US007740168B2

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

(10) **Patent No.: US 7,740,168 B2**
(45) **Date of Patent: Jun. 22, 2010**

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

(75) Inventors: **Ayman Hammad**, Pleasanton, CA (US); **Patrick Faith**, Pleasanton, CA (US); **Christian Aabye**, Foster City, CA (US); **Jagdeep Singh Sahota**, Rodeo, CA (US)

(73) Assignee: **Visa U.S.A. Inc.**, San Francisco, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/764,376**

(22) Filed: **Jun. 18, 2007**

(65) **Prior Publication Data**

US 2008/0029593 A1 Feb. 7, 2008

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/642,878, filed on Aug. 18, 2003.

(60) Provisional application No. 60/815,059, filed on Jun. 19, 2006, provisional application No. 60/815,430, filed on Jun. 20, 2006, provisional application No. 60/884,089, filed on Jan. 9, 2007.

(51) **Int. Cl.**
G06Q 40/00 (2006.01)
G07D 11/00 (2006.01)
G07F 19/00 (2006.01)

(52) **U.S. Cl.** **235/379**; 235/380; 235/493

(58) **Field of Classification Search** 235/379, 235/380, 375, 487, 492, 451, 443; 705/41
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,956,615 A 5/1976 Anderson et al.
4,186,871 A 2/1980 Anderson et al.
4,238,853 A 12/1980 Ehrsam et al.
4,277,837 A 7/1981 Stuckert
4,317,957 A 3/1982 Sendrow
4,423,287 A 12/1983 Zeidler
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
5,530,438 A 6/1996 Bickham et al.
5,615,110 A 3/1997 Wong
5,625,689 A 4/1997 Indeck et al.

(Continued)

OTHER PUBLICATIONS

U.S. Appl. No. 11/761,370, Faith.

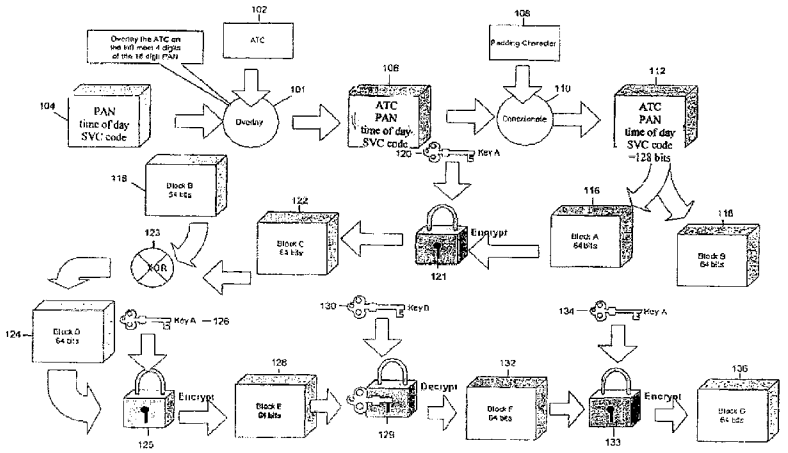
(Continued)

Primary Examiner—Edwyn Labaze
(74) *Attorney, Agent, or Firm*—Townsend and Townsend and Crew LLP

(57) **ABSTRACT**

A method is disclosed. The method includes generating a verification value in response to a transaction involving a portable consumer device, where the verification value is generated using a first dynamic data element and a second dynamic data element. The verification value is sent to a service provider associated with the portable consumer device so that the service provider can verify the transaction.

