The Guide to Open Systems

PATRICIA SEYBOLD'S

UNIX IN THE OFFICE

VOL. 6, NO. 3
ISSN: 0887-3054
MARCH 1991

Ingres

A Database Vendor in Transition

By Judith R. Davis

IN THE FIERCELY competitive relational database arena, Ingres is fighting hard to emerge from its tangle of financial problems and become a major force in two areas: database tools and distributed database integration services. Traditionally, Ingres has provided technical leadership in distributed database and gateways to heterogeneous database management systems (DBMSs). The company is now focusing on extending this leadership to areas such as client environments for heterogeneous back ends, and knowledge (e.g., rules) and object (e.g., the ability to define new data types)

(continued on page 3)

• EDITORIAL •

A Delicate Equilibrium

The balance of power in the workstation market is shifting under the weight of IBM and Sun.

By Judith S. Hurwitz

REMEMBER WHEN IT looked as if Sun MicroSystems and AT&T were going to control the next generation of the Unix operating system? Remember how some of the major systems vendors responded—by forming the Open Software Foundation (OSF)? The competition was reassured. Once again, there would be only one archrival: Sun. Now, the equilibrium is shifting again. And again, Sun Microsystems is at the center of the storm. But it's different this time. This time, Sun isn't joining forces with anyone. This time, IBM's growing strength in the RISC workstation market is the factor that is changing the balance of power.

When IBM began to talk about Unix and its plans for reentering the workstation market, no one really took it seriously. After all, hadn't Big Blue proven that it didn't have the expertise to compete? In reality, IBM was dead serious about workstations and the Unix market. Especially once it realized just how big this market could grow. Recently, IBM announced that it has already sold $1 billion worth of its RS/6000 workstations. Not bad for the new kid on the block.

The growing power of IBM combined with the continued strength of Sun has caused industry competitors to look for some way to equalize the situation. The answer appears to be what we'll call (for lack of a better name) Son of OSF. From our sketchy understanding of the project, a group organized by Microsoft, MIPS, Compaq, Digital, and SCO (to name a few) intend to form a consortium around a binary standard for the MIPS processor.

Each party in this fledgling group has its own agenda and stands to gain different benefits. Microsoft would like the opportunity to dominate the RISC software market with a new and improved OS/2 that isn't linked to Intel. MIPS would gain a potentially larger market share as the primary alternative to Sun SPARC. For Compaq, becoming a key supplier of an important RISC standard architecture could help it move out of the PC niche into a broader market. Digital, one of MIPS's most important customers, would like to become a much bigger workstation supplier. And, for once, it would like to be part of the mainstream rather than a variant (you know, supplying the Berkeley operating system while everyone else uses AT&T System V). Likewise, SCO would like to expand its influence beyond the Intel marketplace. It has the distribution channels to make it a desirable partner.

While this appears to be just another industry power struggle, there is a danger for users. There is the possibility that some users and ISVs could welcome the new initiative and forget about the need for open systems and standards. After all, won't it allow us to return to the good old days of DOS, when everything was so simple? One operating system, one binary.

Probably not. First, the Microsoft operating system kernel (known as NT) will not be a full-fledged product for at least two years. In addition, it is an object-oriented kernel technology, not a full operating system. We suspect that it will not be very different from similar kernels from OSF, Chorus, and Ameba (to name a few). Therefore, it will have to rely on commands, utilities, and other components from third parties. Even Microsoft realizes that it cannot go it alone anymore. If Microsoft wants to rule the software world, it will have to do it with partners. The danger will exist if this new group ignores the standards bodies and tries to force de facto standards in a vacuum. There could be short-term market share gains, but, long term, users will suffer because open systems requires that standards allow for interoperability across all platforms. Therefore, let's make sure that once this group emerges, users make it clear that its members must conform to interoperability and industry standards before users will give them their business.

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Patricia Seybold's UNIX in the Office (ISSN 0887-3054) is published monthly for $495 (US), $507 (Canada), and $519 (Foreign) per year by Patricia Seybold's Office Computing Group, 148 State Street, 7th Floor, Boston, MA 02109. Second-class postage permit at Boston, MA and additional mailing offices. POSTMASTER: Send address changes to *Patricia Seybold's UNIX in the Office*, 148 State Street, 7th Floor, Boston, MA 02109.

•INGRES•

(continued from page 1) management. On the server side, Ingres is also trying to position itself as a key online transaction processing (OLTP) engine for distributed computing. Given the growing importance of this market, Ingres will be well-positioned if it can be successful here.

However, we expect that Ingres faces a difficult battle. Despite its technical achievements, the company has had trouble reaching critical mass. One reason is that it has never understood how important marketing is to success. If, under the new Ask management, Ingres can begin to market its strengths effectively, it could emerge as one of the most important database suppliers in this heterogeneous world. This report will take a look at the directions Ingres is taking.

Product Strategy

Ingres's overall strategy is to be an integrator, to fit comfortably into an existing environment while giving the user organization access to state-of-the-art application development tools and DBMS technology. This would allow the user to implement Ingres technology while continuing to implement existing tools, applications, or data.

Components of Ingres's strategy are:

- Integrated tools, which include the forms-based development tools Ingres provides, its 4GL, Windows 4GL, and Ingres/Vision.

- OLTP facilities, which have been added to the latest release of the Ingres database (Version 6.3) to provide better support for this environment.

- Information integration, which allows users to access and integrate data across a wide variety of computers and operating systems. These services are provided via Ingres/Net (access to a single remote database), Ingres/Star (to distribute a database across multiple systems), and the Ingres gateways (to access heterogeneous DBMSs).

PLATFORM STRATEGY. Instead of following Oracle's strategy of porting its products to as many platforms as possible, Ingres is beginning to focus on its most profitable platforms. The objective is to concentrate in-house resources on the 20 percent of hardware vendors that will produce 80 percent of the company's revenue. Strategic development platforms for both server and client products include Digital VMS and Ultrix, Hewlett-Packard HP-UX and MPE, IBM RS/6000, Sun SPARC, and Intel 386 (both Unix and OS/2). Ingres will also port to other platforms through partnership agreements. Unix desktops are naturally of paramount importance. Ingres also plans to port its suite of tools to Windows 3.0 and the Macintosh (not OS/2 yet) as strategic client-only platforms.

While Digital's VMS has traditionally been Ingres's strongest platform, Unix is fast growing in importance. Unix currently accounts for 40 percent of total revenues, up from only 15 to 20 percent two years ago. Therefore, Ingres can be expected to focus much of its attention on its Unix partners—Digital, Hewlett-Packard, IBM, Sun, and Santa Cruz Operation (SCO). It will continue to port to Digital's VMX and HP's MPE because of its installed base.

Ingres RDBMS

The latest version of Ingres, 6.3, was introduced in November 1989 and began shipping in January 1990 for Digital's VMS and Sun 3 and SPARC workstations. Currently, 6.3 is also available on Data General Aviion, Digital RISC/Ultrix, HP 9000, IBM RS/6000, Pyramid, and Sequent.

MULTISERVER ARCHITECTURE. The major enhancement in Version 6.0 of Ingres was the implementation of an architecture consisting of multiple, multithreaded servers (see Illustration 1). Each server can handle multiple clients, and there can be multiple server processes on a single platform. "Multiserver" means that Ingres can take advantage of multiprocessor hardware configurations. A multithreaded server minimizes resource consumption (memory and CPU time) as much as possible, and gives the server more control over its environment. The objectives are to make Ingres more competitive for online transaction processing applications (target markets include platforms such as Sequent, VAXclusters, and Pyramid) and to handle platforms with limited resources better.

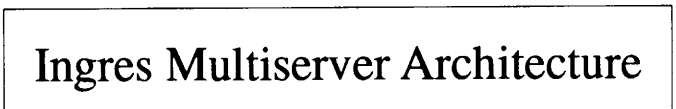


Illustration 1. With Version 6.0, Ingres introduced multiple multithreaded servers.

NEW FEATURES. The new features of Version 6.3 of the Ingres DBMS, called the Ingres Intelligent Database, are focused on the database server itself rather than on the front-end tools. Version 6.3 introduces data management enhancements as well as two optional new products: the Object Management and Knowledge Management extensions.

Data Management Enhancements. In late 1988, a redesigned, multiserver version of Ingres (Version 6) was introduced. The objective was to enhance both performance and functionality in order to meet the requirements of OLTP applications better. In addition to the ability to take advantage of multiprocessing, other major improvements were made in database procedures and in reducing I/O overhead.

The new features of Version 6.3 of the Ingres DBMS are focused on the database server itself rather than on the front-end tools.

Database procedures are written in the Ingres 4GL and stored in the database server. The benefit is the ability to write a procedure once that can be accessed by multiple applications, reducing the need for logic in the application itself. Other benefits include reduced network traffic and easier maintenance since the procedure only has to be changed in one place. While database procedures are similar in function to Sybase stored procedures, there are some major differences. Ingres procedures cannot be nested and can only return a single row as a set of values; Sybase stored procedures can be nested and can return an entire set of rows.

I/O reduction techniques included fast commit (deferred writes), group commit, multiblock reads, and multiblock writes.

Building on this base, Version 6.3 adds several significant features to the database server:

- Two-phase commit (2PC) protocol, a critical component for supporting distributed database processing across multiple sites in a single logical transaction. A two-phase commit protocol decomposes the commit operation into two phases (prepare-to-commit and commit), so that a multisite update is either committed or rolled back by all participating sites. This is necessary to maintain data integrity.

- Online backup for high availability, an important consideration in online transaction processing systems.

- Improved optimization of nested queries.

- International language support: sorting sequences, error messages, and a 2-byte character set.

- An increase in the maximum columns per table from 127 to 300.

Knowledge Management. The optional Knowledge Management Extension to the Ingres server introduces a rules system that can be used to capture both referential integrity constraints and business policies in the database server itself. It allows users to define an unlimited number of independent rules per table; rules can be nested (to unlimited levels) and recursive. Ingres rules are comparable in function to Sybase triggers, although there are (again) differences in implementation. In Sybase, you create a single trigger for each of the data manipulation operations (insert, delete, and update) and embed your rules in the trigger code. Triggers can be nested to 16 levels and cannot be recursive.

Resource/Access Control. Knowledge Management also contains resource- and access-control systems. Resource control allows the administrator to tell the server how much in the way of resources each user can consume. Limits are associated with the user authorization profile. If the user tries to execute a query that will exceed this limit (as evaluated by the query optimizer), the server rejects the query. The important point here is that the query is rejected before it is executed, not after the limit has been reached (e.g., not after the 1,000th row has been retrieved, if that is the defined limit). This reduces the potential conflict between ad hoc and production users of a database, and eliminates unpredictable performance.

The access control system adds group and application permissions to the standard individual user permissions for access to data in a database. Thus, the administrator can define a group called "marketing" and grant the entire group specific levels of access to data. Applications (also known as "roles") can also be given permission to access data. This allows a user to have different permissions when running a particular application (for example, order entry) from when interactively accessing the database. Access control makes the database administrator's (DBA's) life a lot easier.

Object Management. The Object Management Extension allows the creation of user-defined data types, such as geographic coordinates (longitude and latitude), temperatures, weights, and time-series data. The user can also define operators and functions to be used with these data types, e.g., the ability to calculate the distance between two locations, or to convert pounds to ounces. For example, the user could teach Ingres about inches, feet, yards, etc., and how to add and multiply these user-defined values. The data types and functions are defined outside the database itself, using 3GL code. However, the data types can be manipulated using standard SQL. Rules can also be associated with user-defined data types to enforce referential integrity and business policies.

The 3GL code is part of a shared library that is linked with the Ingres DBMS kernel. Since this code runs in the same address space as the server, any problem with the 3GL code can affect the server itself. Therefore, Ingres only sells the Object Management Extension packaged with two days of consulting to ensure that the customer understands how to use the extension properly. Ingres recognizes that Object Management isn't appropriate for every organization. On the other hand, Ingres is the only RDBMS vendor that offers this type of object management to organizations that really need it.

