US 20150134540A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2015/0134540 A1

(43) Pub. Date: May 14, 2015

Law et al.

(54) **SYSTEMS AND METHODS FOR FACILITATING A TRANSACTION USING A VIRTUAL CARD ON A MOBILE DEVICE**

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(21) Appl. No.: **14/395,457**

(22) PCT Filed: **Apr. 16, 2013**

(86) PCT No.: **PCT/CA2013/050294**

§ 371 (c)(1),
(2) Date: **Oct. 17, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/713,302, filed on Oct. 12, 2012, provisional application No. 61/673,096, filed on Jul. 18, 2012, provisional application No. 61/624,947, filed on Apr. 16, 2012.

Publication Classification

(51) **Int. Cl.**

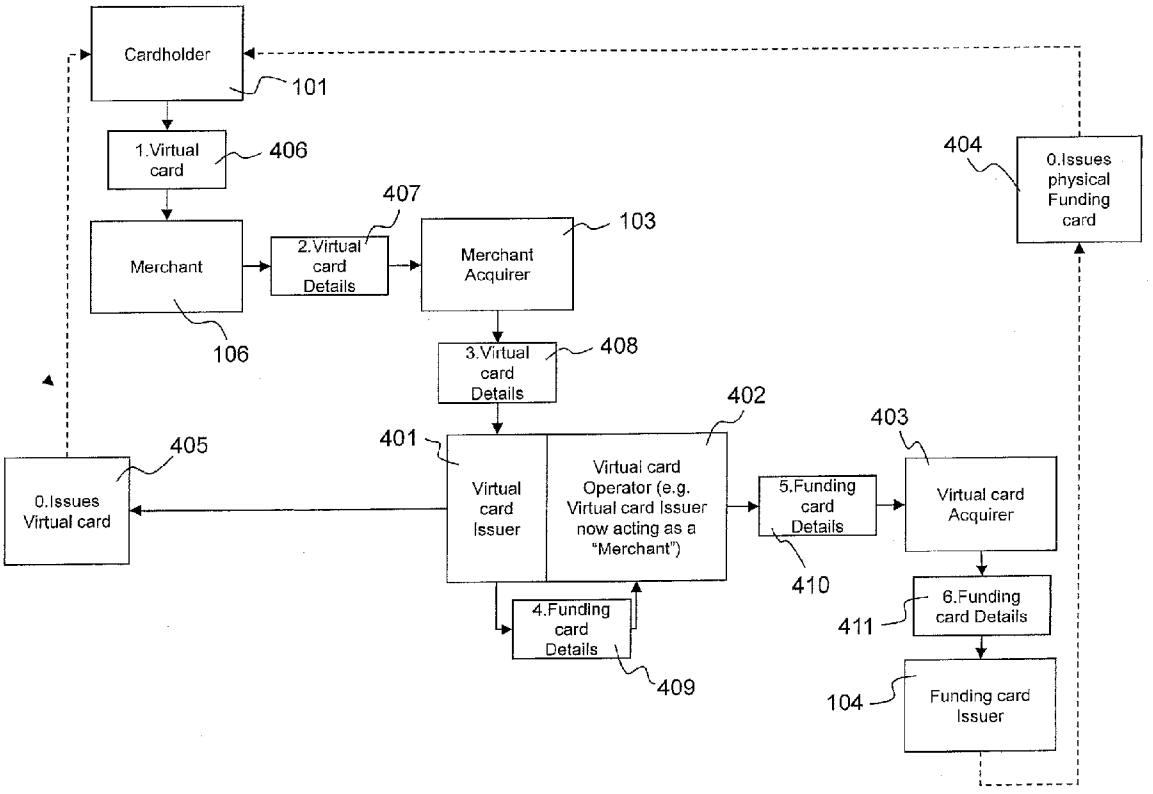
G06Q 20/34	(2006.01)
G06Q 20/40	(2006.01)
G06Q 20/32	(2006.01)

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

CPC ***G06Q 20/351*** (2013.01); ***G06Q 20/3278*** (2013.01); ***G06Q 20/40*** (2013.01); ***G06Q 20/4012*** (2013.01)

(57) **ABSTRACT**

Systems and methods are provided for facilitating contactless payment using cloud-based wallet containing payment credentials (e.g. Visa, Mastercard, American Express) using a near field communication (NFC)-capable device and payment gateway servers. A user can use their existing payment card, herein referred to as a funding card, for contactless payments. A second payment card, herein referred to as a virtual card, is generated. The virtual card is associated with the funding card on a payment gateway server. The virtual card is used on a NFC-enabled mobile device. When a payment is initiated, the virtual card data is sent through the NFC system from a point of sale terminal. This information is sent to the payment gateway server, which retrieves the funding card to make the payment. The funding card, not the virtual card, is used to transfer the money to make payment.



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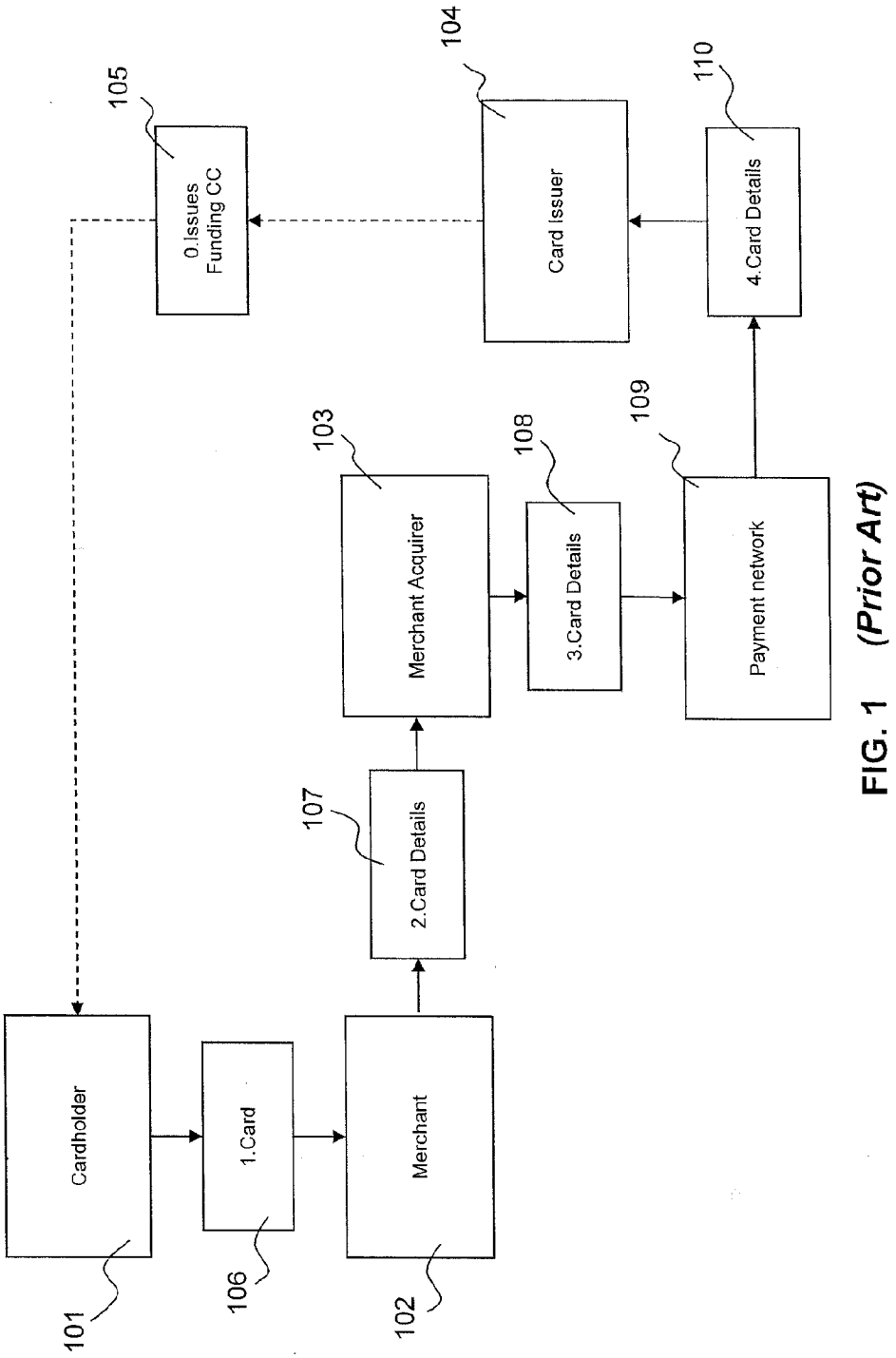

FIG. 1 *(Prior Art)*

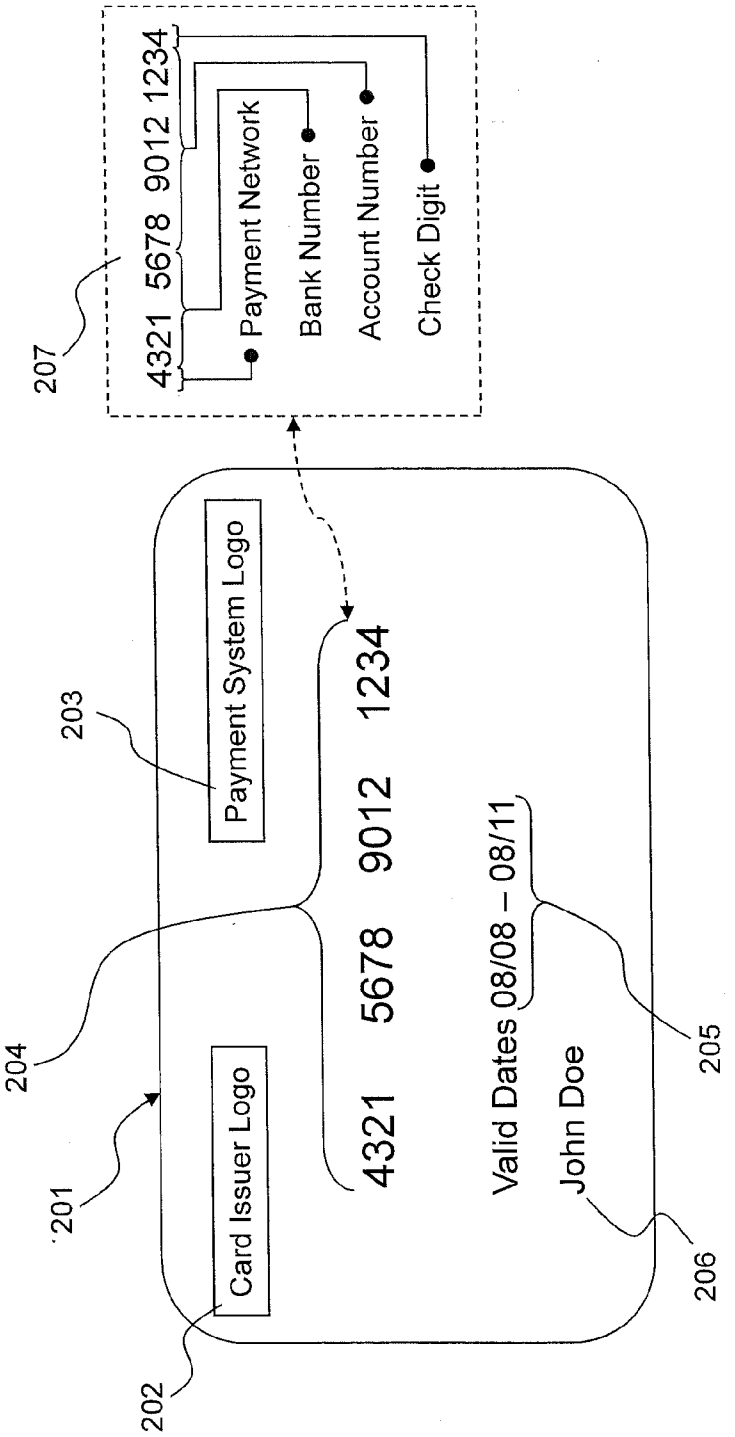

FIG. 2 *(Prior Art)*

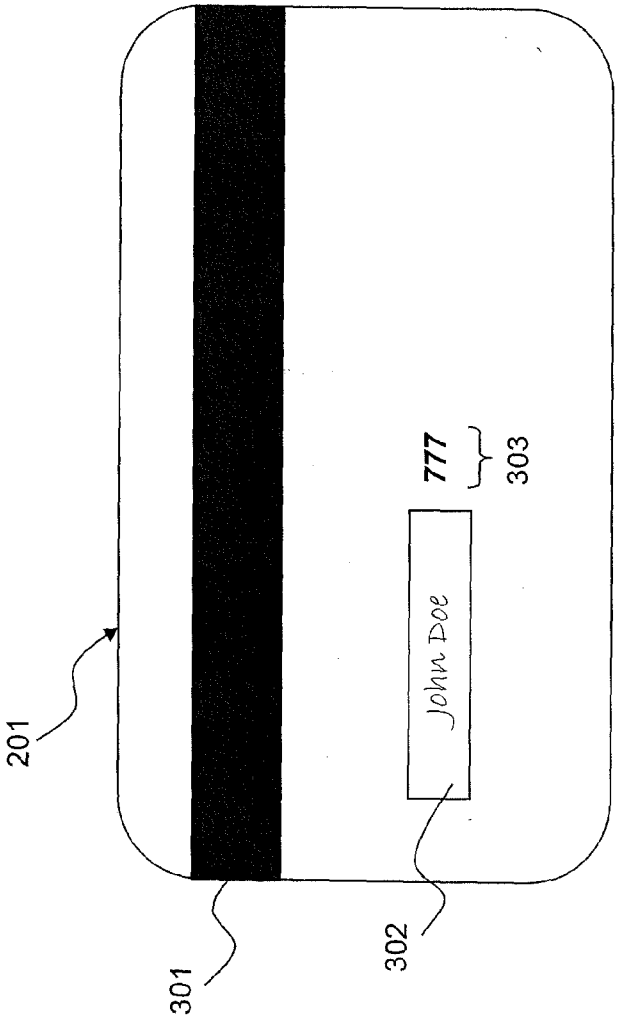

FIG. 3 (Prior Art)

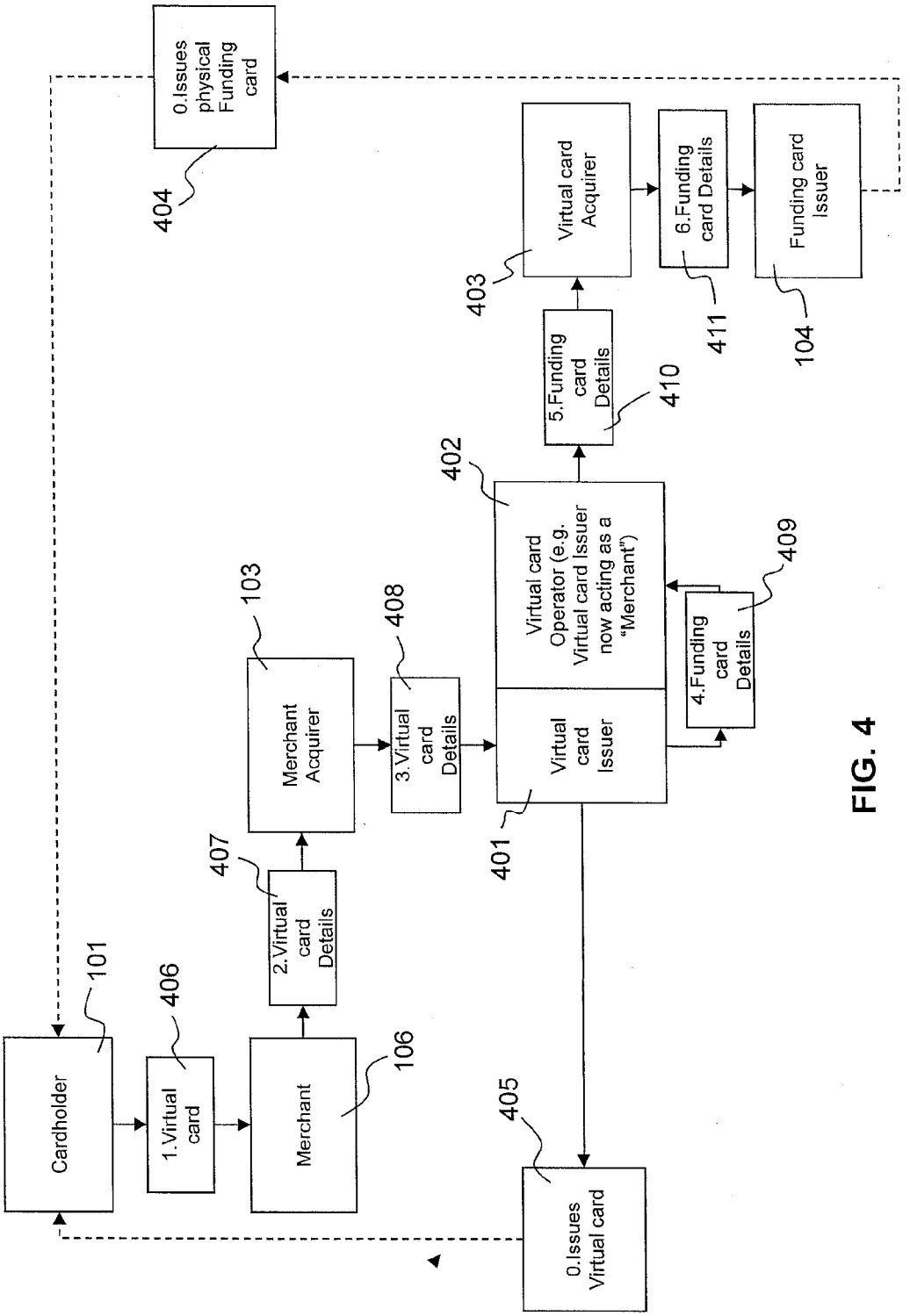

FIG. 4

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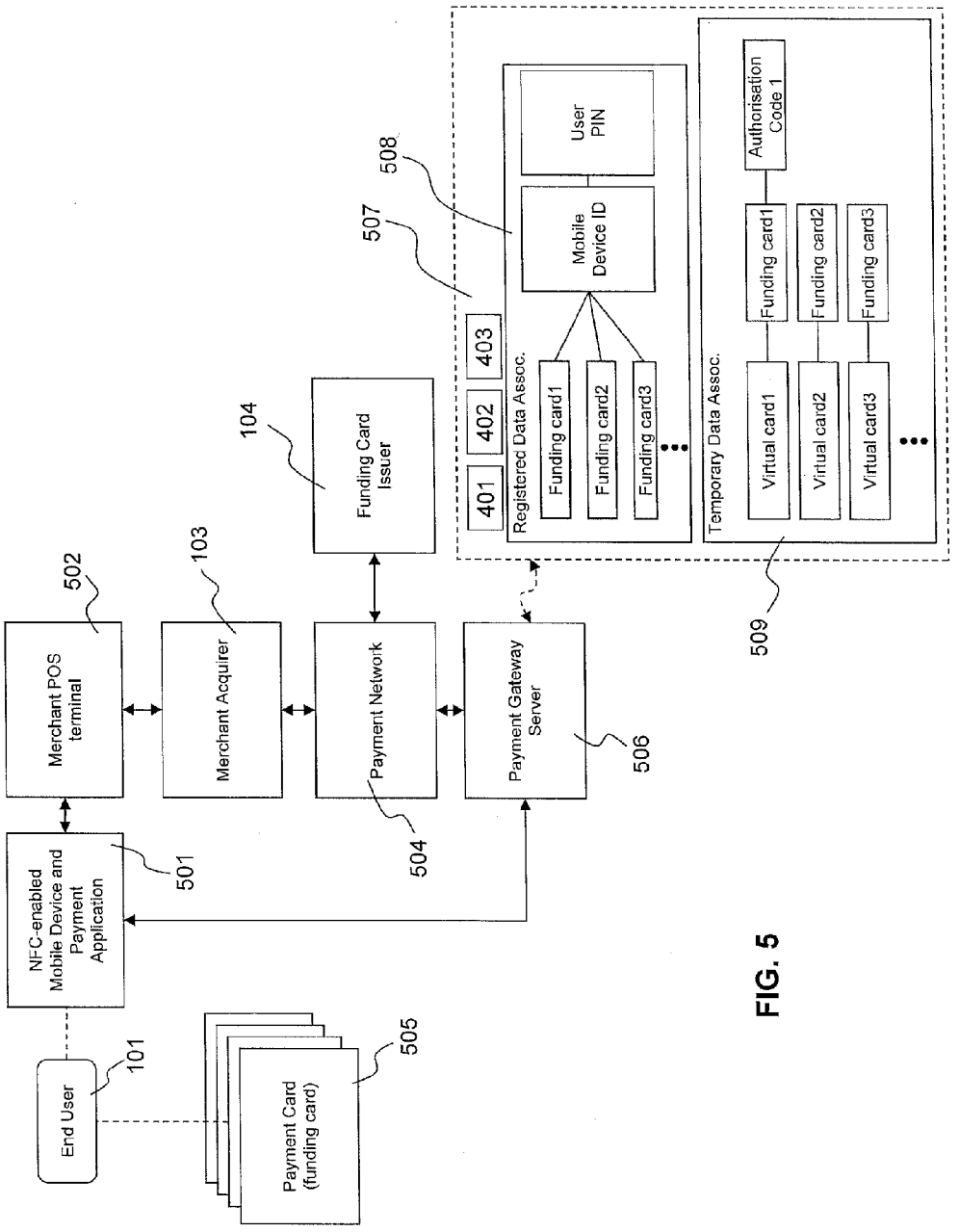
End User
101
NFC-enabled Mobile Device and Payment Application
501
Merchant POS terminal
502
Merchant Acquirer
103
Payment Network
504
Payment Gateway Server
506
Funding Card Issuer
104
Payment Card (funding card)
505
Registered Data Assoc.
401
402
403
Funding card1
Funding card2
Funding card3
Mobile Device ID
User PIN
508
507
Temporary Data Assoc.
Virtual card1
Virtual card2
Virtual card3
Authorisation Code 1
509

FIG. 5

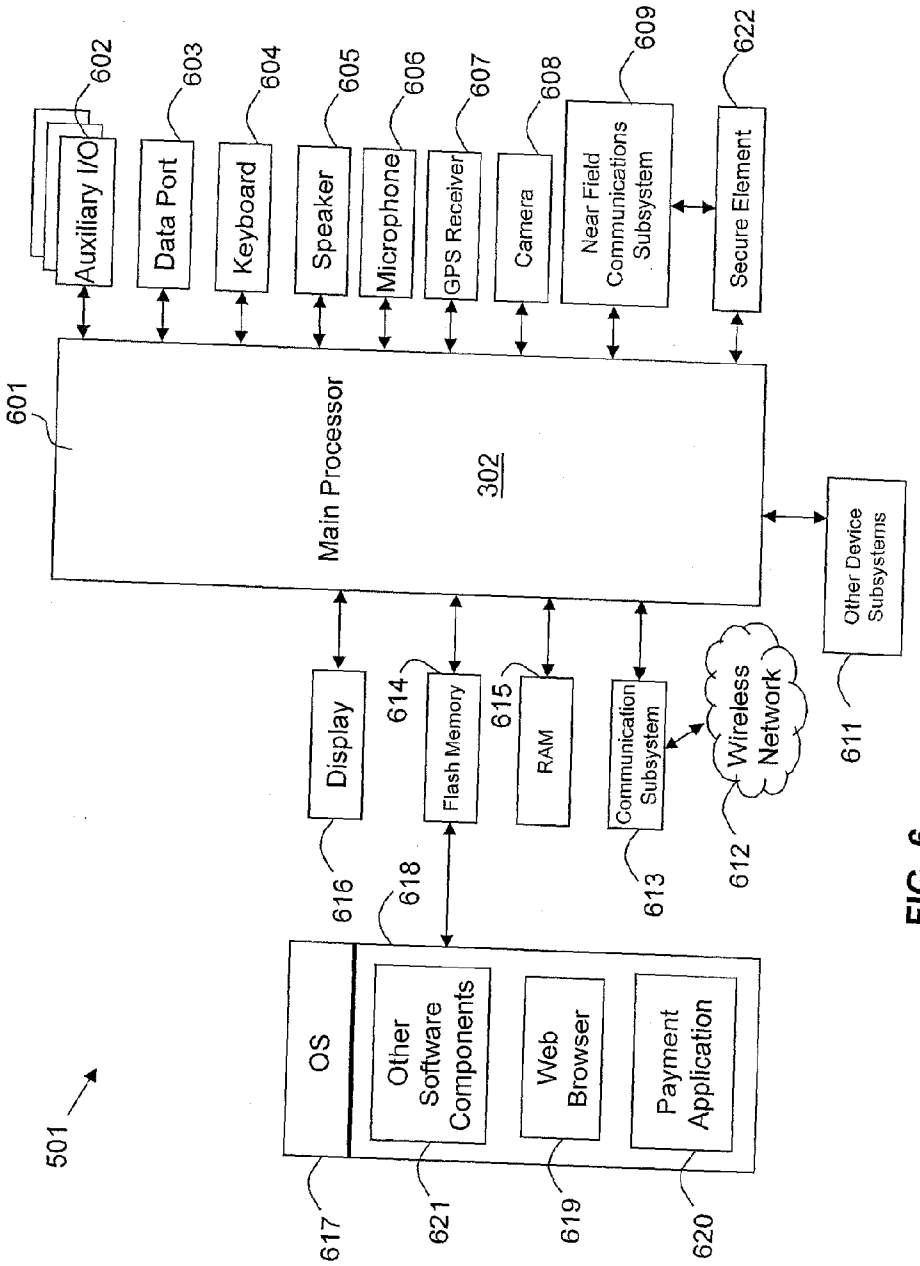
501
601
Main Processor
302
Auxiliary I/O
602
Data Port
603
Keyboard
604
Speaker
605
Microphone
606
GPS Receiver
607
Camera
608
Near Field Communications Subsystem
609
Secure Element
622
Other Device Subsystems
611
Display
616
Flash Memory
614
RAM
615
Communication Subsystem
613
Wireless Network
612
OS
618
Other Software Components
621
Web Browser
619
Payment Application
620
617

FIG. 6

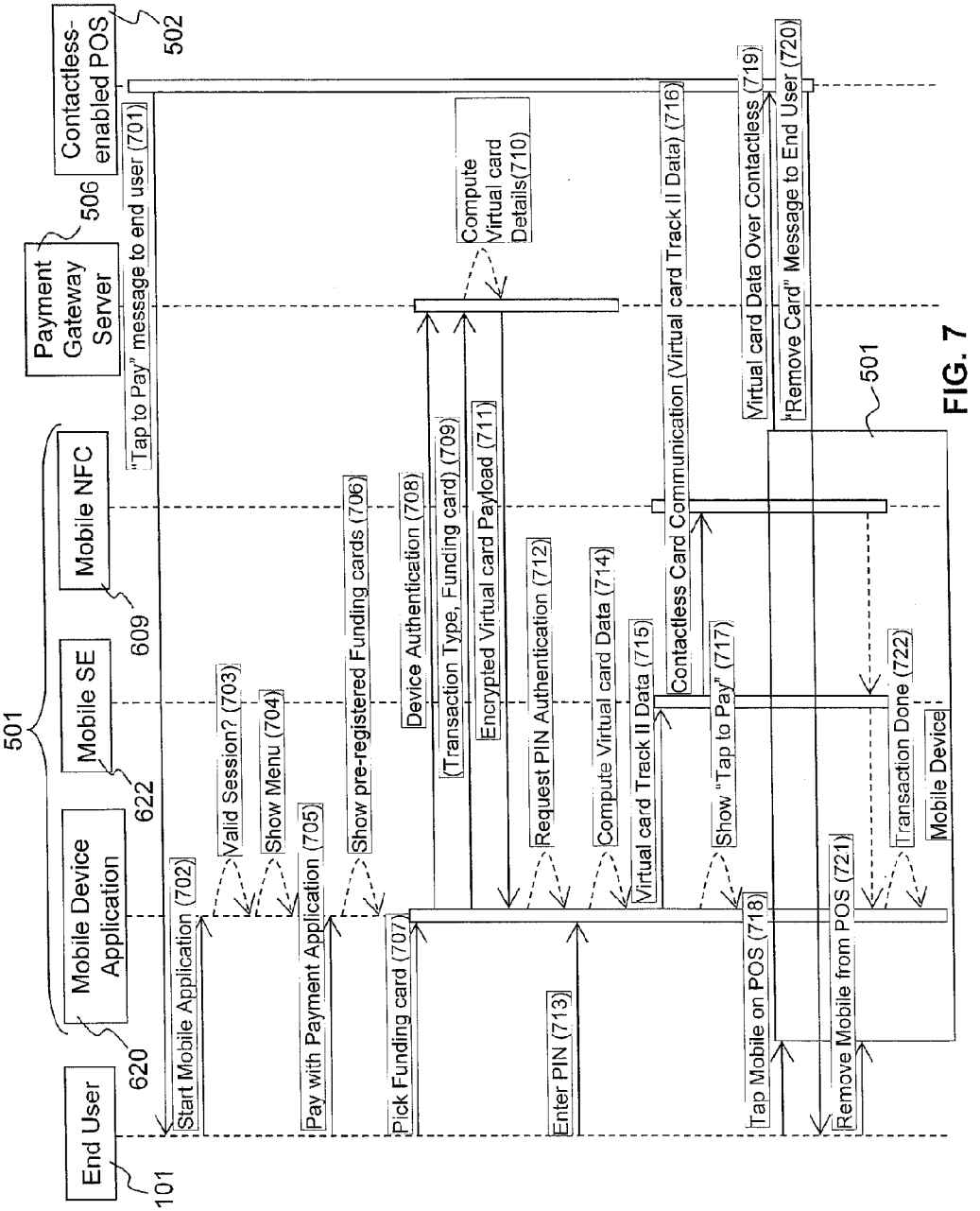

FIG. 7

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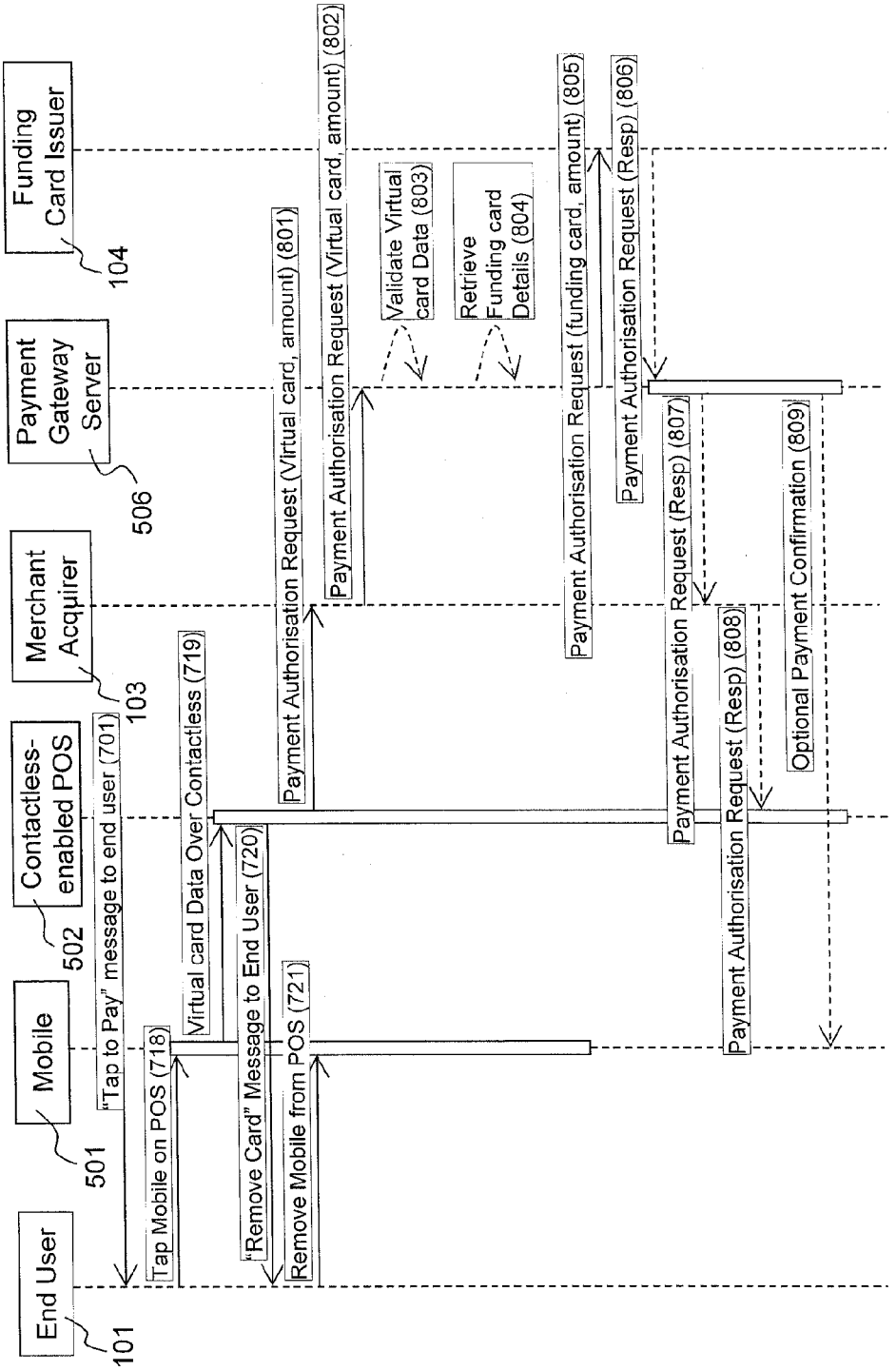

