US008001054B1

(12) United States Patent
Peart et al.

(10) Patent No.: US 8,001,054 B1
(45) Date of Patent: Aug. 16, 2011

(54) **SYSTEM AND METHOD FOR GENERATING AN UNPREDICTABLE NUMBER USING A SEEDED ALGORITHM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 722 days.

(21) Appl. No.: **11/306,617**

(22) Filed: **Jan. 4, 2006**

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/708,545, filed on Mar. 10, 2004, which is a continuation-in-part of application No. 10/340,352, filed on Jan. 10, 2003, which is a continuation-in-part of application No. 10/192,488, filed on Jul. 9, 2002, now Pat. No. 7,239,226.

(60) Provisional application No. 60/507,803, filed on Sep. 30, 2003, provisional application No. 60/396,577, filed on Jul. 16, 2002, provisional application No. 60/304,216, filed on Jul. 10, 2001.

(51) **Int. Cl.**
G06Q 99/00 (2006.01)

(52) **U.S. Cl.** **705/75**; 705/64; 705/78

(58) **Field of Classification Search** 705/50–79
See application file for complete search history.

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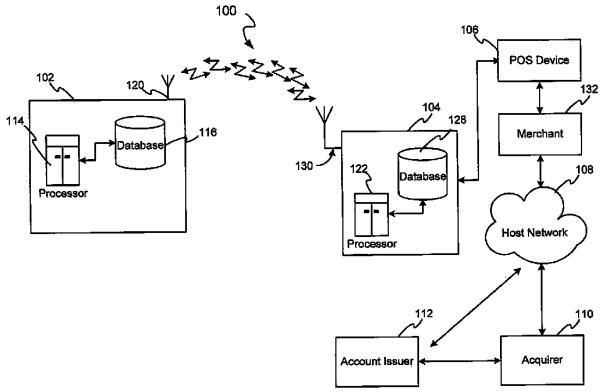
(57) **ABSTRACT**

A random number generating algorithm is seeded with an unpredictable number. The seed value is computed by subjecting variable data to a Secure Hashing Algorithm, and truncating the right most, or left most, 16 bytes from the message digest generated. The algorithm generates the unpredictable number by using the seed value as a counter value in the random number generator, and performing a data encryption standard operation. In one exemplary embodiment, the unpredictable number is modified to a predetermined maximum unpredictable number value as determined by the sender and receiver of the unpredictable number.

9 Claims, 5 Drawing Sheets



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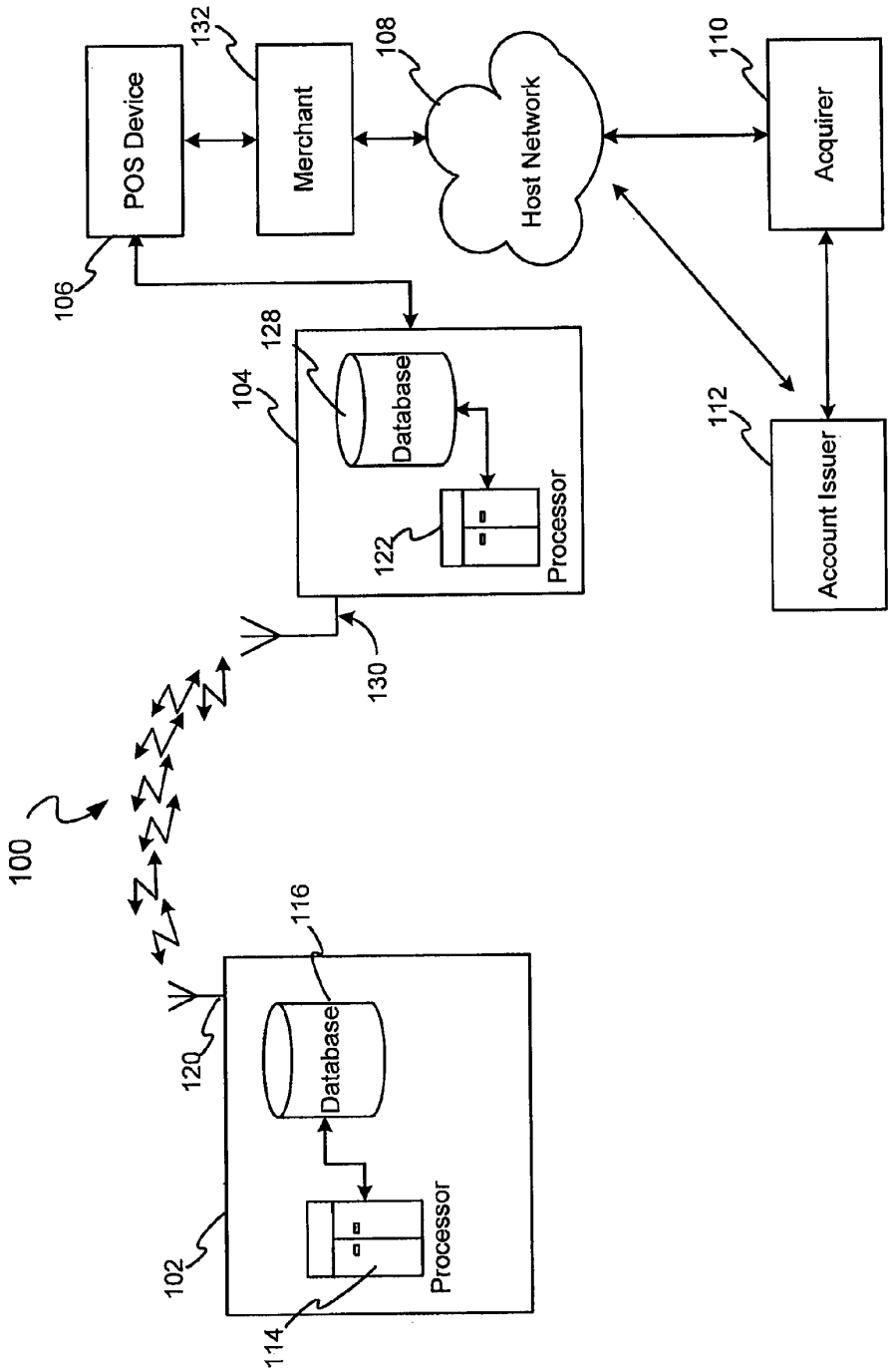
POS Device
Merchant
Host Network
Acquirer
Account Issuer
Database
Processor
Database
Processor
100
102
104
106
108
110
112
114
116
120
122
128
130
132

