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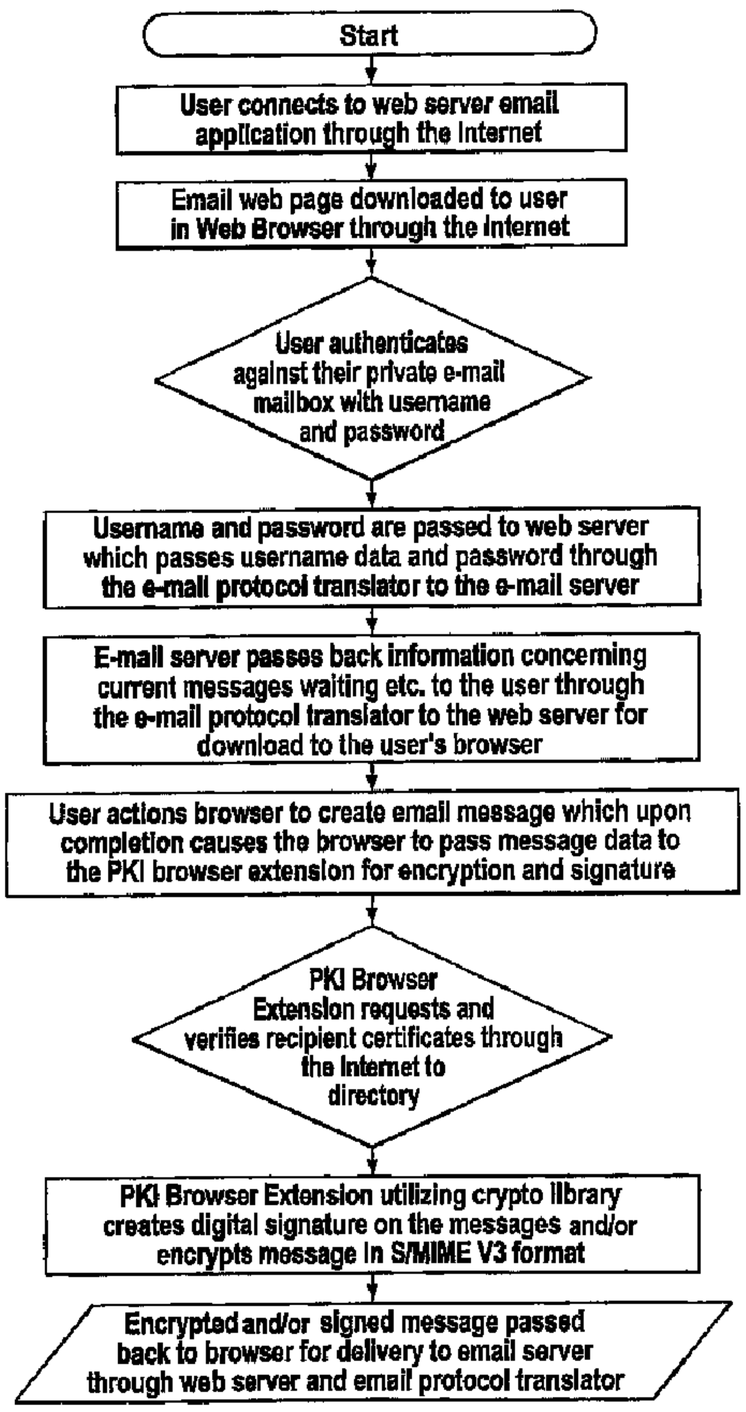
(54) Title: SYSTEM, METHOD AND COMPUTER PRODUCT FOR DELIVERY AND RECEIPT OF S/MIME-ENCRYPTED DATA



(57) Abrégé/Abstract:
A system for encrypting and decrypting S/MIME messages using a browser in either a web or wireless device for transmission to or from a web server on the Internet connected to an email server. The S/MIME encryption and decryption is conducted using a

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(57) Abrégé(suite)/Abstract(continued):
standard web browser on a personal computer or a mini browser on a wireless device such that email transmitted to the web or wireless browser from the web server can be completed and encrypted and signed by the user of the browser with such encrypted and signed data can be sent back to the web server. A method for delivering and using private keys in a browser and to ensure that such keys are destroyed after use is also provided. A method of transmitting encrypted S/MIME compliant messages to a web or wireless browser and decrypting and verifying such messages using the browser on the wireless device is also disclosed. A method for authenticating the sender/user of the browser, and a method for verifying and retrieving the certificates of the intended recipient of such messages in accordance with the public key infrastructure.

ABSTRACT

A system for encrypting and decrypting S/MIME messages using a browser in either a web or wireless device for transmission to or from a web server on the Internet connected to an email server. The S/MIME encryption and decryption is conducted using a standard web browser on a personal computer or a mini browser on a wireless device such that email transmitted to the web or wireless browser from the web server can be completed and encrypted and signed by the user of the browser with such encrypted and signed data can be sent back to the web server. A method for delivering and using private keys in a browser and to ensure that such keys are destroyed after use is also provided. A method of transmitting encrypted S/MIME compliant messages to a web or wireless browser and decrypting and verifying such messages using the browser on the wireless device is also disclosed. A method for authenticating the sender/user of the browser, and a method for verifying and retrieving the certificates of the intended recipient of such messages in accordance with the public key infrastructure.

System, Method and Computer Product for Delivery and Receipt of S/MIME Encrypted Data

Field of the Invention

The invention relates generally to secure delivery and receipt of data in a public key infrastructure (PKI). This invention relates more particularly to secure delivery and receipt of S/MIME encrypted data (such as electronic mail) using web and WAP browsers connected to the Internet.

Background of the Invention

In the past 10 years, email (electronic mail) has taken on unparalleled use, as email has become an invaluable tool that enables parties to communicate work products quickly, easily, and efficiently. While email is very convenient, the security of data communicated using email is becoming an increasing concern as corporate correspondence moves from paper to digital form and hackers become more proficient at penetrating email systems. As 60% of a company's intellectual property can be found in digital form somewhere in its email message system, the need for secure email messaging is a valid concern, particularly in the case of sensitive business information.

In order to address this need for email security, S/MIME (Secure Multipurpose Internet Mail Extension) protocol was established by RSA Data Security and other software vendors in 1995. The goal of S/MIME was to provide message integrity, authentication, non-repudiation and privacy of email messages through the use of PKI (Public Key Infrastructure) encryption and digital signature technologies. Email applications that support S/MIME are assured that third parties, such as network administrators and ISPs, cannot intercept, read or alter their messages. S/MIME functions primarily by building security on top of the common MIME protocol, which defines the manner in which an electronic message is organized, as well as the manner in which the electronic message is supported by most email applications.

Currently, the most popular version of S/MIME is V3 (version three), which was introduced in July, 1999. Further information on S/MIME standardization and related documents can be found on the Internet Mail Consortium web site (www.imc.org) and the IETF S/MIME working group (www.ietf.org/html.charters/smime-charter.html).

The S/MIME V3 Standard consists generally of the following protocols:

- Cryptographic Message Syntax (RFC 2630)
- S/MIME Version 3 Message Specification (RFC 2633)
- S/MIME Version 3 Certificate Handling (RFC 2632)
- Diffie-Hellman Key Agreement Method (RFC 2631)

Enhanced Security Services (RFC 2634) is another protocol for S/MIME, and is a set of extensions which allows signed receipts, security labels, and secure mailing lists. The extensions for signed receipts and security labels will work with either S/MIME V2 or S/MIME V3, whereas the extension for secure mailing lists will only work with S/MIME V3. S/MIME messages are exchanged between users by requiring that the email software prepare an S/MIME file in accordance with the S/MIME specifications. The S/MIME file is sent as an attachment to an email message. Once this message reaches the recipient, it can only be processed if the recipient possesses a comparable version of an S/MIME email reader.

