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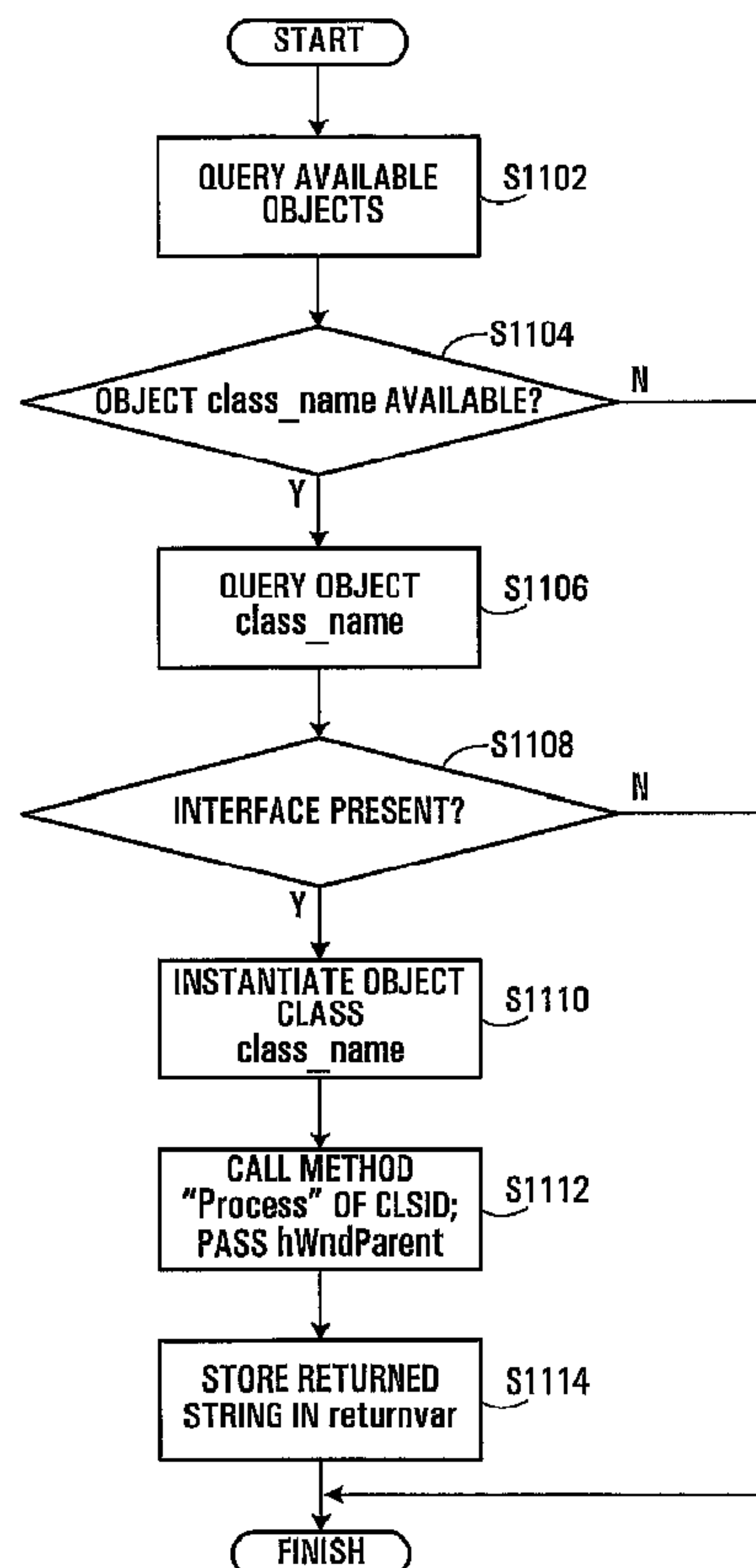
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(54) Title: MOBILE DEVICE HAVING EXTENSIBLE SOFTWARE FOR PRESENTING SERVER-SIDE APPLICATIONS,
SOFTWARE AND METHODS



(57) Abrégé/Abstract:

Data from an application executing at a computing device is presented at a remote wireless device, by providing the device an application definition file, containing a definition of a user interface for the application at the mobile device. Based on the definition



(57) **Abrégé(suite)/Abstract(continued):**

file, the wireless device may receive data from the application and present an interface for the application. Virtual machine software at the mobile device interprets the application definition file. This virtual machine software is extensible to take advantage of other software and/or hardware at the device.

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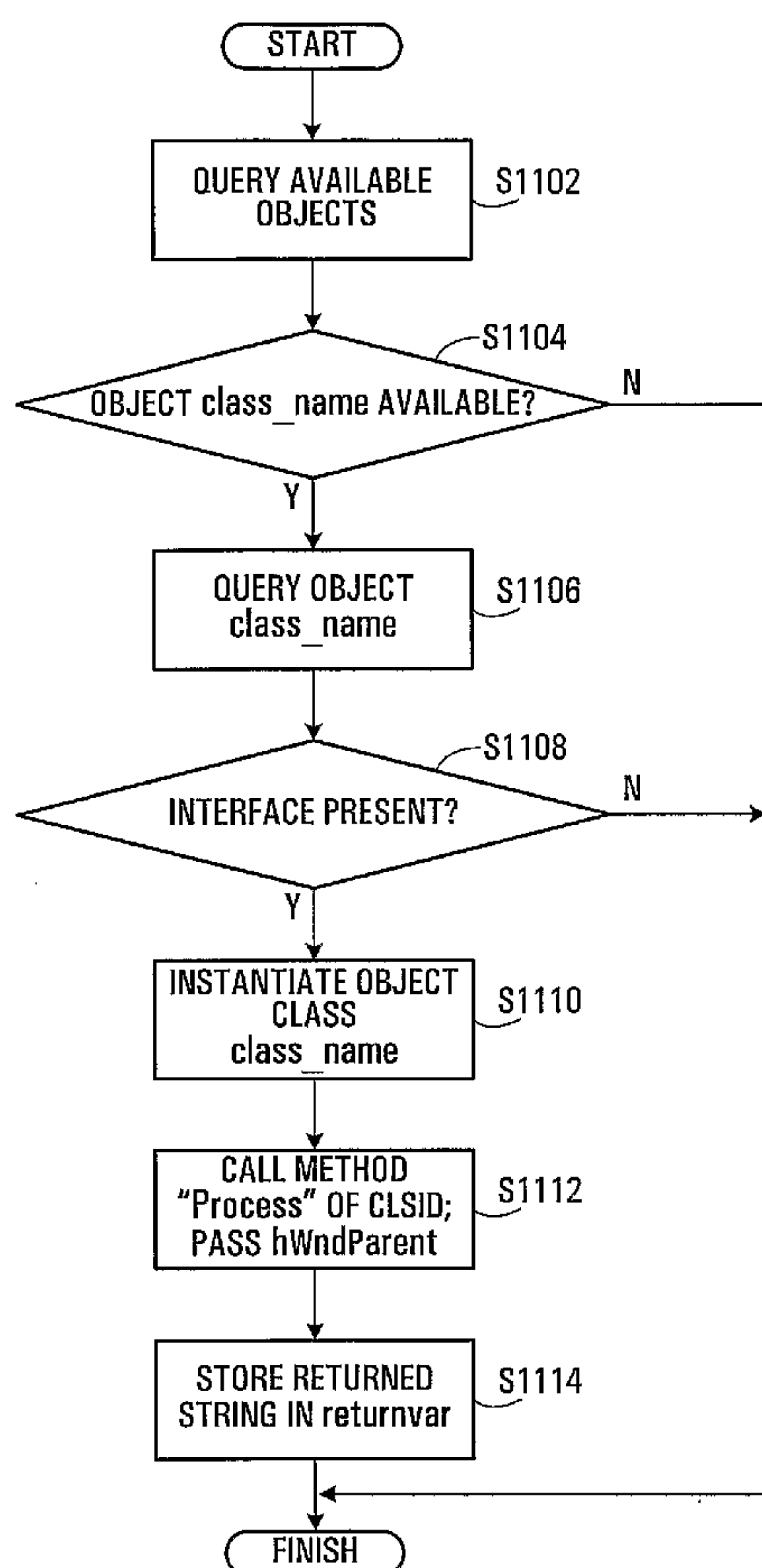
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(54) Title: MOBILE DEVICE HAVING EXTENSIBLE SOFTWARE FOR PRESENTING SERVER-SIDE APPLICATIONS, SOFTWARE AND METHODS



(57) Abstract: Data from an application executing at a computing device is presented at a remote wireless device, by providing the device an application definition file, containing a definition of a user interface for the application at the mobile device. Based on the definition file, the wireless device may receive data from the application and present an interface for the application. Virtual machine software at the mobile device interprets the application definition file. This virtual machine software is extensible to take advantage of other software and/or hardware at the device.

WO 2006/089391 A1

WO 2006/089391 A1



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FIELD OF THE INVENTION

[0002] The present invention relates to software, devices and methods allowing varied mobile devices to interact with server side software applications.

BACKGROUND OF THE INVENTION

[0003] Wireless connectivity is a feature of the modern telecommunications environment. An increasing range of people are using a wide variety of wireless data networks to access corporate data applications.

[0004] However, there are numerous competing mobile devices that can be used to achieve this. Each device has its own operating system and its own display characteristics. Operating systems are not mutually compatible, nor are the display characteristics--some are color, some are black and white, some are text-only, some are pictorial.

[0005] At the same time, an increasing number of mobile device users are people without a technical background or high level of educational achievement. Such people are often intimidated by the need to run complex installation

programs. Furthermore, at present, such installation programs generally depend on cable connections to a personal computer by the means of a `cradle` or other such device.

[0006] U.S. Patent Publication No. US 2003/0060896 discloses a mechanism allowing server-side applications to be presented at multiple wireless devices with minimal modification of the application at the server. As disclosed, how an application is presented at a mobile device is defined by a text based application definition file. The definition file describes how an application is to be presented at the mobile device; the format of transactions over the wireless network; and a format of data related to the application to be stored at the mobile device. A virtual machine software component at the mobile device interprets the definition file and presents an interface to the application in accordance with the definition file. Conveniently, the application definition file may be independent of the particular type of mobile device, while virtual machine software components specific to the mobile device may be created.

[0007] This approach, while flexible in many ways, is somewhat limited. For example, how an application may be presented at the mobile device, and what resources of the mobile device may be used is limited by the nature of the virtual machine software at the device. The virtual machine software component is typically written with a specific mobile device with specific hardware in mind. As the mobile device is expanded to, for example, include new hardware or local software applications the server side application can typically not take advantages of the new hardware and software. Of course, the virtual machine software component could be rewritten (or recompiled). This, however, is cumbersome and would require many versions of virtual machine software specific to many different hardware configurations.

[0008] Accordingly, there is a need for virtual machine software that is extensible.

SUMMARY

[0009] In one aspect, data from an application executing at a computing device is presented at a remote wireless device, by providing the device an application definition file, containing a definition of a user interface for the application at the mobile device. Based on the definition file, the wireless device may receive data from the application and present an interface for the application. Virtual machine software at the mobile device interprets the application definition file. This virtual machine software is extensible to takes advantage of other software and/or hardware at the device.

[0010] Preferably, the application definition file is an XML file. Similarly, application specific network messages provided to the device are also formed using XML. Specific XML tags are used to execute software at the mobile device, but external to the virtual machine software. In particular, object classes external to the virtual machine may be instantiated and their methods performed.

[0011] In another aspect, there is provided, a method of presenting data from an application executing at a computing device at a wireless mobile device remote from the computing device, the method comprising: receiving at the mobile device, a representation of a text file defining a user interface and actions to be taken in response to user interaction with the user interface or received data from the application; receiving data from the application; executing virtual machine software at the mobile device to present the user interface and the received data, in accordance with the text file; wherein at least one of the actions in the text file specifies execution of a software component separate from the virtual machine software, identified in the text file; querying operating system software executing at the wireless mobile device as to whether the software component identified in the text file is available at the device; and if the querying indicates that the software component is available at the wireless mobile device, executing the software component at the device.

[0012] In another aspect, there is provided, a wireless mobile device comprising: a processor; computer readable memory in communication with the processor, storing operating system software and virtual machine software controlling operation of the wireless mobile device, the virtual machine software comprising: a parser for receiving a text file; a screen generation engine, for presenting at least one screen at the wireless

mobile device in accordance with the text file; instructions for querying the operating system software as to whether a software component, which is identified in the text file and is separate from the virtual machine software, is available at the wireless mobile device; and an event handler for processing events arising in response to user interaction with the at least one screen in accordance with the text file, the event handler operable to execute the software component if, upon executing the instructions, it is determined that the software component is available at the wireless mobile device.

[0012A] In another aspect, there is provided a method of presenting data from an application executing at a computing device at a wireless mobile device remote from the computing device, the method comprising: receiving at the mobile device, a representation of a text file defining a user interface and actions to be taken in response to user interaction with the user interface or received data from the application; receiving data from the application; executing virtual machine software at the mobile device to present the user interface and the received data, in accordance with the text file, wherein at least one of the actions in the text file specifies execution of a software component separate from the virtual machine software, identified in the text file and loaded at the device, and wherein the software component is in the form of an object class; creating an instance of the object class; and executing the software component at the device.

[0012B] In another aspect, there is provided, a wireless mobile device comprising: a processor; computer readable memory in communication with the processor, storing operating system software and virtual machine software controlling operation of the wireless mobile device, the virtual machine software comprising: a parser for receiving a text file; a screen generation engine, for presenting at least one screen at the wireless mobile device in accordance with the text file; an event handler for processing events arising in response to user interaction with the at least one screen in accordance with the text file, the event handler operable to execute the software component separate from the virtual machine software, identified in the text file and loaded at the device, and wherein the software component is in the form of an object class.

[0013] Other aspects and features will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] In the figures which illustrate by way of example only, embodiments of the present invention,

[0015] **FIG. 1** schematically illustrates a mobile device, exemplary of an embodiment of the present invention, including virtual machine software, further exemplary of an embodiment of the present invention;

[0016] **FIG. 2** further illustrates the organization of exemplary virtual machine software at the mobile device of **FIG. 1**;

[0017] **FIG. 3** illustrates an operating environment for the device of **FIG. 1**;

[0018] **FIG. 4** illustrates the structure of example application definitions stored at a server of **FIG. 2** used by the device of **FIG. 1**;

[0019] **FIG. 5** schematically illustrates the formation of application definition files at a middleware server of **FIG. 2**;

[0020] **FIG. 6** schematically illustrates the middleware server of **FIG. 2**, exemplary of an embodiment of the present invention, including an application definitions database, further exemplary of an embodiment of the present invention;

[0021] **FIG. 7** is a flow diagram illustrating the exchange of sample messages passed between a mobile device, middleware server and application server of **FIG. 2**;

[0022] **FIGS. 8-11** illustrate steps performed at a mobile device under control of virtual machine software of **FIG. 2**;

[0023] **FIG. 12** illustrates the format of messages exchanged in the message flow of **FIG. 7**;

[0024] **FIGS. 13A and 13B** illustrates a presentation of a user interface for a sample application at a mobile device;

[0025] **FIG. 14, 15 and 16A-16B** illustrate a sample portion of an application definition file defining a user interface illustrated in **FIG. 13**; and

[0026] **FIGS. 17A-17PPP** contain Appendix "A" detailing example XML entities understood by the virtual machine software of the mobile device of **FIG. 1**.

DETAILED DESCRIPTION

[0027] **FIG. 1** illustrates a mobile device **10**, exemplary of an embodiment of the present invention. Mobile device **10** may be any conventional mobile device, modified to function in manners exemplary of the present invention. As such, mobile device **10** includes a processor **12**, in communication with a network interface **14**, storage memory **16**, and a user interface **18** typically including a keypad and/or touch-screen. Network interface **14** enables device **10** to transmit and receive data over a wireless network **22**. Mobile device **10** may be, for example, be a Research in Motion (RIM) two-way paging device, a WinCE based device, a PalmOS device, a WAP enabled mobile telephone, or the like. Memory **16** of device **10** stores a mobile operating system such as the PalmOS, or WinCE operating system software **20**. Operating system software **20** typically includes graphical user interface and network interface software having suitable application programmer interfaces ("API"s) for use by other applications executing at device **10**.

[0028] Memory at device **10** further stores virtual machine software **24**, exemplary of an embodiment of the present invention. Virtual machine software **24**, when executed by mobile device **10** enables device **10** to present an interface for server side applications provided by a middleware server, described below. Specifically, virtual machine software **24** interprets a text application definition file defining a user interface **18** controlling application functionality, and the display format (including display flow) at device **10** for a particular server-side application; the format of data to be exchanged over the wireless network for the application; and the format of data to be stored locally at device **10** for the application. Virtual machine software **24** uses operating system software **20** and associated APIs to interact with device **10**, in accordance with the received application definition file. In this way, device **10** may present interfaces for a variety of applications, stored at a server. From the perspective of operating system software **20**, virtual machine software **24** is viewed as another application resident at device **10**. Moreover, multiple wireless devices each having a similar virtual machine software **24** may use a common server side application in combination with an application definition, to present a user interface and program flow specifically adapted for the device.

[0029] As such, and as will become apparent, the exemplary virtual machine software **24** is specifically adapted to work with the particular mobile device **10**. Thus if device **10** is a RIM Blackberry device, virtual machine software **24** is a RIM virtual machine. Similarly, if device **10** is a PalmOS or WinCE device, virtual machine software **24** would be a PalmOS or a WinCE virtual machine. As further illustrated in FIG. 1, virtual machine software **24** is capable of accessing local storage **26** at device **10**.

[0030] Other applications, libraries, and software may also be present within memory **16** or local storage **26**, and are not specifically illustrated. For example, device **10** may store and execute personal information management (PIM) software, including calendar and contact management applications. Similarly, device **10** could store and execute software allowing device **10** to perform a number of functions. Software could, for example, interact with the hardware at device **10** to allow device **10** to act as a multimedia player; allowing device **10** to print; allowing device **10** to interact with other incorporated hardware not specifically

illustrated, including but not limited to a Bluetooth interface; a Global Positioning Satellite (GPS) Receiver; and the like. In the depicted embodiment, however, memory **16** stores software components in the form of object classes **29** that may be used to extend the functionality of virtual machine software **24**. As will become apparent these external software components in the form of object classes **29** allow virtual machine software **24** to become extensible. Object classes **29** may, for example, allow virtual machine software to access additional hardware or software local to device **10**.

[0031] As detailed below, an exemplary application definition file may be formed using a mark-up language, like XML. In accordance with an embodiment of the present invention, defined XML entities are understood by the virtual machine software **24**. Defined XML entities are detailed in Appendix "A", hereto and Appendix "A" of U.S. Patent Publication **2003/0060896**. The defined XML entities are interpreted by the virtual machine software **24**, and may be used as building blocks to present server-side applications at mobile device **10**, as detailed herein.

[0032] Specifically, as illustrated in **FIG. 2**, virtual machine software **24** includes a conventional XML parser **61**; an event handler **65**; a screen generation engine **67**; and object classes **69** corresponding to XML entities supported by the virtual machine software **24**, and possibly contained within an application definition **28**. Supported XML entities are detailed in Appendix "A" hereto. A person of ordinary skill will readily appreciate that those XML entities identified in Appendix "A" are exemplary only, and may be extended, or shortened as desired.

[0033] XML parser **61** may be formed in accordance with the Document Object Model, or DOM, the specification of which is publicly distributed online by the World Wide Web Consortium Standards Organization. Parser **61** enables virtual machine software **24** to read an application definition file. Using the parser, the virtual machine software **24** may form a binary representation of the application definition file for storage at the mobile device, thereby eliminating the need to parse text each time an application is used. Parser **61** may convert each XML tag contained in the application definition file, and its associated data to tokens, for later processing. As will become apparent, this may avoid the need to repeatedly parse the text of an application definition file.

[0034] Screen generation engine **67** displays initial and subsequent screens at the mobile device, in accordance with an application definition **28**, as detailed below.

[0035] Event handler **65** of virtual machine software **24** allows device **10** under control of virtual machine software **24** to react to certain external events. Example events include user interaction with presented screens or display elements, incoming messages received from a wireless network, or the like.

[0036] Object classes **69** also form part of virtual machine software **24** and define objects that allow device **10** to process each of the supported XML entities at the mobile device. Each of object classes **69** includes attributes used to store parameters defined by the XML file, and functions allowing the XML entity to be processed at the mobile device, as detailed in Appendix "A", for each supported XML entity. So, as should be apparent, supported XML entities are extensible. Virtual machine software **24** may be expanded to support XML entities not detailed in Appendix "A". Corresponding object classes could be added to virtual machine software **24**.

[0037] As detailed below, upon invocation of a particular application at mobile device **10**, the virtual machine software **24** presents an initial screen based on the contents of the application definition **28** for the application. Screen elements are created by screen generation engine **67** by creating instances of corresponding object classes for defined elements, as contained within object classes **69**. The object instances are created using attributes contained in the application definition **28**. Thereafter the event handler **65** of the virtual machine software **24** reacts to events for the application. Again, the event handler consults the contents of the application definition file for the application in order to properly react to events. Events may be reacted to by creating instances of associated "action" objects, from object classes **69** of virtual machine software **24**.

[0038] Similarly, object classes **69** of virtual machine software **24** further include object classes corresponding to data tables and network transactions defined in the Table Definition and Package Definition sections of Appendix "A". At run time,

instances of object classes corresponding to these classes are created and populated with parameters contained within application definition file, as required.

[0039] Using this general description, persons of ordinary skill in the art will be able to form virtual machine software **24** for any particular device. Typically, virtual machine software **24** may be formed using conventional object oriented programming techniques, and existing device libraries and APIs, as to function as detailed herein. As will be appreciated, the particular format of screen generation engine **67**, object classes **69** will vary depending on the type of virtual machine software, its operating system and API available at the device. Once formed, a machine executable version of virtual machine software **24** may be loaded and stored at a mobile device, using conventional techniques. It can be embedded in ROM, loaded into RAM over a network, or from a computer readable medium.

[0040] As so far described, however, operation of virtual machine software **24** is limited by those object classes **69** forming part of virtual machine software **24**. However, exemplary of embodiments of the present invention object classes **29** not forming part of virtual machine software **24**, are further loaded within memory **16** of device **10**. Conveniently, object classes **29** may be created by a user (or administrator) of device **10** do not rely on access to the source code for virtual machine software **24**.

[0041] Instead, as will become apparent, virtual machine software **24** includes a software code portion that instantiates identified ones of object classes **29**, external to virtual machine software **24** and executes methods contained in the object classes **29**. As such, virtual machine software **24** may be extended through the addition of additional object classes.

[0042] Although, in the preferred embodiment the virtual machine software **24** and software forming object classes **29** are formed using object oriented structures, persons of ordinary skill will readily appreciate that other approaches could be used to form suitable virtual machine software. For example, object classes **69** forming part of the virtual machine could be replaced by equivalent functions, data structures or subroutines formed using a conventional (i.e. non-object oriented) programming environment. Object classes **29** could be similarly replaced with

other software components in the form of libraries, sub-routines, programs, combinations thereof, or the like.

[0043] Operation of virtual machine software **24** under control of an application definition containing various XML definitions exemplified in Appendix "A" is further detailed below.

[0044] **FIG. 3** illustrates the operating environment for a mobile device **10**. Further example mobile devices **30**, **32** and **34** are also illustrated in **FIG. 3**. These mobile devices **30**, **32** and **34** are similar to device **10** and also store and execute virtual machine software exemplary of an embodiment of the present invention.

[0045] Virtual machine software like that stored at device **10**, executes on each mobile device **10**, **30**, **32**, **34**, and communicates with a middleware server **44** by way of example wireless networks **36** and **38** and network gateways **40** and **42**. Example gateways **40** and **42** are generally available as a service for those people wishing to have data access to wireless networks. An example network gateway is available from Broadbeam Corporation in association with the trademark SystemsGo!. Wireless networks **36** and **38** are further connected to one or more computer data networks, such as the Internet and/or private data networks by way of gateway **40** or **42**. As will be appreciated, the invention may work with many types of wireless networks. Middleware server **44** is in turn in communication with a data network, that is in communication with wireless network **36** and **38**. The communication used for such communication is via TCP/IP over an HTTP, COM or .NET transport. As could be appreciated, other network protocols such as X.25 or SNA could equally be used for this purpose.

[0046] Devices **10**, **30**, **32**, and **34** communicate with middleware server **44** in two ways. First, virtual machine software **24** at each device may query middleware server **44** for a list of applications that a user of an associated mobile device **10**, **30**, **32** or **34** can make use of. If a user decides to use a particular application, device **10**, **30**, **32** or **34** can download a text description, in the form of an application definition file, for the application from the middleware server **44** over its wireless interface. As noted, the text description is preferably formatted using XML. Second, virtual machine software **24** may send, receive, present, and locally store data

related to the execution of applications, or its own internal operations. The format of exchanged data for each application is defined by an associated application definition file. Again, the exchanged data is formatted using XML, in accordance with the application definition file.

