DIGISOL™

MUSTANG 4000 SWITCH SERIES

DG-FS4528E
INSTALLATION GUIDE

INSTALLATION GUIDE

DG-FS4528E L2 FAST ETHERNET SWITCH

Layer 2 Switch with
24 10/100BASE-TX (RJ-45) Ports,
and 4 Combination Gigabit (RJ-45/SFP) Ports

About This Guide

PURPOSE

This guide details the hardware features of the switch, including the physical and performance-related characteristics, and how to install the switch.

AUDIENCE

The guide is intended for use by network administrators who are responsible for installing and setting up network equipment; consequently, it assumes a basic working knowledge of LANs (Local Area Networks).

CONVENTIONS

The following conventions are used throughout this guide to show information:

NOTE: Emphasizes important information or calls your attention to related features or instructions.

CAUTION: Alerts you to a potential hazard that could cause loss of data, or damage the system or equipment.

WARNING: Alerts you to a potential hazard that could cause personal injury.

RELATED PUBLICATIONS

The following publication gives specific information on how to operate and use the management functions of the switch:

The *Management Guide*

Also, as part of the switch's software, there is an online web-based help that describes all management related features.

REVISION HISTORY

This section summarizes the changes in each revision of this guide.

SEPT 2013 REVISION

This was the first revision of this guide.

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

OVERVIEW

The DG-FS4528E switch is a intelligent switch with 24 10/100BASE-T ports, and four Gigabit combination ports[1] that are comprised of an RJ-45 port and an SFP transceiver slot. There is also an SNMP-based management agent embedded on the main board. This agent supports both in-band and out-of-band access for managing the switch.

This switch provides a broad range of powerful features for Layer 2 switching, delivering reliability and consistent performance for your network traffic. It brings order to poorly performing networks by segregating them into separate broadcast domains with IEEE 802.1Q compliant VLANs, and empower multimedia applications with multicast switching and CoS services.

Figure 1: Front and Rear Panels

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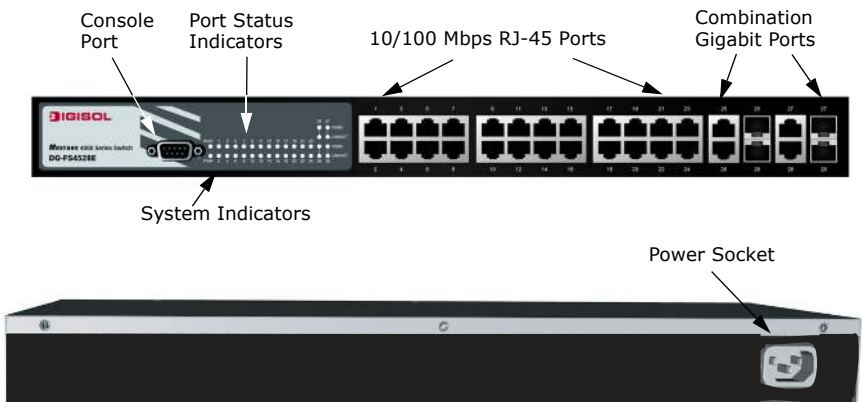
1. RJ-45 ports shared with a SFP transceiver slots. If an SFP transceiver is plugged in, the corresponding RJ-45 port is disabled.

SWITCH ARCHITECTURE

This switch employs a wire-speed, non-blocking switching fabric. This permits simultaneous wire-speed transport of multiple packets at low latency on all ports. This switch also features full-duplex capability on all ports, which effectively doubles the bandwidth of each connection.

This switch uses store-and-forward switching to ensure maximum data integrity. With store-and-forward switching, the entire packet must be received into a buffer and checked for validity before being forwarded. This prevents errors from being propagated throughout the network.

NETWORK MANAGEMENT OPTIONS

This switch contains a comprehensive array of LEDs for "at-a-glance" monitoring of network and port status. It also includes a management agent that allows you to configure or monitor the switch using its embedded management software, or via SNMP applications. To manage a switch, you can make a direct connection to the RS-232 console port (out-of-band), or you can manage it through a network connection (in-band) using Telnet, the on-board Web agent, or Windows-based network management software.

For a detailed description of the switch's software features, refer to the *Management Guide*.

DESCRIPTION OF HARDWARE

10/100BASE-T PORTS

This switch contains 24 RJ-45 ports that operate at 10 Mbps or 100 Mbps, half or full duplex. Because all ports on both switches support automatic MDI/MDI-X operation, you can use straight-through cables for all network connections to PCs or servers, or to other switches or hubs. (See "Twisted-Pair Cable and Pin Assignments" on page 41.)

Each of these ports support auto-negotiation, so the optimum transmission mode (half or full duplex), and data rate (10 or 100 Mbps) can be selected automatically. If a device connected to one of these ports does not support auto-negotiation, the communication mode of that port can be configured manually.

Each port also supports auto-negotiation of flow control, so the switch can automatically prevent port buffers from becoming saturated.

SFP SLOTS

The Small Form Factor Pluggable (SFP) transceiver slots are shared with four RJ-45 ports (combination ports). In its default configuration, if an SFP transceiver (purchased separately) is installed in a slot and has a valid link on its port, the associated RJ-45 port is disabled and cannot be used. The switch can also be configured to force the use of an RJ-45 port or SFP slot, as required.

PORT AND SYSTEM STATUS LEDS

The LEDs, which are located on the front panel for easy viewing, are shown below and described in the following table.

Figure 2: Port Status LEDs

RJ-45 Port Status LEDs   Combination Gigabit Port Status LEDs
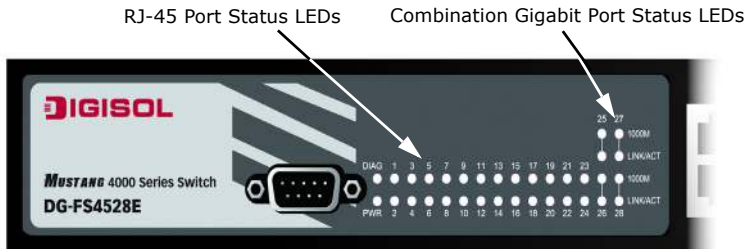
Table 1: Port Status LEDs

LED	Condition	Status
RJ-45 Ports		
Link/ACT (Link/Activity)	On/Blinking Green	The port has a valid 10 or 100 Mbps link. Blinking indicates activity.
	Off	There is no valid link on the port.
Combination Gigabit Ports		
Link/ACT (Link/Activity)	On/Blinking Green	The port has a valid 10/100/1000 Mbps link. Blinking indicates activity.
	Off	There is no valid link on the port.

