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(54) **METHOD AND SYSTEM FOR PARSING NAVIGATION INFORMATION**

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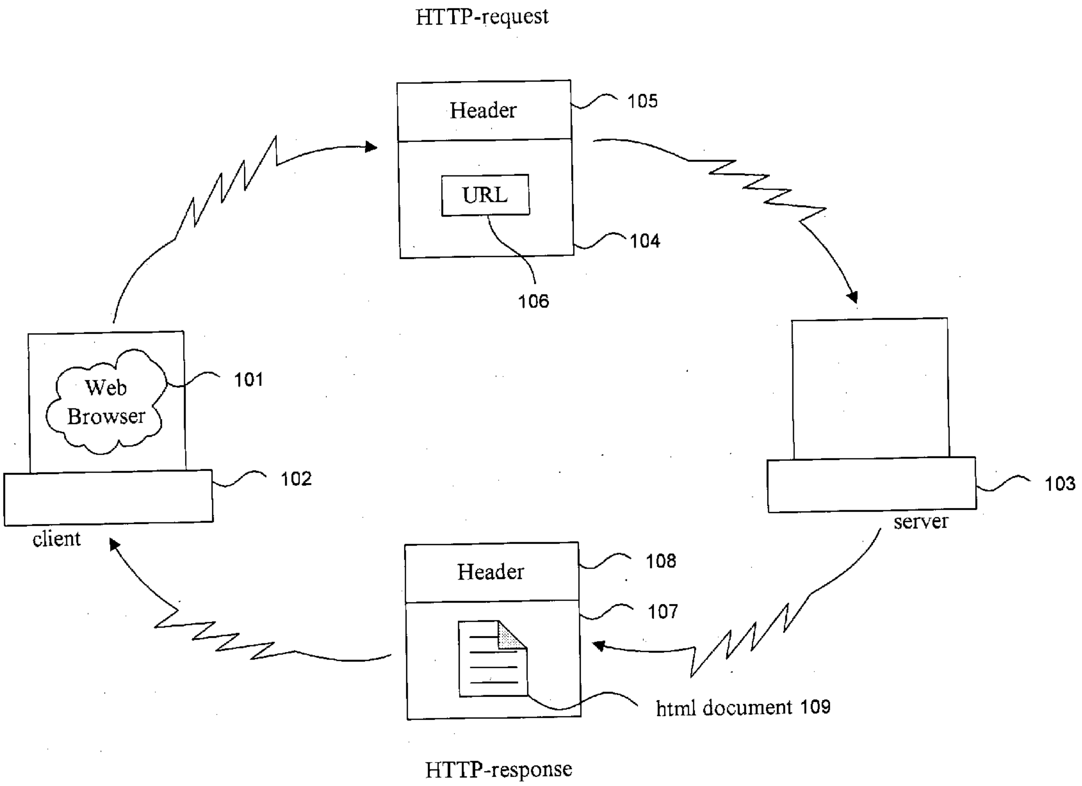
(57) **ABSTRACT**

A method and system for providing customers with access to and analysis of the navigation data collected at customer web sites is provided. In one embodiment, a data warehouse system collects customer data from the customer web sites and stores the data at a data warehouse server. The customer data may include navigation data (e.g., click stream log files), user attribute data of users of the customer web site (e.g., name, age, and gender), product data (e.g., catalog of products offered for sale by the customer), shopping call data (i.e., identification of the products currently in a user's shopping call), and so on. When the data warehouse server receives customer data, it converts the customer data into a format that is more conducive to processing by decision support system applications by which customers can analyze their data. For example, the data warehouse server may analyze low-level navigation events (e.g., each HTTP request that is received by the customer web site) to identify high-level events (e.g., a user session). The data warehouse server then stores the converted data into a data warehouse.



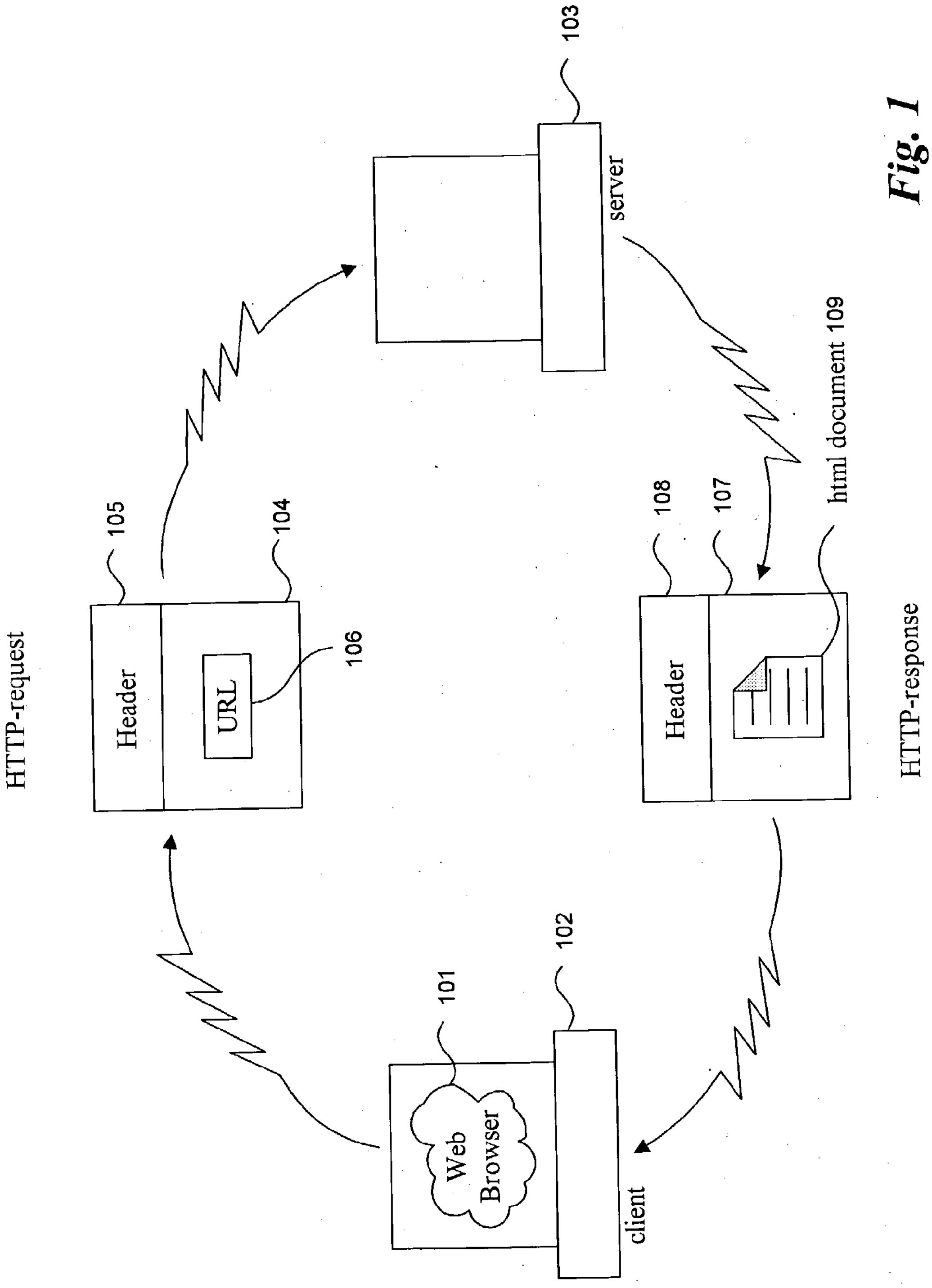

HTTP-request
Header
URL
105
104
106
server
103
html document 109
108
107
Header
HTTP-response
Web Browser
101
102
client

Fig. 1

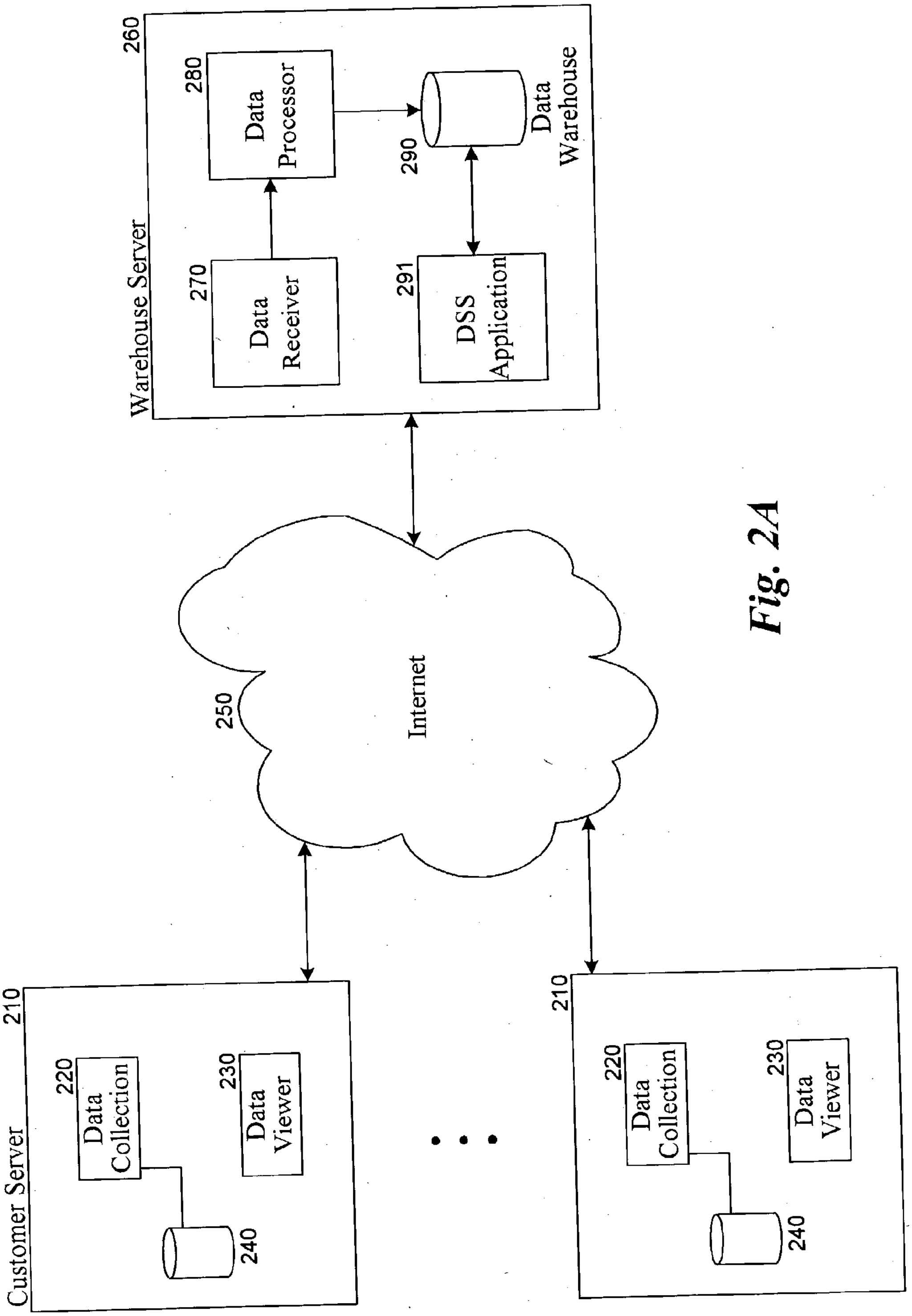

Warehouse Server
260
280
Data Processor
270
Data Receiver
290
Data Warehouse
291
DSS Application
250
Internet
Customer Server
210
220
Data Collection
230
Data Viewer
240
210
220
Data Collection
230
Data Viewer
240
• • •

Fig. 2A

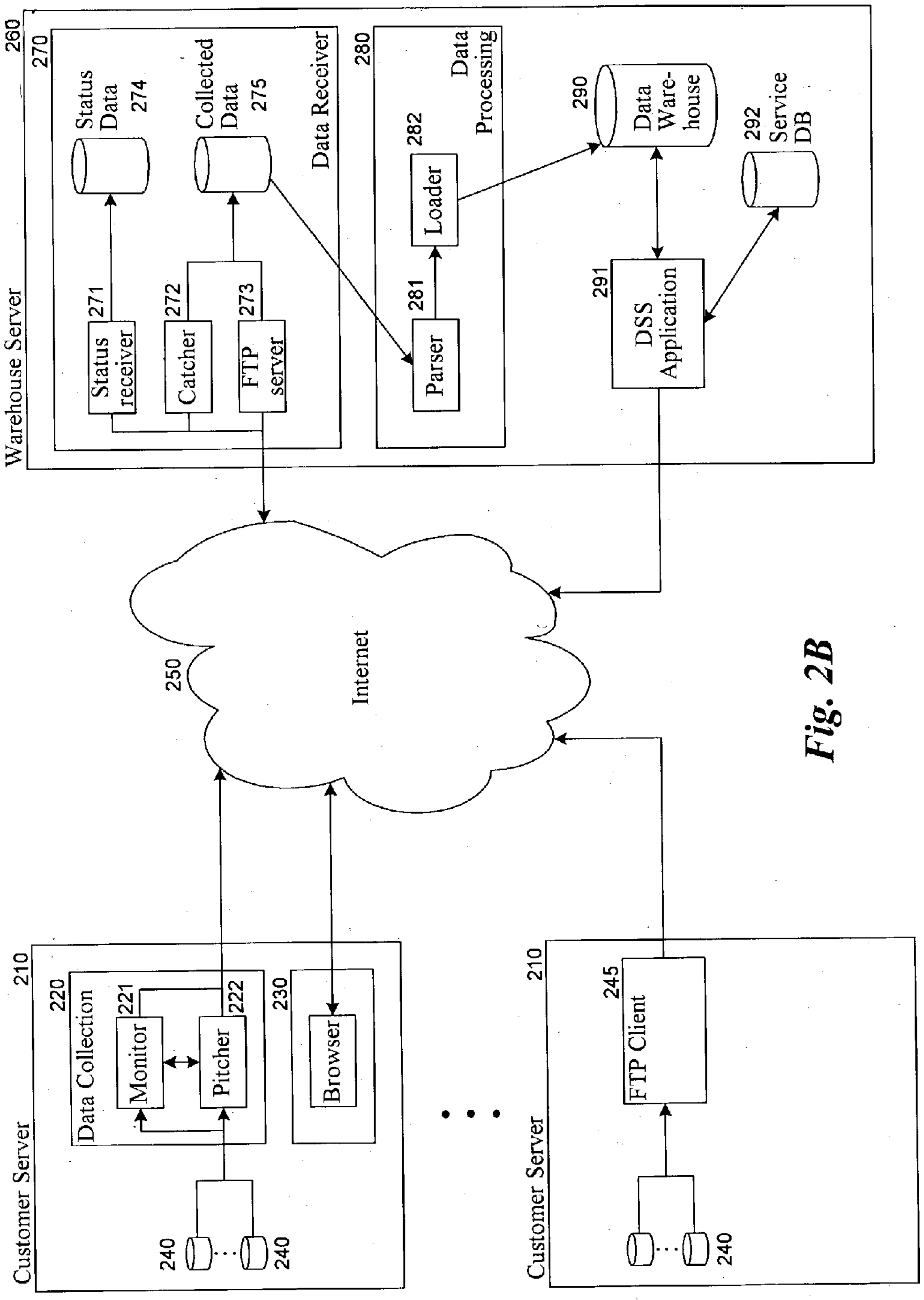

Warehouse Server
260
270
Status Data
274
Collected Data
275
Data Receiver
271
Status receiver
272
Catcher
273
FTP server
280
Data Processing
282
Loader
281
Parser
290
Data Ware-house
291
DSS Application
292
Service DB
250
Internet
Customer Server
210
220
Data Collection
221
Monitor
222
Pitcher
230
Browser
240
240
• • •
Customer Server
210
245
FTP Client
240

