

Greyhound Phoenix X-30



The Phoenix X-30 console will be comfortably familiar to anyone who has operated an IBM 360/30. Atop the CPU cabinet is a multiple-pen chart recorder that was used to measure and analyze the system's performance on live benchmark tests at the National Computer Conference.

MANAGEMENT SUMMARY

The last two years have been lean ones for the computer leasing industry. Most of the major leasing companies have taken huge writeoffs to compensate for the differences between the book values of the IBM System/360 computers in their portfolios and the harsh realities of the current used computer market. What's more, many of the leasing firms have resorted to cutthroat pricing and other desperate measures to keep their System/360 equipment on rent.

Greyhound Computer Corporation has taken a distinctly different and refreshingly positive approach to the problem. Greyhound is convinced that it's still possible to lease System/360 equipment profitably if the price/performance level of that equipment is enhanced so that it equals or exceeds the level of the System/370 and other current computer systems.

Few would seriously dispute that hypothesis—but Greyhound has taken the next big step by assembling an integrated hardware/software package that upgrades the humble System/360 Model 30 into one of the most cost-effective medium-scale computer systems currently on the market. ➤

By means of a neatly integrated collection of hardware and software enhancements, Greyhound has transformed the IBM System/360 Model 30 into a cost-effective new entry in the medium-scale computer market.

CHARACTERISTICS

SUPPLIER: Greyhound Computer Corporation, Greyhound Tower, Phoenix, Arizona 85077. Telephone (602) 248-2900.

MODEL: Phoenix X-30 (an enhanced IBM System/360 Model 30).

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes form a "halfword" of 16 bits, while four consecutive bytes form a 32-bit "word."

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; or 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format.

INSTRUCTIONS: 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively.

INTERNAL CODE: EBCDIC (Extended Binary-Coded Decimal Interchange Code). The processor can alternatively use 8-bit ASCII, but no software support is provided for this code.

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: Model 30-128 - 131,072 bytes; Model 30-256 - 262,144 bytes; Model 30-384 - 393,216 bytes; Model 30-512 - 524,288 bytes; Model 30-768 - 786,432 bytes; Model 30-1024 - 1,048,576 bytes.

CYCLE TIME: 1.5 microseconds per 2-byte access (as compared to 1.5 microseconds per 1-byte access in the original IBM 360/30).

CHECKING: Parity bit with each byte is generated during writing and checking during reading.

STORAGE PROTECTION: The Storage Protection feature, which guards against inadvertent overwriting of data in specified 2048-byte blocks of storage, is standard. ➤

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➤ The Phoenix X-30 System was unveiled and demonstrated at the National Computer Conference in June 1973. It began life as an ordinary IBM 360/30 (one of 300-odd System/360's in Greyhound's \$200 million portfolio). The skins were removed and Computer Hardware Consultants and Services, Inc. (CHCS) installed its unique CPU Accelerator plus the capability for expanded main storage capacities ranging from 131K to 1 million bytes. Double-density CalComp disk drives were made available to complement the increased main storage and processing power. The EDOS (Extended Disk Operating System) enhancements developed by The Computer Software Company were added to increase the system's throughput and operating efficiency. Finally, the skins were replaced and painted a bright, non-IBM orange, and the Greyhound Phoenix flew forth from the ashes of the obsolescent IBM 360/30.

Actually, the Phoenix System has evolved over a period of time. Greyhound Computer Corporation, a leader in the application of System/360 enhancements, was the first to expand the Model 30's memory capacity to 131K bytes, then to 262K bytes, and finally to 512K bytes. The first CHCS Accelerator was installed in Greyhound's San Francisco Data Center in January 1973. At present, Greyhound has Phoenix systems installed in both its Chicago and San Francisco Data Centers. Additional systems will soon be installed in several other Data Centers, where they will be used for both production work and benchmarking.

Details of all the Phoenix hardware and software enhancements, as well as the full story on pricing and support, can be found in the Characteristics section of this report.

The Phoenix System raises two key questions in the minds of most prospective buyers:

1. Is it really a new computer system?
2. Is it a viable alternative to the System/370?

Here are the answers as Datapro sees them.

