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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
61/573,476	09/06/2011		110	10010 . PV		

CONFIRMATION NO. 4285

DOUG YEAGER
7502 WEST RIM DR
AUSTIN, TX 78731

FILING RECEIPT



Date Mailed: 09/29/2011

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Applicant(s)

Charles Douglas Yeager, Austin, TX;

Power of Attorney: None

If Required, Foreign Filing License Granted: 09/28/2011

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 61/573,476**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

Remote hosted secure element repository

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090611
16179 U.S. PTO

PTO/SB/16 (12-08)

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET - Page 1 of 2

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INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
CHARLES DOUGLAS	YEAGER	AUSTIN, TX

Additional inventors are being named on the _____ separately numbered sheets attached hereto.

TITLE OF THE INVENTION (500 characters max):

REMOTE HOSTED SECURE ELEMENT REPOSITORY

Direct all correspondence to: CORRESPONDENCE ADDRESS

☐ The address corresponding to Customer Number:

OR

☒ Firm or Individual Name DOUG YEAGER

Address 7502 WEST RIM DR

City AUSTIN	State TX	Zip 78731
Country	Telephone 8656046546	Email

ENCLOSED APPLICATION PARTS (check all that apply)

☐ Application Data Sheet. See 37 CFR 1.76 ☒ Drawing(s) Number of Sheets 10 ☒ Specification (e.g. description of the invention) Number of Pages 23	☐ CD(s), Number of CDs _____ ☐ Other (specify) _____
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SIGNATURE _____ Date 9/2/2011

TYPED or PRINTED NAME DAUG YEABER REGISTRATION NO. _____
(if appropriate)

TELEPHONE 865 604 6546 Docket Number: 10010 PV

File No. 10010.PV
New **PROVISIONAL APPLICATION**
Applicant(s): C. Douglas YEAGER

Date: Sep. 2, 2011

Title: REMOTE HOSTED SECURE ELEMENT REPOSITORY

Enclosures:

- (1.) Check #1108 in the amount of \$110
- (2.) Provisional Application for Patent Cover Sheet (PTO/SB/16) (2 pp.)(in duplicate)
- (3.) Specification (23 pp.)
- (4.) Drawings (10 pp.)
- (5.) Express Mail #

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Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
CHARLES DOUGLAS	YEAGER	AUSTIN, TX

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 OR
☒ Firm or Individual Name DOUG YEAGER
 Address 7502 WEST RIM DR

City <u>AUSTIN</u>	State <u>TX</u>	Zip <u>78731</u>
Country	Telephone <u>8656046546</u>	Email

ENCLOSED APPLICATION PARTS (check all that apply)

☐ Application Data Sheet. See 37 CFR 1.76	☐ CD(s), Number of CDs _____
☒ Drawing(s) Number of Sheets <u>10</u>	☐ Other (specify) _____
☒ Specification (e.g. description of the invention) Number of Pages <u>23</u>	

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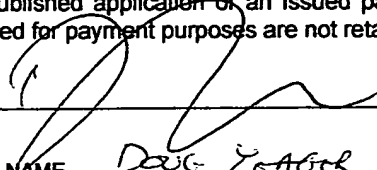
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SIGNATURE  Date 9/2/2011

TYPED or PRINTED NAME DOUG YEAGER REGISTRATION NO. _____
(if appropriate)

TELEPHONE 865 604 6546 Docket Number: 10010 PV

PROVISIONAL PATENT APPLICATION

OF

DOUG YEAGER

FOR

REMOTE HOSTED SECURE ELEMENT REPOSITORY

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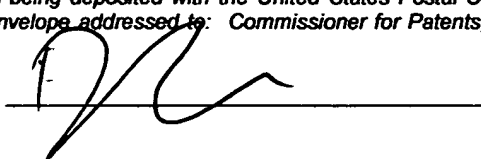
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FIELD

[0001] This invention relates to the field of payment and authorization methods using a mobile computing application in combination with a remotely hosted Secure Element. This invention is also related to methods by which such devices may be used to make payments, authorizations or exchange information with other devices.

[0002] BACKGROUND

[0003] In some payment technologies such as smartcard payment, a microchip referred to as a “Secure Element” (SE) is embedded into the payment card, payment FOB, or other mobile devices that can be used for making payments. For the purpose of simplifying language in this document, the device that houses the SE will be referred to as the “card” or “card device”. It is important to note that the “card” or “card device” may not physically resemble the shape or size of a typical payment card and may come in various form factors such as embedded into a mobile phone or embedded into a removable storage or removable device. Also, it is important to note that the SE may be an emulated software based SE and not strictly hardware based. Any microprocessor controller has the ability to emulate and pretend to be an SE.

[0004] In order to extract information from the SE, an interrogator, which also may be referred to in this document as a “reader”, is required to communicate with the SE. The interrogator typically follows standards set forth by ISO and application providers to do so.

[0005] A significant advantage of extracting and delivering the data within a SE is the ability to know beyond all doubt that the data string being delivered indeed came from a particular SE or card. This knowledge creates a more secure transaction with lower risk to the merchant, card issuing bank, and card associations. Prior to the present invention, most methods for extracting information from a banking card are traditional methods of swiping the magnetic stripe on a card through a magnetic stripe reader, or extracting the information with a separate contact or contactless reader connected to a POS (POS). These more secure methods of extracting the information on the card allow a merchant to receive a discounted transaction fee for the particular transaction. An example of a less secure transaction would be reading or entering account numbers, expiration dates, and card verification codes off of a card during a phone call or internet shopping experience.

[0006] It is important to note that acquiring transactional data from a SE such as Track1/Track2 data is significantly different than simply using a duplicate of

transactional data such as a copy of Track1/Track2 data located on a card magnetic stripe. A magnetic stripe on a card is considered a static data set and never changes Track1/Track2 data between transactions or “swipes”. For this reason, the data on the stripe could simply be copied or duplicated for use by other form factors. Also, simply copying the card digits printed on the front and back of the card presents this same security risk.

[0007] Acquiring transactional Track1/Track2 data from a SE is considered singular and has a life span of a single transaction or a single “swipe” and then the data is no longer valid. Moreover the Track1/Track2 data acquired during an SE interrogation cannot be created by any other entity except the SE which has been programmed with secret shared keys owned by the bank or application which was loaded to that SE.

[0008] In contrast, the data on a magnetic stripe can be copied and programmed to a mobile device and used to make transactions continuously from the copy with no technical limitation. In the same way, card numbers that are simply copied from the face or front or back of the card and programmed to a mobile device and can also be continuously used to make transactions without a technical limitation.

[0009] Knowing this difference, the subject of the present invention is directed specifically to SE transactions because the security of these types of transactions makes the architecture defined in this patent much more plausible and secure to current industry banking and processing standards.

[0010] Cards containing a SE are typically presented to an RFID (Radio Frequency Identification) reader device as the interrogator that extracts the information from the card and delivers the data to the POS (Point Of Sale) and then on to the card processor for authorization. Mobile phones that contain NFC (Near Field Communication) functionality with embedded SEs have the ability to pretend or emulate a card that would contain an SE. In this case the mobile phone can be presented to the RFID reader just as a card would and the information can be extracted from the SE that is on the mobile phone and delivered to POS and then on to the card processor for authorization.

