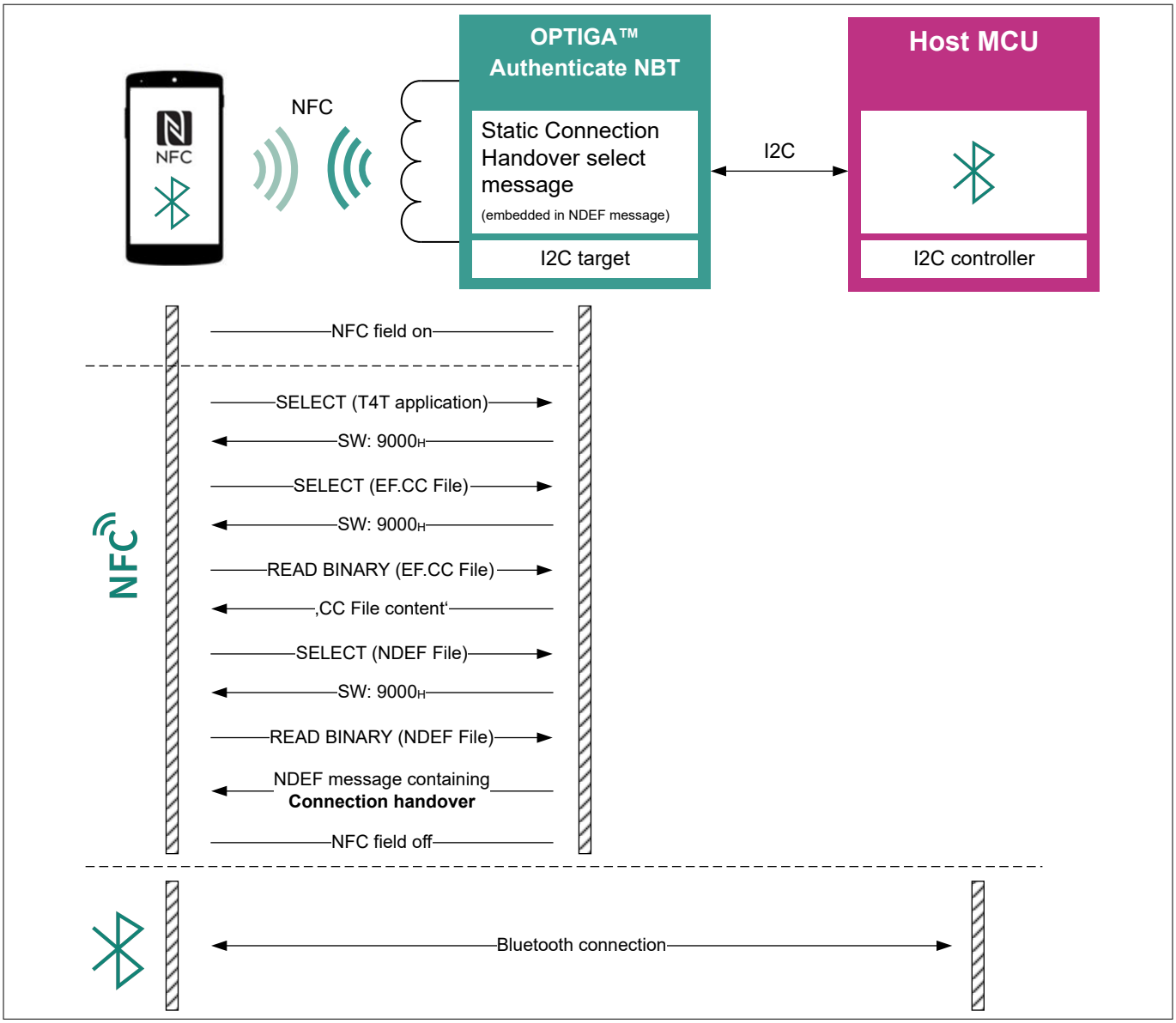


Figure 10 Static connection handover - operational flow

A Appendix

The following section cover technical information about the OPTIGA™ Authenticate NBT, including its features and specifics relating to the product delivery condition. This summary can serve as a starting point to prepare the device for its intended use case.

A.1 Technical background

A brief overview of the OPTIGA™ Authenticate NBT features can be found in following sections. This covers basic information on hardware interconnection scenarios, descriptions of the available communication interfaces, a short introduction of the product architecture including important functional blocks as well as a command reference which is used to personalize and to operate the device.

