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(54) **METHODS, APPARATUS, AND SYSTEMS FOR ACQUIRING AN ENHANCED POSITIVE RESPONSE FOR UNDERGROUND FACILITY LOCATE AND MARKING OPERATIONS BASED ON AN ELECTRONIC MANIFEST DOCUMENTING PHYSICAL LOCATE MARKS ON GROUND, PAVEMENT, OR OTHER SURFACE**

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G06Q 10/06 (2006.01)

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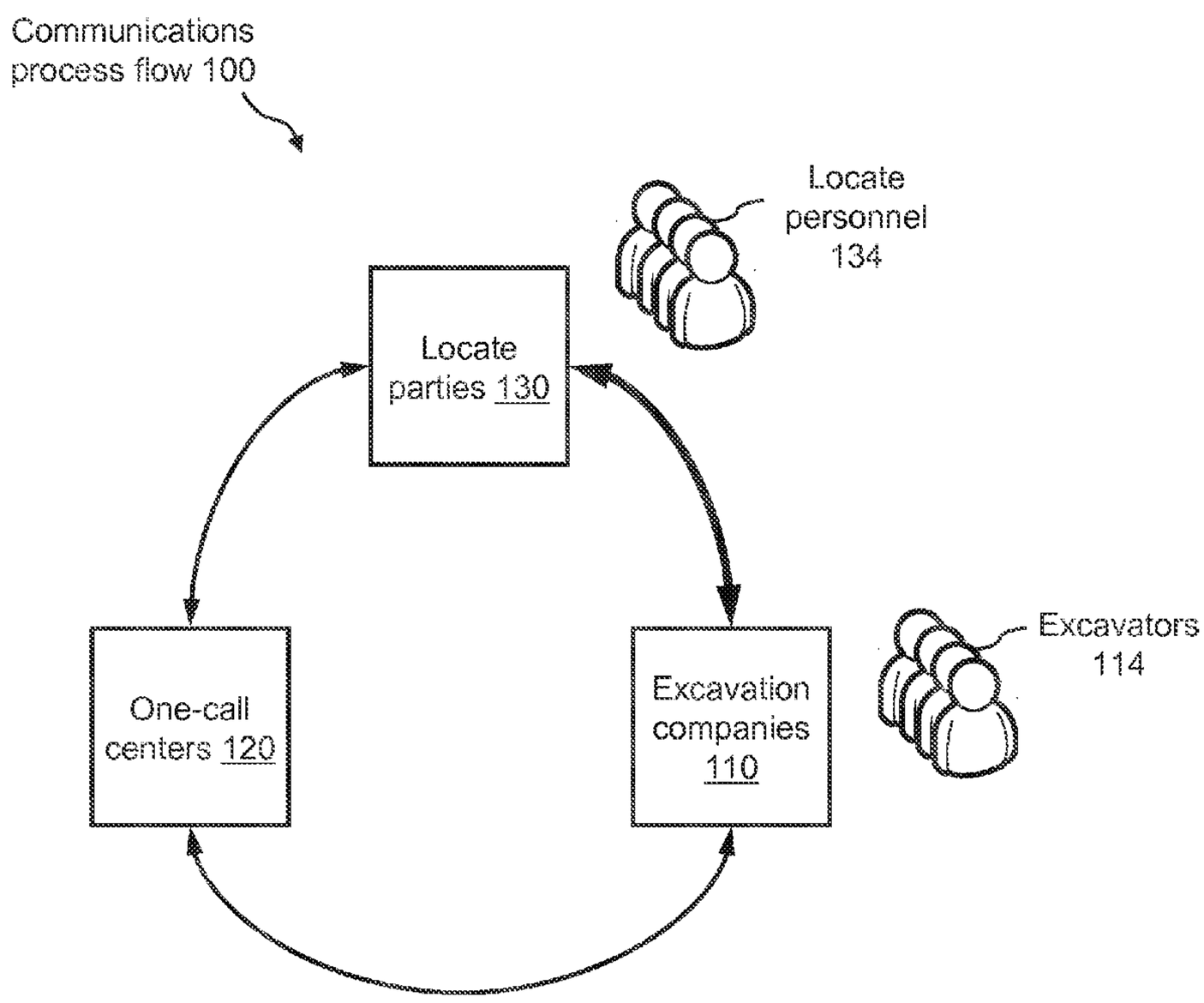
CPC ***G06Q 10/0635*** (2013.01)

(57) **ABSTRACT**

A positive response notification to provide information regarding locate and/or marking operations for underground facilities may include time-stamp information to provide proof of a time at which the locate and/or marking operation was completed by a locate technician, and/or place-stamp information to provide proof of a presence of the locate technician at or near a work site. An electronic manifest image and/or a virtual white line image similarly may be included in a positive response notification. In one example, such images may be bundled together based on respective descriptor files (or descriptor metadata) that associates the corresponding images with a locate request ticket for the operation. In another example, a positive response notification may include environmental information regarding one or more environmental conditions present at or near the work site during the locate and/or marking operation.



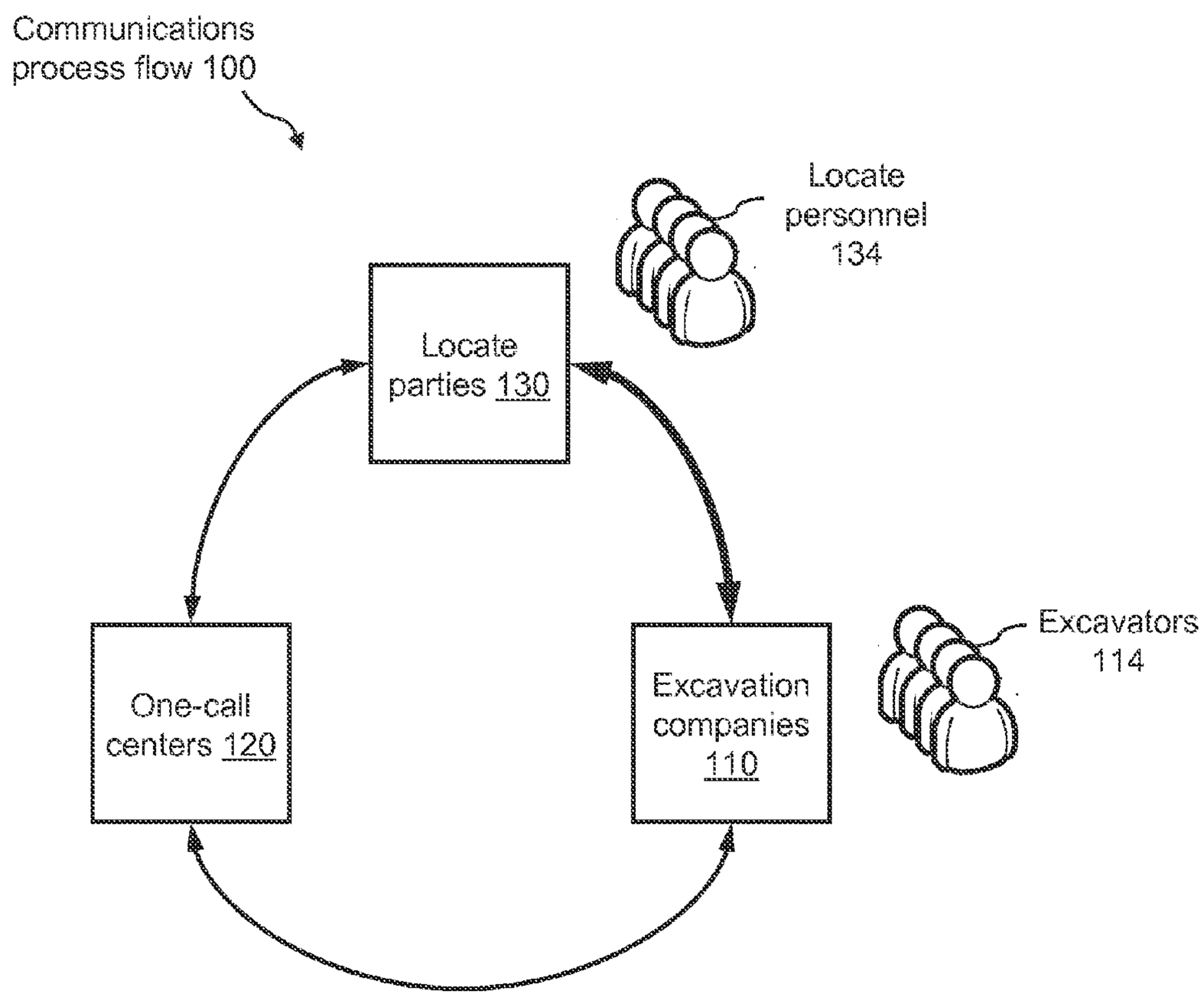

Communications process flow 100
Locate personnel 134
Locate parties 130
One-call centers 120
Excavation companies 110
Excavators 114

FIG. 1

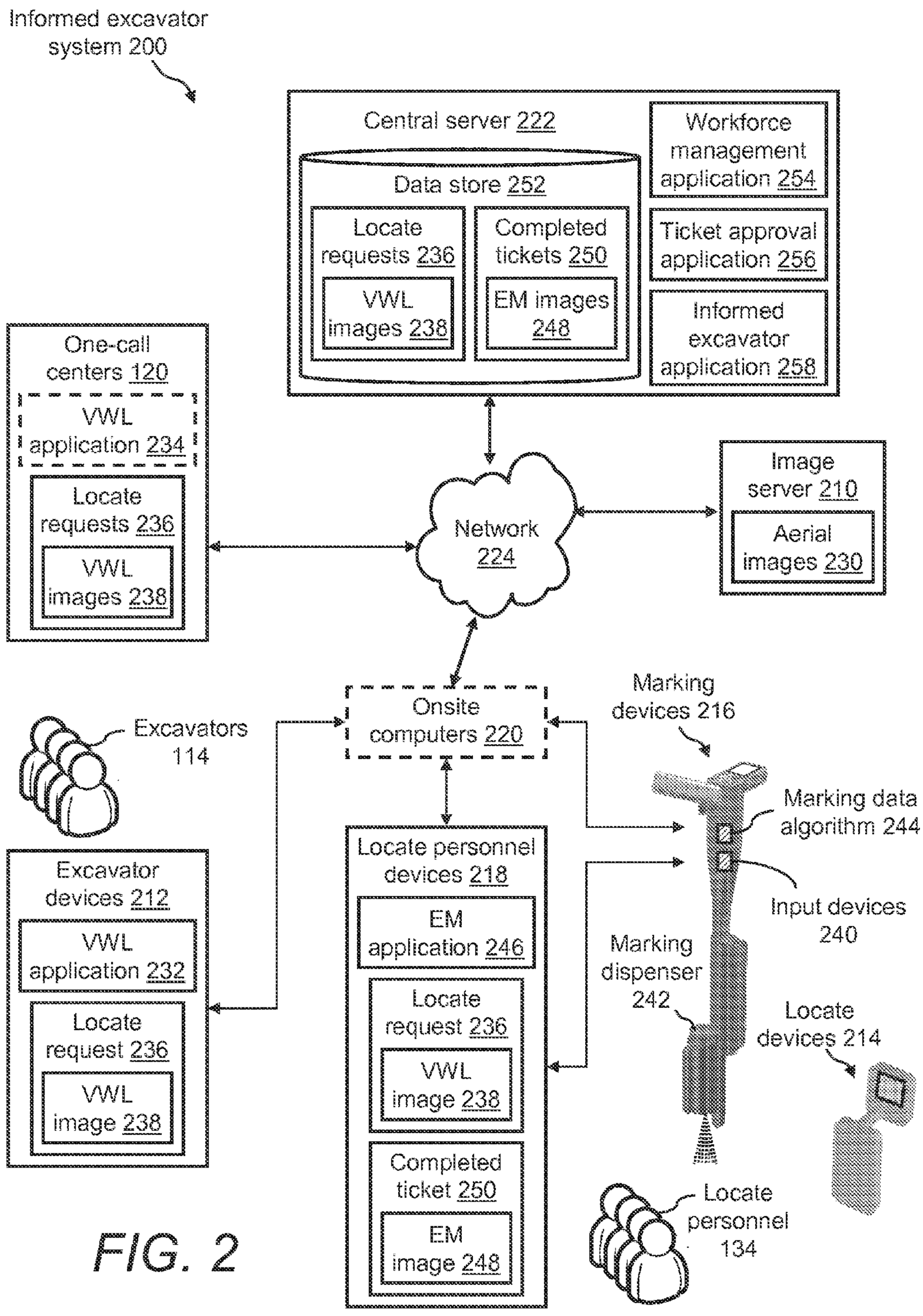

Informed excavator system 200
Central server 222
Data store 252
Locate requests 236
VWL images 238
Completed tickets 250
EM images 248
Workforce management application 254
Ticket approval application 256
Informed excavator application 258
One-call centers 120
VWL application 234
Locate requests 236
VWL images 238
Network 224
Image server 210
Aerial images 230
Onsite computers 220
Marking devices 216
Excavators 114
Marking data algorithm 244
Locate personnel devices 218
Input devices 240
Excavator devices 212
VWL application 232
Locate request 236
VWL image 238
EM application 246
Locate request 236
VWL image 238
Completed ticket 250
EM image 248
Marking dispenser 242
Locate devices 214
Locate personnel 134

FIG. 2

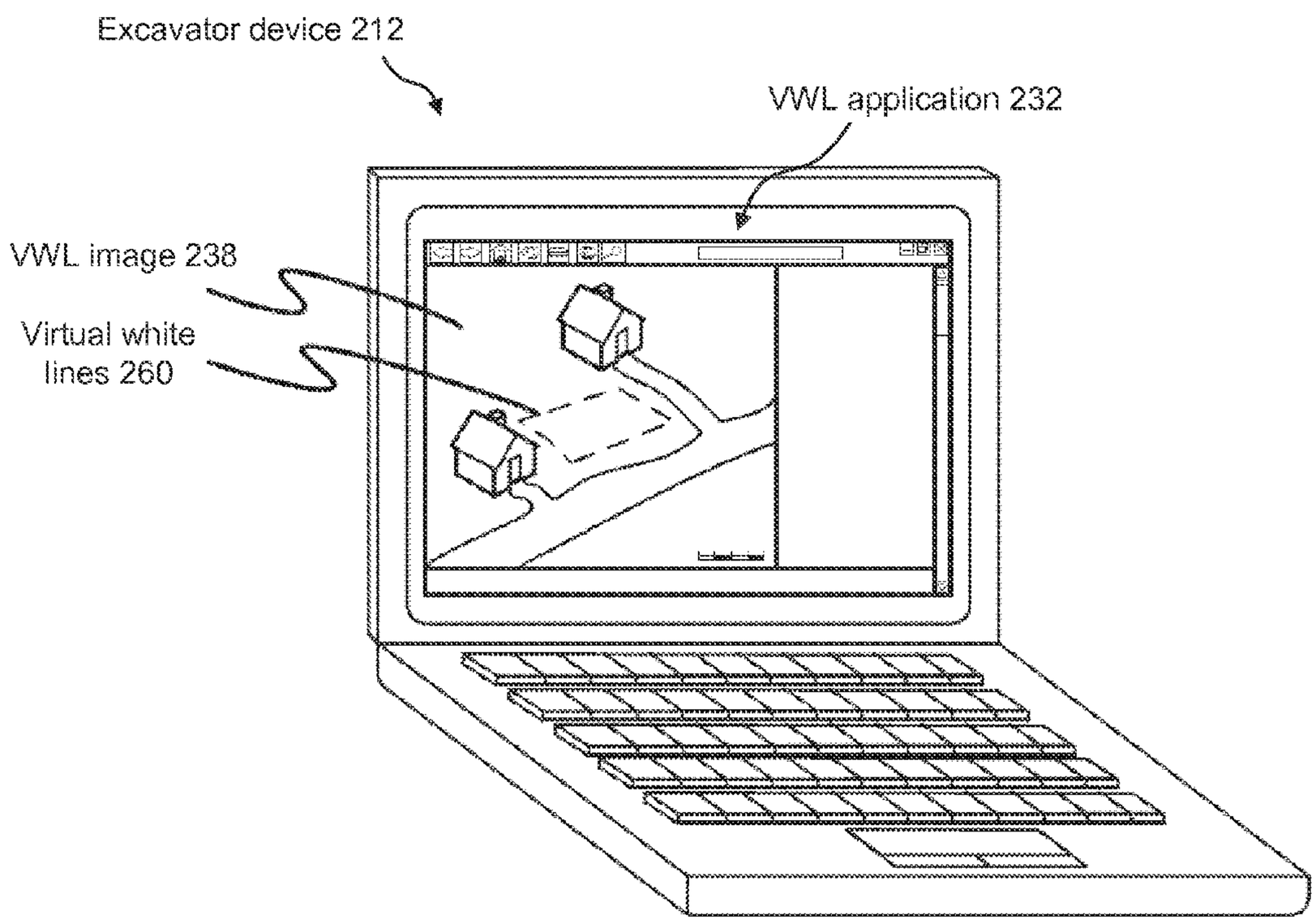

Excavator device 212
VWL application 232
VWL image 238
Virtual white lines 260

FIG. 3

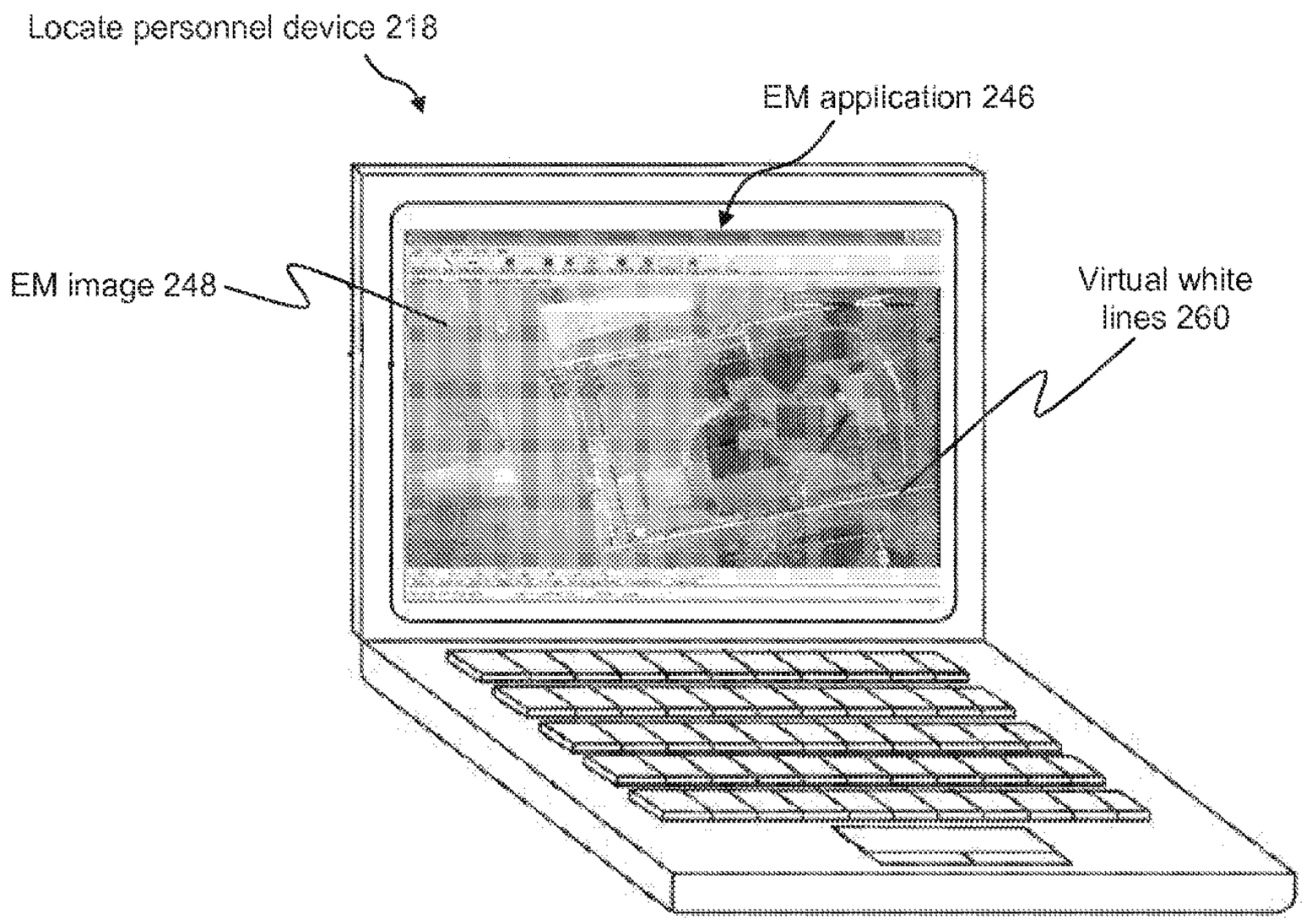

Locate personnel device 218
EM application 246
EM image 248
Virtual white lines 260

FIG. 4

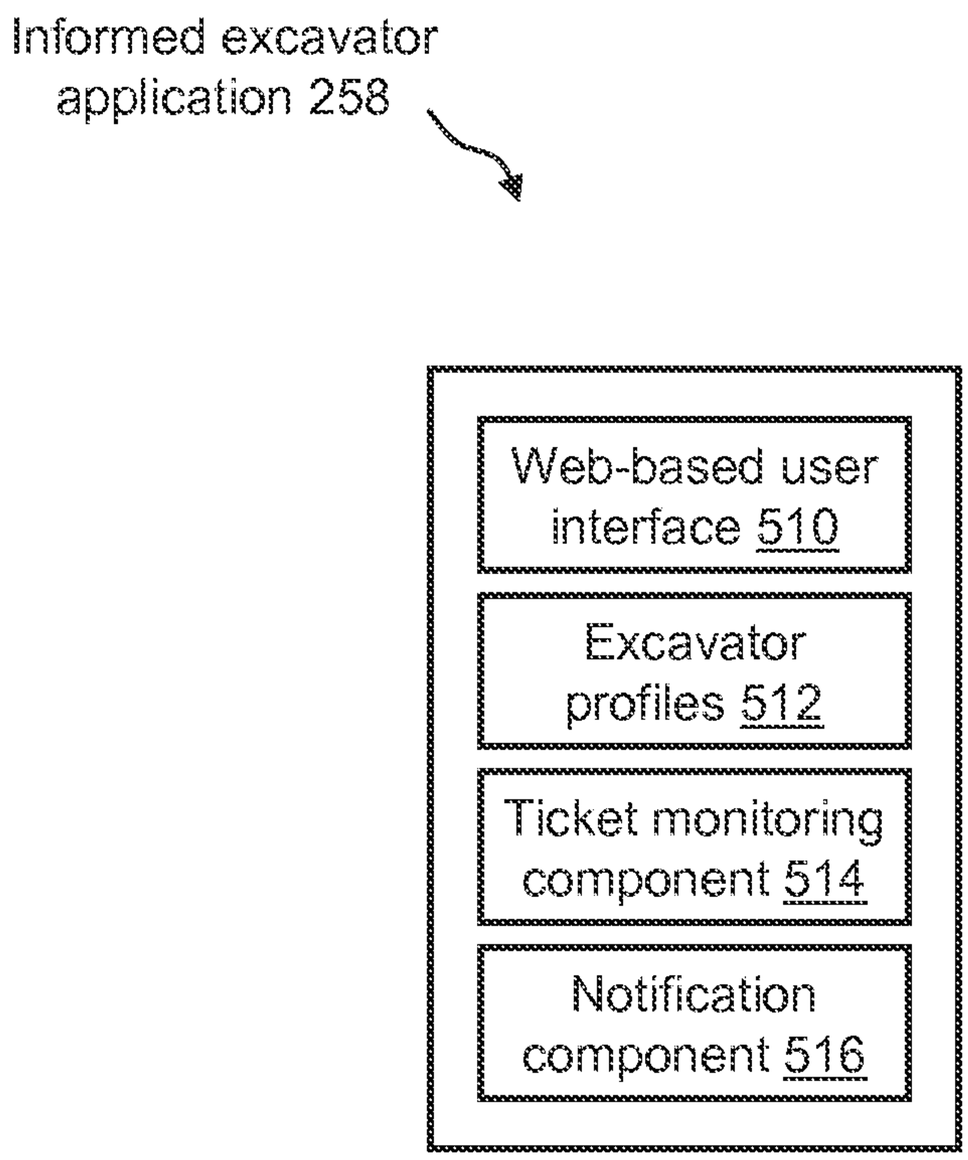

Informed excavator application 258
Web-based user interface 510
Excavator profiles 512
Ticket monitoring component 514
Notification component 516

