US00RE49465E

(19) **United States**

(12) **Reissued Patent**

Lee et al.

(10) **Patent Number: US RE49,465 E**

(45) **Date of Reissued Patent: Mar. 14, 2023**

(54) **METHOD AND APPARATUS FOR SETTING PROFILE**

(71) Applicant: **Samsung Electronics Co., Ltd.**, Gyeonggi-do (KR)

(72) Inventors: **Duckey Lee**, Seoul (KR); **Jungje Son**, Gyeonggi-do (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**

(21) Appl. No.: **16/537,077**

(22) Filed: **Aug. 9, 2019**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **9,800,993**
Issued: **Oct. 24, 2017**
Appl. No.: **14/998,103**
Filed: **Dec. 23, 2015**

U.S. Applications:

(63) Continuation of application No. 14/292,256, filed on May 30, 2014, now Pat. No. 9,232,392.

(30) **Foreign Application Priority Data**

May 30, 2013 (KR) 10-2013-0061851

(51) **Int. Cl.**
H04M 1/66 (2006.01)
H04W 4/00 (2018.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04W 4/50*** (2018.02); ***H04W 8/205*** (2013.01); ***H04W 8/245*** (2013.01); ***H04W 8/265*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H04L 67/306; H04L 63/102; H04L 51/04; H04L 67/10; H04L 67/303; H04W 8/18; H04W 28/18
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,474,050 B2 * 6/2013 Casimere G06F 3/067 726/26
8,712,474 B2 * 4/2014 Gehrmann H04W 12/0023 455/558
(Continued)

FOREIGN PATENT DOCUMENTS

CN 1384689 12/2002
CN 101652776 2/2010
(Continued)

OTHER PUBLICATIONS

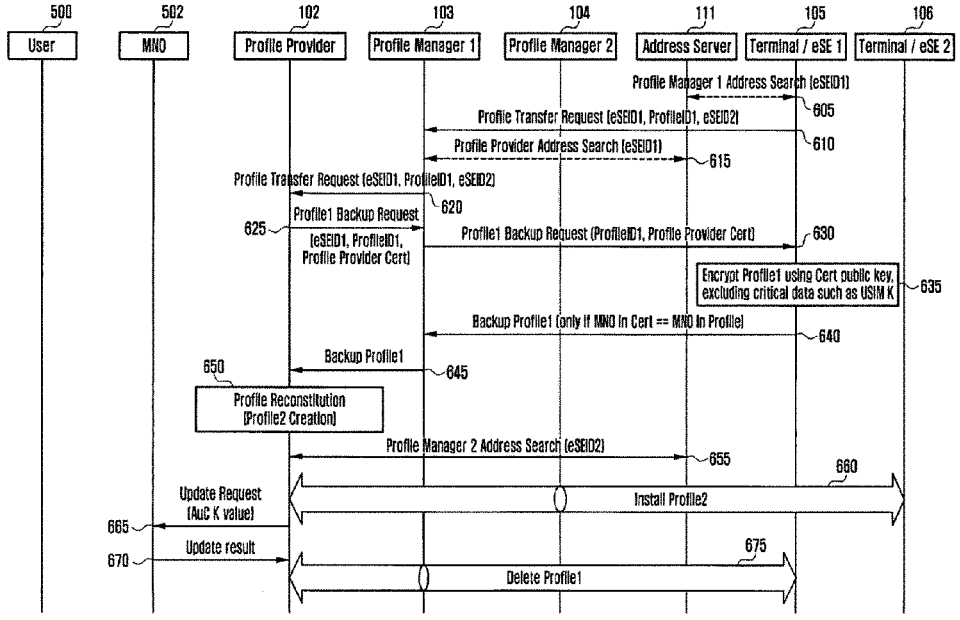
Chinese Office Action dated Apr. 28, 2018 issued in counterpart application No. 201480031102.8, 20 pages.
(Continued)

Primary Examiner — Minh Dieu Nguyen
(74) *Attorney, Agent, or Firm* — The Farrell Law Firm, P.C.

(57) **ABSTRACT**

A method and apparatus for setting profiles are provided. The profile setting method includes receiving, from a first terminal, a profile transfer request message that requests transfer of a first profile or portion thereof from a first secure element to a second secure element; configuring a second profile using the first profile or portion thereof; and sending, to a second terminal, the configured second profile.

18 Claims, 9 Drawing Sheets



(51) **Int. Cl.**

H04W 4/50	(2018.01)
H04W 12/082	(2021.01)
H04W 12/30	(2021.01)
H04W 8/20	(2009.01)
H04W 8/24	(2009.01)
H04W 8/26	(2009.01)
H04W 12/04	(2021.01)
H04W 8/18	(2009.01)
H04W 12/02	(2009.01)
H04W 12/10	(2021.01)

(52) **U.S. Cl.**

CPC ***H04W 12/04*** (2013.01); ***H04W 12/082*** (2021.01); ***H04W 12/35*** (2021.01); *H04W 8/18* (2013.01); *H04W 8/183* (2013.01); *H04W 12/02* (2013.01); *H04W 12/10* (2013.01)

(58) **Field of Classification Search**

USPC 726/1, 5–8; 705/39, 44, 41, 35, 42, 16, 705/40, 43, 2, 30, 316; 455/411, 466; 713/171, 185; 715/205, 844; 717/104

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,863,240	B2 *	10/2014	Tapia	G06F 21/31 726/4
10,242,210	B2	3/2019	Girard et al.	
2003/0119552	A1	6/2003	Laumen et al.	
2004/0025021	A1 *	2/2004	Aikawa	G06Q 20/06 713/172
2005/0279826	A1 *	12/2005	Merrien	G06Q 20/355 235/380
2005/0283533	A1	12/2005	Schluter et al.	
2007/0167161	A1	7/2007	Cheng et al.	
2008/0261561	A1	10/2008	Gehrmann	
2010/0005143	A1	1/2010	Weens et al.	
2012/0108207	A1	5/2012	Schell et al.	
2012/0115441	A1	5/2012	Schell	
2012/0164981	A1	6/2012	Pauliac	
2012/0190354	A1 *	7/2012	Merrien	H04L 63/083 455/422.1
2012/0263298	A1	10/2012	Suh et al.	
2013/0012159	A1	1/2013	Lodeweyckx	
2013/0227646	A1	8/2013	Haggerty et al.	
2014/0136933	A1 *	5/2014	Berger	G06Q 10/10 715/202
2014/0219447	A1	8/2014	Park et al.	
2014/0235210	A1	8/2014	Park	
2014/0237101	A1	8/2014	Park	
2014/0308991	A1	10/2014	Lee et al.	
2014/0329502	A1	11/2014	Lee	
2015/0208238	A1	7/2015	Jiang	
2017/0147574	A1	5/2017	Konttinen	

FOREIGN PATENT DOCUMENTS

CN	101938742	1/2011
CN	102457834	5/2012
CN	102577454	7/2012
CN	102761870	10/2012
CN	102892102	1/2013
EP	2 461 613	6/2012
IN	1122/DELNP/2005	1/2009
JP	2007-513534	5/2007
JP	2010532107	9/2010
JP	2011-028522	2/2011
KR	1020110078627	7/2011
KR	20130026351	3/2013
WO	WO 2008/017788	2/2008
WO	WO 2009/103623	8/2009
WO	WO 2012/076480	6/2012
WO	WO 2013/036009	3/2013
WO	WO 2013/036010	3/2013
WO	WO 2013/048084	4/2013
WO	WO 2013/066077	5/2013
WO	WO 2013/123233	8/2013

OTHER PUBLICATIONS

Japanese Office Action dated Jul. 23, 2018 issued in counterpart application No. 2016-516453, 5 pages.

Korean Office Action dated Apr. 10, 2019 issued in counterpart application No. 10-2013-0061851, 7 pages.

ETSI TC SCP, Liaison Statement on New Work Item for eUICC, S1-113233, 3GPP TSG-SA WG1 #56, Nov. 14-18, 2011, 42 pages.

Japanese Office Action dated Nov. 25, 2019 issued in counterpart application No. 2019-007980, 8 pages.

KR Decision of Grant dated Apr. 7, 2020 issued in counterpart application No. 10-2013-0061851, 4 pages.

Indian Office Action dated Jun. 15, 2020 issued in counterpart application No. 3782/KOLNP/2015, 6 pages.

Chinese Office Action dated Jul. 2, 2021 issued in counterpart application No. 201910355873.7, 21 pages.

Wikipedia: "Create, Read, Update and Delete", XP055316816, May 23, 2013, 2 pages.

GSM Association, Embedded SIM Task Force Requirements and Use Cases 1.0, GSMA, Feb. 21, 2011, 38 pages.

European Search Report dated Nov. 14, 2016 issued in counterpart application No. 14803675.9-1870, 10 pages.

