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**Chhabra**

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(54) **METHOD, APPARATUS, AND SYSTEM FOR SENDING CREDENTIALS SECURELY**


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***H04L 29/06*** (2006.01)

(52) **U.S. Cl.** ............ **726/6**; 726/2; 726/3; 726/4; 726/5; 726/7; 709/225; 709/227; 709/228; 713/182; 713/185

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



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(57) **ABSTRACT**


A software application executing in a first local operating environment may be used to connect to a remote server that requires a credential of a user to complete a transaction. In a second local operating environment that operates external to the first local environment a user may be authenticated based on a user input received in the second local operating environment. The credential of the user may be securely communicated to the remote server from the second local operating environment. Other embodiments are described and claimed.


**20 Claims, 6 Drawing Sheets**

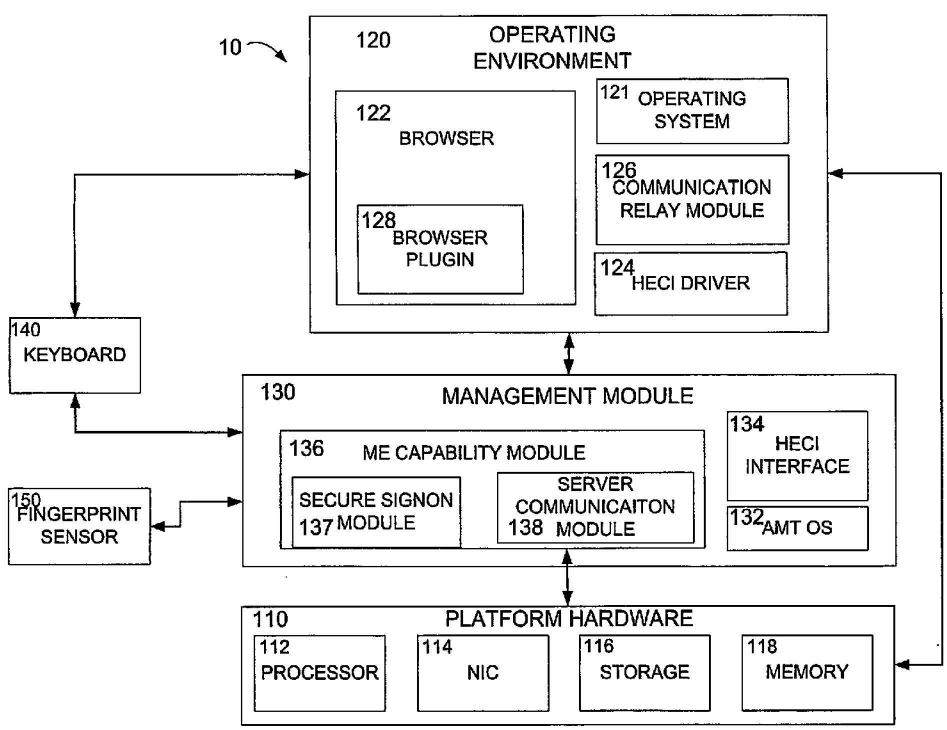
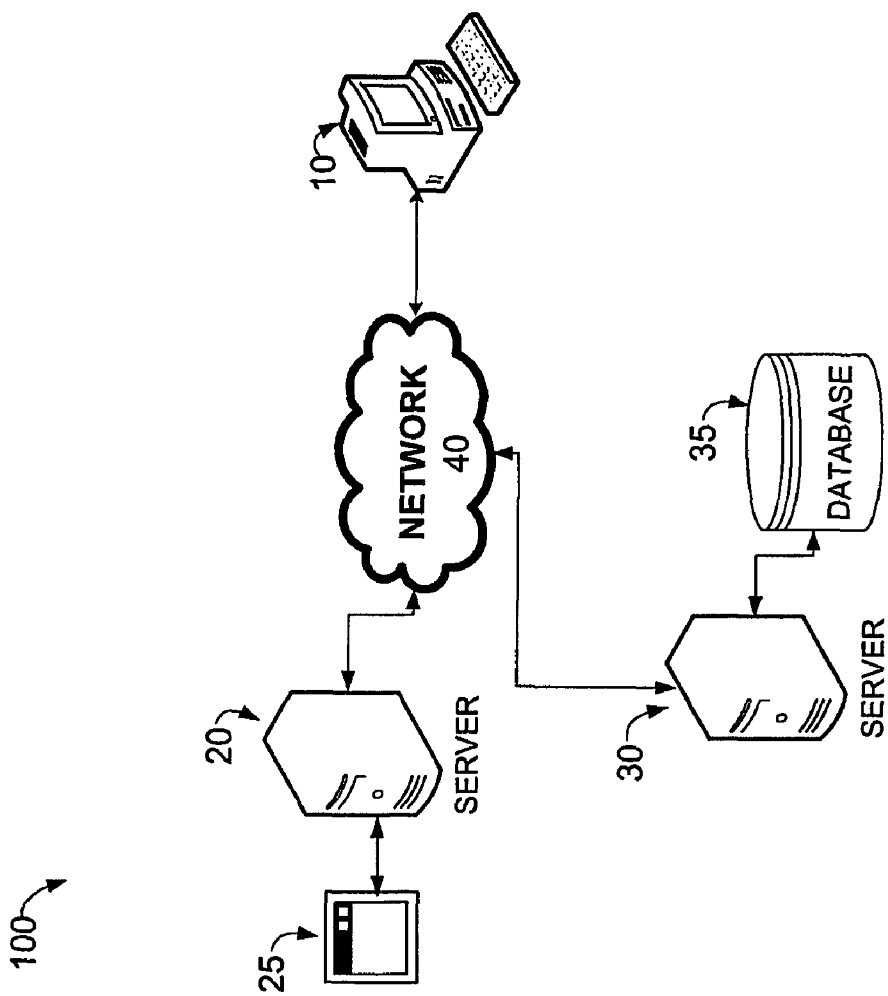