FIG. 1

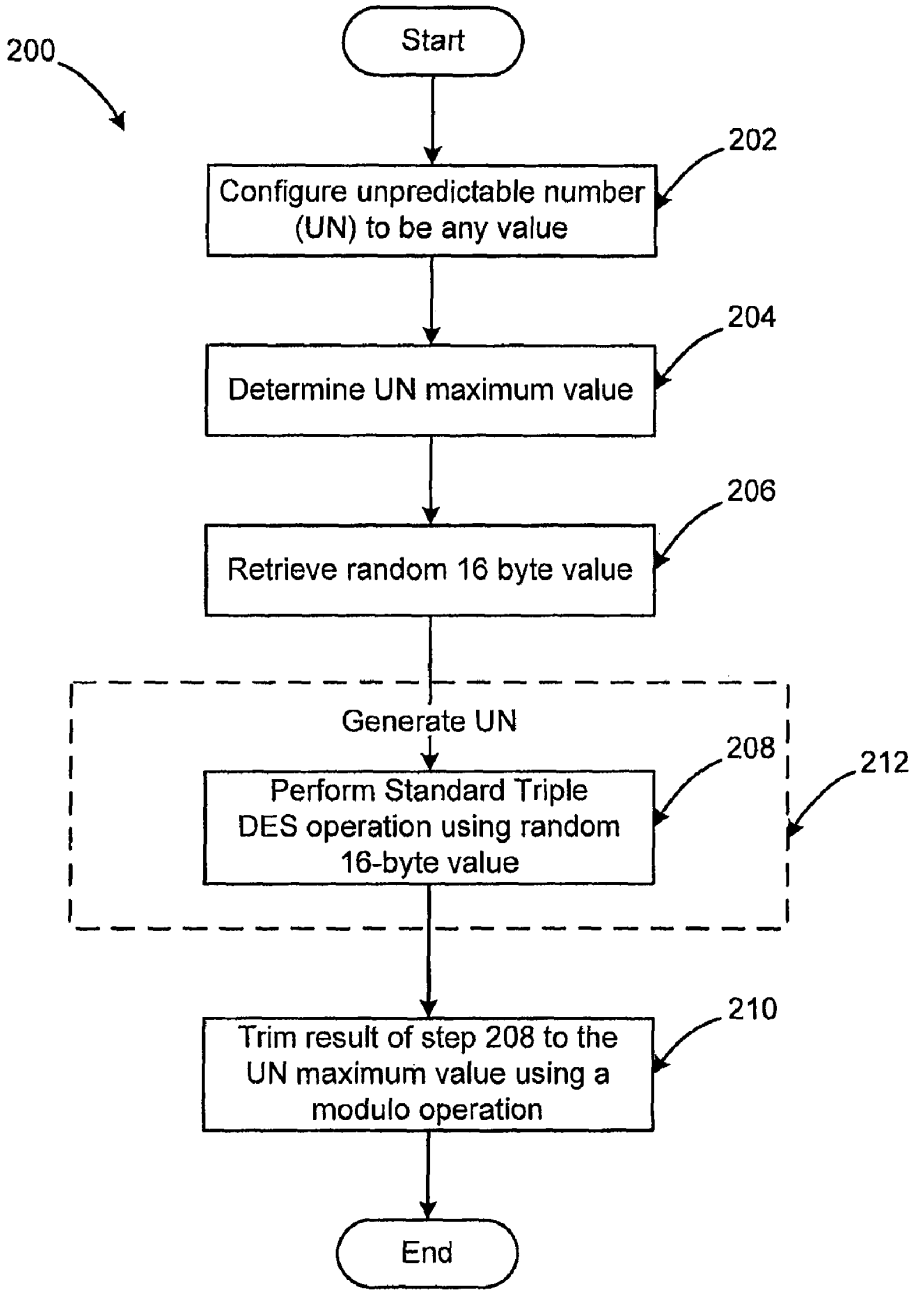
200
Start
202
Configure unpredictable number (UN) to be any value
204
Determine UN maximum value
206
Retrieve random 16 byte value
Generate UN
208
Perform Standard Triple DES operation using random 16-byte value
212
210
Trim result of step 208 to the UN maximum value using a modulo operation
End

FIG. 2

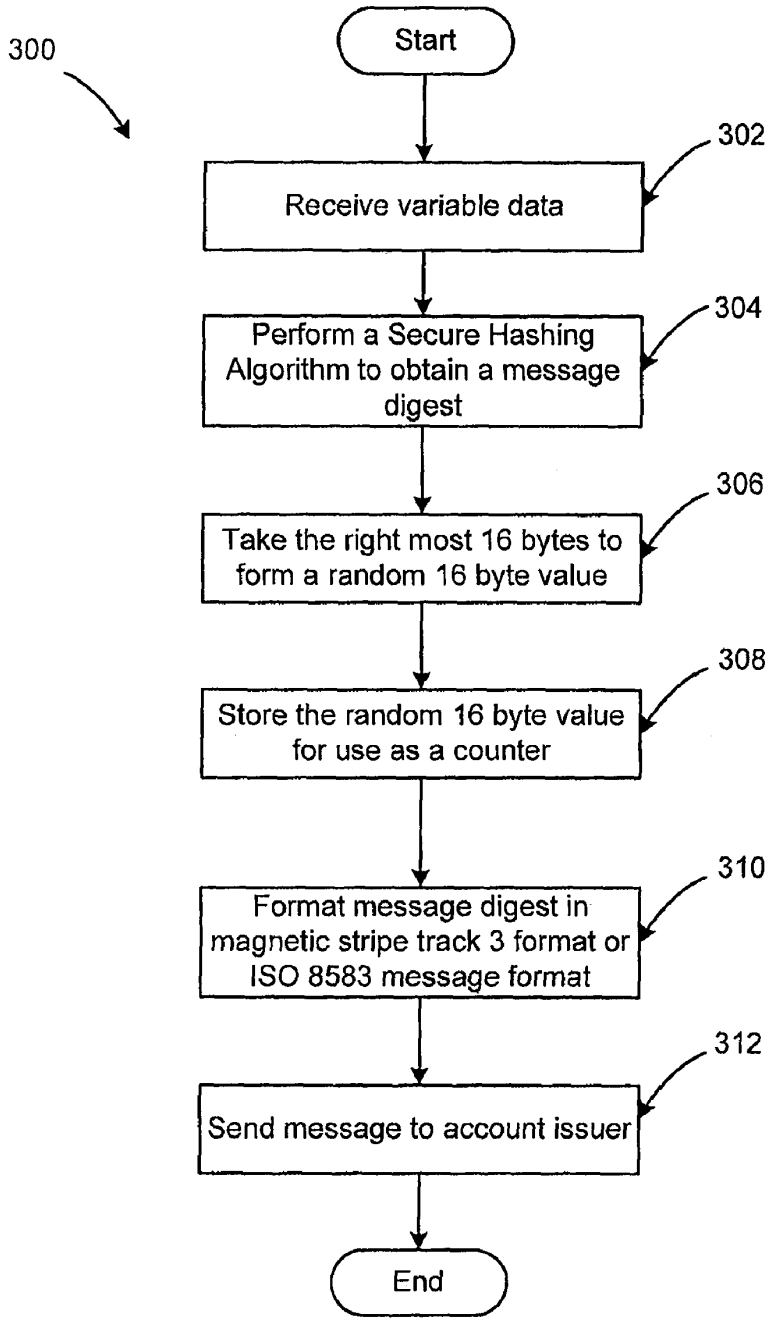
300
Start
302
Receive variable data
304
Perform a Secure Hashing Algorithm to obtain a message digest
306
Take the right most 16 bytes to form a random 16 byte value
308
Store the random 16 byte value for use as a counter
310
Format message digest in magnetic stripe track 3 format or ISO 8583 message format
312
Send message to account issuer
End

