Patents

Domain name system lookup allowing intelligent correction of searches and presentation of auxiliary information

Abstract

A domain name server assists user's in selecting desired domains in the Internet. A domain name query is sent from a resolver process, or equivalent process, when the user (or a process on the user's computer) wishes to obtain information. If the domain name exists, the domain name server provides the corresponding machine address back to the user's computer. However, when the domain name query uses a non-existent domain name then a machine address for a computer that executes a domain recommendation engine is returned instead of a machine address associated with the invalid domain. The domain recommendation engine assists the user (or process on the user's computer) in locating a desired domain name. The domain name recommendation engine can take into account numerous factors that assist in determining the intended domain, including common misspellings, phonetic errors, sub-domain errors, past statistics on website accessing by the present user and prior users. Auxiliary information is provided to the user along with information to assist in locating the intended domain. The auxiliary information can include sponsorship information, referrals, advertisements, educational or other information. The auxiliary information can be in the form of image, audio, database of other types of information.

Images (7)

Classifications

H04L29/12066 Directories; name-to-address mapping involving standard directories and standard directory access protocols using Domain Name System [DNS]

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Claims (22)

Hide Dependent

What is claimed is:

1. A method for handling invalid domain name lookup requests in the Internet, the method executing in a domain name server system responsive to a target domain name request by a user computer, wherein the user computer is coupled to a display screen, the method comprising the following steps executed in the domain name server system

receiving a target domain name lookup from a user computer;

searching a master lookup table to determine a machine address associated with the domain name;

determining that the target domain name does not exist within the lookup table;

transmitting a machine address to the user computer, wherein the machine address maps to a web server;

receiving a machine address request from the user computer based on the target domain name transmitted machine address to the user computer;

in response to the received machine address, sending information to the user computer to assist in that user's selection of a most likely domain name that assumes a misspelling of the target domain name; and

displaying an advertisement on the user computer's display screen.

2. The method of claim **1**, wherein the advertisement is a visual image.

3. The method of claim **1**, wherein the advertisement is audio.

4. The method of claim **1**, wherein the advertisement is an animation.

5. The apparatus of claim **1**, wherein the advertisement is video.

6. The apparatus of claim **1**, wherein the advertisement is a banner associated with a hyperlink to the subject of the banner.

7. The method of claim **1**, wherein the user's computer includes a client-based spellchecker.

8. The method of claim **1**, wherein the target domain name is a non-existent domain name.

9. The method of claim **1**, wherein the target domain name is an existent but non-functioning domain.

10. The method of claim **1**, wherein the domain lookup request is any one of the following types: DNS, MX, TXT, PTR or CNAME.

11. The method of claim **8**, further comprising

transferring information to the user's computer to cause the user's computer to display one or more valid domain names similar in spelling to the non-existent domain name.

12. The method of claim **1**, further comprising

transferring information to the user's computer to cause the user's computer to display a list of valid domain names, wherein the valid domain names are hyperlinked to their corresponding page on the Internet.

13. The method of claim **8**, further comprising

transferring information to the user's computer to cause the user's computer to display the non-existent domain name having a portion of the non-existent domain name highlighted, wherein the highlighted portion distinguishes a non-existent domain name from the one or more valid domain names.

14. The method of claim **1**, further comprising

transferring information to the user's computer to cause the user' computer to display auxiliary information.

15. The method of claim **14**, wherein the auxiliary information is an advertisement.

16. The method of claim **14**, wherein the auxiliary information is sponsorship information.

17. The method of claim **14**, wherein the auxiliary information is a visual image.

18. The method of claim **14**, wherein the auxiliary information is audio.

19. The method of claim **14**, wherein the auxiliary information is an animation.

20. The method of claim **14**, wherein the auxiliary information is video.

21. The method of claim **14**, wherein the auxiliary information is a banner associated with a hyperlink to the subject of the banner.

22. The method of claim **1**, wherein the target domain name is a disabled domain name.

Description

CROSS REFERENCE TO RELATED APPLICATION

This application is a Continuation-in-Part of U.S. application Ser. No. 09/204,855, filed Dec. 3, 1998, now abandoned entitled DOMAIN NAME SYSTEM LOOKUP ALLOWING INTELLIGENT CORRECTION OF SEARCHES AND PRESENTATION OF AUXILIARY INFORMATION the specification if which in incorporated by reference herein for all purposes.

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INCORPORATION BY REFERENCE

The present application includes a Compact Disc Read Only Memory (CD-ROM) containing the following files and byte sizes: Figs, 120 KB; risley patent, 79.5 KB; and risley source code, 67.0 KB which is hereby incorporated by reference as if set forth in full in the present invention.

BACKGROUND OF THE INVENTION

The Domain Name System (DNS) is an integral part of the Internet and other networks that use Internet-type protocols (such as TCP/IP) and architecture similar to the Internet. DNS allows human users to access information on different computers connected to the Internet by typing, entering, selecting or otherwise specifying, text names as opposed to sequences of numbers. This makes it much easier to remember, access and convey the location of information in the vast Internet. For example, “coolsite.com” is generally more appealing to the average user of the Internet than “199.227.249.232.” An analogy is in the use of names of people and places as opposed to being forced to use purely numeric telephone numbers.

However, computers on the Internet execute software that uses machine addresses to access information instead of the mnemonic text domain names. Because of this, the domain names must be mapped to their machine addresses (e.g., “coolsite.com” must be mapped to 192.86.1.90 in the example above) before information at a site or location can be accessed. The mechanism that DNS uses to perform this mapping is a client-server arrangement between a name server and a client resolver. Both the name server and resolver are software processes executing on one or more computers. Essentially, the resolver submits a query to a name server about a domain name. The name server “resolves” the mapping of the domain name to a machine address and sends the machine address back to the resolver as the “answer” to the query. For a detailed discussion of the operation of name servers, routers and DNS in general, see, for example, *DNS and BIND,* by Paul Albitz and Cricket Liu, published by O'Reilly & Associates, Inc.

