



# Standardization of Embedded UICC Remote Provisioning

*Embedded UICC Remote Provisioning technology is receiving much attention in the M2M field. NTT DOCOMO has participated in the GSMA FastTrack project, together with SIM vendors and communications operators in various countries, to study this architecture. This article gives an overview of the architecture and describes use cases.*

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## 1. Introduction

Implementing Machine-to-Machine (M2M) devices, with their diverse requirements, that are both more durable and more compact is an essential factor in developing M2M business. Ordinarily, to use 3G or LTE communications services, devices are equipped with a SIM\*1 card slot, but this leads to an increase in the number of parts in the device. To implement more durable M2M devices by making them more compact and reducing the number of parts, they have been designed with an integrated Machine-to-Machine UICC\*2 (MFF\*3) in a form that is not easy to dismantle.

In parallel with this integration of SIM cards and devices, globalization

of business processes is also accelerating. Generally, when developing a global business, the services of communications providers in each country are used, but if the SIM card is integrated into the device as described above, it becomes difficult to change the SIM card in each case.

Embedded UICC Remote Provisioning (eSIM) was studied to satisfy requirements including this difficulty in changing the SIM card when needing to use services of communication providers in various countries, as described above. It is one technology that is expected to be used more in M2M business in the future, as diversification and globalization of services accelerates. eSIM technology enables the communication provider

registered in the SIM card to be updated remotely using Over-The-Air (OTA)\*4 technology.

At the time of writing, standardization of eSIM is in progress at various international standardization organizations such as the European Telecommunications Standards Institute (ETSI)\*5, but the GSM Association (GSMA)\*6 has taken the lead, publishing a completed standard on December 13, 2013 [1].

In deciding on this architecture, documents were created by ten communication providers and four SIM vendors from around the world. NTT DOCOMO was one of the companies participating in the study for this architecture.

This article describes an overview of eSIM and the architecture and

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\*1 **SIM:** An IC card on which the phone number and other information about a user are stored in subscribing to a mobile communication company. The subscriber identification module in GSM is referred to as SIM.

\*2 **UICC:** An IC card used to record a unique ID for specifying a phone number. UIM card and SIM card are used synonymously.

describes some use cases.

## 2. eSIM Overview

### 2.1 Current SIM Cards

Communication using current SIM cards is showed in **Figure 1**. The communications profile\*<sup>7</sup> of a single Mobile Network Operator (MNO) is stored in the SIM card, and it is used for communication. The communication profile includes the information needed by each MNO for communication, including the Mobile Subscriber ISDN number (MSISDN)\*<sup>8</sup> and the International Mobile Subscriber Identity (IMSI)\*<sup>9</sup>. The MNO is fixed in each SIM card and cannot be changed.

For this reason, the SIM card in the device must be changed each time a different MNO is used.

### 2.2 eUICC

A eUICC is a SIM card with a Remote Provisioning function, and is designed not to be removed or changed. It is able to store multiple communication profiles, one of which is enabled (recognized by the device and used for communication). The network of the MNO in the enabled profile is used for communication. Profiles other than the enabled profile are disabled (not recognized by the

device) (**Figure 2**). With conventional SIM cards, the ICCID is used as the unique key to identify the SIM card, but with eUICC, the ICCID is the key used to identify profiles, and a new ID is defined, called the eUICC-

ID, which is used as the unique key for the eSIM (**Table 1**).

GSMA defines two main types of profile.

