Lecture 2

Hardware Fundamentals

Objectives

Hardware Fundamentals

Network Hardware

Network adapter	• **Physical layer (Layer 1)** • **Data Link layer (Layer 2)**
Repeater	• **Physical layer (Layer 1)**
Hub	• **Physical layer (Layer 1)**
Bridge	• **Data Link layer (Layer 2)**
Switch	• **Operate at the Layer 2** • **Support Layer 3 functionality**

Network Hardware

Router	• **Operates at the Network layer (Layer 3)**
Access point	• **Acts as a bridge**
Wireless router	• **Combines bridge, router, switch, and AP functio-nality**

Network Adapter

can communicate on a network

physical access to a
networking medium
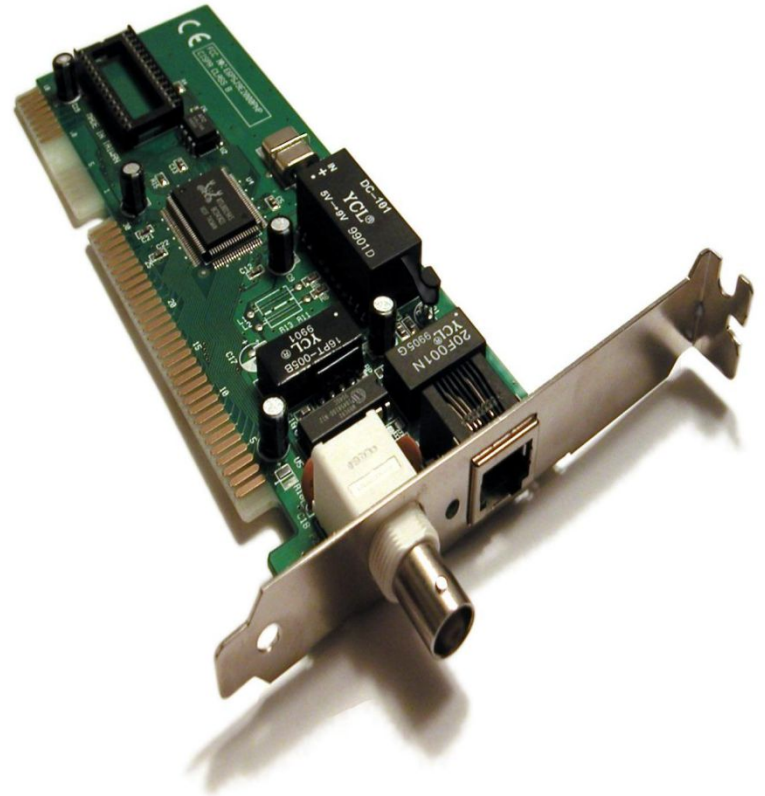
MAC
addresses

Types of Network Adapter

wired and wireless

- **Wired Network Adapter**
.
- **Wireless Network Adapter**
.
- **Network USB Adapter**

Wired Network Adapter

for a wired connection

apply the
proper drivers upon
detection of the device

Wireless Network Adapter

connects to a radio-based computer network.

Network USB Adapter
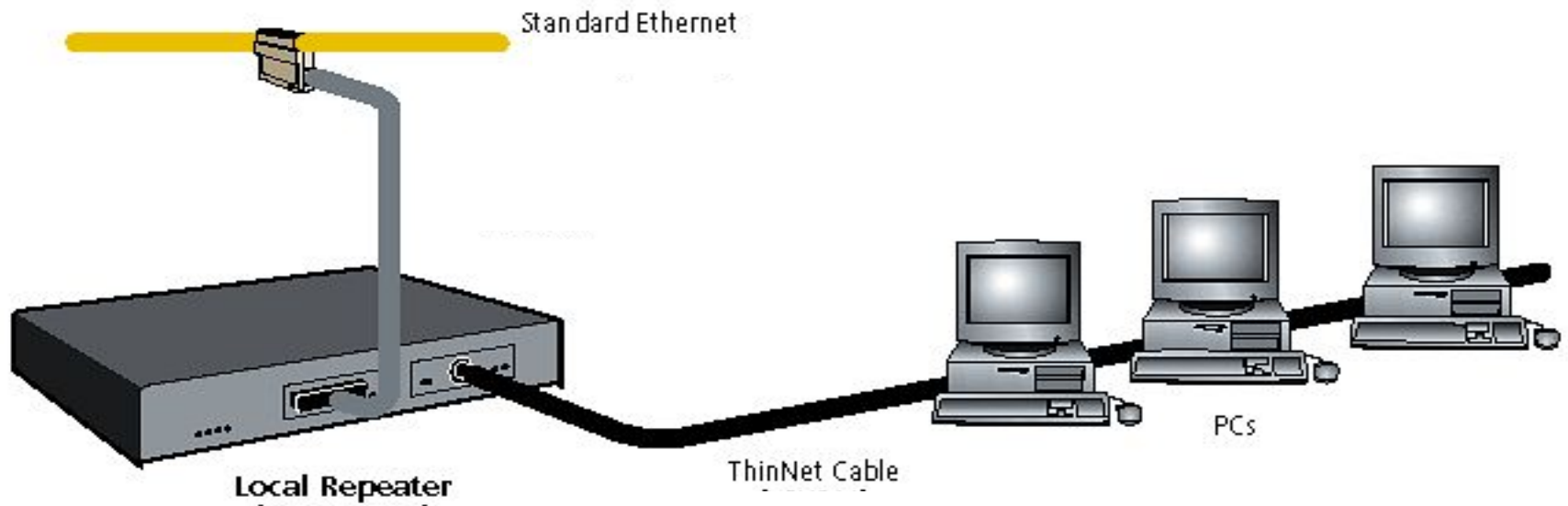
USB wireless adapter