FIGURE 1



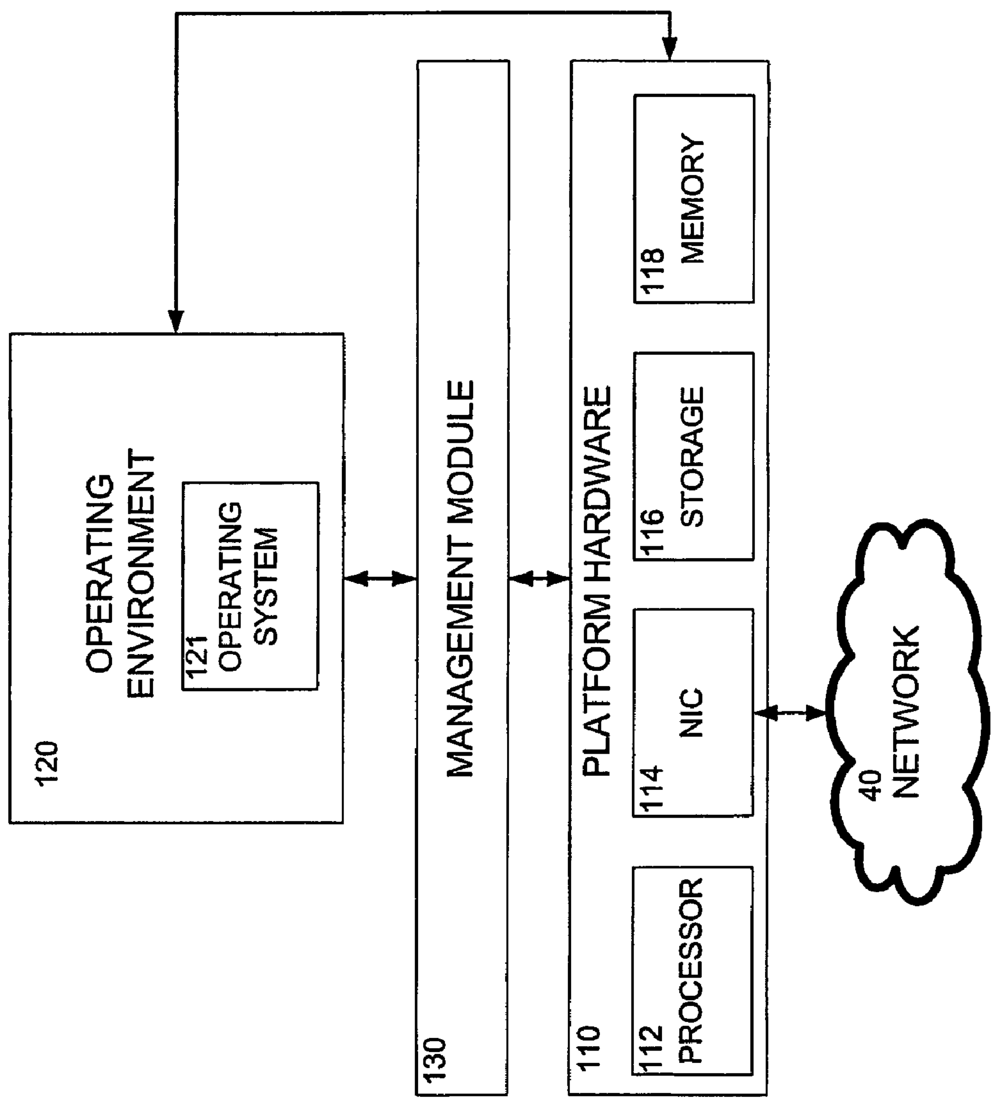

10
120
OPERATING ENVIRONMENT
121 OPERATING SYSTEM
130
MANAGEMENT MODULE
110
PLATFORM HARDWARE
112 PROCESSOR
114 NIC
116 STORAGE
118 MEMORY
40 NETWORK

