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DATE: April 7, 2003
TO: ISAC PCMNET Users
FROM: Ron Follmer
RE: Configuring PCMNET Ethernet/Internet Access
Orig: 7/15/2003

Background

The PCM Series of ISAC controls include support for a variety of networks. One of the most important forms of network is the Ethernet. The Ethernet is not just one protocol of data transmission, but rather, it is a backbone capability that allows a growing list of protocols to be used over a variety of physical wiring links. The Internet is a physical extension, world wide, of the basic Ethernet capabilities. So when I refer to the Ethernet, please understand that the same principles apply to communication via the Internet. There are a number of ways that a Ethernet network can be connected to the global Internet network. More information about that later.

Attempting to understand all the details of the Ethernet network standard would be a daunting task. I can't begin to explain all the details, but it is important to understand the basics so that that understanding can be built upon at the reader's own efforts.

It is important to review a few terms, abbreviations and other factoids.

- An Ethernet network can be built using a variety of hardware/physical connection schemes. Most commonly, Ethernet networks used by business and industrial control applications use a cabling system called 10BaseT or 100BaseT. Other possible hardware/physical connections involve fiber optics and Wireless/RF (radio frequency) technologies. Each of these physical connections has it's advantages and disadvantages that must be evaluated for suitability for a particular application. A 10BaseT network must have all devices connected to the network by means of a Switch/Hub device. The Switch/Hub device provides power and speed buffering to the network. A CAT5 cable with RJ45 connectors at each end is used to connect each device to the Switch/Hub. The cable must not exceed 100 Meters in length. Therefore all network devices **MUST** be within 100 Meters of the central Switch/Hub. Longer distances are possible by switching to a Fiber Optic type of link that will replace the 10BaseT physical wiring with optical cable that can extend the effective length to several thousand Meters.
- The term, LAN, stands for Local Area Network. It refers to an Ethernet network that is designed to connect devices that are related to one another and have frequent need to exchange information on a real time basis. A simple LAN might consist of 2 computers that have Network Interface Cards (NIC) and a

connection “Hub” or “Switch”. A 10BaseT connected network requires that each device be connected to a Hub device which supplies power to the network and adjusts between different network speeds such as 10BaseT (10 Megabits per second) and 100BaseT (100 Megabits per second). A more complex LAN might have hundreds of devices and include one or more “Servers” that provide services to all the devices on the network.

- IP means Internet Protocol and it is the lowest level protocol used on the Ethernet. All other protocols are built on top of this basic data transmission protocol. It is basically a standard way to package data. There is a TO address, a FROM address, a variable length block of data (anything you want to invent), and finally a error detecting value that must be properly computed to verify that the package was delivered exactly as it was transmitted.
- TCP/IP is a term used for one of the most commonly used protocol that is used to transmit data with error checking and automatic re-transmission when errors are detected. As with all protocols, the TCP/IP information must be contained within a basic IP protocol package.
- “MAC Identifier” is a unique ID number that is given to each and every device that is produced containing an Ethernet port. This ID number is rarely important to the device user, but is used by message routing equipment and is required by the manufacturer to be provided.
- “IP Address” is a 32 bit number that will uniquely identify a particular device on an Ethernet network. In the future, this address will be expanded to allow more devices to exist on the same network. You can imagine that the world wide Internet has an enormous number of unique devices and is expanding each day. The IP Address may change periodically, depending on the needs of the network configuration. A “Static” IP address is one that never changes. A “Dynamic” IP address is one that may change. The IP Address is usually expressed as 4 numbers 0-255 separated by periods, ie “192.168.0.10”. When dynamic IP addresses are used, prior to each connection between peers, a connection to a DNS server must be made to find out what is the current IP address of the peer. This makes connections slower with a dynamic IP addressing scheme.
- The “Subnet Mask” is used to specify a range of IP addresses that form a sub category of IP addresses that the device will be able to communicate with. The Subnet Mask must be selected to coordinate with the IP address.
- A Server is an Ethernet device that can provide a service to other devices on the network. Any device can act as a Server for a specific protocol if it is programmed to do so.
- A Client is an Ethernet device that makes a request over the network. The Client is the device that initiates a request for service. The Client is the requestor and the Server is the recipient of a request and the provider of the information requested.
- DNS is a protocol that is used to request an IP address given a Domain name and visa versa.
- A Domain Name is a text name that is used for user readability. It is used to refer to a particular device on the network. In order to make use of Domain

Names, there must be a Server on the network that will provide a service called DNS.