FIG. 1A illustrates a DNS lookup, also called a “mapping” or “resolving” of a domain name to a machine address, as performed in the prior art.

In FIG. 1A, computer **10** makes a request of computer **12**. Computer **12** forms part of the Internet and, in particular, is a name server within the DNS. For example the request from computer **10** may come from a Web browser application executing on computer **10**. In response to computer **10**'s user typing in a domain name such as “www.bessemer_ventures.com,” resolver code used by the browser transmits the domain name query to computer **12**. This assumes that computer **12** has been predesignated as the primary domain name server for computer **10**.

Computer **12** includes DNS name server software that receives the request. One method of DNS lookup allows computer **12** to check a local list of domain names already matched to machine addresses. If the queried domain name is in the local list then computer **12** can respond with an answer, in the form of the associated machine address, immediately. Such a local list is referred to as a “name cache” that is stored in system random access memory (RAM), disk storage or other storage associated with computer **12**. The name cache is updated periodically from other, authoritative, name servers in the Internet.

Assuming computer **12** does not have a match for the queried domain name in computer **12**'s name cache, computer **12** begins a process of querying other name servers in the Internet, such as computers **14**, **16** and **18**, for knowledge of the associated machine address. This querying is organized but takes time because of the limitations of the Internet and the ever-increasing number of domain name queries that need to be handled by a limited number of name servers. For a detailed discussion of DNS lookup, see the above reference. After computer **12** has obtained the machine address associated with the domain name www.bessemer_ventures.com, the machine address, **180**.**201**.**15**.**250**, in this case, is passed back to computer **10** as the answer to computer **10**'s domain name query. Note that this can take on the order of a few seconds, especially where the queried domain name does not exist in primary domain name server computer **12**'s name

cache. Also, the necessity of computer **12** then having to query, sometimes several or many, other name servers adds to the overall Internet traffic and consumption of limited domain name server processing resources. This results in a slower DNS response time for all users of the Internet. Since DNS lookup is a requirement in the large majority of web page accesses, this translates into a slower Internet for users throughout the world.

After computer **10** receives the machine address associated with www.bessemer_ventures.com, it may then use the machine address to communicate with the target computer having the machine address. Note that the target computer can be any computer connected to the Internet. This does not have to be (and typically isn't) the primary domain name server, such as computer **12**. Rather, the target computer is one operated by the provider of information that the user desires and might be located halfway around the world from the user's primary name server. For example, in the present example of a web browser executing on the user's computer **10**, after the user types in the domain name and the browser (via the resolver process) receives the machine address, the next action is to transfer a request to the target machine's address for a specific web page to be displayed on the user's computer **10**.

The process of obtaining a web page is shown in FIG. 1A as taking four steps. However, this is merely a symbolic depiction for ease of discussion. All of the communication steps typically occur over a single physical transmission line from a user's computer to an Internet server, switch, backbone, router or other network device. In accomplishing the process of mapping a domain name to a machine address there are many transactions occurring at different communication layers.

The DNS approach to resolving a domain name with an associated machine address is flexible in that it allows independent growth and relatively automatic propagation of new domain names and their associated machine addresses throughout the Internet. However, the resolution time can become unacceptably long, as where multiple, overloaded name servers must be queried in order to obtain the associated machine address. This problem is exacerbated when the domain name that is the subject of a query does not exist within DNS. This can occur, for example, when a user misspells a domain name, when a user has remembered an incorrect domain name, when an outdated domain name is used, where an error occurs in a software program or database, etc.

In the prior art DNS, when a non-existent domain name is queried for the first time it will not be present in the name cache of the primary domain name server. This starts a chain of potentially many queries to additional name servers—each of which will result in no associated machine address for the domain name. The number of queries depends on the type of DNS searching that is performed and on how many sub-domains in the full domain name are valid before an invalid sub-domain is determined. Even where the domain name may exist, there may be other reasons that a connection can not be made, such as when the web server for the domain is down. Basically, long delays occur any time the underlying protocol, i.e., TCP or UDP, is having problems.

FIG. 1B illustrates the prior art's handling of valid and invalid domain name queries.

In FIG. 1B, client side processing, such as is performed on a user's machine when the user is operating a web browser, is shown at **20**. DNS name server processing is shown in the box at **22**.

The flowchart of FIG. 1B is entered at **24** where it is assumed that a user is executing an application, such as an Internet browser, that allows a Uniform Resource Locator (URL) to be specified by the user for purposes of accessing information. At step **26**, the user enters a domain name. Usually the user types the domain name by using the keyboard. Other ways of entering domain names are by clicking on a hyperlink to a domain name, having the domain name automatically provided by software, etc. While most requests for invalid domain name searches are the result of a user misspelling, or other user mistake, errors can also occur when domain names are obtained by other means. An example is when a previously valid domain name becomes defunct, when the user has been emailed an invalid domain name, etc.

At step **30**, the browser extracts the domain name from the URL, forms a DNS domain name query and sends the query to a pre-designated name server. At step **28**, the name server receives the query and attempts to resolve the domain name. The name server begins by examining its local cache of pre-stored known domain names and associated machine addresses. Typically the name server has received a master list of domain names from a master domain name server, or “root” server. Such lists can be updated every day or so. The list resides in cache, either system RAM or local disk storage, for a predetermined period of time until it is scrapped in favor of another master list. Updates to the cache can also come from the name server's own discoveries about names in DNS as the name server operates and attempts to resolve queries.

At step **32**, if the domain name is in the cache then the name server checks, at step **40**, to determine whether there is a valid machine address associated with the domain name. If so, the machine address is returned to the client (browser application). The browser application uses the returned machine address to access the domain at step **46**. This typically results in the desired information being displayed on the user's computer in the form of a web page. At this point the user has successfully obtained the desired information and the transaction completes at step **50**.