A.1.1 OPTIGA™ Authenticate NBT system architecture

The OPTIGA™ Authenticate NBT is delivered with the following selectable applications:

- CONFIGURATOR application: Used to modify the device's hardware-related settings or configuration such as interface settings, IRQ behavior, life cycle state, and additional settings
- Type 4 Tag application: Contains the EF.CC (Capability Container file), the NDEF file, proprietary "mailbox" files, and the EF.FAP (File Access Policy file)
- Pass-through application: This "virtual" application allows to transfer bigger amount of data between an NFC reader device and a host. The device manages the NFC protocol in terms of framing, timing, and waiting time extensions during the exchange of application commands

The OPTIGA™ Authenticate NBT utilizes a protected key storage to store the BSK (Brand Protection Signing Key) and the BMK (Brand Protection MAC'ing Key). Furthermore, the passwords used to manage the access to the application files are saved in a secured memory area.

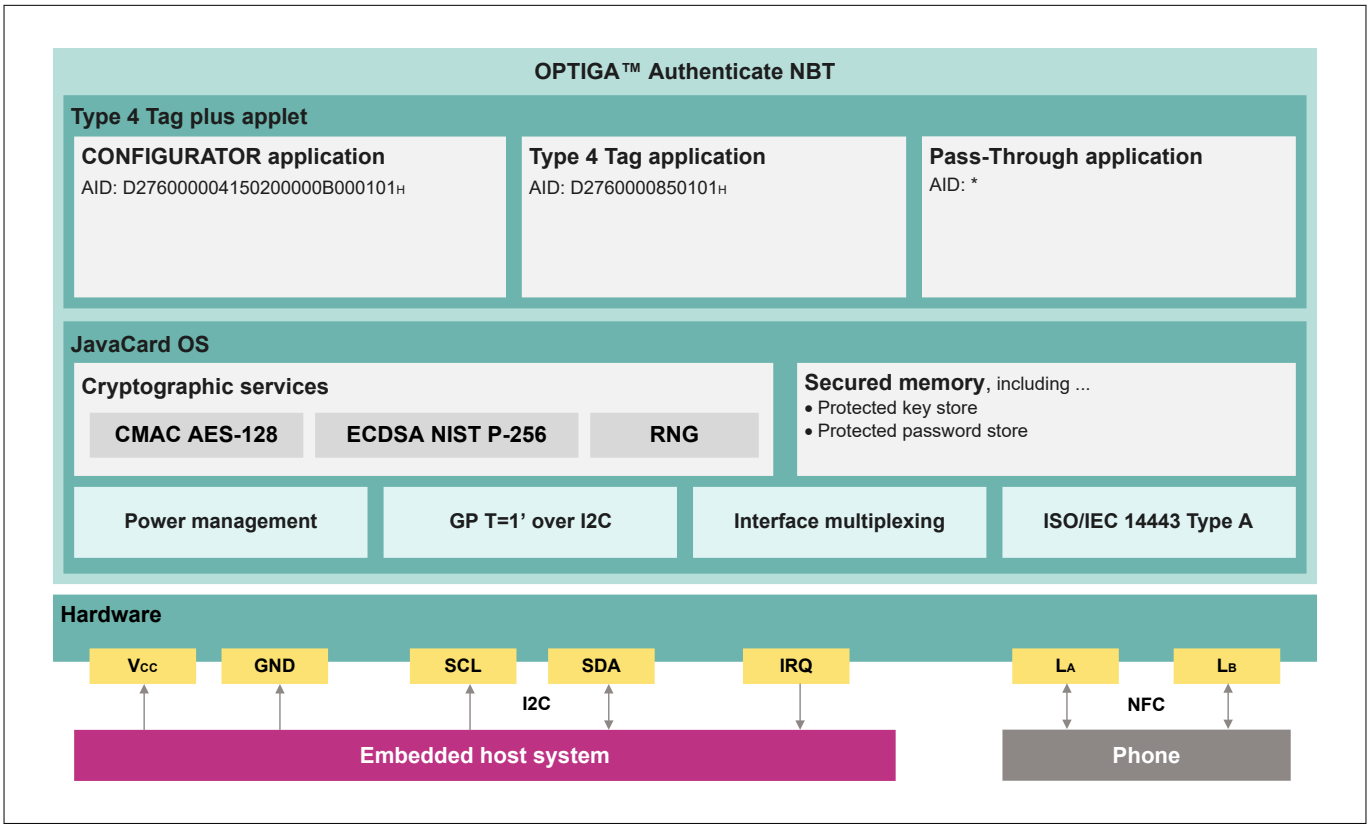


Figure 11 OPTIGA™ Authenticate NBT product architecture

A Appendix

Table 4 Supported applications of the OPTIGA™ Authenticate NBT

Application ID (AID)	Application	Functionality
D2 76 00 00 04 15 02 00 00 0B 00 01 01_H	CONFIGURATOR	Interface configurations
D2 76 00 00 85 01 01_H	Type 4 Tag	NFC Forum Type 4 Tag
Any other (length: 5 to 16 Bytes)	Pass-through	NFC to I2C Bridge Tag

The CONFIGURATOR application controls the OPTIGA™ Authenticate NBT hardware configuration as described in Chapter 4 of the Extended Datasheet [8]. The pass-through application is a "virtual" application that can be activated by attempting to select an application with an AID, which is not used by the CONFIGURATOR or the Type 4 Tag application.

