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(54) METHOD AND SYSTEM FOR PROVIDING A GRAPHICAL WORKBENCH ENVIRONMENT WITH INTELLIGENT PLUG-INS

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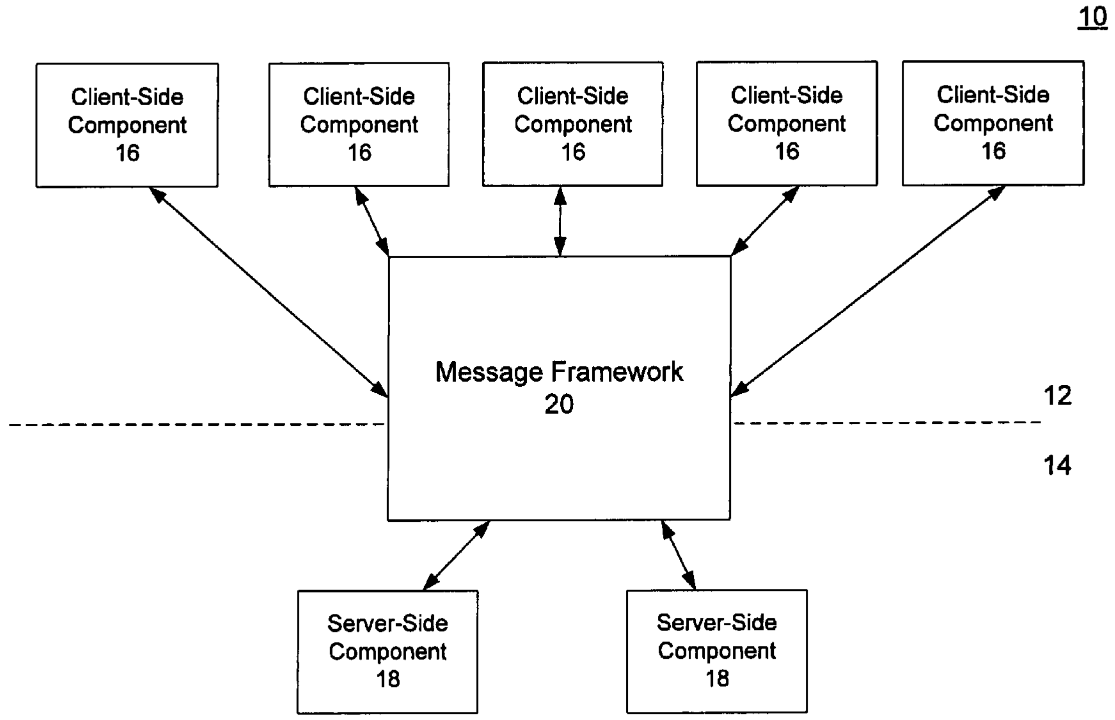
(57) **ABSTRACT**

An apparatus and a method for analysis of point-gathered data. The apparatus and method provide a platform that includes a workbench providing a graphical working environment for a user to view and perform operations on point-gathered data and to interact with the platform, one or more plug-ins that operate on the point-gathered data, including plug-ins that receive inputs from a user through workbench and issue commands as messages and that actively save their state by passing the state as a message, and a message framework that receives all messages from producer plug-ins and passes the messages to an intended consumer. The platform actively saves the workbench state and plug-in states as messages passed to the message framework.



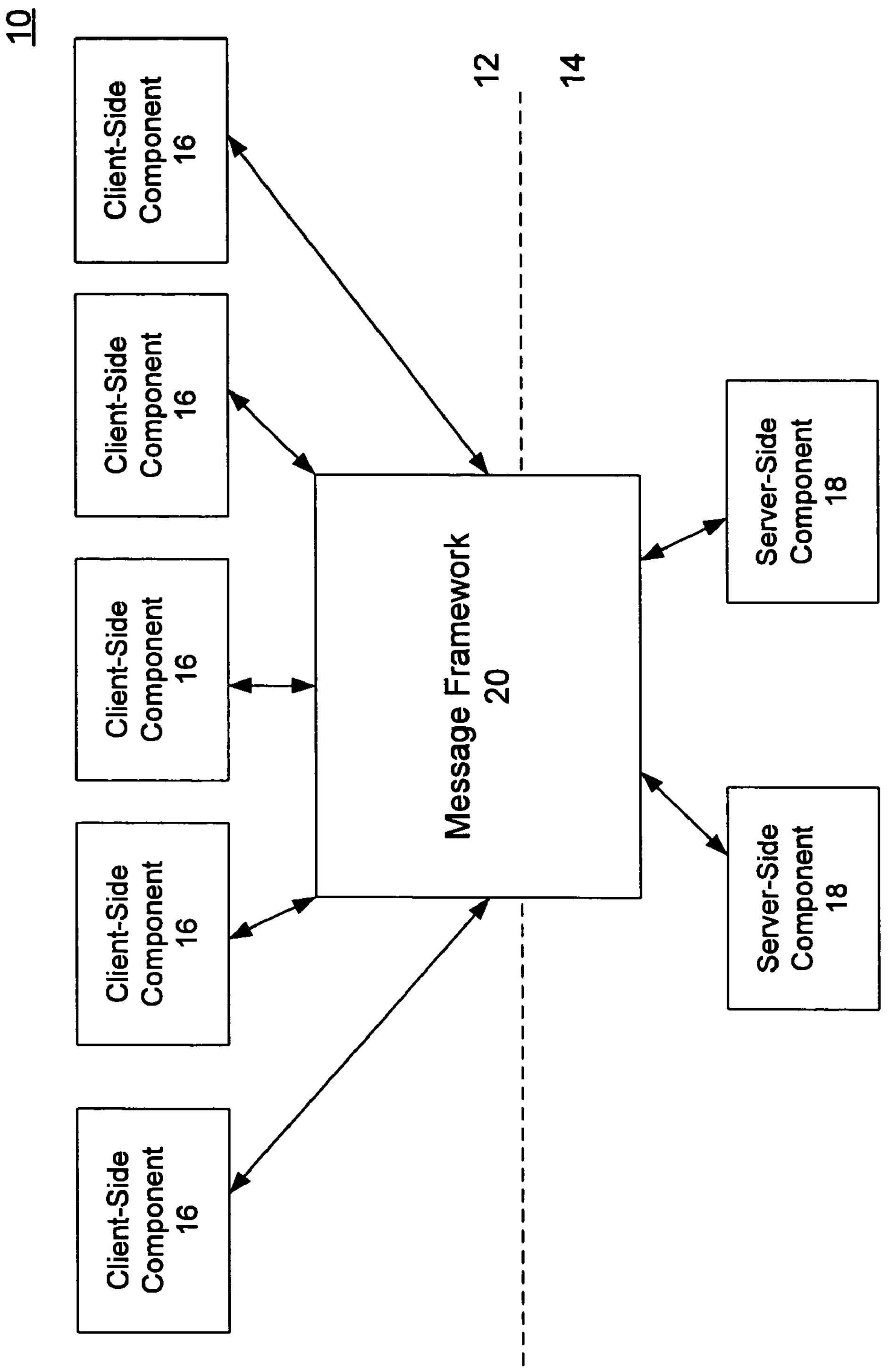

10
Client-Side Component 16
Client-Side Component 16
Client-Side Component 16
Client-Side Component 16
Client-Side Component 16
12
14
Message Framework 20
Server-Side Component 18
Server-Side Component 18

FIG. 1

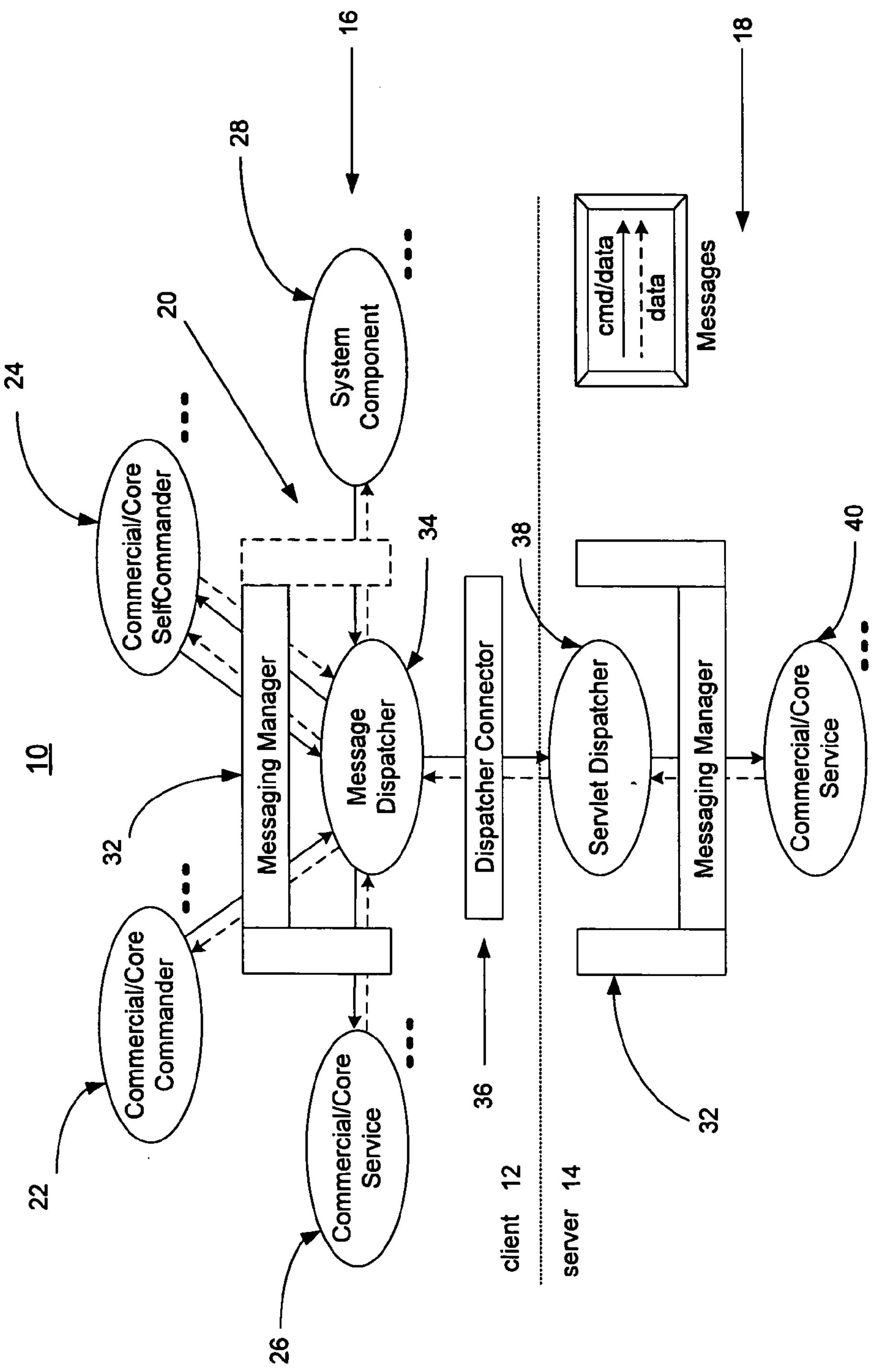

10
Commercial/Core SelfCommander
Commercial/Core Commander
Commercial/Core Service
System Component
Messaging Manager
Message Dispatcher
Dispatcher Connector
Servlet Dispatcher
Messaging Manager
Commercial/Core Service
client 12
server 14
cmd/data
data
Messages
16
18
20
22
24
26
28
32
32
34
36
38
40

FIG. 2

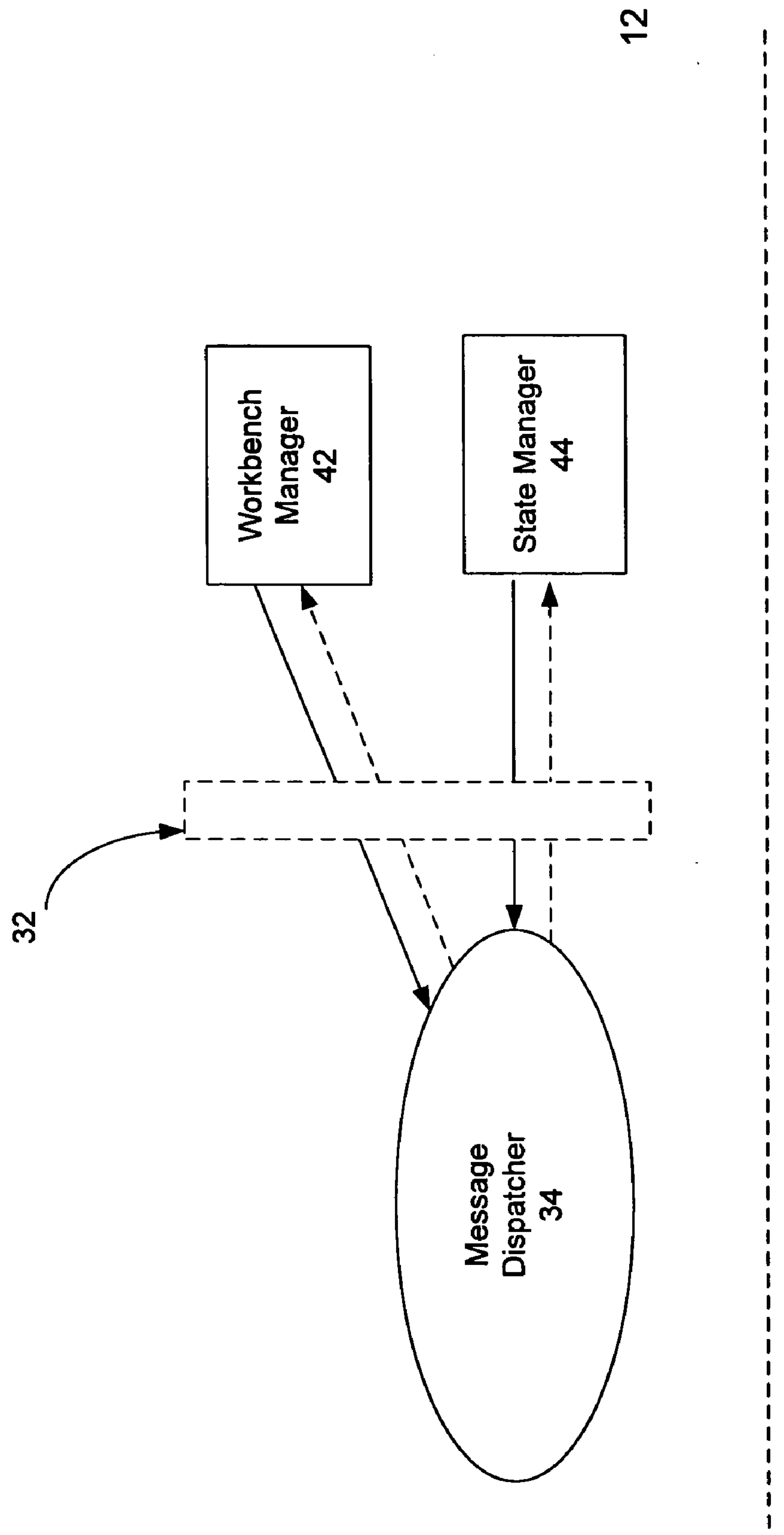

12
Workbench Manager 42
State Manager 44
32
Message Dispatcher 34

FIG. 3

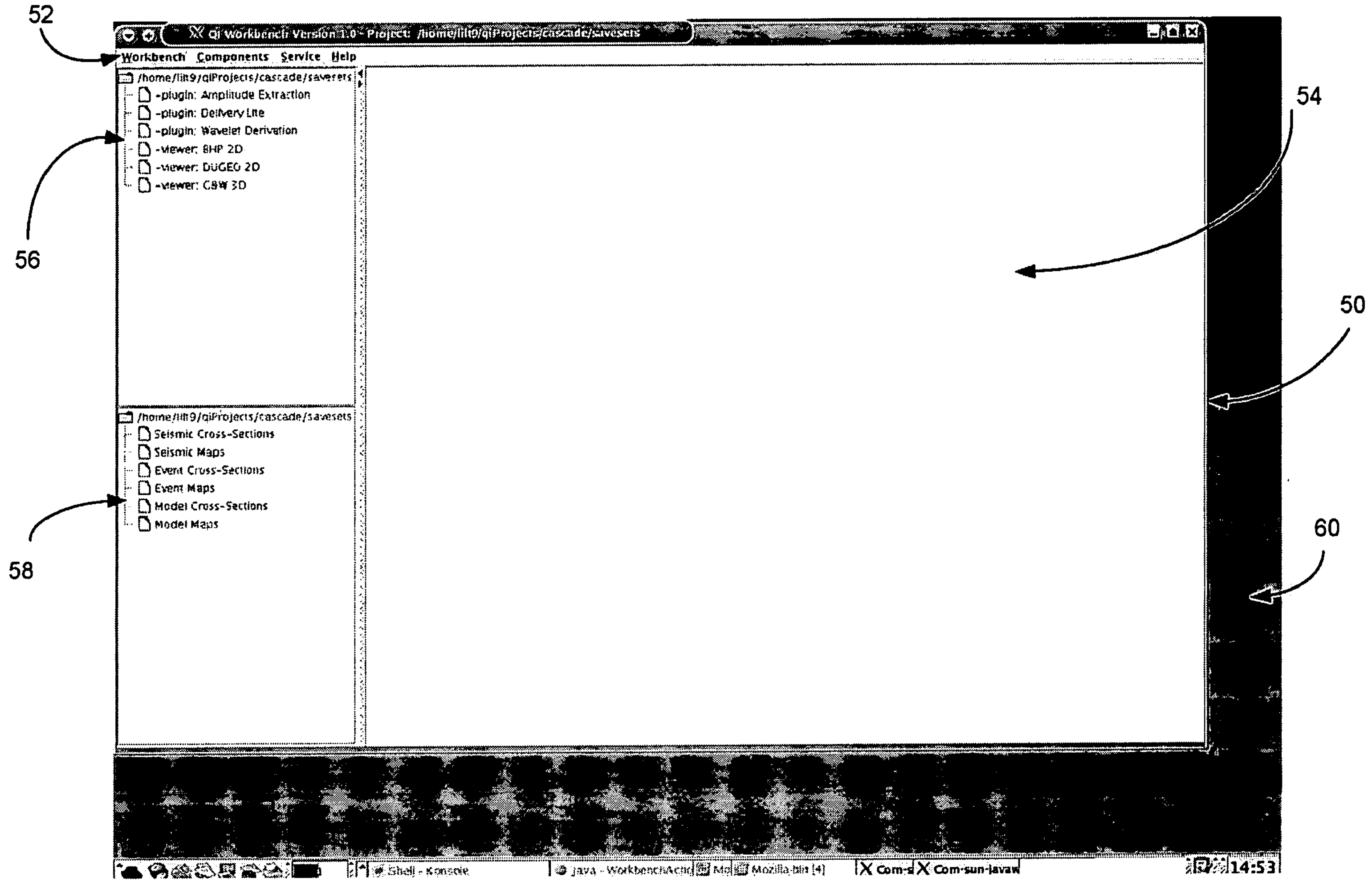

52
54
50
60
56
58
qi Workbench Version 1.0 - Project: /home/lit9/qiProjects/cascade/savesets
Workbench Components Service Help
/home/lit9/qiProjects/cascade/savesets
-plugin: Amplitude Extraction
-plugin: Delivery Lite
-plugin: Wavelet Derivation
-viewer: BHP 2D
-viewer: DUGEO 2D
-viewer: CBW 3D
/home/lit9/qiProjects/cascade/savesets
Seismic Cross-Sections
Seismic Maps
Event Cross-Sections
Event Maps
Model Cross-Sections
Model Maps
Shell - Konsole
Java - WorkbenchActio
Mozilla-bin [4]
Com-s
Com-sun-javaw
14:53

