US007729991B2

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

(10) **Patent No.: US 7,729,991 B2**
(45) **Date of Patent: Jun. 1, 2010**

(54) **METHOD AND SYSTEM FOR ELECTRONIC VOTER REGISTRATION AND ELECTRONIC VOTING OVER A NETWORK**

(75) Inventors: **Edward Rodriguez**, Columbia, MD (US); **Thomas K. Vander Vlis**, Pasedena, MD (US); **Peter J. Butziger**, Columbia, MD (US)

(73) Assignee: **Booz-Allen & Hamilton Inc.**, McLean, VA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 2880 days.

(21) Appl. No.: **09/811,823**

(22) Filed: **Mar. 20, 2001**

(65) **Prior Publication Data**

US 2002/0138341 A1 Sep. 26, 2002

(51) **Int. Cl.**

G06F 21/00	(2006.01)
G06F 11/00	(2006.01)
G07C 13/00	(2006.01)
G06Q 10/00	(2006.01)
G06Q 30/00	(2006.01)

(52) **U.S. Cl.** **705/50**; 705/12; 705/1

(58) **Field of Classification Search** 705/12, 705/1, 50

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,015,106	A	3/1977	De Philipo
4,641,240	A	2/1987	Boram
5,218,528	A	6/1993	Wise et al.
5,278,753	A	1/1994	Graft, III
5,495,532	A	2/1996	Kilian et al.
5,521,980	A	5/1996	Brands
5,583,329	A	12/1996	Davis, III et al.
5,613,001	A	3/1997	Bakhoum et al.
5,682,430	A	10/1997	Kilian et al.
5,748,735	A	5/1998	Ganesan
5,850,443	A	12/1998	Van Oorschot et al.
5,872,846	A	2/1999	Ichikawa
5,878,399	A	3/1999	Peralto
6,081,793	A	6/2000	Challener et al.

(Continued)

OTHER PUBLICATIONS

Election Verification, VoteHere.net (visited Dec. 21, 2000), pp. 1-2, <http://www.votehere.net/>.

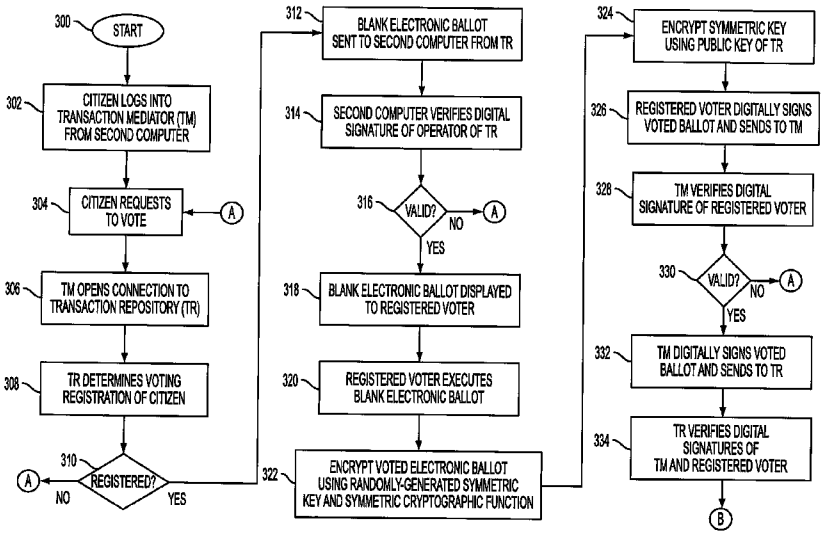
(Continued)

Primary Examiner—Andrew J. Fischer
Assistant Examiner—Nancy T Le
(74) *Attorney, Agent, or Firm*—Buchanan Ingersoll & Rooney PC

(57) **ABSTRACT**

A method and system are described for completing and submitting an electronic voter registration form and an electronic ballot over a network. In accordance with exemplary embodiments of the present invention, a blank registration form is transmitted, upon request at a first computer, via a transaction mediator, to the first computer. Registration information is transmitted from the first computer, via a transaction mediator, to a computer database that resides on a transaction repository server, all of which are networked together, to establish a registered voter. Upon request by a registered voter at a second computer, a blank electronic ballot is transmitted from the computer database that resides on the transaction repository server, via a transaction mediator, to the second computer. A voted electronic ballot is transmitted from the second computer, via the transaction mediator, to the computer database that resides on the transaction repository server.

47 Claims, 9 Drawing Sheets



U.S. PATENT DOCUMENTS

6,092,051	A	7/2000	Kilian et al.	
6,111,952	A	8/2000	Patarin	
6,128,391	A	10/2000	Denno et al.	
6,160,891	A	12/2000	Al-Salqan	
6,161,181	A	12/2000	Haynes, III et al.	
6,250,548	B1 *	6/2001	McClure et al.	235/51
6,311,190	B1 *	10/2001	Bayer et al.	707/104
2002/0077885	A1 *	6/2002	Karro et al.	705/12
2002/0077887	A1 *	6/2002	London Shrader et al.	705/12
2003/0154124	A1 *	8/2003	Neff	705/12
2003/0208395	A1 *	11/2003	McClure et al.	705/12

OTHER PUBLICATIONS

Frequently Asked Questions, VoteHere.net (visited Dec. 21, 2000), pp. 1-8, <http://www.votehere.net/>.

C. Andrew Neff, Recounting an Electronic Election—What Does it Mean?, Nov. 2000, VoteHere.net (visited Dec. 21, 2000), <http://www.votehere.net/>, 4 pages.

C. Andrew Neff, Conducting a Universally Verifiable Electronic Election Using Homomorphic Encryption, Nov. 2000, VoteHere.net (visited Dec. 21, 2000), <http://www.votehere.net/>, 4 pages.

James M. Adler, Wei Dai, Richard L. Green and C. Andrew Neff, Computational Details of the VoteHere Homomorphic Election System, VoteHere.net (visited Dec. 21, 2000), <http://www.votehere.net/>, pp. 1-18.

C. Andrew Neff, Example Homomorphic Election, Mar. 10, 2000, VoteHere.net (visited Dec. 21, 2000), <http://www.votehere.net/>, pp. 1-12.

Jim Adler, Internet Voting Primer, VoteHere.net (visited Dec. 21, 2000), <http://www.votehere.net/>, pp. 1-4.

Jim Adler, Internet Voting Security, Jan. 2000, VoteHere.net (visited Dec. 21, 2000), <http://www.votehere.net/>. pp. 1-4.

Presentation by Ed Gerck, Safevote Internet Decison Making, pp. 1-22, Safevote Inc., 2000.

Technical Information Release by Safevote, Safevote.com (visited Dec. 21, 2000), pp. 1-21, <http://www.safevote.com/>.

California Secretary of State Bill Jones California Internet Voting Task Force, A Report on the Feasibility of Internet Voting, Jan. 2000 (visited Dec. 22, 2000), pp. 1-30, <http://www.ss.ca.gov/executive/ivote/final_report.htm/>.

