US007761374B2

(12) **United States Patent**
Sahota et al.

(10) **Patent No.: US 7,761,374 B2**
(45) **Date of Patent: Jul. 20, 2010**

(54) **METHOD AND SYSTEM FOR GENERATING A DYNAMIC VERIFICATION VALUE**

(75) Inventors: **Jagdeep Singh Sahota**, Rodeo, CA (US); **Christian Aabye**, Foster City, CA (US)

(73) Assignee: **Visa International Service Association**, Foster City, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1472 days.

(21) Appl. No.: **10/642,878**

(22) Filed: **Aug. 18, 2003**

(65) **Prior Publication Data**

US 2005/0043997 A1 Feb. 24, 2005

(51) **Int. Cl.**
G06F 17/00 (2006.01)

(52) **U.S. Cl.** **705/39**

(58) **Field of Classification Search** 705/16, 705/29, 38, 40, 67, 75, 35, 37, 39
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,528,442	A	7/1985	Endo	
5,254,843	A	10/1993	Hynes et al.	
5,311,594	A	5/1994	Penzias	
5,434,398	A	7/1995	Goldberg	
5,465,387	A	11/1995	Mukherjee	
5,513,250	A	4/1996	McAllister	
5,625,689	A	4/1997	Indeck et al.	
5,627,355	A	5/1997	Rahman et al.	
5,708,422	A	1/1998	Blonder et al.	
5,740,244	A	4/1998	Indeck et al.	
5,774,525	A	6/1998	Kanevsky et al.	
5,819,226	A	10/1998	Gopinathan et al.	
5,832,458	A	11/1998	Jones	
5,834,747	A	11/1998	Cooper	
5,835,599	A *	11/1998	Buer	380/29
5,872,834	A	2/1999	Teitelbaum	
5,878,337	A	3/1999	Joao et al.	
5,903,830	A	5/1999	Joao et al.	
5,914,472	A	6/1999	Foladare et al.	
5,920,628	A	7/1999	Indeck et al.	
5,988,497	A	11/1999	Wallace	
6,012,144	A	1/2000	Pickett	

(Continued)

OTHER PUBLICATIONS

International Search Report of PCT/US04/26813, May 7, 2007.

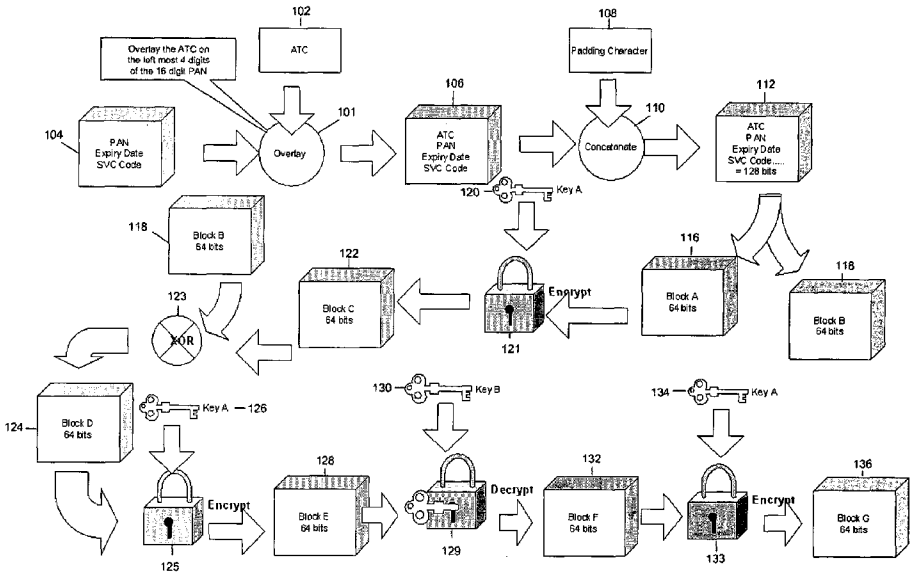
(Continued)

Primary Examiner—James A Kramer
Assistant Examiner—Paul Shumate
(74) *Attorney, Agent, or Firm*—Bradley K. DeSandro; Quarles & Brady LLP

(57) **ABSTRACT**

Methods and systems for dynamically generating a verification value for a transaction and for utilizing such value to verify the authenticity of the payment service application. The dynamically created verification value may be generated on a payment device, such as an integrated circuit credit card or smart card, embedded into the payment data, and transmitted to a point of sale terminal. Alternatively, payment data is sent by a payment device to a point of sale terminal, which generates a verification value and embeds it into the payment data. The embedded verification value is used by a service provider to verify the authenticity of the transaction. The methods and systems may be used in a contactless (wireless) environment or a non-wireless environment.

16 Claims, 7 Drawing Sheets



U.S. PATENT DOCUMENTS

6,029,154	A	2/2000	Pettitt	
6,112,191	A	8/2000	Burke	
6,157,707	A	12/2000	Baulier et al.	
6,219,793	B1	4/2001	Li et al.	
6,260,146	B1	7/2001	Mos et al.	
6,308,890	B1	10/2001	Cooper	
6,442,532	B1	8/2002	Kawan	
6,529,725	B1	3/2003	Joao et al.	
6,612,488	B2	9/2003	Suzuki	
6,714,918	B2	3/2004	Hillmer et al.	
6,823,721	B1	11/2004	Fujii	
6,832,721	B2	12/2004	Fujii	
6,899,269	B1	5/2005	Deland	
6,913,194	B2	7/2005	Suzuki	
7,003,497	B2	2/2006	Maes	
7,024,396	B2	4/2006	Woodward	
7,044,394	B2	5/2006	Brown	
7,051,002	B2	5/2006	Keresman et al.	
7,096,003	B2	8/2006	Joao et al.	
7,143,095	B2	11/2006	Barrett et al.	
2002/0091562	A1	7/2002	Siegel et al.	
2002/0108062	A1	8/2002	Nakajima et al.	
2002/0133462	A1	9/2002	Shteyn	
2002/0153424	A1*	10/2002	Li	235/492
2002/0180584	A1*	12/2002	McGregor et al.	340/5.26
2003/0208684	A1	11/2003	Camacho et al.	
2004/0107170	A1	6/2004	Labrou et al.	
2004/0171406	A1	9/2004	Purk	
2004/0185830	A1	9/2004	Joao et al.	
2005/0080730	A1	4/2005	Sorrentino	
2005/0170814	A1	8/2005	Joao et al.	
2006/0059110	A1	3/2006	Madhok et al.	
2006/0202025	A1	9/2006	Calabrese et al.	
2006/0281439	A1	12/2006	Benco et al.	
2006/0282382	A1	12/2006	Balasubramanian et al.	
2008/0005037	A1	1/2008	Faith	
2008/0029593	A1	2/2008	Faith	
2008/0034221	A1	2/2008	Faith	
2008/0040271	A1	2/2008	Faith	
2008/0040276	A1	2/2008	Faith	
2008/0065553	A1	3/2008	Faith	
2008/0103982	A1	5/2008	Faith	

OTHER PUBLICATIONS

Written Opinion of the International Searching Authority of PCT/US04/26813, May 7, 2007.

International Preliminary Report on Patentability of PCT/US04/26813, May 30, 2007.