[0011] The present invention allows for a mobile phone or mobile device to engage and be interrogated by a POS device while the SE, that is the subject of the transaction, remains remotely hosted in a separate facility. The mobile device in the case of this invention acts as a pass-through to facilitate the interrogation of the remote SE by the POS RFID reader through a data link or data connection to the remotely hosted SE.

[0012] The present invention uses the base-band processor on the NFC mobile device to do one or all of the following tasks:

- a. Begin a connection to a POS RFID reader through the mobile device's NFC radio interface.
- b. Receive queries through the mobile device's NFC radio interface from the interrogation sequence offered by the POS RFID reader and pass those same queries to a remote system that is configured to receive those queries.
- c. Receive query responses from a remote system and pass those responses to a POS RFID reader through the mobile device's NFC radio interface.

[0013] The present invention uses a remote server network and remote array of secure elements or representations of secure elements (remote system) to do one or all of the following tasks:

- a. Authenticate a particular remote mobile device or owner of a mobile device that wishes to send queries from an interrogator to a SE that is contained in this system.
- b. Properly address a single SE within an array of SEs to respond appropriately to the remote authenticated device.
- c. Properly route queries that were passed to this system to a particular SE or SE software representation within the system and properly route responses from the SE out of the system to the correct authenticated remote device.

[0014] The present invention combines both the tasks performed by the NFC mobile device and the remote system to allow for a complete and un-interrupted interrogation between a RFID POS reader and an NFC mobile device. The interrogation may be performed as set forth by payment card standards such as MasterCard PayPass, VISA Contactless, AMEX Express Pay, and Discover Zip.

[0015] The data link or data connection and communication between the mobile device and the remote system stated above could be carried out over standard TCP/UDP/IP services that are currently available on mobile devices.

[0016] Some advantages of the present invention include:

- a. In the event a mobile device that is used to conduct an NFC payment transaction with an RFID terminal is lost or stolen, the remote system can be notified and communication with the SE can be blocked until the stolen or lost device is recovered or replaced. In the event the device is replaced, new card credentials do not have to be issued again, but a communication channel with the SE can be opened back up and continued upon proper authorization. Prior to this invention, all new SE credentials or cards would have to be re-issued as the hardware that contained the SE itself would have been lost or stolen also.
- b. The SE that is associated with a remote mobile device can be switched to another mobile device fast and easily and is not hardware form factor dependant. The same SE may be used with multiple mobile devices, laptop or desktop computers that have the ability to connect to this remote system that contains the SE over a data connection and authenticate properly.
- c. Compared to changing hardware interfaces, and array of different hardware interfaces, and supported hardware interfaces on a mobile device, a data connection is ubiquitous and standard. SE's currently have various hardware form factors such as:

- 1) Embedded microchip (soldered to a circuit board)
- 2) SD, mini-SD, micro-SD interface
- 3) USB interface
- 4) SIM card interface

Many mobile devices support different sets of the above hardware form factors and many support none of them at all, however, most all mobile devices support a data connection. This ubiquity aids to the portability of SE applications from device to device.

- d. Because the present invention contains an array of SEs or SE representations, and because the remote system is designed to host and connect SE applications to multiple remote devices, it is possible for multiple remote devices from separate remote device owners to share a single SE from the array of SEs in the remote system. This sort of sharing of space on the SE enables consolidation and ultimately savings by more efficient utilization of memory on an array of SEs.
- e. Because the present invention does not rely on a hardware specific interface for the SE, but a data connection only. It is a more ubiquitous interface and could be used with more devices without being modified or changed from a hardware perspective.
- f. Because the present invention uses an array or plurality of SEs, the ability to purchase SE chips in quantity for use in this array brings a possibility of a lower over-all cost per SE chip.

[0017] Some additional advantages of the present invention also include:

- a. Using “2 factor” authentication to protect connection to a remote SE from a mobile device. Upon authentication, a connection channel can be opened to a SE that relates to a particular mobile device. 2 factor

authentication comprises of “something you have or do” AND “something you know”.

- b. An example of using “something you do” and “something you know” would be using gestures (moving the phone through 3d space in reasonably reproducible manner) and an accelerometer to measure these gestures on a mobile device to create a “gesture signature” in combination with a typed in pin or password to authenticate to a remote system with an array of SEs as defined in this invention.

[0018] In this document, the concept of “Remote Hosted Secure Element” (RHSE). This is referring to the concept of creating a remote repository for plurality SEs intended for a plurality of mobile devices or mobile device owners. The plurality of SEs or array of SEs is hosted in a secure environment and can be represented literally with actual SE hardware or as a virtual SE representation done entirely in software.

[0019] In the case an array of SEs are present in hardware, the complete system could be created with a large array of SE card readers that are each addressable. These SE card readers simply convert ISO 7816 card protocol into electrical signals that are eventually converted into TCP/UDP/IP data packets. These SE card readers each have an SE card plugged into them. Software and hardware that interacts with each card reader has the ability to query each SE at a particular address that corresponds to a particular remote mobile device. As a result data that is passed to a particular SE from a remote mobile device is translated and routed over a TCP/UDP/IP network to the correct hardware SE reader and hence to the SE. These concepts are not limited to one particular form factor or embodiment.

[0020] In the case an array of SEs are present in software as a representation of an SE, a SE card reader is not needed to interrogate the SE. A software representation would allow a completely contained system the gives the same remote mobile device functionality as the previous completely hardware based case.

[0021] The hardware case may be the preferred case as defined by the industry simply because of the more secure nature of controlling the removable SE that could be manufactured with secure data residing on the SE chip in a secure facility and then shipped to the remote system facility to be plugged in and activated and verified.

[0022] In this document, the concept of managing a remote system containing of a plurality of SE readers, each one being addressable and matched to a particular mobile device is discussed.

[0023] Also, in this document, the concept of authenticating a mobile device with a remote system to obtain access to a particular SE within a plurality of SEs in that remote system is discussed.

[0024] Also, in this document, the concept of connecting a mobile device to a remote service via activating a data-pass-through mode for ISO7816-4 data queries from an POS RFID reader through a mobile device NFC interface through the mobile device OS, to a data connection to a remote system containing a plurality SEs.

[0025] Also, in this document, the concept of using TCP/UDP/IP sockets to enable a communication channel between a RFID POS reader and a single SE within remote system containing a plurality of SEs.

[0026] Also, in this document, the concept of authenticating over SSL to enable a TCP/UDP/IP socket communication channel between a RFID POS reader and a single SE within a remote system containing a plurality of SEs.

[0027] In this document, a specific payment standard issued from MasterCard International will be discussed. This standard is based on reference documentation published by PayPass - Mag Stripe (V3.3).pdf and other derivations. In this specification, PayPass contactless payment card reader and card interrogation is documented. This document discusses specifically how an RFID reader interrogator would interact with a card containing a SE to extract and build Track1/Track2 equivalent data that is compatible for existing processing infrastructure, but contains the more secure and dynamic aspects of SE driven credential data.

[0028] As with some data networks that pass TCP/UDP/IP information, there are network delays and latency that contributes to delay for round trip information to a destination. With the present invention, the data is intended to go round-trip from the mobile device to the remote SE. Many payment applications that communicate with an SE may require a plurality of queries and responses to the SE for each transaction carried out by an interrogation from the POS RFID reader. Each of these query and responses to the SE would be subject to network delays and latency. Prolonged delay during a transaction with the RFID POS could cause a worse user experience. An example of a delay was recorded during testing:

- a. Card transaction with a MasterCard PayPass plastic card and a RFID POS reader was measured to take ~200ms
- b. Card transaction with a remote SE programmed with the MasterCard PayPass application over a 3G network managed by Verizon through a mobile handset was measured to take ~600ms

[0029] The remote SE took ~400ms longer in the above example due to network latency and delay during the SE interrogation.