FIG. 4A

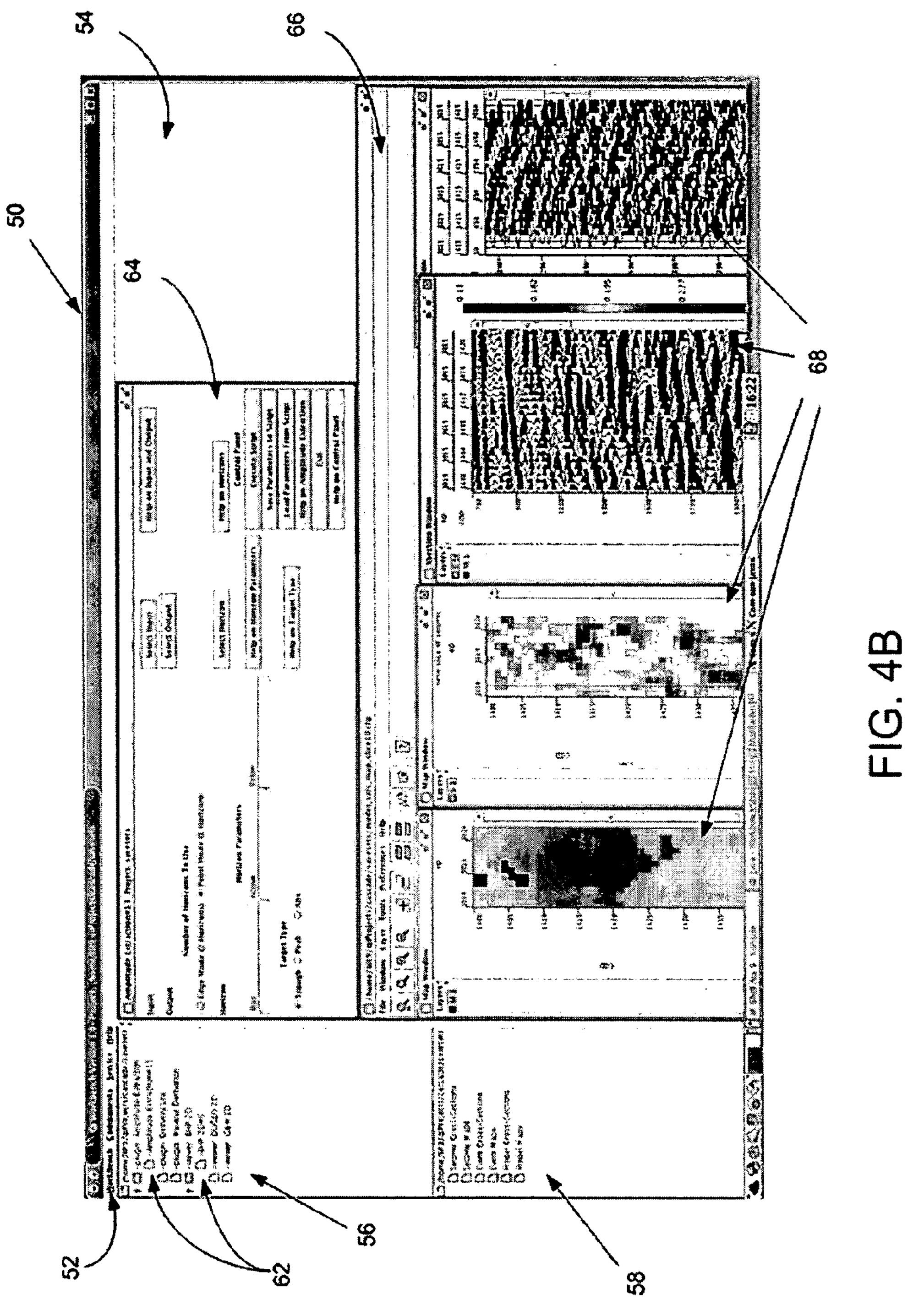


FIG. 4B

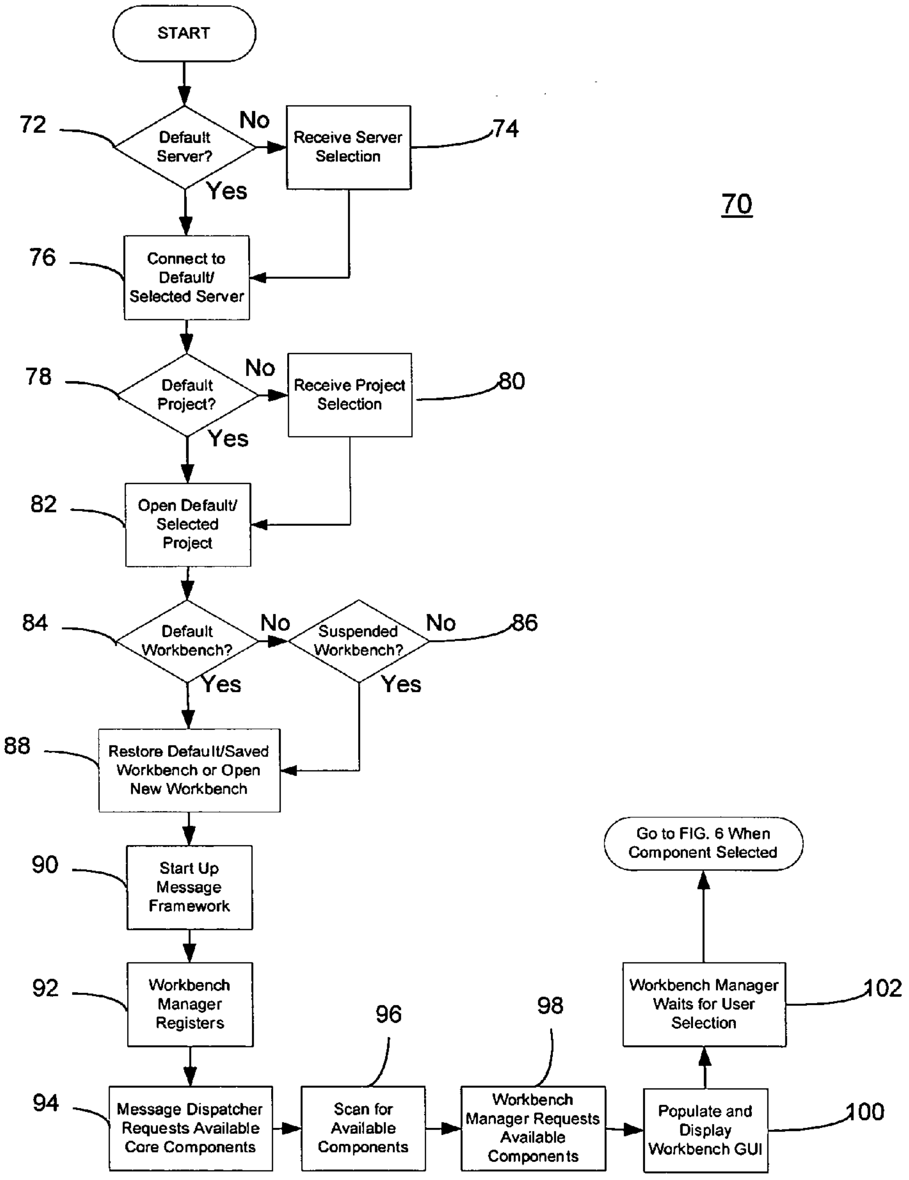

70
START
72
Default Server?
No
Yes
Receive Server Selection
74
76
Connect to Default/ Selected Server
78
Default Project?
No
Yes
Receive Project Selection
80
82
Open Default/ Selected Project
84
Default Workbench?
No
Yes
Suspended Workbench?
No
Yes
86
88
Restore Default/Saved Workbench or Open New Workbench
90
Start Up Message Framework
92
Workbench Manager Registers
94
Message Dispatcher Requests Available Core Components
96
Scan for Available Components
98
Workbench Manager Requests Available Components
100
Populate and Display Workbench GUI
102
Workbench Manager Waits for User Selection
Go to FIG. 6 When Component Selected

FIG. 5

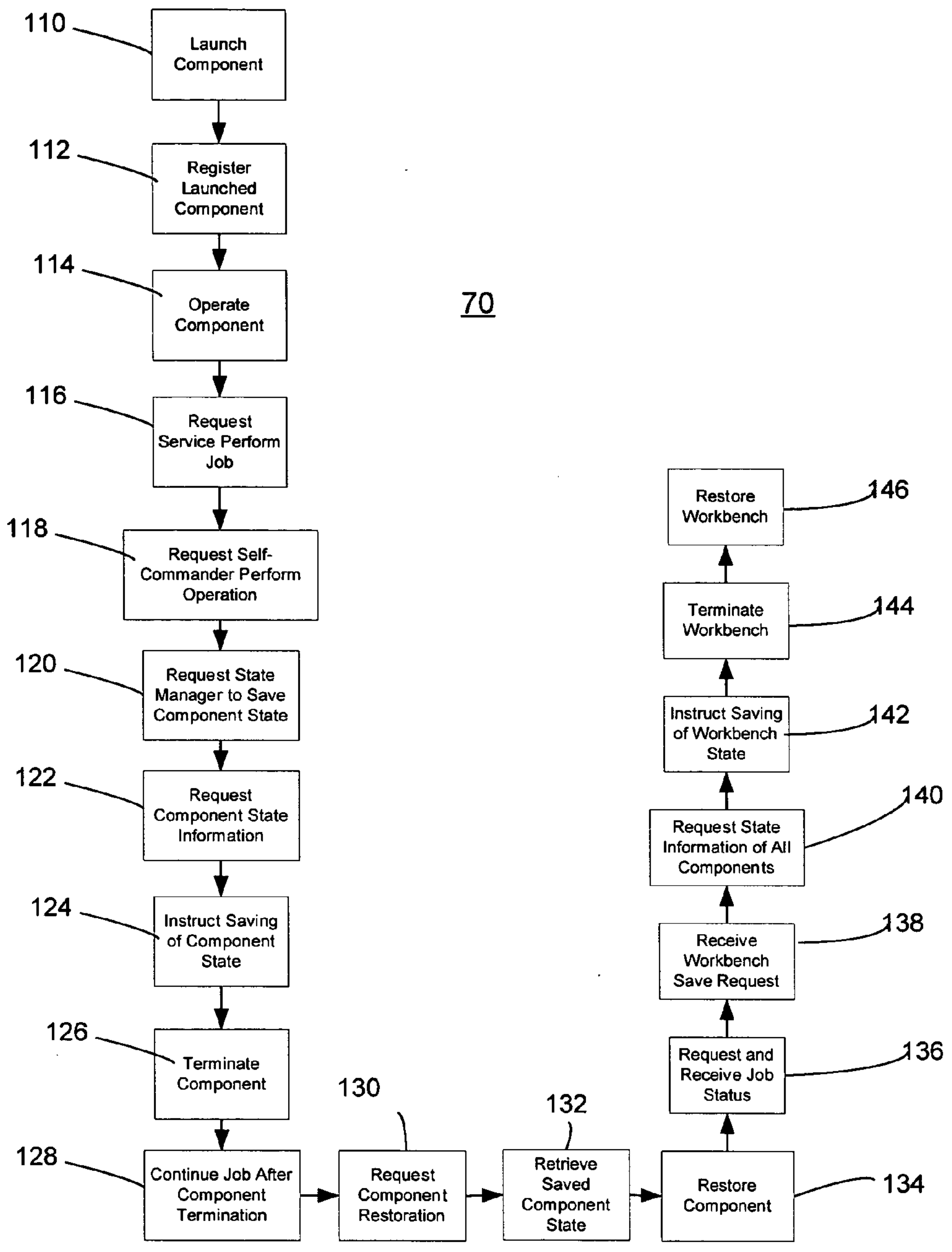

70
110
Launch Component
112
Register Launched Component
114
Operate Component
116
Request Service Perform Job
118
Request Self-Commander Perform Operation
120
Request State Manager to Save Component State
122
Request Component State Information
124
Instruct Saving of Component State
126
Terminate Component
128
Continue Job After Component Termination
130
Request Component Restoration
132
Retrieve Saved Component State
134
Restore Component
136
Request and Receive Job Status
138
Receive Workbench Save Request
140
Request State Information of All Components
142
Instruct Saving of Workbench State
144
Terminate Workbench
146
Restore Workbench

FIG. 6

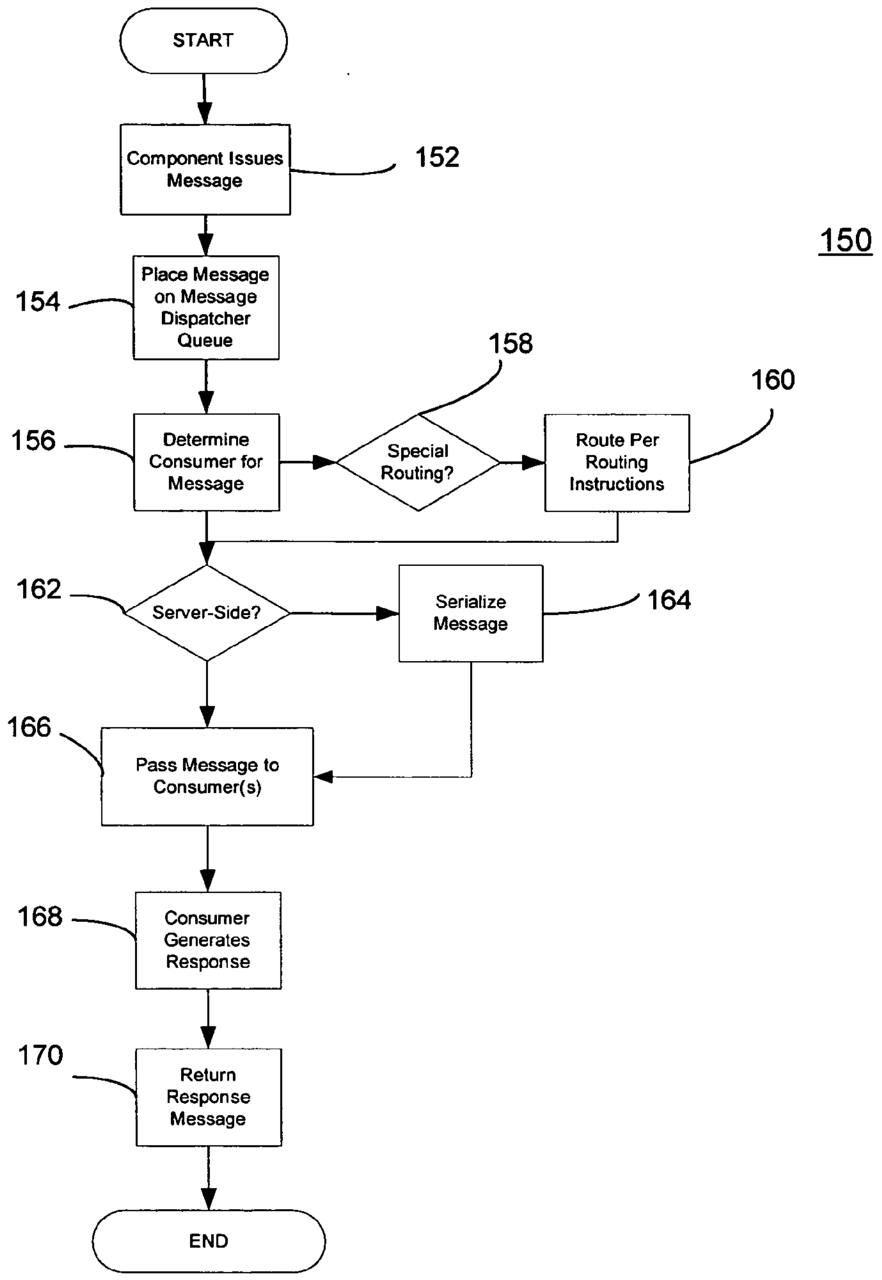

START
Component Issues Message
152
150
Place Message on Message Dispatcher Queue
154
158
160
Determine Consumer for Message
156
Special Routing?
Route Per Routing Instructions
162
Server-Side?
Serialize Message
164
166
Pass Message to Consumer(s)
168
Consumer Generates Response
170
Return Response Message
END

