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Parthasarathy et al.

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(54) **AUTOMATIC SOFTWARE DOWNLOADING FROM A COMPUTER NETWORK**

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(52) **U.S. Cl.** **717/11**; 709/217; 709/221; 707/203

(58) **Field of Search** 717/11; 709/200, 709/217, 221, 220; 707/200, 203

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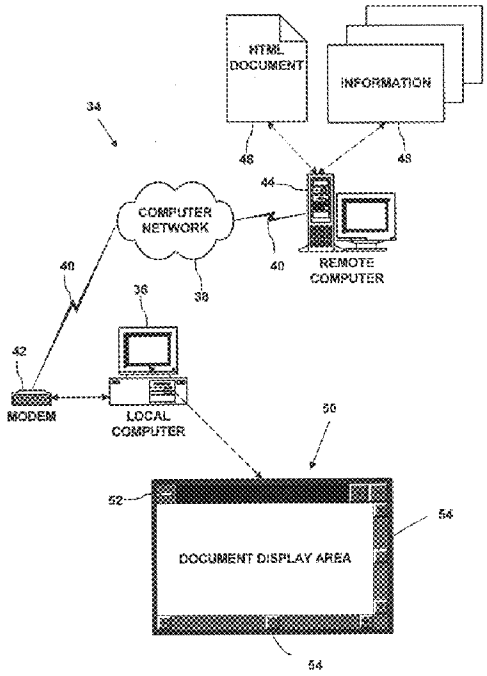
(57) **ABSTRACT**

A method and system to automatically locate, download, verify, install, register and display computer software components from a computer network like the Internet or an intranet. The method and system is used to provide dynamic or interactive multimedia components in HTML documents with HTML <OBJECT> tags. The HTML <OBJECT> tags contain parameters including uniform resource locators (URLs) which reference dynamic or interactive multimedia components on remote computers. Network browsers and other applications can obtain computer software components from a computer network like the Internet or an intranet in a uniform, portable, architecture-neutral, robust manner. The computer software components obtained can be used to provide a variety of new multimedia functionality to an application program which is stored on remote computers.

65 Claims, 8 Drawing Sheets



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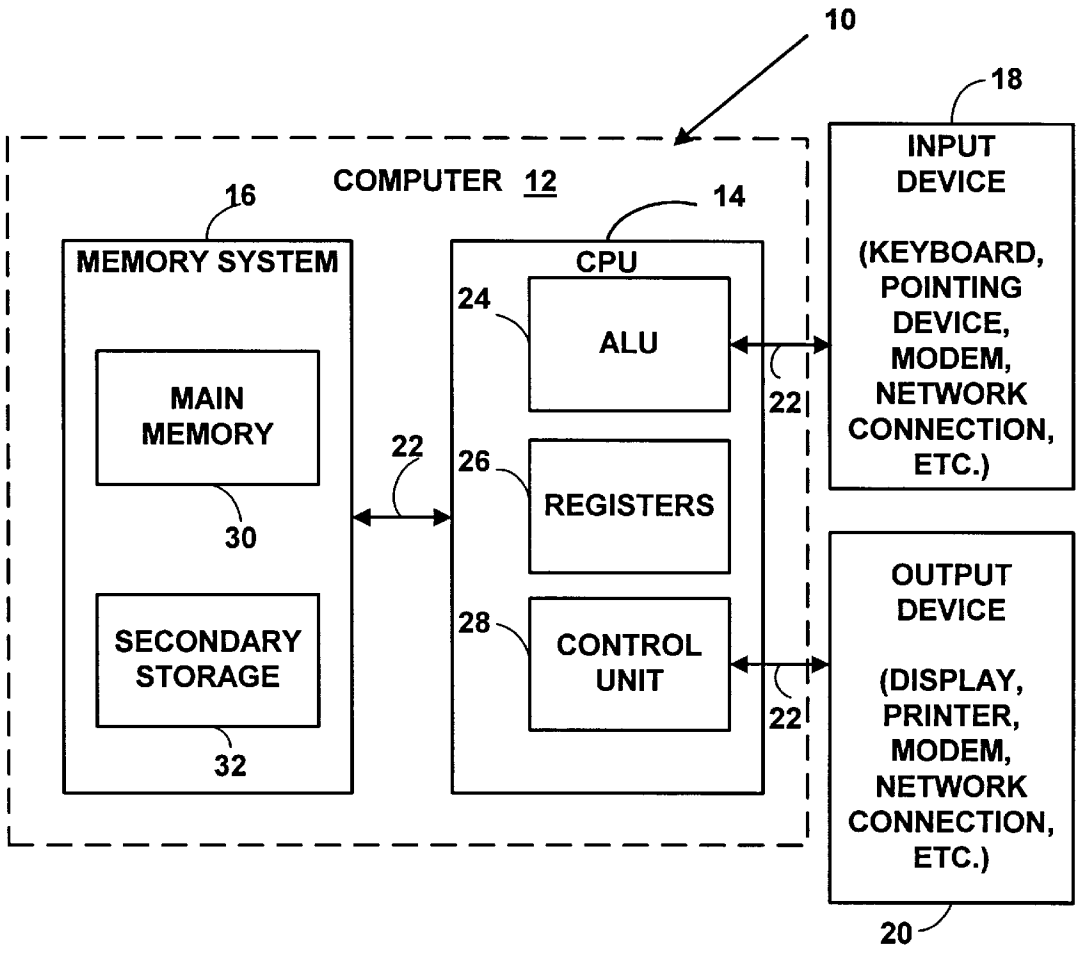

10
18
COMPUTER 12
16
14
MEMORY SYSTEM
CPU
24
ALU
INPUT DEVICE
(KEYBOARD, POINTING DEVICE, MODEM, NETWORK CONNECTION, ETC.)
22
MAIN MEMORY
22
26
REGISTERS
30
SECONDARY STORAGE
28
CONTROL UNIT
22
OUTPUT DEVICE
(DISPLAY, PRINTER, MODEM, NETWORK CONNECTION, ETC.)
32
20

FIG. 1

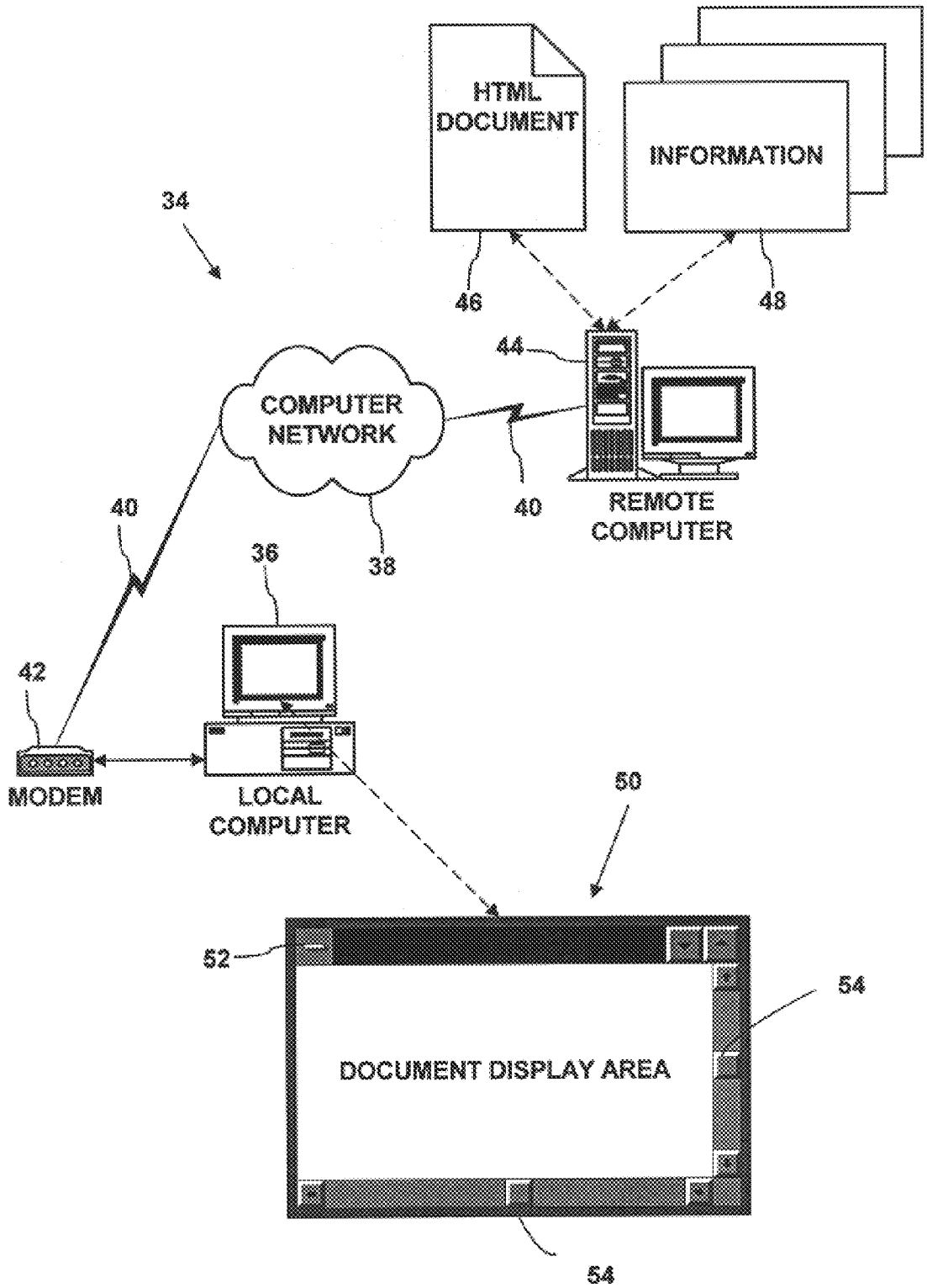

HTML DOCUMENT
INFORMATION
34
46
48
44
COMPUTER NETWORK
40
40
REMOTE COMPUTER
38
36
42
MODEM
LOCAL COMPUTER
50
52
54
DOCUMENT DISPLAY AREA
54

FIG. 2

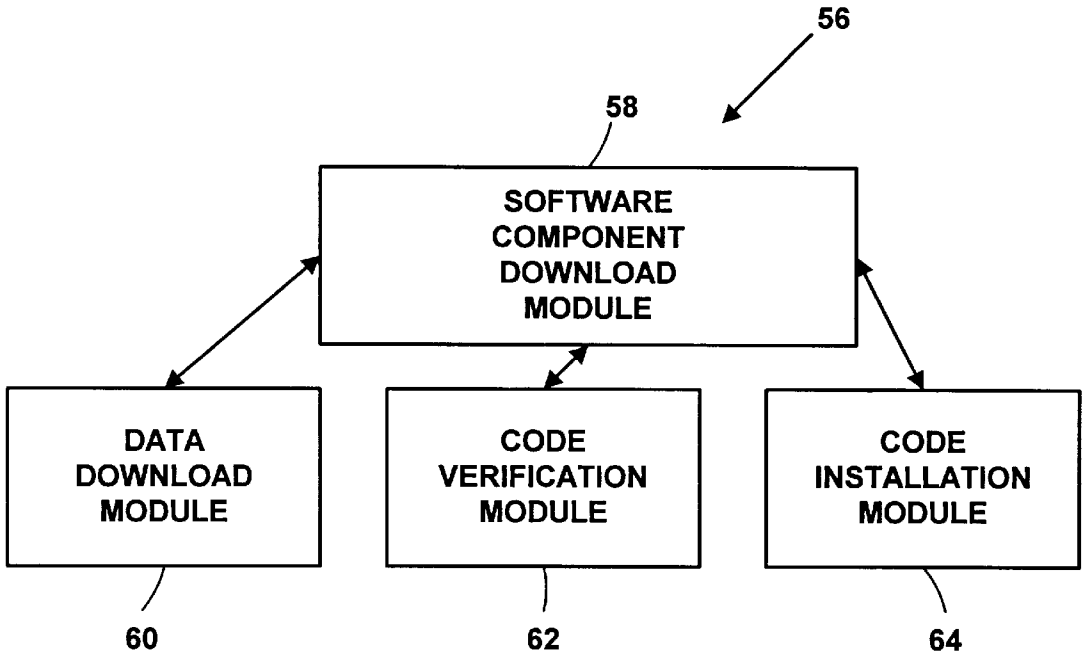

56
58
SOFTWARE COMPONENT DOWNLOAD MODULE
DATA DOWNLOAD MODULE
CODE VERIFICATION MODULE
CODE INSTALLATION MODULE
60
62
64

FIG. 3

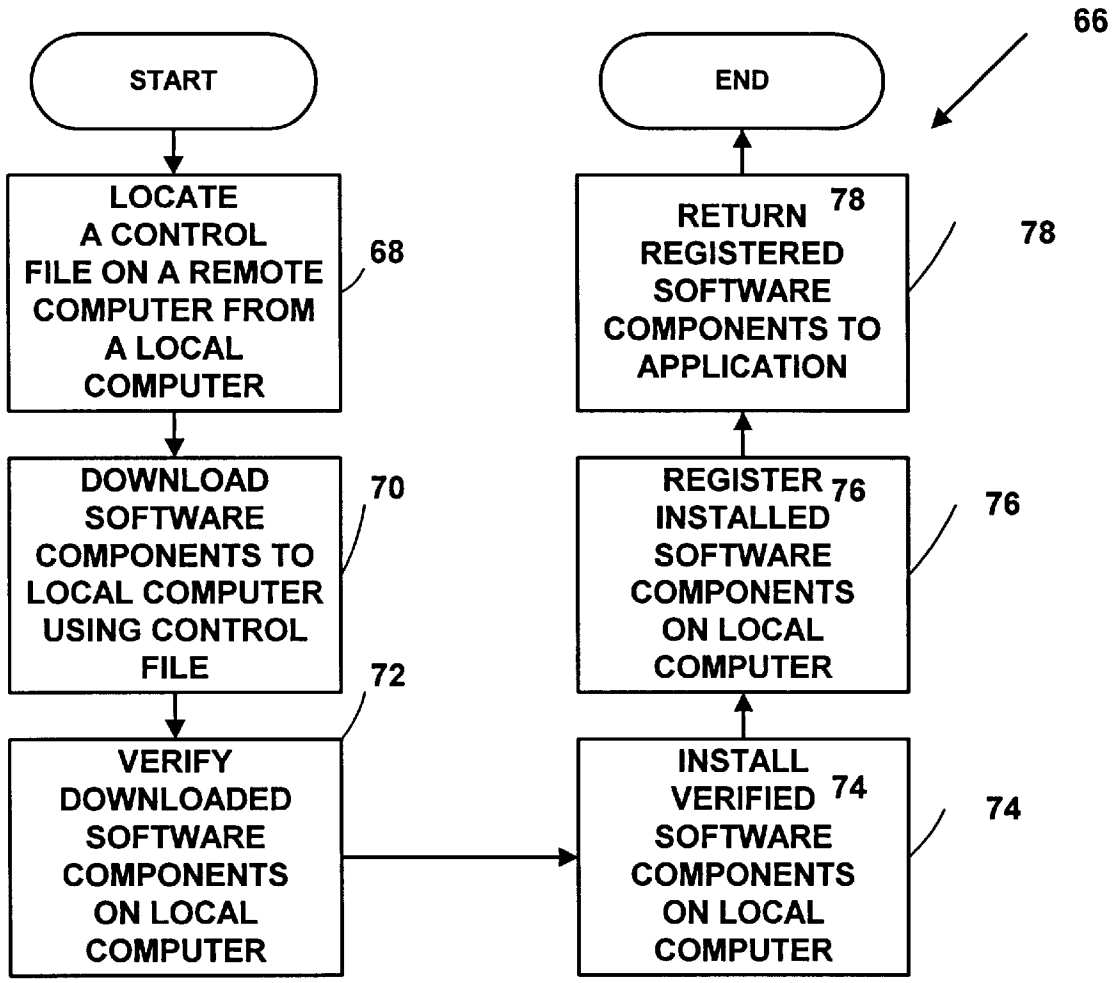

66
START
END
LOCATE A CONTROL FILE ON A REMOTE COMPUTER FROM A LOCAL COMPUTER
68
DOWNLOAD SOFTWARE COMPONENTS TO LOCAL COMPUTER USING CONTROL FILE
70
VERIFY DOWNLOADED SOFTWARE COMPONENTS ON LOCAL COMPUTER
72
INSTALL VERIFIED SOFTWARE COMPONENTS ON LOCAL COMPUTER
74
REGISTER INSTALLED SOFTWARE COMPONENTS ON LOCAL COMPUTER
76
RETURN REGISTERED SOFTWARE COMPONENTS TO APPLICATION
78