[0047] Middleware server **44**, in turn, stores text application definition files for those applications that have been enabled to work with the various devices **10**, **30**, **32**, and **34** using virtual machine software **24** in a pre-defined format understood by virtual machine software **24**. Software providing the functions of the middleware server **44**, in the exemplary embodiment is written in C#, using an SQL Server or MySQL database.

[0048] As noted, text files defining application definitions and data may be formatted in XML. For example XML version 1.0, detailed in the XML version 1.0 specification third edition, dated Feb. 4, 2004, and publicly distributed by the World Wide Web Consortium Standards Organization, may be used. However, as will be appreciated by those of ordinary skill in the art, the functionality of storing XML description files is not dependent on the use of any given programming language or database system.

[0049] Each file containing an application definition **28** is formatted according to defined rules and uses pre-determined XML mark-up tags known by both virtual machine software **24**, and complementary middleware server software **68**. Tags define XML entities used as building blocks to present an application at a mobile device. Knowledge of these rules, and an understanding of how each tag and section of text should be interpreted, allows virtual machine software **24** to process an XML application definition and thereafter execute an application, as described below. Virtual machine software **24** effectively acts as an interpreter for a given application definition file.

[0050] **FIG. 4** illustrates an example format for an XML application definition **28**. As illustrated, the example application definition **28** for a given device and application includes three components: a user interface definition section **48**, specific to the user interface for the device **10**, and defining the format of screen or

screens for the application and how the user interacts with them; a network transactions definition section **50** defining the format of data to be exchanged with the application; and a local data definition section **52** defining the format of data to be stored locally on the mobile device by the application.

[0051] Defined XML mark-up tags correspond to XML entities supported at a device, and are used to create an application definition **28**. The defined tags may broadly be classified into three categories, corresponding to the three sections **48**, **50** and **52** of an application definition **28**.

[0052] Example XML tags and their corresponding significance are detailed in Appendix "A". As noted above, virtual machine software **24** at a mobile device includes object classes corresponding to each of the XML tags. At run time, instances of the objects are created as required.

[0053] Broadly, the following example XML tags may be used to define the user interface definition:

SCREEN -- this defines a screen. A SCREEN tag pair contains the definitions of the user interface elements (buttons, radio buttons, and the like) and the events associated with the screen and its elements

BUTTON -- this tag defines a button and its associated attributes

LIST -- this tag defines a list box

CHOICEBOX -- this tag defines a choice item, that allows selection of a value from predefined list

MENU -- the application developer will use this tag to define a menu for a given screen

EDITBOX -- this tag defines an edit box

TEXT ITEM -- this tag describes a text label that is displayed

CHECKBOX -- this tag describes a checkbox

HELP -- this tag can define a help topic that is used by another element on the screen

IMAGE -- this tag describes an image that appears on those displays that support images

ICON -- this tag describes an icon

EVENT -- this defines an event to be processed by the virtual machine software. Events can be defined against the application as a whole, individual screens or individual items on a given screen. Sample events would be receipt of data over the wireless interface, or a edit of text in an edit box

ACTION -- this describes a particular action that might be associated with an event handler. Sample actions would be navigating to a new window or displaying a message box.

[0054] The second category of example XML tags describes the network transaction section **50** of application definition **28**. These may include the following example XML tags;

TABLEUPDATE--using this tag, the application developer can define an update that is performed to a table in the device's local storage. Attributes allow the update to be performed against multiple rows in a given table at once;

PACKAGEFIELD--this tag is used to define a field in a data package that passes over the wireless interface

[0055] The third category of XML tags used to describe an application are those used to define a logical database that may be stored at the mobile device. The tags available that may be used in this section are:

TABLE--this tag, and its attributes, define a table. Contained within a pair of TABLE tags are definitions of the fields contained in that table. The attributes of a table control such standard relational database functions as the primary key for the table.

FIELD--this tag describes a field and its attributes. Attributes of a field are those found in a standard relational database system, such as the data type, whether the field relates to one in a different table, the need to index the field, and so on.

[0056] As well as these XML tags, virtual machine software **24** may, from time to time, need to perform certain administrative functions on behalf of a user. In order to do this, one of object classes **69** has its own repertoire of tags to communicate its needs to the middleware server **44**. Such tags differ from the previous three groupings in that they do not form part of an application definition file, but are solely used for administrative communications between the virtual machine software **24** and the middleware server **44**. These tags are again detailed in U.S. Patent Publication US 2003/0060896.

[0057] One specific type of ACTION understood by virtual machine software **24** is referred to as a "INTEGRATION" action. This action is identified as an ACTION having an ACTION TYPE="INTEGRATION" tag, as more particularly exemplified in FIGS. 17WW and 17XX.

[0058] Specifically, the format of the TYPE tag identifying the INTEGRATION action takes the form

```
<ACTION TYPE ="INTEGRATION" CLSID = "class_name"
SAVENAME="returnvar" SAVE="true/false"> my input text</ACTION>
```

[0059] That is, the INTEGRATION tag takes as arguments, the name of an external one of classes **29** to be instantiated assigned to CLSID=*class_name*, and the name of a local variable, *returnvar*, used by virtual machine software **24** in

which results passed by the execution should be stored. As well, the value assigned to SAVE is boolean and specifies whether or not the data returned by the instantiated class should be saved.

[0060] Notably, *class_name* identifies one of classes **29** by name. The name of the class is assigned as described below. The name of the local variable corresponds to the name of a variable defined in section **52** of the application definition **28**. Finally, the contents of the ACTION element (i.e. *my input text*) is passed to the instantiated one of classes **29**, as detailed below.

[0061] The exact way in which external accessible objects are formed and may be accessed by virtual machine software **24** will typically depend on the operating system software **20** of device **10** in association with which virtual machine software **24** is executing. Virtual machine software **24** should, however, be able to identify the external object and instantiate it. Optionally, virtual machine software **24** should be able to verify that the external object class has an interface that conforms to virtual machine software **24**.

[0062] For example, virtual machine software **24** written and executing in a WindowsCE environment, object classes developed using the component object model (COM) may be accessible. The component object model (COM) is described in D. Box, Essential COM, (1997: Addison-Wesley Professional) ISBN: **0201634465**.

[0063] Briefly, object classes developed using COM are registered with the WindowsCE operating system. The operating system maintains a list of the COM objects that have been created. Additionally, object classes developed in accordance with the COM include one or more defined interface.

[0064] Other operating systems executing on mobile devices expose classes that may be accessible by virtual machine software **24** in different ways. For example, RIM and PalmOS operating systems expose various PIM object stores as Java Classes or C++ classes. A person of ordinary skill will readily appreciate how

such classes may be used by virtual machine software **24** created for such an operating system.

[0065] Object classes **29** written in accordance with the COM, exemplary of embodiments of the present invention may register their name with the underlying operating system, and further include an interface. In the preferred embodiment, the interface takes has a name known by virtual machine software **24**. For example, the interface may take the name IAIRIXIntegrationPoint. In the preferred embodiment the interface defines a function with name HRESULT that takes parameter hWndParent, InputString, and OutputString. Variables InputString, and OutputString are populated by values passed virtual machine software **24** identifying attributes of the *string* SAVE_NAME.

[0066] The value of hWndParent identifies the main window generated by virtual machine software **24** as a result of the application definition file instantiating the object class. The value may be used by the method of the instantiated class **29** to embed controls on or as a parent window to sub windows that the method creates.

[0067] To summarize, the interface takes the form

```
interface IAIRIXIntegrationPoint : IDispatch
{
    [id(1), helpstring("method Process")] HRESULT Process(VARIANT
    hWndParent, BSTR InputString, BSTR* OutputString);
};
```

As will be appreciated, IDispatch signifies a standard COM interface; id(1) signifies that the method Process is listed as the first method exposed on the interface; and helpstring may be used by a debugging tool.

[0068] The method Process, in turn, performs the function to be implemented by the external object class to perform the desired functionality, extending the functions performed by virtual machine software **24**. For example, method "Process" could provide an interface to other object classes, or hardware at device **10**. The method "Process" could for example gather a signature, a fingerprint, GPS co-ordinates, or virtually any other function that can be performed by device **10**. Conveniently, the method "Process" may make use of the string data contained as

my input text and forming part of the XML element giving rise to the instantiating of the class.

[0069] Upon completion of the method, results should be formatted by the method and placed in the variable `OutputString`, so the results may be passed back to virtual machine software 24 for further processing. In the exemplary embodiment, the content of `OutputString` is XML formatted, so that it may be easily further processed by machine software 24 (or alternatively middleware server 44).

[0070] The value of `Process` returned by the method call may identify successful execution of the method. In response to an error code, virtual machine software 24 may log an error and report that error to the user of device 10 through a standard error message dialog.

[0071] As will be apparent, the name of each class 29 is identified in the `PROGID` variable used as each class is created and will be registered in accordance with COM.

[0072] FIG. 5 illustrates the organization of application definitions at middleware server 44 and how middleware server 44 may form an application definition 28 (FIG. 4) for a given device 10, 30, 32 or 34. In the illustration of FIG. 5, only two mobile devices 10 and 30 are considered. Typically, since network transactions and local data are the same across devices, the only piece of the application definition that varies for different devices is the user interface definition.

[0073] So, middleware server 44 stores a master definition 58 for a given server side application. This master definition 58 contains example user interface descriptions 48, 54, 56 for each possible mobile device 10, 30, 32; descriptions of the network transactions 50 that are possible and data descriptions 52 of the data to be stored locally on the mobile device. Preferably, the network transactions 50 and data descriptions 52 will be the same for all mobile devices 10, 30 and 32.

[0074] For device 10, middleware server 44 composes an application definition 28 by querying the device type and adding an appropriate user interface description 48 for device 10 to the definitions for the network transactions 50 and the data 52. For device 30, middleware server 44 composes the application definition by adding

the user interface description **54** for device **10** to the definitions for the network transactions **50** and data **52**.

[0075] The master definition **58** for a given application is created away from the middleware server and loaded onto the middleware server by administrative staff charged with its operation. Master definition files could be created either by use of a simple text editor, or by a graphical file generation tool. Such a tool might generate part or all of the file, using knowledge of the XML formatting rules, based on the user's interaction with screen painters, graphical data definition tools and the like.

[0076] **FIG. 6** illustrates the organization of middleware server **44** and associated master definitions. Middleware server **44** may be any conventional application server, modified to function in manners exemplary of the present invention. As such, middleware server **44** includes a processor **60**, in communication with a network interface **66** and storage memory **64**. Middleware server **44** may be, for example, be a Windows NT server, a Sun Solaris server, or the like. Memory of middleware server **44** stores an operating system such as Windows NT, or Solaris operating system software **62**.

[0077] Network interface **66** enables middleware server **44** to transmit and receive data over a data network **63**. Transmissions are used to communicate with both the virtual machine software **24** (via the wireless networks **36, 38** and wireless gateways **40,42**) and one or more application servers, such as application server **70**, that are the end recipients of data sent from the mobile client applications and the generators of data that is sent to the mobile client applications.

[0078] Memory at middleware server **44** further stores software **68**, exemplary of an embodiment of the present invention. Middleware server software **68**, when executed by middleware server **44** enables the middleware server to understand and compose XML data packages that are sent and received by the middleware server. These packages may be exchanged between middleware server **44** and the virtual machine software **24**, or between the middleware server **44** and the application server **70**.

[0079] As described above, communication between the application server **70** and the middleware server **44** uses HTTP running on top of a standard TCP/IP

stack. An HTTP connection between a running application at the application server **70** and the middleware server **44** is established in response to the application at a mobile device presenting the application. The server side application provides output to middleware server **44** over this connection. The server side application data is formatted into appropriate XML data packages understood by the virtual machine software **24** at a mobile device by the server side application.

[0080] That is, a server side application (or an interface portion of the application) formats application output into XML in a manner consistent with the format defined by the application definition file for the application. Alternatively, an interface component separate from the application could easily be formed with an understanding of the format and output for a particular application. That is, with a knowledge of the format of data provided and expected by an application at application server **70**, an interface component could be produced using techniques readily understood by those of ordinary skill. The interface portion could translate application output to XML, as expected by middleware server **44**. Similarly, the interface portion may translate XML input from a mobile device into a format understood by the server side application.

[0081] The particular identity of the mobile device on which the application is to be presented may be identified by a suitable identifier, in the form of a header contained in the server side application output. This header may be used by middleware server **44** to forward the data to the appropriate mobile device. Alternatively, the identity of the connection could be used to forward the data to the appropriate mobile device.

[0082] **FIG. 7** illustrates a flow diagram detailing data (application data or application definition files **28**) flow between mobile device **10** and middleware server **44**, in manners exemplary of an embodiment of the present invention.

[0083] For data requested from middleware server **44**, device **10**, under software control by virtual machine software **24** makes requests to middleware server **44** (also illustrated in **FIG. 2**), which passes over the wireless network **36** through network gateway **40**. Network gateway **40** passes the request to the middleware server **44**. Middleware server **44** responds by executing a database

query on its database **46** that finds which applications are available to the user and the user's mobile device. For data passed from middleware server **44** to device **10**, data is routed through network gateway **40**. Network gateway **40** forwards the information to the user's mobile device over the wireless network **36**.

[0084] FIG. 7 when considered with FIG. 3 illustrates a sequence of communications between device **10**, and middleware server **44** that may occur when the user of a mobile device wishes to download an application definition **28** for a server side application.

[0085] So, initially, device **10** interrogates server **44** to determine which applications are available for the particular mobile device being used. In response, a user at device **10** may choose to register for an available server side application. Thereafter the middleware server creates the application definition file and sends to the mobile device (data flow **78**) the created application definition **28**. This all further detailed in US Patent Publication No. US 2003/0060896.

[0086] The user is then able to use the functionality defined by the interface description to send and receive data.

[0087] At this time, parser **61** of virtual machine software **24** may parse the XML text of the application definition file to form a tokenized version of the file. That is, each XML tag may be converted a defined token for compact storage, and to minimize repeated parsing of the XML text file. The tokenized version of the application definition file may be stored for immediate or later use by device **10**.

[0088] Thereafter, upon invocation of a particular application for which the device **10** has registered, the screen generation engine **67** of the virtual machine software **24** at the device causes the virtual device to locate the definition of an initial screen for that application. The initial screen is identified within the application definition **28** for that application using a <SCREEN> tag, and an associated attribute of <First screen="yes">.

[0089] Steps performed by virtual machine software **24** in processing this screen (and any screen) are illustrated in FIG. 8. As illustrated, screen generation engine **67**, generates an instance of an object class, defining a screen by parsing the

section of the XML application definition file corresponding to the <SCREEN> tag in step **S802**. Supported screen elements may be buttons, edit boxes, menus, list boxes, and choice items, as identified in sections **5.3**, **5.4**, and **5.5** of Appendix "A". Other screen elements, such as images and checkboxes, as detailed in Appendix "A" may also be supported. For clarity of illustration, their processing by screen generation engine **67** however, is not detailed. Each supported tag under the SCREEN definition section, in turn causes creation of instances of object classes within the virtual machine software **24**. Typically, instances of objects corresponding to the tags, used for creation of a screen, result in presentation of data at mobile device **10**. As well the creation of such objects may give rise to events (e.g. user interaction) and actions to be processed at device **10**.

[0090] Each element definition causes virtual machine software **24** to use the operating system of the mobile device to create corresponding display element of a graphical user interface as more particularly illustrated in **FIG. 9**. Specifically, for each element, the associated XML definition is read in step **S806**, **S816**, **S826**, **S836**, and **S846**, and a corresponding instance of a screen object defined as part of the virtual machine software **24** is created by the virtual machine software **24** in steps **S808**, **S818**, **S828**, **S838** and **S848**, in accordance with steps **S902** and onward illustrated in **FIG. 9**. Each interface object instance is created in step **S902**. Each instance takes as attribute values defined by the XML text associated with the element. A method of the virtual object is further called in step **S904**, and causes a corresponding device operating system object to be created. Those attributes defined in the XML text file, stored within the virtual machine object instance are applied to the corresponding instance of a display object created using the device operating system in steps **S908S-S914**. These steps are repeated for all attributes of the virtual machine object instance. For any element allowing user interaction, giving rise to an operating system event, the event handler **65** of virtual machine software **24** is registered to process operating system events, as detailed below.

[0091] Additionally, for each event (as identified by an <EVENT> tag) and action (as identified by an <ACTION> tag) associated with each XML element, virtual machine software **24** creates an instance of a corresponding event and action object forming part of virtual machine software **24**. Virtual machine software **24**

further maintains a list identifying each instance of each event and action object, and an associated identifier of an event in steps **S916** to **S928**.

[0092] Steps **S902-S930** are repeated for each element of the screen in steps **S808**, **S818**, **S828**, **S838** and **S848** as illustrated in FIG. 8. All elements between the <SCREEN> definition tags are so processed. After the entire screen has been so created in memory, it is displayed in step **S854**, using conventional techniques.

[0093] As will be appreciated, objects specific to the type of device executing the virtual machine software **24**. Functions initiated as a result of the XML description may require event handling. This event handling is processed by event handler **65** of virtual machine software **24** in accordance with the application definition **28**. Similarly, receipt of data from a mobile network will give rise to events. Event handler **65**, associated with a particular application presented at the device similarly processes incoming messages for that particular application. In response to the events, virtual machine software **24** creates instance of software objects, and calls functions of those object instances, as required by the definitions contained within the XML definitions contained within the application definition **28**, giving rise to the event.

[0094] As noted, the virtual machine software **24** includes object classes, allowing the virtual machine to create object instances corresponding to an <EVENT> tag. The event object classes includes methods specific to the mobile device that allow the device to process each of the defined XML descriptions contained within the application definition file, and also to process program/event flow resulting from the processing of each XML description.

[0095] Events may be handled by virtual machine software **24** as illustrated in FIG. 10. Specifically, as device handler **65** has been registered with the operating system for created objects, upon occurrence of an event, steps **S1002** and onward are performed in response to the operating system detecting an event.

[0096] An identifier of the event is passed to event handler **65** in step **S1002**. In steps **S1004-S1008**, this identifier is compared to the known list of events, created as a result of steps **S916-S930**. For an identified event, actions associated with that event are processed in step **S1008-S1014**.

[0097] That is, virtual machine software **24** performs the action defined as a result of the <ACTION> tag associated with the <EVENT> tag corresponding to the event giving rise to processing by the event handler **65**. The <ACTION> may cause creation of a new screen, as defined by a screen tag, a network transmission, a local storage, or the like.

[0098] In particular, if the NAME tag associated with the action identifies INTEGRATION tag, virtual machine software **24** performs steps **S1102** and onward depicted in **FIG. 11**, as a result of executing the next action in step **S1012**. As illustrated, virtual machine software **24** compares the value provided to the CLSID variable to the names of accessible classes not forming part of virtual machine software **24**.

[0099] In step **S1102**, virtual machine software **24** queries the list of available accessible object classes. If objects classes **29** were created using COM, as detailed above, this is accomplished by querying the WindowsCE registry. If an object class corresponding to the class identified in the CLID (i.e. CLID=class_name) variable is found as determined in steps **S1104**, the class is queried in step **S1106**, to verify that the class indeed extends virtual machine software **24**. Querying may be accomplished by querying the class to determine if it provides the interface expected by virtual machine software **24**. Specifically, the class may be queried to determine if it has an interface having a chose name or type. The interface may be queried using the COM method QueryInterface(). In the example the object class is queried to locate an interface having the name IAIRIXIntegrationPoint is used. If the class does not have the interface, the INTEGRATION action is terminated by machine software **24** and an error message could optionally be generated.

[00100] If the class has the interface (S1108), the class is instantiated in step **S1110** and a method having a chosen name (i.e. Process) is executed by virtual machine software **24** in step **S1112**. Parameters hWndParent and the input and output strings formed (i.e. *my input text*, *returnvar* passed to variable SAVENAME) part of the tag and XML element are passed to the method. As noted, the actual function of the method is entirely determined by the author of the class, and not the provider of virtual machine software **24**. Upon completion of the executed method, the results of the method are passed to virtual machine software **24**, by assigning the

result to the variable *OutputString*. If the *SAVE* variable is set to true, the results returned by the method are stored in the variable identified assigned to the *SAVENAME* variable in step **S1114**. If the identified class does not include the expected interface as determined in step **S1110**, the *INTEGRATION* action is terminated. Again, an error message could be generated.

[00101] Conveniently, once data returned by the method call is stored locally in a variable defined in application definition **28** and otherwise accessible by virtual machine software **24**. Of course, the contents of the variable may be acted upon as otherwise dictated by the application definition **28**. Thus, contents of the variable may be presented as part of the user interface, or sent back to middleware server **44**, for example as part of a message defined in portion **50** of the application definition **28** as identified by the *<DATA>* tag, as detailed in Appendix "A".

[00102] After execution of the method of the external class **29**, additional screens, may be created by invocation of the screen generation engine **67**, as detailed in **FIGS. 8** and **9**. In this manner the navigation through the screens of the application is accomplished according to the definition embodied in the XML application definition.

[00103] Similarly, when the user wishes to communicate with the middleware server, or store data locally, event handler **65** creates instances of corresponding object classes within the object classes **69** of virtual machine software **24** and calls their methods to store or transmit the data using the local device operating system. The format of data is defined by the device local definition section **52**; the format of network packages is defined in the network transaction package definition section **50**.

[00104] For example, data that is to be sent to the wireless network is assembled into the correct XML packages using methods within an XML builder object, formed as a result of creating an instance of a corresponding object class within object classes **69** of virtual machine software **24**. Methods of the XML builder object create a full XML package before passing the completed XML package to another message server object. The message server object uses the device's

network APIs to transmits the assembled data package across the wireless network.

[00105] Received XML data packages from network **63** (**FIG. 2**) give rise to events processed by event handler **65**. Processing of the receipt of data packages is not specifically illustrated in **FIG. 9**. However, the receipt of data triggers a "data" event of the mobile device's operating system. This data event is passed to the virtual machine, and event handler **65** inspects the package received. As long as the data received is a valid XML data package as contained within the application definition, the virtual machine inspects the list of recognised XML entities.

[00106] So, for example, a user could send a login request **80** by interacting with an initial login screen, defined in the application definition file for the application. This would be passed by the middleware server **44** to the backend application server **70**. The backend application server according to the logic embedded within its application, would return a response, which the middleware server **44** would pass to the virtual machine software **24**. Other applications, running on the same or other application servers might involve different interactions, the nature of such interactions being solely dependent on the functionality and logic embedded within the application server **70**, and remaining independent of the middleware server **44**.

[00107] **FIG. 12** illustrates sample XML messages passed as the result of message flows illustrated in **FIG. 6**. For each message, the header portion, between the `<HEAD>` . . . `</HEAD>` tags contains a timestamp and the identifier of the sending device.

[00108] Example message **72** is sent by the mobile device to request the list of applications that the server has available to that user on that device. It specifies the type of device by a text ID contained between the `<PLATFORM>` . . . `</PLATFORM>` tags. Example message **74** is sent in response to message **70** by middleware server **44** to the mobile device **10**. It contains a set of `<APP>` . . . `</APP>` tag pairs, each of which identifying a single application that is available to the user at device **10**. Example message **76** is sent from the mobile device **10** to middleware server **44** to register for a single server side application. The tags

specify information about the user. Message **78** is sent by the middleware server **44** to the mobile device in response to a request to register device **10** for an application. The pair of tags `<VALUE> . . . </VALUE>` gives a code indicating success or failure. In the sample message shown, a success is shown, and is followed by the interface description for the application, contained between the `<INTERFACE> . . . </INTERFACE>` tags. This interface description may then be stored locally within memory **16** of device **10**.

[00109] As noted, when a user starts an application that has been downloaded in the manner described above, the virtual machine software **24** reads the interface description that was downloaded for that device **10**, and the virtual machine software **24** identifies the screen that should be displayed on startup, and displays its elements as detailed in relation to **FIGS. 9** and **10**. The user may then use the functionality defined by the user interface definition section **48** of the application definition **28** to send and receive data from a server side application.

[00110] For the purposes of illustration, **FIGS. 13A** and **13B** illustrate the presentation of a user interface for a sample screen on a Windows CE Portable Digital Assistant, that has invoked an externally generated signature capture dialog, as a result of an externally instantiated object. The signature data is stored in a variable LASTSIG, and sent back to application server **44**.

