

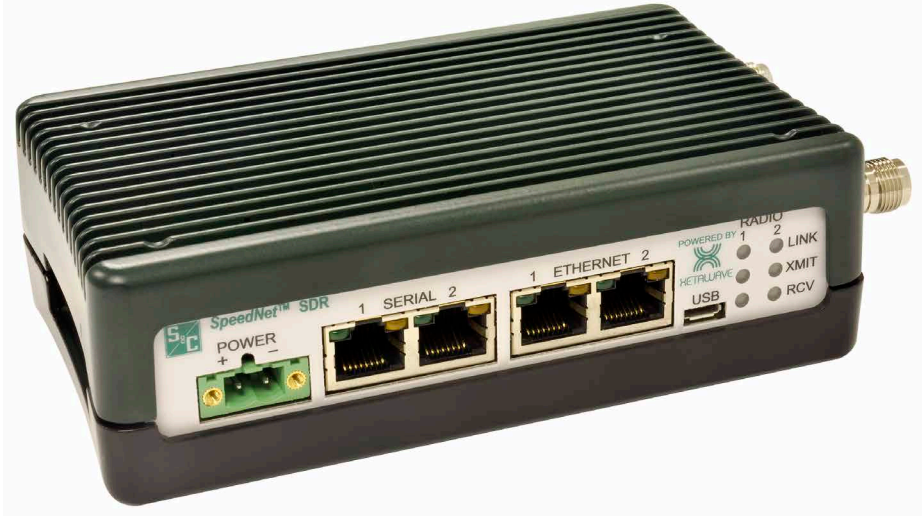
Installation

Table of Contents

Section	Page	Section	Page
Introduction		Installation	
Qualified Persons	2	Before Starting Installation	8
Read this Instruction Sheet	2	Network Design	8
Proper Application	2	Cable Installation	8
Retain this Instruction Sheet	2	Antenna/Cable Installation Requirements	8
Regulatory Information	2	IP Basics	9
Special Warranty Qualifications	4	Subnet Masking	10
Antenna Requirements	4	Private Subnets	10
Safety Information		MAC Address	10
Understanding Safety-Alert Messages	5	Network Example	11
Following Safety Instructions	5	Routing Options	12
Replacement Instructions and Labels	5	Using Static Routes	14
Safety Precautions		Interface Pinouts	16
Shipping and Handling			
Inspection	7		
Packing	7		

NOTICE

The latest SpeedNet SDR Radio Instruction Sheets are posted as PDF documents at sandc.com/en/support/product-literature/. If you need assistance, please contact S&C's Customer Support & Monitoring Center at 888-762-1100.



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 90, 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 installing or operating your S&C SpeedNet SDR Software Defined Radio. Familiarize yourself with Safety Information and Safety Precautions on pages 5 and 6. The latest version is available online in PDF format at sandc.com/en/support/product-literature/.

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 the SpeedNet SDR Software Defined Radio is to be used. Retain this instruction sheet in a location where you can easily retrieve and refer to it.

Regulatory Information

The SpeedNet SDR Software Defined Radio uses a licensed band, and no one is permitted to use this band without an appropriate license. This device must be professionally installed. It is the responsibility of the installer to ensure proper antenna and cable combinations are used to remain within the license limits.

The SpeedNet SDR 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 limits of the license. 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 SDR-4 Radio and SpeedNet SDR-4x4 Radio comply with these FCC exposure guidelines when the following precautions are obeyed:

- The radios have a maximum transmitted output power of 2000 mW in 450- to 470-MHz band. With maximum settings (2 W), these models require that the transmit antenna be kept at least 3.9 meters away from nearby persons when connected to an 6-dBd antenna.

The SpeedNet SDR 9 Radio and SpeedNet SDR 9×9 Radio comply with these FCC exposure guidelines when the following precautions are obeyed:

- Have a maximum transmitted output power of 3000 mW in 928- to 960-MHz band. With maximum settings (3 W), these models require that the transmit antenna be kept at least 65.56 cm away from nearby persons.

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

The SpeedNet SDR-4 Radio and SpeedNet SDR-4×4 Radio have been declared to conform to R&TTE Directive 1999/5/EC of the European Parliament using harmonized standards in the following areas:

Safety

EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 +A2:2013; EN 50385:2002

EMC

EN 301 489-5 v1.3.1 (2002-8); EN 301 489-1 V1.9.2 (2011-09)

Spectrum

EN 300 113-2 v1.5.1 (2011-11); EN 300 113-1 V1.7.1 (2011-11)

NOTICE

1. Operation in the EU is limited to 12.5- and 25-KHz channel spacing.
2. Equipment is intended to be installed in locations with restricted access.
3. Dc power supply lines, Ethernet and Serial cables are limited to a maximum length less than 3 meters/10 feet.

