DIGITAL COMPUTER NEWSLETTER

The purpose of this newsletter is to provide a medium for the interchange among interested persons of information concerning recent developments in various digital computer projects. Distribution is limited to government agencies, contractors, and contributors.

OFFICE OF NAVAL RESEARCH · MATHEMATICAL SCIENCES DIVISION

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Editorial Policy Notices

EDITORIAL

The Digital Computer Newsletter, although a Department of the Navy publication, is not restricted to the publication of Navy-originated material. The Office of Naval Research welcomes contributions to the Newsletter from any source. The Newsletter is subjected to certain limitations in size which prevent publishing all the material received. Contributed items which are not printed are kept on file and are made available to interested personnel within the Government.

DCN is published quarterly (January, April, July, and October). Material for specific issues must be received by the editor at least three months in advance.

It is to be noted that the publication of information pertaining to commercial products does not, in any way, imply Navy approval of those products, nor does it mean that Navy vouches for the accuracy of the statements made by the various contributors. The information contained herein is to be considered only as being representative of the state-of-the-art and not as the sole product or technique available.

CONTRIBUTIONS

The Office of Naval Research welcomes contributions to the Newsletter from any source. Your contributions will provide assistance in improving the contents of the publication, thereby making it an even better medium for the exchange of information between government laboratories, academic institutions, and industry. It is hoped that the readers will continue to participate in transmitting technical material and suggestions to the editor for future issues. Material for specific issues must be received by the editor at least three months in advance. It is often impossible for the editor, because of limited time and personnel, to acknowledge individually all material received.

CIRCULATION

The Newsletter is distributed, without charge, to interested military and government agencies, to contractors for the Federal Government, and to contributors of material for publication.

Requests to receive the Newsletter regularly should be submitted to the editor. Contractors of the Federal Government should reference applicable contracts in their requests.

All communications pertaining to the Newsletter should be addressed to:

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Washington, D. C. 20360

Computers and Data Processors
North America

GE-420 and GE-400 Time Sharing System

General Electric
New York, New York 10022

The first in a new "family" of General Electric time-sharing computers was announced in June by Vern S. Cooper, manager of the General Electric Information Systems Marketing Operation.

The GE-420 time-sharing system employs many of the features of GE's well-established and highly successful GE-265 time-sharing systems plus many improvements. For example, the new system has the ability to permit two programs to reside in core, providing multiprogramming in a time-sharing environment.

GE's new medium-scale time-sharing system, which leases for approximately $17,000 a month and sells for $760,000, is capable of handling 30 users at one. Larger members of the family will be introduced later.

Time-sharing is a technique which permits many people to use a single computer at the same time. It increases the usefulness of the computer by making it available to more users, including those who are not situated near the computer site and those who are unfamiliar with the technical aspects of computers or computer programming.

Businesses which have experienced the greatest benefit from time-sharing to date are banks, large industrial firms, and engineering- and scientific-oriented firms.

The GE-420 can be used as a powerful batch processing system for business data processing and scientific/engineering applications when not being utilized for time-sharing.. This means that the system, when not dedicated to time-sharing, can handle overloads from other data processing systems.

The GE-420 time-sharing system will handle 30 communications lines concurrently. As many as 300 people can use the GE-420 in normal time-sharing operations; experience has shown that this number of communication lines normally can serve more than 100 remote terminals, and each terminal usually can serve the needs of three or four individuals.

A password technique incorporated into the new time-sharing system allows confidential data to be protected against unauthorized or accidental disclosure. Only those authorized to use the appropriate password are able to gain access to any confidential information contained in the permanent file.

The GE-420 uses an extended form of the BASIC computer language, first developed by Dartmouth College and used on the GE-265 system. Present time-sharing users can move up to the medium-scale GE-420 easily and without retraining.

BASIC uses familiar English words as a means of communication with the computer, and can be learned by persons totally unfamiliar with computer programming in as little as 1 hour. The extended BASIC used on the GE-420 includes refinements which make it capable of executing more complex problems than ever before.

For the scientific/engineering user, FORTRAN will be available for the GE-420 during the first quarter of 1968.

Hardware requirements for the GE-420 include a 32K GE-415 central processor, a 16K DATANET-30 communications processor and a DSU-204 disc storage unit.

First deliveries of the GE-420 will be made in the last quarter of 1967. Normal delivery is one year.

GE-420 TIME-SHARING SYSTEM

Hardware
Requirements: GE-415 central processor, 32K
DATANET-30 communications processor, 16K
DSU-204 disc storage unit

GE-420 TIME-SHARING SYSTEM (Cont.)

Peripherals:	Card Reader, 900 cpm Card Punch, 100/300 cpm Printer, 1200 lpm
Magnetic Tape Units:	Tape Controller (2 models available) Tape Handlers (12 models from 200/556 to 200/556/800 BPI intensity)
Languages:	Extended BASIC FORTRAN (first quarter 1968)
Access Time:	1.5 microseconds per character
Memory Size Words:	32K
Floating Point Add.:	17 microseconds
Floating Point Dvd.:	30 microseconds
Disc Storage Capacity:	18-24M
Price (Typical System):	$16,944 monthly lease $760,000 purchase

GE-400 SERIES OF MEDIUM-SCALE COMPUTERS

Specifications Common to GE-415, GE-425, and GE-435 Computers

Electronics:	Solid State
Decimal/Alphanumeric Character:	6 bits
Word Length:	24 bits and parity
Characters per Word:	4
Memory Type:	Coincident Current Core
Data Manipulation and Arithmetic:	Decimal or Binary
Instruction Format:	24 Bits Binary
Addressing:	15 Bits Binary
Internal Data Storage:	Decimal (BCD) or Binary
Number of Instructions:	
Basic	70
Total Single- and Double-Address	200+
Addresses per Instruction:	1 or 2
Number of Fixed Index Words:	6
Maximum Number of I/O Channels:	12

Features Common to All Three Computer Systems

Multiple Read/Write/Compute
Any Word Indexing
Indirect Addressing
Scatter Read/Gather Write
Relocatable Accumulator

Program Packages for All Three Computer Systems

FORTRAN
COBOL Compiler
SIMCON
DAPS
Macro Assembly Compiler
Extended Operating System/Magnetic Tapes
Double Precision Floating Point
Report Program Generator
Sort/Merge Generator
Operating System
Input/Output System
Simultaneous Media Conversion
Service Routines

General Electric's family of GE-400 computers includes three systems: the GE-415, GE-425, and GE-435. Designed by one of the world's largest users of computer systems, the three are compatible in programming, peripherals, and hardware. They handle business data processing, scientific/engineering computations, and data communications assignments with equal facility.

The GE-400 systems have benefited from GE's intimate understanding of users' needs in operating economy, ability to expand promptly to keep pace with growing work loads, and the desirability of amortizing programming costs over as long a period of time as possible.

Users of GE-400 systems represent a cross section of business, industry and government.

Built for ease of upgrading and expansion, the GE-400's have been improved periodically in operation speed and memory capacity, in line with the latest advances in computing technology. Development of new software and systems packages continues constantly.

For example, memory speeds – the time it takes to obtain data from the computer's memory – have been improved from 2.3 to 1.45

microseconds in the GE-415, and from 1.28 microseconds to 975 nanoseconds in the GE-425. The largest member of the series, the GE-435, has a memory speed of 680 nanoseconds.

Last April, it was announced that the core memory capacity of the GE-425 and GE-435 computers was increased from a maximum of 32,000 words to 131,000 words (524,000 characters) in increments of 16,000 words.

When a program is developed for the lower-capacity processor of any one of these computers, it may be used on any system with a higher capacity. Thus, programming investment may be charged against future growth as well as today's needs.

Recently, a Direct Access Programming System (DAPS) was announced for the GE-400's. It brought to users a medium-scale computers the ability to handle multiprogramming, remote operation, and long-distance communications. It provided many of the advanced capabilities usually found in larger-scale systems.

Another new application system for the GE-400's was also recently announced. Scientific Inventory Management and Control (SIMCON) was introduced last month. It provides the user with a means to automate inventory management and control and was drawn from the inventory control experience of some 100 different General Electric product businesses covering a wide range of sizes and complexity. The new system enables many businesses to justify the cost of a computer installation solely on the basis of inventory savings and the resulting improvements in profits.

A new Extended Operating System for Magnetic Tapes (EOS/MT) is currently being announced and already has helped one large national bank to increase its GE-415 throughput by 25 percent.

Advanced AUTODIN System

Philco-Ford Corporation
Philadelphia, Pennsylvania 19134

Philco-Ford Corporation has unveiled a full-scale operating prototype of the automatic digital message centers the company will build around the Free World for the Department of Defense.

The operating prototype, known as the AUTODIN Pilot Production Model, was demonstrated early in 1967 at the Philco-Ford plant. It contains six Philco Model 102 computers and peripheral equipment deployed in three operational rooms.

AUTODIN is an acronym for Automatic Digital Network. A digital network transmits printed messages, as opposed to an Automatic Voice Network (AUTOVON), which transmits the spoken word much as in telephonic communications.

Henry E. Hockeimer, a Philco-Ford vice president and General Manager of the company's Communications & Electronics Division, which is building the AUTODIN centers, said the Overseas AUTODIN network will be among the largest and most sophisticated communications systems in the world.

The overseas AUTODIN network is being implemented by the Army Strategic Communications Command under the management of the Defense Communications Agency in the Department of Defense.

Philco-Ford is furnishing the centers under a prime contract totaling more than $44 million with the Army Electronics Command at Ft. Monmouth, N.J.

AUTODIN is one of several programs for which procurement management is being handled by the Universal Integrated Communications/Strategic Communications (UNICOM/STARCOM) Project Manager's Office, an element of the Army Materiel Command, also at Ft. Monmouth.

Mr. Hockeimer said the AUTODIN system represents "the combining of the communications and computer technologies.

"This represents far more than would just the completion of another contract. It marks the beginning of a new era — digital communications switching making full use of computers for communications.

"We gained substantial operational experience in both hardware and software from a communications switch which we installed for the Ford Motor Company.

"That switch, which we turned over to Ford last year, is processing over 26,000 messages every day from communications centers in the U.S. and abroad.

"This synthesis between computer technology and the communications art could result in a technological revolution. New techniques and new equipment are being made available almost daily.

"Philco-Ford Corporation, through the Communications & Electronics Division, is clearly staking out a leadership position in this field of real-time digital communications switching. We intend to invest whatever time, talent, and money are necessary in the months and years ahead to broaden and strengthen our leadership position."

The Pilot Production Model demonstration was conducted by Lloyd W. Cali, director of Communications Switching and Data Systems for the C & E Division, and Richard R. Reaser, AUTODIN program manager under Cali.

AUTODIN centers already are being installed in The Philippines, Germany, and England. A training center is under construction at Ft. Monmouth, New Jersey. Other overseas centers will be installed in Okinawa, Japan, Guam, Alaska, and at three sites in the Far East. Two additional sites have yet to be selected.

Eight of the overseas AUTODIN centers will service 200 duplex communications lines. Four of the centers will service 100 duplex lines. The larger centers each will require six Philco Model 102 large-scale, high-speed computers, while the smaller centers typically will require four Model 102 computers.

A typical 200-line center will be capable of accepting 18,000 messages (averaging about 2 [illegible] characters) per hour and forwarding them to [illegible] required destinations.

The Philippines center is scheduled to be first to come on-stream, in the spring of 1967. All of the additional centers are scheduled to be operational within 18 months.

The magnitude of hardware and complexity of operation within an Automatic Digital Message Switching Center made it necessary for Philco-Ford Corporation to implement a new concept for evaluating switching center reliability.

The traditional system "mean time between failure" and "mean down time" had to be discarded in favor of a systems effectiveness concept required by the government. The new concept recognizes that a center does not fail completely, but rather operates in a degraded condition in the event of certain subsystem failures.

Four critical performance factors were specified in arriving at the AUTODIN systems effectiveness requirement: input and output capacities, line service availability, and message processing time. Performance levels were specified for each category. Philco-Ford was required to demonstrate that its centers would achieve those levels and maintain that performance with specified statistical probabilities.

For each performance parameter there is one requirement for an expected or average value and another requirement for a limit or "at any time" value with an associated probability.

For example, the message switch in a 200-line center is required to be capable of handling an input of 57,600 bits per second at a sustained rate, with a peak of 70,000 bits per second for at least 12 seconds. At any time, the probability of the switch's limiting the input capacity to less than 10,000 data bits per second is limited to one in 100,000.

A fully equipped 200-line center has to have an expected sustained output of at least 86,400 data bits per second. At any time, the probability of the center's limiting the output capacity to less than 15,000 data bits per second cannot be greater than one in 100,000.

The expected percentage of terminated circuits capable of being served by a center must be at least 98. The probability of the switch's not being capable of serving at least 85 percent of all the terminated circuits at any given time cannot exceed one in 10,000.

One of the ways by which Philco-Ford assured center reliability and continuity of performance lies in a unique function of the program.

The program automatically detects failure of a message switch subsystem, switches the failed subsystem off-line, switches a replacement subsystem on-line, resumes message processing without losing or garbling any messages, and notifies the operator of the failure. All of this takes place in from two to twenty seconds, depending on the nature of the failure and the subsystem involved. This switching of message switch subsystems is accomplished by means of a configuration switching array.

The configuration switching array permits the message processor to interconnect any subsystem with any other appropriate subsystem and to isolate a subsystem from the on-line system.

Preventive and corrective maintenance can be performed on equipment off-line, with no adverse effect on the operation of the center.

This functional interchangerbility permits continuous operation even in the event of subsystem failure, without 100 percent hardware redundancy.

The functional redundancy made possible by the configuration switching array permitted Philco-Ford to meet systems effectiveness requirements and at the same time achieve a considerable cost saving to the government.

The Automatic Digital Network is a direct outgrowth of federal action to integrate the communications of all the departments and agencies of the government. The goal was to reduce costs, increase efficiency, and better serve each department's needs.

At that time, multiple leased communications covered the same paths and routes, each used by different departments or agencies. Often, these were being used only a fraction of leased time. In addition, government-owned communications also covered the same paths.

These individual department networks each used methods and procedures which were not always compatible with the others. There was a definite need for integration.

The White House designated all the government-owned and leased communications as the National Communications System (NCS) and designated the Secretary of Defense as the executive agent of the NCS. The Secretary of Defense designated the Chief of the Defense Communication Agency (DCA) as the manager of the NCS. The manager and representatives from each department and agency, which operate substantial amounts of communications, were to work out integration problems.

