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Chenthamarakshan

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(54) **SYSTEM AND METHOD FOR PROCESSING FEEDBACK ENTRIES RECEIVED FROM SOFTWARE**

(75) Inventor: **Vijil Enara Chenthamarakshan**, Kerala (IN)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

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(52) **U.S. Cl.**
USPC **705/50**; 705/64; 380/278

(58) **Field of Classification Search**
None
See application file for complete search history.

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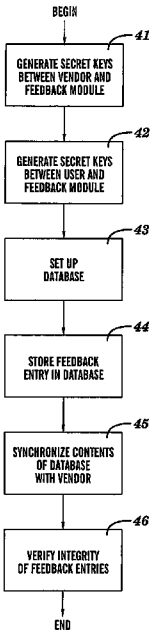
Primary Examiner — Calvin L Hewitt, II
Assistant Examiner — Mohammad A Nilforoush
(74) *Attorney, Agent, or Firm* — Schmeiser, Olsen & Watts; John Pivnichny

(57) **ABSTRACT**

A method and system for processing feedback entries received from software provided by a vendor to an end user machine. The end user machine includes the software, a feedback module, and a database. The feedback module: generates a secret key k(0) and makes the key k(0) known to both the vendor and a user of the software; generates a secret key n(0) and makes the key n0) known to the vendor but not to but not to the user; generates a secret key s(0) and makes the key s(0) known to the user but not to the vendor; generates an encryption E_{k0} of an identification tag using the key (k(0); generates a parameter H_{n0} such that H_{n0}=Hash(n(0)||E_{k0}); generates a parameter H_{s0} such that H_{s0}=Hash(s(0)||E_{k0}); sends E_{k0}, H_{n0}, and H_{s0} to the database; and sends E_{k0} and H_{s0} to the vendor.

32 Claims, 12 Drawing Sheets



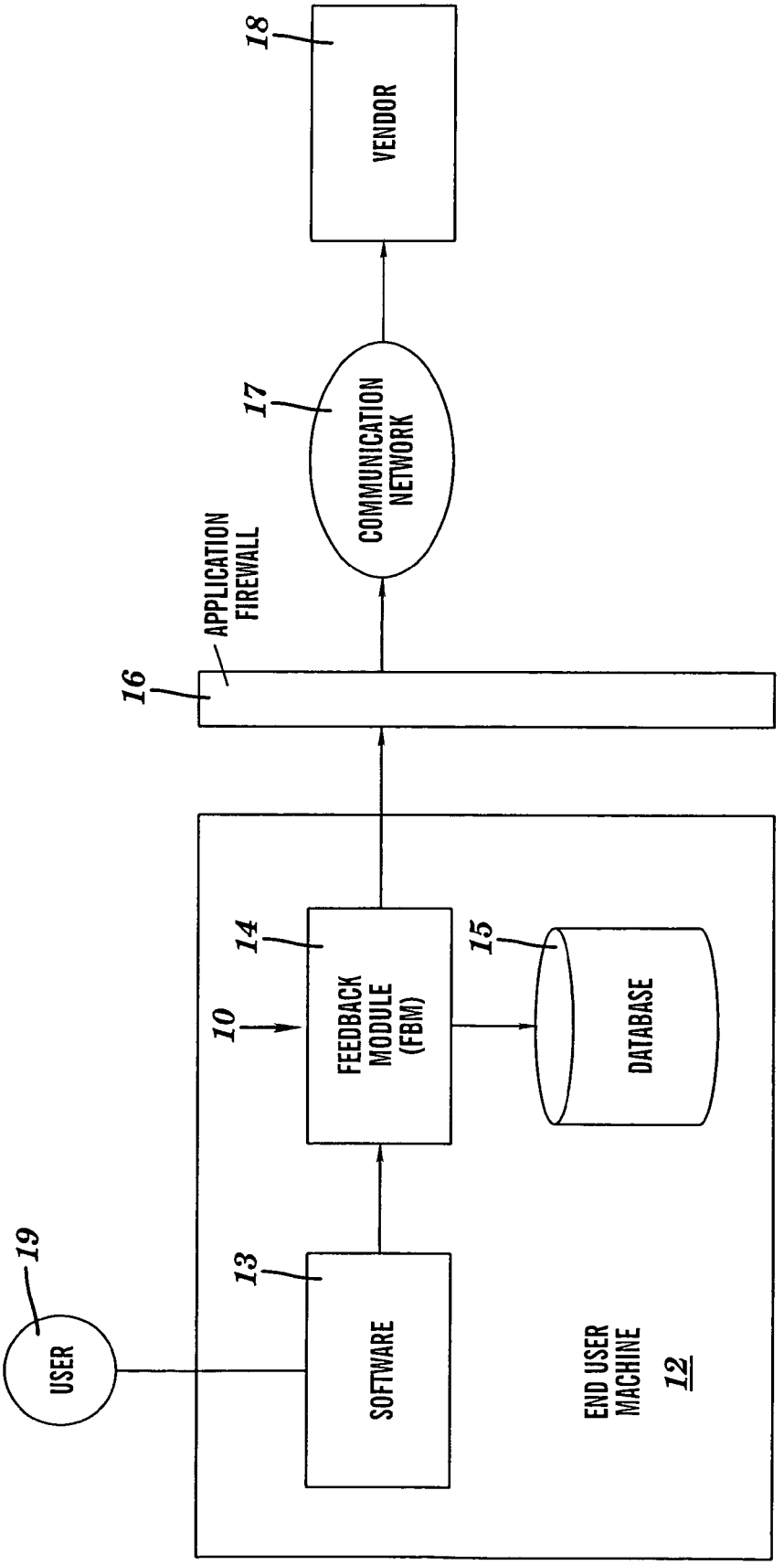

USER
19
SOFTWARE
13
10
FEEDBACK MODULE (FBM)
14
DATABASE
15
END USER MACHINE
12
16
APPLICATION FIREWALL
COMMUNICATION NETWORK
17
VENDOR
18

FIG. 1

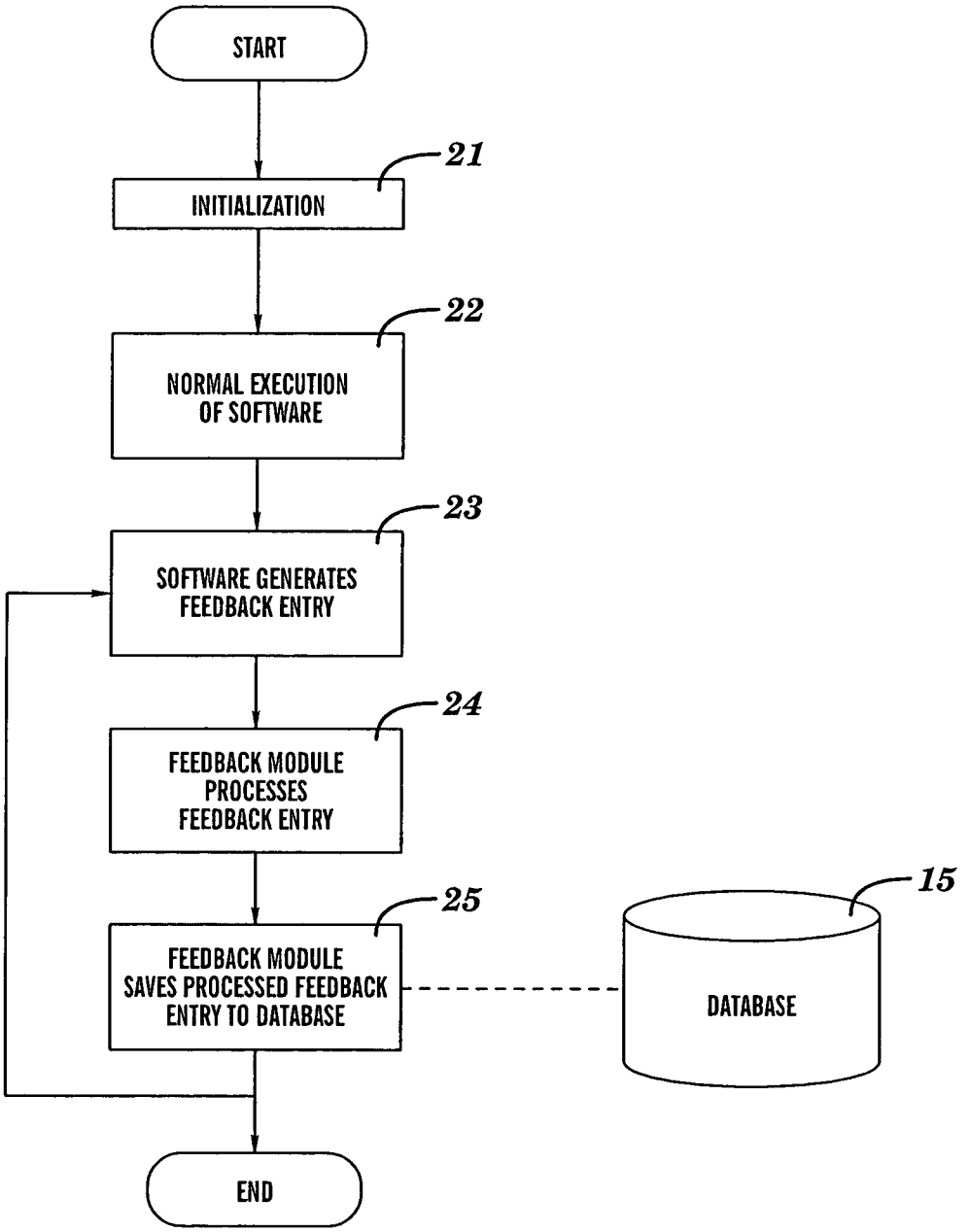

START
21
INITIALIZATION
22
NORMAL EXECUTION OF SOFTWARE
23
SOFTWARE GENERATES FEEDBACK ENTRY
24
FEEDBACK MODULE PROCESSES FEEDBACK ENTRY
25
FEEDBACK MODULE SAVES PROCESSED FEEDBACK ENTRY TO DATABASE
15
DATABASE
END

