Xerox 530 Computer

XEROX

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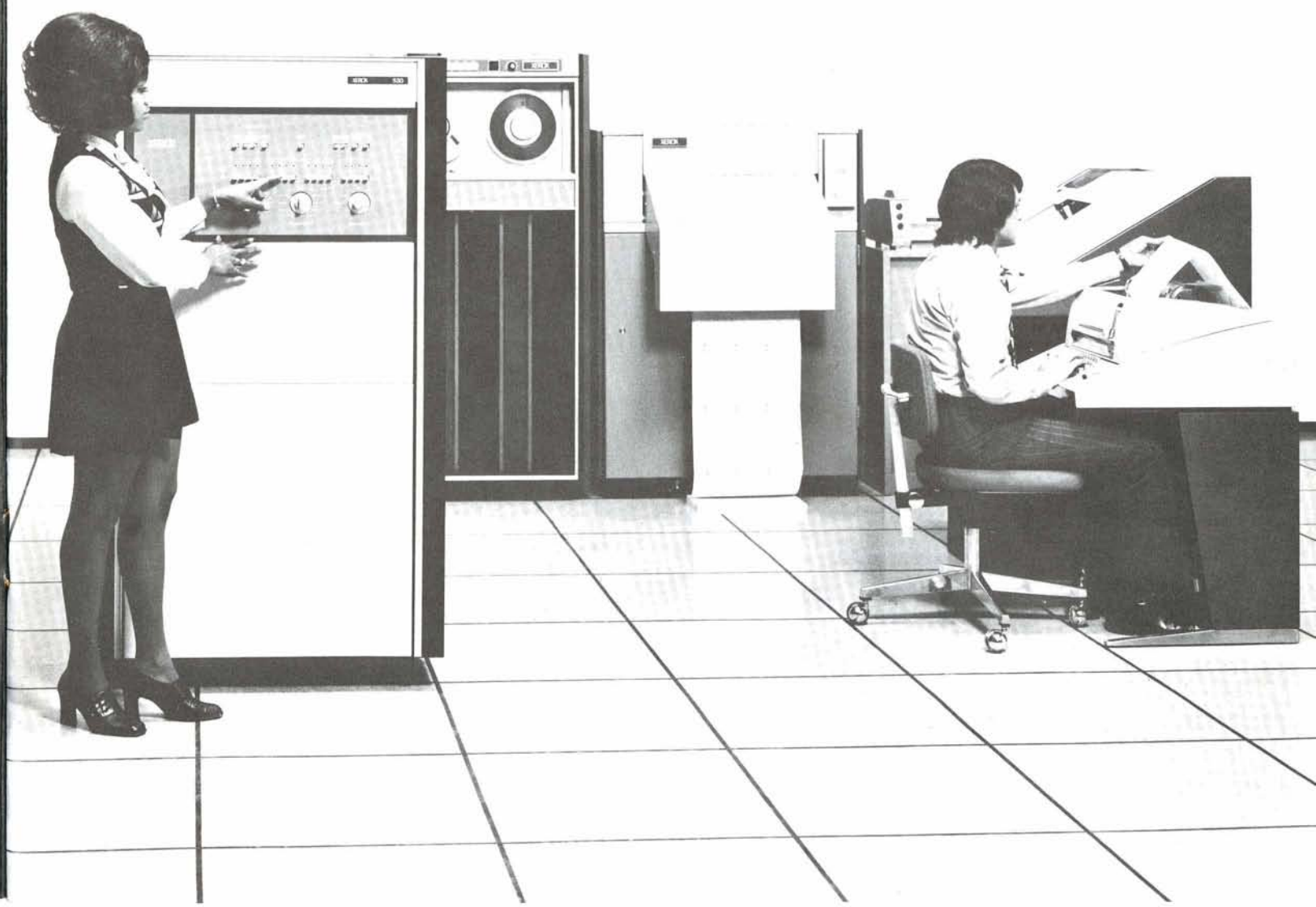
The Xerox 530 is a low-cost, high-performance computer system designed for both commercial and scientific applications. The 530 is a microprogrammed, 16-bit computer offering such hardware features as multiple access paths to memory, up to two asynchronous I/O processors, six general purpose registers, optional floating point hardware and instructions for manipulating portions of a computer word (field addressing). Complemented with field proven software systems, the 530 system is a true multi-use computer and provides the user the flexibility to adapt the system to his present and future needs.

The 530 can react instantaneously to real-time events from the external world, thereby putting its power to effective use in such applications as laboratory research, data acquisition, communications, and process control. Because of its multi-use hardware/software capabilities, the system is equally suited for commercial data processing. Xerox assists the user by providing extensive software support including a powerful operating system like the Real-Time Batch Monitor (RBM) and versatile processors such as RPG II, Disk SORT, ANS COBOL, and ANS FORTRAN IV.

And, to insure a high degree of system availability, the 530 includes a modular hardware/software system which provides remote assistance (diagnostic service) through a standard communications interface. A comprehensive set of hardware features for fault detection, recovery, error logging and diagnostics, combined with the remote assistance capability, provides the Xerox 530 user an unprecedented level of diagnostic support.

Multi-use capability, proven software, large-machine features, and high availability at a low cost...that's the 530. And Xerox is behind it.



Features

The Xerox 530 is ideal for the small computer user who needs the functional capabilities and features of a large computer system but is operating on a small computer budget. Operating with the Real-Time Batch Monitor (RBM), the 530 keeps a combination of real-time and background jobs running at the same time — like the larger machines. In the foreground it can process a large number of real-time tasks while concurrently processing a stream of general purpose batch jobs in the background. Unique reliability and maintainability features provide a level of system availability which is unique — even in the higher priced systems. When it comes to price/performance, the Xerox 530 is in a class by itself — here are some of the reasons why:

Advanced Hardware

Multi-Bus System Multiple access paths to the memory system with independent simultaneously operating I/O processors combine to provide a true multi-bus system.

Multi-Level Interrupts Sixteen standard interrupts (10 internal and 6 external) are provided with the system. These are expandable in two groups of 32 each up to a total of 80. Each external interrupt can be individually armed/disarmed and enabled/disabled under program control.

Real-Time Clocks Two real time clocks permit programs tied to interrupts to be initiated and timed on a different basis.

Memory Protection Protects real-time programs and the operating systems from destruction or alteration by background programs.

General Registers These registers provide for single- or double-precision accumulator; pre-indexing (base address), post-indexing, both (double indexing); subroutine linkage; program address; and temporary storage.

Power Monitor Provides safe shutdown in event of power failure and correct resumption of processing when power returns.

Comprehensive Instruction Set A comprehensive repertoire of instructions provide effective and efficient use of the 530 hardware.

First Memory Module (8K Words) Standard with CPU.

Floating Point Arithmetic (Optional) Provides increased computational speeds for scientific problems.

Field Addressing (Optional) Allows the addressing of a field of up to 16 consecutive bits without regard to either the location of the bit within a memory word or to memory word boundaries.

Reliability and Maintainability

Large Circuit Boards Eliminate a large number of cables, wires and connections which can typically cause system failures.

Error Detection Hardware Automatically alerts the operating system so that appropriate recovery and/or logging can be initiated.

Microdiagnostics These diagnostics are permanently stored in read-only memory and are initiated automatically as part of the initial booting sequence.

Xerox ASSIST Program Provides remote assistance diagnostic services to the user through a communications link to a Xerox field engineering center.

Dump Analysis Program Contents of memory can be dumped onto a RAD disk in order to show the environment of the system at the time of failure.

Load and Go Diagnostic System A set of comprehensive unit diagnostics which is designed to reduce the time required to analyze and interpret failure information used for preventative and corrective maintenance.