FIG. 7

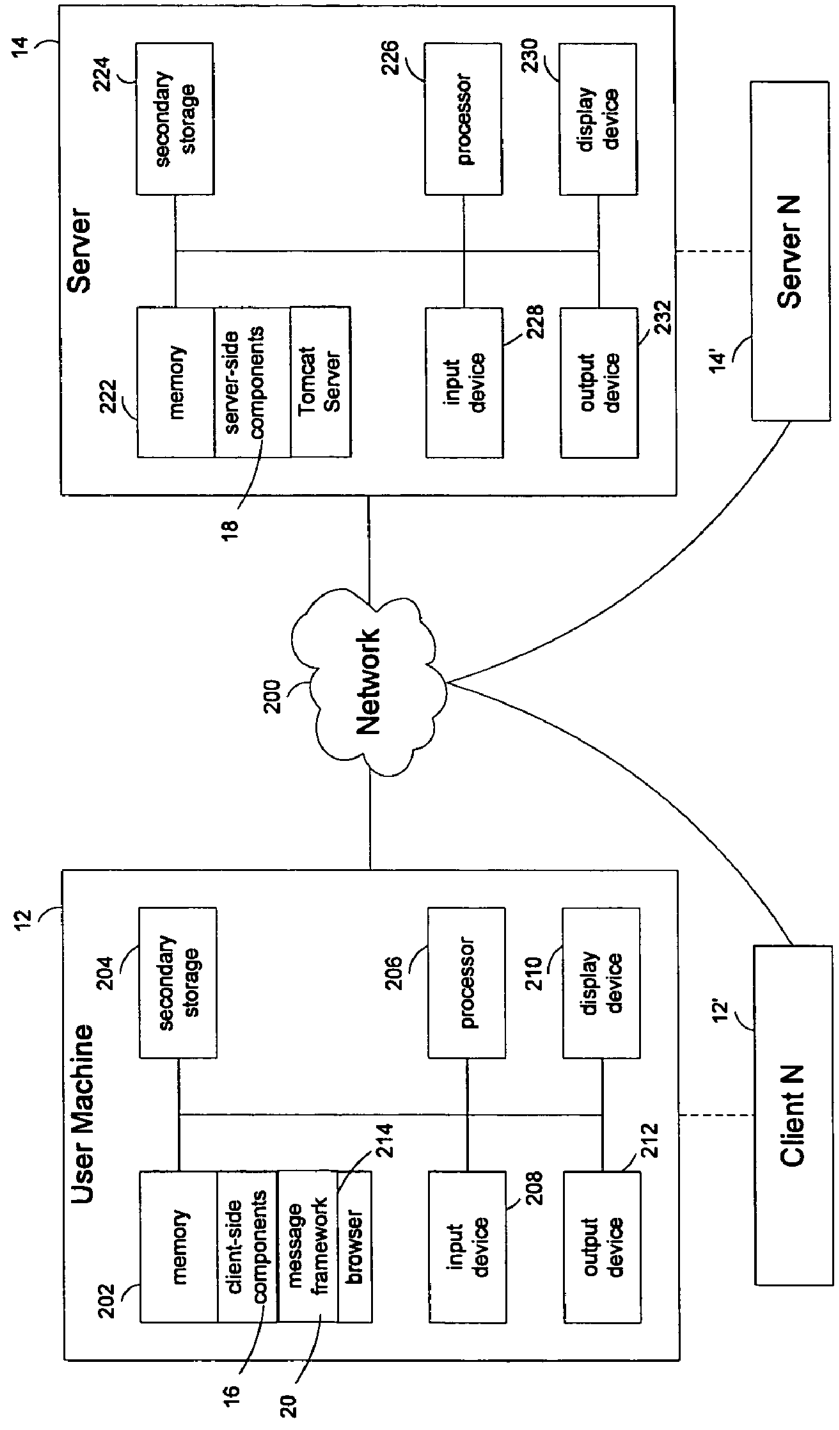

Server
14
secondary storage
224
processor
226
display device
230
memory
222
server-side components
18
Tomcat Server
input device
228
output device
232
Server N
14'
Network
200
User Machine
12
secondary storage
204
processor
206
display device
210
memory
202
client-side components
16
message framework
20
browser
214
input device
208
output device
212
Client N
12'

FIG. 8

METHOD AND SYSTEM FOR PROVIDING A GRAPHICAL WORKBENCH ENVIRONMENT WITH INTELLIGENT PLUG-INS

BACKGROUND

[0001] Numerous computer applications exist for providing users with a desktop environment for remotely connecting to and working in a networked computing system. Such networked computing systems may be a workplace, school, business, etc., networked computing system that a user may want to remotely connect to in order to, for example, tele-commute. One known example of such a computer application is Citrix™. However, such computer applications, including Citrix, may be generally characterized as "lite-client." Lite-client computer applications keep as much functionality and processing on the server-side rather than the client-side (i.e., the user machine). These computer applications do not centralize operations on the client-side and do not have their "brain" on the client-side. Furthermore, such computer applications tend to provide only basic client-side graphic rendering.

[0002] Additionally, computer applications and networked computing systems exist that automatically connect to servers and download applications on a client. For example, U.S. Pat. No. 6,854,009 ("the '009 patent") describes a system for providing voice-over-internet-protocol (VoIP) systems. The '009 patent describes a networked computing system that has a plurality of servers and a plurality of distributed clients. Each client has a boot operating system (OS) that automatically initiates a connection to one of the servers upon startup. The server automatically downloads a base OS and configures a suite of applications on the client.

[0003] However, like the Citrix application and other applications and systems, the system described by the '009 patent does not provide or include intelligent components that save their state as part of an active state-saving mechanism. These systems do not support intelligent, user-built and third-party-built, custom components. These systems do not provide a graphical environment with intelligent and inter-communicating components that may actively drive services and other components. These systems do not provide an extensible environment or workbench that supports multiple active virtual desktops. Further, these systems tend to be event-driven rather than utilizing a message-based architecture. Moreover, as above, these systems may be generally characterized as "light-client," maintaining a greater degree of functionality and processing remotely on a server rather than locally on a client.

SUMMARY

[0004] An advantage of the embodiments described herein is that they overcome the disadvantages of the prior art. Another advantage of embodiments described herein is they provide a user-friendly, graphical web-based workbench environment with intelligent components that are activated on a client when a user connects to a remote server. The components in such embodiments are intelligent in that they include state-saving, state-restoring and message passing capabilities. Another advantage of embodiments described herein is that they support multiple active virtual desktops in a message-driven, extensible environment or workbench. Another advantage of embodiments described herein is that they enable user-built, third-party-built custom components. Yet another advantage of embodiments described herein is that they are heavy-client, centralizing their functionality and processing on a client rather than a server.

[0005] These advantages and others may be achieved by a platform for analysis of data. The platform includes a workbench providing a graphical working environment for a user to view and perform operations on point-gathered data and to interact with the platform, one or more plug-ins that operate on the point-gathered data, including plug-ins that receive inputs from a user through workbench and issue commands as messages and that actively save their state by passing the state as a message, and a message framework that receives all messages from producer plug-ins and passes the messages to an intended consumer. The platform actively saves the workbench state and plug-in states as messages passed to the message framework.

[0006] These advantages and others may be achieved by a system for providing a graphical web-based environment for performing operations on data. The system includes a client operating on a user machine and a server. The client includes a workbench that provides a graphical working environment for a user to interact with and operate a plurality of components operating in the workbench, and message framework. The components include one or more commanders that analyze and perform operations on data, one or more self-commanders and one or more client-side services (and/or server-side services) that perform services per commander or self-commander issued commands and issues responses to the commands. Each commander includes state-saving, state-restoring and message passing capabilities, receives inputs from the user through the workbench, issues commands and receives responses. Self-commanders receive inputs from the user through the workbench, issue and receive commands, and issue and receive responses. The components communicate with each other using messages passed through the message framework. Each message is passed through the message framework and includes data or data and a command. The server stores information regarding the components, including the state and identity of available components.

[0007] These and other advantages are also achieved by a method for providing a graphical web-based environment for performing operations on data. The method includes connecting to a server from a client computer, opening a workbench on the client computer, starting up a message framework, launching one or more commander components on the client computer, launching one or more self-commanders on the client computer and saving the state of at least one of the commander components on the server. These advantages and others are also achieved by a computer readable medium that includes instructions for executing this method.

DESCRIPTION OF THE DRAWINGS

[0008] The detailed description will refer to the following drawings, wherein like numerals refer to like elements, and wherein:

[0009] FIG. **1** is a block diagram illustrating an exemplary architecture of system for providing a graphical web-based environment with intelligent plug-ins according to an embodiment;

[0010] FIG. **2** is a more detailed block diagram illustrating an exemplary architecture of system for providing a graphical web-based environment with intelligent plug-ins according to an embodiment;

[0011] FIG. **3** is a block diagram illustrating an exemplary architecture of exemplary system components;

[0012] FIG. **4**A is a screen shot of an exemplary virtual desktop according to an embodiment of system for providing a graphical web-based environment with intelligent plug-ins;

[0013] FIG. **4**B is a screen shot of an exemplary virtual desktop according to an embodiment of system for providing a graphical web-based environment with intelligent plug-ins displayed;

[0014] FIG. **5** is a flowchart illustrating an exemplary method for providing a graphical web-based environment with intelligent plug-ins;

[0015] FIG. **6** is a flowchart illustrating an exemplary method for providing a graphical web-based environment with intelligent plug-ins;

[0016] FIG. **7** is a flowchart illustrating exemplary message passing in a graphical web-based environment with intelligent plug-ins;

[0017] FIG. **8** is a block diagram illustrating exemplary hardware components of a system for providing a graphical web-based environment with intelligent plug-ins according to an embodiment.

DETAILED DESCRIPTION

[0018] A method and system for providing a graphical environment with intelligent plug-ins is described herein. Embodiments include a component-based application with an underlying message-driven framework that supports multiple virtual desktops. Each instance of a virtual desktop may be referred to herein as a "workbench" and the component-based application may be referred to herein as "workbench application" or simply the "application." Each active desktop may have multiple intercommunicating components active at once. The components include two capabilities, namely message passing and saving/restoring of the component's computational state. Embodiments of the workbench include components that send commands to other components and receive responses, components that send and receive commands, process commands, and receive and send responses, and components that receive commands, process the commands and send responses. The components may receive virtually any kind of data as input, run various computational algorithms on the data and produce output that is consumed by other components and also, for example, displayed to a user. In embodiments, the component-based application is a web-based application that is downloaded from a server to a user machine on which it is installed and run/executed. The application may be a "client-heavy" or "thick client" application because the components, particularly the command-issuing components, run predominantly on the client and not on the server.

[0019] With reference now to FIG. **1**, shown is a block diagram providing a general overview or architecture of computer system **10** for providing a graphical web-based environment with intelligent plug-ins according to an embodiment. In an embodiment, system **10** may be accessed and run by a user downloading (or otherwise obtaining), installing and running the component-based application described above on their user-machine (client **12**).

[0020] Generally speaking, components of system **10** are plug-ins. A plug-in is software (e.g., a module or application) that issues or receives commands to perform certain enumerated operations; new plug-ins may be added to or "plugged-into" system **10** by integrating the plug-in into an exposed application program interface (API) (e.g., message framework) of system **10**. New plug-ins extend capabilities of system **10** ("extend the system"). As is discussed herein, the component-based application running on user machine may detect and instantiate the plug-ins as requested by user. The graphical web-based environment is referred to as a workbench. In embodiments described herein, the workbench is a virtual desktop that appears as a window on the user-machine (client); system **10** is a virtual operating system (OS) for the workbench. The architecture of system **10** defines a component-based application with an underlying message-driven framework that supports multiple virtual desktops. Each desktop may have multiple intercommunicating components active simultaneously.

[0021] As shown, the system **10** includes client **12** (side) and server **14** (side). The client **12** and server **14** shown are exemplary and are shown for illustrative purposes only. See below for detailed description of exemplary client **12** and server **14**. Other configurations of client **12** and server **14** are encompassed. For example, there may be more than one server **14** in an implementation of system **10**. A back-up server **14** may be provided.

[0022] Client **12** is a local user machine. Client **12** may be any local user machine on which a user installs and runs the application. System **10** is preferably implemented using Java, such as Java 5.0, although other programming languages may be used. Embodiments include a Java Runtime Environment (JRE), such as JRE 1.5, installed on client **12**. System **10** may operate in a variety of operating systems installed and running on client **12**, such as Microsoft Windows (e.g., WinXP), Linux, Mac OS. Other applications are installed and used as necessary, such as Seismic Unix (SU) if using plug-ins that generate a SU script or Landmark project environment if using Landmark reader and writer services. Seismic Unix may be the format for sub-surface data passed in system **10**. Server **14** may be, e.g., a Tomcat server, installed on a remote machine, or even a local user machine. If system **10** is implemented in Java, it may work in Java or a machine dependent language, such as C++, through a Java Native Interface (JNI).

[0023] With continued reference to FIG. **1**, system **10** includes client-side components **16**, server-side components **18** and message framework **20** providing the message-driven, intercommunication between the components. Message framework **20** includes client-side elements and server-side elements and is, therefore, illustrated spanning both client **12** and server **14**. System **10** is client-heavy or thick, with a greater proportion of its components, and functionality, on client **12** rather than server **14**. Client-side components **16** are stored and executed on client **12**. However, state information is saved on and retrieved from server **14**. Consequently, a user may restore client-side components **16** to a saved state on any client **12** on which system **10** is installed.

[0024] Message framework **20** supports multiple active, intercommunicating components in a workbench. As mentioned above, workbenches are displays generated by system **10** that have a Windows desktop-type appearance and provide a user access to the components and functionality provided by system **10**. Each workbench may be displayed as a window or other graphical-user-interface (GUI). Generally, workbenches are generated and displayed on client **12** when user invokes system **10** by connecting to server **14**. Further detail on the invocation of workbenches is provided below.

[0025] As discussed above, client-side components **16** and server-side components **18** are plug-ins. These plug-ins, however, are intelligent in that they support two specific capabilities—message passing and saving/restoring of their computational state. The former capability enables client-side components **16** and server-side components **18** to intercommunicate through message framework **20**. The message passing capability includes the ability to send messages that include commands and/or data, as described below. In an embodiment, to support message passing, a component includes a message handler and message queue. The message queue temporarily stores outgoing and incoming messages and the message handler manages the message queue, adding and removing messages from the message queue. The state saving/restoring capability enables the state of each active workbench, and the components running therein, to be saved and later restarted with the same operational state. In embodiments, each component may pass its state as a message sent through the message framework for storing on server **14**. A component state may include the position of a component GUI in workbench window and input parameters entered into said GUI.

[0026] In an embodiment, client-side components **16** and server-side components **18** may include "core" components (plug-ins) that are provided with each implementation of system **10**. In other words, the application that a user installs and runs on the user machine may include a set of core components. In an embodiment, each instance of the application installed and run on a user machine will include the core components. Additionally, commercial or custom components (plug-ins) may be developed and added to an implementation of system **10** by a user or third-party developer. For example, such commercial components may be developed and provided by an entity other than the entity providing the application and the core components. Commercial components are components that are not provided with the application when installed. Commercial components may be written by any third-party. A user may install and run the application and then download additional commercial components for installation and operation in system **10**. Such commercial components may be "plugged-in" system **10**. After the commercial components are installed they may be recognized by the application. Commercial components may extend and expand the functionality of system **10**. In an embodiment, system **10** is provided with "core" components under an open-source license while commercial components must be separately licensed and purchased. Commercial components may be licensed or not, open-source or not, purchased or free, etc.

[0027] With reference again to FIG. **1**, in operation, system **10** users interface with workbench, accessing client-side components **16** through GUIs displayed on the workbench, and requesting client-side components **16** perform certain operations and display certain data. In turn, client-side components **16** issue commands and perform the requested operations. Client-side components **16** may issue commands to other client-side components **16** and server-side components **18**. Client-side components **16** issuing commands may be referred to as producers. Components processing and responding to commands may be referred to as consumers.

[0028] Responses to the commands (output) are generated by consumer components and sent back to the requesting producer client-side component **16** (component issuing command) and/or other components. Responses to commands may also include further commands sent to other client-side components **16** and/or server-side components **18**. The commands and responses are sent and received by message framework **20** as messages. Message framework **20** receives messages from a producer component and routes to the appropriate consumer component. If necessary to send to a server-side component **18**, message framework **20** may serialize the message before transmitting to server **14**. Responses from server-side components **18** may be received and de-serialized by message framework **20** before being passed to the requesting component.

[0029] In an embodiment, client-side components **16** are stored on client **12**. Client-side components **16** may be, e.g., packaged as a file stored on client **12**. For example, client-side components **16** may be packaged as a Java Archive Repository (a .jar or "JAR" file) saved on client **12** (e.g., in a component or plug-in cache). The file includes code that creates an instance of the component when launched and registers the instance with message framework **20**. Some client-side components **16** include a graphical-user interface (GUI) for interaction with the user. Such components would also include code to instantiate the GUI and to receive and process user inputs from the GUI. In an embodiment, every component instance runs as a separate thread in system **10**.

[0030] As mentioned above, system **10** may be used with virtually any type of data. One embodiment described herein manipulates and operates on sub-surface data, including seismic and well log data, gathered from numerous sources. Seismic data includes sub-surface data normally generated or obtained from sound wave propagation through earth. Such sound waves are typically low frequency (e.g., 1 to 100 Hertz). Seismic data may be generated or obtained by looking at seismic reflections showing contrasts in sub-surface material, e.g., as seen from compression data and acoustic components in the propagating sound waves. Well log data (or simply well data) includes data acquired through a hole (well) drilled in the earth, usually expressed as a function of distance (depth) in the well. Such data may be gathered from devices and instruments in the well, from samples taken from the well, and may include pressure, sound and other data. Such data may also include data gathered during drilling the well or from temporarily or permanently down-hole (in the well) sensors and other measuring devices. Such an embodiment may perform quantitative or qualitative interpretation, other analysis or processing, of seismic and well data. Seismic data and well log data are types of sub-surface data. Indeed, when referred to herein, sub-surface data may refer to seismic data, well log data, other related data, and/or derived data (e.g., data derived from sub-surface data, reservoir models, reservoir simulation models, geologic models, etc.). Other data system **10** may be used with includes, for example, medical imaging data, gaming data (e.g., from on-line or standalone computer game applications), financial data, telecommunications data, military application data, security data, weather data, etc. The data may be produced, generated, retrieved, gathered, etc., by separate applications (e.g., web-based or standalone) or by components of system **10**. For example, in a gaming embodiment, clients **12** may be separate gamers' user machines and client-side components **16** may include the gaming application installed on client **12**. The state of a gamer's game session may be saved on server **14**.

[0031] The data may be generated on or gathered by computing devices separate from client **12** and server **14**. The data may be point-gathered (e.g., gathered at a particular geographic or virtual point, such as, e.g., a seismic-data gathering device, a well, a meter, a medical imaging device, a telecommunication device (e.g., a switching center, base station, wireless transmitter/receiver (e.g., mobile phone), wired transmitter/receiver, fixer or mobile transmitter/receiver, land-line), a financial device (e.g., an automated-teller machine, a computer performing electronic banking, a financial institution computer, an automated trading network or computer), a gaming machine (e.g., a user machine running an on-line or standalone computer game, a server running an on-line computer game), a sensor (e.g., radar, sonar, imaging system, ladar, phased-array radar, synthetic aperture radar, motion-sensor, infrared, pressure-sensor, etc.), message notification system, military or security information gathering equipment and devices, other data gathering equipment and devices, computers, servers, and networks, etc.). The data may be actively or passively gathered.

[0032] The data may be communicated to and stored on client **12** and/or server **14** via, e.g., the Internet or another network. The data may be manually loaded onto client **12** and/or server **14**. Alternatively, data may be stored on storage devices remote from client **12** and/or server **14**. Data may be stored in large amounts (e.g., terabytes of data) on server **14** (or other storage device) and subsets of the data (e.g., megabytes or gigabytes) temporarily, or otherwise, retrieved from server **14** (or other storage device) and stored on client **12** for processing and operations performed by client-side components **16** (such as, e.g., display and manipulation through workbench). In some instances, it may be necessary for a server-side component **18** to perform an operation because the data for the operation is resident on server **14** or elsewhere. Other instances include situations when a computation is particularly intense and it requires multiple server-side components **18** resident on multiple, or a cluster or gird of, servers **14**.