FIG. 4

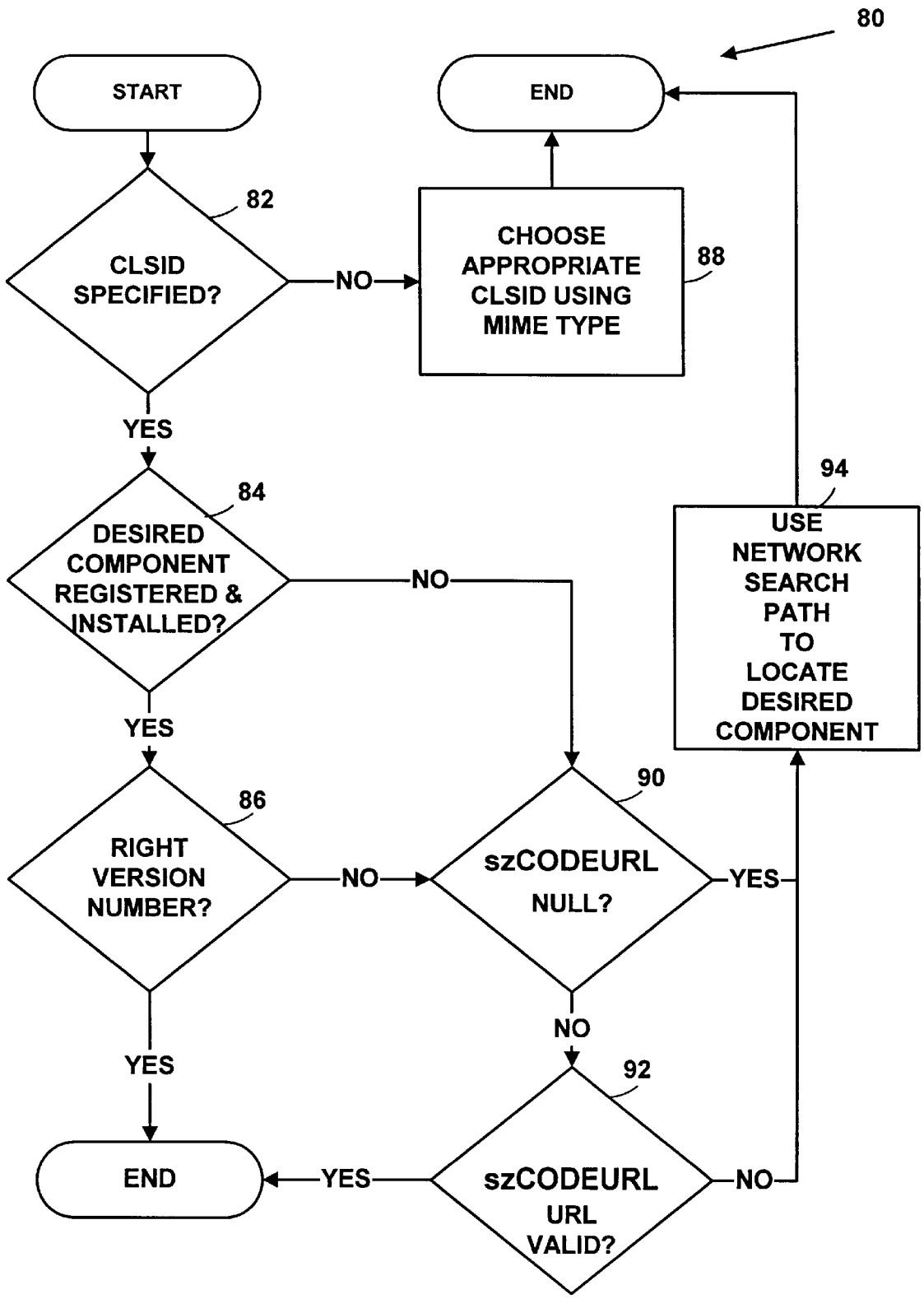

80
START
END
82
CLSID SPECIFIED?
NO
CHOOSE APPROPRIATE CLSID USING MIME TYPE
88
YES
84
DESIRED COMPONENT REGISTERED & INSTALLED?
NO
94
USE NETWORK SEARCH PATH TO LOCATE DESIRED COMPONENT
YES
86
RIGHT VERSION NUMBER?
NO
90
szCODEURL NULL?
YES
NO
YES
92
END
YES
szCODEURL URL VALID?
NO

FIG. 5

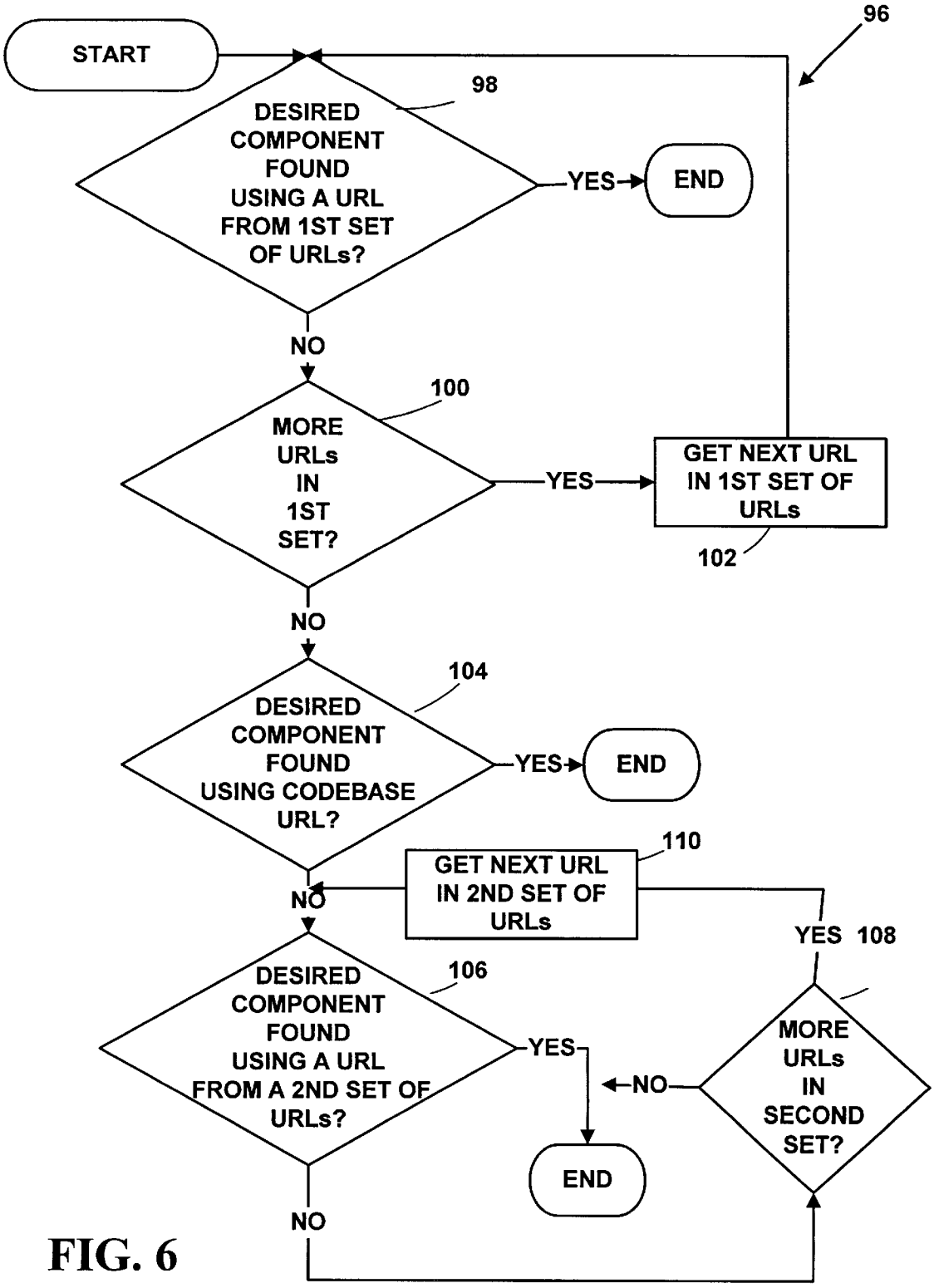

96
START
98
DESIRED COMPONENT FOUND USING A URL FROM 1ST SET OF URLs?
YES
END
NO
100
MORE URLs IN 1ST SET?
YES
GET NEXT URL IN 1ST SET OF URLs
102
NO
104
DESIRED COMPONENT FOUND USING CODEBASE URL?
YES
END
110
GET NEXT URL IN 2ND SET OF URLs
NO
YES 108
106
DESIRED COMPONENT FOUND USING A URL FROM A 2ND SET OF URLs?
YES
NO
MORE URLs IN SECOND SET?
END
NO

FIG. 6

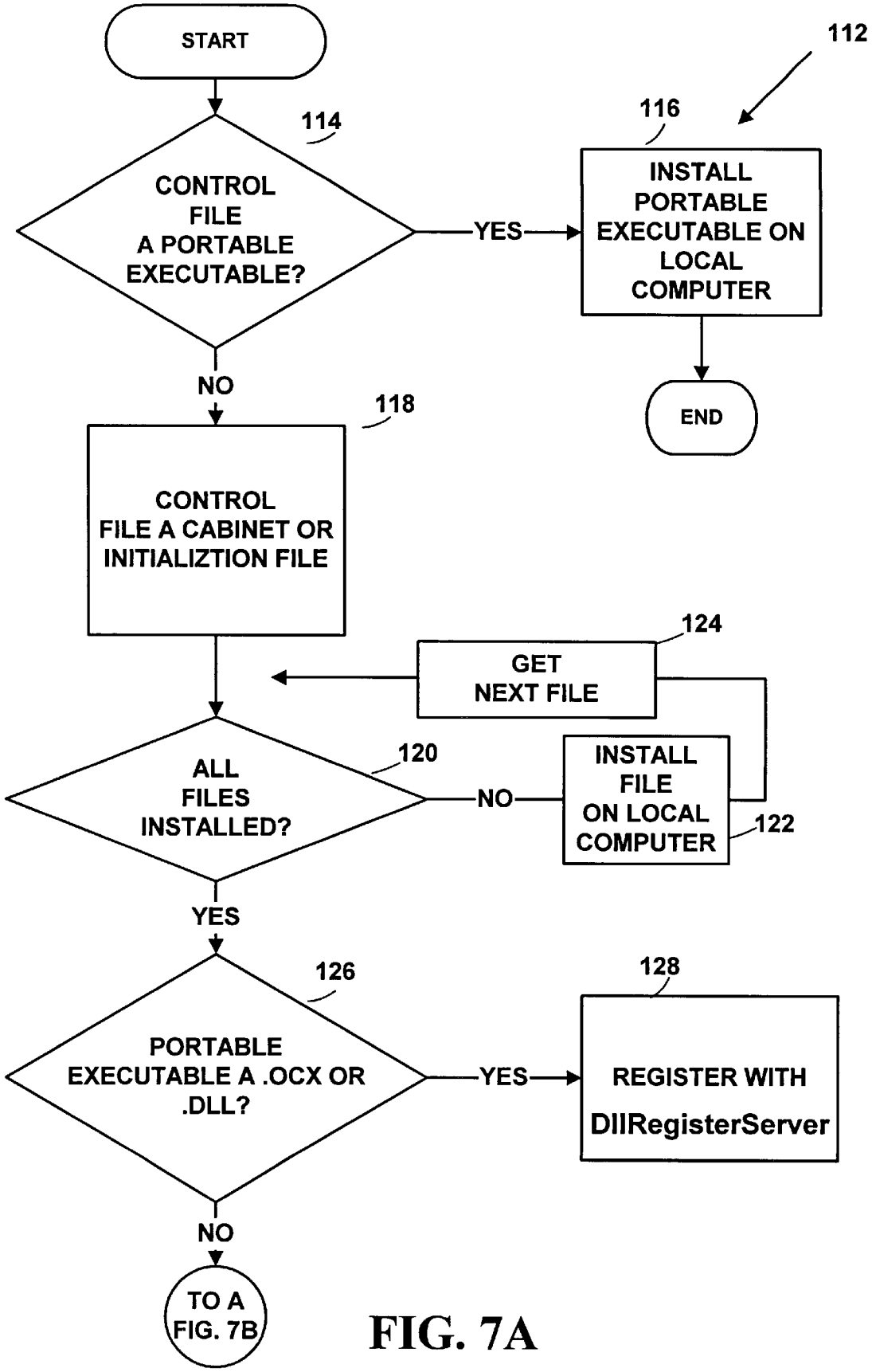

START
112
114
116
CONTROL FILE A PORTABLE EXECUTABLE?
YES
INSTALL PORTABLE EXECUTABLE ON LOCAL COMPUTER
NO
END
118
CONTROL FILE A CABINET OR INITIALIZTION FILE
124
GET NEXT FILE
120
ALL FILES INSTALLED?
NO
INSTALL FILE ON LOCAL COMPUTER
122
YES
126
128
PORTABLE EXECUTABLE A .OCX OR .DLL?
YES
REGISTER WITH DllRegisterServer
NO
TO A FIG. 7B