* cited by examiner

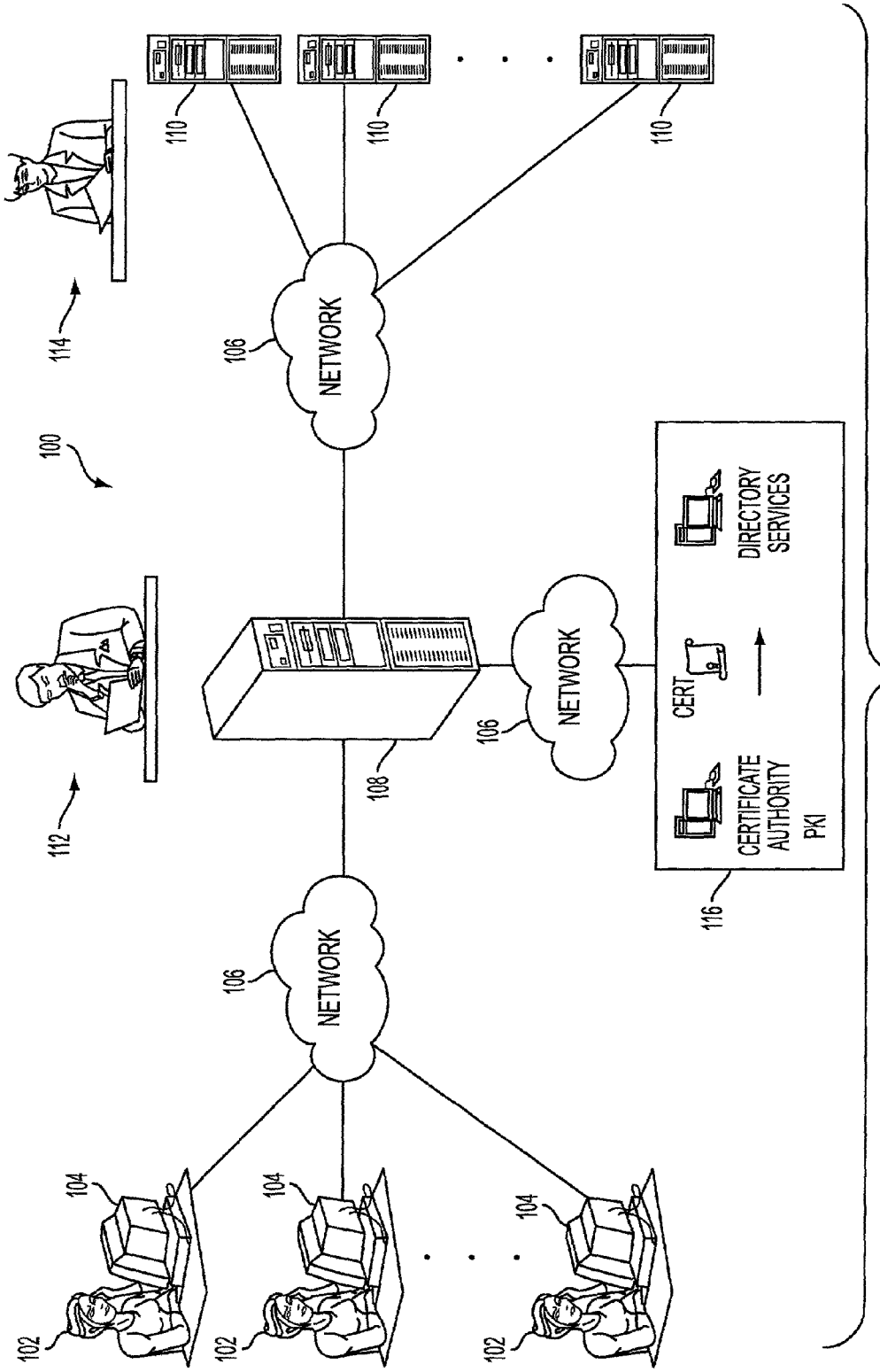

100
102
104
106
NETWORK
108
110
112
114
116
CERTIFICATE AUTHORITY PKI
CERT
DIRECTORY SERVICES

FIG. 1

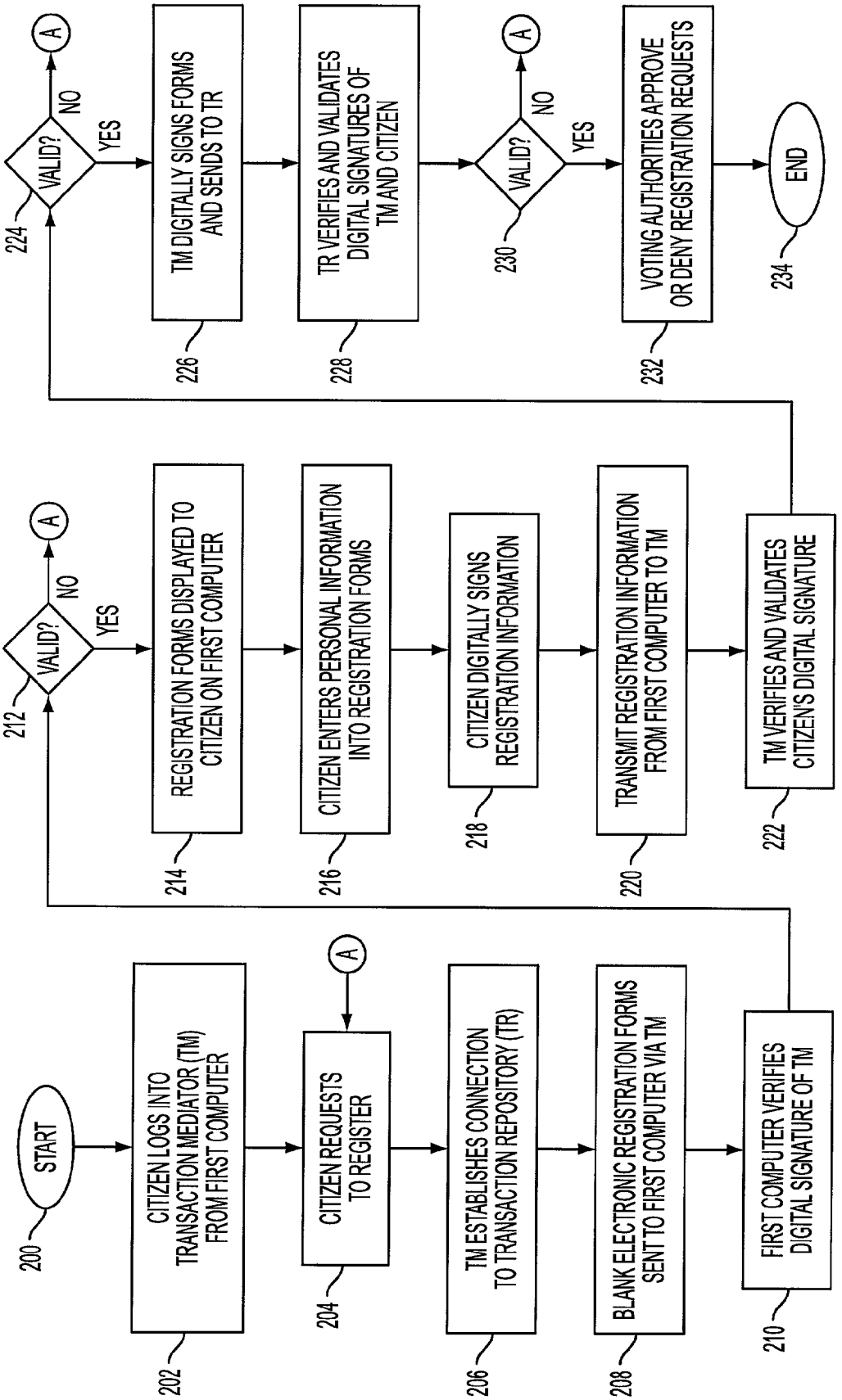

START
200
CITIZEN LOGS INTO TRANSACTION MEDIATOR (TM) FROM FIRST COMPUTER
202
CITIZEN REQUESTS TO REGISTER
204
A
TM ESTABLISHES CONNECTION TO TRANSACTION REPOSITORY (TR)
206
BLANK ELECTRONIC REGISTRATION FORMS SENT TO FIRST COMPUTER VIA TM
208
FIRST COMPUTER VERIFIES DIGITAL SIGNATURE OF TM
210
VALID?
212
YES
NO
A
REGISTRATION FORMS DISPLAYED TO CITIZEN ON FIRST COMPUTER
214
CITIZEN ENTERS PERSONAL INFORMATION INTO REGISTRATION FORMS
216
CITIZEN DIGITALLY SIGNS REGISTRATION INFORMATION
218
TRANSMIT REGISTRATION INFORMATION FROM FIRST COMPUTER TO TM
220
TM VERIFIES AND VALIDATES CITIZEN'S DIGITAL SIGNATURE
222
VALID?
224
YES
NO
A
TM DIGITALLY SIGNS FORMS AND SENDS TO TR
226
TR VERIFIES AND VALIDATES DIGITAL SIGNATURES OF TM AND CITIZEN
228
VALID?
230
YES
NO
A
VOTING AUTHORITIES APPROVE OR DENY REGISTRATION REQUESTS
232
END
234

FIG. 2

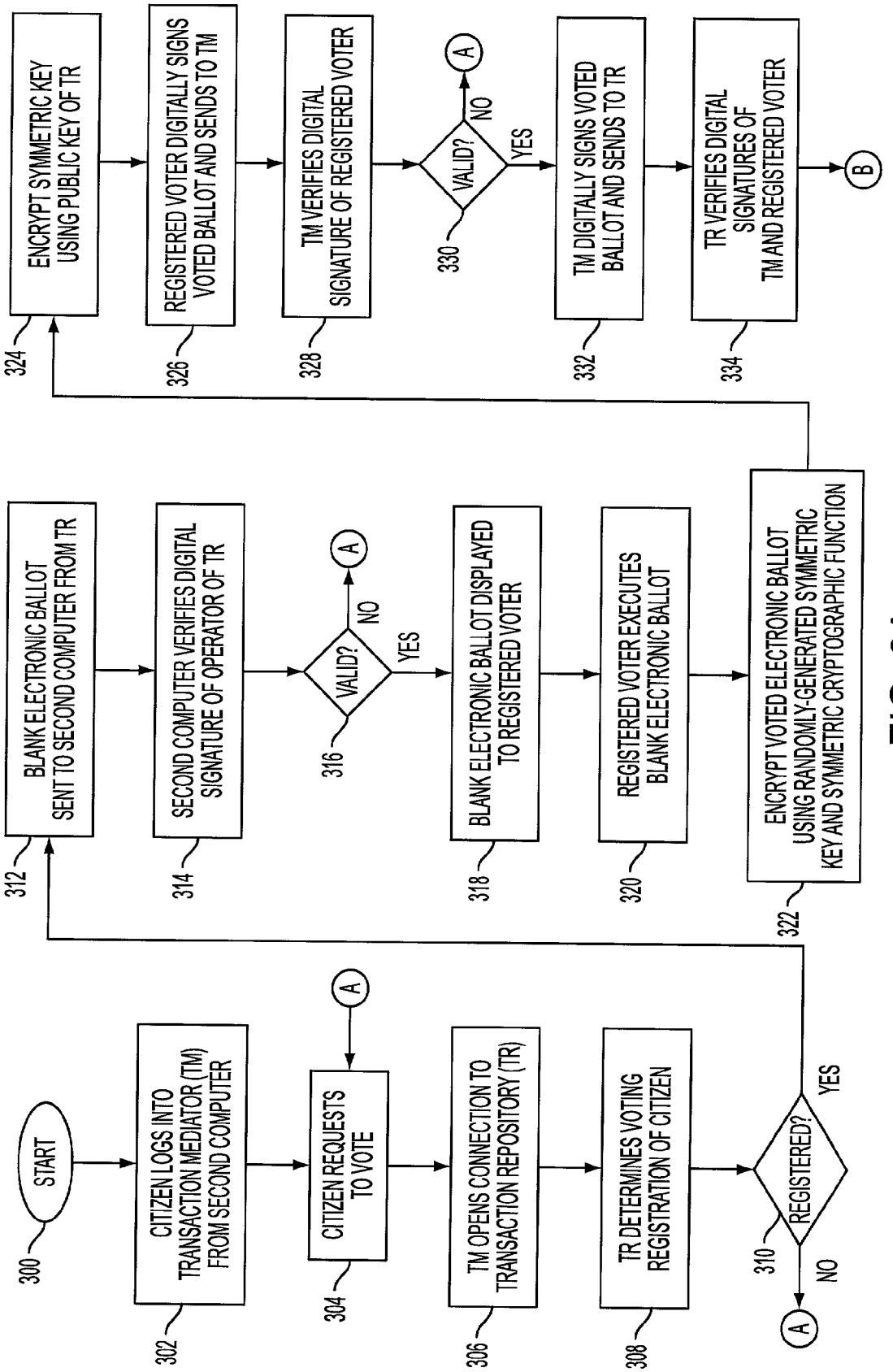

START
300
CITIZEN LOGS INTO TRANSACTION MEDIATOR (TM) FROM SECOND COMPUTER
302
CITIZEN REQUESTS TO VOTE
304
A
TM OPENS CONNECTION TO TRANSACTION REPOSITORY (TR)
306
TR DETERMINES VOTING REGISTRATION OF CITIZEN
308
REGISTERED?
310
YES
NO
A
BLANK ELECTRONIC BALLOT SENT TO SECOND COMPUTER FROM TR
312
SECOND COMPUTER VERIFIES DIGITAL SIGNATURE OF OPERATOR OF TR
314
VALID?
316
YES
NO
A
BLANK ELECTRONIC BALLOT DISPLAYED TO REGISTERED VOTER
318
REGISTERED VOTER EXECUTES BLANK ELECTRONIC BALLOT
320
ENCRYPT VOTED ELECTRONIC BALLOT USING RANDOMLY-GENERATED SYMMETRIC KEY AND SYMMETRIC CRYPTOGRAPHIC FUNCTION
322
ENCRYPT SYMMETRIC KEY USING PUBLIC KEY OF TR
324
REGISTERED VOTER DIGITALLY SIGNS VOTED BALLOT AND SENDS TO TM
326
TM VERIFIES DIGITAL SIGNATURE OF REGISTERED VOTER
328
VALID?
330
YES
NO
A
TM DIGITALLY SIGNS VOTED BALLOT AND SENDS TO TR
332
TR VERIFIES DIGITAL SIGNATURES OF TM AND REGISTERED VOTER
334
B

FIG. 3A

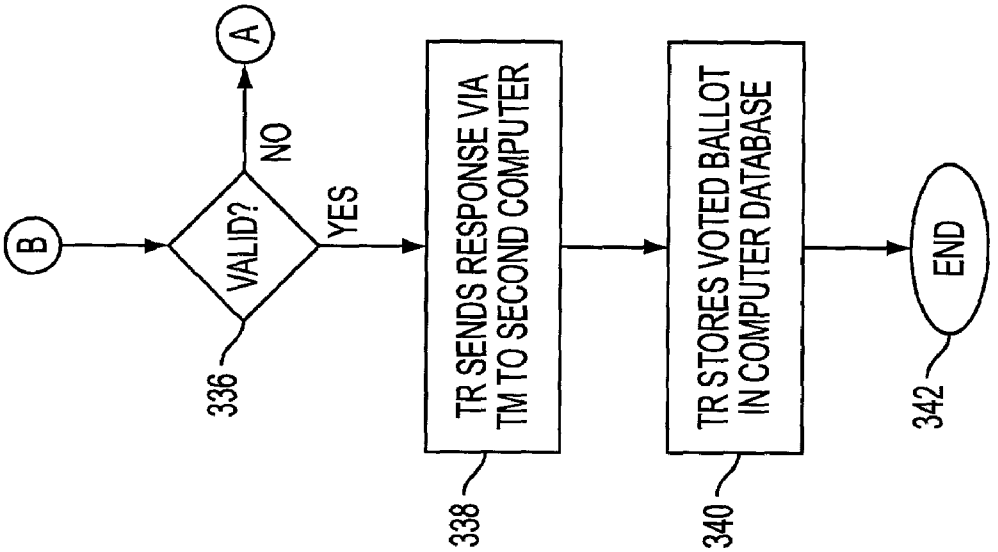

B
VALID?
336
NO
A
YES
TR SENDS RESPONSE VIA TM TO SECOND COMPUTER
338
TR STORES VOTED BALLOT IN COMPUTER DATABASE
340
END
342