FIG. 2

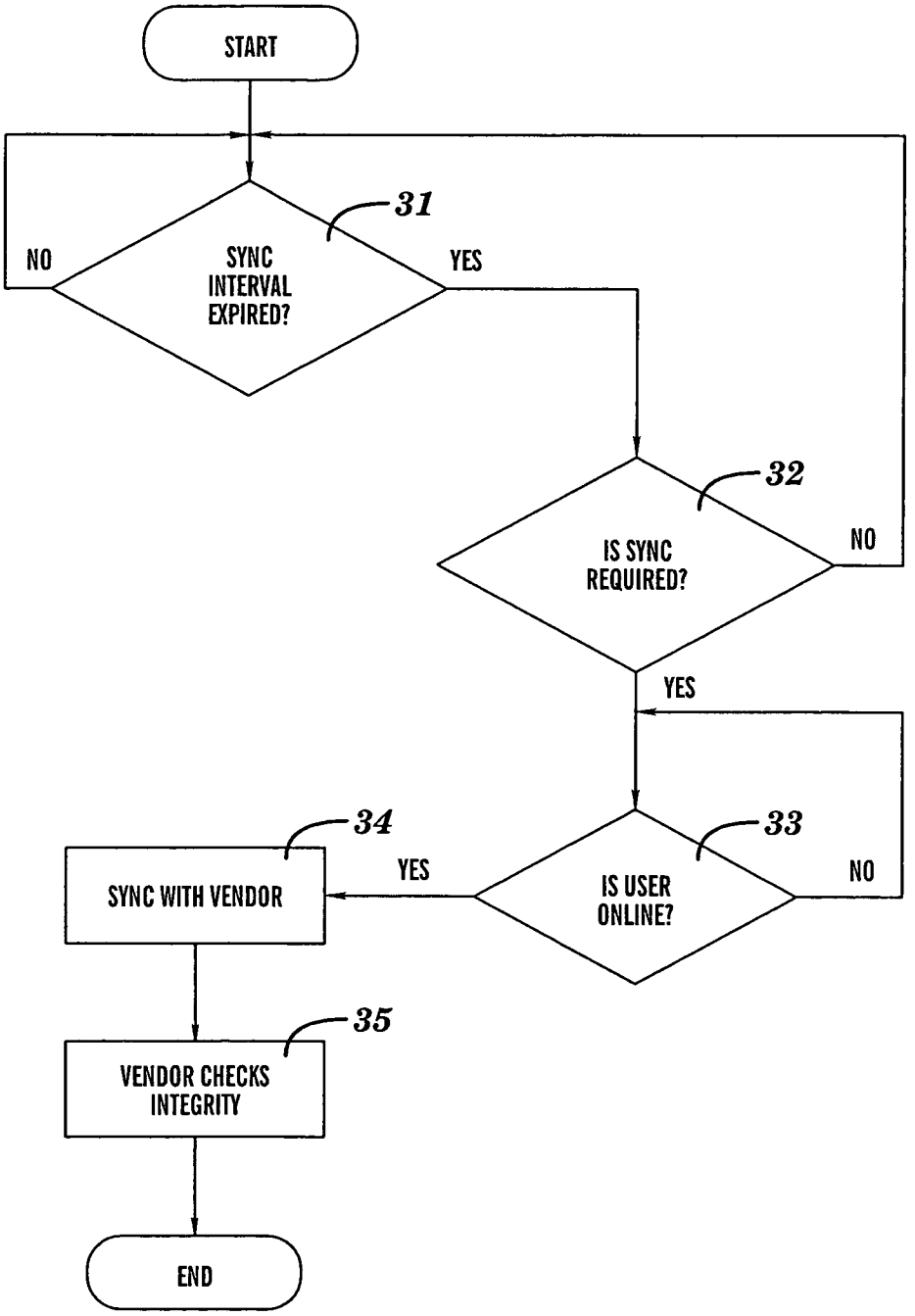

START
31
SYNC INTERVAL EXPIRED?
NO
YES
32
IS SYNC REQUIRED?
NO
YES
33
IS USER ONLINE?
YES
NO
34
SYNC WITH VENDOR
35
VENDOR CHECKS INTEGRITY
END

FIG. 3

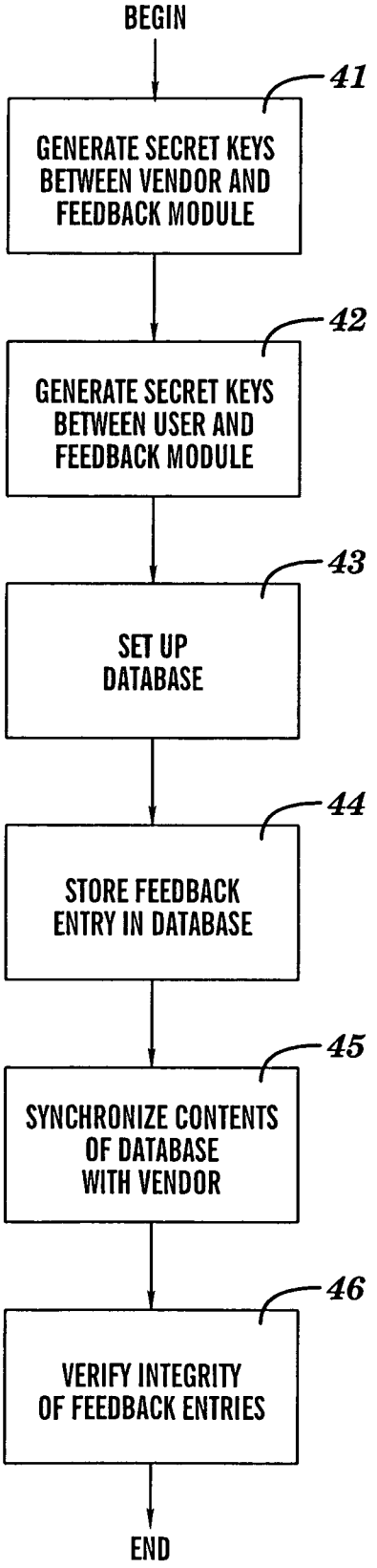

BEGIN
41
GENERATE SECRET KEYS BETWEEN VENDOR AND FEEDBACK MODULE
42
GENERATE SECRET KEYS BETWEEN USER AND FEEDBACK MODULE
43
SET UP DATABASE
44
STORE FEEDBACK ENTRY IN DATABASE
45
SYNCHRONIZE CONTENTS OF DATABASE WITH VENDOR
46
VERIFY INTEGRITY OF FEEDBACK ENTRIES
END

FIG. 4

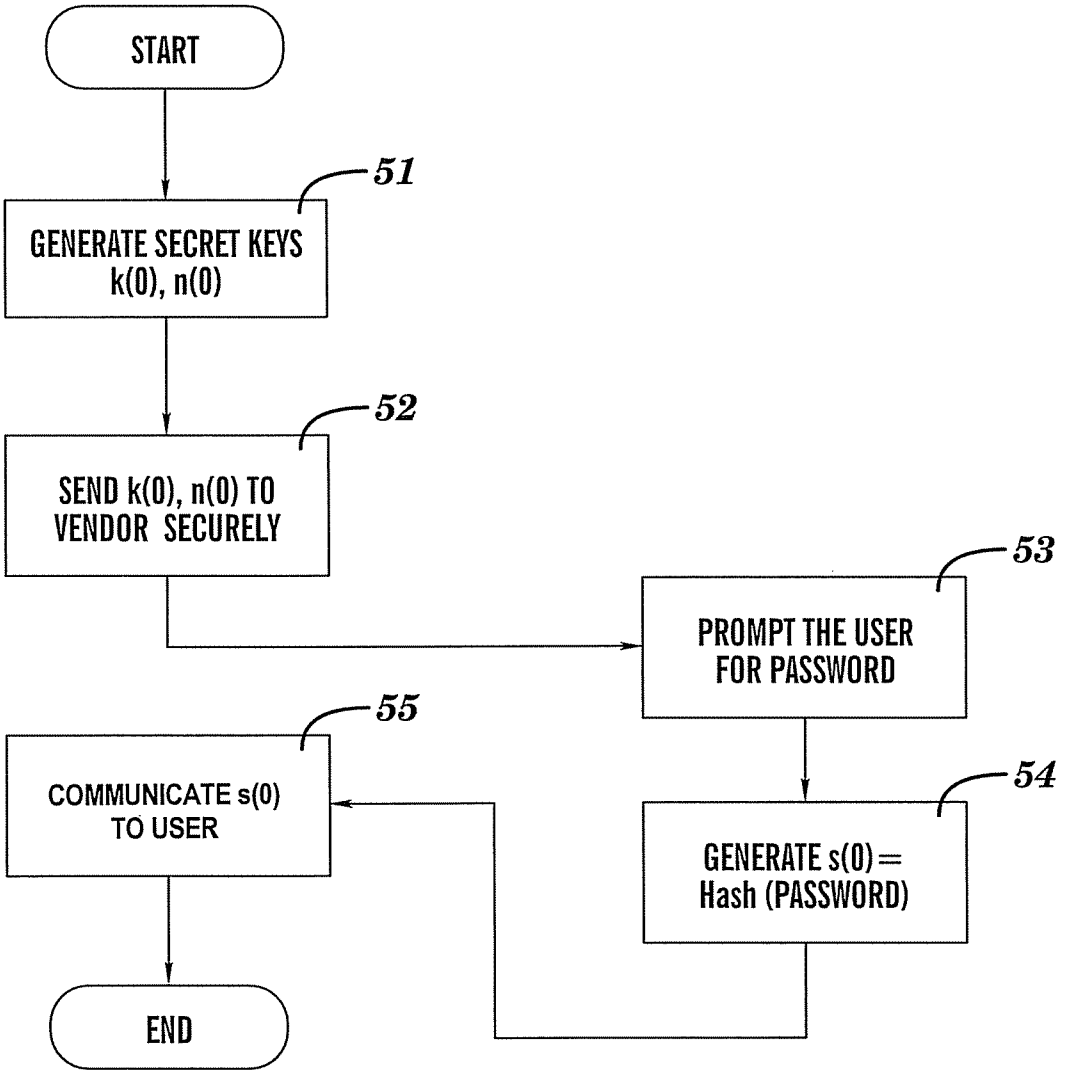

START
51
GENERATE SECRET KEYS k(0), n(0)
52
SEND k(0), n(0) TO VENDOR SECURELY
53
PROMPT THE USER FOR PASSWORD
54
GENERATE s(0) = Hash (PASSWORD)
55
COMMUNICATE s(0) TO USER
END

FIG. 5

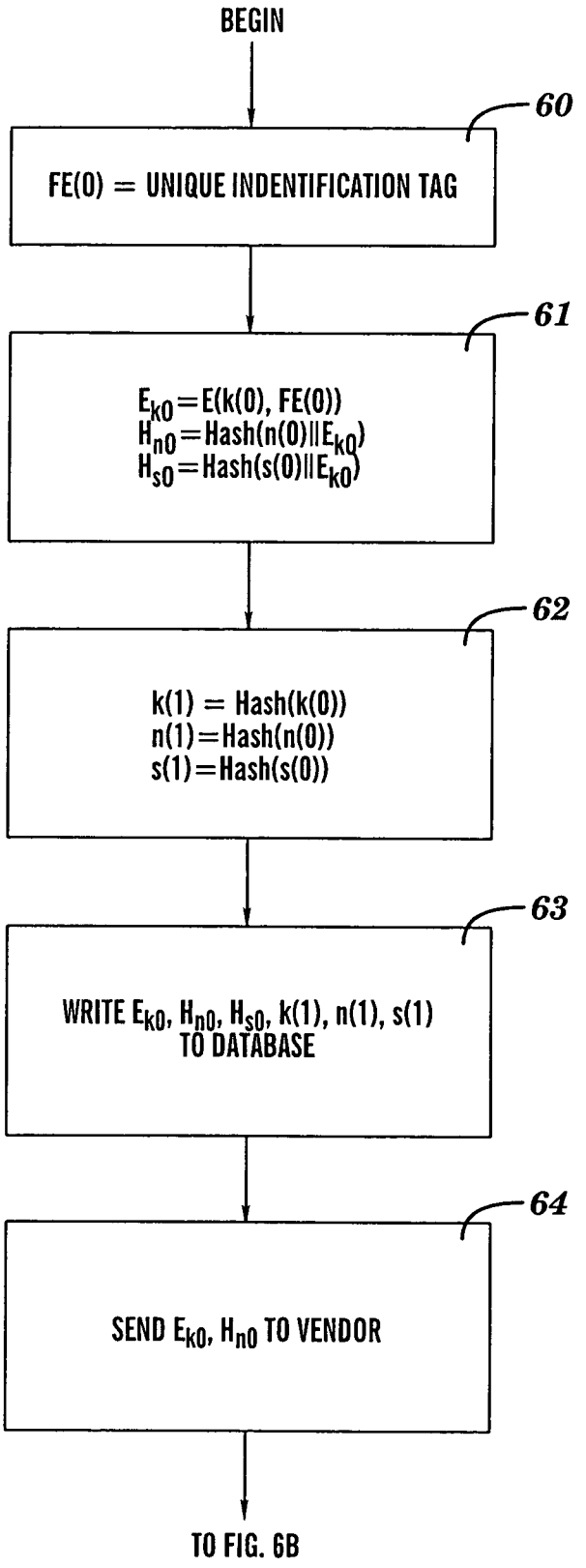

BEGIN
60
FE(0) = UNIQUE INDENTIFICATION TAG
61
E_{k0}=E(k(0), FE(0))
H_{n0}=Hash(n(0)||E_{k0})
H_{s0}=Hash(s(0)||E_{k0})
62
k(1) = Hash(k(0))
n(1)=Hash(n(0))
s(1)=Hash(s(0))
63
WRITE E_{k0}, H_{n0}, H_{s0}, k(1), n(1), s(1) TO DATABASE
64
SEND E_{k0}, H_{n0} TO VENDOR
TO FIG. 6B