[0033] With reference again to FIG. **1**, to summarize, some important features of system **10** include:

- **[0034]** Components are command driven. A component receives/sends either a command and/or data, and returns data. Commands and data are bundled in a message. In embodiments, all messages go through message framework **20**, which handles message passing for all components. Message framework **20** may execute commands contained in a message or direct the message to a client-side component **16** or server-side component **18** for execution. Return messages are directed to the requesting originator component.
- **[0035]** Client-side components **16** or server-side components **18** are plug-ins that include two specific capabilities, namely, message passing and saving/restoring of computational state.

Additionally, commands with defined arguments can be journaled into a script. Replaying this script can be used to test system **10** or to restore system **10** to a past state. It is possible to present a script file to the message framework **20** for execution. Other important features of system **10** are apparent from the description above and as follows.

[0036] With reference now to FIG. **2**, shown is a block diagram illustrating a more detailed, exemplary architecture of an embodiment of system **10**. As above, system **10** includes client-side components **16**, server-side components **18** and message framework **20**. As shown here, client-side components **16** include one or more commanders **22**, one or more self-commanders **24**, one or more client-side services **26** and one or more system components **28**. Message framework **20** includes messaging manager **32**, message dispatcher **34**, and dispatcher connector **36** on client **12**, and servlet dispatcher **38** and messaging manager **32** on server **14**. Server-side components **18** include one or more server-side services **40**. Commanders **22** and other client-side components **16** are resident and executed on client **12**. In alternative embodiments, commanders **22** and other components may be resident and executed on server **14**.

[0037] Commanders

[0038] Commanders **22** are intelligent components. As with other components of system **10**, commanders **22** include message passing and computational state saving/restoring capabilities. Commanders **22** generally act as producers, sending commands to other components and message framework. Commanders **22** send requests (commands with or without data) to other components (client-side components **16** and server-side components **18**) and receive responses back. Some of the responses may include data generated or retrieved by other components. The data may be retrieved from client **12**, server **14** or elsewhere. Commanders **22** may manipulate this data, perform operations, including, e.g., computational algorithms, on the data, and produce output that may be consumed by other components. For example, self-commanders **24** may include viewers which consume output from commanders **22** and display the output on a display in the workbench for the user to view. Commanders **22** include message handlers and message queues as discussed above.

[0039] In embodiments, commanders **22** do not receive commands from self-commanders **24** and services (client-side services **26** or server-side services **40**). The message paths shown in FIG. **2**, by showing outgoing commands/data and incoming data to commanders **22**, illustrate this paradigm. An exception to this paradigm is that commanders **22** do receive and respond to commands from message dispatcher **32** and system components **28** (collectively referred to as "system-level components"). All components, including commanders **22**, may receive commands from system-level components.

[0040] Commanders **22** usually include a GUI through which a user specifies input parameters and selects data for operations performed by commanders **22**. Typically, when the user makes selections requesting commander **22** perform some operation, the commander GUI enters into a dialog with a user in order to determine what file or directory to use for obtaining data, to set parameters for commander **22** operations, to determine what file or directory to write results to, etc. Such dialogs may be common to other client-side components **16** and, therefore, may be provided as a separate client-side component **16** for other client-side components **16**, such as commanders **22** and self-commanders **24**, to use. Some commanders **22**, however, do not have a GUI and may, for example, simply monitor and record message traffic and take actions based on received messages and/or drive other components.

[0041] With continuing reference to FIG. **2**, there are a variety of forms commanders **22** may take. For example, commanders **22** may be: (1) a monitor/report daemon, which commands message framework **20** to feed the monitor daemon the command stream received by message framework **20** and which monitors and reports on the command stream; (2) a monitor/act daemon that monitors commands issued by another commander **22** or self-commander **24** and takes some action when a particular command is issued. For example, as discussed below, self-commanders **24** may include viewers, including three-dimensional (3D) viewers and two-dimensional (2D) viewers. Like commanders **22**, self-commanders **24** may include a GUI. A 3D viewer GUI may issue a command to select and highlight a portion of data displayed in the 3D viewer (e.g., in response to a user input, such as clicking-and-dragging over a portion of the display). The monitor/act daemon may be monitoring for such a command, and when seen, the monitor/act daemon may issue a command to the 2D viewer to select and highlight a corresponding portion of data displayed in the 2D viewer. Other commands that may be monitored and acted upon include such commands as "refresh all displays" or "reload a layer"; (3) a recording daemon that records commands to a script file (which may be later executed); (4) a system backup daemon that, periodically or as scheduled, tells messaging framework **20** to save the state of an active virtual desktop; (5) a static command generator, which presents another component (e.g., a self-commander **24** such as a viewer) with a canned script of commands for execution. The static command generator may contain the canned script or ask the user for a script file; (6) a dynamic command generator that issues commands based on actions taken by the user (e.g., actions taken by users in component GUIs or on displays displayed by a self-commander **24**). Such a dynamic command generator commander **22** may listen to commands from an active instance of self-commander **24**; and, (7) a workflow-wizard or other GUI that receives commands from users in the form of user selections and parameter inputs in the GUI displayed to the user in the virtual desktop, performs operations on selected data (e.g., computational algorithms) and may issue commands to other components in response thereto. The types of commanders **22** include the forms discussed herein, combinations of those forms, and commanders **22** with other functionality limited virtually only by a developer's imagination and compatibility with systems **10** (message passing and computational state saving/restoring).

[0042] Workflow wizard commanders **22** may present a workflow through a GUI to users. The workflow may be a flowchart of various actions and operations performed by workflow wizard commander **22** and/or various other components, such as other commanders **22**, self-commanders **24**, client-side services **26**, and server-side services **40**. The workflow requests and receives input parameters from the user. The workflow may instantiate components to perform operations displayed in the workflow and selected by the user. The received input parameters may include selections of data for operations and parameters for computational algorithms, for example. The received input parameters may be provided to the instantiated components as input for the operations. For example, a workflow wizard commander **22** may instruct a self-commander **24** (e.g., such as a viewer, client-side service **26** or server-side service **40**) to take certain actions in response to a user selection, via commands (sent as messages through message framework **20**).

[0043] The GUI workflow for a workflow wizard commander **22** may be represented, for example, by a layout of Java Swing™ interaction widgets displayed in the GUI (non-workflow components may use Java Swing interaction widgets). The layout specifies the flow of control—the flowchart. Such widgets may include data widgets and control widgets. Data widgets are for specifying options and entering parameters to computational processes. The computational processes may be performed by the workflow wizard commander **22** or other components. Control widgets are for issuing commands to components, such as self-commanders **24** (e.g., commands to viewers to display computational results).

[0044] Commander **22** GUIs displayed in a virtual desktop may have a status area for displaying messages about the progress of computational processes being executed by or for commander **22**. Some computational processes executed for commander **22** may be executed by client-side service **26** or a server-side service **40**. Exemplary statuses of a commander's **22** computational process include: the process started, the process completed successfully, the process took an exception, or the server the process was running on crashed.

[0045] With continuing reference to FIG. **2**, commanders **22** monitor and save their current state. As a result, commanders **22** may be suspended, i.e., the state of an instance of a commander **22** saved and the commander **22** deactivated/closed. Later, commander **22** may be reactivated to the last saved state. Furthermore, while commander **22** is deactivated, all responses (data) that commander **22** would have received from server-side services **40** (or elsewhere) may be saved. When commander **22** is reactivated to the last saved state, commander **22** is sent all of the saved responses.

[0046] In a sub-surface data embodiment, exemplary commanders **22** include but are not limited to an amplitude extraction component (which provides amplitude extraction from maps, events and seismic data), a delivery lite component (which provides model-based inversion calculations on model-based layers), a spectral decomposition component (which provides spectral decomposition functions), a wavelet extraction component (which extracts wavelets from seismic data and from well logs), an XML editor (which enables a user to edit, e.g., XML data files, structured parameter files, input data files, hierarchical data files, workflow files, etc. Such sub-surface data commanders **22** manipulate sub-surface data, e.g., process and/or analyze seismic or well log data, perform computational algorithms on the sub-surface data, instruct job services to perform computations, produce sub-surface data output, produce processed sub-surface data output, etc. The output produced by sub-surface data commanders **22** may be consumed by other components (e.g., by self-commanders **24**, such as viewers).

[0047] As discussed above, some commanders **22** may be "core" components shipped with an implementation of system **10** while other commanders **22** are "commercial" components that are separately licensed and/or purchased. In an embodiment, system **10** may be provided with core commanders **22** free-of-charge while commercial commanders **22** are provided by a third-party and may be separately licensed and purchased or otherwise obtained (e.g., free of charge, open-source licensed, etc.). For example, some sub-surface data commanders **22** may be developed and provided by various vendors for installation and use in system **10**.

[0048] Self-Commanders

[0049] With reference again to FIG. **2**, self-commanders **24** may send and receive requests (commands). This is represented in the architecture diagram of FIG. **2** by two sets of message arrows—one pair for sending commands, one pair for receiving commands. Examples of self-commanders **24** include viewers that graphically render and display data. Such viewers include, e.g., a 2D viewer and a 3D viewer. In a sub-surface data embodiment, viewer self-commanders **24** display, e.g., graphically rendered seismic, horizon and well data, maps, etc.

[0050] Self-commanders **24**, such as viewers, may communicate with each other via message framework **20**. In other words, self-commanders **24** may send each other messages. Indeed, self-commanders **24** may send commands to other self-commanders **24** and themselves via message framework **20**. For example, an active 2D viewer may send an active 3D viewer a command to synchronize the 3D viewer cursor with movement of the 2D viewer cursor. When a user moves the 2D viewer cursor, a synchronized 3D viewer cursor will mimic the 2D viewer cursor movement. Alternatively, a monitoring commander **22** may send a 3D viewer self-commander **24** a command to synchronize upon monitoring 2D viewer self-commander **24** synchronize command. Other viewer actions may also be synchronized. Other commands may be passed between viewers for synchronization and other purposes. Self-commanders **24** also receive and respond to commands from system-level components.

[0051] Moreover, viewer self-commanders **24** enable a user to conduct multi-dimensional analysis. For example, a user may view a 3D view of data displayed by a 3D viewer. While viewing, the user may select a portion of the displayed data and request that a 2D viewer display the same portion of data in a 2D view. The 3D viewer self-commander **24** may send a command message launching 2D viewer self-commander **24**, if not already active, and instructing it to retrieve and display the selected portion of data in its 2D display. The process may also be reversed, requesting a 3D view of displayed 2D data.

[0052] With continuing reference to FIG. **2**, as with commanders **22** above, self-commanders **24** may include a GUI through which a user makes selections, enters input and otherwise interfaces with self-commander **24**. A viewer self-commander **24** may include code for the GUI as well as code to visualize the viewer display. For example, in an embodiment, viewer self-commanders **24** include viewer GUI agents and viewer visualizer services. Viewers control their display (viewer visualizer service) through their GUIs (viewer GUI agent). Messages may be passed from a self-commander **24** GUI to the self-commander **24** visualizer. These messages may contain commands and data for directing viewer visualizer service to display requested data. For example, a user may select a certain portion of data displayed by a 2D viewer for a zooming. Viewer GUI agent may receive data from other components for display and may then send a message (including the data and commands) to viewer visualizer service. Viewer GUI agent may also receive input from a user requesting certain data be displayed or certain services be performed.

[0053] As mentioned above, self-commanders **24** may include a 2D viewer and a 3D viewer. In certain (e.g., sub-surface data) embodiments, self-commanders **24** also includes a well log viewer that displays well log views. Exemplary viewers that may be configured as viewer self-commanders **24**, or upon which viewer self-commanders **24** may be based, include, e.g., bhpViewer, Interactive Petrophysics™ viewer, PowerLog viewer, Landmark's SeisCube™ viewer, GeoQuest's viewer. In certain embodiments, when workbench is instantiated on client **12**, no particular viewer self-commander **24** is active by default. However, the user can change "Preferences" to indicate a default viewer. Self-commanders **24** may be launched explicitly by the user or programmatically by another component (including, e.g., another instance of self-commander **24** currently running). For example, a 3D viewer self-commander **24** may launch (instantiate) a 2D viewer self-commander **24** if a user requests a 2D view of selected data displayed by 3D viewer. Likewise, commanders **22** may launch self-commanders **24**.

[0054] As with other components, self-commanders **24** support message passing and computational state saving/restoring. Self-commanders **24** may be producers and consumers. Self-commanders include message handlers and message queues. Self-commanders **24** may be suspended, i.e., the computational state saved and the self-commander **24** deactivated. While self-commander **24** is deactivated, all commands and data self-commander **24** would have received from other components are saved. When self-commander **24** is reactivated to the last saved state, self-commander **24** may be sent all of these commands and data. A user may also specify which change commands it wants an instance of self-commander **24** to broadcast to other instances of self-commander **24** and other self-commanders **24**, and which change commands it wants the instance of self-commander **24** to listen for from other instances of self-commander **24** and other self-commanders **24**.

[0055] Services

[0056] With reference again to FIG. **2**, client-side services **26** and server-side services **40** receive commands, process the commands and sends back a response (e.g., data). Services may receive commands from commanders **22**, self-commanders **24**, message dispatcher **32** and system components **28**. Examples of client-side services **26** and server-side services **40** are input-output (**10**) services, such as a reader and writer for files (e.g., ASCII files and seismic files in different formats (e.g., segy, Landmark, Petrel, etc.)), and job services for executing and monitoring jobs generated by commanders **22** or self-commander **24** (e.g., to perform calculations for commanders **22** or self-commanders **24**). Client-side services **26** and server-side services **40**, generally speaking, are utilities that provide common operations that may be utilized by different commanders **22** and self-commanders **24**. Jobs may be a script (e.g., a Seismic UNIX (SU) script) of one or more operations executed by one or more client-side services **26** and/or one or more server-side services **40**. Jobs may be run in little time, e.g., micro-seconds or seconds, or may take substantial time, e.g., minutes, hours, days. Some jobs may require one or more server-side services **40** for running jobs on a cluster of servers or computers (which may or may not include server **14**). Client-side services **26** and server-side services **40** may assign each job and cluster job a unique job ID.

[0057] The following exemplary client-side services **26** may be provided as part of an embodiment of system **10**: a reader to read a local file in a given format; a writer to write a local file in a given format; a service to retrieve names of files in a directory (e.g., on client **12**); and, a job service to start a local job and monitor the local job progress. Local jobs typically are executed by one or more client-side services **26** running on the user machine (client **12**). In an embodiment, an instance of a client-side service **26** can only be started by a command from a commander **22** or self-commander **24**.

[0058] As with other components, client-side services **26** and server-side services **40** support message passing and computational state saving/restoring. Client-side services **26** and server-side services **40** may be consumers (and, for their responses, are in affect producers). Client-side services **26** and server-side services **40** include message handlers and message queues. Client-side services **26** and server-side services **40** may be suspended, i.e., the computational state saved and client-side service **26** or server-side service **40** deactivated. While client-side service **26** or server-side service **40** is deactivated, all commands and data client-side service **26** or server-side service **40** would have received from other components are saved. When client-side service **26** or server-side service **40** is reactivated to the last saved state, client-side service **26** or server-side service **40** may be sent all of these commands and data.

[0059] With continuing reference to FIG. **2**, the bulk of commands issued in system **10** (e.g., by commander **22** or self-commander **24**) are executed by client-side components **16**. However, some commands are executed on server **14**. In an embodiment, an instance of server-side service **40** can only be started by a command from commander **22** or self-commander **24**. The following exemplary server-side services **40** may be provided as part of an embodiment of system **10**: a reader to read a file from server **14** in a given format; a writer to write a file on server **14** in a given format; a service to retrieve names of files in a directory (e.g., on server **14**); and a job service to start a server job or a cluster job (e.g., a job executed on multiple servers or computers (a cluster)) and monitor the server job or cluster job progress. The job status may be passed as a message from server-side service **40** and displayed to a user through workbench, such as through commander **22** GUI. If commander **22** or self-commander **24** requesting a job terminates, server-side service **40** may continue the job until completed and then queue the job results for later delivery to commander **22** or self-commander **24** when restored. In the case of a job service requested by commander **22** or self-commander **24**, server-side service **40** may contain all of the intelligence for controlling and monitoring the requested job (e.g., computational process). Server-side services **40** that start and monitor a requested computational process (e.g., cluster jobs) are capable of handling requested processes for multiple commanders **22** and self-commanders **24** simultaneously.

[0060] In an embodiment, server-side services **40** may be implemented as servlets which can be invoked by servlet chaining using aliases. This servlet chaining may be implemented, for example, using servlet filters and/or Request-Dispatchers.

[0061] In an alternative embodiment, message passing between services (e.g., between two or more server-side services **40** or between two or more client-side services **26**) may be accomplished by having messages go directly from one service to the other and not through message framework **20**. Such message passing may avoid message passing overhead.

[0062] System Components

[0063] With reference again to FIG. **2**, system components **28** are client-side components **16** used to manage system **10** and the workbench (i.e., the virtual desktop). As discussed above, system components **28**, along with message dispatcher **32**, may issue commands to any other component (including other system components **28**). With reference now to FIG. **3**, in an embodiment, system components **28** include two components: workbench manager **42** and state manager **44**. Workbench manager **42** provides a user all workbench functionality through a GUI. Via workbench manager **42** GUI, a user may invoke client-side components **16**, such as commanders **22** and self-commanders **24**, save and restore sessions of the workbench (e.g., state of entire active virtual desktop, including each active component and its computational state), determine the version of the workbench being run, determine what components (e.g., commanders **22** and self-commanders **24**) are available, etc. See below for further discussion of workbench manager **42**.

[0064] State manager **44** saves or restores the state of a component and the entire workbench (which includes all active components in the virtual desktop and their state). State manager **44** may maintain each saved state in a session file (e.g., ending in .cfg) which state manager **44** manages. State manager **44** may handle component state information in XML. State manager **44** may save component state information as XML. Component state includes, e.g., component display name, component CID, what was displayed in component GUI, what parameters selected/input in component GUI, what modes selected, if viewer—how data is displayed, what data displayed, and where displayed, what processes being run, where component GUI displayed on workbench (e.g., on workbench canvas—see below), what jobs requested by component (including job IDs—see below), status of requested jobs, etc. Workbench state includes each saved component in workbench session and whether component is active or not (is component GUI open or not). In embodiments, session files are saved on server **14** using a server-side **10** service **40**. Since session files are saved on server **14** a saved workbench may be restored from server **14** and on any client **12** (e.g., a user running workbench application on client **12** may select a previously saved session even if that session was started and run on another client **12**). Session files may be saved in any file system accessible by server **14**. A workbench may be restored from any server **14** with access to the file system on which the state of the workbench is saved.