FIG. 7A

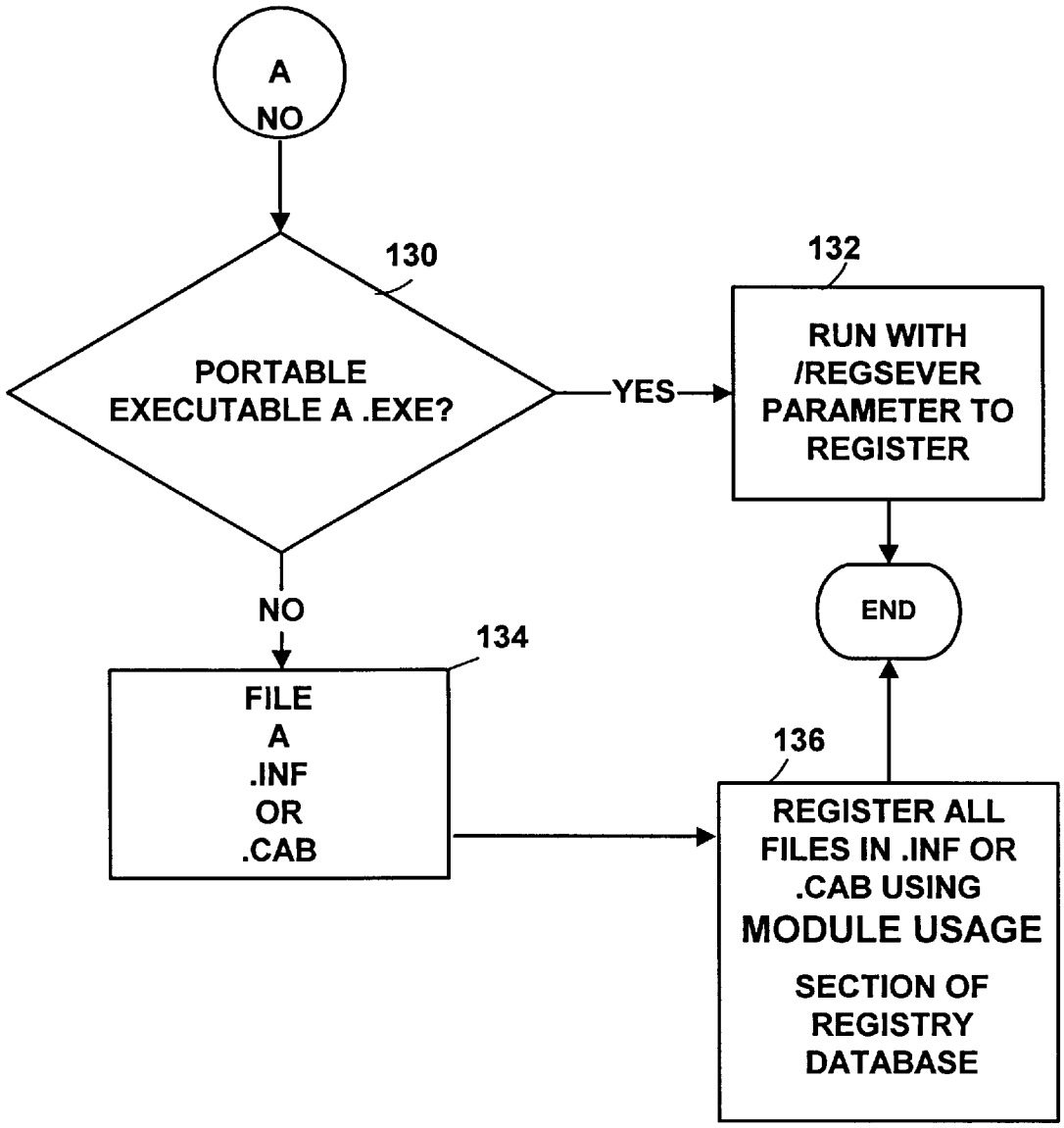

A
NO
130
PORTABLE
EXECUTABLE A .EXE?
YES
132
RUN WITH
/REGSEVER
PARAMETER TO
REGISTER
END
NO
134
FILE
A
.INF
OR
.CAB
136
REGISTER ALL
FILES IN .INF OR
.CAB USING
MODULE USAGE
SECTION OF
REGISTRY
DATABASE

FIG. 7B

AUTOMATIC SOFTWARE DOWNLOADING FROM A COMPUTER NETWORK

CONTINUING APPLICATION DATA

This application is a continuation of U.S. patent application Ser. No. 08/764,040, filed Dec. 12, 1996 now abandoned.

FIELD OF INVENTION

The present invention relates to browsing of information on computer networks. More particularly, the present invention relates to automatically downloading, verifying, installing, registering and displaying computer software components from computer networks like the Internet or an intranet.

BACKGROUND AND SUMMARY OF THE INVENTION

The Internet is a world-wide network of cooperating computer networks. Connected to the Internet are thousands of individual computers, each with a variety of application programs. From a user's point of view, access to the Internet and its services typically are accomplished by invoking a network application program (e.g., a network browser). The network application program acts as an interface between the user and the Internet. Network application programs are typically "client" applications that accept commands from the user and obtain Internet data and services by sending requests to "server" applications on other computers at other locations on the Internet.

There are many types of client network applications known in the art including network browsers such as the Internet Explorer® by Microsoft Corporation of Redmond, Wash., Netscape Navigator™ by Netscape Communications of Mountain View, Calif., and Mosaicm™ by National Center for Super Computer Applications (NCSA) in Champaign-Urbana, Ill. These network browsers send network requests via the File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), Hyper Text Transfer Protocol (HTTP), Gopher document protocol and others. The network requests are used to exchange data with computer networks such as the Internet.

HTTP is a protocol used to access data on the World Wide Web. The World Wide Web is an information service on the Internet containing documents created in the Hyper Text Markup Language (HTML). HTML allows embedded "links" to point to other data or documents, which may be found on the local computer or other remote Internet host computers. HTML document links may retrieve the data by use of HTTP, FTP, Gopher, or other Internet application protocols. The Virual Reality Modeling Language (VRML) is also used to create documents for the World Wide Web. Specifically, VRML is typically used to create three-dimensional graphical documents.

The bulk of the information on World Wide Web is static and non-interactive documents created with HTML. These HTML documents contain text and still images, while a number contain short audio and video clips. As the content of information stored on the Internet and World Wide Web evolves, it is desirable to insert dynamic multimedia components (e.g., animated buttons, scrolling banners, blinking lights, bouncing or spinning objects, high quality music, and full motion video) and interactive multimedia components (e.g., a computer game sent over the Internet and played against one or more other users, or a remote computer) into

a HTML document, to make the information more attractive and interesting to a user browsing the HTML document.

Network browsers currently support a number of dynamic and pseudo-interactive multimedia components directly. However, there are a number of problems currently associated with using dynamic and pseudo-interactive multimedia components in a HTML document. These browsers may still require a user to initiate any dynamic multimedia interaction. For example, a user typically must request the dynamic multimedia interaction by selecting a remote link with input from a keyboard, electronic mouse or other pointing device. Thus, a user cannot be provided dynamic multimedia automatically without first asking for it. This again prevents a user from fully enjoying dynamic multimedia components.

Since the World Wide Web and the Internet currently support a wide variety of information in multiple formats, a typical network browser cannot directly display every possible dynamic multimedia format it encounters. When a network browser encounters a multimedia component in a HTML document the browser is unable to handle directly (e.g., color images with a large number of colors, high quality audio, full motion video), it is common in the art for the network browser to call a helper application (e.g., a help wizard) that can handle the multimedia component. The multimedia component is handed off to the helper application for processing (e.g., playing the audio, full motion video). The constantly changing nature of information on the Internet and World Wide Web requires that the network browser be updated constantly with access to new helper applications. This is a time consuming process for the network browser creators, and prevents a user from fully enjoying new multimedia components that might be encountered.

Another frequent problem is that a HTML document may contain a non-standard HTML tag that describes a new dynamic multimedia component. Non-standard HTML tags cause users to constantly incorporate new updates into their browsers to take advantage of the dynamic multimedia described by the non-standard HTML tags. This is also a slow and time consuming process and may require an additional helper application as was described above.

Most network browsers also do not currently support true interactive multimedia. Most Internet and World Wide Web sites require a user to fill out and submit an electronic form and rely on a Common Gateway Interface (CGI) application, to invoke a remote software application to provide pseudo-interactive multimedia content (e.g., database access, search engines, protocol gateways). The CGI provides a mechanism for information retrieval, processing and formatting within a HTML document. CGI applications are typically written in a programming language or scripting language other than HTML (e.g., C, C++, Perl, UNIX® shell language) and are executed on a remote computer. This remote execution is typically a slow and cumbersome interface process that also requires input (e.g., a mouse click) from a user.

In accordance with an illustrative embodiment of the present invention, the problems of handling dynamic and interactive multimedia in a HTML document are overcome. A method and system for automatically locating, downloading, verifying, registering, installing and displaying a software component from a remote computer is provided.

The method is used to automatically locate, download, verify, install, register, and display a computer software component obtained from a remote computer. The system

includes a software component download module for locating computer software components with uniform resource locators (URLs), registering computer software components in a registry database, and displaying computer software components on a local computer. The software component download module also manages other system modules. A data download module downloads computer software components in an asynchronous manner from one or more remote computers. A code verification module verifies that the downloaded computer software components are safe to install on a local computer by verifying a digital signature and digital certificate sent with the downloaded computer software component. A code installation module installs the verified computer software components on the local computer. The software components are not limited to the display of multimedia information. Almost any software component can be downloaded, verified, and installed via the described method and system, whether it is an ActiveX™ Control, a Netscape™ ONE Plugin, a Java™ class library, a multimedia player, a document viewer, or a custom control or applet for inclusion on a digital form or a digital document.

The method and system are used by applications (e.g., network browsers, network servers) to automatically download and install software components from code depositories on computer networks (e.g., the Internet, or local corporate intranets) to provide dynamic and truly interactive multimedia to a user. The method and system allow any software component, including dynamic and interactive multimedia components, to be described with a standard tag (e.g., the <OBJECT>tag) in a HTML document.

When the <OBJECT>tag is encountered in a HTML document during browsing with a network browser, the multimedia software components referenced by the <OBJECT>tag are automatically downloaded and displayed directly on a user's computer. A HTML document can now provide dynamic multimedia content and true interactivity, in a uniform, portable, architecture-neutral, robust manner using the method and system of the present invention.

Network browsers will no longer require frequent updates or help applications to provide dynamic and truly interactive multimedia to a user. A user browsing an HTML document can now be provided with dynamic and interactive multimedia automatically and take full advantage of the variety of multimedia provided on the World Wide Web, the Internet, and other computer networks such as intranets.

In addition, the method and system of the present can also be used by applications or devices which are not network browsers (e.g. set top boxes for television network computers, satellite receiver boxes, digital personal assistants and wireless personal communications devices) to automatically locate, download, verify, install, register and display virtuly any type of computer software component on any remote computer connected to a computer network like the Internet or an intranet. Any application which desires information from a remote computer can use the method and system of the present invention by sending the proper parameter information to the appropriate interfaces provided by the method and system.

The foregoing and other features and advantages of the illustrated embodiment of the present invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a computer system used to implement an illustrative embodiment of the present invention.

FIG. **2** is a block diagram illustrating a network browsing environment.

FIG. **3** is a block diagram illustrating a system for the present invention.

FIG. **4** is a flow diagram illustrating a code downloading method for the present invention.

FIG. **5** is a flow diagram illustrating a code locating method for the present invention.

FIG. **6** is a flow diagram illustrating a network search method for the present invention.

FIGS. **7A–7B** are a flow diagram illustrating a registration method for the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. **1**, an operating environment for the preferred embodiment of the present invention is a computer system **10** with a computer **12** that comprises at least one high speed processing unit (CPU) **14**, in conjunction with a memory system **16**, an input device **18**, and an output device **20**. These elements are interconnected by a bus structure **22**.

The illustrated CPU **14** is of familiar design and includes an ALU **24** for performing computations, a collection of registers **26** for temporary storage of data and instructions, and a control unit **28** for controlling operation of the system **10**. Any of a variety of processors, including those from Digital Equipment, Sun Microsystem, MIPS, IBM, Motorola, NEC, Intel, Cyrix, AMD, Nexgen and others are equally preferred for CPU **14**. Although shown with one CPU **14**, computer system **10** may alternatively include multiple processing units.

The memory system **16** includes main memory **30** and secondary storage **32**. Illustrated main memory **30** is high speed random access memory (RAM) and read only memory (ROM). Main memory **30** can include any additional or alternative high speed memory device or memory circuitry. Secondary storage **32** takes the form of long term storage, such as ROM, optical or magnetic disks, organic memory or any other volatile or non-volatile mass storage system. Those skilled in the art will recognize that memory **16** can comprise a variety and/or combination of alternative components.

The input and output devices **18**, **20** are also familiar. The input device **18** can comprise a keyboard, mouse, pointing device, audio device (e.g., a microphone, etc.), or any other device providing input to the computer system **10**. The output device **20** can comprise a display, a printer, an audio device (e.g., a speaker, etc.), or other device providing output to the computer system **10**. The input/output devices **18**, **20** can also include network connections (e.g., Internet and intranet connections), modems, or other devices used for communications with other computer systems or devices.

As is familiar to those skilled in the art, the computer system **10** further includes an operating system and at least one application program. The operating system is a set of software which controls the computer system's operation and the allocation of resources. The application program is a set of software that performs a task desired by the user, making use of computer resources made available through the operating system. Both are resident in the illustrated memory system **16**.

In accordance with the practices of persons skilled in the art of computer programming, the present invention is described below with reference to acts and symbolic representations of operations that are performed by computer

system **10**, unless indicated otherwise. Such acts and operations are sometimes referred to as being computer-executed. It will be appreciated that the acts and symbolically represented operations include the manipulation by the CPU **14** of electrical signals representing data bits which causes a resulting transformation or reduction of the electrical signal representation, and the maintenance of data bits at memory locations in memory system **16** to thereby reconfigure or otherwise alter the computer system's operation, as well as other processing of signals. The memory locations where data bits are maintained are physical locations that have particular electrical, magnetic, optical, or organic properties corresponding to the data bits.

The data bits may also be maintained on a computer readable medium including magnetic disks, and any other volatile or non-volatile mass storage system readable by the computer **12**. The computer readable medium includes cooperating or interconnected computer readable media, which exist exclusively on computer system **10** or are distributed among multiple interconnected computer systems **10** that may be local or remote.

In an illustrative embodiment of the present invention, the computer system **10** preferably uses the Windows® 95 client/server operating system. However, other client/server operating systems (e.g. Windows NT™, OS/2®, by IBM, Mac OS, UNIX, Windows CE, etc.) could also be used. A client/server operating system is an operating system which is divided into multiple processes of two different types: server processes, each of which typically implements a single set of services, and client processes, which request a variety of services from the server processes. Object oriented programming is used to design the client/server operating system, and applications which run under the client/operation system, where objects represent system resources.