There are a number of challenges in exchanging email messages with the current S/MIME standards, including the following. If the recipient does not have S/MIME software capabilities, then the S/MIME message cannot be accessed and will be stored unopened, on the recipient's computer. An S/MIME encrypted message can similarly not be read if either the sender or the recipient was not enrolled with a Certificate Authority. The same result would occur if there were incompatibility between the S/MIME versions used by the sender and the recipient. This is a particularly important problem in that the S/MIME standards contemplate a general scale update of the then current

S/MIME version to a modified S/MIME version in the event of a detected security breach. S/MIME email exchange would also be hindered if there was incompatibility between the email software used by each of the sender or recipient. S/MIME encrypted email exchange would also be effectively be prevented if the S/MIME compatible email software was corrupt or if the sender's or recipient's keys have expired.

In order to remedy many of these problems, recipients usually upgrade or obtain their S/MIME email reader to take advantage of the most recent standardized version of the S/MIME protocol. The difficulty with this solution is the fact that it requires the user to download large additional software packages that require constant updating in addition to taking up system resources.

Deployment of S/MIME encryption for secure email messaging using browsers is one possible solution to the aforesaid problems. A number of prior art solutions employing web or WAP browser technology are known.

For example, Application No. WO00/42748, published on July 20, 2000, inventors Dmitry Dolinsky and Jean-Christophe Bandini, assigned to Tumbleweed Communications Corp. (the "Tumbleweed" reference), discloses a prior solution for secure web based email which eliminates the need for the user and the recipient to download S/MIME software packages through the use of an intermediary host server, separate from the email software applications. In this solution, the intermediary host server intercepts emails sent by the sender and then passes a message on to the recipient's email account informing them that a secure email is waiting for them. This message also contains the link to the decrypted message located on the intermediary host server. The decrypted message is presented to the recipient in an SSL session.

This prior art solution has a number of disadvantages. The use of an intermediary host server complicates the secure transactions overall and

increases the infrastructure costs of providing secure email messaging. Another disadvantage of the Tumbleweed reference is that because the sender's computer does not have cryptographic capability, the solution overall bears the risks associated with a relatively porous network environment. Also, the nature of the solution proposed in the Tumbleweed reference overall does not readily provide for deployment over wired and wireless networks.

Another prior art solution, namely W/O 01/97089 A (Cook David P: Zixit Corp (US)) 20 December 2001 (2001-12-20) and Stallings W: "S/MIME: E-mail Gets Secure" Byte, McGraw-Hill Inc. St. Peterborough, US, vol. 23, no.7, 1 July 1998 (1998-07-01), pages 41-42, XP000774260 ISSN: 0360-5280 discloses a solution for sending/receiving S/MIME communications wherein the communications are encrypted/decrypted by a forwarding system consisting of a server based solution that enables the creation and decyphering of S/MIME communications. A browser linked to a network-connected device establishes a secure session with the forwarding system for the purpose of downloading decrypted S/MIME communications, and also creating S/MIME communications, by operation of the forwarding system. This prior art solutions has a number of disadvantages.

The ZIXIT approach integrates with a standard email client software such as Outlook. The user has all the assurances for the security of their email but they do not have any computer anywhere capability. They must always use the computer which has the ZIXIT thick email client and so they are not mobile. The aspect of ZIXIT which uses a browser is to deliver messages securely to recipients who are not using the ZIXIT software. In this scenario when the email author sends the email to a non ZIXIT user the message is stored to a message server and a pick up notice is sent to the recipient with a URL link to the message. The recipient clicks on the link and the message is downloaded to the browser using SSL.

In this way ZIXIT does not provide an S/MIME solution that leverages the pervasive nature of browser technology by enabling users to send and receive S/MIME compliant messages via a browser without the need of a message server linked to PKI infrastructure. Encryption at the client without the need for a thick client enables better utilization of resources at the client while providing pervasive security.

What is needed therefore is a web-based system, computer product and method for communicating data (including emails) on a secure basis using S/MIME that is easy to deploy using web and WAP browsers. What is further needed is an aforesaid system, computer product and method that is easily deployed, and at a relatively low cost, in that the cryptographic resources required for S/MIME encrypted messaging is provided at the network-connected devices themselves. What is also needed is a web-based system, computer product and method whereby the S/MIME encryption persists throughout the communication of data.

Summary of the Invention

The system, computer product and method of the present invention enables users to access their email account on an email server and to create or read S/MIME messages through any browser without the need to install client based email software. From a software distribution and user support perspective this eliminates the need to support client based email thus reducing the cost of user and software support as well as addressing the need to support user mobility.

In another aspect of the present invention also permits users to remotely access private keys and digital certificate over the Internet from any network-connected device. This eliminates the need for location specific private key and digital certificate storage.

Brief Description of the Drawings

A detailed description of the preferred embodiment(s) is(are) provided herein below by way of example only and with reference to the following drawings, in which:

Figure **1** is a schematic System Architectural Component Diagram of the S/MIME browser based email system.

Figure **1a** is a program resource chart illustrating the resources of the application of the present invention.

Figure **2** is a flow chart which depicts the steps in receiving, verifying, and decrypting an S/MIME message from an email server for display in a browser.

Figure **3** is a flow chart which depicts the steps for creating, signing and encrypting an S/MIME message in a browser for transmission to a web server to an email server.

Figure **4** is a schematic illustration of the detailed steps involved with creating, signing, and encrypting an unencrypted message.

Figure **5** is a schematic illustration of the detailed steps involved with retrieving and decrypting an encrypted message.

In the drawings, preferred embodiments of the invention are illustrated by way of example. It is to be expressly understood that the description and drawings are only for the purpose of illustration and as an aid to understanding, and are not intended as a definition of the limits of the invention.

Detailed Description of the Preferred Embodiment

As illustrated in Fig. **1**, at least one known network-connected device **10** is provided. Network-connected devices **10** may include a number of digital devices that provide connectivity to a network of computers. For example, network-connected device **10** may include a known personal computer or a known WAP device, cell phone, PDA or the like.

The network-connected device **10** is connected to the Internet **12** in a manner that is known. Specifically in relation to Fig. **1**, the connection of a network-connected device **10** that is a known WAP device to the Internet is illustrated, whereby a known WAP to WEB gateway **107** is provided, in a manner that is also known.

Each of the network-connected devices **10** also includes a browser **20**. The browser can be a standard Internet based browser, such as Netscape's Navigator™ or Microsoft's Internet Explorer™ or a known mini browser for wireless products such as cell phones or PDAs.

Each of the network-connected devices **10** also includes the application **22** of the present invention. The particulars of this application, and the manner in which it permits PKI enabled communications over wired and wireless networks is disclosed in published U.S. Patent Application No. US2003/0046362 (the "Co-Pending Application").

In one particular embodiment of application **22**, a browser extension or plug-in is provided in a manner that is known. Specifically, the application **22** and the browser **20** inter-operate by means of, for example, customized HTML tags. As opposed to using an intermediate host server, or a relatively large computer program, application **22** preferably provides necessary resources, as particularized below, to function with any third party PKI system, including for example, ENTRUST™, MICROSOFT™, BALTIMORE™, RSA™ and so forth.

It should also be understood that the functions of the application **22** described herein can also be provided as an "ACTIVE X OBJECT" in a manner that is known, or integrated within a browser.

It should also be understood, however, that the resources of the application **22** could also be provided by integration of the features of the application **22** in a browser or mini-browser, as opposed to a standalone application.

Referring now to Figure 1A, application **22** includes a cryptographic utility **24**, provided in a manner that is known, that is adapted to perform at network-connected device **10** a series of cryptographic operations, including but not limited to:

- Digital signature of data in form fields;
- Encryption of data in form fields;
- Decryption of data in form fields;
- Verification of signature of data in form fields;
- Digital signature and encryption of data in form fields;
- Verification of Digital signature and decryption of data in form fields;
- Digital signature of full pages;
- Verification of digital signature of full pages;
- Encryption of full pages; and
- File attachment encryption and signing.

Specifically, application **22** includes a Crypto Library **300**, provided in a manner that is known. In one particular embodiment of the present invention, the application **22** also includes a User Certificate and Private Key Store **302** which contains the cryptographic data required to encrypt and/or digitally sign data included in data communications (including email) contemplated by the

present invention. For example, in one particular implementation of the present invention, namely one whereby Entrust™ acts as the Certificate Authority, the .EPF file required to authenticate both the sender and the recipient is downloaded to the network-connected device **10**. The .EPF file is an encrypted file which is used to access the user credentials and private key required to process cryptographic operations.

