DECsystem-10 NETWORKS
DECsystem-10 COMPUTER NETWORKS

Inter-computer communications—or computer networks—are increasingly important areas of computer design. Computer networks can range from large-scale, expensive systems which exchange information at extremely high data rates to networks consisting of a few low-cost machines of modest size. Often the proponents of a certain system, having pioneered a particular approach, overemphasize the advantages of their own creation. Our purpose here is to present some of the concepts behind computer networks and to illustrate the kind of technical and economic advantages a network system can offer. As a manufacturer of a large, sophisticated computer system as well as medium-scale and minicomputers, we're in a position to supply the right equipment and systems software for networks large and small.

NETWORK ADVANTAGES

Besides the obvious fact that a computer network offers a means for solving problems, some or all of the following advantages may be present.

Load Sharing
In many cases, large and expensive computer systems are under-utilized. When major computer systems are interconnected, job processing may be off-loaded from one to another, creating a distributed processing power capability.

Resource Sharing
System resources—computing power, data storage, extensive software and peripheral equipment—are expensive, generally too expensive to duplicate for all users. When outlying satellite processors can be brought into direct communication with one or more large-scale central facilities, each smaller processor in the network can take advantage of the peripherals, software, and computing power normally available only with much larger systems.

Program Sharing
Programs residing on one computer may be used by others. Often the program will be of a magnitude that could not be made available on the user's own computer. Program sharing can also eliminate the need to provide software for many different machines, resulting in more economical program development. Through program sharing, the user can submit his work to the computer capable of performing it most rapidly and most economically.

Data Sharing
Data stored on one or more facilities, possibly gathered by many diverse groups, can be shared. For example, remote computers could transmit collected data directly to a central site for storage and later retrieval and/or immediate processing.

Specialization of Tasks
In a hierarchical structure, a main control computer or network executive can be used to monitor the entire system and dispatch tasks appropriate to specific processors. For example, a fast small computer can be dedicated to receiving data from external devices and preliminary data sorting while a larger processor can be used for computations, data display, and interactive work.

Increased Reliability
An additional processor can be programmed to assume control in the event of operational difficulties. In addition, a backup processor permits system operation to continue while software is updated on the main processor. As computer-controlled functions expand in variety and complexity, continuity of operation becomes a necessity.

Immediate Access
Immediate access to essential information may be a key element in a successful organization. The need for decisions to be based on up-to-the-minute factual information can be critical, not only in on-line experimental or data acquisition applications, but also in management systems, military systems and financial systems.

Increased Throughput
Up to twice the throughput is possible simply by installing additional CPUs, provided that the supplier supports multiprocessor capability with hardware and operating system software. DIGITAL multiprocessor systems are in operation and available at little additional cost.
DECsystem-10 AS NETWORK EXECUTIVE

Successful network operations depend primarily on the computing and interactive capabilities of the network executive. The executive must be able to manipulate files and process data within the time frame of the other satellite processors, and allow multiple-user interaction for operating on data files and program development.

With its speed, precision, and multiprogramming capabilities, DECsystem-10 is a natural computer network executive. Hardware and software are designed for easy and efficient access by other processors whether they are 60-bit super computers or 12-bit minicomputers. Software allows for efficient multiprogramming operations which take full advantage of the processor power for many concurrent tasks. Within the time frame required, DECsystem-10 can service the simultaneous input/output requirements of many other processors and data communication lines. Each element in the network is responsible for those operations it does best, resulting in a savings of computing power, development effort and system maintenance.

DECsystem-10's overall advantage as network executive is further augmented by its ability to simulate other DIGITAL processors. Using the terminals on the DECsystem-10, a programmer can create, edit, assemble, and execute machine language programs for DIGITAL processors. Software for satellites can be written and checked out prior to adding the satellite to the network. If the satellite is already operative, the system can perform simultaneous dedicated operations and program development. The satellite processor can be functioning in the network or in a standalone mode while programs are developed on the DECsystem-10 for subsequent implementation. Once the programs are operational, they can be transferred through the network to the satellite for immediate operation. The result is minimal downtime on the satellite for program modifications or system changeovers.

In the case of multiple DECsystem-10 networks involving very large computers, the ability to interactively develop operating systems or to change the software on-line assumes an added significance. Necessary changes in the software operating systems of the larger computers require an extensive effort in programmer time and quite often an extended period of testing and implementing the changes. In most cases, single-processor systems give no throughput during this time. But with DECsystem-10's unique editing, compiling, and debugging software, much of this work can be accomplished on-line. Multiprocessor systems have the additional advantage of maintaining throughput with one processor while testing software on another.

Used as the executive for one or more very large systems, DECsystem-10 can do most of the file manipulating and dispatching. This has a twofold advantage: 1) Software alterations can be localized to the DECsystem-10 operating system where they can be easily effected through interaction with the logic via the DECsystem-10 terminals and multiprogramming software; and 2) unnecessary changes in the software systems of the very large computers can be avoided.
TYPICAL DIGITAL COMPUTER NETWORKS
Computers of 12-, 16-, or 18-bit word length can be interconnected as subnetworks linked to the DECSYSTEM-10. The result is an integrated system in which each processor can interact with the -10 and utilize its input/output and mass storage devices.