FIG. 6A

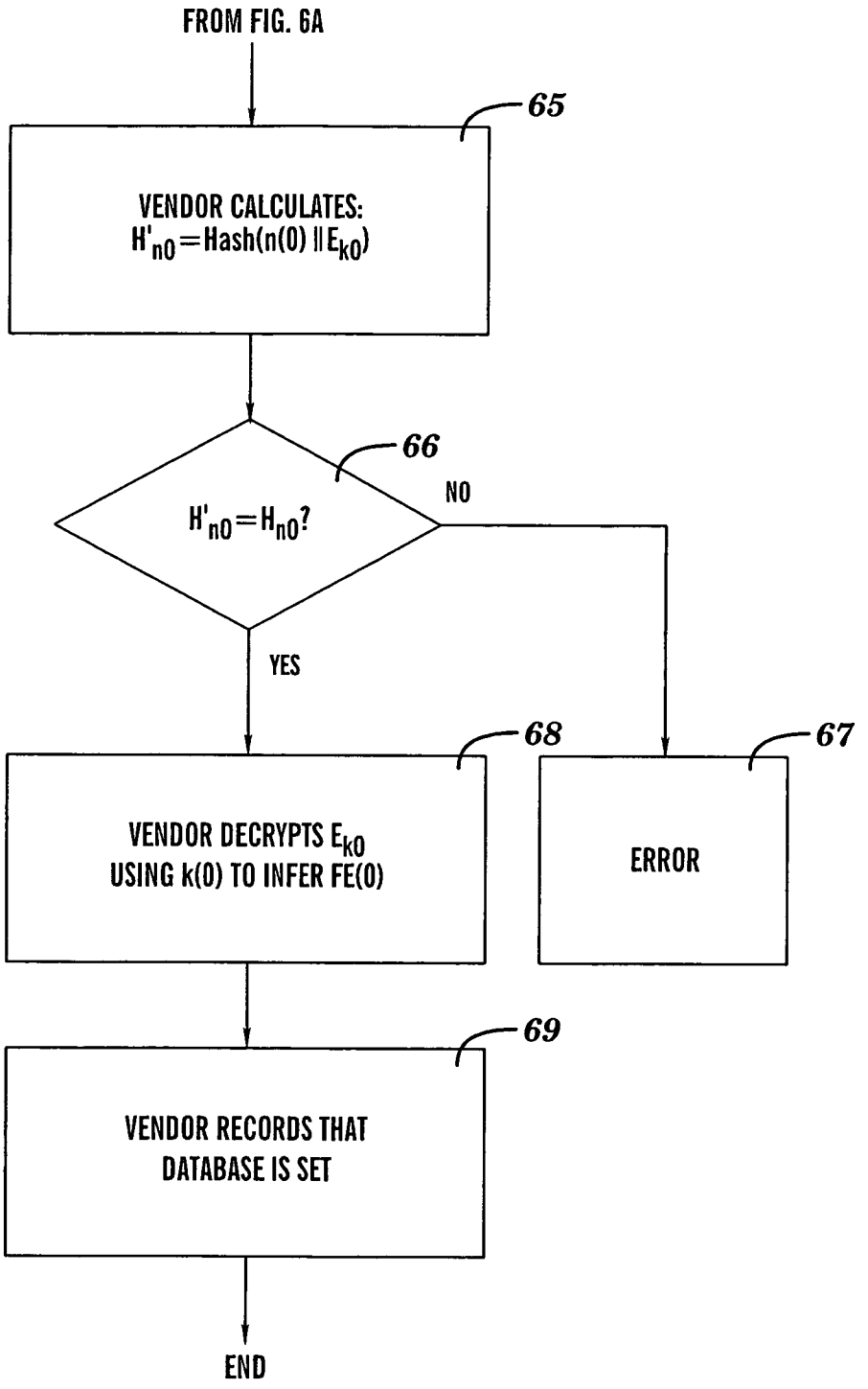

FROM FIG. 6A
65
VENDOR CALCULATES:
$H'_{n0}=Hash(n(0) \| E_{k0})$
66
$H'_{n0}=H_{n0}$?
NO
YES
68
67
VENDOR DECRYPTS E_{k0}
USING k(0) TO INFER FE(0)
ERROR
69
VENDOR RECORDS THAT
DATABASE IS SET
END

FIG. 6B

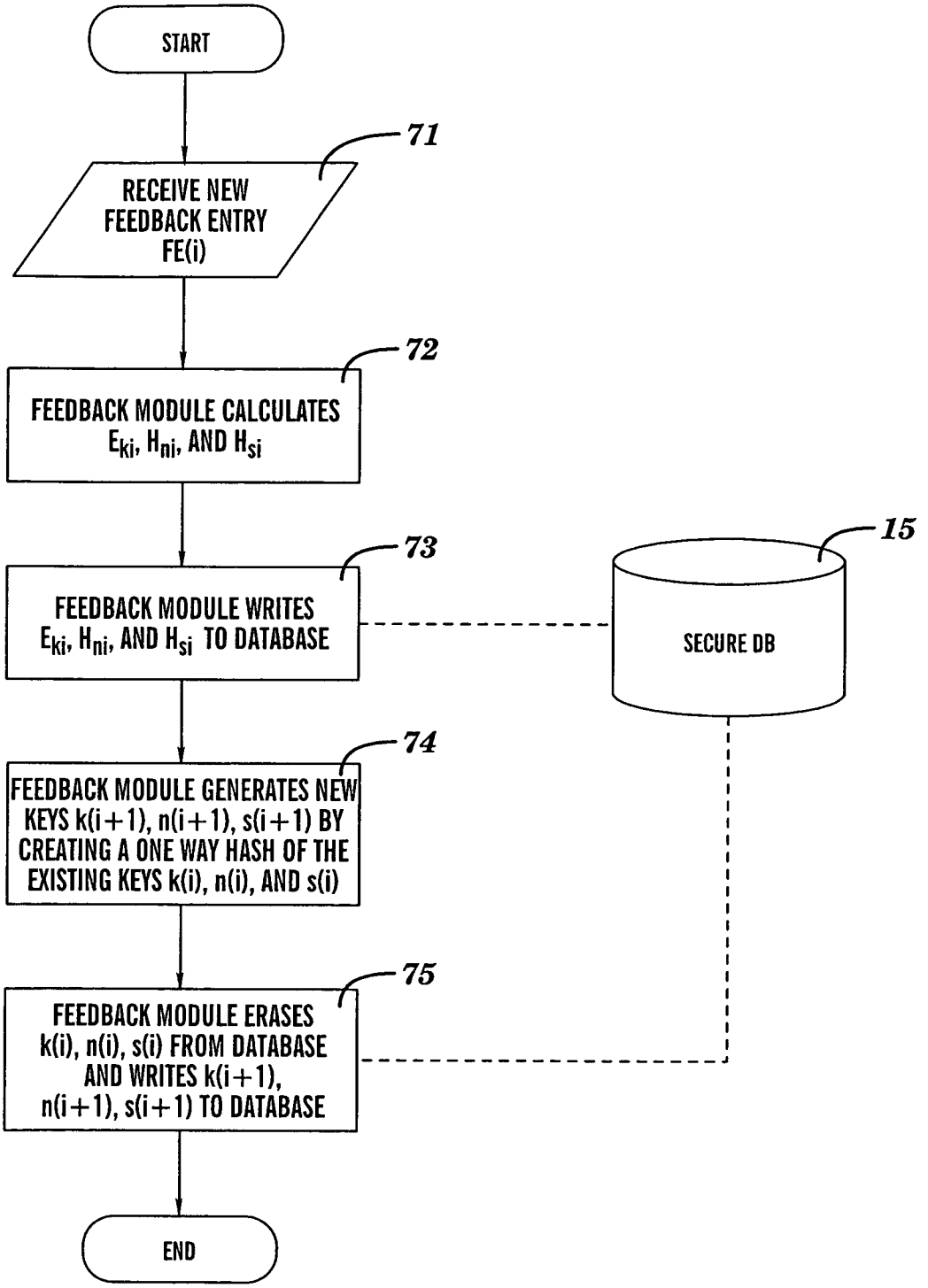

START
71
RECEIVE NEW FEEDBACK ENTRY FE(i)
72
FEEDBACK MODULE CALCULATES E_{ki}, H_{ni}, AND H_{si}
73
FEEDBACK MODULE WRITES E_{ki}, H_{ni}, AND H_{si} TO DATABASE
15
SECURE DB
74
FEEDBACK MODULE GENERATES NEW KEYS k(i+1), n(i+1), s(i+1) BY CREATING A ONE WAY HASH OF THE EXISTING KEYS k(i), n(i), AND s(i)
75
FEEDBACK MODULE ERASES k(i), n(i), s(i) FROM DATABASE AND WRITES k(i+1), n(i+1), s(i+1) TO DATABASE
END

FIG. 7

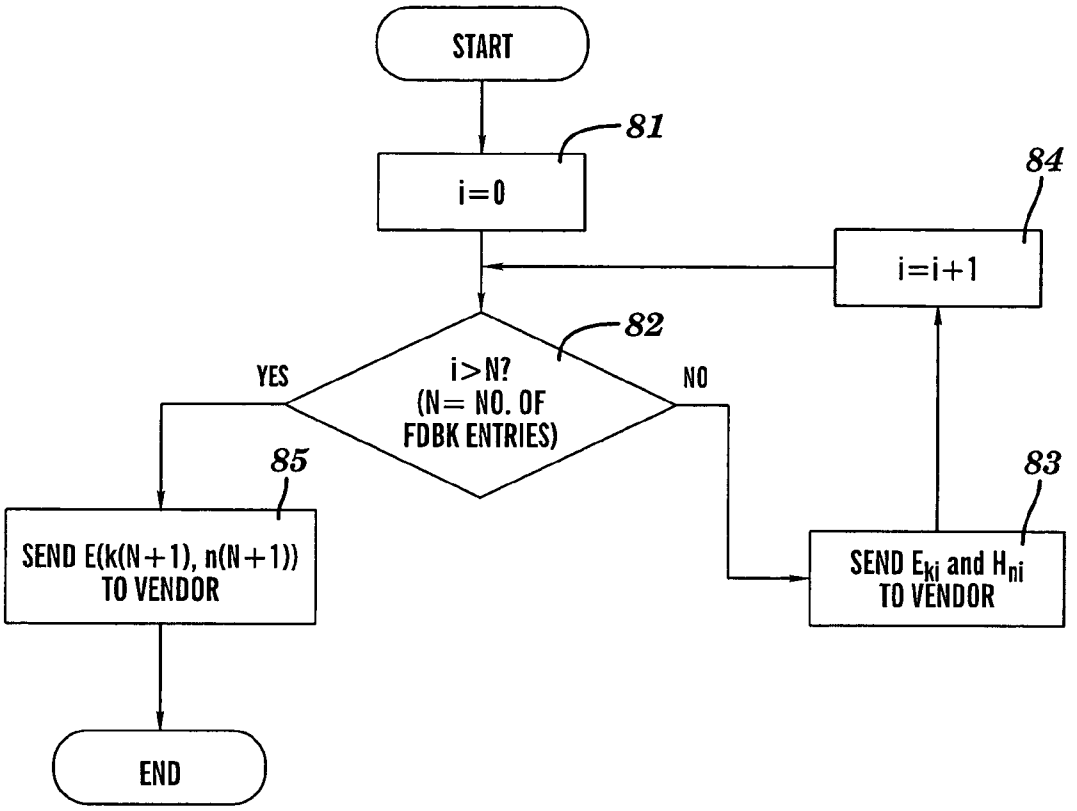

START
81
i=0
84
i=i+1
82
i>N?
(N= NO. OF
FDBK ENTRIES)
YES
NO
85
83
SEND E(k(N+1), n(N+1))
TO VENDOR
SEND E_{ki} and H_{ni}
TO VENDOR
END

