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N30 Supervisory Controller Networking

Introduction

Multiple N30 Supervisory Controllers (N30) can communicate peer-to-peer using Building Automation and Control Network (BACnet®) messaging over Ethernet through adherence to Annex J of the BACnet Specification 135-1995. The BACnet protocol can operate on any Ethernet IP network and can co-exist with Metasys® N1 protocol; however, BACnet nodes do not communicate with N1 nodes.

Note: The Metasys BACnet IP/Ethernet network is referred to as “BACnet network” in this document.

This document contains information about N30 Ethernet networking possibilities, defines important terms, discusses software and hardware requirements, and lists detailed procedures for networking N30s. This document describes how to:

- set up N30s in a new/dedicated Ethernet network
- set up N30s in an existing/shared Ethernet network with Bootstrap Protocol (BOOTP)
- set up N30s in an existing/shared Ethernet network without BOOTP
- network N30s across multiple Ethernet network segments

Note: This document applies to the N30 and N31 Supervisory Controllers unless otherwise noted.
Key Concepts

Chapter Organization

This document consists of five main sections as described in Table 1.

Table 1: Chapter Organization

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Briefly outlines the contents of the chapter.</td>
</tr>
<tr>
<td>Key Concepts</td>
<td>Describes background information necessary to perform or understand specific tasks.</td>
</tr>
<tr>
<td>Procedure Overview</td>
<td>Describes general steps for performing the tasks described in the Detailed Procedures section. This section is geared toward users already experienced in N30 Supervisory Controller networking. This section may be thought of and used as a quick reference guide.</td>
</tr>
<tr>
<td>Detailed Procedures</td>
<td>Describes in detail the steps needed to complete specific tasks described within the chapter. This section is geared toward users who are new to N30 Supervisory Controller networking.</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>Provides information on potential problems as well as methods for solving them.</td>
</tr>
</tbody>
</table>

Related Information

Refer to Table 2 to find information related to N30 Supervisory Controller networking.

Table 2: Related Information

<table>
<thead>
<tr>
<th>For Information About</th>
<th>Refer To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working with objects using the VT100</td>
<td>N30 Supervisory Controller User's Manual</td>
</tr>
<tr>
<td>Generating databases using Project Builder</td>
<td>N30 Supervisory Controller Quick Start Technical Bulletin (LIT-6891200)</td>
</tr>
<tr>
<td>Working with objects using Project Builder</td>
<td>Project Builder User's Guide (LIT-693200)</td>
</tr>
<tr>
<td>Using Site Book</td>
<td>Site Book User's Guide (LIT-6893100)</td>
</tr>
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BACnet Network Possibilities

*New/Dedicated*

A new N30 Network allows communication between BACnet network nodes (N30s) and M-Workstations. In this case, the N30’s factory-assigned unique Internet Protocol (IP) addresses are acceptable since no other devices exist on the network, meaning there will not be duplication of IP addresses causing communication problems.

*Existing/Shared*

N30s and M-Workstations can be networked to an existing Ethernet IP network to share the network with existing devices. In this case, consult your system administrator to ensure unique IP parameters (IP addresses, IP masks, IP routers) are assigned to the new N30s.

*Site*

A site is a logical grouping of multiple N30 or N31 Supervisory Controllers interconnected on an IP network for the purpose of communicating with each other.

BACnet Network Hardware Requirements

Hardware requirements for a BACnet network vary according to system performance needs, existing hardware, and personal preference. In this document, *Appendix A: Networking Hardware* describes communication devices and other hardware used in BACnet networks. Also, the *N30 Supervisory Controller Installation Technical Bulletin (LIT-6891100)* provides information about hardware connections on the N30.

BACnet Network Software Requirements

M-Tool’s Project Builder is used to build and archive a database, which includes setting the network parameters. A VT100 or M-Workstation does not support creating an archive database and storing it on the hard drive for downloading each N30. For details about working with Project Builder, refer to *Project Builder User’s Guide*.

For information about generating N30 databases using Project Builder, refer to the *N30 Supervisory Controller Quick Start Technical Bulletin (LIT-6891200)*.

Site Book is used to establish the Ethernet dial-up networking for an M-Workstation. For information about Site Book, refer to the *Site Book User’s Guide (LIT-6893100)*.
Configuration Possibilities

Since numerous networking possibilities exist, numerous configuration possibilities exist. Figure 1 and Figure 2 show two possibilities.

Figure 1: Single-segment BACnet Network
Figure 2: Multiple-segment BACnet Network

Note: These are isolated segments. In order for communication to span the two segments, a Broadcast Management object (formerly the BACnet Broadcast Management Device [BBMD] object) must be added to one N30 on each segment. This configuration would then be considered a single site. Broadcast Management object operation is explained later in this document.

BACnet Network Node

A BACnet Network node is an addressable device connected to the BACnet network. Examples of BACnet Network nodes are N30 Supervisory Controllers.
System Performance Requirements

Evaluating various network design options requires collecting and understanding historical data and networking resource needs. In cases where there is no existing network, survey vendors or others who have experience with similar network requirements. There are many different methods of segmenting, routing, and filtering traffic on a given Local Area Network (LAN). Seek the advice of a network consultant when in doubt.

For a shared network application, it is important to gather the following information and to understand how these factors affect network usage:

- network users
- network functions
- network usage characteristics
- network traffic patterns

Network Users

The performance of the BACnet network depends on how many nodes are installed and how the system’s functions and features are applied at these nodes. For example, a system with many nodes and light data sharing operates more efficiently than a system with few nodes and heavy data sharing. Therefore, consider how the data is shared when designing the system applications.

An N30 supports 50 N2 devices. Because memory use varies from object to object, use the Project Builder Memory Meter to avoid exceeding the maximum number of objects in a given N30 device. For information on the Memory Meter, see the Getting Started chapter of the Project Builder User’s Guide.

Note: Other factors, such as exceeding the recommended bandwidth of the N30 processor, also control how many objects to put in a given N30. Use 400 objects (N30-0) and 800 objects (N30-1) as starting estimates.

Network Functions

For shared network applications, the size of the messages transferred, printed, and saved, in addition to geographical and environmental concerns, are also issues to look at when making decisions about segmentation, hardware, and media types.
**Network Usage Characteristics**

Identifying potential traffic problems early helps determine the need for and location of bridges and routers. To remedy unreliable communication problems, such as frequent online/offline occurrences, a second network or segmentation of the existing network may be needed. Isolating devices that frequently communicate with one another can reduce collisions.

**Network Traffic Patterns**

When using an existing/shared BACnet network, there is a potential impact from the traffic from non-BACnet equipment on the LAN. The network needs to have sufficient capacity to handle communications. Sufficient bandwidth is particularly important during periods of peak traffic.

**N30 Factory Default Settings**

New N30s contain a default N30 Device object. The N30 Device object contains the Ethernet Media Access Control (MAC) address, unique device name, and unique IP address.

The factory-default settings ensure every new N30 has a MAC address unique to each other and different from any other Ethernet product manufactured.

An N30’s device name is derived from the product name and the last nine digits of the MAC address. An example of a unique N30 device name is N30_000004032. This default device name can be changed via Project Builder, VT100, or BOOTP server. Refer to the *Project Builder User’s Guide* for more information about changing the default N30 device name.

The unique IP address is also derived from the MAC address. In a dedicated network, the default is acceptable. In a shared network, the system administrator should assign new IP addresses to the N30s to ensure unique numbers across the entire network. Alternately, the system administrator can use a BOOTP server to set up the IP address. Check with your system administrator to see if this option is available.

For information about generating N30 databases using Project Builder, refer to the *N30 Supervisory Controller Quick Start Technical Bulletin (LIT-6891200)*.
Media Access Control (MAC) Address

Each N30 has a factory-assigned Media Access Control (MAC) address, which is the physical address of the N30. Messages sent on the Ethernet network include a MAC address, which a device uses to identify messages that belong to it. Transmission Control Protocol/Internet Protocol (TCP/IP) automatically translates between the MAC address and IP address.

An example of an N30’s MAC address is 000.016.141.000.004.032. It consists of a unique Johnson Controls identifier (000.016.141) and numbers assigned by the factory (000.004.032). The MAC address appears on the bar code label on each N30. The default factory name derived from this MAC address is N30_000004032.

IP Address

Internet Protocol (IP) is the family of protocols to which the TCP/IP network-level protocol belongs. The IP address clearly identifies a node on the network and assists in the routing of messages on the BACnet network. Each BACnet Network node (and M-Workstation) must have a unique IP address. The factory default range for unique IP addresses assigned to N30s is 172.16.(64 to 127).(0 to 255). An example of an IP address is 172.16.68.243.