FIG. 3

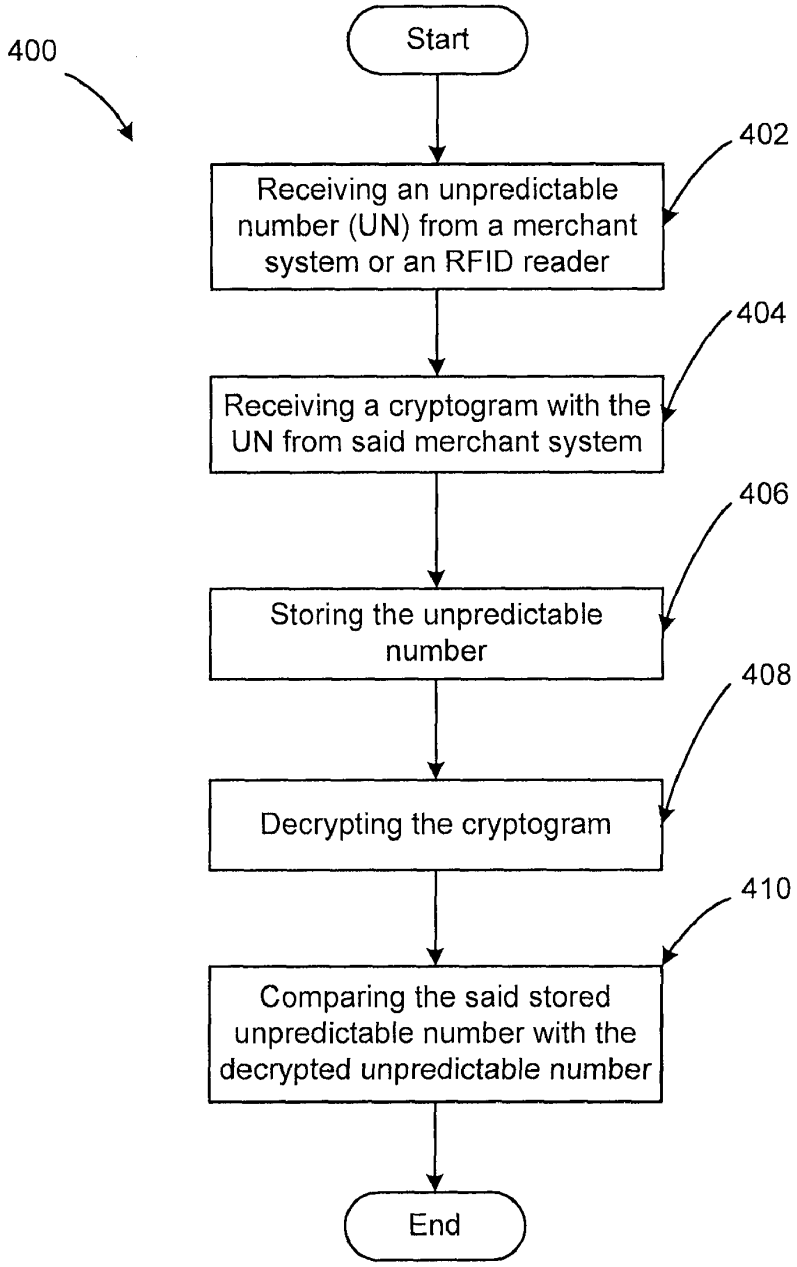
400
Start
402
Receiving an unpredictable number (UN) from a merchant system or an RFID reader
404
Receiving a cryptogram with the UN from said merchant system
406
Storing the unpredictable number
408
Decrypting the cryptogram
410
Comparing the said stored unpredictable number with the decrypted unpredictable number
End

FIG. 4

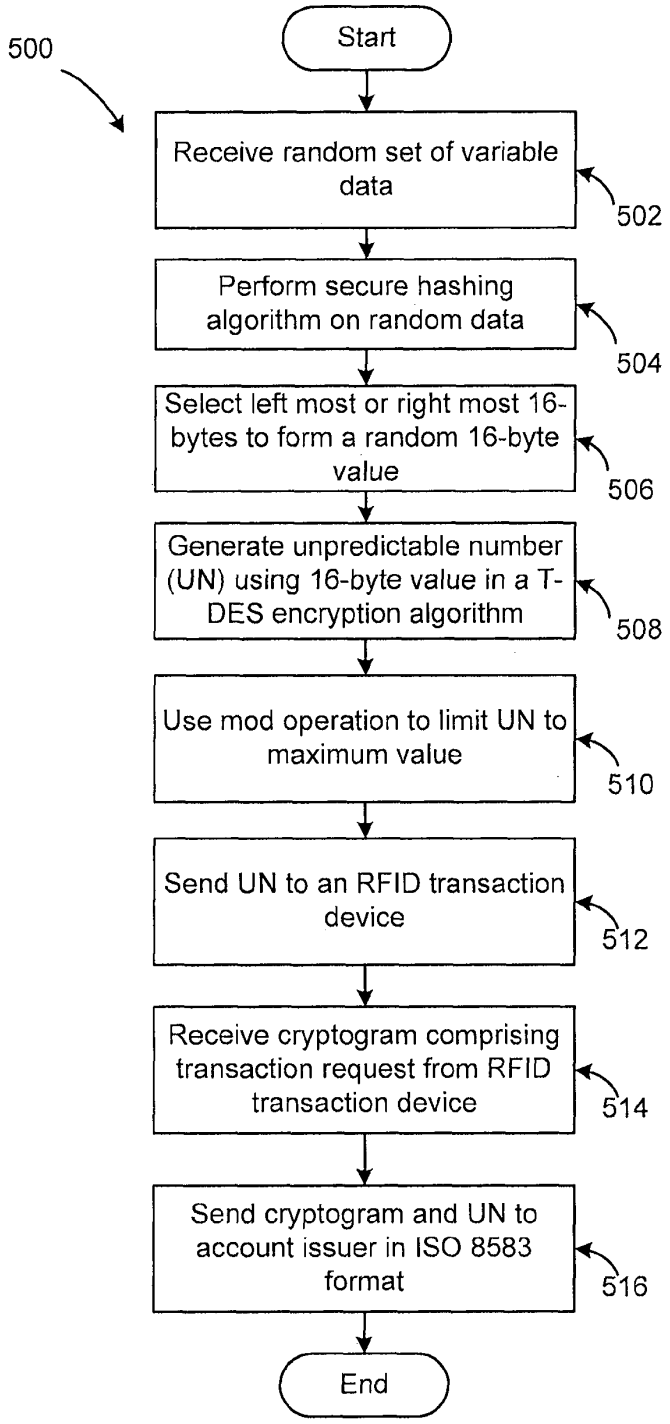
500
Start
Receive random set of variable data
502
Perform secure hashing algorithm on random data
504
Select left most or right most 16-bytes to form a random 16-byte value
506
Generate unpredictable number (UN) using 16-byte value in a T-DES encryption algorithm
508
Use mod operation to limit UN to maximum value
510
Send UN to an RFID transaction device
512
Receive cryptogram comprising transaction request from RFID transaction device
514
Send cryptogram and UN to account issuer in ISO 8583 format
516
End