Assuming that the queried domain name does not reside in the cache at step **32**, step **42** is performed to send a further query to authoritative domain name servers on the Internet in an attempt to resolve the initial query. If a successful resolution is obtained from external name servers, the domain name and associated machine address are stored in the cache and the machine address is returned to the browser at step **46**, as before. This represents a successful resolution of the domain name so the desired information is ultimately obtained and displayed on the user's screen. If, however, the query request at step **42** does not return a machine address associated with the domain name, the check at step **48** fails and step **54** is executed to store the domain name in the cache and flag the domain name as invalid. Step **53** sends notification of the failed query to the browser.

At step **52**, the browser receives notification of the failed DNS query and displays an error message. Step **44** represents the cycle of the user trying a different domain name in an unassisted attempt to locate the desired information in the desired, and possibly unknown (to the user), domain.

DNS requires that the domain name be exactly correct or it may map to an unintended domain or be invalid (non-existent) and fail to map to a machine address. This is becoming more of a problem as the number of domains increases and the commercial, educational, governmental and other activity on the Internet increases. Since domain names are a concatenation of domains names of different levels, the user will often remember some of the names of the levels and misspell, or remember incorrectly, other levels. For example, the domain “www.berkeley.com” is an invalid domain name. One that might easily be entered by a user who is familiar with the much-publicized “.com” extension for Web sites but who is unfamiliar with the lesser-known “.edu” domain that is designed for educational Internet uses. Typically, the user receives a terse error message that the “domain cannot be located,” the domain is “not found,” or the like. These types of errors, unlike simple spelling errors that the user may be in a position to correct, given a second try, may delay the user for a long time. The user may wait on the order of 20 seconds before an error notification is displayed when a domain name is invalid.

A recent study revealed that 3%-4% of DNS queries are invalid and, as a result, are not resolved. Probably nearly all of these invalid queries are because of a user's mistake. Thus, it is apparent that an improved name server system for assisting user's who have requested an invalid domain name lookup is desirable. Further, the ability to create an improved DNS service, such as a name server service, that improves the Internet such as by providing faster overall DNS performance, distribution of useful information and promotion of commerce, is desirable.

SUMMARY OF THE INVENTION

The present invention provides a system including a domain name server that assists user's in selecting desired domains in the Internet. A domain name query is sent from a resolver process, or equivalent process, when the user (or a process on the user's computer) wishes to obtain information. If the domain name exists, the domain name server provides the corresponding machine address back to the user's computer. However, when the domain name query uses a non-existent domain name then a machine address for a computer that executes a domain recommendation engine (DRE) is provided. The domain recommendation engine assists the user (or process on the user's computer) in locating a desired domain name.

One aspect of the system uses the domain recommendation engine to display a list of suggested domain names that have a high likelihood of being the domain name that the user intended. The relationship of the suggested domain names to the invalid domain name include names with slight spelling corrections, or changes;

phonetically similar names; names where a portion of the name (e.g., a sub-domain) is changed; and names that have a high likelihood of being the intended domain based on a collection and analysis of past domain name searches—either by the presently requesting user or by other users.

Another aspect of the system provides for auxiliary information to be provided on a page of information that reports the invalid domain name to the user. The auxiliary information can be provided in conjunction with the list of suggested domain names as described above. The auxiliary information can include sponsorship information, referrals, advertisements, educational or other information. The auxiliary information can be in the form of image, audio, text, numeric, hypertext or other types of information. The auxiliary information can be associated with the invalid domain name, as where the invalid domain name is used to identify a category of interest for the user and sponsorship information in the same category of interest is provided.

Another aspect of the system causes a display of the invalid domain name on the user's computer with an invalid, or likely invalid, portion of the domain name indicated.

One embodiment of the invention provides a method for handling invalid domain name lookup requests in the Internet, wherein a domain name server receives a domain name request from a user's computer. The method includes steps of determining that the domain name request specifies a non-existent target domain name; and using the domain name server to assist the user in selecting a desired domain name.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A illustrates a DNS lookup as performed in the prior art;

FIG. 1B illustrates the prior art's handling of valid and invalid domain name queries;

FIG. 2A shows a computer suitable for use with the present invention;

FIG. 2B shows subsystems in the computer of FIG. 2A;

FIG. 2C is a generalized diagram of a typical network;

FIG. 3 shows the operation of a name server of the present invention;

FIG. 4 shows a flowchart of the steps involved in resolving a DNS name query according to the present invention; and

FIG. 5 shows an example screen display of a temporary web page according to the present invention.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

A preferred embodiment of the invention is implemented as the "Modified Domain Name System" (MDNS) manufactured by Need Incorporated. Source code for this system is included in the computer program listing appendix which should be consulted for detailed information about the invention in conjunction with this specification. The DNS name server of the present invention (the "SuperDNS" server) incorporates the popular Berkeley Internet Name Domain (BIND) code. A preferred embodiment of the invention uses the Internet Software Consortium (ISC) BIND Version 8.1.2 available at http:/www.isc.org/bind/html. The computer program listing appendix includes those routines particular to the invention that work in connection with the BIND code instructions to achieve the functionality of the invention. Specifically, routine nv-rewrite( ) in the computer program listing appendix is called from send-msg( ) in ns-resp.c and nsreq( ) in ns-req.c. and routine.

A loose, but critical linkage between the modified BIND and the web servers and spell checkers is also carried out by nv-rewrite( ). A message is sent out to these devices to give them a head start in creating the web pages that shall contain the "suggested" correct spellings and sites. The c-coded cgi routine in the computer program listing appendix which runs on the specialized web server picks up the information left by the spell checkers and matches it up with the subsequent web pate request coming from the initiating browser.

FIGS. 2A-C illustrate basic hardware components suitable for practicing the present invention.