Table 1: Port Status LEDs (Continued)

LED	Condition	Status
1000M	On/Blinking Green	The port has a valid 1000 Mbps link. Blinking indicates activity.
	Off	There is no valid 1000 Mbps link on the port.

Figure 3: System Status LED
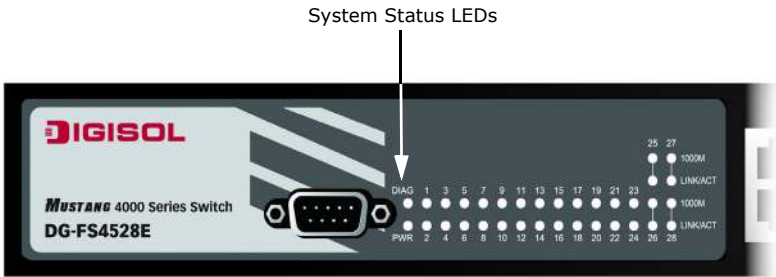
System Status LEDs

Table 2: System Status LEDs

LED	Condition	Status
PWR (Power)	On Green	Internal power is operating normally.
	Off	Power off or failure.
DIAG (Diagnostic)	On Green	System self-diagnostic test successfully completed.
	Blinking Green	System self-diagnostic test in progress.
	Off	System self-diagnostic test has failed.

POWER SUPPLY SOCKET

There is one standard power socket on the rear panel of the switch for the AC power cord.

Figure 4: Power Supply Socket

Power Socket

APPLICATION EXAMPLES

This switch is an excellent choice for mixed Ethernet, Fast Ethernet, and Gigabit Ethernet installations where significant growth is expected in the near future. In a basic stand-alone configuration, it can provide direct full-duplex connections to workstations or servers. When the time comes for further expansion, just connect to another hub or switch using one of the Fast Ethernet ports built into the front panel or a Gigabit Ethernet port on a plug-in SFP transceiver.

Some typical application examples are described in this section.

NETWORK AGGREGATION PLAN

With 24 parallel bridging ports (i.e., 24 distinct collision domains), the switch can collapse a complex network down into a single efficient bridged node, increasing overall bandwidth and throughput.

In the figure below, the 10/100BASE-TX ports on the switch are providing 100 Mbps connectivity through layer 2 switches. In addition, the switch is also connecting several servers at 1000 Mbps.

Figure 5: Network Aggregation Plan
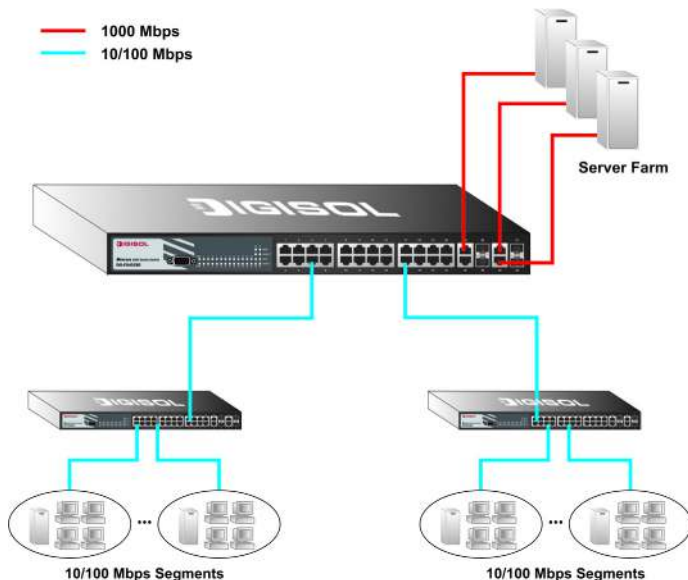
REMOTE CONNECTION WITH FIBER CABLE

Fiber optic technology allows for longer cabling than any other media type. A 1000BASE-SX (MMF) link can connect to a site up to 550 meters away, a 1000BASE-LX (SMF) link up to 10 km, and a 1000BASE-LH link up to 70 km. This allows the switch to serve as a collapsed backbone, providing direct connectivity for a widespread LAN.

A 1000BASE-SX SFP transceiver can be used for a high-speed connection between floors in the same building, a 1000BASE-LX SFP transceiver can be used to connect to other buildings in a campus setting, and a 1000BASE-LH SFP transceiver can be used for a long-haul connection to a remote site.

The figure below illustrates the switch connecting multiple segments with fiber cable.

Figure 6: Remote Connections with Fiber Cable
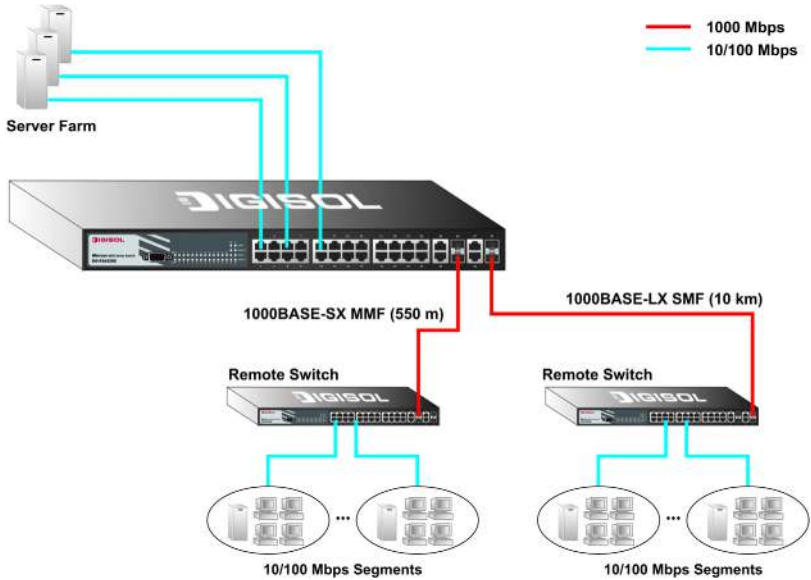
2 INSTALLING THE SWITCH

SELECTING A SITE

Switch units can be mounted in a standard 19-inch equipment rack or on a flat surface. Be sure to follow the guidelines below when choosing a location.