FIG. 5

SYSTEM AND METHOD FOR GENERATING AN UNPREDICTABLE NUMBER USING A SEEDED ALGORITHM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part, and claims priority to, U.S. patent application Ser. No. 10/708,545, entitled "SYSTEM AND METHOD FOR SECURING RF TRANSACTIONS USING A RADIO FREQUENCY IDENTIFICATION DEVICE INCLUDING A TRANSACTIONS COUNTER," filed Mar. 10, 2004 (which itself claims priority to U.S. Provisional Application No. 60/507,803, filed Sep. 30, 2003. This application is also a continuation-in-part of and claims priority to U.S. patent application Ser. No. 10/340,352, entitled "SYSTEM AND METHOD FOR INCENTING PAYMENT USING RADIO FREQUENCY IDENTIFICATION IN CONTACT AND CONTACTLESS TRANSACTIONS," filed Jan. 10, 2003 (which itself claims priority to U.S. Provisional Patent Application No. 60/396,577, filed Jul. 16, 2002). This application is also a continuation-in-part and claims priority to U.S. patent application Ser. No. 10/192,488, entitled "SYSTEM AND METHOD FOR PAYMENT USING RADIO FREQUENCY IDENTIFICATION IN CONTACT AND CONTACTLESS TRANSACTIONS," filed Jul. 9, 2002 now U.S. Pat. No. 7,239,226 (which itself claims priority to U.S. Provisional Patent Application No. 60/304,216, filed Jul. 10, 2001). All of the above-listed applications are incorporated herein by reference.

FIELD OF INVENTION

This invention generally relates to securing a transaction involving radio frequency identification (RFID) technology. More particularly, the invention relates to a system and method for securing the RFID enabled transaction using an unpredictable number generated by a seeded algorithm.

BACKGROUND OF INVENTION

Like barcode and voice data entry, RFID is a contactless information acquisition technology. RFID systems are wireless, and are usually extremely effective in hostile environments where conventional acquisition methods often fail. RFID has established itself in a wide range of markets, such as, for example, the high-speed reading of railway containers, tracking moving objects such as livestock or automobiles, and retail inventory applications. As such, RFID technology has become a primary focus in automated data collection, identification and analysis systems worldwide.

Of late, companies are increasingly embodying RFID data acquisition technology in a fob or tag for use in completing financial transactions. A typical RFID fob is ordinarily a self-contained device, which may take the shape of any portable form factor. The RFID fob may include a transponder for transmitting information during a transaction. In some instances, a battery may be included in the fob to power the transponder, in which case the internal circuitry of the fob (including the transponder) may draw its operating power from the battery power source. Interrogation by the reader for activation of the fob is not required when using a battery source.

Alternatively, the fob may gain its operating power directly from a RF interrogation signal. U.S. Pat. No. 5,053,774, issued to Schuermann, describes a typical transponder RF interrogation system, which may be found in the prior art. The

Schuermann patent generally describes the powering technology surrounding conventional transponder structures. U.S. Pat. No. 4,739,328 discusses a method by which a conventional transponder may respond to a RF interrogation signal. Other typical modulation techniques that may be used include, for example, ISO/IEC 14443 and the like. In the conventional fob powering technologies used, the fob is typically activated upon presenting the fob into an interrogation signal. In this regard, the fob may be activated irrespective of whether the user desires such activation.

One of the more visible uses of the RFID technology is the introduction of American Express' Expresspay®, Exxon/Mobil's Speedpass® and Shell's EasyPay® products. These products use transponders, placed in a fob or tag, which enable automatic identification of the user when the fob is presented at a merchant's point-of-sale (POS) device, for example, when attempting to complete a transaction. During the transaction completion, information from the RFID fob is ordinarily passed to the POS, which delivers the information to a merchant system.

To complete a typical transaction, fob identification data is passed to a third-party server database. The third-party server references the identification data to a consumer (e.g., user) credit or debit account. In an exemplary processing method, the third-party server seeks authorization for the transaction by passing the transaction and account data to an authorizing entity, such as for example an "acquirer" or account issuer. Once the server receives authorization from the authorizing entity, the authorizing entity sends clearance to the POS device for completion of the transaction.

To lessen the financial impact of fraudulent transactions in the RFID environment, fob issuers have focused much effort on securing RFID transactions. Many of the efforts have focused on securing the transaction account or related data during transmission from the user to the merchant, or from the merchant to a third-party server or account provider system. For example, one conventional method for securing RFID transactions involves requiring the device user to provide a secondary form of identification during transaction completion. The RFID transaction device user may be asked to enter a personal identification number (PIN) into a keypad. The PIN may then be verified against a number associated with the user or the RFID transaction device, wherein the associated number is stored in an account issuer database. If the PIN number provided by the device user matches the associated number, then the transaction may be cleared for completion.

One problem with the issuer's efforts in securing RFID transactions is that they are susceptible to eavesdropping and decrypting during transit, such as when transferred from the merchant system to the account issuer system. Such information may be sensitive information concerning the fob user or the fob user's account. Should the fob user's sensitive information be retrieved without authorization during transit, the fob user or issuer may be subjected to fraudulent activity.