Application **22** of the present invention also includes a PKI browser extension, and specifically an S/MIME browser extension **309**. The S/MIME browser extension permits the encryption and decryption of data communications (including email) in browser **20**, as particularized herein. This has the advantage of broad-based deployment as browser technology is commonplace. This also has the advantage of deployment across wireless and wired networks as the application **22** of the present invention, including the S/MIME browser extension, can be associated with a web browser or a WAP browser, as shown in Fig. **1**. In addition, the invention disclosed herein, requires only a browser and the associated application **22** at each network-connected device **10** and thus S/MIME encrypted communications are possible without the resources usually required to run a full S/MIME encryption program/email reader on the network-connected device **10**.

The S/MIME browser extension **309** is provided in a manner known by a skilled programmer. However, it is desirable for the S/MIME browser extension **309** of the present invention to have a number of attributes. First, as a result of the method of the present invention detailed below, it is desirable that the S/MIME browser extension **309** be able to add an attachment to an email message, and also sign and encrypt both the email message and the attachment such that the email message overall is an S/MIME message. Second, the encryption and decryption of data in accordance with the S/MIME standard described herein involves a potential security risk if the S/MIME browser extension **309** is not designed properly. Specifically, it is necessary to ensure that browser memory is utilized in the course of the cryptographic operations such that security is not compromised. In one particular embodiment of the present invention, this is achieved by using the "TEMP" memory space of the browser **20**, in a manner known by a skilled

programmer. Third, the S/MIME browser extension **309** further includes a CLEANUP ROUTINE in a manner that is known that eliminates any remnants from the memory associated with the browser, or otherwise with the network-connected device **10**, of either the message, or the user credential or private key that is part of the User Certificate and Private Key Store **302**, in order to maintain confidentiality.

The present invention also contemplates that the S/MIME browser extension **309** provides means to "cross-certify" digital certificate issued by an entity that is not related to the vendor of the application disclosed in the present invention. Cross-certification is enabled in a manner that is known.

In addition, the present invention contemplates that the S/MIME browser extension **309** facilitates the acceptance of digital certificates issued by an entity not related to the vendor of the application of the present invention, and also that is not "cross-certified", in a manner that is known. More particularly, the S/MIME browser extension **309** is adapted to permit the user of the application **22** of the present invention to store the digital certificates and public keys of users who are not related to the vendor of the application **22**.

Referring again to Figure 1, also connected to the Internet **12**, is a web server **106** which is provided using known hardware and software utilities so as to enable provisioning of hosting web pages to the network-connected device **10**, in a manner that is known. The Web server **106** includes a web application **16**. The web application **16** is adapted to execute the operations, including PKI operations, referenced below.

Two of the aspects of the present invention include, a system, computer product and method for:

1. Creating and delivering an S/MIME compliant email message to an email server; and

2. Retrieving and deciphering an S/MIME compliant email message from an email server.

In order to achieve the foregoing, the system, computer product and method of the present invention relies on aspects of the Co-Pending Application for engaging in PKI enabled transactions. Specifically, the email messages are created and delivered in accordance with the present invention in a manner that is analogous with the "POSTING DATA ON A SECURE BASIS" described in the Co-Pending Application. An email message are retrieved and deciphered in a manner that is analogous with the "RETRIEVING OF DATA ON A SECURE BASIS" also described in the Co-Pending Patent Application. Regarding the details of the manner in which cryptographic operations are processed by the application **22** of the present invention, reference is made to the Co-Pending Patent Application.

As illustrated in Fig. **1**, one aspect of the system of the present invention also includes a known email server **306**. The email server **306** sends and receives emails in a manner that is well known. The email server **306** is provided by known hardware and software utilities. Also as illustrated in Fig. **1**, one aspect of the system of the present invention includes an email protocol translator **308**. The email protocol translator **308** is a known utility which permits the web server **106** and the email server **306** to communicate by translating messages sent by the web server **106** to the particular email protocol understood by the email server **306** such as for example POP3 or IMAP4.

Creating and Delivering an S/MIME Compliant Email Message to an Email Server

Figures **3** and **4** illustrate the creation and delivery of an S/MIME compliant email message to an email server in accordance with the present invention.

A user associated with a network-connected device **10** who desires to create and send an email on a secure basis (the "Sender") requests a page on the web server **106** using the browser **20** loaded on the network-connected device **10**.

The web server **106**, and specifically in co-operation with the web application **16** loaded on the web server **106**, responds to the network-connected device **10** by presenting a web page that is a web form requesting that the user associated with the network-device **10** provide authentication in order to gain access to the web application **16**, and specifically a web email application (not shown) that is included in the web application **16**.

The Sender supplies information in the authentication form fields (such as username and password) on the web page and concludes with submitting the form, typically by pressing a 'SUBMIT' button or equivalent.

The authentication credentials are passed to the web server **106**. The web server **106** in turn delivers the authentication credentials to the email server **306** via the email protocol translator **308**.

Specifically in accordance with the aspect of the present invention whereby the roaming key server **310** is used to access the User Certificate and Private Key Store **302**, the web server **106** also transfers the user credentials to the roaming key server **310**.

The email server **306** authenticates the Sender and then passes back, through the email protocol translator **308**, message waiting lists and other pertinent information about the Sender's email account to the web server **106** for transmission display in the Sender's browser **20** and establishes an email session typically using a cookie, in a manner that is known.

Again, in accordance with the aspect of the present invention utilizing the roaming key server **310**, the roaming key server **310** authenticates the Sender and transmits the Sender's private key and certificate through the web server **106** to the S/MIME browser extension **309**. In accordance with the aspect of the present invention whereby the User Certificate and Private Key Store resides on the network-connected device **10**, the private key and certificate is accessed by the S/MIME browser extension **309**.

The Sender prepares an email message by completing the appropriate fields of the web form referred to, including for example the message subject, body and intended recipients fields. In one particular embodiment of the present invention, the application **22** also provides the recipient's passwords.

The Certificate Authority **312** is contacted whereby the recipient's public keys and certificates are verified and retrieved from the associated directory **314**.

The message form data is passed to the application **22**, including the S/MIME browser extension **309**, for signing and encrypting the message and any attachments using the private key of the Sender and the public key of the recipient(s), so as to form an S/MIME compliant email message.

The message is returned to the browser **20** and sent from the browser **20** to the web server **106**, and using the email protocol translator **308** to the email server **306** for forwarding to the identified recipient(s).

Retrieving and Deciphering an S/MIME compliant email message from an email server

Figures **2** and **5** illustrate the receipt, verification, decryption and display of an S/MIME compliant message from an email server in accordance with the present invention.

A user associated with a network-connected device **10** who desires to display a secure S/MIME compliant that they have received on a secure basis (the "Recipient") requests a page on the web server **106** using the browser **20** loaded on the network-connected device **10**.

The web server **106**, and specifically in co-operation with the web application **16** loaded on the web server **106**, responds to the network-connected device **10** by presenting a web page that is a web form requesting that the Recipient provide authentication in order to gain access to the web application **16**, and specifically a web email application (not shown) that is included in the web application **16**.

The Recipient supplies information in the authentication form fields (such as username and password) on the web page and concludes with submitting the form, typically by pressing a 'SUBMIT' button or equivalent.

The authentication credentials are passed to the web server **106**. The web server **106** in turn delivers the authentication credentials to the email server **306** via the email protocol translator **308**.

Specifically in accordance with the aspect of the present invention whereby the roaming key server **310** is used to access the User Certificate and Private Key Store **302**, the web server **106** also transfers the user credentials to the roaming key server **310**.

The email server **306** authenticates the Recipient and then passes back, through the email protocol translator **308**, message waiting lists and other pertinent information about the Recipient's email account to the web server **106** for transmission display in the Recipient's browser **20** and establishes an email session typically using a cookie, in a manner that is known.

Again, in accordance with the aspect of the present invention utilizing the roaming key server **310**, the roaming key server **310** authenticates the Recipient and transmits the Recipient's private key and certificate through the web server **106** to the S/MIME browser extension **309**. In accordance with the aspect of the present invention whereby the User Certificate and Private Key Store **302** resides on the network-connected device **10**, the private key and certificate is accessed by the S/MIME browser extension **309**.