The variety of networks available is extensive. Links between processors can be made over distances of many miles; subnetworks can be tied to each other or directly to an executive. Configurations can be assembled to satisfy specific user requirements.

1. DECSYSTEM-10 to DECSYSTEM-10
Two or more DECSYSTEM-10 central processors can be interconnected to share memory, peripherals, or system functions. The processes can share portions of memory, some or all of the peripherals, or be used to handle separate functions in the overall system operation. If desired, one processor dedicated to input/output operations can communicate directly through shared memory to another dedicated to executing one or more compute-bound jobs. Under software control, the processors are able to exchange status and control information. Both processors execute user programs and search the scheduler's queues for runnable jobs. Throughput can be double that of single-processor systems. Standard DECSYSTEM-10 operating systems fully support dual-processor operations.

2. DECSYSTEM-10 to PDP-15
One or more PDP-15's can be linked to the DECSYSTEM-10 through memory bus, input/output bus, or over communication lines. Typically, the PDP-15's can be used for fast data acquisition, preprocessing, and message routing while the DECSYSTEM-10 is used for arithmetic calculations, program development, and overall system control.

Bisynchronous data communication software and hardware are available, enabling a DECSYSTEM-10 coupled to a PDP-15 to communicate with an IBM 360/370 or an IBM 2780. The software/hardware package has a combined throughput of approximately 200Kbps. Equipment and software are available through the DECSYSTEM-10 Systems Group. Required hardware includes a DECSYSTEM-10 coupled to a PDP-15 with either a DA25 or DA10 Interface. The PDP-15 requires 16K words of core and a DC15S Synchronous Line Multiplexer. Additional documentation is available on request.
3. DECsystem-10 to PDP-11

The byte manipulation capability of the PDP-11 together with the UNIBUS™ structure makes it an ideal processor for communications work. The PDP-11 is well equipped to assemble or disassemble words for transmission of Teletype-like characters over communication lines. The PDP-11 can be used as a dedicated system for receiving and sending data and for packing and unpacking characters and words directly into or out of the DECsystem-10 memory. Once operation of the PDP-11 link is initiated under program control from the -10, the PDP-11 can input and extract data from the -10 memory without any -10 processor overhead. Transfers are made independent of the DECsystem-10 processor, which is free to carry on normal program operations.

In cases where links are made to remote processors, common carrier or private lines can be used for serial communications. All character packing and unpacking can be done by the PDP-11, leaving the DECsystem-10 processor free to operate on the assembled data. Interface capabilities exist for connecting up to four PDP-11's directly to DECsystem-10 memory. In turn, each PDP-11 can service up to 16 full-duplex communication lines. This type of connection (serial, full-duplex) is supported by the DC75 Synchronous Communication System, a DECsystem-10 peripheral. The standard DECsystem-10 operating system supports this equipment, communicating with one or more DC71 Remote Batch Stations.

4. DECsystem-10 to PDP-8

The price/performance of the PDP-8, coupled with the extensive amount of software now available, often makes it the best choice as a small dedicated processor for many types of monitoring and data acquisition applications. One or more PDP-8 computers can be used to control a series of operations and to gather information for input to a larger system. Hardware and software now exist for connecting many PDP-8's to the -10 over data communication lines. One example of this follows. Alternatively, with the DA25 memory-to-memory connection, blocks of data can be passed between the PDP-8 and DECsystem-10 memories at high speed and with very little overhead to either processor.

Another approach is to connect the PDP-8 to the DECsystem-10 using an asynchronous, serial data line. This is an inexpensive method which provides most of the advantages of more complex, more expensive networks, including the ability to use the PDP-8 teletype console as a DECsystem-10 timesharing terminal; the ability to load and store PDP-8 programs from the DECsystem-10; the ability to perform remote printing and plotting on the PDP-8. An example of this link appears on Page 9.
5. DECsystem-10 to PDP-12
A network of DECsystem-10 and PDP-12 processors would make good use of the applications capability of the PDP-12. The PDP-12 in a stand-alone mode is able to perform a number of functions involved in data acquisition, analysis, and display. When connected to a DECsystem-10, files from the PDP-12 can be exchanged for additional processing or storage on the DECsystem-10 off-line units. In a typical biomedical or laboratory environment, DECsystem-10 can serve as the center for a network of one or more PDP-12 remote stations. DECsystem-10 file handling and protection schemes allow for a common data bank with each file having the desired level of protection. Individual files and records can be maintained under system executive control and exchanged between remote stations. The file identification and protection scheme on the -10 is used to ensure that only correct and authorized files are exchanged.

6. DECsystem-10 to Large Processor Systems
DIGITAL also offers links between a DECsystem-10 and other larger computing systems. Existing networks of this type employ the -10 as the overall network executive. In that capacity, the -10 is used to pass files back and forth to the larger computers and to facilitate on-line interaction. DECsystem-10 software is designed to handle the interactive programming from a number of users and message switching among all the processors in the network.

