

resource sharing: timesharing use of high-speed input/output devices

RSTS-11 terminal users may have exclusive use of any peripheral on a timesharing system (except the disk, which is a shared device). They may use it as long as needed, and then return it for assignment to another user. The ability to enter, store, and retrieve programs and data files using high-speed peripheral devices makes RSTS-11 a true general-purpose problem-solving system.

Examples of the value of the Resource Sharing concept are: one user may use the line printer, card reader, tape and disk files for performing a "batch" administrative data processing task; another terminal user may use a DECtape unit for retrieving or creating a tape file intended for off-line storage; and when the card reader is free, yet

another terminal user may read in a punched-card file which contains a BASIC program he has created at an off-line card punch.



RSTS for business and administrative problem solving

One of the most difficult problems facing business today is increasing the productivity of costly, hard-to-find clerks and secretaries. RSTS-11's power and flexibility offer the benefits of reduced costs, increased customer satisfaction, and increased job satisfaction for clerical workers.

How RSTS-11 Benefits Administrative Applications

- Journals, general ledger, and other account records are stored on-line for quick access from high-speed disk storage, thus reducing paper handling.
- Because RSTS-11 is a full-scale computer system, more of the steps and decisions in accounting applications can be automated, thus reducing the drudgery of accounting operations and the possibility of human errors.
- Records are kept on-line. They can be updated quickly and retrieved easily for generating timely, detailed reports for better management control.
- Customer satisfaction increases when an on-line, RSTS-11 customer account inquiry system reports account status in a matter of seconds.
- Operating costs are reduced because accounting personnel can be trained quickly, work more effectively, make fewer mistakes, and have to handle less paper.

Potential On-Line Administrative Applications include:

- Order Entry/Accounts Receivable/ Sales Analysis
- Inventory Control/Accounts Payable
- Data Entry with automatic error checking, editing, and verification
- Inquiry-Response for "instant" access to records.

RSTS-11 can be dedicated in administrative application systems. The power and versatility of RSTS-11 permit terminals to be used for computational problem solving simultaneously with the execution of administrative applications. Thus, the value of RSTS-11 in an organization can be enhanced, for example, by installing a number of RSTS-11 terminals in the engineering area as well as in administrative offices.

RSTS in schools for interactive timesharing and administrative applications

The low operating costs of RSTS-11 make it an ideal computer system for schools. Up to 16 students may have simultaneous, interactive, access to a true timesharing computer. And, an expanded RSTS-11 hardware configuration lets you execute administrative applications at the same time while students are using the system for instruction.

Students with little or no computer background can use RSTS-11 terminals for developing computer concepts. More advanced students meanwhile, can perform more complex problem-solving exercises. This is because RSTS-11 has powerful features such as terminal-user core space as large as 16,384 bytes (8192 words). Hence RSTS-11 is valuable in many curriculum areas. For example, students can conduct independent research in simulations, capital budgeting, and computer-aided instruction system development.

BASIC-PLUS programming language is so versatile that students may progress from the introductory stages of computer education to learning very advanced concepts in computer science and data processing. It is not necessary to interrupt the students' progress to learn a new language because they have "outgrown" a programming language. The success of BASIC as an introductory programming language has been proven with thousands of students, beginning with those at Dartmouth College, where BASIC was developed. As students become ready, they may be introduced to more and more of the extended features of BASIC-PLUS. For example, introduction of the PRINT USING statement (useful for complex formatting of printed output) may be deferred until the students are assigned more sophisticated projects. Thus, students with a broad range of computer programming skills may all use RSTS interactive terminals simultaneously, each one utilizing the elements of BASIC with which he is familiar.

RSTS-11 features make it an ideal system for the development of low-cost Computer-Assisted-Instruction (CAI) or Computer-Managed Instruction (CMI) systems. CAI and CMI system operations consist primarily of processing of text in the form of character strings.