FIG. 8

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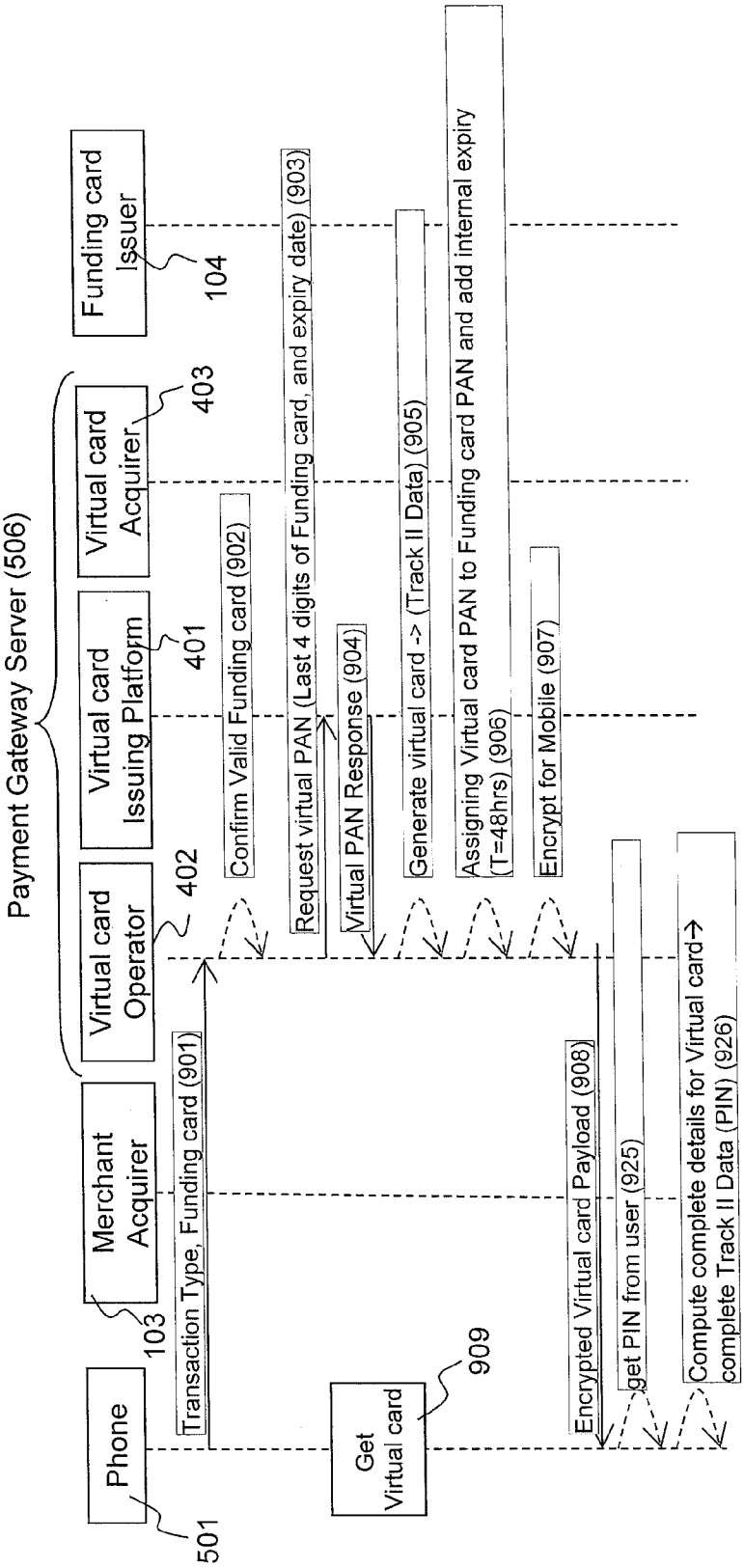
Payment Gateway Server (506)
Phone
501
Merchant Acquirer
103
Virtual card Operator
402
Virtual card Issuing Platform
401
Virtual card Acquirer
403
Funding card Issuer
104
Get Virtual card
909
Transaction Type, Funding card (901)
Confirm Valid Funding card (902)
Request virtual PAN (Last 4 digits of Funding card, and expiry date) (903)
Virtual PAN Response (904)
Generate virtual card -> (Track II Data) (905)
Assigning Virtual card PAN to Funding card PAN and add internal expiry (T=48hrs) (906)
Encrypt for Mobile (907)
Encrypted Virtual card Payload (908)
get PIN from user (925)
Compute complete details for Virtual card→ complete Track II Data (PIN) (926)

FIG. 9a

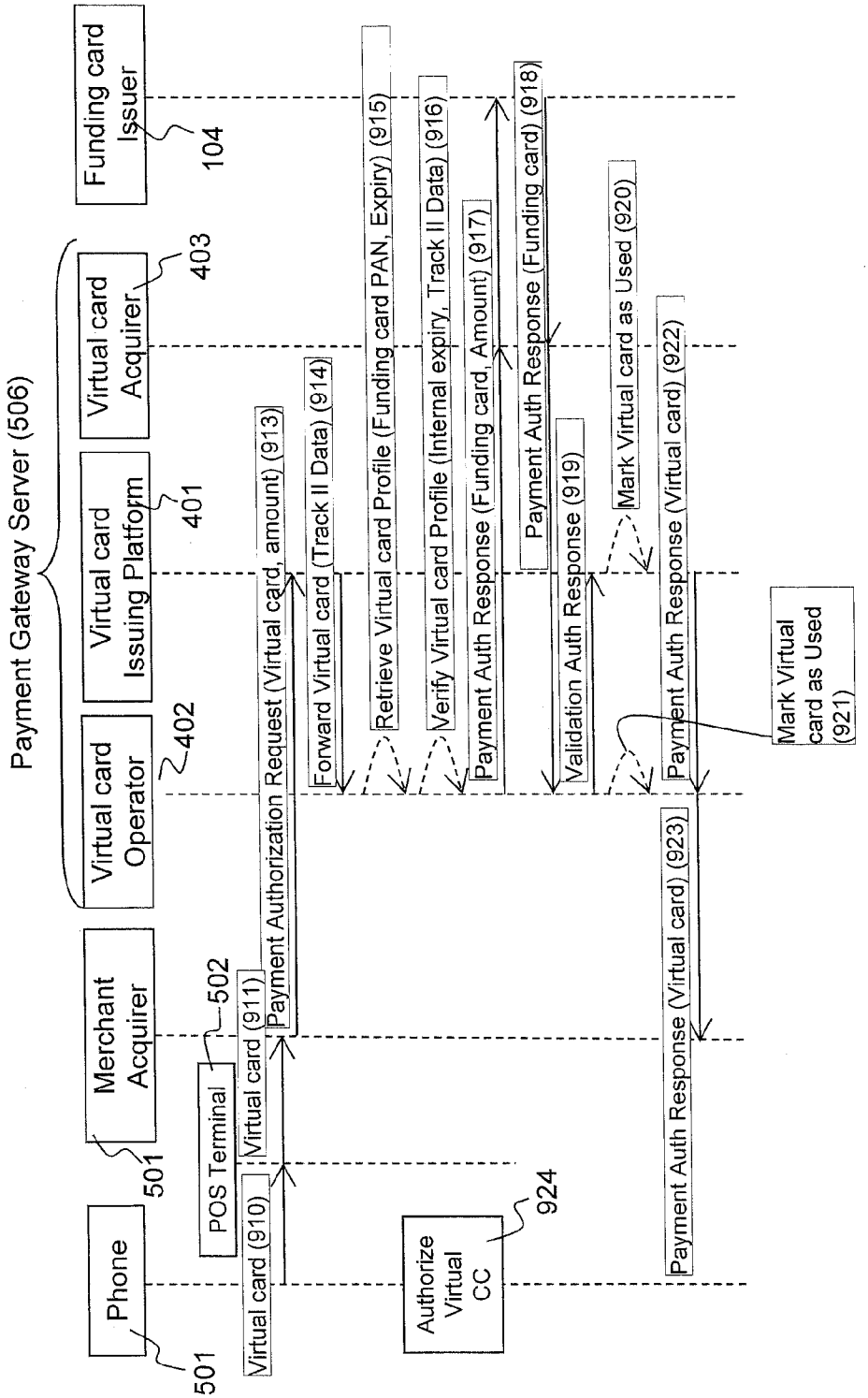

FIG. 9b

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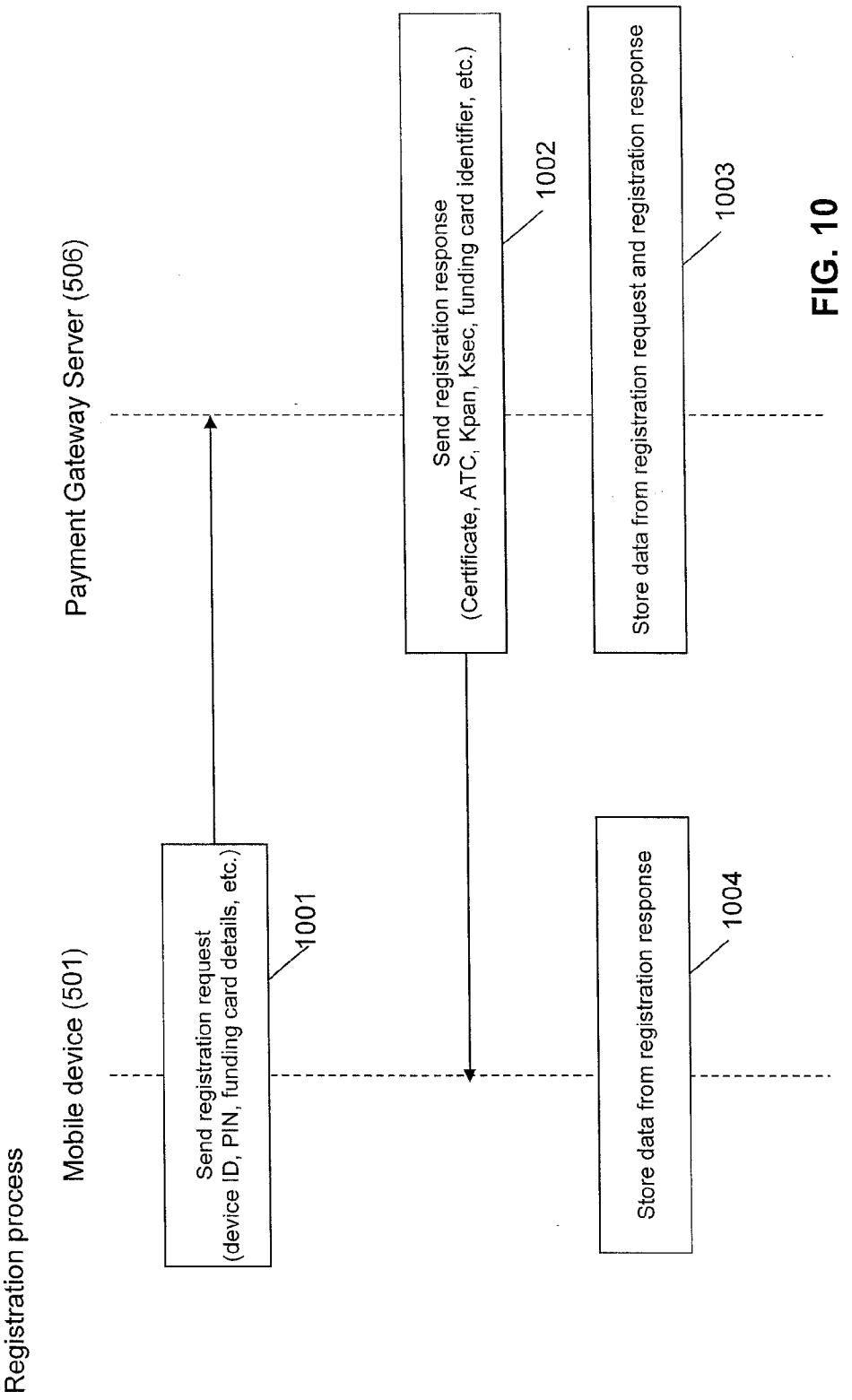

FIG. 10

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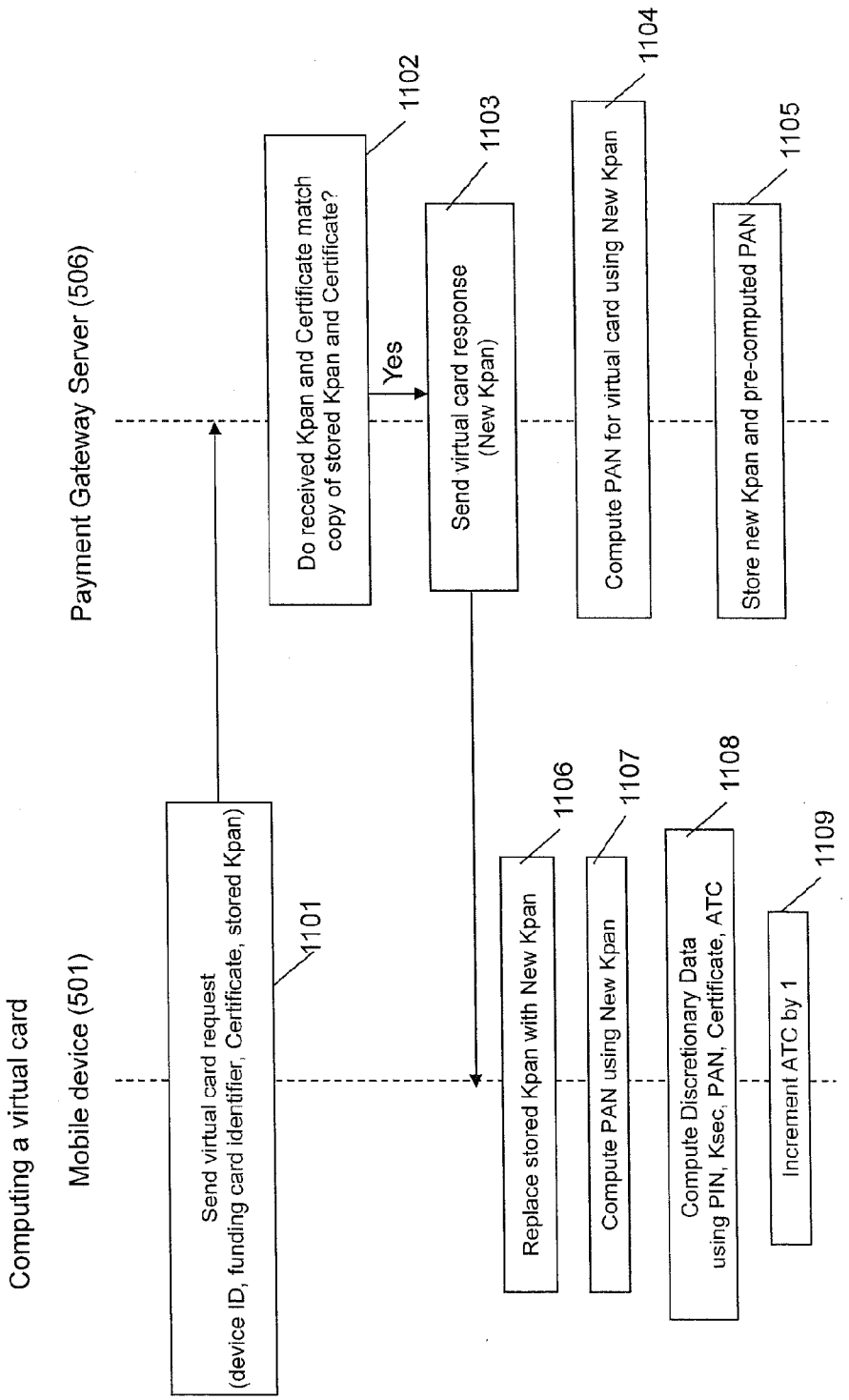

FIG. 11

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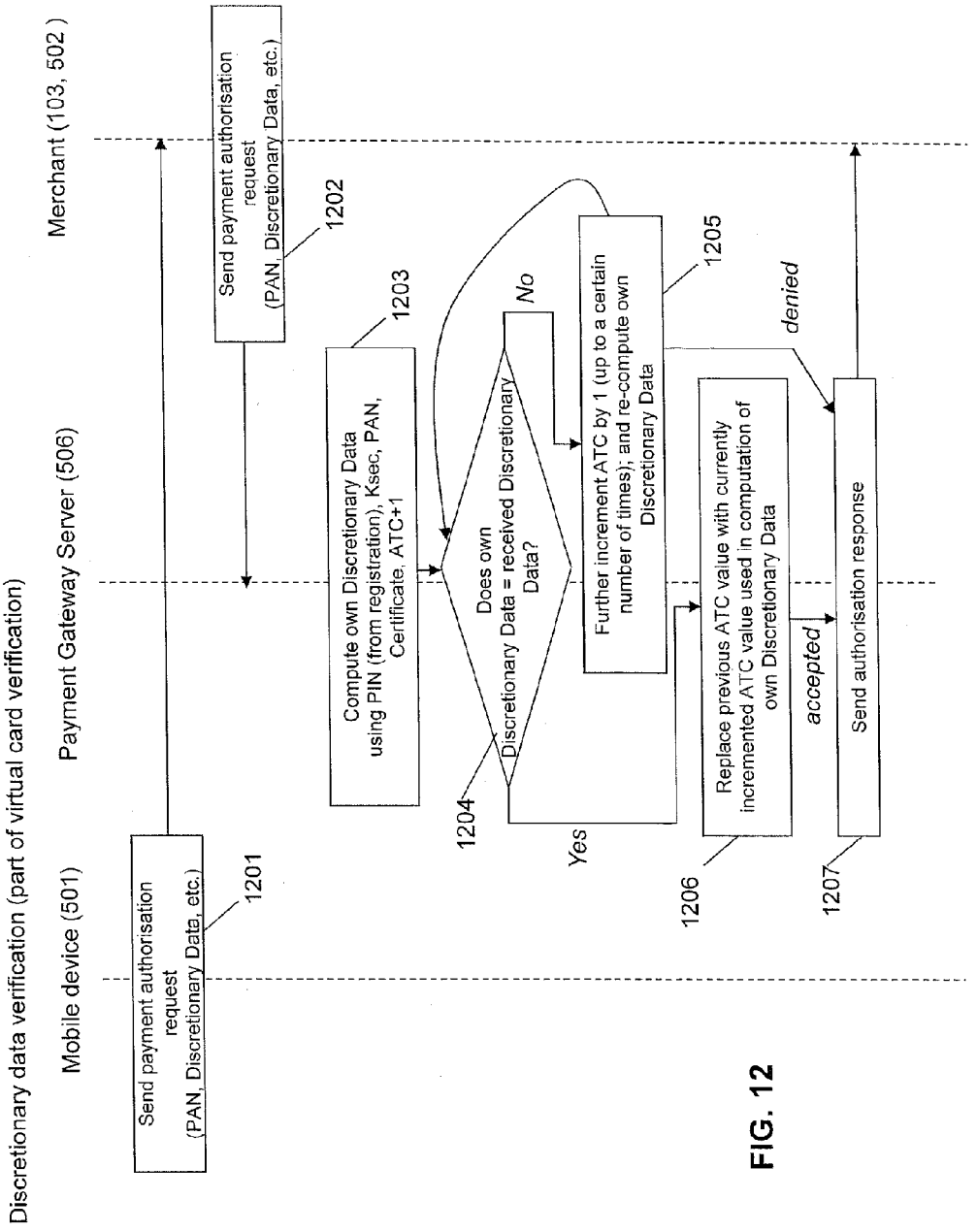
Discretionary data verification (part of virtual card verification)
Mobile device (501)
Payment Gateway Server (506)
Merchant (103, 502)
Send payment authorisation request (PAN, Discretionary Data, etc.)
1201
Send payment authorisation request (PAN, Discretionary Data, etc.)
1202
Compute own Discretionary Data using PIN (from registration), Ksec, PAN, Certificate, ATC+1
1203
Does own Discretionary Data = received Discretionary Data?
1204
No
Yes
Further increment ATC by 1 (up to a certain number of times); and re-compute own Discretionary Data
1205
Replace previous ATC value with currently incremented ATC value used in computation of own Discretionary Data
1206
accepted
denied
Send authorisation response
1207

FIG. 12

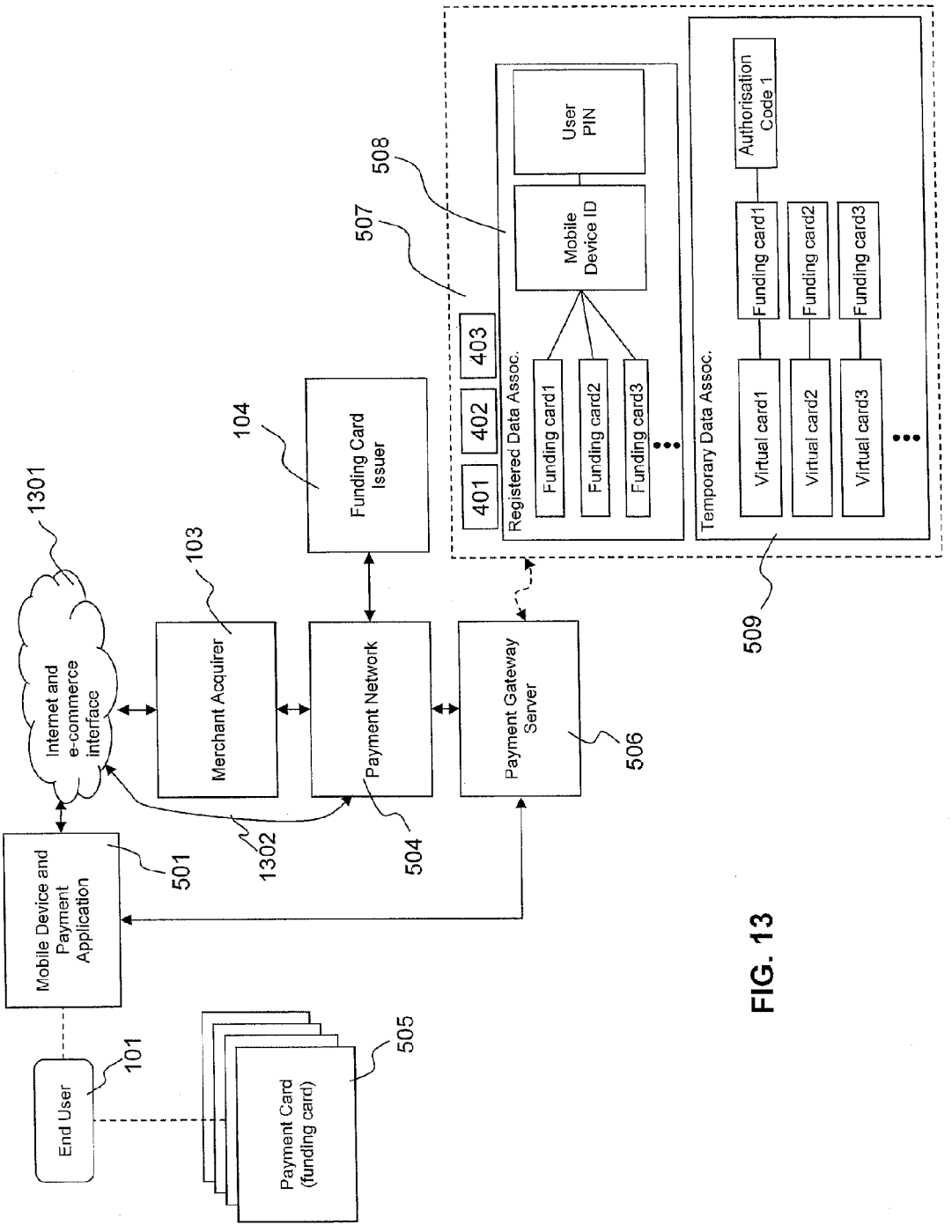
End User
101
Payment Card (funding card)
505
Mobile Device and Payment Application
501
1301
Internet and e-commerce interface
1302
Merchant Acquirer
103
Payment Network
504
Payment Gateway Server
506
Funding Card Issuer
104
401
402
403
Registered Data Assoc.
Funding card1
Funding card2
Funding card3
507
Mobile Device ID
User PIN
508
Temporary Data Assoc.
Virtual card1
Virtual card2
Virtual card3
Funding card1
Funding card2
Funding card3
Authorisation Code 1
509