The Type 4 Tag application adheres to the NFC Forum T4T Specification [1]. In addition, the OPTIGA™ Authenticate NBT's Type 4 Tag application contains four proprietary files (FILE_1 to FILE_4) as well as the File Access Policy file (EF.FAP).

All files in the Type 4 Tag application are accessible from both interfaces (NFC and I2C). Password-based file access rights can be configured to restrict access per-file and per-interface basis. This is accomplished by updating the relevant fields in the EF.FAP file during personalization. Furthermore, the Type 4 Tag application supports the management of each file's content as well as the secure key store. Before reading or modifying file contents, the corresponding application data file must be selected by its FileID using the SELECT file command.

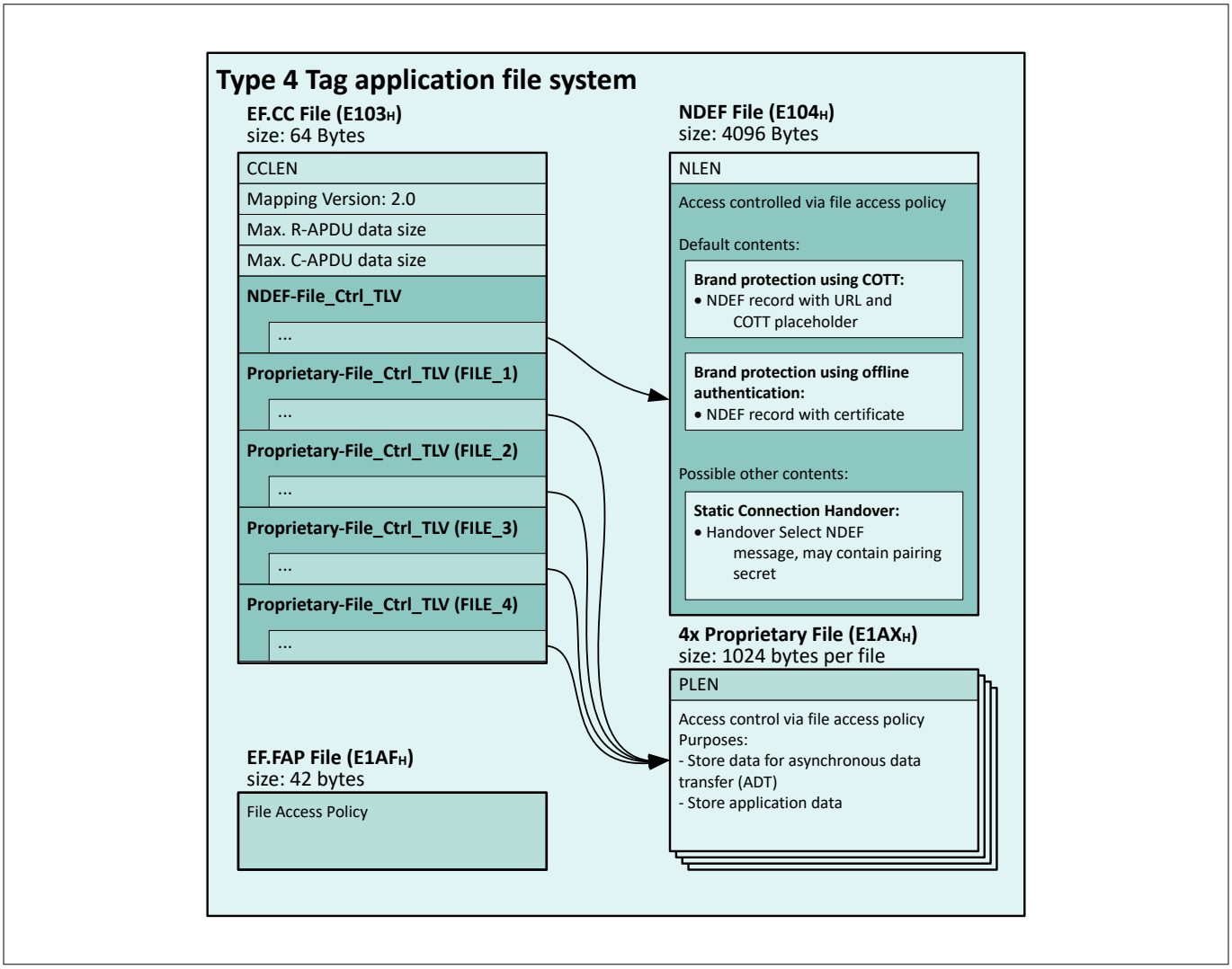


Figure 12 Type 4 Tag file structure

Table 5 Type 4 Tag application and files

File	FileID	Size [bytes]	Content
EF.CC	$E103_H$	64	Size and access policy of • NDEF file • FILE_1 to FILE_4
NDEF	$E104_H$	4096	NDEF message
FILE_1	$E1A1_H$	1024	Proprietary
FILE_2	$E1A2_H$	1024	Proprietary
FILE_3	$E1A3_H$	1024	Proprietary
FILE_4	$E1A4_H$	1024	Proprietary
EF.FAP	$E1AF_H$	42	Definition of access rights to • EF.CC file • NDEF file • FILE_1 to FILE_4 • EF.FAP file