FIG. 5

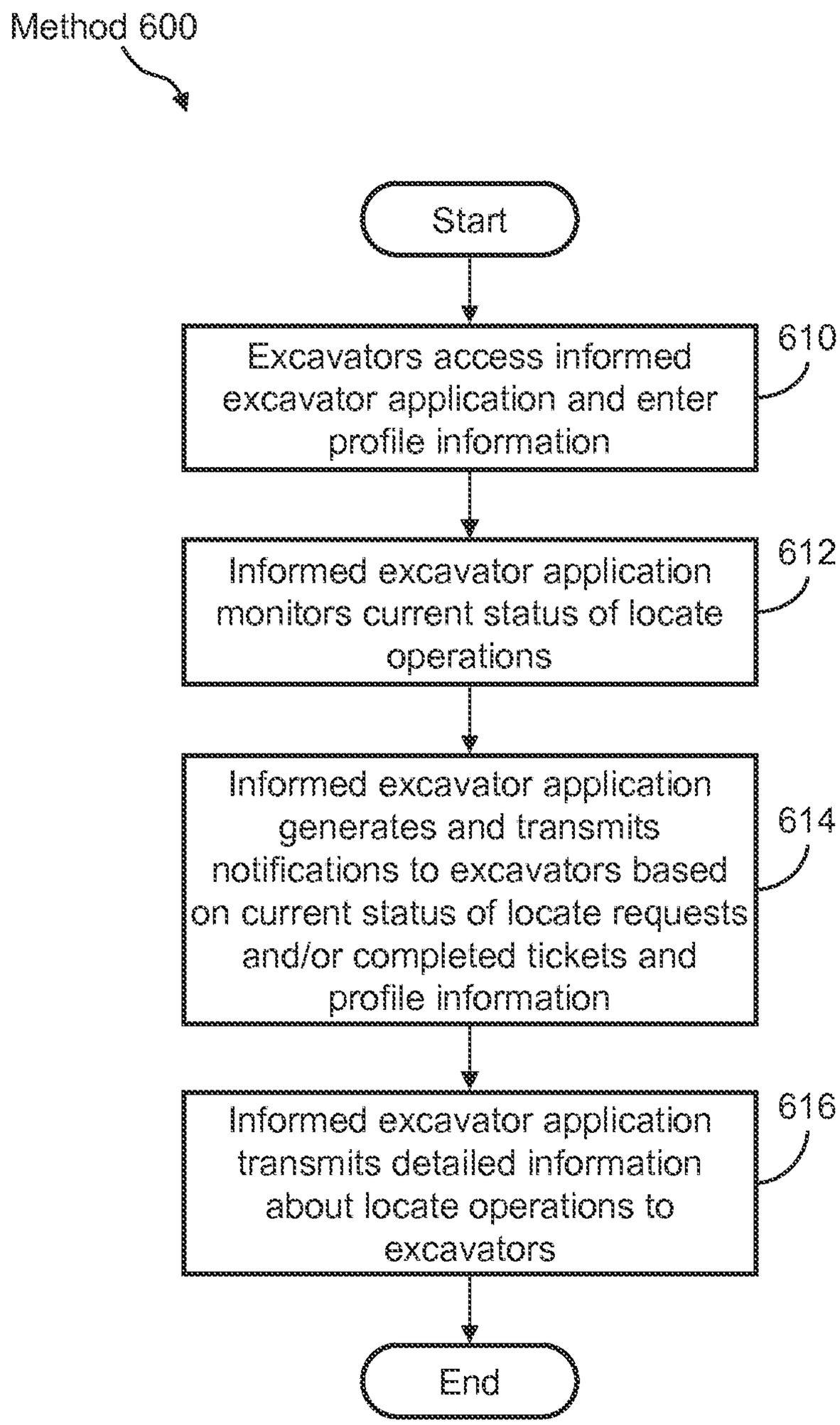

Method 600
Start
Excavators access informed excavator application and enter profile information
610
Informed excavator application monitors current status of locate operations
612
Informed excavator application generates and transmits notifications to excavators based on current status of locate requests and/or completed tickets and profile information
614
Informed excavator application transmits detailed information about locate operations to excavators
616
End

FIG. 6A

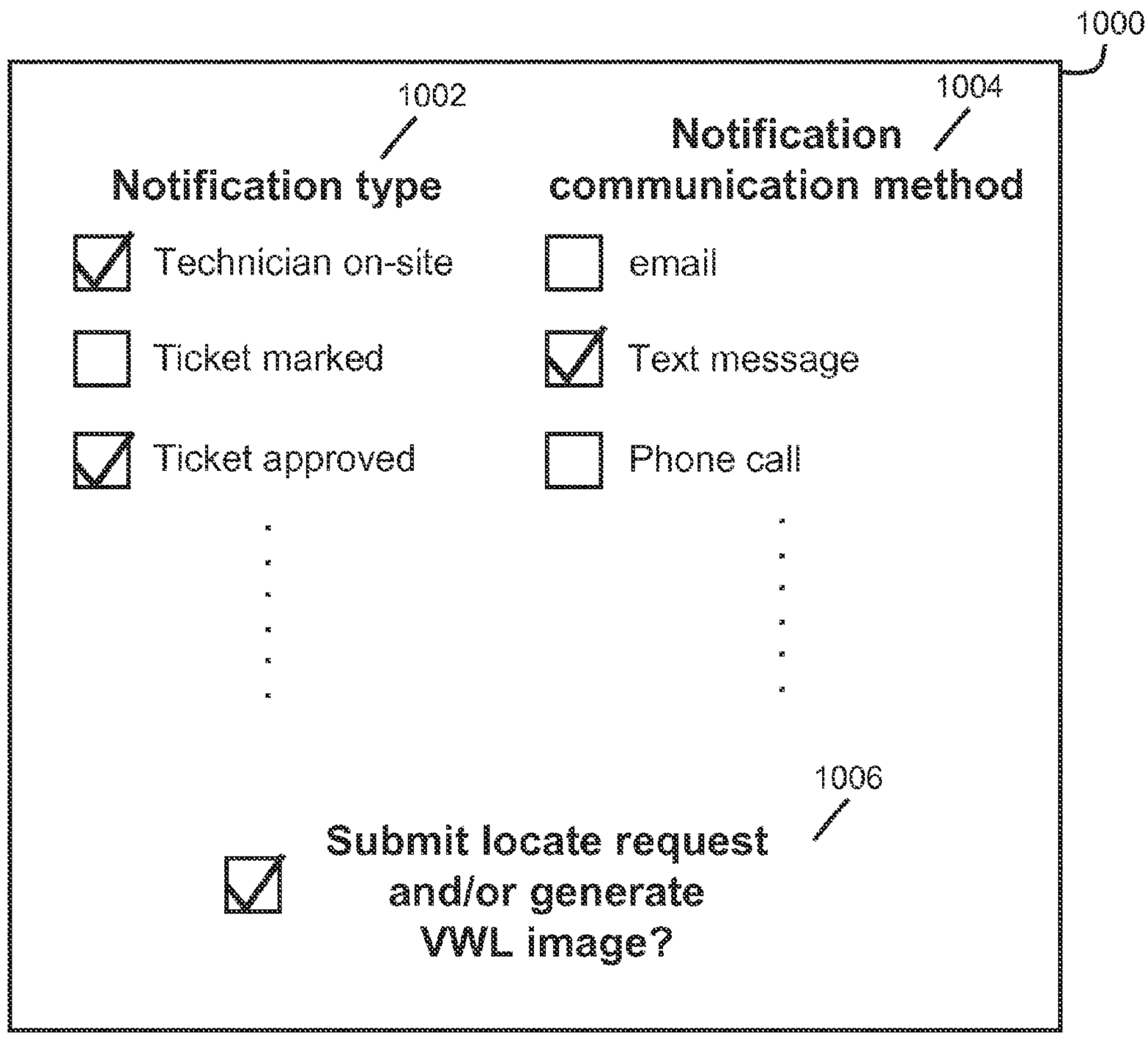

1000
1002
Notification type
Technician on-site
Ticket marked
Ticket approved
1004
Notification communication method
email
Text message
Phone call
1006
Submit locate request and/or generate VWL image?

FIG. 6B

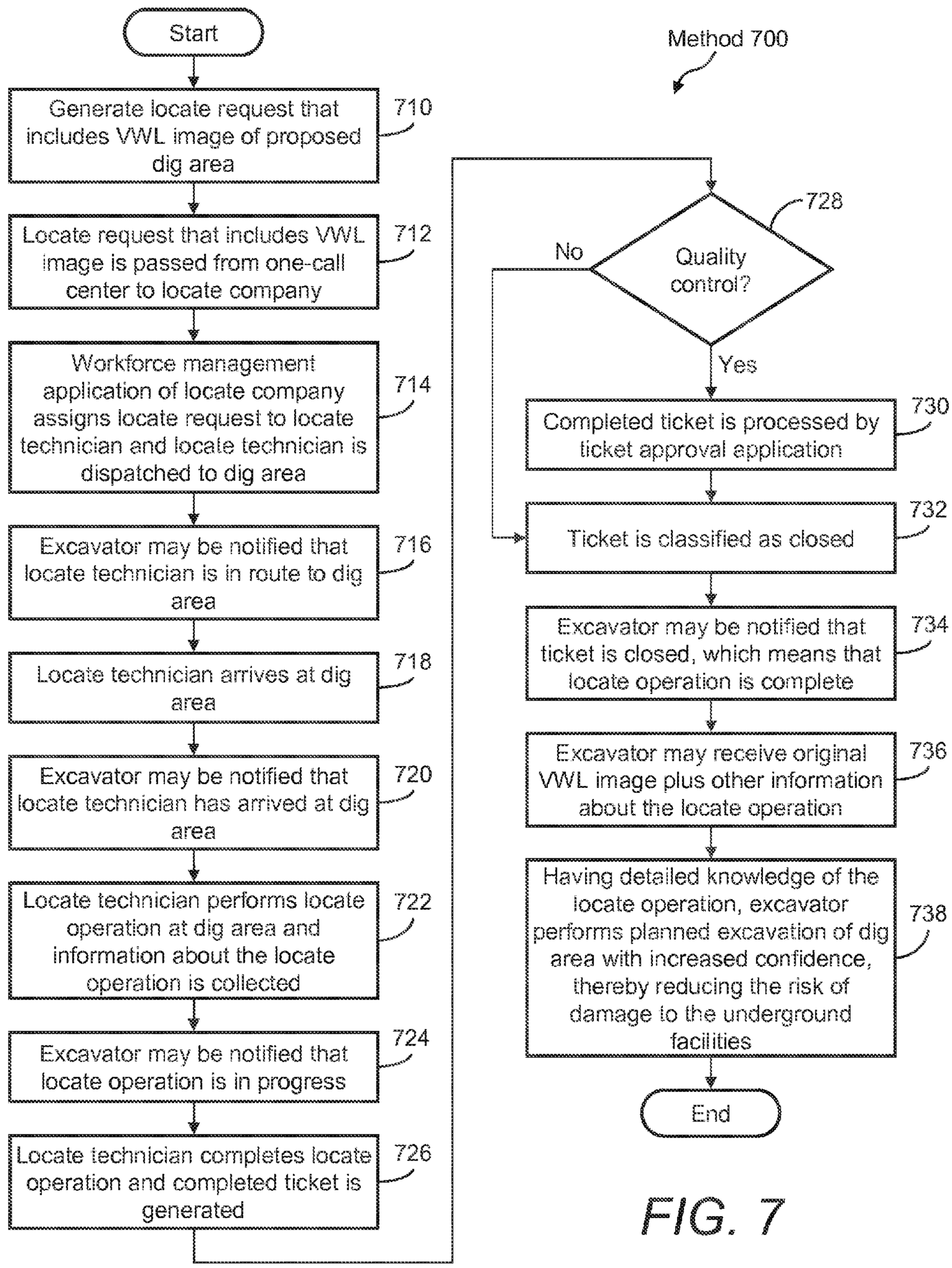

Start
Method 700
Generate locate request that includes VWL image of proposed dig area
710
Locate request that includes VWL image is passed from one-call center to locate company
712
Workforce management application of locate company assigns locate request to locate technician and locate technician is dispatched to dig area
714
Excavator may be notified that locate technician is in route to dig area
716
Locate technician arrives at dig area
718
Excavator may be notified that locate technician has arrived at dig area
720
Locate technician performs locate operation at dig area and information about the locate operation is collected
722
Excavator may be notified that locate operation is in progress
724
Locate technician completes locate operation and completed ticket is generated
726
Quality control?
728
No
Yes
Completed ticket is processed by ticket approval application
730
Ticket is classified as closed
732
Excavator may be notified that ticket is closed, which means that locate operation is complete
734
Excavator may receive original VWL image plus other information about the locate operation
736
Having detailed knowledge of the locate operation, excavator performs planned excavation of dig area with increased confidence, thereby reducing the risk of damage to the underground facilities
738
End

FIG. 7

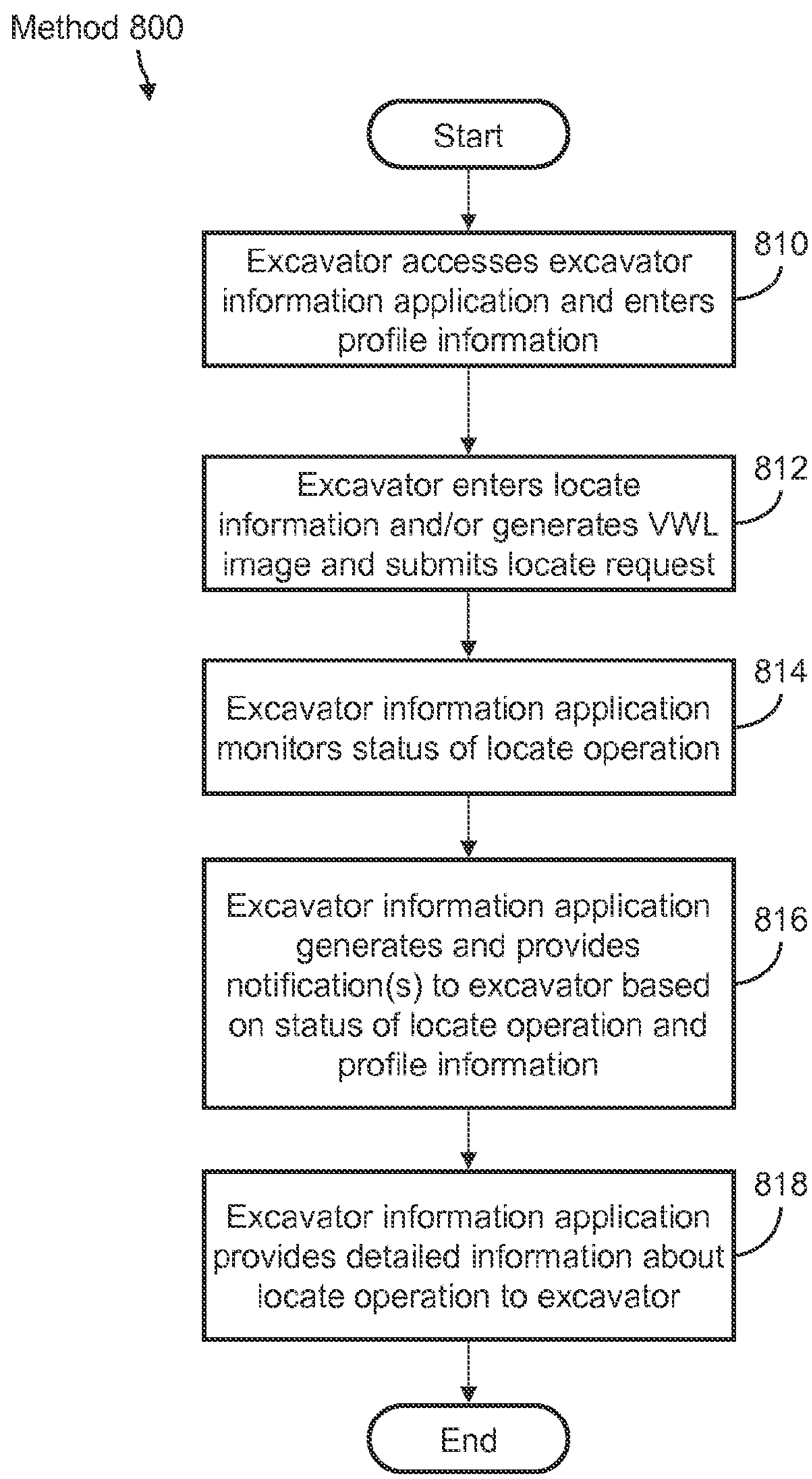

Method 800
Start
Excavator accesses excavator information application and enters profile information
810
Excavator enters locate information and/or generates VWL image and submits locate request
812
Excavator information application monitors status of locate operation
814
Excavator information application generates and provides notification(s) to excavator based on status of locate operation and profile information
816
Excavator information application provides detailed information about locate operation to excavator
818
End

FIG. 8

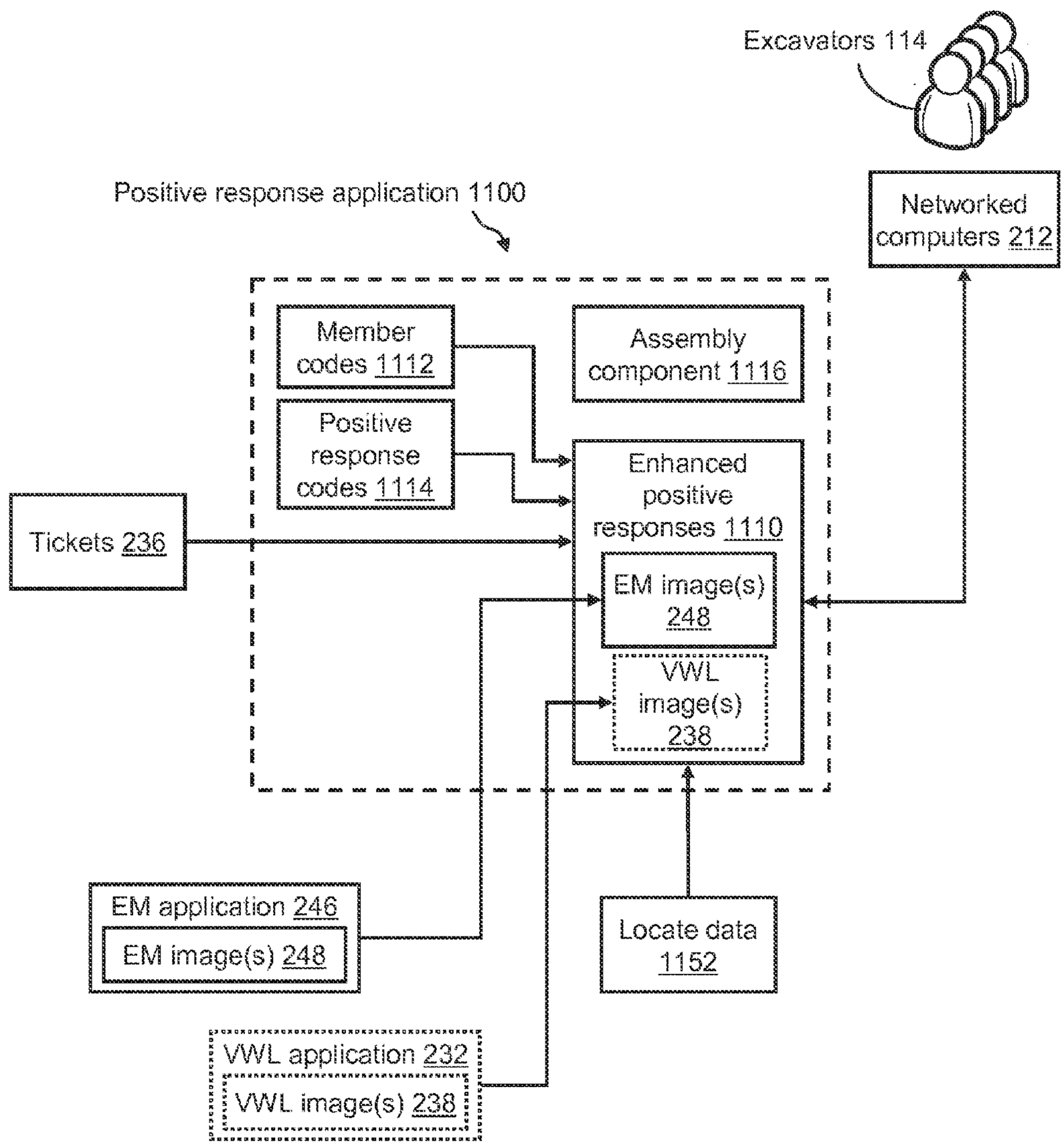

Excavators 114
Positive response application 1100
Networked computers 212
Member codes 1112
Assembly component 1116
Positive response codes 1114
Enhanced positive responses 1110
Tickets 236
EM image(s) 248
VWL image(s) 238
EM application 246
EM image(s) 248
Locate data 1152
VWL application 232
VWL image(s) 238

FIG. 9

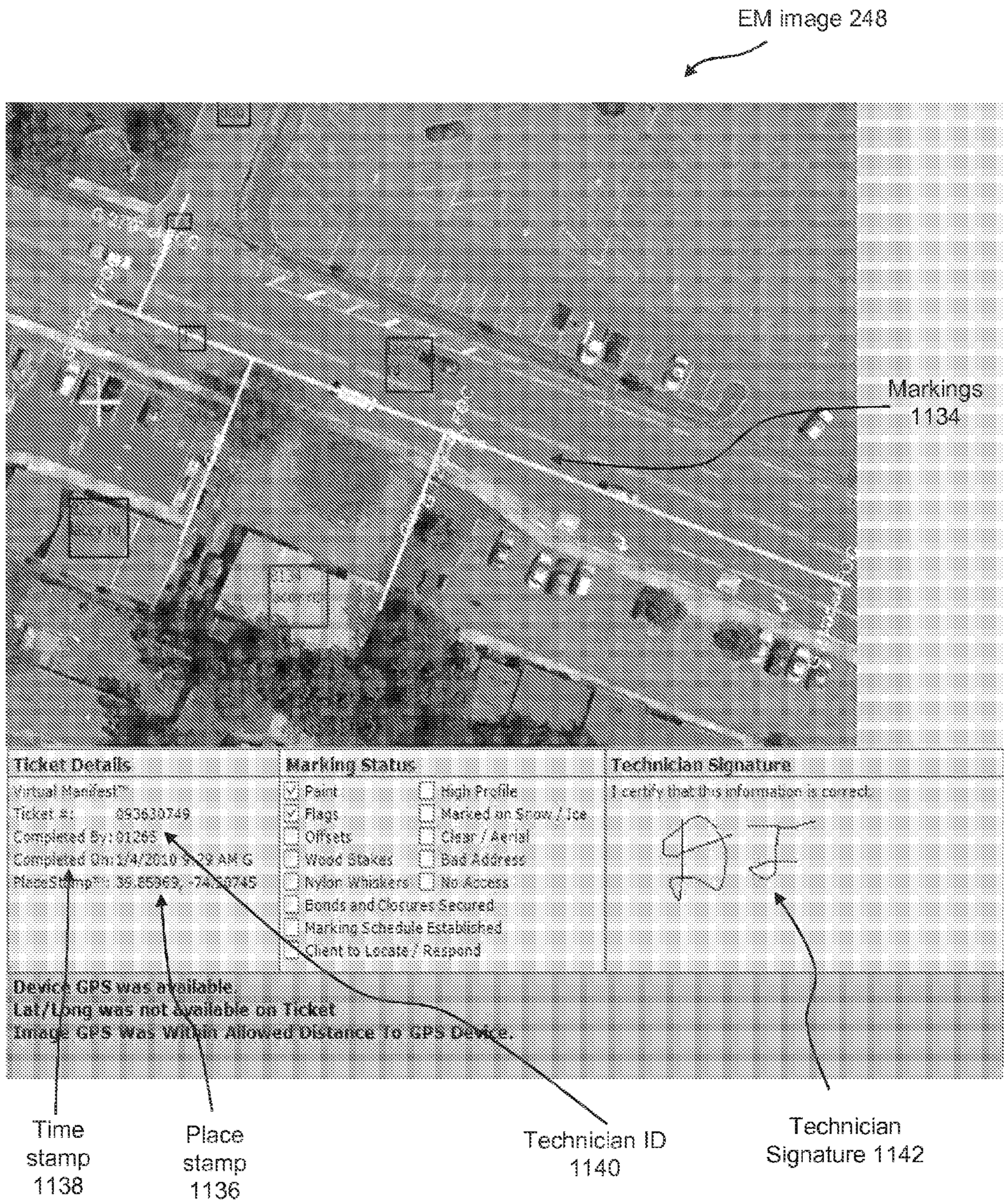

EM image 248
Markings 1134
Ticket Details
Virtual Manifest™
Ticket #: 893630749
Completed By: 01265
Completed On: 2/4/2010
PlaceStamp™: 35.85363, -74.36745
Marking Status
Paint
Flags
Offsets
Wood Stakes
Nylon Whiskers
Bonds and Closures Secured
Marking Schedule Established
Client to Locate / Respond
High Profile
Marked on Snow / Ice
Clear / Aerial
Bad Address
No Access
Technician Signature
I certify that this information is correct.
Device GPS was available.
Lat/Long was not available on Ticket
Image GPS Was Within Allowed Distance To GPS Device.
Time stamp 1138
Place stamp 1136
Technician ID 1140
Technician Signature 1142