FIGURE 2

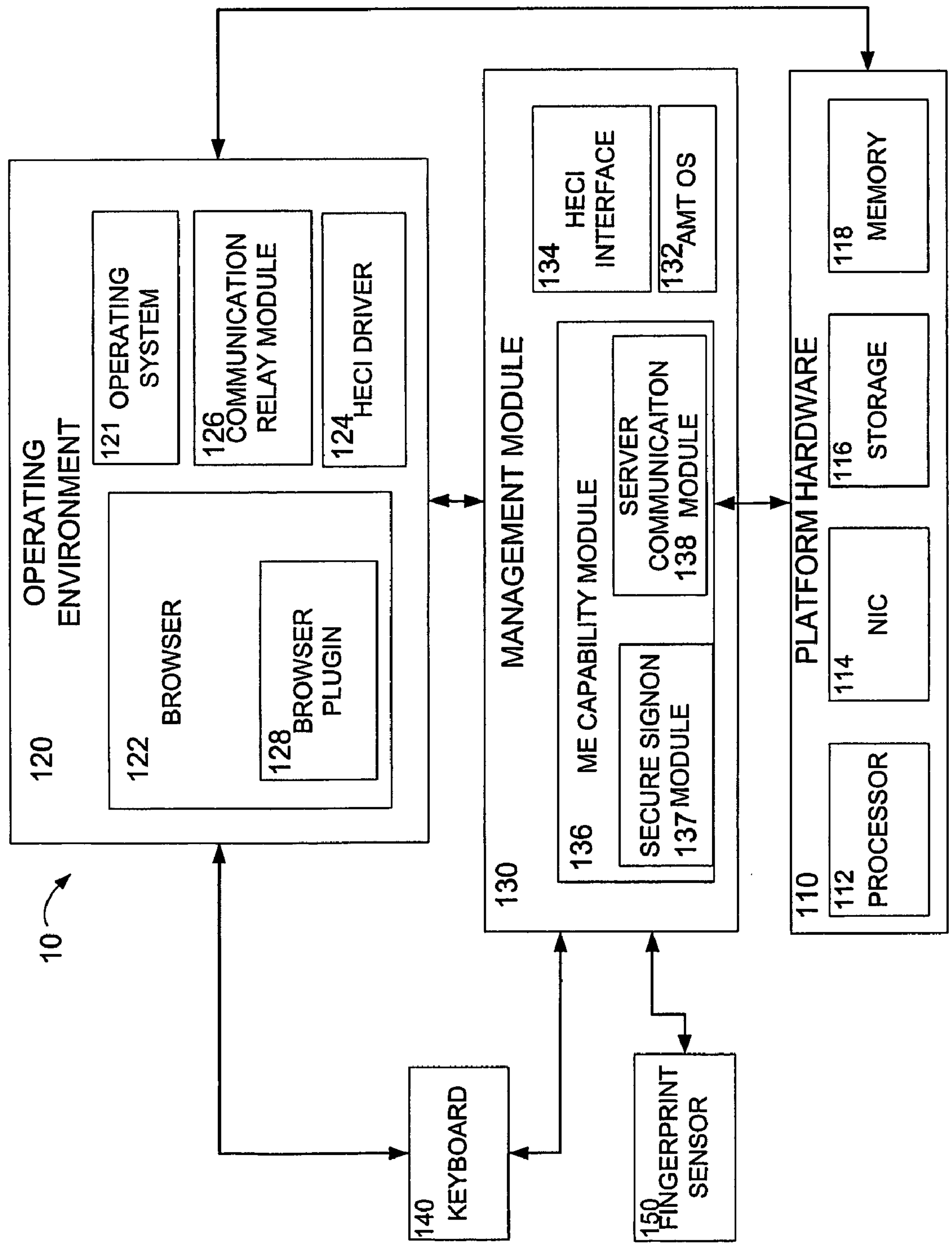
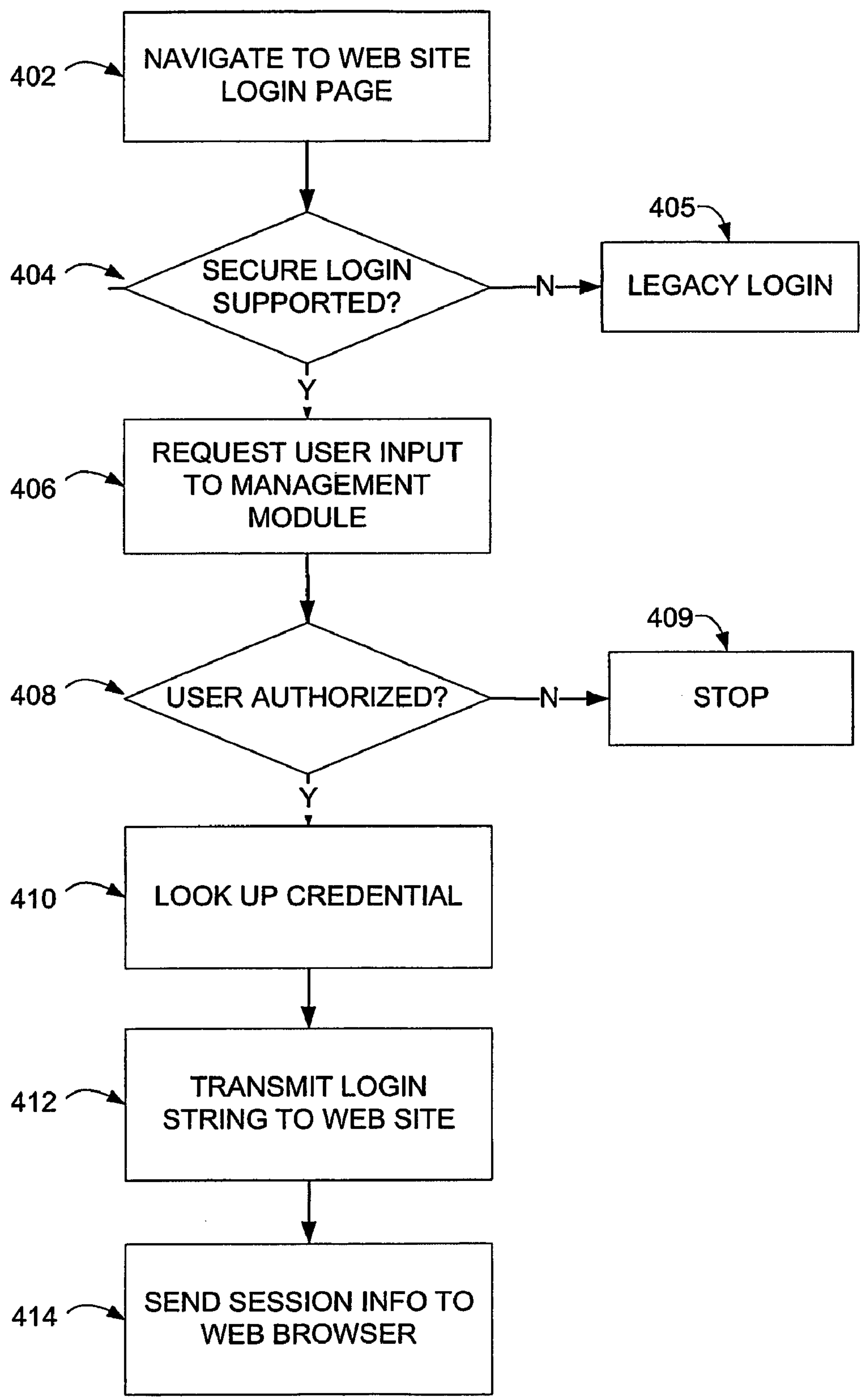
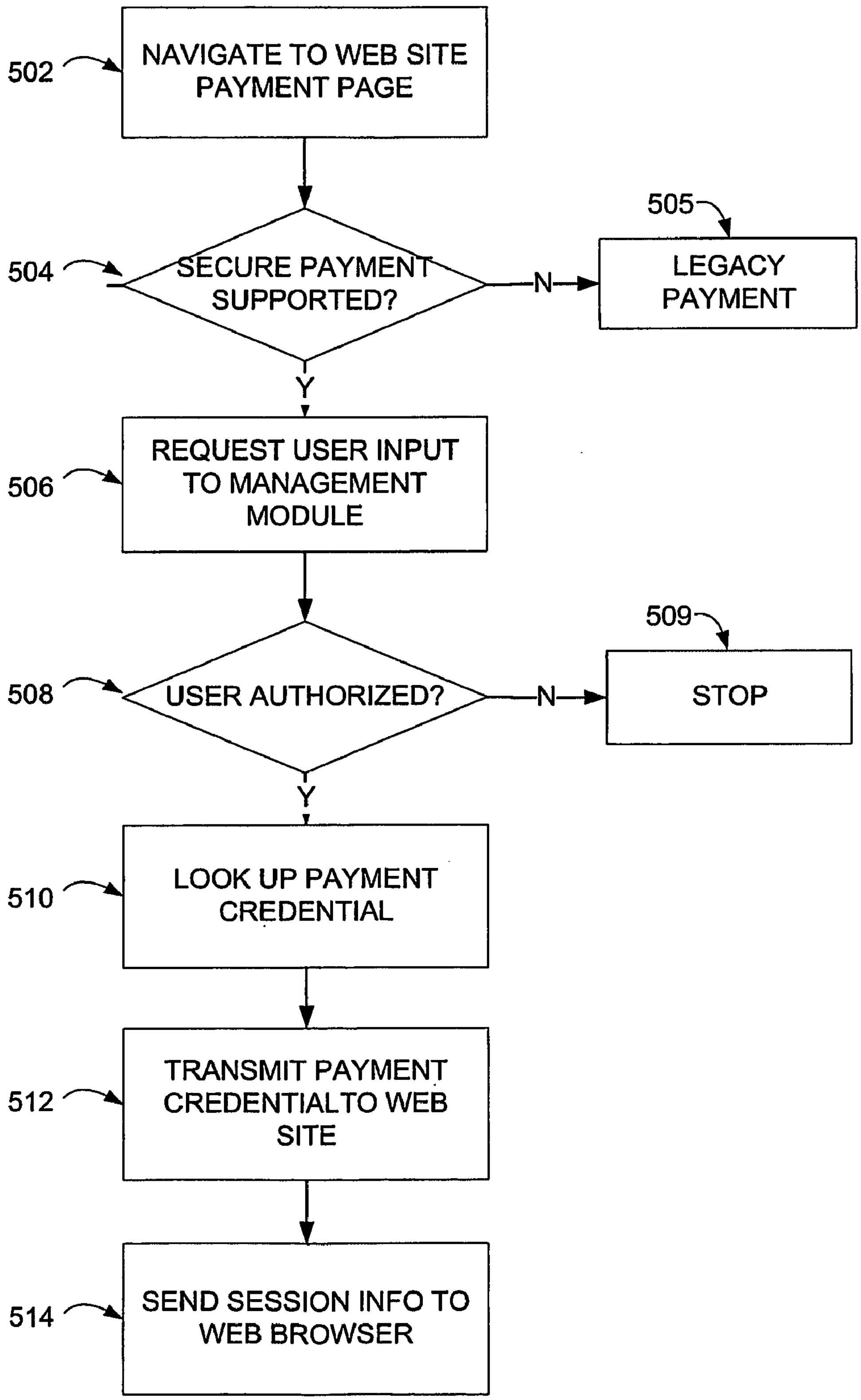

10
120 OPERATING ENVIRONMENT
121 OPERATING SYSTEM
126 COMMUNICATION RELAY MODULE
124 HECI DRIVER
122 BROWSER
128 BROWSER PLUGIN
130 MANAGEMENT MODULE
134 HECI INTERFACE
132 AMT OS
136 ME CAPABILITY MODULE
SERVER COMMUNICAITON 138 MODULE
SECURE SIGNON 137 MODULE
110 PLATFORM HARDWARE
112 PROCESSOR
114 NIC
116 STORAGE
118 MEMORY
140 KEYBOARD
150 FINGERPRINT SENSOR

FIGURE 3

FIGURE 4


402
NAVIGATE TO WEB SITE LOGIN PAGE
404
SECURE LOGIN SUPPORTED?
N
405
LEGACY LOGIN
Y
406
REQUEST USER INPUT TO MANAGEMENT MODULE
408
USER AUTHORIZED?
N
409
STOP
Y
410
LOOK UP CREDENTIAL
412
TRANSMIT LOGIN STRING TO WEB SITE
414
SEND SESSION INFO TO WEB BROWSER