For example, the Windows® 95 client/server operating system provides shareable resources, such as files, memory, processes and threads, which are implemented as "objects" and are accessed by using "object services." As is well known in the art, an "object" is a data structure whose physical format is hidden behind a type definition. Data structures, also referred to as records or formats, are organization schemes applied to data so that it can be interpreted, and so that specific operations can be performed on that data. Such data structures impose a physical organization on the collection of data stored within computer memory **16** and represent specific electrical, magnetic or organic elements.

An "object type," also called an "object class," comprises a data-type, services that operate on instances of the data type, and a set of object attributes. An "object attribute" is a field of data in an object that partially defines that object's state. An "object service" implements and manipulates objects, usually by reading or changing the object attributes. "Object oriented design" is a software development technique in which a system or component is expressed using objects.

An object typically has two components: a function table, containing a pointer to each object member function (i.e., sometimes known as an object method) defined in the object's class, and a data block, containing the current values for each object variable (i.e., data members, sometimes known as an object property). An application has some reference to an object through an object pointer. An application obtains this object reference by using some type of function call (direct or implied) in which that function allocates an object block in computer memory, initializes the function table, and returns the reference to the computer memory to an application. The computer memory may be local or distributed on a remote computer.

The Windows® 95 operating system allows users to execute more than one program at a time by organizing the many tasks that it must perform into "processes." The operating system allocates a portion of the computer's resources to each process and ensures that each process's program is dispatched for execution at the appropriate time and in the appropriate order.

In an illustrative embodiment of the present invention, processes are implemented as objects. A process object comprises the following elements: an executable program; a private address space; system resources (e.g., communication ports and files) that the operating system allocates to the process as the program executes; and at least one "thread of execution." A "thread" is the entity within a process that the operating system kernel schedules for execution. As is well known in the art, each thread has an associated "context" which is the volatile data associated with the execution of the thread. A thread's context includes the contents of system registers and the virtual address belonging to the thread's process. Thus, the actual data comprising a thread's context varies as it executes.

The Component Object Model (COM) and Distributed Component Object Model (DCOM) are models used for object oriented programming. The COM and DCOM specifies how objects within a single application or between applications (e.g. client/server applications) interact and communicate by defining a set of standard interfaces. Interfaces are groupings of semantically related functions through which a client application accesses the services of a server application.

Object Linking and Embedding (OLE), such as OLE Version 2 by the Microsoft Corporation of Redmond, Wash., and ActiveX™ (network activation controls) are based in part on the Component Object Model and allows the creation of objects of different formats which operate on data through defined interfaces, rather than operating on the applications responsible for the data. ActiveX™ is based in part on OLE technologies. The object data can be embedded within an object, or linked to it, so that only a link reference to the data is stored in the object.

In a browsing environment **34** of an illustrative embodiment of the present invention shown in FIG. **2**, a local computer **36** (e.g., computer system **10** shown in FIG. **1**) runs software, referred to herein as a "browser," for unified browsing of electronic documents and other data from local sources (e.g., the memory system **16** of FIG. **1**) and from a computer network **38** (e.g., the Internet, an intranet). The browser can be integrated with the operating system software, or can be a separate application software. The browser is typically an object oriented application. The illustrated remote computer network **38** is the Internet, which is described in the Background and Summary of the Invention above. In the illustrated browsing environment **34**, the local computer **36** connects to the computer network **38** over a telephone line **40** with a modem **42**. Other physical connections to the computer network alternatively can be used, such as an ISDN, T1, DS1 or other high speed telecommunications connections and appropriate connection device, a television cable and modem, a satellite link, an optical fiber link, an Ethernet or other local area network technology wire and adapter card, radio or optical transmission devices, etc. The invention can alternatively be embodied in a browsing environment for other public or private computer networks, such as a computer network of a com-

mercial on-line service or an internal corporate local area network (LAN), an intranet, or like computer network.

Documents for browsing with the illustrated browser can reside as files of a file system stored in the computer's secondary storage **32** (FIG. **1**), or reside as resources at a remote computer **44** (also referred to as a "site" or "store") connected to the computer network **38**, such as a World Wide Web site on the Internet. The illustrated document **46** residing at the site or store **44** conforms with HTML standards, and may include extensions and enhancements of HTML standards. However, the illustrated browser also can browse documents having other data formats (e.g., Virtual Reality Modeling Language (VMRL), Microsoft® Word documents, etc.) from the local computer **36** or remote computer **44**. In conformance with HTML, the illustrated document **46** can incorporate other additional information content **48**, such as images, audio, video, executable programs, etc. which also reside at the remote computer **44** or other remote computers. The document **46** and information **48** preferably are stored as files in a file system of the remote computer **44**. The document **46** incorporates the information **48** using HTML tags and Uniform Resource Locators (URLs) that specify the location of files or other Internet resources containing the images on the computer network **38**. However, other locating formats can also be used.

When used for browsing documents, the illustrated browser displays the document in a window **50** or area of the local computer's **36** display **20** allocated to the browser by the operating system. The illustrated window **50** comprises a document display area **52** and user interface controls **54**. The browser displays the document within the document display area **52** of the window **50**. However, other display types could also be used. The computers **36**, **44** can also be network computers (NCs) which include only selected components of computer system **10**.

The browser and other client applications within the local computer **34** preferably work with documents (which have data formats other than those native to the browser or client application) by encapsulating the document's data into an associated object, and integrating with the object using pre-defined interfaces as described more fully below. This allows full use of all the features described below.

Alternatively, the browser or other client application can work with a document by launching an application program associated with the document and causing the associated application program to load the document and perform a specified operation on the document. In the Microsoft Windows® 95 operating system, this is done by looking up the application program associated with the document's file name extension in the system registry, (e.g., ".doc" for Microsoft® Word documents, ".vsd" for Shapeware's VISIO drawings, etc.) and a text string command for directing the program to perform a desired operation. The application program associated with a document also may be identified in the Microsoft Windows® operating system by matching a bit pattern at specific offset into the file as also specified in the system registry. The browser or other client application patches the document's file name into the text string command and invokes the operating system's shell execute service to execute the command. Shell execute is a well known Windows® operating system service which issues a text string as a command to the operating system's command interpreter (i.e., the "command.com" program in the Windows® operating system).

The text string generally is in the form of an MS-DOS command, which specifies a path and file name of the associated application program's executable file, a flag for specifing the desired operation, and the document's path and file name. The command interpreter responds by parsing the text string, loading the application program specified in the text string, and passing the flag and the document's path and file name as command line arguments into the application program. The application program then "opens" (i.e., loads) the document and performs the operation specified by the flag.

As was described above, it is desirable to add interactive or dynamic behavior to a document **46** written in HTML and other formats by obtaining software components from one or more remote computers. As is shown in FIG. **3**, an illustrative embodiment of the present invention includes an automatic software download system **56** with a software component download module **58**, a data download module **60**, a code verification module **62**, and a code installation module **64**.

When a request is made to download a desired software component stored on a remote computer **44**, the software component download module **58** determines if the desired software component is already installed on the local computer **36**. If the desired software component is already installed on the local computer **36**, then the desired software component on the local computer **34** is checked to see if a more recent version is available. If a more recent version of the desired software component is available, or if the desired computer software component is not available on the local computer **34**, then it is downloaded in an asynchronous manner by the data download module **60**. The software component download module **58** uses a Uniform Resource Locator (URL) or a network search path to locate a desired software component. The URL and network search path will be explained below.

Any software components downloaded to the local computer **36** are verified with the code verification module **62**. The code verification module **62** checks a digital signature in a digital certificate included in the downloaded software component to ensure the downloaded software component is safe (e.g., computer virus and corruption free) on the local computer **34**. The digital certificate is used to inform a user who created the software component and signed it with the digital signature. After it is verified by the code verification module **62**, the downloaded computer software component is installed on the local computer **34** by the code installation module **64**.

In an illustrative embodiment of the present invention, system **56** includes a software interface CoGetClassObjectFromUrl for the software component download module **58**, a software interface URL Moniker for the data download module **60**, a software interface WinVerifyTrust for the code verification module **62**, and a software interface ICodeInstall for the code installation module **64**.

In an illustrative embodiment of the present invention, the software interfaces and corresponding software subroutines just described are available in the Internet Component Download Application Program Interface (API) for the Windows® 95 Operation System by Microsoft Corporation of Redmond, Wash. The details of each of these interfaces will be explained below. However, the modules of system **56** may also be implemented as hardware modules, or a combination of software and hardware modules. In addition, other software subroutines, interfaces, and operating systems could also be used for system **56**.

The system **56** is used with method **66** as is shown in FIG. **4** for automatically locating **68**, downloading **70**, verifying

72, installing 74, registering 76, and returning 78 computer software components obtained from a computer network 36 like the Internet. However, method 66 and system 56 are not limited to downloading software components for HTML documents. Almost any type of computer software components can be obtained from a local or remote computer using system 56 and method 66 for many types of files or documents.

In an illustrative embodiment of the present invention, computer software components (e.g., a control file) are automatically located 68 using one of two designators: a URL or a network search path. The URL or network search path are used to first locate 68 a control file on a remote computer. The control file can be a single portable executable file or a file (e.g., a cabinet or initialization file) which contains one or more remote executable files, library files (e.g., Dynamic Link Library (.DLL) files), or references to one or more remote executable files or library files. The control file is used to determine the location of the software components on one or more remote computers 44 to download to the local computer 36.

In an illustrative embodiment of the present invention, the control file is used to locate object oriented software components including: Object Linking and Embedding (OLE) components, ActiveX™ (network activation) components, Visual Basic components, Netscape™ ONE Plug-ins, Java components or others to provide dynamic or interactive multimedia to a user. Moreover, software components can be downloaded to provide functionality other than dynamic or interactive multimedia and the components need not be in the form of object-oriented software components.

Downloaded software components are automatically verified 72 by checking a digital signature and a digital certificate contained within the software components (e.g., with WinVerifyTrust). However, security measures other than digital signatures and digital certificates could also be used to verify a software component. In another embodiment of the present invention, the software verification step 72 is optional. For example, on a corporate intranet, where all software components behind a corporate firewall are automatically trusted and need no verification. The verified software components are then automatically installed 74 (e.g., with ICodeInstall) in various directories of a file system on the local computer 34. After installation the software components are registered 76 (e.g., with DllRegisterServer or ModuleUsage) in a registry database on the local computer 34. The registry database is used to keep track of which software components are installed on the local computer 34. In another embodiment of the present invention, the registration step 76 is optional. After registration, selected software components are returned 78 to a requesting application. Further details of method 66 will be explained below.

In an illustrative embodiment of the present invention, a network browser such as the Microsoft Internet Explorer® version 3.0, uses system 56 and method 66 to download and install object oriented software components used for dynamic or interactive multimedia in HTML documents 46. However, other applications can use system 56 and method 66 to download and install executable software components from one or more remote computers.

To use dynamic or interactive multimedia in HTML documents, HTML <OBJECT> tags are used. One or more HTML <OBJECT> tags are embedded into a document written in HTML or some other programing or scripting language which permits HTML references. The <OBJECT> tags typically point to object-oriented computer software components or some other file format that is executable or references an executable file.

The HTML <OBJECT> tag has multiple attributes including: DATA, CODEBASE, CLASSID, TYPE, ID, and CLASS attributes. The DATA attribute specifies a Uniform Resource Locator (URL) referencing an object's data. The CODEBASE attribute is an optional attribute used when the object references a desired software component program. Besides the actual location of the desired software component, the "CODEBASE" URL in the <OBJECT> tag may also include an optional version number using the following syntax:

"CODEBASE=http://www.foo.com/bar.ocx#Version=a,b,c,d".

Where "a,b" in "#Version=a,b,c,d" represent the desired version of a software component on a remote server, and "c,d" represent the desired version of a local software component. The method 66 will download 70 and process (72–78) the software component pointed to by the CODEBASE attribute only if the specified version number of the remote software component is more recent than any existing version of the same software component currently installed on the local computer 34. If a version number is not specified for a software component, it is assumed that any version installed on the local computer 34 is proper to use. The CODEBASE attribute can also be a URL fragment with the syntax

"CODEBASE=#Version=−1,−1,−1,−1".

Specifying only "#Version=−1,−1,−1,−1" for the CODEBASE attribute causes a network search path to be used to find the latest version of a desired software component. The network search path will be explained below.

The CLASSID attribute is used to specify an object identifier. On each computer (36,44) connected to the computer network 38, for example, the operating system registry (also called the registration database) is used to store relevant information about object oriented components according to their CLaSs IDentifier (CLSID). An object registers its CLSID in the operating system registry database to enable client applications (e.g., a network browser) to locate and load the executable code associated with the objects. The HTML <OBJECT> CLASSID is equivalent to the object-oriented CLSID.

The CLSIDs are also given the alias "GUID," which stands for Globally Unique IDentifiers. Each object class is represented by a CLSID, a 128-bit (16-byte) number that is assumed to be unique on computer network across space and time. A CLSID is a 16-byte value with a specific structural definition that has an ASCII representation shown below as a group of hexadecimal digits within braces such as "{42754850-16b7-11ce-90eb-00aa003d7352}" (The groupings of the hex digits and the hyphens are part of the ASCII representation as well). Application programs such as the network browser manipulate the structural definition (e.g., the C/C++ structural definition) of the CLSID. The CLSID is used as the HTML <OBJECT> CLASSID.

The TYPE attribute specifies the Internet media type for the OBJECT data. The ID attribute is used to define a document-wide identifier. The CLASS attribute is used for applying a pre-determined style to an OBJECT element. Remaining <OBJECT> tag attributes, like "ID, STYLE, DIR, ALIGN, WIDTH, HEIGHT, BORDER, HSPACE and USPACE" are known attributes in HTML and, although previously used in a manner different from the present invention, are generally described in *HTML 3: Electronic Publishing on the World Wide Web* by Dave Ragget, Jenny Lam, and Ian Alexander, Addison-Wesley, 1996.

An example <OBJECT> tag in a HTML document for an ActiveX™ Control is shown below.

```
<OBJECT
  CLASSID="classid:663CFEE:1A9B-22DC-AB3C-
    080036F12502"
CODEBASE="http://www.microsoft.com/
  test.ocx#FileVersion=0,0,4,2"
  >
</OBJECT>
```

where the CLASSID "663CFEE:1A9B-22DC-AB3C-080036F12502" shows an object identifier (i.e., CLSID) for the ActiveX™ Control "test.ocx", the CODEBASE attribute gives the URL "http://www.msn.com/test.ocx" which specifies where to find the ActiveX™ Control file. </OBJECT> signifies the end of the <OBJECT> tag. If the ActiveX™ Control is not present on the local computer, or if the ActiveX™ Control is already stored on the local computer and has a version earlier than 4.2, then it will be downloaded to the local computer which will replace the current version on the local computer.