FIG. 13

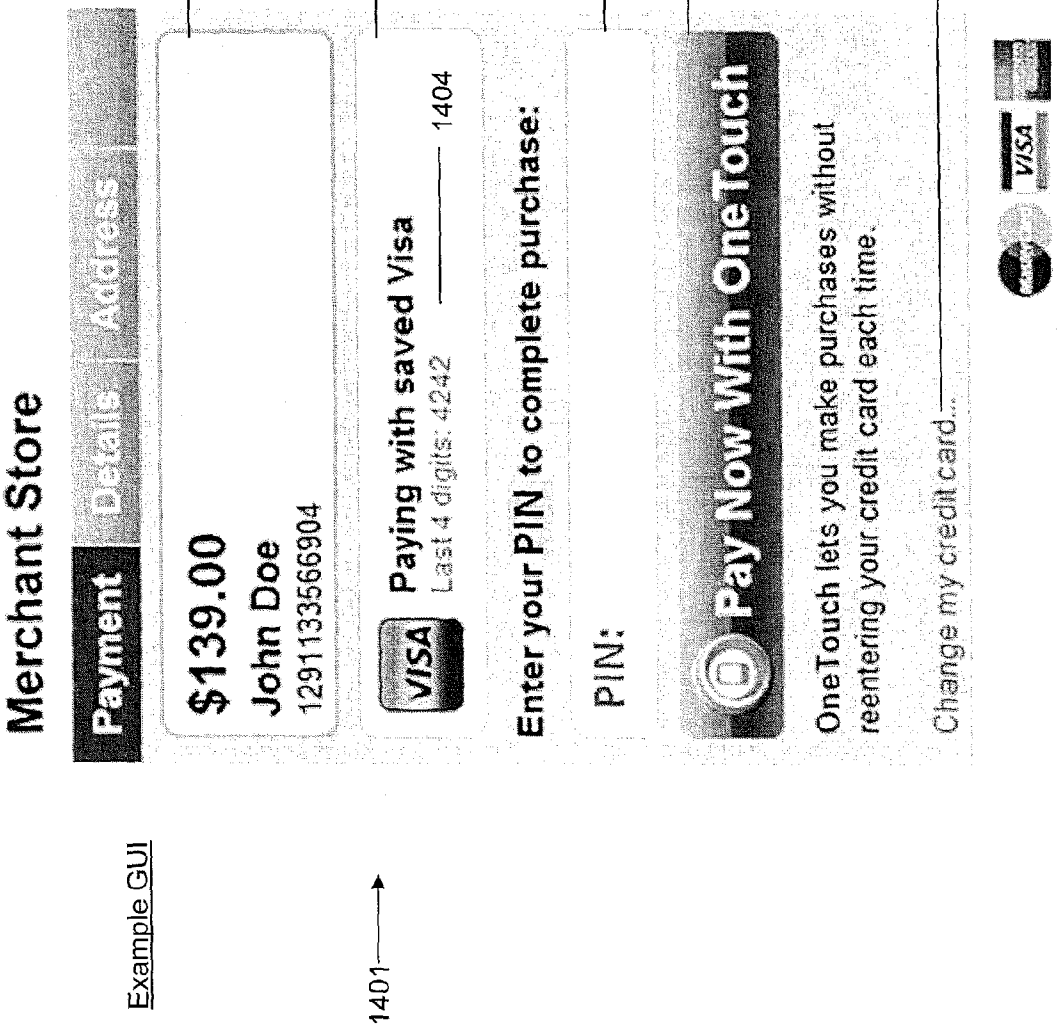

FIG. 14

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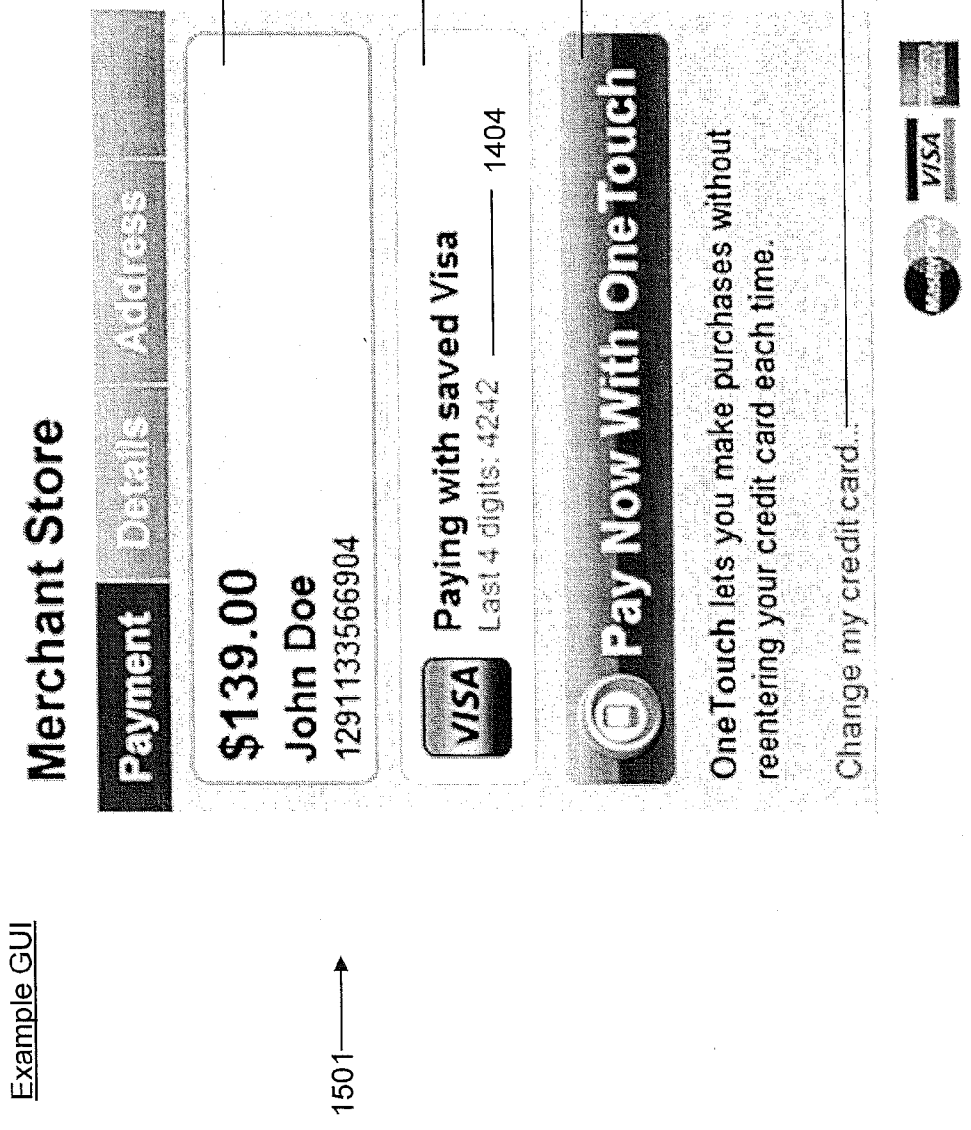

FIG. 15

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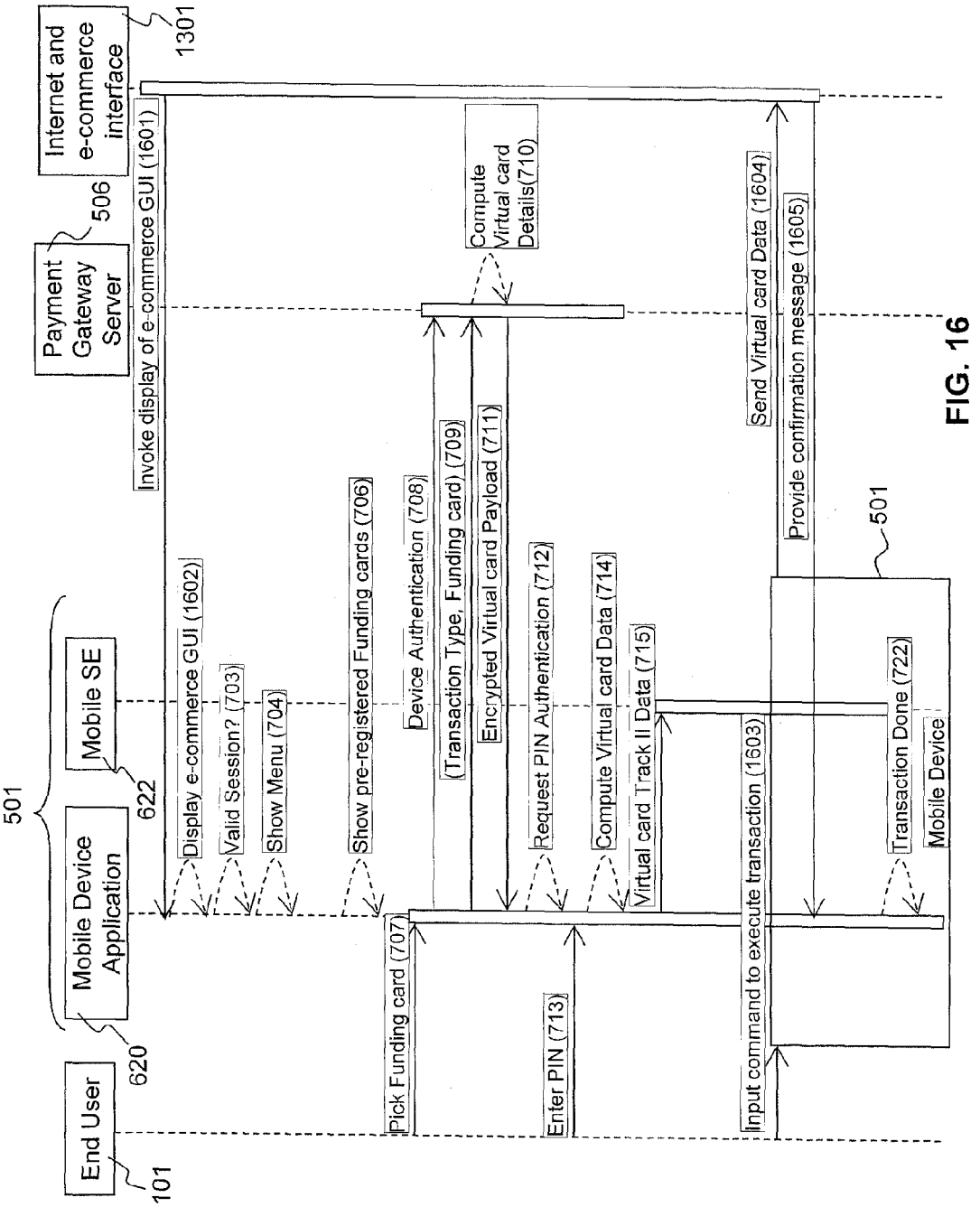

FIG. 16

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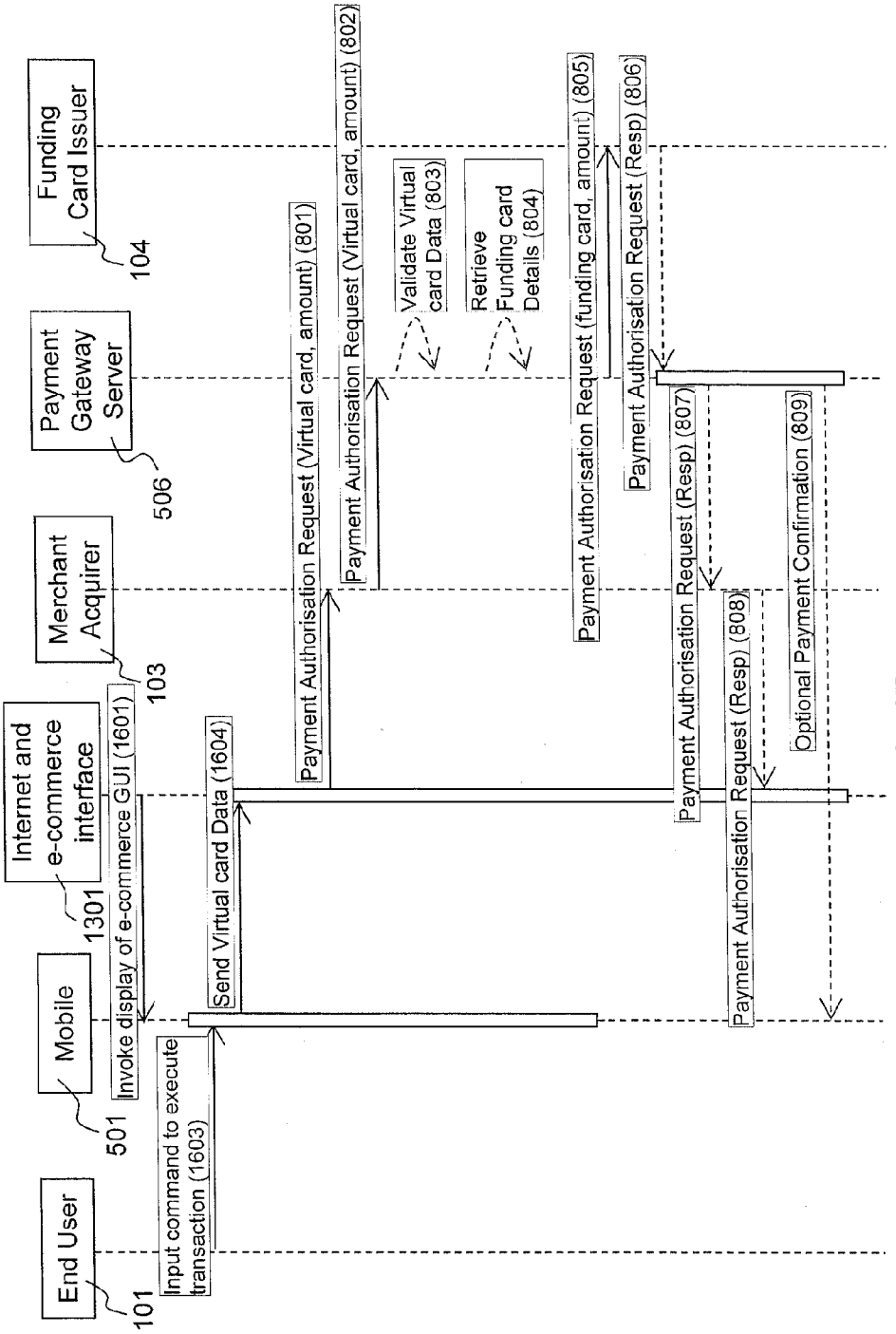
End User
101
Mobile
501
Internet and e-commerce interface
1301
Merchant Acquirer
103
Payment Gateway Server
506
Funding Card Issuer
104
Input command to execute transaction (1603)
Invoke display of e-commerce GUI (1601)
Send Virtual card Data (1604)
Payment Authorisation Request (Virtual card, amount) (801)
Payment Authorisation Request (Virtual card, amount) (802)
Validate Virtual card Data (803)
Retrieve Funding card Details (804)
Payment Authorisation Request (funding card, amount) (805)
Payment Authorisation Request (Resp) (806)
Payment Authorisation Request (Resp) (807)
Payment Authorisation Request (Resp) (808)
Optional Payment Confirmation (809)

FIG. 17

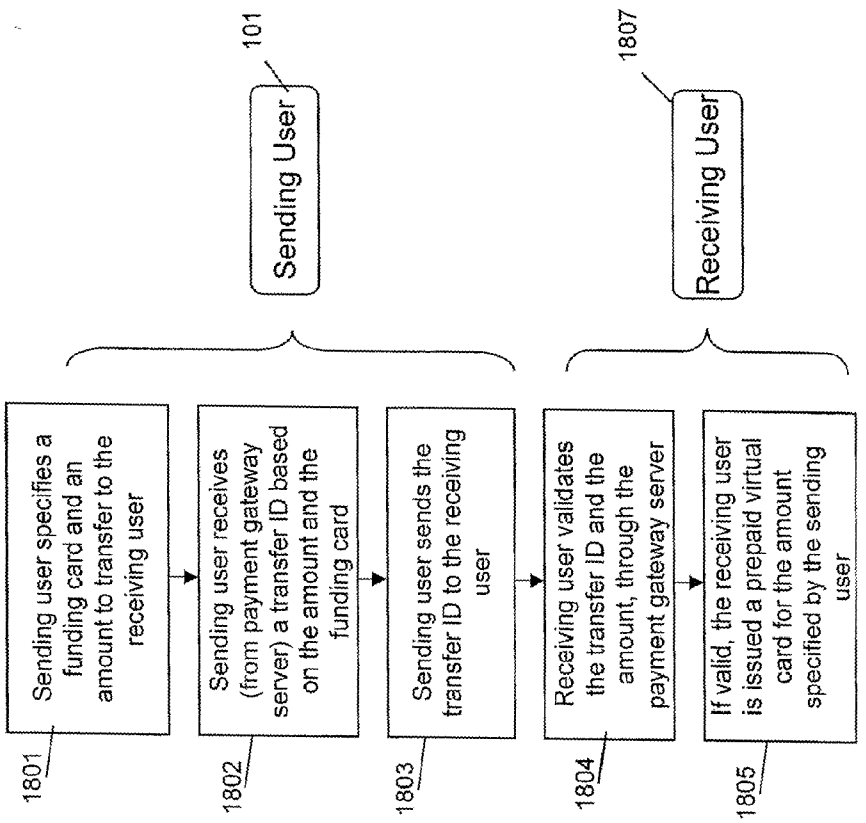

FIG. 18

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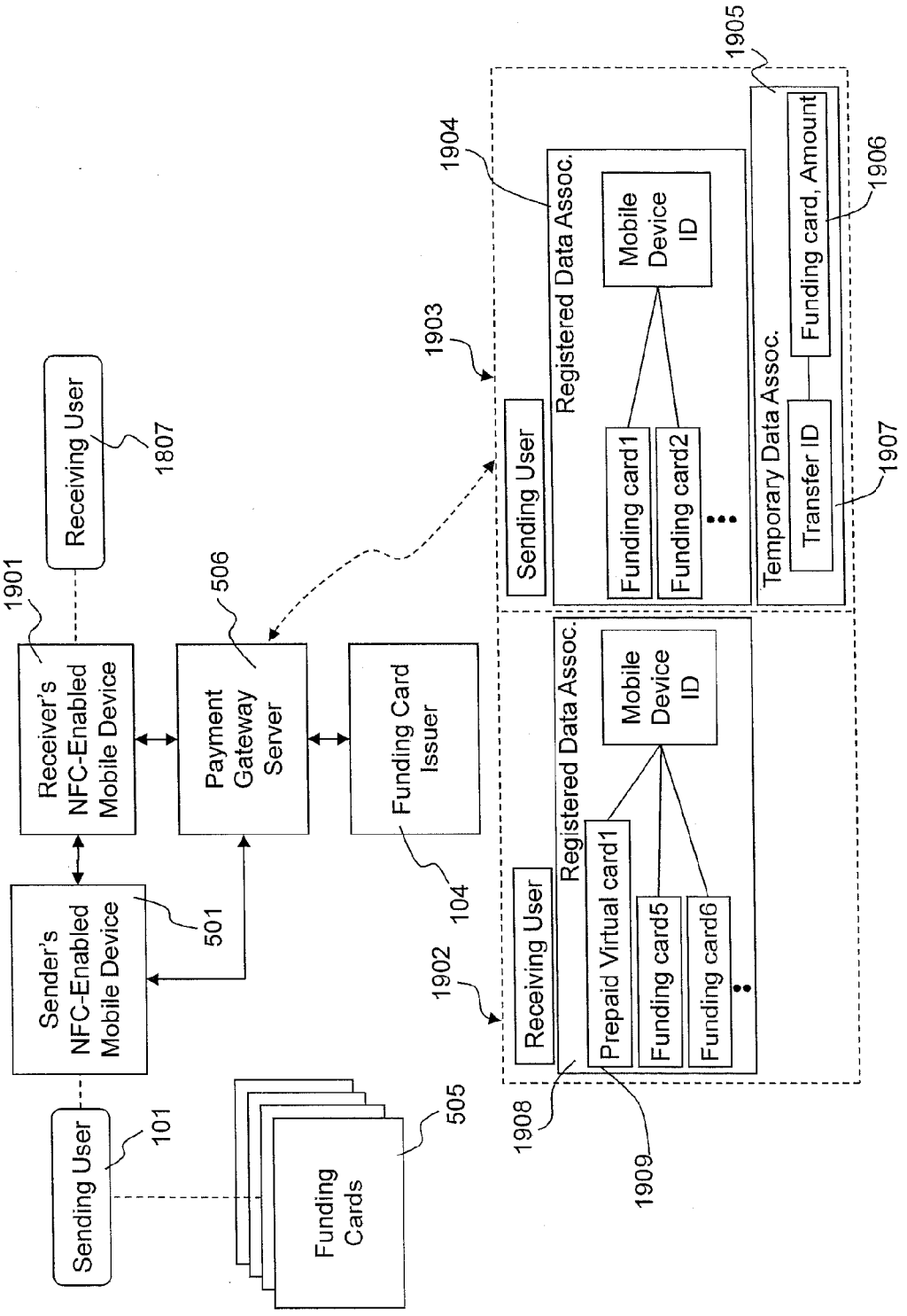

Sending User
101
Sender's NFC-Enabled Mobile Device
501
Receiver's NFC-Enabled Mobile Device
1901
Receiving User
1807
Payment Gateway Server
506
Funding Card Issuer
104
Funding Cards
505
1902
Receiving User
Registered Data Assoc.
Prepaid Virtual card1
Funding card5
Funding card6
Mobile Device ID
1908
1909
1903
Sending User
Registered Data Assoc.
Funding card1
Funding card2
Mobile Device ID
1904
1905
Temporary Data Assoc.
Transfer ID
Funding card, Amount
1907
1906

FIG. 19

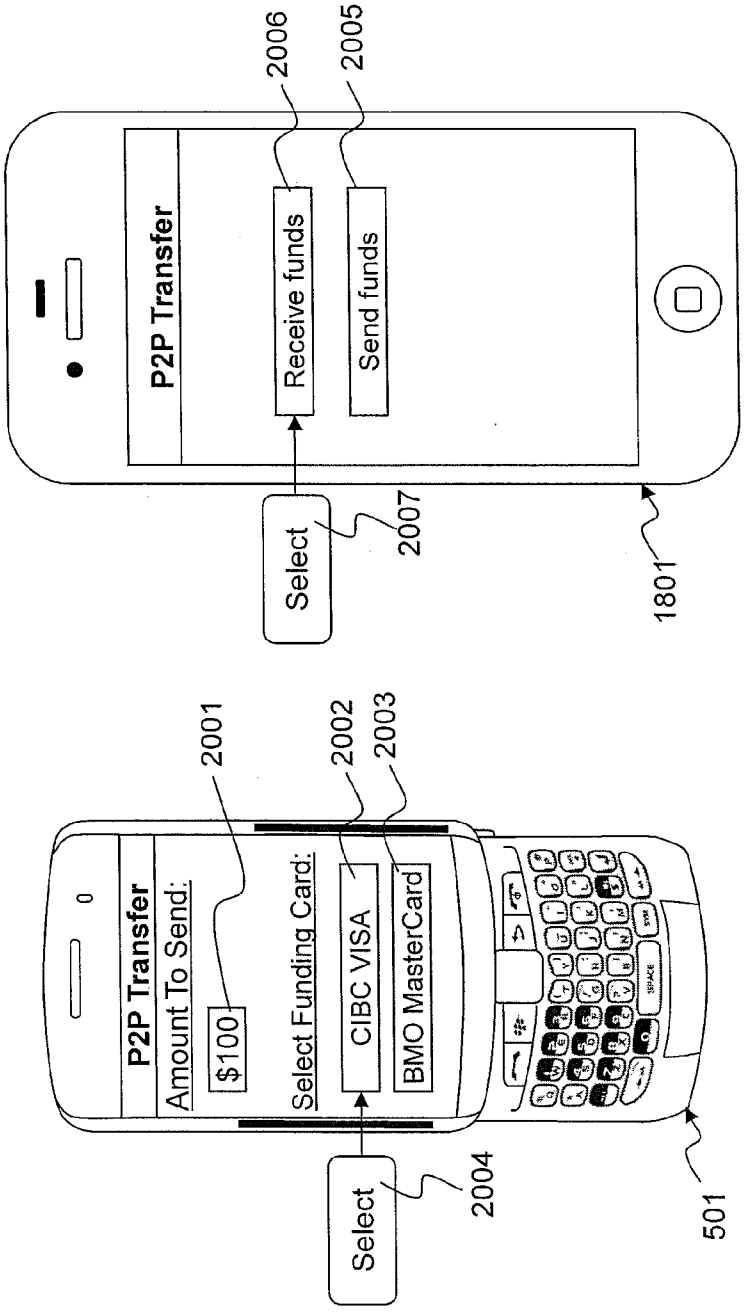

P2P Transfer
Receive funds
Send funds
2006
2005
Select
2007
1801
P2P Transfer
Amount To Send:
$100
Select Funding Card:
CIBC VISA
BMO MasterCard
2001
2002
2003
Select
2004
501

FIG. 20

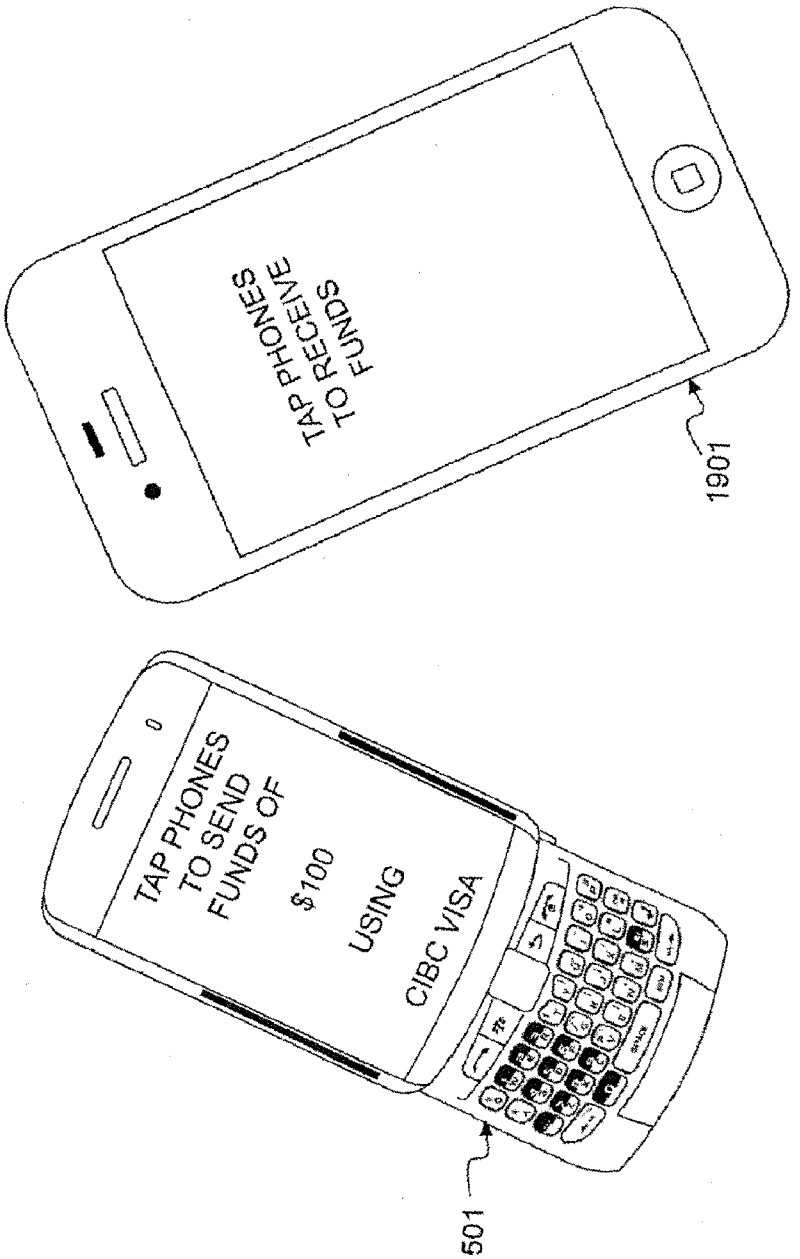
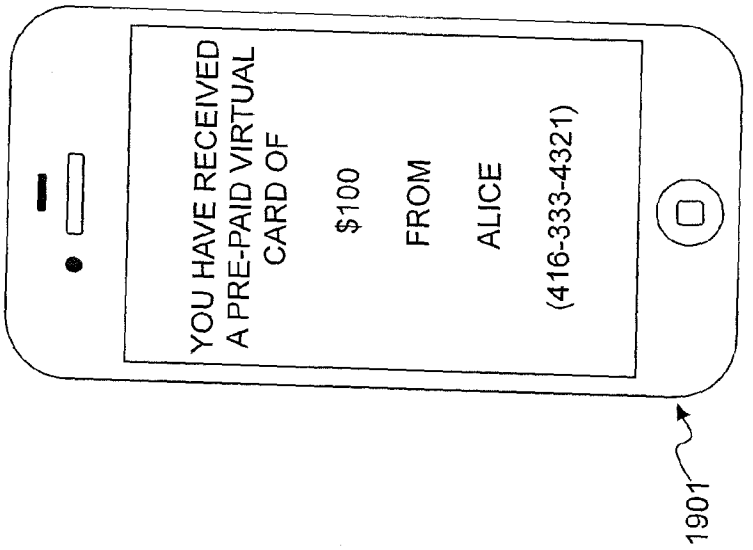

