ORACLE®

White Paper

Client/Server Computing

Part Number A31531

Client/Server Computing

The Gartner Group defines client/server computing as "a software-based architecture which enables distributed computing resources on a network to share common resources among groups of users at intelligent workstations." [15] While there is no one universally accepted definition, Gartner's description highlights four key building-blocks of client/server systems: intelligent workstations (clients) as the user's contact point; common resources (servers) performing specialized tasks for devices requesting their services; networks connecting the clients and servers; and software applications connecting these three components to create a single (logical) architecture. In a typical implementation, Structured Query Language (SQL) is employed to send a request from a client computer to an database management system (DBMS) running on a server which processes the request and generates a response. [10] [12] [23]

Client/server architectures evolved from changing patterns of computer usage in organizations since the early 1980s. With the introduction into the business environment of improved networking technologies and personal computers (PCs) came the desire to leverage that processing power, and as the majority of computer users were no longer data-processing professionals came the need to decentralize computing. [3] It is generally understood that, in opposition to traditional mainframe applications which are centralized, single platform, and proprietary, client/server computing is distributed, multi-vendor, and multi-protocol. Rather than have one machine do it all, the client/server model partitions functionality into three separate areas--presentation services, database services, and application logic. The ultimate aim is to utilize of the processing power on the desktop while retaining the best aspects of centralized data processing.

Expected Benefits of Client/Server Computing

Market research and investment patterns indicate that client/server computing is taking the IT industry by storm. [8] [14] [21] What benefits should you expect from employing a client/server paradigm? Again, there is no universal agreement on the client/server advantages; but the most often projected benefits are:

- Adaptability

  You want the flexibility required to maintain a state-of-the-art technology environment and employ best-of-breed solutions. You want the ability to adapt the computing environment to meet the needs of an ever-changing business environment; to easily up- or downsize computing resources to match your changing business requirements. [1] [6]

- Reduced Operating Costs

  Computer hardware and software costs are on a continually downward spiral, which means that real computing value is ever increasing. Client/server computing offers you a way to cash in on this bonanza by replacing expensive large systems with lower cost smaller ones networked together.[1] [20]

[1] You may be paying more in real dollars for computing needs than ever before, but the bang you are getting for your buck is orders of magnitude greater than you would have received only a short time ago.

- Platform Independence

  The push towards client/server computing goes hand-in-hand with the push towards open systems and industry standards. You do not want to be locked in to a single vendor's proprietary hardware or software environment, but want to be able to freely interchange components based on true value and apples-to-apples comparisons. [11] [17]

- Better Return On Computing Investment

  Freed from dependence on proprietary hardware or software, you can now purchase computing resources based on value, entertain competing bids and demand better customer service. On the other hand, your customers are also demanding improved service and faster results from you--they will not accept booking time on the mainframe well in advance, or wait long for your staff to become proficient in mainframe operating systems. Client/server computing both answers and fuels the demand for 'information at our fingertips'. Advances in client/server tools have led to rapid application development. [1] [12]

- Improved Performance

  With more processing power scattered throughout the enterprise, you expect to process information more quickly with faster response time. With open networked systems and lower component costs, you expect to be able to quickly add resources where they are needed to easily fix performance bottlenecks. With the power of all those networked MIPS and advanced software architectures, you expect improved OLTP times.

- Easier Data Access and Processing

  The rise of client/server systems coincides with the advent of GUIs and interactivity. The major benefits of a GUI are reduced staff training costs, and the spreading of computer usage to a wider audience. Online interactive client/server systems are a major improvement in usability over older batch-oriented systems. More people are able to access more data more quickly than ever before. You want to use this to empower your team, reduce your product development cycles, improve your time to market and gain a competitive edge. [1] [6] [9]

- Decentralized Operations

  Decentralizing IT operations puts computing power and data access in the hands of the users, transforming clerical workers into "knowledge workers". This increases the productivity of MIS staff by reducing trivial requests and allowing them to concentrate on mission-critical applications. Client/server architectures improve the service you can offer by supplying information at the point closest to your customers. [7] [12] [23]

Although, these benefits are impressive, the mainframe computing environment provides some very real advantages that you cannot forgo in the move to client/server computing. Client/server computing must continue to ensure:

