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(54) **MODELING A COMPUTING ARCHITECTURE**

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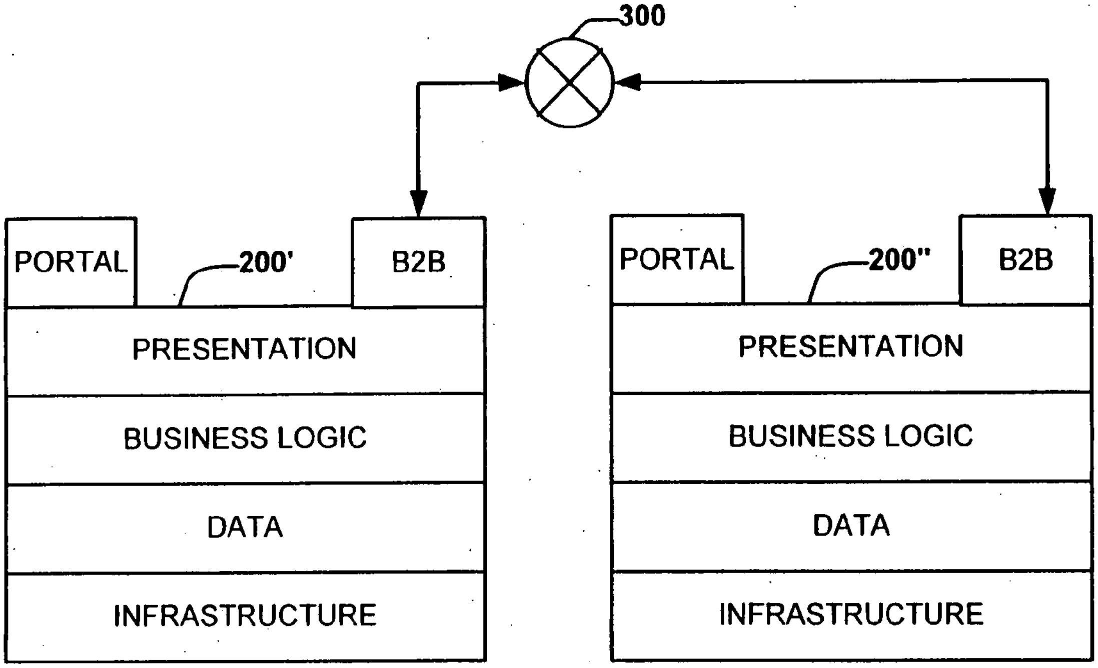
(57) **ABSTRACT**

A method for modeling a computing architecture is provided. Computing layers of the computing architecture are identified, wherein each computing layer represents a functional layer of the computing architecture. Computing systems of the computing system are identified. Computing layers implemented by the computing system are identified. Stacked bars are displayed to represent the computing layers. Second bars orthogonal to the stacked bars are displayed to represent the computing systems, wherein each second bar extends through a portion of the stacked bars an amount corresponding to the computing layers implemented by the computing system represented by the second bar.