After embedding one or more HTML <OBJECT> tags in a document written in HTML and storing the document on a remote computer **44** connected to a computer network **38** (e.g., the Internet, an intranet) the document **46** is browsed with a network browser from the local computer **34**.

When an HTML <OBJECT> tag is encountered in the document by the network browser, the <OBJECT> tag is parsed to pull out <OBJECT> tag attributes (e.g., the CLASSID, CODEBASE, etc.). The network browser passes the <OBJECT> tag attributes to the software component download module **58** via the CoGetClassObjectFromURL interface. If a network browser is not used, other applications could use method **66** and system **56** by sending the proper parameters to the CoGetClassObjectFromURL interface.

In an illustrative embodiment of the present invention, the single interface CoGetClassObjectFromURL manages method **66** and system **56**. However, multiple interfaces could also be used. Any application that wishes to download almost any software component from a remote computer **44** connected to a computer network **38** like the Internet can do so by passing the appropriate parameters to the CoGetClassObjectFromURL interface.

The interface to the CoGetClassObjectFromURL interface is shown below.

```
STDAPI CoGetClassObjectFromURL (
  [in] REFCLSID rclsid,
  [in] LPCWSTR szCodeURL,
  [in] DWORD dwFileVersionMS,
  [in] DWORD dwFileVersionLS,
  [in] LPCWSTR szContentTYPE,
  [in] LPBINDCIX pBindCtx,
  [in] DWORD dwClsContext,
  [in] LPVOID pvReserved,
  [in] REFIID riid,
  [out] VOID **ppv);
```

Where [in] are input parameters and [out] are output parameters.

CoGetClassObjectFromURL accepts the following arguments:

Argument	Type	Description
rclsid	REFCLSID	CLSID of the object that needs to be installed. If value is CLSID_NULL then szContentType is used to determine the CLSID.
szCodeURL	LPCWSTR	URL pointing to the code for the object. This may point to an executable, to an .INF file, or to a .CAB file. If this value is NULL, then Internet Component Download will still attempt to download the desired code from an object store server on an Internet Search Path
dwFileVersionMS	DWORD	Major version number for the object that needs to be installed. If this value and the next are both 0xFFFFFFFF, then it is assumed that the latest version of the code is always desired, an attempt to download new code will be made.
dwFileVersionLS	DWORD	Minor version number for the object that needs to be installed. If this value and the previous one are both 0xFFFFFFFF, then it is assumed that the latest version of the code is always desired, an attempt to download new code will be made.
szContentType	LPCWSTR	MIME type that needs to be understood by the installed object. If rclsid is CLSID_NULL, this string is used to determine the CLSID of the object that must be installed. Note: this parameter is only useful when trying to download a viewer for a particular media type, if the MIME type of the media is known but the CLSID is not.
pBindCtx	LPBINDCTX	A bind context to use for downloading/installing component code. The client should register its IBindStatusCallback in this bind context to receive callbacks during the download and installation process.
dwClsContext	DWORD	Values taken from the CLSCTX enumeration specifying the execution context for the class object.
pvReserved	LPVOID	Reserved value, must be set to NULL.
riid	REFIID	The interface to obtain on the factory object (typically IClassFactory).
ppv	VOID**	Pointer in which to store the interface pointer upon return if the call is synchronous.
Returns	S_OK	Success. ppv contains the requested interface pointer.
	MK_S_ASYNCHRONOUS	Component code will be downloaded and installed

-continued

Argument	Type	Description
		asynchronously. The client will receive notifications through the IBIndStatusCallback interface it has registered on pBindCtx.
	E_NOINTERFACE	The desired interface pointer is not available. Other CoGetClassObject error return values are also possible here.

In an illustrative embodiment of the present invention, the values for parameters passed to the CoGetClassObjectFromURL interface are read directly from an HTML <OBJECT> tag. For example, the szCodeURL, dwFileVersionMS, and dwFileVersionLS are specified inside an <OBJECT> tag with "CODEBASE=http://www.foo.com/bar.ocx#Version=a,b,c,d" where szCodeURL is "http://www.foo.com/bar.ocx", dwFileVersionMS is "a,b", the major version of a file on remote server (e.g., a software provider such as Microsoft), and dwFileVersionLS is "c,d", the version of a file on the local computer. The CoGetClassObjectFromURL interface is responsible for managing method **66** and system **56**. A software component requested with method **66** is typically a factory class object. A class factory generates actual object class instances of an object and is known to those skilled in the art.

As is shown in FIG. **5**, the CoGetClassObjectFromURL interface uses method **80** to locate a control file on a remote computer **44**. If it specifies **82** a CLSID, CoGetClassObjectFromURL checks to see if the desired software component (i.e., the control file) is registered and installed **84** on the local computer **36** with the right version number **86**. If it does not specify a CLSID (i.e., has a value of CLSID_NULL), CoGetClassObjectFromURL will choose the appropriate CLSID by interpreting the Multipurpose Internet Mail Extension (MIME) **88** type specified in the szContentType parameter. MIME provides a standard mechanism for messages to be exchanged over computers connected to the Internet. See *Internet Standard Document: RFC* 1521 for specific details on MIME.

If the desired software component is registered and installed on the local computer, and if the version number is correct, then the desired software component is obtained from the local computer **36**. If the desired software component is not registered and installed on the local computer, or if the version number is incorrect, then the desired software component is obtained from the remote computer **44**.

To obtain the desired software component from the remote computer **44**, the szCodeURL parameter is checked **90**. If the szCodeURL parameter is not NULL, then an attempt is made to locate the desired software component with the URL stored in szCodeURL. If the URL is valid **92**, the desired software component will be downloaded **70** (FIG. **4**) to the local computer **36**. If the szCodeURL is NULL, or the specified URL is invalid, a then a network search path is used to locate the software component **94**. The network search path is specified as shown below.

CodeBaseSearchPath=<URL_1>; <URL_2>; . . . <URL_m>; CODEBASE URL; <URL_{m+1}>; . . . <URL_{n-1}>; <URL_n>

This search path is made accessible to the CoGetClassObjectFromURL interface. For example, using Microsoft's Internet Explorer® 3.0 running on Windows® 95, the search path is stored in the system registry. On other operating systems or with other software applications, this search path may be stored elsewhere as long as it is accessible to the CoGetClassObjectFromURL interface. On Windows operating systems, the network search path is specified in a string in the registry database under the key:

KEY LOCAL MACHINE\Software\Microsoft\Windows\CurrentVersion\Internet Settings\CodeBaseSearchPath

However, other registry database keys could also be used. The value for this key is a string of szCodeURL parameters.

Each of URLs URL_1 through URL_N in the network search path are absolute URLs pointing to HTTP servers acting as "Object Stores" **44**. However, other formats could also be used for the network search string.

As is shown in FIG. **6**, the CoGetClassObjectFromURL interface using method **96** will first try locating **68** (FIG. **4**) the desired control file using URL_1 through URL_m **(98–102)**. If the desired control file cannot be located using URL_1 through URL_m, CoGetClassObjectFromURL will try the location specified in the szCodeURL parameter (e.g., corresponding to the CODEBASE attribute in the <OBJECT> tag) **104**. If the desired control file cannot be located using the szCodeURL search path, CoGetClassObjectFromURL will try the locations specified in locations URL_{m+1} through URL_N **(106–110)**. If this search fails, then the desired control file cannot be located. The network search using a network search path will use the first successful response from a server and will not subsequently continue searching for newer versions of components. However, newer versions of software components can also be searched for.

If the CODEBASE keyword is not included in the CodeBaseSearchPath key, then calls to CoGetClassObjectFromURL will not check the szCodeURL location for downloading code. By removing the CODEBASE keyword from the CodeBaseSearchPath, corporate intranet administrators can effectively disable corporate users from accessing any remote computer to obtain a computer software component specified by a HTML <OBJECT> tag. This also allows registration of default Object Store locations **44** on the World Wide Web, where browsers can find code when no CODEBASE location is explicitly specified. In addition, by removing the CODEBASE keyword from the CodeBaseSearchPath and pointing URL_1 through URL_N to intranet sites, corporate intranet administrators can effectively disable corporate users from accessing software components from any computers outside a local intranet.

In an alternative embodiment of the present invention, the network search path can be used in an alternative way: the URLs in the network search path **(98–102, 106–110)** will be searched for a control file after trying the location specified in the szCodeURL parameter for CoGetClassObjectFromURL, (e.g., after trying the location specified in the CODEBASE attribute **104** from a HTML <OBJECT> TAG).

In an illustrative embodiment of the present invention, an Object Store on the network search path is an HTTP server that services requests for a desired control file. CoGetClas-

sObjectFromURL will try to locate the control file from the various Object Stores in the search path. Specifically, an Object Store will receive an HTTP POST request with data in the format below:

CLSID={class id}

Version=a,b,c,d

MIMETYPE=mimetype

All the values above are optional, although at least one of CLSID or MIMETYPE parameters must be present. The Object Store parses this information, checks an internal database, and either fails, or redirects the HTTP request to the control file on the next remote computer in the network search path.

The HTTP POST parameters are processed by the Object Store as follows: If CLSID is provided with no version number, then the most recent object matching the CLSID will be returned. If the CLSID is provided with Version, then the object matching the CLSID and with the highest version number greater than or equal to Version will be provided. If no object is available that matches the CLSID with a large enough version number, then the HTTP error (e.g., the 404 error) will be returned. MIMETYPE will be ignored when CLSID is provided.

If no CLSID is provided, but MIMETYPE is provided, then the first object found in the database that matches the MIMETYPE will be returned. Version, if provided, is treated as described above. If neither CLSID or MIMETYPE is provided then the HTTP error return code "400 Bad Request" will be returned.

In addition to the HTTP POST data described above, queries to Object Stores may also include HTTP headers for ACCEPT (MIME type) and ACCEPT-LANGUAGE, thus specifying the desired platforms and language-localized implementation for a component. HTTP headers are typically added to all HTTP requests made by method **66** and system **56**. This allows Object Stores to serve different code implementations for differing platforms or even different languages.

The illustrated and alternative embodiments of the present invention described above assume that all computer software storage servers searched with the network search path are active HTTP servers capable of handling HTTP POST requests and querying an object database to find the desired software components. In another alternative embodiment of the present invention, non-HTTP servers can also be used in the network search path (e.g., FTP servers and standard file servers).

The control file located **68** on a remote computer can be, for example, a portable executable file, a cabinet file, or an initialization file. A portable executable (PE) is a single executable file that is downloaded, verified, registered and installed on the user computer according to method **66**. The portable executable is typically an OLE control or ActiveX™ (network activation) control file (e.g., .OCX), a Dynamic Link Library file (e.g., .DLL), or a executable file (.EXE). OLE control, ActiveX™, Dynamic Link Library, and executable files are known to those skilled in art.

A single portable executable file is the simplest way to package a software component to provide dynamic or interactive multimedia. However, when a single portable executable is used, the file is typically not compressed, and the software component will not be platform independent unless a HTTP server negotiates a platform independent format. The HTTP server negotiation will be explained in detail below.

A cabinet file (e.g., CAB) can be used for the control file. The cabinet file contains one or more files, all of which are downloaded together in a compressed "cabinet." One file in the cabinet is an initialization file (e.g., .INF) providing further installation information. This .INF file may refer to files in the cabinet as well as to files at other URLs. Using a cabinet file requires authoring of a .INF and packaging of a CAB file, but in return it provides file compression. File compression is completed with Lempel-Ziv compression, which is known in the art. However, other compression formats could also be used.

Cabinet files can be created with the DIANTZ.EXE tool by Microsoft Corporation. However, other cabinet file creation tools can also be used. The DIANTZ.EXE tool takes a directive file (e.g., .DDF), which specifies how to create a cabinet file, and creates a cabinet file. The DIANTZ.EXE is used with the following command line:

DIANTZ.EXE/f directive_file.ddf

where the "If" attribute tells the DIANTZ.EXE tool to use the file "directive_file.ddf" to create the cabinet file. An example directive file, CIRC3.DDF is shown below.

```
; DIAMOND directive file for CIRC3.OCX+CIRC3.INF
.OPTION EXPLICIT                ; Generate errors on variable typos
.Set CabinetNameTemplate=CIRC3Z.CAB
;** The files specified below are stored, compressed, in cabinet files
.Set Cabinet=on
.Set Compress=on
circ3.INF
circ3.OCX
```

The example directive file shown above would be used to create a cabinet file (e.g., ".Set Cabinet=on") containing two compressed (e.g., ".Set Compress=on") files: circ3.INF and circ3.OCX where "circ3.INF" is the single initialization file and "circ3.OCX" is the desired software component for dynamic or interactive multimedia. The .OCX file extension signifies an OLE control or ActiveX™ (network activation control) file. Comments are designated with a semi-colon ";". As was discussed above for the portable executable, the cabinet file will also not be platform independent, except with HTTP server negotiation which will be explained below.

A stand-alone initialization file (.INF) can also be used for the control file. This file specifies various files that need to be downloaded and setup. The syntax of the .INF file allows URLs pointing to files to download, and provides platform independence by enumerating choices for various platforms. An example initialization file is shown below.

```
;Sample INF file for CIRC3.OCX
[Add.Code]
circ3.ocx=circ3.ocx
random.dll=random.dll
mfc40.d11=mfc40.dll
foo.ocx=foo.ocx
[circ3.ocx]
;lines below specify that the specified circ3.ocx (clsid, version) needs to be
    installed on
;the system. If doesn't exist already, can be downloaded from the given location
    (a .CAB)
;note: if "thiscab" is specified instead of the file location, it is assumed that the
;desired file is present in the same .CAB cabinet that the INF originated from
```

-continued

```
;otherwise, if the location pointed to is a different .CAB, the new cabinet
is also
    downloaded and
;unpacked in order to extract the desired file
file=http://www.code.com/circ3/circ3.cab
clsid={9DBAFCCF-592F-101B-85CE-00608CEC297B}
FileVersion=0,0,1,2
[random.dll]
;lines below specify that the random.dll needs to be installed in the system
;if this doesn't exist already, it can be downloaded from the given loca-
tion.
file=http://www.code.com/circ3/random.dll
;Note that the FileVersion is option, and it may also be left empty,
meaning that
    any version is ok.
FileVersion=
DestDir=10
;DestDir can be set to 10 or 11 (LDID_WIN or LDID_SYS by INF
convention)
;this places files in \windows or\windows\system, respectively
;if no dest dir specified (typical case), code is installed in the fixed
occache
    directory.
[mfc40.dll]
;leaving the file location empty specifies that the installation
;needs mfc40 (version 4,0,0,5), but it should not be downloaded.
;if this file is not already present on the client machine, component
download
    fails
file=
FileVersion=4,0,0,5
[foo.ocx]
;leaving the file location empty specifies that the installation
;needs the specified foo.ocx (clsid, version), but it should not be
downloaded.
;if this file is not already present on the client machine, component
download
    fails
file=
clsid={DEADBEEF-592F-101B-85CE-00608CEC297B}
FileVersion=1,0,0,143
```

The sample .INF file shown above can be used to install the files "circ3.ocx, random.dll, mfc40.dll, and foo.ocx" where the .OCX file extension signifies an OLE control or ActiveX™ control (network activation) file and the .DLL file extension signifies a Dynamic Link Library file. OLE controls, ActiveXTm controls and Dynamic Link Library files are known to those skilled in the art.