# FIGURE 5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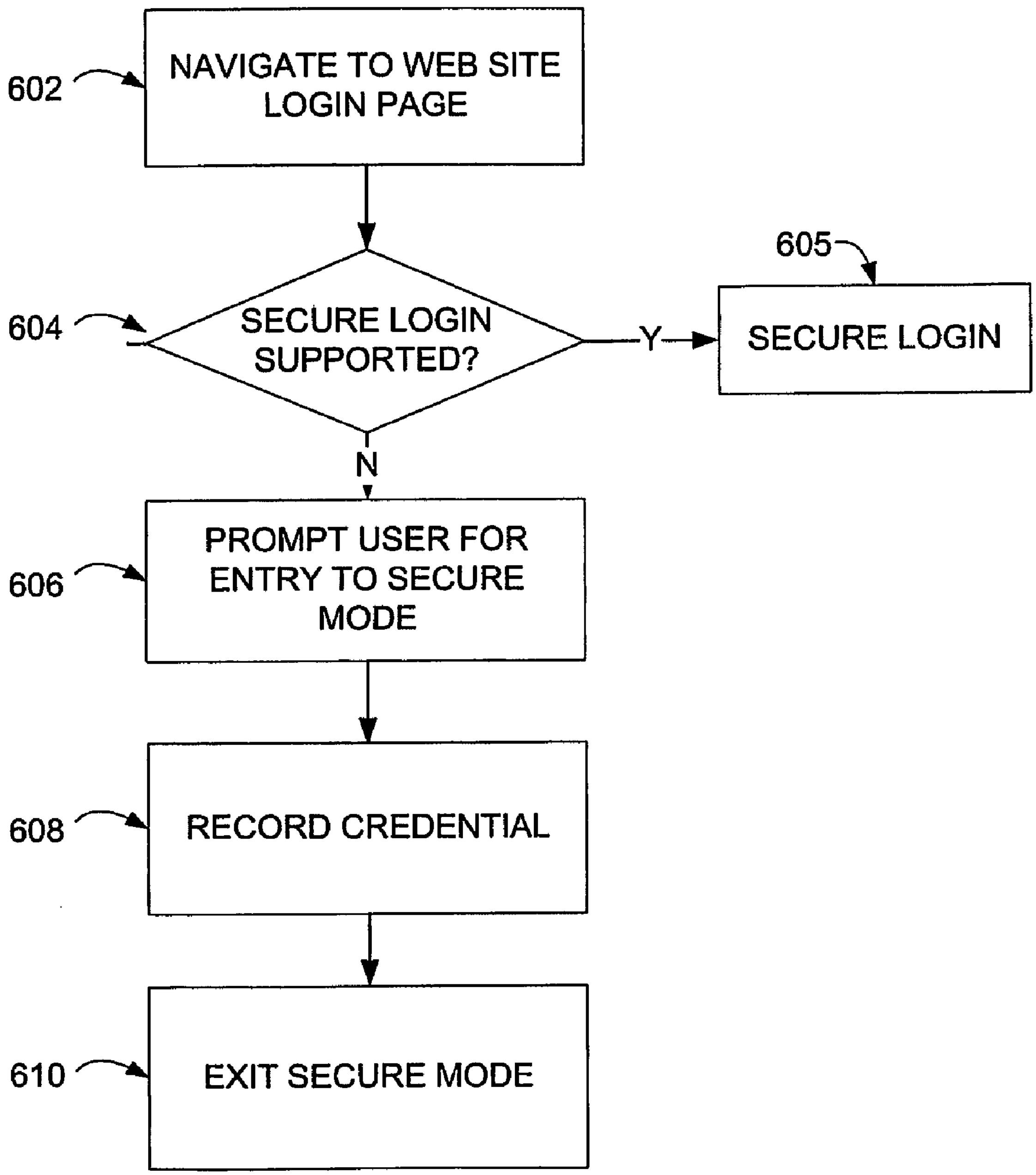
504
SECURE PAYMENT SUPPORTED?
N
505
LEGACY PAYMENT
Y
506
REQUEST USER INPUT TO MANAGEMENT MODULE
508
USER AUTHORIZED?
N
509
STOP
Y
510
LOOK UP PAYMENT CREDENTIAL
512
TRANSMIT PAYMENT CREDENTIALTO WEB SITE
514
SEND SESSION INFO TO WEB BROWSER

FIGURE 6


602
NAVIGATE TO WEB SITE LOGIN PAGE
604
SECURE LOGIN SUPPORTED?
Y
605
SECURE LOGIN
N
606
PROMPT USER FOR ENTRY TO SECURE MODE
608
RECORD CREDENTIAL
610
EXIT SECURE MODE

# METHOD, APPARATUS, AND SYSTEM FOR SENDING CREDENTIALS SECURELY

## BACKGROUND OF THE INVENTION

Many secure web sites require some form of user identification and/or authentication as part of the log in process or as part of a transaction such as for example a payment transaction. Key loggers, root-kits and other malware may observe and capture the credentials entered by a user during one of these processes. Some solutions may require the presence of software or other mechanisms at the remote server or web host.

## BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanied drawings in which:

FIG. **1** is a schematic illustration of a system for sending credentials securely to a remote server according to an embodiment of the invention.

FIG. **2** is a representative illustration of a computing platform according to an embodiment of the invention.

FIG. **3** is a further representative illustration of a computing platform according to an embodiment of the invention.

FIG. **4** is a flowchart of a method for sending credentials securely to a remote server according to an embodiment of the invention.

FIG. **5** is a flowchart of a method for a secure payment transaction according to an embodiment of the invention.

FIG. **6** is a flowchart of a method for accepting a credential in a secure operating environment according to an embodiment of the invention.

It will be appreciated that for simplicity and clarity of illustration, elements shown in the drawings have not necessarily been drawn accurately or to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity or several physical components included in one functional block or element. Further, where considered appropriate, reference numerals may be repeated among the drawings to indicate corresponding or analogous elements. Moreover, some of the blocks depicted in the drawings may be combined into a single function.

## DETAILED DESCRIPTION OF THE INVENTION

In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of embodiments of the invention. However it will be understood by those of ordinary skill in the art that embodiments of the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, components and circuits have not been described in detail so as not to obscure the present invention.

Unless specifically stated otherwise, as apparent from the following discussions, it is appreciated that throughout the specification discussions utilizing terms such as "processing," "computing," "calculating," "determining," or the like, refer to the action and/or processes of a computer or computing system, or similar electronic computing device, that manipulates and/or transforms data represented as physical, such as electronic, quantities within the computing system's



registers and/or memories into other data similarly represented as physical quantities within the computing system's memories, registers or other such information storage, transmission or display devices. In addition, the term "plurality" may be used throughout the specification to describe two or more components, devices, elements, parameters and the like.

As used herein, the term "component" may refer to programming logic and associated data that may be employed to obtain a desired outcome. The term component may be synonymous with "module" or "agent" and may refer to programming logic that may be embodied in hardware or firmware, or in a collection of software instructions, possibly having entry and exit points, written in a programming language, such as for example C++, Intel Architecture 64 bit (IA-64) executable code, etc. Further, components may be callable from other components or from themselves, and/or may be invoked in response to detected events or interrupts. For example, a component may be a software package, module or agent executed by one or more processors.

As used herein, a credential may be a password, username, fingerprint, biometric identifier, user identification (ID) number, or other identifier, digital string, template, or other digitally encoded identifier as needed to confirm a user's authority for access to for example a software application or account. A credential may also be or include a digital identifier required to authorize the completion of a transaction. A transaction may also require more than one credential for completion. For example, a financial transaction may require a financial account number, a credit card number, a wire transfer number, etc. as well as a password, personal identification number and the like. Other types of credentials and transactions requiring different credentials are also possible.

Embodiments of the invention may provide a method and system for sending credentials or other data securely to a remote server according to an embodiment of the invention. In one embodiment, a software application executing in a first local operating environment may be used to connect to a remote server that requires a credential of a user to complete a transaction. In a second local operating environment that may operate securely, may be external to the first local operating environment, and may operate on the same computer as the first local operating environment, a user may be authenticated based on a user input received in the second local operating environment. The credential of the user may be securely communicated to the remote server from the second local operating environment.