As such, a need exists for a method of securing sensitive transaction account information, which permits the account provider, merchant system, or acquirer to have a significant influence on the security of the fob user information stored on a merchant system.

SUMMARY OF INVENTION

The invention includes a system and method for generating an unpredictable number using a seeded algorithm. The algorithm is seeded using a random 16-byte value used as a counter. The random 16-byte value is used in a pseudo random number generator to produce the unpredictable number.

In one embodiment, the random 16-byte value is generated from variable data. The variable data is subjected to a Secure Hashing Algorithm to produce a message digest. The left most, or right most 16 bytes of the message digest is selected as the random 16-byte value. In another embodiment, the random 16-byte value is used in a pseudo random number generator to produce the unpredictable number. A range of values for the unpredictable number is chosen, and the maximum value permitted for the unpredictable number is determined. A standard triple Data Encryption Standard (DES) operation is then performed on the random 16-byte value to produce the unpredictable number. In one exemplary embodiment, the unpredictable number is subjected to a mod function to trim the unpredictable value to the maximum value permitted.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention may be derived by referring to the detailed description and claims when considered in connection with the Figures. In the Figures, like numerals refer to similar elements, throughout.

FIG. **1** illustrates an exemplary RFID-based system depicting exemplary components for use in RFID transaction completion in accordance with an embodiment of the present invention;

FIG. **2** is a block diagram of an exemplary method for a seeded algorithm in accordance with an embodiment of the present invention;

FIG. **3** is a block diagram of an exemplary method for generating a random counter value in accordance with an embodiment of the present invention;

FIG. **4** is a block diagram of an exemplary method for using an unpredictable number in a cryptogram in accordance with an embodiment of the present invention;

FIG. **5** is a block diagram of an exemplary method for using an unpredictable number in a cryptogram to encrypt a transaction request in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

The present invention is described herein in terms of various functional components and processing steps. It should be appreciated that such functional components and processing steps may be realized by any number of software, hardware or structural components configured to perform the specified functions. For example, the present invention may be practiced using various integrated circuit components (e.g., memory elements, digital signal processing elements, logic elements, look-up tables, and the like), which may perform a variety of functions under the control of one or more microprocessors.

FIG. **1** illustrates an exemplary secure RFID transaction system **100** in accordance with the present invention. In general, system **100** includes an RFID transaction device **102** in RF communication with an RFID reader **104** for transmitting data there between. RFID reader **104** is in further communication with a merchant point-of-sale (POS) device **106** for providing to POS **106** data received from RFID transaction device **102**. POS **106** is in further communication with a merchant system **132** for receiving data from the RFID transaction device and providing incentives. Merchant system **132** is in further communication with an acquirer **110** or an account issuer **112** via host network **108**. Merchant system **132** transmits a transaction request to acquirer **110** or account issuer **112**. The transaction request includes information received from RFID reader **104**, RFID transaction device **102** and any information from merchant system **132** concerning the transaction. In sending the transaction request, merchant system **132** requests authorization that the transaction is to be approved or denied. In response, acquirer **110** or account issuer **112** provides merchant system **132** with the authorization necessary for transaction completion.

Although the point-of-interaction (POI) device is described with respect to a merchant point-of-sale (POS) device, the invention is not to be so limited. Indeed, a merchant POS device is used by way of example. Thus, the point-of-interaction device includes any device capable of receiving transaction device **102** account data or data from RFID reader **104**. In this regard, the POS includes any point-of-interaction device enabling the user to complete a transaction using transaction device **102**. POS device **106** receives RFID transaction device **102** information and provides the information to merchant system **132** for processing.

As used herein, an "acquirer" is any software, hardware, and/or entity including various databases and processors for facilitating the routing of the transaction request to an appropriate account issuer **112**. Acquirer **110** routes the request to account issuer **112** in accordance with a routing number provided by RFID transaction device **102**. The "routing number" in this context is a unique network address or any similar device for locating an account issuer **112** on host network **108**. Traditional means of routing the payment request in accordance with the routing number are well understood. As such, the process for using a routing number to provide the payment request will not be discussed herein for brevity.

Additionally, account issuer ("account provider" or "issuer system") **112** includes any software, hardware, and/or entity which provides a transaction account for facilitating completion of a transaction request. The transaction account includes any charge, credit, debit, loyalty, direct debit, checking, savings, financial or other account. The term "issuer" or "account provider" also refers to any software, hardware, and/or entity facilitating payment of a transaction using a transaction device, and which includes systems permitting payment using at least one of a preloaded and non-preloaded transaction device. Typical issuers include American Express, MasterCard, Visa, Discover, and the like. In the preloaded value processing context, an exchange value (e.g., money, rewards points, barter points, etc.) is stored in a preloaded value database (not shown) for use in completing a requested transaction. The preloaded value database, and thus the exchange value, may not be stored on transaction device itself, but is stored remotely, such as, for example, at account issuer **112** location. Further, the preloaded value database is debited the amount of the transaction requiring the value to be replenished. The preloaded value includes any conventional value (e.g., monetary, currency units, rewards points, barter points, etc.) which is exchanged for goods or services. In that regard, the preloaded value has any configuration as determined by issuer system **112**.

In general, during operation of secure system **100**, RFID reader **104** provides an interrogation signal via antenna **130** to transaction device **102** for powering transaction device **102** and receiving transaction device **102** related data. The interrogation signal is received at a transaction device antenna **120** and is further provided to a transponder (not shown). In response, a transaction device processor **114** retrieves a transaction device identifier from a transaction device database **116** for providing to RFID reader **104**. RFID reader **104** receives the transaction device identifier at antenna **130**. RFID reader processor **122** is provided the transaction device identifier and processes it.

As noted, transaction account issuers are continually seeking new ways to secure an RFID transaction. In accordance with the present invention, an RFID transaction is secured using an unpredictable number (UN). In one embodiment, the UN is generated by RFID reader **104** and used by transaction device **102** as one of the data elements that is an input to the calculation of a cryptogram calculated by transaction device **102** and sent in the authorization message. For more information on calculating cryptograms, see U.S. patent application Ser. No. 10/708,545, entitled "SYSTEM AND METHOD FOR SECURING RF TRANSACTIONS USING A RADIO FREQUENCY IDENTIFICATION DEVICE INCLUDING A TRANSACTIONS COUNTER," filed Mar. 10, 2004, and U.S. patent application Ser. No. 10/905,005, entitled "SYSTEM AND METHOD FOR AUTHENTICATING A RF TRANSACTION USING A RADIO FREQUENCY IDENTIFICATION DEVICE INCLUDING A TRANSACTIONS COUNTER," filed Dec. 9, 2004, both of which are incorporated herein by reference.