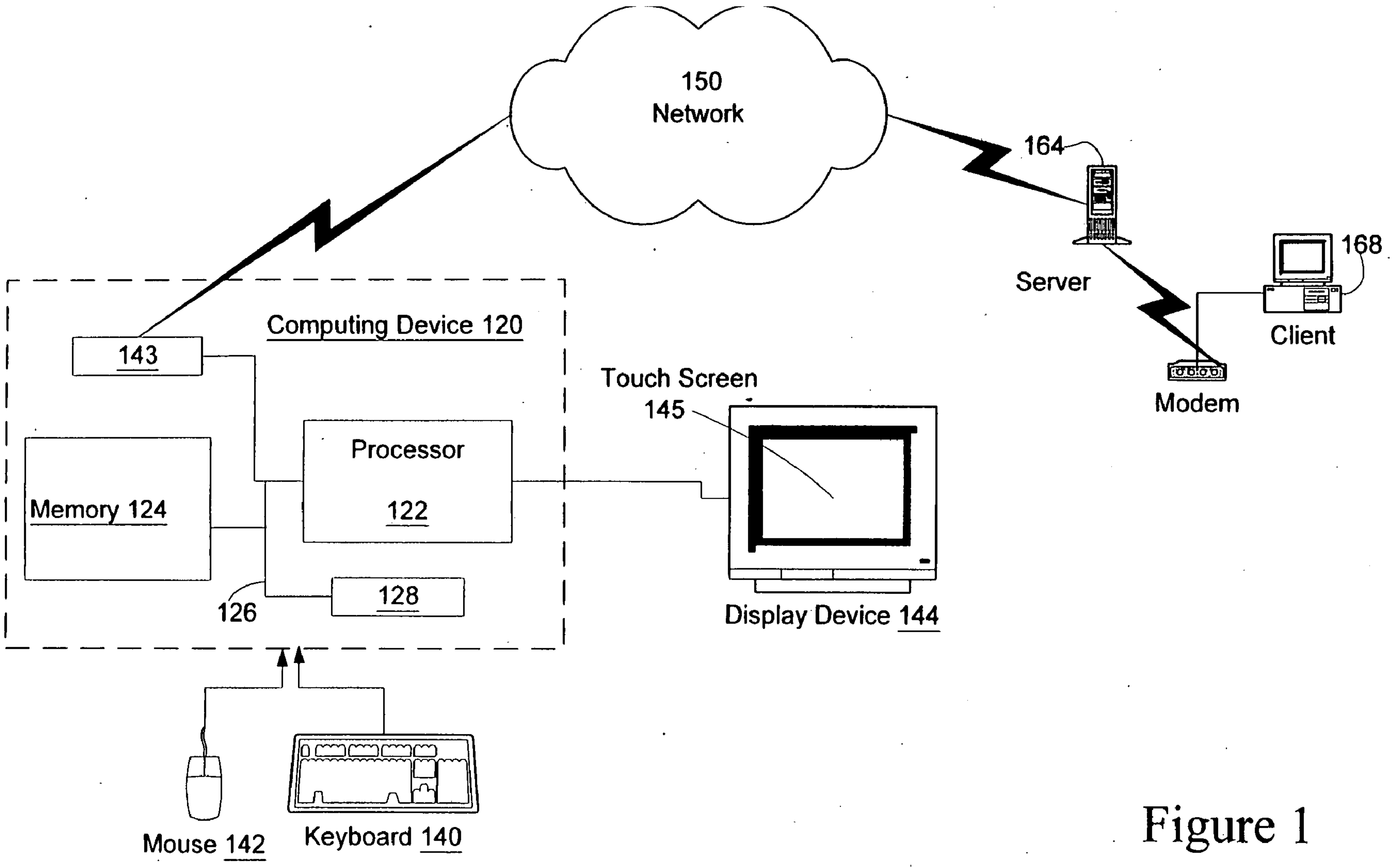

150
Network
164
Server
168
Client
Modem
Computing Device 120
143
Processor
122
Memory 124
128
126
Touch Screen
145
Display Device 144
Mouse 142
Keyboard 140

