NOVEMBER 1974

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Computer Decisions

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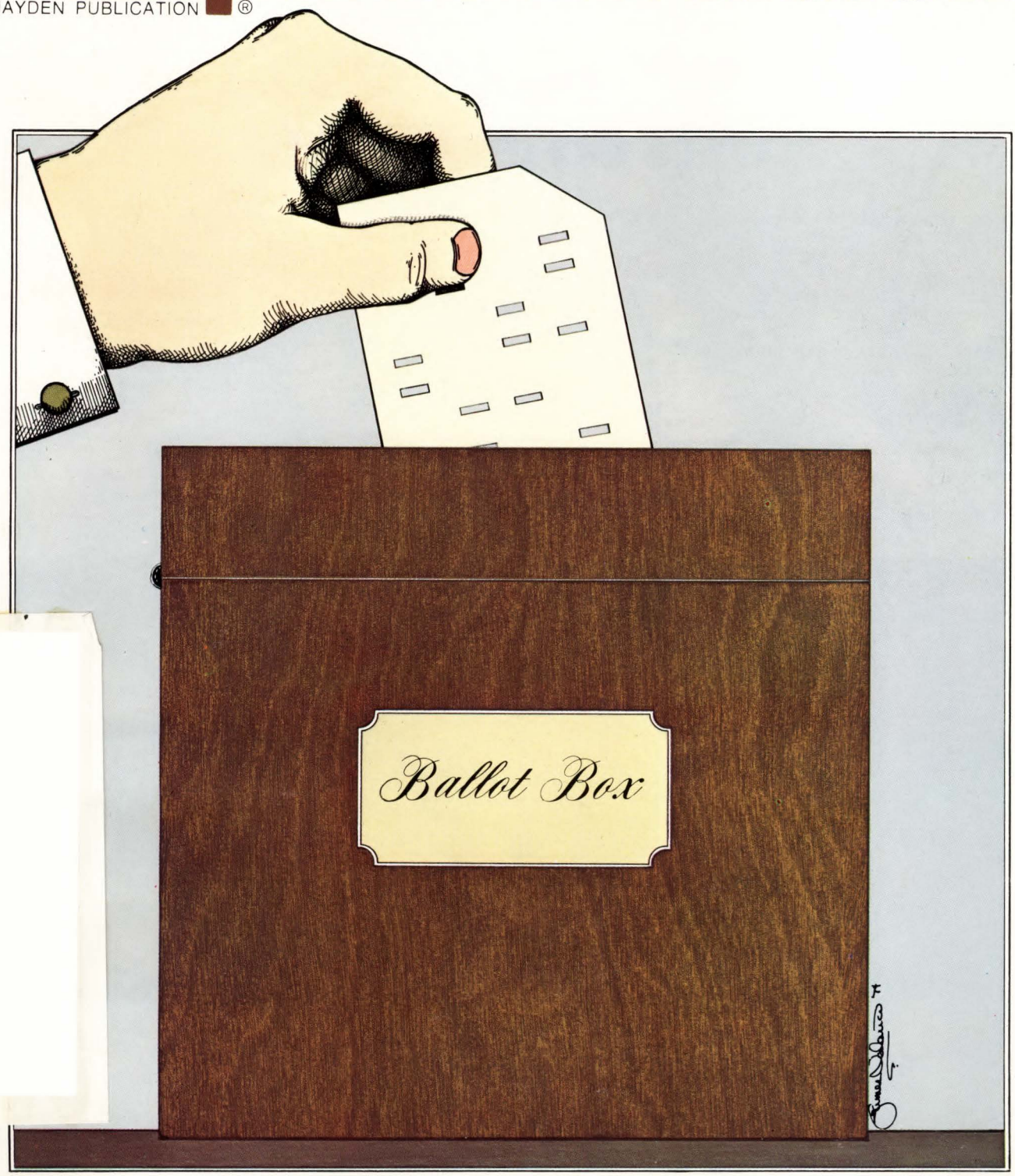
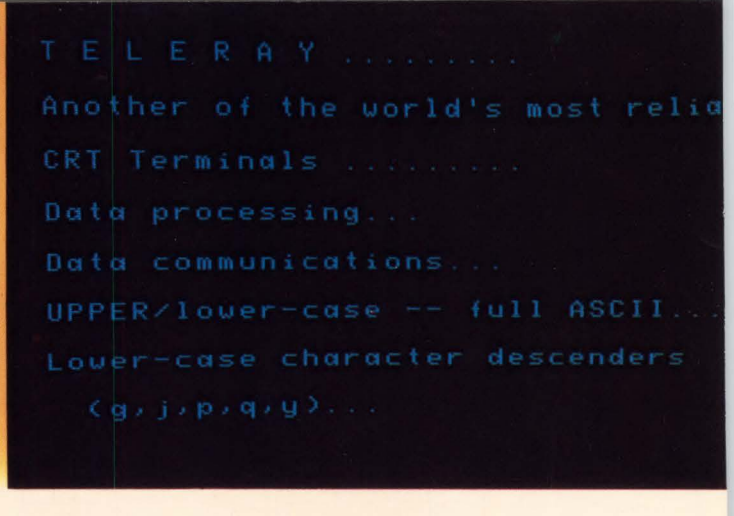


Computerized voting: many happy returns?



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INFORMATION RETRIEVAL NUMBER 91

Computer Decisions

DEPARTMENTS

NEW DEVELOPMENTS

Cover: So far, electronic voting is no ballot-doux, but we'll probably box in the problems by '76.
Illustration by James Talarico.

FEATURES

INFORMATION SYSTEMS AUTOMATED PROCESSING PROBLEM SOLVING VOLUME 6 NUMBER 11 NOVEMBER 1974

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COMPUTER DECISIONS is published monthly by Hayden Publishing Company, Inc., 50 Essex St. Rochelle Park, NJ 07662, (201) 843-0550. James S. Mulholland, Jr., President and Treasurer, and Peter T. Rado, Secretary. Printed at Brown Printing Co., Inc. at Waseca, MN and New York, N.Y.

Controlled circulation postage paid at Waseca, MN and New York, NY and postage pending at Rochelle Park, NJ. Subscription limited to persons with active, professional, functional responsibility in computer or computer user industry. Publisher reserves the right to reject non-qualified requests. No subscriptions accepted without complete qualifying information. Subscription rates: Qualified subscribers in the U.S., free; Canada, $12.00; all other countries $15.00 one year. Limited quota of subscriptions available for persons outside of field served as follows: U.S. and possessions and Canada, $24.00 one year, $48.00 three years; all other countries $30.00 one year, $60.00 three years. Single copies: $3.00

UNDERCURRENTS

Hewlett-Packard reels off mini-cassette

It is said that 3M cassettes, with their little rubber bands, are the most reliable in the industry; Phillips cassettes are a handier size, but not as well-respected in the world of engineering. Combining the best of both worlds, Hewlett-Packard will offer a scaled-down version of the 3M-type tape cassette, roughly the size of the Phillips unit. The mini-tape, which is believed to have a capacity of 100,000 characters, will be made by 3M, the patent-holder. The tape drive will be manufactured by HP. The cassettes will be used with the firm's new line of terminals and may also be offered as a paper tape replacement aboard minicomputer systems. The drive destined for HP's terminals is said to be intelligent. For instance, if the user plucks out the cassette during a data reading operation, when he drops it back the drive will automatically retreat to the beginning of the block of data. HP will reportedly offer the tapes and drives as oem products to speed their dispersion throughout the industry.

Will Wilson get IBM to fish out Memorex?

One Wall Street whisperer has a theory that rings true when all the personalities are factored in. It goes like this: Suppose that Memorex Corp. will settle its $3-billion suit against IBM for three cents on the dollar. IBM is out of the expensive courtroom and Memorex goes into the black with a $100-million kitty. IBM may also have to buy gear from Memorex, but the details don't matter. The gist of the argument in favor is that Telex cost Armonk about 21 cents on the dollar, more or less, so far. The key is Bob Wilson, president of Memorex, who did wonders for Collins Radio, as you may recall. He is one of the best businessmen in the trade. If a deal comes off, watch the bucks get sunk into some monolithic memory house, like AMS of Sunnyvale, CA, so Memorex can make the equipment it will force IBM to buy.

Von Neumann team next NCC Pioneers

As you may recall, the last NCC gave special honors to Dartmouth's timesharing developers. Next year the Pioneers' Day fete will be "We Remember Von Neumann," a get-together of those scientists who built the first modern programmable computer. Among the greats of Princeton and computing history who will attend are Herman Goldstine, Bruce Gilchrist, James Pomerene and Willis Ware. Ware was a founder and the first president of AFIPS, which sponsors NCC. The Von Neumann machine now resides in the Smithsonian. So far there are no plans to bring it to Anaheim, but we bet that someone will simulate it on an HP-45.

Oil's well that ends well

Rumors recently went around financial circles that Arab interests were going to scoop up all the loose IBM stock. Even the Reuters wire is said to have carried the tale. One analyst we know had to set up a super conference call to quell panic among his firm's traders. Some readers phoned to check out the facts with our editors and suggested such things as a sell now, nationalize later foreign policy. Well, it was a steal at $150. . . .

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INFORMATION RETRIEVAL NUMBER 3

NEWSDATA

Charge-card bankers will lead EFT growth

The nation's charge-card bankers will take a leading role in the development of electronic funds transfer services, according to John J. Reynolds, president and chief executive officer of Interbank Card Association, which licenses use of Master Charge cards to 6,600 banks in the United States.

Speaking recently at the annual convention of the American Bankers Association Bank Card Division in New Orleans, Reynolds called on the retail banking industry to use the knowledge it had gained in building bank charge cards "to expand and improve retail banking by creating the total EFT environment of the future."

That environment, Reynolds said, "will be the electronic interfacing of local, regional and national systems for the purpose of transferring funds between banks, retailers, small businesses, large corporations and the consumer."

Most important EFT elements for retail bankers, however, are transactions between consumers and merchants at the point-of-sale, between consumers and banks and between merchants and banks. In such dealings electronic impulses will exchange the value data that is now being transferred by the present paper-based systems.

Reynolds pointed out that national EFT will require interchange between banks. Since charge-card bankers already have two national associations whose business it is to facilitate interchange, they are the logical groups to assume the leadership role. Interbank's national authorization system, INAS, and National BankAmericard's BASE have been transmitting value data in an electronic mode for more than a year.

Reynolds said that Interbank is exploring the possibility of developing a bank services card that will provide national interchange in both credits and debits and which could be capable of performing a wide range of other services. "A sweeping research program to study design and specifications of alternative systems is now under way," he reported.

Stockbroker group gets computerized management

National Clearing Corp., a subsidiary of the National Association of Securities Dealers, has signed a contract with Bradford Computer & Systems Inc. for management of its facilities.

The system, which permits brokers to settle money and securities with one another after trades take place, ran at a deficit of nearly $900,000 in the first eight months of this year. Bradford is expected to protect NCC against further losses and improve its cash flow by about $90,000 a month.

The parent group's automated quotation system for over-the-counter stocks, NASDAQ, is being pushed as the composite quotation system for all listed securities. The SEC is promoting a central market which would display bid and asked prices for all exchange-listed securities, whether traded in exchanges or over the counter. This would permit competition among dealers across the country in offering the best stock prices.

ICL fights for place as USSR top supplier

Détente is resulting in some surprising commercial realignments.

Not so long ago, Britain's ICL seemed to have virtually cornered the Soviet market for Western hardware and technological know-how, while any deals made behind the Iron Curtain by American computer manufacturers were regarded as "guns for the Indians."

Almost total reversal of this state of affairs has occurred. ICL's 70-man staff in Moscow, which includes 50 Soviet citizens, sits around doing nothing much. No sale has been made in ten months, and ICL has scored only three contracts in as many years. However, IBM, Control Data, Univac and Burroughs all have joined the once-select ranks of fully accredited Western firms, as has West Germany's Siemens. And now the politically explicable but technologically improbable prospect of France's CII marketing briskly in the USSR can be discerned.

IBM has Intourist's $15-million contract firmly in hand and reportedly the $40-million Kama River project too. Air France and Univac have clinched the $20-million Aeroflot reservations deal, giving a few edp commissars the chance for *Ninochka*-type escapades in Paris. Control Data, Univac and Burroughs all have plans for large-scale manufacturing plants on Russian soil.

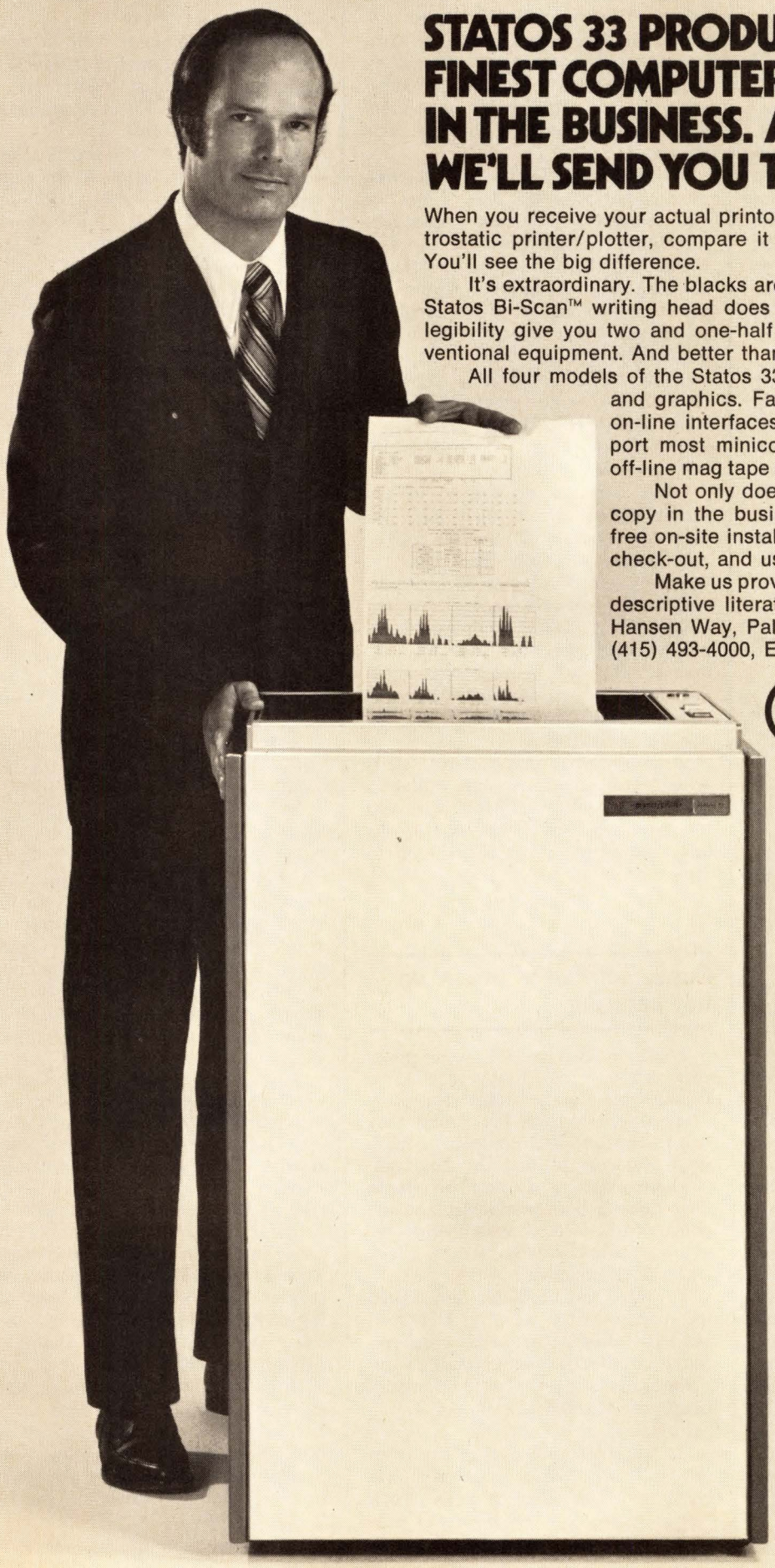
Meanwhile ICL's activities are largely confined to expanding the 18 systems it has installed in the Soviet Union. Its prestigious customers include Moskwitch, Morflot and the Ministries of Radio Production and Foreign Trade. Ralph Land, longtime boss of the British company's Russian trade, has been transferred to West Germany for what can only be a lost-cause marketing effort. Don Broido, ICL's supersalesman in the Soviet Union, has left the company altogether.

ICL owed its favored position to its readiness to trade technology and software knowledge for hardware orders. Large chunks of the initial software for the Eastern bloc's RIAD series of third-generation mainframes was developed on ICL System 4 machines. And the British company's willingness to use Russian-made components in its computers also helped its chances.

But now RIAD is well under way, and the Russians have access to the technology they have coveted for so long. ICL, which could have followed up its initial hardware sales with strengthened "Anglo-Soviet co-operation," got cold feet just as détente was gathering momentum.

Even more galling, CII is trying to negotiate across-the-board compatibil-

continues on page six . . .



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INFORMATION RETRIEVAL NUMBER 5

NEWSDATA. . .

. . . from page four

ity between its large range of Irisbrand mainframes and the RIAD systems, a coup which would open the way to considerable sales throughout the Comecon area. CII, in conjunction with one of its parents, French electronics giant Thomson-CSF, is also discussing with the Russians the prospect of building a components factory three times the size of its own main plant in Toulouse.

Surrounded by a storm of activity in which it is not taking part, unable to fire Russian staff to cut down on expenses, ICL finds itself in an unholy situation. So now the British manufacturer is reportedly preparing to gamble, proposing to staff its Moscow office solely with Soviet citizens. The wisdom of such a move will only be determined in the future.

Hens lay an egg a day eating the computer way

What do pregnant women and a million hens have in common?

Well, yes, they all reproduce. But that's not the proper response. The right answer is diet. The women follow a food plan chosen by their obstetricians and cooked according to Julia Child or Fanny Farmer. The hens eat what an IBM 1130 dictates, blended by an IBM System /7.

These slick chicks are residents of a 600-acre hennery in San Marcos, CA. Their ancestors (there's old Bill and Coo again) were a few fowls who settled in a garage on the Prohoroff Poultry Farms 30 years ago. If they're looking down from Chicken Heaven, they can see about 1.2 million of their descendants producing nearly that many eggs each day.

Brooding over this extravagant hen party is general manager John Prohoroff, Jr. He's not chicken. He admits he wants his feathered females to produce daily eggs, and he wants hen fruit of high nutritional value as well. Both depend on well-balanced feed.

But a hen is a capricious creature —a change in the weather or in the age she admits to might make her decide to lay down on the job and withhold that daily ellipsoid. What's needed is a master chef to provide the best diet to keep 'em rolling. And that's where the 1130 enters.

It takes a thousand tons of feed each week to nurture the flocks on the farm, and that ain't hay—it's a blend of ingredients from four basic food groups. The computer devises formulas that include cereal grains like corn and millet, high-protein foods such as soy beans and meat by-products, minerals like calcium and phosphorous, and concentrated vitamin supplements.

When a flock (that's 70,000 birds of a feather, together) doesn't meet its diurnal quota, its menu is changed, sometimes as often as six times a week. And there are about 17 flocks clucking around. Another reason for the computer chef to switch formulas frequently: The ups and downs of commodity prices. If corn costs more one day, the computer may call for a cheaper substitute that fulfills the same dietary need. If soy beans drop in price another day, a revised menu may use more of them.

Food formulas are mixed in the farm's computer-controlled mill. To make sure that the computer's recipes are blended correctly, load cells on the conveyor belt weigh the ingredients as they move toward the mixing chutes. The System/7 compares actual weights with prescribed amounts, and operates the mill chute doors, which automatically open and close to control the flow of ingredients into the mixing mechanism.

Altering feed mixes almost daily would have been impossible without a computer system, says Prohoroff. And the increased productivity and profits have really given him something to crow about.

Cops, computer break up hot car ring

Police in Wayne, MI, were pretty sure that a certain junkyard was the headquarters of a stolen car ring. They staged a raid, but found they had to check the ID numbers of more than 500 cars to find the hot ones.

Phone-checking the numbers would have tied up both manpower and the police headquarters' switchboard for hours; radio-checking would have jammed all channels.

To solve the problem, they called the cops — the nearby Dearborn Heights police department, which recently installed two-way portable computers, made by Atlantic Research Corp. of Alexandria, VA, in its 15 patrol cars.

As workmen pulled each car from the junkyard stacks, a policeman relayed its ID number to a Dearborn Heights patrol car. By means of programs developed for the Arcom system by Computer Sciences Corporation of El Segundo, CA, the number was sent by radio to a minicomputer at police headquarters.

The minicomputer then sent the number to State Law Enforcement Information Network computers in Lansing, where it was checked against a list of stolen cars.

Within three or four seconds, police in the junkyard knew whether they had a "hit" (stolen car) or a "no-hit." More than a dozen stolen vehicles were found among the first 80 cars checked out.

Frustrations fade as DAAS speeds supplies

One of the most frustrating problems facing a supply requisitioner is identifying the correct sources for the millions of items used by the Department of Defense and several civilian agencies.

With the installation of DAAS, the Defense Automatic Addressing System, this problem has been solved. In addition, service has been speeded up and the cost of routing logistics messages has been substantially cut. DAAS acts as a single point for receiving requests, which are automatically addressed and routed to their proper destinations.

The new process, implemented from concepts designed by the Defense Supply Agency's DAAS office in Dayton, integrates both communications and requisition processing in a single system. It is built around five Control Data 3500 computers, interfaced with four CDC 1700 communications processors, which in turn are interfaced with AUTODIN, the Department of Defense worldwide communications network.

More than a million transactions are handled by DAAS each day. Supply requisitions, from General Services Administration, National Aeronautics and Space Administration, Federal Aviation Administration, as well as the Defense Department, are entered into communications terminals in machine-processible form. Round-the-clock, seven days a week, they are sent through AUTODIN switching centers to either of the two DAAS sites, Gentile Air Force Station in Dayton and Tracy, CA.

Prior to the development of DAAS, each request had to be sent to the last known supply source. Since the DOD inventory alone contains some 5-million active items, and the source of these items is constantly shifting,

continues on page seventy-four . . .

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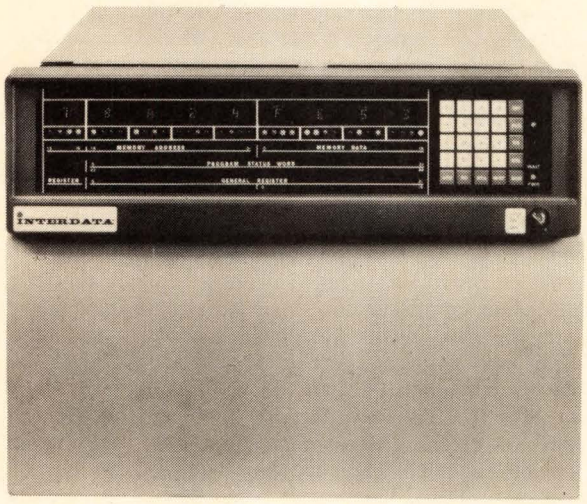

Performance	7/32	Nova 840	PDP-11/40
Word length	32	16	16
Memory speed (nanoseconds)	750	800	900
Maximum memory capacity (bytes)	1,048,576	262,144	262,144
Addressing range (bytes)			
Direct	1,048,576	512	65,536
Relative	±16,384	±256	±32,768
Indexed	1,048,576	65,536	65,536
Double indexed	1,048,576	No	No
General-purpose registers	32 32-bit	4 16-bit	8 16-bit
Index registers	30 32-bit	2 16-bit	8 16-bit
Vectored interrupt levels	Yes	No	Yes
Minimum interrupt overhead time (usec)	6.5	47.5	46.5

Price	7/32	Nova 840	PDP-11/40
32 KB processor	$ 9,950	$12,930	$15,345
64 KB processor	14,450	19,330	26,925
128 KB processor	23,450	35,630	44,725
256 KB processor	41,450	61,230	80,825
1 Megabyte processor	171,650	Not available	Not available

Source: Data General Price List, 5/15/73. DEC PDP-11/40 Price List, 6/73. DEC OEM & Product Services Catalog, 1972. Auerbach Minicomputer Characteristic Digest, June, 1973. "How to use Nova Computers", 1973.

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INFORMATION RETRIEVAL NUMBER 7

WASHINGTON DATALINK

by Linda Flato

DENY IBM-COMSAT UNION, FCC URGED

The Justice Department has asked the Federal Communications Commision to either defer action on IBM's petition for a domestic satellite system with Communications Satellite Corp. or "deny it without prejudice." Early action by the FCC, the department said, would prevent the situation from ripening into a full antitrust violation. Delay in facing the competitive issues raised by the proposal, it warned, "will create additional problems."

Complaining about the "lack of specific information" in the IBM-Comsat petition, the Justice Department told the FCC that it should make IBM and Comsat "provide data on their precise plans and on the nature of the various markets and submarkets relevant to those plans."

The joining of IBM, with its "leading role in almost every area touching upon computers and computer technology," and Comsat, the leading firm in the communications satellite field, "could well raise very high barriers to other entrants and have a further chilling effect on competition," the department warned. As a result of Comsat's position as a domsat partner of both IBM and AT&T, Justice also argued, potential competition between AT&T and IBM-Comsat could be lost if they decided to serve different markets.

The Federal Trade Commission, concerned over the "anticompetitive impact" that the IBM-Comsat venture would have on communications and data processing markets, has also urged the FCC to reject the proposal.

The antitrust agency identified two types of anticompetitive impact that could result from the IBM-Comsat combination. The first was the elimination of potential competition that could otherwise exist if IBM independently, or with limited "toehold" acquisitions of expertise, entered the specialized domsat market. the intergrated business information handling market or related submarket. The second was the entrenchment of CML, bolstered by the joint power, expertise and resources of IBM and Comsat in those markets, so that other potential competitors would be unable to compete meaningfully.

The FTC warned its sister agency that IBM's "combination of resources and know-how would seem to give IBM a commanding lead over other companies in the integrated information handling market." Specialized satellite communications systems, the FTC pointed out, "could provide IBM with a uniquely efficient means of creating a nationwide domestic communications system, tying together a major portion of the nation's computer and non-voice communications capability."

Other protests have been filed by Sanders Associates, Inc., the Computer Industry Association and Sperry Rand Corp. Sanders, which recently announced plans to sue IBM, characterized the IBM-Comsat venture as a "blatant attempt to totally capture the market of the future." Describing potential interconnection problems, Sanders charged that "under the guise of the complexities of satellite communications, and employing an added feature—software——IBM can and will conjure up all manner of obfuscating reasons to impede interconnection for all but its own business products and customers."

Sanders warned the FCC that IBM will carry its "exclusionary" tactics over into the communications arena by not disclosing transmission protocols and device support parameters for its satellite systems and the business equipment attached to it "until it is well into production, has been premarketed extensively and is ready to ship." Using such tactics, Sanders maintained, IBM will "dominate, to the exclusion of meaningful competition, the integrated business information handling market."

The CIA voiced similar objections to the IBM-Comsat arrangement, saying that "the opportunities for IBM and an owned or controlled communications carrier to unite computer and communications services in exclusionary ways are literally, and unfortunately, beyond enumeration." The association urged the FCC, if it does okay the proposal, to provide safeguards to prevent IBM from using CML to extend its monoply power and thwart the development of meaningful competition in the voice, data communications and data processing industries."

The CIA's proposed safeguards were these: IBM should divest itself of controlling interest in CML before CML launches a satellite; IBM should reduce its controlling membership on the board of directors before a satellite is launched; IBM should not supply any equipment to CML; equipment to CML should be supplied on a competitive bidding basis; CML should disclose information about all interfaces.

Sperry Rand joined forces with other industry protestors and asked the commission to hold full-scale evidentiary hearings on the proposal. The joint venture "leads to a number of regulatory issues" which Sperry said should be examined in depth by the FCC.

AT&T FORCED TO PROVIDE HOOKUPS

AT&T's stifling interconnection policies are slowly being liberalized by the strong arm of the Federal Commission. In the latest FCC move, Bell has been forced to provide domestic satellite carriers with full interconnection, including foreign exchange (FX) and common control switching arrangement (CCSA). In support of the position, the FCC cited the earlier Bell domsat grant which, it said, gives Bell a clear "obligation to interconnect with the domestic satellite carriers for purposes of FX and CCSA services." Earlier in September, the agency suspended until Nov. 30 part of AT&T's proposed tariff revisions, which would have severely restricted domsat carrier access to the switched network.

AT&T's restrictive interconnect practices had been vigorously protested by various domsat carriers, including American Satellite Corp. and Western Union. Both firms had filed petitions during the summer urging the FCC to

order AT&T interconnection. The FCC denied a recent ASC request that it revoke AT&T's authorization for a domsat service, scheduled to begin in 1976.

In another FCC action, MCI Communications Corp. asked the commission to reject the proposed tariff revisions, filed by AT&T in August, for interconnection with its competitors. MCI charged that Bell's "discriminatory and predatory policy" violates sections of the Communications Act and antitrust laws. The firm asked the commission to deny the tariffs and require Bell to file new tariffs "to provide service to the specialized carriers at rates, and under terms and conditions, as favorable as those accorded to the Long Lines Department, the independent telephone companies and Western Union."

The FCC has given United States Transmission Systems, Inc. the go-ahead to build a specialized carrier net between New York and Houston, in another move designed to foster greater competition in the common carrier market. USTS, an ITT subsidiary, will use the Transcontinental Gas Pipeline Corp. right-of-way to cover 40 cities in the eastern and southern U. S. The microwave network will consist of 59 stations between New York, Philadelphia, Washington, Norfolk, Atlanta, Baton Rouge and Houston.

FINAL PUSH ON TO PASS PRIVACY LAW

The big push is on in Congress to get the long-awaited privacy legislation passed before the 93rd session winds up next month. The bills—H.R. 16373, introduced by Rep. William S. Moorhead (D-PA), and S. 3418, sponsored by Sen. Sam J. Ervin (D-NC)—are expected to pass by substantial margins in the House and Senate. The measures have been forwarded to a House-Senate conference committee, where they will be merged into one comprehensive bill.

The Moorhead bill, called the Privacy Act of 1974, is a distillation of other privacy measures and recommendations, including the Comprehensive Right to Privacy Act sponsored by Rep. Edward L. Koch (D-NY) and Rep. Barry Goldwater Jr. (R-CA). Koch and Goldwater are among the 12 cosponsors of the bill, which was unanimously approved by the House Government Operations Committee in late September. The legislation is designed to help safeguard the collection and use of records maintained in federal government computer systems. Provisions in the bill allow individuals to have access to their files, to obtain copies and to change erroneous data. The measure also protects transfer of information from one agency to another by requiring an individual's prior written consent.

S. 3418, described as "Ervin's baby," is a stiffer version of the Moorhead bill. Aimed mainly at federal information-gathering practices, the bill was passed by the Senate Government Operations Committee in August. The measure, which Ervin has been pushing for 20 years, would create a Federal Privacy Board to regulate government data banks and the kind of information that goes into them. A Privacy Protection Commission would also be created to investigate the impact of privacy on the public and private sectors.

The controversial social security number restrictions were deleted from both bills. Sen. Barry M. Goldwater (R-AZ) and Sen. Charles H. Percy (R-IL) offered an SSN amendment to S. 3418 in September. The proposed amendment would limit the use of the number to social security purposes. Modeled after an SSN bill Goldwater introduced last year, the amendment would allow individuals to withhold their SSNs. The amendment's restrictions would apply to any federal information system started after January 1, 1975.

Federal agencies, concerned over the controls the bills would impose on their data-gathering activities, have been pressuring Congress to modify some of the bill's provisions. The Office of Management and Budget late last summer sent comments to both the House and Senate committees, requesting various technical changes in the bills. A proposed executive order was also circulated to agencies, suggesting privacy policies which should be followed in the event Congress failed to pass the privacy legislation. The General Services Administration has reportedly drawn up similar interim guidelines modeled after the Moorhead bill.

A spokesman for the House Government Operations Committee expressed optimism over the final bill's passage. He dismissed the agencies' kibitzing, saying that it was a "ploy to try to get Congress to put in a couple of changes. They raised the specter of a veto, but I don't think that there is a snowball's chance in hell that President Ford will veto it."

IBM UNVEILS SPACE-GEARED SYSTEM

Zeroing in on the lucrative aerospace market, IBM unveiled its new hybrid technology computer at a recent Air Force Association meeting in Washington. Developed over more than a year by IBM's Space Systems facility in Huntsville, AL, under a contract with NASA's Marshall Space Flight Center, the HTC system is geared for various space and avionics applications.

An offshoot of NASA's Ultra-reliable Modular Computer (SUM-C) systems, the basic HTC contains 65 chips mounted in 21 LSI modules for a minimal memory configuration. Memory—monolithic or core—is 16k expandable to 64k. Cycle time is 440 nanoseconds. The general register CPU is functionally partitioned into four segments for data flow, sequence control, architecture-dependent processing and timing and miscellaneous tasks.

The system operates with fixed point word lengths of eight, 16 and 32 words, and instruction word lengths of 16, 32 and 48 bits, using standard 360 instruction multiplexing to 10 or more external channels.

STANDARD CODE USE DWINDLING

A recent Department of Commerce report on ASCII has revealed that while federal agencies have made "significant progress" in stocking up on DP gear with ASCII capability, enthusiasm for the standard code appears to be dwindling. A government/industry advisory group, appointed by the Secretary of Commerce early last year, has investigated the impact of the six-year-old code on federal computer operations. The result of that study indicate that federal DP users have been slow in implementing the code except in telecommunications applications.

The study's survey of nongovernmental DP users and suppliers disclosed similar disenchantment with ASCII. Hardware/software vendors labeled it a "hindrance" and expressed their desire to maintain the status quo of the multi-code world. The more cautious private users had a different reaction. Concerned over rapidly mounting costs and massive schedule delays, they favored the use of a single standard code. The National Bureau of Standards is reviewing the report's findings and is expected to issue several recommendations this fall to encourage greater use of the code. □

INSIDE STORY

Voice data entry improves

A new way of entering data into a computer is starting to gain popularity among users involved in material handling and quality control inspection. And judging from its proven advantages in these areas, its uses in other jobs are not far behind.

The new input method is called voice data entry, and is the means to allow men to control machines by simply talking to them—the realization of a long-held dream.