FIG. 8

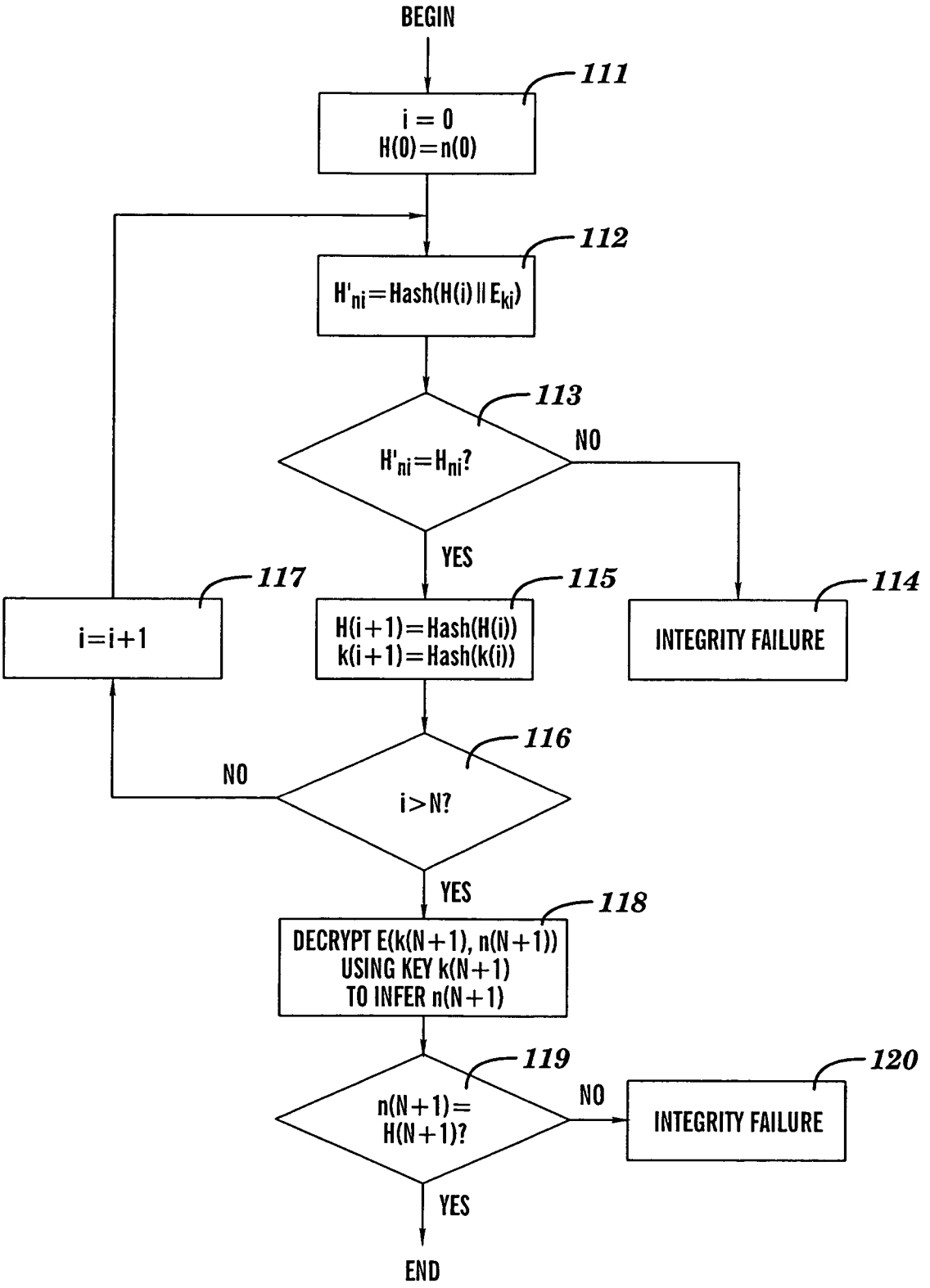

BEGIN
111
i = 0
H(0)=n(0)
112
H'ni=Hash(H(i) || Eki)
113
H'ni=Hni?
NO
YES
117
i=i+1
115
H(i+1)=Hash(H(i))
k(i+1)=Hash(k(i))
114
INTEGRITY FAILURE
116
NO
i>N?
YES
118
DECRYPT E(k(N+1), n(N+1))
USING KEY k(N+1)
TO INFER n(N+1)
119
n(N+1)=
H(N+1)?
NO
120
INTEGRITY FAILURE
YES
END

FIG. 9

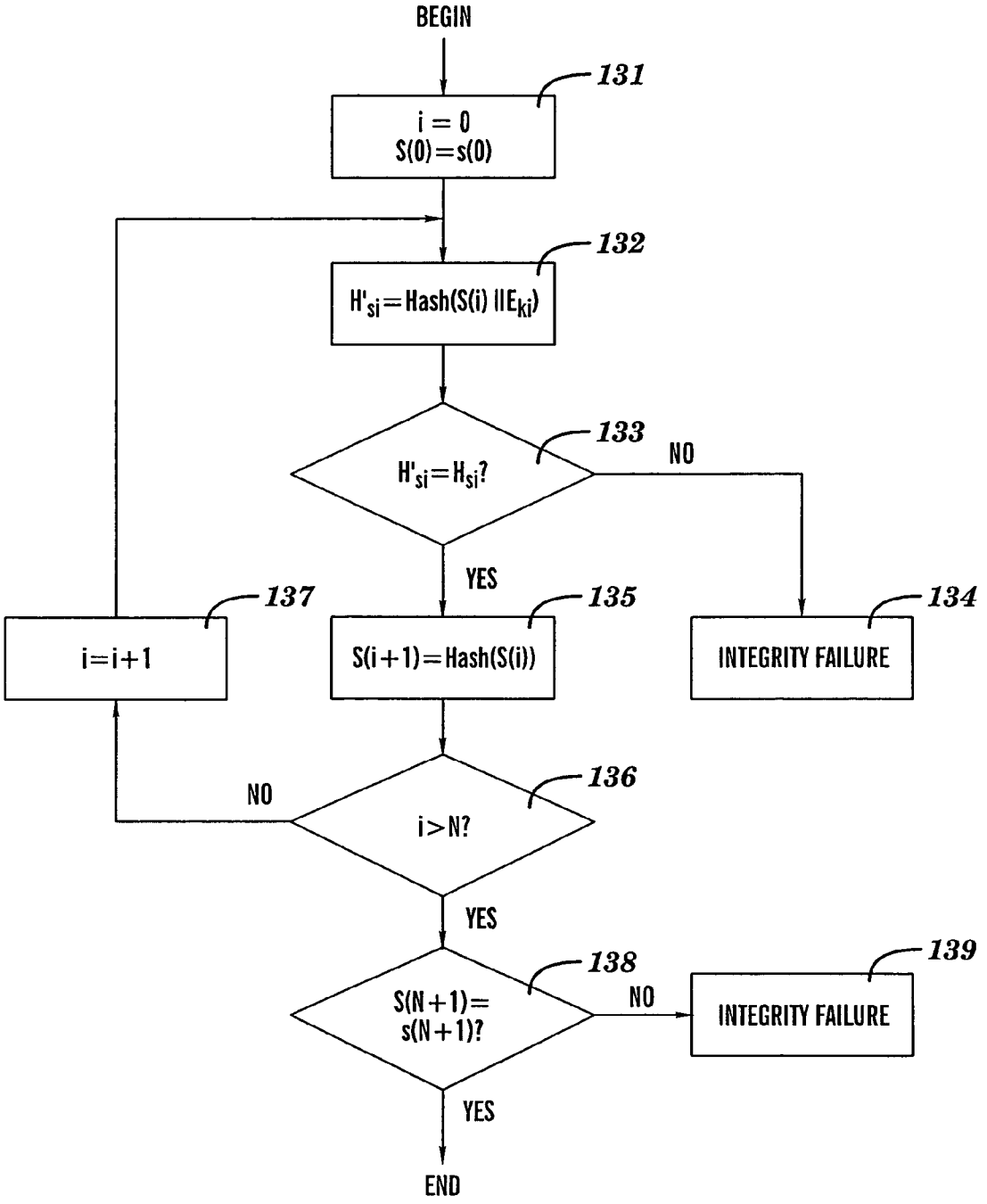

BEGIN
131
i = 0
S(0)=s(0)
132
H'si=Hash(S(i) ||Eki)
133
H'si=Hsi?
NO
YES
137
i=i+1
135
S(i+1)=Hash(S(i))
134
INTEGRITY FAILURE
136
NO
i>N?
YES
138
S(N+1)=
s(N+1)?
NO
139
INTEGRITY FAILURE
YES
END

FIG. 10

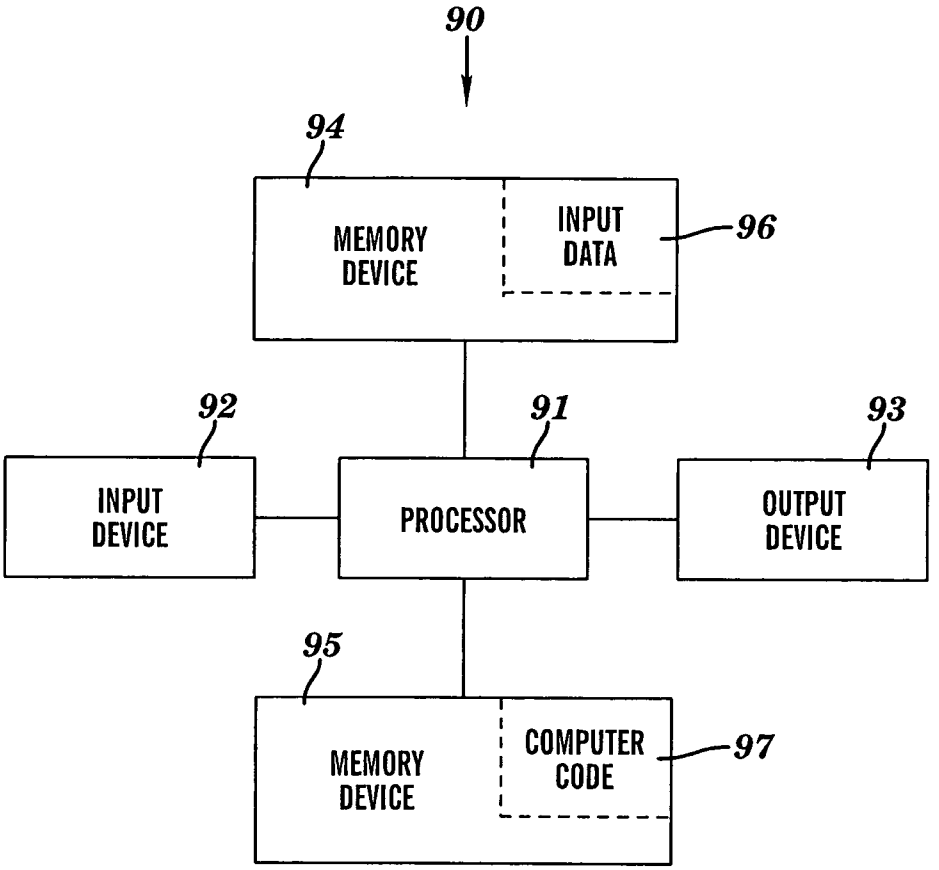

90
94
MEMORY DEVICE
INPUT DATA
96
92
91
93
INPUT DEVICE
PROCESSOR
OUTPUT DEVICE
95
MEMORY DEVICE
COMPUTER CODE
97

FIG. 11

SYSTEM AND METHOD FOR PROCESSING FEEDBACK ENTRIES RECEIVED FROM SOFTWARE

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates to a method and system for processing feedback entries received from software.