IP Mask (or IP Address Mask)

The IP mask is used for subnet addressing and can be supplied by the system administrator. It specifies which bits of the IP address correspond to the network address and which bits of the IP address correspond to the device address. This is different from the IP broadcast distribution mask, which is data required for BACnet compliance and used when adding a Broadcast Management object (formerly the BACnet Broadcast Message Device [BBMD] object). The Broadcast Management object is discussed later.

IP Router Address

This is the IP address that identifies a router device on the local Ethernet segment. The Local Area Network (LAN) administrator can supply this information.
BACnet IP Port

A unique BACnet IP Port allows communication between a group of up to 50 N30s in a system. For example, if a system requires more than 50 N30s or requires isolation from other N30s on the same IP network, use separate BACnet IP Port numbers. N30s must have the same BACnet IP Port number in order to communicate together. The default value is 47808, which is BAC0 in hexadecimal. The range is 0-65,535.

Setting the BACnet IP Port value takes place in the Site Book when the site is configured. If the Connection Information is defined as Ethernet, the BACnet IP Port must be defined. For further information, refer to Site Book User’s Guide (LIT-6893100).

Note: The BACnet IP Port can only be modified in the N30 Supervisory Controller. N31 units are preset to 0xBAC0 at the factory and are not editable.

IMPORTANT: The BACnet IP Port is the User Datagram Protocol (UDP) Port.

Existing Network Requirements

IMPORTANT: Inform the LAN administrator about the existing network requirements.

For a BACnet network to operate on an existing Ethernet IP network, any filtering done on the network must allow all IP packets containing the BACnet IP Port (UDP Port) to be routed to all IP networks where N30s and M3 Workstations reside. This includes any routers or firewalls connecting these networks.

Note: For the N30, the BACnet IP Port (UDP Port) is 47808 (0xBAC0) unless changed for the particular site.

Network Address

The network address is used for message routing at the BACnet network layer. It must be unique for each BACnet network segment.

All nodes on all Ethernet segments must specify the same network address because they are considered one BACnet network segment.

The network address range is 1-65535. The default is 1001. For N30 networking purposes, the default should not be changed.
IP Protocols

The N30 supports several IP protocols including BOOTP, Domain Name System (DNS), and Simple Mail Transfer Protocol (SMTP). These protocols can be used independently of one another. For example, a site may include a BOOTP server but not a DNS server.

Notes:  
Check with your system administrator to verify whether the network uses these protocols.

Although BOOTP and DNS are supported with Release 5.0, their use is not required. Static IP addressing is still a viable option.

BOOTP

BOOTP allows a device (such as an N30) to obtain and configure its own IP information. The device sends a request to the BOOTP server and the BOOTP server responds by providing the device its IP information, such as its IP address and, if a DNS server is also used, its host name. For N30 networking, configure the BOOTP server to assign static IP addresses to devices.

A BOOTP server is not required in order to provide BOOTP protocol, however. Most Dynamic Host Configuration Protocol (DHCP) servers can be configured to accept and respond to BOOTP requests. To assign IP addresses using BOOTP protocol, configure the DHCP server to accept BOOTP requests. This allows a DHCP server to dynamically assign a specific IP address to a device based on its MAC address.

Note:  In this document, the term “BOOTP server” refers both to BOOTP servers and to DHCP servers configured to accept BOOTP requests.

By setting the BOOTP Enabled attribute of an N30 to True, you allow the N30 to obtain and configure its IP address, IP mask, IP router address, host name, domain name, and DNS server IP address. See Setting Up N30s in an Existing/Shared Ethernet Network with BOOTP in the Detailed Procedures section. Also see the N30 Device chapter in the Object Dictionary.

Note:  When a network includes both BOOTP and DNS servers, make certain that host names and IP addresses provided by the BOOTP server are consistent with those configured in the DNS server.
DNS

DNS allows the conversion of text-based names (such as a Web site address) into numeric IP addresses. With a DNS server, you can assign a host name (such as N30-Floor3) to an IP address (such as 172.16.68.243). An N30 uses the Object Name of the device object as its host name. A host name can be reassigned to different IP addresses as needed.

Note: When a network includes both BOOTP and DNS servers, make certain that host names and IP addresses provided by the BOOTP server are consistent with those configured in the DNS server.

A DNS server simplifies the work of identifying individual devices on a network. For example, when setting up Broadcast Management objects, you can elect to identify an object by its host name rather than entering its IP address. See Networking N30s Across Multiple Ethernet Network Segments in the Detailed Procedures section.

SMTP

SMTP is the standard protocol for sending e-mail messages over an Ethernet connection between servers. The E-mail object uses SMTP to send e-mail notifications of alarms. See the E-mail chapter in the Object Dictionary.

BACnet Object Identifier

All objects within an N30 controller each have a unique object identifier. The BACnet Object Identifier makes it possible for an object to communicate with another object. Although this information is internal to the product, it may be extracted for a third-party device that does not support binding by object name.
Broadcast Management Object

A Broadcast Management object (formerly BACnet Broadcast Management Device [BBMD] object) defines a device as a BBMD.

Note: Details of the BBMD function are available in Annex J of the BACnet specification (Standard 135-1995).

A Broadcast Management object is added to N30s on different network segments to allow communication between segments in a situation where broadcasts cannot be sent; for example, when using an IP router. A Broadcast Management object contains a list of designated BBMDs (including itself) on Ethernet IP subnets to which it forwards broadcast messages. This list identifies the BBMDs either by their IP addresses or by their host names (if a DNS server is used).

In a standard configuration, the Broadcast Management object is added to only one N30 on each network segment in order for communication to take place between all the N30s on the different network segments.

Note: In a network environment where broadcasts are to be avoided, an alternate configuration allows point-to-point communication among network segments by adding Broadcast Management objects to all devices and disabling broadcasts on these objects. See Broadcast Management Objects in Broadcast Disabled Configuration in this section for an example configuration.

Refer to the Detailed Procedures section of this document for methods of adding Broadcast Management objects for networking across multiple Ethernet network segments.

IMPORTANT: Using Broadcast Management objects with N30s that do not need to communicate across network segments causes communication problems.
Broadcast Management Objects in Standard Configuration

Figure 3 illustrates the operation of the Broadcast Management object in a standard configuration. Match the numbered callouts with the following statements:

- N30<1> broadcasts a Who-Has message to the N30s on its own segment to find an Outdoor Air point.
- N30<2> has the Broadcast Management object, receives the broadcast message looking for Outdoor Air from N30<1>, and sends a directed message to all N30s with the Broadcast Management object.
- N30<3> has the Broadcast Management object, receives the directed message looking for Outdoor Air from N30<2>, and broadcasts this message to the N30s on its own segment.
- N30<4> has the Outdoor Air point, receives the broadcast message looking for Outdoor Air from N30<3>, and sends an I-Have message with the necessary information back to N30<1> directly.

Figure 3: Broadcast Management Objects in Standard Configuration
Broadcast Management Objects in Broadcast Disabled Configuration

Figure 4 illustrates the operation of the Broadcast Management object in an alternate configuration in which broadcasts are disabled. This configuration includes Broadcast Management objects in each N30 with broadcasts disabled to accommodate a network environment in which broadcast messages are not permitted.

With broadcasts disabled on each Broadcast Management object, a broadcast message is relayed as multiple point-to-point communications to each N30 with the Broadcast Management object. Match the numbered callouts with the following statements:

- N30<1> broadcasts a Who-Has message to find an Outdoor Air point. The broadcast message is relayed as multiple point-to-point communications to each of the N30s with a Broadcast Management object.
- Each of the other N30s (each with its own Broadcast Management object) receives a direct point-to-point communication from N30<1>.
- N30<4>, which has the Outdoor Air point, responds by sending an I-Have message with the necessary information back to N30<1>.

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Broadcast Management Objects in Broadcast Disabled Configuration

Figure 4 illustrates the operation of the Broadcast Management object in an alternate configuration in which broadcasts are disabled. This configuration includes Broadcast Management objects in each N30 with broadcasts disabled to accommodate a network environment in which broadcast messages are not permitted.

