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(54) **SYSTEMS AND METHODS FOR PROCESSING MOBILE PAYMENTS BY PROVISIONING CREDENTIALS TO MOBILE DEVICES WITHOUT SECURE ELEMENTS**

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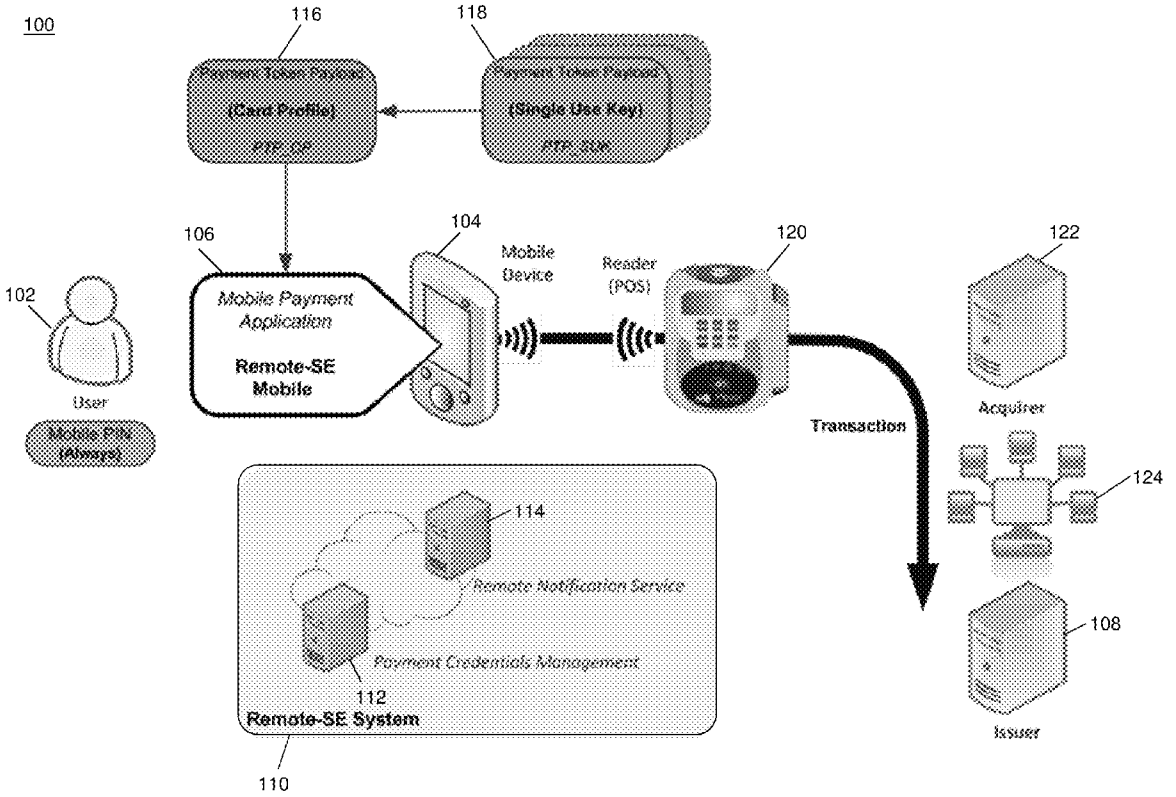
USPC **705/71**; 705/72

(57) **ABSTRACT**

A method for generating and provisioning payment credentials to a mobile device lacking a secure element includes: generating a card profile associated with a payment account, wherein the card profile includes at least payment credentials corresponding to the associated payment account and a profile identifier; provisioning, to a mobile device lacking a secure element, the generated card profile; receiving, from the mobile device, a key request, wherein the key request includes at least a mobile identification number (PIN) and the profile identifier; using the mobile PIN; generating a single use key, wherein the single use key includes at least the profile identifier, an application transaction counter, and a generating key for use in generating a payment cryptogram valid for a single financial transaction; and transmitting the generated single use key to the mobile device.



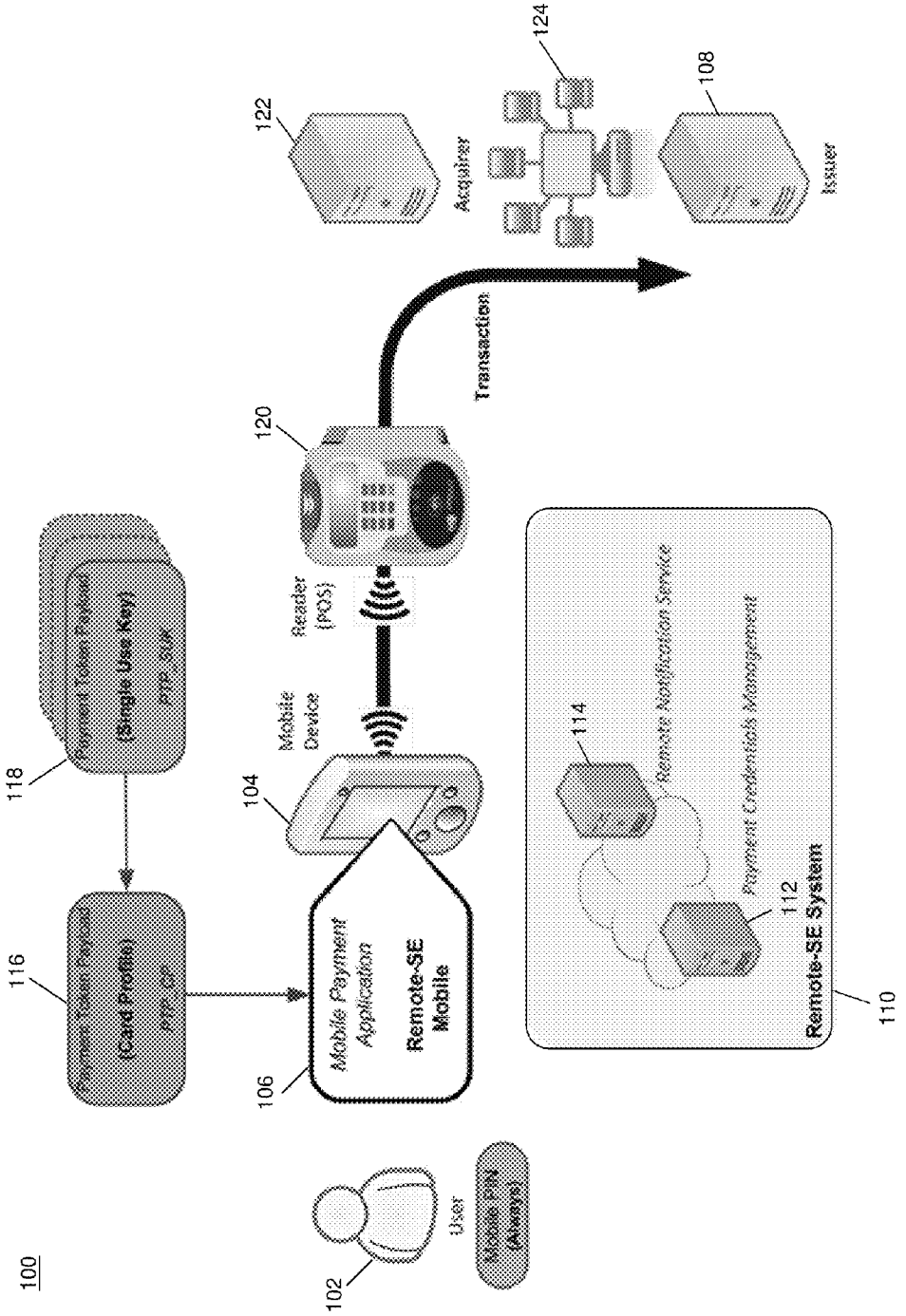

100
102
User
Mobile PIN (Always)
106
Mobile Payment Application
Remote-SE Mobile
116
Payment Token Profile
(Card Profile)
118
Payment Token Profile
(Single Use Key)
104
Mobile Device
120
Reader (POS)
Transaction
122
Acquirer
124
108
Issuer
110
Remote-SE System
112
Payment Credentials Management
114
Remote Notification Service

FIG. 1

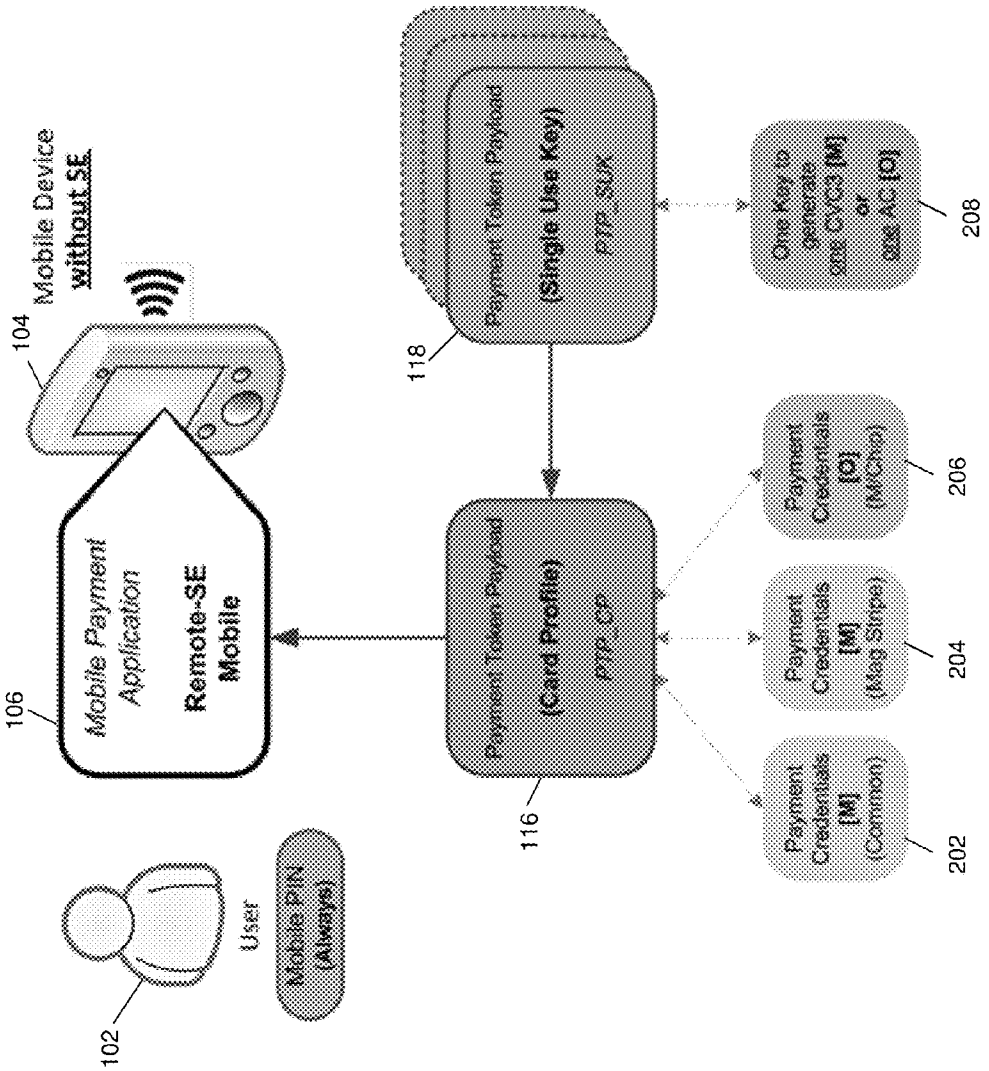

Mobile Device
without SE
104
106
Mobile Payment Application
Remote-SE Mobile
102
User
Mobile PIN (Always)
Payment Token Payload
(Card Profile)
PTP_CP
116
Payment Token Payload
(Single Use Key)
PTP_SUK
118
Payment Credentials [M] (Common)
202
Payment Credentials [M] (Mag Stripe)
204
Payment Credentials [O] (MChip)
206
One Key to generate one CVC3 [M] or one AC [O]
208

FIG. 2

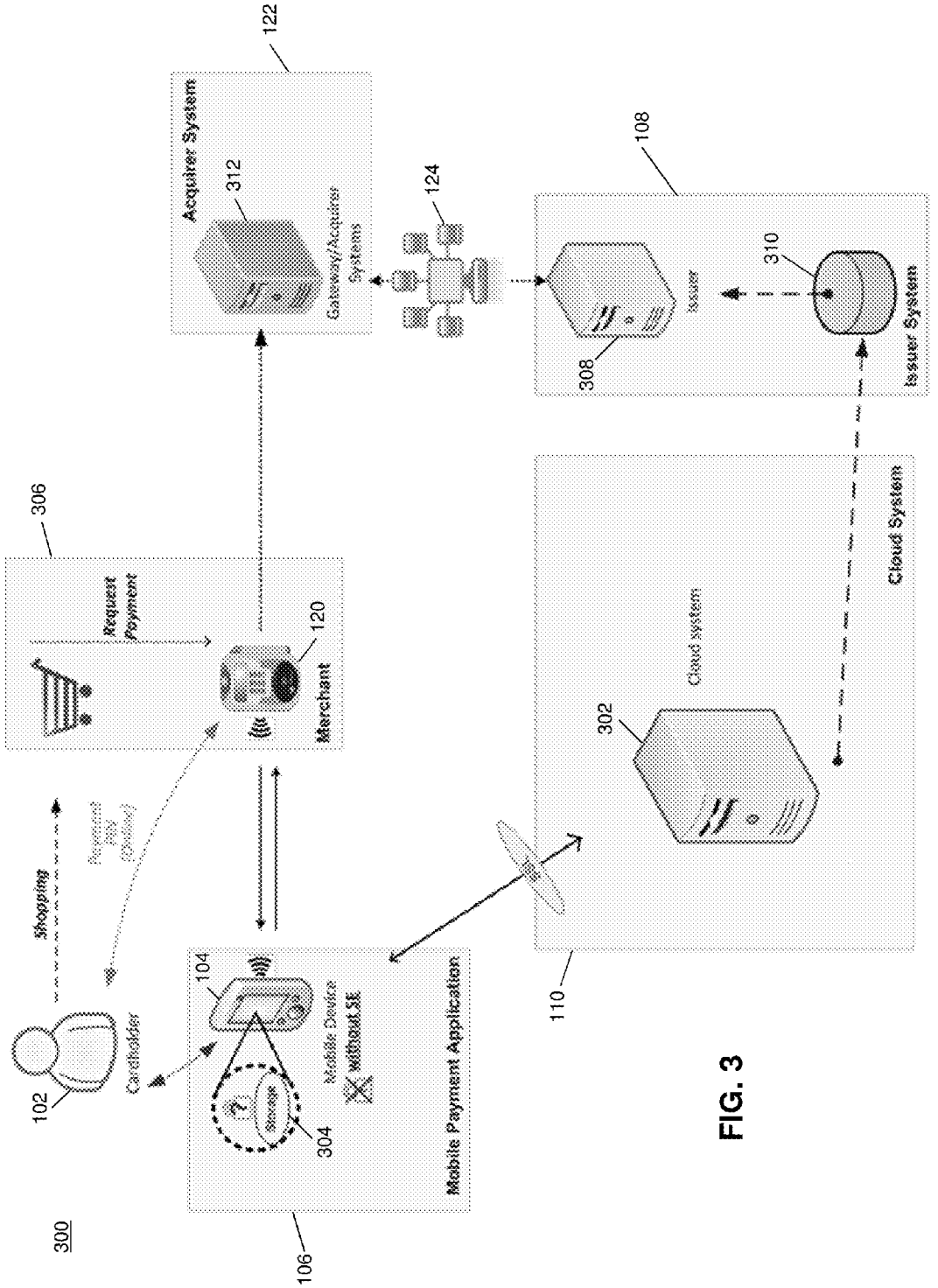

300
102
Cardholder
Shopping
Payment PIN (Online)
104
Mobile Device
without SE
Storage
304
Mobile Payment Application
106
306
Request Payment
120
Merchant
122
Acquirer System
312
Gateway/Acquirer Systems
124
108
Issuer
308
310
Issuer System
Cloud System
Cloud system
302
110

FIG. 3

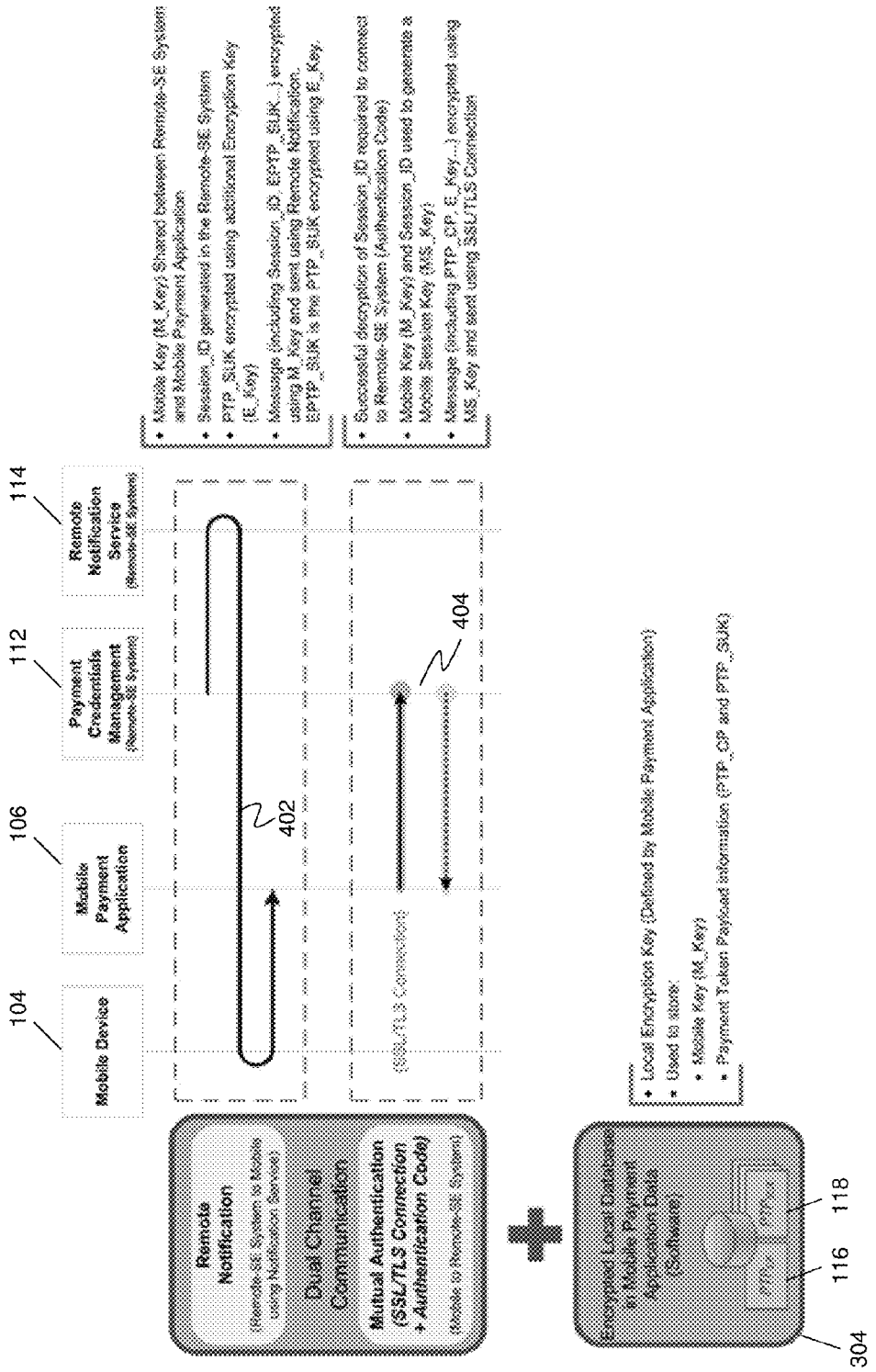

104
Mobile Device
106
Mobile Payment Application
112
Payment Credentials Management (Remote-SE System)
114
Remote Notification Service (Remote-SE System)
402
404
(SSL/TLS Connection)
Mobile Key (M_Key) Shared between Remote-SE System and Mobile Payment Application
Session_ID generated in the Remote-SE System
PTP_SUK encrypted using additional Encryption Key (E_Key)
Message (including Session_ID, EPTP_SUK...) encrypted using M_Key and sent using Remote Notification. EPTP_SUK is the PTP_SUK encrypted using E_Key.
Successful decryption of Session_ID required to connect to Remote-SE System (Authentication Code)
Mobile Key (M_Key) and Session_ID used to generate a Mobile Session Key (MS_Key)
Message (including PTP_CP, E_Key...) encrypted using MS_Key and sent using SSL/TLS Connection
Remote Notification
(Remote-SE System to Mobile using Notification Service)
Dual Channel Communication
Mutual Authentication (SSL/TLS Connection + Authentication Code)
(Mobile to Remote-SE System)
Encrypted Local Data in Mobile Payment Application Data (Software)
Local Encryption Key (Defined by Mobile Payment Application)
Used to store:
Mobile Key (M_Key)
Payment Token Payload Information (PTP_CP and PTP_SUK)
304
116
118