- High Reliability

  The move towards client/server would be a non-starter if these systems could not ensure high transaction rates, timely and continuous data access, data integrity, and corporate security. Mission-critical business data require highly reliable systems. [3] [4] [6] [19]

- Protecting Existing Investment

  It is silly to throw out the baby with the bath water. Wherever possible, existing legacy systems should be leveraged rather than scrapped. New client/server systems should adapt to technology changes and not become the legacy systems of tomorrow. This requires software systems that can access and interoperate with software running on the desktop *and* in the glass house. This requires software systems that are open, integrated, and adaptable. [16]

Expected Costs of Client/Server Computing

But what about the costs of a move to client/server computing? The most often cited drawbacks are complex network administration, hardware upgrade costs, and lack of stability or understanding of the client/server model. [6]

- New Hardware

  Client/server computing requires the replacement of older character terminals and the purchase of servers. The costs of a PC on *everyone*'s desk in the enterprise can often match or surpass the cost of an additional mainframe. [12] [18] And with the pace of technological advancement, this investment is never finished.

- New Software

  To empower your workers, you must invest in productivity tools. Buying an office suite for every white collar worker in the company can quickly add up to large sums. Here too, the investment is an ongoing cost, as major upgrades are introduced every year or so. [5]

- New Networking

  It has oft been said, that in the new client/server environment, the network *is* the computer. Laying LAN and WAN infrastructures is only part of the cost. The rest is found in network operating systems and their support staff which are, once again, ongoing costs. [5]

- New Training

  Whenever there is a change in paradigm, education and training is required to realize the benefits. An investment in new workstations, operating and networking systems, requires a similar investment in new skills training for employees. However, the cost of education is minuscule compared to the cost of ignorance. [22] [1]

Developer/2000: Client/Server Benefits With Minimal Cost

Oracle Corporation is an instrumental player in the client/server revolution, providing for over 15 years a reliable, high performance, fully scalable relational database management system (RDBMS) on open systems. The latest version of this award-winning and best-selling RDBMS is Oracle7™, available on virtually every platform from PCs to massively parallel supercomputers.

A smart database deserves smart tools. To take full advantage of client/server computing, Oracle offers its Developer/2000 for the rapid development of scalable, cross-platform, distributed client/server systems.[2] Developer/2000 is the market leader in the second generation of client/server development tools, offering:

- Application partitioning
- Attractive, professional GUI interface
- Client application portability
- Object orientation and reuse
- Flexible development methodology support including RAD and BPR
- Scalability from workgroup to department to enterprise
- Open, adaptable, interoperable architecture

Built from the ground up to meet the demands of client/server computing, Developer/2000 offers you all the benefits of client/server computing while minimizing your costs of ownership.

- Adaptability

  Will the system you build today adapt to your changing needs tomorrow? Just because a software application can successfully handle 100 concurrent users does not mean that it can easily handle 1,000. Oracle's Developer/2000 represents over a decade of experience in engineering client/server solutions, with a fundamentally scalable architecture that supports heterogeneous distributed data access, complex requirements, gigabytes of data, and thousands of concurrent transactions. Developer/2000 utilizes *all* the advanced features of Oracle7, including bind variables, shared SQL, array fetch, PL/SQL blocks, non-blocking queries, optimizer hints, etc.. There are many Developer/2000 reference sites with production applications supporting thousands of concurrent users. As you grow and enjoy the fruits of your success, you can rely on systems built using Oracle's Developer/2000.

- Reduced Operating Costs

  First generation client/server were popular for two main reasons: they were affordable and they supported rapid prototyping of event-driven (GUI) programming. But because these first generation tools placed a disproportionate emphasis on the client side of the equation, their low initial investment has not translated into a low cost of ownership. There are documented failures where projects trying to use their fast prototyping tools for serious client/server development ended up mired in time consuming

[2] Modeller/2000 is a companion suite of analysis, design, and generation tools. Modeller/2000 lets your team analyze requirements and model your system at a high level in graphical terms, and then generate fully functional, bug-free Developer/2000 applications through its unique generator technology.

coding resulting in over budget and expensive to maintain applications. [2] [24]

Developer/2000 makes your developers more productive, reducing their coding load with object-oriented 4GLs, powerful defaulting, declarative programming, and WYSIWYG editing. To program drill-down relationships in Developer/2000 just click an option in a property sheet. To use Developer/2000's object-orientation you do not need a Ph.D., just a drag and drop for multi-level inheritance and reuse. All of the Developer/2000 products are tightly integrated, sharing common interfaces, code, data repository, and direct bi-directional product links. This reduces your training costs and lets you leverage existing code.

