

Streamlining Brings Oracle Big Savings, Better Service

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The question Oracle asked itself was—once Oracle became an e-business, would it realize enough margin improvement to save a billion dollars? The answer turned out to be no. The company was going to save a lot more. This article covers some of the major internal changes Oracle made involving e-mail globalization, network consolidation, and running integrated internet-based applications. Oracle's experience translated into significant cost savings, but more importantly, better customer service and improved commercial products.

For the past two years Oracle has been changing its internal technology to streamline redundant communications and improve integration among core business systems. Following the desktop application revolution where spreadsheet data integrate easily into a word processing program or a slide presentation, Oracle has taken this same approach into its business applications. This required taking a hard look at its e-mail system, network structure, and use of Internet-based applications.

Initially, the company spent time scratching its head evaluating its current systems. In 43 data centers, Oracle had 70 different computer systems and 70 databases in 70 different countries in a client-server environment with some 40,000 desktops[1]. Its purchasing system could not identify the best suppliers by price, quality, and other metrics. The same was true for human resources and sales data.

On top of the lack of communication among similar and redundant business systems, a lack of integration among the core business systems themselves severely compounded the issue. These core business systems were a patchwork of programs from different vendors. This meant spending a tremendous amount of consulting dollars to make them talk, let alone the internal resources required to run the individual systems. Oracle's revelation was that at best it was not practical and at worst, it probably was not possible to make all these systems work together.

To change its technology in a way that would bring dramatic margin improvements, the company determined it would need to build a global system and defragment data. To keep up with the times, Oracle had to change how it ran its own business and it had to change its own products. The first tool Oracle incorporated to bring it all together was the Internet. This architecture provided a low-cost form

of global communication that allowed the company to centralize network complexity and still distribute information worldwide. Oracle rewrote its databases and software-development tools to run in a three-tier Internet environment. The company rewrote its applications products too. Finally, Oracle implemented the technology internally.

After committing to an Internet environment, Oracle consolidated its Wide Area Network. Information technology (IT) personnel reduced the 43 worldwide data centers to two. One is located at its headquarters, in Redwood Shores, Calif. The backup is in Colorado Springs, Colo. Oracle has one global database for each major business function, such as sales and accounting.

Some of the tangible results from the centralization effort included 250 fewer IT staffers, 2,000 fewer servers, an 80 percent reduction in leased space for computer operations, and an overall estimated \$200 million savings in IT costs for fiscal year 2000. Oracle is anticipating keeping total IT spending down to \$300 million, which is half the amount spent in 1999. While the end results are more than worth the efforts, making it actually happen took both tough decision making and internal selling.

Global E-Mail Consolidation

While centralization, globalization, and consolidation plans were going on behind the scenes, Oracle needed to visibly demonstrate proof to employees and to resistant individual data owners that change was a good thing. Since e-mail performance would be highly visible, the company consolidated all of its e-mail systems. While this better and cheaper change was easy to sell, actually making it happen was challenging.

Oracle employees have many roles. Thousands of employees who use UNIX

machines prefer certain e-mail clients. The Oracle sales force lives on laptops and prefers different e-mail clients. Some employees telecommute and access their e-mail using one client at work and another at home. The Oracle Data Center requires support for an industry standard e-mail interface that allows employees to use the client most appropriate to their jobs. Use of industry standard e-mail clients also avoids incurring additional costs to build and maintain custom clients to access messages.

Prior to the transformation, Oracle's worldwide e-mail "system" was an amalgam of 120 message stores, 50 data centers, and 97 mail servers supporting 33,000 user accounts on multiple platforms (See Figure 1, page 20) [2, 3]. Efficiency and reliability suffered from the large number of potential points of failure in the architecture as well as from recurring interoperability challenges. The company's existing messaging system actually consisted of many smaller systems. Not all servers ran the same versions of messaging software, not all servers were on the same platform, and the servers themselves were geographically scattered. There were 120 message stores worldwide. The system required 60 administrators because there were multiple systems all over the world. Furthermore, the Oracle system did not consist of a single domain (e.g. oracle.com), but sub-domains of oracle.com based on country (e.g. us.oracle.com). The result was an existing system that was inefficient to administer and costly to maintain.

