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Wecker et al.

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(54) **CHANNEL DEFINITION ARCHITECTURE EXTENSION**

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(73) Assignee: **Microsoft Corporation**, Redmond, WA (US)

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(51) **Int. Cl.**[7] **G06F 15/16**; G06F 9/00

(52) **U.S. Cl.** **709/217**; 709/317

(58) **Field of Search** 709/216, 217, 709/218, 219, 223, 238, 317, 318, 328; 707/10

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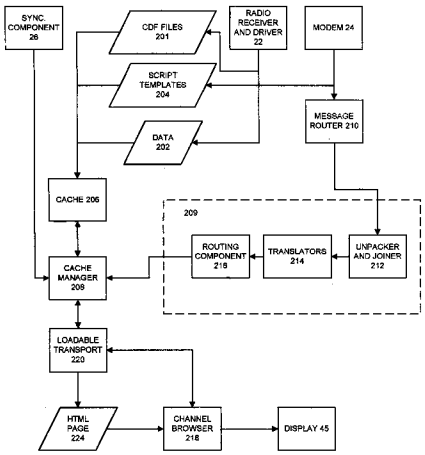
(57) **ABSTRACT**

A method for rendering information, such as, available through the Internet on a computer includes storing a content structure file, a data file and a script file. The data file includes data indicative of the information and the script file includes script information indicative of a desired form in which the data is to be rendered. The content structure file, data file and script file are independently receivable by the computer. The content structure file is read to ascertain which script in the script file is associated with data to be rendered. The data from the data file is retrieved and the associated script file is executed to render the data. Instructions can be provided on a computer readable medium to implement the method.

24 Claims, 8 Drawing Sheets



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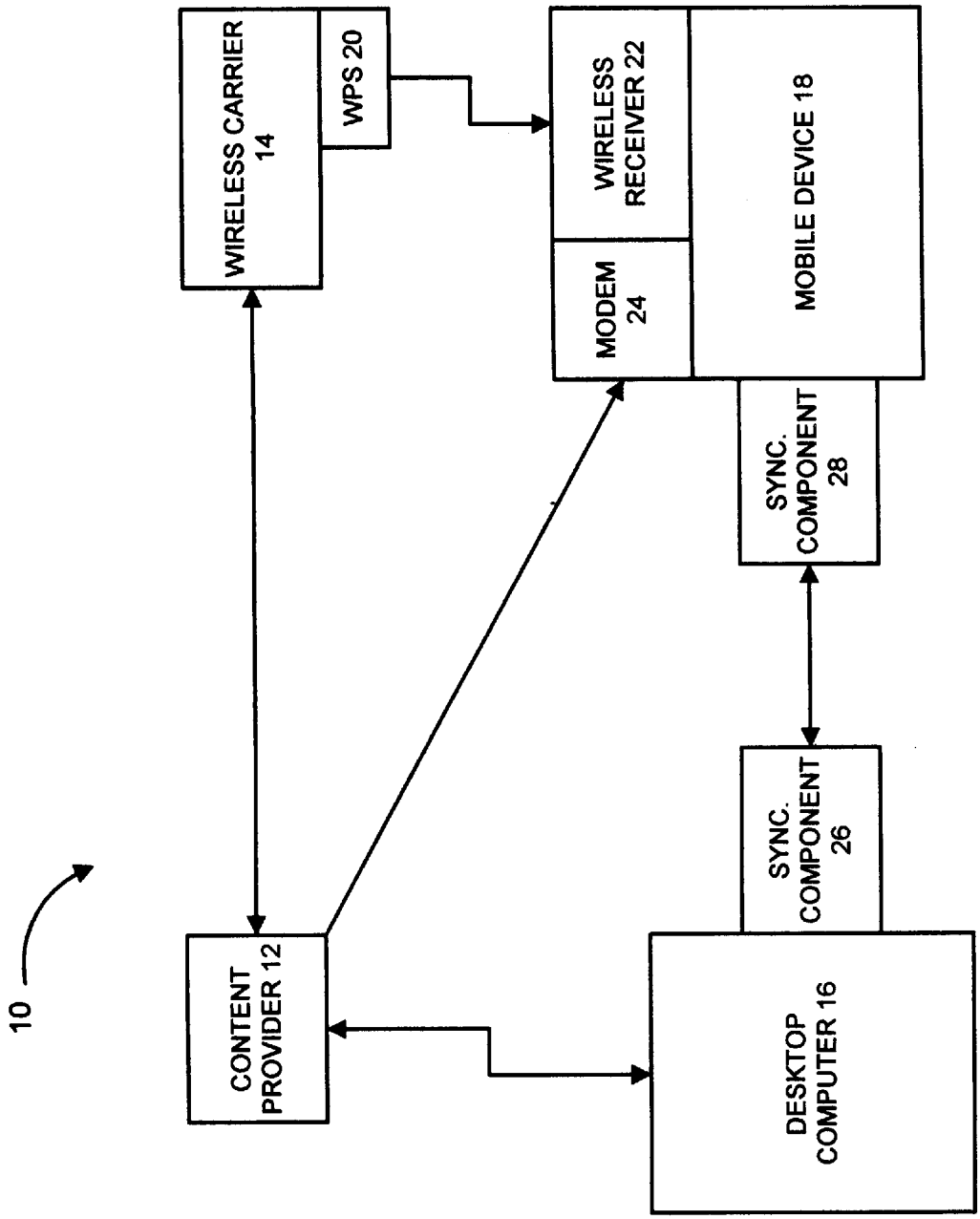
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WIRELESS CARRIER 14
WPS 20
WIRELESS RECEIVER 22
MODEM 24
MOBILE DEVICE 18
SYNC. COMPONENT 28
SYNC. COMPONENT 26
CONTENT PROVIDER 12
DESKTOP COMPUTER 16

FIG. 1

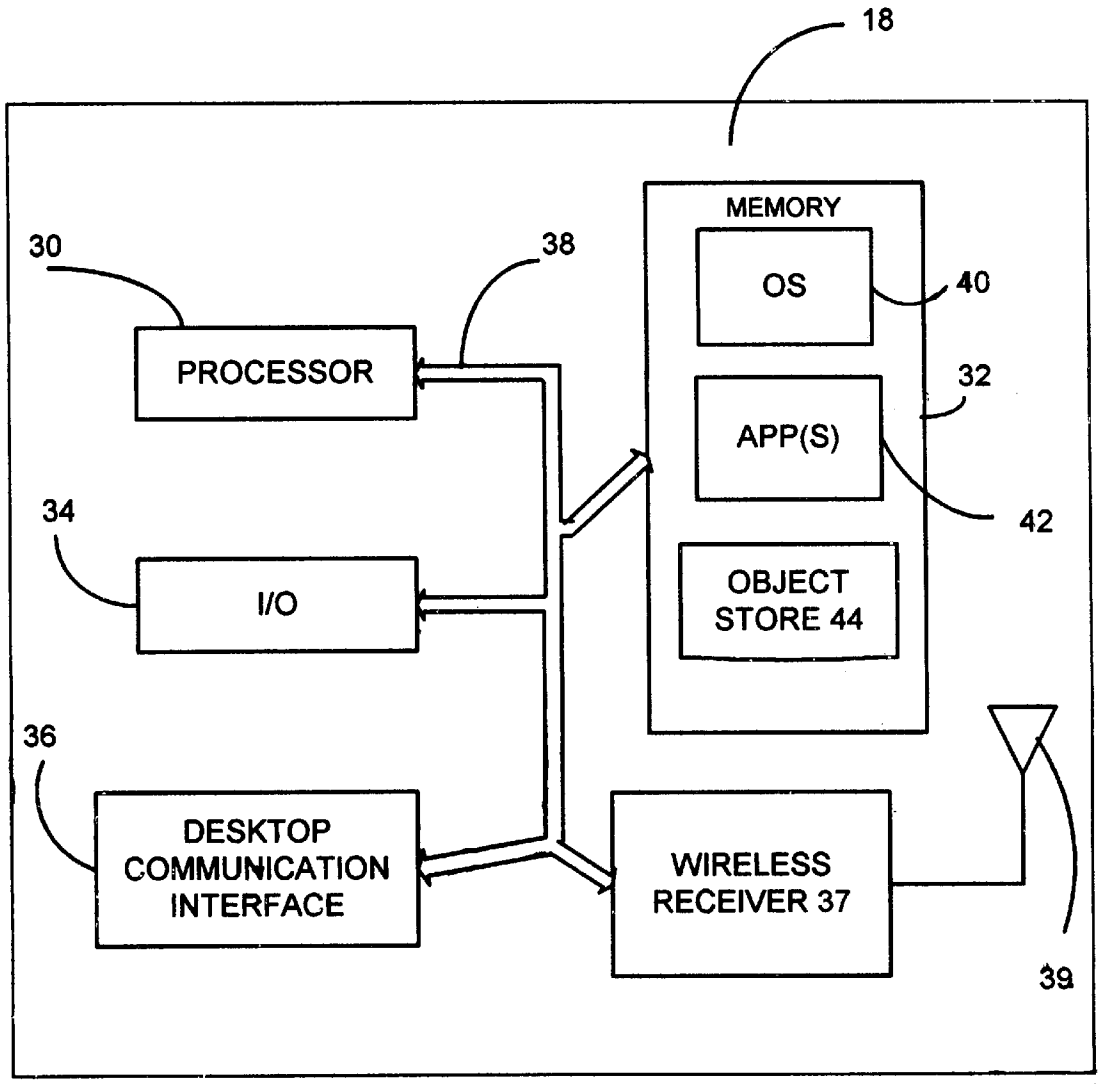

18
MEMORY
30
38
OS
40
PROCESSOR
32
APP(S)
42
34
I/O
OBJECT STORE 44
36
DESKTOP COMMUNICATION INTERFACE
WIRELESS RECEIVER 37
39