According to Ingres, this is "phase 1" of its implementation of object management in the database. The initial goal was to make Object Management SQL-based and to work on improving the performance of manipulating user-defined data types. In the future, we expect Ingres to implement additional object-oriented functionality, such as inheritance, compound objects, and subclasses. Since Ingres doesn't yet offer a library of classes or object types to get the user started in defining objects, it positions the Object Management Extension as a toolkit rather than a full-fledged object-oriented DBMS.

Distributed Processing

Ingres/Net is Ingres's distributed processing product. It allows an Ingres application running on one computer to access a single remote Ingres database. Network protocols supported include TCP/IP, DECnet, asynch, NetBIOS, Novell SPX/IPX, and LU0.

DISTRIBUTED DATABASE. Ingres/Star is the Ingres distributed database product (see Illustration 2). It is built on Ingres/Net to allow the user to access multiple Ingres databases in multiple locations transparently. The first release of Ingres/Star provided distributed query processing—the ability to retrieve data from multiple sites in a single query—and a distributed query optimizer to minimize communications traffic. It also offered real-time updates of a primary table and deferred updates of copies of the table stored at other network locations. It limited updates within a transaction to a single site.

The latest release, 6.3/02, available since August 1990, added an *automatic* two-phase commit capability. Among the other major Unix databases (i.e., Oracle, Informix, Sybase, and

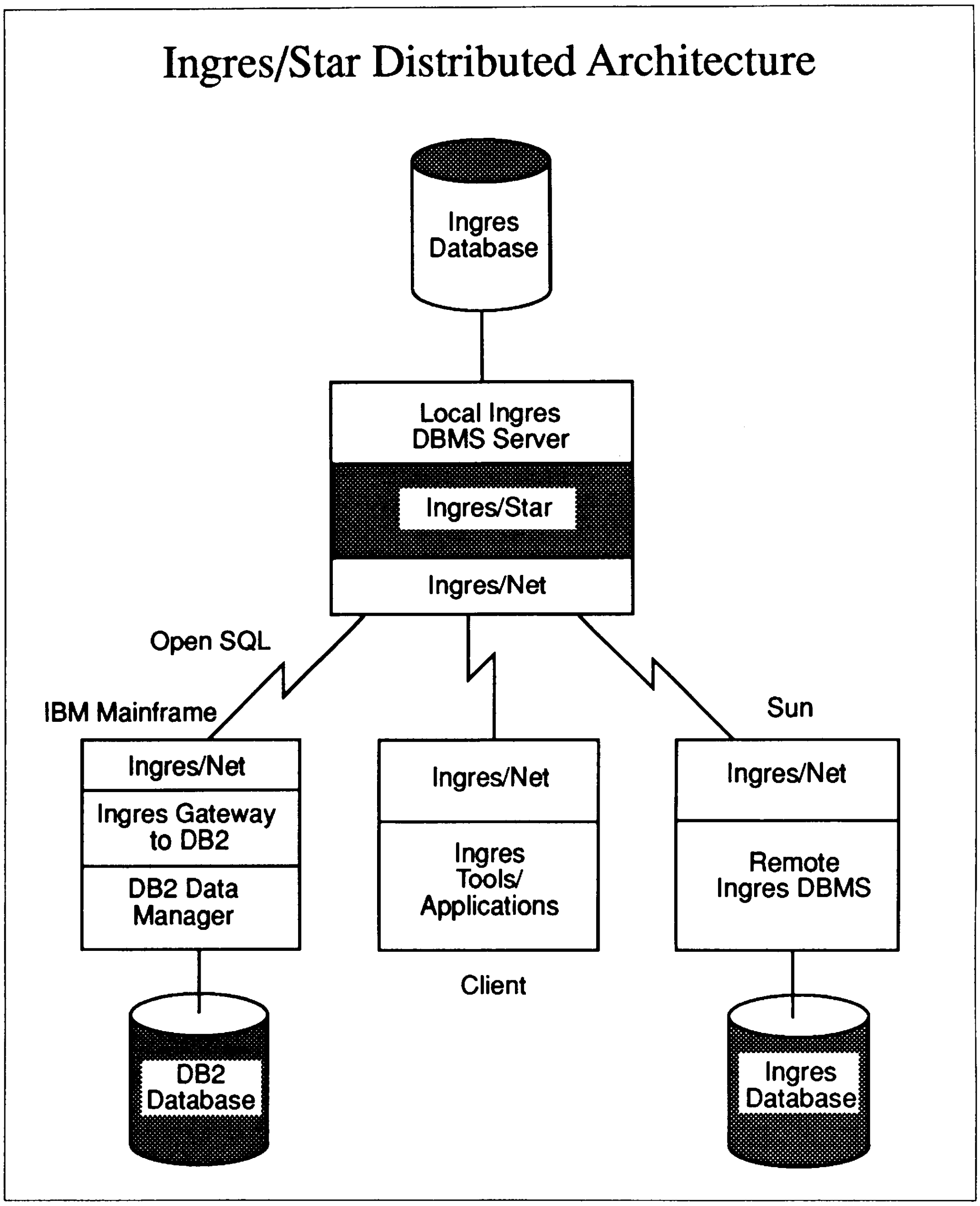


Illustration 2. The Ingres/Star software coordinates queries and updates across multiple distributed databases. Non-Ingres databases can participate in joins via an Ingres gateway; multisite updates in a single transaction are limited to Ingres databases. Currently, Ingres/Star runs only on Digital's VAX/VMS platform.

The Impact of the Ask Acquisition

A number of problems have dogged Ingres in the past. One was lack of strong management direction and focus for the company. Of all of the major independent RDBMS software vendors, Ingres's management was the least visible. The company was driven much more by engineering than by management/marketing. Another problem was the perception that the company simply could not effectively market its products. Oracle blew by Ingres on the basis of its aggressive marketing and portability strategy. While most people know who Oracle is, many are still not familiar with Ingres. Sales, with high overhead and heavy dependence on direct sales as the primary channel of distribution, was another area of concern.

All of these issues contributed to a severe financial downturn between 1988 and 1990. While 1989 revenues grew 50 percent (from $87 million to $131 million), net income dropped 27 percent (from $8.5 million to $6.2 million). Then came a disastrous 1990. Revenues rose about 20 percent to $157 million, but net income dropped precipitously to a mere $76,000. Ingres definitely needed help, and, as we mentioned, had already been looking for one or more partners to invest in the company.

The result was the acquisition of Ingres Corporation by Ask Computer Systems for $110 million in October 1990. The acquisition indirectly involved two other major partners as well—Hewlett-Packard and Electronic Data Systems (EDS), a subsidiary of General Motors. HP bought 10 percent of Ask for $20 million, and EDS bought 19.7 percent for $40 million. With these investments, plus a loan and some of its own cash, Ask bailed out Ingres. Ingres Corporation is now the Ingres Products Division of Ask.

Ask is a value-added reseller (VAR) that develops applications software targeted for manufacturing companies. Ask sells its software bundled with hardware. The company's primary product is ManMan, a Manufacturing Resource Planning (MRP) II system designed for discrete manufacturing. (MRP II systems integrate manufacturing and financial management information systems.) The current version of ManMan runs on HP 3000/MPE and Digital VAX/VMS platforms. MaxCim, another line of manufacturing software, was acquired with NCA Corporation, now a subsidiary of Ask. MaxCim runs only on VAX/VMS. Another acquisition, this time of Data 3 Systems in September 1989, added SIM/400 to the Ask product line. SIM/400 is an IBM AS/400 product.

Even before the acquisition, Ask had already made a major commitment to building its next generation of manufacturing software—Ask Advance—using Ingres/Windows 4GL and the Ingres RDBMS as an underpinning. It was extremely important to Ask that Ingres continue to be a viable, successful entity, and that the right partnership participate in the acquisition.

Ask will certainly provide visible leadership at the top, something that Ingres has lacked in the past. All of Ingres's top managers are gone, with the exception of Marilyn Bohl. Bohl was VP of engineering with Ingres, and retains that position within the Ingres Products Division. Ask promises to make Ingres more market-driven, focusing more on identifying and addressing real customer requirements than on simply building technically elegant general purpose solu-

Progress), only Progress offers a similar capability. Ingres/Star can now coordinate an update that spans multiple Ingres databases, and can carry out the necessary recovery process if any part of the transaction fails.

Ingres describes its 2PC as heterogeneous, meaning heterogeneous at the hardware, operating system, and networking levels, but not at the database level. Although Ingres offers gateways to other DBMS data (see "Gateways" at right), Ingres/Star does not yet implement 2PC across heterogeneous databases. A major stumbling block here is the fact that so few DBMSs have implemented 2PC.

One criticism leveled at Ingres's distributed database architecture is that reliance on the Ingres/Star software means that there is a single point of failure in the distributed network. However, Ingres points out that there can be multiple Ingres/Star nodes in a network to ensure that multisite distributed updates are performed properly.

The company has shipped over 300 licenses for Ingres/Star. Version 6.3 currently runs only on Digital's VAX/VMS. Future releases of Ingres/Star will expand these capabilities to allow concurrent updates of all copies of a table (data replication) and horizontal partitioning.

GATEWAYS. Ingres was one of the first RDBMS vendors to introduce gateways to non-Ingres DBMSs. The initial gateways, to Digital's RMS and Ashton-Tate's dBase, came out in February 1988 (although the dBase gateway is no longer marketed). Ingres now provides full read/write gateways to IBM's DB2 and SQL/DS on the mainframe, and to Digital's Rdb and RMS in the VAX/VMS environment. A read-only gateway is available for IMS on the IBM mainframe. Under development are read/write gateways to Tandem's Non-Stop SQL and HP's Allbase. In addition, Teradata is building a gateway between its own and Ingres's DBMS.

tions. Ask also believes it can market Ingres better than Ingres Corporation did. The combined company sees itself in a better position—both in terms of size and breadth of product offerings—to compete with Oracle.

There are a number of interesting dynamics to consider in this acquisition, and many questions that remain to be answered.

- Successfully merging two companies takes a lot of valuable time and energy, often six months to a year or more. Can Ingres keep up with market requirements during this turbulent, unsettled time? Many Ingres employees have been laid off (200, or about 17 percent), and others have been lost to other companies. Servio Corporation in particular has benefitted from the influx of at least three experienced Ingres managers, including Paul Butterworth, Ingres's chief architect and "employee number one."

- Will Ingres continue to emphasize both its database engine and tools? Or will Ask push Ingres more in the direction of tools? And if Ask needs additional functions or features in order to get its new manufacturing products out, what will this do to Ingres's independence of product strategy and development?

- Ask sells a lot of HP hardware. But Ingres has always concentrated first and foremost on Digital VAX/VMS and Sun/Unix, which generate most of its revenues. HP has always been lumped in a third category of "other platforms." Will this change over time to a primary focus on HP 9000 and HP workstations, based on HP's investment in Ask? Some Digital/Ingres shops are more than a little worried about this.

- Ask is an Ingres VAR, and one of the primary goals of the acquisition is an enhanced VAR program for Ingres. However, competing VARs may view Ask as having an unfair advantage, and choose a different RDBMS platform.

- Ask is not much larger than Ingres, and prior to the acquisition, neither one appeared to be very strong financially. The combined financials for the second quarter of fiscal 1991 (ended December 1990) were revenues of $85.8 million and net income of $405,000.

- Ask does not have much, if any, experience in the Unix environment. Yet, this is a growing segment of Ingres's business and an obvious focal point for all of the RDBMS vendors.

The key for Ask/Ingres is to retain Ingres's pre-acquisition technology leadership while strengthening the effectiveness of its management and marketing. We will watch the company's progress with interest to see if Ingres has finally left behind the problems of the past and created the foundation on which to build future success.