In a second embodiment, a host operating environment may connect to a remote application that requires a credential for completion of a transaction. The remote application's supporting of the completion of the transaction from a secure local operating environment that operates external to the host operating environment may be confirmed. A string for completing the transaction may be received in the secure local operating environment via an out-of-band connection that is inaccessible to the host operating environment. In the secure local operating environment, a user's authorization to complete the transaction may be determined based on a user input to the secure local operating environment. If the user is authorized to complete the transaction, the out-of-band connection may be used to communicate securely the credential to the remote application.

Reference is now made to FIG. **1**, a schematic illustration of a system **10** capable of sending credentials securely to a remote server according to an embodiment of the invention. In some embodiments, system **10** may include at least a computing platform **10** connected to a remote server **20** and a database server **30** by a public network **40**.

Remote server **20** may be or include any computer capable of hosting one or more applications **25** that may interact with a remote user such as may be using computing platform **10**. Application **25** may include software applications that may be used or run remotely and that may require one or more transactions requiring the input of a user credential. For example, application **25** may be a software application requiring a user login transaction for access. Application **25** may also be a merchant application requiring a payment transaction for the purchase of an item. Other applications that include transactions requiring the input of one or more credentials are also possible.

In some embodiments, application **25** may present an interface unique to application **25**. Alternatively, application **25** may also be capable of interacting with browsers or other applications for retrieving and viewing web content. In some embodiments, application **25** may be web-based or appear to the user as a web site or other interface with the login or user identification page appearing as a web page, a frame within a web page, and the like. Such web pages may be written in for example Hypertext Markup Language (HTML) or other suitable language as is known. Other network interfaces besides browsers are also possible.

In some embodiments, application **25** may require a remote user to submit a credential before completing a transaction. For example, if the transaction is a login, application **25** may require a remote user to login with or authenticate himself with a password, personal identification code, etc. prior to his gaining access to application **25**. Login and authentication methods are well known in the art, but may be vulnerable to attack by hijackers and others when utilized in conjunction with a remote user connecting over a public network such public network **40**. These attacks may include attacks at remote server **20** via public network **40** and at computing platform **10**. Attacks targeting computing platform **10** may include keylogging, rootkits, spyware, and other malware. Further, some of these attacks may attempt to hijack one or more of a user's credential as it is being entered at computing platform using for example a keyboard or other device as known. Some embodiments may provide a user's credentials to a remote server securely without exposure to such attacks.

A user may access remote server **20** via for example computing platform **10** which may be, for example, a personal computer (PC), a desktop computer, a mobile computer, a laptop computer, a notebook computer, a terminal, a workstation, a server computer, a personal digital assistant (PDA) device, a network device, or other suitable computing device capable of or supporting, e.g. hosting software capable of interacting remotely with application **25**. Although not limited in this respect, some embodiments of the present invention may incorporate a web browser as an application for retrieving and viewing web content. Such web browsers may retrieve content from the World Wide Web in a client-server dialogue of requests from the browser and responses from the web site or other interface.

Database server **30** may be a server capable of hosting a database **35** and may be remotely located from computing platform **10** and accessible over public network **40**. Alternatively database server **30** may be accessible by computing platform **10** over a local area network or other localized connection. Database **35** may be or include a relational database or other application for storing and retrieving files or data such as for example hypertext transfer protocol (http) post or request strings for web site access. In some embodiments, database **35** may contain information listing web sites, remote servers, and applications which are capable of, e.g. which can support receiving securely transmitted credentials according to embodiments of the present invention. For each such listed web site or application, database **35** may also contain the corresponding command request string, e.g. a hypertext transfer protocol over secure socket layer (https) post string or other permission token, number or data or text string required for login.

Public network **40**, which connects remote server **20** and computing platform **10** may be any publicly accessible network such as the Internet. Public network **40** may also be a local area network (LAN), metropolitan area network (MAN), wide area network (WAN) or other similar network with communications links between two or more network nodes, and may be a combination of networks. Access to public network **40** may be through wire line, terrestrial wireless, satellite or other systems well known in the art.

In some embodiments, the communication between computing platform **10** and remote server **20** may utilize a secure connection such as for example secure socket layer (SSL) and/or transfer layer security (TLS). Other techniques for securing the connection between computing platform **10** and remote server **20** may also be used. Although such technologies may prevent or deter the capture of sensitive data such as for example a user credential in transit, they may not provide protection for attacks at computing platform **10**.

Reference is now made to FIG. **2**, a representative illustration of a computing platform **10** according to an embodiment of the invention. Although the invention is not limited in this respect, computing platform **10** may include for example platform hardware **110**, an operating or executing environment **120** and management module **130**. Computing platform **10** may also be connected to a network **40** for communicating with remote server **20** and other devices.

Although the invention is not limited in this respect, operating environment **120** and management module **130** may have direct connections to platform hardware **110**. However, operating environment **120** and management module **130** may operate independently of each other and with respect to their access to platform hardware **110**.

Platform hardware **110** may include a processor **112**, a network interface controller (NIC) **114**, storage **116**, and/or memory **118**. Other components and/or logical elements may also be included.

Processor **112** may be or include for example a central processing unit (CPU), a digital signal processor (DSP), a microprocessor, a controller, a chip, a microchip, or any suitable multi-purpose or specific processor or controller. In some embodiments, for example, processor **112** may execute programming instructions or perform calculation operations which may be used in the operation of components on computing platform **10**.

Storage **116** may include integrated and/or peripheral storage devices, such as for example disks and associated drives, universal serial bus (USB) storage devices, flash memory, read-only memory (ROM), non-volatile semiconductor devices or other suitable storage devices for storing persistent content to be used for the execution of components on platform **10**. In some embodiments storage **116** may be a storage resource physically part of platform **10** or it may be accessible by, but not necessarily part of, platform **10**. For example, storage **116** may be accessed by platform **10** over public network **40** or other network not shown via NIC **114**.

Memory **118** may include, for example, one or more memories such as a random access memory (RAM), a ROM, a dynamic RAM (DRAM), a synchronous DRAM (SD-RAM), a Flash memory, a volatile memory, a non-volatile memory, a cache memory, a buffer, a short term memory unit, a long term memory unit, or other suitable memory units for storing data and or components such as an operating system and/or other software. In some embodiments, memory **118** may organize content stored therein into a number of groups of memory locations. These organizational groups, which may be fixed and/or variable sized, may facilitate the implementation of multiple operating environments. Alternatively, memory **118** may have a different organizational structure.

In some embodiments, operating environment **120** may be the domain of an executing operating system (OS) **121**. OS **121** may be a software component such as for example a host OS configured to execute and control general operation of other components within operating environment **120**, such as for example a software application. In some instances, operating environment **120** may provide a virtual operating environment in which the components may operate. Alternatively, operating environment **120** may be non-virtualized.

Management module **130** may arbitrate general component access to hardware resources such as for example one or more processors **112**, NIC **114**, storage **116** and/or memory **118**. In some embodiments, management module **130** may be implemented using Intel® Active Management Technology (AMT) or other suitable technology for implementing out-of-band management of a computing platform by use for example of a secondary process, processor or controller. Management module **130** or portions of management module **130** may execute code independently from and may be securely isolated from operating environment **120**. In some embodiments, management module **130** may present multiple abstractions and/or views of platform hardware **110**, e.g. one or more processors **112**, NIC **114**, storage **116**, and/or memory **118**, to operating environment **120**. Further, in some embodiments, management module **130** may be or include a second operating environment (e.g. with operating environment **120** as the first operating environment) that can execute instructions such as for example in firmware and may be for example a manageability engine (ME). In these instances, management module **130** may be for example an OS environment.