The Recipient requests a message to read which request is sent to the web server **106** through the email protocol translator **308** to the email server **306** with the message request.

The email server **306** retrieves the message and transmits the message to the Recipient through the web server **106** using the email protocol translator **308** to the Recipient's browser **20**.

The application **22** authenticates against its User Certificate Private Key Store **302** and thereby the key is released to the S/MIME browser extension **309** where upon the message signature can be verified and the message decrypted for display in the Recipient's browser **20**. Alternatively, in accordance with the aspect of the present invention utilizing the roaming key server **310**, the authentication happens against data provided by the roaming key server **310** whereby the message signature can be verified and the message decrypted by the S/MIME browser extension **309**.

In another aspect of the present invention, the persistent field level encryption disclosed in the Co-Pending Application is used for the purposes of

the present invention to maintain the confidentiality of the identities of users (and for example their clients with whom they communicate on a secure basis in accordance with the present invention) and other personal information, by encrypting related data and storing the data in an encrypted form at a database (not shown) associated with the web server **106**.

The system of the present invention is best understood as the overall system including the network connected device **10** and the resources thereof, including the application **22**, and also the web server **106** and the email server **306**, as well as the resources of these as well. The computer product of the present invention is the application **22** on the one hand, but also the web application **16**, on the other. Another aspect of the present invention includes the roaming key server **310**.

The method of the present invention is best understood as a process for exchanging PKI S/MIME messages through a browser, whether a web browser or WAP browser. The method of the present invention should also be understood as a method for integrating wireless devices with Internet secure messaging using S/MIME. Another aspect of the method of the present invention is a method for delivering private keys and certificates through the Internet or a wireless network. Yet another aspect of the method of the present invention, is a method for eliminating the "man in the middle" security hole of proxy based gateways between the Internet and wireless networks by providing persistent secure data communication using S/MIME. A still other aspect of the present invention is a method for allocating data resources as between the web server and a wireless device such that PKI is provided on the wireless device so as to provide S/MIME encryption on a persistent basis.

The present invention also provides for persistent field level encryption using S/MIME on a selective basis throughout an Internet-based data process. This promotes efficient utilization of resources by invoking PKI operations in relation to specific elements of an Internet-based data process where security/authentication is most needed.

The present invention also provides a set of tools whereby PKI S/MIME capability is added to a browser in an efficient manner.

The present invention should also be understood as a set of tools for complying with legal digital signature requirements, including in association with a wireless device using a web mail system incorporating S/MIME.

A still other aspect of the present invention is a method for permitting secure email messaging between wireless and Internet based or other networks using S/MIME.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A network-connected device for sending and receiving S/MIME compliant communications electronically to other devices over a communication network, comprising:

a processor configured to execute a plurality of programming instructions including:

a browser;

a cryptographic utility operably linked to the browser configured to enable PKI transactions to be conducted in the browser; and

an S/MIME browser extension operably linked to the browser and the cryptographic utility, the S/MIME browser extension configured to send and receive S/MIME compliant communications to and from other remote network-connected devices in cooperation with the browser and the cryptographic utility.

2. The network-connected device of claim 1 further comprising:

a key storage means operably linked to the browser and the cryptographic utility, the key storage means for storing a plurality of keys, each key being useable by an associated user in a public key infrastructure to encrypt and decrypt data; wherein a user authentication means is provided by the cryptographic utility for determining whether a prospective user of a key in the plurality of keys is the associated user for the key; wherein the cryptographic utility encrypts and decrypts data in the browser using the plurality of keys when the user authentication means authenticates a user of the network-connected device.

3. A system for sending and receiving S/MIME compliant communications comprising:

a network;

a device connectable to the network and comprising a processor configured to execute a plurality of programming instructions including:

a browser;

a cryptographic utility operably linked to the browser configured to enable PKI transactions to be conducted in the browser; and

an S/MIME browser extension operably linked to the browser and the cryptographic utility, the S/MIME browser extension configured to send and receive S/MIME compliant communications over the network in cooperation with the browser and the cryptographic utility;

a web server connectable to said network and for hosting a web email application for the browser; and,

an email server connectable to the web server for hosting an email account via the web server and the browser on behalf of a user associated with the device; the cryptographic utility and S/MIME browser extension configured to decrypt messages received from the e-mail server in the browser.

4. The system of claim 3 where the programming instructions of the device further include a key storage means operably linked to the browser and the cryptographic utility; the key storage means for storing a plurality of keys; each key being useable by an associated user in a public key infrastructure to encrypt and decrypt data; wherein a user authentication means is provided by the cryptographic utility for determining whether a prospective user of a key in the plurality of keys is the associated user for the key; wherein the cryptographic utility encrypts and decrypts data in the browser using the plurality of keys when the user authentication means authenticates a user of the network-connected device.

5. The system of claim 4, wherein the user authentication means enables the S/MIME browser extension to communicate with a Certificate Authority to authenticate the prospective user, wherein the user authentication means is operable to signal to the S/MIME browser extension that the user has been authenticated thereby rendering the S/MIME browser extension operable to send and receive for the user S/MIME compliant messages by operation of the browser.

6. The system of claim 3 where the cryptographic utility and S/MIME browser extension are configured to sign and/or encrypt messages created in the browser prior to sending the

messages to the e-mail server.

7. The system of claim 3, including a roaming key server that authenticates a sender of an S/MIME compliant communication within said email account; and the roaming key server additionally transmits a private key and certificate for the sender to the network-connected device, and wherein a user authentication means is operable to release the private key and certificate to the browser.

8. A computer product for a network-connected device; the device for sending and receiving S/MIME compliant communications electronically to other devices over a communication network; the device including a processor and a browser executable on the processor; the product storing a plurality of programming instructions executable on the processor; the programming instructions comprising:

an S/MIME browser extension operably linked to the browser and a cryptographic utility; the cryptographic utility configured to enable PKI transactions to be conducted in the browser; and cryptographic utility, the S/MIME browser extension configured to send and receive S/MIME compliant communications to and from other remote network-connected devices in cooperation with the browser and the cryptographic utility.

9. The computer product as claimed in claim 8, the computer product further comprising a key storage means operably linked to the browser and the cryptographic utility, the key storage means for storing a plurality of keys, each key being useable by an associated user in a public key infrastructure to encrypt and decrypt data; wherein a user authentication means is provided by the cryptographic utility for determining whether a prospective user of a key in the plurality of keys is the associated user for the key; wherein the cryptographic utility is linked to the key storage means such that the cryptographic utility encrypts and decrypts data in the

browser using the plurality of keys when the user authentication means authenticates a user of the network-connected device.

10. A method of sending S/MIME compliant communications electronically from a network-connected device associated with a sender and connected to a communication network

and at least one remote network-connected device comprising the steps of:

(a) providing, on the network-connected device, a browser, a cryptographic utility operably linked to the browser and an S/MIME browser extension operably linked to the browser;

(b) authenticating the sender with a remote server by means of a user authentication means provided by the cryptographic utility, whereby the user authentication means signals to the cryptographic utility that the sender has been authenticated, thereby rendering the cryptographic utility operable to send and receive S/MIME compliant messages by operation of one or more PKI transactions conducted in the browser;

(c) the sender requesting an S/MIME compliant communication with a recipient from the remote server;

(d) the remote server communicating a private key and certificate for the recipient to the S/MIME browser extension;

(e) the network-connected device contacting a Certificate Authority to verify a public key and certificate for the recipient, by operation of the S/MIME browser extension; and

(f) creating in the browser the S/MIME compliant communication by signing and encrypting a communication in the browser using a private key of the sender and the public key of the recipient, by means of the cryptographic utility and the S/MIME browser extension.

11. A method of retrieving and deciphering S/MIME compliant communications electronically from a network-connected device associated with a recipient and

connected to a communication network and at least one remote network-connected device, comprising the steps of:

(a) providing, on the network-connected device, a browser, a cryptographic utility operably linked to the browser and an S/MIME browser extension operably linked to

the browser;

(b) requesting retrieval of an S/MIME compliant communication from the network-connected device;

(c) authenticating the recipient associated with the network-connected device with a remote server;

(d) the remote server communicating a private key and certificate to the S/MIME browser extension;

(e) the remote server sending the requested S/MIME compliant communication to the network-connected device; and

(f) the cryptographic utility authenticating a recipient's private key and certificate against a stored copy of the recipient's private key and certificate stored in a key storage means or roaming key server accessible from the network-connected device whereby upon authentication thereof the recipient's private key and certificate are released to the S/MIME browser extension, thereby enabling the S/MIME compliant communication to be deciphered in the browser.

