

Abekas

Video Systems, Inc.

digital disk recorder A60

A Carlton Company

A60

Ethernet
Manual

PRELIMINARY

A60 Ethernet Manual

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Abekas Video Systems, Inc.

This manual describes the installation and use of the A60 as an Ethernet node supporting file transfer and remote login using some of the TCP/IP family of protocols. It also includes an application note describing some of the mechanisms behind the file transfers.

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1. Introduction to Ethernet and TCP/IP

1.1 Ethernet

Ethernet is a Local Area Network (LAN) Standard originally developed at Xerox Palo Alto Research Center.

Ethernet interconnects a group of computers (referred to as hosts or nodes) with a single 50-ohm coaxial cable with terminations at both ends. Data is passed serially at 10MHz in the form of packets, that is in chunks anywhere from 46 up to 1500 bytes or characters. Each packet carries addressing information to show its' source and destination.

Unlike the Public switched telephone system or a video routing matrix the single cable is shared by all the devices on the network so there are a set of rules to determine when a node can access the cable. The technique used is referred to as Carrier Sense Multiple Access with Collision Detection (CSMA-CD).

Before transmitting a node listens to confirm that nobody else is transmitting, then, as it transmits it continues to monitor the cable in case another node started transmitting at the same time. If two devices transmit simultaneously it is referred to as a collision and both devices have to stop immediately and wait a random amount of time before attempting to transmit again.

Different manufacturers have adopted the low-level Ethernet hardware and packet specifications and built their own networks on top of it. Xerox XNS, IBM-SNA, HP-NS and DEC-DECnet are all networking systems that allow users to share resources and files and can run over Ethernet.

In the area of Personal Computers 3com Corporation and Novell are supplying File server systems based on Ethernet.

Small scale Office LAN's are mostly based on cheapernet which uses thin RG58 50 Ohm cable and BNC connectors, in this case the coaxial cable is 'T'eed directly onto the Ethernet Interface in the computer. Higher level applications use better quality thick yellow cable and external transceivers that can attach to the cable with a spike-like tap.

1.2 TCP/IP

The TCP/IP protocol family is emerging as a useful common standard for network interconnection.

The strength of TCP/IP has been that it is not tied to any particular manufacturer, it is the result of extensive research since the 70's by the Advanced Research Projects Agency (ARPA) community. With backing from the DOD the emphasis for these protocols has been to interconnect different types of computers running different operating systems.

TCP/IP is now available as an add on to most computer systems either in the form of an interface board with built in software such as the Excelan Ethernet Controllers or as an extra software package running along side a native Ethernet implementation. (The Bibliography for this manual lists some of the companies offering TCP/IP packages)

One reason for the spread of TCP/IP amongst the Computer Graphics Community has been its inclusion in the Berkeley Versions of the UNIX operating system (referred to as 4.2 BSD UNIX as opposed to the AT&T Unix V), most graphics engines and the Workstations that control them use Unix as it is a popular operating system for software development.

TCP and IP are acronyms for 'Transmission Control Protocol' and 'Inter-network Protocol' just two of the layers in the suite of communications protocols that are required to allow transfer of data from one computer to another.

IP is the layer immediately on top of Ethernet that adds Network addressing information to the packet. These Internet addresses allow IP packets to be transferred to other networks not just Ethernet, it is similar to the way that Containerized freight can be carried equally well by road rail or sea.

TCP provides an error free bidirectional communications channel above which other utilities such as a remote login or file transfer can be built.

TCP works by giving each packet a sequence number so that a message or file can be reassembled even if the packets arrive in the wrong order.

TCP also has an acknowledgement mechanism whereby the receiver replies with the latest complete sequence number it has assembled, so that should a packet get lost or delayed in the network the sender will retransmit the missing packet if it hasn't been acknowledged within a reasonable timeout period.

The third TCP mechanism is the window which limits the amount of unacknowledged data the sender can send out, so that it can't get too far ahead if the receiver is missing a packet from back at the start of the message.

For the majority of File transfers or TCP connections there is no data lost, all the packets arrive in the correct order, the power of the TCP/IP protocols lies in the fact that they are not restricted to running on a single local area network.

The ARPA Internet for example combines over a 100 different networks and includes satellite links across to research facilities in Europe.

When packets are passing across several networks through 'gateways' which provide an interface from one type of network to another there is more chance of a packet getting lost. There is no guarantee that all that packets will take the same route to the destination, this is possible since each packet carries separate addressing information. It is up to the gateways to decide what the most efficient route is and if during the life of the connection one of the intervening gateways or networks goes down the TCP/IP protocol is robust enough to be able to replace any unacknowledged lost data by retransmission. That is assuming an alternative route can be found.

1.3 Telnet and FTP

On top of the guaranteed delivery TCP connections the A60 supports file transfer and remote control. Remote control is achieved by allowing the remote user to 'login' as if the A60 were another computer and type commands interactively. There are two ways of doing each, firstly the official ARPA file transfer and remote login utilities called FTP (File Transfer Protocol) and Telnet which are specifically intended to work between different Computer architectures and Operating Systems.

1.4 Unix 'r' Commands

The other alternative is the native Unix utilities 'rcp' (Remote CoPy) 'rlogin' (Remote Login) and 'rsh' (remote shell) these will be popular with Unix users since they offer a less verbose user interface - file transfers are achieved by cryptic one line commands rather than FTP which normally produces a secondary prompt and requires at least three commands to transfer one file.

1.5 The Abekas A60

The A60 can be viewed as a Video Server - permitting all the rendering engines and computers in a graphics lab to share the ability to try out animation sequences and lay off rendered images without the preroll and lineup problems associated with single frame VTRs. It is a powerful sharable resource that treats all the frames or fields on a disk as separate files that can be copied to or from the A60.

The remote control provided across Ethernet is intended to be human readable in that the commands for playing or setting up segments are executed by merely typing

"PLAY" or
"DEFSEG 0.20 1.30" so a user sitting at a workstation can easily preview frames or animations without the need for a remote control panels beside every workstation.

As an Ethernet device the A60 appears to be just another node that files can be transferred to in the same way they would be moved from one computer system to another, there is no need for a separate VTR controller or special software.

Installation on Ethernet is just a question of the plugging the A60 into a Transceiver which is a small box that provides the interface to the Ethernet Coax. The System Manager then specifies an Internet address for the machine which has to be entered on the A60 control panel. The other computers on the network can then use this Internet address to access the A60.

2. TCP/IP Application Notes

This section gives a brief outline of the functions of each of the protocols used in the A60 and the way they interact.

2.1 Typical File Transfer

Take for example the opening of an FTP connection on a Unix system. To invoke the FTP program the user types :

```
unix% ftp a60
```

Which causes a control connection to be opened to the host specified. The hostname is the name used to refer to the A60 on the users' machine. Somewhere there will be a file (/etc/hosts on unix) which gives the mapping between the name (or some other optional alias) and the Internet Address that has been assigned for the A60.

A typical entry in /etc/hosts has the following form :

```
192.5.200.9 a60
```

The FTP program will first find the Internet address of the remote host by referring to the /etc/hosts file. Then it has to find an Ethernet address that corresponds to this Internet address. This Ethernet address is the address of a device on the local ethernet, either the A60 itself or a Gateway through which the A60 can be reached.

In some cases the host computer may have retained this information from a previous transaction but for the first transfer to an unknown remote host the local host has to resolve the Internet - Ethernet address mapping. To do this it uses the Address Resolution Protocol (ARP).

ARP involves sending a broadcast packet to all the hosts on the network.

Only the host with the required Internet address or a Gateway that can reach it will reply with a ARP reply packet supplying the requested Ethernet address.

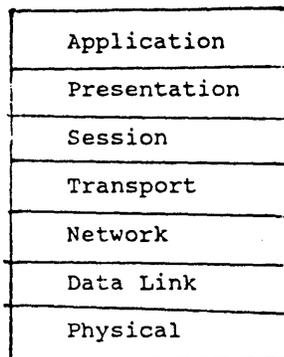
Once the local host knows how to reach the A60 over Ethernet it can open up a TCP connection to the FTP port on the A60.

The A60 which has been waiting for a connection to be made to the FTP port responds with an opening message and the FTP program passes the Users name to the A60.

Since the A60 does not do any username checking the user then specifies the filename to transfer A data connection is opened from the A60 end to the port chosen by the FTP program on the users' machine and the data is transferred. The data connection is closed once the data has been transferred, the control connection is closed when the user issues the 'quit' command.