Management module **130** may be implemented in software (e.g., as a stand-alone program and/or component of a host operating system), hardware, firmware, as hardware architecture resident in firmware, and/or any combination thereof. A micro-controller within a chipset graphics and memory controller hub may house management module firmware although the invention is not limited in this respect. In some embodiments, management module **130** may be a micro-controller or embedded controller or processor. In some embodiments, management module **130** may be included in a chipset of platform hardware **110** and/or may be included in a memory controlled hub of platform hardware **110**. In some embodiments management module **130** may be implemented inside a protected virtual environment running on for example processor **112**, but independent of and protected from operating environment **120**. Other implementations of management module **130** as an ME or otherwise are also possible.

Reference is now made to FIG. **3**, a further representative illustration of computing platform **10** according to an embodiment of the invention. In addition to platform hardware **110**, operating environment **120**, and management module **130**, computing platform **10** may include input units such as a keyboard **140**, fingerprint sensor **150**, a mouse, etc.

In some embodiments, management module **130** may be or include an ME and may address critical manageability issues of computing platform **10**, improve the efficiency of remote management and asset inventory functionality in third-party management software, safeguard the functionality of critical agents from failure of an operating system such as for example operating system **21**, power loss, and intentional or unintentional client removal. Management module **130** may be capable of monitoring activity such as the heartbeat of a local management agent and automatically take remediation action. External systems may communicate with management module **130** hardware to perform diagnosis and recovery actions such as installing, loading or restarting agents, diagnostic programs, drivers and even operating systems. In some embodiments, the infrastructure of management module **130** may support the creation, setup, and configuration of interfaces for management applications as well as network security and storage administration. Management module **130** need not be or include an ME.

Management module **130** may include an AMT operating system (OS) **132**, a Host Embedded Controller Interface (HECI) **134**, and a management engine (ME) capability module **136**. Other or different components or modules may also be included.

AMT OS **132** may be a local operating system designed to operate outside or separately from the host operating system, e.g. OS **121**, and may support the functionality of management module **130**.

HECI **134** may act as the interface between management module **130** and components of operating environment **120** such as for example OS **121**. HECI **134** may be a bi-directional interface, e.g. transactions can be initiated either internal or external to management module **130**.

ME capability module **136** may be implemented in firmware and/or software and may be responsible for exchanging data between management module **130** and devices or systems external to computing platform **10**. In some embodiments, ME capability module **136** may include a secure sign-on module **137** and a server communication module **138**. Other modules and components may also be included.

Secure sign-on module **137** may be responsible for managing the secure sign-on capability of management module **130**, e.g. the input, storage, and retrieval of user credentials as well as other user input as needed for logging into a remote server or other external application. Secure sign-on module may be capable of communicating with external input devices such as for example keyboard **140** and/or fingerprint sensor **150**. Server communication module **138** may manage the transmission of the user credentials and/or other data between management module **130** and a remote server such as for example remote server **20** or remote server **30**. Because management module **130** may interface directly with NIC **114** and other components of platform hardware **110**, transmission of information between management module **130** and an external device or server may occur external to operating environment **120** and, therefore, external to any applications running therein. Alternatively, management module **130** may communicate with external devices through operating environment **110** if such communications is protected from modification and snooping.

In some embodiments operating environment **120** may execute a browser **122** and may include a HECI driver **124** and a communication relay module **126**. Other components or elements may also be included.

Browser **122** may be or include a web browser or other user agent as known for communicating with a remotely located web site or server-based application. Interfaces other than a browser accessing the World Wide Web may be used, and embodiments of the invention may allow secure access to systems other than those that are based on the World Wide

Web (WWW). Browser **122** may include a browser plugin **128** that may be integrated into browser **122** or used with browser **122** when installed. In some embodiments, browser plugin **128** may be capable of detecting if a web site or other process or application is capable of receiving securely transmitted user credentials according to embodiments of the invention by for example contacting database server **30** and querying or looking up in the database **35** to see if the web site is included as a capable or supported web site. If the web site or application is supported, the corresponding command request string, e.g. a sign-on string and possibly other data may be sent securely to management module **130**. Browser plugin **128** may, in some embodiments, inform management module **130** as to the domain name of the supported web site or application. Management module **130** may then retrieve the sign-on string using for example a TLS connection with endpoints at management module **130** and database server **30**. Alternatively, browser plugin may retrieve the sign-on string directly for example in a cryptographically protected form and forward it to management module **130**. Other secure transfer techniques are also possible.

Once a secure transaction has been completed, browser plugin **128** may also be capable of receiving session information such as for example cookies and other session identifiers from management module **130** for use during a session in operating environment **120**.

HECI driver **124** may be or include a software interface that may manage communications between operating environment **120** and management module **134** through HECI interface **134**. In some embodiments HECI driver **124** may utilize Intel® AMT subsystem (Management Engine) interface driver technology to access Intel® AMT capabilities.

Keyboard **140** may be or include a keyboard or other input device as known for text or data entry into computing platform **10**. For applications running in operating environment **120** such as for example browser **122**, the input from keyboard **140** may pass directly to operating environment **120**. Keyboard **140** may also be used for text entry into management module **130**, when a secure mode that directs the input from keyboard **140** exclusively into management module **130** is enabled. In some embodiments, other input devices such as a mouse or a microphone for voice commands may also be used instead of or in addition to keyboard **140**.

Fingerprint sensor **150** may be or include a sensor for capturing a representation of a user's fingerprint for authentication or identification of a user. A digital template may be derived from the captured representation and compared with one or more stored reference digital templates. A positive match may authenticate or identify a user. In some embodiments, this matching process may occur within management module **134** in secure sign-on module **137**. Alternatively, the matching process may occur at a remote server such as for example database server **30** with the digital template being communicated to the remote server in accordance with embodiments of the invention. Other locations for authenticating or identifying a user are also possible.

In some embodiments, computing platform **10** may include a device capable of capturing a representation of a different biometric identifier such as for example a retina scanner. Some embodiments may include a smart input device (SID) capable of receiving a direct input from a user. Other sensors and devices for authenticating or identifying a user as a direct input to management module **134** may also be used.

Reference is now made to FIG. **4** which is a flowchart of a method for sending credentials securely to a remote server according to an embodiment of the invention. Embodiments of the method may be used by, or may be implemented by, for example, computing platform **10** of FIG. **1**, computing platform **10** of FIGS. **2** and **3**, or by other suitable computing devices capable of hosting an environment such as executing environment **120** and management module **130** to communicate user credentials and/or other secure data over a public network such as public network **40** to a remote server such as remote server **20** for gaining access to or logging into for example application **25**, although the invention is not limited in this respect. Other uses for the secure transmission of credentials and/or other data are also possible. While a management module and other specific components are shown as performing certain functions in FIGS. **4**, **5** and **6**, other modules, components, or other combinations of modules or components may perform these functions.

According to some embodiments of the invention, secure login and secure transmission of credentials for a transaction on web site or other interface may take place without any modification of the web site or application. Thus the invention may have advantages over prior art which may require additional software at the remote server for secure operations.

When a user navigates to a login page of application **25**, e.g. a web site, a browser plugin on the user's computer (which may be for example computing platform **10**) may check to see if application **25** login method can be performed securely according to an embodiment of the present invention by for example contacting a database server and querying the database. If application **25** login method is supported, e.g. can be performed securely, the database server may transmit a permission token, number or string such as a http post string required for login to application **25** directly to a management module of computing platform **10** that operates separately from the host operating system. This management module may prompt the user to confirm his identity by for example a fingerprint match or other process. If the management module verifies the identified user is authorized to access application **25**, then the management module may retrieve a password or other credential and possibly encrypt and transmit a, for example, http post login string including the credential using for example a TLS or an SSL cryptographic protocol. The transmission may be encrypted within the management module and sent directly from the management module to application **25** to preclude any malware attacks through the browser or host operating system. Once the user has been logged into application **25**, the management module may send the cookies and/or other session information received from application **25** to the web browser via the browser plugin, and the user may proceed with routine use of application **25**.

