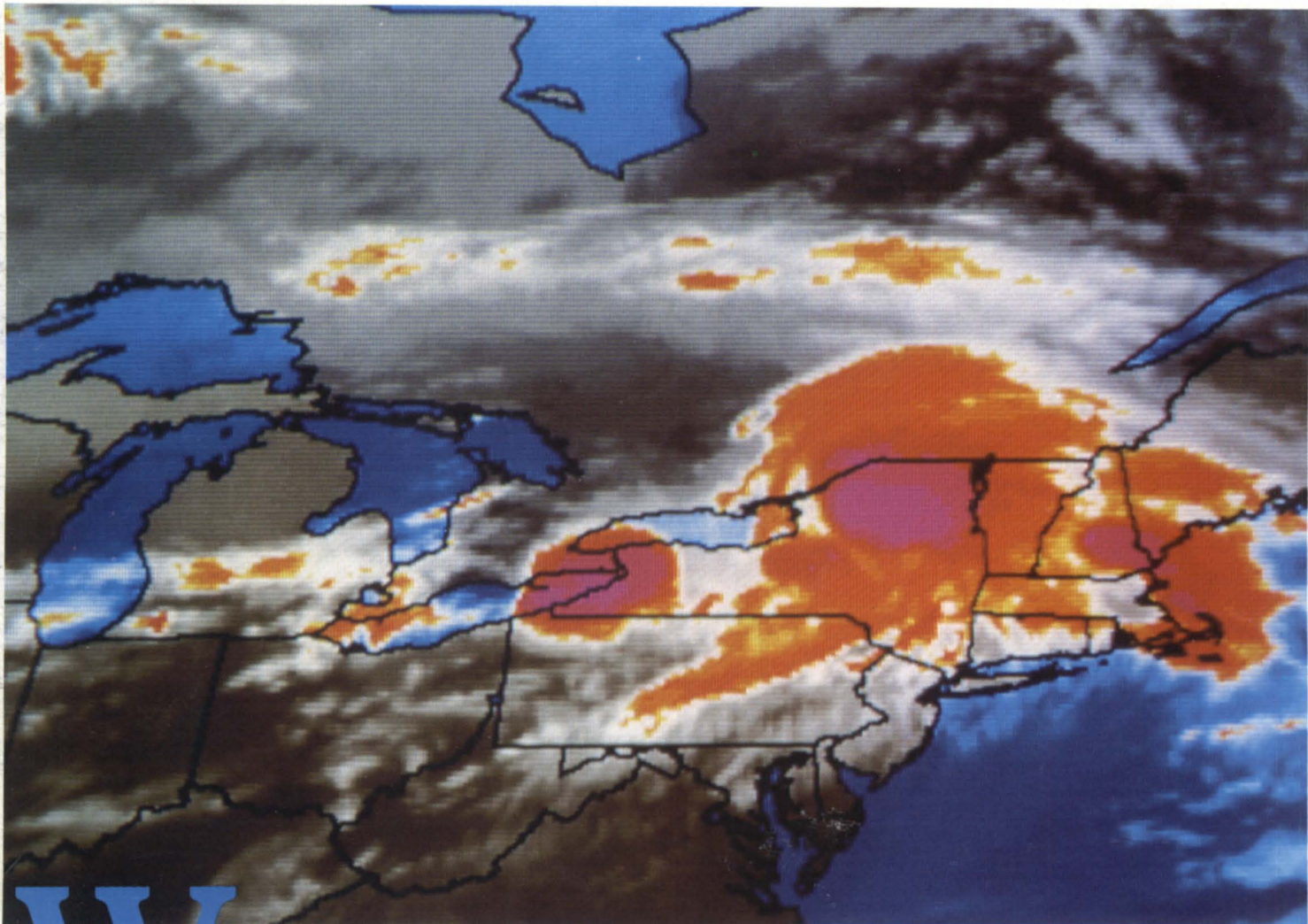


August 1987

FOCUS

The Magazine of the North American Data General Users Group

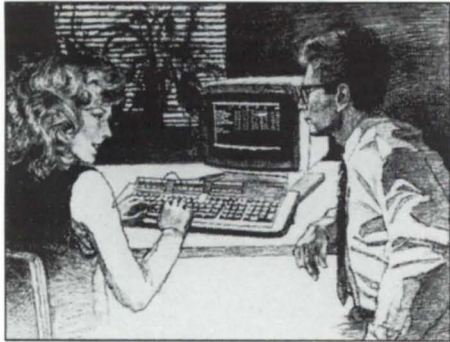


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WordPerfect Corporation (WPCORP) is now offering an annual Software Subscription Service for its products which run on Data General's AOS/VS computers. This service entitles subscribers to ongoing

updates, enhancements, and bug fixes for one charge. It is a particularly good investment in view of WPCORP's focus on product development and support for DG machines.

Update on the way

Arn Perkins, Manager of Product Development for WPCORP's DG division, notes a new version is well underway and is slated for release in September. The 32-bit update will include an extensive thesaurus, as well as on-screen columns, a concordance feature, the ability to add non-printing comments, a document summary, expanded list files capabilities, and substantial improvements in product speed.

But it doesn't pay to wait. DG customers who buy WordPerfect now and sign up for the annual Subscription Service will receive all updates at no extra charge for that year.

Agreement signed

An independent software vendors agreement has recently been

signed between Data General and WPCORP. This agreement applies to DG's AOS/VS operating system for its Eclipse MV minicomputers and also to MS-DOS for its IBM PC-compatible units.

It will not affect any other agreements WPCORP has with its DG OEM resellers.

Growing Popularity

In line with WPCORP's commitment to DG, Guy Pribyl, formerly a regional marketing manager in California, has been transferred to the corporate headquarters as Marketing Manager of WPCORP's DG division.

WordPerfect products have consistently achieved impressive sales performance in the Data General market. Guy attributes a great deal of WPCORP's PC success to the popularity of its products for the DG. WordPerfect now controls 30% of the market share for the IBM PC and compatibles, roughly twice that of its closest competitor.

Sales Manager Judy Hopkins reports that considerable interest on the part of DG resellers has substantially augmented the DG resellers list. WPCORP is still seeking qualified resellers. To sign up, contact Judy at (801) 227-4115.

File Compatibility

WordPerfect users can transfer WordPerfect files from the PC to a DG computer and back again, with no conversion software

necessary. This cross-over compatibility has led an increasing number of large government and industrial accounts to choose WordPerfect, including EF Hutton, the New York State Assembly, and the Federal Department of Justice.

The Justice Department's Civil Division, which acts as defense counsel for almost 200 federal agencies, has made WordPerfect an integral part of its automated management information system, AMICUS II. This system is comprised of 1,400 work stations consisting of various PCs, printers, and minicomputers, scattered across the United States.

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NEW FACES AND OLD FRIENDS

NADGUG needs both

by Calvin Durden
NADGUG President



I expect to see a lot of new faces in Las Vegas. That's a pretty safe bet because every NADGUG conference seems to draw a lot of new members—as well as a lot of old friends. However, when the NADGUG Executive Board first decided to hold Conference 87 in Las Vegas, several members said it would never fly. They were worried that sensible companies and agencies wouldn't pay to send their employees to a venue better known for gambling and glitter than for conducting business.

Their concern was reasonable, and no doubt, there are some companies that won't send their users to Conference 87. On the other hand, I see more and more evidence that attendance will be better than ever. There was an incredible response to our call for papers and exhibitors, and the agenda and the exhibit hall are already overflowing. Conference registration packets were mailed recently, and the early returns look very good indeed.

But back to those new faces . . .

NADGUG is blessed with an active and energetic group of volunteers. If you have been following the "Roundup" articles in *Focus*, you're probably aware of the large number of regional interest groups that are forming all the time. This is a strong channel for bringing in new leadership to the national group.

NADGUG made a wise decision a few years ago to help RIGs and SIGs meet the expenses of sending someone to represent them at meetings of the Executive Board. It's been wise for two reasons: first, it makes us more of a grass roots organization with lots of

input from members, and second, it makes it easier for people who are already active in a RIG or SIG to get involved in the national organization. Many of these RIG/SIG reps come as new faces, but come back as old friends. Even better, many volunteer to help out on one of the NADGUG committees.

Being relatively rich in volunteers, NADGUG was able to establish another precedent that has proved to be very good for the organization. We try to keep moving people around into new positions. That way they get a chance to try different things, and the jobs don't get identified with just one person. This helps build continuity because the committees develop their own policies and procedures, rather than depending too heavily on the talents of just a few people. And with the frequent changes in committee positions, our volunteers get a chance to show what they can do in a lot of areas. Those who show initiative in a couple of different positions are likely to become officers if they don't watch out!

NADGUG has benefited greatly from making it easy for people to get involved. That being the case, I want to emphasize again that the welcome mat is out. We hope every RIG and SIG will send at least one representative to Las Vegas—even if it means we have to find a bigger room to meet in. (With more than 40 people at the spring meeting of the Executive Board, it was getting a little crowded.) Even if you're not active in a RIG or SIG, we'd like to have you drop in. Be advised though—new faces have a way of turning into old friends.

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Contributors:

Nicholas Benwell

Thomas C. Johnson

Richard T. Kouzes

Richard A. Lehman

Art Director:

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A LEG TO STAND ON

Users in the UK find little protection in computer purchase contracts

by Nicholas Benwell
Special to Focus

The keynote speaker at the Spring meeting of the UK Data General User Group was Ted Sumbridge, who is known in Europe for his work on Model Conditions of Contract for computer purchase.

Ted formerly served as a purchasing officer for Britain's electricity supply industry, the Central Electricity Generating Board (CEGB). Soon after he started work for the CEGB, he found that when buying specialized equipment on their behalf, it was essential to read the small print. He also found that, despite acting on behalf of one of Britain's biggest employers, and although he was placing contracts that were worth millions of dollars, it was nearly always impossible to get the vendor to modify standard contractual conditions by even a word or two. Even if an oral or written agreement existed between Ted and a salesperson, which both of them agreed was not in line with the standard conditions, it was not enough to get them modified.

"Those are our standard conditions; we can't change them," was the usual reply. When a discrepancy between the deal struck by the salesperson and the standard conditions was pointed out, a second reply was forthcoming: "Don't

worry—we would never apply our standard conditions to the CEGB. We have too much at stake." What, then, is the object of a written contract?

As a result of his frequent and usually abortive attempts to persuade manufacturers to change their conditions of sale, he eventually approached the Institute of Purchasing and Supply (IPS). He asked if they would sponsor the production and publication of computer model conditions in the same way that the professional institutes of most other industries have published model conditions to cover the fields of their associated manufacturing interests.

The IPS asked Ted to form a working party to carry out the task. He was able to recruit a mixture of commercial, technical, and legal members from both the public and private sectors, but there was one vacancy. It was a position reserved for a representative from the manufacturers, who steadfastly refused all invitations to participate.

The objective of the committee was to design model conditions that would be fair and reasonable to both parties. Furthermore, they should be easily read and practiced.

When their report was submitted to the UK's Office of Fair Trading before publication in 1979, they were cleared as "not being registerable." This means that they were considered to be fair and reasonable and produced by an independent professional institute.

It is fair to say that the manufacturers did not welcome the publication of the model conditions, and initial re-

sistance to their use was high. The first successes were between large users and small manufacturers, but slowly the conditions came to be recognised by more manufacturers. They are now widely used in the UK either in their original form or as a basis for a specially negotiated set of conditions. Ted emphasizes that the IPS conditions are model conditions, which means they are intended to be amended to meet the requirements of any particular contract. This distinguishes them from the standard conditions that manufacturers try to insist are unalterable.

At the moment, there is only one manufacturer doing business in the UK that will neither accept the IPS conditions, nor use them as a basis for negotiations. A lot, however, still depends on the value of the contract and the persistence of the customer as manufacturers will not willingly depart from the protection that their own conditions of sale usually provide; it is for customers to insist on their rights.

Data General terms and conditions

Delegates had been listening patiently, but it was clear that what was uppermost in their minds was how did DG stack up? They were sad to hear that Ted considered DG's conditions to embody most of the examples of conditions that he considered detrimental to equitable contracting.

His first impression was that DG's contract provisions were not intended to be read. They were printed on thin paper on the reverse of a quotation, which made it very difficult to see the print clearly. After 40 years of contract-

LETTERS

This letter concerns the "ICOBOL on an IBM PC" [letter] in the [February 1987, "Discoveries" column] of *Focus*. Dan Lapp of CASI asked if there were software products available that would run ICOBOL programs on an IBM PC and develop (compile) Interactive COBOL programs on a PC for execution on a PC. Jim Siegman said that he knew of none.

In response, Data General's Interactive COBOL on MS-DOS is a runtime-

only system initially targeted for the Data General/One, the DG Dasher/One, and the IBM PC-DOS system. Program and data files are compatible across the line of systems. The first revision of this product (1.20) was made available in September 1984.

ICOBOL on MS-DOS is a single user runtime-only system. Users must develop and compile their ICOBOL programs using ICOBOL on AOS/VS, AOS, AOS-WS, RDOS, or DG/RDOS. All program and data files are transportable to the MS-DOS environment using BLAST or CEO Connection.

The current revision of IC/MS-DOS is 1.31. Revision 1.31 will run on 8086-based machines (Desktop Generation Model 10 or 10SP), 8088-based machines (Dasher/One, DG/One, IBM PC/XT), 80286-based machines (Dasher/286, IBM PC/AT), and 80386-based machines.

This product may be used with MS-DOS or PC-DOS revisions 2.00 or greater.

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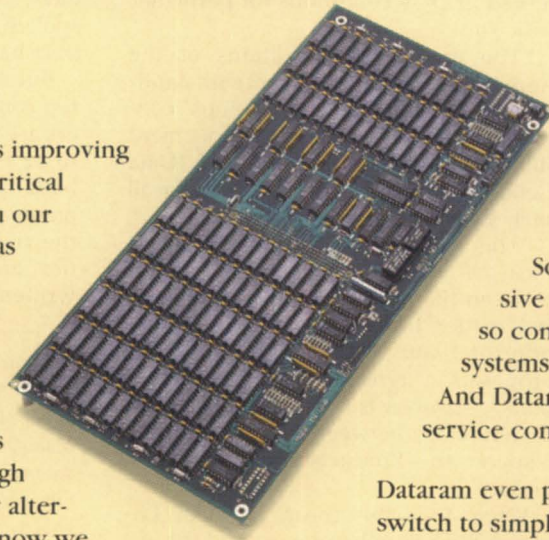
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ing, Ted has grown accustomed to small print, but this was some of the smallest print he had ever seen, he said.

Besides readability, Ted's overriding criticism was that DG's conditions favor DG, and in most areas where decisions have to be made, DG has that unilateral right.

He took the DG contract to task in the following points:

- It contains no guarantee that the hardware will work as intended.
- It puts no restrictions on DG's access to customers' premises.
- It makes no guarantee of delivery by an agreed upon date.
- No variations from the contract terms are allowed.
- There is no provision for the customer to determine tests on completion.
- Its payment terms specify cash with order.
- There is no guarantee that continuing maintenance services will be provided.
- It contains no guarantee that spares

will be available.

- It makes no guarantee that the software will work with the hardware.
- There is no right of the customer to make attachments to the equipment.

Ted picked out general clauses included in DG's conditions for particular criticism:

"The terms and conditions of the Agreement will prevail notwithstanding any variations or additions contained in any order or other document submitted by the Buyer and DGL [Data General Limited] hereby objects to all such variations and additions.

"This Agreement is the complete and exclusive statement of the agreement between the parties relating to the subject matter hereof and supersedes all prior oral and written communication, proposals, agreements, representations, statements, negotiations, and undertakings between the parties with respect to Products ordered here under."

What does this mean in plain English? Ted paused and surveyed the au-

dience (each of whom had signed at least one of these). It means that DGL will resist any alteration to their conditions and is under no legal obligation to observe any of the customer's written specifications or requirements. And, finally, any promise, either written or spoken, made in addition to the contract has no relevance in law.

But then, what is the object of a written contract? Ted's view is that customers are just as entitled as manufacturers to be protected in law. It is about time both customers and manufacturers made a genuine attempt to ensure that the rights and obligations of both parties are properly represented in the written contract. **Δ**

Nicholas Benwell is the newsletter editor for the United Kingdom and Ireland Data General User Group (DGUG) and a professor at the College of Manufacturing of the Cranfield Institute of Technology. This article is based on a talk by Ted Sunbridge presented at the April meeting of the DGUG.

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TRIPLE HEADER

Ohio RIGs cover all the bases

In the past month, three new regional interest groups have been organized in Ohio. Two new RIGs are in the early planning stages, and a former user group is being restarted.

The Northeast Ohio MV User Group, which hasn't met since president Paul Duck left the area several months ago, is being revamped as the Northeast DG User Group through the efforts of Tom Bruns of Lubrizol. Bruns has been making plans with DG representative Mike Dudzinsky. Tentative plans call for an initial kickoff meeting on July 30.

The Northeast area encompasses Cleveland, Akron, and Youngstown. According to Dudzinsky, there are approximately 50 MV users covered in these areas. Although the previous group emphasized 32-bit MV computer users, Bruns wants to include users of all DG equipment. The group will meet on a bimonthly basis.

For more information, call Tom Bruns, 216/943-1200 ext. 3890; or Mike Dudzinsky, 216/459-0990.

About 20 people from the Cincinnati and Dayton area met for an organizational reception and meeting on June 11. The two cities are about an hour apart.

With almost 300 Data General users in the area, there is a great deal of interest in the new organization, according to DG branch manager John Anderson. Data General sent out a mailing to a user base of 210 companies.

The first official meeting is scheduled for August 13, with a planning meeting to be held in July. The RIG will meet bimonthly.

For more information, contact Vince Thomas of Thomas and Thomas at 513/961-5311.

In Columbus, an organizational meeting spearheaded by Raymond Mills of the Online Computer Library Center (OCLC) was held June 18 at the Marriott Hotel. Approximately 36 people attended. After brief introduc-



tions were made and a short presentation given by Tom Bruns, the group decided to postpone the election of officers and the approval of bylaws until their next meeting, scheduled for July 23. It will be held at 6:30 p.m. at the OCLC in Dublin, Ohio (just outside of Columbus).

According to DG systems engineer Kevin Toshok, there is a user base of about 175 companies in the area. He also said they hope to have an occasional function with members of all the user groups in Ohio.

If interested, contact Raymond Mills at 614/764-6000. Δ

Fresh start

Three members of the inactive Northern New England Data General User Group (NNEDGUG) are stirring up the group again. They have scheduled the first meeting for September 21 at 6:30 p.m. at Arthur D. Little Inc. in Burlington, Massachusetts.

Alan Sibert of Dataram, Brad Friedlander of Arthur D. Little, and Tom Harper of NYNEX are getting together a preliminary slate of officers, sending out a letter to scout interest, and calling people on the NADGUG directory list. There are about 50 names on the list, but they hope to reach even more people.

At the kickoff meeting, bylaws and the organizational structure of the group will be established, and Friedlander will give a talk on DG interfaces. They will also send out for pizza.

If you are interested in attending or joining, contact Alan Sibert at 617/890-0071. Δ

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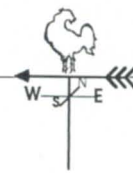
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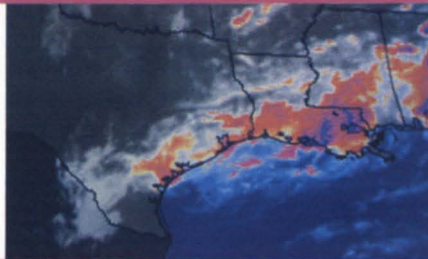
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WEATHER REPORT

Real-time processing under AOS/VS. Well, almost . . .

by Thomas C. Johnson
Special to Focus



This image depicts a long line of thunderstorm cells across the south central region of the United States. It was taken by the GOES East weather satellite on June 10, 1987 at 2100 Greenwich Mean Time (GMT).

Somehow the terms "AOS/VS" and "real-time" don't go together. VS is a multi-user timesharing system with a complete set of tools for business and commercial applications, and real-time belongs with RDOS and RT/32, right?

Not necessarily. With good design and carefully written software, you can do a surprising amount of real-time processing along with your timesharing users. Although AOS/VS was not designed to be a data acquisition system, it has most of the facilities needed to develop respectable real-time applications.

This article describes the function and design of an MV-based system that acquires, processes, and distributes an assortment of weather data and related information. The system is owned by Kavouras, Inc., a Minneapolis company that sells the information to radio and television stations, state agencies, private and corporate aviators, commercial airlines, and other end-users. Clients receive it in a number of ways, including asynchronous dial-up timesharing, dedicated phone lines, packet switched and messaging networks, and communications satellites.

Most of the acquisition and processing of the raw data is done in real-time or "almost" real-time because of the time sensitivity of the data. Clients of Kavouras expect their weather information to be absolutely current, so the data has to be processed and made available as rapidly as possible. This differs from some real-time applications in which acquisition is done in real-time, but processing occurs later in an off-line program.

Real-time means different things to different people. In this article, I define it as the exchange of information, usually in fairly high volumes, between a computer and outside sources that cannot "wait" on the computer. In most cases, the outside sources are other

electronic devices. I use the term "almost real-time" to describe aspects of system design, sometimes in the form of hardware, that allow short-duration buffering or pre-processing of data prior to transferring it into the processor. These techniques can reduce total system cost and implementation time.