The site should:

be at the center of all the devices you want to link and near a power outlet.

be able to maintain its temperature within 0 to 55 °C (32 to 130 °F) and its humidity within 5% to 95%, non-condensing

provide adequate space (approximately two inches) on all sides for proper air flow

be accessible for installing, cabling and maintaining the devices

allow the status LEDs to be clearly visible

Make sure twisted-pair cable is always routed away from power lines, fluorescent lighting fixtures and other sources of electrical interference, such as radios and transmitters.

Make sure that a separate grounded power outlet that provides 100 to 240 VAC, 50 to 60 Hz, is within 2.44 m (8 feet) of each device and is powered from an independent circuit breaker. As with any equipment, using a filter or surge suppressor is recommended.

ETHERNET CABLING

To ensure proper operation when installing the switch into a network, make sure that the current cables are suitable for 10BASE-T, 100BASE-TX or 1000BASE-T operation. Check the following criteria against the current installation of your network:

Cable type: Unshielded twisted pair (UTP) or shielded twisted pair (STP) cables with RJ-45 connectors; Category 3 or better for 10BASE-T, Category 5 or better for 100BASE-TX, and Category 5 or better for 1000BASE-T.

Protection from radio frequency interference emissions

Electrical surge suppression

Separation of electrical wires (switch related or other) and electromagnetic fields from data based network wiring

Safe connections with no damaged cables, connectors or shields

Figure 7: RJ-45 Connections

RJ-45 Connector
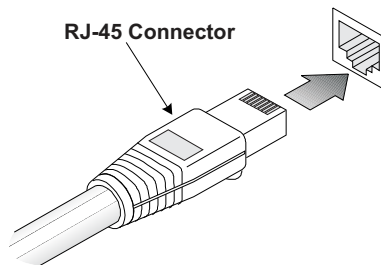
EQUIPMENT CHECKLIST

After unpacking the switch, check the contents to be sure you have received all the components. Then, before beginning the installation, be sure you have all other necessary installation equipment.

PACKAGE CONTENTS

DG-FS4528E Fast Ethernet Switch

Four adhesive foot pads

Bracket Mounting Kit containing two brackets and eight screws for attaching the brackets to the switch

Power Cord

RS-232 console cable

This Installation Guide

Management Guide CD

OPTIONAL RACK-MOUNTING EQUIPMENT

If you plan to rack-mount the switch, be sure to have the following equipment available:

Four mounting screws for each device you plan to install in a rack—these are not included

A screwdriver (Phillips or flathead, depending on the type of screws used)

MOUNTING

The switch units can be mounted in a standard 19-inch equipment rack or on a desktop or shelf. Mounting instructions for each type of site follow.

RACK MOUNTING

Before rack mounting the switch, pay particular attention to the following factors:

Temperature: Since the temperature within a rack assembly may be higher than the ambient room temperature, check that the rack-environment temperature is within the specified operating temperature range.

Mechanical Loading: Do not place any equipment on top of a rack-mounted unit.

Circuit Overloading: Be sure that the supply circuit to the rack assembly is not overloaded.

Grounding: Rack-mounted equipment should be properly grounded. Particular attention should be given to supply connections other than direct connections to the mains.

To rack-mount devices:

1. Attach the brackets to the device using the screws provided in the Bracket Mounting Kit.

Figure 8: Attaching the Brackets
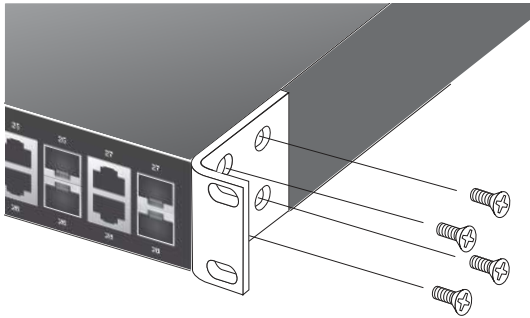
2. Mount the device in the rack, using four rack-mounting screws (not provided).

Figure 9: Installing the Switch in a Rack
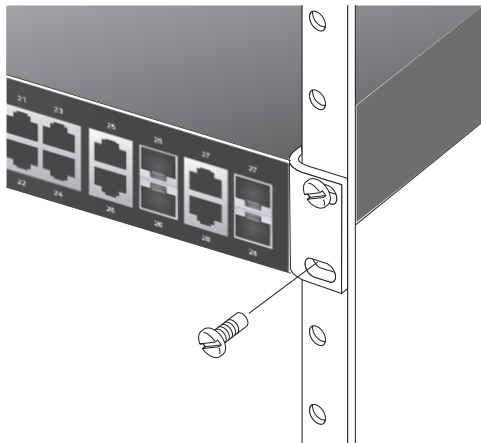
3. If installing a single switch only, go to "Connecting to a Power Source" on page 28.

4. If installing multiple switches, mount them in the rack, one below the other, in any order.

DESKTOP OR SHELF MOUNTING

1. Attach the four adhesive feet to the bottom of the first switch.

Figure 10: Attaching the Adhesive Feet

2. Set the device on a flat surface near an AC power source, making sure there are at least two inches of space on all sides for proper air flow.

3. If installing a single switch only, go to "Connecting to a Power Source" on page 28.

4. If installing multiple switches, attach four adhesive feet to each one. Place each device squarely on top of the one below, in any order.

