NCL1135 User Manual

Version 2.0

WaveRider Communications Inc.
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In no event will WaveRider's liability exceed the amount paid for the product.

Regulatory Notices

This equipment has been tested and found to comply with the limits for a Class A Intentional Radiator, pursuant to Part 15 of the FCC Regulations, and RSS-210 of the IC Regulations. These limits are intended to provide protection against harmful interference when the equipment is operated in a commercial/business/industrial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Any changes or modifications to equipment that are not expressly approved by the manufacturer may void the user's authority to operate the equipment. The NCL1135 contains no user-serviceable parts. Unauthorized opening of the unit voids this warranty.

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Preface

About this Manual

WaveRider recommends that you read the following sections before you install and operate the NCL1135:

- *Software License Agreement* on page ii
- *Warranty* on page iv
- *Regulatory Notices* on page x
- *Warnings and Advisories* on page xiii

This NCL1135 User Manual provides you with information necessary for planning, installing, and operating an NCL1135-based system. The information has been organized in the following sections:

Chapter 1	Provides an overview of the NCL1135 and the spread-spectrum radio technology.
Chapter 2	Describes some typical configurations and provides a flowchart to assist you in planning your network.
Chapter 3	Provides the procedures to set up and configure the NCL1135.
Chapter 4	Describes a ping test that confirms the NCL1135 is configured and ready to be deployed.
Chapter 5	Provides three tests useful when deploying an NCL1135.
Chapter 6	Describes how to obtain the NCL1135 operational statistics.
Chapter 7	Lists typical NCL1135 problems, possible causes, and solutions.
Appendix A	Lists all commands available for the NCL1135.
Appendix B	Provides a list of acronyms and abbreviations and a list of the NCL1135 wireless network terminology used in this manual.
Appendix C	Lists the channel frequency set for each WaveRider regulatory domain.
Appendix D	Provides the NCL1135 technical specifications.
Appendix E	Contains a form that you can use to record the configuration information.

> **NOTE:** The information contained in this manual is subject to change without notice.

Regulatory Notices

Industry Canada

The NCL1135 complies with IC RSS–210.

Operators must be familiar with IC RSS–210 and RSS–102.

The IC certification number for the NCL1135 is 32251021662A.

WARNING!

To prevent radio interference to the licensed service, this device is intended to be operated indoors and away from windows to provide maximum shielding. Equipment (or its transmit antenna) that is installed outdoors is subject to licensing.

Federal Communications Commission

The NCL1135 complies with FCC Part 15 Regulations.

The FCC ID for the NCL1135 is OOX-NCL1100.

The transmitter of this device complies with Part 15.247 of the FCC Rules.

WARNING!

Operators must be familiar with the requirements of the FCC Part 15 Regulations prior to operating any link using this equipment. For installations outside the United States, contact local authorities for applicable regulations.

Interference Environment

Manufacturers and operators of spread-spectrum devices are reminded that the operation of these devices is subject to the conditions that:

- Any received interference, including interference from industrial, scientific, and medical (ISM) operations, must be accepted; and
- These devices are not permitted to cause harmful interference to other radio services.

If the operation of these systems does cause harmful interference, the operator of the spread-spectrum system must correct the interference problem, even if such correction requires the Part 15 transmitter to cease operation. The FCC does not exempt spread-spectrum devices from this latter requirement regardless of the application. The FCC strongly recommends that utilities, cellular stations, public safety services, government agencies, and others that provide

critical communication services exercise due caution to determine if there are any nearby radio services that can be affected by their communications.

Operational Requirements

In accordance with the FCC Part 15 regulations:

1. The maximum peak power output of the intentional radiator shall not exceed one (1) watt for all spread-spectrum systems operating in the 2.4000-2.4835 GHz band.

2. Systems operating in the 2.4000-2.4835 GHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi, provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

3. Stations operating in the 2.400-2.4835 GHz band that are used for fixed, point-to-multipoint operations may use transmitting antennas of directional gain greater that 6 dBi, provided the peak output power from the intentional radiator is reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4. Fixed, point-to-point operation, as used in Point 2, excludes the use of point-to-multipoint systems, omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread-spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations.

5. The operator of a spread-spectrum system is responsible for ensuring that the system is operated in the manner outlined in *Interference Environment* on page x and *Operational Requirements* on page xii.

Warnings and Advisories

General Advisory

Operator and maintenance personnel must be familiar with the related safety requirements before they attempt to install or operate the NCL1135 equipment.

It is the responsibility of the operator to ensure that the public is not exposed to excessive Radio Frequency (RF) levels. The applicable regulations can be obtained from local authorities.

WARNING!

This system must be professionally installed. Antennas and associated transmission cable must be installed by qualified personnel. WaveRider assumes no liability for failure to adhere to this recommendation or to recognized general safety precautions.

WARNING!

To comply with FCC RF exposure limits, the antenna for this transmitter must be fix-mounted on outdoor permanent structures to provide a separation distance of 32 cm (12 inches) or more from all persons to satisfy RF exposure requirements. The distance is measured from the front of the antenna and the human body. It is recommended that the antenna be installed in a location with minimal pathway disruption by nearby personnel.

WARNING!

Do not operate the NCL1135 without connecting a 50-ohm termination to the antenna port. This termination can be a 50-ohm antenna or a 50-ohm resistive load capable of absorbing the full RF output power of the transceiver. Failure to terminate the antenna port properly may cause permanent damage to the NCL1135.

Customer Support

If you have any problems with the hardware or software, please contact WaveRider Communications Inc. Please provide your NCL1135 Model number and software version when you request support.

Telephone:	+1 416–502–3161
Fax:	+1 416–502–2968
Email:	techsupport@waverider.com
URL:	www.waverider.com

WaveRider offers a complete training program. Please contact your sales representative for training information.

1   NCL1135 Overview

1.1   Introduction

The NCL1135 is an intelligent, wireless Internet Protocol (IP) bridge/router that provides high-capacity 2.4 GHz connections between local- and wide-area networks via broadband radio links. The NCL1135 uses direct-sequence spread spectrum (DSSS) techniques to provide secure communications and is completely network configurable.

Figure 1 shows an NCL1135 point-to-point network and point-to-multipoint network.

Figure 1   NCL1135 Network Examples
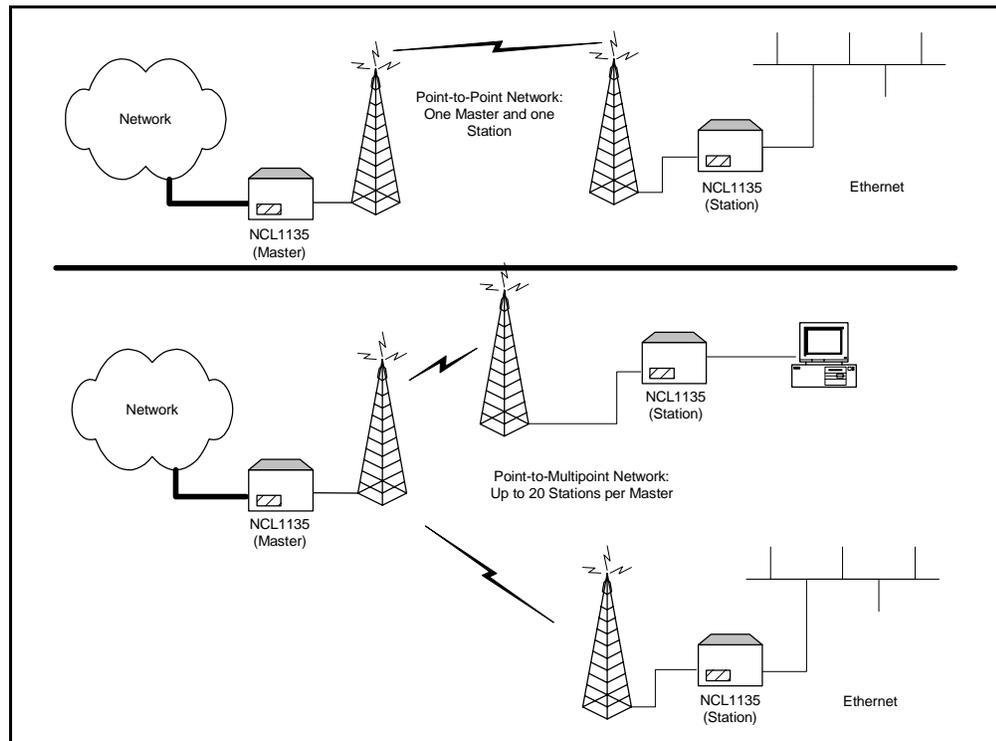
The NCL1135 is used to extend Ethernet networks, access the Internet at high speed, connect remote locations, and perform general data networking without the ongoing costs of leased telephone or data lines.

1.2   Features

- **Flexible deployment**—WaveRider's NCL1135 can operate as either a bridge or router. In routing mode, the NCL1135 can be set up to use dynamic communications strategies such as the Routing Information Protocol (RIP), Dynamic Host Control Protocol (DHCP), and Open Shortest Path First (OSPF).

- **Ethernet compatibility**—WaveRider's NCL1135 allows users to connect with most Ethernet networks or devices.

- **Microprocessor-controlled signal processing**—All functions of WaveRider's spread-spectrum transceiver are controlled through the integration of a powerful microprocessor.

- **Architectural flexibility**—WaveRider's NCL1135 can be set up as a separate point-to-point links, or in a mulitipoint configuration in which a single NCL1135 operating in "master" mode can deliver data to and receive data from a maximum of 20 NCL1135 devices operating in "station" mode.

- **User-configurable and -customizable monitoring**—WaveRider's NCL1135 operating system supports Simple Network Management Protocol (SNMP), which allows for continual status monitoring of any NCL1135 in your network, and remote upgrading.

- **Low interference**—WaveRider's implementation of Direct Sequence Spread-Spectrum (DSSS) technology transmits signal information over a wide channel bandwidth, which reduces the potential for interference with neighboring communications systems. WaveRider's NCL1135 design permits three master units to operate in close proximity without interfering with each other. For example, three master units supporting 20 station units apiece can operate in close proximity, thus providing 60 end-user links.

- **Software-enabled feature sets**—WaveRider offers NCL1135 users an easy, customizable upgrade path through software-enabled feature optioning.

1.3   About Spread-Spectrum Radio Technology

Spread-spectrum communications systems differ from conventional narrowband communications systems because they use a much larger transmission bandwidth to send the same amount of information.

There are two primary forms of spread spectrum—direct sequence and frequency hopping. The NCL1135 uses direct-sequence spread-spectrum (DSSS). In DSSS systems, the transmitted information, along with a digital spreading sequence, are used to modulate the transmit carrier. The received signal is de-spread using the same digital spreading sequence, and the information recovered.

Although spread spectrum appears complex and uses a wider bandwidth, DSSS offers the following advantages for its use:

- **Reduced power spectral density**—Spreading over a wider bandwidth reduces the spectral density (power per Hz of bandwidth) of the transmitted signal, allowing simultaneous operation of many spread spectrum systems in the same frequency band and geographic area. The reduced spectral density also allows you meet the regulatory emissions requirements in frequency bands such as the ISM band.
- **Transmission security**—It is technologically more difficult to surreptitiously recover (or jam, in the case of military communications systems) spread-spectrum signals than it is to recover conventional narrowband signals.
- **Interference suppression**—The same mechanism that de-spreads the desired signal in the receiver, also spreads undesired signals, which then appears to the receiver as lower levels of RF noise.

For more information about spread spectrum communications, contact the **WaveRider Customer Support Centre**.

2 Network Considerations

This section provides an overview of the network considerations that you should make before beginning to implement an NCL1135 network. These network considerations include the following:

- configuration
- mode: bridging or routing
- planning

2.1 Network Configuration

The NCL1135 can be deployed in three different network configurations:

- point-to-point
- repeater
- point-to-multipoint

Before deploying the system, you must determine the required network topology.

2.1.1 Point-to-Point

In a typical point-to-point application, shown in Figure 2, unit A communicates directly with unit B. You can implement the link in either bridging or routing mode.

Figure 2   Point-to-Point Application
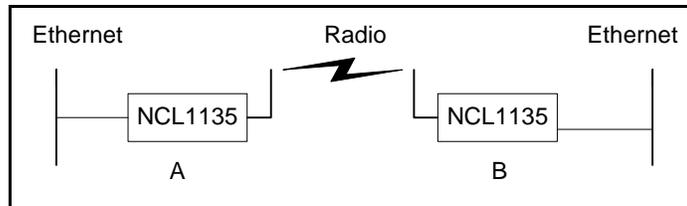
2.1.2 Repeater

You can set up a repeater by using two NCL1135 units back-to-back.

In the configuration shown in Figure 3, unit A communicates with unit B via the back-to-back NCL1135 repeater configuration of units C and D. You must use different frequencies for each leg of the path. Use this configuration to circumvent large obstacles in the radio link path, or when the link from unit A to unit B is too long to provide reasonable signal levels and data throughput.

Figure 3   Repeater Application
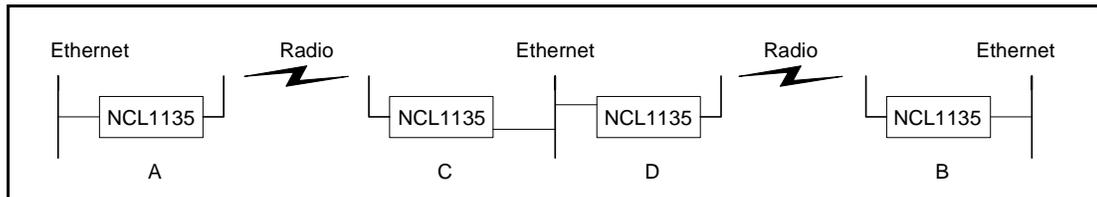
In this configuration, the effective data throughput from unit A to unit B is the same as the lessor data throughput from unit A to unit C or unit D to unit B. That is, the throughput through a series of links will be that of the slowest link.

You can implement this configuration in either bridging or routing mode.

2.1.3 Point-to-Multipoint

Figure 4 shows an example point-to-multipoint configuration. The master, unit A, sends and receives messages to and from NCL1135 stations. In this configuration, the throughput of unit A is shared among the stations.

Although stations may receive communications from other stations, because of RF propagation conditions, the stations are programmed to accept messages only from their designated master.