As indicated at operation **402**, a user using for example a browser such as browser **122** in operating environment **120** of computing platform **10** may navigate to the login page of a web site or other application such as for example application **25** hosted by for example remote server **20** over a public network such as public network **40**. Alternatively, using a local client software application, computing platform **10** may automatically connect over a public network **40**, or private network such as a LAN, to an application **25** that may require user login, the application **25** being hosted on remote server **20**. Other connections and remote applications requiring login or other form of user verification are also possible.

In some embodiments, navigating to a login page or similar entry point for an application may initiate a login or other session as known. Subsequent interaction with the application, e.g. a web site, may include as part of the data stream one or more session identifiers and other session information such as for example cookies being sent from application **25** to computing platform **10**. These cookies and other session information may be stored for further use in the present session as well as possibly for future sessions.

In operation **404**, a browser plugin such as for example browser plugin **128** may check to see if the web site or remote application login method can be performed securely according to an embodiment of the invention, e.g. is supported. In some embodiments, browser plugin **128** may contact an external database server such as database server **35** via public network **40** to determine if application **25** is supported according to embodiments of the invention. Alternatively, the database or list of web sites/applications may be locally stored. Other techniques for confirming that a web site or application's login method is supported may be used with embodiments of the invention.

If the secure login method is not supported, login may proceed in any legacy method such as for example using a password or other text entry as known (operation **405**). If the secure login method is supported, e.g. an entry referencing the remote application is in the database, database server **30** may transmit a permission token, number or string such as an http post login string needed for logging into application **25** directly to management module **130**. Alternatively, database server **30** may transmit an encrypted permission token, number or string to browser **122**. Browser plugin **128** may pass the encrypted data on management module **130**. Because management module **130** may operate external to operating environment **120** and accordingly browser **122**, the query or interrogation and/or response may be an out-of-band process, e.g. occurs external to operating environment **120**.

Management module **130** through for example ME capability module **136** may request a user's input for authorization or authentication in operation **406**. In some embodiments, a user may enter a password, user identification number or other such identifier with for example keyboard **140**. Alternatively, the user may identify himself with a sensor such as for example fingerprint sensor **150** or other biometric device. Other devices for authorizing, authenticating, and/or identifying a user may also be used. Further, in some embodiments multiple inputs from more than one device may also be possible. Because the user's input passes directly to management module **130**, the input process may be invisible to browser **122** and may be impervious to keyloggers and other attacks on operating environment **120**.

Having received the user's input, management module **130** may, in operation **408**, verify or confirm that the user is authorized to access application **25**. This confirmation may include but is not limited to a table or database lookup, fingerprint matching, and other techniques as known for validating a user's identity and/or authority for access to an application. If the user is not authorized, the login process may end in operation **409**. Alternatively, operations **406** and **408** may be repeated one or more times, possibly with a preset limit to the number of attempts to authorize.

If the user is authorized, management module **130** may look up in a table or database the appropriate identifier or credential needed for access to application **25** (operation **410**). The table or database may be stored in any memory on computing platform **10** that is secure, e.g. confidentiality is protected (e.g., no access by operating environment **120** or any other entity other than management module **130**). In some embodiments, this credential may be integrated into a login string for application **25**. Other forms of credentials and login techniques may also be used.

In operation **412**, management module **130** may transmit a permission token, number or string such as an http post login string and/or other appropriate credential to application **25** over public network **40**. In some embodiments, management module may transmit an encrypted credential directly with application **25** outside of operating environment **120**. This connection may be logically directly from management module **130** to remote server **20** over a TLS/https connection. The connection may be secure even if it uses the host (operating environment **120** and browser **122**) Transmission Control Protocol/Internet Protocol (TCP/IP) stack. The encryption may alternatively use SSL or other cryptographic protocols or schemes as known to protect sensitive data in transit, that may be compatible with application **25** and/or other servers and web sites, and that protect the sensitive data from one end, e.g remote server **20** to the other end, e.g. management module **130**. Further, in some alternative embodiments, management module **130** may encrypt the credential and may send the encrypted credential via browser **122** to application **25**.



Upon successfully signing into application **25**, remote server may transmit session identifiers such as for example cookies back to management module **130**. Management module **130** may send the received session information to browser **122** in (host) operating environment **120** via browser plugin **128** (operation **414**) and may redirect browser **122** to the web site. At this point, the user's session may proceed using browser **122**.

Other operations or series of operations may be used.

Embodiments of the present invention may also be used for other secure transactions beside login such as for example a merchant payment or other financial transaction or other transfer of sensitive data. Reference is now made to FIG. **5**, which is a flowchart of a method for a secure payment transaction according to an embodiment of the invention. In some embodiments, some operations described below in the method of FIG. **5** may be similar to like-named operations described above for the method FIG. **4**. Further, embodiments of the method of FIG. **5** may be used by, or may be implemented by, the same elements or components as the method of FIG. **4** including for example an application **25** that may require a financial transaction, although the invention is not limited in this respect.

In operation **502**, a user desiring to complete a financial transaction on a web site such as for example payment to a merchant may navigate to the payment page or frame of the web site (which may be an interface to an application such as application **25**). Alternatively, a user may be automatically redirected to a payment page or frame. Other techniques for requesting payment information from a user may also be used. The payment page may request the user to enter payment credentials as required to complete the financial transaction such as for example, a credit card number, a credit card expiration date, a security code, and the like. Payment credentials may also include payment account information such as for example bank account routing information and password, an on-line payment service (e.g. PayPal®) username and password, or other credentials that may identify or authorize a user and/or a financial account.

In operation **504**, a process such as a browser plugin (e.g. browser plugin **128**) may check to see if the web site's payment or other financial transaction can be performed securely according to an embodiment of the invention, e.g. is supported. Operation **504** may proceed as with operation **404**, with browser plugin **128** contacting database server **30** or may employ other techniques for confirming web site transaction support as known.

If secure payment is not supported, a legacy payment method may be used in operation **505**. If secure payment is supported, database server **30** may communicate for example an http request string or other such string as needed to complete a financial transaction with the web site to management module **130**. In operation **506**, management module **130** may request user input for authorization to complete the financial transaction. As with the embodiment of FIG. **4**, user identification and authorization may use keyboard **140** and/or fingerprint sensor **150** or other authorization/authentication techniques as known. This authorization may occur with the secure environment of management module **130**, e.g. inaccessible to browser **122**.

In some embodiments, operations **508** and **509** may be substantially the same as operations **408** and **409**. If the user is authorized, in operation **510** management module may look up the appropriate payment credential needed to complete the transaction. In some embodiments, a user may be able to select one of several options such as for example one of several credit cards for payment.

In operation **512**, management module may encrypt and transmit the requisite http request string and payment credential over the public network **40** to application **25**. As with operation **412**, a logical connection directly from management module **530** to remote server **20** with a known encryption technique may provide sufficient security to prevent data hijacking or other attack. Upon verification of payment by application **25**, management module **130** may send the session information it receives in response from application **25** to browser **122** via browser plugin **128** (operation **514**) for subsequent redirection to the web site and continued use of browser **122**. Other operations or series of operations may be used.

In some alternate embodiments, the secure operating environment may be external to computing platform **10** and may further include additional cryptographic software such as for example a Kerberos protocol. For these embodiments, the secure operating environment may be in a peripheral device or other smart input device (SID) that may for example connect to computing platform **10** through for example a USB port or other computer interface as known. Operations may proceed as with the embodiments of FIG. **4** and/or FIG. **5**. However, user input and storage/retrieval of credentials may occur respectively through and internal to the SID, e.g. a user's input passes directly to the SID external to the (host) operating environment **120**. Further, a cryptographic client such as for example a Kerberos client may reside within the environment of the SID. Credentials may then be encrypted with the Kerberos or other protocol before being passed through to the browser plugin for transmission to the remote server.