[00111] An example application definition file **92** (of the format of application definition **28**) is illustrated in **FIGS. 14, 15** and **16A-16B** defines an application entitled SignatureCapture, including a definition of local data in the form of a table titled LASTSIG (**FIG. 14**), a format of a user interface having a single screen entitled MAIN (**FIG. 16A-16B**) and the format of network transactions (**FIG. 15**), corresponding to portions **52, 50** and **52**, respectively of an application definition **28**.

[00112] The screen has four single buttons identified by the ``BTN NAME`="btnCapture"`, `BTN NAME`="btnView"`, `BTN NAME`="btnSend"`, `BTN NAME`="btnClose"`.

[00113] Upon invocation of this application at the local device, screen generation engine **67** of virtual machine software **24** at the device process the

screen definition, as detailed with reference to **FIGS. 8** and **9**. That is, for each BTN tag, screen generation engine **67** creates a button object instance, in accordance with steps **S804-S812**. The created buttons will have captions Capture New Signature, View Last Signature, Send to Server, and Close.

[00114] The resulting screen at the mobile device is illustrated in **FIG. 13A**. Each of the screen items is identified with reference to the XML segment within XML definition file **92** giving rise to the screen element.

[00115] Call-backs associated with the presented buttons cause graphical user interface application software/operating system software **20** at the mobile device to return control to the event handler **65** of virtual machine software **24** at the device. Thus, as the user interacts with the application, the user may input data within the presented screen using the mobile device API.

[00116] Notably, if the button btnSend is pressed, a package of type SIG (as defined in **FIG. 15**) is sent back to middleware server **44**. If btnClose is pressed, the application is closed.

[00117] However, if the buttons btnCapture or btnView are captured steps **S1100** are performed to instantiate an external object class **29** named AirixSignature.AirixSignatureCtrl, with arguments,

SAVENAME="SIGNATURE" SAVE="TRUE" for btnCapture, and

SAVENAME="" SAVE="FALSE">[SP.*.SIGNATURE]</ACTION>, for btnView.

[00118] An object class **29** named AirixSignature.AirixSignatureCtrl, of course needs to exist, be registered and expose an interface of the forme IAIRIXIntegrationPoint, as detailed above. Its method Process, in turn, causes device **10** to capture a signature or present the signature. These functions may for example be provided using software written for the WindowsCE platform, in a manner appreciated by a person of ordinary skill. In the case of the btnCapture INTEGRATION action, the results of the method return a captured signature, which is stored in variable SIGNATURE by virtual machine software **24**. In the case of the btnView the previously captured value stored in the variable SIGNATURE will be passed to the instance of the object class.

[00119] The screen presented at device **10** in response to performing the Process method of the AirixSignature.AirixSignatureCtrl object class is displayed in **FIG. 13B**.

[00120] As can be appreciated from the preceding description and example, use of external software components in the form of object classes **29** allows virtual machine software **24** to be expanded, almost arbitrarily. Conveniently, applications may still be defined using an application definition in a manner relatively abstracted from the underlying device. Conveniently, as local software or hardware functions are added to devices, virtual machine software **24** and applications defined in an application definition **28** may take advantage of the new functionality using external object classes **29**.

[00121] It will be further understood that the invention is not limited to the embodiments described herein which are merely illustrative of a preferred embodiment of carrying out the invention, and which is susceptible to modification of form, arrangement of parts, steps, details and order of operation. The invention, rather, is intended to encompass all such modification within its scope, as defined by the claims.

WHAT IS CLAIMED IS:

1. A method of presenting data from an application executing at a computing device at a wireless mobile device remote from said computing device, said method comprising:
 - receiving at said mobile device, a representation of a text file defining a user interface and actions to be taken in response to user interaction with said user interface or received data from said application;
 - receiving data from said application;
 - executing virtual machine software at said mobile device to present said user interface and said received data, in accordance with said text file;
 - wherein at least one of said actions in said text file specifies execution of a software component separate from said virtual machine software, identified in said text file;
 - querying operating system software executing at said wireless mobile device as to whether said software component identified in said text file is available at said device; and
 - if said querying indicates that said software component is available at said wireless mobile device, executing said software component at said device.
2. The method of claim 1, further comprising passing to said software component, parameters identified in said text file.
3. The method of claim 1 or claim 2, further comprising querying said software component as to whether said software component includes a pre-determined interface, and wherein said executing is conditional upon determining that said software component includes said pre-determined interface.

4. The method of any one of claims 1 to 3, further comprising receiving data from said software component to be used by said virtual machine software.
5. The method of any one of claims 1 to 4, wherein said software component is in the form of an object class, and further comprising creating an instance of said object class.
6. The method of claim 5, wherein said text file identifies said object class by name, and wherein said querying comprises querying said operating system software whether an object class having said name exists at said mobile device.
7. The method of any one of claims 1 to 6, wherein said text file is received at said wireless mobile device and wherein said text file is an Extensible Markup Language (XML) file.
8. The method of any one of claims 1 to 7, wherein said text file is parsed, and a representation of said text file is stored at said wireless mobile device for use by said virtual machine software.
9. The method of any one of claims 1 to 8, further comprising storing data generated by said software component at said wireless mobile device in accordance with said text file.
10. The method of any one of claims 1 to 9, wherein said text file further defines a format of network messages for exchange of data generated by said application, and wherein said format of network messages comprises XML definitions, and wherein data for said application are dispatched from said wireless device using said XML definitions.

11. The method of any one of claims 1 to 10, wherein said software component facilitates the capture of a signature of a user.
12. The method of any one of claims 1 to 11, wherein said software component interfaces with peripheral hardware at said device.
13. A wireless mobile device comprising:
 - a processor;
 - computer readable memory in communication with said processor, storing operating system software and virtual machine software controlling operation of said wireless mobile device, said virtual machine software comprising:
 - a parser for receiving a text file;
 - a screen generation engine, for presenting at least one screen at said wireless mobile device in accordance with said text file;
 - instructions for querying said operating system software as to whether a software component, which is identified in said text file and is separate from said virtual machine software, is available at said wireless mobile device; and
 - an event handler for processing events arising in response to user interaction with said at least one screen in accordance with said text file, said event handler operable to execute said software component if, upon executing said instructions, it is determined that said software component is available at said wireless mobile device.
14. The wireless mobile device of claim 13, wherein said memory further stores a representation of said text file.
15. The wireless mobile device of claim 14, wherein said representation of said text file is created by said parser.

16. The wireless mobile device of any one of claims 13 to 15, wherein said parser comprises an Extensible Markup Language (XML) parser.
17. The wireless mobile device of either claim 13 or claim 14, wherein said virtual machine software further adapts said processor to parse said text file.
18. The wireless mobile device of claim 17, wherein said virtual machine software further adapts said parser to parse said text file as an XML file.
19. The wireless mobile device of any one of claims 13 to 18, wherein said virtual machine software further comprises object classes corresponding to actions to be taken by said device in response to interaction with said at least one screen.
20. The wireless mobile device of any one of claims 13 to 19, wherein said memory further stores said software component separate from said virtual machine software.
21. The wireless mobile device of any one of claims 13 to 20, wherein said software component separate from said virtual machine software comprises at least one object class.
22. The wireless mobile device of claim 21, wherein said virtual machine software further comprises instructions for querying said at least one object class as to whether said at least one object class provides a pre-determined interface and instructions for instantiating said at least one object class if said querying indicates that said at least one object class does provide said pre-determined interface.
23. The wireless mobile device of any one of claims 13 to 22, wherein said software component separate from said virtual machine software interacts with hardware at said mobile device.

24. The wireless mobile device of any one of claims 13 to 23, wherein said software component separate from said virtual machine software receives parameters contained in said text file from said virtual machine software.
25. The wireless mobile device of any one of claims 13 to 24, wherein said software component separate from said virtual machine software returns data to said virtual machine software.
26. The wireless mobile device of any one of claims 13 to 25, wherein said software component separate from said virtual machine software returns data to said virtual machine software in XML format.
27. Computer readable medium storing software to be executed at a mobile device, adapting said mobile device to perform the method of any of claims 1 to 12.
28. A method of presenting data from an application executing at a computing device at a wireless mobile device remote from said computing device, said method comprising:
 - receiving at said mobile device, a representation of a text file defining a user interface and actions to be taken in response to user interaction with said user interface or received data from said application;
 - receiving data from said application;
 - executing virtual machine software at said mobile device to present said user interface and said received data, in accordance with said text file,
 - wherein at least one of said actions in said text file specifies execution of a software component separate from said virtual machine software, identified in said text file and loaded at said device, and wherein said software component is in the form of an object class;

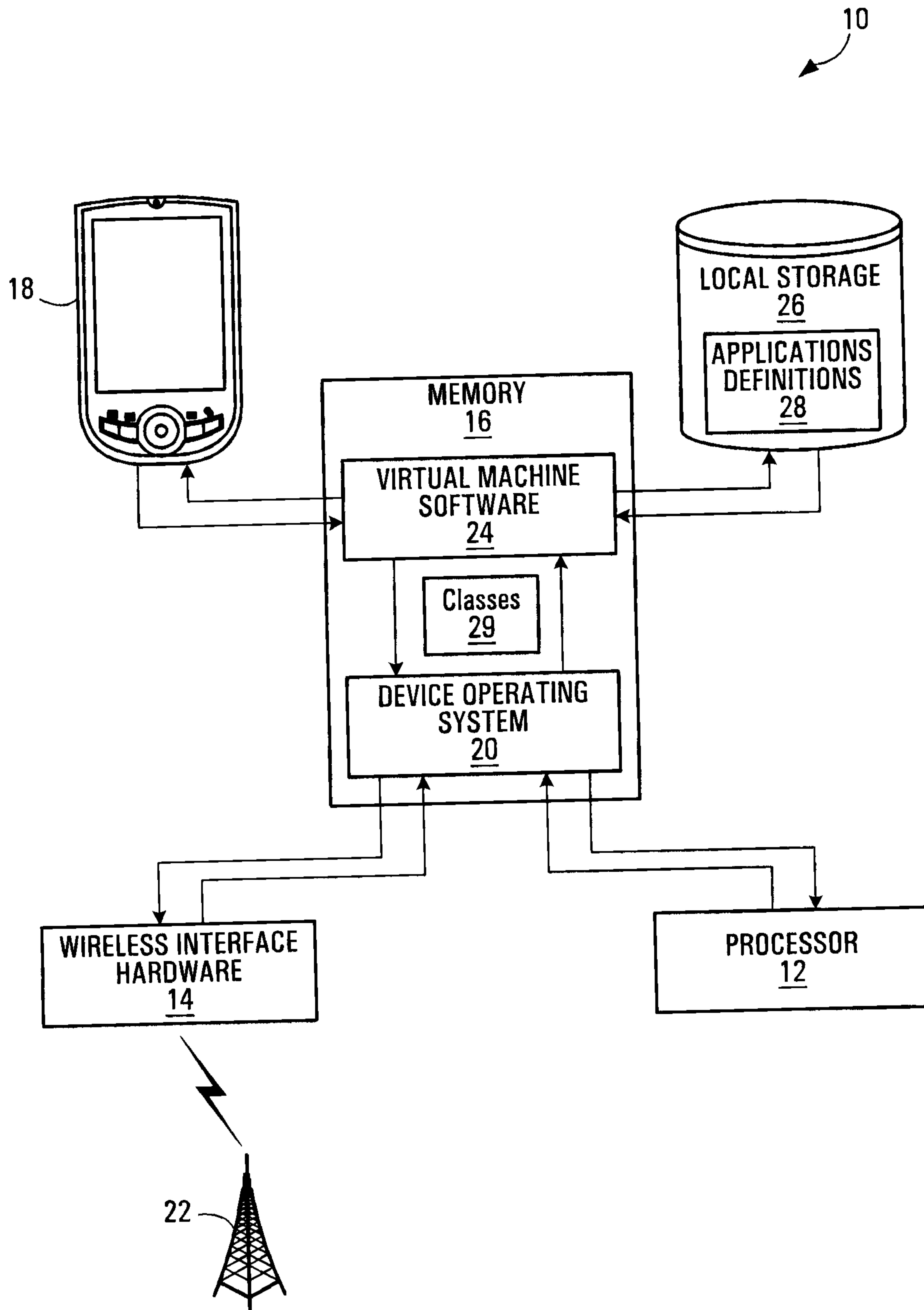
creating an instance of said object class; and
executing said software component at said device.

29. The method of claim 28, further comprising passing to said software component, parameters identified in said text file.
30. The method of claim 28 or claim 29, further comprising receiving data from said software component to be used by said virtual machine software.
31. The method of any one of claims 28 to 30, wherein said text file is received at said wireless mobile device and wherein said text file is an Extensible Markup Language (XML) file.
32. The method of any one of claims 28 to 31, wherein said text file is parsed, and a representation of said text file is stored at said wireless mobile device for use by said virtual machine software.
33. The method of any one of claims 28 to 32, further comprising storing data generated by said software component at said wireless mobile device in accordance with said text file.
34. The method of any one of claims 28 to 33, wherein said text file further defines a format of network messages for exchange of data generated by said application, and said format of network messages comprises XML definitions, and wherein data for said application are dispatched from said wireless device using said XML definitions.
35. The method of any one of claims 28 to 34, wherein said software component facilitates the capture of a signature of a user.
36. The method of any one of claims 28 to 35, wherein said software component interfaces with peripheral hardware at said device.

37. Computer readable medium storing software to be executed at a mobile device, adapting said mobile device to perform the method of any of claims 28 to 36.
38. A wireless mobile device comprising:
 - a processor;
 - computer readable memory in communication with said processor, storing operating system software and virtual machine software controlling operation of said wireless mobile device, said virtual machine software comprising:
 - a parser for receiving a text file;
 - a screen generation engine, for presenting at least one screen at said wireless mobile device in accordance with said text file;
 - an event handler for processing events arising in response to user interaction with said at least one screen in accordance with said text file, said event handler operable to execute a software component separate from said virtual machine software, identified in said text file and loaded at said device, and wherein said software component is in the form of an object class.
39. The wireless mobile device of claim 38, wherein said memory further stores a representation of said text file.
40. The wireless mobile device of claim 39, wherein said representation of said text file is created by said parser.
41. The wireless mobile device of any one of claims 38 to 40, wherein said parser comprises an Extensible Markup Language (XML) parser.

42. The wireless mobile device of either claim 38 or 39, wherein said virtual machine software further adapts said processor to parse said text file.
43. The wireless mobile device of claim 42, wherein said virtual machine software further adapts said parser to parse said text file as an XML file.
44. The wireless mobile device of any one of claims 38 to 43, wherein said virtual machine software further comprises object classes corresponding to actions to be taken by said device in response to interaction with said at least one screen.
45. The wireless mobile device of any one of claims 38 to 44, wherein said memory further stores said software component separate from said virtual machine software.
46. The wireless mobile device of any one of claims 38 to 45, wherein said software component separate from said virtual machine software interacts with hardware at said mobile device.
47. The wireless mobile device of any one of claims 38 to 46, wherein said software component separate from said virtual machine software receives parameters contained in said text file from said virtual machine software.
48. The wireless mobile device of any one of claims 38 to 47, wherein said software component separate from said virtual machine software returns data to said virtual machine software.
49. The wireless mobile device of any one of claims 38 to 48, wherein said software component separate from said virtual machine software returns data to said virtual machine software in XML format.

1/85

**FIG. 1**

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2/85

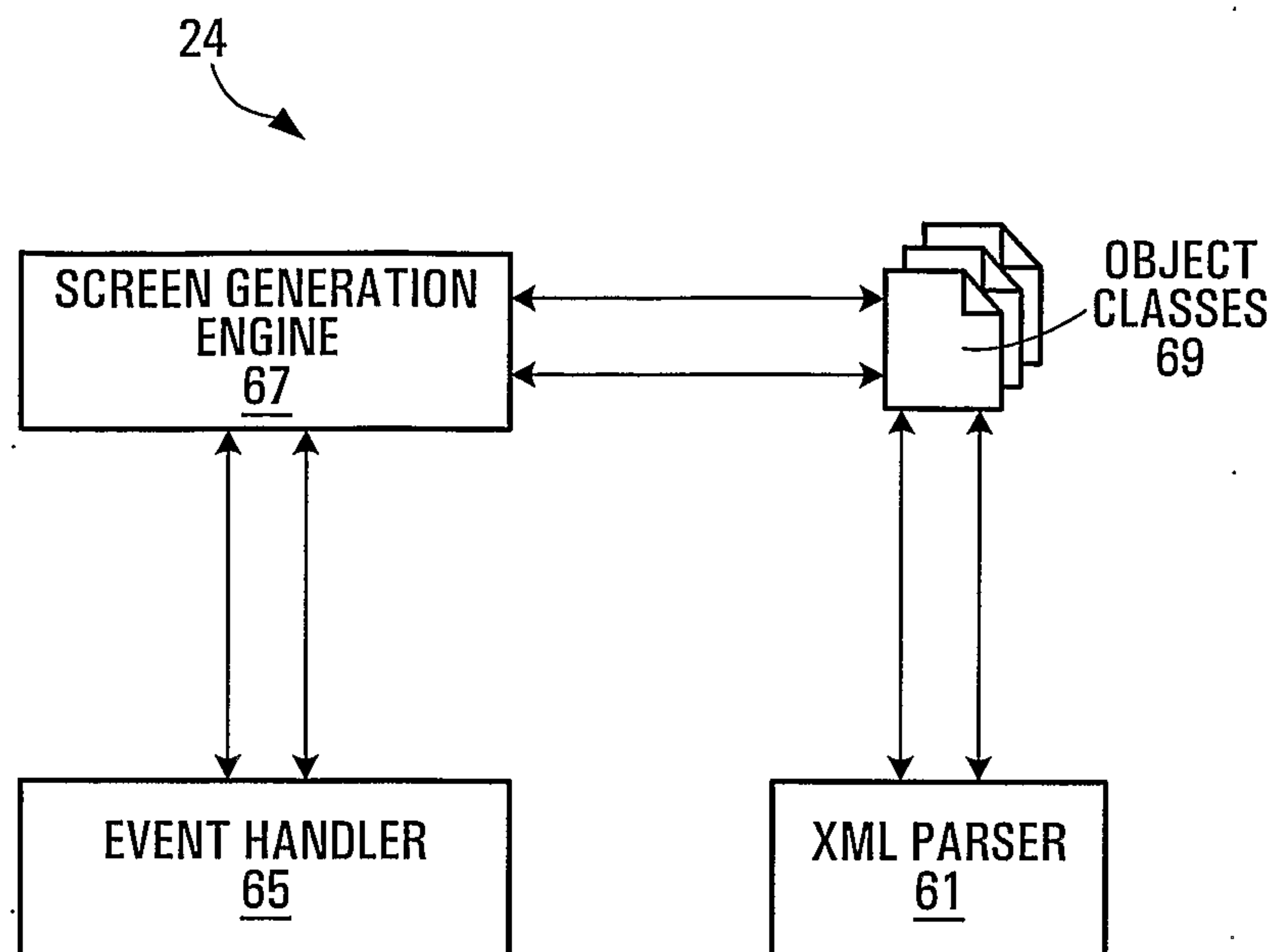
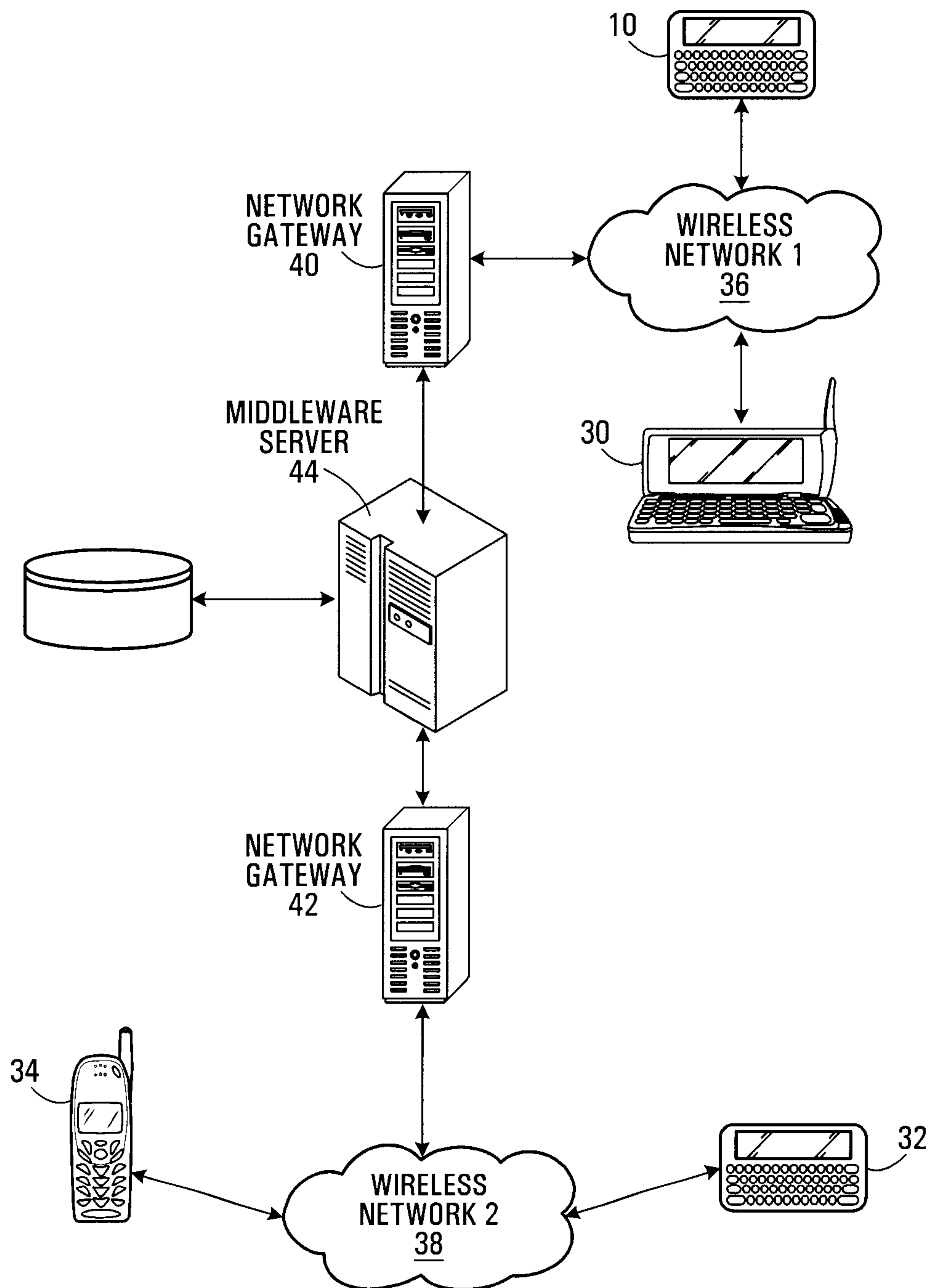