* cited by examiner

FIG. 1

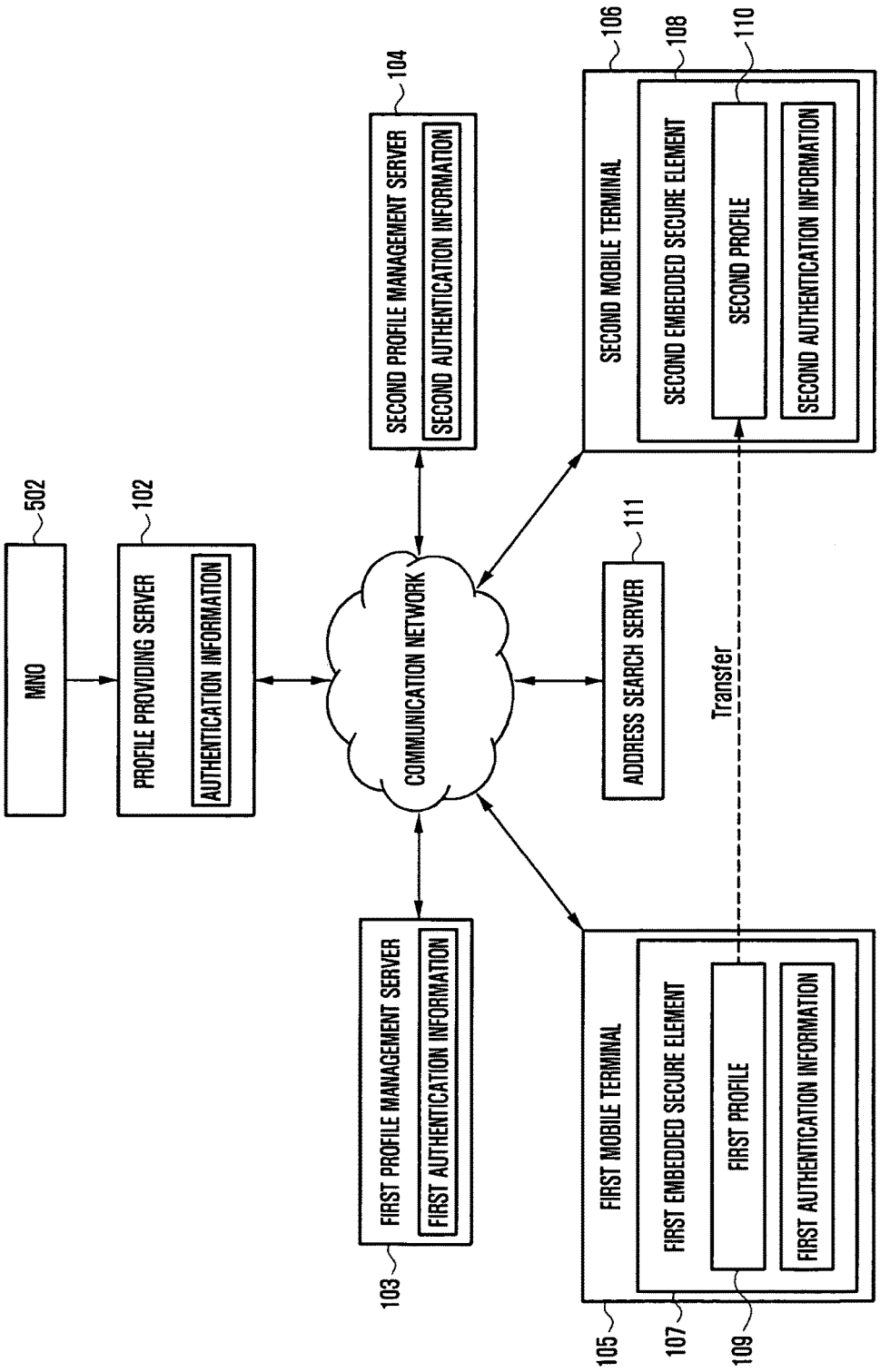

MNO
502
PROFILE PROVIDING SERVER
AUTHENTICATION INFORMATION
102
SECOND PROFILE MANAGEMENT SERVER
SECOND AUTHENTICATION INFORMATION
104
COMMUNICATION NETWORK
ADDRESS SEARCH SERVER
111
SECOND MOBILE TERMINAL
SECOND EMBEDDED SECURE ELEMENT
SECOND PROFILE
SECOND AUTHENTICATION INFORMATION
106
108
110
Transfer
FIRST PROFILE MANAGEMENT SERVER
FIRST AUTHENTICATION INFORMATION
103
FIRST MOBILE TERMINAL
FIRST EMBEDDED SECURE ELEMENT
FIRST PROFILE
FIRST AUTHENTICATION INFORMATION
105
107
109

FIG. 2

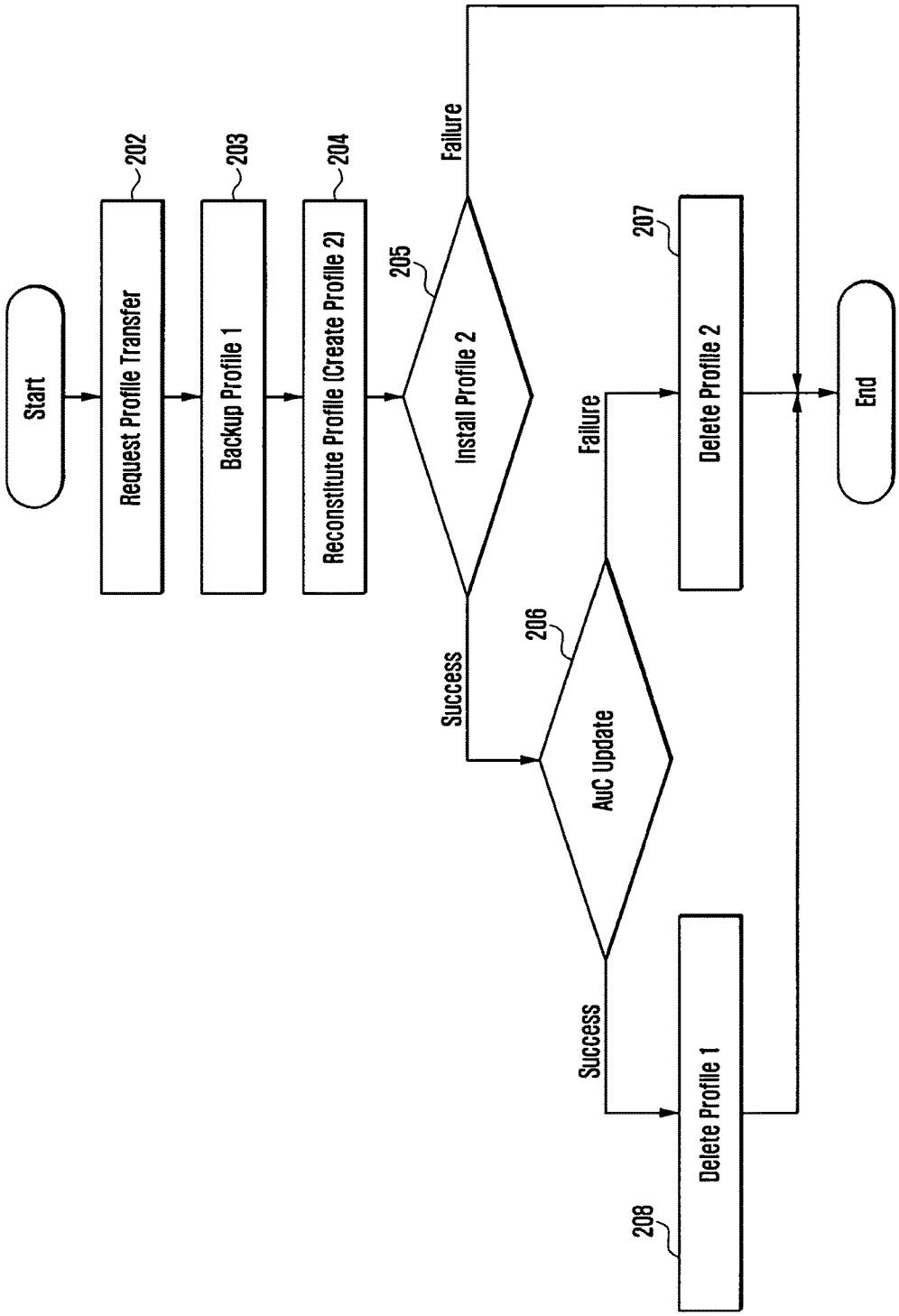

Start
Request Profile Transfer
202
Backup Profile 1
203
Reconstitute Profile (Create Profile 2)
204
Install Profile 2
205
Failure
Success
AuC Update
206
Failure
Success
Delete Profile 2
207
Delete Profile 1
208
End