Xetawave hereby declares that this Xeta4-E / SpeedNet SDR-4 Radio and Xeta4x4 / SpeedNet SDR-4×4 Radio are in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

The Manufactures Declaration of Conformity can be obtained at S&C Electric Company's Europe, Middle East, and Africa (EMEA) office.

NOTICE

The SpeedNet SDR family of products can be used as stand-alone radio equipment or as a component of a larger system. Operational temperature ranges for each configuration are given below:

Configuration	Min Temp	Max Temp
Stand-alone:	-40°F/-40°C	140°F/60°C
System component:	-40°F/-40°C	150°F/70°C

CAUTION

When ambient operating temperatures exceed 140°F/60°C the following warning applies to this device: **CAUTION HOT SURFACE DO NOT TOUCH**

NOTICE

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

NOTICE

This equipment has been tested and found to comply with part 90 of the FCC rules and regulations regarding unlicensed transmissions. 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 causes 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 the one to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC ID: PEJ-93824283-XETA4 SpeedNet SDR-4 Radio and SpeedNet SDR-4×4 Radio

IC ID: 11169A-XETA4 SpeedNet SDR-4 Radio and SpeedNet SDR-4×4 Radio

FCC ID: PEJ-93829283-MSD9 SpeedNet SDR 9 and SpeedNet SDR 9×9 radios

IC ID: 11169A-XETA9 SpeedNet SDR 9 and SpeedNet SDR 9×9 radios

Special Warranty Qualifications

The standard warranty contained in the seller's standard conditions of sale, as set forth in Price Sheets 150 and 155, applies to S&C SpeedNet SDR Software Defined Radios, except that the first paragraph of said warranty is replaced by the following:

(1) General: The seller warrants to the purchaser for a period of two years from the date of shipment that the equipment delivered will be of the kind and quality specified in the contract description and will be free of defects of workmanship and material. Should any failure to conform to this warranty appear under proper and normal use within two years after the date of shipment, the seller agrees, upon prompt notification thereof and confirmation that the equipment has been stored, installed, operated, inspected, and maintained in accordance with recommendations of the seller and standard industry practice, to correct the nonconformity either by repairing any damaged or defective parts of the equipment or (at the seller's option) by shipment of necessary replacement parts.

The above special warranty does not apply to gateway communication devices applied with SpeedNet SDR Software Defined Radios.

The end user is granted a nontransferable, nonsublicensable, nonexclusive license to use the software furnished with SpeedNet SDR Software Defined Radios only upon acceptance of all the terms and conditions of the seller's end user license agreement set forth in Price Sheet 155.

Antenna Requirements

SpeedNet SDR Radios have been designed to operate with 50-ohm antenna systems.

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

Understanding Safety-Alert Messages

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

⚠ DANGER
“DANGER” identifies the most serious and immediate hazards that <i>will likely</i> result in serious personal injury or death if instructions, including recommended precautions, are not followed.
⚠ WARNING
“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.
⚠ CAUTION
“CAUTION” identifies hazards or unsafe practices that <i>can</i> result in minor personal injury if instructions, including recommended precautions, are not followed.
NOTICE
“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, or call S&C Headquarters at (773) 338-1000; in Canada, call S&C Electric Canada Ltd. at (416) 249-9171.

⚠ DANGER	
Read this instruction sheet thoroughly and carefully before installing or operating your S&C SpeedNet SDR 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 SDR Software Defined 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 SDR Software Defined 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.** With maximum settings (2 W), the SpeedNet SDR-4x4 Radio requires that the transmit antenna be kept at least 12.8 feet (3.9 meters) away from nearby persons when connected to a 6-dBd antenna.

With maximum settings (3 W), the SpeedNet SDR 9 and SpeedNet SDR 9x9 radios require that the transmit antenna be kept at least 25.8 inches (65.56 cm) away from nearby persons.

Disconnect the ac/dc input power source from the SpeedNet SDR Software Defined Radio whenever configuring or repositioning the antenna.
- 6. 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 SDR Radio shipment includes the following items:

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

Installation

Before Starting Installation

This instruction sheet provides an overview of the SpeedNet SDR Software Defined Radio and its security features. 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 SDR Radios can be installed in a variety of network configurations. Plan your network in advance and develop a logical Internet Protocol (IP) addressing scheme for your particular application. Depending on your network type, several factors may influence your design, such as terrain, coverage area, and number of radios.