- PPP is a protocol that is used to connect Ethernet networks via telephone Modems. For example, this protocol is used to send IP packets through the telephone to an ISP provider.
- DHCP is a protocol that is used by a device to request and obtain an IP address from a network DHCP Server.
- TELNET is a protocol used to simulate a direct RS232 serial channel connection over the Ethernet. The PC/MNET uses Telnet to allow users to access its built-in menu system remotely via the Ethernet.

The PC/MNET Control has the capability to connect to a LAN via a 10BaseT physical interface, or connect to the Internet via an ISP via a Modem port, or both. Connection to the Internet may be possible (and easier and more reliable) via the 10BaseT LAN port. In fact, the PC/MNET can be connected to both a local LAN and to the Internet via Modem at the same time. This can be confusing, as the PC/MNET will then have two different IP addresses, one for each port. Decisions have to be made in these complex conditions to ensure that client requests from the PC/MNET are directed (routed) to the correct network port. Email is the common area where the decision must be made to perform Email over the LAN or over the Modem. More information on this below.

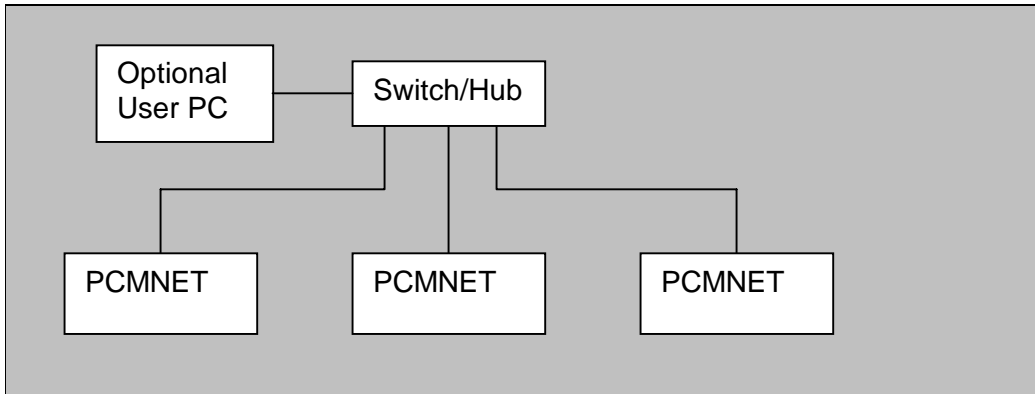
Ethernet Network Layouts

There are several network layouts that are possible when using one or more PC/MNET controls. They vary from a completely private network that contains a minimum of two PC/MNETs to a network that is managed by DHCP/DNS servers that provide full services to the PC/MNET(s) such as email and direct Internet access.

Completely Private Unmanaged Network

A peer to peer network can be constructed with as little equipment as two PC/MNETs and one 10BaseT Switch/Hub. Since there is no DHCP server present, Static IP addresses must be assigned to each of the PC/MNETs. Disable the DHCP and BOOTP selections on the Ethernet Network Configuration Screen and use IP addresses beginning with 10.0.0.1 (not to exceed 10.0.0.255). Also enter this IP address as the Default DNS server IP and the Default Gateway IP address. Lastly, use a Subnet Mask of 255.255.255.0. All PC/MNET devices MUST have unique IP addresses! There cannot be email sending or receiving as there is no email server available on this private network and there is no Internet access unless done via Dialup using a Modem and telephone lines.

If there is a PC on the network to monitor the system, it too will need to have a Static IP address that does not conflict with any other device. The PC can then access the PC/MNET's via Http, Telnet or ModbusTCP.



