PIPELINES

Covering Microware's Real-Time System Solutions

Volume 5 Number 3

Summer 1990

RAVE and CD-I:

Multimedia Products for the 1990s

microware®

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New ZIP Code, Addresses

MICROWARE'S CORPORATE HEADQUARTers in Des Moines now has a new ZIP code — 50325-7077. See our full address above. Also see stories in this issue (pages 8 and back cover) about new addresses for our Western Regional, French and Japanese offices.

Do You Have New OS-9 or OS-9000 Products?

IF YOU HAVE NEW HARDWARE OR SOFTware products that run under OS-9 or OS-9000, please submit a press release and black & white photograph of the product for consideration for publication in *PIPELINES*. All materials should be sent to the Editor of *PIPELINES* at the address above. For more information, call Steve Simpson at (515) 224-1929.

On The Cover

RAVE IS A POWERFUL TOOL FOR THE DEvelopment of graphical user interfaces for industrial control. Interfaces created with RAVE allow non-technical users to control sophisticated processes.

It's The Multimedia Decade

Ken Kaplan,
Microware's President

Multimedia is much more than just a new buzzword. It is an important new technology that will greatly accelerate the integration of intelligent products into everday life, both at home and at work.

In order for technology to be useful to the average person, it must be easy to use. Some simple intelligent devices in use today fit this requirement to varying degrees. Examples are microwave ovens, electronic typewriters, electronic cash registers, etc. These devices are considered by users to be "applicances". Most users don't even realize that the device is in fact controlled by a computer.

Multimedia user interfaces (MMIs) can carry this concept upward to products that are much more intelligent. Using

OS-9000/RAVE Version 1.2: Multimedia Development for the PC

RAVE, MICROWARE'S REVOLUTIONARY multimedia development tool and user interface, will soon be available for PC users running OS-9000. Previous versions were only available for 680X0 VME-based systems.

RAVE allows designers to create realistic man/machine interfaces for real-time process control systems. With RAVE, designers can quickly configure user interfaces and control panels using real-world sounds and images. Images may be actual video or computer graphics. Sounds can include voice, natural sounds or computer-generated sounds.

Rather than using a programmer's conception of a process drawn on a simple screen, RAVE interfaces use video and audio that provide real-world images and sounds. Because the resulting user interface better represents the actual control environment, it can be better manipulated and more easily understood by non-technical users.

Distributed RAVE Development

Version 1.2 of OS-9000/RAVE includes support for the **ATI VGA Wonder** board, one of the more popular PC graphics boards on the market. OS-9000/RAVE also supports the **Vigra VME-MMI-100** audio/video board in conjunction with an MVME147. Both the ATI and Vigra boards run at 640 × 480 resolution with 256 colors available. Images created on both of these man/machine interface boards are compatible with each other, thus allowing for cross-development between PC- and VME-based OS-9000 systems.

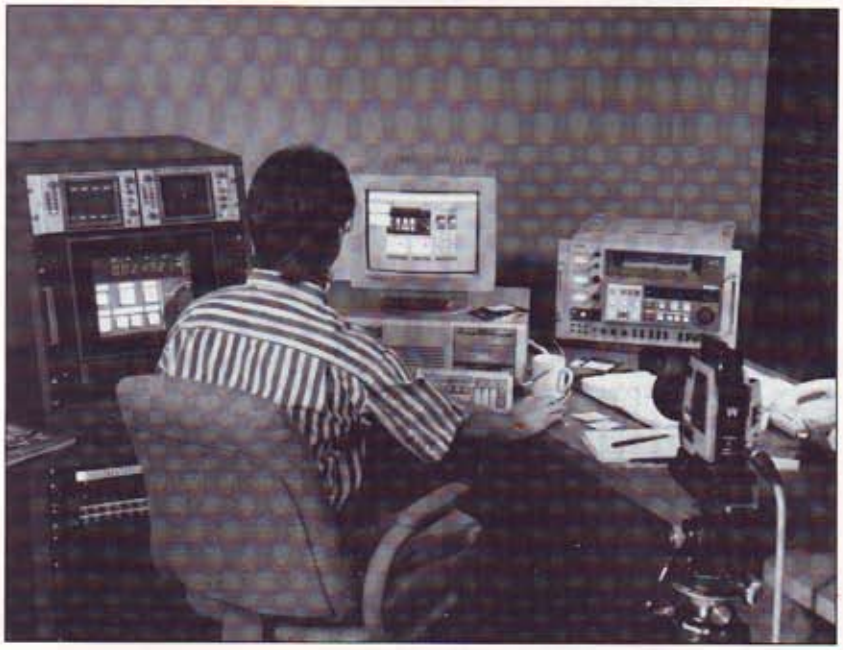
natural images and sounds to mimic familiar real-world control metaphors, the MMI hides the increased internal complexity of the product. Thus it it can be easily understood and operated by non-technical users.

The Compact Disc-Interactive (CD-I) system discussed in this issue is by far the most internally complex consumer electronics product yet devised. A major challenge for the designers (Microware, Sony, and Philips) was how to create a user interface that would be easier to use than a VCR (try programming one without reading the manual). The solution was found in an MMI combined with a simple handheld pointing device. CD-I menu screens look much more like broadcast TV than a Mac or PC. Selections are made using a device which is basically the familiar TV infrared remote control with a small thumb-operated joystick added.

It did not take a giant leap of imagination for us to realize that the industrial products that our customers develop are mostly designed for use by end-users without strong computer skills. Thanks to modern VLSI, adding multimedia I/O often has little cost impact. That is why we decided to develop a version of the CD-I RAVE MMI tailored for embedded and industrial applications.

RAVE can give your product a very significant competitive advantage because easy-to-use means easy-to-sell. It can also dramatically improve documentation, training and support costs. If you haven't looked at using a multimedia user interface with your project, I strongly urge you to do so.

— Ken Kaplan



OS-9000/RAVE lets you create realistic man/machine interfaces on a PC.

RAVE compatibility goes one step further, as well. Images created under OS-9/RAVE and OS-9000/RAVE are compatible with one another and applications developed under either version are 100 percent source code compatible. Source code simply needs to be recompiled for the new target and your RAVE application is ready to run. Applications can be built on several combinations of PC- and VME-based hardware systems running OS-9000 or OS-9.

Capturing and Using MS-DOS Images

OS-9000/RAVE allows you to use many specialized graphics or paintbox pro-

OS-9000/RAVE
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OS-9/RAVE Target and Development Boards from BVM

BVM LIMITED (SOUTHAMPTON, England) recently announced three boards that support Microware's OS-9/RAVE. These include two development boards and one target board.

The **BVME780** 6U VME development board provides a real-time frame grabber and display capabilities with four software switchable inputs. This allows capture of color video without using a filter wheel. The system includes an HD63484 ACRTC video processor and up to 1M video memory.

The BVME780 allows a designer to grab an image and display it in a window. The window can then be resized or moved while still containing the live image. Color graphics can be generated and overlaid onto the grabbed frame.

The **BVME795** offers a powerful RAVE target board. The 3U VME board includes all the output capabilities of the BVME780 but without the frame grabber circuitry.