INSTALLING AN OPTIONAL SFP TRANSCEIVER

Figure 11: Inserting an SFP Transceiver into a Slot
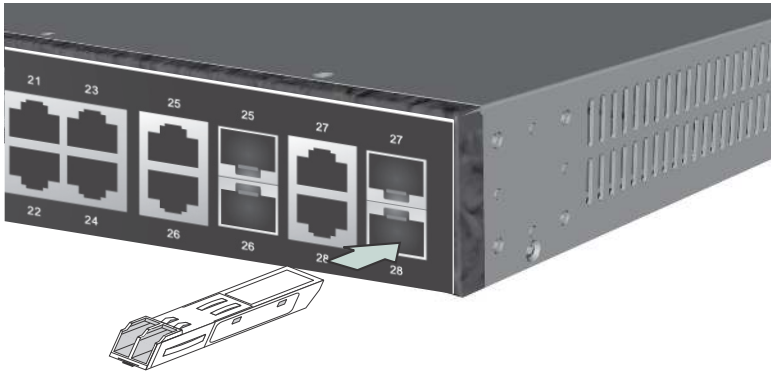
The switch supports 1000BASE-SX, 1000BASE-LX, 1000BASE-LH and other SFP-compatible transceivers. To install an SFP transceiver, do the following:

1. Consider network and cabling requirements to select an appropriate SFP transceiver type.

2. Insert the transceiver with the optical connector facing outward and the slot connector facing down. Note that SFP transceivers are keyed so they can only be installed in one orientation.

3. Slide the SFP transceiver into the slot until it clicks into place.

NOTE: SFP transceivers are hot-swappable. The switch does not need to be powered off before installing or removing a transceiver. However, always first disconnect the network cable before removing a transceiver.

NOTE: SFP transceivers are not provided in the switch package.

CONNECTING TO A POWER SOURCE

To connect a device to a power source:

1. Insert the power cable plug directly into the socket located at the back of the device.

Figure 12: Power Sockets

2. Plug the other end of the cable into a grounded, 3-pin socket.

> ℹ **NOTE:** For International use, you may need to change the AC line cord. You must use a line cord set that has been approved for the socket type in your country.

3. Check the front-panel LEDs as the device is powered on to be sure the Power LED is lit. If not, check that the power cable is correctly plugged in.

4. If you have purchased a Redundant Power Unit, connect it to the switch and to an AC power source now, following the instructions included with the package.

Connecting to the Console Port

The DB-9 serial port on the switch's front panel is used to connect to the switch for out-of-band console configuration. The on-board configuration program can be accessed from a terminal or a PC running a terminal emulation program. The pin assignments used to connect to the serial port are described in the following figure and table.

Figure 13: Serial Port (DB-9 DTE) Pin-Out
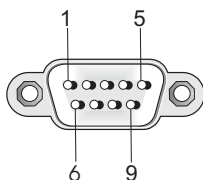
Wiring Map for Serial Cable

Table 3: Console Cable Wiring

Switch's 9-Pin Console Port	Null Modem	PC's 9-Pin DTE Port
2 RXD (receive data)	<--------------------	3 TXD (transmit data)
3 TXD (transmit data)	-------------------->	2 RXD (receive data)
5 SGND (signal ground)	----------------------	5 SGND (signal ground)

No other pins are used.

The serial port's configuration requirements are as follows:

Default Baud rate—115,200 bps

Character Size—8 Characters

Parity—None

Stop bit—One

Data bits—8

3 MAKING NETWORK CONNECTIONS

CONNECTING NETWORK DEVICES

This switch is designed to interconnect multiple segments (or collision domains). It can be connected to network cards in PCs and servers, as well as to hubs, switches or routers. It may also be connected to devices using optional SFP tranceivers.

TWISTED-PAIR DEVICES

Each device requires an unshielded twisted-pair (UTP) cable with RJ-45 connectors at both ends. Use Category 5, 5e or 6 cable for 1000BASE-T connections, Category 5 or better for 100BASE-TX connections, and Category 3 or better for 10BASE-T connections.

CABLING GUIDELINES

The RJ-45 ports on the switch supports automatic MDI/MDI-X pinout configuration, so you can use standard straight-through twisted-pair cables to connect to any other network device (PCs, servers, switches, routers, or hubs).

See Appendix B for further information on cabling.

⚠ **CAUTION:** Do not plug a phone jack connector into an RJ-45 port. This will damage the switch. Use only twisted-pair cables with RJ-45 connectors that conform to FCC standards.

CONNECTING TO PCS, SERVERS, HUBS AND SWITCHES

1. Attach one end of a twisted-pair cable segment to the device's RJ-45 connector.

Figure 14: Making Twisted-Pair Connections
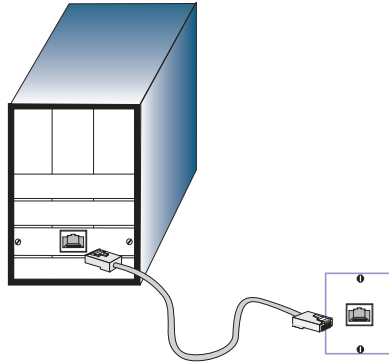
2. If the device is a PC card and the switch is in the wiring closet, attach the other end of the cable segment to a modular wall outlet that is connected to the wiring closet. (See "Network Wiring Connections" on page 33.) Otherwise, attach the other end to an available port on the switch.

Make sure each twisted pair cable does not exceed 100 meters (328 ft) in length.

3. As each connection is made, the Link LED (on the switch) corresponding to each port will light to indicate that the connection is valid.

> **NOTE:** Avoid using flow control on a port connected to a hub unless it is actually required to solve a problem. Otherwise back pressure jamming signals may degrade overall performance for the segment attached to the hub.

NETWORK WIRING CONNECTIONS

Today, the punch-down block is an integral part of many of the newer equipment racks. It is actually part of the patch panel. Instructions for making connections in the wiring closet with this type of equipment follows.

1. Attach one end of a patch cable to an available port on the switch, and the other end to the patch panel.

2. If not already in place, attach one end of a cable segment to the back of the patch panel where the punch-down block is located, and the other end to a modular wall outlet.

