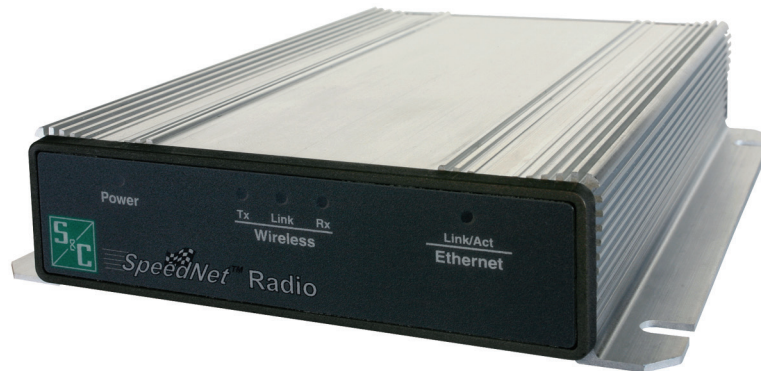


# Installation and Operation

## Table of Contents

Section	Page	Section	Page
<b>Introduction</b>		<b>Installation</b>	
Qualified Persons . . . . .	2	Before Starting Installation. . . . .	8
Read this Instruction Sheet . . . . .	2	Network Design. . . . .	8
Retain this Instruction Sheet. . . . .	2	Cable Installation. . . . .	8
Proper Application. . . . .	2	Antenna/Cable Installation Requirements. . . . .	9
Regulatory Information . . . . .	2	<b>Operation</b>	
Warranty . . . . .	3	IP Basics. . . . .	11
Warranty Qualifications. . . . .	3	Subnet Masking . . . . .	12
Antenna Requirements . . . . .	4	Private Subnets . . . . .	12
<b>Safety Information</b>		MAC Address . . . . .	13
Understanding Safety-Alert Messages . . . . .	5	Network Example . . . . .	14
Following Safety Instructions . . . . .	5	Routing Options . . . . .	15
Replacement Instructions and Labels. . . . .	5	Using Static Routes . . . . .	16
<b>Safety Precautions</b> . . . . .		Interface Pinouts. . . . .	18
<b>Shipping and Handling</b>			
Inspection . . . . .	7		
Packing . . . . .	7		



**NOTICE**

SpeedNet Radio software and instruction sheets can be downloaded at [sandc.com/support/automation-customer-support-portal.asp](http://sandc.com/support/automation-customer-support-portal.asp) If you need assistance, please contact [customerportal@sandc.com](mailto:customerportal@sandc.com) or phone (800) 621-5546.



# Introduction

---

## Qualified Persons

### **WARNING**

The equipment covered by this publication must be installed, operated, and maintained by qualified persons who are knowledgeable in the installation, operation, and maintenance of radios in electric power distribution equipment, along with the associated hazards. A qualified person is a radio technician who is qualified to install transmission-power-limited radio equipment per FCC Part 15 and who is trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed
- The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

## Read this Instruction Sheet

### **NOTICE**

Thoroughly and carefully read this instruction sheet before programming, operating, or maintaining your S&C SpeedNet Radios. Familiarize yourself with the Safety Information and Safety Precautions on pages 5 and 6. The latest version is available online in PDF format at [sandc.com/Support/Product-Literature.asp](http://sandc.com/Support/Product-Literature.asp)

## Proper Application

### **WARNING**

The equipment in this publication must be selected for a specific application. The application must be within the ratings furnished for the selected equipment.

## Retain this Instruction Sheet

This instruction sheet should be available for reference wherever a SpeedNet Radio is to be used. Retain this instruction sheet in a location where you can easily retrieve and refer to it.

## Regulatory Information

This device complies with part 15 of the FCC rules and regulations regarding unlicensed transmissions. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference.

This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme avec Industrie Canada exempts de licence(s) standard RSS. Son fonctionnement est soumis aux deux conditions suivantes: (1) ce dispositif ne doit pas causer d'interférences, et (2) cet appareil doit accepter toute interférence, y compris celles pouvant causer un mauvais fonctionnement de l'appareil.

### **FCC Warning**

This device must be professionally installed. It is the responsibility of the installer to ensure that proper antenna and cable combinations are used in order to remain within FCC Part 15 limits.