Voice data entry systems evolved from work in speech recognition and basically are of two types: Speech identifiers which will determine who the person speaking is—assuming of course information on his voice is available; and word recognizers which can interpret and identify specific commands.

While much of the work in this area has been done for the military—to relieve the already overburdened senses of pilots and crew members—in the past two years significant progress has been made in the application of this technology to commercial problems. It is already being used in inspection and quality control application as well as baggage and parcel sorting. Other proposed uses for voice data entry include control systems for handicapped people, and remote banking and voting via telephone.

One of the leaders in translating the spoken language into digital data is Threshold Technology Inc. of Cinnaminson, NJ. Threshold's entry into the voice recognition field is a voice information processing systems called the VIP 100.

The VIP 100 is an isolated word recognizer. A short pause must be present around each word for it to work properly. Research is continuing in an effort to develop connected speech recognizers—machines that can interpret normal speech—but they are not expected to materialize for another four or five years.

According to J. Michael Nye, vice president for Threshold, VIP 100 systems are currently being used by General Motors for final inspection of assembled cars, Owens-Illinois for inspection and quality control of tv picture tubes and United Airlines, Trans World Airlines and United Parcel Service for the sorting of baggage and parcels. In each case, says Nye, the voice input system has resulted in a more efficient operation and often a reduction in the number of people necessary to do a specific job.

Voice recognition systems in general consist of three functional subsystems: A preprocessor, a feature extractor and a classifier.

The preprocessor consists of circuits designed to clean up and shape the incoming acoustic signal. Its job is to remove irregularities from input speech waveforms and to produce a normalized speech spectrum.

The feature extractor gets its input from the preprocessor and separates the vowel formats, fricative noise bursts and other major features of vocal sound from each other. Once the acoustic features are extracted, they are fed into a minicomputer where they are compared with stored patterns and classified.

In most voice data entry systems it is necessary to enter these reference patterns by having the user repeat the entire vocabulary several times. This is known as training and it enables the computer to develop a feature matrix that is representative of the way the user pronounces the control words.

There are two systems that have been recently developed that claim to eliminate training. One is a system from Perception Technology, Winchester, MA. The user simply pronounces certain vowel sounds that represent the words in the system vocabulary. The other is a unit from Dialog Systems of Cambridge, MA, which requires absolutely no training.

The Perception Technology unit, known as the VE 100 is particularly interesting because it costs only $6,198, about one-third the cost of competing systems.

To eliminate training entirely, Dialog Systems has incorporated linear predictive coding into its product. This is a compact method of stating the meaningful characteristics of voice signals. Another interesting feature of this unit is that it may be used successfully over randomly chosen telephone lines. Most systems are designed for a direct microphone input. The ability to use the common telephone as an input device makes it possible to use voice data entry in credit card verification and other applications that routinely involve telephone inquiries. —*JHG*

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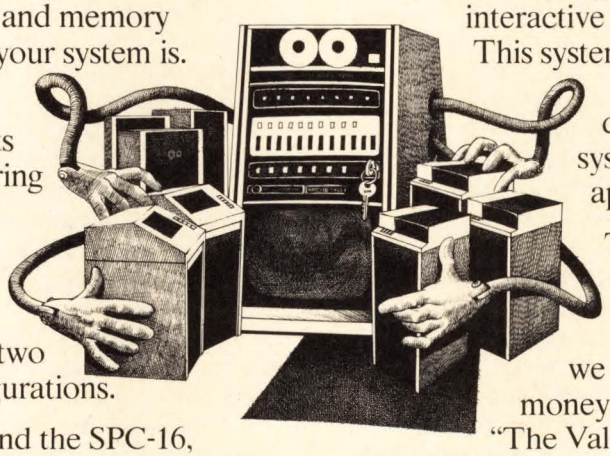

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POWERFUL MINICOMPUTERS BY GENERAL AUTOMATION

INFORMATION RETRIEVAL NUMBER 11

RUNS FOR YOUR MONEY

by Jan Snyders

Where have all the minis gone?

Looking over some of the available minicomputer software manuals, it is hard to realize that the information is really about minis. The copy is peppered with buzz words such as "data management jobs," "serial tasking functions" and "machine independence."

For instance, Hewlett-Packard of Palo Alto, CA, claims that its *Image/2100,* short for "information management," does data management jobs. It further claims that it is comparable in capability to the large computer data management systems. However, it only runs on the Hewlett-Packard computer. This limits the scale of jobs it can perform.

Image/2100 equips the *HP* minicomputer user with the means to create a data base that fits his own needs. The system can handle a base of 100,000 records, each of adequate size to contain, for example, an individual credit record or an entry in a parts inventory. A user can create complex file structures by answering questions and issuing simple commands in English. Files can be linked automatically for later coherent retrieval, without special indexing and without time-consuming sequential searches. All these features are large-machine style.

One of the important assets of *Image/2100* is that a user with no programming skills can enter, change, or selectively access a large data base, online. The system can access chains of records in up to five different data sets by a single key value and can locate a single detail record by as many as five different key values. It provides a full range of data access methods such as sequential, direct (by relative record number), random (by key value), and chaining of logically related records. Master records are linked to detail records with matching key values, and logically related detail records are linked by key value, automatically. In addition, the system prompts the operator for proper input (using its query language). All of this can be done by a minicomputer costing less than $40,000.

Another big little system is the *OS/32-ST* (serial tasking) program developed by Interdata, Inc. of Oceanport, NJ. Designed for use with the Model 7/32 minicomputer, *OS/32-ST* allows the user to write and debug programs to be executed in a serial tasking mode. It includes batch functions, interface and program development facilities that indicate good engineering.

The Interdata 32-bit processors directly address up to 16 million bytes of main memory. Such large memory is fully supported by this operating system. Because of this, users may write programs containing very large data arrays or blocks of code without the need for a special memory management unit to extend the addressing capability of the machine.

OS/32-ST is designed to permit concurrent I/O and it is device independent. Since the I/O requests or calls do not specify any device-dependent information such as physical address or special format characters, programs do not have to be modified when hardware is reconfigured. This capability is provided by the use of logical unit numbers that may be reassigned at run time by simple operator commands.

A comprehensive file management capability is provided in *OS/32-ST*. The elements of this capability are named files and devices, two-file organizations, file protection at the file and task level, systems calls to facilitate file manipulation, and a full set of file-oriented console commands.

Files in *OS/32-ST* are assigned to tasks and to be opened, allocated and otherwise manipulated using what is called a file descriptor. The file descriptor consists of a four-character volume identifier together with an eight-character file name followed by a three-character extension. A chained file structure allows the manipulation of logical records that are automatically blocked and deblocked as needed. These logical records may be accessed in either sequential mode or random mode (by specifying a logical record number).

A contiguous file structure is provided for those applications where rapid access to large blocks of variable-length data is required. Contiguous files consist of series of preallocated sectors, each 256 bytes in length. These sectors are manipulated by using logical sector numbers on an individual basis (random access) or on a group basis (sequential access).

Files may be protected by making write-read keys a part of the file itself or by setting access privileges at the task level. This allows files to be shared either at departmental level or at a functional level within the department.

Incorporated into *OS/32-ST* are a number of systems calls as well as console commands to open, close, delete, rename, reprotect and allocate files.

One of the more interesting of the mini software packages comes not from a minicomputer manufacturer but from an independent software company called The Applications Group, located in Davis, CA. The company calls its operating system *TAG-11.*

TAG-11 is an operating system designed to interface a wide variety of mass storage devices with Digital Equipment Corp.'s PDP-11 series computers. The user-oriented system simplifies time-consuming manual commands so that the user can execute programs with maximum ease and efficiency.

The heart of the *TAG-11* is its executive program, consisting of a resident executive, batch processor, a keyboard monitor and one overlay. The keyboard monitor and overlay are stored on the system device and are brought into core only when needed. The resident executive contains all I/O logic, system tables, and the nucleus of the error handling as well as file open and close routines. The overlay from the system device handles the bulk of device errors, command string decoding, and file opening and closing. The batch processor runs on systems with as little as 12k of memory.

TAG-11 has a feature called "quick-run slots" which substantially reduces program loading time by initiating program loading under control of an abbreviated core resident directory rather than a time-consuming overlay and directory search. Additional speed and direct loading capability is provided by storage of selected files in core-image form. All files are structured in contiguous fashion so that time-consuming random search and linking is not necessary.

The formatting capability of the *TAG-11* enables handling of all I/O on a concurrent interrupt basis. The system also provides complete device independence since it adjusts to the particular characteristics of each peripheral device. All user I/O is done on a variable length, byte string basis, to or from logical I/O slots. In systems greater than 8k, *TAG-11* capabilities can be extended beyond those of most minicomputer monitors through the use of the random, fixed-length record I/O option.

The directory structure within the operating system allows four-level naming keys consisting of file name, extension, group code and user code. The directory structure also provides file security against deletion, renaming or modification.

In addition to the executive program and *Sysgen*, six other programs are provided as part of each *TAG-11* package. These include a text editor, macro assembler, linker, online debugging package (*ODT*), peripheral interchange program (*PIP*), and device packing routing (*PACK*).

Where have all the minis gone? They are still here and will be for a very long time. It is just the image that is disappearing. The old OEM type of unit is being replaced by a real data processing workhorse. □

Music to our fears

Sir: In your July issue IBM delegated 2-1/2 columns of its 4 page ad—"DP dialog"—to state that it is doing everything possible to step up security in its operating systems and that their latest creation, *VS2* Release 2, is rather secure. I do not doubt the security of *VS2*, however IBM sells many systems that they are not as concerned about.

The *MUSIC* (formerly *RAX*) teleprocessing system, written by McGill University but marketed by IBM, is one of these. We, both 17 year old high school students, have found several severe flaws in this system's security allowing fetching and altering all protected core; all I/O to disk (and tape when mounted); and initiating system shutdowns. When we approached IBM with this information, they said that even though they sell the system they are not responsible for its maintenance. If anything happens to a watch or typewriter I own I would bring it back for service to the store where I bought it. It's too bad that this accepted practice in merchandising hasn't penetrated the computer software market yet.

If any readers have systems running under *MUSIC* please contact one of us in regards to plugging the "holes" in your system. Thank you.

Alan Groupe
Jerrold Metcoff
205 Blaisdell Hall, U.R.H.
Urbana, IL 61801

Near miffs

Sir: In reference to J.H.G.'s report on the EEG implemented tv camera control system "Direct Brain-To-Computer Interface On The Way" (September 1974), may I suggest that the difficulties with the words NEAR and FAR are caused by the abstract nature of the concepts NEAR and FAR.

A further difficulty may exist in the ambiquity in the operators' concept of whether a NEAR or FAR subject field is to be corrected for, or rather that the converse applies such that the camera is to bring a FAR field NEAR and vice versa.

May I suggest that a choice of TO and FROM to signify that the operators' field of view, via the camera, move TO the subject or FROM the subject.

IN and OUT may serve as well, which are even less abstract in nature than TO and FROM; and like TO and FROM are much more crisp (definitive?) phonems. This crispness seems to be a characteristic of LEFT, RIGHT, UP, and STOP. Possibly Ms. Mahoney can verify that the reliability of response to the present commands correlate more directly to the terminating hard consonnants of these four commands than to any other factor.

Richard F. Wack, Sr.
McLean, VA

No argument here

Sir: I enjoyed "Computers Don't Argue" in your September '74 issue. I remember enjoying it the first time it appeared, too—15-20 years ago in a science fiction magazine. How about admitting that SF writers like Gordon Dickson have 'had our number' (to coin a phrase!?) for far longer than we might care to admit.

Robert Higgins

Missed media

Sir: I was disappointed that Information Terminals was not listed on page 43 of the June issue. You listed many data processing accessory suppliers of media without listing Information Terminals. We sincerely feel that we are the leading manufacturer of data cassettes and several versions of flexible disks that are currently being used on many low cost data recorders.

Carl L. Holder
Manager
Product Management-Marketing
323 Soquel Way
Sunnyvale, CA 94086
(408) 245-4400.
Editor's note: For information on ITC's products, circle no. 410.

Do while ditty

Sir: The June issue contains an article by Chapin *et. al.* entitled "Structured Programming Simplified." Not only does the first-named author claim to have invented the charting system, the version presented actually is a clumsy cousin of a very detailed technique presented by Nassi and Shneiderman in SIGPLAN Notices. No credit is given to nor mention made of this earlier article. In particular, Chapin *et. al.'s* chart handling of the statement form "DO FOR 1 = 2 to N BY 1" is not only clumsier than the corresponding method of Nassi and Shneiderman, but violates the former group's stated claim that a function or algorithm expressed in chart form "can be directly transcribed into a source program. . ." The Nassi-Shneiderman technique does allow for direct transcription.

Another problem with direct transcription is Chapin *et. al.'s* symbolization of the "WHILE. . . .DO" form. Their form's semantics might be described by "while escape-condition is not met, do" whereas PL/1, BLISS, etc. give the form the meaning "while continue-condition is met, do." The transcription difficulty should be apparent.

R. E. Tulloss
Member of the Research Staff
Western Electric
Princeton, NJ

Ms. nomer

Sir: I read with interest your article entitled "Women On Computing" in the May issue.

I was infuriated with Ms. Roberts' comments that she "would like to be called a salesman, not a salesperson or saleswoman." The entire purpose of using non-sexist terms, like salesperson, is to connote that these positions, such as selling, could be held by a person of either sex. If we continue to use the term "salesmen," our young people will grow up expecting these jobs to be restricted to males.

We cannot really expect a public relations campaign to be launched by the male population; therefore it is up to us women to carry the good word to the people.

Lenore Shaw Schrager
Assistant General Manager
Information Systems Division
National Retail Merchants Association
New York, NY

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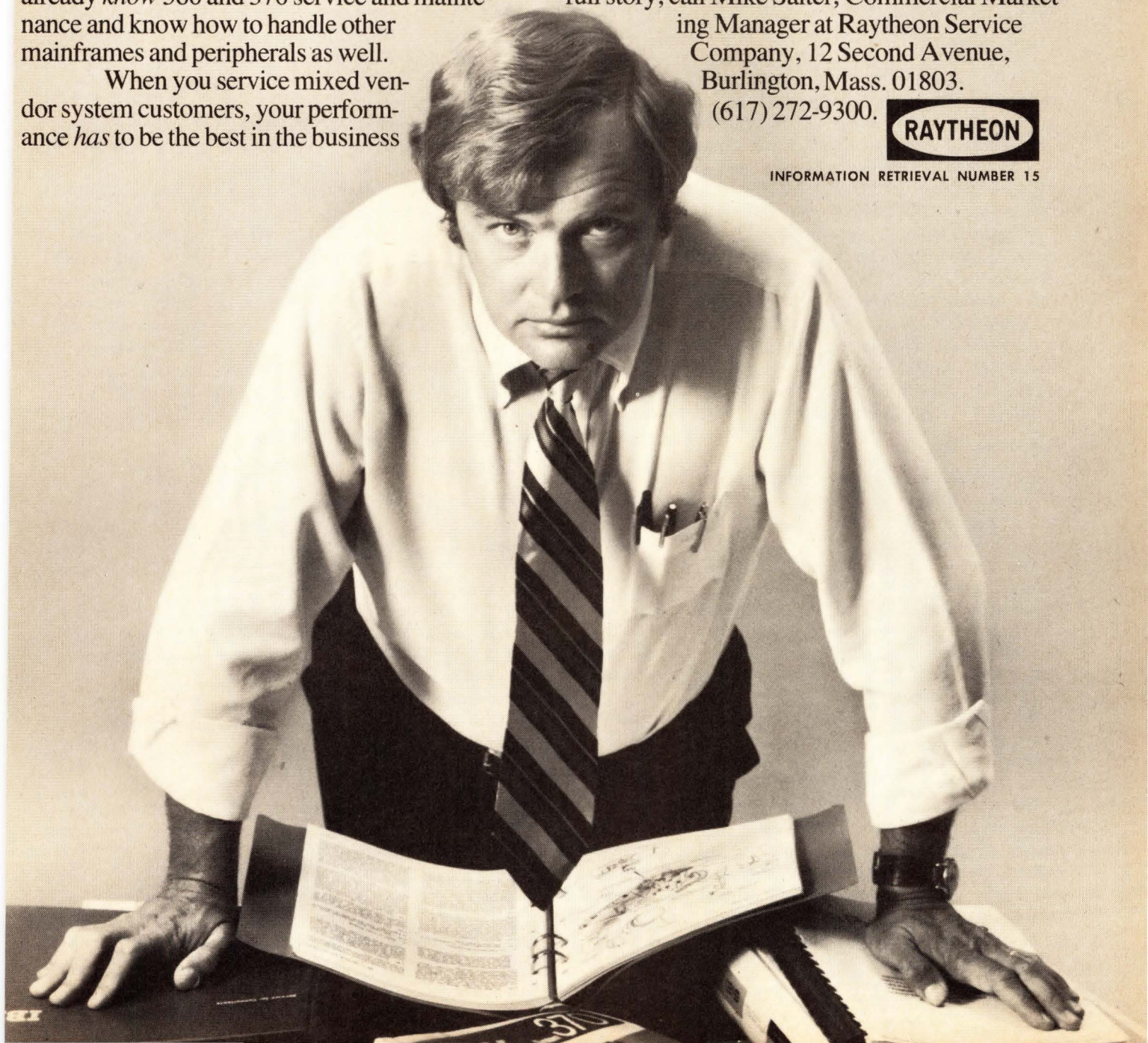
RAYTHEON

INFORMATION RETRIEVAL NUMBER 15



Pricing edp resources

by John M. Grillos
American Management Systems, Inc.
Arlington, VA

Centralized data processing has numerous advantages, but to insure that it reaches its potential is a difficult problem requiring a sophisticated management and planning system.

For centralization to be successful, there are a few important problems that must be addressed: Application diversity, lack of use control and competition.

To address these problems requires not only a good management and planning system but also a good operations staff. The major tools of such a system would include a programming, planning and budgeting (PPB) system for edp, edp accounting, transfer pricing system, and performance standards and reporting.

A PPB system

A PPB system may be operated independently by the dp department, or be part of an overall system used by the organizations. Planning should be done for allocation of edp expertise and equipment to the most important applications—new and current. Allocations should be scheduled for all applications from concept study through cut-over and operation.

Budgets and their review should be worked out jointly between the edp head and the heads of using departments. The edp budgeting process should be based on how much equipment, software and people are required to support those applications which are to be serviced. This means looking at the cost/benefits of the applications, non-edp approaches to the applications which might be cheaper, and the mix of spending for centralized support and development.

Edp accounting

Edp accounting has the same purpose as any accounting: To monitor expenditures for conformance with constraints (budgets, etc.) and to provide cost data for analysis.

The key to successful edp accounting is in the definition of applications against which the costs are accumulated. The definitions must be broad enough to have meaningful output measures and to avoid arbitrary allocations of support/overhead activities. Yet they cannot be so broad that they obscure virtually independent activities.

This means there is no single applications structure that can be used by all organizations. Rather, the applications structure must be tailored to the environment and must be adjusted as the environment changes.

An essential element in edp accounting is a machine accounting system which accumulates for each computer program the basic utilization statitistics—central processing unit usage time, main memory residency, input/output interrupts, channel usage—as well as the use of peripheral devices.

The resource pricing system is the chief demand-regulating device. Because it establishes the cost to user agencies, it guides them to use edp only when it is economical to do so. The pricing system also induces the data center to provide resources at the most economical level and in the most efficient mix.

Users of centralized edp services have two major concerns: First, the prices they must pay, and second, the reliability and quality of services they receive.

Typically, the prices of edp services are satisfactory to users; however, the quality of service often poses a problem. Poor turnaround, system downtime and unreliable operations can be very costly to a user agency.

Pricing edp services

Pricing edp resources is the cornerstone of the edp usage strategy. Charging users on the basis of their consumption of data center resources induces them to manage their demand and to design applications for efficient operation.

The price structure should serve not only to ration total demand for edp services, but also to motivate more efficient use of existing resources.

The collection of revenue under the resource pricing system will interact with the costs of providing the services to produce a profit or loss from operations. The data center must take the prices, and hence its profit and loss statement, seriously, and try to manage to avoid losses. Given a fair price structure, if it runs at a loss, it is either overequipped, operating inefficiently or delivering poor service. If it runs at a profit, it should be able to reinvest some of its profits into additional capacity, and pass the rest of the saving along to the customers in the form of lower prices for the following year.

Basic logic

The actual pricing system at a data center is dependent upon the mix of systems and applications which the center supports. However, the basic logic governing data center pricing in the public sector should be as follows:

- The data center is a profit center with prices set to yield breakdown revenue at a projected usage level.
- Charges should be distributed to users according to the resources each consumes.
- Measures of resource consumption must reflect the difference among application types—batch, remote batch, teleprocessing (CICS), data base (IMS).

The sequence of calculations which result in a set of resource rates is presented in the accompanying charts. The final chart shows some of the rates expected to produce breakeven revenues at the projected utilization of the data center. A single rate for all users is developed for all resources except cpu and main storage. For these two resources we imbed price differentials among CICS, IMS, and batch users to reflect the differences in resources each of these groups consumes. □

Application type	User class	Major user system	Dedicated Core Storage	Resources Disk packs	Hours of dedicated usage
Cost pool	Teleprocessing	CICS	1080k	12	8 a.m. to 5 p.m.
	Teleprocessing	IMS TP region	612k	6	8 a.m. to 8 p.m.
	Remote job entry & batch	Hasp	250k	0	24 hours daily
Overhead	OS	OS queues	260k	0	24 hours daily
		Master scheduler	80k	0	24 hours daily

System resources	Overhead all users	Cost pools RJE & batch users	CICS users	IMS users	Cost pool overhead all TP users
CPU	73,000				
Selector channels	6,215				
Main storage	36,360	3,000	4,800	3,840	
Data transmission equipment					11,426
Disk equipment	33,717				
Printer equipment		18,991			
Software		450	700	1,175	

Column	1	2	3	4	5	6	7	8	9	10	11
Resource	% of total costs	Cost of Computer Resources ($/month)	Overtime rental ($/month)	Personnel cost assignments ($/month)	Personnel fringes ($/month)	Misc. overhead ($/month)	Total ($/month)	All users ($/month)	CICS users ($/month)	IMS users ($/month)	Batch & RJE users ($/month)
CPU	41.0	$118,450	$17,768	$28,003	$2,142	$14,743	$181,106	$177,212	$1,069	$1,793	$1,032
Selector channels	2.0	6,215	932	1,366	104	719	9,337	9,337	—	—	—
Multiplexer channels	6.5	19,244	2,887	4,440	340	2,337	29,247	29,247	—	—	—
Main storage	16.5	48,000	7,200	11,270	862	5,933	73,265	55,498	7,327	5,861	4,579
Tape operations	12.0	34,600	5,190	8,196	627	4,315	52,928	—	—	—	52,928
Disk operations	11.5	33,717	5,058	7,854	601	4,135	51,364	51,364	—	—	—
Printing	6.4	18,991	2,849	4,371	334	2,301	28,846	—	—	—	28,846
Reading punching	0.1	527	79	683	52	360	1,701	249	—	—	1,452
TP occupancy	4.0	11,426	1,713	2,732	209	1,439	17,519	—	9,986	7,533	—
Total cost	100.0	286,435	42,965	68,300	5,225	35,959	445,313	322,906	18,381	15,186	88,838

Resource	Total costs all users ($/month)	Projected monthly utilization	User class rates Base Rate	CICS	IMS	Batch & RJE
CPU	$177,212	506 hrs	$329.39/hr	$372/hr	$419/hr	$329/hr
I/O overhead		32 hrs (@.4ms/EXCP)				
Selector channel	9,337	378 hrs	$24.70/hr		$ 24.70/hr	
Multiplexer channel	29,247	786 hrs	$37.21/hr		$ 37.21/hr	
Main storage	55,498	312,774 k core hrs	.18/k core hr	$.21/k core hr	$.22/k core hr	$.18/k core hr

To see how the pricing system works, let's look at a hypothetical dp center. The center uses two large 370s working under a major operating system. Users are supported by CICS, IMS-TP *and* Hasp. *Work is heavily production-oriented. All hardware and software is leased.*

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INFORMATION RETRIEVAL NUMBER 19

Computerized voting: many happy returns?

The computer can ease election day woes. But computerized vote counting systems have yielded neither accuracy nor economy.

by James Farmer
Systems Research Inc.

Elections require mass reconciliation of data, detailed accounting, the recording of billions of voter choices, and accurate counting and organization of results. Computers can play a significant role in the election process. Yet computerized voting systems have yielded neither consistent accuracy nor economy. And though economists and computer specialists would agree that current technology offers low-cost, accurate elections, most would also admit that the promise remains essentially unfulfilled.

The complexity of elections is illustrated by data in a 1971 Systems Research Inc. survey. The average county conducts elections in approximately 600 precincts, each of which handles 325 voters on Election Day. In a typical county, the longest ballot format has 20 issues, propositions, offices and referenda to be settled. Thus, a county prepares nine or ten different ballot formats for each election. The average county spends approximately $42,000 a year on elections, which is about 57¢ for each inhabitant or $1.80 for each registered voter. Yet the majority of counties still use hand-counted paper ballots, with 33.2 percent using lever machines in some form. Only 6.7 percent actually use computer-counted punch card ballots.

Sixteen percent of all counties use computers to maintain registration lists, 10.7 percent use them for counting, 12.8 percent for precinct and election summaries ,and 9.7 percent for election reports. Utilization is low, considering the extensive use of computers by state and local governments for other purposes.

The lessons of history

The first computerized election took place in 1964, when the IBM Votomatic was introduced. Although the Votomatic was touted as a major advance in election systems, its vaunted technology failed to deliver fast, accurate, and low-cost election results. Shortly after Votomatic's debut, the effectiveness of computerized elections was challenged by the press, which questioned the accuracy of the 1968 Los Angeles County elections.

There are three major problems that stand in the way of widespread computerized elections. First there continues to be belief, and evidence, that many computerized elections are inaccurate. Computer professionals have taken the responsibility for running elections but have not been able to perform acceptably. In other professions this might be called malpractice.

Second, election systems do not have designs which provide for adequate security. The responsibility for accuracy and security has been given to computer programmers, but the public is now learning that this may have been a misplaced trust. Adequate quality standards have not been developed to assure public protection.

Third, city and county governments have not developed procurement procedures for computer systems to assure adequate performance from the vendor. Thus the cost of computerized elections has soared beyond expectations. This has led to the exploitation of cities and counties that desperately need computer services and equipment.

In spite of these deficiencies, the Systems Research survey showed that 14 percent of present paper ballot users and 5 percent of lever machine users would recommend punch card systems. Furthermore, despite the shortcomings of the computerized system, only 12 percent of the current users would recommend returning to paper ballots or lever machines.

There are, of course, cases of city and county governments that consistently run accurate, efficient, low-cost elections using computer systems. It is perhaps the fascination with technology and the expectation of cost savings that motivate current installations.

Batten down the ballots

It may be useful to review first the arguments by Votomatic's proponents. The first argument was that fraud was technically impossible. Relying on the inherent accuracy of a computer, Votomatic's defenders suggested that it would be impossible to modify the hardware or software to miscount ballots.

But in a 1969 report,[1] a model vote counting system was developed and tested containing code that would bias the results. Although one such modification required access to the vote counting program, a bias routine using a modification of the vendor-supplied operating system's binary read routine permitted tampering without access to the system itself. It exploited the publicly available, well-documented, vendor-supplied software.

Although the report suggested several software controls which would decrease vulnerability to intentional fraud or errors in ballot rotation, these have not been incorporated into operational systems.

Professionals don't cheat

The second argument for punch card systems was the assumption that computer professionals would not commit fraud. Only a few cases involving programmer manipulation of software have been reported, partly because computer fraud, like many other white-collar crimes, is rarely prosecuted. Futhermore, there have been no convictions. But as the investigations of the Equity Funding scandal revealed, programmers can be involved in deliberate attempts to misuse computers.

The third argument for computerized systems was that observers could and would prevent fraud. Superficially this can immediately be dismissed, because all elections with identified errors have had observers. The issue is more subtle. It is possible for inspectors watching paper ballots being counted to observe errors on the part of the election officials, but complex subroutiness are required to identify vote counting software mistakes.

Many of the erroneous election results have resulted not from intentional fraud, but from simple mixups —punched ballots confused with control cards, counted ballots with uncounted. It seems that an adequate systems design for as vital a function as elections should pay more attention to the specific security problems that arise in a situation where most of the counting process is invisible.

Lots of locks

The deficiencies in current computerized vote counting systems suggest that adequate security is not possible. On the contrary, it seems more reasonable to assume that adequate systems design and an independent audit program could not only improve election security, but also election planning and execution. There are a number of ways to achieve this.

First, all vote counting programs should be independently certified. This certification would attest to the quality of the design, that the programs will perform according to that design, and that appropriate testing has been undertaken.

After consultation with legislators in several states, laws should be developed which require that computer programs involved in public safety, public welfare, or public trust be independently certified prior to use. Such a requirement would call to the attention of city, county, and state officials the importance of adequate design and testing.

Second, each candidate and party should have the right to inspect the vote counting programs. For this reason, programs should be written in *Cobol* or another high-level language and be freely available to inspectors.

The people's choice

Present \ Recommended	Paper ballots	Lever machines	Punched cards
Paper ballots	59%	25%	14%
Lever machines	1%	93%	5%
Punched cards	6%	6%	88%

Since ballot rotation continues to be one of the most frequent sources of errors, each candidate should also inspect the format of control cards affecting his election. The results, including all control totals (the number of ballots, the number of overvotes, the number of undervotes) should be available to any candidate, party, or citizen requesting them.

Third, absolute ballot accountability must be maintained. The most frequently detected error in elections is a difference between the number of physical ballots and the number voted at local precincts. There are several reasons for this discrepancy: A lack of control during ballot duplication, improper processing of mutilated ballots, and, where there are multiple precincts at the same voting place, voters placing ballots in the wrong ballot box.

The ultimate test

The fourth recommendation is an independent sample recount. The ultimate test of any computerized election system is a separate recount of the ballots, using different software. One significant advantage punch card voting systems have over lever machines is the physical availability of the ballot for recount. Such a recount should be conducted according to established quality control standards.

For example, Los Angeles County now normally recounts only 20 precincts of nearly 3,000. Assume for a moment that only 0.3 percent of the precincts contain an error; the probability remains only .06 percent that one of the 20 recounted precincts would identify an error. The probability of identifying errors through sample precinct recount remains low until the number of precincts counted approaches 100. Had Los Angeles County performed this analysis—which is a standard quality control procedure—it would have realized that even with an error rate as high as nine precincts per election, current sampling techniques will identify an error only once in ten years.

It is interesting to note that the number of precincts checked depends upon the error rate rather than the size of the election. It appears that at least 100 precincts should be recounted for any election to give a reasonable probability of error identification.

Trained observers needed

The fifth suggestion is that trained observers be present at all elections. In 1972 the Democratic National Committee and the McGovern election staff were clearly concerned about election security, and consequently held training sessions for observers in several cities. Observers were provided with briefs on the most likely sources of error in computerized elections. They were told to focus on ballot handling procedures, deviations from the normal vote counting process, and adequate testing.

For example, the observers in Austin, TX, asked that a test of the election system be run, using ballots from a previous election. The test was denied, and only on election night was it discovered that the punch card ballots could not be read by the on-site card reader. The vote count program had to be modified to read the ballots backwards. (The ballots had a torn left edge which, on the specific card reader, was used for mechanical registration of the card.) Thus, the Austin

election count was delayed, and then was processed without any significant evidence that the program itself was accurate.

Although there was some evidence of inadequate preparation and testing, deviation from required procedures, and suspicion of fraud, it became evident on Election Day that nothing could change the final results, and legal actions were consequently abandoned. The efforts of the Democratic National Committee should contribute to an awareness of the problems of punch card systems and the need to provide a small cadre of trained observers.

Improve physical security

As a sixth recommendation, physical security of the ballot counting center must be improved. Unlike paper ballot counting, insignificant actions at the computer center can result in the changes of thousands of votes. Observers should be prevented from handling equipment or ballots. Workers should wear identification badges so that security staff and observers can readily identify all individuals in the count center.

Finally, an independent audit should be taken on a continuing basis, regardless of whether elections are run by outside vendors or by government staff. Unfortunately, most errors can be detected only by the careful scrutiny of a trained analyst. Also, the presence of an auditor would cause close adherence to procedures—a discipline which often disappears under the news media's pressure for instant results.

The independent audit should continue until the results are fully reconciled. All ballots should be accounted for, and a recount using a second program or manual technique should be a part of all independent audit procedures. The audit activity should begin during election planning and continue through the post-election period.

The importance of an independent audit is shown by a recent Los Angeles County election. The results of the county supervisor's race showed repeating patterns, and the units digit differed significantly from random expectations. Since the Los Angeles County vote counting program is one of the most complex in the nation and contains numerous indices and pointers, it was not unreasonable to believe that an error had occurred in processing these pointers.

Faced with similar results in another application, a computer professional would have immediately suspected an error. Since it had been repeatedly demonstrated that logic and accuracy tests in fact tested neither for logic nor for accuracy, it remains inexplicable that, in this case, computer professionals defended inadequate testing when such procedures were clearly unacceptable even for day-to-day accounting activities.

In the 1972 California primary, the Secretary of State, concerned about election preparations, ordered an independent pre-audit of all computerized election systems in the state. The audit indicated several cases where inadequate vendor support had prevented counties from complying with laws concerning computerized elections. As a result, the Secretary of State encouraged these vendors to provide additional resources to California counties. The audit also indicated that many counties had not adequately tested their programs.

Learning the hard way

Although computerized election systems still do not have adequate security safeguards, significant progress has been made in improving the effectiveness of automated elections. Since these systems may be characteristic of other large-scale public applications of computer technology, the lessons of history should be learned, and not repeated.

Complexity: The difficulties of mastering effective computerized vote counting underscore the complexity of the election process itself. While statistics identify the number of ballot formats, the number of precincts, and the number of candidates and issues, they do not appear to convey adequately the complexity of the election process, a process which begins months before the elections and which can be drastically altered by a single court decision, a software failure or even sabotage.