When network system changes are required, they can be made most efficiently on the DECsystem-10. Its operating system software is far easier to generate or modify than that of the larger computers in the network. Once the major changes have been effected in the DECsystem-10 operating system, the changes needed in the operating systems of the larger computers will be relatively minor.

Moreover, while the changes are being made, the calculation power of the larger systems is continually available. Users on the DECsystem-10 can be interacting with data files in the larger systems, developing programs to run on any of the computers in the network, or introducing changes in the network executive, all without a loss of time to the programmers or the computers in the network.
DECsystem-10 TO PDP-8 LINK

Here's an example of low-cost, yet effective communication between a remote, small computer and a large, central computer over hard-wired asynchronous lines. Several such links could be implemented, using private lines or dial-up telephone lines.

The network supports all the features considered most desirable by users of both small and large systems. Besides the specific advantage of using the PDP-8 Teletype as a DECsystem-10 timesharing terminal—loading programs stored on the -10 into the -8 and performing data collection functions from -8 to -10—there are the usual advantages found in most computer networks: program, data and hardware resource sharing. While the relative importance of each of these shared operations may vary within the installation, DIGITAL software supports each equally well.

Supported Functions

1. DECsystem-10 FORTRAN, ALGOL, and BASIC programs can communicate directly with the small computer for on-line data acquisition applications. Thus, the user can apply a higher-level language to collect data on the -10, even though data may have been collected or developed on the PDP-8.

2. Information can be collected and stored on the small computer, then sent to DECsystem-10 for analysis by programs written in any of the higher-level languages available on the -10, such as FORTRAN, ALGOL, BASIC, COBOL, BLISS, and AID.

3. Programs for the small computer may be stored on DECsystem-10 and then loaded directly from the -10 into the mini.

4. DECsystem-10 file creation, file storage, file editing, and file protection and sharing facilities are available to the small computer programmer.

5. The console TTY of the PDP-8 can be used as a terminal of the DECsystem-10 with access to all DECsystem-10 resources, programs and stored data. The TTY has the normal characteristics and "feel" of a standard DECsystem-10 terminal.

PDP-8 Teletype Monitor Service Routine

The Teletype Monitor Service Routine (TMSR) is a control program resident in the PDP-8 which handles all communication between PDP-8 and DECsystem-10 computers. TMSR simulates a full-duplex local copy terminal on DECsystem-10. It has a built-in core dump routine which allows PDP-8 core to be loaded or dumped directly from the -10. TMSR is loaded into PDP-8 memory using the standard -8 binary loader.

All operations involving the asynchronous link between the PDP-8 and DECsystem-10, such as terminal keyboard and printer, are handled by TMSR. The program is capable of receiving a string of ASCII characters and translating them into core loading commands. After core loading is activated, the characters are decoded into memory field change commands, origin commands, or memory data words.

TMSR Software Packages

Several software packages have been written for use on the PDP-8 or PDP-12 with TMSR.

LOAD 8 This is a DECSystem-10 program which will load binary files as output by the PAL-10 assembler directly into the PDP-8 memory. These loads are checksummed to guarantee that the loading process was free of errors.

LPT 8 This is a DECsystem-10 program which allows users of the PDP-8 to direct information coming from DECsystem-10 to go to the TTY, the LPT 8, or the plotter on the PDP-8. This allows remote listings or plots to be performed at the PDP-8.

RL 8 This is a subroutine package for FORTRAN consisting of two routines, Read 8 and Load 8. Read 8 allows a FORTRAN program running on DECsystem-10 to read any block of PDP-8 core. Load 8 allows a FORTRAN program running on DECsystem-10 to load any block of PDP-8 core. These two routines have built-in error detection and error correction facilities to ensure that the data either loaded into or read from the PDP-8 is correct.

TYPPLT This is a DECsystem-10 program which will send a binary plotter file to the PDP-8 for plotting by the LPT-8 program.

Hardware Requirements

The minimum hardware required to establish communication between DECsystem-10 and a PDP-8 is a four wire telephone cable, one leg of a DC10B interface unit, and the appropriate PDP-8 asynchronous line unit (consult PDP-8 price list). This minimum hardware configuration is available for a total cost of approximately $500.
DECSYS-10 INTER-COMPUTER AND COMPUTER INTERFACE EQUIPMENT

The following tables summarize the wide selection of inter-computer and computer interface equipment available. Following the tables are short descriptions of the devices listed.

DIGITAL maintains a custom design and fabrication capability for applications not served by the equipment listed. All DECSYS-10's are fully integrated systems which are thoroughly tested prior to shipment. Custom interface equipment receives special attention from our DECSYS-10 Systems Group, a special team dedicated to engineering reliable multicomputer systems.