* cited by examiner

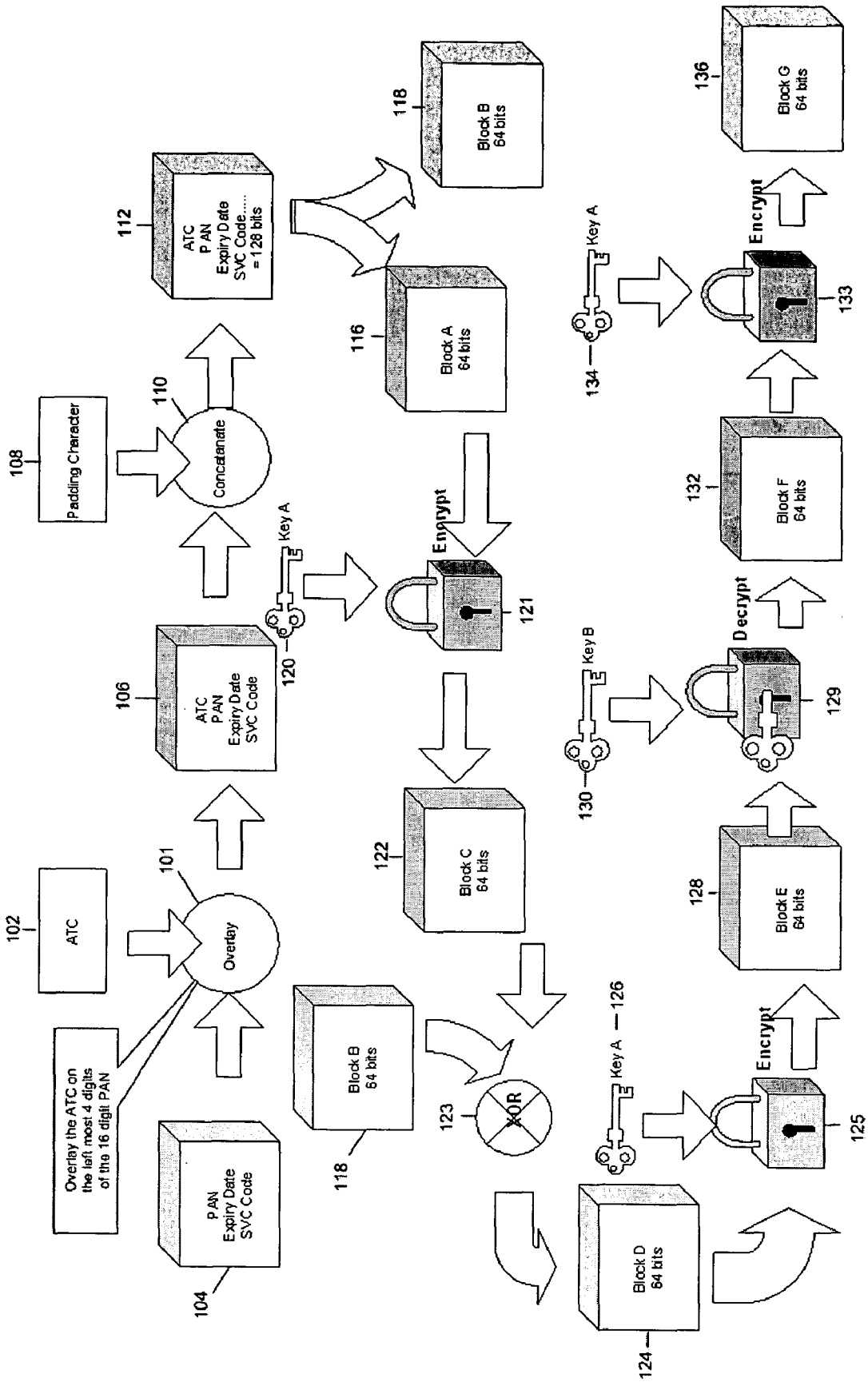

ATC
Overlay
Overlay the ATC on the left most 4 digits of the 16 digit PAN
PAN Expiry Date SVC Code
Padding Character
Concatanate
ATC PAN Expiry Date SVC Code
ATC PAN Expiry Date SVC Code..... = 128 bits
Key A
Encrypt
Block A 64 bits
Block B 64 bits
Block C 64 bits
Block B 64 bits
XOR
Block D 64 bits
Key A
Encrypt
Block E 64 bits
Block F 64 bits
Key B
Decrypt
Key A
Encrypt
Block G 64 bits
101
102
104
106
108
110
112
116
118
120
121
122
123
124
125
126
128
129
130
132
133
134
136