FIG. 4

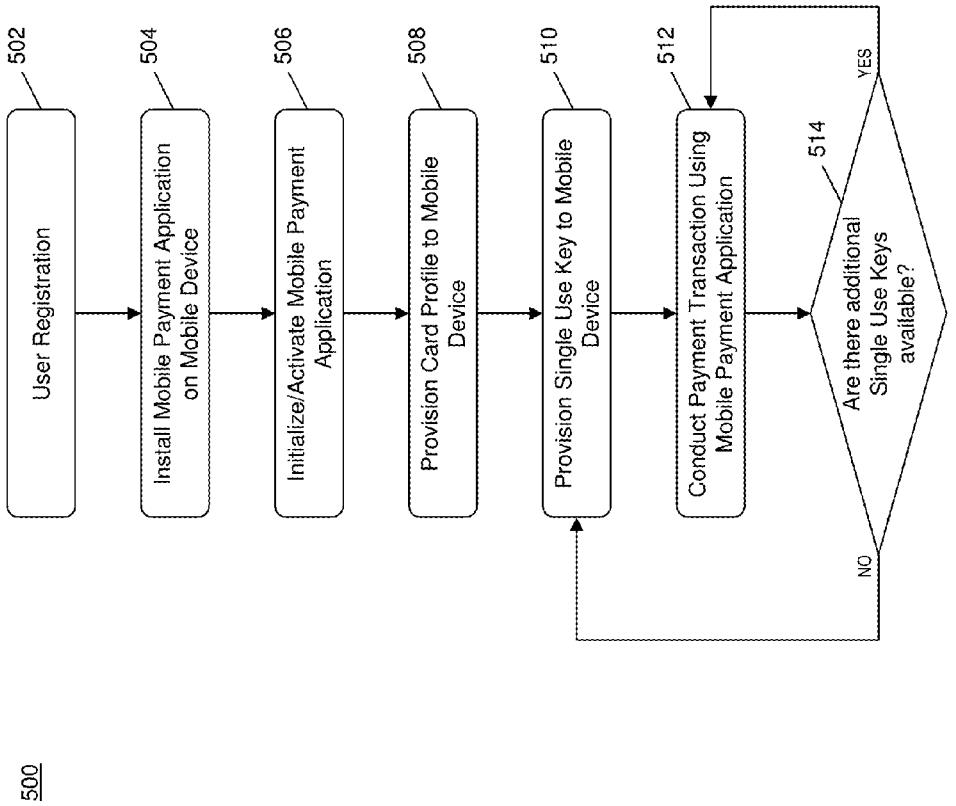

500
502
User Registration
504
Install Mobile Payment Application on Mobile Device
506
Initialize/Activate Mobile Payment Application
508
Provision Card Profile to Mobile Device
510
Provision Single Use Key to Mobile Device
512
Conduct Payment Transaction Using Mobile Payment Application
514
Are there additional Single Use Keys available?
YES
NO

FIG. 5

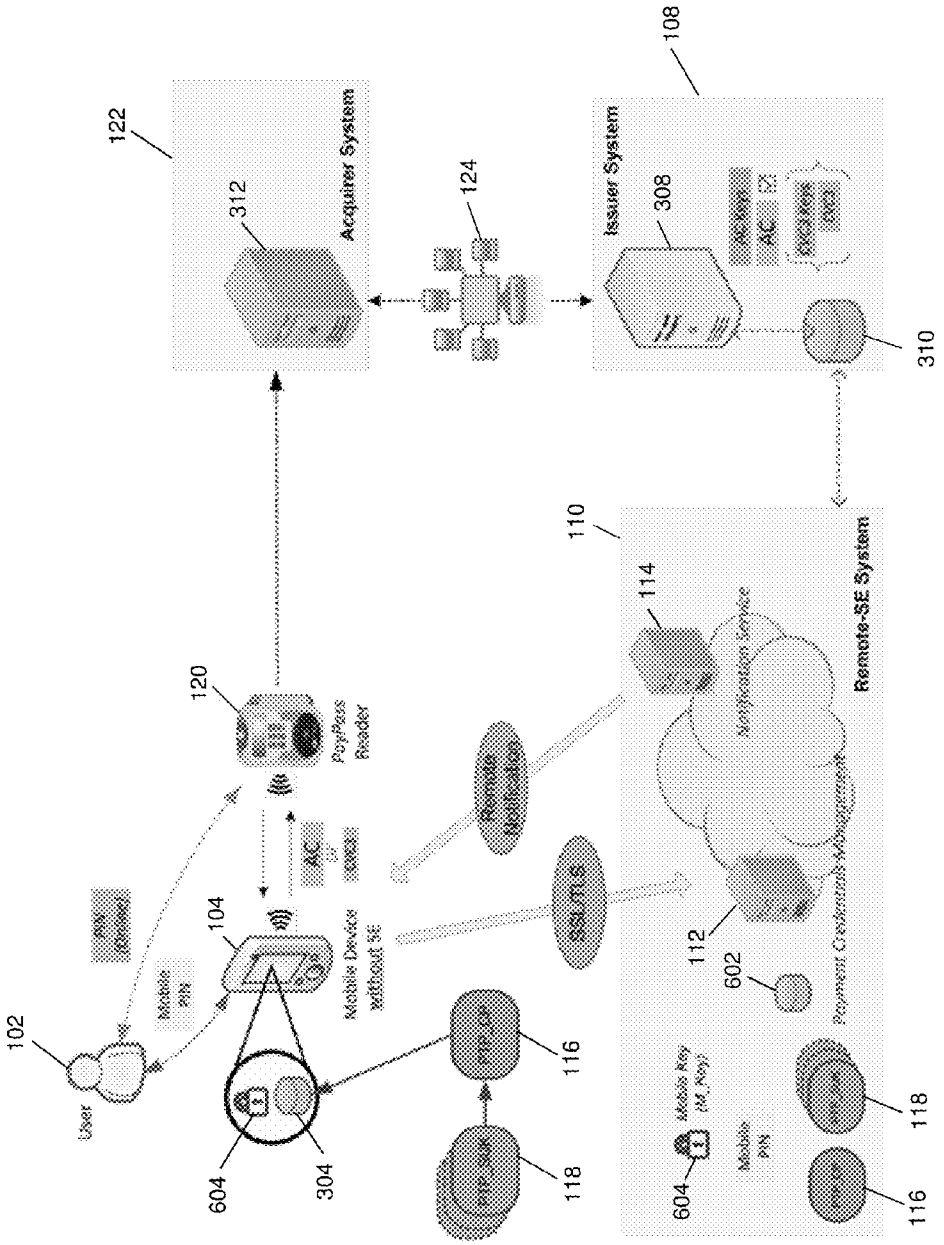

122
Acquirer System
312
124
108
Issuer System
308
AC
310
110
Remote-SE System
114
Notification Service
112
602
Payment Credentials Management
120
PayPass Reader
Remote Notification
SSL/TLS
104
Mobile Device without SE
AC
102
User
Mobile PIN
604
304
116
118
Mobile Key (M_Key)
Mobile PIN
604
118
116

FIG. 6

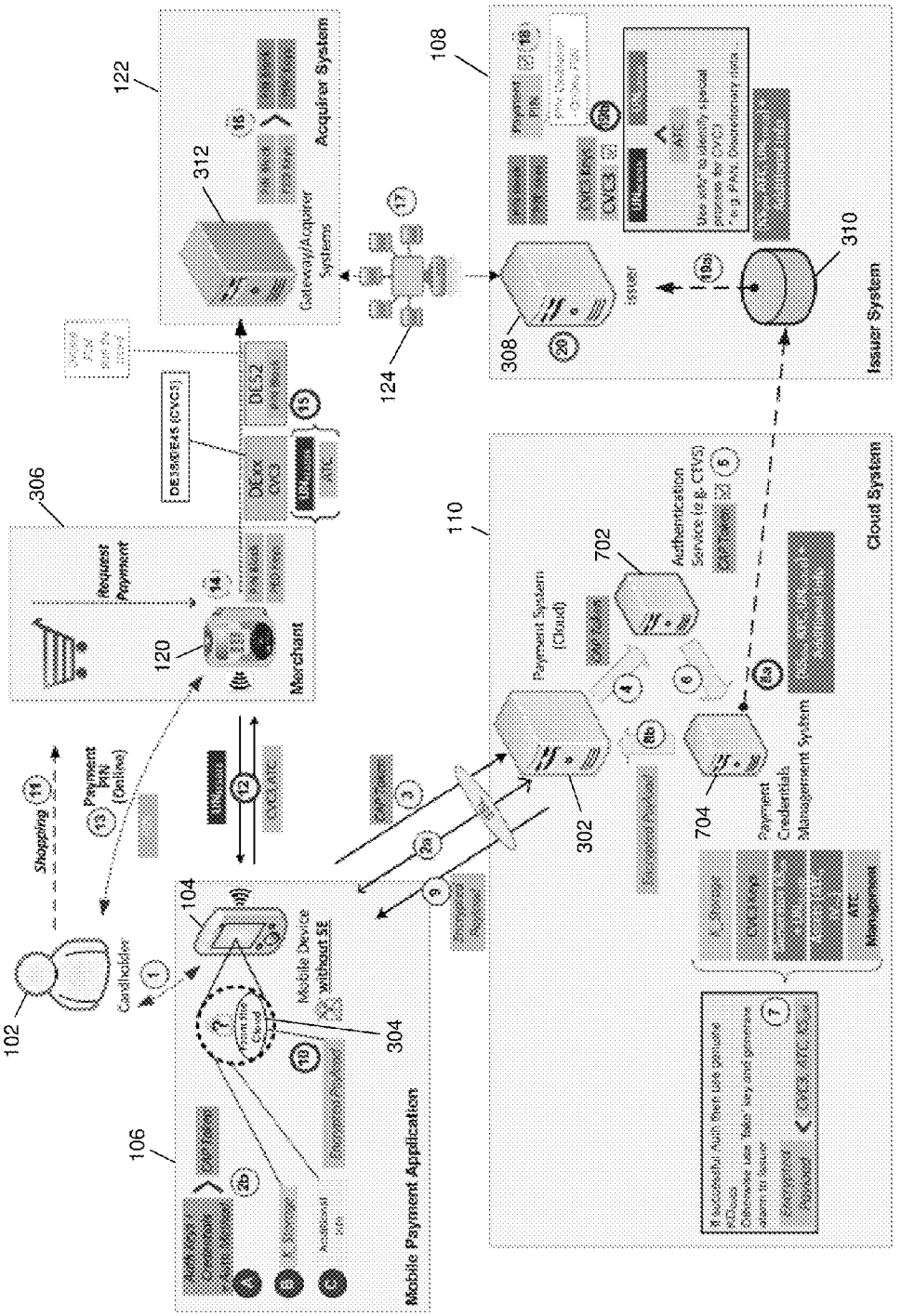

102
Cardholder
104
Mobile Device without SE
304
106
Mobile Payment Application
Shopping
Payment PIN (Online)
306
Request Payment
120
Merchant
DE55/DE45 (CVC3)
DE52
122
312
Gateway/Acquirer Systems
Acquirer System
124
108
308
Issuer
310
Issuer System
110
Payment System (Cloud)
702
Authentication Service (e.g. CTVS)
302
704
Payment Credentials Management System
Cloud System

FIG. 7

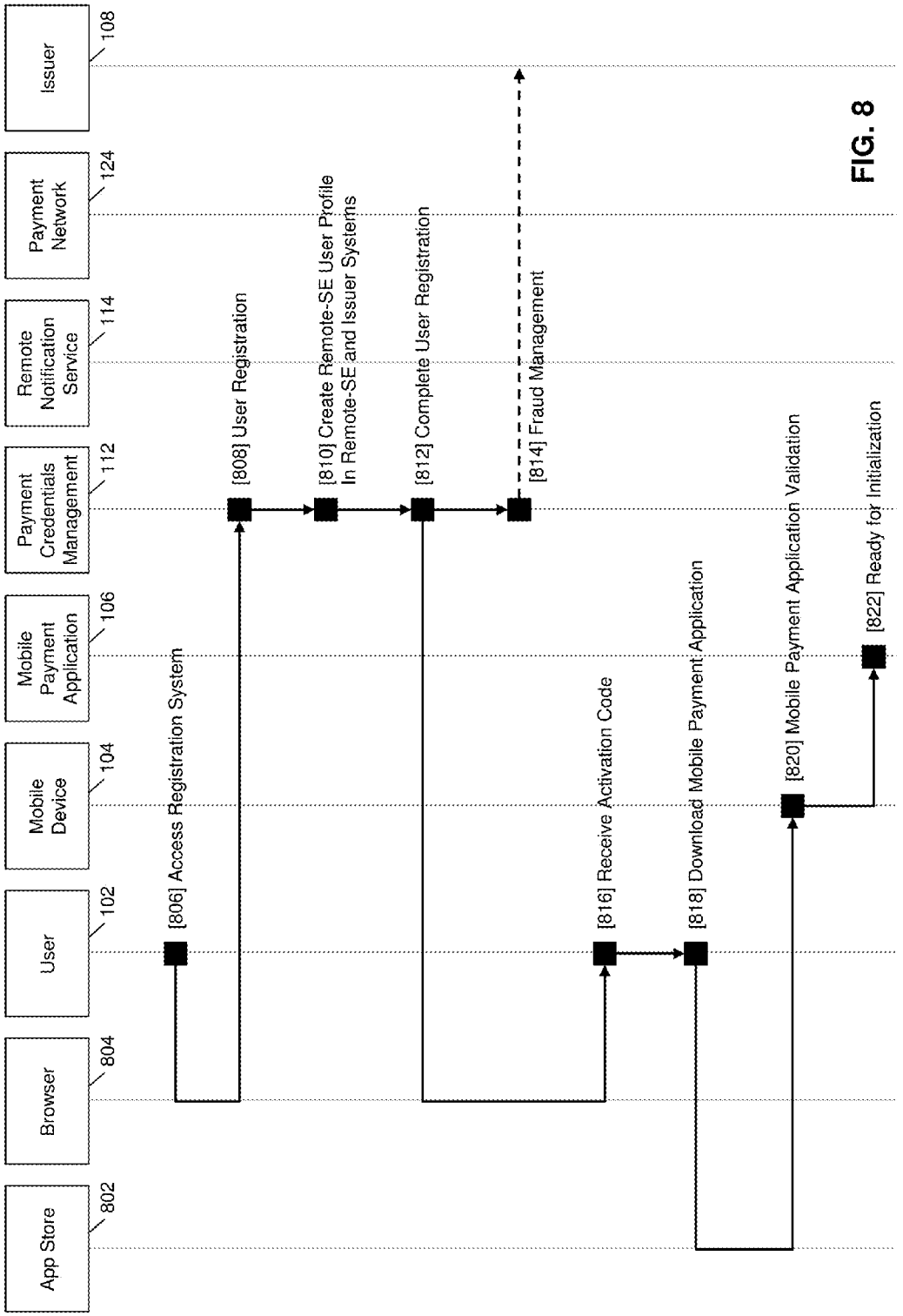

App Store
802
Browser
804
User
102
Mobile Device
104
Mobile Payment Application
106
Payment Credentials Management
112
Remote Notification Service
114
Payment Network
124
Issuer
108
[806] Access Registration System
[808] User Registration
[810] Create Remote-SE User Profile In Remote-SE and Issuer Systems
[812] Complete User Registration
[814] Fraud Management
[816] Receive Activation Code
[818] Download Mobile Payment Application
[820] Mobile Payment Application Validation
[822] Ready for Initialization

FIG. 8

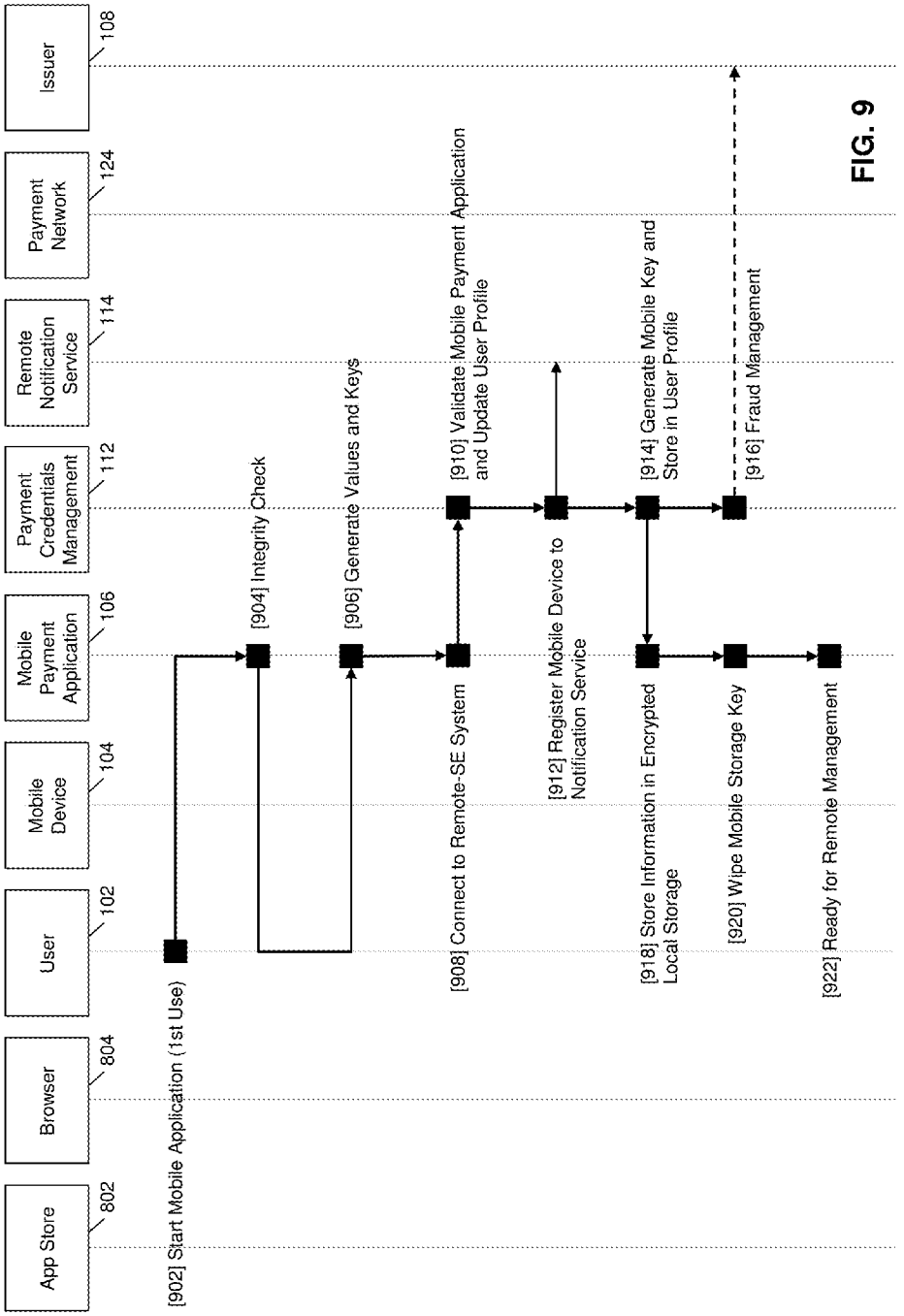

App Store
802
Browser
804
User
102
Mobile Device
104
Mobile Payment Application
106
Payment Credentials Management
112
Remote Notification Service
114
Payment Network
124
Issuer
108
[902] Start Mobile Application (1st Use)
[904] Integrity Check
[906] Generate Values and Keys
[908] Connect to Remote-SE System
[910] Validate Mobile Payment Application and Update User Profile
[912] Register Mobile Device to Notification Service
[914] Generate Mobile Key and Store in User Profile
[916] Fraud Management
[918] Store Information in Encrypted Local Storage
[920] Wipe Mobile Storage Key
[922] Ready for Remote Management