Open SQL. Open SQL is a subset of Ingres SQL that is supported by all of the Ingres gateways to non-Ingres databases. Using Open SQL will ensure that an application is portable across the supported database managers. Ingres SQL is not yet fully compatible with ANSI-standard SQL (it is missing a few elements, such as a packed decimal data type and a "create schema" statement). Open SQL includes all of Ingres's current ANSI-standard SQL statements.

MIGRATION STRATEGY. The company's objective is to give users an easy migration path into the Ingres distributed RDBMS environment from existing non-Ingres database products. The major benefit is the ability to develop new applications with the Ingres 4GL application development tools, yet access existing datafiles. These gateways allow the organization to move on using state-of-the-art development tools without having to convert or leave behind masses of non-Ingres data. An additional benefit is applications coexistence, the ability to continue to run older custom applications that maintain or use the non-Ingres data.

With Ingres/Star, a user can also combine data from one or more of these heterogeneous DBMSs in a single query. As we mentioned, the two-phase commit protocol is currently limited to Ingres databases only.

Database Tools

CORE TOOLS. In addition to the back-end database manager, a set of core tools is packaged with the DBMS. These include Ingres/Menu, Ingres/Forms, SQL/QUEL, Ingres/Query, Ingres/Reports and Report-By-Forms, and Ingres/WindowView. Currently, these are not graphical tools. Ingres states that one of its top priorities is to create a more effective user interface. While the company is innovating in its optional development products (Ingres/Vision and Windows 4GL), it has not significantly improved the basic interface of the vanilla product for developers and end users. We feel that Ingres is somewhat behind here.

Ingres/Menu. Ingres uses a menu interface tying together all of the Ingres subsystems. You use a function key (or control key sequence) to invoke menu items directly; or you can move to the menu line and enter the desired option. In the latter case, you need only type in enough characters to identify a unique item. However, some Ingres menus have two or more commands that begin with the same letter, such as QBFNames and Quit. You would think the menu would indicate the additional letters required to differentiate these commands (EXamine and ENd, for example), but not so. And, instead of just beeping, displaying an error message, and letting you edit the entry, Ingres gives you a message, tells you to press Enter to return to the menu line, and makes you start over.

Furthermore, many menus have more than one line of options, requiring the user to hit the menu key again to display the additional options. We would prefer the option to see all menu choices at once. Why not a two-line menu? Ingres indicated that this is because of backward compatibility issues.

While the company is innovating in its optional development products, it has not significantly improved the basic interface of the vanilla product for developers and end users.

Ingres/Forms. Ingres/Forms includes the forms run-time system and Vifred, the Visual-Forms-Editor for creating and modifying screen forms. Vifred is easy to learn and use, and it provides a great deal of flexibility. Once we got familiar with its capabilities, we found Vifred a very valuable and well-designed facility for creating customized forms.

Ingres will generate a default form for a table that can be used as is or edited. Editing is interactive; the menu at the bottom of the screen assists you in painting the screen in the desired layout.

Forms can contain trim (static text for form titles and explanatory statements), fields, and table fields (which allow you to display multiple rows on the screen rather than one row at a time). You can easily insert blank lines and delete unneeded components from the form. And Vifred has an "Undo" function that comes in handy.

SQL and QUEL. Ingres has two query languages, SQL and QUEL. QUEL is Ingres's original, proprietary query language. SQL was added with Release 5.0 in late 1986. SQL and QUEL were built in parallel in the 1970s and are very close in syntax, although QUEL is not compatible with ANSI SQL. Queries are performed in the same way with both. Selecting either one on the Queries menu invokes the appropriate interactive query editor. You then enter your query and use the menu to run, edit (via the Unix system editor), or store your query in a file. Neither word wrap nor horizontal scrolling is in effect when you enter a query; you must hit Return to continue on the next line to avoid errors in the query. We would rather not worry about this; we're busy enough figuring out how to structure the query.

Both query languages include commands to create databases and tables; manipulate data; query the database; impose integrity constraints on data (field validation expressions); specify access permission to the database by user, table, function, time of day, and location; create views; create and modify the way data is stored in the table; and much more. Either query language is used to create indexes and to modify the storage structure of both tables and indexes.

In Version 5.0, an SQL query was parsed or "translated" to its QUEL equivalent before accessing the database. In Release 6.0, this translation overhead has been eliminated, and applications can talk directly to the database using either SQL or QUEL.

Ingres/Query. Ingres/Query is a forms-based, query-by-example facility also known as QBF, or Query-By-Forms. In typical fashion, a form is displayed on the screen, the user fills in search criteria in the appropriate fields, and the results of the query are returned on the same form. QBF is more flexible than many query-by-example facilities. It supports both "and" and "or" searches and the use of parentheses to specify the order for multiple criteria. And the criteria do not have to fit in the data window on the screen. For lengthy search criteria, the entry scrolls within the data window.

QBF works on what Ingres calls "query targets." A query target can be a single table; a join definition; or a QBFName, a form associated with a table or a join definition. A query target defines the set of information (tables and rows) from which the user wants to retrieve data. If a special form has not been customized for a table or join definition, QBF will generate a default form for entering the query.

After selecting a query target, you then select either the Retrieve or Update function to execute a query. You can also append rows in QBF if you have permission to do so. Selected rows are displayed on the screen individually ("simple field" format) or in lists (called a "table field" format), depending on how the user has designed the form. If the query target is a table rather than an existing form, you can select either format for displaying the results.

There are two aspects of QBF we don't like. QBF still does not indicate how many records it finds that satisfy the criteria.

We would also suggest that Ingres consider combining the catalogues for tables, QBFNames, and JoinDefs on a single screen form rather than have three separate listings. It would be easier (and faster) to move through a single list rather than search among three separate screens if you're not sure what query target you want.

Initially, the differences and relationship between QBF and Vifred (Ingres's Visual Forms Editor) are confusing. QBF is used for data manipulation; Vifred is used for creating and editing screen forms. However, QBF can create default forms when necessary, and you must create a join definition in QBF before you can create and edit an associated custom form in Vifred. Once the user grasps these rules and relationships, it becomes easier to use these two tools effectively.

Data is entered and edited in the QBF module. After you select QBF and specify the table name or join definition name, QBF will give you a choice of Append, Retrieve, or Update. Append allows you to enter new rows into a table; Update enters a mode for editing existing records. QBF then displays the form associated with the table or join definition (it creates a default form if you don't have a customized one). In Update, you first execute a query to locate the record(s) you wish to edit. Any validation criteria defined on the form will be in effect when data is entered through QBF.

Ingres/Reports and Report-By-Forms. Ingres provides both Ingres/Reports, a nonprocedural report writer, and Report-By-Forms, a forms-driven report writer.

Ingres/Reports, the nonprocedural report writer, is used for more complex reports. Here, you use the standard Unix editor (e.g., vi) to create the report and compile it with "sreport", which checks for valid syntax and performs some debugging. However, sreport does miss some things. For example, it doesn't verify whether the tables and fields referred to on a report really exist. Once the report is compiled and saved, the Report option on the menu executes the report. With Ingres/Reports, you are essentially writing a program to generate a report; this product is aimed primarily at the applications developer or sophisticated end user. Ingres/Reports is a major weakness from the perspective of Ingres developers. One negative is that a report is associated with a single query on a table or view. That is, Ingres only provides one pass through the data for a report. If you cannot create the desired set of data in a single table or view, you cannot generate the report in Ingres. In addition, Ingres/Reports cannot handle the more complex reports (e.g., it limits the number of variables on a report), and it also runs more slowly than programs generating reports with C programs.

The flashiest development tool from Ingres is Windows/4GL.

Report-By-Forms (RBF) enables the end user to generate simple reports by modifying a screen form. RBF operates very much like Vifred, and the two products have a consistent interface. RBF will generate a default report format for you and decide whether to use a columnar or block format, depending on how the data in the table fits on the screen. Or you can specify which format you want. The default columnar report will automatically perform a primary sort on the contents of the first column and a secondary sort on the second column. RBF generates standard Ingres/Reports formatting commands for report definitions. A user can also develop a basic report in RBF and then make a text-file copy of the report's formatting commands for further editing within Ingres/Reports.

Ingres/WindowView. WindowView allows Ingres to run in multiple windows on an X Window workstation. It requires Version R3 of X Window.

DEVELOPMENT TOOLS. Optional modules provide embedded SQL or QUEL; Applications-By-Forms (ABF), a forms-based applications generator that includes the Ingres 4GL; Ingres/Vision, an applications generator; Ingres/Windows 4GL, a graphical tool for developing workstation-only applications; and graphics.

Embedded SQL. Ingres provides embedded SQL precompilers for Ada, C, Cobol, Fortran, Pascal, Basic, and PL/1. These all support dynamic SQL, allowing queries to be user defined at run-time.

Ingres/Vision. The newest of Ingres's development offerings, Ingres/Vision, is a character-based applications generator designed to fill the functionality and ease-of-use gap between Query-By-Forms and ABF.

Windows 4GL. The flashiest development tool from Ingres is Windows/4GL. This workstation product provides a graphical development environment designed specifically for generating Ingres DBMS applications that will run on workstations with a graphical user interface (GUI). The product also forms the foundation for the company's tools products for the '90s.

MACINTOSH TOOLS. Ingres offers two products designed specifically for the Macintosh. Graphical Query Language (GQL) allows the Macintosh user to build queries visually using the mouse and point-and-pick.

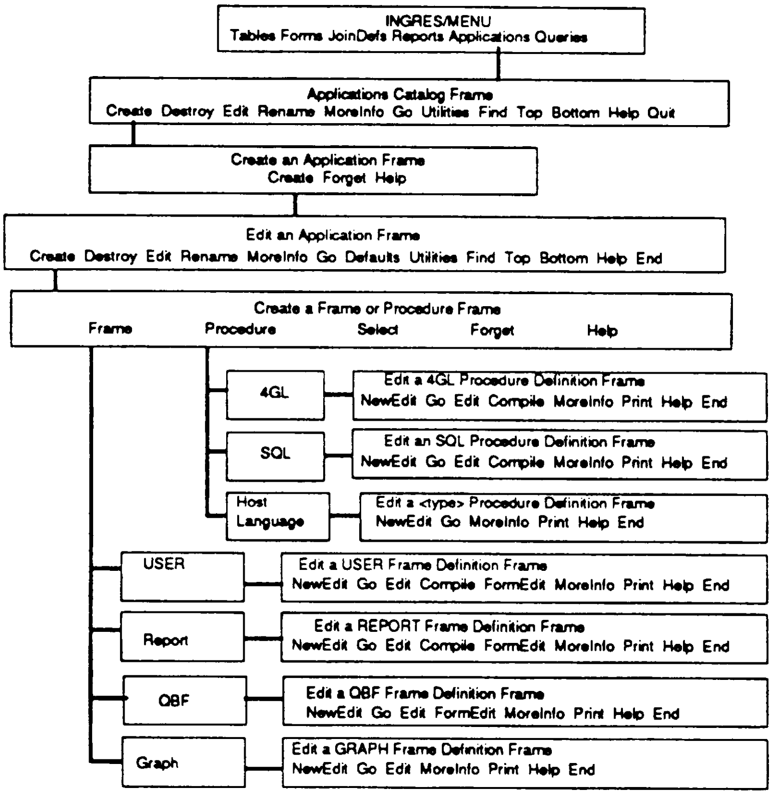
Ingres/SmartLook, introduced in December 1990, can be described as a sort of "WindowView Plus" for Mac users accessing Ingres applications via terminal emulation. SmartLook not only permits an Ingres application to run in a Mac window and the use of the mouse, it also transforms character-based Ingres screens into a graphical, Mac-style interface. The traditional Ingres menu commands at the bottom of the screen become a menu bar at the top of the Mac window, and submenus become pull-downs. Ingres/SmartLook uses extensions to Apple Terminal Service protocols along with Apple MacWorkStation. Any modifications to the application are automatically reflected in SmartLook.

