Title: Necessity of Source Code Review for Dominion Voting Systems EMS and Tabulators
Analyst: James Thomas Penrose, IV

Executive Summary

The Dominion Voting Systems Patent US8,876.002B2 dated Nov 4, 2014 details how Dominion voting machines support pre-election Logic and Accuracy testing (Pre-LAT) system.

This patent outlines the technology concepts and design of Dominion with respect to maximizing automation in the election configuration, ballot generation, processing, and testing process. The outcome is to save the maximum amount of time through automation with features and functionality that make it unnecessary to have humans in the loop of running elections with various configurations that impact the ballot configuration, vote casting, tabulation process, processing of ballot images, and final tallied vote totals.

The specific incident in Antrim county is related to the features and the functionality outlined in this patent; if any of the automated configuration and testing functionality implemented by Dominion were to be abused in a systematic fashion, modification of election outcomes would be trivial for an attacker. Patents do not specify the precise implementation of the features or functionality and the only way to determine the precise functionality implemented is to review the source code of the operational systems using this patented technology.

Details

Here is an excerpt from the patent that speaks extensively about the use of networked functionality to allow for testing at scale in larger jurisdictions:

> ***Additionally, the network communication device 28 enables the Voting machines to have polls opened in pre-LAT mode remotely over the network. Pre-LAT polls mode is a standard mode of operation for a voting device for conducting Pre-election Logic and Accuracy tests. Further, the communication device enables the voting machines 11 to be provided with a vote simulation script over the network. A vote simulation script is a set of commands that can simulate Voting patterns on the machine even to the level of providing pre canned scanned ballot images or PDF images of ballots with machine generated marks for testing the vote interpretation engine on the tabulator. The communication device 28 also***

enables the voting machines 11 to be remotely instructed to run pre-LAT activities such as interpreting vote simulation Scripts and images, performing image calibration procedures, Verifying all system components for readiness and proper function, self printer test etc. Finally, results of all Pre-LAT tests can be communicated back to the EMS through the communications device 28.

Further, the network communication device 28 allows the Voting machines 11 to have pre-LAT polls opened remotely over the network, have pre-LAT polls closed remotely over the network and can communicate pre-LAT results back over the network. Additionally, the pre-LAT polls can be closed manually and can communicate pre-LAT results back over the network.

Thus, the Voting machines 11 can be programmed with an election ballot from over the network, have pre-LAT polls opened remotely over the network and then disable all net work ports thru the tabulator firmware and software. Further, the Voting machines 11 can be programmed with an election ballot from over the network, have pre-LAT polls opened remotely over the network, have pre-LAT polls closed manu ally and then disable all network ports.

Use of a Network to Prepare Voting Machines

Typically the warehouse process cycle consists of the fol lowing functions (see FIG.3): Storage and maintenance 100: Test 101: Repair 102: Machine Preparation 103; Pre-LAT 104; Distribution 105: Acceptance back after election 106: and Escrow storage 107.

The Dominion Voting System's patent states that their machines have network connectivity that can be used to open the polls for pre-LAT activities. Being able to remotely open the polls using networked devices raises a number of questions related to the network security.

- What authentication controls the level of access to the voting machines using the remote access?

- What safeguards are in place to protect the mode of operation of the voting machines; for instance, what prevents a technician from placing the machines in the Pre-LAT mode during the time of an election, and how are such mode changes logged for security review?

The patent also indicates that a vote simulation script is used to produce votes and enable counting of votes for pre-LAT purposes. The vote simulation script includes additional features such as the ability to generate "pre-canned" ballots to scan.

- This script is configurable to generate various election results for testing purposes
- The results from the pre-LAT activities are reported back to the EMS for logging and validation of a successful test

It is unclear from the patent if all parts of networked voting machine infrastructure are properly logged when they are operating in Pre-LAT mode. Given the far-reaching interaction of the pre-LAT scripts across all of the voting machine infrastructure it is imperative to review the original source code of the pre-LAT scripts used by Dominion, their sub-contractors (eg ElectionSource) and the county staff. A review of the pre-LAT script source code would illuminate all of the ways that the networked voting machine infrastructure is manipulated to test. Moreover, to truly understand the impact and methods of the pre-LAT script, the source code for the tabulators, EMS, and other listener servers would be required to make an assessment.

In Antrim County, there was no evidence of pre-LAT test results on the EMS. The use of automated scripts designed to generate votes comes with inherent dangers, not the least of which is the fact that the script could fall into the hands of a malicious actor that wants to use those techniques for fraud.

The versatile pre-LAT set of tools used by Dominion to test the networked voting system is pivotal to understanding whether what happened in Antrim county is attributable to a script that is of the same parentage as pre-LAT scripts, or if the error was purely human in nature.

In order to determine if a pre-LAT script was used in Antrim County, it is critical that the source code be reviewed for the script(s) itself and the appropriate investigative steps be taken to determine if the scripts run to change the vote counting in Antrim are of the same parentage.

The source code for all elections systems is required to be retained by the Michigan Secretary of State in a third-party escrow account. The Michigan Election Code states the following:

168.797c Computer program; disposition and use of source code.

Sec. 797c. A person or company providing a computer program that examines, counts, tabulates, and prints results of the votes cast by a voter on an electronic voting system shall place in an escrow account a copy of the source code of the program and any subsequent revisions or modifications of the source code. The secretary of state or an authorized agent of the secretary of state shall agree to use the information contained in the source code solely for the purpose of analyzing and testing the software and shall not disclose proprietary information to any other person or agency without the prior written consent of the vendor.

Here are the relevant definitions of the terms above:

168.794 Definitions used in MCL 168.794 to 168.799a.

Sec. 794. As used in sections 794 to 799a:

(a) "Audit trail" means a record of the votes cast by each voter that can be printed, recorded, or visually reviewed after the polls are closed. The record shall not allow for the identification of the voter.

(b) "Ballot" means a card, ballot label, paper ballot, envelope, or any medium through which votes are recorded.

(c) "Ballot label" means the display or material containing the names of offices and candidates or the questions to be voted on.

(d) "Counting center" means 1 or more locations selected by the board of election commissioners of the city, county, township, village, or school district at which ballots are counted by means of electronic tabulating equipment or vote totals are electronically received from electronic tabulating equipment and electronically compiled.

(e) "Electronic tabulating equipment" means an apparatus that electronically examines and counts votes recorded on ballots and tabulates the results.

(f) "Electronic voting system" means a system in which votes are recorded and counted by electronic tabulating equipment.

(g) "Escrow account" means a third party approved by the secretary of state for the purpose of taking custody of all source codes, including all revisions or modifications of source codes.

(h) "Source code" means the assembly language or high level language used to program the electronic voting system.

(i) "Voting device" means an apparatus that contains the ballot label and allows the voter to record his or her vote.

(j) "Voting station" means an enclosure provided to ensure ballot secrecy during the voting of the ballot.
(k) "Memory device" means a method or device used to store electronic data.

The benefit of analyzing source code from the third-party escrow account is the fact that all original source code and changes to the source code must be stored with the third-party to ensure that changes that impact any election voting, tabulation, reporting, and testing is memorialized for authorized investigations. The Michigan Election Code (law) provides for this transparency to ensure the integrity of the election system.

Source code is required to perform this evaluation from the following systems and technical tools:

- All scripts (source) used for pre-LAT activities
- All source code associated with all the varieties of tabulators, EMS, poll books, and other networked servers

Under the penalties of perjury, I declare that I have read the foregoing report and that the fact stated in it are true.

James Thomas Penrose, IV
Date: 5/15/2021

MICHIGAN NOTARY ACKNOWLEDGEMENT

State of Michigan
County of Oakland

The foregoing instrument was acknowledged before me on this 15th day of May, 2021 by James Thomas Penrose, IV.

Notary Public Signature: Ann M. Howard

Notary Printed Name: Ann M. Howard
Acting in the County of: Oakland
My Commission Expires: 2/24/2023

US008876002B2

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

(10) **Patent No.: US 8,876,002 B2**
(45) **Date of Patent: Nov. 4, 2014**

(54) **SYSTEMS FOR CONFIGURING VOTING MACHINES, DOCKING DEVICE FOR VOTING MACHINES, WAREHOUSE SUPPORT AND ASSET TRACKING OF VOTING MACHINES**

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(73) Assignee: **Dominion Voting Systems, Inc.**, Denver, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/092,604**

(22) Filed: **Apr. 22, 2011**

(65) **Prior Publication Data**

US 2012/0048930 A1 Mar. 1, 2012

Related U.S. Application Data

(63) Continuation of application No. PCT/US2009/062069, filed on Oct. 26, 2009.

(60) Provisional application No. 61/193,062, filed on Oct. 24, 2008.

(51) **Int. Cl.**
G07C 13/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G07C 13/00*** (2013.01)
USPC ..... **235/386**; 235/51; 235/54 F

(58) **Field of Classification Search**
USPC ..... 235/51, 52, 54 E, 54 F, 56, 57, 386, 454, 235/462.01, 487, 492
See application file for complete search history.