FIG.2

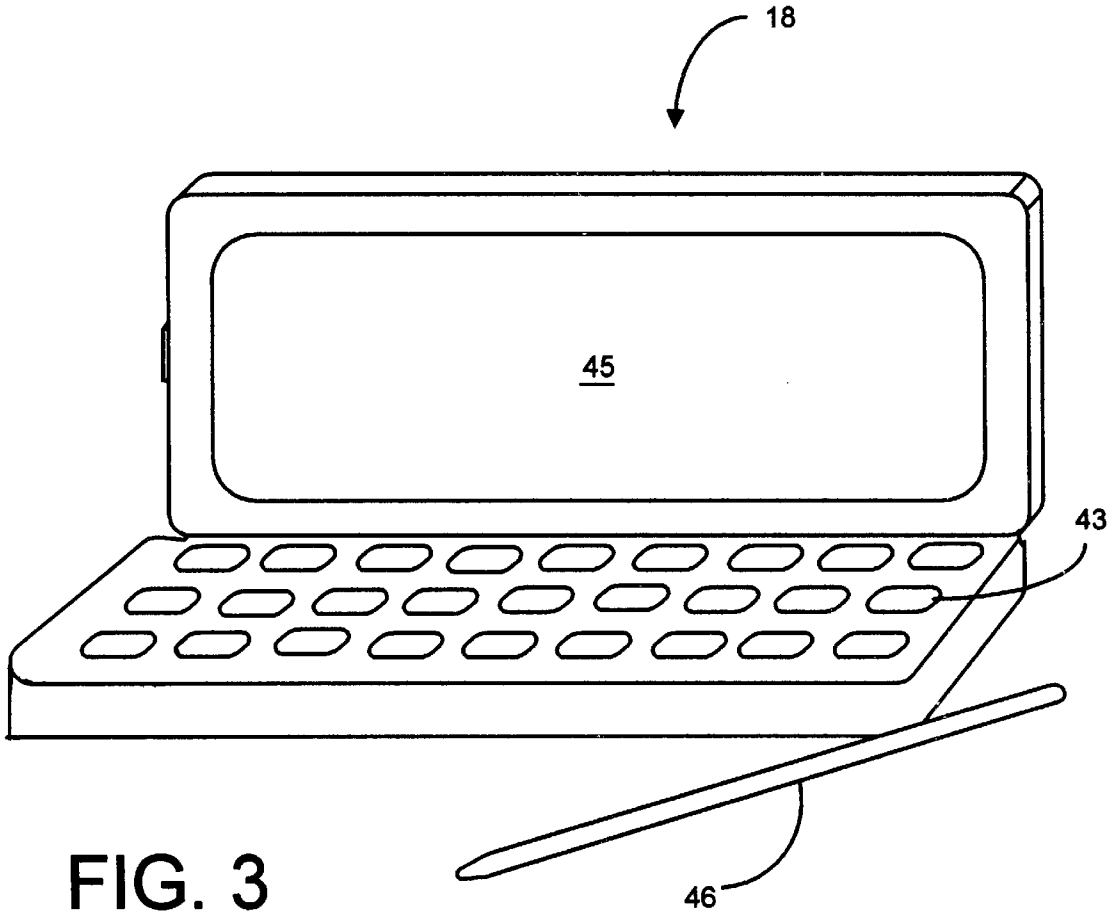


FIG. 3

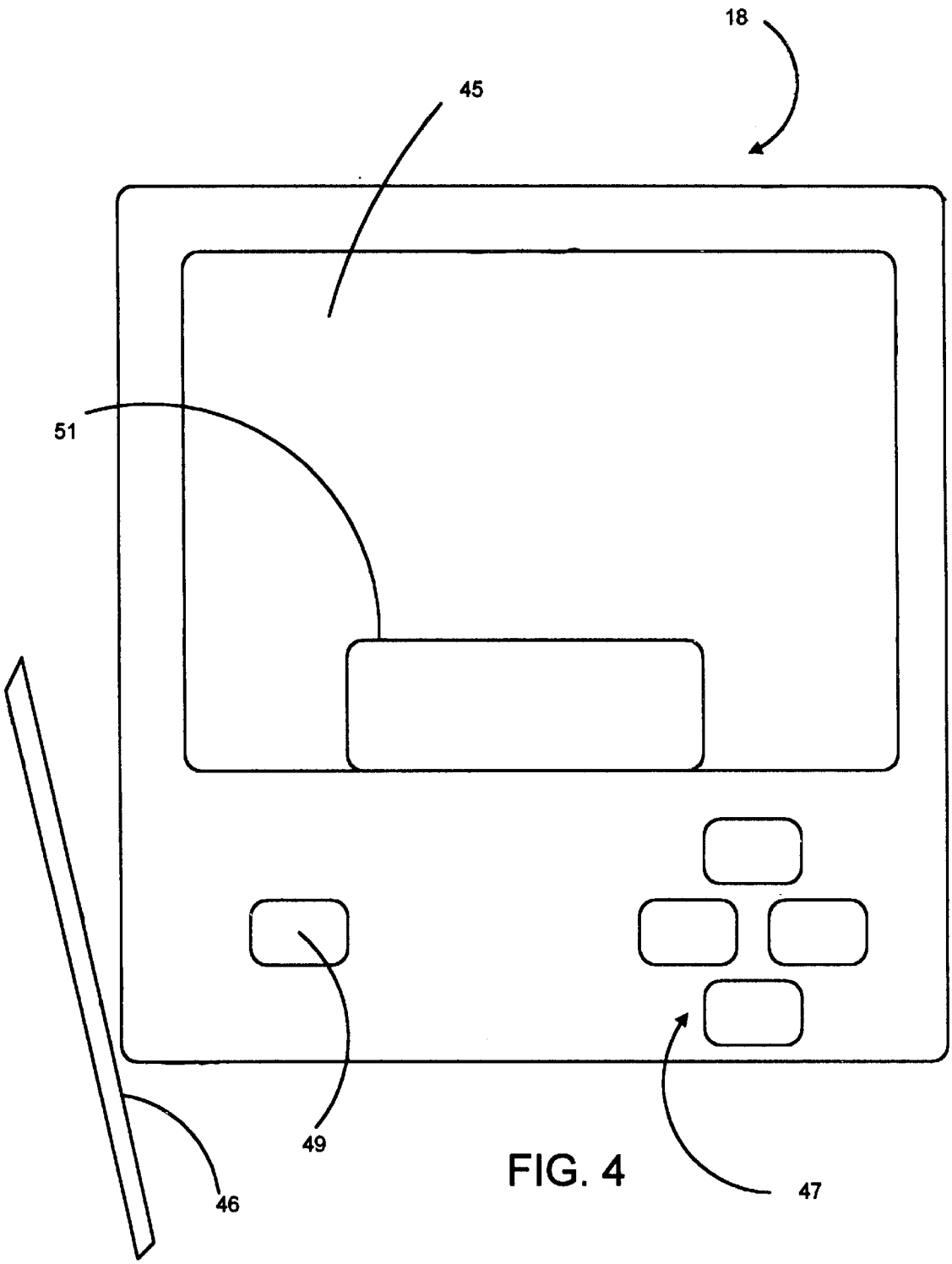
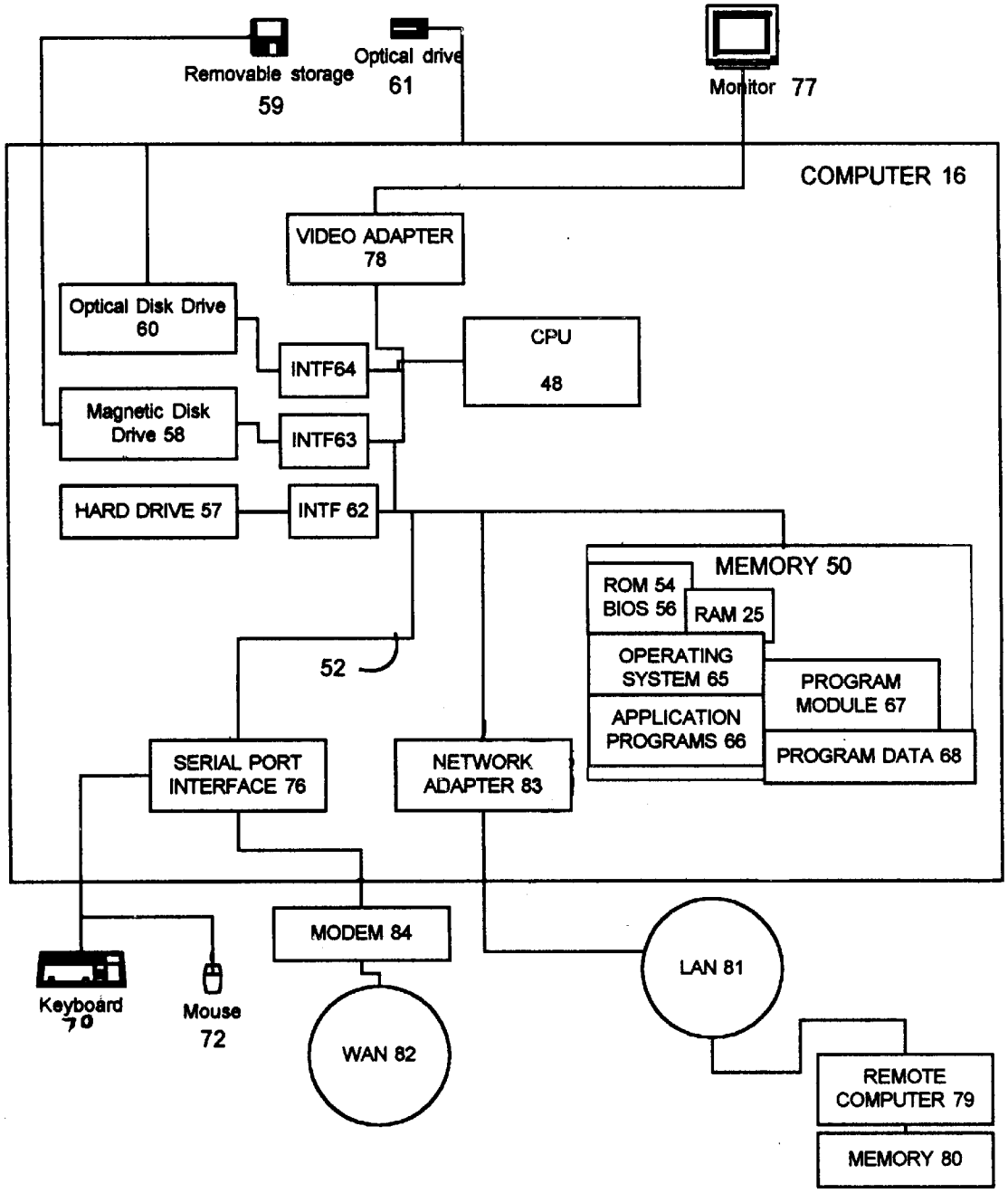