Use of a UN in the calculation of the cryptogram prevents or restricts an unauthorized person from stealing a copy of a transaction and sending this transaction to issuer **112** because the reader generates a random value for the UN and it is nearly impossible to predict the value of the UN to be used for each transaction. The unpredictable number, in one embodiment, is generated using a seeded algorithm. The algorithm is a pseudo random number generator. In another embodiment, the time clock on the reader or POS terminal, which is in seconds, milliseconds, and/or any other time frame, is used. In yet another embodiment, the algorithm is seeded with the transaction value in cents concatenated with the time in milliseconds (or any other time increment) and/or any other changing numerical value that can be used to seed the algorithm.

An exemplary use of the UN in the cryptogram is accomplished as follows: RFID reader **104** sends a UN to transaction device **102** at, for example, the start of a payment transaction. Transaction device **102** encrypts the UN together with other information (a transaction counter and a user identifier) using a secret key and sends the transaction to RFID reader **104**. The process continues as illustrated in FIG. **4**, RFID reader **104** sends the encrypted data (called a cryptogram) and a copy of the UN to account issuer **112** (e.g., in a magnetic stripe format using the ISO 8583 financial message) (Steps **402** and **404**), wherein account issuer **112** stores the UN (Step **406**), checks that the cryptogram is valid, decrypts the cryptogram (Step **408**) and checks that the cryptogram contains an encrypted form of the UN sent by RFID reader **104** (Step **410**). If the values are all valid, the transaction is known to have been generated by a transaction device issued by issuer **112** and that it has not been tampered with. Note that the secret key is loaded onto transaction device **102** by issuer **112** when transaction device **102** is created using standard industry secure methods for key management.

FIG. **2** depicts an exemplary method **200** of a suitable algorithm in accordance with the present invention. The algorithm is processed using RFID processor **122**. Method **200** includes seeding a pseudo random number generator with the unpredictable number generated in accordance with the invention.

Two parties communicating using the present invention may decide that the resulting unpredictable number may have any value (step **202**). For example, the sending party (e.g., merchant system **132**) and the receiving party (e.g., account issuer **112**) may determine that the unpredictable number may have a value range of 0 to 64000. The strength of the security is improved with a larger value for the UN. For example if the range is 0-7, then there is a 1 in 8 chance that someone could 'guess' the correct value of the UN and compromise the security of the transaction. For example, if the range is 1-64000, then the chances for 'guessing' the value is much reduced because it is a 1 in 64000 chance that the guess is correct.

The algorithm of method **200** then uses the predetermined value of the unpredictable number to determine the maximum value of the resulting unpredictable number (step **204**). For example, the maximum value of the UN is selected based on the available space in the message sent to issuer **112**. This limitation is based on, for example, the space in track 1 or 2 of the magnetic stripe format used for financial transactions. The limitation may also be based on the use of predefined optional fields in the ISO 8583 message sent to the issuer and in this case, larger values are used. The final selection of the maximum value is a compromise between the available space in the magnetic stripe format (or the ISO8583 format) which limits the size, and the desired maximum value to make it difficult to predict the UN. The largest size that can be used on the network is normally selected to maximize the strength of the security. The algorithm is then seeded with a seed value generated in accordance with the method of FIG. **3**.

With brief reference to FIG. **3**, an exemplary method **300** of generating the seed value according to this invention is described. In one exemplary embodiment, RFID processor **122** receives variable data from RFID transaction device **102** for use in generating the seed value and running the algorithm illustrated by method **200** (step **302**). The variable data includes any data related to RFID transaction device **102**, RFID reader **104** or the transaction requested. For example, the variable data is an RFID reader **104** identifier, a counter value provided by RFID reader **104** or RFID transaction device **102**, the time of the transaction, a secret password or phrase related to RFID transaction device **102**, an RFID transaction device identifier, non-RFID readers and/or transaction device identifiers and/or data, PIN data, loyalty data, inventory data, storage data, financial data, user data, and the number of milliseconds since the RFID reader **104** has processed the most recent transaction.

RFID processor **122** then performs a secure hashing algorithm on the variable data to obtain an output called a "message digest" (step **304**). RFID processor **122** performs suitable secure hashing algorithms that include, for example, any secure hashing algorithm defined by the Federal Information Processing Standard Publication 180-1, incorporated herein by reference. For example, Secure Hashing Algorithm SHA-1 is an exemplary algorithm that is useful with this invention.

In one exemplary embodiment, the message digest generated by RFID processor **122** includes 160-bits (20-bytes). RFID processor **122** truncates the message digest into a 16-byte format. In one exemplary embodiment, RFID processor **122** truncates the message digest so that only the right most (or left most) 16 bytes of the message digest remain (step **306**). Processor **122** then provides the 16-byte value to a RFID database **128** for storage and/or later use as a counter value in the algorithm describe in FIG. **2** (step **308**). In one embodiment, RFID formats the message digest into either magnetic stripe track 1 format or ISO 8583 format (step **310**) and sends the message to the account issuer.

Returning now to FIG. **2**, RFID processor **122** retrieves the 16-byte value (e.g., counter value) from database **128** (step **206**). RFID processor **122** then uses the counter value to seed the algorithm for use in generating the unpredictable number (step **212**). For example, RFID processor **122** retrieves the counter value and uses the value in a pseudo number genera-

tor to generate the unpredictable number using a Data Encryption Standard (step **208**). Exemplary Data Encryption Standards (DES) which are used are those described in Federal Information Processing Standards (FIPS) Publication 46-3, incorporated herein by reference. In this way, RFID processor **122** creates a random number using the unpredictable number generated by the pseudo number generator. A range of values for the unpredictable number can be chosen, and the maximum value permitted for the unpredictable number is determined.

In an exemplary embodiment, the sender or receiver may wish to trim the unpredictable number to the maximum value allowed (step **210**). Trimming of the maximum number is used because of limitations in the available space in a message. The message can be a magnetic stripe formatted message (track 1, 2 or 3) or a suitable field in the ISO8583 message used to send financial transactions to issuer **112**. For example, in one embodiment, RFID processor **122** uses a modification function to trim the unpredictable number as predetermined by merchant system **132** and/or account issuer **112**.

Although an embodiment of the invention includes generating an unpredictable number at RFID reader **104**, the invention is not so limited. The unpredictable number is generated and/or regenerated by any one of the computing systems in the transaction stream. For example, the unpredictable number is generated by computing systems at the account issuer **112**, acquirer **110**, the receiver, or merchant system **132** locations. Moreover, the algorithm described herein is used in any environment wherein security of a transaction is required.