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(Continued)

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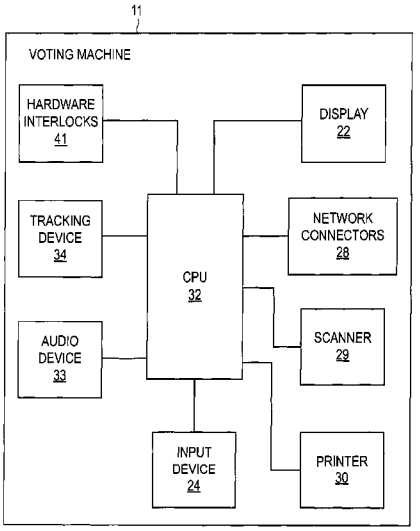
(74) *Attorney, Agent, or Firm* — Holland & Hart LLP

(57) **ABSTRACT**

A system and device facilitate the storage and tracking of warehoused voting machines. A system includes a host computer, a plurality of voting machines that are connected via a network to the host computer, each voting machine having one or both of a wireless communication device and a data port that is coupled to the host computer. The system also includes an election and voting machine preparation portion included in the host computer to manage and/or control the connected voting machines. The election and voting machine preparation portion is configured to manage the status of the connected voting machines, is configured to instruct the voting machines to run self tests, is configured to receive results of the self tests back from the connected voting machines, and is configured to prepare/program the connected voting machines with an election ballot.

17 Claims, 8 Drawing Sheets



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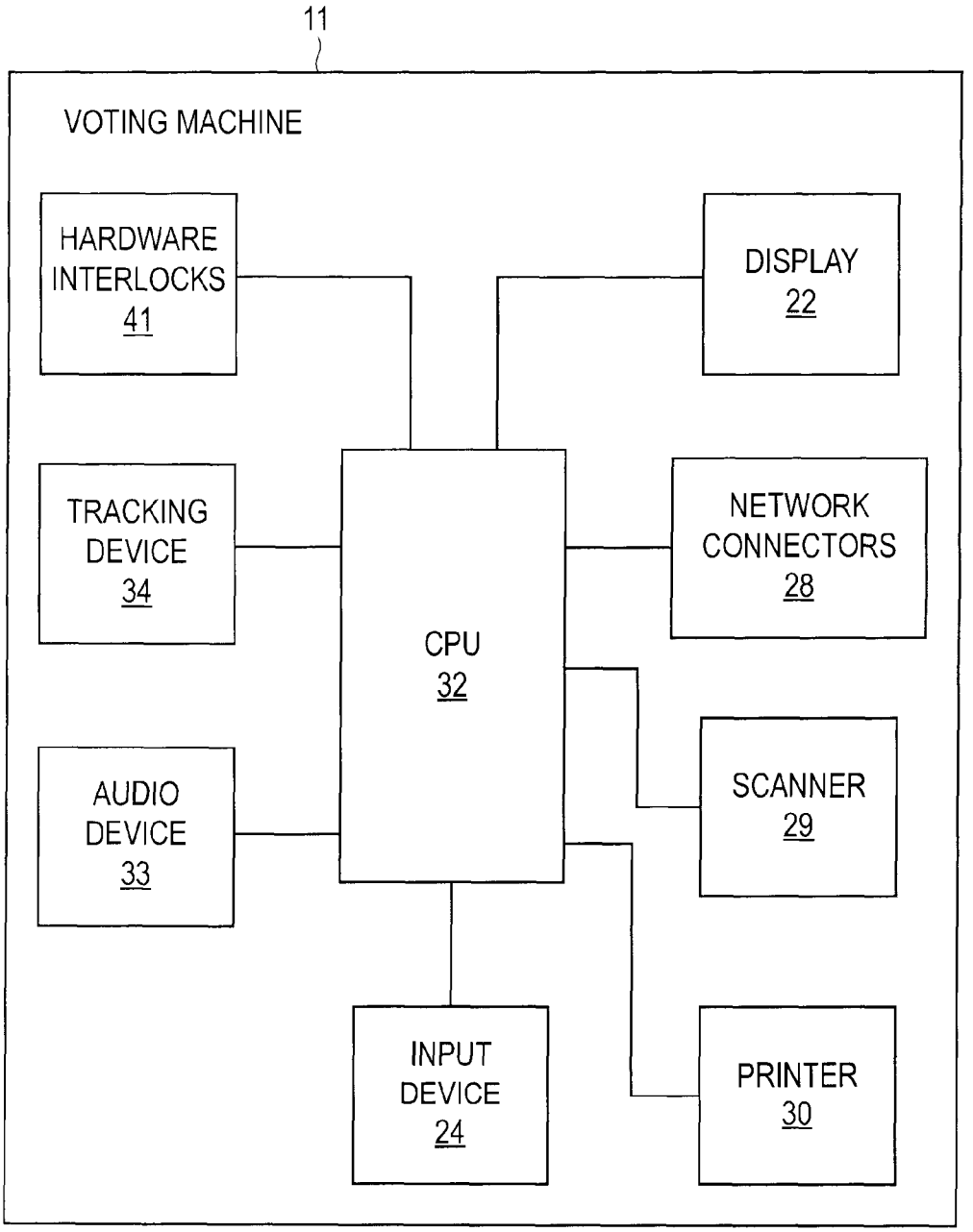
11
VOTING MACHINE
HARDWARE INTERLOCKS 41
DISPLAY 22
TRACKING DEVICE 34
CPU 32
NETWORK CONNECTORS 28
AUDIO DEVICE 33
SCANNER 29
INPUT DEVICE 24
PRINTER 30

FIG. 1

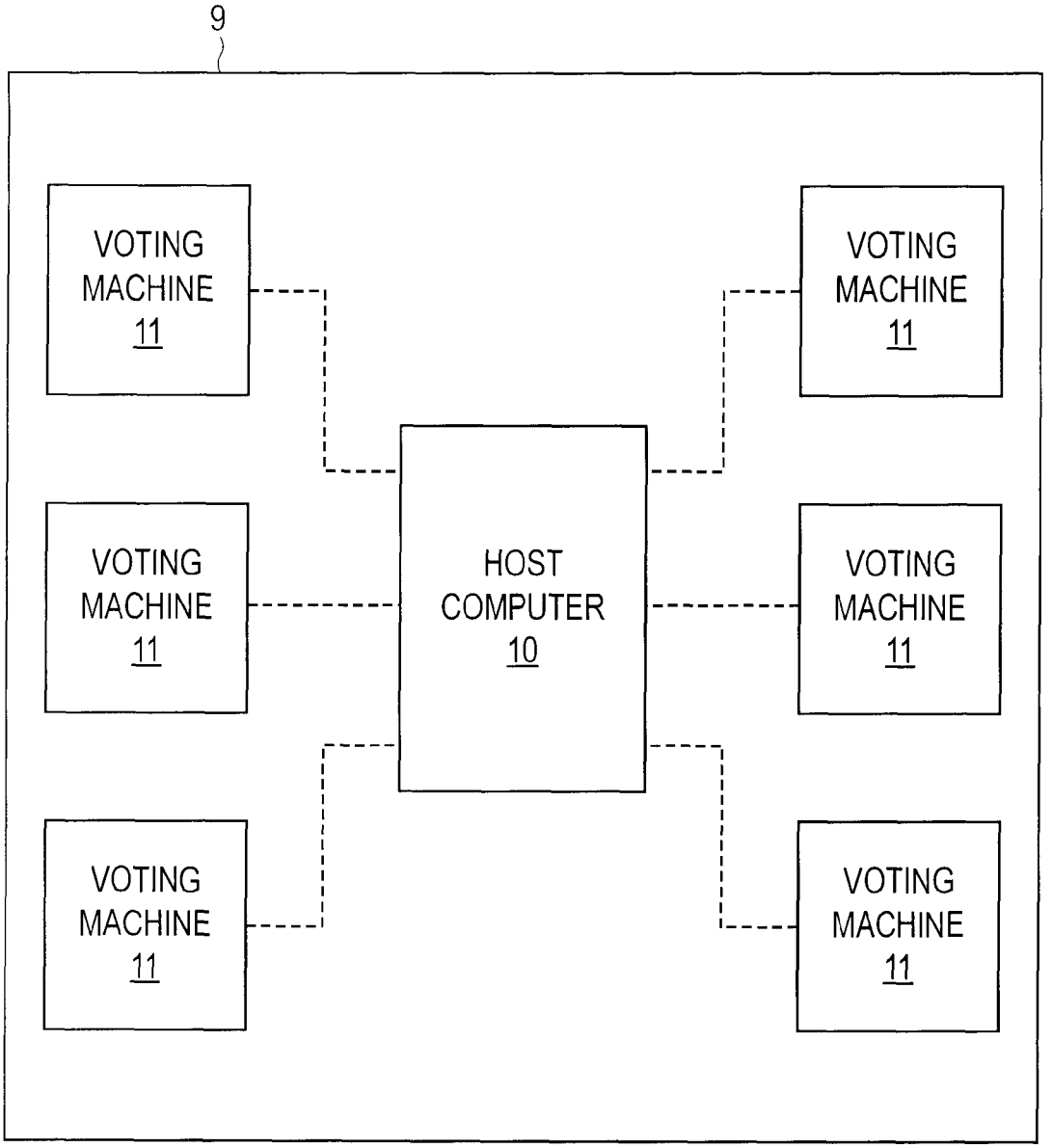
9
VOTING MACHINE 11
VOTING MACHINE 11
VOTING MACHINE 11
HOST COMPUTER 10
VOTING MACHINE 11
VOTING MACHINE 11
VOTING MACHINE 11