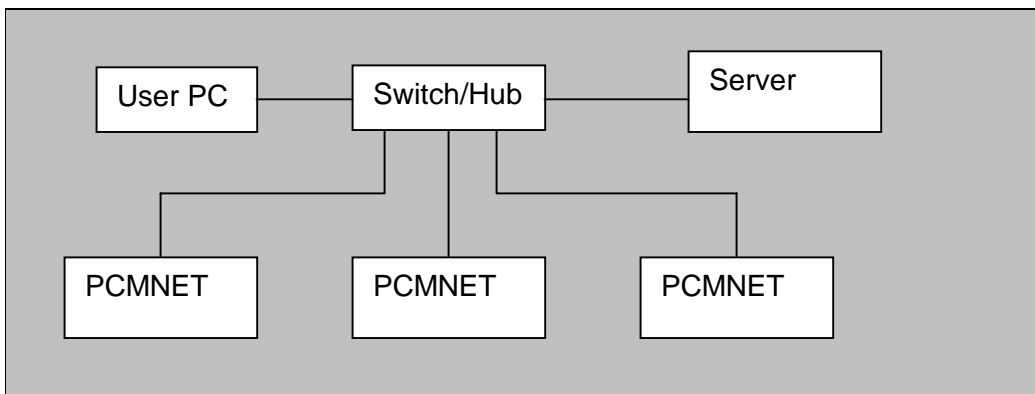
A typical Private Network Layout

Managed Network providing DHCP and DNS Servers

A managed network is one that has a DHCP and DNS server present that will provide a dynamic IP address to each device. Enabling the DHCP client of the PCMNets on the Ethernet Network Configuration Screen will command the PCMNets to find and communicate with the DHCP server on the network. The DHCP server will provide the IP address, Subnet Mask, DNS server IP addresses and the Gateway IP address automatically. The DNS server on a managed network will allow each device to be addressed by a domain name instead of just an IP address. You can then enter a domain name instead of an IP address in Peer Definitions. If there is an email server available on the network (POP and SMTP), then email parameters should be entered as described below.

A managed network may elect to use fixed IP addresses. In this case you will need to get an IP address, Subnet Mask, DNS IP address, and Gateway IP address from your network administrator. Disable the DHCP and BOOTP questions on the Ethernet Network Configuration Screen and enter the numbers provided.

A managed network may elect to use DHCP to provide "reserved" IP addresses. In this arrangement, the DHCP server will recognize the Host Name of the PCMNets and provide the same IP address each time the PCMNets logs onto the DHCP server. This provides the performance advantage of static IP addresses and domain names can also be used for user convenience.



A typical Managed Network Layout

Ethernet Network Configuration Screen

The PCMNET has a configuration screen dedicated to settings for the 10BaseT port.

NOTE: Changes to the fields of this screen will not be effective until the board is reset or power is cycled to the board.

Host Name(31 char text): The default value is "PCMNET". This should be used for most systems. In use, this string is added to a unique number that is different for each board manufactured. Together, the string appears as "PCMNET778", for example. This string appears on the main menus and it will be reported to a DHCP server as the Host Name of the device.

Deflt Domain Name(31 char text): If the PCMNET is part of a larger network using a DNS server and a DHCP server, each device on the network could be identified using a domain name such as "pcmnet778.isacinc.net". Entering this domain name here will allow the Trinet program to document the domain name.

DHCP Enabled? (Y/N): Answering "Y" (yes) will enable the PCMNET to search for and register with a DHCP server on the network. This registration happens at power up and every 24 hours thereafter. If you need to have a Static IP assigned, that never changes, then answer "N" (no).

BOOTP Enabled? (Y/N): If a DHCP server is not present, but a BOOTP server is present, enter "Y" (yes). If you need to have a Static IP assigned, that never changes, then answer "N" (no).

Default IP(xxx.xxx.xxx.xxx): If neither DHCP or BOOTP is selected, or if both fail to provide an IP address for the PCMNET, this IP address will be used.

Default Subnet Mask(ie 255.255.255.0): If neither DHCP or BOOTP is selected, or if both fail to provide an IP address for the PCMNET, this mask will be used.

Default DNS IP(xxx.xxx.xxx.xxx): On a network that does not include a DNS server, enter the primary server IP address here. In a completely private network (just PCMNET boards and no server computer present) enter the Default IP address as the DNS IP address. If DHCP or BOOTP servers are used the DNS IP addresses will be provided automatically.

Alternate DNS IP(xxx.xxx.xxx.xxx): Use this field only when multiple DNS servers are present on the network. If no DNS servers or only one server is present, then this field should be set to "0.0.0.0".

Default Gateway IP(xxx.xxx.xxx.xxx): On a network that does not include a DHCP server, enter the assigned Gateway IP address. In a completely private network (just PCMNET boards and no server computer present) enter the Default IP address as the Gateway IP address. If DHCP or BOOTP servers are used the Gateway IP addresses will be provided automatically.

Telnet Server Enabled? (Y/N): Enter "Y" (yes) in all cases except ones where security restrictions prohibit the use of Telnet server connections.