FIG. 2A is an illustration of computer system **200** including display **202** having display screen **204**. Cabinet **206** houses standard computer components (not shown) such as a disk drive, CDROM drive, display adapter, network card, random access memory (RAM), central processing unit (CPU), and other components, subsystems and devices. User input devices such as mouse **208** having buttons **210**, and keyboard **212** are shown. Other user input devices such as a trackball, touch-screen, digitizing tablet, etc. can be used. In general, the computer system is illustrative of but one type of computer system, such as a desktop computer, suitable for use with the present invention. Computers can be configured with many different hardware components and can be made in many dimensions and styles (e.g., laptop, palmtop, pentop, server, workstation, mainframe).

Any hardware platform suitable for performing the processing described herein is suitable for use with the present invention.

FIG. 2B illustrates subsystems that might typically be found in a computer such as computer **200**.

In FIG. 2B, subsystems within box **220** are directly interfaced to internal bus **228**. Such subsystems typically are contained within the computer system such as within cabinet **206** of FIG. **2**A. Subsystems include input/output (I/O) controller **222**, System Memory (or "RAM") **224**, CPU **226**, Display Adapter **230**, Serial Port **240**, Fixed Disk **242**, Network Interface Adapter **244**. The use of bus **228** allows each of the subsystems to transfer data among subsystems and, most importantly, with the CPU. External devices can communicate with the CPU or other subsystems via bus **228** by interfacing with a subsystem on the bus. Thus, Monitor **246** connects with Display Adapter **230**, a relative pointing device (e.g. a mouse) connects through Serial Port **240**. Some devices such as Keyboard **250** can communicate with the CPU by direct means without using the main data bus as, for example, via an interrupt controller and associated registers. As with the external physical configuration shown in FIG. 2A, many subsystem configurations are possible. FIG. 2B is illustrative of but one suitable configuration.

Subsystems, components or devices other than those shown in FIG. 2B can be added. A suitable computer system can be achieved without using all of the subsystems shown in FIG. **2**B. For example, a standalone computer need not be coupled to a network so Network Interface **244** would not be required. Other subsystems such as a CDROM drive, graphics accelerator, etc. can be included in the configuration without affecting the performance of the system of the present invention.

FIG. 2C is a generalized diagram of a typical network.

In FIG. 2C, network system **260** includes several local networks coupled to the Internet. Although specific network protocols, physical layers, topologies, and other network properties are presented herein, the present invention is suitable for use with any network.

In FIG. 2C, computer USER**1** is connected to Server**1**. This connection can be by a network such as Ethernet, Asynchronous Transfer Mode, IEEE standard 1553 bus, modem connection, Universal Serial Bus, etc. The communication link need not be a wire but can be infrared, radio wave transmission, etc. Server**1** is coupled to the Internet. The Internet is shown symbolically as a collection of server routers **262**. Note that the use of the Internet for distribution or communication of information is not strictly necessary to practice the present invention but is merely used to illustrate a preferred embodiment, below. Further, the use of server computers and the designation of server and client machines is not crucial to an implementation of the present invention. USER**1** Computer can be connected directly to the Internet. Server**1**'s connection to the Internet is typically by a relatively high bandwidth transmission medium such as a T1 or T3 line. Similarly, other computers at **264** are shown utilizing a local network at a different location from USER**1** Computer. The computers at **264** are coupled to the Internet via Server**2**. USER**3** and Server**3** represent yet a third installation.

FIG. 3 shows the operation of a name server of the present invention.

Name server **300** is one of many name servers on the Internet. The vast array of Internet users, computers, software and communication devices is shown symbolically at **316** while a single Internet user **302** is identified for purposes of discussion. Generally, the communication link between the Internet **316** and name server site **300**, and between client **302** and name server **300**, is the same link. There may be a pool of a certain type of link, such as T1 or T3 lines; or there may be alternate physical links such as satellite, cable TV, fiber optic, etc. Neither the physical link to the Internet, nor the number, type or operation of devices on the Internet is critical to the operation of the present invention.

A user's client computer is directed to use a predetermined name server for DNS lookup. This is done by designating the machine address of a name server as the primary DNS name server. When an application running on the client computer, such as an Internet browser, desires to access information at another computer on the Internet, the client computer submits a domain name query to a domain name server. Note that the concepts of "client" and "server," as used in this application and the industry, are very loosely defined and, in fact, are not fixed with respect to machines or software processes executing on the machines. Typically, a server is a machine or process that is providing information to another machine or process, i.e., the "client," that requests the information. In this respect, a computer or process can be acting as a client at one point in time (because it is requesting information) and can be acting as a server at another point in time (because it is providing information). Some machines, such as "full tower" personal computers, workstations, or the like, are consistently referred to as "servers" because they usually act as a repository for a large amount of information that is often requested. For example, a World Wide Web (WWW, or simply, "Web") site is often hosted by a server computer with a large storage capacity, high-speed processor and Internet link having the ability to handle many high-bandwidth communication lines. A server machine will most likely not be manually operated by a human user on a continual basis, but, instead, has software for constantly, and automatically, responding to information requests. On the other hand, some machines, such as desktop computers, are typically thought of as client machines because they are primarily used to obtain information from the Internet for a user operating the machine.

Depending on the specific software executing at any point in time on these machines, the machine may actually be performing the role of a client or server, as the need may be. For example, a user's desktop computer can provide information to another desktop computer. Sometimes this is characterized as "peer-to-peer," communication. Although processes of the present invention, and the hardware executing the processes, may be characterized by language common to a discussion of the Internet (e.g., "client," "server," "peer") it should be apparent that software of the present invention can execute on any type of suitable hardware. Although a software process or program of the present invention may be presented as a single entity, such software is readily able to be executed on multiple machines. That is, there may be multiple instances of a given software program, the program may be executing in a distributed processor environment, parts of a single program may be executing on different physical machines, etc. Further, two different programs, such as a client and server program, can be executing in a single machine, or in different machines. A single program can be operating as a client for one information transaction and as a server for a different information transaction.