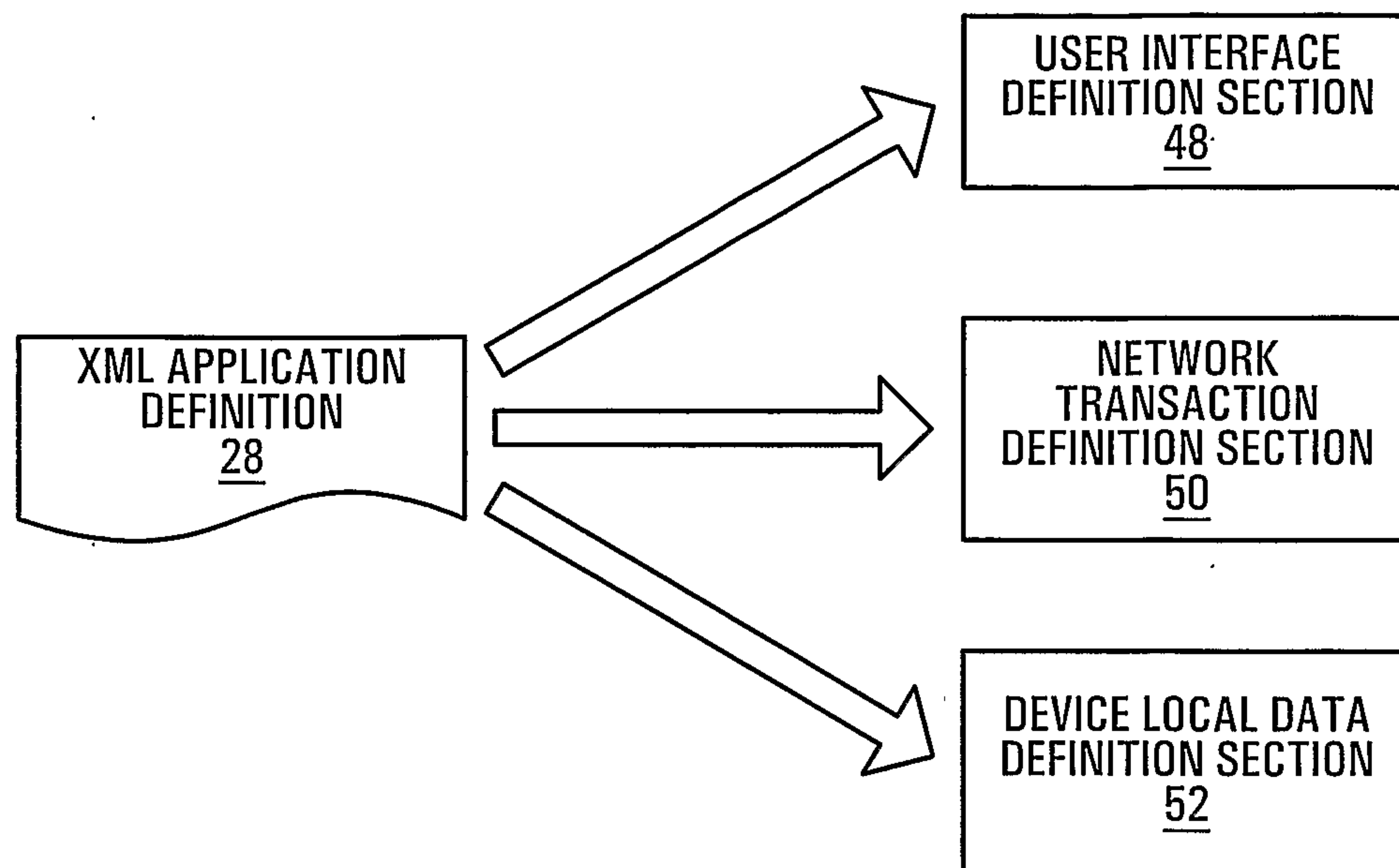
FIG. 2

3/85

**FIG. 3**

*Patent Agents
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4/85

**FIG. 4**

5/85

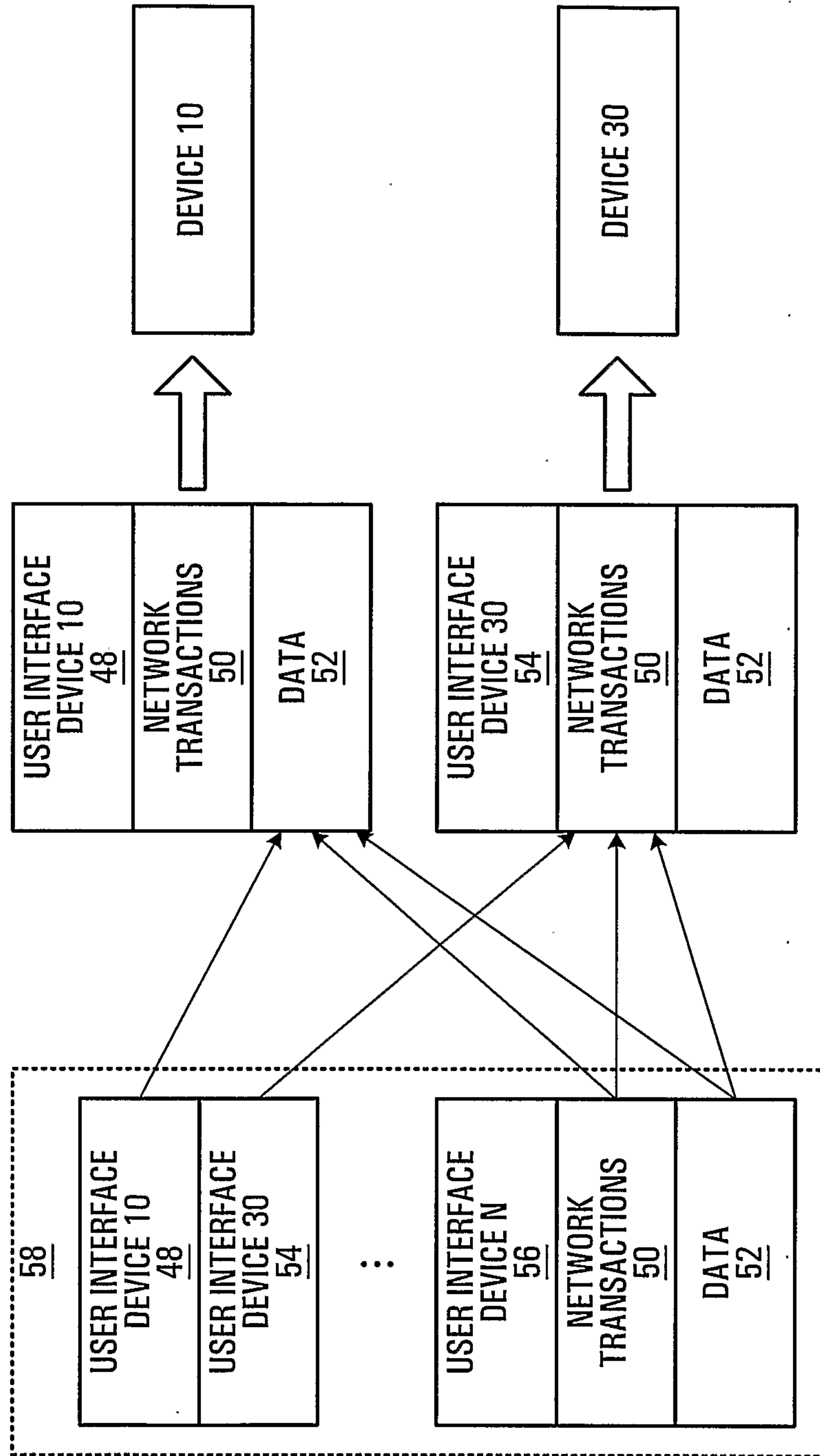
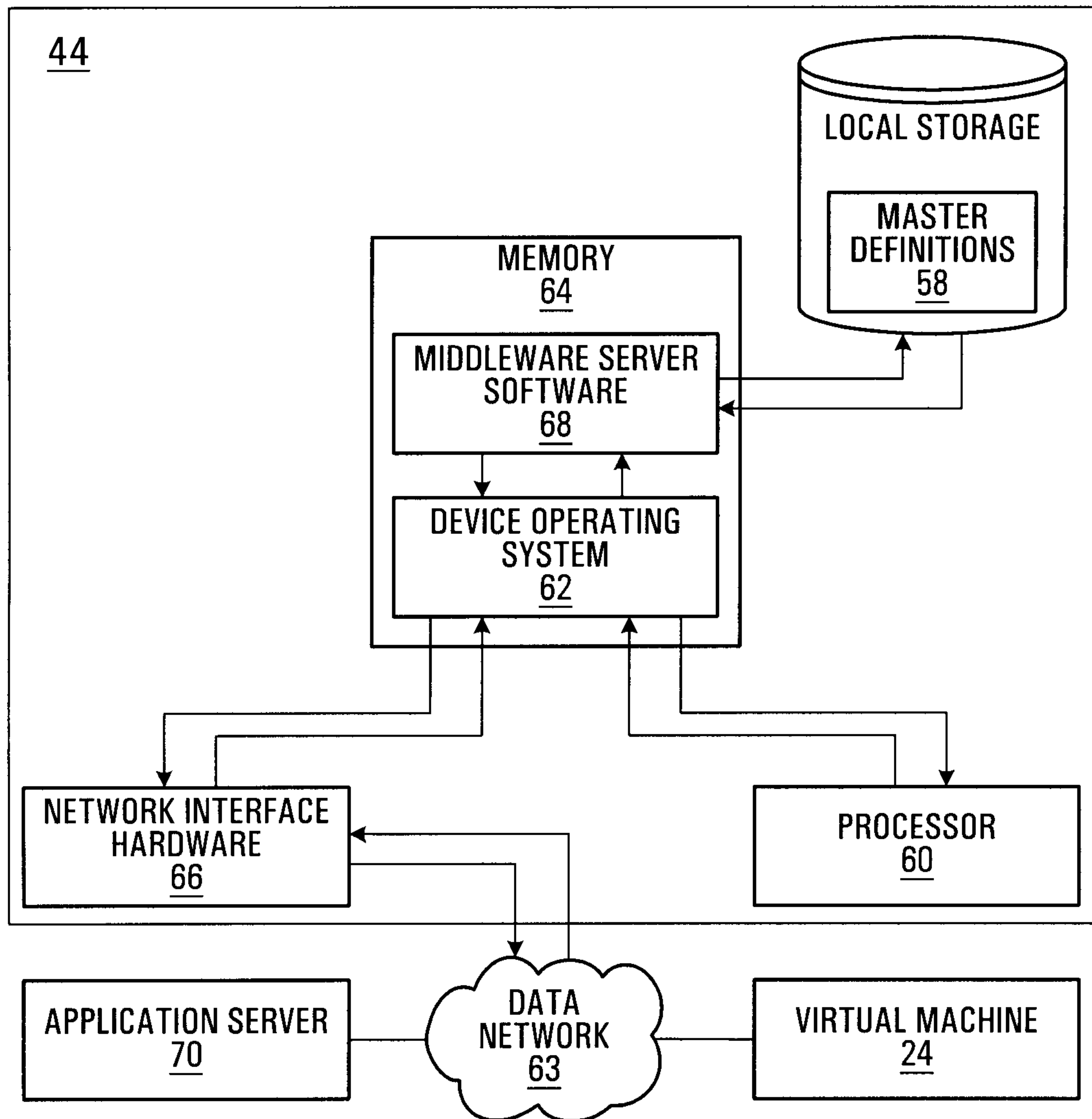


FIG. 5

6/85

**FIG. 6**

7/85

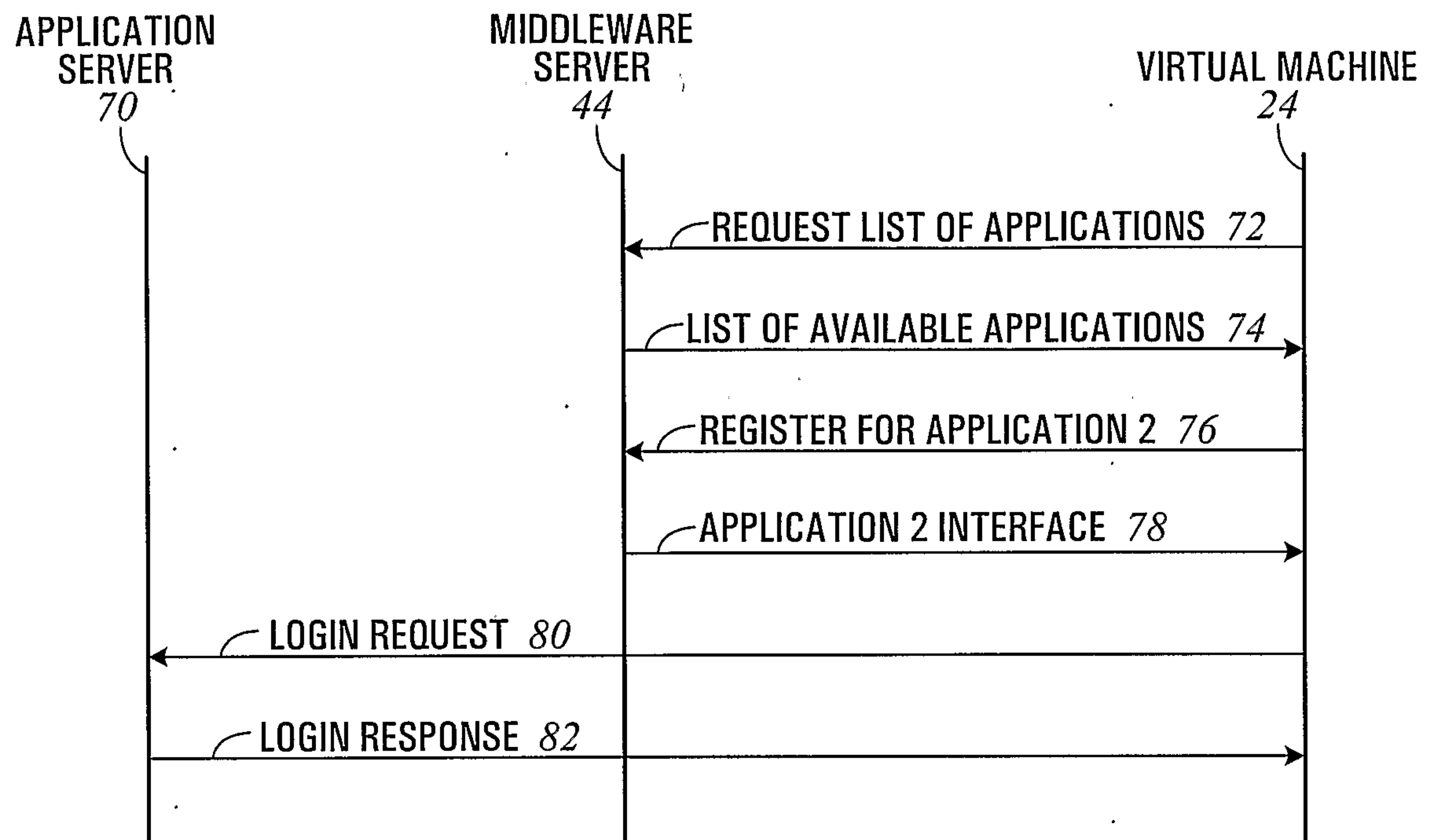
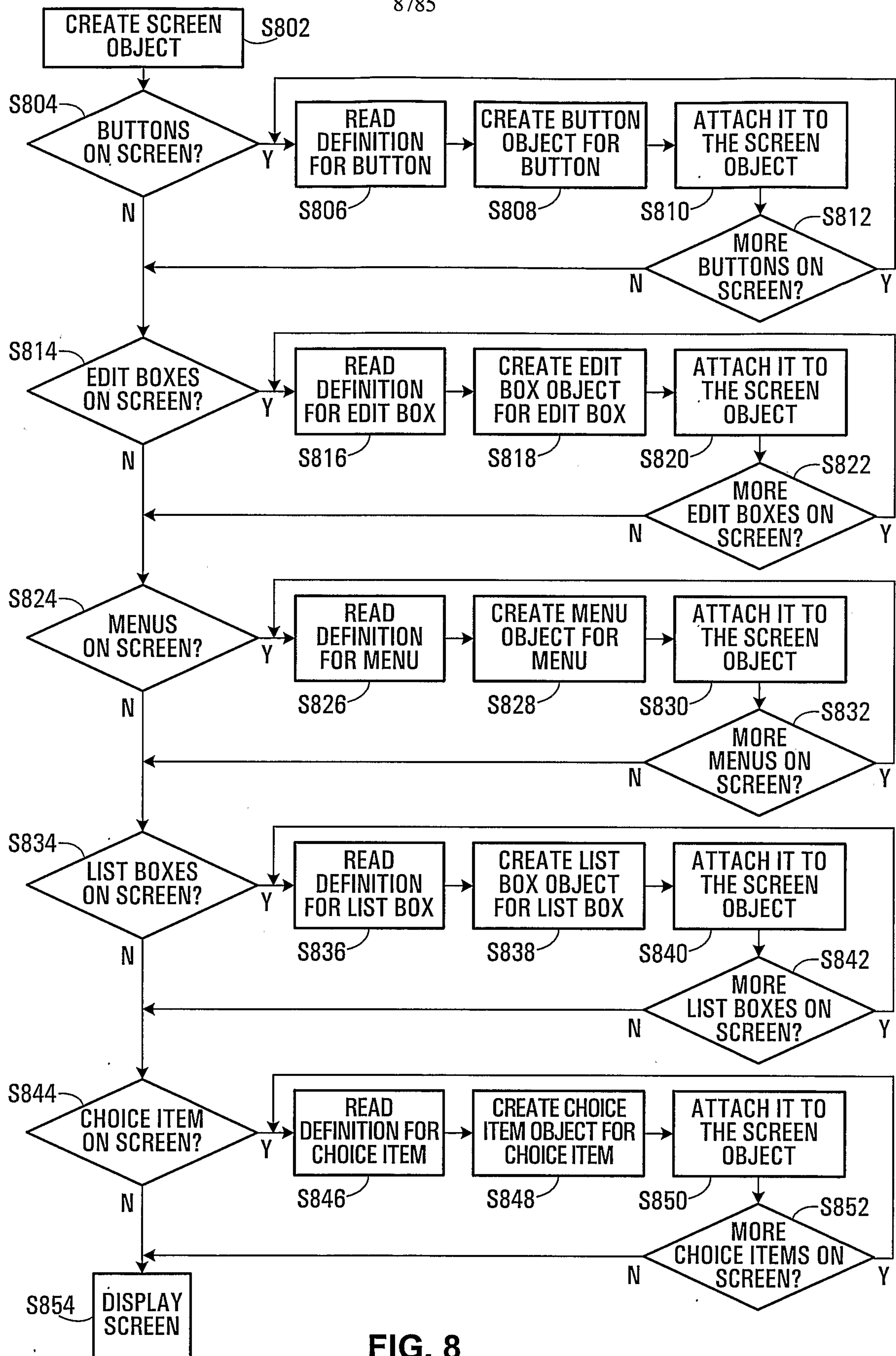