The SpeedNet Radio is specifically designed to close the longest possible links. This goal is accomplished in part by delivering the highest permissible RF output power to the antenna per the FCC Part 15 Rules. In August 1996, the FCC adopted RF exposure guidelines that established safety levels for various categories of wireless transceivers.

Those limits are consistent with safety standards previously published by the National Council on Radiation Protection (NCRP) Report 86, §17.4.1, §17.4.1.1, §17.4.2, and §17.4.3 as well as the American National Standards Institute (ANSI) in §4.1 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 30 GHz,” ANSI/IEEE C95.1-1992.

The SpeedNet Radio complies with these FCC exposure guidelines when the following precautions are obeyed:

- One of the exact antennas recommended in this instruction sheet is installed
- The cable run for the selected antenna exceeds the minimum length quoted in this instruction sheet
- All persons maintain a minimum separation of 12 inches (30.48 cm) from the SpeedNet antenna

Disconnect the ac/dc input power source from the SpeedNet Radio whenever repositioning the antenna. You are responsible for taking the necessary steps to ensure that these guidelines are communicated to all persons that may come near the SpeedNet Radio antenna.

#### NOTICE

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by using one or more of the following measures:

- Reorient or relocate the receiving antenna
  - Increase the separation between the equipment and receiver
  - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
  - Consult the dealer or an experienced radio/TV technician for help
- CAN ICES-3 (B)/NMB-3(B)

#### NOTICE

Changes or modifications not expressly approved by S&C Electric Company could void the user's authority to operate the equipment.

## Warranty

The standard warranty contained in S&C's standard conditions of sale, as set forth in Price Sheet 150, applies to S&C SpeedNet Radios.

## Warranty Qualifications

Warranty of the SpeedNet Radio is contingent upon the installation, configuration, and use of the SpeedNet Radio and software in accordance with S&C's applicable instruction sheets. This warranty does not apply to major components not of S&C manufacture, such as batteries, and other communication devices not of S&C manufacture. However, S&C will assign to immediate purchaser or end user all manufacturers' warranties that apply to such major components.

### Antenna Requirements


SpeedNet Radios have been designed to operate with the antennas listed in these bulleted items having a maximum gain of 3 dBd (5.15 dBi) or 10 dBd (12.15 dBi), respectively, and an impedance of 50 ohms:

- Omni-directional fiberglass antenna: Antenex FG9023 or equivalent, 3 dBd (5.15 dBi)
- Uni-directional Yagi antenna: Kathrein TY-900 or equivalent, 10 dBd (12.15 dBi)

To reduce potential radio interference to other users, choose the antenna type and its gain so the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

**Understanding Safety-Alert Messages**

Several types of safety-alert messages may appear throughout this instruction sheet as well as on labels attached to the SpeedNet Radio. Familiarize yourself with these types of messages and the importance of these various signal words:

 <b>DANGER</b>
“DANGER” identifies the most serious and immediate hazards that <i>will</i> likely result in serious personal injury or death if instructions, including recommended precautions, are not followed.


 <b>WARNING</b>
“WARNING” identifies hazards or unsafe practices that <i>can</i> result in serious personal injury or death if instructions, including recommended precautions, are not followed.

 <b>CAUTION</b>
“CAUTION” identifies hazards or unsafe practices that <i>can</i> result in minor personal injury if instructions, including recommended precautions, are not followed.

<b>NOTICE</b>
“NOTICE” identifies important procedures or requirements that <i>can</i> result in product or property damage if instructions are not followed.

**Following Safety Instructions**

If you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C’s website [sandc.com](http://sandc.com). Or call S&C Headquarters at (773) 338-1000; in Canada, call S&C Electric Canada Ltd. at (416) 249-9171.

<b>NOTICE</b>	
Read this instruction sheet thoroughly and carefully before installing or operating your S&C SpeedNet Radio.	

**Replacement Instructions and Labels**

If you need additional copies of this instruction sheet, contact your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

### DANGER



**SpeedNet Radios operate between +9 and +36 Vdc. Failure to observe the precautions below will result in serious personal injury or death.**

Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

1. **QUALIFIED PERSONS.** Access to an SpeedNet Radio must be restricted only to qualified persons. See "Qualified Persons" on page 2.
2. **SAFETY PROCEDURES.** Always follow safe operating procedures and rules.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment such as rubber gloves, rubber mats, hard hats, safety glasses, and flash clothing, in accordance with safe operating procedures and rules.
4. **SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels.
5. **SAFE DISTANCE.**
  - All persons should maintain a minimum separation of 12 inches (30.48 cm) for the SpeedNet antenna.
  - Disconnect the ac/dc input power source from the SpeedNet Radio whenever configuring or repositioning the antenna.
9. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components.