FIG. 10

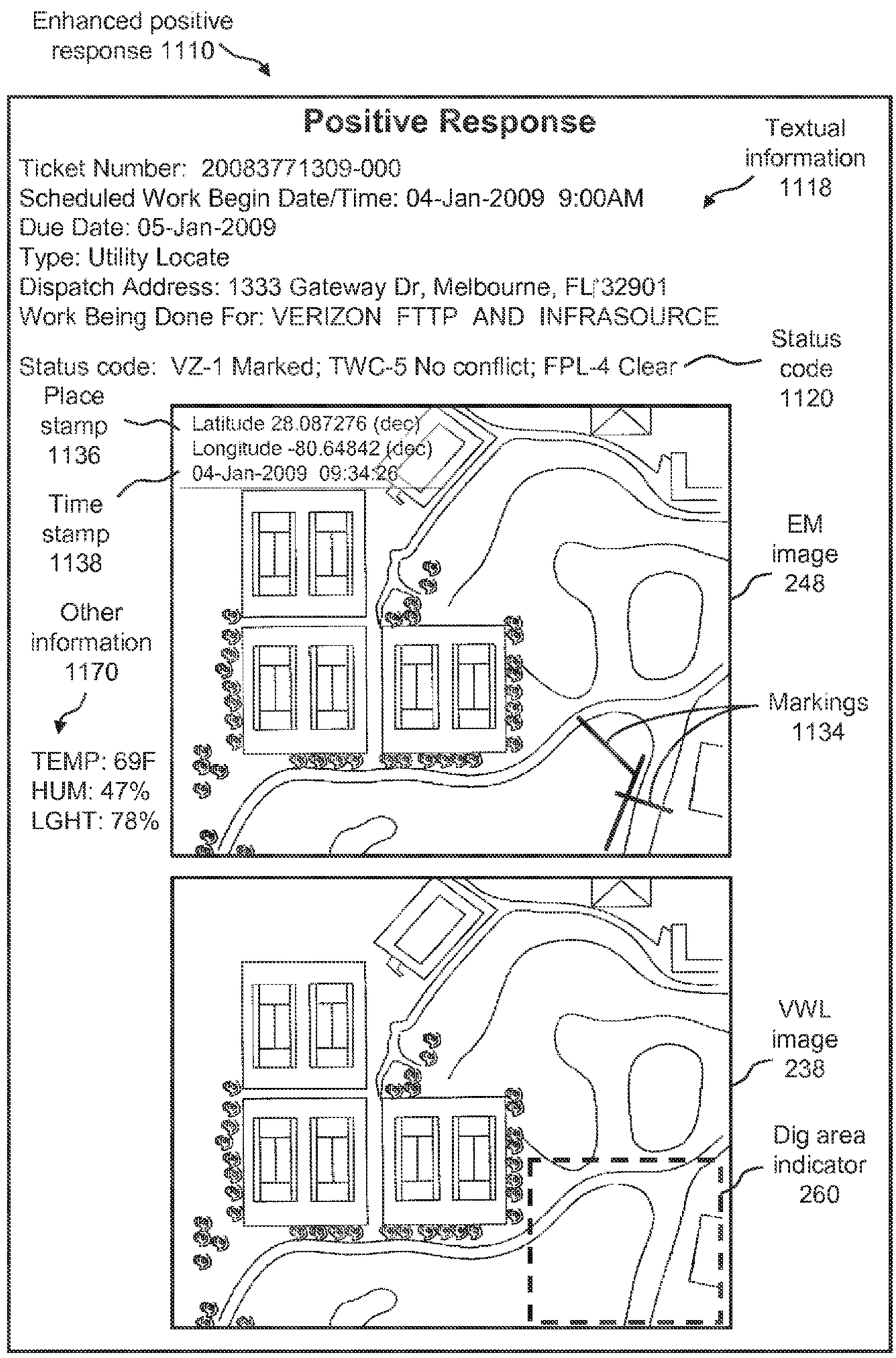

Enhanced positive response 1110
Positive Response
Textual information 1118
Ticket Number: 20083771309-000
Scheduled Work Begin Date/Time: 04-Jan-2009 9:00AM
Due Date: 05-Jan-2009
Type: Utility Locate
Dispatch Address: 1333 Gateway Dr, Melbourne, FL 32901
Work Being Done For: VERIZON FTTP AND INFRASOURCE
Status code: VZ-1 Marked; TWC-5 No conflict; FPL-4 Clear
Status code 1120
Place stamp 1136
Latitude 28.087276 (dec)
Longitude -80.64842 (dec)
04-Jan-2009 09:34:26
Time stamp 1138
Other information 1170
TEMP: 69F
HUM: 47%
LGHT: 78%
EM image 248
Markings 1134
VWL image 238
Dig area indicator 260

FIG. 11A

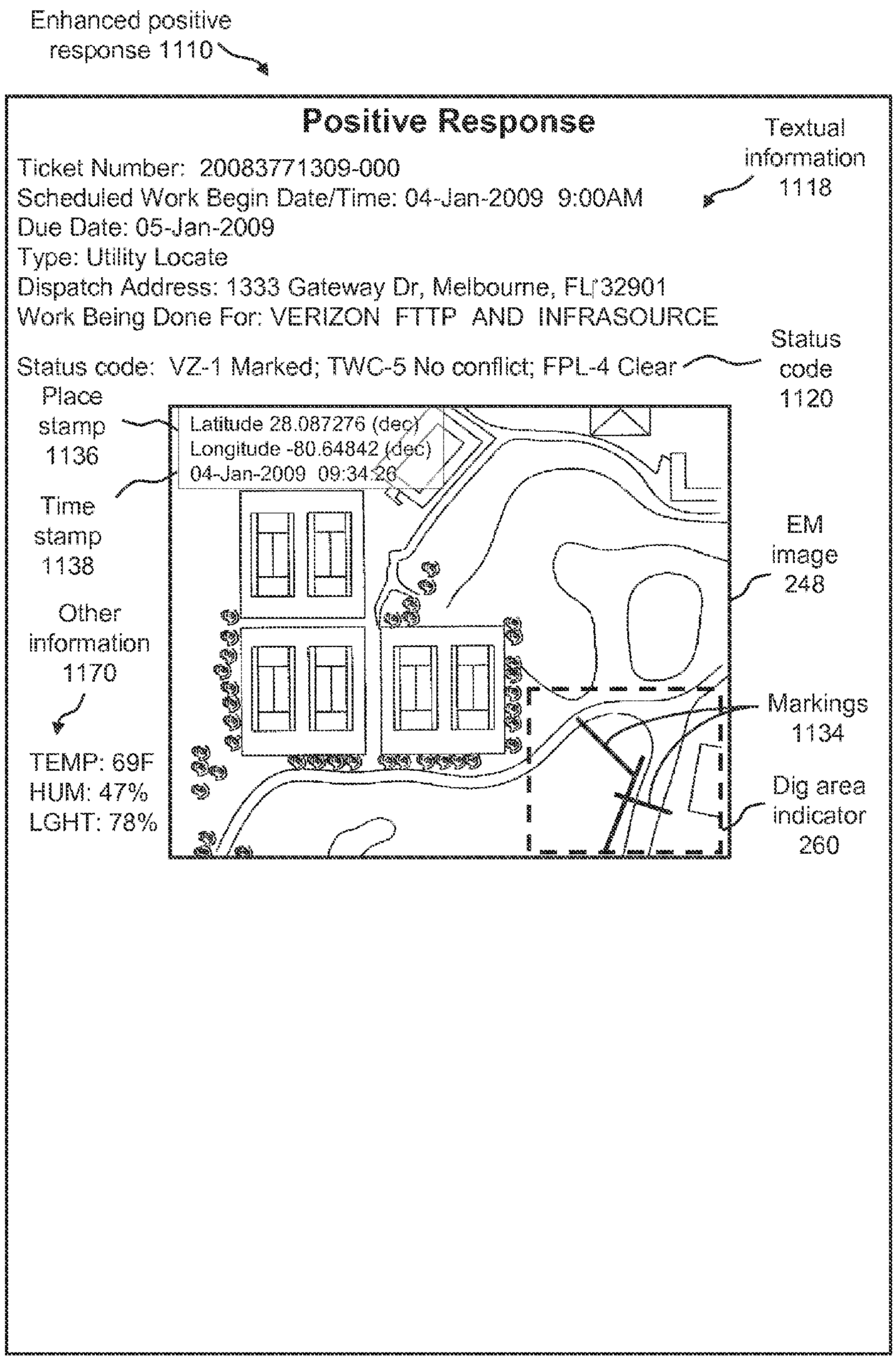

Enhanced positive response 1110
Positive Response
Textual information 1118
Ticket Number: 20083771309-000
Scheduled Work Begin Date/Time: 04-Jan-2009 9:00AM
Due Date: 05-Jan-2009
Type: Utility Locate
Dispatch Address: 1333 Gateway Dr, Melbourne, FL 32901
Work Being Done For: VERIZON FTTP AND INFRASOURCE
Status code: VZ-1 Marked; TWC-5 No conflict; FPL-4 Clear
Status code 1120
Place stamp 1136
Latitude 28.087276 (dec)
Longitude -80.64842 (dec)
04-Jan-2009 09:34:26
Time stamp 1138
EM image 248
Other information 1170
TEMP: 69F
HUM: 47%
LGHT: 78%
Markings 1134
Dig area indicator 260

FIG. 11B

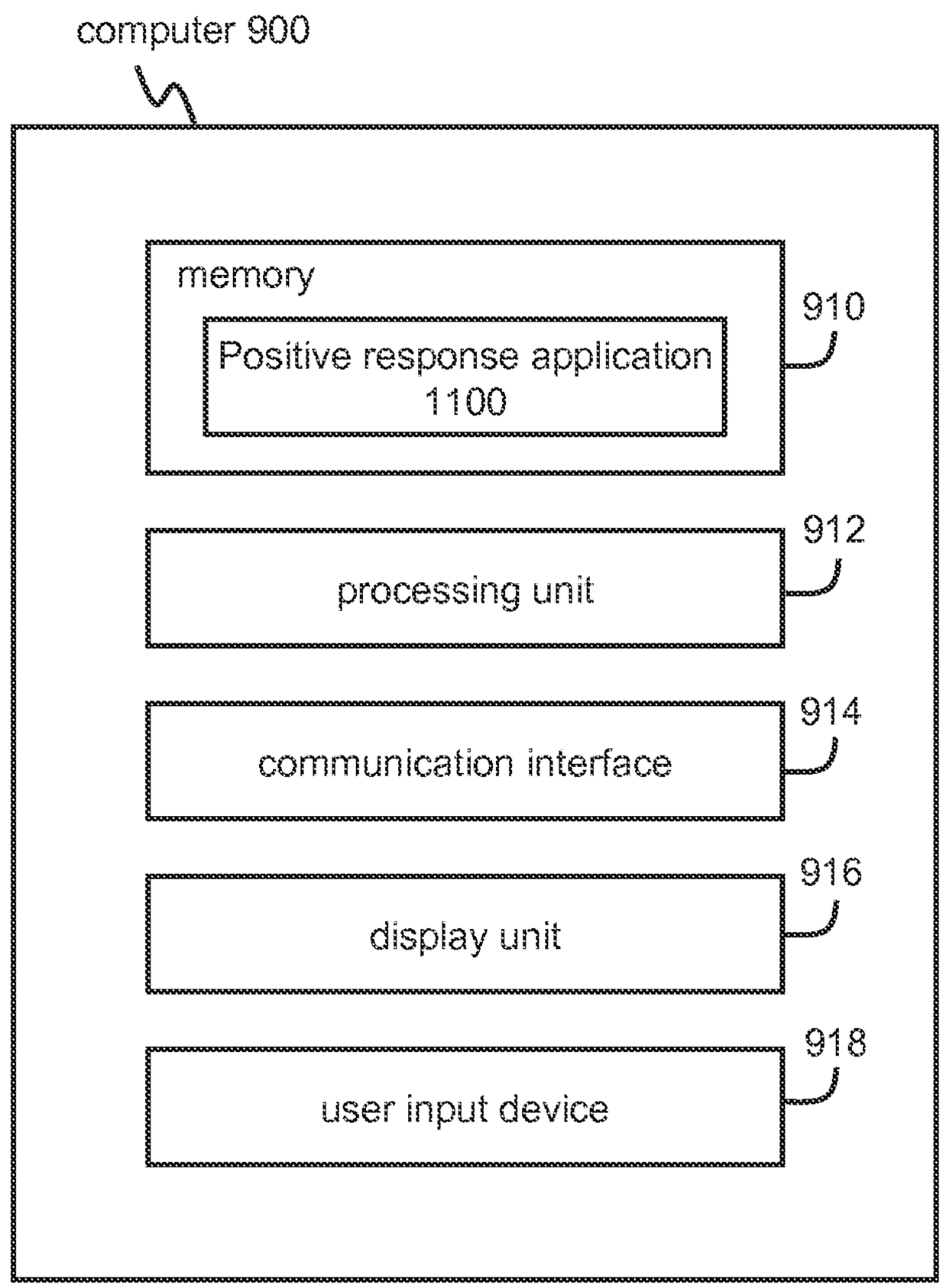

computer 900
memory
Positive response application 1100
910
processing unit
912
communication interface
914
display unit
916
user input device
918

FIG. 12

METHODS, APPARATUS, AND SYSTEMS FOR ACQUIRING AN ENHANCED POSITIVE RESPONSE FOR UNDERGROUND FACILITY LOCATE AND MARKING OPERATIONS BASED ON AN ELECTRONIC MANIFEST DOCUMENTING PHYSICAL LOCATE MARKS ON GROUND, PAVEMENT, OR OTHER SURFACE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims a priority benefit, under 35 U.S.C. §120, as a continuation (CON) of U.S. non-provisional patent application Ser. No. 14/063,417, entitled "Methods, Apparatus, and Systems for Providing an Enhanced Positive Response for Underground Facility Locate and Marking Operations Based on an Electronic Manifest Documenting Physical Locate Marks on Ground, Pavement or Other Surface," filed on Oct. 25, 2013.

[0002] U.S. non-provisional patent application Ser. No. 14/063,417 claims a priority benefit, under 35 U.S.C. §120, as a continuation (CON) of U.S. non-provisional patent application Ser. No. 12/915,516, entitled "Methods, Apparatus, and Systems for Providing an Enhanced Positive Response in Underground Facility Locate and Marking Operations," filed on Oct. 29, 2010.

[0003] U.S. non-provisional patent application Ser. No. 12/915,516 claims a priority benefit, under 35 U.S.C. §120, as a continuation-in-part (CIP) of U.S. non-provisional patent application Ser. No. 12/703,313, entitled "Methods, Apparatus, and Systems for Exchanging Information Between Excavators and Other Entities Associated with Underground Facility Locate and Marking Operations," filed on Feb. 10, 2010.

[0004] U.S. non-provisional patent application Ser. No. 12/703,313 claims a priority benefit, under 35 U.S.C. §119 (e), to U.S. provisional patent application Ser. No. 61/151,419, entitled "Methods and Apparatus for Excavator Notification of Underground Facility Locate Operation Status," filed on Feb. 10, 2009.

[0005] U.S. non-provisional patent application Ser. No. 12/703,313 also claims a priority benefit, under 35 U.S.C. §119(e), to U.S. provisional patent application Ser. No. 61/151,425, entitled "Methods and Apparatus for Exchanging Information Between Excavators and Other Entities Associated with Underground Facility Locate Operations," filed on Feb. 10, 2009.

[0006] U.S. non-provisional patent application Ser. No. 12/703,313 further claims a priority benefit, under 35 U.S.C. §119(a), to Canadian patent application Serial No. 2,690,239, entitled "Methods and Apparatus for Excavator Notification of Underground Facility Locate Operation Status," filed on Feb. 9, 2010.

[0007] Each of the above-identified applications is incorporated herein by reference.

BACKGROUND

[0008] Field service operations may be any operation in which companies dispatch technicians and/or other staff to perform certain activities, for example, installations, services and/or repairs. Field service operations may exist in various industries, examples of which include, but are not limited to, network installations, utility installations, security systems, construction, medical equipment, heating, ventilating and air conditioning (HVAC) and the like.

[0009] In the construction industry, for example, the process of locating and marking underground facilities is an example of a field service application, often referred to as a "locate and marking operation" (or more simply referred to as a "locate operation"). In locate operations, a locate technician may use one or more locate devices (e.g., a locate transmitter and a locate receiver) and a marking device in order to perform the locate operation. A locate receiver is an instrument for detecting the presence or absence of facilities that are concealed in some manner, such as cables and pipes that are located underground. A locate receiver is used to detect electromagnetic fields that are generated by a detection signal that is emitted from the facility (the detection signal typically is provided to the facility via a locate transmitter). A signal, or lack thereof, detected by the locate receiver indicates the presence or absence of the facility.

[0010] Once the presence or absence of the facility is detected, a marking material is dispensed on, for example, the surface of the ground at the location of the facility. Marking material may be any material, substance, compound, and/or element, used or which may be used separately or in combination to mark, signify, and/or indicate. Examples of marking materials may include, but are not limited to, paint, chalk, dye, and/or iron. Marking devices, such as paint marking wands and/or paint marking wheels, provide a convenient method of dispensing marking materials onto surfaces, such as onto the surface of the ground.

[0011] With respect to locate operations, there may be an associated work request (i.e., locate request, also referred to as locate request ticket or merely "ticket") that is originated by, for example, an excavator or other party who wishes to ascertain and/or mark the presence or absence of one or more underground facilities in a certain geographic region. A locate request may be any communication or instruction to perform a locate operation at a certain work site, or in some cases multiple work sites, at which one or more dig areas may be designated for planned excavation (or more generally, some disturbance of the ground). Today, excavators and other parties are required to notify one-call centers in advance of their excavation activities and identify through the locate request the work site(s)/dig area(s) where individual excavating activities/disturbances of the ground are planned. One-call centers may be any organizations, entities, and/or systems that receive, process, and/or transmit locate requests.

[0012] The information on the locate request may include, for example, the physical address or other location information about the dig area to which the locate technician is dispatched and the type of service that is requested, such as detecting and marking one or more types of facilities within a certain area of interest at a certain geographic site. Additionally, the locate request may specify a "must be complete by" date, a "must be performed on" date, and/or a "do not perform until" date.

[0013] In many instances, excavators and other parties who request a locate operation receive very limited or no notification as to whether or when the operation is complete. Once the locate request ticket is in a "closed" status, the one-call center may communicate to the excavator that the locate operation is complete. However, this communication may not be provided in a timely manner. Any delay between performing the locate operation and the planned excavation represents an inefficiency in the excavation process and, perhaps, lost profit by

the excavation companies whose excavators may be unnecessarily idle. Additionally, because there is limited exchange of information between the excavators, other parties requesting locate operations, and locate service providers, there may be confusion as to the scope and status of the locate operation. In some instances, excavators arrive on site and find the locate/marking operation not done or done incorrectly; excavators often wait for the "complete by" date to pass, then arrive at the dig area under the assumption that the locate operation has been performed. Consequently, excavators may perform the planned excavation uncertain as to whether the locate operation is complete as requested or has been performed satisfactorily prior to beginning the excavation activities. As a result, there is a certain amount of risk of damage to underground facilities.

SUMMARY

[0014] Applicants have recognized and appreciated that a need exists for an information exchange process not just between excavators and other parties who may request locate and marking operations (hereafter a "requesting party," e.g., excavators, property owners, facilities owners, regulatory authorities, damage investigators, etc.) and locate service providers, but also among other key players involved in and relating to locate and/or marking operations. More specifically, a need exists for better ways of providing information to one or more requesting parties in a timely manner, for example, to reduce uncertainty and thereby reduce the risk of damage to underground facilities, and in some instances to also improve excavator efficiency.

[0015] In view of the foregoing, various inventive embodiments disclosed herein relate generally to providing information relating to a locate and/or marking operation to excavators, other parties requesting locate and/or marking operations (a requesting party), and/or any other party associated with locate and/or marking activities.

[0016] In one embodiment, one or more computing devices (e.g., having a processor, memory, communications interface, user interface/display, and/or input/output interface, etc.) may be configured so as to provide a graphical user interface (GUI) that may be accessed by a requesting party for a locate and/or marking operation, so as to facilitate submission of locate requests as well as selection and/or customization of "positive response" notifications. For purposes of the present disclosure, a "positive response" notification (also referred to herein simply as "positive response" and/or "notification") refers to one or more communications to one or more requesting parties for a locate and/or marking operation, which communications provide some indication of the status of the operation and/or information relating to one or more elements of performance of the operation (or a link/pointer to such an indication/information, such as a website address containing the indication/information). In some exemplary implementations, such computing devices/GUI may be provided by a one-call-center in a given jurisdiction, to both facilitate submission of locate requests in general, and to further provide for customization in the manner of receiving, and contents of, one or more positive response notifications that may be provided to the requesting party/parties. In other implementations, such computing devices/GUI may be provided by a third party that may be in communication both with one or more requesting parties and a one-call-center issuing locate request tickets.

[0017] In exemplary embodiments, in addition to submitting a locate request, in various aspects a requesting party may specify, via such a GUI, that they would like to receive one or more positive response notifications relating to the requested locate and/or marking operation. In addition to merely selecting an option to receive one or more positive response notifications, the requesting party may specify a particular communication mode in which they wish to receive notification(s) (e.g., text message; e-mail; voice message; etc.) and/or a particular format in which they wish to receive notification(s) (e.g., text based; HTML; images; text and images; tables with particular fields; flat files; etc.). Alternatively or additionally, the requesting party may specify one or more particular times/events during an operation at which they wish to receive notification(s) (e.g., when a locate ticket is dispatched by a one call center; when a ticket is received by a utility owner/locate contractor; when a locate technician is dispatched; when a locate technician arrives at a work site/dig area; when a locate technician begins an operation; when an operation is complete; if and when an operation is approved by a supervisor/quality control assessment; if and when there is some anomaly regarding the operation with respect to information in the ticket; etc.). Likewise, alternatively or additionally, the requesting party may specify particular content that they wish to receive in one or more notifications (e.g., upon arrival of technician to work site, send arrival time and geo-location data/GPS coordinates of technician location; upon completion of the operation send a simple notification indicating such; upon completion of the operation, send a complete electronic manifest of all work performed during the operation; upon completion of the operation, send one or more images of the work site/dig area illustrating dispensed markings; send a quality assessment report or other quality assessment-related information, etc.).

[0018] Once a locate request is submitted, along with selection of positive response notification and preferences for same, the computing device(s) may be configured to thereafter receive further information from a variety of sources (e.g., facility owners; locate contractors; various equipment, instrumentation, and/or vehicles associated with dispatched technicians to perform locate and/marking operations; etc.) relating to allocating tickets to available technicians and dispatching technicians, as well as various steps/events toward performance of the locate and marking operation. The computing device(s) acquire and process such information so as to appropriately provide positive response notification(s) to requesting parties pursuant to their selected preferences. In some embodiments, following receipt of a notification, a requesting party may optionally provide, or in some instances be mandated to provide (e.g., by contractual obligation, applicable statutes/regulations, etc.) an acknowledgement of receipt (e.g., a "return receipt") for one or more received notifications.

[0019] In yet another embodiment, one or more computing devices may be configured so as to provide a graphical user interface (GUI) that not only facilitates submission of locate requests and positive response notification preferences, but also allows for the requesting party to prepare and submit a "virtual white lines" (VWL) image as part of the locate request. As discussed in greater detail herein, a VWL image may contain a digital image of the work site (or some other suitable digital data representing the geographic location of the work site) along with electronic annotations delimiting one or more dig areas in which excavation or disturbances to

the ground are planned. Such electronic annotations also are referred to as "dig area indicators," which may be any electronically generated markings indicating a point, line, path and/or area of the planned excavation. To facilitate generation of a VWL image, the computing device(s) may be configured to execute a VWL application which may be implemented, for example, as described in the following references: U.S. patent application Ser. No. 12/366,853 filed Feb. 6, 2009, entitled "Virtual white lines for delimiting planned excavation sites;" U.S. patent application Ser. No. 12/475,905 filed Jun. 1, 2009, entitled "Virtual white lines for delimiting planned excavation sites of staged excavation projects;" and U.S. patent application Ser. No. 12/422,364 filed Apr. 13, 2009, entitled "Virtual white lines (VWL) application for indicating a planned excavation or locate path," each of which patent applications is hereby incorporated by reference herein in its entirety.