In some embodiments, management module **130** may require user entry of the credentials stored therein although the invention is not limited in this respect. Other techniques for loading credentials into management module **130** for storage or storing credentials in management module **130** external to operating environment **120** are also possible.

Reference is now made to FIG. **6** which is a flowchart of a method for accepting a credential in a secure operating environment such as management module **130** according to an embodiment of the invention. A credential may be requested for example when in operation **404** or similar operation it is determined that a web site or application may not currently support secure login according to embodiments of the invention. A similar request may be made for financial web sites and the like with respect to payment credentials. Other situations such as for example an initialization of management module **130** may also require the secure entry of a credential into management module **130**.

In operation **602**, a user may navigate to the login page of an application such as application **25** (e.g. a web site). If it is determined in operation **604** that secure login is supported, the method may proceed in operation **605** as with for example operations **406-414** or **506-514**. If it is determined in operation **604** that secure login is not supported, then browser plugin **128** may prompt the user to enter a secure input mode (operation **606**), e.g. direct communication between keyboard **140** and management module **130**, but external to operating environment **120**. In some embodiments, entry into secure input mode may require a user to press a specific combination of keys on for example keyboard **140**. Alternatively, a specific button may be designated for secure input mode. Other triggers or actions to enter secure input mode are also possible.

Once keyboard **140** is in secure input mode, a user may enter a credential (e.g. a text credential) such as password, credit card number and the like. The entered credential may be recorded and stored by management module **130** in operation **608**. A separate key combination may in operation **610** cause management module **130** to exit the secure input mode. Alternatively, management module **130** may exit secure input mode once the entered credential is recorded. Other techniques for exiting the secure input mode may also be used.

In some alternative or additional embodiments a user may be able to enter into secure mode directly without prompting by browser plugin **128**. In these embodiments, the method may proceed with operations **608-610**.

While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications and other applications of the invention may be made. Embodiments of the invention may include a computer or processor readable storage medium, such as for example a memory, a disk drive, or a USB or other flash memory, including instructions which when executed by a processor or controller, carry out or perform methods disclosed herein. Embodiments of the present invention may also include other systems for performing the operations herein such as for example mobile computing platforms. Such systems may integrate the elements discussed, or may comprise alternative components to carry out the same purpose. It will be appreciated by persons skilled in the art that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

The invention claimed is:

**1**. A method comprising:

connecting to a remote server using a software application executing in a host operating environment of a user device, wherein the remote server requires a credential of a user to complete a transaction;

receiving the credential in a secure input mode where input from an input device of the user device is received exclusively into the embedded operating environment and is not visible to the host operating environment;

authenticating, in an embedded operating environment, a user based on a user input received in the embedded operating environment, the embedded operating environment local to the user device, being embedded on a hardware platform of the user device, and operating separately from the host operating environment, where operations executed on the embedded operating environment are not visible to the host operating environment; and

communicating the credential of the user to the remote server from the embedded operating environment via an out-of-band connection inaccessible to the host operating environment.

**2**. The method of claim **1**, wherein the credential is accessible only in the embedded operating environment.

3. The method of claim 1, wherein the software application comprises a plugin to communicate with the embedded operating environment.

4. The method of claim 1 comprising:

connecting to a database server using the software application executing in the host operating environment; and

in the embedded operating environment, receiving from the database server a command request string for completing the transaction.

5. The method of claim 1, wherein the transaction is a login transaction.

6. The method of claim 1, comprising accepting the credential in the embedded operating environment in a secure input mode not visible to the host operating environment.

7. The method of claim 1, wherein the embedded operating environment comprises a manageability engine.

8. The method of claim 1, comprising encrypting the credential in the embedded operating environment before the credential is communicated to the remote server.

9. An apparatus comprising:

a computing platform to host a host operating environment, the host operating environment to execute a software application to connect to a remote server, the remote server requiring a credential of a user to complete a transaction, and to host an embedded operating environment embedded on the hardware platform, the embedded operating environment to authenticate a user based on a user input received in the embedded operating environment and to communicate the credential of the user to the remote server via an out-of-band connection inaccessible to the host operating environment,

wherein the embedded operating environment is to operate separately from the host operating environment, where operations executed on the embedded operating environment are not visible to the host operating environment; and

an input device to collect the user input for reception in the embedded operating environment including receive the credential in a secure input mode where input from the input device of the apparatus is received exclusively into the embedded operating environment and is visible to the host operating environment.

10. The apparatus of claim 9, wherein the credential is accessible only in the embedded operating environment.

11. The apparatus of claim 9, wherein the software application comprises a plugin to communicate with the embedded operating environment.

12. The apparatus of claim 9, wherein:

the software application is to connect to a database server; and

the embedded operating environment is to receive from the database server an https string for completing the transaction.

13. The apparatus of claim 9, wherein the transaction is a login transaction.

14. The apparatus of claim 9, wherein the embedded operating environment is a manageability engine.

15. A method comprising:

connecting to a remote application from a host operating environment of a user device, the remote application requiring a credential for completion of a transaction;

confirming that the remote application supports completing the transaction from a secure embedded operating environment, the secure embedded operating environment local to the user device, being embedded on a hardware platform of the user device, and operating separately from the host operating environment, where operations executed on the embedded operating environment are not visible to the host operating environment;

receiving in the secure embedded operating environment via an out-of-band connection a string for completing the transaction, the out-of-band connection being inaccessible to the host operating environment;

in the secure embedded operating environment, determining a user is authorized to complete the transaction based on a user input to the secure embedded operating environment, including obtaining the credential in a secure input mode where input from an input device of the user device is received exclusively into the embedded operating environment; and

if the user is authorized to complete the transaction, communicating the credential to the remote application via the out-of-band connection.

16. The method of claim 15, wherein confirming comprises:

connecting to a database of supported applications; and

confirming an entry referencing the remote application is in the database.

17. The method of claim 15, comprising:

receiving in the secure embedded operating environment from the remote application session information after completing the transaction; and

passing the session information to the host operating environment.

18. A processor-readable storage medium having stored thereon, instructions that, if executed by a processor, cause the processor to perform a method comprising:

connecting to a remote server using a software application executing in a host operating environment of a user device, wherein the remote server requires a credential of a user to complete a transaction;

receiving the credential in a secure input mode where input from an input device of the user device is received exclusively into the embedded operating environment and is not visible to the host operating environment;

authenticating, in an embedded operating environment, a user based on a user input received in the embedded operating environment, the embedded operating environment local to the user device, being embedded on a hardware platform of the user device, and operating separately from the host operating environment, where operations executed on the embedded operating environment are not visible to the host operating environment; and

communicating the credential of the user to the remote server from the embedded operating environment via an out-of-band connection inaccessible to the host operating environment.

19. The processor-readable storage medium of claim 18, further comprising instructions that if executed by a processor, cause the processor to perform the method wherein the credential is accessible only in the embedded operating environment.

20. The processor-readable storage medium of claim 18, further comprising instructions that if executed by a processor, cause the processor to perform the method wherein the software application comprises a plugin to communicate with the embedded operating environment.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

# CERTIFICATE OF CORRECTION



PATENT NO. : 8,234,697 B2
APPLICATION NO. : 12/058844
DATED : July 31, 2012
INVENTOR(S) : Chhabra

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

In the Claims

In Claim 9, column 13, at line 41 delete, "is visible" and insert -- is not visible --.

Signed and Sealed this
Fifteenth Day of April, 2014

Michelle K. Lee

Michelle K. Lee
*Deputy Director of the United States Patent and Trademark Office*