FIG. 3B

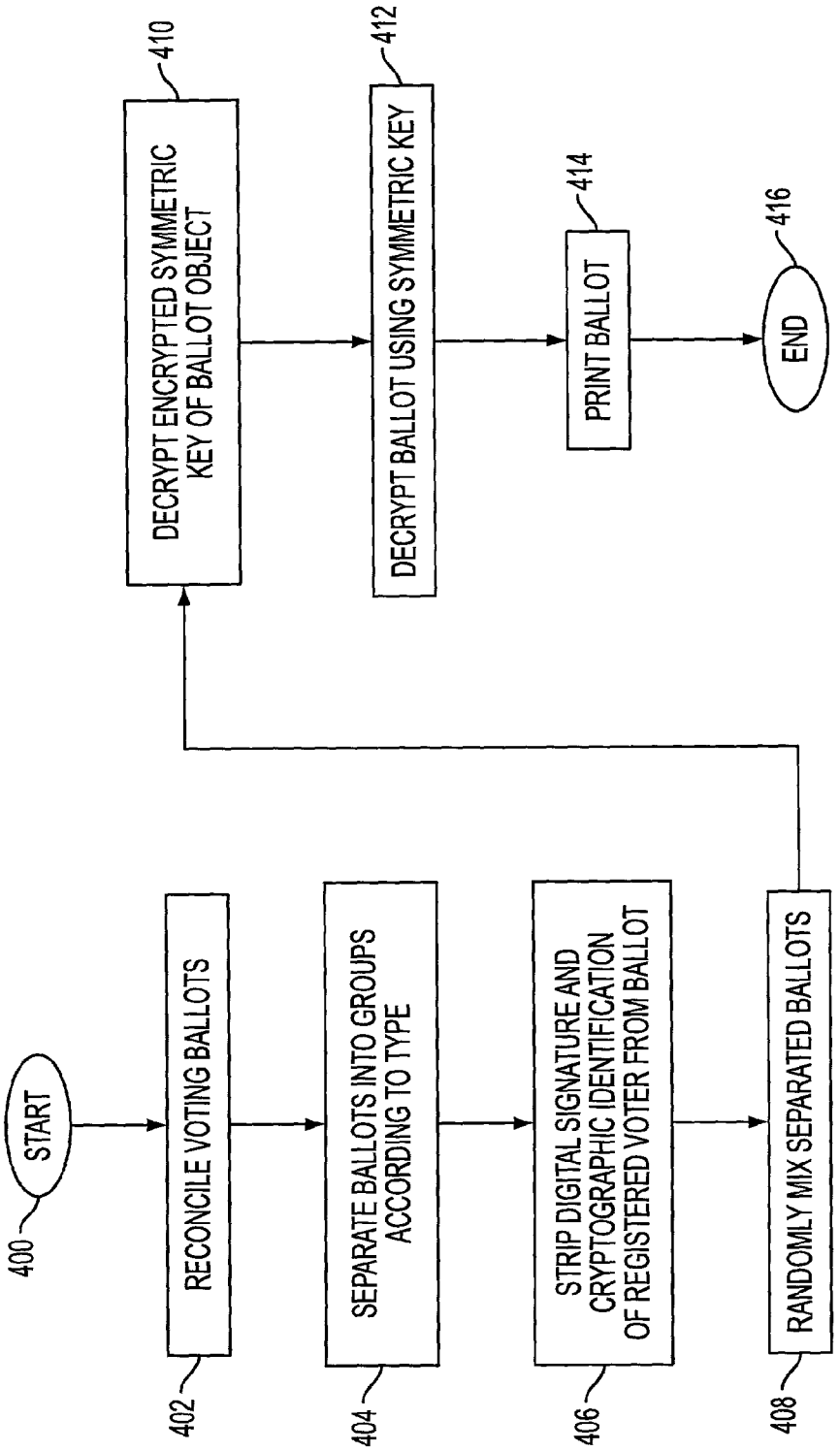

400
START
402
RECONCILE VOTING BALLOTS
404
SEPARATE BALLOTS INTO GROUPS ACCORDING TO TYPE
406
STRIP DIGITAL SIGNATURE AND CRYPTOGRAPHIC IDENTIFICATION OF REGISTERED VOTER FROM BALLOT
408
RANDOMLY MIX SEPARATED BALLOTS
410
DECRYPT ENCRYPTED SYMMETRIC KEY OF BALLOT OBJECT
412
DECRYPT BALLOT USING SYMMETRIC KEY
414
PRINT BALLOT
416
END

FIG. 4

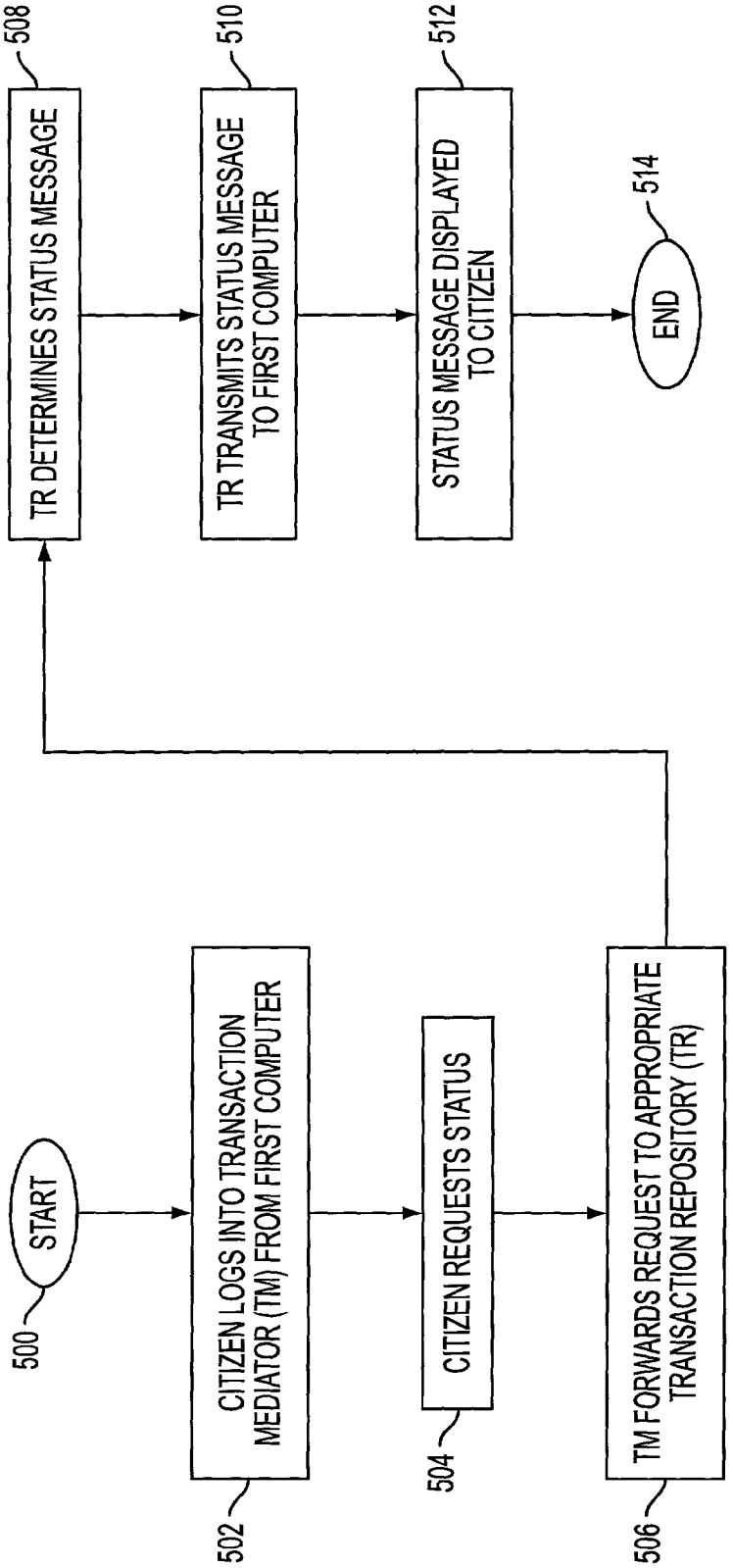

START
500
CITIZEN LOGS INTO TRANSACTION MEDIATOR (TM) FROM FIRST COMPUTER
502
CITIZEN REQUESTS STATUS
504
TM FORWARDS REQUEST TO APPROPRIATE TRANSACTION REPOSITORY (TR)
506
TR DETERMINES STATUS MESSAGE
508
TR TRANSMITS STATUS MESSAGE TO FIRST COMPUTER
510
STATUS MESSAGE DISPLAYED TO CITIZEN
512
END
514