FIG. 4

FIG. 5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Optical drive
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Monitor 77
COMPUTER 16
VIDEO ADAPTER
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Optical Disk Drive
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INTF64
CPU
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Magnetic Disk
Drive 58
INTF63
HARD DRIVE 57
INTF 62
MEMORY 50
ROM 54
BIOS 56
RAM 25
OPERATING
SYSTEM 65
PROGRAM
MODULE 67
APPLICATION
PROGRAMS 66
PROGRAM DATA 68
52
SERIAL PORT
INTERFACE 76
NETWORK
ADAPTER 83
MODEM 84
LAN 81
Keyboard
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Mouse
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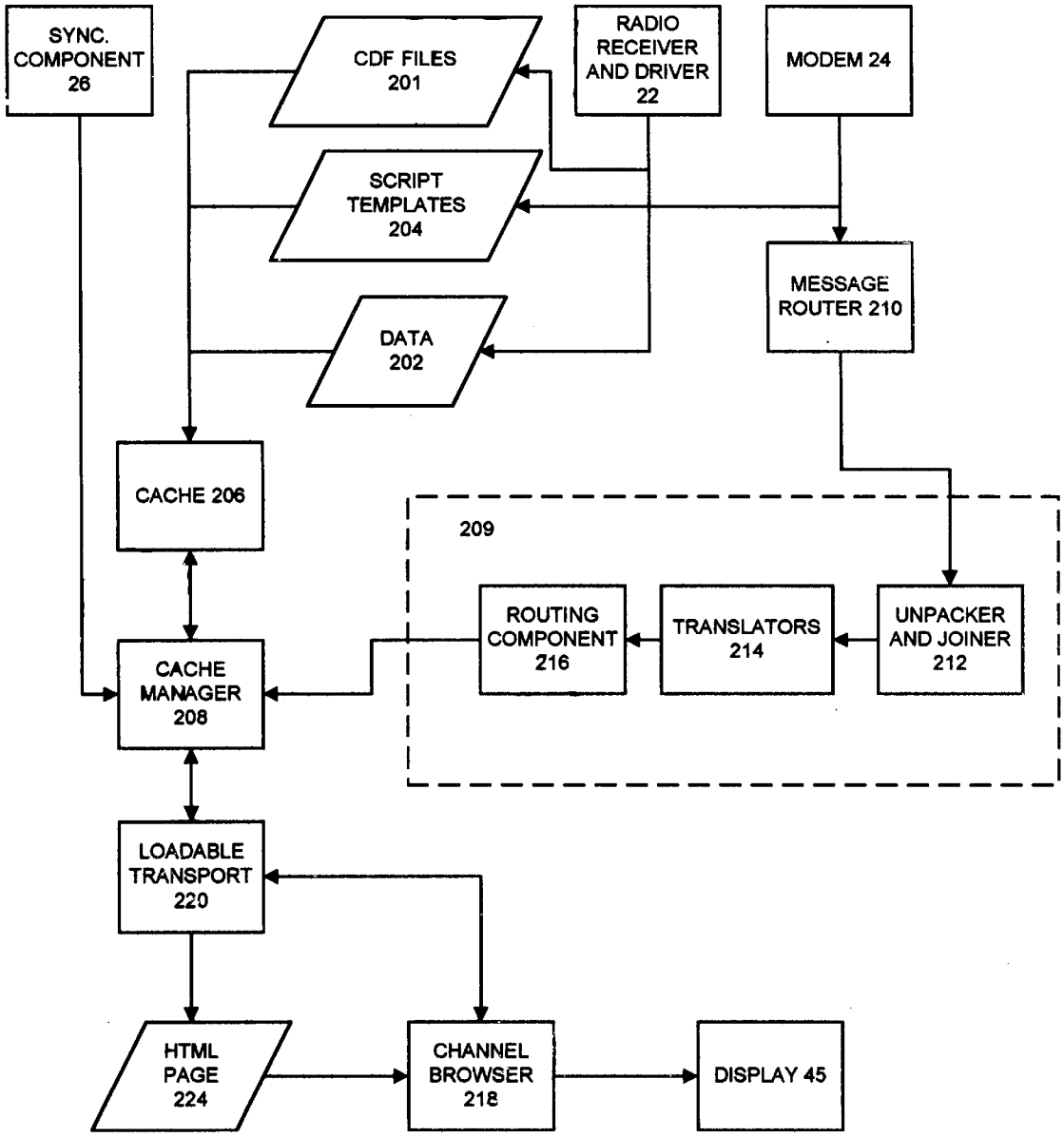
WAN 82
REMOTE
COMPUTER 79
MEMORY 80

FIG. 6


SYNC. COMPONENT 26
CDF FILES 201
RADIO RECEIVER AND DRIVER 22
MODEM 24
SCRIPT TEMPLATES 204
MESSAGE ROUTER 210
DATA 202
CACHE 206
209
ROUTING COMPONENT 216
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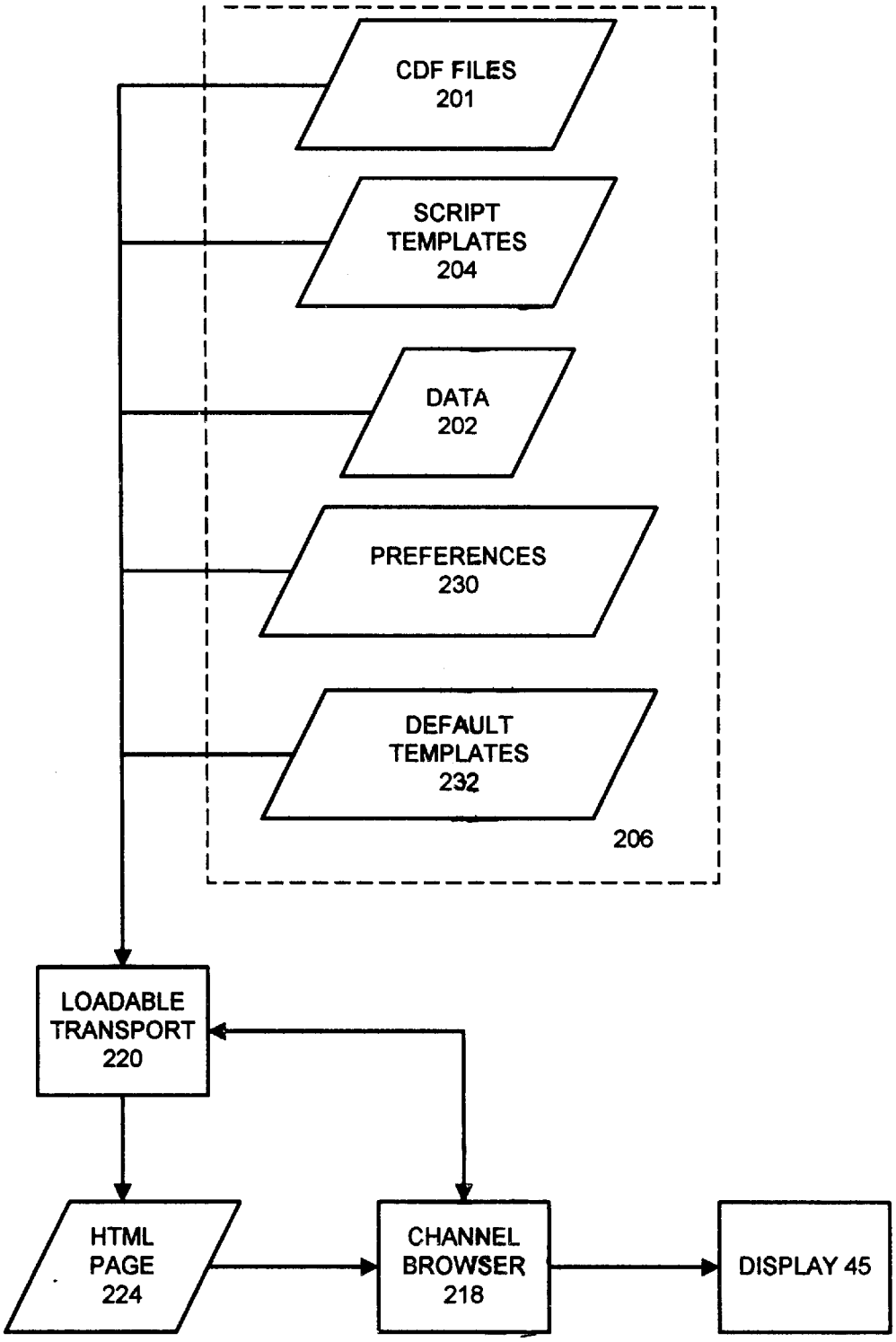
UNPACKER AND JOINER 212
CACHE MANAGER 208
LOADABLE TRANSPORT 220
HTML PAGE 224
CHANNEL BROWSER 218
DISPLAY 45

FIG. 7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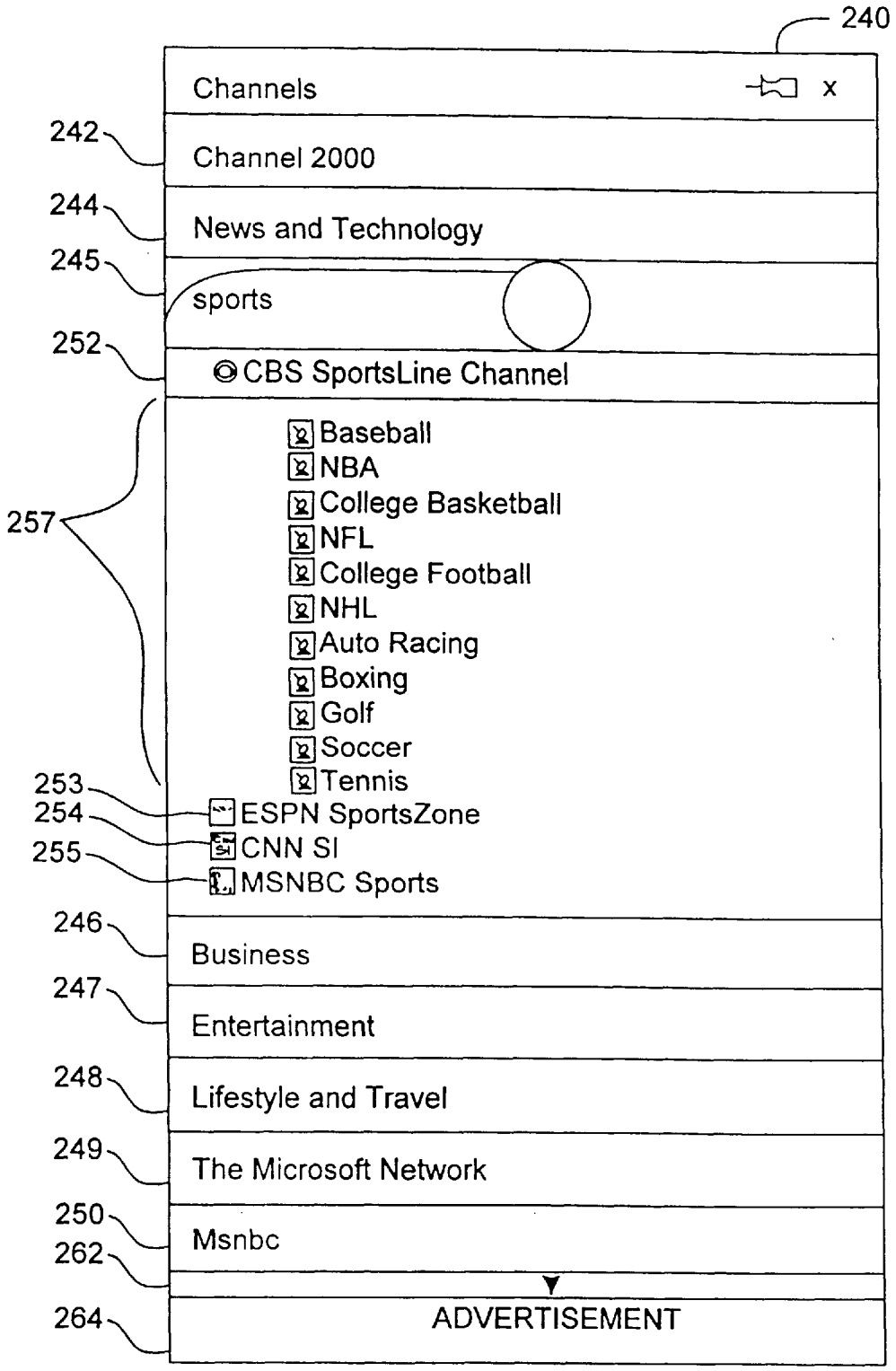
CHANNEL
BROWSER
218
DISPLAY 45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ESPN SportsZone
254
CNN SI
255
MSNBC Sports
246
Business
247
Entertainment
248
Lifestyle and Travel
249
The Microsoft Network
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Msnbc
262
264
ADVERTISEMENT

FIG. 8

CHANNEL DEFINITION ARCHITECTURE EXTENSION

CROSS-REFERENCE TO RELATED APPLICATION

The present application is based on and claims the benefit of provisional patent application, Serial No. 60/070,720 filed on Jan. 7, 1998, and provisional application Serial No. 60/075,123 filed on Feb. 13, 1998.

