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DATACOMPUTER SUPPORT OF SEISMIC
DATA ACTIVITY

Computer Corporation of America

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1. Overview

1.1 Project Goals

The purpose of the project is to support the ARPA-NMRO Seismic Data Activity by providing data storage and retrieval services. The Arpanet will be used as the communication channel. As part of the service, seismic data will be (a) collected from the Arpanet; (b) stored; and (c) made available to computers on the Arpanet in a convenient and timely manner. These services will represent a special application of the Arpanet Datacomputer implemented by CCA under Contract No. MDA903-74-C-0225.

The Datacomputer will require no special programming for the seismic data application, beyond that which has already been planned for the time period being considered. However, the amount of seismic data to be kept on-line necessitates the addition of a tertiary storage mass memory. An Ampex Terabit Memory System (TBM) with a capacity of almost two hundred billion bits will be installed at CCA in 1975.

Also needed for this project is a small Seismic Input Processor (SIP). The SIP will collect data over the network on a round-the-clock basis. It will reformat the data and buffer it. At regular intervals, the SIP will generate a datalanguage update request and burst the data to the datacomputer via the TIP (see Fig. 1).

1.2 Status of the Project

The initial activity on the project has been in two areas: hardware acquisition and coordination with the seismic community.

Contract negotiations are under way with Ampex Corporation for the purchase of a TBM Memory System, to be incorporated into the Datacomputer. The initial system will consist of

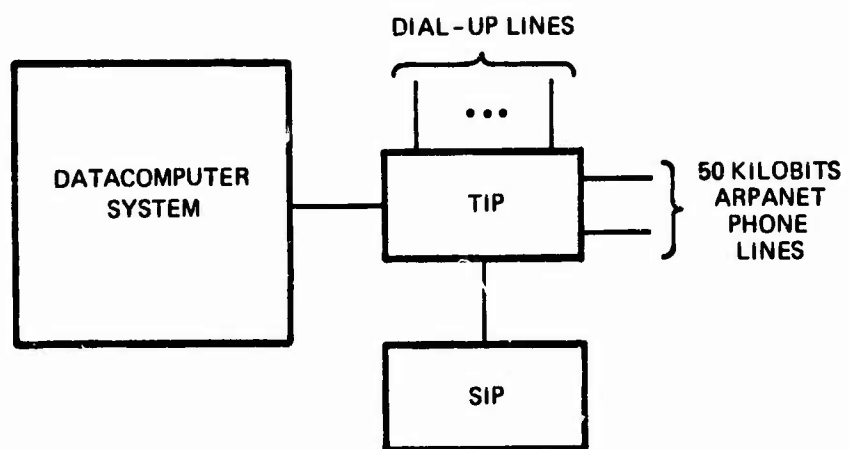


Figure 1 - CCA Installation

one transport driver, one data channel, two dual transport modules, and an interface. New technical concepts regarding the TMB/PDP-10 interface have come out of a recent meeting between Ampex and CCA, and Ampex has revised its proposal to include an improved channel interface unit (CIU). Delivery of the TBM and CIU at CCA is expected to be June 1975.

The SIP hardware requirements have been specified (see Appendix). Vendors have been contacted, and quotations for the SIP hardware have been received. An evaluation of the bids is forthcoming.

CCA has worked closely with the seismic community to determine requirements for data storage and retrieval services. Efforts have been undertaken to specify suitable file formats for storage of the seismic data. These formats reflect the way in which the data is collected, the way in which it will be used, and the most efficient ways of using the Datacomputer hardware and software.

Efforts are also under way to determine the specification of the CCP-SIP protocol. This is a special-purpose protocol that will allow for faster transmission of real-time data than the standard host-host protocol.

2. TBM

In order to satisfy the requirement for a large, on-line seismic file, an Ampex Terabit Memory System will be installed at CCA, as a part of the Datacomputer system. The basic system is described in Appendix E of our proposal, "Datacomputer Support of Seismic Data Activity", submitted August 13, 1973.

An alternative method of interfacing the TBM to the CCA PDP-10 has been proposed by Ampex. This approach involves the use of a PDP-11/05 in addition to special interface hardware to provide interfacing and control functions for the TBM. The channel interface unit interprets and executes instructions from the PDP-10 via an SA-10 IBM-compatible channel, as well as commands typed at the channel interface unit operating console. The advantage in using the proposed Ampex approach is that much of the overhead involved in controlling the TBM is moved from the PDP-10 into the channel interface unit, freeing CPU resources at the PDP-10.

3. SIP

Seismic data will be collected from the Arpanet and buffered by a small Seismic Input Processor (SIP) before retransmission to the Datacomputer. The SIP will have two 3330-type spindles, which allow for 24 hour buffering of a 15 kb data stream. This will ease requirements for both the datacomputer and the Central Communications Processor (CCP) at SDAC.

