

Tandem

TANDEM

Tandem Computers, Inc.

19333 Vallco Parkway
Cupertino, California 95014
Toll Free 800-538-9360 or
408-996-6000 in California
Telex: 352044

Tandem Computers GmbH

Bernerstrasse 50, Frankfurt 56, West Germany
5072071-73, Telex: 416247-tacu-d

Expansion, Service and Maintenance – All NonStop.

Start with what you need.

Tandem's NonStop Computer System is the only computer system on the market which allows you to start with only the computer power you need right now, yet grow as your needs grow—easily, economically and without modification to your programs, either systems or applications.

Through incremental expansion all the way up to sixteen processors, virtually unlimited system growth is assured. Each additional processor module simply increases the system's processing power, input/output capability, and available memory. Allocation of processors to primary and secondary tasks (file editing, report writing, etc.) can be pre-programmed to take place at specified times with no need for user interaction.

Service during On-Line operations.

With any system a hardware failure must be repaired. But only with Tandem can the system keep right on operating, right through the failure and right through the repair too. Tandem's customer service representative can remove and replace any failed module in your system without interrupting service. The operators at terminals and the programs in process are unaffected by either the failure or replacement of the failed module. Without this feature, no system can truly be called NonStop.

Maintenance without shut-down.

Routine maintenance, too, can be accomplished without anyone using the system being aware of or inconvenienced by the process. All programs, the data base, and system capability are maintained in operational status during the entire procedure.

The Tandem 16 NonStop System—conceived for today's and tomorrow's needs, designed for efficiency, built for reliability, and serviced without interruption. A field-proven solution.

Clockwise from upper right:

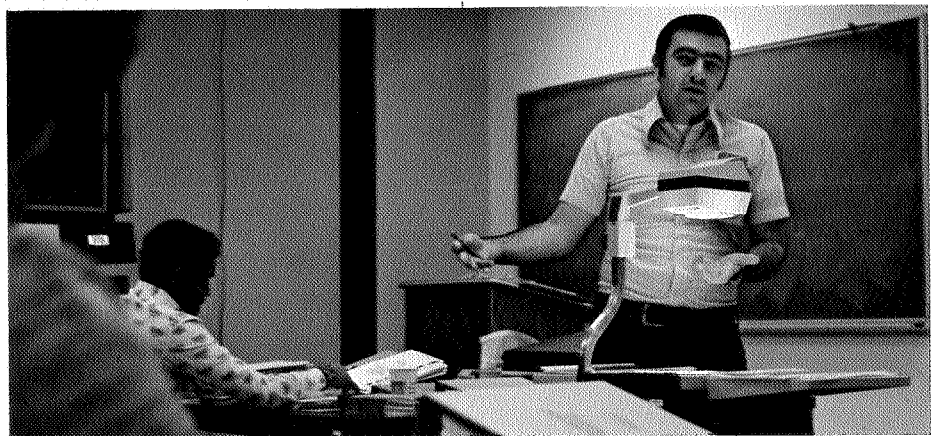
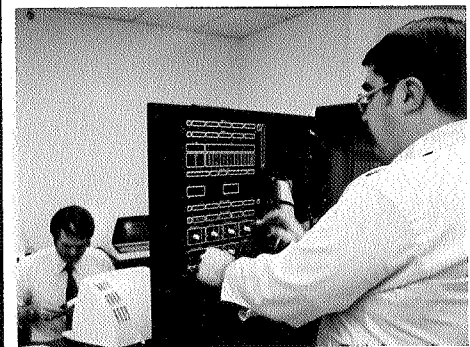
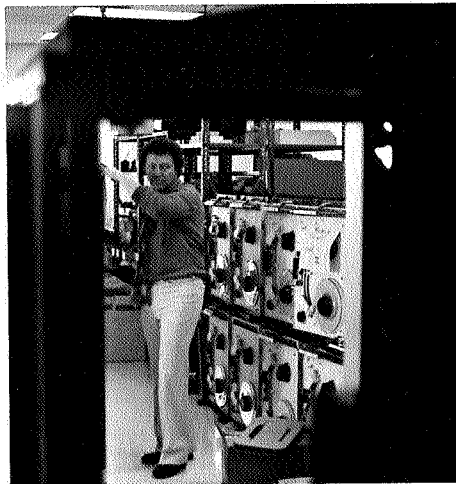
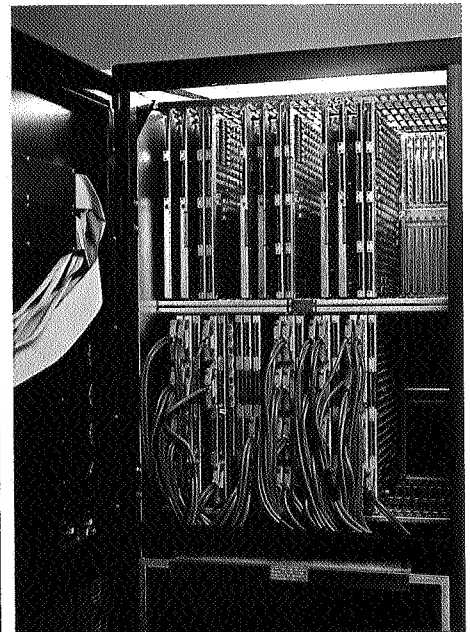
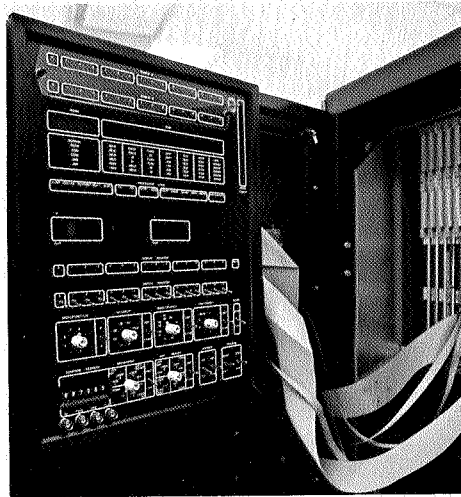
All system modules may be replaced on-line.