Cable Installation

Connecting Cables

1. Connect antenna to SpeedNet SDR Radio.
2. Connect Ethernet cable to SpeedNet SDR Radio and PC used for configuration.
3. Connect power supply to the SpeedNet SDR Radio.

Antenna/Cable Installation Requirements

NOTICE

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

For the following example, assume the license allows for a maximum of 1 W (+30dBm) radiated power and 4 W (+36dBm) Effective Isotropic Radiated Power (EIRP). This is equivalent to a radio running at output power (1 W +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 SDR Radios have configurable transmit power that can be selected using the SpeedNet SDR Web server, command line interface, or by using IntelliTeam® CNMS Communication Network Management System. Any confirmed decrease in output power should be considered when calculating EIRP.

Tables 1 through 4 show 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^①

Antenna Gain	Length/Loss	ERP
+8.2 dBi	60 feet (1829 cm)/2.3 dB loss	+36.0 dBm
+10.2 dBi	110 feet (3353 cm)/4.3 dB loss	+36.0 dBm
+12.1 dBi	160 feet (4877 cm)/6.2 dB loss	+36.0 dBm

^① Assuming 1 W output power from the SpeedNet SDR Radio.

Table 3. Antenna/Cable Loss Examples with LMR-600 Cable^①

Antenna Gain	Length/Loss	ERP
+8.2 dBi	90 feet (2743 cm)/2.3 dB loss	+36.0 dBm
+10.2 dBi	170 feet (5182 cm)/4.3 dB loss	+36.0 dBm
+12.1 dBi	245 feet (7468 cm)/6.1 dB loss	+36.0 dBm

^① Assuming 1 W output power from the SpeedNet SDR Radio.

Table 4. Antenna Cable Loss Examples with LMR-900 Cable^①

Antenna Gain	Length/Loss	ERP
+8.2 dBi	135 feet (4115 cm)/2.3 dB loss	+35.9 dBm
+10.2 dBi	250 feet (7260 cm)/4.3 dB loss	+36.0 dBm
+12.1 dBi	310 feet (9449 cm)/5.3 dB loss	+35.9 dBm

^① Assuming 1 W output power from the SpeedNet SDR Radio.

IP Basics

SpeedNet SDR Radios use 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 above, 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: 101 01100.00011010.11110000.11001000 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 because of 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 SDR Radios have unique MAC addresses. Some devices have user-configurable MAC addresses, but the SpeedNet SDR 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 allows 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 5 on page 11.

Table 5. OSI Model

	Data Unit	Layer	Function
Host IED (Intelligent Electronic Device) Layers	Data	Application	Network process to application IntelliRupter® PulseCloser® Fault Interrupters/ IntelliTeam® Automatic Restoration System
		Presentation	Data representation and encryption
		Session	Interhost communication
	Segments	Transport	End-to-end connections and reliability (UDP/TCP)
Media SpeedNet SDR Radio	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 SDR Radio network. The following example of a SpeedNet SDR Radio network uses several private IP subnets from the 192.168.0.0 block of private addresses.

The SpeedNet SDR 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.

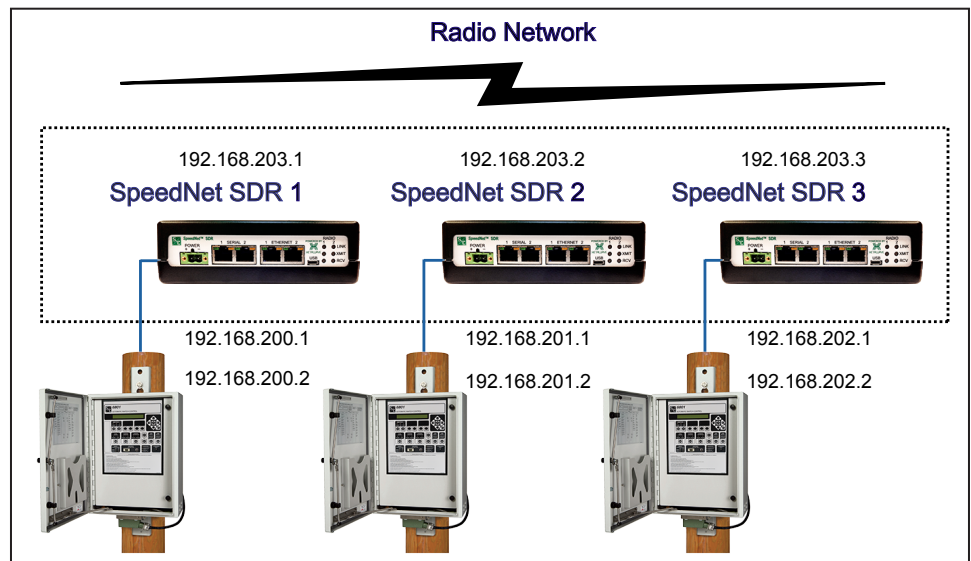


Figure 1. Multi-network using SpeedNet SDR Software Defined Radios.