Figure 1

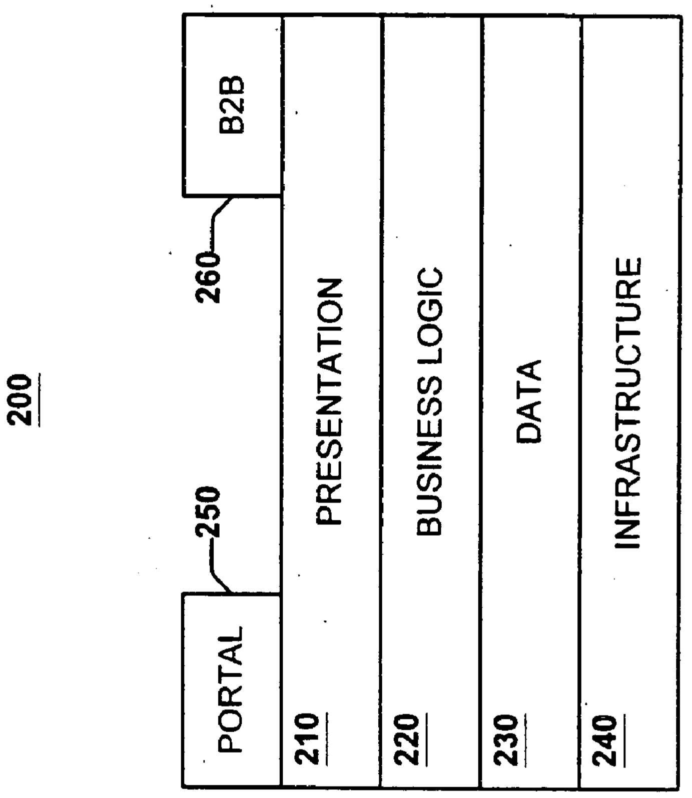

200
PORTAL
B2B
250
260
PRESENTATION
210
BUSINESS LOGIC
220
DATA
230
INFRASTRUCTURE
240

Figure 2

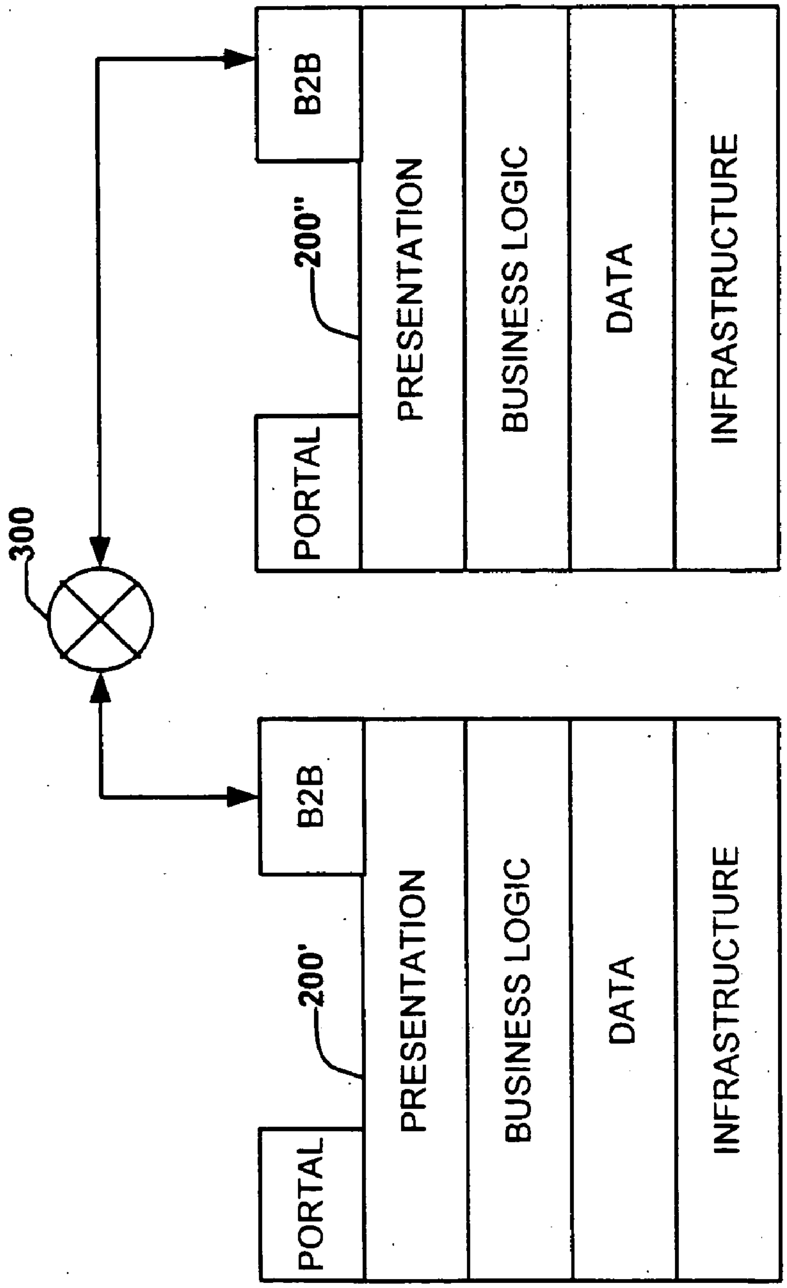

300
PORTAL
B2B
200''
PRESENTATION
BUSINESS LOGIC
DATA
INFRASTRUCTURE
PORTAL
B2B
200'
PRESENTATION
BUSINESS LOGIC
DATA
INFRASTRUCTURE