[For a case study that details how Northrop realized a 60% reduction in MIS costs in 18 months (!) with an all Oracle solution, please see reference 13].

- Independence

  As customers of Developer/2000, your options are open to take advantage of lower cost hardware and software. Oracle has a well established tradition and ingrained methodology for developing its software in a hardware, operating system, and networking protocol independent fashion. You can rely on Oracle's experience and continued heavy investment in interoperability and portability. Developer/2000 runs on all standard GUI desktop configurations and even *character mode* terminals. Its easy-to-use intuitive user interfaces follow all of the standard conventions of the platform on which it runs, lowering the learning curve for new users. Whether on the Macintosh, PowerMac, Windows 3.1 or Windows 95, Sun, or HP Motif, Developer/2000 looks and behaves like a native application.

  Oracle's best-of-breed solution supports multi-tier architectures and all data sources--whether legacy databases on a mainframe, competing RDBMSs, desktop applications, the file system, email, or whatever. Developer/2000 can access heterogeneous distributed data sources using one of a variety of ways:

  - Direct drivers
  - ODBC
  - Open Gateways (Transparent and Procedural)
  - Transactional Triggers (unique to Oracle Forms™)
  - Third party connectivity solutions
  - Custom code

  Developer/2000 is also integrated with a variety of independent software technologies through the *Open Developer/2000* initiative. Open Developer/2000 is designed to enable you to mix and match the technologies that suit you best, providing best-of-breed comprehensive solutions. Among the myriad technologies Open Developer/2000 partners let you take advantage of are: source code version control, Transaction Processing Monitors, workflow, automated quality assurance, and electronic software distribution.

- Better Return On Computing Investment

  Oracle offers a comprehensive product line suitable for individual needs and the needs of the large multinational enterprise. All Oracle tools utilize

Oracle7's open repository for data sharing. Even if today you only take advantage of a piece of Developer/2000's integrated tool set, you can always later reuse and integrate this work with the rest.[3] Developer/2000's inteoperability with desktop applications means you can leverage your personal productivity software investments.

Just as Oracle's unmatched commitment to portability means a single development effort can produce multiple deployments, Oracle's unmatched National Language Support (NLS) lets a single development effort expand to multinational deployments. Oracle is a global company with the infrastructure already in place to fully support multinational enterprises. Oracle can provide all consulting, education, and support services needed to ensure your global success.

- Improved Performance

  The biggest bottleneck in a client/server architecture is the piece not found in its name, the network. Local data can be processed orders of magnitude faster than data can be pumped across a WAN or LAN. A key to high performance in a client/server system is the reduction of network traffic. Network round trips can be reduced by limiting the data sent across the wire. This requires processing data where it is most appropriate and sending minimum information between client and server. An interactive data entry application built using an intelligent client/server tool, would validate user input at the earliest possible moment (on the client) rather than sending the data to the server before detecting input errors. A smart client/server 4GL would only fetch data from the server that could be physically displayed on the client; fetching data on demand as the user browses around the client screen. Systems built with a scalable client/server tool would automatically provide a high concurrency model and pessimistic data locking for volume transaction loads in OLTP applications. Needless to say, Developer/2000 does all this (and more). The many successfully deployed Developer/2000 systems testify to a responsive client/server architecture.

  Unique to the Oracle solution is its approach to application partitioning. True application partitioning is only possible where client and server speak the same language, allowing program units to be indiscriminately run where best suited. Oracle offers the only *unified* client *and* server development environment, supporting the identical programming language, PL/SQL[4], on both client and server. You can program client or server processes using one development environment and one programming language. This lowers your training costs and your staffing needs. You determine that the application logic will run on the platform best optimized for executing it by dragging and dropping code from client to server or vice versa.. This high degree of

[3] For example, you can use the reverse engineering feature of the Modeller/2000 products to produce high level system descriptions from Developer/2000 applications, and existing (Oracle and non-Oracle) database schemas. You can use the Modeller/2000 GUI Business Process Reengineering (BPR) tool to reevaluate your existing business practices; then feed this information into Modeller's structured top-down design tools and eventually its code generators, for the only commercially available BPR-to-code system.