FIG. 2

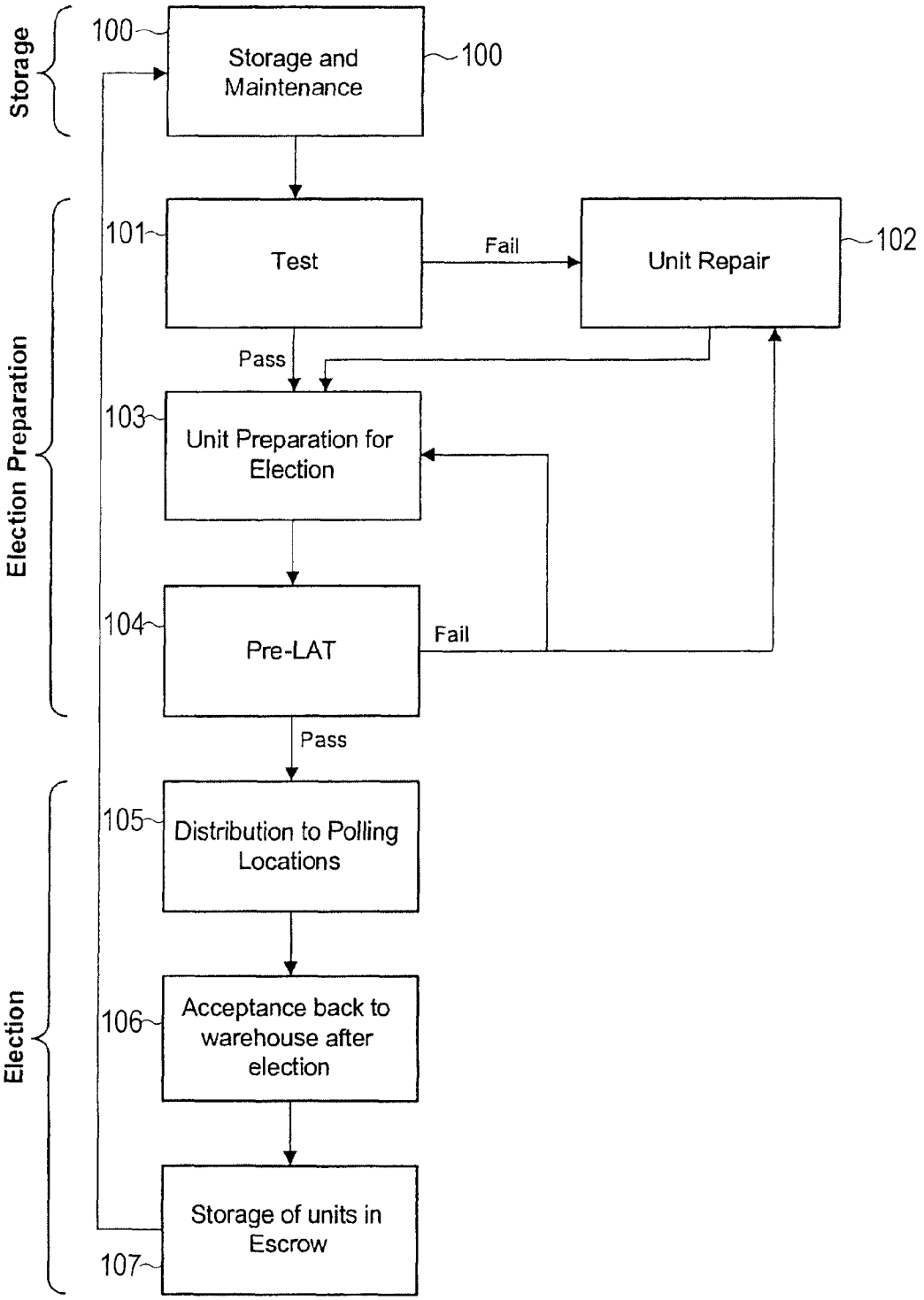
Storage
100
Storage and Maintenance
100
Election Preparation
101
Test
Fail
Unit Repair
102
Pass
103
Unit Preparation for Election
104
Pre-LAT
Fail
Pass
Election
105
Distribution to Polling Locations
106
Acceptance back to warehouse after election
Storage of units in Escrow
107

