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HP-UX Networking in an MPE/iX Environment

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In the ever changing computing environment, networking has and will continue to be a major focus. Many of my MPE/ix customers are incorporating HP-UX platform equipment into their environments in order to meet their expanding computing needs. Most of these customers are beginning to utilize client-server applications. Though they are aware of some of the needs that their MPE/ix equipment has, they have many questions regarding the HP-UX side of this equation. What type of network do I need? How do I "address" the network? What commands, files and utilities are used to configure this environment? Where do I get this information? Where do I go from here? Hewlett Packard Company offers many training classes and services regarding this subject. In the following sections I would like to provide a high level view of this topic along with a detailed configuration example to help you in planning and executing this exciting new environment.

Section I: Planning the topology and transmission medium

The planning of your topology and transmission medium is one of the most important steps. This decision will have an effect on the ease of future growth and maintenance. "The term, topology, in the context of a communications network, refers to the way in which the end points or stations of the network are interconnected".[1] The Star topology_{see fig. 1} has a central point of control such as a server or switch as in an X.25 (the cloud) environment. One of the positive points with this topology is that network administration and control is central to the switch or server. This same point, though, is also a negative, a single point of failure. The Bus or Tree topology_{see fig. 2} is one of the most simple topologies. The individual nodes attach at different points on the "backbone". This lends itself to ease of expansion but also requires more network administration since it is "distributed". A third topology is the ring._{see fig. 3} This topology is a compilation of end to end links in a closed loop. Each node forwards the packets that do not match their address. One disadvantage to this, in a single ring configuration, is if a "node" goes down and cannot forward the other packets.

The transmission medium is another area that requires proper planning. The three types that I would like to address in this forum are: 802.3/Ethernet, (Thin and Thick LAN and EtherTwist), 802.5/TokenRing and FDDI.

802.3/Ethernet:
Since the HP3000 and HP9000 class equipment comes with the 802.3/Ethernet interface integrated, I would like to begin with it. This network link uses one of three cable types: ThinLan (50 ohm thin coaxial), ThickLan (75 ohm thick coaxial) and

[1] Local Networks by William Stallings, III Edition, Mcmillan Publishing

EtherTwist (unshielded twisted-pair). Below are the specifications for each cable type.[2]

Cable Type:	ThinLan	ThickLan	EtherTwist
IEEE cable specification	10Base2	10Base5	10BaseT
Maximum segment length	185 meters	500 meters	100 meters hub to node
Maximum nodes per segment	30	100	N/A
Minimum distance between nodes	.5 meters	2.5 meters	N/A
Maximum AUI cable length	50 meters	50 meters	50 meters

ThinLan is a very good fit for installations that are confined to a small area. ThickLan
is generally used in a "backbone" configuration where greater distances between nodes is needed. EtherTwist is now becoming very common in business environments. PC networks that are dispersed in work areas on different floors of an office building are just one example of this. All three cabling types have their uses.

802.5/TokenRing:
802.5/TokenRing allows the HP3000 and HP9000 great flexibility by providing full interoperability with IBM Token-Ring. It features 4 or 16 mbps (mega-bit per second) transfer rates. The IBM cable types that the 4 mbps support are as follows:[3]

Data Grade	AWG	Type
Type 1	22	2-wire shielded twisted-pair
Type 2	22	2-wire shielded or 4-wire unshielded twisted-pair
Type 3	22, 24	twisted-pair unshielded
Type 6	26	2-wire shielded twisted-pair
Type 9	26	2-wire shielded twisted-pair

For 16 mbps, only the shielded cables are supported.