I should mention that because the Kavouras system is very complex, these descriptions are simplified. The entire system actually includes an MV/10000, an MV/8000, four MV/4000s, a CDC mainframe, and an array of peripheral electronic processing equipment, including several microprocessor systems. Because of the need for load balancing and redundancy, different operations are dynamically switched among the different MVs. However, all of the features described in the article can be (and sometimes are) run concurrently on either the MV/8000 or the MV/10000, which I refer to as "the central system."

Several characteristics make this system unique:

- the wide variety of high-volume real-time activities it performs while concurrently supporting customers and developers
- the use of peripheral hardware to build elasticity into the data acquisition sections
- the use of special software design techniques to reduce the overall hardware requirements.

In the following sections I will describe the functions the system performs for its users, its major hardware and software components, and the general design of several of the more interesting software applications.

Data services

The data inputs to the system are:

1. Alphanumeric weather reports such as current weather observations

from offices of the National Weather Service (NWS). This data arrives through four dedicated lines at data rates of 1200 to 4800 baud. There are about 280 different types of reports, received from some 8,000 cities worldwide; they are more or less randomly intermixed in the data streams. Each report type is edited and stored separately.

2. High-resolution graphics images from the Geostationary Orbiting Environmental Satellite (GOES) East and West weather satellites. The images include both visible and infrared graphics data, and are received into 4.5 meter receive-only dishes and amplifying electronics.

3. Monochrome graphic map images, which are produced by other Kavouras computers and by computers at the National Weather Service. The NWS maps, commonly referred to as facsimile maps, or simply fax, are transmitted across the U.S. through dedicated lines or via satellite. The Kavouras images are transmitted along various local communication paths.

4. Color graphic map images produced by Kavouras meteorologists. More than 50 different maps are created, including temperature gradient maps, forecasts, displays of upper-level winds, etc. These images are produced on standalone microprocessor color graphics systems and downloaded to the central system over asynch lines.

The peaks and valleys in the instantaneous data volume are a critical feature of these data types. For example, one of the alphanumeric data circuits carries all reports from all U.S. weather observing stations. These reports aren't spaced evenly around the clock; in fact, every station reports to Washington D.C. five minutes before the hour. Shortly thereafter, all the reports come across the dedicated line in a continuous data stream that lasts about 10 minutes. The total volume of alpha data is about 1 MB per hour, but half of that data arrives in a 10-minute period.

Similarly, each GOES weather satellite creates two images per hour, but the transmission is an 18-minute burst of 320 MB of data. In neither case can the central system request that data be retransmitted. Although external buffering could be employed (and it is to a limited extent), a significant delay in the availability of data to the user isn't acceptable.

Customers can access this data in the

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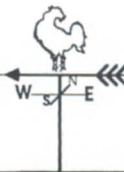
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FOCUS ON: REAL TIME



Weather reports from around the world are received in blocks of ASCII data, each of which contains from 1 to 100 individual reports.

following ways:

1. Dial-up timesharing users can request any alphanumeric report received in the last 24 hours by report type, city, region, route-of-flight, etc. A request typically invokes a program that makes keyed data base lookups.

2. Dial-up timesharing users with certain models of printing terminals can request graphics images of satellite pictures, radar signals, and fax weather maps. These are delivered as gray-scale graphics produced through a "pseudo-half-toning" technique that generates surprisingly usable images on equipment of fairly low resolution (and price). Minnesota and Wisconsin have installed these printing terminals in more than 80 public airports as a service to private and corporate pilots.

3. Dial-up timesharing users with special microprocessor-based graphics systems produced by Kavouras can also have any of the alpha data or the color graphics images downloaded through the phone line.

4. High-volume users of the alphanumeric data can have specific groups of data sent at regular intervals to their computer or standalone printer through dedicated phone lines or messaging networks. Commercial airlines receive enroute weather forecasts for their scheduled flights this way.

5. High-volume users of both graphic and alphanumeric data can downlink data from a commercial communications satellite into special Kavouras microprocessor systems. The data is transmitted continuously from the central system at 56 K baud using a large dish and standard digital satellite transmission electronics. The data stream includes radar, satellite, and weather map images as well as a high volume of alphanumeric data.

System configuration

Figure 1 shows a simplified block diagram of the major components of the system. Most interconnections are

switchable among the various processors to balance loads, allow systems to be brought down for maintenance, etc. The diagram shows the single MV configuration. The other MVs are actually linked by an MCA-based XODIAC network; other processors are linked by asynchronous lines, Ethernet cables, and non-XODIAC X.25 links. Transmission to the satellite uses a synchronous protocol.

Some of the data must be pre-processed by external hardware before it can actually be acquired into the central system. GOES satellite data, for example, is transmitted in a serial data stream that is unique to weather satellites. It must be reformatted and converted several times before it is in a format that is acceptable to a conventional computer interface. Similarly, NWS fax data is sent in a unique serial bit-graphics pattern designed to be input to a special printer. Other electronic interfaces convert this bit stream into a byte format acceptable to the central system.

Alphanumeric data acquisition

Weather reports from around the world are received in blocks of ASCII data, each of which contains from 1 to 100 individual reports. Blocks vary from 20 to 15,000 bytes in length, and are terminated by one of several delimiters.

Incoming data is fed to a small serial "buffer box," which can store up to 64 KB of data. This buffer is included primarily to provide accumulation of data during switchover to backup computers or, in the event of power failure, to the backup power generator. It also provides a degree of elasticity in the data acquisition sequence. If a large number of events occur in the central system simultaneously, the buffer will hold data until the acquisition process can catch up. In practice, the program is never more than 1 KB behind even during peak periods; 1 or 2 bytes is typical.

A ?READ assembly language routine

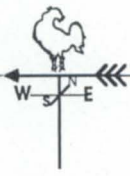
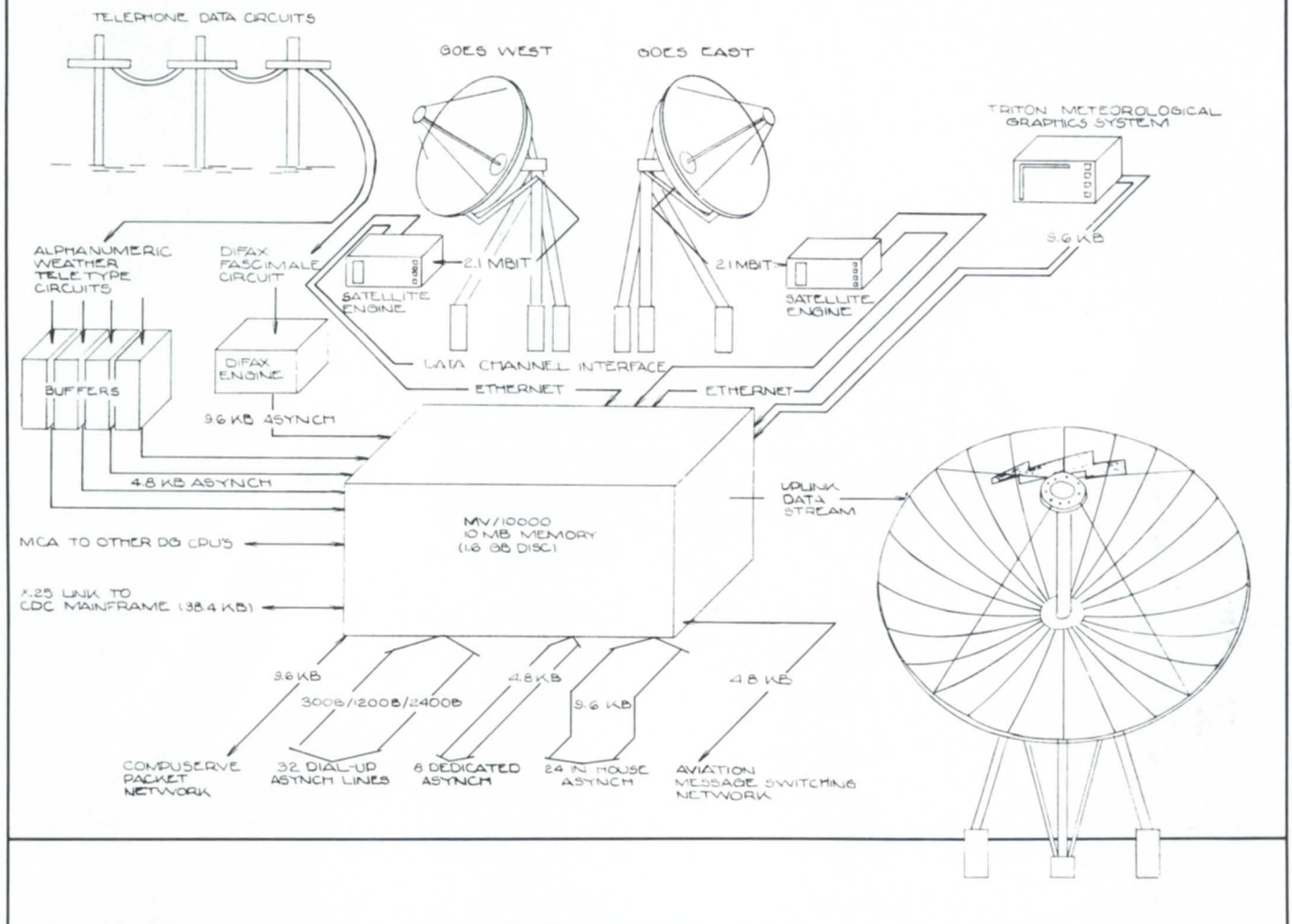


Figure 1



is called from a Fortran 77 program to read in and perform minor translations on a block. The block is then written to a shared sequential file containing all reports for the current hour. There are 24 of these files—one each hour—allowing the system to rebuild the last day's worth of data if necessary. While the first program goes back to read another block, a second program reads the block from the sequential file as soon as it is written.

This program extracts individual reports from the block and calls one of some 300 subroutines (one for each report type) to edit the report as necessary and file it in the master data base. From the data base, records are retransmitted via the satellite uplink. (See satellite retransmission section below.)

This "decoupling" of the data acquisition and editing functions is a critical feature of the design because it builds more elasticity and, thereby, reduces the time-critical components of the processing.

A single program design, even if multitasked, would need to finish editing and filing the reports of the previous block before the block currently being transmitted overran the IAC's input buffer. A second advantage of this method is that, if a power failure should cause data base damage, the second program can be started to reprocess data from just prior to the failure. At the same time, the acquisition program continues to bring in new blocks that accumulated in the buffer boxes.

The data base uses INFOS keys with

partial records, but data records are stored in full disk blocks. Since the report types and cities that report them are known in advance, the INFOS indexes rarely change, and are open for read only. Use of block I/O has proven to be much more efficient than a total INFOS data base design because it reduces the number of disk accesses required to obtain a desired record.

Weather satellite image acquisition

A receiving dish and its associated amplifying electronics are in place for each of the two GOES weather satellites. The East satellite transmits an image of the whole earth on the hour and 30 minutes after the hour; the West satellite does the same at 15 and 45 minutes after the hour. The data is trans-



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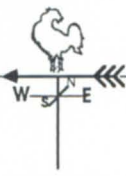
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mitted serially at more than 2 megabits per second and lasts 18 minutes.

Special electronics convert the satellite data from serial to parallel "frames." One frame is a stripe of image across the globe, starting from the North Pole, taken as the satellite spins in space. This is similar in theory to the raster lines that make up a TV picture.

The frames are in turn moved into multiple microprocessor-based systems developed at Kavouras (known as "satellite engines"). These boxes reduce the resolution of the image, which is much higher than can be displayed in video or hardcopy formats.

The satellite engine also decodes satellite navigation and control information used to determine the satellite's position. In theory, geostationary satellites don't move with respect to the earth, but in fact, they do. No satellite orbit is perfect, and the earth itself wobbles and twists all the time. The satellite is constantly navigated by its controllers on earth to keep it in position. The point of view of the image always differs slightly from one image to the next. At the receiving end, the image must be navigated to align it with previous and subsequent images.

There are three engines. The primary engine handles the North American images; another prepares the full earth image from GOES East, and the third receives data from GOES West.

Before it can be used, the raw GOES data must be sectorized—broken into regional images. Satellite images are retransmitted to users serially, as the regional images are completed, from north to south.

Data is transferred serially from the primary engine into the central system over an Ethernet link. The high speed of the Ethernet link allows further processing of the image to begin soon after the raw data is received. Sectorizing of primary images is performed by the MV rather than the engine in the interest of making these images available as quickly as possible. Acquisition in the other engines continues without placing a load on the central system.

Data from the secondary engines is transferred asynchronously. As in the case of the alphanumeric data, the risk of data being dropped because of overruns must be eliminated. In this case, the volume of data is so high that the ?READ system call to a "standard" IAC cannot keep up with the data.

To solve this problem, a program was

The satellite is constantly navigated by its controllers on earth to keep it in position.



written to run in the IAC to read the data in blocks. Data is read into the F77 application on the MV by shared memory transfers from the IAC. Many AOS/V5 users are unaware that an IAC is a separate processor (resembling a small Nova) that runs its own program. Data General supplies a general-purpose program that is loaded into the IAC board at system boot time (if it is gened into the system). This program has many capabilities for reading, writing, and translating data. However, it is designed to handle terminal I/O for multiple processes under the control of PMGR, and isn't efficient enough for high-volume data acquisition. Because this particular application always moves data of a fixed type to a single program, the special IAC program can be designed for maximum throughput.

After the data has been transferred into the central system, it is converted into several image display types. Satellite images are available in 8 and 64 gray-level versions for video display at a resolution of 640 by 480 pixels (or image "dots"); the 8-level version is also converted to a form suitable for printing on a dot matrix hardcopy printer.

Finally, the images are compressed to reduce their size, which also shortens

their transmission time to users. Techniques known as run-length and delta encoding were developed for this purpose. Run-length encoding compresses by counting the number of successive pixels that have the current gray-level or color. Delta compression encodes the change in gray-level or color of the current pixel from the previous one.

The central system software also performs contrast enhancement and colorization for images to be used in color video display. Completed images are then stored on disk and sent to the satellite uplink. (See satellite retransmission section below.)

A purist wouldn't consider this a true real-time data acquisition since the data is buffered before it gets to the central system. Again, there are multiple advantages to the almost real-time approach. First, although an MV can handle an incoming data rate of 2 megabits per second (with some help from peripheral hardware), it certainly can't process it, store it to disk, and continue to support 50 or more other processes.

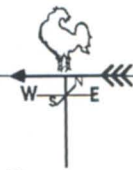
Second, use of the engines allows the central system to begin preparing Northern Hemisphere images even before the satellite completes its total sweep. This makes the high-priority graphics available to users faster. Third, the engines serve as an accumulator of data if the central system were to fail for some reason. It is less costly to provide uninterruptible power to an 8-bit micro than to four heavily loaded MVs.

Facsimile map acquisition

Fax maps are received from three sources: the NWS dedicated fax circuits, other Kavouras mainframes, and specially designed in-house color graphics workstations.

NWS and mainframe fax maps are black and white line drawings. Those from the NWS are accumulated, converted from a serial bit stream to a byte stream of graphics commands suitable for dot matrix printers, stored, and uplinked. Those from the mainframes are received through a non-XODIAC X.25 link, processed for inclusion in both video and hardcopy displays, stored, and uplinked. The total fax data volume is about 1.3 MB per hour.

Color fax maps are being continuously prepared by meteorologists on microprocessor systems. The completed images are transmitted through asynch lines to the central system where they are stored and uplinked.



Satellite retransmission

Most of the data that is processed or generated elsewhere in the system is transmitted to the communications satellite in a process called the uplink. Kavouras makes available to its customers small receive-only earth dishes that receive this data into a microprocessor-based communications subsystem called a downlink. Any downlinked data can be transferred to the graphics system for viewing, printing, or rebroadcasting.

Data is uplinked directly from the central system in real-time at 56 K baud using a proprietary synchronous protocol. Although DG offers a number of synchronous software packages, none are efficient enough to generate continuous output at this speed in a multi-user environment.

These packages are also designed for bi-directional rather than broadcast communication. The approach to this problem was to again build a program to run in the controller itself, in this

Color fax maps are being continuously prepared by meteorologists on microprocessor systems.

case a DCU or ISC, and to transfer data from the application to the controller via shared memory. This is a multitask program that reads the filenames of image and alphanumeric data files from a list that is being continuously updated by other acquisition programs. The

contents of these files are read into the transfer buffers via block I/O system calls. The synchronous controller writes data to the transmitter from one large buffer while the application is filling another from disk. This approach produces continuous output while using less than 5 percent of the horsepower of an MV/8000.

Philosophy of real-time data acquisition

Actually, there is no such thing as true real-time data processing. No matter how fast your machine, you cannot move even a single data bit from an input port to anywhere else in 0 nanoseconds. Computers have finite cycle times and do their work sequentially. Merely bringing data into a controller board or CPU accumulator is never the goal: something must be done with the data before you can consider it to be "acquired." This may include storage, processing, and/or retransmission. These operations take time. Therefore,

No time like real-time

by Thomas C. Johnson
Special to Focus

Knowledgeable users who see the Kavouras system in action are quite surprised that a single MV processor can handle the load without running out of steam. Needless to say, it was not always this efficient.

The initial effort was to design a single program to read in and file data from one 1200 baud asynch circuit. A system was produced that worked, but it ate 75 percent of the MV/8000's capacity. Subsequent refinements were achieved through a painful process of trial and error; many intermediate designs were scrapped after significant investments of time. Those who were familiar with the real-time world quickly found the limits of their knowledge. Engineers, meteorologists, and programmers were pressed into the ranks of real-time development, despite their best efforts to avoid it.

This is how a great many real-time systems (and systems developers) are born. My first DG computer program was a simple transfer of parallel 16-bit data into a Nova 3 running DOS. I spoke Fortran fairly well, but was a bit baffled when I couldn't find the "Read-From-Parallel-Port" routine in the DG manuals. After their laughter died

down, my friendly local sales and systems engineers explained that I would need to write a multitasking program that called an assembly language interrupt service routine.

Several sleepless weeks, 100 programs, and 99 failures later, I finally got it to work. I even understood what I was doing. I believe that no amount of training and reading substitute for hands-on experience when learning real-time design. The learning experience of making mistakes is invaluable.

This brings me to a few philosophical points about how to embark on a real-time project:

1. Be prepared to learn about your software tools through trial and error. This means considerably more than reading the manuals. You can memorize the *AOS/VS System Call Dictionary*, but it won't help you design a data channel device driver.

2. Don't use the I/O statements of high-level languages to move data in real-time. Learn how to use system calls.

3. Bite the bullet and learn at least a little assembly language; you'll be amazed at the power of some of the MV

instructions, especially in the handling of character and floating-point data.

4. On the other hand, don't use assembler and other low-level techniques if high-level language support exists. You'll have a hard time writing more efficient math routines than the ones in F77.

5. Recognize that vendor-supplied utilities are excellent general-purpose tools, but they may not be adequate in a real-time application. Smart controller drivers for communications boards, and utilities for data bases and networks are notable in this regard.

6. Learn everything you can about intertask and interprogram communication before you start coding. The differences among IPCs, signals, pipes, and shared page communication can dictate success or failure all by themselves. If you start a multiprogram or multitask real-time application without completely thinking through the communication design, you'll probably have to start over after 80 percent of your coding is complete.

7. Be prepared to learn about your hardware. Practically all real-time applications deal with the world outside of the computer, which means some sort of electronic interface will be in place, even if it's only a simple asynch line. In general, DG hardware is excellent gear, with many capabilities you



Peaks and valleys in the momentary data volumes are so extreme that the worst-case capacity requirements may be more than 10 times the average load.

knowing how much delay your application can tolerate is a basic question for designing a real-time system.

Recognizing that there is no such thing as "true" real-time, the Kavouras system was built around an "almost real-time" philosophy that significantly reduced the design requirements of the system. Our reasoning went like this:

1. Data being acquired cannot be dropped for *any* reason; completeness of data is critical in the weather business. Murphy's law teaches us that if a

single weather report is dropped, it will surely be a tornado observation at the Los Angeles airport, or something equally embarrassing.

2. The computer must never fall behind. A system that supports multiple concurrent real-time operations must have enough capacity to ensure that, even in worst-case conditions, it will always be slightly ahead of the data it is acquiring.

3. In this application, peaks and valleys in the momentary data volumes are

won't know about unless you investigate.

8. If you're going to be working with really high-speed data, check out the general-purpose boards for data channel and burst mux transfers. They are relatively inexpensive, and work as advertised. You'll have to ask your salesperson to hunt for product information.

9. If high-speed communication is required, learn more about DG's smart communications controllers. The hardware and programming manuals you receive with your IAC or ISC are not DG's way of trying to baffle you with excess information: they're valuable tools for learning how to get the most out of your hardware.

10. If you're not a digital engineer, you'll probably need to find one, preferably one who knows about software. A data channel schematic makes perfect sense to an engineer; to us software types, it's a little like 50 RS-232 connections that have run amuck at a zillion baud.

11. Don't be reluctant to make use of specialized external hardware. Operations like protocol conversion, analog data processing, data reduction, and the like can be performed rapidly in dedicated external boxes. They can often be done in software, but the overhead is usually high.

12. Make sure you have a spare ma-

chine. Real-time programs tend to dominate the CPU. Untested applications that do I/O to and from smart controllers, data channel, and burst mux devices wreak havoc on other processes, including AOS/VS, with their annoying habit of writing into the wrong memory pages. Usually this can be fixed only by resetting the processor and rebooting VS, an action that will make you unpopular among users who may be on the system.