Fig. 2B

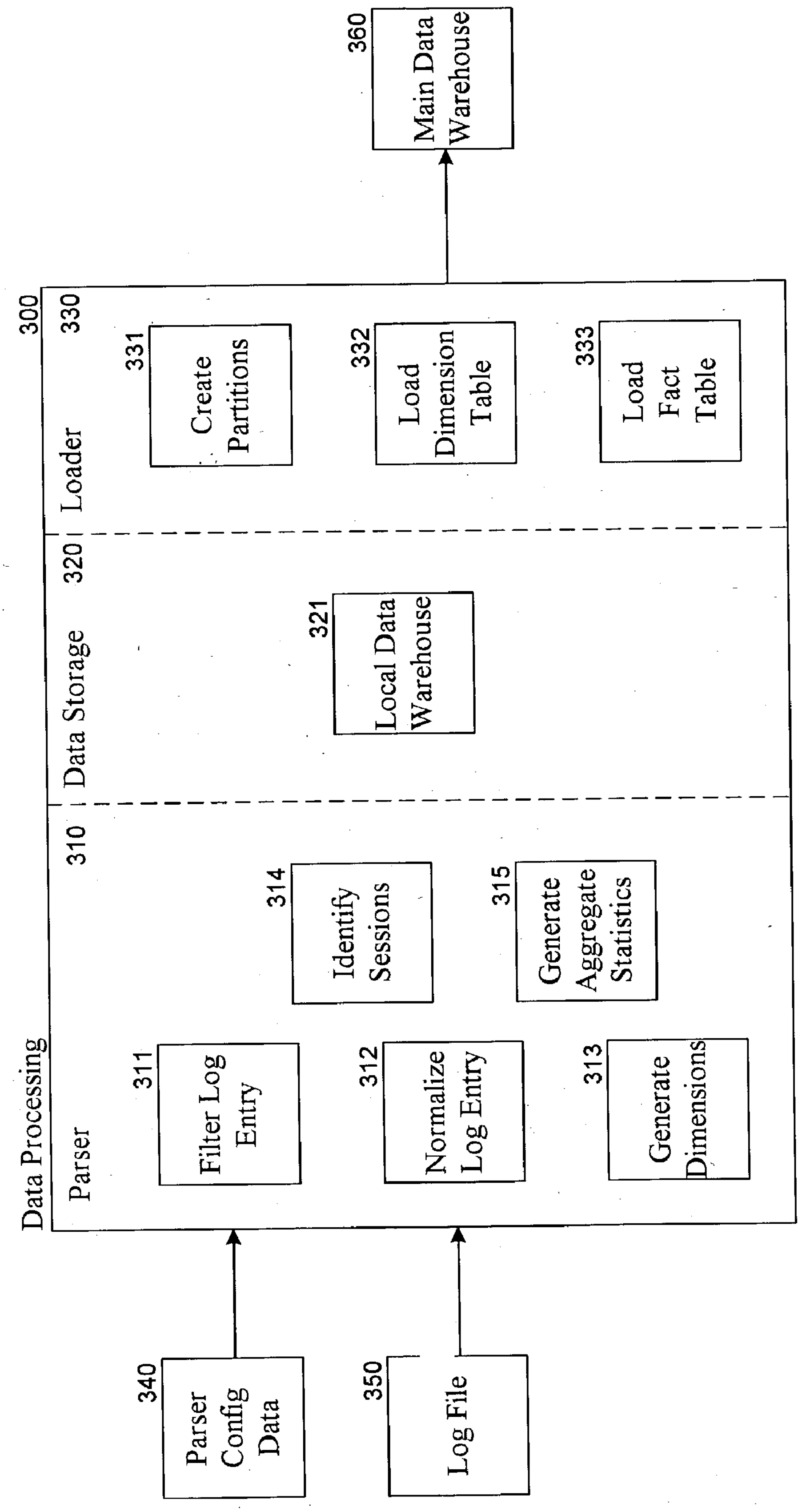

300
Data Processing
310
Parser
311
Filter Log Entry
312
Normalize Log Entry
313
Generate Dimensions
314
Identify Sessions
315
Generate Aggregate Statistics
320
Data Storage
321
Local Data Warehouse
330
Loader
331
Create Partitions
332
Load Dimension Table
333
Load Fact Table
340
Parser Config Data
350
Log File
360
Main Data Warehouse

Fig. 3

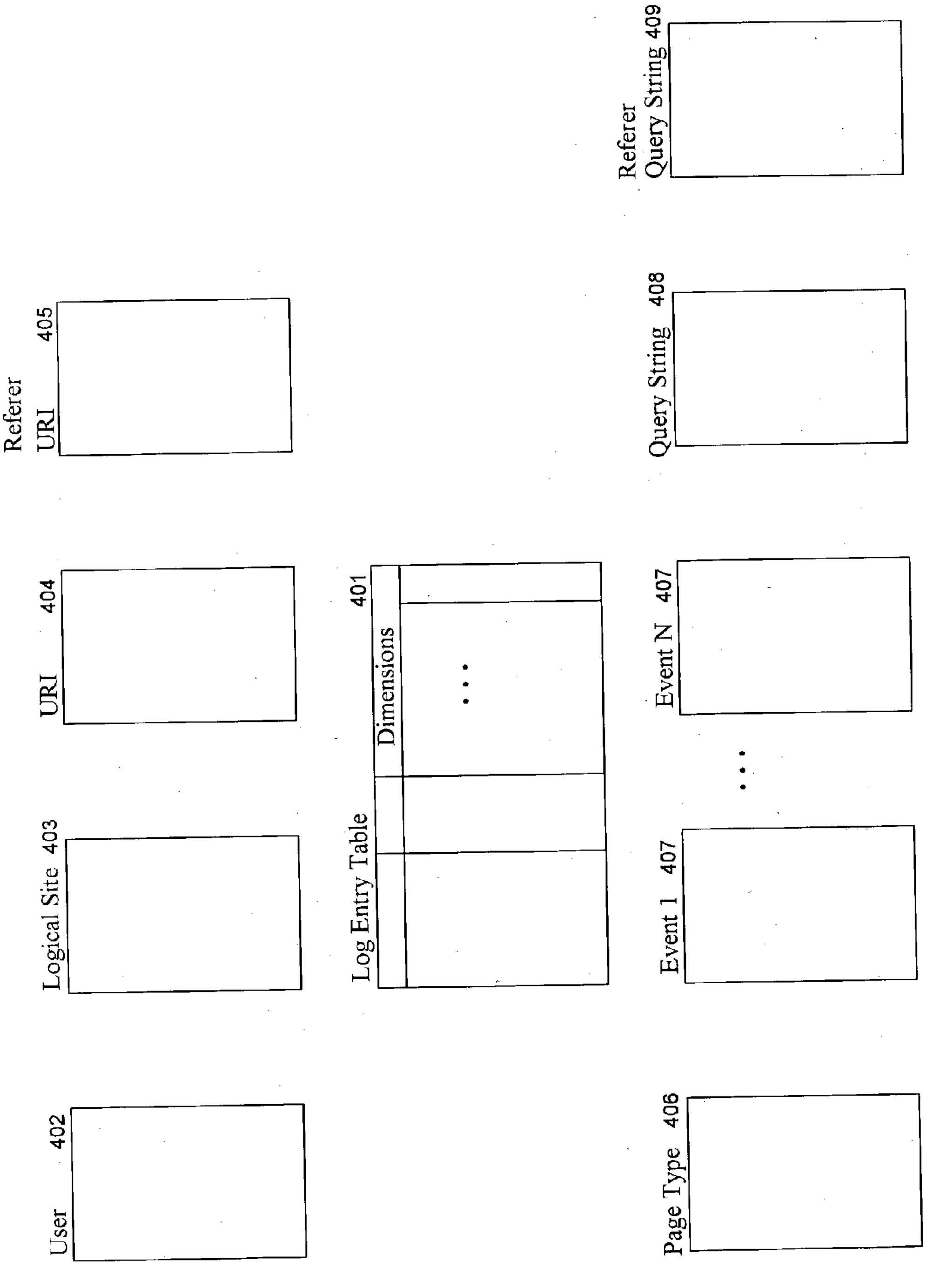

User 402
Logical Site 403
URI 404
Referer URI 405
Log Entry Table
Dimensions
401
Page Type 406
Event 1 407
Event N 407
Query String 408
Referer Query String 409

Fig. 4

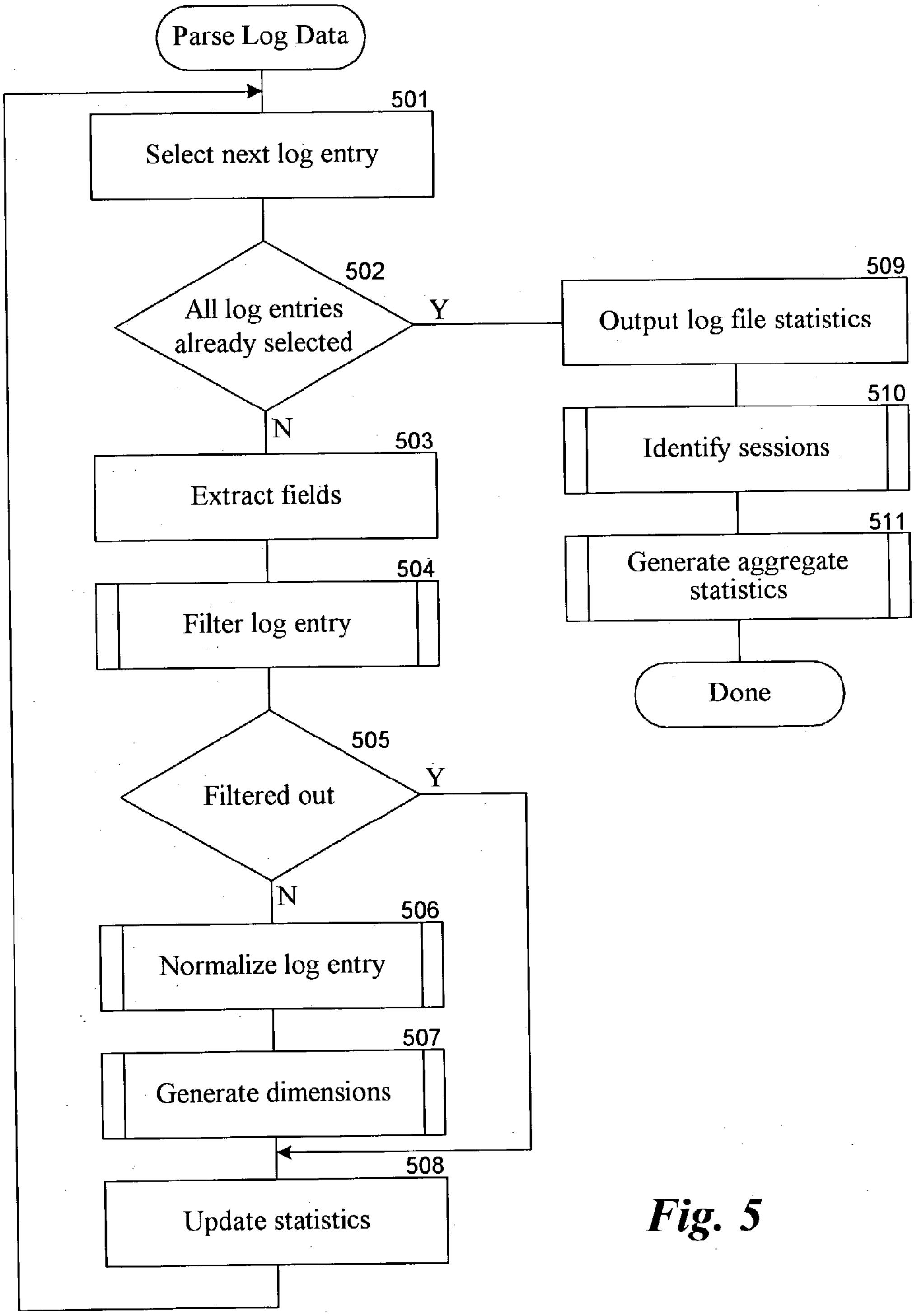

Parse Log Data
501
Select next log entry
502
All log entries already selected
Y
N
509
Output log file statistics
510
Identify sessions
511
Generate aggregate statistics
Done
503
Extract fields
504
Filter log entry
505
Filtered out
Y
N
506
Normalize log entry
507
Generate dimensions
508
Update statistics

Fig. 5

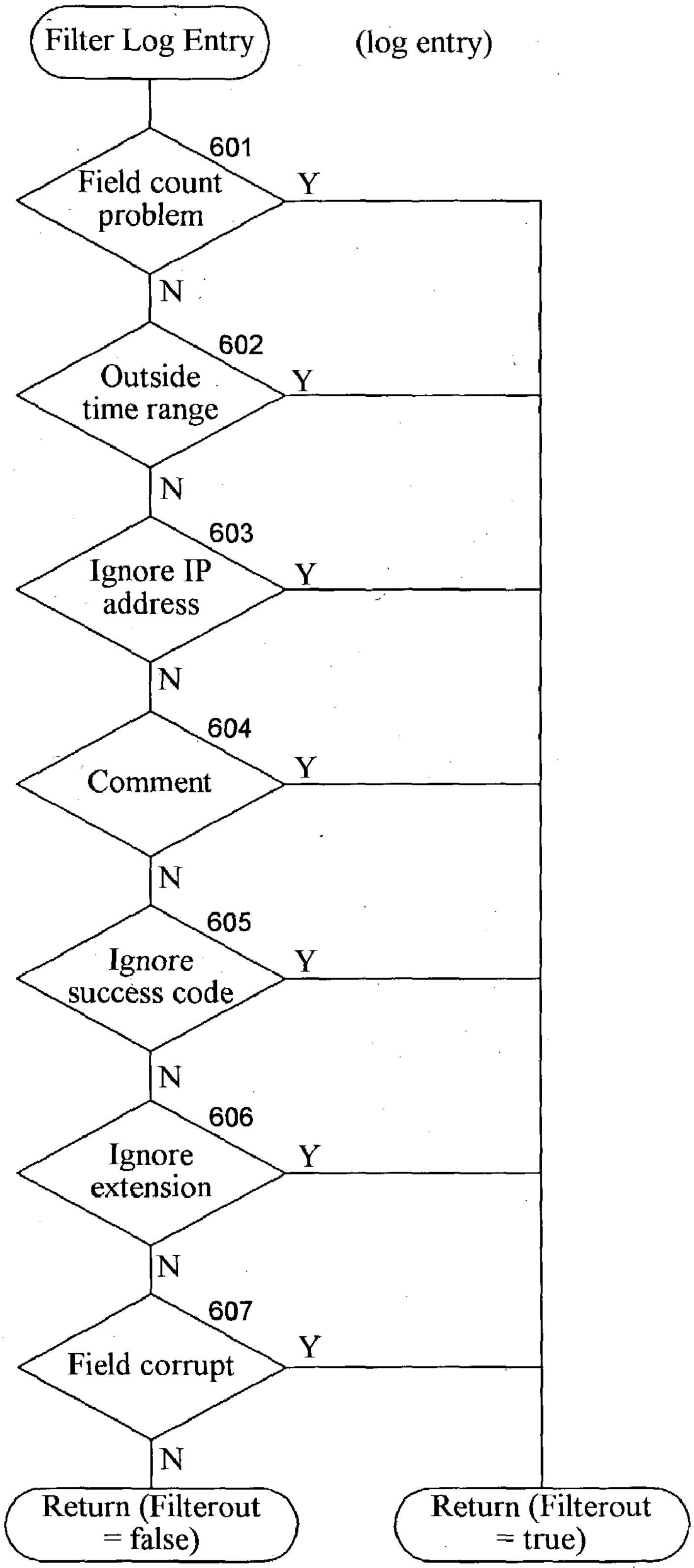

Filter Log Entry
(log entry)
601
Field count problem
Y
N
602
Outside time range
Y
N
603
Ignore IP address
Y
N
604
Comment
Y
N
605
Ignore success code
Y
N
606
Ignore extension
Y
N
607
Field corrupt
Y
N
Return (Filterout = false)
Return (Filterout = true)