By far the largest amount of communications owned or leased by the Government are under the Department of Defense. The long haul point-to-point communications of the three military departments (Army, Navy, and Air Force), whether owned or leased, are known as the Defense Communications System (DCS). The exceptions are tactical communications and the ship-to-shore communications of the Navy and the air-to-ground communications of the Air Force.

The Defense Communications Agency is the manager of DCS even though each element making up the DCS may be operated by one of the military departments. The DCA has set up a management system for control of these networks which depends upon reports from individual stations in the DCS. The DCS is made up of about 160 networks. (A network is defined as a group of circuits interconnecting stations to fulfill a purpose or mission common to these stations. The official definition of the term network is: "a group of stations capable of intercommunication not necessarily on the same channel.") For illustration purposes, DCS networks fall into two main categories: general purpose and special purpose. The general purpose network is often termed a "common-user" network in the military. The term common-user means that any military member, who has an official need, may send a message over this network.

The DCA is attempting to consolidate networks which have dedicated circuits into two networks to improve efficiency and still provide the equivalent in speed of service: AUTOVON for analog communications and AUTODIN for record communications. The AUTOVON is an Automatic Voice Network that serves DCS users with direct long distance dialing capabilities. Like AUTODIN, the network is to provide voice service to all posts, camps, stations and bases of the military services, and other governmental agencies. At present, the AUTOVON network switches exist only in the United States.

The second type, the special purpose network, is designed for a specific mission or purpose. These networks may be further categorized as functional networks or command and control networks.

The functional networks do not follow command lines, but serve the needs of all major commands or their subdivisions for a specific function. For instance, the Air Operations Network (AIROPNET) of the Air Force handles messages pertaining to aircraft movements.

The DOD Automatic Digital Network, designated by the acronym AUTODIN, is one of many networks which make up the Defense Communications System. The AUTODIN is a DCS general purpose (common-user) network designed to relay record (printed) traffic for the military services.

The stations of AUTODIN are divided into two functional categories: the tributary station and the relay or switching station. The tributary stations greatly outnumber the relay or switching stations in the network. They will number about 4000 in AUTODIN. They directly serve users (subscribers, customers). They perform a message acceptance and delivery (A/D) function for the users. Nearly every United States military camp, post, station, or base throughout the Free World has a tributary station.

The tributary generally receives hand-delivered messages in handwritten, typewritten, printed teletype, or card from originators of messages usually on the same camp, post, station, or base. They can also be received in magnetic tape or paper tape form, but these are presently uncommon. The messages can also be delivered to the tributary station over a local circuit between the tributary terminal and another location in the same local area. The messages received at the tributary A/D function from originators contain a mail type addressee for each addresser, a designation as to precedence, a security classification, and a text or body of the message.

The AUTODIN switches serve the tributaries under the operational control and management of the Defense Communications Agency. The Philco-Ford contract is to provide AUTODIN switches in 12 overseas areas plus a training facility at Ft. Monmouth, New Jersey. An AUTODIN switch location is called an Automatic Digital Message Switching Center (ADMSC).

The ADMSC is comprised of a technical control facility, power generating and distribution equipment, timing source and distribution, modems, cryptographic and cryptoancillary equipment, maintenance facilities, an automatic digital message switch (ADMS), the building, primary and emergency power, and environmental equipment.

Functionally, the ADMSC is composed of an aggregation of communications equipment, data processing equipment, monitoring, testing, patching and control equipment and consoles, and support equipment and personnel.

The primary function of the ADMSC is to provide store-and-forward message switching. It will handle both encrypted and unencrypted message traffic. The ADMSC will provide necessary monitoring, supervision, and control required to maintain continuous service.

The overriding responsibility of the switch is to maintain message security, accountability, and integrity.

The store-and-forward message switching is accomplished by the Automatic Digital Message Switch. In store-and-forward message switching, any input message on any circuit, when properly formatted, will be accepted, processed, and distributed to the designated addresses as soon as output circuits are available.

Each ADMSC is composed for four major elements: the communications element, the ADMS element, the uninterrupted power supply element and the programming element.

The communications element includes the technical control facilities and its related functions of station timing and signalling including their distribution; the line equipment which provides the interface between the ADMSC and other centers or tributaries and the DC battery distribution. It is the communications subsystem which provides an automatic interface with the AUTOVON to establish circuit connections to some tributaries and to other AUTODIN stations.

The Automatic Digital Message Switch is the heart of the center. It is composed of electronic digital equipment, employing primarily solid state components for receiving, processing, and transmitting on a store-and-forward basis various forms of printed communications traffic.

It performs the basic functions of message processing and switching. The basic module of the ADMS is a message processor (Philco Model 102 Processor) which, with its associated buffers and scanners, performs its functions of message handling, generation, and display of status, error analysis and automatic reconfiguration of equipments in response to equipment malfunctions.

The basic function of the ADMS is to accept, process, store, and deliver record message traffic containing heading, text, and ending in standard formats, performing code, modulation rate, and format conversion as required. In addition, the ADMS performs various bookkeeping and administrative functions to assure protection and security of message traffic and to provide operations and performance data for management evaluation.

The programming, of course, is the software necessary to carry on message processing,

provide alarms and indications to humans, reconfigure the system automatically, and provide status reports.

The power subsystem provides continuous power for sensitive loads and is designed so that a power failure will not cause loss of any message. Normally the system utilizes the primary power available through local facilities. Adequate uninterrupted power is provided to maintain operation from batteries for at least 15 minutes in the event of primary power failure.

The switching center operation must be compatible with tributaries of various types, other AUTODIN ADMSC, and other teletypewriter networks. It must be capable of automatic interoperation with AUTOVON tributaries and a future automatic digital circuit switch. The switch must provide for format and code conversion necessary for the exchange of traffic between devices utilizing a variety of transmission speeds and modes.

There are five modes of operation with which the switch must be compatible, at various speeds, in either synchronous or asynchronous operation:

1. Duplex operation with automatic error and channel controls allowing independent and simultaneous two-way transmission.

2. Duplex operation without automatic error and channel controls allowing independent and simultaneous two-way transmission.

3. Duplex operation with automatic error and channel controls, but utilizing only one-way data transmission.

4. Undirectional operation, send only or receive only, without automatic error control and channel coordination.

5. Teletypewriter control in a duplex operation with character framing detection and channel controls allowing independent and simultaneous two-way transmission.

Philco-Ford is providing two sizes of switches. The larger size terminates 200 lines. The smaller size switch is capable of terminating 100 lines. Four of the smaller size switches are to be provided under the contract. The training center at Ft. Monmouth will be typical of the overseas centers.

Physically, the communications area of the ADMSC consists of equipment to accept signals from communications lines and transmit signals to communications lines.

These input or output lines may connect to any medium of communications including landline, submarine cable, microwave, tropospheric scatter, inospheric scatter, satellite, and the like. The lines connect the ADMSC with other ADMSC or message relays and tributary stations directly or via other networks such as AUTOVON or a future automatic digital circuit switching network.

The communications equipment consists of distribution frames and patching bays, signal conversion equipment such as modems and high level DC to low level DC, and vice versa, converters, AUTOVON interface unit, link encryption and decryption equipments, the timing source (the chronometer), and consoles to monitor, test, control and coordinate communications performance and the provision of communications to the ADMS.

The modems and link encryption equipment are government furnished. All of the other equipment is to be furnished by Philco-Ford.

The console in the communications area is known as the station control console or, more commonly, the technical control console. There are two operating positions in a 200-line ADMSC and one console operating position in the 100-line ADMSC. A console consists of three cabinets and two teletypewriter sets. One cabinet is called a channel status display cabinet.

The channel status display cabinet provides visual and audible indications of the status of communications lines. The equipment consists of a master alarm panel, common alarm panel and system alarm panel. Sensors are provided along the signal path in the communications area and in the line termination buffers. When one of the sensors is activated, it causes the indicator to illuminate and flash in a red color and a uniquely audible alarm to activate.

The common line alarm panel shows which sensor or sensors caused the alarm. When the alarm condition has cleared, all alarm indications are extinguished.

The two other cabinets are known as the monitor test cabinets and house the channel selection mechanism, controls, and test equipment. A selection, by pushbuttons, can be made to connect a line to the monitor test cabinet and then to specific test or monitor equipment.

A teletypewriter set is used for outputs of status reports from the processor and input of information for status reports. The teletypewriter set is used for monitoring traffic or

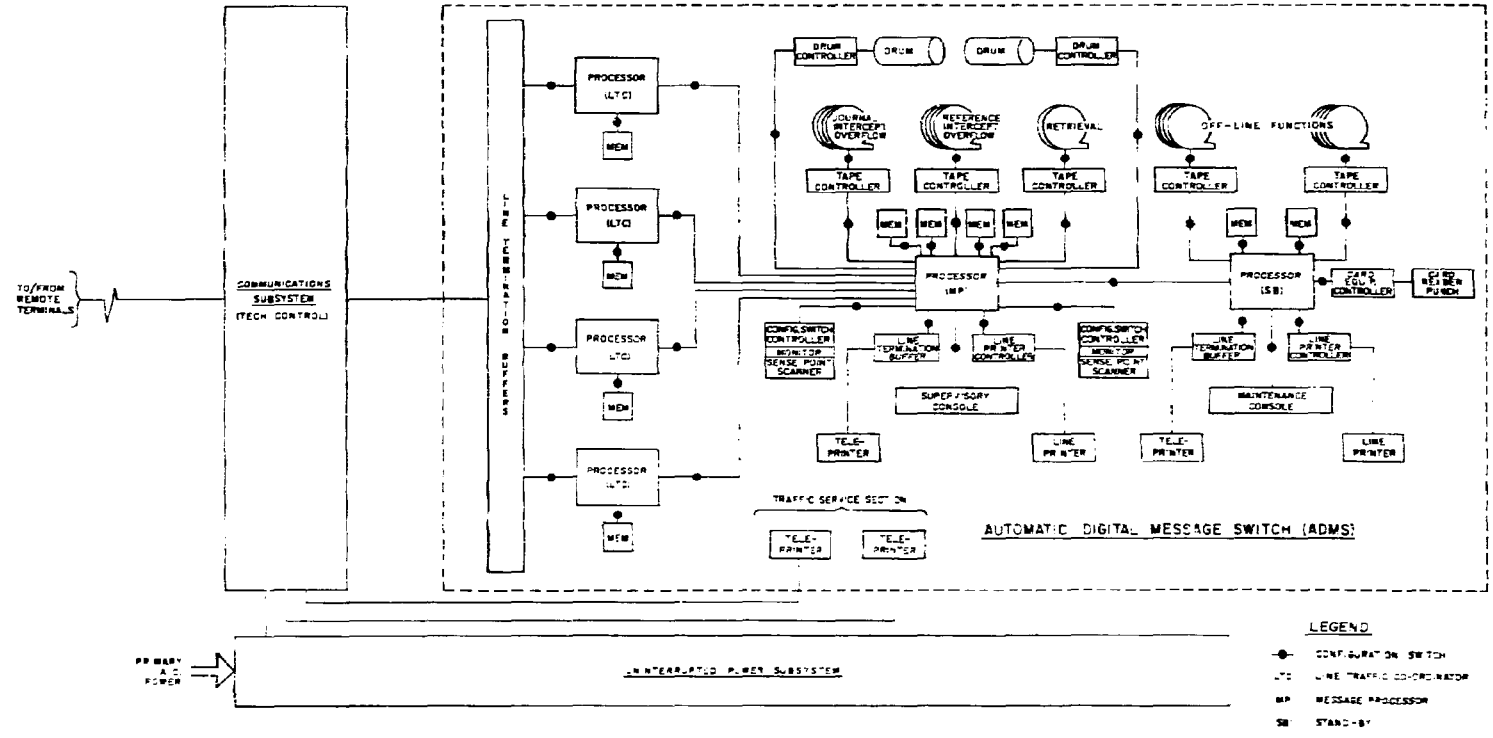

Figure 1 - Functional block diagram: 200-line AUTODIN automatic digital message switching center

signals and for coordination with distant-end stations.

Specifications for the ADMS did not dictate the equipments to be used except to specify solid state components for receiving, processing, and transmitting, on a store-and-forward basis, various forms of digital communications traffic. Modular construction techniques were to be used in the design and fabrication of the equipment to permit maximum performance, reliability and simplicity of operation and maintenance. The number of different types of modules was to be kept to a minimum.

The functional areas of the equipment were to be segmented so that redundant equipment or multiple modules required for operation are maintainable or replaceable without disrupting normal service. It must be possible to add, remove, or repair standby modules without interrupting service. Like units, assemblies, subassemblies, and replaceable parts must be physically and functionally interchangeable, without modification.

The Philco-Ford ADMS consists of processors, peripheral equipment such as magnetic drums, magnetic tapes, high speed printers, card reader and card punch, plus reconfiguration equipment, sensor scanning equipment and consoles for operation of the switch, network traffic handling and maintenance. This equipment in combination with programming software receives, processes, stores, and distributes the message traffic automatically to appropriate output lines. When difficulties are encountered by the automatic switch which are beyond the programmed capabilities, the switch automatically calls the condition to the attention of the supervisory console operator and/or prints out the message at the traffic service section teletypewriter.

There are six Philco 102 processors in a 200-line ADMS. They are interchangeable in the functions of line traffic coordinator, message processor, and standby processor. The interchangeability is accomplished by a reconfiguration switch.

Computing Centers

New 1108 UNIVAC Computer System
Rich Electronic Computer Center

Georgia Institute of Technology
Atlanta, Georgia 30332

The Georgia Institute of Technology has received approval to acquire a UNIVAC 1108-II System. Delivery was expected early in April, and the system was expected to be fully operational by about April 15th.

Acquisition of the $2.6 million UNIVAC 1108 provides Georgia Tech with a powerful third generation computing system. This will greatly enhance the computing facilities of Georgia Tech and those of the entire University System of Georgia as well. The UNIVAC 1108 will broaden the capability of the University System to perform work on research and service contracts. It will also insure Georgia Tech's immediate progress into broader sharing of time systems. It is noted that Georgia Tech is only the second university to obtain one of these powerful new systems. The University of Utah has the other 1108 System.

The UNIVAC 1108 System consists of the following:

- A Central Processor with 65,000 words of core memory
- Twelve input/output (I/O) channels connected to the Central Processor
- High performance drum storage capacity of 24 million characters, and Fastran mass storage capacity of 264 million characters, both under dual channel control
- Three 1004 reader/printer/punch devices for input/output, each served by one I/O channel (These 1004 devices have the capability of reading 700 cards per minute and printing 600 lines per minute)
- Two communication terminals, synchronous (CTS) with voice grade line adaptors and one CTS with a telephone broadband line adaptor
- One single channel tape controller with four high performance tape drives
- One high speed printer capable of printing 1100 lines per minute

The central processing unit for the 1108 will be installed on the second floor of the Rich Electronic Computer Center at Georgia Tech in space now occupied by another much smaller computer system.