A.1.2 Hardware configuration

In an embedded tag setup, the OPTIGA™ Authenticate NBT is integrated into the system via the following external connections:

- L_A and L_B are connected to an NFC antenna
- The device is externally supplied via V_{CC} and GND pins
- I2C host interface via SDA, SCL, and IRQ

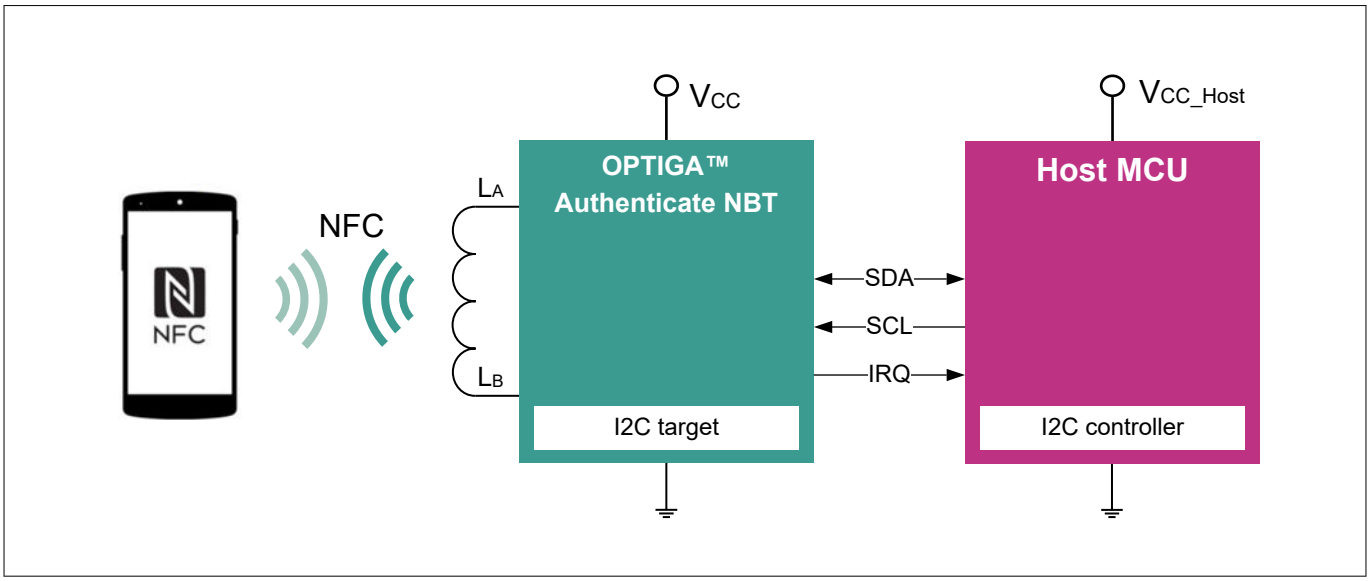


Figure 13 Embedded tag

Alternatively, the OPTIGA™ Authenticate NBT can be used as a stand-alone NFC-only tag, where the NFC-enabled phone may retrieve the connection handover message from the NDEF file. In this configuration, the device is connected to an NFC antenna via its L_A and L_B pins. Optionally, the device may be powered through its V_{CC} and GND pins, which extends the contactless communication distance.