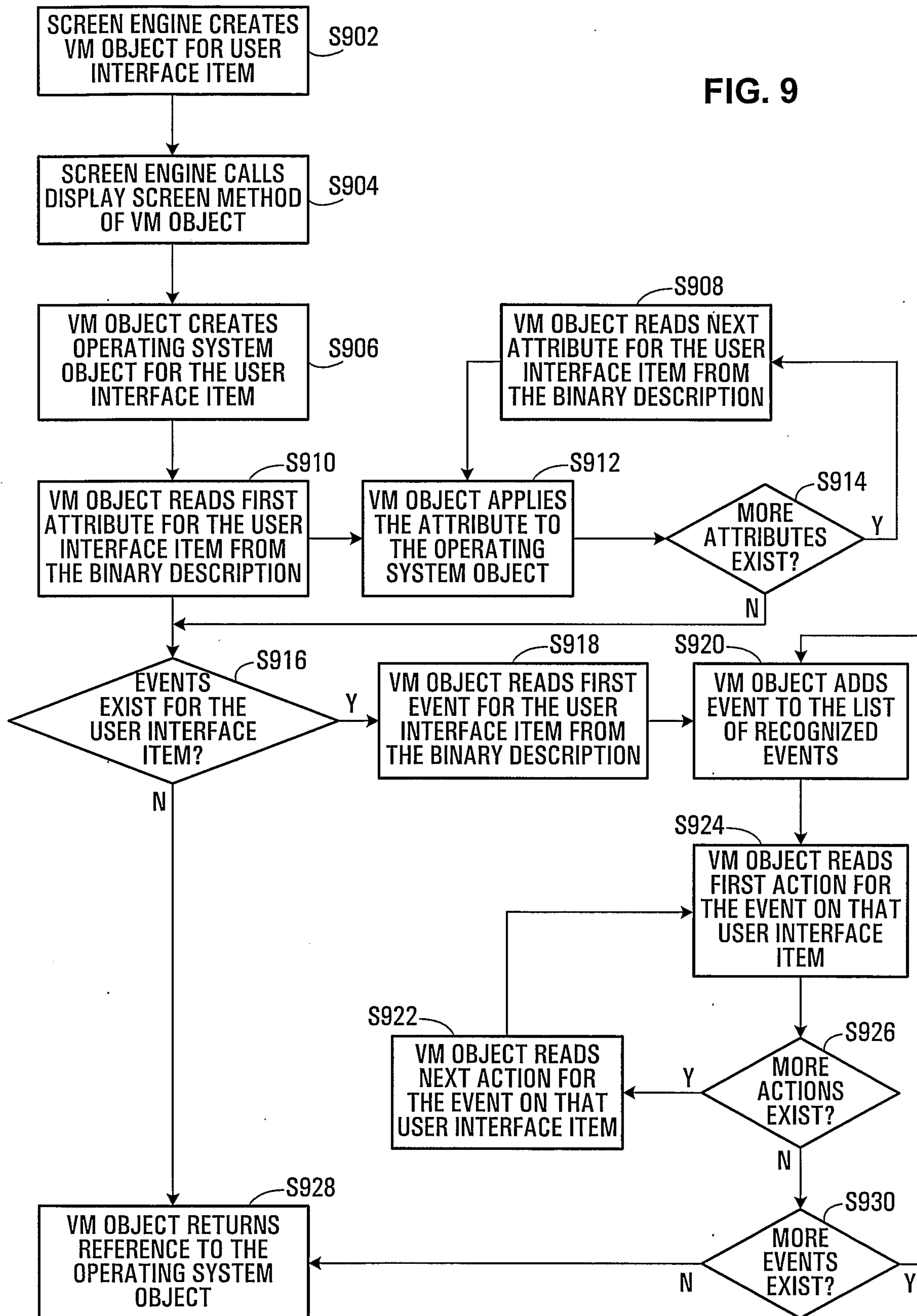
FIG. 7

8/85

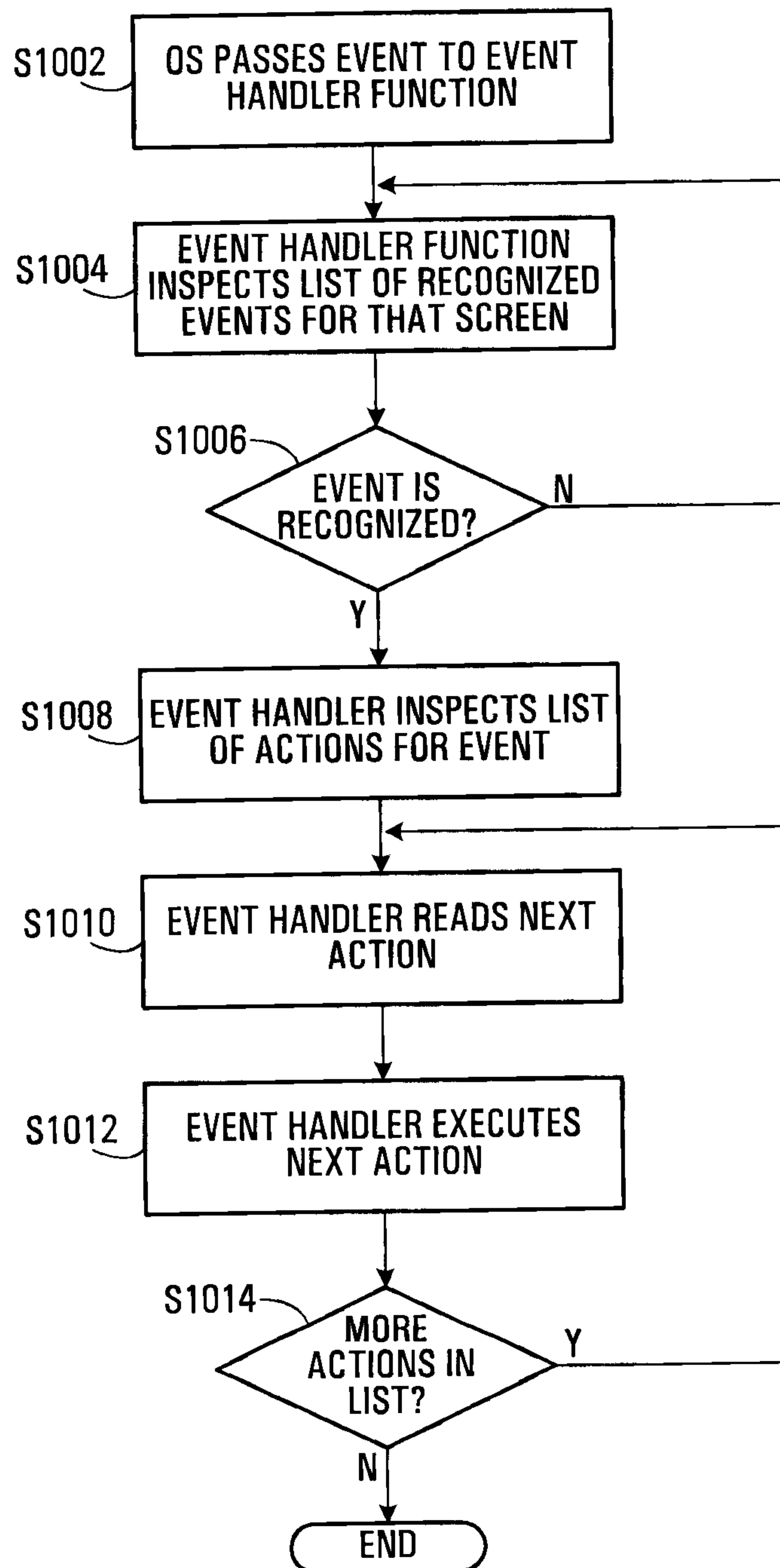


9/85

FIG. 9

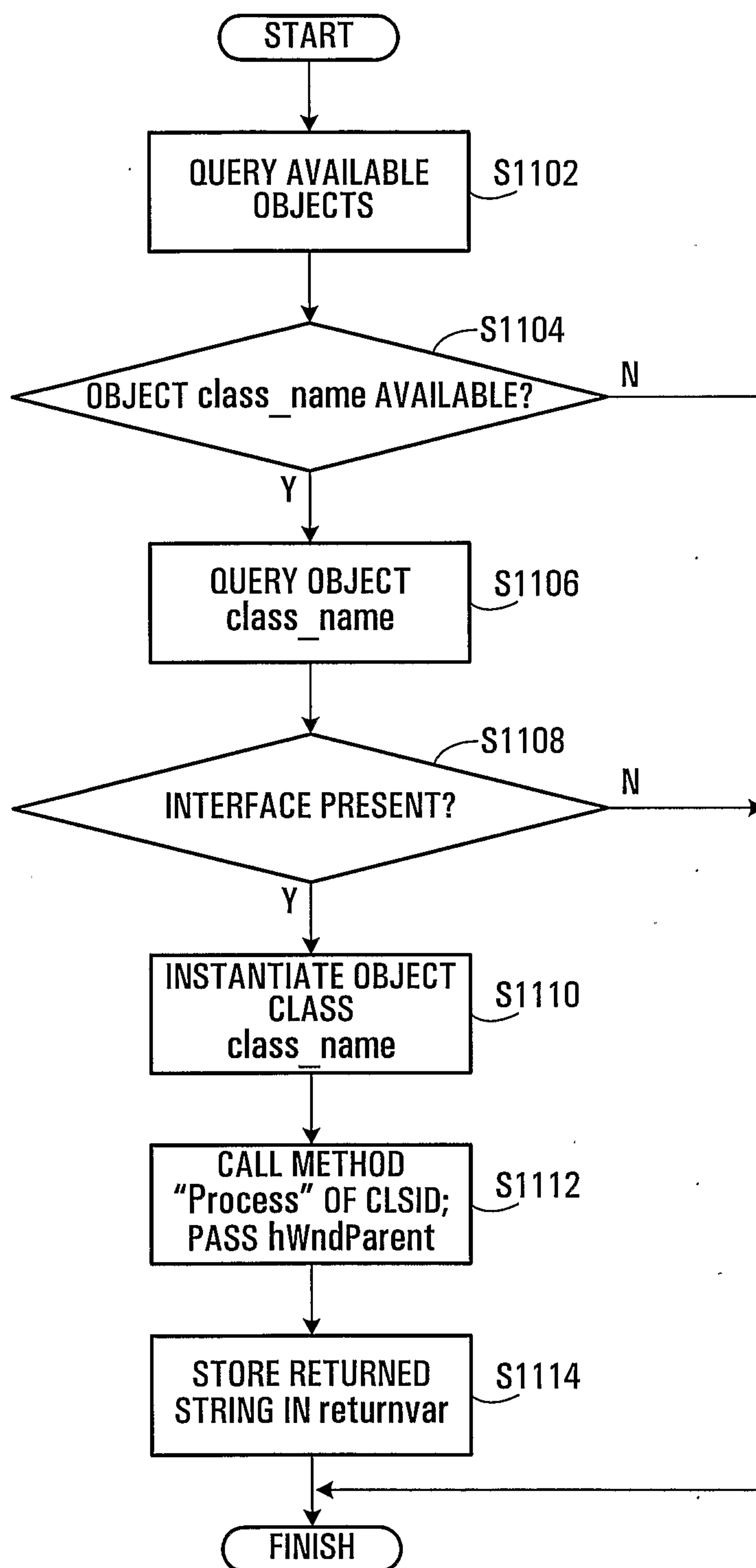


10/85

**FIG. 10**

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11/85

**FIG. 11**

12/85

```

72 {
  <ARML>
    <HEAD>_</HEAD>
    <SYS>
      <QUERY>
        <PLATFORMS>
          <PLATFORM>WinCE</PLATFORM>
        </PLATFORMS>
      </REG>
    </SYS>
  </ARML>
}

74 {
  <ARML>
    <HEAD>_</HEAD>
    <SYS>
      <QUERYRESP>
        <APP>Order Entry</APP>
        <APP>Helpdesk</APP>
        <APP>Engineer Dispatch</APP>
      </QUERYRESP>
    </SYS>
  </ARML>
}

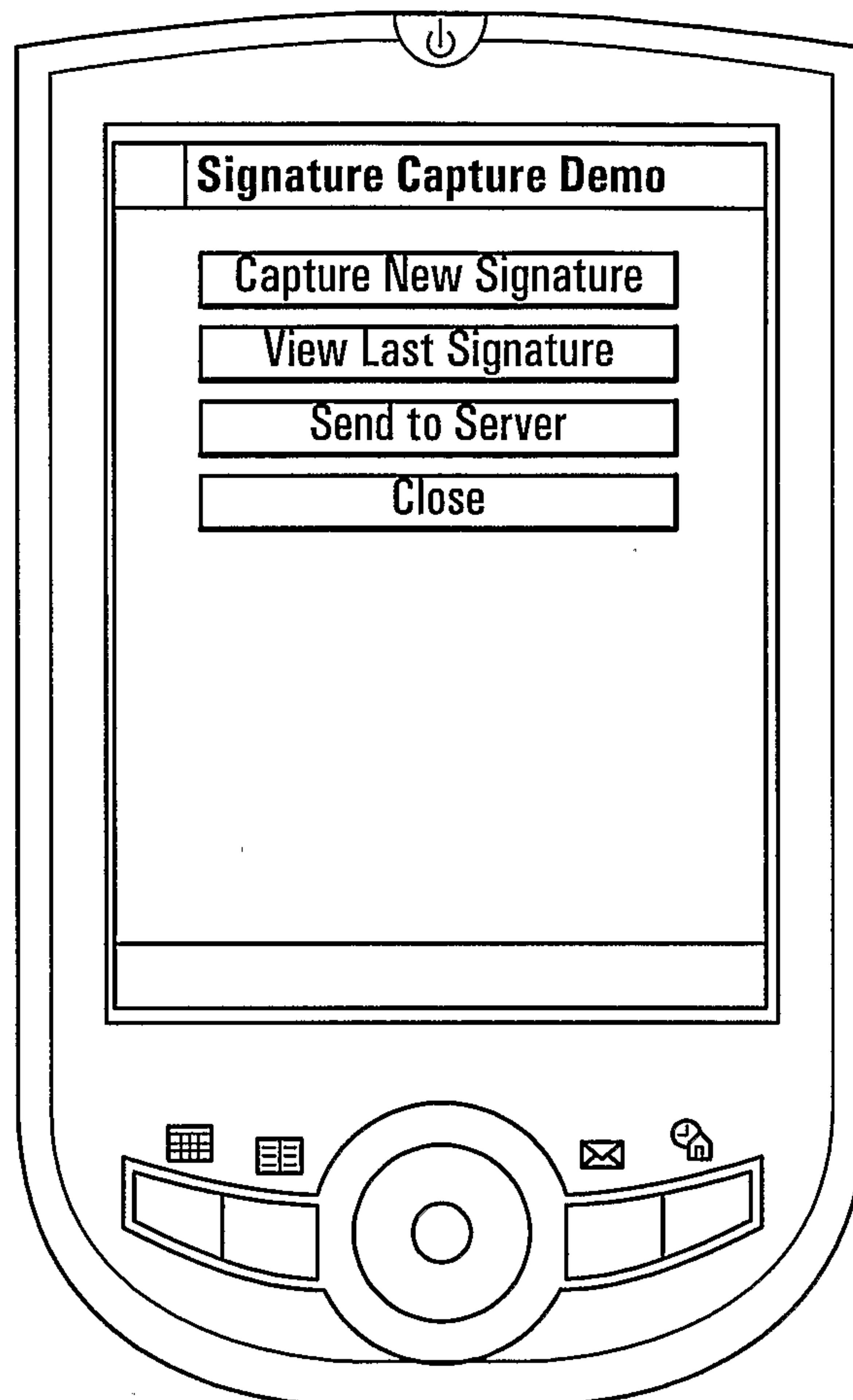
76 {
  <ARML>
    <HEAD>_</HEAD>
    <SYS>
      <REG TYPE="ADD">
        <CLIENTID>SUNTRESS</CLIENTID>
        <MOBILEID>867452</MOBILEID>
        <NEWMOBILEID>268625</NEWMOBILEID>
        <PLATFORMS>
          <PLATFORM>WinCE</PLATFORM>
        </PLATFORMS>
      </REG>
    </SYS>
  </ARML>
}

76 {
  <ARML>
    <HEAD>_</HEAD>
    <SYS>
      <REGCONFIRM TYPE="ADD">
        <MOBILEID>268625</MOBILEID>
        <VALUE>CONFIRM</VALUE>
        <INTERFACE>
          <BUTTONS NUM="1">
            <BTN NAME="OK" CAPTION="Send" INDEX="0">
              </BTN>
            </BUTTONS>
          <EDITBOXES NUM="3">
            <E3 NAME="To" INDEX="1"></E3>
            <E3 NAME="Subject" INDEX="2"></E3>
            <E3 NAME="Body" INDEX="3"></E3>
          </EDITBOXES>
        </INTERFACE>
      </REGCONFIRM>
    </SYS>
  </ARML>
}

```

FIG. 12

13/85

**FIG. 13A**

14/85

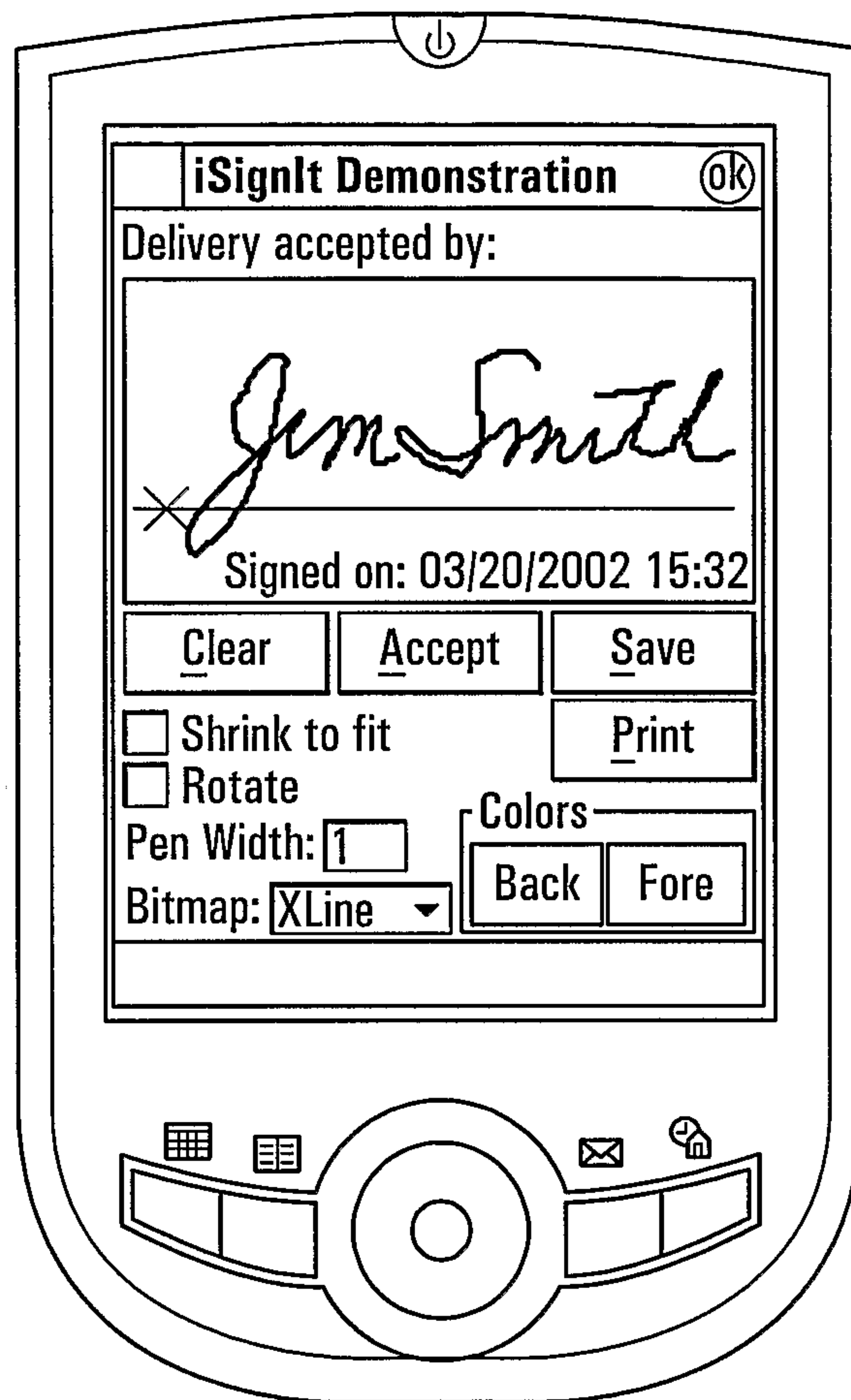


FIG. 13B

15/85

```

-----
= <AXSCHDEF APPNAME="SignatureCapture" VERSION="1.2" DESC="Signature
  Capture - Integration" ARMLMAJOR="3" ARMLMINOR="1">
= <AXTDEFS>
= <TDEF NAME="LASTSIG" PK="SIGNATURE" DELINDEX="0">
= <FIELDS>
= <FLD TYPE="MEMO" SIZE="1" INDEXED="NO"
  ALLOWNULL="NO">SIGNATURE</FLD>
= <FLD TYPE="STRING" SIZE="20" INDEXED="NO"
  ALLOWNULL="NO">SIGNAME</FLD>
= </FIELDS>
= </TDEF>
= </AXTDEFS>
-----

```

FIG. 14

```

-----
= <DPACKETS>
= <AXDATAPACKET BODY="SIG" UPDATELOCALDATA="NO" SENDTOAPP="YES">
= <TABLEUPDATES>
= <TUPDATE TABLE="LASTSIG" UPDATETYPE="DELETE" WHEREFIELD=""
  WHEREPARAM="" SECTION="SIG" MULTIROW="NO" MULTIROWIDENT="" />
= <TUPDATE TABLE="LASTSIG" UPDATETYPE="ADD" WHEREFIELD=""
  WHEREPARAM="" SECTION="SIG" MULTIROW="NO" MULTIROWIDENT="">
= <PKGFIELD>
= <PKGFLD NAME="SIGNATURE" PARAMTYPE="VALUE" />
= <PKGFLD NAME="SIGNAME" PARAMTYPE="PROP">NAME</PKGFLD>
= </PKGFIELD>
= </TUPDATE>
= </TABLEUPDATES>
= </AXDATAPACKET>
= </DPACKETS>
= <DEVICES>
= <DEV TYPE="CE">
-----

```

FIG. 15

16/85

```
- <SCREENS STSCRN="MAIN">
- <SCREEN NAME="MAIN" TITLE="Signature Capture Demo"
-   'ORDERED="FALSE">
-   <EVENTS />
-   <BUTTONS>
-   <BTN NAME="btnCapture" INDEX="0" CAPTION="Capture New Signature"
-     X="28" Y="16" HT="21" WT="180" READONLY="NO">
-   <EVENTS>
-   <EVENT TYPE="BUTTONCLICK">
-   <ACTION TYPE="INTEGRATION" CLSID="AirixSignature.AirixSignatureCtrl"
-     SAVENAME="SIGNATURE" SAVE="TRUE" />
-   </EVENT>
-   </EVENTS>
-   </BTN>
- <BTN NAME="btnView" INDEX="1" CAPTION="View Last Signature" X="28"
-   Y="50" HT="21" WT="180" READONLY="NO">
- <EVENTS>
- <EVENT TYPE="BUTTONCLICK">
- <ACTION TYPE="INTEGRATION" CLSID="AirixSignature.AirixSignatureCtrl"
-   SAVENAME="" SAVE="FALSE">[SP.*.SIGNATURE]</ACTION>
- </EVENT>
- </EVENTS>
- </BTN>
- <BTN NAME="btnSend" INDEX="2" CAPTION="Send to Server" X="28" Y="116"
-   HT="21" WT="180" READONLY="NO">
- <EVENTS>
- <EVENT TYPE="BUTTONCLICK">
- <ACTION TYPE="ARML">
- <ARMLTEXT>
- ...
```

FIG. 16A

17/85

```

...
<PKG TYPE="SIG">
<SIG NAME="Test">[SP.*.SIGNATURE]</SIG>
  </PKG>
  </ARMLTEXT>
  </ACTION>
  </EVENT>
  </EVENTS>
  </BTN>
= <BTN NAME="btnClose" INDEX="3" CAPTION="Close" X="28" Y="148" HT="21"
  WT="180" READONLY="NO">
= <EVENTS>
= <EVENT TYPE="BUTTONCLICK">
= <ACTION TYPE="CLOSE" />
  </EVENT>
  </EVENTS>
  </BTN>
  </BUTTONS>
  </SCREEN>
  </SCREENS>
  </DEV>
  </DEVICES>
  </AXSCHDEF>

```

FIG. 16B

Appendix “A”

Contents

1	Introduction.....	FIG. 17F
1.1	Purpose of document.....	FIG. 17F
1.2	Audience	FIG. 17F
1.3	Definitions & Acronyms.....	FIG. 17F
2	ARML Overview	FIG. 17G
2.1	ARML design considerations	FIG. 17G
2.2	ARML usage.....	FIG. 17H
2.3	The scratchpad area.....	FIG. 17H
2.4	System Variables and Functions.....	FIG. 17I
2.4.1	Variables:	FIG. 17I
2.4.2	Functions:.....	FIG. 17I
2.5	Single-Field Lookup	FIG. 17J
3	ARML application definition.....	FIG. 17K
3.1	General.....	FIG. 17K
3.1.1	Description.....	FIG. 17K
3.1.2	Structure.....	FIG. 17K
3.1.3	Tags.....	FIG. 17K
3.2	Table Definitions Section	FIG. 17M
3.2.1	Description.....	FIG. 17M
3.2.2	Structure.....	FIG. 17M
3.2.3	Tags.....	FIG. 17M
3.2.4	Example	FIG. 17N
3.3	Package Definitions Section	FIG. 17P
3.3.1	Description.....	FIG. 17P
3.3.2	Structure.....	FIG. 17P
3.3.3	Tags.....	FIG. 17P
3.3.4	Example	FIG. 17S
3.4	Device Interface Definitions Section.....	FIG. 17T
3.4.1	Description.....	FIG. 17T
3.4.2	Structure.....	FIG. 17T
3.4.3	Tags.....	FIG. 17T
3.4.4	Example	FIG. 17V

FIG. 17A

Appendix "A"

4	Application-defined packages.....	FIG. 17W
4.1	General.....	FIG. 17W
4.1.1	Description.....	FIG. 17W
4.1.2	Structure.....	FIG. 17W
4.1.3	Tags.....	FIG. 17W
4.2	Package information	FIG. 17X
4.2.1	Example	FIG. 17X
5	User interface Definitions	FIG. 17Z
5.1	General.....	FIG. 17Z
5.1.1	Description.....	FIG. 17Z
5.1.2	Structure.....	FIG. 17Z
5.1.3	Tags.....	FIG. 17AA
5.2	Queries definition section	FIG. 17CC
5.2.1	Description.....	FIG. 17CC
5.2.2	Structure.....	FIG. 17CC
5.2.3	Tags.....	FIG. 17CC
5.3	Menu definition section	FIG. 17DD
5.3.1	Description.....	FIG. 17DD
5.3.2	Structure.....	FIG. 17DD
5.3.3	Tags.....	FIG. 17DD
5.4	Buttons definition section	FIG. 17FF
5.4.1	Description.....	FIG. 17FF
5.4.2	Structure.....	FIG. 17FF
5.4.3	Tags.....	FIG. 17FF
5.5	Text Items definition section	FIG. 17GG
5.5.1	Description.....	FIG. 17GG
5.5.2	Structure.....	FIG. 17GG
5.5.3	Tags.....	FIG. 17GG
5.6	Edit boxes definition section.....	FIG. 17HH
5.6.1	Description.....	FIG. 17HH
5.6.2	Structure.....	FIG. 17HH
5.6.3	Tags.....	FIG. 17II
5.7	Choice items definition section.....	FIG. 17JJ
5.7.1	Description.....	FIG. 17JJ
5.7.2	Structure.....	FIG. 17JJ
5.7.3	Tags.....	FIG. 17KK
5.8	Checkboxes definition section	FIG. 17LL

FIG. 17B

Appendix "A"

5.8.1	Description.....	FIG. 17LL
5.8.2	Structure.....	FIG. 17LL
5.8.3	Tags.....	FIG. 17MM
5.9	Listboxes definition section.....	FIG. 17NN
5.9.1	Description.....	FIG. 17NN
5.9.2	Structure.....	FIG. 17NN
5.9.3	Tags.....	FIG. 17NN
5.10	Grids.....	FIG. 17PP
5.10.1	Description.....	FIG. 17PP
5.10.2	Structure.....	FIG. 17PP
5.10.3	Tags.....	FIG. 17QQ
5.10.4	Example	FIG. 17RR
6	The Smart Client event model	FIG. 17TT
6.1	The EVENTS tag	FIG. 17UU
6.2	The EVENT tag	FIG. 17UU
6.2.1	The BUTTONCLICK event	FIG. 17UU
6.2.2	The MENUITEMSELECTED event	FIG. 17UU
6.2.3	The DATA event.....	FIG. 17UU
6.3	The ACTION tag	FIG. 17UU
6.3.1	The OPEN action	FIG. 17VV
6.3.2	The ARML action.....	FIG. 17VV
6.3.3	The SAVE action	FIG. 17VV
6.3.4	The PURGE action	FIG. 17WW
6.3.5	The NOTIFY action.....	FIG. 17WW
6.3.6	The CLOSE action.....	FIG. 17WW
6.3.7	The ALERT action.....	FIG. 17WW
6.3.8	The INTEGRATION action	FIG. 17WW
6.3.9	The CLOSESCREEN action.....	FIG. 17XX
6.3.10	The REFRESH action	FIG. 17XX
6.3.11	The SAVEITEM action	FIG. 17XX
6.3.12	The IF Action.....	FIG. 17XX
	Example of airix event model.....	FIG. 17BBB
7	AVM-server system interactions	FIG. 17DDD
7.1	General.....	FIG. 17DDD
7.1.1	Description.....	FIG. 17DDD
7.1.2	Structure.....	FIG. 17DDD
7.1.3	Tags.....	FIG. 17DDD

FIG. 17C

Appendix "A"

7.2	Device Registration & deregistration package	FIG. 17EEE
7.2.1	Description.....	FIG. 17EEE
7.2.2	Structure.....	FIG. 17EEE
7.2.3	Tags.....	FIG. 17EEE
7.2.4	Example	FIG. 17EEE
7.3	Registration confirmation package	FIG. 17FFF
7.3.1	Description.....	FIG. 17FFF
7.3.2	Structure.....	FIG. 17FFF
7.3.3	Tags.....	FIG. 17FFF
7.3.4	Example	FIG. 17GGG
7.4	Find applications package.....	FIG. 17HHH
7.4.1	Description.....	FIG. 17HHH
7.4.2	Structure.....	FIG. 17HHH
7.4.3	Tags.....	FIG. 17HHH
7.5	Find applications confirmation package	FIG. 17III
7.5.1	Description.....	FIG. 17III
7.5.2	Structure.....	FIG. 17III
7.5.3	Tags.....	FIG. 17III
7.6	Application Registration & deregistration package.....	FIG. 17JJJ
7.6.1	Description.....	FIG. 17JJJ
7.6.2	Structure.....	FIG. 17JJJ
7.6.3	Tags.....	FIG. 17JJJ
7.7	Application registration & deregistration confirmation package.....	FIG. 17KKK
7.7.1	Description.....	FIG. 17KKK
7.7.2	Structure.....	FIG. 17KKK
7.7.3	Tags.....	FIG. 17KKK
7.7.4	Example	FIG. 17LLL
7.8	Setting the active device package	FIG. 17MMM
7.8.1	Description.....	FIG. 17MMM
7.8.2	Structure.....	FIG. 17MMM
7.8.3	Tags.....	FIG. 17MMM
7.8.4	Example	FIG. 17MMM
7.9	Set active device response	FIG. 17MMM
7.9.1	Description.....	FIG. 17MMM
7.9.2	Structure.....	FIG. 17MMM
7.9.3	Tags.....	FIG. 17NNN
7.9.4	Example	FIG. 17NNN

FIG. 17D

Appendix “A”

7.10	Invalid Application package	FIG. 17NNN
7.10.1	Description.....	FIG. 17NNN
7.10.2	Structure.....	FIG. 17NNN
7.10.3	Tags.....	FIG. 17OOO
7.10.4	Example	FIG. 17OOO
8	Application-server system interactions.....	FIG. 17PPP

FIG. 17E

23/85

Appendix “A”

1 Introduction

1.1 Purpose of document

This document describes the structure and syntax of the ARML language.