TAP PHONES TO RECEIVE FUNDS
1901
TAP PHONES TO SEND FUNDS OF
$100
USING
CIBC VISA
501

FIG. 21


YOU HAVE RECEIVED
A PRE-PAID VIRTUAL
CARD OF
$100
FROM
ALICE
(416-333-4321)
1901

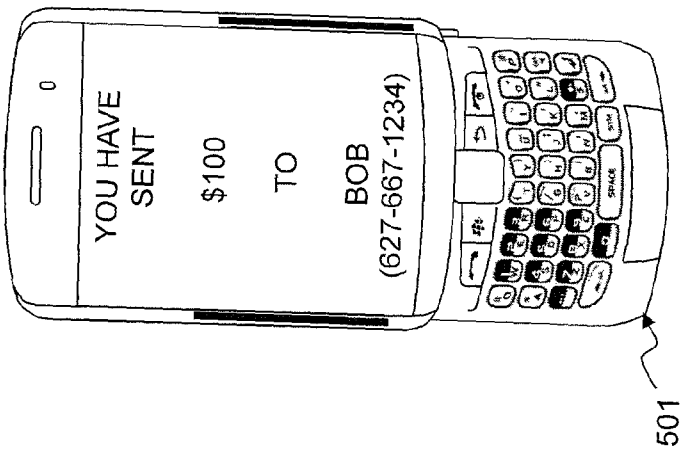

YOU HAVE
SENT
$100
TO
BOB
(627-667-1234)
501

FIG. 22

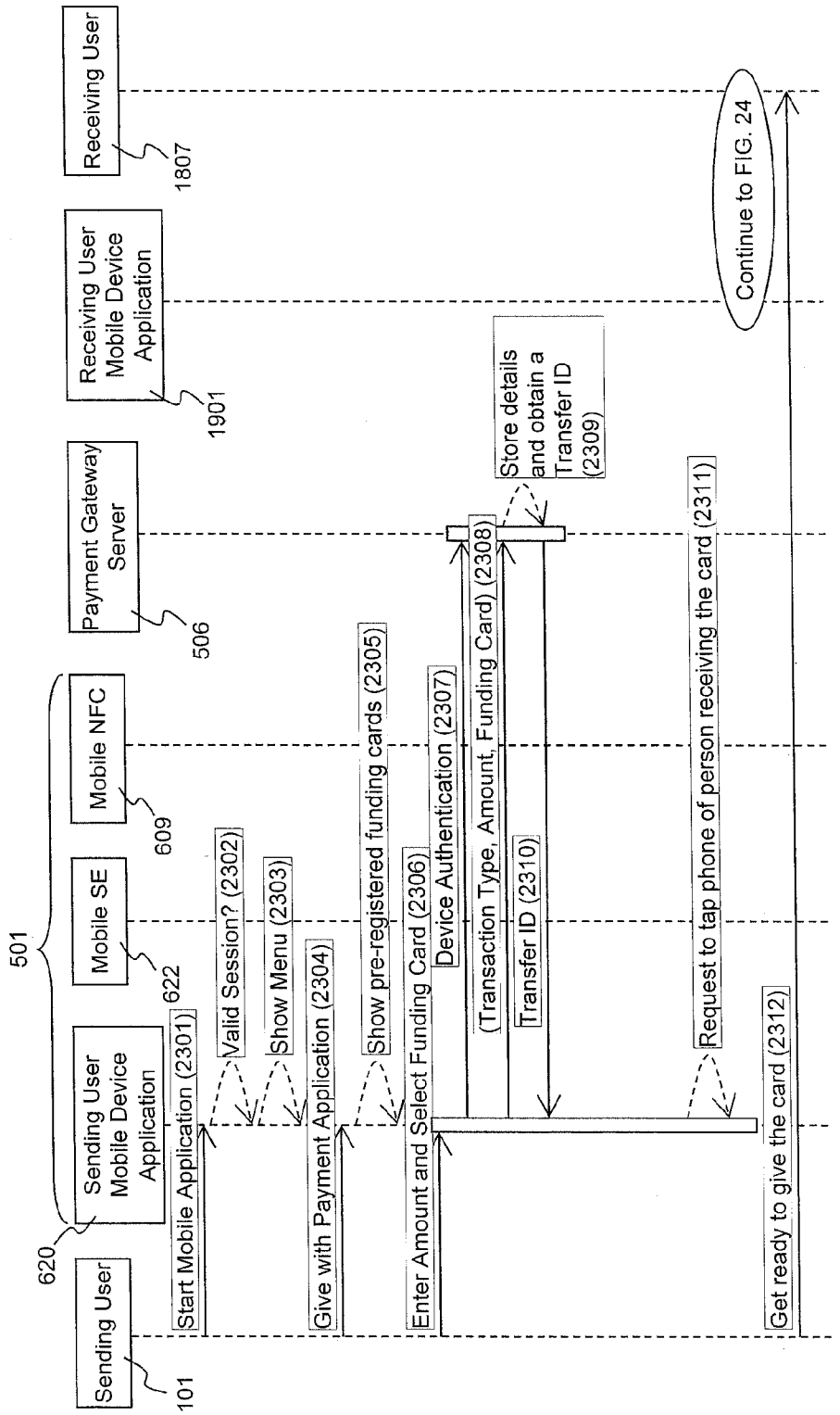


FIG. 23

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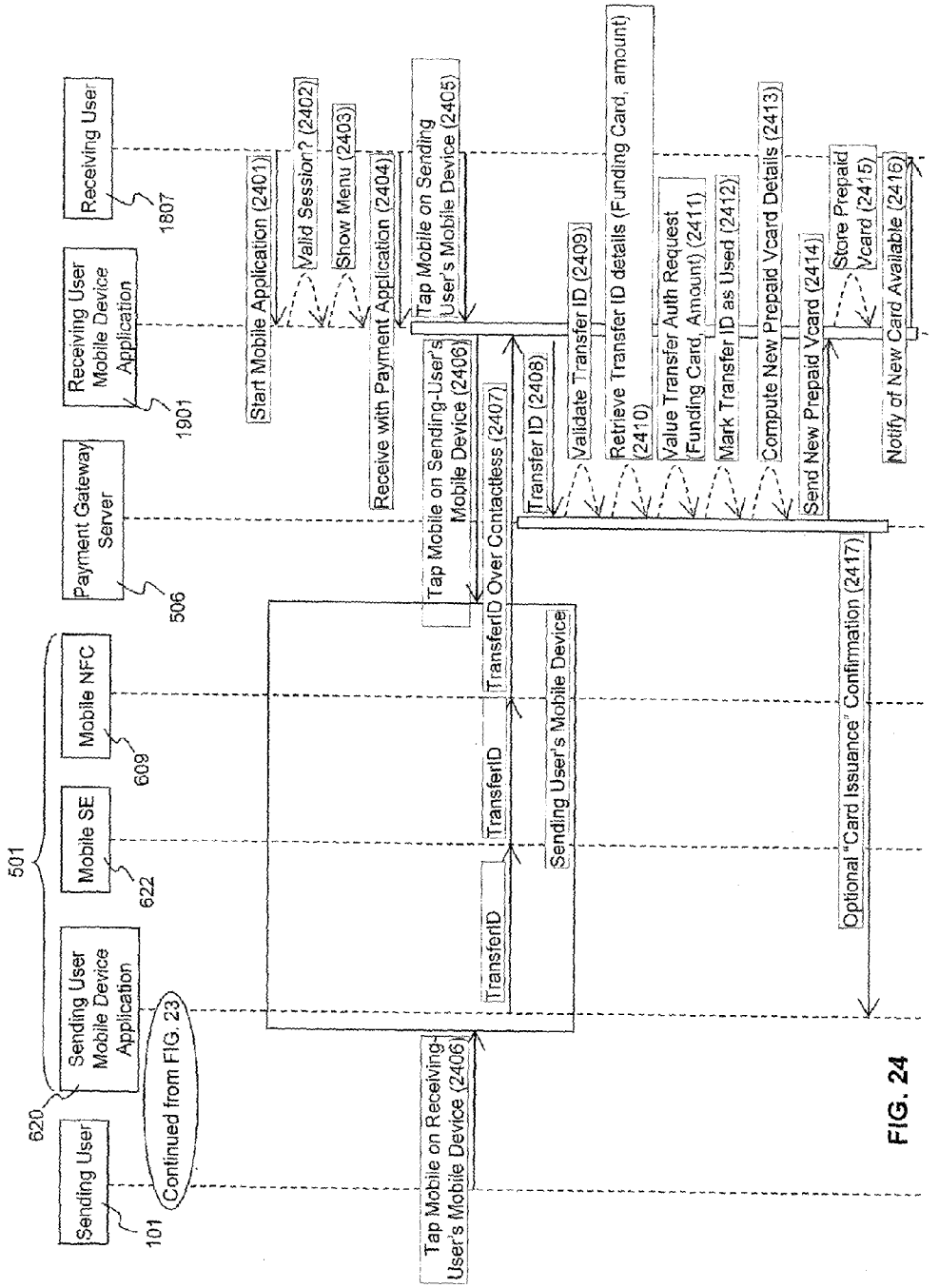

FIG. 24

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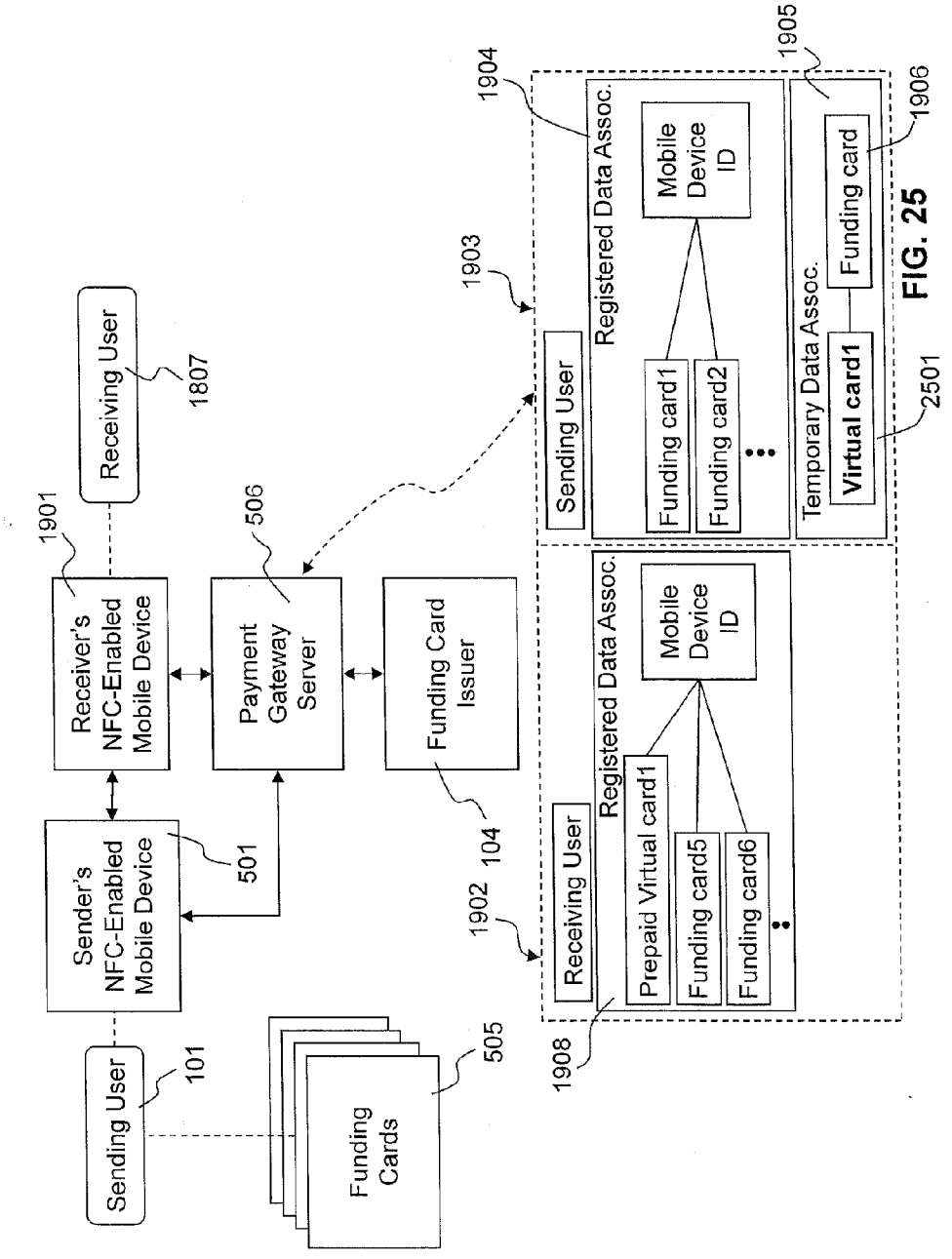
Sending User
101
Sender's NFC-Enabled Mobile Device
501
Receiver's NFC-Enabled Mobile Device
1901
Receiving User
1807
Payment Gateway Server
506
Funding Card Issuer
104
Funding Cards
505
1902
1903
1904
1905
1906
2501
1908
Sending User
Receiving User
Registered Data Assoc.
Mobile Device ID
Funding card1
Funding card2
Prepaid Virtual card1
Funding card5
Funding card6
Temporary Data Assoc.
Funding card
Virtual card1

FIG. 25

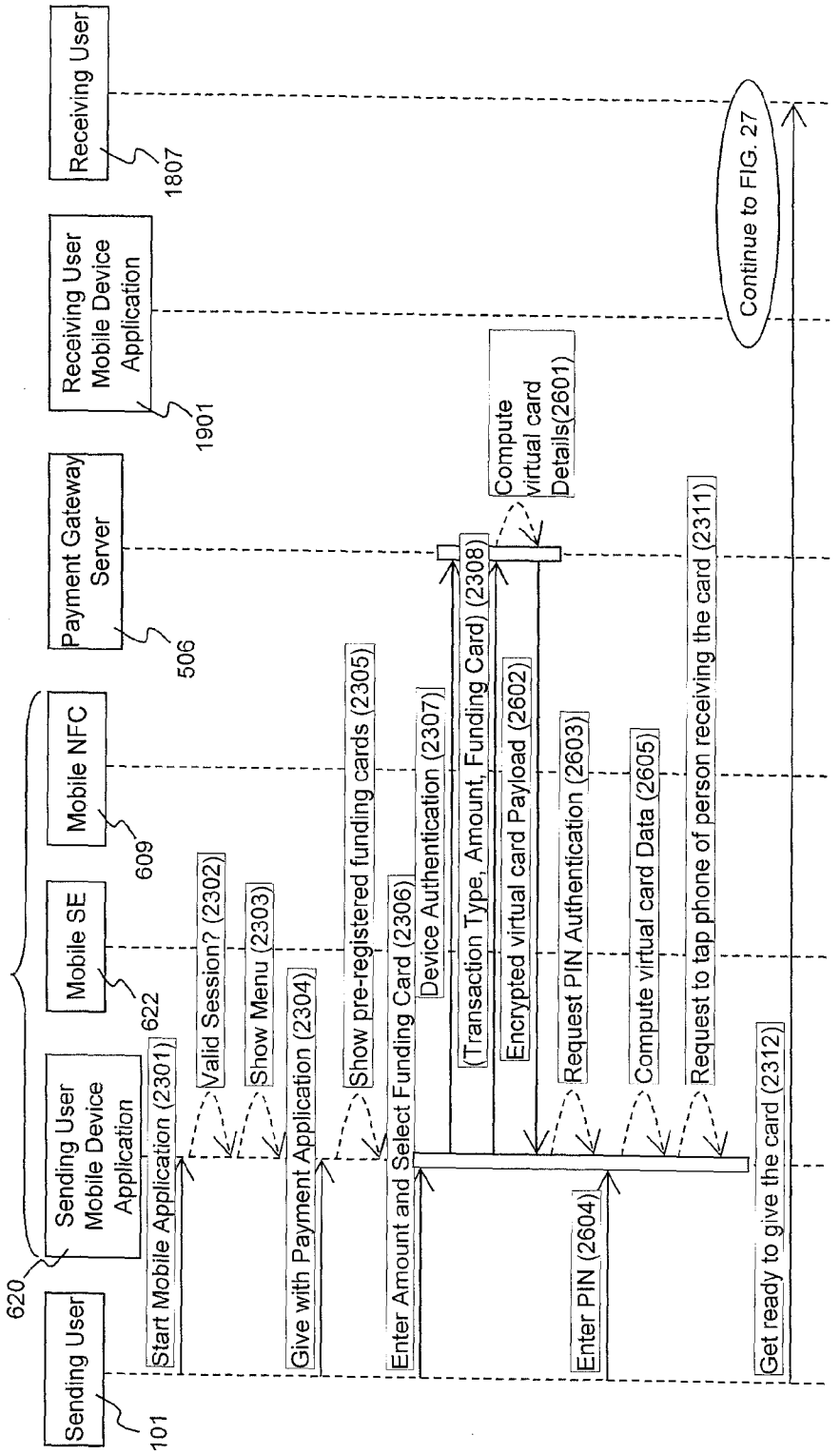
Sending User
101
620
501
Sending User Mobile Device Application
Mobile SE
622
Mobile NFC
609
Payment Gateway Server
506
Receiving User Mobile Device Application
1901
Receiving User
1807
Start Mobile Application (2301)
Valid Session? (2302)
Show Menu (2303)
Give with Payment Application (2304)
Show pre-registered funding cards (2305)
Enter Amount and Select Funding Card (2306)
Device Authentication (2307)
(Transaction Type, Amount, Funding Card) (2308)
Compute virtual card Details(2601)
Encrypted virtual card Payload (2602)
Request PIN Authentication (2603)
Enter PIN (2604)
Compute virtual card Data (2605)
Request to tap phone of person receiving the card (2311)
Get ready to give the card (2312)
Continue to FIG. 27

FIG. 26

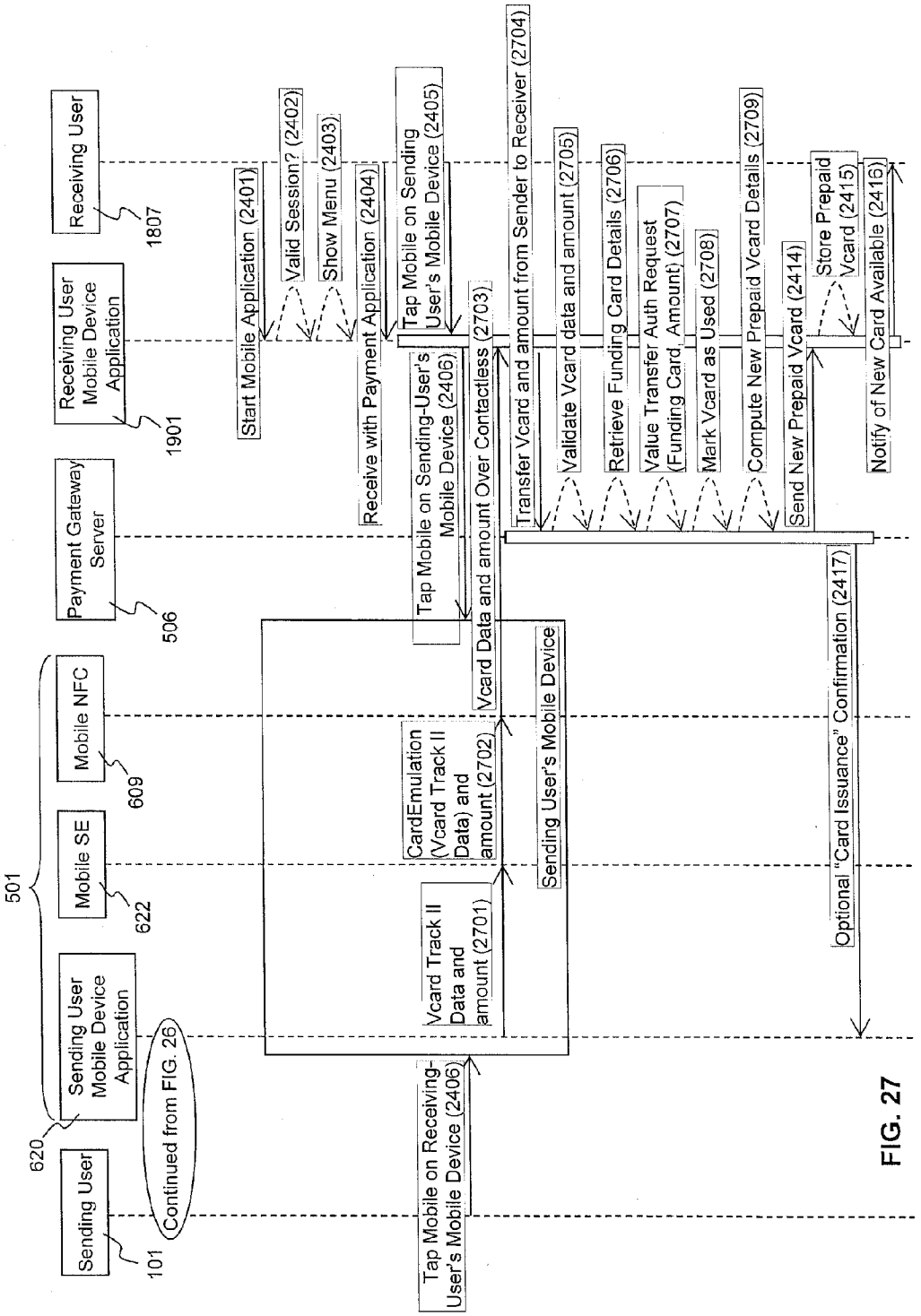
Sending User
Sending User Mobile Device Application
Mobile SE
Mobile NFC
Payment Gateway Server
Receiving User Mobile Device Application
Receiving User
101
620
622
609
506
1901
1807
501
Continued from FIG. 26
Tap Mobile on Receiving-User's Mobile Device (2406)
Vcard Track II Data and amount (2701)
CardEmulation (Vcard Track II Data) and amount (2702)
Sending User's Mobile Device
Tap Mobile on Sending-User's Mobile Device (2406)
Vcard Data and amount Over Contactless (2703)
Start Mobile Application (2401)
Valid Session? (2402)
Show Menu (2403)
Receive with Payment Application (2404)
Tap Mobile on Sending User's Mobile Device (2405)
Transfer Vcard and amount from Sender to Receiver (2704)
Validate Vcard data and amount (2705)
Retrieve Funding Card Details (2706)
Value Transfer Auth Request (Funding Card, Amount) (2707)
Mark Vcard as Used (2708)
Compute New Prepaid Vcard Details (2709)
Send New Prepaid Vcard (2414)
Store Prepaid Vcard (2415)
Notify of New Card Available (2416)
Optional "Card Issuance" Confirmation (2417)

FIG. 27

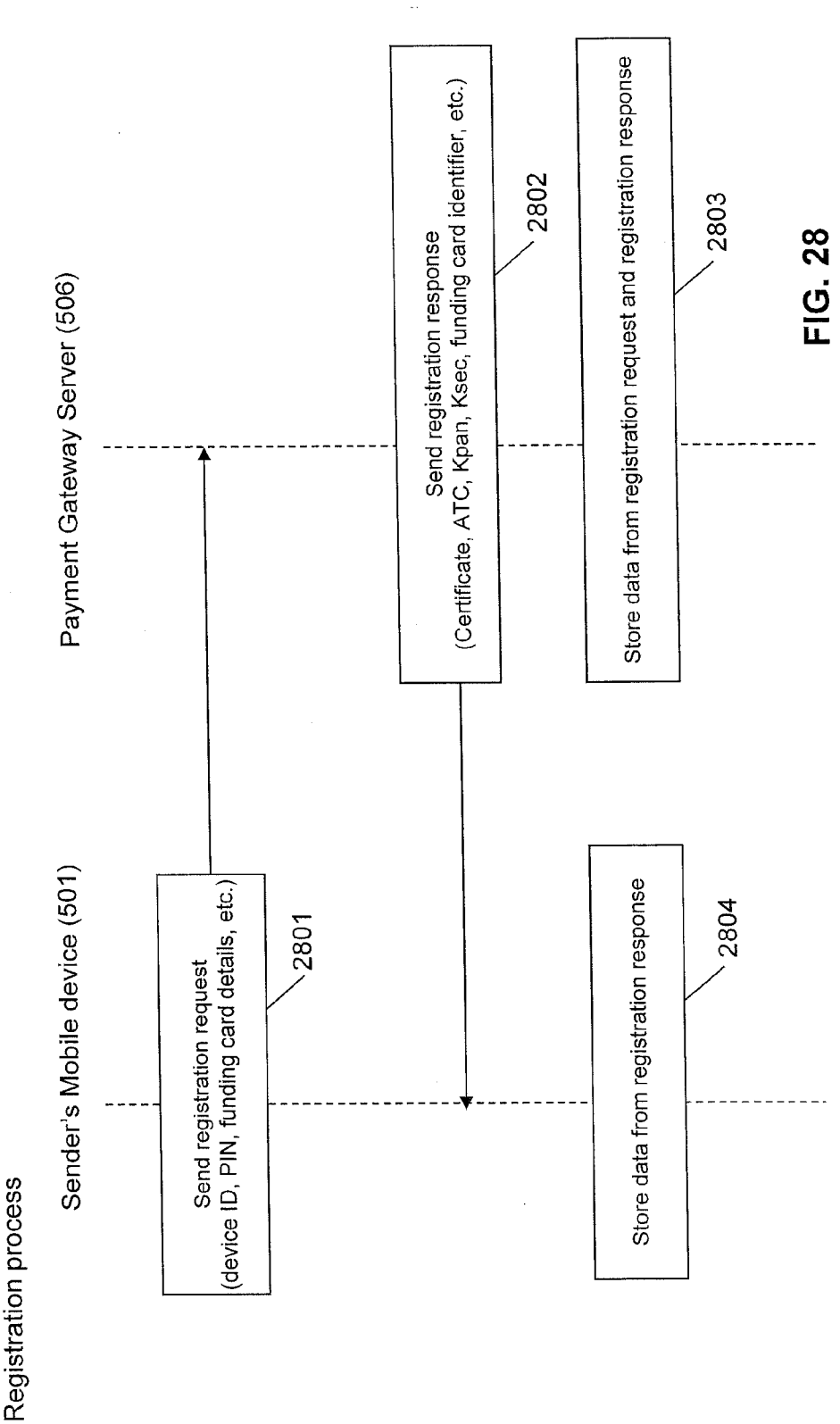

FIG. 28

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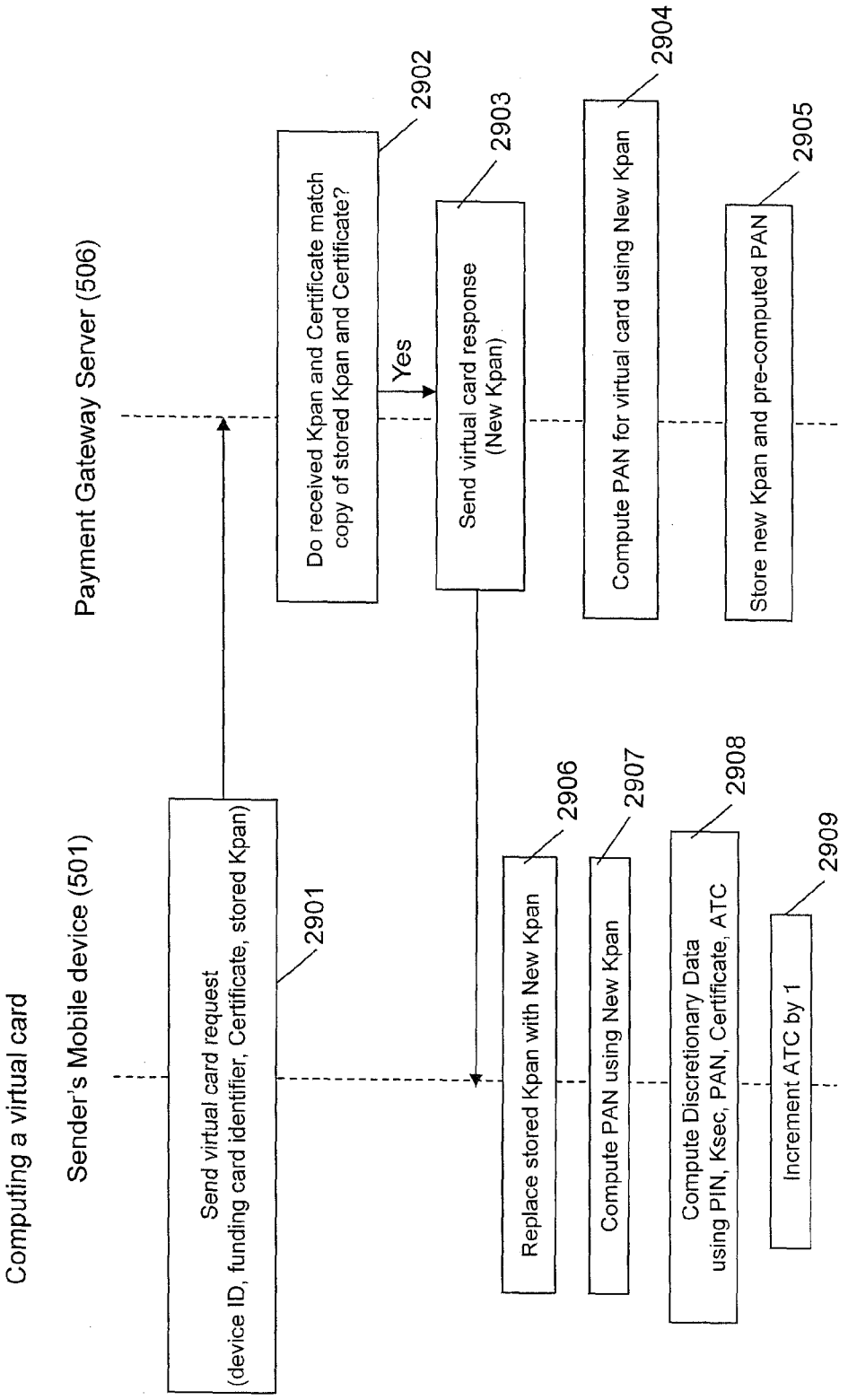

FIG. 29

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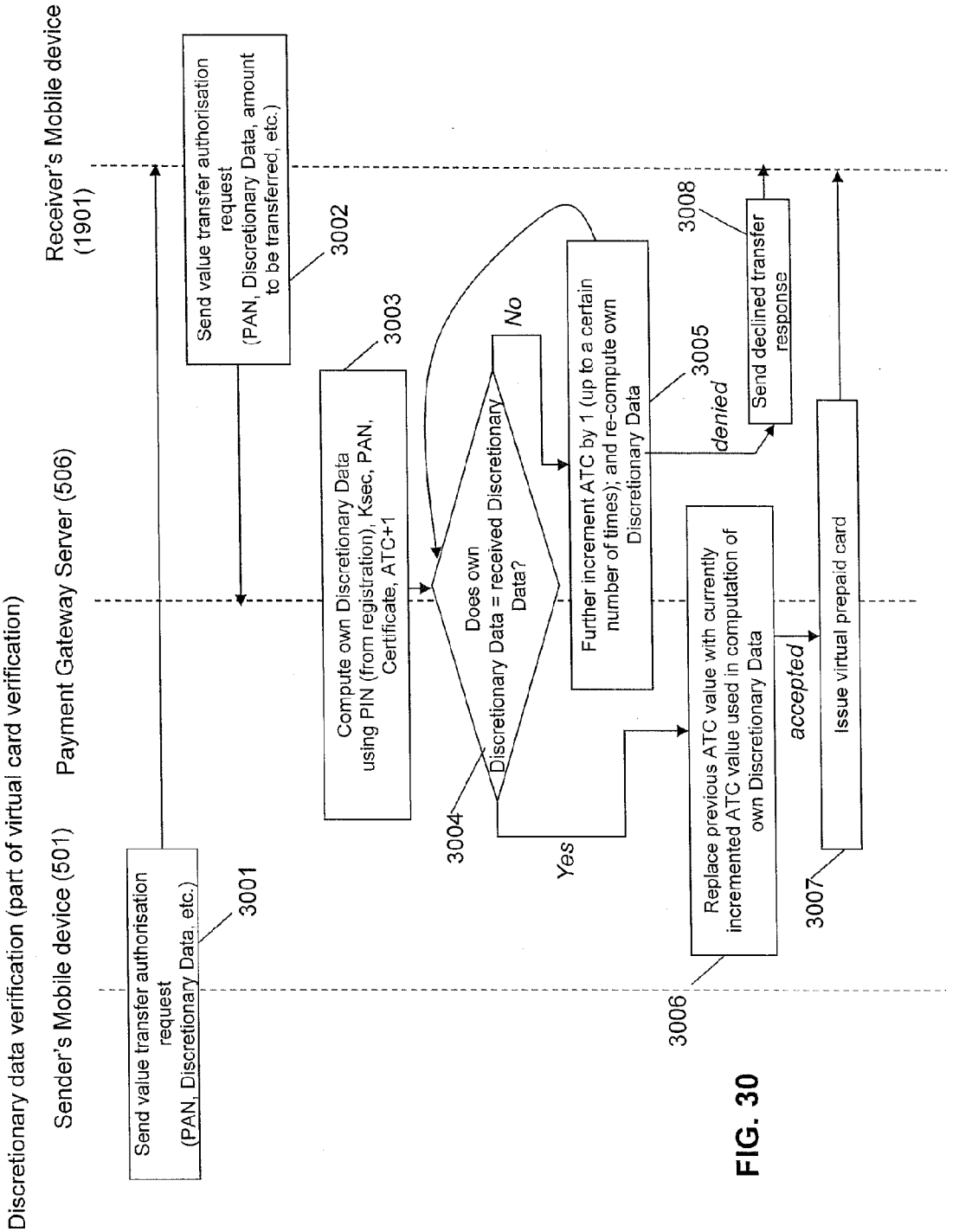

FIG. 30

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SYSTEMS AND METHODS FOR FACILITATING A TRANSACTION USING A VIRTUAL CARD ON A MOBILE DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from: U.S. Provisional Application No. 61/624,947 filed on Apr. 16, 2012, and titled "SYSTEMS AND METHODS FOR MAKING A PAYMENT USING A MOBILE DEVICE"; U.S. Provisional Application No. 61/673,096 filed on Jul. 18, 2012, and titled "SYSTEMS AND METHODS FOR FACILITATING A TRANSACTION USING A VIRTUAL CARD ON A MOBILE DEVICE"; and U.S. Provisional Application No. 61/713,302 filed on Oct. 12, 2012, and titled "SYSTEMS AND METHODS FOR FACILITATING A PARTY-TO-PARTY VALUE TRANSFER USING A VIRTUAL CARD ON A MOBILE DEVICE". The entire contents of these applications are herein incorporated by reference.