### Inspection

Examine the shipment for external evidence of damage as soon after receipt as possible, preferably before removal from the carrier's conveyance. Check the bill of lading to make sure that all shipping skids, crates, cartons, and containers listed thereon are present.

If there is visible loss and/or damage:

1. Notify the delivering carrier immediately.
2. Ask for a carrier inspection.
3. Note condition of shipment on all copies of the delivery receipt.
4. File a claim with the carrier.

If concealed damaged is discovered:

1. Notify the delivering carrier within 15 days of receipt of shipment.
2. Ask for a carrier inspection.
3. File a claim with the carrier.

Also notify S&C Electric Company in all instances of loss and/or damage.

### Packing

A SpeedNet Radio shipment includes the following items:

1. SpeedNet Radio
2. Power cord
3. Antennas and other accessories, as applicable

# Installation

---

## Before Starting Installation

Choose a location where the SpeedNet Radio can be securely mounted.

### **NOTICE**

For remote antenna installations, where the antenna is not mounted directly on the control enclosure, S&C recommends installing lightning protection.

## Network Design

SpeedNet Radios serve as a communication end point for SCADA devices. They can connect to a SpeedNet Radio mesh network, and they can be installed in a variety of network configurations. Plan your network in advance, and develop a logical IP addressing scheme for your particular application. Depending on your network type, several factors may influence your design:

- Point-to-point vs. end-point within a mesh
- A stand-alone network connection

When network topology has been determined, the SpeedNet Radios can be configured appropriately.

## Cable Installation

Cables should be connected in the following order before the radio can be operational:

- (a) Connect the antenna to SpeedNet Radio.
- (b) Connect the Ethernet cable to SpeedNet Radio and PC used for configuration.
- (c) Connect the power supply to the SpeedNet Radio.

### **NOTICE**

Make sure the SMA connector at the back of the radio, used to connect the antenna cable, is not loose. An additional small pliers and a wrench may be needed to hold the nut down to the radio when the SMA connector is being tightened. Use of an SMA torque wrench is advised.

**Antenna/Cable  
Installation  
Requirements**

Antennas for SpeedNet Radios must be installed by a qualified radio technician to comply with FCC Part 15 radiated power limits. Only antennas supplied by S&C Electric Company may be used with the SpeedNet Radios.

The FCC mandates that Effective Isotropic Radiated Power (EIRP) may not exceed +36 dBm. This is equivalent to a radio running at full output power (1 watt +30 dBm) with a +6 dBi antenna. The antenna cable must have sufficient loss to bring the EIRP below +36 dBm if a higher gain antenna is used. For example, using a +8 dBi antenna with a radio transmitting at full power would result in an EIRP of +38 dBm. In this situation, the antenna cable must provide at least 2 dB loss in order to bring the EIRP into compliance. SpeedNet Radios have configurable transmit power that can be selected using the SpeedNet Radio client tool or by using the IntelliTeam CNMS Communication Network Management System. Settings of +30 dBm (default), +25 dBm, and +10 dBm are available. Any confirmed decrease in output power should be considered when calculating EIRP.

The following table shows the amount of loss incurred with several common antenna cables.

**Table 1. Antenna Cable Loss**

Cable Type	Loss per 100 Feet of Cable
LMR-400	3.9 dB
LMR-600	2.5 dB
LMR-900	1.7 dB

**Table 2. Antenna Cable Loss Examples with LMR-400 Cable<sup>①</sup>**

Antenna Gain	Length/Loss	ERP
+8.2 dBi	60 feet/2.3 dB loss	+36.0 dBm
+10.2 dBi	110 feet/4.3 dB loss	+36.0 dBm
+12.1 dBi	160 feet/6.2 dB loss	+36.0 dBm

<sup>①</sup> Assuming 1-watt output power from the SpeedNet Radio.