[4] PL/SQL stands for Procedural Language extensions to ANSI standard SQL; these procedural extensions conform to another standard, the Ada programming language.

client/server integration is unique to Developer/2000. And the best part about it is that no experience is required and no coding is necessary to take advantage of its advanced functionality--just drag and drop.

- Easier Data Access and Processing

  A universally recognized advantage of client/server computing is easier information access, accessible interactively from a GUI on your desktop. Easy access to critical business data can give you a competitive edge. Like other off-the-shelf products you have on the desktop, Developer/2000 is easy to learn and to use, enabling the rapid development of fully functional systems with a polished and professional user interface. Developer/2000 offers point and click application development with intelligent defaults, override-able code generation; object-orientation, and override-able automatic inheritance. Developer/2000 generates much of the code for you, including unmatched Oracle7 RDBMS exploitation, automatic code generation of database rules, all master/detail coordination, and intelligent transaction locking with support for distributed heterogeneous databases. The less code you have to write, the more your application will be error free, the lower the cost of your maintenance, and the faster you can get it done. Developer/2000 has a large reference list of production systems built in months and successfully deployed with thousands of users.[5]

- Decentralized Operations

  You can clearly upsize your operations using Developer/2000, but what about the reverse? Unmistakably, more and more processing is going on the end-user's desktop than ever before. Developer/2000 integrates with popular productivity tools, allowing you to build applications that read information from and export information to familiar desktop applications such as word processors and spreadsheets. On Windows, you can use:

  - OLE 2, including In-Place Activation and Automation
  - VBX 3
  - Direct calls to DLLs (including Windows SDK)

  Oracle is also working closely with Novell, Apple and IBM on OpenDoc compatibility. There is also a major joint engineering effort underway between Oracle and Lotus Corporation to provide integration with Lotus Notes, for Developer/2000 users wishing to access Notes data or integrate with Notes applications. [6]

- High Reliability

  Oracle is a reliable vendor offering an open, integrated set of tools with long-term maintenance capabilities. Developer/2000 is one of the most reliable development environments around, reflecting ten years of client/server experience, and the efforts of an experienced development team involving

[5] Many success stories use the Modeller/2000 repository-driven modelling and generation tools to quickly produce high quality, bug-free Developer/2000 GUI applications.

[6] Another companion suite of products to Developer/2000 is Explorer/2000, for end-user ad hoc querying, OLAP, EIS, data-mining, and data warehousing needs. Explorer/2000 gives access to operational data via on-line analytical processing and end-user decision support tools.

hundreds of programmers. The tight integration with the central repository assures data integrity; with all business rules and constraints specified in the schema automatically enforced. Object-orientation improves development quality and productivity by encouraging reuse. You can build or buy objects once and reuse them many times increasing consistency, reducing costs, and improving reliability. Through freely distributed interfaces, you can use configuration management and version control systems supplied by Open Developer/2000 partners.

- Protecting Existing Investment

  Oracle understands that continuity and compatibility are important in maintaining the long-term support of its customers. You can be assured that an Oracle-based solution will evolve with the latest trends, preserving the overall integrity of the product line while incorporating the best of new technologies. This guarantees a positive return on your investment.

  As customers of Developer/2000, your options are open to take advantage of lower cost hardware and software. Developer/2000 runs on all standard GUI desktop configurations and even *character mode* terminals. Its easy-to-use intuitive user interfaces follow all of the standard conventions of the platform on which it runs, lowering the learning curve for new users. Whether on the Macintosh, PowerMac, Windows 3.1 or Windows 95, Sun, or HP Motif, Developer/2000 looks and behaves like a native application.