Load and Go System Exerciser A stand-alone program used for total system verification.

Field-Proven Software

Choice of Two Operating Systems The Real-Time Batch Monitor (RBM) is a highly efficient operating system that performs multi-task foreground operations concurrent with batch background processing. A disk-based operating system, RBM offers the user a full complement of processors and services. The Basic Control Monitor (BCM), a subset of RBM, provides concurrent multi-task foreground and background processing on a minimal Xerox 530 configuration (8K memory). BCM is ideal for those users who do not require a full complement of services but still want concurrent operations. Each of these operating systems maximizes CPU utilization and optimizes price/performance.

Extensive User Support Services RBM has extensive user support services such as memory conservation (monitor user overlays, nonresident programs, etc.), task management, resident service routines, operator controls, job accounting, and system utilities.

Powerful Processors and Utilities Under RBM, a wide range of industry accepted processors and utilities are offered including a MACRO assembler (Extended Symbolic), ANS COBOL, FORTRAN IV, RPG II, Disk Sort, ANS COBOL Scientific Subroutines and Debug.


XEROX 530
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DATA
0 1 2 3
4 5 6 7
8 9 10 11
12 13 14 15
DATA
DISPLAY SELECT

Hardware

The hardware design for the Xerox 530, implemented using LSI, MSI, and microprogramming techniques, is aimed at two major objectives: (1) provide a highly reliable, multi-use system of the lowest possible cost; and (2) provide maximum flexibility and expandability. Throughout, the Xerox 530 design emphasis has been placed on features that provide efficient, concurrent real-time and batch capabilities. These features include high-speed memory, multi-access paths to memory, extensive system protection, flexible addressing, comprehensive instructions, and a powerful interrupt system.

The Xerox 530 is modular and can be easily expanded in the field by adding memory, input/output channels, peripheral equipment and central processor options.

Multi-Bus System Architecture

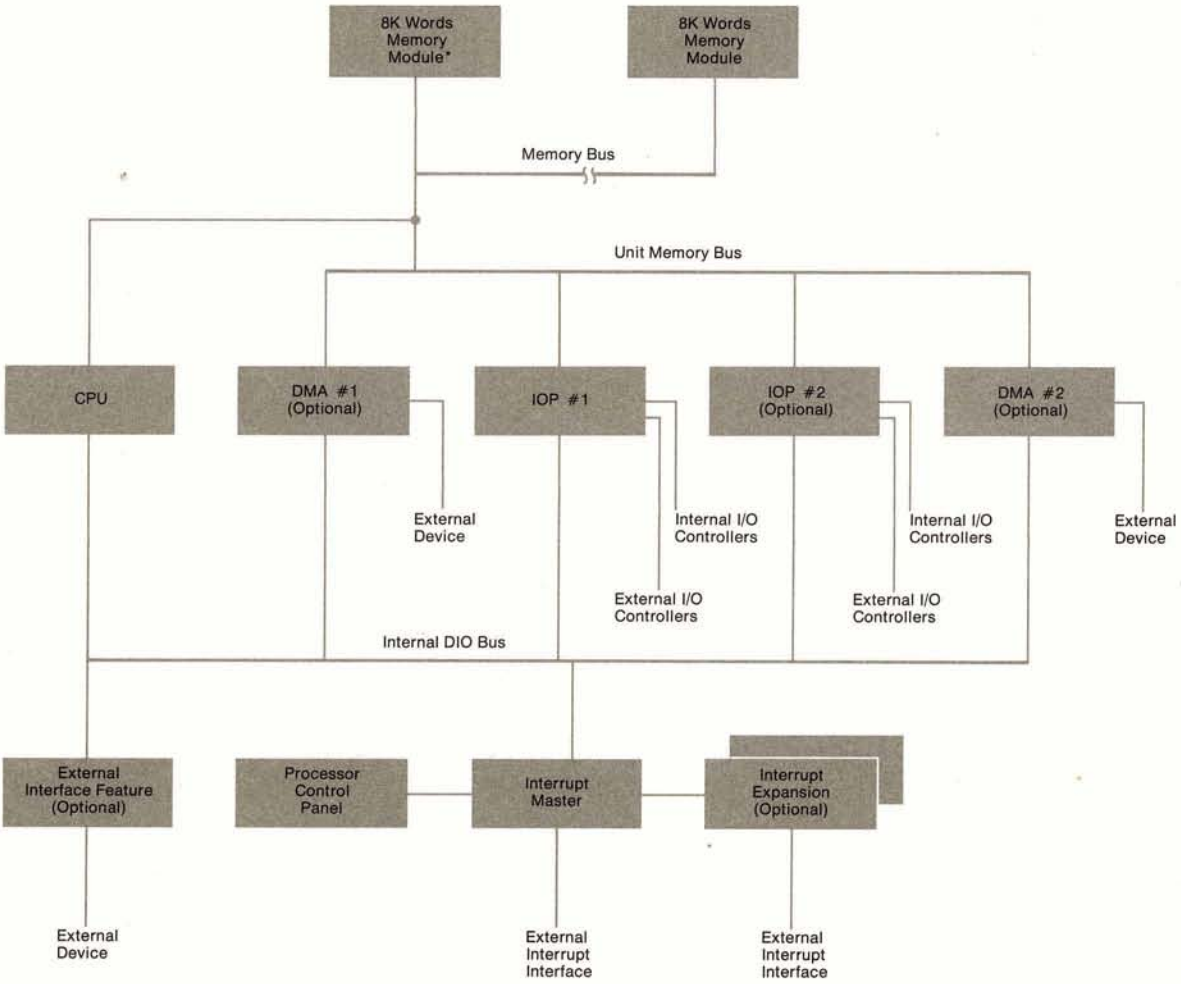
As shown in the accompanying diagram, there are three main busses in the system: the memory bus, unit memory bus and the internal DIO bus. The memory bus connects memory to the unit memory bus and the CPU. The unit memory bus is used by all units that require direct access to memory with the exception of the CPU. The internal DIO bus provides control intercommunication between the CPU, interrupt system, external interface feature, IOPs, and Direct Memory Adapters (DMAs).

Typically, the external interface feature provides for low-speed, intermittent data transfers. The IOPs handle the bulk of medium-speed transfers (typical I/O peripheral requirements). DMAs handle high-speed direct-to-memory transfers.

Memory Access Paths

The Xerox 530 system architecture uses a Unit Memory Bus which provides four memory access paths in addition

Xerox 530 Computer System Architecture



*Expandable to 64K Words. First Memory Module (8K Words) is standard with CPU.

to the CPU memory access path. Memory is addressed identically through all paths and one memory access may be initiated during any instant of time.

Memory

The Xerox 530 memory is word oriented with each word consisting of 16 bits plus 2 parity bits. Memory cycle time for a 16-bit word is 800 nanoseconds. Available in 8K word increments, memory can be field expandable from 8K to 64K words in a single bank.

Input/Output Processors

Input/Output processors are capable of high volume data I/O operations, simultaneously with computing operations. Up to two IOPs are available. The I/O processors operate independently of the CPU communicating with memory through the unit memory bus.

The IOP is composed of channels that operate independently with one another and the processing unit in providing data transfer/communication between various types of I/O devices and memory. Each channel, instructed by its own I/O control doubleword, can govern data transfer operation between main memory and a selected I/O device. IOP #1 is capable of simultaneously handling 16 channels. IOP #2 (optional) handles an additional 12 channels.

Direct Memory Adapter (DMA)

A DMA (optional) is a 16-bit direct memory interface providing data interchange between the user's external devices and the 530 main memory at ultra high data transfer rates for specialized data acquisition applications. It consists of data lines, parity, address lines and control lines. Each DMA (maximum of two) uses one of the memory access paths on the unit memory bus.