Oracle's IT department decided to consolidate the various subsystems into one company-wide messaging system. While this reduced the amount of hardware, running a company-wide, enterprise messaging system on a minimum number of servers required software designed for that environment. IT researched available

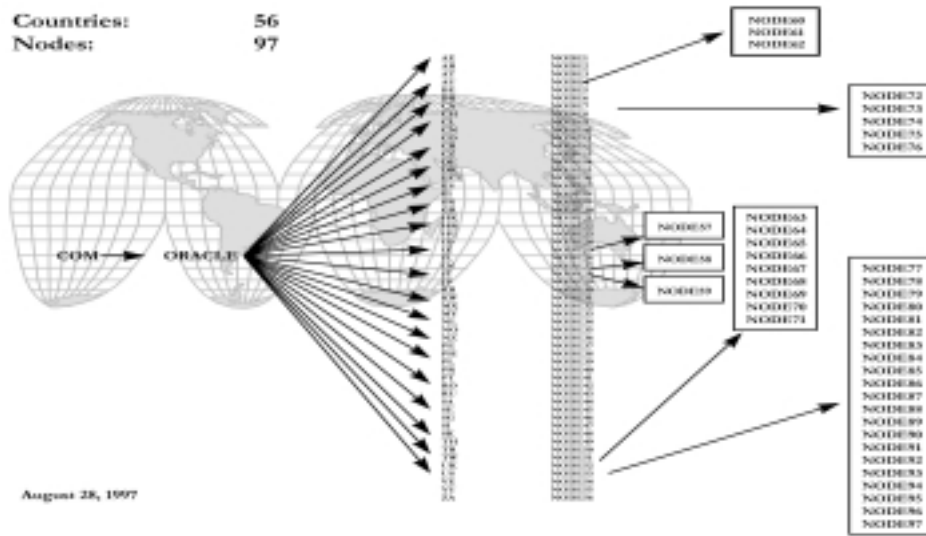


Figure 1: Historical Oracle Messaging Domain Tree and Nodes

software and determined to install an Oracle Email Server (OES) middle tier with Oracle8i databases as message stores, and have all employees use an Internet Message Access Protocol version 4 (IMAP4) Internet browser as an email client. The new system would allow the use of standard e-mail clients and enhance performance.

Among its desired qualities, OES is a highly scalable, open standards-based solution for very large corporate and Internet service provider customers. It allows users to easily access messages using any IMAP4- or Post Office Protocol version 3 (POP3)-compliant client. Its deployment cost per user is reduced because it increases the number of concurrent users that can be supported on the same machine. These qualities allowed the company to meet its goals: minimum hardware, simple deployment, and low cost of administration.

The money Oracle saved through less hardware investment could be used to purchase more powerful machines where needed in the system. The system is then able to support a larger user population because the servers are used around the clock. Administration demands also drop. The new messaging system only requires administration for four message stores on two machines at one physical location (See Figure 2). Administration is also only required for a single release of software on a single technology stack, easing the task considerably. System changes can be made more quickly. Administrators are able to simultaneously manage any of the