The SIP is a host on CCA's IMP. The SIP communicates with the Datacomputer as any other host would, that is, using datalanguage, network data connections, and the standard Arpanet host-host protocol. Transfer rates are much higher than normal network communication, however, since no phone lines are involved.

The SIP communicates with the CCP at SDAC using a data transfer protocol which is specially developed for this purpose. The protocol has mechanisms for describing the data logically, for detecting data link outages and reinitializing the data link, for checksumming the data, and the like. CCA has coordinated with BBN in specifying the CCP-SIP protocol which is described in "Proposed Communication Protocol Between the CCP and SIP", by R.T. Gudz of BBN.

Procurement of the SIP hardware has begun. Specifications for on-line storage capacity, bandwidth, system software, Arpanet interface, and the like are described in "Specifications for the Seismic Input Processor (SIP)", dated June 27, 1974 (see Appendix).

4. Coordination with the Seismic Community

Although no special Datacomputer programming is required for the seismic application, the amount of data to be collected necessitates that the data be handled as efficiently as possible if the application is to be feasible. Design of the application requires a thorough understanding of how the data is to be collected and how it is to be used. Towards this end, CCA has worked closely with VSC, SDAC, BBN and others to identify the data storage and retrieval requirements for the seismic application.

Work continues towards specifying the file formats for the seismic data. Figure 2 contains a sample datalanguage description for a file containing raw waveforms, which account for the bulk of the data. One file contains a day's worth of data, which is a size that is convenient both for the Datacomputer and for a seismologist who is analyzing the data. The data is organized first by site and then by time. Preliminary versions of the formats for the other seismic files (e.g., waveform summary and status file, preliminary event data file, final event data file) are described in "SDAC On-Line Processing with Datacomputer Proposal", Emily McCoy, SDAC.

```

CREATE ALPF.DDYY FILE STRUCT
  ALPA LIST (86400) /* # SECONDS PER DAY*/
    SAMPLE STRUCT
      SEQNO BYTE V = I
      TIME BYTE (1), B=32
      TIMESERIES LIST (51) /* # CHANNELS */
      DATA BYTE (1), B=16
    END

  ILPA LIST (86400) /* # SECONDS PER DAY*/
    SAMPLE STRUCT
      SEQNO BYTE V = I
      TIME BYTE (1), B=32
      TIMESERIES LIST (57) /* # CHANNELS */
      DATA BYTE (1), B=16
    END

  KSRS LIST (86400) /* # SECONDS PER DAY*/
    SAMPLE STRUCT
      SEQNO BYTE V = I
      TIME BYTE (1), B=32
      TIMESERIES LIST (21) /* # CHANNELS */
      DATA BYTE (1) B=16
    END

  SITEII LIST (86400) /* # SECONDS PER DAY*/
    SAMPLE STRUCT
      SEQNO BYTE V = I
      TIME BYTE (1), B=32
      TIMESERIES LIST (21) /* # CHANNELS */
      DATA BYTE (1), B=16
    END

  LASA LIST (86400) /* # SECONDS PER DAY*/
    SAMPLE STRUCT
      SEQNO BYTE V = I
      TIME BYTE (1), B=32
      TIMESERIES LIST (30) /* # CHANNELS */
      DATA BYTE (1), B=16
    END

  NORSAR LIST (86400) /* # SECONDS PER DAY*/
    SAMPLE STRUCT
      SEQNO BYTE V = I
      TIME BYTE (1), B=32
      TIMESERIES LIST (66) /* # CHANNELS */
      DATA BYTE (1), B=16
    END
END;

```

Figure 2 - Sample Datalanguage Description of Seismic File

Appendix

"Specification for the
Seismic Input Processor (SIP)"

June 27, 1974

June 27, 1974

Specifications for the Seismic Input Processor (SIP)

1.0 Background

CCA is developing a data management utility, called the datacomputer, for the ARPA computer network. The datacomputer is implemented on a PDP-10 having a trillion bit capacity tertiary memory. One datacomputer application will involve the management of seismic data. Various reasons dictate the need for an intermediate device between the datacomputer and those Arpanet host machines that are seismic data sources. This intermediary, called the SIP, will consist of a mini-computer with a large disk store. It will be a new host computer on the Arpanet and will communicate with seismic data sources via the Arpanet only. The SIP will deal with each source in the protocol required by that source and will collect its data. Periodically, the accumulated data will be burst through the CCA IMP* to the CCA datacomputer for permanent storage. The SIP will communicate with the datacomputer using its unique protocol -- datalanguage.

