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DEVELOPING A WEB-BASED GEOTHERMAL DATABASE MANAGEMENT SYSTEM USING THIN-CLIENT ARCHITECTURE

by

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ABSTRACT

Recent advances in relational database management systems (RDBMS), network computing, web and internet technology and telecommunication are utilized to design an RDBMS to handle geothermal data. This effectively addresses data management problems typical in a mature geothermal operation such as the massive data quantity from remote diffuse databases, non-homogeneous data types and formats, multiple users at various locations, and accessibility and speed. A system is developed which combines thin software clients with powerful web-enabled data and application servers to function in a distributed workgroup computing environment. The system serves as an effective tool for geothermal reservoir and resource management.

INTRODUCTION

Developing a web-based geothermal database system using thin-client architecture is the same as developing a corporate intranet with database connectivity. A corporate intranet, in the most-basic terms, is nothing more than Internet technology implemented across an internal business-computing network. This means running TCP/IP as the network protocol and providing any number of Internet services, from simple file, print, and mail services to newsgroups, chat areas, the Web or HTTP services. The only difference is that of integrating connection to a relational database.

The thin-client arhitecture set-up is a multi-tier distributed-computing architecture, with a Web-browser client; a middle tier, the Web and/or application server; and the database server on the back end. In this architecture, the client portion is typically an entry screen for gathering input. Basically, the client connects to the application server, the application code is then sent to the Web server and then to the Database Server and then back to the client.

The tiers are logical, not physical, concepts. The second, third, and other tiers may be located physically on the same hardware. The client tier in this model is any PC, network computer, or other networked device that can run a standard Web browser and support HTML and Javascript.

THE ARCHITECTURE

The First Tier

The user interface or presentation layer is referred to as the first tier. It consists of a Web browser, which may be running on a desktop computer, a mobile or laptop computer, or a network computer. Since almost all computers available in the market are packaged with a web browser such as Microsoft Internet Explorer, Netscape Navigator, and, Oracle Power Browser, in effect, no additional cost per computer is involved as far as the first tier is concerned.

The Second Tier

The second tier is the application forms residing on an application server which may be any personal web server supporting HTML and/or Javascript. The forms are all html-based and are designed and developed using any html editor of preference. These html forms reside on a personal web server