3. Label the cables to simplify future troubleshooting.

Figure 15: Network Wiring Connections
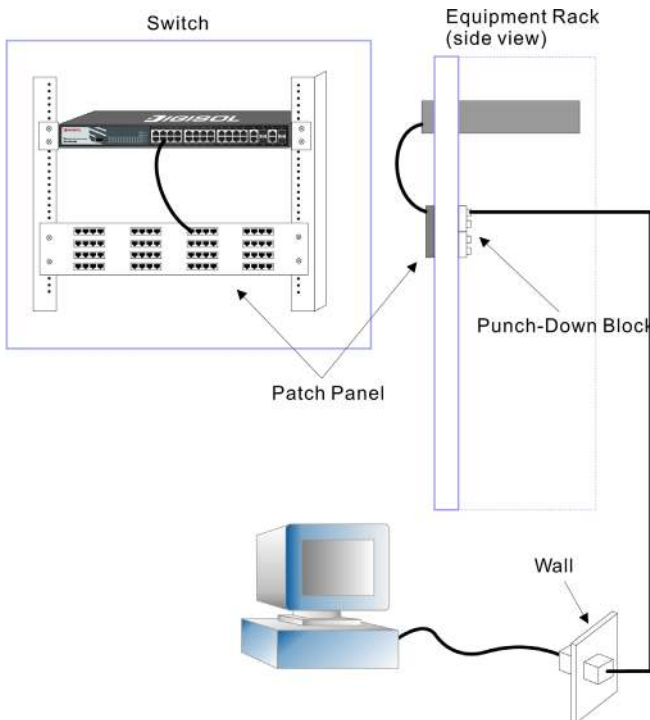
FIBER OPTIC SFP DEVICES

An optional Gigabit SFP transceiver (1000BASE-SX, 1000BASE-LX, or 1000BASE-LH) can be used for a backbone connection between switches, or for connecting to a high-speed server.

Each multimode fiber optic port requires 50/125 or 62.5/125 micron multimode fiber optic cabling with an LC connector at both ends. Each single-mode fiber port requires 9/125 micron single-mode fiber optic cable with an LC connector at both ends.

> ⚠ **WARNING:** This switch uses lasers to transmit signals over fiber optic cable. The lasers are compliant with the requirements of a Class 1 Laser Product and are inherently eye safe in normal operation. However, you should never look directly at a transmit port when it is powered on.
>
> **WARNING:** When selecting a fiber SFP device, considering safety, please make sure that it can function at a temperature that is not less than the recommended maximum operational temperature of the product. You must also use an approved Laser Class 1 SFP transceiver.

1. Remove and keep the LC port's rubber cover. When not connected to a fiber cable, the rubber cover should be replaced to protect the optics.

2. Check that the fiber terminators are clean. You can clean the cable plugs by wiping them gently with a clean tissue or cotton ball moistened with a little ethanol. Dirty fiber terminators on fiber cables will impair the quality of the light transmitted through the cable and lead to degraded performance on the port.

3. Connect one end of the cable to the LC port on the switch and the other end to the LC port on the other device. Since LC connectors are keyed, the cable can be attached in only one orientation.

Figure 16: Making Fiber Port Connections

4. As a connection is made, check the Link LED on the switch corresponding to the port to be sure that the connection is valid.

The 1000BASE-SX, 1000BASE-LX and 1000BASE-LH fiber optic ports operate at 1 Gbps full duplex, with auto-negotiation of flow control. The maximum length for fiber optic cable operating at Gigabit speed will depend on the fiber type as listed under "1000 Mbps Gigabit Ethernet Collision Domain" on page 36.

CONNECTIVITY RULES

When adding hubs (repeaters) to your network, please follow the connectivity rules listed in the manuals for these products. However, note that because switches break up the path for connected devices into separate collision domains, you should not include the switch or connected cabling in your calculations for cascade length involving other devices.

1000BASE-T CABLE REQUIREMENTS

All Category 5 UTP cables that are used for 100BASE-TX connections should also work for 1000BASE-T, providing that all four wire pairs are connected. However, it is recommended that for all critical connections, or any new cable installations, Category 5e (enhanced Category 5) or Category 6 cable should be used. The Category 5e specification includes test parameters that are only recommendations for Category 5. Therefore, the first step in preparing existing

Category 5 cabling for running 1000BASE-T is a simple test of the cable installation to be sure that it complies with the IEEE 802.3ab standards.

1000 MBPS GIGABIT ETHERNET COLLISION DOMAIN

Table 4: Maximum 1000BASE-T Gigabit Ethernet Cable Length

Cable Type	Maximum Cable Length	Connector
Category 5, 5e, or 6 100-ohm UTP or STP	100 m (328 ft)	RJ-45

Table 5: Maximum 1000BASE-SX Gigabit Ethernet Cable Lengths

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
62.5/125 micron multimode fiber	160 MHz/km	2-220 m (7-722 ft)	LC
	200 MHz/km	2-275 m (7-902 ft)	LC
50/125 micron multimode fiber	400 MHz/km	2-500 m (7-1641 ft)	LC
	500 MHz/km	2-550 m (7-1805 ft)	LC

Table 6: Maximum 1000BASE-LX Gigabit Ethernet Cable Length

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
9/125 micron single-mode fiber	N/A	2 m - 10 km (7 ft - 6.2 miles)	LC

Table 7: Maximum 1000BASE-LH Gigabit Ethernet Cable Length

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
9/125 micron single-mode fiber	N/A	2 m - 70 km (7 ft - 43.5 miles)	LC

100 MBPS FAST ETHERNET COLLISION DOMAIN

Table 8: Maximum Fast Ethernet Cable Lengths

Type	Cable Type	Max. Cable Length	Connector
100BASE-TX	Category 5 or better 100-ohm UTP or STP	100 m (328 ft)	RJ-45

10 MBPS ETHERNET COLLISION DOMAIN

Table 9: Maximum Ethernet Cable Length

Type	Cable Type	Max. Cable Length	Connector
10BASE-T	Category 3 or better 100-ohm UTP	100 m (328 ft)	RJ-45

CABLE LABELING AND CONNECTION RECORDS

When planning a network installation, it is essential to label the opposing ends of cables and to record where each cable is connected. Doing so will enable you to easily locate inter-connected devices, isolate faults and change your topology without need for unnecessary time consumption.

To best manage the physical implementations of your network, follow these guidelines:

Clearly label the opposing ends of each cable.

Using your building's floor plans, draw a map of the location of all network-connected equipment. For each piece of equipment, identify the devices to which it is connected.

Note the length of each cable and the maximum cable length supported by the switch ports.

For ease of understanding, use a location-based key when assigning prefixes to your cable labeling.

Use sequential numbers for cables that originate from the same equipment.

Differentiate between racks by naming accordingly.

Label each separate piece of equipment.

Display a copy of your equipment map, including keys to all abbreviations at each equipment rack.