Is the Phoenix X-30 a new computer system or merely an artfully repackaged old one? The question is almost a philosophical one, and an impressive argument could be made for either side. But from the viewpoint of prospective users, the Phoenix X-30 deserves the same careful consideration as other newly announced computers. Its price/performance level is on a par with current industry standards, and Greyhound guarantees and accepts full system responsibility for its installation and maintenance so that the user will need to deal with only one vendor. For current users of the System/360, the Phoenix System offers the further attraction of full ➤

➤ CENTRAL PROCESSOR

INDEX REGISTERS: Sixteen 32-bit general registers, used for indexing, base addressing, and as accumulators, plus four 64-bit floating-point registers.

INDIRECT ADDRESSING: None.

INSTRUCTION REPERTOIRE: The System/360 "Standard Instruction Set" and the Decimal Arithmetic and Floating-Point Arithmetic features are all standard on the Phoenix X-30. The 86 instructions in the standard set handle fixed-point binary arithmetic, loading, storing, comparing, shifting, branching, radix conversion, code translation, logical operations, packing, and unpacking. The Decimal Arithmetic feature provides 8 additional instructions that handle arithmetic, comparison, and editing operations on variable-length decimal operands. The Floating-Point Arithmetic feature provides 44 additional instructions that perform arithmetic and comparison operations on floating-point operands expressed in both the "short" (1-word) and "long" (2-word) formats. Also standard is the Interval Timer, which provides a facility to generate program interrupts at specified time intervals.

INSTRUCTION TIMES: The CHCS Accelerator makes the Phoenix X-30 operate up to 50% faster internally than the basic IBM 360/30. On the average, it appears that overall CPU times will be approximately 25% faster with the Accelerator. Some sample instruction times, in microseconds, are as follows:

	<u>IBM 360/30</u>	<u>Phoenix X-30</u>
Load (L)	24	16.5
Store (ST)	24	16.5
Load Multiple (LM)	206	105
Add (A)	29	22
Load Register (LR)	17	9

The results of three benchmark job timings conducted by CHCS, which compared internal speeds only, are as follows:

	<u>IBM 360/30</u>	<u>Phoenix X-30</u>
Job A	6.45 min.	4.35 min.
Job B	6.30 min.	4.45 min.
Job C	16.20 min.	12.05 min.

INPUT/OUTPUT CONTROL

I/O CHANNELS: One multiplexer channel and two selector channels are standard in the Phoenix X-30.

CONFIGURATION RULES: The multiplexer channel and each selector channel can accommodate up to eight peripheral control units. Most peripheral devices can be connected to either a multiplexer or selector channel. Exceptions are the data communications controllers and character readers, most of which require a multiplexer channel, and the high-speed mass storage units, which require a selector channel.

SIMULTANEOUS I/O OPERATIONS: Concurrently with computing, the Phoenix X-30 can control a maximum of one high-speed I/O operation on each selector channel and one low-speed I/O operation per multiplexer subchannel. Alternatively, the multiplexer channel can operate in the "burst" mode and handle a single high-speed operation. ➤

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▷ compatibility with respect to programs, data, and operating procedures.

Is the Phoenix X-30 a viable alternative to the System/370 and other current computer systems? Unquestionably, Greyhound has done a great deal to increase the capabilities of the original System/360 Model 30:

- The CHCS Accelerator increases the CPU's internal speed by an overall average of roughly 25 percent, and reduces the CPU delays imposed by multiplexer channel I/O operations even more dramatically. This is accomplished by adding a new 2-byte-wide Arithmetic and Logic Unit (ALU) to augment the 360/30's original 1-byte ALU, adding new shift registers to hold the CPU registers' contents while processing I/O, and making extensive changes to the microcode in the 360/30's read-only storage.
- The CHCS add-on memory permits up to 1 million bytes of main storage—16 times the original 360/30 maximum capacity. This large, modestly priced memory allows advanced multiprogramming and will often preclude the need for virtual storage.
- The CalComp disk drives provide faster access times at a lower price than the IBM 2314 drives. (The average head movement times and data transfer rates of these drives are slower than those of IBM's newer 3330 and 3340 drives. Greyhound, however, points out that the resulting performance differences can easily be greatly overestimated because the use of multiple drives and cylinder addressing makes random arm movements a comparative rarity, which can often be avoided by programming.)
- EDOS provides six-partition multiprogramming, input and output spooling, a blocked fetch feature that greatly reduces program load times, simulation of System/370 instructions, and a variety of other "big computer" software facilities. In addition, measurements by an independent consultant have clearly demonstrated that EDOS significantly reduces the number of disk accesses required to perform common systems tasks.

