GE-645 Multics System, Artist's Rendition

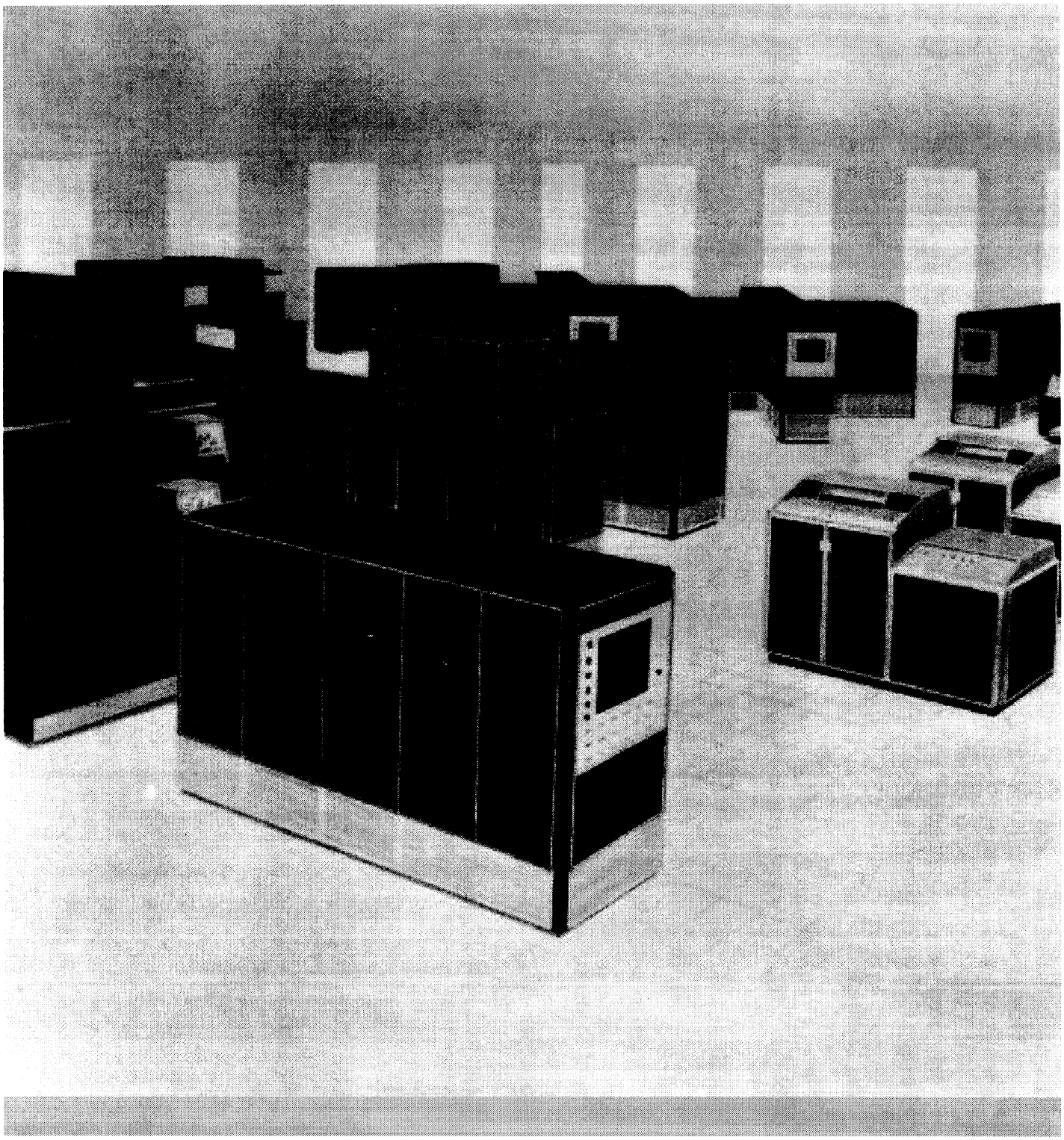

Photo credit: General Electric Information Systems Equipment Division, 1968

Initial M.I.T. Multics System configuration, 1967-1972:

Equipment: General Electric model GE-645

- 2 processors, each about 435,000 instructions/second (technology: discrete transistors)
- 3 Memory boxes, each about 1 Mbyte (organized as 36-bit words) (technology: core memory, 1 microsecond access time)
- Librafile swapping drum, 16 Mbytes
- 2 General I/O controllers
- 2 disk systems, total of 136 Mbytes of disk in 10 Mbyte modules
- Tape drives, card reader, etc.
- Terminals attached directly and via 300 b/s modems:
    - IBM 2741
    - IBM 1050
    - TTY 35 and 37
    - ARDS experimental display
- ARPANet attachment, circa 1971

Performance: In the Spring of 1970, about six months after the Multics system was first made available for public use, it was providing satisfactory response to 35 simultaneous time-sharing users.

The hardware was upgraded in 1972 to processors that were about twice as fast, and the number of users increased accordingly; the system, with further upgrades, continued in production operation at M.I.T. until 1988. Over the lifetime of the system, 82 different sites ran Multics systems. One of the largest commercial configurations, at General Motors Corporation in Detroit, handled 200 simultaneous users.

Innovations

Multics was most notable for the large number of ideas brought together into a single system. Although many of these features had been tried in one or another system, often on an experimental basis, no one had previously attempted to integrate all these ideas into a single production system. Most modern systems can trace their versions of these features directly back to Multics, often via UNIX, which was a direct outgrowth of the Bell Telephone Laboratories participation in the Multics project design. As one example of an idea not transmitted via UNIX,, the one-level store programming interface was picked up directly from Multics by Prime Computer Primos, Stratus Computer VOS, Apollo Domain, Nippon Telephone DIPS, IBM TSS/360, System 38, and AIX, and Livermore's Amber for the S-1.