TECHNICAL FIELD

[0002] The following relates generally to facilitating a payment transaction at a merchant location using a virtual card on a mobile device.

DESCRIPTION OF THE RELATED ART

[0003] Mobile devices can be used to facilitate a payment transaction, for example, in exchange for a good or service at a merchant store. A mobile device can be equipped with a near field communication (NFC) system which can be used to transfer the buyer's payment credential, such as credit card information, to a point of sale terminal that is also equipped with a NFC-compatible system to complete the payment transaction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Embodiments will now be described by way of example only with reference to the appended drawings wherein:

[0005] FIG. **1** is a schematic diagram of an example embodiment of a payment system.

[0006] FIG. **2** is a schematic diagram of an example embodiment of one side of a funding credit card.

[0007] FIG. **3** is a schematic diagram of the other side of the funding credit card in FIG. **2**.

[0008] FIG. **4** is a schematic diagram of an example embodiment of a payment system showing the flow of data when using a virtual card to facilitate a payment.

[0009] FIG. **5** is another schematic diagram view of the entities involved in an example embodiment of a payment transaction using a virtual card to facilitate a payment.

[0010] FIG. **6** is a block diagram of an example embodiment of a mobile device.

[0011] FIG. **7** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for generating and using a virtual card in a payment transaction according to a user's perspective, the instructions performed by at least a mobile device, a point of sale terminal and a payment gateway server.

[0012] FIG. **8** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for facilitating payment transaction using a virtual card, the instructions showing the interaction between at least a merchant and a payment gateway server.

[0013] FIG. **9***a* is a flow diagram of an example embodiment of computer executable or processor implemented instructions for computing virtual card details by the payment gateway server, the instructions implemented as part of the transaction process of FIG. **7**.

[0014] FIG. **9***b* is a flow diagram of an example embodiment of computer executable or processor implemented instructions for authorising virtual card details by the payment gateway server, the instructions implemented as part of the transaction process of FIG. **8**.

[0015] FIG. **10** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for a registration process between a mobile device and a payment gateway server.

[0016] FIG. **11** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for computing virtual card details including a primary account number and discretionary data, using the data exchanged during the registration process of FIG. **10**.

[0017] FIG. **12** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for verifying the discretionary data of FIG. **11**.

[0018] FIG. **13** is a schematic diagram showing example components of a system used to facilitate an e-commerce transaction using a virtual card.

[0019] FIG. **14** is a screenshot of an example embodiment of a graphical user interface (GUI) for performing an e-commerce transaction using a virtual card.

[0020] FIG. **15** is a screenshot of another example embodiment of a GUI for performing an e-commerce transaction using a virtual card.

[0021] FIG. **16** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for performing an e-commerce transaction using a virtual card, the instructions performed by at least a mobile device, a point of sale terminal and a payment gateway server.

[0022] FIG. **17** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for performing an e-commerce transaction using a virtual card, the instructions showing the interaction between at least a merchant and a payment gateway server.

[0023] FIG. **18** is a flow diagram showing a party-to-party value transfer.

[0024] FIG. **19** is a schematic diagram showing example components of a system used to facilitate a party-to-party value transfer using a transfer ID.

[0025] FIG. **20** is an example embodiment illustrating a sender's mobile device and a receiver's mobile device, the sender's mobile device showing a graphical user interface (GUI) for selecting a funding card.

[0026] FIG. **21** is an example embodiment illustrating the sender's mobile device and the receiver's mobile device of FIG. **20** prior to being "tapped" together to facilitate a party-to-party value transfer.

[0027] FIG. **22** is an example embodiment illustrating the sender's mobile device and the receiver's mobile device, after the tapping in FIG. **21**, with both devices showing a GUI indicating that the party-to-party value transfer has been completed.

[0028] FIG. **23** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for computing a transfer ID by the payment gate

way server and the mobile device, such that the transfer ID is used facilitate the transfer of value.

[0029] FIG. **24** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for validating the transfer ID and issuing a prepaid virtual card to the receiver, thereby completing the party-to-party value transfer, the instructions implemented as a continuation of process of FIG. **23**.

[0030] FIG. **25** is a schematic diagram showing example components of a system used to facilitate a party-to-party value transfer using a virtual card.

[0031] FIG. **26** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for computing virtual card details by the payment gateway server and the mobile device.

[0032] FIG. **27** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for authorising virtual card details and completing the party-to-party value transfer, the instructions implemented as a continuation of process of FIG. **26**.

[0033] FIG. **28** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for a registration process between the sender's mobile device and a payment gateway server.

[0034] FIG. **29** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for computing virtual card details including a primary account number and discretionary data, using the data exchanged during the registration process of FIG. **28**.

[0035] FIG. **30** is a flow diagram of an example embodiment of computer executable or processor implemented instructions for verifying the discretionary data of FIG. **29**.

DETAILED DESCRIPTION

[0036] It will be appreciated that for simplicity and clarity of illustration, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements. In addition, numerous specific details are set forth in order to provide a thorough understanding of the example embodiments described herein. However, it will be understood by those of ordinary skill in the art that the example embodiments described herein may be practiced without these specific details. In other instances, well-known methods, procedures and components have not been described in detail so as not to obscure the example embodiments described herein. Also, the description is not to be considered as limiting the scope of the example embodiments described herein.

[0037] FIG. **1** shows an example embodiment of a typical in-person payment flow between a cardholder **101**, a merchant **102**, a merchant acquirer **103**, a payment network **109** and a card issuer **104**. The merchant **102**, the merchant acquirer **103**, the payment network **109** and the card issuer are each associated with computing devices including processors and memory. By way of background, this payment flow is also known as a standard 4-party model, or a standard 4-party protocol. The card issuer **104** is typically a bank which is associated with a payment network. It facilitates the cardholder's use of the payment card to pay for goods or services based on the cardholder's promise to repay the card issuer for the purchase. Non-limiting examples of payment networks include Visa, MasterCard, American Express and Diners Club/Discover. The card issuer **104** issues the payment card, which is associated with a payment network **109**, to the cardholder **101** (block **105**). It is understood that all references to credit card would also apply to debit card, prepaid card, or other payment credentials used to facilitate payment at a merchant location. The term "funding card" is used herein to refer to debit cards, credit cards, prepaid cards, and the like.

[0038] To make a purchase or payment, the cardholder **101** (e.g. a person) provides funding card information to the merchant **102** (block **106**). For example, the funding card can be "swiped" using a magnetic stripe card reader device, or the funding card number can be read to the merchant **102**. The merchant **102** (e.g. a computing device) sends the payment authorisation, including the funding card details, to a merchant acquirer **103** (block **107**). An acquirer **103** is an organization that collects payment-authorisation requests from merchants and facilitates the payment transaction with the payment network on behalf of the merchants.

[0039] When the acquirer **103** gets the funding card payment authorisation request, the acquirer submits the payment transaction (block **108**) to the payment network **109**.

[0040] When the payment network **109** receives the funding card payment authorisation request, the payment network forwards the payment transaction (block **110**) to the card issuer **104** for payment authorisation.

[0041] When the card issuer **104** receives the payment transaction, it checks the transaction details for validity. This includes checking the card number, the expiration date, the funding card limit, etc. The card issuer **104** responds to the merchant acquirer **103** with a payment authorisation code (approved or declined response, transaction identification number, etc) via the payment network **109**. The merchant acquirer **103** forwards the response to the merchant **102**. Then the merchant **102** shares the payment authorisation results with the cardholder.

[0042] It is recognized that such an established computer payment system is well-established and is adopted by many users and large companies. It is recognized however, that such a computer payment system does not provide data processing means for making payments on a mobile device. Such a computer payment system also requires that the funding card details pass through the merchant **102** and the merchant acquirer **103**, which can expose or reveal sensitive financial data. This security risk posed by such a computer payment system is undesirable.

[0043] By way of background, an example embodiment of a credit card **201** is shown in FIG. **2** and FIG. **3**. One side of the credit card, as per FIG. **2**, shows a logo **202** or mark identifying the card issuer. Typically, the card issuer is a bank. A logo **203** or mark is also shown to identify the payment network. The card **201** also shows the credit card number **204**. The credit card number **204** is sometimes referred to as a primary account number (PAN). The length and format of the credit card number **204** varies depending on the card issuer and the payment network. Generally, the first digit in the credit card number **204** identified the payment network. The last digit of the credit card number **204** is a check digit. A check digit is a form of redundancy check used for error detection. The intermediary numbers can signify a bank number (e.g. associated with the card issuer) and an account number (e.g. of the bank).

[0044] In the example shown in FIG. **2**, as per block **207**, the first digit "4" identifies that Visa is the payment network. Digits two through six are the issuing bank identification number. Digits seven through fifteen are the account number. Digit sixteen is the check digit.

[0045] The credit card **201** also includes a range of dates **205** that the credit card is valid. The range of dates includes an expiry date of the credit card. The name **206** of the cardholder is also shown.

[0046] In FIG. **3**, on the other side of the credit card **201**, there is a magnetic strip **301**, the signature **302** of the cardholder's name, and a static security code **303**. The static security code is printed on the credit card **201**.

[0047] The magnetic stripe **301**, also sometimes referred to as a magstripe, is typically made up of tiny iron-based magnetic particles in a plastic-like film. The stripe **301** has information that is written on it.

[0048] Often there are two or three tracks on data encoded on the stripe **301**. In an example embodiment, each track is about one-tenth of an inch wide. The ISO/IEC standard 7811, which is used by banks, specifies that track one is 210 bits per inch (bpi), and holds 79 6-bit plus parity bit read-only characters; track two is 75 bpi, and holds 40 4-bit plus parity bit characters; and track three is 210 bpi, and holds 107 4-bit plus parity bit characters. Other data formats may apply.

[0049] In an example embodiment, the format for Track Two, developed by the banking industry, is as follows (maximum of 40 characters):

[0050] Start sentinel—one character (generally ';')

[0051] Primary account number—up to 19 digits

[0052] Separator—one character (generally '=')

[0053] Expiration date—four digits in the form of the last two digits of the year, and the two digits representing the month (e.g. YYMM)

[0054] Service Code—three digits. The first digit specified the interchange rules, the second specifies authorisation processing and the third specifies the range of service

[0055] Discretionary data—balance of available space to fill the length of the Track Two (ex 10 digits if the PAN is 19 digits long)

[0056] End sentinel—one character (generally '?')

[0057] Longitudinal Redundancy Check (LRC)—one character

[0058] The above data is herein generally referred to as Track Two data.

[0059] It is recognized, that in addition to the typical plastic card form factor, as shown in FIG. **2** and FIG. **3**, there are a growing numbers of other form factors that can be used for payment. Non-limiting examples include a mini card, fob, mobile device, etc. It is also appreciated that other types of funding cards, in addition to credit cards, include similar information (e.g. PAN, expiry date, Track Two data, etc.).

[0060] The way the card data itself is stored on a funding card and shared with a payment terminal has many variants, such as storing the card data on a magnetic stripe and reading the data using a magnetic card reader, or storing the card data using chip technology and using a chip-reader compatible reader to interact with the card. For example, although not shown in FIG. **2** and FIG. **3**, the credit card can include an integrated circuit or logic chip capable of performing computations. Various examples of chip-based card technology includes contactless magnetic stripe emulation, EMV contact, EMV contactless, etc. EMV stands for Europay, MasterCard and VISA, a global standard for inter-operation of integrated circuit cards (IC cards or "chip cards") and IC card reader. In addition to facilitate the exchange of information via the contact interface of the card, information can also be exchanged using the contactless capabilities of capable card. Such contactless cards are sometimes referred to as PayPass, payWave, and ExpressPay.

[0061] It is recognized that contactless payment is well suited for a mobile device. For example, some mobile devices have a near-field communication (NFC) system that allows data to be transferred wirelessly, using the ISO/IEC 18092 standard or other compatible standards, over a relatively short distance. A NFC-enabled mobile device can establish radio communication with another contactless-enabled device by touching them together or keeping them into close proximity. The term "mobile device" and "mobile phone" are interchangeably used herein.

[0062] An NFC-enabled mobile device can be equipped with a "software payment card" (e.g. a software implementation of a contactless payment card) application running inside the mobile device. The software payment card uses the compatible contactless communication capabilities of the device to interact with contactless-enabled POS terminal to facilitate payment transactions.

[0063] In many cases, the software payment card is stored on the secure element to protect the sensitive payment data such as the one used to generate the dynamic data necessary to complete a typical contactless payment transaction. It is recognized that secure elements are limited in their storage capabilities. They are typically available in the form of an embedded chip, such as in a universal integrated circuit card (UICC), or in a subscriber identity module (SIM) card.

[0064] In part to maintain the security of the various applications running inside the secure element, the secure element is typically managed by a mobile phone carrier distributing the secure element with the mobile device. Part of the managed service includes delivering applications into the secure element directly, or giving permission to a third party organization to deploy their application on a particular secure element. The managed service is typically delivered using what the industry referred to as a trusted service manager (TSM).

[0065] All applications stored and running inside the secure element, such as the individual "software payment card", need their own space. Payment cards are issued to consumers by the card issuer. Deploying software payment cards on mobile phones requires a high level of coordination between the mobile phone carrier and the card issuer where the mobile phone carrier provides access to individual secure elements, one at a time, to the issuer. Only cards from funding card issuers that have the infrastructure and the agreement with the mobile phone carrier can be used on the mobile phone for contactless payment. This is limiting for both the card issuers and for cardholders.

[0066] In the United States, for example, there are thousands of issuing banks and tens of mobile phone carriers. The mobile phone carriers use the TSM, in part, to issue and manage payment credentials into mobile phone. The TSM enables mobile phone carriers (also called service providers) or other entities controlling the secure element on mobile phones to distribute and manage remotely the secure applications running inside the secure element by securing access to the secure element in mobile-enabled devices. An example of secure application is a software payment card. The issuing banks also interact with the mobile phone carriers through a service (in an example embodiment, called ISIS) to manage payment credentials issued to NFC-enabled devices. As a non-limiting example, in Canada, Rogers Communication is

a mobile carrier that is in partnership with the Canadian Imperial Bank of Commerce (CIBC), an issuing bank, to issue software payment card to CIBC cardholder's phone on the Rogers network. Establishing systems and methods to manage the secure issuance and management of software payment cards between the issuing banks, the mobile phone carriers, and the mobile device is costly and complex. It involves pre-arranged agreements between the parties as well as some customizations of the software and computing systems to meet the needs of all the entities participating. This can make it difficult for smaller-sized card issuers to adopt NFC technology for facilitate payments. It also means that the issuing bank will likely require numerous point-to-point connections with the various mobile operators it wants to supports, which requires further hardware capabilities and software to support and organize data communications between different mobile operators. The systems and methods described herein attempt to address at least one of these issues.

[0067] It is also recognized that from the user's perspective, the process of associating their mobile device with their funding card to be used for contactless payment is very much dependent on pre-arranged relationships between the mobile phone carrier and the card issuers. Therefore, a user has limited options or no options when determining if their current funding card can be associated with their mobile phone for contactless payments. For example, a user has a funding card from Funding Card Issuer A. The user also has a NFC-enabled mobile phone from Mobile Phone Carrier B. However, Mobile Phone Carrier B only has a pre-arranged agreement and infrastructure to facilitate contactless payments with Funding Card Issuer B. Therefore, even if the user wanted to use their mobile phone to make a contactless payment, the user would not be able to because there is no pre-arranged agreement and computer network infrastructure between Mobile Phone Carrier B and Funding Card Issuer A to issue a software payment card into the user's phone. This limitation of the computer network infrastructure limits the user's ability to make NFC-type payments with their mobile device.

[0068] In a typical example embodiment of making a payment using an NFC-enabled mobile device, a user first requests to its issuer to load a funding card on their mobile device. When this process is completed, a software funding card has been delivered and installed securely on the secure element on the user's mobile device. The user can now use the funding card on the mobile device's to facilitate contactless payment transactions at merchant locations that are equipped to accept such type of payment transaction. Once the user attempts to pay with their mobile device at a merchant, the payment details are sent and are verified by the funding card issuing server in a similar manner to other payment transaction.

[0069] When a contactless funding card credential is used to facilitate a payment transaction, the transaction most often includes dynamic data from the card to securely authenticate the payment credential. The dynamic data changes values every time the credential is used. If the dynamic data received on the funding card issuing server matches the expected value computed by the server for the card, the authentication of the payment credentials is deemed successful and the payment authorisation can continue. It can be appreciated that there are various ways in which the mobile device and the funding card issuing server can compute the dynamic data used to authenticate the payment credential.

[0070] In an example embodiment for credit cards, the dynamic data is a rotating card verification value (CVV, also referred sometime to dynamic CVV or dCVV). This rotating CVV is computable based on changing information provided by the integrated circuit inside the card. In another example embodiment, the dynamic data is dynamic EMV data which is computed using random data from the funding card, or random data from a merchant's point of sale terminal, or both. A common implementation of dynamic data uses an Application Transaction Counter (ATC) on the card so that every transaction produces a different data stream. This is achieved as the ATC is incremented by '1' for every transaction performed. When a user taps, touches or positions their mobile device near a contactless-enabled point of sale (POS) terminal, the funding card data (card number, dynamic data, expiry date, etc.), hereafter referred to as the card's Track Two data, is sent from the mobile device to the POS terminal. This information then makes it way to the funding card issuing server for verification. The funding card issuer will perform numerous checks to validate the transaction, including comparing the dynamic data of the mobile device with the value generated by the server. If the dynamic data is matching, and all the other checks and controls performed by the funding card issuer are successful, the funding card issuer will respond with a positive payment authorisation response.

[0071] It is also recognized that a card application specific to a given funding card can be installed on the mobile device and used to interact with POS terminal as described above. It is also recognized that the card application is typically installed on the mobile device's secure element. Typically, each funding card has its own corresponding card application that resides on the mobile device's secure element. It can be appreciated that as each card application takes up storage space on the secure element, and that the secure element typically has very limited storage space, having multiple card applications on the secure element is some cases is not possible due to insufficient storage space. By way of background, the secure element can have a native operating systems that be programmed to perform various tasks and activities, including for example, a card application that emulates the magnetic strip data of a funding card or a card application that emulates the data used in an EMV contactless payment. Also by way of background, and by way of example, a typical secure element has memory of 256 kB, and each card application can consume memory of 40-80 kB. It can therefore be appreciated that associating multiple funding cards (and each of their card applications) with a mobile device for NFC payments can be limiting.

[0072] Therefore, it is desirable to reduce the amount of storage space that card applications require on the secure element so as to not limit the number of software payment cards a user can load into a secure element. Along the same lines, it is desirable for mobile phone carriers to reduce the amount of data used by "card application" on the secure element so that other types of applications can be loaded thereon. It is also desirable to reduce costs incurred by the funding card issuer to issue and operate software payment cards into secure elements. By way of background, a mobile phone carrier typically charges application providers, such as funding card issuers, for the amount of storage space used on the secure element. It is also desirable to reduce the amount of

infrastructure required by the funding card issuer to issue a software payment card for the mobile phone. It is also desirable to reduce the amount of coordination required between the funding card issuer and the mobile phone carrier to issue a software payment card on particular mobile phone. It is also desirable to enable the user (e.g. the cardholder) to load any, and as many, funding cards they want into their NFC-enabled mobile phone, independently of the funding card issuer having the infrastructure or a commercial relationship or agreement with a particular mobile phone carrier.

[0073] The systems and methods described herein attempt to address the above issues.

[0074] It will be appreciated that different features of the example embodiments of the proposed systems and methods, as described in this document, may be combined with each other in different ways. In other words, a feature described with respect to one embodiment of a mobile payment system or method can be applied to another embodiment of the mobile payment system or method, although not specifically stated.

[0075] In general, the systems and methods described herein allow a cloud-based wallet payment gateway server to synchronize with a NFC-enabled mobile device and application to facilitate contactless payment transactions at a merchant store accepting contactless payment. A pre-arranged agreement or additional infrastructure between the funding card issuer and the mobile phone carrier is not required. A user selects a funding card for making the contactless payment, through their mobile device. A second card, herein referred to as a virtual card, is generated along with all required card data (e.g. PAN, expiry date, dynamic data, discretionary data, etc.) to complete the payment transaction. The virtual card is associated with the funding card on the payment gateway server. In an example embodiment, the association between the virtual card and funding card is limited to some period of time.

[0076] In an example embodiment, the data required to compute virtual card data set is sent to the mobile device, typically every time that the user wants to make a payment. For example, a new virtual card is created for each and every payment transaction. In another example, a new virtual card is created based on time limits, or based on certain events, or both, and has a much shorter usage period compared to a standard funding card which can be used typically over several years. Where the virtual card can be used with the funding card for several transactions, a data for computing a new virtual card does not need to be sent to the mobile device each time the user makes a payment.

[0077] When a payment is initiated, the virtual card data is sent through the NFC system on the mobile device to a contactless-enabled POS terminal. This information is sent from the POS terminal to the merchant system; from the merchant system to the merchant acquiring bank; and from the acquiring bank to the cloud-based wallet payment gateway server (also referred to the "payment gateway server") via the payment network. The cloud-based wallet payment gateway server acts as the virtual card issuer server and verifies the virtual card. If successfully verified, the funding card details associated with the virtual card are retrieved and sent to the funding card issuer server via the payment network to complete the payment authorisation transaction. The funding card issuer server verifies the funding card and sends back an authorization code to the payment gateway server. The payment gateway server sends back a corresponding authorization code to the merchant system.

[0078] The payment can be settled when the merchant system initiates a settlement request, typically, though not necessarily, at the end of every business day. To complete the settlement, the merchant system sends all the virtual card numbers and the corresponding authorization codes received during the period to the virtual card issuer, via the merchant acquiring bank. The virtual card issuer verifies the virtual card numbers and authorisation codes. For all the matching records, the virtual card issuer retrieves the associated funding card numbers and authorisation codes and sends the data to the funding card issuer for settlement via the virtual card issuer acquiring bank. The funding card issuer verifies the funding card numbers and authorization codes, and if successfully verified, sends the money via a standard method to the payment transaction originator, in this case the virtual card issuer. At that point, the virtual card issuer sends the money to the merchant acquiring bank also using a standard method. In an example embodiment, the virtual card issuer is the payment gateway server, or a module within the payment gateway server.

[0079] In an example embodiment, the systems and methods described herein allow a cloud-based wallet (e.g. associated with a funding card) to be synchronized with a NFC-enabled mobile device (e.g. associated with a virtual card). In another example embodiment, the systems and methods described herein provide real time rotation of a primary account number (PAN) and dynamic data used to facilitate contactless payment transactions. In another example embodiment, the systems and methods described herein use virtual payment credentials to complete a brick-and-mortar contactless purchase transaction without disclosing the user's funding card details.

[0080] Turning to FIG. **4**, an example embodiment showing the flow of payment data using a virtual card is provided. A card issuer, also called the funding card issuer **104**, issues a standard card account, most often if the form of a plastic card, to the user **101** (block **404**). The standard card is the funding card, and the user becomes the cardholder.

[0081] Although not shown, the cardholder **101** registers one or many funding cards and their mobile device with a virtual card issuer **401**. It can be appreciated that any funding card can be registered, and is not limited or dependent on the mobile phone carrier having an agreement with the funding card issuer. In other words, even if the funding card and the mobile phone carrier do not have any agreement or connecting computer infrastructure, according to the proposed systems and methods, the user's one or many funding cards and the user's mobile device can be registered with the virtual card issuer **401**. It can also be appreciated that any number of funding cards can be registered in association with the mobile device. The cardholder's mobile device includes a payment application that can interact with the virtual card issuer **401**.

[0082] In an example embodiment of the registration, for each funding card the user wishes to register, the user enters in (e.g. types in) card details into the mobile device (e.g. card details include the name printed on the funding card, the PAN printed on the funding card, the expiry date printed on the funding card, and the static security code printed on the funding card). The mobile device sends this data, plus a user provided PIN and the mobile device ID to the payment gateway server. For each funding card, the payment gateway server computes a funding card identifier which identifies the

given funding card. The payment gateway server stores the funding card identifier in association with the funding card details, mobile device ID and PIN, and it sends the funding card identifier to the mobile device for storage. In an example embodiment, the funding card identifier is a value that is different from the PAN, expiry date or static security code of the funding card. For example, the funding card identifier is a random value so that, if intercepted by an adversary, would not be able to recognize any funding card details. In an example embodiment, the mobile device does not store any funding card details but only stores limited funding card details (e.g. the name funding card issuer and the last 4 digits of the PAN). The mobile device stores the funding card identifier, which it sends to the payment gateway server to indicate a specific funding card. It can be appreciated that there are other methods to capture the funding card details (e.g. besides the user typing in the data), which can be used with the principles described herein.

[0083] It can be appreciated that a single payment application is required on the mobile device, which can manage multiple funding cards. If multiple funding cards are registered, each of the associated funding card identifiers are stored on the mobile device, within the single payment application. The details of each individual funding card are stored on the payment gateway server. In this way, the payment gateway server acts as a cloud-based server that stores the details of multiple funding cards. Additional details of a funding card registration process are described below with respect to FIG. **10**.

[0084] Continuing with FIG. **4**, when the registered cardholder **101** wishes to make a contactless payment using their mobile device, the user selects the funding card. The selected funding card is conveyed to the virtual card issuer **401**, and the virtual card issuer **401** issues a virtual card to the cardholder **101**, and more specifically to the payment application running on the mobile device (block **405**). The cardholder touches their mobile device on the merchant system and the virtual card details are delivered to the merchant **106**, via a NFC-enabled POS terminal (block **406**). The merchant sends the virtual card details to the merchant acquirer **103** (block **407**). Based on some of the virtual card details, the merchant acquirer **103** sends the virtual card details to the virtual card issuer **401** (block **408**) via the payment network. The virtual card issuer **401** uses the virtual card details to determine the corresponding funding card (block **409**). The virtual card operator **402** (e.g. the virtual card issuer now acting as a "merchant") sends the corresponding funding card details, including the original transaction amount, to its acquirer **403** (block **410**). This parallels the typical process of a merchant **106** sending the funding card details to the merchant acquirer **103**. The virtual card acquirer **403** sends the funding card details to the funding card issuer **104** (block **411**) via the payment network for a standard payment authorisation.

[0085] The funding card issuer **104** then can authorise, or not, the payment request and responds back with an authorisation code to the virtual card issuer's acquirer, via the payment network, which in turn notify the virtual card issuer. The virtual card issuer notifies the merchant acquirer using a corresponding authorization code for the merchant system via the payment network.

[0086] To settle the funds (not shown), the merchant will initiate, or the merchant acquirer will initiate on behalf of the merchant, a settlement request to the payment network via the merchant acquirer. The payment network will forward the corresponding virtual card transactions to settle to the virtual card issuer. When the virtual card issuer receives the transactions, the virtual card issuer will send a settlement request for the corresponding funding card transactions to its own acquirer. The settlement request will be sent to the appropriate funding card issuer by the payment network. The funding card issuer receives the transactions settlement request, and will send the funds associated with all matching transactions to the payment transaction originator, in this case the virtual card issuer. When the virtual card issuer receives the funds, the virtual card issuer will send the corresponding funds to the merchant.

[0087] In an example embodiment, the virtual card issuer **401**, the virtual card operator **402**, and the virtual card acquirer **403** are represented by the same entity, referred herein as the payment gateway server. The payment gateway server itself can include one or more servers. For example, each of the entities **401**, **402**, **403** can be individual servers that, combined, form the payment gateway server.

[0088] Turning to FIG. **5**, example embodiment components of a system for facilitating payment using the virtual card is shown. The user **101** has one or more funding cards **505** pre-registered into its cloud-wallet (process not shown). For example, the user has multiple funding cards. The user **101** also owns an NFC-enabled mobile device **501**, which includes a payment application. The mobile device **501** is configured to interact, via NFC, with a merchant POS terminal device **502**. The merchant POS terminal device **502** is in data communication via the merchant payment system with the merchant acquirer **103** (e.g. a server). The merchant acquirer and the payment gateway server **506** are in communication with a payment network (e.g. Visa, MasterCard, Discover, etc.), which is configured to send data related to payments and transactions to relevant parties, including the payment gateway server **506** and the funding card issuer **104** (e.g. a server). The communication between the merchant POS terminal device **502**, the merchant acquirer **103**, the payment network **504**, the payment gateway server **505** and the funding card issuer **104** can occur over wired or wireless communication networks, or both.

[0089] The payment gateway server **506** is also in communication with the mobile device **501** through a wireless network. For example, the wireless network is provided by a mobile phone carrier.

[0090] Example components of the payment gateway server **506** are shown in block **507**. The server **506** can include the virtual card issuer **401**, the virtual card operator **402** and the virtual card acquirer **403**. During a registration process conducted by the user **101**, the payment gateway server **506** stores the user selected personal identification number (PIN), funding card data in association with the user's mobile device ID (e.g. in database **508**). For example, the user PIN, funding card1 and funding card2 (and other funding cards) are stored in association with the mobile device ID of mobile device **501**. Also, in database **509**, the temporary data associations between a given funding card, a virtual card and authorisation code when applicable are stored. For example, virtual card1, funding card1 and authorisation code **1** are all stored in association with each other's. Another example is virtual card2 and funding card2 are also associated but have no authorisation code issued yet for the card pair. In an example embodiment, there is no authorisation code issued yet because the user has not yet tapped the mobile device using funding card2 (e.g. really virtual card2), or because the merchant payment

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authorisation was interrupted such that the payment gateway server never received the authorisation code.

[0091] Turning to FIG. **6**, example components of the mobile device **501** are shown. The mobile device **501** includes a main processor **601** which interacts with a number of components including, among other things, auxiliary inputs/outputs **302**, a data port **603**, a keyboard **604**, a speaker **605** (e.g. an audio speaker), a microphone **606**, a GPS receiver **607** and a camera **608**. The mobile device **501** also includes an NFC subsystem **609**, a secure element **622** which may or may not also have direct connectivity to the NFC subsystems **609**, and other device subsystems **611**.

[0092] The mobile device **501** uses a communication system **613** to interact with a wireless network **612**. Memory types include flash memory **614** and random access memory (RAM) **615**. The mobile device's display **616** can be a touchscreen type display or another type of display.

[0093] An operating system **617** may be used to manage and run software components **618**. Software components or applications include a web browser or internet browser **619** and payment application **620**. Other software components **621** are included.

[0094] The secure element **622** can be used for storing information such as application and data elements, for example a payment application and a mobile identifier. In an example embodiment, the secure element in inside a subscriber identity module (SIM) card. Non-limiting examples of mobile devices include cell phones, smart phones, PDAs, tablets, netbooks, and laptops.