But is all this enough? That's the critical question that every prospective user will have to answer for himself—and the only definitive way to answer it is through benchmark testing to determine run times for the user's own workload on the Phoenix System as compared to the times on his current system and on competitive offerings.

All too often, benchmark testing is fraught with difficulties and hazards that make it a time-consuming and imprecise process. But in this case, System/360 users ▷

▶ **I/O INTERFERENCE:** Although maximum I/O data rates of the Phoenix X-30 multiplexer and selector channels are the same as those of the basic IBM 360/30 channels, the delays imposed upon the CPU by I/O operations are substantially lower in the X-30.

The basic 360/30 selector channels cause the CPU to be delayed for 2 cycles each time a byte of I/O data is transferred. In the Phoenix X-30, the CPU is delayed only when it attempts to access main storage at the same time as a selector channel. According to Greyhound, this improvement typically reduces the selector channel interference with CPU operations by 20 to 25%.

The multiplexer channel, which is generally used for punched card, printer, and communications I/O, shares its logic with that of the CPU. As a result, the basic 360/30 multiplexer channel, when operating in the byte-interleaved mode, typically requires about 60 microseconds of CPU time for each byte of data transferred. The Phoenix X-30's Accelerator reduces this CPU interference to just 36 microseconds per byte through improved microcode and a new set of shift registers that hold the contents of the CPU data registers during multiplexer channel operations.

MASS STORAGE

IBM 2314 DIRECT ACCESS STORAGE FACILITY: Provides large-capacity random-access storage. Consists of a controller and from four to nine independent drive modules, each capable of storing up to 29.17 million bytes in a removable 2316 Disk Pack. A maximum of eight drives can be on-line at a time; the ninth drive module is provided as a spare. Each module has a comb-type access mechanism that can read or write up to 145,880 bytes (20 tracks) at each of its 200 positions. Average head movement time is 75 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 312,000 bytes/sec. Record lengths are variable.

CALCOMP CD22/14 DISK SYSTEM: A faster-access, lower-priced counterpart of the IBM 2314 subsystem described above. Consists of a controller and from one to nine drive modules, housed either one or two drives to a cabinet. Average head movement time is 35 milliseconds. In all other respects, the CalComp subsystem is functionally equivalent to the IBM 2314. CalComp began delivering the CD22/14 Disk System in March 1970.

CALCOMP 1015A DISK SYSTEM: A double-density version of the IBM 2314 subsystem described above. Consists of a controller and from one to nine drive modules, each capable of storing up to 58.34 million bytes in a removable IBM 2316 Disk Pack or equivalent. A maximum of eight drives can be on-line at a time; the ninth drive module is provided as a spare. Each module has a comb-type access mechanism that can read or write up to 145,880 bytes (20 tracks) at each of its 400 positions. Average head movement time is 35 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 312,000 bytes/second. Record lengths are variable. CalComp began delivering the 1015A Disk System in June 1971.

OTHER MASS STORAGE DEVICES: In addition to the subsystems described above, any IBM or IBM-compatible mass storage device that is usable with the IBM 360/30 can also be used with the Phoenix X-30. ▶

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➤ already have all the programs, data, and JCL they'll need to check out the Phoenix System's capabilities and cost-effectiveness with comparatively little effort.