13. Don't be afraid to ask for help. Since many real-time applications are unique, developers tend to feel they are alone in a confusing world. This is not the case. There are a number of system builders who have gone through the real-time school of hard knocks, and they are usually willing to share their tips and techniques. A good hint can save you weeks or months—but you have to ask around.

14. Set realistic schedules. The tongue-in-cheek rule for estimating software development time is to make a worst-case estimate, then double it. For real-time applications, this is hopelessly inadequate unless you've been doing it for 10 years. Most project estimations come down to someone with experience making a mental guess of how long it will take to design and test a piece of code. In the real-time world, distinguishing the easy work from the

so extreme that the worst-case capacity requirement may be more than 10 times the average load.

4. Therefore, the system designer has two choices: buy 10 times the computer capacity in order to handle a peak load that may occur only once a month, or build elasticity into the acquisition techniques to eliminate the possibility of dropped data. The decision is obvious for any cost-conscious system designer. Δ

Tom Johnson is CEO of Riacor Consulting Inc., a firm that specializes in custom software development for DG machines and PCs. He was formerly the vice president of System Development at Kavouras, Inc. Contact him at 9001 E. Bloomington Freeway, Bloomington, MN 55420; 612/884-1605.

The author would like to thank Kavouras, Inc. and James Block, vice president of Systems Development, for their help in preparing this article.

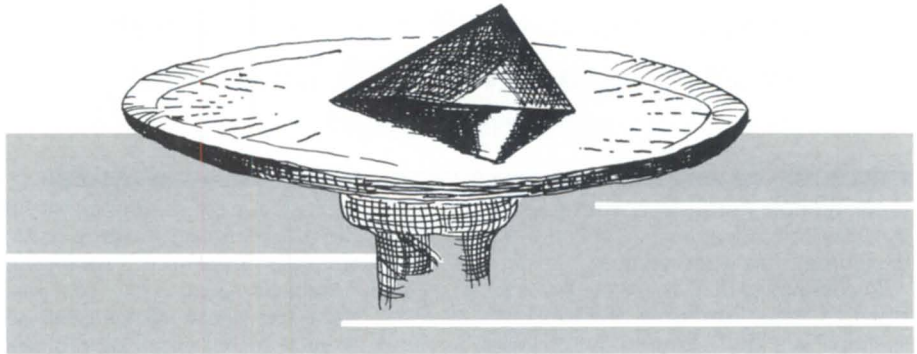
difficult is a challenge. If you can't tell the two apart, increase your estimate.

15. Prepare yourself for frustration. Murphy resides in the computer world, and his favorite room is surely inside your real-time application. There will be many days when the only progress will be of the one-step-forward, two-steps-backward variety. Being prepared for this is important, especially when there are many people working on the same project. Frayed nerves and short tempers can be avoided if everyone accepts in advance the pitfalls that are always encountered in this type of project. You can bypass some of the pitfalls with careful design planning, but you'll never eliminate them.

If you've gotten the impression that doing real-time work means you have to go through a lot of up-front preparation and planning, then I've done my job in this article. Although this is good practice for any software development, it is critical in real-time work. No amount of planning will eliminate all the problems, but in my opinion, there's no such thing as too much advance work. Time spent in careful design invariably pays off in shortened development and testing cycles and always reduces the frequency with which work has to be redone. It can also turn a seemingly impossible project into a fun time for all. Well, almost . . . Δ

What is real-time?

And what role can Ada play in producing real-time systems?



by Richard A. Lehman
Special to Focus

If you visited 10 different system managers and asked each one to describe the meaning of "real-time," you would probably get 10 different responses. It seems that everyone has their own definition.

You may not know it, but many daily situations involve real-time applications. For example, if you dropped by the local catalog store and submitted an order for a camera, the order entry system could be considered real-time.

The next time you visit your favorite car dealer, you will probably wait in the back office while a nice salesperson types into the real-time order entry system. Also, think about how many airline trips you've taken in the last decade. Every time you made reservations via telephone or through a travel agent, your ticket selection was handled by the airline's real-time reservation system. So again, what is real-time?

Within the space shuttle system, real-time is defined as events that occur within 40 msec. A lot of things can occur in 1 second either during a launch or during the operation of a space station in orbit.

Where does Ada come into play when we talk about real-time systems? Ada has been mandated for use in the U.S. Department of Defense's mission-critical computer systems. Because of its unique attributes, Ada has also been selected as the language of choice for space station software. Many of the subsystems within the space station will operate in a real-time or a near real-time domain.

Ada is appropriate for real-time processing because it supports items such as concurrent processing, exception handling, host-to-target systems support, and machine representation specifications. How many other languages do that?

What is concurrent processing?

Multitasking is not new to AOS/VS. For a real-time system to support concurrent processing, system-defined interface structures must be developed and supported. With Ada, a program unit can consist of one or more tasks as defined by the *Ada Language Reference Manual*.

Real-time systems may have to process a number of different activities concurrently. Ada provides parallel threads of control for concurrent processing, and can be used for concurrent actions and controlling resources in a real-time environment. Ada tasking provides for direct mapping of real-time designs to the language, so the system designer doesn't have to introduce complex data structures and additional code often associated with other sequential languages.

This means that program constructs can be mapped directly to real world applications. For example, one task can be allocated to monitor inputs from several sensors and another task assigned to control effectors or output devices. Both of these tasks run within the scope of a single Ada program running on one or more physical CPUs.

Concurrent programming constructs in Ada communicate through the use of the rendezvous statement. A rendezvous is like an AOS/VS mailbox or an IPC. The major difference is that mul-

tiples parameters may be passed from one task to another as defined within their specifications. A rendezvous can also be used to synchronize two tasks when one is dependent on another.

Exceptions

In the Ada language, an unexpected error is called an exception. Exceptions are similar to BASIC "ON ERROR" statements or PL/I "conditions." Remember our visit to the catalog store to buy a camera. If you decide to pay with a credit card, the salesperson will place a call to determine if you are good for the amount of the purchase. On the other end of the phone line, something like this is executing:

```
IF Current_Balance + Camera_Amount >
  Credit_Limit
  Then NO_CAMERA!
```

This is an exception to your credit limit. With Ada, we can define those conditions that can occur:

```
CreditLimitExceeded : Exception;
CreditLimit : CONSTANT
  REAL := 1_000.00;
```

```
Current_Balance := Current_Balance + Purchase;
```

```
.
```

```
.
```

```
.
```

```
Exception
```

```
When CreditLimitExceeded = )
```

```
  Put ("Grab the sucker's credit card!!!");
```

```
When Others = )
```

```
  Put ("Something else wrong . . .");
```

This isn't the best example of how to

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use the exception in Ada, but it gives an idea of how they work. These unexpected situations can include `Numeric_Error`, `Storage_Error`, `Constraint_Error`, or any `User_Defined_Error` such as `Credit_Limit_Exceeded` as well as others. A `Constraint_Error` corresponds to a variable going out of range. For example, pressure within a payload container may exceed the maximum measurable range (e.g., 5,000 psi). With Ada, a derived type can be defined with a range of 0 to 5,000.

```
Type Payload_Pressure is delta 0.25 range
  0.0 .. 5000.0;
```

With this constraint placed on the variable used to receive a value from a sensor, the `Constraint_Error` exception will be raised whenever an algorithm attempts to store a value outside this range. A `Numeric_Error` will be raised whenever an arithmetic error occurs such as a divide by zero.

Ada defines an exception as a halt to sequential execution when a particular condition is reached and a transfer of control to some known memory locations where the condition may be handled. This allows the builder of a real-time system to provide fault tolerance as well as a planned reaction to any condition.

```
Current_Balance := Current_Balance + Purchase;
```

```

.
.
.
Exception
```

```
When Credit_Limit_Exceeded = )
  Restore_Current_Balance( );
  Put ("Would you like a smaller camera?");
  Wait_For_Customer_Response( );
```

```
When Others = )
  Put ("Call the Manager . . . ");
```

As you can see, any kind of correcting logic can be executed within the exception processing. For example, if during a boost phase of a rocket, one of the engines shuts down because of a `Temperature_High_Alarm` exception, the software can check if this is the last engine running. During the execution of this exception, the software can check if this is the last engine running. If so, it can query a flight controller because she may want to ignore the sensor (i.e., maybe the sensor is bad, not the engine).

Right on target

Many real-time systems run in a tar-

get or embedded processor. A programming language for the space station must support both development systems (the host) and a target system. Ada code was designed to be *developed* on one physical machine (such as a large MV Eclipse) but to *run* on a target machine (e.g., a 1750A microprocessor) that doesn't have the same address space and peripherals as the host.

Many of the Ada software tools support host-to-target configurations. On the host machine, the Ada source code is developed into Ada Libraries, but the Ada code can be targeted to a different processor than the host. When the Ada Loader/Linker is invoked, a target processor can be specified. The Ada Loader/Linker will extract from the Ada Runtime Library the necessary code to support a bare-bones software environment within the selected target processor.

If one target processor is only required to do a simple function (for example, a device queuing/buffer), only the Ada software drivers needed to operate the communications devices will be extracted from the Runtime Library. This code is included within the target build. If the Ada program is a multi-tasking program, the Ada Runtime Library will include a Kernel Runtime Scheduler as well. The host-to-target tools can configure an Ada process to run on top of a bare-bones microprocessor.

Machine representation specifications

Machine representation specifications are necessary when a function is only possible with hardware. To support a real-time system, the data structure may contain representations that require manipulation at the bit level. Ada provides features for exploiting underlying hardware features without leaving the high order language.

Machine representation specifications can allow for more efficient use of the underlying hardware by mapping abstract data to physical hardware, by building physical representation of values, by controlling storage through specifying the amount of storage associated with an object, and by overriding the amount of storage normally associated with an object. For example:

```
Type MACHINE_WORD is range 0 .. 1023;
For MACHINE_WORD SIZE use 10;
```

would tell our compiler to use 10 bits for the data type `MACHINE_WORD` which has the range 0 to 1,023. We can also

control the location by specifying a required storage address for an object.

```
Type REGISTER is range 0 .. 15;
Type OPCODE is (ADD, SUB, MOV);
Type MACHINE_INSTRUCTION is
```

```
Record
  CODE : OPCODE;
  R1 : REGISTER;
  R2 : REGISTER;
end Record;
```

```
For MACHINE_INSTRUCTION Use
```

```
Record at mod 2;
  CODE at 0 range 0 .. 7;
  R1 at 1 range 0 .. 3;
  R2 at 1 range 4 .. 7;
End Record;
```

The "at mod 2" tells the Ada compiler to align on a double byte boundary. By using variations of this, the software structures can be directly mapped to specific hardware. Actual machine code or assembly language code can be inserted into the Ada program using Ada statements when it is necessary to gain the required efficiency.

Ada is more than just another programming language. This language provides many powerful constructs to support real-time programming. Developed to be used in all Department of Defense embedded computer systems, Ada represents an environment and supports modern software engineering principles and methodologies.

Besides the basic Ada compiler and Ada Loader/Linker, the Ada Programming Support Environment (APSE) includes many tools to support real-time software systems throughout their life cycle, from requirements analysis to maintenance and enhancement.

According to the Stoneman document (Department of Defense, 1980), the APSE was designed as an entire programming support environment for embedded (real-time target) systems; it provides all necessary program development and support tools. Real-time software systems need these capabilities, and Ada is a cost-effective solution. Δ

Richard A. Lehman is the Ada task manager for the Avionics Systems Department with Lockheed Engineering Management and Services Co., which provides Ada research assistance to the NASA Avionics Systems Division at Johnson Space Center. He can be reached at MC-CO7A, 2400 NASA Rd. 1, Houston, TX 77058; 713/483-8329.

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by Richard T. Kouzes
 Special to Focus

Standards, whether endorsed by an international organization or simply accepted as general practice, provide a basis for the efficient operation of many aspects of the computer industry. In real-time applications, standards help make possible the integration of components from diverse sources into operational systems.

The definition of real-time depends on the application, ranging from "faster than a human" to nanosecond response times. In the scientific data collection and control applications I will discuss, real-time is typically measured in microseconds. How do you get a computer, which may take a microsecond to add two numbers, to respond on such a short time scale? The solution requires the use of specialized front-end hardware, distributed intelligence, large I/O bandwidth, and well-written software.

There are a number of data acquisition options on Data General computers, including support for recognized standards, with products manufactured by Data General or from specialized vendors. You may not discover these options from Data General salespeople so I will discuss several of them here.

Standards

How does an instrumentation technique become a standard? The American National Standards Institute (ANSI), a nonprofit organization of trade associations, professional societies, and companies, is the clearinghouse for voluntary standards in the United States.

One of its member societies, the Institute of Electrical and Electronics Engineers (IEEE), has initiated standards such as GPIB (General-Purpose Interface Bus) and CAMAC (Computer-Aided Measurement and Control). Another ANSI member, the Electronic Industries Association (EIA) has brought us such favorites as RS-232 and RS-422. (By the way, the RS comes from the original name for EIA, which was Radio Electronics and Television Manufacturers Association (RETMA), and stood for RETMA Standard.)

ANSI is a member of the International Standards Organization (ISO), which is a member of the International Telecommunications Union (ITU), an agency of the United Nations. Some standards are formulated, documented, and pushed through the process by members of professional organizations, such as the IEEE, who are solving their specific needs. For example, CAMAC originated in the physics laboratory. Other standards originate in private industry and only become official standards long after they are accepted as de facto standards.

The bus

A real-time system usually consists of signal sources, front-end analog or digital hardware, some form of communications bus, and a host computer. The bus (or buses) used in a system often define the rest of the system components. We

can divide buses into computer buses and instrumentation buses, though any one bus may have applications in both areas.

Most buses have originated from vendors, while a few have been drawn up by standards organizations. Figure 1 gives some of the properties of these buses, including important serial buses. The values given for the approximate maximum speed (in MB/sec) are indicative of the capabilities of the bus, but true bus performance is usually significantly below this theoretical maximum. For example, the GPIB bus is capable of 1 MB/sec, whereas Data General's version of the GPIB board has a maximum speed of only 125 KB/sec. The size shown is the number of data lines in the largest bus component.

Figure 1

Bus	Vendor or standard	Speed	Size
UNIBUS	DEC	2	16
QBUS	DEC	1.6	16
BI	DEC	13	32
VME	Motorola	50	32
Multibus I & II	Intel (IEEE P796)	10	32
S-100	Altair (IEEE P696)	3	16
IBM/PC	IBM	1	8
NuBus	Texas Instruments	40	32
Futurebus	IEEE P896	40	32
GPIB	HP (IEEE 488)	1	8
FASTBUS	IEEE 960	40	32
CAMAC	IEEE 583	3	24
Ethernet	IEEE 802.3	1	1
RS232	EIA RS232	0.002	1
RS422	EIA RS422	0.2	1

Choices

When choosing a bus for assembling a real-time data acquisition system, there are a number of parameters to consider beyond raw speed. These include the distance limitations, the maximum number of instruments to be attached, the selection of commercial modules available, the noise immunity, and the software overhead. One advantage of using a standard bus and the associated modules instead of a single vendor's proprietary system is the availability of a variety of tested modules from multiple sources.

The four standards most relevant to high-speed data acquisition systems are: VME, GPIB, FASTBUS, and CAMAC.

VME is a modular, 32-bit computer bus especially useful for standalone systems or systems requiring integral microcomputers and memory, in addition to the data acquisition modules. Many vendors provide modules for this standard, which is very economical. Connections between a VME bus and other computers can be made in a variety of ways including RS-232, GPIB, Ethernet, and direct interfaces. I expect Data General to come out with a direct VME interface in the near future.

GPIB is an 8-bit instrumentation bus useful for small systems of low to intermediate data rates. Interfaces to this standard are available for most computers, and the widespread usage of this standard in measurement instruments makes it attractive for many applications. The limitations of GPIB include a maximum of 15 devices per bus and a 20-meter length restriction (though bus extension is possible). Software and

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protocol overhead usually limits the data speed significantly below the maximum bus speed as mentioned above. Data General has a GPIB interface board that currently sells for \$2,400. It is supported with a software library under the AOS/VS, AOS, and RDOS operating systems.

FASTBUS is a very high-speed, modular, 32-bit data bus system for data acquisition, data processing, and control applications, particularly when there is a requirement for very high data rates, many data channels, or distributed intelligence. Originally developed for the high-energy physics community to enhance or supersede CAMAC systems, its versatility, speed, and addressing capability make it attractive for many other types of applications. FASTBUS, for example, would be chosen instead of VME for applications in need of any of the following: many data channels, large physical board size, large geographically distributed systems, or very high speeds.

CAMAC is a high-speed, 24-bit, modular data acquisition standard extensively used in physics and other disciplines. More than 50 companies manufacture more than 2,000 modules for assembly of acquisition and control systems. Parallel interfaces are available for virtually all computers. Interfaces also exist in CAMAC for connection to GPIB, RS-232, Ethernet, FASTBUS, and VME.

CAMAC has been used extensively for almost 20 years, and became an IEEE standard in 1982. The modules that can be assembled in CAMAC crates cover a vast range of capabilities, including analog and digital input and output, transient recorders for data logging and sampling, stepper motor controllers, video drivers, microcomputers, and memory.

The microprocessors available in CAMAC modules include the microNova, the LSI-11, the TI 99000, the Motorola 68000, and specialized processors. The data acquisition and control modules in CAMAC (about \$1,000 each) fit into a crate (about \$1,900) that provides all the power and the data bus. A controller (about \$1,200) that sits in the crate makes the connection to the host computer via a bus—which can be the parallel CAMAC bus, the serial CAMAC bus, GPIB, RS-232, Ethernet, or a proprietary bus. This flexibility of connection is one of the advantages of using a mature and accepted standard. Anyone who wants a copy of an IEEE brochure on CAMAC (including vendor names and addresses) may request one from me.

Data General products

Before I say more about implementing the CAMAC standard, I want to mention the products Data General officially supports. Data General treats manufacturing and industrial processing as an area where they can support standards, mostly in the form of networks. It is clear that their support of the MAP, TOP, and TCP/IP protocols, and associated network hardware is a wise move. In my area of data acquisition, networks play a role in providing communications to remote systems, but they are generally not fast enough for our front-end needs. I discussed network standards in greater depth in the December 1986 issue of *Focus*.

In addition to the GPIB product mentioned above, Data General supports a proprietary modular data acquisition product. Data General still supports their DG/DAC data acquisition product, but about two years ago, they selected Computer Products Inc. to supply systems of this form. Computer Products produces an interface board that can support up to eight of their crates containing up to 128 cards providing analog and digital input and output at intermediate data rates. Software drivers are available for AOS/VS. The cost for

such a system is about \$3,000 plus \$100 to \$1,000 per data acquisition card.

CAMAC for Data General computers

For Data General computers, a high-speed parallel interface for CAMAC is manufactured by BiRa Systems Inc. We use the BiRa interface (costing \$2,000), which is a standalone box that plugs directly onto the Eclipse backplane. For an MV machine, the interface connects to an MV I/O bus extender card (costing \$1,500). So, the total cost for implementing a high-speed CAMAC system on an MV computer is about \$6,600 (crate, controller, interface, and I/O extender) plus \$1,000 per module.

One crate can hold 25 modules, and a system can include 7 crates on a parallel highway (which is limited to a few hundred feet) plus 63 crates on each of any number of serial highways originating from the parallel highway crates. The parallel highway operates at 3 MB/sec, while the serial highway, which can be wire or fiber optics cable spread over several miles, can also approach this speed.

I have developed CAMAC driver software in assembly language, including interrupt handling and DMA transfers, for both RDOS and AOS/VS. ACQUIRE, a large and sophisticated data acquisition software system using this driver (which I described in a *Focus* article in December 1985), has been used in our lab for several years. Copies of this software are available at no charge to anyone assembling a CAMAC system.

Interrupts under AOS/VS

One important capability of a real-time system is the ability to define to the system a device driver that can perform I/O and receive interrupts. AOS/VS provides this ability through system calls in a manner similar to the equivalent RDOS implementation.

To execute I/O calls, users must first have the privilege to access devices in their user profile provided by PREDITOR. When the process is started, it must be `PROCEED` with the `/ACCESSDEVICES` switch. Further, if a process is to receive interrupts, it must also have the `/RESIDENT` switch to allow the process to remain memory resident.

Before an interrupt receiver can be defined, any pages of memory required at interrupt level must be locked into memory using the `WIRE` system call. For example, in Fortran 77, the code segment to wire the entire program into memory is:

```
EXTERNAL ?ZBOT, ?NMAX, ?SBOT, ?NTOP
IS = LITERAL (?ZBOT)
IE = LITERAL (?NMAX)
CALL WIRE(IS,IE,IER) !Wire lowest ZREL to highest unshared
IS = LITERAL (?SBOT)
IE = LITERAL (?NTOP)
CALL WIRE(IS,IE,IER) !Wire lowest shared to highest shared
```

where the function `LITERAL` returns the address of its argument, and the subroutine `WIRE` makes the `WIRE` system call, as seen in Figure 2.

Defining an interrupt-receiving routine with name `INTERRUPT` requires the assembly code shown in Figure 3. It is worth mentioning that the `DCT` table should not be changed after the `?IDEF` system call. At least part of the table is copied by this routine, and later changes to the table aren't seen by the system.

Once the device has been declared to the system through the `?IDEF` system call, interrupts from the device will be

FOCUS ON: REAL TIME

passed to the location given in the DCT table (INTERRUPT, in this case). The code that receives the interrupt must clear the cause of the interrupt, do whatever interrupt processing is necessary, and then exit.