Maintenance panel shown in use.

Regularly scheduled classes are held for both programmers and customer service engineers.

Incoming inspection at the factory.

Maintenance panel facilitates on-line diagnosis and repair while the system is up and running.



Clockwise from upper right:

View of back of rack showing construction for a 3 processor system.

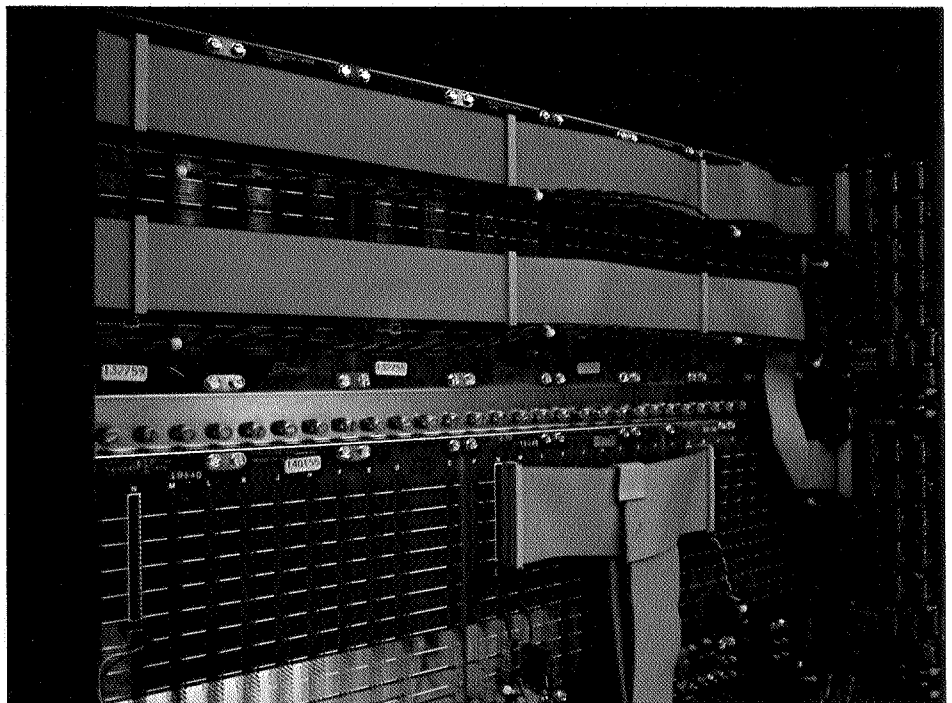
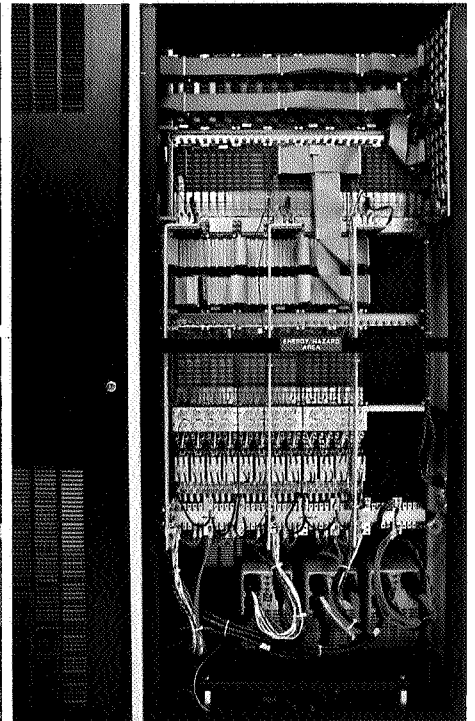
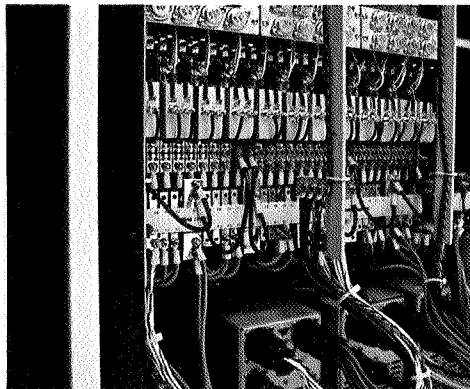
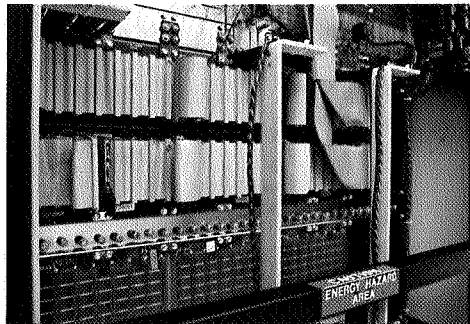
Dual independent, separately controlled interprocessor busses.