The .INF file has instructions to install each of the necessary files, and comments are again designated with a semi-colon ";". For example, the .INF file specifies that the "circ3.ocx" file needs to be installed on the local computer with a "clsid={9DBAFCCF-592F-101B-85CE-00608CEC297B}." "FileVersion=0,0,1,2" is used to check a local version of a file to see if it is earlier than Version 1.2. If it is, it will be downloaded to the local computer. The "circ3.ocx" can be downloaded from a remote computer in a cabinet file using the URL "file=http://www.code.com/circ3/circ3.cab." The "FileVersion=" attribute for the "random.dll" file is empty, so that any version of this file is ok. The "file=" attribute is empty for "mfc40.dll" and "foo.ocx" which signifies that these files should not be downloaded to the local computer. If these files don't exist on the local computer, then the downloading fails.

The initialization file also provides platform independence for HTTP and non-HTTP servers which store the desired software components. It is possible to create platform-independent setup scripts that pull desired software components from different locations depending on the desired platform. A sample platform-independent .INF file would include a text such as the following:

```
[circ3.ocx]
; lines below specify that the specified circ3.ocx (clsid, version) needs to
be installed
    on
; the system. If doesn't exist already, can be downloaded from the given
location (a
    .CAB)
file-win32-x86=file://products/release/circ3/x86/circ3.cab
file-win32-mips=file://products/release/circ3/mips/circ3.cab
file-mac-ppc=ignore
; the 'ignore' keyword means that this file is not needed for this platform
clsid={9DBAFCCF-592F-101B-85CE-00608CEC297B}
FileVersion=1,2,0,0
```

The "file-x-y" syntax used in the .INF file is expanded to "file-%opersys%-%cpu%", (e.g., "file-win32-mips" where %opersys%="win32" and %cpu%="mips") allowing the .INF file to specify multiple locations where various platform-dependent modules can be found and downloaded. Valid values for %opersys% and %cpu% attributes are explained below.

The following MIME types will be used to describe PEs (portable executables - .EXE, .DLL, .OCX), cabinet files (.CAB), and setup scripts (.INF):

File description	MIME Type
PE (portable executable) - .EXE, .DLL, .OCX	application/x-pe-%opersys%-%cpu%
Cabinet files - .CAB	application/x-cabinet-%opersys%-%cpu%
Setup scripts - .INF (platform independent)	application/x-setupscript

The %opersys% and %cpu% attribute values shown below will specify the operating system and CPU for the desired platform desired software components will be executed on. For example, the MIME type for a Win32 cabinet file running on an Intel® x86-architecture processor (whether manufactured by Intel Corporation or another company) would be application/x-cabinet-win32-x86. The following are valid values for %opersys% and %cpu%:

Valid values for %opersys%	Meaning
win32	32-bit Windows ® operating systems (Windows95 or Windows NT)
mac	Macintosh ® operating system
<other>	will be defined as necessary

Valid values for %cpu%	Meaning
x86	Intel ® x86 family of processors
ppc	Motorola ® PowerPC architecture
mips	MIPS ® architecture processors
alpha	DEC ® Alpha architecture

However, more or fewer values could also be used.

When the desired software component is on a non-HTFP server (e.g., at an intranet or local LAN location), a .INF file can be used to achieve platform independence by specifing different URLs for files to be downloaded for different platforms.

Platform independence for HTTP servers which store the desired software components is also provided without using an initialization file. An HTTP ACCEPT header MIME request type is used to provide platform independence. The

MIME request type specifies which platform the code is to run on, thus allowing platform independence when the CODEBASE attribute or the network search path is used.

After locating **68** (FIG. **4**) a desired information file, the necessary software components are downloaded **70** (FIG. **4**)with a data download module **60** (FIG. **3**). The CoGetClassObjectFromURL interface uses the URL moniker interface to download **70** the necessary software components asynchronously from one or more remote computers **44**. However, other interfaces could also be used to download the necessary software components. The URL moniker interface is described in greater detail in URLMON.DOC and ASYNCMON.DOC in the *ActiveX™ Software Development Kit* (SDK) by Microsoft.

The URL moniker interface uses the IBindStatusCallback interface, which is implemented in an application program like the network browser, to pass status information back to the application program. The IBindStatusCallback interface enables the browser to tell the user when the download **70**, verification **72**, registration **74**, and installation **76** steps are complete.

The client of the CoGetClassObjectFromURL interface (e.g., the network browser) will receive notification about the download/install process via the provided IBindStatusCallback interface. During the download process , the following additional values (from the BINDSTATUS enumeration of Windows 95, for example) may be passed back as the ulStatusCode parameter for IBindStatusCallback::OnProgress.

Value	Description
BINDSTATUS_BEGINDOWNLOADCOMPONENTS	The download operation has begun downloading code for software components that will be installed before the object may be instantiated. The szStatusText accompanying IBindStatuscallback::OnProgress provides the display name of the component being downloaded.
BINDSTATUS_INSTALLINGCOMPONENTS	The download operation has downloaded code and is installing it. The szStatusText accompanying IBindStatusCallback::OnProgress provides the display name of the component being installed.
BINDSTATUS_ENDDOWNLOADCOMPONENTS	The download operation has finished downloading and installing all necessary code. The szStatusText accompanying IBindStatusCallbackOnProgress provides the display name of the newly installed component.

Since the downloading **70** of software components occurs asynchronously, the CoGetClassObjectFromURL interface will often return immediately with a return value of E_PENDING. At this point, the IBindStatusCallBack mechanism is used to communicate the status of the download operation to the client (e.g., the network browser). To participate in this communication, the client implements IBindStatusCallback and registers this interface in pBindCtx passed into CoGetClassObjectFromURL using RegisterBindStatusCallback. The client can expect to be called with callback notifications for OnStartBinding (providing an IBinding for controlling the download), OnProgress (reporting progress), OnObjectAvailable (which returns the desired object interface pointer), and OnStopBinding (which returns error codes in case of an error). For further negotiations, the client also implement ICodeInstall to install the desired software component as is described below. However, other downloading and callback processes can also be used.

After downloading **70** the necessary software components to the local computer **36**, the software components are verified **72** with a code verification module **62**. CoGetClassObjectFromURL uses the WinVerifyTrust interface and the ICodeInstall interface to ensure the necessary software components are safe and trusted, and to ensure that the user wants to install the software components. However, other interfaces could also be used to verify and install the necessary software components. ICodeInstall is implemented by the downloading client (e.g., the network browser), and is used whenever installation of software components needs some service (e.g., verification) before the download can be negotiated correctly.

A code install operation **74** requires additional services from the client in order to complete the negotiation necessary for a download operation **70**. Such services are requested using IBindStatusCallback::QueryInterface. The specific interface requested in IBindStatusCallback:: QueryInterface is ICodeInstall. This interface is implemented by a client application (e.g., a network browser). The ICodeInstall interface has two member functions: NeedVerificationUI and OnCodeInstallProblem. The ICodeInstall interface and functions are shown below.

```
interface ICodeInstall : IUnknown {
  HRESULT   NeedVerificationUI(
    [out] HWND* phwnd);
  HRESULT   OnCodeInstallProblem(
    [in] ULONG ulStatusCode,
    [in] LPCWSTR szDestination,
    [in] LPCWSTR szSource,
    [in] DWORD dwReserved);
  };
```

ICodeInstall::NeedVerificationUI is called to display User Interface (UI) for verification of downloaded code. When a client is called with this function, it has the opportunity to clear a message queue of its parent window before allowing UI to be displayed. If the client does not wish to display UI, code verification may continue, but components may fail to be installed. The parameters for ICodeInstall::NeedVerificationUI are explained below.

HRESULT NeedVerificationUI([out] HWND* phwnd);

Argument	Type	Description
phwnd	HWND*	Client-provided HWND of the parent window for displaying code verification UI. If this parameter is NULL, the desktop window is used. If the value is INVALID_HANDLE_VALUE, or if the return value is S_FALSE, then no code verification UI will be displayed, and certain necessary components may not be installed.
Returns	S_OK	Success.
	S_FALSE	No window is available.
	E_INVALIDARG	The argument is invalid.

ICodeInstall::OnCodeInstallProblem is called when there is a problem with code installation. This notification gives the client a chance to resolve the problem, often by displaying UI, or by aborting the code installation process. The parameters for ICodeInstall::OnCodeInstall-Problem are explained below.

```
HRESULT   OnCodeInstallProblem(
  [in] ULONG ulStatusCode,
  [in] LPCWSTR szDestination,
  [in] LPCWSTR szSource,
  [in] DWORD dwReserved);
```

Argument	Type	Description
ulStatusCode	ULONG	Status code describing what problem occurred. A member of CIP_STATUS.
szDestination	LPCWSTR	The name of the existing file that was causing a problem. This may be the name of an existing file that needs to be overwritten, the name of a directory causing access problems, or the name of a drive that is full.
szSource	LPCWSTR	Name of the new file to replace the existing file (if applicable).
dwReserved	DWORD	Reserved for future use
Returns	S_OK	Continue the installation process. If there was an "access denied" or disk-full problem, retry the installation. If there was an existing file (newer or older version), overwrite it.
	S_FALSE	Skip this particular file, but continue with the rest of the code installation process. Note: this is the typical response for the CIP_NEWER_VERSION_EXISTS case.
	E_ABORT	Abort the code installation process.
	E_INVALIDARG	The given arguments are invalid.

The ulStatusCode parameter above is one of the following values:

Value	Description
CIP_DRIVE_FULL	The drive specified in szDestination is full.
CIP_ACCESS_DENIED	Access to the file specified in szDestination is denied. The client is required to take a sequence of steps to possibly correct the situation. The client could check its own state to see if the file in question or the component it belongs to is in use by the client and close the file or release the component and call COM to free unused libraries in the process. If it cannot locate the file or component, it should display UI to the user suggesting that they close other applications in the system to retry the operation. The operation can be retried by returning S_OK. Returning S_FALSE will ignore this file and proceed with the rest of the installation. Any error returns will cause the code download to abort.
CIP_OLDER_VERSION_EXISTS	An existing file (older version) specified in szDestination needs to be overwritten by the file specified in szSource.
CIP_NEWER_VERSION_EXISTS	A file exists (specified in szDestination) that is a newer version of a file to be installed (specified in szSource)
CIP_NAME_CONFLICT	A file exists (specified in szDestination) that has a naming conflict with a file to be installed (specified in szSource). The existing file is neither a newer nor an older version of

-continued

Value	Description
	the new file—they are mismatched but have the same file name.
CIP_TRUST_VERIFICATION_COMPONENT_MISSING	The code installation process cannot find the necessary component (e.g., WinVerifyTrust) for verifying trust in downloaded code. szSource specifies the name of the file that cannot be certified. The client should display UI asking the user whether or not to install the untrusted code, and should then return E_ABORT to abort the download, S_OK to continue anyway, or S_FALSE to skip this file but continue (usually dangerous).
CIP_NEED_REBOOT	The self-extracting EXE or 'hook' (either Win32 INF section or a custom setup program hook run using the run=<cmd-line>) in the hook section updated components in use that can only be used after a reboot. The client should display UI and Shutdown windows if the user agrees to reboot the machine for the changes to take effect. The INF filename or command line of the EXE that caused the reboot is in szDestination. Returning E_ABORT will abort the download.
CIP_EXE_SELF_REGISTRATION_TIMEOUT	The EXE that was spawned to self-register (may also be a self-extracting EXE) is still pending completion. This is usually called out when the client calls IBinding::Abort() while waiting for the self-extracting EXE to complete. The command line of the EXE is available in szDestination. The client should display UI to the user to warn that installation on the page is incomplete. The return value of S_OK from the callback will cause a continued wait for the EXE to complete. S_FALSE will abandon the EXE and proceed with the rest of the installation. Any error returns will cause abortion of the code download.
CIP_UNSAFE_TO_ABORT	Code download is in setup phase and one or more components may have already been installed irreversibly rendering unknown the state of the setup of the component in question. This notification is issued when the client calls IBinding::Abort() while in setup phase. The return value of S_OK will cause Abort() to return with S_FALSE and the code download will continue. Any other return will cause the code download to abort and the state of the component is not guaranteed.

After the necessary software components are downloaded, the WinVerifyTrust interface checks to see if the downloaded components possess a digital signature. However, other verification interfaces could also be used. If the downloaded software components posses a digital signature, the WinVerifyTrust interface validates the digital signature and its corresponding digital certificate. The digital certificate describes who issued the software component and who created the digital signature. If the downloaded software components do not possess a digital signature, or if the corresponding signature was not issued by a trusted authority, WinVerifyTrust gives the client-side (e.g., network browser) user the option of whether or not to trust the code and install it on the local computer **36**. Before asking for verification on its own, WinVerifyTrust uses ICodeInstall::NeedVerificationUI to confirm that it is appropriate to display the appropriate UI for the user of the local computer **34**.

After the code has been verified **72**, the control file is installed **74** on the local computer **34** with a code installation module **64**. As is shown in FIGS. **7A–7B**, method **112** installs **74** and registers **76** the control file. If the control file is a single portable executable file (e.g., .EXE, .OCX, DLL) **114**, the single portable executable file is installed **116** on the local computer **34** by CoGetClassObjectFromURL. If the control file is not a single portable executable **118** (i.e., the file is a .INF or a CAB file), then each of the files referenced in the initialization or cabinet file are installed **120–124** on the local computer **34**.

In an illustrative embodiment of the present invention, most of the downloaded software components are installed in a permanent cache store in an operating system directory called "windows\occache." However, other directories could also be used. Some components (e.g., helper DLLs that need to be on the system PATH but currently are not) will also be installed in the "\windows" and "\windows\system" directories. However, other directories could also be used. If there are any problems during installation (e.g., a full disk, access violations, existing older/newer version of a file, etc.), the code install interface function ICodeInstall:OnCodeInstallProblem is called to make the user aware of the problem.

If the portable executable file is an .OCX or a .DLL file **126**, it is registered by calling the DllRegisterServer interface **128**. The DllRegisterServer interface is an interface which registers a software component in the registry database of the operating system. However, other registering interfaces could also be used. If the portable executable file is a .EXE file **130** (FIG. **7B**), the .EXE is registered during execution with the run-time parameter of "/RegServer" **132**. This run-time parameter registers the .EXE file in the registry database of the operating system.