Summary

In summary, Oracle Developer/2000 is an excellent choice for client/server computing. Developer/2000 minimizes the risks associated with client/server computing and providing you with the benefits of:

Benefit/Advantage	Feature(s)
Performance - Scalability	Ï Minimized Network Traffic Ï Tight Database Integration Ï Optimized Memory and Cursor Management
Distributed Computing - Client/Server	Ï Drag and Drop Application Partitioning Ï Distributed Heterogeneous Data Access Ï Multi-Tiered Architectures
Desktop Integration	Ï OLE 2, (In-Place Activation and Automation) Ï VBX3 Controls Ï Direct Calls to DLLs (Windows SDK) Ï OpenDoc Ï Lotus Notes
Complex Data Management	Ï Configuration Management via Developer/2000 Partners Ï Shared Repository Ï Transaction Control, Database Locking, Advanced Queries, Server Referential Integrity
Interoperability	Ï Build Anywhere, Deploy Everywhere Ï Multiple Database Support Ï Developer/2000 Open Initiative Ï National Language Support
Developer Productivity	Ï Unified Client/Server Development Ï Object-Oriented Reuse Ï Integrated State-of-the-Art Tool Set Ï Backwards Compatibility
Enhanced Data Access	Ï Graphical Multimedia Applications Ï Easy-to-Use, Familiar Look-and-Feel Ï Open to All Data Sources

References

[1] Atre, Shaku, "Train Or Fail: The Hidden Side Of Client/Server", DBMS, October 1994, v7 n11.

[2] Bedell, Jeffrey A., "Beware of Blaming 4GLs", September 1994, v7 n10.

[3] Bobrowski, Steve, "Database Security In A Client/Server World", DBMS September 1994, v7 n10.

[4] Butler, Brian, and Mace, Thomas, "SQL Databases: The Great Leap Forward", PC Magazine, October 11, 1994, v13 n17.

[5] Chisholm, John, "Enterprise Client/Server Costs", UNIX Review, January 1994, v12 n1.

[6] Comaford, Christine, "What MIS Really Thinks About Client/Server", PC Week, January 17, 1994, v11 n2.

[7] Davidson, Clive, "Letting Out The Reins", Computer Weekly, May 12, 1994.

[8] DePompa, Barbara, "Client-Server At Crossroads: Survey Says Companies Have More Confidence Yet Lower Expectations", Information Week, November 14, 1994, n501.

[9] Edelstein, Herb, "Unraveling Client/Server Architecture", DBMS, May 1994, v7 n5.

[10] Edwards, Morris, "So You Think You Know Client/Server", Communications News, April 1994, v31 n4.

[11] Hubbard, Craig, "Government's Weather Forecasting Agency Moves Towards Open Systems", Computing Canada, March 2, 1994, v20 n5.

[12] Jeffery, Brian, "Is It Client/Server Or Is It Hype?; A Practical Guide To Telling The Difference", MIDRANGE Systems, July 15, 1994, v7 n13.

[13] Karon, Paul, "Downsizing The Machine; Northrop Latest To Ditch Mainframe Computing", Los Angeles Times, May 25, 1994, v113.

[14] Lamb, John, "Europe Embraces Client/Server", Computer Weekly, September 29, 1994.

[15] Levis, John, "Companies Still Wary Of New Architecture", Computing Canada, March 16, 1994, v20 n6.

[16] Mahoney, David, "Beyond Client/Server", LAN Magazine, October 1994, v9 n10.

[17] O'Brien, Timothy, "Poised for Leadership as Corporations Move to Distributed Architectures?", Distributed Computing Monitor, April 1994, v9 n4.

[18] Piraino, John, "Benefits Not Buzzwords", Software Magazine, January 1994, v14 n1.

[19] Southern, Tim, "Reliability Is The Key To Client/Server Savings", Computer Weekly September 1, 1994.

[20] Thompson, George A., "When 2 + 2 = 5", HP Professional October 1994, v8 n10.

[21] Walker, Charles, "Climb On The Bandwagon", Computer Weekly, March 24, 1994.

[22] Wallack, Morris, and Cuffe, Sonja, "People: Essential To Downsizing: Education Is The Key To A Successful Move To Networking", LAN Times January 24, 1994, v11 n2.

[23] Watterson, Karen, "Data On Demand," Windows Sources, February 1994, v2 n2.

[24] Watterson, Karen, "Next Stop: Business Objects", Data Based Advisor, October 1994, v12 n10.

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
USA

Worldwide Inquiries:
Phone: +1.415.506.7000
Fax +1.415.506.7200
http://www.oracle.com

To offer our customers the most complete and effective information management solutions, Oracle Corporation offers its products along with support, education, and consulting, in more than 90 countries.

Part #: A31531

Printed on recycled paper with soy-based inks