In FIG. 3, name server site **300** includes hardware used to communicate with client users, such as client **302**, and other computers on the Internet represented at **316**. Server site **300** is a SuperDNS server site having superior ability to respond to DNS lookup requests. In general, response times for valid DNS lookups are kept to a minimum by the use of a large number of communications links, multi-tiered router approach, multiple DNS servers, large capacity name caching and constant updating of authoritative DNS lists. Response times for invalid DNS lookup requests are also kept to a minimum by benefit of these techniques in addition to providing the user with assistance when an invalid DNS lookup request is received.

Reception and transmission of IP traffic is via high-speed and low-speed routers **308** and **312**, respectively, which interface to the Internet through Internet Service Providers (ISPs) such as MCI, UUNET, BBN, ATT, SPRINT and CompuServe. High-speed router **308** is used to handle the majority of general requests from clients specifying the SuperDNS server site as their DNS lookup site. Lower-performance router **312** is used for direct communication with additional SuperDNS sites to maintain consistency and remote management. Lower-performance router **312** provides redundancy for monitoring and management purposes and also provides another link in case of catastrophic failure of the high speed router. Both routers **308** and **312** are connected with, and have access to, other devices at the site. Lower-performance router **312** is also used for private use. For example, one application is to link the private internal networks (**320** in FIG. 3) of multiple SuperDNS sites together to create a virtual private network (VPN).

When a DNS name query, or lookup request, is received by a router, the query is sent to DNS server **306**. DNS server **306** runs a modified version of BIND to resolve DNS queries. This modified DNS implements features of the present invention in custom software instructions incorporated with public domain software that is widely available. This allows the modified DNS software to substitute for responses that would normally have been returned by the public domain, unmodified, DNS software.

For example, where BIND would return a specific type A, class IN response to indicate a non-existent domain name, the modified DNS software, instead, returns the IP address of a server in a server "farm" of web servers **321**. The chosen IP address is the address of the least-busy (or predicted to be least busy) server in the farm. Simultaneously, a request is sent to spell checking and web page creation computers **322**. The spell checking and web-page creation computers try to determine valid likely domain names that the user may have intended. The assistance information is formed into a web page and is sent to the chosen IP in the farm. Because of the parallel processing of sending the IP address to the user's computer, performing the spell checking and forming the web page, it is likely that the web page will be present on the chosen server before the user's computer queries the chosen computer for the web page, thus reducing the time required for an overall response.

Although specific functions such as web page creation, spell checking and temporary web page serving are discussed with respect to a specific computer or machine, these functions can easily be performed at a different machine or can be distributed over two or more machines. For example, the spell checking function can be incorporated into a client-based spellchecker that is run on the user's own computer system.

In the preferred embodiment, the step of forming the web page includes the step of of inserting information or advertisements onto the page, such as a web ad banner.

FIG. 4 shows a flowchart of the steps involved in resolving a DNS name query according to the present invention.

In FIG. 4, flowchart **340** begins at step **342** where a user enters a URL into a browser application. Since valid DNS name queries are handled in a manner similar to the prior art, only a request for a invalid domain name is described here. Next, at step **344**, the browser extracts the domain name and transfers the name to a resolver. At step **346**, the resolver formats a packet with a fully-qualified domain name and sends the request to a DNS server at the DNS server site of the present invention described above in connection with FIG. **3**. At step **348**, the DNS server receives the request and checks its cache for the requested information. Assuming the domain name is not in the cache, step **352** is performed to query external DNS name servers for the machine address corresponding to the DNS name queried. In the case where the invalidity of the DNS name desired is determined from other Internet name servers, the invalid name is stored in the cache and flagged as invalid. If, on the other hand, the invalid name already existed in the cache, step **352** of checking the Internet would not be performed.

After determining that the name is invalid, step **350** is performed to rewrite a packet into a positive response for the resolver. That is, the DNS name server of the present invention responds to an invalid DNS name query by giving the non-standard reply that the domain name is valid and is associated with a machine address. This machine address is referred to here as a "temporary" machine address. The temporary machine address provided is the machine address of a server that creates "temporary" web pages to recommend other DNS names to the user. In FIG. 3, the server creating the temporary web pages is at **321**. In the example of FIG. 4, the temporary machine address **192**.**1**.**1**.**1** is provided to the resolver.

A preferred embodiment of the invention uses multiple servers for creating temporary web pages in order to improve the response times. A determination is made prior to, or at the time of, providing a temporary machine address to the resolver as to which of the three servers to provide. This can be determined on a round-robin basis, on the basis of which server is the least busy, etc. Also, temporary web pages can be cached within each server, or within other storage, so that popular invalid names will have temporary web pages already existing. However, the preferred embodiment does not typically cache the temporary web pages for long periods of time, preferring, instead, to place a short time limit of about 5 minutes on the duration that temporary web pages are kept on the servers. An "unaccessed timeout" mechanism may also be put in place to more finely control the lifetime. This would be more effective in cases where the page may be accessed multiple times from multiple users such as would be the case for a "popular" misspelling.

When the resolver receives the temporary machine address, back at step **346**, step **366** is executed to access the temporary machine address by, for example, obtaining the default web page at the temporary machine. Note that provision exists for optionally triggering an error message at the user's computer. That is, the "NG" signal can be sent back to the resolver, as would be the behavior of a prior art name server system, so that the user's browser takes predefined action to indicate to the user that the name is an invalid name. In other words, the prior art would not perform step **350** and send a temporary machine address to the resolver. Instead, an error message, indicated at step **354**, would be the only result of an invalid name query. This mechanism can still be invoked by the system of the present invention, as desired, although, generally, it will be preferable to "trick" the resolver into obtaining the temporary web page as an aid to the user by providing recommendations.