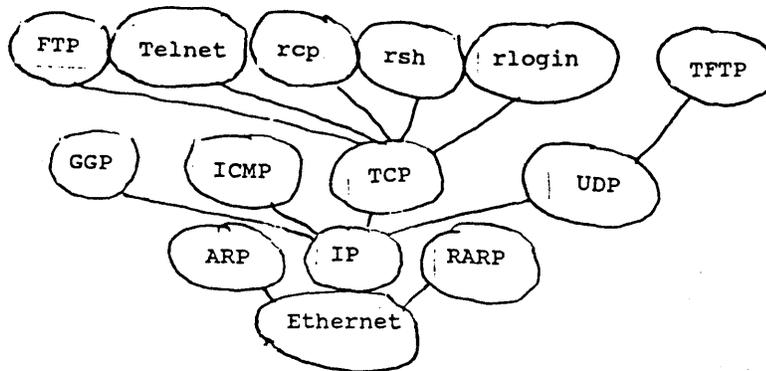
2.2 Layered Model

The ISO standards authority has proposed an Open Systems Interconnection model consisting of seven layers. The reason for dividing the Protocols into layers is so that different protocols at the same level can be used interchangeably to provide the same function for the layers above.



OSI diagram

The TCP/IP family of protocols can be applied to several low level networks architectures, in this case the two lower levels - that is the Physical layer which defines the connectors and voltages, and the Data link layer which defines the way data is passed between two pieces of equipment on the same local network are both defined by the IEEE 802.3 standard (which in turn is based on the Xerox Ethernet V2). Another comparable Network standards is X.25 which is used for public packet switched services.



Family Tree

2.3 Physical layer

Ethernet was developed at Xerox PARC and is based on the concept of a baseband Carrier Sense Multiple Access with Collision Detection. (CSMA-CD)

Transceivers

The host computer will be coupled onto the Ethernet Coax by a device called a transceiver. In some instances (particularly in the case of 'Cheapernet') the transceiver can be part of the Ethernet interface board in the host computer. The Remote

transceivers can be up to 50m away from the computer and typically come with a plug in module to allow either a spike tap, N-series or BNC connectors to interface to the cable.

Cheapernet uses thin RG58 50-ohm coax and BNC style connectors rather than the high grade 10mm thick Yellow coax that permits the non-intrusive "vampire tap" transceivers to be spiked into it and removed without having to take the network down.

The thick coax can be used for networks up 100 nodes on 500m of cable whereas Cheapernet is limited to 30 nodes on 185 m of cable. Only two repeaters are allowed on a local network because of the propagation delays through them. The transceivers should be placed at multiples of 2.5metres on the cable.

The following is an non-exhaustive list of Transceivers currently available.

Inmac Transceivers: part number 8043

HP part number 30241A LAN 802.3 MAU (Medium Attachment Unit)

3com Ethernet/IEEE 802.3 Transceivers:

3C107 Transceiver with AMP piercing tap

3C108 Transceiver with N series connectors

3C109 Tranceiver with BNC connectors

DEC Ethernet bits:

DESTA - Thin ethernet transceiver

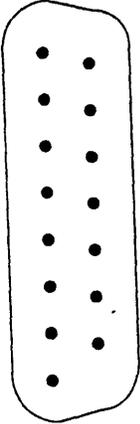
DELNI - Ethernet in a box The DELNI has eight D-15 connectors for connecting up to eight ethernet devices without using transceivers or coaxial cable. It also has a ninth connector for connecting to a regular transceiver (and thus to a larger net), or to another DELNI (for a hierarchical DELNI network).

Different Ethernet Standards

There are three different Ethernet standards : Ethernet V1, V2 and the Newer IEEE 802.3 standard.

The are electrical differences between the different standards mainly concerning the grounding requirements for the transceiver. For Ethernet V1 and V2 the connector shell, cable shield and pin

one of the connector are all connected together whereas for IEEE 802.3 the cable shield is separate from pin 1 ground. The grounding should be achieved at the host end of the transceiver cable.

Outer Shield	1		9	Collision -
Collision +	2		10	Transmit -
Transmit +	3		11	Ground
*Inner Shield	4		12	Receive -
Receive +	5		13	Power +12v
Ground	6		14	Ground
*Vcc	7		15	No Connect
Logic	8			

Transceiver (AUI) cable pinout

* Notes

(Pin 4 Electrically Isolated from Outer shield for 802.3)

(Pin 7 appears to be a no connect on most machines)

Male connector at transceiver, Female at main chassis.

SQE

Some transceivers support SQE or Signal Quality Error (sometimes called heartbeat) in which case they will simulate a collision in the gap at the end of every transmission from the host. This provides a way of assuring that the collision detection circuitry in the host interface is functioning correctly. Ethernet V1 does not provide for SQE.

2.4 Data Link Layer

The Data Link layer provides for source and destination addresses and a trailing CRC allows the integrity of the whole packet to be checked. Ethernet and IEEE specifications differ in a few minor respects, The IEEE spec states that the field immediately following the source address is an optional length, however the Ethernet receiving hardware is capable of determining the packet length by other means. The original Xerox Ethernet spec defines this as a type field which is used to resolve the next protocol above in the hierarchy. The types used for the ARPA family of protocols are intentionally chosen to be illegal lengths (eg larger than the maximum permissible) so as to remove any confusion between the IEEE and Xerox implementation of Ethernet.

Ethernet Addresses

Ethernet addresses are six bytes conventionally written as six hex numbers separated by colons. Ethernet addresses are intended to be unique for any piece of equipment that conforms to the IEEE 802.3 standard.

For instance Abekas Equipment will start 00:00:76:XX:XX:XX

Using the Ethernet Broadcast packet mechanism it is possible for the local host to send a packet to all the devices on the local network rather than to one specific address. This is address FF:FF:FF:FF:FF:FF.

2.5 Network Layer

The Network Layer provides a packet delivery system between two hosts.

IP

The Internet Protocol adds to a packet the information required to pass it from one host to another across different networks. The intention is that a gateway that is passing the packet from one network to another need only examine the IP header to determine the routing information.

The Internet Protocol also provides a mechanism for breaking packets into smaller fragments for passing them over a network with restricted packet size.

Internet Addresses

Internet address is a four byte number conventionally expressed as four decimal numbers (0..255) separated by dots.

eg 192.9.200.5

The Internet Address can be subdivided into two parts, the first is referred to as the Network number and the second as the local address. All the machines on the same local network should have the same Network Number but different Local Addresses. If a host is asked to send a packet to a remote host with a different Network number it will assume that the remote host is on a different network and attempt to find a gateway to it.

Network Numbers for Internet sites are assigned by the ARPA authorities the local addresses are chosen by the local system administrator. There are many Ethernet networks that are not actually part of the Internet and only use a default Network number.

There are three classes of internet address based on the the Network number. For a class A address the first byte of the internet address will be less than 128, the local address is then formed by the lower three bytes allowing for 4096 separate hosts on the one network.

A class B address will have a first byte in the range 128 to 191 and in this case the lower two bytes form the local address.

Class C addresses the first byte will have a value greater than 191 only the last byte identifies the individual machine or internet node.

Internet addresses are intended to be more wide ranging than the native addressing scheme for the the local network, it is possible to connect to an Internet host across several different types of network eg Local Area Ethernet, long haul X.25 packet switched services and Local area Token ring networks.

ICMP

Internet Control Message Protocol Is almost an integral part of IP, it is intended to handle error reporting from Gateways to hosts or hosts to hosts. It gives the originating host more information about the reason a packet has been rejected or cannot be delivered.

ICMP also provides an echo system used by 'ping' programs to help isolate inter-network problems.

A Selection of the ICMP Messages :

Echo Request

Echo reply

Redirect : Use alternative route

Time Exceeded : Packet died of old age

Parameter problem : Something wrong with the IP Header

Destination Unreachable, either:

Network

Host

Protocol

Port

GGP

Gateway to Gateway Protocol Handles communication between Gateways for control purposes. Allows them to exchange routing information and keep up to date on the availability of neighboring Gateways.

ARP

The Address Resolution Protocol uses the Ethernet Broadcast Mechanism to allow a host to resolve Internet to Ethernet address mappings by asking all the hosts on the local network if any of them claim to be the required Internet address.

If the hosts support ARP they will decode the packet, it contains both the Internet and Ethernet Addresses of the local host and the Internet address of the host it is trying to reach. Only the requested host or a Gateway that can reach it on another network reply directly to the requesting machine.

RARP

The Reverse Address Resolution Protocol allows an Ethernet host to determine its own Internet Address by broadcasting a request to the net.

2.6 Transport Layer

The fourth OSI layer is the Transport Layer, which is concerned with creating and maintaining logical connections between individual processes on different hosts.

TCP

The transport layer adds a source and destination port number to the packet addresses. This allows the packet traffic to be routed to several different processes or users within a particular machine. A TCP connection is characterized by the combination of local and remote Internet addresses and the local and remote port numbers. So for instance several people may be logged in on a machine though the port assigned to the rlogin service. If two of the users originate from the same machine they will have to be on different ports on their local machine. The TCP software can then uniquely identify which connection a packet belongs to.