With broadcasts disabled on each Broadcast Management object, a broadcast message is relayed as multiple point-to-point communications to each N30 with the Broadcast Management object. Match the numbered callouts with the following statements:

- N30<1> broadcasts a Who-Has message to find an Outdoor Air point. The broadcast message is relayed as multiple point-to-point communications to each of the N30s with a Broadcast Management object.
- Each of the other N30s (each with its own Broadcast Management object) receives a direct point-to-point communication from N30<1>.
- N30<4>, which has the Outdoor Air point, responds by sending an I-Have message with the necessary information back to N30<1>.
Figure 4: Broadcast Management Objects in Broadcast Disabled Configuration
# Procedure Overview

## Table 3: N30 Supervisory Controller Networking

<table>
<thead>
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<th>To Do This</th>
<th>Follow These Steps:</th>
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<tbody>
<tr>
<td><strong>Set Up N30s in a New/Dedicated Ethernet Network</strong></td>
<td>Analyze network configuration possibilities. Acquire the needed equipment. Using Project Builder, build the archive database and configure the site for the N30s. Decide if the factory-assigned, default IP addresses for the N30s are acceptable. If the default IP parameters are acceptable, determine if multiple segments are being networked. If multiple segments are not being networked, connect the N30s to the Ethernet network through the RJ45 port using CAT5 wire. Download the N30s from the archive database through a serial or Ethernet connection. Use the M-Workstation or VT100 to verify the system is working.</td>
</tr>
<tr>
<td><strong>Set Up N30s in an Existing/Shared Ethernet Network with BOOTP</strong></td>
<td>Analyze network configuration possibilities. Acquire the needed equipment. Work with the system administrator to set up the BOOTP server and, if available, the DNS server. Complete the worksheets located in Appendix B: Networking Worksheets. Using Project Builder, build the archive database and configure the site for the N30s. Verify that a BOOTP server is configured on the network. While in Project Builder, begin enabling BOOTP by double-clicking the row number of an N30 to open the Edit Attributes window. Click the drop-down list for the BOOTP Enabled attribute and click True. Make any necessary adjustments to the other information. Click OK. Repeat these steps as needed to enable BOOTP for each N30. On the File menu, click Save to save all changes to the project. Download the N30s from the archive database through an Ethernet connection. Use the M-Workstation or VT100 to verify the system is working.</td>
</tr>
<tr>
<td><strong>Set Up N30s in an Existing/Shared Ethernet Network without BOOTP</strong></td>
<td>Analyze network configuration possibilities. Acquire the needed equipment. Request new IP parameters for the N30s from the system administrator. Complete the worksheets located in Appendix B: Networking Worksheets. Using Project Builder, build the archive database and configure the site for the N30s. While in Project Builder, begin replacing the IP parameters by double-clicking the row number of an N30 to open the Edit Attributes window. Select the value in the first field and type the first portion of the new IP address, then press the Tab key to go to the next field. Continue entering each portion of the IP address until all four fields are complete. Click Done. Click the button to the right of the IP Mask. Select the value in the first field and enter the first portion of the new IP mask, then press the Tab key to go to the next field and complete all four fields. Click Done. Click the button to the right of the IP Router Address. Select the value in the first field and enter the first portion of the new IP router address, then press the Tab key to go to the next field and complete all four fields. Click Done. Leave the default value of 1001 for the Network Address. Click the drop-down box for BOOTP Enabled and click False. Make any necessary adjustments to the other information. Click OK. Repeat these steps as needed to replace IP parameters for each N30. On the File menu, click Save to save all changes to the project. Download the N30s from the archive database through a serial connection. Connect the N30s to the Ethernet network via the RJ45 port. Use the M-Workstation or VT100 to verify the system is working.</td>
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<table>
<thead>
<tr>
<th>To Do This (Cont.)</th>
<th>Follow These Steps:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network N30s Across Multiple Ethernet Network Segments</strong></td>
<td>After setting IP parameters in the Project Builder, determine which N30 on each network segment will hold a Broadcast Management object. Complete the worksheets located in <em>Appendix B: Networking Worksheets</em>. In Project Builder, click and drag the Broadcast Management object to the N30 Device row in the Project Window. In the Project Window, double-click the row number of the Broadcast Management object. Edit the fields according to Table 4. Determine if the network has a DNS server. If the network has a DNS server, identify each of the BBMDs using the BM Host Name List attribute. Otherwise, identify each of the BBMDs using the BM Address List attribute. Click OK to close the Edit Attributes window. Copy and paste the completed Broadcast Management object to the other N30s requiring Broadcast Management objects. On the File menu, click Save to save all additions to the project. Connect the N30s to the Ethernet network through the RJ45 port. Download the N30s from the archive database through a serial or Ethernet connection. Use the M-Workstation or VT100 to verify the system is working.</td>
</tr>
</tbody>
</table>
Detailed Procedures

Setting Up N30s in a New/Dedicated Ethernet Network

To set up N30s in a new/dedicated Ethernet network:

1. Analyze network configuration possibilities. Consider the number of N30s required for the job, the communication traffic flow, N30 network hardware requirements, the communication needs of the job, etc. See the System Performance Requirements section of this document for details.

2. Acquire the needed equipment—CAT5 wire, hubs, routers, N30s, VT100 Terminals, M-Workstations, Ethernet cards, etc. See Appendix A: Networking Hardware for more information about hardware possibilities.

Note: The physical installation of cable, hubs, routers, M-Workstations, VT100s, N30s, and any other network equipment can take place before, after, or simultaneously to the remaining steps. In other words, an N30 does not need to be installed in order to set the network parameters by building the archive database. This can be done offsite.


4. Decide if the factory-assigned, default IP addresses for the N30s are acceptable. (Adding N30s to a new/dedicated network means the factory-assigned, default IP addresses for the N30s are unique to the network. No changes need to be made to the network parameters in this case.) If the addresses are acceptable, continue with Step 5. If a job site requires or prefers to change the factory-assigned IP addresses, refer to the Setting Up N30s in an Existing/Shared Ethernet Network with BOOTP procedure or the Setting Up N30s in an Existing/Shared Ethernet Network without BOOTP procedure in this bulletin.

5. If multiple segments are being networked, go to the Networking N30s Across Multiple Ethernet Network Segments section. If not, continue with Step 6.

6. Connect the N30s to the Ethernet network through the RJ45 port using CAT5 wire. Networking is complete.
7. Download the N30s from the archive database through a serial or Ethernet connection. The first download should be an advanced download with code. See the *N30 Supervisory Controller Quick Start Technical Bulletin (LIT-6891200)* and *Project Builder User’s Guide* for downloading details.

8. Use the M-Workstation or VT100 to verify the system is working. Check that all N30 devices appear and are online. Expand the N2 container to verify that all N2 devices appear.

**Setting Up N30s in an Existing/Shared Ethernet Network with BOOTP**

To set up N30s in an existing/shared Ethernet network with BOOTP:

1. Analyze network configuration possibilities. Consider the number of N30s required for the job, the communication traffic flow, N30 network hardware requirements, the communication needs of the job, etc. See the *System Performance Requirements* section for details.

2. Acquire the needed equipment -- CAT5 wire, hubs, routers, N30s, VT100 Terminals, M-Workstations, Ethernet cards, etc. See *Appendix A: Networking Hardware* for more information about hardware possibilities.

**Note:** The physical installation of cable, hubs, routers, M-Workstations, VT100s, N30s and any other network equipment can take place before, after, or simultaneously to these remaining networking steps. In other words, an N30 does not need to be installed in order to set the network parameters by building the archive database. This can be done offsite.

3. Work with the system administrator to set up the BOOTP server and, if available, the DNS server. Provide the system administrator with the MAC address of each N30 (appears on the bar code label on each N30). If a DNS server is available, provide the system administrator with the desired Object Name for each N30 device. The Object Name for each device object is the same as the host name for the device object.

4. Complete the worksheets located in *Appendix B: Networking Worksheets*. Use these worksheets as a guide while networking or as a hard copy data archive.

6. Verify that the BOOTP server is configured on the network. The
   BOOTP server provides the N30 with its IP address, IP mask,
   IP router address, host name, domain name, and DNS server
   IP address.

7. While in Project Builder, begin enabling BOOTP by
double-clicking the row number for an N30 to open the Edit
Attributes window.

8. Click the drop-down list for the BOOTP Enabled attribute and
click True (Figure 5).

![Figure 5: Edit Attributes Window](image)

9. Make any necessary adjustments to the other information.

Note: It is not necessary to change any information that the
BOOTP server or DNS server configures (IP address,
IP mask, IP router address, host name, domain name, and
DNS server IP address).

10. Click OK. This returns you to the Project Builder desktop.

11. Repeat Steps 7-10 as needed to enable BOOTP for each N30.

12. On the File menu, click Save to save all changes to the project.

Note: If multiple segments are being networked, go to the
Networking N30s Across Multiple Ethernet Network
Segments section in this bulletin. If not, continue with
Step 13.
13. Connect the N30s to the Ethernet network via the RJ45 port. Connect power. The BOOTP server configures the N30s on the network.

14. Download the N30s from the archive database through an Ethernet connection. (refer to the N30 Supervisory Controller Installation Technical Bulletin (LIT-6891100) for product code numbers) The first download should be an Advanced Download with Main Code, Dictionary, and Objects. Refer to N30 Supervisory Controller Quick Start Technical Bulletin (LIT-6891200) and Project Builder User’s for downloading details.