In an illustrative embodiment of the present invention, self-registering software components are used because the .INF format does not provide syntax for changing registry information (for security reasons). For .OCXs, .DLLs, and .EXEs marked as "OleSelfRegister" in the Version resource, self-registration will be attempted. For .DLLs and OCXs, this means loading the .DLL library and calling DllRegis-

terServer. For .EXEs, this means running the .EXE with the run-time parameter of "/RegServer". This ensures that software components implemented as local servers (e.g. winword.exe) are registered correctly. If an object is not marked as "OleSelfRegister" but registration is necessary, or if it is desired to over-ride the "OleSelfRegister" flag, the following lines can be added to an .INF file:

```
[foo.ocx]
RegisterServer=no ; don't register even if marked OleSelfRegister
  or
RegisterServer=yes ; register this even if not marked OleSelfRegister. This
    is the typical workaround for getting old
      ; controls to register
```

Software components that are a self-extracting .EXE may remain unregistered because the "OleSelfRegister" flag is ignored if the URL points directly at a .EXE file. In this case it is assumed that this is a self-registering .EXE, and this enables self-extracting .EXEs to work correctly as long as they ignore the "/RegServer" command-line parameter. Supporting self-extracting .EXEs enables very complex setup mechanisms to be launched automatically. However, if a self-extracting .EXE is called via this mechanism, then any components that it installs will not be automatically tracked. Such components are permanently installed and may not be available for future cleanup. Every client (e.g., the network browser) of a software module (e.g., .OCX, .DLL, .EXE) is expected to increment and decrement the existing SharedDLLs section in the registry database when the components are registered to allow the operating system to keep track of how many clients are sharing the software components.

Returning to FIG. **7B**, if the file is a .INF or .CAB file, all downloaded software components are registered using a new section in the registry database called Module Usage **136** that keeps track of such components. The Module Usage section in the registry holds a list of "owners" and "clients" for each software module. Thus, the registry can keep track of how many clients a module has (i.e., the SharedDLL count), as well as what software applications executing on the local computer are using the software module. The registry entries for ModuleUsage use the following syntax:

```
[ModuleUsage]
        [<Fully Qualified Path&File Name>]
                .FileVersion=a,b,c,d
                .Owner = Friendly Name/ID of Owner
                <Client ID > = <info peculiar to this client>
                <Client ID > = <info peculiar to this client>
A ModuleUsage section in a sample registry might be:
    Under My Computer\HKEY_LOCAL_MACHINE\Software\Microsoft\Windows
                        \CurrentVersion:
    [ModuleUsage]
        [c:\windows/system/mfc40.dll]
                .FileVersion=1,4,0,0
                .Owner={CLSID of main object rclsid passed to
                CoGetClassObjectFromURL}
                {CLSID of main object rclsid passed to CoGetClassObject
                FromURL}=<any info, or default>
                AnotherAppID=<any info, or default>
```

The parameters of ModuleUsage are as follows:

Key name	Description
<Fully Qualified Path&File Name>	This is the full path of the shared module. This name has to use "/"s instead of "\"s because the "\" is an invalid char in a key name.
.Owner	The application that installs the shared module and creates the original ModuleUsage section will put some identifier in the Owner key section. If the DLL already existed on the system then and this Module Usage key did not exist then the .Owner key should be set to "Unknown" and the DLL should not be removed on uninstall. The owner should always also enlist itself as a client.
.File Version	The version number for the shared module.
<Client ID>	ID of a client who is using the shared module. The value corresponding to each client key contains client specific information. When the client is Internet Component Download, the <Client ID> is {CLSID of main object rclsid passed to CoGetClassObjectFromURL}, and the client-specific information is a number which serves as a reference count. For other clients, the client-specific information should be the full path of the client, so that if the client is accidentally deleted it is possible to do garbage collection.

To permit code caching, the "SharedDLLs" section in the registry database is not used exclusively since reference counts are often incorrectly inflated. For example, any application that is re-installed on the local computer increases the reference count in the SharedDLLs section of the registry database even though the software component already had been incremented previously. However, in an illustrative embodiment of the present invention, every client (e.g., network browser) of a software module is expected to increment and decrement the existing SharedDLLs section in the registry database as well (a client only increments this value once when it adds itself as a client under ModuleUsage). This is to allow a migration path for applications currently implementing only SharedDLLs scheme.

The ModuleUsage registry information complements the reference counts in the SharedDLLs section by remembering which clients are actually using a shared module. The SharedDLLs counting scheme is correct when used with ModuleUsage registry information and allows caching of downloaded code in the permanent cache store. Furthermore, when downloading files, the ModuleUsage registry information is used as an efficient shortcut for verifying whether a file needs to be overwritten because it is an out-of-date version. In another embodiment of the present invention, the registering step **76** is optional.

Downloaded code installed in the permanent cache store can be removed manually or automatically. In one embodiment of this invention, a user is allowed to clean up downloaded code, either through the UI of the application program (e.g., the network browser) or via UI exposed by the operating system itself (e.g. the Windows® 95 "shell." In another alternative embodiment of the present invention, ModuleUsage information is used by the CoGetClassObjectFromURL interface to automatically detect old or unused downloaded code, and automatically delete such code from the permanent cache store.

In another embodiment of the present invention, software can be located **68**, downloaded **70** and installed **74**, with the verifying **72** and registering **76** steps optional. This allows a user to control more of the automatic code downloading method with other software applications chosen by the user.

For example, a "hook" mechanism is provided to override or customize steps of method **66**. In the illustrative embodiment of the present invention, there are two types of hooks: Unconditional (e.g., for a setup program) and Conditional (e.g., for a version of an existing software component) hooks. Unconditional hooks are hooks that are always executed. Conditional Hooks are executed only when a certain selected condition evaluates to TRUE. Hooks are added to the .INF file described above.

Unconditional hooks are used in [Setup Hooks] section of the .INF file. For Unconditional Hooks, the "CODEBASE=" attribute points to a cabinet file "foo.cab" that contains a "foosetup.exe", "foo.ocx" and "foo.inf." file. The setup file "foosetup.exe" run with the "/q" parameter will install the "foo.ocx" file silently in the "windows\occache" directory described above.

For Unconditional hooks, an example initialization file "foo.inf" includes the following:

```
[Add.Code]
[Setup Hooks]
hook1=hook1
[hook1]
run=%EXTRACT_DIR%\foosetup.exe/q
```

When the cabinet file foo.cab is opened, it is verified and then the .INF file is processed. Since the [Add.Code] section is empty, the [Setup Hooks] section is processed. The files in the cabinet file "foo.cab" are installed in a unique temporary directory and the command line listed in the "run=" attribute is executed (i.e., run=%EXTRACT_DIR%\foosetup.exe/q"). All the files left in the temporary directory after the completion of "foosetup.exe" including "foosetup.exe" are discarded. However, other commands could also be used for the Unconditional Hooks.

Conditional Hooks are run only when a certain condition is evaluated as TRUE. This is typically when the [Add.Code] section points at a certain software component and that software component is not available on the client computer. The above example for Unconditional Hooks could be rewritten using Conditional Hooks.

For Conditional Hooks the "CODEBASE=" attribute also points to a cabinet file "foo.cab" that contains a "foosetup.exe", "foo.ocx" and "foo.inf" file. The file setup file "foosetup.exe" run with the "/q" parameter also installs the file "foo.ocx" silently in the "windows\occache" directory as was described above.

For Conditional Hooks, an example initialization file "foo.inf" includes the following:

```
[Add.Code]
foo.ocx=foo.ocx
[foo.ocx]
Clsid={. . . }
hook=hook1
[hook1]
run=%EXTRACT_DIR%\foosetup.exe/q
```

When the .INF is opened, it is processed using the [Add.Code] attribute. When the [foo.ocx] section is processed, the Clsid, (e.g. for "foo.ocx") is used to determine if it is registered or available on the client computer by checking the operating system registry. If "foo.ocx" is not registered on the client computer, the hook mentioned in the [hook**1**] parameter is executed. The execution of [hook**1**] section is identical to the description of the hook as an Unconditional Hook, but occurs only after checking the Cisid of "foo.ocx." However, other commands could also be used for the Conditional Hooks.

Conditional Hooks can be used to make the verifying **72** and registering **76** steps of method **66** conditional (i.e., optional). This allows a user to use method **66** and system **56** to simply locate, download, and install a desired software component without verification or registration. The verification and/or registration steps could be accomplished by methods different than those described in connection with method **66** and system **56** giving the user greater flexibility over the use of the software components downloaded and installed on the local computer.

In another embodiment of the present invention, the HTML tag <EMBED> is also used to add multi-media or interactive behavior to HTML documents with method **66** and system **56**. The <EMBED> tag has three attributes, SRC, WIDTH, and HEIGHT, and may also contain optional parameters that can be sent to a software component (e.g., a Netscape ONE plug-in) handling the embedded data type. The SRC attribute specifies the URL of the source document. The WIDTH attribute specifies the width of the embedded document in pixels. The HEIGHT attribute specifies the height of the embedded document in pixels. There can also be a number of optional parameters passed to a plug-in component with the <EMBED> tag, with PARAMETER_NAME= <PARAMETER_VALUE> (e.g., the parameters described for the <OBJECT> tag above). For more information on the <EMBED> tag, see the *HTML* 3, *Electronic Publishing on the World Wide Web* book cited above.

When the <EMBED> object tag is encountered in the document by the network browser, the <EMBED> tag is parsed to pull out the <EMBED> tag attributes, and the attributes are used with method **66** and system **56** in a manner similar to that described for the <OBJECT> tag above.

The present invention is not limited to the HTML <OBJECT> and <EMBED> tags. Other HTML tags can also be used to provide method **66** and system **56**. In addition, the present invention is not limited to computer system **10** or the browsing environment **34**. The invention can also be used in a set-top box, such as those which provide interfaces to cable television and other television networks, in a satellite control box, such as those which provide interfaces to digital and other satellite transmission services. The present invention may also be used in pagers, cellular telephones, personal assistants and other wireless personal communications devices.

When all of the desired computer software components have been located **68**, downloaded **70**, verified **72**, installed **74**, and registered **76**, any appropriate software components are returned **78** to the client application (e.g., the network browser) which made the request for the computer software components. The software components returned to the client application are then displayed in the document display area **52** on the display device **20** of the local computer **36**.

In an illustrative embodiment of the present invention, the network browser Internet Explorer® 3.0 by Microsoft uses system **56** and method **66** (and methods **80**, **96** and **112**) to browse HTML documents **46** on the Internet **38**. The software interfaces and corresponding software subroutines just described for methods **66** (and methods **80**, **96** and **112**), and system **56** are available in the Internet Component Download Application Program Interface (API) for the Windows® 95 Operation System by Microsoft Corporation.

HTML documents typically contain one or more HTML <OBJECT> or <EMBED> tags. When an HTML <OBJECT> or <EMBED> tag is encountered during browsing, Internet Explorer® parses the appropriate parameters out of the <OBJECT> and <EMBED> tags and passes them to the CoGetClassObjectFromURL interface as was described above. The HTML <OBJECT> or <EMBED> tags typically point to object oriented applications which provide dynamic or interactive multimedia to a HTML document.

However, other applications which are not network browsers, and do not parse HTML documents with <OBJECT> or <EMBED> tags can also use system **56** and methods **66** to download any type of computer software component from a local or remote computer by passing appropriate parameters to CoGetClassObjectFromURL interface. The computer software components need not provide dynamic or interactive multimedia to a client application. In addition interfaces other than CoGetClassObjectFromURL could also be used.

It should be understood that the programs, processes, and methods described herein are not related or limited to any particular type of computer apparatus, unless indicated otherwise. Various types of general purpose or specialized computer apparatus may be used with or perform operations in accordance with the teachings described herein.

In view of the wide variety of embodiments to which the principles of our invention can be applied, it should be understood that the illustrated embodiments are exemplary only, and should not be taken as limiting the scope of our invention. Rather, we claim as our invention all such embodiments as come within the scope and spirit of the following claims and equivalents thereto.

We claim:

1. A method for automatically locating computer software from one or more remote computers, the local and remote computers being connected to a computer network, comprising:

determining whether an object class identifier has been specified for a desired computer software component, and if so, using the object class identifier to locate the desired computer software component, and, if not located,

choosing an appropriate object class identifier using a multipurpose Internet mail extension type associated with the desired software component to locate the desired software component, and, if not located,

determining whether a uniform resource locator has been specified for a desired computer software component, and if so, using the uniform resource locator to locate the desired computer software component, and, if not located,

using a pre-determined network search path to locate the desired software component.

2. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **1**.

3. The method of claim **1** where the determining whether an object class identifier has been specified for a desired computer software component step includes:

determining whether the desired software component is installed and registered on the local computer, and is the proper version of the desired software, and, if so, locating the desired software component on the local computer.

4. The method of claim **1** where the network search path includes a first set of uniform resource locators, a single codebase uniform resource locator, and a second set of uniform resource locators.

5. A method for automatically locating computer software on a plurality of remote computers using a network search path, the method comprising:

providing a network search path which includes a first, second and third set of uniform resource locators, where the second set of uniform resource locators includes a single codebase uniform resource locator corresponding to a predetermined application interface, and further includes one or more uniform resource locators that point to computer software components stored on remote computers connected to an intranet computer network; and

searching for a desired computer software component using the first and third set of uniform resource locators and ignoring the second set of uniform resource locators, thereby preventing a search for computer software components on remote computers not connected to the intranet computer network, and, if the desired computer software component cannot be located,

further searching for the desired computer software component using the second set of resource locators.

6. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **5**.

7. The method of claim **5** where each of the searching steps includes searching a network search path including hypertext transfer protocol servers which are used to store computer software components.

8. The method of claim **5** where each of the searching steps include searching a network search path including servers other than hypertext transfer protocol servers used to store computer software components.

9. The method of claim **5** where the step of searching for a desired computer software component is performed using

the second set of uniform resource locators, and if the desired computer software component cannot be located,

the step of further searching for the desired computer software component is performed using the first set of resource locators, and, if the desired computer software component cannot be located,

the step of further searching for the desired computer software component is further performed using the third set of uniform resource locators.

10. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **9**.

11. A method for automatically managing computer software components obtained from one or more remote computers, the method comprising:

installing computer software components obtained from the one or more of the remote computers in a permanent cache on the local computer;

registering the computer software installed in the permanent cache using a predetermined portion of a registry database on the local computer;

using the pre-determined portion of the registry database on the local computer to keep track of a plurality of programs executing on the local computer using the computer software components installed in the permanent cache; and

using the pre-determined portion of the registry database on the local computer to automatically delete computer software components installed in the permanent cache which are no longer being used by any of the plurality of programs executing on the local computer;

where automatic deletion of components is performed responsive to determining the components are no longer being used by the programs.

12. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **11**.

13. A method for automatically obtaining remote computer software components, the method comprising:

embedding one or more reference tags in a file of data stored on a specific remote computer;

parsing with an application program on the local computer the file of data stored on the specific remote computer;

encountering selected ones of the embedded reference tags during the parsing of the file of data on the specific remote computer;

determining whether the one or more computer software components pointed to by the encountered reference tag are already installed on the local computer, and if not, downloading, verifing, installing in a permanent cache on the local computer, registering, and displaying one of more of the computer software components on a display device on the local computer.