[0030] The concept of query/response caching will be discussed in this document. A cache is a component that transparently stores data so that future requests for that data can be served faster. The data that is stored within a cache might be values that have been computed earlier or duplicates of original values that are stored elsewhere. If requested data is contained in the cache (cache hit), this request can be served by simply reading the local cache, which is comparatively faster than accessing the remote source. Otherwise (cache miss), the data has to be recomputed or fetched from its original storage location, which is comparatively slower. Hence, the more requests can be served from the local cache the faster the overall system performance is.

[0031] A local cache (cache system located on the mobile device) can be implemented for use in the present invention. Many of the responses to a 7816-4 APDU command or queries are static and unchanging in a payment application on a SE. For this reason, a

cache system could successfully be designed to respond locally for these static information requests with the known 7816-4 APDU data responses and only query real time to the remote SE in the event the response 7816-4 APDU data is dynamic or changing with each transaction. This should limit the number of round trip data requests to the remote SE. Because each round trip request to the remote SE is subject to network delay and latency, a relatively significant total transaction time savings can be realized.

[0032] The main advantages of implementing a caching system in the current invention are:

- a. To save over-all time to perform a full transaction with a payment card application between a RFID POS reader through a mobile device to a remote SE.

Brief Description of the Drawings

[0033] Fig. 1 illustrates the command and response APDU (Application Protocol Data Unit) flow between a reader and an SE.

[0034] Fig. 2 illustrates the command and response APDU flow between a reader and an SE with specific details about the MasterCard PayPass application that is installed on the SE

[0035] Fig. 3 illustrates the raw data of a transaction between a reader and an SE

[0036] Fig. 4 illustrates the format for which the reader is expected to deliver the results of the previous interrogation

[0037] Fig. 5 illustrates a diagram of a mobile device that contains NFC capabilities and how that device allows access to secure elements

[0038] Fig. 6 illustrates a diagram of an addressable array of remote hosted SEs

[0039] Fig. 7 illustrates a User ID SE address lookup table

[0040] Fig. 8 illustrates an authorization flow for using a remote hosted SE

[0041] Fig. 9 illustrates a data flow diagram including authorization between a mobile device and a remote hosted SE

[0042] Fig. 10 illustrates an example of caching being used during a MasterCard PayPass transaction between a RFID POS and a remote SE

DETAILED DESCRIPTION

[0043] Fig. 1 describes the protocol level communication between a reader and an SE. The protocol layer is a standard protocol referred to as APDU. APDU stands for Application Protocol Data Unit and the protocol is defined by ISO/IEC 7816 specification. The APDU, ISO/IEC 7816-4 data is typically transmitted over the air on 13.56 Mhz reader to SE radio waves during a contactless or NFC transaction. There is no limitation to this however and the APDU commands are just data moving from one entity to another. The present invention uses the standard APDU commands to interact with the SE regardless if the SE is located on the mobile devices own embedded SE, a remote SE embedded into a remote system or a card. Element (1), (2), (3), and (4) show the sequential commands of a typical command and response between and SE and an interrogator. Usually multiple steps are involved with accessing a SE which require multiple APDU command queries and response for each complete transaction. This specific fig. 1 shows the general interrogation steps to access credential data on a MasterCard PayPass Magstripe application running on a SE.

[0044] Fig. 2 describes the detailed commands and responses expected when a reader interrogates a MasterCard PayPass Magstripe ver. 3.3 application running on a SE. This data is obtained through the MasterCard PayPass specification that was referenced earlier in this document. All details including abbreviations and acronyms are explained in detail through this specification document.

[0045] Fig. 3 describes an example transaction at the ISO/IEC 7816-4 protocol level (APDU) between a reader and a card using the MasterCard PayPass Magstripe application specification v. 3.3. Element (9) defines some of the initial parameters used in the transaction which include an unpredictable number issued by the reader, a transaction counter maintained on the SE. Element (10) describes the command that the reader issues to the SE to find out what applications exist on the SE. this example shows that the mastercard PayPass application responds as an active one. Next element (11) shows how the reader queries the SE to properly select the PayPass application for further processing. Element (12) shows how the reader receives the type of processing options that the PayPass

application supports. Element (13) shows how the readers queries and receives the PayPass application specific credential information about its card holder including card account number, holder name, expiration date, and more. Element (14) shows how the reader receives the dynamic aspects of the transaction that will be inserted into the Track 1 and Track 2 data. This command uses a shared key on the SE, the unpredictable number from the reader, and the transaction counter on the SE to determine a new number sequence for each transaction. After the SE calculates the number, it sends it back to the reader in the response APDU. This data is obtained through the MasterCard PayPass specification that was referenced earlier in this document. All details including abbreviations and acronyms are explained in detail through this specification document.

[0046] Fig. 4 describes how the reader (21) in Fig. 5 is expected to format the response data received from the SE into accepted Track1 and Track2 data strings that are used in existing processing systems. Element (15) shows a Track2 data string built from the card interrogation in figure 3. The CVC3(Track2) UN and ATC numbers will all vary with each transaction or interrogation of the SE. Element (16) shows a Track1 data string built from the card interrogation in figure 3. CVC3(Track1), ATC, and UN numbers will all vary with each transaction or interrogation of the SE. This data is obtained through the MasterCard PayPass specification that was referenced earlier in this document. All details including abbreviations and acronyms are explained in detail through this specification document.

[0047] Fig. 5 describes the inner architecture of a mobile device that supports NFC functionality and how that device would allow access to its attached secure elements as well as a remote secure element. Element (17) is the base band processor of the mobile device and typically runs an OS (Operating System) to control all aspects and interfaces on the device including communication access to the SIM (20), NFC controller (18), Secure IC (25), or data to the internet (27). The NFC controller (18) acts as a router to determine where the communication is routed. When a mobile NFC device is presented to an RFID POS, the ability for the mobile device to emulate a card (pretend to be a payment card) is possible. When this happens the NFC controller (18) which is controlled by the baseband processor on the mobile device (17) can be configured to route the interrogation queries

(1),(2),(3),(4),(5),(6),(7),(8) from the reader (interrogator) (21) to a secure element for processing and response. A SE application that is used in a payment transaction will be configured to respond to interrogation queries the same or similar to Fig. 1 and Fig. 2. The queries and responses illustrated in Fig. 1 and Fig. 2 are comprised of a string of data that conforms to ISO/IEC 7816 specification. The baseband controller can choose to route the queries from the reader (21) to any secure element it chooses for processing. Some of the options would include:

- a. Routing ISO/IEC 7816-4 data through the NFC interface (18) to an embedded secure IC over its proprietary connected SE interface (25)
- b. Routing ISO/IEC 7816-4 data through the NFC interface (18) through the baseband processor (17), to an attached SIM card (20)
- c. Routing ISO/IEC 7816-4 data through the NFC interface (18) through the baseband processor (17), to an attached SD, miniSD, or microSD card that contains an SE
- d. Routing ISO/IEC 7816-4 data through the NFC interface (18) through the baseband processor (17), over a data connection (27),(28),(29),(36),(35),(30) to a remote data server (32) using TCP/UDP/IP

All options a., b., c., and d. use APDU data to exchange information between the RFID reader (21) and the applications located in an SE located in the mobile device (19) or a remote SE (34). It is important to note that the remote SE (34) could also be created with software and emulated within the remote system (31). The interrogation example mapped out in fig. 3 and 4 could easily be implemented on this system in all 4 modes a., b., and c., and d. above. This suggests that the remote system SE (34) could perform the identical interrogation on a remote secure element (19).