Fig. 6

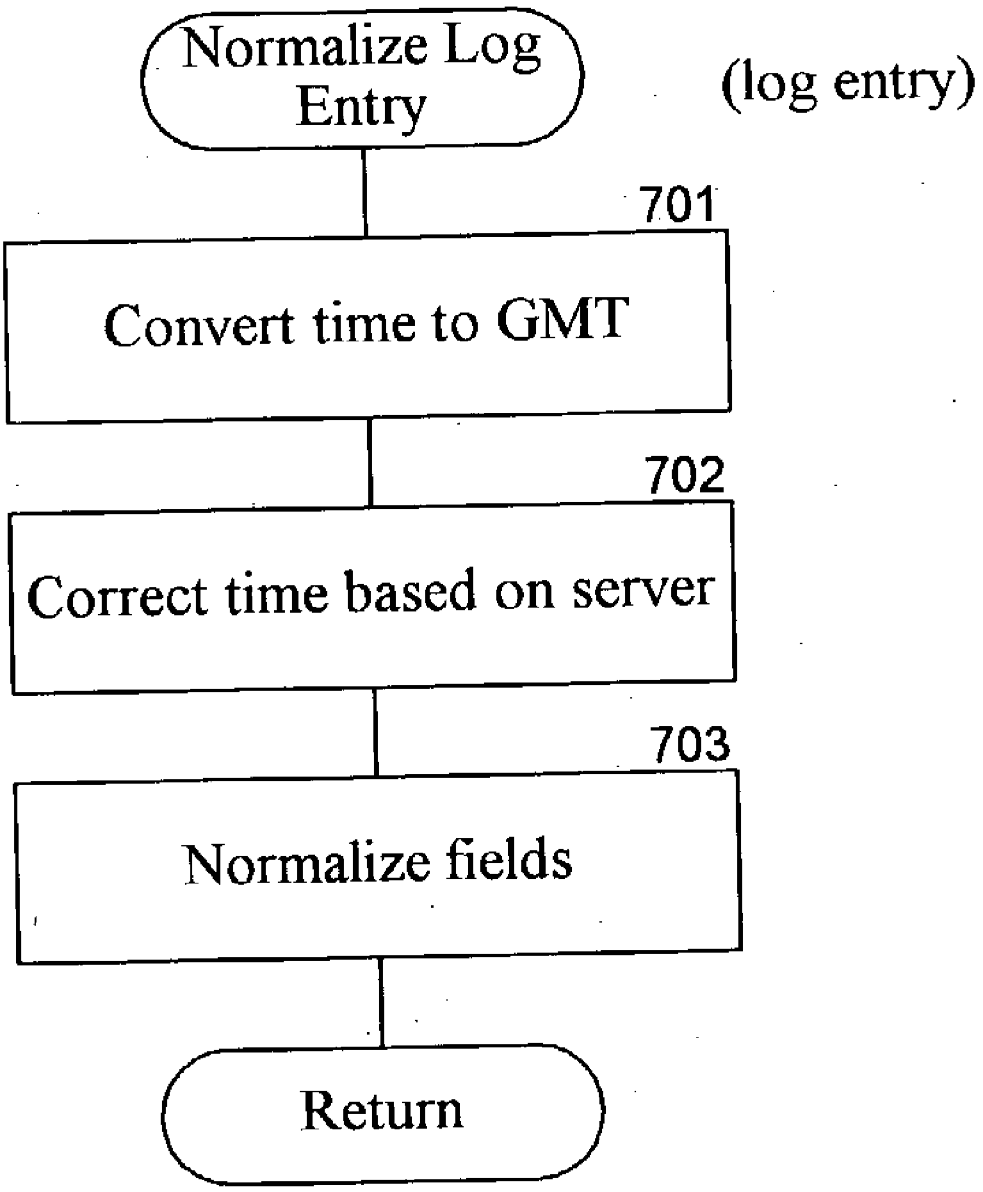

Normalize Log Entry
(log entry)
701
Convert time to GMT
702
Correct time based on server
703
Normalize fields
Return

Fig. 7

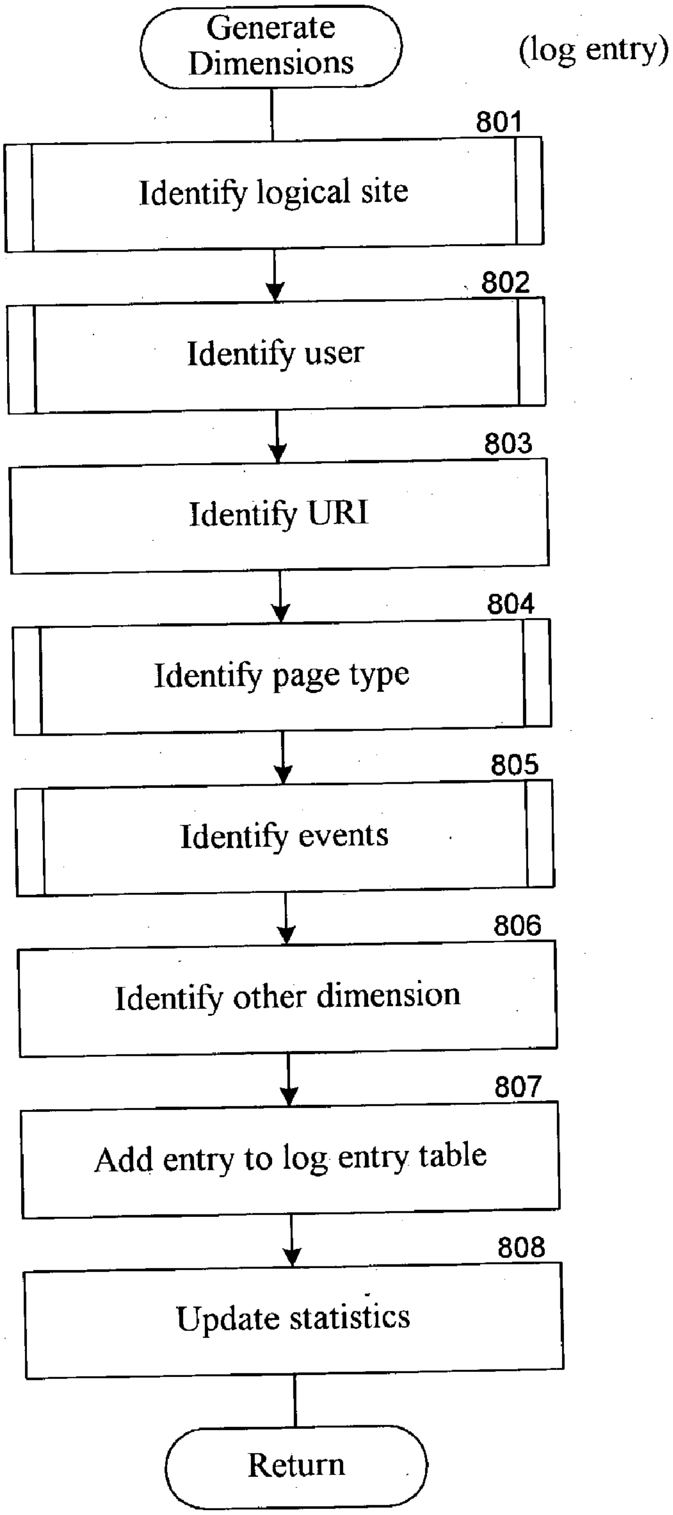

Generate Dimensions
(log entry)
801
Identify logical site
802
Identify user
803
Identify URI
804
Identify page type
805
Identify events
806
Identify other dimension
807
Add entry to log entry table
808
Update statistics
Return

Fig. 8

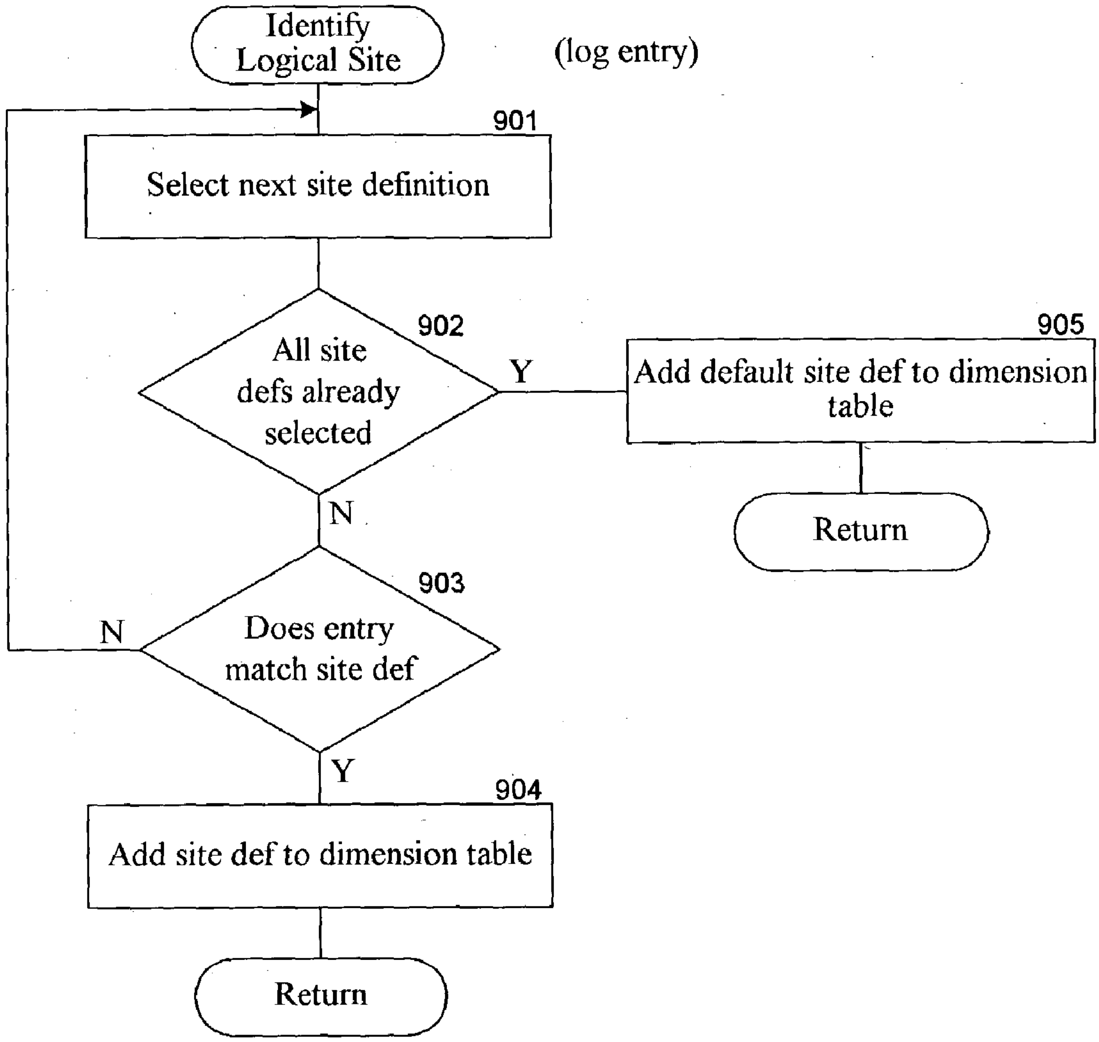

Identify Logical Site
(log entry)
901
Select next site definition
902
All site defs already selected
Y
905
Add default site def to dimension table
Return
N
903
N
Does entry match site def
Y
904
Add site def to dimension table
Return

Fig. 9

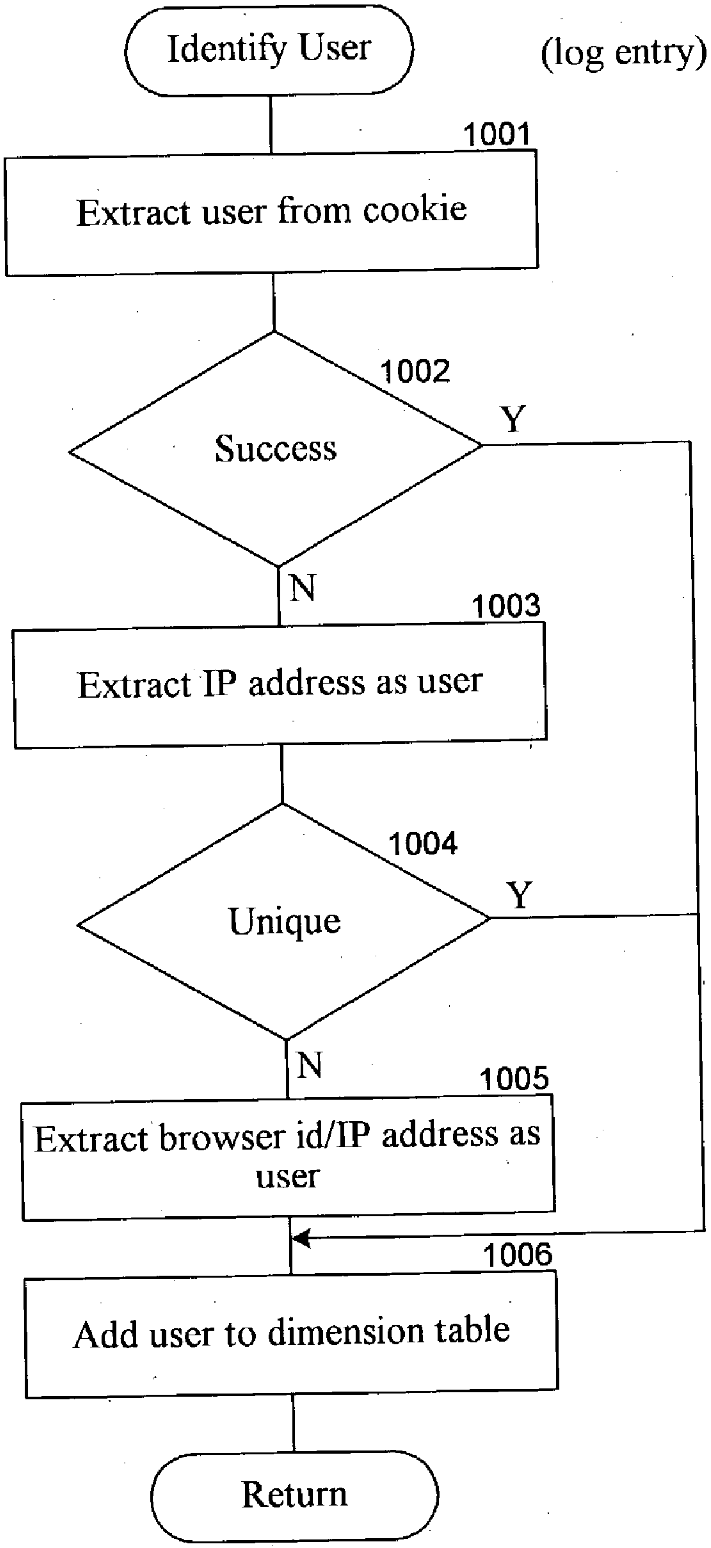

Identify User
(log entry)
1001
Extract user from cookie
1002
Success
Y
N
1003
Extract IP address as user
1004
Unique
Y
N
1005
Extract browser id/IP address as user
1006
Add user to dimension table
Return