**Table 3. Antenna/Cable Loss Examples with LMR-600 Cable<sup>①</sup>**

Antenna Gain	Length/Loss	ERP
+8.2 dBi	90 feet/2.3 dB loss	+36.0 dBm
+10.2 dBi	170 feet/4.3 dB loss	+36.0 dBm
+12.1 dBi	245 feet/6.1 dB loss	+36.0 dBm

① Assuming 1-watt output power from the SpeedNet Radio.

**Table 4. Antenna Cable Loss Examples with LMR-900 Cable<sup>①</sup>**

Antenna Gain	Length/Loss	ERP
+8.2 dBi	135 feet/2.3 dB loss	+35.9 dBm
+10.2 dBi	250 feet/4.3 dB loss	+36.0 dBm
+12.1 dBi	310 feet/5.3 dB loss	+35.9 dBm

① Assuming 1-watt output power from the SpeedNet Radio.

If you are using a different type of cable, verify cable loss before installation.

**Table 5. Attenuation Chart**

Cable Type	Nominal Attenuation Frequency in MHz dB/100ft								
	10MHz	30MHz	50MHz	150MHz	220MHz	450MHz	900MHz	1.2GHz	2.4GHz
100 Series	2.3	3.9	5.1	8.9	10.9	15.8	22.8	26.7	38.9
195 Series	1.1	2.0	2.5	4.4	5.4	7.8	11.1	12.9	18.6
240 Series	0.8	1.3	1.7	3.0	3.7	5.3	7.6	8.8	12.7
400 Series	0.4	0.7	0.9	1.5	1.9	2.7	3.9	4.5	6.6
600 Series	0.2	0.4	0.5	1.0	1.2	1.7	2.5	2.9	4.3
LMR-400-UF	0.5	0.8	1.1	1.8	2.2	3.3	4.7	5.5	7.9
RG142/U									
RG213/U	0.6	1.2	1.5	2.8	x	5.2	7.3	x	x
RG214/U	0.6	0.9	1.3	2.3	x	4.5	7.3	x	x
RG223/U	1.2	2.0	2.8	5.0	x	9.8	13.4	x	x
RG316/U									
RG393/U									
RG58A/U	1.5	2.6	3.3	6.8	x	12.6	21.0	x	x
RG8/U (CXP1318FX)	0.5	0.8	1.1	1.8	2.2	3.3	4.7	5.5	7.9
RG8X-Mini	1.0	2.0	2.3	4.7	x	8.6	13.0	x	x

## IP Basics

SpeedNet Radios use Internet Protocol (IP) version 4, and all references to IP addresses in these installation instructions refer to IPv4 addresses. An IP address is the unique identifier for a node (host connection) on an IP network. The IP address is a 32-bit binary number, usually shown as four decimal values separated by decimal points. Each value represents 8 bits in the range 0 to 255 (known as octets), and this is called “dotted decimal” notation.

For example: 172.26.220.200 can be viewed in binary form:

```

172      .26      .220      .200
10 1 0 11 00.000 11 0 1 0.11 0 11100.11 00 1 000

```

Every IP address consists of two parts that identify the network and the node. The address class and subnet mask determine which part belongs to the network address and which part belongs to the node address.

There are five address classes. You can determine the IP address class by examining the first four bits of the IP address:

- Class A addresses begin with 0xxx, or 1 to 126 decimal.
- Class B addresses begin with 10xx, or 128 to 191 decimal.
- Class C addresses begin with 110x, or 192 to 223 decimal.
- Class D addresses begin with 1110, or 224 to 239 decimal.
- Class E addresses begin with 1111, or 240 to 254 decimal.

Addresses beginning with 01111111, or 127 decimal, are reserved for loop-back and internal testing on a local machine. You can test this by pinging 127.0.0.1, which points to your local machine. Class D addresses are reserved for multicasting, and Class E addresses are reserved for future use and should not be used for a host address.

This is how the class determines, by default, which part of the IP address belongs to the network (N) and which part belongs to the node (n).

- Class A–NNNNNNNN.nnnnnnnn.nnnnnnnn.nnnnnnnn
- Class B–NNNNNNNN.NNNNNNNN.nnnnnnnn.nnnnnnnn
- Class C–NNNNNNNN.NNNNNNNN.NNNNNNNN.nnnnnnnn

In the example, 172.26.220.200 is a Class B address, so by default the network part of the address (known as the network address) is defined by the first two octets (172.26. x.x) and the node part is defined by the last 2 octets (x.x.220.200).

