AN13454

MIFARE Ultralight AES quick start guide

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Application note
COMPANY PUBLIC

Document information

Information	Content
Keywords	MIFARE, MIFARE Ultralight AES, quick start guide, AES Authentication, counter, CMAC
Abstract	This document gives a quick introduction to MIFARE Ultralight AES and lists all supporting documents, software tools and further material that is available and offered from NXP for an easy product design-in. It summarizes all information required for somebody who wants to start solution development including MIFARE Ultralight AES.

Revision history

Revision history

Rev	Date	Description
1.1	20220218	Security status changed to "Company public"
1.0	20211202	Initial version of this document

1 Introduction

1.1 Purpose of this document

This document introduces the MIFARE Ultralight AES technical support items and documentation, and explains which deliverables can be retrieved from NXP to have a quick and smooth start with developing new MIFARE Ultralight AES applications, solutions and infrastructures.

In this document, all the information that is necessary for somebody who is interested in MIFARE Ultralight AES is gathered. This bundle of information and support items which is provided is called “Product Support Package” for the MIFARE Ultralight AES.

The Product Support Package is a full set of documentation and software deliverables, enabling system integrators, software engineers, card manufacturers, etc. to implement their new solution based on MIFARE Ultralight AES very easy and convenient.

1.2 Document audience

This document is targeting technical as well as marketing and business-oriented people who want to gather first knowledge concerning MIFARE Ultralight AES. Everybody who is interested on a more detailed and more technical level will be redirected to the full set of material complementing the IC.

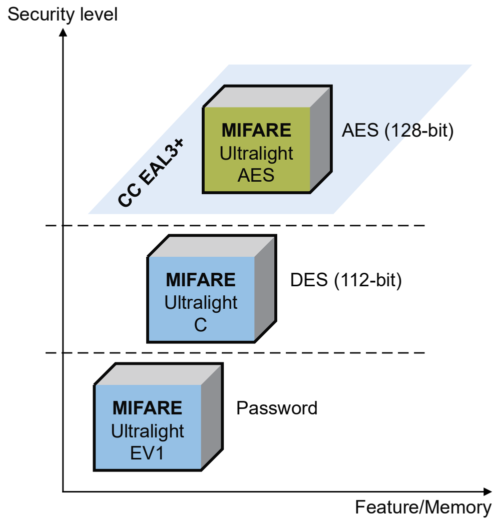
It also addresses developers, project leaders and system integrators who have a general technical understanding and overview of a specific smartcard technology or infrastructure. More in-depth details can be found in the complimentary application notes which are mentioned within this introductory document.

2 MIFARE Ultralight AES overview

2.1 Characteristics of MIFARE Ultralight AES

MIFARE Ultralight AES is the latest addition to the MIFARE Ultralight family, released in 2022.

The MIFARE Ultralight family has evolved since the first MIFARE Ultralight, and culminates with the MIFARE Ultralight AES being the first Common Criteria certified product in its family, providing AES-128 3-pass mutual authentication and memory access protection, and CMAC-based secure messaging for data integrity protection.



aaa-044600

Figure 1. MIFARE Ultralight Evolution

Table 1. MIFARE Ultralight AES feature comparison

Product features	MIFARE Ultralight			
	EV1		C	AES
RF Interface	ISO/IEC 14443-2, Type A 13.56 MHz			
Protocol	ISO/IEC 14443-3			
UID - unique identifier	7-byte UID			
Privacy				Random ID
Communication speed	106 kbps			
Memory size [Bytes]	48	128	144	144
Memory model				
Crypto			3KDES	AES
Key length			112-bit	128-bit
Authentication	Password		3-pass mutual	
Communication security				CMAC
Command Counter to limit negative authentication attempts	-			yes

Table 1. MIFARE Ultralight AES feature comparison*...continued*

3x independent one-way counter	yes	-	yes (AES optional)
Virtual card concept			VC Select Last
Originality check features	ECC signature	-	ECC signature programmable
CC Certification			CC EAL 3+
NFC compliance	NFC Forum Type 2 Tag compliant		
Input capacitance [pF]	17 / 50		

2.2 MIFARE Ultralight AES key pillars

MIFARE Ultralight AES is the first limited-use MIFARE product on the market using Advanced Encryption Standard (AES) with external Common Criteria EAL3+ (AVA_VAN.2) security certification. It is targeted as a cost-effective solution for single use public transport tickets, hospitality applications (such as hotel room access, parking garage access, spas, gyms etc.) and event ticketing.