12. A method of receiving an S/MIME compliant communication electronically in a browser comprising the steps of:

from the browser, connecting to a web server hosting a web mail application on behalf of an email sever that hosts an email account associated with a user accessing the browser;

receiving a message waiting list associated with the email account; presenting the message waiting list in the browser;

receiving, in the browser, user action representing a selection identifying an S/MIME encrypted email from the waiting list;

accessing a key store to retrieve a private key associated with the user;

receiving the S/MIME, encrypted email from the email server via the web server; decrypting the S/MIME encrypted email using the private key; and,

presenting the S/MIME encrypted email in decrypted format in the browser.

13. The method of claim 12 where the key store is a user certificate and private key store local to a device executing the browser.

14. The method of claim 12 where the key store is a roaming key server remotely accessible to the browser.

15. A method of sending an S/MIME compliant communication created electronically in a browser comprising the steps of:

from the browser, connecting to a web server hosting a web mail application on behalf of an email sever that hosts an email account associated with a user accessing the browser;

creating an email in the browser;

accessing a key store to retrieve a public key associated with a recipient of the email;

encrypting the email using the public key to generate an S/MIME compliant email; and,

sending the S/MIME compliant email to the web server for delivery by the email server.

16. The method of claim 15 where the key store is a user certificate and private key store local to a device executing the browser.

17. The method of claim 15 where the key store is a roaming key server remotely accessible to the browser.

18. A computer-readable medium storing a plurality of programming instructions executable on a device; the programming instructions including method of receiving an S/MIME compliant communication electronically in a browser on the device, the method comprising the steps of:

from the browser, connecting to a web server hosting a web mail application on behalf of an email sever that hosts an email account associated with a user accessing the browser;

receiving a message waiting list associated with the email account; presenting the message

waiting list in the browser;

receiving, in the browser, user action representing a selection identifying an S/MIME encrypted email from the waiting list;

accessing a key store to retrieve a private key associated with the user;

receiving the S/MIME encrypted email from the email server via the web server;

decrypting the S/MIME encrypted email using the private key; and,

presenting the S/MIME encrypted email in decrypted format in the browser.

19. A computer-readable medium storing a plurality of programming instructions executable on a device; the programming instructions including a method of sending an S/MIME compliant communication created electronically in a browser comprising the steps of:

from the browser, connecting to a web server hosting a web mail application on behalf of an email sever that hosts an email account associated with a user accessing the browser;

creating an email in the browser;

accessing a key store to retrieve a public key associated with a recipient of the email;

encrypting the email using the public key to generate an S/MIME compliant email; and,

sending the S/MIME compliant email to the web server for delivery by the email server.

20. A roaming key server for authenticating a sender of an S/MIME compliant communication; the roaming key server connectable to a network-connected device that has received the S/MIME compliant communication; the network-connected device having a processor configured to execute a plurality of programming instructions including: a browser; a cryptographic utility operably linked to the browser configured to enable PKI transactions to be conducted in the browser; and an S/MIME browser extension operably linked to the browser and the cryptographic utility; the S/MIME browser extension configured to receive the S/MIME compliant communication in cooperation with the browser and the cryptographic utility; the roaming key server operable to transmit a sender's private key and certificate to the network-

connected device such that the S/MIME browser extension and the cryptographic utility can decrypt the S/MIME compliant communication for presentation thereof in the browser.

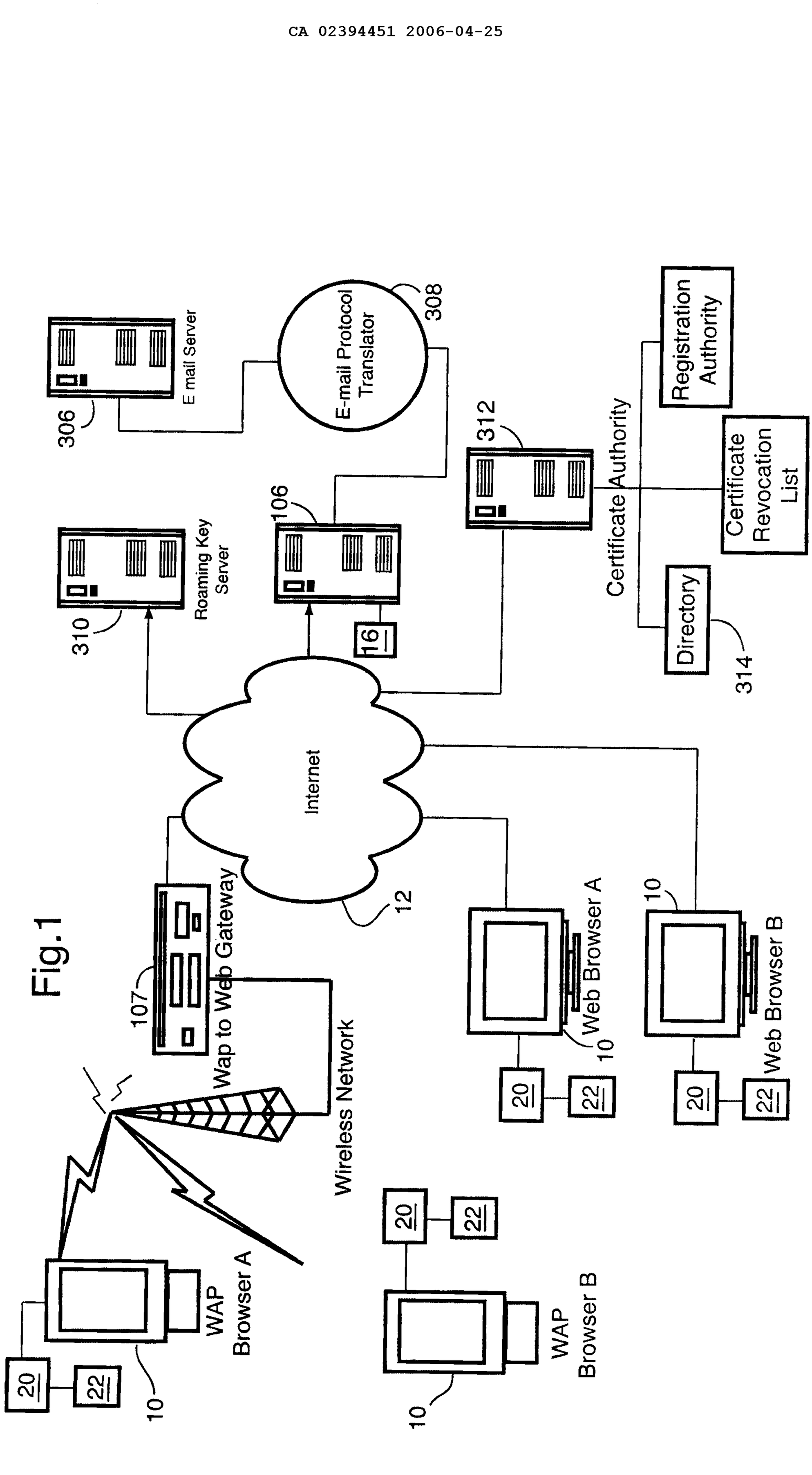


Fig.1
E mail Server
306
E-mail Protocol Translator
308
Registration Authority
312
Certificate Authority
Certificate Revocation List
Directory
314
Roaming Key Server
310
106
16
Internet
12
Wap to Web Gateway
107
Wireless Network
Web Browser A
10
Web Browser B
WAP Browser A
WAP Browser B
20
22

