LoRa Alliance Member™

AVNET® SILICA

LoRaWAN Security solutions

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WHAT IS A SECURE ELEMENT?

A secure element is a tiny chip able to perform cryptography primitives such as AES, SHA and ECC, and to keep secret keys safely hidden from the outside world. Unlike ordinary MCUs and memories, it is very robust against physical attacks and cannot be read or counterfeited.
Secure elements come programmed and personalized with unique IDs and secret keys, and are able to interface with its host MCU via an I^2C, a 1-Wire or an SPI bus.
Common examples of secure elements are SIM cards, banking smart cards, TPMs in computers, etc.

WHY IS THE TO136 SECURE ELEMENT SO SPECIAL?

The TO136 is Avnet Silica's exclusive secure element. It is manufactured on a hardware base supplied by OT-Morpho and is loaded with a firmware (defining its command set and features) developed by Trusted Objects and personalized with unique keys and IDs in a secure area at the heart of Avnet Logistics' European facility in Munich, Germany. The TO136 is the lowest-power secure element on the market: 2.8mA in active mode, 0µA in off mode and a start-up time under 500µs, orders of magnitude better than the competition, allowing it to be used in battery-powered applications without impacting energy consumption. Our production set-up is so flexible that it can be programmed to perform virtually any crypto function and personalized with the most complex key mapping. The TO136 HW is banking-grade EMVCo certified (Europay, Mastercard, Visa), which is equivalent to a Common Criteria CC EAL5+.

WHAT IS LoRaWAN 1.0.2 SECURITY?

There are two layers of security in LoRaWAN 1.0.2:

- A network security layer
- An application security layer

The network security layer is used to authenticate uplink and downlink messages on the network, to ensure that only network-registered devices can use it.

The application security layer ensures end-to-end confidentiality, from sensor to application server, so that network servers cannot read the data they convey.
Both network and application security layers use symmetric cryptography to respectively sign and encrypt messages with 128-bit symmetric keys:

- NtwSKey for network authentication
- AppSKey for end-to-end encryption

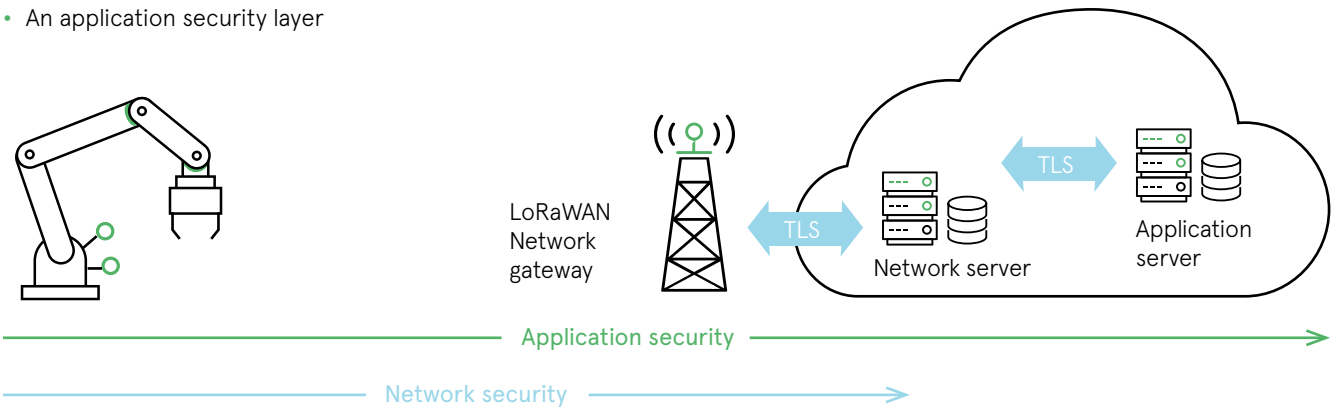
Both the NtwSKey and AppSKey are uniquely defined per sensor and need to be shared with the network server and the application server respectively. However, distributing the keys without exposing them is complex.