Figure 3

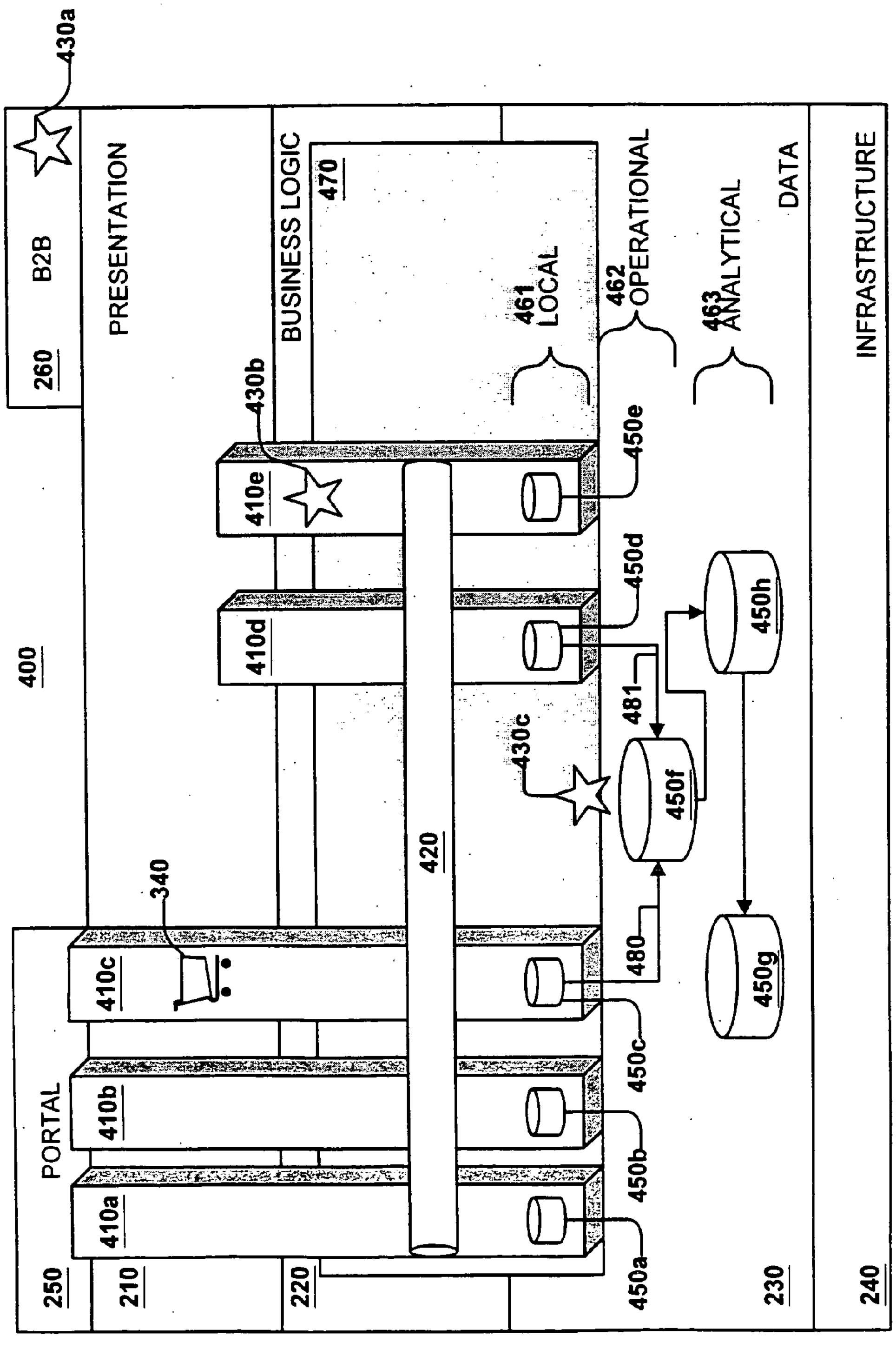

400
260
B2B
430a
PRESENTATION
BUSINESS LOGIC
470
461
LOCAL
462
OPERATIONAL
463
ANALYTICAL
DATA
INFRASTRUCTURE
430b
410e
450e
410d
450d
450h
481
430c
450f
420
340
410c
480
450g
PORTAL
410b
410a
450c
450b
450a
250
210
220
230
240

Figure 4

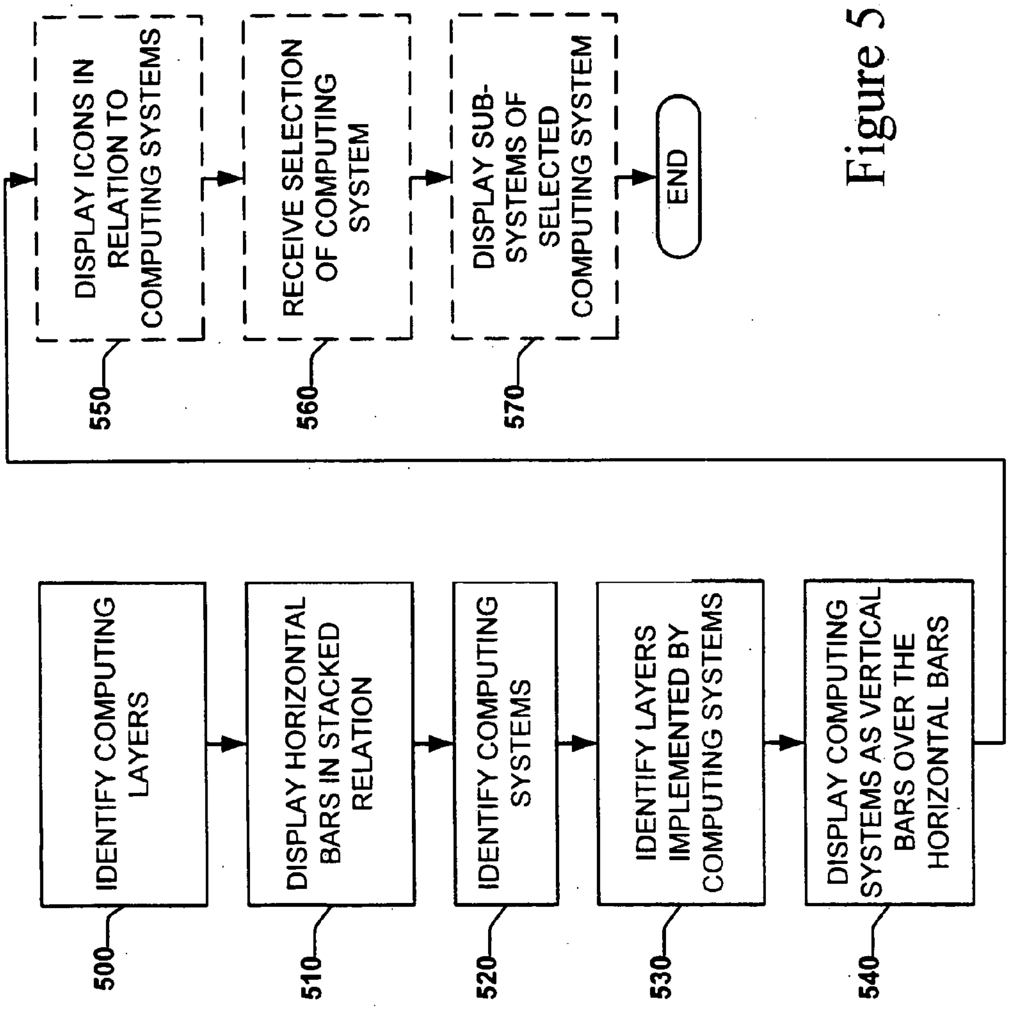

500
IDENTIFY COMPUTING LAYERS
510
DISPLAY HORIZONTAL BARS IN STACKED RELATION
520
IDENTIFY COMPUTING SYSTEMS
530
IDENTIFY LAYERS IMPLEMENTED BY COMPUTING SYSTEMS
540
DISPLAY COMPUTING SYSTEMS AS VERTICAL BARS OVER THE HORIZONTAL BARS
550
DISPLAY ICONS IN RELATION TO COMPUTING SYSTEMS
560
RECEIVE SELECTION OF COMPUTING SYSTEM
570
DISPLAY SUB-SYSTEMS OF SELECTED COMPUTING SYSTEM
END

Figure 5

MODELING A COMPUTING ARCHITECTURE

FIELD OF THE INVENTION

[0001] The invention generally relates to the field of modeling computing architectures. More particularly, the invention relates to graphically modeling a computing architecture that comprises multiple computing systems.