Some of the lower port numbers (normally less than 1024) are reserved for system functions, these are 'well known' port numbers that are published for other computers wishing to use a particular service. Opening connections to these ports is normally a privileged operating system function.

Commonly used TCP port numbers

FTP	21
Telnet	23
Rsh	514
Rlogin	513

The TCP packet header also carries Sequence and Acknowledge numbers. The sequence number represents the position of the first

byte of this packet in the transmitted data stream. The Acknowledge represents the byte after the last fully reassembled byte of the data stream received. In other words the Receiving TCP can buffer several packets that may be out of sequence but the Acknowledge number will only increase once the incoming data is complete up to that byte number.

Sequence numbers are fixed when the connection is opened, packets are exchanged with the SYN flag set to indicate the initial sequence number.

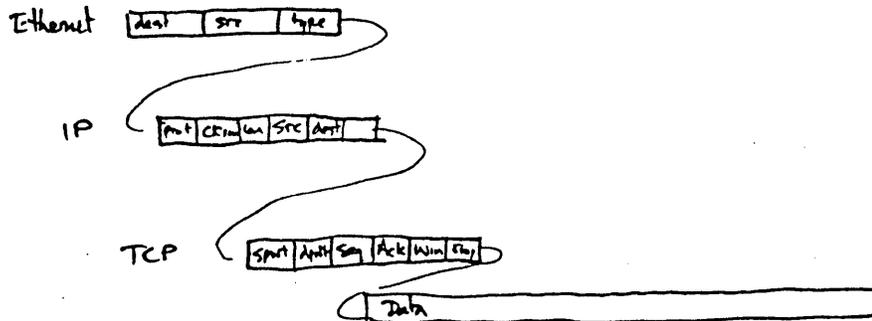
The TCP header also includes a window to indicate to the other end how much buffer space is currently available. This acts as a method of flow control since the transmitter should not continue if more than a windows' worth of data remains unacknowledged.

The transmitting side of TCP is responsible for resending a data if it is not acknowledged within a timeout period.

There is a TCP Option that allows the maximum number of data bytes in a packet to be specified, the default is 512.

TCP connections can be opened either Actively or Passively. In the Active case the remote port and host address are fully specified, whereas a passive open will only specify the port number at the local end and wait for an incoming attempt to connect.

On closing the connection it is necessary for both sides to exchange and acknowledge packets with the FIN flag set.



Typical Data Packet

UDP

The User Datagram Protocol is a simple extension to IP that adds only a source and destination port number and a checksum.

A Datagram is a standalone packet with neither guaranteed delivery nor special sequence.

TFTP and Sun Microsystems' RPC and NFS are among the protocols built on top of UDP.

2.7 Upper Levels

For the TCP/IP protocols the top three OSI reference layers tend to be merged into one program at the highest Application layer. The OSI model also provides for a Session layer which handles user validation and mapping host names to network addresses, and a Presentation Layer which handles machine differences like byte swapping and terminal standardization.

Telnet

Telnet is a remote login program based on the concept of a Virtual Terminal. The Virtual Terminal has a set of default conditions that can be changed by 'negotiation' and mutual agreement between the local and remote host. For instance echo is by default local and the local host is expected to buffer lines of text until <Return> is pressed.

The Telnet connection has an escape mechanism where hex FF is the escape character, FF occurring in the data stream is transmitted as FF FF. The escape character preceds an option negotiation which contains a code to indicate WILL, WON'T, DO or DON'T and the particular option code. Before an option will be implemented on both sides both sides have to positively agree to do it. The escape sequence is also used to implement 'out of band' signals such as Abort Output, Interrupt Process and Erase.

FTP

The File Transfer Protocol uses a Telnet connection for User authentication and control. The control is achieved using a Command and Response Dialog which may or may not be visible to the user. Commands are of the form "USER Simon" and "STOR pic.rgb". FTP responses are preceded by a three digit code which allows a machine to assess the required action.

Some of the meanings are listed below :

1xx is a Positive preliminary reply
2xx is a Positive completion reply
5xx is a Permanent negative completion reply

x0x is a Syntax error
x2x refers to a connection
x5x refers to the file system

Simple FTP transfer

```

[ open TCP connection to port 21 on the A60 ]
<-- 220 Abekas A60 FTP (a60)
--> USER simon\r\n
<-- 230 User OK
--> PORT 192,9,200,1,30,244\r\n
<-- 200 PORT spec accepted : host 192.9.200.1 port 7924
--> STOR 407.rgb\r\n
[ Active open from A60 end port 20 to 192.9.200.1 port 7924 ]
<-- 150 OK here goes
[ Data Transferred ] far end closes data connection when done
<-- 226 File Transfer OK
--> QUIT\r\n
<-- 221 Closing control connection

```

TFTP

The Trivial File Transfer Protocol is built on top of UDP and provides an easy-to-implement file transfer. Data is transferred in 512 byte blocks each data packet carrying a block number. Each block has to be acknowledged before the next one can be transmitted. TFTP is used for booting diskless hosts on a local network and exchanging mail.

rcp

As is the case with most Unix applications the implementation of 'r'copy is elegantly minimal. Most of the handshaking is achieved by the transmission of a single null byte. Most of the 'r' commands use a single TCP connection although there is provision for a 'standard error' connection

```
rcp pic400.rgb a60:312.rgb
```

```

--> \0 (no standard error)
--> simon\0simon\0 (local and remote username)
<-- \0 (user info validated)
--> rcp -t 312.rgb\0 (the command)
<-- \0 (command OK)
--> C0666 1049760 pic400.rgb (Access flags, length, name)

```

```
--> \0  
<-- \0  
--> [1049760 bytes of data]  
--> \0  
<-- \0
```

3. Installing an A60 on a Unix Network

These notes apply in particular to Sun Microsystems Unix, there may be local variations.

Installation should be simply matter of adding the Internet address chosen for the A60 to the file /etc/hosts and then entering this address on the A60 control panel.

For these changes to the host machine you will almost certainly require superuser privilege. This is probably the point to contact your local Unix Guru.

/etc/hosts

In the following notes "ourhost" and "yphost" are fictitious example hostnames.

If there is more than one Sun Workstation connected to the network the chances are that the network service called the Yellow Pages will be running. The Yellow Pages allow all the machines on the network to share the same configuration tables, especially things like host names, password and account information. This simplifies the task of maintaining the system wide databases and means they only need to be updated in one place.

The existence of the Yellow Pages can be determined by typing the command "ypwhich", Unix should respond with the name of the yp server.

```
ourhost% ypwhich
ypwhich : ourhost is not running ypbind
```

Says that the Yellow Pages are not running.
(ypbind is the name of the program that accesses the YP service)

```
ourhost% ypwhich
yphost
```

Says the Yellow Pages are originating form the host called 'yphost'

When the yellow pages are running network nodes only consult their own tables at boot time, after this requests for system configuration such as hostnames are provided by the yellow pages service.

The new hostname need only be entered on the YP server machine and it then has to be "pushed" out to all the other clients.

First login on the YP server machine either over the net or by actually walking over to the YP server.

```
ourhost% rlogin yphost root
```

Then edit the /etc/hosts file (note that root normally has a # as a prompt)

```
yphost# vi /etc/hosts
```

Entries in the hosts file have the following format :

Everything to the right of a '#' is ignored as a comment. Lines consist of two or more fields separated by whitespace (tabs or spaces). The first field on a line is the internet address of the host, following normal convention it is expressed as four decimal numbers separated by dots. The second field on a line is the hostname. Any subsequent names on the line are aliases for the same machine (normally local abbreviations or nicknames).

An example entry would be :

```
192.9.200.5    a60
```

Now we have to update the dynamic version of the host table :

```
yphost# cd /etc/yp
yphost# make hosts
```

the response should be :

```
Updated hosts
Pushed hosts
```

Setting the A60 Internet Address

The A60's Internet address is set via the Miscellaneous Menu on the control panel. To select the appropriate menu type 74<Menu> Then enter the address in two halves as pairs of bytes separated by a dot.

eg 192.009<enter>

200.005<enter> Note that leading zeroes have to be included.

Setting the A60 Hostname

The default A60 hostname is "a60" which is fine unless you have more than one. To make life easier it is possible to change the hostname on the A60 so that it is obvious which machine has been logged into. Log in to the a60 using Telnet or rlogin and issue the hostname command to set a new name.

```
ourhost% rlogin a60
Abekas A60 Remote Login
a60% hostname fred
fred% ^D
ourhost%
```

/etc/ethers

There is a further refinement for Sun networks that allows the A60 to ask the network what its' Internet address is by way of the Reverse Address Resolution Protocol (RARP). This requires an addition to the file /etc/ethers.

Note that this step will not usually be necessary since the A60 stores its Internet address in Non-Volatile RAM. It only uses RARP if the RAM contents are lost, or the Internet Address is manually set from the control panel to 0.0.0.0 and the machine is restarted.