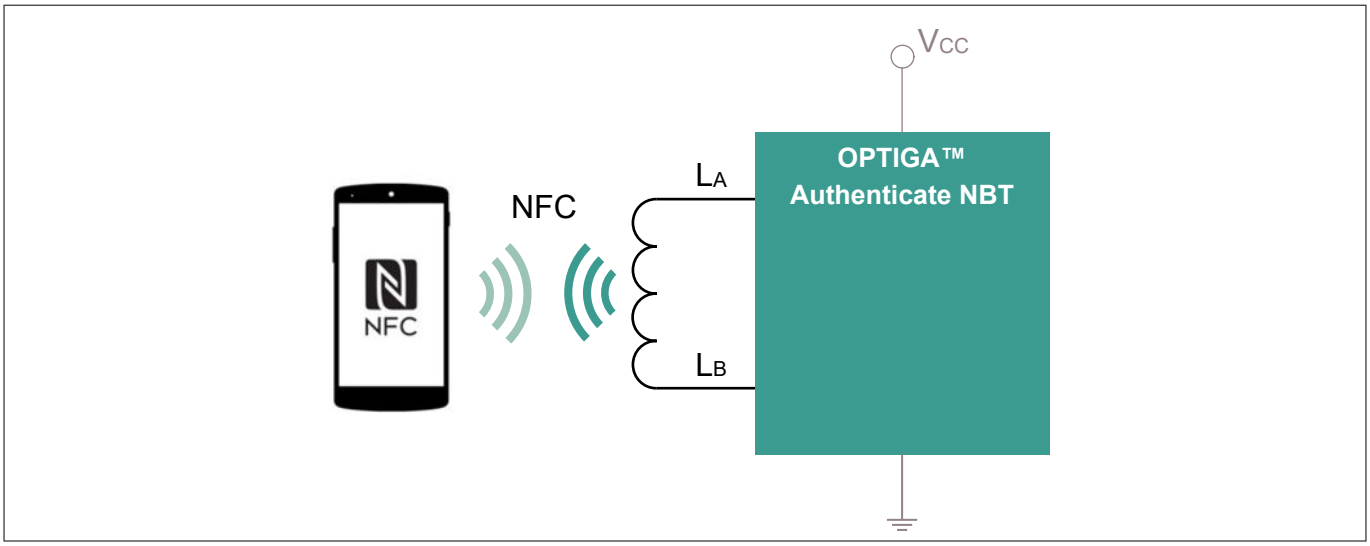


Figure 14 NFC-only tag

A.1.3 Interface description

The OPTIGA™ Authenticate NBT includes an NFC interface as well as an I2C target interface. In the NFC-only tag scenario, for example, the NFC interface of device is physically connected to an external antenna. In an embedded tag hardware setup, the device is powered through its V_{CC} and GND pins from an external source. In this setup, the SCL and SDA lines can also be connected to an host MCU to exchange data via the I2C interface.

The IRQ line of OPTIGA™ Authenticate NBT can directly be connected to one GPIO of the I2C controller MCU (host MCU). Then it must be configured as interrupt pin to support the implementation of the protocol according to Global Platform T=1' I2C specification.

Figure 15 depicts the logical communication states of the OPTIGA™ Authenticate NBT, including state transitions and the events triggering these. Once an interface is activated (either NFC or I2C), the device is locked into that interface until it is released (by field off or a timeout).