Fig. 10

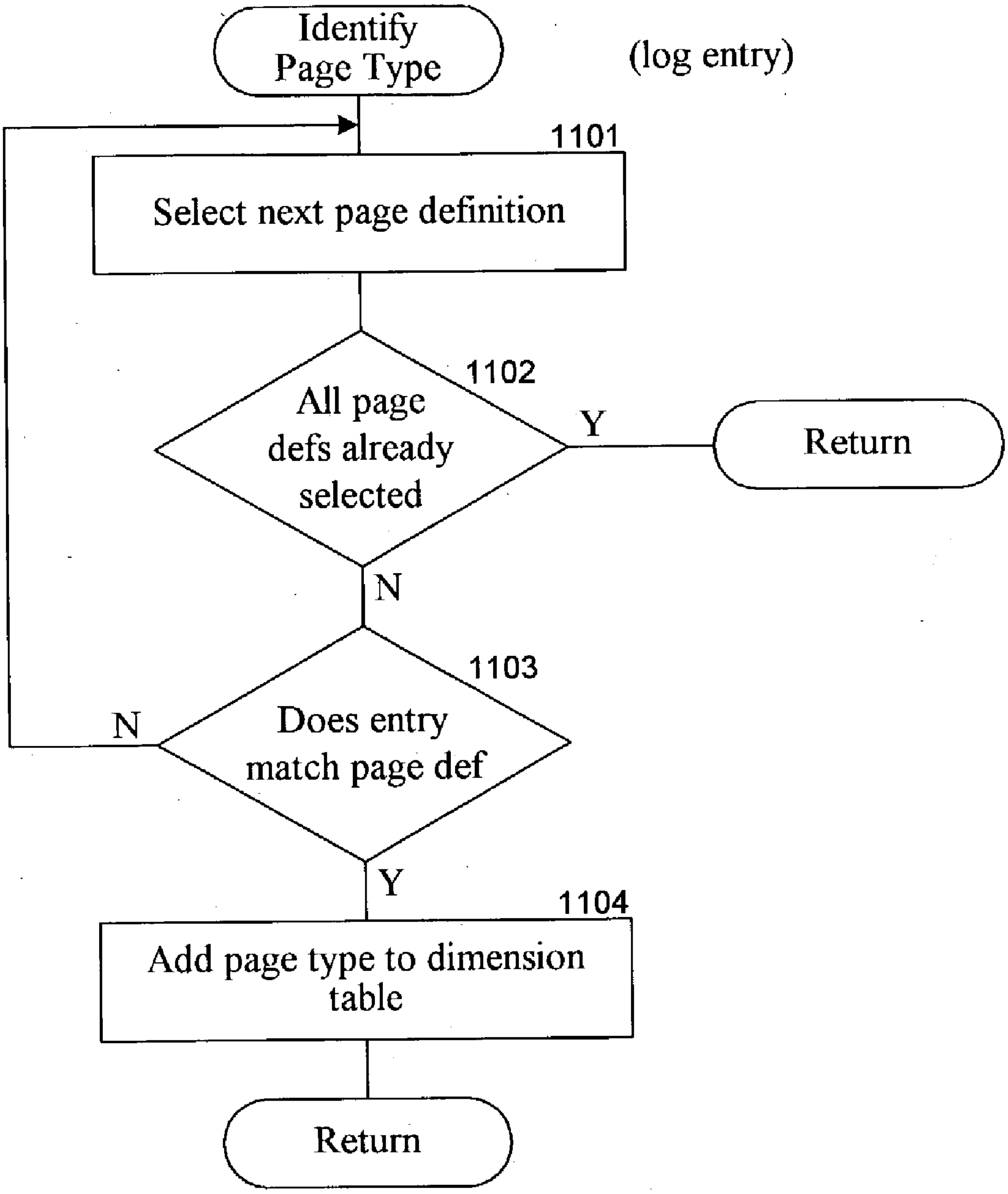

Identify Page Type
(log entry)
1101
Select next page definition
1102
All page defs already selected
Y
Return
N
1103
N
Does entry match page def
Y
1104
Add page type to dimension table
Return

Fig. 11

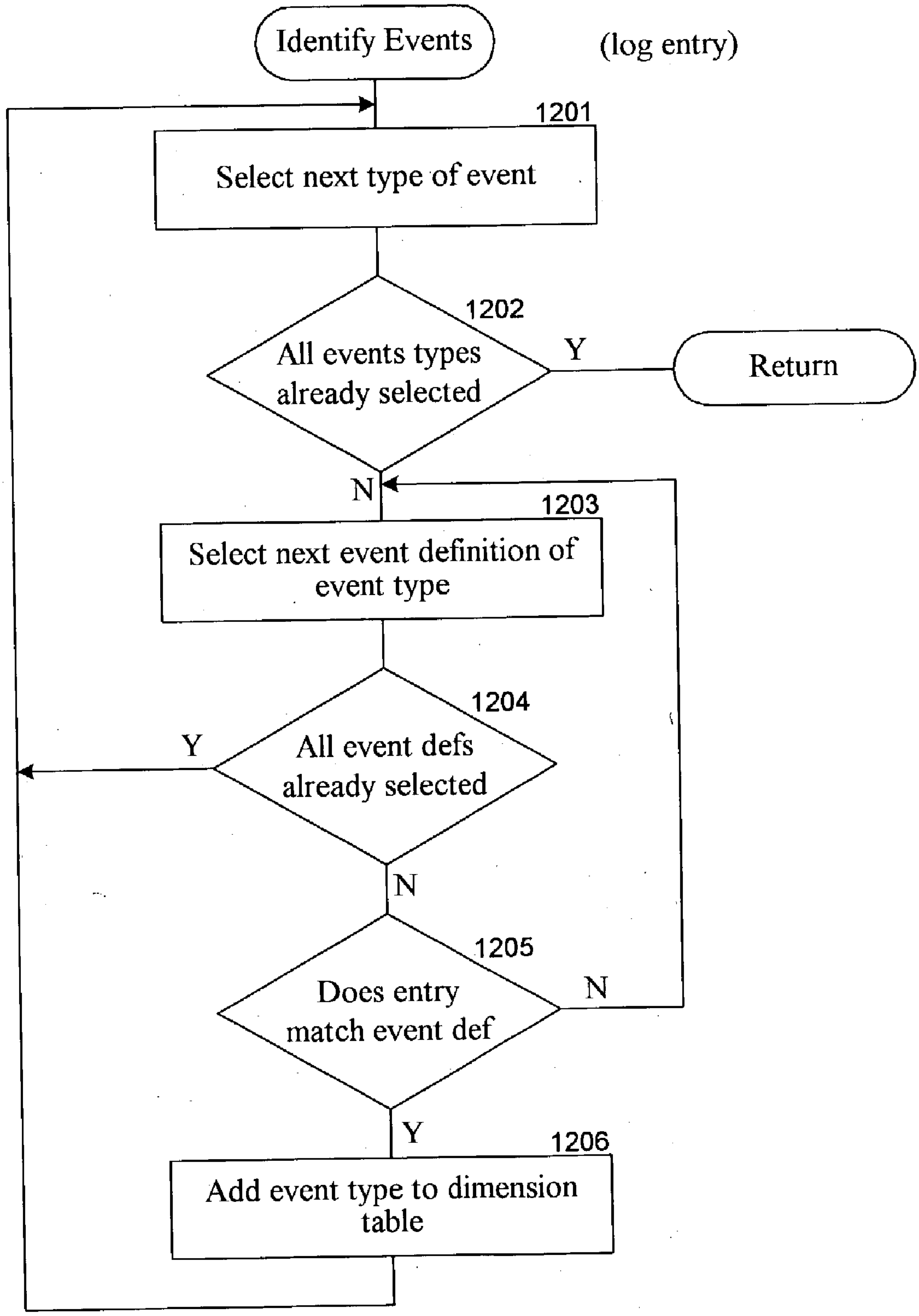

Identify Events
(log entry)
1201
Select next type of event
1202
All events types already selected
Y
Return
N
1203
Select next event definition of event type
1204
Y
All event defs already selected
N
1205
Does entry match event def
N
Y
1206
Add event type to dimension table

Fig. 12

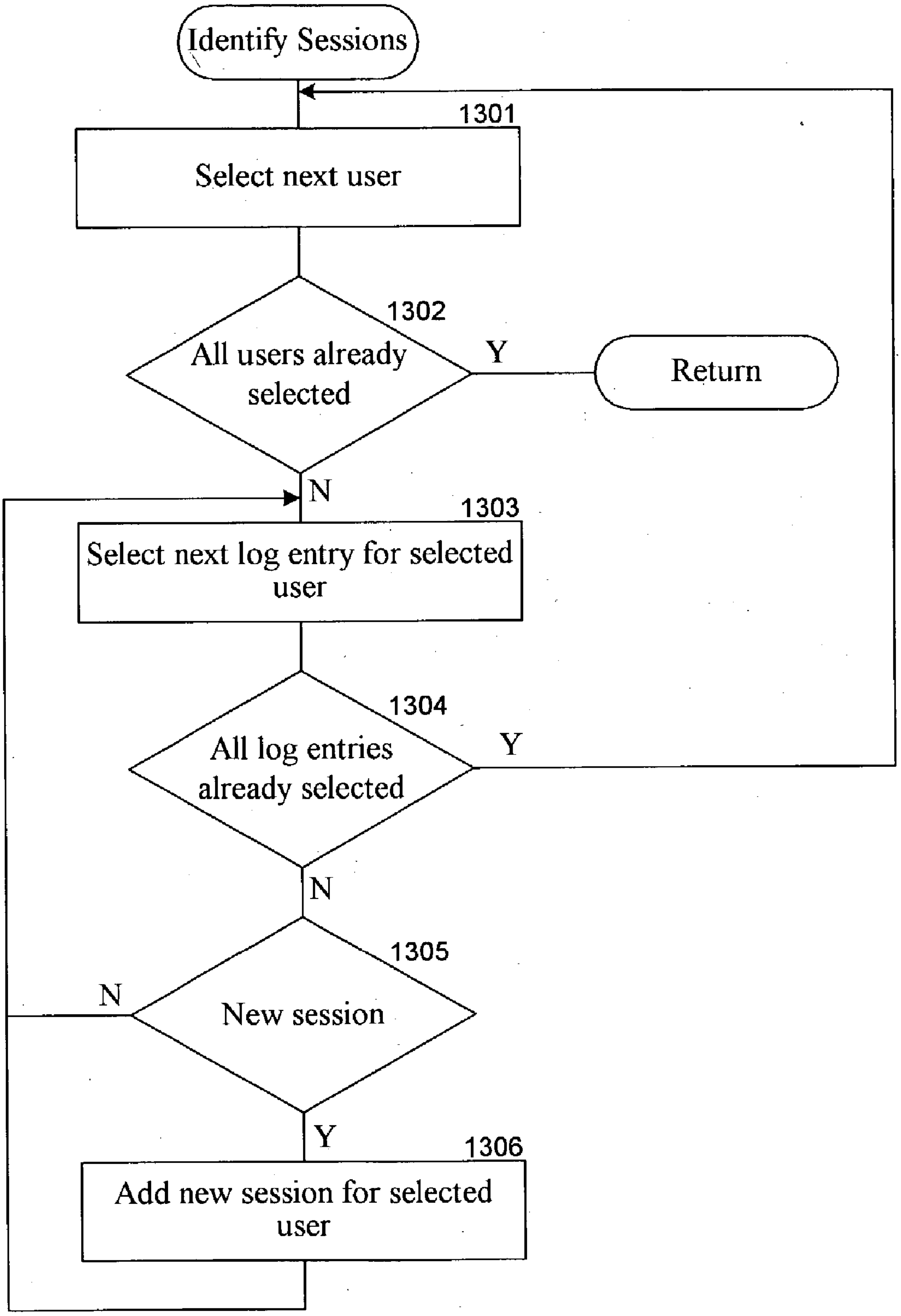

Identify Sessions
1301
Select next user
1302
All users already selected
Y
Return
N
1303
Select next log entry for selected user
1304
All log entries already selected
Y
N
1305
New session
N
Y
1306
Add new session for selected user

Fig. 13

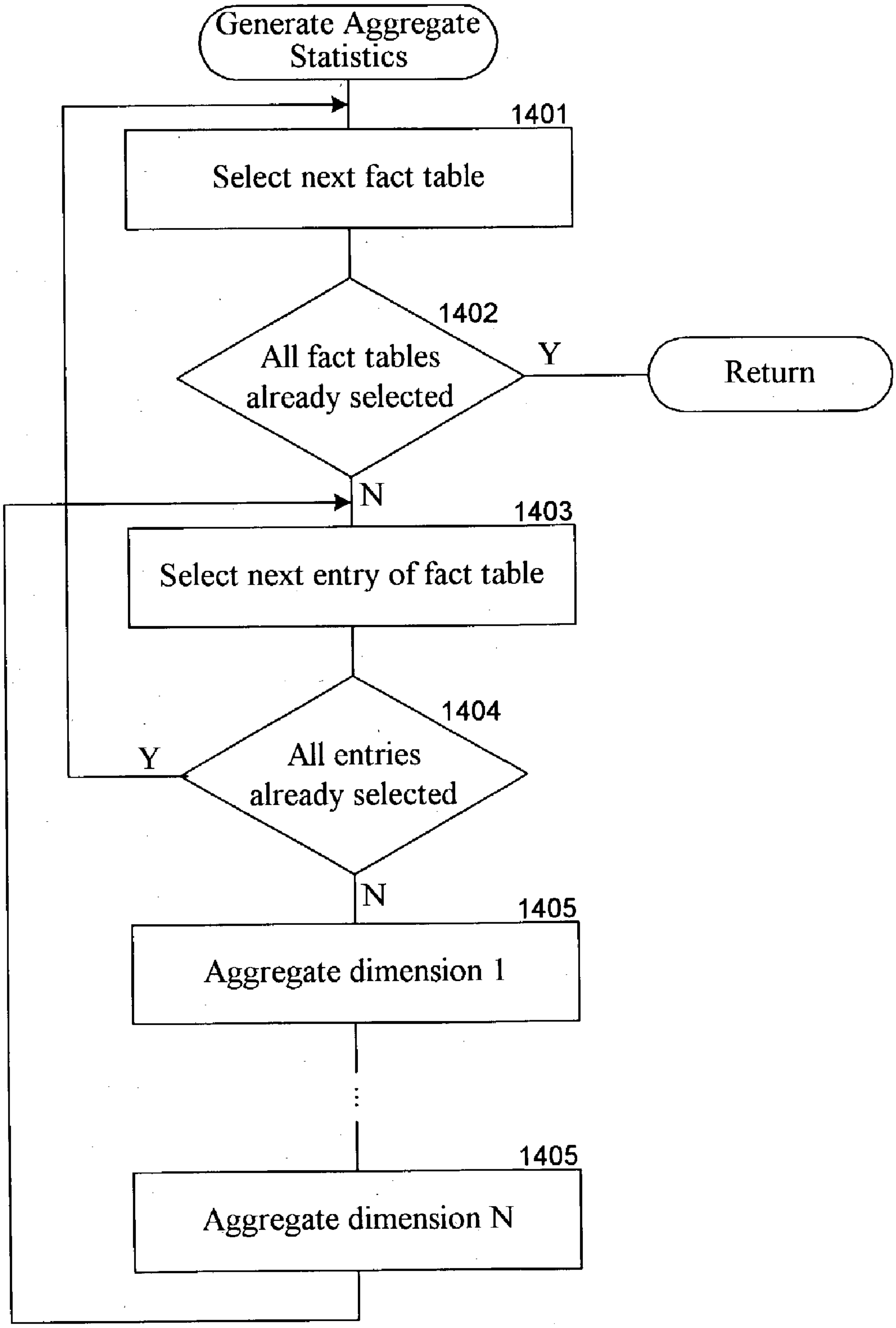

Generate Aggregate Statistics
1401
Select next fact table
1402
All fact tables already selected
Y
Return
N
1403
Select next entry of fact table
1404
All entries already selected
Y
N
1405
Aggregate dimension 1
1405
Aggregate dimension N

Fig. 14

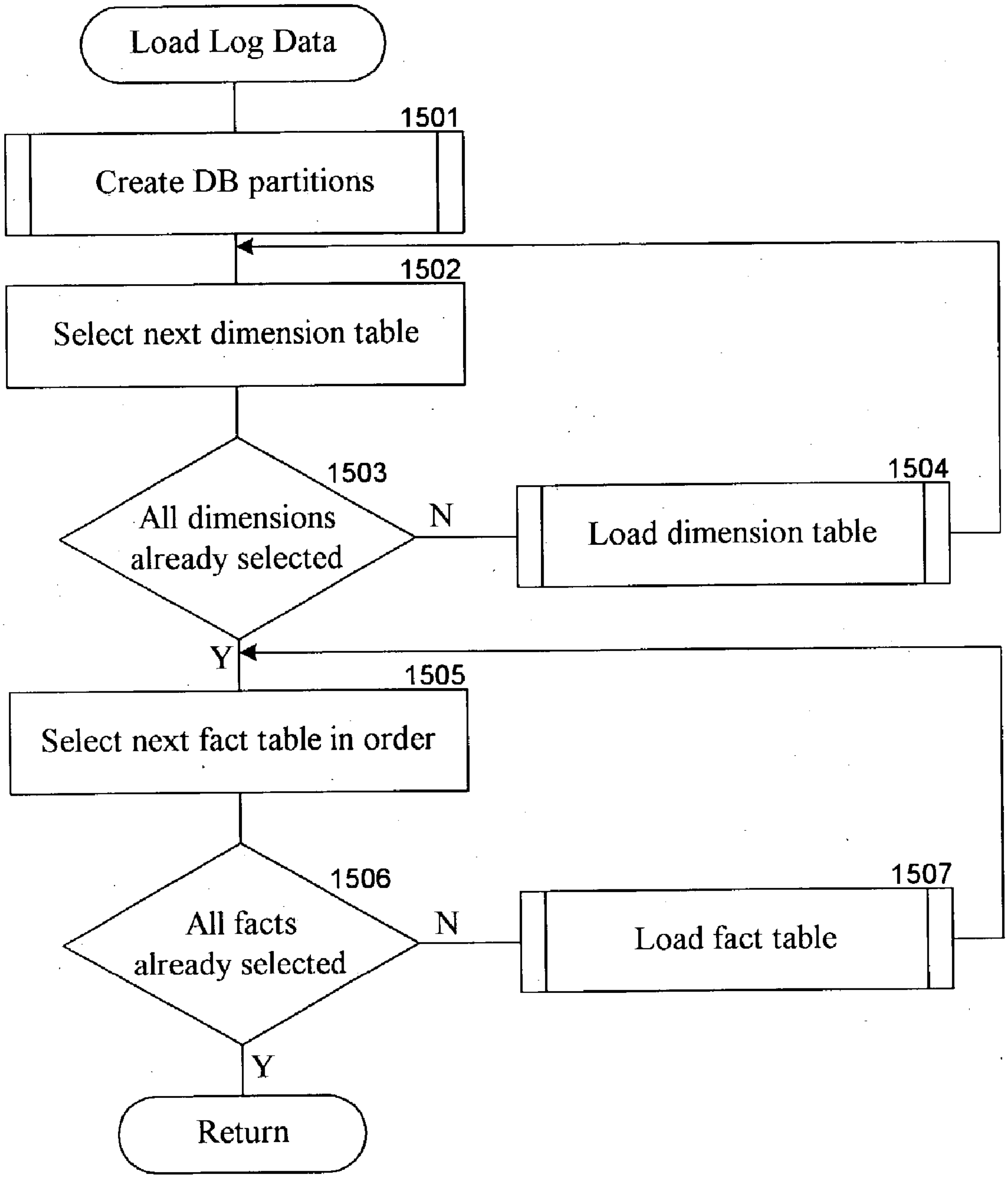

Load Log Data
1501
Create DB partitions
1502
Select next dimension table
1503
All dimensions already selected
N
1504
Load dimension table
Y
1505
Select next fact table in order
1506
All facts already selected
N
1507
Load fact table
Y
Return