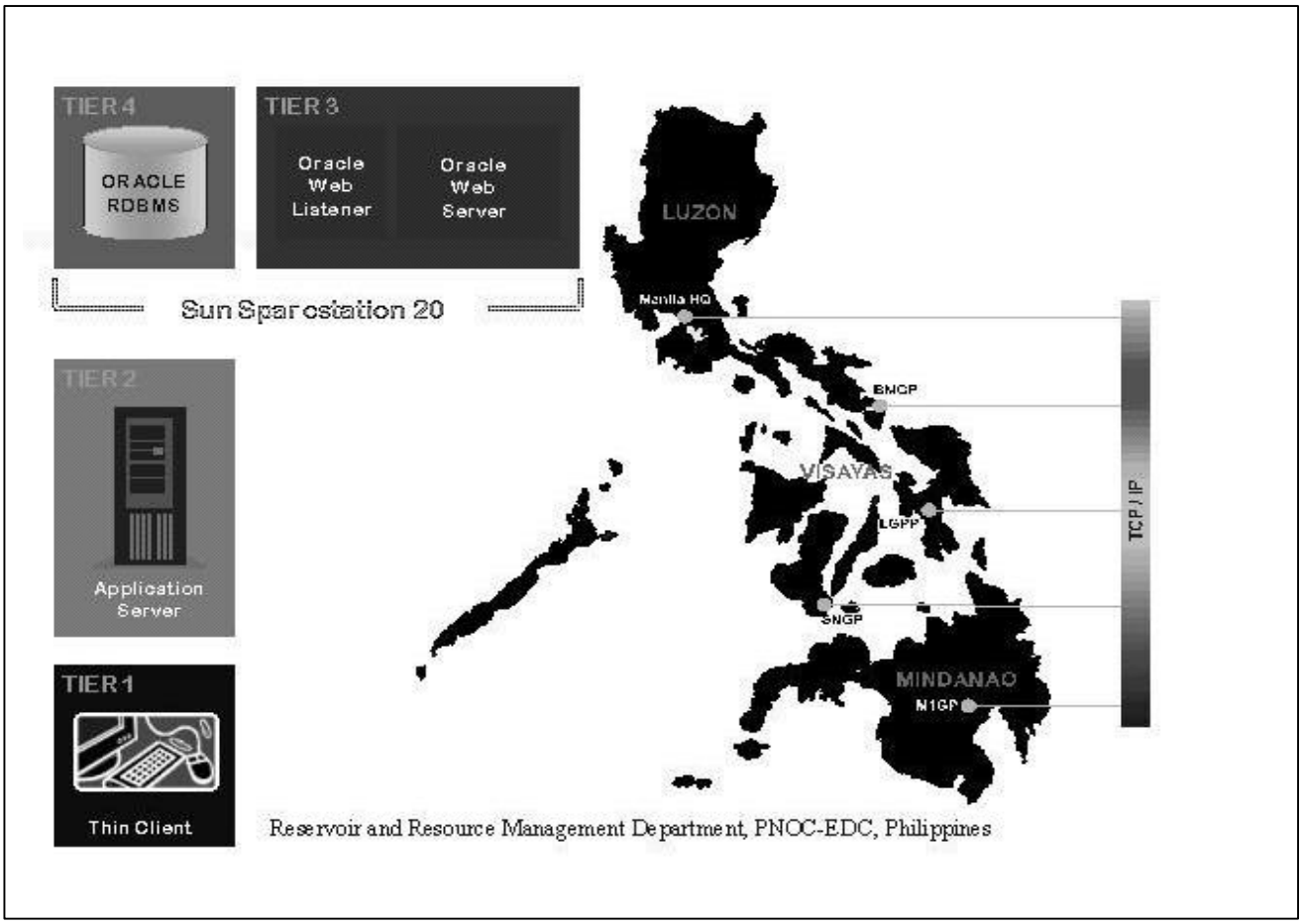

Figure 1. Web-based geothermal database system in a multi-tier set-up.

that could support html scripting such as Javascript, for example. HTML scripting is required for an enhanced interaction with the client users.

The Third Tier

The web server comprises the third tier of applications. The webServer is an HTTP server with a tight integration to a database server that enables the creation of HTML documents from data stored in a relational database. When the data changes, the HTML documents are updated automatically, with no further effort on the part of the web administrator. This approach supplements the presentation of static, or unchanging, data which is found on most Web sites today, with the dynamic real-time data present in business systems based on the database server. The components that make up the webserver work together to make the delivery of both static and dynamic pages possible.

The Fourth Tier

The fourth tier is the data, which may be running on the same physical hardware as the third tier. Geothermal data is stored on the database server. It is formatted into Web documents within the web server and then transmitted to Web clients. All data is stored only once, eliminating the need to "snapshot" data periodically for use on the Web.

Example of a Multi-tier Set-up

To illustrate the system of using thin client architecture, a sample basic set-up is shown in Figure 1. In this example, the first tier is a desktop computer running Windows 95 and Microsoft

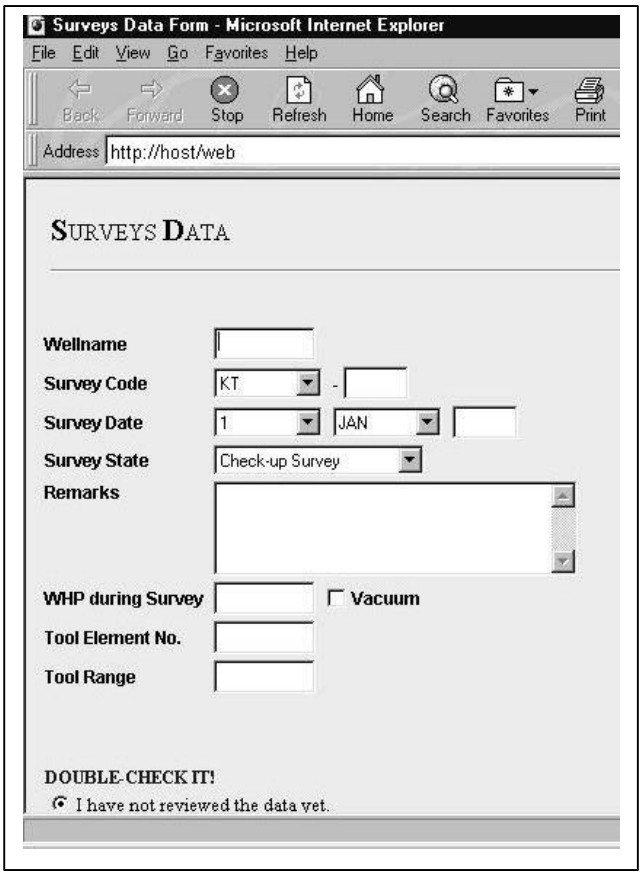

Figure 2. A sample application form accessed from a client web browser.