[0065] In an embodiment, a saved session file may be thought of as a state repository for the saved workbench session. When individual component states are saved, the component state is saved in the session file for the workbench. When the state of an entire workbench is saved, the state of each and every component instance active in the workbench is also saved. Also saved when the state of the entire workbench is saved is the "workbench state", i.e., an indication of whether a component instance that has a saved state in the session file is active or not (e.g., whether component GUI is displayed in workbench). In other words, for each saved component instance in the session file, state manager **44** determines whether that component instance is active. Later when the workbench state is restored, only those saved component instances that were active when the workbench state was saved are restored. Other component instances that were saved, but that were not active when the workbench state was saved, may be restored individually, e.g., by a user selecting the display name of that saved component instance in workbench manager **42** GUI and selecting restore. In an embodiment, whenever a workbench is closed, state manager **44** automatically saves the workbench state (i.e., the indication of which saved component instances were active and which were not active) in the workbench session file. So, for example, if a user starts up a workbench, activates a component instance, saves the component instance state, closes the component instance, and then closes the workbench, the session file will have the saved component instance state and an indication that the component instance was not active when the workbench was closed. If the workbench is restored, the saved component instance will be inactive. The user may then activate the saved component instances by restoring that component instance.

[0066] With continuing reference to FIG. **3**, through workbench manager GUI, a user may manipulate saved states within a session file. For example, a user may delete a saved state for a component, add a state for a new component, create a state for another instance of a component (a component clone), and restore state for a component. State manager **44** executes these requests.

[0067] Message Framework

[0068] With reference again to FIG. **2**, message framework **20** includes message dispatcher **34**, dispatcher connector **36** and servlet dispatcher **38**. Message dispatcher **34** receives and processes messages from system **10** components. Message dispatcher **34** routes a command message from the command producer (e.g., commander **22** or self-commander **24**) to the consumer (e.g., self-commander **24**, client-side service **26**, server-side service **40**, or message dispatcher **34**). The consumer processes the command, which results in a response (e.g., a data message(s)) being returned to message dispatcher **34**. If the consumer is a server-side service **40**, response message is passed to message dispatcher **34** through servlet dispatcher **38** and dispatcher connector **36**. Message dispatcher **34** routes the response message from the consumer to the producer. If there is an exception (error) while processing the request, an abnormal response is sent back to the producer by message dispatcher **34**. The producer determines how to handle the exception.

[0069] Message dispatcher **34** may be implemented as a separate program thread. Implementing message dispatcher **34** as a separate thread makes message dispatcher **34** highly efficient at processing messages. As with system **10** components, message dispatcher **34** includes a message handler and a message queue. When processing messages, message dispatcher **34** interprets the commands contained in the messages for routing purposes, thereby acting as a command interpreter. Message dispatcher **34** may, e.g., also: execute certain commands sent to it by commanders **22** and self-commanders **24**, e.g., send requesting component requested information maintained by message dispatcher **34** (e.g., information about registered components); route received server-side commands to servlet dispatcher **38** for message passing to and execution by server-side service **40**; route received commands to intended client-side component **16** consumer; "feed me your command stream"—send all commands to commanders **22** that requested to monitor the message framework **20** command stream (e.g., in order to be able to take certain actions when certain commands appear in the command stream); send change commands to self-commanders, e.g., to synchronize viewer displays (e.g., "synchronize cursor movement" or "synchronize scroll bar movement"). Such change commands may be directly routed to the consumer component identified in a message or may be routed based, e.g., on a routing matrix message dispatcher **34** constructs for broadcasting purposes (see discussion of Intercommunications below).

[0070] Message dispatcher **34** may be made aware of all available components during system initialization (i.e., start-up of workbench application on client **12**). For example, message dispatcher **34** may scan component JAR files for information (e.g., manifest file) about the components. Message dispatcher **34** may scan JAR files for this information so that it may provide the information to workbench manager **42** for populating workbench manager **42** GUI. Component JAR files include, e.g., executable code for the component and a manifest file, which includes the component's main class and component attributes (properties, display name). Workbench manager **42** may send a command to message dispatcher **34** saying "I want to know all available components". In response, message dispatcher **34** may scan the component JAR files and provide the component descriptor for each available component. Workbench manager **42** may populate menus and one or more trees (see below) with the available component display names. Later, when a component is activated, e.g., through workbench manager **42** GUI (e.g., user selects from menu), the component instance self-registers itself (and its message handlers—see below) by sending a message with its component's component descriptor to message dispatcher **34**. As components self-register, message dispatcher **34** forms a list of all components that are active.

[0071] With reference again to FIG. **2**, dispatcher connector **36** prepares messages for transmission over the Internet, or other network, to servlet dispatcher **38** on server **14**. Messages that are to be executed by server-side services **40** are routed to servlet dispatcher **38**. Servlet dispatcher **38** is the server-side counterpart of message dispatcher **34**. Servlet dispatcher **38** processes and interprets command messages and routes the messages to the appropriate consumer server-side services **40**. Server-side service **40** processes the command and returns a response (data) to servlet dispatcher **38**, which sends the response to message dispatcher **34**, through dispatcher connector **36**, for routing back to the producer. Dispatcher connector **36** may prepare a message for transmission over the Internet (to servlet dispatcher **38**) by serializing the message. Likewise, when dispatcher connector **36** receives response message from servlet dispatcher **38** over the Internet, dispatcher connector **36** may deserialize the message.

[0072] As shown in FIG. **2**, in embodiments of system **10**, message framework **20** may also include messaging manager **32**. Messaging manager **32** provides a messaging interface to message framework **20** for system **10** components. Instead of interacting directly with message dispatcher **34**, client-side components **16** and server-side components **18** send and receive messages through messaging manager **32**. Messaging manager **32** may include messaging methods used in system **10**. In an embodiment, messaging manager **32** and the messaging methods are the API interface for components of system **10**. A third-party developing a commercial component (e.g., a commercial commander **22** or self-commander **24**) designs their commercial component to interface to system **10** through messaging manager **32** and these message commands. Messaging manager **32** may provide the following services to system **10** components: manage components message queues; send component's request (command) messages to another component via message dispatcher **34**; register and unregister component with message dispatcher **34**; retrieve information maintained by message dispatcher, e.g., data about a registered component; test for features of a message; route a response to a request to the request sender (producer). Messaging manager **32** may register a component with message dispatcher **34** by sending the component's component descriptor to message dispatcher **34**. The component descriptor includes an identification of component's message handler (hosted by messaging manager **32**) and a unique, system-wide ID (CID).

[0073] In the embodiment shown in FIG. **2**, there is logically one messaging manager **32**, but programmatically there are two messaging managers **32**, one on client **12** and one on server **14**. Each messaging manager **32** actually may include different methods that client **12** or server **14** can call. Logically, the messaging managers **32** handle communications between the dispatchers (message dispatcher **34** or servlet dispatcher **38**, respectively) and components.

[0074] In an embodiment, each system **10** component, when launched/instantiated, has its own instance (copy) of messaging manager **32**. Each component's messaging manager **32** includes the component's message handler and message queue. The message handler manages the component' message queue. For example, the message handler contains the queue and methods to operate on the queue, including enqueue (put a message on the queue) and dequeue (take a message off the queue) messages. Messaging manager **32** also has higher level methods to send and receive messages which go through the message handler to perform the operations.

[0075] When message dispatcher **34** routes a message to a component, message dispatcher **34** uses that component's message handler to put the message on the component's queue (e.g., hosted by component's copy of messaging manager **32**). When a component sends a message, the component forms the message, which contains the target consumer of the message, and calls a send method in the component's messaging manager **32**, which in turn calls message dispatcher's **34** message handler to put the message on message dispatcher's **34** queue. Message dispatcher **34** takes the message off the queue (dequeue the message) and routes the message to the consumer component, using consumer component's message handler to put the message on the consumer's queue (which is hosted by consumer's messaging manager **32**).

[0076] Consequently, in embodiments described herein, all components have a message handler to manage their message queue. Communication is through the message handlers which contain the message queue and are hosted by messaging manager **32**. A component's messaging manager **32** include send/receive methods which enqueue/dequeue messages using a message handler. Each component includes its own messaging manager **32** which contains that component's message handler.

[0077] One possible exception to this typical arrangement is for system components **28**. System components **28** may host their own message handlers and message queues and may interact directly with message dispatcher **34**. This is indicated in FIG. **2** with the dashed lines surrounding messaging manager **32** facing system components **28**. Consequently, in such an embodiment, each system component **28** interacts with message dispatcher **34** through messaging manager **32**, except for system components **28**, which may directly interact with message dispatcher **34**. Other embodiments include system components **28** interacting through messaging manager **32** some times and directly with message dispatcher **34** other times.

[0078] In an embodiment, much of system **10** may be provided to users under an open source license. In such an embodiment, message dispatcher **34**, dispatcher connector **36**, servlet dispatcher **38**, core commanders **22**, core self-commanders **24**, core client-side services **26**, core server-side services **40** and system components **28** may be provided under an open source license. However, such an embodiment may present licensing and ownership issues for commercial components. If a commercial component provided separately were to interact directly with message dispatcher **34**, certain open source licenses would require the commercial component to also be open source licensed. However, messaging managers **32** may be provided under a Berkeley BSD license, which circumvents this issue (under some open source licenses, a component interacting through a BSD licensed component to open source licensed components is not required to be open source licensed). Consequently, by interacting through BSD-licensed messaging managers **32**, commercial components would not be required to be open source licensed. Likewise, in embodiments that are not provided to users under an open source license, messaging managers **32** may be omitted. In such embodiments, components would host their own message handlers and message queues.

[0079] Message Passing

[0080] As indicated herein, with continued reference to FIG. **2**, normal communication between components follows a request/response paradigm. A command or data is sent in a request message and data is returned in a response message. The requesting component which generated the request message is referred to as a producer. The responding component which receives the request message and generates the response message is referred to as a consumer.

[0081] However, exceptions to this paradigm occur. For example, an exception occurs when message dispatcher **34** a synchronously feeds its command stream as data to a monitoring commander **22** or self-commander **24**, sends change messages so marked to all viewer self-commanders **24** or asks a component for the component's state. In each case, message dispatcher **34** has a list of intended receivers.

[0082] In an embodiment, communication between any two system **10** components is implemented using message handlers and message queues. Each component implements a defined message handler interface. As described above, client-side components **16** and server-side components **18** may implement their defined message handler interface in their messaging manager **32** copy. Components register their message handler instance with message dispatcher **34**. As described above, messaging manager **32** may perform this service. In response, message dispatcher **34** returns its component descriptor, which contains message dispatcher's **34** message handler instance to the registering component.

[0083] Using the message handler of message dispatcher **34**, each component can add to messages to the message dispatcher **34** message queue (e.g., enqueue). Messaging manager **32** (i.e., message handler included in messaging manager **32**) passes the message to message dispatcher **34** message handler with appropriate add message. Message dispatcher **34** determines consumer component and passes message to consumer component's message handler, which adds message to consumer component's message queue (hosted with message handler in consumer component's messaging manager **32**).

[0084] In an embodiment of system **10** implemented using Java 5.0, a Java 5.0 concurrent queue class (e.g., ConcurrentLinkedQueue) is used to implement the message queues. This is a particularly appropriate class given numerous concurrent components will share access to common message queues (numerous components may concurrently access other component's message queues through messaging manager **32** and message dispatcher **34**, along with message dispatcher's **34** message queue). In this embodiment, each item in a queue is an instance of the class QiWorkbenchMsg. The following is an exemplary set of methods for enqueuing and dequeuing messages:

```
interface IMsgHandler {
    // allow someone to send me a message
    public void enqueue(QiWorkbenchMsg);
    // get the next message sent to me for processing
    private QiWorkbenchMsg dequeue( );
}
```

An embodiment may have a concrete implementation of this interface, e.g., ConcurrentMsgHandler, that defines the queue and details of the two methods (enqueue and dequeue) that operate on it. It is sufficient that every component have one message handler. As shown above, message dispatcher **34** can send a message by calling the message consumer's enqueue( ) method (through consumer's message handler). Likewise, a component can get messages sent to it from its message queue by calling its dequeue ( ) method.

[0085] Upon activation of a component instance, when messaging manager **32** registers a component's message handler with message dispatcher **34**, the registration message also includes a component descriptor, as stated above. The component descriptor may include a unique component ID (CID) and component type (e.g., whether a commander **22**, self-commander **24**, or client-side service **26**, and what type of commander **22**, self-commander **24** (e.g., 2D viewer) or client-side service **26** (e.g., a IO service)), the component's message handler, and the components display name. The CID is a system-wide identifier for the component. In an embodiment, message dispatcher **34** keeps this information in a hash table keyed on the CID. As noted above, a component's registration causes message dispatcher **34** to return message dispatcher's **34** message handler. After every component is registered, all components can communicate with each other using message dispatcher **34**, which accordingly knows all component message handlers.

[0086] When enqueue( ) or similar method is executed, the method not only adds the message to the specified message queue, but may also invoke a callback method, notify ( ), which wakes up the consumer component thread. The consumer component then processes the message, generating and sending a response, and checks for more messages in the queue. If there are no messages in the message queue, the component puts itself to sleep until the next message arrives. Other embodiments may have other mechanisms for informing a consumer that a message has been added to its queue. For example, a consumer component may monitor its queue.

[0087] Component Intercommunications

[0088] With reference again to FIG. **2**, as noted above, system **10** components interact via messages. Exemplary interactions are illustrated with the message paths in FIG. **2**. Normally, this interaction occurs by one component, a producer component (e.g., commander **22**), sending a message to another component, a consumer component (e.g., self-commander **24** or client-side service **26**). However, there are times when component (e.g., commander **22** or self-commander **24**) listens for certain messages from other components and reacts to these messages. For example, in an embodiment, a viewer self-commander **24** may be instructed by the user to listen for specific data, window and/or layer change messages from an internal window or layer within a window. The user separately instructs the internal window or layer within a window to broadcast the data, window and/or layer change messages. Similarly, a monitor commander **22** may be so instructed.

[0089] Each commander **22** and self-commander **24** GUI may provide a menu for each category of messages to be broadcasted. The user can instruct the component to broadcast a class of messages to ALL other components or selected components. Likewise, the user can instruct the component to listen for specific messages in each category. These selections are conveyed in a message to message dispatcher **34**, which constructs a routing matrix of the selected components. The user can change the selections at any time, causing the routing matrix to be updated.

[0090] Additionally, a component can control routing and listening programmatically. For example, commander **22** or self-commander **24** may tell message dispatcher **34** for what commands commander **22** or self-commander **24** wants to listen; message dispatcher **34** will construct a routing matrix and route the specified commands to the requesting commander **22** or self-commander **24**. Commander **22** or self-commander **24** may also programmatically turn on the commander **22** or self-commander **24**'s own broadcasting. Commander **22** or self-commander **24** may then ask message dispatcher **34** for a list of active components and tell another component, that commander **22** or self-commander **24** wants to interact with, to turn on that component's broadcasting. Commander **22** or self-commander **24** may tell the other component to turn on its broadcasting by sending a command to the other component instructing the other component to listen for certain commands and to broadcast to the producing commander **22** or self-commander **24**. Each component generates and marks the commands that component wants message dispatcher **34** to route. Such commands are marked by a 'route' flag.

[0091] See "Messages" and "Commands" below for further description of messaging and commands.

[0092] Virtual Desktops (Workbenches)

[0093] With reference now to FIG. **4A**, shown is a screen shot illustrating an embodiment of a virtual desktop, workbench **50**. Workbench **50** may appear as a window on client **12** desktop **60**. Workbench **50** provides the graphical environment in which system **10** components run and are interacted with by users. Indeed, components, including commanders **22** and self-commanders **24** may generate their own GUIs (e.g., a window) that are displayed within workbench **50**, enabling users to interact with and to instruct the component (e.g., input parameters and select options). A user may have multiple workbenches (virtual desktops) **50** open simultaneously on a client **12**. In an embodiment, the user may switch between workbenches **50**, but only one workbench **50** may be active at a given time. In an embodiment, each workbench **50** represents a separate user session. Accordingly, in such embodiments, communication between workbenches **50** is not supported. In an alternative embodiment, communications between workbenches **50**, and components in the different workbenches **50** may be supported. Any GUIs within workbench **50** may be resized, minimized/maximized, moved, etc., and workbench **50** itself may be resized, minimized/maximized, moved, etc.

[0094] In an embodiment, workbench **50** includes menu bar **52**, canvas **54**, navigation tree **56** and dataset analysis tree **58**. Menu bar **52** and component/navigation tree **56** together form the GUI of workbench manager (workbench manager GUI) that is used for managing the overall workbench **50** and system **10** environment, as discussed in more detail below. Canvas **54** is the "working" window or frame of workbench **50**. Canvas **54** is where component GUIs are displayed. Viewer self-commanders **24** display windows, in which viewers graphically render data that are displayed in canvas **54**. Multiple component GUIs and viewer display windows may be displayed simultaneously in canvas **54**. Likewise, multiple copies of a component (e.g., commander **22** or self-commander **24**) may be launched in a workbench **50** instance and corresponding GUIs and display windows displayed in canvas **54**.

[0095] Dataset analysis tree **58** is a directory tree that includes a listing of previously performed data analyses (e.g., results of computational algorithms and other operations performed on sets of data by commanders **22**). Such data analyses listed in dataset analysis tree **58** may be stored in files in a folder on client **12** and/or server **14**. Dataset analysis tree **58** may list data analyses under collapsible/expandable folder paths indicating the location of the folder and the files. Dataset analysis tree **58** may include multiple folder paths listing files in multiple folders on client **12** and/or server **14**.

[0096] As noted above, multiple workbenches **50** may be active on client **12** simultaneously. As with system **10** components, the entire workbench **50** has state saving/restoring capabilities. Each active workbench **50** running on a client **12** may be suspended and restored, as discussed below in detail. In embodiments, when system **10** is launched, the last suspended workbench **50** may be restored to its previous saved state and re-opened as a default setting. A user may also choose at any time to restore and open any previously suspended workbench **50** to its previously saved state. The user may also choose to restore a currently active workbench **50** to its previously saved state. This, in affect, resets active workbench **50** to its previously saved state.

[0097] System **10** provides a desktop environment, workbench **50**, that may be used for a variety of purposes. The uses of a given implementation of system **10** are generally determined by the components, particularly commanders **22** and self-commanders **24**, that are included with the implementation. In an embodiment, system **10** provides a desktop environment for performing analysis (e.g., quantitative interpretation) of seismic and other data.

[0098] Workbench Manager GUI

[0099] With continued reference to FIG. **4**A, an embodiment of the workbench manager GUI is menu bar **52** and navigation tree **56** portion of workbench **50**. As noted above, a user may access all workbench **50** functionality through workbench manager GUI. Through workbench manager GUI, a user may invoke system **10** components (commanders **22** and self-commanders **24**), save and restore sessions (e.g., workbench **50** and components' state), determine what commanders **22** are available, etc.