2. Related Art

Understanding customer behavior facilitates designing products that are more in tune with customer requirements. As an example, if a vendor finds that a large number of customers are not using the spell checker before sending an email, it may means that the spell check feature should be enabled by default. On the other hand, if a large number of users are dismissing an explicit feature without using the explicit feature, it may mean that the explicit feature is more of an irritant. Currently, most software vendors rely on surveys and interviews to understand customer behavior. However, surveys are often unreliable because survey participants are only a small portion of the installed customer base. Also, survey participants tend to behave differently in survey situations and real life situations.

A situation which may requires immediate attention from software vendors is erroneous program behavior. This includes abnormal terminations, assertion failures, crashes etc. Bugs encountered at customer's site are difficult and expensive to resolve because customers who contact customer support to report such problems often find it difficult to articulate the exact nature of the problem. The customers are also usually not competent to provide accurate information that can help in identifying a problem's cause, such as stack traces, environment etc.

It may be desirable for the software to send error reports to the vendor. If the software product sends error reports to the vendor, the error reports could have useful information such as stack traces, crash dumps, etc., which will help the vendor to respond faster to defects, resulting in faster patch release cycles. Some programs provide the user with an option to send error reports to the vendor. If a known problem occurs, the user is provided a link to the service pack, hotfix or knowledge base article that addresses the issue.

Error reports provide the following benefits to software vendors: helps in early identification of critical issues; provides rich information like stack traces, crash dumps, etc., that is assists in reproducing the problem; and provides timely feedback on patches, hotfixes etc., as soon as the problem is detected.

Since user machines are not always online, information collected by the system for error reporting should be stored in user's machine at least until a network connection is available. However, user machines are prone to attacks and the vendor should be able to provide privacy and security for the user even when machines are compromised. However, providing privacy and security even after the user's machine is compromised is a challenging task which is not addressed by existing systems.

Thus, there is a need for an error reporting system that provides security and privacy for the user even after the user's machine is compromised.

SUMMARY OF THE INVENTION

The present invention provides a method for processing feedback entries received from software, said software provided by a vendor to an end user machine, said end user machine comprising the software, a feedback module, and a database, wherein a concatenation operator|| is defined such that A||B denotes a concatenation of strings A and B, wherein E(K,X) defines a symmetric key encryption of a parameter X using a key K, wherein Hash(Y) defines a one way hash function of a parameter Y, wherein said method comprising, as performed by the feedback module:

generating a secret key k(0) and making the key k(0) known to both the vendor and a user of the software;

generating a secret key n(0) and making the key n(0) known to the vendor but not to the user;

generating a secret key s(0) and making the key s(0) known to the user but not to the vendor;

generating an encryption E_{k0} of an identification tag FE(0) such that E_{k0}=E(k(0),FE(0));

generating a parameter H_{n0} such that H_{n0}=Hash(n(0)||E_{k0});

generating a parameter H_{s0} such that H_{s0}=Hash(s(0)||E_{k0});

sending E_{k0}, H_{n0}, and H_{s0} to the database; and

sending E_{k0} and H_{n0} to the vendor.

The present invention provides a computer program product, comprising a computer usable medium having a computer readable program code embodied therein, said computer readable program code comprising an algorithm adapted to implement a method for processing feedback entries received from software, said software provided by a vendor to an end user machine, said end user machine comprising the software, a feedback module, and a database, wherein a concatenation operator || is defined such that A||B denotes a concatenation of strings A and B, wherein E(K,X) defines a symmetric key encryption of a parameter X using a key K, wherein Hash(Y) defines a one way hash function of a parameter Y, wherein said method comprising, as performed by the feedback module:

generating a secret key k(0) and making the key k(0) known to both the vendor and a user of the software;

generating a secret key n(0) and making the key n(0) known to the vendor but not to the user;

generating a secret key s(0) and making the key s(0) known to the user but not to the vendor;

generating an encryption E_{k0} of an identification tag FE(0) such that E_{k0}=E(k(0),FE(0));

generating a parameter H_{n0} such that H_{n0}=Hash(n(0)||E_{k0});

generating a parameter H_{s0} such that H_{s0}=Hash(s(0)||E_{k0});

sending E_{k0}, H_{n0}, and H_{s0} to the database; and

sending E_{k0} and H_{n0} to the vendor.

The present invention provides a process for deploying (or integrating) computing infrastructure, said process comprising integrating computer-readable code into a computing system, wherein the code in combination with the computing system is capable of performing a method for processing feedback entries received from software, said software provided by a vendor to an end user machine, said end user machine comprising the software, a feedback module, and a database, wherein a concatenation operator || is defined such that A||B denotes a concatenation of strings A and B, wherein E(K,X) defines a symmetric key encryption of a parameter X using a key K, wherein Hash(Y) defines a one way hash function of a parameter Y, wherein said method comprising, as performed by the feedback module:

generating a secret key k(0) and making the key k(0) known to both the vendor and a user of the software;

generating a secret key n(0) and making the key n(0) known to the vendor but not to the user;

generating a secret key s(0) and making the key s(0) known to the user but not to the vendor;

generating an encryption E_{k0} of an identification tag FE(0) such that E_{k0}=E(k(0),FE(0));

generating a parameter H_{n0} such that H_{n0}=Hash(n(0)||E_{k0});

generating a parameter H_{s0} such that H_{s0}=Hash(s(0)||E_{k0});

sending E_{k0}, H_{n0}, and H_{s0} to the database; and

sending E_{k0} and H_{n0} to the vendor.

The present invention advantageously provides an error reporting system that provides security and privacy for the user even after the user's machine is compromised.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a system for processing feedback entries received from software provided by a vendor to an end user machine, in accordance with embodiments of the present invention.

FIG. **2** is a flow chart depicting operation of the system of FIG. **1**, in accordance with embodiments of the present invention.

FIG. **3** is a flow chart depicting periodic synchronization of the contents of a database with the vendor of FIG. **1**, in accordance with embodiments of the present invention.

FIG. **4** is a flow chart depicting operation of the system of FIG. **1**, in accordance with embodiments of the present invention.

FIG. **5** is a flow chart depicting generation of secret keys, in accordance with embodiments of the present invention.

FIGS. **6**A and **6**B is a flow chart depicting setting up the database of FIG. **1**, in accordance with embodiments of the present invention.

FIG. **7** is a flow chart depicting storing a feedback entry in the database of FIG. **1**, in accordance with embodiments of the present invention.

FIG. **8** is a flow chart depicting synchronizing contents of the database with the vendor of FIG. **1**, in accordance with embodiments of the present invention.

FIG. **9** is a flow chart describing verification, by the vendor of FIG. **1**, of the integrity of the feedback entries received by the vendor, in accordance with embodiments of the present invention.

FIG. **10** is a flow chart describing verification, by the user of FIG. **1**, of the integrity of the feedback entries in the database, in accordance with embodiments of the present invention.

FIG. **11** illustrates a computer system used for processing feedback entries received from software provided by a vendor to an end user machine, in accordance with embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a secure way of collecting program usage statistics that also protects the privacy of individual users, by using an application firewall, a separate feedback module, a secure database and a special purpose cryptographic protocol. Apart from protecting users from malicious attackers, the present invention also prevents the software vendor from misleading the user on what information was sent to its site for analysis. In other words, the present invention treats even the software vendor as a potential adversary. Also, the present invention invention describes a mechanism that provides security and privacy even when the user's system is taken over by an adversary.

By using this present invention, users will have exact control over the data that is sent to the vendor and will facilitate a huge increase in adoption of automated feedback and error reporting. In fact, when users become more and more aware of online privacy issues, they will insist that all automated feedback and error reporting systems should include mechanisms that provide security and privacy.

The present invention provides an automated feedback and error reporting system that is not too invasive, so that software vendors may employ prudence while deciding what information is collected. In addition, the present invention enables the user to have a fool proof way to ensure that the privacy policy agreed upon by the vendor is kept, so that if there is a breach of privacy, the user would be able to detect the breach.

The present invention enables users to periodically check for privacy policy violations, so that the user may read at any time the information that was sent to the vendor, and nobody other than the vendor and the user are able to read the information that was sent by the software. The vendor is able to verify that all information that was received was actually sent by the software and was not modified in transit. The system is able to function (with all the privacy and security guarantees) even when there is no network connection available to communicate with the vendor.

User machines are prone to attacks and the feedback module of the present invention is able to provide privacy and security even when user machines are compromised. As a first example, if the vendor attacks the user machine and the user's machine is compromised as a result, the vendor should not be able to modify or delete information that was collected (and kept in user's machine) before the compromise and escape detection by the user. As a second example, if the user machine is compromised, any attacker (other than the vendor) should not be able to read the information collected from the user before the compromise. As a third example, if the user machine is compromised, the attacker should not be able to modify or delete information collected from the user before the compromise and escape detection by the vendor or user.

A concatenation operator || is defined such that A||B denotes a concatenation of character strings A and B. For example if A="abc" and B="xyz" then A||B="abcxyz".

E(K,X) is defined as a symmetric key encryption of a parameter X using a key K. E(K,X) results from use of an encryption algorithm such as Data Encryption Standard (DES) or Advanced Encryption Standard (AES), wherein the data cannot be decrypted without the knowledge of the key k.

Hash(Y) is defined as a one way hash function of a parameter Y using a hash algorithm such as MD5 (RFC1321) or SHA1 (RFC3174). Hash(Y) has the following properties: given the Hash(M), it is difficult to find the message M. Hash(Y) is preimage resistant: given a message M**1**, it is difficult to find another message M**2** such that Hash(M**1**)=Hash(M**2**). Hash(Y) is collision resistant: it is difficult to find two messages M**1** and M**2** such that Hash(M**1**)=Hash(M**2**).

FIG. **1** depicts a system **10** for processing feedback entries received from software **13** provided by a vendor **18** to an end user machine **12**, in accordance with embodiments of the present invention. The vendor **18** comprises the vendor's computing site which includes, inter alia, a server of the vendor **18**. The end user machine **12**, which comprises a computer or computer system, includes a feedback module (FBM) **14**, a database **15**, and the software **13**. The database **15** is a secure database due to security features of the present invention as described infra. The feedback module **14** is connected to the vendor **18** via a communication network **17** (e.g., the Internet). The communication network **17** is disposed between the end user machine **12** and the vendor **18**. A user **19**, who uses the software **13** provided by the vendor **18**, may be online with respect to the end user machine **12**.