15. Use the M-Workstation or VT100 to verify the system is working; Check that all N30 devices appear and are online; Expand the N2 container to verify that all N2 devices appear.

Setting Up N30s in an Existing/Shared Ethernet Network without BOOTP

To set up N30s in an existing/shared Ethernet network without BOOTP:

1. Analyze network configuration possibilities. Consider the number of N30s required for the job, the communication traffic flow, N30 network hardware requirements, the communication needs of the job, etc. See the System Performance Requirements section for details.

2. Acquire the needed equipment -- CAT5 wire, hubs, routers, N30s, VT100 Terminals, M-Workstations, Ethernet cards, etc. See Appendix A: Networking Hardware for more information about hardware possibilities.

Note: The physical installation of cable, hubs, routers, M-Workstations, VT100s, N30s and any other network equipment can take place before, after, or simultaneously to these remaining networking steps. In other words, an N30 does not need to be installed in order to set the network parameters by building the archive database. This can be done offsite.

3. Request new IP addresses for the N30s from the system administrator. (Adding N30s to an existing/shared network means factory assigned IP addresses should be changed to ensure unique addresses within the network.) Also request the IP mask and IP router addresses to be used.

Note: New N30 IP addresses must be obtained from the system administrator, not generated through DHCP.
4. Complete the worksheets located in *Appendix B: Networking Worksheets*. Use these worksheets as a guide while networking or as a hard copy data archive.


6. While in Project Builder, begin replacing the IP parameters by double-clicking the row number for an N30 to open the Edit Attributes window (Figure 6).

![Edit Attributes Window](image)

**Figure 6: Edit Attributes Window**

7. Scroll to the Communication section of the Edit Attributes window (Figure 7).
8. Click the Array Elements button to the right of IP Address. The Complex View window opens with fields for the IP Address entry (Figure 8).
Figure 8: Complex View - IP Address Window

9. Select the value in the first field and type the first portion of the new IP address, then press the Tab key to go to the next field. Continue entering each portion of the IP address until all four fields are complete (Figure 9).
10. Click Done. This returns you to the Edit Attributes window.

11. Click the Array Elements button to the right of IP Mask. The Complex View window for the IP Mask opens.

12. Select the value in the first field and enter the first portion of the new IP mask, then press the Tab key to go to the next field. Continue entering each portion of the IP mask until all four fields are complete (Figure 10).

**Figure 9: Completed IP Address Entries**
13. Click Done. This returns you to the Edit Attributes window.

14. Click the Array Elements button to the right of IP Router Address. The Complex View window for the IP Router Address opens.

15. Select the value in the first field and enter the first portion of the new IP router address, then press the Tab key to go to the next field. Continue entering each portion of the IP router address until all four fields are complete (Figure 11).
Figure 11: Completed IP Router Address Entries

16. Click Done. This returns you to the Edit Attributes window.
17. Leave the default value of 1001 for the Network Address.
18. Click the drop-down box for BOOTP Enabled and click False.
19. Make any necessary adjustments to the other information.
20. Click OK. This returns you to the Project Builder desktop.
21. Repeat Steps 6-20 as needed to replace IP parameters for each N30.
22. On the File menu, click Save to save all changes to the project.

Note: If multiple segments are being networked, go to the Networking N30s Across Multiple Ethernet Network Segments section in this bulletin. If not, continue with Step 23.
23. Download the N30s from the archive database through a serial or Ethernet connection. It is recommended that the first download be completed through a serial connection because factory default IP parameters exist in the N30 until after the download. After the initial download, the N30 has the correct IP address. Future downloads on an existing network can be accomplished over the Ethernet provided the N30 to be downloaded has an Ethernet network interface card and is attached to the Ethernet LAN (refer to the N30 Supervisory Controller Installation Technical Bulletin [LIT-6891100] for product code numbers). The first download should also be an Advanced Download with Main Code, Dictionary, and Objects. Refer to N30 Supervisory Controller Quick Start Technical Bulletin (LIT-6891200) and Project Builder User’s Guide for downloading details.

24. Connect the N30s to the Ethernet network via the RJ45 port. Networking is complete.

25. Use the M-Workstation or VT100 to verify the system is working; Check that all N30 devices appear and are online; Expand the N2 container to verify that all N2 devices appear.

Networking N30s Across Multiple Ethernet Network Segments

Notes: Refer to Figure 3 for an example of a standard configuration for networking across multiple segments.

Figure 4 shows an alternate broadcast disabled configuration. For this configuration, each N30 must have a Broadcast Management object with the Broadcast Disabled attribute set to True.

To network N30s across multiple Ethernet network segments:

1. After setting IP parameters in Project Builder, determine which N30 on each network segment will hold a Broadcast Management object. It can be any N30 but preferably one with a light object load.

2. Complete the worksheets located in Appendix B: Networking Worksheets. Indicate which N30s receive the Broadcast Management object. Use these worksheets as a guide while networking or as a hard copy data archive.

Note: Only one Broadcast Management object would need to be edited at this point, as long as the IP address or host name of the N30 where the Broadcast Management object is being added is included in the list of BBMDs. This allows the first Broadcast Management object edited to be copied and pasted to the other N30s requiring Broadcast Management objects.

4. In the Project Window, double-click the row number of the Broadcast Management object (or highlight the Broadcast Management object and select Edit Object on the Edit menu). The Edit Attributes window opens (Figure 12).

![Edit Attributes Window](image)

**Figure 12: Edit Attributes Window**

5. Edit the fields according to Table 4.

Note: For detailed information on the Broadcast Management object and its attributes, see the Object Dictionary.
Table 4: Broadcast Management Object Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Required</th>
<th>Default</th>
<th>Options/Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object Name</td>
<td>Names the object.</td>
<td>Yes</td>
<td>Blank</td>
<td>Maximum 32 characters</td>
</tr>
<tr>
<td>Description</td>
<td>Provides additional information about the object (optional).</td>
<td>No</td>
<td>Blank</td>
<td>Maximum 40 characters</td>
</tr>
<tr>
<td>Object Type</td>
<td>Indicates the kind of object.</td>
<td>Yes (use default)</td>
<td>Broadcast Management</td>
<td></td>
</tr>
<tr>
<td>Object Category</td>
<td>Helps determine user access and message routing.</td>
<td>Yes</td>
<td>HVAC</td>
<td>HVAC, Fire, Security, Services, Administrative</td>
</tr>
<tr>
<td>Enabled</td>
<td>Indicates if the object is active.</td>
<td>Yes</td>
<td>True</td>
<td>True or False</td>
</tr>
<tr>
<td>Broadcast Disabled</td>
<td>False allows broadcast messages to be sent (Standard configuration.) True disables broadcast messages (Broadcast Disabled configuration). See Broadcast Management Objects in Standard Configuration and Broadcast Management Objects in Broadcast Disabled Configuration in the Key Concepts section.</td>
<td>Yes</td>
<td>False</td>
<td>True or False</td>
</tr>
<tr>
<td>BM Address List</td>
<td>See Steps 7-18 in this procedure. Use this attribute to define the IP addresses of BBMDs on the site (N30s or third-party devices) if the site does not use a DNS server. If the site has a DNS server, use BM Host Name List to identify BBMDs instead. Note: You must include the IP address of the N30 where this Broadcast Management object resides.</td>
<td>No</td>
<td></td>
<td>List of two elements:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• IP Address (Array of 4 bytes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• IP Broadcast Mask (Array of 4 bytes: always set to 255.255.255.255)</td>
</tr>
<tr>
<td>BM Host Name List</td>
<td>See Steps 19-28 in this procedure. Use this attribute to define the IP host name of BBMDs on the site (N30s or third-party devices) if the site uses a DNS server. If the site does not use a DNS server, use BM Address List to identify BBMDs instead. Note: You must include the host name of the N30 where this Broadcast Management object resides.</td>
<td>No</td>
<td></td>
<td>List of two elements:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Host Name (String of 0 to 57 characters)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• IP Broadcast Mask (Array of 4 bytes: always set to 255.255.255.255)</td>
</tr>
<tr>
<td>DNS Refresh Period</td>
<td>Specifies the time in minutes between DNS lookups to update the IP address of Broadcast Management objects in the BM Host Name List attribute.</td>
<td>No</td>
<td>20</td>
<td>Range: 0-65535 minutes A value of 0 means that no periodic updates occur.</td>
</tr>
</tbody>
</table>
6. Determine if the network has a DNS server. If the network has a DNS server and you are using host names to identify BBMDs, go to Step 19. Otherwise, to identify BBMDs using IP addresses, continue with Step 7.

7. To add IP addresses, click the List Elements button for the BM Address List attribute. The Complex View window appears (Figure 13).