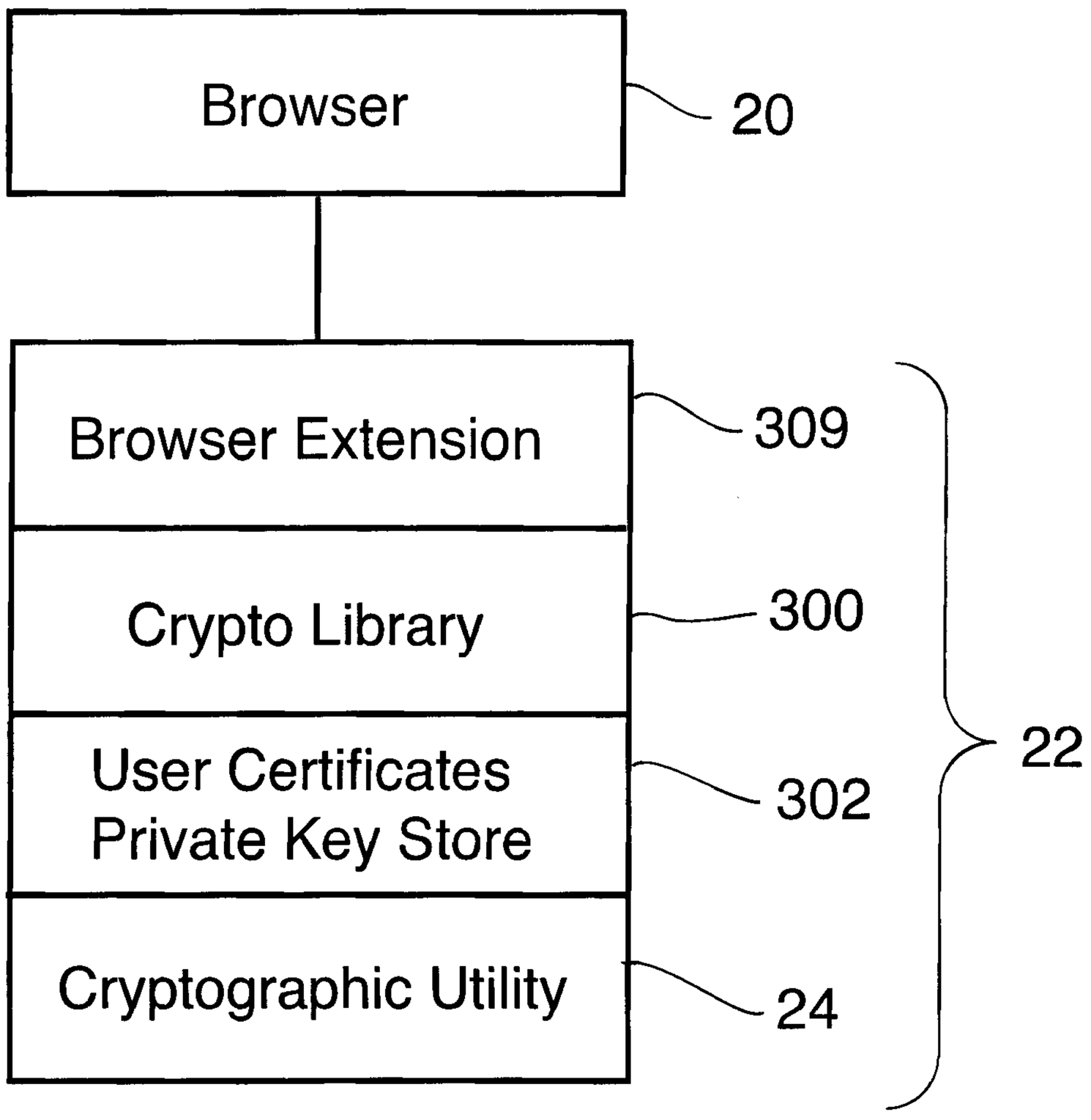

Browser
20
Browser Extension
309
Crypto Library
300
User Certificates
Private Key Store
302
Cryptographic Utility
24
22

FIG 1A

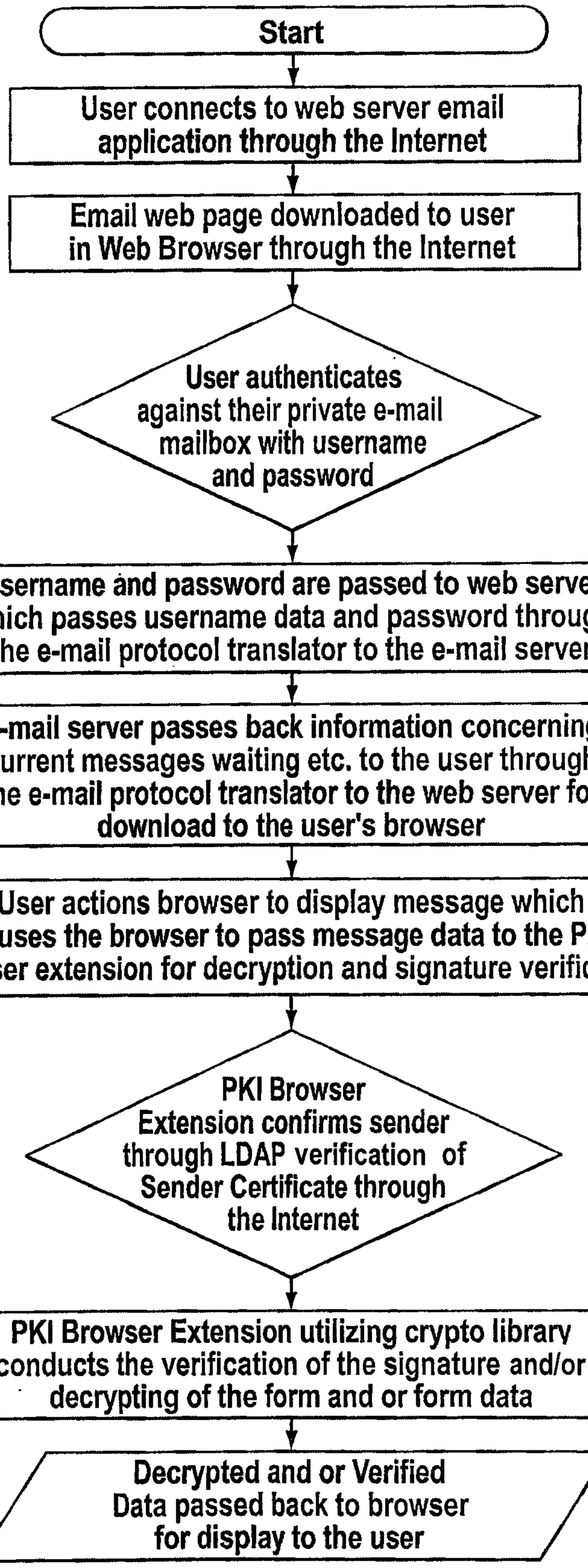

Start
User connects to web server email application through the Internet
Email web page downloaded to user in Web Browser through the Internet
User authenticates against their private e-mail mailbox with username and password
Username and password are passed to web server which passes username data and password through the e-mail protocol translator to the e-mail server
E-mail server passes back information concerning current messages waiting etc. to the user through the e-mail protocol translator to the web server for download to the user's browser
User actions browser to display message which causes the browser to pass message data to the PKI Browser extension for decryption and signature verification
PKI Browser Extension confirms sender through LDAP verification of Sender Certificate through the Internet
PKI Browser Extension utilizing crypto library conducts the verification of the signature and/or decrypting of the form and or form data
Decrypted and or Verified Data passed back to browser for display to the user