Extended Arithmetic Capability

The extended arithmetic feature standard with the 530 contains the multiply and divide, double precision capability, multiple register instructions and general register instructions. Multiple register instructions can handle up to six sequential registers. Software overhead is shortened by allowing register saves and restores to be completed in four instructions. The general register capability allows any of the six general registers to act as the accumulator when executing single-precision Load, Store, Add, Subtract, Compare and Logical And.

Real-Time Clocks

Two real-time clocks permit programs tied to interrupts to be initiated and timed on different bases. Time critical operations can be monitored on an elapse-time basis, since the program is signaled by priority interrupt.

The first clock is hardwired to 500Hz; the other can be set to one of four frequencies via switches. Standard selectable frequencies are 2000 Hz; 8000Hz; equal to the site's power frequency; or a special user supplied external frequency.

Memory Protect

The standard memory protection feature allows the monitor to prevent a background program from accidentally destroying the foreground or resident monitor area. A background attempt to write into or execute instructions in these areas, or execute privileged instructions, triggers the protect violation interrupt.

Power Monitor

Power monitor is a standard feature providing the capability to monitor transient conditions in the commercial power network. The power monitor feature detects the loss or restoration of system power and causes either a power-off or power-on interrupt to initiate program save or restore operations respectively.

With this feature, program and interrupt status can be saved through the operating system thus reducing lost data and system down time.

Multi-Level Priority Interrupts

The Xerox 530 provides 16 interrupt levels as standard with the central processing unit. Ten are dedicated to system use (clock interrupts, power on/off, etc.) and 6 are available for user applications. When an interrupt occurs, its source is identified and its priority in relation to other currently active interrupts is determined rapidly and automatically by the hardware. Because these are functions of the hardware, interrupt programming routines occupy minimum storage space and require shorter execution times. Three levels of control are provided by the interrupt system. Each interrupt level can be individually armed/disarmed and enabled/disabled under program control. Groups of interrupts can also be collectively inhibited under program control.

The Xerox 530 can activate (trigger) any interrupt level with a single instruction. This feature is especially useful when it is necessary to write programs to interact with special equipment that uses interrupts, before that equipment is actually available, since it allows small routines to realistically simulate the special equipment for purposes of program debugging.

Interrupt triggering is useful in establishing a hierarchy of interrupt responses to a given event. A high priority routine can capture system resources to process the time critical function of its application using a high priority interrupt. This routine can then defer the less critical processing to a lower priority interrupt which will assume control when system resources become available. This technique permits faster servicing of intermediate priority interrupts.

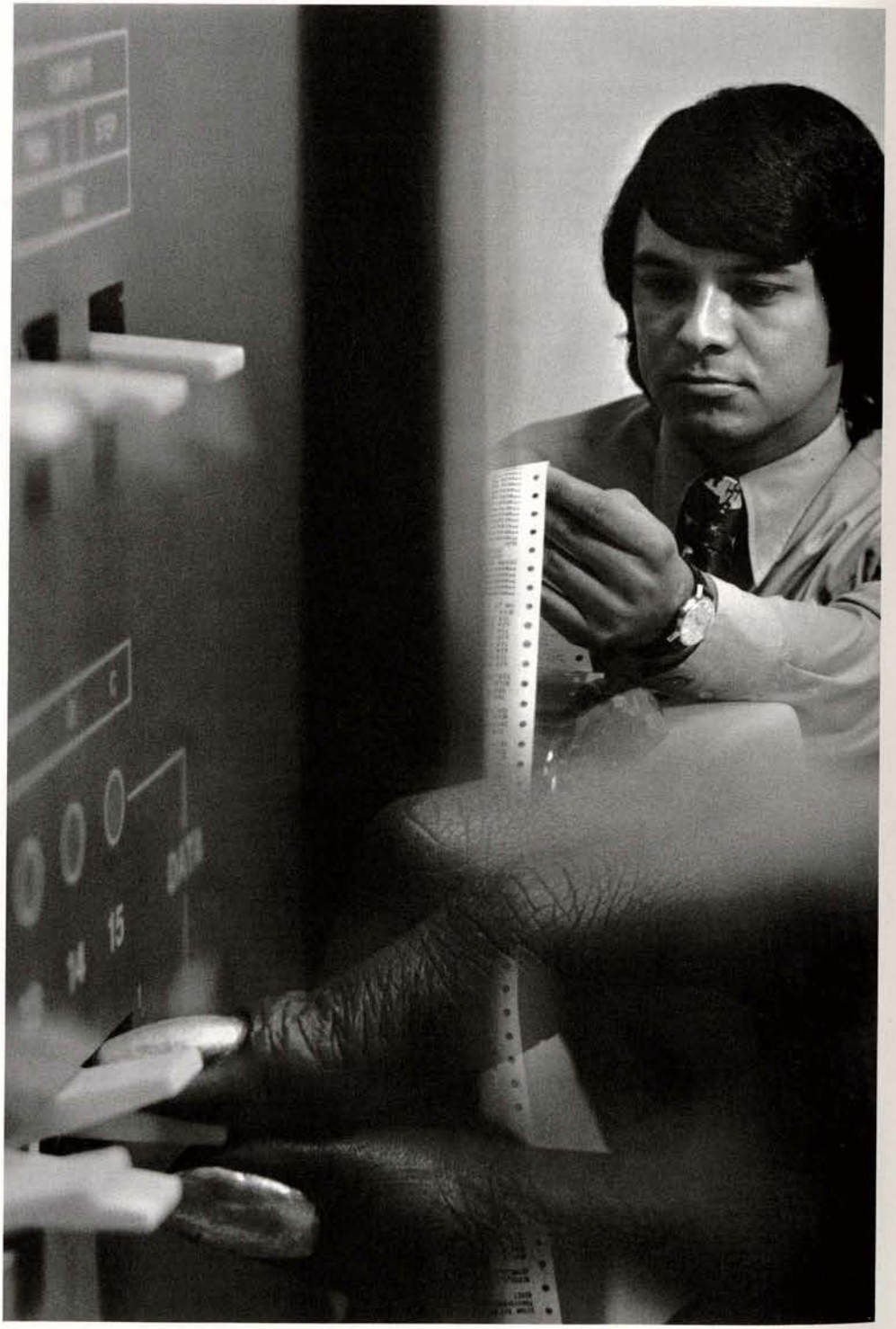
Keyboard Printer Controller

The keyboard printer controller provides all the interface and control to operate the local operator keyboard printer. Additionally, it provides a communication interface which is independent of the presence or absence of any other communications equipment in the system. The communications interface is used to implement the remote assistance (diagnostic service) capability of the 530 system.

Software

Xerox 530 programming systems are compatible with that of the Xerox Sigma 3. This field proven software reduces the user's operating costs by greatly simplifying his programming and operating procedures. The user can focus his attention on the problem to be solved because the Xerox-supplied programming systems automatically perform many routine program-writing functions.

With the 530, the user has the ability to expand his system in terms of memory, peripherals and optional features in order to meet his growth requirements. For example, a minimum Batch Control Monitor (BCM) system with 8K memory can be easily upgraded to a larger Real-Time Batch Monitor (RBM) system. The minimum RBM system can then be easily expanded to the maximum RBM configuration. And processors like ANS FORTRAN IV, ANS COBOL, and RPG II provide for easy transition to larger Xerox computers.