Figure 4   Point-to-Multipoint Application
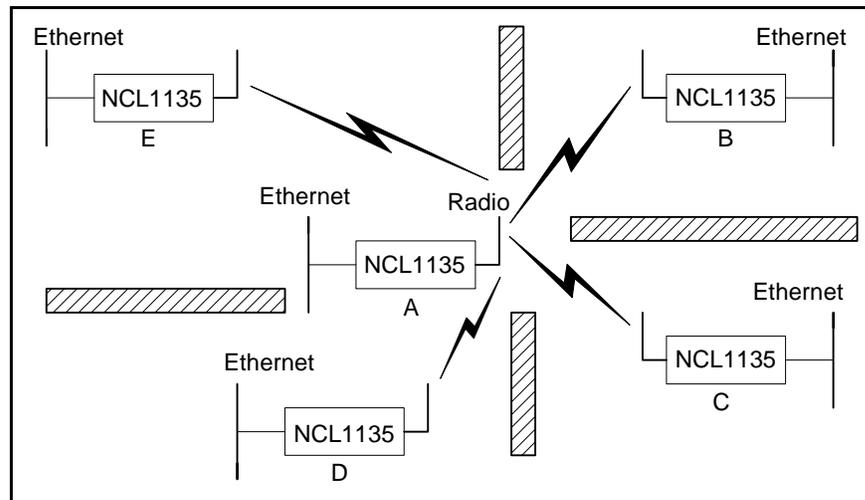
2.2   Bridging and Routing Network Configurations

2.2.1 Point-to-Multipoint Bridging Network

In a point-to-multipoint network configuration, each NCL1135 must be configured as either a bridge or router, not a mix of both operational modes. Figure 5 shows the configuration of a typical point-to-multipoint bridging network.

Figure 5   Point-to-Multipoint Bridging Network Example
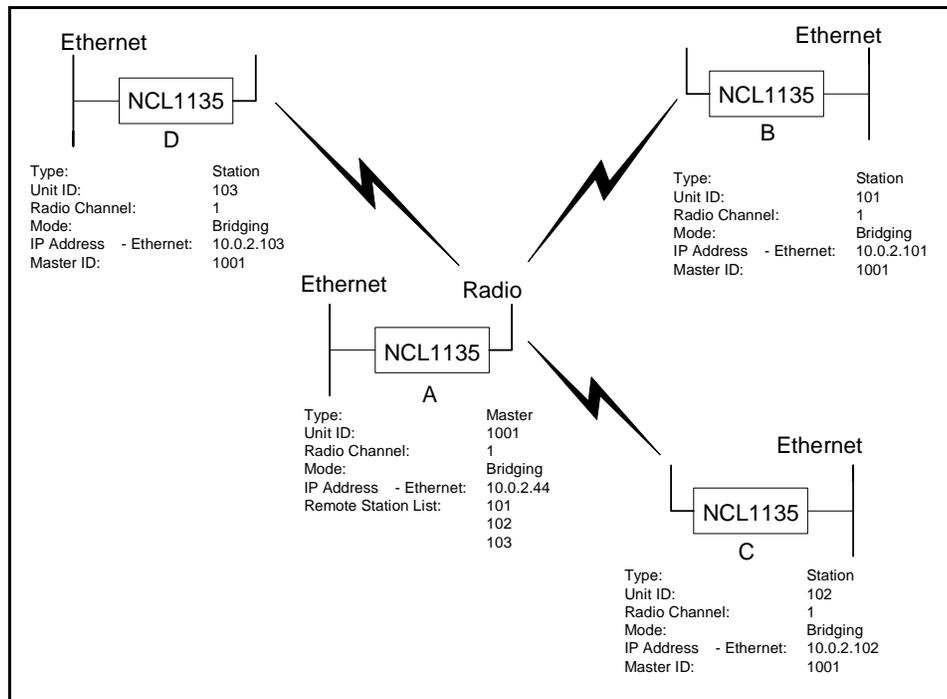
In Figure 5, unit A is configured as the network master and units B, C, and D as stations. Units B, C, and D unit IDs must be manually added to the Remote Station List for unit A. The Master ID on each station is set to the unit ID for Unit A. If a unit is not in the Master Remote Station List and does not have the Master ID set to the unit ID for unit A, it will not be able to join the network.

2.2.2 Point-to-Multipoint Routing Network

Figure 6 shows the configuration of a typical point-to-multipoint routing network.

Figure 6   Point-to-Multipoint Routing Network Example
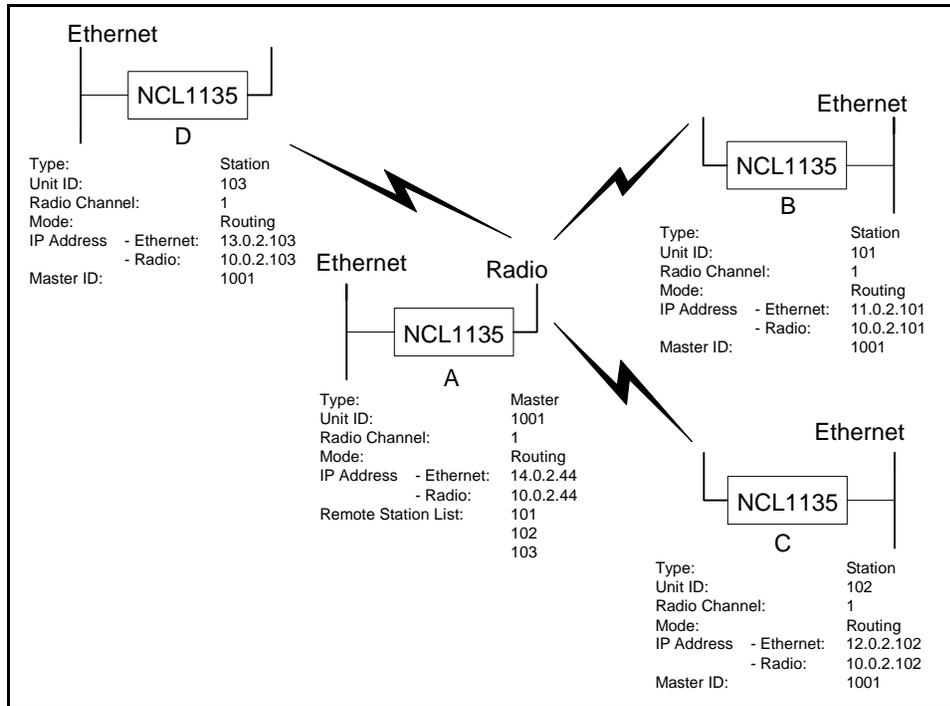
2.3   Planning an NCL1135 Configuration

Configuring each NCL1135 correctly is crucial to the proper operation of your network. Review the flowchart in Figure 7 before starting the configuration to ensure that you have the necessary information to configure the unit correctly.

Record your configuration options for each unit on a configuration record similar to the one provided in Appendix E. Use the Configuration Data Record to help you plan your network and keep track of NCL1135 network assignments.

Figure 7   NCL1135 Configuration Planning Flowchart
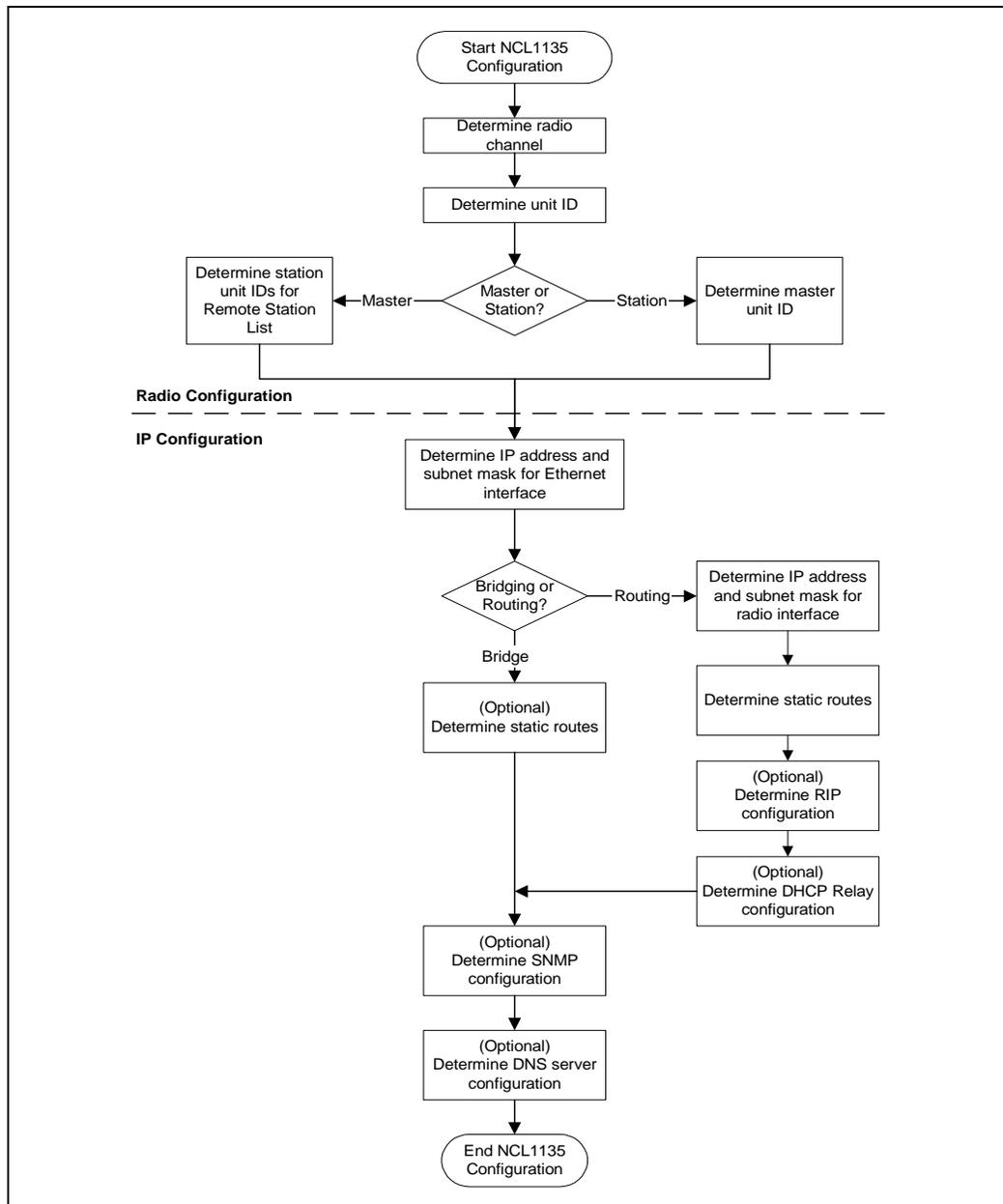
3   Configuring the NCL1135

This section describes the steps required to initialize and configure the NCL1135 for use as either a bridge or router, including the options available for routing and system monitoring. NCL1135 users can perform these steps three ways:

- Telenet command line interface (CLI)
- Windows 95/98 graphical user interface (GUI)
- Internet Explorer/Netscape Communicator web browser

Before you begin these procedures, you should become familiar with the conventions used to display the command-line syntax used in this manual. See *NCL1135 Command-Line Syntax Conventions* on page 57. Table 7 on page 58 defines the keyboard shortcuts for entering commands and requesting help.

> **NOTE:** The following section describes the procedures for configuring the NCL1135 via Telnet CLI. To download the Windows 95/98 GUI application, or more information on configuring the NCL1135 via web browser, visit WaveRider's website at: *<http://www.waverider.com/techsupport/index.html>*.

3.1   Connecting and Initializing the NCL1135

WARNING!

Antennas and associated transmission cable must be installed by qualified personnel. Failure to terminate the antenna port correctly can permanently damage the NCL1135. WaveRider assumes no liability for failure to adhere to this recommendation or to recognized general safety precautions.

1. Attach the antenna or a 50-ohm load to the antenna connection on the back of the NCL1135. Do NOT plug the NCL1135 to the power outlet until you have the antenna or load connected.

   NOTE: The NCL1135 is factory preset with the radio transmission capabilities disabled to prevent equipment damage. However, as a general precaution, WaveRider recommends that you always connect the antenna or load <u>before</u> connecting to a power source.

Figure 8   NCL1135 Connections

2. Use an RS-232 crossover cable to connect a terminal to the DB9 port.

   NOTE: You can use any ASCII terminal to access the NCL1135, such as a single-function terminal or a computer running terminal-

emulation software. Figure 9 illustrates the pin-out for the console port.

Figure 9   Console Port Pin-out Diagram

DB9 Male DTE Configuration

Pin 2 Rx line
Pin 3 Tx line
Pin 5 Ground
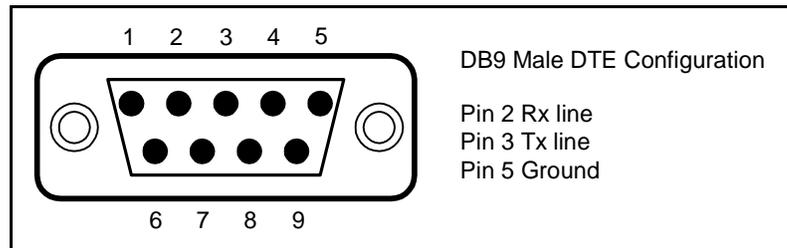
3. If you are using a terminal-emulation package, such as HyperTerminal, start the application.

4. In the terminal-emulation application, select the communications port that you are using to connect to the NCL1135.

5. Configure the application using the following settings:
   - 9600 bps
   - 8 data bits
   - no parity
   - 1 stop bit
   - no flow control

6. Plug the NCL1135 into a 110 or 220 V AC power source using the power cord provided with the unit. The NCL1135 begins an initialization sequence displaying progress messages on the terminal screen.

   When it completes initialization, it displays a message to indicate that the system is operational and the PASSWORD: prompt appears.

7. At the PASSWORD: prompt, press ENTER. The NCL1135 comes factory-configured with no password.

8. Change the password for the NCL1135 by following the instructions in *Changing the NCL1135 Password*, on page 14.

9. Change the system name in the NCL1135 as described in *Setting the NCL1135 System Name*, on page 15.

10. If the NCL1135 had been configured for use elsewhere in your network, reset the unit by following the instructions is *Resetting an NCL1135 to Factory Settings*, on page 15. If the NCL1135 is a factory-configured unit, you can omit this step.

The NCL1135 is now ready to be configured for your network.

3.1.1 Changing the NCL1135 Password

You must be successfully connected and logged into the NCL1135.

For security, we recommend that you set the password for each unit in your network to a unique password and that you record the password on the Configuration Data Record for the group. Refer to Appendix E for a copy of the NCL1135 Network Group Configuration Data Record.

1. At the `NCL1135>` prompt, type `<system password>`.

2. At the `Enter Current Password:` prompt, type the old password.

3. At the `Enter New Password:` prompt, type the new password.

> **TIP:** Use a maximum of sixteen (16) alphanumeric, ASCII characters. Passwords are case-sensitive. For example, "abc" is not the same as "aBc".

4. At the `Verify password:` prompt, type the new password again.

   The system will display a message that your password has been successfully changed.

5. Type `<write>` or `<save>` to save the settings to memory.

Your session to change the password may be similar to the following example session:

```
NCL1135> system password
Enter Current Password: *******
Enter New Password: ****
Verify password: ****
System password has been changed.
NCL1135>
```

> **CAUTION:** Remember to record the password in your Data Configuration Record. Unlocking the NCL1135 can be a complicated process. If you have forgotten the password, contact the **WaveRider Customer Support Centre** for assistance.