BASIC-PLUS includes extensive language features which simplify development of efficient CAI and CMI text processing programs. For example, special functions are included that can measure a student's response time or continue a program if there is no response.

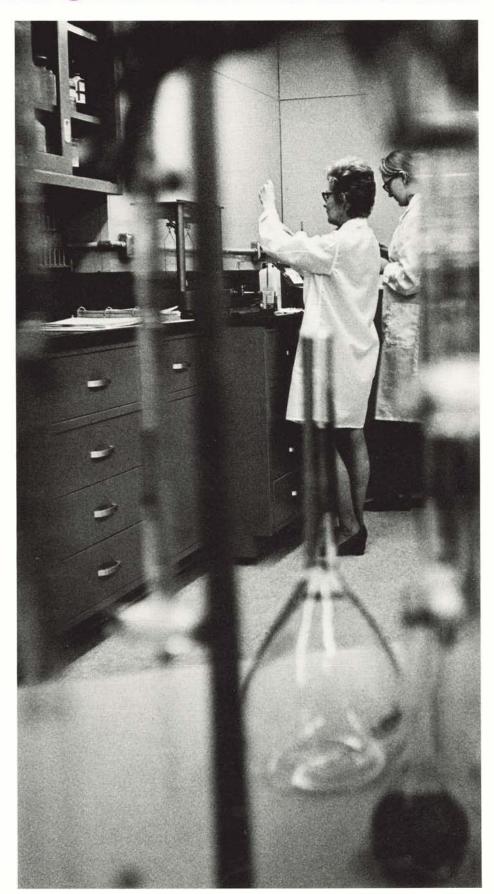
Administrative applications can be run simultaneously with timesharing terminal use on expanded RSTS-11 hardware configurations. For example, a Grade Reporting System may be executed utilizing a card reader, high-speed line printer, and magnetic tape or disk files while up to 15 students are each using an interactive terminal to complete their assignments.





RSTS for in-house timesharing in scientific and industrial environments

BASIC-PLUS with its powerful extended language features makes RSTS-11 an ideal tool for scientific and engineering problem solving. RSTS-11 terminals are easier to use and more flexible than a desk calculator—even for simple problems. And, RSTS-11 has large-scale system features: user core storage of up to 16,000 bytes per terminal; additional programs that can be quickly called from an on-line program library. Sophisticated or simple, all applications can be handled with ease. RSTS-11 terminals can be placed where the problems are. High-speed paper tape and punched-card inputs lets data collected from experiments to be quickly entered and analyzed. RSTS-11 terminals bring computational power to engineers and scientists with the convenience, accessibility, and economy heretofore available only with desk calculators. And, if you're already using a subscription timesharing service, RSTS-11 gives you the same familiar programming language but with many extra extended benefits.



hardware-the PDP-11 computer system

The PDP-11 computer is the heart of RSTS-11. This powerful, state-of-the art computer is ideally suited to fast response timesharing. The PDP-11 features a 16-bit word, UNIBUS™ architecture, over 400 instructions, 8-bit byte handling, and a push-down stack for efficient processing of interrupts and subroutines.

the UNIBUS™ -pathway to system expansion

The PDP-11 UNIBUS™ is the PDP-11's unique means for intercommunications among all system components of RSTS-11. Any unit—including processor, memory, disk, terminals, and other peripheral devices—may be added to RSTS-11 simply by plugging the unit's controller into the UNIBUS. This modularity means that RSTS-11 can grow as your needs and budget grow. Your investment in RSTS-11 is safe and never becomes obsolete. All future devices for the PDP-11 will always be compatible.

RSTS-11 configurations

Because of PDP-11 flexibility, the initial RSTS-11 configurations may be tailored to closely fit your needs and budget. And, when these needs and budget grow, the configuration may be expanded by adding equipment from a broad range of optional hardware.