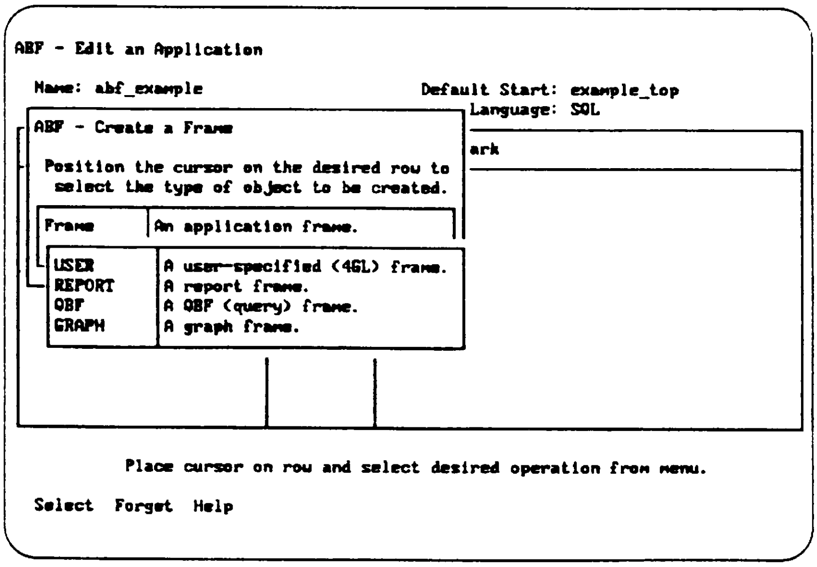
ABF. Application-By-Forms (ABF) is the standard run-time developer interface, and it takes care of compiling and linking the pieces of the application (see Illustration 3). It also allows the user to run the application while defining it. This interactive testing process is extremely helpful. However, you cannot test an application unless all of the components have been compiled. In addition, ABF can access any of the Ingres form-based modules (QBF, RBF, Vifred, and Graphics) and thus can incorporate existing reports and forms in an application. ABF can also access code written with the Ingres 4GL or a non-Ingres procedure, such as one written in C. Windows/4GL extends ABF with bit-mapped graphics, multiple windowing sessions, as well as the ability to deal with mouse and messaging events and to run an application in an interpretive (uncompiled) mode.

ABF is designed for applications developers and sophisticated end users. While certain aspects of ABF are straightforward, such as developing a frame that calls up QBF and a particular query form, others are more complex and can be confusing to the less experienced user. Designing menu screens, for example, requires writing simple 4GL statements, so it is difficult to escape having to write at least a basic program. Ingres offers extensive training programs for applications developers.

From the perspective of the experienced applications developer, however, the flexibility and power of the Ingres

Building an Application in Ingres


INGRES/MENU
Tables Forms JoinDefs Reports Applications Queries
Applications Catalog Frame
Create Destroy Edit Rename MoreInfo Go Utilities Find Top Bottom Help Quit
Create an Application Frame
Create Forget Help
Edit an Application Frame
Create Destroy Edit Rename MoreInfo Go Defaults Utilities Find Top Bottom Help End
Create a Frame or Procedure Frame
Frame Procedure Select Forget Help
4GL
Edit a 4GL Procedure Definition Frame
NewEdit Go Edit Compile MoreInfo Print Help End
SQL
Edit an SQL Procedure Definition Frame
NewEdit Go Edit Compile MoreInfo Print Help End
Host Language
Edit a <type> Procedure Definition Frame
NewEdit Go MoreInfo Print Help End
USER
Edit a USER Frame Definition Frame
NewEdit Go Edit Compile FormEdit MoreInfo Print Help End
Report
Edit a REPORT Frame Definition Frame
NewEdit Go Edit Compile FormEdit MoreInfo Print Help End
QBF
Edit a QBF Frame Definition Frame
NewEdit Go Edit FormEdit MoreInfo Print Help End
Graph
Edit a GRAPH Frame Definition Frame
NewEdit Go Edit MoreInfo Print Help End



```
ABF - Edit an Application

  Name: abf_example                         Default Start: example_top
                                                 Language: SQL
  ABF - Create a Frame
                                                 ark
   Position the cursor on the desired row to
    select the type of object to be created.

   Frame       An application frame.

    USER       A user-specified (4GL) frame.
    REPORT     A report frame.
    QBF        A QBF (query) frame.
    GRAPH      A graph frame.

          Place cursor on row and select desired operation from menu.

  Select  Forget  Help
```

Illustration 3. The top illustration shows the menu structure for building Ingres applications in Application-By-Forms (ABF). The bottom illustration shows how this process actually looks. The user sees a series of popup windows.

applications development environment is one of the product's major strengths.

INGRES/VISION. Ingres/Vision is a natural extension of the Ingres character-based development tools. This product doesn't replace any current Ingres offering, instead filling a gap by providing a graphical applications generator. It is designed to appeal to both serious end users and to professional developers. Vision can be used to generate a complete application, and/or it can produce modifiable 4GL code. It is possible to identify which components of the application need to be customized; Ingres/Vision will generate 4GL code for these, leaving the rest of the application within the generator.

We did not have an opportunity to see Ingres/Vision, but we will describe in general what it offers. There are two primary functions within the product: a frame-flow diagram and a visual query editor. The frame-flow diagram is used to define every frame within the application and the menu items that move the user from frame to frame. The visual query editor is used to identify which data from the database to display on a frame. Added functionality includes computed fields on a form, lookup tables, and aggregate functions for table fields.

Ingres/Vision is packaged as two products—Ingres/Vision, a basic version, and Ingres/Vision Pro, an advanced version for professional developers.

Ingres/Vision includes the applications generator. However, the developer cannot directly modify the generated 4GL code and does not have access to the full 4GL. For example, the "call procedure" statement won't work because you can't write procedures with Ingres/Vision. Developers can, however, use the 4GL escape codes to define processing at specific points in the application. A developer might use the escape codes to define routines to execute either before or after the creation of a new form.

Ingres/Vision Pro adds access to the 4GL to the basic Ingres/Vision product. Developers can edit the generated 4GL code and create standalone 4GL, 3GL, and database procedures that can be called from within the application.

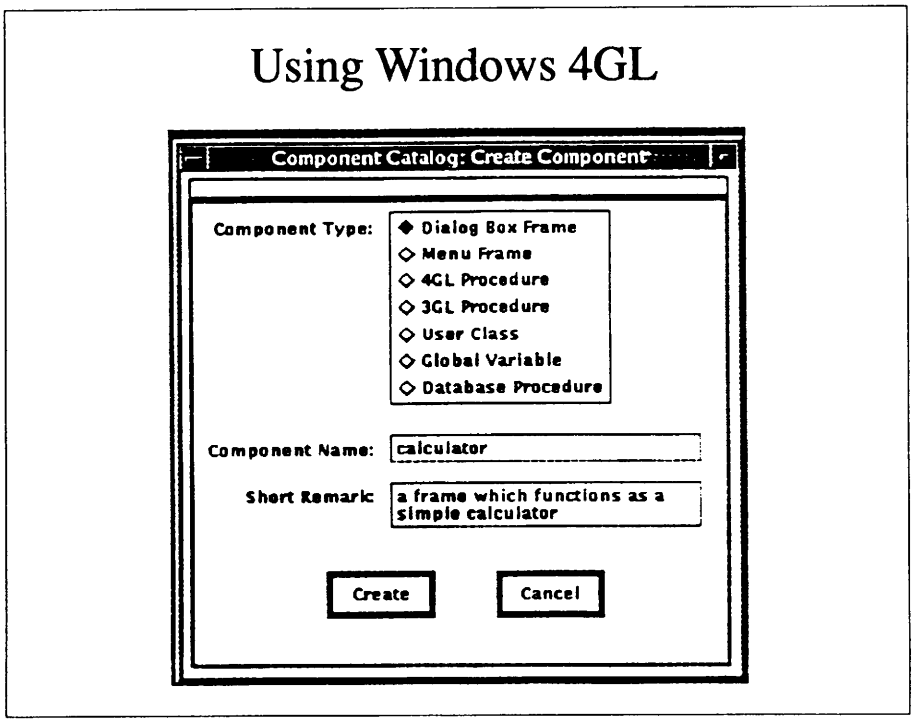
There is no direct connection between Ingres/Vision and Ingres/Windows 4GL. Ingres/Vision generates character-based applications, which can also be run in a graphical workstation environment using WindowView or SmartLook.

Ingres/Vision began shipping for VAX/VMS in December 1990; the product will be formally announced this month.

WINDOWS 4GL. With the introduction of Ingres/Windows 4GL, Ingres is tackling some tough issues in the development of database applications. Designing an application for a workstation that takes full advantage of the native window manager means that the developer must understand the windowing system and its associated toolkit and style guide and must write the DBMS application to the window system's programming interface. Otherwise, the developer is faced with the alternatives of merely moving a character-cell interface to the workstation or of giving the workstation user access to only a small subset of the available interface features. Ingres/Windows 4GL addresses this problem by abstracting the window user interface, providing 4GL access to user interface objects, and implementing visual interface editors. Windows 4GL provides a layer of software that is independent of the underlying window manager and toolkit (see Illustration 4).

The 4GL. The Ingres 4GL has been expanded to provide access to and control over all capabilities of the graphical user interface. These include the graphical user interface elements (e.g., entry fields, button fields, radio buttons, option lists, check boxes, list boxes), the use of multiple concurrent windows within an application, and integration with other applications or windows on the desktop (e.g., sharing data between windows).

Visual Interface Editor. The frame and menu editors provide a GUI for designing the application's user interface. The devel-



Using Windows 4GL

Component Catalog: Create Component

Component Type:
◆ Dialog Box Frame
◇ Menu Frame
◇ 4GL Procedure
◇ 3GL Procedure
◇ User Class
◇ Global Variable
◇ Database Procedure

Component Name: calculator

Short Remark: a frame which functions as a simple calculator

Illustration 4. In Windows 4GL, the developer can create a number of application components and can reference components that are part of other applications.

oper can interactively paint windows from a palette of standard "widgets" (or interface elements) and design complex pull-down/pull-across menus without writing any code. A 4GL script editor is used to tie application code to an entire window or to encapsulate it with individual window elements.

Object-Oriented Features. Ingres continues to incorporate object-oriented features within the Ingres RDBMS as appropriate. With Windows 4GL, object classes may be defined and shared among applications, and 4GL code encapsulated with window fields and menus to reduce coding.

Addressing Portability Issues. The existence of multiple GUIs in the industry compounds the interface problem for developers whose products and applications must run across multiple platforms. One of the primary selling points of the successful RDBMS is applications portability across dissimilar platforms. In the past, the major concern was developing an application that could run unmodified on different CPUs and/or operating systems. Now another area of dissimilarity has developed—the native windowing manager. Is it OSF/Motif, Presentation Manager, MS Windows, or OpenLook? Each of these has its own programming interface and look-and-feel.