FIG. 1

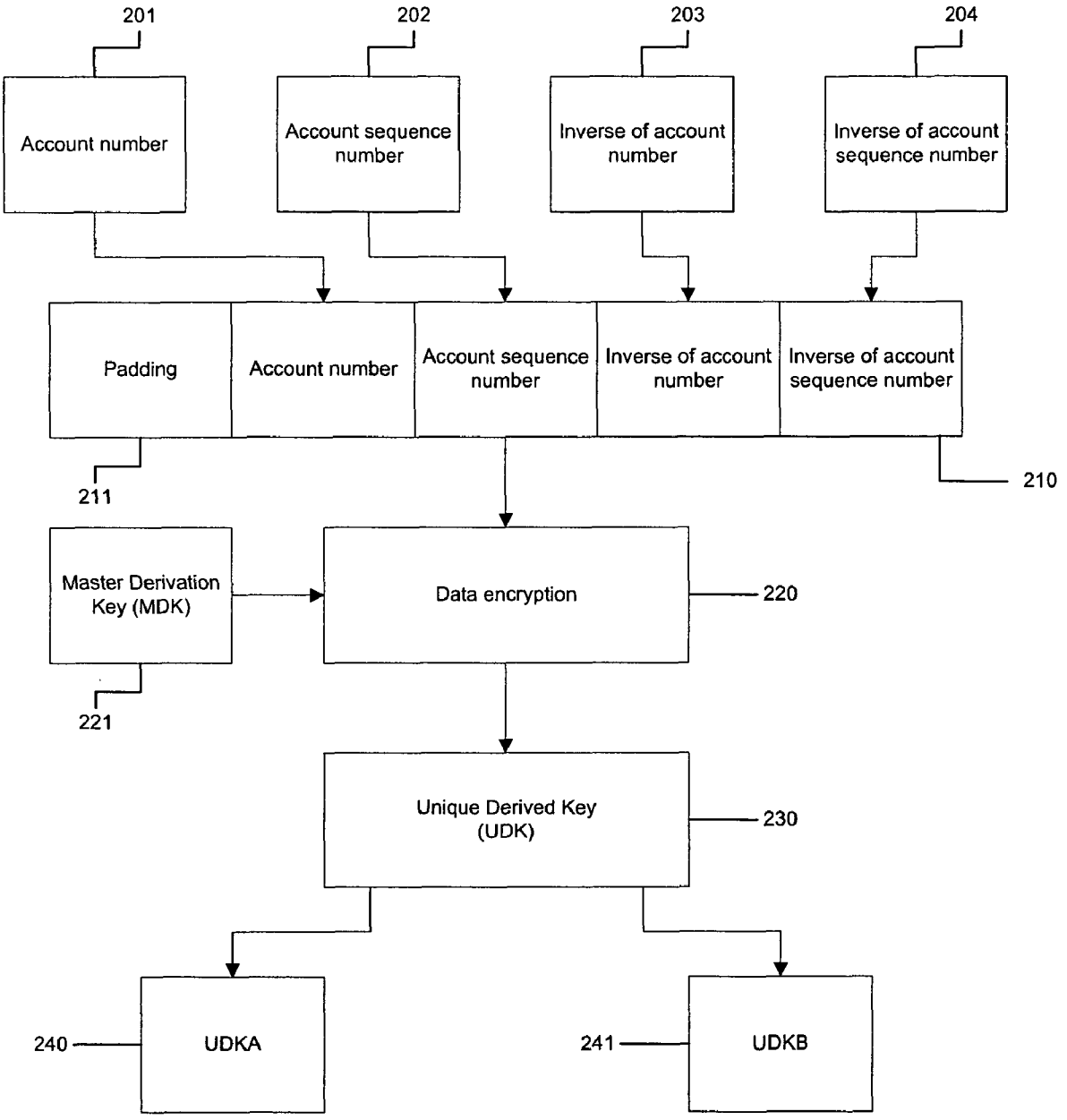

201
202
203
204
Account number
Account sequence number
Inverse of account number
Inverse of account sequence number
Padding
Account number
Account sequence number
Inverse of account number
Inverse of account sequence number
211
210
Master Derivation Key (MDK)
Data encryption
220
221
Unique Derived Key (UDK)
230
240
UDKA
241
UDKB

FIG. 2

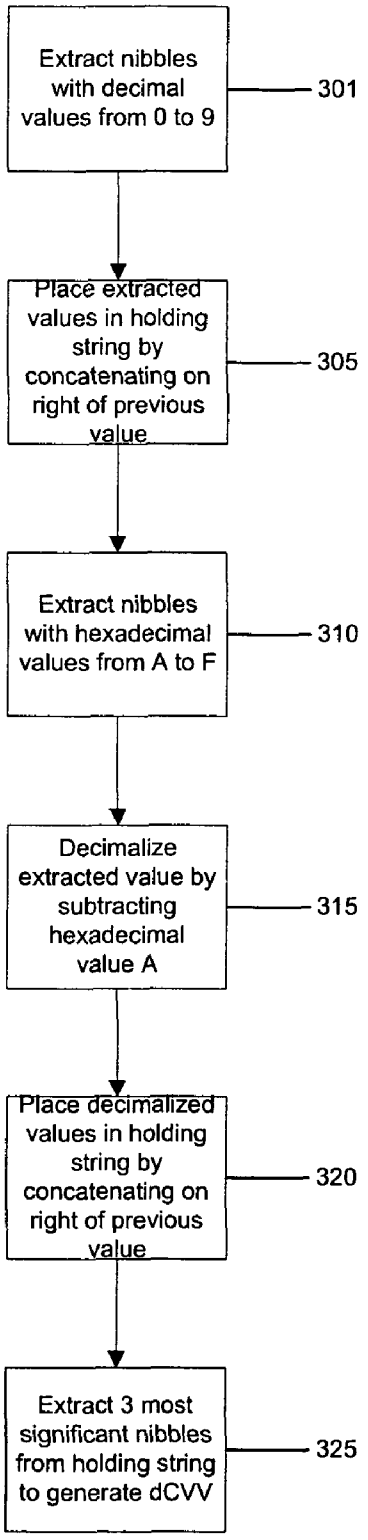

Extract nibbles with decimal values from 0 to 9
301
Place extracted values in holding string by concatenating on right of previous value
305
Extract nibbles with hexadecimal values from A to F
310
Decimalize extracted value by subtracting hexadecimal value A
315
Place decimalized values in holding string by concatenating on right of previous value
320
Extract 3 most significant nibbles from holding string to generate dCVV
325