When the individual data networks are established, you should plan the IP addressing scheme. In Figure 1 on page 7, each SpeedNet SDR 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 SDR Radio from Subnet 1 is assigned an address of 192.168.203.1. The wireless interface of the SpeedNet SDR Radio from Subnet 2 is assigned an address of 192.168.203.2. The wireless interface of the SpeedNet SDR 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.

Routing Options

As a router, SpeedNet SDR 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 13 for an example of a wireless network using SpeedNet SDR 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 SDR Radios that are communicating either point to point or point to multipoint, choose the **Off** setting for **Ad-Hoc Routing** mode. This allows you to insert static routes for each SpeedNet SDR Radio and its connected network. When route redundancy is not required, the **Off** setting is likely the best choice for **Ad-Hoc Routing** mode. 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 on page 14.

When the network consists of meshed SpeedNet SDR Radios, choose *AODV*, the ad-hoc routing mode. This mode allows the SpeedNet SDR 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.

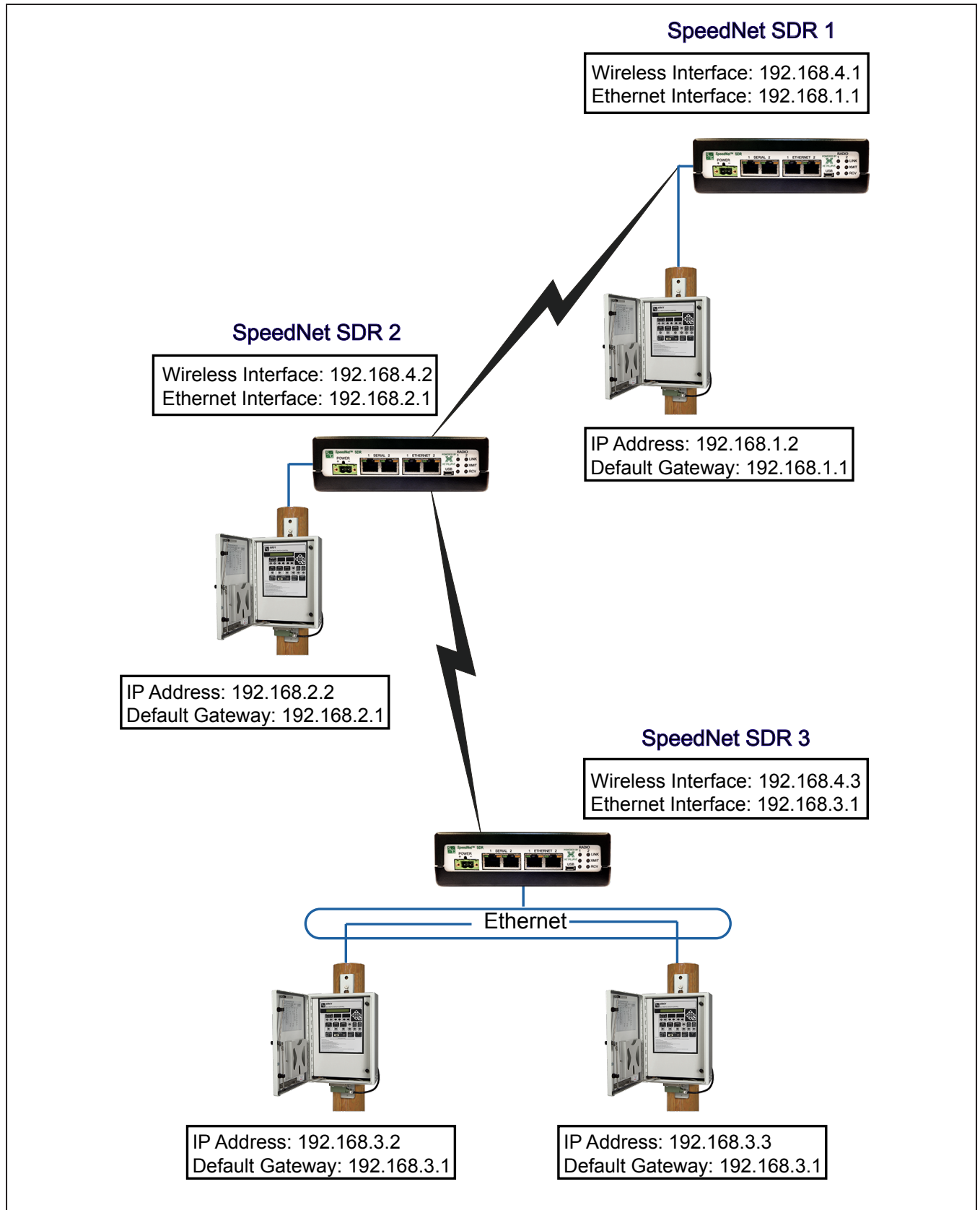


Figure 2. Wireless network using SpeedNet SDR Radios with AODV.