FIG. 3

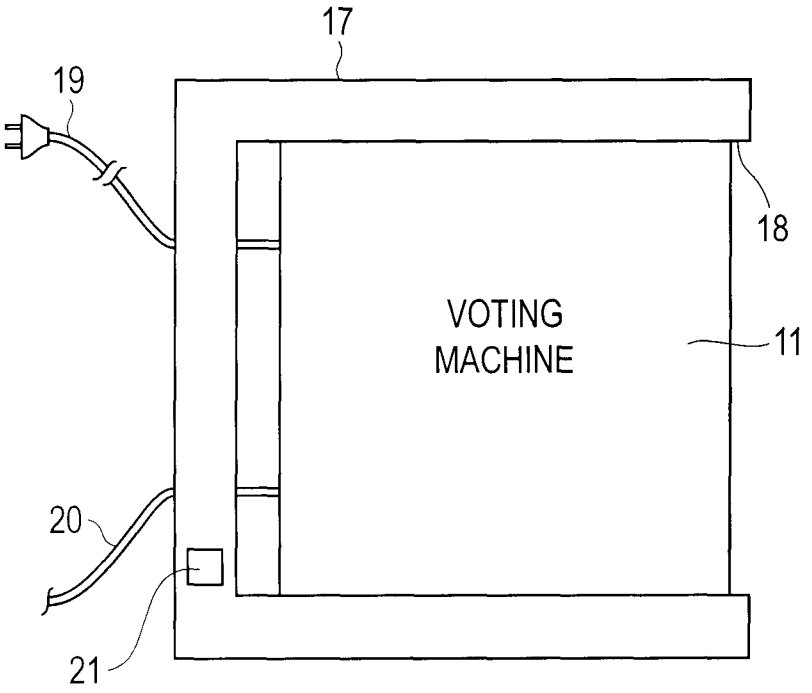

FIG. 4

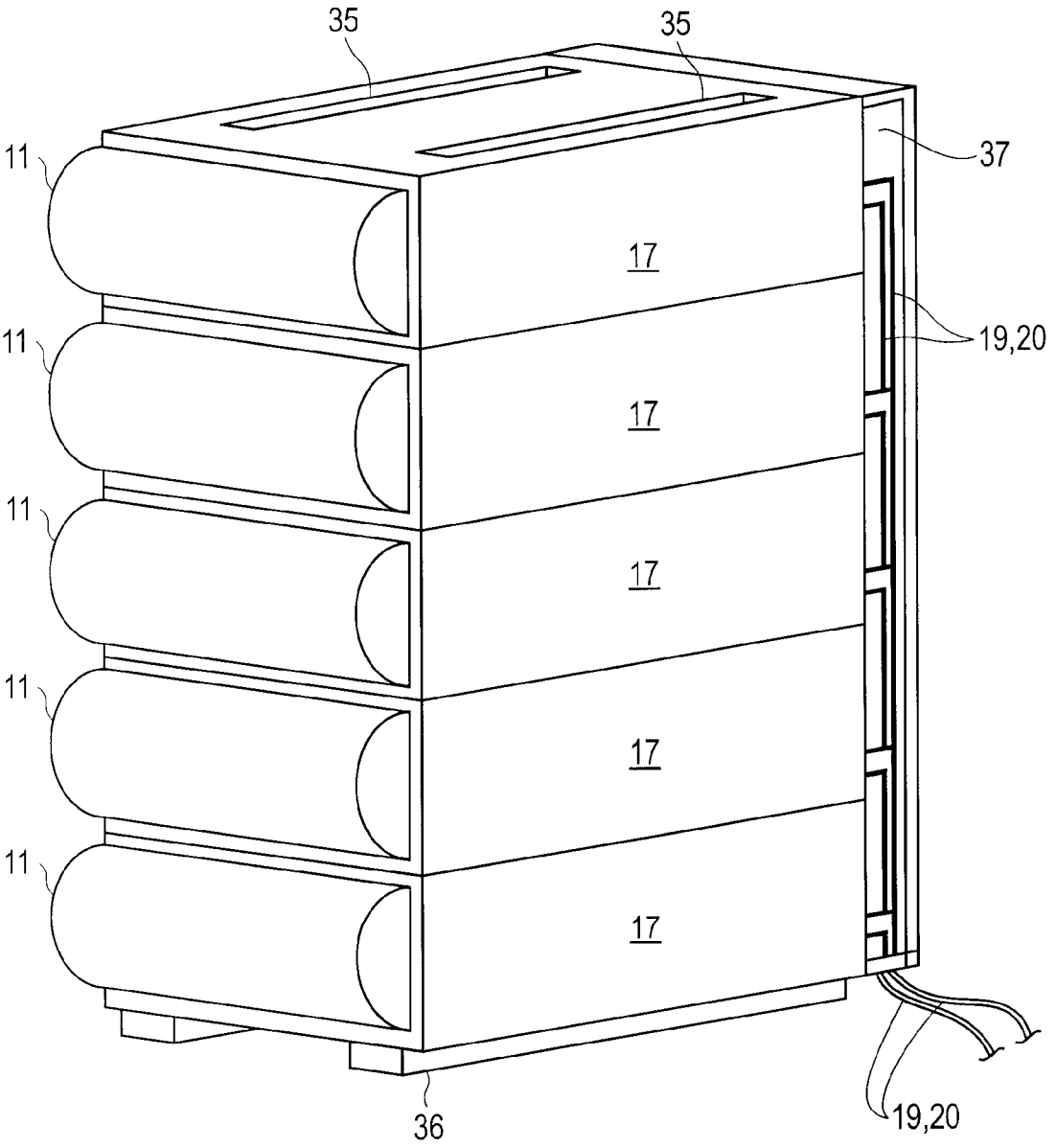

FIG. 5

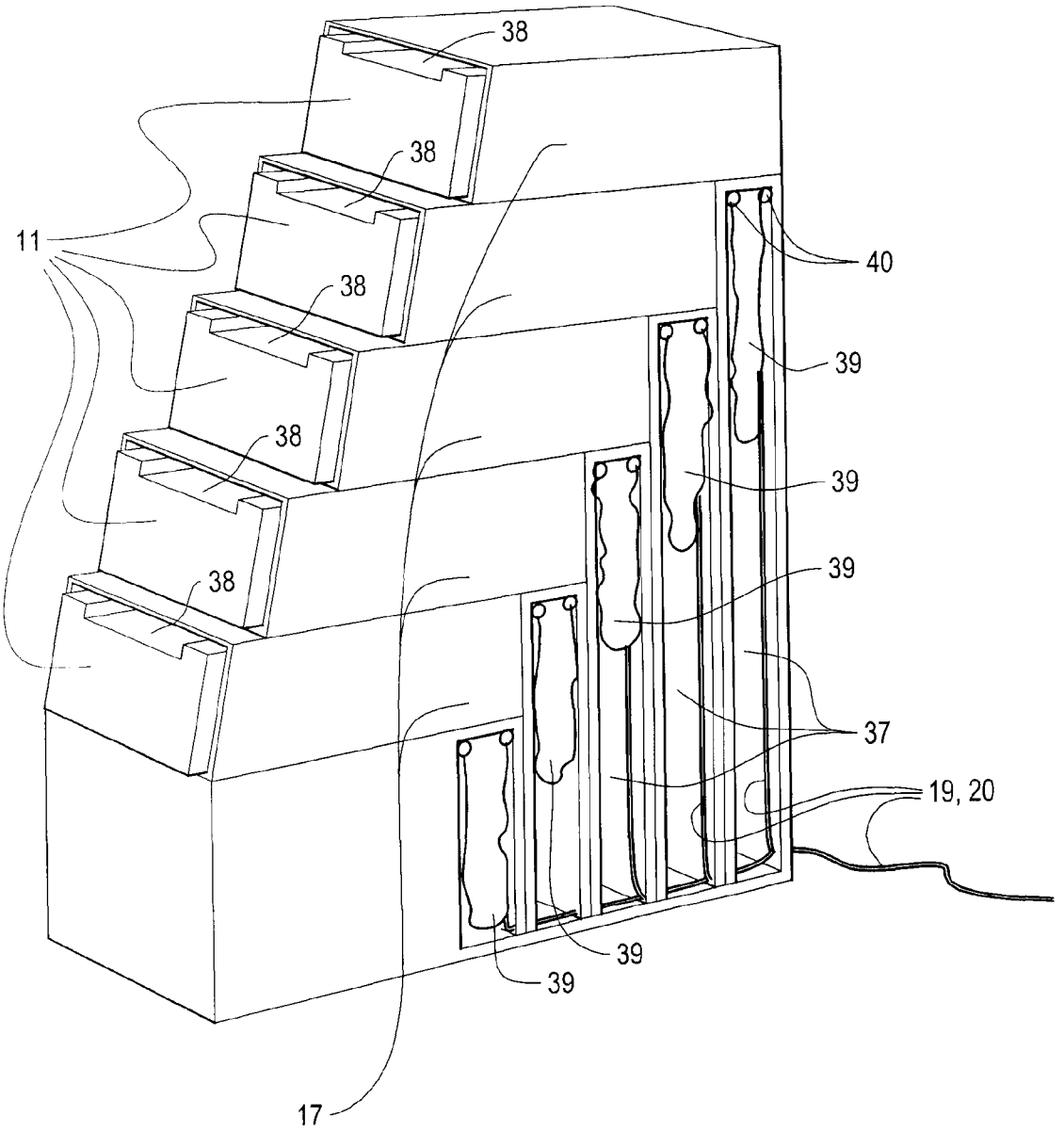

FIG. 6

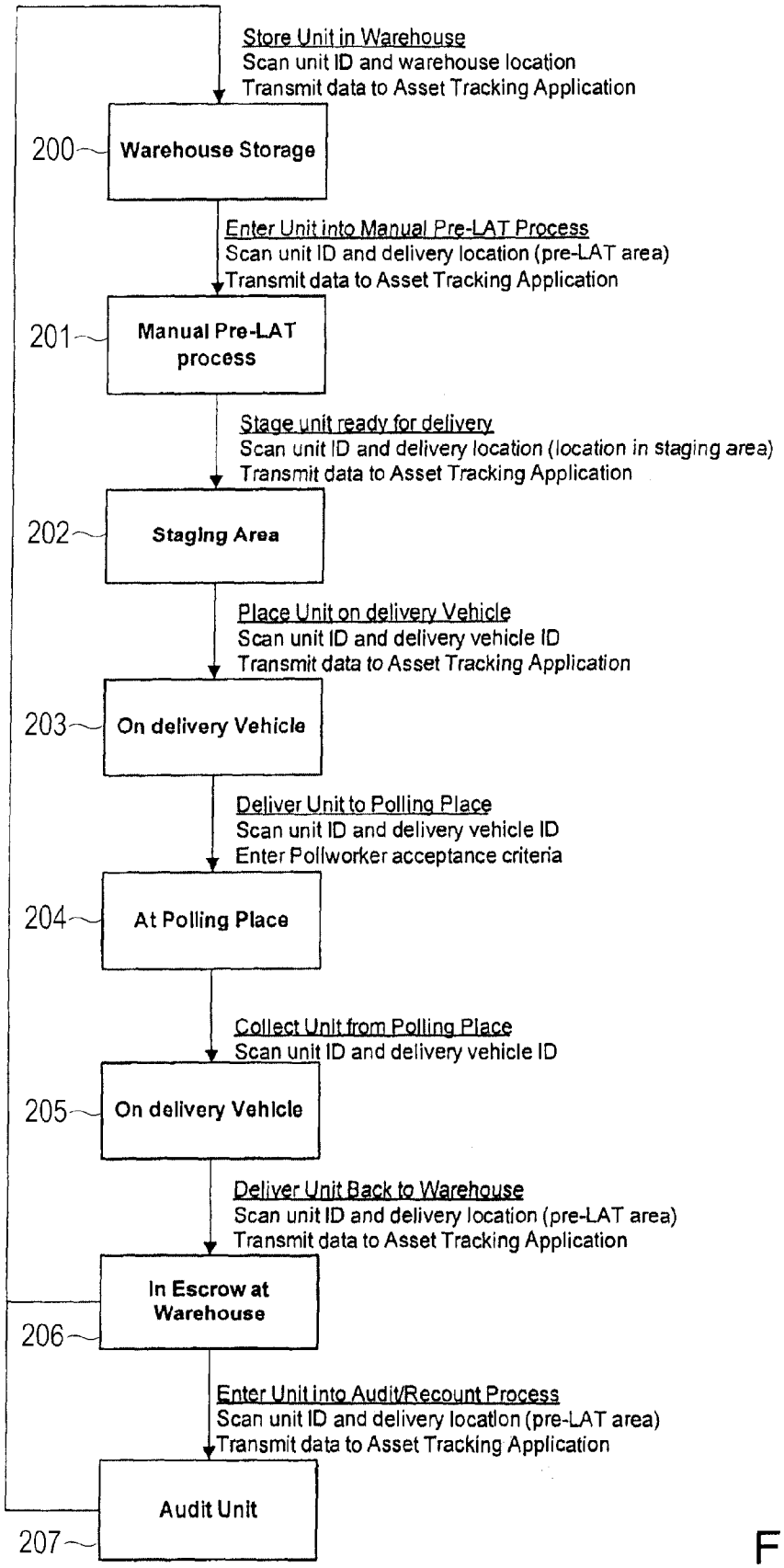
Store Unit in Warehouse
Scan unit ID and warehouse location
Transmit data to Asset Tracking Application
200
Warehouse Storage
Enter Unit into Manual Pre-LAT Process
Scan unit ID and delivery location (pre-LAT area)
Transmit data to Asset Tracking Application
201
Manual Pre-LAT process
Stage unit ready for delivery
Scan unit ID and delivery location (location in staging area)
Transmit data to Asset Tracking Application
202
Staging Area
Place Unit on delivery Vehicle
Scan unit ID and delivery vehicle ID
Transmit data to Asset Tracking Application
203
On delivery Vehicle
Deliver Unit to Polling Place
Scan unit ID and delivery vehicle ID
Enter Pollworker acceptance criteria
204
At Polling Place
Collect Unit from Polling Place
Scan unit ID and delivery vehicle ID
205
On delivery Vehicle
Deliver Unit Back to Warehouse
Scan unit ID and delivery location (pre-LAT area)
Transmit data to Asset Tracking Application
In Escrow at Warehouse
206
Enter Unit into Audit/Recount Process
Scan unit ID and delivery location (pre-LAT area)
Transmit data to Asset Tracking Application
Audit Unit
207