Users of the new system will include Lockheed, UNIVAC, all academic departments of the school, all divisions of the experiment station, and government and industry.

IBM 360/50

University of Hawaii
Honolulu, Hawaii 96822

Development of a campus-wide computing network was announced at the University of Hawaii with the unveiling of a new IBM System/360.

Installed at the University's Statistical and Computing Center, the new computer, a Model 50, is the most powerful system in the state. It is being used in support of more than 600 research projects ranging from studies of tidal waves to linguistics.

Dr. W. Wesley Peterson, Acting Director of the Center, said the System/360 would permit the University to keep pace with the growing demands for computer time. "About 1400 faculty

and students are using the Center," he said, "and each day the Center processes more than 450 jobs, ranging in duration from a few minutes to several hours."

Presently, the System/360 is equipped with six IBM 2260 graphic display terminals. These table-top units have a typewriter-like keyboard to enter information into the System/360 and a cathode ray tube on which is displayed computer-stored information. The 2260s will be used by faculty, researchers and students for a wide variety of projects, including writing and editing computer programs.

It is anticipated terminals similar to this will be installed at the University's Hilo Campus, on Hawaii; the Hawaii Institute of Marine Biology, Coconut Island; the Kewalo Basin Research Facility; and several tidal wave research stations. Data gathered at these off-campus installations will be sent directly to the computer via the terminals.

Among the 600 projects presently being processed at the Computing Center are:

- Tsunami research, or the study of tidal waves. The tsunami is believed caused by suboceanic earthquakes or underwater landslides. But little is known about how tsunami travel through the mid-Pacific, or how to predict their height before they strike land. By using computers, oceanographers are constructing mathematical models or simulating different conditions. Some of these conditions are the location and intensity of the earthquake, and the configuration of the ocean bottom. If some way were found to predict the size of the wave when the seismic activity was detected, an accurate warning could be issued.
- High-energy nuclear physics. Results of experiments carried out at the University of California at Berkeley are analyzed at the University of Hawaii's Computing Center. As subatomic particles travel through a bubble chamber, their tracks are photographed from three directions. Each of these photos is reduced to a digital value and inserted into the computer for analysis. Formerly, each photo had to be analyzed separately but with the increased speed and large information storage capability of the System/360, nuclear researchers are provided with an immediate three dimensional analysis of the experiment.
- Meteorological and Oceanographic investigation. In combining these two sciences, researchers at the University of Hawaii are attempting to use the Computing Center to prepare atlases of the Indian Ocean. The study involves characteristics of the ocean floor, temperatures of water at various depths, direction and speed of currents, wind direction and velocity, air temperatures at various altitudes, and methods of weather forecasting.
- Linguistics. By using a computer, researchers are preparing lexicons or dictionaries of many polynesian and far eastern languages and dialects, many of which are undocumented. This study includes the translation of words and idiomatic phrases, and how they change with time.

In addition, the Computing Center is being used for studies in psychology, social sciences, political science, astronomy, biology, and virtually all departments on campus. It is also used for administrative and accounting functions including student registration, course scheduling, student records, payrolls, and fees.

Environmental Support for the Fleet

U.S. Fleet Numerical Weather Facility
Monterey, California 93940

POSTULATES FOR A SUPPORT SYSTEM

Environmental support agencies justify their existence by providing the products and services required by their users, when the users need them. This implies that the support must be complete, rapid, and accurate. If the reader would consider the set of all possible Naval operations, in particular, the minimum inference to be made would be that all environmental processes and phenomena must be specified in advance for a region extending from the ocean floor to near space. Further, the task must be completed as rapidly as resources permit. Perishability dictates the latter...common sense, the former.

The logical extension of this appraisal has led, at Fleet Numerical Weather Facility, to the

formulation of the following postulates for an effective environmental support system:

1. The environmental "data cycle" (observation, collection, process, analysis, prognosis, distribution, display) must be fully computerized.

2. The oceans and atmosphere must be treated as a coupled, hydrodynamic system.

3. An engineering approach to the environmental problem must be employed.

4. All research and development must be mission oriented.

FLEET NUMERICAL WEATHER FACILITY

Fleet Numerical Weather Facility (FNWF), located on the grounds of the Naval Postgraduate School, at Monterey, California, is the master computer center and controller of the Navy's Environmental Data Network (NEDN). It has been under the command of Captain Paul M. Wolff, USN, since its inception.

FNWF generates a rather complete set of the oceanographic and meteorological products and services required for worldwide Fleet support. At the same time, it develops and tests new computer techniques both in oceanography and meteorology. Its support for Fleet operations, in general, and for ASW operations, in particular, has led many users to refer to FNWF as the world's leading oceanographic forecasting center.

At this juncture, one pertinent question would be: Why is the operation at FNWF somewhat unique? Certainly, atmospheric and oceanographic prediction problems have been tackled before – in the universities, in governmental agencies, in industry. But only a few agencies are using computers to produce operational environmental products. And no other activity besides FNWF, to my knowledge, treats the atmosphere and oceans as a coupled hydrodynamic system with its complex mass-energy exchanges at the interface. It is essential that FNWF embrace this total environment concept because most Naval operations take place near this air-sea boundary. Without heat exchange and momentum exchange terms in the prediction models, realistic solutions might be precluded.

Secondly, all steps in the FNWF data cycle, from collection to display, are fully computerized. Computer technology is applied to environmental analysis and prediction problems on a large scale, and on a synoptic basis. The computers merely duplicate the steps a human specialist might take, if that specialist had unlimited time (and unusually good mental organization). In short, men simply cannot perform all the data quality control checks or make all the required computations for complete, timely support ... in the time allowed! Given unlimited time, moreover, it is still doubtful if the job could be done by hand ... without violating the physical laws of the environment.

Finally, FNWF uses theoretical models in combination with proven synoptic principles. The predictions are compared extensively with the observed features and their time variations. Since most mathematical models are truncated, in one degree or another, the remaining terms must be optimized so that the outputs resemble the real environment. In other words, it is an engineering approach.

THE NUMERICAL PHILOSOPHY

The availability of computer-produced environmental products of any desired form, scale, or projection, had led to what is termed the "numerical philosophy" of FNWF. Essentially, this philosophy is concerned with the effective use of system resources. The specialist in the field, in particular, must be resourceful by devoting his time, energy, and talent to matters of interpretation and judgement – to critical analysis and feedback. This is the correct role of today's environmentalist.

CONCEPT OF OPERATIONS

The Navy Environmental Data Network (NEDN) is the "cardiovascular" system of the Naval Weather Service. Numerical products, in the form of data fields, maps, messages, special plots, or listings, are relayed simultaneously to primary computer sites at the rate of 4,000 words per minute, error-free. At these sites, Fleet Numerical's products are tailored for specific user requirements. Figure 1 depicts the NEDN configuration.

Ultimate dissemination of products is accomplished via two paths: First, fleet units copy products transmitted on the Navy's radiofacsimile and radioteletype broadcasts. Second, activities ashore receive products on the recently-activated West Coast and East Coast Tie Lines, controlled by FWC Alameda and FWC Suitland, respectively. Each tieline station is equipped with automatic digital plotters and offline teletype playback equipment. See Figure 2.

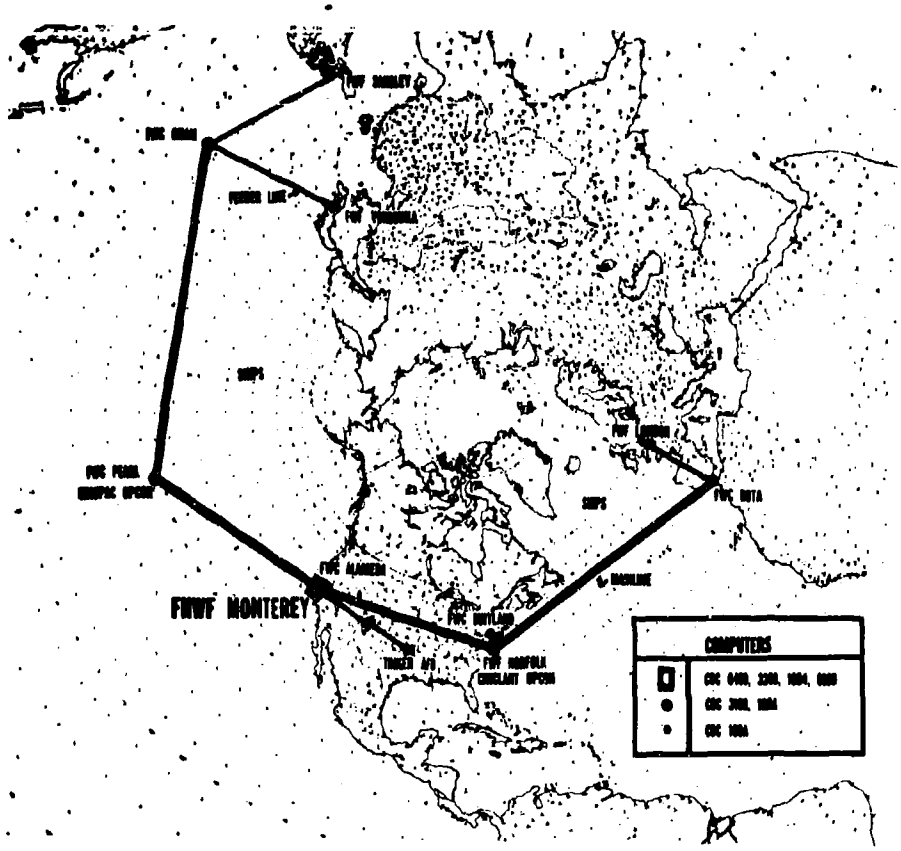

Figure 1 - Navy Environmental Data Network. Fleet numerical Weather Facility generates and transmits hemispheric scale maps and messages to primary computer sites at FWC Guam, FWC Pearl, FWC Rota, FWF Norfolk, simultaneously, on high speed data communications circuits. Products are tailored to use specifications on computers at these sites.

COMPUTER EQUIPMENT

The FNWF computer center houses five Control Data Corporation (CDC) computers at present. The CDC 1604B is used for hemispheric scale computations. There are two CDC 3200 computers: one for processing of raw data inputs and data filed outputs from the 1604, and one for research and development or communications (backup for the 3100). The recently-installed CDC 3100 is used for NEDN communications and utility programs. An 8090 computer is tied full-time to the Digital Automated Weather Network (DAWN), the circuit on which most of the meteorological observations are received.

The auxiliary storage for the 3200 systems is comprised of three Bryant drums, with total capacity of about 4 million 24-bit words. On the 1604 is tied an FH880 Univac drum system with about one million 48-bit word capacity.

In June 1967, FNWF received a CDC 6500 computer system. This has 2 central processing units and 10 peripheral processing units. Internal storage is 131K. External storage consists of two CDC 6603 disc packs with total capacity of 15 million words.

INTERIM SUMMARY

The Navy Environmental Data Network, with FNWF as master computer center, represents an advanced state of the art in the matter of complete, rapid environmental support for Fleet operations. This is possible because of the system postulates discussed earlier.

A complete list of environmental products and services will be described in a later article.

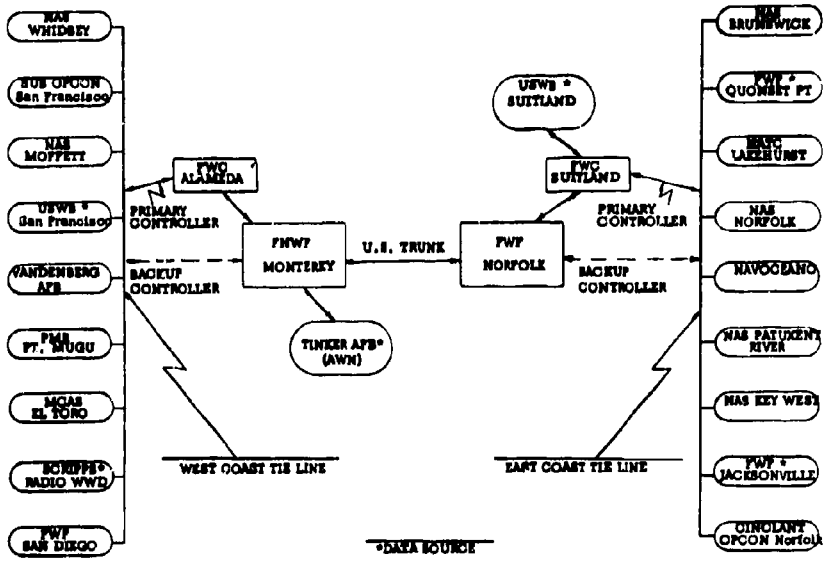

Figure 2 - NEDN Tieline Network. These activities are provided tailored, computer-produced oceanographic and meteorological products simultaneously. Each station is equipped with automatic digital plotters and offline teletype playback equipment.

Computers and Centers, Overseas

Combined Industry/University/Government Computer Software

English Electric-Leo-Marconi Computers Ltd.
London, SW1, England

Details were announced of a tripartite project between English Electric-Leo-Marconi Computers Ltd., the University of Edinburgh, and the Ministry of Technology to provide advanced software for the operation of the multiaccess System 4-75 computer ordered by the Edinburgh Regional Computing Centre.

This is the first time that a commercial organisation, a university, and a Government department have cooperated on a major computer project. The cost — estimated at approximately £350,000 over two and half years — is being shared by English Electric-Leo-Marconi and the Ministry of Technology. The Ministry, by placing a contract with the University of Edinburgh to the value of £195,000, is providing the financial support necessary to allow the University to participate in this work.

A major aim of the project is the provision of a sophisticated multiaccess computing facility and its exploitation in day-to-day use in the environment of a large Regional Computing Centre, fulfilling University research and teaching needs and serving local industry and research organisations. The jointly developed software will also be suitable for commercial use with a System 4-75 computer.

Twenty five programmers are working on the project, which was set up in the Department of Computer Science at the University of Edinburgh following the establishment of the Edinburgh Regional Computing Centre and the placing of an order with English Electric Leo Marconi for a System 4-75 multiaccess computer to equip it. The University has provided 11 programmers and the remainder has been seconded from the Systems Programming Department of English Electric Leo Marconi. The team has already been working at the University for 4 months.