Datapro witnessed benchmark tests on the Phoenix X-30 at both the National Computer Conference in New York City and at the CHCS plant in Newtown, Pennsylvania. In all cases, the tests proceeded smoothly and any problems that arose were quickly solved. Run times were generally 10 to 40 percent shorter than on the IBM 360/30. The greatest improvements were obtained in heavily multiprogrammed environments in which many of the programs were limited by the CPU and/or the multiplexer channel; only modest improvements were noted when I/O-limited programs were processed in a single partition.

Thus, the Phoenix X-30 appears to be an attractive solution to the needs of many organizations that are currently using a System/360 Model 25, 30, or 40 and are looking for increased throughput and/or lower equipment costs. It should be particularly effective in communications-oriented environments that involve multiple partitions, frequent job switching, and heavy multiplexer channel loads. For companies that have these requirements, are willing to make long-term lease commitments, and can resist the pressure to switch to the latest IBM equipment, the Phoenix X-30 could well be a "best buy."

Greyhound is currently working in conjunction with CHCS to develop a larger Phoenix System based on the System/360 Model 40. Its announcement can be expected within the next few months. And if the Phoenix concept is successful, it's a safe bet that many of Greyhound's competitors in the computer leasing field will soon be offering similar integrated packages. From the user's viewpoint, this trend can only be a happy one; it gives him more sources to turn to for the hardware and software he needs, and should therefore help to lessen IBM's dominance of the industry.

USER REACTION

The first two complete Phoenix Systems in user installations are scheduled to go into operation last in August 1973. Thus, it was impossible to interview users of the full system for this report. But all of the key hardware and software features of the Phoenix package are also available separately from their developers, all are already in use in multiple installations, and all have received high marks from their users.

CHCS began delivering its System/360-compatible core memories in July 1970 and has installed approximately 60 units to date. Datapro interviewed several users and found them well pleased with the reliability of the product and the quality of the CHCS service. Compatibility with the ➤

➤ INPUT/OUTPUT UNITS

IBM 2401 MAGNETIC TAPE UNIT, MODELS 1-6: These units have the following basic characteristics:

Model 1:	800 bpi;	30,000 bytes/sec	at 37.5 in/sec.
Model 2:	800 bpi;	60,000 bytes/sec	at 75.0 in/sec.
Model 3:	800 bpi;	90,000 bytes/sec	at 112.5 in/sec.
Model 4:	1600 bpi;	60,000 bytes/sec	at 37.5 in/sec.
Model 5:	1600 bpi;	120,000 bytes/sec	at 75.0 in/sec.
Model 6:	1600 bpi;	180,000 bytes/sec	at 112.5 in/sec.

All models use standard 1/2-inch, 9-track tape, have 0.6-inch inter-record gaps, and can read backward as well as forward. Models 1, 2, and 3 can alternatively be equipped with a 7-track head, making them compatible with the second-generation IBM 729 tape units. Models 4, 5, and 6 can be equipped with a Dual Density feature that enables them to operate at 800 bpi as well as 1600 bpi.

All models perform read-after-write checking of the data they record. Models 1, 2, and 3 perform vertical, longitudinal, and diagonal parity checks. Models 4, 5 and 6 perform vertical parity checking only, but can automatically correct single-track read errors without rereading.

Up to eight 2401 units can be connected to a 2803 (single-channel) or 2804 (dual-channel) Tape Control of the appropriate model.

CALCOMP 345 MAGNETIC TAPE UNIT: A functionally compatible replacement for the IBM 2401, 2420, or 3420 Series Magnetic Tape Units. Uses standard 1/2-inch, 9-track tape and features a vacuum-capstan drive mechanism. The 345 Model 1 records at 1600 bpi only and has a data transfer rate of 200,000 bytes/second. The 345 Model 2 records at either 800 or 1600 bpi and has a data transfer rate of 100,000 or 200,000 bpi, respectively. Up to 8 drives can be connected to a CalComp 1040 controller of the appropriate model. Switching features permit 2, 3, or 4 controllers to share up to 16 drives. CalComp began delivering the 345 drives in April 1972.

IBM 2540 CARD READ PUNCH: Consists of two functionally separate units, a 1000-cpm reader and a 300-cpm punch, in a single cabinet. The 2821 Control Unit provides fully buffered card reading and punching; some models of the 2821 can also control one or two 1403 Printers.