Concurrently with providing a temporary machine address to the resolver, the server site of the present invention begins creating a temporary web page that includes recommendations on the site name that the user desires. To this end, step **356** is executed to immediately begin constructing the web page. This concurrent construction of a temporary web page while transmission, and client-side processing to request the temporary web page, are continuing ultimately saves time in the overall transaction. Step **358** is executed to perform recommendation analysis based on the invalid domain name. The types of analysis can include a spelling check to see whether the invalid domain name is one or a few characters different from a valid domain name. This can include statistics on frequent human misspellings; mis-typings based on the QWERTY keyboard, data entry errors based on common interfaces such as palmtop computers, phonetic misspellings, etc. Another analysis can include checking all Internet domains at this point in time for a similar valid domain name. Typically such a search is time consuming and would have a time limit. Another analysis can include checking for past query histories of invalid domain names to see whether the current invalid domain name has been resolved before. Another analysis can include a look at each sub-domain in the invalid name to determine if a single sub-domain, directory, file, etc., in a multi-part URL is likely in error. Other types of analysis are possible in order to provide the user with intelligent recommendations as to possibly desired names. The system can use external storage, such as **360**, external processors (not shown), human-assisted intervention (not shown), or other means to aid the user.

Step **362** adds an advertisement, sponsorship, or other "revenue enhancer" to the temporary web page. Typically, this can be a web banner ad that includes a link to another website. However, other information can be provided. Such an ad can be tailored to the subject of the user's invalid, or intended (if discernable) DNS domain name. When the temporary web page is fully created, it is stored in a storage device such as **364**. Most popular browsers pass a full URL, including the misspelled domain name, in the initial request. This information is used to look up the temporary web page in the database. Multiple hosts can access the same page without having to create a new page for the same misspelled (or otherwise invalid) URL. Alternatively, where browsers do not provide full information about the URL query, including the misspelled domain name, the temporary web page can be stored with an association to the machine address of the resolver (i.e., the user's computer machine address) for auxiliary functions including associating a query for a machine address with a particular temporary web page. The resolver's machine address is known, for example, from the FQDN format of the original DNS name query.

Another use of the source IP address is for determining the end user's geographical location for purposes of targeted advertising. The use of the suffix, nondomain, portion of the full URL that is received by the browser in phase **2** of a Web page access may be used to further refine the choices and advertising returned to the user. This would fall under the second phase of analysis and not under the domain of the spell checker. For example, www.basebalxshkd.com/redsox would generate and access a temporary page to www.baseball.com (the correct, valid, and intended domain). The system of the present invention could use "redsox" to provide advertising particular to that specific baseball franchise. Also, only those baseball sites covering Boston (home of the Redsox) could be provided to the user as selections from the temporary web page.

After the resolver receives a temporary machine address at step **346**, the temporary machine address is used at step **366** to request a temporary web page. Since the request uses the temporary machine address, it is directed back to a server at the SuperDNS web site and processed at step **368**. Step **368** uses the domain name/URL information sent in the request generated in **366**, or checks for the machine address of the requestor and matches this to existing web pages on storage device **364**. If no web page exists, the browser timeout period allows the web page to be generated "on the fly" within a small amount of time. Assuming the temporary web page associated with the resolver's machine address exists, it is sent back to the resolver's machine and step **370** is executed to display the temporary web page and close the connection.

FIG. 5 shows an example of a temporary web page display as it would appear on a user's computer screen.

In FIG. 5, banner **400** is an advertising banner. Any form of advertising or providing other auxiliary information is suitable with the present invention. Title **402** informs the user that the page is part of a service to aid the user in locating the correct, intended web page. The line at **404** indicates that the URL the user entered, namely, "http://www.infoadsaseek.com/Home" is invalid. The section of text at **406** provides the user with "best guess" alternative URLs. The URLs are provided as hyperlinks so the user need only point and click on one of the URLs to go to the URL. The text at **408** informs the user of the provider of the domain name-assistance service. Naturally, information can be added to, or deleted from, the example temporary web page of FIG. **5**.

Additional refinements to the temporary web page of FIG. 5 include indicating what portions of the URL are likely invalid. For example, if the user types in the URL "www.microsoft.com/developer/toolls", the word "toolls" can be underlined, highlighted, colored, flashing or otherwise animated, etc., to indicate to the user that the rest of the URL is probably valid and that only the small portion of the URL, "toolls," is likely invalid.

Although the present invention has been described with respect to exemplary embodiments, thereof, these descriptions are but illustrative of specific embodiments of the invention. For example, although specific references were made to the DNS format of name search, the invention can be equally applied to any of the MX, TXT, PTR, CNAME, or other, DNS requests. The scope of the invention is to be determined solely by the appended claims.