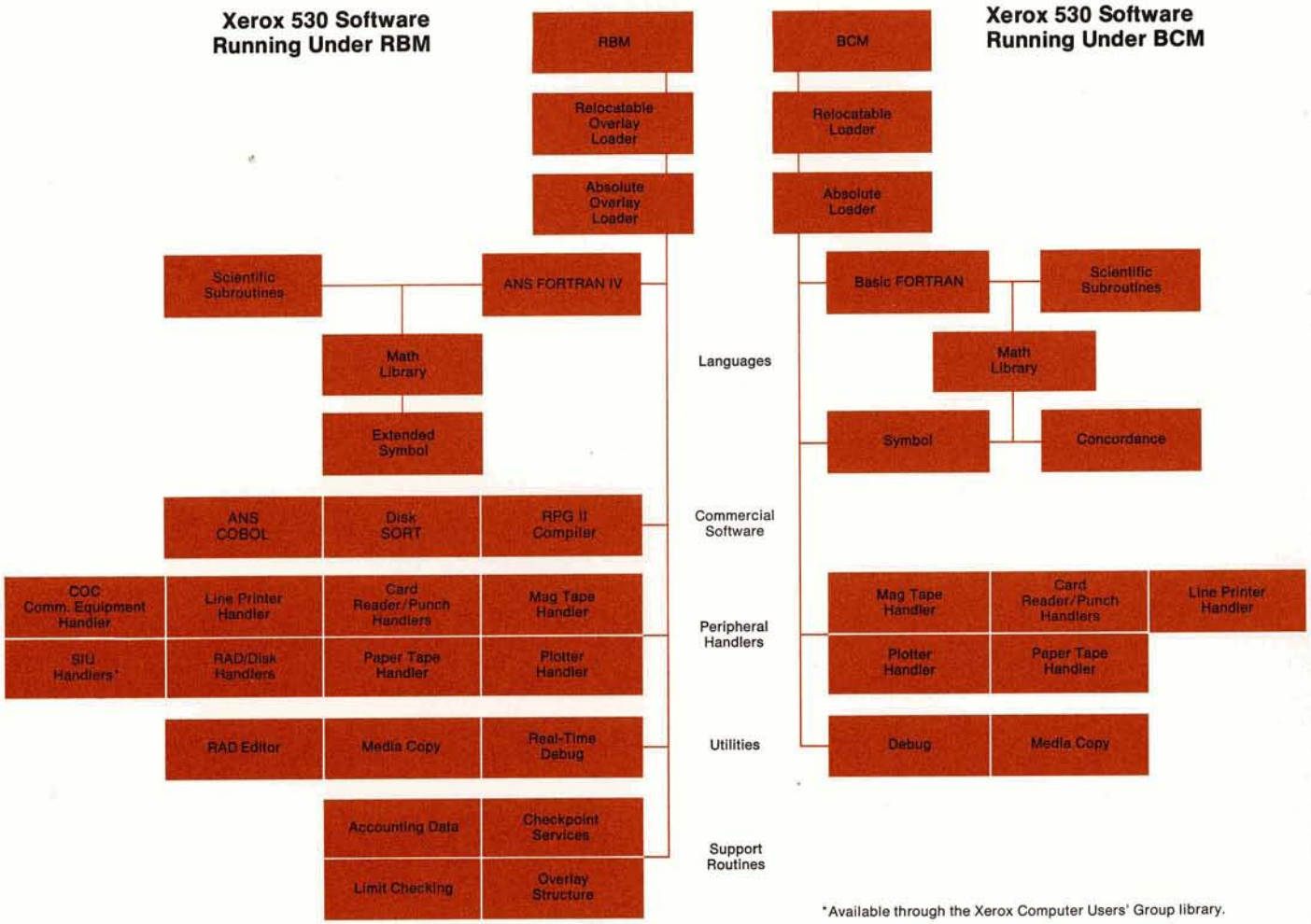


Basic Control Monitor (BCM)

The Basic Control Monitor is an effective and responsive operating system which supports the minimal Xerox 530 hardware configuration. BCM provides centralized services for input/output, interrupts, clocks, etc. It allows the user to perform real-time foreground processing and background batch processing concurrently. Making use of the Xerox 530 memory-protection features, BCM can assure absolute integrity of the foreground real-time task and resident monitor by preventing any background job from modifying protected memory. BCM includes:

- A resident, absolute program loader.
- Relocatable loaders.
- A flexible operator-communication facility that allows interaction of the operator with the background batch stream.

Xerox 530 Programming Systems



*Available through the Xerox Computer Users' Group library.

- An optional debug facility that includes snapshot memory dumps and modification.
- An extensive library of mathematical routines.
- A utility package of media copy routines and text editors.

Real-Time Batch Monitor (RBM)

RBM is an advanced monitor for a 16-bit machine. It offers services and processors that are generally available only on larger computers. It takes maximum advantage of mass storage devices to provide such features as simultaneous background and foreground operations, nonresident real-time programs, foreground/background overlays, and the ability to utilize background memory when needed for real-time programs. The RBM software coordinates foreground and background workloads for maximum concurrency of operations and throughput. As shown in the accompanying Xerox 530 programming systems diagram, the monitor provides a large complement of language processors, handlers, utilities, and support routines. The speed of RAD/disk storage where RBM resides allows the monitor overlay technique to operate efficiently and effectively for those applications requiring extensive monitor services.

Real-Time and Background Features

Certain basic characteristics of RBM contribute equally to both real-time and background (batch) operations. For example:

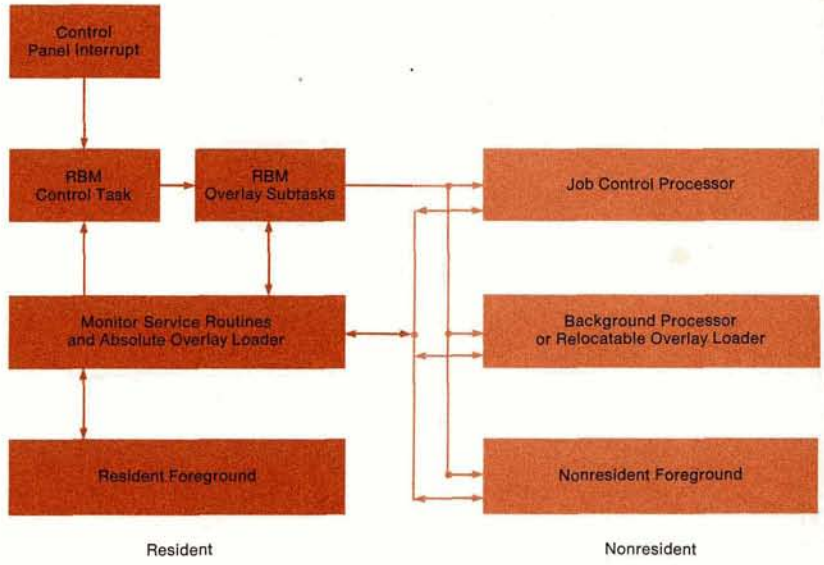
- EXTENSIVE FILE MANAGEMENT CAPABILITIES All files are addressed by file name, not by absolute location. Files can be written in several modes: compressed or expanded, sequential or random. Various levels of Write protection can also be specified for any file.
- FULL OVERLAY SERVICES All types of programs — real time, system, and batch — can be segmented into an overlaid tree structure; segments are then called into core as needed. Absolute and relocatable loaders provide for specification of these overlay structures. RAD/disk speed allows this technique to be used with little loss in efficiency.
- SYSTEM GENERATION This facility allows the user to generate an operating system tailored to his specific application requirements.
- DEVICE-INDEPENDENT INPUT/OUTPUT All I/O commands may be directed to a logical I/O unit; actual assignment of logical I/O units to physical devices (line printers, teletypewriters, card equipment, etc.) is under control of system generation (SYSGEN) as well as the operator. Therefore, no program need be dependent on a particular configuration of peripheral units.
- DEBUG PACKAGE Allows debugging of real-time or background programs without compromising the security of the foreground area.
- CORE RESIDENT PUBLIC LIBRARY This facility allows several foreground tasks to collectively use common core resident routines. It reduces the number of copies of these routines that must reside in memory at the same time.
- MEMORY PROTECT FEATURE This insures system integrity. Both real-time programs and resident monitor are completely protected from batch jobs. Privileged instructions can only be executed in protected memory.