FIG. 5

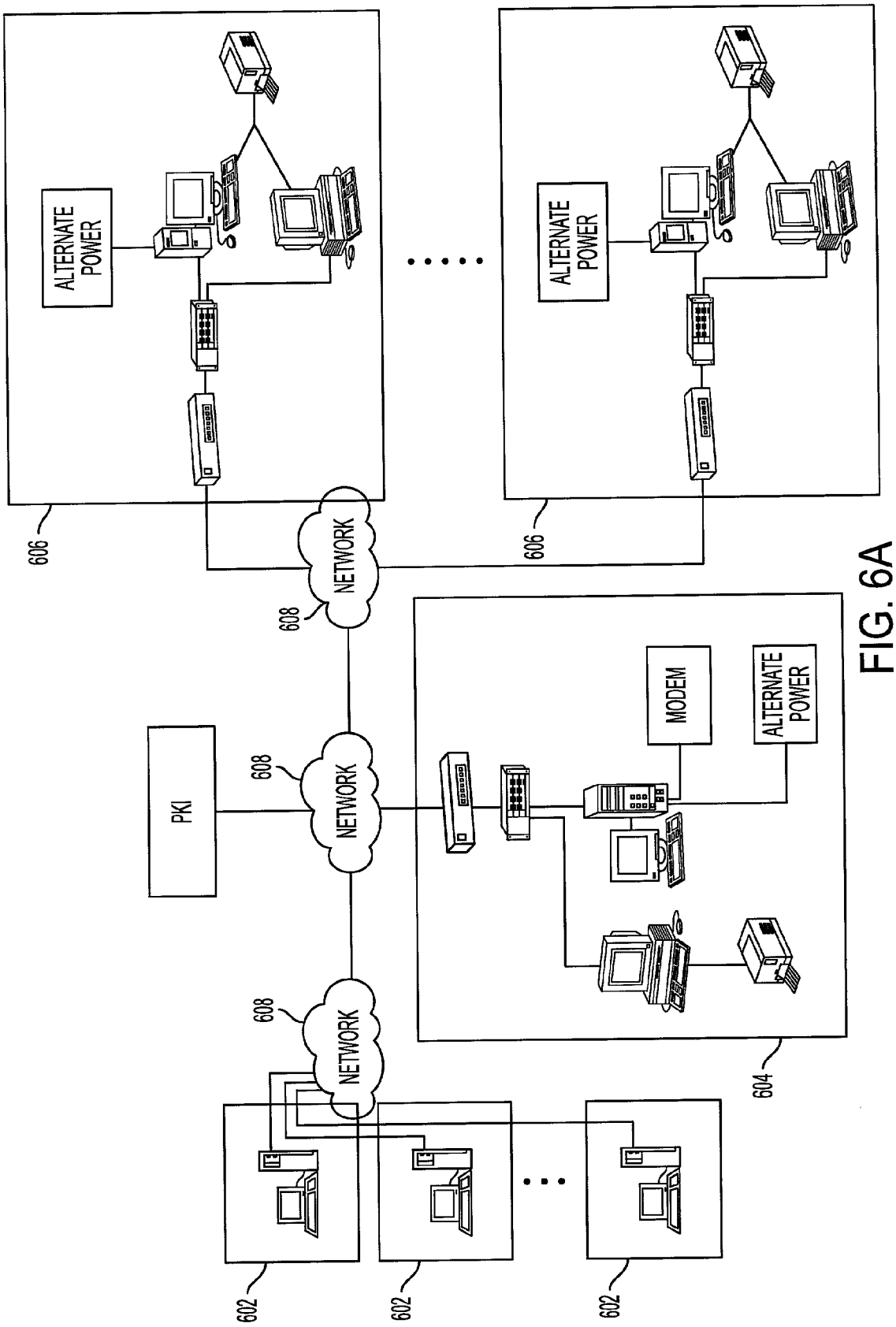

ALTERNATE POWER
ALTERNATE POWER
606
606
NETWORK
608
PKI
NETWORK
608
MODEM
ALTERNATE POWER
604
NETWORK
608
602
602
602

FIG. 6A

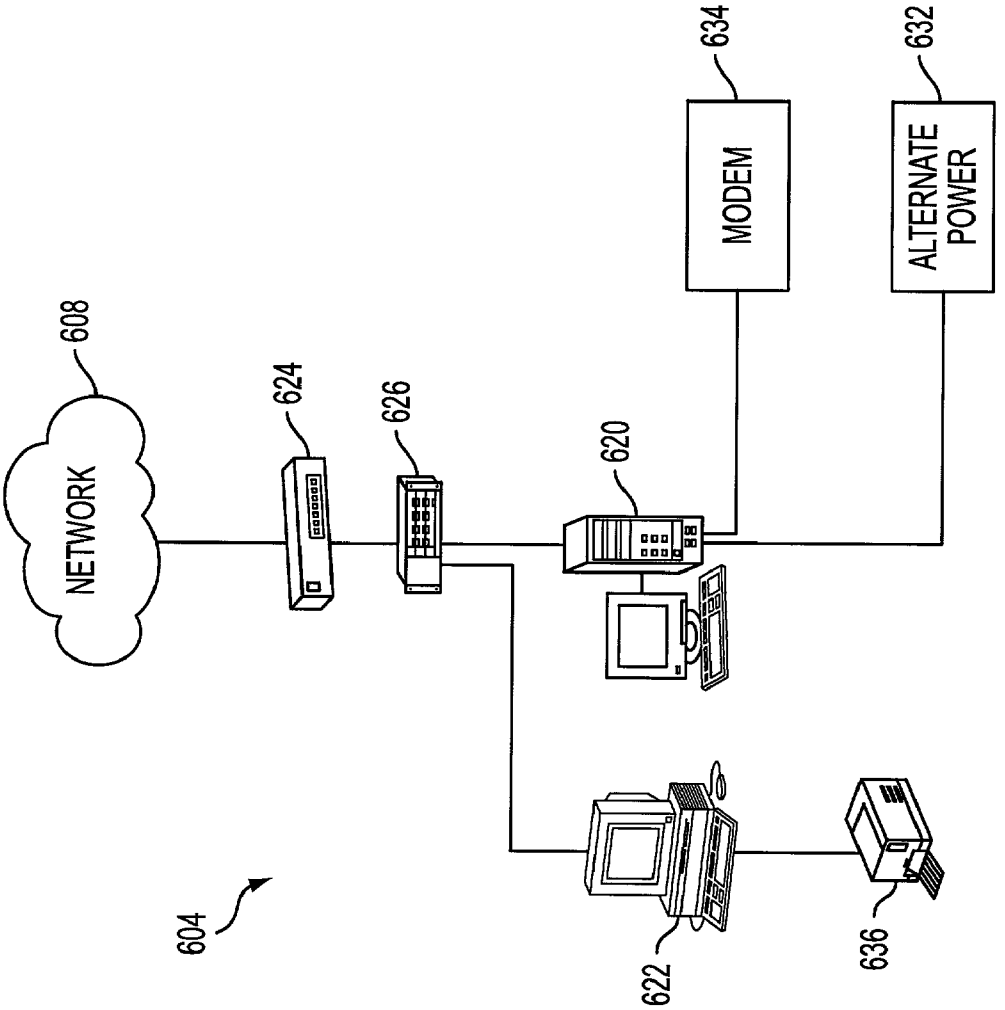

608
NETWORK
624
626
620
634
MODEM
632
ALTERNATE POWER
604
622
636

FIG. 6B

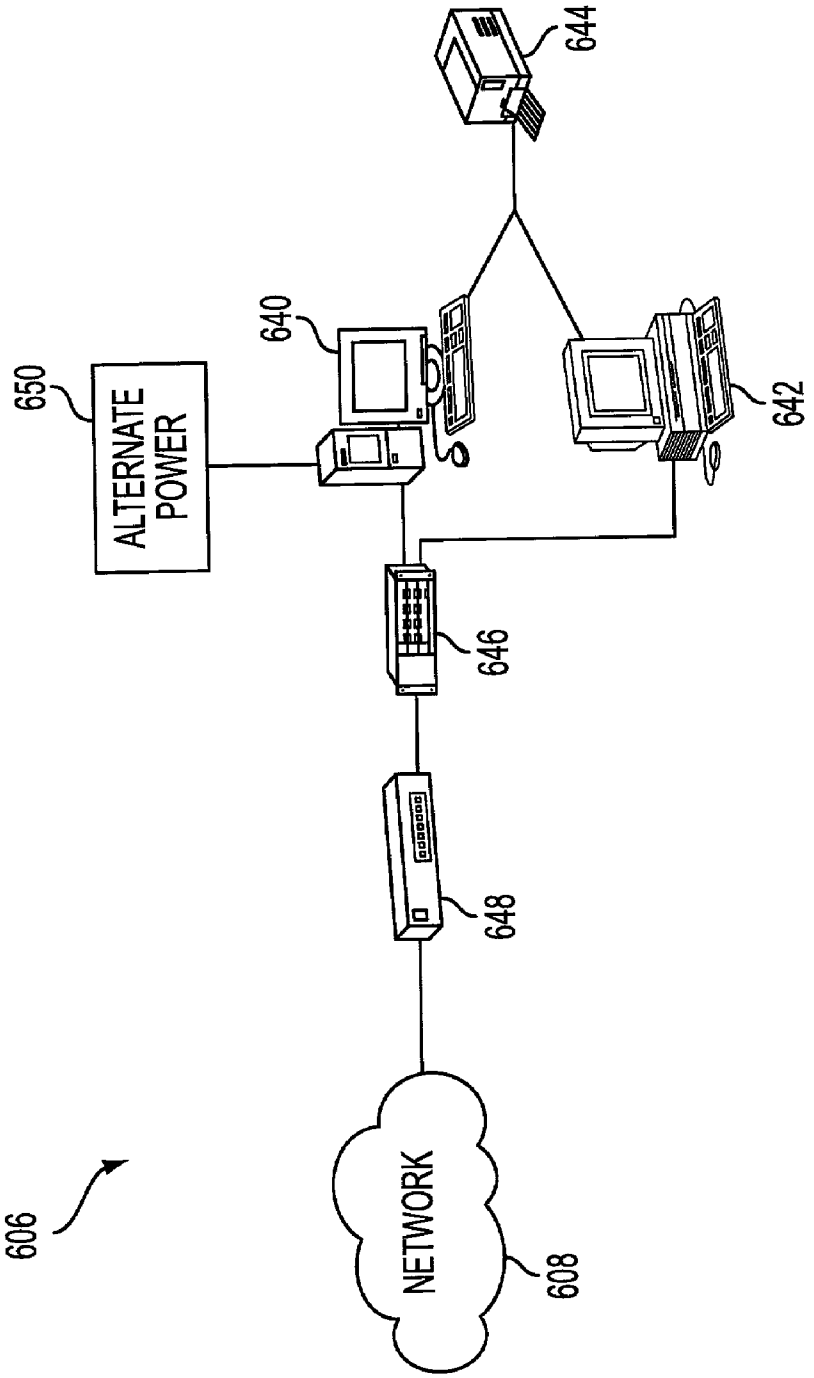


FIG. 6C

METHOD AND SYSTEM FOR ELECTRONIC VOTER REGISTRATION AND ELECTRONIC VOTING OVER A NETWORK

STATEMENT REGARDING FEDERALLY-SPONSORED RESEARCH OR DEVELOPMENT

This invention was made with Government support under contract No. MDA904-96-C-1553 awarded by the National Security Agency. The Government has certain rights in this invention.

BACKGROUND INFORMATION

1. Field of the Invention

The present invention relates to voting systems. More particularly, the present invention relates to voting systems in which voter registration and voting are conducted electronically over a network.

2. Description of the Related Art

Traditionally, elections are conducted utilizing paper ballots that are issued to registered voters at particular polling places. Before being allowed to vote, individuals must register to vote with their local voter registration offices. This is usually accomplished by either completing the necessary forms at the office itself or by requesting the forms and sending the completed paperwork to the office through the mail. Voting requires the physical attendance of the voter at a particular polling place to allow voting, or requires a mailing of an absentee ballot.

There is tremendous expense associated with conducting elections in a manner that renders the election results substantially free from corruption and error. However, there is no guarantee that traditional voting systems will render error-free election results. In recent years, a renewed interest has been sparked to develop voting systems that are more reliable and accurate.

Electronic communication networks can reduce the inconvenience and expense of traditional voting systems. However, concerns about security and privacy have precluded electronic communication networks from being used for voting.

To address the security issues associated with voting over an electronic communication network, U.S. Pat. No. 6,081,793 (Challener et al.) (the '793 patent), the disclosure of which is hereby incorporated by reference in its entirety, discloses a method and system for secure computer moderated voting that uses a plurality of cryptographic functions to ensure the security of the votes and the privacy of the voters. According to the '793 patent, voters register in a conventional manner and receive authorization to vote in a single election.