[0020] In some implementations relating to VWL images, the digital image on which dig area indicators are drawn may be geotagged (i.e., associated with geospatial metadata), and the one or more computing devices may be configured to execute the VWL application so as to use the geospatial metadata associated with the digital image to convert location information regarding the dig area indicators and/or landmarks shown in the digital image into geographic coordinates such as Global Positioning System (GPS) coordinates. These geographic coordinates may be stored in a separate data set that may be attached to a locate request instead of, or in addition to, the VWL image. Accordingly, pursuant to this embodiment, via a suitably-implemented GUI and a VWL application, a party requesting a locate and/or marking information may: 1) submit a locate request; 2) generate a VWL image and attach the image and/or a data set relating to a VWL image; and/or 3) select to receive one or more positive response notifications, and preferences for receiving same.

[0021] In yet other embodiments, according to the methods, apparatus and systems described herein an enhanced positive response may be generated to inform one or more parties of locate and/or marking operation status. In one exemplary implementation, an enhanced positive response may include one or both of time-stamp information to provide proof of a time at which the locate and/or marking operation was completed by a locate technician, and place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the locate request ticket (and corresponding to the dig area). In one aspect, the enhanced positive response may include an electronic manifest (EM) image that itself includes such a time-stamp and/or place-stamp. As discussed in further detail below, an EM image is an electronic image depicting a work site/dig area and its surroundings (e.g., a digital photograph, an aerial photograph, an electronic map, etc.), on which is overlaid various information relating to work performed in the field at the work site/dig area by a locate technician. In one aspect, the inclusion of an EM image in an enhanced positive response provides comprehensive feedback regarding performance of the locate and/or marking operation. Examples of other information that may be included in such an enhanced positive response (and in some cases as part of an EM image) include, but are not limited to, a signature and/or a user identification that identifies the locate technician, one or more member codes for facility owners who may have facilities in or proximate to the dig area, one or more positive response codes representing a status of the locate and/or marking operation, and various textual information. In another aspect, the enhanced positive response may include a virtual white line (VWL) image, in addition to the EM image, that includes one or more dig area indicators to indicate the dig area on an image; alternatively, the EM image itself may include one or more such dig area indicators. As discussed in further detail below, one or both of an EM image and a VWL image may include geo-referenced information (e.g., GPS coordinates) in connection with dig area indicators, environmental landmarks present in and around the work site/dig area, and/or the locate and/or marking operation performed by the technician.

[0022] In another embodiment relating to an enhanced positive response, various environmental information may be provided in such a response regarding one or more environmental conditions present at or near the dig area/work site during a locate and/or marking operation. Examples of environmental conditions about which environmental information may be provided includes, but is not limited to, an ambient temperature, and ambient humidity, and an ambient light level. Various environmental sensors may be employed, alone or together with exemplary locate and marking devices discussed herein, to acquire such environmental information. Additionally, digital photographs and/or digital audio files may be acquired at or near the dig area/work site and included in an enhanced positive response to provide additional information.

[0023] In yet another embodiment relating to an enhanced positive response, according to the methods, apparatus and systems described herein an enhanced positive response may be generated in which an electronic manifest (EM) image and a virtual white line (VWL) image associated with the locate and/or marking operation are bundled together based on respective descriptor files (or descriptor metadata) for the EM image and the VWL image. In one aspect, the descriptor files or descriptor metadata associate the corresponding images with one or more particular tickets in response to which the locate and/or marking operation is performed so as to link the images and relevant information in the locate request ticket. In this manner, a comprehensive enhanced positive response may be generated so as to inform one or more parties of a completed status of the locate and/or marking operation. As noted above, in addition to the EM image and the VWL image, a variety of other information also may be included in an enhanced positive response resulting from bundling of images based on descriptor files/descriptor metadata.

[0024] In sum, one embodiment of the present invention is directed to an apparatus for providing information regarding a locate and/or marking operation. The locate and/or marking operation comprises detecting and/or marking by a locate technician, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The apparatus comprises: a communication interface; a memory to store processor-executable instructions; and a processing unit communicatively coupled to the communication interface and the memory. Upon execution of the processor-executable instructions by the processing unit, the processing unit: controls the communication interface to receive input indicating that the locate and/or marking operation is complete; and based on the input indicating that the locate and/or marking operation is complete, further controls the communication interface and/or the memory to electronically trans-

mit and/or electronically store performance information concerning the locate and/or marking operation. The performance information includes at least one of the following: time-stamp information to provide proof of a time at which the locate and/or marking operation was completed by the locate technician; and place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the locate request ticket and corresponding to the dig area.

[0025] Another embodiment is directed to a computer-implemented method for providing information regarding a locate and/or marking operation. The locate and/or marking operation comprises detecting and/or marking by a locate technician, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises: A) receiving input indicating that the locate and/or marking operation is complete; and B) based on the input indicating that the locate and/or marking operation is complete, electronically transmitting and/or electronically storing performance information concerning the locate and/or marking operation. The performance information includes at least one of the following: time-stamp information to provide proof of a time at which the locate and/or marking operation was completed by the locate technician; and place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the locate request ticket and corresponding to the dig area.

[0026] Another embodiment is directed to at least one non-transitory computer readable medium encoded with instructions that, when executed on at least one processing unit, perform a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking by a locate technician, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities, the method comprising: A) receiving input indicating that the locate and/or marking operation is complete; and B) based on the input indicating that the locate and/or marking operation is complete, electronically transmitting and/or electronically storing performance information concerning the locate and/or marking operation, the performance information including at least one of the following: time-stamp information to provide proof of a time at which the locate and/or marking operation was completed by the locate technician; and place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the locate request ticket and corresponding to the dig area.

[0027] Another embodiment is directed to an apparatus for providing information regarding a locate and/or marking operation. The locate and/or marking operation comprises detecting and/or marking by a locate technician, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The apparatus comprises: a communication interface; a memory to store processor-executable instructions; and a processing unit communicatively coupled to the communication interface and the memory. Upon execution of the processor-executable instructions by the processing unit, the processing unit: controls the communication interface to receive input indicating that the locate and/or marking operation is complete; and based on the input indicating that the locate and/or marking operation is complete, further controls the communication interface and/or the memory to electronically transmit and/or electronically store environmental information regarding at least one environmental condition present at or near the dig area during the locate and/or marking operation, so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the at least one environmental condition.

[0028] Another embodiment is directed to an apparatus for providing an enhanced positive response regarding a locate and/or marking operation. The locate and/or marking operation comprises detecting and/or marking by a locate technician, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The apparatus comprises: a communication interface; a memory to store processor-executable instructions; and a processing unit communicatively coupled to the communication interface and the memory. Upon execution of the processor-executable instructions by the processing unit, the processing unit implements an image assembly component, wherein the image assembly component: bundles together at least one at least one electronic manifest (EM) image and at least one virtual white line (VWL) image associated with the locate and/or marking operation, based on respective descriptor files for the at least one EM image and the at least one VWL image, so as to generate the enhanced positive response; and controls the communication interface and/or the memory to electronically transmit and/or electronically store the enhanced positive response so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of a completed status of the locate and/or marking operation.

[0029] Another embodiment is directed to a computer-implemented method for generating a locate report that describes a completed underground facility locate operation. The method comprises: receiving, by a report application on a computing device, locate information from a locate request ticket, the locate information defining a requested locate operation in a dig area; receiving, by the report application, locate data acquired during the locate operation; receiving, by the report application, at least one image showing the dig area; generating, by the report application, a locate report identifying the locate request ticket and including information based on the locate data and the at least one image; and notifying, by the report application, at least one user that the locate report is available.

[0030] Another embodiment is directed to a computer-readable storage medium encoded with computer-readable instructions that, as a result of being executed by a computing device, controls the computing device to perform a method for generating a locate report that describes a completed underground facility locate operation. The method comprises: receiving locate information from a locate request ticket, the locate information defining a requested locate operation in a dig area; receiving locate data acquired during the locate operation; receiving at least one image showing the dig area; generating a locate report identifying the locate request ticket and including information based on the locate

data and the at least one image; and notifying at least one user that the locate report is available.

[0031] Another embodiment is directed to a system for generating a locate report that describes a completed underground facility locate operation. The system comprises: a processing device; and a memory containing a report application, for execution by the processing device, to receive locate information from a locate request ticket, the locate information defining a requested locate operation in a dig area, to receive locate data acquired during the locate operation, to receive at least one image showing the dig area, to generate a locate report identifying the locate request ticket and including information based on the locate data and the at least one image, and to notify at least one user that the locate report is available.

[0032] Another embodiment is directed to an apparatus for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The apparatus comprises a communication interface; a memory to store processor-executable instructions; and a processing unit communicatively coupled to the communication interface and the memory. Upon execution of the processor-executable instructions by the processing unit, the processing unit controls the communication interface to receive user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; generates the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and further controls the communication interface and/or the memory to electronically transmit and/or electronically store the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0033] Another embodiment of the present invention is directed to at least one computer readable medium encoded with instructions that, when executed on at least one processing unit, perform a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; B) generating the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and C) electronically transmitting and/or electronically storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0034] A further embodiment of the present invention is directed to a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; B) generating the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and C) electronically transmitting and/or electronically storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0035] Another embodiment of the present invention is directed to an apparatus for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The apparatus comprises a communication interface; a memory to store processor-executable instructions; and a processing unit communicatively coupled to the communication interface and the memory. Upon execution of the processor-executable instructions by the processing unit, the processing unit controls the communication interface to receive an input indicating that the locate and/or marking operation is in progress or complete; generates at least one notification indicating that the locate and/or marking operation is in progress or complete; and further controls the communication interface and/or the memory to electronically transmit and/or electronically store the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation that the locate and/or marking operation is in progress or complete.

[0036] A further embodiment of the present invention is directed to at least one computer readable medium encoded with instructions that, when executed on at least one processing unit, perform a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving an input indicating that the locate and/or marking operation is in progress or complete; B) generating at least one notification indicating that the locate and/or marking operation is in progress or complete; and C) electronically transmitting and/or electronically storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation that the locate and/or marking operation is in progress or complete.

[0037] Another embodiment of the present invention is directed to a method for providing information regarding a

locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving an input indicating that the locate and/or marking operation is in progress or complete; B) generating at least one notification indicating that the locate and/or marking operation is in progress or complete; and C) electronically transmitting and/or electronically storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation that the locate and/or marking operation is in progress or complete.

[0038] A further embodiment of the present invention is directed to an apparatus for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The apparatus comprises a communication interface; a memory to store processor-executable instructions; and a processing unit communicatively coupled to the communication interface and the memory. Upon execution of the processor-executable instructions by the processing unit, the processing unit controls the communication interface to receive an input indicating that the locate and/or marking operation is complete; and based on the input indicating that the locate and/or marking operation is complete, further controls the communication interface and/or the memory to electronically transmit and/or electronically store at least one of the following so as to provide information concerning the locate and/or marking operation to at least one party associated with providing at least one locate request relating to the locate and/or marking operation: (a) a virtual white line image indicating the dig area; (b) an electronic copy of a completed locate request ticket; (c) an electronic manifest image showing details of the locate and/or marking operation; and (d) an electronic representation of the locate and/or marking operation.

[0039] Another embodiment of the present invention is directed to at least one computer readable medium encoded with instructions that, when executed on at least one processing unit, perform a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving an input indicating that the locate and/or marking operation is complete; and B) based on the input indicating that the locate and/or marking operation is complete, electronically transmitting and/or electronically storing at least one of the following so as to provide information concerning the locate and/or marking operation to at least one party associated with providing at least one locate request relating to the locate and/or marking operation: (a) a virtual white line image indicating the dig area; (b) an electronic copy of a completed locate request ticket; (c) an electronic manifest image showing details of the locate and/or marking operation; and (d) an electronic representation of the locate and/or marking operation.

[0040] A further embodiment of the present invention is directed to a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving an input indicating that the locate and/or marking operation is complete; and B) based on the input indicating that the locate and/or marking operation is complete, electronically transmitting and/or electronically storing at least one of the following so as to provide information concerning the locate and/or marking operation to at least one party associated with providing at least one locate request relating to the locate and/or marking operation: (a) a virtual white line image indicating the dig area; (b) an electronic copy of a completed locate request ticket; (c) an electronic manifest image showing details of the locate and/or marking operation; and (d) an electronic representation of the locate and/or marking operation.

[0041] Another embodiment of the present invention is directed to an apparatus for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The apparatus comprises a communication interface; a memory to store processor-executable instructions; and a processing unit communicatively coupled to the communication interface and the memory. Upon execution of the processor-executable instructions by the processing unit, the processing unit electronically receives, via the communication interface, first user input relating to the dig area; based on the first user input, renders a digital virtual white line image including at least one dig area indicator to provide at least one indication of the dig area with respect to a geographic area; controls the communication interface and/or the memory to electronically transmit and/or electronically store information relating to the digital virtual white line image so as to facilitate the locate and/or marking operation; further controls the communication interface to electronically receive second user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; generates the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and further controls the communication interface and/or the memory to electronically transmit and/or electronically store the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0042] Another embodiment of the present invention is directed to at least one computer readable medium encoded with instructions that, when executed on at least one processing unit, perform a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig

area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving first user input relating to the dig area; B) based on the first user input, rendering a digital virtual white line image including at least one dig area indicator to provide at least one indication of the dig area with respect to a geographic area; C) electronically transmitting and/or electronically storing information relating to the digital virtual white line image so as to facilitate the locate and/or marking operation; D) electronically receiving second user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; E) generating the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and F) electronically transmitting and/or electronically storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0043] A further embodiment of the present invention is directed to a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving first user input relating to the dig area; B) based on the first user input, rendering a digital virtual white line image including at least one dig area indicator to provide at least one indication of the dig area with respect to a geographic area; C) electronically transmitting and/or electronically storing information relating to the digital virtual white line image so as to facilitate the locate and/or marking operation; D) electronically receiving second user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; E) generating the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and F) electronically transmitting and/or electronically storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0044] Another embodiment of the present invention is directed to an apparatus for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The apparatus comprises a communication interface; a memory to store processor-executable instructions; and a processing unit communicatively coupled to the communication interface and the memory. Upon execution of the processor-executable instructions by the processing unit, the processing unit electronically receives a locate request via the communication interface; based on the locate request, generates the at least one locate request ticket; controls the communication interface and/or the memory to electronically transmit and/or electronically store the locate request ticket so as to initiate the locate and/or marking operation; further controls the communication interface to electronically receive user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; generates the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and further controls the communication interface and/or the memory to electronically transmit and/or electronically store the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0045] Another embodiment of the present invention is directed to at least one computer readable medium encoded with instructions that, when executed on at least one processing unit, perform a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving a locate request; B) based on the locate request, generating the at least one locate request ticket; C) electronically transmitting and/or electronically storing the locate request ticket so as to initiate the locate and/or marking operation; D) electronically receiving user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; E) generating the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and F) electronically transmitting and/or electronically storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0046] A further embodiment of the present invention is directed to a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving a locate request; B) based on the locate request, generating the at least one locate request ticket; C) electronically transmitting and/or electronically storing the locate request ticket so as to initiate the locate and/or marking operation; D) electronically receiving user input regarding a preferred notification type and/or a preferred notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; E) generating the at least one notification based at least in part on the preferred notification type and/or the preferred notification communication method; and F) electronically transmitting and/or electroni-

cally storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation.

[0047] Another embodiment of the present invention is directed to a method for providing information regarding a locate and/or marking operation comprising detecting and/or marking, in response to at least one locate request ticket, a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed during excavation activities. The method comprises A) electronically receiving user input regarding at least one notification type and/or at least one notification communication method for at least one notification indicating a status and/or providing information relating to the performance of the locate and/or marking operation; B) generating the at least one notification based at least in part on the at least one notification type and/or the at least one notification communication method; and C) electronically transmitting and/or electronically storing the at least one notification so as to inform at least one party associated with providing at least one locate request relating to the locate and/or marking operation of the status and/or performance of the locate and/or marking operation. According to some implementations, the at least one notification type and/or the at least one notification communication method may be mandated by at least one regulation and/or required by at least one contract.

[0048] For purposes of the present disclosure, the term "dig area" refers to a specified area of a work site within which there is a plan to disturb the ground (e.g., excavate, dig holes and/or trenches, bore, etc.), and beyond which there is no plan to excavate in the immediate surroundings. Thus, the metes and bounds of a dig area are intended to provide specificity as to where some disturbance to the ground is planned at a given work site. It should be appreciated that a given work site may include multiple dig areas.

[0049] The term "facility" refers to one or more lines, cables, fibers, conduits, transmitters, receivers, or other physical objects or structures capable of or used for carrying, transmitting, receiving, storing, and providing utilities, energy, data, substances, and/or services, and/or any combination thereof. The term "underground facility" means any facility beneath the surface of the ground. Examples of facilities include, but are not limited to, oil, gas, water, sewer, power, telephone, data transmission, cable television (TV), and/or internet services.

[0050] The term "locate device" refers to any apparatus and/or device for detecting and/or inferring the presence or absence of any facility, including without limitation, any underground facility. In various examples, a locate device may include both a locate transmitter and a locate receiver (which in some instances may also be referred to collectively as a "locate instrument set," or simply "locate set").

[0051] The term "marking device" refers to any apparatus, mechanism, or other device that employs a marking dispenser for causing a marking material and/or marking object to be dispensed, or any apparatus, mechanism, or other device for electronically indicating (e.g., logging in memory) a location, such as a location of an underground facility.

[0052] The term "locate mark" means any mark, sign, and/or object employed to indicate the presence or absence of any underground facility. Examples of locate marks may include, but are not limited to, marks made with marking materials, marking objects, global positioning or other information, and/or any other means. Locate marks may be represented in any form including, without limitation, physical, visible, electronic, and/or any combination thereof.

[0053] The terms "locate and marking operation," "locate operation," and "locate" generally are used interchangeably and refer to any activity to detect, infer, and/or mark the presence or absence of an underground facility. In some contexts, the term "locate operation" is used to more specifically refer to detection of one or more underground facilities, and the term "marking operation" is used to more specifically refer to using a marking material and/or one or more marking objects to mark a presence or an absence of one or more underground facilities. The term "locate technician" refers to an individual performing a locate operation. A locate and marking operation often is specified in connection with a dig area, at least a portion of which may be excavated or otherwise disturbed during excavation activities.

[0054] The term "user" refers to an individual utilizing a locate device and/or a marking device and may include, but is not limited to, land surveyors, locate technicians, and support personnel.

[0055] The terms "locate request," "excavation notice," and "work order" are used herein interchangeably to refer to any communication to request a locate and marking operation. The term "locate request ticket" (or simply "ticket") refers to any communication or instruction to perform a locate operation. A ticket might specify, for example, the address or description of a dig area to be marked, the day and/or time that the dig area is to be marked, and/or whether the user is to mark the excavation area for certain gas, water, sewer, power, telephone, cable television, and/or some other underground facility.

[0056] The following U.S. published applications are hereby incorporated herein by reference:

[0057] U.S. Pat. No. 7,640,105, issued Dec. 29, 2009, filed Mar. 13, 2007, and entitled "Marking System and Method With Location and/or Time Tracking;"

[0058] U.S. publication no. 2010-0094553-A1, published Apr. 15, 2010, filed Dec. 16, 2009, and entitled "Systems and Methods for Using Location Data and/or Time Data to Electronically Display Dispensing of Markers by A Marking System or Marking Tool;"

[0059] U.S. publication no. 2008-0245299-A1, published Oct. 9, 2008, filed Apr. 4, 2007, and entitled "Marking System and Method;"

[0060] U.S. publication no. 2009-0013928-A1, published Jan. 15, 2009, filed Sep. 24, 2008, and entitled "Marking System and Method;"

[0061] U.S. publication no. 2010-0090858-A1, published Apr. 15, 2010, filed Dec. 16, 2009, and entitled "Systems and Methods for Using Marking Information to Electronically Display Dispensing of Markers by a Marking System or Marking Tool;"

[0062] U.S. publication no. 2009-0238414-A1, published Sep. 24, 2009, filed Mar. 18, 2008, and entitled "Virtual White Lines for Delimiting Planned Excavation Sites;"

[0063] U.S. publication no. 2009-0241045-A1, published Sep. 24, 2009, filed Sep. 26, 2008, and entitled "Virtual White Lines for Delimiting Planned Excavation Sites;"

[0064] U.S. publication no. 2009-0238415-A1, published Sep. 24, 2009, filed Sep. 26, 2008, and entitled "Virtual White Lines for Delimiting Planned Excavation Sites;"

[0065] U.S. publication no. 2009-0241046-A1, published Sep. 24, 2009, filed Jan. 16, 2009, and entitled "Virtual White Lines for Delimiting Planned Excavation Sites;"

[0066] U.S. publication no. 2009-0238416-A1, published Sep. 24, 2009, filed Jan. 16, 2009, and entitled "Virtual White Lines for Delimiting Planned Excavation Sites;"

[0067] U.S. publication no. 2009-0237408-A1, published Sep. 24, 2009, filed Jan. 16, 2009, and entitled "Virtual White Lines for Delimiting Planned Excavation Sites;"

[0068] U.S. publication no. 2009-0202101-A1, published Aug. 13, 2009, filed Feb. 12, 2008, and entitled "Electronic Manifest of Underground Facility Locate Marks;"

[0069] U.S. publication no. 2009-0202110-A1, published Aug. 13, 2009, filed Sep. 11, 2008, and entitled "Electronic Manifest of Underground Facility Locate Marks;"

[0070] U.S. publication no. 2009-0201311-A1, published Aug. 13, 2009, filed Jan. 30, 2009, and entitled "Electronic Manifest of Underground Facility Locate Marks;"

[0071] U.S. publication no. 2009-0202111-A1, published Aug. 13, 2009, filed Jan. 30, 2009, and entitled "Electronic Manifest of Underground Facility Locate Marks;"

[0072] U.S. publication no. 2009-0204625-A1, published Aug. 13, 2009, filed Feb. 5, 2009, and entitled "Electronic Manifest of Underground Facility Locate Operation;"

[0073] U.S. publication no. 2009-0204466-A1, published Aug. 13, 2009, filed Sep. 4, 2008, and entitled "Ticket Approval System For and Method of Performing Quality Control In Field Service Applications;"

[0074] U.S. publication no. 2009-0207019-A1, published Aug. 20, 2009, filed Apr. 30, 2009, and entitled "Ticket Approval System For and Method of Performing Quality Control In Field Service Applications;"

[0075] U.S. publication no. 2009-0210284-A1, published Aug. 20, 2009, filed Apr. 30, 2009, and entitled "Ticket Approval System For and Method of Performing Quality Control In Field Service Applications;"

[0076] U.S. publication no. 2009-0210297-A1, published Aug. 20, 2009, filed Apr. 30, 2009, and entitled "Ticket Approval System For and Method of Performing Quality Control In Field Service Applications;"

[0077] U.S. publication no. 2009-0210298-A1, published Aug. 20, 2009, filed Apr. 30, 2009, and entitled "Ticket Approval System For and Method of Performing Quality Control In Field Service Applications;"

[0078] U.S. publication no. 2009-0210285-A1, published Aug. 20, 2009, filed Apr. 30, 2009, and entitled "Ticket Approval System For and Method of Performing Quality Control In Field Service Applications;"

[0079] U.S. publication no. 2009-0324815-A1, published Dec. 31, 2009, filed Apr. 24, 2009, and entitled "Marking Apparatus and Marking Methods Using Marking Dispenser with Machine-Readable ID Mechanism;"

[0080] U.S. publication no. 2010-0006667-A1, published Jan. 14, 2010, filed Apr. 24, 2009, and entitled, "Marker Detection Mechanisms for use in Marking Devices And Methods of Using Same;"

[0081] U.S. publication no. 2010-0085694 A1, published Apr. 8, 2010, filed Sep. 30, 2009, and entitled, "Marking Device Docking Stations and Methods of Using Same;"

[0082] U.S. publication no. 2010-0085701 A1, published Apr. 8, 2010, filed Sep. 30, 2009, and entitled, "Marking Device Docking Stations Having Security Features and Methods of Using Same;"

[0083] U.S. publication no. 2010-0084532 A1, published Apr. 8, 2010, filed Sep. 30, 2009, and entitled, "Marking Device Docking Stations Having Mechanical Docking and Methods of Using Same;"