A minimum RSTS-11 configuration includes: a PDP-11 computer with 20,480 words of memory, a fixed-head disk unit, a dual DECtape magnetic tape unit, a real time clock, a bootstrap-loader read-only memory unit, from one to 16 terminals, terminal interfaces and mounting hardware.

This configuration also supports the program development system, DOS, which may be used for the development and execution of FORTRAN IV and assembler-language programs. See page 11 for further details.

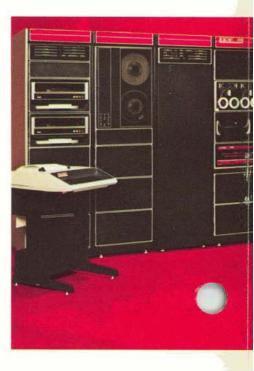
expandibility

The RSTS-11 configuration may be expanded either initially or at a later time with any of the following:

- Additional fixed-head disk units to increase the on-line file capacity available to users.
- Moving-head, removable disk cartridge drives for large-scale on-line file capacity.
- Moving-head disk, removable disk pack units similar to the IBM 2314 for on-line capacity up to 32 million bytes.
- Additional terminals and terminal interfaces (up to 16 total). Terminals may be typewriters, Teletypes, the 30 character-per-second DECwriter, the high-speed DECdisplay for sil terminal operation.
- Communications line terminal interfaces for remote operation of interactive terminals via telephone lines.







- Card reader for entering punched card files.
- Line printer for producing hard-copy output at high speed.
- Additional DECtape transports for expanding the amount of on-line serial file capacity.
- Industry-compatible one-half inch magnetic tape transports for large-scale on-line serial file capacity and for transferring data files manually between RSTS-11 and other computer systems.
- High-speed paper tape reader and punch for economical input and output of files at medium speed.
- Additional core memory for increasing the core storage area per terminal from 8192 bytes (on the minimum configuration) to a maximum of 16,384 bytes. Additional core also helps improve the responsiveness of the system.





BASIC-PLUS...an expanded language

One of the most significant features of the BASIC-PLUS language is that it has been extended to increase the utility of the system and make it an ideal tool for solving a very broad range of problems. For example, administrative applications such as on-line order entry, inventory control and payroll may be implemented efficiently by using language features suited for data processing. Text-processing applications such as Computer-Assisted Instruction, automatic letter or document editing and production may utilize a set of character string handling functions. The utility of BASIC for computational applications such as structural design and simulation is extended with language features which allow more concise, and therefore, more efficient programming and program execution. BASIC-PLUS eliminates constraints of BASIC for a variety of applications programming tasks.

matrix operations

A variety of operations are available which permit efficient operations upon one and two dimensional arrays of data. Matrix data elements may be character strings, floating-point, or integer-numeric quantities.

Operations include:

- MAT READ
- MAT PRINT
- MAT INPUT
- Initialize matrix to zeroes, ones, or the identity matrix.
- Matrix addition, subtraction, transposition, and inversion.
- Large arrays may be dimensioned, stored, and accessed on an element-byelement basis in an on-line disk file, thereby conserving user core memory space.

string operations

Many applications, including Computer-Assisted Instruction and business data processing, require efficient processing of strings of characters. A string may be up to 512 characters in length. String operations available include:

- Concatenation for appending one string to the end of another.
- CHANGE a one dimensional array of characters to a string or a string to a vector (In RSTS-11, a character string need not be considered as a onedimensional array of characters).
- A full set of relational operators for comparing one string to another.
- LENGTH function for determining the number of characters in a string.
- LEFT, MID, and RIGHT functions for extracting a string of characters contained within a larger string.
- INSTR for searching for a substring within a string.
- SPACE function for creating a string of N space characters.