BACKGROUND OF THE INVENTION

[0002] Computing systems, which may comprise, for example, an application or a plurality of applications, have become increasingly complex. Indeed, the sheer number of computing systems has increased dramatically in recent years. Also, each computing system itself often becomes more complex as it evolves through revision releases and the like. Moreover, computing systems typically interconnect to an increasing number of other computing systems as such systems are integrated into a larger computing architecture.

[0003] Further, more and more computing systems are integrated into computing architectures. As such, modeling a computing architecture has become more challenging. For example, an enterprise may have a multitude of computing systems with each computing system comprising a multitude of applications. The applications and/or systems may include purchased applications, developed applications, legacy systems, and the like. Each of these applications and/or systems may have its own database, a shared database, a website interface, a machine interface, a connection to other computing systems, a connection to other computing applications, and the like. Due to these many complexities and the highly integrated nature of computing, modeling complex computing architectures on an enterprise level is often very difficult.

[0004] Nonetheless, the need to communicate such computing architectures at an enterprise level to both technical and non-technical people, is important to achieving business success and to building computing architectures that are efficient, maintainable, and conducive to future growth. Further, the ability to depict the computing architecture at an appropriate level of detail for a specific target audience is important. For example, a member of a board of directors may prefer to be presented with a high-level view of an enterprise computing architecture to determine where to invest resources, while an application developer may prefer to be presented with a mid-level view of a computing system to determine how to integrate new functionality into the computing architecture.

[0005] In view of the foregoing, there is a need for a method for flexibly and dynamically representing a computing architecture at various levels of detail.

SUMMARY OF THE INVENTION

[0006] According to an aspect of the invention, systems and methods are provided for modeling a computing architecture at various levels of detail.

[0007] In a method for modeling a computing architecture in accordance with the invention, computing layers of the computing architecture are identified, wherein each computing layer represents a functional layer of the computing architecture. Computing systems are identified and computing layers implemented by the computing systems are identified. Stacked bars are displayed to represent the computing layers. A second set of bars orthogonal to the stacked bars are displayed to represent the computing systems, wherein each second bar extends through a portion of the stacked bars by an amount corresponding to the computing layers implemented by the computing system represented by the second bar.

[0008] A first rectangle that represents a human interface portal may be displayed adjacent to the stacked bars. A second rectangle that represents a business to business integration may also be displayed adjacent to the stacked bars. Icons representing a preselected area, a data store, or a computing function may be displayed in an area of the model as well.

[0009] Further details of the computing architecture may also be displayed upon selection of a computing system. Sub-systems of the selected computing system are displayed as second bars orthogonal to stacked bars, as above.

[0010] The above-listed features, as well as other features, of the invention will be more fully set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The invention is further described in the detailed description that follows, by reference to the noted plurality of drawings by way of non-limiting illustrative embodiments of the invention, in which like reference numerals represent similar parts throughout the several views of the drawings, and wherein:

[0012] **FIG. 1** is a diagram of a generic computer system with which the invention may be employed;

[0013] **FIG. 2** is a diagram of an illustrative layer model for representing layers of a computing architecture, in accordance with an embodiment of the invention;

[0014] **FIG. 3** is a diagram of an illustrative model of connection of two computing architectures, in accordance with an embodiment of the invention;

[0015] **FIG. 4** is a diagram of an illustrative model of a computing architecture including illustrative representations of computing systems, in accordance with an embodiment of the invention; and

[0016] **FIG. 5** is a flow chart of an illustrative method for modeling a computing architecture, in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0017] **FIG. 1** is a diagram of a generic computer system with which the invention may be employed. As shown in **FIG. 1**, computing device **120** includes processor **122**, system memory **124**, and system bus **126** that couples various system components including system memory **124** to processor **122**. System memory **124** may include read-only memory (ROM) and/or random access memory (RAM). Computing device **120** may further include hard-drive **128**, which provides storage for computer readable instructions, data structures, program modules, data, and the like. A user (not shown) may enter commands and information into the computing device **120** through input devices such as a keyboard **140** and/or a mouse **142**. A display device

144, such as a monitor, a flat panel display, or the like is also connected to the computing device **120** for output. Display device **144** includes touch screen **145**. Display device **144** may also include other pointing devices such as a light pen, a grid of light beams, or the like for inputting information into processor **122**. Communications device **143**, which may be a modem, provides for communications over network **150**. Processor **122** can be programmed with instructions to interact with other processors so as to perform the techniques described below. The instructions may be received from network **150** or stored in memory **124** and/or hard drive **128**. Processor **122** may be loaded with any one of several computer operating systems such as WINDOWS NT operating system, WINDOWS 2000 operating system, LINUX operating system, and the like.