#### 1) Provisioning Profile

This is the communication profile

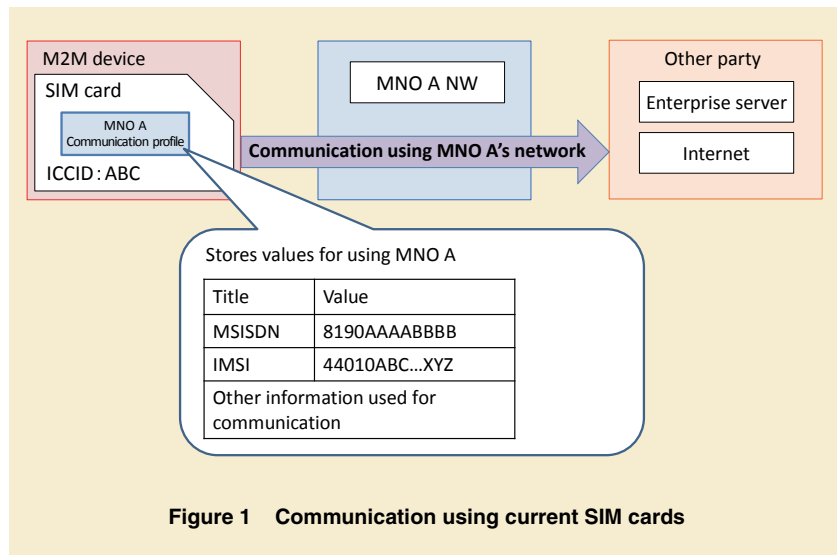


Figure 1 Communication using current SIM cards

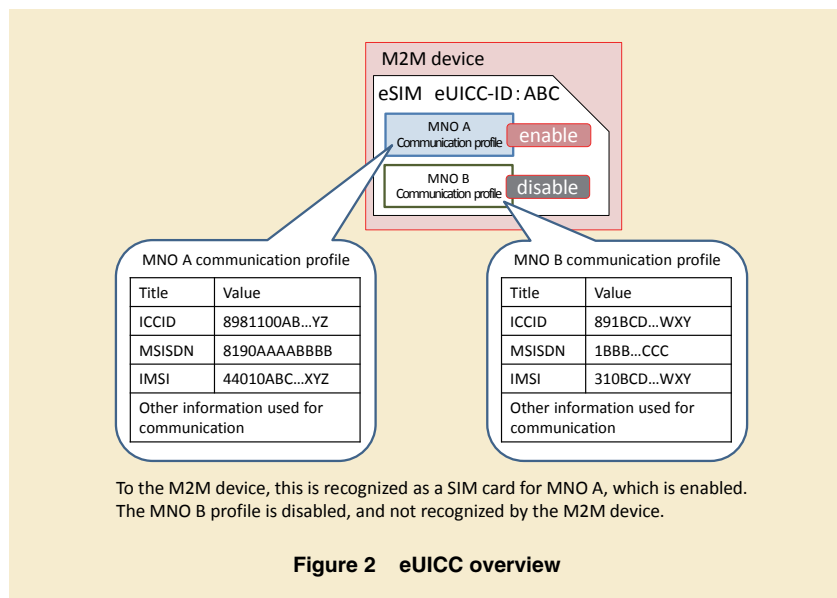


Figure 2 eUICC overview

\*3 **MFF**: An acronym for M2M Form Factor. Refers to a UICC for M2M applications.  
 \*4 **OTA**: Technology for writing data or updating using wireless communications.  
 \*5 **ETSI**: A European standardization body engaged in the standardization of telecommunications technologies. Headquartered in Sophia Antipolis, France.

\*6 **GSMA**: An association that supports and manages activities of the mobile industry such as formulating roaming rules. World's largest industry association in the mobile communications domain. About 800 mobile operators 219 regions and more than 200 IPX operators, terminal, equipment and software vendors have joined the Association.

\*7 **Profile**: A set of files containing the information needed for communication (IMSI, MSISDN, etc.).  
 \*8 **MSISDN**: The phone number assigned to each subscriber as specified by the 3GPP.  
 \*9 **IMSI**: A number used in mobile communications that is unique to each user and stored on a UIM card.

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initially stored in the eUICC when it is shipped. It is a limited-application communication profile used only for downloading and switching Operational Profiles, described next.

## 2) Operational Profile

This is a communication profile for connecting to enterprise servers

or the Internet. It can also perform the roles provided by a Provisioning profile.