[0095] It will be appreciated that any module or component exemplified herein that executes instructions or operations may include or otherwise have access to computer readable media such as storage media, computer storage media, or data storage devices (removable and/or non-removable) such as, for example, magnetic disks, optical disks, or tape. Computer storage media may include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information, such as computer or processor readable instructions, data structures, program modules, or other data, except transitory propagating signals per se. Examples of computer storage media include RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by an application, module, or both. Any such computer storage media may be part of the any one of the servers **103**, **504**, **104**, **506**, **401**, **402**, **403**, the mobile device **501**, the POS terminal **502**, etc. or accessible or connectable thereto. Any application or module herein described may be implemented using computer or processor readable/executable instructions or operations that may be stored or otherwise held by such computer readable media.

[0096] Turning to FIG. **7**, example computer executable or processor implemented instructions are provided for facilitating a transaction between a mobile device **501** and a POS terminal device **502**.

[0097] Is assumed that the end-user has a compatible NFC-mobile device **501**. It is assumed that payment application **620** has been installed on the mobile device **501**. It is assumed that the end user has registered for the service.

[0098] Following the merchant capturing the purchase transaction details into its point of sale system, the NFC-enabled POS terminal device **502** displays a message to the end user to "tap" to pay (block **701**). For example, the user can tap their mobile device **501** or a contactless funding card. The examples described herein relate to tapping the mobile device **501**.

[0099] The end user **101** sees the message from the POS terminal device **502** and starts the payment application **620** on the mobile device **501** (block **702**). For example, the user selects an icon for the payment application **620** on a home screen of the mobile device **501**, thereby launching the payment application **620**. The payment application **620** determines if the user has successfully registered to the service (block **703**), and if so, shows a menu (block **704**) of supported actions by the application. If the user has not registered, the menu offers the user to register with the service (e.g. register one or more funding cards, provide a PIN, link a mobile device identifier to the registration record).

[0100] A graphical user interface (GUI) on the menu is able to receive an input from the user to initiate a payment with a virtual card with the payment application (block **705**). Example of other menu item includes "add a funding card", "delete a funding card", etc.

[0101] The mobile device **501** then displays the funding cards that have been pre-registered by the user (block **706**). A user input is provided to select one of the funding cards (block **707**). In an example embodiment, the displayed funding card information is loaded after the end user successfully registers to the service and has registered at least one funding card. The list is updated when the user adds an additional funding card into the payment application or when a funding card is deleted. For each registered funding card, there is a corresponding record stored on the payment application **620** and on the payment gateway server database **508** which includes an identifier for the payment network associated with the funding card, a funding card identifier, etc.

[0102] The payment application **620** sends the mobile device identifier to the payment gateway server **506** (block **708**). The payment application **620** also sends the transaction type (selected action in the application menu, in this case, "Pay with a virtual card") and the identifier for the selected funding card to the payment gateway server **506** (block **709**). Based on the information received by mobile device **501**, the payment gateway server **506** creates and computes the details regarding the virtual card (block **710**). In particular, the payment gateway server **506** computes a virtual PAN, an expiry date of the virtual card and all or some of the data elements that form the Track Two data. It is noted that Track Two data includes, among other things: the PAN, a service code, an expiry date, discretionary data and a LRC. In an example embodiment, the payment gateway server **506** at this time does not compute the discretionary data, which is dynamic in nature (e.g. the discretionary data is dynamic data). In an example embodiment, the expiry date of the virtual card is identical to the expiry date of the funding card, so that from the perspective of the merchant and the user the virtual card is identical to the funding card. In fact, based on certain similarities between the funding card and the virtual card, the merchant and the user will be unaware that a virtual card is being generated and used and will instead believe that the funding card is being used in the payment. The virtual card details may further include an internal expiry date that is known only to the payment gateway server, and has a short timeline of about a few days from the date that the virtual card is created. The internal expiry date is different from the virtual

card's expiry date, and the function of the internal expiry date is to provide an additional indicator to the payment gateway to determine whether or not a virtual card has expired. The payment gateway server **506** encrypts the virtual card data, which does not include the internal expiry date, and sends the encrypted virtual card payload to the mobile device's payment application **620** (block **711**).

[0103] As an alternate example embodiment, instead of the payment gateway server **506** sending the virtual card PAN as part of the encrypted virtual card payload to the mobile device, the payment gateway server **506** instead sends a key value (called Kpan) that the mobile device can use to generate an identical virtual card PAN as computed by the payment gateway server **506**.

[0104] In an example embodiment, the last four digits of the virtual card PAN are the same as the last four digits of the funding card PAN. The last four digits of the virtual card PAN are identical to the funding card PAN so that, after PAN truncation, it appears as if the PAN of the virtual card is identical to the PAN of the funding card. In other words, the user cannot detect that a virtual card is being used in place of a funding card. By way of background, PAN truncation is enforced by the payment industry as part of the merchant certification process for accepting card payment. A truncated PAN means that the card number, when printed on a customer receipt, is replaced with a printout of only the last four digits, and the remainder of the other PAN digits are replaced usually by asterisks. An example embodiment of a truncated PAN is * * * * * * * * * * * * 7777. This hides the card number from anyone who obtains the receipt when discarded, or by other means, while still allowing a cardholder with multiple cards to identify which was used, and thus record the transaction.

[0105] In an example embodiment, the first portion of digits of the PAN of the virtual card is static and refers to the payment gateway server **506**. For example, the first six digits point to the payment gateway server **506**; the merchant acquirer **103** and associated payment network uses this information to send the transaction and payment details to the payment gateway server **506**.

[0106] In an example embodiment, the PAN of the virtual card is nineteen digits long and compliant to the algorithm LUHN-10. The algorithm, also known as the "modulus 10" or "mod 10" algorithm, is a checksum formula used to validate a variety of identification numbers, such as card numbers. As described above, the first six digits are used to identify the payment gateway server and the last four digits are identical to the last four digits of the funding card PAN. The remaining digits can be computed in a number of ways. In an example embodiment, the remaining digits of the virtual card PAN are randomly generated. In another example embodiment, the remaining digits are computed using the Kpan value; further details in this regard are described in FIG. **11**. Other methods can be used to compute the virtual card PAN.

[0107] The mobile device **501** receives the encrypted virtual card payload, decrypts the encrypted communication and extracts the virtual card details (e.g. the virtual card PAN and other card details).

[0108] In another example embodiment, if the virtual card payload includes a Kpan (e.g. a key value) instead of a virtual card PAN, the mobile device **501** uses the Kpan to compute the virtual card PAN.

[0109] The payment application **620** on the mobile device **501** displays a GUI requesting the user **101** to input their PIN (e.g. which should be the same PIN provided when the user registered for the service) (block **712**). The application **620** receives the PIN from the user **101** (e.g. the user enters in the PIN) (block **713**). The application **620** uses the PIN to compute the discretionary data of the virtual card (block **714**). With the discretionary data computed, the Track Two data set is complete. The virtual card data set (e.g. the Track Two data) is delivered to the mobile device's secure element **622** (block **715**). In an example embodiment, data to be sent over the NFC subsystem **609** needs to be provided by the secure element **622** (block **716**). In another example embodiment, though not shown, the operating system of the mobile device **501** can directly transfer information to the NFC subsystem **609** without the use of the secure element. The virtual card data set includes the virtual card PAN, the expiry date, the discretionary data and all other elements in a Track Two data set to complete a standard contactless payment transaction. The mobile's payment application **620** displays a message to the user to "Tap to pay" (block **717**).

[0110] At this stage, the user **101** touches or positions the mobile device **501** in close proximity to the POS terminal device **502** (block **718**). When the mobile device **501** becomes in communication range to the POS terminal device **502**, the mobile device **501** sends the virtual card data to the POS terminal device **502**, using the mobile device's NFC subsystem **609** (block **719**) following the payment network standard for such contactless payment transaction. The transfer of data occur using radio communication means. In an example embodiment, the POS terminal device **502** displays a message to the user **101** to "Remove card" (block **720**) once the terminal as received all the card data it needed. The user positions the mobile device **501** away from the POS terminal device (block **721**). Other computations and processes can occur within the mobile device **501** which completes the mobile device's participation in the transaction process (block **722**).

[0111] Although not shown in FIG. **7**, the POS terminal device **502** will send the virtual card details to the merchant acquirer, along with other transaction data (e.g. cost for transaction, merchant ID, etc.). This information is eventually routed to the payment gateway server **506**, as identified by the first portion of digits of the virtual card's PAN. See FIG. **8** for more details.

[0112] In an example embodiment, one PIN can be used for all the funding cards associated with the mobile device. In another example embodiment, the registration process can request a specific PIN for each funding card. In other words, if a user selects a different funding card, the user will need to enter in a different PIN.

[0113] In a preferred example embodiment, the mobile device's payment application **620** does not verify the PIN. Instead, the PIN is indirectly or implicitly verified by the payment gateway server **506** when verifying the virtual card data set. In other words, the payment gateway server **506** uses the PIN that was stored at registration time to compute the virtual card data set. If an incorrect PIN was provided by the user or an adversary during the transaction, it will cause the computed virtual data to result in a different, incorrect, value compared to the virtual card data computed by the payment gateway server. Once the received virtual card data set is compared with the expected value by the server, an invalid PIN entry can be detected. When the payment gateway server receives and verifies the virtual card data set and detect an un-expected virtual card data set (e.g. due to the incorrect PIN), then the payment authorization can be declined.

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[0114] Turning to FIG. **8**, example computer executable or processor implemented instructions are provided for facilitating a transaction between a mobile device **501** and a POS terminal device **502**, including further details regarding the processing of data by the merchant acquirer **103**, payment gateway server **506** and funding card issuer server **104**.

[0115] Blocks **701**, **718**, **719**, **720**, and **721** shown again to provide context for the process. After the POS terminal device **502** receives the virtual card data from the mobile device **501** (block **719**), the POS terminal device **502** sends the virtual card data, the transaction information (e.g. amount of payment), and other information (e.g. merchant ID) to the merchant acquirer **103** (block **801**). In an example embodiment, the data sent by the POS terminal device **502** is in a standard payment authorization request format.

[0116] The merchant acquirer **103** sends the payment authorization request, which includes at least the virtual card data (e.g. virtual card's Track Two data) and the payment amount, to the payment gateway server **506** (block **802**) via the payment network. The acquirer **103** and the payment network are able to identify the payment gateway server **506** by the first portion of digits in the PAN of the virtual card. It can be appreciated the PAN is part of the Track Two data.

[0117] The payment gateway server **506** validates the virtual card data (block **803**). To validate the virtual card data received from the mobile device (via the merchant acquirer **103**), the payment gateway server computes the Track Two data set on its own. The Track Two data computation includes the payment gateway server computing the discretionary data using the PIN originally received and stored during registration by the user. In an example embodiment, some of the Track Two data portions (like the PAN and expiry date) were pre-computed and stored; these pre-computed data portions can be compared against the received Track Two data. If the virtual card data is successfully validated (received card Track Two data set matches computed card Track Two data set by the payment gateway server), then the payment gateway server retrieves the funding card data that is associated with the virtual card data card (block **804**).

[0118] The validation of the virtual card data in block **803** can also include verifying if the internal expiry date associated with the virtual card has passed or not. If the present date of the validation is occurring before or on the internal expiry date, then the virtual card can be considered validated and the transaction processing can continue. Otherwise, the virtual card is deemed invalid and the payment authorisation request is denied.

[0119] If the virtual card is validated, the payment gateway server **506**, playing a role that is similar to a merchant at that point, sends a payment authorisation request to its own acquirer, where the payment authorisation includes at least the funding card data and the same payment amount received in block **802**, to the funding card issuer server **104** (block **805**) via the payment network. The funding card issuer **104** then receives the payment authorisation request and process the transaction as standard. Once the transaction is processed, the funding card issuer **104** sends a payment authorisation code to the payment gateway server (block **806**) via the payment network. The authorisation code response includes whether the payment authorisation has been accepted or denied, a transaction identification number, etc.

[0120] The payment gateway server **506** then sends a corresponding payment authorisation response to the merchant acquirer **103** (block **807**) via the payment network, and the acquirer **103** sends the payment authorisation response to the POS terminal device **502** (block **808**) also via the payment network. Although not shown, the payment gateway server stores the payment authorisation code into the database **509**. Although not shown as well, the POS terminal device **502** may display a message to the end user that the payment has been accepted or denied, according to the response.

[0121] In an example embodiment, the payment gateway server **506** may also send a confirmation to the mobile device **501** that indicates whether or not the payment was accepted or denied (block **809**). The indication can be sent as data specific to the payment application **620** on the mobile device, or as an email. After receiving such indication, the mobile device **501** can display a message to the user according to the indication.

[0122] In an example embodiment, after the payment gateway server **506** receives a response that the payment has been processed (block **806**), the payment gateway server **506** marks the virtual card as being used. In this way, if the same virtual card is used again in a future transaction, the payment gateway server will decline the transaction. This is because the virtual card is meant to be used only once.

[0123] In other example embodiment, the same virtual card can be used for more than one transaction.

[0124] Turning to FIG. **9***a*, an example embodiment of computer executable or processor implemented instructions is provided for facilitating a transaction using a virtual card. In an example embodiment, the instructions of FIG. **9***a* are an example detailed implementation of blocks **710** and **711**. In the example embodiment, the virtual card number (also called the PAN of the virtual card), the expiry date of the virtual card and the other data are all computed by the payment gateway server **506**. Details explaining the flow of data between the virtual card issuer server **401**, the virtual card operator **402** and the virtual card acquirer **403** are also provided. The entities **401**, **402**, **403** can be part of the payment gateway server **506**. In another example embodiment, the entities **401**, **402**, **403** are separate entities.

[0125] The operations in blocks **901** through **908** are part of the overall process for the mobile device getting a virtual card (block **909**).

[0126] The process in FIG. **9***a* assumes that the mobile device **501** has the payment application **620** installed, and that the mobile device and the funding cards have been registered with the payment gateway server **506**. It also assumes that a transaction with the merchant has already been initiated. For example, the POS terminal device **502** has displayed the message "Tap to pay", and the user has already selected a funding card through the payment application **620**. These conditions are achieved using, for example, blocks **701**, **702**, **703**, **704**, **705**, **706** and **707**.

[0127] After receiving a user input to select a funding card, the mobile device **501** sends the transaction type (selected action in the application menu, in this case, "Pay with a virtual card") and a funding card identifier. In a preferred example embodiment, the funding card identifier is determined at the time of registration.

[0128] The virtual card operator **402** confirms that the selected funding card is valid (block **902**) by ensuring for example that the funding card identifier is linked with the registered user and that the selected funding card has not expired since its registration.

[0129] The virtual card operator **402** sends a request to create a virtual card PAN to the virtual card issuing server **401** (block **903**). The request for the virtual card PAN includes the

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last four digits of the funding card PAN and the expiry date of the funding card. The virtual card issuing server creates a virtual card PAN which has the last four digits identical to the last four digits of the funding card PAN. The virtual card also has the same expiry date and the funding card. The virtual PAN is created by using the first 6 digits assigned to the virtual card issuer, a unique, never used before, 8 digits long random number (to prevent collision), and the check mod10 digit.

[0130] After the virtual card PAN is computed, the virtual card issuing server **401** sends this information, in a response, to the virtual card operator **402** (block **904**). The virtual card operator will generate portions of the Track Two data such as the PAN, the card expiry, service code, etc (block **905**). In an example embodiment, the discretionary data (which is part of the Track Two data) is not computed by the payment gateway server **506** at this time. The virtual card operator **402** associates the virtual card PAN with the funding card PAN (block **906**) and stores it in the database **509** (not shown). It also adds an internal expiry date to the virtual card records in the database. In an example embodiment, the internal expiry date is computed to be some predetermined time period after the time that the virtual card is created. For example, the internal expiry date is 48 hours from the date and time that the virtual card is created. The virtual card operator **402** then encrypts and sends the virtual card data (e.g. virtual card PAN, external expiry date, etc.) required by the mobile application to generate the final virtual card data set card (block **907**). The result forms an encrypted virtual card payload that is sent to the mobile device **501** (block **908**).

[0131] The mobile device **501** receives the PIN from the user (block **925**). The mobile device **501** then uses the PIN to compute the discretionary data (which is a portion of the virtual card's Track Two data). The computation of the discretionary data can involve a dynamic value which changes over time, or with each transaction, thereby making the discretionary data the dynamic data. The data received from the virtual card payload (e.g. PAN, expiry date, and other data) and the discretionary data form the complete Track Two data set of the virtual card (block **926**).

[0132] Turning to FIG. **9***b*, an example embodiment of computer executable or processor implemented instructions is provided for validating and authorizing a transaction using a virtual card. The process in FIG. **9***b* assumes that a virtual card was already created (e.g. as per FIG. **9***a*) and focuses on the processing for verifying the virtual card. In an example embodiment, the instructions of FIG. **9***b* are an example detailed implementation of blocks **802** to **807**. The entities **401**, **402**, **403** can be part of the payment gateway server **506**. In another example embodiment, the entities **401**, **402**, **403** are separate entities.

[0133] The processes described with respect to blocks **910** through **923** are part of the overall authorization process of the virtual card (block **924**).

[0134] The flow starts after the mobile device **501** has received the encrypted virtual card payload, decrypted the virtual card payload, captured via the GUI the user's PIN, and computed the complete virtual card data set (e.g. the complete Track Two data set). At that point, the mobile application can send the virtual card data set to the POS terminal device **502** via the NFC subsystem **609** (block **910**). The POS terminal device **502** sends the virtual card data, along with transaction data, to the merchant acquirer **103** (block **911**). The merchant acquirer **103** sends a payment authorisation request, which includes the virtual card data and the amount of payment, to the virtual card issuing server **401** (block **913**) via the payment network.

[0135] The virtual card issuing server **401** sends the virtual card data to the virtual card operator **402** (block **914**). The virtual card operator **402** uses the virtual card data, such as the virtual card PAN, to retrieve the associated user profile and funding card data (e.g. PAN and expiry date) (block **915**). The virtual card operator **402** then verifies the received virtual card data, for example, by comparing data with the server computed version of the expected card data. The validation process is similar to operation of block **803**.

[0136] If the virtual card data is successfully verified, then the virtual card operator **402** uses the funding card details associated with the virtual card transaction and send a payment authorisation request, which includes the funding card data and the corresponding payment amount, to the virtual card acquirer **403**. The virtual card acquirer **403** forwards the details to the funding card issuing server **104** (block **917**) via the payment network.

[0137] The funding card issuing server **104** receives and verifies the funding card data. If the funding card data is successfully verified, the funding card issuing server sends a payment authorisation code response to the virtual card acquirer **403**, which forwards the same to the virtual card operator **402** (block **918**), all via the payment network. The payment authorisation code response indicates whether the funding card data is accepted or denied, and a transaction identification number, etc.

[0138] The virtual card operator **402** sends a corresponding validation authorisation code response to the virtual card issuing server **401** (block **919**). The virtual card operator **402** and the virtual card issuing server **401** marks the virtual card as being used (block **920** and block **921**). In this way, if the same virtual card is used again at a later time, the virtual card operator **402** or the virtual card issuing server **401** will be able to detect a possible fraud.

[0139] The virtual card issuing server **401** sends the payment authorisation code response for the virtual card to the virtual card operator **402** (block **922**). This payment authorisation code response for the virtual card is then forwarded to the merchant acquirer **103** (block **923**) via the payment network.

[0140] As described earlier, in other example embodiments, the virtual card is not computed for every transaction. For example, after the virtual card is computed according to blocks **708**, **709**, **710**, **711**, **712**, **713**, and **714**, for one or more subsequent transactions, the same virtual card can be used for the transaction. In other words, blocks **708**, **709**, **710**, **711**, **712**, **713**, and **714** are not performed for the one or more subsequent transactions. This saves on processing power and reduces the computation time when making a transaction. This may also be advantageous when the mobile device **501** is not able to communicate with the payment gateway server **506**. In other words, even if the mobile device **501** is not able to communicate with the payment gateway server **506**, the mobile device can use the already computed virtual card to perform the transaction.

[0141] In an example embodiment where the same virtual card is used for subsequent transactions, certain events, or time periods, or both may trigger a new virtual card to be computed and loaded on the mobile device **501**. In an example embodiment, a new virtual card is computed when a given number of transactions have been performed using the

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previous virtual card, and when the mobile device **501** is able to communicate with the payment gateway server **506**. The given number of transactions is, for example, a randomly generated number that is generated each time a new virtual card is issued to the mobile device **501**. In another example embodiment, a new virtual card is computed for a transaction when a given number of days has passed since the previous virtual card was computed, and when the mobile device **501** is able to communicate with the payment gateway server **506**. The given number of days is, for example, a randomly generated number that is generated each time a new virtual card is issued to the mobile device **501**. It can be appreciated that randomly generated numbers prevent attackers from predicting when the next new virtual card will be computed for the mobile device.

[0142] Turning to FIG. **10**, an example embodiment of computer executable or processor implemented instructions are provided for registering a funding card and mobile device with payment gateway server. Such an embodiment can be used in combination with the principles described above. The mobile device **501** sends a registration request to the payment gateway server **506** (block **1001**). The request includes the mobile device's device ID, a user provided PIN, and funding card details. After receiving the request, the payment gateway server sends a registration response to the mobile device (block **1002**). The response include a certificate, an Application Transaction Counter (ATC), a key value (called Kpan) for generating a PAN, a secure element key value (called Ksec), and a funding card identifier that identifies each registered funding card(s). The certificate is a client certificate for the mobile device **501** and, in an example embodiment, it is configured to according to the RSA algorithm and has a 2048 bit length. The ATC is a counter that is initially set to a random value between "0" or "1000" and increments with each transaction. The initialized ATC value is a random value to prevent adversaries from predicting the ATC values. Copies of the ATC are stored and synchronise on both the payment gateway server and the mobile device. In an example embodiment, the ATC is a 10 digit value. In an example embodiment, the Kpan is 128 bits long, and the Ksec is 128 bits long.

[0143] The payment gateway server **506** stores the data from the registration request and the registration response in association with each other (block **1003**). The mobile device **501** also stores the data from the registration response (block **1004**).

[0144] Turning to FIG. **11**, an example embodiment of computer executable or processor implemented instructions are provided for computing virtual card data. Such an embodiment can be used in combination with the principles described above for computing virtual card data. The mobile device **501** sends a virtual card request to the payment gateway server **506** (block **1101**). This is similar to block **901** in FIG. **9***a*. The request includes the device ID, the identifier of the selected funding card, the Certificate and the stored Kpan. The stored Kpan can be from registration or from the previous transaction.

[0145] The payment gateway server **506** determines if the received Kpan and Certificate match the Kpan and Certificate stored on the payment gateway server (block **1102**) associated with the DeviceID stored in the payment gateway server database. If so, then the payment gateway server **506** sends a virtual card response to the mobile device **501** that includes a new Kpan (block **1103**). A new Kpan is used to generate a different PAN from the previous transaction, and to also prevent against replay attacks. The payment gateway server **506** computes the PAN for the virtual card using the new Kpan (block **1104**). This new Kpan and the pre-computed PAN are stored by the payment gateway server **506** for later use (block **1105**).

[0146] After the mobile device receives the new Kpan, it replaces the stored Kpan with the new Kpan (block **1106**). It uses the new Kpan to compute a PAN for the virtual card, in the same way the payment gateway server computed the PAN (block **1107**). If the conditions and data are correct, although the mobile device computes the PAN independently of the payment gateway server, the PAN computed by the mobile device should be identical to the PAN computed by the payment gateway server.

[0147] The mobile device then computes the discretionary data (which is part of the Track Two data) using the PIN, the Ksec, the PAN, the Certificate, and the ATC (block **1108**). The ATC and the PAN keep changing with each transaction, which causes the discretionary data to be dynamic data.

[0148] The mobile device increments the ATC by 1 (block **1109**).

[0149] In particular, the PAN is computed by the mobile device and the payment gateway server according to the following:

$$PAN=BIN(6)+SHA256[Kpan](8)+Luhn(1)+Reserved(4) \quad (4)$$

wherein

BIN(6) is a 6-digit binary number to identify the payment gateway server;

SHA256[Kpan](8) is an 8-digit number generated by taking the sha256 of the Kpan value, further including converting the sha256 value to decimal and truncating to eight digits from the hash value;

Luhn(1) is a single digit used to ensure the virtual card always passes LUHN algorithm;

and

Reserved(4) is a 4-digit number that is the same as the last 4 digits of the funding card PAN.

[0150] The above values are concatenated together to form the PAN. The symbol "+" in the above computation refers to the concatenation operation.

[0151] In an example embodiment of computing the PAN, the other values may be known or computed first, and the LUHN value is computed lasted. For example, an intermediate form to the PAN is 66666612345678X1111, whereby X represents Luhn(1). In other words, the BIN(6)=666666; SHA256[Kpan](8)=12345678; and Reserved(4)=1111.

[0152] Different LUHN algorithms can be used to solve for X, so as to ensure the PAN satisfies the LUHN algorithm. For example, an example embodiment algorithm includes (step 1) doubling the value of every other digit, starting from the right-most digit; (step 2) summing the all the individual digits including the digit X from step 1; and (step 3) solving the expression mod10(sum total from step 2)=0 for the digit X. In this example embodiment, the solution to the equation is X=9. Other LUHN algorithms can be used.

[0153] In an example embodiment, any digit before the last 4 digits of the PAN that satisfies the LUHN criteria can be used.

[0154] The discretionary data is computed using the following:

$$\text{Discretionary data}=HMAC_SHA256[Ksec+PIN,M] \quad (10)$$

where M=concatenation of (PAN, Certificate ID, ATC)

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[0155] Truncation is performed by encoding the SHA results in decimal, then taking the left most digits. It can be appreciated that SHA256 is a known cryptographic hash function, and HMAC is a hash based message authentication code involving a cryptographic hash function in combination with a secret cryptographic key. The secret cryptographic key of the HMAC function is the concatenated values of Ksec and PIN. The message M is the concatenated values of PAN, Certificate ID and ATC. The Certificate ID is from the Certificate.

[0156] Turning to FIG. **12**, an example embodiment of computer executable or processor implemented instructions are provided for verifying virtual card data, and in particular the verification by the payment gateway server of the discretionary data (e.g. the dynamic data). Such an embodiment can be used in combination with the principles described above for verifying the virtual card data. This can be a continuation of the process described in FIG. **11**.

[0157] The mobile device **501** sends a virtual card to the merchant POS terminal **502**, which then creates and sends a payment authorisation request to the merchant acquirer **103** (block **1201**). The payment authorisation request is eventually received by the payment gateway server **506** (block **1202**). The payment authorisation request includes, among other things, the PAN and the discretionary data of the virtual card, as computed by the mobile device **501**.

[0158] After receiving the request, the payment gateway server **506** uses the PAN to find the relevant stored associated data (e.g. Kpan, Certificate, Ksec, funding card identifier, device ID, and other user data). The relevant stored associated data is identified by the precomputed PAN, which acts as an index to search into the server database. In other words, the received PAN is compared with a number of precomputed PANs, and if a match is found with a given precomputed PAN, then the stored data associated with that given precomputed PAN is considered the relevant stored associated data.

[0159] The payment gateway server **506** uses the relevant stored associated data to computes its own discretionary data. This can include using the PIN (received during the user registration process), the stored Ksec, the Certificate ID from the stored Certificate, and an incremented value of the ATC (block **1203**).

[0160] The computation of the payment gateway's own discretionary data uses the following:

$$\text{Discretionary data} = \text{HMAC_SHA256}[\text{Ksec}+\text{PIN}, M] \quad (10)$$

where M=concatenation of (PAN, Certificate ID, (ATC+1))

[0161] The ATC+1 represents the incremented ATC value.

[0162] The payment gateway server **506** determines if its own discretionary data is equal to the received discretionary data (block **1204**). If they are not equal, the payment gateway server further increments ATC by "1" and re-computes its own discretionary data (block **1205**). The process returns to block **1204** to check if the discretionary data sets are equal. The process involving block **1205** can be repeated, such so that each time the ATC value is further incremented by 1. This can be done up to a certain number of times (e.g. 10 times), after which the transaction process will be stopped.

[0163] If the range of ATC values (e.g. between ATC+1 and ATC+10) does not generate an identical discretionary data set, then the verification is unsuccessful. The range is to account for the possibility that the mobile device's ATC counter may have incremented without the payment gateway server's knowledge. Therefore, a buffer or range or ATC values is used.

[0164] If the payment gateway server's own discretionary data is the same as the received discretionary data, then the payment gateway server replaces the previous ATC value with the currently incremented ATC value that is used in the computation of its own discretionary data. In this way, the ATC value stored on the payment gateway server should now be equal to the ATC value stored on the mobile device.

[0165] It is noted that if the PIN used by the mobile device to compute the discretionary data is incorrectly entered by the user (e.g. is not the same as the PIN provided at registration), then the discretionary data from the mobile device will not equal the payment gateway server's own discretionary data. This is because its own discretionary data is computed using the PIN provided at registration. In this way, the PIN provided by the user into the mobile device during each transaction is implicitly verified by the payment gateway server.

[0166] Continuing with FIG. **12**, after the data is successfully verified or not, the payment gateway server eventually respond to the merchant by sending an authorisation response to the merchant (**103**, **502**) (block **1207**). To further clarify, if the discretionary data verification was not successful (as per block **1205** after a certain of iterations has been reached), then a negative payment authorisation response is sent to the merchant (block **1207**).

[0167] The methods and systems described herein do not rely on having a software payment card stored on the secure element on the mobile device to facilitate contactless payment transaction. This is because the PAN, and the other card data elements of the funding card are not stored on in the mobile device. Instead the PAN and expiry date of the funding card is stored on a secure server (e.g. the payment gateway server). Furthermore, the virtual card data is created on a secure server, and is encrypted for a particular mobile device. Furthermore, the discretionary data in the Track Two data is a function of the PIN which re-entered with each payment. The virtual card data is only sent at the time of making the payment, and can only be used once. In addition, only the server can validate the virtual card data. In other words, there is nothing for an adversary to access via brute force on the mobile device without being detected.

[0168] Furthermore, the virtual card encrypted payload is not reusable. This is because as soon as the card is used once, it cannot be used again by any other party.

[0169] It is also noted that, some example embodiments, the one-time virtual card is created just-in-time, ahead of the payment authorization from merchant.

[0170] Furthermore, the funding card details are never provided to the merchant, since the virtual card details are provided instead.

[0171] The methods and systems described herein are fully compatible with standard 4-party card payment model and systems. There is no system change required by the issuer of the funding card, merchant, acquirer or payment network.

[0172] The methods and systems described herein also allow for the use of a "single application" to be used to support one or many virtual cards as well as one or many funding cards. This reduces the required storage on the secure element (and generally storage on the mobile device) so as not to limit the number of cards a customer can load into a secure element.