FIG. 3

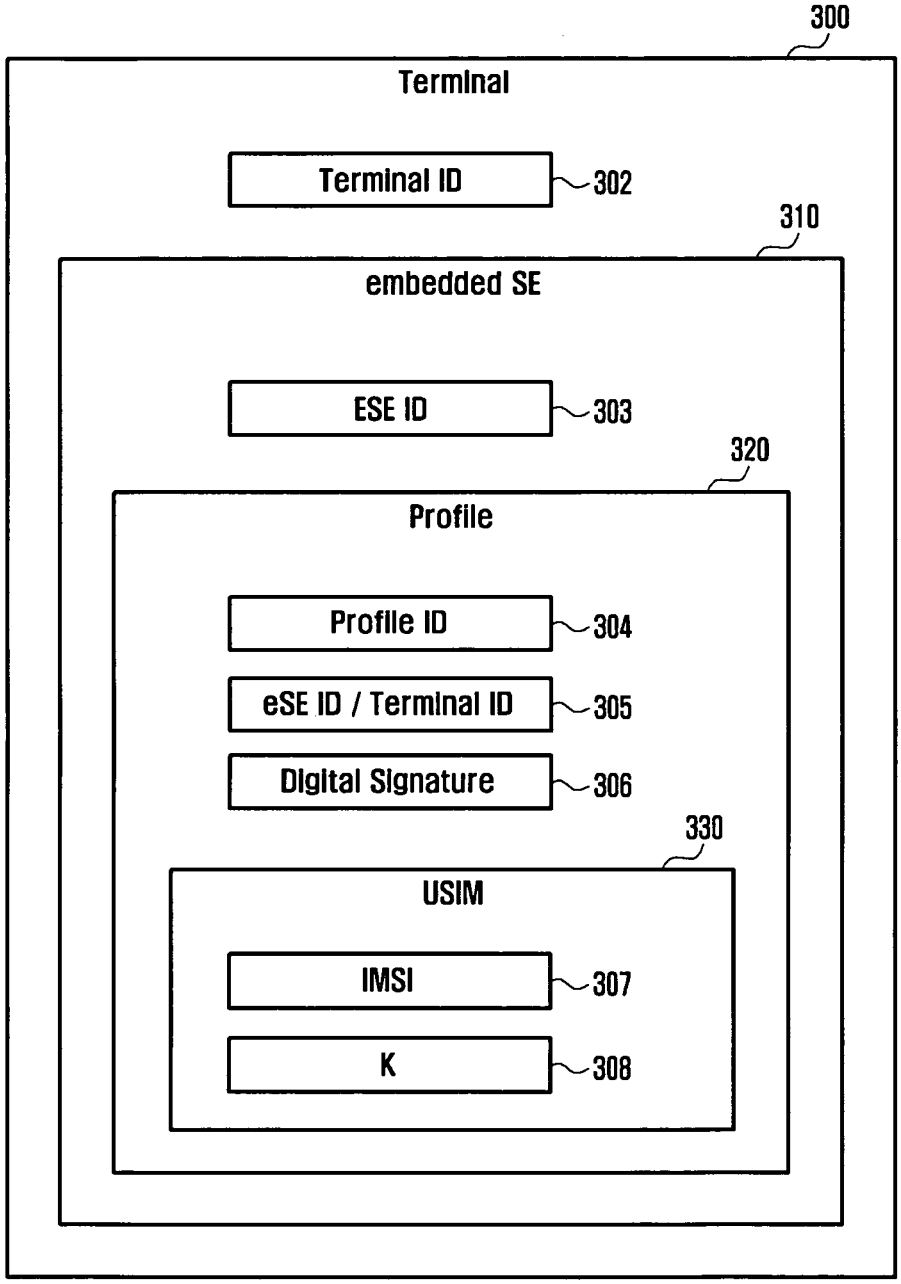

300
Terminal
Terminal ID
302
310
embedded SE
ESE ID
303
320
Profile
Profile ID
304
eSE ID / Terminal ID
305
Digital Signature
306
330
USIM
IMSI
307
K
308

FIG. 4

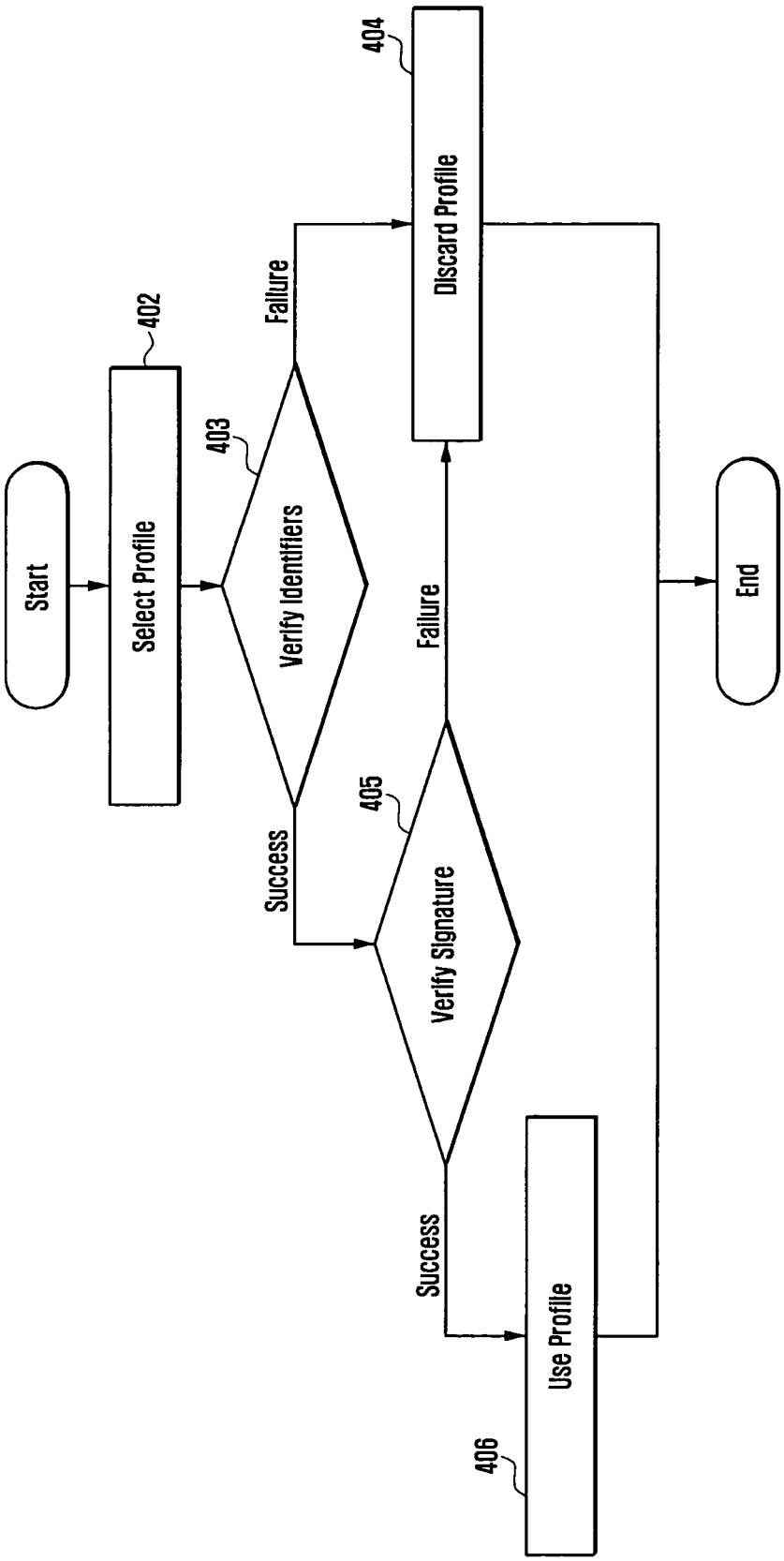

Start
402
Select Profile
403
Verify Identifiers
Failure
404
Discard Profile
Failure
End
Success
405
Verify Signature
Success
406
Use Profile

FIG. 5

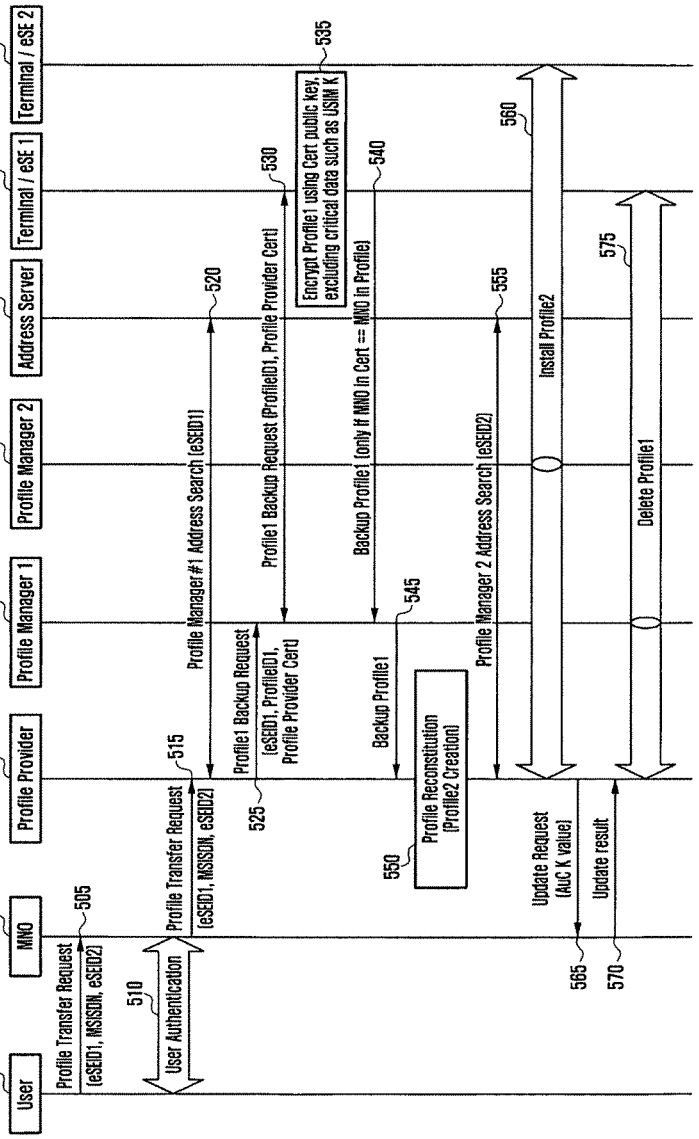

500 User
502 MNO
102 Profile Provider
103 Profile Manager 1
104 Profile Manager 2
111 Address Server
105 Terminal / eSE 1
106 Terminal / eSE 2
Profile Transfer Request (eSEID1, MSISDN, eSEID2)
505
User Authentication
510
Profile Transfer Request (eSEID1, MSISDN, eSEID2)
515
Profile Manager #1 Address Search (eSEID1)
520
Profile1 Backup Request (ProfileID1, Profile Provider Cert)
530
Encrypt Profile1 using Cert public key, excluding critical data such as USIM K
535
Profile1 Backup Request (eSEID1, ProfileID1, Profile Provider Cert)
525
Backup Profile1 (only if MNO in Cert == MNO in Profile)
540
Backup Profile1
545
Profile Reconstitution (Profile2 Creation)
550
Profile Manager 2 Address Search (eSEID2)
555
Install Profile2
560
Delete Profile1
575
Update Request (AuC K value)
565
Update result
570