FIG. 7

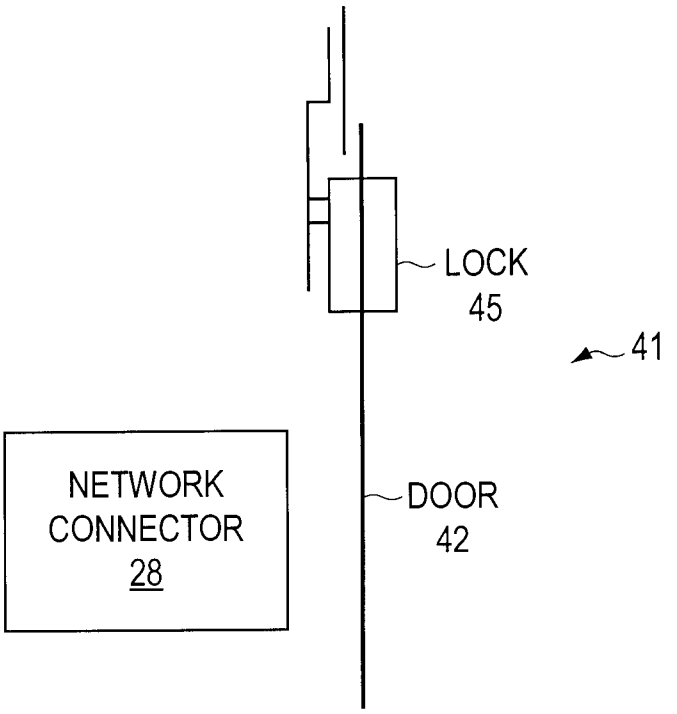
LOCK
45
41
NETWORK
CONNECTOR
28
DOOR
42

FIG. 8

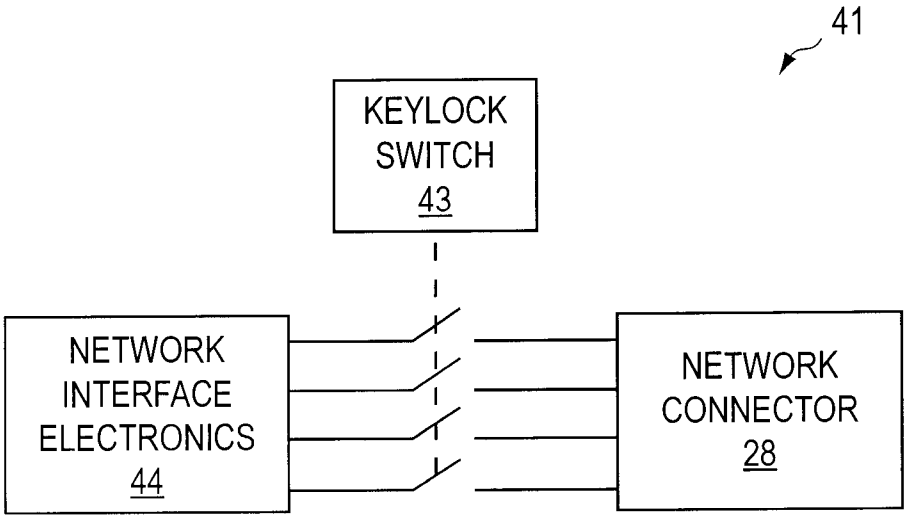
41
KEYLOCK
SWITCH
43
NETWORK
INTERFACE
ELECTRONICS
44
NETWORK
CONNECTOR
28

FIG. 9

SYSTEMS FOR CONFIGURING VOTING MACHINES, DOCKING DEVICE FOR VOTING MACHINES, WAREHOUSE SUPPORT AND ASSET TRACKING OF VOTING MACHINES

This application is a continuation of International Application No. PCT/US2009/062069, filed Oct. 26, 2009, which claims the benefit of U.S. Provisional Application No. 61/193,062, filed Oct. 24, 2008, each of which are incorporated herein by reference in their entirety.

BACKGROUND

The warehousing processes associated with an election are some of the most problematic and time consuming in the entire election process, especially for larger jurisdictions. The complexity of these processes increases exponentially with the size of the jurisdiction.

Electronic voting systems consist of several disparate systems including the Election Management System (EMS), Ballot Tabulators (digital-optical scan voting machines, direct-record-electronic (DRE) voting machines, etc), as well as other ancillary systems including electronic poll-books, accumulation and consolidation devices, and wireless transmission systems for results. Managing these assets can be a significant burden to jurisdictions. In addition, current voting systems rely on a disconnected process for programming the voting machines to transfer the ballot definition data from the EMS to the voting machines. This is historically accomplished by writing the ballot definition data to a removable memory element from the EMS-flash drive usb drives, secure-digital flash drives, PCMCIA flash drives etc. This disconnected process introduces several failure points in the process, and significantly increases the overall effort required of jurisdictions to run an election.

Further, due to the periodic nature of elections, voting machines are necessarily stored for periods up to years in between elections. Therefore, it is desirable to produce apparatus for and methods of adequately, safely and efficiently storing voting machines in between elections.

Furthermore, in large jurisdictions having several voting machines, it is desirable to provide a means for tracking the voting machines as they are used in an election.

SUMMARY

In view of the above issues, a number of improvements are presented.

The system for configuring voting machines described herein has the following benefits. First, the system significantly reduces the effort required to test the functioning of the voting machine by automating the programming and testing of the machines. Second, the system significantly reduces the effort required to prepare and conduct pre-election Logic and Accuracy Tests (pre-LAT) on the voting machines, by automating as much of the process as possible in the warehouse. Third, this system allows warehouse workers to identify and locate voting machines that have faults. Fourth, this system allows warehouse workers to identify and locate voting machines that failed to prepare correctly. Fifth, this system allows warehouse workers to identify and locate voting machines that failed pre-LAT. And sixth, this system ensures voting machine integrity by ensuring that network functionality is not available after pre-LAT has been completed.

Some improvements allow for the safe stacking and storage of voting machines in a warehouse, allow voting machines to be provided with power to operate and charge batteries while being stored in the warehouse, allow voting machines to be connected to a network while being stored in the warehouse, and allow the location of individual voting machines to be tracked while being stored in the warehouse.

Another improvement relates to a storage and docking station designed for each type of voting machine and allows voting machines to be stacked and stored safely such that the voting machines are protected from damage. The storage and docking station also is capable of providing power to the machines for battery charging and network connectivity, if supported, for connection to a warehouse management application. The docking station also provides security authentication, which will allow the voting machine to activate various interface ports and support various modes of operation.

The protective docking device can accept a voting machine such that the protective docking device provides physical protection for the voting machine while being stored. Additionally, the protective docking device is capable of being stacked on other protective docking devices such that no damage occurs to the voting machines while being stored. Additionally, the protective docking device can be stacked in position either with or without a voting machine attached therein. Another feature of this improvement is that the protective docking device can provide power and communication connections (including network connectivity) to the voting machine. The protective docking device can also provide loop-back connections on I/O ports to support external loop back tests.

Further, the docking device can have the necessary authentication devices in them for successful communication with the voting machines.

Furthermore, it is within the scope of the improvement that the voting machines can contain location tracking mechanisms such as unique barcodes and RFID tags.

Additionally, the plurality of protective docking devices can communicate location information of the voting machine to the asset tracking system.

Another improvement provides an asset tracking system that allows jurisdictions to accurately manage and account for their voting machine assets by allowing jurisdictions to monitor the locations of their voting machine assets both in the warehouse and in transit for an election. For example, the voting machine assets can be scanned when they are staged for shipment, scanned when they are loaded onto a truck or other vehicle, scanned when they are delivered to polling places, scanned when they are picked up from polling places and scanned when they are delivered back to the warehouse. The asset tracking system will then be able to track where the voting machine assets are in that lifecycle.

In the asset tracking system, each voting machine can have its own unique serial number identifier, which can be, for example, encoded in a bar code on the outside of the machine. Alternatively, the unique serial number identifier can be encoded in an RFID tag in the machine. Further, the RFID tag in the machine can be an RFID tag that is "read only."

Some improvements can further include asset tracking peripheral devices that are capable of reading the serial number identifiers of the plurality of voting machines via bar codes on the outside of the voting machines. In the case where the unique serial number identifiers are encoded in an RFID tag in the voting machines, the asset tracking peripheral devices are capable of reading the serial numbers of a plurality of voting machines via the RFID tags in the voting machines. These peripheral devices can consist of portable

hand held devices containing supporting applications or fixed location devices directly connected to the asset tracking application.

One improvement also includes asset tracking applications that are capable of managing and tracking assets utilizing the serial number data collected from a plurality of voting machines that have unique serial number identifiers using a plurality of asset tracking peripheral devices. Further, the asset tracking peripheral devices are capable of communicating the serial number data to the asset tracking application.

Another improvement includes a tracking and preparation system for networked voting machines including a host computer, a plurality of voting machines connected via a network to the host computer, each voting machine having one or both of a wireless communication device and a data port for coupling to the host computer, and an election and voting machine preparation portion included in the host computer that is configured to manage and/or control the connected voting machines.

The election and voting machine preparation portion can be configured to manage the status of the connected voting machines, can be configured to instruct the voting machines to run self tests, can be configured to receive results of the self tests back from the connected voting machines, and can be configured to prepare/program the connected voting machines with an election ballot.

The self tests run by the voting machines can correspond to pre-LAT tests.

The election and voting machine preparation portion can be configured to open pre-LAT polls remotely over the network.

The election and voting machine preparation portion can also be configured to run simulation scripts on the voting machines over the network.

The election and voting machine preparation portion can further be configured to disable all network ports of the voting machines after the voting machines have been configured for an election.

Each voting machine can contain a location tracking mechanism. The location tracking mechanism can be a barcode and/or an RFID tag, for example.

Another improvement relates to a protective docking device for a voting machine. The protective docking device includes a voting machine accepting portion configured to accept and store a voting machine, a power connection portion to provide power to the voting machine stored in the voting machine accepting portion, a receiving portion on a top surface of the protective docking device that is configured to receive another protective docking device stacked thereon, a security authentication portion configured to manage interface ports and modes of operation of the voting machines, and a data connection port to provide a data connection to the voting machine stored in the voting machine accepting portion.

The protective docking device can include a plurality of docking stations, each docking station being configured to receive a voting machine.

The protective docking device can include a groove on a top surface of each of the docking stations.

The docking stations can be stacked in a tiered manner.

The protective docking device can include a bag on a back surface of each voting machine within each docking station to collect ballots that have been scanned by the voting machines.

Another improvement relates to a voting machine having an input portion, a network communication device, and a location tracking mechanism.