BACKGROUND OF THE INVENTION

The present invention relates to personal mobile computing devices commonly known as mobile devices. More particularly, the present invention relates to a system and method for delivering and receiving information on a mobile device.

Mobile devices are small electronic computing devices often referred to as personal digital assistants. Many such mobile devices are hand held devices, or palm-size devices, which comfortably fit within the hand. One commercially available mobile device is sold under the trade name Hand-Held PC (or H/PC) having software provided by Microsoft Corporation of Redmond, Wash.

Generally, the mobile device includes a processor, random access memory (RAM), and an input device such as a keyboard and a display. The keyboard can be integrated with the display, such as where the keyboard is incorporated as a touch sensitive display. A communication interface is optionally provided and is commonly used to communicate with a desktop computer. A replaceable or rechargeable battery powers the mobile device. Optionally, the mobile device can receive power from an external power source that overrides or recharges the built-in battery.

In some prior applications, the mobile device is used in conjunction with a desktop computer. For example, the user of the mobile device may also have access to, and use, a desktop computer at work or at home, or both. The user typically runs the same types of applications on both the desktop computer and on the mobile device. Thus, it is quite advantageous for the mobile device to be designed to be coupled to the desktop computer to exchange information with, and share information with, the desktop computer.

Another technique for providing information to such mobile devices is through a wireless transmission link. Such information can include electronic mail or news, weather, sports, traffic and local event information. The information is typically obtained from a desktop computer connected to the Internet and delivered over a wired connection. However, it may be desirable to deliver such information over a wireless connection as well. A wireless receiver on the mobile device can act to receive information as it is being sent to the mobile device.

There is presently no reasonable way to deliver push style content (such as hypertext mark-up language (HTML) content provided on a global network such as the internet and world wide web) to such devices in a wireless manner and in an open and available architecture. The bit rate of conventional wireless channels is very low. Thus, the delivery of very large content (such as HDML content) is highly impractical.

One conventional type of approach to delivering such information is to rewrite the content into a device friendly format, such as HTML. The content is then obtained over a pull-style model. Another approach currently being used to deliver information via a wireless medium in a closed model. In a closed model, a content provider can only provide content which is written in a format suitable for receipt by a specific device implementing a specific type of software. This means that the vast majority of web content is unavailable for viewing on such devices.

SUMMARY OF THE INVENTION

A method for rendering information, such as, available through the Internet on a computer includes storing a content structure file, a data file and a script file. The data file includes data indicative of the information and the script file includes script information indicative of a desired form in which the data is to be rendered. The content structure file, data file and script file are independently receivable by the computer. The content structure file is read to ascertain which script in the script file is associated with data to be rendered. The data from the data file is retrieved and the associated script file is executed to render the data. Instructions can be provided on a computer readable medium to implement the method.

In one preferred embodiment, the content structure file includes references to data and scripts in a hierarchy. In particular, the content structure file includes script tags associated with the scripts in the script file wherein the script tags are arranged in the hierarchy. When the content structure file is read to ascertain which script in the script file is associated with the data to be rendered, the script is chosen as a function of the hierarchy. Organization of the script tags in a hierarchy allows tag inheritance. Specifically, if there is no associated script tag for the data in the lower portion of the hierarchy, a script referenced by a script tag in a higher portion of the hierarchy will be executed to render the data. In another embodiment, if a referenced script in the content structure file cannot be found in the script file, a default script is executed in order to render the data.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagram illustrating one embodiment of a mobile device in a system in accordance with the present invention.

FIG. **2** is a more detailed block diagram of one embodiment of a mobile device shown in FIG. **1**.

FIG. **3** is a simplified pictorial illustration of one embodiment of the mobile device shown in FIG. **2**.

FIG. **4** is a simplified pictorial illustration of another embodiment of the mobile device shown in FIG. **2**.

FIG. **5** is a block diagram of one embodiment of a desktop computer in accordance with one aspect of the present invention.

FIG. **6** is a flow diagram illustrating the operation of a mobile device in accordance with one aspect of the present invention.

FIG. **7** is a simplified block diagram of FIG. **6**.

FIG. **8** is a diagrammatic illustration of a graphical user interface rendered by the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** illustrates a system **10** in which the present invention is illustratively implemented. System **10** includes content provider **12**, wireless carrier **14**, desktop computer **16** and mobile device **18**. Content provider **12** provides any suitable type of data from a database or other data source. For example, content provider **12** is discussed hereinafter as

a provider of internet world wide web content. In the preferred embodiment, the content is provided in a standard format, such as HTML, JPEG, GIF, WAV, etc. The web content is also preferably described in a content structure file also known commonly as a channel definition format (CDF) file. A single portion of content (such as a web page or a web site) is referred to herein as a mobile channel.

A mobile channel is a self describing web site that contains all the information necessary for efficient download of web content to mobile device **18**. Three components are provided in a preferable mobile channel. The components include a channel definition format (CDF) file, a set of script files to render the channel, and a set of data files to be rendered. The CDF files are described in greater detail below. Briefly, the CDF is an inventory of content contained on the mobile channel.

The script files contain script which defines templates which specify the appearance of the data on the screen of mobile device **18**. Scripts are preferably written in visual basic script (VBS).

The data files correspond to one or more script files and include data which is indicative of the substantive content of the channel to be rendered. The data is packaged in small and simple text files. All of this information is used to define web content.

Operation of system **10** using separate script and data files is described in detail in co-pending U.S. patent application, Ser. No. 09/107,666, filed on Jun. 30, 1998, entitled "SYSTEM FOR DELIVERING DATA CONTENT OVER A LOW BIT RATE TRANSMISSION CHANNEL", and hereby incorporated by reference. Briefly, however, wireless carrier **14** is configured to receive web content from the web content provider **12** via dial-up or direct internet connection, or a network connection. Wireless carrier **14** also includes a wireless push server **20**. Server **20** splits the content received from content provider **12** into pieces which are compatible with the particular type of transport being used by wireless carrier **14**. For instance, server **20** may split the data such that it conforms to maximum packet size constraints, character set requirements, etc. for the channel type or transport type being used. Prior to transmission, the data is preferably translated to a different form. Translation may include compression, encryption, encoding and then packaging.

Once the data has been split appropriately such that it conforms to the transport constraints, the data is then configured for transmission over the air through a wireless network (such as through a paging channel) to be received directly on mobile device **18**. The transmitted data is received by a wireless receiver and driver component **22** on mobile device **18** where the data is prepared for use by mobile device **18**.

Mobile device **18** can also includes a modem **24**. Thus, rather than being transmitted through wireless carrier **14**, the web content can be transmitted directly from web content provider **12** through a direct dial-up modem connection to mobile device **18**.

Desktop computer **16** will also be described in greater detail later in the specification. Briefly, however, desktop computer **16** is preferably provided with a standard web browser, such as Internet Explorer 4.0 commercially available from the Microsoft Corporation of Redmond, Wash. That being the case, the users of desktop **16** can preferably subscribe to channels in a standard fashion which provide the user with certain channel content which can be browsed off-line or on-line. Desktop computer **16** is preferably provided with a loadable transport that accesses the script files and acts on the corresponding data file (in accordance with the script) to render the content where desktop computer **16** renders the data. Desktop computer **16**, through the transport, can periodically retrieve or receive new and updated script, data and CDF files either for further transmission to mobile device **18** or simply for rendering the data. The script, data and CDF files can be transmitted either together or independently of one another. Since scripting files typically need updating much less frequently than the data files, this provides the user with the ability to view the web content on the desktop (off-line) while requiring only small amounts of bandwidth for incremental updating of the data files.

Desktop computer **16** also preferably includes synchronization component **26**. Briefly, synchronization component **26** is configured to interact with a similar synchronization component **28** on mobile device **18** such that files which are the subject of synchronization can be synchronized from desktop computer **16** to mobile device **18**, or vice versa. Once synchronized, both files (those on computer **16** and mobile device **18**) contain up to date information.

More specifically, mobile device **18**, in the preferred embodiment, can be synchronized with either desktop computer **16**, or another mobile device **18**, or both. In that instance, properties of objects stored in an object store on mobile device **18** are similar to properties of other instances of the same object stored in an object store on desktop computer **16** or another mobile device **18**. Thus, for example, when a user changes one instance of an object stored in an object store on desktop computer **16**, the second instance of that object in the object store of mobile device **18** is updated the next time mobile device **18** is connected to desktop computer **16** so that both instances of the same object contain up-to-date data. This is referred to as synchronization.

In order to accomplish synchronization, synchronization components **26** and **28** run on both mobile device **18** and desktop computer **16** (or another mobile device **18**). The synchronization components communicate with one another through well defined interfaces to manage communication and synchronization.

Mobile device **18** is also preferably provided with a script interpreter which, in one preferred embodiment, is the same as or similar to the loadable transport on desktop computer **16**. Such a transport may be, for example, a down-sized visual basic interpreter, which receives and interprets the formatting script. The script is associated with a certain data file (typically a text file) that holds the raw data for the web content. Thus, the script interpreter operates on the data associated with a given script to provide a rendering of the web content to the user of mobile device **18**.

By separating the script from the data in the web content, web content can be transmitted to mobile device **18** over very low bit rate channels. The script will only typically need to be transmitted very infrequently. Also, since an individual file is typically much smaller than the script files, the data can be updated quite frequently, giving the user of mobile device **18** updated web content information, without transmitting new script. Thus, the separation of the script and data allows the transmission of web content information in a very efficient manner over low bit rate channels.

It is worth noting that, in the preferred embodiment, while mobile device **18** can be coupled to desktop computer **16**, it can be also coupled to another mobile device **18**. This connection can be made using any suitable, and commercially available, communication link and using a suitable

communications protocol. For instance, in one preferred embodiment, mobile device **18** communicates with either desktop computer **16** or another mobile device **18** with a physical cable which communicates using a serial communications protocol. Other communication mechanisms are also contemplated by the present invention, such as infra-red (IR) communication or other suitable communication mechanisms.

FIG. **2** is a more detailed block diagram of mobile device **18**. Mobile device **18** preferably includes microprocessor **30**, memory **32**, input/output (I/O) components **34**, desktop communication interface **36** wireless receiver **37** and antenna **39**. In a preferred embodiment, these components of mobile device **10** are coupled for communication with one another over a suitable bus **38**.

Memory **32** is preferably implemented as non-volatile electronic memory such as random access memory (RAM) with a battery back-up module (not shown) such that information stored in memory **32** is not lost when the general power to mobile device **18** is shut down. A portion of memory **32** is preferably allocated as addressable memory for program execution, while another portion of memory **32** is preferably used for storage, such as to simulate storage on a disc drive.