8. Click the Add button for each IP address/broadcast mask pair being added to the Broadcast Management object. A 2 Structure Elements button appears for each BM Address List element (Figure 14).
Figure 14: Elements in the BM Address List

9. Click the 2 Structure Elements button to the right of Element 1. Two 4 Array Elements buttons appear, one for the IP address and one for the IP broadcast mask (Figure 15).

Note: Clicking the Done button returns you to the Edit Attributes window. Any entries added to the BM Address List remain. Clicking Delete removes a 2 Structure Elements button from the BM Address List.
Figure 15: IP Address and IP Mask Entries

10. Click the 4 Array Elements button to the right of IP Address. The fields for the entry of the IP address appear (Figure 16).
11. Select the value in the first field and type the first portion of the IP address, then press the Tab key to go to the next field. Continue entering each portion of the IP address until all four fields are complete (Figure 17).
12. Click Back. The 4 Array Elements buttons for the IP Address and IP Mask appear (Figure 15).

13. Click the 4 Array Elements button to the right of IP Broadcast Mask. The fields for the entry of the IP Broadcast Mask appear.

14. Enter 255 in each of the four IP Broadcast Mask fields (Figure 18).
15. Click Back. The 4 Array Elements buttons for the IP Address and IP Mask appear.

16. Click Back. The 2 Structure Elements buttons appear for each BM Address List element (Figure 14).

17. Repeat Steps 9 through 16 for as many IP addresses (and IP broadcast masks) that are to be included in the Broadcast Management object. When all IP addresses (and IP broadcast masks) for all N30s with a Broadcast Management object have been added, including the current N30, and the data required for this Broadcast Management object is complete, go to Step 18.

18. Click Done. The Edit Attributes window appears. All IP parameter data added for the Broadcast Management objects remain. Go to Step 29.

19. To add host names, click the List Elements button for the BM Host Name List attribute. The Complex View - BM Host Name List window appears (Figure 19).
20. Click the Add button for each host name being added to the Broadcast Management object. A 2 Structure Elements button appears for each BM Host Name List element (Figure 20).
21. Click the 2 Structure Elements button to the right of Element 1. A box appears for the Host Name element and a 4 Array Elements button appears for the IP Broadcast Mask (Figure 21).
22. Click in the Host Name box and enter the host name.

23. Click the 4 Array Elements button to the right of IP Broadcast Mask. The fields for the entry of the IP Broadcast Mask appear.

24. Enter 255 in each of the four IP Broadcast Mask fields (Figure 22).
25. Click Back. The Host Name box and 4 Structure Elements button appears (Figure 21).

26. Click Back. The 2 Structure Elements buttons appear for each BM Host Name List element (Figure 20).

27. Repeat Steps 21 through 26 for as many host names (and IP broadcast masks) that are to be included in the Broadcast Management object. When all host names (and IP broadcast distribution masks) for all N30s with a Broadcast Management object have been added, including the current N30, and the data required for this Broadcast Management object is complete, go to Step 28.

28. Click Done. The Edit Attributes window appears. All host name data added for the Broadcast Management objects remain.

29. Click OK to close the Edit Attributes window. This returns you to the Project Builder desktop.

30. Copy and paste the completed Broadcast Management object to the other N30s requiring Broadcast Management objects.

31. On the File menu, click Save to save all additions to the project.

Figure 22: Completed IP Broadcast Mask Elements
32. Connect the N30s to the Ethernet network through the RJ45 port. Networking is complete.

33. Download the N30s from the archive database through a serial or Ethernet connection. The first download should be an Advanced Download with Main Code, Dictionary, and Objects. Refer to *N30 Supervisory Controller Quick Start Technical Bulletin (LIT-6891200)* and *Project Builder User’s Guide* for downloading details.

34. Use the M-Workstation or VT100 to verify the system is working. Check that all N30 devices appear and are online. Expand the N2 container to verify that all N2 devices appear.
## Troubleshooting

### Networking Troubleshooting Guide

Table 5: Symptoms/Causes/Solutions to Communication Problems

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>A BACnet node goes offline.</td>
<td>Part of the network may not be functioning.</td>
<td>Use Windows® 98, Windows NT®, or Windows 2000 tools to diagnose the problem. These programs help determine how much of the network is or is not functioning. These programs are loaded onto your Personal Computer (PC) when the Microsoft® TCP/IP is added: WINIPCFG.EXE or IPCONFIG.EXE - This command displays the IP configuration of the PC. The command is called WINIPCFG.EXE in Windows 98 and IPCONFIG.EXE in Windows NT and Windows 2000. PING.EXE - The PING command verifies that messages can be sent and received over the IP network. The command format is: PING xxx.xxx.xxx.xxx where “xxx.xxx.xxx.xxx” is the IP address of a computer on the IP network. Other workstations and TCP/IP compatible computer systems send back a response. Failures are caused by cable problems, device driver configuration problems, or computers being offline. The display indicates if the PING was successful along with some Ethernet statistics. If there appears to be intermittent IP network failures, put PING into a continuous test mode using the following command: PING -t xxx.xxx.xxx.xxx In this mode the PING program continually asks for a response from the remote computer system. If there are any IP network communications errors, they are noted. If the IP network is running properly, no errors are recorded. After testing the IP network in this mode for several minutes, type Ctrl C. TRACERT.EXE - This command allows you to view the route a packet takes across the network, as well as displaying all the IP addresses. Refer to the Windows 98, Windows NT, or Windows 2000 Help files for information on using this command. ARP.EXE - This command views the Address Resolution Protocol (ARP) table, which is used to direct messages between IP Network nodes. Refer to the Windows 98, Windows NT, or Windows 2000 Help files for more information.</td>
</tr>
<tr>
<td>The new BACnet node added to the IP network does not communicate.</td>
<td>Part of the network may not be functioning.</td>
<td>Same as above. If PING is unsuccessful, check the BACnet IP Port number. BACnet IP Port numbers must be identical to communicate. Note: N31s have the BACnet IP Port fixed at BAC0.</td>
</tr>
</tbody>
</table>

Continued on next page . . .
<table>
<thead>
<tr>
<th>Symptom (Cont.)</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>One N30 is not able to communicate on the network.</td>
<td>It is most likely a commissioning problem with the N30, rather than a network problem.</td>
<td>Verify network parameters. Troubleshoot using these steps: 1. Verify that the IP configuration is correct, including the IP address, subnet mask, and router address. 2. Verify that the N30’s archive database was built and downloaded correctly. 3. Check to make sure any changes to the IP network parameters are correct. 4. Determine if the N30 responds to PING commands. If not, that could mean there is an IP stack problem or a configuration problem. 5. Check the PC’s Ethernet card by running the manufacturer’s diagnostic software that came with the card. This establishes whether the interface card is working properly. If you are unable to bring the N30 online after verifying the above information, contact Field Support Services.</td>
</tr>
<tr>
<td>All of the N30s on a network segment are not communicating on the network.</td>
<td>It is most likely a network problem.</td>
<td>When many nodes fail, the problems tend to be systemic rather than related to a particular node. The system administrator should be called to help resolve these problems. Typically, the system administrator has access to special network hardware that can quickly isolate the problem. Also, investigate hubs and routers. Hubs and repeaters feature Light-Emitting Diodes (LEDs) that indicate their status. When these devices are working properly, the LEDs are On. For detailed troubleshooting information, refer to the manufacturer’s literature.</td>
</tr>
<tr>
<td>N30s on different network segments are unable to communicate with each other.</td>
<td>The network is not allowing broadcast messages.</td>
<td>Add a Broadcast Management object to one N30 on each network segment. Refer to the Detailed Procedures section of this document for the Networking N30s Across Multiple Ethernet Network Segments section. If this was already done, verify that the information added to the object is correct.</td>
</tr>
<tr>
<td>A light on the N30 is on.</td>
<td>Six LEDs exist on the N30 to indicate different conditions.</td>
<td>Refer to the N30 Supervisory Controller Installation Technical Bulletin (LIT-6891100) for details.</td>
</tr>
<tr>
<td>A single IP Address does not respond.</td>
<td>There may be a problem with the node or the segment.</td>
<td>At a workstation that is communicating with other nodes, use the PING command to communicate to a known address on the IP network in the same network segment. Follow the paths of either two outcomes:  • If communication worked, there is a problem with the node. To troubleshoot, check the problem node’s configuration.  • If communication did not work, there is a problem with the segment. Isolate the exact point of breakage, and find out how much of the network is functioning. To do so, PING other nodes on the same segment. PING the Ethernet Router if one exists between the node you’re on and the failed node. Finally, use TRACERT.EXE. Read Windows 98, Windows NT, or Windows 2000 Help files for information about the TRACERT.EXE program.</td>
</tr>
</tbody>
</table>
Appendix A: Networking Hardware

Introduction

Hardware needed for a BACnet network varies according to the network situation. The number of BACnet Network nodes needed for the particular job, existing hardware, and personal preference affects what hardware will be used. This section discusses BACnet network communication devices, media, and some suggestions for hardware.
Key Concepts

N30 Supervisory Controller
An economical supervisory controller designed to monitor and control Heating, Ventilating, and Air Conditioning (HVAC) equipment. It supervises the networking of Application Specific Controllers (ASCs) and provides facility management features. Facility personnel review the system status and modify control parameters for the N30 and its associated ASCs using the Local Display Terminal (LDT) installed in certain models, a VT100 Terminal, or an M-Workstation.