The voting machine can further include hardware interlocks that disable the network communication device to prevent the voting machine from being accessed via the network communication devices during an election.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and further objects, features and advantages of the invention will become apparent from the following descriptions of exemplary embodiments with reference to the accompanying drawings, in which like numerals are used to represent like elements and wherein:

FIG. **1** is a diagram illustrating some of the components of a voting machine;

FIG. **2** is a diagram illustrating an example of warehouse networking system;

FIG. **3** is a diagram illustrating an example of a warehouse process cycle;

FIG. **4** is a diagram illustrating an example of a voting machine in a protective docking station;

FIG. **5** is a diagram illustrating an example of a protective docking station in a stacked configuration;

FIG. **6** is a is a diagram illustrating an example of a protective docking station in a stacked tiered configuration;

FIG. **7** is a flowchart illustrating an example of a process of asset tracking of voting machines;

FIG. **8** is a diagram illustrating an example of a hardware interlock; and

FIG. **9** is a diagram illustrating another example of a hardware interlock.

DETAILED DESCRIPTION OF EMBODIMENTS

FIG. **1** illustrates some of the components that can be included in each voting machine **11**. The voting machine **11** can include a CPU **32** that controls operation of the voting machine **11** including the functions described herein, a tracking device **34**, an audio device **33**, an input device **24**, an optical scanner **29**, a printer **30**, network connectors **28** and a visual display unit **22**. The network communication device (network connector **28**) can be, but is not limited to: ethernet; optical; and wireless communication devices. Voting machine **11** is not limited to these specific components as any number of other components known to one of ordinary skill in the art for inclusion on voting machines **11** could be incorporated therein.

Additionally, the voting machine **11** can completely disable the network communication device **28** using hardware interlocks **41**. The hardware interlocks **41** prevent the voting machine from being accessed via the network communication devices **28** during an election, for example. Further, the voting machine can run self tests such as, but not limited to: destructive memory tests; non-destructive memory tests; tests of I/O ports; I/O communication tests; detection of connected peripheral devices; tests of attached peripheral devices; detection of attached Removable Memory Elements (RME); tests of RMEs; and tests of power supplies and batteries (described below).

There are a variety of methods that can be employed to hardware interlock the secure RME element. A first implementation is to mount the RME port behind a door **42** that can be locked by a lock **45** and controlled by key access (see, for example, FIG. **8**). In addition, a sensor (not shown) can be added to detect whether the door **42** is open or not. If the door **42** is open, an electrical interrupt can be activated to disconnect all power and signal lines connected to the RME port.

FIG. **9** illustrates another embodiment of a hardware interlock **41** where a connection between network interface electronics **44** and network connector **28** is disrupted by a keylock switch **43**.

To facilitate the preparation of voting machines **11** prior to an election, the voting machines **11** can be remotely instructed to run the self tests mentioned above from over the network and can communicate the results of the tests back over the network. That is, in the warehouse, for example, a plurality of voting machines **11** can be coupled to a host computer over a network using the network connectors **28**. The host computer **10** can then control and/or monitor the plural voting machines **11**.

The network communication device **28** in each voting machine **11** enables the voting machine **11** to be configured and tested remotely. Examples of how voting machines **11** can be configured can include, programming the voting machines **11** with an election ballot over the network, performing validation of a loaded election ballot, and communicating results of that validation back over the network.

Additionally, the network communication device **28** enables the voting machines to have polls opened in pre-LAT mode remotely over the network. Pre-LAT polls mode is a standard mode of operation for a voting device for conducting Pre election Logic and Accuracy tests. Further, the communication device enables the voting machines **11** to be provided with a vote simulation script over the network. A vote simulation script is a set of commands that can simulate voting patterns on the machine even to the level of providing pre-canned scanned ballot images or PDF images of ballots with machine generated marks for testing the vote interpretation engine on the tabulator. The communication device **28** also enables the voting machines **11** to be remotely instructed to run pre-LAT activities such as interpreting vote simulation scripts and images, performing image calibration procedures, verifying all system components for readiness and proper function, self printer test etc. Finally, results of all Pre-LAT tests can be communicated back to the EMS through the communications device **28**.

Further, the network communication device **28** allows the voting machines **11** to have pre-LAT polls opened remotely over the network, have pre-LAT polls closed remotely over the network and can communicate pre-LAT results back over the network. Additionally, the pre-LAT polls can be closed manually and can communicate pre-LAT results back over the network.

Thus, the voting machines **11** can be programmed with an election ballot from over the network, have pre-LAT polls opened remotely over the network and then disable all network ports thru the tabulator firmware and software. Further, the voting machines **11** can be programmed with an election ballot from over the network, have pre-LAT polls opened remotely over the network, have pre-LAT polls closed manually and then disable all network ports.

Use of a Network to Prepare Voting Machines

Typically the warehouse process cycle consists of the following functions (see FIG. **3**): Storage and maintenance **100**; Test **101**; Repair **102**; Machine Preparation **103**; Pre-LAT **104**; Distribution **105**; Acceptance back after election **106**; and Escrow storage **107**.

The functions listed above, and illustrated in FIG. **3**, represent a major logistical effort in large jurisdictions. For example, a jurisdiction has to store its voting machines **11** in a benign environment and keep them charged. Prior to an election, the jurisdiction must test every voting machine **11** to ensure it is operational and repair those that are not. Further, the jurisdiction must then prepare each individual voting machine **11** with the ballot styles for the precinct to which the voting machine **11** is assigned. The preparation and machine function must then be validated against that expected in pre-LAT. The voting machines **11** that fail the "pre-LAT" process must either be re-prepared or repaired, depending on the issue. The voting machines **11** must then be distributed to the correct locations in a secure manner, where they are used in the election. After the day of election, the voting machines **11** then must be collected and returned to the warehouse and accounted for, where they are stored in escrow (securely) for auditing purposes. The voting machines **11** are finally retuned to their normal storage modes after auditing or after it is determined that auditing is not needed.

For a jurisdiction with just a few voting machines **11**, this process is not a major issue. However, for a large jurisdiction, such as a jurisdiction with 5,000 or more voting machines **11**, this presents a major logistical problem. Anything that can be done to automate this process and thus reduce the logistical burden on the jurisdictions will be extremely useful. Some of the improvements discussed herein achieve this goal. To solve this problem, the voting machines **11** are networked together to a central management system within the warehouse. Additionally, one improvement includes a software application that assists in the management and implementation of the process.

In order to address this logistical problem, all the voting machines **11** are networked together in the warehouse, either with physical network connections or via wireless technology, in their storage positions. Additionally, the voting machines **11** are supplied with power and operate in a special storage mode of operation when in storage. A warehouse management application is used that is capable of sending commands to and receiving data from, the individual voting machines **11**, groups of voting machines **11**, lists of voting machines or the entire group of voting machines **11** that are stored in the warehouse.

Additionally, the warehouse management application is capable of sending a command instructing voting machines **11** to respond by identifying their location in the warehouse and their current status. The networked voting machines **11** then respond by providing the appropriate data. The voting machines **11** are able to report their location by where they are networked and the status information that includes amongst other information, the firmware version, battery level, current mode of operation, whether the voting machines **11** have results cartridges present and the current configuration of the voting machines **11**. This feature allows the warehouse management application to verify the location of the voting machines **11** and receive information regarding the status of each voting machine **11**.

Further, the warehouse management application is capable of sending a command instructing the voting machines **11** to run a series of diagnostic tests. The purpose of these tests is to ensure that the hardware is operating correctly. The tests include, but are not limited to the following tests listed below.

Internal Memory Tests	Destructive RAM test	This tests the RAM by writing data to memory address and reading it back to verify that it has written correctly. It is called destructive because any data residing

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		in the memory is lost.
	Non-Destructive RAM tests	This tests the RAM by writing data to memory addresses that are not currently in use and reading it back to verify that it has written correctly.
	Destructive storage memory tests	This tests the storage memory (such as CF, hard disk etc.) by writing data to memory address and reading it back to verify that it has written correctly. It is called destructive because any data residing in the memory is lost.
	Non-Destructive storage memory tests	This tests the storage memory (such as CF, hard disk etc.) by writing data to memory addresses that are not currently in use and reading it back to verify that it has written correctly
Removable Memory Element (RME) Tests	Destructive RME tests	This tests the Removable Memory Element (RME) (results cartridge) by writing data to memory addresses and reading it back to verify that it has written correctly. It is called destructive because any data residing in the memory is lost.
	Non-Destructive RMW tests	This tests the Removable Memory Element (RME) (results cartridge) by writing data to memory addresses that are not currently in use and reading it back to verify that it has written correctly.
Serial Port Tests	Internal tests	These tests test the serial ports by performing internal chip set and internal loop back tests, by transmitting and receiving data in the various modes supported by the chipset.
	Loop-back tests	This tests the serial ports by performing an external loop back tests, by transmitting and receiving data over the port. The serial ports must have a connector that connects the Tx and Rx lines.
	Authentication Tests	This test authenticates any devices currently attached the serial ports of the voting machine.
USB Port Tests	Internal tests	This tests the USB ports by performing internal chip set and internal loop back test, by transmitting and receiving data in the various modes supported by the chipset.
	Loop-back tests	This tests the USB ports by performing an external loop back tests, by transmitting and receiving data over the port. The USB ports must have a connector that interfaces the Tx and Rx lines.
	Authentication Tests	This test authenticates any devices currently attached the serial ports of the voting machine.
Ethernet Tests	Internal tests	This tests the ethernet port by performing internal chip set and internal loop back tests, by transmitting and receiving data in the various modes supported by the chipset.
	Loop-back tests	This tests the ethernet port by performing an external loop back test, by transmitting and receiving data over Ethernet connection with the warehouse application.
Wi-Fi Tests	Internal tests	This tests the Wi-Fi connection by performing internal chip set and internal loop back tests, by transmitting and receiving data in the various modes supported by the chipset.
	Loop-back tests	This tests the Wi-Fi connection by performing an external loop back test, by transmitting and receiving data over Wi-Fi connection with the warehouse application.
	Authentication Tests	This test authenticates the data encryption and certificates used in the Wi-Fi connection
Other Port Tests	Internal tests	This tests the other ports by performing internal chip set and internal loop back tests, by transmitting and receiving data in the various modes supported by the chipset.
	Loop-back tests	This tests the other ports by performing an external loop back tests, by transmitting and receiving data over the port. The ports must