print formatting

Many applications, such as business data processing, require more flexible control of the printing format than Dartmouth BASIC allows, BASIC-PLUS includes a PRINT USING statement which may be used to achieve precise definition of printed data format. PRINT USING allows character, decimal, and exponential data field lengths and positions to be defined, and mixed, for a print line. In addition, leading dollar or asterisk symbols may be "floated" to automatically precede the most significant digit of decimal fields. Trailing minus signs for data fields may be specified for compatibility with accounting report standards.



extended program statement coding

The effectiveness of RSTS-11 in solving problems in a broad variety of application areas is significantly increased with the addition of numerous extensions to the structure (syntax) of the BASIC program statements. These highly flexible program statements permit more concise expression of complex program steps. Here are a few examples:

LET A1=P1*R1 IF R1=5.0 OR R1=0.0 GOTO 5530 UNLESS X1\$>Y1\$ AND Z\$="ABC" LET (Y1,Z1)=Z1+3 FOR Z1=1 TO L IF X>Y AND Y>Z THEN Z=X ELSE Z=Y FOR I=X (J) STEP 3 WHILE L\$ (I)=L\$ (I+1) AND J+I<I2 ON X(2,5) GOTO 100, 150, 200, 250, 300

integer data type

BASIC-PLUS includes the definition of integers in addition to strings and floating point numbers. Integers are whole numbers in the range of -32,767 to +32,767. The use of integers often increases the execution efficiency of programs. The most common uses of integers are in counting and indexing operations.

program recovery from input/output errors

One of the more frustrating situations for a timesharing terminal user is when his program is cancelled because an input/output error condition occurs (perhaps temporary) and causes all results created (in a file, for example) to that point to be lost. This situation, although rare, may be eliminated in RSTS-11 applications by use of the ON ERROR GOTO statement. This subroutine call statement is triggered by a variety of input-output operation errors. The call subroutine is passed a value which identifies the error type, and attempts to recover from the error condition. If the subroutine is successful, normal execution of the application program resumes.

interval timer

In some timesharing applications, the length of time that a terminal user takes in responding to a message printed at his terminal is a significant variable. The WAIT function provides an interval timer feature which may be used for signaling the program that the terminal user has not responded within some predetermined length of time. One example of the use of the WAIT function is in Computer-Aided Instruction applications where one measure of student performance is his "think time." If he takes more than 5 seconds, for example, to respond to a question, the computer can restate the question in another manner, and record the delay as one element of his overall performance.

An additional feature provides year, month, day, and time-of-day information to the RSTS-11 program.

file handling

input-output capability

Small computer timesharing does not imply a reduced need for file handling capability. RSTS-11 supports a broad range of peripheral devices with costs and characteristics suitable for a variety of problems. Each peripheral device may be directly accessed by a terminal user to help him solve his problem in the most effective manner:

- Low-speed paper tape at ASR Teletype terminals for short or infrequently used programs and data.
- High-speed paper tape reader and punch for somewhat larger files.
- Industry-compatible DEC Magtape and inexpensive, high-performance DECtape for unlimited program and data file storage. Low-cost reels of DECtape offer many benefits over punched cards for off-line file storage: faster input/output, reduced storage space, ease of handling, and increased reliability.
- DECpack removable disk cartridge drives, DECdisk fast-access fixed-head disk units, and removable disk packs with a capability of 32 million bytes, total, for on-line storage of frequently used files.
- Punched-card files may be created off-line for data collection or classroom programming and then entered into RSTS to build data and program files.
- Files may be printed at high speed under terminal user control via a high-speed line printer.



on-line file library

RSTS-11 users may create and have high-speed access to program and data files stored on disk units with total file space of up to 32,000,000 bytes. Files may be created for either sequential or random access processing, depending upon the requirements of a user's application. Up to 12 files may be open and accessible from a single program at any one time. The number of files a user may have stored in the disk library is bounded only by the total system disk capacity and the library demands of other users.