Operating system and software innovations

- Hierarchical file system
    - Long file names
    - Relative and absolute path names
    - Access control lists
    - Symbolic links
    - Incremental backup
- One-level store programming interface
- 3-level virtual memory
- Dynamic linking of programs
- Higher-level language for system implementation
- Complete system instrumentation and accounting
- Command language interface (shell)
    - Shell active functions
    - Shell scripts
    - Search rules and working directory
    - wild-cards in command arguments
- Switchable I/O streams, standard input and output
- Virtual teletype
- Dynamic reconfiguration of hardware
- Threads, interprocess communication and coordination
- Daemons for background system functions
- Word processing and formatting
- Electronic mail
- B2 security rating

Hardware innovations

- Multiple processors
- Memory Segmentation and paging
- Translation lookaside buffer
- Rings of protection
- General I/O controller
- Time-of-century clock

A more extensive list of features can be found in the paper by F. J. Corbato, Jerome H. Saltzer, and Charles T. Clingen, Multics--the first seven years, AFIPS Conf. Proc 40 (1972 Spring Joint Computer Conference) AFIPS Press, 1972, pages 571-583.

The material on this page was assembled by J. H. Saltzer from several sources:
- his personal files
- the personal files of F. J. Corbato
- Thomas Van Vleck's World-Wide Web collection of Multics memorabilia

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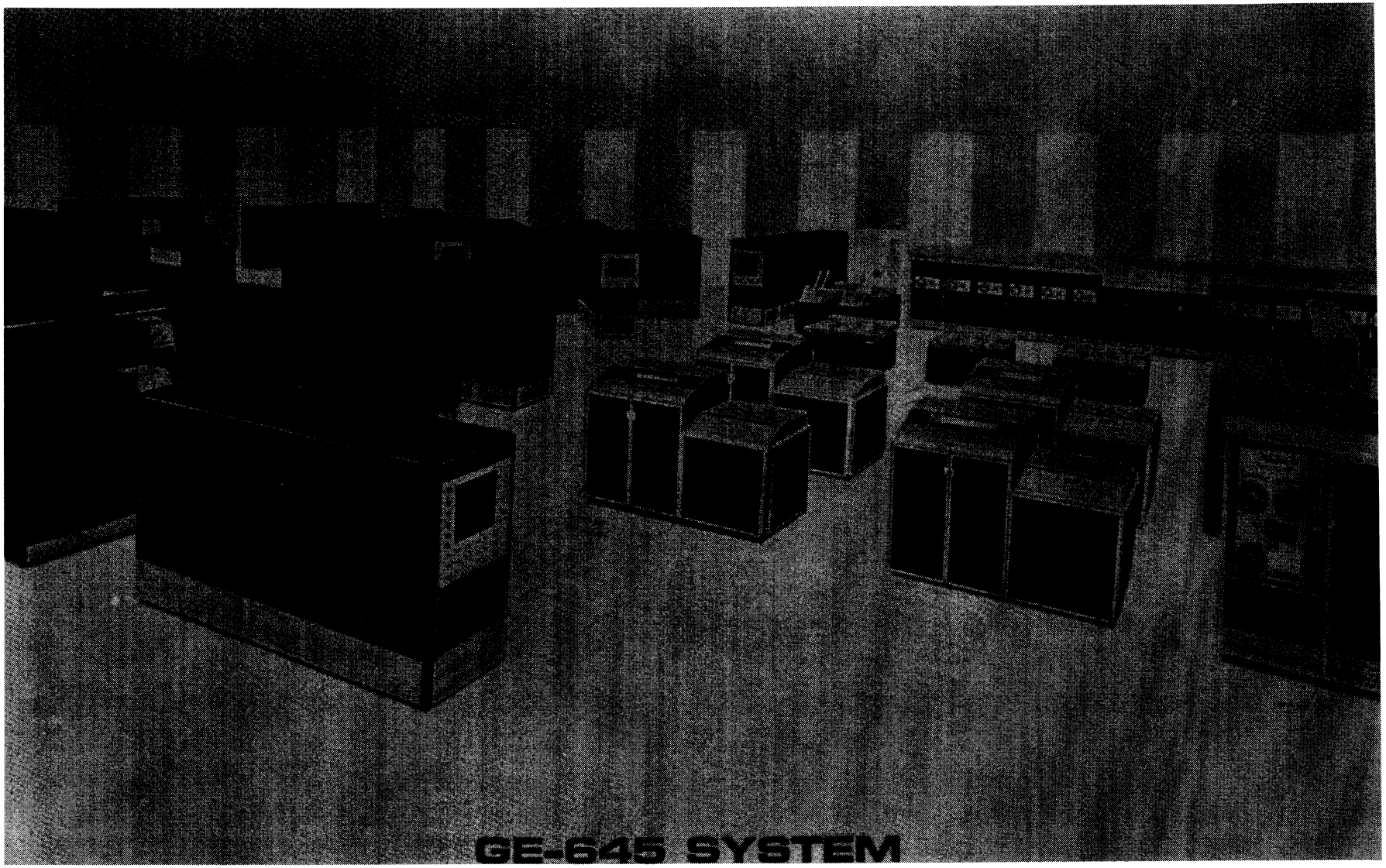

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