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	have a connector that connects the Tx and Rx lines.
Authentication Tests	This test authenticates any devices currently attached the other ports on the voting machine.
Processor Tests	This tests the operation of the processor.
Security Tests	These are a suite of tests that test the security features of the voting machine.
Display communication tests	This tests the connections to the displays and the touch screen membrane.
Firmware authentication tests	This authenticates the version of the firmware by calculating a HASH value of the firmware image using a seed passed to it by the warehouse application.
Audit/event logging tests	These tests test the audit and event logging facilities by simulating events and then checking that the events have been written to the logs.
Printer tests	This tests the operation of the printer and or VVPAT connected to the voting machine.
Battery Charging tests	This tests the battery charging circuits and the state of the battery.
Audio sub-system tests	This tests the correct operation of the audio sub-system.
ADA device interface tests	These test the interfaces provided for the use of ADA devices, for example the audio control unit.

After the tests have been run, the voting machines **11** report back the results of the tests identified above to the warehouse management application. The warehouse management application is then able to identify which voting machines **11** have problems via these tests. This allows the voting machines **11** to be tested remotely without human intervention, thereby reducing the time required to prepare the voting machines for an election.

Further, the warehouse management application is capable of setting system parameters in the voting machines **11**, such as setting the date and time as well as being capable of loading election definitions into the machines across the network. Once the election definitions are received, the voting machines **11** authenticate and verify the election definition and copy it to all necessary memory devices including any internal storage devices, and redundant removable memory elements, verifying that it has loaded correctly. The voting machines **11** then report their status back to the warehouse management application. The warehouse management application tracks and manages which voting machines **11** have been prepared successfully and which have had election load issues and thus may require further attention. FIG. **2** illustrates an example of the warehouse management system in a warehouse **9** including host computer **10**, and voting machines **11** that are, in this embodiment, connected to the host computer **10** via a wireless network. The host computer **10** includes RAM, ROM one or more CPUs and various interfaces. The warehouse management application is stored on and runs on the host computer **10**.

This allows the voting machines **11** to be prepared for an election with the election definition automatically without human intervention.

The warehouse management application also is capable of loading simulation scripts to the voting machines **11**. The voting machines **11** authenticate and verify the simulations scripts and report the status of the load back to the warehouse management application. The warehouse management application is capable of instructing voting machines **11** to open polls in pre-LAT and to run the vote simulation scripts. The voting machines **11** then report the status to the warehouse management application.

The warehouse management application can also instruct the voting machines **11** to open polls in pre-LAT mode, and to accept manual feeding of a deck of test ballots. Once the ballots have been fed into the voting machine **11**, a sequence can be initiated on the voting machine **11** to reconnect with the warehouse management application to transmit the results of the test deck for verification and validation.

These pre-LAT based processes using either a vote simulation script, or a set of test ballots allows the vast majority of pre-LAT to be run automatically without human intervention. Some pre-LAT tests may have to be done manually, such as verifying that: the user interface works correctly; that the scanner mechanism is operating correctly; that test ballots are read correctly; that the audio voting works correctly; and that the printer prints correctly. However, the tests capable of being conducted remotely represent a large reduction in the effort required to prepare the voting machines **11**.

The warehouse management application is capable of instructing voting machines **11** to close pre-LAT polls and to tally the pre-LAT data. The voting machines **11** then report the pre-LAT tally data back to the warehouse management application. The warehouse management application then compares the pre-LAT data with what was expected to automatically verify that pre-LAT was successfully passed. These measures allow pre-LAT to be conducted accurately and with minimum effort.

The warehouse management application also is capable of instructing the voting machines **11** to open polls in official election mode and the voting machines **11** then report this back to the warehouse management application.

Thus, the entire voting machine preparation and test process can be automated and the required effort to test and prepare the voting machines can be considerably reduced.

The warehouse management application also is capable of instructing the voting machines **11** to send their audit and event logs and is being capable of searching for certain types of events. The voting machines **11** can also send back their election tally data (ballot image records) if polls have been closed.

One improvement relates to election and machine preparation applications running on a host computer system connected by a network to a plurality of voting machines **11** that each includes a network communication device via that network (see FIG. **2**). One function of the election and machine preparation applications is to manage the status of the connected voting machines **11**. Additional functions of the election and machine preparation applications are to instruct the voting machines **11** to run self tests (listed below), to receive the results of those self tests back from the voting machines **11**, and to display and archive the results. Any errors or issues identified can be communicated back to the user of the system thru these reports and communicated to the warehouse logistics management in order for the machines to be serviced.

Another function of the election and machine preparation applications is to prepare/program those voting machines **11** with an election ballot over the network. In addition, the election and machine preparation applications are capable of receiving verification that the ballot has loaded correctly.

Further, another function of the election and machine preparation applications is to instruct the voting machines that have an election ballot loaded but have not had any polls opened to open pre-LAT polls. The election and machine preparation applications can then receive verification back that pre-LAT polls were opened successfully.

The election and machine preparation applications are also able to provide a vote simulation script to the voting machines **11** that have pre-LAT polls open. The election and machine preparation applications can then receive verification that the simulation script was successfully loaded.

The election and machine preparation applications can also suspend operation after pre-LAT polls have been opened so that a set of test ballots can be manually fed into the system. Once the ballot has been fed, the pre-LAT polls can be manually closed and the results of the test ballots communicated back to the preparation system for verification.

The election and machine preparation applications also can provide those machines **11** that have pre-LAT polls open with instructions to close pre-LAT polls, and the election and machine preparation applications can receive verification that the ballots have been validated, and that pre-LAT polls have been closed successfully.

The election and machine preparation applications can further provide data on the operational health, pre-LAT data and polls status of the voting machines as well as data on the location in the warehouse of those voting machines

Voting Machine Docking and Storage Station

A storage and docking station is designed specifically for each type of voting machine **11**. This allows the voting machines **11** to be stored safely and protected from damage. Further, the storage and docking station allows the voting machines **11** to be stacked. The storage and docking station also is capable of providing power to the machines for battery charging and network connectivity, if supported, for connection to a warehouse management application. The docking station can also provide connection to support various I/O port loop back tests. The docking station also is capable of providing security authentication, which allows the voting machine to activate various interface ports and support various modes of operation.

FIG. **4** illustrates an exemplary embodiment of the storage and docking station **17**. As seen in FIG. **4**, the storage and docking station **17** includes a cavity **18** into which the voting machine **11** can be placed. FIG. **4** also illustrates some of the plugs and interfaces provided in the storage and docking station **17** for connection with the voting machine **11**. As seen in FIG. **4**, these connections can include, for example, a power connection **19** and a data line **20**. In some examples, the storage and docking station **17** may comprise a channel **21** provided near a back portion of the docking station **17** to provide a conduit for the cables such as power connection **19** and a data line **20** connected to the voting machine **11**.

FIG. **5** illustrates how the storage and docking station **17** can be stacked on top of another storage and docking station **17**. As seen in FIG. **5**, in one embodiment, each docking station **17** can be placed directly on top of the other. Grooves **35** are provided on a top surface of each docking station **17** to facilitate stacking. The grooves **35** are configured to receive a corresponding projecting portion **36** on the bottom surface of another docking station **17**. Additionally, a channel **37** is provided near a back portion of each docking station **17** to provide a conduit for the cables such as a power connections **19** and a data lines **20** connected to each voting machine **11**.

FIG. **6** illustrates another embodiment of the stacked docking stations **17**. In this embodiment, the docking stations **17** are stacked in a tiered manner. Additionally, in this embodiment, the docking stations **17** are configured to allow ballots **1** to be fed into ballot feed trays **38** of the optical ballot scanner **29** in each voting machine **11** while the voting machines **11** are stacked. Therefore, the voting machines **11** do not need to be un-stacked to feed ballots during pre-LAT.

Similar to FIG. **4**, in the embodiment of FIG. **5**, a channel **37** is provided near a back portion of each docking station **17** to provide a conduit for the cables such as a power connection **19** and a data line **20** connected to each voting machine **11**.

Further, a bag **39** is provided on a back surface of each voting machine **11** to collect ballots that have been scanned. The bags **39** can be disposed on runners **40** so that the bags **39** can slide out to facilitate the removal of the ballots from the voting machines **11**.

Asset Tracking of Voting Machines

Each individual voting machine **11** can be configured with machine-readable identifiers on/in them such as bar codes or RFID devices. These are generally referred to as a tracking device **34** shown in FIG. **1**. These machine-readable identifiers can contain information such as, for example, the machine type and serial number. These identifiers can also be used to track the location and 'state' of the voting machines **11** within the election lifecycle.

The machine-readable identifiers are capable of being scanned by devices such as barcode scanners and RFID scanners so that the information can be retrieved and used by the tracking and warehouse applications. RFID is preferable as it allows automatic scanning of the devices without the need for manual interaction by a user.