To specify the network address in an IP address, the node section is entered as zeros. In our example, 172.26.0.0 specifies the network address for 172.26.220.200. When the node section is set to all “1”s, it specifies a broadcast that is sent to all nodes on the network and is indicated: 172.26.255.255, which is the broadcast address for our example. Note that this is true for all classes, regardless of the length of the node section.

### Subnet Masking

Applying a subnet mask to an IP address allows you to identify the network and node parts of the address. The network bits are represented by the “1”s in the mask, and the node bits are represented by the “0”s. Performing a bitwise logical AND operation between the IP address and the subnet mask results in the network address or number. The network address is also called the subnet.

For example, using our test IP address and the default Class B subnet mask, we get:

10101100.00011010.11110000.11001000    172.26.240.200 Class B IP Address

11111111.11111111.00000000.00000000    255.255.000.000 Default Class B Subnet Mask

10101100.00011010.00000000.00000000    172.26.000.000 Network Address

Default subnet masks:

- Class A 255.0.0.0–11111111.00000000.00000000.00000000
- Class B 255.255.0.0–11111111.11111111.00000000.00000000
- Class C 255.255.255.0–11111111.11111111.11111111.00000000

### Private Subnets

Three IP network addresses are reserved for private networks. The addresses are 10.0.0.0, Subnet Mask 255.0.0.0; 172.16.0.0, Subnet Mask 255.240.0.0; and 192.168.0.0, Subnet Mask 255.255.0.0. These addresses are also notated 10.0.0.0/8, 172.16.0.0/12, and 192.168.0.0/16. They can be used by anyone setting up internal IP networks, such as a lab or home LAN behind a NAT or proxy server or a router. It is always safe to use these because routers on the Internet by default will never forward packets coming from these addresses.

Subnetting an IP network can be done for a variety of reasons, including organization, use of different physical media (such as Ethernet, FDDI, WAN, etc.), preservation of address space, and security. The most common reason is to control network traffic. In a traditional unswitched Ethernet network, all nodes on a segment see all the packets transmitted by all the other nodes on that segment. Performance can be adversely affected under heavy traffic loads caused by collisions and the resulting retransmissions. A router is used to connect IP networks to minimize the amount of traffic each segment must receive.

## MAC Address

In networking, the Media Access Control (MAC) address is a unique identifier programmed into each network device. This number acts like a name for the device, and all SpeedNet Radios have unique MAC addresses. Some devices have user-configurable MAC addresses, but the SpeedNet Radio MAC address is configured at the factory and cannot be changed. Most protocols use MAC addresses that are globally unique, but not all protocols use MAC addresses or require that they be unique.

Unlike IP addresses, MAC addresses do not have node and network sections, and a receiving node cannot determine any network information from the MAC address. The length of a MAC address is 6 bytes, and an IP address is 4 bytes long. Therefore, the MAC address cannot be represented using an IP address. So an IP address must be mapped to its corresponding MAC address. Address Resolution Protocol (ARP) is used to locate a specific MAC address. ARP broadcasts an ARP request packet, which contains the source MAC address, the source IP address, and the destination IP address. Each node in the local network receives this packet. A node that has the specified destination IP address returns an ARP reply packet containing its MAC address to the originating host.

On broadcast networks, such as Ethernet, the MAC address allows each node to be uniquely identified and frames to be marked for specific nodes. It thus forms the basis of most of the layer 2 networking upon which higher OSI layer protocols are built to produce complex functioning networks. See Table 6.

**Table 6. OSI model**

	Data Unit	Layer	Function
<b>Host IED (Intelligent Electronic Device) Layers</b>	Data	Application	Network process to application. IntelliRupter/IntelliTeam® Software
		Presentation	Data representation and encryption
		Session	Interhost communication
	Segments	Transport	End-to-end connections and reliability (UDP/TCP)
<b>Media SpeedNet Layers</b>	Packets	Network	Path determination and logical addressing (IP)
	Frames	Data Link	Physical addressing (MAC and LLC)
	Bits	Physical	Media, wireless, fiber optics, and wire

## Network Example

Use of private IP addresses is strongly recommended when configuring a SpeedNet Radio network. The following example of a SpeedNet Radio network uses several private IP subnets from the 192.168.0.0 block of private addresses.