3.1.2 Setting the NCL1135 System Name

You must be successfully connected and logged into the NCL1135.

1. At the `NCL1135>` prompt, type `<system name `*`your_system_name`*`>` to name the NCL1135 in your system.

> **TIP:** We recommend that you use a system name that uniquely identifies the unit. You can use a name based on its location, its purpose, or a combination of both. For example, a system name, Station_firehall identifies the NCL1135 configured as a Station and located at the firehall.

The session to change the system name from `NCL1135` to `Station_firehall` would look like this:

```
NCL1135> system name Station_firehall
System name changed to: Station_firehall


Station_firehall>
```

2. Type `<write>` or `<save>` to save the settings to memory.

> **NOTE:** In this User Manual, the command-line prompt will always be shown as `NCL1135>`.

3.1.3 Resetting an NCL1135 to Factory Settings

If the NCL1135 is a factory-configured unit, the following procedure does not need to be performed. Use this procedure if the NCL1135 had been previously configured for use elsewhere in your network and you would like to prepare it for another location and use.

1. Connect the NCL1135 to a terminal or terminal-emulation software and at the `NCL1135>` prompt, type `<write erase>` to reset the unit to its factory-default settings.

2. Type `<reboot>` for the unit to recognize the factory-default settings.

3.2   Configuring the NCL1135

The procedures to configure the NCL1135 using a command-line interface are divided into two main sections:

- Radio configuration — see *Setting the Radio Configuration* on page 16
- IP configuration — see *Setting the IP Configuration* on page 18

You can also configure the NCL1135 with the following options:

- Routing Information Protocol (RIP)—see *Setting RIP Configuration* on page 19
- Open Shortest Path First (OSPF)—see *Setting OSPF Configuration* on page 20
- Dynamic Host Control Protocol (DHCP) Relay—see *Setting the DHCP Relay Configuration* on page 21
- Simple Network Management Protocol (SNMP)—see *Setting the SNMP Configuration* on page 22
- Domain Name Server (DNS) Resolver—see *Setting the DNS Resolver Configuration* on page 23

3.2.1   Setting the Radio Configuration

Before setting the radio configuration parameters, ensure that the NCL1135 has been connected to a terminal and initialized as described in *Connecting and Initializing the NCL1135*, on page 12 and you have changed the password as described in *Changing the NCL1135 Password*, on page 14.

WARNING!

Antennas and associated transmission cable must be installed by qualified personnel. Failure to terminate the antenna port correctly can permanently damage the NCL1135. WaveRider assumes no liability for failure to adhere to this recommendation or to recognized general safety precautions.

1. Determine the radio channel for the network. See Appendix C for a list of operating frequencies.

2. At the `NCL1135>` prompt, type `<radio channel channel>` to set the radio channel for the NCL1135 where `channel` is the number of the network radio channel on which it will be operating.

3. Determine the unit IDs for the Master and Stations for this NCL1135 network group. The unit ID is a unique number, from 1 to 16383, that is used to identify the NCL1135 within the network group.

4. At the `NCL1135>` prompt, type `<radio unitid unit_id>` to set the NCL1135 unit ID.

5. Set the NCL1135 as a Master or Station. To set the NCL1135 as a Master, type `<radio type master>`. To set the NCL1135 as a Station, type `<radio type station>`.

6. If the NCL1135 is a Master, add the unit IDs for the Stations that are configured for this network group. At the `NCL1135>` prompt, type `<radio station add station_unitid>` where *station_unitid* is the unit ID for a Station.

   NOTE: To remove a Station from the Remote Station List, type `<radio station del station_unitid>` where *station_unitid* is the unit ID for the Station you want removed.

7. Repeat step 6 for each Station that you want to add to the Remote Station List for the Master NCL1135. A maximum of 20 Stations can be added to one Master.

8. If the NCL1135 is a Station, add the Master unit ID for the network group. At the `NCL1135>` prompt, type `<radio masterID master_unitid>` where *master_unitid* is the unit ID for Master NCL1135 in the network group.

9. At the `NCL1135>` prompt, type `<write>` to save the settings to memory.

> **TIP:** To display a list of Stations associated with a Master NCL1135, type `<radio station>` at the `NCL1135>` prompt.

3.2.2 Setting the IP Configuration

Ensure that the NCL1135 has been connected to a terminal and initialized as described in *Connecting and Initializing the NCL1135*, on page 12 and you have changed the password as described in *Changing the NCL1135 Password*, on page 14.

Complete the radio configuration as described in *Setting the IP Configuration*, on page 18 before configuring the IP configuration options.

1. At the `NCL1135>` prompt, type `<ip address ethernet aaa.bbb.ccc.ddd nn>` to set the IP address for the Ethernet interface. `aaa.bbb.ccc.ddd` is the IP address of the NCL1135 and *nn* is the number of bits in the subnet mask (for example, 24 represents a subnet mask of 255.255.255.0).

2. At the `NCL1135>` prompt, type `<mode bridging>` or `<mode routing>` to set the forwarding mode.

3. If the mode is set to bridging in Step 2, omit this step. If the mode is routing, type `<ip address radio remote_unit_id aaa.bbb.ccc.ddd eee.fff.ggg.hhh>` to set the IP address for the radio interface to the remote unit. `aaa.bbb.ccc.ddd` is the IP address for the local unit and `eee.fff.ggg.hhh` is the IP address for the remote unit.

   NOTE: If you change the radio IP address for a Station at a later time, remember to update the Master with the new Station IP address. If you change the radio IP address for a Master at a later time, remember to update each Station in the Remote Station List with the new remote IP address for the Master.

4. For a Master unit, repeat step 3 for every Station in the group. For a Station unit, you only need to enter the remote unit IP address for the Master.

5. You can optionally add a maximum of 256 static routes for the NCL1135. At the `NCL1135>` prompt, type `<ip route add aaa.bbb.ccc.ddd eee.fff.ggg.hhh subnet_mask>` where `aaa.bbb.ccc.ddd` is the IP address for the destination network, `eee.fff.ggg.hhh` is the IP address for the gateway, and `subnet_mask` is specified in the number of bits.

6. If the mode is routing and the NCL1135 is a Master, type `<ip route add station_ethernet_subnet station_radio_ip_address subnet_mask>` to route the Master subnet traffic to the Master.

7. If the mode is routing and the NCL1135 is a Station, type `<ip route add 0.0.0.0 master_radio_ip_address 0>` to add a default static route to route all unknown subnets through the Master.

8. At the `NCL1135>` prompt, type `<radio enable>` to enable the NCL1135 to transmit messages. Ensure that the NCL1135 antenna port is terminated.

9. At the `NCL1135>` prompt, type `<write>` to save the settings to memory.

10. When done configuring the NCL1135, disconnect the terminal from the NCL1135.

3.2.3 Configuration Options

The NCL1135 provides users with the following configuration options:

in Routing Mode

- Routing Information Protocol (RIP)—see *Setting RIP Configuration* on page 19
- Open Shortest Path First (OSPF)—see *Setting OSPF Configuration* on page 20
- Dynamic Host Control Protocol (DHCP) Relay—see *Setting the DHCP Relay Configuration* on page 21

for System Monitoring

- Simple Network Management Protocol (SNMP)—see *Setting the SNMP Configuration* on page 22
- Domain Name Server (DNS) Resolver—see *Setting the DNS Resolver Configuration* on page 23

After completing these procedures, it is important to confirm that the configuration is correct before deploying the NCL1135 in the field. Refer to Chapter 4, *Testing*, on page 35.

Two example configuration diagrams and sessions are provided in *Examples of Bridging and Routing Configurations*, on page 24: one for a point-to-multipoint bridging, and the second for a point-to multipoint routing network.

Setting RIP Configuration

When the NCL1135 is in Routing Mode, you can optionally enable the Routing Information Protocol (RIP) features. RIP is a protocol that runs between two routers (for example, two NCL1135s) or a route server in order toexchange information about routes. When RIP is active, RIP can be configured to "advertise" default routes or static routes.

The NCL1135 supports both RIP version 1 and 2. RIP version 2 can be set as broadcast, compatible, or multicast.

1. At the `NCL1135>` prompt, type `<ip routing rip>` to enable RIP as the routing mode.

2. To transmit the route information in packets, type `<ip rip active>`. If RIP is set to `quiet`, it receives and processes RIP packets, but it does not transmit them.

3. Type `<ip rip version>` to display the current version of RIP.

4. If RIP is version 1, it is broadcast only. To change RIP routing to support version 2, type `<ip rip version 2>`.

5. If you set RIP to version 2, you can additionally specify how RIP handles packets.

To do this....	Type...
Send version 2 advertisements as broadcast.	`<ip rip broadcast>`

To do this....	Type...
Send more compatible version 1 broadcasts (intended for version 1 routers).	`<ip rip compatible>`
Disable RIP routing.	`<ip rip disable>`
Enable RIP routing.	`<ip rip enable>`
Send version 2 advertisements to RIP version 2 multicast addresses. This is generally more efficient than broadcast.	`<ip rip multicast>`

6. To enable RIP to advertise the default route, if one exists, in the advertisement, type `<ip rip default>`.

To send RIP to advertise static routes, as well as all other RIP information, type `<ip rip update>`. `noupdate` sends all route information except static route information.

Setting OSPF Configuration

The Open Shortest Path First (OSPF) routing protocol generates an IP network layer database and forwards that information to all other routers within the same network to determine the shortest path between nodes. OSPF is compatible with other routing protocols and does not affect packet content.

OSPF routing decisions are based on a Link-State Algorithmn (or Advertisement), which allows faster delivery of packetized data, particularly within larger corporate and institutional intranetworks, because each router is aware of the set of links used by every other router, rather than only those of its adjacent router. In an OSPF-enabled environment, whenever a router becomes aware of another router on one of its attached subnetworks, it creates a logical link to that system, and treats it as a 'neighbour'.

To do this....	Type...
Display OSPF area configuration	`<ip ospf area>`
Add an OSPF area	`<ip ospf area add>` `<Area aaa.bbb.ccc.ddd>`
Delete an OSPF area	`<ip ospf area del>` `<Area aaa.bbb.ccc.ddd>`
Disable OSPF protocol.	`<ip ospf disable>`
Enable OSPF protocol.	`<ip ospf enable>`

Configure interface parameters.	`<ip ospf interface>`
	`<interface>`
	`<Area.aaa.bbb.ccc.ddd>`
	`<Cost 0-65535>`

Setting the DHCP Relay Configuration

When the NCL1135 is in Routing mode, you can optionally enable Dynamic Host Control Protocol (DHCP) Relay which makes the NCL1135 aware of the protocol for DHCP traffic and forward the responses back to the designated DHCP Server.

> **NOTE:** DHCP Relay is transparent when the NCL1135 is in bridging mode and, therefore, is not available in that mode.

You can configure a maximum of five DHCP servers in the NCL1135 configuration.

1. At the `NCL1135>` prompt, type `<dhcp mode relay>` to enable DHCP Relay in the device.

2. To add a DHCP server, type `<dhcp relay add` *`ip_address`*`>` where *`ip_address`* is the IP Address for the DHCP Server available for the NCL1135 to forward and receive DHCP traffic.

3. At the `NCL1135>` prompt, type `<write>` to save the settings to memory.

> **NOTE:** To remove a DHCP server, type `<dhcp relay delete` *`ip_address`*`>`. To disable DHCP Relay, type `<dhcp mode none>`.

Setting the SNMP Configuration

SNMP enables a network management station to monitor, control, and remotely configure network devices called agents.

SNMP allows you to look at SNMP variables using READ communities, and to set SNMP variables using WRITE communities. Communities are optional on the NCL1135, but it can support a maximum of five communities. An NCL1135 comes factory-configured with two communities, a READ community called public and a WRITE community called private.

SNMP also provides a mechanism called trap, which notifies a network management station that a significant event took place. A significant event can be an interface going down or coming up, a unit performing a cold or warm start, or an authentication failure. Refer to RFC 1157 for details.

Associated with SNMP are Management Information Bases (MIBs). These specify a collection of management information available from the agent. This information can be controlled and monitored from a network management station.

The NCL1135 implements SNMPv2c and includes a number of standard SNMP MIBs:
- RFC1157 (MIB-II)
- RFC1493 (bridging)
- an NCL1135-specific MIB

WaveRider MIBs can be downloaded from the technical support page at www.waverider.com. The following procedure describes how to configure standard SNMP communities for read/write access to the NCL1135 SNMP agent and to specify a server IP address to which trap messages are sent.

1. At the `NCL1135>` prompt, type `<snmp>` to display the current SNMP settings for the NCL1135.

2. To add a new community, type `<snmp community add community READ|WRITE>` where `community` is the name of the community and `READ|WRITE` is the community type. You can have a maximum of five communities.

3. If a community is not set up the way you want it, delete it by typing `<snmp community del community READ|WRITE>` where `community` is the name of the community and `READ|WRITE` is the community type.

4. At the `NCL1135>` prompt, type `<snmp location location>` to change the geographical location of the NCL1135.

5. Type `<snmp contact contact>` to change the contact name for the NCL1135. The contact can be a name and phone number, a URL, or an email address.

6. To add a trap server to the NCL1135 configuration, type `<snmp trap add aaa.bbb.ccc.ddd community>` where `aaa.bbb.ccc.ddd` is the IP address of the trap server and `community` is the name of the community on the trap server.

7. To delete a trap server from the NCL1135 configuration, type `<snmp trap del aaa.bbb.ccc.ddd community>` where `aaa.bbb.ccc.ddd` is the IP address of the trap server and `community` is the name of the community on the trap server.

8. At the `NCL1135>` prompt, type `<write>` to save the settings to memory.

Setting the DNS Resolver Configuration

The NCL1135 implements DNS resolver software. Once you configure the NCL1135, you can use host names instead of IP addresses when you make a Telnet connection from the NCL1135 console to other IP hosts on the network, or when you send ping messages to test connectivity.

Adding DNS server lists is optional on the NCL1135, but you can configure the NCL1135 to use a maximum of five DNS servers. An NCL1135 comes factory-configured with no DNS servers in the list.

You can also configure the NCL1135 with a domain name for your local IP network.

The following procedure describes how to configure the NCL1135 to implement DNS resolver software and configure the NCL1135 domain name. Setting the DNS resolver configuration is optional.

1. At the `NCL1135>` prompt, type `<ip dns>` to display the current DNS setup used by the NCL1135.

2. To add a DNS Server, type `<ip dns server add aaa.bbb.ccc.ddd>` where `aaa.bbb.ccc.ddd` is the IP address of the DNS Server.

3. To delete a DNS Server, type `<ip dns server del aaa.bbb.ccc.ddd>` where `aaa.bbb.ccc.ddd` is the IP address of the DNS Server.

4. To set the domain name for your local IP network, type `<ip dns domain domain_name>` where `domain_name` is the name for your local IP network.