Input/output controllers power switching and load sharing circuitry.

Independent I/O channels connected to separate independent ports of the I/O controllers.

The benefits of NonStop Computing.

- Hardware and software are designed to work together continually, productively and efficiently.
- The system is designed around multiple, independent processors to provide continuous operation regardless of a failure anywhere in the system.
- A failure in one part of the system will not contaminate the rest of the system.
- On-line maintenance and replacement of failed modules are completed without shutting the system down. Operators at terminals and programs in process are unaffected by either the failure or its repair.
- The standard operating system software program is designed and tested to provide continuous operation. Single hardware failures are automatically dealt with, instantaneously. This is in marked contrast to most operating systems, which are designed to shut the system down in a failure, rather than actively respond to it.
- The system is expandable to meet changing or growing needs without hardware cost penalty, and without having to reprogram. Instead of having to invest initially for an anticipated later need, the user can start with the exact amount of computing power he needs, and add in increments, at mini prices, all the way to a full 16 processor system. Fully expanded, a Tandem system can support 2048 data communication lines, individual files of four billion bytes fully supported by the data base record manager, providing continuous real-time operation, with one of the finest packages of software available in any computer system. And it's all Non-Stop. From Tandem Computers.



code; virtual memory; geographic independence of I/O devices; and checkpoint/checkmonitor facilities. Under Enscribe, Tandem/COBOL provides key-sequenced, entry-sequenced and relative file structures; logical file size up to four billion bytes; up to 255 alternate keys per file; and optional mirror data base recording.

Enscribe: versatile and efficient data base record management, providing high level access to and manipulation of records in data bases. Operating in distributed fashion across multiple processors as a part of Guardian, Enscribe ensures the integrity of the data base in case a processor, an I/O channel or a disc drive fails during transaction processing.

Enscribe protects the file structure.

During operations, Enscribe performs internal checkpointing to ensure integrity of the file structure and ensure that no user data is lost. Control information and data are maintained in two processors controlling a disc volume; if a failure occurs in one processor, Enscribe completes the operation using the alternate processor. And Enscribe maintains all indices; when a new record is added to the file or a key value is changed, Enscribe automatically updates the indices to the affected records. The programmer need never worry about assignment or maintenance of indices.

Multiple file structures.

Key-sequenced, relative or entry-sequenced—all under Enscribe and all accessible by up to 255 key fields, primary and/or alternate. Location of records may be by approximate, generic or exact key value. Enscribe maintains an index of all key values, providing rapid access and update whenever key values are supplied.

Four billion bytes per file.

With Enscribe, individual files may be partitioned in separate volumes, providing large system capacities and significant increase in throughput. Each partition

can be under control of a separate processor, again transparent to the programmer. Enscribe includes a cache buffer management scheme, providing “look ahead” capability to optimize I/O. By increasing memory in the cache, throughput can be increased and there is no need to modify or recompile existing applications programs.

Mirrors to be sure.

Tandem is the only manufacturer which can provide this protection for Virtual Memory: if a failure occurs in the System Disc, Tandem’s Mirror Capability prevents not only a shutdown, but prevents loss of any part of the operating system or application programs.

Enscribe offers an optional mirror volume technique whereby a disc volume’s data can be physically recorded on two separate disc packs simultaneously. Reads may occur from the closest head in either pack, completely transparent to both the applications program and the user. If a failure occurs in one disc, all reads are automatically made from the other. As soon as a failed disc is restored, Enscribe automatically updates the failed device to exactly mirror the safe volume; this takes place concurrent with application updates. Again, completely transparent to both program and user.