The SpeedNet Radio network, depicted in Figure 1, contains three Ethernet segments. The first segment uses the 192.168.200.0 Class C subnet, encompassing a range of addresses from 192.168.200.1 to 192.168.200.254. The second segment uses the 192.168.201.0 Class C subnet, encompassing a range of addresses from 192.168.201.1 to 192.168.201.254. The third segment uses the 192.168.202.0 Class C subnet, encompassing a range of addresses from 192.168.202.1 to 192.168.202.254. All three radios share the 192.168.203.0 Class C subnet for their wireless interfaces. It is over this common subnet that traffic is routed between Ethernet segments.

Once the individual data networks are established, plan the IP addressing scheme. In Figure 1, each SpeedNet Radio host ID is 1, and each automatic switch control host ID is 2. Following a numbering scheme such as this will make it easier to keep track of which IP addresses are used for each device.

The SCADA network in this example uses the 192.168.203.0 subnet. This subnet is different from the subnets used for the Ethernet segments. The wireless interface of the SpeedNet Radio from Subnet 1 is assigned an address of 192.168.203.1. The wireless interface of the SpeedNet Radio from Subnet 2 is assigned an address of 192.168.203.2. The wireless interface of the SpeedNet Radio from Subnet 3 is assigned an address of 192.168.203.3.

You may find it helpful to draw a diagram as a planning aid and reference guide when designing your SCADA network.

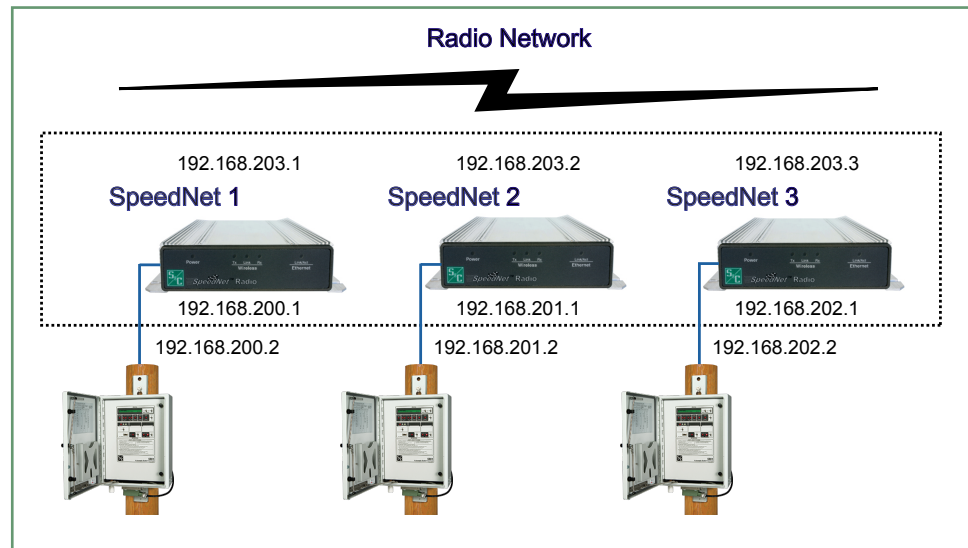


Figure 1. Multi-network use of SpeedNet Radios.