FIG. 2

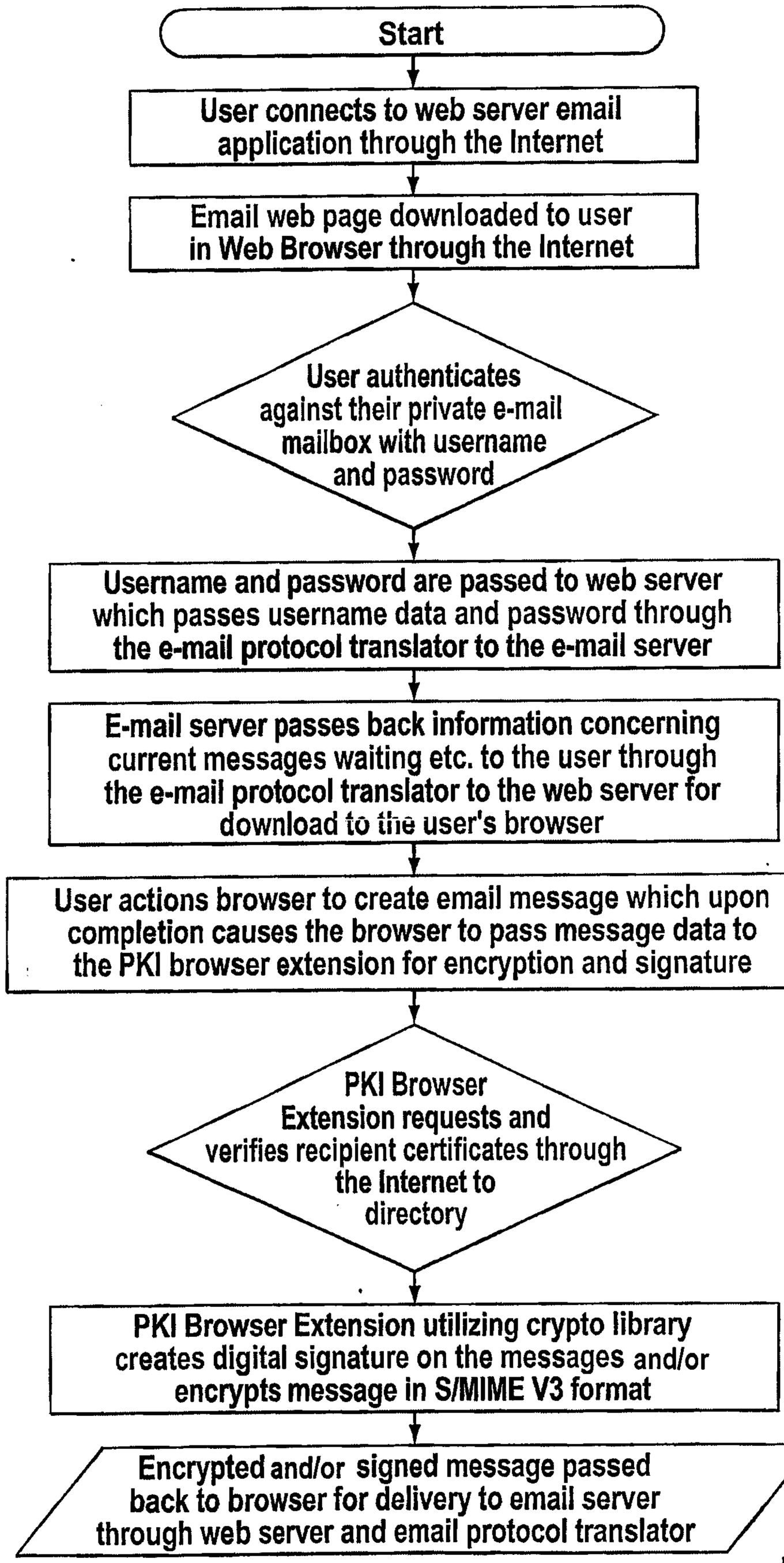

Start
User connects to web server email application through the Internet
Email web page downloaded to user in Web Browser through the Internet
User authenticates against their private e-mail mailbox with username and password
Username and password are passed to web server which passes username data and password through the e-mail protocol translator to the e-mail server
E-mail server passes back information concerning current messages waiting etc. to the user through the e-mail protocol translator to the web server for download to the user's browser
User actions browser to create email message which upon completion causes the browser to pass message data to the PKI browser extension for encryption and signature
PKI Browser Extension requests and verifies recipient certificates through the Internet to directory
PKI Browser Extension utilizing crypto library creates digital signature on the messages and/or encrypts message in S/MIME V3 format
Encrypted and/or signed message passed back to browser for delivery to email server through web server and email protocol translator