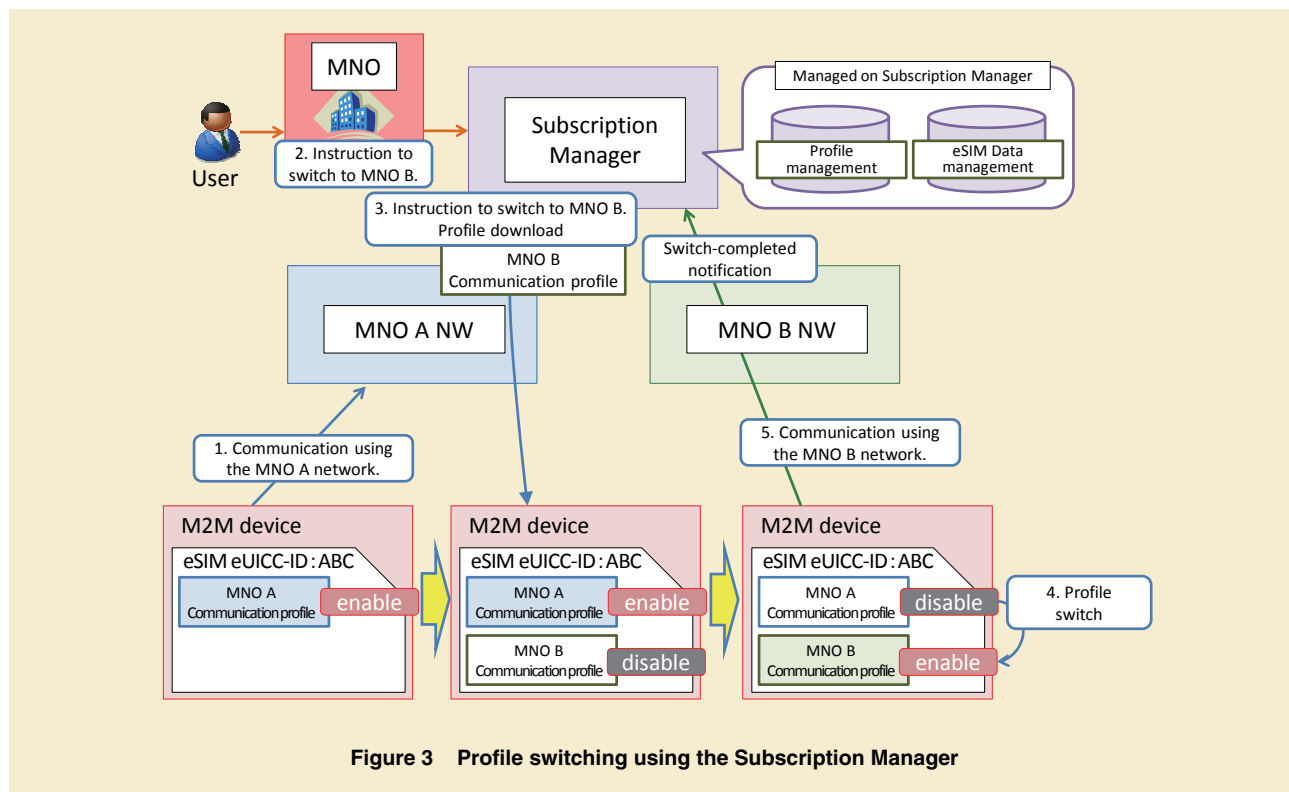
## 3. eSIM Architecture Overview

An eSIM does not perform profile switching as a simple IC card func-

tion, but rather switches profiles based on instructions from equipment called a Subscription Manager. A Subscription Manager is maintained and managed by an MNO. The overall eSIM architecture, centering on the Subscription Manager, is shown in **Figure 3**, using the example of switching pro-

**Table 1 Comparison of eUICC and SIM cards**

	eUICC	SIM card
Card unique key	eUICC-ID * Has ICCIDs as unique keys for profiles	ICCID
Number of profiles	Multiple	1
Number of enabled profiles	1	1



**Figure 3 Profile switching using the Subscription Manager**

files within the eUICC.

An eUICC must have at least one profile stored in it to enable OTA functionality, and one of the stored profiles must be enabled. The enabled profile uses the network of MNO A for communication. When the user switches profiles, a switch instruction is sent to the Subscription Manager. At that time, if the profile to switch to is not stored in the eUICC, the profile is first downloaded. When it receives a switch instruction, the eUICC performs a switch of the enabled profile as an internal process. After the switch is completed, it uses the network of MNO B to send notification that the switch has completed to the Subscription Manager, com-

pleting the process. The same procedure is used to switch back to the original MNO A, or to some other MNO C.

As mentioned earlier, profile switching is implemented using Subscription Manager functionality. The Subscription Manager has two roles: Subscription Manager Data Preparation (SM-DP), and Subscription Manager Secure Routing (SM-SR). Here we describe these Subscription Manager functions in detail using **Figure 4**.

1) Role of SM-DP

The SM-DP securely creates and stores communication profiles. It receives the information it needs to create a communication profile (MSISDN, IMSI, etc.) from the MNO, and cre-

ates a communication profile. It then stores the profile it has created.