Fig. 15

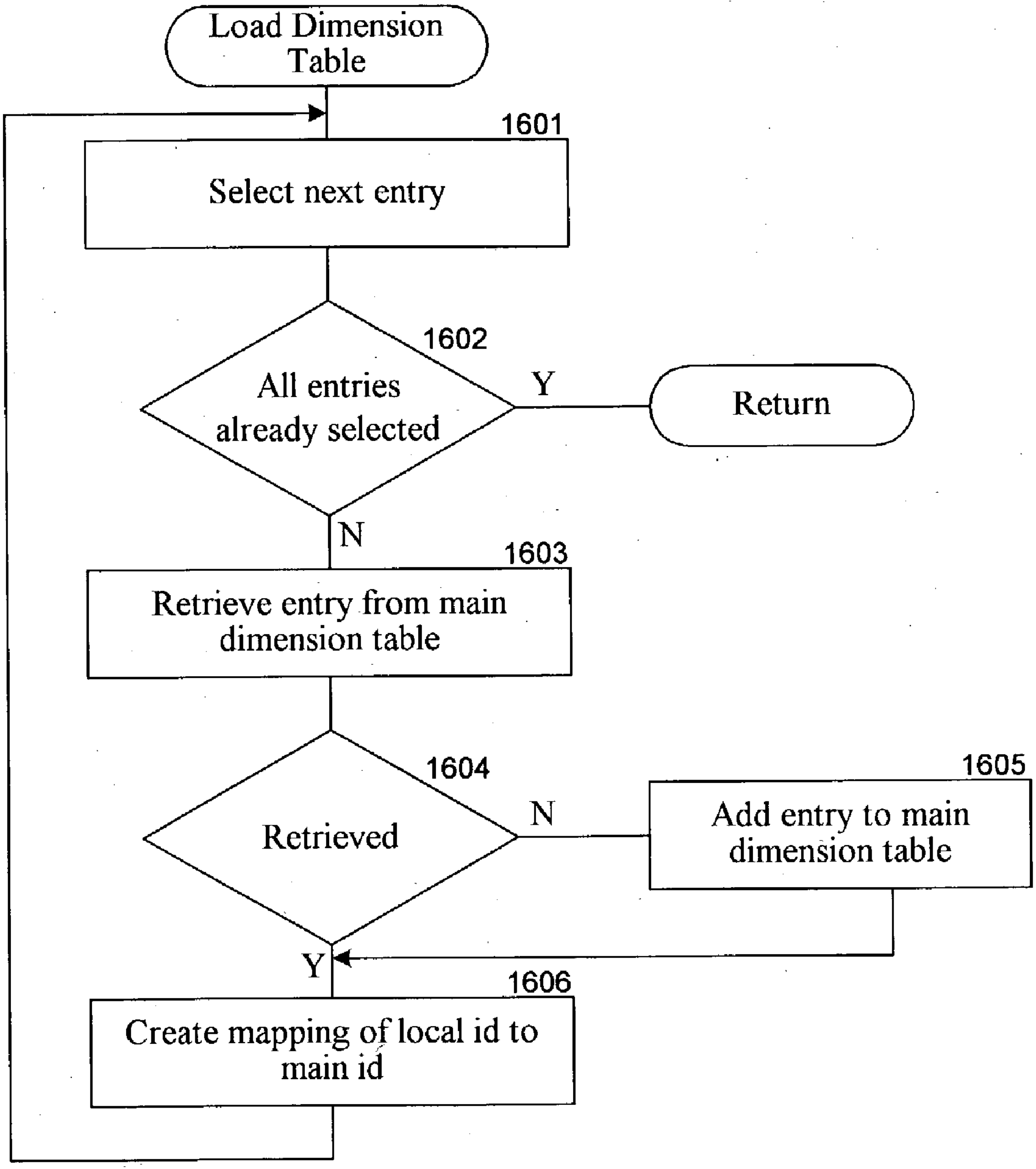

Load Dimension Table
1601
Select next entry
1602
All entries already selected
Y
Return
N
1603
Retrieve entry from main dimension table
1604
Retrieved
N
1605
Add entry to main dimension table
Y
1606
Create mapping of local id to main id

Fig. 16

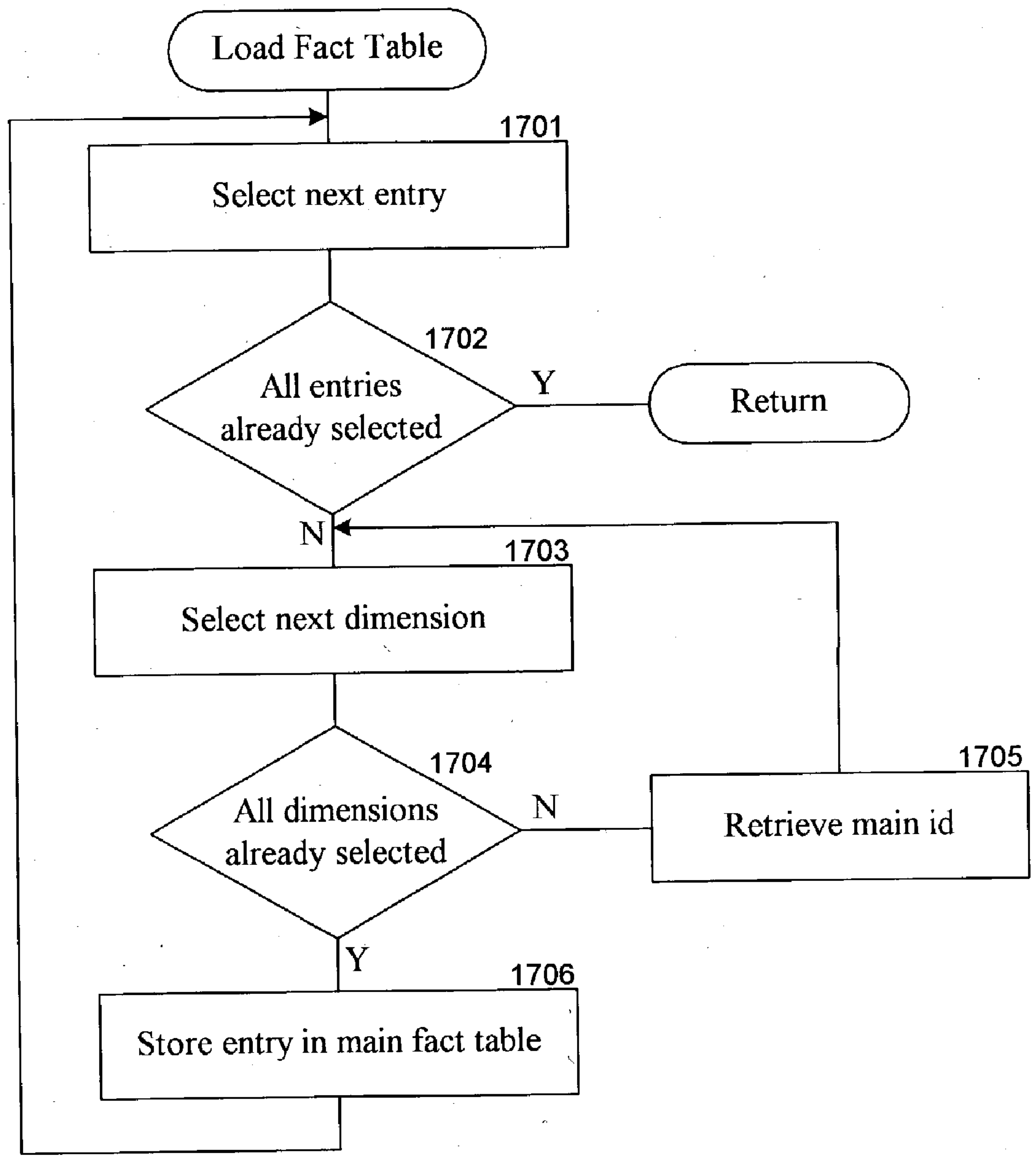

Load Fact Table
1701
Select next entry
1702
All entries already selected
Y
Return
N
1703
Select next dimension
1704
All dimensions already selected
N
1705
Retrieve main id
Y
1706
Store entry in main fact table

Fig. 17

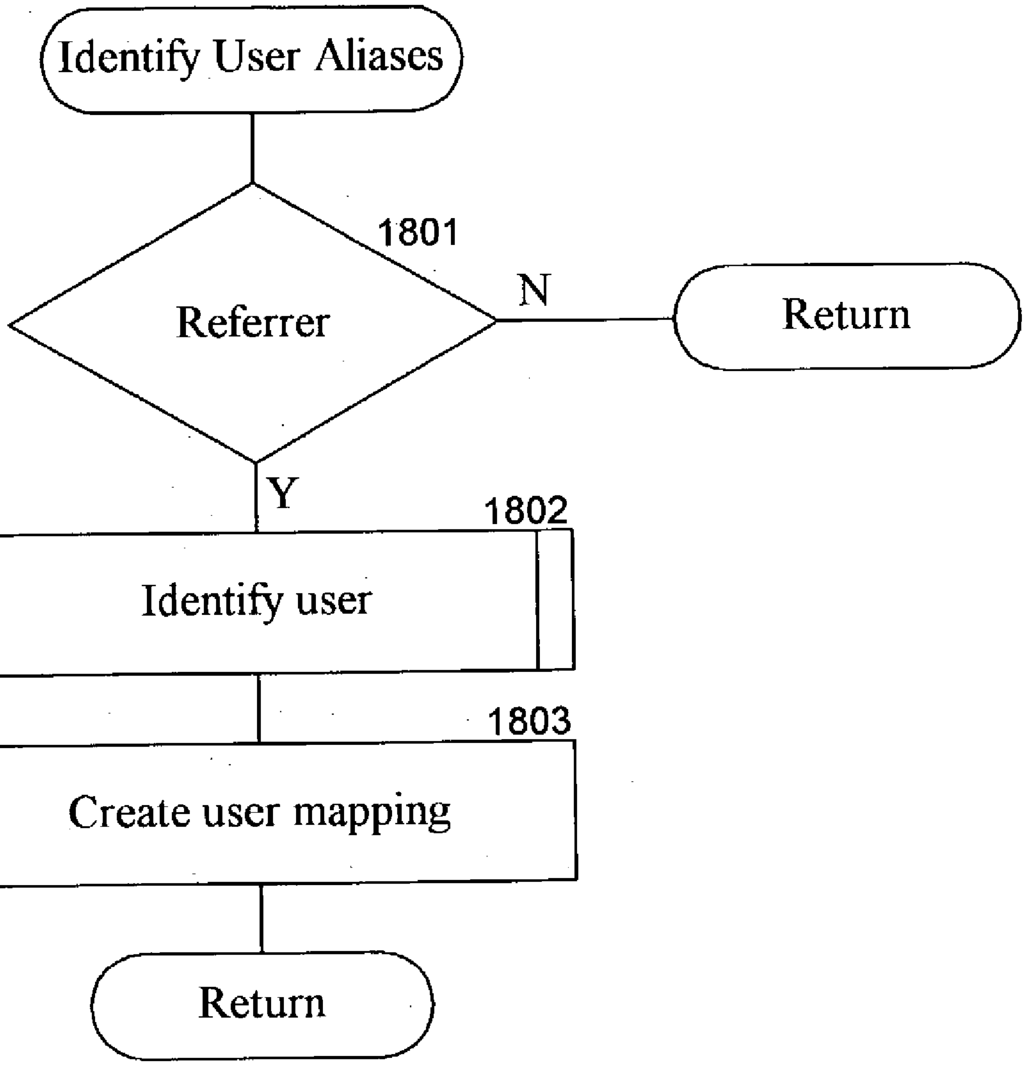

Identify User Aliases
1801
Referrer
N
Return
Y
1802
Identify user
1803
Create user mapping
Return

Fig. 18

METHOD AND SYSTEM FOR PARSING NAVIGATION INFORMATION

TECHNICAL FIELD

[**0001**] The described technology relates to analyzing of data relating to events generated by a computer program.

BACKGROUND

[**0002**] Today's computer networking environments, such as the Internet, offer mechanisms for delivering documents between heterogeneous computer systems. One such network, the World Wide Web network, which comprises a subset of Internet sites, supports a standard protocol for requesting and receiving documents known as web pages. This protocol is known as the Hypertext Transfer Protocol, or "HTTP." HTTP defines a message passing protocol for sending and receiving packets of information between diverse applications. Details of HTTP can be found in various documents including T. Berners-Lee et al., *Hypertext Transfer Protocol—HTTP* 1.0, Request for Comments (RFC) 1945, MIT/LCS, May 1996. Each HTTP message follows a specific layout, which includes among other information, a header which contains information specific to the request or response. Further, each HTTP request message contains a universal resource identifier (a "URI"), which specifies to which network resource the request is to be applied. A URI is either a Uniform Resource Locator ("URL") or Uniform Resource Name ("URN"), or any other formatted string that identifies a network resource. The URI contained in a request message, in effect, identifies the destination machine for a message. URLs, as an example of URIs, are discussed in detail in T. Berners-Lee, et al., *Uniform Resource Locators* (URL), RFC 1738, CERN, Xerox PARC, Univ. of Minn., December 1994.

[**0003**] **FIG. 1** illustrates how a browser application enables users to navigate among nodes on the web network by requesting and receiving web pages. For the purposes of this discussion, a web page is any type of document that abides by the HTML format. That is, the document includes an "<HTML>" statement. Thus, a web page is also referred to as an HTML document. The HTML format is a document mark-up language, defined by the Hypertext Markup Language ("HTML") specification. HTML defines tags for specifying how to interpret the text and images stored in an HTML document. For example, there are HTML tags for defining paragraph formats and for emboldening and underlining text. In addition, the HTML format defines tags for adding images to documents and for formatting and aligning text with respect to images. HTML tags appear between angle brackets, for example, <HTML>. Further details of HTML are discussed in T. Berners-Lee and D. Connolly, *Hypertext Markup Language*-2.0, RFC 1866, MIT/W3C, November 1995.