FIG. 9

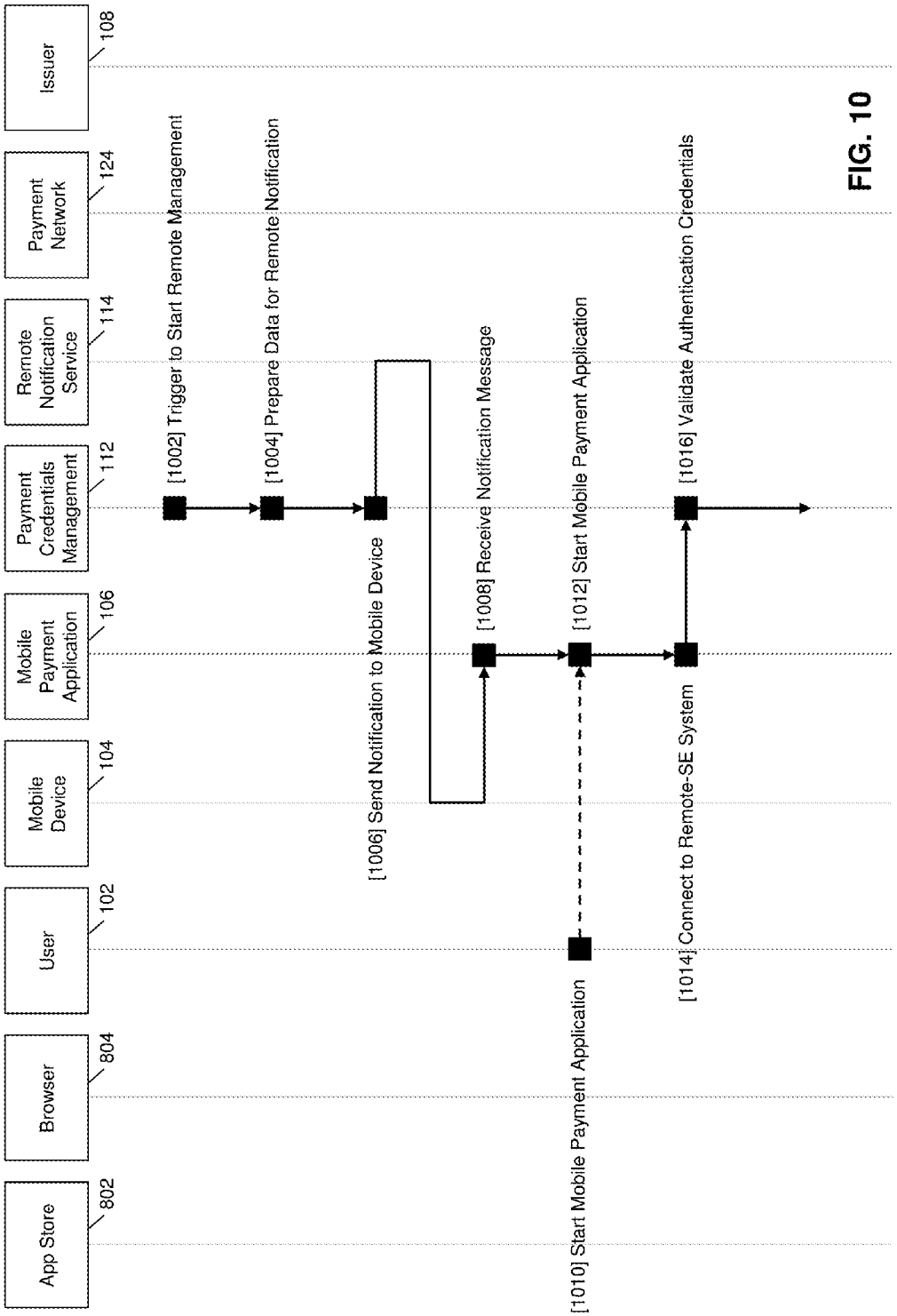

App Store
802
Browser
804
User
102
Mobile Device
104
Mobile Payment Application
106
Payment Credentials Management
112
Remote Notification Service
114
Payment Network
124
Issuer
108
[1002] Trigger to Start Remote Management
[1004] Prepare Data for Remote Notification
[1006] Send Notification to Mobile Device
[1008] Receive Notification Message
[1010] Start Mobile Payment Application
[1012] Start Mobile Payment Application
[1014] Connect to Remote-SE System
[1016] Validate Authentication Credentials

FIG. 10

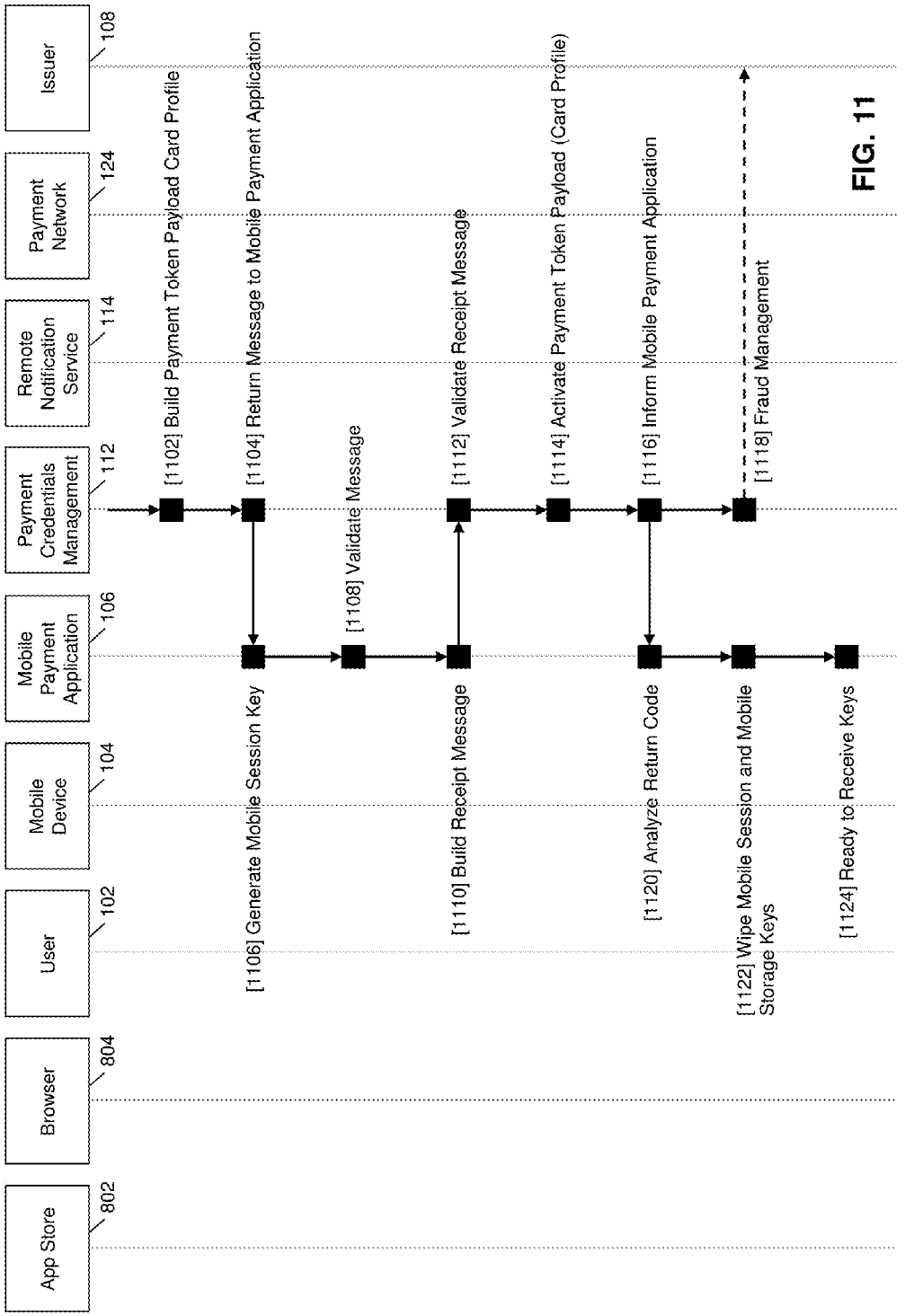

App Store
802
Browser
804
User
102
Mobile Device
104
Mobile Payment Application
106
Payment Credentials Management
112
Remote Notification Service
114
Payment Network
124
Issuer
108
[1102] Build Payment Token Payload Card Profile
[1104] Return Message to Mobile Payment Application
[1106] Generate Mobile Session Key
[1108] Validate Message
[1110] Build Receipt Message
[1112] Validate Receipt Message
[1114] Activate Payment Token Payload (Card Profile)
[1116] Inform Mobile Payment Application
[1118] Fraud Management
[1120] Analyze Return Code
[1122] Wipe Mobile Session and Mobile Storage Keys
[1124] Ready to Receive Keys

FIG. 11

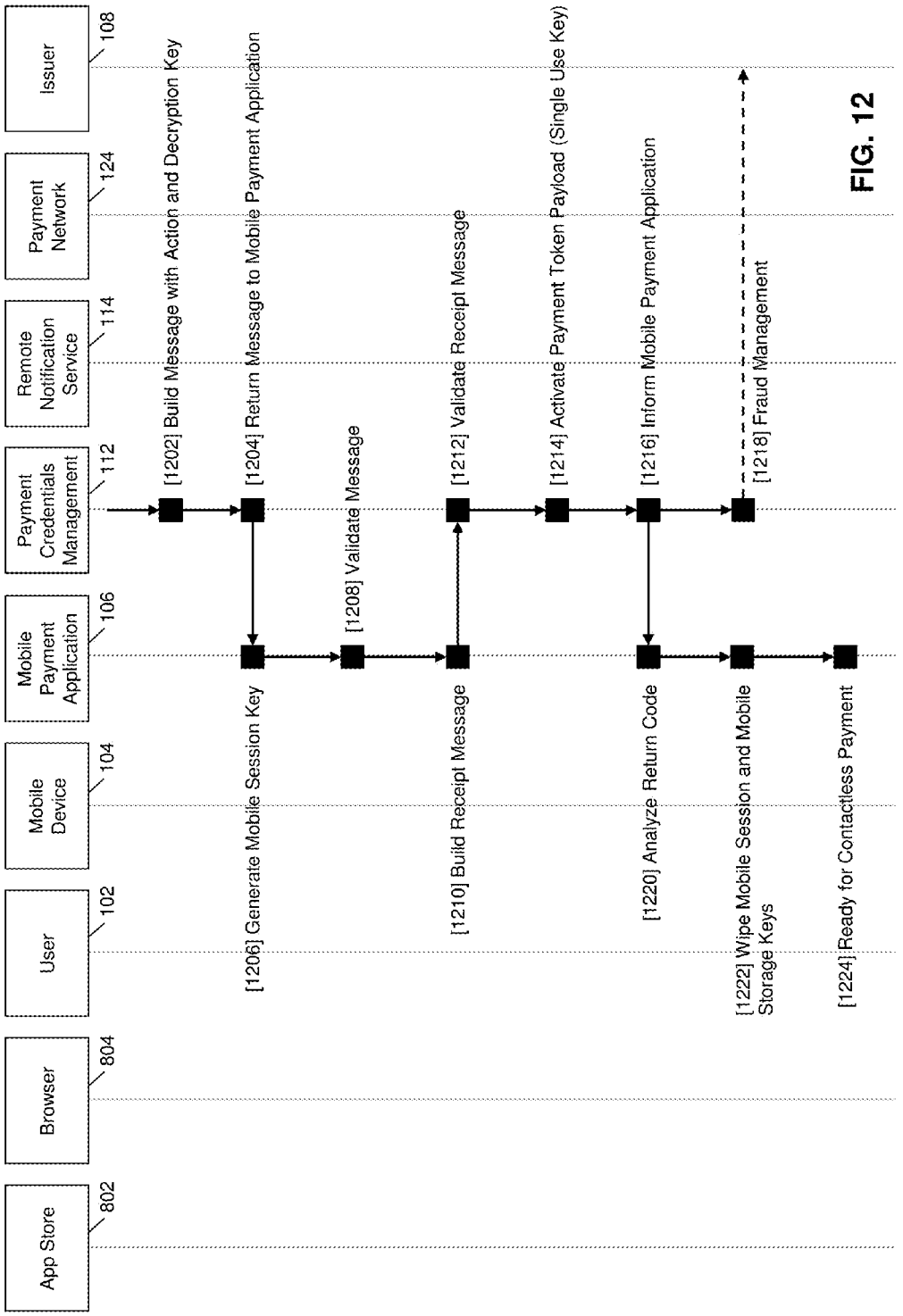

App Store
802
Browser
804
User
102
Mobile Device
104
Mobile Payment Application
106
Payment Credentials Management
112
Remote Notification Service
114
Payment Network
124
Issuer
108
[1202] Build Message with Action and Decryption Key
[1204] Return Message to Mobile Payment Application
[1206] Generate Mobile Session Key
[1208] Validate Message
[1210] Build Receipt Message
[1212] Validate Receipt Message
[1214] Activate Payment Token Payload (Single Use Key)
[1216] Inform Mobile Payment Application
[1218] Fraud Management
[1220] Analyze Return Code
[1222] Wipe Mobile Session and Mobile Storage Keys
[1224] Ready for Contactless Payment

FIG. 12

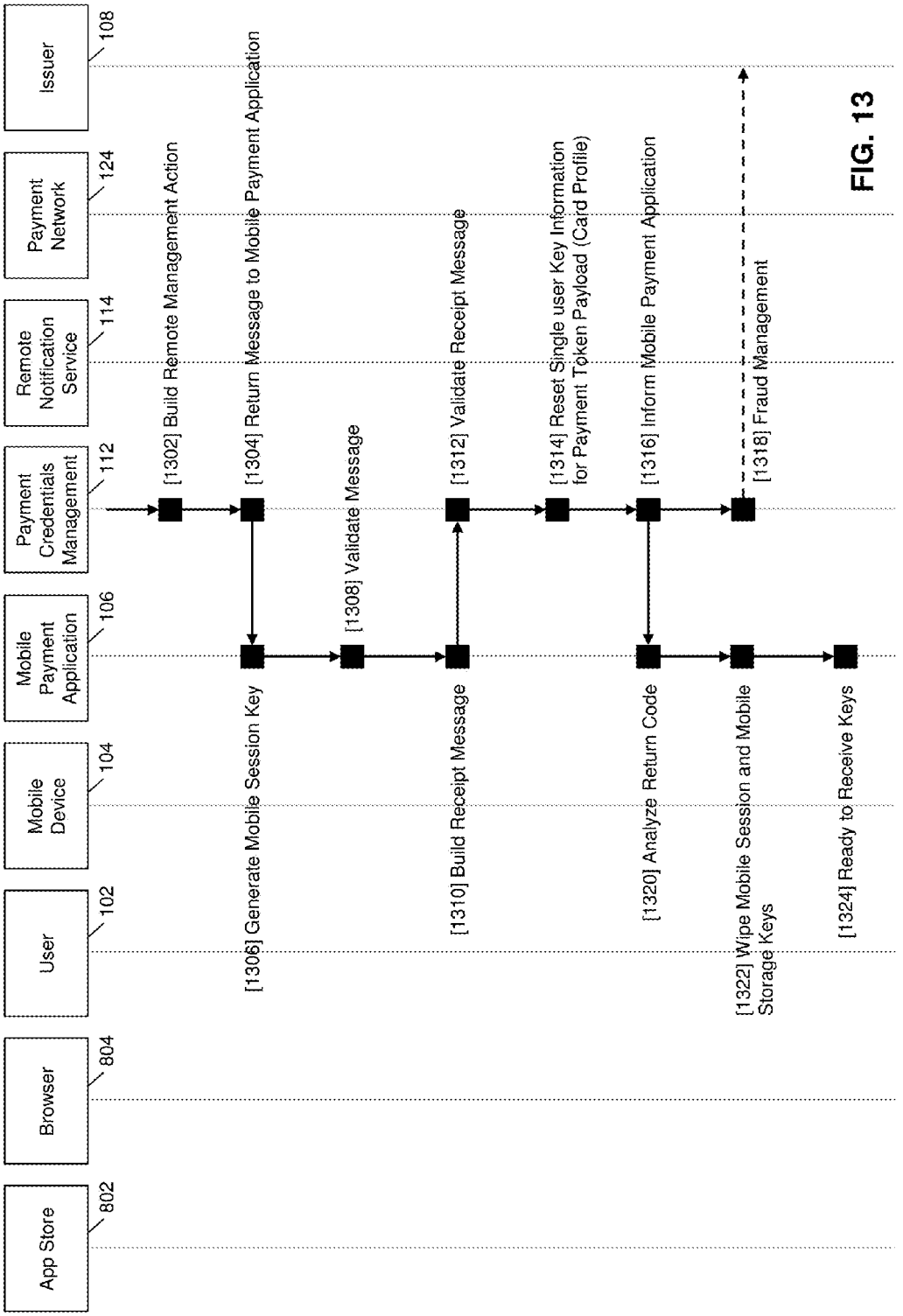

App Store
802
Browser
804
User
102
Mobile Device
104
Mobile Payment Application
106
Payment Credentials Management
112
Remote Notification Service
114
Payment Network
124
Issuer
108
[1302] Build Remote Management Action
[1304] Return Message to Mobile Payment Application
[1306] Generate Mobile Session Key
[1308] Validate Message
[1310] Build Receipt Message
[1312] Validate Receipt Message
[1314] Reset Single user Key Information for Payment Token Payload (Card Profile)
[1316] Inform Mobile Payment Application
[1318] Fraud Management
[1320] Analyze Return Code
[1322] Wipe Mobile Session and Mobile Storage Keys
[1324] Ready to Receive Keys

FIG. 13

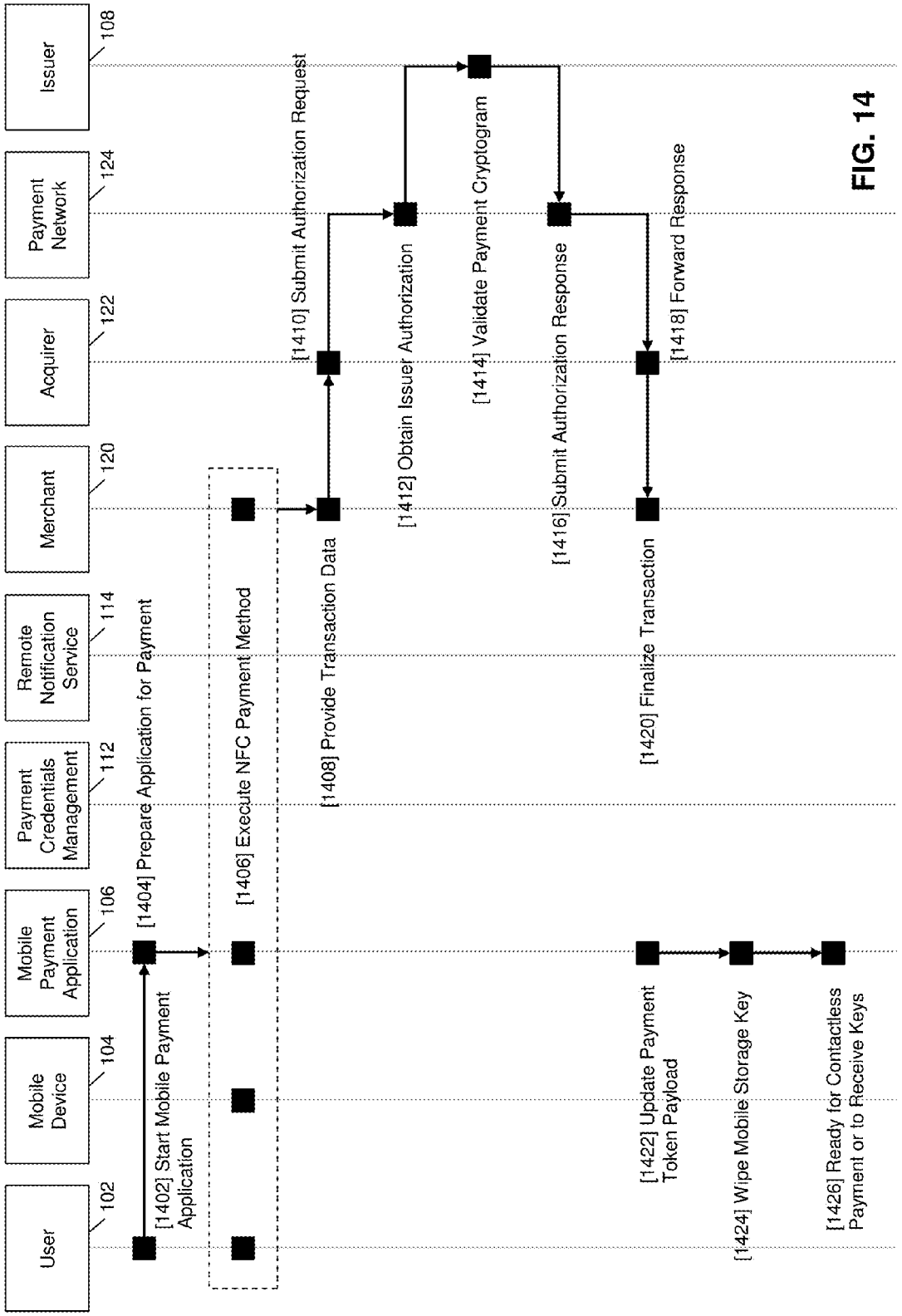

User
102
Mobile Device
104
Mobile Payment Application
106
Payment Credentials Management
112
Remote Notification Service
114
Merchant
120
Acquirer
122
Payment Network
124
Issuer
108
[1402] Start Mobile Payment Application
[1404] Prepare Application for Payment
[1406] Execute NFC Payment Method
[1408] Provide Transaction Data
[1410] Submit Authorization Request
[1412] Obtain Issuer Authorization
[1414] Validate Payment Cryptogram
[1416] Submit Authorization Response
[1418] Forward Response
[1420] Finalize Transaction
[1422] Update Payment Token Payload
[1424] Wipe Mobile Storage Key
[1426] Ready for Contactless Payment or to Receive Keys