A TROUBLESHOOTING

DIAGNOSING SWITCH INDICATORS

Table 10: Troubleshooting Chart

Symptom	Action
PWR LED is Off	Power supply is disconnected.
	Check connections between the switch, the power cord, and the wall outlet.
	Contact your dealer for assistance.
DIAG LED is Off	Power cycle the switch to try and clear the condition.
	If the condition does not clear, contact your dealer for assistance.
Link/ACT LED is Off	Verify that the switch and attached device are powered on.
	Be sure the cable is plugged into both the switch and corresponding device.
	Verify that the proper cable type is used and its length does not exceed specified limits.
	Check the adapter on the attached device and cable connections for possible defects. Replace the defective adapter or cable if necessary.

POWER AND COOLING PROBLEMS

If the power indicator does not turn on when the power cord is plugged in, you may have a problem with the power outlet, power cord, or internal power supply. However, if the unit powers off after running for a while, check for loose power connections, power losses or surges at the power outlet, and verify that the fans on the unit are unobstructed and running prior to shutdown. If you still cannot isolate the problem, then the internal power supply may be defective.

INSTALLATION

Verify that all system components have been properly installed. If one or more components appear to be malfunctioning (such as the power cord or network cabling), test them in an alternate environment where you are sure that all the other components are functioning properly.

IN-BAND ACCESS

You can access the management agent in the switch from anywhere within the attached network using Telnet, a Web browser, or other network management software tools. However, you must first configure the switch with a valid IP address, subnet mask, and default gateway. If you have trouble establishing a link to the management agent, check to see if you have a valid network connection. Then verify that you entered the correct IP address. Also, be sure the port through which you are connecting to the switch has not been disabled. If it has not been disabled, then check the network cabling that runs between your remote location and the switch.

> **NOTE:** The management agent accepts up to four simultaneous Telnet sessions. If the maximum number of sessions already exists, an additional Telnet connection will not be able to log into the system.

B CABLES

TWISTED-PAIR CABLE AND PIN ASSIGNMENTS

For 10/100BASE-TX connections, the twisted-pair cable must have two pairs of wires. For 1000BASE-T connections the twisted-pair cable must have four pairs of wires. Each wire pair is identified by two different colors. For example, one wire might be green and the other, green with white stripes. Also, an RJ-45 connector must be attached to both ends of the cable.

⚠️ **CAUTION:** DO NOT plug a phone jack connector into any RJ-45 port. Use only twisted-pair cables with RJ-45 connectors that conform with FCC standards.

CAUTION: Each wire pair must be attached to the RJ-45 connectors in a specific orientation.

The figure below illustrates how the pins on the RJ-45 connector are numbered. Be sure to hold the connectors in the same orientation when attaching the wires to the pins.

Figure 17: RJ-45 Connector Pin Numbers
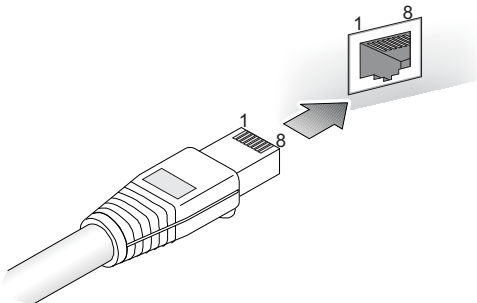
10BASE-T/100BASE-TX Pin Assignments

Use unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cable for RJ-45 connections: 100-ohm Category 3 or better cable for 10 Mbps connections, or 100-ohm Category 5 or better cable for 100 Mbps connections. Also be sure that the length of any twisted-pair connection does not exceed 100 meters (328 feet).

The RJ-45 ports on the switch base unit support automatic MDI/MDI-X operation, so you can use straight-through cables for all network connections to PCs or servers, or to other switches or hubs. In straight-through cable, pins 1, 2, 3, and 6, at one end of the cable, are connected straight through to pins 1, 2, 3, and 6 at the other end of the cable. When using any RJ-45 port on this switch, you can use either straight-through or crossover cable.

Table 11: 10/100BASE-TX MDI and MDI-X Port Pinouts

Pin	MDI Signal Name	MDI-X Signal Name
1	Transmit Data plus (TD+)	Receive Data plus (RD+)
2	Transmit Data minus (TD-)	Receive Data minus (RD-)
3	Receive Data plus (RD+)	Transmit Data plus (TD+)
6	Receive Data minus (RD-)	Transmit Data minus (TD-)
4,5,7,8	Not used	Not used

**Note:** The "+" and "-" signs represent the polarity of the wires that make up each wire pair.

Straight-Through Wiring

If the twisted-pair cable is to join two ports and only one of the ports has an internal crossover (MDI-X), the two pairs of wires must be straight-through. (When auto-negotiation is enabled for any RJ-45 port on this switch, you can use either straight-through or crossover cable to connect to any device type.)

You must connect all four wire pairs as shown in the following diagram to support Gigabit Ethernet.

Figure 18: Straight-through Wiring

EIA/TIA 568B RJ-45 Wiring Standard
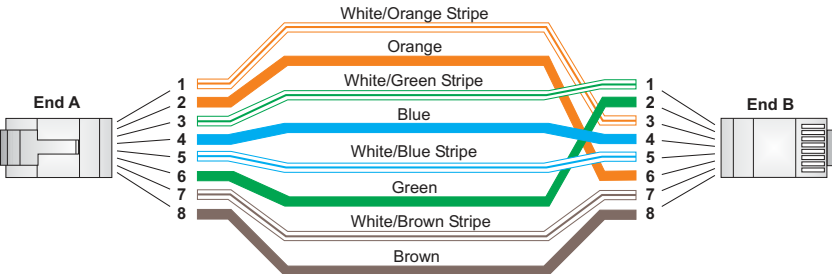10/100BASE-TX Straight-through Cable
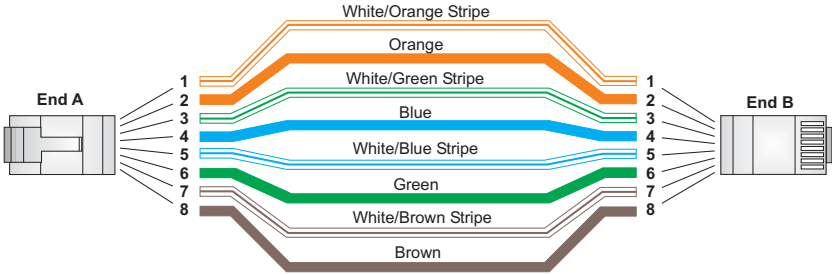
CROSSOVER WIRING

If the twisted-pair cable is to join two ports and either both ports are labeled with an "X" (MDI-X) or neither port is labeled with an "X" (MDI), a crossover must be implemented in the wiring. (When auto-negotiation is enabled for any RJ-45 port on this switch, you can use either straight-through or crossover cable to connect to any device type.)