## DECSYS-10 INTER-COMPUTER AND COMPUTER INTERFACE EQUIPMENT

<table>
<thead>
<tr>
<th>Unit</th>
<th>Computers</th>
<th>Connection</th>
<th>Typical Data Rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT01C</td>
<td>PDP-10/PDP-10</td>
<td>Peripheral Access over I/O Bus Link</td>
<td></td>
<td>Single switch for each shared peripheral chain</td>
</tr>
<tr>
<td>DT04C</td>
<td>PDP-10/PDP-10</td>
<td>Peripheral Access over Memory Bus Link</td>
<td></td>
<td>Single switch for each shared peripheral chain</td>
</tr>
<tr>
<td>DA10 (PLI)</td>
<td>PDP-10/PDP-8* PDP-12* PDP-15*</td>
<td>I/O Bus to I/O Bus</td>
<td>10 KHz word rate</td>
<td>Single processor into PDP-10</td>
</tr>
<tr>
<td>DC10 (PLI)</td>
<td>PDP-10/Asynch Line</td>
<td>I/O Bus to Asynchronous Lines Memory Bus to Memory Bus</td>
<td>110, 150, 300, 1200, 2400 baud 500 KHz word rate</td>
<td>Up to 64 asynchronous lines Single PDP-15 for each interface</td>
</tr>
<tr>
<td>DA15C</td>
<td>PDP-10/PDP-15</td>
<td>Memory Bus to Memory Bus</td>
<td>100 KHz 36-bit word rate</td>
<td>Up to sixteen processors**</td>
</tr>
<tr>
<td>DA28</td>
<td>PDP-10/PDP-8* PDP-12* PDP-15* PDP-11*</td>
<td>Memory Bus to Memory Bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DS10 (PLI)</td>
<td>PDP-10 Synch Line</td>
<td>I/O Bus to Synchronous Line Memory Bus to Memory Bus</td>
<td>4800 bps 9600/4800/2400 bps 40Kbs/40 bps PDP-11/13 Max.</td>
<td>Single synchronous line Multiple synchronous lines See Data Sheet (DC75)</td>
</tr>
<tr>
<td>DC75 (PLI)</td>
<td>PDP-10/Synch Line (up to 64) Memory Bus to Synchronous Line</td>
<td>Memory Bus to Memory Bus</td>
<td>100 KHz word rate</td>
<td>Single PDP-15 for each interface</td>
</tr>
<tr>
<td>DA27</td>
<td>PDP-10/PDP-15</td>
<td>Memory Bus to Memory Bus</td>
<td>Memory Rate</td>
<td>Multi-processor systems software supported using standard monitor Similar to DA10</td>
</tr>
<tr>
<td>PCD</td>
<td>PDP-10 to PDP-10</td>
<td>Memory Bus to Memory Bus</td>
<td>Memory Rate</td>
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<tr>
<td></td>
<td>PDP-10 to PDP-11</td>
<td>I/O Bus to Unibus</td>
<td>Bus Rate</td>
<td></td>
</tr>
</tbody>
</table>

PLI—Standard PDP-10 Product Line Item
* — Requires negative I/O Bus
**— Can be any combination of PDP-8’s, PDP-12’s, PDP-11’s and PDP-15’s.

Note: 1. Data rates quoted are typical values. For information on maximum rates and specifications, contact local DIGITAL Field Office or Digital Equipment Corporation, Maysnrd, Massachusets.

2. Additional documentation is available for all items. Specifications for all items marked PLI in column one are summarized in the DECSYS-10 Technical Summary. Other documentation available.

## INTER-PDP INTERFACES

| Asynchronous Lines | PDP-10: DC10, DA26 | PDP-15: LT19* | PDP-12: DC08, DC02, PT08*, DP12 | PDP-11: DC11, DM11, 680/1, DC02, PT08*, KL8-E/P |

*— Requires negative I/O Bus.
**— CERN Interface (1011 Memory Link)

See DEC Communications Equipment Handbook, DEC-00-GWZA-D, Price Lists, and Individual Data Sheets for information on above Units. For items not listed in handbook, contact local DIGITAL Field Office or Digital Equipment Corporation, Maysnrd, Mass.
DT01C Interprocessor Buffer
The DT01C is an electronic switch which enables two
DECsystem-10 central processors to share peripherals. Each
processor can request use of the switch, and when the request
is granted, the processor has exclusive access to the
peripherals. The switch contains a 36-bit register which is
used as an inter-processor buffer accessible by both processors
and serves as a means for control and communication. The
DT01C is used to link together a chain of peripherals which
can then attach to the I/O bus of the processor having switch
control. All peripherals in the chain can be accessed by this
processor. The other processor is locked out of the peripheral
chain until it requests and is granted control of the switch.
Peripherals which are used exclusively by only one processor
are connected to its I/O bus and not attached to the switch.

DA10 Interface Unit
This unit allows interconnection of the I/O bus of
DECsystem-10 central processor to the I/O bus of either a
PDP-8, PDP-12, or PDP-15 processor. The interface interprets
I/O signals from either interconnected processor and
assembles or disassembles words to the proper size for
transfer. The DA10 allows either processor to generate an
interrupt and to send or receive information under program
control.

DC10 Data Line Scanner
This unit provides a timesharing, two-way interface between
DECsystem-10 and a maximum of sixty-four serial
communication lines. Any device using 5- or 8-level
Teletype code can be handled by the DC10 at speeds up to
100Kbps. Standard software supports ASCII. Data lines to the
devices are serviced either on demand or under program
control, but servicing is controlled by the central processor
on a priority interrupt basis. In operation, the DC10
continually scans the eight possible 8-line groups looking for
a flag that is set. When a flag is found, the DC10 scans within
the group for the appropriate line and then causes a program
interrupt on the P.I. channel assigned to the data line scanner.
Options are available to support IBM 2741 terminals.