Ingres/Windows 4GL has been designed to address the broader development issue of presentation independence. An Ingres DBMS application built with Windows 4GL in the DECwindows environment, for example, can be deployed on OSF/Motif or any other supported windowing system without change. The ported application not only takes on the look and feel of the native interface, but also gains interoperability with other window-based applications on the desktop (e.g., cut and paste). Windows 4GL achieves this at two levels. First, it provides an abstraction of the window user interface, shielding the developer from the gory details. Second, it links the run-time version of Windows 4GL directly with the native window toolkit libraries on each

Ingres Features Chart

Architecture	
Client/server	Yes
Multiserver	Yes
Maximum number of servers/system	No limit
Maximum number of users/server	Platform dependent
Maximum number of users/system	No limit
Support for multiprocessors	Yes; symmetric, asymmetric, loosely coupled
Open architecture (APIs available)	Yes; call level interface and embedded SQL
Underlying file structure	Unix; uses raw input/output for log file
Database parameters	
Database size	No limit
Databases/server	No limit
Tables/database	No limit
Rows/database	No limit
Row size	2K
Fields (columns)/row	300
Indexes/database	No limit
Databases connected to a client	No limit with multisession connect
Maximum number of tables referenced in a single query	32
Maximum number of databases referenced in a single query	32
User interface	Menu-driven
Menu bypass	Yes
Contextual help	Yes
Tutorial	Yes
Ability to customize standard menus	No
Support for color	Yes
Support for graphical user interface	Yes—X Window; Windows/4GL supports OSF/Motif and DECwindows
Data types	Any data type not directly supported by Ingres can be built using the optional Object Management Extension
Character (fixed/variable length)	Yes; char for fixed length, varchar/text for variable length; all limited to 2K
Integer	Yes

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Ingres Features Chart

Decimal	No
Float	Yes
Logical	No
Currency	Yes; money data type
Date/time	Yes
Long text	No
Binary (fixed/variable length)	Yes; 2,008 byte maximum
Image	No; Windows 4GL can handle an image as a series of binary data types
Serial	No
Support for arrays	No
Support for nulls	Yes
Ability to extend base data types	No
Ability to define new data types	Yes, with optional Object Management Extension
Ability to define functions/operators for new data types	Yes, with optional Object Management Extension
B-tree indexing	
Maximum number of indexes	No limit
Maximum number of fields/index	256
Maximum size of index key	400 bytes
Order options	Ascending/descending
Unique index	Yes
Clustered index	Yes
Other file access methods (hash, etc.)	Hash, ISAM, and sorted heap; all table/index storage structures can also be defined as compressed with trailing blanks removed
Screen forms	Visual Forms Editor (Vifred), Windows 4GL, Ingres/Vision
Default form generator	Yes
Customized	Yes
Multiple tables/form	Yes
Multiple screens/form	Yes
Embedded processing (if-then-else, display aggregates)	Yes
Field attributes on forms	
Case conversion	Yes
Default value	Yes

platform, rather than with the lower-level graphical interface itself. Many of the native interoperability features are provided at the window toolkit level.

Style Guide Issues. One area where Windows 4GL cannot provide transparent portability is in accommodating style guide differences (for example, the use of "File View Edit" in an OpenLook main menu versus "File Edit View" in OSF/Motif). Since Windows 4GL separates the definition of 4GL events from window and menu descriptions, the developer can define different windows and menus for use on different systems without recoding any of the application logic.

Application Management. Windows 4GL also provides application management benefits. It supports multiple developers working on the same application with automated locking and version control of application element definitions. All application definitions/objects are catalogued in the Ingres Open Data Dictionary and stored within the DBMS. This allows common application elements to be shared among multiple applications.

What's Missing. Windows 4GL does have some limitations to be noted.

- The developer can take advantage only of window facilities that are common to all underlying GUIs. If a particular toolkit doesn't support a particular function, the developer can use lower level functions and build up the desired capability—but, to do this, the developer is back into the details of a particular window manager. The developer can always escape into a 3GL to build an interface using unique native features.
- The developer cannot yet deploy Ingres/Windows 4GL applications on character terminals, although Ingres has finally stated that this is planned for a later release of the product. We would suspect that the ability to develop an application once and run it

both on workstations and terminals would be particularly important to Ask, with its focus on manufacturing systems. It is highly unlikely that all of the terminals currently used on the factory floor will suddenly be replaced with workstations. And Ask is developing its next generation of manufacturing software with Windows 4GL. In the meantime, Ingres recommends the use of ABF and/or Ingres/Vision for developing applications that must run on character-based terminals. If the application also runs on a workstation, WindowView will allow Ingres to run in a window and support the use of a mouse.

- Deployment is limited to those platforms/GUIs for which Ingres/Windows 4GL is available. Currently, these include Sun SPARC, Digital VAX/VMS and RISC/Ultrix, HP 9000, IBM RS/6000, and Open Desktop. All provide a Motif interface except Digital, which provides DECwindows. Future platforms include Sun OpenLook in the third quarter of 1991, Windows 3.0 in the fourth, and Macintosh in 1992. There will be ports to other platforms by Ingres partners as well.

Developers we talked to were particularly concerned about the limited number of platforms that Windows 4GL runs on and the current lack of support for terminals. Developers need to be able to design an application once and run it in both terminal and workstation environments.

Summary. With Windows 4GL, Ingres is offering an easy-to-use graphical development environment for developing applications on a workstation, a tool for developing GUI applications for a workstation, and a tool for developing applications that are presentation independent. We expect to see more of the DBMS vendors providing this type of software for presentation independence, and we are not surprised by the fact that Ingres got there first.

Ingres Features Chart

Field attributes on forms (continued)	
Required value	Yes
Acceptable values	Yes
Verification (enter data twice)	No; yes in 4GL
Formatting of data	No; yes in 4GL
Calculated values	No; yes in 4GL
Display only (no entry/update)	Yes
Hidden	Yes
Prompt (for data entry)	Yes
Error message	Yes
Customized help	Yes
Video display	Yes
Ability to change field attributes dynamically	Yes
Query-By-Forms	Query-By-Forms (QBF), Windows 4GL, Ingres/Vision
Exact match	Yes
Relational operators	Yes
Ranges	Yes
List of values	Yes
Wildcards	Yes
Maximum/minimum values	Yes
Print query results	No; use print screen function or RBF
Pass results to report writer	No
Text search	Yes
SQL	
Standard SQL statements	
Data definition language (DDL)	Yes
Data manipulation language (DML)	Yes
Extensions to SQL	
Commit/rollback transactions	Yes
Execute operating system commands	Yes
Load/unload data to/from ASCII file	Yes
Additional data definition statements	Yes (no alter table)
Control-of-flow logic	Yes
Outer join	No
Support for SQL precompilers (embedded SQL)	Yes; Ada, C, Cobol, Fortran, Pascal, Basic, PL/1
Support for dynamic SQL	Yes
Support for call level interface to database	Yes
Can create new table with query results	Yes
Stored queries	Yes

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Ingres Features Chart

Case-insensitive (e.g., field names)	Yes
Can call C routines	Yes
How create SQL queries/statements	Interactive query editor
Query optimizer	Yes
Syntax-independent performance	Yes
Uses table statistics	Yes
Minimum/maximum value	Yes
Average count per value	Yes
Distribution of values	Yes
Explain capability	Yes
Report writer	Report-By-Forms (RBF)
Nonprocedural	Yes
Default report generator	Yes
Interactive report generator using screen forms	Yes
Interactive debugging	No
Input source	SQL/QUEL
Multiple tables	Yes
Page formatting	Yes
Headers and footers	Yes
Data formatting	Yes
Sort data	Yes
Aggregate functions	Yes
Logical processing (if-then-else logic)	Yes
User variables	Yes
Prompt for input variables at run-time	Yes
Application development tools	Application-By-Forms (ABF), Ingres/Vision, Windows 4GL
4GL	Yes
Application generator	Yes, Ingres/Vision and Windows 4GL
Ability to design application menus	Yes
Default menu generator	Yes
Custom help	Yes
Integrity	
Transaction logging	Yes
Commit/rollback transaction	Yes
Roll forward	Yes
Referential integrity in data dictionary	Yes, with optional Knowledge Management Extension; done via rules

Database Security

An Ingres account manager maintains the list of users that can access the Ingres DBMS. Within Ingres, the creator of a database automatically owns the database. The owner can then grant permissions to other users to query, add, update, or delete information in a specific table. The permission can be limited to specific records and fields. Access can be further restricted to a specific terminal and day/time. As we described above, the optional Knowledge Management Extension provides additional levels of security for a database.

Database Integrity

The concept of database integrity is appropriate at several levels. In the standard Ingres DBMS, referential integrity must be built in at the application level. There are two options for this. The traditional method is to include the integrity constraints as part of the application code. This means that every application that touches the database must also include the same code. A second option is to create one or more database procedures (which are stored in the data dictionary) and call these from within the application. While every application would still have to invoke these procedures, the procedures themselves could be centrally maintained. If you install the optional Knowledge Management Extension (see "Knowledge Management" on page 4), referential integrity can be automatically maintained with the use of rules.

The second major integrity issue, particularly important in large databases with frequent updates, is the concept of the transaction. Ingres has a very strong transaction-management function, providing for the definition of a transaction, automatic rollback capability, and rollforward for recovery.

Futures

Ingres has already introduced impressive functionality across its product line. The major focus for the company over the next year or two will be "filling in the matrix." One aspect of this is getting the latest version of its products, including Ingres/Vision, ported to all supported operating platforms. Another aspect is to make more network protocols, such as LU6.2, available.

Conclusion

We have always maintained that Ingres has good technology. Version 6.3 of Ingres, with its intelligent server, takes the product significantly beyond what Oracle can offer today. It also implements a number of the features that have impressed us about Sybase and more (e.g., resource and access control features). The Ingres development tools provide a consistency of interface and development effort regardless of the complexity of the application. Ingres is also tackling user interface issues with a vengeance with Windows 4GL and Ingres/Vision, its new applications generator. Other strengths include the query optimizer and extensive support for distributed databases.

But good products are valuable only if they run on the customer's platform. Here, Ingres faces some of the same problems that Oracle does in getting the latest and greatest out on all of its platforms on a timely basis. So far, Ingres 6.3 is not widely ported. Ingres/Star runs only on Digital's VMS. The porting schedule for Windows 4GL is moving along, but we don't expect to see Windows 3.0 and Macintosh versions until late 1991 or into 1992. And it is hard to imagine a product the size of Windows 4GL running on either desktop. Another issue with Windows 4GL is the current inability to deploy applications on terminals as well as workstations. Ingres promises to fix this in the future.

Other areas for improvement include: the ability to deal with multiple databases from within Ingres, which would also help make data dictionary access more comprehensive; support for image and long text data types (without having to use the Object Management Extension); an Alter Table statement; an improved interactive SQL editor; and a

Ingres Features Chart

Integrity (continued)	
Field validation in data dictionary	Yes; can be done on a form via "create integrity" statements, or via rules in optional Knowledge Management Extension
Support for business rules	Yes, with optional Knowledge Management Extension
Number per table	Unlimited
Forward chaining	Unlimited
Recursive	Yes
Stored procedures	Yes
Precompiled	No; compiled on first reference and cached
Can be nested	No
Concurrency control	
Locking levels	
Database	Yes
Table	Yes
Row	No
Page	Yes; default locking level
Data isolation levels	No lock, repeatable read
Lock types	No lock, shared, exclusive
Database security	
Login password	No
Multilevel access control	
User	Yes
Group	Yes, with Knowledge Management Extension
Application	Yes, with Knowledge Management Extension
Database-level access	Yes
Table-level access	Yes
Row-level access	Yes
Field-level access	Yes
Access by time of day	Yes
Access by location (workstation)	No; yes, with QUEL
Ability to define resource limits on user queries	Yes, with optional Knowledge Management Extension
Availability	
Online backup	Yes
Online database changes	Yes
Software-based disk mirroring	No

Ingres Features Chart

Raw input/output	No, except for raw log file
I/O reduction techniques	
Fast commit	Yes
Group commit	Yes
Parallel checkpointing on multiprocessor systems	Yes
Database can span multiple physical devices (disks)	Yes
Network support	TCP/IP, NetBIOS, DECnet, Novell SPX/IPX, LU 0, asynch
Import/export capability	
Import formats	ASCII delimited, fixed field
Export formats	ASCII delimited, fixed field
Distributed database capability	Provided by Ingres/Star
Support for partitioned tables	
Horizontal partitioning	No
Vertical partitioning	No
Location transparency	Yes
Distributed query processing	Yes; supports heterogeneous database query access through gateways
Distributed query optimizer	Yes
Distributed transaction processing (two-phase commit)	Yes; Ingres databases only
Support for data replication	No
Access to heterogeneous databases	Yes; Ingres provides read/write gateways to DB2, SQL/DS, Rdb, and RMS; read-only gateway to IMS; under development are read/write gateways to Tandem's NonStop SQL and HP's Allbase
Maximum number of simultaneously connected databases	Unlimited
International language support	
Upper/lower case conversion	Yes
Sorting/collating sequences	Yes
Error messages	Yes
2-byte character set	Yes

more flexible report writer. Developers would like to see additional functionality in the 4GL for generating large, complex applications and more modularity in nesting procedures.