To find out if a host supports RARP try the following:

```
yphost# ps -ax | grep rarp e it should show you all the processes
with anything to do with RARP apart from the line that says "grep
rarp" (which is part of the command you just typed) there ought to
be a mention of /usr/etc/rarpd if the RARP Daemon (the process
that catches RARP requests) is running. If this is the case you
```

can add the Ethernet address of the A60 to the /etc/ethers.

```
yphost# vi /etc/ethers
```

A typical entry in ethers is :

```
0:0:76:60:FF:FF      a60
```

Again if the Yellow Pages is running you have to force it to update its' copy of the 'ethers' file.

```
yphost# cd /etc/yp  
yphost# make ethers
```

If the Internet address on the A60 is set to all zeros the A60 will attempt try to find its address from the network when it is rebooted. If you watch the Internet Address Menu it should show the correct address when it finds it.

4. Implementation Notes

The following notes list the specific aspects of the implementation of TCP/IP on the A60.

Ethernet Address

The unique Ethernet Address for each machine is set in Software PROM for the 68000 (top 6 bytes of the 27256 at location 7C on the computer card).

A60's have a officially allocated Ethernet address range 00:00:76:60:XX:XX the last two bytes being determined by the Computer Card Serial Number. The Ethernet address of a particular card should be engraved on the left hand side at the front of the card.

Note that if the Computer card is swapped the Ethernet Address is likely to be different.

The A60 is compatible with IEEE 802.3 or 10 Mbit/s Ethernet V2 - only difference is the transceiver cable grounding arrangements.

The A60 doesn't care if the transceivers generate SQE - it's just ignored.

Address Resolution

The A60 supports both the Address Resolution Protocol (ARP) and Reverse ARP.

The A60 will attempt to use RARP in the event that the machines' Internet address is set to 0.0.0.0 and the a power-on reset occurs. This will either be the result of a really cold start - eg the Non Volatile RAM in the machine has been trashed or if the address is set to 0.0.0.0 from the control panel and the Computer Reset button is pressed.

RARP will only work if someone out there is serving up Ethernet/Internet address mappings (such as the rarpdaemon on a Sun which refers to the /etc/ethers file)

If there is no reply the Internet address will remain at zero.

IP

The A60 IP is not capable of reassembling fragmented packets.

The A60 sends ICMP protocol unreachable for services it doesn't support such as UDP.

Incoming ICMP information is not recognized.

Ought to support GGP simple echo reply but it's never been tested.

Don't think we support 4.2 BSD/VAX Trailer Encapsulation whatever that is.

If the Least Significant Byte of the Internet is configured as zero the ethernet drivers will use the broadcast address. I'm not sure why we do this any more.

TCP

The A60 TCP initial sequence number is is always zero.

A60 TCP does not check security or precedence level of packets.

Since the A60 is not really a shareable resource it only supports one connection per socket. Any subsequent connection attempts will meet with a TCP reset.

There appears to be a problem with BSD socket connections. They don't seem to differentiate between different types of ICMP Destination Unreachable replies. If an attempt is made to connect to a socket that is already in use we used to reply with a type three : Port unreachable. On a sun this aborts all existing connections to that host. On the HP 9000/300 it just shows a Network Unreachable error message.

When a TCP packet is not acknowledged the A60 will resend the packet up to twenty times at approx 1 sec intervals before aborting the connection.

TCP Seg size option of 1024 is written out and the A60 responds

appropriately by honoring incoming SEG SIZE option, the default segment size is 512.

Telnet

None of the Telnet options are supported. The A60 will just respond courteously with the appropriate negative response
eg WILL->DONT WONT->DONT DO->WONT etc

Ought to issue the Telnet Option "Suppress go ahead" especially since we don't issue Go Aheads !! but don't as yet.

A60 Telnet will accept CR, LF or CRLF as a line terminator.

The HP 9000/300 workstation has problems with A60 Telnet - <CR> doesn't locally echo as <CRLF> use <LF> instead.

FTP

We attempt to minimise the password and accounting formalities by replying with a User OK after just a user name. Some applications at the other end still insist on providing a name and password however facilities such as the Unix '.netrc' file can smooth the FTP login sequence. The A60 isn't a real computer and there just wasn't space to keep track of names and access permissions.

Third party FTP transfers eg controlled from somewhere different from the data connection have never been tested.

When using FTP most applications require that TYPE IMAGE is specified in order to stop the local host expanding Carriage Returns into Carriage Return-Line Feed sequences. Although these aren't valid CCIR 601 video values (so they shouldn't appear in the file) it still takes the host time to filter the data.

Hangs up at the moment if the Remote client restarts and our end is still open. Its OK if we restart with the other end still up since the next packet sent from the other end will most likely be out of sequence and illicit a reset from our end.

rcp

A60 rcp can't cope with wildcard transfers eg the command

```
rcp *.rgb a60:
```

will return an error message

rlogin can be terminated by <control> D or <control> C In rlogin either ASCII back-space or delete have the same effect.

rcp actually uses the rsh port

General

Segments that have been set "record lockout" from the A60 control Panel appear to the file transfer utilities as write protected files.

Remote Control through the Login utilities is locked out while a file transfer is in progress.

When the A60 SCSI Port is in use the Ethernet services are not available

The A60 is still liable hang up if the remote end of a connection goes away without any warning - it keeps the connection open and refuses any further attempts to connect to that port, even from the same host. At the moment the only way round this is to issue a reset command over rsh, rlogin or Telnet (assuming they are not all hung at once). The reset command will clear out all existing connections.

Filenames (or frame numbers) can have all sorts of directory junk on them - the parser works back from the far end of the name - eg optional extension, plus for second field, frame number, f for field.

4.1 Copyright Notice

The following notice has to be included because Abekas TCP/IP is based on a Public Domain program called PC/IP originally written by John Romkey and others at MIT.

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5. File Transfer

5.1 RGB Conversion

The A60 has the capability to convert raw RGB files to YUV and back again. The arithmetic is done 32 bit fixed point using the on board Multiplier Accumulator Chip. Reciprocal Anti Aliasing and Interpolation filters are used to minimise generation loss. Some slight degradation will be visible on the first pass into and out of the machine. Once the image has been bandwidth limited to YUV space it does not degrade further on successive passes. The conversion process does slow up the transfer of data however.

On a lightly loaded Ethernet with a host that supports 1024 byte TCP packets a 525 line YUV image should take about 5 seconds to transfer in either direction. RGB images take approximately 20 seconds to transfer to the A60 and 33 seconds to read from the A60.

Video data in the files transferred to and from the A60 as raw RGB or YUV data with no compression, Run Length Coding or other structure. Refer to the A60/A64 Digital Video Interface Manual for more information on the format of the data and the size of the frame buffer.

Note that the A60 does not check the length of the file transferred but files longer than a frame in length can cause the Frame buffer addressing to wrap round and cause unpredictable effects.

5.2 File Names on the A60

The A60 expects a filename to contain the frame number and an optional extension .yuv and .rgb are currently supported, yuv is the default. The frame number can either be given as an absolute frame number (in decimal) or a time code.

The A60 starts at the end of the filename and works back so you can include all the directory paths you want they are all get ignored.

```
rcp thing400 a60:/users/simon/piccys/thing400.yuv
```

parses OK as 400.yuv

Be careful that filenames don't have an 'f' immediately before the frame number since this is interpreted as being a field transfer.

Fields and Frames

Video can be transferred as Frames or Fields, A frame is twice as long as a field and the lines are interleaved in the same way as they appear on the display. A field transfer is indicated by an 'F' immediately preceding the frame number. The first field of a frame will be implied by default. To access to the second field the frame number must have a '+' after it or alternatively if the frame number is specified in timecode the seconds and frames should be separated by colons rather than dots.

Write Protection

The A60 has the ability to Write Protect or Record Lockout segments of the Disk, an attempt to transfer to a Record-Locked-out section will result in an appropriate "Write Protected" error message. There is no way to change the Record Lockout form the Ethernet remote software.