The first major improvement in election planning in Los Angeles occurred when a consultant-developed *PERT* chart identified all of the activities necessary for a coordinated election. *PERT* planning isolated critical activities so that resources could be immediately applied to problem areas. Election operation improved significantly as this planning effort became part of normal procedures.

A second step taken by Los Angeles County was the development of an in-house team of computer programmers and analysts whose sole task is election support.

Timing is critical

Timing: Elections cannot be postponed; their timing is critical. If computer technology is to be used in elections, it should be well tested and demonstrated. Most cities and counties have implemented punch card voting by a single massive conversion. Experience indicates that a more effective method of conversion is to change one part of the county or city at a time. Election officials gain the expertise and management experience necessary to avoid unrecoverable planning and operational deficiencies.

Vendor support: Perhaps the most glaring inadequacy of punch card systems has been the lack of vendor support. Of the three major companies, two are bankrupt—having no funds to fulfill the important service requirements which were part of their contracts—and the third has no identifiable financial reserves.

Vendors primarily want to sell the hardware required. Thus, there continues to be, in the minds of county election officials, inadequate support in the sense that full planning, programming and testing services are not available with appropriate lead time. No vendor now establishes a reserve of funds for the future support for which he contracts.

While such an accounting procedure is not an issue with larger hardware vendors, inadequately capitalized firms in voting equipment—which often show large profits one year and financial difficulties the next—are not always able to perform services with funds received in prior years.

Errors are hard to find

Precincts per 1000 with errors	Number of precincts checked: 1	10	20	50	100
3	.003	.03	.06	.14	.26
5	.005	.05	.10	.22	.39
10	.010	.10	.18	.39	.63
20	.020	.18	.32	.64	.87
40	.040	.34	.56	.87	.98

Finding an error through sample recounts is difficult until the number of precincts counted reaches 100.

Separate contracts

Counties, when procuring equipment, could avoid the servicing problem by contracting separately for equipment and support, although from the same vendor. They should pay for these services only after performance has been proven. With separate service contracts, it is easier to identify the specific tasks to be performed and the acceptable standards. There would be every incentive for the vendor to perform since payment would be contingent upon adequate service.

Training: The difficulties which cities and counties have faced in computerized elections prove the need for extensive training. Officials having responsibility for the election should be trained. Individuals with little or no knowledge of computing, who rely fully on the vendor, are not sufficient for a successful election. Since a new centralized procedure is introduced in the collection, inspection, and manual processing of ballots, it is imperative that adequate training be given to all election workers.

Practice elections have been initiated in the state of Washington for this purpose. Election workers simulated an election, using regular materials, without the pressures of news media or the excitement of actual balloting. Computer operators learned how the vote counting programs operate and the proper procedures for handling ballots. Because of this training, workers' performance on election night improved significantly, and the election and post-election audits were quickly completed. Although such training is expensive, in the sense that all election workers have an extra day of work, the complexity of the technology used mandated better training.

Most frequent errors

It may be useful to identify the types of errors most frequently encountered. The most common is misidentification of precincts. Though identification is usually taken from control cards, it may be prepunched in the ballots themselves. And though there are provisions in some programs to check this identification, the mismatching of control cards to ballots still occurs frequently. This can be corrected by maintaining ballot accountability.

Missing or duplicated precincts also cause problems. Arising from improper computer operation or control card errors, these difficulties can be remedied by accounting for the number of ballots processed.

The most difficult error to detect is one in ballot rotation. The average voter is part of some 13 separate jurisdictions (city, county, school district, sewer and water district, mosquito abatement district, etc.). The complex task of identifying appropriate candidates and issues for a voter's ballot is usually performed manually, and IBM's Votomatic machines were configured on the basis of manual records.

Software has been designed to automate ballot rotation and provide appropriate cross-checks for candidates, districts and issues. They insure accurate rotation and provide sample assembly sheets for inspecting equipment. The vote counting program can also be directly generated from these data.

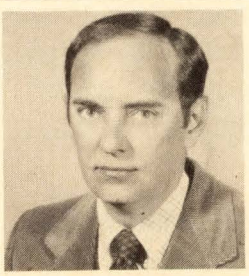
So far, no equipment manufacturer has implemented such software, though it has been demonstrated in several elections. One vendor has developed a method of generating ballot styles from the computer control cards. This permits improved visual inspection of the ballot rotation.

The vote counting program itself is also a source of errors. With a few exceptions, these turn up in untested precincts. Votes have gone to the wrong party or candidate, votes have been left out entirely, or sometimes all votes have gone to a single candidate or issue. Although a logic and accuracy test of all precincts has been encouraged, this is still not done because of complexity and cost.

Poor vendor support also brings problems. Equipment suppliers have not yet published staffing tables or adequately described the tasks associated with manual processing of punched card ballots. This lack of documentation leads to inadequate organization. In this confusion—through errors in planning, training, or staffing—tapes get lost and ballots are misplaced.

To summarize, the automated voting system needs the following improvements: adequate software design, internal cross-check, ballot accountability, software for recounting ballots, logic and accuracy tests, and election staff training. □

1 Farmer, James, Colby H. Springer, Richard Stanton, and Michael J. Strumwasser, Vulnerabilities of Present Computer Vote Counting Systems to Fraud. *Intellectron International Inc., Van Nuys, CA. November, 1969. Additional reference:* Computers and Political Campaigning *by Robert Lee Chartrand, Hayden Book Co., 1972.*



Mr. Farmer is a staff member at Systems Research Inc. and particpates as project manager for systems development and implementation in education, business, government and elections.

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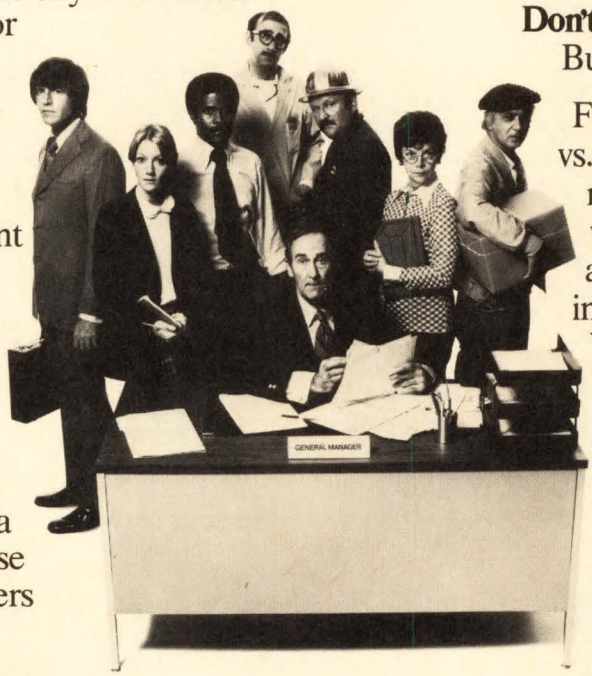

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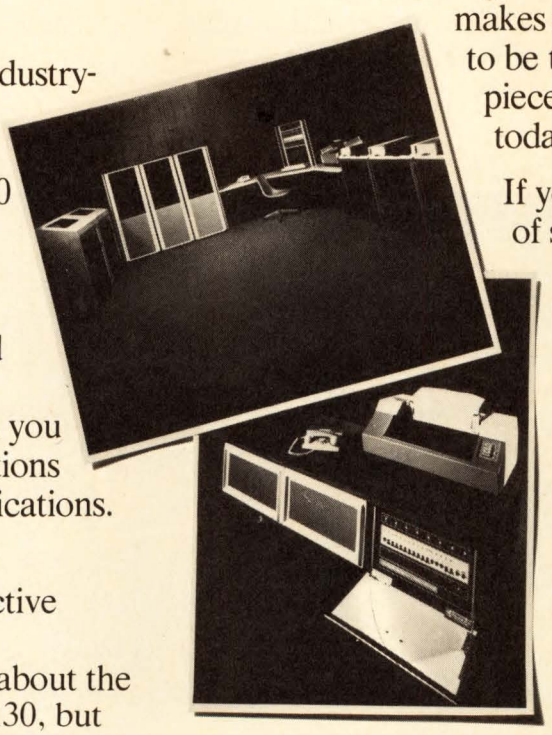

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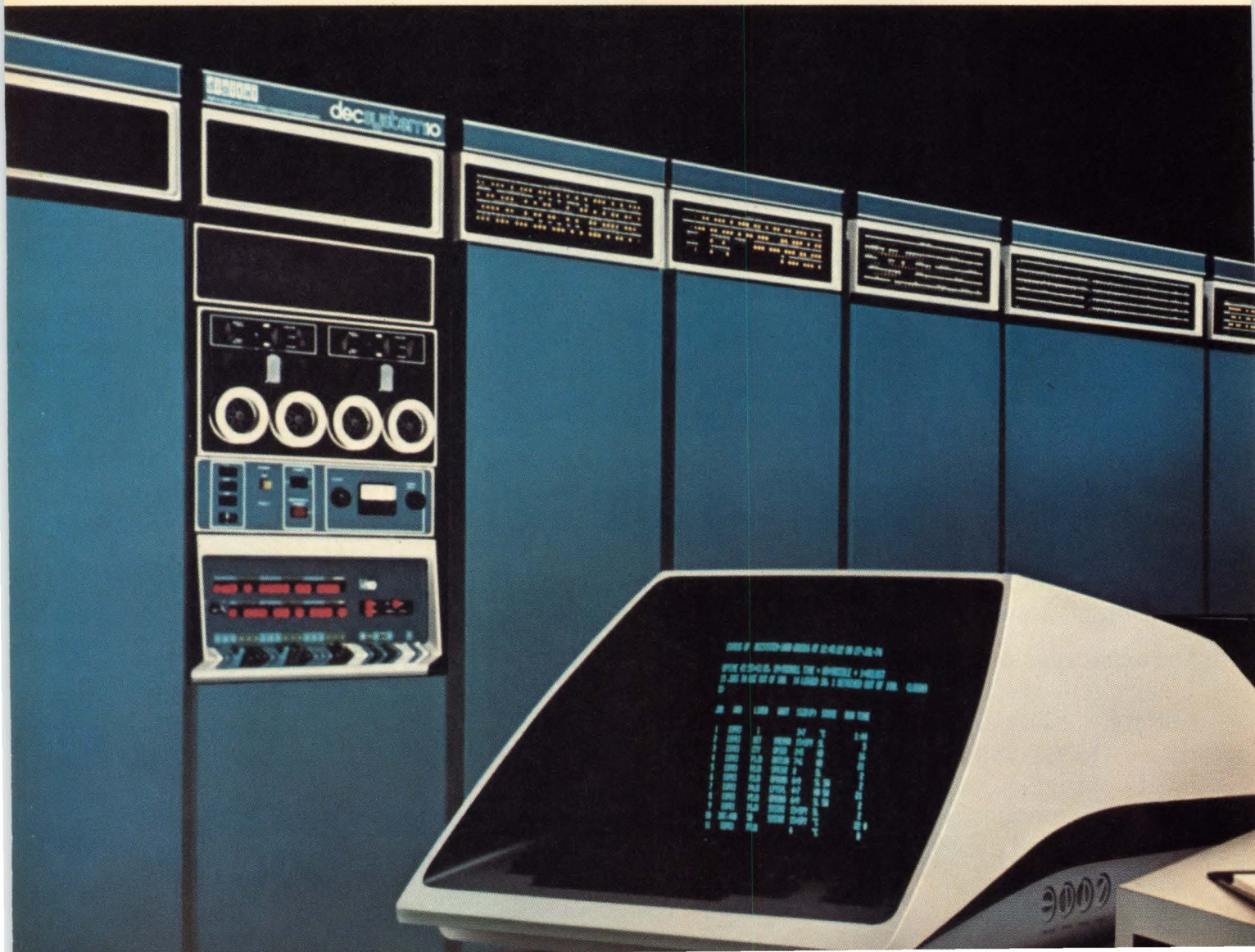

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INFORMATION RETRIEVAL NUMBER 27

Extensive networking and transaction processing.

Washington slept here

The September primaries in the District of Columbia were to be a great leap forward in computerized polling. It is unclear whether or not the city looked first. The vendor involved isn't jumping for joy either.

by Linda Flato and Hesh Wiener

On July 16, 1790, the Congress of the United States authorized the establishment of a permanent seat of government along the Potomac River. Major Pierre Charles L'Enfant, an engineer brought to fledgling America by Lafayette, saw the swamps and hills and formed a vision in his mind: A great capital, Washington, would be built here. L'Enfant had a dream of order. Wide, tree-lined avenues radiating from a central complex of buildings would serve the young and vigorous nation as a spiritual as well as a physical example. Here, the citizens of the New World could govern themselves. The democratic tradition, stretching back to ancient Greece, would finally have a home in this repubilc. Here, free men could vote their conscience.

On September 10, 1974, the District of Columbia Board of Elections and Ethics conducted a primary election. Dr. Robert E. Martin, an administrator brought to power by Mayor Washington and the City Council, saw the wards and precincts of his city and envisioned a swamp: A great concept, machinery to gauge the will of the voters, was bogged down here. A dream of order and efficiency had become an electoral nightmare.

A chain of errors, weighted by gross misunderstanding, dragged the election into a quagmire of accusations. Claims and counterclaims echoed in the halls of the District Building, the five-tiered wedding cake that houses city offices, which served as the foster home of Washington's short-lived dream machines. The vote tabulating system failed on that Election Day, and with it went Washington's rocky marriage of politics and technology.

People made mistakes, machines were cranky, and organizations lost control. Pandemonium reigned. Seasoned professionals cracked under a barrage of unfamiliar pressures. Computer pros, hardened to the perversity of machines, were unable to cope with screaming reporters and their broadcast deadlines. Election officials, familiar with the demands of the press, were boggled by the unexpected rebellion of machinery that had worked just days before. Everybody and nobody seemed to be in charge.

The causes of the confusion, like the ballots, may never be satisfactorily sorted out. So far, numerous meetings, several reports, and a host of allegations have established a few points of agreement and disclosed many unresolved conflicts. Lawsuits have been filed over the conduct of the election, and additional litigation has been mentioned by parties involved in the vote counting operation. The central issue, whether computers may be used successfully to speed election returns, was abandoned in the melee.

Yes we scan

The vote counting system used in Washington's September primary consisted of three OCR document readers, Control Data Corp. Model 921s, used to transform paper ballots into magnetic tape, and a minicomputer. The mini, a CDC 1700 system, consolidated those tapes into printed reports. The system was programmed, maintained and operated by Control Data personnel. On primary day, ballots were collected periodically from polling places throughout the city, bundled by precinct, and brought to the District Building, where they were fed into the system.

The role of the scanning machines was quite simple. Ballots were to be checked for completeness and validity. Questionable ballots were to be automatically directed to a special receptacle in the machine—outstacked—and readable ballots were to be turned into images on magnetic tape. Outstacked ballots were to be tallied by hand, if possible. The tapes were to be gathered into batches and run through the minicomputer which would develop interim and final election reports.

The city had had experience with the Model 921 scanners before, and officials therefore felt that three scanners—one of them a backup unit—would be sufficient. The election board chose to reinforce its report system with software written for an IBM 360/50 housed at Washington's Unemployment Compensation Board. The programming and operation of the 360 was contracted to Authorization Systems, Inc., of Silver Spring, MD. The board had hoped that competition between CDC and ASI would keep both on their toes.

The ballot bogs

Despite what was believed to be adequate preparation, the processing went awry from the first, as soon as the 10 a.m. collection of votes was rushed to the District Building. As election officials, Control Data personnel, and the press looked on, the ballots were scanned. But as soon as the tapes were moved to the 1700 for the noon report, the mini choked.

Apparently, tapes from one of the three scanners were unusable. It was soon discovered that the operator of one of the 921s, characterized by a CDC manager as the "most experienced" on the project, had completely

disregarded instructions and produced indigestible tapes.

During previous elections the District had used 921s to scan and tally votes with different software and operating procedures. The maverick operator yielded to force of habit and ran his scanners as he had previously. Instead of generating a tape on which each precinct was a separate block of data, he inadvertently produced one which had correct ballot images but no end-of-file marks between precincts.

The 1700 was programmed to catch misplaced ballots by checking the precinct number encoded on every ballot against the others in each block of data. When the precinct numbers changed with no intervening end-of-precinct indicator, the 1700 refused to go ahead. The cause of the stoppage was not immediately apparent. Argument as well as confusion ensued, and the disgruntled operator, caught in his error, reportedly stormed out of the room.

Faced with the need to rescan a third of the ballots, election board officials went into a huddle. Richard Owens, the board's technical quarterback, called for a software patch. It would be easier, he decided, to have the 1700 skip the precinct number check than to have the ballots reread. CDC personnel were told to rewrite the 1700 programs. Two consequences of this fix were discovered: Subsequent problems were more difficult to pinpoint, and the validity of the entire count was open to challenge because of the change. Furthermore, modification of the system during the election may have been a violation of the DC election code. Nevertheless, the patch enabled tallying to proceed.

Scanner problems were not limited to operator errors. One of the 921s was clearly outstacking more ballots than the others. Investigation by CDC revealed that this scanner was being too picky, a condition rooted in administrative snarls. According to CDC and the election board, last-minute changes delayed ballot printing. As a result, test runs and subsequent scanner tuning could not be completed on time. The finicky scanner was producing accurate output, but giving election officials extra work by rejecting marginally readable ballots.

Go tally on the mountain

Even without scanner problems, the 1700 was not producing reports as rapidly as had been expected. According to observers, the mini was not feeding figures to its line printer at anywhere near the rated speed of 300 lines a minute. Subsequent investigations indicate that some inefficiency may have been designed into the system software from inception.

According to specifications drawn up by CDC and approved by the Board of Elections, tapes were to be read in batches by the 1700 and used to update precinct totals stored on a disk. When a batch of tapes was completely read, report production would begin. The nature and frequency of the reports to be produced remains in dispute.

A CDC spokesman said that the firm and the election board had agreed that interim reports would include ward and citywide totals, with precinct totals present only in the final tally. The 1700 could, according to specifications and observed performance, handle this load. But the election board and the press seemed to expect mountains of data with each run, a task which would slow reporting considerably. "I told them," said an observer from the city's Computer Services Division, "that if it went at that rate, we'd finish by the Bicentennial."

Contracts between CDC and the city specified that reports should contain precinct, ward and citywide totals. But these contracts made no mention of the number of tallies to be produced, and in particular did not mention interim totals. These figures were run off for the press, and were not part of the official election requirements, nor were they certified.

Throughout the long Election Day, unsympathetic broadcasters were increasing the tempo of their calls for returns. Around 3 in the afternoon, the election board requested a switchover of totals reporting to the backup system. Tapes from the scanners were carried over to the Unemployment Compensation Board, where the 360/50 ground out the first returns. The two-site process continued all afternoon, and the 8 p.m. vote count was ready for distribution two hours ahead of broadcast time. This tally, though unofficial, kept the press at bay.

Down for the count

As if all this confusion were not enough, other bizarre incidents continued to plague the operation. Ninety-one outstacked ballots mysteriously turned up in a desk drawer in the computer room. One reel of tape, certified by the General Services Administration, proved to be defective on reading, after it had been filled with ballot images. Some tapes, which had been prerecorded with special characters to get around minor system incompatibilities, added a new twist to the affair: The characters were produced by an IBM 370 at another Washington facility, and were skewed so badly that neither the 1700 nor the 360 could read them.

The prize for the most macabre incident may go to the election board people who accidentally put a test tape—used days earlier in a system shakedown—in with the live voting data. That tape was read without incident, and became part of the tally!

And on through the night, mishap followed mishap. The press deadline for the 11 p.m. news was missed entirely. Election officials began losing track of the tapes, with two tallying brigades demanding first crack at the data, while couriers and city officials shuttled between sites. Some order was eventually restored, and the backup system was abandoned. The 1700, now running smoothly but slowly, cranked out the totals. By this time it was nearly midnight.

The following morning, a worried election board moved to hand count four precincts as a cross-check of the computer tabulation. Later in the day, ten additional precincts were hand tallied. These totals seemed to agree with those produced by the computer system. However, when a complete hand count was wrapped up ten lays later, discrepancies between man and machine were noted. The hand count was certified at that time, and the computer tabulation was junked.

Heading for the fall

"Basically, we wanted a fail-safe type of system," said the General Counsel of the Board of Elections. Consequently, balloting was to be done in a way that

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could be either machine-read or hand tallied. The quixotic board found that no system existed that could meet their demands. But one would be built. Its roots were two years old.

On July 20, 1972, Control Data submitted a proposal to the DC Board of Elections. CDC claimed it could provide a system that would rapidly and accurately tally the 1972 presidential election returns. This proposal was not accepted until the 28th of October. A selected portion of the November 4 election was successfully run on a single 921 scanner. It is not clear how CDC and the election board managed to prepare ballots and computer equipment so rapidly. In that election, scanner output was summarized using a 370/155, called the SHARE system, operated by the District of Columbia. The processing was completed by 3:45 a.m. on November 5, despite minor equipment problems.

When school board elections were held in 1973, CDC again provided ballot processing. Here, the financial eccentricities of the capital became apparent.

Washington, DC, a bastard-child of the Congress, never gets its allowance on time. Although the school board election took place on November 6, the tallying contract was not signed by the city until November 13, when funding measures went through.

During that race, the 921 scanner gave the election board some annoying problems. Nevertheless, the count was accurately completed by CDC at 3:15 the following morning. Problems at SHARE held up final tallies two and one-half hours after scanning was finished.

This time, the delays caused public outcry. On November 30, 1973, when CDC proposed their equipment for the forthcoming home rule referendum, the Board of Elections turned them down and instead asked Federal City College to run the count. On April 2, 1973, a month before the May 7 referendum, it became clear that the college was not prepared to count the votes and the board went to CDC, hat in hand. The firm honored its five-month-old proposal and began setting up 921s.

With only one question on the ballot, CDC's sole challenge was the expected large turnout. When the ballots came in, the 921s seemed to work, but delays in report production again caused a furor. Scanning was completed by 2:30 a.m. on the day after the election, but the output from the SHARE 370 was not ready until 8 that evening. CDC believes it was unjustly blamed for the delays, despite published reports that the scanning, their responsibility, was accomplished according to plan.

With a major primary scheduled for September and a general election two months later, the election officials faced a tough choice: Should they stick with Control Data, the firm that had performed acceptably before; should they seek a new contractor with different technology and its uncertainties; or should they revert to manual counting, which had proved slow and arduous in the past?

September fidelis

On the first working day in June 1974, CDC informed the Board of Elections that it would be able to produce printed tallies of election returns. What was needed, CDC said, was a minicomputer capable of reading the scanner tapes, checking their validity, and posting totals. The board mulled over the CDC plan, persuaded that the delays in past elections were incurred during the reporting phase, rather than the scanning phase.

CDC was cautious. The firm had never gotten a contract for the May home rule tally. Also, CDC had been asked to pick up the pieces just days before that vote. The upcoming primary was more complex than any previous election CDC had tackled, and it wanted to be prepared. The Board of Elections was informed that CDC wanted a reply within a week, by the 10th of June.

Over two weeks after CDC's deadline had passed, on June 26, the Board of Elections told the firm that it would indeed be asked to process returns, using the proposed systems. CDC was asked to install a 1700 minicomputer system and a third 921 scanner. Written agreements were not issued at this time.

Contracts covering the September primary, the November general election, and the previous May's home rule referendum were finally signed by the city on July 29. The contracts covered system rental, maintenance, operation, and software development. CDC was also hired to print ballots and other election materials. An addendum for site preparation was submitted by CDC but had never been signed by the board. This unsigned contract was a focal point of dispute as the election date approached.

The size of the several contracts—they totalled about $350,000 for the May, September and November races—prompted serious discussions within the city government. Until late July, there was no indication that the services obtained from CDC would be covered by a written agreement. But on July 25 a memo was issued by the city's contracting officer which forced the city to sign the already submitted contracts. That memo characterizes the verbal agreements as "unauthorized." On July 29 the contracts were ratified and delivered to CDC, with the exception of the site preparation addendum.

Clause and effect

Execution of the contracts was trickier than it appeared. Equipment could not be installed in accordance with written deadlines. CDC claims that installation delays resulted from incompleted site preparation. While CDC was responsible for the site preparation, according to verbal agreements and written proposals, these documents were never countersigned by the city, leaving CDC in limbo.

The hardware was delivered on August 30, 11 days behind schedule. Installation was not completed until September 3, just one week before the primary. The Board of Elections claims that its officials were unable to reach CDC's anchorman during the days following the August 19 deadline to push for immediate installation. While it is true that the CDC executive was out of the local office at the time, CDC claims that the board was able to reach him, and was told at that time that the site was not ready. The CDC executive who headed their project has stated that phone records show he was

Story continues on page 37.

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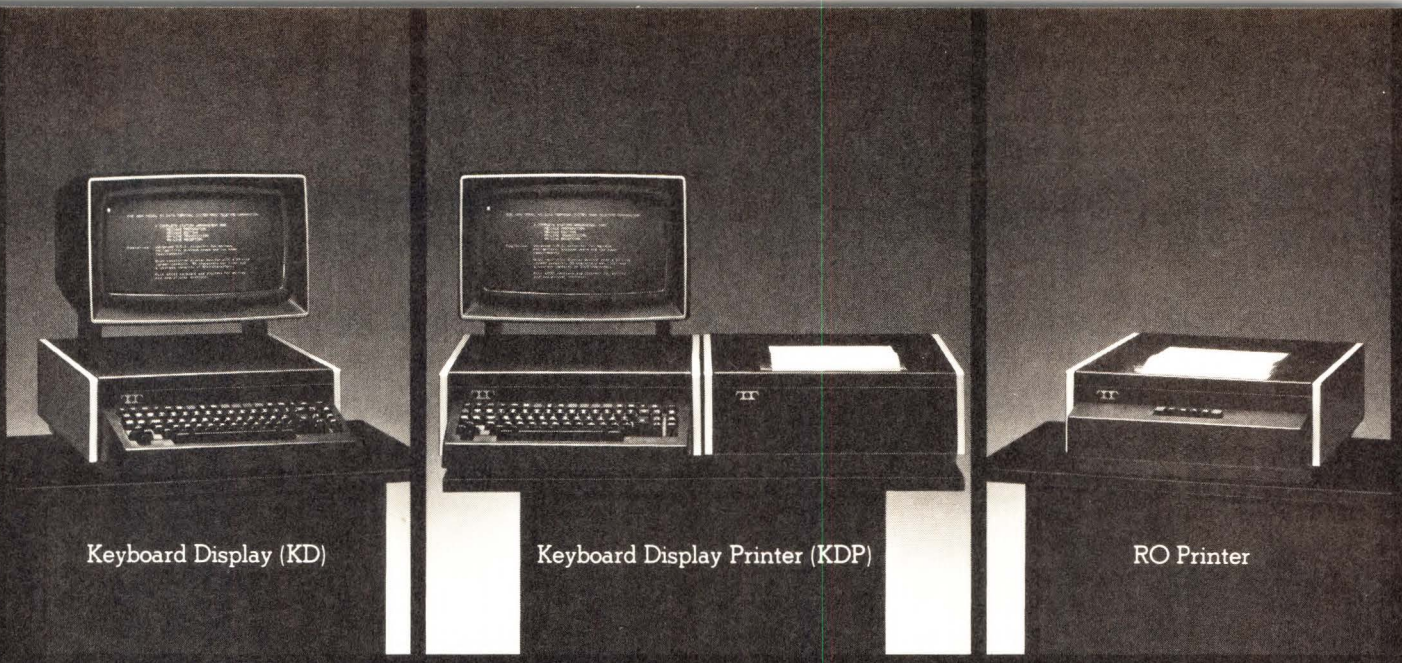

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5¼″ x 11¼″ viewing area on a 13″ display tube.
High resolution 7 x 9 dot matrix character presentation.
127 characters of ASCII code displayed (all except backspace).
1,920 character screen capacity composed of 24 lines of 80 characters per line.
Anti-glare screen, brightness control plus tube tilt.
Constant image cursor—when cursor is positioned over a character, character becomes a negative image.
Refresh rate: 60 frames/second.

Operator Console

Standard keyboard generates 127 ASCII characters.
Six cursor positioning controls; Home, Return, Left, Right, Up and Down.
Five data editing controls; Clear, Character Insert, Character Delete, Line Insert and Line Delete.
Basic terminal controls; Send, Receive, Local.

Optional Page Printer

Impact printer provides hard copy of data stored in the display memory, or of data received directly from the communication line.
Printing speed is over 300 lines per minute (monocase), or 220 lines per minute (full upper and lower case).

Optional Features

Expanded memory, scrolling, protected format, highlight, tabulation, form send. Plus more.

Technical Information

Speed: serial interface; 105 or 120 cps. Code: 1968 USASCII.
Method: transmission is serial by bit and character with low order bit transmitted first.
Synchronization: asynchronous; 1 start bit, 7 information bits, 1 parity bit, 1 stop bit.
Communication line: switched network at 105 or 120 cps.
Bell System Data Sets 202C, 202R or equivalents. Other speeds optional.
Interface: serial—EIA RS-232C. Mode: half duplex.
Error control: optional vertical parity detection on received data (substitute character printed for errored characters). Keyboard generates even vertical parity.
Power requirements: 117V AC ± 10%; 50-60 Hz.
Operating environment: + 40° to 110° F, 2% to 95% humidity.

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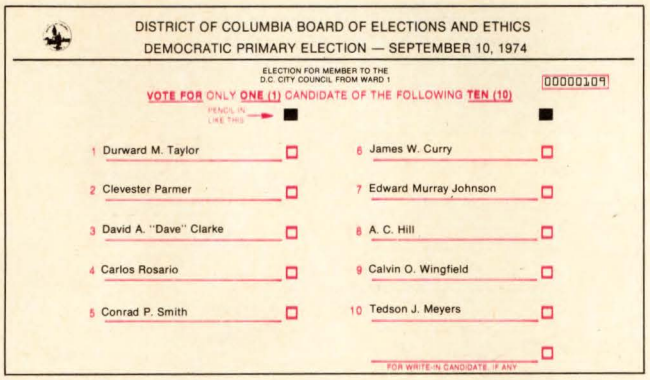


DISTRICT OF COLUMBIA BOARD OF ELECTIONS AND ETHICS
DEMOCRATIC PRIMARY ELECTION — SEPTEMBER 10, 1974

ELECTION FOR MEMBER TO THE D.C. CITY COUNCIL FROM WARD 1

00000109

VOTE FOR ONLY ONE (1) CANDIDATE OF THE FOLLOWING TEN (10)

PENCIL IN LIKE THIS →

1 Durward M. Taylor
2 Clevester Parmer
3 David A. "Dave" Clarke
4 Carlos Rosario
5 Conrad P. Smith
6 James W. Curry
7 Edward Murray Johnson
8 A. C. Hill
9 Calvin O. Wingfield
10 Tedson J. Meyers

FOR WRITE-IN CANDIDATE, IF ANY

The fatal ballot (about half-size)

called by the board at the time when they allege he was "not available." While the post-election report prepared by the city's Computer Services Division mentions communications difficulties and delivery lags, it fails to indicate that any problems were caused by the late installation.

Ballots were printed by CDC and last-minute changes requested by the Board of Elections barely gave the firm time to get them reproduced and checked.

District of Columbia election laws require a public test of machinery within four days of any election. The tests that were conducted were hardly complete. No actual ballots were available at the time. Instead, ballots were simulated on paper tape, transferred to magnetic tape, and then tallied. The magnetic tape generated during the test was the one later mixed up with actual voter data.

Authorization Systems, the backup firm, protested that they were not given sufficient test data for their report run. And on the Saturday before the primary, CDC was still tinkering with the 1700 software. Late that day, a change in the *Fortran* program that tallied ballots was effected and the mini's input rate was said to be up to par for the first time.

Scanners, which require adjustment to both ballot format and reflectivity, could not be fully set up because ballots were not ready, according to CDC. By the time ballots were available, the time-consuming job of tuning the scanners appeared to be impossible. The Computer Services Division's report makes no mention of a public test of the scanners.

Operators for the scanners and the 1700 were provided by CDC. The scanner personnel were said to be experienced in previous District elections. Written instructions, as well as verbal orientation, were given to the operators, according to CDC, but no formal procedures manual was prepared. When difficulties arose during the tally, a lack of proper operator preparation became evident. The Computer Services Division's report states that CDC briefed the operators just one day before the primary.

The Board of Elections had not developed detailed procedures either. No criteria had been established that would guide personnel in a crisis. The switchover to a backup system was a seat-of-the-pants choice by the board rather than a planned tactic.

The game of the blame

Following the election fiasco there was a great rush to cast the first stone. Board of Elections officials blamed "human error," indirectly accusing CDC's operators and programmers of incompetence. Despite the board's cooperation with CDC in simplified testing, its own counsel pointed out that the assurances provided before the primary were inadequate.

The first official airing of grievances before the City Council was one-sided. Control Data's spokesmen were precluded from the discussion, although they were present. The council was preoccupied with contested races and potential litigation. Council members kept their accusations low-keyed and tried to conceal a general ignorance of the concepts of computer technology.

A report by the Board of Elections, largely distilled from a draft of the Computer Services Division study, was presented. The report attempted to justify the choices that had been made but concluded with a recommendation that November elections be tallied by hand. Further study of alternative computer voting systems was also suggested. Subsequently, the board decided to try out voting devices made by Gyrex Corp. of Santa Barbara, CA. The units, valued at $5500 each, will be tested in 19 precincts during the November race.

CDC has prepared its own analysis of the primary and has repeatedly tried to meet with the Board of Elections to sort things out. The City Council has offered to hear CDC's side of the story, but has not set a date for the presentation. The next moves may be in the courts.