Fiber Distributed Data Interface or FDDI:
FDDI offers an industry standard solution for customers who need flexible, robust, high-performance networks. FDDI offers 100 mbps with a maximum length of 2 kilometers between stations and up to 500 stations per ring with a 100 kilometer maximum ring circumference. An FDDI network is made up of two independent rings. The dual rings provide redundancy and the ability to re-configure the network in case of a failure. Hewlett Packard's HP3000 and HP9000 provide a Single Attach

[2] HP Networking Communications Specification Guide, 5091-9389E, 9310 p 282
[3] From HP Networking Communications Specification Guide, 5091-9389E p 79

connection or (SAS) through a concentrator. The HP9000 also provides for a dual attach PCA. FDDI is a way to improve your network bandwidth today.

Section II: Planning the address scheme

In addition to planning your topology and transmission medium, planning your network address scheme is also very important. If not properly planned and maintained, future growth can become a major undertaking. I would like to discuss the different address schemes in a TCP/IP environment. I would also like to discuss the subnet mask and its purpose as well as how to obtain a registered IP address.

An IP address is made up of 32 bits divided into two or three fields, network and host number or network, subnet and host number. An "A" class address is generally used for very large networks. It is divided by an 8 bit network number along with a 24 bit host number. This scheme can provide for about 17 million hosts. An "A" class address range is 1.x.x.x through 126.x.x.x. In binary notation, the "network" portion of an "A" class address always starts with a "0" in the leading bit. A class "B" address is divided by a 16 bit network number along with a 16 bit host number. This scheme can provide for about 65 thousand hosts. A "B" class address range is 128.1.x.x through 191.254.x.x. In binary notation, the "network" portion always begins with a "10" in the first two bits. The "C" class address is divided by a 24 bit network number followed by an 8 bit host number. This provides for 254 hosts. It is generally used in smaller networks. The "C" class address range is 192.0.1.x through 223.255.254.x. In binary notation, the "network" portion of a "C" class address always begins with a "11" in the first two bits. The binary notation I'm referring to is the actual binary address. The decimal notation represents the 32 bit address divided by 8 bits separated by a dot. For example:

	192	.	63	.	10	.	1
C-	1100 0000		0011 1111		0000 1010		0000 0001

The subnet mask is used when dividing a single network address into a more manageable group of smaller networks. This also assists in network traffic management over routers and bridges. The subnet mask tells you how long the network and subnet fields are. It is assigned as follows:

A "1" is assigned to each network and subnet bit.
A "0" is assigned to each host bit.

Each group of 8 bits is converted to its decimal equivalent to obtain dotted decimal notation. The subnet mask for an IP address with field lengths of network - 16, subnet - 8, and host - 8, would be 255.255.255.0. The subnet mask for an address with field lengths of network - 8, subnet - 8 and host - 8, would be 255.255.0.0. As

an example, if your company is assigned the address of 131.10 this could be divided up between work areas to provide even more hosts through the use of subnets. If your network is isolated and will never be connected to other IP networks then you can build your own IP address. Hewlett Packard Company highly recommends that your company obtain an assigned address. To obtain your assigned unique IP address contact Government Systems, Incorporated (GSI) - formerly know as the DDN Network Information Center, or NIC by phone, mail or E-mail.

Telephone 800-365-3642 U.S. only
703-802-4535 Worldwide

Mailing Address: Government Systems, Inc.
Attn: Network Information Center
14200 Park Meadow Drive
Suite 200
Chantilly, VA 22021

E-mail hostmaster@nic.ddn.mil

Section III: Commands, files and utilities used in configuring the network

In this section I would like to provide the reader with the information necessary to configure a simple system to system network between an HP3000 running MPE/ix and an HP-UX HP9000 running HP-UX 9.x in order to take advantage of the bundled-in Arpa services File Transfer Protocol. As of MPE/ix 5.0, Arpa services are now bundled-in. To configure the HP3000 we use the utility NMMGR.PUB.SYS. This menu driven utility makes the configuration very straight forward. In the previous sections we have covered the initial planning that is required to make this installation a success. The following will be a step by step procedure for the HP3000 NMMGR.PUB.SYS utility. Type NMMGR at the system prompt and press return. This will start the utility with the OPEN screen. The default name of the configuration file is NMCONFIG.PUB.SYS. You should use this file. Press the "Open Config" key, (F1). This will take you to the Main Menu. Here you decide what type of network you are going to configure. The first item we need here is the Node Name that you will assign to the HP3000. The name you choose should easily identify this host. Also, here you will assign the domain and organization name. The domain is the group of systems that the HP3000 will be part of. As an example you might choose "Admin". The next portion of the name is the organization. Here you might choose your company name. As an example HP. These names cannot be greater than eight characters. The next item you will see is the question whether you are using an OpenView DTC Manager or not. Answer accordingly. The next item will be whether you have an X.25 system to system or Pad connection. Answer this accordingly as well. When you have completed with

