

## CCN AS A NETWORK SERVICE CENTER

### A. INTRODUCTION

CCN, the Campus Computing network of UCLA, will shortly be connected to the ARPA Network as a host of the "Service Center" type. The purpose of this RFC is to describe the hardware and software available at CCN and the services we are now planning to provide to other Network Hosts.

These services and their implementation priority were chosen in consultation with a particular site (RAND) which plans to use CCN via the Network. We would welcome requests and comments from other sites.

### B. CCN HARDWARE

CCN operates an IBM 360/91KK, i.e., a Model 91 CPU with a 4 million byte fast memory.

CPU Speed: Highly program-dependent; 2-6 Mips, with 3 Mips as a useful average. The upper end of this range occurs heavy floating point in the inner loops. The decimal arithmetic operation of a 360 should be avoided as they are executed interpretively by the 91.

Memory Speed: Memory is interleaved 16 ways and extensively buffered. Effective memory fetch time is 600 ns in lower 2 million bytes, 900 ns in upper 2 million bytes.

I/O Configuration	a) 6 2860	Selector Channels
	b) 1 2870	Multiplexor Channel (with 16 control unit RPQ)
	c) 5 2314	Disk Storage Units (i.e., 40 disk drives).
	d) 1 2301	Drum (Systems residence and catalog only.)
	e) 5 (245x)	9 track tape drives (800 bpi)
	f) 3 (240x)	7 tracks tape drives (200/556/800 bpi)
	g) 1 2291	(Modified 2250 CRT) Operator/Maintenance Console.

Also on the Multiplexor Channel are:

- h) 2 card readers and 4 high speed printers at CCN;
- i) Four 40,000 baud interfaces for CCI alphanumeric TV display consoles (currently supporting 40 consoles);
- j) Six data communication ports (3 dial @ 2000 baud, 1 dedicated @ 4800 baud, and 2 dedicated @ 50,000 baud) for remote batch entry terminals;
- k) a Calcomp plotter;
- l) an interface for BBS Teleputers (the Culler-Fried system);
- m) Ten dial ports for 2741 typewriter terminals; and finally:
- n) the IMP Interface

#### C. OPERATING SYSTEM

The Model 91 operates under the IBM-supplied MVT version of OS/360, currently Release 18.6. This system contains a set of modifications developed at CCN for control of batch job flow. MVT is a realization of the general process model of multiprogramming, although this fact is obscured by IBM's terminology. For example, a process is called a task in MVT, while the fork primitive is called "ATTACH".

#### D. USER SOFTWARE

##### 1. Processors:

CCN provides the following user software:

- a) The usual FORTRAN compilers (FORT G. FORT H. WATFOR);
- b) PL/1 (version 5) and PL/C (Cornell's student PL/1);
- c) Assembler G;
- d) IBM Algol F;
- e) IBM Linkage Editor F, and a fast in-core linkage editor written at CCN;

## f) Miscellaneous processors, including:

COBOL, SPI, XP7, META-5, SNOBOL, LISP 1.5, AUTOFLOW SIMSCRIPT 1.5, MIX (Knuth's student machine), CSMP, GPSS, ECAP, APT, PMS, MATLAN, SYMAP, SPSS, and the BMD series}

## g) the IBM file utilities, SORT, and RPG.

## 2. Interactive Systems

- a) URSA            Conversational remote job entry system based on alphanumeric display consoles (IBM 2260 and CCI CC301 consoles). URSA provides a number of other services, including a "desk calculator", an interactive/interpretive assembler, and on-line utilities for manipulation of the OS file system. It also contains the CCN operator interface to MVT. URSA is not suitable for typewriter interaction because it is designed for "instantaneous" display of at least 480 characters at a time.
- b) APL            IBM Program Product version of this well-known interactive system. Currently supports IBM 2741's (Selectric typewriter terminals) only.
- c) OLMS            UCLA implementation of the Culler-Fried system; nearly identical in language to the UCSX On-line System.
- d) TSO            IBM's new general purpose time-sharing subsystem under MVT, to be available at CCS sometime during 1971. TSO supports 2741's and Teletypes (and at CCN it will support CCI consoles). TSO is reminiscent of CTSS in its capabilities and command language.