5.3 FTP

The following is the example of an FTP transfer files to and from the A60

```
host% ftp a60
Connected to a60.
220 Abekas A60 FTP (a60)
230 User OK
ftp> type image
200 TYPE OK
ftp> send piccy 25
200 PORT spec accepted : host 192.9.200.6 port 1061
150 OK here goes
226 File Transfer OK
699840 bytes sent in 4.92 seconds (1.4e+02 Kbytes/s)
ftp> send sym/symb576.rgb 25.rgb
200 PORT spec accepted : host 192.9.200.6 port 1062
150 OK here goes
226 File Transfer OK
1244160 bytes sent in 29.40 seconds (41 Kbytes/s)
ftp> quit
221 Closing control connection
```

5.4 rcp

```
host% rcp piccy a60:23
host% rcp sym/symb576.rgb a60:rgb
rcp: RGB Not a valid frame number
host% rcp sym/symb576.rgb a60:24.rgb
host% rcp a60:24.rgb zzz
```

Note that rcp from A60 to '.'
(eg the same name in the current dir) is supported

```
host% rcp a60:24.rgb .
host% ls *.rgb
024.rgb
```

The A60 will generate a file in the form [F] 001 [+] .yuv however the reverse case is not supported, the A60 insists on having the filename specified explicitly.

```
host% rcp symb576.rgb a60:
rcp: . Not a valid frame number
```

By the same token directory copies or wildcards aren't accepted

```
host% rcp *.rgb a60:
rcp: A60 only supports single file transfers
```

5.5 Unix Script Hints

Here are some suggestions for ways to use Unix Command Files to shuffle files onto or off the A60. They all run under the 'C'shell.

```
# copy dir SMC Siggraph 87
# copies all the frames with same root name eg 'pic' in pic001.yuv
# takes 3 params : copydir rootname host baseframe
# note that frame numbers in filenames should have leading zeros
# - or ls screws up the ordering
set frame=$3
set list='ls $1*'
foreach i ($list)
  rcp $i $2:$frame
  set frame='expr $frame '+' 1'
end
```

```
# copy tape SMC 9-SEP-87
# unloads frames that have been tar-ed onto Quarter Inch tape
# each file was named tmp.yuv and saved to the tape using
# one call to tar per frame (dd wouldn't stream properly)
# device names are for a Sun SCSI Archive tape
# takes at least 2 args : copytape hostname baseframe
# optional third arg for number of files to transfer
# optional fourth arg for number of files skip before transfer
# transfers 25 frames from tape to A60
if(($1 == "") || ($2 == "")) then
    echo "Usage: copytape hostname startframe [count [skip]]"
    exit
endif
set frame=$2

if($3 == "") then
    set count=25
else
    set count=$3
endif

if($4 != "") then
    echo "skipping $4 files"
    mt -f /dev/nrst0 fsf $4
endif

while($count > 0)
    tar -xvf /dev/nrst0
    mt -f /dev/nrst0 fsf
    rcp tmp.yuv $1:$frame
    set frame='expr $frame '+' 1'
    set count='expr $count '-' 1'
end

echo rewinding tape
mt -f /dev/nrst0 rewind
```

6. A60 Remote Control over Ethernet

The following notes outline the commands available over the A60's TCP/IP Ethernet connection. It assumes some knowledge of the operation of the A60. Refer to the A60 Operators Manual for more information on how the machine can be divided into segments and the limits on play speed etc.

remote commands can be invoked in three ways Telnet, Rsh and Rlogin. The following examples assume the commands are given on a UNIX machine with the prompt "host% "

The A60 has several operating modes particularly Segment, Normal play and Loop Mode, most of the commands given here will work with the machine in any state however they can leave the machine in a different state.

6.1 Telnet

From Sun Unix type

```
host% telnet a60
Abekas A60 Remote Login
a60> play
a60> quit
```

6.2 rsh/rlogin

rsh allows a single command to be executed on the remote machine for instance

```
host% rsh a60 play -0.5
```

Both Rsh and Rlogin offer an interactive login, either

```
host% rsh a60
```

or

```
host% rlogin a60
Abekas A60 Remote Login
a60% play
a60% quit
```

the login can also be terminated by ^D or ^C

Note that it is also possible to redirect a file to the remote shell (even though this is not legal Unix Syntax) Note that to achieve the same effect between two Unix machines you actually have to type "rsh rhost csh < script"

```
host% cat script
clearseg
defseg 100 200
defseg 300 400
loopseg 1 2
host% rsh a60 < script
```

This provides an easy way to keep track of the segment list from the host computer since it is not possible to read back the segment list.

Feedback is limited to the 'where' command but this should be enough to indicate that the A60 has reached the end of a segment with a pause in it.

```
host% cat script
clearseg
defseg 100 200 p
defseg 300 400 p
loopseg 1 2
host% rsh a60 < script
host% rlogin a60
a60% w
165
a60% w
174
a60% w
190
a60% w
199
a60% w
199
a60% plays
a60% w
307
```

Note that out point for a segment is not inclusive eg defseg 100 200 plays frames 100 to 199.

6.3 Command Notes

- Upper or lower case allowed
- Shorter forms of commands given here can be given
- Parameters separated by spaces
- Only one command per line
- Note that segments are numberd from one

Be warned that in the case of ambiguity the earlier command in this list is executed.

6.4 Parameters

speed [-][0-9].[0-9] limits +/- 30 for 525 line systems (25 for 625) resolves three decimal places eg -1 1.5 0.5 .5 -30 7.125 are all legal speeds

frame [f][+-][0-99][.:[0-99][+-] accepts absolute frame numbers with trailing '+' to indicate the second field or timecode with '.' or ':' for field 1 or 2 field mode or auto frame is not changed

eg 1 3:01 1.00.24 f231+ are all valid

seg [1-100] segments can be numbered from 1 - 100 The segment number follows the order in which the segments were defined.

source - any of the following is permissible as a record source, it should only be necessary to type the initial letter of each option.

```
bars
pattern <pattern_num>
input - Digital Video in #1
aux   - Digital Video in #2
<frame> - a frame number
```

pattern_num from 0 100% Bars, 95% Bars, 75% Bars, Lin Ramp, Mod Ramp, 10 Step, X Hatch, 2T pulse, Pluge, Multiburst, Bow Tie, Digital test, 100% Combo, 95% Combo, 75% Combo

display_mode - field or frame - typed in full

6.5 Commands

play [speed] defaults to 1.0
play from the current position

stop
stop loop or play

goto [frame] defaults to 0
goto the given field or frame

jog [offset] defaults to +1
relative goto,
field or frame offset is determined by the current display mode

loop <in> <out> [speed]

loop play the specified segment

defseg <in> <out> [speed] [pause]
define the next segment from in to out with optional speed
speed defaults to 1.0
pause can be typed in full or just 'p'

goseg [seg] defaults to 1
goto the 'in' point of the given segment

playseg [speed]
play thru the segment list from the current position
or alternatively resume playing after a pause

loopseg <in> <out> [speed]
loop play the specified segments

clearseg
clear the segment list

macro <macro_number>
execute the given macro

quit
close down the connection

hostname
set the hostname returned in the prompts (default 'a60')
makes it easier to use two machines

where
where returns the current frame

record <source> <in> [<out>]
record from various sources pattern, input or specific <frame>

pattern [pattern_num]
draws the given pattern into the store

mode <display_mode>

7. Troubleshooting

Some of these things are probably covered in the user manual but if like me you read manuals when it appears to be broken this might save you some reading.

Debug Port

The A60 Computer Card has a RS232 serial port running at 9600 baud. It only sends data it does not receive it. The connection is through the 5 pins on the right-hand end of the card The right most pin is pin 1 which is the transmit data from the A60 and the center pin, pin 3 is ground. Pin 2 would be receive if it did anything.

A60	RS232	D25
1	-->	3
2	<--	2
3	---	7

Debug Mask

The hex weightings of the bits in the debug mask are as follows:

800	TCP window info
400	Telnet
200	IP
100	TCP
80	Application eg FTP or rsh
40	Timeouts
20	Ethernet
10	Protocol Errors
8	Network Errors
4	Info messages
2	Dump packets (when IP debug is on as well)
1	Bughalt

Debug level can be set through any of the login connections by using the debug command with a hex argument.

Alternatively the debug level can be set from the control panel (menu 73)

0 Debug off	
1 Errors and TCP	(11C)
2 Errors TCP and Window	(91C)
3 Everything except Dump	(1FC)
4 Errors and Application	(09C)
5 Errors Telnet/sockets and Application	(49C)
6 Errors Telnet/sockets Application and TCP	(59C)
default Errors and TCP	(11C)

Note that with debug on the machine will run slower especially with the lower levels of debug where it has to print several lines per packet.

The buffering for the debug port is fairly crude so if there are large amounts of debug information being transmitted the buffer can wrap round and information can become garbled.

High Level Debug

If the Telnet/Socket debug bit (400) is set the following messages will be generated

```
***** "\00"
***** "simon\00debug 80\0A"
```

Lines starting with five stars show what arrives on a packet by packet basis. The text is enclosed in double quotes and any non printing characters appear as backslash and two hex digits.

```
*** Open
*** RSH EXIT
```

TELNET recv opt: DO SUPPRESS-GO-AHEAD

If the Application debug bit (80) is set the following messages will

Lines starting with three stars show significant events such as opening and closing connections.