It would be desirable to provide an electronic voting system that allows voters to register and vote over a network with minimal security risks.

SUMMARY OF THE INVENTION

A method and system are described for completing and submitting an electronic voter registration form and an electronic ballot over a network. In accordance with exemplary embodiments of the present invention, a blank registration form is transmitted, upon request at a first computer, via a transaction mediator, to the first computer. Registration information is transmitted from the first computer, via a transaction mediator, to a computer database that resides on a transaction repository server, all of which are networked together, to establish a registered voter. Upon request by a registered voter at a second computer, a blank electronic ballot is transmitted from the computer database that resides on the transaction repository server, via a transaction mediator, to the second computer. A voted electronic ballot is transmitted from the second computer, via the transaction mediator, to the computer database that resides on the transaction repository server.

In addition, a method and system are described for verifying at least one of a voter registration status and an electronic ballot status in a voting system. In accordance with an exemplary embodiment of the present invention, at least one computer database is established on a transaction repository server that contains information associated with the at least one of the voter registration status of a citizen and the electronic ballot status. A status is requested at a first computer from the transaction repository server. A status message is determined in response to the status request by examining the at least one computer database. The status message is transmitted from the transaction repository to the first computer.

In an alternate exemplary embodiment of the present invention, registration information is transmitted from the first computer to the computer database that resides on the transaction repository server, all of which are networked together, to establish a registered voter. The voted electronic ballot is transmitted from the second computer to the computer database that resides on the transaction repository server.

In an alternate exemplary embodiment of the present invention, upon request at a first computer, a blank electronic registration form is transmitted to the first computer. Registration information is transmitted from the first computer to a computer database that resides on a transaction repository server, all of which are networked together, to establish a registered voter.

In accordance with alternate exemplary embodiments of the present invention, each citizen generates, or has generated for them, a public-private key pair, which can be generated using an asymmetric cryptographic function, and has created for and issued to them a cryptographic identification. Both the public-private key pair and the cryptographic identification can be used by the citizen with respect to a plurality of electronic transactions.

In an alternate exemplary embodiment of the present invention, a system for completing and submitting an electronic voter registration form and an electronic ballot over a network includes a transaction repository server for transmitting a blank electronic ballot to a first computer. Alternate exemplary embodiments of the system of the present invention can also include a computer database, accessible by the transaction repository server, for storing the blank electronic ballot. Alternate exemplary embodiments of the system of the present invention can also include a transaction mediator for communicating information between the transaction repository server and the first computer, the transaction mediator being operative to transmit registration information from the first computer to the computer database to establish a registered voter, and operative to transmit the voted electronic ballot from the first computer to the computer database.

To ease integration and acceptance by the voting public of an electronic voting system, the electronic voting system of the present invention emulates as closely as possible those features of the traditional voting systems with which voters are accustomed, but provides those features with greater convenience, accuracy, security, and reliability. Exemplary embodiments of the present invention emulate the paper ballot voting process by providing an integrated means by which a voter can both register to vote and cast a ballot, but allow

both of these and other steps in the voting process to be conducted through a generic personal computer. Exemplary embodiments of the present invention allow voters to participate in elections from their home, office, or, if they choose, established polling places, without having to travel to varied and numerous locations to complete each step in the voting process.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

Other objects and advantages of the present invention will become apparent to those skilled in the art upon reading the following detailed description of preferred embodiments, in conjunction with the accompanying drawings, wherein like reference numerals have been used to designate like elements, and wherein:

FIG. **1** is a pictorial representation illustrating a system in accordance with an exemplary embodiment of the present invention;

FIG. **2** is a flowchart illustrating the steps carried out for a voter registration request and submission in accordance with an exemplary embodiment of the present invention;

FIGS. **3**A and **3**B are flowcharts illustrating the steps carried out for a ballot request and voting in accordance with an exemplary embodiment of the present invention;

FIG. **4** is a flowchart illustrating the steps carried out for ballot processing in accordance with an exemplary embodiment of the present invention;

FIG. **5** is a flowchart illustrating the steps carried out for verifying at least one of a voter registration status request and an electronic ballot status request in accordance with an exemplary embodiment of the present invention;

FIG. **6**A is a detailed pictorial representation of the network architecture of the three principal computer systems of an exemplary embodiment of the present invention;

FIG. **6**B is a detailed pictorial representation of an exemplary embodiment of a network architecture of a Transaction Mediator (TM) server site; and

FIG. **6**C is a detailed pictorial representation of an exemplary embodiment of a network architecture of a Transaction Repository (TR) server site.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** is a pictorial representation of a system **100** for completing and submitting an electronic voter registration form and an electronic ballot transmitted over a network in accordance with an exemplary embodiment of the present invention. According to an exemplary embodiment of the present invention, system **100** can include a plurality of citizen workstations **104**, a plurality of Transaction Repository (TR) servers **110**, and one or more Transaction Mediator (TM) servers **108** that are all networked together over an electronic communications network **106**, such as, for example, the Internet.

Before a citizen **102** can vote, citizen **102** registers to vote in an upcoming election. An exemplary method for voter registration request and submission will now be described with reference to FIG. **2**. In step **202**, citizen **102** logs into the system of the present invention. System login can be performed using any method. According to an exemplary embodiment of the present invention, system **100** login can be performed using a one-time login based on a random challenge response method using a cryptographic identification. To login, citizen **102** accesses a TM server **108** by entering the network address of a TM server **108** into a first computer, for example, by entering the network address into a browser, for example, a web browser, running on the first computer. In an exemplary embodiment of the present invention, the first computer can be a citizen workstation **104**. The first computer (e.g., citizen workstation **104**) can use, for example, any web browser, such as Netscape Communicator, that supports encrypted sessions, or any other encryption protocol.

Once citizen **102** accesses TM server **108**, an encrypted session is initiated. The network of system **100** supports an encrypted communication channel between at least one of the first computer (e.g., citizen workstation **104**) and a second computer (e.g., the same or different citizen workstation **104**) and a transaction mediator (e.g., TM server **108**), and an encrypted communication channel between the transaction mediator (e.g., TM server **108**) and a transaction repository server (e.g., TR server **110**). The encrypted communication channels provide security for the information that is transmitted between the computer systems which comprise the system of the present invention. The communication channels can be encrypted using any known transmission encryption protocol, such as, for example, a secure sockets layer (SSL), or, more specifically, SSL3 with client authentication, or any other encryption protocol. SSL works by using a secret key to encrypt data that is transferred over the SSL connection.

Prior to registering to vote, each citizen **102** generates, or has generated for them, a public-private key pair using an asymmetric cryptographic function. Also prior to registering to vote, each citizen **102** has created for and issued to them a unique cryptographic identification. According to an exemplary embodiment of the present invention, the cryptographic identification of citizen **102** can be an X.509 digital certificate, or any other cryptographic identification. A digital certificate includes, for example, the public key of the generated public-private key pair and personal information of citizen **102**. The personal information of citizen **102** can include, for example, the name, address, voter registration number, and any other desired information that can be used either alone or in combination with other information to uniquely identify citizen **102**. The cryptographic identification can be issued to citizen **102** on, for example, a floppy disk, "smart card," or any other electronic storage media. The cryptographic identification can also be issued to citizen **102** over a network, and subsequently stored on, for example, a floppy disk, "smart card," or any other electronic storage media.

When required by the system of the present invention, citizen **102** is prompted for the private key that was previously generated by or for citizen **102** and for the cryptographic identification that was previously created for and issued to citizen **102**. Citizen **102** enters the information by, for example, inserting the floppy disk or smart card containing the private key and cryptographic identification into the first computer or second computer (e.g., citizen workstation **104**) and providing a personal identification number (PIN) or password. The first computer or second computer (e.g., citizen workstation **104**) can then retrieve the information, for example, from the floppy disk or smart card. According to an exemplary embodiment of the present invention, the PIN or password can be replaced, or accompanied, by the use of a biometric authentication mechanism.

The public-private key pair is generated by or for each citizen **102** using an asymmetric cryptographic function. Asymmetric cryptography, also referred to as public-key cryptography, uses two keys—one key is private and the other key is public. A message encrypted with one key is decrypted with the other key. The public key can be used to encrypt

information that can only be decrypted by someone possessing the private key. Generally, however, the private key is used to digitally sign a document. Once signed, the public key contained as part of the cryptographic identification can be used in verifying the identity of citizen **102**.

In accordance with exemplary embodiments, the process of digitally signing a document involves running a document or other electronic information object through a hash function. A hash function generates a unique hash number such that if any bit or bits of the document are changed, a different hash number is generated if run through the same hash function again. The hash number is encrypted using the private key of citizen **102** resulting in a digital signature. The digital signature and the digital certificate are attached to the document and transmitted.

In accordance with exemplary embodiments, the process of verifying a digital signature involves the recipient running the document through an identical hash function to generate a hash number. The digital signature attached to the document is decrypted using the public key contained in the digital certificate. If the decrypted hash number and the hash number generated by the recipient match, then the recipient can be assured that the document was transmitted without modification.

The cryptographic identification can be created for and issued to citizen **102** by a trusted third party, for example, the United States Post Office or some other Certification Authority (CA). A CA is a trusted third-party organization or company that issues digital certificates used in the creation and verification of digital signatures. The role of the CA in the process is to guarantee that the individual granted the unique certificate is, in fact, who he or she claims to be. When CAs are involved in the process of verifying and authenticating the validity of digital signatures, the system is referred to as a public key infrastructure (PKI). A good discussion of public keys, private keys, digital signatures, and public-key cryptography in general can be found at "Applied Cryptography," by Bruce Schneier, published by John Wiley & Sons, Inc., more precisely identified by International Standard Book Number ISBN 0-471-59756-2, the disclosure of which is hereby incorporated by reference.

According to an exemplary embodiment of the present invention, the public-private key pair generated by or for citizen **102** and the cryptographic identification created for and issued to citizen **102** are generic in nature, meaning that the public-private key pair and cryptographic identification are not vote-specific. In other words, the public-private key pair and the cryptographic identification can be used by the citizen with respect to multiple electronic transactions. For instance, citizen **102** can use the public-private key pair and the cryptographic identification to register to vote and/or vote in different elections. In addition to voting, citizen **102** can use the public-private key pair and the cryptographic identification for engaging in electronic commerce. Thus, citizen **102** can use the public-private key pair and cryptographic identification for any electronic transaction that requires the use of a secure means by which to identify a particular user. Consequently, citizen **102** does not need additional public-private key pairs generated and cryptographic identifications created and issued each time citizen **102** wishes to vote or engage in other electronic transactions. Rather, citizen **102** can use the same public-private key pair and cryptographic identification to vote in any election or engage in any other electronic transaction.

Once citizen **102** is logged into TM server **108**, citizen **102** is provided with election service options, for example, via a web page interface within the web browser running on the first computer (e.g., citizen workstation **104**). Through the election service options on the first computer, citizen **102** can request to register to vote in step **204**. The request to register can include, for example, the state and county of the citizen's residence. Based upon the voting registration request, in step **206** TM server **108** establishes a connection to the TR server **110** that is assigned to process the registration and voting information associated with the district or area in which citizen **102** resides. In step **208**, upon request at a first computer, a blank electronic registration form is transmitted, via a transaction mediator, to the first computer. In an exemplary embodiment of the present invention, the first computer can be one of the citizen workstations **104** and the transaction mediator can be one of the TM servers **108**.