[0173] It can be appreciated that the methods and systems described herein enable the cardholder (e.g. end user) to register any funding card they want into their NFC-enabled mobile device, independently of the card issuer having the infrastructure or a commercial relationship with a particular mobile operator.

[0174] The methods and systems described herein can be used with any type of funding card. The funding cards and the mobile device are pre-registered with the payment gateway server **506**. This registration is independent of any particular mobile phone carrier and any particular funding card issuer. As a result, no commercial agreement and additional computing infrastructure are required by a mobile phone carrier and a funding card issuer to facilitate contactless payment using a mobile device. This in turn reduces the cost incurred by the funding card issuer to issue software payment cards to mobile devices.

[0175] In an example embodiment, a method performed by a server is provided for facilitating payment. The method includes: receiving a message from a mobile device identifying a funding card; searching a database of multiple cards associated with the mobile device for a funding card number associated with the identified funding card; computing data for a virtual card, the data comprising a card number and an expiry date; storing the data for the virtual card number in association with the funding card number; sending the data for the virtual card to the mobile device; computing the card details using the user PIN as input; receiving a first payment authorisation request from a merchant acquirer, the request comprising the data for the virtual card and a requested payment amount; retrieving the funding card number based on the data for the virtual card; sending a second payment authorisation request to a funding card issuer, the request comprising the funding card number and the requested payment amount; receiving a payment authorisation response from the funding card issuer; and sending the payment authorisation response to the merchant acquirer.

E-Commerce and Internet Based Transactions

[0176] In another example embodiment of the proposed systems and methods, the above described principles of the virtual card is also applied to e-commerce or Internet-based transactions. In other words, while the above examples include the use of a physical POS terminal device **502** that interacts with the mobile device **501**, the e-commerce or Internet-based transactions do not use the POS terminal device **502**. A mobile device **501** can instead communicate with the merchant acquirer **103** or the payment gateway server **506** (e.g. via an e-commerce webpage or payment application). In other word, to execute a transaction, the mobile device sends the virtual card data to the merchant acquirer **103** or the payment gateway server **506** (e.g. via an e-commerce webpage or payment application) using Internet connection.

[0177] For example, the above operations involving the POS terminal device **502** can be performed, but using an e-commerce webpage or payment application instead of the POS terminal device **502**. As shown in FIG. **13**, a schematic diagram view of the entities involved in an example embodiment of a payment transaction using a virtual card to facilitate a payment is provided, which is similar to FIG. **5**. However, unlike FIG. **5**, which shows a POS terminal device **502**, in FIG. **13**, an Internet and e-commerce interface **1301** is shown interacting with the mobile device **501** and the merchant acquirer **103**. In another example embodiment, in addition, or in the alternative, the mobile device **501** interacts with the payment network **504** directly through the Internet and e-commerce interface as shown by connection **1302**. It is appreciated that the mobile device **501** does not require an NFC subsystem **609** to perform transactions using the Internet and e-commerce interface **1301**. In other words, the mobile device **501** may or may not have the NFC subsystem **609**, without affecting the storage and retrieval of information on the secure element **622**, and without affecting an Internet or e-commerce transaction. The mobile device connects to the Internet and e-commerce interface **1301** through a webpage that can be viewed through an Internet browser application **619** on the mobile device. In another example embodiment, the mobile device connects to the Internet and e-commerce interface **1301** through a payment application GUI.

[0178] In general, the above examples described with respect to FIGS. **7**, **8**, **9***a*, **9***b*, **10**, **11** and **12** are also used for e-commerce transactions, but with the POS terminal **502** replaced with the Internet and e-commerce interface **1301** as per FIG. **13**.

[0179] An example graphical user interface (GUI) **1401** as displayed by an e-commerce webpage or payment application GUI is shown in FIG. **14**. This is displayed by the mobile device **501**, for example, when a user has selected a product, an item, or a service to purchase. The transaction details **1402** are shown, which include, for example, the amount to be paid by the user and the name of the user. Other information, for example, the product ID or user ID may be shown. The funding card information **1403** is also shown and, in the case of a credit card, may show the last four digits of the funding card **1404**. In an example embodiment, a default funding card is displayed, but a different funding card can be selected using the control **1407**. In the example of FIG. **14**, the mobile device **501** will make a payment using a virtual card associated with the Visa funding card ending in the digits '4242' (**1404**). In another example embodiment, the last four digits are not displayed to prevent attackers from viewing this information.

[0180] When the GUI **1401** is displayed, to complete the transaction, the user enters in a PIN into the field **1405** and selects the "pay now" button **1406**. When the GUI **1401** detects these events, the mobile device **501** sends virtual funding card data to the merchant acquirer **103** or the payment gateway server **506**, via the Internet and e-commerce interface **1301**.

[0181] In another example embodiment GUI (not shown), the "pay now" button **1406** is not displayed. For example, the GUI is able to detect the length of how many characters were entered into the entry field **1405**. After the GUI detects that the required number of characters have been entered in the entry field **1405**, the PIN is automatically submitted.

[0182] In an example embodiment, the PIN is the card verification value (CVV), card security value (CSV), card security code (CSC), card code verification (CCV), card verification code (CVC or CVC2), etc., of the funding card and this value is determined by the funding card issuer **104**. In another example embodiment, the PIN is determined by the user. In another example embodiment, the PIN is a password. In another example embodiment, the PIN is a password used by the system "Verified by Visa", which is a supplemental verification.

[0183] In another example embodiment, as shown in FIG. **15**, another example GUI **1501** is provided and it displays

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transaction details **1402**, funding card information **1403**, and a "pay now" button **1406**. In other words, when the GUI **1501** is displayed, the user only needs to select the "pay now" button **1406** to execute the transaction. This will cause the mobile device **501** to send virtual funding card data to the merchant acquirer **103** or the payment gateway server **506**, via the Internet and e-commerce interface **1301**. It is appreciated that a PIN is not required using the GUI of FIG. **15**.

[0184] Turning to FIG. **16**, an example set of processor implemented instructions are provided for making a payment using an Internet and e-commerce interface **1301**. FIG. **16** is similar to FIG. **7**, so similar operations are not repeated in detail. At block **1601**, the Internet and e-commerce interface invokes the mobile device to display data on an e-commerce GUI (e.g. **1401** and **1501**). The mobile device **501** displays the e-commerce GUI at block **1602**. Optionally, though not necessarily, blocks **703** and **704** are performed by the mobile device **501**. Furthermore, the mobile device, via the e-commerce GUI, optionally shows pre-registered funding cards at block **706**, and the user selects a funding card **707**. In other embodiments, there is only one funding card, or there is a default funding card that is used, unless changed by the user. The operations at blocks **708**, **709**, **710**, and **711** are performed. As described above, in some example embodiments, a previously computed virtual card can be used and so, a new virtual card does not need to be computed for each and every transaction.

[0185] Continuing with FIG. **16**, in an example embodiment, the e-commerce GUI requests PIN authentication (block **712**) and the user provides the PIN (**713**). However, in other embodiments, providing the PIN is not required. The operations in blocks **714** and **715** are also performed. However, in other embodiments, if the previously computed virtual card is being used, the blocks **714** and **715** are not performed.

[0186] In an example embodiment, the user inputs a command, via the e-commerce GUI, to execute the transaction (block **1603**). For example, the user can select the "pay now" button **1406**, or provide some other input that is understood to execute the transaction.

[0187] The mobile device sends the virtual card data to the Internet and e-commerce interface (block **1604**), and the Internet and e-commerce interface sends the same to the merchant acquirer **103** or payment gateway server **506** (see FIG. **17**). When transaction is complete (either accepted or denied), a confirmation message is sent via the Internet and e-commerce interface to the mobile device (block **1605**). Block **722** may then be performed.

[0188] FIG. **17** shows example processor implemented instructions, which is a continuation from FIG. **16**. Blocks **1601**, **1603** and **1604** are included to show context, and were implemented in previous FIG. **16**. FIG. **17** is similar to FIG. **8**, but instead includes the Internet and e-commerce interface **1301**. The operations of blocks **801**, **802**, **803**, **804**, **805**, **806**, **807**, **808** and **809**, apply to FIG. **17** and are not described in detail again, since these blocks were described in detail with respect to FIG. **8**.

Party-to-Party Value Transfer

[0189] In other example embodiments of the proposed systems and methods, the following relates generally to facilitating a party-to-party value transfer using a virtual card on a mobile device.

[0190] Mobile devices can be used to transfer value, for example, between two persons. A mobile device can be equipped with a near field communication (NFC) system which can be used to transfer payment credentials, such as payment card information, to another mobile device that is also equipped with a NFC system.

[0191] It is recognized that, it is difficult to transfer money from one person's mobile device to another person's device, or more generally, from one party to another party using mobile devices. In many cases, mobile phone carriers and funding card issuers do not have computing systems to support the transfer of money from one mobile device to another mobile device, or it is cost prohibitive to the parties. It is also recognized that it is difficult to transfer money between mobile devices in a secure manner, while still maintaining convenience.

[0192] It is also recognized that there are situations in which a sending user wishes to transfer value to a receiving user, but the sending user does not know or trust the receiving user. For example, a sending user owes money to a receiving user, but does not know or trust the receiving user. Transferring value (e.g. money) using a funding card to the receiving user, without providing any data or information about the funding card, can be difficult. Furthermore, doing so in a quick and convenient way also makes the transfer of value difficult.

[0193] It is also recognized that there are situations in which the receiving user does not have a bank account. In other words, the receiving user does not have an established account to receive and store the value (or funds) from the sending user. Therefore, in many cases, the receiving user cannot accept or receive the value (or funds) from the sending user.

Transferring Value Party-to-Party Using a Transfer ID

[0194] The methods and systems described herein allows a sender (e.g. a first person) to send value, for example, money, to a receiver (e.g. a second person). In particular, the sender's NFC-enabled mobile device is "tapped" against the receiver's NFC-enabled mobile device, and the transfer of value occurs. The transferred value is stored in association with the receiver's mobile device as a prepaid virtual card. The receiver can then use their NFC-enabled phone to make payments with the prepaid virtual card, either via NFC (e.g. with a merchant's NFC-enabled point of sale terminal) or via the Internet (e.g. m-commerce or e-commerce).

[0195] As an alternate example embodiment, instead of sending a virtual card, the payment gateway server **506** sends a transfer ID to the giving user to be shared with the receiving user. The transfer ID is used by the payment gateway server to identify the selected funding card and amount specified by the sending user. In other words, the transfer ID is considered a pointer that points to the information stored on the payment gateway server to identify the selected funding card and amount specified by the sending user. Non-limiting examples of a transfer ID can be numerals, a collection of characters (including numerals), and a URL.

[0196] The systems and methods described herein also allow a cloud-based wallet payment gateway server to synchronize with a receiver's NFC-enabled mobile device and application to facilitate contactless transfers of value from a sender's NFC enabled mobile device. A sender user selects a funding card and provides the amount for making the contactless party-to-party value transfer, through their mobile

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device. A transfer ID is generated by the payment gateway server to complete the party-to-party payment transaction. The transfer ID is used by the payment gateway server to identify the selected funding card and the amount to be transferred by the sending user. On the payment gateway server, the transfer ID is temporarily associated with the funding card and the allowed amount of value to be transferred.

[0197] When a party-to-party value transfer is initiated, the data including the transfer ID data is sent through the NFC system on the sender's mobile device to the receiver's NFC-enabled mobile device. This information is sent from the receiver's mobile device to the cloud-based wallet payment gateway server (also referred to the "payment gateway server"). The cloud-based wallet payment gateway server verifies the transfer ID. If successfully verified, the sending user's funding card details associated with the transfer ID are retrieved and sent to the funding card issuer server via the payment gateway server to complete the value transfer authorisation. The funding card issuer server verifies the funding card and sends back an authorization code to the payment gateway server. The payment gateway server then acts as a virtual card issuer server and generates a prepaid virtual card for the receiver user, which can be used by the receiver's mobile device.

[0198] The value transfer for the prepaid virtual card can be settled when the payment gateway server initiates a settlement request, typically once at the end of every business day, using the standard method. This includes retrieving all the funding card numbers and the corresponding authorization codes received during the period and sending this information to the funding card issuer for settlement. The funding card issuer verifies the funding card numbers and authorisation codes, and if successfully verified, sends the money back to the bank account associated with the payment gateway server via a standard electronic funds transfer method. The money is stored in association with the prepaid virtual card account. In an example embodiment, the virtual card issuer is the payment gateway server, or a module within the payment gateway server.

[0199] In another example embodiment, before the sender's mobile device sends the transfer ID to the receiver's mobile device, the sender's mobile device requests authorisation to the funding card issuer via the payment gateway server. After authorisation is completed a transfer ID is created and then sent to the receiver's mobile device. The receiver's mobile device verifies the transfer ID with the payment gateway server. The payment gateway server then performs a settlement request associated with the authorization request from the transfer ID. The payment gateway server then generates a prepaid virtual card for the receiver user, which can be used by the receiver's mobile device.

[0200] In another example embodiment, before the sender's mobile device sends the transfer ID to the receiver's mobile device, both the authorisation and the settlement occur. After the funding card issuer server completes the authorisation, and after the settlement for the value transfer has been performed and a prepaid virtual card has been created, then the transfer ID is transferred to the receiver's mobile device.

[0201] In an example embodiment, the systems and methods described herein allow an NFC-enabled device with the party-to-party transfer application to transfer a user-defined amount of value to another NFC-enabled device, also having the party-to-party transfer application, without ever disclosing the sender's funding card details to the receiver. Furthermore, the sender is able to set or determine the value to give to the receiver. A successful transfer results in the receiving user being issued a prepaid virtual card for the same amount of value as sent by the sending user. Therefore, even if the receiving user does not have a bank account to receive the value, the receiving user can still be given a prepaid virtual card which can be used by the receiving user to make payments and transactions.

[0202] It can be appreciated that any funding card can be used, and is not limited or dependent on the mobile phone carrier having agreement with the funding card issuer. For a card to be used, it first needs to be registered with the service. It can also be appreciated that any number of funding cards can be registered in association with the mobile device. The cardholder's mobile device includes a payment application (also called value transfer application) that can interact with the payment gateway server.

[0203] In an example embodiment of the registration, for each funding card the sending user wishes to register, the user types in card details into the mobile device (e.g. the name printed on the funding card, the PAN printed on the funding card, the expiry date printed on the funding card, and the static security code printed on the funding card). As mentioned above, funding card issuer does not need to have an existing agreement with any mobile phone carrier. The mobile device sends this data and a mobile device ID to the payment gateway server. The payment gateway server computes a funding card identifier which identifies the given funding card. The payment gateway server stores the funding card identifier in association with the funding card details, and it sends the funding card identifier to the mobile device for storage. In another example embodiment, the user simply taps a taps a contactless card on the mobile device so that the mobile application can capture the card details and send it to the payment gateway server for registration. In an example embodiment, the funding card identifier is a value that is different from the PAN, expiry date or static security code of the funding card. For example, the funding card identifier is a random value so that, if intercepted by an adversary, would not be able to recognize any funding card details. In an example embodiment, the mobile device does not store any funding card details or stores limited funding card details (e.g. the name funding card issuer and the last 4 digits of the PAN). The mobile device stores the funding card identifier, which it sends to the payment gateway server to indicate a specific funding card. It can be appreciated that there are other methods to capture the funding credit card details (e.g. besides the user typing in the data), which can be used with the principles described herein.

[0204] It can be appreciated that a single payment application is required on the mobile device, which can manage multiple funding cards. If multiple funding cards are registered, each of the associated funding card identifiers are stored on the mobile device, within the single payment application. The details of each individual funding card are stored on the payment gateway server. In this way, the payment gateway server acts as a cloud-based server that stores the details of multiple funding cards.

[0205] Turning to FIG. **18**, an example of computer executable or processor implemented instructions are provided for facilitating a transfer of value from a sending user **101** to a receiving user **1807**. At block **1801**, the sending user specifies a funding card and an amount to transfer to the receiving user.

At block **1802**, the sending user receives, from the payment gateway server, a transfer ID that is based on the amount and the funding card. At block **1803**, the sending user sends the transfer ID to the receiving user. At block **1804**, the receiving user validates the transfer ID and the amount, for example, through the payment gateway server. At block **1805**, if valid, the receiving user is issued a prepaid virtual card for the amount specified by the sending user.

[0206] With respect to block **1803**, although many of the example embodiments described herein use NFC technology to transmit data between the mobile devices, it can be appreciated that other data transmission methods can be used. For example, the transfer ID can be sent to the receiving user's mobile device via Bluetooth, infrared, and other peer-to-peer (P2P) communication technologies. In other example embodiments, the transfer ID may be transmitted through other means that may not necessarily be P2P, including instant messaging, text messaging, barcodes, 2D barcodes, QR code, email, etc. In an example embodiment, additional data or alternative data is transmitted from the sending user's mobile device to the receiving user's mobile device in order to facilitate the transfer of value, resulting in a prepaid virtual card available for use by the receiving user. In an example embodiment, the transfer ID is securely transmitted, for example, when it is transferred between any of the server, the sending user's mobile device, and the receiver' user's mobile device.

[0207] Turning to FIG. **19**, example embodiment components of a system for facilitating a party-to-party transfer of funds is shown using the transfer ID. The sending user **101** is shown. The user has one or more funding cards **505**. For example, the user has multiple funding cards. The user **101** also owns an NFC-enabled mobile device **501**, which includes a payment application (also called a value transfer application). The sender's mobile device **1901** is configured to interact, via NFC, with the receiver's NFC-enabled mobile device **1901**. It is appreciated that the receiver's mobile device **1901** may have similar hardware and software components to the sender's mobile device, as shown in FIG. **6**. Both the sender's mobile device **501** and the receiver's mobile device **1901** interact with the payment gateway sever **506**. The payment gateway server **506** is also in data communication with a funding card issuing server **104**.

[0208] The payment gateway server **506** stores data components specific to the sending user (block **1903**) and data components specific to the receiving user (block **1902**). For example, data components specific to the sending user (block **1903**) include registered data associations **1904** that associate one or more funding cards with the sender's mobile device ID. For example, funding card1 and funding card2 (and other funding cards) are stored in association with the mobile device ID of the sender's mobile device **501**. There are also temporary data associations **1905**, which includes a transfer ID **1907** being temporarily associated with one of the user's funding cards **1906**. The transfer ID **1907** can be used by the sending user **101** to make a party-to-party value transfer.

[0209] The data components related to the receiving user (block **1902**) include registered data associations **1908** that specify zero or more funding cards are associated with the receiver's mobile device ID. For example, the funding cards associated with the receiver's mobile device ID can include two funding cards and the prepaid virtual card **1909** issued by the payment gateway server **506**. It can be appreciated that the prepaid virtual card **1909** for the receiving user **1807** can be used to make a payment to a merchant or to yet another party-to-party value transfer to another user.

[0210] The payment gateway server **506** is in communication with the mobile devices **501**, **1901** through a wireless network. For example, the wireless network is provided by a mobile phone carrier. The payment gateway server **506** is in data communication with the funding card issuing server **104** through wired or wireless means, or both.

[0211] Turning to FIGS. **20**, **21** and **22**, a sending mobile device **501** and a receiving mobile device **1901** are shown interacting with each other when sending funds via NFC.

[0212] Turning to FIG. **20**, the receiver's mobile device **1901** shows an example embodiment of a graphical user interface (GUI) that allows a user to send or receive funds. Although not shown, the sender's mobile device **501** could have displayed a similar GUI and then, based on a user selection to send funds, the mobile device **501** is placed in a mode to send funds. In "send funds" mode, the sender's mobile device **501** shows a GUI for facilitating the sending of funds. The GUI displayed in FIG. **20** on the sender's mobile device **501** is an example embodiment of such a GUI for facilitating the sending of funds.

[0213] Continuing with FIG. **20**, the GUI on the sender's mobile device **501** includes an input field **2001** that allows the sender to specify how much money to send in a party-to-party transfer. For example, $100 can be specified. It also includes a menu of funding cards that can be selected to make the party-to-party transfer. There is an option, for example, to use the Visa credit card from CIBC (e.g. a name of a first issuing bank) **2002**; there is another option to use the Mastercard credit card from the Bank of Montreal or BMO (e.g. a name of a second issuing bank) **2003**. The user selects **2004** the Visa credit card **2002** as the funding card.

[0214] The receiver's mobile device **1901** also has a payment application that displays a GUI with a control to receive funds **2006** and a control to send funds **2005**. The receiving user provides a selection input **2007**, by selecting the control **2006**, which places the mobile device **1091** in a mode to receive funds.

[0215] Turning to FIG. **21**, after the required information has been entered into the payment applications of the respective mobile devices **501**, **1901**, the funds are ready to be transferred. The sender's mobile device **501** displays a message to "Tap phones to send funds of $100 using CIBC Visa". The receiver's mobile device **1901** displays a message to "Tap phones to receive funds". At this stage, the two mobile devices **501**, **1901** are placed close enough together (e.g. tapped) to allow the successful transfer of data via NFC.

[0216] Turning to FIG. **22**, after the money has transferred from the sender to the receiver, the sender's mobile device **501** displays a message that "You have sent $100 to Bob (647-667-1234)". The message, for example, includes the amount transferred, the name of the receiving user, and a phone number of the receiver's mobile device. The receiver's mobile device **1901** displays a message that "You have received a pre-paid virtual card of $100 from Alice (416-333-4321)". The message, for example, includes the amount received, the name of the sending user, and a phone number of the sender's mobile device.

[0217] Turning to FIG. **23**, example computer executable or processor implemented instructions are provided for facilitating a party-to-party transfer of funds between a sending user and a receiving user.

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[0218] In an example embodiment, it is assumed that both the sending and the receiving users each have a NFC-enabled device. It is also assumed that both mobile devices have installed a payment application. It is also assumed that both users have registered their mobile devices with a payment gateway server. It is also assumed that the sending user has also pre-registered one or more funding cards with the payment gateway server, which are each identified by a funding card identifier. In other words, the payment gateway server has funding card details stored in association with the sender's mobile device ID.

[0219] The sending user **101** starts the payment application **620** on their mobile device **501** (block **2301**). The payment application **620** determines if the user has successfully registered to the service (block **2302**), and if so, an application menu is shown, and displays the option to give using the payment application (block **2303**). The user **101** selects the option to give money using the payment application. It is noted that various user experiences can be used with the principles described herein.

[0220] For example, a GUI on the menu is able to receive an input from the user to initiate a party-to-party transfer of funds with a virtual card with the payment application. Examples of other menu items include "add a funding card", "delete a funding card", etc.

[0221] The mobile device **501** then displays the funding cards that have been pre-registered by the user (block **2305**). A user input is received to specify an amount to be transferred (e.g. given) and an input is received to select one of the funding cards (block **2306**). In an example embodiment, the displayed funding card information is loaded after the end user successfully registers to the service and has registered at least one funding card. The list is updated when the user adds an additional funding card into the payment application or when a funding card is deleted. For each registered funding card, there is a corresponding record stored on the payment application **620** and on the payment gateway server database **506** which includes an identifier for the payment network associated with the funding card, a funding card identifier, etc.

[0222] The payment application **620** sends the mobile device identifier to the payment gateway server **506** for device authentication (block **2307**). The payment application **620** also sends the transaction type (selected action in the application menu, in this case, "Make a party-to-party transfer"), the amount to be transferred (e.g. given) and the funding card identifier for the selected funding card to the payment gateway server **506** (block **2308**). The payment gateway server **506** stores the information sent by mobile device **501**, and it also computes the details regarding a transfer ID (block **2309**). The transfer ID is associated with the funding card and the specified amount. An expiry date may also be associated with the transfer ID, such that the transfer ID is no longer valid after a certain period of time. For example, after a few minutes, or a few hours, or a day, or some other time period starting from the creation of the transfer ID, the transfer ID is no longer valid. In other words, if the sending user is to transfer value to the receiving user, it is to be done before the time period expires. The payment gateway server **506** sends the transfer ID to the sending user's mobile device **501** (block **2310**). In an example embodiment, the transfer ID is encrypted and is able to be decrypted by the sending user's mobile device application **620**.

[0223] As an alternate example embodiment, instead of the payment gateway server **506** sending the transfer ID to the mobile device, the payment gateway server **506** instead sends a key value that the mobile device can use to generate an identical transfer ID as generated by the payment gateway server **506**. Sending a key value may be safer, should an attacker intercept the key value. It is appreciated that the mobile device **501** eventually obtains the transfer ID.

[0224] The mobile's payment application **620** then displays a message requesting the user to the tap the sender's mobile device **501** with the receiver's mobile device **1901** (block **2311**). The sending user **101** tells the receiving user **1807** to get ready to receive the funds, for example, by "tapping" mobile devices together (block **2312**). In other example embodiments, in addition to or in the alternative, the sending user sends the transfer ID to the receiving user through other communication means, including Bluetooth, infrared, email, instant messaging, text messaging, and other wireless and wired means.

[0225] In an example embodiment, before transferring the transfer ID to the payment application **620** on the mobile device **501** displays a GUI requesting the sending user to input their PIN (e.g. which should be the same PIN provided when the sending user registered for the service). In an example embodiment, the PIN is verified first. In another example embodiment, the payment gateway server **506** instead sends a key value to generate a transfer ID, the PIN provided again by the sending user is used with the key value to generate a transfer ID. If the PIN provided by the sending user is correct, then the transfer ID generated by the mobile device **501** should be identical to the transfer ID generated by the payment gateway server **506**.

[0226] Turning to FIG. **24**, after the sending user tells the receiving user to get ready, the receiving user starts the payment application on the receiver's mobile device **1901** (block **2401**). The receiver's mobile device **1901** determines if the user has successfully registered to the service (block **2402**), and if so, shows a menu (block **2403**). The receiving user provides an input to initiate the party-to-party receipt of funds using the payment application (block **2404**). Then both the receiving user **1807** and the sending user **101** tap their mobile devices **501**, **1901** together (blocks **2405** and **2406**).

[0227] This tapping (or more specifically the close proximity of the mobile devices) triggers the sender's mobile device **501** to send the transfer ID, via NFC (block **2407**). In another example embodiment, the transfer ID is transferred to the receiver's mobile device **1901** though other ways (e.g. barcodes, 2D barcodes, QR code, messaging, email, etc.). In an example embodiment, the transfer ID is sent from the mobile device's secure element **622**. In another example embodiment, the sending of the transfer ID does not involve the mobile device's secure element **622**.

[0228] Continuing with FIG. **24**, after the receiver's mobile device **1901** receives the transfer ID from the sender's mobile device **501**, the mobile device **1901** sends the same to the payment gateway server **506** (block **2408**). The payment gateway **506** validates the transfer ID (block **2409**), and if the transfer ID is successfully validated, then the payment gateway server **506** retrieves the sending user's funding card details and the specified amount associated with the transfer ID (block **2410**).

[0229] To validate the transfer ID, the payment gateway server may confirm if the transfer ID itself is correct (e.g. it matches a transfer ID stored on the payment gateway server).

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It may also check to see if the transfer ID has expired, and if so, will decline the transfer. It may also check to see if the transfer ID has been previously used, and if so, will decline the transfer.

[0230] The payment gateway server **506** then generates a value transfer payment authorisation request, which includes the funding card details and the amount to be transferred to the receiving user **1807** (block **2411**). Although not shown, the payment gateway server **506** then sends this standard payment authorisation request to the funding card issuing server **104**. The funding card issuing server **104** verifies the payment authorisation request (e.g. verifies enough funds are available, verifies funding card data, etc.) and provides a payment authorisation response to the payment gateway server **506**. The response indicates if the value transfer is accepted or denied.

[0231] Assuming the payment using the funding card is accepted, the payment gateway server **506** marks the transfer ID as used (block **2412**). It is noted that the transfer ID is a one-time use. In other words, when the sender wishes to make another party-to-party transfer, a new (e.g. different) transfer ID will be created for the other party-to-party transfer, even if the same funding card and amount are being used. In this way, there is increased security, and the receiving user will never obtain the details of the sending user's funding card.

[0232] The payment gateway server **506** computes a prepaid virtual card to be issued to the receiving user, and the details associated therewith (block **2413**). The prepaid virtual card is stored in association with the receiver's mobile device ID. The transferred amount of money (from the sending user) is the amount of money associated (e.g. available) on the prepaid virtual card. The payment gateway server **506** then sends details about the prepaid virtual card (e.g. a prepaid virtual card identifier) to the receiver's mobile device (block **2414**).

[0233] In particular, the payment gateway server computes a prepaid virtual card identifier which identifies the prepaid virtual card account. The payment gateway server stores the prepaid virtual card identifier in association with the prepaid virtual card details, and it sends the prepaid virtual card identifier to the receiving user's mobile device for storage. In an example embodiment, the prepaid virtual card identifier is a value that is different from the PAN, expiry date or static security code of the prepaid virtual card. For example, the prepaid virtual card identifier is a random value so that, if intercepted by an adversary, would not be able to recognize any prepaid virtual card details. In an example embodiment, the receiving user's mobile device does not store any prepaid virtual card details or stores limited prepaid virtual card details (e.g. the name of the prepaid virtual card issuer and the last 4 digits of the PAN). In an example embodiment, the receiving user's mobile device stores at least the prepaid virtual card identifier, which it sends to the payment gateway server to indicate the associated prepaid virtual card.

[0234] After receipt of the prepaid virtual card identifier, the receiver's mobile device stores this information (block **2415**) and displays a message to the receiving user that the new prepaid virtual card is available (block **2416**).

[0235] The payment gateway server **506** may also send a confirmation message to the sender's mobile device **501** indicating that the new prepaid virtual card has been issued to the receiver (block **2417**).

[0236] After the receiver **1807** has the prepaid virtual card, the receiver can use the prepaid virtual card to make a purchase with a merchant.

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[0237] In another example embodiment, instead of using a transfer ID, a virtual card is sent, instead of the transfer ID, to facilitate the transfer of value from the sending user to the receiving user. The virtual card is associated with the funding card. When using the virtual card, the receiving user is not able to obtain information about the sending user's funding card. This increases the security. The results of the transfer is that the receiving user has a prepaid virtual card that can be used for payment or another party-to-party transfer. The virtual card is sometimes referred to in the Figures as "Vcard".

[0238] By way of background, the secure element is typically managed by a mobile phone carrier distributing the secure element with the mobile device. It is used in part to maintain the security of the various applications running inside the secure element. Part of the managed service includes delivering applications into the secure element directly, or giving permission to a third party organization to deploy their application on a particular secure element. The managed service is typically delivered using what the industry referred to as a trusted service manager (TSM).