When a voting machine **11** is stored in the warehouse, the voting machine **11** is scanned for its identifier information and its location is recorded. If the machine-readable identifier is contained in barcode, then the user will have to scan that bar code with a bar code reader. If the identifier is contained in an RFID tag, then this can be scanned automatically either by a hand held device or by a scanning device located in the storage area. The location of the voting machine **11** can be inputted in a number of ways. For example, the location of the voting machine **11** could be entered manually by the user, scanned in via a bar code identifying the location, or scanned in via an RFID tag at the location. If the voting machine **11** has an RFID tag, and the RFID scanners are located in warehouse storage area, the location of the voting machine **11** can be calculated automatically via comparing the relative strength of the RFID signals or by some other comparative technique. This identification and location information can be automatically passed to the warehouse management and asset tracking systems, preferably via a wireless network. These applica-

tions mark the voting machines as being in a warehouse storage location and record that particular location. Hence the location of a particular voting machine **11** is known and verified.

When a voting machine **11** is removed from storage, a similar process occurs. The machine-readable identifier is scanned. Additionally, the reason for the voting machine **11** being moved can be entered into the system, preferably via a button press on a hand held device (which can include multiple selections from which to choose). Therefore, if the voting machine **11** has an RFID tag, the fact that it has been moved from the storage location may be detected automatically. Again, this information can be passed to the asset tracking system, so that its location is still known.

If the voting machine **11** is taken to a different location, such as a pre-LAT or audit area (for example to complete the manual aspects of pre-LAT prior to staging for deployment), then the voting machine **11** can be scanned and information such as the voting machines' **11** presence in that different location and that part of the process can be recorded and passed to the asset tracking and warehouse management applications.

If the jurisdiction uses a staging area prior to distribution of the voting machines **11**, then when the voting machines **11** are placed in that area, the fact that the voting machines **11** are there and the particular location in that area can be recorded using similar means as described above with respect to the storage location at the warehouse.

Additionally, vehicles that are used for delivery of the voting machines **11** can also have machine-readable identifiers. Again, these machine-readable identifiers could be stored via barcodes or RFID tags. As voting machines **11** are deployed onto vehicles for delivery, they can be scanned and the vehicle identifier scanned. If the vehicle does not have a barcode or RFID tag, then the identifier could be entered manually. This information can then be relayed back to the asset management application, so that the presence of the voting machines **11** on a particular vehicle can be tracked.

In addition, each polling place also can have a machine-readable identifier. These machine-readable identifier could be stored, for example, as barcode or MD tags at the polling place; as codes or barcodes on the delivery sheet; as codes or barcodes in a booklet; or be stored in the hand held device used of scanning for manual selection. If the polling place identifier is contained in a barcode or RFID tag, this can be scanned by the handheld device. If the machine-readable identifier is a code, it can be manually entered in the handheld device. Further, if the machine-readable identifier is stored in the application in the handheld device, then it can be manually selected by the user. When a voting machine **11** is delivered, its ID can be scanned by the handheld device as is the polling place ID. This information is stored in the hand held device. If the process includes an acceptance by someone at the polling place, this can also be recorded in the hand held device (depending on the technology in the hand held device, this could be a signature, a thumb print, an acceptance code or just a button press). If an attempt is made to transport the voting machine **11** to an incorrect location, the handheld device can identify this and warn the user.

When the vehicle returns to the warehouse, the data collected can then be downloaded to the asset tracking application. Hence, the asset tracking application will know what voting machines **11** have been delivered and where the voting machines **11** are located. The asset tracking application also can identify if voting machines **11** have been incorrectly delivered.

When voting machines **11** are picked up from polling locations, the voting machines **11** can be scanned by the hand held device to show they have been collected. Similarly, when the voting machines **11** are placed back into storage or an escrow location, they can be scanned so that the location and this information can be relayed to the asset tracking system.

By using this process and information, the asset tracking system can accurately track the location and state of the voting machines **11**. Therefore, if a voting machine **11** is mislaid, its path can be investigated to aid finding the voting machine **11**. In the warehouse, if a voting machine **11** needs to be retrieved (for example, if it requires repair or is going to be audited) then the asset tracking system can identify its location for easy retrieval.

In addition, results cartridges can also have machine-readable identifiers, which can be in the form of barcodes or RFD tags, so that the results cartridges can be tracked in a similar manner as described above. The results cartridges can be scanned when inserted into a machine (which can be a voting machine or another machine) and that information can be relayed back to the warehouse management system so that a specific results cartridge can be associated with a specific voting machine **11**. This step is not necessary if there is a networked warehouse management system in use as this can be done automatically via the warehouse management system.

If results cartridges are collected separately from the voting machines **11** at the end of the election, then as they are delivered to the tally center, they can be scanned in and tracked. Thus, a record can be kept of which cartridges have been delivered and the time of delivery.

FIG. **7** is a flowchart illustrating one example of how the asset tracking process can function. In step **200** the machine-readable identifier of the voting machine **11** is scanned and the location of the voting machine **11** is recorded and transmitted to the asset tracking application. In step **201** the machine-readable identifier of the voting machine **11** is scanned and the delivery location at the pre-LAT area is recorded and transmitted to the asset tracking application. In step **202** the voting machine **11** is ready for delivery and the machine-readable identifier of the voting machine **11** is scanned and the location of the staging area of the voting machine **11** is recorded and transmitted to the asset tracking application. In step **203** the voting machine **11** is placed on a delivery vehicle after scanning the machine-readable identifier of the voting machine **11** and the vehicle ID. This information is then transmitted to the asset tracking application. In step **204** the voting machine **11** is positioned at the polling place after scanning the machine-readable identifier of the voting machine **11** and the delivery vehicle ID. Additionally, when arriving at the polling place the poll worker acceptance criteria is entered. In step **205** the voting machine **11** is placed back on the delivery vehicle after having the machine-readable identifier of the voting machine **11** and the delivery vehicle ID scanned. Once again, this information is then transmitted to the asset tracking application. In step **206** the voting machine **11** is returned back to the warehouse where it is put in escrow. The machine-readable identifier of the voting machine **11** is scanned upon arriving back at the warehouse as well as the delivery location (pre-LAT area). This information is then transmitted to the asset tracking application. Finally, in Step **207** the voting machine **11** enters the audit/recount process. The machine-readable identifier of the voting machine **11** and the delivery location are scanned and the data is transmitted to the asset tracking application. Upon the completion of step **207** the cycle returns back to warehouse storage step **200**.

The foregoing description is considered as illustrative only of the principles of the improvements discussed above. The inventions described herein are not limited to specific examples provided herein.

What is claimed is:

1. A tracking and preparation system for networked voting machines comprising:

a host computer;

a plurality of voting machines connected via a network to the host computer, each voting machine comprising:

a processor;

a user interface coupled with the processor and configured to receive cast votes;

a network communication device coupled with the processor, the network communication device comprising a wireless communication device and a data port for coupling the voting machine to the host computer; and

a hardware interlock coupled with the network communication device and configured to disable the network communication device to prevent the voting machine from being accessed via the network during an election period, wherein disabling the network communication device comprises activating an electrical interrupt to prevent network communication with the voting machine while maintaining a physical network connection; and

an election and voting machine preparation portion included in the host computer that is configured to distribute programming information to each of the connected voting machines prior to receiving the cast votes at the polling location.

2. The system according to claim **1**, wherein the election and voting machine preparation portion is configured to manage the status of the connected voting machines, is configured to instruct the voting machines to run self tests, is configured to receive results of the self tests back from the connected voting machines, and is configured to prepare/program the connected voting machines with an election ballot.

3. The system according to claim **2**, wherein the self tests run by the voting machines correspond to pre-LAT tests.

4. The system according to claim **2**, wherein the election and voting machine preparation portion is configured to open pre-LAT polls remotely over the network.

5. The system according to claim **2**, wherein the election and voting machine preparation portion is configured to run simulation scripts on the voting machines over the network.

6. The system according to claim **2**, wherein the election and voting machine preparation portion is configured to disable all network ports of the voting machines after the voting machines have been configured for an election.

7. The system according to claim **2**, wherein each voting machine contains a location tracking mechanism.

8. The system according to claim **7**, wherein the location tracking mechanism is a barcode.

9. The system according to claim **7**, wherein the location tracking mechanism is an RFID tag.

10. The system of claim **1**, wherein the election and voting machine preparation portion included in the host computer is further configured to upload vote information from the plurality of voting machines after receiving the cast votes at the polling location.

11. The system of claim **1**, wherein the election and voting machine preparation portion is configured to prepare or configure individual voting machines with election-specific information.

12. The system of claim **1**, wherein the election and voting machine preparation portion is configured to manage all pre-election preparation for the plurality of voting machines prior to deploying the voting machines to a polling location.

13. A voting machine comprising:

a processor;

an input portion coupled with the processor and configured to receive ballots to be scanned;

a network communication device coupled with the processor and configured to receive programming information from at least one external device;

a hardware interlock coupled with the network communication device and configured to disable the network communication device to prevent the voting machine from being accessed via the network during an election period, wherein disabling the network communication device comprises activating an electrical interrupt to prevent network communication with the voting machine while maintaining a physical network connection; and

a user interface coupled with the processor and configured to receive cast votes from a voter.

14. The voting machine of claim **13**, wherein the voting machine receives all pre-election preparation programming information via the network communication device prior to deployment to a polling location.

15. The system according to claim **13**, wherein the voting machine contains a location tracking mechanism.

16. The voting machine according to claim **15**, wherein the location tracking mechanism is a barcode.

17. The voting machine according to claim **15**, wherein the location tracking mechanism is an RFID tag.

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