[0100] Navigation or component tree **56** is a window pane in workbench **50** containing a directory tree of available components, including commanders **22** (e.g., listed as "plugins" in FIG. **4**A), self-commanders **24** (e.g., listed as viewers) and services (client-side services **26** and server-side services **40**—not shown), for workbench **50**. Such components (core or commercial) are available if they are installed on client **12**. The root of navigation tree **56** may be a display name of the particular workbench **50** (e.g., "desktop1") or the current project name. Tree **56** may include a root node for each available commander **22** or self-commander **24** (e.g., "plugin: Amplitude Extraction", "viewer: BHP2D"). Note, in the embodiment illustrated by FIG. **4**A, self-commanders **24** are all viewer self-commanders **24**.

[0101] With reference now to FIG. **4**B, active instances of commander **22** or self-commander **24** may be displayed as tree sub-nodes **62** in navigation tree **56**, and have an assigned display name, which may be a unique name (e.g., "Amplitude Extraction#3" or "BHP2D#6"). Each component instance will have a unique internal name. In embodiments, each component instance's display name is initially set to the internal name. However, a user may change the display name. When state is restored, the display name is as saved, even if no longer the same as the internal name. The user may rename the subnode. The display name for a component instance (e.g, commander **22** or self-commander **24**) that has been suspended (state saved and quit) may be shown highlighted (e.g., shown in purple). Any active service instance (e.g., client-side service **26** or server-side service **40**) started by a commander **22** or self-commander **24** instance is displayed as a subnode of the commander **22** or self-commander **24** instance subnode (e.g., "service: writeLocalFile" beneath commander **22** instance "myCommandMonitor#1"). The active service subnode disappears when the service completes (normally or abnormally). Double-clicking on an available component name starts a new instance of that component and an instance subnode appears in the tree beneath the component name. Double clicking on a suspended component instance name restores that component instance.

[0102] As shown, GUIs **64** and **66**, for the active instances of Amplitude Extraction commander **22** and BHP2D viewer self-commander **24**, respectively, corresponding to the displayed subnodes in navigation tree **56** are displayed in canvas **54**. Also shown in FIG. **4**B are active BHP2D viewer self-commander **24** displays **68**. A user may open more than one viewer display **68** for an active viewer self-commander **24**. As shown and discussed above with reference to FIG. **2**, command messages may be sent by viewer self-commander **24** to itself. These command messages may go from viewer self-commander **24** GUI thread to viewer self-commander **24** display thread ("visualizer"). The command messages may include messages launching the display thread, passing selected data for display, manipulating the display per user selections, and other common display controls.

[0103] With continued reference to FIGS. **4A-4B**, workbench manager **42** GUI also includes menu bar **52**. In an embodiment, menu bar **52** may include the following pull-down menus, which are displayed when selected: workbench, component, service and help. Component pull-down menu includes sub-menus which may be separated into commander **22** and self-commander **24** sections.

[0104] The workbench menu may include the following selections: New, for starting a new virtual desktop (workbench **50**); Open, a submenu for restoring a saved workbench **50** (by opening saved workbench session file); Save As, for saving current workbench **50** state (by saving a clone/copy of workbench session file)—first time a workbench **50** state is saved, dialog asks for location and name for session file (e.g., .cfg file); Save, Quit, for saving current workbench **50** state and quitting (terminating workbench **50**); Quit, for quitting (may display dialog asking if want to save state); Rename, for renaming current workbench **50**; and Preferences, for setting workbench preferences. The Restore submenu lists all workbenches **50** the user has previously saved (i.e., saved the state of), which may include current workbench **50**. Restoring current workbench **50** refreshes current workbench **50** to a previously saved state (see discussion above under state manager **44**). Selecting New may open a dialog window that asks the user if they want to save, close (save+quit) or quit current workbench **50**. Selecting Rename opens a dialog window in which the display name of current workbench **50** (root node of the component tree) can be changed. Workbench menu may also include a Delete selection to delete a saved workbench session file.

[0105] Preferences are configuration settings for workbench **50** set be a user for the user's workbench sessions. For example, the user may specify a default server **14**, default project and/or default workbench **50**. While defaults are set, each new workbench application session will automatically launch with those settings. A default workbench **50** may be any workbench **50** previously saved by user. A default project is a previously saved project. A project is folder that may include one or more saved workbenches **50**. It is generally up to the user what is saved in the project folder. For example, a project may correspond to a real-world project (e.g., a drilling project, a well site, etc.). Workbenches, saved state (session) files (save sets), saved data files (data sets), etc., related to the project may be organized and saved in a project folder. A default server **14** is simply server **14** on which system **10** operates (i.e., which hosts server-side components **18** and from which workbench **50** may be launched). System **10** may operate from a plurality of servers **14**. Projects and workbenches **50** are saved on servers **14**.

[0106] In embodiments, component menu provides selections for managing commanders **22** and self-commanders **24**. In embodiments, Component menu includes a Register selection, for registering a commander **22**, an Update submenu, a New submenu, a Open submenu, a Save submenu, a Save As submenu, a Save+Quit submenu, a Quit submenu, a Rename submenu, and a Delete submenu. Selecting Register causes a component registration dialog window to pop-up. This registration refers to the registration of a component with system **10**, not registration of a component instance with message handler **32** upon launching of the component instance. Only components officially registered (authenticated) with system **10** are available to the user. Generally, core components that are provided with workbench application are automatically registered with system **10** and do not need to be registered by a user. Consequently, in embodiments, only commercial components are available for registering with system **10**. The Update submenu displays a list of all available components (e.g., commander **22** or self-commander **24**). In an embodiment, core components are automatically updated upon system **10** startup and are not available for updating by user (i.e., not displayed in Update submenu). Selecting an available component in the list causes an update dialog window to pop-up. The update dialog window enables the user to update the selected component, replacing an existing available component with a newer version of component.

[0107] The New submenu also displays a list of all available components; selecting an available component starts a new instance of the selected component. The Open submenu is a list of all component instances the user has previously saved (i.e., saved the state of) that are inactive; selecting a saved, inactive component instance causes that component instance to be restored (i.e., opened to component's saved state (e.g., from saved session file)). In an alternative embodiment, the list of saved components instances may include active components; opening an active component refreshes it to a previously saved state. The Save submenu, the Save+Quit submenu, the Quit submenu and the Rename submenu each provide a list of all active components, selectable for saving the selected active component state in workbench session file, saving the selected component state and closing the selected component, closing the selected component and renaming the selected component, respectively. The Save As submenu allows the state of an active component instance to be saved as a clone (new instance), given a unique name, and a new clone instance of component opened in canvas **54**. Display name of an active component in tree **56** may be changed via rename. The Delete submenu provides a list of all saved component instances and allows a user to select and delete a saved component instance from a session file. Component menu may also include menu selections for uninstalling available components, checking for updates, downloading new components, etc. In embodiments, such selections are usually limited to commercial components.

[0108] With continued reference to FIGS. **4A-4B**, service menu includes selections for Status and Quit submenus. Each of these submenus includes a list of all active client-side services **26** and server-side services **40**. Selection of a service in the status submenu displays the status of the service in a dialog window. Selection of a service in the quit submenu terminates the service.

[0109] With reference again to FIGS. **4A-4B**, clicking on the workbench name or a component name in navigation tree **56** displays a context menu pop-up for the selected item. The content of the context pop-up may depend on the state of the selected workbench **50** or component. Selecting the workbench name displays a workbench context menu, which includes selections for opening, saving as, saving+ quitting, quitting and renaming current workbench **50**. The name of current workbench **50** may denote project or subproject. The restore selection only appears if workbench's **50** state has been saved. Restoring workbench **50** refreshes it to its previously saved state.

[0110] Component context pop-up menus include selections for opening a new instance of, opening, saving, saving as, saving+quitting, deleting, quitting and renaming the selected component. If the selected component is a suspended instance, the context pop-up menu includes selections for activating a new instance of, opening (restoring) or renaming the selected component. The opening selection only appears for a selected component if its state has been saved. In an alternative embodiment, the opening selection may also appear for active components may also; opening an active component refreshes the component to its previously saved state.

[0111] The service context menu includes selections for status and quitting. If the selected service is active, its status may be queried. An active service may be quit (terminated). Quitting a service removes it from component navigation tree **56**.

[0112] Workbench Manager

[0113] With reference again to FIG. **3**, workbench manager **42** may communicate with servlet dispatcher **38** to determine what components (e.g., commanders **22** and self-commanders **24**) are available. For example, when workbench manager **42** is launched (i.e., on start up of system **10** on client **12**), workbench manager **42** sends a message to servlet dispatcher **38** requesting a list of the available commanders **22**. This list is used to populate workbench manager GUI (see FIGS. **4A-4B** above). List items may be component descriptors. The list of available commanders **22**, and the associated information, may be stored on server **14** in a file or files. For example, the information for the list may be stored in JAR files. The list may be generated by servlet dispatcher **38** scanning the manifest of commander JAR files. The manifest includes various commander **22** attributes, may include the display name, main method name (for launching instance of component), and type of component. The generated list is provided to workbench manager **42**, upon request, for populating workbench manager's menus and component tree. The same procedure may be followed by workbench manager **42** to get a list of available self-commanders **24**, and similar information may be provided.

[0114] As discussed above with reference to FIGS. **4A-4B**, the workbench manager GUI may display selections to register and update a component. If register is selected, a dialog window pops up in which the user specifies the (display) name of component and where component is located, e.g., website from which component may be downloaded (as mentioned above, in embodiments, core components are generally automatically registered and generally do not need to be registered with system or updated by user—launching workbench will update core components). This information is sent to message dispatcher **34** which fetches (downloads) the commander attributes (e.g., the JAR file), saves component in a directory and adds the component profile information to a persisted list of components. The persisted profile information about component may include commander's display name, a URL of the component's attribute file (e.g., component JAR file), etc. The component attribute file (e.g., the JAR file) may then be dynamically loaded on client **12**. Once dynamically loaded, an instance of new component may be launched in workbench. Updating component works the same way except a new component installation file (e.g., a new JAR file) is fetched which replaces the old one. Persistent storage of component profile information may be a component database, such as, e.g., Hibernate or HSQLDB on client **12**. The above describes one exemplary mechanism for obtaining new commercial components. Other mechanisms may be used. For example, a user may manually obtain and install a new component, with registration being completed next time workbench is launched.

[0115] If the registration/updating of commander **22** (or self-commander **24**) is successful, the display name of commander **22** (or self-commander **24**) is added to or update in the commander (or self-commander) menu.

[0116] Messages

[0117] With reference again to FIG. **2**, as mentioned above, each active component of the system has a unique, system wide identifier called the component ID (CID). In an embodiment, CIDs are carried in each message so the producer of a message and the target consumer of a message are uniquely identified. In an embodiment, a CID may be a component's fully qualified Java name (the method which will instantiate an instance of the component), which is unique across the application, e.g., package.class followed by a unique number for different multiple instances.

[0118] Each message also has a unique system wide identifier called the message ID (MSGID). The MSGID is set by the producer of a request message and is carried in each response message so the producer can distinguish responses from multiple requests, especially requests to the same consumer such as a client-side service **26**. One possible MSGID is a timestamp of when the request message was generated.

[0119] In an embodiment, a message is an instance of Java QiWorkbenchMsg class, a serializable object, with the following attributes:

- **[0120]** Producer ID—the CID for the producer of a message. Used by message dispatcher **34** to know where to direct a response message.
- **[0121]** Consumer ID—the CID for the consumer of a message. Used by message dispatcher **34** to know where to direct a request message.
- **[0122]** Message kind. May include:
  - **[0123]** CMD, message is a command to be sent to its designated consumer.
  - **[0124]** CMD_ROUTE, message is a command to be routed to other agents as determined by message dispatcher **34** routing matrix.
  - **[0125]** DATA, message is information to be returned to its designated producer.
  - **[0126]** DATA-CMD, message is a command to be treated as data, not to be executed.
- **[0127]** Command—a command to be executed by the recipient of the message; usually, a string.
- **[0128]** Message ID—the MSGID.
- **[0129]** Content type—data type of the message content, usually expressed as a string.
- **[0130]** Message content—an object. If the message is a command, the object is its argument(s). If the message is data, the object is the data.

[0131] If the message is a command, the Command attribute is not the full command. The command argument(s) are contained in the Content attribute. The reason for this is that it would not be efficient to completely represent a command as a string, as when, for example, an argument is an instance of a class, i.e., an Object. The bulk of message passing is on client **12**, so the message object can be passed as a parameter in a Java method. When the message object is sent to servlet dispatcher **38** running on a remote machine, the message object may be serialized into XML, e.g., using XStream (see http://xstream.codehaus.org), by dispatcher connector **36**. The XML is received and deserialized into an object by servlet dispatcher **38**. Alternatively, system **10** could use a Java Serialization API to flatten an object to a byte file and restore it to an object from the byte file. In this case, both the message and the message content must be serializable objects. To use the objects, they must be cast to their correct type.

[0132] Journaled commands may be serialized into XML, e.g., using XStream. A serialized command script file therefore consists of a sequence of commands in their XML representation.

[0133] Consumers of a command message may decode a command, e.g., by calling methods in a Java CommandDecoder class. The consumer of the message must know the data type of the message content in order to process it; it is up to the consumer to cast the object to its data type. The content's data type is carried with the message for cases where it necessary to distinguish the type.

[0134] In order for a producer of a command to be able to identify returned responses (the producer may have sent out multiple commands), the producer must set the MSGID of a command and maintain a list of commands by MSGID for which the producer is waiting for a response. A response will carry the request's MSGID. The MSGID also serves to distinguish responses from different consumer instances such as a service. For example, a commander **22** or self-commander **24** may request three (3) different files be read by a reader server-side service **40**. The returned messages containing the files would have a different MSGID the producer can use to determine which read request the response matches.

[0135] Commands

[0136] With reference again to FIG. **2**, commands are produced by commanders **22**, self-commanders **24**, message dispatcher **34**, and workbench manager **42**. The following is a summary of different exemplary commands that may be generated by an embodiment of system **10**:

[0137] Commander **22** Commands:

- **[0138]** Ask message dispatcher **34** for list of available services. For commander **22** (or self-commander **24**) to know the CID of a target client-side service **26** or server-side service **40**, commander **22** may ask message dispatcher **34** for a list of available services. Each list item contains the CID of a service and a description of the service so commander **22** can distinguish between services.
- **[0139]** Instruct service to perform specified service—instructs client-side service **26** or server-side service **40** to perform service.
- **[0140]** Monitor message dispatcher **34** command stream (instructs message dispatcher **34** to send commands received by message dispatcher **34**).
- **[0141]** Refresh viewer self-commander **24** displays—instructs viewer self-commanders **24** to refresh displays.
- **[0142]** Tell me the state of a service—instructs client-side service **26** or server-side service **40** to provide state of service (e.g., in-progress, complete, stalled, etc.).

[0143] Self-Commander **24** Commands:

- **[0144]** Synchronize cursor on viewer self-commander **24** display; target consumer is corresponding viewer self-commander **24**.
- **[0145]** Synchronize scroll bar on viewer self-commander **24** display; target consumer is corresponding viewer self-commander **24**.
- **[0146]** Read a file—instructs reader client-side service **26** or server-side service **40** to read a file, provide data from file to self-commander **24**.
- **[0147]** Write a file—instructs writer client-side service **26** or server-side service **40** to write a file.
- **[0148]** Get list of other self-commanders **24** (e.g., other viewers) (from message dispatcher **34**).
- **[0149]** Get the CID of my display visualizer (if display visualizer of viewer self-commander **24** has separate CID, gets CID of corresponding display visualizer from message dispatcher **34**).

[0150] Common Component Commands:

- **[0151]** Register/Unregister me (sent to message dispatcher **34** to register or unregister producer component (e.g., commander **22**, self-commander **24** or client-side service **26**)). Includes, e.g., CID, type of component, description, display name.
- **[0152]** Send me component descriptor of a component which contains component message handler (sent to message dispatcher **34**).
- **[0153]** Save my state (sent to state manager **44** to save state of component).
- **[0154]** Restore my state (sent to state manager **44** to restore state of component).
- **[0155]** Get me a list of files in a directory
- **[0156]** Report an error in processing of request

[0157] Message Dispatcher **34** Commands:

- **[0158]** Give me the list of server-side services **40** (sent to servlet dispatcher **38**).
- **[0159]** Give me the list of available components (e.g., commander **22**, self-commander **24**, client-side service **26** or server-side service **40**) (sent to servlet dispatcher **38**).
- **[0160]** Give me a list of jobs and cluster jobs and their status (sent to servlet dispatcher **38** to request list of jobs being performed by server-side services **40** and status of jobs).
- **[0161]** Give me job/cluster job status (sent to servlet dispatcher **38**).
- **[0162]** Give me a list of saved virtual desktops (workbenches **50**) (sent to servlet dispatcher **38**).

[0163] Workbench Manager **42** Commands:

- **[0164]** Save desktop state (saves selected workbench **50** state)—sent to state manager **44**.
- **[0165]** Save desktop state and quit application (saves selected workbench **50** state and closes application (i.e., all active workbenches **50**, components, message framework **20**, etc.))—save command sent to state manager **44**, quit command sent to message dispatcher **34**.
- **[0166]** Start a saved desktop (restores a saved workbench **50**)—sent to state manager **44**.
- **[0167]** Quit application.
- **[0168]** Register new commander **22** or self-commander **24** (e.g., register new commercial component with system **10**).

[0169] Update commander **22** or self-commander **24** (e.g., update commercial component).

[0170] Launch commander **22** (starts commander **22** instance thread)—sent to message dispatcher **32**.

[0171] Launch self-commander **24** (e.g., a viewer) (starts self-commander **24** instance thread)—sent to message dispatcher **32**.

[0172] Kill commander's **22** (or self-commander **24**) computational process—interrupts and terminates commander's **22** (or self-commander's **24**) computational process —sent to message dispatcher **32**.

[0173] Activate yourself (activates and displays component GUI in workbench **50**)—sent to commander **22** or self-commander **24**.

[0174] Deactivate yourself (deactivates and closes component GUI in workbench **50**)—sent to commander **22** or self-commander **24**.

[0175] Give me a list of active components (sent to message dispatcher **34**). Server-side services **40** are always active.

[0176] Give me a list of non-active available commanders **22** (or self-commanders **24**) (sent to message dispatcher **34**).

[0177] Give me a list of non-active local services (client-side services **26**) (sent to message dispatcher **34**).

[0178] Give me a list of non-active viewers (i.e., viewer self-commanders **24** (sent to message dispatcher **34**).

[0179] Give me status of a job or cluster job (sent to message dispatcher **34**).

[0180] State Manager Commands:

[0181] Give me your state (sent to component (e.g., commander **22**, self-commander **24** or client-side service **26**) to request state of component).

[0182] Save component state (sent to servlet dispatcher **38** via message dispatcher **34** to request that state of component instance be saved). Parameters may include, e.g.: CID for component, state of component, user id and desktopName (name of virtual desktop in which component instance is running).

