Installing and Connecting the Router

This document describes how to install and connect Cisco 2900 series and Cisco 3900 series integrated services routers (ISRs) to LAN, WAN, and Voice networks. The following sections provide technical details.

- Installation Requirements and Warnings, page 3-1
- What you Need to Know, page 3-3
- Before you Begin, page 3-4
- Unpacking the Router, page 3-4
- Installing the Router, page 3-5
- Chassis Grounding, page 3-15
- Connecting Power, page 3-18
- Connecting to a Console Terminal or Modem, page 3-30
- Installing the Cisco Microsoft Windows USB Device Driver, page 3-35
- Uninstalling the Cisco Microsoft Windows USB Driver, page 3-37
- Connecting to the Auxiliary Port, page 3-38
- Connecting WAN, LAN, and Voice Interfaces, page 3-41

Installation Requirements and Warnings

⚠️ Warning
To see translations of the warnings that appear in this publication, see the Regulatory Compliance and Safety Information for Cisco 2900 Series Integrated Services Routers or the Regulatory Compliance and Safety Information for Cisco 3900 Series Integrated Services Routers document. Only trained and qualified personnel should be allowed to install, replace, or service this equipment. Statement 1030

⚠️ Warning
This unit might have more than one power supply connection. All connections must be removed to de-energize the unit. Statement 1028
Installation Requirements and Warnings

Warning Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place. Statement 1029

Warning Hazardous network voltages are present in WAN ports regardless of whether power to the unit is OFF or ON. To avoid electric shock, use caution when working near WAN ports. When detaching cables, detach the end away from the unit first. Statement 1026

Warning This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available. Statement 1024

Warning Before opening the unit, disconnect the telephone-network cables to avoid contact with telephone-network voltages. Statement 1041

Warning Do not use this product near water; for example, near a bath tub, wash bowl, kitchen sink or laundry tub, in a wet basement, or near a swimming pool. Statement 1035

Warning Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations. Statement 1036

Warning Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface. Statement 1037

Warning Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electric shock from lightning. Statement 1038

Warning To report a gas leak, do not use a telephone in the vicinity of the leak. Statement 1039

Warning This unit is intended for installation in restricted access areas. A restricted access area can be accessed only through the use of a special tool, lock and key, or other means of security. Statement 1017
Warning
Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.
Statement 1029

Warning
The covers are an integral part of the safety design of the product. Do not operate the unit without the covers installed. Statement 1077

What you Need to Know

CLI Console Access
Use the new USB console port on the router to access the Cisco Internet Operating System (IOS) CLI on the router and perform configuration tasks. A terminal emulation program, such as Microsoft Windows HyperTerminal, is required to establish communication between the router and a PC. See the “Connecting to a Console Terminal or Modem” section on page 3-30 for instructions.

Note
A Microsoft Windows USB driver must be installed before you establish physical connectivity between the router and the PC.

Slot and Port Numbers
Cisco 2900 series and 3900 series ISRs have built in ports and new slots. The new slots accommodate new modules and interface cards; Enhanced High-Speed WAN Interface Cards (EHWICs), Internal Services Modules (ISMs), Packet Voice Data Modules (PVDM3), and Service Modules (SMs). See the “Slot, Port, and Interface Information” section on page 1-28 for slot and port numbering.

Software Licenses
To use the following features on Cisco Integrated Services Routers, you must purchase a software package.

- Gatekeeper
- IPS (subscription)
- SSL_VPN (counted)
- SNA Switching

See the “Getting Software Licenses for the Router” section on page 6-1 for more information.
Before you Begin

Before installing and connecting a Cisco Integrated Services Router, read the safety warnings and gather the following tools and equipment.

- ESD-preventive cord and wrist strap
- Number 2 Phillips screwdriver
- Flat-blade screwdrivers: small, 3/16-in. (4 to 5 mm) and medium, 1/4-in. (6 to 7 mm)
  - To install or remove modules
  - To remove the cover, if you are upgrading memory or other components
- Screws that fit your rack
- Wire crimper
- Wire for connecting the chassis to an earth ground:
  - AWG 6 (13 mm²) wire for NEBS-compliant chassis grounding
  - AWG 14 (2 mm²) or larger wire for NEC-compliant chassis grounding
  - AWG 18 (1 mm²) or larger wire for EN/IEC 60950-compliant chassis grounding
- For NEC-compliant grounding, an appropriate user-supplied ring terminal, with an inner diameter of 1/4 in. (5 to 7 mm)

In addition, depending on the type of modules you plan to use, you might need the following equipment to connect a port to an external network:

- Cables for connection to the WAN and LAN ports (dependent on configuration)

Note
For more information on cable specifications, see the Cisco Modular Access Router Cable Specifications document on Cisco.com.

- Ethernet hub or PC with a network interface card for connection to an Ethernet (LAN) port.
- Console terminal (an ASCII terminal or a PC running HyperTerminal or similar terminal emulation software) configured for 9600 baud, 8 data bits, 1 stop bit, no flow control, and no parity.
- Modem for connection to the auxiliary port for remote administrative access (optional).
- Data service unit (DSU) or channel service unit/data service unit (CSU/DSU) as appropriate for serial interfaces.
- External CSU for any CT1/PRI modules without a built-in CSU.
- NT1 device for ISDN BRI S/T interfaces (if not supplied by your service provider).

Unpacking the Router

Do not unpack the router until you are ready to install it. If the final installation site will not be ready for some time, keep the chassis in its shipping container to prevent accidental damage. When you are ready to install the router, proceed with unpacking it.

The router, accessory kit, publications, and any optional equipment you ordered may be shipped in more than one container. When you unpack the containers, check the packing list to ensure that you received all of the items on the list.
Installing the Router

If you need to install service modules, interface cards, and FRUs, you can install them either before or after you install the router. Ideally, you install modules and interface cards when you have the best access to the back panel of the router. Internal modules and FRUs, such as internal services modules (ISMs) or packet voice data modules (PVDMs), and fan trays should be installed before rack-mounting. See the “Installing and Upgrading Internal Modules and FRUs” section on page 5-1.

