UM2131
User manual

ST25 Android™ NFC tap application

Introduction

This document describes the functionalities of the ST25 Android™ NFC tap application, helping the user to understand the application features and how to use them.

The ST25 Android™ NFC tap application is linked to the STSW-ST25001 and STSW-ST25002 software categories, and operates with products belonging to the ST25 NFC / RFID Tags and ST25 Dynamic NFC tags.

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1 List of acronyms and definitions

AAR: Android™ Application Record

BLE: Bluetooth® Low Energy

CC: Capability container

DAR: Display aspect ratio

FW: Firmware

I^2C: Inter-integrated circuit

IEC: International Electro-technical Commission

ISO: International Organization for Standardization

ISO/IEC 14443: Proximity standard

ISO/IEC 15693: Vicinity standard

NDEF: NFC data exchange format

NFC: Near field communication

NFC Forum: Association of industry actors promoting the NFC technology

PWD: Password

PWM: Pulse-width modulation

RF: Radio frequency

Tag: PICC in form of a patch, key fob or any similar device, without own power source and not generating RF electromagnetic field, capable of communicating with a reader / writer

PICC (VICC): Proximity (vicinity) IC card: a technology subset, defined in ISO/IEC standards for cards, with a defined set of commands

URI: Unified resource identifier

URL: Unified resource locator

2 Overview

2.1 Prerequisites

The prerequisites to run the Android™ application are:

- an Android™ mobile phone or reader with NFC enabled
- minimum Android version: API level 15 corresponding to *Android™ 4.0.4* (Ice Cream Sandwich)

The ST25 Android™ NFC tap application is available on:

- ST site: *www.st.com*
- Google play: https://play.google.com/store/apps/details?id=com.st.st25nfc

Note: Pictures used within this document illustrate the various application features. They are based on version 1.0.0 of the application. Some discrepancies may be noticed between this documentation and the application itself.

Figure 1. ST25 Android™ NFC tap application overview

Note: For more details regarding ST25 devices, refer to their corresponding datasheets (available on www.st.com).

2.2 Functionalities overview

Thanks to the ST25 Android™ NFC tap application the user can manage the following STMicroelectronics products:

- Tags:
  - ST25TN series NFC Tags
  - ST25TV series NFC Tags
  - ST25TA series NFC/RFID Tags
  - LRI EEPROM tags
- Dynamic tags:
  - ST25DV-I2C series Dynamic NFC Tags
  - ST25DV-PWM series Dynamic NFC Tags
  - M24SR series Dynamic NFC Tags
  - M24LR series Dynamic NFC Tags

The application supports the ISO14443 protocol to communicate with NFC tags (ST25TA and ST25TN series) and Dynamic NFC tags (M24SR series), and the ISO15693 protocol to communicate with NFC tags (ST25TV and LRI series) and Dynamic NFC tags (ST25DV-I2C, ST25DV-PWM and M24LR series).

The ST25 Android™ NFC tap application demonstrates the following product features:

- Read / Write NDEF message, NFC forum compliant example
  - Text, URI, SMS, Email, VCard, AAR, Wi-Fi®, Bluetooth®
- Tag information retrieval (CC file, System file[a])
- Tools functionalities (counters and GPO control according to tag)[a]
- Password management (password authentication, tag Read Only/Write Only)[a]
- Energy harvesting[a]
- Specific use cases usually implemented to work with STMicroelectronics Discovery boards and kits[a]

a. For ST products

3 Application description

The application is composed of the following main activities:

- Welcome screen (refer to *Section 3.1*)
- NDEF editor screen (refer to *Section 3.3*)
- Tag detail screen (refer to *Section 3.2*) with a series of tabs dedicated to main features:
  - Tag info (refer to *Section 3.2.1*)
  - NDEF (refer to *Section 3.2.2*)
  - CC file (refer to *Section 3.2.3*)
  - SYSTEM file (refer to *Section 3.2.4*)
  - Memory dump (refer to *Section 3.2.5*)
- Drawer menu allowing access to tag available features
  - NFC forum:
    Tag info, NDEF editor (refer to *Section 3.3.1*), and CC file
  - Tag features (refer mostly to *Section 4*):
    System file, memory dump, register management, areas management, areas content editor, areas security status, mailbox management, data transfer, counter, tamper detection, Lock block, Untraceable mode, Kill tag and Electronic article surveillance.
  - Tag demonstrations (refer to *Section 5*):
    Stopwatch transfer, firmware update and picture transfer

The following sections describe the main activities and associated functionalities or demonstration use cases included in each tab.

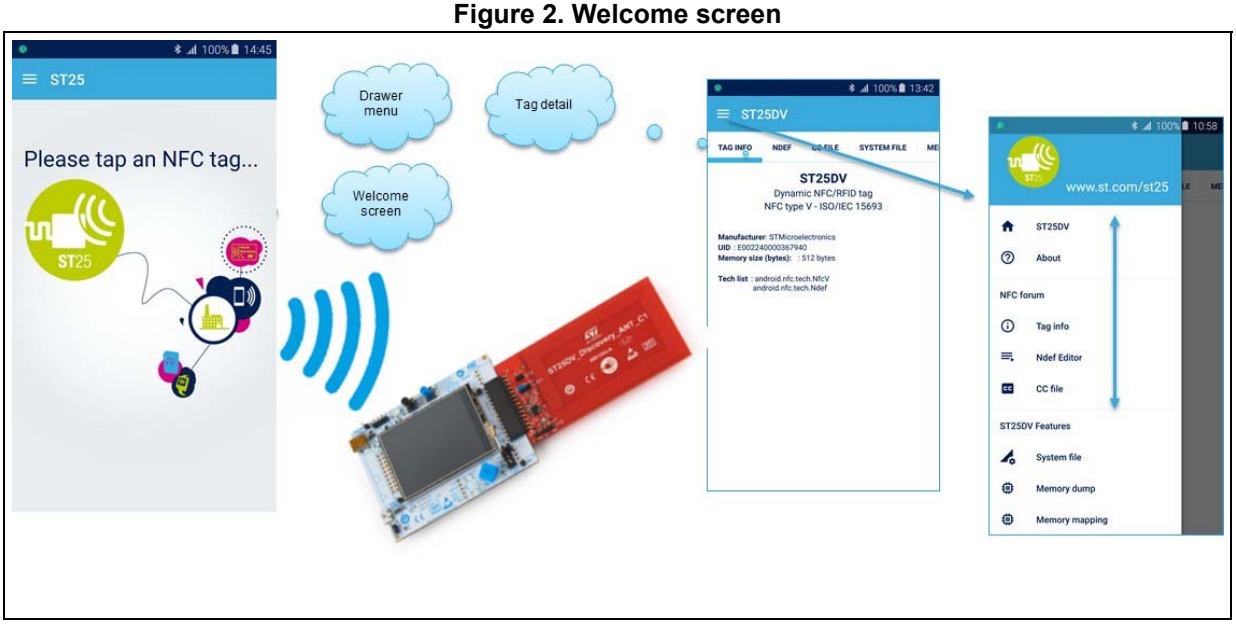
3.1 Welcome screen

When the application is started, the welcome screen is displayed (see *Figure 2*), inviting the user to “tap” a tag.

When the tag has been discovered, and depending on the product discovered, sections including tabs become available or not.

Note: If NFC is not enabled, a message is displayed inviting to use the NFC configuration menu.

Figure 2. Welcome screen



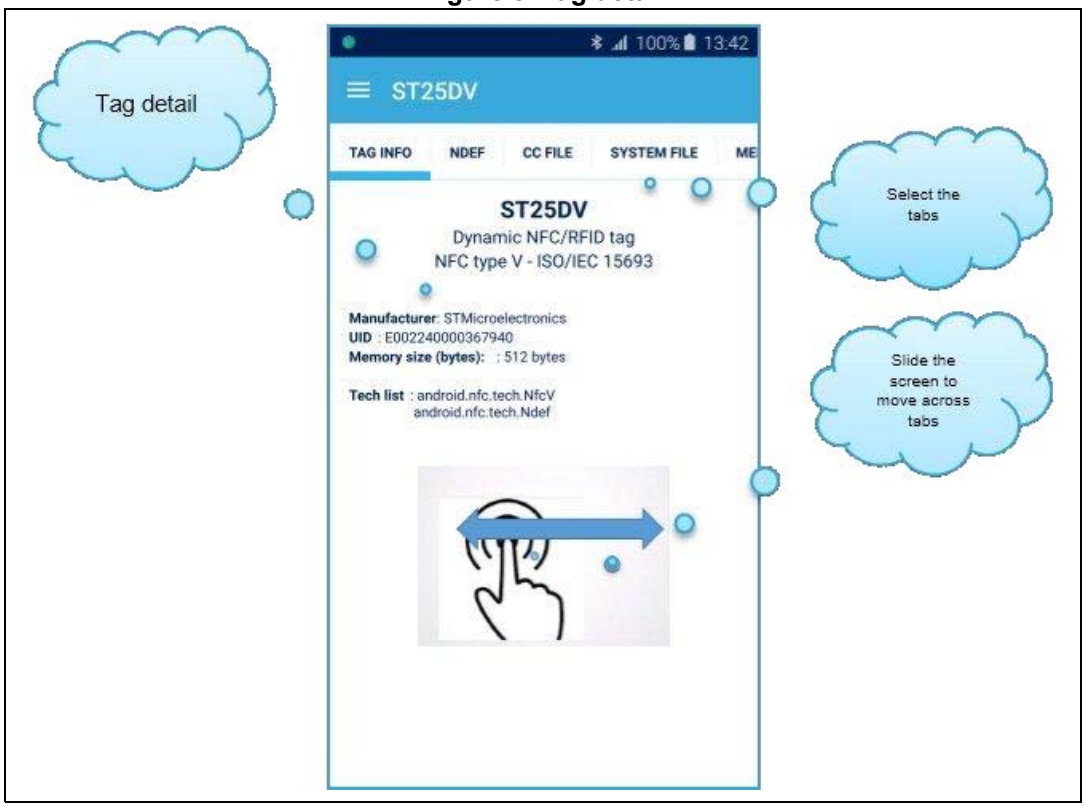
If a tag is tapped, the application starts the tag detail activity (refer to *Section 3.2*).

The drawer menu is updated according to tag and features. Demonstrations, if any, can be started from drawer menus.

3.2 Tag detail

This activity is started when a tag is discovered. Available screen and tabs are shown in *Figure 3*. Tab availabilities depend on the product discovered.

Figure 3. Tag detail



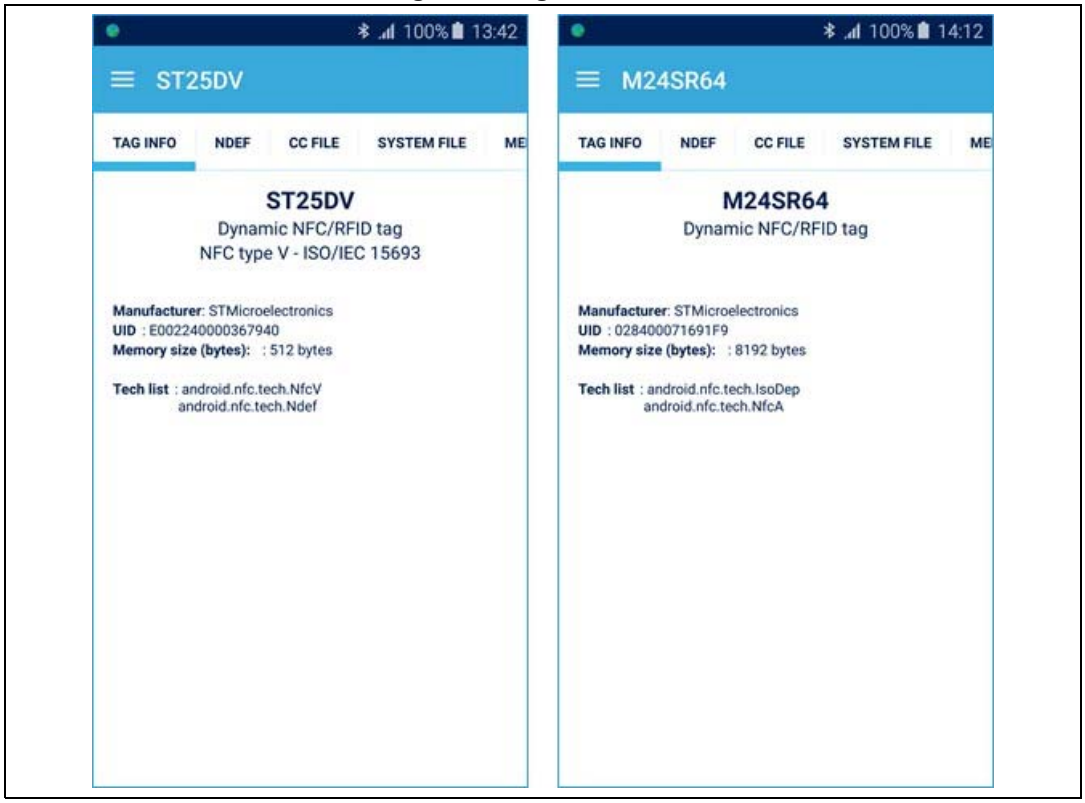
The following subsections describe the main features of each tab.

- TAG INFO: Provides information dealing with the tag (Manufacturer, Memory size, and UID among others)
- NDEF: Displays the content of the NDEF, if any, according to the application implemented ones. Refers to the NDEF editor section for available list and screens.
- CC FILE: Provides CC file information if any
- SYSTEM FILE: Provides System file information if any (ST products)
- MEMORY DUMP: Provides ways to Write/Read memory or dump/fill memory to/from file

3.2.1 Tag info

Provides information related to the tag such as the manufacturer, the memory size or the UID as shown in *Figure 4*.

Figure 4. Tag info screen

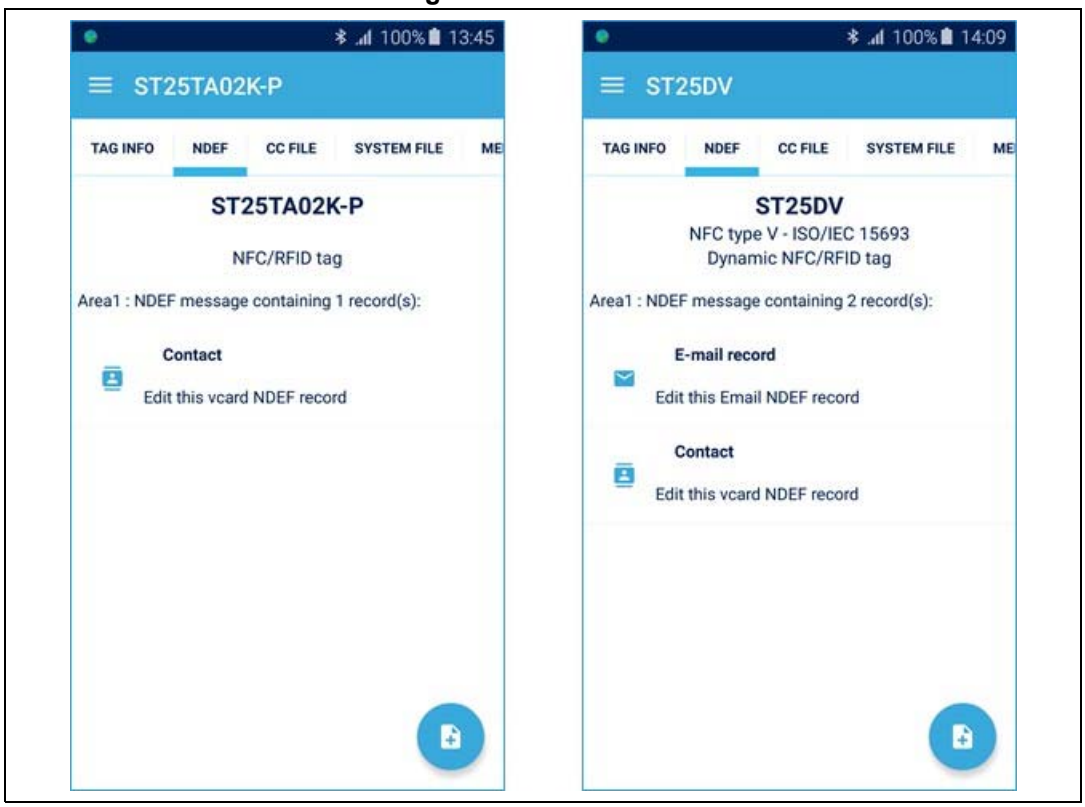


3.2.2 NDEF

The NDEF tab displays the content of the NDEF, if any decoded, according to the application implemented ones as shown in *Figure 5*.

Available lists and screens are detailed in *Section 3.3*.