Real-Time Features

In a typical foreground/background processing environment, foreground tasks are assigned individual priority levels and subsequent scheduling is done by hardware without the need for program intervention. Real-time operations are facilitated by the following RBM features:

- Real-time programs can be either resident or nonresident; if nonresi-

Interrelationship of RBM Operation System Elements



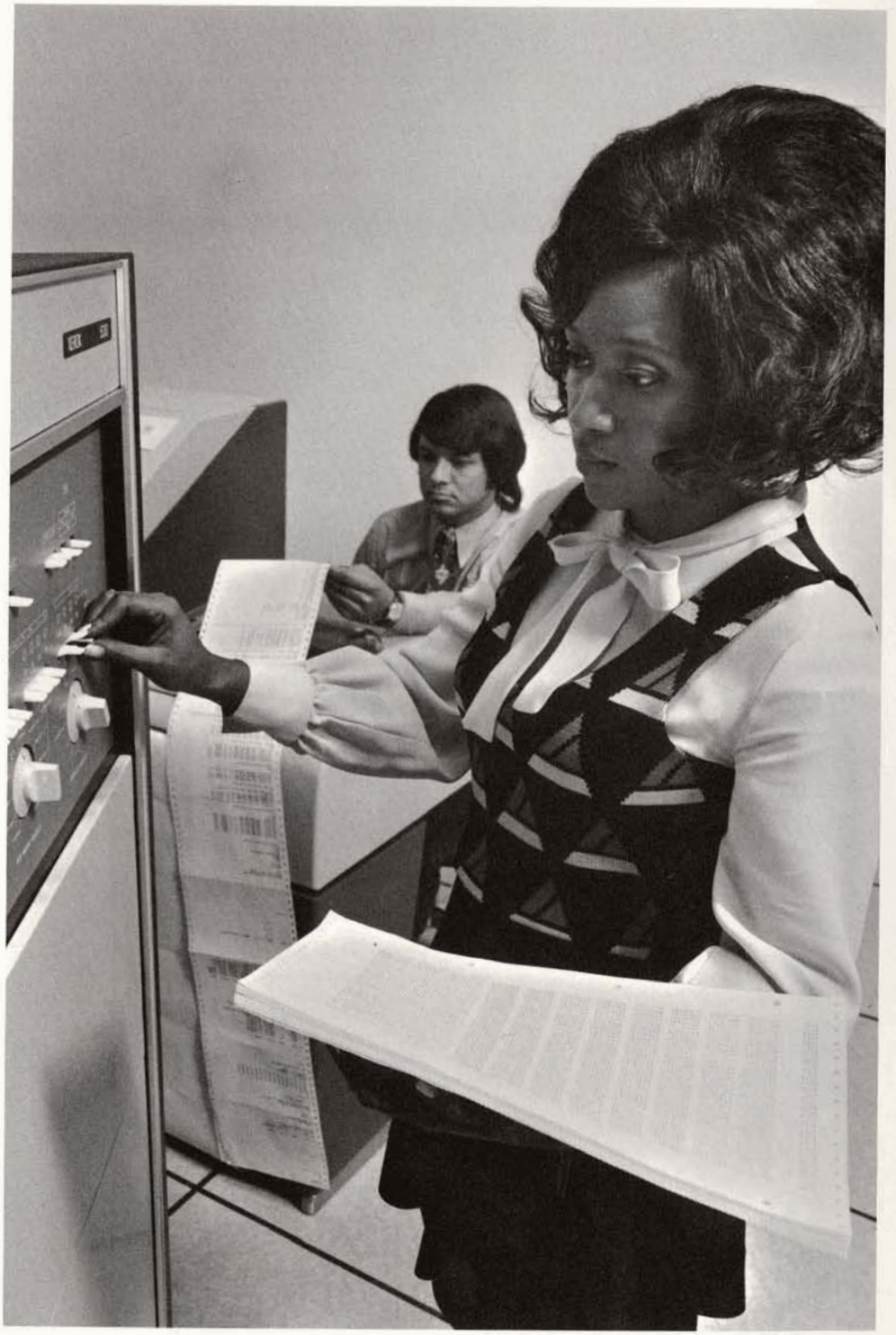
dent, they are loaded and released as required.

- Real-time programs can be initiated by external events, by the operator, or by a real-time clock.
- Real-time programs can initiate other real-time programs or background jobs, and they can communicate via common core areas.
- Multiple real-time tasks can be processed concurrently.
- Reentrant monitor services and libraries are available to the real-time user.
- Checkpoint capability makes background memory available to a foreground program that requires more core than is normally allocated to the foreground area. A check pointed background program can later be restarted at its point of interruption.
- Peripherals can be dedicated to real-time tasks.
- Character-Oriented Communications (COC) handler is provided for use with data communications devices utilizing both half- and full-duplex lines.
- I/O queueing and task dismissal improving system utilization, and throughput.

Background Features

The following RBM features are of special value to background (batch) users:

- A job accounting facility provides a running log of system utilization and a permanent log of utilization by name and account.
- Batch jobs will run continuously with little or no operator intervention.
- Programming languages and aids including RPG II, Disk SORT, ANS COBOL, ANS FORTRAN IV and Extended Symbol are provided, as well as peripheral handlers, utilities, and support routines.



Typical RBM Services

Mnemonic	Name of Command	Services Performed
M:SEGLD	Segment Load	Calls in overlays in both background and foreground.
M:READ/ M:WRITE	Read/Write	READ locates and reads a record on a specified logical device (in the case of the RAD, a dictionary is accessed).
		WRITE writes records on a specified logical device (in the case of the RAD, a dictionary is accessed).
M:CTRL	Control	Positions files (e.g., RAD and magnetic tape).
M:CKREST	Checkpoint/ Restart	CHECKPOINT allows all background I/O to be completed, at which point it saves machine context and transfers entire background to the RAD.
		RESTART reads the previous background back into memory, and restores machine context. Background processing is restarted at point of checkpoint.
M:COC	Communications Handler	Handles communications I/O, accumulating data in unique buffer areas for each input line and directing output to proper output line. Recognizes and responds to communications control codes.
M:LOAD	Load	Calls in a foreground or background program from the RAD for execution. Programs are loaded and executed in the order in which they are requested. Via this command, one program can initiate another.
M:RSVP	Reserve Peripherals	Dedicates a specified peripheral for use by real-time programs only.
M:ASSIGN	Assign a Peripheral	Relates a logical I/O unit to an actual (physical) peripheral, or to a particular RAD file.

Typical Commands for RBM Operator Communication

RBM provides a number of commands that allow the operator to control the background process and selected portions of the foreground process. Following are typical examples of these operator-communication commands.

Command	Foreground or Background Process	Functions Performed
C: (Connect)	Foreground	Allows operator to trigger a real-time process.
Q Program Name (Queue a Program)	Foreground	Allows operator to call in a foreground program for execution.
UL (Unload)	Foreground	Allows operator to force termination of a nonresident foreground program.
FG (Foreground)	Foreground	Allows a background program that has been assembled and debugged to be transferred to the foreground.
SY (System)	Background	Allows a background program to modify a system RAD file. System files cannot be modified except through use of this command.
KP (Keyboard/ Printer)	Background	Tells the Monitor to begin reading control commands from the keyboard/printer.
W (Wait)	Background	Temporarily suspends the current background program.
S (Start)	Background	Causes background program to resume execution.
X (Abort)	Background	Aborts the current background program.
DM (Dump Memory)	Background	Causes a specified portion of memory to be written out to a selected diagnostic peripheral.
DS (Device Substitution)	Foreground or Background	Changes the device address from its SYSGEN assignment.
RA (Remote Arm)	Background	Permits dial-up connection for remote field engineering trouble shooting.