There are three methods of installing the router:

- Rack-Mounting the Chassis, page 3-5
- Setting the Chassis on a Desktop, page 3-12
- Mounting a Cisco 2901 or 2911 Router on a Wall, page 3-13

**Warning**
Before working on a system that has an on/off switch, turn OFF the power and unplug the power cord.

**Statement 1**

**Caution**
To prevent damage to the chassis, never attempt to lift or tilt the chassis by holding it by the plastic panel on the front. Always hold the chassis by the sides of the metal body.

Rack-Mounting the Chassis

Cisco 2900 series and 3900 series routers can be installed in 19-inch (48.26-cm) EIA and 23-inch (58.42-cm) Southwestern Bell Corporation (SBC) racks. The Cisco 3900 series routers can also be mounted in a 600-mm ETSI rack. Use the standard brackets shipped with the router for mounting the chassis in a 19-inch EIA rack; you can order optional larger brackets for mounting the chassis in a 19-inch SBC rack.

You can mount the router in the following ways:

- Center-front mounting—Brackets attached in the center front of the chassis with only the front panel facing forward.
- Center-back mounting—Brackets attached in the center back of the chassis with only the back panel facing forward.
- Front mounting—Brackets attached at the front of the chassis with the front panel facing forward.
- Back mounting—Brackets attached at the back of the chassis with the back panel facing forward.

Attaching Rack-Mount Brackets to Cisco 2901 Routers

For the Cisco 2900 series routers use four of the supplied number-8 Phillips flat-head screws to attach the long side of each bracket to the router. For the Cisco 3900 series routers use four of the supplied number-6 Phillips flat-head screws to attach the long side of each bracket to the router.

**Figure** shows how to attach the brackets to the sides of the router with the front panel forward.
Installing the Router

Figure 3-1 Bracket Installation for Front Mounting

Figure 3-2 shows how to attach the brackets to the sides of the router with the back panel forward.

Figure 3-2 Bracket Installation for Back Mounting

Figure 3-3 shows how to attach the brackets to the sides of the router with center mounting.

Figure 3-3 Bracket Installation for Center Mounting

Attaching Rack-Mount Brackets to Cisco 2911, Cisco 2921, and Cisco 2951 Routers

Attach the mounting brackets to the router chassis as shown in Figure 3-4 through Figure 3-7, using the screws provided.

Caution

Do not over torque the screws. The recommended torque is 15 to 18 inch-lb (1.7 to 2.0 N-m).

Attach the second bracket to the opposite side of the chassis. Use a number-2 Phillips screwdriver to install the number-8 bracket screws.
Caution

Your chassis installation must allow unrestricted airflow for chassis cooling.

Figure 3-4  Bracket Installation for Front Mounting

Figure 3-5  Bracket Installation for Center-Front Mounting

1. Southwestern Bell Corporation (SBC)
Attaching Rack-Mount Brackets to Cisco 3900 Series Routers

Attach the mounting brackets to the router chassis as shown in Figure 3-8 through Figure 3-11, using the screws provided.

**Caution**

Do not over torque the screws. The recommended torque is 8 to 10 inch-lb (0.9 to 1.12 N-m).

Attach the second bracket to the opposite side of the chassis. Use a number-2 Phillips screwdriver to install the number-6 bracket screws.

**Caution**

Your chassis installation must allow unrestricted airflow for chassis cooling.
Figure 3-8  Bracket Installation for Front Mounting

1  23-inch EIA brackets  
2  19-inch EIA brackets

Figure 3-9  Bracket Installation for Center-Front Mounting

1  23-inch EIA brackets  
2  19-inch EIA brackets
Chapter 3 Installing and Connecting the Router

Installing the Router

Figure 3-10 Bracket Installation for Rear Mounting

After you attach the rack-mount brackets to the router chassis, use the screws provided with the rack to install the chassis in the rack. (See Figure 3-12.)

Tip

For 23-inch SBC brackets start the lower pair of screws first, and rest the brackets on the lower screws while you insert the upper pair of screws.

Tip

The screw slots in the brackets are spaced to line up with every second pair of screw holes in the rack. When the correct screw holes are used, the small threaded holes in the brackets line up with unused screw holes in the rack. If the small holes do not line up with the rack holes, you must raise or lower the brackets to the next rack hole.

Mounting the Router in a Rack

After you attach the rack-mount brackets to the router chassis, use the screws provided with the rack to install the chassis in the rack. (See Figure 3-12.)

Tip

For 23-inch SBC brackets start the lower pair of screws first, and rest the brackets on the lower screws while you insert the upper pair of screws.

Tip

The screw slots in the brackets are spaced to line up with every second pair of screw holes in the rack. When the correct screw holes are used, the small threaded holes in the brackets line up with unused screw holes in the rack. If the small holes do not line up with the rack holes, you must raise or lower the brackets to the next rack hole.

1 23-inch EIA brackets  2 19-inch EIA brackets

1 23-inch EIA brackets  2 19-inch EIA brackets
Warning

To prevent bodily injury when mounting or servicing this unit in a rack, you must take special precautions to ensure that the system remains stable. The following guidelines are provided to ensure your safety:

- This unit should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.
- If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack. Statement 1006

Statement 1032

Caution

Be sure to leave space above and below each router in a rack to allow for cooling air circulation.

Figure 3-12 shows a typical installation in a rack.

Figure 3-12  Mounting the Chassis in a Rack (Typical)

![Mounting the Chassis in a Rack](image)

1 Mounting screws (4)

Figure 3-13 shows an installation with a chassis rear-forward.

Cisco 2900 and 3900 Series Hardware Installation
Grounding the Chassis

After the router is installed, you must connect the chassis to a reliable earth ground. For the chassis ground connection procedures, see the “Chassis Grounding” section on page 3-15.

Setting the Chassis on a Desktop

You can place Cisco 2901, Cisco 2911, and Cisco 3900 series routers on a desktop or shelf.

**Note**

Models 2921 and above are not recommended for desktop mounting.

To install a Cisco 2901 or 2911 router on a desktop, first install the four rubber feet that are supplied in the accessory kit. They provide anti-skid protection and space for air circulation. Peel the rubber feet from the adhesive strip, and stick them onto the “+” marked on the bottom of the chassis.