Adapter MAC address

Media Access Control (MAC) address

Repeater

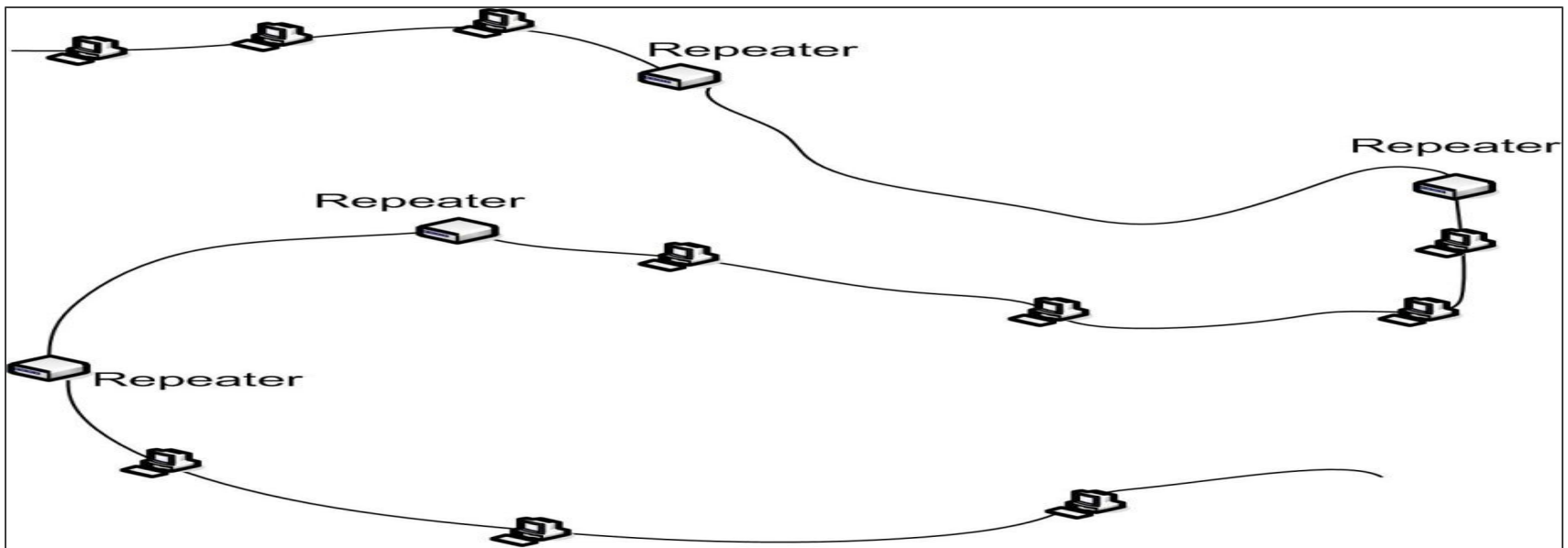**simply an amplifier**

Standard Ethernet

Local Repeater