FIG. 6

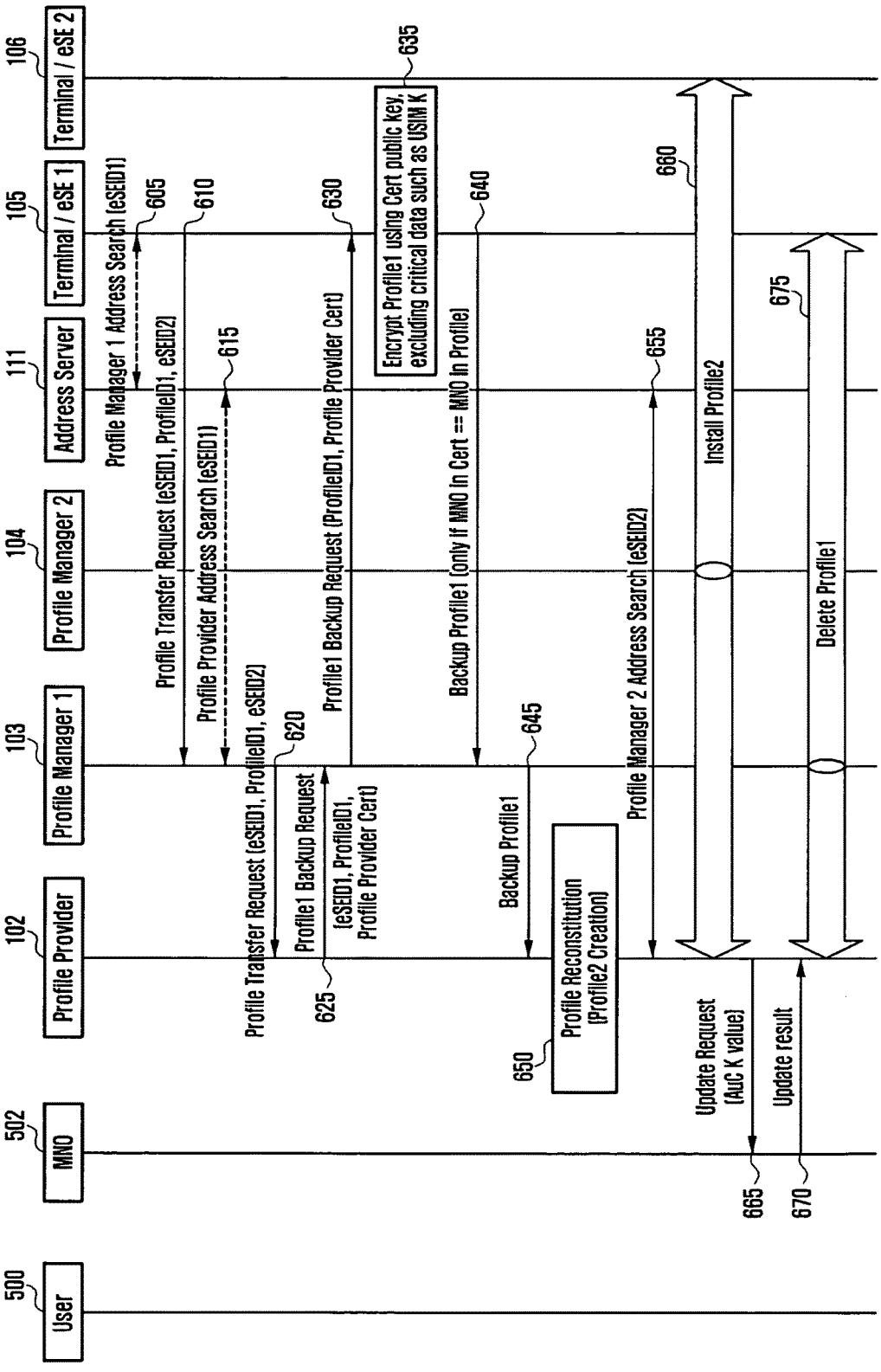

500
User
502
MNO
102
Profile Provider
103
Profile Manager 1
104
Profile Manager 2
111
Address Server
105
Terminal / eSE 1
106
Terminal / eSE 2
Profile Manager 1 Address Search (eSEID1)
605
Profile Transfer Request (eSEID1, ProfileID1, eSEID2)
610
Profile Provider Address Search (eSEID1)
615
Profile Transfer Request (eSEID1, ProfileID1, eSEID2)
620
Profile1 Backup Request (eSEID1, ProfileID1, Profile Provider Cert)
625
Profile1 Backup Request (ProfileID1, Profile Provider Cert)
630
Encrypt Profile1 using Cert public key, excluding critical data such as USIM K
635
Backup Profile1 (only if MNO in Cert == MNO in Profile)
640
Backup Profile1
645
Profile Reconstitution (Profile2 Creation)
650
Profile Manager 2 Address Search (eSEID2)
655
Install Profile2
660
Delete Profile1
675
Update Request (AuC K value)
665
Update result
670

FIG. 7

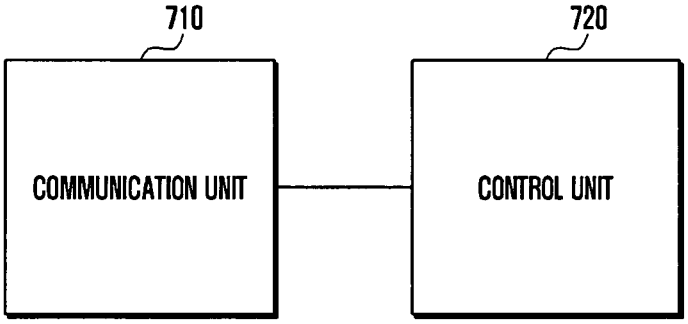


FIG. 8

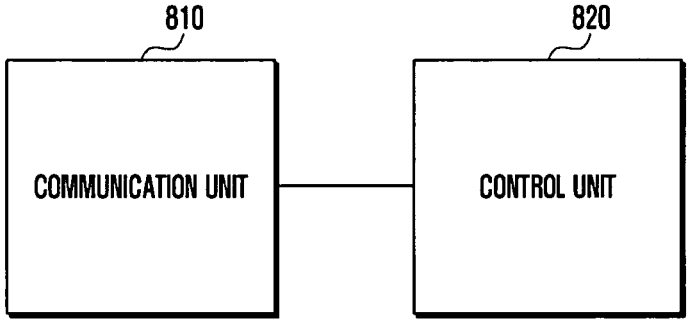
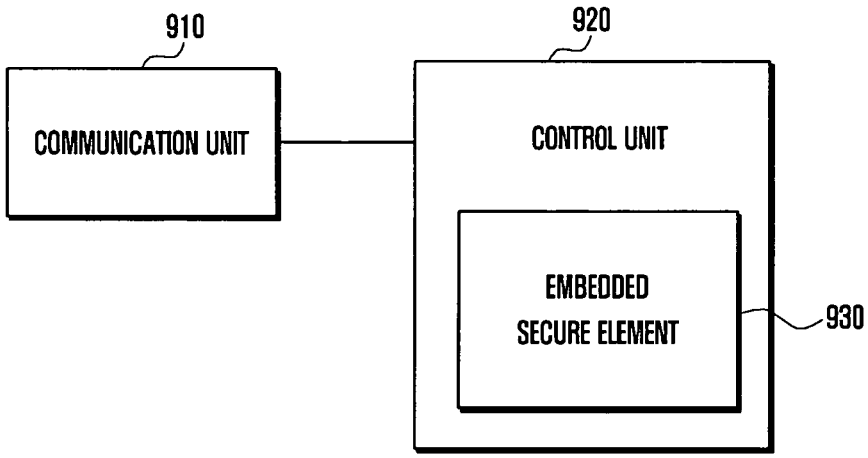


FIG. 9


910
920
COMMUNICATION UNIT
CONTROL UNIT
EMBEDDED
SECURE ELEMENT
930

METHOD AND APPARATUS FOR SETTING PROFILE

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

PRIORITY

This application is a continuation of U.S. application Ser. No. 14/292,256, which was filed in the U.S. Patent and Trademark Office on May 30, 2014, claims priority under 35 U.S.C. §119(a) to a Korean Patent Application filed on May 30, 2013 in the Korean Intellectual Property Office and assigned Serial No. 10-2013-0061851, the entire content of which is incorporated herein by reference.

BACKGROUND

1. Field of Invention

The present invention generally relates to a method and apparatus for setting profiles stored in a mobile terminal.