Memory **32** includes operating system **40**, an application program **42** (such as a personal information manager or PIM) as well as an object store **44**. During operation, operating system **40** is preferably executed by processor **30** from memory **32**. Operating system **40**, in one preferred embodiment, is a Windows CE brand operating system commercially available from Microsoft Corporation. The operating system **40** is preferably designed for mobile devices, and implements database features which can be utilized by PIM **42** through a set of exposed application programming interfaces and methods. The objects in object store **44** are preferably maintained by PIM **42** and operating system **40**, at least partially in response to calls to the exposed application programming interfaces and methods.

I/O components **34**, in one preferred embodiment, are provided to facilitate input and output operations from a user of mobile device **18**. I/O components **34** are described in greater detail with respect to FIGS. **3** and **4**.

Desktop communication interface **36** is optionally provided as any suitable communication interface. Interface **36** is preferably used to communicate with desktop computer **16**, content provider **12**, wireless carrier **14** and optionally another mobile device **18**, as described with respect to FIG. **1**. Thus, communication interface **36** preferably includes synchronization components **28** for communicating with desktop computer **16** and modem **24** for communicating with content provider **12**. Wireless receiver and driver **22** are used for communicating with wireless carrier **14**.

FIG. **3** is a simplified pictorial illustration of one preferred embodiment of a mobile device **10** which can be used in accordance with the present invention. Mobile device **10**, as illustrated in FIG. **3**, can be a desktop assistant sold under the designation H/PC having software provided by the Microsoft Corporation. In one preferred embodiment, mobile device **18** includes a miniaturized keyboard **43**, display **45** and stylus **46**. In the embodiment shown in FIG. **3**, display **45** is a liquid crystal display (LCD) which uses a contact sensitive display screen in conjunction with stylus **46**. Stylus **46** is used to press or contact the display **45** at designated coordinates to accomplish certain user input functions. Miniaturized keyboard **43** is preferably implemented as a miniaturized alpha-numeric keyboard, with any suitable and desired function keys which are also provided for accomplishing certain user input functions.

FIG. **4** is another simplified pictorial illustration of the mobile device **18** in accordance with another preferred embodiment of the present invention. Mobile device **18**, as illustrated in FIG. **4**, includes some items which are similar to those described with respect to FIG. **3**, and are similarly numbered. For instance, mobile device **18**, as shown in FIG. **4**, also includes touch sensitive screen **45** which can be used, in conjunction with stylus **46**, to accomplish certain user input functions. It should be noted that the display **45** for the mobile device as shown in FIGS. **3** and **4** can be the same size as one another, or different sizes from one another, but would typically be much smaller than a conventional display used with a desktop computer. For example, displays **45** shown in FIGS. **3** and **4** may be defined by a matrix of only 240×320 coordinates, or 160×160 coordinates, or any other suitable size.

The mobile device **18** shown in FIG. **4** also includes a number of user input keys or buttons (such as scroll buttons **47**) which allow the user to scroll through menu options or other display options which are displayed on display **45**, or which allow the user to change applications, without contacting display **45**. In addition, the mobile device **18** also shown in FIG. **4** also preferably includes a power button **49** which can be used to turn on and off the general power to the mobile device **18**.

It should also be noted that, in the embodiment illustrated in FIG. **4**, mobile device **18** includes a hand writing area **51**. Hand writing area **51** can be used in conjunction with stylus **46** such that the user can write messages which are stored in memory **42** for later use by the mobile device **18**. In one illustrative embodiment, the hand written messages are simply stored in hand written form and can be recalled by the user and displayed on the display screen **45** such that the user can review the hand written messages entered into the mobile device **18**. In another preferred embodiment, mobile device **18** is provided with a character recognition module such that the user can enter alpha-numeric information into mobile device **18** by writing that alpha-numeric information on area **51** with stylus **46**. In that instance, character recognition module in the mobile device **18** recognizes the alpha-numeric characters and converts the characters into computer recognizable alpha-numeric characters which can be used by the application programs **42** in mobile device **18**.

FIG. **5** and the related discussion are intended to provide a brief, general description of a suitable desktop computer **16** in which portions of the invention may be implemented. Although not required, the invention will be described, at least in part, in the general context of computer-executable instructions, such as program modules, being executed by a personal computer **16** or mobile device **18**. Generally, program modules include routine programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types. Moreover, those skilled in the art will appreciate that desktop computer **16** may be implemented with other computer system configurations, including multiprocessor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, and the like. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

With reference to FIG. **5**, an exemplary system for implementing desktop computer **16** includes a general purpose

computing device in the form of a conventional personal computer **16**, including processing unit **48**, a system memory **50**, and a system bus **52** that couples various system components including the system memory **50** to the processing unit **48**. The system bus **52** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. The system memory **50** includes read only memory (ROM) **54** a random access memory (RAM) **55**. A basic input/output system (BIOS) **56**, containing the basic routine that helps to transfer information between elements within the desktop computer **16**, such as during start-up, is stored in ROM **54**. The desktop computer **16** further includes a hard disk drive **57** for reading from and writing to a hard disk (not shown) a magnetic disk drive **58** for reading from or writing to removable magnetic disk **59**, and an optical disk drive **60** for reading from or writing to a removable optical disk **61** such as a CD ROM or other optical media. The hard disk drive **57**, magnetic disk drive **58**, and optical disk drive **60** are connected to the system bus **52** by a hard disk drive interface **62**, magnetic disk drive interface **63**, and an optical drive interface **64**, respectively. The drives and the associated computer-readable media provide nonvolatile storage of computer readable instructions, data structures, program modules and other data for the desktop computer **16**.

Although the exemplary environment described herein employs a hard disk, a removable magnetic disk **59** and a removable optical disk **61**, it should be appreciated by those skilled in the art that other types of computer readable media which can store data that is accessible by a computer, such as magnetic cassettes, flash memory cards, digital video disks (DVDs), Bernoulli cartridges, random access memories (RAMs), read only memory (ROM), and the like, may also be used in the exemplary operating environment.

A number of program modules may be stored on the hard disk, magnetic disk **59**, optical disk **61**, ROM **54** or RAM **55**, including an operating system **65**, one or more application programs **66** (which may include PIMs), other program modules **67** (which may include synchronization component **26**), and program data **68**. A user may enter commands and information into the desktop computer **16** through input devices such as a keyboard **70**, pointing device **72** and microphone **74**. Other input devices (not shown) may include a joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit **48** through a serial port interface **76** that is coupled to the system bus **52**, but may be connected by other interfaces, such as a sound card, a parallel port, game port or a universal serial bus (USB). A monitor **77** or other type of display device is also connected to the system bus **52** via an interface, such as a video adapter **78**. In addition to the monitor **77**, desktop computers may typically include other peripheral output devices such as speaker **75** and printers.

The desktop computer **16** may operate in a networked environment using logic connections to one or more remote computers (other than mobile device **18**), such as a remote computer **79**. The remote computer **79** may be another personal computer, a server, a router, a network PC, a peer device or other network node, and typically includes many or all of the elements described above relative to desktop computer **16**, although only a memory storage device **80** has been illustrated in FIG. **4**. The logic connections depicted in FIG. **4** include a local area network (LAN) **81** and a wide area network (WAN) **82**. Such networking environments are commonplace in offices, enterprise-wide computer network intranets and the Internet.

When used in a LAN networking environment, the desktop computer **16** is connected to the local area network **81** through a network interface or adapter **83**. When used in a WAN networking environment, the desktop computer **16** typically includes a modem **84** or other means for establishing communications over the wide area network **82**, such as the Internet. The modem **84**, which may be internal or external, is connected to the system bus **52** via the serial port interface **76**. In a network environment, program modules depicted relative to desktop computer **16**, or portions thereof, may be stored in the remote memory storage devices. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

Desktop computer **16** runs operating system **65** that is typically stored in non-volatile memory **54** and executes on the processor **48**. One suitable operating system is a Windows brand operating system sold by Microsoft Corporation, such as Windows 95 or Windows NT, operating systems, other derivative versions of Windows brand operating systems, or another suitable operating system. Other suitable operating systems include systems such as the Macintosh OS sold from Apple Corporation, and the OS/2 Presentation Manager sold by International Business Machines (IBM) of Armonk, N.Y. Application programs are preferably stored in program module **67**, in volatile memory or non-volatile memory, or can be loaded into any of the components shown in FIG. **5** from a floppy diskette **59**, CDROM drive **61**, downloaded from a network via network adapter **83**, or loaded using another suitable mechanism.

FIG. **6** is a block diagram illustrating the functional architecture of mobile device **18**. FIG. **6** shows similar items to those previously shown in the specification. Similar items are similarly numbered. FIG. **6** illustrates that mobile device **18** receives web content information either via synchronization component **26**, wireless receiver (radio receiver and driver) **22** or modem **24**. In any of those cases, CDF files **201** as well as script templates and data files, indicated by blocks **204** and **202** are eventually provided to cache memory **206**. Where the web content information is received through synchronization component **26**, the CDF files **201**, script templates **204** and data files **202** may not be encrypted or encoded or otherwise formatted in the same fashion as they are for transmission over a wireless or modem channel. Therefore, the CDF files **201**, script templates **204** and data files **202** are provided directly to cache manager **208**. Cache manager **208** receives the CDF files **201**, script templates **204** and data files **202**, and provides them to cache memory **206**. Cache manager **208** includes memory manipulation and timing components as well as data transfer components, which are suitable for transferring the CDF files **201**, script templates **204** and data files **202** to a particular location in cache memory **206**, and to track that location.

If, on the other hand, the web content is received over wireless receiver and driver **22** or modem **24**, additional processing steps must be undertaken prior to caching the data. Wireless receiver and driver **22** is a physical layer that receives and filters messages and generates wake-up events to mobile device **18**. In one preferred embodiment, the information transmitted is first translated (such as compressed, encrypted, encoded and packaged) before transmission. Thus, the data must be translated back to its original form prior to further use by mobile device **18**. Therefore, the data is first provided to message router **210**. Message router **210** acts to record the message and route the received message to a translation layer **209**. In FIG. **6**, translation layer **209** includes unpackager and joiner com-

ponent **212**, a group of additional translators collectively labeled **214** and a further routing component **216**.

Unpackager and joiner block **212** acts to receive, unpack and order a group of packets being transmitted. The unpackager rejoins packets of any long messages which were split up by wireless carrier **14**. The ordered data is provided to translation components **214**.

Translation components **214** act to reformat or translate the data into appropriate form to be handled by content handler **216**. For example, once the packets which comprise a message have been unpacked and rejoined by unpacker and joiner **212**, translation components **214** may typically decompress, decrypt and decode those packets.

Content handler **216** delivers the unpacked, joined and translated message to the appropriate registered destination (i.e., to the appropriate application or other functional block) on mobile device **18**. In the embodiment illustrated in FIG. **5**, content handler **216** provides the information to cache manager **208** which stores it in cache **206**.

When the user wishes to off-line browse the web content stored in cache **206**, the user launches an appropriate application program indicated by channel browser block **218** in FIG. **5**. Channel browser **218** preferably generates suitable user interfaces on display **45** which provide the user with the ability to choose a certain channel to be viewed.