Finally, the **BVME650** features high-quality sound digitizing. The board provides 12-bit resolution with sample rates up to 12KHz.

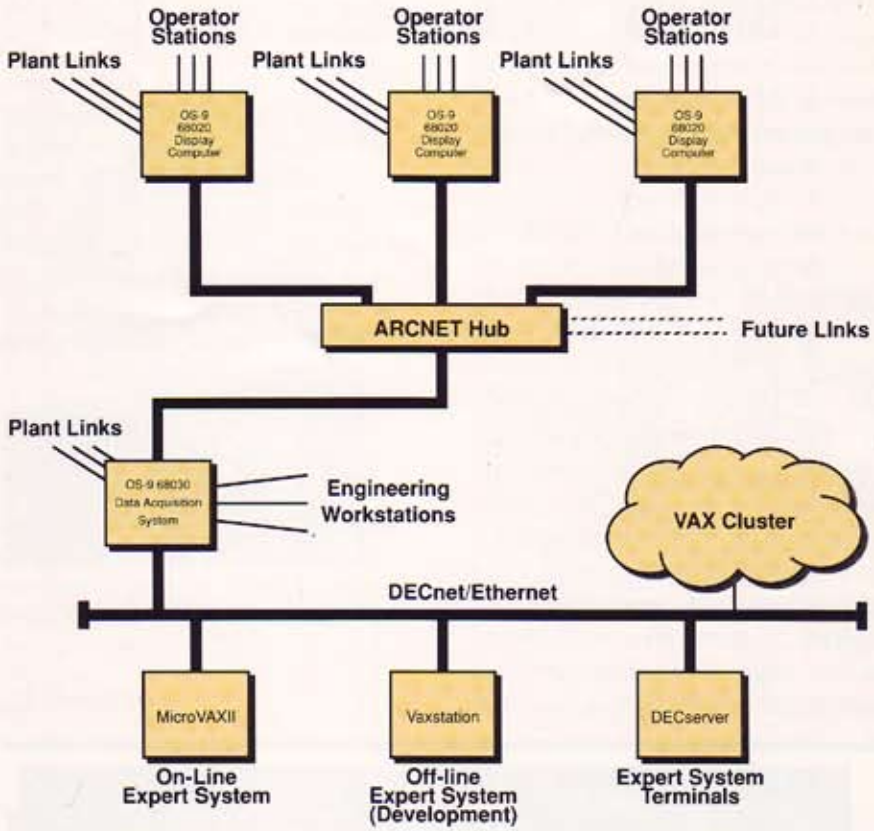
For more information about these new OS-9/RAVE boards, contact Rod Clarke, BVM Limited, Flanders Road, Hedge End, Southampton SO3 3LG, England. Phone: (44) 703 270770. MSC

BVM's OS-9/RAVE System.

Data Acquisition for Engineering Expert Systems

by Raymond Walton
Linklaser Ltd.

"OS-9 was selected ... because of its fast real-time capabilities, unified I/O system and customization capabilities."



British Steel's engineering expert system monitors their Basic Oxygen Steelmaking process.

BRITISH STEEL IN CONJUNCTION WITH Teesside Laboratories has commissioned an engineering expert system for the Basic Oxygen Steelmaking (BOS) Plant at Ravenscraig Works (Motherwell, Scotland). The project involves the use of the ARCNET industrial local area network (LAN) to link previously installed data collection and operator display systems with a front-end data collection master. The latter, in turn, is linked to the expert system.

The system continuously monitors the BOS process and produces diagnostic reports warning of potential failures and breakdowns. The output of the expert system will produce maintenance schedules to reduce downtime and minimize loss of production.

The expert system runs on a DEC VAXcluster, which provides a gateway for access to the plant data from several sources. The expert system, an on-line system running on a MicroVAXII producing real-time diagnostics, is duplicated while a development system runs on a Vaxstation clustered with the MicroVAX. The development system will allow new rules to be tested before inclusion in the on-line package. This configuration requires that the plant data be available to both systems.

Selecting The Systems

Since running an on-line expert system is a very processor-intensive task, it was decided to off-load the data acquisition functions to a front-end processor.

For several years, British Steel at Ravenscraig has been using data acquisition and control systems supplied by Linklaser Ltd. (Macclesfield, England) running **Process Supervisor**. Process Supervisor is a C software package developed by Linklaser for use under OS-9. These systems are used in applications ranging from energy monitoring to production operator display systems. The solution selected for the front-end processor was a system based on the Process Supervisor. Since British Steel already has several installations using this package and is familiar with its capabilities, it was the natural choice on which to base the front-end system.

Process Supervisor is a comprehensive supervisory system that integrates the BOS man/machine interface with real-time plant data acquisition. Linklaser made a careful study of available platforms on which to base development before arriving at its final choice of Motorola 680X0 hardware and Microware's OS-9 Real-Time Operating System.

Motorola was selected as the hardware platform since the design philosophy of

the 680X0 series promised a smooth upgrade path. This has proven to be the case with the introduction of the 68020 and 68030. OS-9 was selected as the software platform because of its fast real-time capabilities, unified I/O system and customization capabilities.

As process control systems have evolved through the years in the BOS plant, various devices from different manufacturers have been installed in different areas of the plant to perform control and monitoring functions. The engineering expert system requires data from many of these systems, and must acquire it quickly and reliably to achieve meaningful results from the engineering rule base.

The first phase of the project acquires data from 17 different sources using seven different protocols over RS-232 links. Extra values are derived from this raw plant data, the calculations being performed in the front-end using the built-in calculation module that forms part of the standard Process Supervisor package. This facility also helps to off-load the VAX machines.

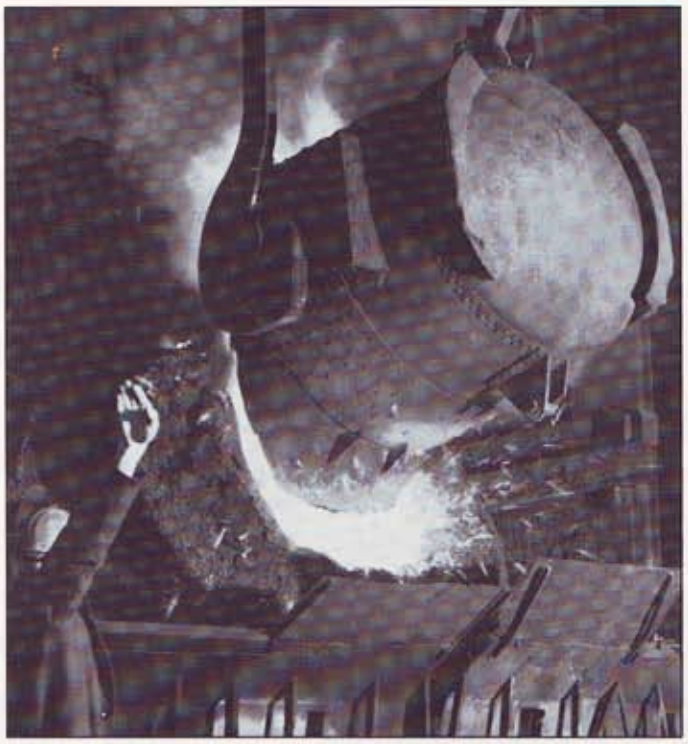
In addition, some required signals are present in operator display systems previously installed by Linklaser. Output from the expert system must be available at these operator control stations, so it was decided to link the existing systems to the new front-end processor via a plant-level ARCNET network.