this information, press the "Save Data" key (F6). To configure the basic communication with the HP-UX equipment, we will use the NS configuration even though we are not configuring HP's Network Services. This should be the F2 key. This will take you to the NS Configuration screen. Here you decide whether you want to use the guided or unguided configurator. You should also see the network name you chose earlier. May I suggest that you use the Guided portion by pressing the "Guided Config" key (F1). This will take you to the Network Transport Configuration. Here you configure the network interface and type. Enter a name for the selected network interface. An example might be, LAN1. Then enter the network type. Here you should enter the type of medium you selected in the previous planning portion. As an example, let's choose "1", which is for a LAN connection. Then press "Config Network (F1). This will take you to the LAN Configuration screen. Here you should find the Node name that you previously configured. Also you should find the Network Interface name that you chose on the previous screen. The next field you find is the "IP Address" field. Here you place the IP address you chose in the planning we
discussed in the previous section. Let's use a "C" class address here as an example. You would enter "C 192.63.10 1". If you are not using a subnet mask leave the "IP subnet mask" field default. The next field identifies the Link name you will use. If you are configuring an HP9x7 or HP9x8 machine, here you would use the same link name that the "DTS" link uses. Typically it is named "DTSLINK". The DTS link is the link name that your DTCs use. The next field you should enter is the "Physical path of LANIC" field. Here you enter the path where your Lan card is. Again, typically this is the same path that your DTCs use. Since we have used the "DTSLINK" in our example, we will continue with that and enter "56" in this field. I would suggest that you leave the remaining two fields at their default of "yes". After you enter the above information, press the "Save Data" or (F6) key. When the configuration is "saved", press the "Validate Netxport" or the (F5) key. This will take you to the "Validate" screen. The following assumes you have already configured and validated the Distributed Terminal Subsystem (DTS) link. The DTS should be validated before you validate the network transport (Netxport) software. Press the "Validate Netxport" or (F2) key. This will start the validation process for the Lan transport. If there are any errors, you must re-configure that section and save that data before continuing. If there are no errors, the configuration should validate correctly and the last thing you should see on the screen should be "(Press RETURN when done viewing screen contents)". When this completes, you are ready to "Cross-Validate" in SYSGEN. To do this, you exit the NMMGR utility and start SYSGEN. When you get the sysgen prompt (sysgen>), assuming there are no errors, enter "sy" and press the return key. This will take you to the sysfile portion of sysgen. Here you enter "RDCC" and then press the return key. When this completes, enter "hold" and press the return key. When you receive the "sysfile>" prompt back, enter "exit" and press the return key. When you get back to the "sysgen>" prompt, enter "keep" and press the return key. Here you will be asked to keep the new config group and

replace the old. Enter "yes" to keep the "new" config group. When the "sysgen>" prompt is returned you can enter "exit" and press return. You should now be ready to "start" the HP3000 portion of the network. One thing to keep in mind is, if this is the first time you have configured a "network" on your HP3000, I would suggest that you shut the system down and re-start with a "START NORECOVERY" boot. This will allow the network drivers to re-aquire the network card. If you re-booted, you are now ready to "start" the network. At the console you would enter the following commands:

```
: Netcontrol start;net=lan1
: Netcontrol start;net=loop
: NScontrol start  <------even though we didn't configure NS.  Arpa will use part of
                          this subsystem.
```

This completes the HP3000 portion of the configuration. At this point you have configured the file NMCONFIG.PUB.SYS to allow the TCP/IP link to be utilized by the HP3000. As a side note, if you have PCs on your network that are using the TCP/IP stack and also have an appropriate emulation package, such as Walker Richer & Quinn's Connect 3000, you can now establish a system to system session with those PCs. The next portion will take you through the utility that we use to configure the HP-UX hardware to communicate in this environment.