**Warning**

To prevent personal injury or damage to the chassis, never attempt to lift or tilt the chassis using the handles on modules (such as power supplies, fans, or cards); these types of handles are not designed to support the weight of the unit. Statement 1032

**Caution**

Do not place anything on top of the router that weighs more than 10 pounds (4.5 kg), and do not stack routers on a desktop. Excessive distributed weight of more than 10 pounds, or pound point load of 10 pounds on top could damage the chassis.

**Caution**

Your chassis installation must allow unrestricted airflow for chassis cooling. For placing the router on a desktop, keep at least 1 inch (2.54 cm) of clear space beside the cooling inlet and exhaust vents.

After the router is installed, you must connect the chassis to a reliable earth ground. For the chassis ground connection procedures, see the “Chassis Grounding” section on page 3-15.
Mounting a Cisco 2901 or 2911 Router on a Wall

This section explains how to mount Cisco 2901 and Cisco 2911 routers on a wall or other vertical surface. We do not recommend mounting a Cisco 2921, 2951, or Cisco 3900 series router on a wall.

The following warning applies to Cisco 2901 and 2911 routers:

Warning

This unit is intended to be mounted on a wall. Please read the wall mounting instructions carefully before beginning installation. Failure to use the correct hardware or to follow the correct procedures could result in a hazardous situation to people and damage to the system. Statement 248

Tip

When choosing a wall-mounting location, consider cable limitations and wall structure.

Note

The Cisco 2901 and Cisco 2911 routers use brackets designed for the 19-inch EIA rack-mounting, the part number 700-16559-01 is stamped on the bracket (shown in Figure 3-15).

Attaching Brackets to the Router for Wall Mounting

Attach the standard brackets to the chassis using the four screws provided for each bracket.

Attaching the Router to a Wall

Attach the router to the wall using the brackets previously attached. Use attachment hardware that you provide as follows:

- For attaching to a wall stud, each bracket requires two number-10 wood screws (round- or pan-head) with number-10 washers, or two number-10 washer-head screws. The screws must be long enough to penetrate at least 1.5 inches (38.1 mm) into the supporting wood or metal wall stud.
- For hollow-wall mounting, each bracket requires two wall anchors with washers. Wall anchors and washers must be size number 10.
- Route the cables so that they do not put a strain on the connectors or mounting hardware.
- The NEBS air baffle (Cisco 2911) should not be used when wall-mounting the router.

Caution

This unit is intended to be mounted on a wall. Please read the wall mounting instructions carefully before beginning installation. Failure to use the correct hardware or to follow the correct procedures could result in a hazardous situation to people and damage to the system.

Caution

The router must be mounted with the power connections oriented downward. Failure to do so could present a fire hazard.
Figure 3-14 and Figure 3-15 show typical wall-mounted installations.

**Figure 3-14**  Mounting the 2901 Chassis on the Wall

**Figure 3-15**  Mounting the 2911 Chassis on the Wall
After the router is installed, you must connect the chassis to a reliable earth ground. For the chassis ground connection procedures, see the “Chassis Grounding” section on page 3-15.

Chassis Grounding

**Warning**
This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available. Statement 1024

**Warning**
During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, you could shock yourself. Statement 94

You must connect the chassis to a reliable earth ground; the ground wire must be installed in accordance with local electrical safety standards.

- For NEBS-compliant grounding, use size 6 AWG (13 mm²) copper wire and the ground lug provided in the accessory kit.

**Note**
NEBS-compliant grounding is not supported on the Cisco 2901 router.

**Note**
This equipment is suitable for installation in Network Telecommunications Facilities and locations where the NEC applies. The equipment is suitable for installation as part of the Common Bonding Network (CBN).

- For NEC-compliant grounding, use size 14 AWG (2 mm²) or larger copper wire and an appropriate user-supplied ring terminal with an inner diameter of 1/4 in. (5–7 mm).
- For EN/IEC 60950-compliant grounding, use size 18 AWG (1 mm²) or larger copper wire and an appropriate user-supplied ring terminal.

To install the ground connection for a Cisco 2900 or Cisco 3900 series router, perform the following steps:

**Step 1**
Strip one end of the ground wire to the length required for the ground lug or terminal.

- For the NEBS ground lug—approximately 0.75 inch (20 mm)
- For user-provided ring terminal—as required

**Step 2**
Crimp the ground wire to the ground lug or ring terminal, using a crimp tool of the appropriate size.

**Step 3**
Attach the ground lug or ring terminal to the chassis as shown in Figure 3-16, Figure 3-17, Figure 3-18, Figure 3-18, or Figure 3-19. For a ground lug, use the two screws with captive locking washers provided. For a ring terminal, use one of the screws provided. Tighten the screws to a torque of 8 to 10 in-lb (0.9 to 1.1 N-m).
Figure 3-16  Chassis Ground Connection Using Ring Terminal on Cisco 2901 Chassis

Figure 3-17  NEBS-Compliant Chassis Ground Connection on Cisco 2911 Chassis
Step 4  Connect the other end of the ground wire to a known reliable earth ground point at your site.
Connecting Power

This section explains how to connect AC or DC power to Cisco 2900 series routers. It covers the following topics:

- Connecting to AC Power, page 3-18
- Connecting to DC Power, page 3-19
- Connecting to Backup Power, page 3-30

**Warning**
Read the installation instructions before connecting the system to the power source. Statement 1004

**Warning**
This unit might have more than one power supply connection. All connections must be removed to de-energize the unit. Statement 1028

**Warning**
Only trained and qualified personnel should be allowed to install, replace, or service this equipment. Statement 1030

**Note**
The installation must comply with all required electrical codes applicable at the installation site.

Connecting to AC Power

If your router uses AC power, connect it to a 15 A, 120 VAC (10 A, 240 VAC) circuit with overcurrent protection. If backup power is required, see the “Connecting to Backup Power” section on page 3-30.

**Note**
The input voltage tolerance limits for AC power are 90 and 264 VAC.

**Note**
This product requires surge protection to be provided as part of the building installation. To comply with the Telcordia GR-1089 NEBS standard for electromagnetic compatibility and safety, an external surge protective device (SPD) is required at the AC power service equipment.