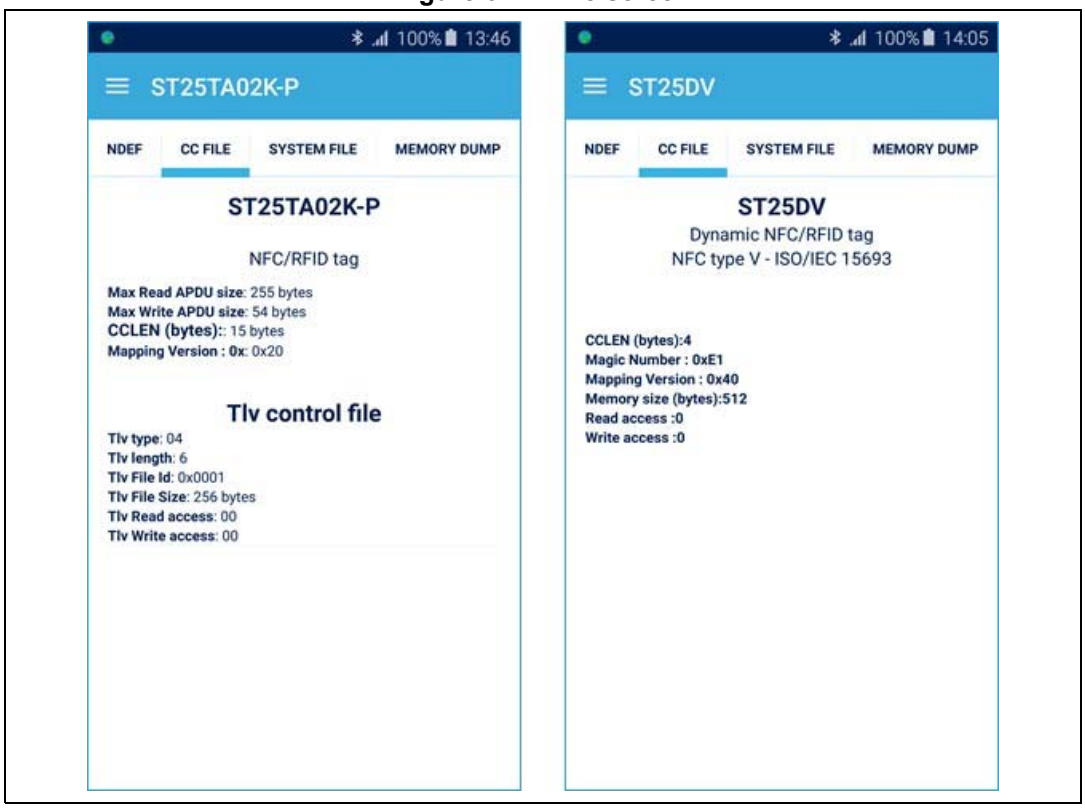
Figure 5. NDEF screen



3.2.3 CC file

Provides CC file information (if any), as shown in *Figure 6*.

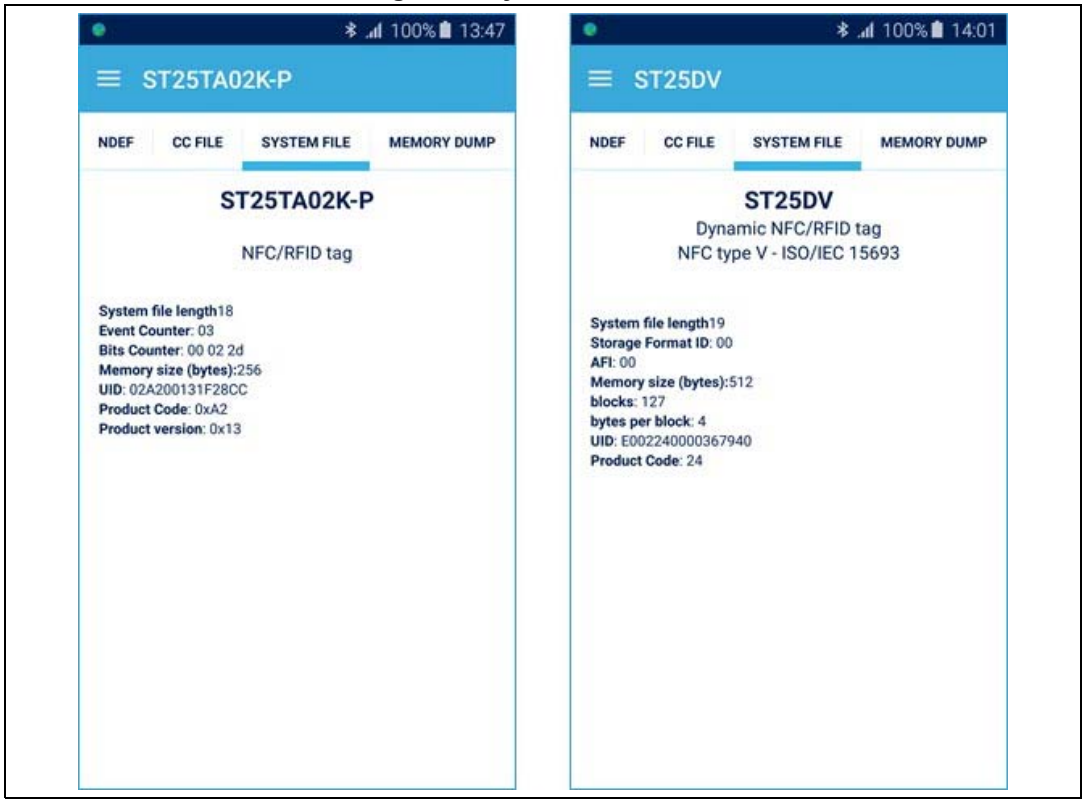
Figure 6. CC file screen



3.2.4 SYSTEM file

Provides information retrieved from the System file and more (registers, counter) associated with the product discovered. as shown in *Figure 7*.

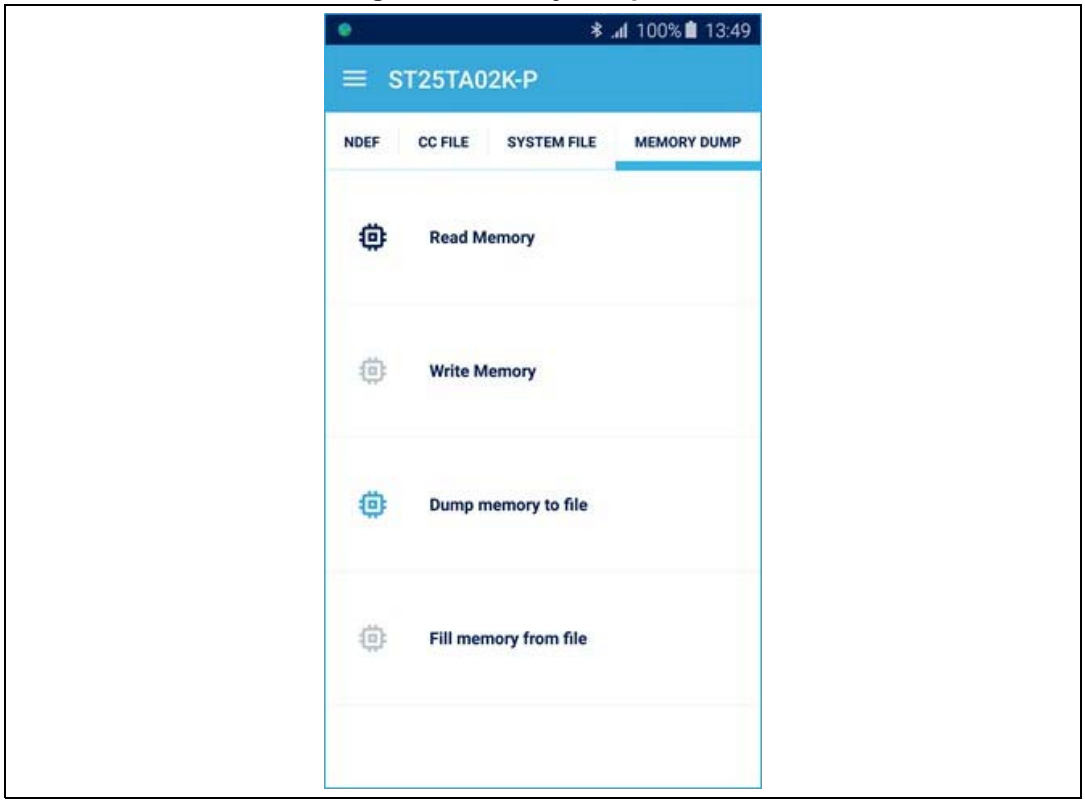
Figure 7. System file screen



3.2.5 Memory dump

Refer to *Section 4.1* for details about the possibilities provided by this activity. The memory dump screen is shown in *Figure 8*.

Figure 8. Memory dump screen



3.3 NDEF editor

The NDEF editor screen enables to create, build, and modify NDEF messages containing one or more records.

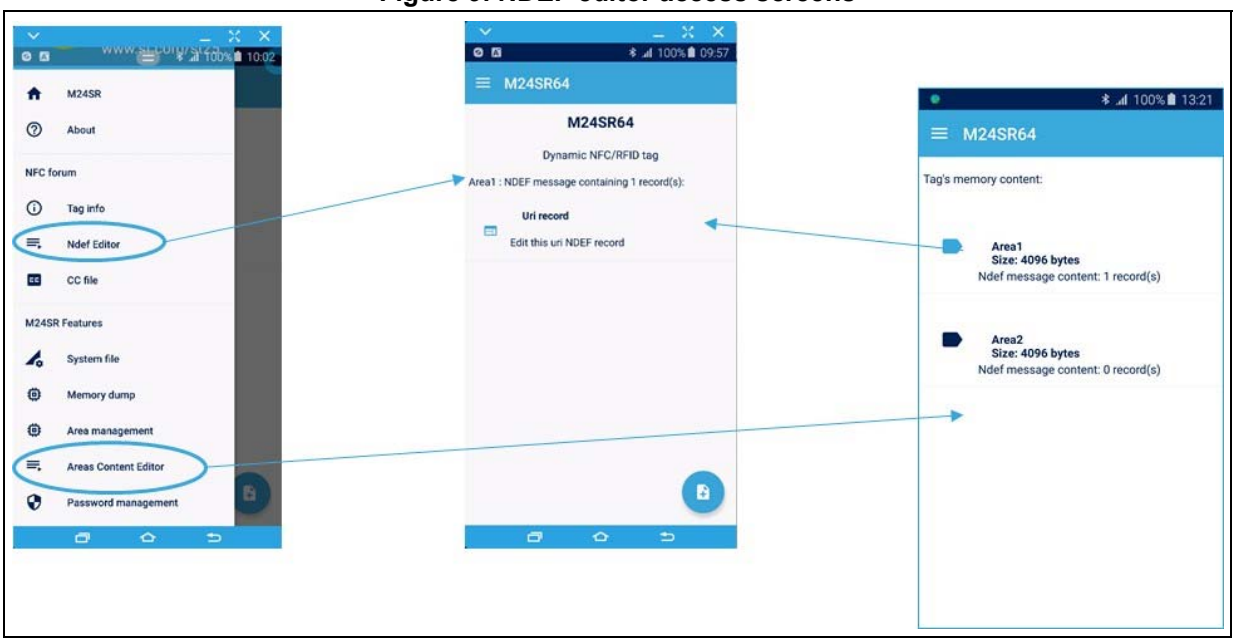
3.3.1 NDEF editor access

The NDEF editor can be started from the following main screens:

- ***Drawer*** > ***NDEF editor*** in the NFC forum menu group for NFC related topics related to Area 1
- ***Drawer*** > ***Areas Content Editor*** for tag full features in case of multiple areas available on the tag. This feature first presents the tag areas for selection, then the NDEF editor for the edition of functionalities.

Figure 9 shows NDEF editor access screens.

Figure 9. NDEF editor access screens



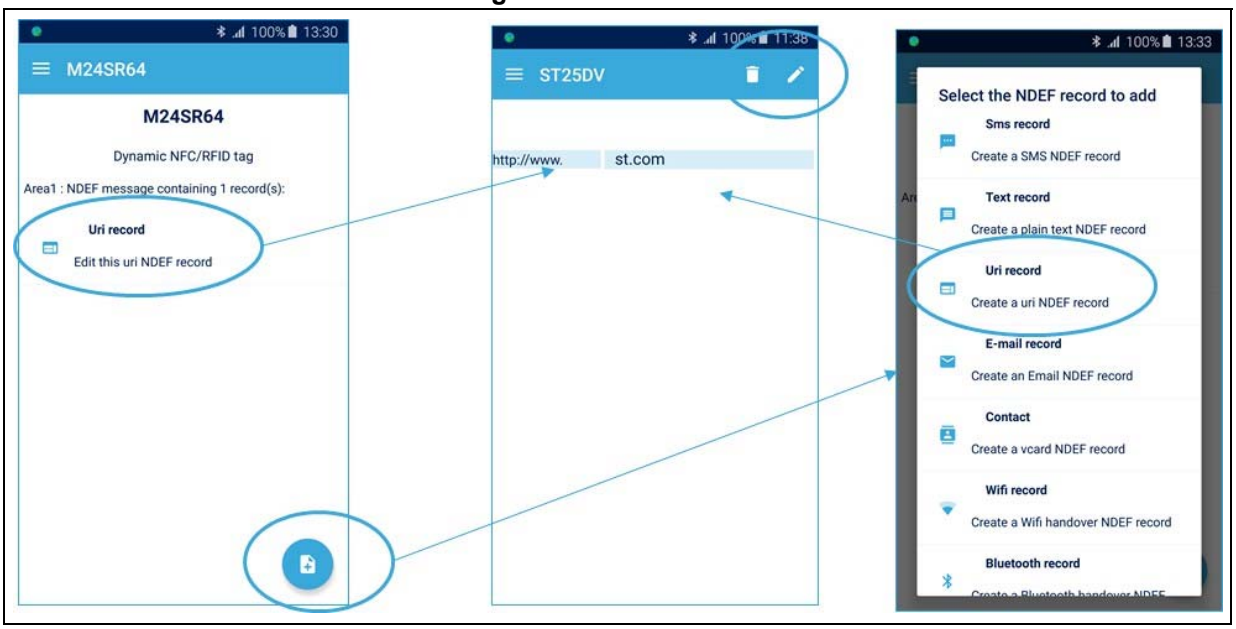
3.3.2 NDEF editor operations

The NDEF editor screen enables to read the NDEF content of an NFC tag or write an NDEF message (made of one or more NDEF records) into it. The NDEF editor screen displays all the NDEF records present in the tag.

As shown in *Figure 10*, the user can:

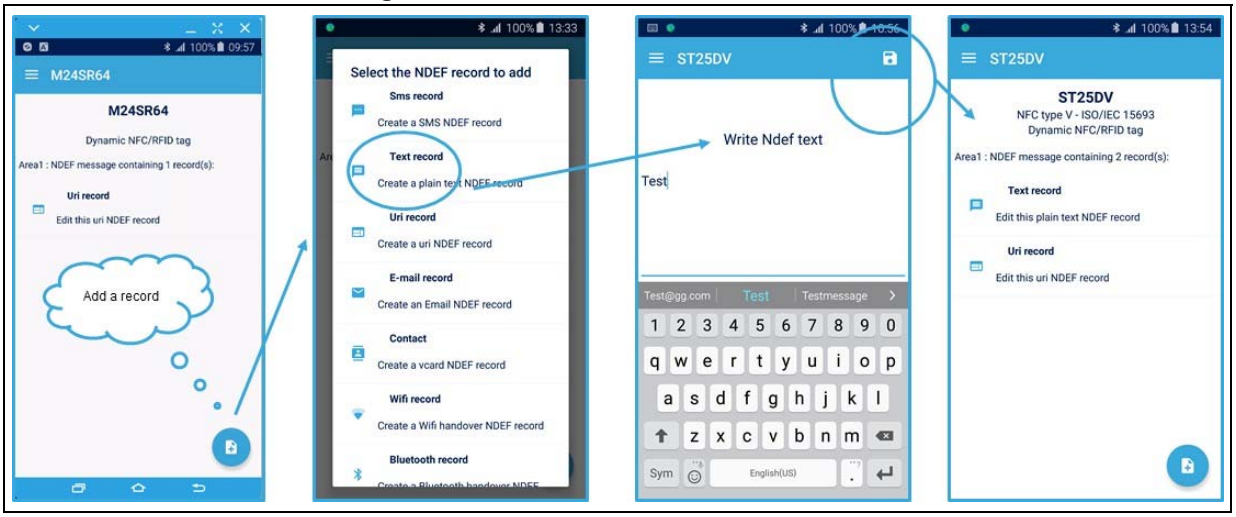
- Click on an NDEF record to view its content and edit it using the *pencil* icon, or delete it using the *recycle bin* icon
- Click on the bottom-right *'+'* button to add an NDEF record, to be selected among all possible types.

Figure 10. NDEF edition



When a click on a disk pictogram is performed as shown in *Figure 11*, the built message is written on the tag as an NDEF message that can contain multiple records.

Figure 11. Discover an NDEF multi record



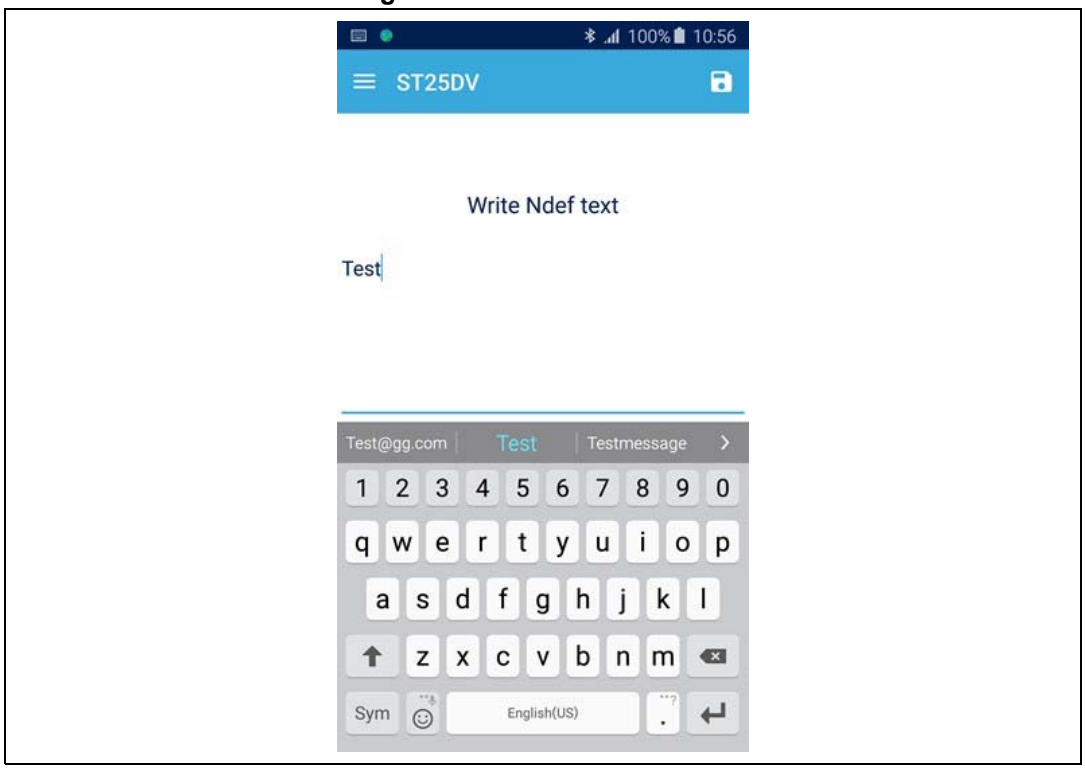
3.3.3 NDEF records

This section describes the main available NDEF records that can be used to compose an NDEF message within the NDEF editor activity.