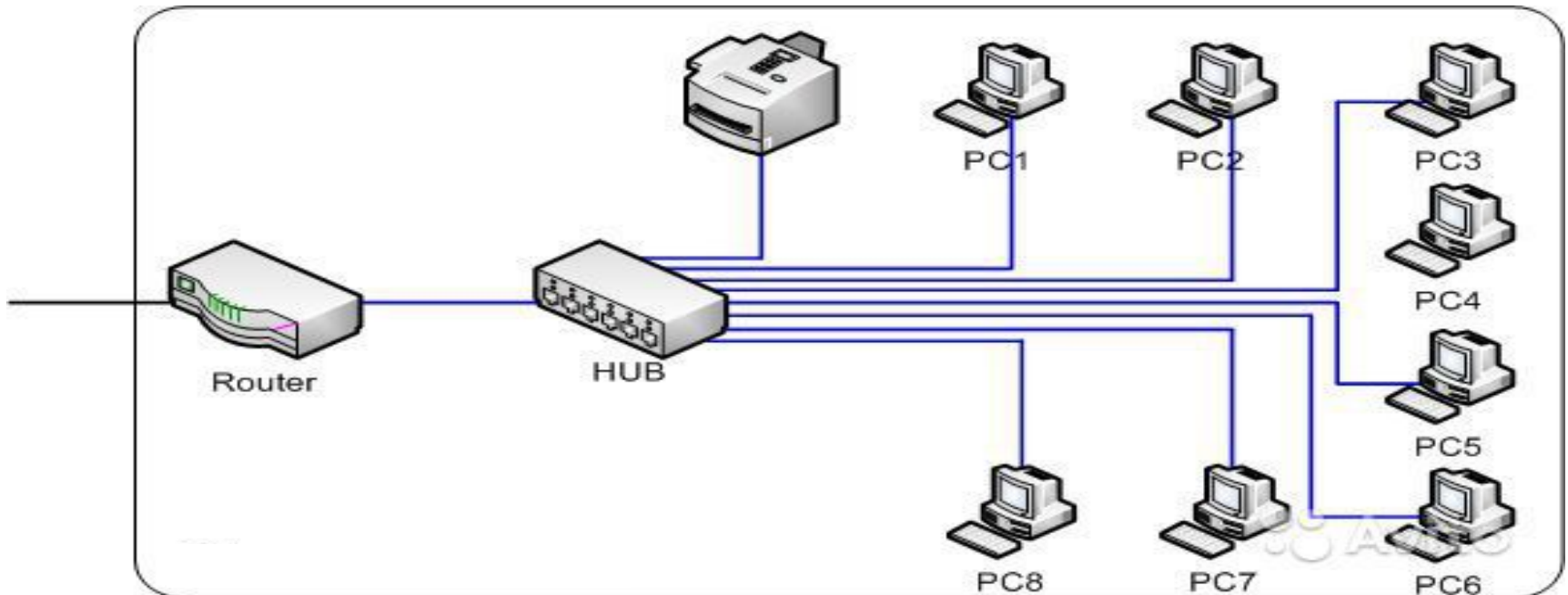
ThinNet Cable

PCs

Repeater use

extend the maximum length

5-4-3 rule.

Hub

for connecting together single network segment.