For the HP-UX system, we will cover configuring your system at initial start-up and after the system is already running. The most straight forward time to configure your HP-UX system is at system installation time. During the initial booting of your system, the user is asked if they are going to attach the system to an existing network. If this request is answered positively at that time, you will be asked what the node name of the system will be. Then you will be asked what the IP address is that you have selected to use. The initial start-up script will then configure all the necessary files that are required to start your network. This works for the first Lan card that the initial script encounters. If you have additional lan cards to configure, then the following procedure will apply. Assuming all filesets and device files are present, let's begin to configure the network connection. We begin by running SAM. SAM is the System Administration Manager program. After the SAM main menu appears, select the item labeled "Network/Communications" menu item. This will take you to the next menu. At this menu select "Network Interface Cards". Select the first available Lan card. Use the Select/Unselect or F3 key. Press the menubar on/off or F5 key. This will activate the windows at the top of the screen. Using the arrow keys highlight the window labeled "Actions". Pull this window down by pressing the return key. Using the arrow keys again, highlight configure. This takes you to the configuration screen. The system will load the Lan card driver name, hardware path and station address. The card type will be defaulted to ethernet. If you need to

enable ethernet and/or IEEE 802.3, this is the window in which you would do that. Tab down to the IP address
field and enter the address you chose when planning the network. The next field is the Aliases field. Here you would assign an alias name to the IP address. If you have a subnet mask to assign enter that in the next field. When you are satisfied that all the information is correct, tab to "ok" and press enter. The system will then generate and configure the necessary files to enable your network connection. To assign the system name, activate the "actions" menu item again. Go to the item labeled "Modify System Name". The first field is used to enter the Host Name or System Name. This name should be a name that identifies this system. The next field is the Node Name field. This field can equal the System Name. Tab to "ok" and press return. Again, the system will modify the necessary files to enable the applicable names. It would be a good idea at this point to re-boot the system to allow the /etc/rc and /etc/netlinkrc to start the network daemons and services.

When you configure your network connection, the following files will be updated or created: /etc/hosts, /etc/netlinkrc, /etc/services, /etc/rc and /etc/inetd.conf, /etc/networks, /etc/hosts.equiv, /etc/protocols.

The "/etc/inetd.conf" file is used by the inetd daemon to determine which servers available on the local host use inetd as their front end. This file is usually pre-configured.

The "/etc/hosts" is a file containing the name of each host the ARPA-Berkley services "know" about and can communicate with. Each entry contains three fields, for example:

internet Address	official host name	aliases
192.45.36.5	hpxs9	testhost

The first entry should be the default 127.0.0.0 and the next entry should be your own host. The proper permissions for /etc/hosts is read/write by owner; read by others; owned by root.

The "/etc/services" lists services the local host "knows" about, their port number and supporting protocol. Each entry contains three or four fields, for example:

official service name	port number/protocol name	aliases
shell	514/TCP	

The proper permissions for /etc/services is the same as for /etc/hosts.

The "/etc/networks" file lists networks "known" by services. This file is initially empty, but it can be utilized to allow the user to refer to a network by a name. Each entry contains three fields, for example:

official network name network portion of Internet address aliases

loop 192.46.4 testlan

The file permissions are the same as /etc/hosts.

The "/etc/protocols" file lists all protocols "known" by the local host. The proper format for an entry contains three fields, for example:

official protocol name protocol number aliases

TCP 6 TCP

The file permissions are the same as /etc/hosts.