Access by feedback module **14** to the communication network **17** is controlled by an application firewall **16** which is disposed between the end user machine **12** and the commu-

nication network **17**. The application firewall **16** is adapted to permit access by the feedback module **14** to the communication network **17**. The application firewall **16** is adapted to prevent access by the software to the communication network **17**. Accessing the communication network **17** comprises sending data to the communication network **17** and/or receiving data from the communication network **17**. The application firewall **16** consults its internal rule database before allowing any application to access the communication network **17**. Examples of application firewalls include Zone Labs Integrity Desktop.

The system **10** comprises the feedback module **14** and the database **15**.

The software **13**, which is installed by the vendor **18** in the end user machine **12**, is prevented from directly accessing the vendor **18** by the application firewall **16**. Instead, the feedback module **14** communicates with the vendor **18**. When the software **13** has information to send to the vendor **18**, the software **13** sends the information to the feedback module **14** as feedback entries. It is assumed herein that the vendor has knowledge of the format used to encode the feedback entries. The feedback module **14** provides security and privacy for the user **19**. The feedback module **14** writes the feedback entries to the database **15** after following a protocol described infra. Then, if a network connection from the feedback module **14** to the vendor **18** is available, the feedback module **14** follows a synchronization protocol (see FIG. **8**) to sync the contents of the database **15** with the vendor **18**. The application firewall **16** is configured to allow the feedback module **14** to connect to the vendor **18** and to prevent all other programs from accessing the vendor **18**. If the synchronization is successful, the vendor **18** can verify the integrity of data received by the vendor **18** by following the algorithm given in FIG. **9**. The user can verify whether or not all the security requirements are met by following the algorithm given in FIG. **10**.

FIG. **2** is a flow chart depicting the operation of the system **10** of FIG. **1**, in accordance with embodiments of the present invention. The flow chart of FIG. **2** comprises steps **21-25**. Step **21** provides initializations, including setup of secret keys and setup of the database **15** to be secure for the feedback module **14** and the vendor **18**. Step **22** executes the software **13**. The feedback module **14** executes a loop comprising steps **23-25**, wherein each pass through the loop performs operations on feedback entries generated by the software **13**. In step **23**, the software **13** generates feedback entries which are processed by the feedback module **14** in step **24**. In step **25**, the feedback module **14** writes the processed feedback entries to the database **15**.

FIG. **3** is a flow chart depicting periodic synchronization of the contents of the database **15** with the vendor **18** of FIG. **1**, in accordance with embodiments of the present invention. The synchronization is performed by the feedback module **14** periodically in accordance with a specified synch interval of time. The sync interval may be specified by vendor **18** or chosen by the user **19**. The flow chart of FIG. **3** comprises steps **31-35**. The process loops through step **31** until it is determined that the current synch interval has expired so that a synchronization may next be performed. Step **32** determines whether a synchronization is required. For example, a synchronization is required if the feedback module **14** has received a feedback entry from the software **13** since the last synchronization. If a synchronization is not required, then the process returns to step **31**. If a synchronization is required, then step **33** is performed. The process loops through step **33** until it is determined that the user **19** is online with respect to the end user machine **12**, which triggeres execution of step **34**. In step **34**, the feedback module **14** synchronizes the contents of the database **15** with the vendor **18**, as described infra in conjunction with FIG. **8**. In step **35**, the vendor **18** checks the integrity of the data received by the vendor **18**, as described infra in conjunction with FIG. **9**.

The feedback module **14** receives messages (feedback entries which could include usage statistics, error reports etc.) from the software **13** and writes the messages to the database **15** (which is secure) to assure security and privacy. The cryptographic protocols that support the security and privacy involve various interactions between the various entities. The entities are: the vendor **18** who can be contacted through the public Internet but access to whom is denied to all software programs except the feedback module **14** by the application firewall **16**; the user **19** of the software **13** provided by the vendor **18**; and the feedback module **14** which is a software program which interacts with the software **13** provided by the vendor **18**.

FIG. **4** is a flow chart depicting operation of the system **10** of FIG. **1**, in accordance with embodiments of the present invention. The flow chart of FIG. **4**, which is more detailed than the flow chart of FIG. **2**, comprises steps **41-46**.

Step **41** of FIG. **4** generates secret keys between the vendor **18** and the feedback module **14**. In step **41**, the feedback module **14** establishes two secret keys, namely k(0) and n(0), that are shared between the feedback module **14** and the vendor **18**. Generation of keys k(0) and n(0) can be done using a public key algorithm such as, inter alia, Diffie-Hellman key exchange. Alternatively, if the public key of the vendor **18** is available to the feedback module **14** as a public key certificate, then the keys k(0) and n(0) can be negotiated using a protocol such as Secure Sockets Layer (SSL). The feedback module **14** makes the secret key k(0) available to both the vendor **18** and the user **19**. In general, any method known to a person of ordinary skill in the art for establishing two secret keys is within the scope of the present invention.

The feedback module **14** also generates an identification tag, denoted illustratively as FBM_ID, that helps in uniquely identifying this installation of the software **13** with the vendor **18**. This identification tag could be the serial number of the software, version number for the software, a combination of the serial number of the software and the version number of the software, etc. The feedback module **14** discloses this identification tag to the user **19**.

The same feedback module **14** could support multiple vendors (e.g., two or more vendors) such that two secret keys are generated for each vendor of the multiple vendors.

In step **42** of FIG. **4**, the feedback module **14** generates a secret key s(0) for use between the user **19** and the feedback module **14**. The feedback module **14** discloses the secret key s(0) to the user **19**. The secret key s(0) can be derived, inter alia, from a password that is known only to the user **19**, by hashing the password using a one way hash function.

FIG. **5** is a flow charting depicting steps **41** and **42** of FIG. **4**, wherein steps **41-42** generate the secret keys k(0) and n(0) (step **41**) and s(0) (step **42**). The flow chart of FIG. **5** comprises steps **51-55**. Step **51** generates the secret keys k(0) and n(0). Step **52** sends the generated secret keys k(0) and n(0) to the vendor **18** securely and communicates the secret key k(0) to the user **19** but does not communicate the secret key n(0) to the user **19**. Step **53** prompts the user **19** for a password "P". Step **54** generates the secret key s(0) as a hash of the password P (i.e., as Hash(P)). Step **55** communicates the secret key s(0) to the user **19**, but does not communicate the secret key s(0) to the vender **18**.

Note that after steps **41** and **42** of FIG. **4** are performed, the secret keys k(0), n(0), and s(0) are known as follows. The key k(0) is known to the feedback module **14**, the vendor **18**, and

the user **19**. The key n(0) is known to the feedback module **14** and the vendor **18**. The key s(0) is known to the feedback module **14** and the user **19**. The keys k(0), n(0), and s(0), as well as all other keys described herein, may be in a character string format.

Step **43** of FIG. **4** sets up the database **15**, which is described in a flow chart in FIGS. **6**A and **6**B (collectively, "FIG. **6**"), in accordance with embodiments of the present invention. The flow chart of FIG. **6** comprises steps **60-69**. The feedback module **14** performs steps **60-64** (FIG. **6**A), and the vendor **18** performs steps **65-69** (FIG. **6**B).

In step **60**, the feedback module **14** sets parameter FE(0) equal to the identification tag denoted illustratively as FBM_ID. In step **61**, the feedback module **14** calculates parameters E_{k0}, H_{n0}, and H_{s0}:

E_{k0}=E(k(0), FE(0))

H_{n0}=Hash(n(0)‖E_{k0})

H_{s0}=Hash(s(0)‖E_{k0})

In step **62**, feedback module **14** generates keys k(1), n(1), and s(1):

k(1)=Hash(k(0))

n(1)=Hash(n(0))

s(1)=Hash(s(0))

In step **63**, the feedback module **14** writes E_{k0}, H_{n0}, H_{s0}, k(1), n(1), and s(1) to the database **15**.

In step **64**, the feedback module **14** sends E_{k0} and H_{n0} to the vendor **18**.

In step **65**, the vendor **18** calculates H'_{n0}=Hash(n(0)‖ E_{k0}) from E_{k0} received by the vendor **18**, using the key n(0) in the possession of the vendor **18**. Step **66** determines whether the vendor-calculated H'_{n0} matches the H_{n0} received by the vendor **18** from the feedback module **14** as a result of step **64**. If step **66** determines that H'_{n0} does not match H_{n0}, then an error or a breach of security has occurred and the process stops in step **67**. If step **66** determines that H'_{n0} matches H_{n0}, then step **68** is executed in which the vendor **18** decrypts E_{k0} using the key k(0) from which FE(0) is determined. In step **69**, the vendor **18** records that the database **15** is set. Since n(0) is known only to the vendor **18** and the feedback module **14**, the vendor **18** has determined that E_{k0} was properly received from the feedback module **14** via step **64**.

In step **44** of FIG. **4**, the feedback module **14** stores a feedback entry in the database **15**, which is described in detail in a flow chart in FIG. **7**, in accordance with embodiments of the present invention. The flow chart of FIG. **7** comprises steps **71-75**, which are performed by the feedback module **14**. In step **71**, the feedback module **14** receives a new feedback entry FE(i) from the software **13**, wherein i =**1** for the first such new feedback entry FE(i). In step **72**, the feedback module **14** calculates parameters E_{ki}, H_{ni}, and H_{si}:

E_{ki}=E(k(i), FE(i))

H_{ni}=Hash(n(i)‖E_{ki})

H_{si}=Hash(s(i)‖E_{ki})

In step **73**, the feedback module **14** writes E_{ki}, H_{ni}, and H_{si} to the database **15**. In step **74**, the feedback module **14** generates new keys k(i+1), n(i+1), and s(i+1):

k(i+1)=Hash(k(i))

n(i+1)=Hash(n(i))

s(i+1)=Hash(s(i))

In step **75**, the feedback module **14** replaces k(i), n(i), and s(i) with keys k(i+1), n(i+1), s(i+1), respectively, in the database **15**. For example, the feedback module **14** may erase keys k(i), n(i), and s(i) from the database **15** and write keys k(i+1), n(i+1), s(i+1) to the database **15**.

Steps **71-75** are executed for each new feedback entry received by the feedback module **14** from the software **13**. If N such new feedback entries are processed by the feedback module **14**, then after the N new feedback entries have been processed in accordance with steps **71-75**, the database **15** will comprise E_{ki}, H_{ni}, and H_{si} and for i=1, 2, . . . , N, and the database **15** will additionally comprise k(N+1), n(N+1), and s(N+1).

In step **45** of FIG. **4**, the feedback module **14** synchronizes contents of the database **15** with the vendor **18**, which is described in detail in a flow chart in FIG. **8**, in accordance with embodiments of the present invention. The flow chart of FIG. **8** comprises steps **81-85**, which are performed periodically by the feedback module **14**.

Step **81** sets an index i equal to 0. Steps **82-84** define a loop in which the index i is executed from i=0 to i=N, wherein N is the number of feedback entries in the database **15**. The index i is a feedback entry index for i=1, 2, . . . , N. Step **82** tests for the end of the loop (i.e., for i>N). If step **82** determines that i is not greater than N, then step **83** is next executed and sends E_{ki} and H_{ni} to the vendor **15**, followed by incrementing i by 1 in step **84** to complete the ith iteration of the loop. If step **82** determines that i>N, then step **85** is next executed to send an encryption of n(N+1), using the key k(N+1), to the vendor **18** which ends the synchronization process, said encryption sent to the vender **18** being expressed as E(k(N+1), n(N+1)).

Alternatively, instead of sending all the feedback entries in the database **15** to the vendor **18**, the synchronization protocol can send only those feedback entries that were added since the last synchronization.

In step **45** of FIG. **4**, the integrity of the feedback entries are verified by the vendor **18** (see FIG. **9**) and by the user (see FIG. **10**).