FIG. 14

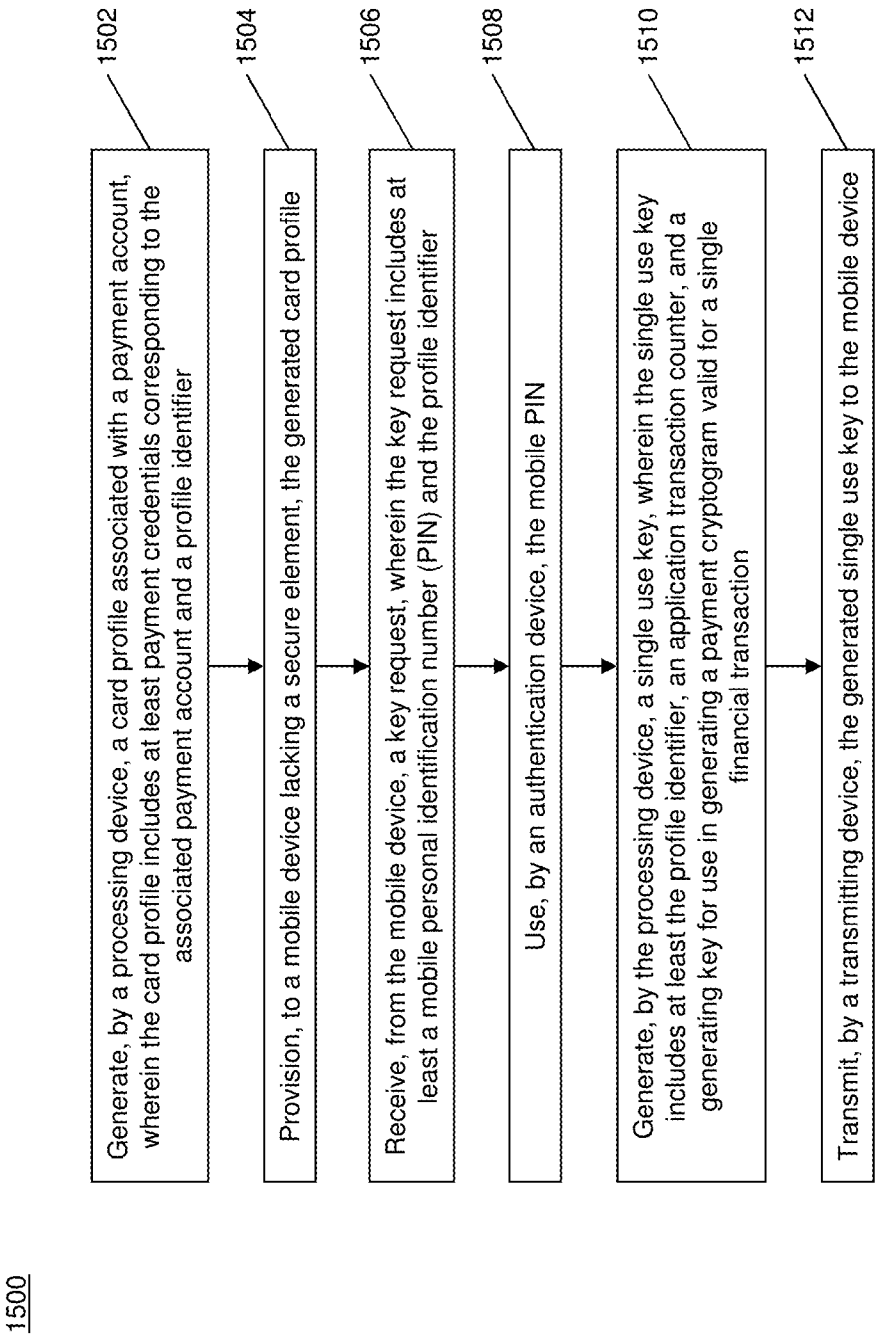

1500
1502
Generate, by a processing device, a card profile associated with a payment account, wherein the card profile includes at least payment credentials corresponding to the associated payment account and a profile identifier
1504
Provision, to a mobile device lacking a secure element, the generated card profile
1506
Receive, from the mobile device, a key request, wherein the key request includes at least a mobile personal identification number (PIN) and the profile identifier
1508
Use, by an authentication device, the mobile PIN
1510
Generate, by the processing device, a single use key, wherein the single use key includes at least the profile identifier, an application transaction counter, and a generating key for use in generating a payment cryptogram valid for a single financial transaction
1512
Transmit, by a transmitting device, the generated single use key to the mobile device

FIG. 15

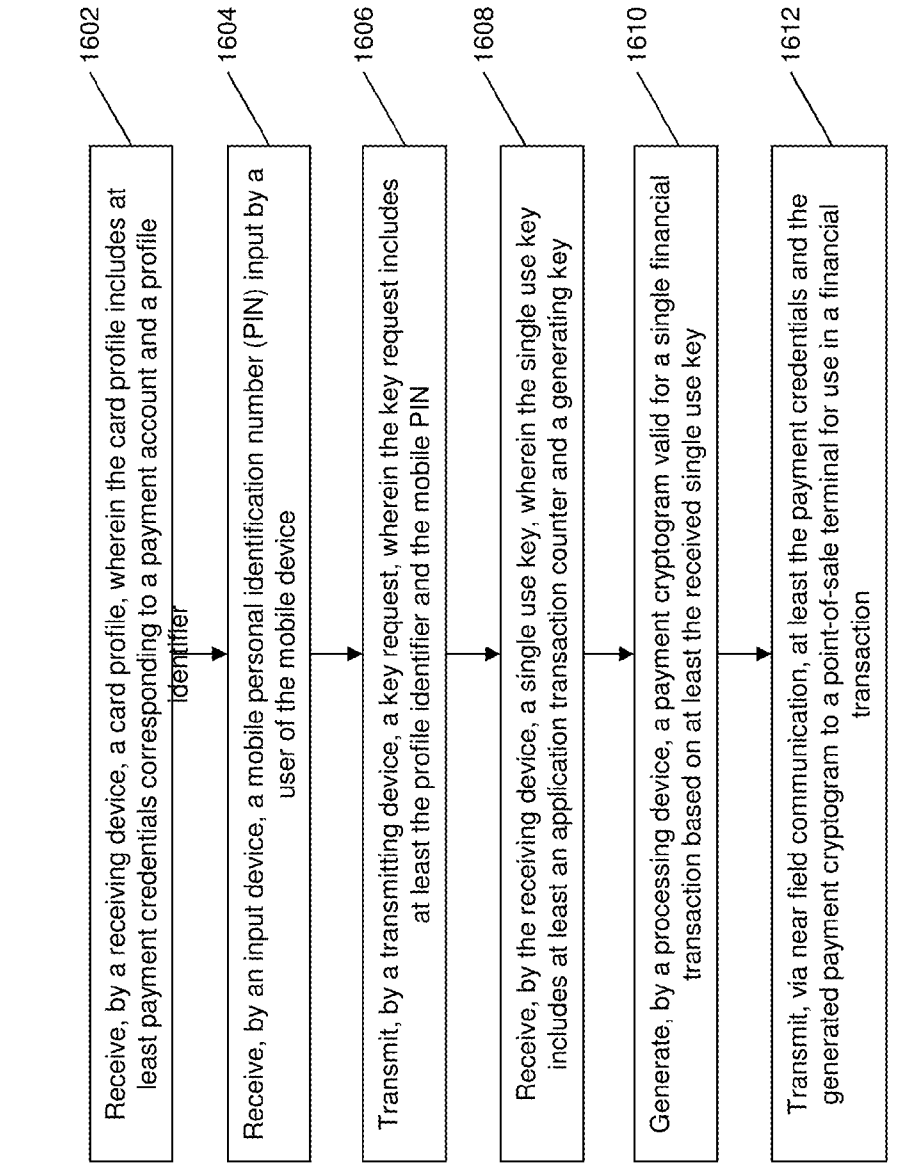

1600
1602
Receive, by a receiving device, a card profile, wherein the card profile includes at least payment credentials corresponding to a payment account and a profile identifier
1604
Receive, by an input device, a mobile personal identification number (PIN) input by a user of the mobile device
1606
Transmit, by a transmitting device, a key request, wherein the key request includes at least the profile identifier and the mobile PIN
1608
Receive, by the receiving device, a single use key, wherein the single use key includes at least an application transaction counter and a generating key
1610
Generate, by a processing device, a payment cryptogram valid for a single financial transaction based on at least the received single use key
1612
Transmit, via near field communication, at least the payment credentials and the generated payment cryptogram to a point-of-sale terminal for use in a financial transaction

FIG. 16

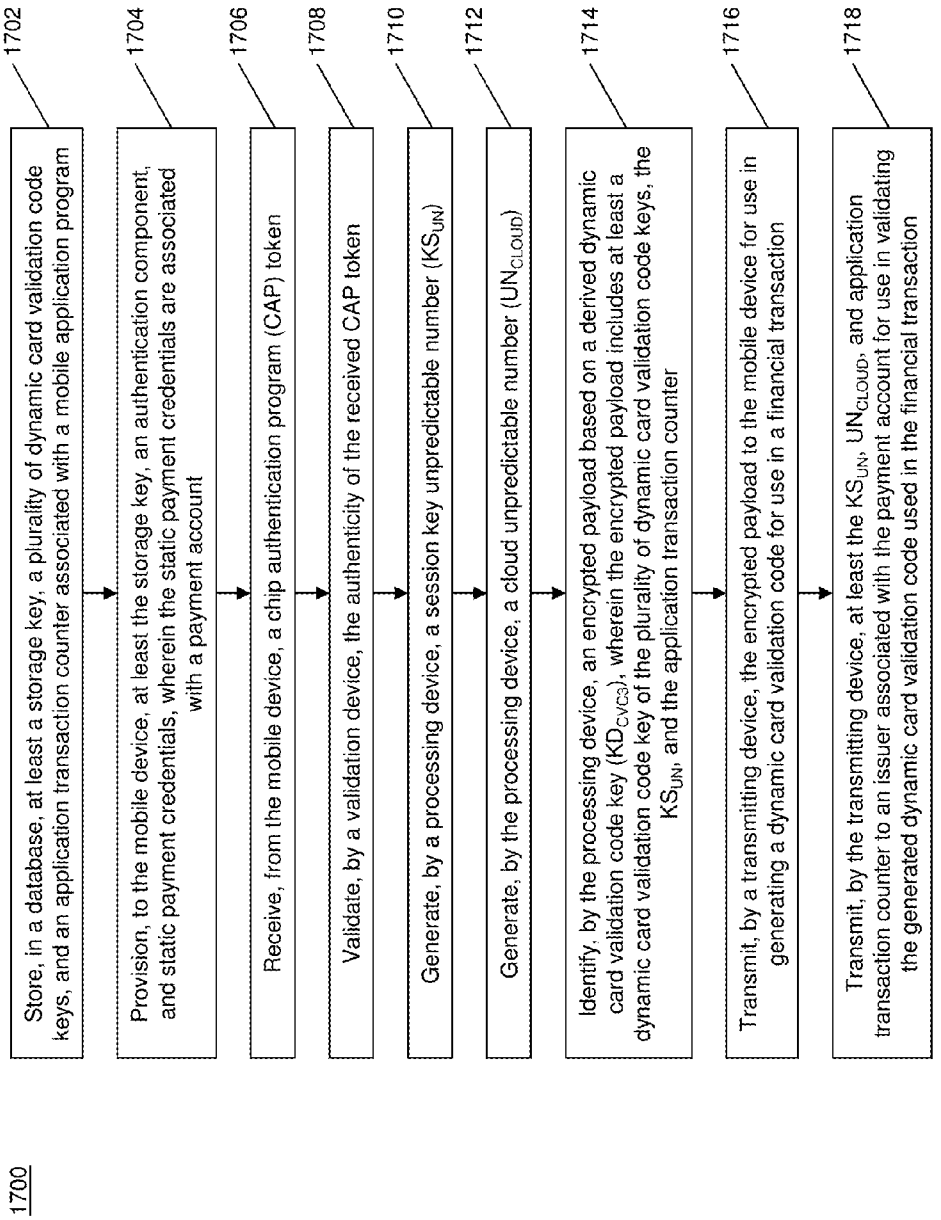

1700
1702
Store, in a database, at least a storage key, a plurality of dynamic card validation code keys, and an application transaction counter associated with a mobile application program
1704
Provision, to the mobile device, at least the storage key, an authentication component, and static payment credentials, wherein the static payment credentials are associated with a payment account
1706
Receive, from the mobile device, a chip authentication program (CAP) token
1708
Validate, by a validation device, the authenticity of the received CAP token
1710
Generate, by a processing device, a session key unpredictable number (KS_{UN})
1712
Generate, by the processing device, a cloud unpredictable number (UN_{CLOUD})
1714
Identify, by the processing device, an encrypted payload based on a derived dynamic card validation code key (KD_{CVC3}), wherein the encrypted payload includes at least a dynamic card validation code key of the plurality of dynamic card validation code keys, the KS_{UN}, and the application transaction counter
1716
Transmit, by a transmitting device, the encrypted payload to the mobile device for use in generating a dynamic card validation code for use in a financial transaction
1718
Transmit, by the transmitting device, at least the KS_{UN}, UN_{CLOUD}, and application transaction counter to an issuer associated with the payment account for use in validating the generated dynamic card validation code used in the financial transaction

FIG. 17

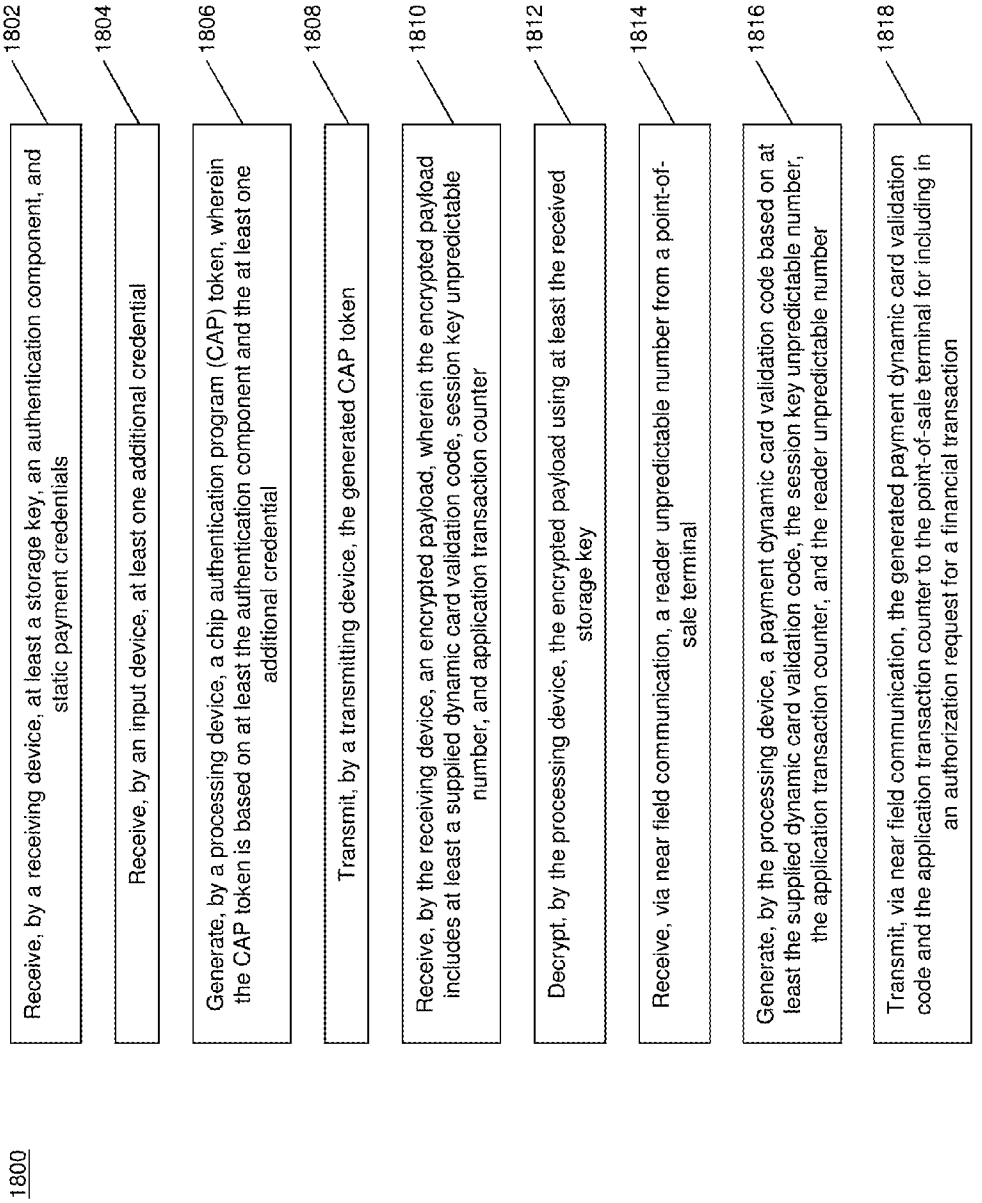

1800
1802
Receive, by a receiving device, at least a storage key, an authentication component, and static payment credentials
1804
Receive, by an input device, at least one additional credential
1806
Generate, by a processing device, a chip authentication program (CAP) token, wherein the CAP token is based on at least the authentication component and the at least one additional credential
1808
Transmit, by a transmitting device, the generated CAP token
1810
Receive, by the receiving device, an encrypted payload, wherein the encrypted payload includes at least a supplied dynamic card validation code, session key unpredictable number, and application transaction counter
1812
Decrypt, by the processing device, the encrypted payload using at least the received storage key
1814
Receive, via near field communication, a reader unpredictable number from a point-of-sale terminal
1816
Generate, by the processing device, a payment dynamic card validation code based on at least the supplied dynamic card validation code, the session key unpredictable number, the application transaction counter, and the reader unpredictable number
1818
Transmit, via near field communication, the generated payment dynamic card validation code and the application transaction counter to the point-of-sale terminal for including in an authorization request for a financial transaction

FIG. 18

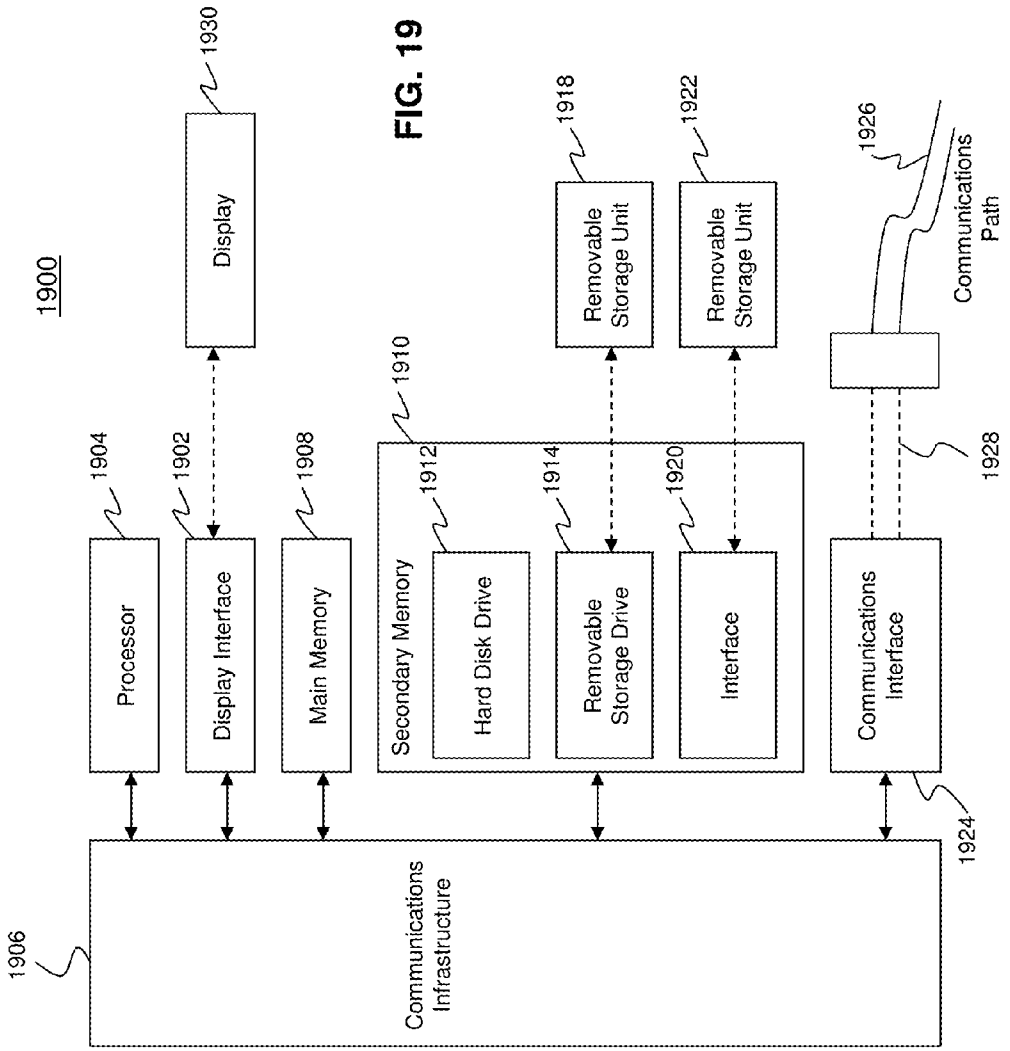

1900
1906
Communications Infrastructure
1904
Processor
1902
Display Interface
1930
Display
1908
Main Memory
1910
Secondary Memory
1912
Hard Disk Drive
1914
Removable Storage Drive
1920
Interface
1918
Removable Storage Unit
1922
Removable Storage Unit
1924
Communications Interface
1928
1926
Communications Path

FIG. 19

SYSTEMS AND METHODS FOR PROCESSING MOBILE PAYMENTS BY PROVISONING CREDENTIALS TO MOBILE DEVICES WITHOUT SECURE ELEMENTS

RELATED APPLICATIONS

[0001] This application claims the priority benefit of commonly assigned U.S. Provisional Application No. 61/619,095, filed Apr. 2, 2012, entitled "Method and System for Processing mobile Payments for Devices Without Secure Elements"; U.S. Provisional Application No. 61/639,248, filed Apr. 18, 2012, entitled "Method and System for Processing mobile Payments by Provisioning Credentials to Mobile Devices Without Secure Elements"; U.S. Provisional Application No. 61/735,383, filed Dec. 10, 2012, entitled "Systems and Methods for Processing Mobile Payments by Provisioning Credentials to Mobile Devices Without Secure Elements," by Mehdi Collinge et al.; and U.S. Provisional Application No. 61/762,098, filed Feb. 7, 2013, entitled "Systems and Methods for Processing Mobile Payments by Provisioning Credentials to Mobile Devices Without Secure Elements," by Mehdi Collinge et al., which are each herein incorporated by reference in their entirety.