IBM 1403 PRINTER: Provides high-quality printed output by means of a horizontal chain or train mechanism. Model 2 and Model N1 have rated printing speeds of 600 and 1100 lines per minute, respectively; both have 132 print positions. The standard character set contains 48 characters, expandable to up to 240 with the optional Universal Character Set feature. Standard skipping speed is 33 inches per second; a dual-speed carriage in Models 2 and N1 permits a speed of 75 inches per second on skips of more than 8 lines. Model N1 has a motor-operated acoustical cover to reduce the noise level. The 2821 Control Unit provides fully buffered printing; some models of the 2821 can also control a 2540 Card Read Punch.

OTHER INPUT/OUTPUT UNITS: In addition to the devices described above, any IBM or IBM-compatible peripheral device that is usable with the IBM 360/30 can also be used with the Phoenix X-30.

COMMUNICATION CONTROL

In the Phoenix X-30, as in the IBM 360/30, data communications operations will normally be controlled by ➤

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Phoenix System buyers can elect to use magnetic tape units and disk drives manufactured by either IBM or CalComp. Punched card I/O functions will normally be handled by the familiar IBM 2540 Card Read Punch at left.

▷ original IBM memories was reported to be complete, and minor installation problems, if any, were quickly resolved.

The CHCS Accelerator was initially installed in January 1973, and approximately six have been delivered to date. Users report that the Accelerator performs as advertised, causes no compatibility problems, and yields worthwhile improvements in throughput. One user found that the Accelerator increased the overall internal speed of his 360/30 by 25 percent in a carefully controlled test. It took CHCS two full days of around-the-clock efforts to complete this installation, but as soon as it was completed the Accelerator performed faultlessly.

CHCS is currently planning a merger with Comma Corporation, a leading independent service organization. The resulting CHCS/Comma organization (whose formal name is undecided at this writing) will have a field maintenance force of approximately 200 technicians located in service offices in 13 major cities from coast to coast. Comma's maintenance service has generally received good ratings from its users, and it is likely that users of the Phoenix mainframe will receive service that is equal to or better than IBM's service.

In Datapro's recent survey of plug-compatible disk drive users, a total of 24 users of CalComp's single- and double-density replacements for the IBM 2314 rated them good to excellent in all four categories: overall performance, ease of operation, hardware reliability, and maintenance service. (The IBM 2314 drives themselves were rated lower in ease of operation and nearly the same as the CalComp drives in the other three categories.)

Users of EDOS give its supplier, The Computer Software Company, a top rating for credibility and quality of service. Respondents to Datapro's recent survey of proprietary software users rated EDOS good to excellent in all five respects: overall satisfaction, throughput/ ▷

▶ an IBM 2701 Data Adapter Unit, a 2702 Transmission Control, or a 2703 Transmission Control; a detailed description of these units can be found in Report 70D-491-30. The newer, programmable IBM 3704 or 3705 Communications Controllers can also be used, but only in the 270X Emulation mode; for details, please see Reports 70D-491-31 and 70D-491-32.

SOFTWARE

The Phoenix X-30 System maintains complete program and data compatibility with the IBM System/360, and can therefore use either the IBM DOS or OS/360 operating system and all of the related language processors, utility routines, and application programs. Most Phoenix installations, however, are expected to use EDOS, an extended version of IBM's DOS that is described below. Also available to Phoenix users is MCS (Management Control System), a modular software system designed to regulate and maintain all the basic business functions of a corporation.

EDOS (EXTENDED DISK OPERATING SYSTEM): EDOS is a collection of enhancements for IBM's DOS Release 26 that give it many of the desirable features of OS/360 and other large-scale operating systems. Developed and marketed by The Computer Software Company of Richmond, Virginia, EDOS is being offered to Phoenix System users as a standard part of the Phoenix package.