24 Claims, 7 Drawing Sheets



U.S. PATENT DOCUMENTS

5,627,355	A	5/1997	Rahman et al.	
5,679,940	A	10/1997	Templeton et al.	
5,708,422	A	1/1998	Blonder et al.	
5,721,781	A	2/1998	Deo et al.	
5,740,244	A	4/1998	Indeck et al.	
5,745,576	A	4/1998	Abraham 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	
5,839,119	A	11/1998	Krsul et al.	
5,872,834	A	2/1999	Teitelbaum	
5,878,337	A	3/1999	Joao et al.	
5,883,810	A	3/1999	Franklin	
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.	
5,956,699	A	9/1999	Wong et al.	
5,988,497	A	11/1999	Wallace	
6,005,942	A	12/1999	Chan et al.	
6,012,144	A	1/2000	Pickett	
6,016,476	A	1/2000	Maes et al.	
6,029,154	A	2/2000	Pettitt	
6,055,505	A	4/2000	Elston	
6,064,990	A	5/2000	Goldsmith	
6,081,792	A	6/2000	Cucinotta et al.	
6,095,413	A	8/2000	Tetro et al.	
6,112,191	A	8/2000	Burke	
6,122,624	A	9/2000	Tetro et al.	
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.	
6,263,447	B1	7/2001	French et al.	
6,282,656	B1	8/2001	Wang	
6,298,336	B1	10/2001	Davis et al.	
6,308,890	B1	10/2001	Cooper	
6,330,550	B1	12/2001	Brisebois et al.	
6,367,011	B1	4/2002	Lee et al.	
6,442,532	B1	8/2002	Kawan	
6,488,206	B1	12/2002	Flaig et al.	
6,496,936	B1	12/2002	French et al.	
6,505,046	B1	1/2003	Baker	
6,523,745	B1	2/2003	Tamori	
6,529,725	B1	3/2003	Joao et al.	
6,535,855	B1	3/2003	Cahill et al.	
6,592,044	B1	7/2003	Wong et al.	
6,607,136	B1	8/2003	Atsmon et al.	
6,612,488	B2	9/2003	Suzuki	
6,647,269	B2	11/2003	Hendrey et al.	
6,714,918	B2	3/2004	Hillmer et al.	
6,715,672	B1	4/2004	Tetro et al.	
RE38,572	E	8/2004	Tetro et al.	
6,775,539	B2	8/2004	Deshpande	
6,830,183	B2	12/2004	von Mueller et al.	
6,832,721	B2	12/2004	Fujii	
6,837,425	B2	1/2005	Gauthier et al.	
6,839,840	B1	1/2005	Cooreman	
6,839,845	B2	1/2005	Hsu et al.	
6,857,073	B2	2/2005	French et al.	
6,862,575	B1	3/2005	Anttila et al.	
6,868,391	B1	3/2005	Hultgren	
6,877,661	B2	4/2005	Webb et al.	
6,899,269	B1	5/2005	Deland	
6,904,526	B1 *	6/2005	Hongwei	713/182
6,913,194	B2	7/2005	Suzuki	
6,944,782	B2	9/2005	von Mueller et al.	
6,948,656	B2	9/2005	Williams	
6,968,180	B2	11/2005	Kirby et al.	
6,983,882	B2	1/2006	Cassone	
7,003,495	B1	2/2006	Burger et al.	
7,003,497	B2	2/2006	Maes	
7,007,840	B2	3/2006	Davis	
7,013,293	B1	3/2006	Kipnis et al.	
7,024,396	B2	4/2006	Woodward	
7,044,394	B2	5/2006	Brown	
7,051,002	B2	5/2006	Keresman, III et al.	
7,058,611	B2	6/2006	Kranzley et al.	
7,058,978	B2	6/2006	Feuerstein et al.	
7,096,003	B2	8/2006	Joao et al.	
7,107,250	B2	9/2006	Harrison	
7,143,095	B2	11/2006	Barrett et al.	
7,152,788	B2	12/2006	Williams	
7,225,156	B2	5/2007	Fisher et al.	
7,243,853	B1	7/2007	Levy et al.	
7,251,624	B1	7/2007	Lee et al.	
7,257,545	B1	8/2007	Hung	
7,264,154	B2	9/2007	Harris	
7,343,317	B2	3/2008	Jokinen et al.	
7,349,668	B2	3/2008	Ilan et al.	
D568,388	S	5/2008	Hammad	
D568,389	S	5/2008	Hammad	
D568,390	S	5/2008	Law et al.	
7,403,908	B1	7/2008	Jaramillo	
7,420,474	B1	9/2008	Elks et al.	
2002/0002681	A1 *	1/2002	Kawano et al.	713/180
2002/0091562	A1	7/2002	Siegel et al.	
2002/0091945	A1	7/2002	Ross	
2002/0095389	A1	7/2002	Gaines	
2002/0096570	A1 *	7/2002	Wong et al.	235/494
2002/0099665	A1	7/2002	Burger et al.	
2002/0108062	A1	8/2002	Nakajima et al.	
2002/0133462	A1	9/2002	Shteyn	
2002/0153424	A1	10/2002	Li	
2002/0180584	A1	12/2002	McGregor et al.	
2002/0194499	A1	12/2002	Audebert et al.	
2003/0074317	A1	4/2003	Hofi	
2003/0105964	A1 *	6/2003	Brainard et al.	713/178
2003/0115142	A1	6/2003	Brickell et al.	
2003/0135463	A1	7/2003	Brown et al.	
2003/0169881	A1	9/2003	Niedermeyer	
2003/0200184	A1	10/2003	Dominguez et al.	
2003/0208684	A1	11/2003	Camacho et al.	
2003/0225703	A1	12/2003	Angel	
2004/0019970	A1	2/2004	Landry	
2004/0024638	A1	2/2004	Restis	
2004/0031856	A1	2/2004	Atsmon et al.	
2004/0059688	A1	3/2004	Dominguez et al.	
2004/0064403	A1	4/2004	Hasumi et al.	
2004/0078340	A1	4/2004	Evans	
2004/0107170	A1	6/2004	Labrou et al.	
2004/0156537	A1	8/2004	Chung et al.	
2004/0171406	A1	9/2004	Purk	
2004/0185830	A1	9/2004	Joao et al.	
2005/0060233	A1	3/2005	Bonalle et al.	
2005/0060730	A1	3/2005	Soeda et al.	
2005/0071226	A1	3/2005	Nguyen et al.	
2005/0071227	A1	3/2005	Hammad et al.	
2005/0071228	A1	3/2005	Bortolin et al.	
2005/0071235	A1	3/2005	Nguyen et al.	
2005/0080730	A1	4/2005	Sorrentino	
2005/0091152	A1	4/2005	Suisa	
2005/0097320	A1	5/2005	Golan et al.	
2005/0122209	A1	6/2005	Black	
2005/0149455	A1	7/2005	Bruesewitz et al.	
2005/0170814	A1	8/2005	Joao et al.	
2005/0218229	A1	10/2005	Morley et al.	
2005/0228986	A1	10/2005	Fukasawa et al.	
2005/0268107	A1	12/2005	Harris et al.	
2005/0273442	A1	12/2005	Bennett et al.	
2006/0018523	A1	1/2006	Saitoh et al.	
2006/0059110	A1	3/2006	Madhok et al.	
2006/0136546	A1	6/2006	Trioano et al.	
2006/0165060	A1	7/2006	Dua	

2006/0202025	A1	9/2006	Calabrese et al.
2006/0219776	A1	10/2006	Finn
2006/0281439	A1	12/2006	Benco et al.
2006/0282382	A1	12/2006	Balasubramanian et al.
2006/0290501	A1	12/2006	Hammad et al.
2006/0293027	A1	12/2006	Hammad et al.
2007/0017970	A1	1/2007	Gauthier et al.
2007/0034679	A1	2/2007	Gauthier et al.
2007/0055630	A1	3/2007	Gauthier et al.
2007/0057034	A1	3/2007	Gauthier et al.
2007/0136131	A1	6/2007	Mankoff
2007/0250380	A1	10/2007	Mankoff
2007/0260544	A1	11/2007	Wankmueller et al.
2007/0288641	A1	12/2007	Lee et al.
2007/0294182	A1	12/2007	Hammad
2008/0005037	A1	1/2008	Hammad et al.
2008/0029593	A1	2/2008	Hammad et al.
2008/0034221	A1	2/2008	Hammad et al.
2008/0040271	A1	2/2008	Hammad et al.
2008/0040276	A1	2/2008	Hammad et al.
2008/0065553	A1	3/2008	Faith et al.
2008/0103982	A1	5/2008	Hammad et al.