[0084] U.S. publication no. 2010-0088032-A1, published Apr. 8, 2010, filed Sep. 29, 2009, and entitled, "Methods, Apparatus and Systems for Generating Electronic Records of Locate And Marking Operations, and Combined Locate and Marking Apparatus for Same;"

[0085] U.S. publication no. 2010-0117654 A1, published May 13, 2010, filed Dec. 30, 2009, and entitled, "Methods and Apparatus for Displaying an Electronic Rendering of a Locate and/or Marking Operation Using Display Layers;"

[0086] U.S. publication no. 2010-0086677 A1, published Apr. 8, 2010, filed Aug. 11, 2009, and entitled, "Methods and Apparatus for Generating an Electronic Record of a Marking Operation Including Service-Related Information and Ticket Information;"

[0087] U.S. publication no. 2010-0086671 A1, published Apr. 8, 2010, filed Nov. 20, 2009, and entitled, "Methods and Apparatus for Generating an Electronic Record of A Marking Operation Including Service-Related Information and Ticket Information;"

[0088] U.S. publication no. 2010-0085376 A1, published Apr. 8, 2010, filed Oct. 28, 2009, and entitled, "Methods and Apparatus for Displaying an Electronic Rendering of a Marking Operation Based on an Electronic Record of Marking Information;"

[0089] U.S. publication no. 2010-0088164-A1, published Apr. 8, 2010, filed Sep. 30, 2009, and entitled, "Methods and Apparatus for Analyzing Locate and Marking Operations with Respect to Facilities Maps;"

[0090] U.S. publication no. 2010-0088134 A1, published Apr. 8, 2010, filed Oct. 1, 2009, and entitled, "Methods and Apparatus for Analyzing Locate and Marking Operations with Respect to Historical Information;"

[0091] U.S. publication no. 2010-0088031 A1, published Apr. 8, 2010, filed Sep. 28, 2009, and entitled, "Methods and Apparatus for Generating an Electronic Record of Environmental Landmarks Based on Marking Device Actuations;"

[0092] U.S. publication no. 2010-0188407 A1, published Jul. 29, 2010, filed Feb. 5, 2010, and entitled "Methods and Apparatus for Displaying and Processing Facilities Map Information and/or Other Image Information on a Marking Device;"

[0093] U.S. publication no. 2010-0198663 A1, published Aug. 5, 2010, filed Feb. 5, 2010, and entitled "Methods and Apparatus for Overlaying Electronic Marking Information on Facilities Map Information and/or Other Image Information Displayed on a Marking Device;"

[0094] U.S. publication no. 2010-0188215 A1, published Jul. 29, 2010, filed Feb. 5, 2010, and entitled "Methods and Apparatus for Generating Alerts on a Marking Device, Based on Comparing Electronic Marking Information to Facilities Map Information and/or Other Image Information;"

[0095] U.S. publication no. 2010-0188088 A1, published Jul. 29, 2010, filed Feb. 5, 2010, and entitled "Methods and Apparatus for Displaying and Processing Facilities Map Information and/or Other Image Information on a Locate Device;"

[0096] U.S. publication no. 2010-0189312 A1, published Jul. 29, 2010, filed Feb. 5, 2010, and entitled "Methods and Apparatus for Overlaying Electronic Locate Information on

Facilities Map Information and/or Other Image Information Displayed on a Locate Device;"

[0097] U.S. publication no. 2010-0188216 A1, published Jul. 29, 2010, filed Feb. 5, 2010, and entitled "Methods and Apparatus for Generating Alerts on a Locate Device, Based ON Comparing Electronic Locate Information TO Facilities Map Information and/or Other Image Information;"

[0098] U.S. publication no. 2010-0189887 A1, published Jul. 29, 2010, filed Feb. 11, 2010, and entitled "Marking Apparatus Having Enhanced Features for Underground Facility Marking Operations, and Associated Methods and Systems;"

[0099] U.S. publication no. 2010-0188245 A1, published Jul. 29, 2010, filed Feb. 11, 2010, and entitled "Locate Apparatus Having Enhanced Features for Underground Facility Locate Operations, and Associated Methods and Systems;"

[0100] U.S. publication no. 2009-0204238-A1, published Aug. 13, 2009, filed Feb. 2, 2009, and entitled "Electronically Controlled Marking Apparatus and Methods;"

[0101] U.S. publication no. 2009-0208642-A1, published Aug. 20, 2009, filed Feb. 2, 2009, and entitled "Marking Apparatus and Methods For Creating an Electronic Record of Marking Operations;"

[0102] U.S. publication no. 2009-0210098-A1, published Aug. 20, 2009, filed Feb. 2, 2009, and entitled "Marking Apparatus and Methods For Creating an Electronic Record of Marking Apparatus Operations;"

[0103] U.S. publication no. 2009-0201178-A1, published Aug. 13, 2009, filed Feb. 2, 2009, and entitled "Methods For Evaluating Operation of Marking Apparatus;"

[0104] U.S. publication no. 2009-0238417-A1, published Sep. 24, 2009, filed Feb. 6, 2009, and entitled "Virtual White Lines for Indicating Planned Excavation Sites on Electronic Images;"

[0105] U.S. publication no. 2010-0205264-A1, published Aug. 12, 2010, filed Feb. 10, 2010, and entitled "Methods, Apparatus, and Systems for Exchanging Information Between Excavators and Other Entities Associated with Underground Facility Locate and Marking Operations;"

[0106] U.S. publication no. 2010-0205031-A1, published Aug. 12, 2010, filed Feb. 10, 2010, and entitled "Methods, Apparatus, and Systems for Exchanging Information Between Excavators and Other Entities Associated with Underground Facility Locate and Marking Operations;"

[0107] U.S. publication no. 2010-0201706-A1, published Aug. 12, 2010, filed Jun. 1, 2009, and entitled "Virtual White Lines (VWL) for Delimiting Planned Excavation Sites of Staged Excavation Projects;"

[0108] U.S. publication no. 2010-0205555-A1, published Aug. 12, 2010, filed Jun. 1, 2009, and entitled "Virtual White Lines (VWL) for Delimiting Planned Excavation Sites of Staged Excavation Projects;"

[0109] U.S. publication no. 2010-0205195-A1, published Aug. 12, 2010, filed Jun. 1, 2009, and entitled "Methods and Apparatus for Associating a Virtual White Line (VWL) Image with Corresponding Ticket Information for an Excavation Project;"

[0110] U.S. publication no. 2010-0205536-A1, published Aug. 12, 2010, filed Jun. 1, 2009, and entitled "Methods and Apparatus for Controlling Access to a Virtual White Line (VWL) Image for an Excavation Project;"

[0111] U.S. publication no. 2010-0228588-A1, published Sep. 9, 2010, filed Feb. 11, 2010, and entitled "Management System, and Associated Methods and Apparatus, for Providing Improved Visibility, Quality Control and Audit Capability for Underground Facility Locate and/or Marking Operations;"

[0112] U.S. publication no. 2010-0201690-A1, published Aug. 12, 2010, filed Apr. 13, 2009, and entitled "Virtual White Lines (VWL) Application for Indicating a Planned Excavation or Locate Path;"

[0113] U.S. publication no. 2010-0205554-A1, published Aug. 12, 2010, filed Apr. 13, 2009, and entitled "Virtual White Lines (VWL) Application for Indicating an Area of Planned Excavation;"

[0114] U.S. publication no. 2009-0202112-A1, published Aug. 13, 2009, filed Feb. 11, 2009, and entitled "Searchable Electronic Records of Underground Facility Locate Marking Operations;"

[0115] U.S. publication no. 2009-0204614-A1, published Aug. 13, 2009, filed Feb. 11, 2009, and entitled "Searchable Electronic Records of Underground Facility Locate Marking Operations;"

[0116] U.S. publication no. 2010-0205032-A1, published Aug. 12, 2010, filed Feb. 11, 2010, and entitled "Marking Apparatus Equipped with Ticket Processing Software for Facilitating Marking Operations, and Associated Methods;"

[0117] U.S. publication no. 2009-0327024-A1, published Dec. 31, 2009, filed Jun. 26, 2009, and entitled "Methods and Apparatus for Quality Assessment of a Field Service Operation;"

[0118] U.S. publication no. 2010-0010862-A1, published Jan. 14, 2010, filed Aug. 7, 2009, and entitled, "Methods and Apparatus for Quality Assessment of a Field Service Operation Based on Geographic Information;"

[0119] U.S. publication No. 2010-0010863-A1, published Jan. 14, 2010, filed Aug. 7, 2009, and entitled, "Methods and Apparatus for Quality Assessment of a Field Service Operation Based on Multiple Scoring Categories;"

[0120] U.S. publication no. 2010-0010882-A1, published Jan. 14, 2010, filed Aug. 7, 2009, and entitled, "Methods and Apparatus for Quality Assessment of a Field Service Operation Based on Dynamic Assessment Parameters;"

[0121] U.S. publication no. 2010-0010883-A1, published Jan. 14, 2010, filed Aug. 7, 2009, and entitled, "Methods and Apparatus for Quality Assessment of a Field Service Operation Based on Multiple Quality Assessment Criteria;"

[0122] U.S. publication no. 2010-0088135 A1, published Apr. 8, 2010, filed Oct. 1, 2009, and entitled, "Methods and Apparatus for Analyzing Locate and Marking Operations with Respect to Environmental Landmarks;"

[0123] U.S. publication no. 2010-0085185 A1, published Apr. 8, 2010, filed Sep. 30, 2009, and entitled, "Methods and Apparatus for Generating Electronic Records of Locate Operations;"

[0124] U.S. publication no. 2010-0090700-A1, published Apr. 15, 2010, filed Oct. 30, 2009, and entitled "Methods and Apparatus for Displaying an Electronic Rendering of a Locate Operation Based on an Electronic Record of Locate Information;" and

[0125] U.S. publication no. 2010-0085054 A1, published Apr. 8, 2010, filed Sep. 30, 2009, and entitled, "Systems and Methods for Generating Electronic Records of Locate And Marking Operations."

[0126] It should be appreciated that all combinations of the foregoing concepts and additional concepts discussed in greater detail below (provided such concepts are not mutually inconsistent) are contemplated as being part of the inventive

subject matter disclosed herein. In particular, all combinations of claimed subject matter appearing at the end of this disclosure are contemplated as being part of the inventive subject matter disclosed herein. It should also be appreciated that terminology explicitly employed herein that also may appear in any disclosure incorporated by reference should be accorded a meaning most consistent with the particular concepts disclosed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0127] The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention.

[0128] FIG. **1** illustrates an example of an information exchange process flow that includes a link between excavators and locate personnel, according to one embodiment of the present invention;

[0129] FIG. **2** illustrates a functional block diagram of an example of an informed excavator system for exchanging information between excavators and other entities associated with locate operations, according to one embodiment of the present invention;

[0130] FIG. **3** illustrates an exemplary excavator device according to one aspect of the present invention, which supports a "virtual white line" (VWL) application to display an image of a geographic area including a dig area and facilitate adding virtual white lines to the displayed image to indicate the dig area;

[0131] FIG. **4** illustrates an exemplary locate personnel device according to one aspect of the present invention, which supports an "electronic manifest" (EM) application to display an image of a geographic area including a dig area and facilitate adding one or more indicators to the displayed image representing one or more physical locate marks applied to the dig area to indicate a presence or an absence of one or more underground facilities;

[0132] FIG. **5** illustrates various elements of an informed excavator application for providing information regarding the status of locate operations, according to one embodiment of the present invention;

[0133] FIG. **6**A illustrates a flow diagram of an exemplary method of providing information regarding the status of locate operations, according to one embodiment of the present invention;

[0134] FIG. **6**B illustrates an exemplary graphical user interface that may be used in connection with providing inputs to the informed excavator application, according to one embodiment of the present invention;

[0135] FIG. **7** illustrates a flow diagram of an exemplary method of generating locate request tickets and performing locate operations in response to such tickets, which method employs aspects of the method illustrated in FIG. **6**A for providing information regarding the status of locate operations, according to one embodiment of the present invention;

[0136] FIG. **8** illustrates a flow diagram of an exemplary method of providing information regarding the status of locate operations and generating a virtual white lines image as part of a locate request submission, according to one embodiment of the present invention;

[0137] FIG. **9** is a block diagram of a positive response application for processing enhanced positive responses for underground facility locate and/or marking operations, according to another embodiment of the present invention;

[0138] FIG. **10** illustrates an exemplary electronic manifest (EM) image including a time-stamp, a place-stamp, and a technician signature/ID, that may be used in an enhanced positive response according to one embodiment of the present invention;

[0139] FIG. **11**A illustrates an example of an enhanced positive response, according to one embodiment of the present invention;

[0140] FIG. **11**B illustrates another example of an enhanced positive response, according to another embodiment of the present invention; and

[0141] FIG. **12** illustrates an exemplary computing device (e.g., a computer) that is configured to execute various applications, according to embodiments of the present invention.

DETAILED DESCRIPTION

[0142] Following below are more detailed descriptions of various concepts related to, and embodiments of, inventive systems, methods and apparatus for providing an information exchange process between excavators and other entities associated with underground facility locate operations and, in particular, providing enhanced positive response notifications (also referred to herein simply as an "enhanced positive response" or "locate report") in connection with such operations. In various aspects, these methods, apparatus, and systems provide communication infrastructure and mechanisms by which information exchange regarding locate and/or marking operations, such as status information, may be reported in real-time and/or other times to excavators or other parties who originate locate requests.

[0143] For purposes of illustrating exemplary embodiments, in the more detailed discussion below an exemplary requesting party is taken to be an excavator, and the systems, methods and apparatus discussed herein are sometimes referred to as "informed excavator" systems, methods and apparatus or "positive response" systems, methods and apparatus. However, it should be appreciated that any reference to an "excavator" or "informed excavator" is merely exemplary, as the concepts discussed herein are contemplated as applying more generally to various parties who may request a locate and/or marking operation, examples of which parties may include, but are not limited to, property owners (e.g., home owners, business owners), facility owners, regulatory authorities, damage investigators, and the like. More generally, it should be appreciated that various concepts introduced above and discussed in greater detail below may be implemented in any of numerous ways, as the disclosed concepts are not limited to any particular manner of implementation. Examples of specific implementations and applications are provided primarily for illustrative purposes.

[0144] While currently a simple conventional communication process may exist between requesting parties and one-call centers and, likewise, a communication process may exist between one-call centers and locate parties, an aspect of the informed excavator systems, methods and apparatus disclosed herein is that they provide an information exchange process among requesting parties, one-call centers and locate parties (independent locate service providers, and/or facility owners who perform their own locate and/or marking operations) which is otherwise not present in current processes with respect to locate operations. Another aspect of the informed excavator system and associated methods of the present disclosure is that it provides improved information exchange between excavators and locate service providers.

[0145] Yet another aspect of the informed excavator system and associated methods of the present disclosure is that it provides better ways of communicating the status of locate operations to excavators in a timely manner, which may significantly reduce, and preferably entirely eliminate, the uncertainty as to whether the locate operation is complete.

[0146] Still another aspect of the informed excavator system and associated methods of the present disclosure is that it provides information to the excavator about the locate operation prior to beginning the excavation activities. This substantially improves the confidence of the excavator that the locate operation has been performed satisfactorily, which may significantly reduce, and preferably entirely eliminate, the risk of damage to underground facilities.

[0147] Still another aspect of the informed excavator system and associated methods of the present disclosure is that it provides improved project planning, decision making, management, and/or tracking with respect to locate operations.

[0148] Referring to FIG. **1**, an example of information exchange process flow **100** that includes a link between excavators and locate personnel is presented. For example, information exchange process flow **100** may include a communications loop among one or more excavation companies **110** and their associated excavators **114**, one or more one-call centers **120**, and one or more locate parties **130** and their associated locate personnel **134**.

[0149] Excavation companies, such as excavation companies **110**, may be any companies that provide excavation services for any purpose, such as, but not limited to, excavation services related to the construction industry and excavation services related to the installation and/or maintenance of underground facilities. Excavators **114** may be any personnel associated with excavation companies **110**, such as, but not limited to, individuals who are requesting and/or performing the excavation operations. In particular, excavators **114** generate locate requests (i.e., tickets), which may be processed via a certain one-call center **120**. A ticket may be any communication or instruction to perform a locate operation at a certain dig area, which is any specified geographic area within which excavation may occur.

[0150] One-call centers, such as one-call centers **120**, may be any organizations, entities, and/or systems that receive, process, and/or transmit locate requests. The locate request (or ticket) may be any communication or instruction to perform a locate operation. One-call centers are generally owned, controlled, or funded by underground facility owners, such as telephone companies, cable television multiple system operators, electric utilities, gas utilities, or others. One-call center operations may be managed by a non-profit entity or outsourced to a for-profit firm. Excavators, such as excavators **114**, are required to notify one-call centers in advance of their excavation activities and identify through the locate request the dig area where individual excavating activities will be performed. Locate requests may include information supplied by the excavator to the one-call center regarding the specific geographic location of the dig area, date, time, purpose of excavation, and so on. The locate request, in turn, requires activity from an underground facility owner to perform a locate operation in the specified dig area.

[0151] Locate parties/entities, such as locate parties **130**, may be any parties that provide locate services. Multiple locate personnel **134** may be associated with each locate party **130**. Locate personnel **134** may be, for example, locate technicians and/or quality control technicians that, for example, perform locate operations.

[0152] While a communication process may exist between excavation companies and one-call centers and also may exist between one-call centers and locate parties in current processes, an aspect of the information exchange process flow **100** of the present disclosure is that it further includes a communications link between excavation companies and locate parties, which is otherwise not present in current processes for generating and processing locate requests. In this way, the communications loop among, for example, excavation companies **110**, one-call centers **120**, and locate parties **130** is closed. As a result, a free flow of information with respect to information about locate operations may occur. More details of an example of a system for facilitating a closed loop communications flow, such as information exchange process flow **100**, with respect to locate operations are described with reference to FIGS. **2** through **7**.

[0153] Referring to FIG. **2**, a functional block diagram of an example of an informed excavator system **200** for exchanging information between excavators and other entities associated with locate operations is presented. In particular, informed excavator system **200** is suitable for facilitating a flow of information among excavation companies, one-call centers, and locate parties in order to provide to the originating excavators notification of the status of locate operations and any other useful information about locate operations.

[0154] Informed excavator system **200** may include, but is not limited to, the one or more one-call centers **120** of FIG. **1**, an image server **210** that may be used by the one or more excavators **114**, one or more onsite computers **220** that may be used by locate personnel **134** and/or excavators **114**, excavator devices **212**, locate personnel devices **218**, and a central server **222**. A network **224** provides the communication link between any and/or among all entities of informed excavator system **200**. For example, network **224** provides the communication network by which information may be exchanged among one-call centers **120**, image server **210**, central server **222**, onsite computers **220**, excavator devices **212** and locate personnel devices **218**. Network **224** may be, for example, any local area network (LAN) and/or wide area network (WAN) for connecting to the Internet.

[0155] In order to connect to network **224**, each entity of informed excavator system **200** includes a communication interface (not shown). For example, the respective communication interfaces of one-call centers **120**, image server **210**, central server **222**, and onsite computers **220**, as well as excavator and locate personnel devices, may be any wired and/or wireless communication interface by which information may be exchanged between any entities of informed excavator system **200**. Examples of wired communication interfaces may include, but are not limited to, USB ports, RS232 connectors, RJ45 connectors, Ethernet, and any combinations thereof. Examples of wireless communication interfaces may include, but are not limited to, an Intranet connection, Internet, Bluetooth® technology, Wi-Fi, Wi-Max, IEEE 802.11 technology, radio frequency (RF), Infrared Data Association (IrDA) compatible protocols, Local Area Networks (LAN), Wide Area Networks (WAN), Shared Wireless Access Protocol (SWAP), any combinations thereof, and other types of wireless networking protocols.

[0156] In exemplary implementations, each entity of the informed excavator system **200** shown in FIG. **2** also gener-

ally includes a memory (e.g., one or more computer-readable media) to store processor-executable instructions as well as other data. Each entity also includes one or more processing units coupled to the communication interface and the memory, wherein upon execution of the processor-executable instructions by the processing unit, the processing unit performs a variety of functions as set forth in greater detail below. Generally speaking, many of the various functionalities described herein and attributed to various entities of the informed excavator system **200** shown in FIG. **2** may be encoded as processor-executable instructions stored in/on one or more computer readable media.

[0157] Informed excavator system **200** is not limited to the types and numbers of entities that are shown in FIG. **2**. Any types and numbers of entities that may be useful in underground facilities locate applications may be included in informed excavator system **200**.

[0158] Image server **210** may be any application server, such as a web application server and/or web portal, by which excavators **114**, one-call center **120**, and locate parties and their personnel may access certain tools with respect to submitting and/or processing locate requests (or tickets) and/or for processing notifications about locate operations, including access to various images relating to the locate operations and excavation activities. Application server **210** may be accessed by excavators **114** via any networked computing device (not shown).

[0159] Central server **222** may be a centralized computer, such as a central server of, for example, a certain locate party **130** of FIG. **1**, which is the underground facility locate service provider. Central server **222** may be utilized for managing the overall operations of informed excavator system **200**. When authorized, applications and/or information that reside on central server **222** may be accessible by any other entities of informed excavator system **200** via network **224**. For example, residing on central server **222** may be a workforce management application **254**, a ticket approval application **256**, and a notification application ("informed excavator application) **258**.

[0160] Each onsite computer **220** may be any computer, such as, but not limited to, a computer that is present in the vehicle that is being used by the field service personnel. Each onsite computer **220** may be, for example, any computing device, such as portable computer, a personal computer, a tablet device, a PDA, a cellular radiotelephone, a mobile computing device, a touch-screen device, a touchpad device, or generally any device including, or connected to, a processor and a user interface. Preferably, onsite computer **220** is a portable computing device, such as laptop computer or tablet device. Residing on onsite computer **220** may be certain tools, such as, but not limited to, a VWL viewer, an electronic manifest (EM) application, and a workforce management client.

[0161] VWL applications **232** and **234**, which may be accessed via the image server **210** and downloaded for use on an onsite computer **220**, an excavator device **212** and/or a one-call center **120**, is a tool for electronically delimiting the particular geographic location of the proposed excavation in order to provide a substantially permanent and reproducible record of the planned excavation. For example, VWL application **232** (and similarly VWL application **234**) may be a drawing application, which, in excavation applications, may be used by the excavator **114** as a dig area marking tool. More specifically, VWL application **232** may be used by the excavator **114** to add markings to an input image to graphically delimit a dig area. For example, VWL application **232** may be used to superimpose over or otherwise display "virtual white lines" on an input image (e.g., an aerial image) that may be received from, for example, the image server **210**. As used herein, the virtual white lines may include lines, drawing shapes, shades, points, symbols, coordinates, data sets, or other indicators to delimit on an input image the dig area in which excavation is to occur. FIG. **3** illustrates an exemplary excavator device **212** according to one aspect of the present invention, which supports VWL application **232** to display an image of a geographic area including a dig area and facilitate adding virtual white lines **260** to the displayed image to provide a marked-up VWL image **238** on which is indicated the dig area.

[0162] Additionally, VWL application **232** may be the application by which excavators **114** may submit locate requests **236** to one-call centers **120**, wherein the locate requests **236** may include the VWL image(s) **238** that are generated by excavators **114**. Alternatively, excavators **114** may submit locate requests without virtual white line marked-up images to one-call centers **120**, and in turn the one-call centers **120** may use the information in the locate request submitted by the excavator to in turn generate a virtual white line marked-up image **238**, via VWL application **234**, that is then forwarded to one or more locate parties **130** as locate request **236**.

[0163] A project component of VWL applications **232** or **234** allows excavators **114** or a one-call center **120** to generate a series of VWL images that may be associated with multiple phases of a "project ticket," meaning a locate request for an ongoing project that requires multiple locate operations over, for example, a span of several days. An example of such a project may be excavation to lay fiber optics along a 20 mile stretch of a highway. With respect to locate operations, the project ticket may be generated that specifies certain subsections to be located and a timetable. Further to the example, the project component of the VWL application may allow the excavator **114** or the one-call center **120** to generate a first VWL image for mile 1 of 20, a second VWL image for mile 2 of 20, a third VWL image for mile 3 of 20, a fourth VWL image for mile 4 of 20, and so on. Each image of the series may be named and/or labeled in a manner that allows the VWL application to read in the series of VWL images in the correct order and geographic position and then overlay all of the VWL images to show the full scope of the locate operation with respect to the project ticket.

[0164] Hereafter, the term "VWL image" means a single VWL image of a locate request (or ticket) and/or a series of VWL images of a project ticket.

