CERNET - A COMPUTER-TO-COMPUTER COMMUNICATIONS NETWORK

Computing at CERN over the last decade has been characterised by a large increase in the number of computers on-site (over 250 at present) and by a general transition to the use of remote access methods to the central, and other computers. These trends have led to data communications playing an increasingly important role in the Laboratory's computing activities.

Communications facilities available to remote users include:

a) INDEX (an INdependent Digital EXchange) providing dial-up connection for computer terminals using asynchronous lines at up to 9600 baud, allowing switching of some 240 lines between up to 100 ports connected to various computers.

b) SUPERMIX, a CERN-designed terminal concentrator system based upon Hewlett Packard computers allowing up to 70 display terminals operating asynchronously at up to 9600 baud to access the INTERCOM system on the central CDC computers.

In addition to these communication facilities for terminals, higher speed links between computers have also become necessary. Small mini-computers in the experimental areas often need access to more powerful computers (for processing power or file storage for example). The OMNET system has provided this for one kind of mini-computer (DEC PDP-11s) originally supported by a CII 10070 computer. This system, connecting some 40 PDP-11s at present, has proved its usefulness in data processing for two major experiments, the Split Field Magnet and the Omega Spectrometer.

This trend towards decentralisation has led to a need for a general communications network providing very high-speed data transmission between experimental areas and the central computers. CERNET has been specifically designed to fulfil this need.

CERNET is a communications network by means of which messages can be sent between users' computers (called "subscribers") which are connected to it. CERNET consists of a number of small computers (called "nodes") interconnected by high-speed data links. When a subscriber computer wishes to send a message to another subscriber computer, it transmits the message to the local node which will use the most appropriate route through the network in order to forward the message. Comprehensive error detection and error correction procedures ensure that the message delivered to the called subscriber is an exact replica of the initial message. Duplication of some nodes and the interconnection of nodes by data links ensures that there is usually more than one route through the network between two subscribers, thus providing protection against breakdown of a particular node or link.

A few of the subscriber computers (called "hosts") provide various services to other subscribers. In particular the central CDC and IBM computers are hosts connected to CERNET. Thus any subscriber computer can, via CERNET, gain access to the services offered by the Laboratory's computer centre, such as file storage services.
A brief technical description

for data and programs, program development facilities, program compilation and execution, etc.

Many of the subscriber computers are the data-acquisition computers used on-line in physics experiments. CERNET provides, for these subscribers, the possibility of using the facilities available on the central computers directly in the running of the experiment. Thus in the setting-up phase of an experiment many tests may be made on programs and data to check equipment and methods being used, whilst during the experimental run data samples may be stored and processed on the central computers to continuously monitor the progress of the experiment, or data may be processed in real-time as it is recorded at the accelerator.

CERNET consists at present (early 1979) of eight Modular Computer Systems Modcomp II/45 computers as nodes, connected by high-speed data-links. Fourteen subscriber computers are connected to the network, of which eight are experiment data-acquisition computers (PDP-11, NORD 10, HP21MX) and four are hosts (the central CDC 6400, 6500 and IBM 370/168 and 3032). In addition, a gateway connection is made to the OMNET network mentioned overleaf.

CERNET is a store-and-forward packet-switching network, based on a three-level protocol structure. The Line Protocol, implemented by link drivers in adjacent computers, controls packet transmission over the data-link connecting them. The End-to-End Protocol, implemented by Transport Manager programs in the subscriber computers controls the communication on a message basis between processes in separate computers; this involves the opening and closing of logical-links between the processes and the transmission of messages (including sequencing and flow control as well as error detection and correction) between them. The File Access Protocol, implemented by a User Interface program in the subscribers and hosts, controls access to a host file-system and transmission of files between this and a subscriber.

The CERN-designed data-links provide full-duplex bit serial transmission over distances up to 2 km at rates up to 2.5 Mbits/s. Asynchronous baseband transmission technique is used over twisted pair cables. A pair of data sets drive one quad in a standard TV transmission PoD cable for each link, and a repeater is provided at 1.5-2 km intervals for long distances. A sender and receiver unit forms the data-link interface to the node computers. These units handle the conversions between 16-bit control- and data-words and the serial bit-strings needed for transmission over the link, as well as the generating and checking of the parity and cyclic redundancy bits needed for error detection. The receivers also provide buffering for a complete packet. A special version of the data-link interface has been developed for the Modcomp II/45 computers used as the CERNET nodes, whilst a CAMAC version has been developed for use with PDP-11, NORD 10 and HP21MX subscriber computers.

References

CERN Yellow Report (Easter 1979)
CERN/DD/79/? The OMNET Manual

Further information

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