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PRENTICE COMPUTER CENTRE

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UNIVERSITY OF QUEENSLAND NETWORK DEVELOPMENT

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## 1. Introduction

With the installation of a number of PDP11/34 systems on campus together with the new PDP1090 system there is a need to provide mechanisms for the interconnection of these machines for various purposes. Until now we have used Centre produced software to provide remote batch station facilities only through relatively slow speed asynchronous transmission links. Although it would be possible, as in the past, for the Centre to develop appropriate software (given sufficient staff), we believe there are appropriate standard products available from the manufacturers (eg DECnet) and other large users of PDP10/11 computers to provide a useful development base. Our development efforts would then be directed towards adaptation of this software to the needs of our environment and we would not be reinventing the wheel. Even so this work will tax our resources.

Because DECnet, as a product is still very much developmental, and the definition of our network requirements in some areas is tentative there are obviously problems in providing a strict specification of the stages to be followed in our network implementation.

This special issue outlines possible development paths and their effect on the Centre's network management policy. In some areas the practical requirements have meant that we have already commenced to implement some facilities. However our views are sufficiently flexible in the longer term to seek criticisms and suggestions from the Digital Equipment Network Development Group and other major installations with similar requirements. We do of course welcome comment and suggestions from our users.

## 2. Development Paths

The proposed development is split into two sections:-

2.1 - departmental mini-computers;

2.2 - remote batch stations

since the requirements of these two sections are seen, at least initially, as different.

### 2.1 Departmental Mini-computers

The requirement here seems to include -

(a) the ability to connect to the KL10 reasonably economically so as to allow occasional work on the 10 and involving low volume

file transfers;

(b) the level of security for normal KL10 users to be not less than it is currently;

(c) normal charging for use of central resources;

(d) the collection of certain information about all jobs run for control purposes.

DECnet as currently developed does not provide these facilities. A major difficulty is that protocols developed for DECnet-10, which allows DEC-10s to communicate, is different than the later protocols developed for DECnet-11M, which allows PDP-11s to communicate.

National Institute of Health, U.S.A. has however developed a system which provides virtual terminal and file transfer capability to PDP-11 users connected via a DN87s to a DEC10. It runs only under RSX11 or RT11 F/B. We are currently obtaining this software. (CLINK - Communications LINK) [1]

Briefly, an 11 user logs on to the 11 and runs a program on the 11 which connects him to the 10 as a virtual terminal. He can then log on to the 10, if the appropriate accounting entries have been set up, and perform all normal timesharing operations. In addition he can transfer files between the two systems by use of the CLINK program residing on the 10.

CLINK will support only one user at a time on an 11 but is shareable on the 10. Communication is between a DL11 or equivalent on the 11 and a TTY interface on the 10.

This system is proposed because it should be easy to get going and matches requirements (a) through (c) above. Requirement (d) above is met by including resource usage monitoring code in all versions of RSX released to connected 11's. We have acquired code from the University of Colorado [2] which monitors terminal connect time and CP usage and writes a FACT type entry including logout time, date and disc space usage.

## 2.2 Remote Batch Stations

Requirements at Griffith and Commerce are believed to be -

(a) to run local timesharing and local batch though on a fairly small scale;

(b) to run as a remote job entry station to the 10;

(c) to transfer files between the 10 and the 11;

(d) to achieve (a) through (c) more or less simultaneously under the one operating system;

(e) to have available some method of measuring and controlling users and usage of local facilities;

(f) to support normal charging for use of central resources.

At the moment RSX-11 provides for local timesharing only and the DN80 RJE software provides for (b), but the two systems must be loaded and run separately.

The batch stream available under RT-11 includes a pre-processor (written by the Centre) to read FORTRAN mark sense cards. This has been used fairly extensively at Griffith.

### Local Batch

Development of a local RSX batch facility has been underway at a low level for some time but we have now received a listing for a batch system from the local DEA software specialist (it is not a DEC product). It will have to be keyed in and the latest version of RSX built before it can be tested. Extra work will be required if the mark sense pre-processor is still required for this batch system.

### Remote Batch

Provision of remote batch via RSX will require writing RSX tasks to control the local card reader and line printer and modifications to the DEC-10 spoolers to use task-to-task communications to control the RSX tasks.

Communications for such a system are based on DECnet-11M and this requires the installation in the DN87S of the so called DECnet Compatible Port (DCP) software. Current versions of both DECnet-11M and DCP are reportedly full of bugs but new versions are believed to be on the way. Presumably they will be available before we reach a stage of serious testing. (It is believed that an LIR for DECnet-10 is due around June or July of this year.)

### File Transfers

The CLINK file mechanism referred to previously is not suitable for the batch station, because it does not use DECnet and it is limited to a single user at a time. A more appropriate mechanism is provided by the ACCESS program written for the NZ Department of Health [3] as an extension to DECnet. ACCESS allows file transfers between a 10 and 11 but they may only be initiated from the 10, thus minimising security problems for 10 users. ACCESS will require the latest versions of DECnet and DCP.

The initial implementation will require either that a user logs in to the 10 and runs ACCESS himself, or requests the Centre operations staff to do it for him. The choice depends on security considerations and the volume of requests.