1.2 Audience

The document is intended to be read by AIRIX developers and users of ARML.

1.3 Definitions & Acronyms

ARML	AIRIX Markup Language
XML	Extensible Markup Language

FIG. 17F

24/85

Appendix “A”

2 ARML Overview

ARML is an XML markup language used by the AIRIX platform. It performs three tasks;

- Data is passed back and forth between the mobile server, AIRIX platform and enterprise application using ARML.
- The AIRIX Smart Client uses ARML to define the user interface for an AIRIX-enabled application on the mobile device
- The AIRIX server uses ARML to define that data that it stores for the application in its database.

2.1 ARML design considerations

ARML has been designed with the following goals in mind;

- Transactions and screen definitions should be as independent as possible
- AIRIX should be unaware of internals of the enterprise application
- Strict conformance to the XML specification will be enforced
- Operation should be transparent to the end user
- ARML packages should be readable as is
- The minimum number of characters needed should be used

FIG. 17G

25/85

Appendix "A"

2.2 ARML usage

The diagram below illustrates how ARML is used.

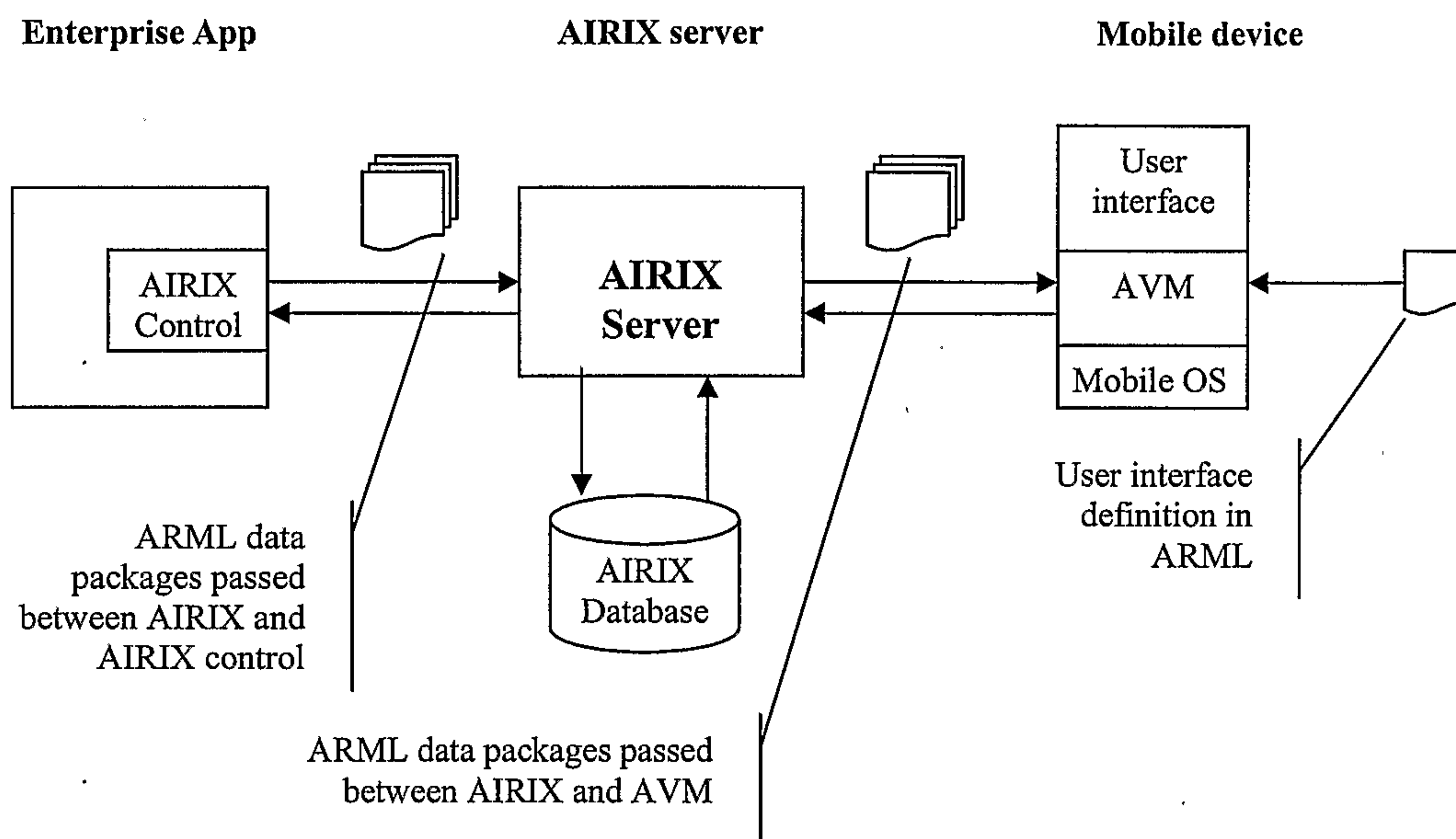


Figure 1 -The ARML environment

The key to ARML usage is the application definition file held on the AIRIX server. This file defines the AIRIX tables for the application, the allowed message set and the user interface definitions for the application on a given device.

2.3 The scratchpad area

The scratchpad is used as a temporary storage area where a global value or a value associated to a screen can be saved for future use. The syntax for a scratchpad value is as follows:

screen scratchpad value: [SP.screen.savename]

FIG. 17H

26/85

Appendix “A”

global scratchpad value: [SP.**savename*]

The syntax for retrieving a global scratchpad value can also be used to retrieve screen scratchpad values.

2.4 System Variables and Functions

There are several variables that are available that will retrieve application and system values to be used throughout the application. The syntax for these variables are as follows:

2.4.1 Variables:

[DATE] – returns the current system date, formatted as dd mmm yy

[TIME] – returns the current system time, formatted as hh:mm:ss am/pm.

[SYS.VAR.DATE] - returns the current system date, formatted as dd mmm yy

[SYS.VAR.MOBILEID] - retrieves the device's Mobile ID

[SYS.VAR.APPNAME] - retrieves the name of the application.

[SYS.VAR.APPVERSION] - retrieves the version number of the application.

[SYS.VAR.SCVERSION] - retrieves the version number of the Smart Client.

[SYS.VAR.ARMLMAJOR] - retrieves the ARML major version of the application.

[SYS.VAR.ARMLMINOR] - retrieves the ARML minor version of the application.

2.4.2 Functions:

[SYS.FUNC.DATEADD([SYS.VAR.DATE],+-x)] - The Date Arithmetic tag is used to add or subtract days from the current date. In the tag, *x* represents the number of days added or subtracted. Developers can also choose to substitute a hard-coded date value in the Date Arithmetic tag, in the place of the [SYS.VAR.DATE] tag.

[SYS.FUNC.DATETOSTR([SYS.VAR.DATE],d mmm yyyy h:nn:ss tz)] - The Date To String tag is used to convert date data to a string value.

[SYS.FUNC.STRTODATE([SYS.VAR.DATE],d mmm yyyy h:nn:ss tz)] - The String to Date tag is used to convert string data to a date value, in the RFC 1123 format.

FIG. 17I

27/85

Appendix “A”

2.5 Single-Field Lookup

The single-field lookup will run a simple SELECT query with one where clause to retrieve specific data. The syntax is as follows:

[DB.DOLOOKUP(*table, field, wherefield, wherevalue*)]

FIG. 17J

28/85

Appendix “A”

3 ARML application definition

3.1 General

3.1.1 Description

The application definition section defines the AIRIX tables and ARML data packages that are used for transactions involved with a specific application.

3.1.2 Structure

The ARML application definition has the following structure;

```

<ARML>
  <AXSCHDEF>
    <EVENTS>
      <EVENT>
        (action definitions)
      </EVENT>
    </EVENTS>
    <AXTDEFS>
      (table definitions)
    </AXTDEFS>
    <DPACKETS>
      (data package definitions)
    </DPACKETS>
    <DEVICES>
      (device interface definitions)
    </DEVICES>
  </AXSCHDEF>
</ARML>

```

3.1.3 Tags

3.1.3.1 The <AXSCHDEF> tag

These tags (<AXSCHDEF>...</AXSCHDEF>) mark the start and end of the application definition. THE AXSCHDEF tag has two attributes;

Attribute	Optional?	Description
APPNAME	No	The name of the application
VERSION	No	Which version of the application the file describes
DESC	No	A text description of the application for display purposes
ARMLMAJOR	No	The major version of the ARML language this application definition was created with.

FIG. 17K

29/85

Appendix “A”

ARMLMINOR	No	The minor version of the ARML language this application definition was created with.
-----------	----	--

3.1.3.2 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

3.1.3.3 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

3.1.3.4 The <AXTDEFS> tag

The <AXTDEFS>...</AXTDEFS> pair marks the start and end of the table definitions section. It has no attributes.

3.1.3.5 The <DPACKETS> tag

The <DPACKETS>...</DPACKETS> pair marks the start and end of the data package definitions section. It has no attributes.

3.1.3.6 The <DEVICES> tag

The <DEVICES>...</DEVICES> pair marks the start and end of the device interface definitions section. It has no attributes.

FIG. 17L

30/85

Appendix “A”

3.2 Table Definitions Section

3.2.1 Description

The table definitions section defines the tables on the mobile device for the application

3.2.2 Structure

The table definitions section has the following structure;

```
{wrapper tags}
<TDEF>
    <FIELDS>
        <FLD>...</FLD>
    </FIELDS>
</TDEF>
(etc.).
{wrapper tags}
```

3.2.3 Tags

3.2.3.1 The <TDEF> tag

Each table definition is enclosed within the <TDEF>...</TDEF> pair. The TDEF tag has the following attributes;

Attribute	Optional?	Description
NAME	No	The number of table definitions in the section
PK	No	Which of the table fields is the primary key for the table
DELINDEX	No	The index of this table with respect to all the tables for specifying the delete order. This value is 1 based.

3.2.3.2 The <FIELDS> tag

The <FIELDS>...</FIELDS> tag pair marks where the fields in a given table are defined. The FIELDS tag has no attributes.

3.2.3.3 The <FLD> tag

The <FLD>...</FLD> tag pair defines a single field in a table. Enclosed between the tags is the field name. The <FLD> tag has the following structure;

Attribute	Optional?	Description
TYPE	No	The data type contained in the field. Permitted values are:

FIG. 17M

Appendix “A”

		INT – integer value STRING – a fixed-length string of n characters (see SIZE field) MEMO – a string of max 65535 characters AUTOINC – an integer value, automatically incremented by the database. This field will be read-only to the applications. DATETIME – a datetime value
SIZE	No	If the TYPE is set to STRING, this field specifies the number of characters in the field
INDEXED	No	Specifies if the field needs to be indexed in the AIRIX database
REFERENCEFIELD	Yes	If this attribute is present, it defines that this field is a foreign key. The foreign table/field is given in the format “table(field)”
ALLOWNULL	No	Specifies if the field is allowed to have a null value

3.2.4 Example

An email application would use 2 tables for storing sent emails.

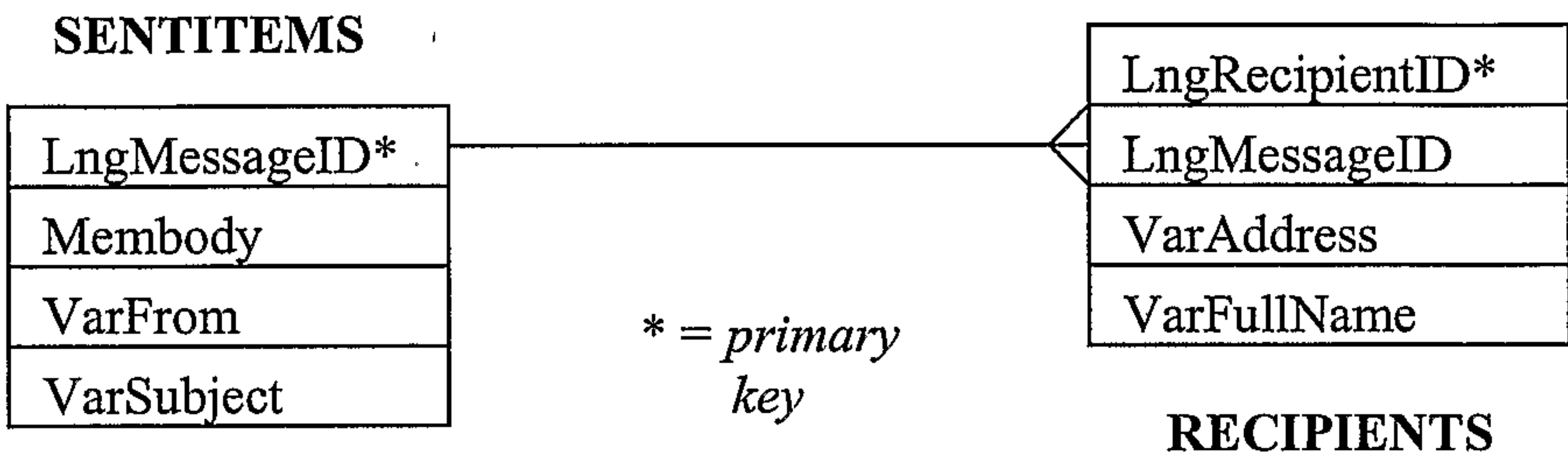


Figure 2 - sample email schema

This translates into the following ARML fragment;

```
<TDEF NAME="SENTITEMS" UPDATETYPE=NEW PK=LNGMESSAGEID DELINDEX=2>
  <FIELDS>
    <FLD TYPE="INT" SIZE="0" INDEXED="NO" REFERENCEFIELD=""
      ALLOWNULL="NO">LNGMESSAGEID</FLD>
    <FLD TYPE="STRING" SIZE="200" INDEXED="NO" REFERENCEFIELD=""
      ALLOWNULL="YES">VARFROM</FLD>
    <FLD TYPE="MEMO" SIZE="0" INDEXED="NO" REFERENCEFIELD=""
      ALLOWNULL="YES">MEMBODY</FLD>
    <FLD TYPE="STRING" SIZE="200" INDEXED="NO" REFERENCEFIELD=""
      ALLOWNULL="YES">VARSUBJECT</FLD>
  </FIELDS>
</TDEF>
<TDEF NAME="RECIPIENTS" UPDATETYPE=NEW PK=LNGRECIPIENTID DELINDEX=1>
  <FIELDS>
    <FLD TYPE="INT" SIZE="AUTOINC" INDEXED="NO" REFERENCEFIELD=""
      ALLOWNULL="NO">LNGMESSAGEID</FLD>
```

FIG. 17N

32/85

Appendix "A"

```
<FLD TYPE="INT" SIZE="0" INDEXED="YES"
    REFERENCEFIELD="SENTITEMS (MESSAGEID) "
    ALLOWNULL="NO">LNGMESSAGEID</FLD>
<FLD TYPE="STRING" SIZE="200" INDEXED="NO" REFERENCEFIELD=""
    ALLOWNULL="YES">VARFULLNAME</FLD>
<FLD TYPE="STRING" SIZE="200" INDEXED="NO" REFERENCEFIELD=""
    ALLOWNULL="YES">VARADDRESS</FLD>
</FIELDS>
</TDEF>
```

Figure 3 - a sample table definition section

FIG. 170

33/85

Appendix “A”

3.3 Package Definitions Section

3.3.1 Description

The package definitions section defines the structure of the application packages and the data that they carry.

3.3.2 Structure

The package definitions section has the following structure;

```
{wrapper tags}
<AXDATAPACKET>
  <TABLEUPDATES>
    <TUPDATE>
      <PKGFIELDS>
        <PKGFLD>...</PKGFLD>
        <PKGFLD>...</PKGFLD>
      </PKGFIELDS>
    </TUPDATE>
  </TABLEUPDATES>
  <TABLEUPDATES>
    <TUPDATE>
      <PKGFIELDS>
        <PKGFLD>...</PKGFLD>
        <PKGFLD>...</PKGFLD>
        (etc.)
      </PKGFIELDS>
    </TUPDATE>
  </TABLEUPDATES>
  (etc.)
</AXDATAPACKET>
{wrapper tags}
```

3.3.3 Tags

3.3.3.1 The <AXDATAPACKET> tag

The <AXDATAPACKET>...</AXDATAPACKET> pair delimits a package definition. The tag has the following attributes;

Attribute	Optional?	Description
BODY	No	This field gives the name by which the data package is known
UPDATELOCALDATA	No	Specifies whether the package is to update the local database.
SENDTOAPP	No	Specifies whether the package is sent to the application server

FIG. 17P

Appendix “A”

3.3.3.2 The <TABLEUPDATES> tag

The <TABLEUPDATES>...</TABLEUPDATES> pair marks the start and end of the table definitions section. It has no attributes.

3.3.3.3 The <TUPDATE> tag

Each table update is enclosed within the <TUPDATE>...</TUPDATE> pair. The TUPDATE tag has the following attributes;

Attribute	Optional?	Description
TABLE	No	The table in the database that is updated
UPDATETYPE	No	The type of update that is being made to the database. Possible values are; ADD – adds a new record into the table DELETE – removes a record into the table UPDATE – modifies a record in the table
WHEREFIELD	Yes	For a conditional update of a table, specifies the field and table to match on. This is in the format “table(field)”.
WHEREPARAM	Yes	Text string specifying the value. This tag has no meaning and will be skipped unless the WHEREFIELD attribute has been specified.
SECTION	No	An identifier for the section in the data package
MULTIROW	No	Boolean field specifying whether multiple rows can be updated by the tag
MULTIROWIDENT	Yes	If the MULTIROW attribute is set to ‘YES’, this field is required and specifies the

3.3.3.4 The <PKGFIELD> tag

The <PKGFIELD>...</PKGFIELD> tag pair marks where the fields in a given data package are defined. The PKGFIELD tag has no attributes.

3.3.3.5 <The PKGFELD> tag

The <PKGFELD>...</PKGFELD> tag pair defines a single parameter in a given data package. Enclosed between the <PKGFELD>...</PKGFELD> tags is the field name. The <PKGFELD> tag has the following attributes;

Attribute	Optional?	Description
NAME	No	This is the field in the AIRIX database that maps to the user

FIG. 17Q

35/85

Appendix “A”

		interface field
PARAMTYPE	No	This defines the type of parameter. It can take two values; PROP – this means that the parameter appears as part of the tag definition VALUE – this means that the parameter is contained between the two tags. Only one parameter in a given data package can be of this type

FIG. 17R

36/85

Appendix "A"

3.3.4 Example

Using the table definitions example in section 3.2.4, when the user sends an email, a data package to transport the data would update the 'SENTITEMS' table and the 'RECIPIENTS' table. The following ARML fragment defines such a data package;

```
<AXDATAPACKET BODY="ME" SENDTOMOBILE="NO" SENDTOAPP="YES">
  <TABLEUPDATES>
    <TUPDATE TABLE="SENTITEMS" UPDATETYPE="ADD" WHEREFIELD=""
      WHEREPARAM=""
        WHERETYPE="PROP" SECTION="MAIL" MULTIROW="NO" MULTIROWIDENT="">
      <FIELDS>
        <PKGFLD NAME="LNGMESSAGEID" PARAMTYPE="PROP">MSGID</PKGFLD>
        <PKGFLD NAME="VARFROM" PARAMTYPE="PROP">FROM</PKGFLD>
        <PKGFLD NAME="VARSUBJECT" PARAMTYPE="PROP">SUBJECT</PKGFLD>
        <PKGFLD NAME="MEMBODY" PARAMTYPE="VALUE">DATA</PKGFLD>
      </FIELDS>
    </TUPDATE>
    <TUPDATE TABLE="RECIPIENTS" UPDATETYPE="ADD" WHEREFIELD=""
      WHEREPARAM=""
        WHERETYPE="PROP" SECTION="RECIPS" MULTIROW="YES"
        MULTIROWIDENT="RCP">
      <FIELDS>
        <PKGFLD NAME="LNGMESSAGEID" PARAMTYPE="PROP">MSGID</PKGFLD>
        <PKGFLD NAME="VARFULLNAME" PARAMTYPE="PROP">TO</PKGFLD>
        <PKGFLD NAME="VARADDRESS" PARAMTYPE="PROP">ADDRESS</PKGFLD>
      </FIELDS>
    </TUPDATE>
  </TABLEUPDATES>
</AXDATAPACKET>
```

Figure 4 - a sample package definition

FIG. 17S

37/85

Appendix “A”

3.4 Device Interface Definitions Section

3.4.1 Description

The display definitions section contains the user interface definitions for the various mobile devices that an application supports.

3.4.2 Structure

The device display definitions section has the following structure;

```
{wrapper tags}
<DEV>
    <SCREENS>
        <SCREEN>
            {screen definitions}
        </SCREEN>
    </SCREENS>
</DEV>
{other devices}
{wrapper tags}
```

3.4.3 Tags

3.4.3.1 The <DEV> tag

The <DEV>...</DEV> pair delimits an interface definition for a specific device. The tag has the following attributes;

Attribute	Optional?	Description
TYPE	No	The type of device. Allowed values are: RIM – a Research in Motion Blackberry pager WAP – a WAP phone CE – Pocket PC

3.4.3.2 The <SCREENS> tag

The <SCREENS>...</SCREENS> pair delimits the screens definition for a specific device. The tag has one attribute;

Attribute	Optional?	Description
STSCRN	No	The first screen that is displayed when the application starts

FIG. 17T

38/85

Appendix “A”

3.4.3.3 The <SCREEN> tag

The <SCREEN>...</SCREEN> pair, and its contents are described in section 5.1.3.1

FIG. 17U

39/85

Appendix "A"

3.4.4 Example

The following example shows the screen definitions section for an application that allows a user to view their inbox and the mails in it.

```
{wrapper tags}
<DEV TYPE="RIM">
  <SCREENS>
    <SCREEN NAME="INBOX ">
      {screen definition}
    </SCREEN>
    <SCREEN NAME="VIEWNEWMAIL">
      {screen definition}
    </SCREEN>
  </SCREENS>
</DEV>
<DEV TYPE="PALM">
  <SCREENS>
    <SCREEN NAME="INBOX">
      {screen definition}
    </SCREEN>
    <SCREEN NAME="VIEWNEWMAIL">
      {screen definition}
    </SCREEN>
  </SCREENS>
</DEV>
{wrapper tags}
```

FIG. 17V

40/85

Appendix “A”

4 Application-defined packages

This section describes the format of application defined packages.

4.1 General

This section describes the general structure of an application-specific data package.
As described in section , ;

4.1.1 Description

System level packages are sent between AIRIX and the application server, and between AIRIX and the AVM

4.1.2 Structure

An application defined package has the following structure;

```
<ARML>
  <HEAD>
    (header information)
  </HEAD>
  <PKG>
    (package information)
  </PKG>
</ARML>
```

4.1.3 Tags

4.1.3.1 The <HEAD> tag

The <HEAD> tag is as described in section 7.1.3.1

4.1.3.2 The <PKG> tag

The <PKG>...</PKG> tags delimit the package data. The PKG tag has the following attributes;

Attribute	Optional?	Description
TYPE	No	A text string identifying the type of package being sent

FIG. 17W

41/85

Appendix "A"

4.2 Package information

The format and rules for application-defined data packages depend on the package definitions for that application.