Internet Explorer v.3.02, the second tier is a desktop computer running Windows 95 and Microsoft Frontpage Web Server (PWS32/3.0.2.926), the third tier is an ORACLE Web Server v1.0, and the fourth tier is an ORACLE RDBMS v7.3. The third and the fourth tier reside on a Sun Sparcstation 20 under Solaris 2.5 environment.

Clients can be located anywhere on a network using the standard HTTP protocol. Using the web browser (first tier), the client connects to the Frontpage Web Server (second tier) - a commercial quality HTTP server that services document requests from any Web browser. The type of the document is sent to the client along with the document itself. Clients either interpret and display the document appropriately, or pass the document to a program that specifically handles that document type. When the Frontpage Web Server receives a request from a client, it first determines whether that request is for a static document or a dynamic document. If the request is for a static document, the Frontpage Web Server sends the file and the associated type information directly to the client. If the request is for a dynamic document, it is created "on the fly" by a program invoked by the Frontpage Web Server, in compliance with the Common Gateway Interface (CGI). CGI is an interface that enables HTTP servers to run a program and use the output of that program in a document that is sent to the user. Most HTTP servers support this interface.

When a database connectivity is requested, the request is passed on to the (third tier) Oracle Web Server's Listener to invoke its Oracle Web Agent. The Oracle Web Agent upon receiving a request for a database procedure, handles the details of making a connection to the Oracle RDBMS v7.3 database server (fourth tier). The Oracle7 Server is a high performance, fault-tolerant relational database management system, especially designed for on-line transaction processing and large database applications. The Oracle7 Server reliably manages a large amount of data in a multi-user environment. The Oracle7 Server delivers high performance even while many users concurrently access the data. It is also secure from unauthorized access and provides efficient solutions for failure recovery.

DEVELOPMENT

With geothermal fields that may be situated at various locations, it is typical to have a system of massive data quantity from remote diffuse databases of non-homogeneous data types and formats. If a client-server based system is to be developed, then all applications should be deployed to the client level. This means that in order for the system to run correctly, all changes to the application program that is installed at the client should be updated. Else, the integrity of the data being accessed by a user from a particular site is at stake. To address this problem, a web-based geothermal database management system was developed using thin client architecture.

At our Manila Headquarters, we have set-up the Oracle Database and Oracle Web Server in a Sun Sparcstation 20 machine. Our Application Server is a high-end PC running Frontpage Web Server. All our other geothermal field offices situated at various locations in the country have access simply through their client browsers (Figure 1).

Using Microsoft Frontpage Explorer, the web server is set-up on a high-end PC assigning browse, authoring and administrative access. An application form (Figure 2) is designed and developed using Microsoft Frontpage Editor incorporating HTML forms and Javascript to process and filter data requests right at the client side before passing them on to the ORACLE Webserver; this avoids server congestion because scripting enhances basic interaction between the client and the user and thereby minimizes direct inputs to the webserver. Then, a corresponding SQL stored procedure is created and compiled at the Oracle7 Server which provides the storage for all dynamic data in relational tables, and all the program logic used to create dynamic HTML pages.

From a web browser client, a network user from a remote location may then access the web site in our Manila Headquarters say http://host/web where *host* is the alias or IP address of the desktop computer running the Frontpage *web*. The Frontpage web server in Manila then evaluates the http request from the remote client. Request for the Frontpage Web Server to access the application form (Figure 2) are sent directly to the web browser client. The application form is an entry screen serving as a user interface between the client and the web/database servers. Data entered into the application form are submitted and passed as parameters for the SQL stored procedure which reside on the Oracle7 Server. Since the stored procedure combines the power of SQL database commands and a set of built-in procedures that generate dynamic documents that are easily presented in HTML, once the requested procedure is invoked, the resulting HTML document with database content is transmitted back to the remote client Web browser.

CONCLUSIONS

A web-based geothermal database management system was developed using thin client architecture to address data management problems typical in a mature geothermal operation. In this thin client architecture, no additional program is to be installed at the remote client desktop computers if and when there is a revision to be made to the application, whether it is a change in the application forms design, an html scripting debugging, or a major database re-structuring. In this manner, clients at various locations maintain database connectivity using their web-browsers alone without having to re-install additional application programs.

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