[0183] Get saved component state (sent to servlet dispatcher **38** via message dispatcher **34**). Parameters may include, e.g.: CID for component, user id and desktopName (name of virtual desktop in which component instance is running).

[0184] Launching Workbench System

[0185] With reference again to FIG. **2**, the workbench application implementation of system **10** is a client-server application. Embodiments of the workbench application run under the Tomcat Web Servlet container. Server **14** (e.g., a Tomcat server) runs either remotely on a separate machine or locally on the user's machine (i.e., on same machine as client **12**). In an embodiment, each component comprising the application is a separate thread which performs its own initialization.

[0186] In an embodiment, server-side components **18** are server-side services **40** (e.g., servlets) and servlet dispatcher **38**, as discussed above. In an embodiment, servlet dispatcher **38** either knows about all server-side services **40** or can learn about them if each is packaged in, e.g., separate JAR files with manifest files itemizing their properties. If the latter, the JAR files may be stored in a library directory (e.g., "lib" directory stored on server **14**), from which servlet dispatcher **38** can access and scan the manifest files. The manifest files contain a property that identifies the JAR file as for a server-side service **40**. In a similar manner, servlet dispatcher **38** can learn about available core client-side components **16** (commanders **22**, self-commanders **24** and client-side services **26**). Message dispatcher **34** may learn about commercial components installed on client **12**.

[0187] In an embodiment, once system **10** is deployed to server **14** (e.g., Tomcat), the user may accesses a main installation web page of system **10** via a browser which contains a Java WebStart™ link. For example, a user may enter a Universal Resource Locator (URL) for the installation web page of system **10** into a web-browser (e.g., Internet Explorer™ (IE), Firefox™, Opera™, Safari™, Netscape Navigator™) and follows specified steps provided by installation web page to install application, including client-side components **16**, onto client **12**. Client-side components **16** only need be installed once (e.g., using this link)—once installed, for example, a WebStart desktop icon may be created on client's **12** desktop (e.g., client desktop **60**—see FIG. **4**A). Thereafter, the user can launch/start the workbench application (access system **10**) on client **12** using the WebStart desktop icon. Client-side components **16** provided with installation of system **10** are saved and loaded on client **12**. Client-side components **16** may also be packaged in, e.g., separate JAR files with manifest files itemizing their properties. JAR files, downloaded and saved on client **12** during installation may be stored in a library directory, from which workbench manager **42** can access and scan the manifest files. In embodiments, primary copies of core client-side components **16** are maintained on server **14**. When application is installed on client **12**, executable copies of client-side components **16** are downloaded and saved on client **12**. Instances of client-side components **16** are launched from these copies. However, in embodiments, servlet dispatcher **38** may more readily locate and obtain information from the primary copies on server **14**.

[0188] Launching the workbench application (e.g., directly from a system **10** website or by clicking WebStart desktop icon) starts execution of the workbench manager's **42** initialization routine. With reference now to FIG. **5**, shown is a flowchart illustrating the initialization routine, an embodiment of method **70** for providing a graphical web-based workbench environment with intelligent plug-ins. Workbench manager **42** may determine if user has set a default server (see preferences above, with reference to FIGS. **4**A-**4**B) (block **72**). If not, workbench manager **42** starts dialog with user (e.g., display server dialog GUI requesting user select or enter server **14**) and receive user server selection (block **74**). Workbench manager **42** connects to default or selected server (block **76**). Workbench manager **42** may determine if user has set a default project (see preferences above) (block **78**) and, if not, start dialog with user (e.g., display project dialog GUI requesting user select or enter project) and receive user project selection (block **80**). Workbench manager **42** opens selected/default project folder on server **14** (block **82**). Workbench manager **42** may determine if user has set a default workbench (block **84**) and, if not, determine if user has any suspended (saved) workbenches **50** (block **86**). If the user does not have a default workbench **50**, but, has any suspended workbenches **50**, the latest one may be automatically restored; otherwise, a new workbench **50** is created (block **88**). In an embodiment, a default or new workbench **50** may be instantiated with a Java webpage invocation using a URL that points to Java code on server **14** that invokes workbench **50** as shown in FIG. **4**A. If restoring default or suspended workbench **50**, saved states of workbench **50** and active components are obtained from server **14** to further populate workbench **50**. If there are any saved data sets in open project folder, they may be displayed in dataset analysis tree **66**.

[0189] Workbench manager **42** starts up message framework **20**, specifically starting message dispatcher **34** thread and calling message dispatcher's **34** initialization method (block **90**). The workbench manager **42** receives message dispatcher **34** component descriptor, which includes message dispatcher's **34** message handler, when instantiating message dispatcher **34**. Afterwards, workbench manager **42** registers itself and its message handler with message dispatcher **34** (block **92**). Message dispatcher **34** asks servlet dispatcher **38** for a list of all server-side services **40** and available components (e.g., commanders **22** and self-commanders **24**) (block **94**). In response to this request, servlet dispatcher **38** may scan for available core components, e.g., by scanning JAR files looking for available components (e.g., commanders **22** and self-commanders **24**) (block **96**). In this manner, components that ship with workbench application get recognized as available. Likewise, message dispatcher **34** may scan for available commercial components (e.g., scan commercial component JAR files in component cache).

[0190] Workbench manager **42** may ask message dispatcher **34** for all available components in system **10** (block **98**). In an embodiment, workbench manager **42** may ask for available components before blocks **94-96**. Workbench manager **42** may then display workbench manager GUI in displayed workbench **50**, populating the workbench manager GUI with available components determined as set forth above (block **100**). Workbench manager **42** waits for user to take action in workbench manager GUI (e.g., make selection to launch a component), and issues messages in response to user actions (block **102**).

[0191] System **10** may optionally display a login dialog window before the beginning of the process described above. For example, the login dialog window may be displayed as soon as user accesses system **10** website or selects WebStart desktop icon to launch application. User logins through login dialog window. After the user is authenticated, system **10** proceeds to launch workbench **50** and proceed to execute method **70**.

[0192] Note that system **10** initialization process described does not mention automatically launching any components on startup of workbench **50** (e.g., viewer self-commander **24**). In an embodiment, components are not automatically launched, but must be explicitly activated by the user. However, the user may set an option/preference to start up workbench **50** with a component or components active.

[0193] Suspending and Restoring Workbench

[0194] When using system **10**, a user may wish to quit for the day, but want to pick up later from where they left off on the same user machine (client **12**) or a different user machine (client **12**). System **10** provides this ability, by having the ability to save the state of an active workbench **50** and restoring workbench's **50** saved state later. The state of workbench **50** includes the state of all components active in workbench **50**. Saving the state of a workbench **50** thus comprises collecting the state of each active component in workbench **50** and the workbench state itself (e.g., which component GUIs active and displayed in canvas **54**), and saving the state on server **14**. Restoring workbench **50** includes reinstating the saved state of each component and the workbench state at the time the state of workbench **50** was saved. If re-instating the saved state of an active workbench **50**, system **10** reinstates the state of all previously saved components. Only components that were active when workbench **50** was saved are active when it is reinstated.

[0195] With reference now to FIG. **6**, shown is a flowchart illustrating further steps of method **70** for providing a graphical web-based workbench environment with intelligent plug-in, including exemplary launching, saving and restoring of components and workbench. The example shown here is for commander **22**, but the same may apply for other components, such as self-commanders **24**. Workbench manager receives user selection of available commander **22** (e.g., from pull-down menu on workbench manager GUI or component context pop-up menu (see FIG. **4**A-**4**B description above)) and launches commander **22** (block **110**). If commander **22** has a GUI, commander **22** GUI is displayed on workbench **50** (e.g., in canvas **54**). Messaging manager **32** instance for commander **22** is created and commander **22** instance and its message handler are registered with message dispatcher **34** (block **112**). User uses or operates commander **22**, for example, entering input parameters and selecting specific operations to be performed through commander **22** GUI (block **114**). Certain operations may cause commander **22** to request a service (e.g., command client-side service **26** or server-side service **40** to read data from client **12** or server **14** or perform a job) (block **116**). Likewise, commander **22** may command self-commander **24** to perform some operation (e.g., request viewer to graphically render results of a computational operation or synchronize cursor movement) (block **118**).

[0196] User may request saving of commander **22** state, which causes workbench manager **42** to send command to state manager **44** to save commander **22** state (block **120**). Message with state save request includes CID of commander **22**. State manager **44** may send message to commander **22** requesting commander's **22** state information (block **122**). When the state information is retrieved, state manager **44** in turn instructs servlet dispatcher **38** to save commander's **22** state on server **14** (block **124**). Embodiments of system **10** include a server-side service **18** (e.g., servlet) that performs the state-saving operations on server **14**.

[0197] Alternatively, components may send messages to state manager **44** with the component's state for automatic saving of component state. Such messages may be sent on a periodic basis, similar to a timed-backup. As mentioned above, system **10** may include components that perform this periodic backup of state (e.g., workbench and/or component state). Such automatic state saving may be set up under user workbench or component preferences.

[0198] User may terminate commander **22** (block **126**). If any requested jobs are still in progress when commander **22** terminates, the requested job may continue after commander **22** termination until complete (e.g., minutes, hours, days, etc.) (block **128**). When components' (including commander **22** and job service instances) states are saved, the saved states may include pending requested job information (e.g., job IDs and job status). If commander **22** and job service (client-side service **26** or server-side service **40**) state has been saved with job information when commander **22** is terminated, the job result may be retrieved when commander **22** is reinstated for that workbench **50**. The job result may have been saved to a user requested file. When commander **22** is reinstated, job service requests job status and job status is returned with job result (block **136**). If job completed normally, job result may be standard, expected output of job. If job terminated abnormally or another error was encountered, job result may be error message. This process of continuing jobs after commander **22** termination may apply to other services besides jobs in progress when commander **22** terminates.

[0199] With continuing reference to FIG. **6**, user may request restoration of commander **22** (block **130**) (e.g., select open in component pull-down menu and selected available, saved commander **22**—see above). When workbench manager **42** receives restoration request, workbench manager **42** sends a command to state manager **44**. State manager **44** in turn instructs servlet dispatcher **38** to retrieve commander's **22** state from server **14** (block **132**). Embodiments of system **10** include a server-side service **18** (e.g., servlet) that performs the state-retrieving operations on server **14**. The state information is sent in a response message back to state manager **44**, which then sends message to commander **22** instructing commander **22** to restore its state (block **134**). As noted above, launching, state-saving and restoring of self-commanders **24** may be performed in the same manner as described above and illustrated in FIG. **6** for commanders **22**.

[0200] To save and restore a virtual desktop (workbench **50**), similar actions are performed. User may request saving of workbench **50** state (e.g, through workbench manager GUI), which causes workbench manager **42** to send command to state manager **44** requesting state of workbench **50** (and all open components) be saved (message includes workbench **50** name or other ID) (block **138**). State manager **44** requests state information from all active client-side components **16** (including workbench manager **42**) (block **140**). State manager **44** may also request status and save of all pending services. Once state information is received, state manager **44** instructs servlet dispatcher **38** to save workbench state and client-side components **16** states on server **14** (block **142**). The workbench state and components state may be saved as a .cfg file(s). Embodiments of system **10** include server-side service(s) **18** (e.g., servlet) that performs the state-saving operations on server **14**. This state information may include status of pending server-side services and jobs. If workbench **50** is terminated (block **144**), pending server-side services and jobs may continue as discussed above. Workbench **50** may be restored as described above (block **146**). For example, state manager **44** may instruct servlet dispatcher **38** to retrieve workbench **50** state and saved state of all client-side components **16** from server **14**. Embodiments of system **10** include a server-side service(s) **18** (e.g., servlet) that performs the state-retrieving operations on server **14**. The state information is sent in a message back to client **12** and workbench **50** is restored. Once restored, user may continue use of workbench **50** and system **10**.

[0201] Login and Security

[0202] In some embodiments, users must login before they can use system **10**. In an embodiment, login requires a user to enter their user id and password. System **10** may include a database of registered users that contains their profile information. Part of a user's profile may be a role which controls the user's access rights to system **10**.

[0203] User's may be restricted to accessing certain client-side components **16** (and/or server-side components **18**) based on privileges or additional roles. A user only needs to log-in once. Embodiments may includes an option to remember their user id and password on the computer they are logging-in from. This login information may be saved, for example, in a cookie on user's machine. In an embodiment, servlet dispatcher **38** handles security. Accordingly, servlet dispatcher **38** determines what components a user can access, controls user's realm of control, etc.

[0204] Exemplary Commanders

[0205] As discussed above, system **10** may include a number of core commanders **22** and self-commanders **24** that are provided or packaged with implementations of system **10** and commercial commanders **22** and self-commanders **24** that are developed and provided separately (e.g., by third-parties) for addition to system **10**. In a sub-surface data embodiment of system **10**, the following commanders **22** may be provided (as core or commercial). The exemplary commanders **22** below perform multi-dimensional analysis of data through their computational analysis and displays on viewer self-commanders **24** (e.g., 2D, 3D and well-log viewers).

[0206] Wavelet Extraction Commander

[0207] Wavelet extraction or derivation commander **22** is invoked as other commanders **22** discussed above. The wavelet extraction commander **22** may run a well-tie and wavelet extraction tool. Wavelet extraction commander **22** estimates wavelet coefficients, other parameters associated with uncertainty in time-to-depth mapping, positioning errors in the seismic imaging, and useful AVO-related parameters in multistack extractions. Wavelet extraction commander **22** is capable of multistack and multiwell extractions. Wavelet extraction commander **22** performs multi-dimensional analysis of data (e.g., uncertainty and estimation analysis). An exemplary wavelet extraction tool is described in "Wavelet extractor: A Bayesian well-tie and wavelet extraction program," James Gunning, Michael E. Glinsky (Feb. 21, 2005), Computer & Geosciences 32, p. 681-695 (2006), is hereby incorporated by references (see also http://oplink.net/~glinsky/tech_papers/WaveletExtraction_cg.pdf). Set-up parameters for a wavelet extraction commander **22** that may appear in wavelet extraction commander **22** GUI displayed to user on workbench **50** may include:

- **[0208]** The filepath of an Extensible-Markup Language (XML) file, e.g., ModelDescription.xml, that specifies parameters needed for the wavelet extraction. This file may be stored on server **14**.
- **[0209]** The filepaths of the near offset seismic data and the far offset seismic data files. This data may be stored on server **14**.
- **[0210]** The filepath of the well log file. This file may be stored on server **14**.
- **[0211]** The filepath of the output synthetic seismic traces data file. This file may be stored on server **14**.

[0212] Wavelet extraction commander **22** GUI may also include an Edit button that is active once the path is entered. Selecting the Edit button invokes an XML Editor (see below) to edit the above-mentioned XML file. After editing the XML file, it can be saved. When all of the input and output parameters have been specified, the user may select an OK button and the wavelet extraction commander **22** performs the wavelet extraction with the specified parameters. When wavelet extraction commander **22** has completed wavelet extraction, the user may add the resulting data file (e.g., displayed in dataset analysis tree **66**) as a layer on a compatible view—e.g., on a display of a viewer self-commander **24**, such as a well-log or 3D viewer. In other words, user may launch a viewer self-commander **24** and load result data file generated by wavelet extraction commander **22**. Alternatively, wavelet extraction commander **22** may automatically launch viewer self-commander **24** and send it result data. Wavelet extraction commander **22** may utilize well-log and 3D viewer to display.

[0213] Amplitude Extraction Commander

[0214] Amplitude extraction commander **22** is invoked as other commanders **22** discussed above. Amplitude extraction commander **22** may run an amplitude extraction tool, such as the exemplary tool described in the paper "Integration of Uncertain Subsurface Information Into Multiple Reservoir Simulation Models," Michael E. Glinsky et al., The Leading Edge, pages 990-999 (October 2005), which is hereby incorporated by reference (see also http://oplink.net/~glinsky/papers_refereed/tle_stybarrow__05.ndf). Amplitude extraction commander **22** extracts amplitudes and analyzes extracted amplitudes to generate volumetric and risk estimates. Bayesian probabilistic techniques may be used extensively in the process.

[0215] Parameters such as described in the paper may be entered through amplitude extraction commander **22** GUI. Such parameters may be selected from data displayed by viewer self-commanders **24**. For example, seismic data for the amplitude extraction may be selected from data displayed on a 2D or 3D viewer, e.g., as prompted by amplitude extraction commander **22**. Furthermore, a user may select a region or area on a map displayed on a 2D viewer on which the amplitude extraction is to be performed, e.g., as prompted by amplitude extraction commander **22**. For example, amplitude extraction commander **22** may send a command message launching viewer self-commander **24** and requesting that it obtain and display map or other data. Viewer self-commander **24** may send as response the data (e.g., area on map) selected by user. Amplitude extraction commander **22** may then retrieve necessary additional data (e.g., associated with selected area on map), e.g., by sending command messages to client-side service(s) **26**, if data on client **12**, or server-side service(s) **40**, if data on server **14** or elsewhere. Alternatively, amplitude extraction commander **22** may send command messages to server-side services **40** to perform necessary computational operations on data, if data on server **14** or elsewhere, rather than retrieving the necessary data and performing operation on client **12**. Such computational operations may be requested and performed as a cluster job. Only the computational results would then be returned to amplitude extraction commander **22**. In this manner, client **12** processing load may be reduced. Other commanders **22** may operate in this manner. Amplitude extraction commander **22** may also request viewer self-commander **24** display the results (resulting data file). Resulting data file may also be displayed as above.

[0216] Delivery Lite Commander

[0217] Delivery Lite commander **22** is invoked as other commanders **22** discussed above. Delivery Lite commander **22** may run a tool for model-based Bayesian seismic inversion. Such a tool may be the exemplary tool described in the paper "Delivery: an open-source model-based Bayesian seismic inversion program," James Gunning and Michael E. Glinsky, Computers & Geosciences 30, pp. 619-636 (2004), which is hereby incorporated by reference (see also http://oplink.net/~glinsky/tech_papers/DeliveryPaper.pdf). Delivery Lite commander **22** may operate in system **10** as described above for wavelet extraction commander **22** and amplitude extraction commander **22**.