WHAT ARE THE PROVISIONING OPTIONS?

The LoRaWAN 1.0.2 specification defines two provisioning schemes for onboarding a LoRaWAN sensor:

- ABP: activation by personalization
- OTAA: over-the-air activation

ABP is the simplest but most restrictive option. Both the NtwSKey and the AppSKey are issued and shared with one network operator for one application server provider at end-device manufacturing. This option best applies to network- and application-specific devices, but does not fit objects that need to be able to roam or operate on different networks.



Using OTAA in conjunction with a third-party join server (JS) solves this problem. Via a join procedure with the JS sitting above the network operators, a device can attach to any network with a connection to the JS and any application server provider connecting to the JS. In this case, NtwSKey and AppSKey are derived by both the JS and the end-device simultaneously, from a pre-shared symmetric root key.However, in both cases, ABP and OTAA, symmetric keys need to be shared between the device manufacturer and outside third parties. If manufacturing is outsourced, it adds even more complexity to the key ceremonies and processes.

MANUFACTURING A NETWORK-SPECIFIC DEVICE

WITHOUT A SECURE ELEMENT	WITH THE TO136-LoRaWAN-ABP
The network operator, on which the device will operate, needs to issue a list of device addresses (DevAddr) to the OEM. The OEM then generates NtwSKey and AppSKey and builds two lists: - List 1: DevAddr + NtwSKey - List 2: DevAddr + AppSKey The OEM securely sends List 1 to the network operator, and List 2 to the application server provider for pre-provisioning of the devices. Then, the OEM aggregates both lists and sends the resulting file to the EMS manufacturing the physical devices, asking it to personalize the production as per the file. Once programmed, the OEM asks the EMS to destroy the keys.	The OEM orders TO136-LoRaWAN-ABP from Avnet Silica, referring the network operator and the application server provider. The network operator issues a list of DevAddr to Avnet Silica. Avnet Silica issues NwkSKey and AppSKey lists and personalizes secure elements accordingly. Avnet Silica securely shares information to compute the NwkSkey list and AppSKey list with the network operator and the application server provider respectively. Avnet Silica ships the batch of secure element to the EMS and destroys the key files.

MANUFACTURING A GENERIC DEVICE

WITHOUT A SECURE ELEMENT	WITH THE TO136-LoRaWAN-OTAA
The OEM needs to issue a list of device unique identifiers (DevEUI) to Avnet Silica, and also shares it with the join server behind the AppEUI. The OEM then generates unique device root keys AppKey and builds a list: DevEUI + AppKey The OEM securely sends the list to the join server provider for pre-provisioning of the devices. The OEM securely sends the list to the EMS manufacturing the physical devices, asking to personalize the production according to the list of keys. Once programmed, the OEM asks the EMS to destroy the list of keys.	The OEM orders TO136-LoRaWAN-OTAA from Avnet Silica and refers the join server provider to Avnet Silica. A list of device unique identifiers (DevEUI) can be generated by the OEM or the join server provider at will. This list of DevEUI is shared with Avnet Silica via a secure procedure. For each DevEUI, Avnet Silica issues a root key AppKey and personalizes secure elements accordingly. Avnet Silica securely shares the production information (DevEUI + AppKey) with the join server provider. Avnet Silica ships the batch of secure element to the EMS and destroys the key files.

HOW CAN I ORDER?

Two secure elements are available depending on the personalization scheme retained:

- TO136-LoRaWAN-ABP
- TO136-LoRaWAN-OTAA

Upon ordering, the customer will be asked to provide information regarding the workflow, as described above, so that Avnet Silica can smoothly manage the key ceremonies with the different parties involved.

Please contact your nearest Avnet Silica representative or email us at security-solutions@avnet.eu

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IDEMIA augmented identity

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