ARCNET emerged as the best choice on a number of grounds. Two purely practical reasons for this is the network's predictability and flexible configuration options. Plus, readily available bus interfaces and low-cost coax contributed to a low total network cost.

Linking It All Together

Transfer of signals to and from these networked systems is via Linklaser's in-house network protocol and is based on Microware's flexible OS-9/NFM (Network File Manager). Up to 255 nodes can be installed on a single ARCNET and, when combined with the standard four-mile distance capability, gives British Steel and Linklaser the option of linking further data acquisition systems as data is required by the expert system.

Linklaser has also provided a communications module that will run in both VAXs and acquire the same plant data that is held in the front-end processor's database via DECnet. This link makes use of Linklaser's in-house network protocol which is used for intersystem communication over a variety of physical links.



One of three 120 ton Basic Oxygen Steel (BOS) vessels at British Steel's Ravenscraig Works.

The front-end processor has powerful graphics capabilities that form part of the standard Process Supervisor package. British Steel has installed five engineering workstations that directly connect to the front-end for access to its database. The workstations are based on the ABB Tesselator color graphics generator, which is fully supported by Linklaser. These workstations allow diagnostic messages/alarms to be presented as they are received from the expert system with explanations of any plant faults or warnings of potential problems.

Dynamic plant mimics are built using the display creations utilities available within Process Supervisor. These show the current status of any area of the plant and highlight areas that have faults or problems as indicated by the expert system. A trending module allows any of the plant signals to be logged and trended for comparison and analysis whenever a plant fault occurs or the expert system predicts deterioration in plant performance.

The system is currently undergoing trials, during which each signal has to be validated and the development rule base tested against predicted data. A large amount of historical plant data has been logged in the VAXcluster. These logs are checked for trends and events to allow the rule base to be tuned to the actual behavior of the plant.

This project is a pilot for the complete BOS plant consisting of three BOS vessels, each with a capacity of 120 tons. This pilot is implemented on a single vessel. However, when the primary phase is complete and the results are analyzed, the intention is to expand the system to all three vessels. The initial design has had to take this into account and British Steel has acquired a flexible system that should allow this future expansion to take place with minimum disruption.

Raymond Walton is co-founder and Managing Director of Linklaser Ltd. He is one of the principal designers of the Process Supervisor software package and has over 10 years computer systems design experience, including five years with OS-9. Ray initially trained and qualified as a mechanical engineer and has found his early experience as an engineering designer very useful in process control applications. Linklaser can be reached in the U.K. at (0)625 34497. MSC

Looking to the Future with CD-I

by Bob Sorensen, President
OptImage Interactive Services Co.

THE FIRST WORLDWIDE CONFERENCE ON Compact Disc-Interactive (CD-I) was held in London last June. *The Multimedia Conference on Interactive CD* was organized by Philips, Sony, Matsushita and Polygram to introduce CD-I to entertainment, education and information businesses around the world.

The CD-I Arcade at the conference provided an introduction of CD-I players and titles from major consumer electronics firms. But, the most important part of the conference was the speeches made by industry leaders.

Forming A CD-I Coalition

Speeches at the conference focused on several areas including CD-I applications, development tools and marketing considerations. The most striking messages came from executives from Sony and Matsushita.

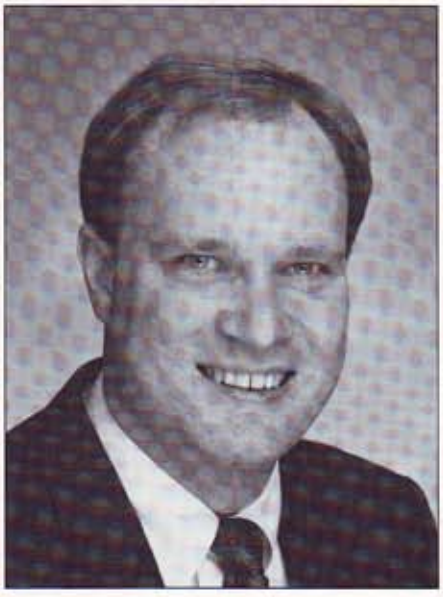
Mr. Nobuyuki Idei, director of Sony Corporation, and Mr. Mikio Higashi, director of Matsushita Electric Industry, stressed the importance of CD-I in the consumer electronics market. Both firms are committed to reaching the consumer market and realize the need for a coalition of CD-I hardware and software manufacturers. Mr. Idei stated, "Now computers will really come closer to people, and there will be a platform for the multimedia concept. We might say that dawn is breaking at last...CD-I is the multimedia platform for the 1990s. Sony would like to work in partnership with [CD-I developers] to usher in the new consumer electronics. Together let's create a Multimedia Decade."

A Whole New Realm

The conference in London helped companies involved in CD-I focus on future plans. CD-I was created for both consumer and industrial markets. However, until the conference there was no true commitment from consumer electronics firms other than Philips to pursue this market.

The professional market for CD-I is quickly developing as firms realize the tremendous importance it will have for training. French auto maker Renault has implemented a CD-I system for dealer training and education that provides detailed information about the marketing of Renault's cars. One CD-I disc contains all the information in several languages, so Renault dealers around the world can use the same disc and choose their native language. Firms like Renault and Principal (see inset) are choosing CD-I because it provides a low-cost multimedia delivery method packaged in a powerful computer-based device.

OptImage's CD-I authoring tools. From left: CD-I Starter System, CD-I Emulator and SUN Sparcstation.



Bob Sorensen

The announcements by Sony and Matsushita at the CD-I conference have increased CD-I's momentum toward the home market. CD-I offers unlimited potential for the consumer electronics market. Early consumer titles will primarily consist of interactive games, "how-to's", children's educational/entertainment and reference materials. However, as CD-I takes root, new and imaginative uses will be created. "Living" books, interactive adventures and elaborate educational material will make their way into CD-I.

From its inception, three basic concepts have helped make CD-I ideal for the consumer market. Like its CD Audio relative, CD-I is designed to provide:

- An easy-to-use device
- High-quality multimedia at a low price
- One worldwide standard for title production

In the 1980s, CD Audio helped put sophisticated electronics in many homes. In the 1990s, CD-I will bring multimedia into homes.

Vision for the Future

While the present holds exciting possibilities for CD-I, the future holds even more. The basis for these possibilities is

the powerful computer and operating system around which CD-I is built.

Because a CD-I player is a true computer in disguise, a full range of products can easily be developed and marketed for CD-I. The most promising of these is communications capabilities, particularly using simple phone lines and, in the future, ISDN (Integrated Services Digital Network). This creates tremendous potential for information storage and retrieval. Industrial users could connect to remote CD-I systems that contain specialized information and use it on their local system. Home users could "dial up" a CD-I service and retrieve titles or portions of titles.