You must connect all four wire pairs as shown in the following diagram to support Gigabit Ethernet.

Figure 19: Crossover Wiring

EIA/TIA 568B RJ-45 Wiring Standard
10/100BASE-TX Crossover Cable

1000BASE-T PIN ASSIGNMENTS

All 1000BASE-T ports support automatic MDI/MDI-X operation, so you can use straight-through cables for all network connections to PCs or servers, or to other switches or hubs.

The table below shows the 1000BASE-T MDI and MDI-X port pinouts. These ports require that all four pairs of wires be connected. Note that for 1000BASE-T operation, all four pairs of wires are used for both transmit and receive.

Use 100-ohm Category 5, 5e or 6 unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cable for 1000BASE-T connections. Also be sure that the length of any twisted-pair connection does not exceed 100 meters (328 feet).

Table 12: 1000BASE-T MDI and MDI-X Port Pinouts

Pin	MDI Signal Name	MDI-X Signal Name
1	Bi-directional Pair A Plus (BI_DA+)	Bi-directional Pair B Plus (BI_DB+)
2	Bi-directional Pair A Minus (BI_DA-)	Bi-directional Pair B Minus (BI_DB-)
3	Bi-directional Pair B Plus (BI_DB+)	Bi-directional Pair A Plus (BI_DA+)
4	Bi-directional Pair C Plus (BI_DC+)	Bi-directional Pair D Plus (BI_DD+)
5	Bi-directional Pair C Minus (BI_DC-)	Bi-directional Pair D Minus (BI_DD-)
6	Bi-directional Pair B Minus (BI_DB-)	Bi-directional Pair A Minus (BI_DA-)
7	Bi-directional Pair D Plus (BI_DD+)	Bi-directional Pair C Plus (BI_DC+)
8	Bi-directional Pair D Minus (BI_DD-)	Bi-directional Pair C Minus (BI_DC-)

CABLE TESTING FOR EXISTING CATEGORY 5 CABLE

Installed Category 5 cabling must pass tests for Attenuation, Near-End Crosstalk (NEXT), and Far-End Crosstalk (FEXT). This cable testing information is specified in the ANSI/TIA/EIA-TSB-67 standard. Additionally, cables must also pass test parameters for Return Loss and Equal-Level Far-End Crosstalk (ELFEXT). These tests are specified in the ANSI/TIA/EIA-TSB-95 Bulletin, "The Additional Transmission Performance Guidelines for 100 Ohm 4-Pair Category 5 Cabling."

Note that when testing your cable installation, be sure to include all patch cables between switches and end devices.

ADJUSTING EXISTING CATEGORY 5 CABLING TO RUN 1000BASE-T

If your existing Category 5 installation does not meet one of the test parameters for 1000BASE-T, there are basically three measures that can be applied to try and correct the problem:

1. Replace any Category 5 patch cables with high-performance Category 5e or Category 6 cables.

2. Reduce the number of connectors used in the link.

3. Reconnect some of the connectors in the link.

FIBER STANDARDS

The International Telecommunication Union (ITU-T) has standardized various fiber types for data networks. These are summarized in the following table.

Table 13: Fiber Standards

ITU-T Standard	Description	Application
G.651	**Multimode Fiber** 50/125-micron core	Short-reach connections in the 1300-nm or 850-nm band
G.652	**Non-Dispersion-Shifted Fiber** Single-mode, 9/125-micron core	Longer spans and extended reach. Optimized for operation in the 1310-nm band. but can also be used in the 1550-nm band
G.652.C	**Low Water Peak Non-Dispersion-Shifted Fiber** Single-mode, 9/125-micron core	Longer spans and extended reach. Optimized for wavelength-division multiplexing (WDM) transmission across wavelengths from 1285 to 1625 nm. The zero dispersion wavelength is in the 1310-nm region.
G.653	**Dispersion-Shifted Fiber** Single-mode, 9/125-micron core	Longer spans and extended reach. Optimized for operation in the region from 1500 to 1600-nm.

Table 13: Fiber Standards (Continued)

ITU-T Standard	Description	Application
G.654	**1550-nm Loss-Minimized Fiber** Single-mode, 9/125-micron core	Extended long-haul applications. Optimized for high-power transmission in the 1500 to 1600-nm region, with low loss in the 1550-nm band.
G.655	**Non-Zero Dispersion-Shifted Fiber** Single-mode, 9/125-micron core	Extended long-haul applications. Optimized for high-power dense wavelength-division multiplexing (DWDM) operation in the region from 1500 to 1600-nm.

C SPECIFICATIONS

PHYSICAL CHARACTERISTICS

PORTS
24 10/100BASE-TX, with auto-negotiation
4 Combination Gigabit Ports (RJ-45/SFP)

NETWORK INTERFACE
Ports 1-24: RJ-45 connector, auto MDI/X
    10BASE-T: RJ-45 (100-ohm, UTP cable; Category 3 or better)
    100BASE-TX: RJ-45 (100-ohm, UTP cable; Category 5 or better)
Ports 25-28: RJ-45 connector, auto MDI/X
    10BASE-T: RJ-45 (100-ohm, UTP cable; Category 3 or better)
    100BASE-TX: RJ-45 (100-ohm, UTP cable; Category 5 or better)
    1000BASE-T: RJ-45 (100-ohm, UTP cable; Category 5e or better)

BUFFER ARCHITECTURE
8 Mbits

AGGREGATE BANDWIDTH
12.8 Gbps

SWITCHING DATABASE
16K MAC address entries

LEDs
System: PWR (Power Supply), DIAG (Diagnostic)
Port: Link/ACT (Link/Activity)

WEIGHT

2 kg (4.41 lbs)

SIZE

4.4 x 44 x 17 cm (1.7 x 17.3 x 6.7 in.)