5. At the `NCL1135>` prompt, type `<write>` to save the settings to memory.

3.3   Examples of Bridging and Routing Configurations

The following two examples for a point-to-multipoint network configuration provide detailed diagrams for a bridging and routing configuration and the corresponding command-line sessions to configure the appropriate devices in the network.

In a point-to-multipoint network configuration, all the NCL1135s in the network must be either configured as bridges or routers, not a mix of both operational modes.

3.3.1   Point-to-Multipoint Bridging Network

Figure 10 shows a configuration of a typical point-to-multipoint bridging network.

Figure 10   Example Point-to-Multipoint Bridging Network
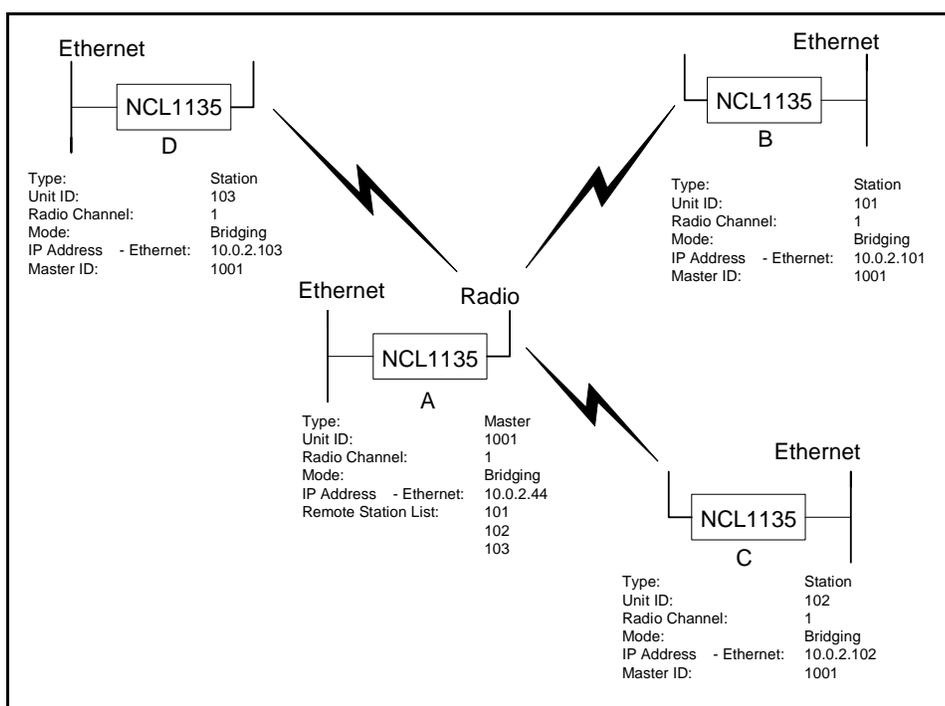
In Figure 10, unit A has been configured as the Master of the system with remote units B, C, and D configured as Stations. Units B, C, and D unit IDs have been manually added to the Master (unit A) Remote Station List. The Master unit ID on each Station is set to the unit ID for unit A. If a unit is not in the Master Remote Station List and does not have the Master unit ID set, it will not be able to join the network.

The following example session shows how to configure the Master NCL1135 for the bridging network shown in Figure 10.

```
NCL1135>

NCL1135> radio channel 1                    ◄──────  Sets the radio channel
Radio channel changed to: 1

NCL1135> radio unitid 1001                  ◄──────  Sets the NCL1135 unit ID
Unit ID changed to: 1001

NCL1135> radio type master                  ◄──────  Sets the NCL1135 type to Master
Radio type changed to: Master

NCL1135> radio station add 101              ◄──────  Adds a station to the Master Remote
Station added.                                        Station List

NCL1135> radio station add 102
Station added.

NCL1135> radio station add 103
Station added.

NCL1135> radio                              ◄──────  Displays the radio configuration
RADIO CONFIGURATION:                                  information
Radio type        : Master
Wireless ID       : 1001
Speed             : 11Mbs
Channel           : 1
Regulatory Domain : FCC/IC
Frequency         : 2.412 GHz
Interframe spacing: 32 (281.6 micro seconds)
Hardware address  : 00:90:27:CA:62:A3
Network Card IRQ  : 5
NIC Base Address  : 0x0d0000
Remote Stations   : 101
                  : 102
                  : 103

NCL1135> ip address ethernet 10.0.2.44 16   ◄──────  Changes the local
IP addresses:                                         Ethernet IP address
  Ethernet: 10.0.2.44/16

NCL1135> mode bridging                       ◄──────  Sets the mode to bridging
Forwarding mode: Bridging

NCL1135> ip                                  ◄──────  Displays the IP configuration
Forwarding Mode: BRIDGING                             information
Addresses:
  Ethernet: 10.0.2.44/16
Routing: IP Routing (Static Only)
Routing Table:
Destination     Mask Gateway        Flags         Protocol  Interface
----------------------------------------------------------------------
10.0.0.0        16   10.0.2.44       UC            Local     eeE0
10.0.2.44       0    10.0.2.44       UHL           ICMP      lo0
127.0.0.1       0    127.0.0.1       UH            Local     lo0
----------------------------------------------------------------------
DNS Domain Name:
DNS Servers:
No DNS servers defined.

NCL1135> write                               ◄──────  Saves the configuration
```

The following example session shows how to configure Station B in Figure 10 to join the network. To configure the remaining Stations, use the same procedure, replacing the unit ID and IP address for each with the appropriate information for that Station.

```
NCL1135>

NCL1135> radio channel 1
Radio channel changed to: 1

NCL1135> radio unitid 101
Unit ID changed to: 101

NCL1135> radio type station                    Sets the NCL1135 type to Station
Radio type changed to: Station

NCL1135> radio masterid 1001                    Identifies the unit ID of the Master for
Master Id changed to: 1001                      this Station

NCL1135> ip address ethernet 10.0.2.101 16
IP addresses:
  Ethernet: 10.0.2.101/16

NCL1135> mode bridging
Forwarding mode: Bridging

NCL1135> radio
RADIO CONFIGURATION:
Radio type        : Station
Wireless ID       : 101
Speed             : 11Mbs
Channel           : 1
Regulatory Domain : FCC/IC
Frequency         : 2.412 GHz
Interframe spacing: 32 (281.6 micro seconds)
Hardware address  : 00:90:27:CA:62:A3
Network Card IRQ  : 5
NIC Base Address  : 0x0d0000
Master ID         : 1001

NCL1135> ip
Forwarding Mode: BRIDGING
Addresses:
  Ethernet: 10.0.2.101/16
Routing: IP Routing (Static Only)
Routing Table:
Destination     Mask Gateway          Flags        Protocol  Interface
-------------------------------------------------------------------
10.0.0.0        16   10.0.2.101        UC           Local     eeE0
10.0.2.101      0    10.0.2.101        UHL          ICMP      lo0
127.0.0.1       0    127.0.0.1         UH           Local     lo0
-------------------------------------------------------------------
DNS Domain Name:
DNS Servers:
No DNS servers defined.

NCL1135> write
```

3.3.2 Point-to-Multipoint Routing Network

Figure 11 shows a configuration of a typical point-to-multipoint routing network.

Figure 11   Example Point-to-Multipoint Routing Network
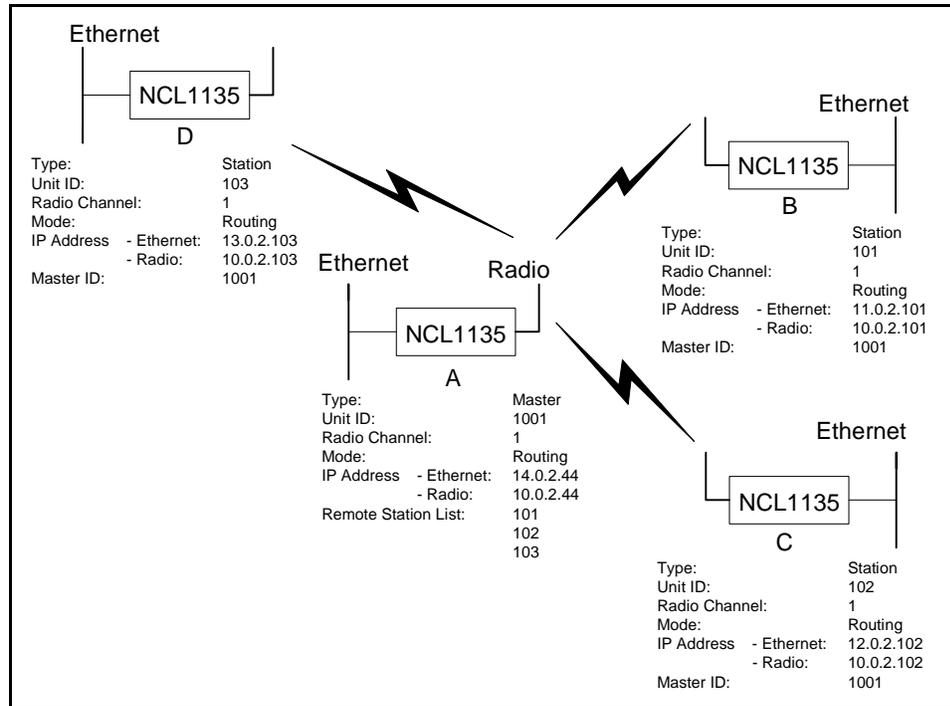
The following example session shows how to configure the Master NCL1135 for the routing network shown in Figure 11.

```
NCL1135>
NCL1135> ip address ethernet 14.0.2.44 16
IP addresses:
  Ethernet: 14.0.2.44/16

NCL1135> mode routing                        ◀────── Sets the mode to routing
Forwarding mode: IP Routing

ncl1135> dhcp                                 ◀────── DHCP Relay is disabled by default
DHCP Disabled

ncl1135> dhcp mode relay                      ◀────── Enable DHCP Relay
DHCP Relay Enabled

ncl1135> dhcp relay add 10.0.1.44            ◀────── Add a DHCP Server to the DHCP
DHCP Servers/Relay Agents:                            Relay table
  10.0.1.44

NCL1135> radio channel 1

NCL1135> radio type master
Radio type changed to: Master

NCL1135> radio unitid 1001
Unit ID changed to: 1001
```

```
NCL1135> radio station add 101
Station added.

NCL1135> radio station add 102
Station added.

NCL1135> radio station add 103
Station added.

NCL1135> ip                                      ◄────── Displays the IP configuration
Forwarding Mode: IP ROUTING                              information
Addresses:
  Ethernet: 14.0.2.44/16
  Radio:   101, 10.0.2.44 p-t-p ?               ◄────── The ? means that the IP address for
           102, 10.0.2.44 p-t-p ?                       the remote unit in the routing network
           103, 10.0.2.44 p-t-p ?                       has not been set
Routing: IP Routing (Static Only)
Routing Table:
Destination     Mask Gateway        Flags       Protocol  Interface
--------------------------------------------------------------------
14.0.2.44       0    14.0.2.44       UHL         ICMP      lo0
14.0.0.0        16   14.0.2.44       UC          Local     eeE0
127.0.0.1       0    127.0.0.1       UH          Local     lo0
--------------------------------------------------------------------
DNS Domain Name:
DNS Servers:
No DNS servers defined.

NCL1135> radio
RADIO CONFIGURATION:
Radio type        : Master
Wireless ID       : 1001
Speed             : 11Mbs
Channel           : 1
Regulatory Domain : FCC/IC
Frequency         : 2.412 GHz
Interframe spacing: 32 (281.6 micro seconds)
Hardware address  : 00:90:27:CA:62:A3
Network Card IRQ  : 5
NIC Base Address  : 0x0d0000
Remote Stations   : 101
                  : 102
                  : 103

NCL1135> ip address radio 101 10.0.2.44 10.0.2.101   ◄──── Sets the radio IP
IP addresses:                                               address for the route to
  Ethernet: 14.0.2.44/16                                    station B (unit ID 101)
  Radio:   101, 10.0.2.44 p-t-p 10.0.2.101
           102, 10.0.2.44 p-t-p ?
           103, 10.0.2.44 p-t-p ?

NCL1135> ip address radio 102 10.0.2.44 10.0.2.102   ◄──── Sets the radio IP
IP addresses:                                               address for the route to
  Ethernet: 14.0.2.44/16                                    station C (unit ID 102)
  Radio:   101, 10.0.2.44 p-t-p 10.0.2.101
           102, 10.0.2.44 p-t-p 10.0.2.102
           103, 10.0.2.44 p-t-p ?

NCL1135> ip address radio 103 10.0.2.44 10.0.2.103   ◄──── Sets the radio IP
IP addresses:                                               address for the route to
  Ethernet: 14.0.2.44/16                                    station D (unit ID 103)
  Radio:   101, 10.0.2.44 p-t-p 10.0.2.101
           102, 10.0.2.44 p-t-p 10.0.2.102
           103, 10.0.2.44 p-t-p 10.0.2.103
```

```
NCL1135> ip route add 11.0.0.0 10.0.2.101 16
Routing Table:
Destination     Mask Gateway         Flags      Protocol  Interface
-------------------------------------------------------------------
14.0.2.44       0    14.0.2.44        UHL        ICMP      lo0
10.0.2.101      0    10.0.2.44        UHC        Local     mdr1
10.0.2.102      0    10.0.2.44        UHC        Local     mdr2
10.0.2.103      0    10.0.2.44        UHC        Local     mdr3
14.0.0.0        16   14.0.2.44        UC         Local     eeE0
11.0.0.0        16   10.0.2.101       UC         Static    mdr1
127.0.0.1       0    127.0.0.1        UH         Local     lo0
-------------------------------------------------------------------
```