FIG. 3

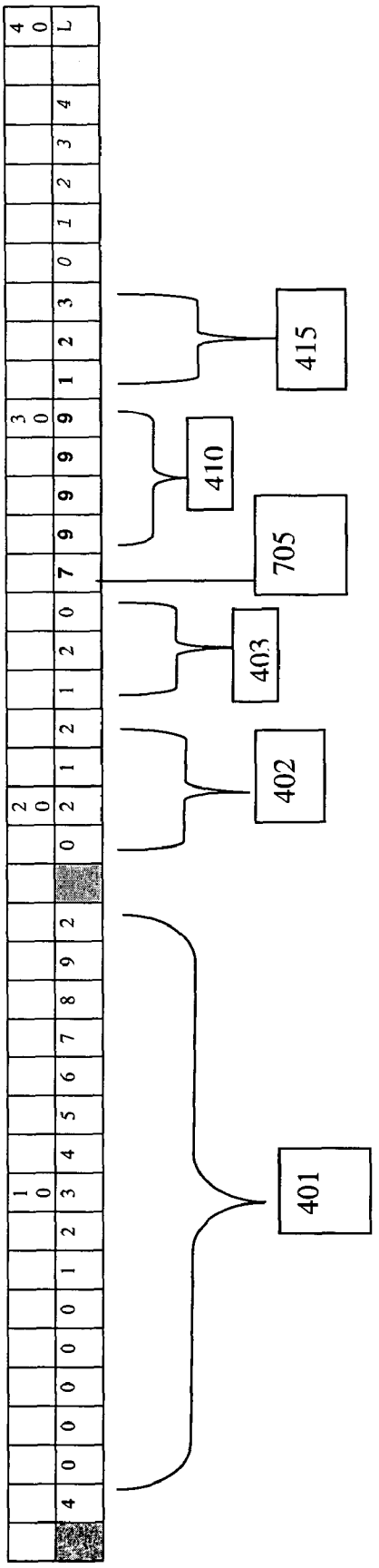


FIG. 4

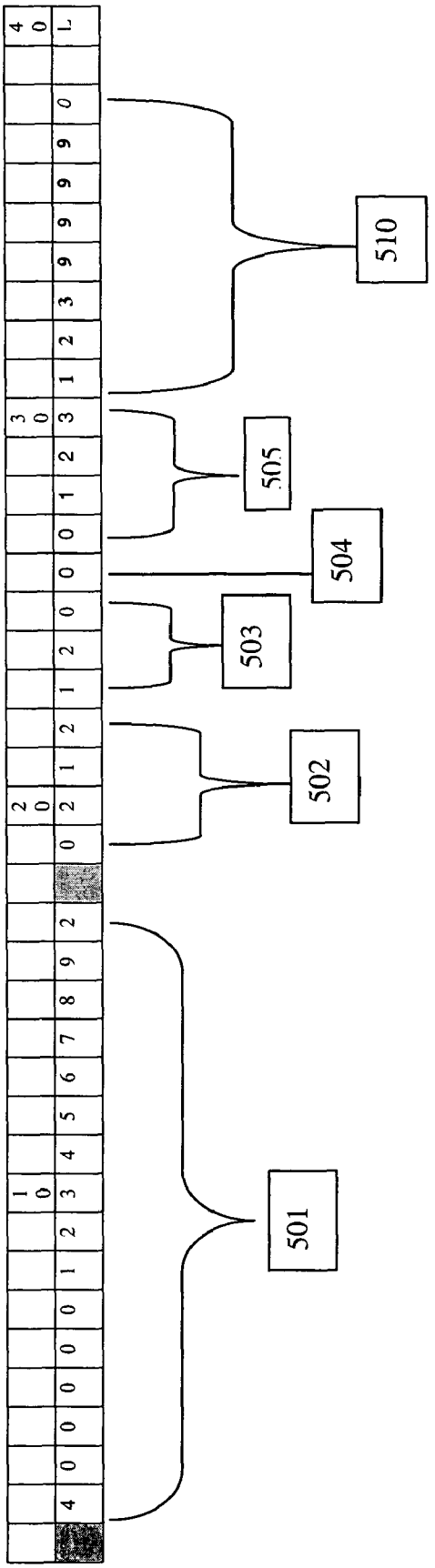


FIG. 5

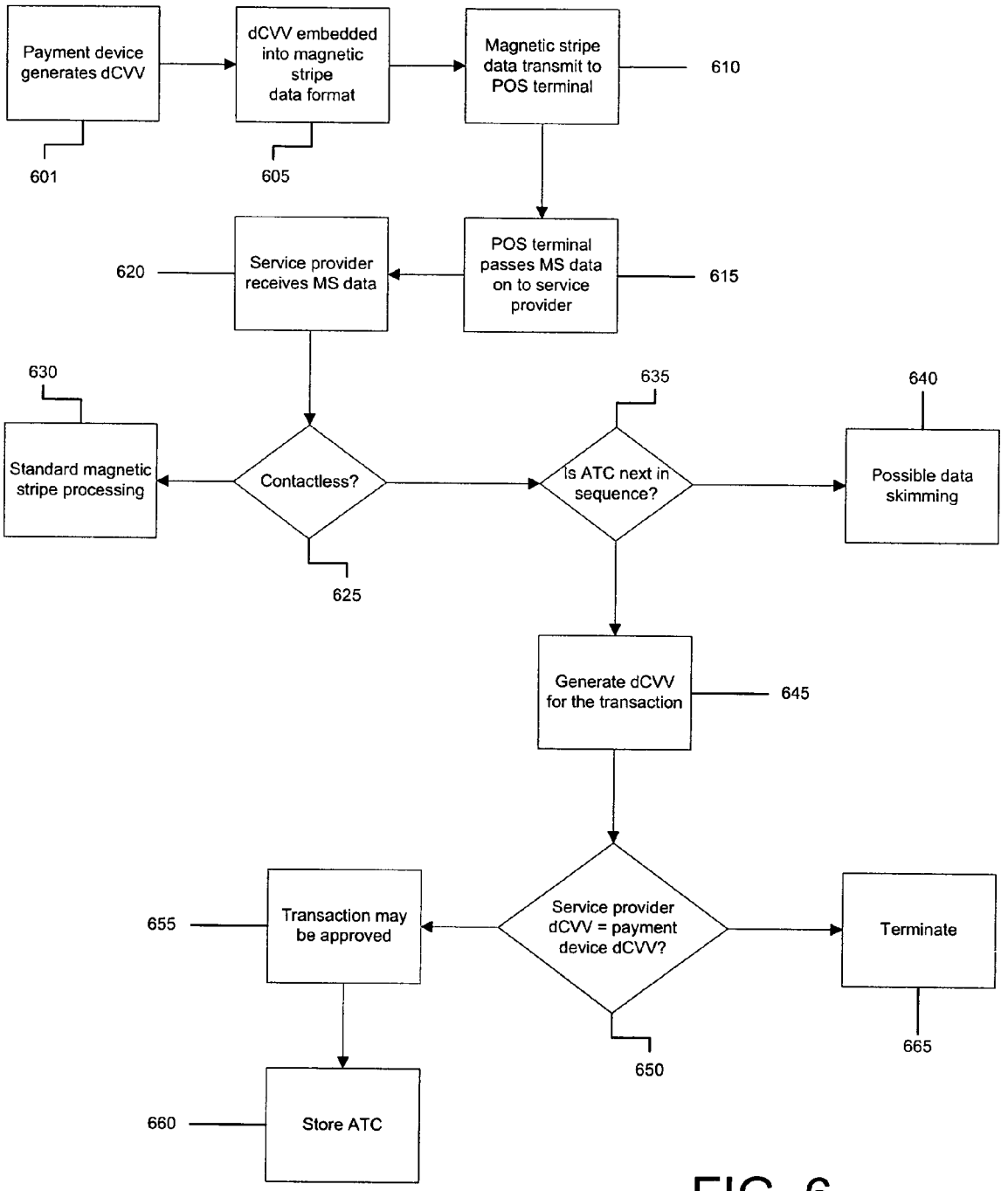

Payment device generates dCVV
601
dCVV embedded into magnetic stripe data format
605
Magnetic stripe data transmit to POS terminal
610
POS terminal passes MS data on to service provider
615
Service provider receives MS data
620
Contactless?
625
Standard magnetic stripe processing
630
Is ATC next in sequence?
635
Possible data skimming
640
Generate dCVV for the transaction
645
Service provider dCVV = payment device dCVV?
650
Terminate
665
Transaction may be approved
655
Store ATC
660