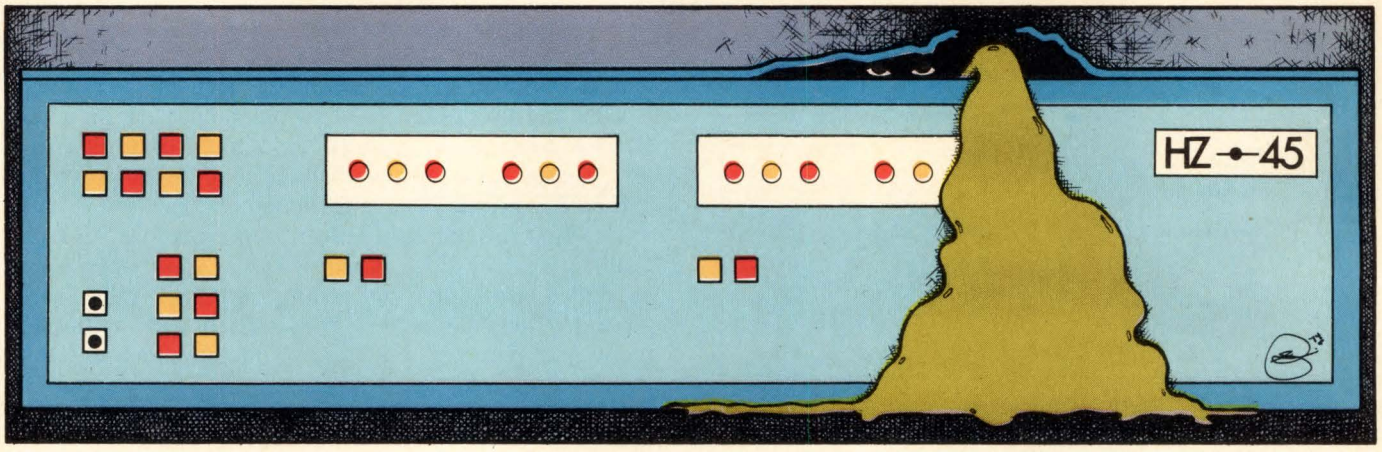
Courting disaster

It is expected that the Board of Elections will try to terminate parts of its contracts with CDC. The contracts cover services for all of 1974 and run through August 1975. Cancellation may be obtained by the board on several grounds. The counsel for the election board has said that the most likely means are through a "convenience of the District" clause, which permits discretionary early termination, or a default clause. Default implies specific contract violations by the vendor and such a cancellation could affect payment for all services, including those rendered during the May referendum. These cancellation clauses are part of all District of Columbia contracts.

The tone of the discussion to date has not been vindictive. Indications are that the city will only seek to avoid paying for services it feels were not provided and will not be needed in future elections.

CDC will probably appeal any cancellation under District laws, particularly if the cancellation implies that the firm did not perform. CDC believes that it met contractual obligations. In addition, CDC views its tolerance of verbal committments and unsigned site preparation contracts as an expression of good will. To date, CDC's only official statements have been vague, but unofficial comments indicate a desire to settle all disputes fairly and amicably. □

The lurker in the inter-record gap



by John Race

The occasional visitor to Miskatonic University's Information Science Department can hardly help but remark on the contrast between the lowering, inbred looks of the head porter, as he unloads the visitor's portmanteaux from the electric brougham that carried him from the railroad station, and the comparatively frank and open expression of your average Yankee university servant.

Certainly Edwin, returning to the involuted and claustrophobic region of his upbringing in the belief that the creatures of the deep were quiescent again, suspected that the man who carried his disk packs was one of his Arkham half brothers, possibly a three-quarters brother.

"Did they seal up the window in the granite tower above Arkham?" he asked by way of experiment. As a consequence of the man's multiple speech defects, the answer was unintelligible, but Edwin caught the sense from the livid patches that sprang up on the fellow's forehead and from his letting fall six volumes of operating manuals. Clearer than words came the message that one could still—if imprudent enough—look out the window that faced no point of the compass, and that certain things could still look in. Meddlers might yet give Cthulhu and the Old Ones their opportunity.

In contrast, Dr. James Pendine was like a breath of fresh air when Edwin sat down with him to plan how they would generate the new operating system on the Miskatonic computer. Young, hair trimmed in the *en brosse* style affected by New York academics, he struck but one faint, discordant note: His tie-tack was fashioned into a shape familiar to those who have studied the abominable writings of the satanic Arab, el Oufkr af't.

The main problem was to get rid of the old Arkham monitor, Reptilian 13. Into the dusk they worked, poring over the vellum sheets.

Once a student came in to report slimy things creeping out of the multiplex channel. James Pendine looked at him levelly. "Did you invoke a recursive procedure?" The student admitted it, was given a temporary fix, and left.

The new operating system was urgent now.

They went into the computer room just after midnight. Little by little they cut away parts of the Arkham monitor, trying to leave only an amount sufficient for the reading in of the clean new code. Edwin heard a muted scream as the job scheduler went. There were toads everywhere. Grim-faced they continued.

At two o'clock the telephone rang.

"That's Project MAC," said James Pendine. "We let them hook into our processor when theirs is down for maintenance." The telephone stopped ringing and a light came on to show that the line had been connected automatically to the computer.

Edwin shrieked and pulled the cable, fizzing and sparking, out of the communications front-end. Pendine had not moved.

"Pray Heaven I was quick enough," said Edwin. "Why had you not disconnected that telephone?" Pendine smiled. "You are fearful that somehow the remnants of the Reptilian might have fled down the line to Massachusetts?"

"I hardly know what I feared," answered Edwin, and he began loading the disks and tapes and cards that would make the Miskatonic computer a healthy thing again.

Rosy-fingered Dawn broke, cloudless, serene. The computer was compiling *Algol*, working much more slowly than it used to under the old monitor, but at least there were no toads. Edwin and Pendine had some kidneys brought in on a salver for breakfast.

Across the dewy campus lawn the porter was seen approaching. Absently Edwin noticed he left the prints of three feet behind him. He proffered a telegram.

TO PENDINE MISKATONIC STOP SINCE CONNECTION YOUR CPU LAST NITE OUR GRAPH PLOTTER WONT DRAW PENTACLES STOP ALSO TOADS EVERYWHERE STOP HOWEVER WELL WORTH IT STOP EXECUTION SPEEDS MUCH IMPROVED STOP THANKS MIT ENDS

As is the case with many telegrams, the text was followed by a few meaningless characters—random ripples on Mr. Bell's fluid that append themselves as parasites to the real symbols of human intercourse. For the sake of this narrative's completeness they are given below:

CTHULHU . . . CTHULHU . . . HAHA . . . CTHULHU . . . . □

DP DIALOG

Notes and observations from IBM which may prove of interest to data processing professionals.

Milwaukee, which borders on Lake Michigan, as it looks after the computer has classified the different land use categories using the satellite data. The lavender areas are industrial; the red, older housing; orange, newer housing; light and dark green, agricultural and wooded areas; the blues, water.

Analyzing the Great Lakes Area from Space

Pollution of the Great Lakes—the largest body of fresh water in North America—continues to be a major concern to the governments of the United States and Canada. But new techniques are being pursued which can put a halt to the harmful pollutants now flowing into the lakes.

One of the best ways environmentalists can curb this pollution is to have information about the entire region showing how the land is being used. The trouble is, it would take years to prepare such data by conventional methods and by then some would be hopelessly outdated.

To tackle the problem scientists at the Laboratory for Applications of Remote Sensing (LARS) at Purdue University are using an IBM computer to help analyze multispectral scanner data taken of 82,000,000 acres of the Great Lakes region from a satellite orbiting the earth 500 miles up. The end result will be color-coded maps and statistical tables of each of the 191 counties in the United States with watersheds or water runoffs that spill into the Great Lakes.

"The U.S. Environmental Protection Agency will use these maps to pinpoint industrial and agricultural areas that may be causing pollutants to enter the lakes," explains Dr. Richard Weismiller, head of the Great Lakes project. "Once the sources are found, steps can be taken to minimize further pollution."

The official name of the project is The Great Lakes Pollution From Land Use Activities Study. It is a direct result of the Great Lakes Water Quality Agreement between the U.S. and Canada under the aegis of an International Joint Commission. The Commission will use the data gathered to evaluate the adequacy of existing pollution control measures and recommend remedial steps to be taken.

Remote sensing technology is not new in this country, but analysts have depended mainly on photographic data coupled with manual analysis. "With the advent of multispectral scanner systems in the mid-60's, we found there was a real need to find faster, more efficient methods for analyzing data," recalls Terry Phillips, director of data processing.

The answer lay in the computer, which could quickly analyze scanner data both from aircraft and later from space satellites. "Now data and computer-aided analysis techniques can be made available to any interested local, state or federal agency and to universities or industrial groups," says Phillips.

"In fact, we have trained other interested users to analyze our computer data themselves. We've installed terminals at six locations so they can use

(Continued on next page)

Advertisement

Computers and Mathematics Explore the Inner Ear

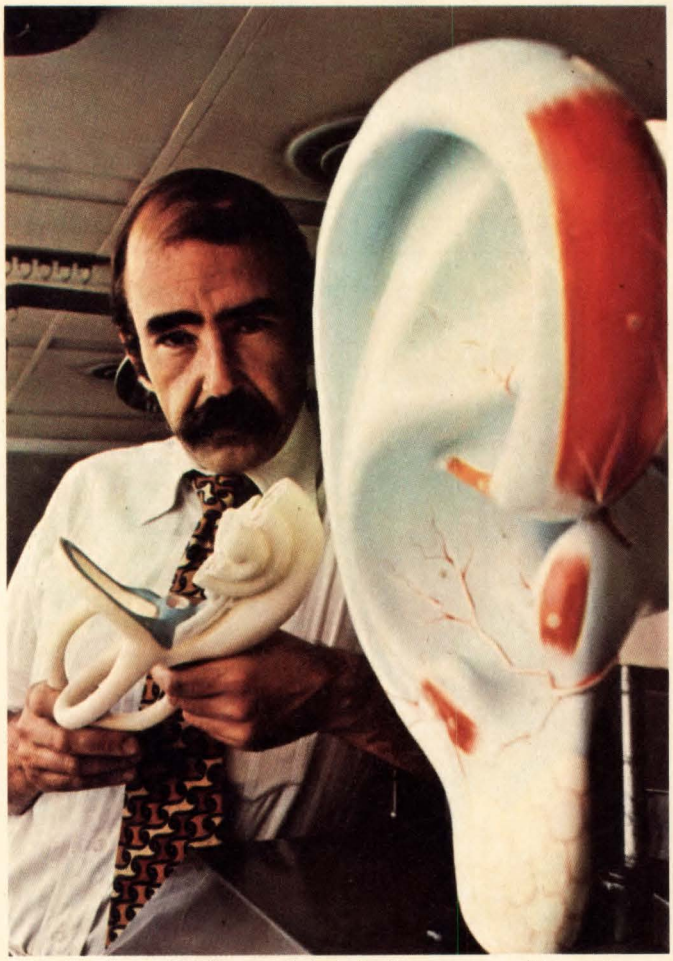
Close to 17 million people in the United States currently suffer from hearing problems. Of these, at least three million have severe hearing disorders due to defects in the inner ear or auditory nerve. Little can be done to correct or even provide some relief for this kind of deafness. The main problem is that specialists know little about parts of the inner ear called the cochlea, and inside the cochlea, the basilar membrane. This membrane, in particular, is not only hard to reach, but is so delicate that it's difficult to study without destroying it.

Over a century ago, the physicist Helmholtz came up with an idea for bypassing some of these experimental difficulties. He suggested that a mathematical description of the cochlea would provide important information. The only trouble was that Helmholtz was a century ahead of history—he didn't have all the experimental evidence he needed, and he didn't have the computational power of the high-speed computer.

Today, what Helmholtz had only dreamed of is being realized by specialists like Dr. Alfred Inselberg, a mathematician at IBM's Los Angeles Scientific Center. For 15 years, he has been developing mathematical models of the cochlea, first as a personal research interest, and later on as a full-time IBM project in collaboration with the Ear Research Institute in Los Angeles.

"We can generate a computer model based on the mathematical model," explains Dr. Inselberg. "We can then do experiments on the model that could not be done on the actual ear."

These experiments together with the mathematical analysis of the model have provided some important information. "We found, for example," says Dr. Inselberg, "that the ear's high-frequency threshold is determined by the properties of the cochlear fluids—like density and viscosity—and the elasticity of the basilar membrane.



Dr. Inselberg holds a model of the inner ear used in anatomy classes at UCLA medical school.

"By contrast, the low frequency threshold depends on the shapes and relative dimensions of the cochlea and the membrane. From this, the nature of Meniere's disease—a kind of deafness characterized by ringing in the ear, where the lower frequencies are primarily affected—can be better understood.

"We also found that certain defects could—in principle—be compensated for by changes in various properties of the cochlea. For example, changes in the stiffness of the basilar membrane could be compensated for by changes in the viscosity of the cochlear fluids."

This kind of information is of great assistance to Dr. Inselberg's colleagues at the Ear Research Institute. They hope to use the model to diagnose the hearing defect. Then by experimenting with different approaches on the computer model, they plan to determine the best one to take. **IBM**

The Great Lakes... *(Continued from first page)*

the data and the analysis techniques stored here in the Purdue computer any time they want."

On the Great Lakes project the scientists are working from data gathered by remote sensing devices located in a NASA-operated satellite called ERTS, Earth Resources Technology Satellite.

ERTS is essentially a flying observatory orbiting the earth every 103 minutes. It carries two independent sensors —one a camera system that is really three cameras in one. The cameras simultaneously photograph overlapping views of the same area segments, each one hundred miles square.

The other sensor is a multispectral line scanning device. It picks up the reflected energy of a scene in a line-by-line fashion. The optics of the system refract this beam of energy separating it into components according to wavelength.

The spacecraft can transmit the data to a ground station when it is in line of sight. Otherwise, it stores the information on tape for later transmission. In the United States there are three ground stations—in Alaska, California and Goddard Space Flight Center in Greenbelt, Maryland.

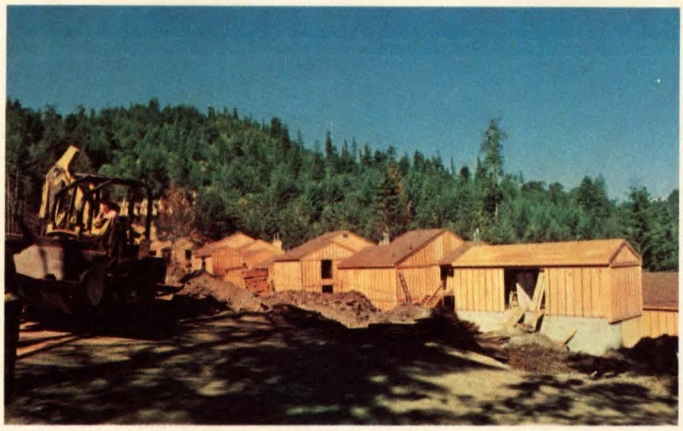
The data from all three centers is digitized at Goddard, which sends it to laboratories like LARS for analysis. Scientists at LARS run these scanner tapes against programs stored in its computer to generate either color images or printed statistical charts.

Dr. Weismiller believes the combined technology of the satellite and the computer offers us a chance to take a comprehensive inventory of our earthly resources. "The Great Lakes project is only one of many possible applications. We can now survey hundreds of thousands of square miles to identify regions of highly promising ore potential; map forests, determining types and volumes of trees in specific areas; make soil maps which sort out productive land from unproductive land; and determine such facts about the soil as iron content, organic matter and drainage patterns." **IBM**

A Model Approach to City Planning in Oregon

Eugene, Ore., nestled in the green Willamette Valley of the Pacific Northwest, is growing at about five percent a year, and its 90,000 citizens want to keep its growth orderly. In developing new areas under their general plan, the city fathers don't want to exceed the boundaries already set for urban services, such as street networks and sewer lines.

A series of computer programs utilizing a System/370 Model 155 is currently being developed to aid in the analysis of proposed zoning changes, development proposals and planning studies. Data on each parcel of land is stored in the computer—ownership of the parcel, its assessed value, address, current land use and, for certain parts of the city, topography, soil type, vegetation and slope characteristics.



Geographic modeling helps planners determine if new housing subdivisions, like this one, can be serviced adequately.

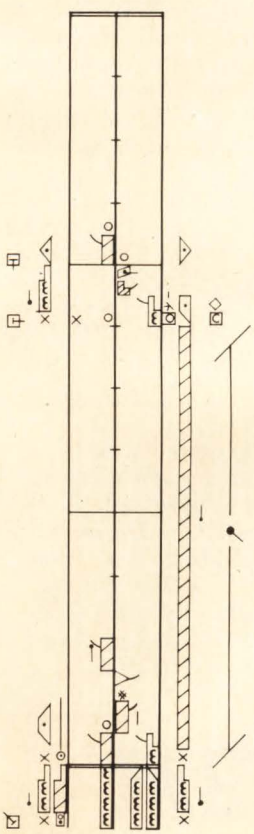
"By simulating different uses of land in the computer, we will be better able to predict what effects any change in zoning may have," explains John Porter, planning director for the city.

A plotter attached to the computer can sketch out any area of the city, from an entire downtown section to individual blocks or parcels. In addition to being able to specify certain geographic areas for data retrieval, the system can retrieve selected data elements. By initiating a job through remotely located IBM 3270 terminals, planners can obtain information in the form of printouts or plots.

The City Planning Department is not alone in the effort to develop a geographically-based information system and modeling techniques. The Public Works Department has implemented a sewer analysis model which has been used most recently to simulate the effects of population increase in one part of the city. The model is designed to compute, for varying levels of population, the amount of sewerage that must be carried by the remote collector lines through the major trunk systems to the treatment facility.

In another use of geobase modeling, traffic planners are completing environmental impact statements with the aid of an urban gas diffusion model. The system is able to predict emission concentrations at a given point based on such considerations as the street network and traffic volumes.

Through such geographic modeling projects, the computer can help make it possible to compare the effects of alternative courses of action for city decision-makers. Joe Williams, director of data processing, says, "The series of projects makes well-managed, orderly growth for the Eugene area a possibility instead of just a goal." **IBM**



A Typewriter for the Dance

The illustration at left is not an architectural rendering but a part of a ballet score typed with an IBM Selectric® typewriter. It tells the ballet master that a "bourrée avec port de bras" is what is most called for, or more simply, a graceful step across the stage with an upward movement of the arms.

These notes are written in Labanotation—a system developed by Rudolf Laban 45 years ago. In short, it is to dance what a music score is to music. Until recently, it had one serious drawback: the notator had to prepare the dance script by hand. This required the skilled hand of an artist, trained in Labanotation, who could render the symbols with proper emphasis and clarity.

In an effort to speed up the process the Dance Notation Bureau of New York approached IBM to help find a way to reproduce dance notation symbols mechanically. Therein began a collaboration between a group of dancers and notation directors at the Bureau and a team of IBM engineers and type designers from IBM's Office Products Division.

The outcome was the development of a special ball-shaped typing element which, when used with a modified IBM Selectric® typewriter, permits the printing of the Labanotation symbols. The element contains 88 separate characters which can be arranged and built upon to form a complete vocabulary for recording movement of any kind.

In fact, Herbert Kummel, executive director of the Dance Notation Bureau believes the extension of the system to electric typewriters is "just the first step in making movement notation more accessible. Without question it will facilitate the use of Labanotation in the 90 colleges and universities now teaching the method. By describing the movement and recording it mechanically we hope to make comparative studies on physiotherapy, athletics, anthropology and the behavioral sciences." **IBM**

A comprehensive new approach to teleprocessing makes it possible for any terminal, on any line, to talk with any program in the computer.

Teleprocessing Landmark

As teleprocessing has evolved, so has the variety of terminals, line control methods and programming support —many of which are incompatible with each other.

A new development from IBM, called Advanced Function for Communications, is designed to expand communications capability and improve productivity. Available till now only for systems within specific industries, it combines new equipment and programming and uses System/370 computers under virtual storage.

This new approach applies a unifying design to an entire teleprocessing function. It permits users to move readily from one IBM terminal-based system to another with a minimum of application programming changes.

A single teleprocessing network is now available for many uses. The network can handle a broad range of multiple online applications. And terminals and equipment on any line can be shared by different applications.

For example:

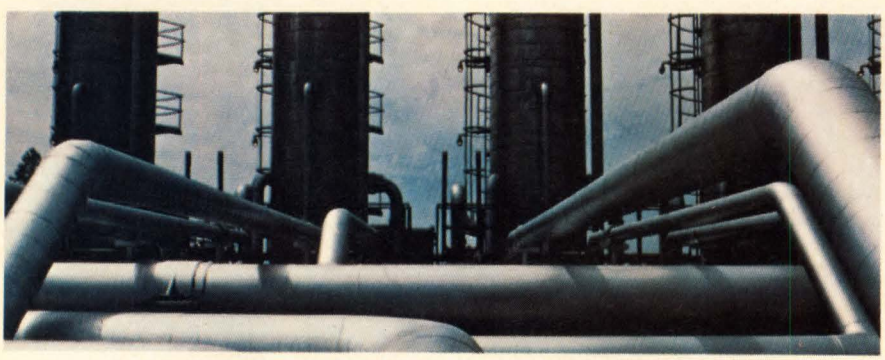
- In manufacturing and process industries, remote sales offices and plants can share communications facilities and terminals for sales, order entry, production reporting, and finished goods inventory.
- A motor freight company can enter freight bills and, with the same terminal, do message switching and equipment control transactions.
- Railroads can combine yard reporting, waybill entry and demurrage accounting.
- In insurance offices, terminals can be shared for claim verification and policy endorsements.
- In banks, making changes on CIF files, calculating yields on bonds and entering data in the trust department can be done on the same terminals.

Advanced Function for Communications includes three major software elements: the virtual operating system itself; the Network Control Program (NCP/VS) resident in the IBM 3704/3705 Communications Controller; and VTAM, the teleprocessing access method for System/370 virtual systems.

A family of terminals and communications products—most using advanced Large Scale Integration (LSI) technology—is available for use with Advanced Function for Communications. All utilize Synchronous Data Link Control (SDLC), a flexible, more efficient line control method.

The latest members are included in the IBM 3767 Communication Terminal, the IBM 3770 Data Communication System, and new models of the IBM 3270 Information Display System. For the 3767 and 3770 systems, an automatic terminal identification capability, an optional security key lock and an optional magnetic stripe reader (operating under SDLC) offer safeguards against unauthorized use of terminals or access to data files.

Other IBM terminal-oriented systems that offer Advanced Function for Communications are the 3600 Finance Communication System, the 3650 Retail Store System, the 3660 Supermarket System, and the 3790 Communication System.



In manufacturing and process industries, remote sales offices and plants can share communications facilities and terminals.

DP Dialog appears regularly in these pages. As its name suggests, we hope DP Dialog will be a two-way medium for DP professionals. We'd like to hear from you. Just write: Editor, DP Dialog, IBM Data Processing Division, 1133 Westchester Ave., White Plains, N.Y. 10604.

IBM® 74-6

Making sense of minicomputer prices

by Robert D. Oakley
Harris Corp., Computer Systems Division

When a potential buyer starts looking at the minicomputer market, he is usually too busy thinking about the product's labor-saving and profit-making effects to wonder about how its price was set. If he investigated, he would find that the price is the result of delicate balancing by the manufacturer of some important factors: appropriate sales volume, production capability and profit margin.

Take sales volume: Sometimes new orders are coming in fast and production capabilities are over capacity. At times like these, a manufacturer will want to slow down sales. He seldom does it by raising prices; usually he reduces advertising and promotion, postpones hiring replacement salesmen, or just extends delivery time.

He might decide to slow down production on a more painful occasion. Suppose he's contented with his sales volume and profit margin, but his sales suddenly plummet. He's losing business to his competitors. He could decide to lower his prices and decrease his profits or to slow down production.

Then there's the question of higher prices: Will his profit go up if his prices do? Not necessarily. When product prices are too high, profits go down, because higher prices mean higher sales and service costs and lower production rates. The volume of production appropriate for that company has a greater effect upon profits than the price of the product.

How does a minimaker achieve the correct balance? The well-managed company starts out by determining its product field, its primary interest market, its corporate objective, and its profit and growth opportunities. Since no business deliberately plans to be a nonprofit organization (although a few have ended up that way and stayed in business), the company must consider the key ingredient to success: smart pricing.

More bang for the buck

Smart pricing comes only after a comprehensive return-on-investment (ROI) analysis. An ROI cannot be rigid: It must be flexible and sensitive. It must consider the full range of possible results, from optimistic to pessimistic. And the good pricing plan will anticipate future as well as initial prices.

The competition determines the price of a new minicomputer. Comparable products are usually similarly priced; the most recent entries are priced the lowest. Price and performance superlatives always draw attention to a new machine, but each new computer does offer more bang for the customer's buck.

A new mini is priced as low as possible with future production costs always in mind. If state-of-the-art components have been used throughout the mini's development—products which themselves are dropping in price—production costs can be kept low. Occasionally, though, low pricing backfires on the manufacturer, especially if he has chosen the wrong technology or has pressed state of the art too far.

Meet the corporate objective

No mini is placed on the market if there's a chance it won't make money. A mini maker wants to be sure his new product is going to bring a good net earning. How does a mini maker set the price of his new machine, keeping in mind the corporate objective? Let's take a look at a hypothetical pricing plan.

Our mini maker has R&D, marketing and G&A expenses that will force him to meet a 50 percent gross margin of profit if his new mini is to yield a 10 percent net earning. This is his corporate objectve.

Based on the current market, the retail price for a machine with 4096 words of memory should be $3,500; a machine with 8192 words of memory should cost $4,200. Competitive discounts are offered.

The selling price is equal to the retail price minus the average discount. (Though discounts of up to 40 percent are likely, the average discount is 25 percent.) So, the 4k mini will sell for $2,625, and the 8k mini for $3,150.

But the manufacturer also has to account for his production expenses. Material, material overhead, labor and its overhead come to $1,375 and $1,565 for the 4k and 8k machines respectively.

How do these two products fare in meeting the corporate objective? Well, let's see. The gross profit margins for each mini can be calculated with the following formulas:

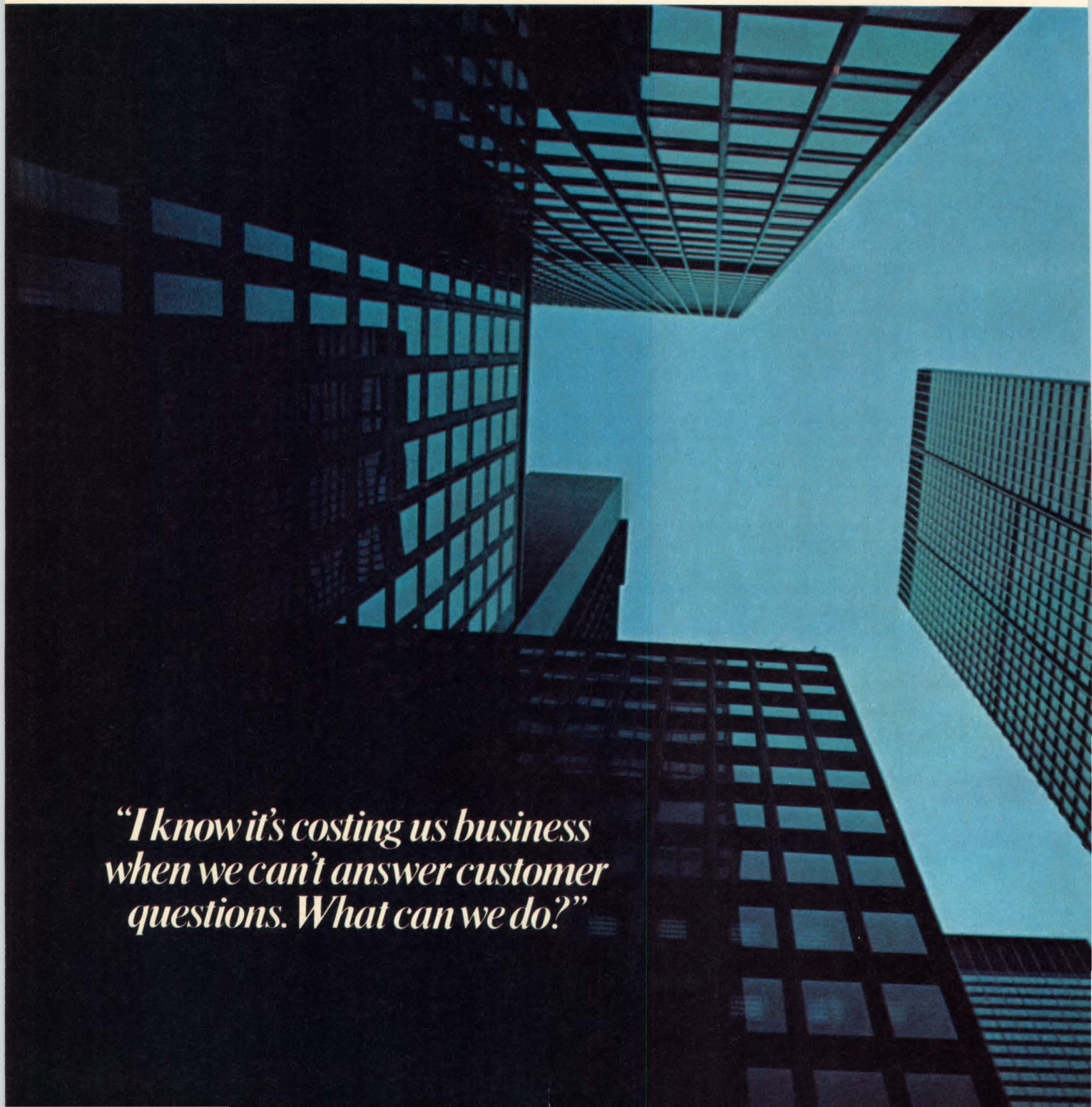
$$GM = \frac{SP\text{-}COG}{SP}$$

Where
GM = Gross Margin Percentage
SP = Selling Price
COG = Total Cost of Goods

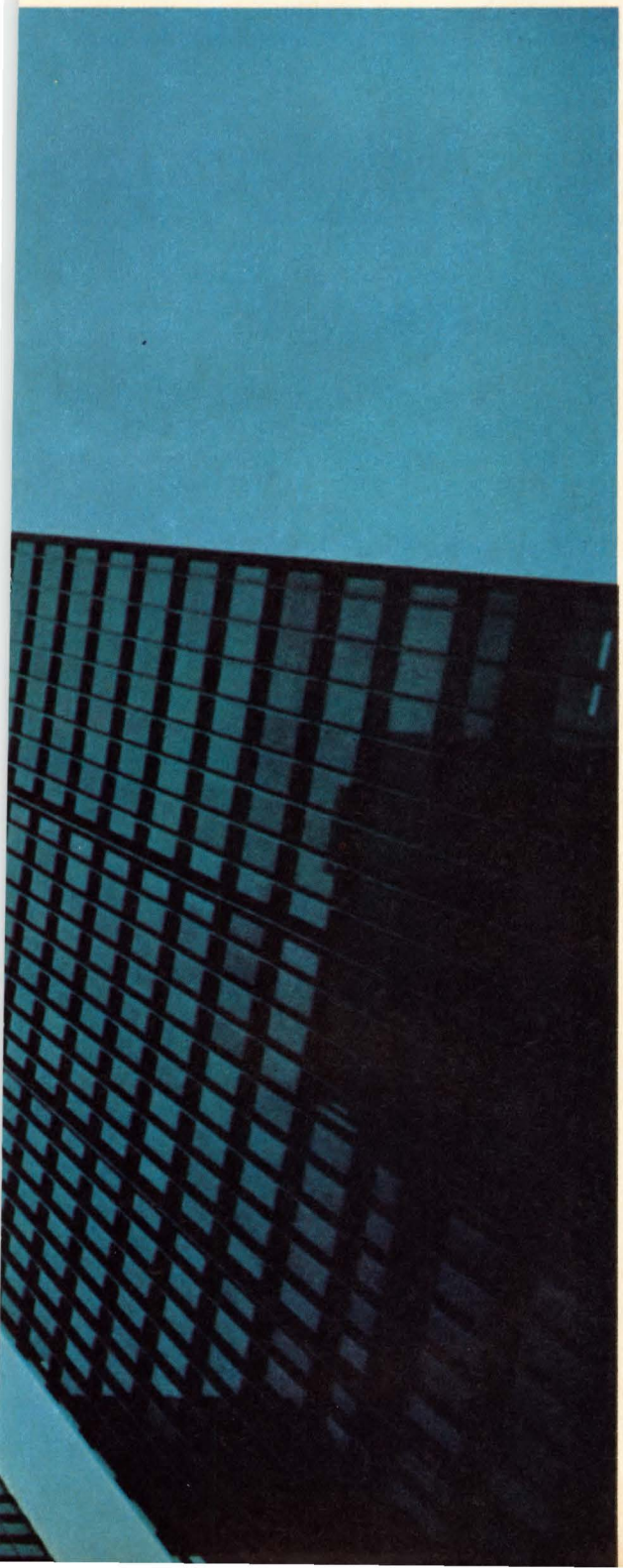
Mini with 4k
$$GM = \frac{\$2625 - \$1375}{\$2625}$$
$$GM = 47.6\%$$

Mini with 8k
$$GM = \frac{\$3150 - \$1565}{\$3150}$$
$$GM = 50.3\%$$

Looking out for his company's welfare, the mini maker sees that the 4k mini does not fare well at all, but the 8k machine does. This is frequently the case, and often a low-end machine offers even less profit potential. But from a marketing viewpoint, the value of the 4k mini is significant, and management will usually approve the pricing plan. In most cases, the low-end mini is not supplied with useful software. But those that are sold will later be enhanced with add-on memory and other peripherals. □


"I know it's costing us business
when we can't answer customer
questions. What can we do?"

Ask us



You've already gained speed and efficiency in some of your procedures by using microfilm. There's even more dramatic progress available to handle customer inquiries. For example:

A major retailer failed to find the needed records once out of every five calls. Now all the records are on film and virtually any one can be displayed on a screen at the touch of a button.

A telephone company was laboring to answer more than 2,000 customer questions every day. The answers are now on film and are handled *ten* times faster than before.

More than just lookups: A bank is using the same basic method to keep track of daily transactions. Having the records on film produced a saving of $50,000 in the first year.

To make this kind of progress in your business takes your determination to seek better answers. The sooner you ask us, the sooner we can help. Just write on your letterhead to W. O. Fullerton, Eastman Kodak Company, Dept. DP4875, Rochester, New York 14650. Or call 800-447-4700. In Illinois, call 800-322-4400.

What you're saving now with microfilm is only the beginning.

Kodak

THAT MAKES OS RATING

by Philip G. Stein and Howard M. Shapiro

Harvest time again, and the Editors of *Computer Decisions* have raked together this year's crop of minicomputers for you, hoe hoe. It falls to us seasoned experts to help you plow through it all, weed out the nonessentials, and pick the right mini for your plant.