FIG. **9** is a flow chart describing verification of the integrity of the feedback entries received by the vendor **18**, in accordance with embodiments of the present invention. The flow chart of FIG. **9** comprises steps **111-120**, which are performed by the vendor **18**. The inputs to the process of FIG. **9** are the following parameters previously received by the vendor **18**:

(1) keys n(0) and k(0) from step **41** of FIG. **4**;

(2) E_{k0} and H_{n0} from step **64** of FIG. **6**A;

(3) N=number of feedback entries received by vendor **18**

(4) E_{ki} and H_{ni}(i=1, 2, . . . , N) from step **83** of FIG. **8**; and

(5) E(k(N+1),n(N+1)) from step **85** of FIG. **8**.

Step **111** initializes an iteration index i to 0 and calculates H(0):

$$H(0)=n(0) \text{ (using the input key } n(0))$$

Next, a loop comprising steps **112-117** is executed.

Step **112** calculates H'_{ni}:

$$H'_{ni}=\text{Hash}(H(i)\|E_{ki})$$

using the input E_{k0} if i=0 or the input E_{ki} if i>1, and using H(0) from step **111** if i=0 or H(i) from step **115** of previous iteration of the loop if i>0.

Step **113** determines whether H_{ni} is equal to H_{ni}, using the input H_{n0} if i=0 or the input H_{ni} if i>1. If step **113** determines that H'_{ni} is unequal to H_n then step **114** is executed wherein step **114** announces that an integrity failure has occurred. If step **113** determines that H'_{ni}=H_{ni} then step **115** is next executed.

Step **115** calculates:

$$H(i+1)=\text{Hash}(H(i)) \text{ and}$$

$$k(i+1)=\text{Hash}(k(i))$$

The computation of k(i+1) uses the input key k(0) if i=0 or uses k(i) from step **115** of the previous iteration of the loop if i>0.

Step **116** ascertains whether to exit the loop by determining whether i>N. If step **116** determines that i does not exceed N, then step **117** is executed to increment i by 1, followed by looping back to step **112** to perform the next iteration of the loop. If step **116** determines that i>N, then the loop is exited and step **118** is next performed.

Step **118** decrypts E(k(N+1), n(N+1)) (input from step **85** of FIG. **8**), using the key k(N+1) from step **115** of the last iteration of the loop, to infer n(N+1).

Step **119** determines whether the inferred n(N+1) equals H(N+1), wherein H(N+1) was calculated in step **115** of the last iteration of the loop. If step **119** determines that n(N+1) does not equal H(N+1) then step **120** is executed wherein step **120** announces that an integrity failure has occurred. If step **119** determines that H(N+1)=H(N+1) then the verification by the vendor **18** ends.

FIG. **10** is a flow chart describing verification of the integrity of the feedback entries in the database **15**, in accordance with embodiments of the present invention. The flow chart of FIG. **10** comprises steps **131-139**, which are performed by the user **19**. The inputs to the process of FIG. **9** are the following parameters previously inserted into the database **15** by the feedback module **14**:

(1) key s(0) from step **42** of FIG. **4**;

(2) E_{k0} and H_{s0} from step **63** of FIG. **6**A;

(3) N=number of feedback entries in database **15**

(4) E_{ki} and H_{si}(i=1, 2, . . . , N) from step **73** of FIG. **7**;

(5) s(N+1) from step **75** of FIG. **7**

Step **131** initializes an iteration index i to 0 and calculates S(0):

$$S(0)=s(0) \text{ (using the input key } s(0))$$

Next, a loop comprising steps **132-137** is executed.

Step **132** calculates H'_{si}:

$$H'_{si}=\text{Hash}(S(i)\|E_{ki})$$

using the input E_{k0} if i=0 or the input E_{ki} if i>1, and using S(0) from step **131** if i=0 or S(i) from step **135** of the previous iteration of the loop if i>0.

Step **133** determines whether H'_{si} is equal to H_{si}, using the input H_{s0} if i=0 or the input H_{si} if i>1. If step **133** determines that H'_{si} is unequal to H_{si} then step **134** is executed wherein step **134** announces that an integrity failure has occurred. If step **133** determines that $H'_{si}=H_{si}$ then step **135** is next executed.

Step **135** calculates:

$$S(i+1)=\text{Hash}(S(i))$$

Step **136** ascertains whether to exit the loop by determining whether i>N. If step **136** determines that i does not exceed N, then step **137** is executed to increment i by 1, followed by looping back to step **132** to perform the next iteration of the loop. If step **136** determines that i>N, then the loop is exited and step **138** is next performed.

Step **138** determines whether S(N+1)equals s(N+1), wherein S(N+1)was calculated in step **135** of the last iteration of the loop, and wherein s(N+1)is obtained from the database **15**. If step **138** determines that S(N+1)does not equal s(N+1) then step **139** is executed wherein step **139** announces that an integrity failure has occurred. If step **138** determines that S(N+1)=s(N+1)then the verification by the user **19** ends.

For the purpose of security, the application firewall **16** prevents all communication between the software **13** and the vendor **18** and ensures that only the feedback module **14** is allowed to communicate with the vendor **18**. Hence, the software **13** cannot send arbitrary entries without the arbitrary entries getting recorded by the feedback module **14**. The feedback module **14** maintains all of the feedback entries sent to the vendor **18** in the database **15** so that the feedback entries can be verified by the user **19** at any time. Different keys are used for encrypting and verifying each feedback entry. Each key is derived from the previous key, but given a key, its previous version cannot be found since a one way hash function is used to derive newer keys. At the time of intrusion, the intruder has access only to the latest values of the keys k(i+1), n(i+1) and s(i+1). All communication between the feedback module **14** and vendor **18** is encrypted using k(i) which is not known to others. Since there is no way for the intruder to derive previous values of the keys, the intruder cannot forge or read or delete previous feedback entries that were created prior to the intrusion. Note that two verification keys (n(0) and s(0)) are used, one verification key for the vendor **18** and the other verification key for the user **19**, which ensures that if the vendor **18** becomes the intruder, the user **19** can still locate any forgery.

FIG. **11** illustrates a computer system **90** used for processing feedback entries received from software provided by a vendor to an end user machine, in accordance with embodiments of the present invention. Either or both of the end user machine **12** and the computer system of the vendor **18** of FIG. **1** may comprise the computer system **90** of FIG. **11**.

The computer system **90** comprises a processor **91**, an input device **92** coupled to the processor **91**, an output device **93** coupled to the processor **91**, and memory devices **94** and **95** each coupled to the processor **91**. The input device **92** may be, inter alia, a keyboard, a mouse, etc. The output device **93** may be, inter alia, a printer, a plotter, a computer screen, a magnetic tape, a removable hard disk, a floppy disk, etc. The memory devices **94** and **95** may be, inter alia, a hard disk, a floppy disk, a magnetic tape, an optical storage such as a compact disc (CD) or a digital video disc (DVD), a dynamic random access memory (DRAM), a read-only memory (ROM), etc. The memory device **95** includes a computer code **97**.

The computer code **97** includes an algorithm for processing feedback entries received from software provided by a vendor to an end user machine. The computer code **97** may represent the feedback module **14** of FIG. **1** if the end user machine **12** comprises the computer system **90**. The computer code **97** may represent software of the vendor **18** if the computer system of the vendor **18** comprises the computer system **90**.

The processor **91** executes the computer code **97**. The memory device **94** includes input data **96**. The input data **96** includes input required by the computer code **97**. The output device **93** displays output from the computer code **97**. Either or both memory devices **94** and **95** (or one or more additional memory devices not shown in FIG. **11**) may be used as a computer usable medium (or a computer readable medium or a program storage device) having a computer readable program code embodied therein and/or having other data stored therein, wherein the computer readable program code comprises the computer code **97**. Generally, a computer program product (or, alternatively, an article of manufacture) of the computer system **90** may comprise said computer usable medium (or said program storage device).

Thus the present invention discloses a process for deploying or integrating computing infrastructure, comprising integrating computer-readable code into the computer system **90**, wherein the code in combination with the computer system **90** is capable of performing a method for processing feedback entries received from software provided by a vendor to an end user machine.

While FIG. **11** shows the computer system **90** as a particular configuration of hardware and software, any configuration of hardware and software, as would be known to a person of ordinary skill in the art, may be utilized for the purposes stated supra in conjunction with the particular computer system **90** of FIG. **11**. For example, the memory devices **94** and **95** may be portions of a single memory device rather than separate memory devices.

While embodiments of the present invention have been described herein for purposes of illustration, many modifications and changes will become apparent to those skilled in the art. Accordingly, the appended claims are intended to encompass all such modifications and changes as fall within the true spirit and scope of this invention.

What is claimed is:

1. A method for processing feedback entries received from software, said software provided by a vendor to an end user machine, said end user machine comprising a processor, the software, a feedback module, and a database, wherein a concatenation operator || is defined such that A||B denotes a concatenation of strings A and B, wherein E(K,X) defines a symmetric key encryption of a parameter X using a key K, wherein Hash(Y) defines a one way hash function of a parameter Y, and wherein said method comprises:

said processor, via execution of the feedback module, establishing a secret key k(0), said feedback module sending the key k(0) to the vendor, and communicating the key k(0) to a user of the software;

said processor, via execution of the feedback module, establishing a secret key n(0), the feedback module sending the key n(0) to the vendor, and communicating the key n(0) to a user;

said processor, via execution of the feedback module, generating an identification tag FE(0);

said processor, via execution of the feedback module, generating a secret key s(0) and communicating the generated key s(0) to the user but not to the vendor;

said processor, via execution of the feedback module, generating an encryption E_{k0} of an identification tag FE(0) using the secret key k(0) where E_{k0}=E(k(0),FE(0));

said processor, via execution of the feedback module, generating a parameter H_{n0} using the secret key n(0) where H_{n0}=Hash(n(0)||Ek0);

said processor, via execution of the feedback module, generating a parameter H_{s0} using the secret key s(0) where H_{s0}=Hash(s(0)||Ek0);

said processor, via execution of the feedback module, sending E_{k0}, H_{n0}, and H_{s0} to the database; and

said processor, via execution of the feedback module, sending $E_{k0}$and H_{n0} to the vendor.

2. The method of claim **1**, said method comprising:

said processor, via execution of the feedback module, generating keys k(1), n(1), and s(1) such that k(1)=Hash(k(0)), n(1)=Hash(n(0)), and s(1)=Hash(s(0)); and

said processor, via execution of the feedback module, sending k(1), n(1), and s(1) to the database.

3. The method of claim **2**, said method comprising said processor, via execution of the feedback module, receiving N feedback entries from the software and processing the N feedback entries, said N feedback entries denoted as FE(1), . . . , FE(N), said N at least 1, said processing the feedback entry FE(i) for each of i=1, . . . , N comprising:

calculating parameters E_{ki}, H_{ni}, and H_{si} such that E_{ki}=E(k(i), FE(i)), H_{ni}=Hash(n(i)||E_{ki}), and H_{si}=Hash(s(i)||E_{ki});

writing E_{ki}, H_{ni}, and H_{si} to the database;

said processor, via execution of the feedback module, generating keys k(i+1), n(i+1), and s(i+1) such that k(i+1)=Hash(k(i)), n(i+1)=Hash(n(i)), and s(i+1)=Hash(s(i)); and

replacing keys k(i), n(i), and s(i) in the database with keys k(i+1), n(i+1), and s(i+1),

wherein after said processing the N feedback entries, the database comprises k(N+1), n(N+1), and s(N+1).

4. The method of claim **3**, said method comprising said processor, via execution of the feedback module, synchronizing content of the database with the vendor, said synchronizing comprising sending to the vendor: (E_{ki}, H_{ni}, i=M, . . . , N) and E(k(N+1), n(N+1)), wherein 1≦M≦N.