TEXT

Displays NDEF TEXT edition fields and enables to write a text NDEF message, as shown in *Figure 12*.

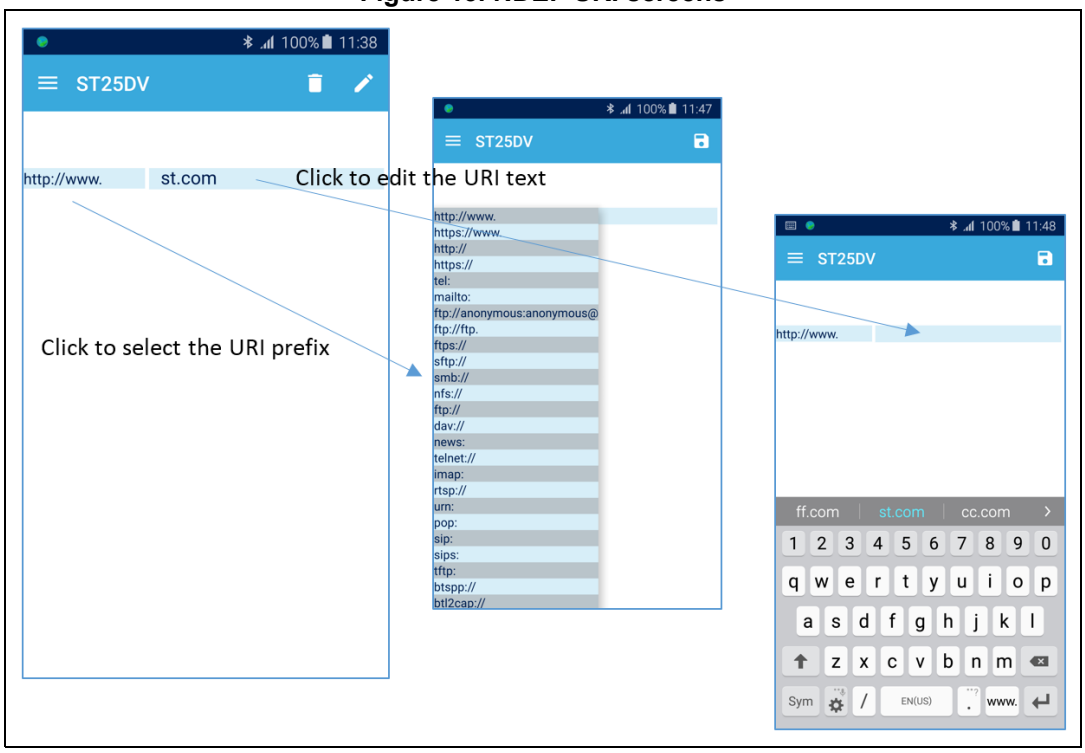
Figure 12. NDEF TEXT screen



URI

Displays NDEF URI edition fields and enables to write a URI NDEF message, as shown in *Figure 13*.

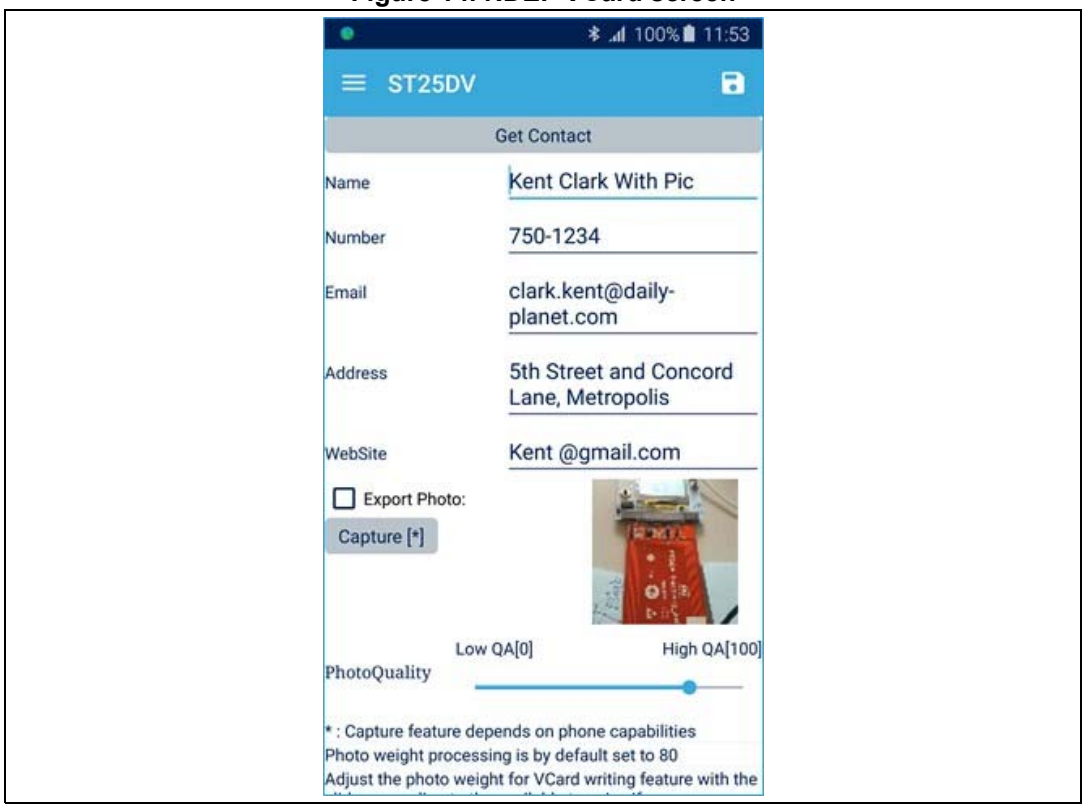
Figure 13. NDEF URI screens



Contact

Displays NDEF VCard edition fields and enables to write a VCard NDEF message, as shown in *Figure 14*.

Figure 14. NDEF VCard screen



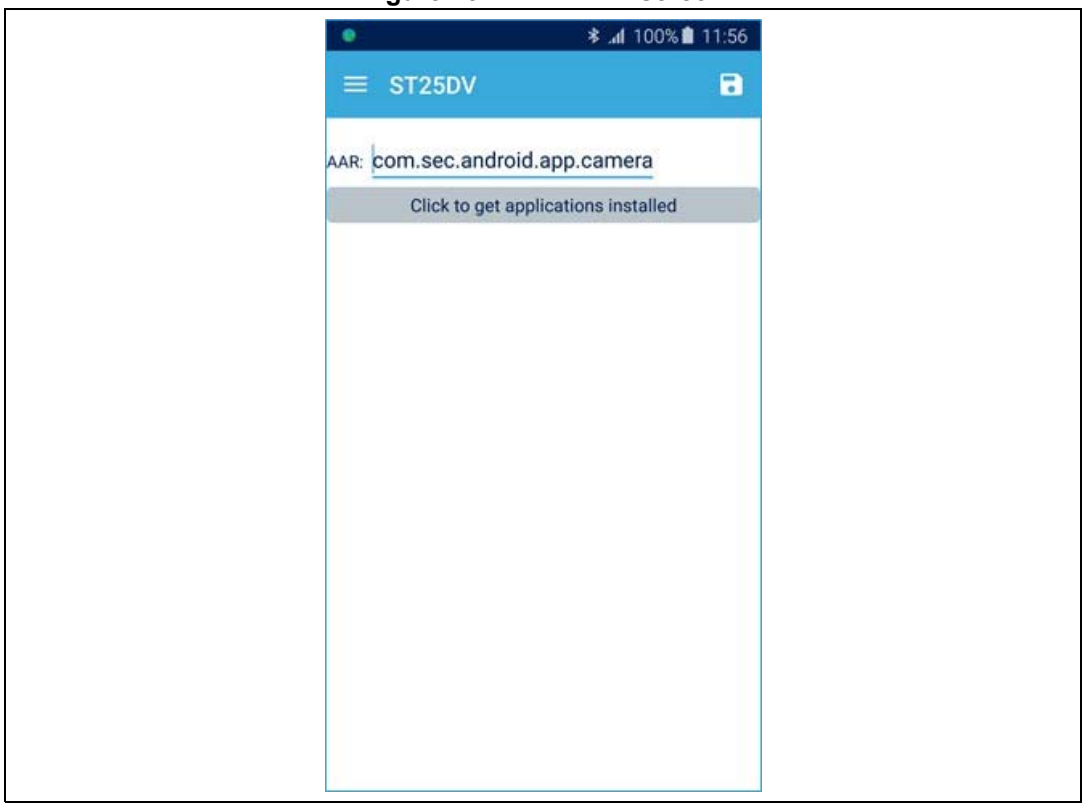
Options:

- GetContact button to get a contact from the phone list and initiate all fields from the selected contact
- Capture from camera
- Export photo check box used to include the image into the NDEF message
- A slider is available under the picture to adjust the image size to fit within the tag available size

AAR

Displays NDEF AAR edition fields and enables to write an AAR NDEF message.

Figure 15. NDEF AAR screen

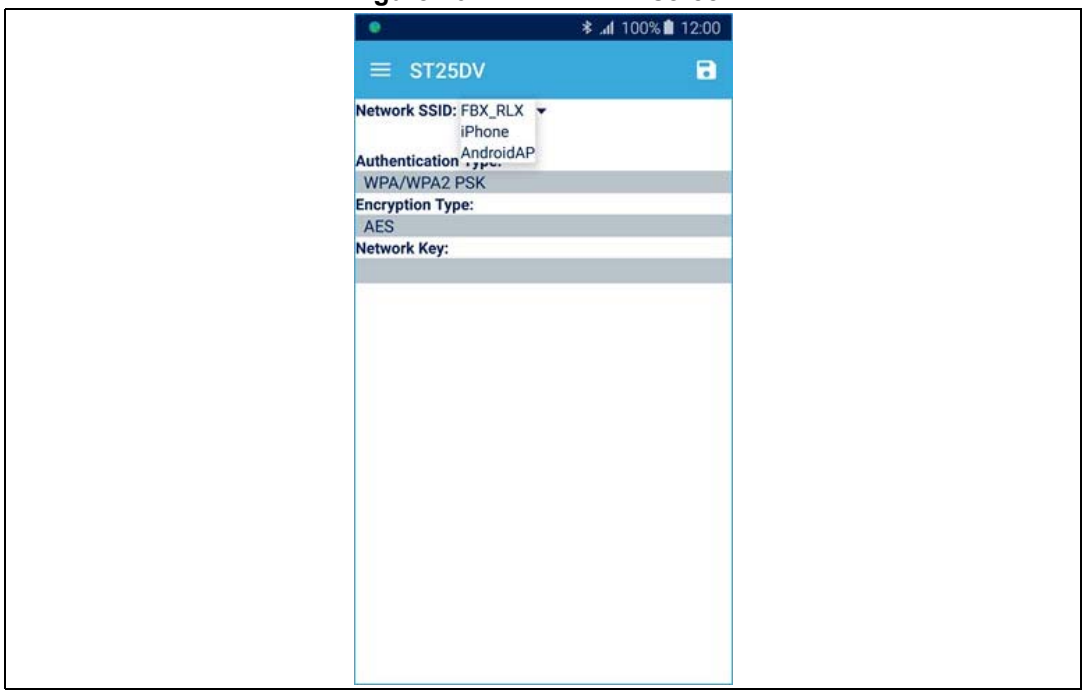


The selection of an installed application helps to retrieve the AAR message from an already installed application.

Wi-Fi®

Displays NDEF Wi-Fi® edition fields and enables to write a Wi-Fi® NDEF message.

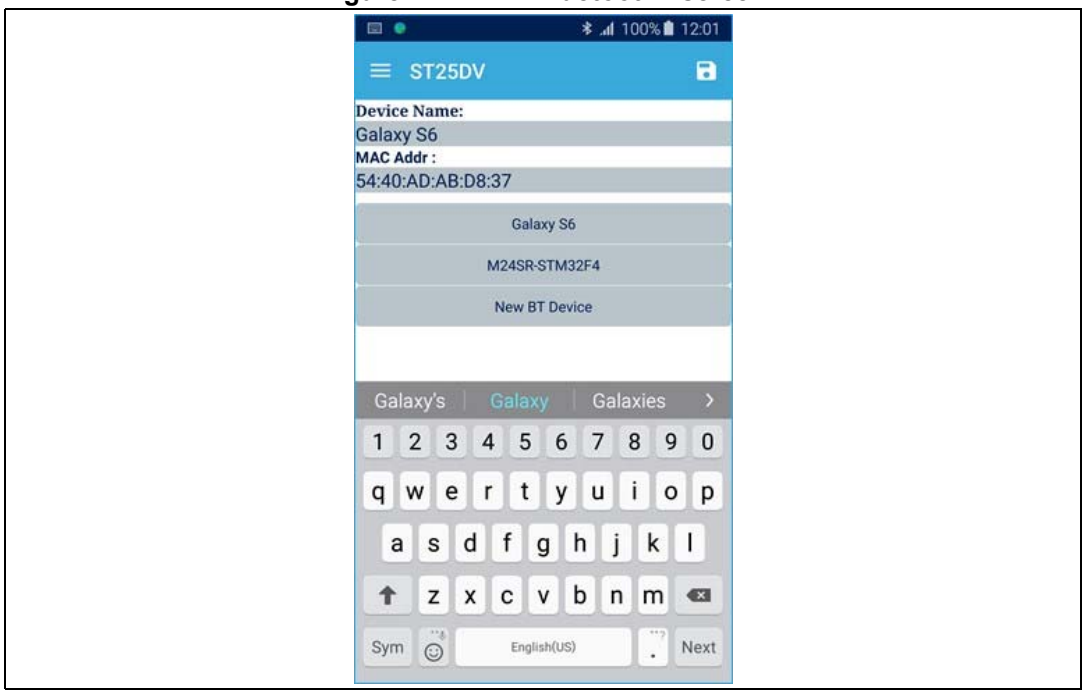
Figure 16. NDEF Wi-Fi® screen



Bluetooth®

Displays NDEF Bluetooth® edition fields and enables to write a Bluetooth® NDEF message.

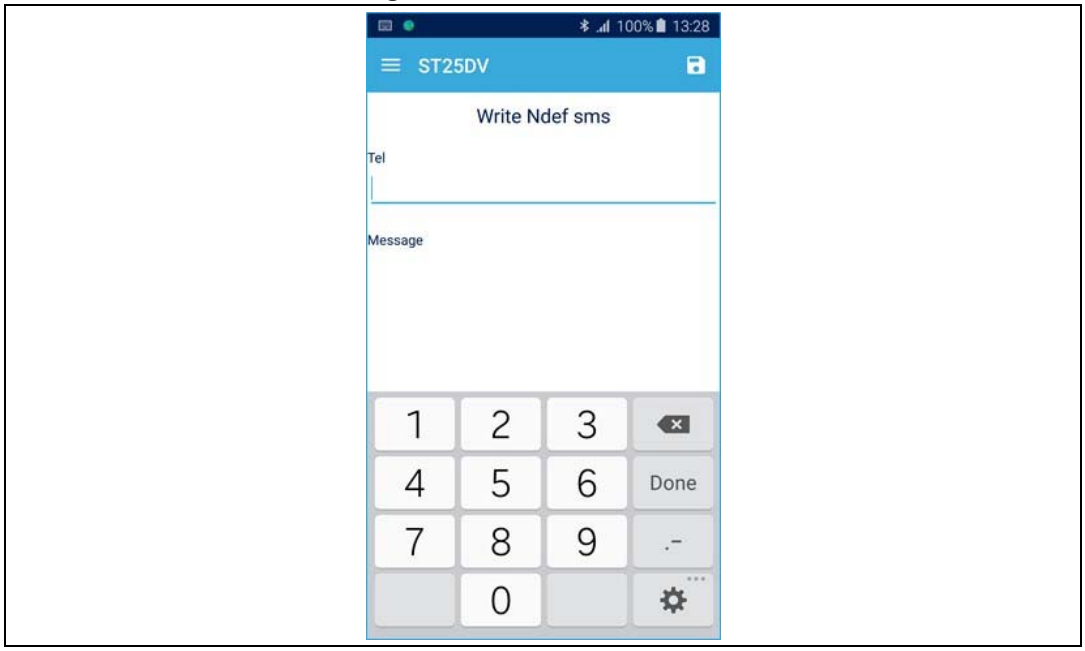
Figure 17. NDEF Bluetooth® screen



SMS

Displays NDEF SMS edition fields and enables to write an SMS NDEF message.

Figure 18. NDEF SMS screen



Email

Displays NDEF Email edition fields and enables to write an email NDEF message.