**Warning**
AC connected units must have a permanent ground connection in addition to the power cable ground wire. NEBS-compliant grounding satisfies this requirement. Statement 284

**Warning**
This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations. Statement 1045
Warning  This product relies on the building’s installation for short-circuit (overcurrent) protection. Ensure that the protective device is rated not greater than: 15A, 120VAC (16A, 240VAC). Statement 1005

Connecting to DC Power

If your router has a DC-input power supply, follow the directions in this section for proper wiring. A router with a DC-input power supply has a terminal block for the DC power connections. If backup power is required, see the “Connecting to Backup Power” section.

- DC Wiring Requirements for Cisco 2911, 2921, and 2951 Routers, page 3-19
- Wiring Procedure for DC Input on Cisco 2911, 2921, and 2951 Routers, page 3-20
- Approved Scenarios and Scenarios Not Approved for Dual DC Power Supply Configuration on Cisco 2911, 2921, and 2951 Routers, page 3-23
- DC Wiring Requirements for Cisco 3900 Series Routers, page 3-24

Caution  DC return is isolated from the frame. (NEBS DC-I)

Warning  This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations. Statement 1045

Warning  This product relies on the building’s installation for short-circuit (overcurrent) protection. Ensure that the protective device is rated not greater than: 60 VDC, 20 A.  
Statement 1005

Warning  Only trained and qualified personnel should be allowed to install, replace, or service this equipment.  
Statement 1030

Warning  Use copper conductors only. Statement 1025

DC Wiring Requirements for Cisco 2911, 2921, and 2951 Routers

A Cisco 2911, Cisco 2921, or Cisco 2951 router with a DC-input power supply requires copper wire and crimp-type terminals for the power connections. Table 3-1 and Table 3-2 summarize the wiring requirements.

You can connect a single DC power source to either the A input or the B input. If there are dual power sources, connect one source to the A input and one source to the B input; both sources must be the same polarity and voltage.
Connecting Power

Chapter 3      Installing and Connecting the Router

Connecting Power

Wiring Procedure for DC Input on Cisco 2911, 2921, and 2951 Routers

To connect a router to a DC power source, perform the following steps:

<table>
<thead>
<tr>
<th>Step 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove power from the DC circuit. To ensure that power is removed from the DC circuit, locate the circuit breaker for the DC circuit, switch the circuit breaker to the OFF position.</td>
</tr>
</tbody>
</table>

Warning Follow proper Lockout /Tagout Procedures as defined by your company in accordance with local and national laws (e.g. Title 29 CFR Part 1910.147).

Warning Before performing any of the following procedures, ensure that power is removed from the DC circuit. Statement 1003

Warning Use copper conductors only. Statement 1025

Warning Only trained and qualified personnel should be allowed to install, replace, or service this equipment. Statement 1030

| Table 3-1 DC Wiring Requirements for Cisco 2911 Routers |
| DC Power Input                                           | DC Input Wire Size | Safety Ground Wire Size | Wire Terminal (Lug) | Overcurrent Protection |
| 24-36 VDC, 11 A, positive or negative, single source or dual sources | AWG 14 (2.0 mm²) | AWG 14 (2.0 mm²), minimum | Amp/Tyco No. 32957 | 20 A maximum |
| 36-60 VDC, 4 A, positive or negative, single source or dual sources | | | | |

| Table 3-2 DC Wiring Requirements for Cisco 2921 and 2951 Routers |
| DC Power Input                                           | DC Input Wire Size | Safety Ground Wire Size | Wire Terminal (Lug) | Overcurrent Protection |
| 24-36 VDC, 17 A, positive or negative, single source or dual sources | AWG 14 (2.0 mm²) | AWG 14 (2.0 mm²), minimum | Amp/Tyco No. 32957 | 20 A maximum |
| 36-60 VDC, 7 A, positive or negative, single source or dual sources | | | | |
Tip Secure all power cabling when installing this unit to avoid disturbing field-wiring connections.

Warning When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations should be the appropriate size for the wires and should clamp both the insulation and conductor. Statement 1002

Step 2 Strip the wires to the appropriate length for the terminals. The strip length is 5/64 to 1/8 inch (2 to 4 mm) for Amp/Tyco No. 32957 terminals.

Step 3 Crimp the terminals to the power input and safety ground wires.

Step 4 Remove the plastic covers from the terminal block. Save the covers for reinstallation after you finish wiring.

Step 5 Connect the wires to the terminal block, starting with the safety ground wire. Connect each wire to the appropriate terminal as shown in Figure 1. Tighten the terminal screws to 8.0 ± 0.5 in-lb (0.9 ± 0.05 N-m).

Warning This unit might have more than one power supply connection. All connections must be removed to de-energize the unit. Statement 1028

Warning The illustration shows the DC power supply terminal block. Wire the DC power supply as illustrated. The proper wiring sequence is ground to ground, positive to positive, and negative to negative. The ground wire should always be connected first and disconnected last. Statement 239

Warning An exposed wire lead from a DC-input power source can conduct harmful levels of electricity. Be sure that no exposed portion of the DC-input power source wire extends from the terminal block plug. Statement 122

Caution Dual sources with opposite-polarity grounding damage equipment.

Caution Do not overtorque the terminal block contact screws. Recommended torque is 5.0 ± 0.5 in-lb (0.56 ± 0.06 N-m) for 2911 series routers, and 9 ± 1.0 in-lb (1.02 ± 0.11 N-m)
Step 6: Install the plastic covers over the terminals. (See Figure 3-21 or Figure 3-22.)

**Warning**
The safety cover is an integral part of the product. Do not operate the unit without the safety cover installed. Operating the unit without the cover in place will invalidate the safety approvals and pose a risk of fire and electrical hazards. Statement 117

Step 7: Organize and secure the wires using cable ties as shown in Figure 2 or Figure 3. Make sure that the wires do not project above or below the front panel of the router.

Step 8: Turn on power to the DC circuit. Be sure to remove tape used to secure the circuit-breaker switch in the OFF position.