2) Role of SM-SR

The SM-SR has the role of establishing secure communication with the eUICC. The communication profiles stored in an eUICC are highly confidential information and require a mechanism to prevent them from being read or altered easily from outside the system. For this reason, a secure environment is built by separating the SM-DP, which creates the profiles, and the SM-SR, which establishes communication with the eUICC. The SM-SR has an eUICC Information Set (EIS) for establishing secure communication with the eUICC. The EIS has key information for accessing the

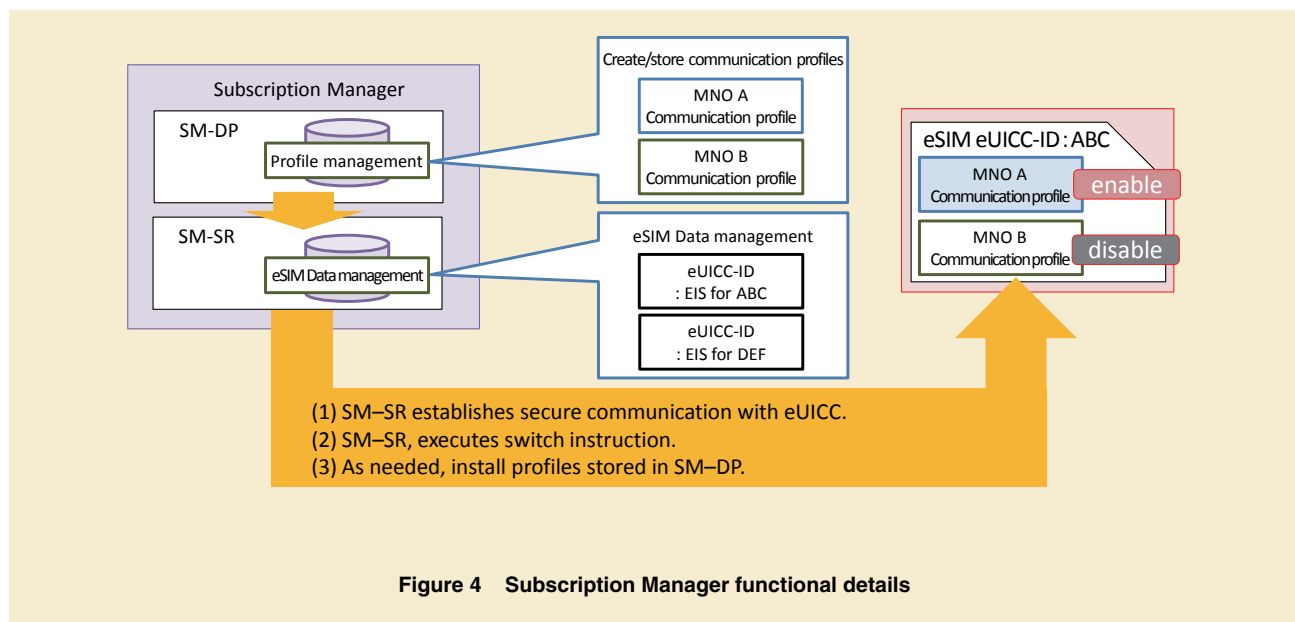


Figure 4 Subscription Manager functional details

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eUICC (the Platform Management Credential) and state information such as whether each profile is enabled or disabled.

The Platform Management Credential enables the SM-SR to access the eUICC securely and to perform instructions to switch the enabled profile.

## 4. Use Cases

We introduce two use cases for eSIM below.

### 1) Optimizing Logistics

Often in the M2M field, it is difficult to remove the SIM from a device, or the device is installed in a remote location difficult to reach for maintenance. For example, global production and delivery of products is a case having these conditions. With

conventional SIM cards, cards with a different communication profile for each country being shipped to have to be built into the device, production and distribution lines for each had to be established and managed, and production and delivery quantities had to be adjusted for each region. With the introduction of eSIMs, it is possible to switch profiles using a process desired by the user. This enables implementation of optimized logistics, such as changing the region to which products are shipped based on the actual balance of supply and demand, even after production and shipping (**Figure 5**).

### 2) Provision of Continuous Service

When M2M devices are used globally, with conventional SIM cards they had to be changed for each dif-

ferent region, so it was difficult to use services continuously. In contrast, with the introduction of eSIMs, it is possible to switch profiles using OTA technology, so services can be used more seamlessly than with conventional SIM cards in global use cases. This should lower the barriers to developing global businesses (**Figure 6**).

## 5. Conclusion

In this article we have given an overview of eSIM with use cases, based on documents published by the GSMA. Standardization activities are expected to continue at international standardizations such as the ETSI, using the GSMA documents as input. In parallel with technical standardization, GSMA is also creating authorized standards for operational as-