The computer that is the basis of every CD-I player is virtually transparent to the user. This transparency holds particular potential for home users. Consumers will buy CD-I players as entertainment and educational devices, similar to VCRs or compact disc players. Future products will allow them to tap directly into the powerful computer, still without even knowing they are using a computer. These products might include easy-to-use home control centers or bank-at-home systems.

Products for CD-I Development

OptImage is the world's leader in CD-I authoring tools — more than 90 percent of today's titles were developed with OptImage products. We have been fully involved with CD-I since its inception and now offer a full line of hardware and software tools for CD-I development.

The first level for most people entering CD-I will be OptImage's CD-I Starter System. The Starter System is ideal for introducing people to CD-I, creating simple presentations and designing sample discs. The Starter System is built on the philosophy that a CD-I player is the best environment in which to develop CD-I applications.

The Starter System is an integrated package centered around a CD-I player and includes a development extension, hard drive, monitor and a sample disc with images and sounds. The Starter System also includes software for CD-I authoring. CD-I Art allows you to manipulate existing images (included in the sampler disc) and create new ones. The Sequence Editor lets you create multimedia sequences using a simple point-and-click interface. The Menu Editor gives you the ability to activate areas of the screen and add interactive capabilities to your title.

Starter System users won't be left high and dry when they add more sophisticated capabilities. The Starter System is specifically designed to become part of any CD-I development environment, regardless of the level of sophistication.

Thanks to the alliances formed at the recent Multimedia Conference on Interactive CD, the future offers many opportunities for CD-I. OptImage will remain at the forefront as CD-I reaches users around the world.

Bob Sorensen is president and chief executive officer of OptImage. Prior to joining OptImage, Bob was vice president of research and development for Microware. Bob holds a Bachelors degree in electronics technology from Iowa State University (Ames, Iowa). MSC

Principal Mutual Life Insurance rolls out the nation's first CD-I information kiosk. Shown here: Walter Walsh (l.) and Mike Walsh (r.).

First U.S. CD-I Installation

Principal Mutual Life Insurance Company (Des Moines, Iowa) is the first U.S. corporation to use CD-I. The CD-I Kiosk was unveiled on May 21, 1990 during a brief ceremony for Principal employees. The kiosk includes a CD-I player and monitor.

Principal's title, *Being a Marketing Organization*, is an employee training tool that details the various market segments the company tries to reach. The disc includes photographs, computer graphics and audio highlighting Principal's markets.

Microware France Moves to 17th Century Castle

MICROWARE SYSTEMS FRANCE, LOCATED in Aix-en-Provence, is expanding and recently moved to new quarters. In April, Microware France moved its offices into Chateau de la Saurine, a restored castle built during the 17th century.

History of the Castle

The first parts of the castle were built during the 17th and 18th centuries. Since then, several additions have been made by various owners. From the second floor, the castle offers a wonderful view of Montagne Sainte Victoire, a subject of one of Paul Cezanne's paintings.

First called Roche Fontaine for the surrounding rocks and springs, the area was originally owned by Pierre Saurin. Saurin was a famous lawyer in the area and gave his name to the castle. After Saurin's death, Joseph de Chaix, Lord of Claret, inherited the estate. After de Chaix, various nobility and gentry owned the estate, including a merchant ship captain who bought the estate for his mistress. It is currently owned by a local antiquarian, who converted it to an office building.

On the grounds of Chateau de la Saurine, the new home of Microware Systems France. Pictured from left to right: André Demarque, Nick Rainey and Cathy Hochart.

France's Growing Staff

In addition to general manager *Nick Rainey*, Microware France has two other employees.

André Demarque joins Microware as technical manager. Prior to joining Microware, André worked in hardware and software design, as well as being director of project development, for several firms. André earned his degree from Nice University of Science.

Cathy Hochart is Microware France's office manager. Cathy received her French Baccalaureate with specialization in foreign languages including English, Russian and German, and attended Aix-enProvence University where she studied English and Russian.

Microware's French subsidiary may be reached at:

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13590 Meyreuil France
Phone: (33) 42 58 63 00
Fax: (33) 42 58 62 28

New Offices for Microware K.K.

Microware Systems K.K. recently moved to an expanded office. Pictured here is Microware's Japanese research and development department.

MICROWARE'S JAPANESE SUBSIDIARY, Microware Systems K.K., has expanded their staff and moved to a larger office.

Microware K.K. provides product development, technical support and sales for customers in Japan. To help meet the needs of a growing market, the subsidiary has expanded their staff to over 25 people. The growth has been in the marketing, research and development, and technical documentation areas.

To accommodate the expanding staff, Microware K.K. has moved to larger quarters in a Tokyo office building. The move has doubled the space available over their previous office and includes room for future expansion.

"We've watched our Japanese market grow every year," says Ken Kaplan, Microware's president. "Now with OS-9000, we're expecting even stronger growth. Japanese PC users have a very limited selection of options. They see OS-9000 as the solution they've been waiting for."

"Our new offices will allow us to accommodate the expected growth in Japan and the Pacific Rim."

In Japan, contact Microware at:

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17-3, Sotokanda 2-Chome
Chiyoda-Ku
Tokyo 101, Japan
Phone: (81) 3-257-9000
Fax: (81) 3-257-9200

Automated Warehouses and OS-9: Real-Time Performance with Built-In Reliability

by Ronnie E. Lackey, Research Triangle Institute

"RTI has not received any software problem reports one year after final acceptance of the WICS remote terminals and vehicles in large part due to the real-time performance and built-in reliability of OS-9."

THE RESEARCH TRIANGLE INSTITUTE (RTI) (Research Triangle Park, NC) is a not-for-profit, contract research and development institute. The RTI Center for Technology Applications has extensive experience in technology transfer and industrial automation, including the design, development and installation of small- and medium-scale computer automated systems.

The Air Force Logistics Command at Warner Robins Air Force Base (Warner Robins, Georgia), recently replaced the aging terminals and vehicle fleet for their **Warehouse Inventory Control System (WICS)** warehouse. WICS is an automated, narrow-aisle, order-picking warehouse system supplying component parts for Air Force flight systems on- and off-base. RTI designed, developed, integrated and tested the hardware and software on the remote terminals and vehicles which directly interface to the operator and the WICS host computers. Hyster Company (Portland, Oregon) was the prime contractor and supplied the replacement vehicles. The entire project was performed in parallel with existing WICS system operation resulting in only minimal disruptions to ongoing day-to-day warehouse activities. RTI has not received any software problem reports one year after final acceptance of the WICS remote terminals and vehicles in large part due to the real-time performance and built-in reliability of OS-9.

High Expectations

The original WICS system had been working for almost 10 years. Failures of component parts and increasing unavailability of spares drove the need for a modern replacement system. Although the existing system was operational, there were hidden problems and high-risk system software elements awaiting the replacement contractor. Initial conditions for the WICS replacement project consisted of:

- Minimal software specifications for the original terminals or vehicles existed.
- The terminals were connected on-line, real-time to the WICS hosts.