Channel browser **218** is configured to interact with a loadable transport **220** which is, in turn, coupled to cache manager **208**. In response to the user requesting to view information provided via the chosen channel, loadable transport **220** requests cache manager **208** to retrieve the corresponding web content information (in the form of script templates and data files) from cache **206**. The desired script templates **204** and data files **202** are provided from cache manager **208** to loadable transport **220**.

The script interpreter in transport **220** is preferably a visual basic script interpreter which interprets script templates **204** and acts on data files **202** as a function also of the CDF file **201** to provide a desired rendering of the web content. In the embodiment illustrated in FIG. **5**, the web content is rendered as a conventional hypertext mark-up language (HTML) page **224**. Loadable transport **220** then provides the HTML page **224** rendering to channel browser **218** for viewing by the user of mobile device **18** on display **45**.

The system **10** allows logging of desired information for use by content provider **12**. In other words, by providing an entry in the CDF file **201**, the content providers can tag certain items which they want to track (i.e., they can tag certain items for which they would like to know when, and for how long, those items were viewed by any given user).

For example, when the user launches channel browser **218**, and requests information from loadable transport **220**, loadable transport **220** determines whether the requested information includes the appropriate CDF tag indicating that the content provider wishes to log information regarding the time and duration which the information was viewed. If so, loadable transport **220** logs information which is representative of the time and duration that the information was viewed by the user. This information is stored in cache **206** in a location which corresponds to that particular web content information.

The next time mobile device **18** is synchronized with desktop computer **16**, not only is mobile device **18** updated with the current web content received by desktop computer **16**, but desktop computer **16** is updated with the current logging information maintained by mobile device **18**. Similarly, the next time the browser on desktop computer **16** accesses the appropriate web content from content provider **12**, the logging information is transmitted from desktop computer **16** to content provider **12**. In one preferred embodiment, since the browser on desktop computer **16** is Internet Explorer 4.0, logging information which has been synchronized to desktop computer **16** is transmitted to content provider **12** when the scheduler of Internet Explorer 4.0 is next invoked on desktop computer **16**.

FIG. **7** is a simplified block diagram of a portion of FIG. **6** focusing on those components used to access data stored on the mobile device **18** for display to the user through the display **45**. In FIG. **7**, the CDF files **201**, data **202**, script templates **204** and preferences **230**, discussed below, are shown as part of cache **206**.

One aspect of the present invention includes use of the CDF files **201** for construction of HTML pages **224**. In particular, HTML pages **224** combine the script templates **204** and data **202** using structural information contained in the CDF files **201**. For example, a particular script template **204** determines what subchannel of a CDF file **201** is being displayed and obtains the title and logo for that subchannel from the CDF file **201**, incorporating them into the HTML page **224**. In addition, particular data items such as an article or picture and/or additional subchannels within the subchannel can be obtained from the CDF file **201** to present an index to the subchannel being displayed. Typically, since items will change frequently as new data is obtained, item titles for the HTML page **224** can be obtained directly from the data stored in the data **202**. Although this method of blending script templates **204**, data **202** and CDF files **201** is more complex than conventional systems and methods where full HTML pages are transferred from a server to a client, this method is beneficial. In particular, the present system and method is able to deliver content in small segments of data instead of full HTML pages. This incremental approach makes it efficient and economical to update time-critical information, such as stock market values during peak network hours. The system and method also allows the use of default script templates **232** stored in the cache **206**. The default script templates **232** can be used to render channel content (i.e. subchannels and data) if a particular script template is missing.

CDF is a standard for creating "channels" for use with browsers such as Internet Explorer 4.0. The CDF standard is based on the Extensible Markup Language (XML). One aspect of the present invention includes additional tags to extend CDF for improved use on mobile devices. Specifically, the additional tags are used to navigate through the CDF files **201** when content is to be displayed on the display **45** in order to reduce the necessary storage space on the mobile device **18**. Table 1 below is an example of a CDF file in accordance with the present invention.

TABLE 1

```
—       <!-Declare item scripts -->
        <ITEM HREF="Http://www.microsoft.com/test/script1.mcs", ID="IS1">
            <USAGE VALUE="None"/>
K       </ITEM>
        <ITEM HREF="Http://www.microsoft.com/test/script2.mcs", ID="IS2">
            <USAGE VALUE="None"/>
        </ITEM>
—       < -- Declare channel scripts -->
        <ITEM HREF="Http://www.microsoft.com/test/script3.mcs" ID="CS1">
            <USAGE VALUE="None"/>
J       </ITEM>
        <ITEM HREF="Http://www.microsoft.com/test/script4.mcs" ID="CS2">
            <USAGE VALUE="None"/>
—       </ITEM>
    A   <CHANNEL HREF = "mctp://www.microsoft.com/test/test.cdf", ID="test"
    C   BASE = "http://www.microsoft.com/test/
    B   SELF = "http://www.microsoft.com/test.cdf/>
            <TITLE VALUE = "Test Channel" />
            <!-IS1 is the general item script to use within the channel -->
            <ITEMSCRIPT VALUE-"IS1"/>
            <!-CS1 is the general channel script to use within the channel -->
            <CHANSCRIPT VALUE = "CS1"/>
    E       <ITEM HREF = "Http://www.microsoft.com/test/AD1.mad" ID="AD1">
                <USAGE VALUE = "MobileAd"/>
            <ITEM>
            <ITEM HREF = "Http://www.microsoft.com/test/AD2.mad" ID-"AD2">
                <USAGE VALUE = "MobileAd"/>
            <ITEM>
    G       <CHANNEL ID = "C1" DEFAULTPREF = "ON">
                <TITLE VALUE = "Test Subchannel 1" />
                -This subchannel is also rendered by the general channel script
                CS1 -->
                <ITEM HREF="http://www.microsoft.com/test/item-a.mcd" ID="ITA">
                <!This item is rendered by the item-specific IS2 script -->
                    <ITEMSCRIPT VALUE="IS2"/>
                    <USAGE VALUE="MOBILECHANNEL"/>
                </ITEM>
                . . . . . .
            </CHANNEL>
    H       <CHANNEL ID = "C2" DEFAULTPREF = "OFF">
                <TITLE VALUE = "Test Subchannel 2" />
                -This subchannel is rendered by the channel-specific script CS2
        -->
                    <CHANSCRIPT VALUE = "CS2" />
                    <ITEM HREF="http://www.microsoft.com/test/item-b.mcd"
                    ID="ITB">
                    <!-This item is also rendered by the general IS1 item
                    script -->
                    <USAGE VALUE="MOBILECHANNEL"/>
            </ITEM>
        </CHANNEL>
        </CHANNEL>
```

Referring to Table 1, the path of the CDF is present in two attributes of the top-level "CHANNEL" tag that is standard in CDF files. In particular, the "HREF" attribute, indicated at "A" references the CDF path using the transport protocol of the loadable transport **220** (FIG. **6**), for example, a Mobile Channels Transport Protocol (MCTP) can be used. The HREF attribute uses the MCTP prefix to indicate the CDF file is for a mobile device **18**. If the CDF file is present on the desktop computer **16** (FIG. **1**) rather than on the mobile device **18**, the MCTP prefix can invoke special processing when referenced by the browser used on the desktop computer **16**. Unlike the HREF attribute as used by browsers such as Internet Explorer 4.0 on the desktop computer **16**, the URL does not directly indicate the page to render. Rather, the attribute references the top-level channel as specified by the CDF file.

The "SELF" attribute "B" references the CDF path using the standard HTTP prefix. Unlike standard implementation of the CDF on the desktop computer **16**, the SELF attribute is preferably used with the top-level CHANNEL tag.

The "BASE" attribute "C" has the same functionality in the CDF file of the present invention as it does for use in a browser on the desktop computer **16**. Its URL is an HTTP URL. In the example illustrated, the HREF attribute "A" for the top-level CHANNEL tag is the only one that has a transport protocol-style URL. All other HREF attribute values are of the HTTP-style

Several attributes and attribute values that may appear in the CDF files **201** according to the present invention appear in standard CDF tags. The tags are described in the following table.

TABLE 2

ID	A short string identifier for the CHANNEL, ITEM, and LOGO elements.
DEFAULTPREF	A Boolean operator indicating the suggested preference setting for a CHANNEL element. Values include "On" or "Off".
USAGE	New usage values "MobileChannel", "MobileDesktopComputer" and "MobileAD".

TABLE 2-continued

CHANNEL	CHANNEL element may take a USAGE tag specifying either the "MobileChannel or "MobileDesktop Computer" USAGE values defined above. It is required for the top-level CHANNEL element of a Mobile Desktop Component.

Each tag or attribute is discussed in detail below:

"ID"

An ID tag is a text string used as an attribute to identify the specified element. An ID tag must be provided for all CHANNEL, ITEM, and LOGO elements in a mobile channel.

ID = "ChanId"

ID = "ItemId"

I D= "LogoId"

An ID tag is used for short and quick references both within the CDF file **201** and within the script templates **204**. Within the CDF file **201**, the ID tag is used as a value for both CHANSCRIPT and ITEMSCRIPT, discussed below, tags to refer to the associated ITEM tag that represents the script template **204**.

Within the script template **204**, the ID tag is used, along with the MCTP discussed below, to form unique URLs. The ID tag is used by the loadable transport **220** to uniquely reference a channel or item. MCTP references are of the form

" mctp://Cdfid/ChanID" for a channel or

" mctp://CDFid/ItemID" for an item.

In one embodiment, the string length of an ID tag is kept to the minimum necessary to uniquely define it within the CDF over time. Keeping the ID string length short is important in order to conserve network bandwidth and storage space.

In the CDF file **201**, the ID tag of the top-level channel is used as a handle to the channel. In one embodiment, the maximum length of the ID string is **64** characters, but a handle of between 6 and 10 characters is recommended for the top-level ID to be unique. The following are three code examples.

<CHANNEL ID	= " Sports" >
<ITEM HREF	= " www.microsoft.com/test/sports/article001.mcd"
ID	= " Art1" >
<LOGO HREF	= " www.microsoft.com/test/sports/sportslogo.gif"
STYLE	= " IMAGE"
ID	= " L_Sports"

The ID tag is preferred for each parent element and can be of a single occurrence.

"USAGE"

For the USAGE tag, three new values are provided:

(1) MobileChannel

The statement,

<USAGE Value = "MobileChannel" /> specifies the channel as a channel or a data item as for use with the mobile device **18**. The top-level channel should be given a USAGE value of "MobileChannel". When the USAGE value is set to "MobileChannel", items will be recognized by the channel browser **218** and displayed on the display **45** of the mobile device **18** but not recognized by a channel browser on the desktop computer **16**. This feature makes it possible to properly display special data items (having the file extension ".mcd") on the mobile device **18** and to ignore them when the CDF **201** is used with the desktop computer **16**. For example,

<ITEM HREF=" http//www.microsoft.com/test1.mcd" ID=" T1"

<USAGE VALUE ="MobileChannel/>

</ITEM>

<ITEM HREF=" http//www.microsoft.com/test2. mcd" ID=" T2"

<USAGE VALUE ="None/>

</ITEM>

Item T1 above is a data item for the mobile device **18** and will be recognized by the channel browser **218**, but not by the channel browser on the desktop computer **16**. Item T2 is a script and will not be recognized by the channel browsers for the mobile device **18** or the desktop computer **16** since the value equals "None"

(2) MobileDesktopComponent

The statement

<USAGE VALUE ="MobileDesktopComponent"/>

specifies the channel as a component viewable on the display **45** in conjunction with other applications such as personal information managers, for example, schedulers and electronic mail applications.