(continued on page 58)

Figure 2: LITERAL.SR and WIRE.F77 subroutines

```

-----
FUNCTION LITERAL(VALUE)
Return the literal value of an argument
(For getting an address in Fortran)

TITLE LITERAL
.NREL
DEFARGS DEF VALUE
DEFTMPS

FENTRY LITERAL
LWLDA 2,@VALUE,3 ;Pick up the Fortran variable address
LWSTA 2,FRTN,3 ;Store this as the function value
FRET
END
-----

SUBROUTINE WIRE(ISTART,IEND,IER)
THIS ROUTINE WIRES IN THE MEMORY FROM ISTART TO IEND
ARGUMENTS PASSED MIGHT BE OF THE FORM:
CALL WIRE(WORD/DDR(ARRAYSTART),WORDADDR(ARRAYEND),IER)

INTEGER*4 ACO,AC1,AC2

INCLUDE 'QSYM.F77.IN'

ACO=ISTART
AC1=IEND
AC2=0
IER=[SYS(1SYS_WIRE,ACO,AC1,AC2) !System call to wire in memory
RETURN
END
-----

```

Figure 3: Segment of assembly code

```

?DEBL ; System call to declare device access enable
WBR ; Error return - an endless loop
WLDAI 60-1S1,0 ; Load ACO with the physical device code and
; set the high bit to declare use of a map table
LLEF 1,DCT ; Load AC1 with the device control table address
LLEF 2,DCM ; Load AC2 with the map table address - this is
; only required when using a device that
; performs DMA transfers
?IDEF ; Do the system call to declare the interrupt
; receiver
WBR ; Error return - an endless loop

DCT: .BLK ?UDLN ;Length of DCT table
.LOC DCT+?UDVXM
.DWORD 0 ;No ?IMSG pointer needed
.LOC DCT+?UDVIS
.DWORD INTERRUPT ;Address of interrupt handling routine
.LOC DCT+?UDVBX
.DWORD 0 ;No ?IXMT mailbox needed
.LOC DCT+?UDDRS
.DWORD -1 ;No powerfail restart routine
.LOC DCT+?UDVMS
.WORD 17777 ;Interrupt service mask
.LOC DCT+?UDRS
.WORD 0 ;Reserved
.LOC DCT+?UDLN

DCM: .BLK ?UDLTH ;Length of map allocation table
.LOC DCM+?UDID
.WORD ?UDDA ;Use the DCH A map
.LOC DCM+?UDNS
.WORD 1 ;1 slot needed
.LOC DCM+?UDID+?UDELTH
.WORD ?UDDA ;Use the DCH A map
.LOC DCM+?UDNS+?UDELTH
.WORD 1 ;1 slot needed
.LOC DCM+?UDELTH+?UDELTH
.WORD -1 ;End of the table
.LOC DCM+?UDLTH

```

Figure 4: Code fragment

```

INTERRUPT: WLDAI 40,0 ; Load the data value 40 into ACO
DOC 0,60 ; Send the data to device 60
WLDAI 33753,0 ; Load the next data value
DOAS 0,60 ; Send the value to device 60 and start
; the device to clear the interrupt source
?IXIT ; Exit the interrupt

```

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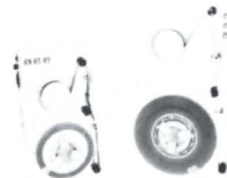
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MARKETING TO MANUFACTURERS

DG's industrial marketing strategy and real-time applications

by Geri Farman
Focus staff

"Until about two years ago," said Terry Bennett, director of DG's Manufacturing Industries Marketing, "Data General wasn't focused along industry marketing lines." After a period of market analysis, however, DG started concentrating its efforts on discrete manufacturing, process manufacturing, financial services, government, education, medicine, telecommunications, and utilities.

"We're not trying to cover that entire waterfront uniformly at this point," he said. "Our major focus at this time is on discrete manufacturing and the petroleum industry."

By analyzing where the company had done best in the past, they found that in these areas, Data General tends to be most successful with companies that have complex manufacturing environments.

"After we made this general observation," Bennett said, "we tried to look at the solutions or software vendors that have been favored by those customers."

"We mapped out the software we've been successful with there," he said, "and found that we have very thorough coverage across the entire spectrum with quality software vendors. Based on that observation, our strategy has been to sign up the 'best of breed' in each functional area."

Bennett draws a sharp contrast between DG's approach and DEC's. By focusing on key vendors in specific functional areas, he feels that DG has the right software for customers, and can offer more value to the vendors through their exclusive relationship.

This strategy also makes it easier for the sales force to advise customers. "We've been pleased with this strategy

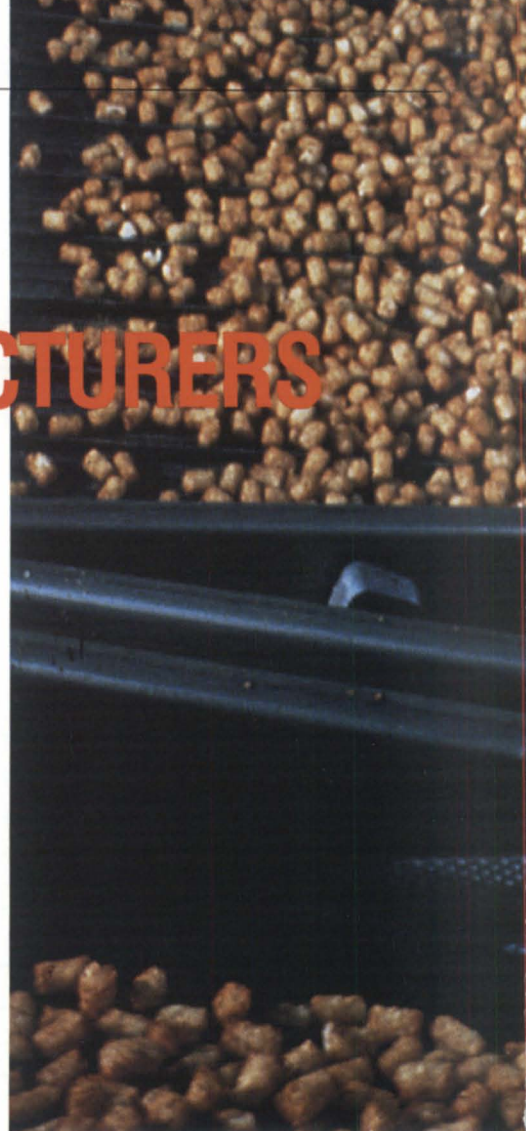
as opposed to the DEC strategy of signing up virtually everyone and turning their sales force into an analogy of an independent insurance agent." DEC and IBM also attempt to do a great deal of the shop-floor hardware themselves, whereas DG is signing on partners for this work.

Slightly less than half of DG's manufacturing business is done through OEMs. The Manufacturing Industries Division works closely with the Distribution Division and those OEMs. "What we've added to the Distribution Division strategy is a focused sales program to offer those OEMs or VARs," Bennett said. "We'll actively go sell with them as part of our effort to be recognized as a solution supplier."

Data General's work with Ore-Ida Foods, Inc. is an example of their "solutions" approach in a real-time environment. DG's sales force was working with Ore-Ida to help automate operations when the need to automate potato processing arose. The sales force worked with the industry marketing group to identify a set of solutions to offer their customer.

The heart of the system that was eventually installed is Flexcon Supervisory Control and Data Acquisition (SCADA) software from GeoControls Systems, Inc., combined with two Data General MV/4000s to handle data acquisition, data base management, and communication with other nodes in Ore-Ida's network.

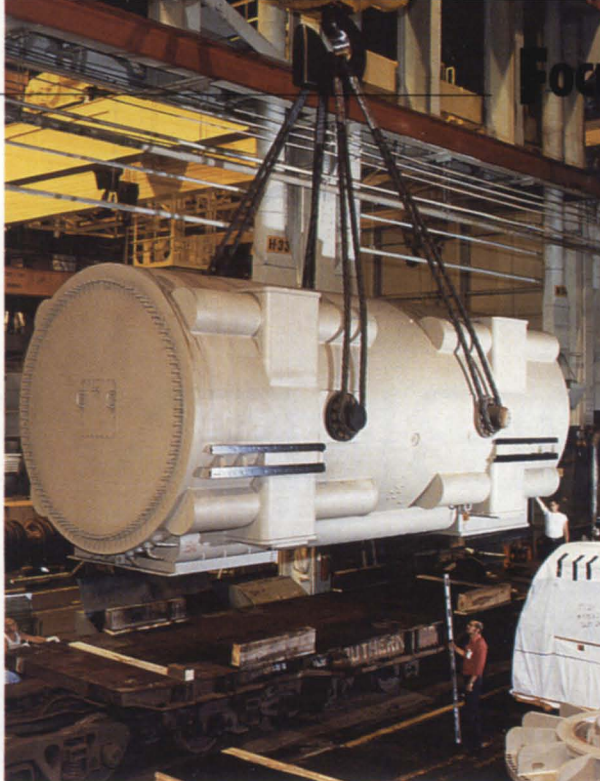
Data throughout the plant is acquired primarily from a Foxboro Videospec process control system. Gould Programmable Logic Controllers (PLCs) and other intelligent instruments feed



data to the Flexcon system. There are 10 distinct sources of information communicating with the process control system that monitors between 6,000 and 9,000 data points throughout the plant.

"It's really interesting to see what goes into producing those tater tots you might have had last night," said Julie Doro, manager of Data General's Manufacturing Automation Marketing. In the past, large amounts of the finished product had to be discarded due to errors in the control system. The types of data that need to be tracked include such factors as the water and starch content of the potatoes, peeling and cutting requirements for varying potato types, optimum cooking oil temperature and cooking times, water freshness, acceptable product size, etc.

With islands of automation throughout the plant, correcting errors during processing often took two to three hours. Using the DG system to integrate the various real-time processes, they've been able to cut the response



Data General's push into industry marketing includes a new relationship with GE's Turbine Business Group.

Data General has helped Ore-Ida Foods, Inc. automate their potato processing.

time down to two or three minutes. "Even figuring that potatoes are a relatively inexpensive commodity," said Doro, "you can see that investing in a supervisory control system is going to pay back Ore-Ida very quickly."

A variety of product developments are lending support to Data General's new emphasis on solutions for manufacturing. One of the key products is MAP (Manufacturing Automation Protocol), a set of communication standards spearheaded by General Motors and almost 300 other user companies.

Data General announced its MAP 2.1 product in May 1986, and it is currently in beta site testing. MAP 3.0 should be ready for its first public display at the MAP/TOP COS event in June 1988.

"One of our key decisions in this area and in terms of real-time applications," said Bennett, "is to join with Allen-Bradley for the active control element. For a minicomputer manufacturer and a PLC and control manufacturer to reach the types of agreements we have gives people a tremendous spectrum to choose from in building a

control system in an integrated hierarchical environment."

Allen-Bradley is an IHV (Independent Hardware Vendor) for DG—supplying components such as remodulators that are needed to build a MAP network. DG also worked with them to develop a software driver and modem interface for Allen-Bradley's proprietary Data Highway. DG, in turn, acts as an OEM for Allen-Bradley, putting Allen-Bradley's chip sets on DG's modem board to interface DG's product line with the MAP network.

"Possibly the most important thing," Bennett said, "is that we are going to subcontract cabling services for our customers to Allen-Bradley. They have installed more miles of cabling in shop-floor environments than probably anyone else. They can assure our customers that it will function cleanly."

In other developments, DG has aligned itself through an IHV agreement with Computer Products Inc. (CPI) in Pompano Beach, Florida for RTP (Real-Time Product) data acquisition and control equipment. "At one point, we developed and sold our own line known as DG/DAC, but as we moved into an industry marketing focus, we realized it made more sense for us to concentrate on our capabilities as a computer supplier," said Doro.

DG identified CPI as the leading domestic vendor of sensor I/O products and through them has developed an in-

terface supported under AOS/VS and DVS operating systems. This interface gives DG systems the ability to collect signals of virtually any type. With this interface, application programmers can design their own data acquisition or monitoring systems or tie these to their own application program.

Other developments that support the industry marketing thrust include the new relationship with GE's Turbine Business Group. The new agreement has DG taking over maintaining and enhancing the Factory Management System developed by GE. Now known as DG/FMS, this software integrates shop-floor control, factory communication, direct numerical control, and maintenance logging. GE, in turn, helps market and install the system.

"Our ability to attract people like Allen-Bradley and GE to these types of relationships proves our claim that we are a very strong contender in this marketplace. The key to industry marketing, we believe, is finding the right partners who have leading capabilities in their field and who are flexible, inventive business partners," Bennett said.

"We are now focused on assuring that we have the complete and definitive set of capabilities that someone is going to need to do factory automation, for example. And our sales force is focused on developing revenues that will keep those third-party relationships healthy." Δ



PROBLEMS?

Just report them to the Customer Support Center

Data General's Customer Support Center (CSC) in Atlanta is undergoing some major reorganization to help respond to customers needs. The new Software Problem Management Department (SPMD) has the responsibility of routing Software Trouble Reports (STRs) to the appropriate area in a timely manner. They send the STRs to the Corporate Software Development (CSD) Group in Westboro. They are also the centralized distributor for the answers received from DG. To understand the CSC structure, refer to Figure 1.

The procedure goes like this: When you call the CSC (1-800-DGHELPS), a



dispatcher gathers information such as your name, your company's name, the machine you use, and the type of software associated with the problem you're reporting. The call is then routed to the appropriate Problem Identification (P.I.) Group. (CEO has its own.)

A CEO specialist will ask you to explain the problem in detail. It's important to tell them as much as you can about the problem. The P.I. Group has 30 minutes to check for similar reports and to see if there is a patch or a temporary workaround already available.

If nothing is found, the problem is sent to the internal Software Support Representatives (SSRs). They try to reproduce the problem from the details you reported. Depending on the urgency of the problem, a local SSR may be dispatched to your company's site. If the problem cannot be resolved by the local SSR, it is turned over to the National Software Technical Support (NSTS) Group. This group also recreates the problem and works directly with the CSD Group to resolve it as quickly as possible.

If a local SSR isn't dispatched, the internal SSR will write up an STR and ask you to send any necessary tapes or supporting materials. The STR is then processed to SPMD for review. The SPMD assigns a priority level from the following criteria:

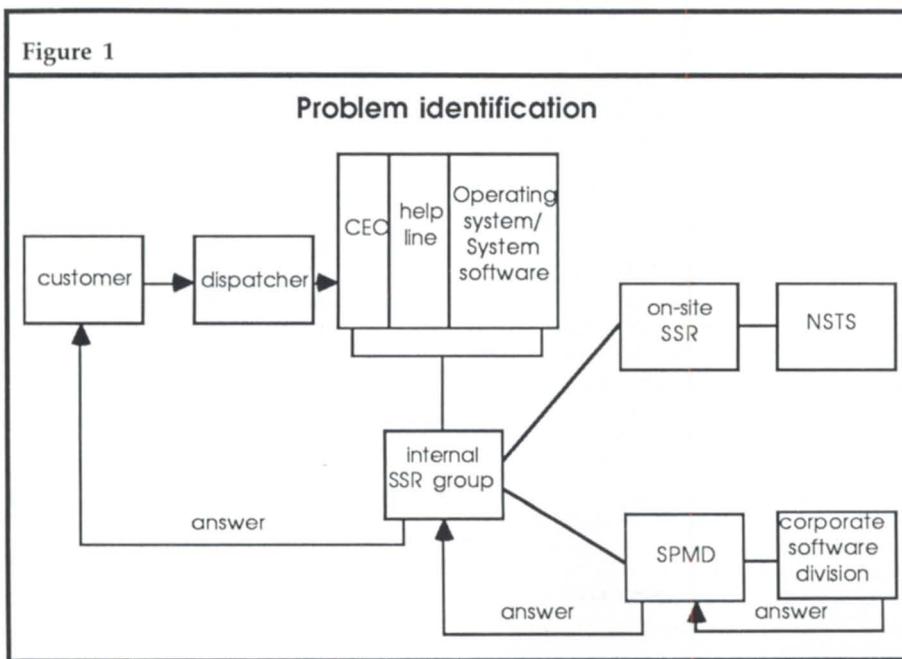
- Level 1 = urgent/critical (can't work around)
- Level 2 = important (can work around until a patch is obtained)
- Level 3 = noncritical (can wait for the next revision)

The STR is sent to CSD for resolution. When an answer is sent back, the SPMD reviews the answer and forwards it to the original internal SSR. That person is responsible for calling you and sending you a copy of the answer.

If you aren't happy with the solution, call the CSC and tell them you would like the STR re-opened. (Use a controlled voice level—they don't receive you well if you're screaming and shouting.)

Doris Slocum, the STR coordinator, is

Figure 1



the person to call for the status of your STR or to register a complaint. (Forgive me, Doris. Your boss gave me your name.) Doris will be getting a direct line, but in the meantime, she can be reached by calling 1-800-DGHELPS. Her boss, Madeleine Andrews, assured me that if critical information is missing from the STR that was submitted, a representative will call you, instead of sending it back with "Insufficient information to reproduce" stamped across it.

She encourages users to call the center and have a staff member fill out the report and submit it, rather than send in the information yourself. They know what to ask to complete a report.

Still, if you would rather fill out the STR yourself, follow these three guidelines:

1. Each STR should describe only *one* problem.
2. STR forms should be filled out completely and concisely. Give enough information for them to reproduce the problem.
3. All necessary supporting information (as may be specified in the product release notice) should be supplied with the STR.

The following is a fairly comprehensive guide to filling out the report:

Product information—The first several lines ask for problem-specific information about your computer equipment. List the software program where the problem is believed to exist, the revision and update under which the problem exists, the name and revision/update number of the operating system that supports the software with the problem, any software that should be examined as part of the problem, and a brief but complete list of the hardware components on which the problem occurred.

Company information—Enter the name of the company submitting the STR, along with the complete and correct address.

STR originator information—List a contact person to whom all questions and correspondence should be directed, the date the STR is sent to the processing center, and a number assigned by you for your internal tracking purposes. Be sure to indicate any supporting media or documentation you're sending with the STR—then don't forget to send it.

Problem status—Indicate if you can work around the problem. Is it non-critical? Remember, not every problem

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can be urgent or nothing will be resolved.

Frequency—Indicate how often the problem occurs.

Hardware diagnostics—List the name and results of the last diagnostics tests executed on the system. Include the dates these tests were run.

Type of failure

Panic or fatal error number—A panic code for RDOS/ICOS/DOS is indicated by five six-digit numbers that appear on the master console when the system crashes. Under AOS, the fatal error may be printed on the console and followed by a number. Record the panic or error number in the space provided. Any additional numbers should be recorded in the "Problem description" section of the STR form.

Hang, halt, or loop—A hang is evident when all or some of the consoles are locked out of the system. Refer to specific instructions for your machine to determine a halt or loop.

Trap: user or ghost—The word "trap" will be printed on the console

followed by five six-digit numbers, qualified by "user" or "ghost" on AOS systems. For other operating systems, all trap messages mean "user."

Incorrect results—If computational errors occur, check the "Incorrect Results" box.

CPU state—Mark the illuminated lights as appropriate.

Processes running—Include information regarding the environment (e.g., list processing, etc.).

Sequence of events preceding failure—List programs or events that occurred prior to the symptoms.

Problem description—Describe in detail the conditions, circumstances, prior keystrokes, commands entered, error messages, response, and frequency. Include the terminal type, configuration, and if necessary, supporting media or documentation.

You may want to create your own problem report to help gather and report this information, using the items listed above as your guideline. If you would like a sample copy of what I use,

feel free to contact me.

When a user completes the report, it should be routed to the person that handles reporting problems to DG. Before calling the CSC, try reproducing the problem so you are aware of exactly what happens before, during, and after the problem occurs. This will save you and the CSC staff considerable time and frustration.

Calling the support center can be painless if you have the necessary information at your fingertips. If you don't receive the service you think you should, don't hesitate to call and air your concerns. The staff in Atlanta wants to help you with your problems, and if they're not doing their job, we should let them know it. Δ

Charlene A. Kirian is PC/OA instructor for the Online Computer Library Center, Inc., 6565 Frantz Road, Dublin, OH 43017; 614/764-6435. She also serves as president of NADGUG's OASIS (Office Automation Special Interest Subcommittee).