RTI: Automated Warehouse
Please turn to Page Ten

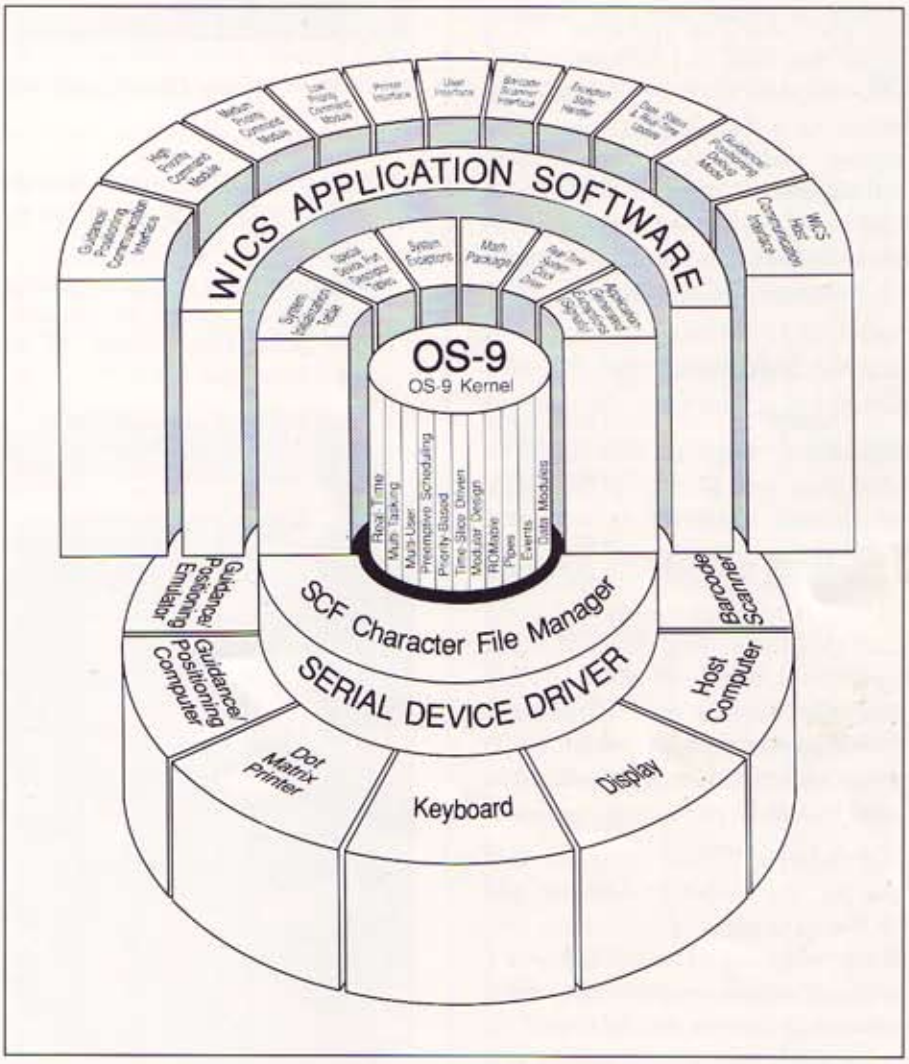


Figure 1. OS-9 Features and Capabilities used by WICS Remote Terminal and Vehicle Application Software.

Continued from Page Nine

- The vehicles could operate under both real-time host control and local on-board control.
- The original functionality of the terminals and vehicles was implemented in sparsely documented, but highly optimized (for size and speed) assembler source code with no access to a development system platform.
- WICS is a transaction-based inventory control system, but the dependencies among transactions were not documented sufficiently.
- Access to WICS host code was limited to the vehicle routing command generation algorithm.

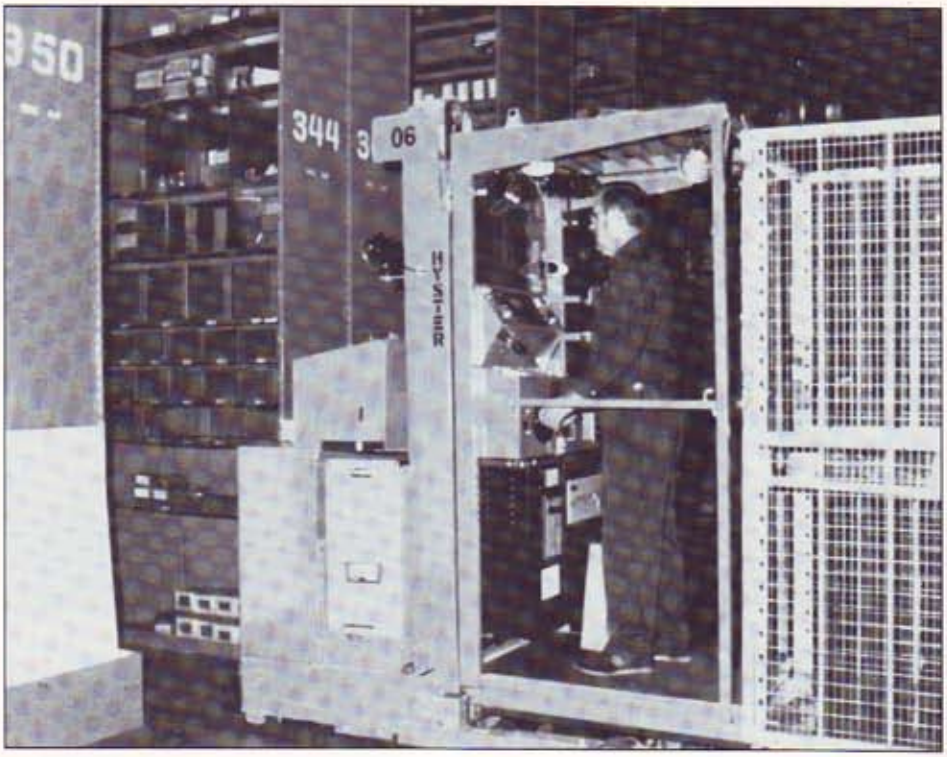
The goal, then, of replacing WICS remote terminals and vehicles was to provide modern hardware using software written in a high-level programming language which could meet existing user- and host-interface functionality. In other words, replace the existing terminals and vehicles and continue to maintain a working WICS system.

Simple Solutions

RTI chose "C" as the high-level programming language because of its readability, portability, ROM-ability and general capability as a system programming language. OS-9 was chosen as the operating system for its real-time functionality in the real-world industrial environment. Also, OS-9 was chosen based on many of its features and capabilities and how these features and capabilities matched up with WICS application software needs as outlined in Figure 1 (page 9).

After choosing "C" and OS-9 as a platform for the software solution, the WICS remote terminal and vehicle software development activities followed a traditional software engineering path including the following specific steps:

- Designed software components in a modular fashion to permit rapid modification and provide robust error prevention and error detection. Functionally-related operations were grouped into tasks.
- Designed tasks to communicate with each other through signals, events and global data modules, all standard features of OS-9.
- Designed tasks with different priorities to better handle the real-time constraints.