For each Station, route the Ethernet subnet to the radio IP address of the Station

```
NCL1135> ip route add 12.0.0.0 10.0.2.102 16
Routing Table:
Destination     Mask Gateway         Flags      Protocol  Interface
-------------------------------------------------------------------
14.0.2.44       0    14.0.2.44        UHL        ICMP      lo0
10.0.2.101      0    10.0.2.44        UHC        Local     mdr1
10.0.2.102      0    10.0.2.44        UHC        Local     mdr2
10.0.2.103      0    10.0.2.44        UHC        Local     mdr3
14.0.0.0        16   14.0.2.44        UC         Local     eeE0
11.0.0.0        16   10.0.2.101       UC         Static    mdr1
12.0.0.0        16   10.0.2.102       UC         Static    mdr2
127.0.0.1       0    127.0.0.1        UH         Local     lo0
-------------------------------------------------------------------


NCL1135> ip route add 13.0.0.0 10.0.2.103 16
Routing Table:
Destination     Mask Gateway         Flags      Protocol  Interface
-------------------------------------------------------------------
14.0.2.44       0    14.0.2.44        UHL        ICMP      lo0
10.0.2.101      0    10.0.2.44        UHC        Local     mdr1
10.0.2.102      0    10.0.2.44        UHC        Local     mdr2
10.0.2.103      0    10.0.2.44        UHC        Local     mdr3
14.0.0.0        16   14.0.2.44        UC         Local     eeE0
11.0.0.0        16   10.0.2.101       UC         Static    mdr1
12.0.0.0        16   10.0.2.102       UC         Static    mdr2
13.0.0.0        16   10.0.2.103       UC         Static    mdr3
127.0.0.1       0    127.0.0.1        UH         Local     lo0
-------------------------------------------------------------------


NCL1135> ip
Forwarding Mode: IP ROUTING
Addresses:
  Ethernet: 14.0.2.44/16
  Radio:   101, 10.0.2.44 p-t-p 10.0.2.101
           102, 10.0.2.44 p-t-p 10.0.2.102
           103, 10.0.2.44 p-t-p 10.0.2.103
Routing: IP Routing (Static Only)
Routing Table:
Destination     Mask Gateway         Flags      Protocol  Interface
-------------------------------------------------------------------
14.0.2.44       0    14.0.2.44        UHL        ICMP      lo0
10.0.2.101      0    10.0.2.44        UHC        Local     mdr1
10.0.2.102      0    10.0.2.44        UHC        Local     mdr2
10.0.2.103      0    10.0.2.44        UHC        Local     mdr3
14.0.0.0        16   14.0.2.44        UC         Local     eeE0
11.0.0.0        16   10.0.2.101       UC         Static    mdr1
12.0.0.0        16   10.0.2.102       UC         Static    mdr2
13.0.0.0        16   10.0.2.103       UC         Static    mdr3
127.0.0.1       0    127.0.0.1        UH         Local     lo0
-------------------------------------------------------------------
DNS Domain Name:
```

Note the IP addresses for the remote Stations are now set

```
        DNS Servers:
        No DNS servers defined.

        NCL1135> write
```

The following example session shows how to configure Station B in Figure 11 to join the routing network. To configure the remaining Stations, use the same procedure, replacing the unit ID for each Station with the appropriate ID for that Station.

```
     NCL1135>
     NCL1135> ip address ethernet 11.0.2.101 16
     IP addresses:
       Ethernet: 11.0.2.101/16
       Radio:   200, 10.0.2.44 p-t-p ?

     ncl1135> dhcp mode relay           ◄─────────  Enable DHCP Relay
     DHCP Relay Enabled

     ncl1135> dhcp relay add 10.0.1.44  ◄─────  Add a DHCP Server to the DHCP
     DHCP Servers/Relay Agents:                 Relay table
       10.0.1.44

     NCL1135> radio channel 1           ◄─────────  Set the radio channel

     NCL1135> mode routing
     Forwarding mode: IP Routing

     NCL1135> radio type station
     Radio type changed to: Station

     NCL1135> radio unitid 101
     Unit ID changed to: 101

     NCL1135> radio masterid 1001
     Master Id changed to: 1001

     NCL1135> ip address radio 1001 10.0.2.101 10.0.2.44  ◄──  Sets the radio IP
     IP addresses:                                             address for the route to
       Ethernet: 11.0.2.101/16                                 the Master NCL1135
       Radio:  1001, 10.0.2.101 p-t-p 10.0.2.44

     NCL1135> ip route add 0.0.0.0 10.0.2.44 16  ◄─────  Sets the default static route

     Routing Table:
     Destination    Mask Gateway          Flags      Protocol  Interface
     --------------------------------------------------------------------
     10.0.2.44      0    10.0.2.101        UHC        Local     mdr1
     11.0.2.101     0    11.0.2.101        UHL        ICMP      lo0
     11.0.0.0       16   11.0.2.101        UC         Local     eeE0
     0.0.0.0        0    10.0.2.44         UC         Static    mdr1
     127.0.0.1      0    127.0.0.1         UH         Local     lo0
     --------------------------------------------------------------------

     NCL1135> radio
     RADIO CONFIGURATION:
     Radio type        : Station
     Wireless ID       : 101
     Speed             : 11Mbs
     Channel           : 4
     Regulatory Domain : FCC/IC
     Frequency         : 2.412 GHz
     Interframe spacing: 32 (281.6 micro seconds)
     Hardware address  : 00:90:27:CA:62:A3
```

```
Network Card IRQ  : 5
NIC Base Address  : 0x0d0000
Master ID         : 1001

NCL1135> ip
Forwarding Mode: IP ROUTING
Addresses:
  Ethernet: 11.0.2.101/16
  Radio:  1001, 10.0.2.101 p-t-p 10.0.2.44
Routing: IP Routing (Static Only)
Routing Table:
Destination     Mask Gateway        Flags       Protocol  Interface
------------------------------------------------------------------
10.0.2.44       0    10.0.2.101     UHC         Local     mdr1
11.0.2.101      0    11.0.2.101     UHL         ICMP      lo0
11.0.0.0        16   11.0.2.101     UC          Local     eeE0
0.0.0.0         0    10.0.2.44      UC          Static    mdr1
127.0.0.1       0    127.0.0.1      UH          Local     lo0
------------------------------------------------------------------
DNS Domain Name:
DNS Servers:
No DNS servers defined.
```

3.4   Updating an NCL1135 Using Remote Connections

The NCL1135 allows you to connect to it remotely using any of the following methods:
- FTP
- Telnet

In order to remotely access an NCL1135, you will need the following information:
- IP address for the NCL1135
- NCL1135 Password (Refer to the Configuration Data Record for the NCL1135.)

> **NOTE:** If your network has a firewall, you will only be able to access the NCL1135 from within the network. Before attempting to configure the NCL1135 using a remote connection, you should be familiar with the configuration procedures described in *Configuring the NCL1135*, on page 16.

3.4.1 Establishing an FTP Connection

Use an FTP session to upload firmware upgrades to the NCL1135. Specific instructions to upgrade firmware will be provided with each new release.

> **NOTE:** The following procedure assumes that you are using a basic command-line FTP application.

1. From a computer or terminal, start an FTP session following the instructions for the FTP application you are using.

2. Log into the NCL1135.

3. At the User Name prompt, press ENTER. For FTP sessions, the User Name for the NCL1135 is blank.

4. At the Password prompt, type the NCL1135 password that you defined for the device. Refer to the Configuration Data Record for the NCL1135.

5. On the FTP client, change the Transfer Mode to binary (for example, type `<binary>`).

6. On the FTP client, put the file to the client (for example: type `<put `*`filename.exe filename.exe`*`>`). The file transfer will take a few minutes to complete.

7. After the confirmation message is received, quit the FTP session (for example, type `<quit>`).

> **NOTE:** Once finished with the FTP session, you will need to follow up with a Telnet session to reboot the NCL1135 for the upgrade to take effect.

3.4.2 Establishing a Telnet Session

Use a Telnet connection to the NCL1135 to modify configuration parameters or to restart the NCL1135 from a remote location.

CAUTION: If you connect to the NCL1135 using Telnet and change the radio or Ethernet IP address, your connection to the device will be dropped. You will need to reconnect to the NCL1135 using the new IP address in order to save your changes to the device. When you use a local serial connection, this does not occur.

You can use a standard Telnet application to connect to the NCL1135.

1. Start the Telnet application on your computer.

2. Use a remote system connection to connect to the IP address for the NCL1135.

3. At the Password prompt, type the NCL1135 password. The application opens a terminal-emulation screen.

4. Modify the configuration parameters as necessary.

5. When done, type `<exit>` to close the Telnet session.

   NOTE: If you perform a restart or reboot from a Telnet connection, the NCL1135 will drop your connection. You will need to reconnect to the NCL1135 after a restart.

4 Testing

To test the NCL1135 configuration you will need at least two NCL1135s, one of which must be configured as a Master. Use the Ping Test to test the NCL1135s to verify that the NCL1135 have been configured correctly and that they are able to communicate with each other.

4.1 Performing a Ping Test

1. Set up the NCL1135s on either side of a room (at least 12 feet apart).

2. Ensure that each NCL1135 has an antenna connected to it. Do NOT plug the NCL1135 to the power outlet until you have an antenna connected.

WARNING!

Antennas and associated transmission cable must be installed by qualified personnel. Failure to terminate the antenna port correctly can permanently damage the NCL1135. WaveRider assumes no liability for failure to adhere to this recommendation or to recognized general safety precautions.

3. Plug the NCL1135 back into the power source and at the terminal console keyboard, log into the NCL1135.

4. At the `NCL1135>` prompt, type `<ip ping ip_address>` where *ip_address* is the IP address for the other NCL1135.

5. Let the `ip ping` command run for approximately 10 seconds. Press any key to end the `ip ping` command. If the configuration is correct, you should get a response similar to the following:

```
ncl1135>
ncl1135> ip ping 10.0.2.52
Press any key to stop.
```

```
PING 10.0.2.52: 56 data bytes
64 bytes from 10.0.2.52: icmp_seq=0. time=0. ms
64 bytes from 10.0.2.52: icmp_seq=1. time=30. ms
64 bytes from 10.0.2.52: icmp_seq=2. time=0. ms
64 bytes from 10.0.2.52: icmp_seq=3. time=0. ms
64 bytes from 10.0.2.52: icmp_seq=4. time=0. ms
64 bytes from 10.0.2.52: icmp_seq=5. time=0. ms
64 bytes from 10.0.2.52: icmp_seq=6. time=0. ms
----10.0.2.52 PING Statistics----
7 packets transmitted, 7 packets received, 0% packet loss
round-trip (ms)  min/avg/max = 0/4/30

ncl1135>
```

If the connection does not work, you will receive the following message:

```
ncl1135>
ncl1135> ip ping 10.0.2.52
Press any key to stop.
PING 10.0.2.52: 56 data bytes
no answer from 10.0.2.52

ncl1135>
```

You receive replies only if the link is operational. Refer to Chapter 7, *Troubleshooting*, on page 53 if the device does not respond.

5 Deploying the NCL1135

The following section describes tests that you can use to optimize the signal strength and align the NCL1135 antennas after they are set up and transmitting.

NOTE: You cannot run more than one test at a time at a given unit.

5.1 Optimizing Signal Strength

5.1.1 Running the Continuous Transmit (Tx) Test

This test should only be used when setting up a Master and the first Station of a new network. The purpose of this test is to send a continuous stream of messages from an NCL1135 Master to a Station which receives and discards the messages, or to a spectrum analyzer for signal monitoring. The Radio Packet Error Rate (PER) is displayed at a Station receiving the Continuous Transmit messages and using that information, an installer aligns the antenna accordingly. Refer to *Displaying the Radio Packet Error Rate (PER)*, on page 43 for more information.

You will need one NCL1135 configured as a Master. At the other end of the link, you can have an NCL1135 Station or a spectrum analyzer. The following procedure describes the test for a Master NCL1135 and one Station NCL1135. If you are using a spectrum analyzer, adjust the antenna for maximum received signal.

CAUTION: Do NOT run this test in a working network. Doing so will cause every device in the network to slow down.

1. Ensure that the NCL1135s (one Master and one Station) have been configured and tested.

2. Deploy the Master and Station connecting the antennas as required.

WARNING!

Antennas and associated transmission cable must be installed by qualified personnel. Failure to terminate the antenna port correctly can permanently damage the NCL1135. WaveRider assumes no liability for failure to adhere to this recommendation or to recognized general safety precautions.

3. Connect a terminal at each NCL1135 using a serial cable and log into each device.

4. At the Master NCL1135 console terminal, type `<radio txTest start>` to begin the Continuous Transmit Test. "Radio Tx Test On" is displayed above the `NCL1135>` prompt when the test is running.

5. At the Station NCL1135 console terminal, type `<radio per continuous>` to begin displaying the Radio PER. Refer to *Displaying the Radio Packet Error Rate (PER)*, on page 43 for more information.

6. Using the information from Radio PER, align the antenna at the NCL1135 Station so that the number of packets missed is at a minimum rate.

7. When done with the antenna alignment, stop the test at the Master NCL1135. Type `<radio txTest stop>`.

8. At the Station NCL1135, press any key to end the Radio PER output.

   NOTE: By default, a Master NCL1135 keeps track of the Radio PER of each Station. A Station does not track the Radio PER of another visible Station unless it is running the Continuous Receive test. Refer to *Running the Continuous Receive (Rx) Test*, on page 39. A Station does track the Radio PER of both direct and broadcast communication with the Master.

The information received from Radio PER during the Continuous Transmit test will be similar to the following output. The following output is from a Station (unit ID 2) communicating with the Master (unit ID 1) that is running the Continuous Transmit test.

```
station> radio per continuous

Unit Id    Link Status   Total # Received  Total # Missed  PER (%)
---------  -----------   ----------------  --------------  -------
1          UP            2                 0               0
broadcast                5                 0               0

Unit Id    Link Status   Total # Received  Total # Missed  PER (%)
---------  -----------   ----------------  --------------  -------
1          UP            2                 0               0
broadcast                820               56              6
```

```
Unit Id      Link Status    Total # Received  Total # Missed  PER (%)
---------    -----------    ----------------  --------------  -------
1            UP             2                 0               0
broadcast                   1679              91              5

Unit Id      Link Status    Total # Received  Total # Missed  PER (%)
---------    -----------    ----------------  --------------  -------
1            UP             2                 0               0
broadcast                   2545              126             4

Unit Id      Link Status    Total # Received  Total # Missed  PER (%)
---------    -----------    ----------------  --------------  -------
1            UP             2                 0               0
broadcast                   3411              149             4

station>
```

5.1.2 Running the Continuous Receive (Rx) Test

The purpose of this test is to help you deploy an additional Station in an existing network
without interrupting traffic to the currently active Stations in the network. The test is run from
the new Station to "sniff" packets destined to every other Station (originated by the Master) in
the system. The test is run simultaneously with Radio PER which displays the number of
packets received and missed for each Station that is sniffed. This test can also be used at
existing Stations to analyze throughput in a running system.

1. Ensure that the new Station NCL1135 has been configured and tested.

2. Deploy the Station and connect the antenna.

WARNING!

**Antennas and associated transmission cable must be installed
by qualified personnel. Failure to terminate the antenna port
correctly can permanently damage the NCL1135. WaveRider
assumes no liability for failure to adhere to this recommendation
or to recognized general safety precautions.**

3. Connect a terminal at the Station NCL1135 using a serial cable and log into the
   device.

4. At the Station NCL1135, type `<radio rxTest start>` to begin "sniffing" the
   transmissions and automatically start the Radio PER display. "Continuous Rx test
   started" is displayed when the test is started.

   NOTE: If you stop the Radio PER display (press any key), you can
   restart the display by typing `<radio per continuous>`. Refer
   to *Displaying the Radio Packet Error Rate (PER)*, on page 43 for
   more information.

5. Using the information from Radio PER, align the antenna at the NCL1135 Station so that the number of packets missed is at a minimum rate.

6. When done with the antenna alignment, press any key to stop the Radio PER display, then type <radio rxTest stop> to stop the test.