FIELD

[0002] The present disclosure relates to provisioning of payment credentials to a mobile device lacking a secure element, specifically the provisioning and storage of payment credentials for use in conducting a near field financial transaction using a mobile device lacking a secure element.

BACKGROUND

[0003] Advances in both mobile and communication technologies have created tremendous opportunities, one of which is providing user of mobile computing devices the ability to initiate payment transactions using their mobile device. One such approach to enable mobile devices to conduct payment transactions has been the use of near field communication (NFC) technology to securely transmit payment information to a nearby contactless point-of-sale terminal. In order to achieve this, mobile phones with secure element hardware (e.g., a Secure Element chip) are used to securely store payment account credentials, such as credit card credentials.

[0004] However, not all mobile devices have secure elements. Furthermore, some issuers may not have access to a secure element on a mobile device, even if the mobile device has one available. As a result, a consumer who has a NFC-capable mobile device may not be able to use their device to conduct payment transactions if their mobile device lacks a secure element, and even in some cases where their mobile device has a secure element.

[0005] Thus, there is a need for a technical solution to enable a mobile device lacking a secure element to conduct contactless payment transactions.

SUMMARY

[0006] The present disclosure provides a description of a systems and methods for the provisioning of payment credentials to mobile devices lacking secure elements for use in mobile payment transactions.

[0007] A method for generating and provisioning payment credentials to a mobile device lacking a secure element includes: generating, by a processing device, a card profile associated with a payment account, wherein the card profile includes at least payment credentials corresponding to the associated payment account and a profile identifier; provisioning, to a mobile device, the generated card profile; receiving, from the mobile device, a key request, wherein the key request includes at least a mobile identification number (PIN) and the profile identifier; using, by an authentication device, the mobile PIN; generating, by the processing device, a single use key, wherein the single use key includes at least the profile identifier, an application transaction counter, and a generating key for use in generating a payment cryptogram valid for a single financial transaction; and transmitting, by a transmitting device, the generated single use key to the mobile device, wherein the mobile device is not required to have a secure element.

[0008] A method for generating a payment cryptogram in a mobile device lacking a secure element includes: receiving, by a receiving device, a card profile, wherein the card profile includes at least payment credentials corresponding to a payment account and a profile identifier; receiving, by an input device, a mobile personal identification number (PIN) input by a user of the mobile device; transmitting, by a transmitting device, a key request, wherein the key request includes at least the profile identifier; receiving, by the receiving device, a single use key, wherein the single use key includes at least an application transaction counter and a generating key; generating, by a processing device, a payment cryptogram valid for a single financial transaction based on at least the received single use key and the mobile PIN; and transmitting, via near field communication, at least the payment credentials and the generated payment cryptogram to a point-of-sale terminal for use in a financial transaction.

[0009] Another method for generating and provisioning payment credentials to a mobile device lacking a secure element includes: storing, in a database, at least a storage key, a plurality of dynamic card validation code keys, and an application transaction counter associated with a mobile application program; provisioning, to the mobile device, at least the storage key, an authentication component, and static payment credentials, wherein the static payment credentials are associated with a payment account; receiving, from a mobile device, a chip authentication program (CAP) token; validating, by a validation device, the authenticity of the received CAP token; generating, by a processing device, a session key unpredictable number (KS_{UN}); generating, by the processing device, a cloud unpredictable number (UN_{CLOUD}); identifying, by the processing device, an encrypted payload based on a derived dynamic card validation code key (KD_{CVC3}), wherein the encrypted payload includes at least a dynamic card validation code key of the plurality of dynamic card validation code keys, the KS_{UN}, and the application transaction counter; transmitting, by a transmitting device, the encrypted payload to the mobile device for use in generating a dynamic card validation code for use in a financial transaction; and transmitting, by the transmitting device, at least the KS_{UN}, UN_{CLOUD}, and application transaction counter to an issuer associated with the payment account for use in validating the generated dynamic card validation code used in the financial transaction.

[0010] A method for generating a dynamic card validation code in a mobile device lacking a secure element includes: receiving, by a receiving device, at least a storage key, an authentication component, and static payment credentials;

receiving, by an input device, at least one additional credential; generating, by a processing device, a chip authentication program (CAP) token, wherein the CAP token is based on at least the authentication component and the at least one additional credential; transmitting, by a transmitting device, the generated CAP token; receiving, by the receiving device, an encrypted payload, wherein the encrypted payload includes at least a supplied dynamic card validation code, session key unpredictable number, and application transaction counter; decrypting, by the processing device, the encrypted payload using at least the received storage key; receiving, via near field communication, a reader unpredictable number from a point-of-sale terminal; generating, by the processing device, a payment dynamic card validation code based on at least the supplied dynamic card validation code, the session key unpredictable number, the application transaction counter, and the reader unpredictable number; and transmitting, via near field communication, the generated payment dynamic card validation code and the application transaction counter to the point-of-sale terminal for including in an authorization request for a financial transaction.

[0011] A system for generating and provisioning payment credentials to a mobile device lacking a secure element includes a transmitting device, a processing device, a provisioning device, a receiving device, and an authentication device. The processing device is configured to generate a card profile associated with a payment account, wherein the card profile includes at least payment credentials corresponding to the associated payment account and a profile identifier. The provisioning device is configured to provision, to a mobile device lacking a secure element, the generated card profile. The receiving device is configured to receive, from the mobile device, a key request, wherein the key request includes at least a mobile identification number (PIN) and the profile identifier. The authentication device is configured to use the mobile PIN. The processing device is further configured to generate a single use key, wherein the single use key includes at least the profile identifier, an application transaction counter, and a generating key for use in generating a payment cryptogram valid for a single financial transaction. The transmitting device is configured to transmit the generated single use key to the mobile device.

[0012] A system for generating a payment cryptogram in a mobile device lacking a secure element includes a processing device, a receiving device, an input device, and a transmitting device. The receiving device is configured to receive a card profile, wherein the card profile includes at least payment credentials corresponding to a payment account and a profile identifier. The input device is configured to receive a mobile personal identification number (PIN) input by a user of the mobile device. The transmitting device is configured to transmit a key request, wherein the key request includes at least the profile identifier. The receiving device is further configured to receive a single use key, wherein the single use key includes at least an application transaction counter and a generating key. The processing device is configured to generate a payment cryptogram valid for a single financial transaction based on at least the received single use key and the mobile PIN. The transmitting device is further configured to transmit, via near field communication, at least the payment credentials and the generated payment cryptogram to a point-of-sale terminal for use in a financial transaction.

[0013] Another system for generating and provisioning payment credentials to a mobile device lacking a secure element includes a database, a provisioning device, a receiving device, a processing device, and a transmitting device. The database is configured to store at least a storage key, a plurality of dynamic card validation code keys, and an application transaction counter associated with a mobile application program. The provisioning device is configured to provision, to the mobile device, at least the storage key, an authentication component, and static payment credentials, wherein the static payment credentials are associated with a payment account. The receiving device is configured to receive, from a mobile device, a chip authentication program (CAP) token. The processing device is configured to: validate the authenticity of the received CAP token; generate a session key unpredictable number (KS_{UN}); generate a cloud unpredictable number (UN_{CLOUD}); and identify an encrypted payload based on a derived dynamic card validation code key (KD_{CVC3}), wherein the encrypted payload includes at least a dynamic card validation code key of the plurality of dynamic card validation code keys, the KS_{UN}, and the application transaction counter. The transmitting device is configured to: transmit the encrypted payload to the mobile device for use in generating a dynamic card validation code for use in a financial transaction; and transmit at least the KS_{UN}, UN_{CLOUD}, and application transaction counter to an issuer associated with the payment account for use in validating the generated dynamic card validation code used in the financial transaction.

[0014] A system for generating a dynamic card validation code in a mobile device lacking a secure element includes a receiving device, an input device, a processing device, and a transmitting device. The receiving device is configured to receive at least a storage key, an authentication component, and static payment credentials. The input device is configured to receive at least one additional credential. The processing device is configured to generate a chip authentication program (CAP) token, wherein the CAP token is based on at least the authentication component and the at least one additional credential. The transmitting device is configured to transmit the generated CAP token. The receiving device is further configured to receive an encrypted payload, wherein the encrypted payload includes at least a supplied dynamic card validation code, session key unpredictable number, and application transaction counter. The processing device is further configured to decrypt the encrypted payload using at least the received storage key. The receiving device is further configured to receive, via near field communication, a reader unpredictable number from a point-of-sale terminal. The processing device is further configured to generate a payment dynamic card validation code based on at least the supplied dynamic card validation code, the session key unpredictable number, the application transaction counter, and the reader unpredictable number. The transmitting device is further configured to transmit, via near field communication, the generated payment dynamic card validation code and the application transaction counter to the point-of-sale terminal for including in an authorization request for a financial transaction.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0015] The scope of the present disclosure is best understood from the following detailed description of exemplary embodiments when read in conjunction with the accompanying drawings. Included in the drawings are the following figures:

[0016] FIG. **1** is a high level diagram illustrating a system for generating and provisioning payment credentials to a mobile device in accordance with exemplary embodiments.

[0017] FIG. **2** is a block diagram illustrating the payment token payload of the system of FIG. **1** in accordance with exemplary embodiments.

[0018] FIG. **3** is a high level diagram illustrating an alternative system for provisioning payment credentials to a mobile device in accordance with exemplary embodiments.

[0019] FIG. **4** is a diagram illustrating a method for dual channel communication for use in the system of FIG. **1** in accordance with exemplary embodiments.

[0020] FIG. **5** is a flow chart illustrating the experience of a user of the mobile device of the system of FIG. **1** in accordance with exemplary embodiments.

[0021] FIG. **6** is a high level diagram illustrating methods for provisioning payment credentials to a mobile device and generating a payment cryptogram in accordance with exemplary embodiments.

[0022] FIG. **7** is a high level diagram illustrating methods for provisioning payment credentials to a mobile device and generating a dynamic card validation code in accordance with exemplary embodiments.

[0023] FIG. **8** is a flow diagram illustrating a method for registration of a mobile device for use in the system of FIG. **1** in accordance with exemplary embodiments.

[0024] FIG. **9** is a flow diagram illustrating a method for the initialization of a mobile application program on the mobile device of the system of FIG. **1** in accordance with exemplary embodiments.

[0025] FIG. **10** is a flow diagram illustrating a method for remote management of the mobile application program of the mobile device in accordance with exemplary embodiments.

[0026] FIG. **11** is a flow diagram illustrating a method for the delivery of a card profile to the mobile device of the system of FIG. **1** in accordance with exemplary embodiments.

[0027] FIG. **12** is a flow diagram illustrating a method for the delivery of a single use key to the mobile device of the system of FIG. **1** in accordance with exemplary embodiments.

[0028] FIG. **13** is a flow diagram illustrating a method for managing the mobile application program following the update of a mobile personal identification number of the mobile device of the system of FIG. **1** in accordance with exemplary embodiments.

[0029] FIG. **14** is a flow diagram illustrating a method for conducting a payment transaction using the mobile device of the system of FIG. **1** in accordance with exemplary embodiments.

[0030] FIG. **15** is a flow chart illustrating an exemplary method for generating and provisioning payment credentials to a mobile device lacking a secure element in accordance with exemplary embodiments.

[0031] FIG. **16** is a flow chart illustrating an exemplary method for generating a payment cryptogram in a mobile device lacking a secure element in accordance with exemplary embodiments.

[0032] FIG. **17** is a flow chart illustrating an alternative method for generating and provisioning payment credentials to a mobile device lacking a secure element in accordance with exemplary embodiments.

[0033] FIG. **18** is a flow chart illustrating an exemplary method for generating a dynamic card validation code in a mobile device lacking a secure element in accordance with exemplary embodiments.

[0034] FIG. **19** is a block diagram illustrating a computer system architecture in accordance with exemplary embodiments.

[0035] Further areas of applicability of the present disclosure will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description of exemplary embodiments are intended for illustration purposes only and are, therefore, not intended to necessarily limit the scope of the disclosure.

DETAILED DESCRIPTION

Definition of Terms

[0036] Payment Network—A system or network used for the transfer of money via the use of cash-substitutes. Payment networks may use a variety of different protocols and procedures in order to process the transfer of money for various types of transactions. Transactions that may be performed via a payment network may include product or service purchases, credit purchases, debit transactions, fund transfers, account withdrawals, etc. Payment networks may be configured to perform transactions via cash-substitutes, which may include payment cards, letters of credit, checks, financial accounts, etc. Examples of networks or systems configured to perform as payment networks include those operated by MasterCard®, VISA®, Discover®, American Express®, etc.

[0037] Payment Account—A financial account that may be used to fund a transaction, such as a checking account, savings account, credit account, virtual payment account, etc. A payment account may be associated with an entity, which may include a person, family, company, corporation, governmental entity, etc. In some instances, a payment account may be virtual, such as those accounts operated by PayPal®, etc.

[0038] Payment Card—A card or data associated with a payment account that may be provided to a merchant in order to fund a financial transaction via the associated payment account. Payment cards may include credit cards, debit cards, charge cards, stored-value cards, prepaid cards, fleet cards, virtual payment numbers, virtual card numbers, controlled payment numbers, etc. A payment card may be a physical card that may be provided to a merchant, or may be data representing the associated payment account (e.g., as stored in a communication device, such as a smart phone or computer). For example, in some instances, data including a payment account number may be considered a payment card for the processing of a transaction funded by the associated payment account. In some instances, a check may be considered a payment card where applicable.

System for Generating and Provisioning Payment Credentials

[0039] FIG. **1** is a diagram illustrating a system **100** for the generating and provisioning of payment credentials to a mobile device lacking a secure element.

[0040] The system **100** may include a user **102**. The user **102** may possess a mobile device **104**. The mobile device **104** may be any type of mobile computing device suitable for performing the functions as disclosed herein, such as a cellular phone, smart phone, tablet computer, personal digital

assistant, etc. In an exemplary embodiment, the mobile device **104** may not include a secure element.

[0041] The mobile device **104** may include a mobile payment application **106**, which may be an application program stored in data storage of the mobile device **104** and executed by a processor included in the mobile device **104**. The mobile payment application **106** may be configured to receive and store payment credentials and conduct payment transactions via near field communication without the use of a secure element, as discussed in more detail herein.

[0042] The user **102** may have a payment account with an issuer **108**, such as a credit card account. The user **102** may desire to use their mobile device **104** to conduct payment transactions using their payment account with the issuer **108** for funding of the transactions. Payment credentials corresponding to the payment account may be stored by a remote-SE (remote-secure element) system **110** for provisioning to the mobile device **104**. The remote-SE system **110** may include at least a payment credentials management service **112** and a remote notification server **114**, each of which are discussed in more detail below.

[0043] The remote-SE system **110** may build a payment token payload in order to provision the payment credentials to the mobile device **104** for use in a payment transaction. The payment token payload (PTP) may be a container used to carry payment credentials from the remote-SE system **100** to the mobile payment application **106** in the mobile device **104**. The payment token payload may include a card profile **116** and a single use key **118**, discussed in more detail below. The card profile **116** may include the payment credentials, and the single use key **118** may be a single use (e.g., one-time use) key used to generate a payment cryptogram valid for a single payment transaction. In some embodiments, the remote-SE system **110** and the mobile device **104** may communicate using dual channel communication, discussed in more detail below.

[0044] The mobile device **104** may be further configured to transmit a generated payment cryptogram and payment credentials to a point-of-sale terminal **120** at a merchant. The point-of-sale terminal **120** may be any type of point-of-sale terminal or device suitable for receiving payment credentials via near field communication (NFC). Suitable methods and protocols for the secure transmission of information via NFC will be apparent to persons having skill in the relevant art. The point-of-sale terminal **120** may transmit the received payment credentials and other transaction information (e.g., transaction amount, product details, etc.) to an acquirer **122**, such as an acquiring bank.

[0045] The acquirer **122** may submit an authorization request for the payment transaction to a payment network **124**. The payment network **124** may be configured to process the authorization request, such as by querying the issuer **108** for approval of the payment transaction (e.g., based on funds or credits in the payment account). The payment network **124** may then submit an authorization response to the acquirer **122** and/or the merchant, who may then finalize the payment transaction with the user **102**. Methods and systems suitable for the processing of a financial transaction will be apparent to persons having skill in the relevant art.

[0046] The system **100** and the use of the payment token payload may enable the user **102** to use the mobile device **104** to conduct NFC payment transactions without the use of a secure element.

Payment Token Payload

[0047] FIG. **2** is a diagram illustrating the payment token payload provisioned to the mobile device **104** in additional detail.

[0048] As discussed above, the payment token payload may include the card profile **116** and the single use key **118**. The card profile **116** may include payment credentials provisioned to the mobile payment application **106** by the remote-SE system for use in conducting payment transactions. The payment credentials included in the card profile **116** may include common payment credentials **202**, magnetic stripe (mag stripe) payment credentials **204**, and m/chip payment credentials **206**.

[0049] The common payment credentials **202** may include all data elements common to any type of payment transactions, such as both mag stripe and m/chip payment transactions. Such data elements may include payment account number, tracking data, and card layout description data. The mag stripe payment credentials **204** may include data elements specific to mag stripe transactions, such as the number of digits in an application transaction counter and a bitmap for an unpredictable number and the application transaction counter. The m/chip payment credentials **206** may include data elements specific to m/chip payment transactions, such as issuer action codes, risk management data, and offline data authentication object lists. In some embodiments, the mag stripe payment credentials **204** may be mandatory in the card profile **116** and the m/chip payment credentials **206** may be optional.

[0050] The single use key **118** may be a payment token used one time to generate a payment cryptogram to be used in a payment transaction. The single use key may include an application transaction counter (ATC) and a generating key **208**. The application transaction counter may be a count of transactions used for fraud management and authentication as will be apparent to persons having skill in the relevant art. The generating key **208** may be a key used to generate a payment cryptogram used in a financial transaction. In one embodiment, the generating key **208** may generate a dynamic card validation code (CVC3) or an application cryptogram (AC). In a further embodiment, the application cryptogram may be optional.

[0051] The single use key **118** may also include an identifier used to identify the card profile **116** to which it corresponds to. In some embodiments, the single use key **118** may be protected based on a mobile personal identification number (PIN) value. In such an embodiment, the user **102** may provide a mobile PIN for authentication. If the mobile PIN provided is incorrect, an incorrect value of the single use key may be used by the mobile payment application **106**. In such an instance, the issuer **108** will not authorize the payment transaction. Such an embodiment may result in additional security for the user **102**, the issuer **108**, and the merchant involved in the payment transaction.

Alternative System for Generating and Provisioning Payment Credentials

[0052] FIG. **3** illustrates an alternative system **300** for generating and provisioning payment credentials to the mobile device **104** lacking a secure element.

[0053] In the system **300**, the mobile device **104** may include the mobile payment application **106**. The mobile device **104** may also include storage **304**, such as a database.

The remote-SE system **110** may include a cloud system **302**. The cloud system **302** may store keys, payment credentials, and an application transaction counter, which may be provisioned from the cloud system **302** to the mobile device **104** and stored in the storage **304**.