DC44 Extended Memory Interface
This unit is a device for interfacing up to four PDP-11
processors into DECsystem-10 memory. It packs and unpacks
characters in the -10 memory, allows the -10 to control
operation of each PDP-11, and permits PDP-11 programs to be
executed directly from -10 memory. The interface is
connected to the DECsystem-10 memory and I/O busses and
the PDP-11 UNIBUS. Under program control, a base address
and memory block size can be set for each PDP-11. The
format of the PDP-11 information stored in DECsystem-10
memory gives a 16-bit PDP-11 word and an associated byte
pointer. Pointer options allow for the 16-bit word to be either
data or the address of the data. DECsystem-10 memory
blocks for different PDP-11's can be overlapped to allow
processor reentrancy. The interface includes two I/O bus
ports for access by two DECsystem-10 processors if required.
DA15C Extended Memory Interface
The DA15C is an interface unit between a DECsystem-10 and a PDP-15. It extends the addressing space of the PDP-15 beyond its physical memory size by allowing the PDP-15 to read and write directly into DECsystem-10 memory. Two 18-bit PDP-15 words are stored in each -10 location. The interface connects to the memory and I/O busses of both processors. Control and status information is transferred under program control to activate or deactivate the interface. Protection and relocation registers in the interface allow the blocks of -10 memory addressable by the PDP-15 to be dynamic; i.e., under monitor control, the interface can be deactivated, the block moved within memory, and the registers updated. The monitor then reactivates the interface to resume normal operations. Block size can be chosen in 1K increments by setting the interface protection register through DECsystem-10 program control.

DS10 I/O Bus to Synchronous Modem
The DS10 synchronous interface connects the DECsystem-10 to a synchronous full-duplex data line operating at voice grade rates. Software is provided to support use of the DS10 in conjunction with a DC72 (PDP-8/E) remote batch terminal.

DC75 Memory Bus to Synchronous Modem
The DC75 provides communication over as many as 64 synchronous lines at multiple speeds. A basic DC75 contains a DL10 Memory Bus Interface, PDP-11 Computer, and DS11 Synchronous Line Control for handling up to 16 full-duplex lines with 8 full-duplex lines implemented in the basic package. Software is supplied to support the quantity of DC72 Remote Terminals purchased.

One DC71 will handle a Card Reader (300 cpm), Line Printer (200 lpm), and up to 16 asynchronous local lines (if asynchronous line hardware is purchased).

DA28 Memory-to-Memory Interface
The DA28 is a direct memory-to-memory interface between a DECsystem-10 and a PDP-8, PDP-11, or PDP-15 which allows block transfers of data in a single-cycle break mode. Hardware design allows for a combination of sixteen processors to be connected directly to DECsystem-10 memory. The block transfers in either direction are initiated under program control and the processors are immediately freed to continue program execution. The interface associates with each satellite processor a unique device number which can be addressed to connect the satellite to the -10. When the connection is free, the -10 end is placed in a scan mode to check for any satellite requesting service. Data is sent by a request/response method. Because of the asynchronous nature of this link, the data bus cable length is not restricted by timing considerations, and bus lengths of a few thousand feet can be accommodated. (Line drivers are required for distances over 100 feet.)

DECsystem-10 Large Computer Interfaces
In addition to providing the units listed above, DIGITAL can interface any network of PDP computers to other types of processors. A number of special-purpose interfaces exist for linking DECsystem-10 to many of the very large computer systems now in use.

Those include but are limited to:
1. DECsystem-10 to CDC 6600 (parallel interface)
2. DECsystem-10 to UNIVAC 1108 (parallel interface)
3. DECsystem-10 to IBM 360 (synch lines)

Write DECsystem-10 Marketing or call your nearest DIGITAL sales office for complete information.
DATA COMMUNICATIONS EQUIPMENT

The following tables summarize the data communications equipment currently available. New product developments will result in additional equipment becoming available, with the trend toward increased performance and/or lower cost.

It is essential that appropriate data sheets and other reference material be obtained prior to finalizing system design. DIGITAL Sales Offices have trained personnel who can provide assistance with system planning. Several DIGITAL publications are available that discuss data communications in detail.

It should be kept in mind that the most sophisticated system may not necessarily be the best. Sophistication is expensive and can result in unnecessary complexity without attendant benefits. High-speed lines and line modems are expensive, yet asynchronous, medium-speed transmission may provide an ideal solution as well as low-cost hardware and simple software.

An earlier example indicates what can be accomplished with an inexpensive PDP-8/E interface and one full-duplex line connection to the DECSYSTEM-10 through the DC10 Line Scanner.

DC10 Data Line Scanner

Data line scanner provides on-line servicing of up to 64 communication lines. It accommodates any device which uses five- or eight-level serial Teletype code at speeds up to 2400 Baud. Special devices may operate at higher speeds. Full-duplex with local and half-duplex data modes are available on each line serviced.

DC10A Control Unit. The scanner and control unit for the DC10 communication controller provides four units of cabinet space and power supplies for various combinations of line equipment.