   NOTE: When the Continuous Receive test is stopped, the Master NCL1135 statistics, both direct and broadcast, remain in the Radio PER list and continue to be updated. If the Continuous Receive test is restarted, the statistics for the Master and broadcast will continue from where they left off. The Stations will start from zero again.

The information received from Radio PER during the Continuous Receive test will be similar to the following output. The following output is from a Station (unit ID 2) communicating with the Master (unit ID 1) that is also transmitting to another Station (unit ID 3).

```
station> radio rxtest start

Continuous Rx test started

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 509               0               0
3          UP             1                 0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 510               0               0
3          UP             1                 0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 512               0               0
3          UP             1                 0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 515               0               0
3          UP             1                 0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 518               0               0
3          UP             1                 0               0

[Radio Rx Test On]
station> radio rxtest stop
station>
```

5.1.3 Performing the Transmit/Receive Loopback Test

This test should only be used when setting up a new network. The purpose of this test is to ensure that the Master NCL1135 can "see" the Station. It also determines the quality of the links between Master and Station. The test originates at the Master NCL1135, repeatedly sending test packets to the Stations. A Station recognizes these as test packets from the Master and echoes them back to the Master. When the Master receives the replies from the Station, it updates its Radio PER for that Station. One Master NCL1135 can have up to ten Stations simultaneously echoing test packets back to it.

You will need one NCL1135 configured as a Master and at least one NCL1135 Station.

CAUTION: Do NOT run this test in a working network. Doing so will cause every device in the network to slow down.

1. Ensure that the Master NCL1135 and Station NCL1135s have been configured and tested.

2. Deploy the Master and at least one Station connecting the antennas for each device as required.

WARNING!

Antennas and associated transmission cable must be installed by qualified personnel. Failure to terminate the antenna port correctly can permanently damage the NCL1135. WaveRider assumes no liability for failure to adhere to this recommendation or to recognized general safety precautions.

3. Connect a terminal to the Master NCL1135 using a serial cable and log into the device.

4. At the Master NCL1135 console terminal, type `<radio txrx start>` to begin the Transmit/Receive Loopback test and automatically start the Radio PER display. "Tx/Rx test started" is displayed when the test is started. Refer to *Displaying the Radio Packet Error Rate (PER)*, on page 43 for more information.

5. Using the information from Radio PER, determine the quality of the link between the Master and Stations.

6. When done, press any key to stop Radio PER, then stop the Transmit/Receive Loopback Test by typing `<radio txrx stop>`.

The information received from Radio PER during the Transmit/Receive Loopback test will be similar to the following output. The following output is from a Master (unit ID 1) communicating with two Stations (unit IDs 2 and 3).

```
master> radio txrx start

Tx/Rx test started

Unit Id     Link Status     Total # Received  Total # Missed   PER (%)
---------   -----------     ----------------  --------------   -------
2           UP              9                 0                0
3           UP              5                 0                0

Unit Id     Link Status     Total # Received  Total # Missed   PER (%)
---------   -----------     ----------------  --------------   -------
2           UP              827               53               6
3           UP              820               56               6

Unit Id     Link Status     Total # Received  Total # Missed   PER (%)
---------   -----------     ----------------  --------------   -------
2           UP              1689              85               4
3           UP              1679              91               5

Unit Id     Link Status     Total # Received  Total # Missed   PER (%)
---------   -----------     ----------------  --------------   -------
2           UP              2566              109              4
3           UP              2545              126              4

Unit Id     Link Status     Total # Received  Total # Missed   PER (%)
---------   -----------     ----------------  --------------   -------
2           UP              3423              141              3
3           UP              3411              149              4

[Radio TxRx Test On]
master>  radio txrx stop
master>
```

6 Operational Statistics

After the NCL1135 is configured, you can obtain the radio Packet Error Rate (PER) information in addition to the operational statistics on the NCL1135 interfaces, radio, and IP protocol layer.

6.1 Displaying the Radio Packet Error Rate (PER)

Radio PER can be displayed at any time, including during tests. See Chapter 5, *Deploying the NCL1135*, on page 37 for tests that use Radio PER to display statistics during testing.

To display the current Radio PER for an NCL1135 during normal operation, type `<radio per>` or `<radio per single>`.

Table 1 defines how to interpret the Radio PER output.

At a Master NCL1135, you will receive output similar to the following. The following example was taken at a Master NCL1135 communicating with two Stations (unit IDs 2 and 3).

```
master> radio per single

Unit Id     Link Status    Total # Received  Total # Missed  PER (%)
---------   -----------    ----------------  --------------   -------
2           UP             2                 0                0
3           UP             2                 0                0

master>
```

At a Station NCL1135, you will receive output similar to the following. The following example was taken at a Station (unit ID 2) communicating with a Master (unit ID 1).

```
station> radio per single

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 72                0               0

station>
```

To display the radio PER once every second during normal operation, type <radio per continuous>.

> **NOTE:** All Radio PER results are cumulative.

To clear the Radio PER statistics, type <radio per reset>.

To stop the Radio PER display, press any key.

At a Master NCL1135, you will receive output similar to the following. The following example was taken at a Master (unit ID 1) communicating with two Stations (unit IDs 2 and 3).

```
master> radio per continuous

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
2          UP             2                 0               0
3          UP             2                 0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
2          UP             102               0               0
3          UP             42                0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
2          UP             112               1               0
3          UP             4                 0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
2          UP             140               2               0
3          UP             85                0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
2          UP             171               2               0
3          UP             101               0               0

master>
```

At a Station NCL1135, you will receive output similar to the following. The following example was taken at a Station (unit ID 2) communicating with a Master (unit ID 1).

```
station> radio per continuous

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 236               0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 237               0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 239               0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 240               0               0

Unit Id    Link Status    Total # Received  Total # Missed  PER (%)
---------  -----------    ----------------  --------------  -------
1          UP             1                 0               0
broadcast                 241               0               0


station>
```

Table 1   Radio Packet Error Rate Assessment

Radio PER Ratio	Transmission Quality
less than 1%	excellent
less than 2%	good
less than 5%	marginal
greater than 5%	poor

TIP: Use Radio PER during deployment testing to monitor the transmission quality. Refer to Chapter 5, *Deploying the NCL1135*, on page 37 for sample output of Radio PER during testing.

6.2   Displaying the Operational Statistics

6.2.1 Interface Statistics

The `interface statistics` command displays the configuration information and statistics for the three interfaces associated with the NCL1135: radio, Ethernet and loopback.

The loopback interface is an interface on a logical network that returns all output packets as input packets. The address for this logical network is 127.0.0.0 and the address for the loopback interface is usually 127.0.0.1. This means that any packets sent to the IP address 127.0.0.1 will be turned around and queued as input packets to the same interface. The values of the input and output statistics for the loopback interface should both be the same.

To see the interface information for a NCL1135, type `<interface statistics>` at the `NCL1135>` prompt.

Table 2 provides definitions for the statistics labels.

For a Master NCL1135, information similar to the following example is displayed.

```
NCL1135> interface statistics
Statistics For Loopback
-------------------
Flags                        UP LOOPBACK NOTRAILERS RUNNING MULTICAST
MTU                          32768
Hardware Address
Administrative Status        UP(1)
Operational Status           UP(1)
Input Octets                 3808
Input Unicast Packets        64
Input Non-Unicast Packets    0
Input Discards               0
Input Errors                 0
Input Unknown Protocols      0
Output Octets                3808
Output Unicast Packets       64
Output Non-Unicast Packets   0
Output Discards              0
Output Errors                0
more...
Statistics For Ethernet
-------------------
Flags                        UP BROADCAST NOTRAILERS RUNNING MULTICAST
MTU                          1500
Hardware Address             00:90:27:b1:aa:ad
Administrative Status        UP(1)
Operational Status           UP(1)
Input Octets                 31614896
Input Unicast Packets        20923
Input Non-Unicast Packets    0
Input Discards               9022
Input Errors                 0
Input Unknown Protocols      0
Output Octets                3371158
Output Unicast Packets       2255
Output Non-Unicast Packets   0
Output Discards              2215
Output Errors                0
```

```
more...
Statistics For Master Radio
---------------------------
Flags                         UP POINT-TO-POINT NOTRAILERS RUNNING NOARP MULTIC
AST
MTU                           1552
Hardware Address              00:90:27:b1:aa:ad
Administrative Status    UP(1)
Operational Status       UP(1)

Input Statistics
---------------------------
Remote                  Non-
Station    Input      Unicast    Unicast                              Unknown
ID         Octets     Packets    Packets    Discards    Errors    Protocols
-------    ------     -------    -------    --------    ------    ---------
101        967998     0          645        0           0         0
102        1218723    0          808        0           0         0
103        1251987    0          830        0           0         0
more...

Output Statistics
---------------------------
Remote                  Non-
Station    Output     Unicast    Unicast
ID         Octets     Packets    Packets    Discards    Errors
-------    ------     -------    -------    --------    ------
101        10419675   6943       1          45          0
102        10446473   6958       0          33          0
103        10402915   6929       0          43          0
```

For a Station NCL1135, information similar to the following example is displayed.

```
NCL1135> interface statistics
Statistics For Loopback
-------------------
Flags                         UP LOOPBACK NOTRAILERS RUNNING MULTICAST
MTU                           32768
Hardware Address
Administrative Status    UP(1)
Operational Status       UP(1)
Input Octets             2975
Input Unicast Packets    50
Input Non-Unicast Packets    0
Input Discards           0
Input Errors             0
Input Unknown Protocols  0
Output Octets            2975
Output Unicast Packets   50
Output Non-Unicast Packets   0
Output Discards          0
Output Errors            0
more...
Statistics For Ethernet
-------------------
Flags                         UP BROADCAST NOTRAILERS RUNNING MULTICAST
MTU                           1500
Hardware Address              00:90:27:b1:ad:01
Administrative Status    UP(1)
Operational Status       UP(1)
Input Octets             7479220
Input Unicast Packets    4941
```

```
Input Non-Unicast Packets     0
Input Discards                0
Input Errors                  0
Input Unknown Protocols       0
Output Octets                 25364516
Output Unicast Packets        16759
Output Non-Unicast Packets    0
Output Discards               76
Output Errors                 0
more...
Statistics For Radio
-------------------
Flags                         UP POINT-TO-POINT NOTRAILERS RUNNING NOARP MULTIC
AST
MTU                           1552
Hardware Address              00:90:27:b1:ad:01
Administrative Status         UP(1)
Operational Status            UP(1)
Input Octets                  25331759
Input Unicast Packets         16769
Input Non-Unicast Packets     5
Input Discards                0
Input Errors                  0
Input Unknown Protocols       0
Output Octets                 7441747
Output Unicast Packets        4970
Output Non-Unicast Packets    0
Output Discards               0
Output Errors                 0
```

Table 2   Interface Statistics

Label	Description
Flags	Specifies the operational state and properties of the interface. Possible flags are: • BROADCAST: interface is for a broadcast network • MULTICAST: interface supports multicasting • POINT-TO-POINT: interface is for a point-to-point network • LOOPBACK: interface is for a loopback network • RUNNING: resources are allocated for this interface • SIMPLEX: interface cannot receive its own transmissions • ALLMULTI: interface is receiving all multicast packets • DEBUG: debugging is enabled for the interface • NOARP: do not use ARP on this interface • NOTRAILERS: avoid using trailer encapsulation • PROMISCUOUS: interface receives all network packets • TX: a transmission is in progress • UP: interface is operating
MTU	Maximum transmission unit or the size of the largest packet the interface can handle.
Hardware Address	MAC address or Ethernet address of the interface.

Label	Description
Administrative Status	Desired state of the interface. The NCL1135 supports UP and DOWN states.
Operational Status	Current operational state of the interface.
Input Octets	Number of bytes that arrived on this interface since the last `interface reset` or `reboot`.
Input Unicast Packets	Number of unicast packets that arrived on this interface since the last `interface reset` or `reboot`.
Input Non-Unicast Packets	Number of non-unicast packets that arrived on this interface since the last `interface reset` or `reboot`.
Input Discards	Number of packets that arrived on this interface and were discarded since the last `interface reset` or `reboot`.
Input Errors	Number of packets that arrived on this interface with errors since the last `interface reset` or `reboot`.
Output Octets	Number of bytes that were sent from this interface since the last `interface reset` or `reboot`.
Output Unicast Packets	Number of unicast packets that were sent from this interface since the last `interface reset` or `reboot`.
Output Non-Unicast Packets	Number of non-unicast packets that were sent from this interface since the last `interface reset` or `reboot`.
Output Discards	Number of outbound packets that were dropped because of implementation limits since the last `interface reset` or `reboot`.
Output Errors	Number of outbound packets dropped because of errors since the last `interface reset` or `reboot`.

6.2.2 IP Statistics

To see the IP protocol layer statistics for a NCL1135, at the `NCL1135>` prompt, type `<ip statistics>`.

Table 3 provides definitions for the statistics labels.

Information similar to the following example is displayed. The statistics for this command are from the time of the last reboot of the NCL1135.

```
NCL1135> ip statistics

IP STATISTICS
-------------
Total packets received          50
Bad checksum discards            0
Packet too short discards        0
Not enough data discards         0
Bad header length discards       0
Bad data length discards         0
Fragments received               0
Fragments dropped                0
```

```
Fragments timed out              0
Packets forwarded                0
Couldn't forward discards        0
Redirected forwards              0
Unknown protocol discards       25
No space discards                0
Packets reassembled              0
Fragments sent                   0
No route discards                0
```

Table 3   IP Statistics

Label	Descriptions
Total packets received	Number of packets sent to the IP layer.
Bad checksum discards	Number of packets discarded due to a bad checksum.
Packet too short discards	Number of packets dropped due to an invalid data length.
Not enough data discards	Number of packets dropped because they did not contain enough data to be an IP packet.
Bad header length discards	Number of packets discarded because of inconsistent IP header and IP data lengths.
Fragment received	Number of packet fragments received.
Fragments dropped	Number of fragments dropped due to lack of space or duplicates.
Fragments timed out	Number of fragments that were timed-out.
Packets forwarded	Number of packets forwarded at the IP layer.
Couldn't forward discards	Number of packets received for unreachable destinations.
Redirected forwards	Number of redirect messages that were sent.
Unknown protocol discards	Number of packets of unknown or unsupported protocol received and discarded.
No space discards	Number of packets dropped because of resource shortages.
Packets reassembled	Number of packets that needed to be reassembled.
Fragments sent	Number of fragments successfully sent.
No route discards	Number of packets discarded because there was no route to the destination given.

6.2.3 Radio Statistics

To see the radio statistics for a NCL1135, at the `NCL1135>` prompt, type
`<radio statistics>`.

Table 4 provides definitions for the statistics labels.