4.2.1 Example

A sample data package following the rules in section 3.3.4 would have a body section like this;

```
{wrapper tags}
<PKG TYPE="ME">
  <MAIL MSGID="1" FROM="Tim Neil" FROMADDRESS="timn@nextair.com"
    SUBJECT="Hello Back">
    <DATA>I am responding to your message</DATA>
  </MAIL>
  <RECIPS>
    <RCP MSGID="1" TO="Jeff Jones"
      ADDRESS="jeff@nextair.com"></RCP>
    <RCP MSGID="1" TO="Scott Neil"
      ADDRESS="scottn@nextair.com"></RCP>
    <RCP MSGID="1" TO="Steve Hulaj"
      ADDRESS="steveh@nextair.com"></RCP>
  </RECIPS>
</PKG>
{wrapper tags}
```

Figure 5 - a sample package

We will use this sample package to illustrate how packages are derived from the package definition file. The first tag in the package is the BODY tag. This tag defines which type of package it is;

Package Definition

```
<AXDATAPACKET BODY="ME" UPDATELOCALDATA="NO"
Package
<BODY TYPE="ME">
```

The package has two sections, which correspond to the two table update sections in the package definition;

FIG. 17X

42/85

Appendix "A"

Package Definition

```

<TUPDATE TABLE="SENTITEMS" UPDATETYPE="ADD" WHEREFIELD="" WHEREPARAM=""
  WHEREATYPE="PROP" SECTION="MAIL" MULTIROW="NO" MULTIROWIDENT="">

<TUPDATE TABLE="RECIPIENTS" UPDATETYPE="ADD" WHEREFIELD="" WHEREPARAM=""
  WHEREATYPE="PROP" SECTION="RECIPS" MULTIROW="YES"
  MULTIROWIDENT="RCP">
  Package
  <MAIL MSGID="1" FROM="Tim Neil"
    <RECIPS>
    <RCP>
    <RCP>
    <RCP>
    <RCP>
  </RECIPS>

```

The 'MAIL' section updates the 'SENTITEMS' table in the database. It does not update multiple rows. The 'RECIPS' section updates the 'RECIPIENTS' table in the database; it does update multiple rows, and each row is contained within a pair of <RCP> tags.

Each of the MAIL and RCP tags have fields which are used to update the field in the database tables;

Package Definition

```

<FIELDS>
  <PKGFLD NAME="LNGMESSAGEID" PARAMTYPE="PROP">MSGID</PKGFLD>
  <PKGFLD NAME="VARFULLNAME" PARAMTYPE="PROP">TO</PKGFLD>
  <PKGFLD NAME="VARADDRESS" PARAMTYPE="PROP">ADDRESS</PKGFLD>
</FIELDS>
  Package
  <RCP MSGID="1" TO="Jeff Jones" ADDRESS="jeff@nextair.com"></RCP>

```

FIG. 17Y

43/85

Appendix "A"

5 User interface Definitions

5.1 General

5.1.1 Description

A screen definition file defines a single screen for a specific device.

5.1.2 Structure

A screen definition file has the following structure;

```

<ARML>
  <SCREEN>
    <EVENTS>
      <EVENT>
        <ACTION>...</ACTION>
      </EVENT>
    </EVENTS>
    <QUERIES>
      (menu definition)
    </QUERIES>
    <MENUS>
      (menu definition)
    </MENUS>
    <BUTTONS>
      (button definitions)
    </BUTTONS>
    <TEXTITEMS>
      (textitem definitions)
    </TEXTITEMS>
    <EDITBOXES>
      (edit box definitions)
    </EDITBOXES>
    <CHOICEITEMS>
      (choice item definitions)
    </CHOICEITEMS>
    <IMAGES>
      (image definitions)
    </IMAGES>
    <LISTBOXES>
      (list box definitions)
    </LISTBOXES>
    <CHECKBOXES>
      (check box definitions)
    </CHECKBOXES>
    <GRIDS>
      (check grid definition)
  </SCREEN>
</ARML>

```

FIG. 17Z

Appendix “A”

```

        </GRIDS>
    </SCREEN>
</ARML>

```

5.1.3 Tags

5.1.3.1 The SCREEN tag

The <SCREEN>...</SCREEN> pair marks the start and end of the screen definitions section. It has attribute –

Attribute	Optional?	Description
NAME	No	An identifier for the screen. This is used to qualify variables and navigate between screens
TITLE	No	The title that appears for the screen.
BACKGROUND	Yes	If used, an image that appears behind the interface elements
ORDERED	Yes, only applicable on WAP	If yes, WML is created with ORDERED property set to true, if NO, WML is created with ORDERED property set to false. Only applicable on WAP. See WML standard for definition of ORDERED.

5.1.3.2 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.1.3.3 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.1.3.4 The <ACTION> tag

The <ACTION>...</ACTION> pair marks the start and end of an action definition. See section 6 for a detailed discussion of the Smart Client event model.

5.1.3.5 The QUERIES tag

The <QUERIES>...</QUERIES> pair marks the start and end of the queries definitions section. It has no attributes.

FIG. 17AA

Appendix “A”

5.1.3.6 The MENUS tag

The <MENUS>...</MENUS> pair marks the start and end of the menu definition section. It has no attributes.

5.1.3.7 The BUTTONS tag

The <BUTTONS>...</BUTTONS> pair marks the start and end of the button definitions section. It has no attributes.

5.1.3.8 The TEXTITEMS tag

The <TEXTITEMS>...</TEXTITEMS> pair marks the start and end of the text items section. It has no attributes.

5.1.3.9 The EDITBOXES tag

The <EDITBOXES>...</EDITBOXES> pair marks the start and end of the editboxes section. It has no attributes.

5.1.3.10 The CHOICEITEMS tag

The <CHOICEITEMS>...</CHOICEITEMS> pair marks the start and end of the choiceitems section. It has no attributes.

5.1.3.11 The IMAGES tag

The <IMAGES>...</IMAGES> pair marks the start and end of the images section. It has no attributes.

5.1.3.12 The CHECKBOXES tag

The <CHECKBOXES>...</CHECKBOXES> pair marks the start and end of the checkboxes section. It has no attributes.

5.1.3.13 The LISTBOXES tag

The <LISTBOXES>...</LISTBOXES> pair marks the start and end of the listboxes section. It has no attributes.

5.1.3.14 The GRIDS tag

The <GRIDS>...</GRIDS> pair marks the start and end of the grids section. It has no attributes.

FIG. 17BB

46/85

Appendix “A”

5.2 Queries definition section

5.2.1 Description

The queries definition section describes any queries that need to be run to populate a screen.

5.2.2 Structure

The queries definition section has the following structure;

```
{wrapper tags}
<QUERIES>
    <QUERY>
        <W>...</W>
    </QUERY>
</QUERIES>
{wrapper tags}
```

5.2.3 Tags

5.2.3.1 The <QUERIES> tag

The <QUERIES> ... </QUERIES> pair marks the start and end of query definition section. It has no attributes.

5.2.3.2 The <QUERY> tag

The <QUERY>...</QUERY> pair marks the start and end of a given query. It has the following attributes;

Attribute	Optional?	Description
NAME	No	Name of the query.
TABLE	No	The table in the database that is updated
ORDERBY	Yes	Specifies the name of the field in the table that the results are to be ordered on.
ORDERDIR	Yes	ASC or DESC, sort ascending or descending respectively. If ORDERBY is present and ORDERDIR is not, ASC is assumed.

FIG. 17CC

47/85

Appendix “A”

5.2.3.3 The <W> tag

The <W>...</W> pair marks the start and end of a given where clause. The value of the parameter is contained within the <W>...</W> tags. This value can be a specific value or a reference to a user interface field in the format “[SP.screen.savename] or [QU.query.field]”. It has the following attributes;

Attribute	Optional?	Description
F	No	Specifies the field to match on.
E	No	Specifies the expression type. Available expression types include: EQ NE LT GT BW (applicable only to fields of type STRING)

5.3 Menu definition section

5.3.1 Description

The menu definition section describes the menu for a given screen.

5.3.2 Structure

The menu definition section has the following structure;

```
{wrapper tags}

<MENUS>
  <MENU>
    <MENUITEM>
      <EVENTS>
        <EVENT>
          <ACTION>...</ACTION>
        </EVENT>
      </EVENTS>
    </MENUITEM>
  </MENU>
</MENUS>
{wrapper tags}
```

5.3.3 Tags

FIG. 17DD

Appendix “A”

5.3.3.1 The <MENUS> tag

The <MENUS> ... </MENUS> pair marks the start and end of menu definition section. It has no attributes.

5.3.3.2 The <MENU> tag

The <MENU> ... </MENU> pair marks the start and end of a menu definition. It has the following attributes.

Attribute	Optional?	Description
NAME	No	An internal identifier for the menu
CAPTION	No	The text that appears for this item in the menu

5.3.3.3 The <MENUITEM> tag

The <MENUITEM>...</MENUITEM> pair marks the start and end of a menuitem definition. It has the following tags;

Attribute	Optional?	Description
NAME	No	An internal identifier for the menu
CAPTION	No	The text that appears for this item in the menu
INDEX	Yes	The index of this menu item with respect to all of the menu items on this menu.
READONLY	Yes	If True, the menu item is inactive. False is the default.

5.3.3.4 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.3.3.5 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.3.3.6 The <ACTION> tag

The <ACTION>...</ACTION> pair marks the start and end of an action definition. See section 6 for a detailed discussion of the Smart Client event model.

FIG. 17EE

49/85

Appendix “A”

5.4 Buttons definition section

5.4.1 Description

The buttons definition section describes the buttons that appear on a given screen.

5.4.2 Structure

The buttons definition section has the following structure;

```
{wrapper tags}
<BTN>
  <EVENTS>
    <EVENT>
      <ACTION>...</ACTION>
    </EVENT>
  </EVENTS>
</BTN>
{wrapper tags}
```

5.4.3 Tags

5.4.3.1 The BTN tag

The <BTN>...</BTN> pair marks the start and end of a button definition. It has one attribute –

Attribute	Optional?	Description
NAME	No	An identifier for the button.
INDEX	No	The order in which the button appears
CAPTION	No	The caption that appears on a given button
X	Yes	The X-coordinate of the button on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
Y	Yes	The Y-coordinate of the button on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
HT	Yes	This is the Height of the button. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
WT	Yes	This is the Width of the Button. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
READONLY	Yes	If True, the button is not enabled. False is the default.

FIG. 17FF

50/85

Appendix “A”

5.4.3.2 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.4.3.3 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.4.3.4 The <ACTION> tag

The <ACTION>...</ACTION> pair marks the start and end of an action definition. See section 6 for a detailed discussion of the Smart Client event model.

5.5 Text items definition section

5.5.1 Description

The text items definition

5.5.2 Structure

The text items section has the following structure;

```
{wrapper tags}
<TI>
    <EVENTS>
        <EVENT>
            <ACTION>...</ACTION>
        </EVENT>
    </EVENTS>
</TI>
{wrapper tags}
```

5.5.3 Tags

5.5.3.1 The TI tag

The <TI>...</TI> pair marks the start and end of the screen definitions section. It has attribute –

Attribute	Optional?	Description
INDEX	No	The order in which the text item appears

FIG. 17GG

51/85

Appendix “A”

NAME	No	An Identifier for the Text Item
CAPTION	No	Text to appear on the Text Item
X	Yes	The X-coordinate of the text item on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
Y	Yes	The Y-coordinate of the text item on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
HT	Yes	This is the Height of the Text Item. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
WT	Yes	This is the Width of the Text Item. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser

5.5.3.2 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.5.3.3 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.5.3.4 The <ACTION> tag

The <ACTION>...</ACTION> pair marks the start and end of an action definition. See section 6 for a detailed discussion of the Smart Client event model.

5.6 Edit boxes definition section

5.6.1 Description

The edit boxes definition section describes what edit boxes exist for the screen.

5.6.2 Structure

The edit boxes section has the following structure;

FIG. 17HH

52/85

Appendix “A”

```

{wrapper tags}
<EB>
    <EVENTS>
        <EVENT>
            <ACTION>...</ACTION>
        </EVENT>
    </EVENTS>
</EB>
{wrapper tags}

```

5.6.3 Tags

5.6.3.1 The EB tag

The <EB>...</EB> pair marks an edit box definition. It has the following attributes –

Attribute	Optional?	Description
NAME	No	An identifier for the edit box.
TEXT	No	The text to display in the edit box before any entry has been made. Only used if the DATASRC attribute is invalid or omitted. Can be a scratchpad or query value of the form [SP.screen.savename] or [QU.query.field].
INDEX	No	The order in which the edit box appears
CAPTION	No	The caption for on a given edit box.
MULTILINE	No	Boolean field that indicates whether the edit box is a multiline field.
SAVE	No	Boolean value indicating whether or not to save the value in this field to temporary storage for use by other screens later on. Saving the value to the scratchpad is triggered by either exiting the screen or by an explicit ‘SAVE’ action on a user interface control.
SAVENAME	Yes	If present, the name to save the field under in the scratchpad. This attribute has no meaning unless the SAVE attribute is set to ‘Yes’
X	Yes	The X-coordinate of the edit box on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
Y	Yes	The Y-coordinate of the edit box on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
HT	Yes	The Height of the Edit Box. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
WT	Yes	The Width of the Edit Box. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
FT	Yes	Specifies the type of value expected (INT, STRING,

FIG. 17II

Appendix “A”

		MEMO,DATETIME) for the VM to validate prior to continuing a Save. If omitted, STRING is the default data type.
DATASRC	Yes	If present, the query and field in the query that populates this edit box. This is given in the format “query.field”.
READONLY	Yes	If “TRUE” the edit box will be read only, otherwise it is editable. “FALSE is the default value.

5.6.3.2 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.6.3.3 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.6.3.4 The <ACTION> tag

The <ACTION>...</ACTION> pair marks the start and end of an action definition. See section 6 for a detailed discussion of the Smart Client event model.

5.7 Choice items definition section

5.7.1 Description

The choice item definitions section describes the choice items that exist on a given screen. A choice item is an interface item that requires the user to make a selection from a list of options. It can be represented in different ways on different devices; on a RIM pager, it is a choice box, while on a WinCE device, it is a drop-down list.

5.7.2 Structure

The choice items section has the following structure;

```
{wrapper tags}
<CHOICE>
  <EVENTS>
    <EVENT>
      <ACTION>...</ACTION>
    </EVENT>
  </EVENTS>
  <ITEMS>
    <I>...</I>
```

FIG. 17JJ

54/85

Appendix “A”

```

    </ITEMS>
  </CHOICE>
  {wrapper tags}

```

5.7.3 Tags

5.7.3.1 The <CHOICE> tag

The <CHOICE>...</CHOICE> pair marks the start and end of a choice item definition. It has these attributes –

Attribute	Optional?	Description
NAME	No	An identifier for the choice item.
TEXT	No	The text to display in the choice item before any selection has been made.
INDEX	No	The order in which the choice item appears
CAPTION	No	The caption that appears for a given choice item
SAVE	No	Boolean value indicating whether or not to save the value in this field to temporary storage for use by other screens later on. Saving the value to the scratchpad is triggered by either exiting the screen or by an explicit 'SAVE' action on a user interface control.
SAVENAME	Yes	If present, the name to save the field under in the scratchpad. This attribute has no meaning unless the SAVE attribute is set to 'Yes'
X	Yes	The X-coordinate of the choice item on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
Y	Yes	The Y-coordinate of the choice item on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
DATASRC	Yes	If present, the query and field in the query that populates this choice item. This is given in the format “query.field”.
IDDATASRC	Yes	If present, the query and field in the query that populates the Ids for this choice item. This is given in the format “query.field”. The ID values created by the attributes should correspond directly to the choice item values. I.e. they should create a value, id pair.
READONLY	Yes	If “True”, the control cannot be modified. “False” is the default.
SI	Yes	The value to indicate which item of the choice item is to be selected when loaded. This value will be compared with the ID property (hard-coded items) or the IDDATASRC property (database items).

FIG. 17KK

55/85

Appendix “A”

5.7.3.2 The <ITEMS> tag

The <ITEMS>...</ITEMS> pair marks the start and end of a list of items to be included in the in the choice item. If a datasrc is specified, the <ITEMS> section is ignored.

5.7.3.3 The <I> tag

The <I>...</I> pair marks the start and end of an individual item in the choice items list. It has the following attributes:

Attribute	Optional?	Description
ID	Yes	An id used to identify this item in the list.

The value between the pair is the text value that is to be displayed in the choice item.

5.7.3.4 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.7.3.5 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.7.3.6 The <ACTION> tag

The <ACTION>...</ACTION> pair marks the start and end of an action definition. See section 6 for a detailed discussion of the Smart Client event model.

5.8 Checkboxes definition section

5.8.1 Description

The checkboxes section describes a check box that appears on a given screen.

5.8.2 Structure

The checkboxes section has the following structure;

FIG. 17LL

56/85

Appendix “A”

```

{wrapper tags}
  <CHK>
    <EVENTS>
      <EVENT>
        <ACTION>...</ACTION>
      </EVENT>
    </EVENTS>
  </CHK>
{wrapper tags}

```

5.8.3 Tags

5.8.3.1 The CHK tag

The <CHK>...</CHK> pair marks a check box definition

Attribute	Optional?	Description
NAME	No	An identifier for the check box.
INDEX	No	The index of this control with respect to the list of all controls on the screen.
CAPTION	No	The text to be displayed for this check box if the DATASRC is not available or is not specified.
Save	No	Boolean value indicating whether or not to save the value in this field to temporary storage for use by other screens later on. Saving the value to the scratchpad is triggered by either exiting the screen or by an explicit 'SAVE' action on a user interface control.
SAVENAME	Yes	If present, the name to save the field under in the scratchpad. This attribute has no meaning unless the SAVE attribute is set to 'Yes'
X	Yes	The X-coordinate of the check box on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
Y	Yes	The Y-coordinate of the check box on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
HT	Yes	The Height of the Checkbox. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
WT	Yes	The Width of the Checkbox. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
DATASRC	Yes	If present, the query and field in the query that populates this check box. This is given in the format "query.field".
VALUE	Yes	If present, specifies the initial state of the check box ('TRUE' = checked, 'FALSE' = Unchecked. If unspecified, FALSE is the default value.
READONLY	Yes	If "TRUE" the check box cannot be modified. "FALSE" is the default value.

FIG. 17MM

57/85

Appendix “A”

5.8.3.2 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.8.3.3 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.8.3.4 The <ACTION> tag

The <ACTION>...</ACTION> pair marks the start and end of an action definition. See section 6 for a detailed discussion of the Smart Client event model.

5.9 Listboxes definition section

5.9.1 Description

The listboxes section describes a list box that appears on a given screen.

5.9.2 Structure

The listboxes section has the following structure;

```
{wrapper tags}
  <LB>
    <EVENTS>
      <EVENT>
        <ACTION> ... </ACTION>
      </EVENT>
    </EVENTS>
    <ITEMS>
      <I> ... </I>
    </ITEMS>
  </LB>
{wrapper tags}
```

5.9.3 Tags

5.9.3.1 The LB tag

The <LB>...</LB> pair marks a list box definition

FIG. 17NN

58/85

Appendix “A”

Attribute	Optional?	Description
NAME	No	An identifier for the list box.
INDEX	No	The index of this control with respect to all of the controls on the screen.
CAPTION	No	The text to be displayed as the title of this list box, where applicable.
SAVE	No	Boolean value indicating whether or not to save the value in this field to temporary storage for use by other screens later on. Saving the value to the scratchpad is triggered by either exiting the screen or by an explicit ‘SAVE’ action on a user interface control.
SAVENAME	Yes	If present, the name to save the field under in the scratchpad. This attribute has no meaning unless the SAVE attribute is set to ‘Yes’.
X	Yes	The X-coordinate of the list box on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
Y	Yes	The Y-coordinate of the list box on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
HT	Yes	The Height of the Listbox. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
WT	Yes	The Width of the Listbox. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
DATASRC	Yes	If present, the query and field in the query that populates this list box. This is given in the format “query.field”.
IDDATASRC	Yes	If present, the query and field in the query that populates the list box Ids. This is given in the format “query.field”. This value will create a list of ID values that correspond to the list box values in DATASRC. I.e. they should create a value, id pair.
READONLY	Yes	If “TRUE” the list box cannot be modified. “FALSE” is the default.
SI	Yes	The value to indicate which item of the choice item is to be selected when loaded. This value will be compared with the ID property (hard-coded items) or the IDDATASRC property (database items).

5.9.3.2 The <ITEMS> tag

The <ITEMS>...</ITEMS> pair marks the start and end of a list of items to be included in the in the list box. If a datasrc is specified, the <ITEMS> section is ignored.

5.9.3.3 The <I> tag

The <I>...</I> pair marks the start and end of an individual item in the list box items list. It has the following attributes:

FIG. 1700

59/85

Appendix “A”

Attribute	Optional?	Description
ID	Yes	An id used to identify this item in the list.

The value between the pair is the text value that is to be displayed in the list box. Can be a scratchpad or query value of the form [SP.screen.savename] or [QU.query.field].

5.9.3.4 The <EVENTS> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.9.3.5 The <EVENT> tag

The <EVENT>...</EVENT> pair marks the start and end of a user-interface level event definition. See section 6 for a detailed discussion of the Smart Client event model.

5.9.3.6 The <ACTION> tag

The <ACTION>...</ACTION> pair marks the start and end of an action definition. See section 6 for a detailed discussion of the Smart Client event model.

5.10 Grids

5.10.1 Description

Grids allow data to be displayed in row-column format. Grids can display data from a data source (query) or they can contain hard coded values. Each column in a grid can be visible or hidden. Hidden values are maintained, but not visible to the user.

5.10.2 Structure

The grids section has the following structure;

```
{wrapper tags}
  <GRID>
    <COLS>
      <COL> ... </COL>
    </COLS>
    <ROWS>
      <R>
        <V> ... </V>
```

FIG. 17PP

60/85

Appendix “A”

```

        </R>
      </ROWS>
    </GRID>
{wrapper tags}

```

5.10.3 Tags

5.10.3.1 GRID Tag

<GRID>...</GRID> The grid item itself will have the following attributes

Attribute	Optional?	Description
NAME	No	An identifier for the edit box.
INDEX	No	The order in which the edit box appears
X	Yes	The X-coordinate of the edit box on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
Y	Yes	The Y-coordinate of the edit box on the screen. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
HT	Yes	The Height of the Edit Box. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
WT	Yes	The Width of the Edit Box. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser
GRDSRC	Yes	This is the Query on the screen that will provide the data to the grid. No field name will be specified in this value

5.10.3.2 COLS Tag

<COLS>...</COLS> This tag contains no attributes. But instead contains all the columns that are associated with the grid in the order in which they appear from left to right.

5.10.3.3 COL Tag

<COL>...</COL> This tag will determine the column specification for the grid. The attributes for this item are the following:

Attribute	Optional?	Description
-----------	-----------	-------------

FIG. 17QQ

61/85

Appendix “A”

CAPTION	Yes	This is the caption that appears at the top of the grid where applicable.
FIELDNAME	Yes	This field name represents the Field to pull information from out of the GRDSRC of the grid control.
SAVE	No	This true false value will be checked when the SAVE action is called to save values to the scratchpad
SAVENAME	Yes	This is the name in which the data will be saved when the SAVE action is called and the column is marked for Saving
WT	Yes	The Width of the Edit Box. This attribute may not be meaningful in some display environments, in which case it would be skipped without processing by the parser

5.10.3.4 ROWS Tag

<ROWS>...</ROWS> This will Indicate any hard coded rows that would be created in the design studio. It does not contain any attributes but instead contains all the row definitions.

5.10.3.5 R Tag

<R>...</R> This is the row declaration that contains all the values for the row that has been hard coded. It has no attributes itself, but contains the value definitions for the row.

5.10.3.6 V Tag

<V>...</V> This definition contains the data that is related to the ROW and to the column.

5.10.4 Example

An example of a grid declaration is as follows:

```
<GRID INDEX="2" NAME="mygrid" X="10" Y="50" HT="100" WT="100" GRDSRC="QUERY1">
<COLS>
<COL CAPTION="Id" FIELDNAME="lngID" SAVE="TRUE" SAVENAME="lngID" WT="20"></COL>
<COL CAPTION="Subject" FIELDNAME="strSubject" SAVE="TRUE" SAVENAME="Sub"
WT="80"></COL>
</COLS>
<ROWS>
<R>
<V>343432</V>
<V>This is a subject</V>
</R>
<R>
```

FIG. 17RR

62/85

Appendix “A”

<V>5456</V>
<V>This is another subject</V>
</R>
</ROWS>
</GRID>

FIG. 17SS

63/85

Appendix "A"

6 The Smart Client event model

The Smart Client has a set of actions that it ties to events. Events can occur at the application level, the screen level or the user interface item level; an application level event is listened for throughout the operation of the application, a screen level event is listened for while the screen is displayed, and so on. If an action for an event is defined at multiple levels, the lowest level has precedence; i.e., user interface actions override screen level actions, which override application level actions. An attempt to list an event multiple times at the same level (application, screen, item) is invalid and will generate an error message.

The following ARML fragment illustrates this schema (tags and attributes not relevant to the event model have been omitted);

```

<AXTSCHDEF>
  <EVENTS>
    <EVENT>
      <ACTION>...</ACTION>
      <ACTION>...</ACTION>
    </EVENT>
  </EVENTS>
  <INTERFACE>
    <SCREEN>
      <EVENT>
        <ACTION>...</ACTION>
      </EVENT>
      <EVENT>
        <ACTION>...</ACTION>
      </EVENT>
      <BUTTON>
        <EVENT>
          <ACTION>...</ACTION>
        </EVENT>
        <EVENT>
          <ACTION>...</ACTION>
        </EVENT>
      </BUTTON>
    </SCREEN>
  </INTERFACE>
</AXTSCHDEF>

```

FIG. 17TT

64/85

Appendix “A”

6.1 The EVENTS tag

The <EVENTS>...</EVENTS> pair marks the start and end of the events section. It has no attributes.