Figure 19. NDEF Email screen

Bluetooth® Low Energy

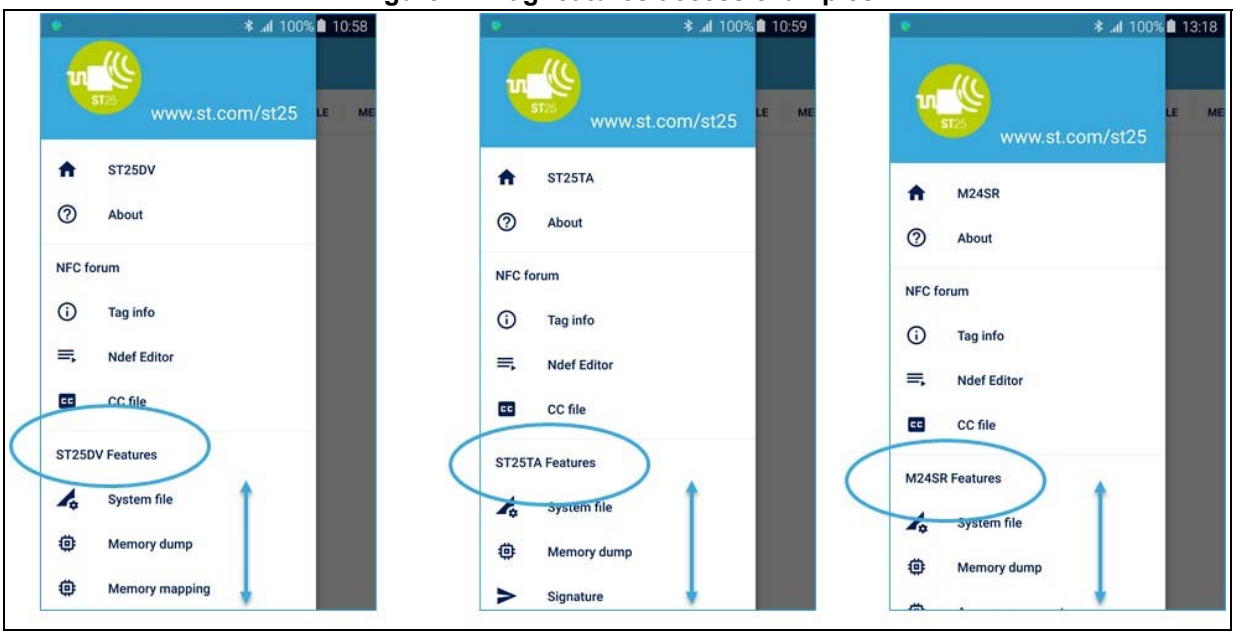
Displays NDEF Bluetooth® Low Energy edition fields and enables to write a BLE NDEF message, as shown in *Figure 20*.

Figure 20. NDEF Bluetooth® LE screen

4 Tag main features

This section describes the tag main features that can be reached from the ***Drawer*** > ***<Tag name> features*** menu. Examples for various tags are shown in *Figure 21*.

Figure 21. Tag features access examples



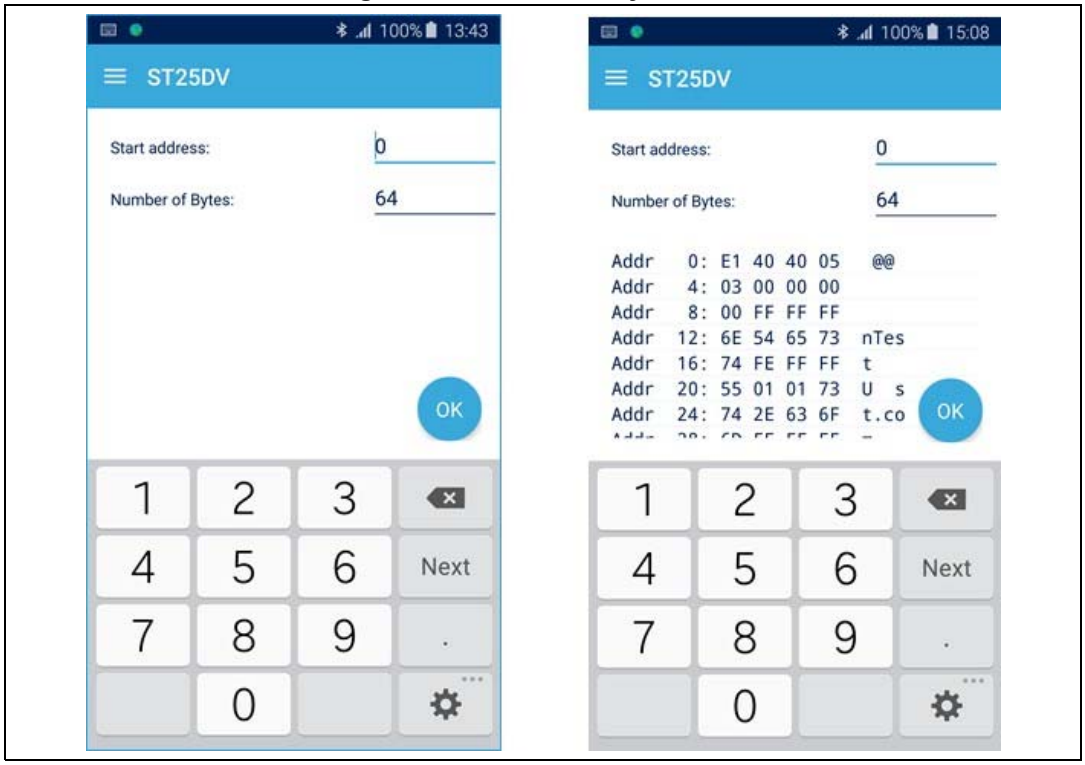
4.1 Memory features

The memory features illustrated in *Section 4.1.1* to *Section 4.1.4* provide ways of reading or writing to tag memory with the possibility to store or restore memory content to or from a file.

4.1.1 Read memory

The read memory feature enables to dump a number of bytes from the memory starting at a given address. Read memory screen examples are shown in *Figure 22*.

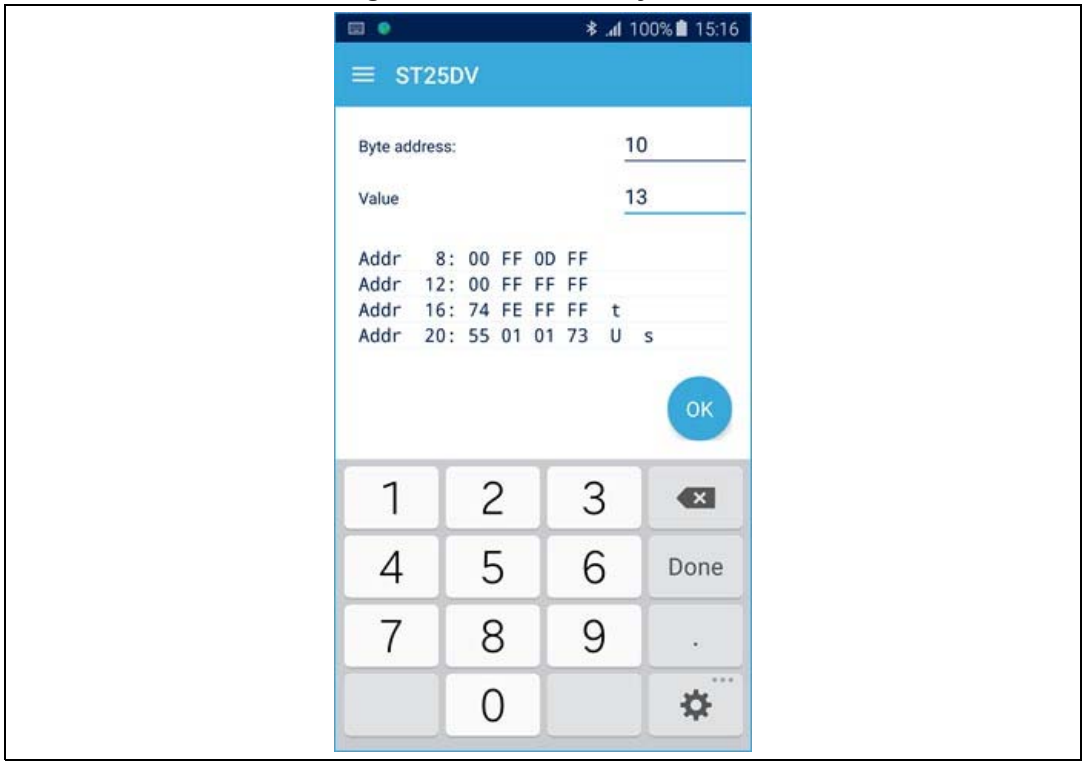
Figure 22. Read memory screens



4.1.2 Write memory

The write memory feature enables to write a given value to the memory at a given address. A write memory screen example is shown in *Figure 23*.

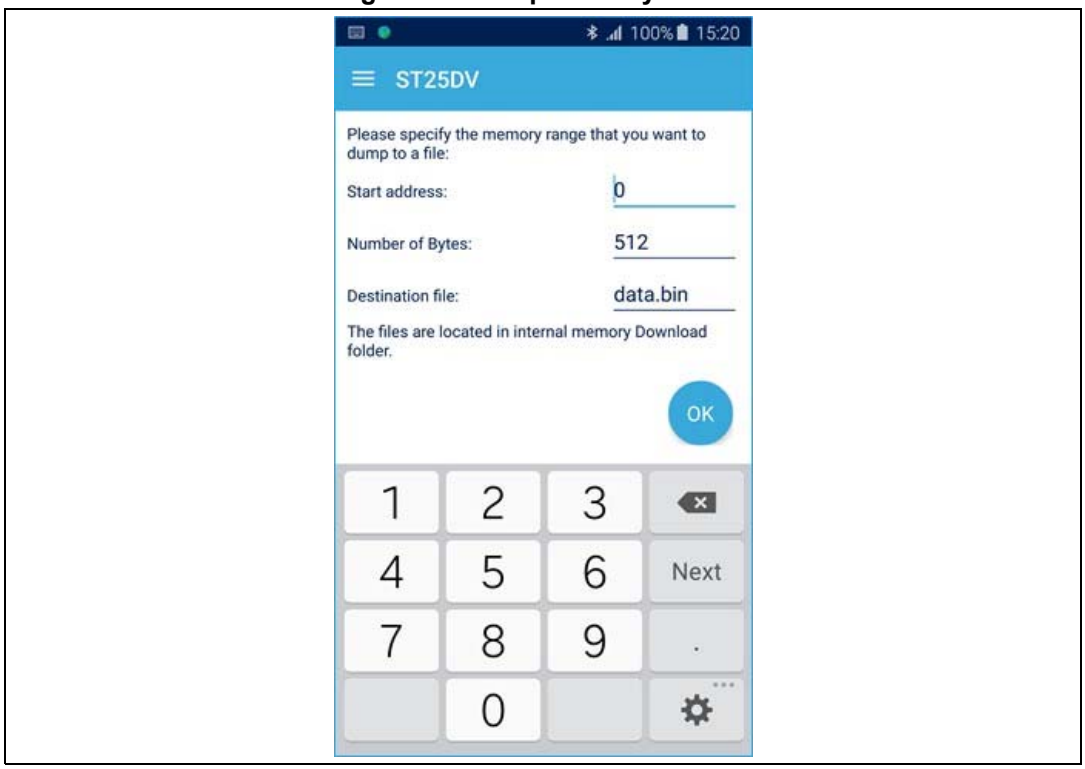
Figure 23. Write memory screen



4.1.3 Dump memory

The dump memory feature enables to write to a given file a number of bytes from the memory starting at a given address. A dump memory screen example is shown in *Figure 24*.

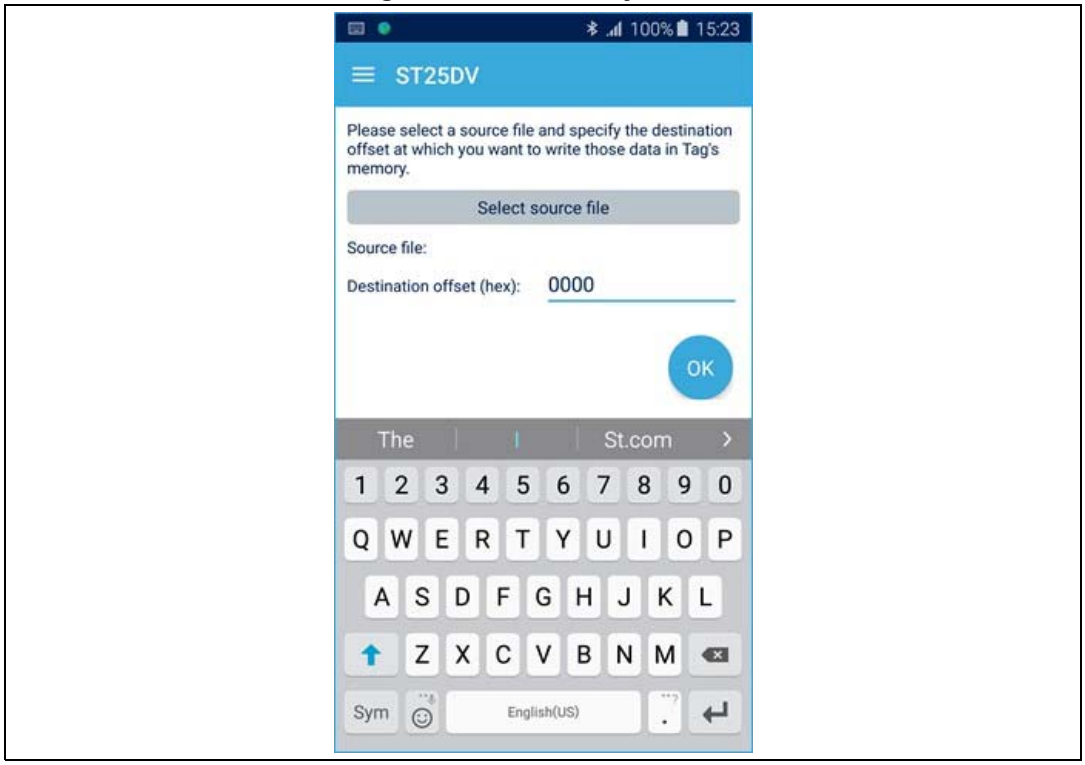
Figure 24. Dump memory screen



4.1.4 Fill memory

The fill memory feature enables to write the content of a given file to the memory starting at a given address. A fill memory screen example is shown in *Figure 25*.

Figure 25. Fill memory screen



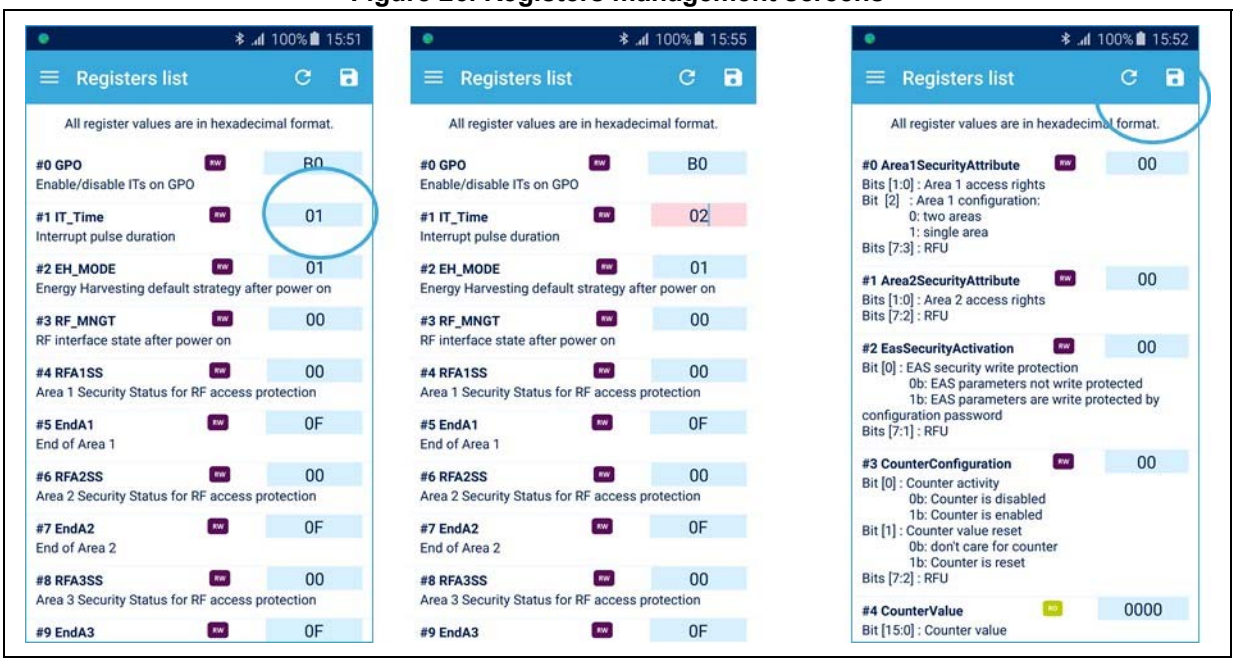
4.2 Registers management

This section illustrates the way to configure tag registers if any. The configuration of tag registers is tag-implementation specific including:

- Display of registers values
- Change of registers values
- Refresh of registers values
- Tag update and write of values to tag

Registers management examples are shown in *Figure 26*.

Figure 26. Registers management screens



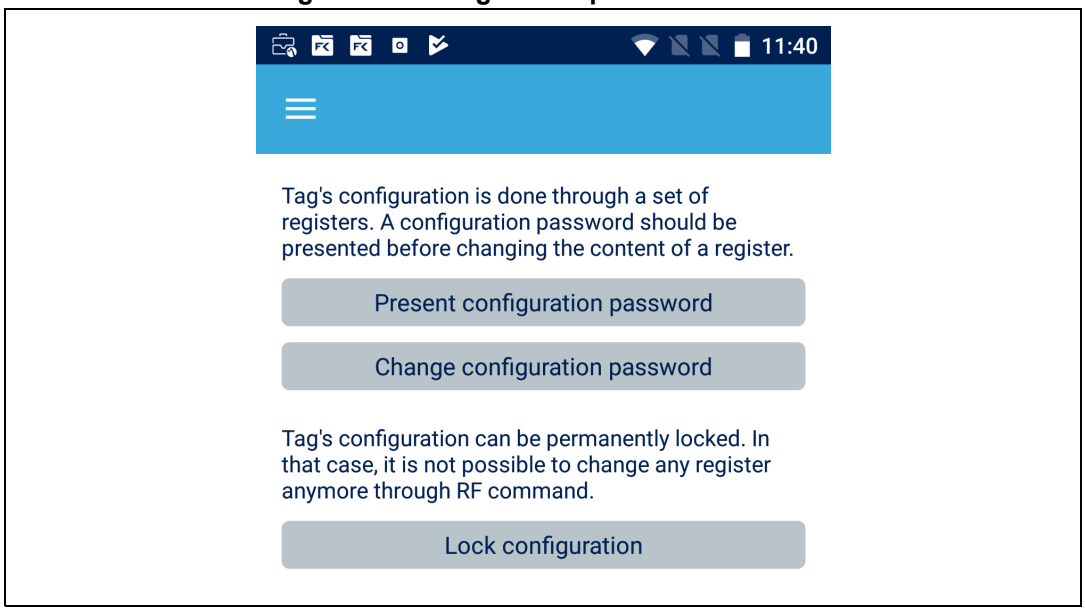
4.3 Configuration protection

The configuration protection screen is specific to some tags like ST25DV-I2C and ST25TV. The configuration password is needed each time the user wants to change a configuration register.