Locks, compression and utilities.

Enscribe allows for both record locking and file locking, providing flexibility of both access and security. For key-sequenced files, an optional set of techniques provides for both data and index compression, thereby reducing the number of head movements. A file update program provides for easy file creation and loading.

Data definition and manipulation.

Under Enscribe, the user can use Tandem’s DDL Data Definition Language, describing the data base as a “schema.” Since all programs use the schema to access the data base, a correct view of the data

is assured. It also defines which fields are to be used as access paths (keys) to retrieve records from the data base. Changes to data base record layout, additions of types of records or new fields within record types are accomplished without modification of existing programs.

Envoy: multifaceted data communications system.

Operating as an integral part of Guardian, Envoy provides the interface between applications programs and data communications networks. Envoy supports both binary synchronous and asynchronous communications, with single or multi-drop lines on either a local or remote basis.

Data is transferred from terminals directly into main memory, which means processors are not interrupted until a complete message has been received. Binary synchronous terminal polling and character translation between ASCII and other communications codes are hardware executed, minimizing overhead. Asynchronous operations run at rates up to 19.2 K baud per line; binary synchronous at rates up to 56 K baud per line.

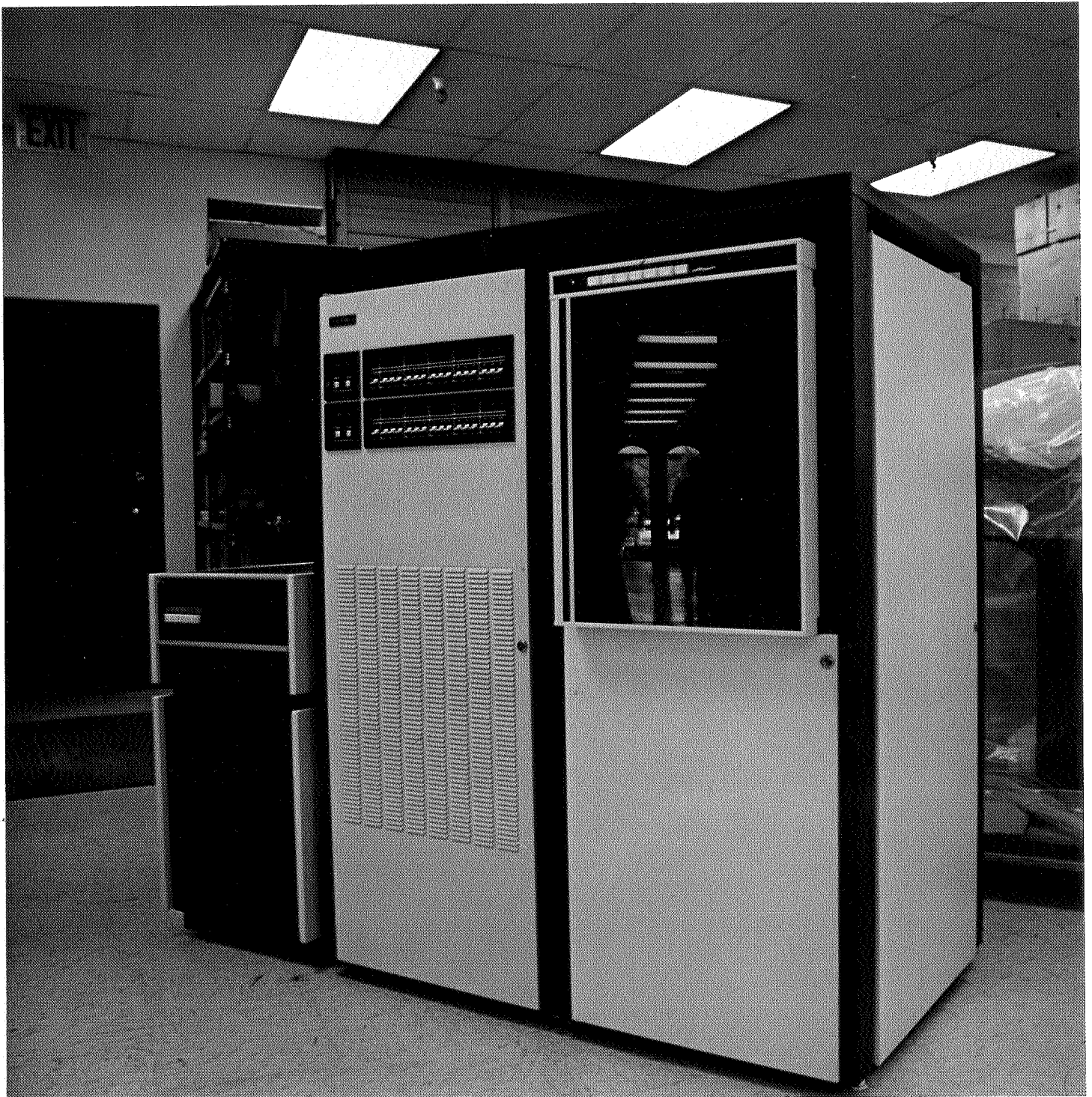
Entry: page mode forms creation, display and access.