[**0004**] In **FIG. 1, a** web browser application **101** is shown executing on a client computer **102**, which communicates with a server computer **103** by sending and receiving HTTP packets (messages). HTTP messages may also be generated by other types of computer programs, such as spiders and crawlers. The web browser "navigates" to new locations on the network to browse (display) what is available at these locations. In particular, when the web browser "navigates" to a new location, it requests a new document from the new location (e.g., the server computer) by sending an HTTP-request message **104** using any well-known underlying communications wire protocol. The HTTP-request message follows the specific layout discussed above, which includes a header **105** and a URI field **106**, which specifies the network location to which to apply the request. When the server computer specified by URI receives the HTTP-request message, it interprets the message packet and sends a return message packet to the source location that originated the message in the form of an HTTP-response message **107**. It also stores a copy of the request and basic information about the requesting computer in a log file. In addition to the standard features of an HTTP message, such as the header **108**, the HTTP-response message contains the requested HTML document **109**. When the HTTP-response message reaches the client computer, the web browser application extracts the HTML document from the message, and parses and interprets (executes) the HTML code in the document and displays the document on a display screen of the client computer as specified by the HTML tags. HTTP can also be used to transfer other media types, such as the Extensible Markup Language ("XML") and graphics interchange format ("GIF") formats.

[**0005**] The World Wide Web is especially conducive to conducting electronic commerce ("e-commerce"). E-commerce generally refers to commercial transactions that are at least partially conducted using the World Wide Web. For example, numerous web sites are available through which a user using a web browser can purchase items, such as books, groceries, and software. A user of these web sites can browse through an electronic catalog of available items to select the items to be purchased. To purchase the items, a user typically adds the items to an electronic shopping call and then electronically pays for the items that are in the shopping cart. The purchased items can then be delivered to the user via conventional distribution channels (e.g., an overnight courier) or via electronic delivery when, for example, software is being purchased. Many web sites are also informational in nature, rather than commercial in nature. For example, many standards organizations and governmental organizations have web sites with a primary purpose of distributing information. Also, some web sites (e.g., a search engine) provide information and derive revenue from advertisements that are displayed.

[**0006**] The success of any web-based business depends in large pall on the number of users who visit the business's web site and that number depends in large part on the usefulness and ease-of-use of the web site. Web sites typically collect extensive information on how its users use the site's web pages. This information may include a complete history of each HTTP request received by and each HTTP response sent by the web site. The web site may store this information in a navigation file, also referred to as a log file or click stream file. By analyzing this navigation information, a web site operator may be able to identify trends in the access of the web pages and modify the web site to make it easier to use and more useful. Because the information is presented as a series of events that are not soiled in a useful way, many software tools are available to assist in this analysis. A web site operator would typically purchase such a tool and install it on one of the computers of the web site. There are several drawbacks with the use of such an approach of analyzing navigation information. First, the analysis often is given a low priority because the programmers are typically busy with the high priority task of maintaining the web site. Second, the tools that are available provide little more than standard reports relating to low-level navigation through a web site. Such reports are not very useful in helping a web site operator to visualize and discover high-level access trends. Recognition of these high-level access trends can help a web site operator to design the web site. Third, web sites are typically resource intensive, that is they use a lot of computing resources and may not have available resources to effectively analyze the navigation information.

[0007] It would also be useful to analyze the execution of computer programs, other than web server programs. In particular, many types of computer programs generate events that are logged by the computer programs themselves or by other programs that receive the events. If a computer program does not generate explicit events, another program may be able to monitor the execution and generate events on behalf of that computer program. Regardless of how event data is collected, it may be important to analyze that data. For example, the developer of an operating system may want to track and analyze how the operating system is used so that the developer can focus resources on problems that are detected, optimize services that are frequently accessed, and so on. The operating system may generate a log file that contains entries for various types of events (e.g., invocation of a certain system call).

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] **FIG. 1** illustrates how a browser application enables users to navigate among nodes on the web network by requesting and receiving web pages.

[0009] **FIG. 2A** is a block diagram illustrating components of the data warehouse system in one embodiment.

[0010] **FIG. 2B** is a block diagram illustrating details of the components of the data warehouse system in one embodiment.

[0011] **FIG. 3** is a block diagram illustrating the subcomponents of the data processor component in one embodiment.

[0012] **FIG. 4** is a block diagram illustrating some of the tables of the local data warehouse and the main data warehouse in one embodiment.

[0013] **FIG. 5** is a flow diagram illustrating the parse log data routine that implements the parser in one embodiment.

[0014] **FIG. 6** is a flow diagram of the filter log entry routine in one embodiment.

[0015] **FIG. 7** is a flow diagram illustrating the normalize log entry routine.

[0016] **FIG. 8** is a flow diagram of the generate dimensions routine in one embodiment.

[0017] **FIG. 9** is a flow diagram of the identify logical site routine in one embodiment.

[0018] **FIG. 10** is a flow diagram of the identify user routine in one embodiment.

[0019] **FIG. 11** is a flow diagram of the identify page type routine in one embodiment.

[0020] **FIG. 12** is a flow diagram illustrating the identify events routine in one embodiment.

[0021] **FIG. 13** is a flow diagram illustrating the identify sessions routine in one embodiment.

[0022] **FIG. 14** is a flow diagram of the generate aggregate statistics routine in one embodiment.

[0023] **FIG. 15** is a flow diagram of the import log data routine implementing the importer in one embodiment.

[0024] **FIG. 16** is a flow diagram of the load dimension table routine and one embodiment.

[0025] **FIG. 17** is a flow diagram of the load fact table routine in one embodiment.

[0026] **FIG. 18** is a flow diagram illustrating the identify user aliases routine in one embodiment.

DETAILED DESCRIPTION

[0027] A method and system for providing customers with access to and analysis of event data (e.g., navigation data collected at customer web sites) is provided. The event data may be stored in log files and supplemented with data from other sources, such as product databases and customer invoices. In one embodiment, a data warehouse system collects customer data from the customer web sites and stores the data at a data warehouse server. The customer data may include application event data (e.g., click stream log files), user attribute data of users of the customer web site (e.g., name, age, and gender), product data (e.g., catalog of products offered for sale by the customer), shopping call data (i.e., identification of the products currently in a user's shopping cart), and so on. The data warehouse server interacts with the customer servers to collect to the customer data on a periodic basis. The data warehouse server may provide instructions to the customer servers identifying the customer data that is to be uploaded to the data warehouse server. These instructions may include the names of the files that contains the customer data and the name of the web servers on which the files reside. These instructions may also indicate the time the day when the customer data is to be uploaded to the data warehouse server. When the data warehouse server receives customer data, it converts the customer data into a format that is more conducive to processing by decision support system applications by which customers can analyze their data. For example, the data warehouse server may analyze low-level navigation events (e.g., each HTTP request that is received by the customer web site) to identify high-level events (e.g., a user session). The data warehouse server then stores the converted data into a data warehouse. The data warehouse server functions as an application service provider that provides various decision support system applications to the customers. For example, the data warehouse server provides decision support system applications to analyze and graphically display the results of the analysis for a customer. The decision support system applications may be accessed through a web browser. In one embodiment, the customer servers are connected to the data warehouse server via the Internet and the data warehouse server provides data warehousing services to multiple customers.

[0028] The data warehouse system may provide a data processor component that converts the log files into a format that is more conducive to processing by the decision support system applications. In one embodiment, the converted data is stored in a data warehouse that includes fact and dimension tables. Each fact table contains entries corresponding to a type of fact derived from the log files. For example, a web page access fact table may contain an entry for each web page access identified in the log files. Each entry may reference attributes of the web page access, such as the identity of the web page and identity of the accessing user. The values for each attribute are stored in a dimension table for that attribute. For example, a user dimension table may include an entry for each user and the entries of the web access fact table may include a user field that contains an index (or some other reference) to the entry of the user dimension table for the accessing user. The user dimension table may contain the names of the users and other user-specific information. Alternatively, the user dimension table may itself also be a fact table that includes references to dimension tables for the attributes of users. The data warehouse may also include fact tables and dimension tables that represent high-level facts and attributes derived from the low-level facts and attributes of the log files. For example, high-level facts and attributes may not be derivable from only the data in a single log entry. For example, the higher level category (e.g., shoes or shirts) of a web page may be identified using a mapping of web page URIs to categories. These categories may be stored in a category dimension table. Also, certain facts, such as the collection of log entries that comprise a single user web access session or visit, may only be derivable by analyzing a series of log entries.

[**0029**] The data processor component may have a parser component and a loader component. The parser of the data processor parses and analyzes a log file and stores the resulting data in a local data warehouse that contains information for only that log file. The local data warehouse may be similar in structure (e.g., similar fact and dimension tables) to the main data warehouse used by decision support system applications. The local data warehouse may be adapted to allow efficient processing by the parser. For example, the local data warehouse may be stored in primary storage (e.g., main memory) for speed of access, rather than in secondary storage (e.g., disks). The parser may use parser configuration data that defines, on a customer-by-customer-basis, the high-level data to be derived from the log entries. For example, the parser configuration data may specify the mapping of URIs to web page categories. The loader of the data processor transfers the data from the local data warehouse to the main data warehouse. The loader may create separate partitions for the main data warehouse. These separate partitions may hold the customer data for a certain time period (e.g., a month's worth of data). The loader adds entries to the main fact tables (i.e., fact tables of the main data warehouse) for each fact in a local fact table (i.e., fact table of the local data warehouse). The loader also adds new entries to the main dimension tables to represent attribute values of the local dimension tables that are not already in the main dimension tables. The loader also maps the local indices (or other references) of the local dimension tables to the main indices used by the main dimension tables.

[**0030**] **FIG. 2A** is a block diagram illustrating components of the data warehouse system in one embodiment. The data warehouse system includes customer components that execute on the customer servers and data warehouse components that execute on the data warehouse server. The customer servers **210** and the data warehouse server **260** are interconnected via the Internet **250**. Customer components executing on a customer server includes a data collection component **220** and a data viewer **230**. The data viewer may reside on a client computer of the customer, rather than a server. The data collection component collects the customer data from the storage devices **240** of the customer servers. The data viewer provides access for viewing of data generated by the decision support system applications of the data warehouse server. In one embodiment, the data viewer may be a web browser. The data warehouse server includes a data receiver component **270**, the data processor component **280**, the data warehouse **290**, and decision support system applications **291**. The data receiver component receives customer data sent by the data collection components executing at the various customer web sites. The data processor component processes the customer data and stores it in the data warehouse. The decision support system application provides the customer with tools for analyzing and reviewing the customer data that is stored in the main data warehouse. Analysis performed on and reports generated from are described in U.S. patent application No. ______ (Attorney Ref. No. 34821-8010US), entitled "Identifying and Reporting on Combinations of Events in Usage Data," and U.S. patent application No. ______ (Attorney Ref No. 34821-8013US), entitled "Extracting and Displaying Usage Data for Graphical Structures," which are being filed concurrently and which are hereby incorporated by reference. In one embodiment, each customer has its own set of dimension and fact tables so that the information of multiple customers are not intermingled.

[**0031**] **FIG. 2B** is a block diagram illustrating details of the components of the data warehouse system in one embodiment. The data collection component **220** includes a monitor sub-component **221** and a pitcher sub-component **222**. The data collection component is described in more detail in U.S. patent application No. ______ (Attorney Ref. No. 34821-8001US), entitled "Method and System for Monitoring Resource via the Web," which is being filed concurrently and which is hereby incorporated by reference. The pitcher is responsible for retrieving instructions from the data warehouse server, collecting the customer data in accordance with the retrieved instructions, and uploading the customer data to the data warehouse server. The monitor is responsible for monitoring the operation of the pitcher and detecting when the pitcher may have problems in collecting and uploading the customer data. When the monitor detects that a problem may occur, it notifies the data warehouse server so that corrective action may be taken in advance of the collecting and uploading of the customer data. For example, the pitcher may use certain log on information (e.g., user ID and password) to access a customer web server that contains customer data to be uploaded. The monitor may use that log on information to verify that the log on information will permit access to the customer data. Access may be denied if, for example, a customer administrator inadvertently deleted from the customer web server the user ID used by the pitcher. When the monitor provides advance notification of a problem, the problem might be corrected before the pitcher attempts to access the customer data. The monitor also periodically checks the pitcher to ensure that the pitcher is executing and, if executing, executing correctly.

[0032] The data receiver component of the data warehouse server includes a status receiver sub-component **271**, a catcher sub-component **272**, an FTP server **273**, a status database **274**, and a collected data database **275**. The status receiver receives status reports from the customer servers and stores the status information in the status database. The catcher receives and processes the customer data that is uploaded from the customer web sites and stores the data in the collected data database. The data processor component includes a parser sub-component **281** and a loader sub-component **282**. The parser analyzes the low-level events of the customer data and identifies high-level events and converts the customer data into a format that facilitates processing by the decision support system applications. The loader is responsible for storing the identified high-level events in the data warehouse **290**. In one embodiment, a customer may decide not to have the data collection component executing on its computer systems. In such a case, the customer server may include an FTP client **245** that is responsible for periodically transferring the customer data to the FTP server **273** of the data warehouse server. The data receiver may process this customer data at the data warehouse server in the same way as the pitcher processes the data at the customer servers. The processed data is then stored in the collected data database.

[0033] **FIG. 3** is a block diagram illustrating the sub-components of the data processor component in one embodiment. The data processor component **300** includes a parser **310**, data storage area **320**, and a loader **330**. The data processor component inputs parser configuration data **340** and a log file **350** and updates the main data warehouse **360**. The parser configuration data may include a mapping of actual web sites to logical sites and a mapping of a combination of Uniform Resource Identifiers ("URIs") and query strings of the log entries to page definitions (e.g., categories) and event definitions. The parser processes the entries of the log file to generate facts and dimensions to eventually be stored in the main data warehouse. The parser identifies events in accordance with the parser configuration data. The parser includes a filter log entry component **311**, a normalize log entry component **312**, a generate dimensions component **313**, an identify sessions component **314**, and a generate aggregate statistics component **315**. The filter log entry component identifies which log entries should not be included in the main data warehouse. For example, a log entry that has an invalid format should not be included. The normalize log entry component normalizes the data in a log entry. For example, the component may convert all times to Greenwich Mean Time ("GMT"). The generate dimensions component identifies the various dimensions related to a log entry. For example, a dimension may be the Uniform Resource Identifier of the entry or the logical site identifier. The identify sessions component processes the parsed log file data stored in the local data warehouse to identify user sessions. A user session generally refers to the concept of a series of web page accesses that may be related in some way, such as by temporal proximity. The generate aggregate statistics component aggregates data for the log file being processed as each log entry is processed or after the log file is parsed. The data storage area **320** includes a local data warehouse **321**. In one embodiment, the local data warehouse is stored non-persistently (or temporarily) in main memory of the computer system. The local data warehouse may contain fact tables and dimension tables that correspond generally to the tables of the main data warehouse **360**. The loader retrieves the information from the local data warehouse and stores the information in the main data warehouse. The loader includes a create partitions component **331**, a load dimension table component **332**, and a load fact table component **333**. The create partitions components creates new partitions for the main data warehouse. A partition may correspond to a collection of information within a certain time range. For example, the main data warehouse may have a partition for each month, which contains all the data for that month. The load dimension table component and the load fact table component are responsible for loading the main data warehouse with the dimensions and facts that are stored in the local data warehouse.

[0034] In one embodiment, the log file is a web server log file of a customer. The log file may be in the "Extended Log File Format" as described in the document "http://www.w3.org/TR/WD-logfile-960323" provided by the World Wide Web Consortium, which is hereby incorporated by reference. According to that description, the log file contains lines that are either directives or entries. An entry corresponds to a single HTTP transaction (e.g., HTTP request and an HTTP response) and consists of a sequence of fields (e.g., integer, fixed, URI, date, time, and string). The meaning of the fields in an entry is specified by a field directive specified in the log file. For example, a field directive may specify that a log entry contains the fields date, time, client IP address, server IP address, and success code. Each entry in the log file would contain these five fields.

[0035] The parser configuration data defines logical sites, page definitions, and event definitions. A logical site is a collection of one or more IP addresses and ports that should be treated as a single web site. For example, a web site may actually have five web servers with different IP addresses that handle HTTP requests for the same domain. These five IP addresses may be mapped to the same logical site to be treated as a single web site. The page definitions define the format of the URIs of log entries that are certain page types. For example, a URI with a query string of "category=shoes" may indicate a page type of "shoes." Each event definition defines an event type and a value for that event type. For example, a log entry with a query string that includes "search=shoes" represents an event type of "search" with an event value of "shoes." Another log entry with a query string of "add=99ABC" may represent an event type of "add" an item to the shopping cart with an event value of item number "99ABC".