OTHER PUBLICATIONS

U.S. Appl. No. 11/763,240, Faith.
U.S. Appl. No. 11/764,343, Faith.
U.S. Appl. No. 11/764,351, Faith.
U.S. Appl. No. 11/764,361, Faith.
U.S. Appl. No. 11/764,376, Faith.
U.S. Appl. No. 11/764,622, Faith.
U.S. Appl. No. 10/642,878, filed Aug. 18, 2003, Jagdeep Sahota.
Fujitsu Microelectronics America Announces New Fingerprint Identification Technology for Cell Phones, Mobile Devices Mar. 11, 2002 by Fujitsu Microelectronics America, Inc at www.fujitsu.com/us/news/pr/fma_20020311.html.
U.S. Appl. No. 11/536,296, filed Sep. 26, 2006.
U.S. Appl. No. 11/566,614, filed Dec. 4, 2006.
U.S. Appl. No. 11/680,589, filed Feb. 28, 2007.
U.S. Appl. No. 11/680,592, filed Feb. 28, 2007.
U.S. Appl. No. 11/680,594, filed Feb. 28, 2007.
U.S. Appl. No. 11/761,821, filed Jun. 12, 2007.
U.S. Appl. No. 11/764,370, filed Jun. 18, 2007.
U.S. Appl. No. 11/811,875, filed Jun. 11, 2007.
U.S. Appl. No. 11/935,740, filed Nov. 6, 2007.
U.S. Appl. No. 11/940,074, filed Nov. 14, 2007.
U.S. Appl. No. 11/962,836, filed Dec. 21, 2007.
U.S. Appl. No. 11/963,736, filed Dec. 28, 2007.
U.S. Appl. No. 11/966,233, filed Dec. 21, 2007.
U.S. Appl. No. 12/022,060, filed Jan. 28, 2008.
U.S. Appl. No. 12/022,075, filed Jan. 29, 2008.
U.S. Appl. No. 12/028,220, filed Feb. 8, 2008.
Office Action dated Jan. 11, 2008 from U.S. Appl. No. 10/642,878 (9 pages).
Office Action dated Oct. 3, 2008 from U.S. Appl. No. 10/642,878 (9 pages).
Office Action dated Jun. 10, 2009 from U.S. Appl. No. 10/642,878 (6 pages).
Applicant response dated May 12, 2008 to Office Action from U.S. Appl. No. 10/642,878 dated Jan. 11, 2008 (7 pages).
Applicant response dated Mar. 24, 2009 to Office Action from U.S. Appl. No. 10/642,878 dated Oct. 3, 2008 15 pages).
International Search Report from PCT/US04/26813, May 7, 2007.
Written Opinion of the International Searching Authority from PCT/US04/26813, May 7, 2007.
International Preliminary Report on Patentability from PCT/US04/26813, May 30, 2007.

* cited by examiner

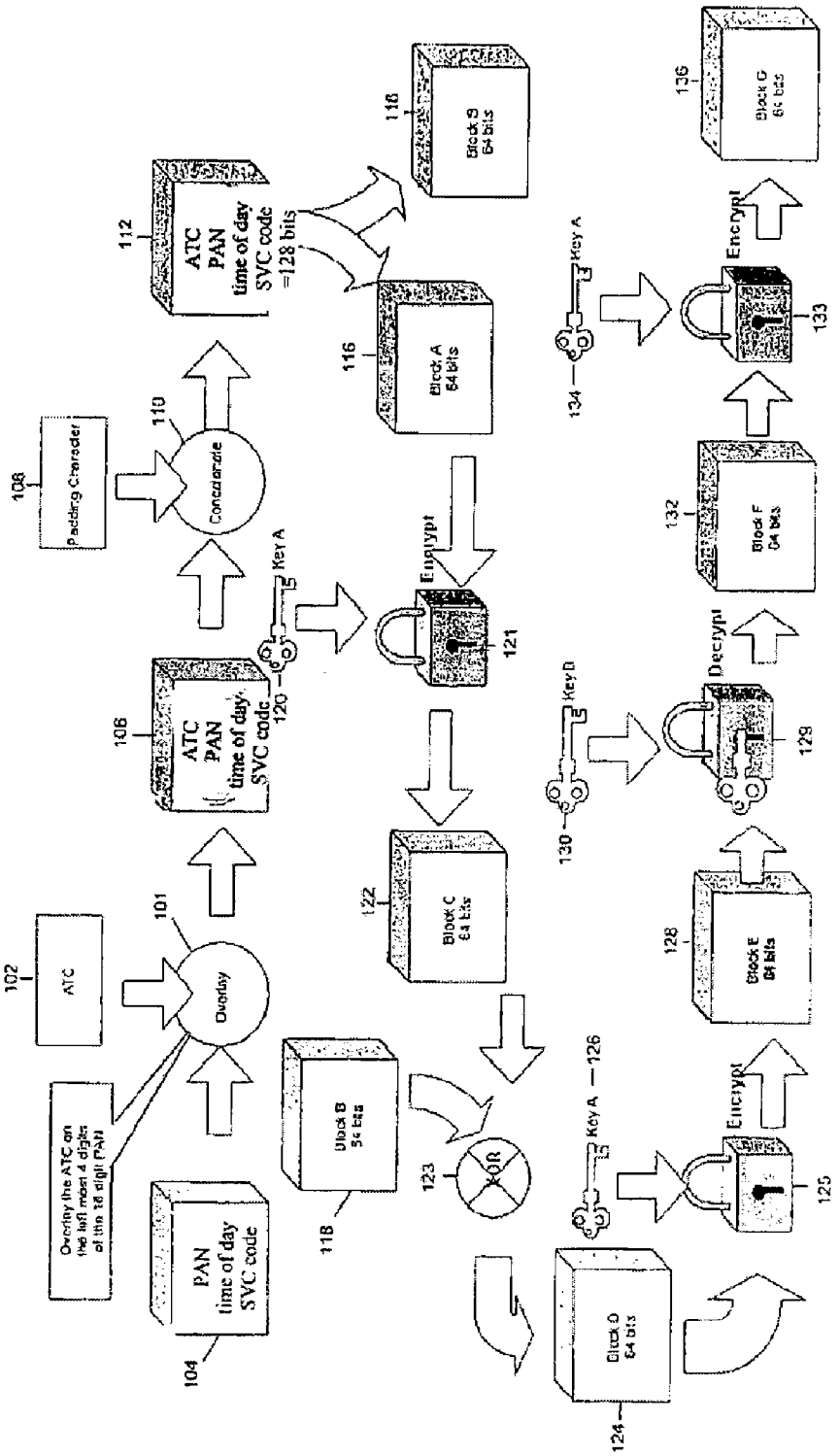

102
ATC
101
Overlay
Overlay the ATC on the left most 4 digits of the 16 digit PAN
104
PAN
time of day
SVC code
106
ATC
PAN
time of day
SVC code
108
Padding Character
110
Concatenate
112
ATC
PAN
time of day
SVC code
=128 bits
116
Block A
64 bits
118
Block B
64 bits
120
Key A
121
Encrypt
122
Block C
64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