File transfers initiated from an 11 could be provided in the future by modifying ACCESS to poll queues of file transfer requests created by 11 users at local sites. This method provides for better control of line utilization and is better from a security point of view. Probably the FACTS generated on the 10 by running ACCESS should contain the 11 node number and the UIC also.

A fairly long term project would be to allow 11 users via ACCESS, to submit control files to the 10 Batch system.

### Control

The University of Colorado code referred to above also contains a time out option for idle terminals. The time out system could be extended, if required, to include control of maximum ordinary terminal connect time or such other variations as seem useful.

## 2.3 Communications Interfaces

### DN87S

The standard synchronous interfaces supplied with the DN87S are DQ11s. It was decided before ordering the KL10 that the newer DMC11s would be installed instead of DQ11s, thus relieving the 11/40 of the load associated with DDCMP protocol and that corresponding changes would be made in the DN87S code. A further consequence was that DMC11s would be installed in the remote batch stations and changes would also be required for the DN80 series code. Apart from the line interfaces the batch stations are configured on 11/34s not 11/40s so there would be DN80 series code changes anyway. The standard DN87S asynchronous line interface is the DH11.

### Other PDP-11s

Currently then, users wishing to connect a PDP11 to the network may connect to the DN87S via a DMC11 and a high speed synchronous line, or a DL11 and a low speed asynchronous line.

As a third future possibility, users may connect via a DUP-11 at the 11 end, and a medium speed synchronous line to a DMC-11 on the DN87. A DUP-11 is a synchronous line interface which will talk to a DMC-11 but the DDCMP protocol must be handled in the 11.

The choice depends on traffic volume and funds available. The cost of a DMC-11 is about \$2800, a DUP-11 is about \$1400, and a DL11 is about \$800.

Some recent announcements by DEA offer some possible future alternatives. The new KMC11 auxilliary processor [4] which is similar in function to the microprocessor in the DMC11 can support a number of DUP11 synchronous line interfaces in a DN87. Remote 11s may connect to the DN87 via DUP11's and medium speed synchronous lines. There will be some necessary software development but at this stage its extent is unknown.

## 2.4 Terminal Concentrators

A terminal concentrator allows a group of terminal users at a remote site to share a common communication line between themselves and a central computer, in our case, the 10. The justification is the saving of the costs of individual lines. Offset against this saving is the capital cost of the concentrating equipment and the higher cost of the common line. The beakeven point varies from time to time as costs change.

Concentrator facilities may be installed now using DN80 series software running in a PDP-11 connected via DMC-11s and a synchronous line.

It is not envisaged that terminal concentration or virtual terminal access to the 10 will be included in any future extensions to RSX-11.

## 3. Security

The objective generally is that users of the network should enjoy the same level of security available currently to the KL10 user.

When 11's running DECnet are connected together and via the DN87S to the 10, then at least according to the DECnet specification, all users at any node have more or less the same access privileges to files in other nodes as users do amongst themselves on the 10. The threat to a user arises when someone also logs in to another node using the user's PPN and thereby gain immediate access to all the user's files.

Fortunately the current implementation of DECnet does not allow terminal access or file transfers between the 10 and 11's though it is implemented between 11's.

## 1,2 Jobs

Each 11 node has a controller who administers the node via a 1,2 UIC. When a user, logged in under 1,2 on any node, communicates with a 10, the destination node transforms the UIC into the PPN 1nn,2 where nn is the source node number. Thus since node numbers can run from 01 to 77, PPNs 101,2 through 177,2 should be frozen at least on the 10 for future network requirements.

## 11 to 11 Communication

The proposed network is a 'star' structure, ie remote minis are all connected to the DN87s but not to each other. 11 users thus connected cannot communicate with each other as DECnet is currently implemented. If specific users have a need for communication between 11s which they control, such as between 11s in a department, then separate lines will have to be set up. These users will have to control the allocation of UIC's between themselves.

There is then no need to set up an elaborate control mechanism to control and allocate UICs amongst 11 users. Another reason not to do so is that the range of projects under RSX is 001-377 octal or 255 decimal different projects. If there are say 10 11s in the network then there will be less than 20 projects per node and that is not enough. (Project codes in the range 1-7 are reserved for the system).

## CLINK

It was proposed above that departmental 11's use the program CLINK. This provides virtual terminal capacity to the 10 but users have to log on to the 10 in the usual way using a PPN which has been previously set up for them. File transfers under CLINK can only occur to and from that PPN or within the Project according to the present rules. There is therefore no special security problem with CLINK.

## ACCESS

### Current Implementation

ACCESS is proposed above to provide for file transfers between the 10 and 11's running DECnet. Initially these will only be the batch stations but departmental or other users with high volume transfer requirements may want the facility also.

ACCESS as it is, requires a user to log on to the 10, run ACCESS and specify the files to be transferred. In this case other 10 users are secure, in that the logged in user has the usual access privileges only, but other 11 users on the node being addressed may not. There is a PASSWORD switch associated with the 11 filespec in the ACCESS command line which appears not to be

mandatory. If it were made so, then 11 users would gain additional protection.