---

**Figure 3-20** DC Power Connections for Cisco 2911, 2921, and 2951 Routers

**Figure 3-21** Wire Routing and Attachment for Cisco 2911 Routers
Approved Scenarios and Scenarios Not Approved for Dual DC Power Supply Configuration on Cisco 2911, 2921, and 2951 Routers

You can connect a single DC power source to either the A input or the B input. If there are dual power sources, connect one source to the A input and one source to the B input. Both sources must be the same polarity (with respect to ground) and voltage (within 0.25 volts). Do not connect –DC grounded and +DC grounded dual sources to Cisco 2911, Cisco 2921, and Cisco 2951 routers.

**Caution**

Dual sources with opposite-polarity grounding damage equipment.

In Figure 3-23, either the positive source terminal or the negative source terminal is tied to ground.

**Figure 3-23 Connecting to One Source Only—Source A or Source B**
In Figure 3-24, source A and source B share common negative terminal connections.

![Diagram of connecting power sources A and B with common negative terminals]

**Figure 3-24 Connecting Source A and Source B with Common Negative Terminals**

**DC Wiring Requirements for Cisco 3900 Series Routers**

If your router has a DC-input power supply, follow the directions in this section for proper wiring. If backup power is required, see the “Connecting to Backup Power” section.

**Warning**

*Use copper conductors only.* Statement 1025

**Warning**

*This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations.* Statement 1045

The following warning applies to the Cisco 3925 and Cisco 3925-NOVPN routers only:

**Warning**

*This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that the protective device is rated not greater than:* 60 VDC, 20 A.

Statement 1005

The following warning applies to the Cisco 3945 and Cisco 3945-NOVPN routers only:

**Warning**

*This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that the protective device is rated not greater than:* 60 VDC, 30 A.

Statement 1005
Warning
This unit might have more than one power supply connection. All connections must be removed to de-energize the unit. Statement 1028

Table 3-3 summarizes DC wiring requirements for all Cisco 3925 and Cisco 3945 routers.

Note
For Cisco 3945 and Cisco 3945-NOVPN routers, the safety ground wire connection must be at the same potential as the 0 V (return) connection.

### Table 3-3 DC Wiring Requirements for Cisco 3900

<table>
<thead>
<tr>
<th>DC Power Input</th>
<th>DC Input Wire Size</th>
<th>Safety Ground Wire Size</th>
<th>Wire Terminal (Lug)</th>
<th>Overcurrent Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-36 VDC, 12 A, positive or negative, single source or dual sources</td>
<td>AWG 10</td>
<td>AWG 10 minimum</td>
<td>Panduit No. LCAS8-10F-L</td>
<td>30 A maximum</td>
</tr>
<tr>
<td>36-60 VDC, 8 A, positive or negative, single or dual source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Cisco 3900 Series Router Wiring Procedure for DC Input

To connect the router to a DC power source, follow these steps:

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove power from the DC circuit. To ensure that power is removed from the DC circuit, locate the circuit breaker for the DC circuit, switch the circuit breaker to the OFF position.</td>
</tr>
<tr>
<td><strong>Warning</strong></td>
<td>Follow proper Lockout / Tagout Procedures as defined by your company in accordance with local and national laws (e.g. Title 29 CFR Part 1910.147).</td>
</tr>
<tr>
<td><strong>Warning</strong></td>
<td>Before performing any of the following procedures, ensure that power is removed from the DC circuit. Statement 1003</td>
</tr>
<tr>
<td>Tip</td>
<td>Secure all power cabling when installing this unit to avoid disturbing field-wiring connections.</td>
</tr>
<tr>
<td><strong>Warning</strong></td>
<td>When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations should be the appropriate size for the wires and should clamp both the insulation and conductor. Statement 1002</td>
</tr>
<tr>
<td>2</td>
<td>Strip the wires to the appropriate length for the terminals. The length is 3/16 to 1/4 inch (5 to 6 mm) for Panduit No. LCAS8-10F-L terminals.</td>
</tr>
<tr>
<td>3</td>
<td>Crimp the terminals onto the DC power input and safety ground wires.</td>
</tr>
<tr>
<td>4</td>
<td>Remove the plastic covers from the terminal block. Save the covers for reinstallation after you finish wiring.</td>
</tr>
<tr>
<td>5</td>
<td>Connect the wires to the terminal block, starting with the safety ground wire. Connect each wire to the appropriate terminal as shown in Figure 3-25.</td>
</tr>
<tr>
<td><strong>Warning</strong></td>
<td>The illustration shows the DC power supply terminal block. Wire the DC power supply as illustrated. The proper wiring sequence is ground to ground, positive to positive, and negative to negative. The ground wire should always be connected first and disconnected last. Statement 239</td>
</tr>
<tr>
<td><strong>Warning</strong></td>
<td>An exposed wire lead from a DC-input power source can conduct harmful levels of electricity. Be sure that no exposed portion of the DC-input power source wire extends from the terminal block plug. Statement 122</td>
</tr>
<tr>
<td><strong>Caution</strong></td>
<td>Do not overtorque the terminal block screws. The recommended torque is 18.0 – 20.0 in-lb (2.03 – 2.26 N-m).</td>
</tr>
</tbody>
</table>
Step 6  Install the plastic cover over the terminals. (See Figure 3-27.)

**Warning**  The safety cover is an integral part of the product. Do not operate the unit without the safety cover installed. Operating the unit without the cover in place will invalidate the safety approvals and pose a risk of fire and electrical hazards. Statement 117

Step 7  Organize and bundle the wires using cable ties as shown in Figure 3-27 or Figure 3-28.

Step 8  If you are installing a second DC power supply, repeat Step 1 through Step 7 for the second supply (input B).

Step 9  Turn on power to the DC circuit. Be sure to remove tape used to secure the circuit-breaker switch in the OFF position.
Dual DC Power Supply Configuration in Cisco 3925 and Cisco 3925-NOVPN Routers

You can connect a single DC power source to either the A input or the B input. If there are dual power sources, connect one source to the A input and one source to the B input. Both sources must have the same polarity (with respect to ground) and voltage (within 0.25 V). Do not connect -DC-grounded and +DC-grounded dual sources to Cisco 3925 and Cisco 3925-NOVPN routers.

Caution
Dual sources with opposite-polarity grounding damage equipment.
In Figure 3-29, either the positive source terminal or the negative source terminal is tied to ground.

**Figure 3-29**    **Connecting to One Source Only—Source A or Source B**

In Figure 3-30, source A and source B share common negative terminal connections.