Reliability and Maintainability

To insure a high level of availability, a comprehensive set of features are included in the Xerox 530 for fault detection, logging, diagnosis and recovery. Extensive fault detection circuits are provided throughout which include such features as parity checking on address and data information for main memory operations as well as for read-only memory used in the micro-instruction control logic; internal and external interface timeouts; checking of IOP data paths; and many others.

Fault Register

A unique hardware fault register is provided which automatically collects fault status and alters the operating system as to the nature of faults via the machine fault interrupt. Once the monitor has retrieved the contents of the fault register, an appropriate subroutine is called to perform recovery and logging procedures. The fault register contains status which both identifies the specific nature of the fault and isolates the faulty unit. Contents of the fault register may be displayed on the processor control panel.

Error Log

An error log file can save a history of all fault occurrences including those reported by the fault register, by input/output status, as well as various software checks. The error log is a powerful tool in the early identification and repair of intermittent problems. The error log can be accessed in various ways both locally at the site, and by experts located remote from the system but connected to it by means of the remote assistance interface.

Remote Assistance

The Xerox 530 offers the user a new service and maintenance concept. Every 530 maintained by Xerox is provided with a special remote troubleshooting communication link to a Xerox Field Engineering center. This interface is independent of any other communications equipment.

At the center, through the remote communication link, a trained Xerox Customer Engineer can assist with operator problems; debug software; examine monitor dumps; run verification programs; run off-line diagnostics; and run and query the system exerciser — all this can be accomplished *on line* through the Xerox 530 ASSIST program.

Diagnostic and Exerciser Programs

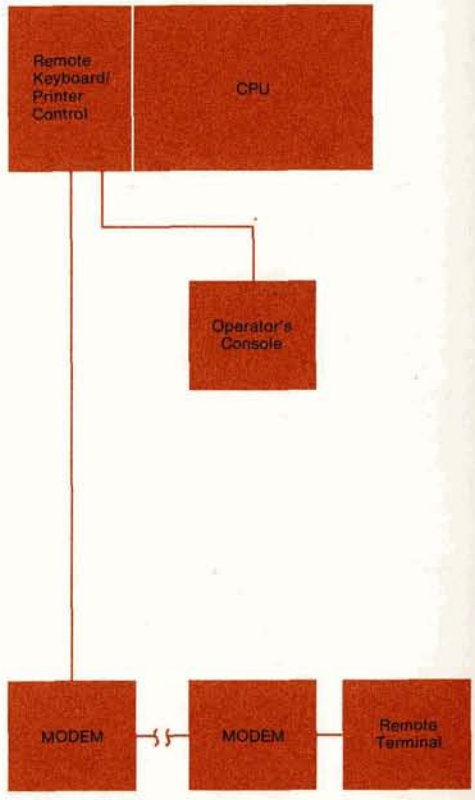
In addition to the error log as a diagnostic tool, there are three ways to diagnose or exercise the Xerox 530. The first is a "microdiagnostic," which tests the basic data and control paths. This diagnostic is permanently stored in read-only memory and is initiated automatically as a part of the load sequence. Faults detected during its execution are clearly displayed on the processor control panel.

The second is a set of unit diagnostics which have as their objective fault isolation to the smallest set of replaceable elements. These are provided for the CPU, memory, IOPs, and each peripheral. Special test instructions and features are provided that assist in the isolation process.

The third way is a system exerciser which, under program control, activates units in the system in order to verify their proper operation or to rapidly converge on a unit which is exhibiting subtle or infrequent fault characteristics.

The error log, unit diagnostics, and the system exerciser make use of improved English language user interface protocols, and all may be accessed or controlled remotely as well as locally.

Remote Assistance Communications Interface



Applications

Hundreds of Xerox multi-use systems, at work in applications similar to those shown here, have established Xerox as the world leader in the real-time computing field. The Xerox 530 offers the low-cost computer user the power and versatility required by these diverse applications.

Scientific and Engineering Processing
Data Acquisition
Circuit Design and Analysis
Statistical Analysis
Control Applications

Business Data Processing
Accounts Payable
Accounts Receivable
Payroll
Sales Analysis
General Ledger
Budget Reporting

Health Care
Physiological Monitoring
Hospital Accounting
Clinical and Research Laboratory Computerization
Analysis of Mathematical Models
Multiphasic Health Screening
ECG Analysis

Education
Teaching of Computer Sciences
On-Line, Real-Time Monitoring and Control of Laboratory Experiments
Business Data Processing
Student Use in Solving Homework Problems

Communications
Store-Forward Message Switching
Remote Information Retrieval and Update
Remote Data Display
Data Concentration
Order Entry
Data Collection

Radar
Precision Tracking
Target Identification
Impact Prediction
Coordinate Transformation

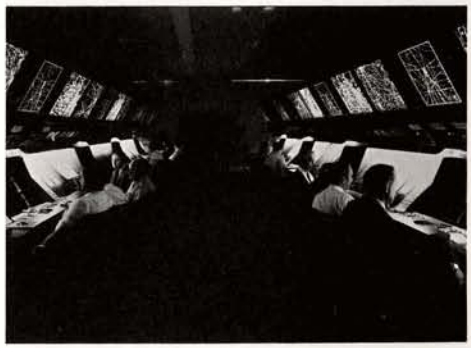
Simulation
Aircraft and Missile Simulation
Pilot Training
Fire Control Officer Training
Direct Digital Control
Test Report Generation
System Analysis and Parameter Optimization
Hybrid Computation

Nuclear Physics
Reactor Monitoring
Film Scanning
Pulse Height Analysis
Spark Chamber Data Analysis
Instrument and Reactor Control

Telemetry
Data Conversion
Data Editing
Data Compression
Data Quality
Data Display

Analytical and Scientific Laboratories
Gas and Liquid Chromatography
Mass Spectrometry
X-Ray Diffractometry
Nuclear Magnetic Resonance Spectroscopy

Industrial
Process Control
Process Monitoring
Automatic Testing and Checkout
Environmental Control
Accounting
Inventory Control