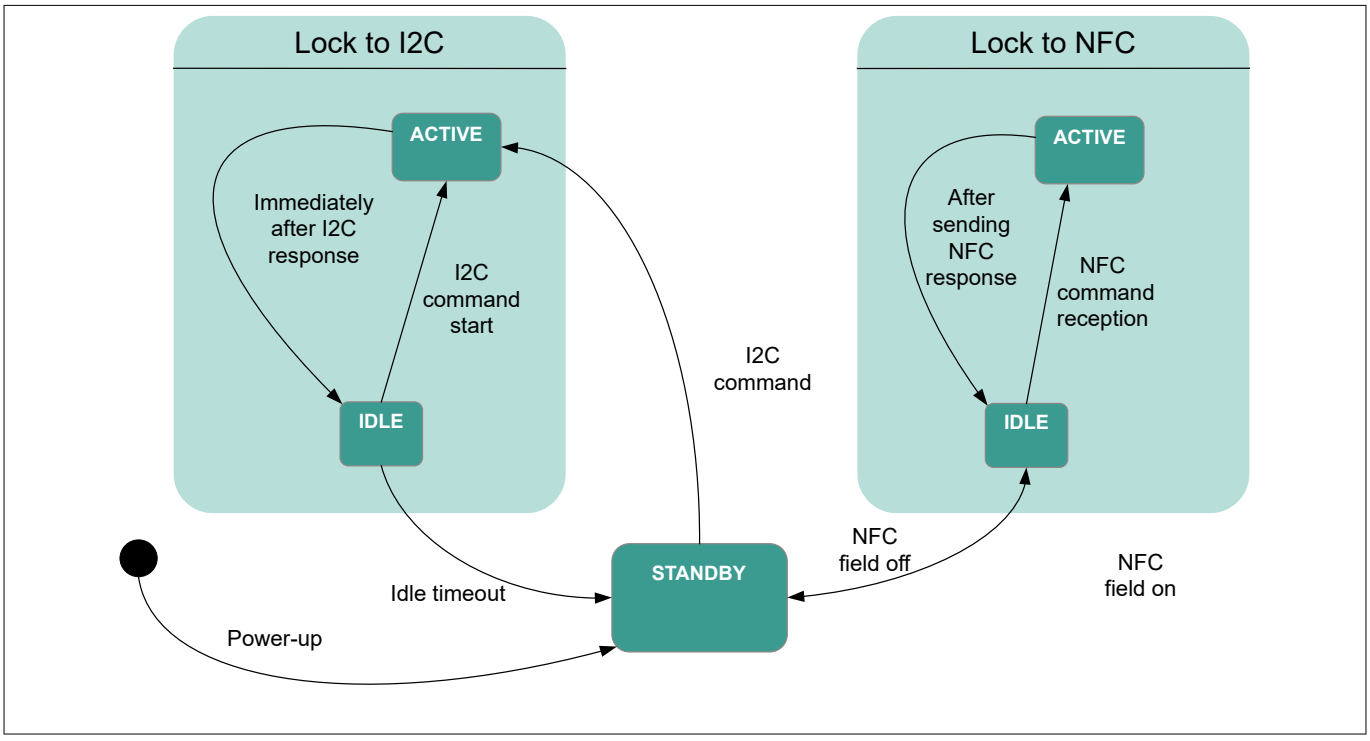


Figure 15 Logical communication states of OPTIGA™ Authenticate NBT

A.1.4 Command reference

The list of commands to personalize the OPTIGA™ Authenticate NBT for a use case and to operate the device in this application is provided in Table 6. Moreover, the table specifies the acceptance of each command, depending on the product life cycle state.

Table 6 Command set of the OPTIGA™ Authenticate NBT

Command	CLA	INS	Application	PERSONALIZATION	OPERATIONAL
SELECT (application)	00_H	$A4_H$	Type 4 Tag CONFIGURATOR	✓	✓
SELECT (file)	00_H	$A4_H$	Type 4 Tag	✓	✓
READ BINARY	00_H	$B0_H$	Type 4 Tag	✓	✓
UPDATE BINARY	00_H	$D6_H$	Type 4 Tag	✓	✓
PERSONALIZE DATA	00_H	$E2_H$	Type 4 Tag	✓	x
CHANGE/UNBLOCK PASSWORD	00_H	24_H	Type 4 Tag	✓	✓
AUTHENTICATE TAG	00_H	88_H	Type 4 Tag	✓	✓
GET CONFIGURATION	20_H	30_H	CONFIGURATOR	✓	x
SET CONFIGURATION	20_H	20_H	CONFIGURATOR	✓	x

A.1.5 Life cycle states

The OPTIGA™ Authenticate NBT supports two life cycle states as described in the Extended Datasheet [8]:

- PERSONALIZATION state: The product will be in the PERSONALIZATION state at the time of delivery. In this life cycle state, application developers can unconditionally modify the specific settings to prepare the device for the targeted use case. This covers:
  - Interface configurations
  - File access conditions and passwords
  - File content
  - Cryptographic keys

  ***Note**: When the product configuration and the data personalization steps are finished, it is recommended to switch the OPTIGA™ Authenticate NBT to the OPERATIONAL life cycle state to prevent unintended changes during the usage*

- OPERATIONAL state: In this state, the device is ready to be operated in the target application scenario. Product configuration functions are disabled. Configured file access policies prevent unverified operations on the file (based on the use case configuration)

  ***Note**: After the activation of the OPERATIONAL state on the OPTIGA™ Authenticate NBT, the life cycle cannot be restored to PERSONALIZATION state*

A.2 Device delivery condition

The OPTIGA™ Authenticate NBT comes with preloaded CONFIGURATOR and the Type 4 Tag applications. At delivery, the product is set to PERSONALIZATION state and the default configuration of the applications allow unconditional access to the following:

A Appendix

- CONFIGURATOR application
  - To adopt interface settings
  - To set life cycle state to OPERATIONAL
- Type 4 Tag application
  - To modify the File Access Policy (FAP)
  - To modify file content of user data files
  - Execute key exchange of the BSK or BMK

The OPTIGA™ Authenticate NBT is configured with I2C and NFC interfaces enabled. Refer to Extended Datasheet [8] for more details.

Interface settings	I2C interface	Enabled
	NFC interface	Enabled
IRQ settings	I2C-IRQ	Disabled
	PT-IRQ	Disabled
	NFC-IRQ	Disabled

Figure 16 Delivery condition: Interface configuration

The Type 4 Tag application consists of the following seven files:

- Capability Container file (EF.CC)
- NDEF file
- Four proprietary files (FILE_1 to FILE_4)
- File Access Policy file (EF.FAP)

The EF.CC File contains meta information such as the FileID, file size, and access conditions of the NDEF file, and the proprietary files FILE_1 to FILE_4 in the File_CTRL_TLVs. The content is set to the default values described in the Extended Datasheet [8]

The FAP is used to manage the file access conditions on a per-file and per-interface basis. The initial file access conditions are set as shown in Figure 17. The FAP can be updated while the OPTIGA™ Authenticate NBT is in the PERSONALIZATION state.