DC10B Eight-line Group Unit. Provides Teletype interface for up to eight local lines, full-duplex. May be used with duplex or full-duplex with local copy data sets. When used with data sets, communications must be established, maintained, and terminated manually, unless DC10E expander data set control units are provided. Requires one unit of cabinet space in a DC10A or DC10F.

DC10C Eight-line Telegraph Relay Assembly. Provides conversion from local to long lines using full- or half-duplex facilities. Requires two units of cabinet space in a DC10A or DC10F.

DC10D Telegraph Power Supply. The standard line voltage supply used with DC10C (120V dc at 2 amperes). No additional cabinet space required.

DC10E Expander Data Control. Provides expanded control of eight data sets in the DC10 system. Requires two units of cabinet space in a DC10A or DC10F.

DC10F Expander Cabinet. Provides eight units of cabinet space and power supplies for expansion beyond capacity of DC10A.

CRT Display Terminal

VT05 Alphanumeric Terminal. Displays 1440 characters on a scan CRT. Comprehensive 64/128 character set keyboard. 72 characters per line, 20 lines. 300/2400 Baud.

Synchronous Communications System

DS10 Single-line Synchronous Interface. Between I/O bus and one full- or half-duplex serial synchronous modem. EIA standard RS-232B or C. Total rate for one or two DS10 units is 9600 Baud half- or full-duplex. Programmable character width is six or eight bits.

DC75 Synchronous Communication System. Provides direct memory interface for full-duplex synchronous lines. Total throughput capacity is 40KB, i.e. four lines at 9600 Baud or eight lines at 4800 Baud etc. DC75 provides eight lines and connects to memory access port.

DC75D Expander Option for DC75. Provides an additional 40KB throughput capacity for DC75, i.e. eight additional lines at 4800 Baud. Up to three DC75D's can be added to one DC75.

DC75E Incremental Eight-line Group for DC75 or DC75D. Provides for up to eight additional lines on a DC75 or DC75D for a total of up to 16 lines. DC75E does not increase throughput capacity of DC75; it still remains at 40KB, i.e. 16 lines at 2400 Baud. Only one DC75E per basic DC75 or DC75D.
OVERVIEW OF DECsystem-10
DATA COMMUNICATIONS FACILITIES
Remote Batch Station

DC72A Remote Batch Station. This equipment interfaces to a DECsystem-10 via modems and a DS10 or DC75 synchronous modem controller to provide remote batch processing.
- Teleprinter
- 300 CPM card reader
- 132 column, 64-character printer

DC72B Remote Batch Station. This is identical to the DC72A except for a 96-character 245 LPM line printer.

DC71D Teletype Concentration Package. Provides for concentration of up to 16 Teletype lines through the DC71 to DECsystem-10. DC71D includes eight lines.

DC71E Expander Option. Provides for second eight lines on DC71D.

DC72C Same as DC72A except line printer is 173 LPM, 96-characters.

DC72L Teletype Concentration Package. Eight lines; max. 2 per DC72.

PDP-15 Data Communications Equipment

LT19D Multi-station Teletype Control. Separate transmit clock per channel; can accommodate (but does not include) up to 5 LT19E line units. Four LT19D units may be attached to a PDP-15 system.

LT19E Line Unit. (One required for each Teletype or EIA Line Adaptor).

LT19F EIA Line Adaptor (per line).

LT19H Cable Set for Interprocessor Buffer for use with LT19H/LT19F or LT19E/PT38F combinations. Specify length.
- LT19HA 50 feet
- LT19HB 100 feet
- LT19HC 150 feet
- LT19HD 200 feet
- LT19HE 250 feet

LT15A Single Teletype Control.

DP09A Data Communications System. Compatible with EIA RS 232B Interface, Bell System Type 201 Dataphone.

DC01ED Multi-Station Teletype Control. Separate transmit clock per channel, includes 8 serial channels.
PDP-11 Data Communications Equipment

Asynchronous Interfaces

**KL1-A**
Full Duplex Asynchronous Line Interface Unit. 110 Baud.
**Prerequisite**
PDP-11/20

**KL1-B**
Full Duplex Asynchronous Line Interface Unit. 150 Baud.
**Prerequisite**
PDP-11/20

**KL1-C**
Same as KL1-B except 300 Baud.
**Prerequisite**
PDP-11/20

**KL1-D**
Same as KL1-B except 600 Baud.
**Prerequisite**
PDP-11/20

**KL1-E**
Same as KL1-B except 1200 Baud send, 110 Baud receive.
**Prerequisite**
PDP-11/20

**KL1-F**
Same as KL1-B except 2400 Baud.
**Prerequisite**
PDP-11/20

**DE11-A**
EIA level, RS-232-C Line Adaptor for VT06 or other EIA level devices (Requires KL11 interface). Mounts on KL11.
**Prerequisite**
PDP-11/20

**DC11-AA**
Dual Asynchronous Serial Line System Unit and Clock for mounting 2 DC11IDA Module Sets. 110, 134.5, 150, 300 baud (typical speeds with 103 modem, program selectable).
**Prerequisite**
PDP-11/20