[0036] **FIG. 4** is a block diagram illustrating some of the tables of the local data warehouse and the main data warehouse in one embodiment. These data warehouses are databases that include fact tables and dimension tables. A fact table contains an entry for each instance of fact (e.g., web page access). A dimension table contains an entry for each possible attribute value of an attribute (e.g., user). The entries of a fact table contain dimension fields that refer to the entries into the dimension tables for their attribute values. A table may be both a fact table and a dimension table. For example, a user dimension table with an entry for each unique user may also be a fact table that refers to attributes of the users that are stored in other dimension tables. The data warehouses contain a log entry table **401**, a user table **402**, a logical site table **403**, a URI table **404**, a referrer URI table **405**, a page type table **406**, event type tables **407**, a query string table **408**, and a referrer query string table **409**. The log entry table is a fact table that contains an entry for each log entry that is not filtered out by the parser. The other tables are dimension tables for the log entry table. The user table contains an entry for each unique user identified by the parser. The logical site table contains an entry for each logical site as defined in the parser configuration data. The URI table contains an entry for each unique URI of an entry in the log entry table. The referrer URI table contains an entry for each referrer URI of the log entry table. The page type table contains an entry for each page type identified by the parser as defined in the parser configuration data. The data warehouse contains an event table for each type of event defined in the parser configuration data. Each event table contains an entry for each event value of that event is type specified in an entry of the log entry table. The query string table contains an entry for each unique query string identified in an entry of the log entry table. The referrer query string contains an entry for each unique referrer query string identified in an entry of the log entry table.

[**0037**] Table 1 is an example portion of a log file. The "#fields" directive specifies the meaning of the fields in the log entries. Each field in a log entry is separated by a space and an empty field is represented by a hyphen. The #fields directive in this example indicates that each entry includes the date and time when the transaction was completed (i.e., "date" and "time"), the client IP address (i.e., "c-ip"), and so on. For example, the first log entry has a data and time of "2000-06-01 07:00:04" and a client IP address of "165.21.83.161."

TABLE I

```
#Software: Microsoft Internet Information Server 4.0
#Version 1.0
#Date: 2000-06-01 07:00:04
#Fields: date time c-ip cs-usemame s-sitename s-computername s-ip cs-method cs-uri-stem cs-uri-query sc-status sc-win32-
status sc-bytes cs-bytes time-taken s-port cs-version csCUser-Agent) cs(Cookie) cs(Referrer)
2000-06-01 07:00:04 165.21.83.161 - W3SVC2 COOK_002 206.191.163.41 GET /direetory/28.ASP - 200 0 148428 369
9714     80     HTTP/1.0 Mozilla/3.04+(Win95;+1) ASPSESSIONIDQQGGQGPG=JBCCFIPBBHHDANBAFFIGLGPH
http://allrecipes.com/Default.asp
2000-06-01 07:00:20 4.20.197.70 - W3SVC2 COOK_002 206.191.163.41 GET /Default.asp - 302 0 408 259 30 80
HTTP/1.0 Mozilla/4.0+(compatible:+Kevnote-Perspective+4.0) --
2000-06-01 07:00:20 4.20.197.70 - W3SVC2 COOK_002 206.191.163.41 GET /Default.asp - 200 0 41245 266 200 80
HTTP/1.0 Mozilla/4.0+(compatible:+Keynote-Perspective+4.0) --
2000-06-01 07:00:27 204.182.65.192 - W3SVC2 COOK_002 206.191.163.41 HEAD /Default.asp - 302 0 254 66 40 80
HTTP/1.0 Ipswitch_WhatsUp/3.0 --
2000-06-01 07:00:32 24.10.69.137 - W3SVC2 COOK_002 206.191.163.41 GET /directory/541.asp -200 0 22427 459 421
80     HTTP/1.0     Mozilla/4.7+[en]+(Win98:+U)     ASPSESSIONIDQQGGQGPG=BHBCFIPBEJPNOMDPKCGLKNGC;
+ARSiteUser=1%2DC2B25364%2D3775%2D11D4%2DBAC1%2D0050049BD2E4;+ARSites=ALR=1
http://allrecipes.com/directory/34.asp
2000-06-01 07:00:34 192.102.216.101 - W3SVC2 COOK_002 206.191.163.41 GET /encyc/terms/L/7276.asp - 200 0
20385    471    290    80    HTTP/1.0 Mozilla/4.7+8 en]+(X11;+1;+SunOS+5.5.1++sun4u)    ASPSESSIONIDQQGGQGPG=
PKBCFIPBIKONBPDHKDMMEHCE http://search.allrecipes.com/gsearchresults.asp?site=allrecipes&allrecipes=allrecipes&
allsites=1&q1=loin
2000-06-01 07:00:34 216.88.216.227 - W3SVC2 COOK_002 206.191.163.41 GET /Default.asp - 200 0 41253 258 180 80
HTTP/1.1 Mozilla/4.0(compatible;+MSN+2.5;+MSN+2.5;+Windows+98) --
2000-06-01 07:00:36 199.203.4.10 - W3SVC2 COOK_002 206.191.163.41 GET /Default.asp - 302 0 408 485 30 80
HTTP/1.0 Mozilla/4.0+(compatible: MSH;+5.01:+Windows+98;+TUCOWS) SITESERVER=ID=22fl17fb3708b2278f3c
426796a78e2a -
2000-06-01 07:00:37 199.203.4.10 - W3SVC2 COOK_002 206.191.163.41 GET /Default.asp - 200 0 41277 492 421 80
HTTP/1.0 Mozilla/4.0+(compatible:+MSH;+5.01; +Windous+98;+TUCOWS) SITESERVER=ID=22fl17fh3708b2278f3c
426796a78e2a -
2000-06-01 07:00:43 24.10.69.137 - W3SVC2 COOK_002 206.191.163.41 GET /directory/34.asp - 200 0 17835 458 320
80     HTTP/1.0     Mozilla/4.7+[en]+(Win98;+U)ASPSESSIONIDQQGGQGPG=BHBCFIPBEJPNOMDPKCGLKNGC;
+ARSiteUser=1%2DC2B25364%2D3775% 2D11D4%2DBAC1%2D0050049BD2E4;+ARSites=ALR=1     http://allrecipes.
com/directory/25.asp
2000-06-01     07:00:47    199.203.4.10     - W3SVC2 COOK_002 206.191.163.41     GET     /jumpsite.asp
jumpsite=5&Go.x=16&Go.y=14 302 0 341 611 40 80 HTTP/1.0 Mozilla/4.0+(compatible;+MSIE+5.01;+Windows+98;+
TUCOWS)     SITESERVER=ID=22fl17fb3708b227813c426796a78e2a;+ASPSESSIONIDQQGGQGPG=FCCCFIPBKJM
BDJJHBNCOEDG11 http://allrecipes.com/Default.asp
2000-06-01 07:00:47 24.10.69.137 - W3SVC2 COOK_002 206.191.163.41 GET /directory/538.asp - 200 0 27471 459 881
80     HTTP/1.0 Mozilla/4.7+[en]+(Win98:+U) ASPSESSIONIDQQGGQGPG=BBHCFIPBEJPNOMDPKCGLKNGC;
+ARSiteUser=1%2DC2B25364%2D3775%2D3775%2D11D4%2DBAC1%2D0050049BD2E4;+ARSites=ALR=1
http://allrecipes.com/directory/34.asp
2000-06-01 07:00:47 207.136.48.117 - W3SVC2 COOK_002 206.191.163.41 GET /directory/511.asp - 200 0 77593 369
12538 80 HTTP/1.0 Mozilla/3.01Gold+(Win95:+1) ASPSESSIONIDQQGGQGPG=MFACFIPBDBN PBFPBOENJKHJN;
+ARSiteUser=1%2DC2B251E5%2 D3775%211D4%2DBAC1%2D0050049BD2E4;+ARSites=ALR=1
http://allrecipes.com/directory/506.asp
2000-06-01 07:00:49 192.102.216.101 - W3SVC2 COOK_002 206.191.163.41 GET /encye/A1.asp ARRefSite=
15&ARRefCookie=1-C2B253B8-3775-11D4-BAC1-0050049BD2E4 200 0 47193 457 260 80 HTTP//1.0 Mozilla 4.7+
[en]+(X11l+1;+SunOS+5.5.1+sun4U        ASPSESSIONIDQQGGQGPG=PKBCFIPBKONBPDHKDMMEHCE
http://porkrecipe.co/hints/tips.asp
```

[**0038**] Table 2 is an example portion of parser configuration data. The logical site definitions map a server IP address, port, and root URI to a logical site. For example, the entry "LOGICALSITEURIDEFINITION=209.114.94.26, 80,/,1" maps all the accesses to port **80** of IP address 209.114.94.26 at URIs with a prefix "/" to logical site 1. The page type definitions map a logical site identifier, URI patter, and query string pattern to a page type. For example, the entry "PAGEKEYDEFINITION=news item, news item, 1, {prefix}=homepage_include/industrynews_detail.asp, ,<NewsItemID>#{Uri }" indicates that a page type of "news item" is specified for logical site 1 by a URI pattern of "/homepage_include/industrynews_detail.asp." The definition also indicates that the event value is "<NewsItemID>#{Uri}," where the URI of the log entry is substituted for "{Uri} and the value of NewsItemID in the query string is substituted for "<NewsItemID>." The event type definitions map a site identifier, URI pattern, and query string patter to an event type and value. The definitions also specify the name of the event type and the name of the dimension table for that event type. For example, the entry "EVENTDEFINITION=View News Article, View News Article, 1, {prefix}=/homepage_include/industrynews_detail.asp, <NewsItemId>=*, <NewsItemId>" indicates that View News Article event types are stored in the View News Article dimension table. That event type is indicated by a URI with "/Homepage_include/industrynews_detail.asp," and the event value is the string that follows "<NewsItemId>=" in the query string.

TABLE 2

```
LOGICALSITEURIDEFINITION= 209.114.94.26.80./.1
PAGEKEYDEFINITION= news item, news tem, 1, {prefix} =/homepage__include/industrynews detail.asp.
<NewsItemId>#{Uri}
PAGEKEYDEFINITION= page, page, 1... {Uri}
EVENTDEFINITION= Login, Login, 1, {prefix}=/registration/login.asp.,
EVENTDEFINITION= Logout, Logout, 1, {prefix}=/registration/logout.asp.,
EVENTDEFINITION= Register Page 1, Register Page 1, 1, {prefix}=/registration/register.asp.,
EVENTDEFINITION= Register Page 2, Register Page 2, 1, {prefix}=/registration/register2.asp. <UserID>=*,
EVENTDEFINITION= Registration Confirmation, Registration Confirmation, 1, {prefix}=/registration/register3.asp.
EVENTDEFINITION= Abort Registration, Abort Registration, 1, {prefix}=/registration/registrationabort.asp.,
EVENTDEFINITION= Member Services, Member Services, 1, {prefix}=/registration/memberservices.asp.,
EVENTDEFINITION= Change Password, Change Password, 1, {prefix}=/registration/changepassword.asp.,
EVENTDEFINITION= Profile Edit, Profile Edit, 1, {prefix}=/registration/profile.asp.,
EVENTDEFINITION= Change Affiliation, Change Affiliation, 1, {prefix}=/registration/changeafliliation.asp, <UserID>*,
EVENTDEFINITION= Change Secret Question, Change Secret Quesion, 1, {prefix}=/registration/changesecretquestion.asp.,
EVENTDEFINITION= Forgot Infonnation, Forgot Informtation, 1, {prefix}/registration/forgotinfo.asp,
EVENTDEFINITION= 32 Forgot Password, Forgot Password, 1, {prefix}=/registration/forgotpasssword.asp.,
EVENTDEFINITION= Forgot Signin, Forgot Signin, 1, {prefix}=/ registration/forgotsignin.asp.,
EVENTDEFINITION= View News Article, View News Article, 1, {prefix}=/homepage__include/industrynews__detail.asp,
<NewsItemId>=*,<NewsItemId>
```

[**0039**] FIGS. **5-14** are flow diagrams of components of the parser in one embodiment. **FIG. 5** is a flow diagram illustrating the parse log data routine that implements the main routine of parser in one embodiment. The routine processes each entry in the log file based on the parser configuration data. The routine filters out certain log entries, normalizes the attribute values of the log entries, and generates entries in the dimension tables for the attributes of the log entries. After processing all the log entries, the parser identifies user sessions and generates various statistics. In blocks **501-508**, the routine loops selecting and processing each log entry. In block **501**, the routine selects the next log entry of the log file starting with the first log entry. The routine may also pre-process the header information of the log file to identify the fields of the log entries. In decision block **1502**, if all the log entries have already been selected, then the routine continues at block **509**, else the routine continues at block **503**. In block **503**, the routine extracts the values for the fields of the selected log entry. In block **504**, the routine invokes the filter log entry routine, which returns an indication as to whether the selected log entry should be filtered out. In decision block **505**, if the filter log entry routine indicates that the selected log entry should be filtered out, then the routine skips to block **508**, else the routine continues at block **506**. In block **506**, the routine invokes the normalize log entry routine to normalize the values of the fields of the selected log entry. In block **507**, the routine invokes the generate dimensions routine to update the dimension tables based on the selected log entry and to add an entry into the log entry fact table. In block **508**, the routine updates the statistics for the log file. For example, the routine may track the number of log entries that have been filtered out. The routine then loops to block **501** to select the next log entry. In block **509**, the routine outputs the log file statistics. In block **510**, the routine invokes the identify sessions routine that scans the log entry table to identify the user sessions and updates a session dimension table. In block **511**, the routine invokes the generate aggregate statistics routine to generate various statistics and then completes.

[**0040**] **FIG. 6** is a flow diagram of the filter log entry routine in one embodiment. The filter log entry routine is passed a log entry and determines whether the log entry should be filtered out. In blocks **601-607**, the routine determines whether the filter out conditions have been satisfied. In decision block **601**, the routine determines whether the log entry has a field count problem. A field count problem arises when the number of fields in the log entry does not correspond to the number of expected fields for that log entry. The number and types of fields may be defined in a "fields" directive line of the log file. In decision block **602**, the routine determines whether the log entry is outside of a specified time range. The routine compares the time field of the log entry to the time range. The time range may be specified so that only those log entries within that time range are processed. In decision block **603**, the routine determines whether the IP address of the log entry should be ignored. For example, a log entry may be ignored if the entry originated from a server whose function is to ping the customer's web server at periodic intervals. In decision block **604**, the routine determines whether the log entry corresponds to a comment (e.g., a "#remarks" directive). In decision block **605**, the routine determines whether the success code associated with the log entry indicates that log entry should be ignored. For example, if the success code indicates a failure, then the log entry may be ignored. In decision block **606**, the routine determines whether the log entry is requesting a resource whose extension indicates that the log entry should be ignored. For example, the routine may ignore log entries requesting graphic files, such as those in the ".gif" format. In decision block **607**, the routine determines whether the values within the fields of the log entry are corrupt. For example, a value in the date field that indicates a date of February 30th is corrupt. One skilled in the ale would appreciate that the various filtering conditions may be specified in a configuration file. For example, the time range, IP addresses, and so on may be specified in the configuration file. These configuration files may be specified on a customer-by-customer basis.

[**0041**] **FIG. 7** is a flow diagram illustrating the normalize log entry routine. The routine normalizes the values of the fields in the passed log entry. In block **701**, the routine converts the time of the log entry into a standard time such as Greenwich Mean Time. In block **702**, the routine corrects the time based on the variation between the times of the customer web servers. For example, the time of one web server may be five minutes ahead of the time of another web server. This correction may be based on current time information collected from computer systems that generated the events and then correlated to base current time information. In block **703**, the routine normalizes the values of the fields of the log entry. This normalization may include processing search strings to place them in a canonical form. For example, a search string of "back pack" may have a canonical form of "backpack." Other normalization of search strings may include stemming of words (e.g., changing "clothes" and "clothing" to "cloth"), synonym matching, and first and last word grouping. The first word grouping for the search strings of "winter clothing" and "winter shoes" results in the string of "winter."