***Note**: The access conditions for the NFC interface configured in the FAP overrule the FILE_CTRL_TLV settings in the Capability Container. When access conditions defined in the FAP get modified, access conditions in the EF.CC for in the NDEF-File_CTRL_TLV are automatically synchronized by the OPTIGA™ Authenticate NBT, while Proprietary-File_CTRL_TLVs need to be updated by the implementer.*

The NDEF file contains the initial NDEF message, which is described in detail in the following chapter.

Type 4 Tag application file	File Access Policy file				Capability Container file				NDEF message file				FILE_1				FILE_2				FILE_3				FILE_4			
File usage / content	Type 4 Tag application file access settings				References to Type 4 Tag files				Infineon URL and certificate				<empty>				<empty>				<empty>				<empty>			
Operation	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update	I2C_Read	I2C_Update	NFC_Read	NFC_Update
Access condition at delivery	A	A	A	A	A	N	A	N	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

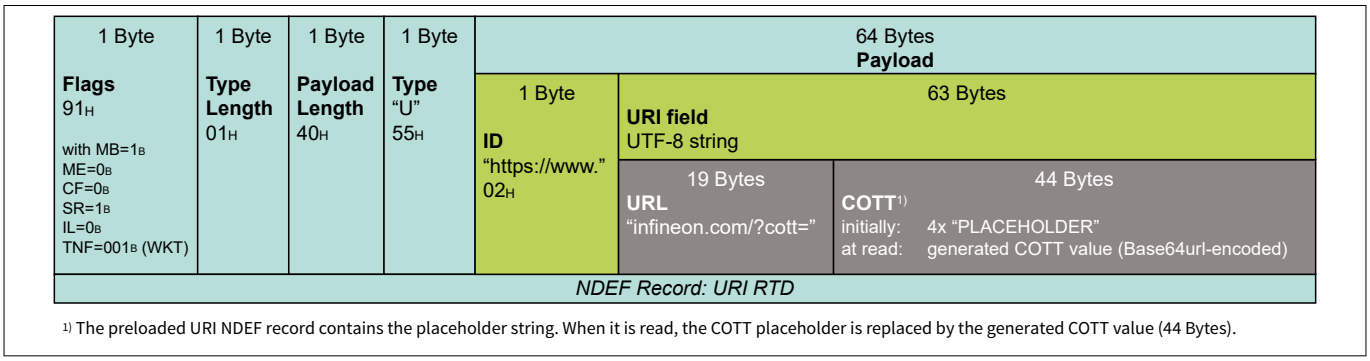
Access conditions: A = ALWAYS; N = NEVER; P = PASSWORD REQUIRED

Figure 17 Delivery condition: Application file content, access conditions (per-file, per-interface)

An AES-128-CMAC key (BMK) is preloaded to support online brand protection applications that use cryptographic one-time tokens. In addition, the OPTIGA™ Authenticate NBT's key store contains a private key for NIST P-256-based one-way authentication (BSK). The corresponding public key is stored inside an X.509 certificate, allowing the chip's authenticity to be checked. The NDEF record containing this certificate is also stored inside the NDEF file.

A.2.1 Initial NDEF message

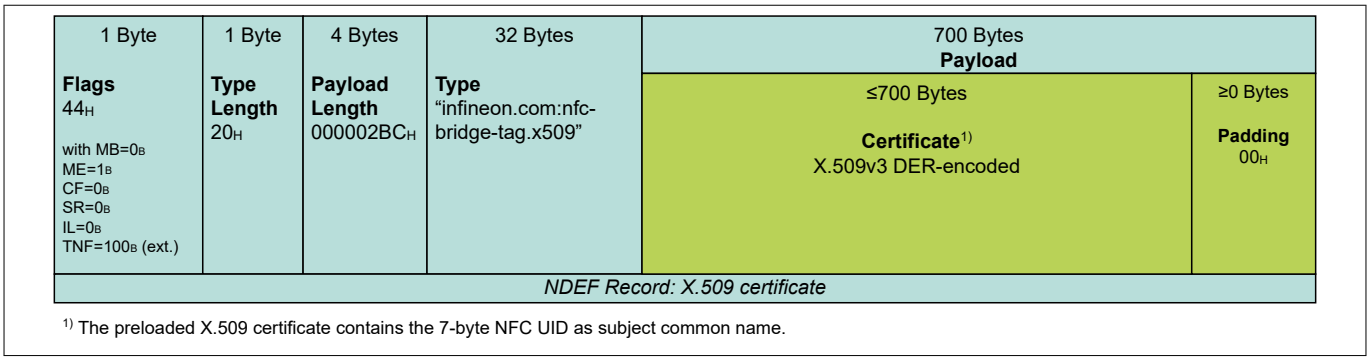
The OPTIGA™ Authenticate NBT is delivered with a preloaded NDEF message in the NDEF file. This NDEF message contains two NDEF records: the first is an URI record followed by an external record. Initially, the URI record contains a link to https://www.infineon.com/, followed by the COTT placeholder string used for online brand protection use cases.