2. Description of the Related Art

A Universal Integrated Circuit Card (UICC) is a smart card inserted and used in a mobile terminal. The UICC stores personal information of a mobile communication subscriber, such as authentication information for network access, phonebook data, and text messages. When the mobile terminal connects to a mobile communication network such as a Global System for Mobile Communications (GSM), Wideband Code Division Multiple Access (WCDMA) or Long Term Evolution (LTE) network, the UICC performs subscriber authentication and traffic security key generation to thereby enable secure mobile communication. The UICC may store communication applications including a Subscriber Identity Module (SIM), Universal Subscriber Identity Module (USIM), and IP Multimedia Services Identity Module (ISIM) according to the type of mobile communication network to which the subscriber connects. In addition, the UICC provides a high level security function to install a variety of applications such as electronic wallets, tickets and passports.

A typical UICC is manufactured as a proprietary smart card of a specific mobile network operator according to requests of the mobile network operator. At the time of shipment, such a UICC is pre-embedded with authentication information for access to the corresponding mobile operator network (e.g. USIM application, International Mobile Subscriber Identity (IMSI), and key value (K)). Hence, the mobile network operator receives a manufactured UICC and provides the received UICC to a subscriber, and later, if necessary, performs management of the UICC by installing, modifying and removing an application through Over-The-Air (OTA) programming or the like. After inserting the UICC into a mobile terminal, the subscriber may manipulate the mobile terminal to use network and application services of the corresponding mobile network operator. To change terminals, the subscriber removes the UICC from the existing terminal and inserts it into a new terminal. Hence, the authentication information, the mobile phone number and the phonebook data stored in the UICC may be used in the new terminal.

The European Telecommunications Standards Institute (ETSI) has defined physical configurations and logical functions of UICCs to maintain worldwide compatibility. The form factor specifying physical configurations has continuously decreased: mini-SIMs (most widely used) were followed by micro-SIMs (introduced several years ago), and nano-SIMs (introduced in recent years). The development of smaller SIM cards has contributed to the development of smaller terminals. However, it is expected that it will be difficult to standardize UICC cards smaller than recently specified nano-SIMs because of the high likelihood of losing a card. It is also expected that it will be difficult to further miniaturize removable UICC cards, because space for card slots is needed in terminals.

Removable UICC cards may be unsuitable for machine-to-machine (M2M) devices, such as smart home appliances, electricity meters, water meters and Closed Circuit Television (CCTV) cameras, which require access to mobile data networks in various deployment environments without direct human intervention.

To address the above-mentioned problems, it is proposed to embed a secure element that has UICC or similar functions in a mobile terminal at the time of manufacture, in place of a removable UICC. However, such an embedded secure element would be irremovable after being installed in a mobile terminal. Hence, the mobile terminal may be unable to pre-store authentication information for access to a mobile operator network (such as USIM application, IMSI and key value) at the time of manufacture unless the mobile terminal is manufactured as a proprietary terminal of a particular mobile network operator. It would only be possible to configure such authentication information in a mobile terminal after a user who has purchased a mobile terminal subscribes to a mobile network operator.

In addition, unlike an existing UICC card that is manufactured and distributed as a proprietary card of a particular mobile network operator, a new embedded secure element would enable authentication information of various mobile network operators to be installed and managed in a secure and flexible manner when a user who has purchased a corresponding mobile terminal subscribes to a mobile network operator, unsubscribes from a mobile network operator, or changes mobile network operators. According to various usage scenarios such as a purchase of a new terminal, the new embedded secure element would also enable configured authentication information and stored user data to be securely transferred to a new mobile terminal.

SUMMARY

The present invention has been made to address the above problems and disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the present invention is to provide an effective method for setting a profile.

In accordance with an aspect of the present invention, a method for setting profiles for a profile server is provided. The method includes receiving, from a first terminal, a profile transfer request message that requests transfer of a first profile or portion thereof from a first secure element to a second secure element; configuring a second profile using the first profile or portion thereof; and sending, to a second terminal, the configured second profile.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features, and advantages of the present invention will be more apparent from the fol-

lowing detailed description, taken in conjunction with the accompanying drawings, in which:

FIG. **1** illustrates an architecture of a communication system according to an embodiment of the present invention;

FIG. **2** is a flowchart of a profile setting procedure according to an embodiment of the present invention;

FIG. **3** illustrates a data structure in a mobile terminal according to an embodiment of the present invention;

FIG. **4** is a flowchart of a profile activation procedure according to an embodiment of the present invention;

FIG. **5** is a sequence diagram illustrating a profile setting procedure according to a first embodiment of the present invention;

FIG. **6** is a sequence diagram illustrating a profile setting procedure according to a second embodiment of the present invention;

FIG. **7** is a block diagram of a profile provider according to an embodiment of the present invention;

FIG. **8** is a block diagram of a profile manager according to an embodiment of the present invention; and

FIG. **9** is a block diagram of a mobile terminal according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE PRESENT INVENTION

Hereinafter, embodiments of the present invention are described in detail with reference to the accompanying drawings.

Descriptions of functions and constructions that are well-known in the relevant art and are not directly related with the present invention are omitted to avoid obscuring the subject matter of the present invention.

In the drawings, some elements are exaggerated, omitted or only outlined in brief, and thus may not be drawn to scale. The same reference numbers are used throughout the drawings to refer to the same or like elements.

FIG. **1** illustrates an architecture of a communication system according to an embodiment of the present invention.

Referring to FIG. **1**, the communication system includes first and second mobile terminals **105** and **106**, first and second embedded Secure Elements (eSEs) **107** and **108**, respectively installed in the first and second mobile terminals **105** and **106**, a profile provider **102**, first and second profile managers **103** and **104**, and an address search server **111**. In an embodiment of the present invention, the address search server **111** may be omitted.

The first and second embedded secure elements **107** and **108** may include an embedded secure element that may be attached to a substrate of the first or second mobile terminals **105** and **106** or installed therein. The embedded UICC (eUICC) is a type of secure element embedded in a terminal. First and second profiles **109** and **110** are installed as software items in the first and second embedded secure elements **107** and **108**, respectively. The first and second profiles **109** and **110** are software packages containing information corresponding to one or more existing removable UICCs. For example, the first and second profiles **109** and **110** may be defined as software packages that contain user data, such as one or more applications, subscriber authentication information and phonebook data, embedded in a UICC.

The profile provider **102** may be directly operated by a Mobile Network Operator (MNO) or may be operated by an agent fully trusted by the MNO. The profile provider **102** generates a profile for a subscriber subscribing to the corresponding mobile network operator, encrypts the profile, and sends the encrypted profile to the first and second profile managers **103** and **104**. The profile provider **102** may be implemented as, for example, a profile providing server as in FIG. **1**.

The first and second profile managers **103** and **104** manage profiles for the first and second embedded secure elements **107** and **108**, respectively. Due to characteristics of secure elements based on smart card technology, the same security key information is configured in both the first and second embedded secure elements **107** and **108** and the first and second profile managers **103** and **104** before the first and second mobile terminals **105** and **106** are sold to a user (typically, at the time of terminal manufacture). Hence, the first and second profile managers **103** and **104** may be operated by the manufacturer of the first and second embedded secure elements **107** and **108** or the first and second mobile terminals **105** and **106**. The first and second profile managers **103** and **104** may be implemented as, for example, a profile management server as in FIG. **1**.

The first and second profile managers **103** and **104** each receive an encrypted profile from the profile provider **102** and securely send the same to the corresponding first and second embedded secure elements **107** and **108**, which decrypt and install the profiles. Thereafter, the first and second profile managers **103** and **104** each perform profile management including profile activation, deactivation, backup or deletion. According to the terminal state of a subscription to mobile network operators, the first and second embedded secure elements **107** and **108** may store multiple profiles. In this case, if the first and second mobile terminals **105** and **106** connect to a mobile communication network, one of the profiles stored in the first and second embedded secure elements **107** and **108** is selected and used.

FIG. **2** is a flowchart of a profile setting procedure according to an embodiment of the present invention.

FIG. **2** describes a procedure in which, in response to a request for a profile transfer from the first embedded secure element **107** to the second embedded secure element **108**, profile information of the first embedded secure element **107** is backed up and reconfigured so as to be installable in the second embedded secure element **108**, the reconfigured profile is installed in the second embedded secure element **108**, and processing continues according to the results of installation and Authentication Center (AuC) update.

Referring to FIG. **2**, at step **202**, the profile provider **102** or first profile manager **103** receives a profile transfer request from a user or user terminal. The profile transfer request message may include an identifier of the first mobile terminal **105** or first embedded secure element **107** and an identifier of the second mobile terminal **106** or second embedded secure element **108**. When multiple profiles are stored in the first embedded secure element **107**, the profile transfer request message may further include, an indication of the desired profile, at least one of a profile identifier, Mobile Subscriber Integrated Services Digital Network-Number (MSISDN, phone number), and IMSI. Then, the profile manager **103** sends a profile backup request message to the first mobile terminal **105**.

At step **203**, the first profile **109** stored in the first embedded secure element **107** is backed up, encrypted, and sent to the profile providing server **102**. Here, the first embedded secure element **107** of the first mobile terminal **105** encrypts the first profile **109** using a public key in a certificate of the profile provider server **102**. Alternatively, the first embedded secure element **107** of the first mobile

terminal **105** generates a symmetric key for encryption and decryption and encrypts the first profile **109** using the symmetric key, and encrypts the symmetric key using the public key in the certificate of the profile provider server **102** and sends the encrypted symmetric key to the profile provider server **102**.