RSH EXEC GOT FNAME RSH EXEC play

TELNET EXEC goseg

TCP Debug

Port Numbers

20 FTP Data 21 FTP Command 23 Telnet 513 rlogin 514 rsh and rcp

These are the 'well known' port numbers used for

TCP 1022 send [4] 102.9.200.3 1021 (tcb 4) Seq 33741057 Ack 1 Win 4096 SYN ACK

Intitially TCP debug describes each packet by the local port number and the foreign Internet Address and port. Once Established the TCP connection is only referenced by tcb (tcp control block) number.

TCP (4) send [0] Seq 1 Ack 33741058 Win 450 PSH ACK

IP Debug

ipdemux got pkt[120] prot 6 from 192.9.200.1

On the input side IP prints a message per packet with the length and the protocol number. Relevant protocol numbers are as follows:

TCP 6
ICMP 1
GGP 3

inwrite pkt[25] prot 6 to 192.9.200.1 route 192.9.200.1

Ethernet Debug

ET_SEND: p[45] -> 192.9.200.1

ET_DEMUX: got pkt[60] buf(0) type IP

ET free buf(0)

PRELIMINARY

Ethernet Debug

```
IP 0800
ARP 0806
RARP 8035
```

```
ET_DEMUX: got pkt[60] type ARP
```

```
ET_SEND -> 02:60:8C:29:79:10
```

Some packets will be discarded - ARP request that are not intended for this machine.

7.1 Where to Start

Ethernet cable

Is the machine correctly connected to the ethernet cable ?"

Assuming Ethernet activity can be generated from another host eg attempt to 'ping' the A60 repeatedly.

There is an LED on the computer card (second from left) that shows Ethernet receives. (Some Transceivers also have transmit, receive and collision LEDs which are of great assistance at this stage.)

Receive LEDs permanently 'on' on both the Transceiver and the Computer Card - Transceiver not connected connected to cable.

Collisions with every receive - cable incorrectly terminated.

Receive at transceiver but not at Computer - Problems with the Transceiver cable.

Internet Address

Is the Internet Address set up correctly ?

Assuming you have access to a 'ping' program and that the Internet address has been entered on the Control panel.

The Internet address should have the same network address as the rset of the hosts on the same local net. The network address is

PRELIMINARY

Internet Address

the top byte of the internet address if the top byte is less than 128, the top two bytes if the top byte is greater or equal to 128 and less than 192 or the top three bytes if the top byte is greater or equal to 192. If the Network part of the address is not the same the remote host will think the A60 is on a different network.

Most pings will have to start by using ARP to find the Ethernet Address of the A60.

If Ping fails more than about 1 percent of the time, unless the network is unusually heavily loaded this sounds like a grounding problem.

68000

Is the Motorola 68000 that controls the A60 Ethernet Hardware running ? If the 68000 has hung the A60 will be unable to write test patterns into the store but the disk transport functions may appear to work OK. - Press the Reset Switch on the Computer card at the right hand side near the front.

Disks

Are the disks up ? If communications appear to be OK but the A60 won't record or play, the disks might be spun down, there is a toggle switch on the front of the Computer card which should be to the right for normal operation.

Z80

Has one of the Z80s crashed ? If the HLC or LLC goes down the A60 will not respond to commands from the control panel. The Status display may be showing an illegal timecode. If the Reset button fails to correct this condition try clearing the Non-Volatile RAM by changing the position of the first DIP switch at 18k on the computer card.

Reference Syncs

Is the external reference selected ? If the disks are up but churning their innards out trying to lock to a non existent reference sync you could extend their life somewhat by switching the Internal/External Sync select to the right.

RGB Transfers

If YUV data can be transferred OK but RGB comes out green. Is the file extension being specified correctly ? - There may be problems with the MAC chip.

8. Example Program

The following is a simple SunView application intended to demonstrate use of the Berkeley Socket interface and remote control of the A60 over Ethernet.

It consists of three files, `demo.c` the Ethernet interface to the A60, `panel.c` a simple Suntools panel, and `a60.icon` an icon used by the program.

Since the origination of an `rlogin` is a privileged operation the program has to be owned by `root` and have the `set` user ID on execution bit set. The following sequence of commands should produce an executable program.

```
% cc demo.c panel.c -lsuntool -lsunwindow -lpixrect -o demo
% su
# /etc/chown root demo
# chmod 4755 demo
```

Although the program starts up with the window open you have to close it and then reopen it before it actually establishes a connection to the A60.

There can only be one connection (to A60 `rlogin`) open at a time so if the window refuses to open someone else must be logged on to the A60.

Something probably ought to be done about throwing away data from the A60, at the moment this is just being buffered up, but at least there is no echo unless the `rlogin` was opened up with the string `"\0simon\0simon\0sun/9600\0"`. `Rlogin` turns off echo if the terminal speed param is omitted.

8.1 demo.c

```

/* demo.c - quick lash up to show remote control of A60
 * - from within a Suntools app - using TCP/IP
 * Copyright (c) 1987 Abekas Video Systems Inc.
 *
 * Based on an example proggys
 * in the IPC Primer in "Networking on the Sun Workstation"
 */

#include <stdio.h>
#include <netdb.h>
#include <errno.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

char login_str[] = "\0simon\0simon\0sun\0";
char play_fwd_str[] = "play\n";
char play_back_str[] = "play -1\n";
char stop_str[] = "stop\n";

int sd;          /* global socket descriptor */

open_connection()
{
    struct sockaddr_in skt;
    struct servent *rlogin_service;
    struct hostent *a60;
    int lport;
    char c, tmp_str[80], str[80];

    if((rlogin_service = getservbyname("login", "tcp")) == NULL)
    {
        fprintf(stderr, "demo : tcp: unknown service\n");
        exit(1);
    }
    if((a60 = gethostbyname("a60")) == NULL)
    {
        fprintf(stderr, "demo : a60 : unknown host\n");
        exit(1);
    }
    bzero((char *)&skt, sizeof(skt));
    bcopy(a60->h_addr, (char *)&skt.sin_addr, a60->h_length);
    skt.sin_addr.s_addr = INADDR_ANY;

```

```

if((sd = socket(AF_INET, SOCK_STREAM, 0)) < 0)
{
    perror("demo : socket");
    exit(3);
}

/* attempt bind to a privileged socket */
lport = IPPORT_RESERVED -1;
for(;;)
{
    skt.sin_port = htons((u_short)lport);
    if(bind(sd, (caddr_t)&skt, sizeof(skt)) >= 0)
        break;
    if(errno != EADDRINUSE && errno != EADDRNOTAVAIL)
    {
        perror("socket");
        break;
    }
    lport--;
    if(lport == IPPORT_RESERVED/2)
    {
        fprintf(stderr, "socket : All ports in use\n");
        break;
    }
}

bzero((char *)&skt, sizeof(skt));
bcopy(a60->h_addr, (char *)&skt.sin_addr, a60->h_length);
skt.sin_family = a60->h_addrtype;
skt.sin_port = rlogin_service->s_port;
if((connect(sd, (char *)&skt, sizeof(skt))) < 0)
{
    perror("demo : connect");
    exit(3);
}
printf("OK so far\n");

write(sd, login_str, sizeof(login_str));
}

close_connection()
{
close(sd);
}

```

```
}  
  
play_forwards()  
{  
write(sd, play_fwd_str, strlen(play_fwd_str));  
}  
  
play_backwards()  
{  
write(sd, play_back_str, strlen(play_back_str));  
}  
  
stop()  
{  
write(sd, stop_str, strlen(stop_str));  
}
```

8.2 panel.c

```
/* panel.c - quick lash up to show remote control of A60
 * - from within a Suntools app - using TCP/IP
 * see Sunview programmers guide for examples
 * Copyright (c) 1987 Abekas Video Systems Inc.
 */
#include <suntool/sunview.h>
#include <suntool/canvas.h>
#include <suntool/panel.h>
#include <stdio.h>
#include <math.h>

static short icon_image[] = {
#include "a60.icon"
};

DEFINE_ICON_FROM_IMAGE(a60_icon, icon_image);

Frame frame;
Canvas canvas;
Panel a60_panel;
Panel_item play_fwd_button, stop_button, play_back_button;

Pixwin *pw;
Pixfont *font, *bold;

static Notify_value catch_closes();

/* calls five routines from demo.c
 * these first three are called when the appropriate button is pressed */

extern void play_backwards();
extern void stop();
extern void play_forwards();

/* also calls open_connection and close_connection as the window
 * is opened and closed */

main()
{

/* open fonts */
font = pf_open ("/usr/lib/fonts/fixedwidthfonts/screen.r.12");
bold = pf_open ("/usr/lib/fonts/fixedwidthfonts/screen.b.12");
```

```
/* create frame */
frame = window_create(NULL, FRAME,
                      FRAME_LABEL, "demo - A60 panel",
                      FRAME_ICON, &a60_icon,
                      0);

a60_panel = window_create(frame, PANEL,
                          0);

play_back_button = panel_create_item(a60_panel, PANEL_BUTTON,
                                     PANEL_NOTIFY_PROC, play_backwards,
                                     PANEL_LABEL_IMAGE,
                                     panel_button_image(a60_panel, "<<", 4, bold),
                                     0);

stop_button = panel_create_item(a60_panel, PANEL_BUTTON,
                                PANEL_NOTIFY_PROC, stop,
                                PANEL_LABEL_IMAGE,
                                panel_button_image(a60_panel, "STOP", 6, bold),
                                0);

play_fwd_button = panel_create_item(a60_panel, PANEL_BUTTON,
                                     PANEL_NOTIFY_PROC, play_forwards,
                                     PANEL_LABEL_IMAGE,
                                     panel_button_image(a60_panel, ">>", 4, bold),
                                     0);

window_fit(a60_panel);
window_fit(frame);

notify_interpose_event_func(frame, catch_closes, NOTIFY_SAFE);

window_main_loop(frame);
}

/* this routine intercepts events and catches open and closes */

static Notify_value catch_closes(frame, event, arg, type)
Frame frame;
Event *event;
Notify_arg arg;
Notify_event_type type;

{
```

```
int was_closed, now_closed;
Notify_value value;

was_closed = (int) window_get(frame, FRAME_CLOSED);
value = notify_next_event_func(frame, event, arg, type);
now_closed = (int) window_get(frame, FRAME_CLOSED);

if(was_closed != now_closed)
    if(now_closed) close_connection();
    else open_connection();

return(value);
}
```