[0018] As shown in **FIG. 1**, computing device **120** may communicate with other computing devices, such as, for example, server **164** over network **150**. Network **150** may be the Internet, a local area network, a wide area network, or the like. Server **164** may communicate e-mails, web pages, and other data. Server **164** may be operated by an ISP, a corporate computer department, or any other organization or person with a server connected to network **150**. Server **164** is accessible by client stations **168** from which users may send and receive data and browse web pages. Client stations **168** may connect to servers via a local area network (not shown) or using a remote connection device **172** such as, for example, a modem, as is shown in connection with server **164**.

[0019] In an illustrative embodiment of the present invention, horizontal bars represent computing layers and vertical bars represent computing systems. The vertical bars extend through a portion of the horizontal bars and thereby designate the computing layers that the corresponding computing system implements. In this manner, a computing architecture may be modeled that may be more readily understood by both technical and non-technical people. The number of computing layers is limited to a manageable number and each computing system is typically represented by a single vertical bar. Beyond layers and systems, more details of the computing architecture may be modeled onto the computing architecture model, for example, with marks or icons at various positions in the model.

[0020] **FIG. 2** is a diagram of an illustrative layer model for representing layers of a computing architecture. As shown in **FIG. 2**, computing architecture layer model **200** comprises a plurality of horizontal bars, wherein each horizontal bar represents a layer of a computing architecture. In the illustrative model of **FIG. 2**, computing architectural layer model **200** comprises presentation layer bar **210**, business logic layer bar **220**, data layer bar **230**, and infrastructure layer bar **240**.

[0021] Presentation layer bar **210** represents the user interface functionality of a computing system. For example, presentation layer bar **210** may represent a portion of a computing system that displays information on a user interface (e.g., display device **144** of **FIG. 1**). Business logic layer bar **220** represents portions of the computing system directed to business logic functionality. For example, business logic layer **220** may represent a search engine for RealPages^{SM}.com, an online telephone directory application. Data layer bar **230** represents data of the enterprise. For example, data layer bar **230** may represent a database for RealPages^{SM}.com. Infrastructure layer bar **240** represents the infrastructure for implementing computing systems such as security systems, content management systems, and the like.

[0022] Model **200** also includes a first rectangle **250** representing a portal. Portal rectangle **250** may represent an Internet website interface that may be accessed via an Internet access device, such as for example, a browser, a cellular telephone, a two-way Internet wireless communication device, a television compatible browser, and the like.

[0023] Model **200** further includes a second rectangle **260** representing a business to business integration. Such a business to business integration rectangle **260** may represent a business to business exchange, a business to business marketplace, and the like.

[0024] Model **200** is more simplistic than the OSI network model which has seven layers including the following: an application, presentation, session, transport, network, data link, and physical layer. As such, computing architecture model **200** provides a model that can be more easily and quickly grasped. Both technical and non-technical people may quickly understand the concepts of the four layer model. For example, the concept that the presentation layer is for presentation to a user and that the business logic layer performs logic on the data of the data layer is relatively straightforward. This simplified model may be easier to comprehend than the relatively technical concepts of session and transport layers of the OSI model that may be very unfamiliar to non-technical people. While a four layer model is illustrated, the model may include various numbers of layers and may employ other groupings to model a computing architecture. Thus, an enterprise may select a number of layers and groupings consistent with its internal model.

[0025] Connectivity between enterprises can also be modeled. A business to business interchange computing architecture model is illustrated in **FIG. 3**, using the four layer model of **FIG. 1**. As shown in **FIG. 3**, a first computing architecture model **200'** of a first enterprise is in communication with a second computing architecture model **200"** of a second enterprise. The first and second computing architectures models **200'** and **200"** are shown connected by control point icon **300**.

[0026] The computing architecture may be depicted at various levels of detail. Thus, on a computing device, such as computing device **120** of **FIG. 1**, a user (not shown) may select, via mouse **142**, a computing architecture model, a mark, or icon displayed on display device **144**. In response to such selection, further details of the selected computing architecture, mark, or icon are displayed on the display device. For example, selection of control point icon **300** of **FIG. 3** causes further details (not shown) of the control point represented by icon **300** to be displayed. Similarly, selection of computing architecture layer model **200'** causes further details of the computing architecture represented by model **200'** to be displayed.

[0027] An example of such details is shown in computing architecture model **400** of **FIG. 4**. **FIG. 4** is a diagram of an illustrative model of a computing architecture including computing systems. As shown in **FIG. 4**, computing architecture model **400** comprises a plurality of horizontal bars

210, **220**, **230**, **240** in stacked relationship to each other. The horizontal bars represent presentation layer **210**, business logic layer **220**, data layer **230**, and infrastructure layer **240**, respectively. Model **400** also comprises a portal rectangle **250** and a business to business integration rectangle **260** adjacent to presentation layer bar **210**.

[**0028**] Model **400** also comprises a plurality of vertical bars extending through the horizontal bars. Each vertical bar represents a computing system and extends through the horizontal bars an amount corresponding to the computing layers implemented by the computing system represented by the vertical bar. Computing system bar **410***a* extends from data layer bar **230**, through business logic layer bar **220**, through presentation layer bar **210**, and to portal rectangle **250**. Bar **410***a* extends through data layer bar **230**, through business logic layer bar **220**, through presentation layer bar **210**, indicating that the computing system represented by bar **410***a* implements logic corresponding to each of these computing layers. Computing system bar **410***a* contacts portal rectangle **250**, indicating that the computing system represented by bar **410***a* is accessible via a portal. The computing system represented by bar **410***a* may be for example, RealPages^{SM}.com, an online telephone directory application accessible via the Internet. Computing system bar **410***a* may or may not be displayed extending into infrastructure layer bar **240**. Computing system bar **410***a* also includes an icon **450***a* representing that the computing system represented by bar **410***a* includes a data store.