FIG. 6

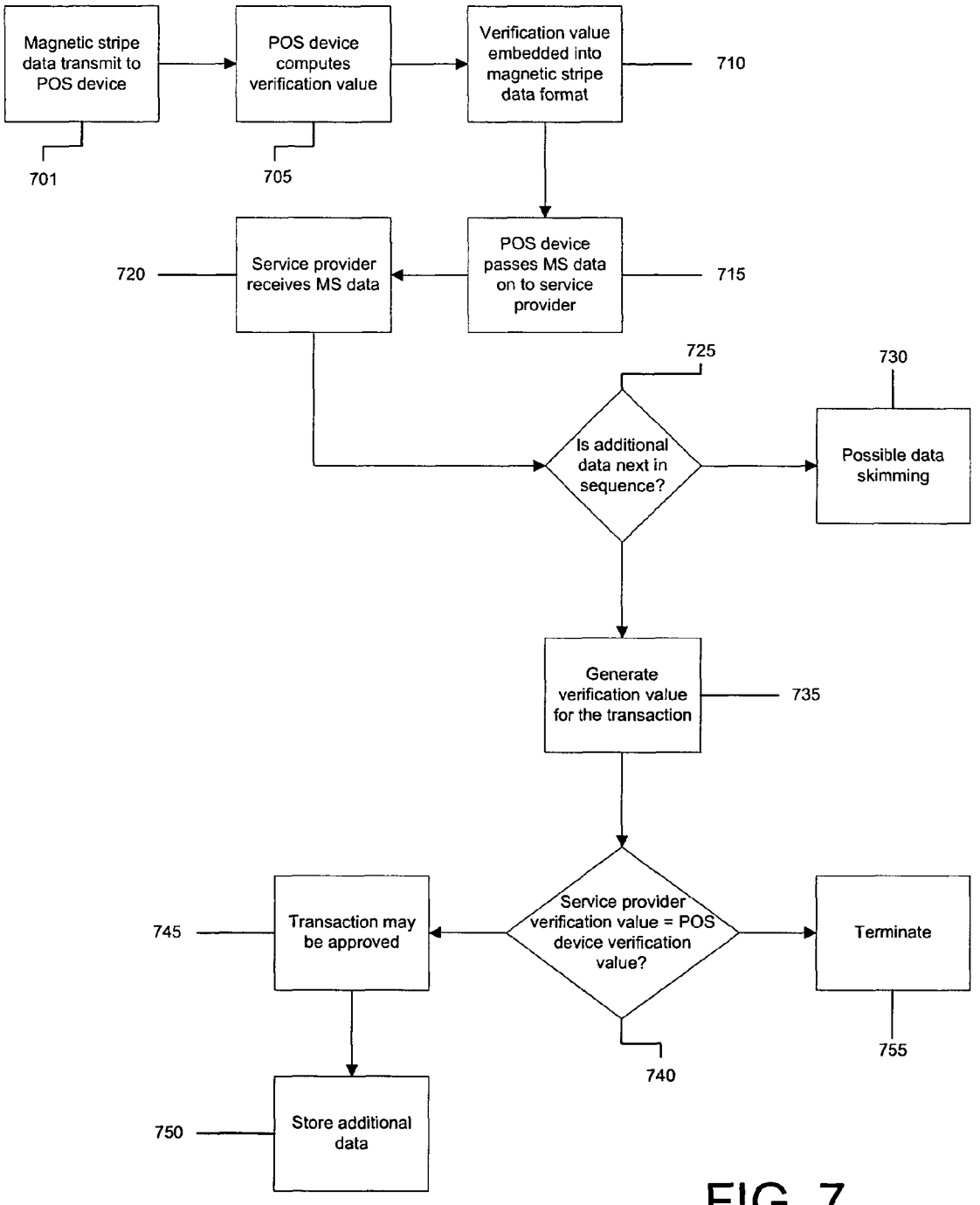

Magnetic stripe data transmit to POS device
POS device computes verification value
Verification value embedded into magnetic stripe data format
710
701
705
Service provider receives MS data
720
POS device passes MS data on to service provider
715
725
730
Is additional data next in sequence?
Possible data skimming
Generate verification value for the transaction
735
Service provider verification value = POS device verification value?
745
Transaction may be approved
Terminate
740
755
Store additional data
750

FIG. 7

METHOD AND SYSTEM FOR GENERATING A DYNAMIC VERIFICATION VALUE

BACKGROUND OF THE INVENTION

As methods and devices for engaging in financial transactions have increased and expanded into new horizons, age old problems such as fraud and counterfeiting persist. In fact, as applications and devices are developed which make credit or debit based transactions a more attractive and readily available alternative to cash, fraud and counterfeiting activities have seen a proportionate increase.

In order to protect financial institutions, consumers and merchants from the fraudulent use of transaction cards, the industry has developed and introduced many features designed to reduce fraud and counterfeiting such as holograms, special over-layers, and watermarks. Nonetheless, many of these features are proving to be less effective as financial transactions are increasingly being conducted in a wireless environment. Similarly, as financial instruments are increasingly being employed on electronic devices, rather than physical plastic cards, the ability to use techniques such as a customer signature or holograms to verify a party to a transaction is becoming less available.

One of the primary sources of fraud which is prevalent in the credit card industry is skimming, which refers to the electronic copying of the card's magnetic stripe data to create counterfeit cards. Early skimming was difficult to hide and required cumbersome equipment. As credit card technology has become more sophisticated, so has the technology used by skimmers.

In addition, new forms of skimming have appeared. For example, in one instance a small bug was implanted in a terminal, and left in place for weeks to collect hundreds of card numbers before being removed to harvest the collective card data. Also, one of the more insidious forms of skimming involved line tapping wherein the communication lines between the terminal and the credit card issuer is tapped and the card data extracted from the communications string. One of the most sophisticated examples of line tapping involved skimmers renting an office next to an issuers regional data center and tapping lines going to the issuer computers. The tapped lines were redirected through a computer on the skimmer's site. Compounding the problem, the skimmers were able to remotely access their computer thus permitting the skimmers to harvest the credit card numbers from a remote location. By some estimates, skimming costs financial institutions hundreds of billions of dollars annually. Furthermore, some industry analysts have estimated that each skimmed card will engage in at least $2,000 in transactions before the fraud is uncovered.

Skimming is predominantly a phenomenon afflicting magnetic stripe based transactions. This is because the magnetic stripe, which is placed on the back of a transaction card and stores a variety of data on three separate tracks, is a passive media. In other words, the digital content of the magnetic stripe can be perfectly copied, without any difference between the copy and the original. Largely, this feature is relied upon in legitimate magnetic stripe transactions as a point of sale terminal is simply required to read the data present on the magnetic stripe.

One of the primary means by which skimming can be prevented is for the consumer to closely monitor the whereabouts of their transaction card. This will allow the consumer to prevent the card from being swiped through inappropriate devices. However, as magnetic stripe contactless cards evolve and bring the promise of quick transactions to current payment environments, the classic skimming problem comes along with it. In fact, in a wireless environment the opportunity to skim magnetic stripe data is more prevalent. In a wireless environment, a potential skimmer need not physically possess the card to be skimmed nor have access to any of the physical equipment (e.g. POS terminal, communication lines, etc.) which is required for skimming in a wire based environment. A skimmer can simply, and without knowledge of the consumer or merchant, intercept the wireless transaction and copy the data being transmitted from the card to POS terminal.

Nonetheless, magnetic stripe data and magnetic stripe payment applications are increasingly being deployed on integrated circuit cards or similar devices which have processing capabilities. Accordingly, what is needed is to dynamically generate a verification value for each transaction which can be used to authenticate the transaction. Such an approach to authentication of the payment service will significantly reduce the opportunity for skimming since the verification value is different for each transaction. Therefore, even if the data utilized in a given transaction is skimmed, that data will not be useful in conducting further transactions since the skimmed verification value is not valid for subsequent transactions.

SUMMARY OF THE INVENTION

The present invention describes a system and method for dynamically generating a verification value for verifying the authenticity of a payment service deployed on a payment device, such as an integrated circuit credit card, each time the payment service is utilized in a transaction. With each transaction, a verification value is dynamically generated on the payment device from data specific to the payment service. The verification value is embedded into the payment data which is transmitted from the payment device to a point of sale terminal such as a credit card terminal. The point of sale terminal transmits the payment data, with the embedded verification data, which may be in the form of magnetic stripe credit card Track 1 and/or Track 2 data, to a payment network which transmits the payment data to a service provider computer. The service provider computer independently generates a verification value. The transaction is disapproved if the service provider generated verification value does not match the payment device generated verification value.

In an alternate embodiment, payment data generated with each transaction on the payment device is transmitted from the payment device on which the payment data was generated to a point of sale terminal such as a credit card terminal. A verification value may be generated by the point of sale terminal using the payment data and information contained within the point of sale device. The point of sale terminal transmits the payment data, with the verification data, which may be in the form of magnetic stripe credit card Track 1 and/or Track 2 data, to a payment network which transmits the payment data to a service provider computer. The service provider computer independently generates a verification value. The transaction is disapproved if the service provider generated verification value does not match the verification value generated on the point of sale terminal.