[0054] The mobile device **104** may generate a chip authentication program (CAP) token. The generation and use of CAP tokens will be apparent to persons having skill in the relevant art. The mobile device **104** may transmit the generated CAP token to the cloud system **302**. The cloud system **302** may then authenticate (e.g., validate) the CAP token, such as by using a CAP token validation system as will be apparent to persons having skill in the relevant art. The cloud system **302** may then generate unpredictable numbers, and may generate an encrypted payload including a derived dynamic card validation code key (KD_{CVC3}) and the generated unpredictable number. The cloud system **302** may also transmit at least some of the information to the issuer **108**. The issuer **108** may store the received information in an issuer database **310**.

[0055] The encrypted payload may be transmitted to the mobile device **104**, which may decrypt the payload and then generate a dynamic card validation code based on the information included in the encrypted payload and stored payment credentials. The user **102** may shop at a merchant **306**, and, when goods or services have been selected for purchase, may transmit the payment credentials and dynamic card validation code from the mobile device **104** to the point-of-sale terminal **120**. The point-of-sale terminal **120** may transmit the information and relevant transaction information to the acquirer **122**.

[0056] An acquirer processing server **312** may receive the information at the acquirer **122** and may generate and submit an authorization request for the financial transaction including the payment credentials and dynamic card validation code to the payment network **124**. The payment network **124** may forward relevant information to the issuer **108** for authorization of the transaction for a specific transaction amount. The issuer **108** may include an issuer processing server **308**. The issuer processing server **308** may authenticate the dynamic card validation code based on the information stored in the issuer database **310** and received from the cloud system **302**. The issuer **108** may then, based on the authentication, approve or deny the payment transaction.

[0057] The issuer **108** may submit a response to the payment network **124**, which may then submit an authorization response to the acquirer **122**. The acquirer may inform the merchant **306** of the results of the authorization, who may then finalize the transaction with the cardholder **102**. Methods for provisioning payment credentials to the mobile device **104** and for processing a payment transaction via the mobile device **104** are discussed in more detail below.

Dual Channel Communication

[0058] FIG. **4** illustrates a method for dual channel communication for use in the system **100** of FIG. **1** for communication between the mobile device **104** and the remote-SE system **110**. Dual channel communication may enable the mobile device **104** and the remote-SE system **110** to communicate using multiple protocols, which may allow for faster and/or more secure transmissions between the two systems.

[0059] Dual channel communication may include using remote notification **402** as a first channel, and mutual authentication **404** as a second channel. Remote notification **402** may be performed between the remote notification service **114** and the mobile device **104**. In some embodiments, the payment credentials management service **112** may generate information, such as the single use key **118**, to be provided to the mobile payment application **106**. The payment credentials management service **112** may generate a message including the single use key encrypted with a random key to be provided and may encrypt the message using the mobile key.

[0060] The remote notification service **114** may then transmit the message to the mobile device **104** using remote notification. The mobile device **104** may provide the message to the mobile payment application **106**, which may then decrypt the message using the shared mobile key, and then may decrypt the encrypted single use key with the random key, and thus use the single use key in a payment transaction. Methods for transmission of message using remote notification will be apparent to persons having skill in the relevant art.

[0061] Mutual authentication **404** may be used in instances where additional security may be desired, such as in forming an initial connection between the mobile device **104** and the remote-SE system **110**. The mutual authentication **404** may use SSL/TLS communication to authenticate the remote-SE system **110** to the mobile device **104**, and may use an authentication code, discussed in more detail below, to authenticate the mobile device **104** to the remote-SE system **110**. In such an instance, the authentication of both systems to the other provides the mutual authentication and additional security.

[0062] SSL/TLS communication is a standard method of communication as will be apparent to persons having skill in the relevant art. The authentication code may be a hash computed over a set of data known by both the remote-SE system **110** and the mobile device **104**. For example, the authentication code may be computed over a unique identifier defined by the remote-SE system **110** to uniquely identify the mobile device **104**, which may be provided to the mobile payment application **106** during initialization, discussed in more detail below. In an exemplary embodiment, the authentication code may be based on, in part, a session identifier. The session identifier may be transmitted from the remote-SE system **110** to the mobile device **104** using remote notification **402**. In a further embodiment, the session identifier may be encrypted (e.g., using the mobile key). In such an embodiment, the mobile key may be used to decrypt the session identifier to be used to build the authentication code to be used for the mutual authentication **404**.

[0063] The mobile device **104** and the remote-SE system **110** may both include the mobile key to be used as a shared key for the encrypting and decrypting of messages transmitted via remote notification. The mobile payment application **106** may also include a local storage encryption key. The local storage encryption key may be generated by the mobile payment application **106** and used to provide the storage **304** as an encrypted local database. The storage **304** may then store the shared mobile key, received payment credentials, and any additional information in the mobile device **104** to prevent unauthorized access.

Initialization and Use of the Mobile Payment Application

[0064] FIG. **5** illustrates a method **500** for the initialization and use of the mobile payment application **106** in the mobile device **104**.

[0065] In step **502**, the user **102** may register with the remote-SE system **110** to use the mobile device **104** for contactless payment transactions. The user **102** may register with

the remote-SE system **110** using the mobile device **104** or another computing device, such as a desktop computer. Registration may be performed via a web browser, application program, or any other suitable method as will be apparent to persons having skill in the relevant art. As part of the registration, the user **102** may provide account information for the payment account with which the user **102** wants to use for payment transactions using the mobile device **104**. The user **102** may receive an activation code and may also identify and/or receive a unique identifier used to identify the user **102**.

[0066] In step **504**, the user **102** may install the mobile payment application **106** on the mobile device **104**. Methods for installing application programs on a mobile device will be apparent to persons having skill in the relevant art and may include using a web browser or application program on the mobile device **104** to identify and download the mobile payment application **106**. It will also be apparent to persons having skill in the relevant art that step **504** may be performed before or concurrently with step **502**.

[0067] In step **506**, the user **102** may initialize/activate the mobile payment application **106**. The user **102** may enter the activation code received in step **502** into the mobile payment application **106**. The mobile payment application **106** may then communicate with the remote-SE system **110** and may receive the shared mobile key. The mobile payment application **106** may also generate the local storage encryption key and encrypt the storage **304** to create the local encrypted database.

[0068] In step **508**, the remote-SE system **110** may transmit the card profile **116** to the mobile device **104**. In one embodiment, the mobile device **104** may receive a remote notification message to notify the user **102** that the mobile payment application **106** must connect with the remote-SE system **110** using mutual authentication **404**. Once connected, the remote-SE system **110** may then transmit the card profile including payment credentials for the account specified by the user **102** in step **502**, which may then be stored by the mobile payment application **106** in the local encrypted database **304**.

[0069] In step **510**, the remote-SE system **110** may transmit a single use key **118** to the mobile payment application **106**. In some embodiments, the transmission may be performed using mutual authentication **404** in the same process performed in step **510**. In some embodiments, steps **508** and **510** may be combined in a single step, such that the remote-SE system may transmit both the card profile **116** and a single use key **118** to the mobile payment application **106** in a single or consecutive transactions.

[0070] In step **512**, the mobile device **104** may conduct a contactless/NFC payment transaction using the mobile payment application **106** and the single use key **118**. The mobile payment application **106** may generate a payment cryptogram, discussed in more detail below, and may transmit the generated cryptogram and payment credentials to a point-of-sale terminal **120**. Methods for transmitting payment credentials and a payment cryptogram to a point-of-sale terminal **120** via NFC will be apparent to persons having skill in the relevant art.

[0071] In step **514**, the mobile payment application **106** may identify if there are any single use keys **118** available for use in subsequent payment transactions. If there are additional keys **118** available for use, then the method **500** may return to step **512** where additional payment transactions may be conducted with the remaining single use key(s) **118**. If there are no single use keys **118** remaining, then, the method **500** may return to step **510** where connection may be made with the remote-SE system **110** and a new single use key **118** provisioned to the mobile device **104**.

Method for Provisioning Payment Credentials and Generating a Payment Cryptogram

[0072] FIG. **6** illustrates a more detailed version of the system **100** and illustrates the process by which payment credentials may be generated and provisioned to the mobile device **104** and the mobile device **104** used to conduct a contactless payment transaction without the use of a secure element.

[0073] The user **102** may register with the remote-SE system **110**. The remote-SE system **110** may store the user registration information (e.g., payment account information) in a database **602** and may return an activation code to the user **102**. The user **102** may then install the mobile payment application **106** on the mobile device **104** and activate the mobile payment application **106** using the activation code. As part of the activation, the remote-SE system **110** may transmit a shared mobile key **604** to the mobile payment application **106**. The mobile payment application **106** may also generate a local storage encryption key and may encrypt the storage **304** on the mobile device **104**. The mobile key **604** may be stored in the local encrypted database **304**.

[0074] The payment credentials management service **112** may store the shared mobile key **604** in the database **602**. The payment credentials management service **112** may also identify payment credentials corresponding to the payment account indicated by the user, and build the card profile **116** including the payment credentials. The remote notification service **114** may transmit a remote notification to the mobile device **104** to indicate to the user **102** that the card profile **116** is ready to be downloaded to the mobile payment application **106**. The mobile payment application **106** may then communicate with the payment credentials management service **112** using mutual authentication and receive the card profile **116** from the remote-SE system. The mobile payment application **106** may then store the received card profile **116** in the local encrypted database **304**.

[0075] The payment credentials management service **112** may also generate a single use key **118** including a generating key. In some embodiments, the single use key **118** may be generated in response to the receipt of a key request from the mobile device **104**. In a further embodiment, the key request may include a mobile PIN. The payment credentials management service **112** may have previously stored the mobile PIN (e.g., as set by the user **102**) in the database **602**.

[0076] The payment credentials management service **112** may then transmit the generated single use key **118** to the mobile device **104**, which may then store the single use key **118** in the local encrypted database **304**. In some instances, the single use key **118** may be incorrect (e.g., fake, not genuine, etc.) if the key request includes a mobile PIN for which authentication is unsuccessful. In some embodiments the key may have been combined with the PIN such that when used it is incorrect without any explicit authentication step. In some embodiments, the card profile **116** and/or the single use key **118** may be encrypted by the payment credentials management service **112** prior to transmission to the mobile device **104**, such as by using the mobile key **604**. The mobile pay-

ment application **106** may then decrypt the received message, also using the shared mobile key **604**, or, in some embodiments, a random key.

[0077] Once the mobile payment application **106** includes both the card profile **116** and the single use key **118**, the user **102** may shop at a merchant **306** and select goods or services for purchase. The user **102** may then input to the mobile payment application **106** that a payment transaction is to be conducted. The mobile payment application **106** may then generate a payment cryptogram using the generating key included in the single use key **118**. The payment cryptogram may be, for example, an application cryptogram or a dynamic card validation code (CVC3). The mobile payment application **106** may transmit the payment cryptogram to the merchant point-of-sale terminal **120**. The merchant point-of-sale terminal **120** may transmit the received payment information and any additional transaction information (e.g., transaction amount, merchant identifier, etc.) to the acquirer processing server **312** of the acquirer **122**. The acquirer processing server **312** may then generate and submit an authorization request for the financial transaction to the payment network **124**. The payment network **124** may transmit relevant transaction data, such as the payment information and transaction amount, to the issuer processing server **308**. The issuer processing server **308** may then validate the application cryptogram. If the validation is successful, the issuer may approve the payment transaction for the transaction amount (e.g., based on an available amount, credit, etc. for the payment account). If the validation is unsuccessful, the issuer may deny the payment transaction. Methods for validating a cryptogram will be apparent to persons having skill in the relevant art.

[0078] In some embodiments, the remote-SE system **110** may transmit information to the issuer **108** for storage in the issuer database **310**, such as for fraud management. Such information will be apparent to persons having skill in the relevant art and may include, for example, application transaction counters. Methods suitable for performing the functions as disclosed herein are discussed in more detail below with respect to the flow diagrams illustrated in FIGS. **8-14**.

Alternative Method for Provisioning Payment Credentials and Generating a Payment Cryptogram

[0079] FIG. **7** illustrates a more detailed version of the alternative system **300** and illustrates the process by which payment credentials may be generated and provisioned to the mobile device **104** and the mobile device **104** used to conduct a contactless payment transaction without the use of a secure element.

[0080] The user **102** may install the mobile application program **106** on the mobile device **104**. Prior to the beginning of the process, at stage A, the mobile application program **106** may store authentication keys and credentials in the storage **304** as received from the remote-SE system **110**. At stage B, a storage key ($K_{STORAGE}$) may be stored in the storage **304** as well. At stage C, additional information, including static payment credentials, may be stored in the storage **304**.

[0081] At stage **1**, the user **102** may launch the mobile payment application **106** using the mobile device **104**. At stage **2***a*, the mobile payment application **106** may connect with the remote-SE system **110** via the cloud system **302**, such as by using SSL authentication or any other suitable method for authenticated transmission. The cloud system **302** may transmit payment credentials to the mobile payment application **106**, which may then be stored in the storage **304**. At stage **2***b*, the mobile payment application **106** may generate a CAP token used for authentication. In some embodiments, the user **102** may supply additional authentication credentials, such as a gesture, a password, or a biometric identifier.

[0082] In stage **3**, the mobile payment application **106** may transmit the generated CAP token to the remote-SE system **100**. At stage **4**, the CAP token may be forward to a CAP token validation service (CTVS) **702**. At stage **5**, the CTVS **702** may validate the CAP token using methods apparent to persons having skill in the relevant art. At stage **6**, the results of the validation may be sent to the payment credentials management system **704**. In some embodiments, the payment credentials management system **704** may be operated by or on behalf of the issuer **108**.

[0083] At stage **7**, the payment credentials management system **704** may generate an encrypted payload. As part of the encrypted payload, the payment credentials management system **704** may generate a session key unpredictable number (KS_{UN}), a cloud unpredictable number (UN_{CLOUD}), and may identify and/or store a plurality of dynamic card validation code (CVC3) keys and the $K_{STORAGE}$. Methods and systems for the generation of unpredictable numbers will be apparent to persons having skilled in the relevant art. The encrypted payload may include at least one CVC3 key, the KSUN, and the application transaction counter and may be generated using a derived CVC3 key (KD_{CVC3}). In one embodiment, the KD_{CVC3} used may be fake if the CAP token validation is unsuccessful. The payload may be encrypted using the $K_{STORAGE}$.

[0084] At stage **8***a*, the payment credentials management system **704** may perform a synchronization process with the issuer **108**. The synchronization process may include defining rules for the validity of the values generated by the mobile payment application **106** for conducting a payment transaction. In one embodiment, the process may include transmitting at least the KS_{UN}, application transaction counter, and UN_{CLOUD} to the issuer **108** for storage in the issuer database **310**.

[0085] At stage **8***b*, the encrypted payload may be transmitted to the cloud system **302** for transmitting to the mobile payment application **106** in stage **9**. At stage **10**, the encrypted payload may be decrypted using the $K_{STORAGE}$ and stored in the storage **304**. At stage **11**, the user **102** may shop at the merchant **306** and select goods or services for purchase. As part of the purchase, at stage **12**, the mobile payment application **106** may generate a payment CVC3 value. In one embodiment, the mobile device **104** may communicate with the point-of-sale terminal **120**. The point-of-sale terminal **120** may generate a reader unpredictable number (UN_{READER}) and transmit the UN_{READER} to the mobile payment application **106**, which may then generate the payment CVC3 value using the information in the encrypted payload and the UN_{READER}. The generated payment CVC3 value and the application transaction counter may be transmitted to the point-of-sale terminal **120** via NFC.

[0086] In some embodiments, the user **102** may be required to enter a PIN at the point-of-sale terminal **120** for additional authentication at stage **13**. At stage **14**, the point-of-sale terminal **120** may execute standard NFC payment transaction processes as will be apparent to persons having skill in the relevant art. At stage **15**, the point-of-sale terminal **120** may generate an authorization request for the payment transaction, which may include the UN_{READER}, the generated CVC3

value, the application transaction counter, and, if applicable, the PIN value input by the user **102**. At stage **16**, the acquirer processing server **312** may translate the PIN included in the authorization request using methods apparent to persons having skill in the relevant art. It will be further apparent that stage **16** may be optional.

[0087] At stage **17**, the authorization request may be forwarded to the payment network **124**, which may forward the authorization request and/or information included in the authorization request to the issuer **108**. At optional stage **18**, the issuer may verify the translated PIN. At stage **19***a*, the issuer **108** may identify if additional processing is necessary and may, if necessary, retrieve the values stored in the issuer database **310**. At stage **19***b*, the issuer processing server **308** may validate the payment CVC3 value using at least the UN_{READER}, UN_{CLOUD}, and application transaction counter. Methods for validating a CVC3 will be apparent to persons having skill in the relevant art. At stage **20**, the issuer **108** may submit a response based on the validation, and the method may proceed accordingly as in traditional payment transactions.

Method for Registration of a User for Remote Payment Transactions

[0088] FIG. **8** is a flow diagram illustrating a method for the user **102** to register with the remote-SE system **110** to enable a payment account for remote payment transactions using a mobile device **104** lacking a secure element.

[0089] At step **806**, the user **102** may access the registration system of the remote-SE system **110**. The user **102** may access the system via a web browser **804**, which may be executed on a computing device. In one embodiment, the computing device may be the mobile device **104**. The user **102** may navigate to a webpage hosted by or on behalf of the remote-SE system **110**. At step **808**, the user **102** may register with the payment credentials management service **112** via the browser **804**. As part of the registration, the user **102** may provide account details for a payment account, and the payment credentials management service **112** may ensure the payment account is eligible for remote payment transactions.

[0090] At step **810**, the payment credentials management service **112** may create a user profile for the user **102** in the remote-SE system **110**. In some embodiments, a user profile may also be created in the issuer system **108**. As part of the creation of the user profile, the payment credentials management service **112** may generate and/or identify an activation code. At step **812**, the user registration may be completed and the activation code transmitted back to the **102** via the browser **804**. At step **814**, the payment credentials management service **112** may synchronize information (e.g., the user profile, activation code status, etc.) with the issuer **108** for fraud management. It will be apparent to persons having skill in the relevant art that step **814** may be optional.

[0091] At step **816**, the user **102** may receive the activation code via the web browser **804**. At step **818**, the user **102** may download the mobile payment application **106** to the mobile device **104**. In one embodiment, the user **102** may utilize an app store **802**, such as the Apple® App Store, to download the mobile payment application **106**. The mobile payment application **106** may be validated and installed on the mobile device at step **820** using methods and systems apparent to persons having skill in the relevant art. At step **822**, the mobile payment application **106** may be successfully installed on the mobile device **104** and may await initialization.

Method for Initialization of the Mobile Payment Application

[0092] FIG. **9** is a flow diagram illustrating a method for initialization of the mobile payment application **106** on the mobile device **104** for use in contactless payment transactions.

[0093] At step **902**, the user may start (e.g., execute) the mobile payment application on the mobile device **104**. At step **904**, the mobile payment application **106** may perform an integrity check. As part of the integrity check, the mobile payment application **106** may authenticate the user **102** and request the activation code provided to the user **102** during the registration process (e.g., at step **812** in FIG. **8**). At step **906**, the mobile payment application **106** may generate a unique identifier and additional values and keys, such as a local database storage key (e.g., mobile storage key).

[0094] At step **908**, the mobile payment application **106** may connect to the payment credentials management service **112** using mutual authentication. The mobile payment application **106** may transmit the activation code and any other additional user authentication information (e.g., a user identifier, a password, etc.) as a method of authentication. The mobile payment application **106** may also transmit the generated unique identifier. In some embodiments, the user **102** may also provide a mobile PIN to be transmitted to the payment credentials management service **112** as part of step **908**.

[0095] At step **910**, the payment credentials management service **112** may validate the mobile payment application **106** using the provided authentication information and may, if validated, update the user profile to include the unique identifier. At step **912**, the payment credentials management service **112** may also register the mobile device **104** with the remote notification service **114** using the unique identifier. At step **914**, the payment credentials management service **112** may generate the shared mobile key **604** and may store the shared mobile key **604** in the user profile. At optional step **916**, the payment credentials management service **112** may synchronize with the issuer **108** for fraud management.

[0096] At step **918**, the mobile payment application **106** may receive the shared mobile key **604** from the payment credentials management service **112** and may store the mobile key **604** in the encrypted local storage **304**. At step **920**, the mobile payment application **106** may wipe the mobile storage key, such that the encrypted local storage **304** may not be access without authorization. The mobile payment application **106** may store data with which the mobile storage key is generated separate from the encrypted local storage **304** for use in regenerating the mobile storage key for access to the encrypted local storage **304**. At step **922**, the mobile payment application **106** may be ready for remote management by the payment credentials management service **112**. In some embodiments, the mobile payment application **106** may notify the user **102** when initialization is completed.

Method for Remote Management of the Mobile Payment Application

[0097] FIG. **10** is a flow diagram illustrating a method for remote management of the mobile payment application **106** of the mobile device **104** via the payment credentials management service **112**.

[0098] In step **1002**, the payment credentials management service **112** may receive a trigger to start the remote management of the mobile payment application **106**. In some embodiments, the trigger may be received from the payment

credentials management service **112** itself based on predefined rules. In another embodiment, the trigger may be received from the issuer **108**. In step **1004**, the payment credentials management service **112** may prepare data for remote notification. The preparation of data may include the building of a notification based on a function to be performed, such as the provisioning of the card profile **116**, provisioning of a single use key **118**, changing of the mobile PIN, etc. An exemplary method for provisioning of the card profile **116** to the mobile device **104** is discussed in more detail below with reference to FIG. **11**.