[0239] All applications stored and running inside the secure element, such as the individual "software payment card", need their storage own space. Payment cards are issued to consumers by the card issuer. Deploying software payment cards on mobile phones requires a high level of coordination between the mobile phone carrier and the card issuer where the mobile phone carrier provides access to individual secure elements, one at a time, to the issuer. Only cards from funding card issuers that have the infrastructure and the agreement with the mobile phone carrier can be delivered and used on the mobile phone for contactless payment. This is limiting for both the card issuers and for cardholders.

[0240] It is also recognized that from the user's perspective, the process of associating their mobile device with their funding card to be used for contactless payment is very much dependent on pre-arranged relationships between the mobile phone carrier and the card issuers. Therefore, a user has limited options or no options when determining if their current funding card can be associated with their mobile phone for contactless payments. For example, a user has a funding card from Funding Card Issuer A. The user also has a NFC-enabled mobile phone from Mobile Phone Carrier B. However, Mobile Phone Carrier B only has a pre-arranged agreement and infrastructure to facilitate contactless payments with Funding Card Issuer B. Therefore, even if the user wanted to use their mobile phone to make a contactless payment, the user would not be able to because there is no pre-arranged agreement and infrastructure between Mobile Phone Carrier B and Funding Card Issuer A to issue a software payment card into the user's phone. This limits the user's ability to make NFC-type payments with their mobile device.

[0241] In another example embodiment, the payment card dynamic data is a rotating card verification value (CVV, also referred sometime to dynamic CVV or dCVV). This rotating CVV is computable based on changing information provided by the integrated circuit inside the card. In another example embodiment, the dynamic data is dynamic EMV data which is computed using random data from the funding card or

random data from a merchant's point of sale terminal, or both. A common implementation of dynamic data uses an Application Transaction Counter (ATC) on the card so that every transaction produces a different data stream. This is achieved as the ATC is incremented by 1 for every transaction performed.

[0242] It is also recognized that a card application specific to a given funding card can be installed on the mobile device and used to interact with POS terminal as described above. It is also recognized that the card application is typically installed on the mobile device's secure element. Typically, each funding card has its own corresponding card application that resides on the mobile device's secure element. It can be appreciated that as each card application takes up storage space on the secure element, and that the secure element typically has very limited storage space, having multiple card applications on the secure element is some cases is not possible due to insufficient storage space. By way of background, the secure element can have a native operating system that is programmed to perform various tasks and activities, including for example, a card application that emulates the magnetic strip data of a funding card or a card application that emulates the data used in an EMV contactless payment. Also by way of background, and by way of example, a typical secure element has memory of 256 kB, and each card application can consume memory of 40-80 kB. It can therefore be appreciated that associating multiple funding cards (and each of their card applications) with a mobile device for NFC payments can be limiting.

[0243] Therefore, it is desirable to reduce the amount of required storage space card applications need on the secure element so as to not limit the number of software payment cards a user can load into a secure element. Along the same lines, it is desirable for mobile phone carriers to reduce the amount of data used by "card application" on the secure element so that other types of applications can be loaded thereon. It is also desirable to reduce costs incurred by the funding card issuer to issue and operate software payment cards into secure elements. By way of background, a mobile phone carrier typically charges application providers, such as funding card issuers, for the amount of storage space used on the secure element. It is also desirable to reduce the amount of infrastructure required by the funding card issuer to issue a software payment card for the mobile phone. It is also desirable to reduce the amount of coordination required between the funding card issuer and the mobile phone carrier to issue a software payment card on particular mobile phone. It is also desirable to enable the user (e.g. the cardholder) to load any, and as many, funding cards they want into their NFC-enabled mobile phone, independently of the funding card issuer having the infrastructure or a commercial relationship or agreement with a particular mobile phone carrier. It is also desirable to enable the user (e.g. the cardholder) to load any, and as many, funding cards they want into their NFC-enabled mobile phone, independently of the funding card issuer having the infrastructure or a commercial relationship or agreement with a particular mobile phone carrier. It is also desirable to facilitate the transfer of money between two users in a party-to-party manner using their NFC-enabled mobile devices.

[0244] The systems and methods described herein also allow a cloud-based wallet payment gateway server to synchronize with a receiver's NFC-enabled mobile device and application to facilitate contactless transfers of value from a sender's NFC enabled mobile device. A sender user selects a funding card and provides the amount for making the contactless party-to-party value transfer, through their mobile device. A second card, herein referred to as a virtual card, is generated along with all required card data (e.g. PAN, expiry date, dynamic data, discretionary data, etc) to facilitate the party-to-party payment transaction. On the payment gateway server, the virtual card is temporarily associated with the funding card and the allowed amount of value to be transferred. The sending user sends the virtual card data and the amount to be transferred to the receiving user (e.g. via NFC or other communication means). The receiving user sends this data to the payment gateway server, and validates the virtual card data. If validated, the payment gateway server retrieves the funding card details and uses the same to transfer the specified amount from the funding card to a new prepaid virtual card. The prepaid virtual card can be used by the receiving user to make payments, transactions, party-to-party transfers, etc.

[0245] Turning to FIG. **25**, example embodiment components of a system for facilitating a party-to-party transfer of funds is shown using the virtual card. FIG. **25** is similar to FIG. **19**, however it differs in that the temporary data associations **1905** includes a virtual card (e.g. virtual card1) **2501** being temporarily associated with one of the user's funding cards **505**. The virtual card **1101** can be used by the sending user **101** to make a party-to-party value transfer.

[0246] Turning to FIGS. **26** and **27**, example computer executable or processor implemented instructions are provided for facilitating a party-to-party transfer of funds between a sending user and a receiving user. The examples of FIGS. **26** and **27** are similar to FIGS. **23** and **24**, but use a virtual card instead of a transfer ID. Therefore, similar elements or steps are not repeated in the discussion of FIGS. **26** and **27**.

[0247] It is assumed that the sender's mobile device has undergone a registration process, which includes providing PIN. An example of such a process is described later with respect to FIG. **28**.

[0248] Turning to FIG. **26**, blocks **2301** to **2308** are performed. After receiving request **2308**, based on the information sent by mobile device **501**, the payment gateway server **404** creates and computes the details regarding the virtual card (block **2601**). In particular, the payment gateway server **506** computes a virtual PAN, an expiry date of the virtual card and other data that forms the Track Two data. It is noted that Track Two data includes, among other things: the PAN, a service code, an expiry date, discretionary data and a LRC. In an example embodiment, the payment gateway server **506** at this time does not compute the discretionary data, which is dynamic in nature (e.g. the discretionary data is dynamic data). The virtual card details may further include an internal expiry date that is known only to the payment gateway server, and has a short timeline of about a few days from the date that the virtual card is created. The internal expiry date is different from the virtual card's expiry date, and the function of the internal expiry date is to provide an additional indicator to the payment gateway to determine whether or not a virtual card has expired. The payment gateway server **506** encrypts the virtual card data, which does not include the internal expiry date, and sends the encrypted virtual card payload to the mobile device's payment application **620** (block **2602**).

[0249] As an alternate example embodiment, instead of the payment gateway server **506** sending the virtual card PAN as

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part of the encrypted virtual card payload to the mobile device, the payment gateway server **506** instead sends a key value (called Kpan) that the mobile device can use to generate an identical virtual card PAN as computed by the payment gateway server **506**. This example is described in FIG. **29**.

[0250] In an example embodiment, the first portion of digits of the PAN of the virtual card is static and refers to the payment gateway server **506**. For example, the first six digits point to the payment gateway server **506**; a merchant or payment network, or any other entity, can use this information to send the transaction and payment details to the payment gateway server **506**.

[0251] In an example embodiment, the PAN of the virtual card is nineteen digits long and compliant to the algorithm LUHN-10. The algorithm, also known as the "modulus 10" or "mod 10" algorithm, is a checksum formula used to validate a variety of identification numbers, such as card numbers. As described above, the first six digits are used to identify the payment gateway server. The remaining digits can be computed in a number of ways. In an example embodiment, the remaining digits of the virtual card PAN are randomly generated. In another example embodiment, the remaining digits are computed using the Kpan value; further details in this regard are described with respect to FIG. **29**. Other methods can be used to compute the virtual card PAN. The mobile device **501** receives the encrypted virtual card payload, it decrypts the encrypted communication and extracts the virtual card details (e.g. the virtual card PAN and other card details).

[0252] In another example embodiment, if the virtual card payload includes a Kpan (e.g. a key value) instead of a virtual card PAN, the mobile device **501** uses the Kpan to compute the virtual card PAN.

[0253] Continuing with FIG. **26**, the payment application **620** on the mobile device **501** displays a GUI requesting the sending user to input their PIN (e.g. which should be the same PIN provided when the sending user registered for the service) (block **2603**). The application **620** receives the PIN from the sending user (e.g. the sending user enters in the PIN) (block **2604**). The application **620** uses the PIN to compute the discretionary data of the virtual card (block **2605**). An example embodiment of computing the discretionary data is described below with respect to FIG. **30**. With the discretionary data computed, the Track Two data set is complete. The mobile's payment application **620** then displays a message requesting the user to the tap the sender's mobile device **402** with the receiver's mobile device **1901** (block **2311**). The sending user **101** tells the receiving user **1807** to get ready to receive the funds (block **2312**).

[0254] In an example embodiment, one PIN can be used for all the funding cards associated with the mobile device. In another example embodiment, the registration process can request a specific PIN for each funding card. In other words, if a user selects a different funding card, the user will need to enter in a different PIN.

[0255] In an example embodiment, the mobile device's payment application **620** does not verify the PIN. Instead, the PIN is indirectly or implicitly verified by the payment gateway server **506** when verifying the virtual card data set. In other words, the payment gateway server **506** uses the PIN that was stored at registration time to compute the virtual card data set, and if an incorrect PIN was provided by the user or an adversary during the transaction, it will cause the computed virtual data to result in a different, incorrect, value compared to the virtual card data computed by the payment gateway server. Once the received virtual card data set is compared with the expected value by the payment gateway server, an invalid PIN entry can be detected. When the payment gateway server receives and verifies the virtual card data set and detects an un-expected virtual card data set (e.g. due to the incorrect PIN), then the value transfer authorization can be declined.

[0256] Turning to FIG. **27**, after the sending user tells the receiving user to get ready, the receiving user starts the payment application on the receiver's mobile device **1901** (block **2401**). Blocks **2401** to **2406** are performed, leading to the mobile devices of both users tapping their phone together to transfer data via NFC.

[0257] This tapping (or more specifically the close proximity of the mobile devices) triggers the sender's mobile device **501** to send the authorised amount and Track Two data for the virtual card on the mobile device's secure element **622** (block **2701**). The mobile device **501** configures the Track Two data to emulate a virtual card, and this emulated virtual card data and authorised amount is provided to the mobile device's NFC subsystem **609** (block **2702**). The emulated virtual card data includes the complete Track Two data set. The amount to be transferred and the virtual card data is then transferred, via NFC, to the receiving user's mobile device **1901** (block **2703**). In another example embodiment, though not shown, the operating system of the mobile device **501** can directly transfer information to the NFC subsystem **609** without the use of the secure element. The virtual card data set includes the virtual card PAN, the expiry date, the discretionary data and all other elements in a Track Two data set to complete a standard contactless value transfer.

[0258] Continuing with FIG. **27**, after the receiver's mobile device **1901** receives the virtual card data and authorised amount from the sender's mobile device **501**, the mobile device **1901** sends the same to the payment gateway server **506** (block **2704**). The payment gateway **506** validates the virtual card data and authorised amount (block **2705**), and if the data is successfully validated, then the payment gateway server **506** retrieves the funding card details association with the sender's virtual card (block **2706**).

[0259] To validate the virtual card data received from the sender's mobile device, the payment gateway server computes the Track Two data set on its own. The Track Two data computation includes the payment gateway server computing the discretionary data using the PIN originally received and stored during registration by the sending user. In an example embodiment, some of the Track Two data portions (like the PAN and expiry date) were pre-computed and stored; these pre-computed data portions can be compared against the received Track Two data. If the virtual card data is successfully validated (received card Track Two data set matches computed card Track Two data set by the payment gateway server), then the payment gateway server retrieves the funding card data that is associated with the virtual card data.

[0260] The validation of the virtual card data in block **2705** can also include verifying if the internal expiry date associated with the virtual card has passed or not. If the present date of the validation is occurring before or on the internal expiry date, then the virtual card can be considered validated and the transaction processing can continue. If validated, the payment gateway server **506** retrieves funding card details **2706**. Otherwise, the virtual card is deemed invalid and the value transfer authorisation request is denied.

[0261] When validated, the payment gateway server **506** then generates a value transfer authorisation payment request, which includes the funding card details and the amount to be transferred to the receiving user **1807** (block **2707**). Although not shown, the payment gateway server **506** then sends this standard payment authorisation request to the funding card issuing server **104**. The funding card issuing server **104** verifies the payment authorisation request (e.g. verifies enough funds are available, verifies funding card data, etc.) and provides a payment authorisation response to the payment gateway server **506**. The response indicates if the value transfer is accepted or denied.

[0262] Assuming the payment using the funding card is accepted, the payment gateway server **506** marks the sender's virtual card as being used (block **2708**). It is noted that the virtual card is a one-time use. In other words, when the sender wishes to make another party-to-party transfer, a new (e.g. different) virtual card will be created for the other party-to-party transfer, even if the same funding card and amount are being used. In this way, there is increased security, and the receiving user will never obtain the details of the sending user's funding card.

[0263] The payment gateway server **506** computes a prepaid virtual card to be issued to the receiving user, and the details associated therewith (block **2709**).

[0264] After generating the prepaid virtual card, block **2414**, **2415**, **2416** and **2417** are performed. These were previously described with respect to FIG. **24**.

[0265] Turning to FIG. **28**, an example embodiment of computer executable or processor implemented instructions are provided for registering a funding card and mobile device with payment gateway server. Such an embodiment can be used in combination with the principles described above. The sender's mobile device sends a registration request to the payment gateway server (block **2801**). The request includes the mobile device's device ID, a user provided PIN, and funding card details. After receiving the request, the payment gateway server sends a registration response to the sender's mobile device (block **2802**). The response include a certificate, an Application Transaction Counter (ATC), a key value (called Kpan) for generating a PAN, a secure element key value (called Ksec), and a funding card identifier that identifies the funding card. The certificate is a client certificate for the sender's mobile device and, in an example embodiment, it is configured to according to the RSA algorithm and has a 2048 bit length. The ATC is a counter that is initially set to a random value between "0" or "1000" and increments with each transaction. The initialized ATC value is a random value to prevent adversaries from predicting the ATC values. Copies of the ATC are stored and synchronise on both the payment gateway server and the mobile device. In an example embodiment, the ATC is a 10 digit value. In an example embodiment, the Kpan is 128 bits long, and the Ksec is 128 bits long.

[0266] The payment gateway server **404** stores the data from the registration request and the registration response in association with each other (block **2803**). The sender's mobile device **402** also stores the data from the registration response (block **2804**).

[0267] Turning to FIG. **29**, an example embodiment of computer executable or processor implemented instructions are provided for computing virtual card data. Such an embodiment can be used in combination with the principles described above for computing virtual card data. The sender's mobile device sends a virtual card request to the payment gateway server (block **2901**). The request includes the device ID, the funding card identifier, the Certificate and the stored Kpan. The stored Kpan can be from registration or from the previous transaction.

[0268] The payment gateway server determines if the received Kpan and Certificate match the Kpan and Certificate stored on the payment gateway server (block **2902**) associated with the DeviceID stored in the payment gateway server database. If so, then the payment gateway server sends a virtual card response to the sender's mobile device that includes a new Kpan (block **2903**). A new Kpan is used to generate a new or different PAN for each transaction, and to also prevent against replay attacks. The payment gateway server computes the PAN for the virtual card using the new Kpan (block **2904**). This new Kpan and the pre-computed PAN are stored by the payment gateway server for later use (block **2905**).

[0269] After the mobile device receives the new Kpan, it replaces the stored Kpan with the new Kpan (block **2906**). It uses the new Kpan to compute a PAN for the virtual card, in the same way the payment gateway server computed the PAN (block **2907**). If the conditions and data are correct, although the mobile device computes the PAN independently of the payment gateway server, the PAN computed by the mobile device should be identical to the PAN computed by the payment gateway server.

[0270] The mobile device then computes the discretionary data (which is part of the Track Two data) using the PIN, the Ksec, the PAN, the Certificate, and the ATC (block **2908**). The ATC and the PAN keep changing with each transaction, which causes the discretionary data to be dynamic data.

[0271] The mobile device increments the ATC by 1 (block **2909**).

[0272] In particular, the PAN is computed by the mobile device and the payment gateway server according to the following:

$$PAN=BIN(6)+SHA256[Kpan](12)+Luhn(1)$$

wherein

BIN(6) is a 6-digit binary number to identify the payment gateway server;

SHA256[Kpan](12) is a 12-digit number generated by taking the sha256 of the Kpan value, further including converting the sha256 value to decimal and truncating to twelve digits from the hash value;

and

Luhn(1) is a single digit used to ensure the virtual card always passes LUHN algorithm.

[0273] The above values are concatenated together to form the PAN. The symbol "+" in the above computation refers to the concatenation operation.

[0274] The discretionary data is computed using the following:

$$\text{Discretionary data}=HMAC_SHA256[Ksec+PIN,M] \quad (10)$$

where M=concatenation of (PAN, Certificate ID, ATC)

[0275] Truncation is performed by encoding the SHA results in decimal, then taking the left most digits. It can be appreciated that SHA256 is a known cryptographic hash function, and HMAC is a hash based message authentication code involving a cryptographic hash function in combination with a secret cryptographic key. The secret cryptographic key of the HMAC function is the concatenated values of Ksec and

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PIN. The message M is the concatenated values of PAN, Certificate ID and ATC. The Certificate ID is from the Certificate.

[0276] Turning to FIG. **30**, an example embodiment of computer executable or processor implemented instructions are provided for verifying virtual card data, and in particular the verification by the payment gateway server of the discretionary data (e.g. the dynamic data). Such an embodiment can be used in combination with the principles described above for verifying the virtual card data. This can be a continuation of the process described in FIG. **26**.

[0277] The sender's mobile device **501** sends a virtual card to the receiver's mobile device **1901** (block **3001**). The receiver's mobile device **1901** then creates and sends a value transfer authorisation request to the payment gateway server **506** (block **3002**). The value transfer authorisation request includes, among other things, the PAN and the discretionary data of the virtual card, as computed by the sender's mobile device. It also includes the amount of money or funds to be transferred from the sender to the receiver.

[0278] After receiving the request, the payment gateway server **506** uses the PAN to find the relevant stored associated data (e.g. Kpan, Certificate, Ksec, funding card identifier, device ID, and other user data). The relevant stored associated data is identified by the precomputed PAN, which acts as an index. In other words, the received PAN is compared with a number of precomputed PANs, and if a match is found with a given precomputed PAN, then the stored data associated with that given precomputed PAN is considered the relevant stored associated data.

[0279] The payment gateway server **506** uses the relevant stored associated data to computes its own discretionary data. This can include using the PIN (received during the user registration process), the stored Ksec, the Certificate ID from the stored Certificate, and an incremented value of the ATC (block **3003**).

[0280] The computation of the payment gateway's own discretionary data uses the following:

$$\text{Discretionary data} = \text{HMAC_SHA256}[\text{Ksec}+\text{PIN}, M] \quad (10)$$

where M=concatenation of (PAN, Certificate ID, (ATC+1))

[0281] The ATC+1 represents the incremented ATC value.

[0282] The payment gateway server **506** determines if its own discretionary data is equal to the received discretionary data (block **3004**). If they are not equal, the payment gateway server further increments ATC by "1" and re-computes its own discretionary data (block **3005**). The process returns to block **3004** to check if the discretionary data sets are equal. The process involving block **3005** can be repeated, such so that each time the ATC value is further incremented by 1. This can be done up to a certain number of times (e.g. 10 times), after which the transaction process will be stopped.

[0283] If the range of ATC values (e.g. between ATC+1 and ATC+10) does not generate an identical discretionary data set, then the verification is unsuccessful. The range is to account for the possibility that the mobile device's ATC counter may have incremented without the payment gateway server's knowledge. Therefore, a buffer or range or ATC values is used.

[0284] If the payment gateway server's own discretionary data is the same as the received discretionary data, then the payment gateway server replaces the previous ATC value with the currently incremented ATC value that is used in the computation of its own discretionary data (block **3006**). In this way, the ATC value stored on the payment gateway server should now be equal to the ATC value stored on the mobile device. This leads to the authorisation request being accepted and, accordingly, the payment gateway server issues a virtual prepaid card for the receiver's mobile device (block **1607**).

[0285] It is noted that if the PIN used by the mobile device to compute the discretionary data is incorrectly entered by the user (e.g. is not the same as the PIN provided at registration), then the discretionary data from the mobile device will not equal the payment gateway server's own discretionary data. This is because the payment gateway server's own discretionary data is computed using the PIN provided at registration. In this way, the PIN provided by the user into the mobile device during each transaction is implicitly verified by the payment gateway server.

[0286] Continuing with FIG. **30**, after the data is successfully verified or not, the payment gateway server eventually responds to the receiver's mobile device **1901** by sending a response to the receiver's mobile device. The response may indicate that the transfer is declined, or may indicate that a virtual prepaid card has been issued.

[0287] In particular, as per block **3005**, there is an upper limit of iterations that, when reached, means the discretionary data verification is not successful. If the verification is not successful, then a declined transfer response is sent to the receiver's mobile device **1901** (block **3008**). If the verification is successful, as described above, the process to issue a virtual prepaid card is started and delivered to the receiver's mobile device **1901** (block **3007**).

[0288] It can therefore be appreciated that a sending user can transfer value to a receiving user in various ways, including using a transfer ID or a virtual card. The result of successful transfer is that the receiving user has a prepaid virtual card.

[0289] In an example embodiment, after the receiving user receives the prepaid virtual card, the receiving user can use the prepaid virtual card to make a payment with a merchant. For example, the prepaid virtual card can be used to make a payment using a POS terminal **502** or an e-commerce and Internet base interface **1301**.

[0290] The methods and systems described herein can be used with any type of funding card. The sender's funding cards and the mobile device are pre-registered with the payment gateway server **506**. This registration is independent of any particular mobile phone carrier and any particular funding credit card issuer. As a result, no commercial agreement and additional infrastructure are required between a mobile phone carrier and a funding card issuer to facilitate contactless (e.g. NFC) payment using a mobile device. This in turn reduces the cost incurred by the funding card issuer to issue software cards to mobile devices.

[0291] In an example embodiment, a method performed by a server for facilitating a party-to-party value transfer is provided. The method includes: receiving a message from a sender's mobile device to transfer a specified amount using a funding card identifier; searching a database of multiple cards associated with the sender's mobile device for funding card details associated with the funding card identifier and amount; generating a transfer ID and associating the transfer ID with the funding card number and the specified amount; sending the transfer ID to the sender's mobile device; receiving a value transfer authorisation request from a receiver's mobile device, the request comprising the transfer ID; identifying the funding card number and authorised amount based on the transfer ID; sending a payment authorisation request to

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a funding card issuer, the request comprising the funding card number and the specified amount; receiving a payment authorisation response from the funding card issuer; and sending a value transfer authorisation response to the receiver's mobile device.

[0292] In an example aspect, the method further includes: if the value transfer authorisation response is positive, creating a prepaid virtual card associated with the receiver's mobile device and having the specified amount.

[0293] In another example embodiment, a method performed by a server is provided for facilitating a party-to-party value transfer. The method includes: receiving a message from a sender's mobile device identifying a funding card and amount; searching a database of multiple cards associated with the sender's mobile device for funding card details associated with the identified funding card and amount; computing data for a virtual card, the data comprising a card number and an expiry date; storing the data for the virtual card number in association with the funding card number; sending the data for the virtual card to the sender's mobile device; computing the card details using a PIN as input; receiving a value transfer authorisation request from a receiver's mobile device, the request comprising the data for the virtual card and a requested value transfer amount; retrieving the funding card details based on the data for the virtual card and amount; sending a payment authorisation request to a funding card issuer, the request comprising the funding card number and the requested payment amount; receiving a payment authorisation response from the funding card issuer; and sending a value transfer authorisation response to the receiver's mobile device.

[0294] The steps or operations in the flow charts described herein are just for example. There may be many variations to these steps or operations without departing from the spirit of the invention. For instance, the steps may be performed in a differing order, or steps may be added, deleted, or modified.

[0295] While the basic principles of this invention has been herein illustrated along with the example embodiments shown, it will be appreciated by those skilled in the art that variations in the disclosed arrangement, both as to its details and the organization of such details, may be made without departing from the spirit and scope thereof. Accordingly, it is intended that the foregoing disclosure and the showings made in the drawings will be considered only as illustrative of the principles of the invention, and not construed in a limiting sense.

1-3. (canceled)

4. A computer-implemented method comprising:

registering a funding card comprising storing a funding card number;

receiving a message from a mobile device indicating a desire to make a payment using the registered funding card;

computing data for a virtual card, wherein the data for the virtual card comprises a virtual card number that is different than the funding card number;

storing the data for the virtual card in association with the funding card number;

sending information related to the data for the virtual card to the mobile device;

receiving a first payment authorization request from a merchant or a merchant acquirer, the first payment authorization request comprising the data for the virtual card and a requested payment amount;

retrieving the funding card number based on the data for the virtual card;

sending a second payment authorization request to a funding card issuer, the second payment authorization request comprising the funding card number and the requested payment amount;

receiving a payment authorization response from the funding card issuer; and

sending the payment authorization response to the merchant or the merchant acquirer.

5. The computer-implemented method of claim **4** wherein the step of registering a funding card further comprises:

generating a funding card identifier;

storing the funding card identifier in association with the funding card number; and

sending the funding card identifier to the mobile device.

6. The computer-implemented method of claim **5** wherein the step of receiving a message from a mobile device indicating a desire to make a payment using a registered funding card comprises receiving the funding card identifier associated with the registered funding card.

7. The computer-implemented method of claim **4** wherein the step of registering a funding card further comprises storing a PIN associated with the funding card, wherein the data for the virtual card is computed using the PIN with other parameters, wherein the step of sending information related to the data for the virtual card to the mobile device comprises sending the other parameters but not the PIN to the mobile device, and further comprising:

comparing the data for the virtual card received with the first payment authorization request to the computed data for the virtual card; and

sending a notice to the mobile device indicating whether the payment authorization is accepted or denied based on the comparison.

8. The computer-implemented method of claim **4** wherein the step of registering a funding card further comprises storing a funding card expiry date associated with the funding card, and further comprising:

sending a notice to the mobile device indicating the first payment authorization request is denied for all first payment authorization requests received after the funding card expiry date.

9. The computer-implemented method of claim **8** wherein the data for the virtual card further comprises a virtual card expiry date, and further comprising:

sending a notice to the mobile device indicating the first payment authorization request is denied for all first payment authorization requests received after the virtual card expiry date.

10. The computer-implemented method of claim **9** wherein the virtual card expiry date is the same as the funding card expiry date.

11. The computer-implemented method of claim **9** wherein the virtual card expiry date is different than the funding card expiry date.

12. The computer-implemented method of claim **11** wherein the virtual card expiry date is a predetermined number of days following computation of the data for the virtual card.

13. The computer-implemented method of claim **4** wherein the data for the virtual card is used for a single payment.

14. The computer-implemented method of claim **4** wherein the data for the virtual card is used for multiple payments.

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15. The computer-implemented method of claim **4** wherein the data for the virtual card is sent to the mobile device in encrypted form.

16. The computer-implemented method of claim **15** wherein the step of sending information related to the data for the virtual card to the mobile device comprises sending an encryption key value to the mobile device that allows the mobile device to determine the data for the virtual card.

17. The computer-implemented method of claim **4** wherein at least a portion of the virtual card number identifies the recipient of the first payment authorization request.

18. The computer-implemented method of claim **4** wherein the last four digits of the virtual card number are the same as the last four digits of the funding card number.

19. A system comprising:

one or more data processing apparatus programmed to perform operations comprising:

registering a funding card comprising storing a funding card number;

receiving a message from a mobile device indicating a desire to make a payment using the registered funding card;

computing data for a virtual card, wherein the data for the virtual card comprises a virtual card number that is different than the funding card number;

storing the data for the virtual card in association with the funding card number;

sending information related to the data for the virtual card to the mobile device;

receiving a first payment authorization request from a merchant or a merchant acquirer, the first payment authorization request comprising the data for the virtual card and a requested payment amount;

retrieving the funding card number based on the data for the virtual card;

sending a second payment authorization request to a funding card issuer, the second payment authorization request comprising the funding card number and the requested payment amount;

receiving a payment authorization response from the funding card issuer; and

sending the payment authorization response to the merchant or the merchant acquirer.

20. The system of claim **19** wherein the operations further comprise:

generating a funding card identifier;

storing the funding card identifier in association with the funding card number; and

sending the funding card identifier to the mobile device.

21. The system of claim **20** wherein the step of receiving a message from a mobile device indicating a desire to make a payment using a registered funding card comprises receiving the funding card identifier associated with the registered funding card.

22. The system of claim **19** wherein the step of registering a funding card further comprises storing a PIN associated with the funding card, wherein the data for the virtual card is computed using the PIN with other parameters, wherein the step of sending information related to the data for the virtual card to the mobile device comprises sending the other parameters but not the PIN to the mobile device, and wherein the operations further comprise:

comparing the data for the virtual card received with the first payment authorization request to the computed data for the virtual card; and

sending a notice to the mobile device indicating whether the payment authorization is accepted or denied based on the comparison.

23. The system of claim **19** wherein the step of registering a funding card further comprises storing a funding card expiry date associated with the funding card, and wherein the operations further comprise:

sending a notice to the mobile device indicating the first payment authorization request is denied for all first payment authorization requests received after the funding card expiry date.

24. The system of claim **23** wherein the data for the virtual card further comprises a virtual card expiry date, and wherein the operations further comprise:

sending a notice to the mobile device indicating the first payment authorization request is denied for all first payment authorization requests received after the virtual card expiry date.

25. The system of claim **24** wherein the virtual card expiry date is the same as the funding card expiry date.

26. The system of claim **24** wherein the virtual card expiry date is different than the funding card expiry date.

27. The system of claim **26** wherein the virtual card expiry date is a predetermined number of days following computation of the data for the virtual card.

28. The system of claim **19** wherein the data for the virtual card is used for a single payment.

29. The system of claim **19** wherein the data for the virtual card is used for multiple payments.

30. The system of claim **19** wherein the data for the virtual card is sent to the mobile device in encrypted form.

32. The system of claim **19** wherein at least a portion of the virtual card number identifies the recipient of the first payment authorization request.

33. The system of claim **19** wherein the last four digits of the virtual card number are the same as the last four digits of the funding card number.

34. The system of claim **19** wherein the system is adapted to register multiple funding cards.

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