14. A computer readable medium having stored therein instructions capable of causing a computer to perform the method according to claim **13**.

15. The method of claim **13** where the reference tag includes a HTML <OBJECT> tag or a HTML <EMBED> tag.

16. The method of claim **13** where the file of data includes HTML data, Visual Basic programming language data, or Java programming language data.

17. A method for automatically downloading and installing one or more computer software components to a local computer from one or more computers using reference tags, the computer software components including a plurality of sub-components, the reference tags used to identify the computer software components, the method comprising:

receiving a request to present a document at the local computer, where the document comprises an embedded reference tag;

locating automatically a control file on a specific remote computer connected to the computer network using the reference tag embedded in the document, the control file including references to one or more computer software components on the specific remote computer or one or more links to one or more computer software components on one or more of the remote computers;

determining with the control file which of the plurality of sub-components for a computer software component are to be downloaded by checking version information included in the control file;

downloading automatically to the local computer in an asynchronous manner each of the determined computer software sub-components; and

installing automatically each of the downloaded computer software sub-components in one or more locations on the local computer.

18. A computer readable medium having stored therein instructions capable of causing a computer to perform the method of claim **17**.

19. The method of claim **17** where the embedded reference tag includes one of the following: the HTML <OBJECT> and <EMBED> tags.

20. A method for automatically downloading and installing computer software on a local computer from one or more remote computers, the local and remote computers being connected to a computer network, the method comprising:

responsive to encountering in a document an indication that software components are specified for presentation of the document, locating automatically a control file on a specific remote computer connected to the computer network, the control file including references to one or more computer software components on the specific remote computer or one or more links to one or more computer software components on one or more other remote computers;

downloading automatically to the local computer the one or more of the computer software components referenced in or linked to the control file using a uniform resource locator to locate the computer software components;

verifying automatically that the computer software components downloaded to the local computer are safe to install on the local computer;

installing automatically the verified computer software components in one or more locations on the local computer; and

registering automatically the installed computer software components in a registry database on the local computer.

21. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **20**.

22. The method of claim **20** where

the local computer has a central processing unit (CPU) and an operating system; and

the control file includes an initialization file that includes one or more universal resource locators pointing to one

or more computer software components on one or more remote computers, at least one of the computer software components being specified for the operating system or the CPU of the local computer.

23. The method of claim **20** where

the control file includes a cabinet file, the cabinet file including an initialization file, one or more software components in a compressed format, and one or more universal resource locators pointing to remote computer software components on one or more remote computers; and

the initialization file includes information about the version of files needed for the software component.

24. The method of claim **20** where the control file is a single portable executable file.

25. The method of claim **24** where the single portable executable file is an executable application file, a dynamic link library file, and object linking and embedding control file, or an network activation control file.

26. The method of claim **20** where the locating includes using an object class identifier, a uniform resource locator, or a network search path to locate the control file.

27. The method of claim **20** where the verifying uses a digital signature with a digital certificate to verify the computer software components.

28. The method of claim **20** where

the registering includes registering the downloaded and verified computer software components in a module usage section of the registry database on the local computer; and

the module usage section of the registry database permits tracking of usage of downloaded and installed computer software components.

29. The method of claim **20** where

the local computer has a central processing unit (CPU) and an operating system; and

the locating includes using a hypertext transfer protocol server to negotiate the location of a control file including at least one computer software component specified for the CPU or the operating system of the local computer.

30. A method for automatically locating computer software from one or more remote computers, the local and remote computers being connected to a computer network, the method comprising:

determining whether an object class identifier has been specified for a desired computer software component, and if so,

using the object class identifier to locate the desired computer software component and if not,

determining whether a uniform resource locator has been specified for a desired computer software component, and if so,

using the uniform resource locator to locate the desired computer software component, and if not,

using a pre-determined network search path to locate the desired software component.

31. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **30**.

32. The method of claim **30** further comprising:

when an object class identifier has not been specified for a desired computer software component, choosing an appropriate object class identifier using a multipurpose Internet mail extension type associated with the desired software component to locate the desired software component.

33. The method of claim **30** where the determining whether an object class identifier has been specified for a desired computer software component step includes:

determining whether the desired software component is installed and registered on the local computer, and is the proper version of the desired software,

and if so, locating the desired software component on the local computer.

34. The method of claim **30** where the network search path includes a first set of uniform resource locators, a single codebase uniform resource locator, and a second set of uniform resource locators.

35. A method for automatically locating computer software on one or more remote computers using a network search path, the method comprising:

providing a network search path which includes a first set of uniform resource locators, a second set of uniform resource locators including a single codebase uniform resource locator corresponding to a predetermined application interface, and a third set of uniform resource locators;

searching for a desired computer software component using the first set of uniform resource locations, and if the desired computer software component cannot be located,

searching for the desired computer software component using the second set of resource locators, and if the desired computer software component cannot be located,

searching for the desired computer software component using the third set of uniform resource locators.

36. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **35**.

37. The method of claim **35** where the searching includes searching a network search path including hypertext transfer protocol servers which are used to store computer software components.

38. The method of claim **35** where the searching includes searching a network search path including servers other than hypertext transfer protocol servers used to store computer software components.

39. The method of claim **35** further comprising:

providing a network search path which includes the first, second and third sets of uniform resource locators, where the second set of uniform resource locators point to computer software components stored on remote computers connected to an intranet computer network; and

searching the first and third set of uniform resource locators and ignoring the second set of uniform resource locators, thereby preventing a search for computer software components on remote computers not connected to the intranet computer network.

40. A method for automatically locating computer software on one or more remote computers using a network search path, the method comprising:

providing a network search path which includes a first set of uniform resource locators, a second set of uniform resource locators including a single codebase uniform resource locator corresponding to a predetermined application interface, and a third set of uniform resource locators;

searching for a desired computer software component using the second set of uniform resource locators, and if the desired computer software component cannot be located,

searching for the desired computer software component using the first set of resource locators, and if the desired computer software component cannot be located,

searching for the desired computer software component using the third set of uniform resource locators.

41. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **40**.

42. A method for automatically obtaining on a local computer a computer software component from one or more remote computers, the local computer having a central processing unit (CPU) and an operating system, where the computer software component is available in different formats for different platforms, the method comprising:

requesting a desired computer software component stored on a remote computer using a specified platform-independent uniform resource locator, where the specified uniform resource locator can be used to obtain different versions of the component for different platforms; and

receiving the desired computer software component in a format appropriate for the operating system or CPU of the local computer.

43. A computer-readable storage medium having stored therein instructions capable of causing a computer to perform the method of claim **42**.

44. The method of claim **42** where the requesting includes an initialization file that includes one or more uniform resource locators pointing to one or more computer software components on one or more remote computers, at least one of the computer software components being specified for the operating system or the CPU of the local computer.

45. The method of claim **42** where the requesting step includes using a uniform resource locator to access a hypertext transfer protocol server on a remote computer to locate the desired software component in a format specified for the operating system and CPU of the local computer.

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

receiving a MIME request type, where the MIME request type specifies a platform; and

determining an appropriate format of the computer software component based on the specified platform.

47. A method for automatically obtaining remote computer software components, the method comprising:

embedding one or more reference tags in a file of data stored on a specific remote computer;

parsing with a program on the local computer the file of data stored on the specific remote computer;

encountering selected ones of the embedded reference tags during the parsing of the file of data on the specific remote computer; and

determining whether the one or more computer software components pointed to by the encountered reference tag are already installed on the local computer, and if not, downloading, verifying, installing, registering, and displaying one of more of the computer software components on a display device on the local computer.

48. A computer readable medium having stored therein instructions capable of causing a computer to perform the method according to claim **47**.

49. The method of claim **47** where the reference tag includes a HTML <OBJECT> tag or a HTML <EMBED> tag.

50. The method of claim **47** where the file of data includes HTML data, Visual Basic programming language data, or Java programming language data.

51. In an HTML document stored on computer-readable medium, the improvement comprising:

a reference tag including one or more universal resource locators pointing to one or more computer software components on one or more remote computers, the one or more computer software components capable of being displayed on a display device on the local computer;

where the computer software components provide functionality not available at the local computer; and

where the reference tag is capable of being used to locate, download and install the one or more computer software components on the local computer.

52. In an HTML document stored on computer-readable medium, the improvement comprising:

a reference tag including one or more universal resource locators, pointing to one or more computer software components on one or more remote computers, at least one universal resource locator pointing to a computer software component on a local computer, the one or more computer software components capable of being displayed on a display device on the local computer;

where the computer software components at the remote computers provide functionality not available at the local computer; and

where the reference tag is capable of being used to locate, download and install the one or more computer software components on the local computer.

53. A method for automatically downloading and installing computer software components from one or more computers using a HTML document being parsed on a local computer, the HTML document including one or more reference tags used to identify the computer software components, the method comprising:

encountering in the HTML document one of the reference tags;

responsive to encountering the reference tag in the HTML document, locating automatically a control file on a specific remote computer connected to the computer network using the reference tag, the control file including one or more computer software components on the specific remote computer or one or more links to one or more computer software components on one or more of the remote computers;

downloading automatically to the local computer the one or more of the computer software components included in or linked to the control file using a uniform resource locator to locate the computer software components;

installing automatically the downloaded computer software components in one or more locations on the local computer.

54. A computer readable medium having stored therein instructions capable of causing a computer to perform the method of claim **53**.

55. The method of claim **53** further comprising:

verifying automatically that the computer software components downloaded to the local computer are safe to install on the local computer; and

registering automatically the installed computer software components in a registry database on the local computer.

56. The method of claim **53** where at least one of the reference tags comprises one of the following: the HTML <OBJECT> and <EMBED> tags.

57. A method for downloading one or more software components specified in information for presenting a document to be rendered on the local computer, the method comprising:

receiving a request that the document be presented; and

responsive to the request, retrieving the information for presenting the document, where the information for presenting the document comprises one or more references to the software components, where the references include a location-independent identifier;

determining whether the software components are installed on the local computer via the location-independent identifier;

responsive to determining the software components are not installed on the local computer, automatically downloading the software components from one or more remote locations to the local computer; and

installing the software components on the local computer.

58. The method of claim **57** where

the one or more references to the software components comprise a list of one or more specified locations at which a software component to be downloaded may reside.

59. The method of claim **58** where the automatically downloading searches the specified locations for at least one of the software components.

60. The method of claim **58** further comprising:

inhibiting searching of the specified locations to avoid downloading components from the specified locations.

61. The method of claim **57** further comprising:

presenting at least one of the installed software components in a rendered presentation of the document.

62. The method of claim **57** where

the location-independent identifier comprises an object class identifier; and

the determining determines whether a component corresponding to the object class identifier is already installed on the local computer.

63. The method of claim **57** where the document is a hypertext page and the information for presenting the document comprises HTML.

64. The method of claim **57** where the document is presented during a first browsing session and at least one of the software components is downloaded to a permanent cache, the method further comprising:

during a second browsing session, reusing the software components downloaded to the permanent cache.

65. The method of claim **57** where the document is a first document, the method further comprising:

receiving a request that the second document be presented; and

responsive to the request, retrieving information for presenting the second document, where the information for presenting the second document comprises at least one reference to a software component already downloaded and installed as a result of receiving the request for the first document;

determining the already-installed software components are already installed on the local computer via the location-independent identifier; and

responsive to determining the already-installed software components are already installed on the local computer, presenting the second document with the already-installed software components.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,347,398 B1
DATED : February 12, 2002
INVENTOR(S) : Parthasarathy et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 3,
Line 45, "method and system of the present" should read -- method and system --.
Line 51, "virtualy" should read -- virtually --.

Column 5,
Lines 33 and 34, "client/operation system" should read -- client/server operating system --.

Column 6,
Line 60, "DS1" should read -- DSL --.

Column 7,
Line 57, "at specific offset" should read -- at a specific offset --.

Column 9,
Line 66, "programing" should read -- programming --.

Column 10,
Line 27, "syntax" should read -- syntax: --.
Line 47, "on computer network" should read -- on a computer network --.

Column 12,
Line 21, "szContentTYPE" should read -- szContentType --.
Line 22, "LPBINDCIX" should read -- LPBINDCTX --.
Line 39, "Path" should read -- Path. --.

Column 13,
Line 5, "IBIndStatusCallback" should read -- IBindStatusCallback --.
Line 56, "invalid, a then a" should read -- invalid, then a --.

Column 14,
Line 15, "KEY" should read -- HKEY --.
Line 64, "TAG" should read -- tag --.

Column 15,
Line 57, "skilled in art" should read -- skilled in the art --.
Line 66, "CAB" should read -- .CAB --.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,347,398 B1
DATED : February 12, 2002
INVENTOR(S) : Parthasarathy et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 16,
Line 6, "CAB" should read -- .CAB --.
Line 19, "If" should read -- /f --.
Line 63, "specified" should read -- specified --.

Column 17,
Line 43, "ActiveXTm" should read –ActiveX™ --.

Column 19,
Line 67, "implement" should read -- implements --.

Column 20,
Line 14, "ICodeInstall" should read -- ICodeInstall --.

Column 21,
Line 31, "use" should read -- use. --.

Column 23,
Line 43, "posses" should read -- possess --.
Line 61, "DLL" should read -- .DLL --.
Line 65, "CAB" should read -- .CAB --.

Column 24,
Line 66, "OCXs" should read -- .OCXs --.

Column 27,
Line 31, ""shell."" should read -- "shell"). --.

Column 28,
Line 36, "Cisid of" should read -- Clsid of --.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

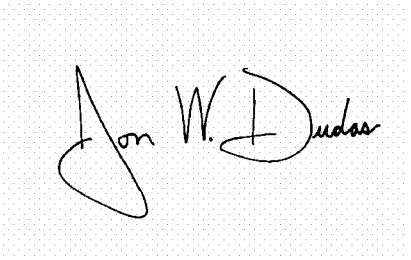
PATENT NO. : 6,347,398 B1
DATED : February 12, 2002
INVENTOR(S) : Parthasarathy et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 33,
Line 17, "an network" should read -- a network --.

Signed and Sealed this

Fifteenth Day of February, 2005



JON W. DUDAS
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,347,398 B1
DATED : February 12, 2002
INVENTOR(S) : Parthasarathy et al.

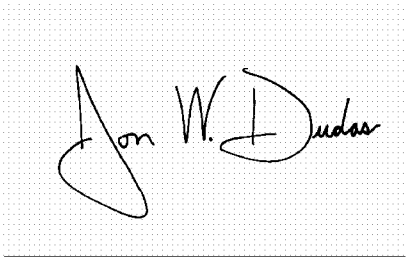
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 31,
Line 55, "one of more" should read -- one or more --.

Column 35,
Line 57, "one of more" should read -- one or more --.

Signed and Sealed this

Twenty-sixth Day of July, 2005



JON W. DUDAS
Director of the United States Patent and Trademark Office