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US8645471B2	2003-07-21	2014-02-04	Synchronoss Technologies, Inc.	Device message management system
CN104079438A *	2014-07-18	2014-10-01	□□□□□□□□□□□	DNS (domain name sever) domain name management system and method
US20140344474A1 *	2013-05-20	2014-11-20	Palo Alto Research Center Incorporated	Method and system for name resolution across heterogeneous architectures
US8898137B1	2010-06-24	2014-11-25	Amazon Technologies, Inc.	URL rescue by execution of search using information extracted from invalid URL
US8909558B1	2010-02-19	2014-12-09	Go Daddy Operating Company, LLC	Appraising a domain name using keyword monetary value data
US8938438B2	2012-10-11	2015-01-20	Go Daddy Operating Company, LLC	Optimizing search engine ranking by recommending content including frequently searched questions
US8943428B2	2010-11-01	2015-01-27	Synchronoss Technologies, Inc.	System for and method of field mapping
US8965971B2	2011-12-30	2015-02-24	Verisign, Inc.	Image, audio, and metadata inputs for name suggestion
US20150074290A1 *	2013-09-11	2015-03-12	International Business Machines Corporation	Browser based hostname resolution for non-dns (domain name service) and/or different dns environments
US8990347B2	1999-09-01	2015-03-24	Esdr Network Solutions Llc	Method, product, and apparatus for processing a data request
US9002926B2	2011-04-22	2015-04-07	Go Daddy Operating Company, LLC	Methods for suggesting domain names from a geographic location data
US9015263B2	2004-10-29	2015-04-21	Go Daddy Operating Company, LLC	Domain name searching with reputation rating
US9049229B2	2010-10-28	2015-06-02	Verisign, Inc.	Evaluation of DNS pre-registration data to predict future DNS traffic
US9058393B1	2010-02-19	2015-06-16	Go Daddy Operating Company, LLC	Tools for appraising a domain name using keyword monetary value data
US9063936B2	2011-12-30	2015-06-23	Verisign, Inc.	Image, audio, and metadata inputs for keyword resource navigation links
US9141717B2	1999-03-22	2015-09-22	Esdr Network Solutions Llc	Methods, systems, products, and devices for processing DNS friendly identifiers
US20150295987A1 *	2012-10-26	2015-10-15	Eutelsat S A	Method for the recovery of content corresponding to a url address by a client device
US9185120B2	2013-05-23	2015-11-10	Palo Alto Research Center Incorporated	Method and system for mitigating interest flooding attacks in content-centric networks
US9203885B2	2014-04-28	2015-12-01	Palo Alto Research Center Incorporated	Method and apparatus for exchanging bidirectional streams over a content centric network
US9218335B2 *	2012-10-10	2015-12-22	Verisign, Inc.	Automated language detection for domain names
US9276751B2	2014-05-28	2016-03-01	Palo Alto Research Center Incorporated	System and method for circular link resolution with computable hash-based names in content-centric networks
US9276840B2	2013-10-30	2016-03-01	Palo Alto Research Center Incorporated	Interest messages with a payload for a named data network
US9282050B2	2013-10-30	2016-03-08	Palo Alto Research Center Incorporated	System and method for minimum path MTU discovery in content centric networks
US9280546B2	2012-10-31	2016-03-08	Palo Alto Research Center Incorporated	System and method for accessing digital content using a location-independent name

US9311423B1	2010-02-19	2016-04-12	Go Daddy Operating Company, LLC	System and method for website categorization
US9311399B2	1999-09-07	2016-04-12	C. Douglass Thomas	System and method for providing an updating on-line forms and registrations
US9311377B2	2013-11-13	2016-04-12	Palo Alto Research Center Incorporated	Method and apparatus for performing server handoff in a name-based content distribution system
US9330168B1	2010-02-19	2016-05-03	Go Daddy Operating Company, LLC	System and method for identifying website verticals
US9363179B2	2014-03-26	2016-06-07	Palo Alto Research Center Incorporated	Multi-publisher routing protocol for named data networks
US9363086B2	2014-03-31	2016-06-07	Palo Alto Research Center Incorporated	Aggregate signing of data in content centric networking
US9374304B2	2014-01-24	2016-06-21	Palo Alto Research Center Incorporated	End-to end route tracing over a named-data network
US9379979B2	2014-01-14	2016-06-28	Palo Alto Research Center Incorporated	Method and apparatus for establishing a virtual interface for a set of mutual-listener devices
US9391896B2	2014-03-10	2016-07-12	Palo Alto Research Center Incorporated	System and method for packet forwarding using a conjunctive normal form strategy in a content-centric network
US9390289B2	2014-04-07	2016-07-12	Palo Alto Research Center Incorporated	Secure collection synchronization using matched network names
US9391777B2	2014-08-15	2016-07-12	Palo Alto Research Center Incorporated	System and method for performing key resolution over a content centric network
US9401864B2	2013-10-31	2016-07-26	Palo Alto Research Center Incorporated	Express header for packets with hierarchically structured variable-length identifiers
US9400800B2	2012-11-19	2016-07-26	Palo Alto Research Center Incorporated	Data transport by named content synchronization
US9407432B2	2014-03-19	2016-08-02	Palo Alto Research Center Incorporated	System and method for efficient and secure distribution of digital content
US9407549B2	2013-10-29	2016-08-02	Palo Alto Research Center Incorporated	System and method for hash-based forwarding of packets with hierarchically structured variable-length identifiers
US9426113B2	2014-06-30	2016-08-23	Palo Alto Research Center Incorporated	System and method for managing devices over a content centric network
US9444722B2	2013-08-01	2016-09-13	Palo Alto Research Center Incorporated	Method and apparatus for configuring routing paths in a custodian-based routing architecture
US9451032B2	2014-04-10	2016-09-20	Palo Alto Research Center Incorporated	System and method for simple service discovery in content-centric networks
US9456054B2	2008-05-16	2016-09-27	Palo Alto Research Center Incorporated	Controlling the spread of interests and content in a content centric network
US9455835B2	2014-05-23	2016-09-27	Palo Alto Research Center Incorporated	System and method for circular link resolution with hash-based names in content-centric networks
US9462006B2	2015-01-21	2016-10-04	Palo Alto Research Center Incorporated	Network-layer application-specific trust model
US9467377B2	2014-06-19	2016-10-11	Palo Alto Research Center Incorporated	Associating consumer states with interests in a content-centric network
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US9473475B2	2014-12-22	2016-10-18	Palo Alto Research Center Incorporated	Low-cost authenticated signing delegation in content centric networking
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US9473405B2	2014-03-10	2016-10-18	Palo Alto Research Center Incorporated	Concurrent hashes and sub-hashes on data streams
US9497282B2	2014-08-27	2016-11-15	Palo Alto Research Center Incorporated	Network coding for content-centric network
US9503365B2	2014-08-11	2016-11-22	Palo Alto Research Center Incorporated	Reputation-based instruction processing over an information centric network
US9503358B2	2013-12-05	2016-11-22	Palo Alto Research Center Incorporated	Distance-based routing in an information-centric network
US9516144B2	2014-06-19	2016-12-06	Palo Alto Research Center Incorporated	Cut-through forwarding of CCNx message fragments with IP encapsulation
US9531679B2	2014-02-06	2016-12-27	Palo Alto Research Center Incorporated	Content-based transport security for distributed producers