[0048] It is important to note that this document and this figure is suggesting that at the ISO/IEC 7816-4 (APDU) level, an entire interrogation similar to those described in Fig. 1, and Fig. 2 can be carried out from a RFID POS reader (21) through an NFC enabled mobile

device (26), through a data connection over the internet (35) to a remote system (31) that contains the actual SE (34). An example of reader commands is illustrated in element (38) as a paypass reader. The paypass reader (38) shows the proper sequence of ISO/IEC 7816-4 APDU queries and responses that are pushed through the reader (21) and end up at the remote SE (38). Element (37) shows an example of APDU queries that are received by the remote SE (34) and the appropriate response that is issued as defined by the 7816-4 application for MasterCard PayPass. Elements (38) and (37) simply show how Figure 2 could be broken up so that the PayPass card could be hosted on a remote SE (34) on a remote system (31) and the paypass reader could be an RFID POS (21).

[0049] Element (31) describes a remote system with an external connection to the internet (30) and internal connections to an array or plurality of SE readers (33) that are each connected to a SE (34). A server or set of servers (32) is responsible for marrying the connections originating at the mobile NFC device (26) to the correct SE (34) within the remote system (31).

[0050] The data connection described in Fig. 5 (27),(28),(29),(36),(35),(30) is a TCP/UDP/IP connection that is offered by most cellular carriers over a cellular network and cellular towers (29) & (28). The TCP/UDP/IP connection can run socket software that allows for raw data to be transmitted from one end of the data connection (26) and the other (31) and visa versa. The data packets within the socket software can be configured to exchange data that contains ISO/IEC 7816-4 data.

[0051] Fig. 6 describes a remote system that is capable of bridging a data (TCP/UDP/IP) connection through the internet (39) to a single addressable SE reader (49) and SE (50). Elements (40) and (41) show how a data link (TCP/UDP/IP) (40) can be used to pass ISO/IEC 7816-4 APDU data (41) to a remote server (42). In this example the remote system is identified on the internet through the IP address (43). The remote system is comprised of a remote server (42) that routes the connection to an internet network of attached SE Array Managers (46). The TCP/UDP/IP data (40) that enters this remote system and is routed to an internal SE Array Manager device over TCP/UDP/IP (44), contains data that uses the protocol for ISO/IEC 7816-4 APDU data (41) and (45). Each SE Array Manager (46)

contains an internally unique IP address (48) within its TCP/UDP/IP server (47). Each SE Array Manager's TCP/UDP/IP server is responsible for receiving ISO/IEC 7816-4 APDU data (45) and (51) and routing it to the appropriate addressable SE reader (49) and SE (50).

[0052] One method to create a communication channel shown in Fig. 6 from the remote system to the mobile device over TCP/UDP/IP using socket server and client methods. Identification data from the mobile device can be used to setup a socket connection all the way through the remote server socket server (42) to the SE Array Manager TCP/UDP/IP socket server (47). The data that is sent over the socket server and client can be formatted to be ISO/IEC 7816-4 APDU data. The APDU query would enter the socket server (47) and be routed to the appropriate SE reader (49) and SE (50) and the response APDU would be sent from the SE (50) and SE reader (49) back to the remote mobile device through the SE Array Manager socket server (48), the remote system socket server (42), and through the internet (39) and be received by the socket client on the remote mobile device.

[0053] Fig. 6 also describes a plurality of remote SEs that are each addressable and can be accessed by a plurality of remote mobile devices independently. The descriptions in the above paragraphs describe how a single remote mobile device would connect to a remote system and specifically a single remote SE to complete a transaction. This same scenario is intended to go on congruently through this same system to different SE's in the system from different remote mobile devices.

[0054] Fig. 7 describes a table in a database that could be used to identify which remote SE within a remote system described in Fig. 6 that a user and particular mobile device can be attached to. Element (54) is a unique row identifier in the table. Each row contains related data. The other columns of this table are the User ID (52) and the SE Address (53). The SE address is the unique address within the remote system for a particular SE. This table in Fig. 7 could be used to properly match a remote user or remote mobile device with the address of a particular SE.

[0055] Fig. 8 describes one authentication flow for allowing connection over a data connection between a mobile device and remote hosted secure element. Element (56)

describes how a mobile device that supports NFC is initiated and presented to a RFID POS reader in order to make a payment transaction. The phone is placed into a mode that is referred to as card emulation mode where the NFC interface on the phone pretends to be contactless RFID card. The phone has a bit more control to select which card is presented to the POS. The subject of this patent describes how the NFC mobile device has the ability to use a SE for the transaction that is not physically located on the mobile device. This is done by creating a data connection to a remote SE for which is used for the payment transaction. In element (57), while the phone is being placed into card emulation mode, the connection to the remote SE that will be used for emulation is attempting to connect. There is a chance that the connection is already open in which case the flow in Fig. 8 will simply allow the ISO/IEC 7816-4 APDU data to pass directly through the connection to the remote SE and back (63) successfully completing the transaction (64). There is also a chance that the connection to the remote SE does not exist and needs to be created. In order to connect to the remote system and create the final connection to the correct SE for that user or mobile device, the device must be authenticated to the remote system.

[0056] One method of authentication to the remote system is described in Fig. 8., and further detailed below. The authorization to the remote system can be initiated using HTTPS/SSL web services. The mobile device connecting to the remote system is able to pass various credentials to the remote system such as user ID, passwords, PIN, “gesture signature”, and so on securely to the remote system for mobile device validation (59), upon successful authorization and validation, the remote system opens up a communication channel to the appropriate SE within the remote system and creates a handle to that communication channel that can be used to access it from the remote mobile device. The remote system can securely pass back over HTTPS/SSL a shared encryption key and handle to the communication channel that can be used for continued communication over that communication channel through a TCP/UDP/IP data socket (62). If the authorization fails (65), the connection to the remote SE is not opened, and the process ends. When the remote device receives the shared encryption key and handle to the communication channel to a particular SE on the remote system, the ISO/IEC 7816-4 APDU queries from the RFID POS can be passed to this remote hosted SE through a socket connection and the data can be encrypted with the shared

encryption key. The remote system can decrypt the data and send it to the correct SE within the remote system. The remote system can then send the response APDU from the SE back to the remote mobile device in a similar manner. The remote mobile device and forward this response APDU back through the NFC interface to the RFID POS reader.

[0057] Fig. 9 illustrates the authorization and communication process in more detail. The vertical line (66) represents the RFID POS entity. The vertical line (67) represents the mobile device. The vertical line (68) represents the remote system authentication server, and the vertical line (69) represents the remote hosted SE.

[0058] To open a communication socket between the RFID POS (66) and the remote SE (69), authorization over SSL is initiated and credentials are sent to the server (70). The server verifies the credentials and sends back a successful response (71) which contains a handle to a communication channel and an encryption key. The mobile device can then open a channel to the remote SE. At that point APDU query and response APDUs can be sent securely between the RFID POS reader and the remote POS and back. Element (72) shows how the APDU query is emitted from the RFID POS reader to the mobile phone (72) which encrypts that APDU query and forwards it on to the remote system (73) and on to the remote SE (74). The return APDU response from the SE is delivered back to the RFID POS in a similar manner (75),(76),(77).