8.3 a60.icon

```

/* Format_version=1, Width=64, Height=64, Depth=1, Valid_bits_per_item=16
*/
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x07FF,0xFFFF,0xFFFF,0xFFC0,0x0622,0x2222,0x2222,0x2240,
0x0444,0x4444,0x4444,0x4440,0x05FF,0xF911,0x1115,0x3140,
0x04FF,0xF888,0x888A,0xD8C0,0x06FF,0xFA22,0x223E,0xB240,
0x0444,0x445F,0xFFC5,0x7440,0x0511,0x111F,0xFF90,0x1140,
0x0488,0x889F,0xFF88,0x88C0,0x06E3,0xBF3F,0xFFA2,0x2240,
0x04E7,0xDF5F,0xFFC7,0xE440,0x05F3,0x9F1F,0xFF97,0xF140,
0x04EB,0x9F9F,0xFF8F,0xF8C0,0x06E3,0xBF3F,0xFFBF,0xFE40,
0x04E7,0xDF5F,0xFFDF,0xFC40,0x05F3,0x9F1F,0xFF9F,0xFD40,
0x04EB,0x9F9F,0xFF9F,0xFCC0,0x06E3,0xBF3F,0xFFBF,0xFE40,
0x04FF,0xDF5F,0xFFCF,0xFC40,0x05FF,0x9F1F,0xFF97,0xF140,
0x04FF,0x9F9F,0xFF8B,0xE8C0,0x0622,0x2222,0x2222,0x2240,
0x0444,0x4444,0x4444,0x4440,0x0511,0x1111,0x1111,0x1140,
0x07FF,0xFFFF,0xFFFF,0xFFC0,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0083,0x8700,0x0000,0x0000,0x0084,0x4880,0x0000,
0x0000,0x0144,0x0880,0x0000,0x0000,0x0144,0x0980,0x0000,
0x0000,0x0147,0x8A80,0x0000,0x0000,0x0224,0x4C80,0x0000,
0x0000,0x03E4,0x4880,0x0000,0x0000,0x0224,0x4880,0x0000,
0x0000,0x0223,0x8700,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,
0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000,0x0000

```

9. Glossary

ARP

Address Resolution Protocol - used to obtain Internet to Ethernet address mappings rather than configure and maintain a list on each host.

ARPA

Advance Research Projects Agency, US Government agency responsible for developing TCP/IP family of protocols.

AUI

Attachment Unit Interface - the long way of saying transceiver cable. Normally limited to 50 meters and carries twisted pair differential signals for transmit, receive and collision detection. The AUI cable also carries 12v power for the Transceiver.

Bridge

Bridges are generally connections between Networks of the same type at the Data Link Layer.

Broadcast Packet

an Ethernet packet carrying the address FF:FF:FF:FF:FF:FF which will be recieved by all the hosts on the network.

Cheapernet

an alternative form of ethernet that uses thin RG58 50-Ohm cable with BNC connectors and 'T' pieces at the traneivers rather than the normal normally used for Ethernet. This cable suffers from greater loss and the the cable run is typically limited to 185 m. In all other respects it is electrically compatible with 'Normal' Ethernet.

Client

The consuming (user) end of a client-server relationship.

Connection

the link between two specific ports on two Internet Hosts analogous to a telephone call being set up between two phones on a network.

CRC

Cyclic Redundancy Check - a sort of serial check sum that

assures the integrity of a serial data stream by using some sort of polynomial feedback - basically a shift register and a few exclusive or gates.

CSMA-CD

Collision Sense Multiple Access with Collision Detection - Describes the mechanism that allows several devices to share the single Ethernet cable.

Domain Names

A name addressing scheme that uses a hierarchy of domain names to describe the address of a remote computer in a similar way to the way as a mailing address eg
simon@master.abekas.COM.uucp

Ethernet V1 and V2

The original Ethernet standard was developed by Xerox and published jointly with DEC and Intel.

Ethernet Address

A 48 bit address conventionally written as 6 hex bytes separated by colons The IEEE hopes that there are enough addresses for every piece of ethernet equipment in the universe to have its own unique address, typically vendors ship equipment with the Ethernet address contained in a small bipolar ROM.

Fragments

Sub divisions of Internet packets - some times necessary if a different networks have different maximum packet lengths.

FTP

File Transfer Protocol

4:2:2

The Ratio of the sampling frequencies for components in Digital Video. Four Luminance samples for two each of the color difference signals.

Gateway

Gateways allow interconnection of different Networks at the Network layer.

IEEE 802.3

The IEEE standard for CSMA/CD Networks, forms part of the 802.x family of standards for Local Area Network Interfaces and Protocols.

Internet Address

A Four byte number representing the address of a host on the "Internet".

Jabber

A condition detected by a Tranceiver to prevent locking up the net - if the output is active for more than 1/10 second the Transceiver should latch up and prevent further transmissions until the Transmit signal is inactive for at least 1/4 second.

Heartbeat

See SQE

Host

A computer that is a node on a network.

Hostname

The name by which a particular machine is known at the user interface level - normally associated with a Network address.

MAU

Medium Attachment Unit The official IEEE name for what mortals refer to as a Transceiver.

NFS

Network File System (Developed by Sun Microsystems)

NIC

Network Information Center - The central repository for all information regarding the development of the ARPANet

OSI Layered Model

The much vaunted abstract model for the seven layer hierarchy of network protocols issued by ISO the International standards body. Still under development at the higher layers.

Ping

Program that uses the ICMP Echo Request facility to verify the connections between two machines. Note that this only checks correct operation of IP or up to the Network layer.

Port Number

An addressing scheme within a host computer that allows more than one simultaneous connection to that computer.

Repeaters

Repeaters connect buffer two sections of the same Network with very little intelligent signal processing.

RFC

Request For Comment - the main instrument of the ARPA Community a sort of Network Memo. Often quoted in references e.g. RFC 793 is the latest description of TCP. Available from the Network Information Center (see NIC above).

Server

A host or node on the network that provides a service, eg a File Server provides a File system for Diskless nodes.

SQE

Signal Quality Error - some Ethernet Transceivers generate a collision signal immediately after each transmission. This permits the Ethernet Interface to verify that its collision detection circuitry is functioning correctly.

Socket

a socket is an abstraction in BSD Unix for the interprocess communications primitive the known as the pipe. A socket can be opened in much the same way as a file would be opened.

Telnet

ARPA remote terminal/login program.

TFTP

Trivial File Transfer Protocol - built on UDP - simple to implement.

10BASE5 and 10BASE2

IEEE names for Ethernet and Cheapernet respectively

Thin-LAN or Thin-net

see Cheapernet

Transceivers

the box that attaches the Host computers Ethernet Interface the best ones use a spike arrangement to non-intrusively attach to the cable (eg without cutting it). Couples the Transmit signal from the ethernet signal onto the cable through an isolating transformer, detects collisions, and passes the received Ethernet signal up to the interface.

UNIX

is a Trademark of (AT&T) Bell Laboratories! two main flavors BSD 4.2 and ATT system V the Berkeley Software Distribution (BSD) version is the one that supports the ARPA protocols most popular Unix Systems eg Sun Microsystems, HP-UX and DEC Ultrix are a mixture of the two

X.25

Public Wide Area Packet Switched Network Standard.

YUV

the Native data format of the A60, an alternative encoding to RGB for component video and one that is more suited to the limited bandwidth of Broadcast TV. The Y channel is luminance and the U and V are color difference components B-Y and R-Y respectively. The color difference signals are normally stored at half the sampling frequency of the Luminance.