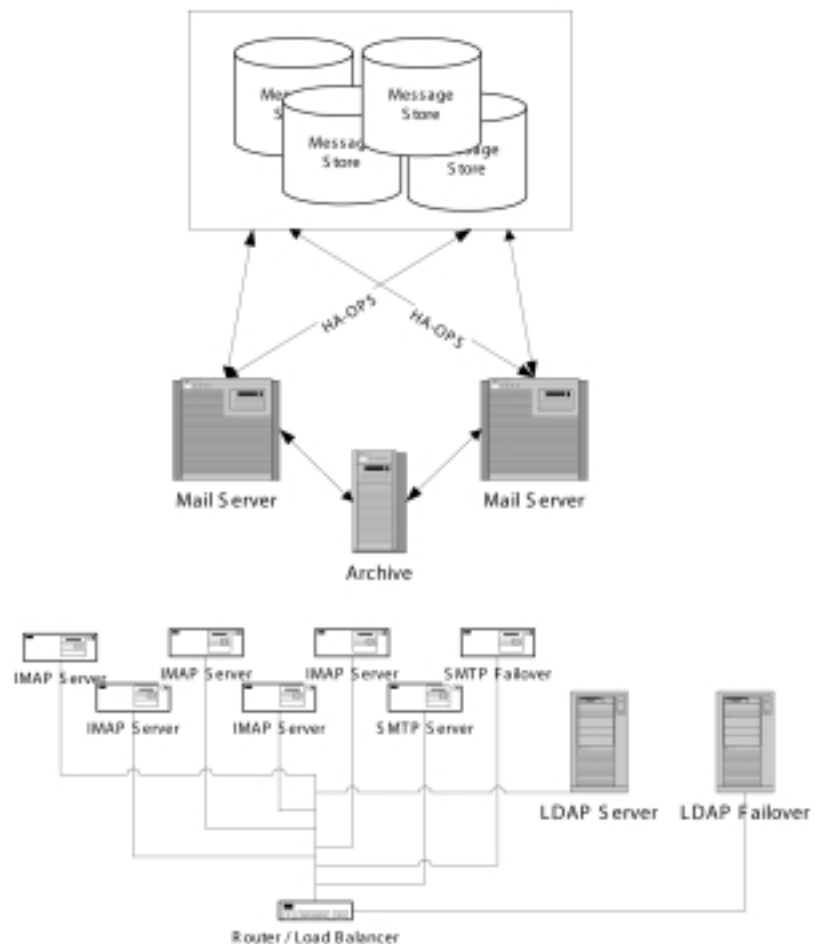
system's component hosts, such as message stores and IMAP servers, from any point on the network.

The new system serves all the employees different needs. All messages can be controlled and administered in a central place to avoid synchronization problems. Employees who telecommute see the same

inbox on their work systems as they do on their home systems. Furthermore, employees have the flexibility to change messaging clients when necessary.

Another benefit of Oracle's new consolidated messaging system is a global lightweight directory access protocol (LDAP) directory service. OES works with any directory that is compliant with the LDAP standard. This means that any LDAP-based client can access information in the directory, and directory information can be easily synchronized with any other LDAP-compliant directory. The LDAP product Oracle uses contains two nodes in the data center that each contains employee information. The directory data can be updated on either node. Employee searches are also easier. Users no longer need to look up employees by country, but just by name in a single worldwide directory. Misaddressed e-mails are corrected immediately; no message is bounced. Multiple languages are also supported, meaning employees in more than 96 countries around the world can use standards-based

Figure 2: Architecture of New Oracle Single Instance Messaging System



clients to access e-mail in their native languages.

The Oracle messaging system is a three-tiered architecture that can grow with a continually growing user population and mail storage needs (See Figure 3). To provide fault tolerance, the messaging servers containing the data would be high availability clusters with hot backups in a different geographic location. The messaging workload is partitioned into two distinct tiers. The middle tier acts as a protocol negotiator, allowing the translation of LDAP, IMAP4, POP3 and SMTP protocols into direct database queries. Each middle tier server multiplexes the Internet protocol requests over a relatively small number of database connections. This middle tier of protocol listeners work independently of each other so servers can be added one at a time as growth dictates, providing linear scalability. No data reside on this tier, so the demands for nearly zero down time can be relaxed as surviving servers fill in for a failed node.