One of the easiest-to-use programs of its kind. Users simply design the forms on the screen to appear as it will be used. Delimiters, field names and validity checking are automatically recorded in a designated file on disc. In use, invalid data is automatically checked and displayed as a flashing entry on the screen. Individual fields in any form may be accessed by name. This package is available for both Tandem’s page mode terminals and IBM 3270 terminals.

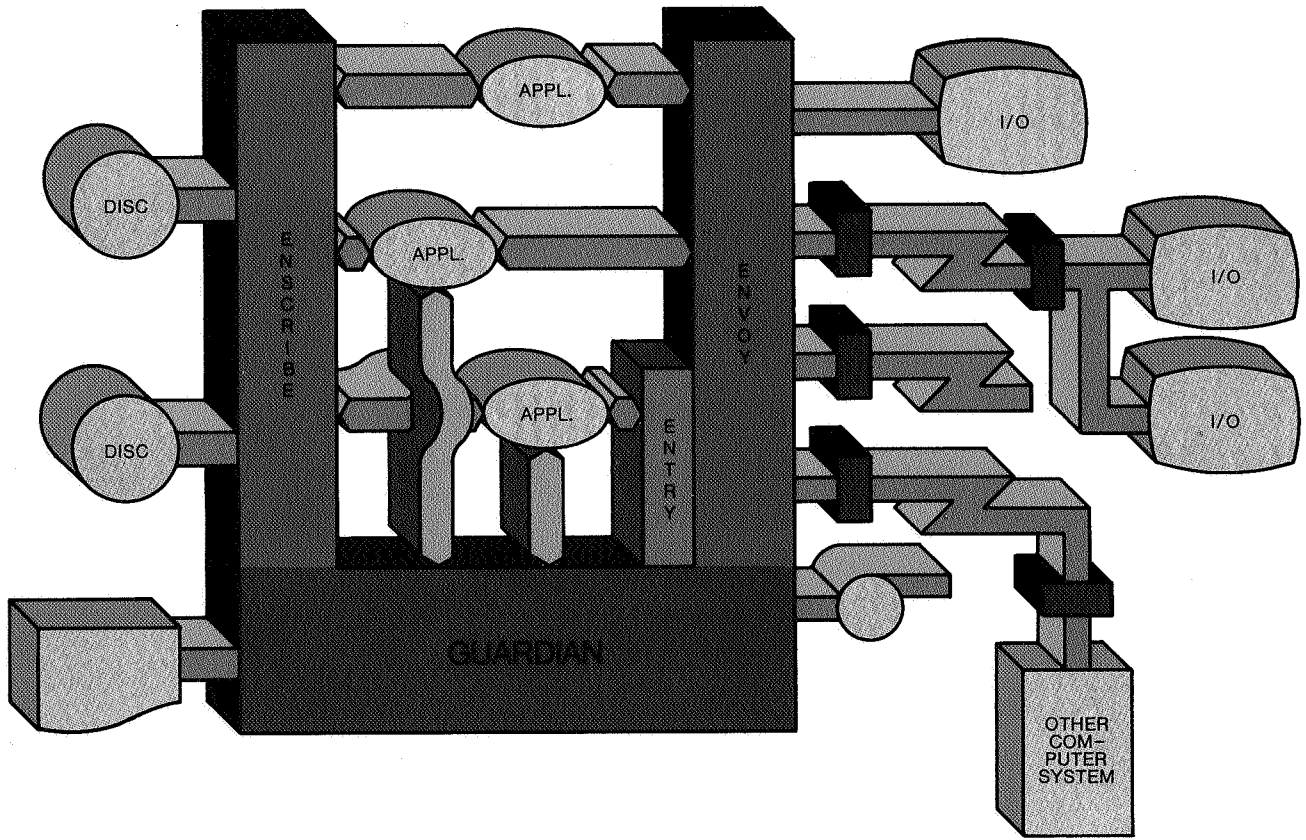
Software tools to work with.

In addition to T/TAL, Tandem also provides a source file editor and interactive debugging facilities. The source file editor provides for string manipulation, page mode editing and context as well as line editing.