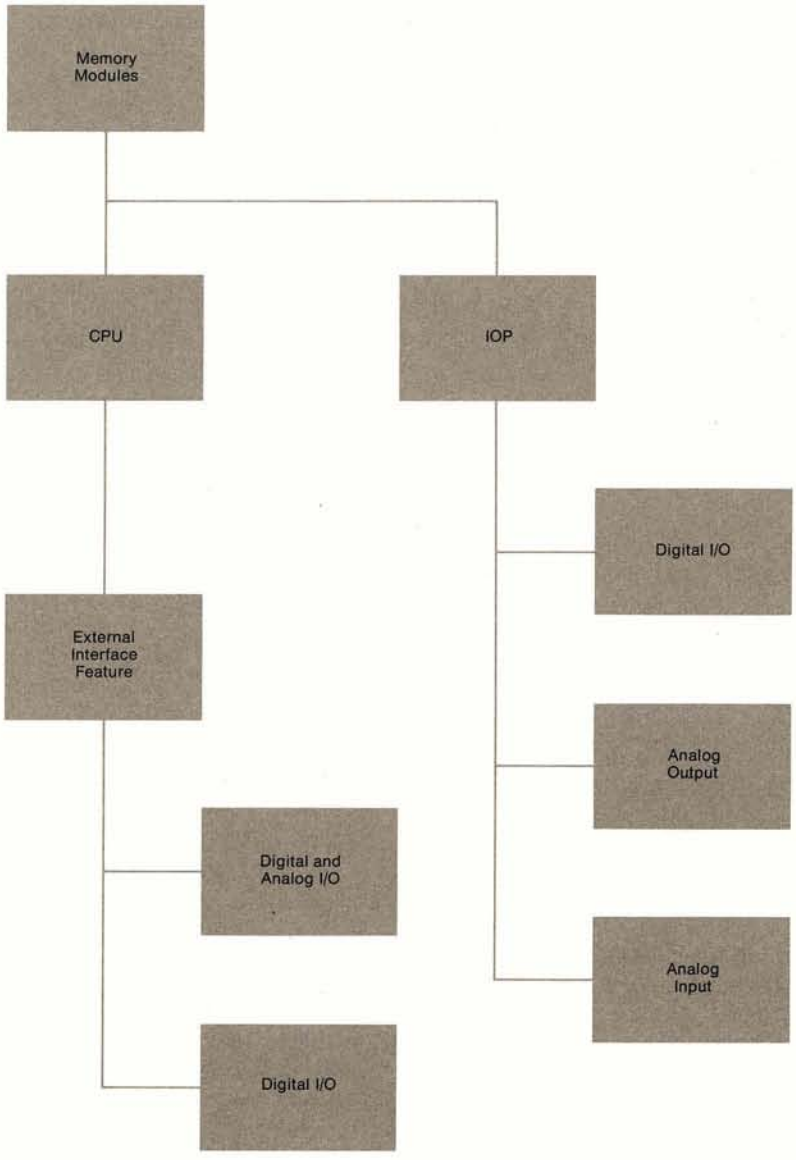


Systems Capabilities

The two Xerox technology centers — The Eastern Technology Center in Rockville, Maryland, and the Western Technology Center in El Segundo, California — provide complete system support, from concept through design, production, documentation, installation, maintenance, and facilities management.

Successful real-time, on-line systems require more than a highly efficient systems-oriented computer; they need hardware and software capable of interfacing the computer with specialized input/output devices, and capable of dealing with many kinds of information formats. In developing such systems, the degree of Xerox Systems Organization involvement is negotiable on any specific contract; however, there are definite advantages to the customer in allowing Xerox to take total, single-source responsibility for the entire system. These advantages include assurance of highest performance standards, greater confidence in the implemented solution, lower operational and maintenance costs, maximum system availability, and prevention of premature obsolescence.

Typical Xerox 530 Interface Configuration



System Interface Units (SIUs)

In many cases, a system can be satisfactorily implemented using standard off-the-shelf components. Xerox 530 customers preferring to take this approach will find their task greatly facilitated by the standardized System Interface Units available from Xerox. A wide selection of these off-the-shelf, modular units is provided, meeting the requirements for many types of special-purpose systems without the need for special engineering. SIUs, which connect analog and digital I/O devices to the system, are designed to take advantage of the advanced Xerox 530 input/output structure.

Specific benefits derived from using SIUs include:

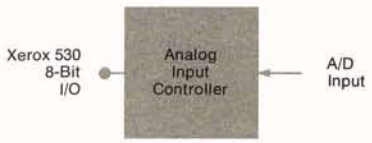
- LOWER COST User costs to perform each function are lower because these are standard units which are in full production.
- EASE OF DESIGN Because flexible performance is available in a wide variety of operating modes, the user can design his own system faster and more simply.
- EASE OF MAINTENANCE A full range of standard diagnostic and check-out programs facilitate SIU maintenance.
- EXTENSIVE DOCUMENTATION Thorough and accurate documentation is available to the user before hardware is installed.
- GREATER FLEXIBILITY Xerox engineers thoroughly research the design of these units, with special emphasis on their interaction with other system elements. Future expansion or change is simplified, with minimum cost to the user and minimum disturbance to the operating system.

SIU Software Support

A complete selection of diagnostics and handlers is available to support SIUs. Diagnostic software includes analog calibration and checkout programs, as well as input/output handlers. These handlers, available through the Xerox Computers Users' Group Library, are written in re-entrant code and are FORTRAN callable.

Standard System Interface Units Available for the Xerox 530 Systems Include:

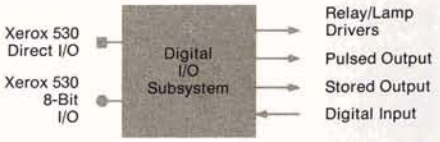
Analog Input Controller Provides the interface and control necessary to operate an analog-to-digital converter and a high-speed multiplexer through an 8-bit I/O channel. It permits random or sequential sampling of analog inputs, under program control, at prespecified intervals.



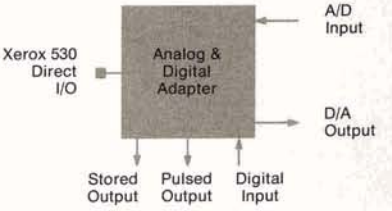
Analog Output Controller Provides the interface and control necessary to operate from one to 16 digital-to-analog channel controllers through an 8-bit I/O channel. Each channel controller can operate five to 16 digital-to analog converters. The analog output controller allows analog outputs to be controlled randomly, sequentially, or simultaneously.

IOP-to-DIO Adapter Transforms any Xerox 530 8-bit I/O channel into an interface identical to the Xerox 530 Direct I/O interface. This unit enables users to perform a program-specified number of 32-bit direct input or output operations, in any combinations, through an 8-bit I/O channel.

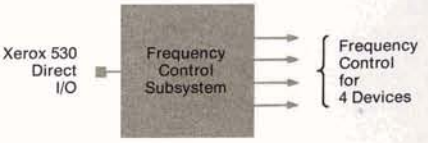
Digital I/O Subsystem Generates pulsed digital outputs, transfers data in memory to output registers, stores input signals in memory, drives relays or lamps, and provides latched relay drive signals. Each fully expanded subsystem accommodates 480 to 960 lines (intermixed input/output).



Analog and Digital Adapter Provides the interface and control circuitry to operate one analog-to-digital converter, one analog multiplexer, and one to 16 digital-to-analog channel controllers on Direct I/O. It generates pulsed digital outputs, transfers data in memory to output registers, and stores the states of input lines in memory.



Frequency Control Subsystem Provides frequency control of analog input, analog output, and digital transfer control units, causing external devices to perform operations at prespecified intervals. Each fully expanded unit furnishes four frequency sources. The frequency of each source can be specified manually or, optionally, under program control.



Peripheral Devices

A wide range of standard and special-purpose peripheral equipment is offered to meet the user's cost and performance requirements.

Rapid Access Data (RAD) Files
Capacities to 3 million bytes per unit; transfer rates of 188,000 bytes per second; average access times from 17 milliseconds.

Magnetic Tape Units
Both 7-track and 9-track systems, IBM compatible; units operating at 37.5 inches per second and 75 inches per second respectively. Transfer rates of 20.8k characters per second for the 7-track unit and 30,000 bytes per second for the 9-track unit.

Card Equipment
Reading speeds of 200 and 400 cards per minute; intermixed binary and EBCDIC card codes. Card punch operates at 100 cards per minute.

Line Printers
Fully buffered with speeds of 350 and 1100 lines per minute; 132 print positions and up to 64 characters.

Keyboard/Printers
Speed of 10 characters per second; also available with paper tape reader (20 characters per second) and punch (10 characters per second).