The network of system **100** includes one or more transaction mediators. In an exemplary embodiment of the present invention, the transaction mediator can be TM server **108**. In accordance with an exemplary embodiment, TM server **108** is networked with the first computer (e.g., citizen workstation **104**) and TR server **110**. TM server **108**, for example, authenticates identities using cryptographic information transmitted between the first computer (e.g., citizen workstation **104**) and TR server **110**. TM server **108** verifies digital signatures and validates the cryptographic identification of citizen **102** in accordance with, for example, X.509 standards. TM server **108** performs the validation using the transmitted cryptographic information and additional information obtained from CA **116** to confirm the identity of the owner of the digital certificate and to confirm that the digital certificate is currently valid. TM Server **108** also has generated by or for it a public-private key pair and created and issued to it a unique cryptographic identification, such as a digital certificate.

In an exemplary embodiment of the present invention, TM server **108** can also maintain a database of blank electronic registration forms. Alternatively, the database of blank electronic registration forms can be maintained by a TR server **110**. In addition, TM server **108** can perform event logging and reporting. Along with the voting registration forms, other information that is to be displayed, filled out, or submitted with a voting registration form, such as instructions, state oaths, and affirmations, can be maintained in the database along with the voting registration forms. The electronic registration forms and accompanying information are created using, for example, a software program that generates HyperText Markup Language (HTML) files so that the information can be displayed to citizen **102** within the web browser running on the first computer (e.g., citizen workstation **104**). Once created, the forms and information can be digitally signed with the private key of TM server **108**. The digital certificate of TM server **108** can be attached to the digitally signed forms. In addition, an identification tag of the TR server **108** which will process the forms can also be attached to the forms. The TR identification tag can be, for example, an IP address of the corresponding TR server **108**. The digitally signed and tagged forms can be stored within the database residing in, for example, TM server **108**, or in any other desired database.

In step **208**, TM server **108** transmits the blank electronic registration form to the first computer (e.g., citizen workstation **104**). Upon receipt of the blank electronic registration form, the first computer (e.g., citizen workstation **104**) verifies the digital signature of TM server **108** in step **210**. If successfully verified in step **212**, in step **214** the electronic registration form (and any accompanying information) is displayed to citizen **102** within the web browser running on the first computer (e.g., citizen workstation **104**). In step **216**, citizen **102** enters registration information into the electronic

registration form by, for example, either typing in information using a keyboard or making selections using a computer pointing device, such as, for example, a computer mouse, or in any manner in which an individual can enter information into a computer. If the digital signature of TM server **108** is not successfully verified in step **212**, citizen **102** must make another request to register in step **204**. In step **218**, citizen **102** digitally signs the registration information using the private key of the public-private key pair generated by or for citizen **102**.

To become a registered voter, in step **220** citizen **102** transmits registration information from the first computer (e.g., citizen workstation **104**), via the transaction mediator (e.g., TM server **108**), to a computer database that resides on a transaction repository server (e.g., TR server **110**), all of which are networked together, to establish a registered voter. The registration information includes at least one descriptive element associated with a citizen. Such descriptive elements can include, for example, at least one of a name, mailing address, voting address, age, social security number, race, occupation, and any other information that is desired to uniquely describe and identify a citizen. In accordance with exemplary embodiments of the present invention, the registration information can include not only the descriptive elements, but also the electronic registration forms as well. Thus, the information that is transmitted from the first computer (e.g., citizen workstation **104**) can include either the descriptive elements entered by citizen **102** alone, or both the descriptive elements and the electronic registration form combined.

Once citizen **102** has completed entering registration information into the electronic registration form in step **216**, citizen **102** submits the registration information for transmission to the appropriate TR server **110** in step **220**. Submission of the registration information can also require citizen **102** to affirm the entered information in whole or in part and adhere to any required state oath. The affirmation and oath can be submitted to the designated TR server **110** along with the completed registration information. Once the registration information and any accompanying forms are completed and digitally signed, the identification tag of the appropriate TR server is attached to the information. In step **218**, the registration information and identification tag can be digitally signed by citizen **102** using the private key generated by or for citizen **102**. The cryptographic identification created for and issued to citizen **102** can also be attached to the digitally signed registration information and identification tag in step **218** and transmitted to TM server **108** in step **220**. If confidentiality of the registration information is necessary, the registration information can be encrypted prior to digitally signing using any known encryption technique or combination of encryption techniques, such as, for example, symmetric or asymmetric cryptography. Once the registration information is transmitted, information associated with the registration information, including, for example, all forms and descriptive elements, can be erased from the first computer (e.g., citizen workstation **104**).

In step **222**, TM server **108** can verify the digital signature of the registration information using the public key of the public-private key pair generated by or for citizen **102** and contained within the cryptographic identification of citizen **102**. TM server **108** can verify the digital signature of citizen **102** and validate the cryptographic identification of citizen **102** in accordance with, for example, X.509 standards. If successful in step **224**, in step **226** TM server **108** can attach a date-time stamp and digitally sign the validated registration information using the private key generated by or for TM server **108**. TM server **108** can also attach the cryptographic identification created for and issued to TM server **108**. Also in step **226**, TM server **108** then forwards the validated registration information to the TR server **110** indicated by the TR server identification attached to the validated registration information. If unsuccessful in step **224**, citizen **102** must make another request to register in step **204**. Once the registration information is transmitted, information associated with the registration information, including, for example, all forms and descriptive elements, can be erased from TM server **108**.

Upon receipt of the validated registration information at the designated TR server **110** in step **228**, TR server **110** can use the public keys of TM server **108** and citizen **102** to verify the digital signatures of both TM server **108** and citizen **102**. If successfully verified in step **230**, TR server **110** can, for example, send a confirmation response to TM server **108**. The confirmation response received by TM server **108** can cause TM server **108** to provide an additional confirmation response to the first computer (e.g., citizen workstation **104**). If not successfully verified in step **234**, citizen **102** must make another request to register in step **204**. In an alternate exemplary embodiment, if not successfully verified in step **234**, TR server **110** can, for example, send a failure response to TM server **108**. The failure response received by TM server **108** can cause TM server **108** to provide a similar failure response to the first computer (e.g., citizen workstation **104**).

Voter registration requests are processed by TR administrative personnel **114** in step **232** by approving or denying a voting registration request at the computer database based on the registration information of a citizen. According to an exemplary embodiment of the present invention, TR server **110** can store all received electronic registration forms in the computer database residing on TR server **110**. Initially, all requests can be stored, for example, in a pending table within the computer database. The registration information associated with approved requests is stored in the computer database, for example, in a table of approved requests. The registration information associated with denied requests are stored in the computer database in, for example, a table of denied requests. TR personnel **114** can view the registration information of any citizen at any time, but cannot change registration information. Once voting registration is approved, citizen **102** becomes a registered voter.

Once a citizen **102** becomes a registered voter, citizen **102** can vote in at least one future election. An exemplary method for ballot request and voting for a single election will now be described with reference to FIGS. **3**A and **3**B. In step **302** of FIG. **3**A, citizen **102** begins by logging into TM server **108**, if not already, in the manner described previously. After successful login, citizen **102** is presented with election service options through which citizen **102** requests to vote in step **304**. As part of the request, citizen **102** can include, for example, the state and county of the citizen's residence. As a result of the request to vote, in step **306** TM server **108** establishes a connection to the appropriate TR server **110** and forwards the voting request to that appropriate TR server **110**.

Upon request by the registered voter at a second computer, in step **312** a blank electronic ballot is transmitted from the computer database that resides on the transaction repository server (e.g., TR server **110**), via the transaction mediator (e.g., TM server **108**), to the second computer. Since voter registration and voting can be performed on the same or different citizen workstations **104**, the second computer used by the registered voter can be the first computer (e.g., the same citizen workstation **104** that citizen **102** used to register) or a different citizen workstation **104** that citizen **102** uses to vote

electronically. The transaction repository server (e.g., TR server **110**) also has generated by it or for it a public-private key pair and created for it and issued to it a unique cryptographic identification, such as a digital certificate.

After receiving the request to vote, in step **308** TR server **110** determines if citizen **102** is registered to vote. TR server **110** can make this determination by, for example, retrieving registration information for citizen **102** from the approved table stored in the computer database that resides in TR server **110**. If TR server **110** determines in step **310** that citizen **102** is eligible to vote, then TR server **110** transmits a blank electronic ballot to the second computer in step **314**. If it is determined that citizen **102** is ineligible to vote in step **210**, citizen **102** must make another request to vote in step **304**. In an exemplary embodiment of the present invention, to send the blank electronic ballot, TR server **110** can transmit the blank electronic ballot, for example, via TM server **108**. TM server **108** can, for example, relay the blank electronic ballot to the second computer (e.g., citizen workstation **104**) into which citizen **102** is logged.

Voted electronic ballots are created by, for example, TR personnel **114** and stored in the computer database residing on the transaction repository server (e.g., TR server **110**). Ballots can be created using any conventional tool, for example, that supports the creation of HMTL files. Each type or style of blank electronic ballot can have a state oath and/or affirmation statement accompany the ballot, depending on the federal, state, and local election requirements. Each blank electronic ballot can have included with it the cryptographic identification (e.g., digital certificate) created for and issued to, or the public key of the public-private key pair generated by or for, the transaction repository server (e.g., TR server **110**). In addition, the blank electronic ballot can have included with it the ballot type, an identification tag of the appropriate TR server **110**, and a return network address for the voted electronic ballot. These pieces of information can be used to create a blank electronic ballot object that is digitally signed with the private key generated by or for the operator of the transaction repository server, e.g., TR personnel **114**. The cryptographic identification created for and issued to the transaction repository server can be attached to the digitally-signed ballot object and the entire object stored in the computer database which resides on the transaction repository server (e.g., TR server **108**).

After receiving the blank electronic ballot, in step **314** the second computer (e.g., citizen workstation **104**) can verify the digital signature of TR server **110**. If successfully verified in step **316**, in step **318** the second computer (e.g., citizen workstation **104**) displays the blank electronic ballot to citizen **102**, for example, in the web browser running on the second computer (e.g., citizen workstation **104**). If not successfully verified in step **318**, the registered voter must make another request to vote in step **304**. In step **320**, the registered voter executes the blank electronic ballot. In executing the ballot, the registered voter, for example, makes selections within the ballot, answers questions, and supplies whatever information is necessary to vote the electronic ballot. Citizen **102** can make selections by, for example, using a keyboard or by using a computer pointing device, such as, for example, a computer mouse, or in any manner in which an individual can enter information into a computer.

Once the registered voter has voted, the voted electronic ballot is transmitted from the second computer, via the transaction mediator, to the computer database that resides on the transaction repository server. In accordance with an exemplary embodiment of the present invention, the voted electronic ballot is transmitted from the second computer (e.g., citizen workstation **104**) to the computer database residing on TR server **110**, via TM server **108**. According to an exemplary embodiment of the present invention, the voted electronic ballot can include, for example, both the ballot form and the selections of the voter. Alternatively, the information which is transmitted to the computer database can include the selections of the voter alone. In an alternate exemplary embodiment of the present invention, the registered voter can, for example, print out the voted electronic ballot at the second computer (e.g., citizen workstation **104**) and submit the ballot through regular mail instead of proceeding with electronic voting.