[**0029**] Model **400** further comprises computing system bars **410***b* and **410***c*. Bars **410***b* and **410***c* may represent other computing systems, such as, for example, an electronic bill payment and bill presentation computing system, a new connection order computing system, a change order computing system, a customer registration computing system, an integrated product catalog computing system, and the like.

[**0030**] Model **400** also comprises a computing system bar **410***d* that extends from data layer bar **230**, through business logic layer bar **220**, to presentation layer bar **210**, indicating the computing system represented by bar **410***d* implements logic corresponding to each of these layers. Computing system bar **410***d* does not contact portal rectangle **250**, thereby, indicating that the computing system represented by bar **410***d* is not accessible via a portal. The computing system represented by bar **410***d* may be for example, a legacy system, a billing system, and the like. Computing system bar **410***d* may or may not be displayed extending into infrastructure layer bar **240**. Computing system **410***d* also includes a mark or icon **450***d* indicating that the computing system represented by bar **410***d* includes a data store.

[**0031**] Marks or icons may be used to designate special items of note associated with a particular computing system or with a particular portion of the computing architecture. Thus, computing system bar **410***e* is similar to computing system bar **410***d* but further comprises an icon **430***b* indicating a preselected area of the computing architecture. Icon **430***b* may be a star or other symbol and may be used to identify a portion of the computing architecture that is deserving of special designation. For example, icon **430***b* may indicate a "problem" area in the computing architecture, an area having a technical issue, an area of a developing industry trend, or the like. Icon **430***a* may indicate that there are technical issues within business to business integration, such as, for example, immature industry standards, rudimentary tools, and the like. Icon **430***c* is disposed proximate to data store **450***f* and may indicate that there are technical issues with integrating data into data store **450***f.*

[**0032**] Other such marks or icons may be incorporated into model **400**. Computing system bar **410***c* comprises icon **440** indicating a predefined computing function of the computing architecture. Icon **440** may be any symbol, but typically is a symbol that is indicative of the computing function. As shown, icon **440** is a shopping cart icon and indicates a shopping cart computing function. Icon **440** may be used, for example, to illustrate that many computing systems include a particular computing function and to illustrate consistency or inconsistency between the computing functions of various computing systems.

[**0033**] Computing architecture model **400** also comprises icons **450***f*, **450***g*, and **450***h* representing data stores. As shown, each icon **450***f*, **450***g*, **450***h* is a data store icon and represents a data store that is located in data layer bar **230**. The data layer represented by data layer bar **230** is further divided into sub-layers by notations **461**, **462**, and **463**. Notation **461** defines a sub-layer of data layer bar **230** that represents data stores local to computing systems **410**.. Notation **462** defines a sub-layer of data layer bar **230** that represents data stores containing operational data and notation **463** defines a sub-layer of data layer bar **230** that represents data stores containing analytical data. As can be seen in **FIG. 4**, data stores **450***a* through **450***e* are located in the sub-layer defined by mark **461**. Data store **450***f* is located in the sub-layer defined by mark **462** and data stores **450***g* and **450***h* are located in the sub-layer defined by notation **463**. In this manner, a particular sub-layer of a computing architecture may be indicated, such that both technical and non-technical people may be able to comprehend the area and its relation to the entire computing architecture. In addition, connectivity between computing systems and devices or functions represented by icons may be modeled, as described in more detail below.

[**0034**] Connection lines indicate interconnectivity between data stores. For example, the data stores represented by icons **450***c* and **450***d* are capable of uploading data to the data store represented by icon **450***f.* This interconnectivity between the data stores is represented by connection lines **480**, **481**, respectively. Arrow heads may be used to model a direction of data flow.

[**0035**] To indicate interconnectivity between computing systems **410***a* through **410***e*, horizontal conduit **420** is located in business logic layer bar **220** and extends through each of computing systems **410***a* through **410***f* and represents communication between such computing systems. Communications horizontal conduit **420** may represent a message broker data bus, a local area network, a wide area network, or the like. In this manner, both technical and non-technical people may be able to quickly comprehend the interconnections of computing systems and other devices of the computing architecture.

[**0036**] Computing architecture model **400** also comprises a mark **470** indicating a preselected region of the computing architecture. Mark **470** is a rectangle that encompasses a portion of business logic layer bar **220** and a portion of data layer bar **230**. Mark **470** may indicate a middle tier of computing architecture model **400** that comprises a portion of business logic bar **220** and a portion of data logic bar **230**. With such a region mark, regions of the computing architecture may be indicated that encompass all or portions of layer bars **210** through **240** and all or a portion of the computing systems. For example, middle tier region mark **470** indicates a region of computing architecture that may include system interconnectivity and database synchronization issues.

[0037] Computing architecture model **400** may be manipulated in other ways to present details in a particular section. For example, some horizontal bars may be scaled larger than other bars to allow more room for detail, for marks, to illustrate relative importance, complexity, or the like.