Peripheral prices this year are at lower levels than ever, and there is the perennial cornucopia of new hardware. But the software and operating systems supplied with minis still have not achieved parity with those available for bigger machines. And, despite the amount of fertilizer that's being spread in this area, minicomputers can't crunch numbers like the big guys.

Why?

- Mini hardware is neither as complex in architecture nor as fast, although the breed is improving.
- Mini software and operating systems are small potatoes compared to what's on larger machines.
- User-level aids, training, and documentation run on the lean side. They're fine for old computer wranglers, but they need fattening up to be palatable to the average user.
- Such mathematical libraries as exist are in the seedling stage, especially regarding accuracy. Libraries for statistical applications are almost nonexistent.

Still, though the fanciest mini has its limits, minis can be and have been fruitfully applied in many fields, and there are many tasks for which they're a natural. To see whether your shop is an ecological niche for a mini, you have to define an environment.

An environment?

In the context of minicomputers, this pretty much means an operating system (OS) or lack of it. A store-bought OS does a lot of different chores for you which you otherwise would have had to program yourself. However, the manufacturers can't survive unless the OS fits the needs of many other customers as well. As a result, you are apt to find that your OS doesn't do anything just the way you would like it, and/or that it does a lot of things you don't need. It's well known in evolution that infinitely adaptable species become extinct. Naturally, selecting your OS for size, elegance, and capability can also increase your overhead, response time, and memory requirements. Let no sales rep tell you otherwise; such a tyrant OS always wrecks a system. A less ambitious OS can ameliorate this, changing things for the better, even though it may not work like a wizard. Pray for an OS that puts a proper editor, assembler, etc. Darwin you need it; you'll be glad it's around.

OS sense

As we shall show, both real-time and multiprogramming OS's have their place. Most manufacturers have trotted out OS's which do both. Multiprogramming allows your computer to be cognizant of several processes or programs, although only one is executing at any instant. The scheduling algorithm, part of the OS, will start a job, run part of it, tidy up and then switch to doing part of the next job, etc. The handicap of multiprogramming is that you can't whip from one job to another without keeping track of where you left off. This stretches execution times for individual programs by only a hair, but the overhead really totals up.

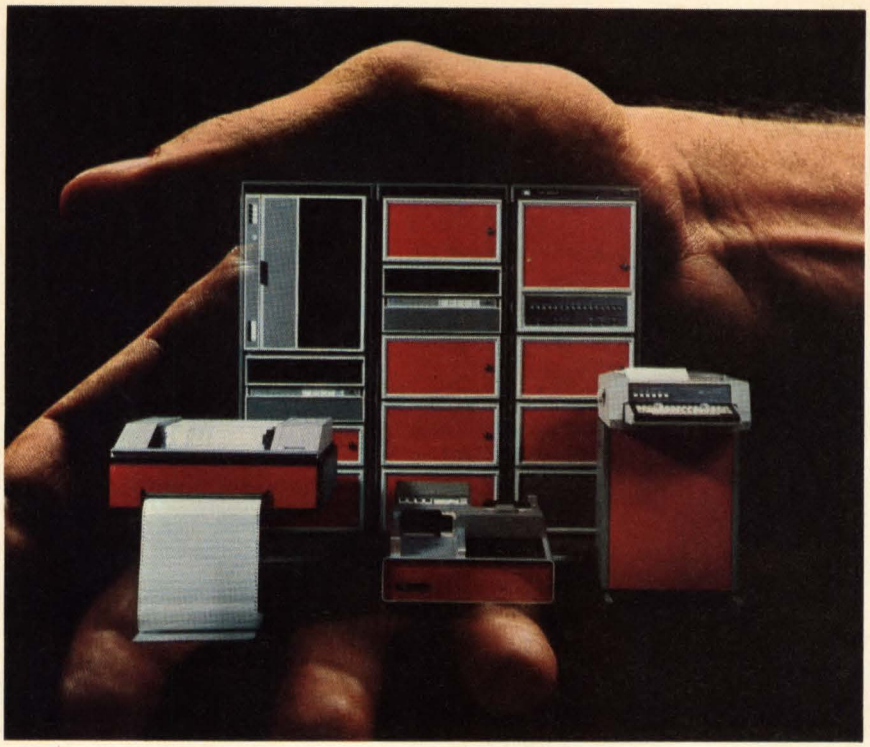
Real-time systems are OS's of another caller. They respond to requests or interrupts as they come in from users and their equipment. A good system can field interrupts at a rapid pace, and can handle multiple interrupts as well. When the same relatively simple program is used for each request, a real-time system without multiprogramming can do the same job for many users in rapid succession, if it's not saddled with too many interrupts.

The bigger OS's for most minicomputers are both multiprogramming and real-time, and you can't buy one without the other. Bigger is not necessarily better; it may pay off to use a smaller system if it's just the ticket for your job, or to get by without an OS. The Ticketron reservations system came out a winner by treating the processing of many remote inquiries as one large task, instead of establishing many small tasks sharing the same software. You might perfect a similar system for your exact application.

They shoot OS's don't they?

A typical real-time multiprogramming set up is foreground/background. For example, a laboratory instrument produces a datum once per second, and requires some control information from the computer before collecting the next point. This is the foreground. Another program, the background, analyzes the data gathered over the last few hours, prints summaries, and produces the control information for the foreground program. Sounds like a sure thing for a real-time multiprogramming OS, but let us tip you off how to do it without one.

The data collection program runs as needed, in real-time, handling its own interrupts. When it finishes, it returns to the data processing program. By putting your OS out to pasture, you save enough core to keep both jobs resident. All the dope which must go from



This $129,500* timesharing system gives you better BASIC than any other minicomputer system. With batch at the same time.

HP's 3000 Model 100 lets you do more with BASIC than ever before. You can intermix integer, real, long precision and complex numbers. Share resources with any kind of peripheral. Call subroutines compiled in FORTRAN, COBOL, and our Systems Programming Language.

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INFORMATION RETRIEVAL NUMBER 47

OS features shopping list

A list of the services performed by your faithful OS. A good thing to do is to check off those you would like to have, then go shopping.

Staples—the basics

- I/O drivers: To simplify the task of programming those sometimes balky peripherals. You specify a block of data to be transferred and the external device involved.
- Logical unit assignments: Lets you specify the device at run time. You can list on tape or disk or a printer as you wish; switch input devices and consoles too.
- Console messages and commands: The operator can start and stop jobs, rewind tapes, inspect or change specified memory locations, load new user programs, get messages from running jobs.
- Mass storage support: Keep an index of files, location on disk or drum, etc. Usually allows naming the files and passing them from editor to compiler to loader, etc. by name.
- Interrupt service: For internal errors and software simulation of unimplemented instructions. Sometimes also handles data transfers to I/O drivers on an interrupt basis. Also handles power failure and automatic restart if implemented in the hardware.

Goodies—some are necessities in real-time or multiprogramming systems

- Overlays and chaining: Allows programs to be larger than core, and to start other programs.
- Watchdog timer: Re-boots systems and restarts in case of a crash.
- Privileged instructions: Prevents user from doing his own I/O. Requires him to use the OS to talk to peripherals.
- Clock handling: Keep time of day and time intervals from real-time hardware clock. Start jobs after a delay or at a given time.
- Memory protect: Keep users out of each others space, and out of the OS.
- Interrupt service for user routines: Saving and restoring the interrupted programs. Vectoring into the user interrupt service routine.
- Multiprogramming. Swapping among many concurrently active jobs according to some priority or schedule, or in response to a real-time event.
- Timesharing: A subset of multiprogramming. Lets you have many users but usually with a narrow choice of what they can run. Usually just *Basic* or *Fortran* plus the editor and file system.

Icing on the cake

- Dynamic memory allocation: Allows programs to fight each other for available core space.
- Dynamic program relocation: Crunches programs together so that more space is available to fight for.
- Virtual memory: Eliminates the need for the above two features by making memory address space appear enormous and contiguous for each user when in fact it's neither.
- Sharing of re-entrant processors: Support the separation of programs into pure and impure segments, and allow many users to share a single copy of a pure segment.
- Higher level command language: Since all of the above make such a complicated system that is virtually unlearnable, a higher-level command language interpreter gives the user simplified control commands for every day tasks.

one to the other is stored in a few shared memory locations. Some of these can be simple binary switches—they're on if there are new data to be analyzed and they're off otherwise. The processing program will, of course, reset such switches.

You, too, may need no OS for your kingdom. If there's no need to boot a dedicated OS, you'll need less core. Perhaps you can then afford more interface hardware, putting the cards before the OS, or another terminal, giving you an OS-less carriage. Returning to OS's, though, you probably need a real-time multiprogramming OS if:

- You will be running various, unpredictable combinations of jobs at different times, or
- The jobs needed at the same time don't all fit in your memory, or
- You are doing program development and running real-time jobs at the same time (The old OS-and-debuggy trick, which may get your programmers sulky. A good place for a second machine.)

You may speculate that you need an OS if none of your programmers are savvy enough to write a small interrupt handler so you can run without one. If you can't write one, what you need is not an OS, it's a service bureau. Taming real-time systems isn't easy, even for well-trained, experienced systems people. A dilatory effort at programming is apt to get you into a scrape, even with a competent OS.

Summing up

To carry out bit to its conclusion, we'll add that most minicomputer suppliers offer a wide range of hardware and operating system capabilities. The overflowing list accompanying proves our point. The differences between two manufacturers are often less than those between the least and most elaborate versions of the same mini. There's a dividend in using the most economical system which is equal to the task, rather than letting your over-equipped mini become a status symbol. We have long been exponents of this principle of parsimony; it's the only way to operate. Make a notation of what you need, polish it up, take our list, and look and see which mini you end up with. It's not hard to figure out. □

Philip Stein is a minicomputer/electronics/measurements maven. He will begin a regular column for COMPUTER DECISIONS next month. Howard Shapiro, M.D. is a surgeon/statitician/songwriter currently doing medical instrumentation for a drug company. Together since 1956, they now have a rock and roll group called The Turing Machine.

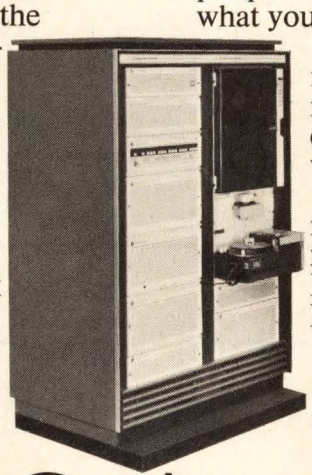
Introducing the V-71. 32K for 8 grand.

Incredible. Getting 32K out of an off-the-shelf mini. Plus the option of a power fail/restart, teletype controller, automatic bootstrap loader for TTY's and real-time clock for only $800 more*.

It gives us the distinction of being the cheapest computer in the world delivering 32K. And gives you the chance to get a lot more power for your money.

But the V-71 is more than just another piece of bare metal selling at a rock-bottom price (we leave that specialty to others). It–like the entire Varian V-70 family–has been elegantly designed by Varian engineers who think in terms of systems and total concepts.

With additions, the V-71 is capable of a powerful blend of hardware, systems software (the VORTEX operating system), and extensive peripherals. And Writable Control Store if that's what you need.



How much of a system you want to make out of the V-71 is up to you. The raw power is there. And Varian's open-ended architecture makes it easy to add whatever building blocks you need.

If you want more power for less money, check out the new V-71. For further information, write Varian Data Machines, 2722 Michelson Drive, Irvine, CA 92664. Or call 833-2400.

*V-71 price and options based on orders of a dozen.

varian data machines

INFORMATION RETRIEVAL NUMBER 49

Minicomputer roundup

Manufacturer & model	Applied Comp. PPS-4ME	Applied Comp. PPS4-MP	Applied Comp. CBC-4	Applied Comp. CBC-4N	Applied Comp. UMPS-4	Automatic Elect. AES-80
Word length/Instruction length (bits)	4, 8/8, 16	4, 8/8, 16	4, 8/8, 16	4, 8/8, 16	4, 8/8, 16	8/12
Cycle time (microseconds/word)	5	5	11.8	11.8	5	1.0
Word cap (min/max)	1,024/16,384	256/16,384	1,024/4,096	256/4,096	256/16,384	16k
No. of directly addressable words	4,096	NA	4,096	4,096	4,096	11k
I/O word size, bits	12	12	4	4	12	8
Direct memory access channel	Standard	Standard	No	No	Standard	No
Maximum I/O rate, words/sec	20,000	20,000	10,000	10,000	20,000	131,072
Hardware multiply/divide	No	No	No	No	No	No
Hardware floating point	No	No	No	No	No	No
Hardware byte manipulation	No	No	No	No	No	No
Assembler	No	No	1 pass	No	No	1 & 2 pass
Macro assembler	No	No	No	No	No	No
Fortran compiler	No	Yes	No	No	Optional	No
Other compilers	No	Yes	No	No	No	AES
Price of basic system	$2,950	$2,495	$4,950	$495	$695/4k	$3,640/4k
Circle No.	200	201	202	203	204	205

Manufacturer & model	Automatic Elect. AES/80C	Basic/Four 350, 400, 500	Bendix BDX6200	Bendix BDX9000	Calif. Data Proces. CAL-DATA-1	Cascade Data Concept II
Word length/Instruction length (bits)	8/12	2 bytes/1 byte	20/20	16/16	16/48	16/16, 40
Cycle time (microseconds/word)	0.24	1.0	20	2.0	0.675	1.2
Word cap (min/max)	16k	16/65	4,096/16,384	4,096/32,768	8,192/131,072	4,096/16,384
No. of directly addressable words	1k	32k	4,096	256	131,072	16,384
I/O word size, bits	8	8	20	20	16	16
Direct memory access channel	No	Yes	Optional	Optional	Optional	Standard
Maximum I/O rate, words/sec	1,048,576	106	500,000	500,000	3,000,000	413,000
Hardware multiply/divide	Optional	Yes	Standard	Standard	Optional	Standard
Hardware floating point	Optional	No	No	No	Optional	No
Hardware byte manipulation	Standard	No	No	No	Standard	Standard
Assembler	1 & 2 pass	No	2 pass	2 pass	2 pass	2 pass
Macro assembler	No	No	No	No	Yes	Yes
Fortran compiler	No	No	No	No	No	No
Other compilers	No	Basic	Atlas	No	No	RPG
Price of basic system	$3,640/4k	$770/mo	NA	NA	NA	$29,500/4k
Circle No.	206	207	208	209	210	211

Manufacturer & model	Cincinnati Milacron CIP/2200	Computer Auto. LSI 2/10	Computer Auto Alpha LSI-1	Computer Auto LSI-2/20	Computer Auto Naked Mini LSI-1	Computer Auto Naked LSI-2/10
Word length/Instruction length (bits)	8/variable	16/16, 32	16/16, 32	16/16, 32	16/16	16/16, 32
Cycle time (microseconds/word)	1.7	1.6	1.6	1.6	1.6	1.6
Word cap (min/max)	8,192/65,536	1,024/262,144	1,024/262,144	4,096/262,144	1,024/262,144	4,096/262,144
No. of directly addressable words		1,024	1,024	1,024	1,024	
I/O word size, bits	8	8, 16	8,16	8, 16	8, 16	8,16
Direct memory access channel	Optional	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	909,000	1,666,000	1,666,000	1,666,000	1,666,000	1,666,000
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	No	No	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard	Standard
Assembler	2 pass	2 pass	2 pass	2 pass	2 pass	2 pass
Macro assembler	Yes	Yes	Yes	Yes	Yes	Yes
Fortran compiler	No	Yes	Yes	Yes	Yes	Yes
Other compilers	$2,370/4k	Basic	Basic	Basic	Basic	Basic
Price of basic system	RPG	$1,750/4k	$2,390/4k	$2,765/4k	$1,650/4k	$1,750/4k
Circle No.	212*	213	214	215	216	217

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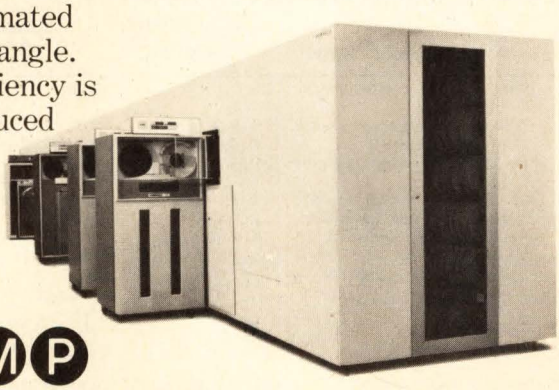

CALCOMP

INFORMATION RETRIEVAL NUMBER 51

Manufacturer & model	Computer Auto Naked LSI-2/20	Computer Hard-ware CHI 2130	Comp Tech. Modular One 1.11	Comp Tech. Modular One 1.12	Comp Tech. Modular One 1.14	Comstar Corp. CS4
Word length/Instruction length (bits)	16/16, 32	16/32	16/16	16/16	16/16	4/8, 16
Cycle time (microseconds/word)	1.6	0.8	0.75	1.5, 0.75	1.5, 0.75	10.8
Word cap (min/max)	4,096/262,144	8,192/65,536	8,192/57,324	8,192/57,324	12,288/24,556	10.24k
No. of directly addressable words	1,024	65,536	NA	32,768	24,556	32k/10.2k/10.24
I/O word size, bits	8, 16	16	16	16	16	4
Direct memory access channel	Standard	Optional	Optional	Optional	Optional	Yes
Maximum I/O rate, words/sec	1,666,000	1,250,000	156,000	156,000	156,000	80,000
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard	Optional
Hardware floating point	No	Optional	No	No	No	No
Hardware byte manipulation	Standard	No	Standard	Standard	Standard	No
Assembler	2 pass	No	1 or 2 pass	No	1 or 2 pass	Yes
Macro assembler	Yes	Yes	Yes	No	Yes	Yes
Fortran compiler	Yes	Yes	Yes	No	Yes	Yes
Other compilers	Basic	Cobol, Basic, Snobol, SLI	Coral 66, Basic, Modus 4	No	Coral 66, Basic	PCL
Price of basic system	$2,300/4k	$28,000/8k	NA	NA	NA	$950
Circle No.	218	219	220	221	222	223

Manufacturer & model	Control Data 1700	Control Data SC-1700	Control Data System 17	Data General Nova 2/4	Data General Nova 2/10	Data General Nova 800
Word length/Instruction length (bits)	16+2/16, 32	16+2/16, 32	16+2/16, 32	16/16	16/16	16/16
Cycle time (microseconds/word)	1.1	1.5	0.6/0.9	1.0/0.8	1.0/0.8	0.8
Word cap (min/max)	4,096/32,768	4,096/32,768	4,096/16,384	4,096/32,768	4,096/32,768	4,096/32,768
No. of directly addressable words	256	256	256	1,024	1,024	1,024
I/O word size, bits	16	16	16	16	16	16
Direct memory access channel	Optional	Optional	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	900,000	650,000		1.25/.833m	1.25/.833m	1.25/833m
Hardware multiply/divide	Standard	Standard		Optional	Optional	Optional
Hardware floating point	No	No	No	No	Optional	Optional
Hardware byte manipulation	No	Optional	Optional	Standard	Standard	Standard
Assembler	Optional	2 pass	2 pass	2 pass	2 pass	2 pass
Macro assembler	No	Yes	Yes	Yes	Yes	Yes
Fortran compiler	No	Yes	Yes	Yes	Yes	Yes
Other compilers	Process Control	No	No	Algol, Basic	Algol, Basic	Algol, Basic
Price of basic system	$20,000/4k	$15,900/4k	$14,175/4k	$3,500/4k	$4,400/4k	$6,600/4k
Circle No.	224	225	226	227	228	229

Manufacturer & model	Data General Nova 820	Data General Nova 840	Data General Nova 1200	Data General Nova 1210	Data General Nova 1220	Data General Nova 1230
Word length/Instruction length (bits)	16/16	16/16	16/16	16/16	16/16	16/16
Cycle time (microseconds/word)	0.8	0.8	1.2	1.2	1.2	1.2
Word cap (min/max)	4,096/32,768	16,384/31,072	4,096/32,768	4,096/32,768	4,096/32,768	4,096/32.768
No. of directly addressable words	1,024	1,024	1,024	1,024	1,024	1,024
I/O word size, bits	16	16	16	16	16	116
Direct memory access channel	Standard	NA	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	1,250,000	1,250,000	833,000	833,000	833,000	833,000
Hardware multiply/divide	Optional	Optional	Optional	Optional	Optional	Optional
Hardware floating point	Optional	Optional	Optional	No	Optional	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard	Standard
Assembler	2 pass	NA	2 pass	2 pass	2 pass	2 pass
Macro assembler	Yes	NA	Yes	Yes	Yes	Yes
Fortran compiler	Yes	NA	Yes	Yes	Yes	Yes
Other compilers	Algol, Basic	No	Algol, Basic	Algol, Basic	Algol, Basic	Algol, Basic
Price of basic system	$6,100/4k	$16,530/8k	$5,100/4k	$4,000/4k	$4,900/4k	$7,100/8k
Circle No.	230	231	232	233	234	235

Manufacturer & model	Data General Supernova	Datapoint 2200	DCC D-116S	DCC D-112, 112H	DCC D-116H	DEC PDP-8A
Word length/Instruction length (bits)	16/16	8/8, 16, 24	16/16	12/12, 24	16/16	12/12
Cycle time (microseconds/word)	0.8/0.3	1.2	1.2	1.2, 0.9	.96	1.5
Word cap (min/max)	1,024/4,096/32,768	4,096/32,768	1,000/128,000	256; 4,096/32,768	1,000/128,000	1,000/32,000
No. of directly addressable words	1,024	16,384	1,024	256	1,024	256
I/O word size, bits	16	8	16	12	16	12
Direct memory access channel	Standard	No	Yes	Optional	Yes	Yes
Maximum I/O rate, words/sec	1,250,000	30,000	833,000	833,000	1,040,000	666,400
Hardware multiply/divide	Optional	No	Optional	Optional	Optional	No
Hardware floating point	Optional	No	No	Optional	No	Optional
Hardware byte manipulation	Standard	No	Yes	Opt., Stand.	Yes	No
Assembler	2 pass	2 pass	Yes	1 & 2 pass	Yes	Yes
Macro assembler	Yes	No	No	Yes	No	Yes
Fortran compiler	Yes	No	Yes	Yes	Yes	Yes
Other compilers	Algol, Basic	Basic, RPG II	Basic	Basic	Basic	Algol, Basic, Dibol, Focal
Price of basic system	$9,250/4k	$8,571/4k	$2,975/4k	$3,490; $4,095/4k	3,075/4k	$2,600/4k
Circle No.	236	238	239	240	241	242

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INFORMATION RETRIEVAL NUMBER 53

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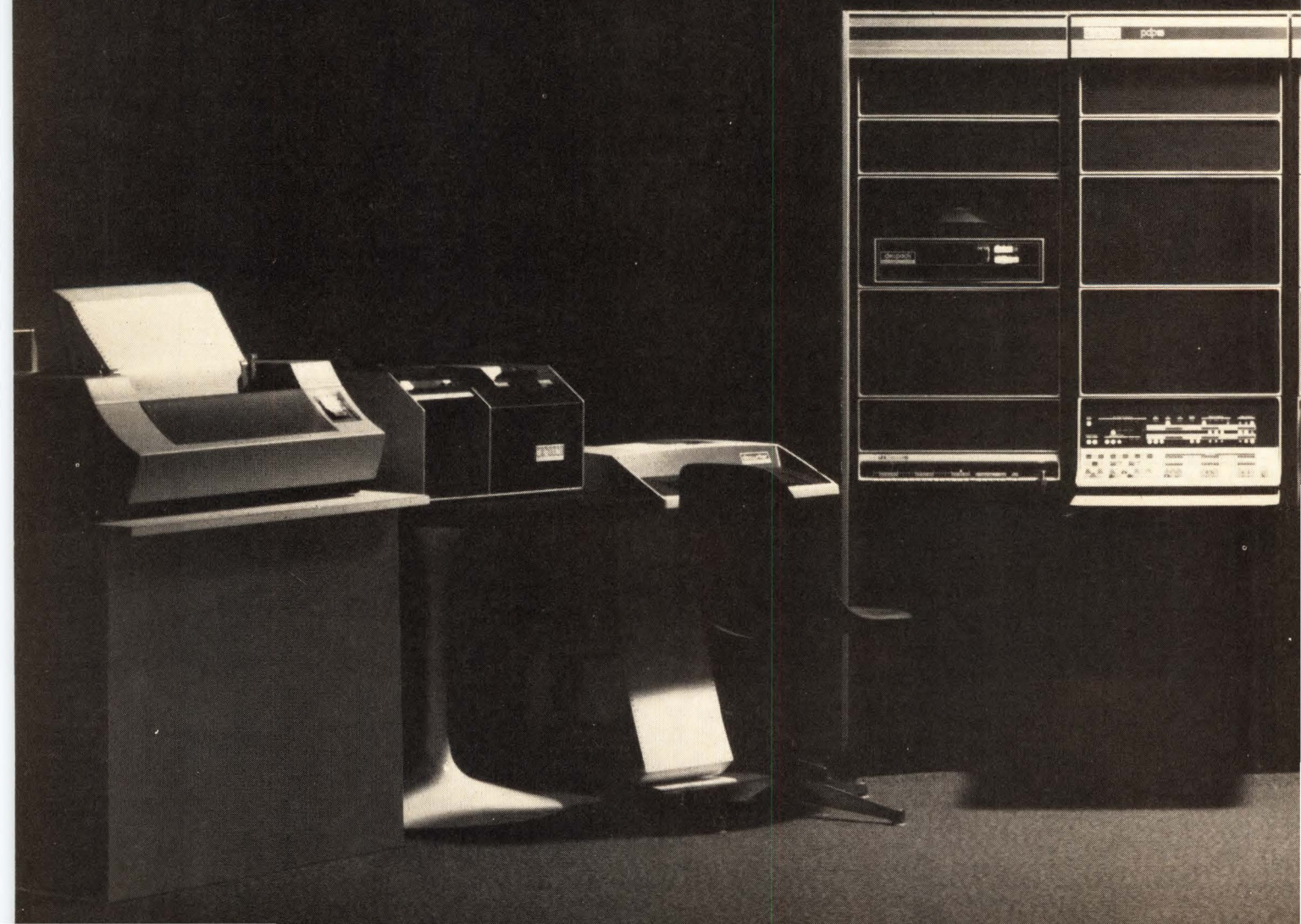

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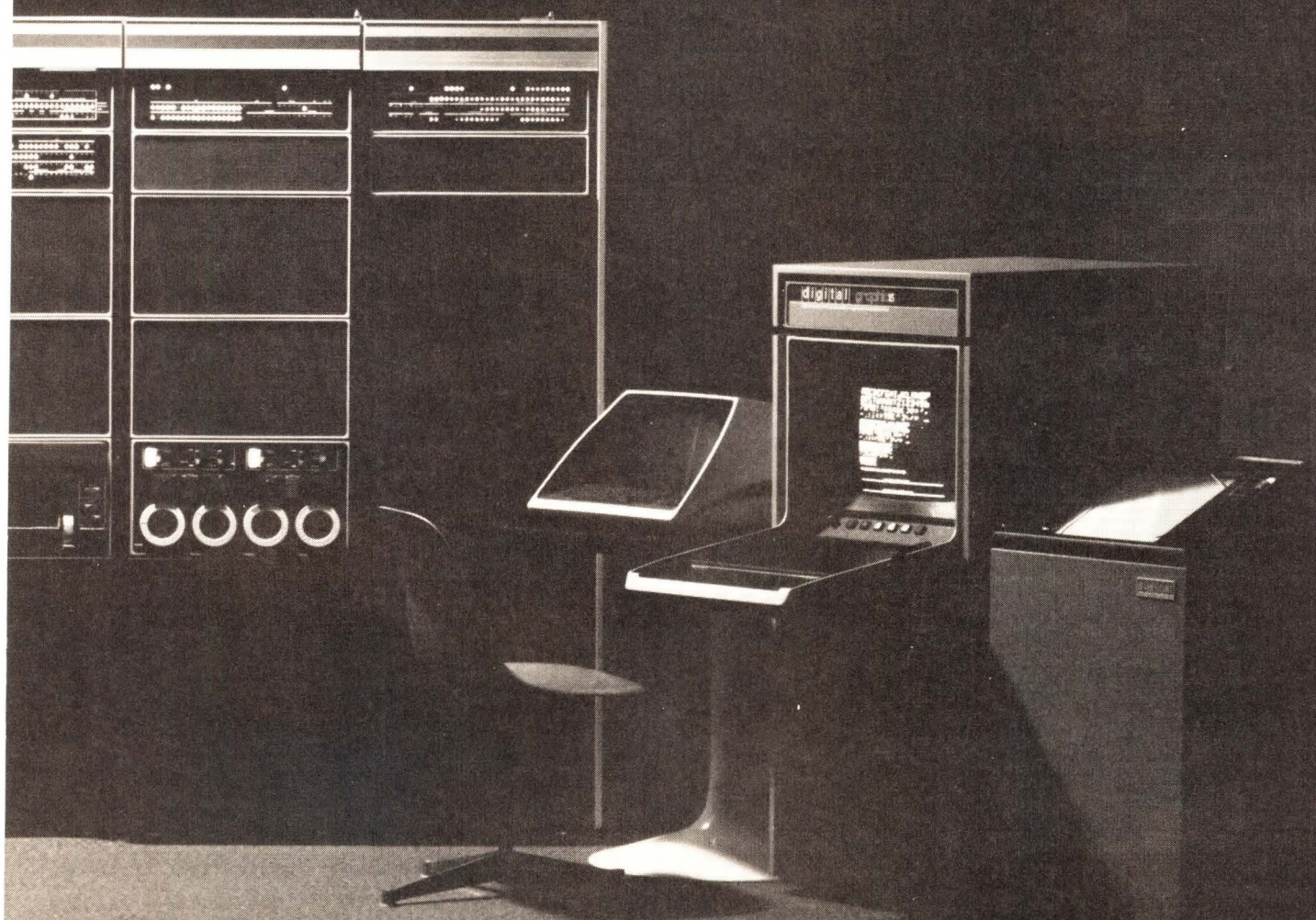

Manufacturer & model	DEC PDP-8E	DEC PDP-8F	DEC PDP-8M	DEC PDP-12	DEC PDP-15	DEC PDP-11/05
Word length/Instruction length (bits)	12/12	12/12	12/12	12/12	18/18	16/16, 32, 48
Cycle time (microseconds/word)	1.2	1.2	1.2	1.6	.800	.900
Word cap (min/max)	1,000/32,000	1,000/32,000	1,000/32,000	4,000/32,000	8,000/128,000	4,000/28,000
No. of directly addressable words	256	256	256	1,000	8,000	32,000
I/O word size, bits	12	12	12	12	18	16
Direct memory access channel	Yes	Yes	Yes	Yes	Yes	Yes
Maximum I/O rate, words/sec	833,000	833,000	833,000	660,000	1,000,000	2,000,000
Hardware multiply/divide	Optional	Optional	Optional	Yes	Optional	Optional
Hardware floating point	Optional	Optional	Optional	Optional	Optional	No
Hardware byte manipulation	No	No	No	No	No	Yes
Assembler	Yes	Yes	Yes	Yes	Yes	Yes
Macro assembler	Yes	Yes	Yes	Yes	Yes	Yes
Fortran compiler	Yes	Yes	Yes	Yes	Yes	Yes
Other compilers	Algol, Basic, Dibol, Focal	Algol, Basic, Dibol Focal	Algol, Basic, Dibol, Focal	Algol, Basic, Dibol, Focal	Focal, Algol	Basic
Price of basic system	$4,490/4k	3,200/4k	$3,200/4k	$17,170/4k	$21,000/8k	$4,395/4k
Circle No.	243	244	245	246	247	248

Manufacturer & model	DEC PDP-11/10	DEC PDP-11/35	DEC PDP-1140	DEC PDP-11/45	DEC PDP-11/50	Digital Scientific 4030
Word length/Instruction length (bits)	16/16, 32, 48	16/16, 32, 48	16/16, 32, 48	16/16, 32, 48	16/16, 32, 48	16/1 or 2 wds
Cycle time (microseconds/word)	.900	.900	.900	.900	.900	900
Word cap (min/max)	4,000/28,000	8,000/128,000	8,000/128,000	1,000/128,000	1,000/128,000	8,000/32,000
No. of directly addressable words	32,000	32,000	32,000	32,000	32,000	32,000
I/O word size, bits	16	16	16	16	16	8/16
Direct memory access channel	Yes	Yes	Yes	Yes	Yes	Yes
Maximum I/O rate, words/sec	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	1.1 million
Hardware multiply/divide	Optional	Optional	Optional	Yes	Yes	Yes
Hardware floating point	No	Optional	Optional	Optional	Optional	Optional
Hardware byte manipulation	Yes	Yes	Yes	Yes	Yes	Yes
Assembler	Yes	Yes	Yes	Yes	Yes	Yes
Macro assembler	Yes	Yes	Yes	Yes	Yes	Yes
Fortran compiler	Yes	Yes	Yes	Yes	Yes	Yes
Other compilers	Basic	Basic	Basic	Basic	Basic	Cobol, RPL
Price of basic system	$3,995/8k	$9,495/8k	$12,995/8k	$23,900/16k	$32,000/16k	$33,175/8k
Circle No.	249	250	251	252	253	254

Manufacturer & model	Digital Scientific 4040	Electronic Assoc. Pacer	Elect Processors EPI-118	Elect Processors EPI-218	Four-Phase Systems IV/40	Four-Phase Systems IV/70
Word length/Instruction length (bits)	16/1 or 2 wds	16/16	18/18	18/18, 36	24/24	24/24
Cycle time (microseconds/word)	900	1.0	1.0	1.0	2.0	2.0
Word cap (min/max)	8,000/65,000	8,192/65,536	4,096/32,768	4,096/32,768	8,192/24,576	4,096/32,768
No. of directly addressable words	65,000	512	32,768	32,768	24,576	32,768
I/O word size, bits	8/16	16	21	21	24	24
Direct memory access channel	Yes	Optional	Optional	Optional	No	No
Maximum I/O rate, words/sec	1.1 million	1,000,000	900,000	900,000	125,000	125,000
Hardware multiply/divide	Yes	Standard	No	Optional	Standard	Standard
Hardware floating point	Optional	Optional	No	No	Standard	Standard
Hardware byte manipulation	Yes	No	Standard	Standard	Standard	Standard
Assembler	Yes	2 pass	2 pass	2 pass	2 pass	2 pass
Macro assembler	Yes	No	No	No	No	No
Fortran compiler	Yes	Yes	No	No	No	No
Other compilers	No	Op. Interpreter	Basic	Basic	Cobol, RPG	Cobol, RPG
Price of basic system	$42,725/8k	$15,100/8k	$2,790/4k	$3,490/4k	$15,750/8k	$16,000/4k
Circle No.	255	256	257	258	259	260