Telnet Port#? (std=23): Some networks change the default Telnet server port numbers for security reasons. The default is 23 and should be used in most cases.

HTTP Server Enabled? (Y/N): Enter "Y" (yes) in all cases except ones where security restrictions prohibit the use of an HTTP server connections.

HTTP Port#? (std=80): Some networks change the default HTTP server port numbers for security reasons. The default is 80 and should be used in most cases.

ModbusTCP Server Enabled? (Y/N): The ModbusTCP protocol is used for Peer to Peer communications between PCMNETS. Enter "Y" (yes) for all but the most unusual network situations.

ModbusTCP Port#? (std=502): Some networks change the default ModbusTCP server port numbers for security reasons. The default is 502 and should be used in most cases.

Use 10BaseT for Mailboxes? (Y/N): In the case where dialup Internet connections are to be used for email transmissions, answer "N" (no) to this question. In all other circumstances enter "Y" (yes).

Email Check Interval (sec): If the 10BaseT connection will be used for sending and receiving emails, this value will determine how often the PCMNETS will attempt to receive incoming email command messages.

Log Email? (Y/N): Answer "Y" (yes) to trigger an Activity Log entry each time an email message is sent via the 10BaseT network connection.

Dialup Network Configuration Screen

If your application needs to access the Internet and cannot do so using the 10BaseT connection, a Dialup connection using an Internet Service Provider can be used.

Dialup Phone#(ie 1-xxx-xxx-xxxx): Enter the primary phone number provided by your ISP to make dialup connections.

Alt Dialup Phone#(ie 1-xxx-xxx-xxxx): Enter a secondary phone number to use if the primary number is not available.

Dialup Account Name(23 char text): Enter the Account Name provided by your ISP.

Dialup Password(23 char text): Enter the Account Password provided by your ISP.

Dialup Enable(0=no,999=always,1-480=pt): Enter the Point number in your Trinet program that will be used to schedule when the PCMNETS should establish a dialup connection. Using the value of "999" is NOT recommended as it will force the PCMNETS to attempt to keep a 24-7 dialup connection. This is not a practical solution. Entering "0" will prevent all dialup attempts. The enable Point must be held in the ON state long enough to allow all the programmed attempts (discussed below) to be completed. It is recommended that a minimum logon time be 10 minutes.

Dialup ISP Type#(1=script,2=PAP): There are two methods of establishing a connection to the ISP's server once the phone Modem connection has been established. The PAP method is faster and is recommended. Some older ISP equipment may require a Script type logon.

Dialup Retries(1-10): The number of retry attempts the PCMNETS will make before giving up on establishing a connection. It is recommended that 2 or 3 attempts be programmed.

Dialup Failure Downtime(1-240 min): Enter a delay in minutes that the PCMNET will wait between dialup connection attempts. There should be a minimum 1 or 2 minute delay between attempts, as the Modem will need time to re-cycle.

Use Dialup for Mailboxes? (Y/N): In the case where 10BaseT Internet connections are to be used for email transmissions, answer "N" (no) to this question. If you are sending email over the Dialup connection, then answer "Y" (yes).

Email Check Interval (sec): If a Dialup connection will be used for sending and receiving emails, this value will determine how often the PCMNET will attempt to receive incoming email command messages while online.

Dialup Inactivity delay(3-60 min): Each time a valid Internet access is established with the PCMNET over the Dialup connection a timer is re-started to prevent the dialup connection from being dropped prematurely. The Dialup connection will be held open until the control point is OFF and the inactivity timer has elapsed. A 3 to 5 minute delay is recommended.

Email Configuration Screen

From Email Address: The return address for emails sent from the PCMNET. This is a 31 character field. Example, myemail@mycompany.com.

Email Acct Name: The account name used to send and receive emails. This is usually the string to the left of the "@" sign in the email address. For the example above, this would be "myemail". Even if your application will only send emails using SMTP, a valid name/password must be provided as the POP (incoming) email server must be accessed first to allow the sending of email for some ISP's. This is to stop email spammers.

Email Acct Password: Enter the password for this account. Even if your application will only send emails using SMTP, a valid name/password must be provided as the POP (incoming) email server must be accessed first to allow the sending of email for some ISP's. This is to stop email spammers.

SMTP Server: Enter the URL to your ISP's SMTP server. This field has a 31 character length limit.

POP Server: Enter the URL to your ISP's POP server. This field has a 31 character length limit.