Information similar to the following example is displayed. The statistics for this command are from the time of the last reboot of the NCL1135.

```
NCL1135> radio statistics

RADIO STATISTICS:
----------------------------------------------------------------------
Transmitted            :             1
Tx Blocks delayed      :             0
Rx Packets             :             0
Rx Data CRC Error      :             0
ALF Header Chksum Error :            0
Rx MAC Header CRC Error :            0
RX MAC Header CRC Fixed :            0
Rx Invalid Data Length  :            0
NIC Failures           :             0
Broadcast Discards     :             0
Transmit Timeouts      :             0
```

Table 4   Radio Statistics

Label	Description
Transmitted	Number of packets sent.
Tx Blocks delayed	Number of transmitted blocks delayed.
Rx Packets	Number of packets received.
Rx Data CRC Error	Number of received data CRC errors that occurred.
ALF Header Chksum Error	Number of packets received with an invalid Air Link Frame (ALF) header.
Rx MAC Header CRC Error	Number of times packets were discarded because headers were invalid.
Rx MAC Header CRC Fixed	Number of times the MAC header CRC was fixed.
RX Invalid Data Length	Number of packets received with an invalid length (that is, greater than the maximum size).
NIC Failure	Number of network interface card failures.
Broadcast Discards	Number of broadcast packets that the NCL1135 received and discarded.
Transmit Timeouts	Number of transmit timeouts due to the radio channel being too busy or due to interference.

7 Troubleshooting

This section provides possible solutions for common problems associated with NCL1135 operation.

To verify that the connection has been re-established, test the connection using a ping test described in *Performing a Ping Test*, on page 35.

To verify the routing, follow the procedures in *Verifying NCL1135 Routing*, on page 55.

Table 5   Common Problems and Solutions

Symptom	Possible Cause	Solution
Power LED on back panel of NCL1135 is off	NCL1135 is not receiving power.	• Ensure that the device is plugged into a 110 - 220 V AC outlet and that there is power at the outlet. • Check all cables for loose or faulty connections. Replace cables if necessary.
Cannot communicate with NCL1135 from the Ethernet side and the Ethernet light is off	NCL1135 is not receiving power.	• Ensure that the device is plugged into a 110 - 220 V AC outlet and that there is power at the outlet. • Check all cables for loose or faulty connections. Replace cables if necessary.
	Ethernet cable is faulty or the wrong type (crossover vs. straight-through).	• Replace Ethernet cable, if necessary.
Cannot communicate with NCL1135 from the Ethernet side and the Ethernet light is on	NCL1135 configuration is incorrect.	Connect a computer to the RS-232 port and log into the NCL1135. • Verify Ethernet IP address. • Verify bridging or routing. • Verify Routing Table, if applicable. See *Verifying NCL1135 Routing*, on page 55.

Symptom	Possible Cause	Solution
Master cannot communicate with any Stations	Master NCL1135 is disabled.	Connect a computer to the RS-232 port and log into the NCL1135. • Ensure that the radio transmission is enabled.
	Master NCL1135 configuration is incorrect.	Connect a computer to the RS-232 port and log into the NCL1135. • Verify radio channel. • Verify Master unit ID. • Verify Station IDs have been added to Remote Station List. • Verify that the Master has all Stations enabled. • Verify routing or bridging. • Verify Routing Table, if applicable. See *Verifying NCL1135 Routing*, on page 55.
	Master NCL1135 antenna system has a problem.	• Verify RF connections. • Check RF cable for damage. • Check antenna for damage.
Master cannot communicate with an individual Station	Station is not receiving power.	• Ensure that the device is plugged into a 110 - 220 VAC outlet and that there is power at the outlet. • Check all cables for loose or faulty connections. Replace cables if necessary.
	Station NCL1135 antenna system has a problem.	• Verify RF connections. • Check RF cable for damage. • Check antenna for damage. • Check for any deviation from set direction.
	Antenna line-of-sight (LOS) to master has been obstructed.	• Ensure that a clear LOS still exists to the Master NCL1135 antenna.
	Station configuration is incorrect.	Connect a computer to the RS-232 port and log into the NCL1135. • Verify radio channel. • Verify Station unit ID. • Verify Master unit ID. • Verify routing or bridging. • Verify Routing Table, if applicable. See *Verifying NCL1135 Routing*, on page 55.
	Station is disabled.	Connect a computer to the RS-232 port and log into the Master NCL1135 for the group. • Verify that the Station has been enabled from the Master.
	Station has not been added to the Master NCL1135 Remote Station List.	Connect a computer to the RS-232 port and log into the Master NCL1135 for the group. • Verify the Station has been added to the Remote Station List. • Verify the Routing Table, if applicable. See *Verifying NCL1135 Routing*, on page 55.

7.1   Verifying NCL1135 Routing

To verify the routing is correct, you will need to verify both the Master and Station Routing Tables. If the Routing Tables are incorrect, configure the devices with the corrected values.

7.1.1   Verify the NCL1135 Routing Table

Use the Configuration Data Record for the NCL1135 to verify the information is configured correctly in the device.

1. Connect to the NCL1135 using a crossover serial cable.

2. Log in to the NCL1135. You will be prompted for the NCL1135 password when you log in.

3. Type `<mode>` to verify bridging or routing is set correctly for the NCL1135 group.

4. At the `NCL1135>` prompt, type `<ip>`. The configuration information is displayed.

5. Verify the NCL1135 Ethernet IP address and subnet mask are configured correctly.

6. Verify the radio IP address is correct, if applicable.

7. Verify the Routing Table is correct according to your routing plan.

8. If the forwarding mode is routing, at a Station NCL1135, ensure that the default static route is set. At a Master NCL1135, ensure the Ethernet subnet for each Station is set.

Appendix A   NCL1135 Command-Line Syntax

The NCL1135 can be configured using the commands listed in Table 8.

Table 6 shows the typographical conventions used to represent command-line syntax. Press ENTER after typing a command to execute the command.

Table 7 provides a list of shortcuts and methods to get help on commands.

Table 6   NCL1135 Command-Line Syntax Conventions

Convention	Use	Examples
`<monospaced font>`	Indicates that you must type the text inside the angle brackets, not the angle brackets.	`<ip route>`
ENTER	Indicates a keyboard key press. A plus sign (+) indicates key combinations. For example, for CTRL+U, press and hold down the CTRL key, then press the U key.	ENTER ESC CTRL+U
italic	Specifies a variable name or other information that you must replace with a real name or value.	`ip address ethernet` `ipaddress`
bold **ch**aracters	Indicates the shortcut characters for a command.	`<`**`ra`**`dio `**`ch`**`annel>` can also be typed as `<ra ch>`
`[ ]`	Indicates optional items. Do not type the brackets as part of the command.	`ip address` `[ethernet|radio]`
`|`	Separates two mutually exclusive choices in a command. Type one choice and do not type the vertical bar.	`interface|if`
`( )`	Encloses a range of values from which you can choose a value.	`radio channel (1-15)`

Table 7 Command-Line Shortcuts and Getting Help

Type	To do this...
`?`	To display the names of the root commands.
`[`*command_name*`] ?`	To display the syntax for a command.
`help`	To display all the commands, their subcommands and the parameters and options for each command.
`help [`*command_name*`]`	To display the parameters and options for the command.
`!!`	To repeat the last command that was executed.
ESC	To cancel the command you are typing.

Subnet Masks

Where a command requires you to enter a subnet mask, you can do one of the following:

- Enter it as a range, which is the number of bits (0-32 are valid) in the subnet mask.
- Do not enter it, and let the NCL1135 decide what value to use. Note that the NCL1135 does not necessarily pick the correct subnet mask.

Table 8 NCL1135 Command-line Syntax Descriptions

Command Syntax	Description
arp	Displays the Address Resolution Protocol (ARP) configuration information.
arp **f**lush	Removes the temporary ARP table entries from the ARP table.
arp **a**dd *aaa.bbb.ccc.ddd aa:bb:cc:dd:ee:ff*	Adds an entry to the ARP table. *aaa.bbb.ccc.ddd* is the IP address of the entry that you want to add. *aa:bb:cc:dd:ee:ff* is the MAC address associated with the IP address.
arp **d**el *aaa.bbb.ccc.ddd*	Deletes a specified entry from the ARP table. *aaa.bbb.ccc.ddd* is the IP address of the entry that you want to delete.
bridge **st**atistics	Displays the bridge statistics (frames in, frames out, etc.). Only available in bridging mode.
bridge **t**able	Displays the bridge table entries. Only available in bridging mode.
bridge **t**able **f**lush	Removes the learned entries from the bridge table. Only available in bridging mode.

Command Syntax	Description
bridge **t**able **t**imeout	Sets the time-out value for entries in the bridge table. If the NCL1135 receives no packet from the specified entry's address during the time-out period you set (for example, 15 s), then it clears the address from the table. Valid times are 10 to 1 000 000 s; the default is 300 s. Only available in bridging mode.
dhcp **m**ode [**n**one|**re**lay]	Sets the NCL1135 to use Dynamic Host Configuration Protocol (DHCP). • none - disables DHCP Relay. • relay - enables DHCP Relay. Available only if the mode is set to routing.
dhcp **r**elay [**add**|**del**ete *ip_address*]	Adds or removes the IP address of a Dynamic Host Configuration Protocol (DHCP) server. Available only if the mode is set to routing and DHCP mode is set to Relay.
interface|**if st**atistics	Displays configuration information and statistics for all interfaces.
interface|**if st**atistics **eth**ernet|**rad**io|**loo**pback	Displays configuration information and statistics for each interface: Ethernet, radio, or loopback.
interface|**if r**eset	Resets the statistics for all interfaces.
interface|**if r**eset **eth**ernet|**rad**io|**loo**pback	Resets the statistics for the specified interface.
ip	Displays the IP configuration information.
ip address	Displays the IP addresses for the Ethernet and radio interface. In bridging mode, the IP address is for management purposes only. An IP address is not required to perform bridge functions. When in Bridging mode, if you assign an IP address to the NCL1135, you only need to assign it to the Ethernet interface, because the radio and Ethernet are considered as one interface. In routing mode, you must configure both addresses.
ip address **eth**ernet *aaa.bbb.ccc.ddd [subnet mask]*	Changes the IP address for the Ethernet interface for routing or bridging. aaa.bbb.ccc.ddd is the IP address for the Ethernet interface and *[subnet mask]* is specified in either dotted decimal format or number of bits.

Command Syntax	Description
`ip addr`ess `radio` *remote_unit_id* *aaa.bbb.ccc.ddd eee.fff.ggg.hhh*	Changes the radio interface IP route and binds the radio channel between the remote NCL1135 and the local NCL1135 using the IP addresses. This command is only available in routing mode. For an NCL1135 configured as a Station, *remote_unit_id* is the unit ID of the remote master; *aaa.bbb.ccc.ddd* is the radio IP address for the local station NCL1135; and *eee.fff.ggg.hhh* is the radio IP address for the remote master NCL1135. For an NCL1135 configured as a Master, *remote_unit_id* is the unit ID of the remote station NCL1135; *aaa.bbb.ccc.ddd* is the radio IP address for the local master NCL1135; and *eee.fff.ggg.hhh* is the radio IP address for the remote station NCL1135. Repeat this command for each station in the Remote Station List.
`ip d`ns	Displays the DNS configuration information.
`ip d`ns `s`erver	Displays the list of domain name servers.
`ip d`ns `s`erver `add`|`del` *aaa.bbb.ccc.ddd*	Adds a server to or deletes a server from the DNS table. *aaa.bbb.ccc.ddd* is the IP address for the DNS server that you want to add or delete.
`ip d`ns `dom`ain	Displays the DNS domain name.
`ip d`ns `dom`ain *DNS_domain_name*	Changes the DNS domain name. *DNS_domain_name* can be a maximum of 256 ASCII characters.
`ip p`ing *destination*	Sends ICMP echo requests to a remote host that is used to see if you can reach a remote IP address or for network debugging. *destination* is the radio IP address for the remote host that you want to reach.
`ip ri`p	Displays the RIP configuration information. Available only if routing mode is set to RIP.
`ip ri`p `q`uiet|`a`ctive	Disables or enables RIP to advertise routes. Available only if routing mode is set to RIP. `active` - transmits route information, in packets, to the interfaces. `quiet` - disables RIP packets from being sent.
`ip ri`p `nod`efault|`d`efault	Disables or enables RIP to advertise the default route. Available only if routing mode is set to RIP. `default` - if a default route exists, it is sent in the advertisement. `nodefault` - the default route is not sent, whether or not it exists.

Command Syntax	Description
`ip ri`p `b`roadcast|`c`ompatible|`m`ulticast	When RIP is set to version 2, specifies how RIP handles packets. Available only if routing mode is set to RIP and the RIP version is set to 2. • `broadcast` sends RIP version 2 advertisements as broadcast. • `compatible` sends more compatible version 2 broadcasts to version 1 routers. • `multicast` sends version 2 advertisements to RIP version 2 multicast addresses. Multicast is generally more efficient than broadcast.
`ip ri`p `nou`pdate|`u`pdate	Disables or enables RIP to advertise static routes. `update` - sends static route information in a RIP advertisement, as well as all other RIP information. `noupdate` - sends everything except the static route information. Available only if routing mode is set to RIP.
`ip ri`p `v`ersion 1|2	Changes the RIP version to either 1 or 2. Available only if routing mode is set to RIP. `ip rip version` displays the current version. Note that version 1 is broadcast only; version 2 is multicast, broadcast, or compatible (both).
`ip route`	Displays the routing table information. Local interface routes are always present as long as an address for the interface exists.
`ip route add`|`del` *Network(aaa.bbb.ccc.ddd)* *Gateway(eee.fff.ggg.hhh)* *Mask(0-32)*	Adds or deletes a static route. *Network(aaa.bbb.ccc.ddd)* is the IP address of the destination network; *Gateway(eee.fff.ggg.hhh)* is the IP address for the gateway; and *Mask(0-32)* is specified in either dotted decimal format or number of bits.
`ip route f`lush	Removes all dynamic entries from the routing table. Dynamic entries are those routes that the system has learned.
`ip route e`rase	Removes all static and dynamic entries, except interface routes, from the routing table.
`ip routi`ng	Displays the IP routing protocol.
`ip routi`ng `st`atic|`r`ip	Changes the IP routing protocol to either Static or RIP.
`ip st`atistics	Displays the IP statistics information.
`ip te`lnet *host(aaa.bbb.ccc.ddd)*	Establishes a Telnet session with a remote host to access and control a remote computer. *host(aaa.bbb.ccc.ddd)* is the IP address of the remote host.
`ip tr`aceroute *destination(aaa.bbb.ccc.ddd)*	Displays the route that the packets take to a remote destination. *destination(aaa.bbb.ccc.ddd)* is the IP address of the remote destination. The maximum is 30 hops. An asterisk (*) represents each unsuccessful try. For example, 1 * * *. Press any key to stop the `ip traceroute` output.