Table 2. MIFARE Ultralight AES key features

Security	• Support of 3-pass mutual AES authentication based on a key length of 128-bit – Data protection in user memory – One-way counter with optional AES authentication protection • Secure messaging communication mode (CMAC) for data integrity protection over RF-Interface – Countermeasure against both replay attacks and man-in-middle attacks • Common Criteria (CC) EAL3+ (AVA_VAN.2) certification
Privacy and ownership	• Random ID (optional) addressing privacy concerns to prevent personal data tracking – Regulations do not allow to trace end user of a ticket outside authorized use case infrastructure – Retrieval of 7-byte UNIQUE ID requires authentication with a dedicated 128-bit AES key • Originality Check based on customizable ECC signature
Design-in and scalability	• AES support from ticket to card to phone – Allows security streamline from cost-effective single use ticket up to multi-application product • Silicon comes with DARK GREEN classification supporting eco-friendly paper tickets and cards

3 MIFARE Ultralight AES Product support package

The Product Support Package (PSP) for the MIFARE Ultralight AES is composed of the following deliverables:

1. **Data sheet – DS5379 MIFARE Ultralight AES MF0AES(H)20**
   Product data sheet, available in NXP DocStore document number 5379xx
2. **Data sheet – DS7036 MIFARE Ultralight AES MF0AES(H)30**
   Product data sheet, available in NXP DocStore document number 7036xx
3. **Application note – AN13454 MIFARE Ultralight AES quick start guide**
   available in NXP DocStore, document number 7108xx
4. **Application note – AN13452 MIFARE Ultralight AES features and hints**
   available in NXP DocStore, document number 7106xx
5. **Application note – AN13453 MIFARE Ultralight AES card coil design guide**
   available in NXP DocStore, document number 7107xx
6. **Product qualification package – PQP MIFARE Ultralight AES**
   available in NXP DocStore, document number 7172xx
7. **TapLinx**
   An Android SDK offering easy implementation of Android Apps interacting with any of the NXPs offered contactless NFC-based ICs. Available via the NXP website under the following weblink: https://www.mifare.net/en/products/tools/taplinx/
8. **RFID Discover**
   A Windows-based software tool that can be used for NXP product-specific command exchange with the MIFARE Ultralight AES IC. Available in NXP DocStore and on the NXP website under the following weblinks:
   https://www.nxp.com/search?category=softwaretools&keyword=rfiddiscover
   https://www.mifare.net/en/products/tools/rfiddiscover/
9. **NXP card test framework**
   A Windows-based software tool that can be used for NXP product-specific command exchange with the MIFARE Ultralight AES IC. Especially suitable for generating transactions and scripts that can be used for chip configuration, personalization, transaction testing and much more. Available in NXP DocStore.
10. **Android applications – TagInfo and TagWriter**
    Android Apps offering the possibility to interact with the MIFARE Ultralight AES smartcards as well as any other of the NXPs offered contactless NFC-based ICs. Available via the NXP Website under the following weblinks:
    https://www.mifare.net/en/products/tools/nfc-taginfo-app/
    https://www.mifare.net/en/products/tools/nfc-tagwriter-app/

11. **MIFARE Ultralight AES sample cards**
    Sample cards can be requested directly at your NXP representative or contact person (sales, marketing, business development).

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ICs with DPA Countermeasures functionality

LICENSED DPA COUNTERMEASURES ™

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