AN13647

ICODE 3 and ICODE 3 TagTamper features and hints

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Document information

Information	Content
Keywords	ICODE 3, ICODE 3 TagTamper, implementation hints
Abstract	This document introduces features and hints for application development on the ICODE 3 and ICODE 3 TagTamper.

1 Introduction

The application note describes a few features of the ICODE 3 and ICODE 3 TagTamper (ICODE 3 TT) products. The document is a complement to ICODE 3 (TagTamper) data sheet [1].

1.1 Purpose and scope

The application note is addressed to developers of applications based on ICODE 3 and ICODE 3 TagTamper (ICODE 3 TT) products.

The document is focused on the security mechanisms used to protect the data stored in ICODE 3 and ICODE 3 TagTamper.

Note: *For more details on ICODE 3 and ICODE 3 TT, refer to [1] and [3].*

1.2 Disclaimer

ICODE 3 and ICODE3 TT are not security certified products. Terms like locking, read-only, fraud protection, or security do not guarantee protection against any attack to circumvent a feature. Depending on the value of the assets that need protection, consider using Common Criteria certified products. For example, consider the security features that demonstrate some resistance to specific attacks during certification.

2 ASCII mirroring

With ASCII mirroring, information in ASCII code is reflected over the physical memory of the IC. The ICODE 3 and ICODE 3 TagTamper (ICODE 3 TT) use ASCII mirroring on the following:

- 8 bytes UID
- 8 bytes UID + 3 bytes counter
- 8 bytes UID + 3 bytes counter + 4 bytes TagTamper message (ICODE 3 TT only)
- 8 bytes UID + 3 bytes counter + 4 bytes TagTamper message + 1 byte current TagTamper status (ICODE 3 TT only)

If the mirrored information is a combination (for example UID + counter), the "x" character (78h ASCII code, 1-byte length) is added as separator between the items.

Note: In ASCII format, the byte length of the combinations doubles, excluding separators.

The ICODE 3/ICODE 3 TT responds to a READ or FAST READ command to the involved user memory pages with the virtual content in ASCII code including:

- The UID,
- The NFC counter value,
- The TagTamper message (ICODE 3 TT only).

Figure 1 shows the example of ICODE 3 configured to mirror its UID + Counter to the end of the URL https://www.nxp.com/?

- NFC_MIRROR_SEL bits are set to 010b.
- NFC_MIRROR_BLK defines the first block within the user memory where the NFC mirror starts. In the example, NFC mirror starts at block number 5.
- NFC_MIRROR_BYTE defines the byte within the defined block in NFC_MIRROR_BLK where the mirror starts. In this example, the byte is 0.

Note: The ASCII code is part of NDEF message record. The size or length of the NDEF message and NDEF record must be defined so the URL including the mirrors is accounted for. For example:

Protocol field (1 byte) + nxp.com/? (9 bytes) + UID (16 bytes) + separation (1 byte) + counter (6 bytes) = 33 bytes (0x21)

Block [Hex]	Byte 0	Byte 1	Byte 2	Byte 3	ASCII
00	E1	40	20	00	á@
01	03	25	D1	01	$Ñ
02	21	55	02	6E	U□n
03	78	70	2E	63	xp.c
04	6F	6D	2F	3F	om/?
05	45	30	30	34	E004
06	30	31	32	30	0120
07	30	30	33	35	0035
08	42	39	46	32	B9F2
09	78	30	30	30	x000
0A	30	31	35	FE	0015þ
.	.	.	.	.	.

Legend:
- Capability container
- NDEF message header
- NDEF record
- UID mirror
- Separator
- Counter mirror

Figure 1. UID + Counter ASCII mirror

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3 TagTamper feature

The ICODE 3 TagTamper (ICODE 3 TT) can detect and store the opening event of a connected TagTamper loop. The TagTamper detection can be enabled or disabled by setting the "OTP_TT_EN" bit accordingly. The ICODE 3 TT supports two TagTamper statuses:

- Actual status: the state of the TagTamper loop at the given moment.
- Stored status: the state permanently stored at the first detection of the opened TagTamper loop.

The TT_SHOW_STATUS byte is used to configure how the ICODE 3 TT responds to a READ TT command, and the behavior of the NFC mirror feature.

If the ICODE 3 TT is configured to store the first detection of an opened TagTamper loop (stored status of TagTamper), you can program a 4-byte customizable open message TT_OPEN_MSG. The TT_OPEN_MSG can be mirrored if ASCII mirroring is enabled.

Note: *To avoid fraud, use an encrypted message which is not predictable. For example, use an AES_CMAC calculated string including the unique identifier (UID) of the tag, and a constant. Next, use defined bytes from AES_CMAC calculated string. For more details and examples, refer to [2].*

4 Counter

ICODE 3 and ICODE 3 TT support the 24-bit counter feature.

Two counter modes are available: NFC counter and command-based counter. The COUNTER MODE bit is used to set the mode in the configuration memory. For more details, refer to [1].

If the counter mode is set to command-based, the WRITE SINGLE BLOCK command to block 75 is used to increment the counter. The counter can be incremented by values of one to 0xFF. Here is how:

- If password protection is enabled, send the SET PASSWORD command with the read password before issuing the WRITE SINGLE BLOCK command.
- Set the PROT byte in block 75 to 0x80.
- To increment the counter by one, use WRITE SINGLE BLOCK command to block 75 with a value of 0x01.
- To increment the counter by a value in the range of one to 0xFF, use the WRITE SINGLE BLOCK command with a value in the range of 0x01 to 0xFF.

If the counter mode is set to NFC counter (COUNTER MODE bit set to one), the ICODE 3 and ICODE 3 TT automatically increase the counter when tapped, for more information refer to [1]

The ICODE 3 and ICODE 3 TT also support mirroring of the current counter value. Refer to Section 2 and [1].

5 References

[1] Data sheet - SL2S3003/SL2S3003TT ICODE 3 (TagTamper)

[2] Application note - AN6121 - NTAG Secure Services Architecture and API

[3] Application note - AN13428 - ICODE Coil Design Guide

6 Revision history

Table 1. Revision history

Document ID	Release date	Description
AN13647 v.1	29 March 2024	• Initial version

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