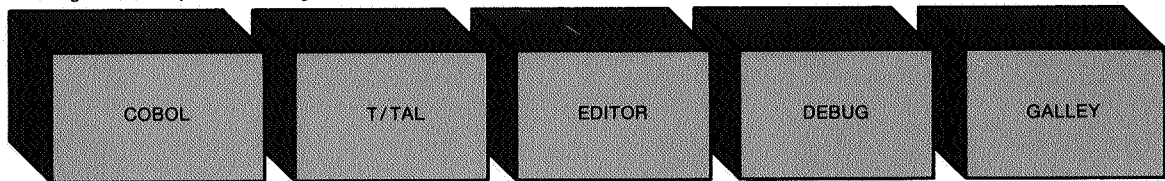
Dual processor system cabinet utilizing standard 19" rack mountable modules.



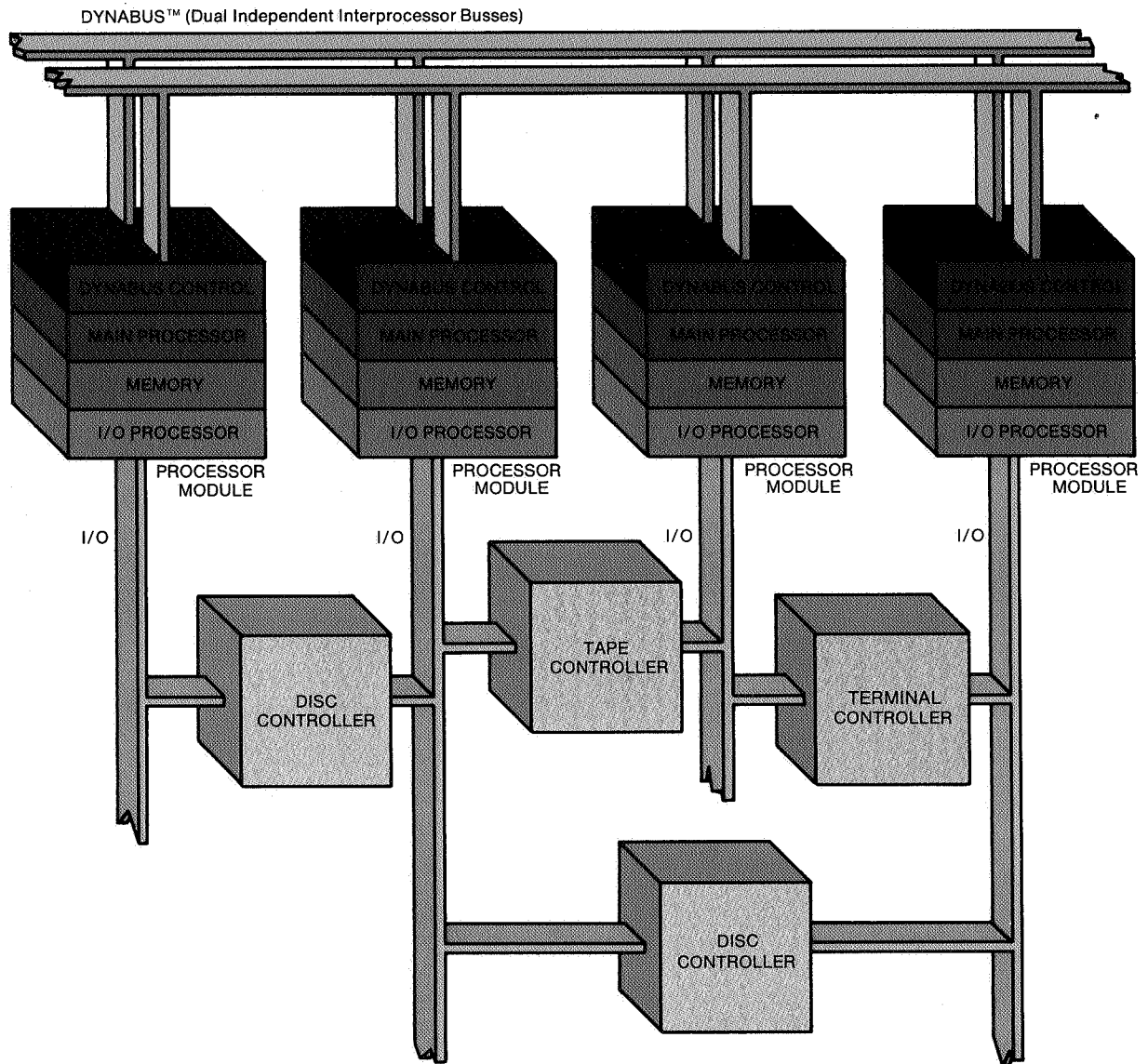
NonStop Software



Program Development Building Blocks



NonStop Hardware



TANDEM NonStop™ Systems.

The age of on-line computers.

It's begun in earnest now, and the reasons are sound. Dedicated, efficient, low-in-cost, today's small computers provide immediate, positive response in all types of applications.