Both Ingres and Ask paint the expected rosy picture of how the acquisition will take the combined company into the '90s with the right mix of products and expertise to meet customer requirements. The participation of HP and Electronic Data Systems (EDS) ensures deeper financial pockets as well as a vested interest in the success of Ask/Ingres. Two important goals of the acquisition are increased market visibility and an enhanced VAR program for Ingres.

However, it is not easy to predict how a variety of market segments will react to this marriage, and some delicate balancing of partnerships is required. Any misstep can be costly in such a fiercely competitive environment. Users are much less likely to bet their futures on vendor promises than they were in the past. So they may tend to wait and see how it all plays out before committing to Ask. If so, the competition has a window of opportunity in which to close the functionality gap in database architecture (implementing multiple, multithreaded servers), user interface support, distributed database, and knowledge/object management.

Ask/Ingres faces a major challenge over the next year, and we hope the company is successful in meeting that challenge. We would hate to see Ingres's technology leadership get lost in the shuffle.

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What's Inside The OCG's Newsletters This Month

Here's the latest from our other research newletters, *The Office Computing Report* and *Network Monitor,* and our audiotape newsletter service *Paradigm Shift*.

❑ **Object-Oriented Development—A New Foundation for Software in the '90s**

Office Computing Report: Guide to Workgroup Computing
March 1991 *$40*

Object-oriented software design and development technology offer organizations a new foundation for applications software. This foundation supports an inherently more user-driven approach to software development than do earlier technologies. Objects allow software to imitate real life. This article describes the new foundation of objects and examines the migration issues users face as they seek to adopt it.

❑ **Digital NAS—Services for the Distributed Computing Environment**

Network Monitor: Guide to Distributed Computing
March 1991 *$50*

The March issue of *Network Monitor* examines Digital's strategic Network Application Support product family.

NAS represents a critical element for distributed computing environments—services, interfaces and products that provide function and transparency across multiple platforms.

❑ **In Search of the Management Paradigm for the Information Economy**

Paradigm Shift: Guide to the Information Revolution
March 1991 (audiotape and newsletter) $40

This issue is a synthesis of three years of research and interviews investigating the paradigm shifts that are underway in our social and economic systems, management and organizational models, and trends in information and technology.

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The title of next month's Unix in the Office *is "CASE: Towards Software Interoperability for Open Systems."*

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GUI Portability at Last

Porting applications to the many so-called graphical user interface "standards" has been plaguing applications developers for some time now. The differences between Motif and OpenLook are just part of the problem. Developers who want to produce truly open applications must also face Presentation Manager, MS Windows, NextStep, and Macintosh—not to mention character-based interfaces.

Many software vendors are so busy and spending so much money trying to port their current applications among different GUIs, they've postponed new application development. Therefore, although the GUI portability problem appears to be a developer's issue, it ultimately hurts users. They're the ones who are stuck with dull applications as they wait for developers to get past the user interface quandary.

ENTER OPEN INTERFACE. Fortunately, we've noticed a few tools cropping up that help developers with GUI portability. Solbourne Computer, for example, has a toolkit that bridges OpenLook and Motif. And last year Ingres introduced a presentation-independent 4GL tool. But the most comprehensive GUI porting tool comes from Neuron Data's Open Interface.

We've actually been interested in Open Interface for some time now—ever since Neuron Data submitted the technology to the Open Software Foundation (OSF) during the GUI Request for Technology (RFT). At the time, however, it wasn't a product. Neuron Data had been using it internally to port its own product across different platforms. Obviously, the company recognized the marketable value of the tool and has finally released it as a product.

Open Interface is a toolkit that abstracts interface objects from native toolkits of major windowing environments, including Motif, OpenLook, Presentation Manager, Windows, and Macintosh. In other words, if you use Open Interface, you need to write the interface only once, and it will be portable to all these platforms. In addition, the application won't suffer from lowest-common-denominator syndrome, since it's ported from one environment to another.

Open Interface is a combination of the interface technologies we listed above. Therefore, it has a superset of the objects (or widgets) that you'll find in any single interface technology. If an OpenLook object (a push-pin, for instance) has no obvious MS Windows (or Mac or PM or Motif) counterpart, Open Interface extends the Windows look and feel by using one of its superset objects (i.e., you could have a Mac or Windows application with push-pins). Similarly, the product is extendible, so if you build new Open Interface widgets, those, too, will be portable.

Architecture for Portability. Essentially, Open Interface uses the concept of an intermediate library layer between the underlying window system and the Open Interface development platform. The library actually has several versions—one for each system that the product supports. You port an Open Interface application to another system by moving the source code and resource files between machines and by compiling and linking to the appropriate library.

Specifically, Open Interface functions via two libraries or interface definitions (APIs): the virtual graphics machine (VGM) and the toolkit. The VGM is a low-level facility that defines the machine-independent abstraction of a window system, and developers use the VGM interface rather than the native window subsystem to create and extend the widget set. The toolkit stores the widgets that have been created with the VGM. Open Interface comes with a full set of predefined widgets (e.g., scroll bar, menu, table, button, icon, etc.), and most developers won't need to look beyond this set to create application interfaces. But the VGM is extensible, and widget programmers can build custom interface components and add them to the toolkit library.

The depth of this tool is impressive. Since the VGM is interface independent, even new widgets added to the toolkit will be portable. However, programmers can bypass the toolkit and the VGM altogether and reach into the native window system if need be (i.e., an interface can contain both Open Interface and native window system components)—although in these cases, the window system-derived objects won't be portable.

Building Interfaces. Neuron Data includes a layout editor, which has a reference browser that gives programmers a graphical, context-sensitive means of viewing and accessing interface objects. The layout editor provides parameters such as the type of text button to implement (e.g., push button, toggle, check), its shape, its font type, and its behavior to mouse events. The layout editor produces two types of files: ASCII resource files that describe the layout of the user interface (its form) and C source code (its function). While programmers can merely paint the look of the interface, they still must do source-coding for its functionality. Neuron Data gives some guidance for source-coding by providing templates to add application-specific functionality. Thus, coding is reduced to a "fill in the blank" situation. Once the source-coding is complete, the code is compiled and linked to the platform-specific Open Interface libraries.

Marketing and Pricing. Neuron Data is focusing its marketing efforts for Open Interface on both corporate and commercial application developers and user organizations. Development licenses are priced at $7,000 for DOS and Macintosh, $9,000 for OS/2, and $12,000 for Unix and VMS. Run-time licenses go for $250, $350, and $500, respectively.

CONCLUSION. Neuron Data has made a pre-release Open Interface product available to some of its existing customers, and apparently it's been well-received. The product could very well be a big success for the company. Since no single user interface technology has surfaced as a standard—and, frankly, we don't see GUI standardization as a probability in the future—portability is the answer. Open Interface is precisely the kind of tool developers need. Hopefully, once ISVs no longer need to worry about the cost of porting to multiple interfaces, we'll begin to see more innovative and practical application development. *—L. Rowan*

• RPC •

RPC War Over: Sun and HP Build Unity Interface

The RPC war is over. Hewlett-Packard and Sun Microsystems have decided to stop fighting over remote procedure call (RPC) technology and let users decide which RPC will be the "standard." The agreement gives users a portable RPC interface that lets them choose between the companies' RPCs—Sun's Open Network Computing (ONC) or HP's Network Computing System (NCS)—for the right job.

There's more to the HP/Sun alliance than RPCs. The two companies also agreed to collaborate on a broader set of applications-integration standards. The basis for these standards will be the portable RPC interface and a distributed version of Hewlett-Packard's Object Management Facility (OMF).

This is the first cooperative agreement on object management technology between two major vendors. The standards Sun and HP are backing are not complete. They leave out, for example, the new Object-Linking and -Embedding (OLE) protocol backed by Microsoft, Lotus, and WordPerfect. However, the HP/Sun technology can accommodate OLE, and probably will at a future date.

The political implications of the HP/Sun alliance are also intriguing. HP's NCS, after all, is at the heart of the Open Software Foundation's Distributed Computing Environment (OSF's DCE). Sun has been battling OSF—which is to say IBM, Digital, HP, and a host of other large companies—at every turn. It was Sun's key Unix partner—AT&T—that encouraged the two companies to work together.

Sun appears to have realized that it is better to accommodate the OSF and its technology than to fight it. With the HP alliance, Sun has presented its claim that ONC is the most practical distributed computing technology on the line. It will let users decide.

This is a calculated risk. OMG could choose another submission, bypassing the HP/Sun technology. HP and Sun will undoubtedly cite the combined market share of the ONC and NCS RPCs as a reason to select their submission.

WHY THIS AGREEMENT? WHY NOW? The HP/Sun alliance was forged within standards-setting framework of the Object Management Group (Framingham, Massachusetts). The OMG is a consortium of vendors and users seeking integration standards using object-oriented technology.

OMG Object Request Broker. OMG's first target is an Object Request Broker (ORB), which will allow requests, responses, and other messages to be passed reliably between "objects"—applications, databases, printers, etc.—across a network. Sun and Hewlett-Packard announced their agreement on February 25, 1991, OMG's deadline for ORB technology submissions. (See illustration, page 22, for a list of ORB submitters.)

For HP, the Sun alliance solves a fundamental problem with its object management technology. After failing to build a distributed version of the OMF using non-NCS technology during 1989 and early 1990, HP turned to NCS as the basis for the product last year. However, the OMG requires ORB submissions to be transport-independent. It wasn't clear that an NCS-based OMF would be. NCS is transport independent, but dependent on a particular RPC—NCS's NIDL RPC. The HP/Sun submission to the OMG is not dependent on a particular RPC.

The other key requirement for ORB technology submitted for consideration by the OMG: It must be commercially available by mid-1991. HP and Sun say their first products based on the merged RPC and distributed OMF will be available by that time.

HP and Sun chose to jointly submit their technology to the OMG in hopes of achieving broad acceptance for it in the industry. One hundred and eight companies are OMG members, and most of them are committed to adopting the OMG's standards. HP and Sun are confident that their submission will be selected by OMG in part or in its entirety.

TERMS OF THE ALLIANCE. The HP/Sun alliance is based on a joint software-development agreement between Hewlett-Packard and Sun Soft, the new Sun software subsidiary established in February 1991. The agreement has several parts.

Joint OMG Submission. As discussed, HP and Sun will make a joint submission of ORB technology to the OMG. The submission has two parts: a portable RPC interface and a distributed object manager.

Joint RPC Development. Sun and HP are the leading vendors of remote procedure call technology. Sun's ONC uses the RPC developed by Netwise Incorporated of Boulder, Colorado, which has been adopted by many vendors, including Novell Incorporated (Provo, Utah). HP's Network Computing System RPC was developed at its Apollo Systems Division, and has been licensed by IBM, Digital, and other major systems vendors.

Few products using either RPC are available today. One of the primary reasons has been the competition between HP and Sun. Users at Patricia Seybold's 1990 Technology Forum, for example, said they were hanging back on RPC development for fear of selecting the wrong "standard."

Portable RPC Interface. The joint development agreement should erase this fear. HP and Sun have agreed to develop a common RPC interface that can be used with either ONC or NCS.

The common interface will be called the Common Interface Definition Language (CIDL). Developers will be able to write remote procedure calls into their applications using this interface and then compile to either Sun's ONC or HP's NCS. CIDL, thus, is a single RPC API.

Developers get portability across RPCs and network transports from CIDL. Both ONC and NCS are transport independent.