English Electric-Leo-Marconi welcomes the project as a means of shortening the development time scale necessary for the provision of software for the System 4-75 multiaccess computer. By the early concentration of intensive effort and by cooperative action with the University of Edinburgh in bringing together a wealth of skills and experience, a sophisticated multiaccess facility will be provided in the shortest possible time. By working together in this way, the University and English Electric-Leo-Marconi will be making an outstanding contribution to the conservation of national programming resources.

INTERNATIONAL SOFTWARE CENTRE AT EDINBURGH

The University of Edinburgh views the project as a major research and development undertaking in the field of computer software. It will enable British staff to use a British multiaccess computer at a British University and will bring immense benefits to the national computer industry and further computer knowledge in Universities. With the establishment of a skilled programming staff having experience in multiaccess software, Edinburgh is expected to become a major international centre for research and development into programs for computer systems.

The purpose of the present project is to construct the basic multiaccess software structure for the System 4-75 computer. Items of standard System 4 software will be used, where appropriate, in conjunction with this specialised software. In particular, System 4-70 operating system facilities for multiprogramming, batch processing and program development will be able to coexist, and be used without major functional change, within the special operating environment of the multiaccess system. English Electric-Leo-Marconi standard conventions and terminology for software are to be followed in the interests of compatibility and PERT and related management facilities for monitoring the progress of the project will be provided.

The completion of the project will enable the University of Edinburgh to pursue a planned

sequence of research into conversational programming, console languages, program debugging systems, computer aided design, specialist problem orientated languages and future computer system structures.

MULTIACCESS COMPUTER IN 1968

The multiaccess computer will be delivered to the Edinburgh Regional Computing Centre in the summer of 1968. Initially it will be in the form of a System 4-70 computer, and additional equipment will be delivered later in the year to provide multiaccess facilities.

The number of scientists and other users who will have simultaneous access to the computer will gradually build up to over 200. Access to the computer will be by remote terminals located in offices throughout Edinburgh and as far away as Aberdeen. Each will have full and immediate use of the machine, which will also be capable of accepting and running programs for standard production work initiated within the Regional Centre. It is expected that 3000 undergraduates will be among the users of the system.

The multiaccess facility makes use of a technique known as "paging" in which the addressing unit selects the pages of the programs which are most used by the computer subscribers and ensures that they are available for instant use. The less frequently used pages of each program are held in the computer back-up store and can be brought into use in one sixtieth of a second.

As an interim measure, the Edinburgh Regional Computing Centre is renting an English Electric-Leo-Marconi KDF 9 computer until the System 4-75 machine is available. It was installed in November, 1966 and has been operating for 14 hours per day since the beginning of the year. Use of the KDF 9 computer has enabled the Centre to offer immediately a service to University users and research workers in local Research Institutes and Units, in particular those administered by the Agricultural Research Council.

Commercial and industrial users will be encouraged to approach the Edinburgh Regional Computing Centre for facilities on the KDF 9 computer and to facilitate this, a number of applications programs produced by the Bureau Division of English Electric-Leo-Marconi will be made available to the Centre.

Computerized Crime Prevention

International Computers and Tabulators Limited
London, SW15, England

The police force in Dorset, in conjunction with the computer staff of the County Treasurer's Department, has devised a computer scheme to help with crime prevention and detection in the country. The scheme represents the most determined attempt yet by any force to use the power of a computer in the fight against crime. It was brought into operation during January 1967 and makes use of the County Council's Data Processing Department, which has a newly installed I.C.T. 1902 computer.

In January 1965, Dorset Constabulary became the first police force in the country to use a computer to establish trends and patterns of criminal offences and redeploy patrols accordingly. A limited scheme was used, based upon detailed crime statistics, prepared very rapidly by the Council's previous computer – an I.C.T. 1301. But the new scheme, built upon the experience gained in 1965 and 1966, classifies and presents the necessary information in a form that can be readily interpreted and used by senior officers. The computer will show in map form precisely where and when crimes which are preventable and detectable by patrols have occurred. These same maps will show the disposition of patrols at corresponding times of the day. It should then be possible to make appropriate and timely adjustments to patrol routes to cover the pattern of crime. Subsequently the effect of this redeployment of personnel, both as a deterrent and a detection aid, can readily be assessed.

It is the speed and accuracy of the computer in assembling, sorting, and analysing masses of facts that makes such a system possible. At present, for each crime committed in Dorset, a detailed statistics sheet is completed in less than a minute by the investigating officer. This includes all major – and many minor – characteristics of the offence. For example, information about a break-in indicates which of 40 or so different methods of entry was used, and even classifies in detail the type of property stolen. From the completed statistics sheet, a card is punched. At the end of the month, punched cards for all newly committed (strictly newly reported) crimes are read by the computer, which juggles

the mass of facts and figures to produce detailed analyses. Output tabulations printed automatically by the computer show crimes by area, time of the day, day of the week, type and so on. From information presented in this form, Dorset police have, over the past two years, been able to recognise the more obvious criminal patterns, while at the same time preparing all statistics required by the Home Office.

With the output from the I.C.T. 1902 computer presented in a direct graphical form, and crimes indicated as a mark on a map, even the slightest trends should be instantly detectable. Maps are prepared by area, time of day, and day of week. It is, for example, possible for the computer to mark the locations to within a few hundred yards of all crimes committed in the town of Poole between sunrise and noon on a Monday. Direct comparison is then possible with known patrol distributions.

Although an enormous number of factors influence the crime rate in various parts of the country, it is interesting that while the provisional 1966 crime figures for England and Wales show substantial increases over 1965, Dorset and its computer can boast a 2 percent reduction in crime, coupled with a 10 percent increase in detections. A similar system operates with regard to traffic accidents and the deployment of motor patrols. This has revealed a striking similarity in accident pattern by time, day, and location from week to week and year to year. Detective Superintendent H. Green, head of Dorset's C.I.D., who has been working on this project, has been awarded a 1967 Winston Churchill Travelling Fellowship to enable him to spend six months in the United States studying the use of computers for crime prevention and detection.

European Datel System

The Marconi Company Limited
Chelmsford, Essex, England

An international data communications system, the first of its type in Europe, is being supplied by The Marconi Company to Esso Europe, Inc. and its affiliates in Europe. Initially it will interconnect Britain, France, Germany, Holland, and Denmark in a scheme which will dramatically speed the flow of data from one country to another.

The order is the first to make widespread use of the international Datel service, which is gradually being extended, by the use of STD, throughout Europe (see Fig. 1). Marconi's equipment will enable Esso Headquarters in five countries to exchange information with great accuracy at speeds in excess of ten times that of the normal telex service. It is anticipated that eventually additional terminals will be sited at key locations in Belgium and Italy.

John R. Farrar, Marconi's Chief of Data Sales, looks forward to a time when there is a world-wide network of the data transfer links like the Esso system. "The Marconi system, operated in conjunction with the Datel service, provides the answer to the problems of international data communications. Whether Britain joins the Common Market or not, we anticipate a large number of sales to the large industrial organisations and other bodies with important associates overseas."

"We have now reached the stage when, by an ordinary telephone call, large volumes of data can be transmitted between two countries. This new tool for business and commerce has a vast potential considering the numbers and types of business machines and computers which can now be interconnected internationally. The next step could be the rapid development of global data links, via communication satellites."

The equipment which is being supplied, is one of the latest in a range of special data transfer systems which have been designed by The Marconi Company and which is collectively known as "Marconidata." In particular, the type H.6010, which has been ordered by Esso, has been specifically designed to handle all type of digital data, including computer traffic. The data is stored momentarily by the Marconidata terminal, prior to being fed into a computer at a rate of 50,000 characters per second, thereby reducing computer interrupt time to a minimum.

The Marconidata equipment has one other important function; it completely eliminates any errors caused by interference with the telephone circuit. Accurate transmission is ensured by a highly effective method of "parity" coding which prevents errors being reproduced. Not more than one error in 10,000,000 ever goes undetected. Data flow from one country to a computer in another country can be achieved faultlessly, utilising the minimum of computer time.

The Esso scheme initially involves the installation of transmit/receive terminals at

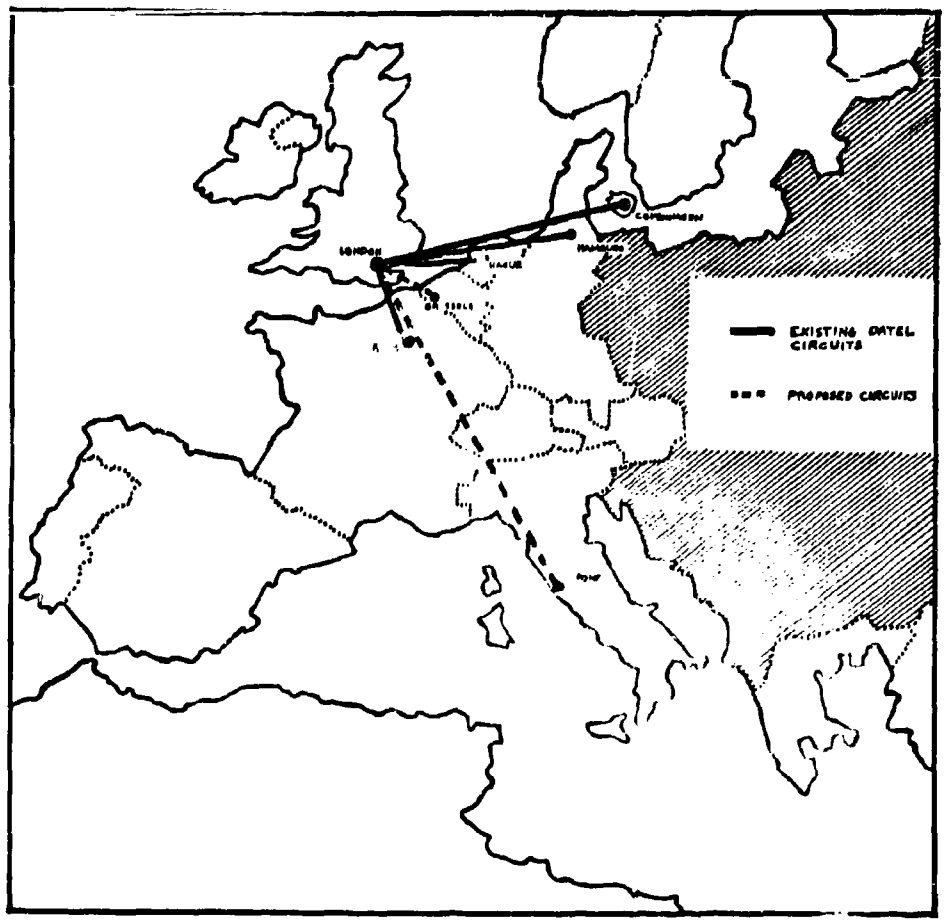

Figure 1 - European Datel circuits

London, Copenhagen, Hamburg, The Hague, and Paris, with later extensions to Brussels and Rome. Such a major hook up has been greatly improved by the opening of Datel over the STD telephone dialing service between Britain and some continental countries.

The introduction of STD into Britain has enabled industrial and commercial organisations to transmit data to subsidiaries throughout the U.K. Marconidata is already installed in a variety of data transfer systems currently in operation.

The original Marconidata system was first introduced some two years ago to provide facilities for passing medium speed data over normal telephone circuits. With the new system, paper tape produced by all types of business machines and conventional communications equipment can be fed into the terminals and faithfully reproduced at the receiving station in its original form or fed directly into a computer on-line without the need for human intervention. This system effectively brings computing facilities directly to a number of remote stations via ordinary telephone circuits.

This equipment is now in full production in the Marconi factories. Further developments will permit the use of a wider variety of remote input-output devices.

Meteorology Computer Use

Commonwealth Bureau of Meteorology
Melbourne, Australia

Weather information of vital importance to Australia's primary industries, airlines, shipping, tourism, and the private citizen, will soon be processed here by a new and powerful twin computer centre.

The Commonwealth Bureau of Meteorology will install the central computing facility in Melbourne, where a large IBM computer complex costing approximately $4 million will be linked by a communications system with meteorological data sources and information users throughout Australia and overseas.

The new centre will play an important role in the World Weather Watch, planned by the World Meteorological Organization in response to a request of the United Nations General Assembly. It will have the responsibilities of a World Weather Centre, together with similar centres in Washington and Moscow, exchanging global weather data and charts.

To help Australia's weathermen in local weather forecasting, the computers will process, round the clock, data from nearly 1,000 surface reporting stations supplying meteorological observations gathered in the Australian Area, the Southern Hemisphere, and the Tropical Region.

Using this data, the computer centre will assist in issuing forecasts – including warnings of weather conditions likely to endanger life and property – plot weather charts, compile lists of selected observations, carry out statistical processing and research calculations including mathematical modelling, and generally apply the latest principles of electronic data processing to the Bureau's principal functions.

Electronic Equipment in the centre will include two identical IBM System/360 Models 65 central processors with high speed printers, and magnetic disk drives capable of storing and updating vast quantities of weather data.

The peripheral equipment will also include magnetic tape units, visual display stations with television-like screens capable of retrieving and flashing in seconds, tabulated weather data.

Graphic plotting equipment linked to the central processor will automatically plot weather charts showing the movement of weather patterns over Australia and adjacent geographic areas.

During normal operation one Model 65 processor will extract and analyse meteorological data and carry out prognosis on a real time basis – that is, simultaneously with the arrival of data via communications lines. It will operate day and night.

The second Model 65 will be available for research, development, and generally the center's nonroutine tasks, while providing full back up to the first central processor.

The complete computing and communications system will not become operational for some time to come. It will be installed in two phases over a number of years.

Installation of the initial phase will begin in early 1968 with the arrival of the first Model 65 and peripheral equipment required to operate the computer in conjunction with the Bureau's existing system of communications.

This includes a complex of telegraph services to relay meteorological data to the Central Office, Regional Offices in State Capitals and Darwin, and Meteorological Stations, such as seaports and airports. From the Central Office in Melbourne, analysed data are distributed over a nationwide facsimile network.

In Phase 1 of the installation, the Bureau's systems analyst and programmers will develop and test the necessary programs and procedures for off-line use of the computers.

Installation of the second phase is expected to begin towards the end of 1968 and will comprise the second Model 65 and additional peripheral equipment.

During Phase 2 the Bureau will put into practice the procedures developed in Phase 1, while continuing further development work towards the ultimate system to be linked on-line with communications.

Meanwhile, the Bureau is expected to invite tenders for an advanced communications system capable of linking the computers in Melbourne, on-line with data source and information users throughout Australia.