[0165] In one embodiment of the informed excavator system **200** shown in FIG. **2**, an informed excavator application **258**, which may reside on the central server **222**, provides for the communication of information relating to the status of one or more locate operations. As discussed in greater detail below, such status information may be communicated in real time during various phases of a given locate operation, or at some point after the completion of a locate operation, to excavators, one-call centers, or other parties associated with the locate operation. In some exemplary implementations, an excavator may provide profile information regarding preferences in receiving notifications of the status information, in response to which one or more notifications may be automatically provided to the excavator.

[0166] For example, an excavator **114** may login to the informed excavator application **258** and specify (e.g., via a menu) the types of notifications that he/she wishes to receive and the methods by which notifications may be automatically received. For each excavator **114**, the selected types and methods of notification may be saved in a respective "excavator profile" of informed excavator application **258**. In this case, the specified preferences may be applied, by default, to all locate requests originated by that excavator. However, notification preferences may also be established in connection with individual locate operations or the like. For example, the excavator may be prompted to separately specify his or her preferences for notifications in connection with each requested locate operation. An excavator may override globally established notification preferences by specifying notification preferences for a particular locate operation without affecting the preferences set forth in the excavator profile.

[0167] Examples of types of notifications may include, but are not limited to, the following:

[0168] "Locate technician dispatched to dig area," which means that the locate technician is in route to the dig area. For example, the notification that is transmitted to the originating excavator **114** may be—"For Ticket No. 2645134, the locate technician Jack Stewart, telephone no. 622-222-2222, has been dispatched to dig area on Friday, Dec. 5, 2008 at 9:30 AM." Such a notification may include a map or a link to a map that shows the locate technician's current location. The locate technician's location may be based on location information derived from a global positioning system (GPS) device or other positioning system device associated with the locate technician. For example, the locate technician's location may be based on coordinates received from a GPS-enabled vehicle, computer, or personal digital assistant (PDA) in proximity to the locate technician while traveling between dig areas and/or during locate operations. The workforce management application **254** described in connection with FIG. **2** may receive and manage such location information.

[0169] "Locate technician on site at dig area," which means that locate technician has arrived at the dig area. For example, the notification that is transmitted to the originating excavator **114** may be—"For Ticket No. 2645134, the locate technician is on site at dig area on Friday, Dec. 5, 2008 at 10:05 AM."

[0170] "Ticket marked," which means that locate technician has completed the locate operation. However, a ticket approval process may be pending. For example, the notification that is transmitted to the originating excavator **114** may be—be "Ticket No. 2645134 is marked on Friday, Dec. 5, 2008 at 11:46 AM and is pending approval."

[0171] "Ticket approved," which means that the locate operation associated with the ticket has been certified by supervisors and/or quality control personnel of locate parties **130** to meet a certain quality standard. The certification process may be via ticket approval application **224** of central server **212**. For example, the notification that is transmitted to the originating excavator **114** may be—"Ticket No. 2645134 is approved on Friday, Dec. 5, 2008 at 12:35 PM." Since approval of the ticket may be the last step of the locate process, such a notification may also include a positive indication that the locate operation is complete and/or that the excavator may proceed with excavation activities.

[0172] "Locate details," which means that detailed information about the locate operation may be transmitted to excavators **114**, such as information generated by locate personnel **134** using EM application **232** of onsite computers **214**.

[0173] "Locate operation delayed," which means that the locate operation has been delayed for some reason (e.g., rain).

[0174] "Ticket expired" or "Ticket about to expire," which means that the specified time frame for the locate operation has or is about to expire without the locate operation having been completed.

[0175] "Locate Request Submitted," which means that the locate request has been submitted to the one-call center. This notification may include, for example, the name of the person who originated the locate request and/or the locate party or parties who will be responsible for performing the locate operation.

[0176] The types of notifications listed above are merely exemplary, and it should be appreciated that many additional types of notifications are possible. For example, notifications may have a high degree of specificity. Rather than simply electing to be notified when a locate technician is on-site, a user may elect to be notified when the locate technician has turned on his marking device, begun marking, changed paint colors, etc. A notification can also relate to a planned event so that, for example, an excavator may be informed when the locate technician plans to be on-site so that the excavator can meet with the locate technician at the specified time.

[0177] Examples of methods by which notifications may be automatically received by excavators **114** may include, but are not limited to, email, SMS text message, instant message, phone call (such as from an interactive voice response (IVR) system), pager message, and rich site summary (RSS) feed, which is a family of Web feed formats used to publish frequently updated works, such as blog entries, news headlines, audio, and video, in a standardized format. The notifications may optionally include image(s) or video. For example, an image showing details of the completed locate and/or marking activities may be transmitted to an excavator **114** as an attachment to an email or text message.

[0178] Alternatively, an authorized excavator **114** may query the status of certain locate requests by, for example, accessing a secure web site. For example, text-based notifications (e.g., emails or SMS text messages) received by excavators **114** may include a link or reference to a web site, such as one maintained by a locate service provider, that includes information on the status of a locate request and/or locate operation. By accessing the web site, such as by clicking on the hyperlink in an email, the excavator **114** may view periodically updated, recent, and/or real-time information on the status of a locate request and/or locate operation.

[0179] Such a web site may display an image showing details of a locate operation and/or a corresponding electronic representation of the locate operation. Further, such a web site may display aggregate information, such that an excavator **114** can view information supplied by multiple locate technicians or parties and/or information relating to a multiple submitted locate requests or multiple dig areas. According to one illustrative example, an excavator **114** may receive an email with a notification that a locate party has completed its locate activities, along with a link to a web site that includes an image and/or electronic representation showing details of the locate activities completed by that locate party as well as the locate activities previously completed by other locate parties.

[0180] In some instances, it may be desirable for a single entity or a limited number of entities to retain control over the

status or other information relating to a locate operation. For example, it may be desirable for the entity that provides access to an electronic manifest (EM) creation application (e.g., the EM application **246**) and has initial control of one or more created EM images (e.g., EM images **248**) to retain control of such images. One potential benefit of retaining control of the EM image(s) once created is avoiding unauthorized edits to or unauthorized use of the image(s).

[0181] According to one example, a "controlling" entity that provides access to an EM creation application (e.g., the EM application **246**) retains control of one or more created images, but allows other entities to access the images in some instances in a limited manner. For example, the controlling entity may provide a link (e.g., a hyperlink) to one or more EM images (e.g., via an e-mail) or otherwise provide an interface allowing the EM image(s) to be accessed (e.g., via a customized or proprietary image viewing application). Such a link may have a pre-established expiration date, such that clicking on the link will not access the EM image(s)/web page after the specified expiration date. To maintain the integrity of the EM image(s), the application providing access to the EM image(s) may prohibit copying of, saving of, or writing to the images. For example, the EM image may be viewable only using a corresponding image file viewer that allows limited access to the EM image. In particular, copy, save and/or write access to the EM image may be prohibited. In these and other respects discussed below, one or more EM image files may be stored and/or transmitted as "limited access files."

[0182] The EM image may, for example, be transmitted to a party associated with the at least one underground facility with the corresponding image file viewer so that the party may view the EM image. For example, an executable file comprising the EM image and image file viewer may be transmitted (e.g., a customized image viewer may be transmitted to one or more onsite computers). Alternatively, the image file viewer may be downloaded/installed separately, e.g., from a web site of the controlling entity, or the EM image may be viewed using an image file viewer stored and executed on a server of the controlling entity.

[0183] In one implementation, the controlling entity may allow access to the EM image(s) only when a certain condition or conditions are met. For example, the controlling entity may require a password protected log-in procedure for access to the EM image(s). In particular, the image file viewer may require a password to permit access to the EM image. As another example, the controlling entity may require acceptance of certain terms and/or conditions to permit access to the EM image. According to one implementation, the image file viewer may be programmed to require an indication of acceptance of terms and/or conditions prior to permitting access to the EM image. According to yet another example, the controlling entity may charge a fee for permitting a third party to access one or more EM images, such as a per-transaction fee or a subscription fee.

[0184] To prevent access to the EM image unless or until a condition or conditions are met, the EM image may be encrypted and require decryption to be readable. A corresponding image file viewer may be required to decrypt the EM image. The EM image and/or the corresponding image file viewer may also or alternatively be proprietary, and may have a format specific to the controlling entity. The image file viewer may optionally be programmed to determine whether an updated version of the image file viewer is available. For example, the image file viewer may interrogate information associated with the EM image to determine a corresponding version of the image file viewer. If an updated version is found, the viewer may prompt the user to upgrade the application or otherwise facilitate an update.

[0185] The EM image may be transmitted in a variety of different formats. For example, the EM image may be transmitted as an image including locate mark indicators thereon. Alternatively, the EM image may be transmitted as a base image with associated metadata and/or a separate file (e.g., an XML file) including information that allows the locate mark indicators to be rendered on or in connection with the base image. Such information may comprise geographic coordinates specifying the locate mark indicators to be displayed on the base image. The information included in the metadata and/or separate file may also specify access permissions for the locate mark indicators. For example, in the case where the information that allows locate mark indicators to be rendered relates to a plurality of dig sites, locate mark information for one or more dig sites may have restricted access such that the corresponding locate mark indicators are not rendered unless certain access conditions are met.

[0186] While the status information described above as being stored and/or transmitted as a "limited access file" corresponds to one or more EM images, the same principles may be applied to other types of image-based or non-image files to limit the access to the status information.

[0187] In some implementations, an acknowledgement is required from the recipient of a positive response notification that he or she has received and/or reviewed the information included in the notification. Thus, a return receipt may be solicited from the recipient of an notification in the form of an automatic confirmation that the notification was opened or received, for example by an automatic return email or text message. A notification may also be automatically generated when the notification recipient logs in to a web site or otherwise accesses information via a web site. Alternatively, a recipient-generated confirmation may be solicited. For example, the recipient may be requested to reply to a text or email with a certain word or code when a notification is received, accessed and/or reviewed.

[0188] Turning again to FIG. **2**, one-call centers **120** may process locate requests that may be submitted by excavators **114**. More specifically, a certain one-call center **120** may pass locate requests to central server **222** of a certain locate party **130**. The locate requests may include corresponding VWL images that are generated by excavators **114**, who originate the locate requests. Subsequently, workforce management application **254** of central server **222** may be used to process the locate requests that are received from one-call centers **120** and dispatch the locate requests to locate personnel **134** that are in the field. Locate personnel **134** are able to receive locate requests (along with any VWL images) that are dispatched by workforce management application **222** via their respective onsite computers **220** or locate personnel devices **218**.

[0189] Once received at a certain onsite computer or device, a certain locate personnel **134** may view the locate request and may view the corresponding VWL image via the VWL viewer **230**. VWL viewer **230** may be any graphical viewer application that is capable of reading and displaying the VWL images. Alternatively, VWL images may be read into and viewed by an "electronic manifest" (EM) application **246**. EM application **246** may be a drawing application, which, in underground facility locate applications, may be used by locate personnel **134** as a marking tool for document-

ing the locate operation. FIG. **4** illustrates an exemplary locate personnel device **218** according to one aspect of the present invention, which supports an EM application **246** to display an image of a geographic area including a dig area and facilitate adding one or more indicators to the displayed image representing one or more physical locate marks applied to the dig area to indicate a presence or an absence of one or more underground facilities, thereby forming EM image **248**.

[0190] More specifically, EM application **246** may be used by locate personnel **134** to add markings (one or more "locate mark indicators") to an input image of a geographic area including the dig area, so as to graphically indicate (digitally represent in an electronic image) the work performed in the locate operation. The input image may be received from, for example, the image server **210** that may be associated with a party that provides images for a fee. In some implementations, the input image may be an aerial image **230**. EM application **246** may superimpose over or otherwise display these markings on the displayed input image and save them as, for example, an EM image **248**. The markings may include lines, drawing shapes, shades, points, symbols, coordinates, data sets, or other indicators to graphically depict the work performing in the locate operation. The EM image may then be associated with a marked ticket that may be transmitted to central server **222**.

[0191] The resulting EM image generated by EM application **246** may show, for example, the original virtual white lines **260** from the original VWL image; a mark-up of one or more types of facilities, the presence or absence of which have been determined during the locate operation, and a mark-up of one or more environmental landmarks. An environmental landmark may be any location specified by any means that is used or can be used as a reference point for measurement or orientation. Examples of environmental landmarks may include, but are not limited to, a tree, a curb, a driveway, a utility pole, a fire hydrant, a storm drain, a pedestal, a water meter box, a manhole lid, a building structure, a light post, or a set of global positioning system coordinates.

[0192] Alternatively, EM application **246** may read in information about the locate operation from a data-enabled electronic marking device **216** that is used during the locate operation. The data-enabled electronic marking device may, for example, be based on the marking devices that are described with reference to U.S. Patent Application publication no. 2008-0245299-A1, filed Apr. 4, 2007, entitled "Marking system and method," and U.S. Patent Application publication no. 2008-0228294-A1, filed Mar. 13, 2007, entitled "Marking system and method with location and/or time tracking," which publications are incorporated by reference herein in their entirety.

[0193] By way of example, the marking device **216** may include certain software components and/or applications, such as, but not limited to, a device health component, a marking data algorithm **244**, a map viewer application, ticket processing software, a speech synthesis component, and an operating mode controller that allows the marking device to operate in multiple modes, such as, but not limited to, marking mode, landmark identification mode, solo mode, and group mode. Additionally, the marking device **216** may include certain input devices **240**, such as, but not limited to, a marking material detection mechanism, a location tracking system, a temperature sensor, a humidity sensor, a light sensor, a compass, an inclinometer, an accelerometer, a digital camera, and an audio recorder.

[0194] Subsequently, the information from the data-enabled electronic marking device **216** may then be rendered into the graphical depiction of the work performed in the locate operation. More specifically, the information from the data-enabled electronic marking device may be processed by EM application **246** and a graphical depiction of the locate operation may be superimposed over or otherwise displayed on the input image and saved as the EM image **248**. Again, the EM image **248** may then be associated with a marked or completed ticket **250** that may be transmitted to central server **222**. When excavators **114** select "Locate information" as one type of notification in their excavator profiles, the source of this information may be, for example, the marked up EM images **248**.

[0195] In some locate operations, no underground facilities are determined to be present in a designated dig area. Such locate operations are sometimes referred to as "clears." In some implementations of the inventive concepts discussed herein, the EM application **246** may nonetheless be employed to provide an electronic record of a "clear;" more specifically, although no locate mark indicators may be added to an input image (because there are no physical locate marks to digitally represent), the EM application may be employed to provide other information associated with the "clear" locate operation (e.g., a timestamp of when the locate operation was performed, an identifier for a technician or locate party performing the locate operation, a text address or other geographical identifier for the dig area, etc.) and this other information may be associated with the input image (e.g., as a separate data set linked to the input image, as metadata, a combined file of image and non-image data, etc.) to create a searchable electronic record that may be consulted (e.g., forward to an excavator or other party as part of a notification) to verify that the locate operation was indeed completed, even though no underground facilities were found.

[0196] Workforce management client of onsite computers **220** and/or locate personnel devices **218** may be a counterpart to workforce management application **254** of central server **222**. That is, workforce management client may be used to transmit the current status of locate operations from onsite computers/locate personnel devices to workforce management application **254**. During locate operations, workforce management application **254** monitors status and other information returned from workforce management client and/or ticket approval application **256** of central server **222**. Workforce management client exposes this information to the informed excavator application **258**. As discussed above, certain status conditions may include, but are not limited to, "ticket received" by locate party **130**, "ticket dispatched," "locate operation in progress," "ticket marked," "ticket approved," "ticket closed," and the like.

[0197] Ticket approval application **256** of central server **222** may be used for collecting data associated with locate operations that are performed in the field and by which quality control functions may be performed. In one example, one or more approvers (not shown) are associated with ticket approval application **224**. The approvers may be, for example, any personnel associated with the underground facility locate service provider, such as, but not limited to, the supervisors of locate technicians that are dispatched into the field, quality control supervisors, and/or any management personnel.

[0198] Ticket approval application **256** may use the information found in the of EM images **248** of marked or completed tickets **250** that are returned from onsite computers **220**/locate personnel devices **218** in order to rapidly assess the quality of the work performed in the field. This assessment may be by visual inspection of each marked ticket by one or more approvers and/or by analyzing the information of each marked ticket against one or more facilities maps (not shown) that correspond to the geographic location associated with marked ticket. Ticket approval application **256** may be a source of locate operation status information that may be monitored by informed excavator application **258**.

[0199] FIG. **5** illustrates various elements of an informed excavator application **258** for providing information regarding the status of locate operations, according to one aspect of the present invention. According to various aspects, for each locate request received at central server **222**, informed excavator application **258** reads in information from excavator profiles **512** in order to determine the preferred types and methods of notification entered by the originating excavator **114**. During locate operations, informed excavator application **258** monitors status and other information about locate operations that may be provided by workforce management application **254** and/or ticket approval application **256** via ticket monitoring component **514**. In so doing, informed excavator application **258** automatically generates notifications, via notification component **516**, according to information in the excavator profiles **512** that are associated with the originating excavators **114**.

[0200] Referring to FIG. **6**A, a flow diagram of an example of a method **600** of operation of informed excavator system **200**, and more particularly the informed excavator application **256**, is presented. Method **600** may include, but is not limited to, the following steps, which are not limited to any order.

[0201] At step **610**, excavators **114** access informed excavator application **256** and enter profile information. More specifically, excavators **114** may log into the informed excavator application **256** and enter profile information, such as information about their identity and the preferred types of notifications (e.g., Locate technician dispatched to dig area, Locate technician on site at dig area, Ticket marked, Ticket approved, Locate details) and preferred methods of notifications (e.g., email, SMS text message, phone call, pager message).

[0202] FIG. **6**B illustrates an exemplary graphical user interface (GUI) **1000** that may be used in connection with providing inputs to the informed excavator application **258** shown in FIG. **5**, and in particular the excavator profiles **512**, according to one embodiment of the present invention. The GUI **1000** may comprise, for example, a liquid crystal display or other display screen to display information, and may have a touch-sensitive screen and/or be associated with one or more other user input devices to receive user inputs. In the exemplary interface shown in FIG. **6**B, a checklist of notification types **1002** and a checklist of notification communication methods **1004** are displayed. To establish a user profile, a user may check one or more desired notification types **1002** and one or more desired notification communication methods **1004** in the displayed checklists. The selected notification type(s) and/or notification communication method(s) may be saved as a user profile, which may include default preferences for the user.

[0203] At the bottom of the screen, the user is prompted to indicate, via check box and prompt **1006**, whether the user would like to submit a locate request and/or generate a VWL image. If the user indicates such interest by selecting the check box, the GUI **1000** will display an interface such as the VWL application interface shown in FIG. **3** so that the user may generate a VWL image and/or submit a locate request as discussed in connection with that application. The locate request may include a VWL image and/or a data set relating to a VWL image, although such information may not be necessary. The foregoing is discussed in greater detail below in connection with FIG. **8**.

[0204] In the example described above, the user who establishes a user profile using the GUI **1000** of FIG. **6**B may be an excavator or other party associated with providing a locate request. However, a user profile may be established by other parties, such as a facility owner, a locate party, a party informed by regulatory requirements, contract requirements, or other requirements for such notifications, and/or some combination of the foregoing. In this way, a facility owner, locate party, and/or regulatory body may dictate the positive response notifications received by a party associated with providing a locate request (e.g., an excavator) and/or how such positive notifications are received by the party. For example, a particular facility owner may specify preferred notification type(s) and notification communication method (s) for all locate and/or marking operations that involve their facility, per agreement with a locate party. Further, a user profile may be established without using the GUI described in connection with FIG. **6**B. For example, the excavator information application may receive inputs from a file that includes information (e.g., contract and/or regulatory requirements) that may be used to generate the user profile.

[0205] Returning now to FIG. **6**A, at step **612**, the current status of locate requests is monitored. For example, status and/or other information is returned from onsite computers/locate personnel devices to workforce management application **254** and/or ticket approval application **256** of central server **222**. Informed excavator application **258** queries workforce management application **254** and/or ticket approval application **256** for the status and/or other information. Certain status conditions may include, but are not limited to, ticket received, ticket dispatched, locate operation in progress, ticket marked, ticket approved, ticket closed, and the like.

[0206] At step **614**, notification component **516** of informed excavator application **258** generates notifications to excavators **114** based on the current status of locate requests and then transits the notifications based on the types and methods of notifications that are selected in the respective excavator profiles **512** of excavators **114**.

[0207] In one example, when the types of notifications selected in the profile information is "All types of notifications," the preferred method of notification is "SMS text message," and the current status is "ticket dispatched," a "Locate technician dispatched to dig area" notification may be automatically transmitted to the excavator **114**. For example, a text message may be generated and transmitted to the cell phone of the excavator **114** as follows—"For Ticket No. 2645134, locate technician has been dispatched to dig area on Friday, Dec. 5, 2008 at 9:30 AM." Continuing the example, when the current status changes to "ticket marked," a "Ticket marked" notification may be automatically transmitted to the excavator **114**. For example, a text message may

be generated and transmitted to the cell phone of the excavator **114** as follows "Ticket No. 2645134 is marked on Friday, Dec. 5, 2008 at 11:46 AM."

[0208] In another example, when the types of notifications selected in the profile information is "Ticket closed" only and the preferred method of notification is a phone call, only when the current status is "ticket closed" will the excavator **114** receive a phone call notification. For example, when the current status is "ticket closed," the excavator **114** may receive a phone call directly from the locate technician who performed the locate operation to inform the excavator **114** that the ticket of interest has been closed on a certain date and time. Alternatively, the excavator **114** may receive a phone call from a certain locate party **130** and/or one-call center **120** in order to inform the excavator **114** that the ticket of interest has been closed. The phone call may be a manually generated phone call from personnel of a certain locate party **130** and/or one-call center **120**. Alternatively, the phone call is automatically initiated via an IVR system.

[0209] At step **616**, notification component **516** of informed excavator application **258** transmits detailed information about locate operations to the excavators. More specifically, when "Locate information" is selected in the excavator profile, detailed information about the locate operation of a certain ticket may be transmitted by notification application **226** to the excavator **114** who originated the locate request. For example, the excavator **114** may receive the following information about a certain locate operation: (1) the original VWL image and/or series of VWL images; (2) an electronic copy of the completed ticket, which may include a status code indicating whether or not the locate operation was completed; (3) the corresponding EM image **248** that was generated by locate personnel **134** via EM application **246** and that shows various details of the locate operation; (4) the corresponding electronic representation of the locate operation, which may include, e.g., the locate technician's name, the locate equipment used, the diagnosis software used on the locate equipment, the locate technician's history at the site, and a description of the conditions in and/or around the dig area (e.g., whether there is a fence and the number of houses or other structures present); (5) an assessment of the risk of excavation in the dig area (e.g., a descriptive or numeric risk assigned based on such factors as whether there is a buried line, a high pressure gas line, or other high risk condition within or near the dig area); and (6) any combinations thereof

[0210] Referring to FIG. **7**, a flow diagram of an example of a method **700** of using informed excavator system **200** is presented. Method **700** may include, but is not limited to, the following steps, which are not limited to any order.

[0211] At step **710**, a locate request that includes a VWL image and/or a project ticket that includes a series of VWL images of the proposed dig area is submitted to a one-call center.

[0212] More specifically, a certain excavator **114** may use VWL application to generate a VWL image and/or series of VWL images and then submit a locate request and/or project ticket, respectively, to a certain one-call center **120**.

[0213] At step **712**, the locate request that includes a VWL image and/or a project ticket that includes a series of VWL images is passed from a certain one-call center **120** to a certain locate party **130**. More specifically, the locate request that is generated in step **710** is transmitted from the one-call center **120** to central server **212** of a certain locate party **130** that is to perform the locate operation.

[0214] In various exemplary implementations, a locate request ticket provided to a locate party **130** may include one or both of image data and non-image data associated with the dig area. As discussed above, the image data may include at least one marked-up image of a geographic area including the dig area, wherein the marked-up image(s) includes at least one dig area indicator (e.g., virtual white lines) to provide an indication of the dig area. Again, the dig area indicator(s) (e.g., virtual white lines) typically are placed on the image (e.g., by the excavator or one-call center) before the ticket is received by the locate party. In some implementations, the dig indicator(s)/virtual white lines may be added to the image at a first user location remote from the dig area and/or without acquiring geographic coordinates for the dig area indicator (s). Examples of non-image data that may be included in or otherwise associated with the locate request ticket may include, but are not limited to, one or more of the following: a text description of the dig area; a plurality of geographic coordinates associated with the at least one dig area indicator; an address or a lot number of at least one property within which the dig area is located; a street intersection in a vicinity of the dig area; a date and/or time of day for an excavation of the dig area; a first identifier associated with an excavator to perform the excavation activities; a second identifier associated with at least one environmental landmark in the vicinity of the dig area; and a ticket identifier for the locate request ticket. Any of the image data or non-image data associated with the locate request ticket may be provided to one or more parties in connection with one or more notifications regarding the status of locate operations, as discussed in greater detail below.