FIG. 1

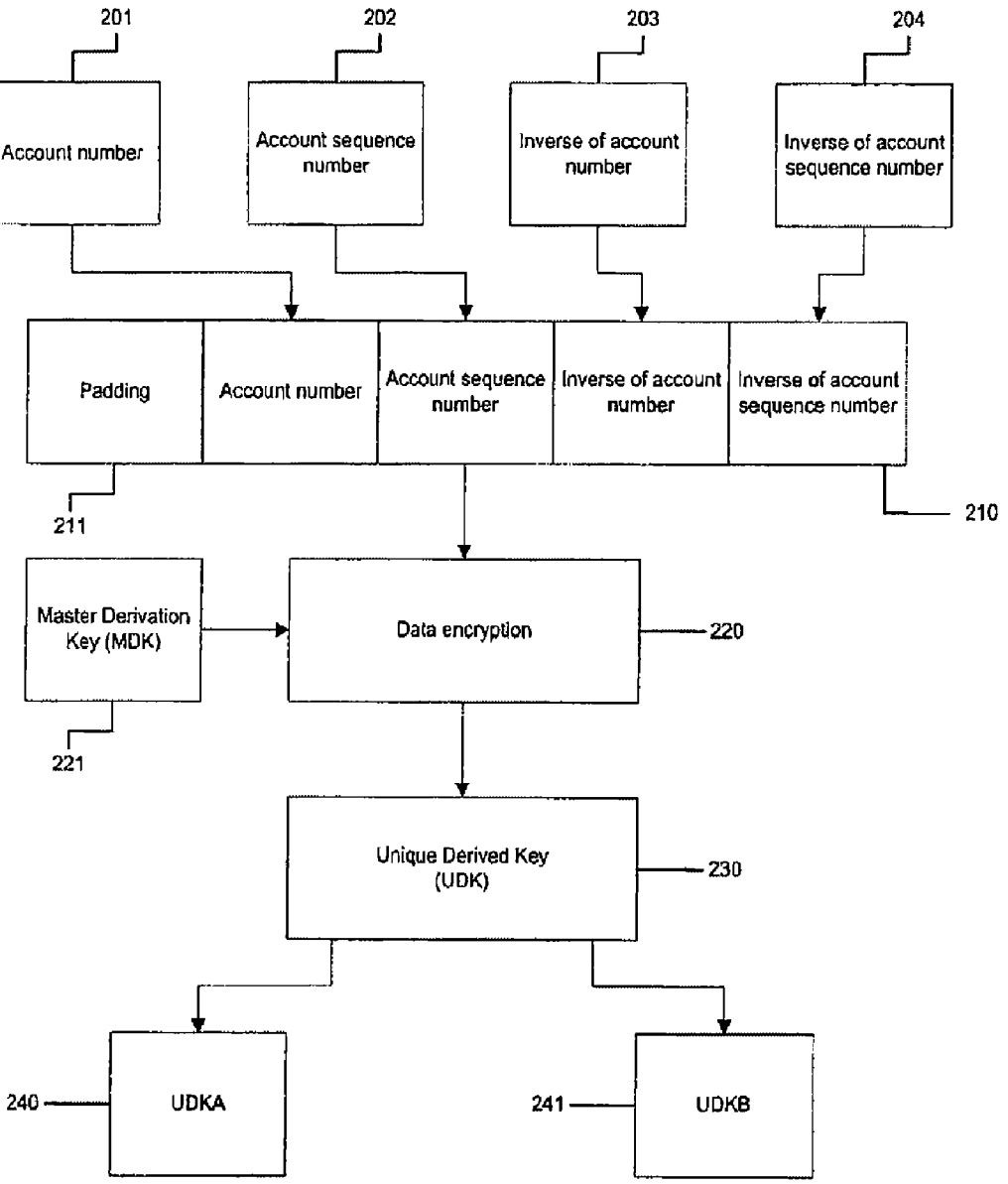

201
202
203
204
Account number
Account sequence number
Inverse of account number
Inverse of account sequence number
Padding
Account number
Account sequence number
Inverse of account number
Inverse of account sequence number
211
210
Master Derivation Key (MDK)
Data encryption
220
221
Unique Derived Key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

FIG. 2

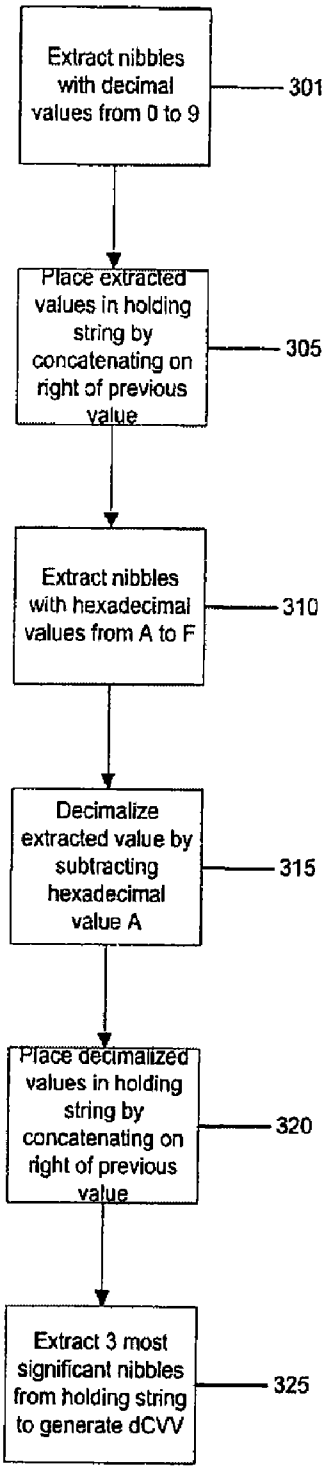

Extract nibbles with decimal values from 0 to 9
301
Place extracted values in holding string by concatenating on right of previous value
305
Extract nibbles with hexadecimal values from A to F
310
Decimalize extracted value by subtracting hexadecimal value A
315
Place decimalized values in holding string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