Hyster Orderpicker with RTI Remote Vehicle Processor.

WICS Receipt Station with RTI Remote Terminal Processor.

Specialized Features Implemented

In addition to the many standard OS-9 features available, RTI developed some specialized features needed for completion of the project. These included: circular queuing of signals for a task; host/remote communications audit trail; and windowing with keyboard, application software exception and bar code scanner input override capabilities.

When an application program (task) generates a user-defined exception state, a signal is sent to the appropriate task. If the receiving task has installed a signal exception handler, then the handler will receive the signal and can act on it somewhat independently of the actual execution of code within that task. Application program signals can, of course, be blocked and unblocked temporarily. Normally OS-9 will FIFO queue signals for a task. When the task is scheduled for CPU time it will receive as many signals as are queued and as permitted by other system constraints including task priority. RTI found it necessary to locally buffer the signals in certain cases so that

processing of the signals could be done at a later, less real-time critical moment. The signals were received by the task and placed into a circular FIFO queue to be removed at the controlled leisure of the task.

Communication audit trails are often quite useful in production systems. They can be especially useful in the development, testing and integration phases of a software project life cycle. RTI added a transaction-based printer buffer which could be activated to log to the printer all or partial host/remote communication activity.

During the WICS project activity, RTI was using OS-9 Version 2.2 which supported no formal windowing software functions. RTI developed a windowing capability similar to that of the µMacs editor in OS-9. The window library supports keyboard, application software exception and bar code scanner input with override capabilities. Data fields can be masked for visibility, user input accepted or rejected, input character validation, and input field function validation. Multiple windows can be active on the physical screen at any given time, but a given application task can only have one window definition open at any given time.

RTI chose OS-9 because the WICS automated warehouse project required real-time performance with built-in reliability. OS-9 met those requirements and more. RTI has been very pleased with the performance of their WICS remote terminal and vehicle software running on an OS-9 platform. OS-9 has proven itself to be a reliable system software solution.

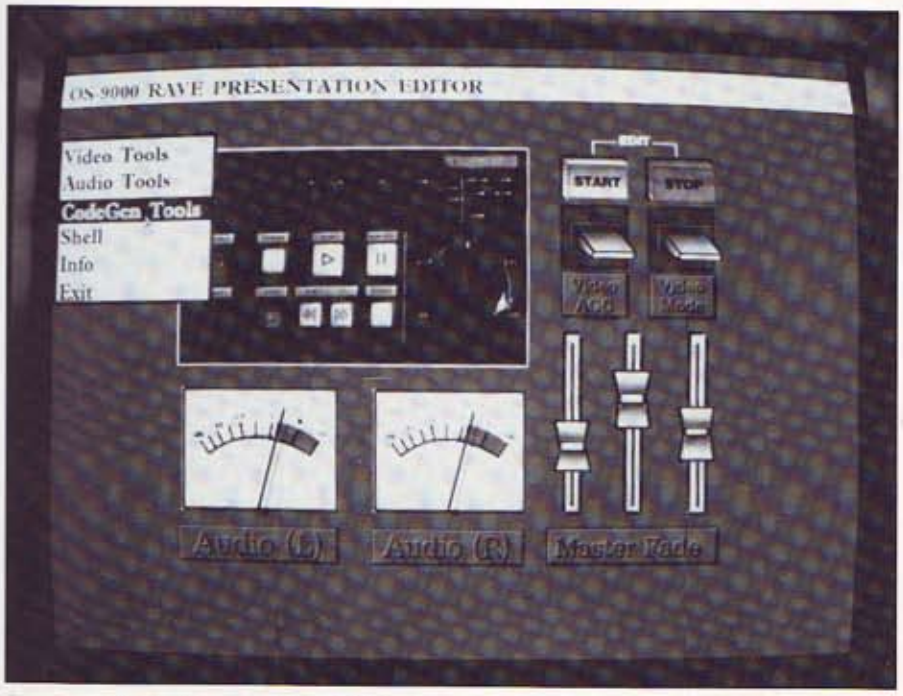
Ronnie Lackey is a Research Computer Scientist for Research Triangle Institute and holds a Bachelor of Science in computer science from North Carolina State University (Raleigh, NC). His research activities within the Center for Technology Applications include: throughput analysis of transaction-based communication systems, real-time industrial automation of warehousing systems, vehicle fleet routing and control simulations, autonomous robot path-planning and collision avoidance, and CAD/CAM of 3D objects with compound curved surfaces.

Acknowledgments: The U.S. Air Force funded the WICS replacement project under contract no. F33600-87-C-0476. The staff and employees at all levels involved with WICS were very helpful at all times throughout the course of the project. The Microware Technical Support Staff (Des Moines, Iowa) provided insightful tips during the early stages of the project. Matrix Corporation (Raleigh, NC) was helpful in resolving hardware and software problems throughout the project's life cycle. MSC

OS-9000/RAVE

Continued from Page Three

grams available under MS-DOS. These include packages for simple line drawings, computer aided design (CAD), computer aided manufacturing (CAM) and full-color graphic design. Images can be created under the packages that designers are most accustomed to or packages that provide specific tools the designer needs.



RAVE's Presentation Editor lets you build your user interface.

RAVE allows you to import images from other packages in either TARGA or GIF format. RAVE also includes a shareware TSR (terminate and stay resident) program for capturing MS-DOS images. The TSR runs under MS-DOS and lets you open an image from your MS-DOS design package, then capture the screen in GIF format.

Future PC Board Support

Microware selected the ATI VGA Wonder for the first release of OS-9000/RAVE because of its popularity and resolution compatibility with the Vigra board. Future plans call for support of several other VGA boards including Paradise, Video Seven and Orchid ProDesigner boards.

Vigra's board provides digital audio for VME RAVE systems. The initial release of OS-9000/RAVE for the PC, however, does not support any audio cards. Microware is examining audio cards for future releases of OS-9000/ RAVE. MSC

On The C Side: UNIX to OS-9 Porting Tricks

by Dr. Peter Dibble
Microware Systems Corporation

Sometimes, porting code from UNIX to OS-9 is as easy as changing file names and compiler options in the make file. Other times the port requires a few special OS-9 functions. For particularly UNIX-dependent programs, the logic of the program may have to be changed or a feature might be deleted.

For this C Side I have ***grep***'ed through some of my favorite ports and selected an especially tricky porting problem and a few steps that are so common that I do them before I even try to make a program the first time.

New Line

I think the trickiest problem I've run across struck is the port of Lawrence Berkeley Laboratory ***flex*** to OS-9. ***Flex*** is a program that generates lexical analysis tools (It's like the UNIX ***lex*** utility). Since part of ***flex*** is a machine-generated scanner, it has a bootstrap problem. You need ***flex*** to make ***flex***. The problem is solved by including the C code for the scanner as part of the ***flex*** distribution.

Flex seemed like a simple port, but when I ran the program it had mysterious problems. After much diagnostic work it turned out that ***flex*** was never detecting end-of-line. The included scanner was made on a UNIX system where the new line character is linefeed so the assumption that new line is linefeed was embedded somewhere in ***flex***. OS-9 text almost never contains linefeeds, so whole files looked like single lines.