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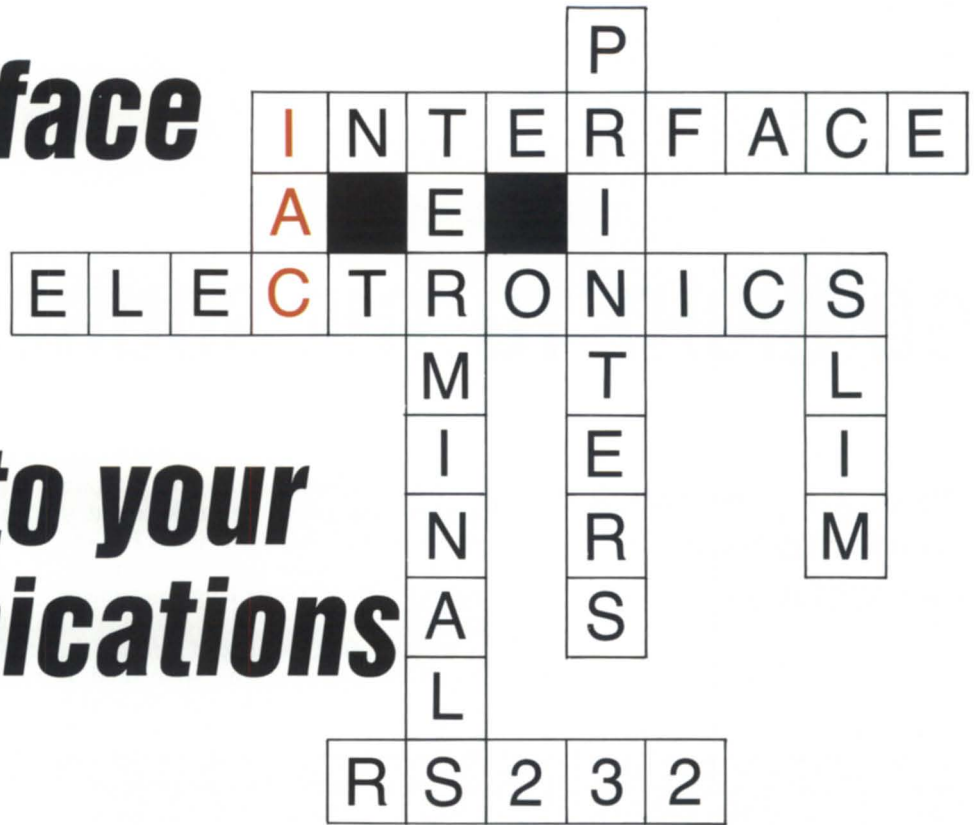
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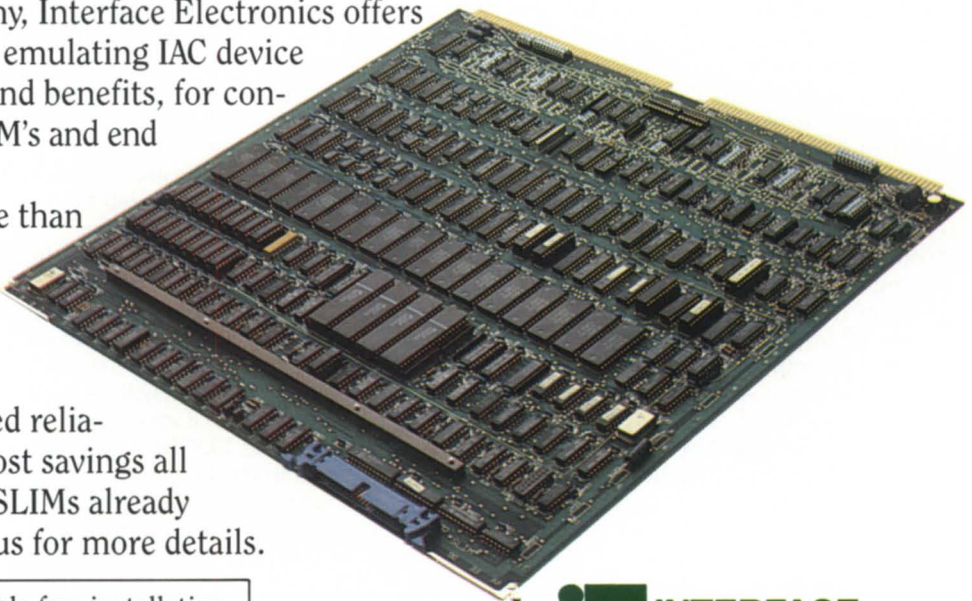


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GO RIGHT TO THE SOURCE . . .

Why not give users a chance to fix it themselves?

When I ran into a little problem with ANALYZE and CREV the other day, I decided to try DG's On-line Information Service. The results were interesting enough to be passed along.

It seems that occasionally—seemingly at random—when I try to bring up ANALYZE or CREV from a mux line, the programs fail. With ANALYZE, for instance, the main screen came up with the message "CANNOT OPEN FILE: 870331," and I'd get a STOP RUN. A similar thing happened with CREV. As I said, it happened only occasionally, but once it popped up, I couldn't get the programs to work until I brought the system down and back up again.

"Aha," I said to myself, "that data looks suspiciously like something from my LINKAGE section. But LOGON doesn't contain a LINKAGE section—what is going on here? So I decided to try the On-line Information Service. OIS is a godsend for those of us who don't have software support. Later on in this episode, I was asked why I was running without software support. I replied that, since there will be no new revs of regular RDOS or ICOBOL for RDOS, I saw no good reason to pay \$1,000 a year in order to not get my problems solved. However, I'll gladly pay \$70 per hour to upload my specific problems and get an answer. Now that the DG-TALK portion of OIS is free, you only pay for the cost of the telephone call.

So, I logged onto OIS, got into the DG-TALK section, and posted my

problem—complete with my LINKAGE section suspicions. It took about a month and several false starts before I finally got back the three most dreaded words in the English language: *submit an STR*.

At this point, I put my plea on the NADGUG bulletin board sponsored by Rational Data Systems. A few days later, I got a message from Larry Mayberry telling me that, not only did he know about the problem, STR USKC-7881 told about the fix for it. It seems that this is a situation where the interpreter doesn't clear out the old passing fields, and ANALYZE and CREV see these fields as a request. It is supposed to be fixed in the next rev of DG/RDOS. Since there is no next rev of regular RDOS, we'll just have to come up with a solution by ourselves.

Note to myself: Check out the STRs on the OIS bulletin board before spending a lot of time and money on DG-TALK. Since the STRs are now easy to browse by keyword, this will be my first step in the future.

Note to DG-TALK: Check out the STRs on the OIS bulletin board.

Anyway, DG/RDOS users will have a fix in the next rev. I don't know about the AOS{VS} users—either it isn't broken, or I'm sure that it will be fixed in the next rev. But what about all of us still using good old RDOS? Well, there are three ways to fix this problem.

The first is probably the simplest. Put a LINKAGE section with a 255-byte long record in LOGON. Move low values to it first. You'll never have a problem again.

The second way is more creative. After all, this problem isn't a *bug*, it's a *feature*. Put the LINKAGE section in LOGON, and if ANALYZE or CREV are invoked, request a filename. Put the file-

name into your linkage record, and the programs will work automatically.

Although this works, I can see no great use for it. The only possible use would be from within other programs—if you get a file error, move the filename into the link record and run ANALYZE. However, I think it's much simpler just to put a message into the program telling the user to run ANALYZE. If they don't know how, then they won't know what to do with the numbers they get when it runs automatically. All in all, I think it would be better if the LINKAGE section was simply removed from the offending programs.

That's the third—and best—solution. If DG would give us the source code, we could take out the LINKAGE section ourselves.

I can see why the good people from Lotus or WordPerfect don't give out source code with their programs. But somehow, I just can't imagine thousands of people illegally posting copies of CREV up on the local bulletin board. I mean, CREV has to be about the simplest routine you can write in ICOBOL. I just wrote one for the heck of it—the procedure division is less than 30 lines long. (In case anyone is interested, the rev number is the sixth byte of the .PD).

But CREV is a rather trivial matter; after all, I use it about once every year. There are other programs that would be very useful if only we could get the source code.

A prime example is CALC. As it stands now, CALC is not very useful. The times that I need CALC happen when I'm running another program and need to add up a few numbers. In order to use it, I would need to END out

of the program, get to LOGON, get into CALC, do my calculation, write it down on a piece of paper, exit CALC, hit escape to get back to LOGON, and get back into my program. Instead, I have a calculator by my desk and SideKick up on my computer.

Look how useful CALC could be. If we had the source code, we could use the CALL . . . EXIT statements of ICOBOL 1.3 and get into CALC from any point of a program, do the calculations, and return to the same point. Now *that* would be useful! The modifications required wouldn't exactly be major: change one STOP RUN to an EXIT PROGRAM. With the CALL statement, CALC also will not wipe out any of your variables. You can call CALC, do a calculation, return to your program, call CALC again, and the original variables and values will still be there.

That is exactly what I did with NOTES when DG stopped supporting it and released the source code. I'll admit that NOTES ain't exactly SideKick, but on a 6053 it's quite useful. People here can break out of a program, jot down a note, and get back to the same point.

There are plenty of other candidates for releasing the source code. How about the alarm clock? I don't use it now because I don't want to tie up a terminal with a silly digital clock. If I had the code, however, I might do a CALL to the program whenever I left a menu and have it appear when the alarm is about to go off.

But back to CALC. Even without having the source, there's a way to change the object code so that is does an EXIT instead of a STOP RUN. Before I tell you how, I must issue a few warnings.

I've been running CALC this way for months, and I've never had a problem. This doesn't mean that I won't have one in the future. Keep a copy of your original files. This modification will only work with CALC rev 1.31 because earlier revs don't do a STOP RUN—they return to LOGON.

First, we need to invoke the octal editor by typing OEDIT CALC.PD. When the period appears on the screen, type 1440/ and the number 047115 should appear. If it doesn't, *stop right there*—it's the wrong revision. Anything you do could wreck the program. If 047115 shows up, type 074515, press enter, and type (ESCAPE)z. Your new version of CALC is now ready. To get into CALC, your program should say CALL "CALC"

rather than CALL PROGRAM "CALC." Now, go in and change every program that you have so that it uses this. Seriously, go around and ask your personnel when they use a calculator while keypunching. At those points, call CALC. I have it so that a SHIFT-CTRL-F8 will invoke CALC since the same combination will get you out of CALC. Your code would look like this:

```
DISPLAY ITEM-1, ACCEPT ITEM-1.
ACCEPT ESCAPE-CODE FROM ESCAPE KEY.
IF ESCAPE-CODE = 33
  CALL "CALC",
  PERFORM RE-DISPLAY-SCREEN,
ELSE . . .
```

Remember that after you invoke CALC, you'll have to display the screen again. For the most part, therefore, I allow a call to CALC only before any data has been entered.

Now, onto something from the MS-DOS world.

In many ways, I consider myself a radical, but when it comes to software, I tend to be a pure conservative reactionary. After all, I am running ICOBOL under RDOS on a 16-bit machine. It should come as no surprise, therefore, that my preferred MS-DOS editor is WordStar.

Rev 4 of WordStar brings the venerable old processor into the modern age. It includes an on-line spell checker and thesaurus, handles math functions, and can finally support subdirectories, along with macro capability, line/box drawing, UNDELETE, and more than 100 other enhancements.

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Tim Boyer is EDP manager at Denman Tire Corp. and president of the Northern Ohio Data General Users Association. He may be reached at P.O. Box 951, Warren, OH 44482; 216/898-2711, or on the NADGUG bulletin board at 415/924-3652.

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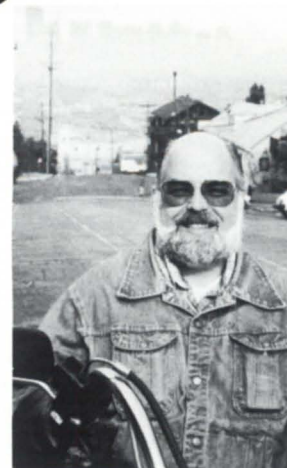
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:ERRATA

A few years back, I started using the term "AOS{VS}" to indicate applicability to both AOS and AOS/VS. Well, someone finally pointed out that the more correct form is "AOS{ /VS}" because that matches the documentation convention used throughout DG's manuals.

For those of you who routinely skip the section labeled "Documentation Conventions" in the DG manuals, brackets are used to enclose optional items, and braces are used to enclose multiple choices, where a choice is required. I suppose I could use "AOS{ /VS}" ("/" indicates "or"), but AOS{/VS} takes fewer keystrokes and is easier to read. Starting with this column, I'm going to follow DG's "Documentation Conventions" as closely as possible.

Just so you know that I don't harbor bad feelings about being corrected, I've shipped the reader a genuine original Coca-Cola can encased in Lucite (only the second one awarded to date). Now, did I or didn't I remember to empty out the nerve gas? Hmmm.

Figure 1: GET_BITMAP.CLI

```
[!EQUAL,%3%,]
WRITE
WRITE Usage: %\% disk-unit-name bitmap-address bitmap-size
WRITE
WRITE Use the simple disk-unit-name (omit the "@"). bitmap-address
WRITE and bitmap-size are the octal numbers from CFMTR.
WRITE
WRITE Example: %\% DPF13 614663 205
WRITE
[!ELSE]
COMMENT Convert 1st block no. to decimal & add invisible space
VAR0 [!UADD,[!DECIMAL %2%],8]
COMMENT Compute ending block no. in decimal
VAR1 [!USUB,[!UADD,[!DECIMAL %3%],[!VAR0]],1]
X DISPLAY/FIRST=[!VAR0]/LAST=[!VAR1]/NOLIST @%1% %1%.BITMAP
WRITE The bitmap is in %1%.BITMAP
[!END]
```

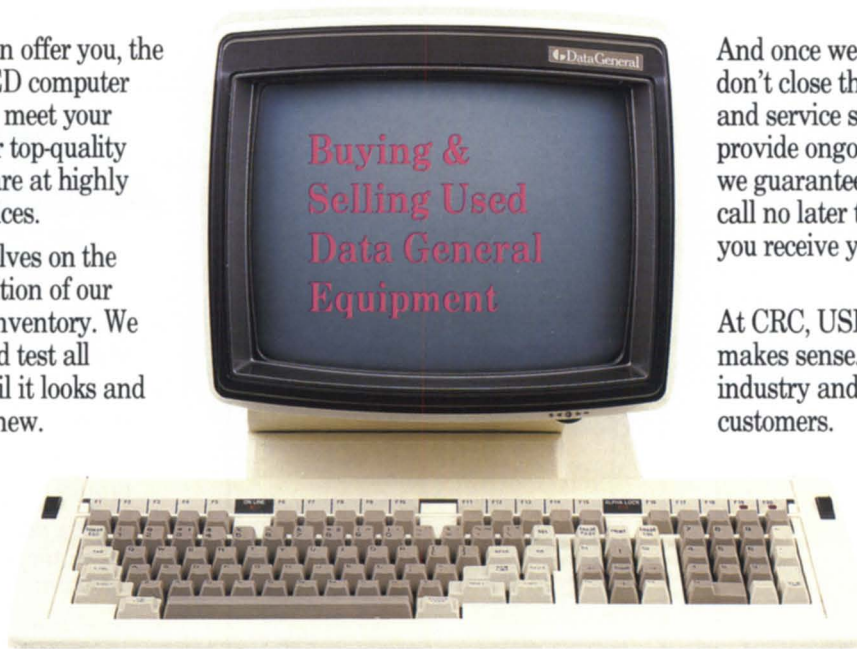
Figure 2: BUILD.CLI

```
[!EQUAL,%1%,]
WRITE
WRITE Usage: %\%[!ASCII 333]/switches[!ASCII 335] &
build-filename [!ASCII 333]template...[!ASCII 335]
WRITE
WRITE A list of qualifying filenames is written to build-filename in a
WRITE format suitable for framing. The following switches can be used:
WRITE
WRITE,,,,,,,,,/AFTER/BEFORE/TCR=/TLA=/TLM=/TYPE=
WRITE
[!ELSE]
[!NEQUAL,[!FILENAME %1%],]
WRITE
WRITE Sorry - %1% already exists.
WRITE
[!ELSE]
FILESTATUS%/%/CPL=1/NHEADER/L=%1%/SORT %2-%
[!UNE,[!SIZE %1%],0]
X/M SPEED %1%
<3D@S\
\;-1M@I\.&\1M>
ZJ-3M1D
FUH
)
[!END]
[!END]
[!END]
```

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Figure 3a: ADDSEA.CLI

```
[!EQUAL,%/II%,]
WRITE
[!EQUAL,%1%,]
WRITE Usage: %\% dir-name...
WRITE
WRITE This macro adds the specified directory names to the FRONT of
WRITE your current searchlist. If the directory is already in your
WRITE searchlist then its position will be left unchanged.
[!ELSE]
%\%/II (%-%)
WRITE Your new searchlist is "[!searchlist]"
[!END]
WRITE
[!ELSE]
SEARCHLIST %1% [!SEARCHLIST]
[!END]
```

:BACK TO THE FUTURE

This month, I'm going to start giving you a mini-tour of my macros directory. It seems like every time I use them with someone looking over my shoulder, they say things like, "Hey, that's neat. Mind if I grab a copy?" I guess there

are some things I consider trivial that other people haven't yet stumbled onto. Anyway, there are too many for a single column, so I'll start with a few simple ones, and maybe we'll continue this in some future column.

The macros supplied here have been

edited to make them more palatable to typesetters. In most cases, I just took out a lot of the comments and revision history info and discarded some of the fancier features that took up too much space. None of the stuff I tore out has a material affect on the usability of the macro. You can re-embellish them to your heart's content.

Before we begin, let me point out a few of my quirks when it comes to writing macros. First, if a macro requires arguments, then using the macro without arguments will cause a mini-help to be output. Second, I never abbreviate commands and pseudo-macros—that ensures no future problems when the CLI gets enriched. Third, I use Roman numeral switches (/II, /III, /IV, . . .) to indicate recursion. I'll switch to decimal switches when DG switches from octal to hex. Lastly, my macros never "know" their own names; instead, they use %\%. This allows you to rename them without having to modify them.

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:CONTIGUOUS_DISK_BLOCKS

Apparently, a lot of system managers are interested in how fragmented the remaining space is on their disks. Seemed like a reasonable request to me, so I developed a little macro to display the available space on single-disk LDUs in a crude fashion. Here's how it works:

First, you have to be able to RELEASE the drive you're interested in. If you're on a single disk system, I'm afraid you're out of luck (probably in more ways than one).

After you release the drive, do a "partial" DFMT (without read-only surface analysis) to discover the disk address and the size of the bitmap. Using one of my 277 MB drives as the test case, I found a bitmap disk address of 614663 (octal) and a size of 205 (octal) blocks. Don't fall into the trap of using my address for your 277 MB drives: the actual address depends on various DFMT options that you may have selected differently.

Now use DISPLAY to copy the bitmap to a disk file for analysis. A copy of a macro I use to do this is shown in Fig-

Figure 3b: APPSEA.CLI

```
[!EQUAL,%/II%,]
WRITE
[!EQUAL,%1%,]
WRITE Usage: %\% dir-name...
WRITE
WRITE This macro appends the specified directory names to the END of
WRITE your current searchlist. If the directory is already in your
WRITE searchlist then its position will be left unchanged.
[!ELSE]
%\%/II (%-%)
WRITE Your new searchlist is "[!SEARCHLIST]"
[!END]
WRITE
[!ELSE]
SEARCHLIST [!SEARCHLIST] %1%
[!END]
```

ure 1. It takes three arguments: the disk unit name and the bitmap address and size (both specified in octal).

Once you have copied the bitmap, you can REINITIALIZE the disk to put it back in service. This way you can analyze the bitmap file at your leisure.

At this point, you have two options: you can simply X DISPLAY DPXX.BITMAP to see the contents of the bitmap (normal behavior), or you can write a program to report the number of holes by size and by location (compulsive

behavior).

I know this won't dissuade the compulsives from writing exotic analysis programs, but about 99 percent of the bitmaps I've examined exhibit similar characteristics: the vast majority of empty space, except for a few odd-sized 1, 2, or 3 block holes, is at the end of the disk. That's because the AOS/[VS] algorithm for allocating disk space is (correctly) biased toward re-allocating the most recently deleted space. That effectively makes AOS/[VS]

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behave like a disk compactor when there is any amount of DELETE/CREATE activity on a drive.

How often do I perform this little procedure to check my disks? Almost never. Once you know how AOS[VS] behaves when allocating disk space, there's usually no need to check. The only exception is when a disk has become extremely full at some point (e.g., more than 90 percent), after which some space has been recovered to bring the disk back below 90 percent. This situation will often produce a disk with plenty of apparent space, but few large contiguous blocks. Even in this case, I still don't perform the analysis because there's nothing to discover other than what I already know: the disk has to be dumped to tape, full DFMTred (using the old bad block info to save time), and reloaded.

:BUILD.CLI

Every time someone spots me using my BUILD macro and says, "Hey! That's great! Where do I get one?" I wonder how anybody gets along without it.

Basically, a BUILD macro produces a file containing a list of filenames that meet some combination of criteria and that can be used as part of a CLI command using "<" or "(". Suppose you want to print a large collection of files, but you want them printed in alphabetical order by filename. If you just use QPRINT +.LS, the files will be printed in hash-code order. Alternatively, BUILD allows you to do this:

```
) BUILD FOO +.LS  
) QPRINT [FOO]
```

BUILD FOO +.LS creates a file called FOO containing one filename per line, followed by ",&" (except for the last one, which is followed by "&").

Have you ever wished you could do this:

```
) RENAME/TYPE=\LNK +.COB OLD+.COB
```

Well, you can. BUILD accepts any switch or template supported by the FILESTATUS command, and like FILESTATUS, defaults to "+" if no arguments are supplied.

```
) BUILD/TYPE=\LNK FOO  
) RENAME ([FOO]) OLD.([FOO])  
) DELETE FOO
```

Pretty handy, huh? I don't know how I'd get along without it. A listing of a simple version of BUILD.CLI is shown in Figure 2. I picked the name BUILD be-

cause the macro behaves similarly to the RDOS CLI's BUILD command, which for some reason wasn't carried through to AOS[VS].

Warning: Do not "enhance" this macro by having it delete the "build" file automatically. Some afternoon, you'll type BUILD +.COB instead of BUILD FOO +.COB, and the result will be bye-bye to all your .COB files.

Last month, Jim Siegman offered an "advertised specials only" dinner at the

How often do I perform this little procedure to check my disks? Almost never.