[0038] Thus, computing architecture model **400** can represent a complex computing architecture in a single, easy to comprehend model. The model can be comprehended by both technical and non-technical people alike. Details of the computing architecture can be displayed as necessary upon request. For example, if implemented on computing device **120** of **FIG. 1**, a user may select a computing system of computing architecture model **400** of **FIG. 4**. Upon selection of a computing system, the selected computing system may be displayed as a model similar to computing architecture model **400**. As such, a user can "drill-down" to an appropriate level of detail, and the information is displayed in-a consistent manner. Accordingly, the user does not have to learn a new model for a computing architecture; rather, the same basic model is used at multiple levels.

[0039] **FIG. 5** is a flow chart of an illustrative method for representing a computing architecture in a manner consistent with that described above in connection with **FIG. 4**. The method may be performed by a computer processor, such as, for example, processor **122** of **FIG. 1**. It is, however, contemplated that the method may be performed other ways.

[0040] As shown in **FIG. 5**, at step **500**, processor **122** identifies a number of computing layers corresponding to the computing architecture. The number of layers may be predefined and constant for a given enterprise and the number of layers may be determined based on a lookup from a database or from analysis of the functionality of computing systems.

[0041] At step **510**, processor **122** displays on display device **144** a plurality of horizontal bars in stacked relationship to each other, wherein each horizontal bar represents a computing layer, as determined in step **500**. The layers may further include rectangle boxes, as described above, to represent portals and/or interchanges.

[0042] At step **520**, processor **122** identifies a plurality of computing systems of the computing architecture. The plurality of computing systems may be identified via a database containing information about the computing systems of the computing architecture or an alternative form of mapping. Further, processor **122** may identify the computing system by analyzing existing computing systems that can be accessed, for example, via network **150**.

[0043] At step **530**, processor **122** identifies computing layers implemented by each computing system. The layers implemented by each computing system may be may be determined based on a lookup from a database or from analysis of the functionality of each computing system.

[0044] At step **540**, processor **122** displays the identified computing systems as a plurality of vertical bars over at least a portion of the horizontal bars. Each vertical bar represents a computing system and each vertical bar extends through the horizontal bars an amount corresponding to the computing layers implemented by the computing system represented by the vertical bar. Further, computing systems that implement access via a portal are displayed as a vertical bar contacting the portal rectangle and computing systems that implement a business to business interchange are displayed as a vertical bar contacting the business to business interchange rectangle.

[0045] At optional step **550**, processor **122** displays an icon or mark on an area of display device **144** (and computing architecture) that corresponds to a device or function represented by the icon. The icons may represent a preselected area of the computing architecture, a data store of the computing architecture, a predefined computing function, a communication link between computing systems, as described above, and the like. Icons may be displayed based on a database, a mapping, or via analysis of existing computing systems.

[0046] At optional step **560**, processor **122*a*** receives a selection of a computing system. For example, a user may select a computing system using touch screen **145**, mouse **142**, or keyboard **140**.

[0047] At optional step **570**, sub-systems of the selected computing system are displayed using horizontal and vertical bars as is described above.

[0048] Thus, there has been described a system and method for flexibly and dynamically representing a computing architecture at various levels of detail. The method displays an easy to understand model of a computing architecture that is useful for both technical and non-technical people.

[0049] The invention may be embodied in the form of program code (i.e., instructions) stored on a computer-readable medium, such as a magnetic, electrical, or optical storage medium, including without limitation a floppy diskette, CD-ROM, CD-RW, DVD-ROM, DVD-RAM, magnetic tape, flash memory, hard disk drive, or any other machine-readable storage medium, wherein, when the program code is loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the invention. The invention may also be embodied in the form of program code that is transmitted over some transmission medium, such as over electrical wiring or cabling, through fiber optics, over a network, including the Internet or an intranet, or via any other form of transmission, wherein, when the program code is received and loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the invention. When implemented on a general-purpose processor, the program code combines with the processor to provide a unique apparatus that operates analogously to specific logic circuits.

[0050] It is noted that the foregoing description has been provided merely for the purpose of explanation and is in no way to be construed as limiting of the invention. While the invention has been described with reference to illustrative embodiments, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Further, although the invention has been described herein with reference to particular structure, methods, and embodiments, the invention is not intended to be limited to the particulars disclosed herein; rather, the invention extends to all structures, methods and uses that are within the scope of the appended claims. Those skilled in the art, having the benefit of the teachings of this specification, may effect numerous modifications thereto and changes may be made without departing from the scope and spirit of the invention, as defined by the appended claims.

1. A method for modeling a computing architecture, the method comprising:

identifying a plurality of computing layers, each computing layer representing a functional layer of the computing architecture;

identifying a plurality of computing systems;

identifying, for each of the plurality of computing systems, at least one of the plurality of computing layers that is implemented by the computing system;

displaying a first plurality of bars in stacked relationship to each other, each of the first plurality of bars representing a computing layer of the plurality of computing layers; and

displaying a second plurality of bars substantially orthogonal to the first plurality of bars and over at least a portion of the first plurality of bars, each of the second plurality of bars representing a computing system, wherein each of the second plurality of bars extends through a portion of the first plurality of bars an amount corresponding to the identified at least one of the computing layers that is implemented by the computing system represented by the bar.

2-24. (canceled)

* * * * *