Among the major "OS-type" facilities of EDOS are:

- Support for up to six independent job partitions, allowing up to twice the usual number of job streams to be processed concurrently.
- Comprehensive input and output spooling on disk for up to 63 "virtual" devices.
- Full-fledged job accounting statistics, prepared by means of a report generator included in the system.
- Automatic volume sensing, allowing the operator to mount tape and disk volumes with minimal console intervention.
- Program relocatability, allowing any user-written program to be executed in any partition. ▶

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▷ efficiency, ease of installation, documentation, and vendor technical support.

The IBM 360/30 mainframe, which forms the basis for the Phoenix X-30 System, enjoys a long-established reputation as a solid though unspectacular performer, and the System/360 software, despite its well-publicized faults, is getting the job done in thousands of installations. Thus, the overall outlook for user satisfaction with the Phoenix System must be regarded as unusually good. □

- ▶ ● Dynamic priority reassignment to balance CPU-bound and I/O-bound problem-program partitions for increased throughput.
- Source program library facilities that enable the user to store, modify, and retrieve his programs more efficiently.
- Blocked fetch, a feature that greatly reduces the load times required to fetch program modules from the core-image library.
- Improved Storage Dump and Volume Dump-Restore facilities, which slash the times required for these utility functions.

Details of these and other facilities of EDOS can be found in Report 70E-841-01. In addition, EDOS Release 5.1, which is the latest version and the one currently furnished with the Phoenix System, includes one important new feature: 360/370 Compatibility. This feature makes the full System/370 instruction set available to System/360 users through software simulation routines, which are entered automatically when the System/360 processor recognizes an "illegal" (i.e., 370-only) operation code. The 360/370 Compatibility Feature adds 2K bytes to the EDOS main memory requirements and, according to Greyhound, enables a Phoenix System with adequate storage and I/O devices to execute any real-mode System/370 program. Most programs make comparatively little use of the instructions that are unique to the System/370; as a result, the software simulation of these instructions will normally cause little or no noticeable degradation in performance.

MCS (MANAGEMENT CONTROL SYSTEM): MCS is a comprehensive accounting and control system that consists of seven modules: Input Processor, Invoicing, Accounts Receivable, Inventory, Accounts Payable, Payroll and Labor Distribution, Fixed Assets, and General Accounting. The MCS modules can be utilized to implement either individual functions or a complete integrated system. Developed by Management Computer Services, Inc. of Phoenix, Arizona, MCS is being offered to Phoenix System users as an optional part of the Phoenix package.

The MCS Input Processor handles the transaction data for all modules, edits and validates the input data, and handles the master-file creation and maintenance functions. A

central master-file data base holds the file data required by all of the functional modules. Transaction data needs to be entered only once, and multiple records are generated or updated automatically when necessary. A system dictionary and a variety of output options make it comparatively easy to adapt the MCS reports to changing application requirements. A "parent company" feature facilitates the production of financial reports on subsidiary levels. MCS is coded in COBOL and can accept input from cards, tape, or optical scanners.

PRICING

TYPICAL TAPE/DISK SYSTEM: Consists of Phoenix Model 30-384 Processing Unit with 393K bytes of core storage and two selector channels, console, Calcomp 1015A Disk System with four "double-density" drives (233.4 million bytes total), IBM 2803 Model 2 Tape Control and four IBM 2401 Model 5 Magnetic Tape Drives (120KB), IBM 2821 Model 1 Control Unit, IBM 1403 Model N1 Printer, and IBM 2540 Card Read Punch. Monthly lease prices, including equipment maintenance, are as follows: \$16,878 on 1-year lease, \$12,838 on 3-year lease, or \$10,880 on 5-year lease.

SOFTWARE: EDOS is included as part of the basic Phoenix System package. The complete MCS package is offered (to Phoenix System users only) at the following monthly charges: \$1,405 on a 2-year lease, \$1,000 on a 3-year lease, \$795 on a 4-year lease, or \$650 on a 5-year lease. Individual MCS modules are available at lower prices. IBM Type I and II (pre-unbundling) programs are available to anyone—including Phoenix Users—at modest service charges. IBM Program Products are also available to anyone at specified monthly use charges.