In an embodiment of the present invention, the first mobile terminal **105** encrypts the entire contents of the first profile **109** for transfer. In another embodiment of the present invention, the first mobile terminal **105** encrypts only user data of the first profile **109** (such as phonebook data) excluding security-sensitive data (such as the USIM authentication key K) and sends the encrypted data. In this case, the profile provider **102** may add data corresponding to the unsent contents at step **204** (described below). In another embodiment of the present invention, if necessary, the user selects a portion of applications and data constituting the first profile **109** to be transferred to the second embedded secure element **108**.

FIG. **3** illustrates a structure of data in a mobile terminal according to an embodiment of the present invention.

Referring to FIG. **3**, the mobile terminal **300** has a terminal ID **302**. The eSE **310** embedded in the mobile terminal **300** has an eSE ID **303**. The eSE **310** stores a profile **320**.

The profile **320** has a profile ID **304**. The profile **320** includes a USIM **330**. The USIM **330** includes an IMSI **307** and K **308**. The profile **320** further includes supplementary values **305** and **306**, which are used to deactivate the profile **320** when the profile **320** is illegitimately copied or cloned to another eSE. The profile **320** may further include an eSE ID **305** indicating the identifier of the eSE in which the profile **320** is to be installed. Here, terminal ID may be used instead of eSE ID, eSE ID and terminal ID may be used together, or a combination of eSE ID and terminal ID may be used. Later, for ease of description, it is assumed that only eSE ID is used in the field **305**.

The profile **320** may further include a digital signature **306**. The digital signature **306** may be used to detect illegitimate modification of the eSE ID **305** or USIM **330** by a third party attempting to clone the eSE **310**. The profile provider may generate the digital signature **306** by applying a digital signing procedure to the profile ID **304**, eSE ID and/or terminal ID **305**, and IMSI **307** and/or K **308** of the USIM **330**.

In one embodiment of the present invention, the digital signature **306** may be generated using the following Equation 1.

$$\text{Digital Signature}=\text{RSAwithSHA1}(\text{Profile ID}|\text{eSE ID}|\text{IMSI}) \quad \text{Equation 1}$$

When the digital signature **306** is generated using the profile ID **304**, eSE ID **305** and IMSI **307**, illegitimate copying of both the profile **320** and the USIM **330** through examination of the digital signature **306** is prevented.

In another embodiment of the present invention, the digital signature **306** is generated using only the profile ID **304** and eSE ID **305**. That is, the digital signature **306** is generated using the following Equation 2.

$$\text{Digital Signature}=\text{RSAwithSHA1}(\text{Profile ID}|\text{eSE ID}) \quad \text{Equation 2}$$

In this embodiment of the present invention, illegitimate copying of the profile **320** is prevented while illegitimate copying of the USIM **330** is not prevented.

In another embodiment of the present invention, the digital signature **306** may be generated using only the profile ID **304** and IMSI **307**. That is, the digital signature **306** may be generated using the following Equation 3.

$$\text{Digital Signature}=\text{RSAwithSHA1}(\text{Profile ID}|\text{IMSI}) \quad \text{Equation 3}$$

In this embodiment of the present invention, illegitimate copying of the profile **320** is not prevented, while illegitimate copying of the USIM **330** is prevented.

FIG. **4** is a flowchart of a profile activation procedure according to an embodiment of the present invention. The mobile terminal **300** activates the profile according to the procedure of FIG. **4**, and detects illegitimate copying of the profile and/or the USIM.

Referring to FIG. **4**, at step **402**, the embedded secure element (eSE) **310** selects a profile. In an embodiment of the present invention, the eSE **310** selects a profile according to a user selection through the touchscreen or keypad. In another embodiment of the present invention, when the mobile terminal **300** boots or transitions from flight mode to communication mode, the eSE **310** automatically selects a profile. The eSE **310** selects at least one stored profile in a suitable manner.

At step **403**, the eSE **310** verifies the eSE ID in the selected profile. As described above, the terminal ID may be used instead of the eSE ID, or a combination of the eSE ID and terminal ID may be used.

If the eSE ID is not correct, the eSE **310** proceeds to step **404** at which the eSE **310** does not use the selected profile. Here, the eSE **310** discards the selected profile. Then, the eSE **310** selects another profile and repeats the above procedure. Here, a profile having an incorrect identifier is not used. If the eSE ID is correct, the eSE **310** proceeds to step **405**.

At step **405**, the eSE **310** verifies the digital signature in the selected profile. If the digital signature is correct, the eSE **310** proceeds to step **406** at which the eSE **310** uses the selected profile. If the digital signature is not correct, the eSE **310** proceeds to step **404** at which the eSE **310** does not use the selected profile and discards it.

Referring to FIG. **2**, at step **204**, the profile provider **102** reconfigures the second profile **110** using data in the received first profile **109**.

For profile reconfiguration with reference to a scheme for illegitimate copy prevention described in FIGS. **3** and **4**, the profile provider **102** replaces the identifier of the first embedded secure element **107** in the first profile **109** with the identifier of the second embedded secure element **108** and regenerates the signature correspondingly.

In addition, if the reconfigured second profile **110** is successfully installed in the second embedded secure element **108**, the existing first profile **109** installed in the first embedded secure element **107** is removed or invalidated. If the first profile **109** is not removed due to a technical error or malicious intent, to prevent illegitimate use of the first profile **109**, the profile provider **102** generates the second profile using the USIM authentication key K of the second profile **110** to be installed in the second embedded secure element **108** at step **204**. The K of the second profile **110** may differ from that of the first profile **109**. Alternatively, the profile provider **102** sends the AuC of the corresponding mobile network operator a request for updating the K of the first profile **109** with that of the second profile **110**. Then, the AuC updates the K in accordance with the profile. While the first profile **109** is not removed from the first embedded secure element **107**, as the K of the AuC is changed, the first mobile terminal **105** is unable to connect to a 3GPP network using the USIM of the first profile **109**. In other words, when a connection approval request is received from the first mobile terminal **105** using the first profile **109**, the AuC performs authentication using the K stored in the AuC. In this embodiment of the present invention, as the K stored in the AuC is updated with the K corresponding to the second

profile **110**, the connection approval request made by the first mobile terminal **105** using the old K is rejected.

At step **205**, the reconfigured second profile **110** is installed in the second embedded secure element **108**. The installation result is sent to the profile provider **102** and the first and second profile managers **103** and **104**.

If installation of the second profile **110** is unsuccessful, the procedure ends. Hence, the first profile **109** installed in the first mobile terminal **105** remains in the same state as before the profile transfer request was made.

If installation of the second profile **110** is successful, the profile provider **102** proceeds to step **206** at which the profile provider **102** sends an update K request to the AuC. The AuC updates the K and sends the update result to the profile provider **102**.

If update of the K is successful, the profile provider **102** proceeds to step **208** at which the profile provider **102** sends a request message for deleting the first profile **109** to the first mobile terminal **105**. Then, the first mobile terminal **105** deletes the first profile **109**. As described above, although the first profile **109** is not removed at step **208** due to a technical error or malicious intent, as the AuC has updated the K at operation **206**, the first mobile terminal **105** using the first profile **109** is not allowed to access the network.

If update of the K is unsuccessful at step **206**, the profile provider **102** proceeds to step **207** at which the profile provider **102** sends a request message to delete the second profile **110** to the second mobile terminal **106**. Then, the second mobile terminal **106** deletes the second profile **110** and returns to the state before the profile transfer request was made. Here, although the second profile **110** is not removed due to a technical error or malicious intent, as the AuC has failed to update the K at step **206**, the second mobile terminal **106** using the second profile **110** is not allowed to access the communication network.

Through the procedure described above, the profile is transferred from the first mobile terminal **105** to the second mobile terminal **106** in a secure manner. If a failure occurs at any step of the procedure, the initial state is recovered as in the case of transaction processing.

FIG. **5** is a sequence diagram illustrating a profile setting procedure according to an embodiment of the present invention.

The embodiment described in FIG. **5** may be realized on the system disclosed in FIG. **1**.

Referring to FIG. **5**, at step **505**, the MNO **502** receives a profile transfer request message from a user **500**. With regard to FIG. **2**, the profile transfer request message includes an identifier of the first mobile terminal **105** or first embedded secure element **107** and an identifier of the second mobile terminal **106** or second embedded secure element **108**. If multiple profiles are stored in the first embedded secure element **107**, the profile transfer request message further includes, to indicate a desired profile, at least one of a profile identifier, MSISDN and IMSI.

In step **510**, user authentication is performed between the MNO **502** and the user **500**. A request from an unauthorized user is rejected. If user authentication is successfully, the procedure continues to the next step.

In step **515**, the MNO **502** forwards the received profile transfer request message to the profile provider **102**.

In step **520**, to find the address of a profile manager related to the first embedded secure element **107** of the first mobile terminal **105** at which the profile to be transferred is stored, the profile provider **102** sends a query to the address search server **111** and receives a corresponding response therefrom. Instead of the address search server **111**, another type of address search interface or address storage device may beused. The address search server **111** is implemented as a distributed server such as a Domain Name Service (DNS) server. Alternatively, the profile provider **102** may directly store and manage addresses corresponding to individual embedded secure elements. In this embodiment of the present invention, the profile provider **102** finds the address of the first profile manager **103** without external communication, where the address may be in the form of an IP address and/or a domain address.