RPC Interoperability. What the HP/Sun agreement doesn't give users is interoperability between NCS and ONC. That is, an NCS call can't invoke an ONC remote procedure, and vice versa. A key goal of the joint development is a common data-representation standard that will support interoperability.

ONC and NCS use different data-representation formats. In the short term, the two companies might build translation bridges between their respective formats to achieve interoperability. However, both companies will eventually migrate to a single data-representation format. They can be expected to adopt ASN.1, an emerging International Standards Organization (ISO) data-representation format. ONC already supports ASN.1.

Standard RPC. In addition to their current work on a common RPC interface, HP and Sun will work with ISO committees to define and implement a de jure RPC standard. No such standard exists today.

Joint Object Management Development. The Object Management Facility (OMF) of HP's NewWave applications environment is at the heart of the HP/Sun distributed object management facility.

Distributed Object Management Facility. The OMF records, tracks, and manages links between application "objects." It also includes a Task Language that application developers use to send other applications commands, requests, and responses. The OMG and its Task Language constitute an API to object management services.

HP's Apollo Division has been readying a distributed version of the OMF that uses NCS to transport messages between objects on distributed networks and between distributed OMFs. Sun's role in this development project is not clear.

HP stresses that its distributed OMF is open. That is, it can accommodate and work with a variety of "object managers." The two leading types of non-OMF object managers are Microsoft's OLE clients and servers and object-oriented databases.

PACKAGING, LICENSING, AND PLATFORMS. HP and Sun will package their joint technology in two ways. First, they will put their interface specifications into the public domain for use by all comers. Second, they will make products available that implement the joint technology at "reasonable" licensing costs. This is as it should be.

Platforms. The target platform for this technology is Unix. HP's second target is its MPE operating system. DOS and OS/2 are lower on the priority list.

Both companies offered as a rationale the statement that Unix developers are well ahead of those on DOS,

OMG ORB Submitters

Architecture Projects Management Limited
Cambridge, United Kingdom

Digital Equipment Corporation
Maynard, Massachusetts

DSET Corporation
Lebanon, New Jersey

Groupe Bull
Gieres, France

Hewlett-Packard Company and Sun Microsystems Incorporated
Palo Alto, California, and Mountain View, California

HyperDesk Incorporated
Westboro, Massachusetts

NCR Corporation and Object Databases Incorporated
Dayton, Ohio, and Burlington, Massachusetts

Macintosh, OS/2, and other operating system environments in implementing distributed computing technologies. This may be a true statement, but it is also a self-serving one. Leaving DOS as a third priority is a mistake. Large commercial users are committed to DOS on the desktop for the foreseeable future. These users also need application integration and distributed computing.

Users can only hope that HP, which sells DOS systems, sees the light on this issue.

HOW NOW, MICROSOFT AND IBM? Microsoft and IBM are both absent from the picture of the market drawn by HP and Sun. Both companies have their own strategies to use object-oriented technology to integrate applications. Both must play a role in the development of object-management standards.

Microsoft Power. Microsoft joined the OMG in late February 1991(see page 23)—just in time to participate in the selection of the ORB technology. Microsoft plans to adopt over time the same basic object-oriented applications-integration approach that OMG and its members have embraced. Now, there's a good chance that Microsoft will be in step with industry-consensus standards in this area. (Or is it the other way around?)

No object-management solution is complete if it doesn't accommodate key Microsoft standards, such as Dynamic Data Exchange (DDE) and OLE. These protocols are the most important applications-integration standards for independent software vendors and corporate developers to adopt.

IBM's Twin Thrusts. IBM has not joined OMG. It is pursuing its own object management solutions on two fronts. First, IBM's OfficeVision/2 LAN includes an object management facility. Second, IBM is a leading member of Patriot Partners, a company headed up by Metaphor's David Liddle to create an advanced user environment within two to three years.

Of these two thrusts, Patriot Partners is the most important. OV/2 LAN is a lackluster product that will ultimately fail. Will Patriot choose to work with the OMG's ORB technology? This is too close to call at this point. But Dave Liddle is a rational man. He's also under time pressure. If the OMG's technology fits his needs, he's likely to accept it.

FINAL THOUGHTS. We applaud HP and Sun—particularly Sun—for calling a truce in the RPC wars. The industry as a whole can only benefit from this development.

RPC users now have a choice. They can use the NCS/DCE RPC for applications requiring wide area network support, and the other services (security, time, enterprise directory, etc.) that DCE provides. Sun's ONC RPC, on the other hand, is a leaner, meaner design for applications that don't require WANs and the kinds of services provided by DCE.

The only losers in this truce are organizations that have already written applications to either the ONC or the NCS interface definition languages. They will have to rewrite their applications to the new CIDL interface. However, there are so few RPC applications out there that the damage is really very limited.

The new interface also is unlikely to disrupt the development of applications facilities for OSF's DCE. For example, the transaction-oriented RPC preprocessor for DCE announced in January 1991 by Transarc Corporation (Pittsburgh) can be modified fairly quickly to accommodate a new interface definition language. —*J. Rymer*

•OBJECT STANDARDS•

Quietly, Microsoft Joins the OMG

A glance down the evaluation task force list for the Object Management Group's (OMG's) Object Request Broker (ORB) technology selection yielded one big surprise: Microsoft. Without fanfare, Microsoft has joined the Object Management Group just in time to participate in formulating the group's first standard.

Greg Whitten, Microsoft's object-oriented technology maven, will join the ORB Task Force as it evaluates the seven responses to the OMG's request for technology for this key integration standard. The evaluation process begins on March 19, 1991. Microsoft did not submit technology to the process.

Microsoft's absence from the OMG's roster of 108 member companies has been a cause for concern about the ability of the group to drive standards. Microsoft is the standards-setter for DOS, OS/2, and Macintosh applications software. The company began this year to define object management standards for use in local environments. By virtue of its size, clout, and technical smarts, Microsoft will play a leading role in emerging object management standards—OMG or no OMG.

OLE AND OMG. The latest illustration of Microsoft's clout was its development of the Object-Linking and -Embedding (OLE) extensions to its Dynamic Data Exchange (DDE) inter-application communications protocol. Lotus Development Corporation and WordPerfect Corporation both adopted OLE for use in their products. For example, Lotus uses OLE in Lotus Notes Version 2.0.

OLE provides two features. First, using OLE, an object within an application file can reference (or be referenced by) an object in another application file. Second, OLE allows an object within an application file to be embedded and dynamically updated in another file.

OLE is a practical way to link elements within applications files *as editable objects.* Before OLE, users could only copy uneditable copies of files or pieces of files into other files. OLE is an extremely useful feature for all sorts of applications, particularly those involving compound documents.

DIFFERENCES BETWEEN OLE AND ORB. Microsoft probably didn't submit OLE and DDE to the OMG process because they don't meet all of the requirements for the ORB. (Microsoft also has no immediate business need to participate in the OMG. Its sales and profits are growing nicely.)

OLE is not a distributed object management facility. It is oriented to applications on a single workstation, not applications shared across a workgroup. The OMG requires a distributed facility (that is also network independent) for its ORB.

However, we can easily see OLE and DDE riding atop the OMG's ORB. The ORB would be a group/department/enterprise object manager. OLE/DDE would be a local object manager that uses ORB to communicate with other systems.

HAIL AND GOOD CHEER. Our reaction to the presence of Whitten and Microsoft on the ORB Task Force: Two down and one to go. Within the last three months, the OMG has filled two of three major gaps in its membership. First, in December, the group gained the active involvement of object-oriented database vendors in its ORB process and other efforts. Now, it has gained the involvement of Microsoft. The only remaining gap is IBM's participation. Now that Microsoft is in, we expect IBM to follow shortly.

We were more worried by Microsoft's absence from the OMG than we are about IBM. The standards the OMG seeks to identify and implement are crucial to application integration and interoperability across heterogeneous environments. Without Microsoft's participation, there was a risk that OMG would create an ORB that failed to meet the needs of workstation-applications vendors, such as Lotus or WordPerfect. With Microsoft in the process, OMG has a much improved chance of creating an ORB that meets the needs of these important players.

Indeed, Microsoft may be able to bring at least some of these vendors into the OMG as active participants. However, this will depend on how the ORB selection process goes. Stay tuned to this space for updates. —*J. Rymer*

•ELECTRONIC MAIL•

Adapting to the Commercial Market

As Unix continues to attract the commercial market, traditional Unix tools need to adapt to a different class of users. Electronic mail is just one example. Typical Unix mail tools have a rather crude command-line interface that commercial users would find unacceptable.

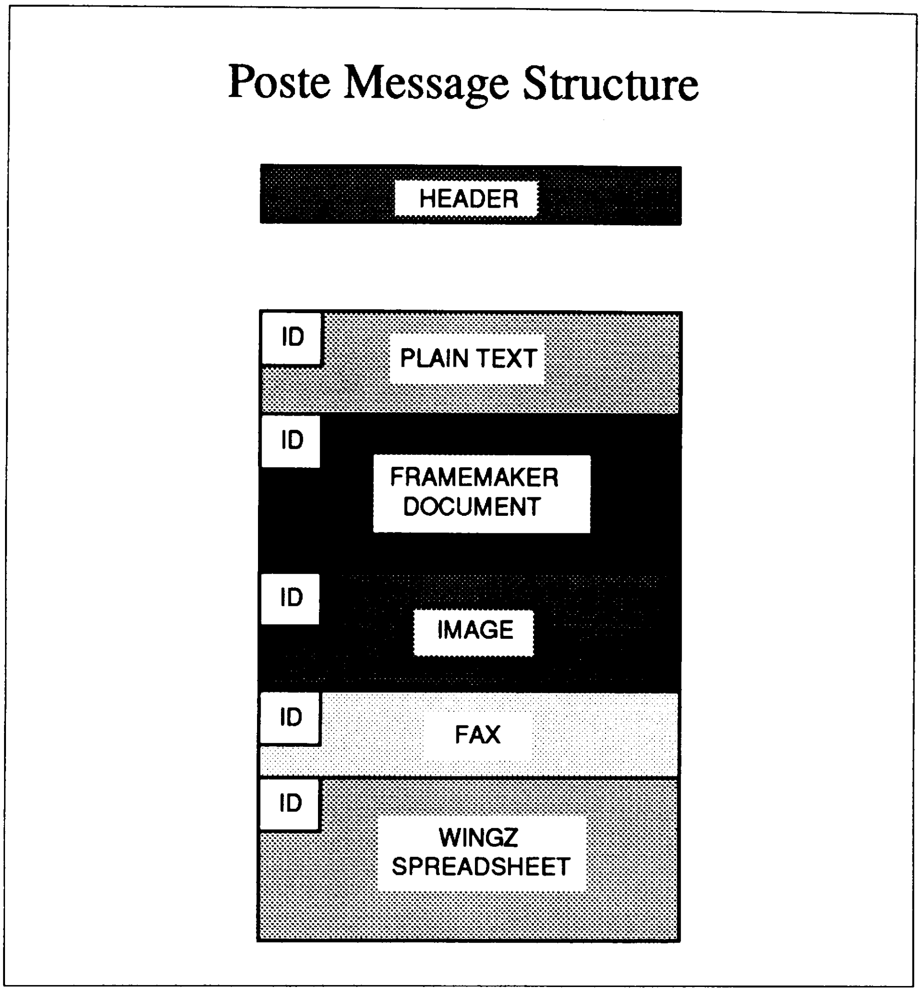
Alfalfa Software, a young company based in Cambridge, Massachusetts, has turned this shortcoming into an opportunity. Poste, Alfalfa's newly-developed E-mail product, was designed to bridge the gap between traditional Unix communication and emerging commercial standards and communication protocols. Poste's Motif front end gives users convenient access to most state-of-the-art E-mail functions, such as return receipts, distribution lists, indexing, searching, sorting, etc. Poste also supports both Internet and X.400 messaging standards.