A file transfer service could be run for batch station users, in which case the operator would log on to the 10 using a 1,2 job and run ACCESS but it would only be practical with a low level of requests.

#### Future Implementation

The suggested future extension to ACCESS, ie set up a queue mechanism to allow transfers to be initiated from an 11, has some security problems. In general users on nodes receiving file transfer request are at risk, since the node sending the request can check on the access rights of the sender.

One possibility is to include the password for the receiving UFD in the queue request but there is some danger from having psswords in more than one place in the system. The password may be encrypted at say the 11 end but that requires the encryption algorithm to be located in all nodes.

Another suggestion is to transform PPNs as is already done with 1,2 jobs in DECnet-10. For example a user on an 11 with node number 15 has UIC 20,102. When he wishes to transfer a file to the 10, ACCESS could be made to transform his UIC into 15020,102 which becomes that user's PPN on the 10. The reverse mapping could also apply. That is, a 10 user wishing to access UIC 20,102 on the 11 would have to log in to the 10 on PPN 15020,102 to run ACCESS.

#### Task to Task Communication

Communication between programs running on different nodes is available now between 11s and will be available between the 10 and 11s with the implementation of DCP software. Presumably there will be little requirement amongst users for this facility and in any event there does not seem to any special security problems.

#### 4. Proposed Development Stages

- (a) Set up batch stations to run with DN80 software;
- (b) Make CLINK available to departmental users;
- (c) Write RSX tasks to allow a local batch stream and spooling from the 10;
- (d) Instal DECnet in the DN87S to allow Griffith and Commerce to run local batch, local timesharing and RJE under RSX.

(e) Test and implement ACCESS to perform file transfers at batch stations.

(f) Modify ACCESS to allow initiation of transfers from either the 10 or an 11 ie. by polling queues.

(g) Modify ACCESS to allow control files to be submitted for processing by the 10.

#### Time Estimates - as at 28.4.78

#### DN80 Batch Implementation

The modifications to DN80 software to handle DMC11s is complete. The first pair of 4800 bps modems have been installed in the Commerce line. The Commerce batch station is now running. If all goes well at Commerce, then the Griffithwbatch station will be connected next.

#### KA to KL Link

The DN80/DMC11 code is complete -there is some work to do with the DH11. Twis will be completed after the two batch stations are running.

#### CLINK

CLINK should be operational within a month of its arrival.

Items c,wd and e will require about six months work after about one months experience with the latest versions of DECnet and DCP.

Items (f) and (g) are difficult to estimate at this stage.

#### 5. Policy

The Centre will only support the following facilities for the immediate future:-

There will be two levels of minicomputer access to the network -

##### (a) Low Level

PDP11s may connect to the 10 via a DL11 and a low speed asynchronous terminal line. The 11 will run Centre supplied RSX or RT11 and actual terminal and file transfer facilities will be provided by CLINK.

(b) High Level

PDP11s may connect to the 10 via a DMC11 and high speed synchronous line, or possibly a DUP11 and a medium speed synchronous line, and a DECNET Compatible Port. The 11 will run Centre supplied RSX-11 and file transfer facilities will be provided by ACCESS using DECnet protocols. Security will be ensured by an appropriate password or PPN mapping scheme.

In either case job information will be collected at all times by all nodes and be available as and when required by the Centre.

(This last policy allows any subsequent money charging scheme to be implemented easily if required either for individual PDP-11s or globally.)

Terminal concentrators using standard DN80 series software will be installed where there is economic justification.

There will be no attempt at this stage to control the issue of PPNs or UICs centrally for the whole network. This task will be carried out by the local controller of each node. Users of nodes other than their own must arrange appropriate accounts with the respective node controller(s).

6. Areas not Considered

U.Q.Network

Current limitations on resources preclude the support of other PDP11 based operating systems eg, RSTS or UNIX.

DECnet/E, for RSTS, is recently available but is not compatible with current versions of DECnet-11M. A new software product - DECnet "PHASE 11", Version 1 - has just been announced [5] which includes DECnet-11M, Version 2.0 and DECnet/E, Version 1 which are claimed to be compatible. Nothing is known about the performance of this software.

It is believed that there have been some private developments of UNIX interfaces for DECnet in the USA. These may be obtainable and may be compatible with the version of DECnet then implemented.

CSIRO

Any future link up with their network is made easier since their recent decision to implement DECnet-11 also.

Other Minis

There may be a requirement to connect other minis than PDP-11s running DECnet, to the network. What that will involve will depend on the individual circumstances. The Centre cannot provide any resources for this line of development for the foreseeable future.

7. References

[1] CLINK - an asynchronous file transfer program - DECUS U.S. DECSys-10/20 Fall 1976 Reports.

[2] RSX-11/IAS SIG - newsletter vol. 8 N 4, page 38

[3] NZDOH File Access Design Spec. 30.6.77

[4] DEC Software Product Descriptions for COMM IOP-DZ and Comm IOP-DUP.

[5] DEC Software Product Description - SPD 10.78.0. DECnet Phase 11 Products, Version 1.