CC Email Address: Optionally, you may specify an email address that will receive a copy of every email sent from the PCMNET. If this field is unused, clear all characters from the field (a Ctrl +] character combination will clear the field completely).

Max Email Retries(0-3): You may specify the number of retries that should be attempted in the case that the SMTP server is off line or busy. One retry is recommended.

Retry Period(sec): You may specify the time delay between email attempts in seconds. It is recommended that this value be at least 60 seconds.

Other Internet Configuration Screen

There are several optional features of the PCMNET that can be performed using Ethernet/Internet services.

TZO Dynamic Name Server parameters

The TZO service is designed for dialup Internet applications. It allows a device to obtain a changing IP address from the ISP and then to report the current IP address to the TZO dynamic name server (DNS) service. Remote users can then access the device using an URL such as "bigsystem.isacinc.net". When using this URL, the TZO server will provide the current IP address to the user's browser to allow access to the PCMNET. The TZO service requires an annual fee to be paid. Contact ISAC to purchase the service and obtain a special domain name.

TZO Domain Name(optional, 31 char text): Supply the TZO supplied domain name, if TZO is to be used.

TZO Server use Enabled? (Y/N): Enter "Y" (yes) if the TZO server is to be used, if you enter "N" (no), leave the other TZO fields at their defaults.

TZO Key (optional, 16 char text): When the TZO service is being used a 16 character key string is supplied. Enter the 16 character key here.

TZO Server 1 to 4 (optional, 23 char text): TZO maintains redundant servers to handle users. Enter the 4 supplied server IP addresses here. If there are less than 4 supplied, then leave the remaining server IP addresses as blank.

Clock Synchronization Parameters

Time Server URL: To provide synchronization of the PCMNET clock, you may specify a Web site and page URL that will allow the PCMNET to obtain the current GMT time. The PCMNET will access the Html Header of the specified URL and extract the current time (adjusted by the local offset from GMT programmed). If you want the time updated via the Ethernet network ensure that the "Use 10BaseT for Mailboxes? (Y/N)" setting is set to YES. Otherwise, if you want a Dialup connection to provide the time synchronization, answer YES to the "Use Dialup for Mailboxes? (Y/N)" question. If you do not want to use time synchronization, the leave the URL field blank.

Time Poll Freq(sec): Enter the frequency of time updates in seconds. The default is 86400 seconds or 1 day.

Max Time Drift(sec): The time update process will change the current time if the board's clock is different from the Http server's time by at least this amount of time. Enter the time difference in seconds that must exist before the PCMNET's clock will be set.

Max Time Latency(sec): If the time it takes to retrieve the current time from the web server URL specified is greater than this Latency time the PCMNET clock will NOT be changed. This prevents errors in the time due to an unusual delay in accessing the Http server.

Curtailment Parameters

The Curtailment function allows an external computer to send a command via the PCMNET's Http server, to curtail energy usage in a peak demand period. This function can be used for other purposes as well. Generally, a command is sent to override up to 5 points that are user defined. The 5 Points are a Level (analog) point, beginning Time

and Date points, and ending Time and Date points. User programming will use these Points to interact with logic to cause the intended process to be modified for the span of time between the beginning and ending dates. Consult the Pcmnet_Commo_Summary.pdf document for more information regarding the Curtail command for the Http server of the PCMNET.

Curtail Level Point(0=none,1-480): Enter the Point number to hold the curtail level.

Curtail Begin Date Point(0=none,1-480): Enter the beginning date Point number.

Curtail Begin Time Point(0=none,1-480): Enter the beginning time Point number.

Curtail End Date Point(0=none,1-480): Enter the ending date Point number.

Curtail End Time Point(0=none,1-480): Enter the ending time Point number.

How to determine what is the PCMNET's current IP address

To determine what the current PCMNET IP address, subnet mask, DNS and Gateway IP addresses are, enter the "Command Mode" and enter the ETCK command. Use the Actions menu of ITERM (ISAC interface PC software tool) or other ISAC software to select the "Go to Command Mode" menu pick to logon to Command Mode. Among the information output with this command is the current Host Name which is a combination of the Host Name from the Ethernet Configuration screen and a serial number. These two strings are combined to ensure that each PCMNET on the network will have a unique identification even if the application programming in each is identical. If used in a managed network using DHCP, the network server will show this Host Name and serial number for each unit and match them to the IP address assigned by the DHCP server software.

(PCMNET_Ethernet_Configuration.doc)