The system may include an application server, host server or other computing systems including a processor for processing digital data, a memory coupled to said processor for storing digital data, an input digitizer coupled to the processor for inputting digital data, an application program stored in said memory and accessible by said processor for directing processing of digital data by said processor, a display coupled to the processor and memory for displaying information derived from digital data processed by said processor and a plurality of databases, said databases including client data, merchant data, financial institution data and/or like data that could be used in association with the present invention. As those skilled in the art will appreciate, user computer will typically include an operating system (e.g., Windows NT, 95/98/2000, Linux, Solaris, etc.) as well as various conventional support software and drivers typically associated with computers.

Similarly, the software elements of the present invention can be implemented with any programming or scripting language such as C, C++, Java, COBOL, assembler, PERL, extensible markup language (XML), JavaCard and MULTOS with the various algorithms being implemented with any combination of data structures, objects, processes, routines or other programming elements. Further, it should be noted that the present invention employs any number of conventional techniques for communicating data, data transmission, signaling, data processing, network control, and the like. For a basic introduction on cryptography, review a text written by Bruce Schneier entitled "Applied Cryptography: Protocols, Algorithms, and Source Code in C," published by John Wiley & Sons (second edition, 1996), herein incorporated by reference.

The term "communication" refers to a signal that travels to/from one component to another. The components are directly connected to each other or are connected through one or more other devices or components. The various coupling components for the devices can include but are not limited to the Internet, a wireless network, a conventional wire cable, an optical cable or connection through air, water, or any other medium that conducts signals, and any other coupling device or medium. A variety of conventional communications media and protocols are used for data links between components. For example, the data links include an Internet Service Provider (ISP) configured to facilitate communications over a local loop as is typically used in connection with standard modem communication, cable modem, dish networks, ISDN, Digital Subscriber Lines (DSL), or any wireless communication media. In addition, a merchant system according to this invention includes a POS device and host network. The merchant system may reside on a local area network which interfaces to a remote network for remote authorization of an intended transaction. The merchant system communicates with the remote network via a leased line, such as a T1, D3 line, or the like. Such communications lines are described in a variety of texts, such as, "Understanding Data Communications," by Gilbert Held, which is incorporated herein by reference.

Certain communications between the parties and the system of the present invention are accomplished through any suitable communication means, such as, for example, a telephone network, intranet, Internet, point-of-interaction device (point-of-sale device, personal digital assistant, cellular phone, kiosk, etc.), online communications, off-line communications, wireless communications, transponder communications and/or the like. One skilled in the art will also appreciate that, for security reasons, any databases, systems, or components of the present invention may consist of any combination of databases or components at a single location or at multiple locations, wherein each database or system includes any of various suitable security features, such as firewalls, access codes, encryption, decryption, compression, decompression, and/or the like.

Where required, the system user communicates with a system via any input device such as, a keypad, keyboard, mouse, kiosk, personal digital assistant, handheld computer (e.g., Palm Pilot®, Blackberry®), cellular phone and/or the like). Similarly, the invention could be used in conjunction with any type of personal computer, network computer, work station, minicomputer, mainframe, or the like, running any operating system such as any version of Windows, Windows NT, Windows 2000, Windows 98, Windows 95, MacOS, OS/2, BeOS, Linux, UNIX, Solaris, or the like. Moreover, although the invention may frequently be described as being implemented with TCP/IP communications protocol, it should be understood that the invention could also be implemented using SNA, IPX, Appletalk, IPte, NetBIOS, OSI or any number of communications protocols. Moreover, the system contemplates the use, sale, or distribution of any goods, services or information over any network having similar functionality described herein.

It should be further noted that the transfer of information in accordance with this invention, is done in a format recognizable by a merchant system or account issuer. In that regard, by way of example, the information is transmitted in magnetic stripe or multi-track magnetic stripe format. Because of the proliferation of devices using magnetic stripe format, the standards for coding information in magnetic stripe format were standardized by the International Standards Organization (ISO).

Typically, magnetic stripe information is formatted in three tracks. Certain industry information must be maintained on certain portion of the tracks, while other portions of the tracks may have open data fields. The contents of each track and the formatting of the information provided to each track is con-

trolled by ISO standard ISO/IEC 7811. For example, the information must typically be encoded in binary. Track 1 is usually encoded with user information (name) in alphanumeric format. Track 2 is typically comprised of discretionary and nondiscretionary data fields. In one example, the nondiscretionary field may comprise 19 characters and the discretionary field may comprise 13 characters. Track 3 is typically reserved for financial transactions and includes enciphered versions of the user's personal identification number, country code, currency units, amount authorized per cycle, subsidiary accounts, and restrictions.

As such, where information is provided in accordance with this invention, it is provided in magnetic stripe format track. For example, counter values, authentication tags and encrypted identifiers, described herein, is forwarded encoded in all or a portion of a data stream representing data encoded in, for example, track 2 or track 3 format.

An RFID transaction device identifier, as used herein, may include an identifier for a transaction device which is correlated to a user transaction account (e.g., credit, charge debit, checking, savings, reward, loyalty, or the like) maintained by a transaction account provider (e.g., payment authorization center). A typical transaction account identifier (e.g., account number) is correlated to a charge, credit or debit account, loyalty account, or rewards account maintained and serviced by such entities as American Express, Visa and/or MasterCard, or the like.

In that regard, the transaction device identifier discussed herein may be, for example, a sixteen-digit credit card number, although each credit provider has its own numbering system, such as the fifteen-digit numbering system used by American Express. Each company's credit card numbers comply with that company's standardized format such that the company using a sixteen-digit format will generally use four spaced sets of numbers, as represented by the number "0000 0000 0000 0000". In a typical example, the first five to seven digits are reserved for processing purposes and identify the issuing bank, card type and, etc. In this example, the last sixteenth digit is used as a sum check for the sixteen-digit number. The intermediary eight-to-ten digits are used to uniquely identify the customer. The account number is stored as Track 1 and Track 2 data as defined in ISO/IEC 7813, and is unique to RFID transaction device.

In one exemplary embodiment, the transaction device identifier may include a unique RFID transaction device serial number and user identification number, as well as specific application applets. In another embodiment, the transaction device identifier may include a marker that facilitates recognition of the transaction device identifier as originating with an RFID device. The transaction device identifier is stored on a transaction device database located on the transaction device. Additionally, the RFID device may include a transaction device database configured to store multiple account numbers issued to an RFID transaction device user by the same or different account providing institutions. In addition, where the transaction device identifier corresponds to a loyalty or rewards account, a merchant system database is configured to store the attendant loyalty or rewards points data in associated relationship with the RFID transaction device identifier.