**Figure 3-30**    **Connecting Source A and Source B with Common Negative Terminals**
Connecting to Backup Power

The redundant power supply (RPS) for the Cisco 2911, Cisco 2921, and Cisco 2951 router is an external Cisco RPS 2300. To connect the RPS, the router must be fitted with an RPS adapter. See the “Installing and Removing a Redundant Power Supply Adapter” section on page 5-41 before connecting to a backup power source.

If your router uses the Cisco Redundant Power System (RPS), see the Cisco Redundant Power System 2300 Hardware Installation Guide for instructions about the power connections. You can access this document at:


Caution

Before connecting the RPS to the router, make sure that either the RPS is in standby mode or the RPS AC power is disconnected. Connecting the RPS to AC power automatically places the RPS in active mode.

Note

The Cisco 2901 router does not support an RPS.

Connecting to a Console Terminal or Modem

The router has asynchronous serial ports and auxiliary ports. These ports provide administrative access to the router either locally (with a console terminal or a PC) or remotely (with a modem). To configure the router through the Cisco IOS CLI, you must establish a connection between the router console port and either a terminal or a PC.

Use the following cables and adapters to establish a local or remote connection.

Table 3-4  Local and Remote Connections

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Cable</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial (RJ-45)</td>
<td>EIA RJ-45</td>
<td>Connecting to the Serial Port with Microsoft Windows</td>
</tr>
<tr>
<td>Serial (USB)</td>
<td>USB 5-pin mini USB Type-B-to-USB Type-A</td>
<td></td>
</tr>
<tr>
<td>Auxiliary (Modem)</td>
<td>DB-9-to-DB-25</td>
<td>Connecting to the Auxiliary Port</td>
</tr>
</tbody>
</table>

Connecting to the Serial Port with Microsoft Windows

Note

Install the USB device driver before establishing a physical connection between the router and the PC using the USB Console cable plugged into the USB serial port, otherwise the connection will fail. See the “Installing the Cisco Microsoft Windows USB Device Driver” section on page 3-35.
Step 1  Connect the end of the console cable with the RJ-45 connector to the light blue console port on the router.

or

Connect a USB 5-pin mini USB Type-B to the USB console port as shown in Figure 3-31, Figure 3-32 or Figure 3-33. If you are using the USB serial port for the first time on a Windows-based PC, install the USB driver now according to the instructions in the following sections.

- “Installing the Cisco Microsoft Windows XP USB Driver” section on page 3-35
- “Installing the Cisco Microsoft Windows 2000 USB Driver” section on page 3-36
- “Installing the Cisco Microsoft Windows Vista USB Driver” section on page 3-36

Note  You cannot use the USB port and the EIA port concurrently. See “Connecting to the Auxiliary Port” section on page 3-38. When the USB port is used it takes priority over the RJ-45 EIA port.

Step 2  Connect the end of the cable with the DB-9 connector (or USB Type-A) to the terminal or PC. If your terminal or PC has a console port that does not accommodate a DB-9 connector, you must provide an appropriate adapter for that port.

Step 3  To communicate with the router, start a terminal emulator application, such as Microsoft Windows HyperTerminal. This software should be configured with the following parameters:

- 9600 baud
- 8 data bits
- no parity
- 1 stop bit
- no flow control
Figure 3-31  Connecting the USB Console Cable to the Cisco 2901 Router

1. USB 5-pin mini USB Type-B console port
2. USB 5-pin mini USB Type-B to USB Type-A console cable
3. USB Type-A
Figure 3-32 Connecting the USB Console Cable to the Cisco 2911 Router

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USB 5-pin mini USB Type-B console port</td>
</tr>
<tr>
<td>2</td>
<td>USB 5-pin mini USB Type-B to USB Type-A console cable</td>
</tr>
<tr>
<td>3</td>
<td>USB Type-A</td>
</tr>
</tbody>
</table>
Connecting to the Console Port with Mac OS X

This procedure describes how to connect a Mac OS X system USB port to the console using the built in OS X Terminal utility.

**Step 1**  Use the Finder to go to **Applications > Utilities > Terminal**.

**Step 2**  Connect the OS X USB port to the router.

**Step 3**  Enter the following commands to find the OS X USB port number

```
macbook:user$ cd /dev
macbook:user$ ls -ltr /dev/*usb*
crw-rw-rw-  1 root    wheel       9,  66 Apr  1 16:46 tty.usbmodem1a21
DT-macbook:dev user$
```

**Step 4**  Connect to the USB port with the following command followed by the router USB port speed

```
1 USB 5-pin mini USB Type-B console port
2 USB 5-pin mini USB Type-B to USB Type-A console cable
3 USB Type-A
```
Connecting to the Console Port with Linux

This procedure shows how to connect a Linux system USB port to the console using the built in Linux Terminal utility.

**Step 1**  Open the Linux Terminal window.
**Step 2**  Connect the Linux USB port to the router.
**Step 3**  Enter the following commands to find the Linux USB port number

```
root@usb-suse# cd /dev
root@usb-suse /dev# ls -ltr *ACM*
crw-r--r--    1 root     root     188,   0 Jan 14 18:02 ttyACM0
root@usb-suse /dev#
```

**Step 4**  Connect to the USB port with the following command followed by the router USB port speed

```
root@usb-suse /dev# screen /dev/ttyACM0 9600
```

To disconnect the Linux USB console from the Terminal window
Enter Ctrl-a followed by : then quit

Installing the Cisco Microsoft Windows USB Device Driver

A USB device driver must be installed the first time a Microsoft Windows-based PC is connected to the USB serial port on the router.

This section contains the following topics:

- “Installing the Cisco Microsoft Windows XP USB Driver”
- “Installing the Cisco Microsoft Windows 2000 USB Driver”
- “Installing the Cisco Microsoft Windows Vista USB Driver”

Installing the Cisco Microsoft Windows XP USB Driver

This procedure shows how to install the Microsoft Windows XP USB driver. Download the driver for your router model from the Tools and Resources Download Software site, USB Console Software category:

www.cisco.com/cisco/pub/software/portal/select.html?mdfid=268437899&?i=rp

**Step 1**  Unzip the file Cisco_usbconsole_driver_X_X.zip (where X is a revision number).
Installing the Cisco Microsoft Windows USB Device Driver

This procedure shows how to install the Microsoft Windows USB driver.