US9536059B2	2014-12-15	2017-01-03	Palo Alto Research Center Incorporated	Method and system for verifying renamed content using manifests in a content centric network
US9535968B2	2014-07-21	2017-01-03	Palo Alto Research Center Incorporated	System for distributing nameless objects using self-certifying names
US9537719B2	2014-06-19	2017-01-03	Palo Alto Research Center Incorporated	Method and apparatus for deploying a minimal-cost CCN topology
US9542076B1	2004-05-12	2017-01-10	Synchronoss Technologies, Inc.	System for and method of updating a personal profile
US9553812B2	2014-09-09	2017-01-24	Palo Alto Research Center Incorporated	Interest keep alives at intermediate routers in a CCN
US9552493B2	2015-02-03	2017-01-24	Palo Alto Research Center Incorporated	Access control framework for information centric networking
US9590887B2	2014-07-18	2017-03-07	Cisco Systems, Inc.	Method and system for keeping interest alive in a content centric network
US9590948B2	2014-12-15	2017-03-07	Cisco Systems, Inc.	CCN routing using hardware-assisted hash tables
US9602596B2	2015-01-12	2017-03-21	Cisco Systems, Inc.	Peer-to-peer sharing in a content centric network
US9609014B2	2014-05-22	2017-03-28	Cisco Systems, Inc.	Method and apparatus for preventing insertion of malicious content at a named data network router
US9613374B2	2013-10-10	2017-04-04	Go Daddy Operating Company, LLC	Presentation of candidate domain name bundles in a user interface
US9621354B2	2014-07-17	2017-04-11	Cisco Systems, Inc.	Reconstructable content objects
US9626413B2	2014-03-10	2017-04-18	Cisco Systems, Inc.	System and method for ranking content popularity in a content-centric network
US9660825B2	2014-12-24	2017-05-23	Cisco Technology, Inc.	System and method for multi-source multicasting in content-centric networks
US9678998B2	2014-02-28	2017-06-13	Cisco Technology, Inc.	Content name resolution for information centric networking
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US9699198B2	2014-07-07	2017-07-04	Cisco Technology, Inc.	System and method for parallel secure content bootstrapping in content-centric networks
US9716622B2	2014-04-01	2017-07-25	Cisco Technology, Inc.	System and method for dynamic name configuration in content-centric networks
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US9930146B2	2016-04-04	2018-03-27	Cisco Technology, Inc.	System and method for compressing content centric networking messages
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US9990432B1	2014-12-12	2018-06-05	Go Daddy Operating Company, LLC	Generic folksonomy for concept-based domain name searches
US9992097B2	2016-07-11	2018-06-05	Cisco Technology, Inc.	System and method for piggybacking routing information in interests in a content centric network
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US10078062B2	2015-12-15	2018-09-18	Palo Alto Research Center Incorporated	Device health estimation by combining contextual information with sensor data
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US10097346B2	2015-12-09	2018-10-09	Cisco Technology, Inc.	Key catalogs in a content centric network
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US10103989B2	2016-06-13	2018-10-16	Cisco Technology, Inc.	Content object return messages in a content centric network
US10101801B2	2013-11-13	2018-10-16	Cisco Technology, Inc.	Method and apparatus for prefetching content in a data stream
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US10122624B2	2016-07-25	2018-11-06	Cisco Technology, Inc.	System and method for ephemeral entries in a forwarding information base in a content centric network
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Family To Family Citations				

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
US9544394B2	2017-01-10	Network resource identification
US9961164B2	2018-05-01	DNS overriding-based methods of accelerating content delivery
US9479613B2	2016-10-25	Maintaining independent states for multiple web browser instances
US20150201039A1	2015-07-16	Method, product, and apparatus for processing a data request
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US6233606B1	2001-05-15	Automatic cache synchronization
US8260938B2	2012-09-04	Predicting user requests to reduce network connection latency
JP4592184B2	2010-12-01	Method and apparatus for accessing device with static identifier and intermittently connected to network
US6055572A	2000-04-25	System and method for creating pathfiles for use to predict patterns of web surfaces
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US7280999B2	2007-10-09	Network address server
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US7496566B2	2009-02-24	Priority based LDAP service publication mechanism

Priority And Related Applications

Parent Applications (1)

Application	Priority date	Filing date	Relation	Title
US20485598A	1998-12-03	1998-12-03	Continuation-In-Part	

Priority Applications (2)

Application	Priority date	Filing date	Title
US20485598A	1998-12-03	1998-12-03	*US Provisional Application*
US09/207,701	1998-12-03	1998-12-09	Domain name system lookup allowing intelligent correction of searches and presentation of auxiliary information

Applications Claiming Priority (1)

Application	Filing date	Title
US09/207,701	1998-12-09	Domain name system lookup allowing intelligent correction of searches and presentation of auxiliary information

Legal Events

Date	Code	Title	Description
2001-11-29	STCF	Information on status: patent grant	**Free format text**: PATENTED CASE
2005-06-15	FPAY	Fee payment	**Year of fee payment**: 4
2007-08-23	AS	Assignment	**Owner name**: ISCATEL, INC., MASSACHUSETTS **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:RISLEY, CHRIS;LAMB, RICHARD;GUZOVSKY, EDUARD;REEL/FRAME:019733/0554 **Effective date**: 20070806
2009-01-02	FPAY	Fee payment	**Year of fee payment**: 8
2011-08-04	AS	Assignment	**Owner name**: ACACIA RESEARCH GROUP LLC, TEXAS **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:ISCATEL, INC.;REEL/FRAME:026702/0418 **Effective date**: 20110730
2013-07-26	REMI	Maintenance fee reminder mailed	
2013-12-17	SULP	Surcharge for late payment	**Year of fee payment**: 11
2013-12-17	FPAY	Fee payment	**Year of fee payment**: 12
2013-12-24	SULP	Surcharge for late payment	

Concepts

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corresponding		claims,abstract,description	4	0.000
methods		abstract,description	19	0.000

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