Command Syntax	Description
mode	Displays the forwarding mode: Bridging or IP Routing.
mode **bri**dging|**rou**ting	Changes the forwarding mode. `bridging`: connects two networks on the same subnet (they have the same subnet address). `routing`: connects two networks on different subnets.
radio	Displays the radio configuration information.
radio **ch**annel	Displays the radio channel.
radio **ch**annel (1–14)	Changes the radio channel.
radio **d**isable|**en**able	Disables or enables the NCL1135 radio transmission capabilities. The NCL1135 is factory-configured as disabled to prevent accidental damage should it be powered up without an antenna or load connected.
radio **per** [**s**ingle|**c**ontinuous|**r**eset]	Displays or resets the cumulative radio packet error rate statistics to the screen. This command is available during tests and normal operation. • `single` displays the current statistics. • `continuous` displays the statistics every one second. • `reset` resets the calculations.
radio **rx**test **sta**rt|**sto**p	Starts and stops the Radio Continuous Receive Test. When you start this test, the Radio PER display is also automatically started. Available only at the Station NCL1135. Use this test to deploy a new Station NCL1135 in an existing network.
radio **tx**test **sta**rt|**sto**p	Starts and stops the Radio Continuous Transmit Test. Available only at the Master NCL1135. Use this test to set up a Master and Station for a new network.
radio **txrx** **sta**rt|**sto**p	Starts and stops the Radio Transmit/Receive Loopback Test. When you start this test, the Radio PER display is also automatically started. Available only at the Master NCL1135. Use this test for a new installation only.
radio **r**eset	Forces the NCL1135 to reset. If you reset the NCL1135 radio instead of shutting down, the statistics are not lost. If you use this command, the link service is disrupted for the duration of the test.
radio unitid	Displays the NCL1135 unit ID.
radio unitid (1–16383)	Changes the NCL1135 unit ID. An NCL1135 unit ID is a unique number between 1 and 16383.
radio **m**asterID	Displays the Master Unit ID to which the NCL1135 belongs. Available only if the NCL1135 radio type is Station.
radio masterID (1–16383)	Changes the Master Unit ID to which the NCL1135 belongs. Available only if the NCL1135 radio type is Station.

Command Syntax	Description
radio statistics|stats	Displays the current radio statistics.
radio **t**ype	Displays the NCL1135 radio type.
radio **t**ype **mas**ter|**sta**tion	Changes the radio type. Use this to configure an NCL1135 as a master unit. All NCL1135 units are factory-configured as 'station'.
radio **st**ation	Displays the list of unit IDs to which the master unit can talk. Available only if the NCL1135 radio type is Master.
radio **st**ation **add** (1–16383)	Adds a remote Unit ID to the list of stations to which a Master Unit can talk. Available only if the NCL1135 radio type is Master.
radio **st**ation **del** (1–16383)	Removes a remote Unit ID from the list of stations to which a Master Unit can talk. Available only if the NCL1135 radio type is Master.
radio **st**ation **d**isable|**e**nable *unitID*	Disables or enables the transmission capabilities of the remote station. *unitID* is the unit ID of the remote station that you want to disable. Available only if the NCL1135 radio type is Master.
snmp	Displays the SNMP configuration information. SNMP is useful for monitoring network performance and debugging.
snmp **com**munity	Displays the SNMP community table. The default SNMP communities are: public read and private write.
snmp **com**munity **add**|**del** *community* **r**ead|**w**rite	Adds a community name to or deletes one from the SNMP community table. A community name can be a maximum of 32 ASCII characters. • read: enables the community to view the variables in SNMP. • write: enables the community to change and view the variables. To change SNMP variables, you must have a write community. To view SNMP variables, you must have a write or read community.
snmp **con**tact	Displays the SNMP system contact (that is, the person or company).
snmp **con**tact *contact*	Changes the SNMP system contact and telephone number. *contact* can be a maximum of 256 ASCII characters that you can use to define the contact person or address for the NCL1135.
snmp **l**ocation	Displays the SNMP geographical location of the system.
snmp **l**ocation *location*	Changes the SNMP geographical location of the system. *location* can be a maximum of 256 ASCII characters that you can use to define the physical location of the NCL1135.
snmp **t**rap	Displays the list of SNMP trap servers defined for the NCL1135.

Command Syntax	Description
snmp **t**rap **add**|**del** *server(aaa.bbb.ccc.ddd) community*	Adds a trap to or deletes one from the SNMP trap server table. *server(aaa.bbb.ccc.ddd)* is the IP address for the trap server. *community* is the name of the community on the trap server and can be a maximum or 16 ASCII characters.
system	Displays the system configuration information.
system **m**emory	Displays the memory statistics, such as memory allocation information.
system **na**me	Displays the system name.
system **na**me *name*	Changes the system name. *name* can be a maximum of 64 ASCII characters that you can use to name the NCL1135 in your system. The system name is used for the command-line prompt for the NCL1135.
system **ne**twork	Displays the network system statistics from the network buffer memory pools.
system **ne**twork **eth**ernet|**rad**io|**dat**a|**sys**tem	Displays network buffer pool-allocation information for each parameter:
system **pa**ssword	Changes the password for the NCL1135.
system **pr**otocol	Displays information about the configuration of protocols bound to the interface.
system **pr**otocol *interface*	Displays the protocol configuration for the specific interface that you name. *interface* is either Ethernet or Radio.
system **u**ptime	Displays how long the system has been running. If the uptime is more than 24 hours, the time appears as *n* days, *hh:mm:ss* where *n* is the number of days and *hh:mm:ss* is the hours:minutes:seconds.
system **v**ersion	Displays the build date and time, and lists all software libraries and their version numbers.
test **r**adio	Performs self tests and displays the results for all the radio device. If you use this command, the link service is disrupted for the duration of the test.
reboot|**re**start|**re**load|**re**set	Resets the NCL1135.
write|**sa**ve	Saves the current configuration. If you want to save the new configuration, you must write (save) any configuration changes before you reboot the NCL1135; otherwise, the NCL1135 reverts to the previously saved configuration.
write **d**efault|**e**rase	Removes all configuration changes, even if you saved them, and resets the NCL1135 to the factory default configuration.

Command Syntax	Description
help [*command*]	Displays a list of all commands. If you type a command name after help, the syntax for that command is displayed. For example, type help ip to display all IP commands and the syntax for each.
exit|**q**uit|**by**e	Closes the console session.

Appendix B   Abbreviations and Terminology

Table 9   Acronyms and Abbreviations

Acronym or Abbreviation	Definition
AC	Alternating Current
ALF	Air Link Frame
ARP	Address Resolution Protocol
ASCII	American Standard Code for Information Interchange
dB	decibel
dBi	decibel, with respect to an isotropic antenna
CLI	Command Line Interface
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CSA	Canadian Standards Association
CTS	Clear To Send
DCE	Data Communication Equipment
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server, Domain Network Server
DPRAM	Dual Port Random-Access Memory
DRAM	Dynamic Random-Access Memory
DSR	Data Set Ready
DSSS	Direct-Sequence Spread Spectrum
DTE	Data Terminal Equipment
ESN	Electronic Serial Number
ETSI	European Telecommunications Standards for Industry

Acronym or Abbreviation	Definition
FCC	Federal Communications Commission (U.S.A.)
FTP	File Transfer Protocol
GHz	Gigahertz
IC	Industry Canada
ICMP	Internet Control Message Protocol
ID	Identifier, Identification
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
IP	Internet Protocol
ISM	Industrial, Scientific, And Medical (unlicensed radio band)
LAN	Local Area Network
LED	Light-Emitting Diode
MAC	Media Access Control, Medium Access Controller
MHz	Megahertz
MIB	Management Information Base
MTU	Maximum Transmission Unit
NCL	Network Communication Link, as in NCL1135, a WaveRider product
NIC	Network Interface Card
OSPF	Open Shortest Path First
PC	Personal Computer
PER	Packet Error Rate
RF	Radio Frequency
RFC	Request For Comments
RIP	Routing Information Protocol
RMA	Returned Merchandise Authorization
RSSI	Receive Signal Strength Indicator
RTS	Request To Send
Rx	Receive
SNMP	Simple Network Management Protocol
SRAM	Static Random Access Memory
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
Tx	Transmit
URL	Uniform Resource Locator

Acronym or Abbreviation	Definition
V	Volt

Table 10   NCL1135 Network Terminology

Term	Definition
Address Resolution Protocol (ARP)	The layer below the IP layer; maps the IP and MAC addresses together.
Bridge	A device that connects and passes packets between two network segments. Bridgers operate at the MAC layer. A bridge filters or forwards an incoming frame based on the MAC address of the frame. A learning bridge listens to traffic on its interfaces and maintains a table of addresses. See also *Router*.
Channel	Generally, the medium through which information is communicated. In wireless communications, the channel is usually defined by the center frequency, modulation type, and occupied bandwidth.
Command Line Interface (CLI)	In contrast to a graphical user interface, a CLI is a configuration and control interface based on keyboard-entry commands and responses.
Console Port	Typically, the 9-pin RS 232 serial port on an NCL1135 to which a terminal or laptop computer is connected to configure or control the device.
Domain Name Server (DNS)	A database system that translates IP addresses into domain names. For example, 207.23.187.242 is converted into waverider.com.
Direct-Sequence Spread Spectrum (DSSS)	A form of spread-spectrum communications that uses a high-speed code sequence, along with the information being sent, to modulate the RF carrier.
MAC address	This refers to the 6-byte low-level hardware address of physical address of an Ethernet device.
Master	The NCL1135 defined as a master provides the access control for all NCL1135 stations in the same radio network. The master configuration determines the channel that the NCL1135 stations use. There must be only one master using the same channel in the radio network. You must configure a master within the coverage area of another master to use a different channel.
Master ID	Improves security on the wireless network. NCL1135s must have the same master ID in order to communicate with each other.

Term	Definition
Master vs. Station	Decide which NCL1135 is the master. In the point-to-point configurations, it does not matter which NCL1135 is master, just remember that the master provides the access control to the station. In the case of point-to-multipoint, the master must have a line of sight to each station, but each station may not have a radio communication path to other stations.
Open Shortest Path First	A routing protocol for autonomous IP networks based on the Shortest Path First (SPF) algorithm, where link-state advertisements (LSAs) are sent to all other routers within the same network to determine the shortest path to the desired node.
Radio Channel	A 22 MHz wide RF channel with a center frequency specified in Appendix C. In any given network, all NCL1135s must operate on the same radio channel to communicate.
Radio Type	This parameter specifies the role of the NCL1135 in the radio network. Each NCL1135 is classified as either a master or a station.
Router	A device that connects and passes packets between two or more network segments. A router filters or forwards an incoming packet based on the IP address of the packet. Routers use static routes which take precedence over routes chosen by all dynamic routing protocols. See also *Bridge*.
Routing Information Protocol	A routing protocol for IP networks based on the distance-vector algorithm, where all or a portion of the routing table is sent to all other neighbouring devices along with each message.
Static Route	A route that is explicitly configured and entered in the routing table. Static routes take precedence over routes chosen by dynamic routing protocols.
Station	An NCL1135 defined as a station synchronizes with an NCL1135 master that has the same station and master ID setting.
System Name	A name that allows a user to identify a particular NCL1135. Once the Name is assigned, the system name appears as the prompt.
System Password	A set of characters that prevents unauthorized access to console commands. The same password applies when accessing the console from the RS-232 port, from the network using Telnet, or when connecting to the FTP server.
Unit ID	In the case of a station, unit ID provides the wireless address at the station. In the case of a Master, a list of unit IDs forms the access list of stations allowed to communicate with the Master. Any station not on the list will be disabled whenever the station attempts to access the Master.

Appendix C   Operating Channel Frequencies

The following table defines the channel frequency set for each WaveRider regulatory domain..

Channel ID	FCC/IC Channel Frequencies (USA/ Canada)	MKK Channel Frequencies (Japan)	ETSI Channel Frequencies (Europe)	French Channel Frequencies	Spanish Channel Frequencies
1	2412 MHz	not available	2412 MHz	not available	not available
2	2417 MHz	not available	2417 MHz	not available	not available
3	2422 MHz	not available	2422 MHz	not available	not available
4	2427 MHz	not available	2427 MHz	not available	not available
5	2432 MHz	not available	2432 MHz	not available	not available
6	2437 MHz	not available	2437 MHz	not available	not available
7	2442 MHz	not available	2442 MHz	not available	not available
8	2447 MHz	not available	2447 MHz	not available	not available
9	2452 MHz	not available	2452 MHz	not available	not available
10	2457 MHz	not available	2457 MHz	2457 MHz	2457 MHz
11	2462 MHz	not available	2462 MHz	2462 MHz	2462 MHz
12	not available	not available	2467 MHz	2467 MHz	not available
13	not available	not available	2472 MHz	2472 MHz	not available
14	not available	2484 MHz	not available	not available	not available

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Appendix D   NCL1135 Specifications

The followiing tables list the technical specifications for the NCL1135 (FCC/IC RF Regulatory Domains).

Table 11   Radio Specifications

Minimum Channel Centre Frequency	2.412 GHz
Maximum Channel Centre Frequency	2.462 GHz
Channel Bandwidth	22 MHz
Center Frequency Spacing Increment	5 MHz
Minimum Separation Between Orthogonal Channels	25 MHz
Maximum Orthogonal Channels	3
Orthogonal Channel Set	1, 6, 11
Orthogonal Channel Set Centre Frequencies	2.412 GHz, 2.437 GHz, 2.462 GHz
Modulation Scheme	CCK (Complementary Code Keying) DSSS (Direct Sequence Spread Spectrum)
Receiver Sensitivity for BER < 10^{-5}	< -72 dBm
Maximum Over-the-Air, Raw Data Rate	11 Mbps

Table 12   Ethernet Interface Specifications

Physical Interface	RJ-45, 10BaseT autosensing

Table 13   Power Supply Specifications

AC Input	85 to 265 VAC, single phase
AC Input Frequency	47 to 63 Hz
Maximum Input Current	1.5 A

Table 14   Environmental Specifications

Operating Temperature	0° to 55° C
Storage Temperature	-20° to 70° C

Appendix E   Configuration Data Record

Use the following form to record your NCL1135 information for each NCL1135 group.

NCL1135 Network Group Configuration Data Record

Radio Channel	Subnet Mask	Software Version	Bridge or Routing	DHCP IP Address

Master Information

Unit ID	Password	Serial Number	System Name	IP Address		Location	Hardware Address		Antenna (Yagi/ parabolic/omni/ panel)		Cable		SNMP Communities		SNMP Trap Server	
				Ethernet	Radio (Routing only)		Radio	Ethernet	Type	Gain	Type	Loss	R/W	Community Name	IP Address	Community Name

Station Information

Unit ID	Password	Serial Number	System Name	IP Address		Location	Hardware Address		Antenna (Yagi/ parabolic/omni/ panel)		Cable		SNMP Communities		SNMP Trap Server	
				Ethernet	Radio (Routing only)		Radio	Ethernet	Type	Gain	Type	Loss	R/W	Community Name	IP Address	Community Name

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