[0218] Spectral Decomposition and Stratigraphic Flattening Commander

[0219] Spectral decomposition and stratigraphic flattening commander **22** is invoked as other commanders **22** discussed above. Spectral decomposition and stratigraphic flattening commander **22** may run a tool for estimating lithofacies probabilities given a seismic wavelet response via a Bayesian inversion. Such a tool may be the exemplary tool described in the paper "Geologic Lithofacies Identification Using the Multiscale Character of Seismic Reflections," Moshe Strauss, et al., Journal of Applied Physics, pp. 5350-5358 (Vol. 94, No. 8, Oct. 15, 2003), which is hereby incorporated by reference (see also http://oplink.net/~glinsky/papers_refereed/i_appl_phys$_{13}$ wavelet_id__03.pdf). Spectral decomposition and stratigraphic flattening commander **22** may operate in system **10** as described above for wavelet extraction commander **22** and amplitude extraction commander **22**

[0220] Massaging and Decorating Commander

[0221] Massaging and decorating commander **22** is invoked as other commanders **22** discussed above. Massaging and decorating commander **22** may run a tool for transforming inversion data from seismic inversion software to industry-standard cornerpoint grid formats suitable for reservoir modeling and flow simulations. Such a tool may be the exemplary tool described in the paper "DeliveryMassager: A Tool for Propagating Seismic Inversion Information Into Reservoir Models," James Gunning et al., (submitted to Computers & Geosciences for publication on Feb. 23, 2006), which is hereby incorporated by reference and is available at http://oplink.net/~glinsky/tech_papers/DeliveryMassager.pdf Massaging and decorating commander **22** may operate in system **10** as described above for wavelet extraction commander **22** and amplitude extraction commander **22**.

[0222] XML Editor Commander

[0223] As discussed above, data (e.g., seismic data) that is analyzed and used by commanders **22** and self-commanders **24** in system **10** may include XML metadata containing the variable information. When performing analyses using commanders **22** and self-commanders **24**, a user may want to edit this XML metadata to adjust computations or results of analysis. XML editor commander **22** may run an XML editor to edit the XML metadata and other XML data. XML editor commander **22** is invoked as other commanders **22** discussed above. As noted above, XML editor commander **22** may be invoked by a user selection in another active commander **22**, or self-commander **24**, GUI. XML editor commander **22** sends command messages to client-side services **16** and/or server-side services **18** to retrieve XML data files, displays the XML data (e.g., in a viewer self-commander **24**), receives and stores user changes, and sends command messages to client-side services **16** and/or server-side services **18** to save edited XML data files.

[0224] Component Intercommunication Example

[0225] With reference now to FIG. **7**, shown is a flowchart illustrating exemplary message passing **150** in an embodiment of method and system providing a graphical environment with intelligent plug-ins as described herein. Client-side component **16** instance issues a message (block **152**). Message may be a command or data. Component sends a message using component's messaging manager **32** instance. Messaging manager **32** places command message on message dispatcher's **34** queue (which it knows from component instance registration when component instance launched—see above) (block **154**). Message dispatcher **34** determines consumer for message (block **156**). Ordinarily, the message dispatcher **34** examines message and determines consumer component for message from consumer component CID included in message. Alternatively, message dispatcher **34** may determine if there is any special routing for message (block **158**). For example, certain components may monitor messages from other components. Further, a user may request that certain messages be broadcasted. Indeed, message from component may be a command requesting message dispatcher **34** to forward all messages from a component or to broadcast all messages from a component. Moreover, message may be marked for special routing, as described above. If there is special routing, message dispatcher **34** routes messages per routing instructions (e.g., per routing matrix).

[0226] If message consumer is a server-side component **18**, including servlet dispatcher **38** (block **160**), message dispatcher **34** passes message to dispatcher connector **36** and dispatcher connector **36** may serialize message for transmission to server **14** (block **162**). In an embodiment, the message is not serialized if client **12** and server **14** are resident on the same computer. In such an embodiment, workbench application is a stand-alone application and there is, in affect, only a client **12**. Per the above, the message is passed to the message consumer(s) (block **164**). If message is sent to server-side component **18**, servlet dispatcher **38** de-serializes the message on receipt. The message is placed on consumer's message queue (block **166**). Consumer processes message, performing any requested tasks, and generates a response(s) message (block **168**). Note, some command messages do not require a response message. For example, a command message may simply request message dispatcher **34** forward all messages of a certain type or from a certain component. No response message is needed to this message. Rather, the "response" would be message dispatcher **34** forwarding the requested messages. Response message is returned to producer (block **170**) in a manner similar to the above (see blocks **154-166**). Response message includes CID of producer, obtained from original message by consumer.

[0227] If there is an error exception when processing a message, consumer provides an abnormal response whose content provides details about the exception. It is up to the producer of the message how to handle an abnormal response (e.g., send message again, display error message, etc.).

[0228] Exemplary Hardware

[0229] With reference now to FIG. **8**, shown is a block diagram illustrating exemplary hardware components for implementing system **10** for providing a graphical environment with intelligent plug-ins. Hardware components includes client **12** (user machine) connected with a network such as the Internet **200**, providing a network connection to server(s) **14**. Other user machines, such as client **12'**, may also be connected via network **200** to server **14**. Client **12'**, and other clients, may include the same components as client **12**.

[0230] Client **12** illustrates typical components of a user machine. Client **12** typically includes a memory **202**, a secondary storage device **204**, a processor **206**, an input device **208**, a display device **210**, and an output device **212**. Memory **202** may include random access memory (RAM) or similar types of memory, and it may temporarily store one or more active client-side components **16**, client-side aspects of message framework **20**, a web browser **214**, or other applications, for execution by processor **206**. Secondary storage device **204** may include a hard disk drive, floppy disk drive, CD-ROM drive, or other types of non-volatile data storage, and may store client-side components **16** and data for use by system **10**. Processor **206** may execute applications or programs, including client-side components **16**, stored in memory **202** or secondary storage **204**, or received from the Internet or other network **200**, and the processing may be implemented in software, such as software modules, for execution. These applications preferably include instructions executable to perform the methods described herein.

[0231] Input device **208** may include any device for entering input or user selections into client **12**, such as a keyboard, mouse, cursor-control device, touch-screen, microphone, digital camera, video recorder or camcorder. The input device **208** may be used to enter information into GUIs during operations of system **10**, as described above. Display device **210** may include any type of device for presenting visual information such as, for example, a computer monitor or flat-screen display. The display device **210** may display workbench **50**, client desktop **60**, and the various GUIs described above. Output device **212** may include any type of device for presenting a hard copy of information, such as a printer, and other types of output devices include speakers or any device for providing information in audio form.

[0232] Web browser **214** is used to install system **10**, as described above. Examples of web browsers include Netscape Navigator, Microsoft IE, Firefox, Opera, etc. In an embodiment, web browser **214** includes Java plug-ins. Any web browser, co-browser, or other application capable of retrieving content from a network and displaying pages or screens may be used. Examples of clients **12** for interacting with system **10** include personal computers, laptop computers, notebook computers, palm top computers, network computers, or any processor-controlled device capable of executing a web browser or other type of application for interacting with system **10**.

[0233] With continuing reference to FIG. **8**, server **14** typically includes a memory **222**, a secondary storage device **224**, a processor **226**, an input device **228**, a display device **230**, and an output device **232**. Memory **222** may include RAM or similar types of memory, and it may store one or more applications, including server-side components **18**, server-side aspects of message framework **20**, server software (e.g., Tomcat server), for execution by processor **226**. Secondary storage device **224** may include a hard disk drive, floppy disk drive, CD-ROM drive, or other types of non-volatile data storage. Processor **226** executes server-side components **18** and other application(s), which are stored in memory **222** or secondary storage **224**, or received from the Internet or other network **200**. Input device **228** may include any device for entering information into server **14**, such as a keyboard, mouse, cursor-control device, touch-screen, microphone, digital camera, video recorder or camcorder. Display device **230** may include any type of device for presenting visual information such as, for example, a computer monitor or flat-screen display. Output device **232** may include any type of device for presenting a hard copy of information, such as a printer, and other types of output devices include speakers or any device for providing information in audio form.

[0234] Server **14** may store a database structure in secondary storage **224**, for example, for storing and maintaining information used by system **10**. For example, it may maintain a relational or object-oriented database for storing information such as component saved state information, registered component information, user preferences, etc. Secondary storage **224** may also storing data used by system **10**, including without limitation, sub-surface data used in sub-surface data embodiment, point-collected data described above, etc. Such information and data may be retrieved by server-side services **40**.

[0235] Although only one server **14** is shown, system **10** may use multiple servers **14** as necessary or desired to support system **10**. In an embodiment, client **12** and server **14** may be the same machine. Client **12** and server **14** may also be connected to other computers via Internet or other network, such as a cluster for performing cluster jobs. In addition, although client **12** and server **14** are depicted with various components, one skilled in the art will appreciate that these machines and the server can contain additional or different components. In addition, although aspects of an implementation consistent with the above are described as being stored in memory, one skilled in the art will appreciate that these aspects can also be stored on or read from other types of computer program products or computer-readable media, such as secondary storage devices, including hard disks, floppy disks, or CD-ROM; or other forms of RAM or ROM. The computer-readable media may include instructions for controlling client **12** and server **14**, to operate in the manners described herein.

[0236] As mentioned above, the uses of system **10** and workbench **50** are virtually unlimited. Commanders **22** and self-commanders **24** may be created for virtually any purpose. Data that may be manipulated and operated on by system **10** is also virtually unlimited. Because of the unique architecture of system **10** it is very flexible and highly efficient. Multidimensional data analysis may be performed using, e.g., 2D and 3D viewer self-commanders **24** and commanders **22** that interact with each other, e.g., as described herein. Workbench **50** provides a portable graphical working environment that a user can take to any client **12** that can connect to server **14** over the Internet or other network. Highly intensive computational operations may be performed, e.g., via cluster jobs on a cluster of servers, without sacrificing processing efficiency. Components intelligently monitor and save state information. An open messaging framework is utilized that enables any component to listen and monitor messages, taking intelligent actions based on monitored messages. Users may quit workbench **50** and component sessions, restoring from saved states to continue at a later time. Components may be added to system **10** to provide increased functionality. Client-heavy nature of workbench **50** facilitates these features and each use of system **10**.

[0237] The terms and descriptions used herein are set forth by way of illustration only and are not meant as limitations. Those skilled in the art will recognize that many variations are possible within the spirit and scope of the invention as defined in the following claims, and their equivalents, in which all terms are to be understood in their broadest possible sense unless otherwise indicated.

1. A platform for analysis of point-gathered data comprising:

a workbench providing a graphical working environment for a user to view and perform operations on point-gathered data and to interact with the platform;

one or more plug-ins that operate on the point-gathered data, including plug-ins that receive inputs from a user through workbench and issue commands as messages and that actively save their state by passing the state as a message; and

a message framework that receives all messages from producer plug-ins and passes the messages to an intended consumer, in which the platform actively saves the workbench state and plug-in states as messages passed to the message framework.

2. The platform of claim **1** further comprising one or more services that execute commands from other plug-ins and return responses to the commands as messages sent through the message framework.

3. The platform of claim **2** in which the one or more services include input/output (IO) services.

4. The platform of claim **2** in which the one or more services include job services for executing and monitoring jobs generated by plug-ins.

5. The platform of claim **1** in which the plug-ins include commanders that provide certain functions and issue messages that include commands and data and receive messages that include data.

6. The platform of claim **5** in which the certain functions include performing computational algorithms on the point-gathered data.

7. The platform of claim **5** in which new commanders may be added to the platform to increase the functionality of the platform.

8. The platform of claim **7** in which the platform is provided under an open-source license and the new commanders are provided under a separate license.

9. The platform of claim **1** in which the plug-ins include self-commanders that issue messages that include commands and data and receive messages that include data or commands and data.

10. The platform of claim **9** in which the self-commanders include viewer self-commanders that display the point-gathered data.

11. The platform of claim **1** further comprising a client computer and a server, in which the plug-ins are resident on and executed on the client computer.

12. The platform of claim **11** in which plug-in and workbench states are saved on the server.

13. The platform of claim **11** in which the point-gathered data is saved on the server.

14. The platform of claim **13** in which selected portions of the point-gathered data are retrieved from the server and saved on the client computer.

15. The platform of claim **11** further comprising one or more client-side services on the client and one or more server-side services on the server and in which the client-side services and server-side services execute commands from plug-ins and return responses to the commands.

16. The platform of claim **1** in which the one or more plug-ins generate and display graphical user interfaces (GUIs) on the workbench.

17. The platform of claim **1** in which the one or more plug-ins include core plug-ins that are provided for free with an installation of the platform and commercial plug-ins that are separately provided and licensed to the user.

18. The platform of claim **1** in which the messaging framework comprises a messaging manager that comprises a message handler and a message queue for each plug-in.

19. The platform of claim **1** in which the point-gathered data is actively or passively gathered.

20. The platform of claim **1** in which the point-gathered data includes seismic data.

21. The platform of claim **1** in which the point-gathered data includes financial data.

22. The platform of claim **1** in which the point-gathered data includes gaming data.

23. The platform of claim **1** in which the point-gathered data include military data.

24. The platform of claim **1** in which the point-gathered data include medical data.

25. The platform of claim **1** in which the plug-ins include plug-ins that monitor messages received by the message framework.

26. The platform of claim **1** in which the message framework broadcasts certain received messages to all plug-ins.

27. The platform of claim **1** in which the message framework broadcasts certain received messages to selected plug-ins.

28. The platform of claim **1** wherein the operations performed on the data by the plug-ins include analysis of the data.

29. The platform of claim **1** wherein the operations performed on the data by the plug-ins include multidimensional analysis of the data.

30. A system for providing a graphical web-based environment for performing operations on data comprising:

a client operating on a user machine, including:

a workbench that provides a graphical working environment for a user to interact with and operate a plurality of components;

a plurality of components operating in the workbench, including:

one or more commanders that analyze and perform operations on data, in which each commander includes state-saving, state-restoring and message passing capabilities, receives inputs from the user through the workbench, issues commands and receives responses; and

one or more self-commanders that receive inputs from the user through the workbench, issue and receive commands, and issue and receive responses; and

one or more client-side services that perform services on the client per commander or self-commander issued commands and issues responses to the commands; and

a message framework, in which the components communicate with each other using messages passed through the message framework, in which each message is passed through the message framework and includes data or data and a command and the commands and responses issued by components are sent as messages;

a server in which the server stores information regarding the components, including the state and identity of registered components.

31. The system of claim **30** in which the system is configured to accept and operate with additional, third-party developed components referred to as commercial components.

32. The system of claim **30** in which the server is resident on a remote machine.

33. The system of claim **30** in which the message framework comprises a message dispatcher resident on the client and a servlet dispatcher resident on the server, and the message dispatcher receives and process messages and passes messages to the servlet dispatcher for execution on the server.

34. The system of claim **30** in which the server comprises one or more server-side services that perform services on the server per issued commands and issues responses to the commands.

35. The system of claim **30** in which the components further include system components for managing the system and the state-saving.

36. The system of claim **35** in which the system components include:

a workbench manager that manages the workbench and provides a workbench GUI for the user to control the workbench and launch components; and

a state manager that manages the state of the workbench and components.

37. The system of claim **30** in which the one or more commanders include an XML editor commander that is used to edit XML data.

38. The system of claim **30** in which the self-commanders include one or more viewer self-commanders that display the data and results of operations on the data performed by commanders.

37. The system of claim **36** in which the viewer self-commanders include a two-dimensional (2D) viewer.

38. The system of claim **36** in which the viewer self-commanders include a three-dimensional (3D) viewer.

39. The system of claim **28** in which the messaging framework comprises a messaging manager that comprises a message handler and a message queue for each commander and each self-commander.

40. The system of claim **28** in which the message framework extends to the server and the server comprises elements of the message framework.

41. A method for providing a graphical web-based environment for performing operations on data comprising:

connecting to a server from a client computer;

opening a workbench on the client computer, in which the workbench provides a graphical working environment for a user to interact with and operate a plurality of components;

starting up a message framework, in which the components communicate with each other using messages passed through the message framework, in which each message is passed through the message framework and includes data or data and a command;

launching one or more commander components on the client computer, in which commander components analyze and perform operations on data, in which each commander component includes state-saving, state-restoring and message passing capabilities, receives inputs from the user through the workbench, issues commands and receives responses;

launching one or more self-commanders on the client computer, in which the self-commanders receive inputs from the user through the workbench, issue and receive commands, and issue and receive responses; and

saving the state of at least one of the commander components on the server.

42. The method of claim **41** further comprising:

receiving a user input through the workbench; and

one of the commander components issuing a command in response to the user input.

43. The method of claim **41** further comprising launching one or more client-side services on the client computer, in which the client-side services perform services on the client per commander or self-commander issued commands and issues responses to the commands.

44. The method of claim **41** further comprising launching one or more server-side services on the client computer, in which the server-side services perform services on the server per commander or self-commander issued commands and issues responses to the commands.

45. The method of claim **41** in which saving the state of at least one of the commander components on the server comprises the at least one commander component sending a message that comprises the at least one commander state information to the message framework.

46. The method of claim **41** further comprising restoring the state of the at least one commander component.

47. The method of claim **46** in which restoring the state of the at least one commander component comprises:

retrieving saved state information from the server; and

restoring the at least one commander to the state indicated by the saved state information.

48. The method of claim **41** further comprising operating at least one of the commander components based on user input.

49. The method of claim **41** in which the self-commanders include a viewer self-commander that displays the data and results of the analysis and operations on the data performed by commander components, the method further comprising the viewer self-commander displaying data in response to user input.

50. A computer readable medium comprising instructions for executing the steps of the method of claim **41**.

51. A computer readable medium comprising instructions for providing a graphical web-based environment for performing operations on data, by:

opening a workbench on the client computer, in which the workbench provides a graphical working environment for a user to interact with and operate a plurality of components;

starting up a message framework, in which the components communicate with each other using messages passed through the message framework, in which each message is passed through the message framework and includes data or data and a command;

launching one or more commander components on the client computer, in which commander components analyze and perform operations on data, in which each commander component includes state-saving, state-restoring and message passing capabilities, receives inputs from the user through the workbench, issues commands and receives responses;

launching one or more self-commanders on the client computer, in which the self-commanders receive inputs from the user through the workbench, issue and receive commands, and issue and receive responses; and

saving the state of at least one of the commander components on a server.

52. The computer readable medium of claim **51** further comprising instructions for:

receiving a user input through the workbench; and

one of the commander components issuing a command in response to the user input.

53. The computer readable medium of claim **51** further comprising instructions for launching one or more client-side services on the client computer, in which the client-side services perform services on the client per commander or self-commander issued commands and issues responses to the commands.

54. The computer readable medium of claim **51** further comprising instructions for launching one or more server-side services on the client computer, in which the server-side services perform services on the server per commander or self-commander issued commands and issues responses to the commands.

55. The computer readable medium of claim **51** in which saving the state of at least one of the commander components on the server comprises the at least one commander component sending a message that comprises the at least one commander state information to the message framework.

56. The computer readable medium of claim **51** further comprising instructions for further comprising restoring the state of the at least one commander component.

57. The computer readable medium of claim **56** in which restoring the state of the at least one commander component comprises:

retrieving saved state information from the server; and

relaunching and restoring the at least one commander to the state indicated by the saved state information.

58. The computer readable medium of claim **51** further comprising instructions for operating at least one of the commander components based on user input.

59. The computer readable medium of claim **51** in which the self-commanders include a viewer self-commander that displays the data and results of the analysis and operations on the data performed by commander components, the method further comprising the viewer self-commander displaying data in response to user input.

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