[**0042**] **FIG. 8** is a flow diagram of the generate dimensions routine in one embodiment. This routine identifies a value for each dimension associated with the passed log entry and ensures that the dimension tables contains entries corresponding to those values. In one embodiment, each entry in a dimension table includes the attribute value (e.g., user identifier) and a hash value. The hash value may be used by the loader when transferring information to the main data warehouse. Also, each entry has a local identifier, which may be an index into the local dimension table. The loader maps these local identifiers to their corresponding main identifiers that are used in the main data warehouse. In block **801**, the routine invokes a routine that identifies the logical site associated with the log entry and ensures that an entry for the logical site is in the logical site dimension table. In block **802**, the routine invokes a routine that identifies the user associated with the log entry and ensures that an entry for the user is in the user dimension table. In block **803**, the routine invokes a routine that identifies the URI associated with log entry and ensures that an entry for that URI is in the URI dimension table. In block **804**, the routine invokes a routine that identifies the page type based on the parser configuration data and ensures that an entry for that page type is in the page type dimension table. In block **805**, the routine invokes a routine that identifies the various events associated with the log entry based on the parser configuration data and ensures that an entry for each event type is in the corresponding event table. In block **806**, the routine identifies other dimensions (e.g., referrer URI) as appropriate. In block **807**, the routine adds an entry to the log entry table that is linked to each of the identified dimensions using the local identifiers. In block **808**, the routine updates the statistics information based on the log entry and then returns.

[**0043**] **FIG. 9** is a flow diagram of the identify logical site routine in one embodiment. This routine compares the site information of the passed log entry with the logical site definitions in the parser configuration data. In block **901**, the routine selects the next logical site definition from the parser configuration data. In decision block **902**, if all the logical site definitions have already been selected, then the routine continues the block **905**, else the routine continues at block **903**. In decision block **903**, if the URI of the log entry matches the selected logical site definition, then the routine continues at block **904**, else the routine loops to block **901** to select the next logical site definition. In block **904**, the routine updates the logical site dimension table to ensure that it contains an entry for the logical site defined by the selected logical site definition. The routine then returns. In block **905**, the routine updates the logical site dimension table to ensure that it contains a default logical site definition and then returns. The log entries that do not map to a logical site definition are mapped to a default logical site.

[**0044**] **FIG. 10** is a flow diagram of the identify user routine in one embodiment. This routine may use various techniques to identify the user associated with the passed log entry. In one embodiment, the selection of the technique is configured based on the customer web site. For example, one customer may specify to use a cookie to identify users. In absence of a user identifier in the cookie, the industry norm is to identify users based on their IP addresses. This routine illustrates a technique in which a combination of cookies and IP addresses are used to identify a user. In block **1001**, the routine extracts the user identifier from the cookie associated with the log entry. The format of a cookie may be specified on a customer-by-customer basis. In decision block **1002**, if the extraction from the cookie was successful, then the routine continues at block **1006**, else the routine continues at block **1003**. The extraction may not be successful if, for example, the log entry did not include a cookie. In block **1003**, the routine extracts the IP address from the log entry. In decision block **1004**, if the IP address is determined to be unique, then routine continues at block **1006**, else the routine continues at block **1005**. Certain IP addresses may not be unique. For example, an Internet service provider may use one IP address for many of its users. The Internet service provider performs the mapping of the one IP address to the various users. In block **1005**, the routine extracts the browser identifier from the log entry. The combination of IP address and browser identifier may uniquely identify a user. In block **1006**, the routine updates the user dimension table to ensure that it has an entry for this user and then returns.

[**0045**] **FIG. 11** is a flow diagram of the identify page type routine in one embodiment. This routine uses the page type definitions of the parser configuration data to identify the page type associated with the log entry. In block **1101**, the routine selects the next page type definition from the parser configuration data. In decision block **1101**, if all the page type definitions have already been selected, then no matching page type has been found and the routine returns, else the routine continues at block **1103**. In decision block **1103**, if the log entry matches the selected page type definition, then the routine continues at block **1104**, else the routine loops to block **1101** to select the next page type definition. In block **1104**, the routine updates the page type dimension table to ensure that it contains an entry for the page type represented by the selected page type definition. The routine then returns.

[**0046**] **FIG. 12** is a flow diagram illustrating the identify events routine in one embodiment. This routine determines whether the log entry corresponds to any of the events specified in the parser configuration data. In block **1201**, the routine selects the next type of event from the parser configuration data. In decision block **1202**, if all the event types have already been selected, then the routine returns, else the routine continues at block **1203**. In block **1203**, the routine selects the next event definition of the selected event type. In decision block **1204**, if all the event definitions of the selected event type have already been selected, then the log entry does not correspond to this type of event and the routine loops to block **1201** to select the next type of event, else the routine continues at block **1205**. In block **1205**, if the log entry matches the selected event definition, then the routine continues at block **1206**, else the routine loops to block **1203** to select the next event definition of the selected event type. In block **1206**, the routine updates the dimension table for the selected type of the event to ensure that it contains an entry for the selected event definition. The routine then loops to block **1201** to select the next type of event. In this way, the routine matches no more than one event definition for a given event type. For example, if there are two event definitions for the event type "Keyword Search," then if the first one processed matches, then the second one is ignored.

[**0047**] **FIG. 13** is a flow diagram illustrating the identify sessions routine in one embodiment. This routine scans the log entry table of the local data warehouse to identify user sessions. In one embodiment, a user session may be delimited by a certain period of inactivity (e.g., thirty minutes). The criteria for identifying a session may be configurable on a customer-by-customer basis. In block **1301**, the routine selects the next user from the user dimension table. In decision block **1302**, if all the users have already been selected, then the routine returns, else the routine continues at block **1303**. In block **1303**, the routine selects the next log entry for the selected user in time order. In decision block **1304**, if all log entries for the selected user have already been selected, then the routine loops to block **1301** to select the next user, else the routine continues at block **1305**. In decision block **1305**, if the selected log entry indicates that a new session is starting (e.g., its time is more than 30 minutes greater than that of the last log entry processed), then the routine continues at block **1306**, else the routine loops to block **1303** to select the next log entry for the selected user. In block **1306**, the routine updates a session fact table to add an indication of the new session. The routine then loops to block **1303** to select the next log entry for the selected user. The routine may also update the log entries to reference their sessions.

[**0048**] **FIG. 14** is a flow diagram of the generate aggregate statistics routine in one embodiment. This routine generate statistics based on analysis of the fact and dimension tables used by the parser. In block **1401**, the routine selects the next fact table of intent. In decision block **1402**, if all the fact tables have already been selected, then the routine returns, else the routine continues at block **1403**. In block **1403**, the routine selects the next entry of the selected fact table. In decision block **1404**, if all the entries of the selected fact table have already been selected, then the routine loops to block **1401** to select the next fact table, else the routine continues at block **1405**. In block **1405**, the routine aggregates various statistics about the selected fact table. The routine then loops to block **1404** to select the next entry of the fact table.

[**0049**] FIGS. **15**-**17** are flow diagrams illustrating components of the loader in one embodiment. **FIG. 15** is a flow diagram of the load log data routine implementing the main routine of the loader in one embodiment. This routine controls the moving of the data from the local data warehouse (created and used by the parser) into the main data warehouse. In block **1501**, the routine invokes the create partitions routine to create partitions for the main data warehouse as appropriate. In blocks **1502**-**1504**, the routine loops loading the dimension tables into the main data warehouse. In block **1502**, the routine selects the next dimension table. In decision block **1503**, if all the dimension tables have already been selected, then the routine continues at block **1505**, else the routine continues at block **1504**. In block **1504**, the routine invokes the load dimension table routine for the selected dimension table. The routine then loops to block **1502** to select the next dimension table. In blocks **1505**-**1507**, the routine loops adding the entries to the fact tables of the main data warehouse. In block **1505**, the routine selects the next fact table in order. The order in which the fact tables are to be loaded may be specified by configuration information. The fact tables may be loaded in order based on their various dependencies. For example, a log entry fact table may be dependent on a user dimension table that is itself a fact table. In decision block **1506**, if all the fact tables have already been loaded, then the routine returns, else the routine continues at block **1507**. In block **1507**, the routine invokes the load fact table routine for the selected fact table. The routine then loops to block **1505** to select the next fact table.

[**0050**] **FIG. 16** is a flow diagram of the load dimension table routine in one embodiment. This routine maps the local identifiers used in the local data warehouse to the main identifiers used in the main data warehouse. In block **1601**, the routine selects the next entry from the dimension table. In decision block **1602**, if all the entries of the dimension table have already been selected, then the routine returns, else the routine continues at block **1603**. In block **1603**, the routine retrieves an entry from the dimension table of the main data warehouse corresponding to the selected entry. In decision block **1604**, if the entry is retrieved, then the routine continues at block **1606**, else the dimension table does not contain an entry and the routine continues at block **1605**. In block **1605**, the routine adds an entry to the dimension table of the main data warehouse corresponding to the selected entry from the dimension table of the local data warehouse. In block **1606**, the routine creates a mapping of the local identifier (e.g., index into the local dimension table) of the selected entry to the main identifier (e.g., index into the main dimension table) for that selected entry. The routine then loops to block **1601** to select the next entry of the dimension table.

[**0051**] **FIG. 17** is a flow diagram of the load fact table routine in one embodiment. This routine adds the facts of the local data warehouse to the main data warehouse. The routine maps the local identifiers for the dimensions used in the local warehouse to the main identifiers of dimensions used in the main data warehouse. In block **1701**, the routine selects the next entry in the fact table. In decision block **1702**, if all the entries of the fact table have already been selected, then the routine returns, else the routine continues at block **1703**. In block **1703**, the routine selects the next dimension for the selected entry. In decision block **1704**, if all the dimensions for the selected entry have already been selected, then the routine continues at block **1706**, else the routine continues at block **1705**. In block **1705**, the routine retrieves the main identifier for the selected dimension and then loops to block **1703** to select the next dimension. In block **1706**, the routine stores an entry in the fact table of the main data warehouse. The routine then loops to block **1701** to select the next entry in the fact table.

[**0052**] **FIG. 18** is a flow diagram illustrating the identify user aliases routine in one embodiment. This routine tracks the different user identifiers as a user switches from one web site to another. In particular, the routine maps the user identifiers used by a referrer web site to the user identifiers used by the referred-to web site. In this way, the same user can be tracked even though different web sites use different identifiers for that user. This routine may be invoked as pail of the parsing of the log files. In decision block **1801**, if the log entry indicates a referrer web site, then the routine continues at block **1802**, else the routine returns. In block **1802**, the routine identifies the user identifier for the referrer web site. In block **1803**, the routine creates a mapping between the referrer user identifier and the referred-to user identifier. The routine then returns.

[**0053**] From the above description it will be appreciated that although specific embodiments of the technology have been described for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention. For example, the processing of the parser may be performed by the data collection component before sending the data to the data warehouse server. Accordingly, the invention is not limited except by the appended claims.

1. A method of processing data before updating a database based on the processed data, the database having a main table with a main identifier for each entry in the main table, the method comprising:

identifying an entry that should be in the main table;

generating a local identifier for the entry;

adding the entry with the local identifier to a local table;

generating information to be stored in the database that references the entry in the local table using the local identifier; and

after generating the information,

generating a main identifier for the entry;

adding an entry with the main identifier to the main table; and

storing the generated information in the database with the local identifier replaced with the main identifier.

2. The method of claim 1 wherein the local table is stored in main memory.

3. The method of claim 1 wherein the table is a dimension table of the database.

4. The method of claim 1 wherein the generated information is stored in a fact table of the database.

5. The method of claim 1 wherein the local identifier is generated based on key information.

6. The method of claim 5 including generating a hash value based on the key information and storing the hash value in the entry of the local table.

7. The method of claim 6 including using the stored hash value to locate entries in the main table.

8. The method of claim 1 wherein the processed data relates to navigation information of a web site.

9. The method of claim 1 wherein the processed data is click stream data.

10. A method in a computer system for parsing information before updating data in a main database, the main database having fact tables and dimension tables, the method comprising:

creating a fact table and a dimension table corresponding to a fact table and dimension table of the main database;

identifying from the information entries for the created fact table and dimension table;

storing the identified entries in the created fact table and dimension table; and

analyzing the entries stored in the created fact table and dimension table.

11. The method of claim 10 wherein the parsed information relates to user interactions with web pages.

12. The method of claim 10 including updating data in the main database based on the entries in the created fact table and dimension table.

13. The method of claim 10 wherein the created fact table and dimension table are stored in main memory.

14. The method of claim 10 wherein the created fact and dimension table are stored in non-persistent memory.

15. The method of claim 10 wherein the created fact and dimension table are stored in temporary memory.

16. The method of claim 10 wherein the created fact and dimension table are destroyed after information in the main database is updated based on the created fact and dimension table.

17. The method of claim 10 wherein the data in the main database is updated based on an ordering of fact and dimension tables.

18. A method in a computer system for identifying navigation paths through web pages based on user navigation information, the method comprising:

analyzing the user navigation information to identify entries associated with the same user; and

for each user,

identifying the web pages that are accessed by the user; and storing an indication of the identified web pages as a navigation path in a persistent database.

19. The method of claim 18 wherein a sequence of identified web pages for a user is designated as a session.

20. The method of claim 19 wherein a session is delimited by time between access of web pages by the user.

21. A method in a computer for processing navigation information for web pages, the method comprising:

selecting an entry of the navigation information;

identifying a uniform resource identifier of the selected entry; and

when the identified uniform resource identifier satisfies a match criterion, storing in a persistent database an indication that the entry matches the criterion.

22. The method of claim 21 wherein criterion indicates that the entry is for a web pages of a certain category.

23. The method of claim 21 wherein the criterion identifies an event.

24. The method of claim 21 wherein the criterion specifies a type of web page.

25. A method in a computer system for identifying a user who accesses a web page, the method comprising:

providing an indication of a request for a second web page, the request including second information identifying a user who requested the second web page and first information identifying a user who requested a first web page that included a reference to the second web page; and

indicating the first information and the second information identify the same user.

26. The method of claim 25 wherein the first information is included as information of a referrer.

27. The method of claim 25 including storing a mapping of the first information to the second information.

28. The method of claim 27 including checking the mapping to determine whether user information corresponds to a user identified with other information.

29. The method of claim 25 wherein the first information and second information are provided by different web domains.

30. A method in a computer system for identifying high-level events from low-level events, the method comprising:

providing a plurality of event definitions that map low-level events to high-level events; and

for each low-level event,

determining whether the low-level event matches a provided event definition; and

when a low-level event matches an event definition, persistently storing an indication of the high-level event associated with the matching event definition.

31. The method of claim 30 wherein the low-level events are navigation events.

32. The method of claim 30 wherein the low-level events are derived from click stream information.

33. The method of claim 30 wherein the indication of the high-level event is persistently stored in a data warehouse.

34. A method in a computer system for processing click steam data, the method comprising:

receiving time synchronization information for the click stream data;

adjusting times associated with the click stream data based on the received time synchronization information; and

persistently storing the adjusted times.

35. The method of claim 34 wherein the time synchronization information is based on current time information received from a web server associated with the click stream data.

36. The method of claim 35 including sending a request to the web server for current time information.

37. The method of claim 34 wherein the time synchronization information is based on current time information of a web server and base time information.

38. A computer-readable medium containing instructions for controlling a computer system to parse information before updating data in a main database, the main database having fact tables and dimension tables, by a method comprising:

creating fact tables and dimension tables corresponding to fact tables and dimension tables of the main database;

identifying from the information entries for the created fact tables and dimension tables;

storing the identified entries in the created fact tables and dimension tables; and

analyzing the entries stored in the created fact tables and dimension tables.

39. The computer-readable medium of claim 38 wherein the parsed information relates to user interactions with web pages.

40. The computer-readable medium of claim 38 including updating data in the main database based on the entries in the created fact tables and dimension tables.

41. The computer-readable medium of claim 38 wherein the created fact tables and dimension tables are stored in main memory.

42. The computer-readable medium of claim 38 wherein the created fact tables and dimension tables are stored in non-persistent memory.

43. The computer-readable medium of claim 38 wherein the created fact and dimension tables are stored in temporary memory.

44. The computer-readable medium of claim 38 wherein the created fact and dimension tables are destroyed after information in the main database is updated based on the created fact and dimension tables.

45. The computer-readable medium of claim 38 wherein the data in the main database is updated based on an ordering of fact and dimension tables.

46. A method in a computer system for processing of search strings, the method comprising:

identifying a search sting in a log file;

identifying a canonical form of the search string; and storing the identified canonical from so that subsequent processing of the search string uses the canonical form.

47. The method of claim 46 wherein the identifying of a canonical form includes stemming of a word in the search string.

48. The method of claim 46 wherein the identifying of a canonical form includes first or last word grouping.

49. The method of claim 46 wherein the identifying of a canonical form includes removal of spaces between words.

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