[0215] At step **714**, workforce management application **254** assigns the locate request that is generated in step **712** to a certain locate personnel **134**, such as a locate technician, and the locate technician is dispatched to dig area.

[0216] At step **716**, the originating excavator **114** may be notified by informed excavator application **258**, which is monitoring the status of the locate request, that the locate technician is in route to the dig area. For example, notification component **516** may generate a "Locate technician dispatched to dig area" notification, which may be received by the excavator **114** by the notification method selected in his/her excavator profile. Receiving this notification allows the excavator **114** the opportunity to proceed to the dig area in the event that he/she wishes to discuss any details of the planned excavation with locate personnel **134**, in order to avoid any misunderstanding and/or miscommunications about the locate operation and, thereby, reduce the risk of damage to underground facilities during excavation.

[0217] At step **718**, the locate technician that was dispatched in step **714** arrives at dig area.

[0218] At step **720**, the originating excavator **114** may be notified by informed excavator application **258**, which is monitoring the status of the locate request, that the locate technician has arrived at the dig area. For example, notification component **516** may generate a "Locate technician on site at dig area" notification, which may be received by the excavator **114** by the notification method selected in his/her excavator profile. Again, receiving this notification allows the excavator **114** the opportunity to proceed to the dig area in the event that the excavator **114** wishes to discuss any details of the planned excavation with the locate personnel.

[0219] At step **722**, the locate technician performs the locate operation at the dig area according to the instructions of

the locate request to which he/she has been assigned. As noted earlier, it should be appreciated that during a given locate operation, underground facilities may or may not be found at the dig area, but that given either a presence or absence of facilities, the performance of the locate operation, including an inspection of the dig area, may be verified as completed by the locate technician.

[0220] In particular, at step **724**, the locate technician completes the locate operation and the ticket status is updated accordingly. For example, a "ticket marked" status may be communicated by workforce management client of onsite computer/locate personnel device to workforce management application **254**.

[0221] At step **726**, the excavator **114** may be notified by informed excavator application **258**, which is monitoring the status of the locate request, that the ticket is marked, which means that the locate operation has been completed by the locate technician, but may be pending approval. More specifically, notification component **516** may generate a "Ticket marked (but pending approval)" notification. This notification may be received by the excavator **114** by the notification method selected in his/her excavator profile.

[0222] At decision step **728**, it is determined whether the ticket of the current locate operation is to be subjected to a quality control process. If yes, method **700** may proceed to step **730**. If no, method **700** may proceed to step **732**.

[0223] At step **730**, the ticket of the current locate operation is processed by ticket approval application **256**. If the ticket passes the quality control process satisfactorily, method **700** may proceed directly to step **732** with no further action. If the ticket does not pass the quality control process satisfactorily, quality control action is taken until the ticket passes the quality control process satisfactorily, method **700** may then proceed to step **732**.

[0224] At step **732**, the ticket of the current locate operation is classified as ticket approved. In this way, the quality of the locate operation is certified.

[0225] At step **734**, the originating excavator **114** may be notified by informed excavator application **258**, which is monitoring the status of the locate request, that the ticket is approved. For example, notification component **516** may generate a "Ticket approved" notification, which may be received by the excavator **114** by the notification method selected in his/her excavator profile. Receiving this notification allows the excavator **114** the opportunity to proceed to the dig area to perform the planned excavation with little or no delay from the date and time at which the locate operation was completed.

[0226] At step **736**, the originating excavator **114** may receive the original VWL image plus other information about the locate operation. More specifically, when "Locate information" is selected in the excavator profile, detailed information about the locate operation of a certain ticket (e.g., one or both of image data and non-image data, some examples of which were discussed above) may be transmitted by informed excavator application **258** to the originating excavator **114**. For example, the excavator **114** may receive (1) the original VWL image and/or series of VWL images; (2) an electronic copy of the completed ticket (including image and/or non-image data); (3) the corresponding EM image that was generated via EM application **246** and that shows details of the locate operation (including "clears" in which an image is not necessarily marked-up with locate mark indicators, but other important non-image data is associated with the EM image), including an EM image that may also show the original virtual white lines; (4) the corresponding electronic representation of the locate operation (e.g., non-image data or information without a marked-up image component); (5) an assessment of the risk of excavation in the dig area (e.g., a descriptive or numeric risk assigned based on such factors as whether there is a buried line, a high pressure gas line, or other high risk condition within or near the dig area); and (6) any combinations thereof.

[0227] At step **738**, having detailed knowledge of the locate operation from the information provided in step **736**, the excavator **114** may perform the planned excavation of the dig area with increased confidence, which has the result of reducing the risk of damage to underground facilities during excavation.

[0228] Referring again to FIGS. **1** through **7**, informed excavator system **200** and the associated methods **600** and **700** of the present disclosure are not limited to providing status notifications and/or information about locate operations to personnel (e.g., excavators **114**) of excavation companies only. Status notifications and/or information about locate operations may be provided to any entity associated with locate operations, such as, but not limited to, those included in informed excavator system **200**.

[0229] Referring again to FIG. **2**, the functionality of the informed excavator application **258** may be combined with the functionality of VWL application **232** or **234** so that a single interface can be used not only to manage the communication of status notifications and/or information about locate operations, but also to submit one or more VWL images and/or locate requests, as described herein. More particularly, an excavator may use a single interface to manage the communication of status notifications and/or information about locate operations and submit VWL images and/or locate requests, and efficiently perform these tasks during a single login session or the like.

[0230] FIG. **8** shows an exemplary method **800** of using an excavator information application that combines the functionality of the informed excavator application **258** and VWL application **232** or **234**. The excavator information application may be stored on central server **222** as discussed in connection with the informed excavator application **258**, on excavator devices **212** as discussed in connection with VWL application **232**, on a computing system associated with one-call center **120** as discussed in connection with VWL application **234**, or some other suitable location(s). Method **800** may include, but is not limited to, the following steps, which need not be performed in the order shown.

[0231] At step **810**, an excavator accesses the excavator information application and enters profile information. This step is analogous to step **610** of FIG. **6**A and may involve the same actions described in connection therewith. An exemplary GUI for facilitating entry of relevant information also was discussed above in connection with FIG. **6**B.

[0232] At step **812**, the excavator enters locate information and/or generates a VWL image. The excavator information application may include the functionality of VWL application **232** or **234**, such that the locate information may be entered and the VWL image may be generated in the manner described in connection with those applications. For example, a VWL image **238** may be created using the VWL application **232** shown in FIG. **3**. Locate information, such as information specifying a dig area, may be input by an excavator using a marking tool such as the dig area marking tool of

VWL application **232**, a form with data fields, or another means of data input. The locate information and/or VWL image may be submitted to a one-call center as part of a locate request. For example, the excavator may submit a locate request without a VWL image. If a VWL image is required, the one-call center may use the information in the locate request submitted by the excavator to generate a VWL image. Alternatively, the excavator may submit the locate information and/or VWL image to a one-call center pursuant to an already submitted locate request, or in advance of a locate request not yet submitted.

[0233] Steps **814**, **816** and **818** may proceed as discussed in connection with analogous steps **612**, **614** and **616** of FIG. **6**A. In particular, the excavator information application may monitor the status of a locate operation, generate and provides notification(s) to an excavator based on the status of the locate operation and profile information entered in step **810**, and optionally provide detailed information about the locate operation to the excavator in the same manner as the informed excavator application **258** discussed herein.

[0234] "Enhanced" Positive Response Notifications

[0235] In yet other embodiments, according to the methods, apparatus and systems described herein an enhanced positive response notification (also referred to as an "enhanced positive response" or a "locate report") may be generated to inform one or more parties of locate and/or marking operation status. In exemplary implementations, an enhanced positive response may be an electronic communication, alert or document that may include (or have a link/pointer to) textual information and/or graphical information, including image information, relating to performance of a locate and/or marking operation.

[0236] In one example, an enhanced positive response may include one or both of time-stamp information to provide proof of a time at which the locate and/or marking operation was completed by a locate technician, and place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the locate request ticket (and corresponding to the dig area). In another example, the enhanced positive response may include an electronic manifest (EM) image that itself includes such a time-stamp and/or place-stamp to provide comprehensive feedback regarding performance of the locate and/or marking operation. Examples of other information that may be included in such an enhanced positive response (and in some cases as part of an EM image) include, but are not limited to, a signature and/or a user identification that identifies the locate technician, one or more member codes for facility owners who may have facilities in or proximate to the dig area, one or more positive response codes representing a status of the locate and/or marking operation, and various textual information.

[0237] In another embodiment, an enhanced positive response may include a virtual white line (VWL) image, in addition to the EM image, that includes one or more dig area indicators to indicate the dig area on an image; alternatively, the EM image itself may include one or more such dig area indicators. As discussed above, one or both of an EM image and a VWL image constituting an enhanced positive response may include geo-referenced information (e.g., GPS coordinates) in connection with dig area indicators, environmental landmarks present in and around the work site/dig area, and/or the locate and/or marking operation performed by the technician.

[0238] In another embodiment relating to an enhanced positive response, various environmental information may be provided in such a response regarding one or more environmental conditions present at or near the dig area/work site during a locate and/or marking operation. Examples of environmental conditions about which environmental information may be provided include, but are not limited to, an ambient temperature, and ambient humidity, and an ambient light level. Various environmental sensors may be employed, alone or together with exemplary locate and/or marking devices discussed herein, to acquire such environmental information. Digital photographs and/or digital audio files also may be acquired at or near the dig area/work site and included in an enhanced positive response to provide additional information.

[0239] In yet another embodiment relating to an enhanced positive response, according to the methods, apparatus and systems described herein an enhanced positive response may be generated in which an electronic manifest (EM) image and a virtual white line (VWL) image associated with the locate and/or marking operation are bundled together based on respective descriptor files (or descriptor metadata) for the EM image and the VWL image. In one aspect, the descriptor files or descriptor metadata associate the corresponding images with one or more particular tickets in response to which the locate and/or marking operation is performed, so as to link the images and relevant information in the locate request ticket. In this manner, a comprehensive enhanced positive response may be generated so as to inform one or more parties of a completed status of the locate and/or marking operation. As noted above, in addition to the EM image and the VWL image, a variety of other information also may be included in an enhanced positive response resulting from bundling of images based on descriptor files/descriptor metadata.

[0240] FIG. **9** is a functional block diagram of an exemplary positive response application **1100** for generating one or more enhanced positive responses **1110**, according to one embodiment of the present invention. In various aspects, the positive response application **1100** may be implemented by one or more processing units executing processor-executable instructions, and may share one or more features similar to those described above in connection with the informed excavator application **258** for providing positive response notifications to various parties. With reference again to FIG. **2**, it should be appreciated that the positive response application **1100** shown in FIG. **9** and described in greater detail below, and/or other applications implementing similar functionality, may reside in memory and/or execute on one or more processing units at one or more of a one-call center **120**, a central server **222**, an onsite computer **220**, an excavator device **212** or a locate personnel device **218**. Furthermore, it should be appreciated that in some exemplary implementations, at least some or all of the functionality provided by the positive response application **1100** may be realized in a distributed fashion, e.g., one portion of the positive response application may reside and/or execute at the one-call center **120**, another portion may reside and/or execute at the central server **222**, another portion may reside and/or execute at the onsite computer **220**, etc.

[0241] As shown in FIG. **9**, member codes **1112** and positive response codes **1114** may provide sources of information to the positive response application **1100** and may constitute some of the content in an enhanced positive response **1110** generated by the application **1100**. Member codes **1112** may

be unique identification codes that are assigned to facility owners by a certain controlling entity with respect to underground facility locate operations (Sunshine State One Call of Florida, Inc.—SSOCOF—is one example of a such a controlling entity). By way of example, a sample of member codes **112** of the SSOCOF is shown in Table 1 below.

TABLE 1

Example member codes 1112 of, for example, the SSOCOF

Member Code	Facility Owner
ATT	AT&T
FPL	Florida Power & Light
COM	Comcast
ADEL	Adelphia
TWC	Time Warner Cable

TABLE 1-continued

Example member codes 1112 of, for example, the SSOCOF

Member Code	Facility Owner
VZ	Verizon
PGS	TECO Peoples Gas

[0242] Positive response codes **1114** may be unique codes that have particular meaning with respect to locate and/or marking operations. The unique positive response codes may be determined by a certain controlling entity with respect to underground facility locate operations (again, SSOCOF is one example of a such a controlling entity). By way of example, a sample of positive response codes **1114** of the SSOCOF and their meanings are shown in Table 2 below.

TABLE 2

Example positive response codes 1114 of, for example, the SSOCOF

Positive Response Code	Positive Response Code Meaning
1 Marked	A locate technician has been to your excavation site and marked the approximate horizontal location of underground facilities within the boundaries described on the ticket.
2A Marked with Exceptions	High profile utility in conflict. An underground facility that delivers services to a large number of people or that could cause major problems if hit is within your excavation site (i.e., fiber optic line, gas line, etc.). While the locate technician has marked the approximate horizontal location of the facility, the utility or its locate technician want to be present during any excavation near that facility.
2B Marked with Exceptions	A utility or its locate technician has located and marked its underground facility, but other facilities of that same type are in the area and were not marked because the utility claims no responsibility for locating them.
3A Unmarked	Locate technician could not gain access to property; call utility to schedule access.
3B Unmarked	Excavation site is unmarked because the address could not be found.
3C Unmarked	Excavation site is unmarked. The locate technician and excavator negotiated an alternate time to meet at the excavation site.
3D Unmarked	Excavation site is unmarked. An underground facility that delivers services to a large number of people or that could cause major problems if hit is located near your excavation site (i.e., fiber optic, gas or electric line, etc.). The utility or locate technician want to be present during any excavation near that facility and will mark as necessary.
3F Unmarked	Excavation site is unmarked. The locate technician cannot mark within two full business days. The excavator was contacted and a new deadline was scheduled.
3H Unmarked	A locate technician went to the excavation site and found none of the facility owner's lines there; however, there are lines of a similar facility located in that area which are considered privately owned.
3M Unmarked	Excavation site is unmarked. The marking instructions on the locate ticket are not clear. The description may not make sense or the description may not match what the locate technician sees at the excavation site. Contact the utility to provide clarification.
3N Unmarked	Excavation site is unmarked. Based on the written description on the ticket, the locate technician could not determine the exact area that needed locating.
3P Unmarked	Excavation site is unmarked. A utility does not have accurate information about the location of those underground facilities. The utility is required, however, to give the excavator the best available information.
3R Unmarked	Excavation site is unmarked. A locate technician went to the excavation site, but the excavation work had already been completed.
3T Unmarked	Excavation site is unmarked. The utility has declared extraordinary circumstances through SSOCOF that render them unable to respond to your locate request. Extraordinary circumstances indicate situations other than normal operating conditions such as a natural or manmade disaster.

TABLE 2-continued

Example positive response codes 1114 of, for example, the SSOCOF

Positive Response Code	Positive Response Code Meaning
3U Unmarked	Excavation site is unmarked. Another company provides the services at this location.
3W Unmarked	Work is being performed by the utility and the excavator will mark the underground lines per agreement.
4 Clear	The utility has no underground facilities at the specified excavation site.
5 No conflict	The utility has a facility near the excavation site, but it is not within the area that was either described on the ticket or white lined.
6a Active facilities are present	The member has active facilities within the area described by the noticed demolition. Do not demolish until the member notifies you the site is clear.
8 Ongoing job	The locate technician and excavator have established an agreement on scheduled marking.

[0243] As also shown in FIG. **9**, locate request tickets **236** also may be an input to positive response application **1100** and provide another source of information which may be used at least in part to generate enhanced positive responses **1110**. As discussed above, tickets **236** may include textual ticket information (e.g., a ticket and/or work order number, ticket submission date, requested completion date, geographic location information or address information, excavation information, excavator information, site information, locate operations instructions information, caller information, remarks information, task information), any portion or all of which may be included in an enhanced positive response **1110**.

[0244] An EM application **246** may provide yet another input to positive response application **1100** as shown in FIG. **9**. For example, the EM application **246** generates one or more electronic manifest (EM) images **248** that may themselves be included as part of the contents of an enhanced positive response **1110**. As discussed above in connection with FIG. **4**, EM application **246** is a computer software application that, when executed, provides an electronic drawing tool that may be used by locate technicians for electronically marking up, for example, a digital aerial image of the dig area for indicating locate marks that have been dispensed at the site, thereby indicating the geo-locations and types of facilities present. The marked-up digital images may be saved as, for example, EM images **248**, which may be associated with tickets **236** and may be used by locate companies to support proof of work compliance.

[0245] FIG. **10** provides an example of an EM image **248** that may be generated by an EM application **246** and employed, all or in part, in an enhanced positive response **1110** according to one embodiment of the present invention. As illustrated in FIG. **10**, an aerial image of a work site/dig area of interest may provide a basis upon which markings **1134** are made to indicate the geographic locations of one or more underground facilities detected and/or marked during a locate and/or marking operation. The EM image **248** also may include various textual information relating to ticket details, marking status, and the technician performing the locate and/or marking information. For example, FIG. **10** shows that the EM image **248** may include a time-stamp **1138** indicating the date and time that an operation was completed (and/or the EM image created), a place-stamp **1136** indicating geographic coordinates corresponding to where the operation was completed (and/or the EM image was created), a technician ID **1140**, and a technician signature **1142**. Again, any or all information contained in the EM image **248** shown in FIG. **10** may be included in an enhanced positive response **1110**, including some or all of the textual information without the image portion of the information (or vice versa).

[0246] With respect to the place-stamp **1136** shown in FIG. **10**, in one aspect as noted above the place-stamp provides proof of a presence of the locate technician sufficiently proximate to, or at, a geographic location specified on the locate request ticket and corresponding to the work site/dig area. Accordingly, the place-stamp helps to mitigate potential damage to an underground facility that could occur in instances in which the locate technician did not go to the work site/dig area indicated on the ticket and did not perform a locate and/or marking operation at that site (e.g., because the locate technician unintentionally performed the locate operation at the wrong address or location; because the locate technician chose not to perform the locate operation believing that there are no underground facilities at the site, perhaps based on past experiences at the site; etc.).

[0247] In view of the foregoing, in some embodiments the EM application **246** employed to generate the EM image **248** shown in FIG. **10** may be configured to analyze and compare various geographic information so as to provide the place-stamp **1136** with sufficient accuracy. Examples of geographic information that may be analyzed by the EM application to facilitate generation of the place-stamp **1136** includes, but is not limited to, geographic location data (e.g. GPS coordinates) corresponding to: 1) address information or other location information, if available, about the work site/dig area derived from or specified on a locate request ticket; 2) a locate technician's whereabouts, based on use of locate device **214** and/or marking device **216**, a locate personnel device **218**, onsite computer **220**, or other tracking device on the person of the locate technician; and/or 3) one or more points on a digital image serving as a basis for the EM image **248** (e.g., a centroid of the digital image). In exemplary implementations, the place-stamp **1136** generally corresponds to the locate technician's whereabouts when actually performing the locate and/or marking operation, or when using the EM application to enter in various information to facilitate generation of the EM image **248**.

[0248] To ensure that the place-stamp **1136** provides reasonable proof that the locate technician was sufficiently proximate to or at the work site/dig area, in one embodiment the EM application **246** may determine whether two or more of the geographic locations indicated above (i.e., work site/

dig area specified on ticket, technician whereabouts, and image coordinates) are within some predetermined distance (i.e., a "threshold distance") of each other. A variety of values for the threshold distance may be used as a metric for sufficient proximity to the work site/dig area; in some cases these metrics may be based at least in part on recommended best practices for a particular jurisdiction, operating procedures for a given locate company/contractor, and/or contractual obligations imposed by one or more facility owners and/or one-call centers. In one exemplary implementation, the threshold distance for sufficient proximity may be on the order of tens of feet, while in other implementations the threshold distance may be greater depending on various circumstances (e.g., hundreds or thousands of feet).

[0249] Additional details relating to the place-stamp **1136** and a quality assessment analysis regarding same are discussed in U.S. application publication US2009-0327024-A1, entitled "Methods and Apparatus for Quality Assessment of a Field Service Operation," published Dec. 31, 2009, which publication is hereby incorporated herein by reference.

[0250] With reference again to FIG. **9**, a VWL application **232**, as discussed above in connection with FIG. **3**, may provide yet another input to positive response application **1100** in the form of one or more VWL images **238** that may be included as part of the contents of enhanced positive responses **1110**. Similarly, locate data **1152** may provide another input to positive response application **1100**. Locate data **1152** may include various information provided by marking devices **216** or locate devices **214**, and also may include data from, but not limited to, one or more of the following sources: environmental sensors that are onsite of the locate operation, which may provide information about the environmental conditions; digital photographs that are taken onsite; and digital audio files that are recorded onsite. With respect to environmental information regarding one or more environmental conditions, advanced knowledge of environmental conditions at a work site may play a role in the excavator's planning process. For example, if the excavator is aware that the work site/dig area was marked while it was raining, the excavator may make special effort to perform the excavation before the markings wash away. Additionally, digital photographs and/or digital audio files that capture information about the work site may be useful to locate companies with respect to providing proof of presence and proof of the work performed.

[0251] In FIG. **9**, an assembly component **1116** of positive response application **1100** is a software component configured to facilitate collecting and assembling information including or derived from member codes **1112**, positive response codes **1114**, tickets **236**, EM images **248** and/or VWL images **238** into enhanced positive responses **1110**. In one example, assembly component **116** queries and/or processes descriptor files and/or descriptor metadata, respectively associated with EM images **248** and VWL images **238**, which descriptor files/metadata reference the corresponding images to a particular locate request ticket **236**. By querying/processing the descriptor files/metadata, assembly component **1116** can effectively assemble an appropriate EM image **248** and VWL image **238** corresponding to the locate request ticket and resulting locate and/or marking operation in question. In some instances, the assembly component **1116** further combines image files with other information such as corresponding member codes **1112**, positive response codes **1114**, and/or information from ticket **236**. Assembly component **1116** then bundles all image files and information in order to generate enhanced positive responses **1110**.

[0252] FIG. **11**A is a front view of an example of an enhanced positive response **1110** according to one embodiment of the present invention. In this example, enhanced positive response **1110** may include textual information **1118**, which in turn may include any information contained in or derived from ticket **236** (e.g., the ticket number, date information, geographic location information or address information, excavation information, excavator information, site information, locate operations instructions information, caller information, remarks information, task information, etc.). Further, textual information **1118** may includes a status code **1120**, which may be standard status code information that is formed by the combination of member codes **1112** and positive response codes **1114** for each facility type.

[0253] In one example and referring to Tables 1 and 2, status code **1120** is "VZ-1 Marked; TWC-5 No conflict; FPL-4 Clear." In this example, "VZ-1 Marked" means that with respect to facilities owned by Verizon—a locate technician has been to your excavation site and marked the approximate horizontal location of underground facilities within the boundaries described on the ticket. "TWC-5 No conflict" means that with respect to facilities owned by Time Warner Cable—the utility has a facility near the excavation site, but it is not within the area that was either described on the ticket or white lined. "FPL-4 Clear" means that with respect to facilities owned by Florida Power & Light—the utility has no underground facilities at the specified excavation site.

[0254] The enhanced positive response **1110** shown in FIG. **11**A also includes an EM image **248** and a VWL image **238**. In one example, the EM image **248** and VWL image **238** are digital geo-referenced aerial images that correspond to the address information in textual information **1118** (e.g., 1333 Gateway Dr, Melbourne, Fla. 32901). With respect to EM image **248**, the digital image has been marked up electronically using EM application **246** to show markings **1134** of a certain color that indicate the location and type of facilities present at the work site/dig area. Further, in one exemplary implementation as discussed above in connection with FIG. **10**, when creating the EM image **248** using EM application **246**, EM application **246** automatically superimposes a place-stamp **1136** and a time-stamp **1138** upon the saved EM image **248**. Place-stamp **1136** may include, for example, the latitude and longitude coordinates of the actual geographic location at which the locate operation is performed (which may be acquired from the geo-referenced input image used as a basis for EM image **248**). In one example, time-stamp **1138** may be the date and time that EM image **248** is created. In another example, time-stamp **1138** may be the date and time that the certain enhanced positive response is saved. In yet another example, time-stamp **1138** may be the date and time that the certain enhanced positive response is transmitted to an interested party. By use of place-stamp **1136** and time-stamp **1138**, proof of presence at the work site and proof of the time the work is performed is automatically provided in enhanced positive response **1110**.