1) The preloaded URI NDEF record contains the placeholder string. When it is read, the COTT placeholder is replaced by the generated COTT value (44 Bytes).

Figure 18 URI record

The external record is essential for the offline brand protection scheme supported by the OPTIGA™ Authenticate NBT. The record includes an X.509v3 DER-encoded public-key certificate generated by Infineon Technologies. During the manufacturing process of the chip, a certificate is created. This certificate contains each chip's individual UID and is generated during wafer-level personalization. It is embedded into the NDEF message's external record. For more information about the certificate, refer to the Appendix in [8].



1) The preloaded X.509 certificate contains the 7-byte NFC UID as subject common name.

Figure 19 External record

References

NFC Forum

[1] NFC Forum: *Type 4 Tag Technical Specification (Version 1.2)*; 2022-08-16
[2] NFC Forum: *NFC Data Exchange Format (NDEF) Technical Specification (Version 1.0);* 2006-07-24
[3] NFC Forum: *Activity Technical Specification (Version 2.3)*; 2023-02-03
[4] NFC Forum: *Connection Handover Technical Specification (Version 1.5)*; 2020-04-10
[5] NFC Forum: *Bluetooth Secure Simple Pairing Using NFC Application (Version 1.3)*; 2022-11-16

GlobalPlatform

[6] GlobalPlatform: *APDU Transport over SPI/I2C (Version 1.0);* 2020-01

Infineon

[7] Infineon Technologies AG: *OPTIGA™ Authenticate NBT, product website* - https://www.infineon.com/OPTIGA-Authenticate-NBT
[8] Infineon Technologies AG: *OPTIGA™ Authenticate NBT, Extended Datasheet (latest revision)*
[9] Infineon Technologies AG: *OPTIGA™ Authenticate NBT, Release Notes (latest revision)*
[10] Infineon Technologies AG: *OPTIGA™ Authenticate NBT, Software Integration Guide (latest revision)*

Glossary

AES

Advanced Encryption Standard (AES)

The standard for the encryption of electronic data established by the U.S. National Institute of Standards and Technology (NIST) in 2001. The algorithm described by AES is a symmetric-key algorithm (the same key is used for both encryption and decryption).

AID

application identifier (AID)

Used to reference an application.

APDU

application protocol data unit (APDU)
The communication unit between a smart card reader and a smart card.

BMK

brand protection MAC'ing key (BMK)

BSK

brand protection signing key (BSK)

BT

Bluetooth (BT)
A short-range wireless technology standard that is used for exchanging data between fixed and mobile devices over short distances.

C-MAC

command MAC (C-MAC)

CA

certificate authority (CA)

CC

capability container (CC)

CLA

class byte (CLA)

COTT

cryptographic one-time token (COTT)

DGI

data group identifier (DGI)

ECDSA

elliptic curve digital signature algorithm (ECDSA)

EIR

extended inquiry response (EIR)

Glossary

FAP
file access policy (FAP)

FileID
file identifier (FileID)
Used to reference an elementary file.

GND
ground (GND)

GP
GlobalPlatform (GP)

GPIO
general purpose input/output (GPIO)

I2C
inter-integrated circuit (I2C)

ID
identification (ID)

INS
instruction byte (INS)

IoT
Internet of Things (IoT)

IRQ
interrupt request (IRQ)
A type of exception that breaks the linear flow of a program. The requesting module needs a software service routine to evaluate its current state and take the necessary actions.

ISO
International Organization for Standardization (ISO)

MCU
microcontroller unit (MCU)
One or more processor cores along with memory and programmable input/output peripherals.

NBT
NFC bridge tags (NBT)

NDEF
NFC data exchange format (NDEF)
A standardized data format specification by the NFC Forum to describe how a set of actions are to be encoded onto a NFC tag or to be exchanged between two active NFC devices.

NFC
near field communication (NFC)

Glossary

NFCT4T
NFC Type 4 Tag (NFCT4T)

NLEN
NDEF length (NLEN)
A field in the NDEF message that indicates the size of the NDEF message.

OOB
out of band (OOB)

RNG
random number generator (RNG)

RTD
record type definition (RTD)

SCL
serial clock line (SCL)

SDA
serial data line (SDA)

T4T
Type 4 Tag (T4T)

TLV
tag length value (TLV)

UID
unique identifier (UID)

URI
uniform resource identifier (URI)
A string of characters that uniquely identify a name or a resource on a network, such as the Internet.

URL
uniform resource locator (URL)
A unique identifier used to locate a resource on the Internet (also referred to as a web address).

Revision history

Reference	Description
Revision 1.1, 2024-04-30	
All	Editorial changes
Revision 1.0, 2024-03-28	
All	Initial release

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