NADGUG conference to the first person to spot that dow.CLI screwed up during the first two months of each leap year. I'll go one better: the best submission (in writing) by August 20th of a version of BUILD.CLI that supports a global /ENAME switch (i.e., build a list of filenames without extensions) wins a real dinner at the conference for themselves and a significant other. Judging will be pretty much arbitrary on my part, but I can tell you that pure macros (no user programs invoked other than DG-supplied utilities) that execute speedily will get high marks. Cryptic elegance will get low marks. Simple elegance will get high marks.

:SEARCHLISTS

The CLI command to change the searchlist is necessarily clumsy because any searchlist command usually includes [!SEARCHLIST], and most two-finger typists have difficulty typing the exclamation point because it either requires both hands or a double-jointed left hand.

My solution to this dilemma is to use three macros: ADDSEA.CLI, APPSEA.CLI, and SUBSEA.CLI. ADDSEA adds a directory to the front of the searchlist, APPSEA adds it to the end, and SUBSEA removes a directory from the searchlist. Listings of the three macros are shown in Figures 3a, 3b, and 3c.

Implementation details: ADDSEA and APPSEA function as no-ops if the directory is already in the searchlist. SUBSEA makes no complaint if the directory is

Figure 3c: SUBSEA.CLI

```
[!EQUAL,%/II%,]
WRITE
[!EQUAL,%1%,]
WRITE Usage: %\% dir-name
WRITE
WRITE This macros removes the specified directory from your
WRITE searchlist. If the specified directory does not exist
WRITE then it is ignored.
[!ELSE]
COMMENT Care to guess why I didn't use %\% in the next line?
[!PATHNAME [!ENAME %\%].CLI]/II %1% (,[!SEARCHLIST])
WRITE
WRITE Your new SEARCHLIST is "[!SEARCHLIST]"
[!END]
WRITE
[!ELSE]
[!EQUAL,%2%,]
SEARCHLIST/K ; COMMENT 1st time thru: reset the SEARCHLIST
[!ELSE]
[!EQUAL,[!PATHNAME %1%],%2%,]
WRITE Removing, %2%...
[!ELSE]
WRITE Retaining %2%...
SEARCHLIST [!SEARCHLIST] %2%
[!END]
[!END]
[!END]
```

Figure 4: D400.CLI

```
COMMENT D4xx macro
COMMENT
COMMENT Usage: D400
COMMENT or: D400/WIDE {/WIDE may be abbreviated}
COMMENT

COMMENT Blink enable, roll enable, underscore off, dim off
WRITE [!ASCII 217 217 222 225 235]

[!NEQUAL,%/WIDE/WID/WI/W%,]
WRITE [!ASCII 236]FK ; COMMENT compressed
WRITE [!ASCII 236]FX0086 ; COMMENT set margin
CHARACTERISTICS/CPL=135
[!ELSE]
WRITE [!ASCII 236]FJ ; COMMENT normal
WRITE [!ASCII 236]FX0047 ; COMMENT set margin
CHARACTERISTICS/CPL=80
[!END]

COMMENT Last but not least: turn on SCREENEDIT just in case...
SCREENEDIT ON
```

Figure 5: SPAWN.CLI

```
WRITE
[!EQUAL,(%-%),()]
WRITE Usage: %\% cli-command
WRITE
WRITE In order to detect your son's completion you should include
WRITE CHECKTERMS in your CLI prompt. e.g.: PROMPT DIRECTORY CHECKTERMS
[!ELSE]
COMMENT The Miracle of Birth.
CREATE/2=IGNORE/DATASENSITIVE/TYPE=TXT ?%\%.[!PID].TMP
PROCESS/DEFAULT/INPUT=@NULL/OUTPUT=?%\%.[!PID].TMP/PRIORITY=3 :CLI %-%
DELETE/2=IGNORE/V ?%\%.PROMPT.[!PID].TMP
WRITE Output will be in ?%\%.[!PID].TMP...
[!END]
WRITE
```

not in the searchlist. Note that SUBSEA recommends that CHECKTERMS be included in your CLI prompt to detect

son completion. Because there is no !PROMPT pseudo-op, and because the PROMPT command does not ignore du-

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plicates, the macro cannot add it to the prompt setting for you.

:CINEMAX

I frequently find it handy to use my terminal to preview output destined for wide line printer paper or to SED documents wider than 72 columns (SED uses columns 1 through 8 for the line numbers). Simply hitting the NORM/COMP key on my D400 doesn't solve the problem for two reasons: AOS/[VS] still thinks I'm in 80 column mode, and the D400 always wraps at column 80 unless you define a larger window.

The macro that I use to switch back and forth between 35 mm and 70 mm takes care of the problem by notifying both the operating system and the terminal. In addition, the macro sets the normal video attributes, in case I've inadvertently gotten into dim mode, underline mode, or page mode.

A listing of the macro is shown in Figure 4. D400/WIDE switches to 135 column mode and D400 switches back to 80 column mode. Note that this macro works on any DG tube that supports compressed screen mode (e.g., D400, D410, D450, etc.), but not on the cheap tubes (e.g., D210). Also note that many utilities like SED work just fine in wide mode. PED used to take advantage of the wide screen also, until it was rewritten for rev 7. Yet another price of progress?

:UPSTREAM_ANTIICS

Frequently, I need to do something, and I don't want to lock up my terminal waiting for it to complete. In addition, what I want to do isn't usually worth the overhead of a batch job log on/off sequence (which can be quite a bit). The solution I've adopted is to spawn a low priority son process to do the work.

The procedure involves PROCING up a CLI as a son process, without blocking myself. The input and output files for the CLI son are set to disk files, and a PROMPT CHECKTERMS takes care of letting me know when the son has completed his work. The results of the spawned son can be determined by examining the output file after the son terminates. A listing of the macro is shown in Figure 5.

A typical spawning example would be a short COBOL compile. Using SPAWN, you simply type:

```
) SPAWN COBOL/E=F00.ER/L=F00.LS F00  
PID: 91
```

Later when you get the process termination message, check the results by typing ?SPAWN.91.TMP.

The second thing that SPAWN is really handy for is if you have a cyclical job that has to run periodically, and you don't want the overhead of the batch log on/off sequence or the need to dedicate an entire batch stream to the job just to ensure that it runs in a timely fashion. INFOS file checkpoints come to mind. Here's an example: make a macro called CYCLICAL_CP.CLI that looks like this:

```
CHECKPOINT GONADS.DB
PAUSE [!UMUL,%1%,60]
CYCLICAL_CP
```

Now type this at the master console:

```
) SPAWN CYCLICAL_CP 15
```

The result is a son process that checkpoints GONADS.DB, goes to sleep for 15 minutes, and then repeats itself. Indefinitely. In between executions, the only overhead is another dormant CLI.PR process with minimal working set size.

Here's where our tour ends. More on this topic in another column!

:FLASHBACK:87:JUNE

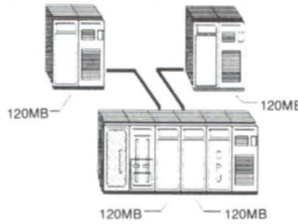
The column on shared libraries and inner-ring libraries (June 1987, page 46) generated quite a few phone calls. The people who had problems tended to be those with revs that were too early of either COBOL or LANG_RT. Just for the record, all the examples I published were done with COBOL 3.20 and LANG_RT 3.42.

One person called to point out that "CALL data-item" didn't work properly with inner-ring user libraries. I indicated that it was probably because the LINKER has to be aware of all inner-ring subroutine names so it can divert them properly. I haven't heard from the caller again, so I can only assume that my suggestion to use a series of specific "CALL 'subroutine-name'" statements must have worked.

Another caller indicated that he had problems using COBOL's new multi-tasked, buffered I/O (see Appendix H in the 093.000289.02 file supplied with COBOL 3.20) with shared and inner-ring libraries. I haven't had time to identify the source of the problem, but for now, I recommend avoiding multi-tasked, buffered I/O with shared and inner-ring libraries. My experience is that single-task, buffered I/O with nice, healthy buffer sizes is about twice as

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Finally, a caller from inside DG indicated that I should stress a little bit more that shared libraries are not completely "free": the execution time and I/O penalty will be noticeable on short programs, typically those of less than a

minute or two in duration. I agree, so consider it reiterated.

Since the column was published, there has been some NADGUG bulletin board traffic asking, "Why doesn't DG make all product .PR files use shared libraries?" Well, according to some sources inside DG, there is some hope. However, there are some short-term ob-

stacles standing in the way.

The common examples cited are "What if we ship a utility written in PL/I, and the user isn't licensed for PL/I? Will we have to ship him a P.LI.SL file and .SL files for all the other languages used to produce products? If so, what happens when the user wants to use a different revision of P.LI.SL?" Anyway, it's not as simple as it sounds, but I believe shared libraries for products will happen eventually.

Other than that, a lot of people seem to have tried shared libraries, and somewhat fewer have tried inner-ring libraries, but no other problems have been reported so far. Everybody has noticed significantly reduced .PR file sizes and reduced memory consumption with only slight increases in CPU consumption. Increased disk I/O doesn't seem to be a problem; for large or long-running programs, the extra I/O required to initialize the shared library seems to usually be offset by the decreased physical page-fault frequency due to a higher incidence of sharing.

:FLASHBACK:87:JULY

Since I wrote the July column, I have figured out why some PC software packages transfer binary files through my stat mux without hanging, while others hang. The ones that don't hang append a "launch" character to the end of each transmitted block. Typically, the launch character is a <CR> or <NEWLINE>. The occurrence of this launch character takes care of the case when the last character of the block (the CRC or checksum) is an XOFF.

Launch characters are handy when using public networks. They signal the networks to go ahead and transmit the packet in case they had been buffering it. All protocols that I'm aware of (XMODEM, YMODEM, KERMIT, BLAST, etc.) can handle launch characters with no problems since their specs include a mandate that any characters occurring between the end of one block and the beginning of the next block should be discarded by the receiving end. Δ

B.J. is the president of B.J. Inc., a San Francisco-based consultancy specializing in system auditing, system management, and performance analysis. He can be reached at 109 Minna St., Suite 215, San Francisco, CA 94105; 415/550-1444, Telex 296544.

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EXCUUUUSE ME!

A “clean” method of listing errors

One of the most important aspects of an application program is the correct and meaningful treatment of exceptions. Unfortunately, errors are usually handled in a casual or incomplete manner that serves only to frustrate users and create headaches for the developer.

Here’s a classic example: Years ago, the AZ-TEXT word processor would report “AOS ERROR 21” when I tried to print a file. Of course, the number 21 meant nothing to me so I used the CLI MESSAGE command to show the text of the error message. The message was “FILE DOES NOT EXIST.” I don’t know how many hours I spent trying to find out why AZ-TEXT couldn’t find my file. (I was still a novice.) I could see the file in the directory, I could DISPLAY it, and edit it—the only thing I couldn’t do was print it!

I finally discovered that the file it couldn’t find was not my file, but rather the IPC file through which it was trying to communicate with the server (formatter). The server had died without me knowing it. The AZ-TEXT program committed two sins: it showed the error code instead of looking up the error text, and it didn’t interpret the error code in the context of the error. In fact, it should have said, “FORMATTER NOT RUNNING, PLEASE CONTACT YOUR SYSTEM MANAGER.” Is that too much to ask? I don’t think so!

Most of the AOS{/VS} system calls return a completion code in accumulator 0 (AC0). If you are using the F77 isys function to make system calls, the completion code is returned as the function value. Fortran 77 I/O operations also return a completion code in the variable (usually “IER”) specified with the IOSTAT=IER option. As far as I know, all of the other programming languages work the same way. The code is 0 if the operation succeeded; otherwise, it is an

error code number that is unique within the entire system.

When you make system calls with isys, the completion code is automatically returned as the function value; you may choose to ignore it or process it. If you are using Fortran 77 I/O routines (OPEN, CLOSE, READ, WRITE, INQUIRE, REWIND, BACKSPACE, and ENDFILE), you can either retrieve the completion code with the IOSTAT=IER option and process it yourself:

```
READ(*,*,IOSTAT=IER) X
IF(IER.NE.0) . . .
```

or you can let the Fortran 77 runtime error reporter handle it by not using the IOSTAT=IER option:

```
READ(*,*) X
```

There is absolutely no excuse for using the latter “unguarded” form of the READ statement. If an error occurs, the runtime error reporter for Fortran 77 (or whatever language you are using) dumps a whole page of gibberish on the screen and terminates the program. For example, if “BYE” is entered from



the keyboard for the above free-format read of a REAL variable, the result is shown in Figure 1.

Now I ask you, is that tacky or is that tacky? This hardly qualifies as a “user-friendly” program. Not only is the text of the error message listed twice, but so is the error code number. The fp (frame pointer) and pc (program counter) values are meaningless unless you have the assembly language code generated by the compiler and the LINK load map beside you. Of course, if you had compiled with /PROCID or /LINEID, the runtime error reporter would also list the subroutine name and line number for you (in addition to the rest of the report).

If the code for READ/WRITE or other I/O operations on disk files is reason-

Figure 1

```
ERROR          11343.
Invalid real or complex input form for LIST DIRECTED input
at location: 16001724174K.

ERROR OCCURRED DURING ACCESS TO UNIT 5
WHILE EXECUTING A LIST DIRECTED READ

CONTENTS OF INPUT RECORD:
BYE
^(2)
TASK terminated

ERROR          11343.
Call Traceback:
  from fp=16000006410,   pc=16001747003
  from fp=16000006316,   pc=16001725773
  from fp=16000006162,   pc=16001732511
  from fp=16000006136,   pc=16001724204
  from fp=              0,   pc=16001757410

Invalid real or complex input form for LIST DIRECTED input
```

ably well debugged, you may choose not to retrieve the completion code with `IOSTAT=` and let the runtime error reporter have a field day on totally unexpected (but rare) errors. However, you should *always* retrieve the completion code and process it yourself for critical operations such as file `OPEN` and all console I/O.

In addition to `IOSTAT=IER`, you may also choose to use the `END=n` and/or `ERR=n` branches. You can use `ERR=n` to go somewhere else to process the error, or you can simply process the error below the I/O statement. `ERR=n` without `IOSTAT=IER` is somewhat useless because, although you know an error occurred, you still don't know the error number. `END=n` can be used without `IOSTAT=IER` because it has only one meaning: end-of-file.

Now that you have decided to process the `IER` or `ISYS` completion code yourself, what are you going to do with it?

The following is not very useful or bulletproof:

```
READ(*,*,IOSTAT=IER) X
IF(IER.NE.0) THEN
```

```
WRITE(*,*)"ERROR CODE=",IER
STOP
END IF
```

The problem is not only that it doesn't list the error text in plain English, but also that it doesn't check for simple and recoverable (especially for console I/O) errors first. Listing the error text or code and stopping should only be a last resort for a program.

If the I/O operation was `READ`, the first item to check for is `IER=-1`, especially if the read was from the console. A `CTRL-D` from the keyboard will generate `IER=-1` or cause the `READ` to follow the `END=n` branch. Note that -1 is the Fortran 77 standard error code for "end-of-file." If you are checking for EOF on `?READ`, the AOS{VS} code for EOF is 24 (`EREOF`). The AOS{VS} error codes and their mnemonics are listed in `PARU.32.SR` (AOS{VS}) or `PARU.SR` (AOS).

If the completion code is not zero or -1, then you must do a little more work. The treatment of the error depends on the context of your program, but at the very least, you should list the text of the error message. This can be done

using the `ERRCODE` routine supplied with Fortran 77. (See the *Fortran 77 Environment Manual*.) The calling sequence is:

	Unit	Action
<code>CALL ERRCODE(IER)</code>	program	program terminates
<code>CALL ERRCODE(IER,0)</code>	task	task continues
<code>CALL ERRCODE(IER,1)</code>	task	task terminates
<code>CALL ERRCODE(IER,N)</code>	program	program terminates

Now if you use `ERRCODE`, you will find that regardless of which option is selected for argument 2, the listing of the error text is the same. It is shown in Figure 2.

While certainly better than the runtime error reporter, it still leaves a lot to be desired. (It lists everything twice and still insists on showing fp and pc information.)

AOS{VS} has a file called `:ERMES`, which is a huge file of all of the error code numbers and error text. The system manager creates `:ERMES` by combining all of the error message text files created for each AOS{VS} product (`SPEED`, `SED`, `LINK`, `EXEC`, `CLI`, `DUMP.II`, and `LOAD.II`) as well as each programming language. The runtime error reporter and `ERRCODE` provide the same function as the `CLI MESSAGE` command;

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they just differ in their presentation. They all use the ?ERMSG system call to look up the text in the :ERMES file for a particular error code number. If you see the error text "UNKNOWN MESSAGE CODE," it means the :ERMES file on your system hasn't been built or updated properly.

Subroutine LISTERR shown in Figure 3 is yet another routine that looks up the error text, but this one differs because it allows you full control of the format of the error text listing.

The ?ERMSG system call uses an AOS{VS} channel to read from the :ERMES file. Originally, if ?ERMSG failed, I had it look up its own error code. This worked fine until I had a program that used all available channels, and LISTERR went into an infinite loop on ?ERNMC.

You can modify LISTERR to suit your taste. I usually use it after listing a context error message:

```
OPEN(1,FILE="XXX",IOSTAT=IER,...
IF(IER.NE.0) THEN
  WRITE(*,*)"ERROR WHILE OPENING FILE
  'XXX'"
  CALL LISTERR(IER)
  STOP
END IF
```

Variations

1. You can also supply the context message text as an argument to LISTERR:

```
IF(IER.NE.0) THEN
  CALL LISTERR(IER,"ERROR WHILE OPENING
  'XXX'")
  STOP
END IF
```

so that LISTERR lists the context error message for you.

2. If the error occurred on a READ or WRITE statement, you can pass the F77 logical unit number as an argument, and LISTERR can look up and list the name of the file:

```
SUBROUTINE LISTERR(ICHANNEL,IER)
CHARACTER*256 PATHNAME
IF(ICHANNEL.GE.0) THEN
  INQUIRE(ICHANNEL,FILE=PATHNAME)
  WRITE(*,*)"ERROR OCCURRED ON FILE
  ",PATHNAME
END IF
...
```

In this case, if the IER error did not occur on I/O statement, simply call LISTERR with -1 instead of the F77 logical unit number.

3. You may also wish to add an argument to indicate whether or not the error is fatal (like ERRCODE); if fatal, LISTERR does a STOP after listing the error text.

Figure 2

```
ERROR          11342.
Invalid integer input form for LIST DIRECTED input

ERROR          11342.

Call Traceback:

from fp=16000006136, pc=16001714272
from fp=          0, pc=16001757141

Invalid integer input form for LIST DIRECTED input
```

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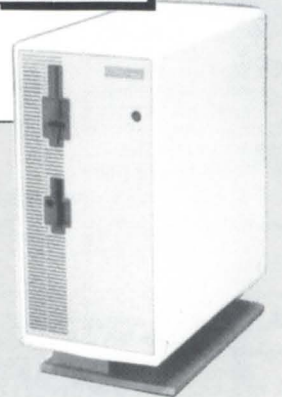
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AOS{VS} TRICKS

Figure 3

```
subroutine listerr(iostat_ier)

include      "qsym.f77.in"
integer*4    iostat_ier
integer*4    isys,ac0,ac1,ac2,ier
character*500 etext

c>>>begin
c-->check for no error
      if(iostat_ier.eq.0)      return      !false alarm

c-->if -1, then f77 eof
      if(iostat_ier.eq.-1) then
        write(*,*) "<7><24>Error<25> -1: F77 End-of-File"
        return
      end if

c-->if no free channels, do it manually or it will loop
      if(iostat_ier.eq.?ernmc) then
        etext="NO FREE CHANNELS"
        ac0=16                                !message length
        go to 2                                !list it
      end if

c-->look up text for error code
      ac0=iostat_ier

1      ac1=len(etext)*256 + 377k                !read from ' :ermes'
      ac2=byteaddr(etext)
      ier=isys(?errmsg,ac0,ac1,ac2)
      if(ier.eq.0)      go to 2                !list it

c...if 'no free channels', give up
      if(ier.eq.?ernmc) then
        etext="CAN'T LOOK UP ERROR TEXT"
        ac0=24                                !message length
        go to 2                                !list it
      else
        write(*,*)"CAN'T GET ERROR TEXT FOR IER=",Iostat_ier
        ac0=ier                                !lookup ?errmsg error instead
        go to 1                                !try again
      end if

c-->list error (ac0=length in bytes)
c...re-open if record too long (ignore any error)
2      if(ac0.gt.136) open(*,maxrecl=ac0+1,iostat=ier)

      write(*,*) "<7><24>Error<25> ",iostat_ier
      write(*,*) "<11>",etext(1:ac0)

      return

end
```

In the preceding examples, the error text is retrieved and listed by the application program (LISTERR, ERRCODE, or the F77 runtime error reporter). Another method of reporting error message text is to use the ?TERMINATE or ?RETURN system call.