10. Appendix

This information is provided for those who intend to write their own applications to 'manually' access the file transfer and remote control services on the A60.

10.1 Complete TCP/IP Packet

The following is a complete dump of a packet.

```
Physical | Link
         | Network
         | Transport
         |
```

AA AA AA AA AA AA AB

Ethernet Preamble and sync

```
00 00 76 60 FF FF
08 00 20 01 FF 9D
08 00
```

Destination Addr

Source Addr

Type

```
45 00
00 35
FE 7D 00 00
0F 06
9D 2B
C0 09 C8 01
C0 09 C8 05
```

Version, Header len, Type of Serv
Length

ID, Fragment Stuff

Time to live, Protocol

Header Checksum

Source Address

Destination Address

```
21 83
00 17
18 4A 0E DB
00 00 00 3B
50 18
10 00
AA CF
00 00
```

Source Port

Destination Port

Sequence

Acknowledge

Flags

Window

Checksum

Urgent Pointer

68 65 6C 6C 6F 20 77 6F 72 6C 64 0D 0A Data

2A 2B 49 8D

Ethernet CRC

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Complete TCP/IP Packet

10.2 FTP Implementation

The following notes are intended to show the various states and messages of the Abekas FTP server.

Defaults

As suggested in the ARPA FTP Paper these are the defaults assumed by A60 FTP.

```
ftp->fport = 20;
ftp->lport = 20;
ftp->passive = FALSE;
ftp->type = ASCII;
ftp->format = NON_PRINT;
ftp->byte_size = 8;
ftp->mode = STREAM;
ftp->structure = FILE;
```

Opening Message

```
220 Abekas A60 FTP (Hostname) 220 Abekas A60 FTP
```

Commands and Responses

The following are a list of all the commands supported and the possible responses. Some of the responses are as the result of internal events such as ABORT where the data connection was closed mid-transfer.

USER

```
name > 20          500 Username too long
230 User OK QUIT
221 Closing control connection PASV
227 Entering Passive Mode. iii,iii,iii,iii,ppp,ppp PORT
error             501 Host/Port spec not enough commas

200 PORT spec accepted : host iii.iii.iii.iii port nnn TYPE
error             501 TYPE : bad args
ASCII            NON_PRINT                200 TYPE OK

NON_PRINT        TELNET                   CC
                504 can't cope with that TYPE

IMAGE           200 TYPE OK
```

EBCDIC
LOCAL 504 can't cope with that TYPE

MODE

error 501 MODE : bad arg
STREAM 200 MODE OK
BLOCK
COMPRESSED 504 can't cope with that MODE STRU
error 501 STRU : bad arg
FILE 200 STRU OK
RECORD
PAGE 504 can't cope with that STRU RETR
argc != 2 501 arg count
name parse 550 Bad File name
data conn 125 Data Connection already open
150 OK here goes

UNOPEN 425 Can't open Data Connection
ABORT 426 Connection Closed Transfer Aborted
LRESET 426 Connection Closed Local Reset
FRESET 426 Connection Closed Foreign Reset
NORMAL 226 File Transfer OK

STOR

name parse 550 Bad File name

data_conn 125 Data Connection already open
150 OK here goes

UNOPEN 425 Can't open Data Connection
ABORT 426 Connection Closed Transfer Aborted
LRESET 426 Connection Closed Local Reset
FRESET 426 Connection Closed Foreign Reset
NORMAL 226 File Transfer OK

NOOP

200 NOOP OK else
202 Command not implemented

10.3 File Names

The A60 is not case sensitive The correct syntax for a 'filename' on the A60 is as follows:

```
optional leading slash or directory path (ignored)
'F' to indicate a field transfer (optional)
timecode    19.20 frame at 19 seconds 20 frames          or 19:20
second field          or 590    frame 590                or 590+   frame 590
second field
extension  .RGB or .YUV (optional - defaults to YUV)
```

10.4 rlogin Implementation

```
--> \0                (no standard error connection)
--> simon\0simon\0    (local and foreign username)
--> vt100/9600\0      (term/speed)
<-- \0                (user info validated)
<-- Abekas A60 Remote Login\n
<-- a60%
```

User input is echoed character for character
Both backspace and delete characters do the same thing eg

```
--> \b                (backspace)
<-- \b \b            (backspace space backspace)
```

The Sun appears to leave out the /9600 bit when the connection doesn't expect echo eg when invoked by "rlogin host < script"

Venix running on a PC, sent \n\n instead of vt100/9600

10.5 rsh Implementation

```
--> 1022\0            (open standard error to port 1022)
--> simon\0simon\0    (local and foreign username, or vice versa)
<-- \0                (user info validated)
--> play -1\r         (the command)
```

Possible responses (even if stderr open - still sent down stdout)

```
<-- \001rsh: framestore access locked
<-- \001XXX: command not found
```

10.6 rcp Implementation

Copy to A60 eg rcp pic312.yuv a60:312

```

--> \0          (no standard error)
--> simon\0simon\0 (local and foreign username, or vice versa)
<-- \0          (user info validated)
--> rcp -t 400\0 (the command)
<-- \0          (command OK)
--> C0666 829440 pic400.yuv\n (File info access flags, length, name)
--> \0
<-- \0
--> [829440 bytes of data]
--> \0
<-- \0

```

Copy from A60

eg rcp a60:400.rgb pic400.rgb

```

--> \0          (no standard error)
--> simon\0simon\0 (local and foreign username, or vice versa)
<-- \0          (user info validated)
--> rcp -f 400.rgb\0 (the command)
--> \0
<-- C0666,400.rgb\n
--> \0
<-- ( bytes of data)
-> \0

```

Possible responses

```

<-- \001rsh: framestore access locked
<-- \001rcp: arg count
<-- \001rcp: A60 only supports single file transfers
<-- \001rcp: nnn Not a valid frame number
<-- \001rcp server: expected flag
<-- \001rcp: nnn : Permission denied
<-- \001rcp: invalid flag

```

11. Bibliography

Related Documents from Abekas

Abekas A64 External Control Protocol Manual
Abekas A60 External Control Protocol Manual
Abekas A60/64 Digital Video Interface Manual

ARPA Publications

DDN Network Information Center
SRI International, Room EJ291
333 Ravenswood Avenue
Menlo Park, CA 94025

DDN Protocol Implementations and Vendors Guide
- useful compendium of different TCP/IP applications
revised bi-annually

DDN Protocol Handbook (Three Volumes)

Particular RFC's of interest :

RFC 826 Address Resolution Protocol Nov 82
David Plummer Symbolics

RFC 903 Reverse Address Resolution Protocol June 84
Finlayson, Mann, Mogul, Theimer Stanford University

RFC 791 DARPA Internet Protocol Sept 81
J Postel (Editor)

RFC 792 DARPA Internet Control Message Protocol Sept 81
J Postel (Editor)

RFC 793 DARPA Transmission Control Protocol
J Postel (Editor)

RFC 854 TELNET Protocol Specification May 83
Postel and Reynolds

RFC 959 File Transfer Protocol Oct 85
Postel and Reynolds

IEEE 802.3 LAN Standards
CSMA/CD Access Method and Physical Specifications
Oct 84
IEEE

Ethernet specs :

A LAN Data Link Layer and Physical Layer Specification
Version 2 Nov 82
DEC, Intel, Xerox

Other Background Reading

Byte Magazine July 87

Scientific American October 87 P 136
Networks for Advanced Computing
Robert E Kahn

Handbook of Computer Communication Standards Vol 3
Department of Defense (DOD) Protocol Standards
William Stallings, Macmillian 87

TCP/IP Implementations

The following machines are known to support TCP/IP, in some cases it will depend on the operating system.

Digital Equipment Corp. VAX and microVAX running ULTRIX or BSD Unix

Hewlett Packard HP 9000 300 and 800 running HP-UX

Sun Microsystems

Apollo Computer

Symbolics

Apple Computer Macintosh II with Ethertalk

For the remainder there are add ons available from the following vendors (Information based on entries in the DDN Protocol Implementations and Vendors Guide)

Excelan

2180 Fortune Drive
San Jose, CA 95131
(408) 434-2300

Intelligent Ethernet Controllers for VAX, MicroVAX and IBM-PC.
TCP/IP software support for RSX-11, VMS, Unix System V and MS-DOS

Wollongong

1129 San Antonio Road
Palo Alto, CA 94303
(415) 962-7200

TCP/IP software for HP 9000 series 500, VAX, IBM-PC

3com Corporation

1365 Shorebird Way
PO Box 7390
Mountain View, CA 94039
(415) 961-9602

Ethernet Interfaces for the IBM-PC

FTP Software

PO Box 150
Kendall Square Branch
Boston, MA 02142
(617) 864-1711

TCP/IP software for the IBM-PC

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Bibliography