Oracle's goal was to reduce the cost of maintaining the messaging system while meeting the messaging reliability, scalability, and performance needs of a company consisting of more than 43,000 employees. In calendar year 2000, the goal has been achieved; annualized e-mail system costs declined by \$13 million, reliability is approaching "five 9s," worldwide operations are supported by a single corporate domain, and one-second message delivery times are standard.

Along with the dollar savings, Oracle also has a system that is easier to adminis-

ter, support for standard clients to meet the needs of a mobile employee base, and a fault tolerant system that can grow with the needs of the company.

Many government agencies and corporate enterprises can achieve similar savings and performance improvements in their e-mail systems. Organizations may set targets well below the 50-to-1 e-mail server reduction that Oracle has already achieved, but huge potential savings would still accrue. Some organizations may be able to achieve high degrees of consolidation along the lines of the Oracle model.

Consolidating the Network

For Oracle these changes — leveraging the Internet and globalizing e-mail — meant a heavy emphasis on redesigning its Wide Area Network. Previously, each of the Oracle subsidiaries throughout the world ran localized applications within each country's data center. Oracle's existing network at the time was not designed to meet the demands placed by running global applications from a single data center [4].

The biggest impact to the network was probably the most obvious: to have adequate capacity on all WAN links to carry the increased traffic load. The second biggest impact was one of availability. As users become increasingly dependent upon the WAN to run their business, the network design had to be as resilient as possible.

Since users were accustomed to interacting with a local applications server, enjoying LAN performance characteris-

tics, Oracle had to look to reduce the WAN latency as much as possible. The ability to route traffic to a disaster recovery data center also became a network design

Things to Consider in Consolidating an E-Mail System

Many companies offer hardware and software solutions for e-mail consolidation. Here are a few points to keep in mind while you do your research along with some of the results Oracle achieved in its solution:

— How many users can run on the system and still maintain rapid response times? An audited Oracle benchmark simulating 360,000 concurrent users on a single server with an average of over 13,700 messaging transactions per minute resulted in a response time of less than one second for a typical user sequence of sending or retrieving/reading email.

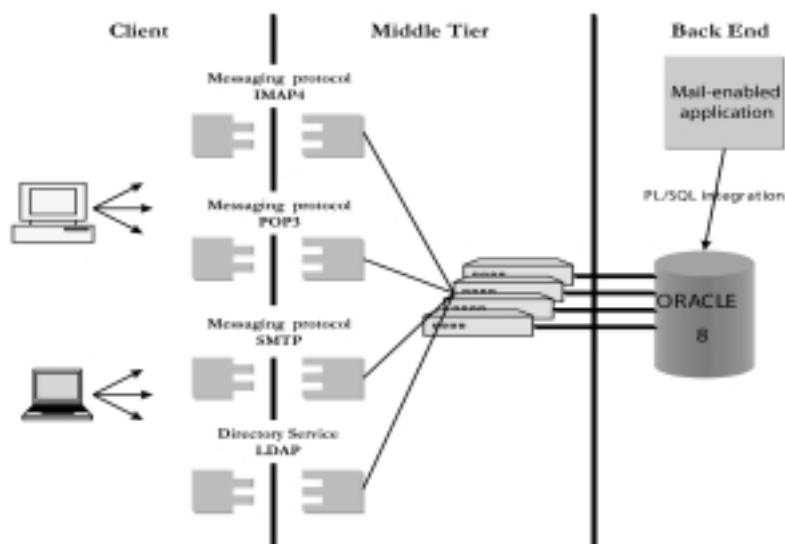
— What percent of server utilization reduction can be expected? Just by moving away from proprietary email clients, server utilization on the Oracle messaging system was reduced by an average of 15 percent to 20 percent, enhancing overall performance of the messaging system.

— What level of fault tolerance can be achieved? Oracle's messaging system node failure on the back end does not preclude data access because all data can be accessed from any node. Data integrity is maintained because committed work on a failed node is recovered automatically without administrator intervention and without data loss.