This screen can be used for:

- The presentation of the configuration password
- Changing the configuration password
- Permanently locking the configuration. In that case, it is not be possible anymore to change any register through RF.
  Note: it is still possible to unlock the products with an I^2C interface, like the ST25DV-I2C tags, through their I^2C interface.

Figure 27. Configuration protection screen

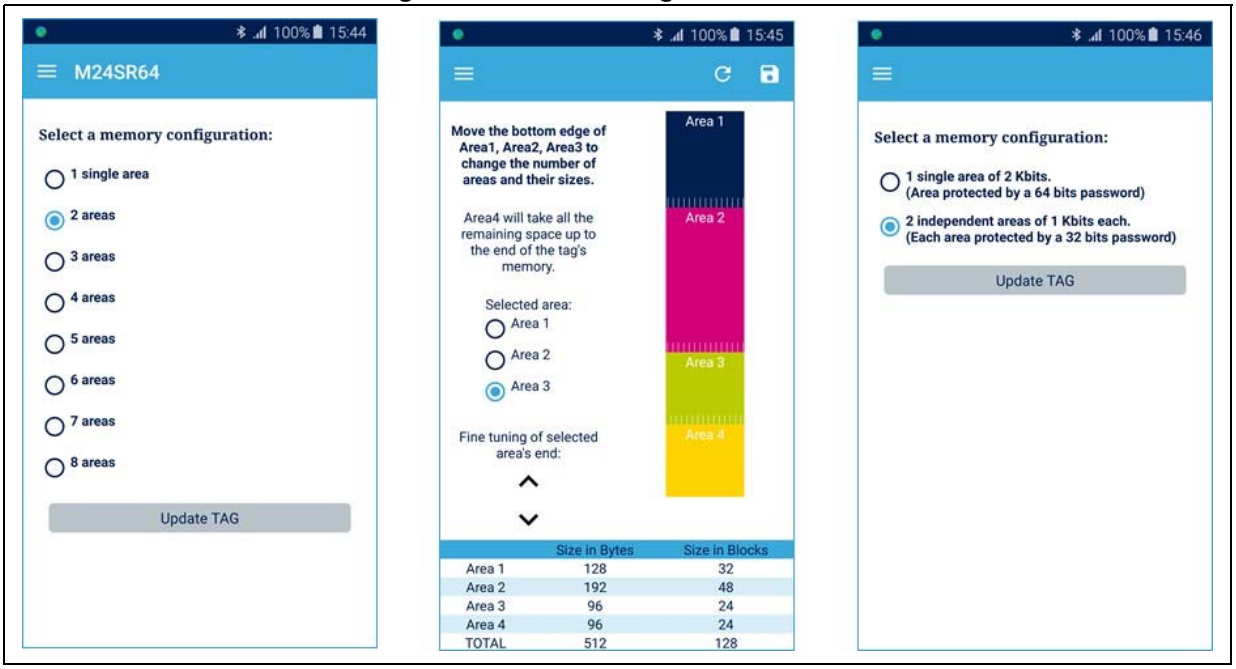


4.4 Areas management

This section illustrates the way to configure the tag memory with areas. This configuration is tag-dependent and tag-implementation specific.

Areas management example screens are shown in *Figure 28*.

Figure 28. Areas management screens



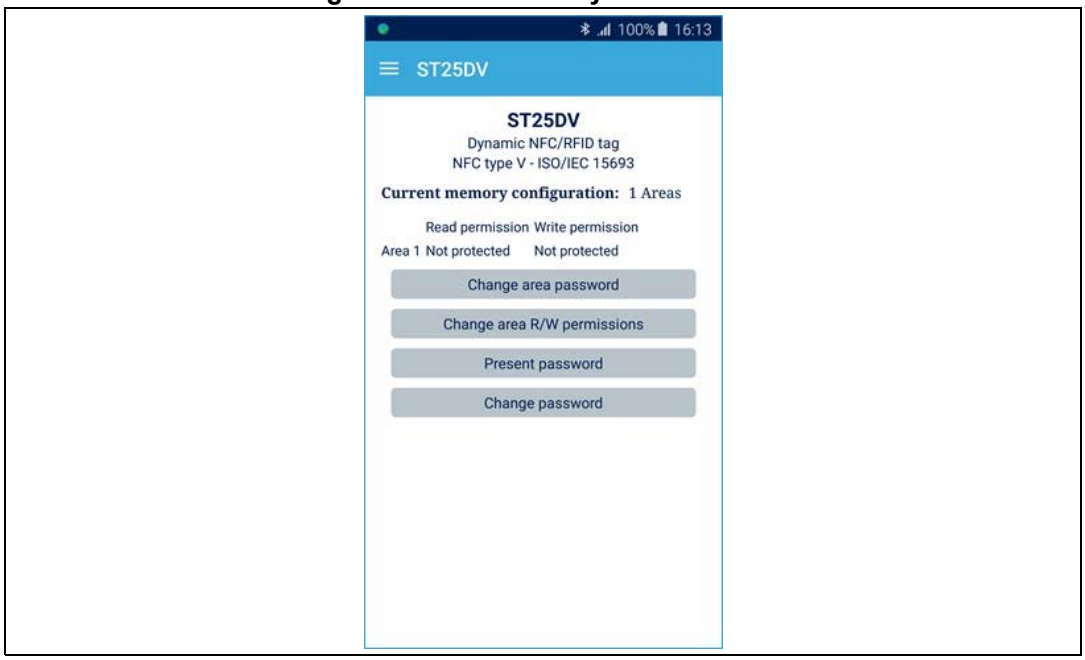
4.5 Areas security status

This section and its sub-sections illustrate the way to configure the tag areas security status, usually composed of a password and R/W permission. The configuration of tag areas security status is tag-dependent and tag-implementation specific including:

- Change of area password
- Change of area R/W permission
- Password presentation
- Password change

The area security status main screen is shown in *Figure 29*.

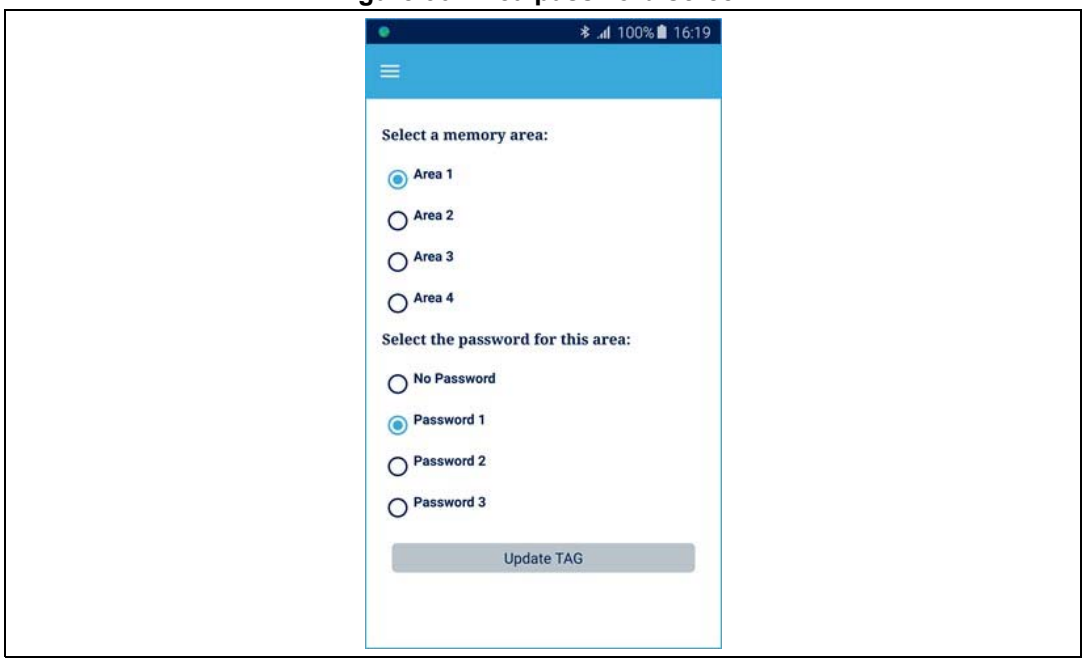
Figure 29. Area security status screen



4.5.1 Area password

Figure 30 shows a tag area password configuration example.

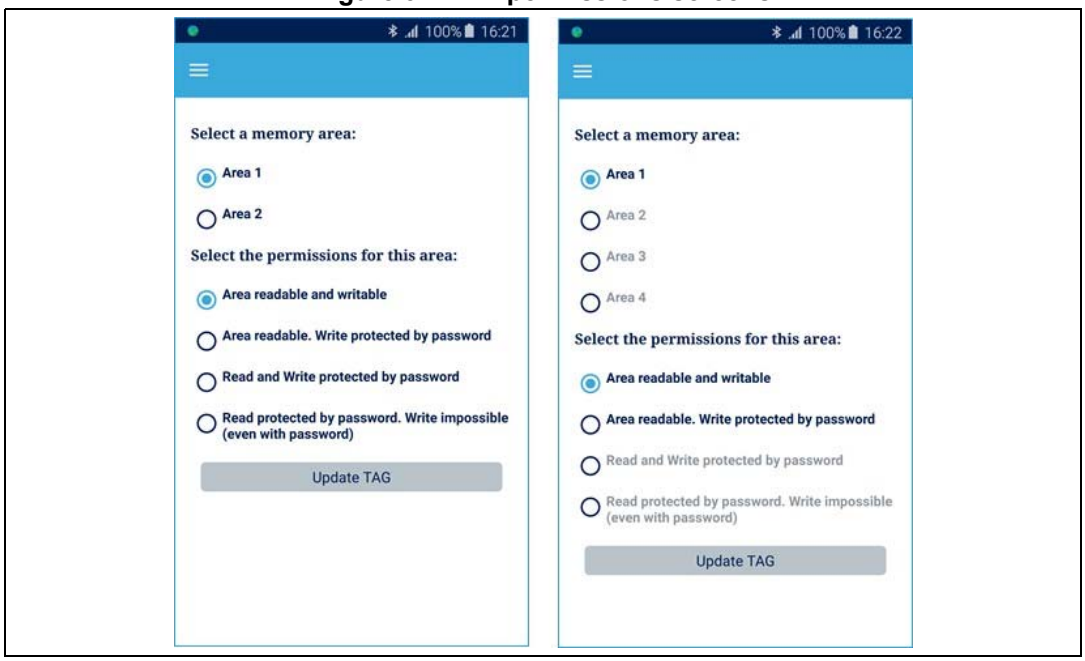
Figure 30. Area password screen



4.5.2 R/W permissions

Figure 31 shows a tag R/W attributes configuration example.

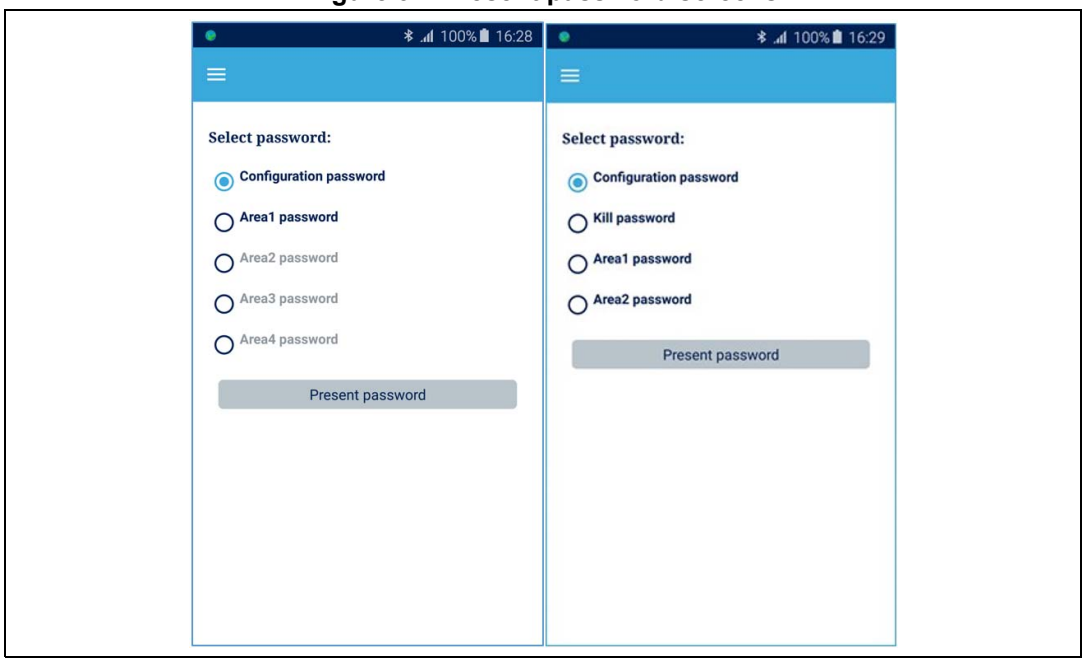
Figure 31. R/W permissions screens



4.5.3 Present password

Figure 32 shows a tag password presentation example.

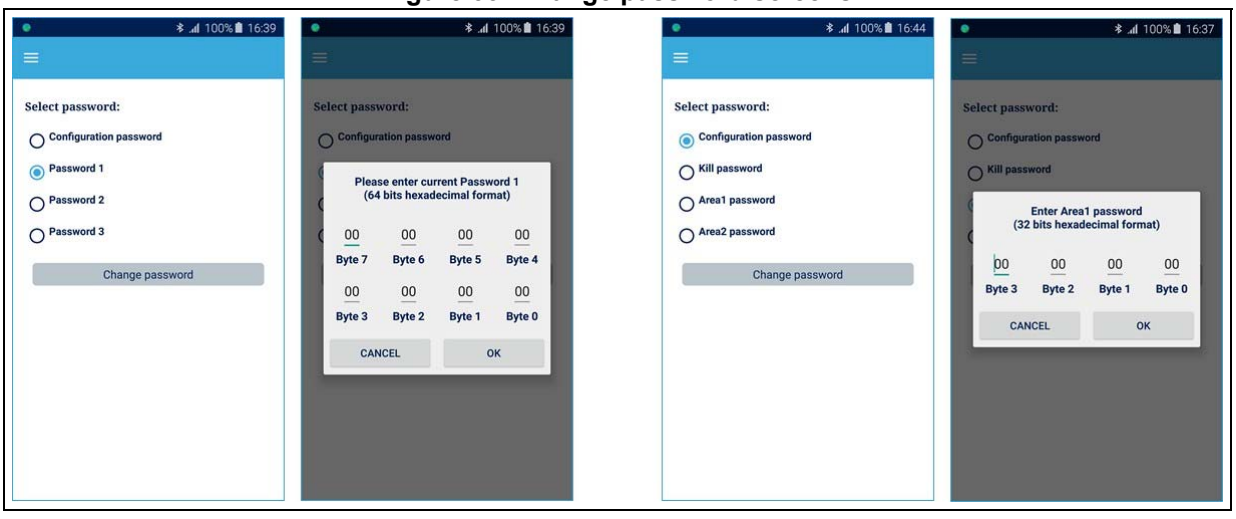
Figure 32. Present password screens



4.5.4 Change password

Figure 33 illustrates how to change tag passwords.

Figure 33. Change password screens



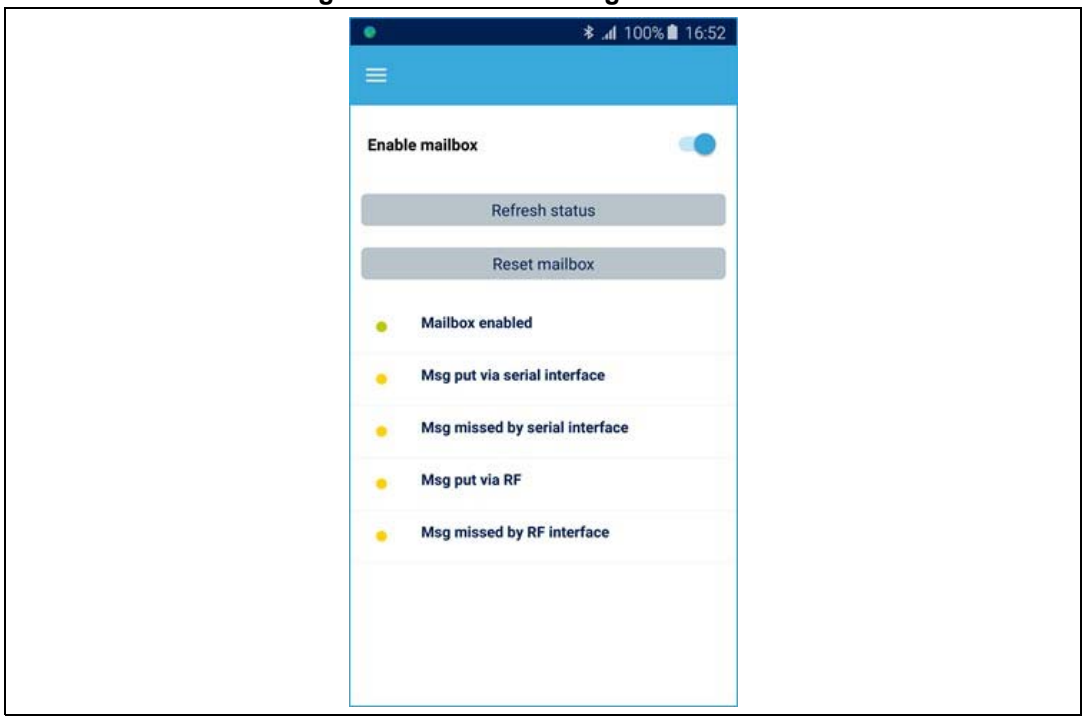
4.6 Mailbox management

This section illustrates the way to configure the tag mailbox. The configuration of the tag mailbox is specific to the tag and possible for ST25DV-I2C products only. The main configuration items are listed below.