FIG. 3

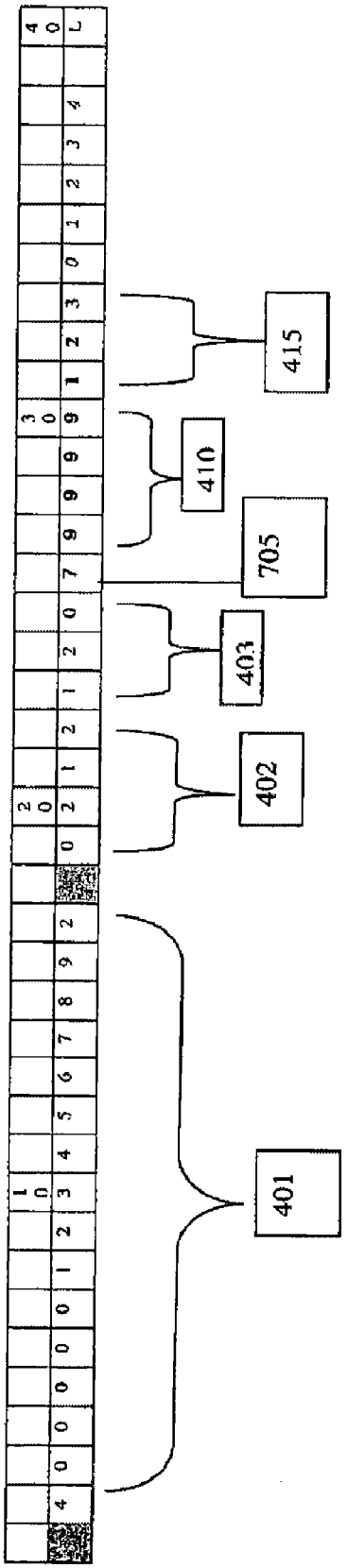


FIG. 4

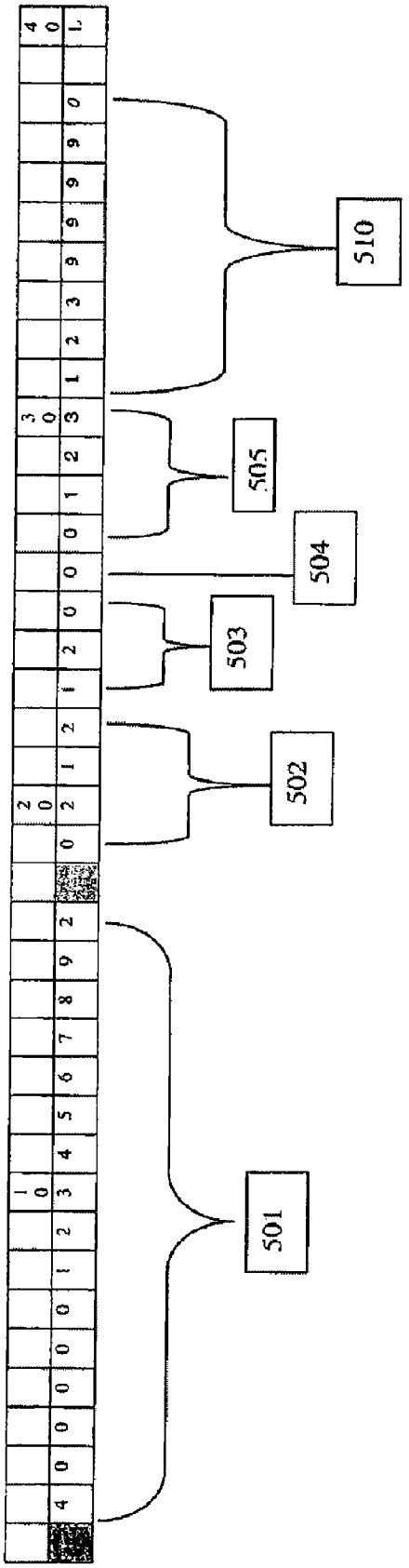


FIG. 5

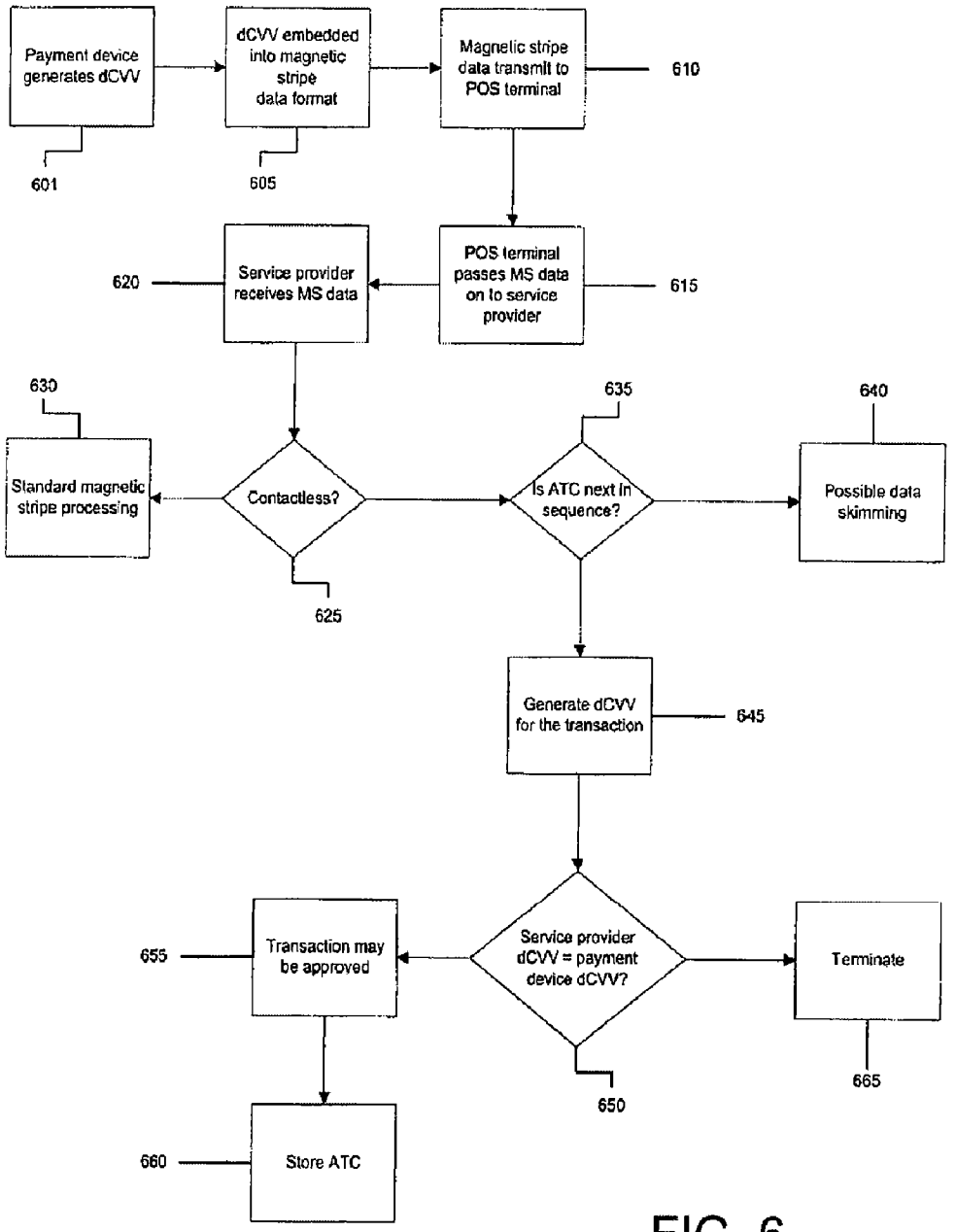

Payment device generates dCVV
601
dCVV embedded into magnetic stripe data format
605
Magnetic stripe data transmit to POS terminal
610
POS terminal passes MS data on to service provider
615
Service provider receives MS data
620
Contactless?
625
Standard magnetic stripe processing
630
Is ATC next in sequence?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