The Australian Bureau of Meteorology and overseas services already have introduced a measure of automation into weather monitoring

and forecasting. In the last few years, however, the pace of research and development in the environmental sciences has considerably quickened. The present state of the art of applying computers and communications in meteorology represents only a beginning.

The World Weather Watch, as planned by the World Meteorological Organization in response to a resolution of the United Nations General Assembly, highlights the growing worldwide interest in improving communications between centres of meteorology and developing new techniques of prognosis on a global scale.

The three centres of the World Weather Watch in Melbourne, Washington and Moscow will become focal points in the drive for better understanding of local weather in terms of global weather patterns.

The World Weather Watch will comprise three distinct systems: the global observational system, the global data processing system, and the global telecommunications system, which are very closely interrelated.

One purpose of the World Weather Watch is to enable countries to obtain data which they cannot get under the existing world system. The requirements for processed data are taken into account to specify the output requirements of the global observational system. This system must therefore provide for the individual data requirements of Meteorological Services and also for the data requirements of the global data processing system.

With the announcement of a large dual computer system for its Melbourne based centre, the Australian Bureau of Meteorology and IBM Australia will cooperate in the extensive pioneering which lies ahead in creating the computer programs and systems necessary to apply the new computers, in the first instance, to local weather operations, and later to weather analyses and prognoses on a global scale for the ultimate users of the World Weather Watch, the National Meteorological Services of the world.

Miscellaneous

Project GENIE
University of California
Berkeley, California 94720

Man-computer interaction is the subject of a research project started in 1962 by Prof. H.D. Huskey and others and supported by the Advanced Research Projects Agency (ARPA) of the Department of Defense. Carnegie Institute of Technology, MIT, and Stanford University have similar contracts devoted to the field of computer applications. The Berkeley program, known locally as the "ARPA project," but more widely throughout the nation as the "Berkeley Time-Sharing System," was christened Project Genie some two years ago before the direction of its research was completely fixed. Now it involves about thirty-five people, including Profs. Gary Hornbuckle, H. D. Huskey, Butler Lampson, W. W. Lichtenberger, P. L. Morton, and M. W. Flirtle, working with an overall investment that so far totals almost $2 million.

"Conversational" use of computers, in which the machine responds at once to each instruction presented by the user at the input console, is not new. Early computers were frequently used in that way, especially during preparation of programs and exploration of new techniques. But larger, more expensive, and faster machines forced a change to "batch processing." The Berkeley Computer Center, for example, may process a thousand separate jobs in a day with most of them occupying less than a minute of macine time each. Because it is so difficult to write a perfect program at the first attempt, the time required for complete solution usually includes several runs, interspersed with periods of "debugging" and refinement of the program. Thus the "turn-around time," rather than the time used for computing by the machine, usually fixes the total time required for problem solution, and in a busy center those problems which require direct human intervention may be completely impractical.

The college scheduling problem, with an enormous mass of information about courses and hours, classrooms available and instructor teaching preferences, student schedules and required courses, curricular changes and last-minute enrollments, is typical of problems that still cannot be solved without human intervention. If all this information is fed into the machine even with an ingenious program, the usual result is that no feasible solution appears. Present-day computers must then dump the partial solutions, and hours of study may be required before the nature of the difficulty is recognized and some change in the input data is proposed (such as canceling sections with zero enrollment and, offering others at more convenient hours). If the schedule officer can examine key portions of the machine solution before the dump, then suggest alternatives and restart computation immediately, a feasible solution may be found with a few hours — for example, before the end of the registration period and the start of classes.

Many other examples of "conversational" use of machines have been proposed, often for purposes of engineering design or architectural sketching, where experience and judgment rather than merely mathematical algorithms must be applied to large bodies of information and data. Because modern computers work so enormously fast compared with the response time of the human user, the notion of time sharing, with many users served simultaneously by one expensive, but very capable, machine has evolved to bring the human expert back into the solution process at the most useful time.

Most of the effort in the ARPA project has been devoted to the development of the extensive and flexible Berkeley-Time-Sharing System. As it now runs in Cory Hall it can handle up to 16 remote terminals. Some of these terminals are connected to teletypewriters by telephone lines, but others are connected to increasingly capable graphic consoles with cathode-ray-tube displays. Improvement of the system is leading more and more to its use by project members for attacks on new problems of man-machine interaction. Among the most interesting are the new "languages" in which instructions may be written; the different terminals may each use a different language, or several may share a "library" program without interference. Inactive (or sleepy?) users get "swapped" out of the system's active memory in microseconds,

but obtain sensibly instantaneous response when next they present an instruction or a query.

A striking compliment to the efforts of the project members appears in recent advertising of Scientific Data Systems Corp., which is marketing systems patterned after the one developed here. Few federally sponsored university projects lead so quickly to improvement of the products available to the public on the open market, and thus justify the federal support of engineering research.

Successful as it has been, however, the project finds itself still far from the ultimate goal suggested by Prof. Lichtenberger, who would place "really good computation, conveniently operated and without any artificial or unnecessary restrictions, in the hands of every user with an important need."

Shipboard Computer Control Programs

Cornell Aeronautical Laboratory, Inc.
Buffalo, New York 14221

A computer technique developed by Cornell Aeronautical Laboratory for shipboard computers of the U.S. Navy will automatically design computer programs for optimally controlling the varied, complex equipment on modern naval ships. Skilled computer engineers have previously been required to design and program such functions.

CAL's design technique, developed for the Naval Ship Systems Command, enables an engineer or technician to specify in simple terms the characteristics of the ship's system equipment to be controlled as well as measure of performance. A large scale computer program using the information then automatically proceeds to design the digital controller so that optimum performance is achieved. Many ships are now equipped with computers in order to get the best performance from complex equipment.

Aboard each Navy ship are numerous power machinery systems which must be controlled. Conventional control devices, such as analog computers, are limited because of their inflexibility to change and the consequent restrictions on possible control designs.

The advent of the digital computer has opened new avenues of approach to the control of such devices as ships' rudders, ships' guns, fire control systems, and other shipboard machinery.

The technique is considered by CAL to have broad applications in modern control systems design. The effectiveness of the automatic design now permits the engineer to design systems efficiently and expeditiously so that many designs can be considered and the best candidate system from a broad class of systems can be chosen for actual use.

An automatic controller designer is actually a large compiling program which can automatically develop optimum control programs. These programs can be used in existing Navy digital computers for controlling a unit of the ship's equipment.

Dr. Stephen Hoppe of CAL's Computer Research Department, the principal investigator of the automatic design project, has completed a prototype digital controller synthesizer which is useful for a broad class of control systems.

Automatic design is accomplished through three distinct program phases. The first phase is that of converting simple problem descriptions provided by the engineer into a form more readily used by the computer. The second phase proceeds to the design of alternative candidate digital controllers and produces the digital control programs which can be used in the control computer. Automatic evaluation of the designs is performed by the third phase, which provides the engineer with a graphical description of what performance he can expect from the control system.

Other areas of Cornell Lab's research for the Naval Ship Systems Command during the past several years include the development of schemes for tracking hostile aircraft, development of a technique for directing interceptor aircraft against their targets, the evaluation of targets, and the evaluation of target threat from available information. The most recent series of studies has dealt with the problem of control and direction of shipboard equipment solely by digital computers.

Computerized Crime Information

Dade Country Public Safety Department
Miami, Florida 33132

All law enforcement officers throughout Dade County can ask a centrally located computer for vital crime information and get answers in seconds as a result of new equipment unveiled in May 1967.

While newspaper, radio, and TV representatives in the Dade County Public Safety Department Building watched, a teletypewriter fed inquiries by wire to the Dade County Courthouse and into an IBM System/360 computer. The machine will serve as the information storehouse of Florida's first computer-operated police information network.

In less than a minute, the computer fed back answers officers will need in identifying drivers, automobiles, and license plates connected with law violations. Classes of information will be broadened, it was pointed out.

Dean Claussen, chairman of the Central Communications and Records Sub-Committee of Dade County, which began work on the project 10 months previous, described the new police information system as "the product of excellent cooperation between local municipalities and the county."

Pointing out the computer-based network will provide many benefits including saving of time for officers who formerly had to wait for files to be searched, Claussen, a Miami Shores councilman, said, "Law enforcement men will get their information 10 times faster than ever before.

"This not only will result in more solutions of crimes through rapid identification of suspects and evidence, but, also, officers can apply more of their time to crime prevention and law enforcement."

An interlocking system of teletype and radio communications among a number of police departments in Dade County will enable all municipal and Metro officers to secure answers from the central computer, Ben Demby, City of Miami Director of Communications, explained in demonstrating the equipment at the press conference.

The City of Miami Communications Center and Dade County Public Safety Department will act as collecting terminals, passing inquiries by telephone line connections into the computer central.

When it receives a request, the computer automatically searches its electronic files for information, compiles an answer, sends it back to the terminal and prints it on an IBM 1050 typewriter. The typewritten message is then radioed back to the requesting officer.

E. Wilson Purdy, Director of Dade County Public Safety Department, said the computer already has data on 670,000 local vehicles including owners' names, vehicle descriptions, and identification numbers.

"Once the computer's files are completely loaded," Purdy stated, "we expect the speed of the system in many instances will enable police to apprehend criminals before they have a chance to get away from the scene of the crime."

Dade's public safety director explained the computer's files, which can store about 400 million characters of information, will be fully utilized to hold data on stolen autos and license plates, warrants, stolen property and guns, and wanted criminals.

The new system eventually will be tied through communications lines into the Federal Bureau of Investigation IBM System/360 computer at the recently established National Crime Information Center, Washington, D.C.

The central computer in the courthouse will be performing other county work at the same time it is operating the new crime information network. The machine is capable of performing several data processing jobs simultaneously.

Types of work being performed include payrolls, tax collections and bill statistics, and other accounting work.

The Central Communications and Records Sub-Committee includes Dean R. Claussen, Miami Shores, chairman; Metro Commissioner Harold A. Greene; Ben Demby, Director of Communications, City of Miami; Earl Schroeder, Director of Data Processing, Dade County; Charles Zmuda, Chief of Central Services, Dade County; Captain R. J. Crittenden, Coral Gables Police Dept; Captain Jesse Webb, Miami Beach Police Dept; Captain L. D. Leggett, Hialeah Police Dept; David Walker, Southern Bell Telephone and Telegraph Co.; and Paul Stockelman, IBM Corp.

The sub-committee has operated as part of the Joint Liaison Committee representing Metropolitan Dade County government and Dade municipalities.

Other members comprising the joint liaison committee include Metro Commissioners R. Hardy Matheson and Earl M. Starnes; Arthur M. Snyder, former mayor of North Miami Beach; Mayor Clyde M. Taylor of South Miami; Miami Vice Mayor Stephen P. Clark; Thomas C. Britton, County Attorney; and Allen Clements, Jr. and Russ Marchner, representing Dade League of Municipalities.

Computerized Tax Records

Hennepin County
Minneapolis, Minnesota 55415

In 1967 Hennepin County installed a new computer designed for high speed handling of records and better service to the taxpayers of Minnesota's largest county.

The IBM System/360 Model 30 will centralize the county's record keeping program and provide a far greater degree of fiscal control to save taxpayers' dollars and county employees' time.

It was one of the first few county governments in the nation to install this system.

Robert P. Janes, County Board Chairman, says the installation of the new computer "will permit us to combine the data processing tasks of the auditor, treasurer, and assessor in an up-to-the-minute tax accounting information system."

Preparing tax reports is the computer's pilot project. It will electronically program and process tax statements from direct inquiries and information previously handled manually, and with more speed and accuracy than ever before.

"Data on each parcel of land in the county will be electronically stored in the computer and updated as the county and town assessors report changes," Janes explains. "Having been fed this information, the System/360 will generate tax statements and supporting registers for the auditor and treasurer.

"Six special, television-like terminals will be installed in the offices of the auditor and treasurer. By using display stations, personnel will be able to call out of storage information about a parcel of land and update it, read it for information, or prepare reports from it.

"As questions occur, answers will be available instantly at both county and local levels. Assessors in each city now keep books identical to those here in the courthouse. With a terminal in his office, the local assessor won't have to keep manual records."

Other department heads will assign new jobs to the System/360 as the workload increases. Programming and planning phases are already under way to meet a January 1969 target date for completion of the centralized system.

At that time, these departments will make inquiries through a kind of typewriter and will receive near-instantaneous answers on a television screen. Telephone lines link the typewriter-television screen to the computer so communication and response are almost immediate.

In addition to the new tax information system, the county's new computer is currently handling accounting for the General Hospital, Municipal Court, District Court, and the Welfare department.

Dale G. Folstad, Data Processing director, says, "We are considering a control program for the 1.5 million books in the thirteen Minneapolis and 22 county library branches. The computer could handle circulation, book ordering, shelf lists, delinquency reporting, indexing, and book labeling.

"We hope to provide better service to taxpayers at less cost. One person can operate the System/360, but we will assign new tasks to the employees now recording information manually as the volume of work increases."

PLATO
Coordinated Sciences Laboratory

University of Illinois
Urbana, Illinois 61801

INTRODUCTION

The Coordinated Science Laboratory has been deeply involved for the past several years in the development of a computer-based education system* – the PLATO system (see DCN, July 1966). In the early phases of this project, the major effort was in the development of a research system and its implementation into classroom use. In its present form, the system consists of a CDC 1604 computer and a classroom of twenty student stations. With the completion of this system, the attention of the group has properly turned to a more intensive study of the educational aspects of the system with particular emphasis on the development of a large scale computer-based educational system.

In recognition of the importance of this large-scale concept to the future developments for the University of Illinois, and more broadly for the region and nation, the University has organized the Computer-based Education Research Laboratory (CERL) under the direction of Dr. Louis D. Volpp. This Laboratory has assumed responsibility for directing the program and for determining the nature and magnitude of the next engineering system that will be developed. Many of the staff associated with the PLATO project in the Coordinated Science Laboratory are now continuing their work in the new Laboratory, some on a part-time basis and others, full-time. The two laboratories will retain a close working relationship and will continue to develop programs of mutual interest.

PLATO SYSTEM EQUIPMENT

PLATO III Equipment

Work has continued in the development of circuitry that would update or provide special capabilities for a twenty-station, computer-based teaching system.

Circuitry for the elimination of spurious writing caused by storage-tube grid emission has been installed and checked out for all student-station equipment. Circuitry for the elimination of ion-spot formation and for more effective total erasure is being considered. It is expected that experimental circuitry to provide for better erasure and less ion-spot degradation will be operable by the end of the coming semi-annual period.