The present invention may be used in any transaction in which magnetic stripe Track 1 and/or Track 2 data will be

exchanged over any type of interface including contact-based interfaces and wireless interfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

Aspects, features, benefits and advantages of the embodiments of the present invention will be apparent with regard to the following description, appended claims and accompanying drawings where:

FIG. **1** depicts the method of creating an encrypted data block for use in the present invention.

FIG. **2** depicts a method for generating unique derived keys from data residing on a payment device.

FIG. **3** depicts a method for extracting portions of an encrypted data block for creating a dynamic card verification value according to the present invention.

FIG. **4** depicts an exemplary record format for use in an embodiment of the present invention.

FIG. **5** depicts an alternative exemplary format for use in an embodiment of the present invention.

FIG. **6** is a flowchart of a preferred method of utilizing a dynamically created verification value to authenticate a transaction.

FIG. **7** is a flowchart of an alternate method of utilizing a dynamically created verification value to authenticate a transaction.

DETAILED DESCRIPTION OF THE INVENTION

Before the present methods are described, it is to be understood that this invention is not limited to the particular methodologies, devices or protocols described, as these may vary. It is also to be understood that the terminology used in the description is for the purpose of describing the particular versions or embodiments only, and is not intended to limit the scope of the present invention which will be limited only by the appended claims. In particular, although the present invention is described in conjunction with financial transactions, it will be appreciated that the present invention may find use in any electronic exchange of data.

It must also be noted that as used herein and in the appended claims, the singular forms "a", "an", and "the" include plural reference unless the context clearly dictates otherwise. Thus, for example, reference to a "key" is a reference to one or more keys and equivalents thereof known to those skilled in the art, and so forth. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art. Although any methods similar or equivalent to those described herein can be used in the practice or testing of embodiments of the present invention, the preferred methods are now described. All publications mentioned herein are incorporated by reference. Nothing herein is to be construed as an admission that the invention is not entitled to antedate such disclosure by virtue of prior invention.

Generally, the present invention provides methods and systems for dynamically generating a card verification value for each transaction and for utilizing such value to verify that the payment service is authentic and has not been skimmed. The dynamically generated Card Verification Value (referred to herein as the "dCVV") is generated on the payment device, embedded into the payment data, and transmitted to a point of sale terminal. In an alternate embodiment, payment data is received from a payment device, a verification value is generated by a point of sale terminal, and the verification value is embedded into the payment data.

In an embodiment, data received by the point of sale terminal is interpreted as simply payment data (e.g. standard magnetic stripe Track 1 and/or Track 2 data without an embedded dCVV) by the point of sale terminal. The point of sale terminal passes on the received data to a payment network which, in turn, passes the data on to the service provider. If the service provider determines the transaction is one for which a dCVV is required, the service provider independently generates a verification value. If the verification value generated by the service provider does not match the dCVV received from the payment device, the transaction is identified as potentially fraudulent and disapproved.

In an alternate embodiment, data is received by the point of sale terminal and is used by the point of sale terminal to generate a verification value. The point of sale terminal passes on the received data to a payment network which, in turn, passes the data on to the service provider. The service provider independently generates a verification value. If the verification value generated by the service provider does not match the dCVV received from the point of sale terminal, the transaction is identified as potentially fraudulent and disapproved.

For purposes of this application, the term "payment device" shall mean any device comprising a microprocessor which may be used in a transaction or data exchange as described herein. Without limiting the generality of the foregoing, "payment device" shall include an integrated circuit card (also commonly known as a smartcard), a memory card, a cellular telephone, a personal digital assistant, a mobile electronic device, or a computer.

For purposes of this application, "contactless" or "wireless" shall mean any communications method or protocol, including proprietary protocols, in which data is exchanged between two devices without the need for the devices to be physically coupled. Without limiting the generality of the foregoing, "contactless" or "wireless" shall include data transmissions by laser, radio frequency, infrared communications, Bluetooth, or wireless local area network.

For purposes of this application, the term "payment service" shall mean any application deployed on a payment device which causes the exchange of data between the payment device and any other device or location. It should be appreciated that "payment service" is not limited to financial applications.

For purposes of this application, "payment data" shall mean, with respect to financial applications those data elements used by the payment service to execute a transaction, and with respect to non-financial transactions any necessary data elements exclusive of the present invention. For example, when the payment service is a magnetic stripe credit card transaction, "payment data" would comprise Track 1 and/or Track 2 data, as that is understood by one of ordinary skill in the credit card industry, such as the primary account number, expiration date, service codes, and discretionary data. "Payment data" may also comprise a unique card identification number or a unique identification number for a service provider.

In an embodiment, the payment data will reside on memory located on the payment device. The payment device will also maintain an application transaction counter (ATC). The ATC will initially be set by the service provider to a predetermined value. Thereafter, the ATC will be incremented with each transaction. Alternately, the ATC may be decremented from its initial predetermined value with each transaction. The ATC may be a value of any length. In addition, the service provider which deployed the payment service will maintain a corresponding ATC accessable to the service provider's com-

puter. As discussed in more detail below, this corresponding ATC is used to identify payment services which may have been skimmed. In an alternate embodiment, a cryptogram, digital signature, or hash value based on transaction data may be used in place of or in conjunction with the ATC.

Each time the payment service is initiated, a dCVV is generated on the payment device for authentication purposes. FIG. **1** depicts the method of generating a dCVV for each transaction according to the present invention. Initially, a numeric string of predetermined length is created. This numeric string is created by overlaying **101** the ATC **102** over the corresponding leftmost digits of the account number for the payment service or PAN **104**. This numeric string is concatenated on the right with the expiration date for the payment service and the service code to produce a concatenated value **106**. If necessary, padding characters **108** are concatenated **110** on the right of the concatenated value **106** to form a numeric string **112** with a predetermined fixed length. In a preferred embodiment, this numeric string **112** is 128-bits in length, although a numeric string of any length may be used. The padding characters **108** may consist of a stream of 0's, 1's, or any other numeric value that is known both to the payment device and the service provider. The numeric string **112** is bisected into two blocks of equal length, Block A **116** and Block B **118**. Block A **116** is then encrypted **121** with a first encryption key **120**. The result of the encryption step **121** is Block C **122** of length equal to Block A **116**. Block C **122** is then exclusively OR'ed (XOR) **123** with Block B **118** resulting in Block D **124**. Block D **124** is then encrypted **125** with a second encryption key **126** to produce Block E **128**. Block E **128** is then decrypted **129** using a decryption key **130** to produce Block F **132**. Block F **132** is then encrypted **133** using a fourth encryption key **134** to produce Block G **136**.

It will be apparent to one of ordinary still in the art that the first encryption key **120**, the second encryption key **126**, the third encryption key **130** and the fourth encryption key **134** may take any preselected value. In an embodiment of the present invention, the first encryption key **120**, the second encryption key **126**, and the fourth encryption key **134** are equivalent and of a different value from the third encryption key **130**. Other permutations of the encryption key values utilized in the methodology of FIG. **1** are within the scope of the present invention.