- Mailbox field status
- Refresh status
- Mailbox reset
- Mailbox enable

The mailbox management screen is shown in *Figure 34*.

Figure 34. Mailbox management screen



4.7 Data transfer

The Fast Transfer Mode basic demonstration illustrates the data transfer features of ST25DV-I2C products. This demonstration is dedicated to the ST25DV-I2C tag and requires a specific firmware driving the TAG through I^2C on a Discovery board. The firmware reads and/or writes the data to transfer.

Note: Refer to ST25DV-DISCOVERY firmware for details. The Mailbox must be enabled first through firmware or RF (refer to the mailbox management features introduced in Section 4.6).

The data transfer features are:

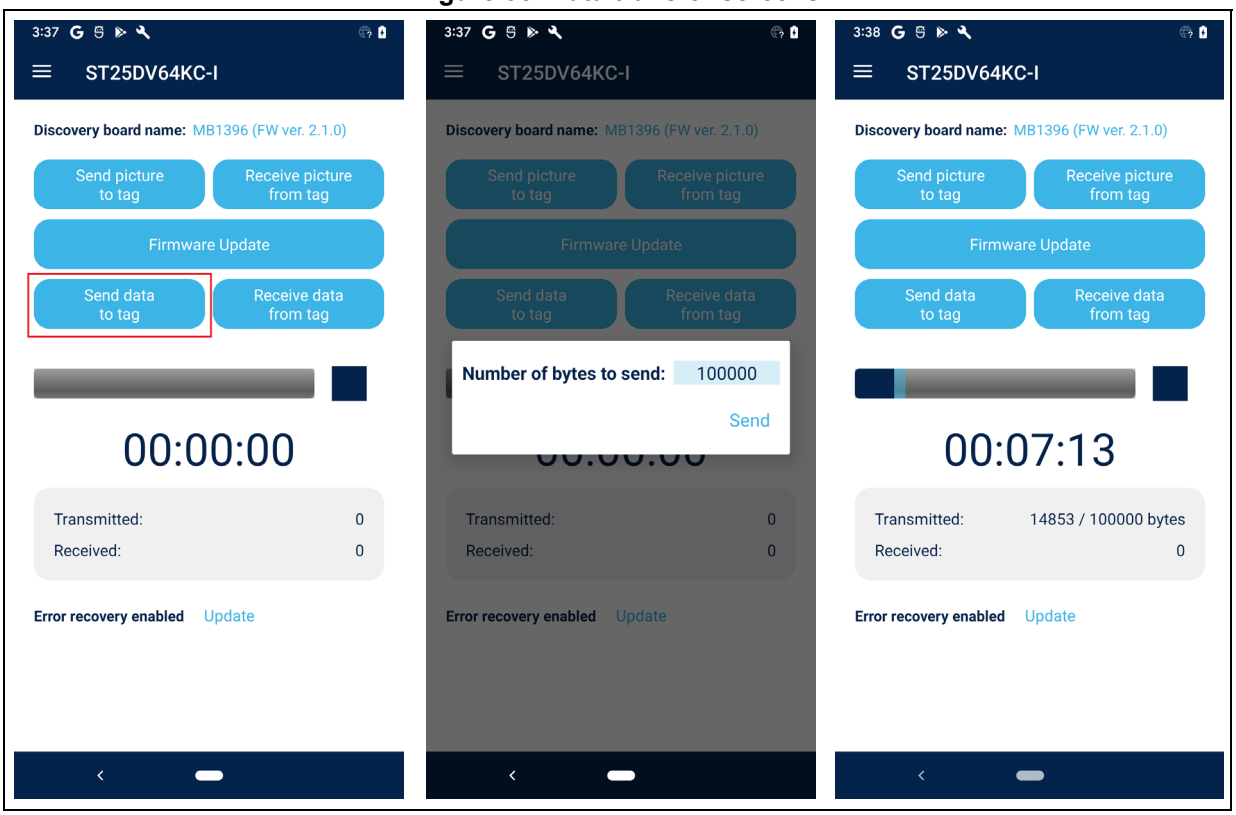
- Send data to tag
- Receive data from tag

Data transfer is observable by means of:

- A progression bar displayed during the transfer
- A stopwatch counter displayed and triggered by actions

Figure 35 shows examples of data transfer screens.

Figure 35. Data transfer screens



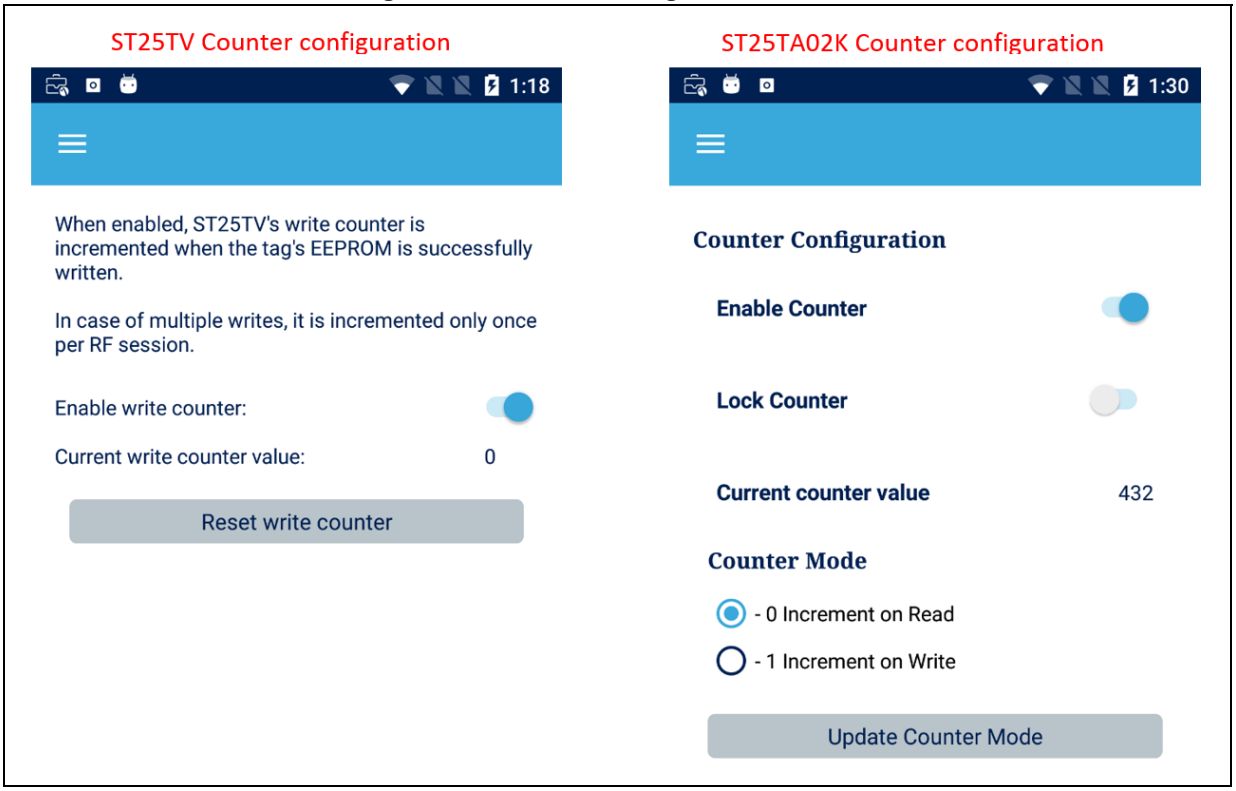
4.8 Counter

Some tags (like ST25TA02K and ST25TV) have their counter incremented when the user reads from, or writes to their memory, with slight differences (tag-dependent).

- Depending on the features of the tag, the counter configuration screen allows:
- Activating the counter
- Displaying the current value of the counter
- Locking the counter
- Resetting the counter
- Selecting if the counter is incremented by read or write operations

Figure 36 shows the counter configuration screens for an ST25TV tag as well as for an ST25TA02K tag.

Figure 36. Counter configuration screens



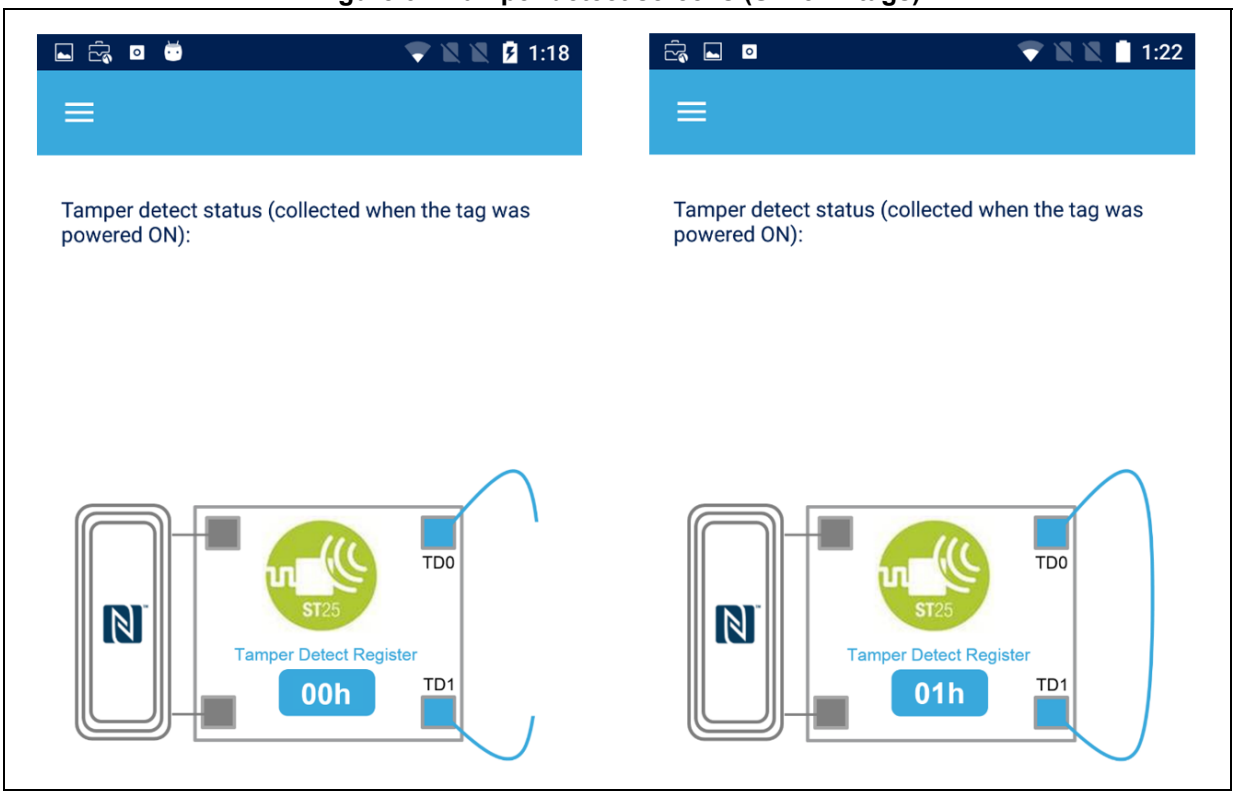
4.9 Tamper detect

The tamper detection feature is specific to ST25TV tags.

Each time the ST25TV tag is powered on, it checks if there is a closed loop between pins TD0 and TD1. This feature can be used to check if a good, for example a bottle, has been opened (tampered).

Figure 37 shows the tamper detect screens for an ST25TV tag with the corresponding register for each of the two detection cases.

Figure 37. Tamper detect screens (ST25TV tags)



4.10 Lock block

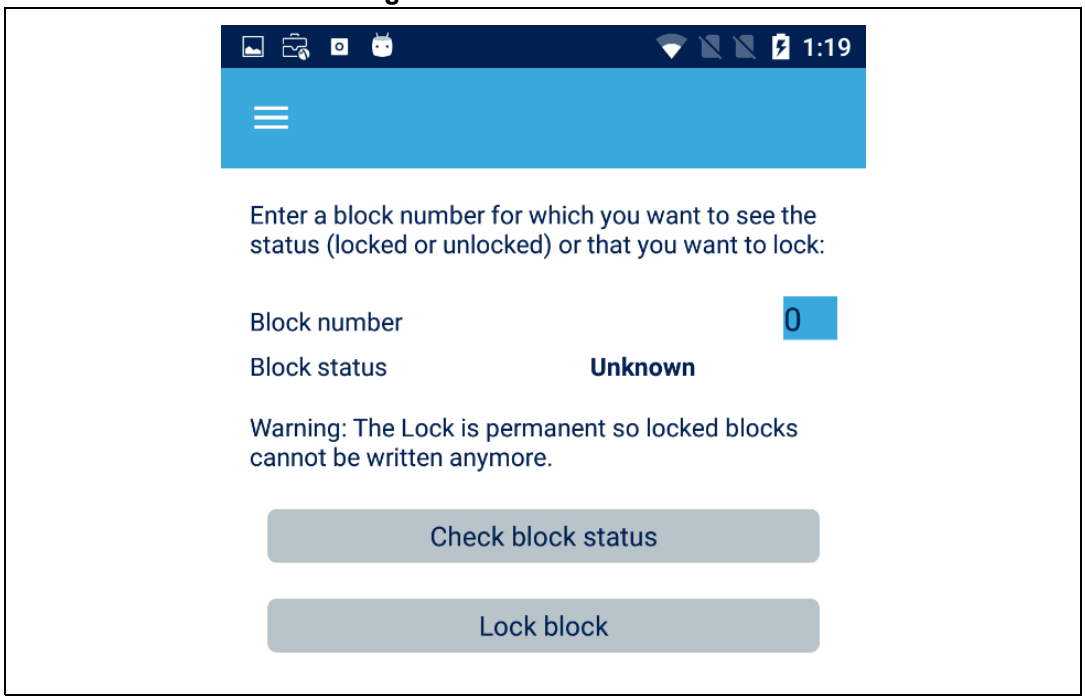
This feature is specific to NFC Type 5 tags.

In NFC Type 5 tags, the memory is divided into blocks of a given number of bytes. For STMicroelectronics Type 5 products, each block is made of 4 bytes.

Thanks to the *Lock block* screen it is possible to read the status of each block (locked or unlocked) and the permanent lock of any block in the memory. This action is irreversible. It can be used when the user wants to be sure that the content of the block(s) will never be changed.

Figure 38 shows a *Lock block* screen example.

Figure 38. Lock block screen



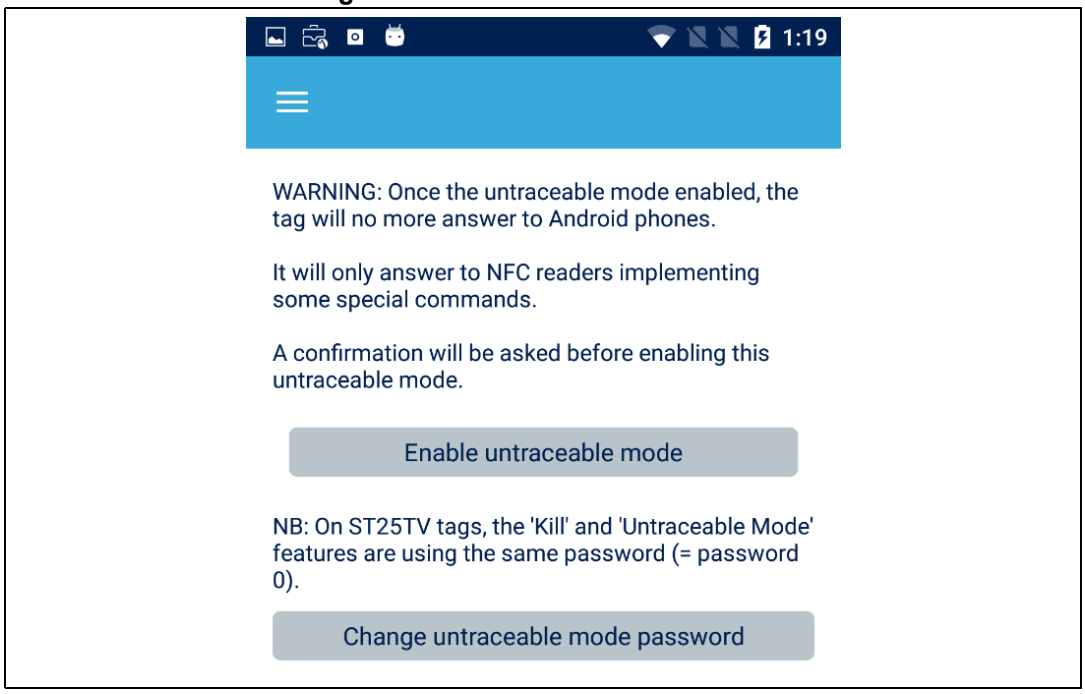
The *Lock block* and *Area Read/Write permissions* described in *Section 4.5.2* are two possible means to prevent the modification of parts of the memory:

- *Lock block* is permanent and must be done for each block one by one
- *Area configuration* is global and applicable to a whole area. The area can be protected by password for read, write, or both. It also offers a mode for which the content of the area cannot be written anymore. This is the mode for which the reading of the memory is protected by password and the writing is impossible, even if the password is presented.