[0255] With respect to the optional VWL image **238**, the digital image has been marked up electronically using VWL application **232** to show a dig area indicator **260** that indicates the extent of the dig area in which locate operations are performed. Additionally, enhanced positive response **1110** shown in FIG. **11**A may include other information **1170**, which may be information extracted from locate data **152**. In

one example, other information **1170** may include the environmental conditions at the job site, such as the ambient temperature, ambient humidity, and/or ambient lighting conditions.

[0256] FIG. **11**B provides another example of an enhanced positive response **1110** according to one embodiment of the present invention. In this example, enhanced positive response **1110** includes EM image **248** only, with no VWL image **238**. However, in one aspect of this embodiment, the dig area indicator **260**, which is geo-encoded in the VWL image, is overlaid on the markings **1134** of the EM image **248**.

[0257] With reference again to FIG. **9**, an additional feature of positive response application **1100** according to one embodiment of the present invention relates to a "time-of-life" limitation, or expiration period, for EM images **248**. As would be appreciated by those of skill in the art, in certain jurisdictions physical locate marks applied to the ground or surface during a marking operation may be valid only for a limited amount of time (e.g., two days, two weeks, etc.), after which the marks are considered to be expired—and if excavation does not occur within this designated periods, a remarking request may be required. Accordingly, in one embodiment, a similar type of expiration period may be ascribed to an EM image **248**, i.e., the EM image **248** may be valid only for a limited time period following the locate and/or marking operation (or the creation of the EM image). In one example, the EM image includes an expiration code, or "time-bomb code," that allows viewing of the EM image only for a predetermined time period (a "time-bomb code" refers to a computer program that is written so that it will stop functioning after a predetermined date or time is reached). Alternatively, when past the time period, EM images may be viewable, but a disclaimer may be displayed with the EM images that the information depicted thereon is expired/no longer valid.

[0258] In yet another aspect, as discussed in part above in connection with FIG. **7**, an enhanced positive response **1110** may be generated and transmitted before or after completion of a quality assurance process to assess the accuracy/completeness of a locate and/or marking operation. In instances in which an enhanced positive response is generated prior to a quality assurance process, an enhanced positive response **1110** may include a flag, such as a "Work complete, but pending approval" flag. The latter may be useful in certain time-sensitive instances in which it may be detrimental to delay an enhanced positive response **1110** until the quality assurance process is complete.

[0259] Enhanced positive responses **1110**, such as those shown in FIGS. **11**A and **11**B, may be saved in an electronic form that is easily transmitted using standard network computing systems. In one example, enhanced positive responses **1110** may be provided in the form of an electronic document (e.g., a Microsoft® Word document) that includes textual information **1118**, EM image **248**, and, optionally, VWL image **238**. In another example, enhanced positive response **1110** may be provided in the form of an email; for example, textual information **1118** may be provided in the body of the email and EM image **248**, and optionally VWL image **238**, may be provided as attachments to the email. In yet another example, a website address may be provided by email to an interested party, and the contents of the enhanced positive response may be available via the website address (e.g., by clicking on the link to the website as contained in the email).

CONCLUSION

[0260] While various inventive embodiments have been described and illustrated herein, those of ordinary skill in the art will readily envision a variety of other means and/or structures for performing the function and/or obtaining the results and/or one or more of the advantages described herein, and each of such variations and/or modifications is deemed to be within the scope of the inventive embodiments described herein. More generally, those skilled in the art will readily appreciate that all parameters, dimensions, materials, and configurations described herein are meant to be exemplary and that the actual parameters, dimensions, materials, and/or configurations will depend upon the specific application or applications for which the inventive teachings is/are used. Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific inventive embodiments described herein. It is, therefore, to be understood that the foregoing embodiments are presented by way of example only and that, within the scope of the appended claims and equivalents thereto, inventive embodiments may be practiced otherwise than as specifically described and claimed. Inventive embodiments of the present disclosure are directed to each individual feature, system, article, material, kit, and/or method described herein. In addition, any combination of two or more such features, systems, articles, materials, kits, and/or methods, if such features, systems, articles, materials, kits, and/or methods are not mutually inconsistent, is included within the inventive scope of the present disclosure.

[0261] The above-described embodiments can be implemented in any of numerous ways. For example, the embodiments may be implemented using hardware, software or a combination thereof. When implemented in software, the software code can be executed on any suitable processor or collection of processors, whether provided in a single computer or distributed among multiple computers.

[0262] Further, it should be appreciated that a computer may be embodied in any of a number of forms, such as a rack-mounted computer, a desktop computer, a laptop computer, or a tablet computer. Additionally, a computer may be embedded in a device not generally regarded as a computer but with suitable processing capabilities, including a Personal Digital Assistant (PDA), a smart phone or any other suitable portable or fixed electronic device.

[0263] Also, a computer may have one or more input and output devices. These devices can be used, among other things, to present a user interface. Examples of output devices that can be used to provide a user interface include printers or display screens for visual presentation of output and speakers or other sound generating devices for audible presentation of output. Examples of input devices that can be used for a user interface include keyboards, and pointing devices, such as mice, touch pads, and digitizing tablets. As another example, a computer may receive input information through speech recognition or in other audible format.

[0264] Such computers may be interconnected by one or more networks in any suitable form, including a local area network or a wide area network, such as an enterprise network, and intelligent network (IN) or the Internet. Such networks may be based on any suitable technology and may operate according to any suitable protocol and may include wireless networks, wired networks or fiber optic networks.

[0265] FIG. **12** shows an illustrative computing device, e.g., computer **900**, that may be used at least in part to imple-

ment any one or more of the applications described herein. In the example shown, the illustrative computer **900** is used to implement the positive response application **1100** described in connection with FIG. **9**; however, it should be appreciated that the computer **900** may be employed to implement any of the applications discussed herein (e.g., the informed excavator application **258**, the excavator information application discussed in connection with FIG. **8**, VWL application **232**, EM application **246**, workforce management application **254**, ticket approval application **256**, etc.). The computer **900** comprises a memory **910**, one or more processing units **912**, one or more communication interfaces **914**, one or more display units **916**, and one or more user input devices **918**. The memory **910** may comprise any computer-readable media, and may store computer instructions for implementing the excavator information application **902**. The processing unit (s) **912** may be used to execute the instructions. The communication interface(s) **914** may be coupled to a wired or wireless network, bus, or other communication means and may therefore allow the computer **900** to transmit communications to and/or receive communications from other devices. The display unit(s) **916** may be provided, for example, to allow a user to view various information in connection with execution of the instructions. The user input device(s) **918** may be provided, for example, to allow the user to make manual adjustments, make selections, enter data or various other information, and/or interact in any of a variety of manners with the processor during execution of the instructions.

[0266] The various methods or processes outlined herein may be coded as software that is executable on one or more processors that employ any one of a variety of operating systems or platforms. Additionally, such software may be written using any of a number of suitable programming languages and/or programming or scripting tools, and also may be compiled as executable machine language code or intermediate code that is executed on a framework or virtual machine.

[0267] In this respect, various inventive concepts may be embodied as a computer readable storage medium (or multiple computer readable storage media) (e.g., a computer memory, one or more floppy discs, compact discs, optical discs, magnetic tapes, flash memories, circuit configurations in Field Programmable Gate Arrays or other semiconductor devices, or other non-transitory medium or tangible computer storage medium) encoded with one or more programs that, when executed on one or more computers or other processors, perform methods that implement the various embodiments of the invention discussed above. The computer readable medium or media can be transportable, such that the program or programs stored thereon can be loaded onto one or more different computers or other processors to implement various aspects of the present invention as discussed above.

[0268] The terms "program" or "software" are used herein in a generic sense to refer to any type of computer code or set of computer-executable instructions that can be employed to program a computer or other processor to implement various aspects of embodiments as discussed above. Additionally, it should be appreciated that according to one aspect, one or more computer programs that when executed perform methods of the present invention need not reside on a single computer or processor, but may be distributed in a modular fashion amongst a number of different computers or processors to implement various aspects of the present invention.

[0269] Computer-executable instructions may be in many forms, such as program modules, executed by one or more computers or other devices. Generally, program modules include routines, programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types. Typically the functionality of the program modules may be combined or distributed as desired in various embodiments.

[0270] Also, data structures may be stored in computer-readable media in any suitable form. For simplicity of illustration, data structures may be shown to have fields that are related through location in the data structure. Such relationships may likewise be achieved by assigning storage for the fields with locations in a computer-readable medium that convey relationship between the fields. However, any suitable mechanism may be used to establish a relationship between information in fields of a data structure, including through the use of pointers, tags or other mechanisms that establish relationship between data elements.

[0271] Also, various inventive concepts may be embodied as one or more methods, of which an example has been provided. The acts performed as part of the method may be ordered in any suitable way. Accordingly, embodiments may be constructed in which acts are performed in an order different than illustrated, which may include performing some acts simultaneously, even though shown as sequential acts in illustrative embodiments.

[0272] All definitions, as defined and used herein, should be understood to control over dictionary definitions, definitions in documents incorporated by reference, and/or ordinary meanings of the defined terms.

[0273] The indefinite articles "a" and "an," as used herein in the specification and in the claims, unless clearly indicated to the contrary, should be understood to mean "at least one."

[0274] The phrase "and/or," as used herein in the specification and in the claims, should be understood to mean "either or both" of the elements so conjoined, i.e., elements that are conjunctively present in some cases and disjunctively present in other cases. Multiple elements listed with "and/or" should be construed in the same fashion, i.e., "one or more" of the elements so conjoined. Other elements may optionally be present other than the elements specifically identified by the "and/or" clause, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, a reference to "A and/or B", when used in conjunction with open-ended language such as "comprising" can refer, in one embodiment, to A only (optionally including elements other than B); in another embodiment, to B only (optionally including elements other than A); in yet another embodiment, to both A and B (optionally including other elements); etc.

[0275] As used herein in the specification and in the claims, "or" should be understood to have the same meaning as "and/or" as defined above. For example, when separating items in a list, "or" or "and/or" shall be interpreted as being inclusive, i.e., the inclusion of at least one, but also including more than one, of a number or list of elements, and, optionally, additional unlisted items. Only terms clearly indicated to the contrary, such as "only one of or "exactly one of," or, when used in the claims, "consisting of," will refer to the inclusion of exactly one element of a number or list of elements. In general, the term "or" as used herein shall only be interpreted as indicating exclusive alternatives (i.e. "one or the other but not both") when preceded by terms of exclusivity, such as

"either," "one of," "only one of," or "exactly one of" "Consisting essentially of," when used in the claims, shall have its ordinary meaning as used in the field of patent law.

[0276] As used herein in the specification and in the claims, the phrase "at least one," in reference to a list of one or more elements, should be understood to mean at least one element selected from any one or more of the elements in the list of elements, but not necessarily including at least one of each and every element specifically listed within the list of elements and not excluding any combinations of elements in the list of elements. This definition also allows that elements may optionally be present other than the elements specifically identified within the list of elements to which the phrase "at least one" refers, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, "at least one of A and B" (or, equivalently, "at least one of A or B," or, equivalently "at least one of A and/or B") can refer, in one embodiment, to at least one, optionally including more than one, A, with no B present (and optionally including elements other than B); in another embodiment, to at least one, optionally including more than one, B, with no A present (and optionally including elements other than A); in yet another embodiment, to at least one, optionally including more than one, A, and at least one, optionally including more than one, B (and optionally including other elements); etc.

[0277] In the claims, as well as in the specification above, all transitional phrases such as "comprising," "including," "carrying," "having," "containing," "involving," "holding," "composed of," and the like are to be understood to be open-ended, i.e., to mean including but not limited to. Only the transitional phrases "consisting of and "consisting essentially of shall be closed or semi-closed transitional phrases, respectively, as set forth in the United States Patent Office Manual of Patent Examining Procedures, Section 2111.03.

What is claimed is:

1. An apparatus for integrating multiple elements of information relating to a locate and marking operation so as to provide an enhanced positive response to at least one first entity associated with requesting the locate and marking operation, the locate and marking operation performed by a locate technician in response to at least one locate request ticket and comprising applying, by the locate technician, at least one physical locate mark on ground, pavement, or other surface to indicate a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed by an excavator during excavation activities, the apparatus comprising:

a communication interface;

a memory to store processor-executable instructions; and

at least one processor communicatively coupled to the communication interface and the memory, wherein upon execution of the processor-executable instructions by the at least one processor, the at least one processor:

A) generates the at least one locate request ticket, the at least one locate request ticket comprising at least one digital image of a geographic area proximate to and including the dig area and at least one of:

at least one electronic dig area indicator to delimit the dig area on the at least one digital image; and

geographic coordinates for the at least one electronic dig area indicator;

B) controls the communication interface to electronically transmit the at least one locate request ticket to at least one second entity associated with performing the locate and marking operation;

C) controls the communication interface to electronically receive from the at least one second entity associated with performing the locate and marking operation, in response to the at least one locate request ticket, at least one of:

the enhanced positive response for the locate and marking operation; and

an electronic link to the enhanced positive response, wherein the enhanced positive response includes at least one of:

an electronic manifest of the locate and marking operation, the electronic manifest including the at least one digital image, the at least one electronic dig area indicator on the at least one digital image, and at least one electronic marking electronically drawn on the at least one digital image by the locate technician and corresponding to the at least one physical locate mark applied by the locate technician to the ground, pavement, or other surface during the locate and marking operation, so as to graphically depict the locate and marking operation performed by the locate technician; and

geographic coordinates for the at least one electronic dig area indicator and the at least one electronic marking corresponding to the at least one physical locate mark applied by the locate technician to the ground, pavement, or other surface; and

D) controls the communication interface to electronically transmit to the at least one first entity associated with requesting the locate and marking operation at least one of:

the enhanced positive response for the locate and marking operation; and

the electronic link to the enhanced positive response, so as to reduce uncertainty relating to a completeness and/or a quality of performance of the locate and marking operation and reduce a risk of damage to underground facilities during the excavation activities.

2. A one-call center locate request management system, comprising the apparatus of claim **1**.

3. The apparatus of claim **1**, wherein the at least one first entity associated with requesting the locate and marking operation includes the excavator.

4. The apparatus of claim **1**, wherein:

prior to D), the at least one processor processes at least one of the at least one locate request ticket and the enhanced positive response to:

generate a descriptive and/or numeric risk assessment associated with the excavation activities in the dig area; and

integrate the descriptive and/or numeric risk assessment with the enhanced positive response.

5. The apparatus of claim **4**, wherein the at least one processor generates the descriptive and/or numeric risk assessment based on at least one of a buried line, a high pressure gas line, and a high risk condition within or near the dig area.

6. A one-call center locate request management system, comprising the apparatus of claim **4**.

7. The apparatus of claim **1**, wherein the electronic manifest is formatted as a limited access file to prevent unauthorized use of the electronic manifest included in the enhanced positive response.

8. The apparatus of claim **1**, wherein the enhanced positive response further includes at least one of:

a user identification identifying the locate technician;

status information regarding a status of the locate technician;

a description of a history of the locate technician at the dig area;

at least one member code assigned to a facility owner of the at least one underground facility;

at least one positive response code representing a status of the locate and marking operation;

the at least one locate request ticket;

a completed locate request ticket;

time-stamp information to provide proof of a time at which the locate and marking operation is performed by the locate technician;

place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the at least one locate request ticket and corresponding to the dig area;

environmental information regarding at least one environmental condition present at or near the dig area during the locate and marking operation;

at least one of a digital photograph, a digital video, and a digital audio file representing proof of presence and work performed at the dig area;

at least one virtual white line image comprising a second digital image of the geographic area proximate to and including the dig area, and the at least one electronic dig area indicator to delimit the dig area on the second digital image;

a quality assessment of the locate and marking operation as at least partially performed by the locate technician; and

a descriptive and/or numeric assessment of a risk of excavation in the dig area based at least in part on a risk condition within or near the dig area.

9. The apparatus of claim **1**, wherein the electronic link to the enhanced positive response provides access to a menu of notification preferences to facilitate selection of contents for the enhanced positive response.

10. The apparatus of claim **9**, wherein the menu of notification preferences to facilitate selection of the contents for the enhanced positive response includes:

at least one of:

the electronic manifest of the locate and marking operation; and

the geographic coordinates for the at least one dig area indicator and the at least one electronic marking corresponding to the at least one physical locate mark applied by the locate technician to the ground, pavement or other surface; and

at least one of:

a user identification identifying the locate technician;

status information regarding a status of the locate technician;

a description of a history of the locate technician at the dig area;

at least one member code assigned to a facility owner of the at least one underground facility;

at least one positive response code representing a status of the locate and marking operation;

the at least one locate request ticket;

a completed locate request ticket;

time-stamp information to provide proof of a time at which the locate and marking operation is performed by the locate technician;

place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the at least one locate request ticket and corresponding to the dig area;

environmental information regarding at least one environmental condition present at or near the dig area during the locate and marking operation;

at least one of a digital photograph, a digital video, and a digital audio file representing proof of presence and work performed at the dig area;

at least one virtual white line image comprising a second digital image of the geographic area proximate to and including the dig area, and the at least one electronic dig area indicator to delimit the dig area on the second digital image;

a quality assessment of the locate and marking operation as at least partially performed by the locate technician; and

a descriptive and/or numeric assessment of a risk of excavation in the dig area based at least in part on a risk condition within or near the dig area.

11. A method for integrating multiple elements of information relating to a locate and marking operation so as to provide an enhanced positive response to at least one first entity associated with requesting the locate and marking operation, the locate and marking operation performed by a locate technician in response to at least one locate request ticket, the locate and marking operation comprising applying, by the locate technician, at least one physical locate mark on ground, pavement, or other surface to indicate a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed by an excavator during excavation activities, the method facilitated by an apparatus including at least one processor, the method comprising:

A) generating, by the at least one processor, the at least one locate request ticket including at least one digital image of a geographic area proximate to and including the dig area and at least one of:

at least one electronic dig area indicator to delimit the dig area on the at least one digital image; and

geographic coordinates for the at least one electronic dig area indicator;

B) electronically transmitting, by the at least one processor via at least one communication interface, the at least one locate request ticket to at least one second entity associated with performing the locate and marking operation;

C) electronically receiving, by the at least one processor via the at least one communication interface, from the at least one second entity associated with performing the locate and marking operation, in response to the at least one locate request ticket, at least one of:

the enhanced positive response for the locate and marking operation; and

an electronic link to the enhanced positive response, wherein the enhanced positive response includes at least one of:

an electronic manifest of the locate and marking operation, the electronic manifest including the at least one digital image, the at least one electronic dig area indicator on the at least one digital image, and at least one electronic marking electronically drawn on the at least one digital image by the locate technician and corresponding to the at least one physical locate mark applied by the locate technician to the ground, pavement, or other surface during the locate and marking operation, so as to graphically depict the locate and marking operation performed by the locate technician; and

geographic coordinates for the at least one electronic dig area indicator and the at least one electronic marking corresponding to the at least one physical locate mark applied by the locate technician to the ground, pavement, or other surface; and

D) electronically transmitting, by the at least one processor via the at least one communication interface, to the at least one first entity associated with requesting the locate and marking operation at least one of:

the enhanced positive response for the locate and marking operation; and

the electronic link to the enhanced positive response, so as to reduce uncertainty relating to a completeness and/or a quality of performance of the locate and marking operation and reduce a risk of damage to underground facilities during the excavation activities.

12. The method of claim **11**, wherein the facilitating apparatus is a one-call center locate request management system comprising the at least one processor and the at least one communication interface.

13. The method of claim **11**, wherein the at least one first entity associated with requesting the locate and marking operation includes the excavator.

14. The method of claim **11**, further including, prior to D), processing, by the at least one processor, at least one of the at least one locate request ticket and the enhanced positive response to:

generate a descriptive and/or numeric risk assessment associated with the excavation activities in the dig area; and

integrate the descriptive and/or numeric risk assessment with at least one of the at least one locate request ticket and the enhanced positive response.

15. The method of claim **14**, wherein the descriptive and/or numeric risk assessment is generated based on at least one of a buried line, a high pressure gas line, and a high risk condition within or near the dig area.

16. The method of claim **14**, wherein the facilitating apparatus is a one-call center locate request management system comprising the at least one processor and the at least one communication interface.

17. The method of claim **11**, wherein the enhanced positive response further includes at least one of:

a user identification identifying the locate technician;

status information regarding a status of the locate technician;

a description of a history of the locate technician at the dig area;

at least one member code assigned to a facility owner of the at least one underground facility;

at least one positive response code representing a status of the locate and marking operation;

the locate request ticket;

a completed locate request ticket;

time-stamp information to provide proof of a time at which the locate and marking operation is performed by the locate technician;

place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the locate request ticket and corresponding to the dig area;

environmental information regarding at least one environmental condition present at or near the dig area during the locate and marking operation;

at least one of a digital photograph, a digital video, and a digital audio file representing proof of presence and work performed at the dig area;

at least one virtual white line image comprising a second digital image of the geographic area proximate to and including the dig area, and the at least one electronic dig area indicator to delimit the dig area on the second digital image;

a quality assessment of the locate and marking operation as at least partially performed by the locate technician; and

a descriptive and/or numeric assessment of a risk of excavation in the dig area based at least in part on a risk condition within or near the dig area.

18. The method of claim **11**, wherein the electronic link to the enhanced positive response provides access to a menu of notification preferences to facilitate selection of contents for the enhanced positive response.

19. The method of claim **18**, wherein the menu of notification preferences to facilitate selection of the contents for the enhanced positive response includes:

at least one of:

the electronic manifest of the locate and marking operation; and

the geographic coordinates for the at least one dig area indicator and the at least one electronic marking corresponding to the at least one physical locate mark applied by the locate technician to the ground, pavement or other surface; and

at least one of:

a user identification identifying the locate technician;

status information regarding a status of the locate technician;

a description of a history of the locate technician at the dig area;

at least one member code assigned to a facility owner of the at least one underground facility;

at least one positive response code representing a status of the locate and marking operation;

the locate request ticket;

a completed locate request ticket;

time-stamp information to provide proof of a time at which the locate and marking operation is performed by the locate technician;

place-stamp information to provide proof of a presence of the locate technician sufficiently proximate to or at a geographic location specified on the locate request ticket and corresponding to the dig area;

environmental information regarding at least one environmental condition present at or near the dig area during the locate and marking operation;

at least one of a digital photograph, a digital video, and a digital audio file representing proof of presence and work performed at the dig area;

at least one virtual white line image comprising a second digital image of the geographic area proximate to and including the dig area, and the at least one electronic dig area indicator to delimit the dig area on the second digital image;

a quality assessment of the locate and marking operation as at least partially performed by the locate technician; and

a descriptive and/or numeric assessment of a risk of excavation in the dig area based at least in part on a risk condition within or near the dig area.

20. At least one non-transitory computer readable storage medium encoded with instructions that, when executed by at least one processor, perform a method for integrating multiple elements of information relating to a locate and marking operation so as to provide an enhanced positive response to at least one first entity associated with requesting the locate and marking operation, the locate and marking operation performed by a locate technician in response to at least one locate request ticket, the locate and marking operation comprising applying, by the locate technician, at least one physical locate mark on ground, pavement, or other surface to indicate a presence or an absence of at least one underground facility within a dig area, wherein at least a portion of the dig area is planned to be excavated or disturbed by an excavator during excavation activities, the method comprising:

A) generating the at least one locate request ticket including at least one digital image of a geographic area proximate to and including the dig area and at least one of:

at least one electronic dig area indicator to delimit the dig area on the at least one digital image; and

geographic coordinates for the at least one electronic dig area indicator;

B) electronically transmitting, via at least one communication interface, the at least one locate request ticket to at least one second entity associated with performing the locate and marking operation;

C) electronically receiving, via the at least one communication interface, from the at least one second entity associated with performing the locate and marking operation, in response to the at least one locate request ticket, at least one of:

the enhanced positive response for the locate and marking operation; and

an electronic link to the enhanced positive response, wherein the enhanced positive response includes at least one of:

an electronic manifest of the locate and marking operation, the electronic manifest including the at least one digital image, the at least one electronic dig area indicator on the at least one digital image, and at least one electronic marking electronically drawn on the at least one digital image by the locate technician and corresponding to the at least one physical locate mark applied by the locate technician to the ground, pavement, or other surface during the locate and marking operation, so as to graphically depict the locate and marking operation performed by the locate technician; and

geographic coordinates for the at least one electronic dig area indicator and the at least one electronic marking corresponding to the at least one physical locate mark applied by the locate technician to the ground, pavement, or other surface; and

D) electronically transmitting, via the at least one communication interface, to the at least one first entity associated with requesting the locate and marking operation at least one of:

the enhanced positive response for the locate and marking operation; and

the electronic link to the enhanced positive response, so as to reduce uncertainty relating to a completeness and/or a quality of performance of the locate and marking operation and reduce a risk of damage to underground facilities during the planned excavation activities.

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