[0059] Fig. 10 illustrates an example of caching being used during a MasterCard PayPass transaction between a RFID POS and a remote SE. The vertical line (78) represents the RFID POS entity. The vertical line (79) represents the mobile device. The vertical line (81) represents the remote system authentication server, and the vertical line (82) represents the remote hosted SE. The vertical line (80) represents the caching system on the mobile device.

[0060] The MasterCard PayPass specification indicates that the response to the Select PPSE APDU (83) always be the same:

- a. APDU to the card for Select PPSE APDU:

```
00 A4 04 00 0E 32 50 41 59 2E 53 59 53 2E 44 44 46
30 31 00
```

- b. APDU response from the card for Select PPSE APDU is ALWAYS:

```
6F 23 84 0E 32 50 41 59 2E 53 59 53 2E 44 44 46 30
31 A5 11 BF 0C 0E 61 0C 4F 07 A0 00 00 00 04 10 10
87 01 01 90 00
```

This would indicate that the response to this APDU can be cached and the caching system (80) can respond to this APDU without making a query all the way to the remote SE over the data network.

[0061] The MasterCard PayPass specification indicates that the response to the Select PayPass AID APDU (84) always be the same:

- a. APDU to the card for Select PayPass AID APDU:

```
00 A4 04 00 07 A0 00 00 00 04 10 10 00
```

- b. APDU response from the card for Select AID APDU is ALWAYS:

```
6F 17 84 07 A0 00 00 00 04 10 10 A5 0C 50 0A 4D 61
73 74 65 72 43 61 72 64 90 00
```

This would indicate that the response to this APDU can be cached and the caching system (80) can respond to this APDU without making a query all the way to the remote SE over the data network.

[0062] The MasterCard PayPass specification indicates that the response to the GPO (Get Processing Options) APDU (85) always be the same:

- a. APDU to the card for GPO APDU:

```
80 A8 00 00 02 83 00 00
```

- b. APDU response from the card for GPO APDU is ALWAYS:

77 0A 82 02 00 00 94 04 08 01 01 00 90 00

This would indicate that the response to this APDU can be cached and the caching system (80) can respond to this APDU without making a query all the way to the remote SE over the data network.

[0063] The MasterCard PayPass specification indicates that the response to the Read Record APDU (86) always be the same for a particular card that has been personalized, but will be different from personalized card to a different personalized card:

- a. APDU to the card for Read Record APDU:

00 B2 01 0C 00

- b. APDU response from the card for Read Record APDU is ALWAYS for a specific card:

70 7F 9F 6C 02 00 01 56 3E 42 35 34 31 33 31 32 33
 34 35 36 37 38 34 38 30 30 5E 53 55 50 50 4C 49 45
 44 2F 4E 4F 54 5E 30 39 30 36 31 30 31 33 33 30 30
 30 33 33 33 30 30 30 32 32 32 32 32 30 30 30 31 31
 31 31 30 9F 64 01 03 9F 62 06 00 00 00 38 00 00 9F
 63 06 00 00 00 00 E0 E0 9F 65 02 00 0E 9F 66 02 0E
 70 9F 6B 13 54 13 12 34 56 78 48 00 D0 90 61 01 90
 00 99 00 00 00 0F 9F 67 01 03 90 00

This would indicate that the response to this APDU can be cached and the caching system (80) can respond to this APDU without making a query all the way to the remote SE over the data network, UNLESS the card on the SE has changed to a different card, in which case the caching system should send this command to the remote SE for processing.

[0064] The MasterCard PayPass specification indicates that the request and the response to the Compute Cryptographic Checksum APDU (87) always will be different for each transaction. This means that this APDU will always need to be processed by the actual remote SE through the data network. Element (93) indicates the estimated or example of network processing time for this single APDU query and response (87). The over-all example in Fig. 10 illustrates how there is potentially only a single query and response that need to happen in real time over the data network (93) as a result of implementing a caching system.

[0065] In this specific example in Fig. 10, Element (88) illustrates one method to maintain the proper state of the remote SE (82) when a caching system is used. It is important that the remote SE (82) maintain the same processing state as the system is expecting when introducing a caching system. For this reason, it is important to actually issue the APDU commands to the remote SE in order to bring that SE to the appropriate system state. The dashed line illustrates how these ghost commands would need to be issued by the remote system in order for the SE to maintain an up to date state. The elements (89),(90),(91), and (92) mirror the APDU queries and responses (83),(84),(85),(86) managed by the caching system (80).

[0066] ABSTRACT

A method and apparatus for creating a remotely hosted plurality of secure elements that can be connected to a single mobile NFC device and interrogated by a RFID POS reader through the mobile NFC device over a data connection between that mobile NFC device and remote hosted secure element.