**DC11-AB**
Same as DC11-AA except 110, 300, 1200, and 1800 baud (typical 202 speeds, program selectable).
**Prerequisite**
PDP-11/20

**DC11-AC**
Same as DC11-AA except 110, 150, 600, and 1200 baud (typical European, program selectable).
**Prerequisite**
PDP-11/20

**DC11-AD**
Same as DC11-AA except 50, 110, 134.5, 150 baud.
**Prerequisite**
PDP-11/20

**DC11-AE**
Same as DC11-AA except 75, 110, 134.5, 150 baud.
**Prerequisite**
PDP-11/20

**DC11-AG**
Same as DC11-AA except 134.5, 150, 300, 1200 baud.
**Prerequisite**
PDP-11/20

**DC11-AH**
Same as DC11-AA except 110, 134.5, 600, 1200 baud.
**Prerequisite**
PDP-11/20

**DC11-AX**
Same as DC11-AA except 110, 134.5, 150 baud plus one non-standard baud rate above 600 baud.
**Prerequisite**
PDP-11/20

**DM11-AC**
Same as DM11-AA for 230V, 50Hz
**Prerequisite**
PDP-11/20

**DM11-DA**
Line Adaptor which implements four Teletype lines (data only).
**Prerequisite**
PDP-11/20

**DM11-DB**
Line Adaptor which implements four EIA lines (data only). Includes four 25-ft. modem cables.
**Prerequisite**
PDP-11/20

Synchronous Interfaces

**DP11-DA**
Full/Half Duplex Synchronous Line Module Set and System Unit. Double buffered. EIA/CCITT termination suitable for direct use with 201 modems. Includes 25-ft. modem cable. Space available for one DP11-CA or DP11-KA.
**Prerequisite**
PDP-11/20

**DP11-DC**
Same as DP11-DA except suitable for direct use with 303 modems. Includes 25-ft. modem cable. Space available for one DP11-CA or DP11-KA.
**Prerequisite**
PDP-11/20

**DP11-CA**
Data/Sync Register Extender. Adds the ability to handle 10, 11 and 12-bit data characters. Mounts in DP11.
**Prerequisite**
PDP-11/20

**DP11-KA**
Internal Clock. Clocking source to be used for direct connection of DP11 to local synchronous terminal or a local synchronous computer interface (without modems). For following baud rates: 2400, 4800, 9600, 19.2K and 40.8K. Baud rate must be specified. Mounts in DP11.
**Prerequisite**
PDP-11/20

**Auto Dial Interfaces**

**DN11-AA**
Prewired System Unit for four Bell Automatic Calling Unit Interfaces. Includes 25-ft. cable.
**Prerequisite**
PDP-11/20

**DN11-DA**
Module Set for the DN11-AA. Interfaces directly with Bell 801 ACU. Includes 25-ft. cable (up to 4 DN11-DA’s can be mounted in each DN11-MA).
**Prerequisite**
PDP-11/20

**DC11-DA**
Full Duplex Serial Module Set Any DC11-A (DC11-A accommodates 2 each) with EIA/CCITT termination suitable for direct use with 103 or 202 modems. Handles 5, 6, 7 or 8-bit codes with 1 or 2 stop bits.
**Prerequisite**
PDP-11/20

**H312A**
Asynchronous Null Modem. Allows direct connection of any peripheral having an EIA 232 interface. Mounts DC11-DA, DP11-DA or DM11-DB. Note: DP11-KA required with DP11-DA.
**Prerequisite**
PDP-11/20

**DM11-AA**
Asynchronous 16-line Single-speed Multiplexer and Mounting Panel. Includes space for mounting up to 4 line adaptors (16 line interfaces). Order must specify the baud rate (up to 1200 baud for 16 lines). If no speed is specified, 110 baud will be supplied. (115V).
**Prerequisite**
PDP-11/20

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**Diagram:**

[Diagram of PDP-11 Data Communications System]
PDP-8/E or PDP-8/M Data Communications Equipment

**Prerequisite**

KL8-E
Asynchronous Serial Line Interface. 110 baud send/receive. 20MA current loop. Interconnecting interface cable included.

KL8-E thru EG
Asynchronous Serial Line Interface. EIA-compatible data leads only. Interconnecting interface cable included. Stop codes are jumper selectable. (Max. 17 per system).

KL8-EA 110 baud Send/110 baud Receive
KL8-EB 150 baud Send/150 baud Receive
KL8-EC 300 baud Send/300 baud Receive
KL8-ED 600 baud Send/600 baud Receive
KL8-EE 1200 baud Send/1200 baud Receive
KL8-EF 1200 baud Send/150 baud Receive
KL8-EG 2400 baud Send/150 baud Receive

KL8-FA thru FK
Double-buffered Asynchronous Serial Line Interface. EIA-compatible data leads only. Interconnecting modem cable included.