In a preferred embodiment, the first encryption key **120**, the second encryption key **126**, the third encryption key **130**, and the fourth encryption key **134** take the value of unique keys derived from data existing on the payment device. Upon deployment, each payment service is personalized by the service provider with a master derivation key. The master derived key may be deployed with payment services in batches (i.e. multiple payment services receive the same master derived key) or individually. Each payment device will be personalized with the functionality to derive keys unique to the payment service. FIG. **2** shows the methodology for deriving two unique keys which are utilized in the preferred embodiment. The account number **201**, the account sequence number **202**, the inverse of the account number **203**, and the inverse of the account sequence number **204** are concatenated together to create a concatenated value **210**. If necessary, the concatenated value **210** may be padded with zeroes, or some other value **211**, to create a string of a predetermined fixed length. In a preferred embodiment, the concatenated value **210** may be 128 bits in length, although the concatenated value is not limited to being this length. The concatenated value **210** is then encrypted **220** using the master derivation key **221** as the encryption key for each encryption stage. The encryption utilized may include any type of encryption methodology. For example, this encryption step may utilize Triple-DES encryption. The value resulting from the encryption step **220** is a unique derived key or UDK **230** for the application identified by the account number. Two additional keys, UDKA **240** and UDKB **241**, are derived from the UDK. The derivation of UDKA **240** and UDKB **241** from the UDK **230** may take any form, including assigning the value of the leftmost half of the UDK **230** to UDKA **240**, and assigning the value of the rightmost half of the UDK **230** to UDKB **241**. Alternatively, the UDKA **240** may be derived by selecting alternating or other predetermined bit sequences from the UDK **230** while the remaining bits are assigned to UDKB **241**. Furthermore, there is no requirement that UDKA **240** and UDKB **241** are of equal length.

Returning now to the result of the methodology set forth in FIG. **1**. FIG. **3** describes the further processing required to generate the dCVV. Each nibble (4-bit grouping) of the value stored in Block G **136** is subjected to two separate iterative processes to evaluate the value of each nibble. As shown in FIG. **3**, beginning with the most significant (i.e left most) digit of Block G **136** and examining each sequential nibble, if a nibble contains a value ranging from zero to nine, inclusive, that value is extracted **301** and placed in a new numeric string **305**, referred to herein as a holding string, by concatenating the extracted value to the right of the previously extracted value, if any. The result will be that the holding string contains a series of values ranging from zero to nine, inclusive, which appear from left to right in the holding string in the same sequence in which they appear in Block G **136**.

A second evaluation is then performed again beginning with the most significant digit of Block G **136** and examining each sequential nibble. If a nibble contains a hexadecimal value ranging from ten (A) to fifteen (F), inclusive, that value is extracted **310**. The extracted value is then decimalized by subtracting the hexadecimal value A from the extracted value resulting in a decimalized value ranging from zero to five **315**. This decimalized value is then concatenated on the right to the right most value of the holding string **320**.

Once all nibbles in Block G have been twice examined as described, the three most-significant (i.e. leftmost) nibbles of the holding string are extracted **325**. This 3-digit value is the dCVV for the transaction. Other numbers of bits may be extracted from the twice-examined nibble string to generate the dCVV for a transaction. Furthermore, different nibbles, such as the rightmost nibbles, may be used as the dCVV for a transaction. The three leftmost nibbles, however, represent a preferred embodiment.

Once generated, the dCVV is embedded into the payment data transmitted from the payment device to the point of sale terminal. The data received by the point of sale terminal will appear to the point of sale terminal as standard payment data. In other words, the point of sale terminal will not be able to determine if a dCVV is embedded and where such dCVV may be located. There is no indication to the point of sale terminal that a dCVV is embedded into the data received from the payment device.

FIG. **4** depicts an exemplary record format for transmitting payment data, with the dCVV embedded therein, from the payment device to the point of sale terminal. The record format of FIG. **4** is created by concatenating a primary account number **401** for the payment service, with an expiration date **402**, and a service code **403**. In a preferred embodiment, the primary account number **401** is 16 digits long, the expiration date **402** is four digits long, and the service code **403** is three digits long. However, the primary account number **401**, the expiration date **402**, and the service code **403** are

not limited to being these lengths. Next, in a field typically reserved for other uses, a value is placed as an indicator **405** that a dCVV has been embedded in this record. The value of this indicator is known by the service provider which deployed the application on the payment device. Next, the ATC **410** is placed in the field which may typically be reserved for PIN verification data. Finally, the dCVV **415** is concatenated on the right of the record. The remainder of the record may comprise additional discretionary data.

Alternately, FIG. **5** depicts a second exemplary format for transmitting payment information with the dCVV embedded thereon from the payment device to the point of sale terminal. The format in FIG. **5** is created by concatenating a primary account number **501** for the payment service, with an expiration date **502**, a service code **503**, a PVKI **504**, and a field for PIN verification data **505**. In a preferred embodiment, the primary account number **501** is sixteen digits long, the expiration date **502** is four digits long, the service code **503** is three digits long, the PVKI **504** is one digit long, and the PIN verification data **505** is four digits long. However, the primary account number **501**, the expiration date **502**, the service code **503**, the PVKI **504**, and the PIN verification data **505** are not limited to being these lengths. Next, in a single data field **510** each of the dynamically created CVV, the ATC and the indicator to be used by the service provider to identify that a dynamic CVV has been embedded are stored in sequence. The remainder of the record may comprise additional discretionary data.

An important aspect of the present invention is that the system of utilizing the dynamically created CVV allows the service provider to make a determination of the authenticity of the payment service being utilized. This authentication step is not left to merchants, individual point of sale terminals, or other third parties or devices. FIG. **6** shows how the dCVV is used in a contactless environment to permit the service provider to evaluate the authenticity of the payment application deployed on the payment device to make a determination of whether the payment application has been skimmed. Although shown in the embodiment of a contactless environment in FIG. **6**, the present invention is not limited to such an environment and may be used for any transaction where magnetic stripe Track 1 and/or Track 2 data is exchanged using any method or means for communicating such data. As shown in FIG. **6**, the payment device generates the dCVV **601**, preferably using the methodology described above. The dCVV is embedded into the payment data **605**. In this respect, the exemplary record formats shown in FIG. **4** or FIG. **5** may be utilized. The payment data with the embedded dCVV is transmitted by data communication to the point of sale terminal **610**. The point of sale terminal recognizes the received data as in the standard format of payment data and passes the data stream on to the service provider computer **615**, likely via a payment network (not shown). The service provider computer receives **620** the payment data with the embedded dCVV and interrogates the appropriate indicator to determine if the transaction was a contactless transaction or not **625**. If the service provider computer determines that the transaction was not a contactless transaction, the transaction is processed in its normal manner **630**. If the service provider computer determines that the transaction was contactless, the service provider computer compares the ATC received from the payment device to the corresponding ATC stored on the service provider computer to determine if the received ATC is the expected next ATC **635**. If the ATC received from the payment device is not the expected next ATC, the payment service deployed on the payment device has potentially been skimmed **640**. If the expected next ATC is received, the service provider computer will independently re-generate the dCVV for the given transaction **645** utilizing the same process as described above. If the service provider generated dCVV matches the dCVV received from the payment device **650**, the service provider deems the payment application to be authentic **655**. The service provider computer then replaces the ATC which was previously stored on the service provider computer with the ATC received from the payment device **660** for subsequent authentications. If the service provider generated dCVV does not match the dCVV received from the payment device, the transaction is potentially fraudulent and is terminated **665**.