Once the electronic ballot is voted, in step **322** the voted electronic ballot is encrypted, for example, using a symmetric cryptographic function and a symmetric key that is randomly generated by the second computer (e.g., citizen workstation **104**). Any symmetric cryptographic function, such as, for example, Triple Data Encryption Standard (DES), may be used to encrypt the voted electronic ballot.

Symmetric key cryptography is an encryption system where the same key is used both to encrypt and to decrypt information. Thus, if a sender and receiver of a message want to communicate, they must share a single, common key that is used to encrypt and decrypt the message. Symmetric key systems are very strong, but are more limited than public key cryptographic systems, because the two parties must somehow exchange or agree to a shared key in a manner that does not disclose the key to any third party. To overcome this limitation, in step **324** exemplary embodiments of the present invention encrypt the randomly-generated symmetric key using the public key of the transaction repository server that was originally transmitted with the blank electronic ballot.

Any affirmations and/or state oaths that citizen **102** is required to electronically submit, the identification tag of the appropriate TR server **110**, and the ballot type or style are appended to the encrypted voted electronic ballot and encrypted symmetric key to create a voted electronic ballot object. In step **326**, the voted electronic ballot object can be digitally signed using the private key of citizen **102** in the manner described previously. Also in step **326**, the digitally-signed voted electronic ballot object can be sent to TM server **108**. Once the voted electronic ballot object has been transmitted, information associated with the encrypted voted electronic ballot object can be erased from the second computer.

TM server **108** can attach a date-time stamp to the voted electronic ballot. TM server **108** can also perform several checks on the ballot in step **328**, including, for example, verifying the digital signature of citizen **102** (using, for example, the public key generated by or for the registered voter) and validating the cryptographic identification of citizen **102** in accordance with, for example, X.509 standards. If the checks are successful in step **330**, in step **332** TM server **108** can digitally sign the voted electronic ballot (including the date-time stamp), attach the cryptographic identification created for and issued to TM server **108**, and forward the ballot to the TR server **110** indicated by the TR server identification tag contained in the ballot. If not successfully verified in step **330**, citizen **102** must make another request to vote in step **304**. Once the voted electronic ballot has been transmitted from TM server **108**, information associated with the voted electronic ballot can be erased from TM server **108**.

Upon receipt of the electronic ballot at the designated TR server **110**, in step **334** TR server **110** can use the public keys of TM server **108** and citizen **102** to verify the digital signatures of both TM server **108** and citizen **102**. If successfully verified in step **336** of FIG. **3**B, in step **338** TR server **110** can provide a confirmation response to TM server **108**. The

response provided by TR server **110** can cause TM server **108** to provide to the second computer (e.g., citizen workstation **104**) similar confirmation response. If not successfully verified in step **336**, citizen **102** must make another request to vote in step **304**. In an alternate exemplary embodiment, if not successfully verified in step **336**, TR server **110** can, for example, send a failure response to TM server **108**. The failure response received by TM server **108** can cause TM server **108** to provide a similar failure response to the second computer (e.g., citizen workstation **104**). In step **340**, the verified voted electronic ballot objects are stored in the computer database residing on TR server **110**.

Each voted electronic ballot object is processed by TR personnel **114**. An exemplary method for ballot processing will now be described with reference to FIG. **4**. In step **402**, voted electronic ballots are reconciled by an operator of the transaction repository server (e.g., TR personnel **114**) to establish the validity of each transmitted voted electronic ballot. The vote of each citizen **102** counts only once, but a citizen **102** may re-submit ballots in an election using the electronic voting system of the present invention. For example, citizen **102** may submit an original ballot, then realize that their ballot was entered or processed incorrectly. According to exemplary embodiments of the present invention, citizen **102** can correct their ballot by re-submitting another voted electronic ballot. Given the multiplicity of ballots that could be submitted for each citizen **102**, it is the responsibility of the TR personnel **114** who oversee the election to determine which ballot is to be counted for each citizen **102**. In addition, for example, ballots could arrive too late to be counted, or a voter might become deceased or convicted of felonies after a ballot is received, or the citizen's vote might be successfully challenged. The determination of validity, therefore, can be made based on, for example, the registration information of citizen **102**, the date-time stamp of the voted electronic ballot, and other factors.

To process a voted electronic ballot, TR personnel **114** can access the computer database residing on TR server **110** through, for example, a TR admin workstation (e.g., TR admin workstation **642** as shown in FIG. **6**C). According to exemplary embodiments of the present invention, the TR personnel **114** can view certain details of each voted electronic ballot, such as, for example, the ballot type. When viewing the details, TR server **110** can re-verify the digital signatures of both citizen **102** and TM server **108**. Based on their analysis of the ballot or ballots of citizen **102**, exemplary embodiments of the present invention allow only one valid voted electronic ballot to exist for each citizen **102** at any one time.

Once the voted electronic ballots are reconciled, in step **404** a plurality of valid encrypted voted electronic ballots are separated into groups based on at least one characteristic, such as, for example, ballot type. Once separated, in step **406**, the digital signature and the cryptographic identification of the registered voter are stripped from each group of valid encrypted voted electronic ballots. In step **408**, the separated encrypted voted electronic ballots are randomly mixed within each group. Stripping and mixing ensure that citizen **102** cannot be associated with the selections made within their voted electronic ballot, thereby preserving the secrecy of each voted electronic ballot. The stripped voted electronic ballots can be stored in a computer database residing on TR server **110**.

Using the stripped voted electronic ballots, each electronic vote can be tallied by TR personnel **114**. To tally the votes, each vote can be printed out. To print a voted electronic ballot, in step **410** TR server **110** decrypts the encrypted symmetric key of each separated voted electronic ballot using the private key generated by or for the transaction repository server (e.g., TR server **110**). Since the encrypted voted electronic ballot can only be decrypted by the trusted party (e.g., TR personnel **114**) that possesses the corresponding private key, ballot objects can reside securely in the computer database. Using the symmetric key, in step **412** TR server **110** decrypts the encrypted voted electronic ballot to recover the voted electronic ballot. Once decrypted, TR server **110** can reassemble the modified voted electronic ballot into a single printable file, such as, for example, an HTML file. In step **414**, TR server **110** can print each voted electronic ballot for tallying. Each voted electronic ballot can also be printed with, for example, the ballot type and date of the ballot. Although after a ballot is printed TR server **110** can erase the printable file, the stripped voted electronic ballots can be retained for potential reprint.

According to exemplary embodiments of the present invention, citizen **102** can verify at least one of a voter registration status and an electronic ballot status in the voting system and method of the present invention. Citizen **102** can also verify both the voter registration status and the electronic ballot status. Status can be verified by establishing at least one computer database on a transaction repository server (e.g., TR server **110**) that contains information associated with at least one of the voter registration status of a citizen and the electronic ballot status, or by using any conventional technique for verifying voter registration status and electronic voting ballot status of a citizen. The computer database can be established according to the voting registration process described previously, or by any method that can establish, in a computer database, information associated with voter registration status and electronic ballot status.

An exemplary method for verifying at least one of a voter registration status and an electronic ballot status request will now be described with reference to FIG. **5**. In step **502**, citizen **102** logs into TM server **108** in the manner described previously, if not already logged in. When presented with the election service options, in step **504** citizen **102** can request a status at a first computer (e.g., citizen workstation **104**) from the transaction repository server (e.g., TR server **110**). As part of the status request, citizen **102** can include, for example, the state and county of their residence. In an exemplary embodiment of the present invention, a transaction mediator (e.g., TM server **108**) communicates information between the first computer (e.g., citizen workstation **104**) and the transaction repository server (e.g., TR server **110**). In accordance with an exemplary embodiment of the present invention, in step **506** the status request can be forwarded by TM server **108** to the appropriate TR server **110**.

Upon receipt of the status request, in step **508** TR server **110** determines a status message in response to the status request by examining the at least one computer database. The status message can be at least one of the voter registration status and the electronic ballot status from the at least one computer database. Upon determination, in step **510** the status message is transmitted from the transaction repository server (e.g., TR server **110**) to the first computer (e.g., citizen workstation **104**). In accordance with an exemplary embodiment of the present invention, the status message can be forwarded by TM server **108** to the first computer (e.g., citizen workstation **104**). According to an exemplary embodiment of the present invention, the status response message provided by TR server **110** can include information such as, for example: citizen **102** is not registered to vote; the voting registration of citizen **102** is rejected; the voting registration of citizen **102** is still pending; the voting registration of citizen

102 is approved, but it is too early to vote; the voting registration of citizen 102 is approved, but it is too late to vote; the voting registration of citizen 102 is approved, but the ballot is not loaded; the voting registration of citizen 102 is approved, and the ballot is available; the voting registration of citizen 102 is approved, and citizen 102 has already voted; and the voting registration of citizen 102 is approved, but citizen 102 has requested too many ballots.

FIG. 6A is a detailed pictorial representation of the network architecture of the three principal computer systems of an exemplary embodiment of the present invention. The citizen workstations 602 are the interface through which each citizen is able to register and vote. Citizen workstations 602 can be located anywhere—in a home, office, or an established polling place, for example. Exemplary embodiments of the present invention allow citizens to vote at citizen workstations 602 that are located outside of the voting district of the citizens. Each citizen workstation 602 can be, for example, a generic personal computer that should have a network card or modem, for example, installed so that the citizen using the personal computer can access an electronic communications network 608, such as the Internet. Each citizen workstation 602 should be loaded with a web browser, such as, for example, Netscape Communicator. Each citizen workstation 602 should have a floppy drive or smart card reader, for example, to allow each citizen to input their floppy disk or smart card containing their private key and cryptographic identification.

A TM server network 604 includes one or more TM servers. As shown in greater detail in FIG. 6B, TM server network 604 includes at least one TM server 620. In an exemplary embodiment of the present invention, TM server 620 can be, for example, a high performance personal computer or computer workstation that is loaded with software including, for example, Windows NT 4.0 Server, Microsoft Internet Information Service 4.0, Cold Fusion Application Server 4.5, and Microsoft SQL Server 7.0, or any other operating system software and software that supports networking, network accessing, and database management, for example. TM admin workstation 222 can be, for example, a low-end personal computer. TM admin workstation 622 can be used to monitor TM server 620 and access information residing on TM server 620, such as, for example, reports and event logs. In an exemplary embodiment of the present invention, TM admin workstation 622 can be loaded with Windows NT 4.0 Workstation, for example, or any other operating system software, and a web browser, such as, for example, Netscape Communicator, and can be connected to TM server 620 over a local area network connection. TM server network 604 can also include a printer 636, such as a laser printer, for example, connected to TM admin workstation 622 for report printing.

In addition, TM server network 604 can include a TM router 624 to connect TM server network 204 to electronic communications network 608. TM server network 604 can also include a TM hub 626 to allow networking of each of the components of TM server network 604. For added support, TM uninterruptible power supply 632 can be used, for example, for server alarms and graceful system shutdown in the event of power failure. TM modem 634 can be used, for example, to dial pagers in the event of TM alarms.