Equipment for the generation of 16-mm film frames via cathode-ray tube has been completed. Checkout is not complete in that solutions to problems regarding alignment of CRT raster and film-exposure times have not been completely solved. Solutions are straightforward and will be achieved through several trial runs to be conducted in the near future.

A special keyset featuring codeable keys and flexible key formating has been constructed and checked out. An additional keyboard to be used in conjunction with the special keyset is being considered by its principal user.

PLATO IV EQUIPMENT

Student Terminals

Preliminary work has been started on the development of a prototype of the student terminal to be used in the PLATO IV system.

A block diagram of the proposed terminal is shown in Fig. 1. For a display, the terminal will contain a plasma display panel now under development by D. L. Bitzer and H. G. Slottow. The panel will be approximately 14 inches square and contain 512 positions along each axis.

A digitally addressable slide projector permits prestored textbook information to be projected on the display panel. The slide projector has a proposed capacity of 500 or more slides, all addressable by the computer.

All data arriving from the central computer enter the terminal through the input register. Data rates, both into and out of the terminal will be held to 1200 bps to permit data transmission over voice-grade telephone circuits. Assuming a word length of 20 bits, the terminal will receive data at about 60 words per second. With proper data-word formats this will provide adequate data rates to handle most applications. For example, packing three characters per word allows a character writing rate

*This work was supported in part of the Advanced Research Projects Agency through the Office of Naval Research under Contract Nonr-3985(08), by the Office of Education under Contract No. O[illegible]-6-10-184, and by the Mercy Hospital School of Nursing.

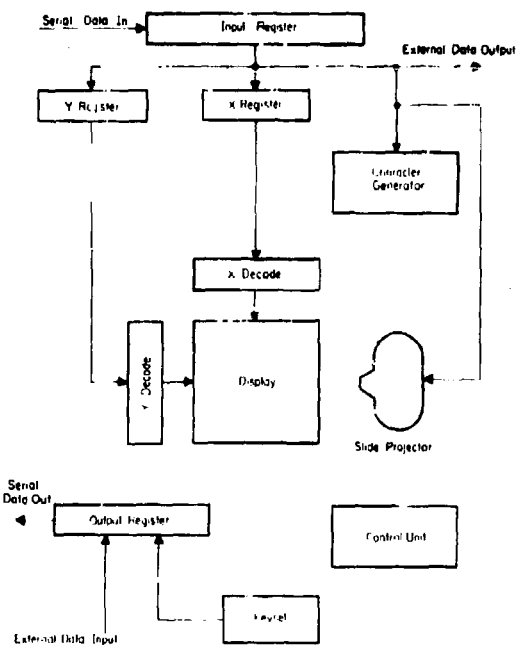

Figure 1 - Proposed PLATO IV terminal

of 180 characters per second, which is about 18 to 20 times faster than most teletypewriters.

From the input register, data may be transferred to the x and y registers for display; to the character generator to select characters; to the slide projector to select a slide; or to an external device connected to the terminal (such as an audio storage unit).

The character generator will contain 256 characters of which 128 are permanently installed with the remaining 128 being interchangeable. The interchangeable set of characters may contain foreign-language alphabets or other special symbols as may be required.

The keyset provides the terminal operator with a means of communicating with the central computer. Data from the keyset is entered in the output register and transferred serially to the computer. An external input to the output register is provided to allow external equipment at the terminal to transmit data to the computer.

The control unit directs the operation of the entire terminal and supervises the flow of data in and out of the terminal.

It is planned to have the vast majority of these terminals operating in some form of dedicated telephone network within the University. To permit isolated use of a terminal such as in a private home, however, an acoustical coupler will be provided to connect the terminal to an ordinary telephone receiver.

Audio Capability

The study of audio storage continues. Of various systems contemplated to date, one employing magnetic-oxide coated discs is considered the most appropriate for the specifications of the system and the resources of the laboratory. Experimental apparatus is being devised and constructed for the evaluation of basic ideas involved in the disc scheme. It is expected that a judgment as to the feasibility of the disc scheme will be realized by the end of the coming period.

BEHAVIORAL SCIENCE PROJECTS

Learning and Retention of Verbal Materials

A PLATO program PAVLEW, was revised and completed early in 1967. It provides a means of running verbal learning experiments on many subjects simultaneously under a variety of procedural, timing, and material conditions. The program includes its own response recording (doping) in binary form. Improvements were also made on program RAWDATA, which analyzes the PAVLEW responses.

Two experiments are currently in progress. The first is concerned with a demonstration that subjects' idiosyncratic mediations have played a determining role in confounding the results of experiments in testing important variables relating to the interference theory of forgetting. The second is an attempt to demonstrate the effectiveness of a measure of idiosyncratic mnemonic probability to predict retention. W. E. Montague and H. Kiess have developed a measure of Associability which, for a pair of consonant-vowel-consonant items, is the proportion of subjects able to generate a mediator for the pair. The study attempts to determine the functional relationship between Associability and Recall.

Research on Attention Control

The PLATO system is being used in an experiment to determine whether a response contingency affects the amount of time a student spends learning and the amount of material he tries to master. In order to test the hypothesis,

students are being exposed to different types of lesson material. In one session, some of the material on which they are tested is highly predictable and the other material on which they are tested is not predictable. Two trial runs with twenty students each were made in December.

Group Interaction

Programming and planning for group-interaction studies continued throughout the year. An inter-nation simulation in cooperation with Dr. Harold Guetzkow of Northwestern University has been prepared and tested in March and April 1967. A basic computer program permits the participants to read, write, send, and receive information used in the group negotiations. The sending and receiving are controlled by communication rules which help define the roles of the decision makers. Using this facility, they plan to study principles of negotiation and train students in negotiating techniques.

Interpersonal Behavior

A project concerned with filming computer-generated figures to provide animated scenes of interpersonal behavior has been under the direction of Prof. C. E. Osgood. New equipment was designed and tested to facilitate the experiments. Two "test runs" have been made. Some difficulty still lies in the control of shading in the pictures.

LEARNING AND TEACHING RESEARCH

Electrical Engineering 322 — Circuit Analysis

The lesson material prepared for the circuit-analysis course in electrical engineering was used by twenty students in the fall semester. Thirty-five students from two sections of the course used this material during the spring. Some minor revisions to the material are being made.

Library Science 195 — Introduction to Library Use

The three-semester experiment for LIBUSE, the first University-of-Illinois credit course given entirely using the PLATO system, was completed during the fall semester. A total of 66 students participated. Thirty-four of the students were in the control group and 32 in the experimental group. Of the 66 students, 41 were females and 25 were males. The students came from six colleges within the University. Table 1 lists the six colleges represented with the number of students in each college.

Table 1. Distribution of Students by Colleges within the University

Colleges	Students
Liberal Arts and Sciences	37
Education	12
Fine and Applied Arts	9
Agriculture	5
Engineering	2
Physical Education	1

Over half of the students in the experiment were either freshmen or sophomores. Table 2 gives the complete number of students in each class.

Table 2. Student Breakdown by Class Standing

Class	Students
Freshman	25
Sophomore	22
Junior	5
Senior	14

Both the control and experimental groups were given a pretest, mid-term, final, and post-test. The post-test was the same form as the pretest. A student-attitude questionnaire was also administered to each student in the experiment.

FORTRAN Programming Course for Business Students

The on-line interpretative compiler is nearing completion. The program will allow students, as a part of lessons in FORTRAN programming, to compose simple FORTRAN programs at the PLATO station; these programs will be immediately executed and the results shown on the PLATO display.

Computer-based Education for a Basic Nursing Program

A course in Maternity Nursing is being prepared for use on the PLATO system. To date, four units (approximately 18 hours) of course material have been written. The logic adopted is a combination of inquiry and tutorial. Students are presented with questions which force them to seek the information necessary for their answers and to analyze and synthesize as well as collect data.

Completed material is presently being tested on 18 student subjects from Mercy Hospital School of Nursing, a 2-year diploma program. Data from these first test runs are being used mainly for revision of material.

The basis of the new inquiry-tutorial computer program is the generalized tutorial logic developed for use with the electrical-engineering and library courses. To this have been added sources of information for the students which are: a dictionary, a data section, and an investigation mode in which simulated experiments can take place. A keyword judger has been included which allows the student flexibility in the structure of responses and also recognizes duplicate answers. Just as new judging subroutines may easily be added to the basic program, variation in the investigation subroutines is a simple editing task.

Further organization and generalization of the new program will provide one of the most flexible teaching logics now available for use with the PLATO system.

GENETICS PROGRAMS

College Genetics

A basic college-genetics review has been programmed for the PLATO system. The program has been designed to be used in any of the more than half-dozen courses teaching basic genetics at the University of Illinois. It is designed to discover a student's weakness in basic genetics, to aid the student by leading him through the genetic logic involved in solving problems, and to aid the instructor by freeing him from spending the great amounts of time needed to personally help students with problems in basic genetics.

At the present time, the major parts of programming that are completed or under final development are:

Path: A program that calculates what problem the student works on depending upon his choice of review area, previous performance, and "help" needs.

Terms: A program that gives the student definitions of basic genetic terms.

Check: A program that checks the student's answers. Special parts of this program analyze the student's answer according to its type (e.g., genotype, gamete, ratio, probability, word) and give diagnostic error messages (the genotype "checker" has over twenty error messages).

Help: A subprogram of path that is activated after the student pushes the "Help" key. This sequence leads the student through simplified questions and answers to a logical genetic answer to his problem. For example, in parent-offspring problems (the bulk of genetic problems) the Help sequence asks the student what gametes each parent can form. Then he is asked to unite the gametes from each parent to form the genotypes of all possible offspring. Finally, he is asked to tally the genotypes and the physical appearance of these genotypes.

In addition to these programs, the basic programs linking the student input to the computer output of writing, erasing, etc., are completed. Many small programs that "set up" a problem of a given type are completed.

The program was demonstrated in March to faculty members concerned in teaching basic genetics and a trial student run was scheduled for early spring.

Junior High-School Genetics

A simulated genetics laboratory for the PLATO system, GENO, has been used by five groups of junior high-school students. The program permits students to select parents by specifying their genotypes. GENO will then randomly select offspring, plot these on the screen and keep a tally of the number of offspring of each possible type as well as the total number of offspring. Students may select one offspring or any number less than 10,000 at a

time. They may then tally the results and select more offspring if desired, or begin over by selecting a new set of parents. GENO will also do arithmetic problems for the students enabling them to easily find the coordinates for graphs which they construct from their data.

Mathematics 111 (College Algebra)

A team of mathematicians is studying the application of computer-based education to the teaching of college algebra. During the first semester of the 1966-67 academic year, Mr. J. Casey and Mr. R. Williams each taught Mathematics 111 to a class of University-of-Illinois college freshman. They were asked to take special notice of deficiencies in the backgrounds which their students brought to the course and of topics which seemed to be especially difficult for the students. They also collected copies of their examinations and photocopies of their students' examination papers. Errors made by the students on these examinations have been analyzed by Mr. H. Will. His analysis is available to guide the team.

As a first effort, no attempt is being made to produce a computer-based course in algebra. Rather, several troublesome topics have been selected and appropriate lessons are being prepared. The first two topics chosen are mathematical functions and equation solving. The first was chosen because it appears to be the most difficult important concept in the course. The second was chosen because it is probably the most important concept in the course.

Mr. Williams is teaching a section of Mathematics 111 the second semester. His class is available to the team for observation, and his students are being used to test the new lessons. Mr. Wills is writing lesson material for the topic of mathematical functions. Tentatively, it is expected that these lessons will utilize one of the versions of the tutorial teaching logic. Mr. Casey is developing several new judgers needed for the lessons. Mr. Beberman is expected to join in the effort to produce these lessons.

Mr. W. Golden is developing a program which permits the entry of algebraic equations in standard format from the keyset. That is, it accepts vertically-arrayed fractions, exponents, multiplication implied by juxtaposition, and so forth. The program rejects malformed expressions, and when it is completed, it will solve equations entered by the student. The initial use of this program is as a judger that will be able to determine whether a student is correctly solving an equation. Most of the same programming can also be used for graphing equations, either those presented by a lesson or those input by the student, for evaluating polynomial expressions for arbitrary replacements of the variable, and for utilizing a PLATO keyset as a desk calculator. The portions of the program needed for typing equations, and for judging whether they are well-formed, are now complete. The portions needed for equation solving have been outlined, but not coded.

On-line Structural Design

An experimental program for on-line design of structures using the PLATO facilities has been completed. The program is applicable to the design of continuous beams only, but all program components have been designed so that they are applicable to much more general structures. There is no teaching logic built into the program: the student-user is free to formulate problems, input and modify data, and select options to be executed. The results requested are displayed in the form of graphs, but "hard-copy" printed output can also be requested.

French Instruction

There have been 255 characters constructed that are useful in language programming for PLATO. In addition, a program logic involving ten modes has been designed, which will comprise a very flexible means for teaching the reading and writing of any major European language. Provision is made in the logic for audio-lingual skills so that these aspects can be added when the PLATO audio capabilities become available.

A preliminary program, restricted to the teaching of reading skills in French, has been constructed and is in the final stages of debugging. Texts have been selected for use with this program and fifty pages have been prepared for presentation on PLATO. Preliminary student runs were scheduled.

Based on experience gained in using this preliminary program with volunteer students, and possibly with French 400 students, modifications in the design of the ten-mode logic will be made.

AUTOLAB

AUTOLAB is an introduction to the collection, recording, and analysis of data. Students

are told they are quality-control engineers for Intercontinental Motors, and are asked to determine which of three subcontracting firms may be supplying IM with faulty accelerator-return springs. The computer simulates a laboratory assistant collecting spring data at the student's request, allowing students to concentrate upon the processing and interpreting of data rather than on time-consuming laboratory manipulations.

During AUTOLAB, students work with their teacher, use printed materials, and the computer, so that each of these elements of the teaching situation is coordinated. For the students, the primary importance of the program lies in experience gained by exposure to an unfamiliar situation and in their attempts to collect and analyze data about this situation.

To date, five experimental sessions have been conducted with University High-School Sub-Freshmen. Certain revisions of the format and content of the program now seem indicated. Preliminary examination of the data obtained through the use of program NEWSORT suggest, (1) that during the same interval of time, students perceived by the investigators as dealing effectively with the problem, made many more moves (key presses) than students displaying difficulty, and (2) those students having difficulty seemed inclined to try systematically each move in sequence, while those students perceived as effective did not appear to be so constrained but instead seemed to develop an economical set of moves.