5. The method of claim **4**, wherein M=1.

6. The method of claim **4**, wherein M>1.

7. A validation method for validating the N feedback entries resulting from performance of the method of claim **4**, said validation method comprising verifying, by the vendor, an integrity of the N feedback entries received by the vendor as a result of said sending to the vendor: ((E_{ki}, H_{ni}), i=M, . . . , N) and E(k(N+1), n(N+1)), wherein 1≦M≦N.

8. The validation method of claim **7**, wherein said verifying comprises:

setting i=0 and H(0)=n(0);

executing iterations i=0, 1, . . . , N of a loop, wherein executing each iteration i of the loop comprises: setting H'_{ni}=Hash(H(i)||E_{ki}); determining that H'_{ni}=H_{ni}; and responsive to said determining that H'_{ni}=H_{ni}, setting H(i+1)=Hash(H(i)) and k(i+1)=Hash(k(i));

after said executing:

decrypting E(k(N+1), n(N+1)) using key k(N+1) to infer n(N+1);

determining if n(N+1)=H(N+1); and

responsive to said determining that n(N+1)=H(N+1), ascertaining that the integrity of the N feedback entries received by the vendor has been verified.

9. The validation method of claim **7**, wherein the validation method further comprises, as performed by the vendor prior to said verifying:

calculating H'_{n0}=Hash(n(0)||E_{k0});

determining if H'_{n0}=H_{n0}; and

responsive to said determining that H'_{n0}=H_{n0}, decrypting $E_{k0}$to infer FE(0) and recording that the database is set.

10. A validation method for validating the N feedback entries resulting from performance of the method of claim **3**, said validation method comprising verifying, by the user, an integrity of the N feedback entries in the database as a result of writing ((E_{ki}, H_{ni}, H_{si}), i=1, . . . , N) to the database.

11. The validation method of claim **10**, wherein said verifying comprises:

setting i=0 and S(0)=s(0);

executing iterations i=0, 1, . . . , N of a loop, wherein executing each iteration i of the loop comprises: setting H'_{si}=Hash(S(i)||E_{ki}); determining that H'_{si}=H_{si}; and responsive to said determining that H'_{si}=H_{si}, setting S(i+1)=Hash(S(i));

after said executing:

determining if S(N+1)=s(N+1); and

responsive to said determining that S(N+1)=s(N+1), ascertaining that the integrity of the N feedback entries in the database has been verified.

12. The method of claim **1**, wherein a communication network is disposed between the end user machine and the vendor, wherein an application firewall is disposed between the end user machine and the communication network, wherein the feedback module is connected to both the application firewall and the database, wherein the software is con-

nected to the feedback module, wherein the software is coupled to the application firewall via the feedback module, wherein the software is coupled to the database via the feedback module, and wherein the method further comprises:

said feedback module receiving the feedback entries from the software;

said feedback module writing, to the database, the feedback entries that the feedback module received from the software;

said application firewall preventing the software from accessing the communication network; and

said application firewall controlling access of the communication network by the feedback module.

13. The method of claim **12**, wherein the communication network comprises the Internet.

14. The method of claim **1**, wherein the identification tag is selected from the group consisting of a serial number of the software, a version number of the software and a combination of the serial number of the software and the version number of the software.

15. A computer program product, comprising a non-volatile computer readable storage medium having a computer readable program code stored therein, said computer readable program code, upon being executed by a processor, performs a method for processing feedback entries received from software, said software provided by a vendor to an end user machine, said end user machine comprising the processor, the software, a feedback module, and a database, wherein a concatenation operator || is defined such that A||B denotes a concatenation of strings A and B, wherein E(K,X) defines a symmetric key encryption of a parameter X using a key K, wherein Hash(Y) defines a one way hash function of a parameter Y, and wherein said method comprises:

said processor via execution of the feedback module, establishing a secret key k(0), said feedback module sending the key k(0) to the vendor, and communicating the key k(0) to a user of the software;

said processor via execution of the feedback module, establishing a secret key n(0), the feedback module sending the key n(0) to the vendor, and not communicating the key n(0) to the user;

said processor, via execution of the feedback module, generating an identification tag FE(0);

said processor, via execution of the feedback module, generating a secret key s(0) and communicating the generated key s(0) to the user but not to the vendor;

said processor, via execution of the feedback module, generating an encryption E_{k0} of the identification tag FE(0) using the secret key k(0) where E_{k0}=E(k(0),FE(0));

said processor, via execution of the feedback module, generating a parameter H_{n0} using the secret key n(0) where H_{n0}=Hash(n(0)||E_{k0});

said processor, via execution of the feedback module, generating a parameter H_{s0} using the secret key s(0) where H_{s0}=Hash(s(0)||E_{k0});

said processor, via execution of the feedback module, sending E_{k0}, H_{n0}, and H_{s0} to the database; and

said processor, via execution of the feedback module, sending E_{k0} and H_{n0} to the vendor.

16. The computer program product of claim **15**, said method comprising:

said processor, via execution of the feedback module, generating keys k(1), n(1), and s(1) such that k(1)=Hash(k(0)), n(1)=Hash(n(0)), and s(1)=Hash(s(0)); and

said processor, via execution of the feedback module, sending k(1), n(1), and s(1) to the database.

17. The computer program product of claim **16**, said method comprising said processor, via execution of the feedback module, receiving N feedback entries from the software and processing the N feedback entries, said N feedback entries denoted as FE(1), . . . , FE(N), said N at least 1, said processing the feedback entry FE(i) for each of i=1, . . . , N comprising:

calculating parameters E_{ki}, H_{ni}, and H_{si} such that E_{ki}=E(k(i), FE(i)), H_{ni}=Hash(n(i)||E_{ki}), and H_{si}=Hash(s(i)||E_{ki});

writing E_{ki}, H_{ni}, and H_{si} to the database;

generating keys k(i+1), n(i+1), and s(i+1) such that k(i+1)=Hash(k(i)), n(i+1)=Hash(n(i)), and s(i+1)=Hash(s(i)); and

replacing keys k(i), n(i), and s(i) in the database with keys k(i+1), n(i+1), and s(i+1),

wherein after said processing the N feedback entries, the database comprises k(N+1), n(N+1), and s(N+1).

18. The computer program product of claim **17**, said method comprising said processor, via execution of the feedback module, synchronizing content of the database with the vendor, said synchronizing comprising sending to the vendor: (E_{ki}, H_{ni}, i=M, . . . , N) and E(k(N+1), n(N+1)), wherein $1 \leqq M \leqq N$.

19. The computer program product of claim **18**, wherein M=1.

20. The computer program product of claim **18**, wherein M>1.

21. The computer program product of claim **15**, wherein a communication network is disposed between the end user machine and the vendor, wherein an application firewall is disposed between the end user machine and the communication network, wherein the feedback module is connected to both the application firewall and the database, wherein the software is connected to the feedback module, wherein the software is coupled to the application firewall via the feedback module, wherein the software is coupled to the database via the feedback module, and wherein the method further comprises:

said feedback module receiving the feedback entries from the software;

said feedback module writing, to the database, the feedback entries that the feedback module received from the software;

said application firewall preventing the software from accessing the communication network; and

said application firewall controlling access of the communication network by the feedback module.

22. The computer program product of claim **21**, wherein the communication network comprises the Internet.

23. The computer program product of claim **15**, wherein the identification tag is selected from the group consisting of a serial number of the software, a version number of the software and a combination of the serial number of the software and the version number of the software.

24. A process for deploying (or integrating) computing infrastructure, said process comprising integrating computer-readable code into a computing system, wherein the code in combination with the computing system is capable of performing a method for processing feedback entries received from software, said software provided by a vendor to an end user machine, said end user machine comprising a processor, the software, a feedback module, and a database, wherein a concatenation operator || is defined such that A||B denotes a concatenation of strings A and B, wherein E(K,X) defines a symmetric key encryption of a parameter X using a key K, wherein Hash(Y) defines a one way hash function of a parameter Y, and wherein said method comprises:

said processor via execution of the feedback module, establishing a secret key k(0), said feedback module sending the key k(0) to the vendor, and communicating the key k(0) to a user of the software;

said processor via execution of the feedback module, establishing a secret key n(0), the feedback module sending the key n(0) to the vendor, and not communicating the key n(0) to the user;

said processor, via execution of the feedback module, generating an identification tag FE(0);

said processor, via execution of the feedback module, generating a secret key s(0) and communicating the generated key s(0) to the user but not to the vendor;

said processor, via execution of the feedback module, generating an encryption E_{k0} of the identification tag FE(0) using the secret key k(0) where E_{k0}=E(k(0),FE(0));

said processor, via execution of the feedback module, generating a parameter H_{n0} using the secret key n(0) where H_{n0}=Hash(n(0)||Ek0);

said processor, via execution of the feedback module, generating a parameter H_{s0} using the secret key s(0) where H_{s0}=Hash(s(0)||Ek0);

said processor, via execution of the feedback module, sending E_{k0}, H_{n0}, and H_{s0} to the database; and

said processor, via execution of the feedback module, sending E_{k0} and H_{n0} to the vendor.

25. The process of claim **24**, said method comprising:

said processor, via execution of the feedback module, generating keys k(1), n(1), and s(1) such that k(1)=Hash(k(0)), n(1)=Hash(n(0)), and s(1)=Hash(s(0)); and

said processor, via execution of the feedback module, sending k(1), n(1), and s(1) to the database.

26. The process of claim **25**, said method comprising, said processor, via execution of the feedback module, receiving N feedback entries from the software and processing the N feedback entries, said N feedback entries denoted as FE(1), . . . , FE(N), said N at least 1, said processing the feedback entry FE(i) for each of i=1, . . . , N comprising:

calculating parameters E_{ki}, H_{ni}, and H_{si} such that E_{ki}=E(k(i), FE(i)), H_{ni}=Hash(n(i)||E_{ki}), and H_{si}=Hash(s(i)||E_{ki});

writing E_{ki}, H_{ni}, and H_{si} to the database;

generating keys k(i+1), n(i+1), and s(i+1) such that k(i+1)=Hash(k(i)), n(i+1)=Hash(n(i)), and s(i+1)=Hash(s(i)); and

replacing keys k(i), n(i), and s(i) in the database with keys k(i+1), n(i+1), and s(i+1),

wherein after said processing the N feedback entries, the database comprises k(N+1), n(N+1), and s(N+1).

27. The process of claim **26**, said method comprising said processor, via execution of the feedback module, synchronizing content of the database with the vendor, said synchronizing comprising sending to the vendor: (E_{ki}, H_{ni}, i=M, . . . , N) and E(k(N+1), n(N+1)), wherein 1≦M≦N.

28. The process of claim **27**, wherein M=1.

29. The process of claim **27**, wherein M>1.

30. The process of claim **24**, wherein a communication network is disposed between the end user machine and the vendor, wherein an application firewall is disposed between the end user machine and the communication network, wherein the feedback module is connected to both the application firewall and the database, wherein the software is connected to the feedback module, wherein the software is coupled to the application firewall via the feedback module, wherein the software is coupled to the database via the feedback module, and wherein the method further comprises, and wherein the method further comprises:

said feedback module receiving the feedback entries from the software;

said feedback module writing, to the database, the feedback entries that the feedback module received from the software;

said application firewall preventing the software from accessing the communication network; and

said application firewall controlling access of the communication network by the feedback module.

31. The process of claim **30**, wherein the communication network comprises the Internet.

32. The process of claim **24**, wherein the identification tag is selected from the group consisting of a serial number of the software, a version number of the software and a combination of the serial number of the software and the version number of the software.

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