6.2 The EVENT tag

The <EVENT>...</EVENT> pair marks the start and end of an event definition. It has the following attributes;

Attribute	Optional?	Description
TYPE	No	The type of event that should be performed when the button is pushed. Allowed values are; BUTTONCLICK MENUITEMSELECTED DATA

6.2.1 The BUTTONCLICK event

The button click event occurs when the user selects a button. It has no attributes.

6.2.2 The MENUITEMSELECTED event

The menu items selected event occurs when the user selects a menu item. It has no attributes.

6.2.3 The DATA event

The data event occurs when ARML data is received from the wireless interface. It has the following attributes;

Attribute	Optional?	Description
NAME	No	The identifier of the specific package

6.3 The ACTION tag

The <ACTION>...</ACTION> pair marks the start and end of an event definition. It has one fixed attribute, and a number of attributes that may or may not appear depending on the type of action required. The fixed attribute is;

Attribute	Optional?	Description
TYPE	No	The type of action that should be performed when the button is pushed.

FIG. 17UU

65/85

Appendix “A”

		Allowed values are; OPEN ARML SAVE PURGE NOTIFY CLOSE ALERT IF...Then...Else CLOSESCREEN REFRESH SAVEITEM
--	--	--

6.3.1 The OPEN action

The open action tells the Smart Client to open a new screen. It adds one extra attribute to the ACTION tag;

Attribute	Optional?	Description
NAME	No	The name of the screen to open
NEWINST	Yes	If true, a new instance of the screen is created. If false, the least recently used instance of the screen is opened and the data is not refreshed. True is the default.

6.3.2 The ARML action

The arml action tells the Smart Client to compose and send an arml package. It does not add any attributes to the ACTION tag, but has the following subtag;

<ARMLTEXT>

Contained between the <ARMLTEXT>...</ARMLTEXT> pair is one of the application-defined data packages. Individual data items are marked with the user interface item that their value should be taken from, in the format “[SP.*screen.savename*]”, or [QU.*query.field*]. If *screen* is not the current screen, then the Smart Client will look for the data in its scratchpad. See section 0 for an example of the ARML action.

6.3.3 The SAVE action

The save action tells the Smart Client to save all fields marked as persistent (i.e., they are defined with SAVE=”Yes”) to be saved to the scratchpad area. It has no attributes.

FIG. 17VV

66/85

Appendix “A”

6.3.4 The PURGE action

The purge action tells the Smart Client to clear all fields that have been saved to the scratchpad. It has no attributes.

6.3.5 The NOTIFY action

The notify action tells the Smart Client to activate the configured notification on a device. For devices where this has no meaning, it will cause a beep to be played. It has no attributes.

6.3.6 The CLOSE action

The close action tells the Smart Client to close the application. It has no attributes.

6.3.7 The ALERT action

The alert action tells the Smart Client to display an alert item (e.g., a message box on Windows, an alert box on the RIM pager, an alert card on WAP). It has the following attributes;

Attribute	Optional?	Description
CAPTION	Yes	The caption to display in the title bar of the message box
TEXT	Yes	The text to display in the message box

6.3.8 The INTEGRATION action

The integration action tells the Smart Client to pass data to an interface exposed on a device. For example a COM interface on Pocket PC. This action will allow the developer to pass a parameter into an exposed method and then also save the result of that method in a global scratchpad value. The contents of the integration action's element are the input values to be passed to the interface. It has the following attributes;

Attribute	Optional?	Description
CLSID	No	This is the class identifier of the component that is to be called.
SAVE	No	This tells the smart client if it should save the result into a global scratchpad value or not.
SAVENAME	Yes	This is the name of the global scratchpad value

Example ARML:

FIG. 17WW

67/85

Appendix "A"

```
<ACTION TYPE="INTEGRATION" CLSID="AirixSignature.AirixSignatureCtrl"
SAVENAME="" SAVE="FALSE">[SP.*.SIGNATURE]</ACTION>
```

6.3.9 The CLOSESCREEN action

The close screen action tells the Smart Client to close all open instances of the screen specified by name in the NAME attribute. This action has the following attributes:

Attribute	Optional?	Description
NAME	No	Name of the screen to close.

6.3.10 The REFRESH action

The refresh action tells the Smart Client to re-run any queries and re-initialize all UI elements on the screen with the name specified by the NAME attribute. If there are multiple open instances of the screen, all open instances will be refreshed. The refresh action has the following attributes:

Attribute	Optional?	Description
NAME	No	Name of the screen to refresh.

6.3.11 The SAVEITEM action

The saveitem action tells the Smart Client to create a new scratchpad item or to edit an existing scratchpad item. The value of the scratchpad item is defined within the <ACTION>...</ACTION> tags. The saveitem action has the following attributes:

Attribute	Optional?	Description
SPN	No	Name of the scratchpad item to create or modify.

6.3.12 The IF Action

This action will contain two lists of actions. One a list of actions to perform if the condition evaluates to TRUE (IFLIST), and another list of actions to perform if the condition evaluates to FALSE (ELSEIFLIST).

The structure of the action is as follows:

```
<ACTION TYPE="IF">
  <COND EVAL="parameter" TYPE="condition type" VALUE="literal">
  </COND>
  <IFLIST>
```

FIG. 17XX

68/85

Appendix "A"

```

        <ACTION></ACTION>
    </IFLIST>
    <ELSEIFLIST>
        <ACTION></ACTION>
    </ELSEIFLIST>
</ACTION>

```

6.3.12.1 Conditions (COND)

Conditions are used in conjunction with the IF Action. Conditions are specified as follows:

Attribute	Optional?	Description
EVAL	NO	Specifies the parameter to be evaluated. Can be hard coded, scratchpad, or query values. It is the "input" to the function.
TYPE	NO	Specifies the type of the condition. Possible values are: LESSTHAN MORETHAN EQUALS ISNUMERIC ISALPHA ISEMAIL ISFORMAT MAXCHARS MINCHARS
VALUE	Depends on TYPE	The value that EVAL will be evaluated against. Not relevant for all conditions.

The following is a description of each of the supported conditions:

- **EQUALS**, this function will take an input and a value to evaluate the input against. If the two items are determined to be Equal, the condition will return true. If they are not equal, the condition will return false. The value and the input must be of the same data type, otherwise the condition will return false. Memo values will be treated as a string and auto-increment types will be treated as integers. The following criteria will be used to determine equality:
 - Two strings are equal if each of the characters in the strings is identical and the strings have the same number of characters. The string comparison will not be case sensitive.
 - Two integers are equal if their values are mathematically equal.
- **MORETHAN**, this function will take an input and a value to evaluate the input against. If the input is determined to be greater in value than the evaluation

FIG. 17YY

69/85

Appendix "A"

value, the condition will return true. If the values are equal, false is returned. If the evaluation value is determined to be greater than the input, the function will return false. The evaluation value and the input must be of the same data type, otherwise an error condition will occur. Memo values will be treated as a string and the auto-increment type will be treated as an integer. The following criteria will be used to determine which value is greater:

- String A is more in value than String B if String A occurs before String B in alphabetical order.
 - Integer A is greater than Integer B if $A > B$, mathematically.
- LESSTHAN, this function will take an input and a value to evaluate the input against. If the input is determined to be lesser in value than the evaluation value, the condition will return true. If the values are equal, false is returned. If the evaluation value is determined to be lesser than the input, the function will return false. The evaluation value and the input must be of the same data type, otherwise an error condition will occur. Memo values will be treated as a string and the auto-increment type will be treated as an integer. The following criteria will be used to determine which value is greater:
 - String A is lesser in value than String B if String A occurs after String B in alphabetical order.
 - Integer A is greater than Integer B if $A < B$, mathematically.
- ISNUMERIC, this function will take an input and evaluate whether or not it is a value number. If the input can be converted successfully to a number, the function will return true. If the input cannot be converted to a number, the function will return false. All input values will be treated as a string data type.
- ISALPHA, this function will take an input and evaluate whether or not it contains only alphabetic characters. Alphabetic characters are defined as all characters from A-Z, a-z, and spaces. All input values will be treated as a string data type.
- ISEMAIL, this function will take an input and evaluate whether or not it contains a string of the form something@something. All input values will be treated as a string data type.
- ISFORMAT, this function will take an input and a value to evaluate the input against. If the input is determined to be formatted as the evaluation value, the condition will return true. If the evaluation value is determined to be formatted differently than the input, the function will return false. The evaluation value must comply with the ARML formatting standards.

FIG. 17ZZ

70/85

Appendix "A"

- MAXCHARS, this function will take an input and evaluate whether or not the number of characters in the string is less than or equal to the evaluation value passed into the function. If the number of characters in the string is less than or equal to the evaluation value, true is returned. If the number of characters in the string is greater than the evaluation value, false is returned. All input values will be treated as a string data type.
- MINCHARS, this function will take an input and evaluate whether or not the number of characters in the string is greater than or equal to the evaluation value passed into the function. If the number of characters in the string is greater than or equal to the evaluation value, true is returned. If the number of characters in the string is less than the evaluation value, false is returned. All input values will be treated as a string data type.

Example:

```

<ACTION TYPE="IF">
  <COND EVAL="[QUERY1.STRREAD]" TYPE="EQUALS" VALUE="READ"></COND>
  <IFLIST>
    <ACTION TYPE="SAVE"></ACTION>
    <ACTION TYPE="OPEN" NAME="INBOX" NEWINST="FALSE"></ACTION>
  </IFLIST>
  <ELSELIST>
    <ACTION TYPE="OPEN" NAME="MSGREAD"
NEWINST="FALSE"></ACTION>
  </ELSELIST>
</ACTION>

```

FIG. 17AAA

71/85

Appendix "A"

Example of airix event model

The following example serves to illustrate how a screen is used to compose a data package to be sent back to the AIRIX server. The example used is a screen giving the bare functionality for composing a basic email message – to simplify the example, the user cannot cancel the action, and multiple recipients are not allowed.

```
<ARML>
  <SCREEN NAME="NewMsg">
    <BUTTONS>
      <BTN NAME="OK" CAPTION="Send" INDEX="0">
        <EVENTS>
          <EVENT TYPE="MODIFY">
            <ACTION TYPE="ARML">
              <ARMLTEXT>
                <BODY TYPE="ME">
                  <ME MSGID="1" FROM="Tim Neil"
                    SUBJECT="[SP.NewMsg.Subject]">
                  <DATA>[SP.NewMsg.Body]</DATA>
                  <RECIPS>
                    <RCP MSGID="1"
                      TO="[SP.NewMsg.To]"></RCP>
                  </RECIPS>
                </ME>
              </BODY>
            </ARMLTEXT>
          </ACTION>
        </EVENT>
      </EVENTS>
    </BTN>
  </BUTTONS>
  <EDITBOXES>
    <EB NAME="To" INDEX="1"></EB>
    <EB NAME="Subject" INDEX="2"></EB>
    <EB NAME="Body" INDEX="3"></EB>
  </EDITBOXES>
</SCREEN>
</ARML>
```

The Editboxes section at the bottom defines 3 editboxes, with the names of 'To', 'Subject', and 'Body';

```
<EB NAME="To" INDEX="1"></EB>
<EB NAME="Subject" INDEX="2"></EB>
<EB NAME="Body" INDEX="3"></EB>
```

FIG. 17BBB

72/85

Appendix "A"

There is one button on the screen, with the name of 'OK';

```
<BTN NAME="OK" CAPTION="Send" INDEX="0">
```

When the user clicks on OK, the button composes an ARML package to be sent to the AIRIX server;

```
<EVENT>
  <ACTION TYPE="ARML">
```

The ARML package sent is an 'ME' package as described in the example in section 4.2.1. It is composed as follows;

```
<BODY TYPE="ME">
  <ME MSGID="1" FROM="Tim Neil"
    SUBJECT=" [SP.NewMsg.Subject] ">
    <DATA> [SP.NewMsg.Body] </DATA>
    <RECIPS>
      <RCP MSGID="1" TO=" [SP.NewMsg.To] "></RCP>
    </RECIPS>
  </ME>
</BODY>
```

The subject field is taken from the edit box named 'Subject';

```
<ME MSGID="1" FROM="Tim Neil" SUBJECT=" [SP.NewMsg.Subject] ">
```

The recipients field is taken from the edit box named 'Subject';

```
<RECIPS>
  <RCP MSGID="1" TO=" [SP.NewMsg.To] "></RCP>
</RECIPS>
```

Finally the text of the message is filled from the 'Body' field;

```
<DATA> [SP.NewMsg.Body] </DATA>
```

FIG. 17CCC

73/85

Appendix “A”

7 AVM-server system interactions

This section describes the primitives that are used for system-level interactions that the AIRIX Smart Client has with the AIRIX server.

7.1 General

7.1.1 Description

System level packages are sent between AIRIX and the AVM (wirelessly).

7.1.2 Structure

System interactions are performed by exchanging ARML data packages with the following structure;

```
<ARML>
<HEAD>...</HEAD>
<SYS>
{data}
</SYS>
</ARML>
```

7.1.3 Tags

7.1.3.1 The <HEAD> tag

The package header is delimited by the <HEAD>...</HEAD> tags. Contained in text between the two tags is the id of the destination mobile. The HEAD tag has the following attributes;

Attribute	Optional?	Description
DT	No	The date & time in RFC 1123 format (including time zone)
ID	No	A unique ID for the message
VERSION	No	The version number of the application (currently “2.0”)
APPNAME	No	The application name (“0” for System Messages)
DEVICE	No	A numeric constant identifying the device
PID	Yes	A unique value used to designate a device.
AVMV	No	The version number of the Smart Client.

7.1.3.2 The <SYS> tag

The <SYS>...</SYS> pair contains the actual system package. The tag does not have any attributes.

FIG. 17DDD

74/85

Appendix "A"

7.2 Device Registration & deregistration package

7.2.1 Description

Device registration packages are sent from the AVM to the AIRIX server when a user registers their device.

7.2.2 Structure

A device registration package has the following structure;

```
{wrapper tags}
<REG>
    <USERNAME> {data} </USERNAME>
    <PASSWORD> {data} </PASSWORD>
</REG>
{wrapper tags}
```

7.2.3 Tags

7.2.3.1 The <REG> tag

The <REG>...</REG> pair delimit the registration request. The tag has no attributes.

7.2.3.2 The <USERNAME> tag

The <USERNAME>...</USERNAME> pair contain the user name. The tag does not have any attributes.

7.2.3.3 The <PASSWORD> tag

The <PASSWORD>...</PASSWORD> pair contain the password. The tag does not have any attributes.

7.2.4 Example

This package would be sent by a user, to register their device under a given name;

```
{wrapper tags}
<REG>
    <USERNAME>SUNTRESS</USERNAME>
    <PASSWORD>MYPASS</PASSWORD>
</REG>
{wrapper tags}
```

FIG. 17EEE

75/85

Appendix “A”

7.3 Registration confirmation package

7.3.1 Description

This package is sent back from the AIRIX server to the AVM to confirm that the device has been registered.

7.3.2 Structure

A registration confirmation package has the following structure;

```
{wrapper tags}
<REGCONFIRM>
  <VALUE> {data} </VALUE>
  <APPS>
    <APP></APP>
    <APP></APP>
  </APPS>
</REGCONFIRM>
{wrapper tags}
```

7.3.3 Tags

7.3.3.1 The <REGCONFIRM> tag

The <REGCONFIRM>...</REGCONFIRM> pair delimit the confirmation. The tag has no attributes.

7.3.3.2 The <VALUE> tag

The <VALUE>...</VALUE> pair contains the status of the registration request. The following text strings are allowable;

CONFIRM – this means that the registration request was successful

NOTREGPLATFORM – this means that the registration request failed because the device is not registered for the platform

INVALIDUSERPASS – this means that the registration request failed because the user name or password was not valid

NODEVICE – this means that the registration request failed because the device was not registered previously by an application

7.3.3.3 The <APPS> tag

The <APPS>...</APPS> pair contains a list of applications for the device.

FIG. 17FFF

76/85

Appendix "A"

7.3.3.4 The <APP> tag

The <APP>...</APP> pair contains an application header. It has the following attributes;

Attribute	Optional?	Description
ID	No	The application ID
NAME	No	The name of the application
DESCRIPTION	No	A text description of the application
REG	No	'YES' if the user is registered for this application. 'NO' if they are not.

7.3.4 Example

This package would be sent to confirm the example request in section 7.2.4;

```
{wrapper tags}
<REGCONFIRM>
  <VALUE>CONFIRM</VALUE>
  <APPS>
    <APP ID="4" NAME="EMAIL" DESCRIPTION="E-Mail Application"
    REG="YES">
      <APP ID="22" NAME="STOCKS" DESCRIPTION="Stock Quotes" REG="NO">
    </APPS>
  </REGCONFIRM>
{wrapper tags}
```

FIG. 17GGG

77/85

Appendix "A"

7.4 Find applications package

7.4.1 Description

Find applications packages are sent from the AIRIX component to the AIRIX server when a user wishes to refresh their list of applications on a device

7.4.2 Structure

A device registration package has the following structure;

```
{wrapper tags}
<FINDAPPS>
</FINDAPPS>
{wrapper tags}
```

7.4.3 Tags

7.4.3.1 The <FINDAPPS> tag

The <FINDAPPS>...</FINDAPPS> pair delimit the application registration request. It has no attributes.

FIG. 17HHH

78/85

Appendix “A”

7.5 Find applications confirmation package

7.5.1 Description

This package is sent back from the AIRIX server to the AVM to and contains a list of applications available for the user

7.5.2 Structure

A registration confirmation package has the following structure;

```
{wrapper tags}
<FINDAPPSCONFIRM>
  <APPS>
    <APP></APP>
    <APP></APP>
  </APPS>
</FINDAPPSCONFIRM>
{wrapper tags}
```

7.5.3 Tags

7.5.3.1 The <FINDAPPSCONFIRM> tag

The <FINDAPPSCONFIRM>...</FINDAPPSCONFIRM> pair delimit the confirmation. The tag has no attributes.

7.5.3.2 The <APPS> tag

The <APPS>...</APPS> pair contains a list of applications for the device.

7.5.3.3 The <APP> tag

The <APP>...</APP> pair contains an application header. It has the following attributes;

Attribute	Optional?	Description
ID	No	The application ID
NAME	No	The name of the application
DESCRIPTION	No	A text description of the application
REG	No	'YES' if the user is registered for the application. 'NO' if they are not.

FIG. 17III

79/85

Appendix “A”

7.6 Application Registration & deregistration package

7.6.1 Description

Application registration packages are sent from the AIRIX component to the AIRIX server when a user wishes to register or deregister for an application.

7.6.2 Structure

A device registration package has the following structure;

```
{wrapper tags}  
<APPREG>  
</APPREG>  
{wrapper tags}
```

7.6.3 Tags

7.6.3.1 The <APPREG> tag

The <APPREG>...</APPREG> pair delimit the application registration request. The tag has the following attributes;

Attribute	Optional?	Description
TYPE	No	This defines the type of parameter. It can take two values; ADD – this means that the application is to be added to the registration database DELETE – this means that the application is to be removed to the registration database
ID	No	The ID of the application being registered/deregistered

FIG. 17JJJ

80/85

Appendix “A”

7.7 Application registration & deregistration confirmation package

7.7.1 Description

This package is sent back from the AIRIX server to the AVM to confirm that the application has been registered or deregistered.

7.7.2 Structure

A registration confirmation package has the following structure (note that for DELETE types, the <INTERFACE>...</INTERFACE> section will not be included);

```
{wrapper tags}
<APPREGCONFIRM>
  <INTERFACE>
    interface definition
  </INTERFACE>
</APPREGCONFIRM>
{wrapper tags}
```

7.7.3 Tags

7.7.3.1 The <APPREGCONFIRM> tag

The <APPREGCONFIRM>...</APPREGCONFIRM> pair delimit the confirmation. The tag has the following attributes;

Attribute	Optional?	Description
TYPE	No	This defines the type of parameter. It can take two values; ADD – this means that the application is to be added to the registration database DELETE – this means that the application is to be removed to the registration database
ID	Yes	The ID of the application being returned (if any)

7.7.3.2 The <INTERFACE> tag

The <INTERFACE>...</INTERFACE> pair delimit the interface definition. The tag has no attributes, and contains an interface definition as laid out in section 3. Note that instead of the <DEVICES>...</DEVICES> tags in section 3.1.3.6, it will be replaced by <SCREENS>...</SCREENS> with the screen definitions for only the one device that the interface is being sent to (see section 3.4.3.2 for the definition of the

FIG. 17KKK

81/85

Appendix "A"

<SCREENS> tag). This section will **not be sent** for APPREGCONFIRM messages of TYPE="DELETE".

7.7.4 Example

The following example shows the application confirmation with screen definitions for an application that allows a user to view their inbox and the mails in it.

```
{wrapper tags}
<APPREGCONFIRM TYPE="ADD" ID="12">
  <INTERFACE>
    <AXSCHDEF>
      <EVENTS>
        <EVENT>
          (action definitions)
        </EVENT>
      </EVENTS>
      <AXTDEFS>
        (table definitions)
      </AXTDEFS>
      <DPACKETS>
        (data package definitions)
      </DPACKETS>

      <SCREENS>
        <SCREEN NAME="INBOX ">
          {screen definition}
        </SCREEN>
        <SCREEN NAME="VIEWNEWMAIL">
          {screen definition}
        </SCREEN>
      </SCREENS>
    </AXSCHDEF>
  </INTERFACE>
</APPREGCONFIRM>
{wrapper tags}
```

FIG. 17LLL

82/85

Appendix “A”

7.8 Setting the active device package

7.8.1 Description

If a user wishes to set the current device as their active device, the AVM must send a ‘set active device’ package to the AIRIX server

7.8.2 Structure

A ‘set active device’ package has the following structure;

```
{wrapper tags}
<SA>
{data}
</SA>
{wrapper tags}
```

7.8.3 Tags

7.8.3.1 The <SA> tag

The ‘set active device’ package is shown by the <SA>...</SA> tags. The tag has no attributes; the tag pair contains the user’s username

7.8.4 Example

This package would be sent by a user with the username of ‘scotty’;

```
{wrapper tags}
<SA>scotty</SA>
{wrapper tags}
```

7.9 Set active device response

7.9.1 Description

This packages is sent back from the AIRIX server to the client in response to a request to set the current device as the active one.

7.9.2 Structure

A ‘set active device response’ package has the following structure;

```
{wrapper tags}
<SACONFIRM>
  <VALUE> {data} </VALUE>
</SACONFIRM>
```

FIG. 17MMM

83/85

Appendix “A”

{wrapper tags}

7.9.3 Tags

7.9.3.1 The <SACONFIRM> tag

The <SACONFIRM>...</SACONFIRM> pair delimit the confirmation. The tag does not have any attributes.

7.9.3.2 The <VALUE> tag

The <VALUE>...</VALUE> pair contains the status of the registration request. The following text strings are allowable;

CONFIRM – this means that the registration request was successful

NOTREGISTERED – this means that the registration request failed because

7.9.4 Example

This package would be sent by the AIRIX server to confirm a set active request;

```
{wrapper tags}
<SACONFIRM>
    <VALUE>CONFIRM</VALUE>
</SACONFIRM>
{wrapper tags}
```

7.10 Invalid Application package

7.10.1 Description

This package is sent back from the AIRIX server to the AVM in response to a request to interact with an application that is no longer registered with AIRIX.

7.10.2 Structure

An ‘invalid application’ package has the following structure;

```
{wrapper tags}
<NOAPP>
    <VALUE> {data} </VALUE>
</NOAPP>
{wrapper tags}
```

FIG. 17NNN

Appendix “A”

7.10.3 Tags

7.10.3.1 The <NOAPP> tag

The <NOAPP>...</NOAPP> pair delimit the confirmation. The tag has no attributes.

7.10.3.2 The <VALUE> tag

The <VALUE>...</VALUE> pair delimit the return code. It can only be NOAPPLICATION – Application not found.

7.10.4 Example

This package would be sent in response to a request if the application cannot be found;

```
{wrapper tags}  
<NOAPP>  
    <VALUE>NOAPPLICATION</VALUE>  
</NOAPP>  
{wrapper tags}
```

FIG. 17000

85/85

Appendix “A”

8 Application-server system interactions

The section that defines Application to server system interactions has been made obsolete by the document “AIRIX Polling XML Language Specification”. It describes an XML-HTTP interface to AIRIX using POST and GET commands to a web-based ISAPI DLL.

FIG. 17PPP