Credit verification. Bank deposits and withdrawals. Funds transfers. Order processing and inventory control. Medical systems. Retail sales. Emergency vehicle dispatch. Theater and sports events ticketing. Hotel and motel reservations. Communications networks. Manufacturing and material control systems. Wherever there's a high volume of transactions requiring speed and accuracy; wherever there's a critical need for reliability and expandability; wherever efficient, low cost transaction processing is essential; Tandem's unique multiple-processor architecture and system software offer a new and powerful solution. And it's field-proven.

On-line means on-demand.

And there's the rub. For as reliable as the modern computer is, and it is remarkably reliable, it will on occasion fail. Which can cause lost business, or missed schedules, or unhappy customers, or costly errors, or worse. In live data base systems, a crash during processing can cause untold damage to, or even destruction of, the data base. That's a nightmare. All of which is why Tandem came into business.

The search for alternatives.

Until now, the only way an on-line computer user could protect himself against the possibility of a computer failure was to install a "back-up" system, typically a second processor strapped into the system, ready to come on-line when a failure occurred. It required special interfaces and customized system software; and there was the penalty of system inflexibility, loss of processing power, and uncertainty as to the status of transac-

tions-in-process when a failure occurred. But aside from manual back-up systems, which went rapidly out-of-date, and were slow, inefficient and uncertain, it's all that there was. Until Tandem.

NonStop Computing.

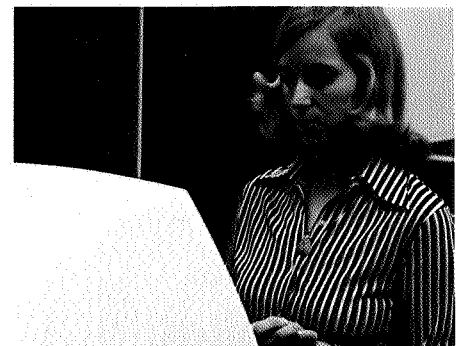
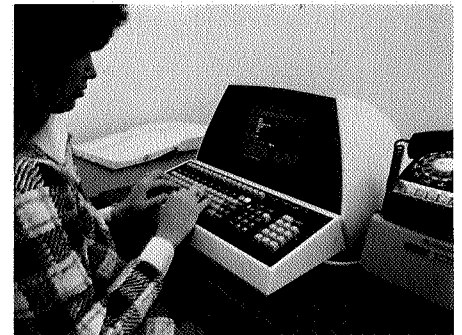
Tandem has designed and built the first multiple processor system designed from scratch to provide non-stop processing — even during a failure — with no penalties in the speed, capacity, throughput or memory utilization of the system. With no strapped-up interfaces and no customized software, and perhaps most important, no loss of system flexibility. The Tandem NonStop System can expand from a basic two-processor system all the way to sixteen processors, without re-programming, without customizing, and without penalty on the original investment.

NonStop Protection.

And because of its unique design, the Tandem NonStop System provides an unprecedented level of protection for both transactions and files. No module failure need result in a transaction being lost or duplicated. With Tandem, restart time and restart uncertainties are eliminated; recovery is instantaneous. No other system offers this protection or this capability.

Tandem NonStop Computers.

The one and only answer from the computer industry to the opportunities and problems of today's advanced computer applications. Data Base Systems. Distributed Systems. Data Communications Systems. Multi-Terminal Systems. All of these have grown out of the enormous capabilities of the computer itself, but as of today, only one company has dedicated itself to the design and construction of efficient, low-cost systems which meet their needs head-on. Tandem Computers. Up and running. NonStop.



NonStop Hardware

Multiple independent processors.

In order to insure that the loss of a processor will never completely isolate the peripheral devices attached to any controller, each Tandem controller module has two independent ports which allow it to be connected to two Tandem processor modules. In the event of a failure of that processor or I/O path, the other processor takes control automatically to insure that the system will always have a communications path to that controller.

All processor modules are interconnected through a unique, high-speed dual bus structure—Dynabus.™

Each Dynabus path is fully autonomous, operating independently of, but simultaneously with, the other bus to insure that two communications paths exist between all processor modules in the Tandem 16 NonStop system. All Dynabus interprocessor transfers are hardware controlled, independent of, but concurrent with, all normal I/O transfers and other CPU activities. Since Dynabus handles interprocessor transfers at 26 megabytes/second, this produces extremely low overhead interprocessor communications at speeds fast enough to simultaneously handle peak transaction and message loads even when the Tandem system is fully expanded to sixteen processors.

The Tandem processors are independently powerful.

Designed to increase transaction throughput and minimize system overhead, the Tandem processors separate I/O processing from interprocessor communications and CPU workloads. Each processor can handle up to 128 19.2 K Baud communications lines, a message handling capability miles ahead of other processors in their price category. The CPU segment of each processor is a pipelined microprogrammed unit designed specifically to handle business transaction data appli-

cations. With a cycle time of 100 nanoseconds, each CPU can, for example, add two 18-digit numbers in under 2.4 microseconds.