FIG. 6

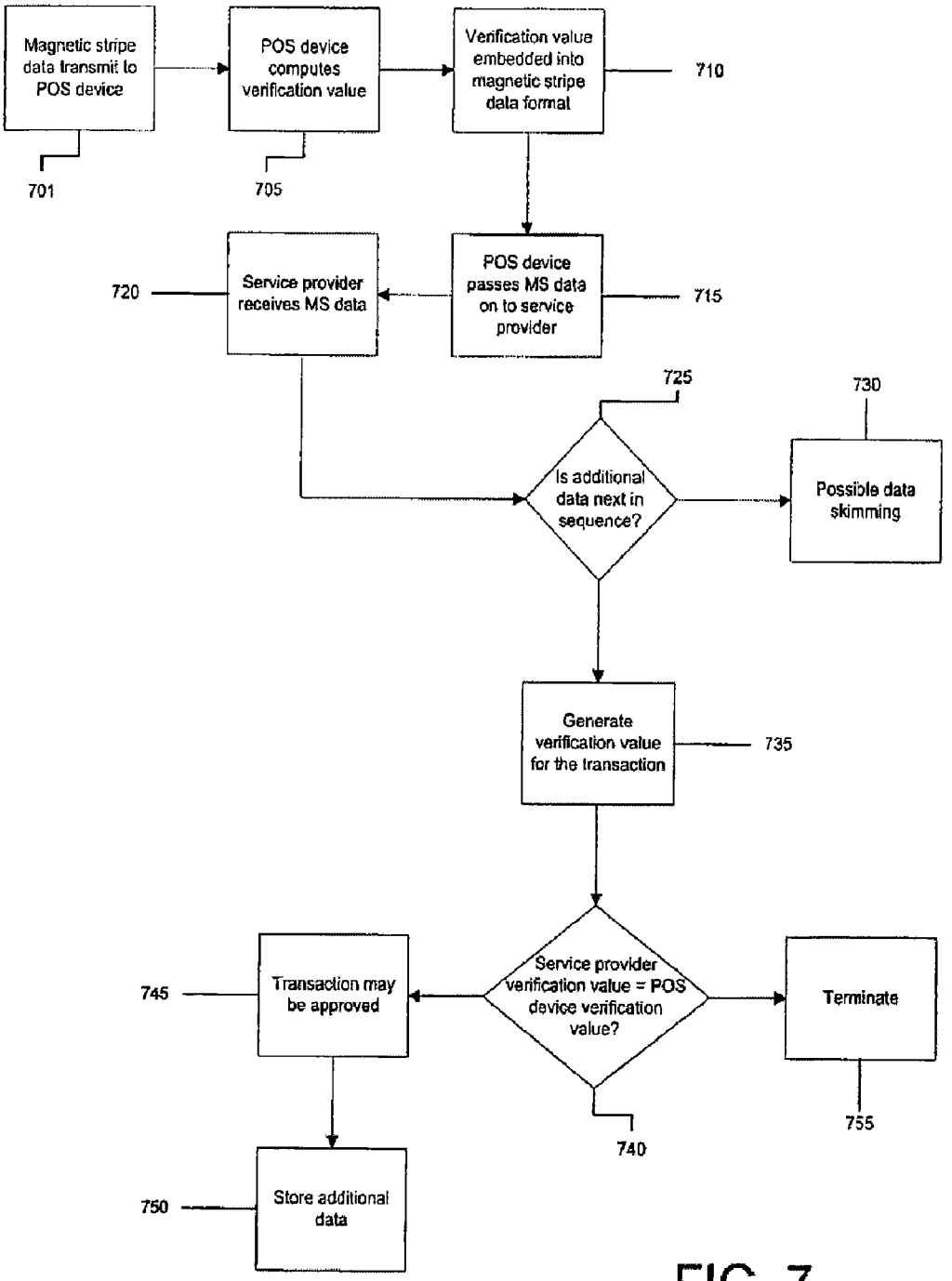

Magnetic stripe data transmit to POS device
POS device computes verification value
Verification value embedded into magnetic stripe data format
710
701
705
Service provider receives MS data
POS device passes MS data on to service provider
720
715
725
730
Is additional data next in sequence?
Possible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

FIG. 7

METHOD AND SYSTEM FOR GENERATING A DYNAMIC VERIFICATION VALUE

CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims priority from U.S. Provisional Patent Application Nos. 60/815,059 filed Jun. 19, 2006, 60/815,430 filed Jun. 20, 2006, and 60/884,089 filed Jan. 9, 2007. The application is also a continuation in part application of U.S. patent application Ser. No. 10/642,878 filed on Aug. 18, 2003. All of the above applications are herein incorporated by reference in their entirety for all purposes.

BACKGROUND

As methods and devices for engaging in financial transactions have increased, old problems such as fraud and counterfeiting persist.

One of the primary sources of fraud, which is prevalent in the credit card industry is skimming. Skimming refers to the electronic copying of a card's magnetic stripe data to create counterfeit cards.

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 medium. In other words, the digital content of the magnetic stripe can be perfectly copied, without any difference between the copy and the original.

One of the primary means by which skimming can be prevented is for the consumer to closely monitor the whereabouts of his transaction card. This may allow the consumer to prevent the card from being swiped through inappropriate devices. However, as contactless cards evolve, 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, without the knowledge of the consumer or merchant, intercept the wireless transaction and copy the data being transmitted from the card to POS terminal.

To address the above problems, a dCVV or a dynamic card verification value can be used. The dCVV can be generated using an algorithm which uses at least a counter and input data such as an account number, expiration date, and other information. The counter can increase by one each time a transaction is conducted. The dCVV can be independently generated by either a portable consumer device or POS terminal at the front end of a transaction and can be sent to a back end computer. The counter may be sent from the merchant to the back end computer so that it knows the current counter value associated with the portable consumer device. In other cases, the counter may simply to present at the back end computer. In the latter case, the counter increments every time the back end computer sees a transaction. The back end computer, using a similar algorithm to the one that generated the dCVV at the front end, the counter value, and input data, can independently generate a second dCVV. If the received dCVV and the generated dCVV match, the transaction can be considered authentic. If the dCVVs do not match, this may indicate that the transaction is fraudulent.

Some dCVVs, however, typically only include one dynamic data element to generate the dCVV. The dynamic data element may be counter. If the counter and other data elements that are used to create the dynamic CVV are intercepted, the dynamic CVV could be used by an unauthorized person.