PROOF

The mathematical problem-solving PLATO program, PROOF, while not completely debugged, is in operating condition for algebraic proofs. It has not been tested for logical or geometrical proofs, as yet. The lemma mode works under some conditions. A comment mode has been added.

ARITHDRILL

A new version of ARITHDRILL has been designed which will be easier to modify for experimental purposes than the old version. In addition, dope analysis will be more flexible and efficient and certain irremediable ambiguities in the data collected by the old version will be removed. Program writing is currently proceeding.

PROGMAT

PROGMAT is a program which collects and analyzes test data. It is now complete. Student runs for calibration will be carried out during the spring.

SIRA, SYSTEM FOR INSTRUCTIONAL RESPONSE ANALYSIS

Synopsis of Project Work

The main work of the SIRA project during the last period has been devoted to coding and debugging programs that had been designed during previous months. The work is now essentially complete, and effective use of these programs is being made in the collection and analysis of instructional responses. Programs providing data are: GENO (J. A. Easley and J. Millar), AUTOLAB (SSCP), Recursive Definitions (H. Wills), QED (R. Stake), and an Introduction to Arrays (Nishida).

A consultation conference for the group was held in November 1966. Those in attendwere: Dr. Joe H. Ward, Jr., Personnel Research Laboratory, Lackland Air Force Base and Southwest Educational Development Corporation; Dr. Robert B. Davis, Director, Madison Project, Syracuse University and Webster College; Mr. Leander Smith, Specialist in Programmed Instruction, Science Research Associates; Dr. Veryl Schult, United States Office of Education; Dr. Joseph Murnin, United States Office of Education; Messrs Jason Millman, Richard Salinger, Brian Carss, and the SIRA staff, University of Illinois. The conference provided a valuable interaction between the project staff and persons whose experience in curriculum development and computer technology was different from and deeper than theirs.

SOME SIRA PLATO PROGRAMS

TUDOPE is program which provides summary information about student responses to the tutorial logic.

Information may be plotted on the PLATO screen or printed. Information is in the form of lists of student responses and response latencies or histogram plots. Histogram plots may be across students or across items. All plots contain information about the following:

minimum	time per item
maximum	number of trials per item
mean	number of errors (judged wrong)/item

Tudope was designed to process BCD dope tapes containing only: student, key, mode, and time information. A version which will process binary dope tapes has not been completed.

Modified Tutorial

A modification of the tutorial logic has been made which outputs additional (XDOPE) dope including:

1. Current Main or Help page number
2. Current question number (on each page)
3. Trial number (increased upon each new attempt to respond to a question)
4. Time in Help or Comment mode. (Output upon each reentry to Tutor mode)
5. Judge result (Yes, No, or SP are coded "1, 2, or 3" upon each legal press of the Judge key).
6. BCD Response: (Each key which has a BCD equivalent is recorded in BCD code. A listing of this dope BYTE would provide a listing of all student responses and comments without the need for translation.)
7. Legal Flag: (distinguishes legal keys from illegal keys in calc. Keys illegal in the current mode may be distinguished by the absence of extra dope.)

legal key coded	2
calc illegal key coded	1
mode illegal key implied code	0

Special effects were also added to this version of the tutorial logic, one of which provides a timing device which may be used to force a student into the Help mode after a predetermined amount of time has been spent on a question in the main sequence without the occurrence of a correct response to the question. A second special effect permits the author to enter questions in the main sequence from the keyset. These questions are plotted on the student's screen and may be altered or deleted without modification to the slides.

This version of the tutorial logic is currently operative.

DO DAD (Diagnostic Output Data Addition Device)

Given most CATO programs, this program is intended to alter the CATO program and create a (temporary) version which will output on the printer the names of all calcs called subsequent to each key that is pressed. Names and values of student bank values which are altered in the calcs are also printed.

A labelled dump of common (non-zero values) is optional.

The program is intended for use in debugging and/or interpreting CATO programs. The program is currently being code checked.

MOVIE

MOVIE is a PLATO program designed to act as a supplement to other programs where short animated "films" are needed. It permits students to view slides at variable speeds.

NEWSORT

NEWSORT is an analysis program by which an author can select subsets of stored response parameters in which all the records of keypushes have some common characteristics or combination of characteristics (e.g., all the keypush records for the student at a certain station, or only particular keys for that student). Subsets of subsets may also be requested and can be re-ordered by the ascending values of any of the response parameters. In addition point graphs of any response parameter vs any other response parameter may be requested. The records and the graphs are shown on the PLATO screen, but can be obtained in hard copy by request.

SOME OPERATIONAL DETAILS IN THE PLATO GROUP

CDC 1604 Computer Operations

Period: September 1, 1966 to February 28, 1967

Total Running Time:	2387.70 hours
Average Per Day (7 day week):	13.19 hours
Operational Time: 95.74%	2286.05 hours
Preventive Maintenance Time: 4.26%	101.65 hours

Engineering Time: 0.00%	0.00 hours
Emergency Maintenance Time: 0.00%	0.00 hours

SYSTEMS PROGRAMMING

CATO, the PLATO Compiler

CATORES (resident program for CATO programs) has been revised to include modifications in the plot and selective erase routines. In addition, SPECTRE (Simulation Program Executing CATO Transcribed Re-Runs) has been completely rewritten using the new "doping" format. Improved features of SPECTRE permit the user (1) to proceed at various speeds, and (2) to construct new "dope" tapes with additional information from previous student runs.

Improvements in the resident and the CATO compiler have been made. The new service programs CHARPLT and BDPLST and a new subroutine GETPUTN have been added to the CATO master. (The binary mode "doping" method, in use for several months, has been successfully tested by student runs.)

MONSTER, an Editing System

MONSTER (Multiple Operator Nifty Student Terminal Editing Routine) has been developed to provide PLATO users with a fast, flexible, time-shared program-editing system. Flexibility is accomplished through a variety of magnetic-tape manipulations such as PLATO-FORMAT text construction, special listings, and inserts from paper tape. PLATO student terminals are utilized as the basic editing input media as well as providing editors with immediate feedback to the various edit commands. Currently three users may share the system.

Classification and Indexing at The Office of Standard Reference Data

National Bureau of Standards
Washington, D.C. 20234

Classification and Indexing proved to be the most controversial topic on the agenda of the Discussion Forum of the Operators of Data and Information Centers associated with the NBS Office of Standard Reference Data, which was held at the Bureau.

Classification and indexing of information and data are basic requirements for the efficient operation of an information service. One segment of such a service is its data file operation. The objective of this operation is to organize the collection of data and information by means of a classification and indexing system so as to provide ready and efficient retrieval of data and information to answer competently properly structured queries. Properly designed, a classification and indexing system can minimize the work involved in negative searches by readily identifying those subjects not within its collection.

Classification is a technique by which documents and information are "fitted" into a preestablished scheme. The essence of classification is to design the scheme so that the one most suitable class of items is placed into a group by virtue of its role within the scheme.

Indexing is a technique for locating and retrieving items from a collection. It may also be a device that, when triggered by an inquiry, identifies the subclass of items within a class of items that applies to the subject of the inquiry. An inquiry is a question directed to an information system that requires the index to locate a particular item from the collection, if there is one, that satisfies the inquiry.

Conventional libraries rely on author and subject indexing as well as classification as a principal means of retrieval. The preparation of author indexes is straightforward; the design of subject indexes, however, can be very complex. There are two basic approaches: single access indexing and coordinate or conjunctive indexing. The standard index found in the back of a book is typical of the single access approach. Such an index limits the method of searching to one term at a time. The coordinate index, on the other hand, permits searching for information that can be characterized by a number of terms in conjunction.

Consider, for example, the inquiry, "Give me information on the effect of gamma irradiation on the adsorption spectrum of potassium permanganate solutions." In the single access index, the searcher will search one of the terms first (probably potassium permanganate). The index will locate all items that discuss potassium permanganate in any sense whatever. The

searcher must screen these documents and discard those items not related to gamma irradiation effects on its absorption spectrum. Similar searches may have to be performed for the remaining important terms in the inquiry. Use of the coordinate index on the other hand, requires only one search; the searcher will look for all three terms, potassium permanganate, absorption spectrum, and gamma irradiation, in conjunction. A coordinate index locates only those items indexed by all three terms of the search, thus eliminating most of the manual screening inherent in single access indexes. There are various coordinate indexes in use today, and such approaches lend themselves to mechanization.

With a universe of about a million substances and more than a thousand properties, however, even the coordinate indexing approach faces a very formidable problem in the NSRDS indexing requirements.

In the present early stages of development and restricted resources the Office of Standard Reference Data can respond only in a limited way to inquiries. Its response is based on the contents of its data file or referrals to knowledgeable individuals at the Bureau or at associated data centers. Its data file comprises approximately 25 NSRDS and related publications and 800 worldwide physical property data compilations. Within the next year the number of NSRDS and related publications is expected to double and the number of other compilations to increase 50 percent.

The initial classification and indexing procedures used for the publications collected by the Office of Standard Reference Data are exploratory steps toward what is expected to be a large mechanized system. The difficulty in developing classification and indexing systems that withstand the test of file growth, time, and complexity is recognized. For this reason, the experimental nature of the present effort is emphasized. As no existing widely-used classification scheme is satisfactory for NSRDS needs, it is necessary to develop a new scheme. The present small size of the file and its highly specialized nature and use are important factors that make it reasonable to devise a classification system suited to the particular needs of the Office of Standard Reference Data. The present approach is intended to do this and at the same time to maintain flexibility to change as the system changes.

Classifying publications to provide for a shelf location and for convenient browsing should be considered a somewhat different problem than that of indexing contents to permit rapid location of individual data points. A classification scheme for shelving does not need to have a large number of partitions of the subject matter. Factors that should not be ignored in deciding the number and size of the partitions are: the needs of the user, his familiarity with the shelving system, and his subjective reactions while browsing. For this reason, the approach to shelving holdings at the Office of Standard Reference Data emphasizes the needs of those who use the file for browsing – the professional staff of the Office.

Eight classification categories are used:

1. General
2. Nuclear properties
3. Atomic and molecular properties
4. Solid state properties
5. Thermodynamics and transport properties
6. Chemical kinetics
7. Colloid and surface properties
8. Mechanical properties of materials.

This partitioning results in groups that contain at present an average of 150 items. Further subject breakdowns are being explored on the basis of utility to the user. At present it appears that more than one scheme of classification may be required. In particular, nuclear properties data cannot be subdivided on the basis of chemical substance classes like organic and inorganic, whereas the other categories subdivide fairly well on the basis of chemical substance. The present approach is to accept this difficulty as a fact and to institute a separate scheme for subdividing nuclear data – by dividing property data on the basis of time-dependent and stationary states. Additional subdivisions of the file will be developed as the need arises with the increased file size.

The first and primary indexing task of the Office of Standard Reference Data is to develop reference terms to aid in locating specific data on the physical properties of well-defined substances. In a collection of approximately 800 compilations, it is not an arduous task, even without indexing aids, to locate data points when a specific property and substance are cited. As the number of inquiries increases, however, time-saving indexes should be of significant

value, especially for inquiries where a list of properties by substance and/or a list of substances by a stated property value or set of values is desired.

The task of indexing in-depth (identifying each data point) a collection of 800 items that grows at the rate of 400 items per year would be an overly ambitious undertaking at this time. In-depth indexing of the NSRDS publication collection, which contains less than 25 items and which is now growing at the rate of 25 items per year, is feasible, however, when considered as a pilot operation to determine more exactly the needs and capabilities of the Office. This approach should provide more information on the magnitude of the task, immediate assistance for responding to inquiries, and should indicate future directions for exploration as greater numbers of inquiries are handled. The proposed system will attempt to define a data point by physical property and substance terms.

Initial efforts to index the NSRDS data compilations indicate that in-depth indexing of properties and materials should be based on the following guidelines:

1. Subject matter knowledge is essential for adequate indexing.

2. A single pass through a compilation is not sufficient to obtain all terms.

3. An open ended inventory of terms would be a useful aid to the indexing operation.

These guidelines testify to the inherent difficulties of indexing even a limited and fairly well defined collection such as the one held by the Office of Standard Reference Data.

One of the first objectives will be to develop a method to identify rapidly those questions for which there is no answer in the file. Significant effort can be saved if file searches that will yield negative results can be identified at the outset. A thoroughly indexed collection of data points should provide this capability.

It may be meaningless to speak of an optimum indexing system as future demands on the system are undefined and, at present, cannot be known. Nevertheless, a well conceived and implemented indexing effort will be necessary to the successful operation of an inquiry service, particularly where the system is flexible and able to incorporate changes as the situation dictates. The Office of Standard Reference Data is hopeful that its approach to the indexing problem will yield a useful and flexible system.

General-Purpose Code System for Scientific Documents

National Bureau of Standards
Washington, D.C. 20234

Blanton C. Duncan of the Chemical Thermodynamics Data Group, National Standard Reference Data System, is responsible for the development of the taxywriter which is a modified tape typewriter for use as an input device for the preparation of machine-readable records. With this device he is attempting to record scientific text in machine language, providing accurate representation of the nonnumeric portions.

The taxywriter is a principal component of a system whose primary objective is to improve by mechanization the day-by-day operations of the Chemical Thermodynamics Data Group activity. This mechanized system should prove valuable in the preparation of copy for computer-aided publication, but its primary use here is to improve the efficiency of producing and using files of 3 x 5 cards. The continued usefulness of a manual file system for rapidly and easily locating single data points, and for critical evaluation of data entries, should not be underestimated.

Mechanization in file preparation offers considerable advantages. For instance, a single abstract generally yields ten or more handwritten file cards. Each of these cards contains information which is largely identical to that on every other card of the set. In a mechanized system, where the set of cards for each abstract is machine generated and printed, an analyst need mark only the abstract and is spared manual preparation of each file card. This saves a considerable amount of professional staff time, produces legible file cards, and provides data in form suitable for manipulation and search in a mechanized system.

The purpose of mechanizing basic data and reference files is to enable:

1. the scientist to prepare his written material with minimum interference to his usual recording method,

2. an ordinary typist to work at a familiar device that requires no special training of the operator, and

3. the digitizing of the recorded information for machine use at the first typing.

The taxywriter accomplishes these objectives by providing the machine function of a man-machine input system that minimizes demands upon the man (scientist or typist) while augmenting his effort efficiently at low initial cost.

The scientist records what he wishes with the full range of scientific symbolism to which he is accustomed (Greek alphabet, brackets, special symbols, mathematical notation). The typist prepares typewritten copy exactly duplicating the handwritten manuscript with the aid of familiar type face units individually inserted at the platen. Half spacing in the vertical direction permits the typist to join brackets, to make super and subscripts, and special symbols. Back spacing provides a variety of graphics by underscoring and overstriking. The byproduct paper tape contains a record that enables a computer to develop the exact image of the typewritten page including all graphic elements used in their proper coordinate location.