The "/etc/hosts.equiv" file specifies remote hosts that are equivalent to the local host. By using this file a user from an "equivalent" remote host can access the local non super-user login without a password if the local username matches the remote user's name. This file is used only by the Berkeley services. FTP and TELNET do not check /etc/hosts.equiv. Each entry contains one field, for example:

HostA /etc/hosts.equiv
  HostB

HostB /etc/hosts.equiv
  HostA

The file permissions for /etc/hosts.equiv are read/write by super-user: read by all others.

The "/etc/netlinkrc" file is executed in order to bring up netipc, bsdipc, all network diagnostics, NS services, ARPA services and NFS services. The modifications made to this file depend on what services you are going to configure. In our example for the system to system configuration the following items are configured. The IP address is assigned to a LAN interface, an NS nodename, if Hewlett Packard's Network Services is configured, and routes if needed. The assigning of an IP address to a LAN interface can be accomplished with the /etc/ifconfig command. This

command also is used to bring an interface "up" or "down", enable or disable IEEE 802.3 and ethernet and set an optional subnet-mask. As an example:

/etc/ifconfig lan0 192.34.52.2 up ether ieee

The "/etc/rc" file is used to start many of the services required to operate the HP-UX system. In this file we assign the variable SYSTEM_NAME or hostname.

The above configuration section describes the configuration of a pre-HP-UX 10.X system. While the steps in the SAM portion are pretty much the same, the files that will be modified are not. The most dramatic difference is the replacement of the /etc/rc file.

Prior to HP-UX 10.01 the /etc/rc file started most if not all of the services that needed to be initialized at run time. An example was the starting of the /etc/netlinkrc script. This script would then configure, and enable the IP address and host name on each of the configured LAN devices. In HP-UX 10.X when the system reaches run level "2" or higher the startup script, /sbin/init.d/net is invoked. It takes some of its configurable parameters from /etc/rc.config.d/netconf which is the configuration file. Then it actually executes the ifconfig, lanconfig and route commands to setup the network environment. We no longer use the /etc/netlinkrc file. The items that you configured through SAM that changed the netlinkrc file are now modified in the /etc/rc.config.d/netconf file. Another item that changed as of HP-UX 10.X is the SAM menu items. By changing the "view", you can now configure all of the necessary files from one screen!

Section IV. Network start-up services that Hewlett Packard Company offers

Hewlett Packard Company offers many services regarding networking. The range is very broad beginning with the initial design going all the way through management and support of your network. I would like to go into three of these services. As discussed in the first section of
this paper, the planning step is the most important. Hewlett Packard Company offers Network Design and Implementation services from the Professional Services Organization. This service provides the customer with a comprehensive network design that is tailored for their environment. Not only does this plan contain the necessary components to "build" a successful network but also contains the information needed to properly handle growth as well. The implementation portion of this service provides the user with the needed training, schedule, and support to bring the network into production. Hewlett Packard's Startup service provides the customer with timely and coordinated implementation. With Start-up, the customer is assured that the installation, configuration and verification of the network is

complete. Hewlett Packard Company provides the technical expertise and project management to assist you in implementing your computing environment. This service covers the range of physical preparation of the computing environment all the way through verification of the completed network connections. Another valuable service that Hewlett Packard Company offers is the Cabling Service. The Wire-Test Service also fits well here. Hewlett Packard's cabling service provides complete network cabling project management from design to installation. Hewlett Packard Company can implement an entirely new cable system or expand or modify an existing system. This service is scaleable to fit your network environment and size. The wire-test service provides complete and reliable testing of your existing cabling. Using sophisticated testing equipment, Hewlett Packard works with you to help preserve your investment in wiring wherever possible.

In order to successfully implement an open systems network solution, I cannot stress how important the planning process is. It is the intent of this paper to give the reader a high-level view of planning the topology, transmission medium and IP address scheme coupled with a configuration example in order to include an HP-UX system in an MPE/ix environment.