Time robbing I/O overhead is completely removed from the main processor.

Each processor contains an independent microprogrammed I/O processor which controls the 4 megabyte/second block multiplexed I/O channel. With truly large computer capability, each of these I/O channels can handle up to 32 device controllers. Each Tandem processor incorporates a powerful memory system capable of complete single-error correction and multiple-error detection, performed using semiconductor memory at a cycle speed of 500 nanoseconds. Because of the virtual memory management feature, applications programmers need not worry about many of the constraints of physical memory.

NonStop Software

Guardian controls the traffic and watches over the system.

Guardian is Tandem's complete, transaction-oriented operating system. It resides in each processor, and has the capability to respond positively to a failure anywhere in the system. With Guardian, there is no need for customized or special operating system development by the user. Since programs are geographically independent, the task of applications programming is vastly simplified for the user. Further, Guardian carries the user-assigned priorities for applications programs, handles all communications among programs and between programs and the outside world, and extends the capability to start program execution in any available processor module from any processor.

Geographical independence of programs and data is a noteworthy feature of Guardian. Programs are not only unaware of which processor is running them; they

may well be running simultaneously on all processors. And programs can access any device in the system, even those not physically connected to the processor(s) running the program. Because of this geographic independence, the Tandem NonStop system can be expanded all the way to sixteen processors without any reprogramming.

Multiprocessor message system.

Guardian automatically handles all communications between Tandem processor modules, system processes and applications programs—routing messages to the correct processor, verifying correct receipt and deciding which program receives the message in the destination processor.

Guardian provides protection, performing comprehensive data validation on all transfers. It was designed to detect and isolate any faulty module, preventing corruption of any other module by a "mad" processor. Guardian has the inherent ability to detect an error or point of non-response anywhere in the system, log the failure and disallow access to the faulty module without disturbing system operation. The Guardian operating system, along with the system hardware architecture, is the basis of Tandem's NonStop operation.

Tandem's Transaction Application Language.

T/TAL. A powerful block structured language designed for fast, flexible programming. T/TAL is self-documenting and is easy to read, modify and maintain. Developed by Tandem, T/TAL gives the programmer every vehicle to optimize the hardware potentials of its interactive, multi-processor environment.

Tandem/COBOL

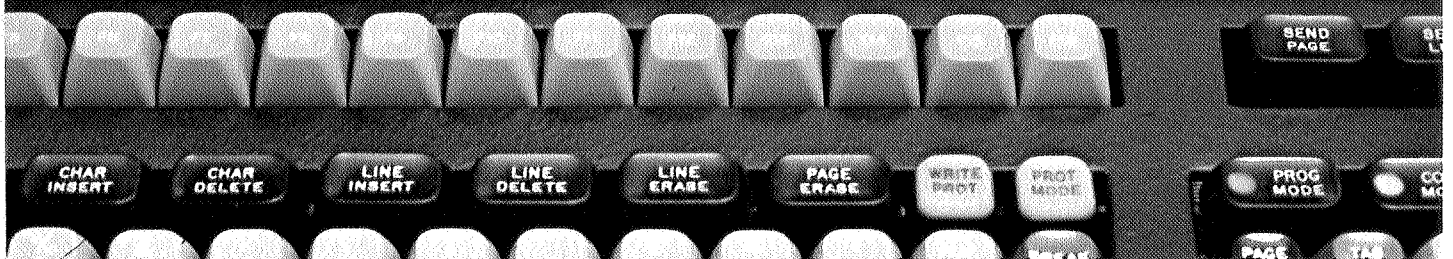
The only COBOL available for multiple processor systems, Tandem/COBOL (ANSI X3.23-1974) utilizes all the capabilities of Guardian and Enscribe. Under Guardian, Tandem/COBOL features NonStop operation; shared, re-entrant

Tandem four processor system, expandable to six in same cabinetry, expandable to sixteen processors with additional cabinetry.



- 13:35 Processor 1 fails, messages are printed from both processor 0 and processor 2 noting this fact. Effect on system users— none.
- 15:20 Parity error during a disc read, retry was successful. Effect on system users — none.
- 17:30 Processor 1 repaired and re-incorporated into the system. Effect on system users— none.
- 19:10 Complete system power-interrupt and restart. Effect on system users— none.

```
20 13:35 24FEB77 FROM 00,000 CPU 01 IS DOWN
20 13:35 24FEB77 FROM 02,000 CPU 01 IS DOWN
05 15:20 24FEB77 FROM 00,005 LDEV 0001 RETRY 2002000 200001 2116000
21 17:30 24FEB77 FROM 01,000 PROCESSOR UP
20 19:10 24FEB77 FROM 01,000 *POWER ON*
20 19:10 24FEB77 FROM 00,000 *POWER ON*
20 19:10 24FEB77 FROM 02,000 *POWER ON*
```



FRANDE