An on-line file library system means that RSTS-11 terminal users have the convenience of almost instant access to any desired file or file item. Terminal users are spared the problems and frustrations of handling paper tape each time a program is to be executed. Many applications such as on-line customer inquiry-response are possible with the large-scale file library system of RSTS-11.

file security

Each terminal user has full control on the degree of privacy he desires for each file he creates. The disk library file directory system, which provides efficient access to files, includes a privacy-protection level which may be set only by the terminal user responsible for creation of the file. Personnel records, for example, can be given absolute protection from all other users. Other levels of protection include access limited to a particular group of users, read only, write only, and public.

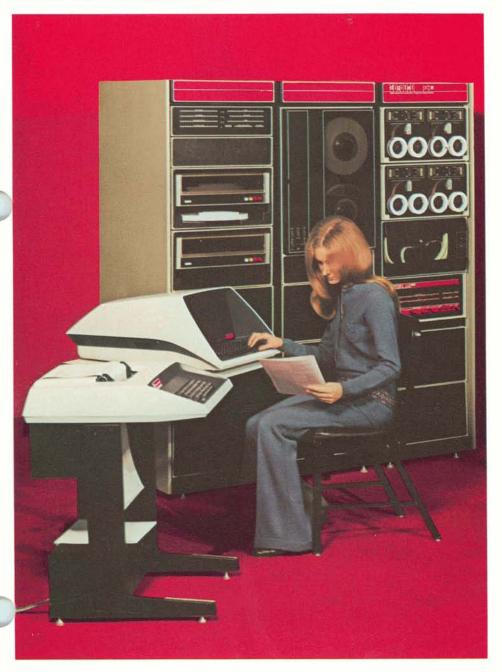




running other languages on RSTS-11

To satisfy the need for a variety of programming languages, the RSTS-11 hardware configurations may be used for the development and execution of FORTRAN IV and assembly-language programs using the program development software system, DOS.

PDP-11 FORTRAN includes language compatibility elements that permit transfer of FORTRAN IV programs from other systems such as the IBM 1130 to the PDP-11. The language, which is an ANSI-standard compatible FORTRAN IV, will operate in the minimum RSTS hardware configuration described on page 6. DOS is a disk-resident software system which enables a user to both develop and run his own programs. A series of software modules permits creation, debugging and editing of programs with a series of simple commands. During the program run, the monitor furnishes all the I/O device routines, loaders and basic resources accounting necessary from disk resident files. Additional features of DOS include random access and sequential files, file protection for user privacy, simultaneous use of input/output devices with processing and input/output device independence.



digital equipment corporation and its timesharing experience

Your decision to buy a minicomputer timesharing system is an important one. The company behind the system is important too.

Digital Equipment Corporation is the world's largest and most experienced manufacturer of small computer systems. Over 11,000 Digital small computers are now in use performing a large variety of tasks. Digital has a network of sales, support, and field service offices throughout the United States, Europe, Canada, The United Kingdom, Australia, and Japan. These offices are prepared to respond quickly to your needs for training, programming assistance, and maintenance.

Digital produced the first minicomputer timesharing system—TSS-8, a 16-user system based on the popular PDP-8 computer. The features built into RSTS-11 reflect Digital's experience in responding to the needs of the many owners and users of TSS-8 in schools, research and development organizations and timesharing utilities. The developers of TSS-8 system software participated in the development of RSTS-11. You benefit from Digital's knowledge about minicomputer timesharing.

Digital also produces the 127-user PDP-10 timesharing system, giving you the added benefit of large-scale experience. This background has allowed Digital to produce the best medium-scale system—the RSTS-11; one that has many of the best features of both large and small scale systems.



in conclusion

his brochure serves only to introduce you to RSTS-11. If you are interested in more detailed information about RSTS-11 and how it may help meet the needs of your organization, please contact the Digital Equipment Corporation sales office nearest you, or fill out the attached reply card and return it to Digital for more information. A Digital sales engineer will be happy to discuss the use of RSTS-11 in your organization at your convenience.

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