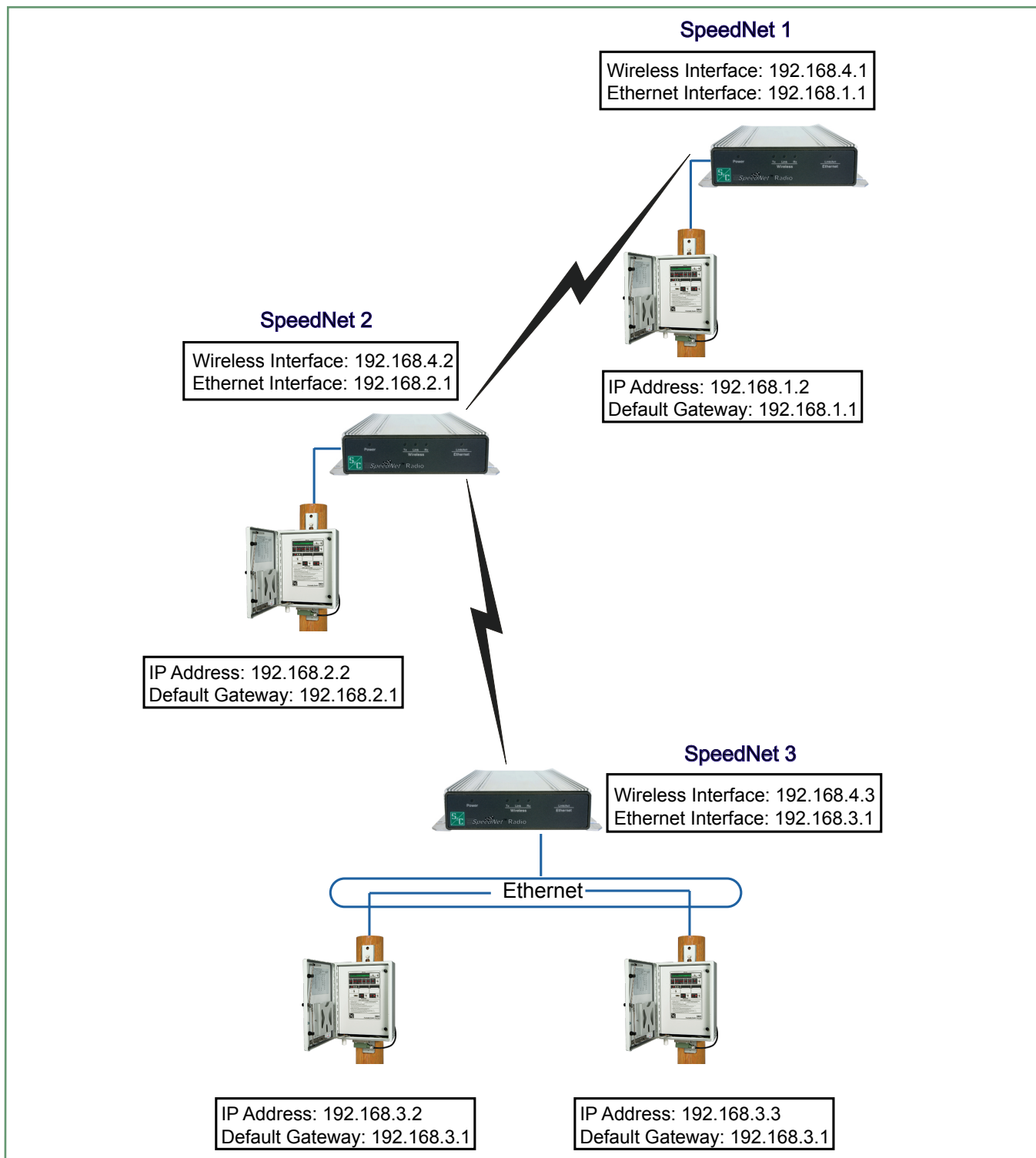


Figure 2. A wireless network using SpeedNet Radios with AODV.

## Routing Options

As a router, SpeedNet Radios provide a wireless connection between two or more separate Ethernet subnets. Data are then routed between the Ethernet subnets. Route information can be entered manually, or it can be processed automatically by AODV. See Figure 2 on page 15 for an example of a wireless network using SpeedNet Radios with AODV.

The type of network you are designing will help determine the best routing mode to use. If the network consists of stationary SpeedNet Radios that are communicating either point-to-point or point-to-multipoint, choose “Off” for ad-hoc routing mode. This allows you to insert static routes for each SpeedNet Radio and its connected network. If route redundancy is not required, “Off” is likely the best ad-hoc routing mode to choose. Note that if static routing is selected (ad-hoc routing mode is “Off”), then all routes that a given radio might need must be specified as static routes. The radios do not support a mixture of static routes and AODV routing. See Figure 3.

If the network consists of meshed SpeedNet Radios, choose “AODV,” the ad-hoc routing mode. This mode allows the SpeedNet Radios to automatically find their neighbors and quickly and dynamically update the route tables as the network topology changes. For environments where routes are required to change dynamically or where enhanced reliability through redundancy is required, AODV is typically the best ad-hoc routing mode to choose.

## Using Static Routes

Figure 3 is an example of a point-to-point SpeedNet Radio network. In this example, Subnet 1 has been assigned the 192.168.1.0 Class C subnet, while Subnet 2 has been assigned the 192.168.2.0 Class C subnet. For the wireless network common between the two radios, the 192.168.3.0 Class C subnet has been assigned.