1.1 SIP Functions

The SIP is a dedicated, one job, system which serves as a data buffer, protocol translator, and perhaps as a data reformatter as well. The SIP must also keep an audit trail of its transactions and keep its status plainly visible for human

* Interface Message Processor.

examination. The slowly changing information will be printed on a hard copy device at the rate of one line every few minutes. High speed information will be displayed on a CCA provided CRT terminal connected to the SIP by an auxiliary EIA interface. The SIP will run 24 hours a day, 7 days a week, and will be mostly unattended.

1.1.1 Buffer Function

The data sources will send data to the SIP at an average rate of about 10,000 baud. Early in its use the data rate may be 5,000 baud and, in a few years, it may grow to 15,000 baud. The eventual destination of the data is the CCA datacomputer, which will be under development for several years. We wish to allow for the datacomputer being down for up to two days. Since about 800,000,000 bits of data is generated per day, the SIP needs an on-line storage capacity of twice that (200 megabytes). There should be at least two drives (spindles) present so that one may be down and the other still usable by the SIP.

1.1.2 Bandwidths

The data from the IMP is burst to the SIP at a 100 KBS rate (one bit every 10 microseconds). This rate may increase in the future. Using the seismic source data rate of 10 KBS, about 10% of the bandwidth is spent acquiring the data from the IMP. The datacomputer can accept data at an estimated 40 KBS, so the SIP should unload itself about 4 times faster than it was loaded. Nominally this would be a 15 minute period out of each hour. Handshaking messages should be a negligible part of the above rates. These rates do not seem to demand a "Direct Memory Access" type of IMP interface in the SIP; a word-at-a-time interrupt interface appears adequate. Also, for generality

and potential speed-ups at the destination, the SIP-to-IMP transmission logic should be capable of sending a variable number of bits per word. For example, the command "send 4 bits" should be possible.

1.2 Software

All the application software for the SIP will be done by CCA personnel. However, the tools to develop such software should be available from the vendor. These tools include:

- a) an assembler
- b) a text editor
- c) an on-line interactive debugging program, and
- d) a binary loader.

If a cross assembler for the PDP-10 is available, only (c) and (d) may be necessary. All IO in above programs should take place in customer-modifiable subroutines.

1.3 Maintenance

Although vendors may quote on portions of the SIP system, it would be highly desirable if the total SIP system were maintained by one vendor to minimize MTTR. It is intended that the SIP be a reliable system needing only monthly preventative maintenance. On-site spares should be provided and CCA personnel may replace any faulty components discovered.

1.4 Physical Considerations

There are two locations being considered for the SIP. One is the existing computer room at CCA. The other is about 100 feet away. The host/IMP interface is dependent on the cable distance. Since the final location has not been determined, we feel it safer to specify that the Distant Host type interface be used.

If the existing computer room is to be the SIP's location, then floor space occupied is critical. Therefore the physical arrangement should be limited to two cabinets. For example, one cabinet could contain the disk drives in an "over/under" arrangement and the other cabinet house the computer, interfaces and power supplies. These cabinets should not be over 8 feet high. Some equipment may sit on top of the disk cabinet.

2.0 Summary

Responsive vendors may quote on either the total SIP system or any of the following subsystems. In any case, in your quotation please state power requirements and floor or rack space required. If you have any options which enhance reliability or provide error detection/correction capabilities, please include them in your response.

2.1 The CPU

The CPU is to be a 1 microsecond (or better) machine with a 16 bit word length and 30,000 (+ 10%) words of central storage. Single-bit error correction or detection should be a feature of the central memory. A line clock must be provided. The CPU must be able to process efficiently interrupts from the IMP interface, the disk controller, the EIA terminals, power failure/restart, and the line clock.

2.2 Console Printer/Keyboard

A hard copy printer/keyboard device, impact or thermal, with a preferable 30 character per second rate, should be provided for software development/debugging and the audit trail function. Some vendors may wish to supply a low-speed paper tape or a cassette capability for loading diagnostic programs.

2.3 EIA Interface

A selectable baud rate, asynchronous EIA RS232C, interface should be provided capable of driving either a CCA supplied CRT terminal or a TIF* port. This interface may be used to provide source text to an assembler, binary to a loader, and display high speed status information.

* Terminal IMP.

2.4 ROM

A customer modifiable ROM of from 128 to 256 words should be provided for use in a special bootstrap loader and power fail routine.

2.5 Special IMP Interface

A non-DMA, interrupt generating IMP Interface must be provided. It should use the "distant host" line drivers/receivers. It would be highly desirable, for fault location purposes, for every flip-flop state to be indicated on a LED panel. It would be highly desirable to be able to transmit a variable (1-16) number of bits per word.

2.6 Disks

A controller and at least two spindles of a 200 megabyte capacity must be provided. A means of error correction (at least 11 bit bursts) must be provided. If a 3330-type is proposed, then the use of CCA provided, already formatted (IBM style), disk packs should be possible.

"TO BE STORED IN A COOL DRY LOCATION"

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