Manufacturer & model	Fujitsu FACOM R-E	Fujitsu FACOM U-200	GEC 2050	GEC 4080	GA SPC-12	GA LSI-12/16
Word length/Instruction length (bits)	16/16	8/16, 32, 48	8/8, 16	8/8, 16	8/8, 16	8/8, 16
Cycle time (microseconds/word)	1.5	0.65/0.75	0.950	0.550	2.16	2.64
Word cap (min/max)	4,096/32,768	4,096/32,768	4,096/65,536	32,768/262,144	4,096/16,384	1,024/32,768
No. of directly addressable words	512	32,768	NA	4,096	4,096	4,096
I/O word size, bits	16	8/16	8	8/12	8/12	16
Direct memory access channel	Standard	Standard	Optional	Optional	Optional	No
Maximum I/O rate, words/sec	400,000	1,000,000	1,200,000	460,000	460,000	2,256
Hardware multiply/divide	No	Optional	Standard	No	No	No
Hardware floating point	No	No	No	No	No	No
Hardware byte manipulation	NA	Standard	Standard	Standard	Standard	Standard
Assembler	2 pass	1 & 2 pass	Symbolic	Babbage	1 pass	2 pass
Macro assembler	No	Yes	Yes	Yes	No	Yes
Fortran compiler	Yes	Yes	Yes	Yes	No	No
Other compilers	No	No	Coral 66	Coral 66	No	No
Price of basic system	NA	$8,036/4k	$12,000/8k	$35,000/8k	$2,980-3,980/4k	NA
Circle No.	261	262	263	264	265	266

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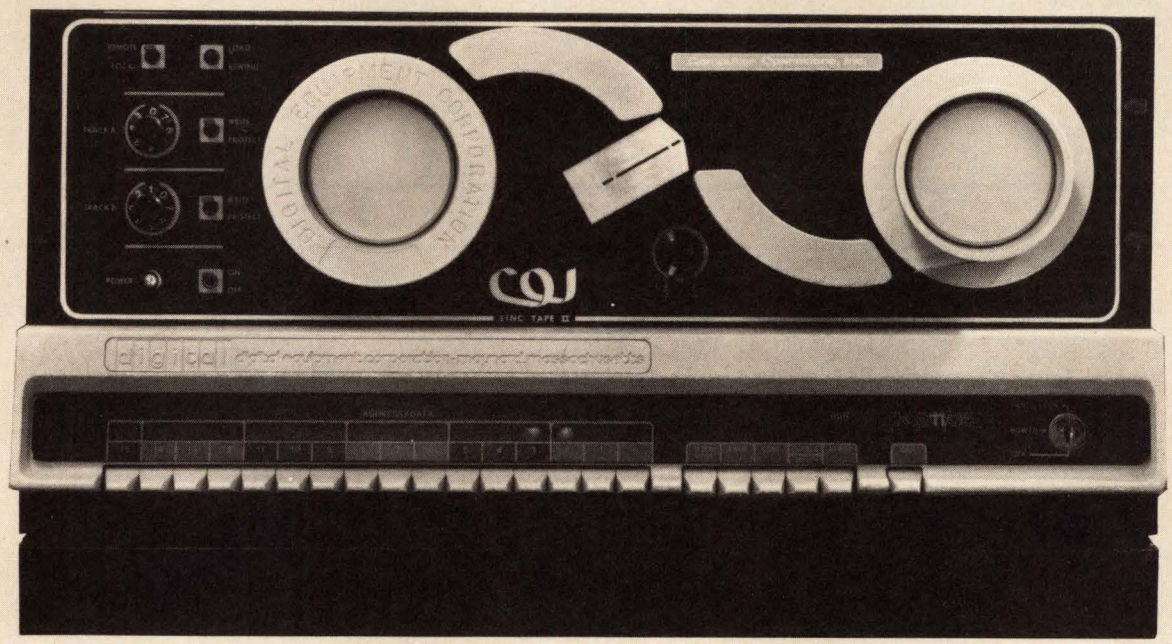

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INFORMATION RETRIEVAL NUMBER 57

Manufacturer & model	GA LSI-16	GA SPC-16	GA System 18/30	GRI Model 10	GRI Model 30	GRI Model 40
Word length/Instruction length (bits)	16/16	16/16	16/16, 32	16/16, 32	16/16, 32	16/16, 32
Cycle time (microseconds/word)	1.8	0.80/0.96/1.44	0.96	1.76	1.76	1.76
Word cap (min/max)	1,024/32,768	4,096/65,536	4,096/32,768	4,096/32,768	4,096/32,768	4,096/32,768
No. of directly addressable words	32,768	32,768	32,768	32,768		32,768
I/O word size, bits	16	16	16	16	16	16
Direct memory access channel	Standard	Standard	5 Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	185,000	1,040,000	568,000	568,000	568,000	568,000
Hardware multiply/divide	Standard	Optional	Optional	Optional	Optional	Standard
Hardware floating point	Optional	Optional	No	No	No	No
Hardware byte manipulation	Standard	Standard	Optional	Optional	Optional	Optional
Assembler	2 pass	2 pass	2 pass	2 pass	2 pass	2 pass
Macro assembler	Yes	Yes	No	No	No	No
Fortran compiler	Yes	Yes	Yes	Yes	No	No
Other compilers	Basic	Basic	RPG	Basic	Basic	Basic
Price of basic system	NA	$3,950-8,550/4k	$18,950/4k	$4,670/4k	$5,060/4k	$5,725/4k
Circle No.	267	268	269	270	271	272

Manufacturer & model	GRI Model 50	GTE IS/1100	Harris Slash 5	Harris Slash 4VM	Harris Slash 4	HP 2100
Word length/Instruction length (bits)	16/16, 32, 48	16/16	24/24	24/24	24/24	16/16
Cycle time (microseconds/word)	1.76	0.75	1.6	0.75	0.75	0.98
Word cap (min/max)	8,192/131,072	4,096/262,144	4,096/16,384	32,768/262,144	8,192/65,536	8,192/32,768
No. of directly addressable words	32,768	65,536	16,384	262,144	32,768	2,048
I/O word size, bits	16	16	8	24 or 8	24 or 8	16
Direct memory access channel	Standard	Optional	Optional	Optional	Optional	Optional
Maximum I/O rate, words/sec	568,000	650,000	30,000	5,000,000	5,000,000	1,000,000
Hardware multiply/divide	Optional	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	Standard	No	Optional	Optional	Standard
Hardware byte manipulation	Standard	No	Standard	Standard	Standard	No
Assembler	1 & 2 pass	2 pass	2 pass	2 pass	2 pass	2 pass
Macro assembler	No	No	Yes	Yes	Yes	No
Fortran compiler	No	Yes	Yes	Yes	Yes	Yes
Other compilers	RPG II	Algol, Basic	Basic, RPG	Basic RPG	Basic RPG	Algol, BAsic
Price of basic system	$6,300/8k	5,700/4k	$16,500/8k	$89,600/8k	$24,000/8k	$9,015/8k
Circle No.	273	274	275	276	277	278

Manufacturer & model	HP 2105A (21-M/10)	HP 2108A (21-M/20)	HP 3000	Hitachi HITAC 10-II	Honeywell System 700	Honeywell 316
Word length/Instruction length (bits)	16/16	16/16	16/16	16/16	16/16	16/16
Cycle time (microseconds/word)	0.650	0.650	0.90	0.9	0.775	1.6
Word cap (min/max)	4,096/32,768	4,096/65,536	32,768/65,536	4,096/32,768	8,192/65,536	4,096/32,768
No. of directly addressable words	2,048	NA	512	512	1,024	1,024
I/O word size, bits	16	16	16	16	16	16
Direct memory access channel	Optional	Optional	Standard	Optional	Standard	Optional
Maximum I/O rate, words/sec	617,000	617,000	1,400,000	833,100	1,000,000	313,000
Hardware multiply/divide	Standard	Standard	Standard	Optional	Standard	Optional
Hardware floating point	Standard	Standard	Standard	No	No	Special Order
Hardware byte manipulation	Standard	Standard	Standard	No	Standard	Standard
Assembler	2 pass	2 pass	Yes	Yes 1 & 2 pass	2 pass	1 & 2 pass
Macro assembler	No	No	Yes	Yes	Yes	Yes
Fortran compiler	Yes	Yes	Yes	Yes	Yes	Yes
Other compilers	Algol, Basic	Algol, Basic	Basic, Cobol	Basic	Basic	Basic
Price of basic system	$5,950/4k	$7,100/4k	NA	$3,000/4k	$10,800/8k	$8,400/4k
Circle No.	279	280	281	282	283	284

Manufacturer & model	Honeywell 516	ICS ALP1	ICS ALP2	ICS ALP3	Intel MCS-4	Intel Intellec 4
Word length/Instruction length (bits)	16/16	16/16	16/16	16/16	4, 8, 8, 16	4, 8/8, 16
Cycle time (microseconds/word)	0.96	0.65/0.33	0.65/0.33	0.65/0.33	10.8	10.8
Word cap (min/max)	4,096/32,768	4,096/65,536	4,096/262,144	4,096/262,144	256/8, 192	4,096/8,192
No. of directly addressable words	1,024	256	256	256	4,096	8,192
I/O word size, bits	16	16	16	16	4	4
Direct memory access channel	Optional	Standard	Standard	NA	Optional	Optional
Maximum I/O rate, words/sec	1,040,000	1,500,000	6,000,000	64	100,000	100,000
Hardware multiply/divide	Optional	Standard	Standard	Standard	No	No
Hardware floating point	Special Order	No	No	Standard	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	No	No
Assembler	1 & 2 pass	2 pass	2 pass	2 pass	2 pass	2 pass
Macro assembler	Yes	Yes	Yes	Yes	No	No
Fortran compiler	Yes	Yes	Yes	Yes	No	No
Other compilers	Basic	Algol, Basic	Algol, Basic	Algol, Basic	No	No
Price of basic system	$23,800/4k	$11,100/4k	$13,700/4k	$14,600/4k	NA	$2,545/4k
Circle No.	285	286	287	288	289	290

Manufacturer & model	Intel MCS-8	Intel Intellec 8/Mod 8	Intel MCS-80	Intel Intellec 8/Mod 80	Interdata Model 50	Interdata Model 55
Word length/Instruction length (bits)	8/8, 16, 24	8/8, 16, 24	8/8, 16, 24	8/8, 16, 24	16/16, 32	16/16, 32
Cycle time (microseconds/word)	12.5	12.5	2.0	2.0	1.0	1.0
Word cap (min/max)	256/16,384	4,096/16,384	256/65,536	4,096/16,384	4,096/32,768	8,192/57,344
No. of directly addressable words	16,384	NA	65,536	65,536	32,768	57,344
I/O word size, bits	8	8	8	8	8/16	8/16
Direct memory access channel	Optional	No	Optional	No	Optional	Optional
Maximum I/O rate, words/sec	80,000	80,000	500,000	500,000	1,000,000	2,000,000
Hardware multiply/divide	No	No	No	No	Standard	Standard
Hardware floating point	No	No	No	No	Standard	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard	Standard
Assembler	2 pass	3 pass	2 pass	3 pass	1 & 2 pass	1 & 2 pass
Macro assembler	Yes	Yes	Yes	Yes	No	No
Fortran compiler	Yes	Yes	Yes	No	Yes	Yes
Other compilers	PL/M	PL/M	PL/M	PL/M	No	No
Price of basic system	NA	$3,540/8k	NA	$3,840/8k	$6,800/4k	$15,900/8k
Circle No.	291	292	293	294	295	296

Manufacturer & model	Interdata Model 60	Interdata Model 70	Interdata Model 74	Interdata Model 80	Interdata Model 85	Interdata Model 7/16
Word length/Instruction length (bits)	16/16, 32	16/16, 32	16/16, 32	16/16, 32	16/16, 32	8, 16, 32/16, 32
Cycle time (microseconds/word)	0.270	1.0	1.0	0.24	0.27	1.0
Word cap (min/max)	8,192/32,768	4,096/32,768	4,096/32,768	8,192/32,768	8,192/32,768	4,096/32,768
No. of directly addressable words	32,768	32,768	32,768	32,768	32,768	32,768
I/O word size, bits	8/16	8/16	8/16	8/16	8/16	8/16
Direct memory access channel	Optional	Optional	Standard	Optional	Standard	Optional
Maximum I/O rate, words/sec	1,575,000	1,000,000	1,000,000	4,500,000	2,000,000	33,000
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard	Optional
Hardware floating point	No	Standard	No	Standard	Standard	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard	Standard
Assembler	1 & 2 pass	1 & 2 pass	1 & 2 pass	1 & 2 pass	1 & 2 pass	1 & 2 pass
Macro assembler	No	No	No	No	No	No
Fortran compiler	Yes	Yes	Yes	Yes	Yes	Yes
Other compilers	Basic	No	No	No	No	No
Price of basic system	$14,900/8k	$6,800/4k	$3,600/4k	$14,900/8k	$22,800/8k	$3,200/4k
Circle No.	297	298	299	300	301	302

Manufacturer & model	Interdata 7/16 (HSALU)	Interdata Model 7/32	IBM System/7	Linolex Model 1203	Lockheed MAC 16	Lockheed SUE
Word length/Instruction length (bits)	8, 16, 32/16, 32	8, 16 32/16, 32, 48	16/16, 32	8/Variable	16/16	16/36
Cycle time (microseconds/word)	0.75/1.0	0.75/1.0	0.4	1.2	1.0	850
Word cap (min/max)	4,096/32,768	4,096/262,144	2,048/65,536	8,192/32,768	4,000/64,000	4,000/32,000
No. of directly addressable words	32,768	262,144	16,384	32,768	64,000	31,000
I/O word size, bits	8/16	8/16	16	8	16	16
Direct memory access channel	Optional	Optional	Standard	No	Optional	Yes
Maximum I/O rate, words/sec	120,000	350,000	500,000	10,000	DMA 800,000	5 mega
Hardware multiply/divide	Standard	Standard	No	Mult. standard	Optional	Yes
Hardware floating point	Standard	Optional	No	No	Optional	Optional
Hardware byte manipulation	Standard	Standard	No	Standard	Yes	Yes
Assembler	1 & 2 pass	1 & 2 pass	1 pass	6 pass	Yes	Yes
Macro assembler	No	No	Yes	Yes	Yes	Yes
Fortran compiler	Yes	Yes	Runs on S/360	No	Yes	Yes
Other compilers	No	No	No	Basic, Degen	No	No
Price of basic system	$8,100/4k	$9,950/16k	$16,400/4k	$12,900/8k	$12,760/4k	$5,545/4k
Circle No.	303	304	305	306	307	308

Manufacturer & model	Lockheed System III	Microdata 32/S	Microdata 1600/31	Microdata 1600/21	Microdata Micro TM-One	Modular Modcomp I
Word length/Instruction length (bits)	16/36	16/Variable	8/16	8/16	8/16	16/16, 32
Cycle time (microseconds/word)	850	300	1.0	1.0	1.2	0.8
Word cap (min/max)	4,000/32,000	4,000/128,000	8,000/128,000	8,000/128,000	1,000/32,000	512/32,000
No. of directly addressable words	31,000	128,000	32,000	32,000	32,000	
I/O word size, bits	16	16	8	8	8	16
Direct memory access channel	Yes	Optional	No	Optional	Optional	Yes
Maximum I/O rate, words/sec	5 mega	2.5 meg	20,000	20,000	20,000	1,250,000
Hardware multiply/divide	No	Yes	Yes	Yes	Yes	Optional
Hardware floating point	No	Yes	Optional	Optional	Optional	No
Hardware byte manipulation	Yes	No	No	No	No	Yes
Assembler	Yes	No	Yes	Yes	Yes	Yes
Macro assembler	Yes	No	No	No	No	No
Fortran compiler	Yes	Yes	Yes	Yes	Yes	No
Other compilers	RPG II	MPL Compiler	Basic	Basic	Basic	No
Price of basic system	$39,975	$8,000	$4,000	$4,000	$636	$4,400
Circle No.	309	310	311	312	313	314

Manufacturer & model	Modular Modcomp II	Modular Modcomp IV/10	Modular Modcomp IV/25	Modular QM-1A/1B	National IMP-8	National IMP-16P(L)
Word length/Instruction length (bits)	16/16, 32	16, 32/16, 32	16, 32/16, 32	18/Variable	8/8, 16	16/16, 32
Cycle time (microseconds/word)	0.8	0.64	0.64	0.75/1.25	Semiconductor	Semiconductor
Word cap (min/max)	4,000/64,000	16,000/64,000	16,000/262,000	16,384/262,144	8,192/32,768	4,096/32,768
No. of directly addressable words	64,000	64,000	131,000	262,144	256	256
I/O word size, bits	16	16	16	18	8	16
Direct memory access channel	Optional	Optional	Optional	Optional	No	Standard
Maximum I/O rate, words/sec	1,250,000	1,560,000	1,560,000	NA	27,000	32,000
Hardware multiply/divide	Optional	Yes	Yes	Standard	No	Standard
Hardware floating point	Optional	Optional	Optional	Standard	No	No
Hardware byte manipulation	Yes	Yes	Yes	Standard	Standard	Standard
Assembler	Yes	Yes	Yes	1 & 2 pass	3 pass	3 pass
Macro assembler	Yes	Yes	Yes	Yes	No	No
Fortran compiler	Yes	Yes	Yes	Yes	No	No
Other compilers	Basic	Basic, RPG	Basic, RPG	Basic, Algol, Cobol, RPA, PL/1	No	No
Price of basic system	$7,400	$18,500	$23,500	$96,000/8k	$3,750/8k	$3,850/8k
Circle No.	315	316	317	318	319	320

Manufacturer & model	Nuclear Data ND 812	Omnus Omnus-1	Philips P850M	Philips P852M	Philips P855M	Prime 100
Word length/Instruction length (bits)	12/12, 24	16, 16/32	16/16, 32	16/16, 32	16/16, 32	16/16, 32
Cycle time (microseconds/word)	1.0	800	3.2	1.2	0.84	1.0
Word cap (min/max)	8,000/16,000	8,000/131,000	512/2,048	4,096/32,768	4,096/32,768	4,096/65,536
No. of directly addressable words	16,000	32,000	2,048	32,768	32,768	32,768
I/O word size, bits	12/24	8/16	16	16	16	16
Direct memory access channel	Yes	Yes	No	Optional	Optional	Standard
Maximum I/O rate, words/sec	500,000	1.25 mega	10,500	833,000	1,190,000	694,444
Hardware multiply/divide	Yes	Optional	No	No	Optional	Optional
Hardware floating point	No	Optional	No	No	No	No
Hardware byte manipulation	No	Yes	Standard	Standard	Standard	Standard
Assembler	Yes	Yes	1 pass	1 pass	1 pass	2 pass
Macro assembler	Yes	Optional	No	Yes	Yes	Yes
Fortran compiler	Optional	No	No	Yes	Yes	Yes
Other compilers	Nutran	No	No	Basic	Basic	Basic
Price of basic system	$9,600	NA	$3,100/4k	$4,002/4k	$4,600/4k	$4,600/4k
Circle No.	321	322	323	324	325	326

Manufacturer & model	Prime 200	Prime 300	Qantel 1100	Qantel 1200	Raytheon RDS-500	Raytheon 704
Word length/Instruction length (bits)	16/16	16/16	8/3, 6	8/3, 6	16/4, 16	16/16
Cycle time (microseconds/word)	750	,600/.750	1.5	1.5	0.8	1.0
Word cap (min/max)	4,000/256,000	4,000/256,000	4,000/32,000	4,000/32,000	8,000/64,000	4,096/32,768
No. of directly addressable words	64,000	64,000	32,000	32,000	64,000	32,768
I/O word size, bits	16	16	8	8	16	16
Direct memory access channel	Yes	Yes	Yes	Yes	Yes	Optional
Maximum I/O rate, words/sec	1.2M	1.2M	666,000	666,000	2.5 million	1,000,000
Hardware multiply/divide	Yes	Yes	Yes	Yes	Yes	Optional
Hardware floating point	Optional	Optional	No	No	Yes	No
Hardware byte manipulation	Yes	Yes	Yes	Yes	Yes	Standard
Assembler	Yes	Yes	Yes	Yes	Yes	1 & 2 pass
Macro assembler	Yes	Yes	No	No	Yes	Yes
Fortran compiler	Yes	Yes	No	No	Yes	Yes
Other compilers	Basic	Basic	QIC	QIC	Cobol	Cobol
Price of basic system	$5,000 - $20,000	$5,000 - $20,000	$30,975	$30,975	$14,500	$7,200/4k
Circle No.	327	328	329	330	331	332

Manufacturer & model	Rolm 1603	Rolm 1602	R2E MICRAL B	R2E MICRAL G	R2E MICRAL S	Systems 85
Word length/Instruction length (bits)	16/16	16, 16/32	8/8, 16, 24	8/8, 16, 24	8/8, 16, 24	32/32
Cycle time (microseconds/word)	1.2	1.0	24	12	2	0.85
Word cap (min/max)	256/32,768	256/262,144	256/16,384	256/16, 384	256/65,536	8,192/131,072
No. of directly addressable words	1,024	1,024	One level	16/384	65,536	131,072
I/O word size, bits	16	16	8	8	8	16/32
Direct memory access channel	Yes	Yes	No	No	Optional	Standard
Maximum I/O rate, words/sec	285,500	1,000,000	1,000,000	1,000,000	1,000,000	1,176,470
Hardware multiply/divide	Optional	Yes	No	No	Optional	Standard
Hardware floating point	No	Optional	Optional	Optional	Optional	Optional
Hardware byte manipulation	Yes	Yes	Standard	Standard	Standard	Standard
Assembler	Yes	Yes	2 pass	2 pass	2 pass	2 pass
Macro assembler	No	No	Yes	Yes	Yes	Yes
Fortran compiler	Yes	Yes	Cross assembly	Cross assembly	Cross assembly	Yes
Other compilers	Algol, Basic	No	Basic	Micro, CTL	Basic, Micro, CTL	No
Price of basic system	$9,950/4k	$18,500/8k	$1,470/4k	$1,520/4k	$1,670/4k	$80,000/8k
Circle No.	333	334	335	336	337	338

Manufacturer & model	Systems 86	Texas Inst Model 960A	Texas Inst Model 960B	Texas Inst Model 980A	Texas Inst Model 980B	Univac 1616
Word length/Instruction length (bits)	32/32	16/32	16/32	16/16, 32	16/16, 32	16+2/16, 32
Cycle time (microseconds/word)	0.60	0.75	750	Semiconductor	750	16/32
Word cap (min/max)	8,192/131,072	4,096/65,536	8,000/65,000	4,096/65,536	8,000/65,000	8,192/65,536
No. of directly addressable words	131,072	65,536	65,000	65,536	65,000	65,536
I/O word size, bits	16/32	1 to 16	4,000	16	16	8/16/32
Direct memory access channel	Standard	Standard	Yes	Standard	Yes	Optional
Maximum I/O rate, words/sec	1,666,666	1,300,000	NA	1,300,000	180,000	1,300,000
Hardware multiply/divide	Standard	Optional	Yes	Standard	No	Standard
Hardware floating point	Optional	No	No	No	Optional	No
Hardware byte manipulation	Standard	Standard	No	Standard	No	Standard
Assembler	2 pass	2 pass	Yes	2 pass	Yes	1 pass
Macro assembler	Yes	Yes	Yes	Yes	Yes	Yes
Fortran compiler	Yes	Yes	Yes	Yes	Yes	Yes
Other compilers	No	No	No	Basic	Basic	Hast 1108
Price of basic system	$104,000/8k	$2,850/4k	$4,350/8k	$3,475/4k	$4,975/8k	$23,100/8k
Circle No.	339	340	341	342	343	344

Manufacturer & model	Univac 1816	Varian V71	Varian V72	Varian V73	Varian V74	Westinghouse 2500
Word length/Instruction length (bits)	16+2/16, 32	16/16, 32	16/16, 32	16/16, 32	16/16, 32	16/16
Cycle time (microseconds/word)	1.0	1,200	0.660	0.330	0.330	.750
Word cap (min/max)	16,384/65,536	16,000/32,000	8,000/256,000	8,000/256,000	32,000/256,000	8,000/64,000
No. of directly addressable words	65,536	32,000	32,000	32,000	32,000	256,000
I/O word size, bits	8/16/32	16	16	16	16	16
Direct memory access channel	Optional	Yes	Yes	Yes	Yes	Optional
Maximum I/O rate, words/sec	1,300,000	897,800	1,347,000	1,347,000	1,347,000	100,000
Hardware multiply/divide	Optional	Yes	Yes	Yes	Yes	Yes
Hardware floating point	No	Optional	Optional	Optional	Optional	Optional
Hardware byte manipulation	Standard	Optional	Optional	Optional	Optional	No
Assembler	1 pass	Yes	Yes	Yes	Yes	Yes
Macro assembler	Yes	Yes	Yes	Yes	Yes	Yes
Fortran compiler	Yes	Yes	Yes	Yes	Yes	Yes
Other compilers	Hast 1108	RPG, IV, Basic Extended Basic, Vortex	RPG IV, Basic, Extended Basic, Vortex	RPG IV, Basic, Extended Basic, Vortex	RPG, IV, Basic Extended Basic, Vortex	Basic II & III, Disk RPG
Price of basic system	$65,000/8k	$7,200/16k	$10,500	$14,500	$35,900/32k	$11,500/8k
Circle No.	345	346	347	348	349	350

Manufacturer & model	Xerox 530
Word length/Instruction length (bits)	16/16, 32
Cycle time (microseconds/word)	0.8
Word cap (min/max)	8,192/65,536
No. of directly addressable words	1,024
I/O word size, bits	16
Direct memory access channel	Optional
Maximum I/O rate, words/sec	850,000
Hardware multiply/divide	Standard
Hardware floating point	Optional
Hardware byte manipulation	Optional
Assembler	Yes
Macro assembler	Yes
Fortran compiler	Yes
Other compilers	Cobol, RPG II
Price of basic system	$20,000/8k
Circle No.	351

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For complete minicomputer data
Circle number **480** on the information retrieval card to receive information on all minicomputers in this survey.

Mini makers

Applied Computing Technology
17815 Sky Park Circle
Irvine, CA 92707
(714) 549-3123

Automatic Electronic Systems
5455 Pare St.,
Montreal 309, P. Quebec, Canada
(514) 735-6581

Basic/Four Corporation
18552 MacArthur Blvd.
Santa Ana, CA 92707
(714) 833-9530

Bendix Corporation
Navigation & Control Div.
Teterboro, NJ 07608
(201) 288-2000

California Data Processors
2019 S. Ritchey Street
Santa Ana, CA 92705
(714) 558-8211

Cascade Data
3000 Kraft Ave., S.E.
Grand Rapids, MI 49508
(616) 949-8850

Cincinnati Milacron
Process Controls Div.
Lebanon, OH 45036
(513) 494-1200

Computer Automation
895 W. 16th Street
Newport Beach, CA 92660
(714) 642-9630

Comstar Corporation
7413 Washington Avenue S.
Edina, MN 55435
(612) 941-4454

Control Data
8100 34th Ave. So.
Mineapolis, MN 55440
(612) 888-5555

Data General
Southboro,MA 01772
(617) 485-9100

Harris Corporation
1200 N.W. 70th St.
P.O. Box 23550
Ft. Lauderdale, FL 33307
(305) 974-1700

Datapoint Corporation
9725 Datapoint Drive
San Antonio, TX 78284
(512) 696-4520

Digital Computer Controls
12 Industrial Road
Fairfield, NJ 07006
(201) 227-4861

Digital Equipment Corp.
Maynard, MA 01754
(617) 897-5111

Digital Scientific Corporation
11455 Sorrento Valley Road
San Diego, CA 92121
(714) 453-6050

Electronic Associates
West Long Branch, NJ 07764
(201) 229-1100

Electronic Processors, Inc.
1265 West Dartmouth
Englewood, CO 80110
(303) 761-8540

Four-Phase Systems
19333 Valco Parkway
Cupertino, CA 95014
(408) 255-0900

Fujitsu, Ltd.
680 Fifth Avenue
New York, NY 10019
(212) 265-5360

GEC Computers Ltd.
Elstree Way
Borehamwood, Hertsfordshire
WD6 1RX, England

General Automation
1055 S. East Street
Anaheim, CA 92805
(714) 778-4800

GRI Computer Corp.
320 Needham Street
Newton, MA 02164
(617) 969-0800

GTE Information Systems
One Stamford Forum
Stamford, CT 06904
(203) 357-2622

Hewlett-Packard
11000 Wolfe Road
Cupertino, CA 95014
(213) 877-1282

Hitachi, Ltd.
23-15 6-chrome,
Minamiohi, Shinagawa-ku, Tokyo
140, Japan. (765) 3111

Honeywell Information Systems
60 Walnut Street
Wellesley Hills, MA 02181
(617) 237-4100

Information Computer Systems
Heron House, 19 Marylebone Road
London NW1, England
(01) 486-4635

Intel Corporation
3065 Bowers Avenue
Santa Clara, CA 95051
(408) 246-7501

Interdata, Inc.
2 Crescent Place
Oceanport, NJ 07757
(201) 229-4040

IBM, Data Processing Div.
1133 Westchester Avenue
White Plains, NY 10604
(213) 376-9763

Linolex Systems
5 Esquire Road
North Billerica, MA 01862
(617) 667-4151

Lockheed Electronics Co.
6201 E. Randolph Street
Los Angeles, CA 90022
(213) 722-6810

Microdata Corporation
17481 Red Hill Avenue
Irvine, CA 92705
(714) 540-6730

Modular Computer Systems
1650 W. McNab Road
Ft. Lauderdale, FL 33309
(305) 974-1380

National Semiconductor
2900 Semiconductor Dr.
Santa Clara, CA 95051
(408) 732-5000

Nuclear Data Inc.
P.O. Box 451
Palatine, IL 60067
(312) 529-4600

Omnus Computer Corporation
1538 E. Chestnut Street, Suite E
Santa Ana, CA 92701
(714) 547-8444

Philips-Electrologica B. V.
OEM Marketing, P.O. Box 245
Apeldoorn, the Netherlands
05760-30123

Prime Computer
145 Pennsylvania Avenue
Framingham, MA 01701
(617) 879-2960

Qantel Corporation
3525 Breakwater Avenue
Hayward, CA 94545
(415) 783-3410

Raytheon Data Systems
1415 Boston-Providence Turnpike
Norwood, MA 02062
(617) 762-6700

Rolm Corporation
18922 Forge Drive
Cupertino, CA 95014
(408) 257-6440

R2E Microcomputers
38 Garden Road
Wellesley Hills, MA 02181
(617) 235-8830

Systems Engineering Laboratories
6901 W. Sunrise Blvd.
Ft. Lauderdale, FL 33313
(305) 587-2900

Texas Instruments
Systems Div. P.O. Box 1444
Houston, TX 77001
(713) 494-5115

Univac
Univac Park, Box 3525
St. Paul, MN 55165
(612) 456-2222

Varian Data Machines
2722 Michelson Drive
Irvine, CA 92664
(714) 833-2400

Westinghouse Electric Corp.
Computer Dept. 1200 W. Colonial Dr.
Orlando, FL 32804
(305) 843-7030

Xerox Corporation
701 S. Aviation Blvd.
El Segundo, CA 90245
(213) 679-4511

A team approach to hardware analysis

Don't be swayed by sales representatives. Use inhouse personnel to select your next piece of hardware.

by Daniel S. Farbman
Western Electric Co.

Thousands of dollars are spent each month on computer hardware. Costs are continually rising. Yet the hardware analysis for many data centers is left to, indeed demanded of, the sales representatives of computer manufacturers.

The reason that the computer equipment salesman is often given so much responsibility is that answers are difficult to formulate and require constant observation of many factors. Planning for an upgrade may well become a frantic effort if no one realizes that capacity is being eaten away through increased systems growth, and that a thorough hardware study requires a good deal of time.

If the hardware study is left to the salesman, even a well-meaning, competent salesman, he has three strikes against him.

First, although he may be well informed about your operation, he has neither the tools nor the time to observe the operation constantly and thereby pinpoint problem areas.

Second, his solution to any problem that is readily observed is biased by his limited resources for solving the problem — the products of his company.

Third, the primary objective of any salesman is to sell equipment. His commission is based on sales, and he has a sales quota to meet. While the salesman's solution may be good, the question still remains: Is it necessarily the best solution?

Growing pains

The problems associated with systems growth can best be handled in house by people whose primary function is to provide the tools and equipment necessary to satisfy the information system. When your own personnel are studying your systems-growth difficulties, you can direct them toward the proper goal. That is, you can ascertain that their solutions will be effective and economical.

For this type of solution to evolve, a team of specialists is required. The size and makeup of this team is largely dependent on the sophistication of the data center, the company's commitment to it's information system, and the size and budget of the data processing organization.

Some of the team may be full-time members who devote their entire efforts toward the smooth and efficient growth of the data center. Other members may only be required for portions of an analysis and can handle other functions in addition to their duties on the team.

Ideal team

The ideal team consists of eight members, three full-time and five part-time. Full-time members are the team leader, the hardware man and the computer measurement analyst. Part-time members are the software man, the development programmer, the operations manager, the purchasing and legal representative and the sales representative.

A complete team would be much too expensive and cumbersome for smaller data centers. This means a center must decide how many members it needs to ease the growing pains without drawing on resources which would be better used elsewhere.

In some instances a number of the team functions can be combined and handled by one person. This, however, should never cause that individual to become so overburdened with any one function that he cannot perform all of them. It is important to remember that no matter what the size of the data center, all the team functions should be carried out.

Perhaps the best way to show how the hardware analysis team would perform a computer capacity study is to give a case history.