## E. REMOTE JOB SERVICE

The RJS ("remote Job service") subsystem, was written by CCN to support remote batch terminals communicating over dial and leased lines. A remote batch terminal consists of a set of unit record devices (one or more card readers, printers, and punches) driven either by a hardwired controller or by a small CPU (e.g., IBM Model 20 or 1130). A remote RJS user enters OS/360 jobs, complete with JCL, into the remote reader; the jobs are spooled into the operating system and run in their turn, and the printed and/or punched output is

returned to the remote terminal from which the jobs originated (unless the user or operator re-routes the output). The remote terminal may also include a console typewriter to be used by the remote operator to receive and send messages and to exert control over his terminal.

#### F. FAST BATCH SUBSYSTEM

CCN has written a fast batch subsystem called QUICKRUN to provide "instant" turnaround for small, simple batch jobs which are common in a university computing center. QUICKRUN accepts a very simple job control language ("QCL") without much of the generality of OS/360 JCL.

QUICKRUN is really a batch job control subsystem which itself runs essentially as a job within MVT. Because of its lack of generality, the QUICKRUN subsystem creates much less system overhead than normal OS batch; this is reflected in lower cost per job in QUICKRUN.

QUICKRUN is available at remote batch terminals through RJS as well as through a self-service card reader at CCN.

#### G. SPECIAL CONSIDERATIONS

##### 1. Core Memory for Batch Jobs

CCN can easily run batch jobs requiring up to 3 million bytes, although jobs over 600K bytes will normally not run during prime time.

##### 2. Disk Space

CCN provides extensive on-line disk space for permanent files. The resident disk pack configuration includes:

220 M bytes (8 packs) of user source programs, for use through URSA.

170 M bytes (6 packs) of user object and load modules ("binary decks") and other files.

100 M bytes of limited-time storage (n days, where n is published number satisfying  $7 \leq n < \infty$ )

This space is charged for, at about 5s per kilobyte per month.

In the future, we plan to significantly extend this on-line space by implementing a tertiary storage system using magnetic tapes. In addition, a batch job may always request that the user's own disk pack be mounted, thus allowing very large private collections

of files.

### 3. Rates

Batch charges are based upon  $t$ (CPU time),  $I$ (number of I/O requests), and  $R$ (core memory region size). The current rate schedule may be obtained from:

Mr. Kenneth Tom  
User Relations Supervisor  
UCLA  
Campus Computing Network  
Math Sciences Addition  
Los Angeles, California 90024

Generally speaking, the CCN Model 91 cost is very attractive for compute-bound, heavy floating-point calculations, particularly where large regions are required. For most other jobs, the CCN machine is competitive with other cost-recovery computing centers which operate without special subsidy.

## G. SERVICE TO NETWORK

CCN currently plans to provide RJS, URSA, and (eventually) TSO service to the Network. Each of these will have its own third-level protocol. In addition, there will be a "transparent" third level protocol to allow a user-written program running in batch or TSO at CCN to converse directly with the Network.

The third-level protocols, in the order in which we plan to implement them, are as follows:

### 1. NETRJS

NETRJS is the name of the third level protocol by which a user process in a remote host will simulate a remote batch terminal connected to CCN's RJS system. Thus, NETRJS will allow a user to submit complete batch jobs to the 360/91 and receive their print and punch output streams back over the Network. NETRJS has been specified in RFC #88 and implementation is targeted for March, 1971.

### 2. NETCRT

This protocol will allow a Network user to simulate an (idealized) CCI alphanumeric display console and use CCN's URSA system (and eventually TSO). An initial version of NETCRT will be circulated shortly as an RFC.

### 3. NETTRANS

This is the "transparent" protocol allowing a user process at CCN to talk over the Network. It has not yet been specified.

### 4. NETTYPE

This protocol will allow a real or simulated 2741 to use TSO (and perhaps APL) via the Network.

## H. REFERENCES

1. "IBM System/360 Model 91 Functional Characteristics". IBM Form A22-690 7.
2. "An Implementation of MVT". CCN Technical Report TR-1 (August, 1969).
3. For more information, see CCN Users' Manual.
4. "APL/360 Primer". IBM Form GH20-0689.
5. "Planning for TSO". IBM Form GC28-6698.
6. "Remote Job Service". CCN Technical Report TR-2 (undated).

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