(3) MobileAd

The statement

<Usage value = "MobileAd"/>

specifies an item as an advertisement viewable on the display **45**. For the following example:

<ITEM HREF = http://www.microsoft.com/AD**1**.mad" >

<USAGE VALUE = "MobileAd">

</ITEM>

"AD**1**.mad" specifies the advertising to be displayed according to the script templates **204**, discussed below. In the example of Table 1, two advertisements are defined in the top-level channel at "E". When the top-level channel is displayed on the display **45** according to the script template **204**, one or both of the advertisements can also be displayed. In an alternative embodiment, the script template **204** can alternate display of the advertisements if more than one is present. In the example of Table 1, the advertisements are defined with respect to the top-level channel; however, a feature of the present invention allows the advertisements also to be displayed when the subchannels "C1" or "C2" are also displayed without having to repeat the syntax for the advertisements in the subchannel definition. As used herein, this feature is called "inheritance". If desired, new advertisements can be defined in the subchannels.

DEFAULTPREF

The DEFAULTPREF tag can be used as follows:

<CHANNEL

ID = "ChanId"

DEFAULTPREF = "ON" | " OFF"

In the example of Table 1, the DEFAULTPREF tags are used at "G" and "H".

The DEFAULTPREF tag marks a subchannel with specific default preferences. In other words, the DEFAULTPREF tag controls which subchannels a user will receive content for by default. By default, when content for a new channel is provided to the mobile device **18** items within subchannels that are marked with the attribute DEFAULTPREF = "OFF" are not transferred.

The feature allows the content provider **12** to create a channel that offers more content than can reasonably be accommodated by the limited storage resources available on the mobile device **18**, and yet does not, by default, over-

whelm the mobile device **18** with all of the channel's content. In one embodiment, the DEFAULTPREF tags are examined are stored at **230** when the channel is first provided to the mobile device **18**. The user can change and store his or her preferences **230**, as desired, to include more or less content than the DEFAULTPREF settings allow.

The DEFAULTPREF tag can have values of either "ON" or "OFF". If DEFAULTPREF attribute is not specified, the mobile device **18** treats the subchannel as if it were marked with DEFAULTPREF="ON". The DEFAULTPREF tag can appear only once in a CHANNEL element.

In addition to the tags described above, which are present in CDF files of prior art, but now include new attributes, the CDF files **201** also include new tags for use with the script templates **204** and data **202**. The new tags are described in the following table.

TABLE 3

Tag	Description
CHANSCRIPT	Identifies the ID of the script file to render the channel and subchannels.
ITEMSCRIPT	Identifies the ID of the script file to render the item data file.
ITEMFORMAT	Defines the file structure for data files.

Each tag is discussed in detail below:

CHANSCRIPT

The CHANSCRIPT tag is generally of the form:

<CHANSRIPT VALUE = "ChannelID"/>

where "ChannelID" specifies the URL. In the example of Table 1, the script for display of a channel or a subchannel is denoted with a ".mcs" extension as indicated at "J". In one embodiment, "tag inheritance" is provided where the CHANSCRIPT tag value will apply to all channels or "child" channels of the current channel or subchannel. The subchannel CHANSCRIPT tag will supersede any CHANSCRIPT value previously defined by a higher or "parent" CHANNEL element. The VALUE attribute specifies the ID of the ITEM element corresponding to the script to be run to render this level of the channel. For example, in Table 1,

<CHANSCRIPT VALUE=CS1"/>

specifies use of a particular script template where the channel script identified by "CS1" has been defined in the beginning portion of the CDF file.

The top-level CHANNEL element can have at least one CHANSCRIPT tag as the child element. Each subchannel can have at most one such tag.

ITEMSCRIPT

The ITEMSCRIPT tag is generally of the form:

<ITEMSCRIPT VALUE = "ItemID"/>

where "ItemID" specifies the URL. In the example of Table 1, the script for display of an item is denoted with a ".mcs" extension as indicated at "K". In one embodiment, "tag inheritance" is provided where the ITEMSCRIPT tag value applies to all child items of the current channel or subchannel. Subchannel ITEMSCRIPT tag supersedes any ITEMSCRIPT value previously defined by a parent CHANNEL element. The VALUE attribute specifies the ID of the ITEM element corresponding to the script to run to render this level of the channel. For example, in Table 1,

<ITEMSCRIPT VALUE = "IS1" />

specifies a particular script template where the script identified by "IS1" was previously defined in the CDF. It should be noted that when the following statement:

<USAGE VALUE="NONE" />

appears in conjunction with a script file, the VALUE attribute of "None" for the USAGE tag prevents the script file from being displayed by the channel browser **218**.

The top-most CHANNEL element can have at least one ITEMSCRIPT tag. At all other channel levels there can be at most one such tag.

ITEMFORMAT

The ITEMFORMAT tag is generally the form:

<ITEMFORMAT VALUE="header_block; repeat_block"/>

The tag specifies the format of a class of data items by identifying the associated file structure. The data items are simple text files that can have a unique header and a repeating block structure for record-oriented data. Helper functions are provided in the scripting environment to access the data content using information contained in the ITEMFORMAT tag. Both header_block and repeat_block are optional. But at least one or the other of the header_block or the repeat_block must exist. If repeat_block exists, it should be preceded by a delimiter such as a semi-colon (;) as indicated above. The header block typically contains the description about the data items. And the repeatable data block contains description about particular data items therein. The header_block and repeat block are of the form:

Vi [=Ti], for i=1 to n

Here "Vi" is the field name of the block value and "Ti" is the optional type of the block value. If "Ti"is omitted, a default value "HTML" is assumed. Valid types are listed in the following table:

TABLE 4

Type	Description
HTML	HTML text including markup.
TEXT	Same as HTML.
IMG	ID of image item in CDF files.
HREF	URL to a page, for example, data file and channel script.

A data block is merely a group of values. There is one value per line. Any meaningful data file should have at least one data block. For example, three data blocks might be used to show a portfolio of three stocks. In the following example, a "Market" channel displays stock values listed in the "Stocks.mcd" file. The header gives the title and displays the data of the shown stocks. The data to be listed includes the name, the low price, high price, and closing prices of each stock.

```
<ITEM HREF="http://www.market.com/Stocks.mcs"
  ID="Stock_S"
  <USAGE VALUE="None"
</ITEM>
. . .
<CHANNEL ID = "Stock_C" >
  <TITLE VALUE="Market"/>
  <ITEM HREF="http://www.market.com/stocks.mcd"
  ID="Stock_D">
    <USAGE VALTE="MobileChannel"/>
    <ITEMSCRIPT VALUE="Stock_S"/>
    <ITEMFORMAT VALUE="Title,Date, Picture=
      IMG;
       Name, Low, High, Close"/>
  </ITEM>
</CHANNEL>
```

Here the header block has three values, "Title", "Date" and "Picture", and the data block has four: "Name", "Low", "High" and "Close".

IMG indicates the field that represents an image, such as JPG or GIF. The field value is the identifier of the item defining the URL of the image. The built-in item script creates an IMG value to display this item.

The data block may be repeated to build a table of stock prices. If the Stocks.mcd file contains a single data block, the script displays a single stock per page. If it has multiple data blocks, the script could display a table of stocks.

The repeat block can be omitted, as shown in the following example, which is represents a news article with a title, an image, and the body of text:

<ITEMFORMAT VALUE="TITLE, PICTURE=IMG, BODY"/>

The header block can also be omitted, as shown in the following example that represents a stock page with a listing of stocks. Note the presence of the semi-colon (;) to indicate the value list. It is, therefore, a repeat block and not a header block.

<ITEMFORMAT VALUE="; Name, Low, High, Close"/>

It should be noted that not all the standard tags are supported and used on the mobile devices **18**. In particular, the CDF files **201** need not support any software update channel tags (EARLIESTTIME, INTERVALTIME, and LASTTIME tags) if the channel browser **218** is operated only in an "offline" mode. In addition, the LOGIN tag can be ignored. However, while the EARLIESTTIME, INTERVALTIME, and LASTTIME tags are ignored on the mobile device **18** when operated offline, they are supported if the mobile device **18** can be operated in an "on-line" mode. In addition, if the CDF file **201**, script template files **204** and data file **202** structures is used on the desktop computer **16** or other similar device, the software update tags will be recognized and used to download the channel from the content provider **12**.

Mobile Channels Data Files

The data files **202** are used to deliver incremental data for a channel. These are simple text files that contain data with one data item per line in the file. Within the CDF file **201**, a structure for the data file may be declared using an ITEMFORMAT tag as discussed earlier.

In the example, each data file has a ".mcd"extension. The CDF file **201** includes an ITEM tag to define the "mcd" file. Within the ITEM tag, the ID attribute is used as a short-hand way to reference the "mcd" file from within the script without having to reference its complete URL.

Unlike the conventional script-drives approach, where script files are run and call for data to display, in the present system the opposite is performed for displaying incremental data. Because new information can come in at any time within a new "mcd" file, it is more efficient to activate the script template **204** to display data **202** when it arrives. This data-triggers-script approach has an added benefit in that it permits the inheritance of script templates.

The file format for data files **202** is flexible. It is simply a text file that contains the data, such as references to images with each item on a separate line. The present system exposes methods within the scripting environment for reading this content from the data file **202**.

The ITEMFORMAT tag is used to specify the kind of data present in the file. Generally, files have the following format:

[Head Block]
[Data Block 1]
[Data Block 2]
. . .
[Data Block n]

As discussed above, the use of particular script templates **204** in the CDF files **201** are identified with the CHANNELSCRIPT and ITEMSCRIPT tags. The script templates **204** are invoked in a data-driven manner. When it is time to display a particular data file **202**, the reference is made to the data file **202** and the appropriate item script template is located to display it. Likewise, when it is time to show channel content, such as a listing a subchannels or data items, the reference to the channel is made and the appropriate channel script template is located to display it.

ITEMSCRIPT Selection

When it is necessary to render a particular data file **202** through the channel browser **218**, the appropriate script template **204** must be selected. Item script templates are responsible for rendering data files and are invoked as a result of referencing the URL of the data file **202**. The appropriate script template **204** is selected based upon the proximity of an ITEMSCRIPT tag to the particular data file **202** to be rendered.

In the embodiment illustrated, an item URL, as it appears in scripts, is in the following form:

Mctp://CDFid/ItemID

Here mctp specifies the use of Mobile Channels Transport Protocol to resolve the URL and to invoke the scripting engine. CDFid is the ID tag of the top-level CHANNEL element and is used to select the correct CDF file in the CDF files **201**. ItemId is the ID tag of the ITEM element for the data file **202** to be rendered.

The data file appears in an ITEM element within the channel hierarchy. The location of the ITEM element relative to an ITEMSCRIPT tag determines which script template **204** will be used to render the data. The script template **204** is identified by matching the ID value in the ITEMSCRIPT tag with the ID value of an ITEM element, which is the item for the script template **204**, within the CDF file **201**.