In this case, the error code is returned to the program's father. If the father is the CLI, the CLI will list the

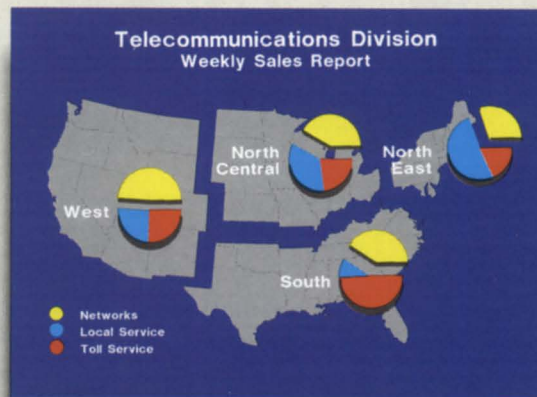
error text for you. More on that in a future article. Δ

John A. Grant is a geophysicist with the Geological Survey of Canada. He is also system manager, chief cook, and bottle washer for the Exploration Geophysics Subdivision's MV/4000. He may be contacted at 601 Booth St., Room 591, Ottawa, Ontario, K1A 0E8; 613/996-2325.

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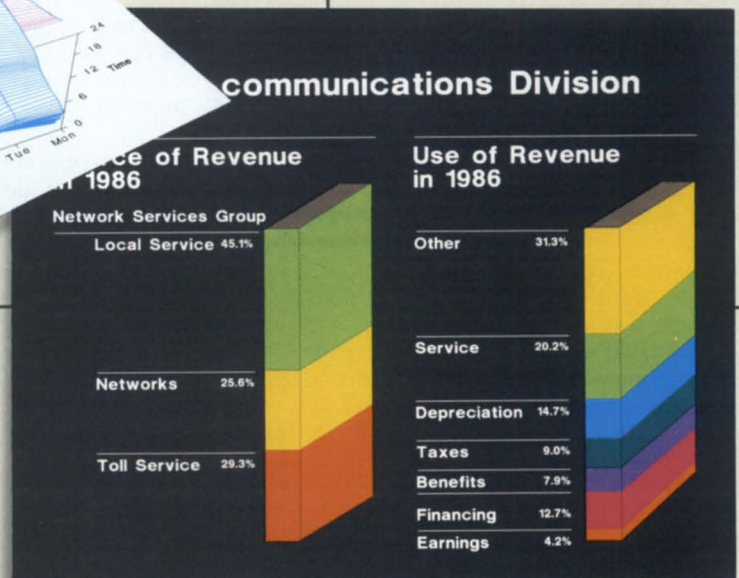
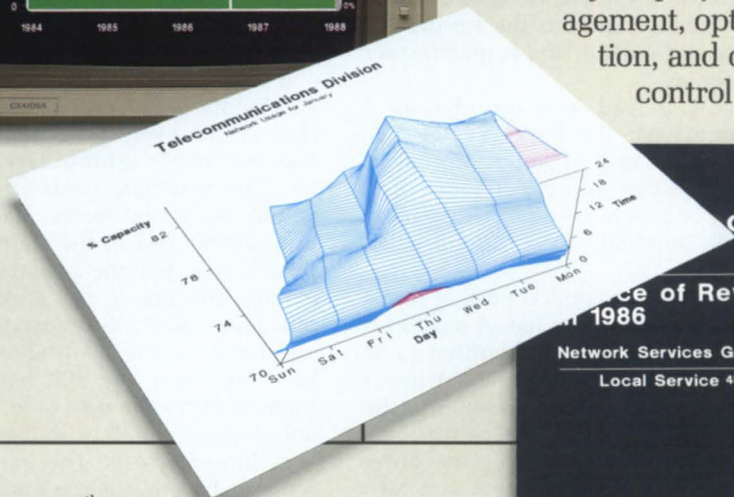
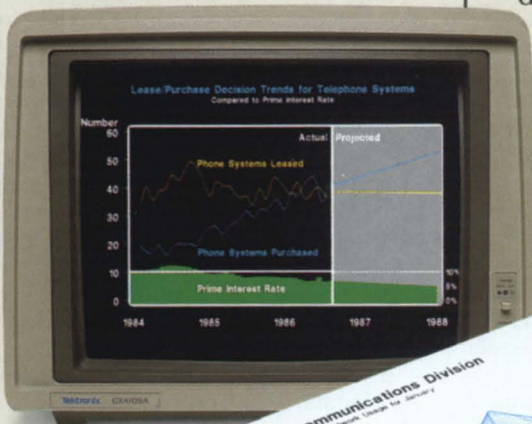
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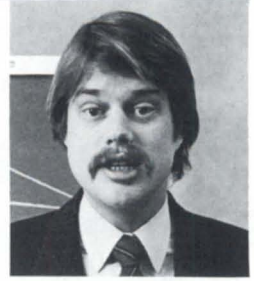


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TIPS OF THE TRADE



A few pointers for good programming

My columns in the May and June issues of *Focus* led you through the BBASIC Hall of Shame, spotlighting the programming techniques least likely to succeed. This month, to present a more balanced picture, I'd like to discuss some methods of writing more robust and reliable code.

This is an area I've given a lot of attention to throughout the years. When you've got a couple of hundred installations to worry about, the time you spend in support can be significant. It's worth some trouble to do whatever can be done to reduce this.

Even if you're responsible for just one site, it's often worth taking some pains. Software is almost certain to have bugs in it, but even if it is perfect, it will still mess up one day from hardware or operator error. (Idiot-proof software may be impossible: idiots seem to get smarter all the time!)

So, let's look at some of the techniques of Integrity Programming:

1. STOP after KADD and KDEL: If adding or deleting a key is unsuccessful, the last argument is returned as zero. Always place a statement after KADDS or KDELS to check this value and force an immediate STOP or error condition if it occurs.

Let me stress the "always" in that statement. Even if I'm absolutely sure that there is no way the operation could fail, it could bomb for a reason beyond any possible imagination. If it does fail, we're sure to get a call to the help desk about a report that doesn't balance, or whatever.

If an index operation doesn't complete, you want to know about it right away. This way you can figure out immediately what went wrong, not at the end of the month when all you can do is rebuild the file and hope it doesn't get messed up again.

This test is especially useful during development. When software is first

being tested, index files constantly get incorrect data. It pays to get the bad news early.

I'm so convinced of the importance of this checking that I avoid the use of index files with duplicate keys, preferring to make the key a few bytes longer so it will be unique.

2. Check after READ: Using the same logic, it's a good idea to check if the record you just read in from a file is the one you expected. Do it by checking the value of some field such as the order number, customer number, etc. If it's the right one, you use a short amount of time. If it's the wrong one, you avoid updating the wrong record, or even the wrong file.

A few times when a disk drive has gone bad, this checking has prevented bad data in one file from being updated to another file that was still all right.

3. Put the key in the data record: This one seems obvious, but it is violated regularly. Sooner or later, you're going to have to rebuild an index file. Make sure everything you need is in the data file. You'll see another reason for this when I discuss integrity tests.

4. Put back pointers in records: If you have a record that is accessed by a pointer, put a pointer back to the original record. If the record is in a linked list, a pointer back to the header (or first) record will do, and is much easier to program.

After you read in a record from a pointer, check the back pointer (see number 2 above). Pointers are more likely to get messed up than index files, but can be much more efficient. Therefore, it's important to be careful when using them.

I once saw an application that had a linked list to the order file. A record for one of the detail lines got written a few bytes to the left, and the customer number was used as the pointer to the next line. You can imagine the mess the whole system was in after the order was updated! A simple check of a back pointer would have saved a lot of grief.

5. What to do with an error: My approach to an unexpected error has always been to halt all further operations on that terminal, forcing the operator to

contact the help desk right away. Of course, this means support had better be available quickly. The sooner the support people find out about a problem, the smaller it will be and the easier it will be to fix.

The best way to react is to have a global ON ERR condition that goes to a standard recovery routine. This routine should first do an ON ERR THEN INT, then report the error in the screen (program name, line number, error message), tell the operator to get help, and SAVE the program under a different name.

It is important to have the option of hitting a BREAK key here and getting into console mode. One of the great advantages of BBASIC is its interactive nature, allowing programs and data to be changed by the programmer in the middle of execution. If an error condition interrupts a complex update of files, the option to fix the problem and continue can often prevent having to do a complete restore of the data base.

The root of this logic shows an important reason why CHAIN is better than SWAP. If you are SWAPPED, going into console mode returns you to the original environment, losing the program and data in which the error occurred. (Note that in B32, you stay SWAPPED until the program actually terminates, which helps a lot.)

If your error-handling code has more statements than you care to have included with every program in the system, you might want to LIST them to a file. The first thing your error routine would do is an ENTER statement to bring in the rest of the code. This approach gives you the advantage of later making changes to the error-handling procedure that will automatically take effect everywhere. On the other hand, be careful that you still have enough room to ENTER the new code; if you run out of space, you'll be in big trouble!

6. Integrity tests: The hardest problems to fix are not the ones that give you a neat, concise error message on the screen. The worst ones always seem to occur after the month-end reports are printed, and something doesn't add right. You can deduce that something

went wrong in the last month, but you have a hard time pinpointing when and what program.

Most of our systems have a great deal of idle time during off hours. We put them to work running integrity tests of the data in the system. We check the keys against the data files (and vice versa), add up the outstanding invoices, compare them against the A/R account, and see if the detail G/L balances agree with all the levels of account totals.

Designing good integrity tests is a job that should be done when the rest of the system is designed. A simple example is to have the data file contain all the key fields, but other checking features can also be designed in from the beginning.

Every night, our computers do all the checking an operator should do at each month end. Any problems that are found are reported in a one-page report, along with a message to call support. Because the problem must have occurred in the previous 24 hours (since the last time the integrity tests were run), it is relatively easy to ask what might have happened in between.

If amounts are out of balance, the difference can often be matched with a specific transaction. When questioned about a specific situation, an operator might be able to remember something useful.

All of our integrity tests are on a separate menu. The system is chained to them automatically as part of the night processing. This approach lets us run individual tests at any time, or to ask the user to run them. The most elusive problems might even demand you to run the tests once an hour until the problem occurs again.

■ **In other Business BASIC news,** Data General has found a serious problem that might affect some of you. If you have an index file that uses block numbers within a physical file higher than 32767, you may experience some corruption problems.

A single index file this large probably never occurs. However, if you use logical files, and over-allocate them in ad-

vance so you never need to expand them, you could easily end up in this situation.

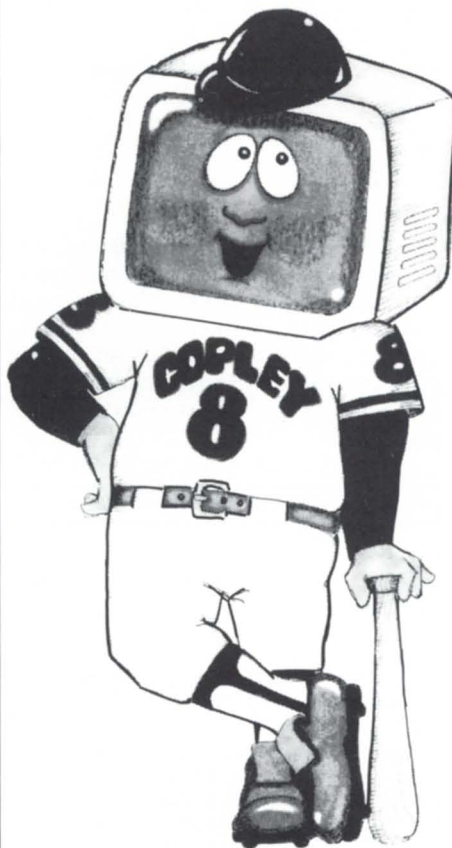
A patched version of OINDEX.OB should be available now from your local SE for AOS/VS Business BASIC. The patch for AOS may also be available by the time you read this. It will be included as part of the next release of Business BASIC as well. There is no

need to install this patch if your files don't reach this size.

The latest revision of B32 has an enhancement that's been high on many people's wish lists for quite some time. It includes a nice DO WHILE statement that works just like you'd expect. Does this mean BBASIC programmers will stop using GOTO statements and become responsible structured programmers? Δ

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George Henne, a contributing editor to Focus, has worked with Business BASIC users for nearly a decade. He is the vice president of MAXON Computer Systems, and can be reached at 575 Madison Avenue, Suite 1006, New York, NY 10022; 416/445-4823.

Circle 12 on reader service card.



BORING? MAYBE!

But these tips could save you some time and trouble

Many of you might find the topic this month a little less than interesting. Maybe it is. However, I feel that most system managers should take a good look at these techniques. I've extracted them from various :UP.CLI macro commands at a number of client sites over the last few years. These techniques have so vastly simplified bringing the system up or down that it has cut down on the number of support calls I have to answer.

You may ask, "How can you simplify a totally automated UP macro?" Easy. Most macros are designed to bring a system completely up or completely down from a system that is in the other state (i.e., down or up). I have enhanced them so that if anything doesn't come up (or down) for any reason, the up/down macro can be rerun in its entirety without something else getting messed up.

In general, my UP macros handle things in the following order:

1. configuration of peripherals
2. starting global process servers
3. starting applications servers
4. starting EXEC and the users.

Step 1 is the configuration of peripherals. I discovered some time ago that it became easier to sysgen all IAC ports as standard CRT3 type terminals and use CHAR/DEF statements in the UP macro to make the minor adjustments needed for the different devices attached to the system. The wonderful advantage of this is that, if you need to move things around, you just change a few lines of the UP macro and away you go. No need to gen a new system. Quick and easy. Also, when I logged onto a system, all I had to do was look at the first part of the UP macro, and most of the configuration of that system was readily available.

Let's back up a step. The macro :UP.CLI that I had on many systems was extremely short. It allowed a "dumb" operator to simply hit NEWLINE, and it would continue on. In a recovery situation, it would allow an easy way to by-

pass the normal boot procedure. See the listing below.

```
UP.CLI
write
superu on
write Hit N to bypass the standard boot
  procedure
string/= @null [!read or hit NEWLINE to
  continue . . . ]
comment Next line converts lower to upper case
[!equal,(!string),.n)string N[!end]
[!equal,(!string),.N)
write
write Bypassing standard boot procedure
write Entering CLI
write
[!else]
  :UP1
[!end]
```

As you can see from the listing, UP1 does all the work. Well, that's half right. UP1 decides what needs to be done and calls a number of other macros to do it. The first thing UP1 does is set up the environment for the boot and define the peripherals. This is shown in Figure 1.

In defining the serial devices, I have

done two things. I have given generic names to devices by naming the three printers and the modem. These names replace the CONX name and will be used by all other macros. This will be demonstrated later in this column. (See "Start LQP @BOB" in February '87 for an in-depth look at this technique.) I also set up my printers to run at a slower baud rate, not so slow as to allow them to sit idle, but slow enough to smooth out the load on the system. (See "Overrated Overload" by Brian Johnson, June 86 for more information.)

Most significant though is that, by using the generic name, you won't have a problem changing characteristics. The above example doesn't include multiple disks because that deserves a whole paragraph itself. Most people bring in the second, third, etc. disk drive by doing simply "INIT DPF1," "INIT DPJ1," and so on. I still do that for a few select clients; however, I prefer using the following method. When I format the disks, I give the system disk the name and ID of "DISK0." All of the other drives become "DISK1," "DISK2," etc.

Figure 1: UP1.CLI—initialization

```
[!une,[!pid],2]
write
write **** ERROR **** You aren't PID 2.
write **** I won't let you do this ****
write
[!else]
push; prompt pop ; comment to restore things if needed
superuser on
dir :
searchlist :macros :util
comment - Tape Drives
create/link/2=ig @mta0 @mtb0 ; comm some applications want mta0!
acl/2=ignore @mtb0 + ware
Comment - Serial Devices
create/link @sysprinter @lpb ; Comment main printer
create/link @gatecon
@con17 ; Comment modem
create/link @lqp1
@con16 ; Comment daisy wheel for typing pool
create/link @dmp1
@con14 ; Comment dot matrix for pick lists
Char/def/baud=19200/2=ig @con(2 3 4) ; comment programmer's CRTs
Char/def/baud=4800/2=ig @con(7 8) ; comment upper management's
Char/def/baud=1200/2=ig @gatecon ; comment modem for GATE/BLAST
Char/def/baud=600/on/ofc/nas/off/eb0/2=ig @lqp1
Char/def/baud=2400/on/ofc/nas/off/eb0/2=ig @dmp1
...rest of up1.cli
[!end] ; Comment - this is for the PID=2 check
```

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This naming convention allows me to describe the device as a disk drive, and I can handle up to 100 drives on a system before I exceed the six character limit of the disk name. All disk drives will be INITed into the root directory. All the directories on these drives that are used by the applications will be linked through the disk drive number, so I can use the disk ID to see if I need to INIT it into the system as follows:

```
write
[!equal,[!file :DISK1],]
write Bringing DISK1 into the system
init @dpj1
[!else]
write DISK1 already in system
[!end]
write
```

For systems with only one or two drives, I insert the code in :UP.CLI for each disk. For systems with a lot of drives, I write a macro called INIT_DISK.CLI with two arguments, the first being the disk number (from 1 to 99), and the second is the drive name. Then :UP.CLI can call it like this:

```
INIT_DISK 1 @DPJ1
INIT_DISK 2 @DPJ10
INIT_DISK 3 @DPJ11
INIT_DISK 4 @DPJ20!@DPJ21 ; com Mirrored disk!
```

When each disk drive was installed, I decided what directories would be stored on that drive, moved them over, and created a link. For example, DISK1 might be for the CEO_FILES. In that case, I would have created a link from :CEO_FILES to :DISK1:CEO_FILES, leaving :CEO_FILES in the root as a link. CEO will be happy; it doesn't care that its directory is actually on another disk. Even if it looked for a file :CEO.FILE:DUMMY_FILE.A, it would still be found on DISK1. It's not that unusual for an application to assume a certain directory structure from the root, but if it's written well, all files are opened in such a way that AOS/VS can resolve the link.

At this point, all the peripherals are defined, and the disks initiated. It's time to start up the software. Unfortunately, I've run out of space for this month. We'll get to that next time. Δ

Jim Siegman is a contributing editor to Focus, chairman of the NADGUG publications committee, and treasurer of the Chicago Area Data General User Group. Send comments or questions to him c/o of Focus Magazine, 5332 Thunder Creek Road, Suite 105, Austin, TX 78759-4022.

DG announces PC integration products

Data General has announced several new hardware and software products for the integration of IBM and IBM-compatible personal computers with Data General MV family departmental computers.

DG/PC*I is an integrated platform of hardware and software products consisting of industry-standard LAN choices, distributed operating systems, and data communications services. This platform is designed to support specific network-ready applications such as the new CEOWrite word processing package and other Microsoft MS-DOS applications.

Another product, called PXA (Profs Exchange Architecture), provides electronic mail and document exchange connections between the IBM Professional Office System (Profs) and Data General's CEO office automation system.

DG/PC*I offers the user a choice of three different LANs so physical wiring schemes already installed can be used. The LANs are: DG/StarLAN (IEEE 802.3 1Base5), Thin Ethernet (IEEE 802.3 10Base2), and Ethernet (IEEE802.3 10Base5).

DG/StarLAN has a data transfer rate of 1 megabit per second. It uses existing voice-grade twisted pair telephone wiring, so it can be configured within existing telephone wiring schemes.

Thin Ethernet has a transfer rate of 10 megabits per second. It uses common RG-58 coaxial cable, the same type used for cable television programs, so it is less expensive and easier to install than standard Ethernet. It also incorporates an on-board transceiver.

Ethernet also has a transfer rate of 10 megabits per second. However, it supports connections of 500 meters, compared to 185 meters for Thin Ethernet. Ethernet uses an RG-9 coaxial cable, the standard cable used for Ethernet LANs.

The LANs can link personal computers directly to departmental minicomputers, which can function as communication, file, or print servers. Servers give the user access to shared peripheral equipment and data files. LAN selection is based on cost and performance requirements of the specific applications environment.

DG/PC*I supports all Data General

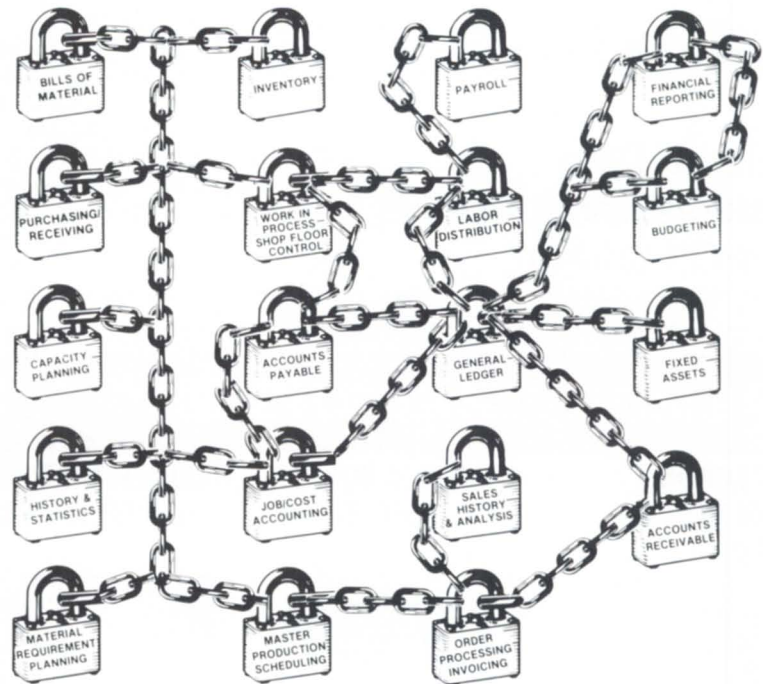
MV family computer systems and DS/7000 series engineering workstations, along with a range of personal computers including DG/One, Dasher/One, Dasher/286 as well as IBM PC, IBM PC-XT, IBM PC-AT, and specific IBM PC compatibles.