Using Static Routes

Figure 3 is an example of a point-to-point SpeedNet SDR 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.

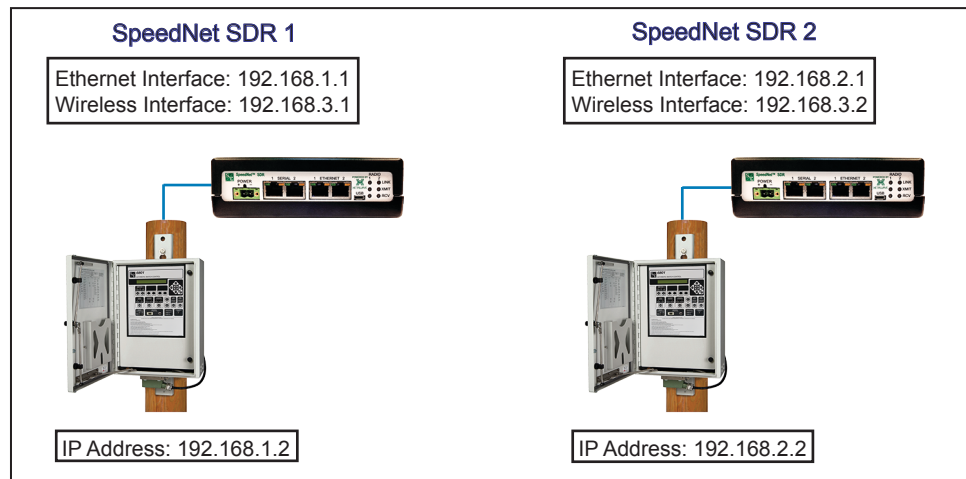


Figure 3. Wireless network using SpeedNet SDR Radios with static routes.

To route traffic between subnets, several things must happen. First, all hosts on a given subnet must use the attached SpeedNet SDR 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. Assuming that ad-hoc routing is deactivated, it is also necessary to add static routes in each SpeedNet SDR Radio. The SpeedNet SDR Radio from Subnet 1 must have a static route to Subnet 2, using the SpeedNet SDR 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 SDR Radio from Subnet 2 must have a static route to Subnet 1, using the SpeedNet SDR 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

NOTICE

It is important to understand there are actually three subnets in this example: Subnet 1, Subnet 2, and the radio network.

It is also important that all radio wireless IP addresses be on the same subnet, while all radio Ethernet IP addresses must be on different, non-overlapping subnets.

If you are using a different type of cable, verify cable loss before installation. See Table 6.

Table 6. Attenuation Chart

Cable Type	Nominal Attenuation Frequency in MHz dB/100ft								
	10 MHz	30 MHz	50 MHz	150 MHz	220 MHz	450 MHz	900 MHz	1.2 GHz	2.4 GHz
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		5.2	7.3		
RG214/U	0.6	0.9	1.3	2.3		4.5	7.3		
RG223/U	1.2	2.0	2.8	5.0		9.8	13.4		
RG316/U									
RG393/U									
RG58A/U	1.5	2.6	3.3	6.8		12.6	21.0		
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		8.6	13.0		

Interface Pinouts

The SpeedNet SDR Radio serial ports have hardware to support RS 232, RS 422, and RS 485. Table 7 shows the pin definitions for each:

Table 7. SpeedNet SDR Radio Interface Pinout

Pin	RS 232	RS 422	RS 485
1		DSR	
2		DCD	
3		DTR	
4	GND	GND	GND
5	TXD	RX+	B+
6	RXD	TX+	B+
7	CTS	TX-	B-
8	RTS	RX-	B

The SpeedNet SDR Radio Ethernet interfaces use an RJ-45 connector with the pinout shown in Table 8. The Ethernet port is on the rear panel of the SpeedNet SDR Radio. It is auto-sensing for assignment of transmit and receive lines (no crossover cables required) and auto-negotiates for a 10-Mbps or 100-Mbps data rate as required by the connected device.

Table 8. SpeedNet SDR Radio Ethernet RJ-45 Interface Pinout

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