KL8-FA 110 baud Send/110 baud Receive
KL8-FH 134.5 baud Send/134.5 baud Receive
KL8-FB 150 baud Send/150 baud Receive
KL8-FC 300 baud Send/300 baud Receive
KL8-FD 600 baud Send/600 baud Receive
KL8-FE 1200 baud Send/1200 baud Receive
KL8-FF 1200 baud Send/150 baud Receive
KL8-FG 2400 baud Send/150 baud Receive
KL8-FJ 1800 baud Send/1800 baud Receive
KL8-FK 2400 baud Send/2400 baud Receive

KL8-M Modem Control Interface. Provides control for Bell 103 series modems or equivalent.
KL8-EA thru EG

LC8-E LA30 DECwriter. Parallel interface to the PDP-8 (up to 17 LC8-E controls may be implemented). Device codes are jumper selectable.

LC8-L LA30 DECwriter. Parallel interface to the DC02F-B. Each LC8-L implements one channel in the DC02F-B for the LA30. (No charge when ordered with LA30-PA).

DP8-EA Synchronous Modem Interface. For Bell 201 Modems or equivalent. 25-ft. long Modem Cable included.

DP8-EB Synchronous Modem Interface. For Bell 300 Series Modems or equivalent. 25-ft. long Modem Cable included.

DP8-EP Redundancy Check Option (Industry Compatible).

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**Diagram:**

- PDP-8/E or PDP-8/M Data Communications
  - PDP-8/E or PDP-8/M
  - KL8-E or KL8-M Communicating Interface
  - KL8-E or KL8-M Modem Control
  - DP8-E or DP8-M Synchronous Data Interface
  - Modem
  - Optional
  - Uses Data Facility
  - Phone Line
  - Asynchronous Lines
  - Synchronous Lines
  - PDP-8/E or PDP-8/M Data Communications
PDP-8/L Data Communications Equipment

DC02A Serial Line Interface Group Adaptor. Accommodates up to 4 serial line interface units. Type DC02D. Adaptor includes two separate line clocks for Lines 1 and 2, and Lines 3 and 4. Unless otherwise specified when ordering format converters, Type DC02DA, both clocks are for 110 baud.

DC02D Serial Line Interface Unit. Implements one full duplex serial line interface unit in the serial line interface group adaptor Type DC02A. Unless otherwise specified when ordering format converter, Type DC02DA, format is for 1 start bit, 8 data bits and 2 stop bits. See DC02A for line speed.

DC02DA Format-Speed Option. Permits customer to specify the speed of Lines 1 and 2 and Lines 3 and 4 in the Group Adapter, Type DC02A, and the format of each interface unit Type DC02D.

DC01A-25 Modem Interface Adaptor Cable. DC02D Provides interface compatibility between asynchronous serial line units and modems which conform to EIA-RS232-B specifications (Bell 103 or equivalent). Adaptor includes 25-ft. cable and modem interface connector (send/receive leads only).

DP01AA Synchronous Modem Interface. High and medium speed. PDP-8/L & DW08A

PDP-8/I Data Communications Equipment

DP01AA Synchronous Modem Interface. High and medium speed. PDP-8/I

PT08B Asynchronous Serial Line Interface. Full duplex (single channel).

PT08C Asynchronous Serial Line Interface. Full duplex (dual channel).

PT08F EIA Adaptor. Converts PT08 Channel to RS-232-B Standard.

PT08X Variable Interface. Permits user to specify speed and code of PT08 Channel.

DP01A Synchronous Modem Interface. High and medium speed.
PDP-12 Data Communications Equipment

**Prerequisites**

DC02F  Multiple Terminal Control for up to 8 lines (4 DC02F’s permitted per PDP-12). Specify up to 3 baud rates per DC02F.

DC02G  Module Set for DC02F. 1 required for each remote terminal; specify baud rate.

BC01A-25  Cable for DC02G; 25-ft. with 25-pin Cannon connector.

DC02E  Multiple Teletype Control. Up to 4 lines.

DC02D  Module Set for each Teletype.

DP12A  Serial-line Interface. Full duplex, asynchronous, 110 baud for TTY operation.

DP12B  Dataphone Interface. Full duplex, asynchronous, up to 100K baud crystal controlled. EIA interface levels available (specify baud rate).

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**DECsystem-10 NETWORK CONTROLS OIL PIPELINE DISTRIBUTION SYSTEM**

A network comprised of a DECsystem-10 and over 45 remote minicomputers controls and manages a major oil pipeline distribution system. Located at pumping stations along the pipeline, the minicomputers communicate with the DECsystem-10 over leased, voice-grade telephone lines.

The satellite computers monitor each pumping station and report changes in status to the DECsystem-10. They also control the pumping stations in response to information received from the -10, but are able to take independent action if alarm conditions arise.

The DECsystem-10 continuously accepts, validates and stores operating data from the satellites. It also operates special control consoles at the central installation, maintains inventory information on all of the various batches in the pipe, routes each batch to the right customer, and adjusts the operation of the pumping stations so as to minimize power consumption, the principal operating expense of the pipeline. In addition to these on-line functions, DECsystem-10 handles engineering studies and normal business data processing.

Since the installation of the computer network, many of the pumping stations have been able to operate unattended, power consumption has been reduced, and product tracking and routing have been improved.

Computer data communications hardware consists of an asynchronous serial line multiplexer at the DECsystem-10 site, while each minicomputer has a single, full-duplex line unit.