DG/PC*I support was announced for

a networking version of the Microsoft Corporation MS-DOS operating system. MS-NET enables network-ready MS-DOS application software packages such as dBase III+ and MS-WORD to run with the DG/PC*I platform.

Part of the platform also includes the Workstation Transport System (WTS), a

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Each of the application modules are designed to function independently with automatic interfaces to other modules as they are added. Thus a client can start with a selective system and expand easily as required. The software operates on Data General Eclipse* 'C' or 'MV' series hardware which allows a wide range of expansion without change in the operating system. For the smaller manufacturing company, a modified software package is available for the Data General Desktop Generation.*

JAI software may be leased or purchased and is fully warranted with full maintenance contracts available at a nominal fee. COBOL Source Code is available should the client choose to modify and/or maintain his own software.

* Eclipse and Desktop Generation are Data General Registered Trademarks

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NETBIOS- and ISO-compatible interface between application programs and the physical network. WTS allows for linking with systems and applications from vendors complying with these standards.

Lastly, DG introduced new functionality to CEOwrite, the MS-DOS word processing program. Through CEO Connection, a file transfer program, CEOwrite users have access to a range of CEO functions such as electronic mail, calendaring, document exchange, and scheduling.

New CEOwrite 2.00 features include: spelling corrector, automatic hyphenation, column editing, snaking, and scientific and math functions.

The price for CEOwrite 2.00 is \$450. Δ

Rational Data Systems announces DG/PC*I add-on

Corte Madera, CA—Rational Data

Systems (RDS) announced NetLink, the first add-on product to Data General's PC integration platform, DG/PC*I.

Based on their earlier micro-mini product, PC/VS, NetLink provides a variety of minicomputer-based services for PC-compatible workstations, including virtual disk and print service, file transfer, remote command execution, and electronic mail notification.

RDS and Data General have agreed to offer current PC/VS users licenses for DG/PC*I and NetLink at no charge.

According to Doug Kaye, president of RDS, "Many customers have requested Microsoft MS-NET-compatible file service along with PC/VS."

"We prefer to call this a migration rather than an upgrade," he said, referring to the fact that although PC/VS users who switch to NetLink and DG/PC*I gain file service and NETBIOS compatibility, they also give up more PC memory and lose certain PC/VS features such as LAN-based terminal emulation (PopTerm).

NetLink includes software for both

the minicomputer and the workstation, but unlike PC/VS, which comes with Ethernet hardware, NetLink uses the Ethernet or StarLAN hardware already in use for the DG/PC*I network.

NetLink is in final testing and will be shipped in August.

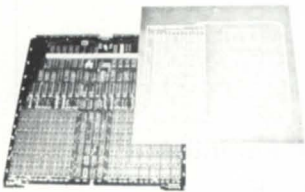
Rational Data Systems, 5725 Paradise Dr., Corte Madera, CA 94925; 415/924-0840. Δ

CPI offers digital and analog input/output equipment

Pompano Beach, FL—The Measurement and Control Division of Computer Products Inc. (CPI) offers digital and analog input/output equipment that is compatible with Data General 32-bit computers through the use of a CPI-designed Input/Output Bus Converter (IOBC). Both programmed I/O and DMA modes of operation are supported.

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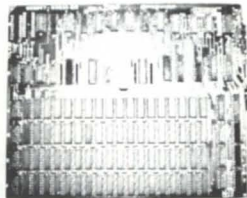
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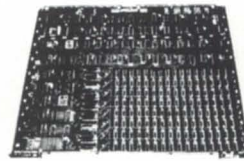
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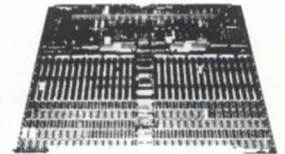
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of CPI's Real-Time Products (RTP), I/O subsystems, and chassis in conjunction with the DG AOS/VS operating system. RTP is also compatible with Eclipse, Nova, and microNova computers.

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Mr. Milton Larson
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Dear Milton,

I have finally found the time in my hectic schedule to express my appreciation for the value of your VS Toolbox package. I have been using it for quite some time now, so I can safely say that it is a fully debugged, working set of programs.

My first interest in VS Toolbox was aroused by the Rebuilder and the other INPOS-related programs, and they are still the programs which I use most often. I have been regularly rebuilding all our INPOS files ever since, and have had some dramatic improvements. In one benchmark taken, a particular report program reduced its CPU time from two hours to twenty minutes.

Our INPOS files are complex, using up to six levels, linked subindexes, inversions, and (in one case) partial records. Our application programs are written so that they use an optimal subindex node size which we calculated in advance (since in many cases there is no way in our applications to know in how many keys will be written to the subindexes). Still, this has proven to be much more efficient than simply taking the default 2047. Despite this, a rebuild of the files using your REBUILDER program with the OPTIMIZE switch reduced the size of the indices substantially - up to 50%. Of course this means that the rebuilt files are not only more efficient, but also consume less disk space.

I would like also to thank you for your helpfulness and responsiveness in the three cases in which we experienced problems with your software. I can only add that I wish all our software suppliers were as knowledgeable and cooperative as your company has proven to be.

Sincerely,
BOBST GROUP INC.
Gary Littleton
Gary Littleton
Manager of Data Processing

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GCS offers modular control system software

Houston—GeoControl Systems, Inc. (GCS) has announced the availability of its Flexcon modular control system software on DG Eclipse MV computer systems. The software can be configured to provide functions ranging from simple data acquisition to fully automated closed loop control and factory automation.

Flexcon's modular architecture allows users to design control systems to meet specific functional requirements. Flexcon systems are used in industries such as petroleum/gas pipelines, electric utilities, aerospace materials testing, food processing, and operator training simulation.

Remote terminal units, programmable logic controllers, intelligent instruments, measuring devices, or stand-alone process control systems can be used for data acquisition with the software. The architecture can be configured for stand-alone computers, multiple computer master/submaster systems, and independent computer systems communicating with each other. Flexcon can communicate with remote devices via local links, LANs, and wide area networks based on dedicated communication lines or microwave/satellite links.

The operator interfaces with Flexcon through keyboards, light pens, or touch-sensitive screens. Standard features include dedicated alarm zones on displays and touch-sensitive poke points on specially adapted color graphic CRTs.

Flexcon software is available from GCS for any data acquisition or control

Circle 18 on reader service card.

application, or GCS can provide turnkey configuration and installation of complex hardware/software configurations.

GeoControl Systems, Inc., 1100 Hercules, Suite 200, Houston, TX 77058; 713/488-8571. Δ

CIMPAC offers inventory and production control software

Concord, MA—CIMPAC Computer Integrated Manufacturing Systems now offers an inventory and production control system called CIMPAL Manufacturing that has been designed within Oracle's relational data base system. The system uses Oracle's utilities and fourth generation language.

The CIMPAL Manufacturing MRP module contains:

- screen functionality for the maintenance of master schedule information
- the ability to pass this schedule against product structure information maintained in bills of material
- an MRP explosion that identifies component and subassembly demands. These MRP produced demands are visible in various formats including on-line supply/demand inquiries as well as vertical and bucketed reports.

A separate BOM (Bill Of Material) module provides for documentation control of parts (item master) and product structure (bill of material). This module also includes standard reporting features including: indented, summarized, and costed bills of material; indented where used; and parts listing.

The purchasing module permits the entry and printing of purchase orders and the tracking of open orders. In addition to a master vendor file, the system maintains information identifying qualified vendors for each part and historical information on vendor performance. The MRP module produces purchase action recommendations that can be translated by the user into system-generated purchase orders.

The stockroom module provides for the receipt of material needed for manufacturing against purchase orders, the receipt of built assemblies from the factory on shop orders, cycle counting and inventory adjustment, the movement of stock between stockroom or warehouse locations, and the shipment

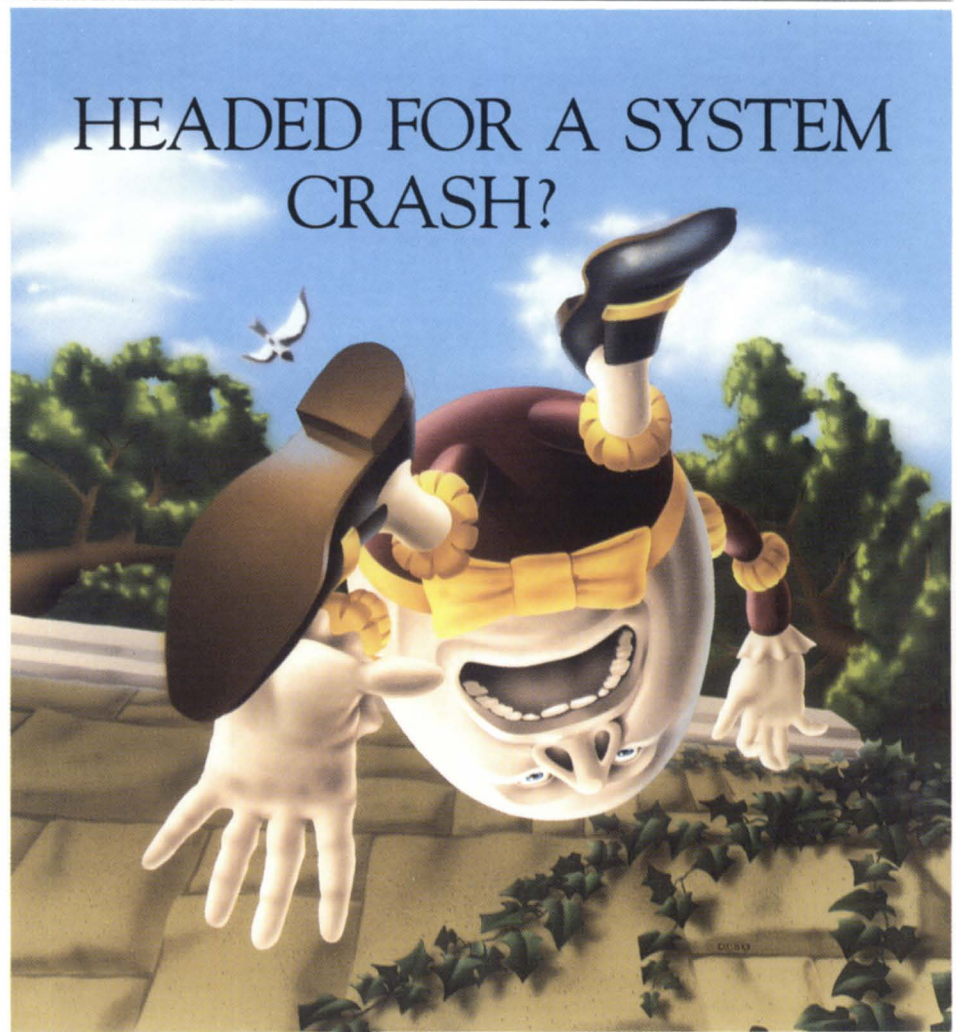
of finished goods against sales orders.

The Work In Progress (WIP) module permits the release of shop orders based on MRP recommendation, the issuance of kits, and the release of shop orders. Material released on kits is tracked and costed to WIP until the work order is received back into inventory as an assembled component.

The sales order module permits the entry and printing of sales orders and provides visibility to open orders.

The package runs on MV machines under AOS/VS or DG/UX. The runtime license for CIMPAL Manufacturing on an MV/2000 costs \$25,000.

CIMPAC, Damonmill Sq., Suite 5C, Concord, MA 01742; 617/369-0015. Δ



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Circle 19 on reader service card.

(from page 25)

It is worth noting that AOS/VS is very tolerant of interrupt handlers consuming a lot of time. When capturing experimental data, we can allow our system to sit at interrupt level locking out all other interrupts for many minutes in order to maximize data throughput. The consequences are that terminal I/O is lost and the time-of-day clock isn't updated. The code fragment that clears our device is shown in Figure 4. This example shows how straightforward it can be in AOS/VS to define an interrupt handler.

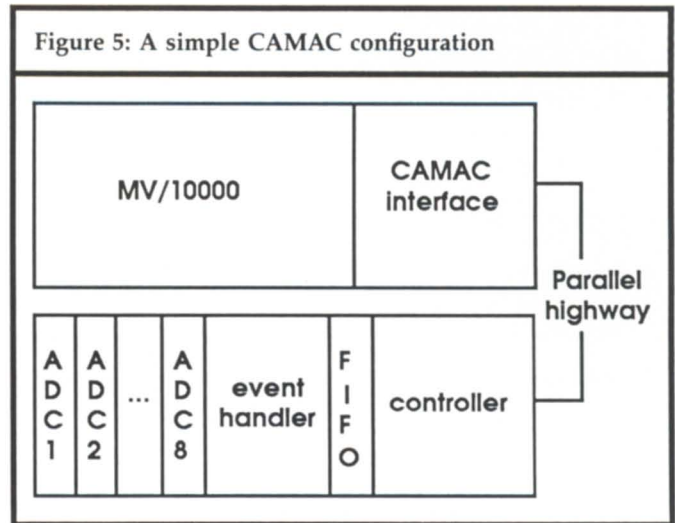
Data rate limits

One of the important considerations for a real-time system is the maximum average data throughput rate. This is generally a complicated value to project, and is usually well below the maximum computer bus speeds of about 2 MB/sec for the MV data channel or 10 MB/sec for the burst multiplexor channel. For example, a typical fast tape drive can only transfer about 200 KB/sec, and it is difficult to transfer more than 1 MB/sec to most disk drives.

I recently made some measurements on a complex system to determine whether an MV/10000 could accept a continuous data stream and process it at a rate of 800 KB/sec (or 1.25 microseconds/byte). My conclusion was that it could be handled with a few modifications to our present data acquisition software.

First, I have to describe how we plan to take this data. Figure 5 shows schematically the CAMAC hardware for this ex-

Figure 5: A simple CAMAC configuration



periment. It shows a simple CAMAC configuration with eight ADCs, a dedicated processor, and memory in a crate attached to a controller on an MV/10000. The data source is a collection of detectors to be used for a measurement of a physical principle called time-reversal violation, which is basically the statement that the laws of physics are the same if time flows forward or backward. We plan to run 50,000 events per second into eight detectors, each producing a 16-bit data word, giving the 800 KB/sec rate mentioned above.

The CAMAC analog to digital converters (ADCs) take only 5 microseconds to digitize the pulses. A specialized byte slice processor module, called an event handler, performs the CAMAC read operations and stores the values from each event in a first-in, first-out (FIFO) memory. This processor is capable of reading the data at about 2 MB/sec, and doesn't contribute much to the system speed limitation.

The MV/10000 receives an interrupt when the FIFO is one-quarter full, and a direct memory access (DMA) transfer is initiated. The time from the interrupt until the interrupt-handling software starts to act was 120 microseconds on an MV/10000 (155 microseconds on an MV/4000). The DMA rate that the CAMAC interface can support was measured as 430 KB/sec (faster on an MV/4000 at 580 KB/sec). This rate limit can be tackled by tuning the CAMAC interface hardware for faster cycles, plus compacting data by the event handler to reduce the required byte rate. If this weren't possible, we couldn't meet the experimental requirements. The time it takes to analyze and dispose of one event of data is about 15 microseconds.

If this sequence were to happen in a serial fashion, we couldn't handle data at the required rate. But by grouping data in the FIFO at an optimal level, the interrupt latency, DMA transfers, and event processing can be overlapped in time. We predict that a maximum rate of 55,000 events per second (which is effectively 880 KB/sec) can be handled. Even so, the experiment will last several months and fill hundreds of tapes with data. Δ

Dr. Richard T. Kouzes is a research physicist at Princeton University where he conducts research in nuclear physics and instrumentation. He is a member of the IEEE Technical Committee on Computer Applications in Nuclear and Plasma Sciences. He may be reached at Princeton University, Department of Physics, Jadwin Hall, P.O. Box 708, Princeton, NJ 08544; 609/452-4425, or at 0457523@PUCC on BITNET.

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Some of the biggest news comes from little (and unobtrusive) press releases. In one of the most recent announcements, DG has expanded its On-call Support Services to include additional selected non-DG hardware products integrated into customers' DG computer systems.

This announcement follows another one made earlier this month that said DG was extending support to the IBM family of personal computers, along with popular peripherals and options cards that are part of DG's new DG/PC*I integration network. This exemplifies DG's move to support mixed-vendor environments, providing customers with a single source for service. Among the hardware products that DG will support are Genicom, Dataproducts, and NEC printers; Urx interactive voice processors; and Micom communications equipment. During the coming months, DG will continue to add more non-Data General printers, plotters, drives, controllers, and other hardware products to the list.

Don't MIS out! Conference 87 is putting new emphasis on end-user and management concerns. Addressing the latter category, James C. Wetherbe, director of the MIS Research Center at the University of Minnesota, will lead two seminars at the NADGUG conference. He stresses that information systems are powerful and competitive tools. According to Dr. Wetherbe, MIS managers must constantly be looking to update their systems, or else become outdated. But in order to attend these sessions, you must first register to attend. Packets are in the mail. Sign up early and you may be eligible to win a DG/One!

As noted here last month, the strains of Data General "In Concert" culminated in the announcement of several new products, including the DG/PC*I. This assemblage of products addresses those buzzwords "information management" with a three-tier model that integrates corporate mainframes, personal computers, and mid-range supermini-computers. For details, see page 53.

Lobster and butter are just two reasons to attend Access Technology's third annual 20/20 user group meeting held in Boston's Marriott Copley Place from

August 12 to 14. 20/20 is the company's integrated spreadsheet program for DG and other machines. The 1986 meeting brought 226 attendees from 163 organizations.

The two-day schedule includes technical sessions; an applications panel discussion; and sessions with topics including teaching 20/20, macros, 20/20 and Lotus 1-2-3, and 20/20 and OA systems.

The \$190 attendance fee covers seminar sessions, handouts, conference materials, the opening night reception, two continental breakfasts, two lunches, and, of course, a lobster dinner. For more information, contact Access Technology, 6 Pleasant St., South Natick, MA 01760; 617/655-9191.

Citicorp Information Resources (CIR) has selected Data Assurance Corporation (DAC), a Colorado-based disaster recovery firm, to provide on-line alternate data processing facilities for CIR's DG-equipped data centers that operate the Galaxy 2000 Credit Union System. Equipped with an MV/20000, DAC will subcontract similar services to CIR bank and credit union customers that use in-house Data General computer systems.

According to Marshall Burton, CIR spokesman, the selection of DAC was made shortly after CIR bought an MV/20000 to be used as the primary computer at CIR's four large data centers.

The people at Interscience Computer Services, Inc. used a lot of ink lately, having recently signed several agreements with other companies. They entered an agreement with Interface Electronics to sell and service Interface's DG-compatible products in the southwestern United States.

Two of the new Interface products that Interscience (based in Augora Hills, California) will distribute are SLIM, a 16-line intelligent multiplexor, and SLAM, a 16-line asynchronous multiplexor.

In two separate deals, Interscience has also acquired the line and band printer division of BDS. They signed a similar agreement with Zetaco to distribute the Zetaco line of DG-compatible products. Interscience will sell and service all Zetaco's DG-compatible disk, tape, and printer products as well as the new memories.

In a move to strengthen user support and distribution, the authors of SM BASIC, Yermac Data Systems of Canada, have appointed DI/Systems as exclusive marketing representatives for U.S. and international markets.

SM BASIC is a programming language with several hundred installations on Data General's 16- and 32-bit products under their RDOS and AOS/VS operating systems. SM BASIC was originally developed to provide an easy migration path for MAI/BASIC Four users.

As part of this development, CI/Systems is offering new licenses to current users, along with a set of system utilities and a year of support. CI/Systems' support facility provides experienced BBASIC programmers to answer field problems by mail or telephone.

"Ideas in Action" is the theme for the 9th Annual Reseller Conference to be held September 20 to 23 at the Hotel Meridien in New Orleans. More than 150 DG Value-Added Resellers from around the world are expected to attend.

The workshops and panel sessions will emphasize practical facts and techniques that VARs can apply to better operate and grow their business.

The agenda, covering marketing, sales, business, and technical topics, will be conducted by VARs, industry experts, and Data General staff. A new addition to the program, a VAR-to-VAR Networking Breakfast, will give VARs the opportunity to make business contacts and exchange ideas.

Those registered by August 19 are eligible for reduced registration fees as well as the grand prize drawing for a DG/One Model 2T. For more information or for a registration package, contact Data General Marketing Communications at 617/898-4086 or 617/898-4088.

"Wake up and smell the coffee," is some advice from a disgruntled Paul Duck via a Quick Connect card. In the abridged version, he writes, "Regarding the May letters section and the gentleman who thinks that the IBM/38 will 'outperform any Data General equipment on the market,' I'll bet that's what your IBM rep would like to have you think. Statistically, the MV/20000 Model II runs circles around the System/38." Δ



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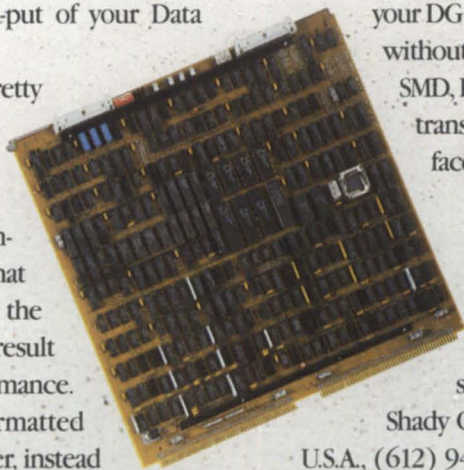
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