In step **525**, the profile provider **102** sends a profile backup request message to the first profile manager **103**, using the found address, where the profile backup request message includes an identifier of the first profile **109** to be transferred, an identifier of the first embedded secure element **107** (or the first mobile terminal **105**), and a certificate of the profile provider **102**. The certificate of the profile provider **102** includes an identifier of the MNO **502** as a field, and signing is performed based thereon.

In step **530**, the first profile manager **103** forwards the profile backup request message to the first mobile terminal **105**. The first profile manager **103** extracts the identifier of the first mobile terminal **105** or first embedded secure element **107** from the received profile backup request message, and identifies the destination to which the profile backup request message is to be forwarded. In particular, if an MSISDN is delivered through step **515**, an SMS message may be sent as a profile backup request message to the desired terminal, where the profile backup request message includes an identifier of the first profile **109** and a certificate of the profile provider **102**.

Upon reception of the profile backup request message, at step **535**, the first mobile terminal **105** encrypts the profile. The first embedded secure element **107** of the first mobile terminal **105** identifies the identifier of the target profile **109** from the received profile backup request message. The first embedded secure element **107** encrypts at least a portion of the target profile **109**. Profile encryption is described in detail with reference to FIG. **2**.

In FIG. **5**, in step **540**, the first mobile terminal **105** sends the encrypted profile to the first profile manager **103**. Only when the MNO ID contained in the certificate of the profile provider is identical to the MNO ID contained in the profile **109** and the certificate is determined to be valid, are steps **535** (encryption) and **540** (transfer) performed.

In step **545**, the first profile manager **103** forwards the backed-up profile to the profile provider **102**.

In step **550**, the profile provider **102** configures a second profile **110** on the basis of the received profile and a new K. A description of how to configure the second profile **110** is provided with reference to FIGS. **2** to **4**.

In FIG. **5**, in step **555**, the profile provider **102** finds the address of the profile manager **105** related to the second embedded secure element **108** that will receive the second profile **110** through communication with the address search server **111**. Address search is similar to that in step **520**. As described above, when the profile provider **102** directly maintains address information', it finds a desired address without external communication.

In step **560**, the profile provider **102** installs the second profile **110** in the second embedded secure element **108** of the second mobile terminal **106** via the second profile manager **104**. The second profile **110** may be encrypted as in the case of the first profile **109**. If installation is successful, the procedure continues to the next step.

In step **565**, the profile provider **102** sends the AuC of the MNO **502** a request message for updating the K of the corresponding profile.

In step **570**, the AuC notifies the profile provider **102** of the update result.

If update of the K is successful, in step **575**, the profile provider **102** sends a request message for deleting the first profile **109** to the first mobile terminal **105**. If update of the K is unsuccessful, the second profile **110** will be deleted.

FIG. **6** is a sequence diagram illustrating a profile setting procedure according to an embodiment of the present invention.

The embodiment of the invention disclosed in FIG. **6** is similar to that of FIG. **5**, but differs in that profile transfer is triggered by the first mobile terminal **105**.

Referring to FIG. **6**, according to a user input or the like, the first mobile terminal **105** attempts to transfer the first profile **109** to the second embedded secure element **108** of the second mobile terminal **106**. In step **605**, the first mobile terminal **105** finds the address of a profile manager related to the first embedded secure element **107** through communication with the address search server **111**. As described above, when the first mobile terminal **105** directly maintains such addresses, step **605** is skipped.

In step **610**, the first mobile terminal **105**, using the found address, sends a profile transfer request message to the first profile manager **103**. The profile transfer request message includes an identifier of the first embedded secure element **107**, an identifier of a profile to be transferred (e.g. Profile ID, MSISDN or IMSI), and an identifier of the second embedded secure element **108**.

In step **615**, the first profile manager **103** finds the address of a profile provider **102** related to the first embedded secure element **107** through communication with the address search server **111**. As described above, when the first profile manager **103** directly maintains such addresses, step **615** may be skipped.

In step **620**, the first profile manager **103** forwards the received profile transfer request message to the profile provider **102**.

Subsequently, steps **620** to **675** are identical or similar to steps **520** to **575** of FIG. **5**, and hence a detailed description thereof is omitted.

FIG. **7** is a block diagram of a profile provider according to an embodiment of the present invention.

Referring to FIG. **7**, the profile provider includes a communication unit **710** and a control unit **720**.

The communication unit **710** sends and receives signals, which are required to realize at least part of the embodiments described in connection with FIGS. **1** to **6**. For example, in FIG. **7**, the communication unit **710** receives a profile transfer request message and sends a profile backup request message. The communication unit **710** sends an update request message for the K to the AuC and receives a corresponding result message. In addition, the communication unit **710** sends and receives encrypted profiles.

The control unit **720** performs processing required to realize at least part of the embodiments described in connection with FIGS. **1** to **6** and controls individual components of the profile provider accordingly. In particular, in FIG. **7**, the control unit **720** decrypts an encrypted profile and encrypts a plaintext profile.

FIG. **8** is a block diagram of a profile manager according to an embodiment of the present invention.

Referring to FIG. **8**, the profile manager includes a communication unit **810** and a control unit **820**.

The communication unit **810** sends and receives signals, which are required to realize at least part of the embodiments described in connection with FIGS. **1** to **6**. For example, in FIG. **8** the communication unit **810** sends and receives a profile transfer request message and a profile backup request message. In addition, the communication unit **810** sends and receives encrypted profiles.

The control unit **820** performs processing required to realize at least part of the embodiments described in connection with FIGS. **1** to **6** and controls individual components of the profile manager accordingly.

FIG. **9** is a block diagram of a mobile terminal according to an embodiment of the present invention.

Referring to FIG. **9**, the mobile terminal includes a communication unit **910** and a control unit **920**. The control unit **920** includes an embedded secure element **930**.

The communication unit **910** sends and receives signals, which are required to realize at least part of the embodiments described in connection with FIGS. **1** to **6**. For example, in FIG. **9**, the communication unit **910** sends and receives a profile transfer request message and a profile backup request message. In addition, the communication unit **910** sends and receives encrypted profiles.

The control unit **920** performs processing required to realize at least part of the embodiments described in connection with FIGS. **1** to **6** and controls individual components of the mobile terminal accordingly. In particular, in FIG. **9**, the control unit **920** installs a profile in the embedded secure element **930** or uninstalls a profile therefrom. The control unit **920** encrypts or decrypts a profile. Among steps performed by the embedded secure element **930**, some steps suitable for external processing may be performed by an entity external to the embedded secure element **930**.

With regard to a removable UICC, when changing a terminal from a first terminal to a second terminal, the UICC is removed from the first terminal and be is inserted into the second terminal. In this case, as a physical card is transferred, the problem of card copying or duplication between two terminals does not arise.

In an environment where a software profile corresponding to one existing UICC is transferred between two embedded secure elements of different terminals, the problem of illegitimate copying or duplicated usage of a profile may arise. Additionally, in the event that a failure occurs while the profile of a first mobile terminal is copied to a second mobile terminal and is removed, both the first mobile terminal and the second mobile terminal may use the profile or neither may use the profile. This is an erroneous situation.

According to various embodiments of the present invention, when a user purchases a new mobile terminal or replaces an existing mobile terminal, the existing profile of the first mobile terminal can be safely transferred to the second mobile terminal. Moreover, after the profile is successfully transferred, only the second profile of the second mobile terminal is usable. When a failure occurs during profile transfer, the initial state is restored and only the first profile of the first mobile terminal is usable. Hence, characteristics of transaction processing (all or nothing) are achieved. In addition to applications provided initially by the MNO, applications added later to the profile (e.g. NFC banking/card application) and data added by the user (e.g. phonebook) may be transferred. In one embodiment of the present invention, unlike an existing removable UICC (which carries all stored data when removed from or inserted into a terminal), it is possible to back up and transfer all or a portion of the contents of a profile according to user or MNO selection.

The backed-up first profile is reconfigured by the profile providing server into a second profile through data addition or modification so that the second profile is installable in the second embedded secure element. When a profile is backed up, security information such as USIM key (K) is excluded from the backup target. Hence, the security risk is minimized even if the backed-up profile is leaked.

During profile reconfiguration, the first eSE ID is replaced with the second eSE ID so that the second profile is operable only in the second embedded secure element, preventing illegitimate profile copying. In addition, when the second profile is generated, the K managed by the AuC is changed. Hence, even when the first profile is not removed from the first embedded secure element, the first profile cannot be illegitimately used. Thereby, a security mechanism is provided.

In an embodiment of the present invention, security sensitive information (e.g. authentication key K of the USIM application) in the contents of a profile is not backed up, and the profile providing server adds corresponding data during profile reconfiguration, thereby minimizing the risk due to leakage. In the present invention, it is possible for the user or manager to designate applications and data to be backed up or transferred.

As described above, when a profile is successfully copied to the new embedded secure element, the profile is deleted from the old embedded secure element. It is necessary to cope with the possibility that two copies of the same profile are present in two mobile terminals due to one copy not being deleted because of an error or malicious intent. In an embodiment of the present invention, when a new profile is configured, the profile provider changes the USIM K and updates the AuC accordingly, preventing access to the communication network using the old profile.

As described above, it is necessary to prevent a profile from being copied to another embedded secure element without permission.