The exact character used for **\n** is usually not an issue. Good programmers don't write **\012** when they mean new line, so the compiler keeps everything straight. ***Flex***, however, builds tables using the numerical value of each character to determine the action the scanner should take on that input. There was one table that started like this:

```
static char e[128] =
   {  0,
      1,  1,  1,  1,  1,  1,  1,  1,  2,  3,
      1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
```

That table was the problem. The tenth entry in the table gives the equivalence class of linefeed, 3. You see tab in class 2, and lots of class 1's. In particular, a CR looks just like any other control character. I fixed the problem by changing entry 13 to 3 and recompiling ***flex***.

Two other porting problems relate to **\n**. Sometimes a UNIX program will include a switch statement like:

```
switch(c) {
   case '\n':
   ....
   case '\015':
```

Here the program is trying to do different things for **\n** and carriage return expressed in octal. The C compiler will complain. Here you have to look at the switch statement and do the right thing with CR and LF.

There's also a nasty little difference in the UNIX ***write*** system call. It will write all the bytes you give it and do new-line processing. Under OS-9 you have a choice of ***I$Write*** which writes everything you give it, or ***I$Writeln*** which does new-line processing but stops at the first **\n**.

UNIX programmers generally don't use the low-level I/O calls like ***write()***, ***read()***, and ***open()***. They use the C ***stdio*** library calls like ***fwrite()***, ***fread()***, and ***fopen()*** which port painlessly. Low-level I/O functions are a sign of trouble. Each ***open()*** function must be converted to an OS-9 ***open()*** with an OS-9 mode. ***Write()*** calls may become single ***writeln()*** or ***write()*** calls, or they might expand into multiple ***writeln()*** calls.

stty and gtty

Some UNIX programs such as text editors need to get raw input from the keyboard, and have full control of output. When you see code like:

```
ioctl(0, TCGETA, &ostate);
nstate = ostate;
nstate.c_lflag &= ~(ICANON|ECHO|ECHOE|
   ECHOK|ECHONL);
nstate.c_cc[VMIN] = 1;
nstate.c_cc[VTIME] = 0;
ioctl(0, TCSETAW, &nstate);
```

replace it with OS-9 code like:

```
_gs_opt(0, &nstate);/* get base of new state */
nstate.sg_echo  =   /* no echo for now... */
nstate.sg_psch  =
nstate.sg_pause =   /* no pause character */
nstate.sg_dlnch =   /* no delete line char */
nstate.sg_rlnch =   /* no reprint line char */
nstate.sg_dulnch=   /* no dup last line char */
nstate.sg_eofch =   /* kill eof character */
nstate.sg_kbich =   /* kill kbd interrupt */
nstate.sg_kbach =   /* kill kbd abort */
nstate.sg_psch = 0; /* kill pause character */
_ss_opt(0, &nstate);
```

Random()

UNIX has random number generators in its standard library, and they get plenty of use. The following code makes random numbers that are good enough for casual use:

```
#define MULTIPLIER 39709L
#define INCREMENT 13L
#define MODULUS 65537

static long RandomSeed;

long random()
   {
      RandomSeed = abs((RandomSeed * MULTIPLIER +
      INCREMENT) % MODULUS);
      return (int)(RandomSeed & 0x7FFFFFFF);
   }

initstate()
   {
      return;
   }

setstate()
   {
      return;
   }

srandom(seed)
   long seed;
   {
      RandomSeed = seed;
      return seed;
   }
```

Makefile

UNIX uses a **.o** suffix where OS-9 uses **.r**. The first thing to do with a UNIX makefile is to query-replace all occurances of **.o** with **.r**.

The other easy changes are to get rid of the "install" entry, and find all the file names that start with a slash (mostly **/usr**) and make them into OS-9 names like **/h0/lib** or **/dd/sys**.

Also make sure that all macros in the makefile are defined. OS-9 ***make*** fails when it finds an undefined macro. UNIX ***make*** seems to tolerate them.

File I/O

Porting a program that messes around in the UNIX disk file system is less relaxing than most ports. A call to ***stat()***, ***fstat()***, or ***lstat()*** is a sign that the port will require some new OS-9 code.

The ***stat()*** functions can generally be replaced with various ***_gs*** functions. ***_gs_gfd()*** is the most powerful file information function OS-9 has; if it doesn't have the information the program needs, you have to find a way to fake it. (For instance, UNIX keeps last access time, last modify time and last status change time. OS-9 only keeps the file creation date and last modified date and time.)

Sometimes a program calls for the whole ***inode*** from ***fstat()***, but only needs the file's size. For these situations use ***_gs_size()***.

Long Lines

Long lines used to be a big problem. UNIX programmers would use huge macros to look like function calls but generate inline code. The OS-9 C preprocessor and compiler used fixed-length input buffers and protested vigorously when they were asked to handle input lines that sometimes ran past 2000 characters in length.

Now the compiler handles long lines...though there does have to be enough available RAM to hold the line.

malloc()

UNIX programmers seem to believe that there is always enough memory. This shows up in code like

```
ptr = malloc(sizeof(bigstructure));
*ptr = *data;
```

This is fine provided ***malloc()*** never fails. If it fails and returns a NULL, the assignment statement crashes the program. They can get away with this because UNIX programmers work with large virtual address spaces that aren't effected by other processes and they always have memory protection.

OS-9 processes can be squeezed by other processes' memory requirements, and if there is no SSM the ****ptr = *data;*** actually would write a block of stuff starting at 0. That would very likely crash the whole system.

If there are few unprotected ***malloc()*** calls, the best approach is to replace each call with something like:

```
if((ptr = malloc(sizeof(bigstructure)) == NULL){
   ... deal with the problem ...
}
```

If there are too many ***malloc()*** calls, or if the only way to deal with a RAM shortage is to die gracefully, ***malloc()*** can be replaced with a macro:

```
#define malloc(n)   safemalloc(n)
```

and a function (in a file that doesn't include the ***malloc*** macro):

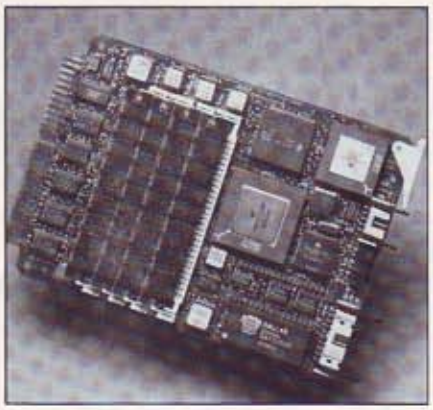
```
safemalloc(n)
   unsigned long n;
   {
      void *ptr;
      if((ptr = malloc(n)) == NULL){
         /* Do a graceful shutdown */
         CleanUp();
         exit(E_NORAM);
      }
      return ptr;
   }
```

New Vendor Products

Pro-Log Introduces 25 MHz 68030 STD Board

Pro-Log Corporation (Monterey, California) now offers a 25 MHz 68030 single board computer (SBC) for the STD Bus. The **7850** features 1M or 4M 32-bit DRAM with parity, two RS-232 ports, a battery-backed calendar clock, 50 bytes of battery-backed RAM and two independent watchdog timers. The SBC also includes a user-programmable periodic interrupt, and software-controllable STD Bus timing and data size.