TEMPERATURE

Operating: 0 to 55 °C (32 to 130 °F)
Storage: -20 to 70 °C (-4 to 158 °F)

HUMIDITY

Operating: 5% to 95% (non-condensing)

POWER SUPPLY

Internal, auto-ranging transformer: 100-240 VAC, 50/60 Hz, 1.0 A

POWER CONSUMPTION

20 Watts maximum

MAXIMUM CURRENT

1.0 A

SWITCH FEATURES

FORWARDING MODE

Store-and-forward

THROUGHPUT

Wire speed

FLOW CONTROL
Full Duplex: IEEE 802.3x
Half Duplex: Back pressure

MANAGEMENT FEATURES

IN-BAND MANAGEMENT
Telnet, SSH, HTTP, or SNMP manager

OUT-OF-BAND MANAGEMENT
RS-232 DB-9 console port

SOFTWARE LOADING
HTTP or FTP/TFTP in-band, or XModem out-of-band

STANDARDS

IEEE 802.3 Ethernet
IEEE 802.3u Fast Ethernet
IEEE 802.3z and 802.3ab Gigabit Ethernet
IEEE 802.1D (Bridging)
IEEE 802.3x full-duplex flow control
IEEE 802.1Q (Virtual LAN)
ISO/IEC 8802-3

GLOSSARY

10BASE-T

IEEE 802.3 specification for 10 Mbps Ethernet over two pairs of Category 3, 4, or 5 UTP cable.

100BASE-FX

IEEE 802.3u specification for 100 Mbps Ethernet over two strands of 50/125, 62.5/125 or 9/125 micron core fiber cable.

100BASE-TX

IEEE 802.3u specification for 100 Mbps Ethernet over two pairs of Category 5 UTP cable.

1000BASE-LX

IEEE 802.3z specification for Gigabit Ethernet over two strands of 50/125, 62.5/125 or 9/125 micron core fiber cable.

1000BASE-LH

A specification for Gigabit Ethernet over two strands of 9/125 micron core fiber cable.

1000BASE-SX

IEEE 802.3z specification for Gigabit Ethernet over two strands of 50/125 or 62.5/125 micron core fiber cable.

1000BASE-T

IEEE 802.3ab specification for Gigabit Ethernet over 100-ohm Category 5, 5e or 6 twisted-pair cable (using all four wire pairs).

AUTO-NEGOTIATION

Signalling method allowing each node to select its optimum operational mode (e.g., speed and duplex mode) based on the capabilities of the node to which it is connected.

BANDWIDTH

The difference between the highest and lowest frequencies available for network signals. Also synonymous with wire speed, the actual speed of the data transmission along the cable.

COLLISION DOMAIN

Single CSMA/CD LAN segment.

CSMA/CD

CSMA/CD (Carrier Sense Multiple Access/Collision Detect) is the communication method employed by Ethernet, Fast Ethernet, and Gigabit Ethernet.

END STATION

A workstation, server, or other device that does not forward traffic.

ETHERNET

A network communication system developed and standardized by DEC, Intel, and Xerox, using baseband transmission, CSMA/CD access, logical bus topology, and coaxial cable. The successor IEEE 802.3 standard provides for integration into the OSI model and extends the physical layer and media with repeaters and implementations that operate on fiber, thin coax and twisted-pair cable.

FAST ETHERNET

A 100 Mbps network communication system based on Ethernet and the CSMA/CD access method.

FULL DUPLEX

Transmission method that allows two network devices to transmit and receive concurrently, effectively doubling the bandwidth of that link.

GIGABIT ETHERNET
A 1000 Mbps network communication system based on Ethernet and the CSMA/CD access method.

IEEE
Institute of Electrical and Electronic Engineers.

IEEE 802.3
Defines carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

IEEE 802.3AB
Defines CSMA/CD access method and physical layer specifications for 1000BASE-T Gigabit Ethernet. (Now incorporated in IEEE 802.3-2005.)

IEEE 802.3U
Defines CSMA/CD access method and physical layer specifications for 100BASE-TX Fast Ethernet. (Now incorporated in IEEE 802.3-2005.)

IEEE 802.3X
Defines Ethernet frame start/stop requests and timers used for flow control on full-duplex links. (Now incorporated in IEEE 802.3-2005.)

IEEE 802.3Z
Defines CSMA/CD access method and physical layer specifications for 1000BASE Gigabit Ethernet. (Now incorporated in IEEE 802.3-2005.)

LAN SEGMENT
Separate LAN or collision domain.

LED
Light emitting diode used for monitoring a device or network condition.

LOCAL AREA NETWORK (LAN)
A group of interconnected computer and support devices.

MEDIA ACCESS CONTROL (MAC)
A portion of the networking protocol that governs access to the transmission medium, facilitating the exchange of data between network nodes.

MIB
An acronym for Management Information Base. It is a set of database objects that contains information about the device.

MODAL BANDWIDTH
Bandwidth for multimode fiber is referred to as modal bandwidth because it varies with the modal field (or core diameter) of the fiber. Modal bandwidth is specified in units of MHz per km, which indicates the amount of bandwidth supported by the fiber for a one km distance.

NETWORK DIAMETER
Wire distance between two end stations in the same collision domain.

RJ-45 CONNECTOR
A connector for twisted-pair wiring.

SWITCHED PORTS
Ports that are on separate collision domains or LAN segments.

TIA
Telecommunications Industry Association

TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP)
Protocol suite that includes TCP as the primary transport protocol, and IP as the network layer protocol.

USER DATAGRAM PROTOCOL (UDP)

UDP provides a datagram mode for packet-switched communications. It uses IP as the underlying transport mechanism to provide access to IP-like services. UDP packets are delivered just like IP packets – connection-less datagrams that may be discarded before reaching their targets. UDP is useful when TCP would be too complex, too slow, or just unnecessary.

UTP

Unshielded twisted-pair cable.

VIRTUAL LAN (VLAN)

A Virtual LAN is a collection of network nodes that share the same collision domain regardless of their physical location or connection point in the network. A VLAN serves as a logical workgroup with no physical barriers, allowing users to share information and resources as though located on the same LAN.

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