In an embodiment of the present invention, a profile is configured to include the identifier of the embedded secure element in which the profile is to be installed (eSE ID) and an associated digital signature, so that the profile is either not installable or is inoperable in a different embedded secure element. The digital signature prevents the eSE ID from being modified. The digital signature may be generated on the basis of a concatenation of important parameters in the profile (e.g. profile ID, eSE ID and IMSI) and a public key of the certificate of the profile providing server. Other similar schemes may be used to generate the digital signature. When the profile is transferred, the profile provider may change certain values and regenerate the digital signature.

It is known to those skilled in the art that blocks of a flowchart (or sequence diagram) and a combination of flowcharts may be represented and executed by computer program instructions. These computer program instructions may be loaded on a processor of a general purpose computer, special purpose computer or programmable data processing equipment. When the loaded program instructions are executed by the processor, they create a means for carrying out functions described in the flowchart. As the computer program instructions may be stored in a computer readable memory that is usable in a specialized computer or a programmable data processing equipment, it is also possible to create articles of manufacture that carry out functions described in the flowchart. As the computer program instructions may be loaded on a computer or a programmable data processing equipment, when executed as processes, they may carry out steps of functions described in the flowchart.

A block of a flowchart may correspond to a module, a segment or code containing one or more executable instructions implementing one or more logical functions, or to a part thereof. In some cases, functions described by blocks may be executed in an order different from the listed order. For example, two blocks listed in sequence may be executed at the same time or executed in reverse order.

In the description, the word "unit", "module" or the like may refer to a software component or hardware component such as a Field Programmable Gate Array (FPGA) or an Application Specific Integrated Circuit (ASIC) capable of carrying out a function or an operation. However, "unit" or the like is not limited to hardware or software. A unit or the like may be configured so as to reside in an addressable storage medium or to drive one or more processors. Units or the like may refer to software components, object-oriented software components, class components, task components, processes, functions, attributes, procedures, subroutines, program code segments, drivers, firmware, microcode, circuits, data, databases, data structures, tables, arrays or variables. A function provided by a component and unit may be a combination of smaller components and units, and may be combined with other components and units to compose large components and units. Components and units may be configured to drive a device or one or more processors in a secure multimedia card.

The above description is provided to assist in a comprehensive understanding of various embodiments of the present invention. It includes various specific details to assist in that understanding but these are to be regarded as mere examples. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the present disclosure.

Embodiments of the present invention have been described with reference to the accompanying drawings. Specific terms or words used in the description should be construed in accordance with the spirit of the present invention without limiting the subject matter thereof. It should be understood that many variations and modifications of the basic inventive concept described herein will still fall within the spirit and scope of the present invention as defined in the appended claims and their equivalents.

What is claimed is:

1. A method for a profile server, the method comprising:

receiving, from a first terminal, a first message that requests transfer of a portion or a whole of a first profile from a first module in the first terminal to a second module in a second terminal;

generating a second profile **[**using**]** *including* the portion **[**or the whole**]** of the first profile *and an identifier of the second module of the second terminal and a signature which is obtained based on the identifier of the second module of the second terminal*; **[**and**]**

transmitting, to the second terminal, the generated second profile*;*

transmitting, to an authentication server, in response to the second profile being successfully installed in the second module, a third message requesting update of authentication key information stored in the authentication server based on the second profile; and

transmitting, to the first terminal, a fourth message that requests a deletion of the first profile in case that the authentication key information is updated successfully.

2. The method of claim **1**, wherein **[**receiving of**]** the first message **[**comprises: receiving, from the first terminal,**]** *includes* the portion or the whole of the first profile.

3. The method of claim 1, further comprising:

transmitting, to the first terminal, a second message requesting the portion or the whole of the first profile; and

receiving, from the first terminal, the portion or the whole of the first profile.

[4. The method of claim 1, further comprising:

transmitting, if the second profile is successfully installed in the second module, a third message requesting update of authentication key information associated with the second profile to an authentication center (AuC)].

5. The method of claim [4] *1*, further comprising:

transmitting, to the first terminal, a [fourth] *fifth* message that requests a deletion of the first profile[if the authentication key information is updated successfully], *when the second profile is successfully installed in the second module of the second terminal.*

6. A profile server, comprising:

a transceiver; and

a controller configured to:

[control the transceiver to] receive, *via the transceiver,* from a first terminal, a first message that requests transfer of a portion or a whole of a first profile from a first module in the first terminal to a second module in a second terminal, and

generate a second profile [using] *including* the portion [or the whole] of the first profile *and an identifier of the second module of the second terminal and a signature which is obtained based on the identifier of the second module of the second terminal*, [and]

[control the transceiver to] transmit, *via the transceiver,* to the second terminal, the generated second profile,

transmit, to an authentication server, via the transceiver, when the second profile is successfully installed in the second module, a third message requesting update of authentication key information stored in the authentication server based on the second profile, and

transmit, to the first terminal, a fourth message that requests a deletion of the first profile in case that the authentication key information is updated successfully.

7. The profile server of claim 6, wherein the [controller is further configured to control the transceiver to receive, from the first terminal,] *first message includes* the portion or the whole of the first profile.

8. The profile server of claim 6, wherein the controller is further configured to [control the transceiver to] transmit, *via the transceiver,* to the first terminal, a second message requesting the portion or the whole of the first profile, and receive, *via the transceiver,* from the first terminal, the portion or the whole of the first profile.

[9. The profile server of claim 6, wherein the controller is further configured to control the transceiver to transmit, if the second profile is successfully installed in the second module, a third message requesting update of authentication key information associated with the second profile to an authentication center (AuC) transmit, via the transceiver, to the first terminal, a fourth message that requests a deletion of the first profile if the authentication key information is updated successfully].

10. The profile server of [claim 9] *claim 6*, wherein the controller is further configured [to control the transceiver] to transmit, *via the transceiver,* to the first terminal, a [forth] *fifth* message that requests a deletion of the first profile[if the authentication key information is updated successfully], *when the second profile is successfully installed in the second module of the second terminal.*

11. The profile server of claim 6, wherein the first profile includes at least one of an identifier of the first module, an identifier of the first terminal, and a signature obtained based on the identifier of the first module, and

wherein the second profile includes at least one of the identifier of the second module, an identifier of the second terminal, and the signature which is obtained based on the identifier of the second module of the second terminal.

12. The method of claim 1, wherein the first profile includes at least one of an identifier of the first module, an identifier of the first terminal, and a signature obtained based on the identifier of the first module, and

wherein the second profile includes at least one of the identifier of the second module, an identifier of the second terminal, and the signature which is obtained based on the identifier of the second module of the second terminal.

13. A method for a terminal, the method comprising:

transmitting, to a profile server, a first message that requests transfer of a portion or a whole of a first profile from a first module in the terminal to a second module in another terminal;

receiving, from the profile server, a second message that requests a deletion of the first profile; and

deleting the first profile from the first module based on the second message,

wherein an authentication server is requested to update authentication key information based on a second profile, in response to the second profile being successfully installed in the second module,

wherein the second message is transmitted from the profile server to the terminal, in response to the second profile including the portion of the first profile and an identifier of the second module of the another terminal and a signature which is obtained based on the identifier of the second module of the another terminal being generated by the profile server, the second profile being transmitted from the profile server to the another terminal, the second profile being successfully installed in the second module, and the authentication key information stored in the authentication server being successfully updated based on the second profile.

14. The method of claim 13, wherein the first message includes the portion or the whole of the first profile.

15. The method of claim 13, further comprising:

receiving, from the profile server, a third message requesting the portion or the whole of the first profile; and

transmitting, to the profile server, the portion or the whole of the first profile based on the third message.

16. The method of claim 13, wherein the first profile includes at least one of an identifier of the first module, an identifier of the terminal, and a signature obtained based on the identifier of the first module, and

wherein the second profile includes at least one of the identifier of the second module, an identifier of the another terminal, and the signature which is obtained based on the identifier of the second module of the another terminal.

17. A terminal, comprising:

a transceiver,

a first module; and

a controller configured to:

transmit, via the transceiver, to a profile server, a first message that requests transfer of a portion or a

whole of a first profile from the first module to a second module in another terminal,

receive, via the transceiver, from the profile server, a second message that requests a deletion of the first profile, and

delete the first profile from the first module based on the second message,

wherein an authentication server is requested to update authentication key information based on a second profile, when the second profile is successfully installed in the second module, and

wherein the second message is transmitted from the profile server to the terminal, when the second profile including the portion of the first profile and an identifier of the second module of the another terminal and a signature which is obtained based on the identifier of the second module of the another terminal is generated by the profile server, the second profile is transmitted from the profile server to the another terminal, the second profile is successfully installed in the second module, and the authentication key information stored in the authentication serve is successfully updated based on the second profile.

18. The terminal of claim 17, wherein the first message includes the portion or the whole of the first profile.

19. The terminal of claim 17, wherein the controller is further configured:

receive, via the transceiver, from the profile server, a third message requesting the portion or the whole of the first profile, and

transmit, via the transceiver, to the profile server, the portion or the whole of the first profile based on the third message.

20. The terminal of claim 17, wherein the first profile includes at least one of an identifier of the first module, an identifier of the terminal, and a signature obtained based on the identifier of the first module, and

wherein the second profile includes at least one of the identifier of the second module, an identifier of the another terminal, and the signature which is obtained based on the identifier of the second module of the another terminal.

* * * * *