The manuscript image is stored by the computer in a general purpose scientific document code. After retrieval from this storage, the manuscript image can be output to the taxywriter, to a high speed printer (with approximately 200 graphics), and to photocomposition devices.

Although this system was developed to meet specific needs of the Chemical Thermodynamics Data Group, the general character of the input device, the use of a generalized code, and the variety of output devices suggest that broader usage is possible and feasible.

Naval Training Device Center

Research Tool, Digital Computer Facility
Orlando, Florida 32813

On April 14, 1967 the Naval Training Device Center terminated the operation of UDOFTT (Universal Digital Operational Flight Trainer Tool), after seven years of service and 21,008 hours of operation. Simultaneously, a contract has been let for a replacement for UDOFTT, a new Research Tool Digital Computer Facility. This system will incorporate a modern general purpose digital computer and associated peripheral equipment, a large analog computer for hybrid problems and a fixed wind cockpit and a helicopter cockpit with associated motion systems (Fig. 1). This will provide NTDC with a versatile in-house capability for future computer and trainer research.

UDOFTT, which was completed in 1959, was the first successful general purpose type digital computer activated flight simulator. It was designed by the Moore School of Electrical Engineering, University of Pennsylvania and built for NTDC by Sylvania. This project developed numerous advances in this state of the computer art including dual magnetic core memories, a five-phase clock system and a special high speed parallel/serial adder. Originally designed for the simulation of the F100 and F9F aircraft, UDOFTT has since been used for the simulation of space, surface ship, subsurface, fixed wing, and rotary wing vehicles. The simulation of these vehicles has been a part of investigations into the simplification of aerodynamic equations, into control systems, transfer of training studies, and mathematical investigations into characteristics of numerical integration formulas. It has been the forerunner and prototype of digital simulators for aircraft, submarines, and other military training systems including multi-cockpit training simulators activated by a single digital general purpose computer.

The new computer system will consist of a Scientific Data Systems SIGMA 7 central processor with 16,000 32 bit words of directly accessible core memory. The SIGMA 7 has a memory cycle time of 850 nanoseconds, full word add in 1.8 microseconds and full word multiply in 4.9 microseconds. The system features memory protection, a floating point arithmetic unit, priority interrupt system, and dynamic memory mapping. Additional storage consists of two magnetic tape units (60,000 byte/sec transfer rate) and a 1.5 million word capacity disk system (188,000 bytes/sec transfer rate). Peripheral equipment includes a 600 line per minute buffered line printer, a 400 card per minute card reader and 300 card per minute card punch, paper tape reader and punch, and a keypunch.

The research tool also includes two cockpits with associated sound and motion systems. One is a helicopter cockpit which was used with UDOFTT and is being modified for use with this system. The other is a variable configuration

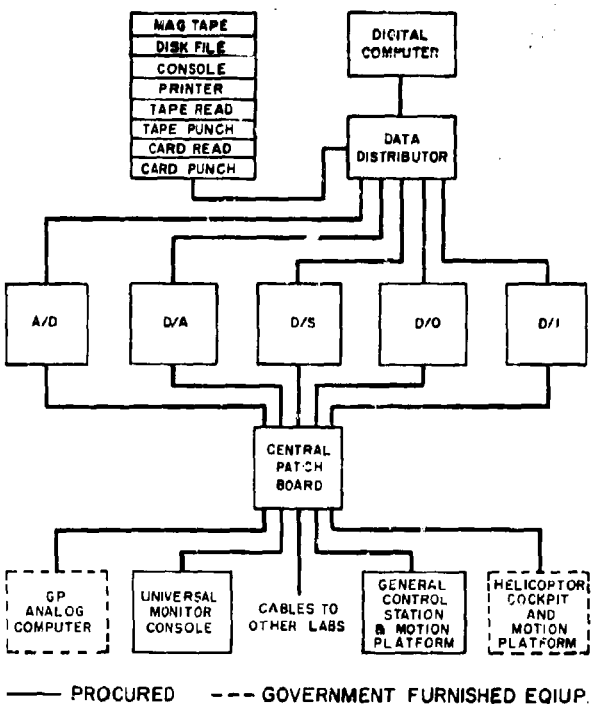

Figure 1 - Naval Training Device Center Research Tool Digital Computer System

fixed wing cockpit. This will be modular in nature and flexible enough to provide a research tool mock-up of almost any fixed wing aircraft. Its motion system is a state-of-the-art system with motion limits of ±15° in roll, ±15° in yaw, ±20° -10° in pitch (yaw and pitch referenced about a variable remote center of gravity) and +1.5 ft -0.5 ft in vertical heave.

The interface system for the research tool is modular in design with emphasis on flexibility. It consists of digital to analog and analog to digital conversion modules, digital to synchro modules, and digital to discrete and discret to digital conversion modules. A large central patchboard will provide communication and permit variable configuration of this equipment. A linkage system between the computer lab's two REAC 550 Analog computers and the SIGMA 7 will provide the Center with a modern hybrid computation facility.

The research tool system will be used primarily for training device and simulation research. Areas of time sharing, computer generated display and hybrid computation will be studied. General purpose data processing will be performed on the system with possible future Centerwide usage via the time-shared mode with remote stations located throughout the Center. The system is scheduled for completion by approximately December 1968.

Advanced Inventory Control

Navy Aviation Supply Office
Philadelphia, Pennsylvania

A Marine helicopter returning to a field hospital from an ambulance evacuation mission in South Vietnam, loses ground radio contact 10 minutes short of touchdown. Though it gets back to the hospital, it cannot fly any more missions without its transmitter. The radioman can't repair it. The 'copter supply shackdoesn't have a replacement. Neither does the Naval Supply Depot at Subic Bay. The request must be relayed to the states. It comes to the Navy's

Aviation Supply Office (ASO) in northeast Philadelphia which is responsible for the world-wide spare part support of Navy and Marine aircraft.

In a computer at ASO there is a combination of digits that will tell where the needed transmitter is stocked and punch out a shipping order to have it sent to South Vietnam.

Most of ASO's work is done with the discs, drums, and tapes of data processing. They have become an invaluable aid to ASO's technical and administrative personnel. In January 1967 ASO expanded its computer capacity and standardized procedures. In recent years ASO has operated one of the most advanced data processing systems in the Department of Defense; however, stock status information for the computer lagged behind actual status at the time of the reading. There has also been a lack of standardization of automated systems between ASO and other Naval activities outside of the Naval Aeronautical Supply System. The new data processing system will close these gaps. "With this system," says Commander Bob Austin, Director of ASO's Data Processing Division, "we will be able to accelerate the movement of spares from the time they are purchased until they leave the system as excess, obsolete, or scrap."

The movement of aviation material in the Navy Supply System is reported daily from 27 major stock points. Receipts, issues, or other changes in stock status are transmitted to ASO as they occur over a wire network called AUTODIN. These are fed daily to the ASO computer. This is Transaction Item Reporting. Previously, these transactions, although sent daily, were not processed immediately. Computer limitations hindered rapid updating of files. With daily processing, actual system status is furnished by the computer. It is never more than one day old. This almost up-to-the-minute capability approaches a "Real-Time" reading. This capability is a major system improvement.

The record of movement of spares in the field is mixed and matched in computers with information on paperwork action at ASO to provide a complete picture of the status of material at both ends of the system. To speed the traffic of business between ASO's personnel and the computers, remote interrogators are being used in key locations throughout the organization. These are similar to teletypewriters, and are wired into a computer's circuits. Inventory mangers, buyers, technical personnel and others can feed decisions to, or extract information from the computer with these units.

When an activity's assets fall below a reorder point, the computer will set the wheels in motion for automatically redistributing material to the activity so that shortages can be balanced out with assets from other stock points or with purchases. Based on a record of an activity's issues, the computer also forecasts an activity's expected quarterly requirements. Every three months the computers recompute these reorder points and project future requirements.

In the second phase of the new program after July 1, computers will help to decide when to recall disposed material and where it is available. They will provide instant information on outstanding procurements, deciding if they should be cancelled or expedited. They will compute average Navy and Commercial repair turnaround-times (the time it takes for a repaired item to get back on the shelves). They will work out averages on contract delivery time, and on survival rates of repaired items.

Processing requisitions, of course, is one of the computer's most important jobs. Requests for supplies come in by message, phone, mail, and the AUTODIN network. Until the recent expansion of automated techniques, all requests except those sent by AUTODIN had to be sent to keypunch areas for translation to punched cards before the computers could handle them. Today, ASO's requisition center is tied into the computers with remote interrogaters. With these units, requisitions can be keyed directly to the computer. This directness, together with the capability of the computer to process the requisition immediately, speeds responsiveness to fleet requirements.

The requisition for the helicopter transmitter was processed through the computer in three hours. The end product of the processing was two punched cards that went to an AUTODIN transmitter. One told the activity stocking the transmitter to ship it. The other sent out the word along the network to the requesting activity that the item was on its way.

Three hour processing is possible when a needed item is stocked somewhere in the system. When it is not, the computer prints out an action form for ASO's commodity managers. They will check Overhaul and Repair shops for repairable items to see if any of the items are being repaired. If so, the item will be expedited. They will also check excess stocks of other services. They will review contracts to see if the item is on order from a manufacturer, and expedite completion of an emergency quantity; if not, arrangements will be made for purchase.

ASO's computers are put to work in all these actions.

There are about a hundred stock points in ASO's distribution system reaching across the country and overseas. "ASO's computer library, with its up-to-the-minute 'Real-Time' readings on stock status, is so complete and current," says CDR Austin, "that these widely scattered storage points will provide visibility as though they were one huge warehouse. It will mean quicker response to the needs of the Navy's aircraft whether they be helicopters in Vietnam, cargo carriers in the Antarctic, or Phantom jets on an aircraft carrier in the Mediterranean."

Centralized Data Processing

Headquarters, Navy Pacific Missile Range
Point Mugu, California 93041

In the "Newsletter" of October 1966, an article entitled "Navy Computer Systems" described the use of computer capabilities by the Navy at Point Mugu. The article contained an account of a study on future use of computers at Point Mugu by a committee appointed by Rear Admiral R. N. Sharp, Range Commander. The committee was headed by John F. Donlan, Deputy Plans and Resources Management Officer. The Committee's objective was to improve significantly the effectiveness in acquiring, controlling, and utilizing the overall Point Mugu data processing capability. Significant changes in function and organization resulted from committee recommendations.

Following the committee's recommendations, the Commander, Pacific Missile Range, directed the establishment of a new centralized data processing activity called the Data Processing Department. The Department combined the data reduction, processing and scientific problem solving facilities and personnel of the Range Operations Department's Test Data Division with the management data processing facilities and personnel of the Comptroller's Data Processing Division. Mr. Donlan was named Data Processing Officer and Mr. Langford, who had been Acting Head, Test Data Division, was named Deputy, Data Processing Officer.

The Data Processing Department currently operates two IBM-7094 Systems, one IBM-1401 computer and one IBM-1460 unit. In addition, elements of the Department operate one Univac 642A computer plus two Univac 642B systems and one NCR-315 system. The software responsibilities of the Department include the programming for the above mentioned systems plus Univac Model 1230, 642B and 1218 systems located on Johnston Atoll at Barking Sands, Kauai, Hawaii and on the instrumentation ship USNS WHEELING.

Planning has been accomplished towards incorporation of the CDC-3100 capability, now with the Range Operations Department's Geophysics Division, into the Data Processing Department. This is being phased with the Navy's Civilian Substitution Program.

Also in furtherance of the Five Year Plan mentioned in the October, 1966 article, action is underway to acquire third generation computer systems to replace several of the existing systems.

Mobile Medical Check-ups

University of Southern California
Los Angeles, California 90007

Your complete medical check-up of the future may be as near as the computer-equipped van parked down the street.

That is the prediction of William R. Larson, Ph.D., University of Southern California computer and systems development expert, who has begun work on the first phase of a bold new concept to improve medical care.

He has launched a feasibility study of developmental approaches to what he envisions as a far-reaching medical and health information system which provide a variety of computerized medical testing and screening services in mobile clinics. The study is financed under a contract with the Adult Health and Aging Branch, U. S. Public Health Service.

The proposed system is under the direction of Dr. Larson, adjunct associate professor of Public Administration and research associate at Rossmoor-Cortese Institute for the Study of Retirement and Aging, both at USC.

The computer expert believes the revolutionary proposal will provide virtually unlimited possibilities as a resource link in the chains of public and private health services.

Specifically, he believes such a system could play vital roles in the provision of detailed information on patients for their private physicians, provision of materials for the continuing professional education of physicians and health education for laymen, and furnishing otherwise unobtainable information for public health agencies.

"Foreseeable advantages of the system," says Dr. Larson, "are the high-speed analysis, comparison and correlation capabilities of the computer, and the fact that such a program would literally bring a clinic to elderly persons or others who would be either unable or unmotivated to travel distances for needed medical care."

This is how the proposed system, as it is now envisioned, would work:

A series of vans, constituting what is called a "multiphasic screening clinic" and containing the latest in computers with bio-medical capabilities, would be set up for a period of time in a local neighborhood.

Bus service for shut-ins and elderly persons would be provided from their homes to the clinic site. Each area resident would go through a series of stations, at one for example, having his blood sample analyzed by computer, which would perform literally hundreds of tasks almost instantaneously. At another station, the person would have respiratory tests taken and the results analyzed.

A preliminary report would be issued to the examinee, and a complete report sent to his private physician. The private physician, on reviewing the data, would decide if a visit were necessary. If at any time the examinee had to see a physician, he would have a well ordered body of information which the physician could use as a guide to diagnosis and therapy.

All the information gathered in each individual test would be stored in a central information bank, for later use by the public health agencies.

The proposed system, conceived by Dr. Larson originally for use in meeting the medical needs of elderly persons more adequately, would be applicable as well, he says, to poverty area residents in need of better medical care, for civil defense emergencies, and to compile health information on the general population.

An expanded system could integrate such present day chores as immunization programs and blood collection and distribution.

By attaching transportable field hospital units developed for use in Vietnam, the system would become an emergency hospital complete with staffed laboratories.

The feasibility study will be completed by January 1968.

Co-director of the project is Dr. James Birren, head of the Rossmoor-Cortese Institute.

The project staff includes Garst Reese, a programmer at USC's Computer Sciences Laboratory; Jon Greene, a graduate student at USC; and Karin Daley, a research assistant.