SUPPORT: Hardware and software installation, maintenance and improvements are provided on-site and are guaranteed by Greyhound Computer Corporation. EDOS is installed and field-supported by Greyhound; maintenance and additional technical support are furnished by The Computer Software Company, its developer. Equipment maintenance will normally be handled by CHCS/Comma for the Phoenix CPU and by CalComp for the CalComp disk drives. Users can choose to have their IBM peripheral equipment serviced by either IBM or CHCS/Comma; basic lease prices are the same in either case, but CHCS/Comma's prices for extra-shift coverage or per-call service are much lower than IBM's. Additional technical support, including complete turnkey conversions, can be obtained from Greyhound's Data Services Division.

CONTRACT TERMS: The Phoenix System is available under lease plans of one, two, three, four, and five years. The standard lease contract permits unlimited use of the equipment and includes single-shift maintenance coverage. Additional maintenance coverage is available from either IBM or CHCS/Comma on either a scheduled extra-shift basis or a per-call basis. Greyhound also offers purchase option plans; prospective users interested in either purchase options or outright purchase of the equipment should contact Greyhound Computer Corporation for details. ■

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EQUIPMENT PRICES

	Monthly Lease Prices*				
	1-Year	2-Year	3-Year	4-Year	5-Year
PROCESSOR AND MAIN STORAGE					
Phoenix System: includes EDOS, CHCS Accelerator, Decimal Arithmetic, Floating Point, Interval Timer, Multiplexer Channel, 2 Selector Channels, Storage Protection, Console, Printer-Keyboard, transportation to customer site (in continental U.S.A.), installation, personal property tax, and prime-shift maintenance:					
Model 30-128; 131,072 bytes	5,700	5,000	4,400	3,900	3,500
Model 30-256; 262,144 bytes	7,700	6,200	5,400	4,800	4,300
Model 30-384; 393,216 bytes	9,400	7,400	6,400	5,700	5,100
Model 30-512; 524,288 bytes	11,000	8,700	7,500	6,600	6,000
Model 30-768; 786,432 bytes	14,400	11,200	9,600	8,500	7,600
Model 30-1024; 1,048,576 bytes	17,700	13,700	11,700	10,300	9,300
MASS STORAGE					
IBM 2314 Direct Access Storage Facility:					
Model 4; 4 drives, 116.6M bytes	2,332	2,203	2,074	1,945	1,816
Model 5; 5 drives, 145.8M bytes	2,744	2,593	2,443	2,293	2,142
Model 6; 6 drives, 175.2M bytes	2,877	2,709	2,542	2,375	2,207
Model 7; 7 drives, 204.4M bytes	3,262	3,073	2,884	2,696	2,507
Model 8; 8 drives, 233.2M bytes	3,660	3,450	3,240	3,030	2,820
Model 9; 9 drives, 233.2M bytes plus spare	3,660	3,450	3,240	3,030	2,820
CalComp CD22/14 Disk System, including controller:					
Model 1; 1 drive, 29.2M bytes	1,502	1,371	1,306	1,240	1,178
Model 2; 2 drives, 58.3M bytes	1,778	1,623	1,546	1,468	1,395
Model 3; 3 drives, 87.6M bytes	2,054	1,875	1,786	1,696	1,611
Model 4; 5 drives, 116.6M bytes	2,330	2,127	2,026	1,924	1,828
Model 5; 5 drives, 145.8M bytes	2,606	2,379	2,266	2,152	2,044
Model 6; 6 drives, 175.2M bytes	2,882	2,631	2,506	2,380	2,261
Model 7; 7 drives, 204.4M bytes	3,158	2,883	2,746	2,608	2,478
Model 8; 8 drives, 233.2M bytes	3,434	3,135	2,986	2,836	2,694
Model 9; 9 drives, 233.2M bytes plus spare	3,710	3,387	3,226	3,064	2,911
Two-Channel Switch	123	109	106	100	95
CalComp 1015A Disk System, including controller:					
Model 1; 1 drive, 58.3M bytes	1,735	1,580	1,500	1,440	1,368
Model 2; 2 drives, 116.7M bytes	2,140	1,950	1,850	1,780	1,691
Model 3; 3 drives, 175.0M bytes	2,545	2,320	2,200	2,120	2,014
Model 4; 4 drives, 233.4M bytes	2,950	2,690	2,550	2,460	2,337
Model 5; 5 drives, 291.7M bytes	3,355	3,060	2,900	2,800	2,660
Model 6; 6 drives, 350.0M bytes	3,760	3,430	3,250	3,130	2,983
Model 7; 7 drives, 408.3M bytes	4,165	3,800	3,600	3,480	3,306
Model 8; 8 drives, 466.8M bytes	4,570	4,170	3,950	3,820	3,629
Model 9; 9 drives, 466.8M bytes plus spare	4,975	4,540	4,300	4,160	3,952
Two-Channel Switch	137	130	123	117	111
INPUT/OUTPUT UNITS					
IBM 2401 Magnetic Tape Units:					
Model 1; 800 bpi, 30KB	277	250	237	223	210
Model 2; 800 bpi, 60KB	371	332	313	293	274
Model 3; 800 bpi, 90KB	524	461	429	398	367
Model 4; 1600 bpi, 60KB	341	310	295	279	264
Model 5; 1600 bpi, 120KB	430	388	366	345	323
Model 6; 1600 bpi, 180KB	514	447	414	380	347
#3471 Dual Density (for 2401 Model 4, 5, or 6)	6	5	5	5	4
#7160 Simultaneous Read/Write (for any 2401)	6	5	5	5	4
IBM 2803 Tape Control (single channel):					
Model 1; 800 bpi	455	403	377	351	325
Model 2; 1600 bpi	561	497	465	433	401
#3228 Data Conversion (for 2803)	31	27	26	24	22
#7125 7-Track Compatibility (for 2803-1)	35	31	29	27	25
#5320 9-Track Compatibility (for 2803-2)	182	164	154	145	136
#7235 7 & 9-Track Compatibility (for 2803-2)	298	268	253	238	213
IBM 2804 Tape Control (dual channel):					
Model 1; 800 bpi	658	584	546	509	472
Model 2; 1600 bpi	764	677	634	591	548
#3236 Data Conversion (for 2804)	31	28	26	24	22
#7126 7-Track Compatibility (for 2804-1)	35	31	29	27	25
#5321 9-Track Compatibility (for 2804-2)	182	164	154	145	136