**Step 1** Obtain the file Cisco_usbconsole_driver.zip from the Cisco.com web site and unzip it.

**Step 2** Double-click the file setup.exe.

**Step 3** The Cisco Virtual Com InstallShield Wizard begins. Click Next.

**Step 4** The Ready to Install the Program window appears. Click Install.

**Step 5** The InstallShield Wizard Completed window appears. Click Finish.

**Step 6** Connect the USB cable to the PC and router USB console ports. See Table 3-1. The EN LED for the USB console port turns green, and within a few moments a series of Found New Hardware Wizard windows appear. Following the instructions to complete the installation of the driver.

**Step 7** The USB console is ready for use.

---

Installing the Cisco Microsoft Windows 2000 USB Driver

This procedure shows how to install the Microsoft Windows 2000 USB driver.

**Step 1** Obtain the file Cisco_usbconsole_driver.zip from the Cisco.com web site and unzip it.

**Step 2** Double-click the file setup.exe.

**Step 3** The Cisco Virtual Com InstallShield Wizard begins. Click Next.

**Step 4** The Ready to Install the Program window appears. Click Install.

**Step 5** The InstallShield Wizard Completed window appears. Click Finish.

**Step 6** Connect the USB cable to the PC and router USB console ports. See Table 3-1. The EN LED for the USB console port turns green, and within a few moments a series of Found New Hardware Wizard windows appear. Following the instructions to complete the installation of the driver.

**Step 7** The USB console is ready for use.

---

Installing the Cisco Microsoft Windows Vista USB Driver

This procedure shows how to install the Microsoft Windows Vista USB driver.

**Step 1** Obtain the file Cisco_usbconsole_driver.zip from the Cisco.com web site and unzip it.

**Step 2** If using 32-bit Windows Vista double-click the file setup.exe from the Windows_32 folder, or if using 64-bit Windows Vista double-click the file setup(x64).exe from the Windows_64 folder.

**Step 3** The Cisco Virtual Com InstallShield Wizard begins. Click Next.

**Step 4** The Ready to Install the Program window appears. Click Install.

**Step 5** The InstallShield Wizard Completed window appears. Click Finish.

**Note** If a User Account Control warning appears, click “Allow - I trust this program...” to proceed.

**Step 5** The InstallShield Wizard Completed window appears. Click Finish.
Step 6 Connect the USB cable to the PC and router USB console ports. See Table 3-1. The EN LED for the USB console port turns green, and within a few moments a pop up window stating “Installing device driver software” appears. Following the instructions to complete the installation of the driver.

Step 7 The USB console is ready for use.

Uninstalling the Cisco Microsoft Windows USB Driver

This section provides instructions for how to uninstall the Cisco Microsoft Windows USB device driver.

- “Uninstalling the Cisco Microsoft Windows XP and 2000 USB Driver”
- “Uninstalling the Cisco Microsoft Windows Vista USB Driver”

Uninstalling the Cisco Microsoft Windows XP and 2000 USB Driver

This procedure shows you how to uninstall both the Microsoft Windows XP and 2000 USB driver. The driver can be removed using the Windows Add Remove Programs utility or the setup.exe program.

Using the Add Remove Programs utility

Note Disconnect the router console terminal before uninstalling the driver.

Step 1 Click Start > Control Panel > Add or Remove Programs.
Step 2 Scroll to Cisco Virtual Com and click Remove.
Step 3 When the Program Maintenance window appears, select the Remove radio button. Click Next.

Using the Setup.exe program

Note Disconnect the router console terminal before uninstalling the driver.

Step 1 Run the setup.exe for Windows 32-bit or setup(x64).exe for Windows-64bit. Click Next.
Step 2 The InstallShield Wizard for Cisco Virtual Com appears. Click Next.
Step 3 When the Program Maintenance window appears, select the Remove radio button. Click Next.
Step 4 When the Remove the Program window appears, click Remove.
Step 5 When the InstallShield Wizard Completed window appears click Finish.

Uninstalling the Cisco Microsoft Windows Vista USB Driver

This procedure shows you how to uninstall the Microsoft Windows Vista USB driver.
Connecting to the Auxiliary Port

When a modem is connected to the auxiliary port, a remote user can dial in to the router and configure it. Use the light blue console cable and the DB-9-to-DB-25 connector adapter that came in the router accessory kit.

To connect a modem to the router, follow these steps:

Step 1 Connect the RJ-45 end of the adapter cable to the black AUX port on the router. (See Figure 3-34, Figure 3-35, or Figure 3-36.)
Connecting to the Auxiliary Port

Figure 3-34 Connecting a Modem to the Cisco 2901 Router

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RJ-45 AUX port</td>
</tr>
<tr>
<td>2</td>
<td>DB-9 to DB-25 adapter</td>
</tr>
<tr>
<td>3</td>
<td>RJ-45 to DB-9</td>
</tr>
<tr>
<td>4</td>
<td>Modem</td>
</tr>
</tbody>
</table>
Connecting to the Auxiliary Port

Figure 3-35  Connecting a Modem to the Cisco 2921 Router

1 RJ-45 AUX port  
2 DB-9 to DB-25 adapter  
3 RJ-45 to DB-9  
4 Modem

Figure 3-36  Connecting a Modem to the Cisco 2921, 2925, 3925, and 3945 Routers

1 RJ-45 AUX port  
2 DB-9 to DB-25 adapter  
3 RJ-45 to DB-9  
4 Modem
Step 2 Connect the DB-9 end of the console cable to the DB-9 end of the modem adapter.
Step 3 Connect the DB-25 end of the modem adapter to the modem.
Step 4 Make sure that your modem and the router auxiliary port are configured for the same transmission speed (up to 115200 bps is supported) and for mode control with data carrier detect (DCD) and data terminal ready (DTR) operations.

Connecting WAN, LAN, and Voice Interfaces

This section describes how to connect WAN, LAN, and voice interface cables. It covers the following topics:
- Ports and Cabling, page 3-43
- Connection Procedures and Precautions, page 3-44

Note
One or two Ethernet cables are typically provided with the router. Additional cables and transceivers can be ordered from Cisco. For ordering information, contact customer service. For cable pinouts, see the Cisco Modular Access Router Cable Specifications document.