The methodology of FIG. **6** discussed in conjunction with contactless transactions, is not limited thereto. For example, the methodology may be utilized with respect to transactions above a certain threshold value. In such an instance, the service provider, upon deploying the application, would configure the application to generate a dCVV for transactions above the threshold. The indicator interrogated in Step **625** would then be set for transactions above the threshold value. Similarly, the methodology may be utilized with respect to any other transaction criteria including, but not limited to, geographic location, use patterns, or any other criteria.

In an alternate embodiment, the payment device transmits payment data to a point of sale terminal such as a credit card terminal **701**. The point of sale terminal receives the data and computes a verification value for the transaction **705**. The verification value may be computed in a number of different ways including, without limitation, using a unique transaction number provided by the point of sale terminal, a timestamp, or a transaction amount added to a timestamp. The point of sale terminal may then embed and/or append the verification value and additional data to the payment data **710**. The additional data may be required for the service provider computer to verify the transaction. The point of sale terminal then passes the data stream on to the service provider computer **715**, likely via a payment network (not shown). The service provider computer receives the payment data with the verification value **720**. The service provider computer may optionally compare at least a portion of the additional data embedded or appended by the point of sale terminal to corresponding data stored on the service provider computer to determine if the received data is proper **725**. If the received data from the point of sale terminal is improper, the transaction data may potentially have been skimmed **730**. If proper data is received, the service provider computer will independently re-generate the verification value for the given transaction utilizing the same process as used by the point of sale terminal **735**. If the service provider generated verification value matches the verification value received from the point of sale terminal **740**, the service provider deems the payment application to be authentic **745**. The service provider computer may then optionally update the additional data which was previously stored on the service provider computer with the additional data received from the payment device for subsequent authentications **750**. If the service provider generated verification value does not match the verification value received from the point of sale terminal, the transaction is potentially fraudulent and is terminated **755**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed is:

1. A method comprising a plurality of steps, each being performed by hardware executing software, wherein the steps include:

generating a verification value in response to a transaction involving a mobile electronic device, wherein the verification value is generated by:

creating a base record comprising:

digits for an application transaction counter overlaying the left most digits of a primary account number corresponding to an account upon which the transaction is being conducted, wherein the application transaction counter is incremented for each said transaction; and

concatenated to the right most digits of the primary account number:

a card security code for the primary account number; and

an expiration date for the primary account number;

bisecting the base record into a first field and a second field;

encrypting the first field using a first encryption key;

performing an exclusive-OR (XOR) operation on the encrypted first field and the second field to produce a first result;

encrypting the first result using a second encryption key to produce a second result:

decrypting the second result using a decryption key to produce a third result;

encrypting the third result using a third encryption key to produce a fourth result;

sequentially extracting each value between 0 and 9 from the most-significant digit to the least-significant digit of the fourth result to produce a fifth result;

sequentially extracting and subtracting hexadecimal A from each value between hexadecimal A and hexadecimal F from the most-significant digit to the least-significant digit of the fourth result to produce the sixth result;

concatenating the fifth result and the sixth result to produce a seventh result; and

selecting one or more values from the seventh result as the verification value; and

sending the verification value for delivery to the service provider with data in a magnetic stripe data format so that the service provider can verify the verification value.

2. The method of claim 1 wherein the base record has a length equal to the number of digits of the primary account number corresponding to the account upon which the transaction is being conducted.

3. The method of claim 2, wherein the base record has a length of 128 bits.

4. The method of claim 1 wherein the steps further include a determination that a transaction amount for the transaction exceeds a predetermined threshold value prior to the generation of the verification value.

5. The method of claim 1 wherein the steps further comprise a determination, prior to the generating of the verification value, that a geographic location of the transaction corresponds to a predetermined geographic location.

6. The method of claim 1 wherein:

the verification value is generated on the mobile electronic device;

the transaction is a payment transaction; and

the mobile electronic device is a payment device.

7. The method of claim 6 wherein the mobile electronic device is selected from the group consisting of an integrated circuit card, a smartcard, a memory card, a cellular telephone, a personal digital assistant, and a computer.

8. The method of claim 1 wherein the sending of the verification value for delivery to the service provider comprises the mobile electronic device transmitting the verification value to a point of sale terminal via wireless communications.

9. A method comprising a plurality of steps each being performed by hardware executing software, wherein the steps include:

generating, at a point of sale terminal, unique transaction data for a transaction being processed by the point of sale terminal;

sending, from the point of sale terminal in a wireless communication, the unique transaction data for the transaction;

receiving, at a mobile electronic device, the unique transaction data for the transaction;

creating, at the mobile electronic device, a base record comprising:

digits for an application transaction counter overlaying the left most digits of a primary account number corresponding to an account upon which the transaction is being conducted, wherein the application transaction counter is incremented for each said transaction; and

concatenated to the right most digits of the primary account number:

a card security code for the primary account number; and

an expiration date for the primary account number;

splitting, at the mobile electronic device, the base record into a first field and a second field;

encrypting, at the mobile electronic device, the first field using a first encryption key;

performing, at the mobile electronic device, an exclusive-OR (XOR) operation on the encrypted first field and the second field to produce a first result;

encrypting, at the mobile electronic device, the first result using a second encryption key to produce a second result;

decrypting, at the mobile electronic device, the second result using a decryption key to produce a third result;

encrypting, at the mobile electronic device, the third result using a third encryption key to produce a fourth result;

sequentially extracting, at the mobile electronic device, each value between 0 and 9 from the most-significant digit to the least-significant digit of the fourth result to produce a fifth result;

sequentially extracting and subtracting, at the mobile electronic device, hexadecimal A from each value between hexadecimal A and hexadecimal F from the most-significant digit to the least-significant digit of the fourth result to produce the sixth result;

concatenating, at the mobile electronic device, the fifth result and the sixth result to produce a seventh result; and

selecting, at the mobile electronic device, one or more values from the seventh result as a verification value;

sending, from the mobile electronic device, data in a magnetic stripe data format that includes the verification value; and

receiving, at the point of sale terminal in a wireless communication, the data in a magnetic stripe data format and

transmitting, from the point of sale terminal, the verification value for delivery to the service provider so that the service provider can verify the verification value.

10. The method as defined in claim **9**, wherein the base record has a length equal to the number of digits of the primary account number corresponding to the account upon which the transaction is being conducted.

11. The method as defined in claim **10**, wherein the base record has a length of 128 bits.

12. The method as defined in claim **9**, wherein the steps further include a determination that a transaction amount for the transaction exceeds a predetermined threshold value prior to the generation of the verification value.

13. The method as defined in claim **9**, wherein the steps further comprise a determination, prior to the sending, receiving and transmitting,

that a geographic location of the transaction corresponds to a predetermined geographic location.

14. The method as defined in claim **9**, wherein:

the transaction is a payment transaction;

the verification value is generated by the mobile electronic device in response to the transaction at the point of sale terminal; and

the mobile electronic device is in communication with the point of sale terminal; and

the mobile electronic device is a payment device.

15. The method as defined in claim **14**, wherein the payment device is selected from the group consisting of an integrated circuit card, a smartcard, a memory card, a cellular telephone, a personal digital assistant, and a computer.

16. The method as defined in claim **9**, wherein each said wireless communication is selected from a group consisting of a laser transmission, a radio frequency transmission, an infrared transmission, a Bluetooth transmission, and a wireless local area network transmission.

* * * * *