Case history

Let us take the Manypenny Services Co. Although Manypenny is a fictitious organization, its growing pains are typical and should be familiar.

Manypenny had two computers, one a medium-sized processor manufactured by Mighty Brains Inc. and the other a small-sized processor, also manufactured by MBI. Although the small processor was on rent from MBI, the medium-sized one was leased from a third-party leasing company.

The hardware analysis team had been in existence for about a year. For several months a number of symptoms of growing pains had been reported to the team leader by members of the group.

One of the most important symptoms was the fact that the third-party lease on the medium-sized processor was due to expire in nine months. This fact was brought to the attention of the team leader by two of the team members—the purchasing representatives and the Mighty Brains salesman. The purchasing representative was interested in the upcoming lease termination since it would be his job to negotiate a renewal or extension of the lease. The MBI salesman was interested in the termination date because it gave him an opportunity to replace the leased processor with one rented directly from MBI.

A second major symptom reported to the team leader was the upcoming implementation of a number of major systems, as well as the long awaited start of converting the remaining programs from the small-sized processor so that they could be effectively multiprogrammed on the medium-sized processor. This information was supplied to the team leader by the development programmer.

Sizeable complaints

Other symptoms of growing pains were in the form of complaints. These complaints, as you will see (and as the team leader saw), foretold a sizeable problem. The software man complained about the difficulty of maintaining two separate sets of control software. The operations manager complained about his scheduling problems and felt that with the implementation of new systems he would run out of capacity. In addition, the growing number of disk packs were overcrowding his library.

The development programmer was complaining that due to storage restrictions set up by the systems programmer-software man he was required to use many overlays, thus increasing run time and reducing program efficiency.

The software man countered that he could not increase partition sizes without upgrading the machine. The sales representative (who never complained) was busy drawing up a proposal which would increase the computer capacity, relieve the scheduling problems, provide for growth and earn him a tidy commission.

The team leader took the steps necessary to decide what would be required to avoid the oncoming capacity problems. The following steps, some of which were quite lengthy, were undertaken in order to obtain the necessary data.

A list of systems scheduled for implementation was compiled, containing the estimated run time, peripheral requirements, scheduling restrictions and implementation dates.

The computer measurement analyst monitored the utilization of the central processor, channels and peripheral devices for a prolonged period.

Changing channels

The computer measurement analyst and the software man combined their efforts to determine if any system fine tuning would give additional capacity. It was found through the hardware monitor that the disk usage on channel 3 was quite low, while the usage on channel 1 was high. By transferring a highly used disk pack to channel 3 from channel 1, balance was obtained.

A software monitor indicated that a number of heavily used modules of the control software were disk resident. These modules were made core resident, replacing lesser-used modules. This action reduced the number of disk accesses and thus reduced overhead.

The salesman suggested that the latest MBI computer could replace the leased computer and provide the increased core and speed that he felt was necessary. In order to provide Manypenny with an opportunity to satisfy any skeptics, the salesman arranged for a benchmark of the new computer. The hardware man coordinated the benchmark. Both the development programmer and the software man were consulted in setting up the jobstream for the benchmark. The actual performance of the benchmark was monitored by the computer measurement analyst. The computer measurement analyst and the hardware man analyzed the results of the benchmark to verify the MBI proposal.

Study rewarded

The results of the study by the hardware analysis team led to the following conclusions:

The operations manager decided that an additional partition would be needed in about six months to handle the increased workload. Since growth was expected to continue at a rapid pace, an extension of the present equipment with a core increase would suffice as an interim step but not as a long-term solution.

The hardware man verified that the computer they had benchmarked would suit the needs of Manypenny for at least three years because of its expandability. The hardware man further advised that the ability of this new computer to simulate the small-scale computer would do away with the need for the small processor. The systems from the small machine could be simulated until they were converted. Since the bulk of the systems run at Manypenny were written in assembly language, it would not have been practical to go to another vendor.

The team leader then made the following recommendations to management:

Acquire MBI's new computer three months prior to expiration of the current third-party lease.

Have the purchasing representative contact third-party leasing companies for bids on a three-year lease for the new processor and selected peripherals.

Obtain plug-compatible disks with double capacity, as recommended by the hardware man, to alleviate the physical space problems of the library.

Rent MBI tape drives and printers directly from MBI on a month-to-month basis, because the plug-compatible industry was expected to surpass the price/performance ratio of these devices within a year, and replacement could take place with little prior notice.

Little change in cost

The team leader noted that with the removal of the small-scale processor, the cost of the new computer configuration would differ very little from the original two-processor system.

The Manypenny case history, somewhat abbreviated in this account, is offered not so much to show what took place as to indicate the interrelationship of the functions of the team members. The study shows that each member of the team is dependent upon the others in performing his task.

The case study has shown how a hardware analysis team would go about performing a study. Now, by examining the makeup of the team and the function of each of its members, the complexity of a hardware study will be more easily understood.

Team leader

The team leader has the primary function of coordinating the efforts of the team. He must keep each member informed of the progress of the other members. He must establish the time frame for the study and must assure that the team adheres to the schedule. The leader must be a contact point in arranging meet-

ings, equipment demonstrations, benchmark tests, etc. Without the team leader to coordinate the efforts of the entire team and to pass along each individual's findings, the efforts of the team are doomed to failure.

The team leader has ultimate responsibility for all decisions. He is the boss.

Hardware man

The hardware man is an expert on the computer-equipment marketplace. Since expertise in all available hardware is a relatively impossible task, the hardware man, in fact, can be a number of people who specialize in natural subsets of the computer equipment market. The hardware men, should be thoroughly familiar with the equipment that is available, its performance in the field, and any interface requirements with currently installed machinery.

Of major importance is knowledge of plug-compatible equipment, which can often provide substantial costs savings. Also, plug-compatible vendors have often provided technological advances that were several years ahead of the mainframe manufacturer.

Software man

The software man can be the systems programmer on the staff. He adds his familiarity with the everyday software problems affecting production to the knowledge of the team. In addition, the software man has two important functions. Many growing pains that at first glance seem to be hardware problems can be solved by properly fine-tuning the operating system. The software man should constantly be looking for the symptoms of an out-of-tune system, i.e., improper disk formatting, improper use of residency options in the operating system, improper use of multipack systems residence and others. Significant improvement is often the result of a simple change in an item such as the list of resident-access modules.

The second major function of the software man is to evaluate software packages on the marketplace.

The next member of the team works hand-in-hand with the software man. The computer measurement analyst utilizes hardware and software monitoring devices in order to determine exactly how the computer is operating. By constantly appraising the functioning of the computer, this member of the team can often detect early stages of oncoming growing pains.

Development programmer

It is the development programmer's function to keep the entire team informed of significant changes in existing production schedules of programs soon to be implemented and requirements for special hardware. If the team is allowed enough time to plan upcoming changes or additions to the production schedule, the need for these new requirements can be combined with any symptoms of other growing pains already detected so that a more permanent solution can be recommended. The development programmer also contributes to the team by constantly reviewing his programs to be sure that they run efficiently and take advantage of recently installed hardware.

Operations manager

Although the operations manager is only a part-time member of the team, he can contribute greatly. His contribution is often directly related to his performance in his primary function. A competent operations manager will keep the data center running efficiently, making sure that deadlines for submitting data are adhered to, that schedules are carefully prepared and followed, and that output is delivered properly.

The operations manager should also keep vital records of run times, volumes, reruns, maintenance—both scheduled and unscheduled—overtime costs for equipment and personnel, console logs, etc. All of these records will be needed in determining whether a capacity problem is temporary, due to an unusual combination of events, or permanent, requiring more complete action to rectify the problem.

The operations manager can be of use to the team in a second way. He can add his experience and that of his operators to the criteria for selection of a vendor.

Finally, the cooperation of the operations manager is essential in order for the software man and the computer measurement analyst to do their jobs.

Purchasing and legal representative

The purchasing and legal representative in most cases actually will be two people. They are listed as one part-time member of the team because their duties have overlapping responsibilities. The major jobs of this member of the team are writing contracts for the acquisition of equipment, sending out formal specifications to vendors for bids, and evaluating the financial position of potential suppliers to reduce the risk of doing business with a company which may not be able to meet its contractual obligations.

Probably the most important of these functions is writing contracts. This function entails determination of the most economical lease/purchase/rental arrangement in consideration of future changes in technology and capital-funding decisions.

Sales representative

The computer equipment sales representative does have his place on the hardware analysis team, but only as a part-time member. Actually there are many sales representatives of many companies. The part-time membership on the team belongs to all salesmen.

As stated previously, it would not be feasible for all data centers to staff the entire team as described.

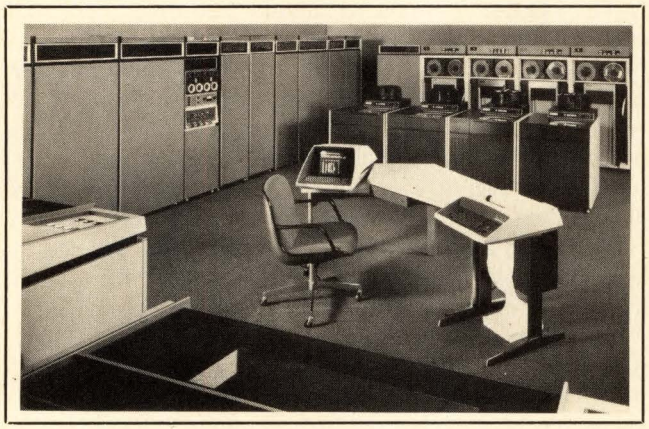
A small data center probably would not own a hardware monitoring unit with the capability of providing a complete profile of the computer. In addition, the small data center would not keep a computer measurement analyst busy on a full-time basis.

This does not mean that computer measurement should be eliminated. Periodically a hardware monitoring device should be rented for a two- to four-week period in order to profile the computer.

The hardware man or the operations manager should be responsible for obtaining this service and understanding the implications of the resulting profile.

It should be understood, however, that due to its complexity, a proper study cannot be performed in a haphazard manner. By spending enough time, effort and money, and by properly establishing the analysis team, a major step will be taken in the direction of providing a correctly equipped and economically sound data center. □

Mr. Farbman is a member of the information systems staff, computer applications studies, at Western Electric.



DEC unveils large-scale systems

Designated the DECsystem-1080 and -1090, the systems incorporate a new processor, three new peripheral subsystems and software. They perform concurrent timesharing, transaction processing, batch processing, remote batch, and real-time user requirements, An extended instruction set for business data processing has been included. System prices depend on configuration, but start at approximately $600,000 and can range to more than $1,500,000. Deliveries are scheduled for June 1975. Both systems are built around Digital's newest processor, the KL10, which has twice the instruction rate of the current KI10. The KL10 employs an integral PDP-11/40 minicomputer as an architectural element. The KL10 is microprogrammable, with 386 instructions. Main memory for both systems expands from 128k 36-bit words to over four million words. The new peripheral subsystems include a disk system for online storage of 3.2 billion characters, industry-standard 200 ips magnetic tape system, and a fixed-head swapping disk. The software packages include an expanded data base management system, a message control system, and virtual memory software. All new software works under Digital's *TOPS-10* operating system, which is used with all DECsystem-10 software.

Digital Equipment Corp., Maynard, MA 01754. (617) 481-9511.

CIRCLE NO. 360

Remote communications processor

The COPE 1600 is a remote communications processor consisting of a 16 to 64k 16-bit minicomputer and *COS (Communications Operating System),* a multitasking operating system which allows communication with two computers at the same time. Up to 16 slow speed (9600 baud) asynchronous lines can access memory via an I/O multiplexer, while up to four high-speed (50k-bits) synchronous lines can access memory directly. Emulators and line protocols include 2780/3780, Univac 1004, CDC *User 200* and *Hasp* multileaving. Bisynchronous and SDLC lines are also serviced. Peripherals available include 150 to 1200 cpm card readers; a 200 cpm punch; 300 to 1500 lpm printers; 29 megabytes of disk storage; and 7- or 9-track tape drives. From $1,400/month. Deliveries begin Febraury, 1975.

Harris Corp., Data Communications Div., 11262 Indian Trail, Dallas, TX 75234. (214) 241-0551.

CIRCLE NO. 362

Data management systems grow

The DM 100 series offers four systems: the DM 120 work station; the DM 130/2 small first-time user machine; the DM 130 intermediate satellite processor system; and the DM 140 large-scale multi-user central processing system. The DM 120 is a remote job entry work station. It can transfer data to, and accept it from, other members of the DM 100 family, as well as an IBM 360 or 370. The DM 120 controls the communication at speeds from 1200 to 4800 baud. A typical DM 120 includes a SPC-16/65 with 16k of memory, a single crt workstation, a 300 cpm reader, and a 125 lpm printer for about $25,000. The DM 130 is a completely free standing system. It operates in a multitasking/multiprogramming environment. The minimum DM 130 would include a SPC-16/65 with 24k of memory, a 165 cps printer, a 10 megabyte disk and one crt work station for about $42,000. Up to 32 remote crts can interact with the DM 140 while concurrent compilations or communications are performed in the background. A minimum DM 140 includes a SPC-16/65 with 32k of memory, a 300 cpm reader, a 125 lpm printer, 10 megabytes of disk storage, a crt, and the DM 140 concurrent foreground/background processing os for $61,500.

General Automation, Inc. 1055 South East St., Anaheim, CA 92805. (714) 778-4800.

CIRCLE NO. 361

HP adds top-end 3000

Hewlett-Packard's 3000CX series minicomputers have a common operating system, *MPE/C*—a communications facility, spooling, and virtual memory. The communications facility allows 3000s to communicate with other 3000s or with other machines that support IBM 2780 and 3780 terminals. The basic cpu can be enhanced by decimal arithmetic firmware and extended precision floating point firmware. A timesharing option, with a *Basic* interpreter and compiler, is offered, as is a scientific and a business option. New peripherals include 300 and 1250 lpm printers, a card reader/punch, and the new HP 2640 crt terminal. The smallest member of the family is the 50CX which has a 96k byte cpu, 5M byte moving head disk, 800 bpi tape unit, a system console and a sixteen port asynchronous terminal controller. The system includes *MPE/C* and basic utility software, such as the *SPL* compiler, text editor, and *SORT/MERGE*. The system costs $99,500. The system 100CX has twice the disk storage of the 50CX. It has the same standard software; plus enhanced *Fortran IV* and *RPG* compiler, each with extended firmware. Cost for the system is $129,500. A system 200CX has 128k bytes of main memory, and adds a 47 M byte moving head disk and a 2M byte fixed head swapping disk to the 100 CX configuartion *Cobol* is offered in addition to the software supported on the 100CX. The price for the system is approximately $171,000. At the top of the line, the 300CX adds a 1250 lpm printer and a card reader/punch. It supports the *IMAGE/QUERY* data base package. The 300CX costs $203,500. Deliveries will begin in early 1975.

Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, CA 94304. (415) 493-1501.

CIRCLE NO. 405

Systems New Developments

Rugged minicomputer gives user core or semi memory

The model 1603 16-bit minicomputer includes 8k of memory expandable to 32k and a 47-440Hz power supply. Core memory is available in 8k increments and up to 2 semiconductor memory modules can be installed in the chassis. All memory in the 1603 provides typical minicomputer cycle time of 1.2 usec. Direct memory access is standard. The optional extended arithmetic unit provides 7.7 usec. hardware multiply/divide. The 1603 uses the same software as all Rolm computers. It is compatible with the Rolm 1601 and Data General Nova computers. Price is $9,950. Available now.

Rolm Corp., 18922 Forge Dr., Cupertino, CA 95014.
(408) 257-6440.

CIRCLE NO. 363

Terminal added to small system line

The model 4011 video terminal has a display capacity of 1728 characters, (27 lines with 64 characters per line), and is equipped with both a standard typewriter keyboard and a numerical-key cluster. Also featured is automatic right-justification of numeric entries. This new terminal can be located up to 2000 feet from a Qantel computer in a local environment or can operate remotely via a standard data communications interface. The model 4011, priced at $5,950, also has the capability of controlling a printer. Available 90 days aro.

Qantel Corp., 3525 Breakwater Ave., Hayward, CA 94545.
(415) 783-3410.

CIRCLE NO. 364

IBM enhances data entry system

The IBM 3886 optical character reader converts images of machine-printed or handwritten characters into digital information. The transformed data can be displayed on a specially-equipped IBM 3277 terminal for easy operator correction, verification and key entry of non-scannable characters. The model 3881 optical mark reader has a built-in diskette drive and permits users of IBM's 3740 data entry system to process, edit and reformat information at central or remote sites before entering it into a computer. The 3886 video collect capability rents for $224 to $324. Purchase prices range from $10,318 to $14,918. The special feature that enable the 3277 to display video-collected images is available at a monthly rental of $125. Purchase price is $5,625. Rental for the 3881 Model 3 optical mark reader with diskette storage begins at $1,360. Purchase prices begin at $66,000. Shipments will begin in the fourth quarter.

IBM, Data Processing Div., 1133 Westchester Ave., White Plains, NY 10604.
(914) 696-1900.

CIRCLE NO. 365

Retail system interacts with in-store computer

The 280/725 interactive retail system can be programmed so that the selling-floor terminals interact directly with the in-store computer. The system can print merchandise descriptions on customer receipts, validate department and class numbers, and maintain and improve the free-standing features of the previous 280 systems. Functions such as tax computations, extensions, discounts and itemization are done entirely by the terminal. Price of the 280-550 terminal is $3,650 and the basic 725 control processor is $25,-000. Delivery is scheduled for the first quarter of 1975.

NCR Corp., Dayton, OH 45479.
(513) 449-2150.

CIRCLE NO. 366

Static memory system

This static semiconductor memory system, called MOSRAM 410, is TTL compatible and features Tri-State outputs. Designed for use in POS and crt terminals and in 8-bit processors, the system is available in three different capacities: 4k by 8 bits, 4k by 9 bits and 4k by 10 bits. Also available are cycle/access times of 550, 700, and 1050 ns. A 4k by 8-bit system is priced at $400 for unit quantities with an oem discount of up to 30%.

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, CA 95051.

CIRCLE NO. 367

Phototypesetting system for moderate volumes

The Econosetter system is offered in three input system configurations —paper tape, a combination of on-line keyboard and paper tape, and magnetic tape cassettes. The photoelectric paper tape reader accepts 6-level and 8-level tape from a variety of counting and noncounting perforating keyboards, wire service perforators, optical character recognition devices, video display terminals and computers, and (without lenses or disks) is priced at $9,400. The plug-in online keyboard accesses all functions, controls and programming with 68 characters and command keys in secretarial layout with illuminated visual displays above the keys. Price for the basic Econosetter with online keyboad and paper tape reader is $10,900. The magnetic tape cassette drive is through the Photon Cassette Reader. At present it is factory-interfaced to operate in conjunction with Redactron and Remington word processing systems. Basic price with the plug-in magnetic tape reader is $11,500. Available in the last quarter of 1974.

Photon, Inc., 355 Middlesex Ave., Wilmington, MA 01887.
(617) 933-7000.

CIRCLE NO. 368

Intelligent terminal systems for interactive applications

The Sanders series 8171 and 8172 intelligent terminal systems are compatible with the IBM 3270 operating specifications and include features such as dual intensity, key click, audible alarm, coaxial cable and Photopen. Both are designed for online alphanumeric display requirements such as inquiry/response, data entry, order distribution, and can be plugged into 3270 application systems without change. Each system is comprised of a 12k microprocessor, two crt displays with keyboards, and emulation software. Price of the 8171 is $28,-925, and $29,925 for the 8172. March 1975 deliveries.

Sanders Associates, Inc., Daniel Webster Highway, So., Nashua, NH 03060.
(603) 885-6685.

CIRCLE NO. 369

Tape testing wallows in FATS

Fast Analysis of Tape Surfaces (FATS) is an OS, DOS or VS tape certification utility program that permits certification of one to nine tapes, online, at tape speed. Most IBM compatible brand tape drives can be used by *FATS*. Designed to certify tapes on the drives where they will be used, *FATS* certifies scratch tapes and verifies that data tapes can be read. These functions can be performed independently or concurrently. It also provides a permanent record in the from of a comprehensive detail and summary report for each tape tested and can be used for preventive maintenance to upgrade the quality of a library as a diagnostic tool to assist in defining the cause of ABENDS. *Fast Analysis of Tape and Recover (FATAR),* is an option that permits records containing data checks to be corrected, replaced or eliminated. *FATS* is priced at $750 for the first site, $600 for each additional site; *FATAR* is priced at $250 for the first site, $200 for each additional site. Both will be available in November 1974.

Innovation Data Processing, 925 Clifton Ave., Clifton, NJ 07013. (201) 777-1940.

CIRCLE NO. 394

Free software

A computer media program called *PROCSCAN (Procedure Library Scanning),* converts and upgrades tapes and disk drives. It enables System 360/370 users to reduce the time required for modifying disk and tape devices by eliminating manual *JCL*. *PROCSCAN* is available free of charge to those who agree to purchase a year's supply of tape and disk packs.

Memorex Corp., San Tomas at Central Expressway, Santa Clara, CA 95052.

CIRCLE NO. 395

Usage reporting system for small computer users

The *Computer Utilization Reporting System* is currently operational on IBM System 3 model 10 and NCR Century Series computers. It reports on daily use and idle time, gives summary reports on usage by operation type (production, test, compile, down etc.) and provides an analysis of idle time by the number of occurences during a particular period. *Computer Utilization* reports by cost center (up to 100) and operators (up to 10) are also generated. A 16k cpu is required. Purchase price is $645, rental is $33 per month with a 30 day free trial available.

Real Time Computer Systems, Inc., 11 Earl St., Huntington, CT 06484. (203) 929-7279.

CIRCLE NO. 396

OS medical system soothes medical billing problems

The *Professional Office Management System (POMS)* is a new OS version of the Occidental Computer Systems' Medical Billing Systems and is available for larger installations. *POMS* controls parameters for each doctor, clinic, or professional office serviced and allows the service organization to process clients with varying and individual requirements in one pass. It provides complete patient billing and accounts receivable processing and produces all of the required insurance forms. *POMS* file structure can accommodate the coding structures for procedure and diagnostic codes that are in prevalent use and with the built-in flexibility of providing for future PSRO and insurance requirements. Input to the system may be via keypunch, Entrex key-to-disk, or Sycor remote terminals. *POMS* is all ANSI/OS *Cobol* and is priced at $17,600.

Occidental Computer Systems, Inc., 11311 Camarillo St., North Hollywood, CA 91602. (213) 763-5144.

CIRCLE NO. 397

Non-linear optimization

NLO is a non-linear optimization package that finds the optimum of a non-linear objective function in the presence of non-linear constraints. Written in *Fortran IV, NLO* can be installed on any system with a 16k word partition. It is operable under *DOS* and *OS* and requires a minimum of peripheral devices and no files. Price is $7,500.

University Software Inc., 221 Princeton Dr., Aliquippa, PA 15001.

CIRCLE NO. 398

Data/systems dictionary is machine independent

Logik is a data and systems dictionary which has the capability of performing all the functions of traditional data dictionaries with the added ability of cataloging systems descriptions. Systems diagnostics can be performed during the design process along with a logical check of data, records, files, input and output descriptions. It has a search feature that permits an element to be searched by an almost unlimited number of physical and logical attributes even when the name or number of the element is unkown. This system is available only to *PRIDE* users and is written entirely in ANS *Cobol*. Therefore, any machine with this complier can use the system. *Logik* can be leased for $450/mo., or on an unlimited use basis for $10,000.

M. Bryce & Associates, Inc., 1248 Springfield Pike, Cincinnati, OH 45215. (513) 821-2645.

CIRCLE NO. 399

Mini data base management

A minicomputer database management system called *Express File Manager (EFM)* is available on Wang 2200B minicomputers. Hierarchical structures up to 16 levels are handled. File description, maintenance, and inquiry are performed interactively via crt and involves no programming. *EFM* runs on a minimum of 16k bytes and is priced at $5,000.

Express Software Systems, Inc., 20 East 46th St., New York, NY 10017.

CIRCLE NO. 400

Terminal support

A software package which enables users of T-COMM 7 Front-End to use Sanders Series 800 terminals on their networks communicates with the Sanders terminals in asynchronous or synchronous half- or full-duplex mode. Asynchronous transmission rates can be specified from 110 to 1800 bps; synchronous from 2000 to 9600 bps. Cost of this software module is $170/month on a three year lease.

Periphonics, 75 Orville Dr., Bohemia, NY 11716.

CIRCLE NO. 401

Datapoint adds three support packages

Three support languages have been added to Datapoint's data processing applications: The *RPG II* business language; a new version of *Datashare III,* a multi-user multi-job language; and a disk-based version of *Dataform,* a data entry language. *RPG II* runs under the Datapoint disk operating system on a 2200 with a 16k word memory. The language includes an *ISAM (Indexed Sequential Access Method). Datashare III,* also features *ISAM* file access, plus variable partitioning, a new arithmetic package, and the capability to use a servo printer with any Datapoint terminal in a Datashare system. It allows users to connect up to eight video display terminals to a 2200 with a 16k word memory and one or more 2.4 million character cartridge disks via a multiport communications adaptor. The *RPG Prep* program permits users to type *RPG* programs directly on a Datapoint keyboard with the text of the program appearing on the display screen. Editing is performed automatically and keypunching is by-passed. Price of program tapes is $15 each. Users guides are also $15.

Datapoint Corp., 9725 Datapoint Dr., San Antonio, TX 78284. (512) 696-4520.

CIRCLE NO. 402

MICR proof of deposit

Primary functions of the MICR proof of deposit application software are proof of deposits, validation of on-us transactions, pocket distribution, float analysis and cash letter preparation. This system is for use wih NCR Century 101, 200, 2501 or 300 computers with at least 48k memory and an NCR 671 MICR sorter/reader. This software is being released without charge to Century users.

NCR Corp., Dayton, OH 45479.

CIRCLE NO. 403

IC test language compiler, documentation package

ICENTER (Integrated Circuit Engineering Test and Report) operates on general purpose computers such as the Univac 1108 and IBM 360. The output or target code is in a format acceptable to the particular test equipment. Functions include comprehensive test specification, functional and parametric circuit tests, documentation of the test program in an English-Engineering vocabulary, including a program flowchart and a base for adaptation of programs to other test machines. It enables the test engineer to concentrate on the test and circuit rather than the coding idiosyncracies of a particular test computer, and frees the test computer for testing. Price is $23,950.

Proprietary Software Systems, Inc., 292 So. La Cienega Blvd., Suite 218 Beverly Hills, CA 90211. (213) 658-6858.

CIRCLE NO. 404

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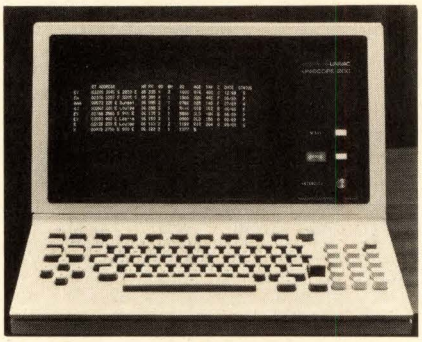
MAIL TO: COMPUTER DECISIONS Circulation Dept. Hayden Publishing Co., Inc., 50 Essex Street, Rochelle Park, NJ 07662

Intelligent crt has 8k memory floppy disk, new software

The model 200/10 intelligent crt features a semi-conductor RAM program memory expandable to 8k, 16-bit words, floppy disks, dual tape cassette, and printer options with speeds up to 250 lpm. Other features include a software package called *MIDAS*. *MIDAS* aids users in writing and debugging series 200 terminal programs. The floppy disk option comes as a single or dual disk system with 2,944 bytes per disk, and disks can be shared between terminals. The format is IBM 3740 compatible. The basic 200/10 is priced at $4,200. RAM memory ranges from $840 to $3,300; interrupt is $260 and dual cassette is $2,950. Model 200/10 will be available for delivery in the fourth quarter of 1974.

Computek Inc., 143 Albany St., Cambridge, MA 02139.
(617) 864-5140.

CIRCLE NO. 370



Large screen display matches Uniscope 100

The Uniscope 200 display terminal can show 1,920 characters of many languages on a 15-inch screen. Displaying a 7 x 9 dot matrix character, it is available with either a 24 line x 64-character-per-line or 24 line x 80-character-per-line format. Uniscope 200 may be used as a receive-only or as a receive-transmit terminal with a variety of keyboards. Lease prices of the 200 begin at $121 per month, including maintenance. Purchase price is $4,128. Available now.

Sperry Univac, P.O. Box 500, Blue Bell, PA 19422.
(215) 542-4215.

CIRCLE NO. 371

Oem mass memory

The model 176 digital cassette subsystem is an ANSI/ECMA compatible, multipurpose, single-transport, magnetic tape, mass memory device. It is specifically designed for use as a storage/retrieval component in oem computer based systems, data communication systems, terminals, peripherals and special purpose applications. Price is $975 in oem quantities.

Dicom Industries, 715 North Pastoria Ave., Sunnyvale, CA 94086.

CIRCLE NO. 372

Video display terminal

The Hazeltine 1200 is a teletypewriter compatible terminal providing a 1920 character screen with 80 characters per line by 24 lines and will operate at speeds up to 9600 bps. Options include lower case, current loop, answerback and an auxiliary EIA output. Purchase price is $1,590 with discounts offered for quantity and oem purchasers.

Hazeltine Corp., Greenlawn, NY 11740.

CIRCLE NO. 373

Electro discharge printer

A 16-column electro discharge printer, model DC 1606-B, prints eight lines per second using a 5 x 7 dot matrix, with both alphanumeric characters and mathematical signs and symbols. Cost is $65 per unit in 1000 quantity.

Hycom, 16841 Armstrong Ave., Irvine, CA 92705.

CIRCLE NO. 374

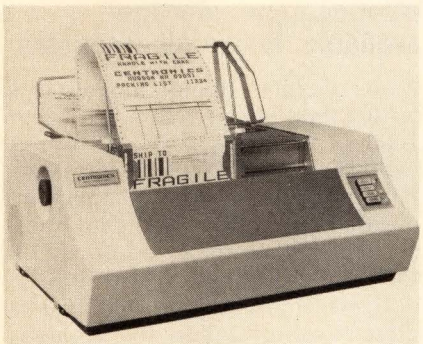
PE magnetic tape formatter

This phase encoded magnetic tape formatter, model 6922, permits daisychaining of up to four tape units. In addition, formatter addressing capability allows the use of two formatters with up to eight units per controller. Has speeds up to 45 ips. In oem quantities, $4,000.

Microdata Corp., 17481 Red Hill Ave., Irvine, CA 92705.

CIRCLE NO. 375

Peripherals New Developments



Variable font printer forms characters in any size

Model 101S is a serial dot matrix impact printer that prints alphanumeric characters in any size. This 132 column multicopy impact printer can print lines of characters ranging from the standard one-tenth inch high characters to newspaper front page banner headline size characters. For added versatility in character formation, transmission of an octal 016 code forms all characters in that line to be printed as double width elongated characters. The 101S receives eight bit ASCII parallel data input; serial data input to 9600 baud is an available option. Priced at $4,495; delivery is 60 days aro.

Centronics Data Computer Corp., Hudson, NH 03051. (603) 883-0111.

CIRCLE NO. 376

128k add-on memory for DEC PDP-10 systems

An add-on memory system for the DEC PDP-10 with the capacity of 128k words of 37-bit (36 data bits and parity) is plug-to-plug compatible with DEC System 10 Computer Systems and features small size (19-inch-wide cabinet) and power savings. This system is the latest in a series of model DMS-10 add-on memories that have ultrareliable magnetic core memories, an access time of 350 nanoseconds, a cycle time of 750 nanoseconds, and have a multiport capability that is expandable from one to eight ports. Prices range from $80,000 to $90,000 depending upon configuration. Available now.

Dimensional Systems, Inc., 6 Nevada Dr., Lake Success, NY 11040. (516) 895-0844.

CIRCLE NO. 377

Crt supplies two color channels for viewing

Designed to supply two channels of simultaneous color viewing of any two-dimensional data, the model 420 crt trend display supplements online alphanumeric data with a graphic historical summary or trend. Industrial applications include thickness/concentration monitoring in the production of paper, plastic, rubber, glass and chemicals. Utility applications permit the monitoring of power, oil, gas transmission, and water treatment facilities. Model 420 is also useful in laboratory analysis, business analysis and statistical studies. The 420 with 19-inch RGB color monitor is priced at $5,800 and with a 14-inch B&W monitor $4,750. First deliveries start December 1974; standard delivery is 90 days aro.

Control System Industries, 2920 San Ysidro Way, Santa Clara, CA 95051. (408) 732-9400.

CIRCLE NO. 378

Six megabits for PDP-11s

The SA3900 storage facility interfaces with the PDP-8 or-11 enabling the users of the SA3900 to connect to these minicomputers with a storage capacity of 6 megabits of online data. The basic two drive SA3900 for PDP-8 or-11 includes the SA90 Controller/Formatter, an interface board, and I/O Driver Programming Tape and a Cable Connector. Up to eight drives can be attached to these systems. Price is $3,000.

Shugart Associates, 335 Soquel Way, Sunnyvale, CA 94086.

CIRCLE NO. 379

Cross patch programming

Cross Patch, a miniature XY programmable module, consists of 100 interconnection points in a 10 x 10 grid configuration. Any X selected point may be connected to any Y point by the use of bifurcated shorting plugs. Cross Patch can be used for programming computers, machine tools, vending machines, or used for test purposes. Depending on quantity, board mounted costs $40 to $60.

Aries Electronics, Inc., P.O. Box 231, Frenchtown, NJ 08825.

CIRCLE NO. 380

Accelerated storage adapter upgrades IBM 370/155

Accelerated Storage Adapter (ASA) in combination with Fabri-Tek/Data Recall memory allows the IBM 370/155 central processing unit to execute instructions faster than the standard 155. The ASA is attachable to any 155 system in combination with 3360 memory. This enables the 155 user to add memory with the ASA to improve his system's performance without the necessity of disposing of his 3360. The 3360's will run at their original speed. Price of the ASA is $76,000. Available now.

Fabri-Tek Inc., 5901 South County Rd. 18, Minneapolis, MN 55436. (612) 935-8811.