4.11 Untraceable mode

This feature is specific to ST25TV products, it is enabled through the *Untraceable mode* screen. Once enabled, the tag is no longer seen by NFC Type 5 inventory. However, it is possible to communicate with it if its UID is known. For doing so, the *Untraceable mode* password must be presented (the UID must be specified in the command). The tag answers to every command.

Figure 39. Untraceable mode screen



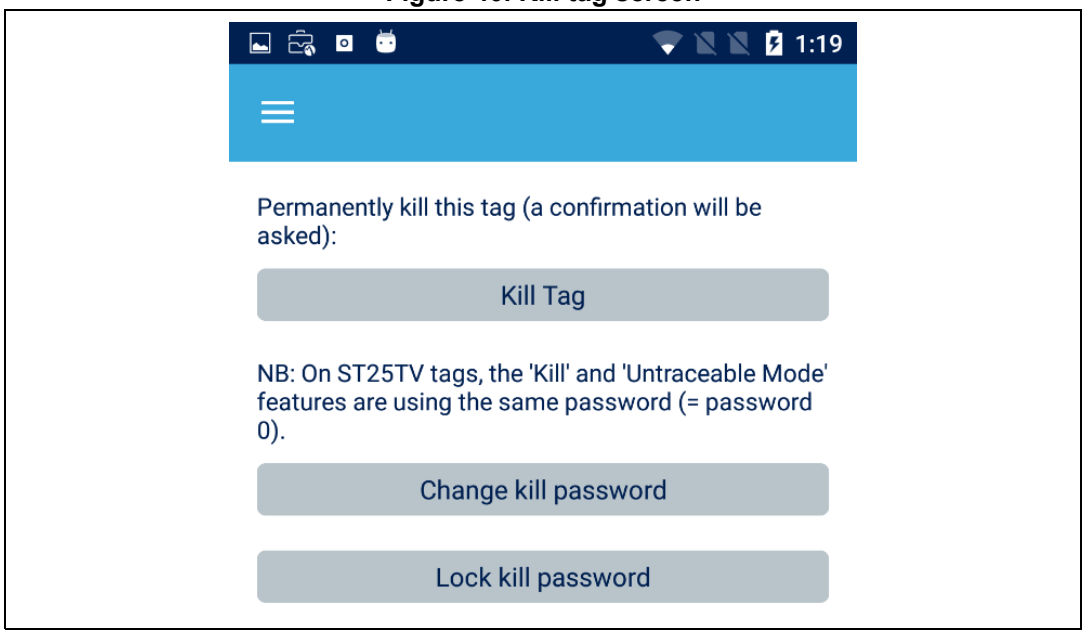
Caution: If the *Untraceable mode* is enabled, the tag cannot be discovered by smartphones.

4.12 Kill tag

This feature is specific to ST25TV products. It can be used to permanently kill the tag.

The *Lock kill password* button allows preventing modifications of the kill password. Once activated, it is not possible anymore to change the kill password.

Figure 40. Kill tag screen

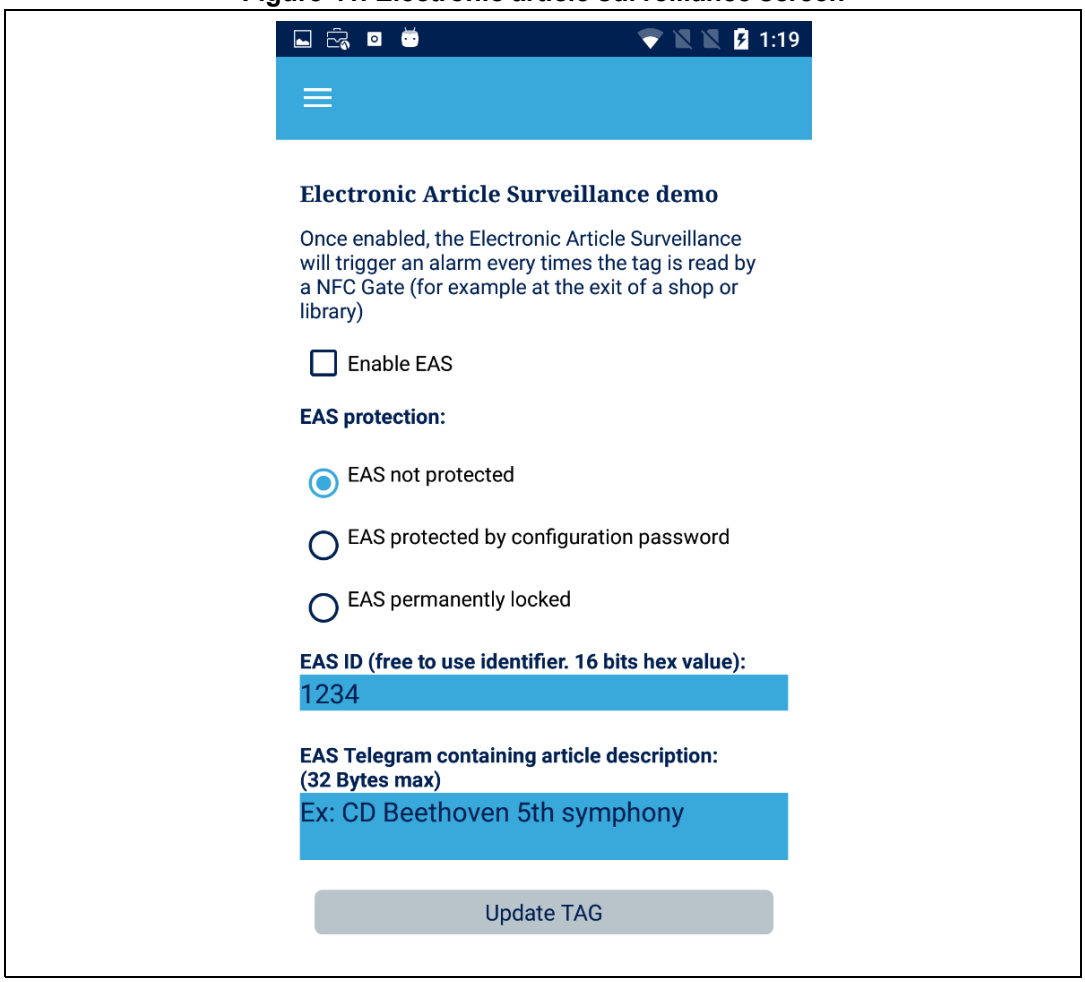


4.13 Electronic article surveillance

This feature is specific to ST25TV products.

Electronic article surveillance (EAS) can be used to control goods (e.g. books, CDs, DVDs, and others in a library). NFC gate readers at the library exit raise an alarm each time an article, with EAS enabled, goes through the gate.

Figure 41. Electronic article surveillance screen

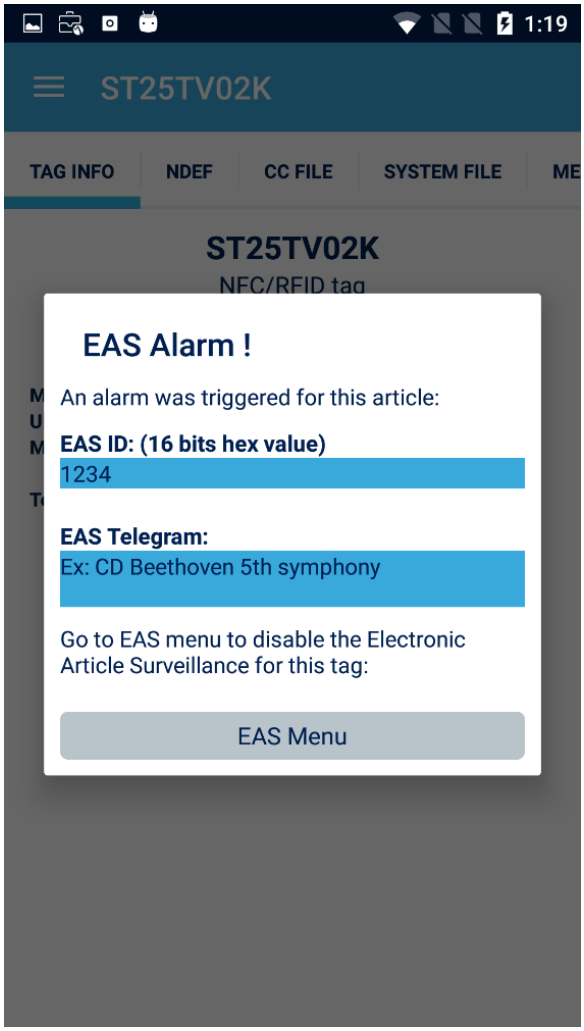


With this screen, the user can:

- Enable *Electronic article surveillance*
- Set the *Electronic article surveillance* protection:
  - This protection is needed to prevent a user of the library to disable the alarm. Only library employees are able to disable the EAS protection when an article is rented thanks to the configuration password.
  - The EAS can be permanently locked. In such a case, it is not possible to disable it and the only way to turn the alarm off is to kill the tag. This can be used when the EAS is used to protect a product in a shop. Once the product is purchased, the tag can be killed.
- The *EAS ID* is a 16-bit identifier, which can be set freely to identify the article.
- The *EAS Telegram* is a text limited to 32 characters describing the article.

The ST25 Android™ NFC tap application demonstrates how the EAS alarm can be handled. Each time a ST25TV tag is found by the inventory, the application checks if the EAS is enabled. If it is enabled, it raises an alarm, as illustrated in *Figure 42*.

Figure 42. Electronic article surveillance alarm screen



4.14 Pulse-width modulation configuration

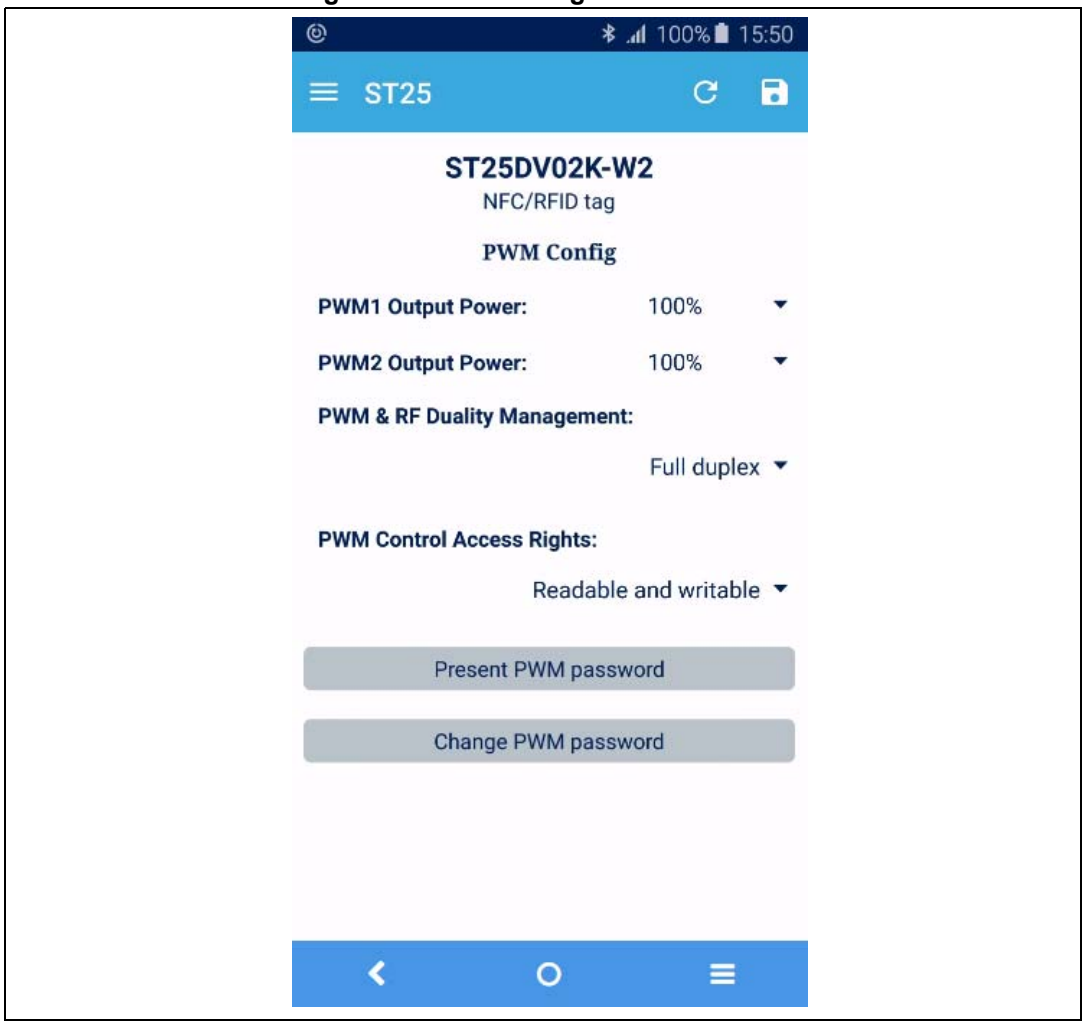
This feature is specific to ST25DV-PWM products.

Due to RF high-sensitivity levels, and because of the switching noise generated by a PWM output (by construction), the adjustment of different PWM parameters is proposed to improve the coexistence between the PWM interface and the RF interface:

- PWM output driver trimming
- PWM output coexistence with RF interface

Also available in the configuration, the PWM control access rights, to define R/W permissions and password for PWM control area.

Figure 43. PWM configuration features



4.15 Pulse-width modulation control

This feature is specific to ST25DV-PWM products.

PWM control enables to set PWM registers using the following main setting attributes:

- Disable/Enable PWM
- Period value
- Pulse-width value

Four profiles are available, with different level of detail and features:

- **Normal**: sets the duty cycle of each PWM with simple bar sliders (frequency already set through the Expert mode).
- **Expert**: provides detail setting for PWM attributes and corresponding registers values.
- **Auto**: demonstrator use case for autonomous changing of the duty cycle on the two channels, like one going up and the other down. Same as the normal profile with automatic setting.
- **Musics**: demonstrator use case that enables the playback of music note using frequency/period setting. A simple finite music list is available for selection (a buzzer must be connected to the PWM1 output for playback).

The PWM controls are shown in figures *44* to *46*.

Figure 44. PWM control (normal mode)

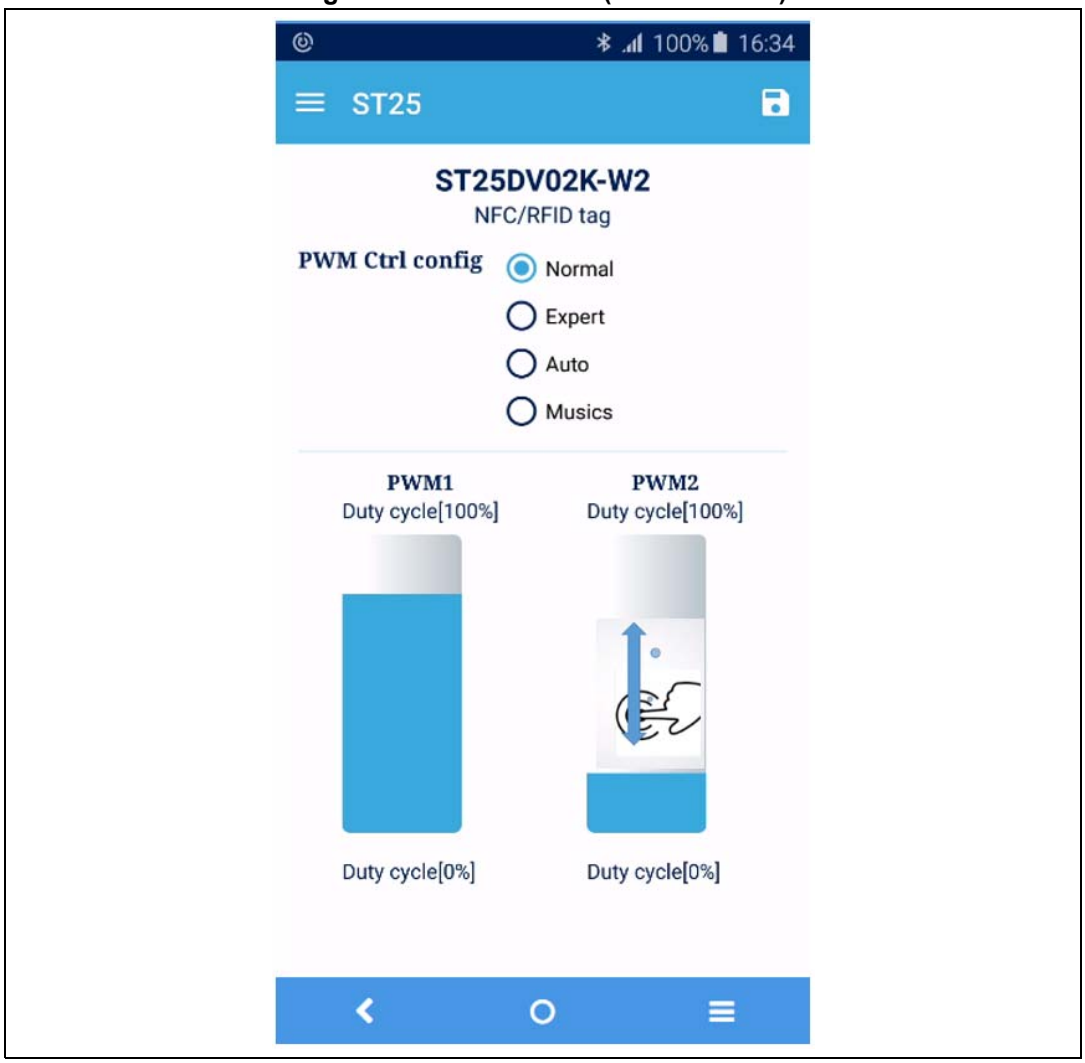


Figure 45. PWM control (expert mode)