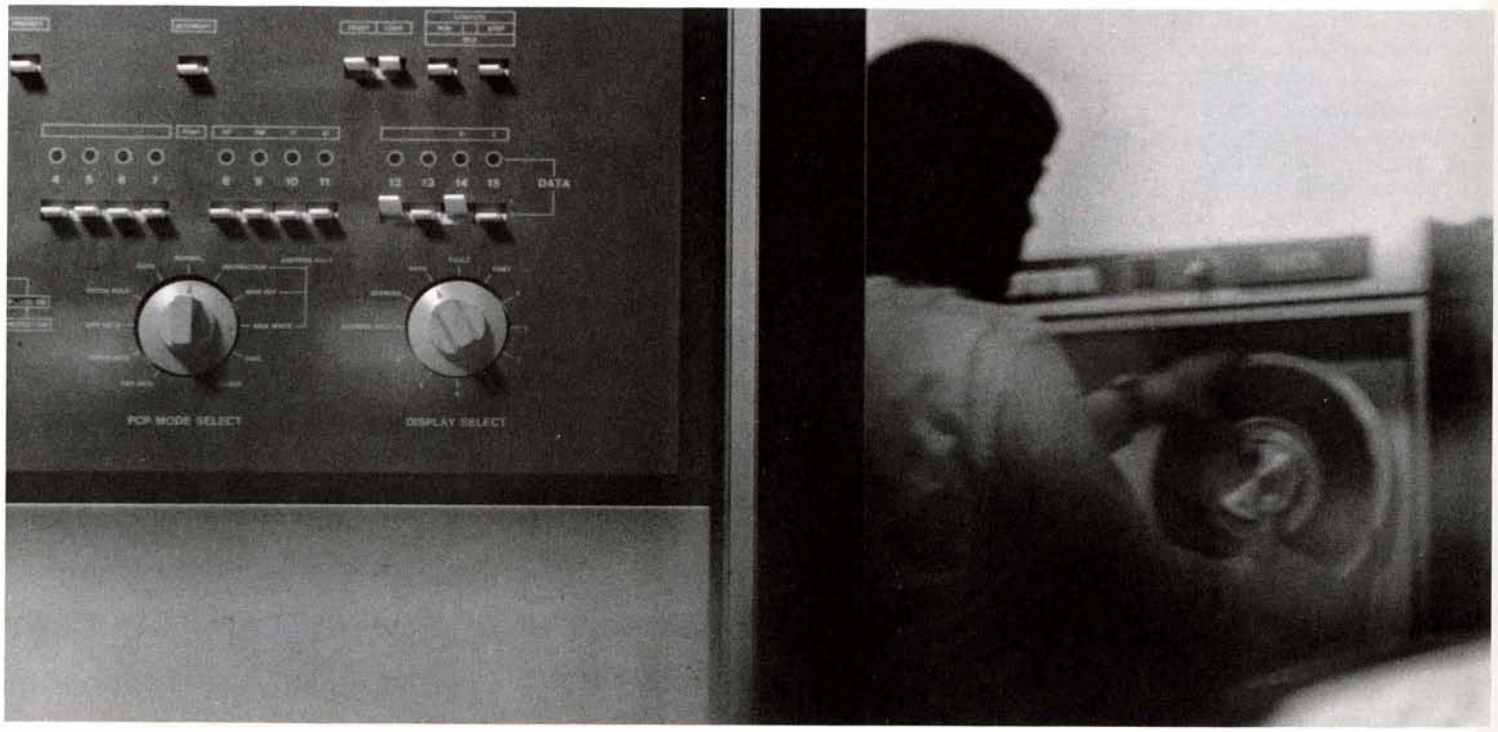
Paper Tape Equipment
Reader with speed of 300 characters per second; punch with speed of 75 characters per second.

Graph Plotters
Digital incremental, providing drift-free plotting at up to 300 steps per second. Available in 12 and 30 inch versions with increment sizes of 0.01 inches, 0.005 inches or 0.1 millimeters.

Data Communications Equipment
Complete line of character-oriented and message-oriented equipment to connect remote user terminals to the computer system via common carrier lines and local terminals directly.

Removable Disk Storage
Capacities from 24.5 million to 196 million bytes; transfer rate of 312,000 bytes per second; average access time of 87.5 milliseconds.

Xerox Cartridge Disk
Capacities from 2.3 megabytes per cartridige to 18.4 megabytes per controller are available. Transfer rate is 312,000 bytes per second and the average access time is 50.5 milliseconds (38 milliseconds seek plus 12.5 milliseconds latency).



Instruction List

Memory Reference Instructions

LDA	Load Register A
STA	Store Register A
LDX	Load Index
ADD	Add
SUB	Subtract
AND	Logical And
IM	Increment Memory
S	Shift (General)
SARS	Shift Arithmetic Right Single
SARD	Shift Arithmetic Right Double
SALS	Shift Arithmetic Left Single
SALD	Shift Arithmetic Left Double
SCRS	Shift Circular Right Single
SCRD	Shift Circular Right Double
SCLS	Shift Circular Left Single
SCLD	Shift Circular Left Double
CP	Compare
B	Branch

Conditional Branch Instructions

BAN	Branch if Accumulator Negative
BAZ	Branch if Accumulator Zero
BEN	Branch if Extended Accumulator Negative
BNO	Branch if No Overflow
BNC	Branch if No Carry
BIX	Branch on Incrementing Index
BXNO	Branch on Incrementing Index and No Overflow
BXNC	Branch on Incrementing Index and No Carry

Copy Instructions

A one-word copy instruction specifies operations between any two general registers.

RCPY	Register Copy
RADD	Register Add
ROR	Register OR
REOR	Register Exclusive OR
RAND	Register AND
RCPYI	Register Copy and Increment
RADDI	Register Add and Increment
RORI	Register OR and Increment
REORI	Register Exclusive OR and Increment
RANDI	Register AND and Increment
RCPYC	Register Copy and Carry
RADDC	Register Add and Carry
RORC	Register OR and Carry
REORC	Register Exclusive OR and Carry
RANDC	Register AND and Carry
RCLA	Register Clear and Add
RCLAI	Register Clear, Add, and Increment
RCLAC	Register Clear, Add, and Carry
MUL	Multiply
DIV	Divide

Read Direct (RD) and Write Direct (WD) Instructions

The READ DIRECT and WRITE DIRECT instructions generate a set of control or nonarithmetic instructions that may be comprised of 16 subsets of instructions (one subset of instructions for each mode or for each portion of the computer system).

General Register Instructions

LW	Load Word
STW	Store Word
AW	Add Word
SW	Subtract Word
AND	Logical And
CW	Compare Word

Multiple Register Instructions

LDM	Load Multiple
LDD	Load Double
STM	Store Multiple
STD	Store Double
DAD	Double Add
DSB	Double Subtract
CPD	Compare Double

Floating Point Instructions (Optional)

FLD	Floating Load
FST	Floating Store
FAD	Floating Add
FSB	Floating Subtract
FMP	Floating Multiply
FDV	Floating Divide
FCP	Floating Compare
SFM	Set Floating Mode

Field Addressing Instructions (Optional)

LLF	Load Logical Field
LAF	Load Arithmetic Field
STF	Store Field
STZ	Store Zero Field
SOF	Store Ones Field
CLF	Compare Logical Field
CAF	Compare Arithmetic Field
SLF	Sense Left Bit of Field

I/O Instructions

SIO	Start Input/Output
TIO	Test Input/Output
TDV	Test Device
HIO	Halt Input/Output
AIO	Acknowledge I/O Interrupt

Xerox 530 Specification Summary

Memory Capacity	8,192 to 65,536 16-bit words
Memory Cycle Time	800 nsec
Word Size	16 bits plus 2 bits parity
General Registers	6
I/O Channels	28
Maximum Number of External Priority Interrupts	30
Instruction Execution Speeds (microseconds)	
Load	1.92
Store	2.20
Add	1.92
Multiply	8.00
Divide	13.12
Compare	1.92
Logical And	1.92

XEROX

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