Embodiments of the invention address the above problems, and other problems, individually and collectively.

BRIEF SUMMARY

Embodiments of the invention are directed to methods and systems for generating verification values.

One embodiment of the invention is directed to a method comprising: generating a verification value in response to a transaction involving a portable consumer device, wherein the verification value is generated using a first dynamic data element and a second dynamic data element; and sending the verification value to a service provider so that the service provider can verify the verification value. The service provider can be, for example, a payment processing organization or an issuer of the portable consumer device.

Another embodiment of the invention is directed to a computer readable medium comprising: code for generating a verification value in response to a transaction involving a portable consumer device, wherein the verification value is generated using a first dynamic data element and a second dynamic data element; and code for sending the verification value with data in a magnetic stripe data format to a service provider so that the service provider can verify the transaction. The service provider can be, for example, a payment processing organization or an issuer of the portable consumer device.

Another embodiment of the invention is directed to a method comprising: receiving a verification value with data in a magnetic stripe data format in response to a transaction involving a portable consumer device, wherein the verification value is generated using a first dynamic data element and a second dynamic data element; and determining if the received verification value matches a verification value at a service provider computer.

These and other embodiments of the invention are described in further detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

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 portable consumer 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

Generally, embodiments of the present invention provide for 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 portable consumer device, embedded into the payment data, and transmitted to a point of sale terminal. In an alternate embodiment, payment data is received from a portable consumer device, a verification value is generated by a point of sale terminal, and the verification value is embedded into the payment data. The dCVV may be generated using at least two different dynamic data elements such as a counter and a time of day.

In another 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 in a magnetic stripe data format to a payment network which, in turn, passes the data on to the service provider in the magnetic stripe data format. As used herein, "magnetic stripe data format" may include a data format that is compatible with conventional magnetic stripe payment card system. Thus, although contactless cards and the like do not have a magnetic stripe, they may still provide data that can eventually be put into a magnetic stripe data format. If the service provider determines that 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 portable consumer 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 computer does not match the dCVV received from the point of sale terminal, the transaction is identified as potentially fraudulent and disapproved.

The service provider computer may comprise a processor, and a computer readable medium comprising instructions executable by the processor. The computer readable medium may comprise code for generating a verification value in response to a transaction involving a portable consumer device, wherein the verification value is generated using a first data dynamic element and a second dynamic data element, and code for sending the verification value to a service provider associated with the portable consumer device so that the service provider can verify the transaction.

For purposes of this application, the term "portable consumer device" can include any device comprising a microprocessor which may be used in a transaction or data exchange as described herein. Other portable consumer devices need not use a microprocessor. Without limiting the generality of the foregoing, "portable consumer device" can 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" can include 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" can include data transmissions by laser, radio frequency, infrared communications, Bluetooth, or wireless local area network.

For purposes of this application, the term "payment service" can include any application deployed on a portable consumer device which causes the exchange of data between the portable consumer 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" can include, 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. The payment data may reside in a memory located on the portable consumer device.

The portable consumer device can also maintain various dynamic data elements. An example of a dynamic data element is an application transaction counter (ATC). The ATC may initially be set by the service provider to a predetermined value. Thereafter, the ATC may 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 may maintain a corresponding ATC portable consumer device accessible to the service provider's computer. 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 portable consumer device.

Examples of other dynamic data elements may include a time of day, a current transaction amount, a terminal ID, a merchant ID, and a randomly generated number from a terminal, etc. The data elements are dynamic in the sense that they can change with each transaction or nearly each transaction. The dynamic data elements may relate to a consumer's portable consumer device and/or may relate to the consumer generally.

In embodiments of the invention, the dCVV is generated using at least two dynamic data elements. By using at least two (e.g., at least three or four) dynamic data elements to create a dCVV, it is highly unlikely that a skimmer can determine the dCVV. The skimmer cannot simply skim the counter, but would also have to skim various other pieces of dynamic data in order to generate the dCVV.

The at least two dynamic data elements may be used, with or without other static data elements to create a dCVV. Examples of static data elements comprise a telephone number, a SIM card number, an account number, birthday, home address, expiration date, etc. Static data elements include those that typically do not change from transaction to transaction. For example, an account number associated with a portable consumer device generally does no change from transaction to transaction.

Each time the payment service is initiated, a dCVV is generated on the portable consumer device for authentication purposes. FIG. **1** depicts the method of generating a dCVV for each transaction according an embodiment the present invention. Initially, a numeric string of predetermined length is created. This numeric string is created by overlaying **101** a first dynamic data element such as an 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 a second dynamic data element such as the time of day and a static data element such as 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 one 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 portable consumer 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 is 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 one 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 one 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 portable consumer 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 portable consumer device can 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 one 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 may 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. left-most) 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 portable consumer device to the point of sale terminal. The data received by the point of sale terminal may appear to the point of sale terminal as standard payment data. In other words, the point of sale terminal may 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 portable consumer device.

FIG. **4** depicts an exemplary record format for transmitting payment data, with the dCVV embedded therein, from the portable consumer 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 a time of day **402**, and a service code **403**. In one embodiment, the primary account number **401** is 16 digits long, the time of day **402** (e.g., 12:00) is four digits long, and the service code **403** is three digits long. However, the primary account number **401**, the time of day **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 **705** 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 portable consumer 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.

Another data field (not shown) may be provided for a static data element such as an expiration date associated with the portable consumer device.

Alternately, FIG. **5** depicts a second exemplary format for transmitting payment information with the dCVV embedded thereon from the portable consumer 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 a time of day **502**, a service code **503**, a PVKI **504**, and a field for PIN verification data **505**. In one embodiment, the primary account number **501** is sixteen digits long, the time of day **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 time of day **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. The additional discretionary data may comprise other dynamic or static data elements that are used by the service provider computer to independently generate a dCVV. Such data could alternatively reside in a data field such as Field **55**. Another data field (not shown) may be provided for a static data element such as an expiration date associated with the portable consumer device.

An 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 portable consumer 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 portable consumer device generates the dCVV **601**, preferably using the methodology described above. The dCVV is embedded into the payment data **605**.

The payment data may also comprise at least the first and/or second dynamic data elements. Preferably, any dynamic data elements that are sent up to the service provider computer are sent in different data fields, at different times, and/or along different communication paths to the service provider computer. This would make it difficult for a skimmer to determine, which dynamic data elements are used to generate the dCVV, and where they are located.

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 portable consumer 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 portable consumer device is not the expected next ATC, the payment service deployed on the portable consumer device has potentially been skimmed **640**. The computer may also determine if the second dynamic data element matches the second dynamic data element at the service provider computer. For example, the second dynamic data element may be a time of day, and the service provider computer can determine if the time of day that it has matches the time of day that is received from the POS terminal.