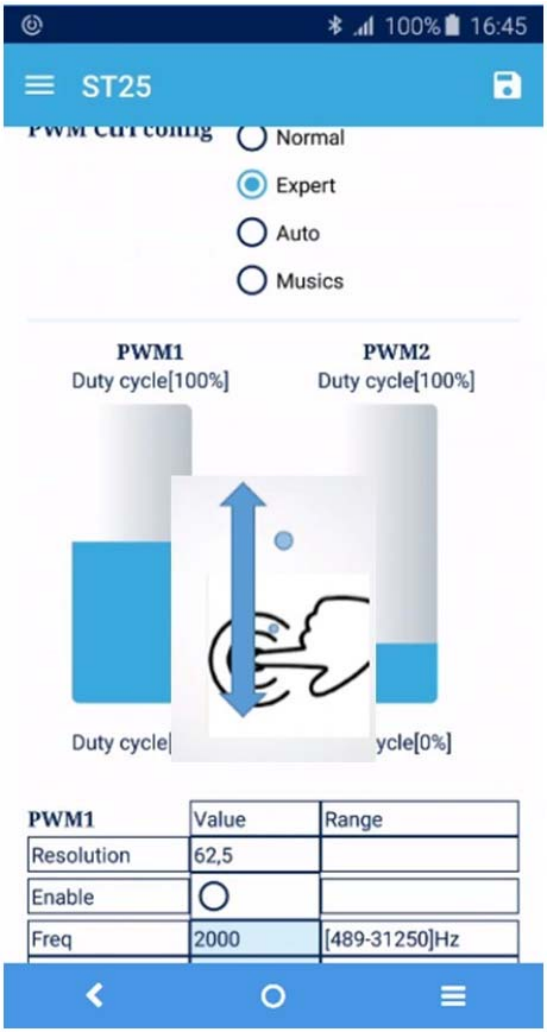
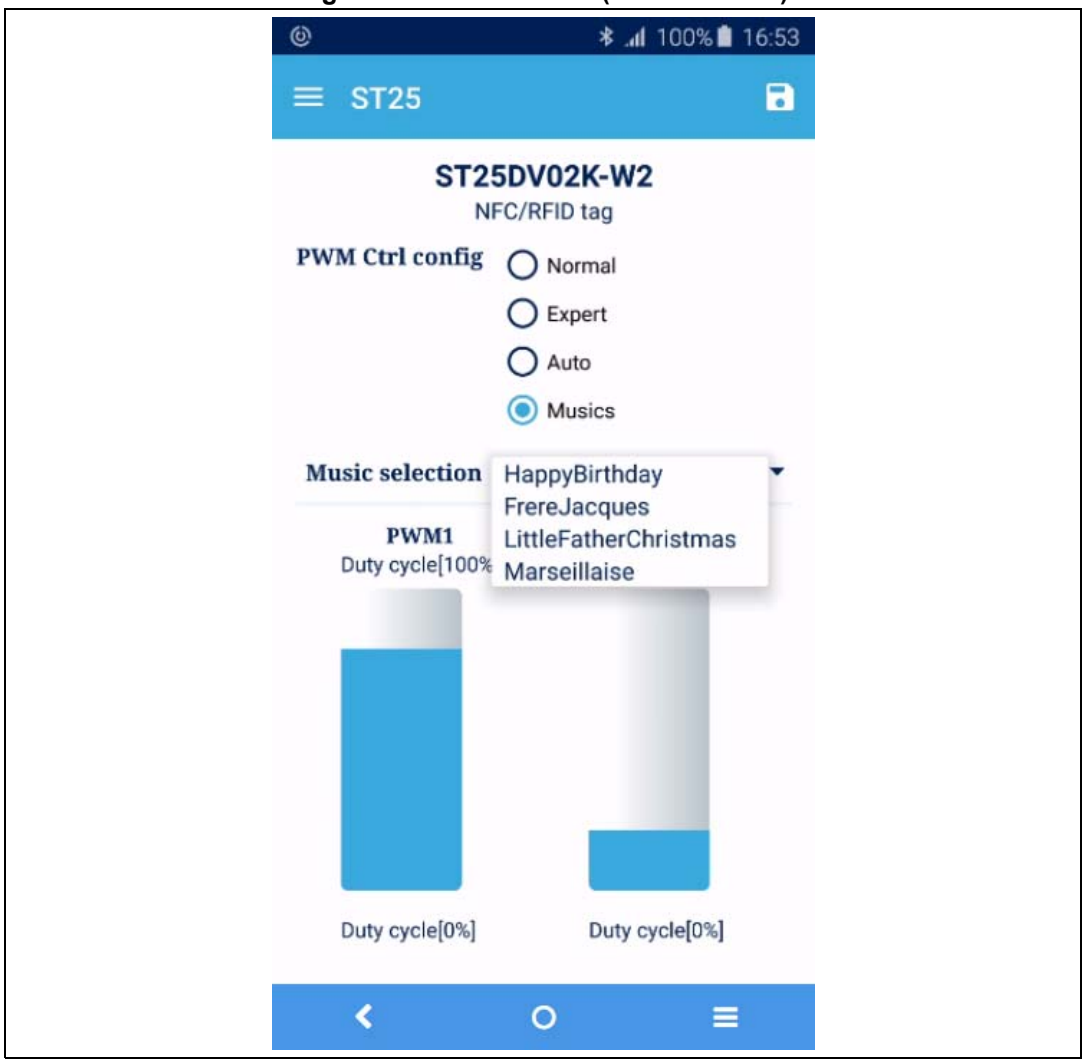


Figure 46. PWM control (musics mode)



5 Demonstrations use cases

The demonstrations are product specific. The available demonstrations related to a given product can be reached through the tag drawer demonstration menu.

Note: Some demonstrations require boards with specific firmwares associated.

5.1 Stopwatch

Stopwatch demonstration (ST25DV-I2C product only) - Discovery board

This demonstration is dedicated to the ST25DV-I2C tag and requires a specific firmware driving the TAG through I^2C on a Discovery board. The firmware reads and/or writes the data to transfer.

Note: Refer to ST25DV-DISCOVERY firmware for details.

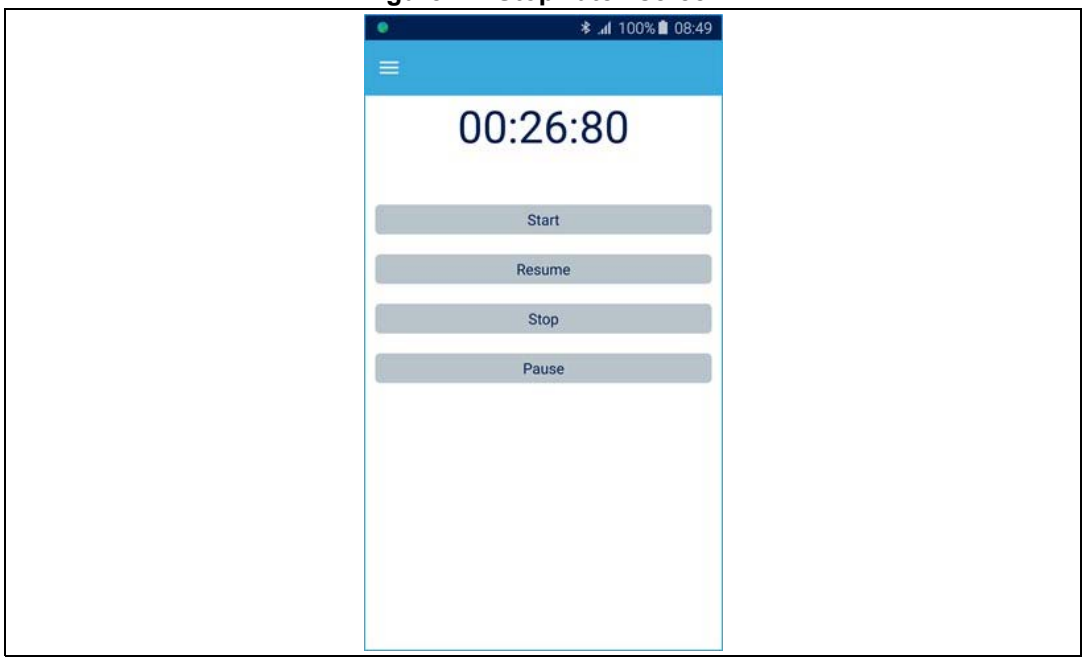
The stopwatch feature is:

- Stopwatch information transfer between phone and board

Stopwatch observability is provided thanks to a counter, displayed and triggered by actions

The stopwatch screen is shown in *Figure 47*.

Figure 47. Stopwatch screen



5.2 Firmware update

Firmware update demonstration (ST25DV-I2C product only) - Discovery board

This demonstration is dedicated to the ST25DV-I2C tag and requires a specific firmware driving the TAG through I^2C on a Discovery board. The firmware reads and/or writes the data to transfer.

Note: Refer to ST25DV-DISCOVERY firmware for details.

The firmware update feature is:

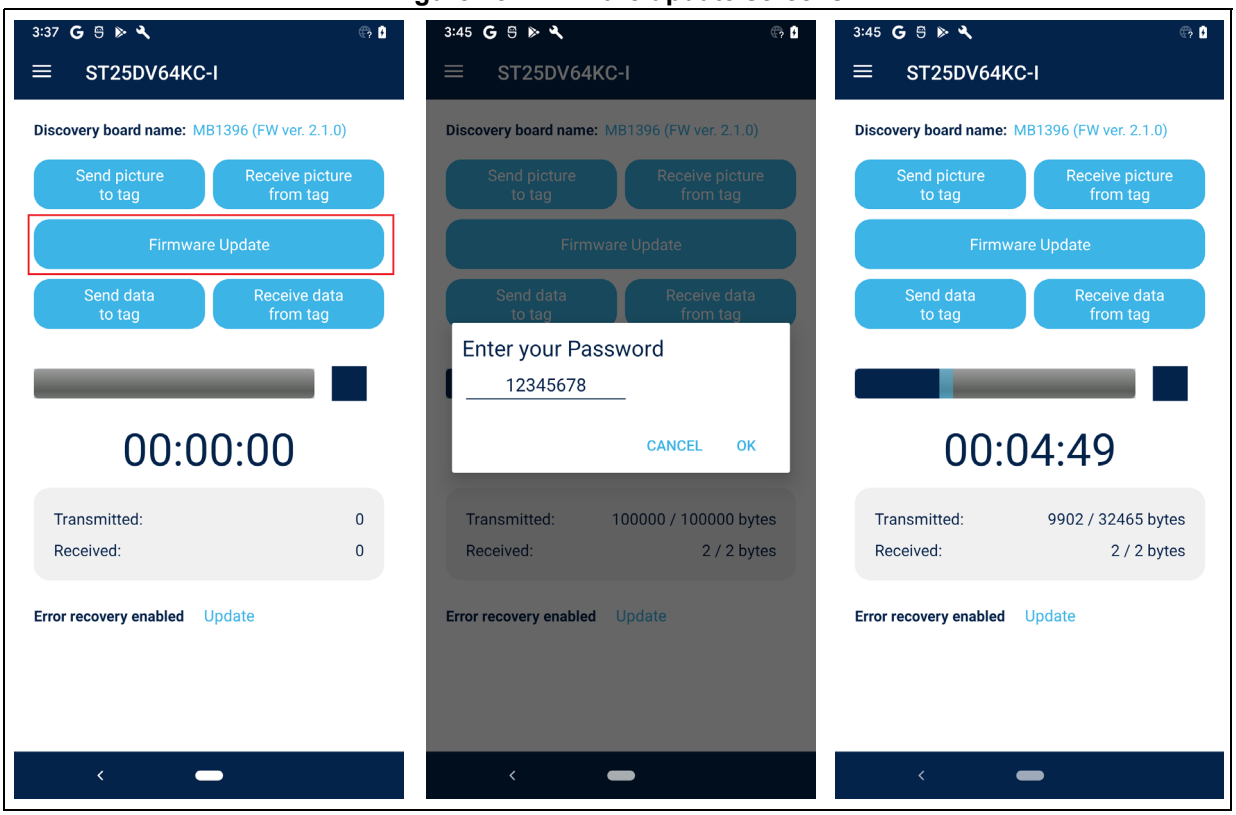
- Pick a firmware to upload: enables to send file content to host through tag Password exchange is part of the transfer protocol. Refer to ST25DV-DISCOVERY firmware documentation for default settings

Firmware update can be monitored thanks to:

- a progression bar displayed during the transfer
- a stopwatch counter displayed and triggered by actions

Figure 48 shows examples of firmware update screens.

Figure 48. Firmware update screens



5.3 Picture transfers

Picture transfer demonstration (ST25DV-I2C product only) - Discovery board

This demonstration is dedicated to the ST25DV-I2C tag and requires a specific firmware driving the TAG through I^2C on a Discovery board. The firmware reads and/or writes the data to transfer.

Note: Refer to ST25DV-DISCOVERY firmware for details.

The picture transfer features are:

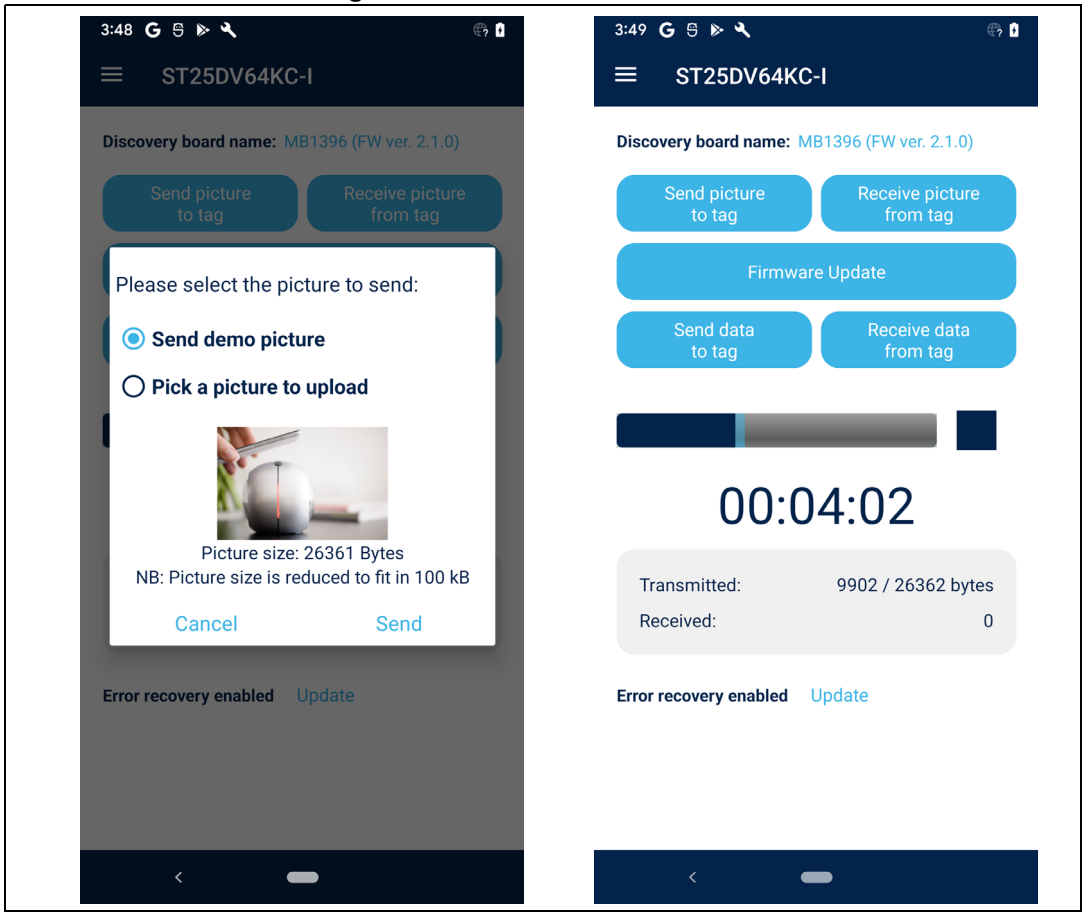
- Send picture to tag
- Receive picture from tag

Picture transfer observability is provided by means of the following status:

- A progression bar is displayed during the transfer
- A stopwatch counter is displayed and triggered by actions

Figure 49 shows examples of picture transfer screens.

Figure 49. Picture transfer screens



Note: For download features, start the demonstration on board first, and then click on the start button of the application.

6 Revision history

Table 1. Document revision history

Date	Revision	Changes
27-Feb-2017	1	Initial release.
30-May-2017	2	Full document update in relation with the application update: sections updated and reordered in all chapters. All figures updated.
08-Jun-2017	3	Updated application URL in *Section 2.1: Prerequisites*.
10-Apr-2018	4	Document scope extended to the ST25TV series NFC tags and new feature descriptions added or updated: – Updated *Section 2.2: Functionalities overview* – Updated *Section 3.3.2: NDEF editor operations* – Added *Section 4.3: Configuration protection* – Added *Section 4.8: Counter* – Added *Section 4.9: Tamper detect* – Added *Section 4.10: Lock block* – Added *Section 4.11: Untraceable mode* – Added *Section 4.12: Kill tag* – Added *Section 4.13: Electronic article surveillance* Application renamed “ST25 Android™ NFC tap application”.
26-Jun-2018	5	Document scope extended to PWM features: – Updated *Introduction* – Updated *Section 2.2: Functionalities overview* – Added *Section 4.14: Pulse-width modulation configuration* – Added *Section 4.15: Pulse-width modulation control*
05-Aug-2021	6	Updated *Introduction*, *Section 2.2: Functionalities overview*, *Section 4.7: Data transfer*, *Section 5.1: Stopwatch*, *Section 5.2: Firmware update* and *Section 5.3: Picture transfers*. Updated *Figure 35: Data transfer screens*, *Figure 48: Firmware update screens* and *Figure 49: Picture transfer screens*. Minor text edits across the whole document.