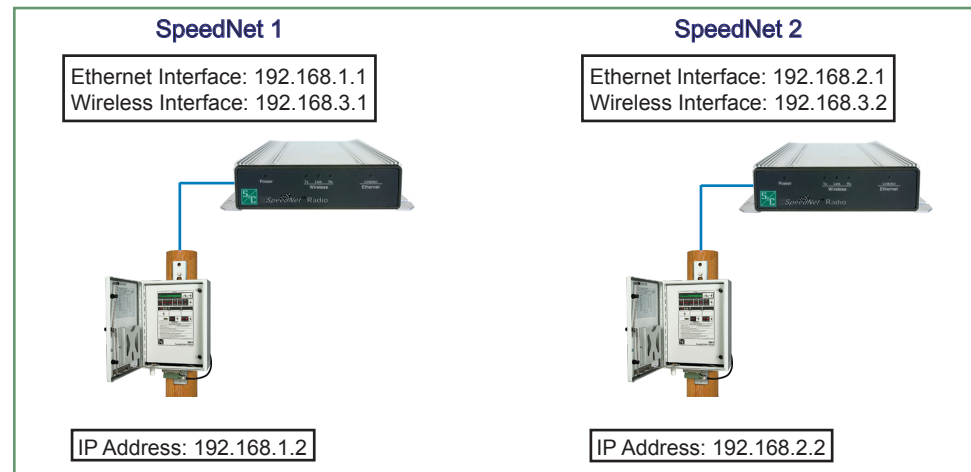


Figure 3. A wireless network using SpeedNet Radios with static routes.

To route traffic between subnets, several things must happen. First, all hosts on a given subnet must use the attached SpeedNet Radio as their default gateway. As an alternative, manual routes can be entered in each host's routing table. Hosts from Subnet 1 will list 192.168.1.1 as their default gateway. If AODV is disabled, and static routing is used, it is necessary to add static routes in each SpeedNet Radio. The SpeedNet Radio from Subnet 1 must have a static route to Subnet 2, using the SpeedNet Radio from Subnet 2 as the gateway. The route should be set up like this:

192.168.2.0	255.255.255.0	192.168.3.2
Network	Netmask	Gateway

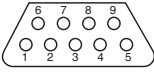
All hosts from Subnet 2 should use 192.168.2.1 as their default gateway. As an alternative, manual routes can be entered in each host's routing table. The SpeedNet Radio from Subnet 2 must have a static route to Subnet 1, using the SpeedNet Radio from Subnet 1 as the gateway. This route should be set up like this:

192.168.1.0	255.255.255.0	192.168.3.1
Network	Netmask	Gateway

<b>NOTICE</b>
<p>It is important to understand that there are actually three subnets in this example: Subnet 1, Subnet 2, and the radio network.</p> <p>It is also important that all radio wireless IP addresses should be on the same subnet, while all radio Ethernet IP addresses should be on different, non-overlapping subnets.</p>

## Interface Pinouts

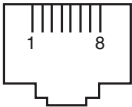
The RS-232 Interface of the SpeedNet Radio is configured as data communications equipment. See Figure 4.



Pin	Function	Description
1	NC	No Connection
2	TXD	RS-232 Transmit
3	RXD	RS-232 Receive
4	NC	No Connection
5	GND	Signal Ground
6	NC	No Connection
7	CTS	Clear to Send
8	RTS	Request to Send
9	NC	No Connection

**Figure 4. SpeedNet Radio RS-232 interface pinout.**

The SpeedNet Radio Ethernet interface uses an RJ-45 connector with the pinout shown in Figure 5. The Ethernet port is on the rear panel of the SpeedNet Radio. It is auto-sensing for assignment of transmit and receive lines (no crossover cables required) and auto-negotiates for 10-Mbps or 100-Mbps data rate as required by the connected device.



Pin	Function	Description
1	TXD+	Transmit
2	TXD-	Transmit
3	RXD+	Receive
4	NC	No Connection
5	NC	No Connection
6	RXD-	Receive
7	NC	No Connection
8	NC	No Connection

**Figure 5. SpeedNet Radio Ethernet RJ-45 interface pinout.**