— In a node failure, how easily can load be balanced across surviving machines? Oracle's messaging system uses multiple servers, labeled the IMAP servers in the single instance architecture diagram, running OES in the middle tier, which are load-balanced. A failure of any of these machines simply means that users are redistributed among the surviving machines without loss of service. Similarly, Oracle Internet Directory is a highly available system.

— How will the system cut costs? Oracle achieved cost reductions by using software that can make the most of a smaller amount of powerful hardware.

Figure 3 : *Messaging Workload Tiers*



consideration point.

The first task was to determine the actual traffic load that the single instance applications would place on the WAN links. E-mail, by its nature, is impossible to model using traditional modeling tools. The message sizes can vary greatly in size, from a 1KB message to a multi MB message with an attachment. The occurrence of these messages is also too random to model.

Oracle set out to actually measure the existing traffic load on the local mail servers. It found that traffic arrived at a fairly consistent number from .6 to .8 kbps. Not wanting to err on the low side and for planning purposes, the company used 1kbps per user, .8kbps of measured traffic + .2kbps for headroom. The per user number was multiplied by the number of users in each country by 1kbps to determine how much the WAN capacity needed to be increased for consolidating the email application. Therefore, a 200-person office would require capacity of 200kbps on the WAN links.

Oracle used 1kbps per user to determine where and how much the WAN capacity needed to be upgraded. Network resilience was increased, especially for its most critical locations, by carrier diversity and route diversity where possible, and by ensuring major backbone links do not traverse the same marine cable. The network had to be capable of automatically re-routing traffic to the disaster recovery data center located in Colorado Springs. To hold recurring WAN costs, a new network hub was created in Japan for North Asia locations. For example, Korea's mileage to the United States was reduced by more than 5,000 miles. There was a similar mileage saving for China as well. Oracle also converted two of the 64Kbps-satellite circuit at its India Development Center to a 768Kbps circuit over marine cables.

To mitigate earthquake concerns in Japan, Oracle split the network hub to two locations, Tokyo and Osaka, which are about 300 miles apart. The network hubs are located within carrier facilities, which are built to withstand earthquakes and other utility failures. With this design, the Japan-to-U.S. circuit's hub is out of Tokyo and the Japan-to-Singapore circuit's hub is out of Osaka. The North Asia countries normally have hubs out of Tokyo but can

be switched to the Osaka facility in the event of a failure in Tokyo.

Also, in keeping with its design goals, the resilience between Singapore and Japan is built with high capacity links from different carrier's facilities. This design allows for Japan and Singapore to act as each other's backup and also maintain a full-time high-capacity link into the backup data center via the Singapore to Colorado Springs link. Similarly, the two sites in Australia back each other up and provide a direct link into the disaster recovery site, as well as a third backup route via Singapore being available.

The new Asia Pacific network met all of the design goals: increased capacity and resilience, reduced latency, and automatic routing to the disaster recovery site. In addition, Oracle was able to make all of these network changes without incurring too much of an increase in the run rate.

For example, Oracle previously had a 768kbps International Private Leased Circuit (IPLC) between Japan and the United States. Management upgraded to an Asynchronous Transfer Mode (ATM) service of 3mbps Sustained Cell Rate (SCR)/6mbps Peak Cell Rate (PCR) for approximately \$6,000 per month less. That's quadruple the bandwidth for less money. Once the Japan hub was created, Oracle was able to provision ATM services to three out of the four North Asian sites, which were obtained at significantly less cost per kbps compared to the bandwidth provisioned over IPLCs [same as above] to Singapore.

Another example is the T-1 IPLCs into Australia from the United States. By changing to a carrier with a new presence in Australia, Oracle obtained the two T-1s for \$9,000 per month less than the previous single T-1 service. The third T-1 to Colorado Springs is \$9,000 per month less than the previous 768k circuit. This was done through renegotiating of the contract with the existing provider of the 768kbps service.