[0099] The payment credentials management service **112** may build a message including the notification and a session identifier, and then may encrypt the message using the mobile key **604**. The payment credentials management service **112** may also identify the mobile device **104** for receipt using the unique identifier in the user profile. In embodiments where step **1004** may include the provisioning of the single use key **118**, the single use key **118** may be encrypted using a random key (e.g., or suitable key other than the mobile key **604**), and then the encrypted single use key may be encrypted using the mobile **604** and provisioned to the mobile payment application **106** similar to the encryption and transmission of the message as disclosed herein.

[0100] In step **1006**, the payment credentials management service **112** may transmit the encrypted message to the mobile payment application **106** using remote notification **402**. As discussed above, remote notification **402** may include the forwarding of the encrypted message to the remote notification service **114**, which may transmit the encrypted message to the mobile device **104** using remote notification, which may then make the encrypted message available to the mobile payment application **106**. In step **1008**, the mobile payment application **106** may receive the encrypted message.

[0101] In step **1010**, the user **102** may start the mobile payment application **106**. It will be apparent to persons having skill in the relevant art that step **1010** may be optional (e.g., the mobile payment application **106** may start upon receipt of the encrypted message, the mobile payment application **106** may always run in the background, etc.). In step **1012**, the mobile payment application **106** may start, which may include regenerating the mobile storage key, retrieving the mobile key **406** from the local encrypted storage **304**, and decrypting the message using the retrieved mobile key **406**.

[0102] In step **1014**, the mobile payment application **106** may connect to the payment credentials management service **112** using mutual authentication **404** as discussed above, such as by generating, transmitting, and then wiping an authentication code including the session identifier. At step **1016**, the payment credentials management service **112** may validate the authentication credentials transmitted by the mobile payment application **106**. If validated, the payment credentials management service **112** may then have a secure connection with the mobile payment application **106** and may proceed with the function indicated in the notification.

Method for Provisioning of a Card Profile to the Mobile Payment Application

[0103] FIG. **11** is a flow diagram illustrating a method for provisioning the card profile **116** to the mobile payment application **106** of the mobile device **104** by the payment credentials management service **112**.

[0104] Utilizing the connection made upon the triggering of remote management illustrated in FIG. **10**, at step **1102** the payment credentials management service **112** may build the payment token payload card profile **116**. The card profile **116** may include payment credentials for the payment account indicated by the user **102** during registration, which may have been stored in the user profile. The payment credentials management service **112** may build the card profile by generating a message including the payment credentials, generating a mobile session key, and encrypting the message using the mobile session key. The payment credentials management service **112** may store the card profile **116** in the user profile and, in step **1104**, may transmit the message including the card profile **116** to the mobile payment application **106**.

[0105] In step **1106**, the mobile payment application **106** may receive the message and may generate the mobile session key used for decrypting the message. At step **1108**, the mobile payment application **106** may decrypt the message using the generated mobile session key and may validate the message. Once validated, at step **1110** the mobile payment application **106** may build a receipt message indicating successful receipt and validation of the card profile **116**, and may be used as an activation message and/or used to carry information from the mobile payment application **106** to the remote-SE system **110**. The receipt message may be encrypted using the mobile session key. The mobile payment application **106** may also update a status to indicate that the card profile **116** is successfully received and stored.

[0106] In step **1112**, the receipt message may be received by the payment credentials management service **112** and may be decrypted using the mobile session key and validated. Upon successful validation, in step **1114** the payment credentials management service **112** may activate the card profile **116** and may update the user profile accordingly. In step **1116**, the payment credentials management service **112** may transmit a notification to the mobile payment application **106** that the card profile **116** has been activated and may wipe the mobile session key. In step **1118**, the payment credentials management service **112** may synchronize the user profile indicating activation of the card profile **116** with the issuer **108** for fraud management.

[0107] In step **1120**, the mobile payment application **106** may analyze the return code indicating activation of the card profile **116**. In step **1122**, the mobile payment application **106** may wipe the mobile session key, and in step **1124** may be ready to receive single use keys **118** for use in conducting payment transactions. In some embodiments, the mobile payment application **106** may display a notification to the user **102** via a user interface to indicate that single use keys **118** may be received.

Method for Provisioning Single Use Keys to the Mobile Payment Application

[0108] FIG. **12** is a flow diagram illustrating a method for the provisioning of single use keys **118** to the mobile payment application **106** in the mobile device **104** by the payment credentials management service **112** for use in payment transactions.

[0109] In an exemplary embodiment, while performing the connection with the payment credentials management service **112** made upon the triggering of remote management illustrated in FIG. **10**, the encrypted single use key **118**, may be previously transmitted to the mobile payment application **106** in a message encrypted by the mobile key **604**. At step **1202**, the payment credentials management service **112** may build a message with an action to activate (e.g., decrypt) the previ-

ously provisioned single use key **118**, the message including the random key used to encrypt the single use key **118**. The payment credentials management service **112** may then generate a mobile session key and then may encrypt the message including the random key using the mobile session key. The payment credentials management service **112** may then, in step **1204**, transmit the message including the random key to the mobile payment application **106**.

[0110] In step **1206**, the mobile payment application **106** may receive the message and may generate the mobile session key used for decrypting the message. At step **1208**, the mobile payment application **106** may decrypt the message using the generated mobile session key and may validate the message. The mobile payment application **106** may also decrypt the single use key **118** using the random key included in the decrypted message, and may validate the decrypted single use key **118**. Once validated, at step **1210** the mobile payment application **106** may build a receipt message indicating successful receipt and validation of the single use key **118**. The receipt message may be encrypted using the mobile session key. The mobile payment application **106** may also update a status to indicate that the single use key **118** is successfully received and stored and that the mobile payment application **106** is ready to conduct a payment transaction.

[0111] In step **1212**, the receipt message may be received by the payment credentials management service **112** and may be decrypted using the mobile session key and validated. Upon successful validation, in step **1214** the payment credentials management service **112** may activate the single use key **118** and may update the user profile accordingly. In step **1216**, the payment credentials management service **112** may transmit a notification to the mobile payment application **106** that the single use key **118** has been activated and may wipe the mobile session key. In step **1218**, the payment credentials management service **112** may synchronize the user profile indicating activation of the single use key **118** with the issuer **108** for fraud management.

[0112] In step **1220**, the mobile payment application **106** may analyze the return code indicating activation of the single use key **118**. In step **1222**, the mobile payment application **106** may wipe the mobile session key, and in step **1224** may be ready to conduct a contactless payment transaction. In some embodiments, the mobile payment application **106** may display a notification to the user **102** via a user interface to indicate that the mobile payment application **106** is ready to conduct a contactless payment transaction.

Method for Modification of Mobile PIN in the Mobile Payment Application

[0113] FIG. **13** is a flow diagram illustrating a method for the management of a change in the mobile PIN of the user **102** in the mobile payment application **106** by the payment credentials management service **112**.

[0114] Utilizing the connection made upon the triggering of remote management illustrated in FIG. **10**, at step **1302** the payment credentials management service **112** may build a remote management action indicating a change to the mobile PIN and removal of all stored single use keys **118**. The payment credentials management service **112** may build a message including the remote management action, generate a mobile session key, and encrypt the message using the mobile session key. The payment credentials management service **112** may, in step **1304**, transmit the message including remote management action to the mobile payment application **106**.

[0115] In step **1306**, the mobile payment application **106** may receive the message and may generate the mobile session key used for decrypting the message. At step **1308**, the mobile payment application **106** may decrypt the message using the generated mobile session key and may validate the message. Once the message has been validated, the mobile payment application may update the card profile **116** accordingly and may remove any available single use keys **118** from the encrypted local storage **304**. Then, at step **1310**, the mobile payment application **106** may build a receipt message indicating successful receipt and execution of the remote management action. The receipt message may be encrypted using the mobile session key.

[0116] In step **1312**, the receipt message may be received by the payment credentials management service **112** and may be decrypted using the mobile session key and validated. Upon successful validation, in step **1314** the payment credentials management service **112** may update the user profile accordingly. In step **1316**, the payment credentials management service **112** may transmit a notification to the mobile payment application **106** that the user profile has been updated and no single use keys **118** have been issued, and may wipe the mobile session key. In step **1318**, the payment credentials management service **112** may synchronize the user profile indicating the change to the mobile PIN and wiping of single use keys **118** with the issuer **108** for fraud management.

[0117] In step **1320**, the mobile payment application **106** may analyze the return code. In step **1322**, the mobile payment application **106** may wipe the mobile session key, and in step **1324** may be ready to receive single use keys **118** for use in conducting payment transactions. In some embodiments, the mobile payment application **106** may display a notification to the user **102** via a user interface to indicate that single use keys **118** may be received.

Method for Conducting a Payment Transaction Using the Mobile Payment Application

[0118] FIG. **14** is a flow diagram illustrating a method for conducting a contactless payment transaction using the mobile payment application **106** on the mobile device **104** using the card profile **116** and single use key **118** provisioned by the payment credentials management service **112**.

[0119] In step **1402**, the user **102** may start the mobile payment application **106** on the mobile device **104**. In step **1404**, the mobile payment application **106** may prepare for payment. To prepare for payment, the mobile payment application **106** may regenerate the mobile storage key and may retrieve the payment credentials and generating key from the card profile **116** and the single use key **118** in the encrypted local storage **304**. The generating key may be used by the mobile payment application **106** to generate a payment cryptogram for use in the payment transaction. The mobile payment application **106** may also indicate to the user **102** that the application is ready for payment.

[0120] In step **1406**, a NFC payment method may be executed between the user **102**, the mobile device **104**, the mobile payment application **106**, and the point-of-sale terminal **120**. Methods for executing transmission of payment credentials from a mobile device to a point-of-sale terminal will be apparent to persons having skill in the relevant art.

[0121] In step **1408**, the point-of-sale terminal **120** at the merchant **306** may provide transaction data to the acquirer **122** including the payment credentials and payment cryptogram. In step **1410**, the acquirer **122** may submit an authori-

zation request including the transaction data to the payment network **124**. In step **1412**, the payment network **124** may seek authorization from the issuer **108** for the payment transaction and may forward relevant information to the issuer **108**. In step **1414**, the issuer **108** may validate the payment cryptogram using methods that will be apparent to persons having skill in the relevant art. The issuer **108** may, once the payment cryptogram is validated, approve or deny the payment transaction (e.g., based on a transaction amount and available credit in the payment account for the user **102**) and notify the payment network **124**. At step **1416**, the payment network **124** may submit an authorization response to the acquirer **122**, which may then forward the response to the merchant **306** and/or point-of-sale terminal **120** at step **1418**. At step **1420**, the merchant may finalize the payment transaction, such as by providing the transacted goods or services to the user **102** or by providing a receipt to the user **102**.

[0122] Once the payment transaction has been completed, the mobile payment application **106** may, at step **1422**, update the payment token payload stored in the encrypted local storage **304** based on the outcome of the payment transaction. At step **1424**, the mobile payment application **106** may wipe the mobile storage key, and at step **1426**, may indicate (e.g., to the user **102**) that the mobile payment application **106** is ready for another contactless payment transaction (e.g., if additional single use keys **118** are available) or to receive single use keys **118**.

[0123] In some embodiments, the payment transaction may be conducted via the use of local data authentication (LDA). In some instances, the storage of payment credentials received by the mobile device **104** in the encrypted local storage **304** (e.g., and not in a Secure Element) may be such that CDA (combined dynamic data authentication/application cryptogram generation) may be unavailable to support traditional card verification methods to verify the payment credentials used in the financial transaction. As a result, the point-of-sale terminal **120** may be configured such that it may require authentication by the user **102** at both the mobile device **104** (e.g., entering of the mobile PIN) and the point-of-sale terminal **120** (e.g., entering of an online PIN or signature).

[0124] LDA may be used in order to provide card authentication support such that a financial transaction may be supported by the point-of-sale terminal **120** utilizing a single point of authentication (e.g., the mobile PIN). In order to perform LDA, the card profile **116** may further include one RSA key pair and certificate. The performing of the LDA may include the swapping of the meaning of the effective date and the expiration date in the payment credentials included in the card profile **116**, and the setting of at least one issuer action code to force the payment transaction to be an online transaction. In a further embodiment, the expiration date may be set as a date prior to the date of issuance, or the effective date may be set as a date beyond the expiry date, or both may be set as defined. This may result in the point-of-sale terminal **120** declining the transaction due to the expiration and/or effective dates, but transmitting the transaction for online authorization, which may result in processing of the transaction using the single point of authentication by the user **102**. In a further embodiment, the expiration date may be set as a previous date, or the effective date may be set as a future date, or both may be set as defined. In some embodiments, performing LDA may further include setting an issuer action code configured to decline offline transactions (e.g., such that if the point-of-sale terminal **120** is an offline-only terminal it may decline all such transactions).

[0125] It is noted that, although the method illustrated in FIG. **14** and described above is a method for conducting a contactless payment transaction, such a method may also be used for conducting a remote payment transaction, for the secure transmission of payment credentials, for use as part of an authentication solution (whether part of a transaction or otherwise), or in other applications as will be apparent to persons having skill in the relevant art and not limited to those illustrated herein.

Exemplary Method for Generating and Provisioning Payment Credentials

[0126] FIG. **15** is a flow chart illustrating a method **1500** for generating and provisioning payment credentials to a mobile device lacking a secure element.

[0127] At step **1502**, a card profile (e.g., the card profile **116**) associated with a payment account may be generated by a processing device (e.g., of the payment credentials management service **112**), wherein the card profile **116** includes at least payment credentials corresponding to the associated payment account and a profile identifier. At step **1504**, the generated card profile **116** may be provisioned to a mobile device (e.g., the mobile device **104**) lacking a secure element. In one embodiment, provisioning the card profile **116** may include building a message including the generated card profile **116**, generating an encryption key, encrypting the message using the generated encryption key, and provisioning the encrypted message to the mobile device **104**.

[0128] At step **1506**, a key request may be received from the mobile device **104**, wherein the key request includes at least a mobile personal identification number (PIN) and the profile identifier. At step **1508**, an authentication device (e.g., of the payment credentials management service **112**) may use the mobile PIN. In one embodiment, the authentication device may use the mobile PIN using an XOR method. At step **1510**, a single use key (e.g., the single use key **118**) may be generated by the processing device, wherein the single use key **118** includes at least the profile identifier, an application transaction counter, and a generating key for use in generating a payment cryptogram valid for a single financial transaction. In some embodiments, the single use key **118** may be genuine if the mobile PIN is successfully authenticated in step **1508**, and fake if the mobile PIN is unsuccessfully authenticated. In one embodiment, the method **1500** may further include transmitting the generated single use key **118** to an issuer associated with the payment account. In some embodiments, the generated single use key **118** may be inactive.

[0129] At step **1512**, the generated single use key **118** may be transmitted, by a transmitting device, to the mobile device **104**. In one embodiment, transmitting the generated single use key **118** may include building a message including the generated single use key **118**, generating an encryption key, encrypting the message using the generated encryption key, and provisioning the encrypted message to the mobile device **104**.

[0130] In embodiments where the generated single use key **118** may be inactive, the method **1500** may further include receiving, from the mobile device **104**, and indication of use of the single use key **118** and activating, by the processing device, the generated single use key **118**. In a further embodiment, the method **1500** may also include transmitting, by the

transmitting device, an indication of activation of the single use key **118** to an issuer (e.g., the issuer **108**) associated with the payment account.

Method for Generating a Payment Cryptogram

[0131] FIG. **16** is a flow chart illustrating a method **1600** for generating a payment cryptogram in a mobile device (e.g., the mobile device **104**) lacking a secure element.

[0132] In step **1602**, a card profile (e.g., the card profile **116**) may be received by a receiving device (e.g., in the mobile device **104**), wherein the card profile **116** includes at least payment credentials corresponding to a payment account and a profile identifier. In one embodiment, receiving the card profile **116** may include receiving an encrypted message including the card profile **116**, generating a mobile session key, and decrypting the message using the generated mobile session key to obtain the included card profile **116**. In some embodiments, the card profile **116** may be configured to utilize local data authentication, wherein the local data authentication includes swapping, in the payment credentials, the meaning of an expiration date and an effective date, and setting an issuer action code configured to force the financial transaction to be an online transaction. In a further embodiment, the expiration date may be set as a date prior to the date of issuance, or the effective date may be set as a date beyond the expiry date, or both may be set as defined. In a further embodiment, the card profile **116** may further include one RSA key pair and certificate.

[0133] In step **1604**, an input device (e.g., of the mobile device **104**, such as a touch screen) may receive a mobile personal identification number (PIN) input by a user (e.g., the user **102**) of the mobile device **104**. In step **1606**, a transmitting device may transmit a key request, wherein the key request includes at least the profile identifier.

[0134] In step **1608**, a single use key (e.g., the single use key **118**) may be received, by the receiving device, wherein the single use key **118** includes at least an application transaction counter and a generating key. In one embodiment, receiving the single use key **118** may include receiving an encrypted message including the single use key **118**, generating a mobile session key, and decrypting the message using the generated mobile session key to obtain the included single use key **118**.

[0135] In step **1610**, a payment cryptogram valid for a single payment transaction may be generated, by a processing device, based on at least the received single use key **108** and the mobile PIN. In some embodiments, the payment cryptogram may be an application cryptogram or a dynamic card validation code. In step **1612**, at least the payment credentials and the generated payment cryptogram may be transmitted, via near field communication, to a point-of-sale terminal (e.g., the point-of-sale terminal **120**) for use in a financial transaction.

[0136] In some embodiments, the method **1600** may further include receiving, by the input device, an indication of use of the received single use key **118**, transmitting, by the transmitting device, an activation request including at least the profile identifier, and receiving, by the receiving device, an indication of activation of the single use key **118**. In a further embodiment, the payment credentials and generated payment cryptogram may be transmitted to the point-of-sale terminal **120** in response to receiving the indication of activation of the single use key **118**. In an alternative further embodiment, the payment cryptogram may be generated in response to receiving the indication of activation of the single use key **118**.

Alternative Method for Generating and Provisioning Payment Details

[0137] FIG. **17** is a flow chart illustrating an alternative method **1700** for generating and provisioning payment details to a mobile device (e.g., the mobile device **104**) lacking a secure element.

[0138] In step **1702**, at least a storage key, a plurality of dynamic card validation code (CVC3) keys, and an application transaction counter associated with a mobile application program (e.g., the mobile payment application **106**) may be stored in a database (e.g., the storage **304**). In step **1704**, at least the storage key, an authentication component, and static payment credentials may be provisioned to the mobile device **104**, wherein the static payment credentials are associated with a payment account.

[0139] In step **1706**, a chip authentication program (CAP) token may be received from the mobile device **104**. In step **1708**, the authenticity of the received CAP token may be validated by a validation service (e.g., the CTVS **702**). In one embodiment, the CAP token may be validated based on at least the provisioned authentication component and an additional credential received from the mobile device **104**. In a further embodiment, the additional credential may be at least one of: a gesture, a password, a passcode, and a biometric identifier. In another embodiment, validating the authenticity of the CAP token may include validating the authenticity of the CAP token based on at least the application transaction counter.

[0140] In step **1710**, a session key unpredictable number (KS_{UN}) may be generated by a processing device (e.g., the cloud system **302**). In step **1712**, a cloud unpredictable number (UN_{CLOUD}) may be generated by the processing device **302**. In step **1714**, the processing device **302** may identify an encrypted payload based on a derived CVC3 key (KD_{CVC3}), wherein the encrypted payload includes at least a CVC3 key of the plurality of CVC3 keys, the KS_{UN}, and the application transaction counter. In one embodiment, the KD_{CVC3} may be genuine if the received CAP token is successfully validated, and may be fake if the received CAP token is unsuccessfully validated. In some embodiment, the payload may be encrypted using at least the storage key.

[0141] In step **1716**, a transmitting device may transmit the encrypted payload to the mobile device **104** for use in generating a CVC3 value for use in a financial transaction. In step **1718**, the transmitting device may transmit at least the KS_{UN}, UN_{CLOUD}, and application transaction counter to an issuer (e.g., the issuer **108**) associated with the payment account for use in validating the generated CVC3 value used in the financial transaction.

Method for Generating a Dynamic Card Validation Code

[0142] FIG. **18** is a flow chart illustrating a method **1800** for generating a dynamic card validation code (CVC3) value in a mobile device (e.g., the mobile device **104**) lacking a secure element.

[0143] In step **1802**, at least a storage key, an authentication component, and static payment credentials may be received by a receiving device. In step **1804**, at least one additional credential may be received by an input device (e.g., of the mobile device **104**). In some embodiments, the at least one

additional credential may include at least one of: a gesture, a password, a passcode, and a biometric identifier. In step **1806**, a chip authentication program (CAP) token may be generated by a processing device, wherein the CAP token is based on at least the authentication component and the at least one additional credential.