Warning
Do not work on the system or connect or disconnect cables during periods of lightning activity. Statement 1001

Warning
To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. LAN ports contain SELV circuits, and WAN ports contain TNV circuits. Some LAN and WAN ports both use RJ-45 connectors. Use caution when connecting cables. Statement 1021

Warning
Hazardous network voltages are present in WAN ports regardless of whether power to the unit is OFF or ON. To avoid electric shock, use caution when working near WAN ports. When detaching cables, detach the end away from the unit first. Statement 1026

Caution
To comply with the Telcordia GR-1089 NEBS standard for electromagnetic compatibility and safety, connect Gigabit Ethernet ports using RJ-45 connectors for shielded twisted pair cable only to intra-building or unexposed wiring or cable. The intrabuilding cable must be shielded and the shield must be grounded at both ends. The intra-building port(s) of the equipment or subassembly must not be metallically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE, Issue 4) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

Warning
Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations. Statement 1036
Connecting WAN, LAN, and Voice Interfaces

Warning

Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface. Statement 1037

Warning

Class 1 laser product. Statement 1008
## Ports and Cabling

Table 3-5 summarizes typical WAN, LAN, and voice connections for Cisco 2900 and Cisco 3900 series routers. The connections summarized here are also described in detail in the document on Cisco.com *Cisco Modular Access Router Cable Specifications*

<table>
<thead>
<tr>
<th>Port or Connection</th>
<th>Port Type, Color</th>
<th>Connection:</th>
<th>Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet</td>
<td>RJ-45, yellow</td>
<td>Ethernet hub or Ethernet switch</td>
<td>Category 5 or higher Ethernet</td>
</tr>
<tr>
<td>T1/E1 WAN xCE1T1-PRI</td>
<td>RJ-48C/CA81A, RJ-48S, tan</td>
<td>T1 or E1 network External T1 CSU or other T1 equipment</td>
<td>RJ-48 T1/E1 RJ-48S to RJ-48S TE RJ-48S to RJ-48S NT RJ-48S to RJ-48S T1 RJ-48S to bare RJ-48S to BNC RJ-48S to twinaxial cable RJ-48S to DB-15 RJ-48S to DB-15 null</td>
</tr>
<tr>
<td>T3/DS3/E3 WAN</td>
<td>BNC connector</td>
<td>T3 network, CSU/DSU, or other T3/DS3 equipment</td>
<td>75-ohm coaxial cable</td>
</tr>
<tr>
<td>Cisco serial</td>
<td>60-pin D-sub, blue</td>
<td>CSU/DSU and serial network or equipment</td>
<td>Cisco serial transition cable that matches the signaling protocol (EIA/TIA-232, EIA/TIA-449, V.35, X.21, or EIA-530) and the serial port operating mode (DTE or DCE).[^2]</td>
</tr>
<tr>
<td>Cisco Smart serial</td>
<td>Cisco Smart compact connector, blue</td>
<td>CSU/DSU and serial network or equipment</td>
<td></td>
</tr>
<tr>
<td>ADSL</td>
<td>RJ-11C/CA11A, lavender</td>
<td>Network demarcation device for service provider DSL interface</td>
<td>RJ-11 straight-through</td>
</tr>
<tr>
<td>SHDSL</td>
<td>RJ-11C/CA11A, lavender, RJ-14</td>
<td>Network demarcation device for service provider DSL interface</td>
<td>RJ-11 straight-through for 2-wire RJ-14 straight-through for 4-wire</td>
</tr>
<tr>
<td>T1/E1 digital voice</td>
<td>RJ-48C/CA81A, tan</td>
<td>Digital PBX, ISDN network, CSU/DSU</td>
<td>RJ-48 T1/E1</td>
</tr>
<tr>
<td>Analog voice FXS</td>
<td>RJ-11, gray</td>
<td>Telephone, fax</td>
<td>RJ-11; RJ21 if using NM-HDA, straight-through</td>
</tr>
<tr>
<td>Analog voice FXO</td>
<td>RJ-11, pink</td>
<td>Central office, analog PBX</td>
<td></td>
</tr>
<tr>
<td>Analog voice E&amp;M</td>
<td>RJ-45, brown</td>
<td>Analog PBX</td>
<td>RJ-45</td>
</tr>
<tr>
<td>BRI S/T WAN</td>
<td>RJ-45/CB-1D, orange</td>
<td>NT1 device or private integrated network exchange (PINX)</td>
<td>RJ-45 straight-through</td>
</tr>
<tr>
<td>56/64-kbps DSU/CSU</td>
<td>8-pin modular, blue</td>
<td>RJ-48S interface in subrate device or network</td>
<td>RJ-48 straight-through</td>
</tr>
<tr>
<td>T1/FT1 DSU/CSU</td>
<td>8-pin modular, blue</td>
<td>RJ-48C interface</td>
<td>RJ-48 straight-through</td>
</tr>
<tr>
<td>Gigabit Ethernet SFP, optical</td>
<td>LC, color according to optical wavelength 1000BASE-SX, -LX, -LH, -ZX, -CWDM</td>
<td>Optical fiber as specified on applicable data sheet</td>
<td></td>
</tr>
<tr>
<td>Gigabit Ethernet SFP, copper</td>
<td>RJ-45 1000BASE-T</td>
<td>Category 5, 5e, 6 UTP</td>
<td></td>
</tr>
</tbody>
</table>
1. Cable color codes are specific to Cisco cables.
2. See the Cisco Modular Access Router Cable Specifications document for information about choosing these cables.

## Connection Procedures and Precautions

- Connect each WAN, LAN, and voice cable to the appropriate connector on the chassis or on a network module or interface card.
- Position the cables carefully, so that they do not put strain on the connectors.
- Organize cables in bundles so that cables do not intertwine.
- Inspect the cables to make sure that the routing and bend radius is satisfactory. Reposition cables, if necessary.
- Install cable ties in accordance with site requirements.

For cable pinouts, see *Cisco Modular Access Router Cable Specifications*. 