Within the United States, the network is based upon ATM and Frame Relay circuits. Oracle currently has 37 ATM sites and 44 Frame Relay sites for a total of 81 sites. Each site has at least two PVCs; one to headquarters and one to the disaster recovery site. Through new rates obtained by renegotiating with an existing U.S. network carrier and making use of a new net-

work service offering, Oracle was able to double the bandwidth capacity to 70 of the sites and still realize a savings of \$18,000 per month.

These changes did not happen overnight. Oracle's methodical approach to using the Internet, creating a global e-mail system and re-designing its WAN to a more centralized model, laid the foundation, over which Oracle could then integrate its business systems and leverage ultimate cost savings.

Implementing Internet-Based Integrated Applications

The final implementation step was to roll out global Internet-based applications that allowed customers and employees to access information from a single database through an Internet browser, and to do transactions on their own such as on-line shopping or filing on-line employee expense reports. The cost of processing expense reports went from \$60 down to \$10, saving a total of \$11 million in fiscal 2000. In total, the combination of other internal self-service applications cut employee costs by \$150 million.

Through Internet customer self-service Oracle reduced the cost of supporting customers by \$550 million in fiscal 2000. Several global databases allow customers to enter their own bug reports. This saves both time and money because individuals sitting on the phone do not have to serve as data entry go-betweens. It is estimated that a call handled by a Website is \$20, while one handled by a person, which likely results in more follow up, costs \$350. This change allowed Oracle to increase the chances of solving a problem by 100 percent and reduce costs by a factor of 17.

Oracle also saw huge savings in customer training. The company averaged a \$250 cost per head to train customers at hotel seminars or conference centers. They moved training seminars online and dropped the cost per attendee to about \$2. Oracle's margins on its education segment jumped to 41 percent in 2000 from 17 percent in 1999.

Oracle's infrastructure consolidation has certainly reduced operations and maintenance costs, with far fewer servers to administer. And, because web-enabled applications do not require installation of a software suite on individual clients

beyond an e-mail-capable web browser, workgroup administration costs have declined dramatically. Some savings must also be apportioned to resourcing the supporting IT workforce and to establishing client help-desks where new or reengineered processes are introduced.

While Oracle is still in the midst of transformation and moving all its business processes to the Web, cost savings for new capabilities in knowledge management are still being defined. However, this area holds the promise for the greatest resource savings. Many cost reductions will derive from reengineering secondary processes that exist to enable legacy activity that is no longer required in a knowledge management environment (e.g., context-based content search routines that automatically return requested information, greatly reducing the requirement to maintain call centers).

For Oracle, what once was a pipe dream of consolidating stove pipe systems has now turned those client-server nightmares into fluid, Web-based information streams of seamless integration, making IT

dreams come true while keeping bottom lines positive. ♦

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Coming Events

June 11-13

E-Business Quality Applications Conference

qaiusa.com/conferences/june2001/index.html

June 18-22

ACM/IEEE Design Automation Conference

www.dac.com

June 25-27

2001 American Control Conference

www.ece.cmu.edu/~acc2001

July 1-5

Eleventh Annual International Symposium

of the International Council on Systems Engineering

incose.org/symp2001

July 7-13

2nd Int'l Symposium on Image and Signal

Processing and Analysis ISPA'01

ispa.zesoi.fer.hr/

August 1-5

OHCI International 2001: 9th International Conference on Human-Computer Interaction.

1st International Conference on Universal Access in Human-Computer

Interaction (UAHCI 2001)

hcii2001.engr.wisc.edu/

August 27-31

Fifth IEEE International Symposium on

Requirements Engineering

www.re01.org/

September 10-14

Joint 8th European Software Engineering Conference (ESEC) and 9th ACM SIGSOFT International Symposium on the Foundations of Software Engineering (FSE-9)

www.esec.ocg.at/



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