FIG. 3

Figure 4 Message creation signing and encryption

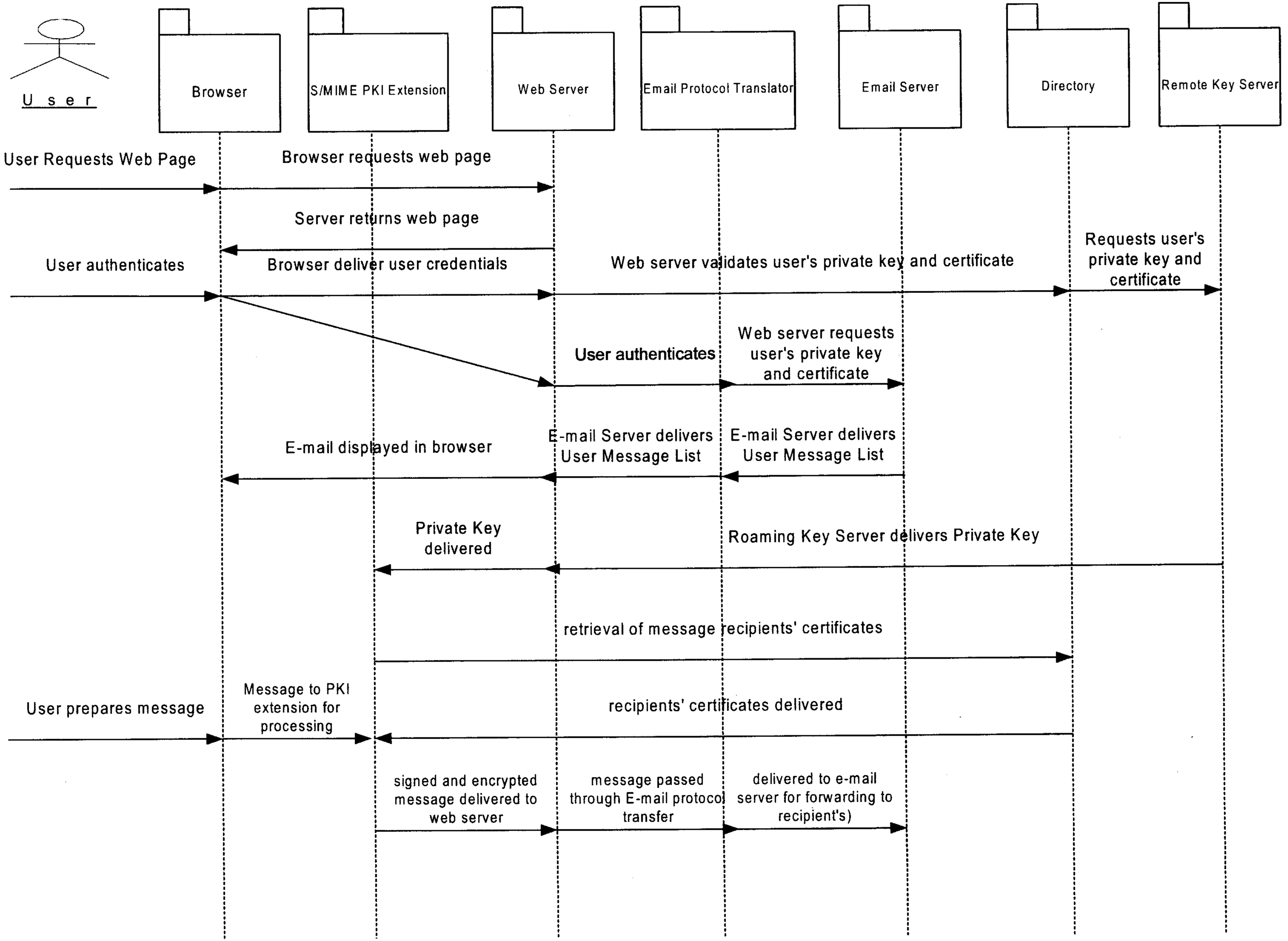
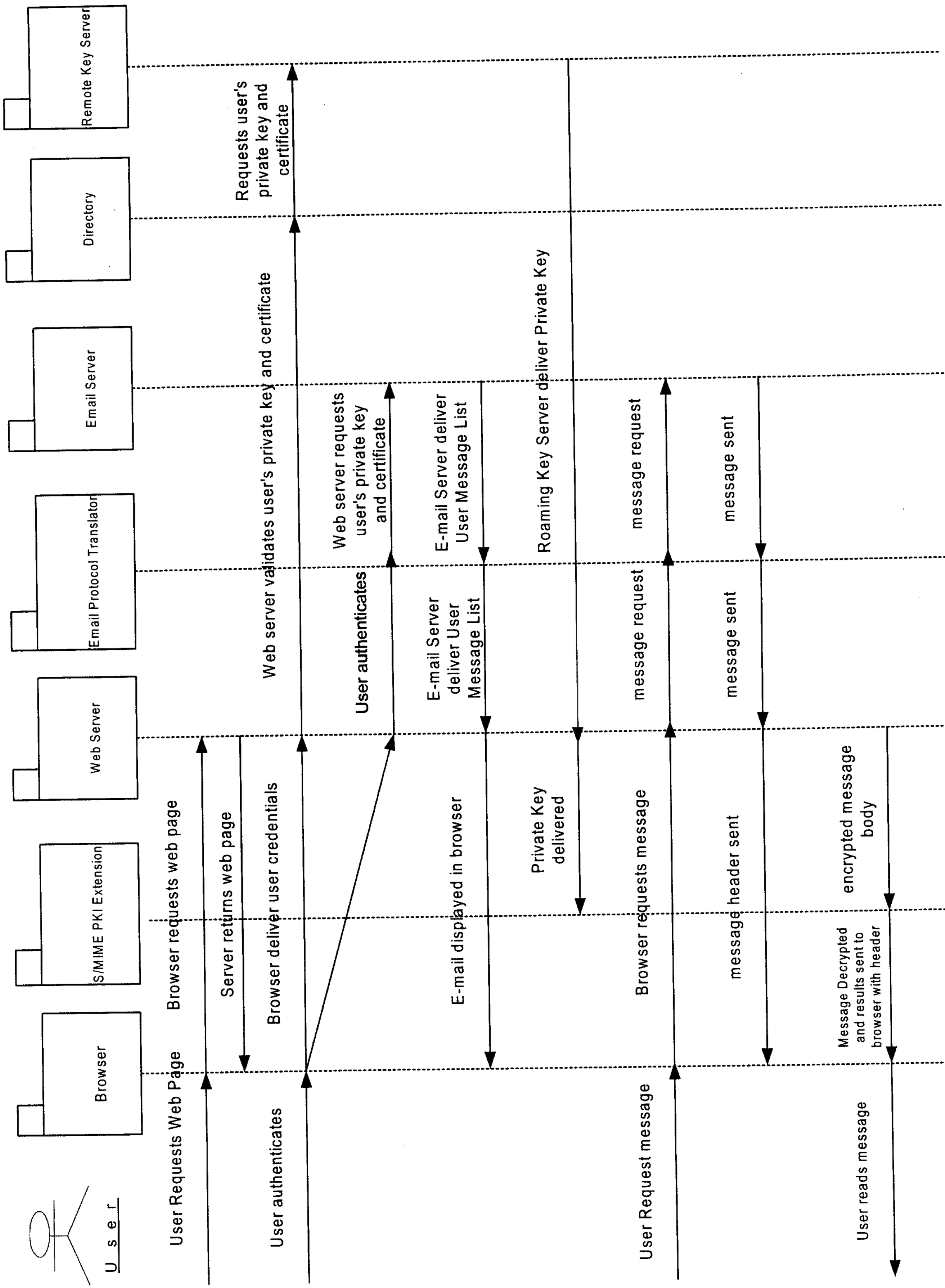
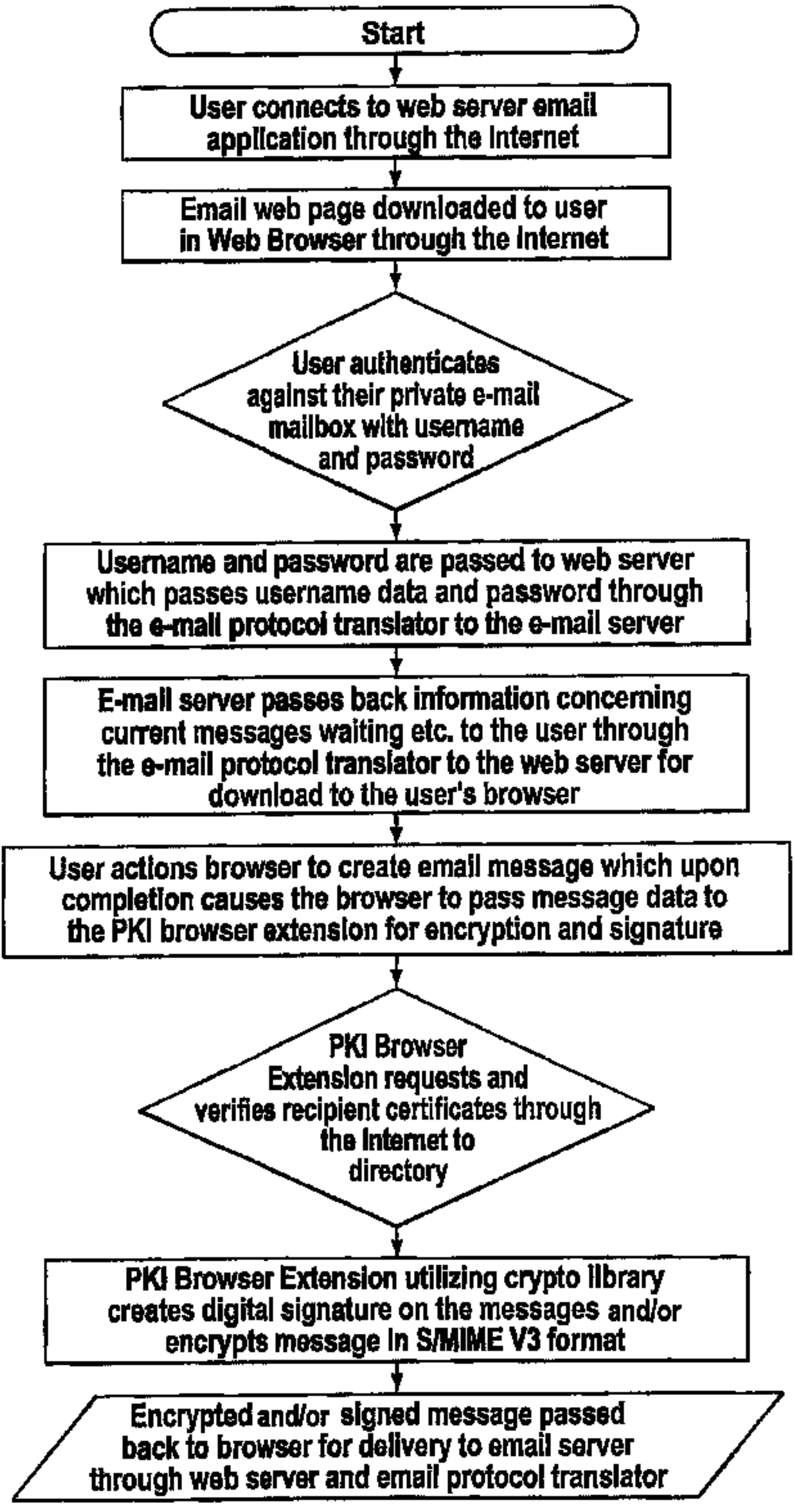


Figure 5 Encrypted message retrieval and decryption




Start
User connects to web server email application through the Internet
Email web page downloaded to user in Web Browser through the Internet
User authenticates against their private e-mail mailbox with username and password
Username and password are passed to web server which passes username data and password through the e-mail protocol translator to the e-mail server
E-mail server passes back information concerning current messages waiting etc. to the user through the e-mail protocol translator to the web server for download to the user's browser
User actions browser to create email message which upon completion causes the browser to pass message data to the PKI browser extension for encryption and signature
PKI Browser Extension requests and verifies recipient certificates through the Internet to directory
PKI Browser Extension utilizing crypto library creates digital signature on the messages and/or encrypts message in S/MIME V3 format
Encrypted and/or signed message passed back to browser for delivery to email server through web server and email protocol translator