Fig. 1

-Command – Response APDU Flow

Secure Element
Banking Application

Interrogator

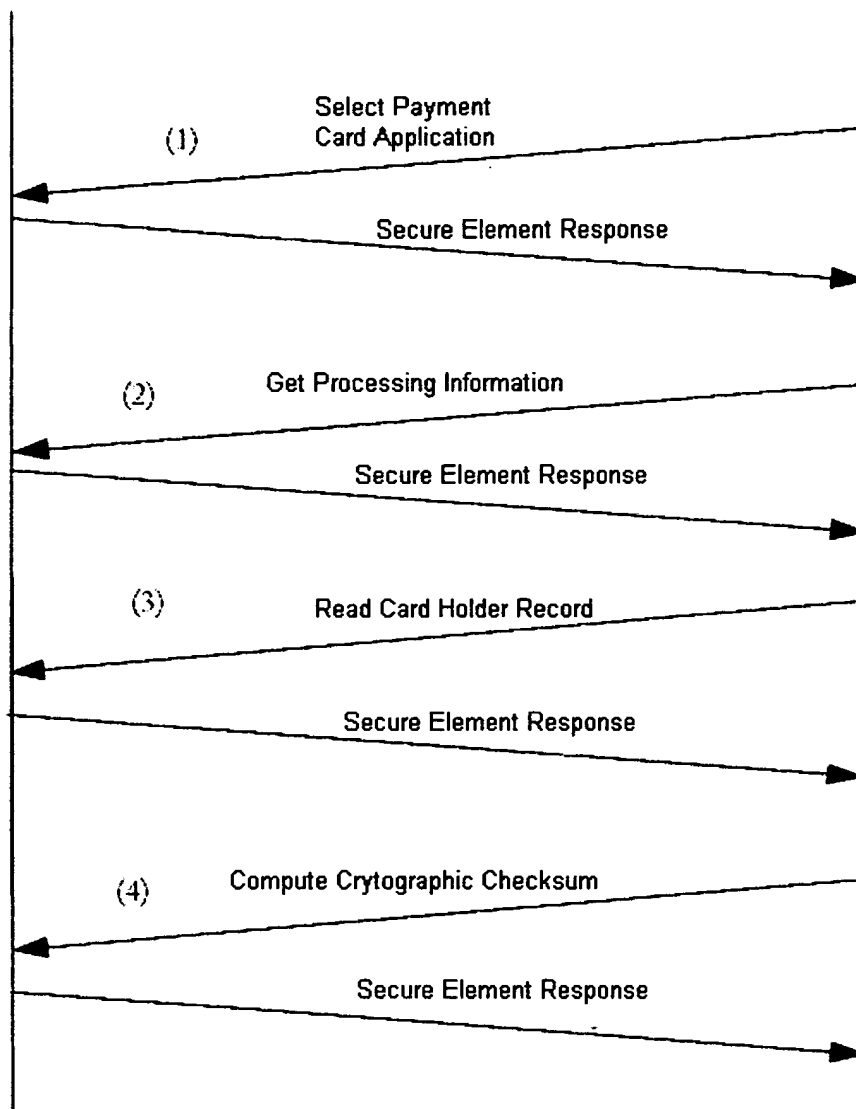
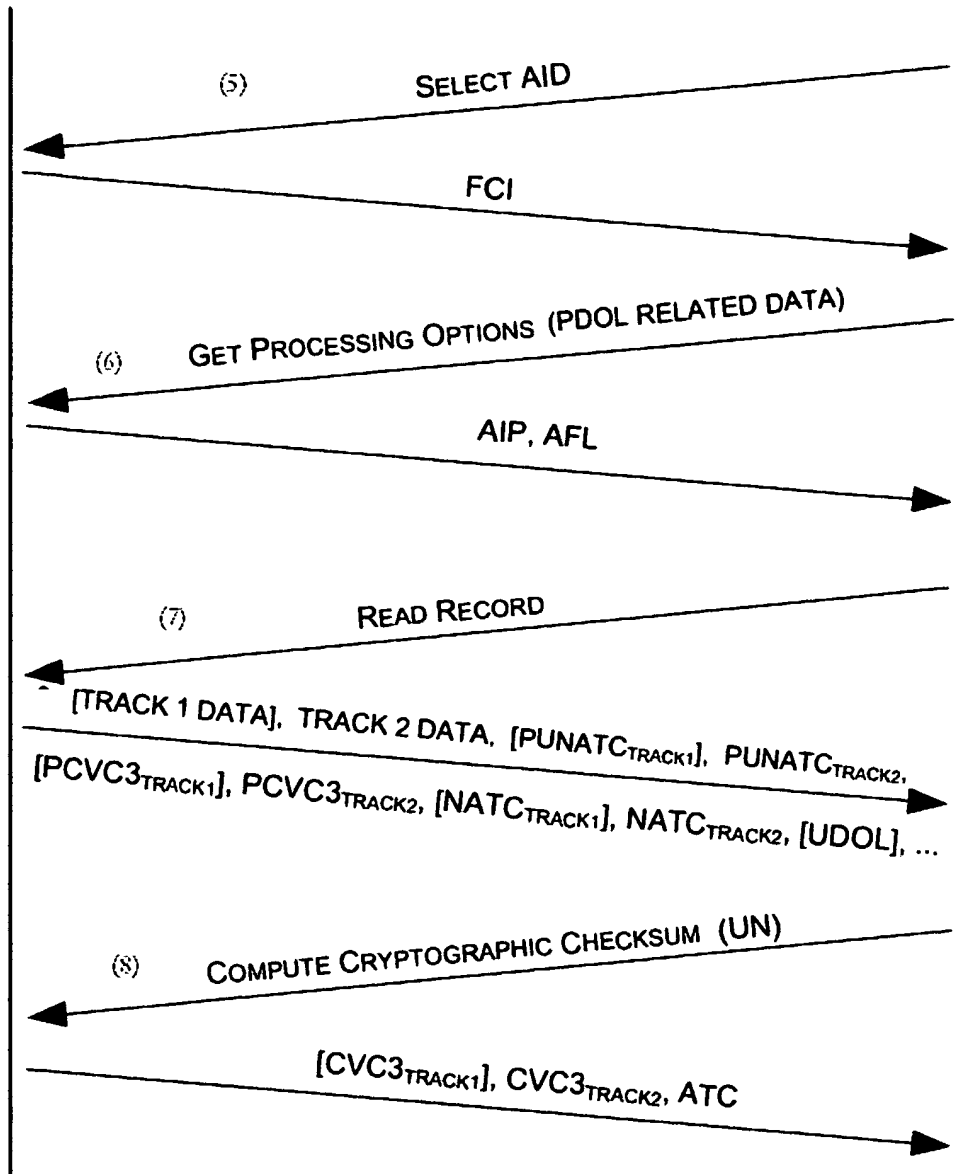


Fig. 2

—Command – Response APDU Flow

PayPass card

PayPass reader



Transaction Processing

(9)

- **SELECT PPSE Command**

(10)

>CARD: 00 A4 04 00 07 A0 00 00 00 04 10 10 00

(11)

>CARD: 80 A8 00 00 02 83 00 00

(12)

>CARD: 00 B2 01 0C 00

(13)

>CARD: 80 2A 8E 80 04 00 00 08 99 00

(14)

Fig. 4

The *PayPass* reader generates the track 2 data to be included in the authorization message as follows:

```

CVC3TRACK2 in base 10: 47250          (15)
ATC in base 10:       94
=> track 2 data:      54 13 12 34 56 78 48 00 D0 90 61 01
                      9 094 99 899 250      3 F
                      ↑↑↑   ↑↑↑ ↑↑↑      ↑
                      ATC    UN CVC3TRACK2 nUN

```

The *PayPass* reader generates the track 1 data to be included in the authorization message as follows:

```

CVC3TRACK1 in base 10: 64455          (16)
ATC in base 10:       94
=> track 1 data:      42 35 34 31 33 31 32 33 34 35 36 37 38 34 38 30
                      30 5E 53 55 50 50 4C 49 45 44 2F 4E 4F 54 5E 30
                      39 30 36 31 30 31 33 33 34 35 35 33 33 33 30 39
                      34 32 32 32 32 32 38 39 39 31 31 31 31 33
ASCII dump:           B5413123456784800^SUPPLIED/NOT^0906101
                      3345533309422222289911113
                      ↑↑↑   ↑↑↑   ↑↑↑   ↑
                      CVC3TRACK1 ATC    UN    nUN

```

Figure 1 illustrates the system architecture. A mobile device (17) is connected to a baseband (18) and an NFC interface (19). The baseband includes ISO/IEC 7816 and ISO/IEC 7818 components. The NFC interface connects to a Secure IC (20) via S2C interface (21) and Sign (22) signals. The Secure IC is connected to a SIM card (23) and a Secure IC (24). The system is connected to a network (25) via a Cell Tower (26) and an Internet cloud (27). A Pass reader (28) is shown on the left, and a Pass card (29) is shown on the right.