VT100 Terminal
A video terminal used as a standard interface. A VT100 Terminal can be connected to a serial port on an N30 either directly or via modem.

VT100 Terminal Emulator
A program that allows a computer to act like a VT100 Terminal. The computer thus appears as a terminal to the host computer and accepts the same escape sequences for functions such as cursor positioning and clearing the screen.

M-Workstation
The local M-Workstation, such as an M3 Workstation, is a Personal Computer (PC) with the associated software to provide a graphical user interface to interact with N30s. It connects to an N30 either directly to the RS-232 port or via the Ethernet network. A remote M-Workstation can connect to the network via a modem and phone lines. The N30 can dial out to this remote workstation when a Fire, Critical, or Network alarm is detected, and display the alarm on the remote workstation screen. In addition, an operator at the remote workstation can dial up the network to issue a command, modify object parameters, or perform other N30 functions. For more information about M3 Workstation, refer to the M3 Workstation Overview and Installation Technical Bulletin (LIT-1153100) and the M3 Workstation User’s Guide.

Printers
A printer connects to an N30 via a serial port or modem. The N30 sends data, such as alarm messages, summaries, or scheduled reports, to a printer file in one of three ways: automatically, by operator command, or by schedule command.
**Network Media**

Networking N30s requires 10BaseT, twisted pair as the media type for Ethernet communication. Specified by the IEEE, 10BaseT standard, Unshielded Twisted Pair (UTP)/Shielded Twisted Pair (STP) cable is the most common and economical media type to install. Some manufacturers provide pre-terminated wire.

From an N30 to a hub or user interface, the maximum recommended length of this cable is 100 meters (330 feet). If using a maximum of four populated hubs (possibly five if one hub is unpopulated), the total maximum cable length is 400 meters (1320 feet). The distance limitations for any additional cabling used in an Ethernet network are based on the media type being used.

Many buildings have CAT5 UTP 24 gauge telephone lines already in place that could be used for the BACnet network. This is the recommended cable because of its 100 MB capacity and its ability to facilitate future system upgrades.

**Serial Connection Cable**

In situations where factory-default IP parameters must be changed, it is possible to download through a serial or Ethernet connection; however, it is recommended that the first download of the N30 from the archive database be a serial download because factory default IP parameters exist in the N30 until after the download. An initial serial download allows a user to avoid having to make additional changes to IP data. This requires an RS-232C-compatible 9-pin serial connection cable to connect the N30 to the computer with Project Builder installed. The connection between N30s and VT100s also requires an RS-232C-compatible 9-pin serial connection cable. For details about the cable pinouts, refer to the *N30 Supervisory Controller Installation Technical Bulletin (LIT-6891100).*
Crossover Cable

A crossover cable is an Ethernet cable using RJ45 connectors. One end of the cable has the order of the middle four of the eight wires reversed. A crossover cable directly connects two N30s with Ethernet network interface cards. Crossover cables are available at most computer or electronic supply stores. Refer to Figure 23 for the crossover cable pinout.

Note: A crossover cable is not used when connecting to a hub. Hub connections require straight-through cables.

![Crossover Cable Pinout](image)

**Figure 23: Crossover Cable Pinout**

Communication Devices

Communication devices that can be used for networking N30s include:

- **Ethernet Network Interface Card (NIC):** M-Workstation needs an Ethernet NIC for communicating to N30s over Ethernet. Some PCs are manufactured with an integrated Ethernet adapter card. Some N30 models have an Ethernet NIC factory-installed. Refer to the *N30 Supervisory Controller Installation Technical Bulletin (LIT-6891100)* for product code numbers.

- **Hub:** The hub is the core of a network or cabling system. Twisted pair, and many proprietary network topologies use hubs to connect multiple cable segments together. These cable segments could be a star or bus topology. Hubs have multiple ports to attach the different cable runs. Either a switching or non-switching hub can be used in the BACnet network.

- **Intelligent Hub:** The intelligent hub acts as a multi-port bridge by monitoring the physical port address segments to prevent collisions, and improve efficiency and network speed. The isolation capability of an intelligent hub requires adequate processing power, memory, and interconnect technology.
- **Unmanaged Hub or Concentrator**: Similar to an inexpensive multiplexer, the unmanaged hub allows nodes to connect to the network in a star configuration. Many unmanaged hubs are being replaced with intelligent hubs.

- **Router**: A router is a network device typically used in Wide Area Networks (WANs). It forwards IP network traffic from one connected network to another. The router functions much like the bridge but also has filtering capabilities. The filters allow the router to make decisions on how to route the IP packets it sends and receives.

- **Gateway**: A gateway is used to pass network traffic from one protocol to another and to handle differences in data format, speed, and signal levels. An IP gateway would be used to transmit IP packets using different protocols such as ARCNET® protocol.

- **Repeat**: The function of a repeater is to regenerate incoming signals so you can extend transmission distances while maintaining signal quality. In addition to collision detection, the repeater reshapes, re-times, and retransmits signals to both Ethernet segments. An Ethernet hub is also a repeater. The signal can be regenerated for Ethernet a maximum of four times.

- **Multi-port Repeater or Hub**: A multi-port repeater connects more than two segments. The multi-port repeater usually has an Attachment Unit Interface (AUl) connection and multiple ports for thin coaxial, twisted pair, or other common media. The primary application for a multi-port repeater is to provide a connection to the thick coaxial, or fiber backbone while serving an area that uses thin coaxial, AUl, or twisted pair.

- **Bridge**: Similar to the repeater, a bridge joins two network segments from separate sites. However, a bridge passes only those packets intended for a node on the other side. The segments on either side of the bridge are separate in terms of length rules. The bridge can be used to lengthen a segment and to segregate traffic on busy networks. Isolating the N30 Network from other network traffic can increase reliability and still provide all network users access to N30 Network data. To address high traffic needs, a better choice may be a **Switch**, which increases the bandwidth by allowing simultaneous switching of packets between its ports, and works with conventional cabling and adapters. Shared segments or dedicated segments can be attached to any port on the switch.
Appendix B: Networking Worksheets

Introduction

This section provides networking worksheets to be used as a guide while setting network parameters or as a hard copy data archive for future reference and/or changes to the network. Provide the information for the sections of the worksheets that pertain to your job. Examples of completed networking worksheets appear at the end of this appendix.
### Key Concepts

#### Networking Worksheets

Use the Site Worksheet (Table 6) and N30 Device Worksheet (Table 7) to track network information. Examples of completed worksheets follow this section.

**Table 6: Site Worksheet**

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOOTP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMTP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segmented Network (Network Needs Broadcast Management Objects)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **DNS**
  - If Yes:
    - DNS Server IP Address =
    - Domain Name =

- **SMTP**
  - If Yes:
    - SMTP Server IP Address =
    - SMTP Server Name (if using DNS) =

- **Segmented Network**
  - If Yes, complete the information below for all Broadcast Management objects:
    - IP Broadcast Mask (for BM Address List or BM Host Name List) = 255.255.255.255
    - IP address entries for **BM Address List** (if not using DNS) or host name entries for **BM Host Name List** (if using DNS):

**Notes**
### Table 7: N30 Device Worksheet

<table>
<thead>
<tr>
<th>N30 Device Name¹</th>
<th>IP Address</th>
<th>IP Mask</th>
<th>IP Router Address</th>
<th>IP Network</th>
<th>BM² Object</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
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<td>Yes</td>
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<td>Yes</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

1. If DNS is used, the N30 Device Name is the host name for that device.
2. If an N30 has a Broadcast Management (BM) object, include the IP address (if not using DNS) or host name (if using DNS) of the N30 in the Segmented Network row of the Site Worksheet. This row must include the IP address or host name of each N30 that has a Broadcast Management object. Use the completed information in the Segmented Network row of the Site Worksheet to configure the Broadcast Management object for each N30.
Networking Worksheet Example Data

Example 1: Single-Segment Network

Table 8 and Table 9 show network data for an example job that consists of three N30s on one IP network segment.