CIRCLE NO. 381

Tape subsystem for Honeywell 200, 2000

The F383 magnetic tape subsystem is plug-compatible with Honeywell Series 200 and 2000 computer systems, and can function in a wide range of operating modes, including eight Honeywell-equivalent modes, such as seven-channel (at 200, 556, or 800 bpi), and nine-channel (800 or 1600 bpi NRZ) and at speeds from 70 to 150 ips. The F383 micro-programmed control unit can accommodate all modes, and can control up to eight tape drives in a dual-channel configuration, with read/write simultaneity. The system's software is compatible with Honeywell software, as well as industry compatible with S-6000, EBCDIC, and ASCII tapes. Rental of the basic F383 subsystem starts at $3,500/month; availability is 90 days aro.

Formation, Inc., One Computer Dr., Cherry Hill, NJ 08034. (609) 424-1713.

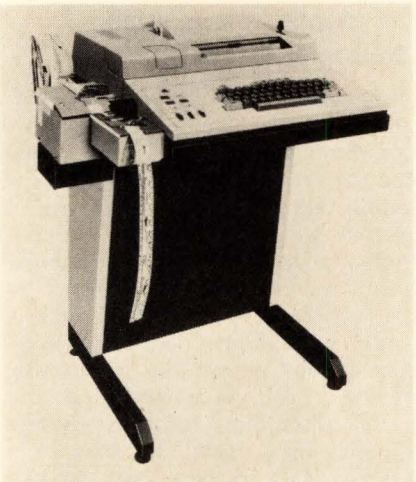
CIRCLE NO. 382

PDP-11 tape storage

Series 2400 tape storage system provides the PDP-11 with up to 23 megabytes of mass storage. The interface card plugs directly into a small peripheral controller slot in the mini. Price is $3,935.

Qantex, 200 Terminal Dr., Plainview, NY 11803.

CIRCLE NO. 383



Ink jet printers for oem market

Models 400 and 500 printers are electronically controlled ink jet devices that form characters and symbols on ordinary paper. The Typuter 400 (KSR) is a terminal printer for minicomputers which offers a keyboard sending and receiving capability which can be interfaced to almost any known data processing unit. The Typuter 500 (ASR) incorporates an eight-channel paper tape punch and reader unit that reads at 55 characters per second, and the punch has a speed of 30 characters per second. All Typuter printers use ASCII code. Prices range from $800 to $2,000; available now.

Casio, Inc., One World Trade Center, Suite 4011, New York, NY 10048. (212) 432-9230.

CIRCLE NO. 384

Display terminal runs locally, remotely

The model 4011 video terminal has a display capacity of 1728 characters and is equipped with both a standard typewriter keyboard and a numerical-key cluster. Model 4011 can be located up to 2000 feet from a Qantel computer in a local environment or can operate remotely via a standard data communications interface. It can also control an attached printer to provide printed copy of its screen or of data transmitted from a central computer. Price is $5,950.

Qantel Corp., 3474 Investment Blvd., Hayward, CA 94545. (415) 783-3410.

CIRCLE NO. 385

40-megabyte storage available for minicomputers

A 40-megabyte storage module disk system for minicomputers, the Xebec 7000, combines the CDC 9760 drive with the Xebec XDF-70 formatter. This formatter controls all functions of disk drive motion and data transfer between a minicomputer and up to four disk drives. Its 256-word buffer memory permits computer/drive synchronization for a variety of computer speeds. Multi-sector transfer, allowing up to 64k words with one command, eliminates the need for additional programming to transfer adjacent sectors. Data integrity is protected by comprehensive status reporting, a large repertoire of read/write operations, and marginal error recovery features. Xebec 7000 system is priced at $14,-500; available now.

Xebec Systems Inc. 566 San Xavier Ave., Sunnyvale, CA 94086. (408) 732-9444.

CIRCLE NO. 386

Disk cartridge memory

Available for both the PDP-8 and PDP-11 computers, the DSD 240 controller eliminates bus cabling by either plugging directly into the PDP-8 OMNIBUS or mounting inside a PDP-11 as a system unit. Up to eight disks, providing 400 million bits of data storage, can be accessed. Price is $2,500 in small oem quantities.

Data Systems Design, 1122 University Ave., Berkeley, CA 94702.

CIRCLE NO. 387

Plug-in compatible controller

The S1403/1130 controller is plug-in compatible with the IBM 1403-6 or -7, 1130, or Digital Scientific META IV computers through their storage access channels. The faster print speed is achieved without computer program changes. It comes in a stand-alone enclosure and includes all logic cards, memories, mating connectors, and power supplies. Price is $18,000 installed.

Spur Products Corp., 2928 Santa Monica Blvd., Santa Monica, CA 90404.

CIRCLE NO. 388

4800 bps modem is heart of network control system

This network control system consists of central site and remote site modems, including the MCS 4800 modem, plus a range of network testing and corrective equipment. The MCS 4800 operates on both unconditioned private (leased) lines and the direct dial network for dial back-up when the private lines fail. The network control system enables both multipoint and point-to-point network users to monitor, test, diagnose and correct the performance of large networks from a central site with no manual involvement at remote terminal locations. A multiplexer option enables network operators to combine 1200 baud and 240.0 bps data streams into the 4800 bps data stream handled by the modem. Price for the modem is $120 per month on a two-year lease contract; purchase price is $4,700 per unit. Available 30 days aro.

Intertel, 6 Vine Brook Park, Burlington, MA 01803.
(617) 273-0950.

CIRCLE NO. 389

Solid state stuntbox matches terminals to systems

Model 130, a data terminal controller with microprogrammable firmware, is programmed to perform a wide range of standard terminal control functions, and links the communications line and the terminal device(s) with the station attendant. Firmware is available for exercising the controller in most standard operating systems including Bell 83, 85, 8A, and Western Union 135, etc. Model 130/ASR performs send-receive function while model 130/RO performs the receive only function; both provide start-stop selectable operating speeds between 37.5 and 1200 baud. Model 130 optional features include: firmware for various systems, prewired interconnect cables, attendant sets, automatic motor controls, custom firmware to provide character buffering, code conversions, and send-receive monitoring. Price is from $950; delivery in four to six weeks aro.

NuData Corp., 12 Fairview Ave., Little Silver, NJ 07739.
(201) 842-5757.

CIRCLE NO. 390

Communications controller handles up to 128 lines

The model 1005 data communications interface controller developed for Nova minicomputers occupies one card slot and interfaces directly to the Nova data channel. Up to 128 communication lines of synchronous or asynchronous data can be intermixed simultaneously. Automatic line speed detection is available as an option and full control of line loop-back and diagnostics under program control is standard. Many types of interfaces are available: EIA/CCITT, telegraph, teletype, current loop, A/D, D/A, and contact closure. Remote time-division multiplexers are supported without software modifications by installation of multiplexer interfaces in the standard card bay. Expansion from several lines to 128 lines is accomplished by additional card racks attached in a chain sequence using a single cable for the attachment of each bay. Optional test features include an asynchronous line test module that generates and tests data. Externally attached terminals or devices can also be tested. A system with 50 modems attached is $9,050. Delivery is 90 days aro.

Micom Systems, Inc., 20426 Corisco St., Chatsworth, CA 91311.
(213) 882-6890.

CIRCLE NO. 391

TTY-compatible coupler

Model 501A is an acoustic coupler designed to interface with remote computer time-sharing systems using the Model 33 Teletype terminal. Features include half or full duplex switching, carrier indicator light, and integral acoustic shield. Price is $150.

Omnitec Corp., 2405 South 20th St., Phoenix, AZ 85034.

CIRCLE NO. 392

Short range data sets talk over ten miles

Designed to extend EIA signals over distances of up to 10 miles (at 2400 bits per second), these short range data sets are designed for applications within a facility where access to the cpu or the communications network by remote terminals with a complex is required. Available in two models, SR-200 operates synchronously at switch selectable speeds of 2400, 4800 and 9600 bits per second; and SR-100 operates asynchronously at speeds to one megabit per second. Both models operate full duplex, half duplex and simplex over standard twisted pair balanced non-repeated telephone cable. Model SR-100 is priced at $300 and Model SR-200 at $500. Delivery is 60 days aro.

Data-Control Systems, Inc., Box 584, Danbury, CT 06810.
(203) 743-9241.

CIRCLE NO. 393

NEWSDATA . . .

continues on page six . . .

the problem of identifying the current source was often difficult indeed. Thousands of supply requisitions were sent back to the customer each month, or delayed while being passed to the correct source.

Now, all requests for any item stocked by the military services, GSA or DSA can be sent as a single message to DAAS at Gentile or Tracy. DAAS examines each message for correctness of routing indicators, then automatically forwards each part of the message to the proper source.

When DAAS began in 1965, it was implemented as a service test, using one computer. During its first year of operation, DAAS processed 11.2-million transactions. By 1972, the annual volume had grown to 227.3-million, requiring 14 additional computers.

Anticipating this growth, DSA's Logistics Systems Division had begun planning the next generation DAAS in 1971, for start-up in 1973. The new version of DAAS is open-ended: It will be responsive to any foreseeable changes in requirements, message volume, or procedural routines.

Nearly a thousand different types of documents, most of them supply related, are processed by DAAS. Requests are "passed" when the system identifies the proper addressee by a code inserted in the request by the originator. Other documents are "routed," with the source of supply automatically determined by reference to their programs.

DAAS performs these functions on three types of logistics traffic: Up-traffic from requisitioners to higher echelons of supply, down-traffic from higher echelons to requisitioners, and cross-traffic of documents between inventory control points, depots, and weapons system managers. DAAS routes up-traffic, passes down-traffic, and may pass or route cross-traffic depending on type.

The eyes have it in computer rooms

The eyes never had it so good as in the favorable climate of computer rooms, says the Society for Visual Care of New York.

SVC, a research group sponsored by the Optical Manufacturers Assn., claims that the cooler temperatures, higher humidity and smokeless surroundings in which computers function best are good conditions for the eyes of the people who work with them.

According to SVC consultant Dr. Richard Hopping, the warm, humid air helps the eyes retain their normal moist surfaces. Contact lens wearers also benefit: There is less evaporation of eye lubricants.

Absence of cigarette smoke is also helpful, says Hopping. "Smoke introduces small particles into the atmosphere which can cause eye discomfort. Furthermore, smoke has a drying effect on the eyes."

But all is not on the plus side for computer rooms. Overhead fluorescent lights cause glare, uneven lighting and shadows. Light printouts, coupled with inadequate lighting, can cause eye strain. For this problem Hopping recommends closing the eyes for a few seconds or looking into the distance now and then.

Electronic noses collect bad-air warning data

The fight against air pollution in Connecticut is being helped by a mobile, automated system that combines electronic sensors and computer technology.

The state's Department of Environmental Protection has filled three trailers with air-monitoring equipment. Currently located in Stamford, Greenwich and Hartford, the sophisticated noses track atmospheric changes and air pollutants such as carbon monoxide and ozones.

The electronic sensors on the trailers are linked to an IBM System/7 by telephone lines. Every 15 minutes the computer dials a data transmission phone in each trailer, gathers, records, analyzes and stores the data it receives. It provides the department with an hourly printout of the various air pollutant levels. If the levels increase beyond normal ranges, the computer triggers a bell alarm so that immediate action may be taken.

Connecticut has four air-pollution alert stages. A Stage 1 Alert is issued when the National Weather Service advises of approaching air stagnation systems. A Stage 2 Alert is called if levels rise to a point where people with heart or respiratory conditions might be affected. The more serious Stages 3 and 4 are rarely called.

The department expects to expand its trailer network to 12 locations by the end of the year. It hopes to take advantage eventually of the computer's potential to assist in water, hazardous substance and solid waste pollution control efforts.

Small computers benefit small law firms

A San Francisco law firm recently reduced its professional billing and related operations from 25 man-hours daily to nine, and its billings are current instead of six weeks behind schedule. They did it all with a little Varian Data Machines computer, with application programs provided by Prodata International Corp.

Computerization has long been ignored by small law firms because of its presumed high cost and lack of programming expertise in the field, says Dennis Doherty, president of Prodata. His company, which serves more than 600 attorneys, uses turnkey Varian installations for larger firms but also has service bureau support for smaller ones.

According to Seymour Rubinstein, vice president of systems development for Prodata, "The small law firm, with fewer than 10 attorneys, typically employs manual accounting systems, and as a result suffers a three to six months' lag in cash flow. Such a float can amount to an uncomfortable $200,000 to $400,000 of nonproductive funds while interest is at an all-time high."

The growing complexities in legal billing are well suited to computers that can retrieve and manipulate internally stored data under various billing parameters, such as hourly basis, project basis, retainer disbursements, Prodata has found.

The computerized system for law firms, whether an in-house installation or service bureau, starts with attorneys logging their daily times and activities. This process is simplified by the use of codes on file in the computer's internal memory: CW for conference with; RR for research and review.

In addition to descriptive work codes, the attorney's log includes client and matter identification, number of hours and tenths worked on a matter, date and individual attorney code.

A work status report or client ledger—a monthly listing of all transactions from the daily log, arranged by client and by matter—allows individual attorneys to review all transactions sequentially for the previous month, with the related hours and billing amounts. A computer-

printed monthly statement can be prepared in two versions, one for the client and another for the company, detailing hours and fees.

Prodata's legal software extends beyond billing applications. Its document-assembly system performs text editing and print format tasks. For example, standard paragraphs, together with specially required language, may be combined in the preparation of wills, contracts, deeds of trust and other documents.

Programs under development will permit an attorney or his client to answer computer-controlled questions, using the keyboard of a communications terminal tied to the V73, to produce preliminary drafts of documents.

Western Union launches Westar II satellite

Western Union's Westar II satellite was launched last month by NASA. It joins Westar I to complete the country's first domestic communications satellite system.

Westar I began regular transmission July 15. *Mailgram* service from East Coast to West Coast via satellite was inaugurated jointly by Western Union and the U.S. Postal Service in September.

More than 70 companies already have contracted for Westar services, Western Union announced.

Computer puts away all kinds of nuts

As if a computer doesn't have enough bits and patches, here's one that also has 15,000 kinds of nuts and bolts in it.

It's an IBM System/3 model 6 in Salt Lake City, and firmly fastened in its memory are the quantities and whereabouts of hundreds of thousands of items in the Bolt & Nut Supply Company's stock.

There are all kinds of nuts in this business, and the computer takes care of all of them. Some are three feet long—like the fasteners used in the big gantry cranes that steady rockets on their launching pads—and cost hundreds of dollars. Some are so tiny that a dozen fit inside a paper clip, and so inexpensive that it's cheaper to sweep away dropped pieces than to pick them up. They're made of various materials: Some are of zirconium, for sewage disposal plants, and some are even silver-plated, for electronic firms.

In addition to keeping inventory, the small System/3 figures quantity discounts—orders ranges from one to 150,000—and prepares customer bills.

Speech input firm talks up new technique

Now you can reach for the nearest phone, get your company computer on the line, and cuss it out. And, if the computer has been programmed with an appropriate vocabulary, it will understand every word you say.

Dialog Systems, Inc. of Cambridge, Mass. has unveiled a machine which they claim removes some of the last barriers to everyday application of speech recognition by computers. The new machine is said to understand spoken words transmitted over ordinary phone lines—even, for example, by long distance from Los Angeles to Boston. At the same time, it can understand almost anyone's voice, without special training.

"For people, speech is the preferred means of communication," says the system's developer. "Anybody who tells you that human beings would rather peck on a keyboard than talk must have an ulterior motive; he is just trying to sell keyboards. Our sanity and cultural survival will be lost if we become the effect of our own byproducts. This includes machines. We should be able to tell a machine off, in our own way, by voice.

"It will be some time before any computer is as clever as 'Hal' in the Space Odyssey movie," he continues, "but we have today limited systems that are so reliable and inexpensive that companies can begin to realize cost savings by installing them. Voice input systems made by a New Jersey firm are already successful in material handling and quality control applications. Now we can ease the load on operators for routine telephone inquiries, or eliminate costly computer terminals that aren't used very frequently. In many instances the economic difference between keyboard input and voice input will disappear completely in the near future."

Dialog's researchers have been building speech recognition equipment since 1964, when they engineered an instrument which translates human speech into dolphin whistles. The instrument was employed on a Navy research program in which captive dolphins were trained to understand a simple language of spoken phrases, as translated into their own "whistle talk."

In 1967 the company's technical director S. L. Moshier discovered that a mathematical technique of Norbert Wiener, now called "linear predictive coding," could provide a compact way of stating the meaningful characteristics of speech signals. This speech analysis technique, developed at about the same time at several different laboratories, is now considered one of the most promising methods of compressing several telephone conversations onto a single voice channel. While others concentrated on the compression problem, Dialog's people began developing the idea into a speech recognition system. An experimental "voice print" type of identification system was also constructed, in 1968, and the group demonstrated a prototype of its speech recognizer to private investors in 1970.

"Our present system accepts 1,000 different telephone messages with a average untrained accuracy of about 99%," Moshier reports. "The only hitch is that you can't speak normally, running one word into the next. The machine will understand you only if you stop at the end of each word and make a little pause. This tells it when the last word is finished and the next one is about to begin.

"For a vocabulary such as single digit numbers our method has a basic accuracy of about 95%," he explains. "We achieve extra reliability in message comprehension by adding extra information, in the same way that credit card numbers have an extra check sum digit added at the end. In ordinary conversation, language experts call this extra information 'linguistic context.'

"To increase the accuracy still further, the system repeats the message back and asks for verification. After the first message has been verified, the computer adjusts itself to understand the caller's particular voice quality more reliably as it listens to subsequent messages. Once the machine is well trained, the error rate for single digit numbers drops to as low as one in a thousand. In the majority of cases the machine recognizes a word almost perfectly after hearing it once in the caller's voice."

Great Lakes shippers get mini-based "phones"

The Great Lakes are soon to be "wired" by an automated ship-to-shore radiotelephone system. The federal Maritime Administration is paying the toll to have Lorain Electronics, of Lorain, OH, install the new VHF system.

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The new Great Lakes Automated VHF Radiotelephone System will initially cover all or parts of three of the Great Lakes: Erie, Michigan, and Superior. The system will start operations with six shore stations, later expanding to 14 when all five lakes are covered. The VHF system will have much more resistance to interference than the existing network, but more shore stations are needed because the stations have less range. The shore stations won't have their own operators, instead a Varian 72 minicomputer will sit behind the switchboard at the central station in Lorain. Computer hardware and software responsibilities for the system belong to Systems Data, Inc., of Akron, OH, under a contract from Lorain Electronics.

The system will be doing more than just handling ship to shore calls. Subscribing ships will be equipped with "status-monitor units," which are somewhat analogous to telephone answering machines. The ship's captain will be able to load information, such as position, course, local weather conditions, and coded word messages to the ship's owners, into the status-monitor unit. The computer controlling the system will poll the ships every few hours, taking the messages from the status-monitor unit and placing them into protected storage. This data will then be available to authorized personnel, such as the ship's owners and the National Weather Service (for weather data only). Every six hours the system will clear itself of message traffic, and send a pre-recorded weather report conference call to all subscribing ships.

By keeping track of the progress of each ship, the minicomputer will know which shore station to use. If a ship can't be contacted through the most probable shore stations, a human operator at the central station will be alerted.

Lorain is an interconnect carrier, so they must rely on Ma Bell to handle part of the job. Each shore station will have a dial line to accomodate individual calls between telephone subscribers and ships under way. Leased lines will be used to connect each shore station with the central station in Lorain.

California, here we come: NCC '75 taking shape

Although the 1975 National Computer Conference is still six months away, plans are taking final shape for the first West Coast convention, to be held May 19 through 22 in the Anaheim (CA) Convention Center.

Sponsors of the convention, the American Federation of Information Processing Societies, anticipate the largest display of computer products ever seen. More than 800 booths already have been reserved, out of a maximum 900 planned for the 20,000 square foot exhibition hall. Visitors can also see Disneyland, which adjoins the 40-acre Convention Center.

Attendance is expected to top 30,000, according to conference general chairman Donal A. Meier. A gold Everything Card, available to advance full-conference registrants, will offer substantial savings, including $15 off the regular registration fee, luncheon discounts, copy of the $40 postconference Proceedings, and a chance at one of the five NCC lifetime registrations.

Approximately 84 program sessions, covering computer science and technology, data processing methods and applications, and societal issues are planned, with more than 400 leading speakers and program participants scheduled.

New York and Dallas will be the sites of the 1976 and 1977 National Computer Conferences, the NCC Board recently decided.

In 1976 the NCC will return to the New York Coliseum June 7-10, with the hope of duplicating the successful 1973 conference there. The 1977 meetings will be held in the Dallas Convention Center June 13-16. Located midway between the East and West Coasts, Dallas will be the first Southwestern city to host an NCC.

Museum fingerprints its mineral collection

Thousands of mineral samples are on display in a New Mexico museum —and an IBM computer has "fingerprinted" each one by X-ray analysis.

In addition, the science-oriented System/360 keeps an exhaustive record of each of the 9,200 specimens at the New Mexico Bureau of Mines Mineralogical Museum in Socorro.

"We were the first mineralogical museum to be computerized," said Dr. Jacques Renault, a geologist who also teaches at the New Mexico Institute of Mining and Technology. Begun in the early 1900s, the museum was maintained by the institute until 1964, when it was turned over to the Bureau of Mines.

"Much of the material had never been classified," Dr. Renault explained. "Some of it was in cardboard

boxes and desk drawers. Several people tackled the job, but it was an immense task. Finally we decided the IBM system could handle it better."

The computer was also used to analyze the mineral content of each sample. "It's very much like a fingerprint," said Dr. Renault.

Now geologists have everything at their fingertips. Printouts can give each sample's exact location, can turn up all minerals from any geographic area or from any donor.

Travel firm's costs tumble with mini

Business is looking up and overhead is going down for Rogal Associates, a Massachusetts-based wholesale travel firm. The "up" is due to their clients, the "down" to their Basic/Four minicomputer.

The firm, which specializes in group and incentive travel programs for companies such as General Electric, Hotpoint and ITT, recently installed a minicomputer with programs designed expressly for the travel industry. According to vice president Bruce A. Rogal, the installation comes at a time when business is increasing.

"Many of the bigger companies feel that one way to get the economy moving is to offer travel as an incentive to their distributors, dealers and salespeople," he said. Since overhead is now way down, operation is more efficient and the benefits are being passed on to the clients.

"The savings in manpower are phenomenal," Rogal said. "With the minicomputer, we type a client's name, address, telephone number and passport number just once. This information is required repeatedly before actual departure date, and will be printed out over and over again, saving us a fantastic amount of sorting and typing."

The new system also prints out boarding passes complete with seat assignments and coupons to identify those who get particular options.

While all these functions are going on, the computer is also used for handling accounts receivable, accounts payable, cash disbursements and payroll. Shortly, the firm will have its entire accounting operation online.

The firm has discovered several other applications for the computer. For example, a quota award system was set up for several clients to help them keep track of salespeople who qualified for an incentive plan.

Without the computer, estimates Rogal, four or five additional clerks would be needed.

Bring around the color say Missouri researchers

Bioengineers at the University of Missouri (Columbia) are experimenting with applications for the color displays that their computers can produce. Aiming to add another 500 colors and shades to the eight their computer's memory bank now stores, the UMC engineers are working in areas such as the graphic arts, communication, industry and medicine.

Here's how the color display works: A color photograph or transparency is electronically scanned, then converted into a digital representation that's stored inside the computer. This digital representation, when called out via the keyboard, is converted into information that produces a color display on a crt. The computer can also be programmed to generate color from computer software.

For use in printing, the color display is photographed, picking up the digitized pattern on the cathode ray tube, and is then transferred to a conventional printing plate. Although colors can readily be called out of the computer, the color display is not as brilliant as the researchers would like. Right now, they're working within the limitations imposed by the design of the crts that display the color images.

There are a great many potential medical applications, too. Pathologists use color extensively in their diagnoses of diseases, so the first application in a pathology laboratory might involve the transmission over telephone lines of a stained-slide color image to a consulting expert.

Another area in which computer-generated color can be useful is in the design and color selection involved in the manufacture of textiles.

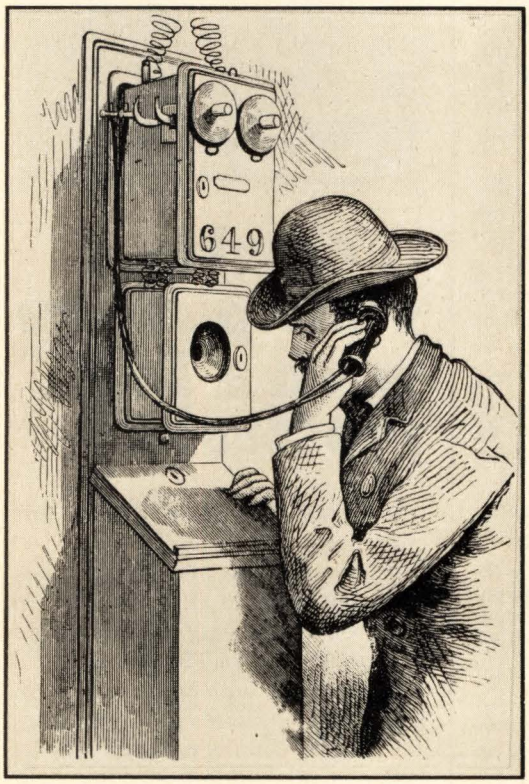
And another lucky winner!

The wheel of fortune has spun once again and once again we have a winner. This time he's Jim Jinkins, who describes himself as "the chief and the Indian, too," of Creative Software Development Inc., a Knoxville, TN software house. Jim's forte is designing programs for Wang calculators.

He says he'll use his new TI 2500 calculator to do the kind of work that takes too much time and money to do on a computer.

Congratulations, Jim!

Hold that line



In computing, as in Middle Eastern wars, boundaries can shift rapidly. What was once hardware becomes software, or firmware, or is found superfluous and is nowhere. Functions performed by programs for years suddenly become tiny pieces of silicon, cells indistinguishable from their neighbors in the organism we call a system. Storage, once a separate unit in a computer, has been fragmented: Part is real, part isn't, is in the cpu, some attached, some in far-flung floppies kept in Terminaland.

These boundaries have shifted for a host of reasons, among them sensible ones, silly ones, technical ones, and marketing ones. Over the years we have grown used to change in our computers, because it generally has meant better products and more efficient business. But we have grown weary. We wonder if all this change must be accompanied by so much inconvenience. We wonder if there is not some way to blend in a bit of stability with progress (or whatever we choose to call change).

If we picked one "natural" boundary, one place where standards might be readily developed—or might already exist if we only went along with them—we might be able to split system development plans neatly in two. On either side of this line progress would yield its usual dividends. But the boundary would enable users to upgrade on either side, without fear that support from vendors would vanish.

We suggest the terminal and its interface to the mainframe as the best spot for stability. There are many reasons, but most users of terminal systems would probably agree with our list as a beginning:

- Terminals are widely produced; the competition is fierce and progress is rapid. Forcing all parties to meet one set of specifications—well-reasoned specifications, we hope—would enable the user to switch terminals, communications gear, and even carriers to meet new business challenges without having to rebuild from scratch. A step forward would no longer require the user to back up for a running start.
- The industry giants, AT&T and IBM, are playing tug-of-war, and the user seems to be the rope. Getting these two firms to agree on standards would make things simple for everyone else in the business. Most independents would gladly invest in any changes they need to meet a joint AT&T-IBM spec if they felt it would be a permanent change.
- Security of data and the integrity of systems would be advanced by any standard. Once everyone agrees on what interface we should protect, the protection effort could move from talk to engineering.
- Competition in the terminal and the communications business would be inspired. Instead of building several lines of look-alikes to penetrate different markets, vendors would concentrate on product enhancements, such as improvements in storage devices, user facilities, and price/performance.

One reason we have the problems we do with interfaces is that users have been sheepish about demanding standards from their suppliers. That is changing, spurred by battles in the courts and the need to save as the rough seas of our economy make navigation more of a challenge for business.

The big moves, those undertaken by the vendors, are next. We hope that the firms involved will lead the effort, instead of waiting for regulatory action which is sure to come. But if it takes a battle between the users and the vendors, so be it. We think the users have a winning case. —*HW*

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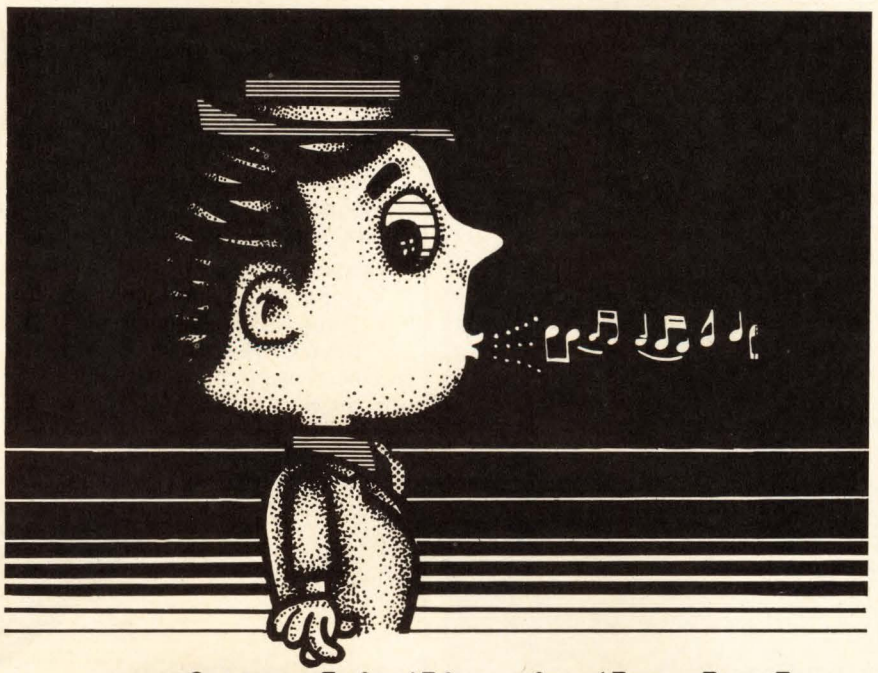

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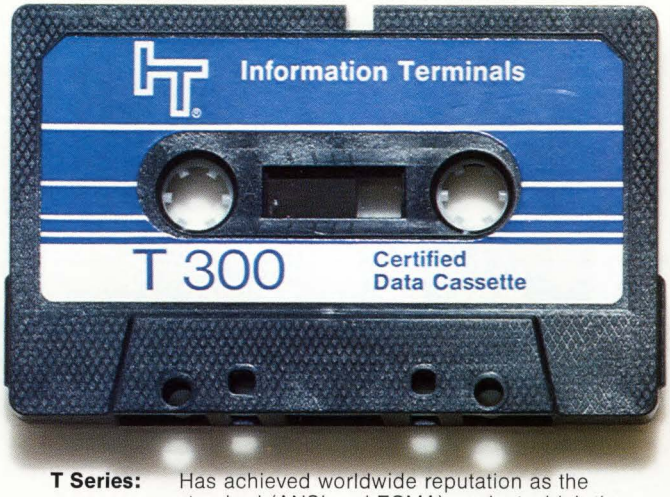

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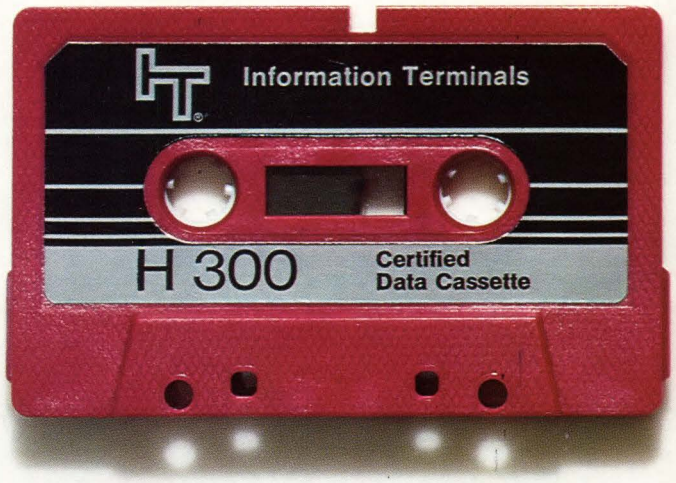

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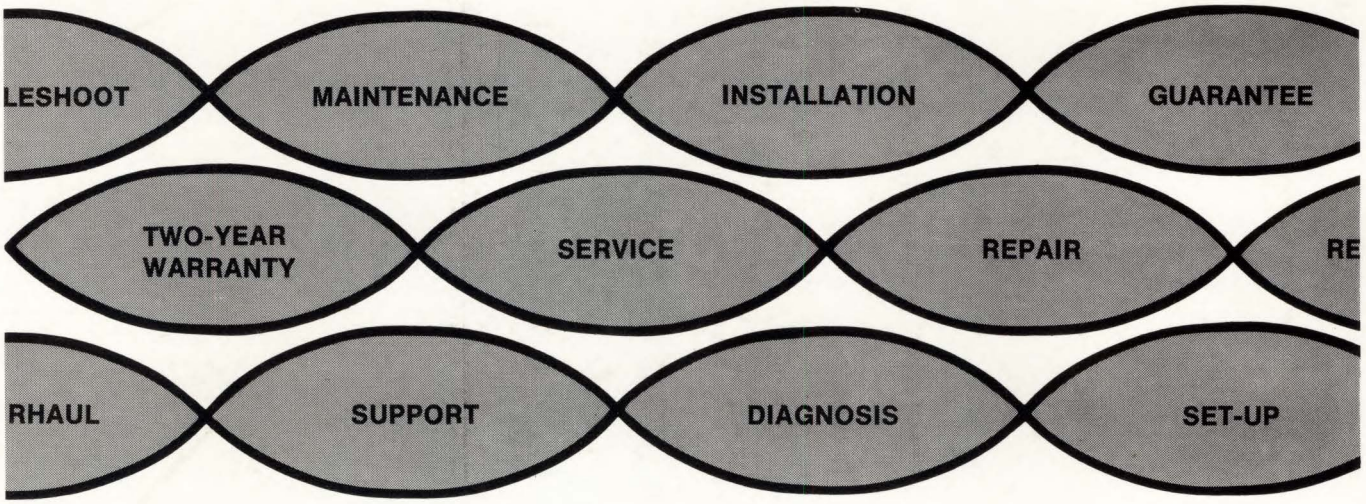

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