As shown in greater detail in FIG. 6C, TR server network 606 includes a plurality of TR servers 640. In an exemplary embodiment of the present invention, TR server 640 can be, for example, a medium performance personal computer or computer workstation running software including, for example, Windows NT 4.0 Server, Microsoft Internet Information Service 4.0, Cold Fusion Application Server 4.5, and Microsoft SQL Server 7.0, or any other operating system software and software that supports networking, network accessing, and database management, for example. In an exemplary embodiment of the present invention, TR admin workstation 642 can be, for example, a low-end personal computer running software including Windows NT 4.0 Workstation, for example, or any other operating system software, and a web browser, such as, for example, Netscape Communicator. TR admin workstation 642 can be connected to TR server 640 through a local area network. TR admin workstation 642 can be used by TR personnel 114 to monitor TR server 640 remotely.

TR server network 606 can also include a printer 644, such as a laser printer, for example, connected to both TR server 640 and TR admin workstation 642 for printing voted electronic ballots and registration forms, respectively. In addition, TR server network 606 can include a TR router 648 to connect TR server network 606 to electronic communications network 608 and TR hub 646 to allow networking of each of the components of TR server network 606. For added support, TR uninterruptible power supply 650 can be used, for example, for server alarms and graceful system shutdown in the event of power failure.

It will be appreciated by those skilled in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential character thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restrictive. The scope of the invention is indicated by the appended claims rather than the foregoing description and all changes that come within the meaning and range of equivalents thereof are indicated to be embraced therein.

What is claimed is:

1. A method for completing and submitting an electronic voter registration form and an electronic ballot over a network, comprising the steps of:

transmitting a blank electronic registration form, upon request at a first computer, via a transaction mediator, to the first computer;

transmitting registration information from the first computer, via the transaction mediator, to a computer database that resides on a transaction repository server, all of which are networked together, to establish a registered voter;

transmitting a blank electronic ballot, upon request by the registered voter at a second computer, from the computer database that resides on the transaction repository server, via the transaction mediator, to the second computer; and

transmitting a voted electronic ballot from the second computer, via the transaction mediator, to the computer database that resides on the transaction repository server.

2. The method of claim 1, comprising:

establishing at least one computer database on the transaction repository server that contains information associated with at least one of a voter registration status of a citizen and a electronic ballot status;

requesting a status at the first computer from the transaction repository server;

determining a status message in response to the step of requesting by examining the at least one computer database; and

transmitting the status message from the transaction repository server to the first computer.

3. The method of claim 2, wherein the voter registration status of the citizen and the electronic ballot status are verified.

4. The method of claim 1, wherein the network includes:

an encrypted communication channel between at least one of the first and second computer and the transaction mediator, and an encrypted communication channel between the transaction mediator and the transaction repository server.

5. The method of claim 1, wherein the registration information includes at least one descriptive element associated with a citizen.

6. The method of claim 1, wherein the step of transmitting registration information comprises:

entering the registration information; and

digitally signing the registration information using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of a citizen, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the registration information.

7. The method of claim 6, wherein the step of transmitting registration information comprises:

erasing from the first computer information associated with the registration information once the registration information has been transmitted.

8. The method of claim 6, wherein the step of transmitting registration information comprises:

verifying the digital signature using the public key of the public-private key pair.

9. The method of claim 6, wherein the public-private key pair and the cryptographic identification can be used by the citizen with respect to a plurality of electronic transactions.

10. The method of claim 1, wherein the step of transmitting registration information comprises:

approving or denying a voting registration request at the computer database based on the registration information of a citizen.

11. The method of claim 1, wherein the second computer is the first computer.

12. The method of claim 1, wherein the step of transmitting a blank electronic ballot comprises:

digitally signing the blank electronic ballot using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of an operator of the transaction repository server, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the blank electronic ballot; and

transmitting a public key of a public-private key pair of the transaction repository server.

13. The method of claim 1, wherein the step of transmitting the voted electronic ballot comprises:

executing the blank electronic ballot;

encrypting the voted electronic ballot using a symmetric cryptographic function and a symmetric key that is randomly generated by the second computer;

encrypting the symmetric key using a public key of a public-private key pair of the transaction repository server; and

digitally signing the encrypted voted electronic ballot and the encrypted symmetric key using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of the registered voter, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the voted electronic ballot.

14. The method of claim 13, comprising:

erasing from the second computer information associated with the encrypted voted electronic ballot once the voted electronic ballot has been transmitted.

15. The method of claim 13, comprising:

verifying the digital signature of the encrypted voted electronic ballot and the encrypted symmetric key using the public key of the public-private key pair of the registered voter.

16. The method of claim 13, comprising:

reconciling transmitted voted electronic ballots by an operator of the transaction repository server to establish the validity of each transmitted voted electronic ballot.

17. The method of claim 16, comprising:

separating a plurality of valid encrypted voted electronic ballots into groups based on at least one characteristic;

stripping the digital signature and the cryptographic identification of the registered voter from each group of valid encrypted voted electronic ballots; and

randomly mixing within each group the separated encrypted voted electronic ballots.

18. The method of claim 17, wherein the at least one characteristic is a type of voted electronic ballot.

19. The method of claim 17, comprising:

decrypting the encrypted symmetric key of each separated voted electronic ballot using a private key of the public-private key pair of the transaction repository server;

decrypting the encrypted voted electronic ballot using the symmetric key to recover the voted electronic ballot; and

printing the voted electronic ballot.

20. A method for verifying at least one of a voter registration status and an electronic ballot status in a voting system, comprising the steps of:

establishing at least one computer database on a transaction repository server that contains information associated with at least one of the voter registration status of a citizen and the electronic ballot status;

receiving, from a first computer connected to a computer network, a citizen's request regarding status of at least one of the citizen's voter registration and the citizen's electronic ballot status;

determining a status message in response to the step of receiving by examining the at least one computer database; and

transmitting the status message from the transaction repository server to the first computer over the computer network.

21. The method of claim 20, wherein a transaction mediator communicates information between the first computer and the transaction repository server.

22. The method of claim 20, wherein the voter registration status of the citizen and the electronic ballot status are verified.

23. A method for completing and submitting an electronic voter registration form and an electronic ballot transmitted over a network, comprising the steps of:

transmitting registration information from a first computer to a computer database that resides on a transaction repository server, all of which are networked together, to establish a registered voter; and

transmitting a voted electronic ballot of the registered voter from a second computer to the computer database that resides on the transaction repository server.

24. The method of claim 23, wherein the second computer is the first computer.

25. The method of claim 23, comprising:

transmitting a blank electronic registration form, upon request at the first computer, to the first computer.

26. The method of claim 25, comprising:

transmitting a blank electronic ballot, upon request by the registered voter at the second computer, from the computer database that resides on the transaction repository server to the second computer.

27. The method of claim 23, wherein the step of transmitting registration information comprises:

entering the registration information; and

digitally signing the registration information using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of a citizen, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the registration information.

28. The method of claim 27, wherein the public-private key pair and the cryptographic identification can be used by the citizen with respect to a plurality of electronic transactions.

29. The method of claim 26, wherein the step of transmitting a blank electronic ballot comprises:

digitally signing the blank electronic ballot using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of an operator of the transaction repository server, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the blank electronic ballot; and

transmitting a public key of a public-private key pair of the transaction repository server.

30. The method of claim 23, wherein the step of transmitting the voted electronic ballot comprises:

executing the blank electronic ballot;

encrypting the voted electronic ballot using a symmetric cryptographic function and a symmetric key that is randomly generated by the second computer;

encrypting the symmetric key using a public key of a public-private key pair of the transaction repository server; and

digitally signing the encrypted voted electronic ballot and the encrypted symmetric key using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of the registered voter, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the voted electronic ballot.

31. The method of claim 30, comprising:

decrypting the encrypted symmetric key using a private key of the public-private key pair of the transaction repository server;

decrypting the encrypted voted electronic ballot using the symmetric key to recover the voted electronic ballot; and

printing the voted electronic ballot.

32. A method for completing and submitting an electronic registration form and an electronic ballot over a network, comprising the steps of:

transmitting a blank electronic registration form, upon request at a first computer, to the first computer; and

transmitting registration information from the first computer to a computer database that resides on a transaction repository server, all of which are networked together, to establish a registered voter, so that a voted electronic ballot can be transmitted from a second computer.

33. The method of claim 32, comprising:

transmitting a blank electronic ballot, upon request by the registered voter at a the second computer, from the computer database that resides on the transaction repository server to the second computer.

34. The method of claim 33, wherein the second computer is the first computer.

35. The method of claim 33, comprising:

transmitting a voted electronic ballot from the second computer to the computer database that resides on the transaction repository server.

36. The method of claim 32, wherein the step of transmitting registration information comprises:

entering the registration information; and

digitally signing the registration information using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of a citizen, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the registration information.

37. The method of claim 36, wherein the public-private key pair and the cryptographic identification can be used by the citizen with respect to a plurality of electronic transactions.

38. The method of claim 33, the step of transmitting a blank electronic ballot comprises:

digitally signing the blank electronic ballot using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of an operator of the transaction repository server, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the blank electronic ballot; and

transmitting a public key of a public-private key pair of the transaction repository server.

39. The method of claim 35, wherein the step of transmitting the voted electronic ballot comprises:

executing the blank electronic ballot;

encrypting the voted electronic ballot using a symmetric cryptographic function and a symmetric key that is randomly generated by the second computer;

encrypting the symmetric key using a public key of a public-private key pair of the transaction repository server; and

digitally signing the encrypted voted electronic ballot and the encrypted symmetric key using a private key of a public-private key pair, wherein the public-private key pair is generated using an asymmetric cryptographic function, wherein a public key of the public-private key pair is associated with a cryptographic identification of the registered voter, and wherein the public-private key pair and the cryptographic identification are created prior to transmitting the voted electronic ballot.

40. The method of claim 39, comprising:

decrypting the encrypted symmetric key using a private key of the public-private key pair of the transaction repository server;

decrypting the encrypted voted electronic ballot using the symmetric key to recover the voted electronic ballot; and

printing the voted electronic ballot.

41. A system for completing and submitting an electronic voter registration form and an electronic ballot over a network, comprising:

a transaction repository server for transmitting a blank electronic ballot to a first computer;

a computer database, accessible by the transaction repository server, for storing the blank electronic ballot; and

a transaction mediator for communicating information between the transaction repository server and the first computer, the transaction mediator being operative to transmit registration information from the first computer to the computer database to establish a registered voter, so that a voted electronic ballot can be transmitted from a second computer.

42. The system of claim **41**, wherein the transaction mediator is operative to transmit the voted electronic ballot from the first computer to the computer database.

43. The system of claim **42**, wherein the first computer comprises multiple computers.

44. The system of claim **41**, comprising:

an encrypted communication channel between the first computer and the transaction mediator, and an encrypted communication channel between the transaction mediator and the transaction repository server.

45. The system of claim **41**, wherein the registration information includes at least one descriptive element associated with the citizen.

46. A system for verifying at least one of a voter registration status and an electronic ballot status in a voting system, comprising:

a first computer connected to a computer network by which a citizen can request at least one of the citizen's voter registration status and the citizen's electronic ballot status from a transaction repository server; and

at least one computer database, accessible by the transaction repository server, for containing information associated with at least one of the voter registration status of a citizen and the electronic ballot status;

the transaction repository server being operative for determining a status message in response to the status request by examining the at least one computer database, and for transmitting the status message to the first computer.

47. The system of claim **46**, wherein the voter registration status of the citizen and the electronic ballot status are verified.

* * * * *