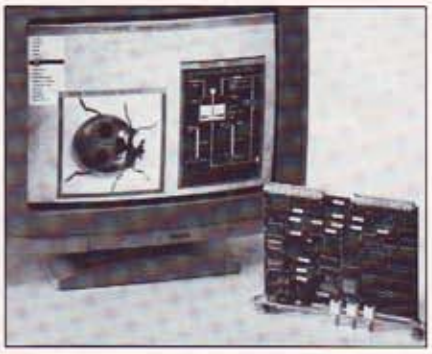
For more information, contact Paul Virgo, Pro-Log Corporation, 2555 Garden Road, Monterey, California 93940. Phone: 1-800-538-9570. Fax: (408) 646-3517.



Pro-Log's 7850 STD board.

G300-Based Graphics Board Includes Up To 4M Video RAM

Compcontrol B.V. (Eindhoven, Holland) now offers their **CC143** fast bit-mapped VMEbus graphics board that includes up to 4M multi-port video RAM. The board can connect to most RGB monitors with resolution up to 1280 × 1024 with 8 bits/pixel. The board incorporates Inmos' IMS G300 color video controller and offers a color look-up table of 256 colors from a palette of 16 million. The 6U VMEbus board includes a serial interface for an IBM PC-compatible keyboard and an RS-232 serial port for a mouse interface.



CC143 graphics board.

The large on-board memory allows the CC143 to hold several display pages simultaneously and quickly switch between them. Special video RAMs optionally allow the board to perform special functions, including fast bit manipulation.

For more information, contact Mr. Cees Lambrechtse, Compcontrol B.V., Stratumsedijk 31, Postbus/P.O. Box 193, 5600 AD Eindhoven, Holland. Phone: (31) 40-124955.

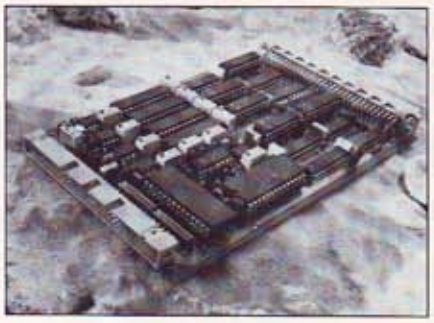
STEbus Products from Arcom

New STEbus Ethernet and ADC/DAC boards are now available from Arcom Control Systems, Ltd. (Cambridge, England).

Arcom's **SETHER** board provides an Ethernet interface for STEbus. In addition, Arcom has developed a port for the board to OS-9/Internet. The board is designed for optimum performance in real-time automation and employs dual-port RAM buffering, selectable for 8K or 32K. SETHER supports both thick-wire and thin-wire (Ethernet and Cheapernet) standards with data-rates up to 10M/sec.

Arcom's 14-bit ADC/DAC STEbus board, the **SDAD8414**, can scan as many as 128 input channels at 90 ksamples/sec. from a single STEbus slot. The SDAD8414 is built around a state-of-the-art 14-bit A/D convertor and features link-selectable input ranges for 5 or 10V, and unipolar or bipolar signals. Four analog outputs are provided by four 14-bit D/A converters with ranges of 0 to +5V or +10V, and -5 to +5V.

For more information, contact Paul Cuthbert, Arcom Control Systems, Ltd., Units 8-10 Clifton Road, Cambridge CB1 4WH, England. Phone: (44) 223 411200.



SDAD8414 from Arcom.

FlexeLint Version 4.0 Now Available

Gimpel Software announces the release of **FlexeLint Version 4.0**. FlexeLint (formerly Generic Lint) is a C source code analysis tool that analyzes C programs and reports on bugs and inconsistencies. Version 4.0 has more than 70 new diagnostics including checks for compile-time objects such as macros, typedefs and declarations. This version also has 30 new options and improved error messages that provide more detailed information than previous versions.

Gimpel also offers **The C Shroud**, a source code obfuscation tool for the C programming language. The C Shroud allows for distribution of C programs in an encoded format.

For more information, contact Gimpel Software, 3207 Hogarth Lane, Collegeville, Pennsylvania 19426. Phone: (215) 584-4261. MSC

New Employees at Microware

Allan Kirkhart joins Microware as a technical support engineer. Previously, Allan provided UNIX technical support for NCR Corporation (Dayton,Ohio). He holds a Bachelor of Science in computer science and math from Buena Vista College (Storm Lake, Iowa) and is working on his Masters in computer science from Iowa State University (Ames, Iowa). In his spare time, Allan enjoys leathercraft and bicycling.

Barbara Gordon is the new voice of Microware's "Hotline", working as the technical support "Hotline" receptionist. Before coming to Microware, Barb was the credit card coordinator for First Iowa Community Credit Union (Des Moines, Iowa), as well as a loan officer. Barb is working toward her Bachelor of Science degree in computer science from Simpson College (Indianola, Iowa) and enjoys cooking and camping.

Microware's newest technical writer is *Debbie Baier*. Debbie comes to us from National Traveler's Life Company (Des Moines), where she was the systems and compliance coordinator. Debbie holds an Associates degree in computer programming and liberal arts from Des Moines Area Community College. She enjoys gardening, reading and bicycling.

Steve Vickery comes to Microware as marketing and sales director for CD-I Publishing Services. Before joining Microware, Steve was a producer and sales representative for Busby Productions (Des Moines). Steve holds a Bachelor of Arts degree in journalism and mass communication from Drake University (Des Moines). In his spare time, he enjoys music and sailing.

Patty Smith joins Microware's production department as a production assistant. Previously, Patty was warehouse foreman for Diamond Crystal Speciality Foods (Des Moines). She enjoys gardening, sewing and cooking.

Jana Hibbs spent the summer at Microware as a student intern in the product integration department. Jana is a student at Iowa State University where she will graduate next year with a Bachelor of Science degree in computer science. Last spring, she was a co-op student with COMSAT Labs (Clarksburg, Maryland). She enjoys water skiing and swimming. MSC

Front row (left to right): Patty Smith, Barbara Gordon and Jana Hibbs.
Back row: Allan Kirkhart, Cheri Warden, Steve Vickery and Debbie Baier.

Western Regional Office Moves to New Location

MICROWARE'S WESTERN REGIONAL Office (Santa Clara, California) has just moved to a new location in Santa Clara. In addition to the move, the office has a new manager.

The Western Regional Office's new quarters provide almost double the available space over the previous location. The move was made so the branch could better serve the needs of West Coast customers.

Mike Burgher has assumed the position of manager for the Western Regional Office. Mike previously was the office's technical manager. *Drew Crane*, former Western Regional Office manager, has moved to corporate headquarters in Des Moines and holds the title of strategic marketing manager.

The courtyard of Santa Clara's Gateway Place, the new home to Microware's Western Regional Office.

Microware's Western Regional Office can be contacted at:

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