The Site Worksheet shows that this network does not use BOOTP or DNS protocol. However, because the network uses SMTP for routing e-mail alarm notifications, the SMTP server IP address is included in the worksheet.

The N30 Device Name lists the unique default device name for each N30. It can be changed from the default to be more descriptive. In this example, the default N30 names are changed to FL1, FL2, and FL3 to indicate the floor where they are located.

Each N30 also has a unique IP Address and an associated IP Mask, as well as the IP Router Address for the router the N30 communicates to.

The IP Network number differentiates network segments. It is determined by using a logical AND (converting the numbers first to hexadecimal and then to binary) of the IP address and the IP mask. In this example, one IP network segment exists.

The BM (Broadcast Management) Object column is not completed because, in this example, a Broadcast Management object is not required for communication to take place between all of the N30s.

IMPORTANT: The data provided in these examples are not to be used in an actual job. Only use the factory defaults or data provided by a system administrator.
Table 8: Site Worksheet - Example 1

<table>
<thead>
<tr>
<th>BootP</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNS</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If Yes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• DNS Server IP Address =</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Domain Name =</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMTP</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If Yes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SMTP Server IP Address = 172.17.90.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SMTP Server Name (if using DNS) =</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segmented Network (Network Needs Broadcast Management Objects)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If Yes, complete the information below for all Broadcast Management objects:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• IP Broadcast Mask (for BM Address List or BM Host Name List) = 255.255.255.255</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• IP address entries for BM Address List (if not using DNS) or host name entries for BM Host Name List (if using DNS):</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes

Table 9: N30 Device Worksheet - Example 1

<table>
<thead>
<tr>
<th>N30 Device Name</th>
<th>IP Address</th>
<th>IP Mask</th>
<th>IP Router Address</th>
<th>IP Network</th>
<th>BM Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL1</td>
<td>172.16.70.1</td>
<td>255.255.0.0</td>
<td>172.16.8.5</td>
<td>172.16.0.0</td>
<td>No</td>
</tr>
<tr>
<td>FL2</td>
<td>172.16.70.2</td>
<td>255.255.0.0</td>
<td>172.16.8.5</td>
<td>172.16.0.0</td>
<td>No</td>
</tr>
<tr>
<td>FL3</td>
<td>172.16.70.3</td>
<td>255.255.0.0</td>
<td>172.16.8.5</td>
<td>172.16.0.0</td>
<td>No</td>
</tr>
</tbody>
</table>
**Example 2: Multiple-Segment Network**

Table 10 and Table 11 show network data for an example job that consists of seven N30s.

The Site Worksheet shows that the network does not use BOOTP, DNS, or SMTP. The *Segmented Network* row in this worksheet indicates that the network requires Broadcast Management objects. This row lists the information to be included in the BM Address List attribute of each Broadcast Management object.

**N30 Device Name** lists the unique default device name for each N30. It can be changed from the default to be more descriptive. In this example, the name of an N30 is changed to B1F1 to indicate that it is located in Building 1 on Floor 1.

Each N30 also has a unique **IP Address** and an associated **IP Mask**, as well as the **IP Router Address** for the router the N30 communicates to.

The **IP Network** number differentiates network segments. It is determined by using a logical AND (converting the numbers first to hexadecimal and then to binary) of the IP address and the IP mask. In this example, three IP network segments exist. The N30s in Building 1 on Floors 1 and 2 belong to one network, and the N30s in Building 2 on Floors 1, 2, and 3 are on another network, and the N30s in Building 3 on Floors 1 and 2 reside on the third network.

For communication to take place between all of the N30s, a **Broadcast Management** object is added to one N30 on each of the network segments. The Broadcast Management object contains the IP address and IP broadcast distribution mask of all the N30s with a Broadcast Management object. This allows the N30s with Broadcast Management objects to locate the other N30s with Broadcast Management objects and to create a communication link with all of the N30s on the three network segments.

**IMPORTANT:** The data provided in these examples are not to be used in an actual job. Only use the factory defaults or data provided by the LAN administrator.
Table 10: Site Worksheet - Example 2

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BOOTP</strong></td>
<td>☑ ○</td>
<td></td>
</tr>
<tr>
<td><strong>DNS</strong></td>
<td>☑ ○</td>
<td></td>
</tr>
<tr>
<td><strong>SMTP</strong></td>
<td>☑ ○</td>
<td></td>
</tr>
<tr>
<td><strong>Segmented Network</strong> (Network Needs Broadcast Management Objects)</td>
<td>☑ ○</td>
<td></td>
</tr>
</tbody>
</table>

If Yes, complete the information below for all Broadcast Management objects:
- IP Broadcast Mask (for BM Address List or BM Host Name List)= 255.255.255.255
- IP address entries for **BM Address List** (if not using DNS) or host name entries for **BM Host Name List** (if using DNS):
  - 172.16.90.52
  - 172.18.92.161
  - 172.223.85.92

**Notes**
Table 11: N30 Device Worksheet - Example 2

<table>
<thead>
<tr>
<th>N30 Device Name</th>
<th>IP Address</th>
<th>IP Mask</th>
<th>IP Router Address</th>
<th>IP Network</th>
<th>BM Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1F1</td>
<td>172.16.90.52</td>
<td>255.255.0.0</td>
<td>172.16.8.0</td>
<td>172.16.0.0</td>
<td>☑ No  ☐ Yes</td>
</tr>
<tr>
<td>B1F2</td>
<td>172.16.90.53</td>
<td>255.255.0.0</td>
<td>172.16.8.0</td>
<td>172.16.0.0</td>
<td>☑ No  ☐ Yes</td>
</tr>
<tr>
<td>B2F1</td>
<td>172.18.92.161</td>
<td>255.255.0.0</td>
<td>172.18.4.1</td>
<td>172.18.0.0</td>
<td>☑ No  ☐ Yes</td>
</tr>
<tr>
<td>B2F2</td>
<td>172.18.92.162</td>
<td>255.255.0.0</td>
<td>172.18.4.1</td>
<td>172.18.0.0</td>
<td>☑ No  ☐ Yes</td>
</tr>
<tr>
<td>B2F3</td>
<td>172.18.93.213</td>
<td>255.255.0.0</td>
<td>172.18.4.1</td>
<td>172.18.0.0</td>
<td>☑ No  ☐ Yes</td>
</tr>
<tr>
<td>B3F1</td>
<td>172.223.85.92</td>
<td>255.255.0.0</td>
<td>172.223.6.0</td>
<td>172.223.0.0</td>
<td>☑ No  ☐ Yes</td>
</tr>
<tr>
<td>B3F2</td>
<td>172.223.95.49</td>
<td>255.255.0.0</td>
<td>172.223.6.0</td>
<td>172.223.0.0</td>
<td>☑ No  ☐ Yes</td>
</tr>
</tbody>
</table>
Example 3: Multiple-Segment Network with BOOTP

Table 10 and Table 11 show network data for an example job that consists of seven N30s.

The Site Worksheet shows that the network uses BOOTP. Because the network uses BOOTP, the BOOTP server provides each N30 with its IP address information as listed in the N30 Device worksheet.

The Segmented Network row in the Site Worksheet indicates that the network requires Broadcast Management objects. This row lists the information to be included in the BM Address List attribute of each Broadcast Management object.

N30 Device Name lists the unique default device name for each N30. It can be changed from the default to be more descriptive. In this example, the name of an N30 is changed to B1F1 to indicate that it is located in Building 1 on Floor 1. Because this network uses BOOTP, the BOOTP server is configured to provide the N30 with its N30 device name.

Each N30 also has a unique IP Address and an associated IP Mask, as well as the IP Router Address for the router the N30 communicates to. The BOOTP server is configured to provide this IP addressing information (as listed in this worksheet) to each N30 device.

The IP Network number differentiates network segments. It is determined by using a logical AND (converting the numbers first to hexadecimal and then to binary) of the IP address and the IP mask. In this example, three IP network segments exist. The N30s in Building 1 on Floors 1 and 2 belong to one network, and the N30s in Building 2 on Floors 1, 2, and 3 are on another network, and the N30s in Building 3 on Floors 1 and 2 reside on the third network.

For communication to take place between all of the N30s, a Broadcast Management object is added to one N30 on each of the network segments. The Broadcast Management object contains the IP address and IP broadcast distribution mask of all the N30s with a Broadcast Management object. This allows the N30s with Broadcast Management objects to locate the other N30s with Broadcast Management objects and to create a communication link with all of the N30s on the three network segments.