Most important, perhaps, is that Poste lets users exchange different types of documents—from spreadsheets to text to scanned images and faxes. Furthermore, users can integrate these different document types into a single message.

ADJUSTING TO A DIVERSE MARKET. Alfalfa has correctly identified the differences among today's Unix users. On one hand, there are traditional technical users who depend on the internet or uunet protocol for communication; on the other, new business users who are used to commercial E-mail systems.

Alfalfa has not only sought to provide a clean yet sophisticated interface that serves both audiences (see "Usability" below), but it also designed Poste to support both X.400 (via a third party), the emerging commercial standard, and Internet communication protocols (sendmail and mmdf transport agents as well as uucp, the uunet protocol) with gateways.

Thus, Poste gives commercial users a smoother transition to the internet. It also gives Unix users and X.400 users a way to communicate. (Alfalfa is by no means alone here; several SMTP and X.400 gateways are available to link commercial E-mail systems to Unix mail.)



Poste features multipart messages. Enclosures of various data types may be included as attachments.

"MULTIPART" MESSAGES. As we mentioned above, Poste users can compose and receive what Alfalfa refers to as "multipart" messages, which consist of various types—or "enclosures"—of editable data, including text, spreadsheet tables, and images. We should point out that this isn't quite compound document messaging; the data types cannot be embedded into each other. Rather, enclosures may be attached to messages in a sequential order. (See illustration at right.)

Each enclosure is typed according to the kind of information it contains, be it plain text, an executable binary file, or something as specific as a FrameMaker document or Lotus table. The sender selects the enclosure type from a menu, and Poste automatically invokes the appropriate viewing format and editor. In other words, Poste makes sure that the person receiving the message has the proper tools for viewing and editing its data.

The product comes with a number of default enclosure types: plain text, Graphics Information File (GIF) format images, X Bitmap, compressed text, and fax. But application-specific enclosures can be added to the system (see "Extending the System" below).

Which brings us to the question of file conversion. What happens if, for example, you've added WingZ spreadsheets as an enclosure type to your system, and you send one to someone who doesn't use WingZ? In these cases, Poste will automatically convert the file into an appropriate format as specified by the recipient's predefined user profile. (The administrator must define these profiles in a configuration file beforehand.) If no proper converter exists or if you're sending to a non-Poste user, the enclosure can at least be sent as a generic, plain-text Unix file. Users need know nothing of converters or user profiles. They simply mail and receive multipart messages with the editors of their choice.

Alfalfa was smart in its design for the Poste converter mechanism. Information is often lost when it's converted back and forth among different formats and editors. Therefore, when Poste converts an enclosure, it caches the converted enclosure temporarily, but it doesn't replace the original. That way, the enclosures won't die of lowest common denominator syndrome as they're forwarded and edited around a system.

Extending the System. Users and third parties can extend the enclosure types at either the workstation or LAN level. However, this is an administrator's job. For integrating additional applications, Poste depends on International Standards Organization (ISO) Object-Identifiers, which specify data types. A WordPerfect document, for instance, will have a text data type. If you want to add WordPerfect as an enclosure type, your administrator must edit the configuration file, add the WordPerfect Object-Identifier, and include additional associated information (e.g., defining viewing, editing, and conversion formats).

At that point, users can select WordPerfect from the a menu just as they would any other predefined enclosure type. The system will recognize a WordPerfect enclosure by Object-Identifier so that other Poste users on your system can view and edit it as a WordPerfect document—or convert it, if necessary.

USABILITY. Poste's interface is straightforward and well-designed. And, frankly, it has to be. Unix mail is free. If the interface to an E-mail product based on Unix mail is anything less than topnotch, users simply won't buy in.

Again, Poste is based on Motif, so it provides a graphical, point-and-click presentation. Users manipulate Poste through three windows: a Composition window for creating and sending messages; a Browser window (a.k.a. message summary window) for scanning and managing messages (i.e., saving, filing, and deleting messages, switching folders, etc.); and a View window, where you read the actual contents of messages.

Adding enclosures is a simple process. It's just a matter of clicking on the "Add Enclosure" button and selecting the proper enclosure type from a menu. You can either compose an enclosure on the fly or import an existing file. Poste presents a dialog box that lists directories and filenames, which makes importing files easy enough.

Poste also has a few features that help manage and organize your messages. As with many mail systems, Poste lets you create folders and even subfolders to store messages. The product also provides cross-indexing that cuts down substantially on disk space. Cross-indexing saves only a single copy of a message, regardless of how many times it appears in different folders. Other copies are actually just pointers to the single version. In addition, Poste's query facility lets you search from a number of fields, including subject, sender, recipient, date, as well as keywords.

ARCHITECTURE. Since organizations are turning to distributed, server-based environments, most newer-generation electronic mail products have adopted a client/server, store-and-forward mail service. Poste is no exception. (Store-and-forward messaging is an appropriate solution for a multiserver environment because, if a server happens to be down and a connection is not established immediately, your mail server stores your message and waits for the connection.)

Poste uses message stores at both the user and group level to receive and store incoming messages. A user agent sends messages and interacts with the message store, and a message store registry keeps track of the location of messages stored across a LAN—giving users the benefit of transparent addressing—as well as aliases and distribution lists.

Transport Services. Poste's transport service actually delivers the messages—across the LAN and across wide area networks with internet or X.400 transport agents. The transport service looks at the address and takes one of three actions: If it's a local address to another Poste user, Poste handles it directly; if it's an X.400 address, Poste hands it off to the X.400 gateway processes; if it's an internet address, Poste sends it directly to Unix mail.

Poste currently has no support for X.500 and offers directory services only at the LAN level. Alfalfa maintains that X.500 is still immature, and it would rather wait for the standard to evolve before implementing it.

CONCLUSION. Alfalfa may have found a nice little niche for itself with Poste. As we mentioned, Unix mail could use a friendlier, more intuitive front end. The company's major competition comes from office systems vendors who offer mail as just one of many components (e.g., Alis, Uniplex, Cliq). But there are plenty of user organizations that have already standardized on a number of specific applications and are looking for a mail product to balance their application suite. In other words, they need mail, not a whole office system. Furthermore, the cost of Poste is significantly lower than these office systems—$395 per single-user copy (the average going rate for E-mail packages). — *L. Rowan*

•MIPS•

MIPS'S R/4000: A Race for Dominance

MIPS is finally beginning to release some details on its long-awaited chip, the R/4000. In essence, MIPS has taken its popular R/3000 and implemented it on a single chip. MIPS expects that this new architecture will cement the role of RISC as the premiere architecture for the future. It contends that its implementation of RISC will be the first "true" 64-bit implementation on the market and will put the company well ahead of the competition. This claim is based on the fact that the R/4000 implements 64 bits in its paths to cache and main memory, in floating point Arithmetic Logic Unit (ALU), and in all addressing and registers. The benefit of a 64-bit architecture is in providing an unsegmented virtual address space needed for large databases and graphics applications. MIPS also contends that the R/4000 is a true RISC processor without remnants of CISC. Because of this, MIPS is able to claim between a three- and five-to-one performance enhancement over CISC. Another reason that MIPS is so confident about the future success of its chip is that it implements superscaler and instruction-level parallelism. MIPS also boasts of a superpipeline design. Superpipelining increases performance both for integer and floating-point applications.

Initial implementations of the processor are expected to run at approximately 40 to 50 MIPS. These should sell at about the same price as the high end of the R/3000 line and be binary compatible with those systems. While MIPS hasn't yet set pricing for its new chip, we expect that chips will sell for the equivalent of between $200 and $300 per MIPS (before they are configured into full-fledged systems). MIPS anticipates that system pricing for systems based on the R/4000 will be comparable to Intel 486-based systems.

In this fiercely competitive hardware market, MIPS is hoping to advance its fortunes by staying ahead on technology such as its 64-bit architecture, and by adding value on the software side. We believe that its work on compilers and other tools that help developers more easily port their applications is vitally important to MIPS's future success.

CONCLUSION. MIPS is doing a credible job providing technical leadership in this semiconductor marketplace. The company is working hard to prove to its OEMs that it can stay ahead of the price/performance curve set by its competitors. It knows that it must deliver this next-generation processor quickly to keep pace. MIPS is beginning to prove that it also has the marketing savvy to begin to build mass market appeal for its technology. Landing key accounts like Compaq is evidence that its stance is working. We will be watching closely the alliance MIPS is forming with Compaq, Microsoft, Digital, etc. to see how well it can finesse an even more strategic role as a contender in the chip standard wars. *—J. Hurwitz*

•DATABASE TOOLS•

Jyacc's Presentation-Independent 4GL

Jyacc has recognized the problem that database developers face now that they have to deploy applications across a number of different machines and interface environments. The company recently announced a presentation interface for Jam, its 4GL tool, that allows portability among different interfaces. The new product, Jam/Presentation Interface (Jam/Pi), will initially bring interface independence between character-based and Motif environments, but Jyacc is planning support for other interfaces—including OpenLook and Windows 3.0—in the near future.

PRODUCT HISTORY. Jyacc's database tools have been around for some time now. The company released Jam, its 4GL with screen painter and data dictionary, in 1984.

Over the years, it has added layered products on top of the original to make it a more flexible and productive tool. For example, Jyacc offers Jam/DBi—a database interface that integrates Jam applications with several relational databases, including Oracle, Sybase, Informix, and Ingres (among others)—a worthwhile development in itself.

However, each database has a separate Jam interface; Jyacc hasn't tackled the SQL portability issue. You can't pull information from multiple databases, but you can at least choose which database you want to work with. Jyacc also offers a report writer, a terminal emulator, and a language interface for linking programming languages (C, Cobol, Fortran, and the like). Jam/Presentation Interface is its newest development, and was announced at UniForum in January.

JAM/PI. Jam/Pi is a layered product that gives developers the ability to run Jam applications on character- and Motif-based machines without modification or recompilation. Jyacc expects to have an OpenLook version some time this month, and DECwindows and MS Windows versions should be available in the second quarter.

Technical Design. Jyacc has essentially reorganized its product to separate the application from the presentation interface. Each interface function is encapsulated as an object that contains different versions of that function (at the moment, a character-based version and a Motif version). Menu objects, for instance, look and behave differently from one user interface design to another, but you can always count on the function and the outcome of interacting with that menu object to remain constant.

Thus, a developer can draw a form in Motif, save it on a network server, and let it be accessed by both the terminal user, who will have a character-based form, and the Motif user, who will have a Motif form. Ultimately, that form may be accessed by OpenLook and Windows users.

CONCLUSION. Jyacc is definitely on the right track in adapting its 4GL tool to perform in a mixed-platform, mixed-database environment. We're especially pleased that the company is planning a Windows version, since that's the environment of so many end users. Application flexibility is crucial now that organizations are turning to heterogeneous computing.

As we mentioned, the Jam/Pi for Motif is a separately sold, add-on product. Likewise, Jam/Pi for OpenLook, Windows, and DECwindows will be separately sold products. In other words, you select the product to fit your existing systems. The price ranges from $395 to $1,995, depending on platform. *—L. Rowan*

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▲ Overview

The Third Annual Executive UniForum Symposium will spotlight the realities of implementing UNIX by exploring the applications and tools necessary to move UNIX and Open Systems into a traditional MIS shop.

Tools, applications, and strategies will be the major focuses of this conference. We will explore strategies for integrating UNIX with existing systems, tools for CASE and 4GL development, and critical applications for Open Systems migration and implementation. In addition, we will look at database interoperability, systems integration, and user requirements in the age of Open Systems.

This three-day conference will present views of respected industry leaders—including hardware, software, and networking vendors—and influential commercial users. More than half of the conference speakers are corporate information systems executives. We will also discuss and explore next-generation UNIX applications and platforms, such as distributed computing applications and object orientation.

▲ Registration and Speaker Information

Call **(800) 826-2424** for a conference schedule and registration information. Massachusetts and international callers dial **(617) 742-5200** or fax **(617) 742-1028.**

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