In addition to the above, the transaction device identifier is associated with any secondary form of identification configured to allow the consumer to interact or communicate with a payment system. For example, the transaction device identifier is associated with, an authorization/access code, personal identification number (PIN), Internet code, digital certificate, biometric data, and/or other secondary identification data used to verify a transaction device user identity.

Databases discussed herein is a graphical, hierarchical, relational, object-oriented or other database, and is maintained on a local drive of a server or on a separate computer coupled to the server via a local area or other network (not shown). In one embodiment, databases disclosed are a collection of ASCII or other text files stored on a local drive of a server. Database information is suitably retrieved from the database and provided to transaction processing systems upon request via a server application, as described more fully below.

Further still, various components are described herein in terms of their "validity." In this context, a "valid" component is one which is authorized for use in completing a transaction request in accordance with the present invention. Contrarily, an "invalid" component is one which is not authorized for transaction completion. In addition, an invalid component is one which is not recognized as being permitted for use on the secure RF system described herein.

It should be noted that conventional components of RFID transaction devices may not be discussed herein for brevity. For instance, one skilled in the art will appreciate that RFID transaction device and RFID reader disclosed herein include traditional transponders, antennas, protocol sequence controllers, modulators/demodulators and the like, necessary for proper RFID data transmission. As such, those components are contemplated to be included in the scope of the invention. For a more detailed description of the operation of RFID transaction devices and RFID readers please refer to commonly-owned U.S. patent application Ser. No. 10/340,352, entitled "SYSTEM AND METHOD FOR INCENTING PAYMENT USING RADIO FREQUENCY IDENTIFICATION IN CONTACT AND CONTACTLESS TRANSACTIONS," filed Jan. 10, 2003, and its progeny, all incorporated by reference in their entirety.

The preceding detailed description of exemplary embodiments of the invention makes reference to the accompanying drawings, which show the exemplary embodiment by way of illustration. While these exemplary embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, it should be understood that other embodiments may be realized and that logical and mechanical changes may be made without departing from the spirit and scope of the invention. In addition, the steps recited in any of the method or process claims may be executed in any order and are not limited to the order presented. Further, the present invention may be practiced using one or more servers, as necessary. Thus, the preceding detailed description is presented for purposes of illustration only and not of limitation, and the scope of the invention is defined by the preceding description, and with respect to the attached claims.

What is claimed is:

1. A method for generating an unpredictable number to facilitate securing a transaction:

obtaining, by an Radio Frequency Identification (RFID) reader, variable data;

performing, by said RFID reader, a secure hashing algorithm on said variable data to produce a message digest, wherein the secure hashing algorithm is configured to produce a digest of at least 16 bytes;

selecting, by said RFID reader, at least one of a left-most 16 bytes or a right-most 16 bytes of said message digest to form a random 16-byte value;

creating, by said RFID reader, said unpredictable number using said random 16-byte value as an input for a seeded pseudo-random number generator;

determining, by said RFID reader and based upon at least one of an account issuer or a merchant system, a proposed maximum value for said unpredictable number;

truncating, by said RFID reader, said unpredictable number, wherein the result of said truncating is said unpredictable number limited to said proposed maximum value;

sending, by said RFID reader, the truncated unpredictable number to an RFID transaction device;

receiving, by said RFID reader, a cryptogram from said RFID transaction device, wherein said cryptogram includes the truncated unpredictable number; and

sending, by said RFID reader, the truncated unpredictable number and said cryptogram to an account issuer, wherein said account issuer validates said cryptogram and verifies that said cryptogram includes the truncated unpredictable number.

2. The method of claim **1**, wherein said obtaining said variable data includes receiving at least one of an RFID transaction device identifier, RFID transaction device data, an RFID reader identifier, RFID reader data, transaction request data, a counter value provided by said RFID reader, a counter value provided by said RFID transaction device, a time of said transaction, a password related to said RFID transaction device, non-RFID transaction device data, non-RFID reader data, PIN data, loyalty data, inventory data, storage data, financial data, user data, or a number of milliseconds since said RFID reader has processed a most recent transaction.

3. The method of claim **2**, wherein said seeded pseudo-random number generator comprises a triple Data Encryption Standard (DES) operation.

4. The method of claim **3**, wherein said performing said secure hashing algorithm on said variable data to produce said message digest comprises formatting said message in at least one of magnetic strip format, track 1 format, track 2 format, or track 3 format.

5. The method of claim **4**, wherein said sending said cryptogram and the truncated unpredictable number to said account issuer comprises sending in a magnetic stripe format using an ISO 8583 message.

6. The method of claim **5**, wherein said performing said secure hashing algorithm on said variable data comprises using a Radio Frequency Identification (RFID) processor to perform said secure hashing algorithm.

7. The method of claim **6**, wherein said performing said secure hashing algorithm on said random set of variable data comprises using Secure Hashing Algorithm SHA-1.

8. A tangible computer-readable medium having stored thereon a plurality of non-transitory computer executable instructions, the plurality of instructions when executed by an RFID reader cause said RFID reader to perform the method comprising:

obtaining variable data;

performing a secure hashing algorithm on said variable data to produce a message digest, wherein the secure hashing algorithm is configured to produce a digest of at least 16 bytes;

selecting at least one of a left-most 16 bytes or a right-most 16 bytes of said message digest to form a random 16-byte value;

creating said unpredictable number using said random 16-byte value as an input for a seeded pseudo-random number generator;

determining, based upon at least one of an account issuer or a merchant system, a proposed maximum value for said unpredictable number;

truncating said unpredictable number, wherein the result of said truncating is said unpredictable number limited to said proposed maximum value;

sending the truncated unpredictable number to an RFID transaction device;

receiving a cryptogram from said RFID transaction device, wherein said cryptogram includes the truncated unpredictable number; and

sending the truncated unpredictable number and said cryptogram to an account issuer, wherein said account issuer validates said cryptogram and verifies that said cryptogram includes the truncated unpredictable number.

9. The computer-readable medium of claim **8**, wherein said seeded algorithm is a triple Data Encryption Standard (DES) operation.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,001,054 B1
APPLICATION NO. : 11/306617
DATED : August 16, 2011
INVENTOR(S) : Lee J. Peart et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title page, section (63) Related U.S. Application Data, after Mar. 10, 2004, please delete "which" and insert therefor --and--.

On the Title page, section (63) Related U.S. Application Data, after Jan. 10, 2003, please delete "which" and insert therefor --and--.

Signed and Sealed this
Twenty-seventh Day of September, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office