In some instances, a dynamic data element such as a counter (or other type of data element that can change) can be received at a back end computer along with a dCVV generated by a portable consumer device. The back end computer can determine if the counter is within a predetermined range. If it is, then the back end computer can independently generate another dCVV. If the received dCVV and the generated dCVV match, then the transaction can be considered authentic. As explained in co-pending U.S. patent application Ser. No. 11/764,370, entitled "Verification Error Reduction System", which is being filed on the same day as the present application, which is incorporated herein by reference, allowing the counter to fall within a range can decrease the number of declined transactions. Thus, in some embodiments of the invention, the first dynamic data element (e.g., a counter) can fall within a first range (e.g., between 5-10) and a second dynamic data element (time of day) may fall within a second range (e.g., between 12:00 and 12:05). If one or both of the dynamic data elements are within their predetermined ranges, than the authorization process may continue. If not, then the transaction may be declined and/or more information may be requested from the consumer for authentication purposes.

If the expected next ATC (and/or the expected next second dynamic data element) is received, the service provider computer can independently re-generate the dCVV for the given transaction **645** utilizing a similar or analogous process as described above. If the service provider generated dCVV matches the dCVV received from the portable consumer 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 portable consumer device **660** for subsequent authentications. If the service provider generated dCVV does not match the dCVV received from the portable consumer 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 a specific embodiment, the portable consumer 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, and/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 can 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 portable consumer 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**.

It should be understood that the present invention as described above can be implemented in the form of control logic using computer software in a modular or integrated manner. Based on the disclosure and teachings provided herein, a person of ordinary skill in the art will know and appreciate other ways and/or methods to implement the present invention using hardware and a combination of hardware and software

Any of the software components or functions described in this application, may be implemented as software code to be executed by a processor using any suitable computer language such as, for example, Java, C++ or Perl using, for example, conventional or object-oriented techniques. The software code may be stored as a series of instructions, or commands on a computer readable medium, such as a random access memory (RAM), a read only memory (ROM), a magnetic medium such as a hard-drive or a floppy disk, or an optical medium such as a CD-ROM. Any such computer readable medium may reside on or within a single computational apparatus, and may be present on or within different computational apparatuses within a system or network.

The above description is illustrative and is not restrictive. Many variations of the invention will become apparent to those skilled in the art upon review of the disclosure. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the pending claims along with their full scope or equivalents.

One or more features from any embodiment may be combined with one or more features of any other embodiment without departing from the scope of the invention.

A recitation of "a", "an" or "the" is intended to mean "one or more" unless specifically indicated to the contrary.

What is claimed is:

1. A method comprising:

generating a verification value in response to a transaction involving a portable consumer device, wherein the verification value is generated using a first dynamic data element and a second dynamic data element, wherein the first dynamic data element or the second dynamic data element includes a time of day or a current transaction amount; and

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

wherein the verification value is also generated using at least one static data element, and wherein the transaction is a payment transaction, and wherein the static data element includes at least one of an expiration date, a phone number, a SIM card number, a service code, and an account number.

2. The method of claim **1** wherein the verification value is derived using unique derived keys (UDKs).

3. The method of claim **1** wherein the verification value is generated on the portable consumer device.

4. The method of claim **1** wherein the verification value is generated on a point of sale terminal.

5. The method of claim **1** wherein the portable consumer device is in the form of a card.

6. The method of claim **1** wherein the first dynamic data element or the second dynamic data element includes the time of day.

7. The method of claim **1** wherein the portable consumer device is in the form of a phone.

8. The method of claim **1** wherein at least one of the first dynamic data element, and second dynamic data element, and the at least one static data element are sent to the service provider in a discretionary data field, along with the current transaction amount.

9. The method of claim **1** wherein the verification value is generated by the portable consumer device, wherein the portable consumer device comprises a wireless device.

10. The method of claim **9** wherein the portable consumer device wirelessly transmits the generated verification value to a point of sale terminal, before being sent to the service provider.

11. A computer readable medium comprising:

code for generating a verification value in response to a transaction involving a portable consumer device, wherein the verification value is generated using a first dynamic data element and a second dynamic data element, wherein the first dynamic data element or the second dynamic data element includes a time of day or a current transaction amount; and

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

wherein the verification value is also generated using at least one static data element, and wherein the transaction is a payment transaction, and wherein the static data element includes at least one of an expiration date, a phone number, a SIM card number, a service code, and an account number.

12. The computer readable medium of claim **11** wherein the verification value is derived using unique derived keys (UDKs).

13. A portable consumer device comprising the computer readable medium of claim **11**.

14. A phone comprising the computer readable medium of claim **11**.

15. A point of sale terminal comprising the computer readable medium of claim **11**.

16. The computer readable medium of claim **11** wherein the first dynamic data element or the second dynamic data element includes the time of day.

17. A method comprising:

receiving an authorization request message comprising a first verification value, along with data comprising an indicator that the first verification value is included in the authorization request message, in a magnetic stripe data format in response to a transaction involving a portable consumer device, wherein the first verification value is generated using a first dynamic data element and a second dynamic data element, wherein the first dynamic data element or the second dynamic data element includes a time of day or a current transaction amount, and wherein the authorization request message further comprises the time of day or the current transaction amount; and

determining if the received first verification value matches a second verification value at a service provider computer.

18. A computer readable medium comprising code for performing the method of claim **17**.

19. A computer comprising the computer readable medium of claim **17**.

20. The method of claim **17** wherein the first dynamic data element includes the time of day.

21. The method of claim **17** wherein at least one of the first dynamic data element, and second dynamic data element, and the at least one static data element are sent to the service provider in a discretionary data field, along with the current transaction amount.

22. The method of claim **17** wherein the verification value is generated by the portable consumer device, wherein the portable consumer device comprises a wireless device, and wherein the portable consumer device wirelessly transmits the generated verification value to a point of sale terminal, before being sent to the service provider.

23. A system comprising:

means for receiving an authorization request message comprising a first verification value, along with data comprising an indicator that the first verification value is included in the authorization request message, in a magnetic stripe data format in response to a transaction involving a portable consumer device, wherein the first verification value is generated using a first dynamic data element and a second dynamic data element, wherein the first dynamic data element or the second dynamic data element includes a time of day or a current transaction amount, and wherein the authorization request message further comprises the time of day or the current transaction amount; and

means for determining if the received first verification value matches a second verification value at a service provider computer.

24. The system of claim **23** wherein the first dynamic data element includes the time of day.

* * * * *