IMPORTANT: The data provided in these examples are not to be used in an actual job. Only use the factory defaults or data provided by the LAN administrator.
### Table 12: Site Worksheet - Example 3

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BOOTP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DNS</strong></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>If Yes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• DNS Server IP Address =</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Domain Name =</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SMTP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>If Yes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SMTP Server IP Address =</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SMTP Server Name (if using DNS) =</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Segmented Network</strong> (Network Needs Broadcast Management Objects)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>If Yes, complete the information below for all Broadcast Management objects:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• IP Broadcast Mask (for BM Address List or BM Host Name List)=</td>
<td></td>
<td>255.255.255.255</td>
</tr>
<tr>
<td>• IP address entries for <strong>BM Address List</strong> (if not using DNS) or host name entries for <strong>BM Host Name List</strong> (if using DNS):</td>
<td></td>
<td>172.16.90.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>172.18.92.161</td>
</tr>
<tr>
<td></td>
<td></td>
<td>172.223.85.92</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 13: N30 Device Worksheet - Example 3

<table>
<thead>
<tr>
<th>N30 Device Name</th>
<th>IP Address</th>
<th>IP Mask</th>
<th>IP Router Address</th>
<th>IP Network</th>
<th>BM Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1F1</td>
<td>172.16.90.52</td>
<td>255.255.0.0</td>
<td>172.16.8.0</td>
<td>172.16.0.0</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☒ Yes</td>
</tr>
<tr>
<td>B1F2</td>
<td>172.16.90.53</td>
<td>255.255.0.0</td>
<td>172.16.8.0</td>
<td>172.16.0.0</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☒ Yes</td>
</tr>
<tr>
<td>B2F1</td>
<td>172.18.92.161</td>
<td>255.255.0.0</td>
<td>172.18.4.1</td>
<td>172.18.0.0</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☒ Yes</td>
</tr>
<tr>
<td>B2F2</td>
<td>172.18.92.162</td>
<td>255.255.0.0</td>
<td>172.18.4.1</td>
<td>172.18.0.0</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☒ Yes</td>
</tr>
<tr>
<td>B2F3</td>
<td>172.18.93.213</td>
<td>255.255.0.0</td>
<td>172.18.4.1</td>
<td>172.18.0.0</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☒ Yes</td>
</tr>
<tr>
<td>B3F1</td>
<td>172.223.85.92</td>
<td>255.255.0.0</td>
<td>172.223.6.0</td>
<td>172.223.0.0</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☒ Yes</td>
</tr>
<tr>
<td>B3F2</td>
<td>172.223.95.49</td>
<td>255.255.0.0</td>
<td>172.223.6.0</td>
<td>172.223.0.0</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>☒ Yes</td>
</tr>
</tbody>
</table>
Example 4: Multiple-Segment Network with BOOTP and DNS

Table 10 and Table 11 show network data for an example job that consists of seven N30s.

The Site Worksheet shows that the network uses BOOTP, DNS, and SMTP. Because the network uses BOOTP, the BOOTP server provides each N30 with its IP address information as listed in the N30 Device worksheet.

The DNS row in the Site Worksheet indicates the DNS server location and the domain name. Because the network uses DNS, the SMTP row indicates the host name (rather than the IP address) of the SMTP server.

The Segmented Network row in the Site Worksheet indicates that the network requires Broadcast Management objects. This row lists the information to be included in the BM Host Name List attribute of each Broadcast Management object. Host names are used in place of IP addresses because this network uses DNS.

N30 Device Name lists the unique default device name for each N30. It can be changed from the default to be more descriptive. In this example, the name of an N30 is changed to B1F1 to indicate that it is located in Building 1 on Floor 1. Because this network uses BOOTP, the BOOTP server is configured to provide the N30 with its N30 device name.

Each N30 also has a unique IP Address and an associated IP Mask, as well as the IP Router Address for the router the N30 communicates to. The BOOTP server is configured to provide this IP addressing information (as listed in this worksheet) to each N30 device.

The IP Network number differentiates network segments. It is determined by using a logical AND (converting the numbers first to hexadecimal and then to binary) of the IP address and the IP mask. In this example, three IP network segments exist. The N30s in Building 1 on Floors 1 and 2 belong to one network, and the N30s in Building 2 on Floors 1, 2, and 3 are on another network, and the N30s in Building 3 on Floors 1 and 2 reside on the third network.

For communication to take place between all of the N30s, a Broadcast Management object is added to one N30 on each of the network segments. The Broadcast Management object contains the host name and IP broadcast distribution mask of all the N30s with a Broadcast Management object. This allows the N30s with Broadcast Management objects to locate the other N30s with Broadcast Management objects and to create a communication link with all of the N30s on the three network segments.
IMPORTANT: The data provided in these examples are not to be used in an actual job. Only use the factory defaults or data provided by the LAN administrator.

Table 14: Site Worksheet - Example 4

<table>
<thead>
<tr>
<th></th>
<th>☐ No</th>
<th>☑ Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BOOTP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DNS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ No</td>
<td>☑ Yes</td>
<td></td>
</tr>
<tr>
<td>If Yes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• DNS Server IP Address = 172.17.90.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Domain Name = MEDCTR.COM</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SMTP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ No</td>
<td>☑ Yes</td>
<td></td>
</tr>
<tr>
<td>If Yes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SMTP Server IP Address =</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SMTP Server Name (if using DNS) = MAILSRV3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Segmented Network (Network Needs Broadcast Management Objects)</strong></td>
<td>☐ No</td>
<td>☑ Yes</td>
</tr>
<tr>
<td>If Yes, complete the information below for all Broadcast Management objects:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• IP Broadcast Mask (for BM Address List or BM Host Name List)= 255.255.255.255</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• IP address entries for <strong>BM Address List</strong> (if not using DNS) or host name entries for <strong>BM Host Name List</strong> (if using DNS):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1F1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2F1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3F1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N30 Device Name</td>
<td>IP Address</td>
<td>IP Mask</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>B1F1</td>
<td>172.16.90.52</td>
<td>255.255.0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1F2</td>
<td>172.16.90.53</td>
<td>255.255.0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2F1</td>
<td>172.18.92.161</td>
<td>255.255.0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2F2</td>
<td>172.18.92.162</td>
<td>255.255.0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2F3</td>
<td>172.18.93.213</td>
<td>255.255.0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3F1</td>
<td>172.223.85.92</td>
<td>255.255.0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3F2</td>
<td>172.223.95.49</td>
<td>255.255.0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix C: Information for Network or System Administrator

Introduction

This section provides information about N30 networking to pass along to your network or system administrator.
**Key Concepts**

**Information for Network or System Administrator**

Provide your network or system administrator with the information in this section about including N30s in a network.

Use Appendix B: Networking Worksheets as a guide for collecting information from your system or network administrator. Be prepared to provide the administrator with the following site-specific information:

- desired host names (device names) for N30s (if the site uses DNS)
- MAC addresses of the N30s (if the site uses BOOTP)

**Protocols**

User Datagram Protocol (UDP) is the primary protocol for network communications with N30 Supervisory Controllers.

The N30 also supports BOOTP, DNS, and SMTP. These protocols can be used independently of one another. For example, a network may include a BOOTP server but not a DNS server.

**Note:** Although the N30 supports BOOTP protocol, the N30 does not require its use. The N30 also supports static IP address assignment.

**Host Names**

When a network includes both BOOTP and DNS servers, make certain that host names and IP addresses provided by the BOOTP server are consistent with those configured in the DNS server.

**BOOTP, DHCP, and IP Address Assignment**

BOOTP protocol provides IP address assignment to N30 devices. A BOOTP server is not required to provide BOOTP protocol, however. Most DHCP servers can be configured to accept and respond to BOOTP requests. To assign IP addresses using BOOTP protocol, configure the DHCP server to accept BOOTP requests. This allows a DHCP server to respond to a BOOTP request by assigning a specific IP address to a device based on its MAC address.

**Note:** In this document, the term “BOOTP server” refers both to BOOTP servers and to DHCP servers configured to accept BOOTP requests.
Before adding an N30 device to a network, ensure that the BOOTP server is configured with the N30 device MAC address and the appropriate IP address. If you add an N30 to a network without configuring this information first, the BOOTP server does not respond to a BOOTP request from the N30 device and does not assign the device’s IP address.

Configure the BOOTP server to assign the following information:

- IP address
- IP mask
- default route (IP router address)
- host name (N30 device name or object name)
- DNS server IP address

To change any of these parameters on an N30 device on the network, first reconfigure the information on the BOOTP server, then force a reboot on the N30 (either warm start or cold start). Downloading the N30 from Project Builder accomplishes the reboot task as well.

**SMTP**

N30 devices can use e-mail messages to deliver alarms and other notifications. In order to enable an N30 device to use email messaging, you must indicate the location of the SMTP mail gateway. If the network uses DNS, identify the SMTP mail gateway name in the SMTP Server Name attribute of the N30 device object. If the network does not use DNS, identify the IP address of the SMTP mail gateway in the SMTP Server Address attribute of the N30 device object.