* Lease prices include equipment maintenance.

**Greyhound Phoenix X-30
EQUIPMENT PRICES**

Monthly Lease Prices*

	<u>1-Year</u>	<u>2-Year</u>	<u>3-Year</u>	<u>4-Year</u>	<u>5-Year</u>
INPUT/OUTPUT UNITS (Continued)					
CalComp 345 Magnetic Tape Unit:					
Model 1; 1600 bpi, 200KB	463	422	402	382	363
Model 2; 800/1600 bpi, 100/200KB	484	442	420	399	379
CalComp 1040 Magnetic Tape Controller:					
Model 1; 1600 bpi	559	510	485	461	438
Model 2; 800/1600 bpi	621	567	539	512	486
#2204 Two-Channel Switch Feature	124	113	107	102	97
#2205 2 x 16 Control	166	151	143	136	129
#2206 3 x 16 Control	212	193	183	174	165
#2207 4 x 16 Control	248	227	216	205	195
IBM 1403 Printer:					
Model 2; 6 600 lpm	643	583	553	523	493
Model N1; 1100 lpm	748	678	643	608	573
#8640 Universal Character Set (for 1403-N1)	8	7	7	7	6
IBM 2540 Card Read Punch	642	614	585	557	529
#5895 Punch Feed Read (for 2540)	24	23	21	21	19
IBM 2821 Control Unit:					
Model 1; for one 1403 and one 2540	798	720	681	642	604
Model 2; for one 1403 only	500	452	428	404	380
Model 5; for two 1403's and one 2540	1,294	1,168	1,106	1,043	981
#3615 1100-lpm Printer Adapter (for 2821)	59	53	50	47	44
#5895 Punch Feed Read Control (for 2821)	45	40	38	36	34
#8637 Universal Character Set Adapter (for 2821)	15	14	13	13	12

* Lease prices include equipment maintenance.