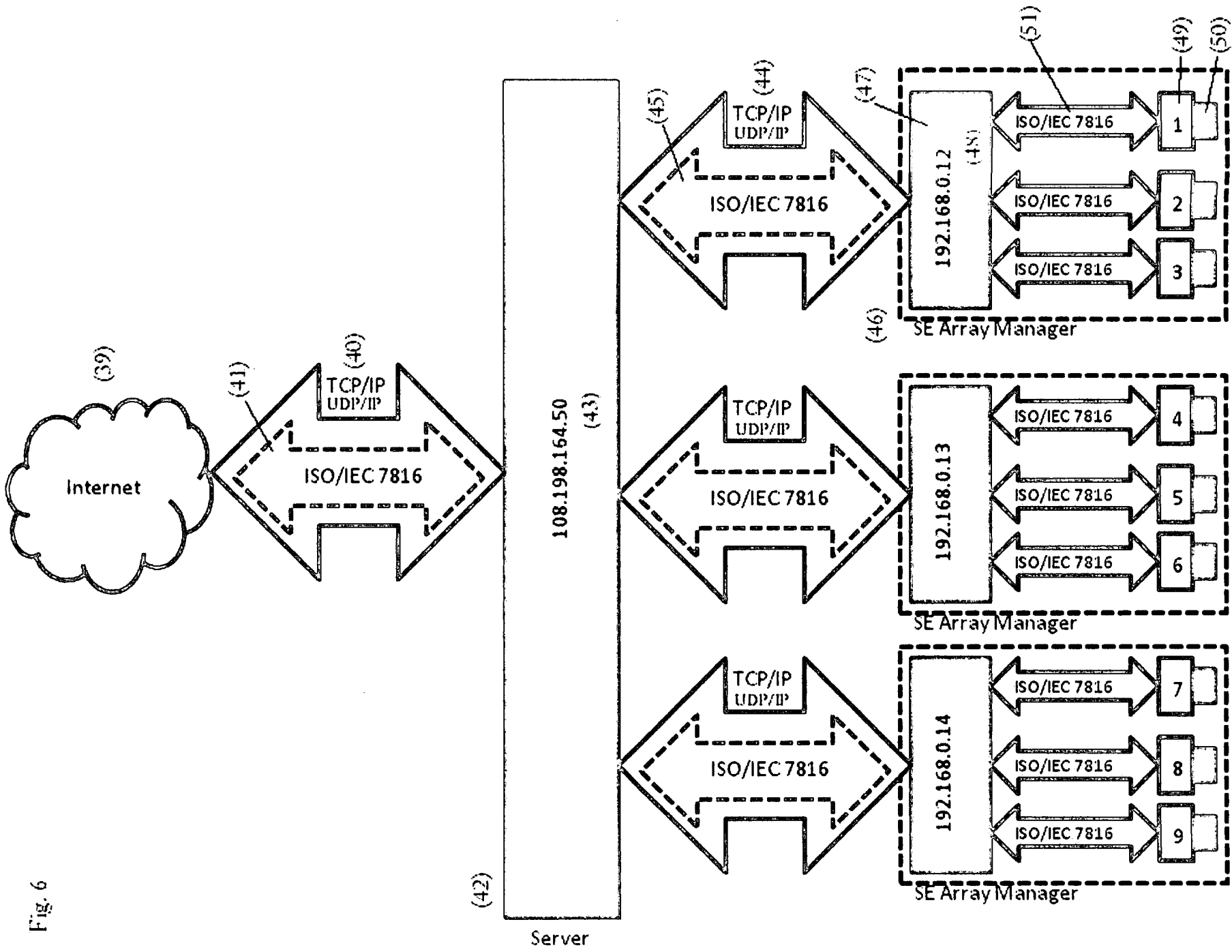


Fig. 6

Fig. 7

(52)		(53)
	User ID	SE Address
(54)	1 doug@elementalknowledge.com	7
	2 ravi@intel.com	6
	3 tom@intel.com	8
	4 ken@intel.com	2
	5 mark@intel.com	4
	6 greg@intel.com	9
	.	.
	.	.
	.	.