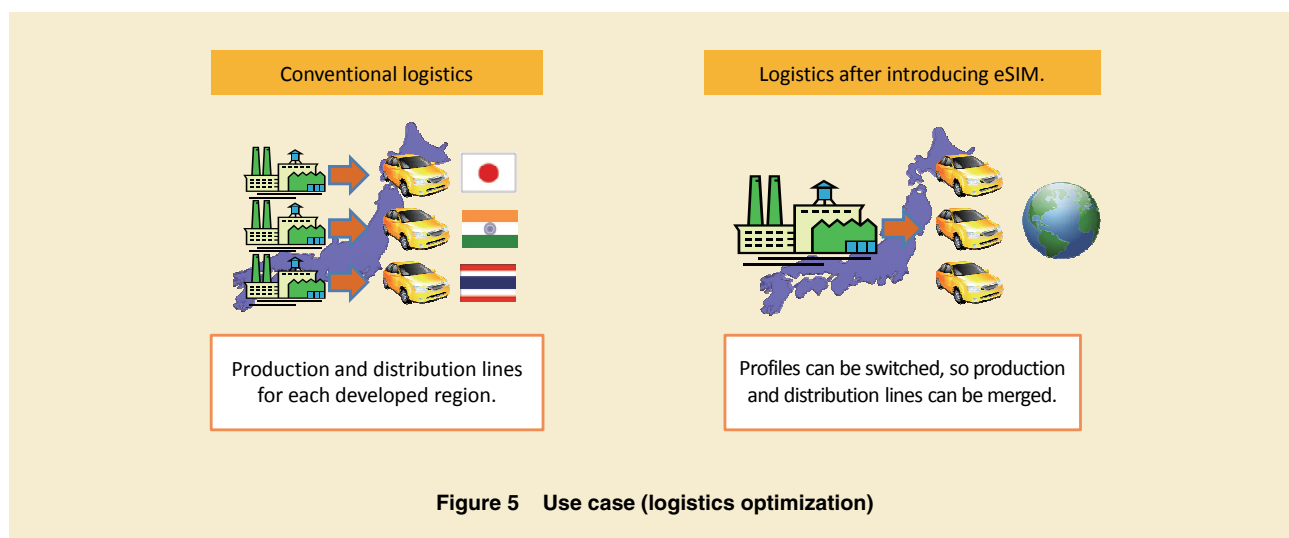


Figure 5 Use case (logistics optimization)

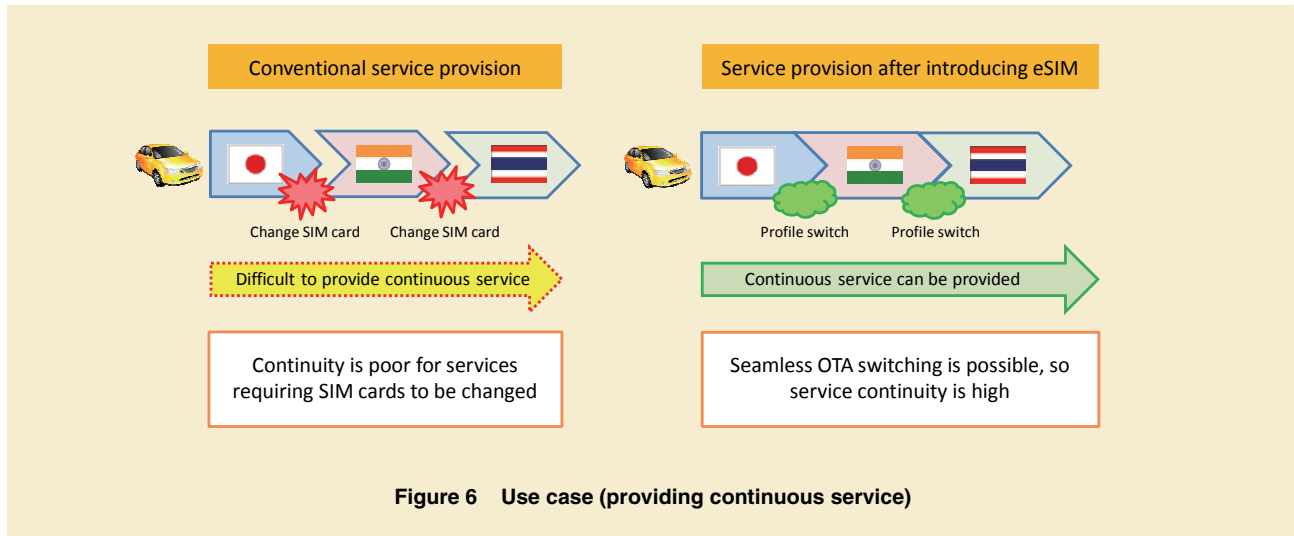


Figure 6 Use case (providing continuous service)

pects such as the Subscription Manager.

NTT DOCOMO will continue with standardization activities and technical study in the future, to contribute to

developing M2M businesses in the Internet Of Things (IOT) era.

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[1] GSM Association: "Embedded SIM

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