[0144] In step **1808** the generated CAP token may be transmitted by a transmitting device. In step **1810**, an encrypted payload may be received by the receiving device, wherein the encrypted payload includes at least a supplied CVC3 value, session key unpredictable number, and an application transaction counter. In step **1812**, the processing device may decrypt the encrypted payload using at least the received storage key.

[0145] In step **1814**, a reader unpredictable number may be received, via near field communication, from a point-of-sale terminal (e.g., the point-of-sale terminal **120**). In step **1816**, the processing device may generate a payment CVC3 value based on at least the supplied CVC3 value, the session key unpredictable number, the application transaction counter, and the reader unpredictable number. In step **1818**, the generated payment CVC3 value and the application transaction counter may be transmitted, via near field communication, to the point-of-sale terminal **120** for including in an authorization request in a financial transaction.

Computer System Architecture

[0146] FIG. **19** illustrates a computer system **1900** in which embodiments of the present disclosure, or portions thereof, may be implemented as computer-readable code. For example, the payment credentials management **112**, the remote notification service **114**, the mobile device **104**, the acquirer processing server **312**, and the issuer processing server **308** may be implemented in the computer system **1900** using hardware, software, firmware, non-transitory computer readable media having instructions stored thereon, or a combination thereof and may be implemented in one or more computer systems or other processing systems. Hardware, software, or any combination thereof may embody modules and components used to implement the methods of FIGS. **6-18**.

[0147] If programmable logic is used, such logic may execute on a commercially available processing platform or a special purpose device. A person having ordinary skill in the art may appreciate that embodiments of the disclosed subject matter can be practiced with various computer system configurations, including multi-core multiprocessor systems, minicomputers, mainframe computers, computers linked or clustered with distributed functions, as well as pervasive or miniature computers that may be embedded into virtually any device. For instance, at least one processor device and a memory may be used to implement the above described embodiments.

[0148] A processor device as discussed herein may be a single processor, a plurality of processors, or combinations thereof. Processor devices may have one or more processor "cores." The terms "computer program medium," "non-transitory computer readable medium," and "computer usable medium" as discussed herein are used to generally refer to tangible media such as a removable storage unit **1918**, a removable storage unit **1922**, and a hard disk installed in hard disk drive **1912**.

[0149] Various embodiments of the present disclosure are described in terms of this example computer system **1900**. After reading this description, it will become apparent to a person skilled in the relevant art how to implement the present disclosure using other computer systems and/or computer architectures. Although operations may be described as a sequential process, some of the operations may in fact be performed in parallel, concurrently, and/or in a distributed environment, and with program code stored locally or remotely for access by single or multi-processor machines. In addition, in some embodiments the order of operations may be rearranged without departing from the spirit of the disclosed subject matter.

[0150] Processor device **1904** may be a special purpose or a general purpose processor device. The processor device **1904** may be connected to a communication infrastructure **1906**, such as a bus, message queue, network, multi-core message-passing scheme, etc. The network may be any network suitable for performing the functions as disclosed herein and may include a local area network (LAN), a wide area network (WAN), a wireless network (e.g., WiFi), a mobile communication network, a satellite network, the Internet, fiber optic, coaxial cable, infrared, radio frequency (RF), or any combination thereof. Other suitable network types and configurations will be apparent to persons having skill in the relevant art. The computer system **1900** may also include a main memory **1908** (e.g., random access memory, read-only memory, etc.), and may also include a secondary memory **1910**. The secondary memory **1910** may include the hard disk drive **1912** and a removable storage drive **1914**, such as a floppy disk drive, a magnetic tape drive, an optical disk drive, a flash memory, etc.

[0151] The removable storage drive **1914** may read from and/or write to the removable storage unit **1918** in a well-known manner. The removable storage unit **1918** may include a removable storage media that may be read by and written to by the removable storage drive **1914**. For example, if the removable storage drive **1914** is a floppy disk drive, the removable storage unit **1918** may be a floppy disk. In one embodiment, the removable storage unit **1918** may be non-transitory computer readable recording media.

[0152] In some embodiments, the secondary memory **1910** may include alternative means for allowing computer programs or other instructions to be loaded into the computer system **1900**, for example, the removable storage unit **1922** and an interface **1920**. Examples of such means may include a program cartridge and cartridge interface (e.g., as found in video game systems), a removable memory chip (e.g., EEPROM, PROM, etc.) and associated socket, and other removable storage units **1922** and interfaces **1920** as will be apparent to persons having skill in the relevant art.

[0153] Data stored in the computer system **1900** (e.g., in the main memory **1908** and/or the secondary memory **1910**) may be stored on any type of suitable computer readable media, such as optical storage (e.g., a compact disc, digital versatile disc, Blu-ray disc, etc.) or magnetic tape storage (e.g., a hard disk drive). The data may be configured in any type of suitable database configuration, such as a relational database, a structured query language (SQL) database, a distributed database, an object database, etc. Suitable configurations and storage types will be apparent to persons having skill in the relevant art.

[0154] The computer system **1900** may also include a communications interface **1924**. The communications interface **1924** may be configured to allow software and data to be transferred between the computer system **1900** and external

devices. Exemplary communications interfaces **1924** may include a modem, a network interface (e.g., an Ethernet card), a communications port, a PCMCIA slot and card, etc. Software and data transferred via the communications interface **1924** may be in the form of signals, which may be electronic, electromagnetic, optical, or other signals as will be apparent to persons having skill in the relevant art. The signals may travel via a communications path **1926**, which may be configured to carry the signals and may be implemented using wire, cable, fiber optics, a phone line, a cellular phone link, a radio frequency link, etc.

[0155] Computer program medium and computer usable medium may refer to memories, such as the main memory **1908** and secondary memory **1910**, which may be memory semiconductors (e.g. DRAMs, etc.). These computer program products may be means for providing software to the computer system **1900**. Computer programs (e.g., computer control logic) may be stored in the main memory **1908** and/or the secondary memory **1910**. Computer programs may also be received via the communications interface **1924**. Such computer programs, when executed, may enable computer system **1900** to implement the present methods as discussed herein. In particular, the computer programs, when executed, may enable processor device **1904** to implement the methods illustrated by FIGS. **6-18**, as discussed herein. Accordingly, such computer programs may represent controllers of the computer system **1900**. Where the present disclosure is implemented using software, the software may be stored in a computer program product and loaded into the computer system **1900** using the removable storage drive **1914**, interface **1920**, and hard disk drive **1912**, or communications interface **1924**.

[0156] Techniques consistent with the present disclosure provide, among other features, systems and methods for the provisioning of payment credentials to mobile devices lacking a secure element and the generation of payment cryptograms based thereon. While various exemplary embodiments of the disclosed system and method have been described above it should be understood that they have been presented for purposes of example only, not limitations. It is not exhaustive and does not limit the disclosure to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practicing of the disclosure, without departing from the breadth or scope.

What is claimed is:

1. A method for generating and provisioning payment credentials to a mobile device lacking a secure element, comprising:

generating, by a processing device, a card profile associated with a payment account, wherein the card profile includes at least payment credentials corresponding to the associated payment account and a profile identifier;

provisioning, to a mobile device, the generated card profile;

receiving, from the mobile device, a key request, wherein the key request includes at least a mobile personal identification number (PIN) and the profile identifier;

using, by an authentication device, the mobile PIN;

generating, by the processing device, a single use key, wherein the single use key includes at least the profile identifier, an application transaction counter, and a generating key for use in generating a payment cryptogram valid for a single financial transaction; and

transmitting, by a transmitting device, the generated single use key to the mobile device, wherein the mobile device is not required to have a secure element.

2. The method of claim **1**, wherein

the single use key is genuine if the mobile PIN is successfully authenticated, and

the single use key is fake if the mobile PIN is unsuccessfully authenticated.

3. The method of claim **1**, further comprising:

transmitting, by the transmitting device, the generated single use key to an issuer associated with the payment account.

4. The method of claim **1**, wherein provisioning the generated card profile to the mobile device may include building a message including the generated card profile, generating an encryption key, encrypting the message using the generated encryption key, and provisioning the encrypted message to the mobile device.

5. The method of claim **1**, wherein transmitting the generated single use key to the mobile device may include building a message including the generated single use key, generating an encryption key, encrypting the message using the generated encryption key, and provisioning the encrypted message to the mobile device.

6. The method of claim **1**, wherein the generated single use key is inactive.

7. The method of claim **6**, further comprising:

receiving, from the mobile device, an indication of use of the single use key; and

activating, by the processing device, the generated single use key.

8. The method of claim **7**, further comprising:

transmitting, by the transmitting device, an indication of activation of the single use key to an issuer associated with the payment account.

9. The method of claim **1**, wherein the payment cryptogram is an application cryptogram or a dynamic card validation code.

10. The method of claim **1**, wherein using the mobile PIN includes using, by the authentication device, the mobile PIN using an XOR method.

11. A method for generating a payment cryptogram in a mobile device lacking a secure element, comprising:

receiving, by a receiving device, a card profile, wherein the card profile includes at least payment credentials corresponding to a payment account and a profile identifier;

receiving, by an input device, a mobile personal identification number (PIN) input by a user of the mobile device;

transmitting, by a transmitting device, a key request, wherein the key request includes at least the profile identifier;

receiving, by the receiving device, a single use key, wherein the single use key includes at least an application transaction counter and a generating key;

generating, by a processing device, a payment cryptogram valid for a single financial transaction based on at least the received single use key and the mobile PIN; and

transmitting, via near field communication, at least the payment credentials and the generated payment cryptogram to a point-of-sale terminal for use in a financial transaction.

12. The method of claim **11**, wherein the payment cryptogram is an application cryptogram or a dynamic card validation code.

13. The method of claim **11**, wherein receiving the card profile may include receiving an encrypted message including the card profile, generating a mobile session key, and decrypting the message using the generated mobile session key to obtain the included card profile.

14. The method of claim **11**, wherein receiving the single use key may include receiving an encrypted message including the single use key, generating a mobile session key, and decrypting the message using the generated mobile session key to obtain the included single use key.

15. The method of claim **11**, further comprising:

receiving, by the input device, an indication of use of the received single use key;

transmitting, by the transmitting device, an activation request, wherein the activation request includes at least the profile identifier; and

receiving, by the receiving device, an indication of activation of the single use key.

16. The method of claim **15**, wherein the payment credentials and generated payment cryptogram are transmitted to the point-of-sale terminal in response to receiving the indication of activation of the single use key.

17. The method of claim **15**, wherein the payment cryptogram is generated in response to receiving the indication of activation of the single use key.

18. The method of claim **11**, wherein

the card profile is configured to utilize local data authentication, and

local data authentication includes one of (1) swapping, in the payment credentials, the meaning of an expiration date and an effective date, (2) setting the expiration date as a date prior to the date of issuance, or (3) setting the effective date as a date beyond the expiry date, or both may be set as the expiration date and effective date as defined, and setting an issuer action code configured to force the financial transaction to be an online transaction.

19. The method of claim **18**, wherein the card profile further includes one RSA key pair and certificate.

20. A method for generating and provisioning payment credentials to a mobile device lacking a secure element, comprising:

storing, in a database, at least a storage key, a plurality of dynamic card validation code keys, and an application transaction counter associated with a mobile application program;

provisioning, to the mobile device, at least the storage key, an authentication component, and static payment credentials, wherein the static payment credentials are associated with a payment account;

receiving, from the mobile device, a chip authentication program (CAP) token;

validating, by a validation device, the authenticity of the received CAP token;

generating, by a processing device, a session key unpredictable number (KS_{UN});

generating, by the processing device, a cloud unpredictable number (UN_{CLOUD});

identifying, by the processing device, an encrypted payload based on a derived dynamic card validation code key (KD_{CVC3}), wherein the encrypted payload includes at least a dynamic card validation code key of the plurality of dynamic card validation code keys, the KS_{UN}, and the application transaction counter;

transmitting, by a transmitting device, the encrypted payload to the mobile device for use in generating a dynamic card validation code for use in a financial transaction; and

transmitting, by the transmitting device, at least the KS_{UN}, UN_{CLOUD}, and application transaction counter to an issuer associated with the payment account for use in validating the generated dynamic card validation code used in the financial transaction.

21. The method of claim **20**, wherein

the KD_{CVC3} is genuine if the received CAP token is successfully validated, and

the KD_{CVC3} is fake if the received CAP token is unsuccessfully validated.

22. The method of claim **20**, wherein validating the authenticity of the CAP token includes validating the authenticity of the CAP token based on at least the provisioned authentication component and an additional credential received from the mobile device.

23. The method of claim **22**, wherein the additional credential is at least one of: a gesture, a password, a passcode, and a biometric identifier.

24. The method of claim **20**, wherein validating the authenticity of the CAP token includes validating the authenticity of the CAP token based on at least the application transaction counter.

25. The method of claim **20**, wherein the encrypted payload is encrypted using at least the storage key.

26. A method for generating a dynamic card validation code in a mobile device lacking a secure element, comprising:

receiving, by a receiving device, at least a storage key, an authentication component, and static payment credentials;

receiving, by an input device, at least one additional credential;

generating, by a processing device, a chip authentication program (CAP) token, wherein the CAP token is based on at least the authentication component and the at least one additional credential;

transmitting, by a transmitting device, the generated CAP token;

receiving, by the receiving device, an encrypted payload, wherein the encrypted payload includes at least a supplied dynamic card validation code, session key unpredictable number, and application transaction counter;

decrypting, by the processing device, the encrypted payload using at least the received storage key;

receiving, via near field communication, a reader unpredictable number from a point-of-sale terminal;

generating, by the processing device, a payment dynamic card validation code based on at least the supplied dynamic card validation code, the session key unpredictable number, the application transaction counter, and the reader unpredictable number; and

transmitting, via near field communication, the generated payment dynamic card validation code and the application transaction counter to the point-of-sale terminal for including in an authorization request for a financial transaction.

27. The method of claim **26**, wherein the at least one additional credential is at least one of: a gesture, a password, a passcode, and a biometric identifier.

28. A system for generating and provisioning payment credentials to a mobile device lacking a secure element, comprising:

a transmitting device;

a processing device configured to generate a card profile associated with a payment account, wherein the card profile includes at least payment credentials corresponding to the associated payment account and a profile identifier;

a provisioning device configured to provision, to a mobile device lacking a secure element, the generated card profile;

a receiving device configured to receive, from the mobile device, a key request, wherein the key request includes at least a mobile personal identification number (PIN) and the profile identifier; and

an authentication device configured to use the mobile PIN, wherein

the processing device is further configured to generate a single use key, wherein the single use key includes at least the profile identifier, an application transaction counter, and a generating key for use in generating a payment cryptogram valid for a single financial transaction, and

the transmitting device is configured to transmit the generated single use key to the mobile device.

29. The system of claim **28**, wherein

the single use key is genuine if the mobile PIN is successfully authenticated, and

the single use key is fake if the mobile PIN is unsuccessfully authenticated.

30. The system of claim **28**, wherein the transmitting device is further configured to transmit the generated single use key to an issuer associated with the payment account.

31. The system of claim **28**, wherein the authentication device is further configured to use the mobile PIN using an XOR method.

32. The system of claim **28**, wherein provisioning the generated card profile to the mobile device may include building a message including the generated card profile, generating an encryption key, encrypting the message using the generated encryption key, and provisioning the encrypted message to the mobile device.

33. The system of claim **28**, wherein transmitting the generated single use key to the mobile device may include building a message including the generated single use key, generating an encryption key, encrypting the message using the generated encryption key, and provisioning the encrypted message to the mobile device.

34. The system of claim **28**, wherein the generated single use key is inactive.

35. The system of claim **34**, wherein

the receiving device is further configured to receive, from the mobile device, an indication of use of the single use key, and

the processing device is further configured to activate the generated single use key.

36. The system of claim **35**, wherein the transmitting device is further configured to transmit an indication of activation of the single use key to an issuer associated with the payment account.

37. The system of claim **28**, wherein the payment cryptogram is an application cryptogram or a dynamic card validation code.

38. A system for generating a payment cryptogram in a mobile device lacking a secure element, comprising:

a processing device;

a receiving device configured to receive a card profile, wherein the card profile includes at least payment credentials corresponding to a payment account and a profile identifier;

an input device configured to receive a mobile personal identification number (PIN) input by a user of the mobile device; and

a transmitting device configured to transmit a key request, wherein the key request includes at least the profile identifier, wherein

the receiving device is further configured to receive a single use key, wherein the single use key includes at least an application transaction counter and a generating key,

the processing device is configured to generate a payment cryptogram valid for a single financial transaction based on at least the received single use key and the mobile PIN, and

the transmitting device is further configured to transmit, via near field communication, at least the payment credentials and the generated payment cryptogram to a point-of-sale terminal for use in a financial transaction.

39. The system of claim **38**, wherein the payment cryptogram is an application cryptogram or a dynamic card validation code.

40. The system of claim **38**, wherein receiving the card profile may include receiving an encrypted message including the card profile, generating a mobile session key, and decrypting the message using the generated mobile session key to obtain the included card profile.

41. The system of claim **38**, wherein receiving the single use key may include receiving an encrypted message including the single use key, generating a mobile session key, and decrypting the message using the generated mobile session key to obtain the included single use key.

42. The system of claim **38**, wherein

the input device is further configured to receive indication of use of the received single use key,

the transmitting device is further configured to transmit an activation request, wherein the activation request includes at least the profile identifier, and

the receiving device is further configured to receive an indication of activation of the single use key.

43. The system of claim **42**, wherein the transmitting device is configured to transmit the payment credentials and the generated payment cryptogram in response to the receipt of the indication of activation of the single use key.

44. The system of claim **42**, wherein the processing device is configured to generate the payment cryptogram in response to the receipt of the indication of activation of the single use key.

45. The system of claim **38**, wherein

the card profile is configured to utilize local data authentication, and

local data authentication includes one of (1) swapping, in the payment credentials, the meaning of an expiration date and an effective date, (2) setting the expiration date as a date prior to the date of issuance, or (3) setting the effective date as a date beyond the expiry date, or both

may be set as the expiration date and effective date as defined, and setting an issuer action code configured to force the financial transaction to be an online transaction.

46. The system of claim **45**, wherein the card profile further includes one RSA key pair and certificate.

47. A system for generating and provisioning payment credentials to a mobile device lacking a secure element, comprising:

a database configured to store at least a storage key, a plurality of dynamic card validation code keys, and an application transaction counter associated with a mobile application program;

a provisioning device configured to provision, to the mobile device, at least the storage key, an authentication component, and static payment credentials, wherein the static payment credentials are associated with a payment account;

a receiving device configured to receive, from the mobile device, a chip authentication program (CAP) token generated based on at least the static payment credentials;

a processing device configured to

validate the authenticity of the received CAP token,

generate a session key unpredictable number (KS_{UN}),

generate a cloud unpredictable number (UN_{CLOUD}), and

identify an encrypted payload based on a derived dynamic card validation code key (KD_{CVC3}), wherein the encrypted payload includes at least a dynamic card validation code key of the plurality of dynamic card validation code keys, the KS_{UN}, and the application transaction counter; and

a transmitting device configured to

transmit the encrypted payload to the mobile device for use in generating a dynamic card validation code for use in a financial transaction, and

transmit at least the KS_{UN}, UN_{CLOUD}, and application transaction counter to an issuer associated with the payment account for use in validating the generated dynamic card validation code used in the financial transaction.

48. The system of claim **47**, wherein

the KD_{CVC3} is genuine if the received CAP token is successfully validated, and

the KD_{CVC3} is fake if the received CAP token is unsuccessfully validated.

49. The system of claim **47**, wherein the processing device is configured to validate the authenticity of the CAP token based on at least the provisioned authentication component and an additional credential received from the mobile device.

50. The system of claim **49**, wherein the additional credential is at least one of: a gesture, a password, a passcode, and a biometric identifier.

51. The system of claim **47**, wherein the processing device is configured to validate the authenticity of the CAP token based on at least the application transaction counter.

52. The system of claim **47**, wherein the processing device is further configured to encrypt the encrypted payload using at least the storage key.

53. A system for generating a dynamic card validation code in a mobile device lacking a secure element, comprising:

a receiving device configured to receive at least a storage key, an authentication component, and static payment credentials;

an input device configured to receive at least one additional credential;

a processing device configured to generate a chip authentication program (CAP) token, wherein the CAP token is based on at least the authentication component and the at least one additional credential; and

a transmitting device configured to transmit the generated CAP token, wherein

the receiving device is further configured to receive an encrypted payload, wherein the encrypted payload includes at least a supplied dynamic card validation code, session key unpredictable number, and application transaction counter,

the processing device is further configured to decrypt the encrypted payload using at least the received storage key,

the receiving device is further configured to receive, via near field communication, a reader unpredictable number from a point-of-sale terminal,

the processing device is further configured to generate a payment dynamic card validation code based on at least the supplied dynamic card validation code, the session key unpredictable number, the application transaction counter, and the reader unpredictable number, and

the transmitting device is further configured to transmit, via near field communication, the generated payment dynamic card validation code and the application transaction counter to the point-of-sale terminal for including in an authorization request for a financial transaction.

54. The system of claim **53**, wherein the at least one additional credential is at least one of: a gesture, a password, a passcode, and a biometric identifier.

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