ITEMSCRIPT tags can be children of either CHANNEL elements or ITEM elements. An ITEMSCRIPT tag determines the script template **204** to be used for all items of the current channel and its subchannels, if no further ITEMSCRIPT tags are associated with the subchannels. An item script template **204**, as identified by ITEMSCRIPT, for a CHANNEL or ITEM element supercedes any previously defined ITEMSCRIPT value.

Thus, an inheritance model is used. When it is necessary to render a particular data item, the nearest ITEMSCRIPT element in the hierarchy is used to determine what script template **204** should render the data. In the event that the appropriate script template **204** is not available on the mobile device **18**, a built-in script template is used to render the data. The default item script template is stored at **232** and simply enumerates through all the fields specified in the ITEMFORMAT tag and for each one displays the appropriate data from the specified data file. If the data file contains a repeating block, all the block values are enumerated on the page in a list until the end of the data file is reached.

By convention, item script templates are specified at the top-level of a channel, usually at the top of the file as shown in Table 1. Each item script template is assigned a unique ID. The script can then be referenced using an ITEMSCRIPT element from any location in the CDF loadable transport **220**, rather than the usual HTTP protocol.

It should be noted that due to a limitation in the way standard channel browsers for the desktop computer **16** handles URLs for images, in order for an image to be rendered on the desktop computer **16** images should be referenced using standard HTTP references, rather than the loadable transport. If allowing the channel to be viewed, the desktop computer **16** is not important, then the loadable transport type URLs may be used.

CHANNEL SCRIPT Selection

In addition to rendering data from data files, such as a news article, it is usually necessary to render the current

location within the CDF so that the user can navigate to the desired data. When it is necessary to render a CDF navigation page (i.e. the channel and/or subchannels) on the display **45**, the appropriate script template must be selected. Channel script templates are responsible for rendering the CDF navigation pages supplied by the content provider **12**. As with an item script template, referencing the URL of the subchannel results in the invocation of a channel script template. The appropriate script template is selected based upon the proximity of an CHANSCRIPT tag to the particular CHANNEL element in the URL.

A channel URL, as appears in script templates, is of the following form: mctp: //CDFid/ChanID

Here, mctp specifies the use of the loadable transport protocol to resolve the URL and to invoke the scripting engine. "ICDFid" is the ID tag of the top-level CHANNEL element. It is used to select the correct CDF file. "ChanId" is the ID tag of the CHANNEL element for the subchannel within the CDF to be rendered. As a user navigates through the channel, he or she is effectively moving up and down through the CDF channel hierarchy accessing data files. At each level in the channel hierarchy, it is possible to associate a script template to display the channel content, which is usually a list of subchannels or available items.

The CHANSCRIPT tag identifies the script template to be used to render the current channel location in a way similar to how the ITEMSCRIPT tag identifies the script template to render data. The location of a CHANNEL element relative to a CHANSCRIPT determines which script template will be used to render the subchannel. The script template is identified by matching the ID value in the CHANSCRIPT element with the ID value of an ITEM element, that is, the ITEM for the script template, within the CDF.

CHANSCRIPT tags are children of CHANNEL elements. A CHANSCRIPT tag determines the script template to be used for the current channel and its subchannels. A CHANSCRIPT tag specified for a CHANNEL element supercedes any previously defined CHANSCRIPT value.

Thus, an inheritance model is used. When it is necessary to render a particular subchannel, the nearest CHANSCRIPT tag upward in the hierarchy is used to determine what script template should render the data. In the event that the appropriate script template is not available on the mobile device **18**, a built-in script template **232** is used to render the channel as best it can.

SCRIPTING

The script template specifies the layout and behavior of HTML pages. Script segments are enclosed between the "<%" and "%>" or "<%=" and "%>" delimiter pairs. The second pair of delimiters entails special use and meaning in the script template. In each script segment, there must be at least one valid executable, or non-comment, statement. There must also be at least one scripting segment in the mcs file. In one embodiment, any empty script segment generates a syntax error. Scripting segments can be freely intermixed with standard HTML text, provided that the script-generated, HTML output has the valid syntax within the context of the standard HTML display code. Appendix A provides an example of a CHANNELSCRIPT and an ITEMSCRIPT. Appendix B is a description of a scripting environment for use in the present system.

FIG. **8** illustrates an example of an index viewer user interface **240** for rendering content information using the CDF files **201**, the script templates **204** and the data **202**. The index viewer user interface **240** can cover the complete display **45** when the information is rendered, or alternatively, the index viewer user interface **240** can be a "pane" of a larger graphical user interface presented on the display **45**.

In the exemplary embodiment of FIG. **5**, the top-level channel is indicated at **242**. The top-level channel **242** includes general subchannel categories, such as "News and Technology", "Sports", "Business", "Entertainment", "Life Style and Travel", "The Microsoft Network", and "MSNBC". Subchannels **244**, **245**, **246**, **247**, **248**, **249** and **250** correspond to the first level subchannels "Test Subchannel **1**" and Test Subchannel **2**" shown in the example of Table 1. Each of the subchannels **244–250** lead to further subchannels and/or data items. In the example of FIG. **8**, the subchannel **245** includes further subchannels **252**, **253**, **254** and **255**. In this example, subchannel **252** includes yet further subchannels generally indicated at **257** which, when accessed, will display the latest article pertaining to the listed subject heading. An indicator button **260** can be provided to the user when additional information is present but not shown. In this example, the indicator button **260** indicates that additional subchannels to the top-level channel **242** are present. A portion **264** of the user interface **240** can be set aside for advertisements.

To display the content information of the top-level channel **242**, the channel browser **218** (FIG. **6**) accesses the loadable transport **220** in order to locate the CDF file for the top-level channel **242** in the stored CDF files **201**. By examining the CDF file for the top-level channel **242**, the loadable transport **220** determines which script file will be executed from the script templates **204** in order to render the titles of the subchannel **244–250** illustrated in FIG. **8**. It should be noted that the titles of the subchannels **244–250** are not contained in the script file that is executed, but rather, form a part of the CDF file for the top-level channel **242**. Thus, the script file used to render the top-level channel **242** examines the CDF file for the top-level channel **242** in order to generate the HTML page **224** as provided to the channel browser **218**. This allows general script files to be used rather than specific script files for each portion of the information that is rendered. As discussed above, when a subchannel, such as subchannel **245**, is rendered, a different script file can be called, or if one is not called, the script file used to generate the top-level channel **242** can be used. Again, when any of the subchannels **252–255** or **257** are to be rendered, the scripts executed will examine the CDF file for the top-level channel **242** in order to obtain relevant information that will be displayed as well as determine how the information is to be displayed in the hierarchy. Along with the script templates **204** and data **202**, the CDF files **201** can be updated as desired.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

What is claimed is:

1. A computer readable medium including instructions readable by a computer which, when implemented, cause the computer to handle information from a server remote from the computer by performing steps comprising:

storing a content structure file, a data file and a script file on the computer, the data file including data indicative of the information and the script file including script information indicative of a desired form in which the data is to be rendered, the content structure file, data file and script file being independently received and stored by the computer;

reading the content structure file to ascertain which script in the script file is associated with data to be rendered;

retrieving the data from the data file and executing the associated script in the script file to render the data; and

displaying the rendered data on a display controlled by the computer.

2. The computer readable medium of claim **1** wherein the content structure file includes references to data and scripts in a hierarchy.

3. The computer readable medium of claim **2** wherein reading the content structure file to ascertain which script in the script file is associated with the data to be rendered includes choosing the script as a function of the hierarchy.

4. The computer readable medium of claim **3** wherein the content structure file includes script tags associated with scripts in the script file, the script tags being in the hierarchy.

5. The computer readable medium of claim **4** wherein choosing the script file includes choosing a script referenced by a script tag in a higher portion of the hierarchy for data to be rendered in a lower portion of the hierarchy if there is no associated script tag for the data in the lower portion of the hierarchy.

6. The computer readable medium of claim **1** including instructions readable by a computer which, when implemented, cause the computer to handle information by performing steps comprising:

storing a preference on the computer file having information regarding data to be stored in the data file; and

intermittently receiving updated data and reading the preference file to ascertain if the updated data is to be stored in the data file.

7. The computer readable medium of claim **6** wherein the content structure file includes preference tags associated with default preferences, and wherein storing a preference file includes reading the preference tags.

8. The computer readable medium of claim **7** including instructions readable by a computer which, when implemented, cause the computer to handle information by performing steps comprising:

changing the information in the preference file.

9. The computer readable medium of claim **1** wherein executing the script comprises rendering the data in a processor independent form.

10. The computer readable medium of claim **9** wherein the computer comprises a mobile device, and wherein storing the content structure file, data file and script file includes receiving the content structure file, data file and script file from a desktop computer.

11. The computer readable medium of claim **9** wherein executing the script comprises rendering the data in hypertext markup language (HTML) form.

12. The computer readable medium of claim **1** including instructions readable by a computer which, when implemented, cause the computer to handle information by performing steps comprising:

storing a first script file and a second script file on the computer; and

wherein reading the content structure file to ascertain which script includes examining the first script file for the associated script and wherein executing includes executing another script from the second script file if the associated script is not found.

13. A method for displaying information from a server on a display of a computer remote from the server comprising:

storing a content structure file, a data file and a script file on the computer, the data file including data indicative of the information and the script file including script information indicative of a desired form in which the data is to be rendered, the content structure file, data file and script file being independently received and stored by the computer;

reading the content structure file to ascertain which script in the script file is associated with data to be rendered; retrieving the data from the data file and executing the associated script in the script file to render the data; and

displaying the rendered data on the computer's display.

14. The method of claim **13** wherein the content structure file includes references to data and scripts in a hierarchy.

15. The method of claim **14** wherein reading the content structure file to ascertain which script in the script file is associated with the data to be rendered includes choosing the script as a function of the hierarchy.

16. The method of claim **15** wherein the content structure file includes script tags associated with scripts in the script file, the script tags being in the hierarchy.

17. The method of claim **16** wherein choosing the script file includes choosing a script referenced by a script tag in a higher portion of the hierarchy for data to be rendered in a lower portion of the hierarchy if there is no associated script tag for the data in the lower portion of the hierarchy.

18. The method of claim **17** wherein executing the script comprises rendering the data in a processor independent form.

19. The method of claim **18** wherein executing the script comprises rendering the data in hypertext markup language (HTML) form.

20. The method of claim **18** wherein the computer comprises a mobile device, and wherein storing the content structure file, data file and script file includes receiving the content structure file, data file and script file from a desktop computer.

21. The method of claim **13** and further comprising:

storing a preference file on the computer having information regarding data to be stored in the data file; and

intermittently receiving updated data and reading the preference file to ascertain if the updated data is to be stored in the data file.

22. The method of claim **21** wherein the content structure file includes preference tags associated with default preferences, and wherein storing a preference file includes reading the preference tags.

23. The method of claim **22** and further comprising changing the information in the preference file.

24. The method of claim **13** and further comprising storing a first script file and a second script file on the computer; and wherein reading the content structure file to ascertain which script includes examining the first script file for the associated script and wherein executing includes executing another script from the second script file if the associated script is not found.

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