Fig. 8

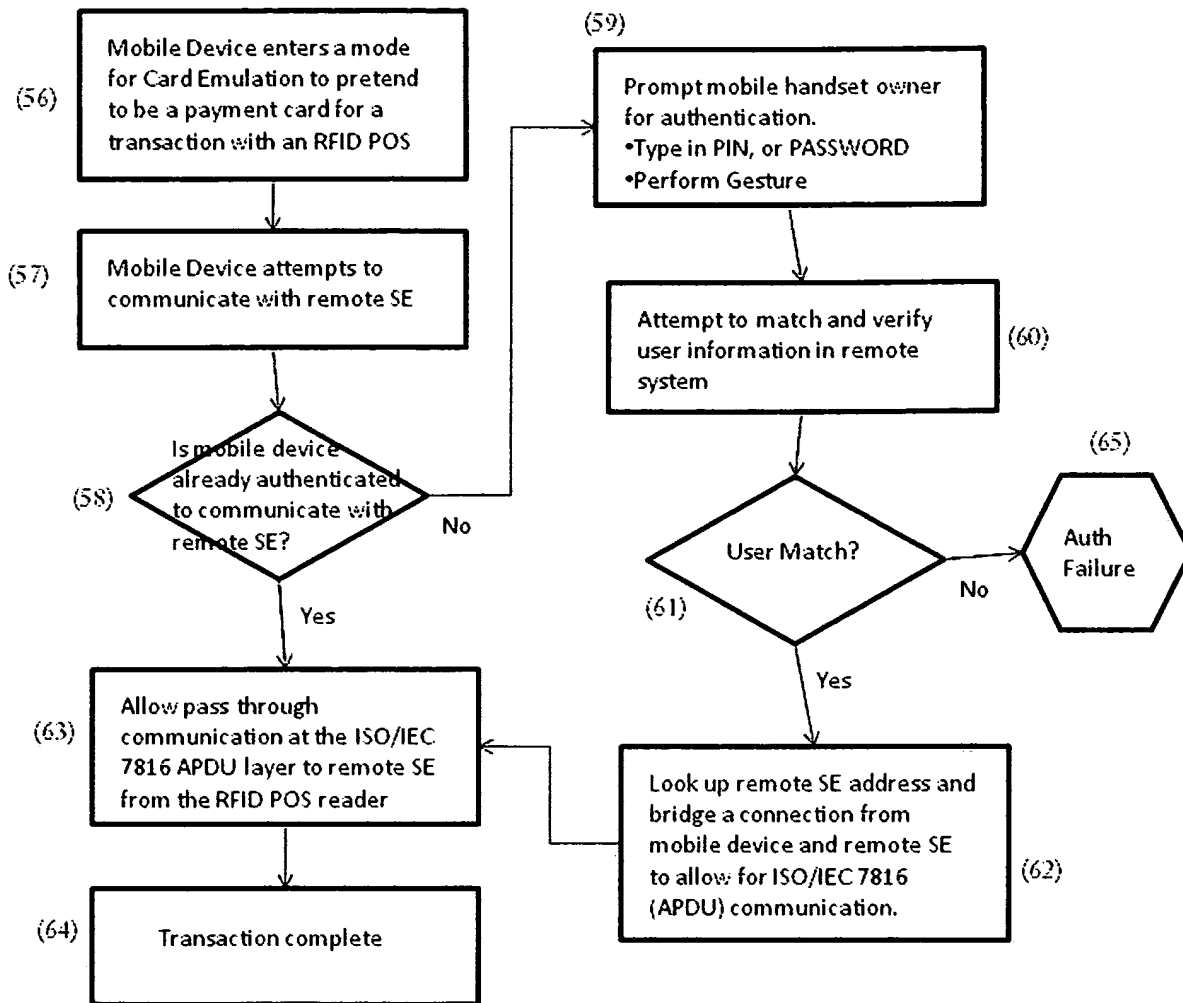


Fig. 9

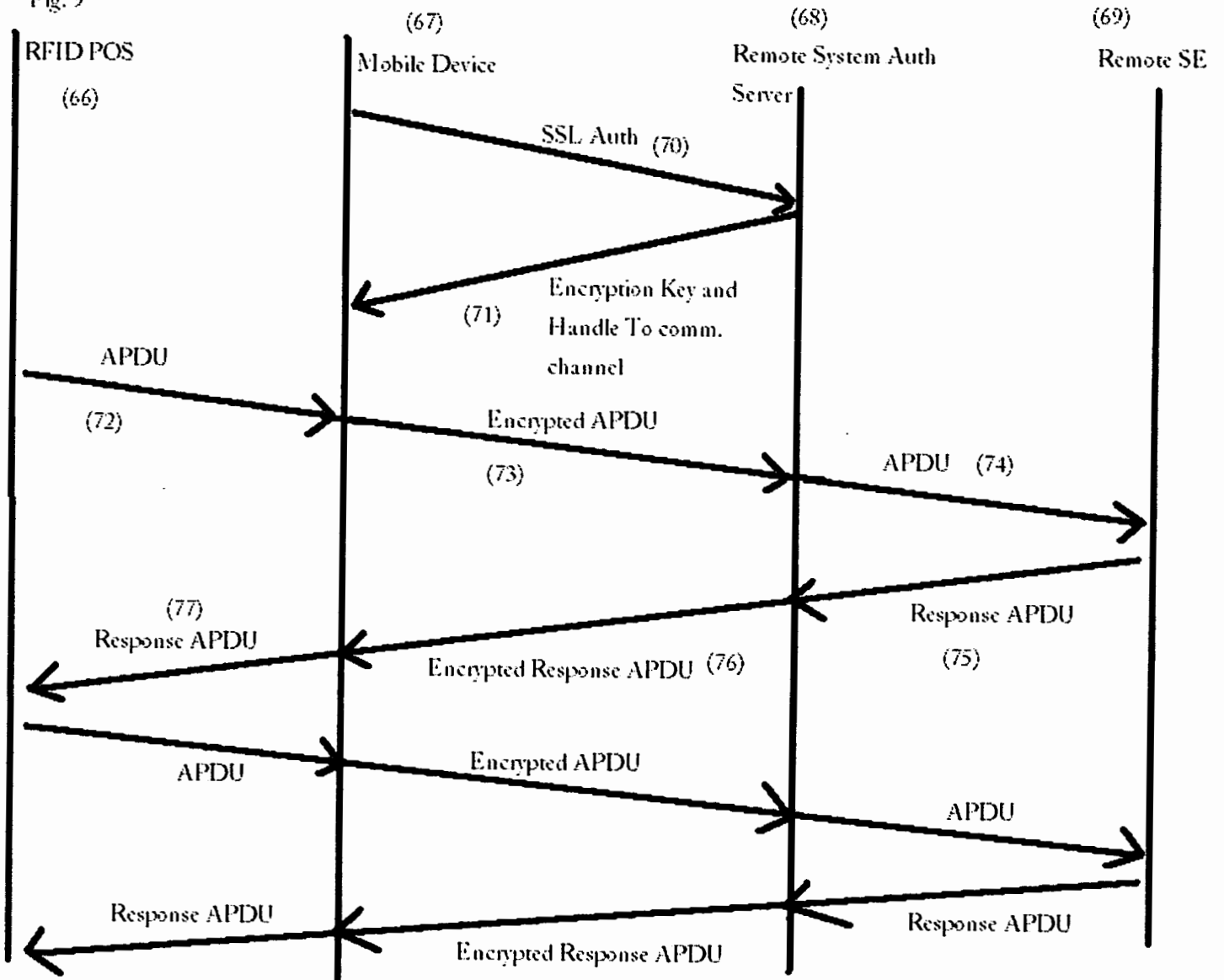
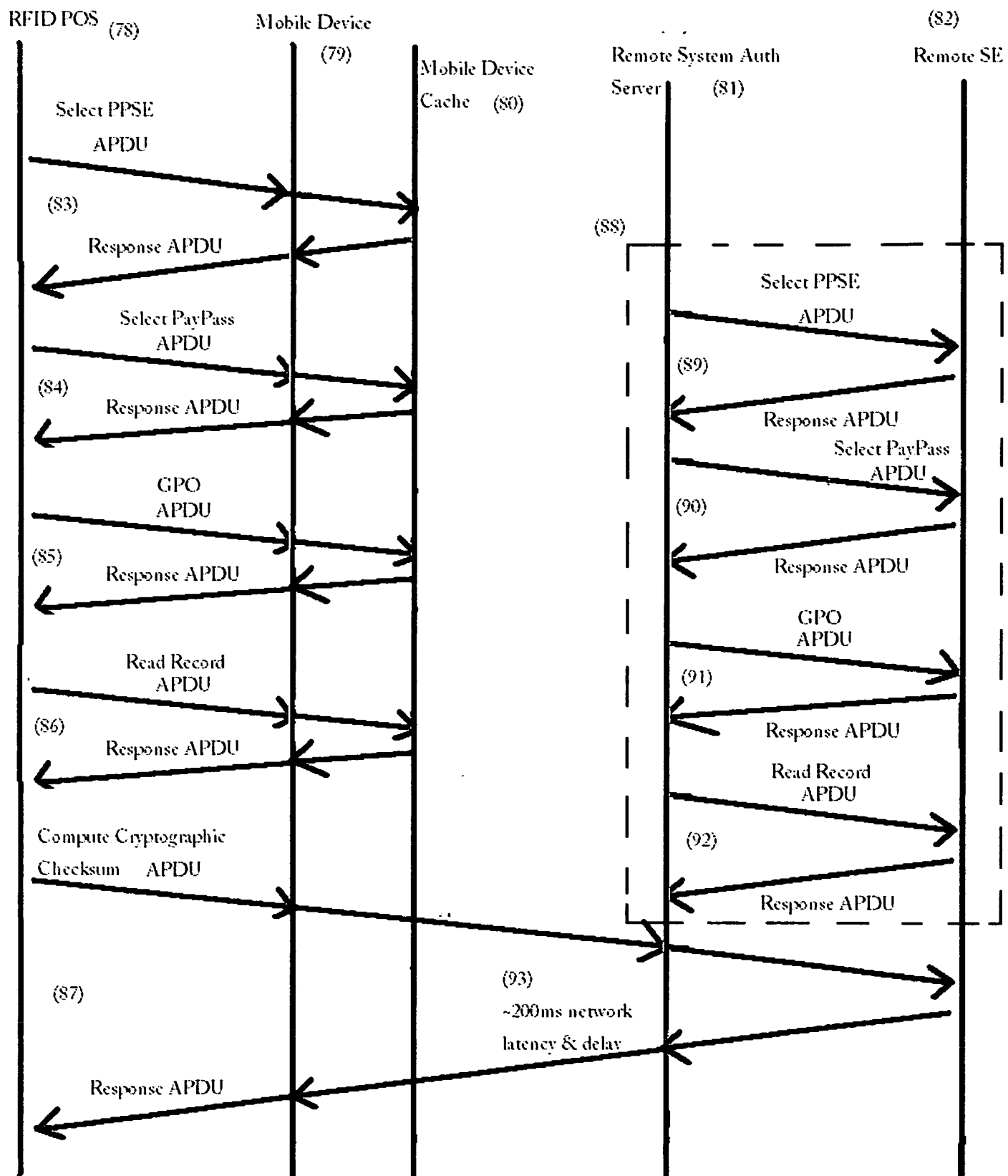


Fig. 10



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