Hub use
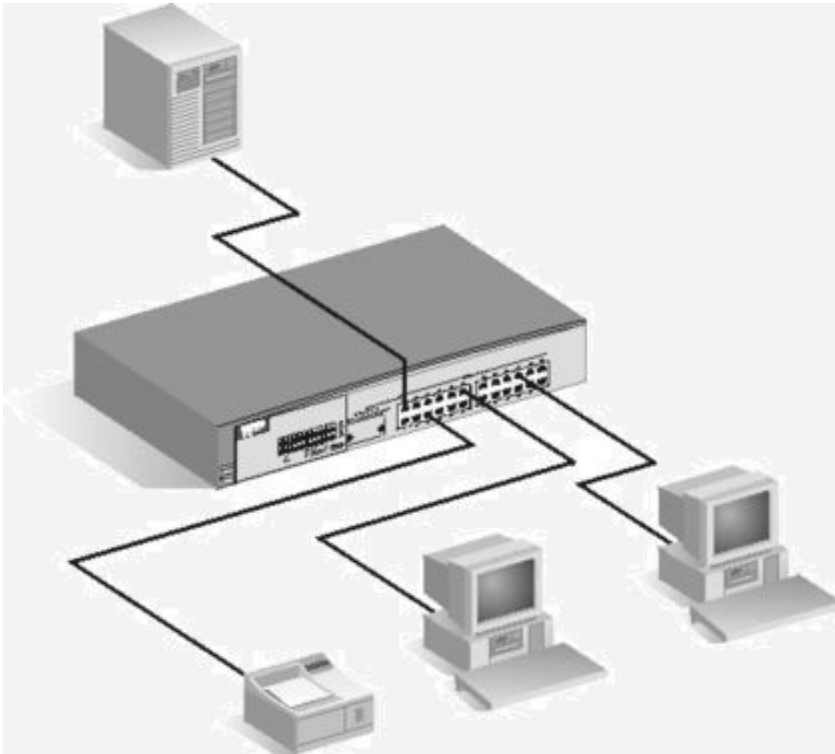
electronically

do not manage

Hub and packet collisions

The packet of data from the server is sent to all of the workstations connected to the hub
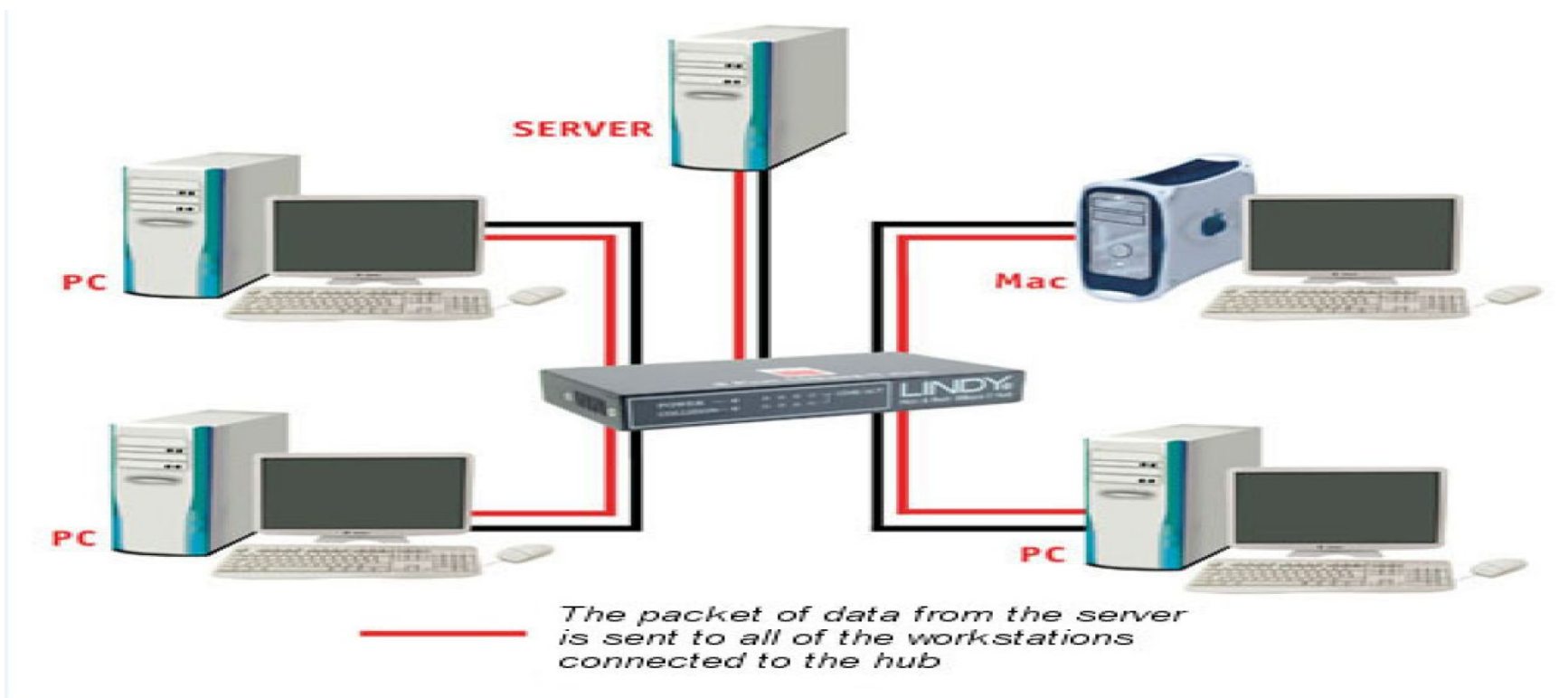
packet collisions result

Connected Hubs

uplink port

Uplink port
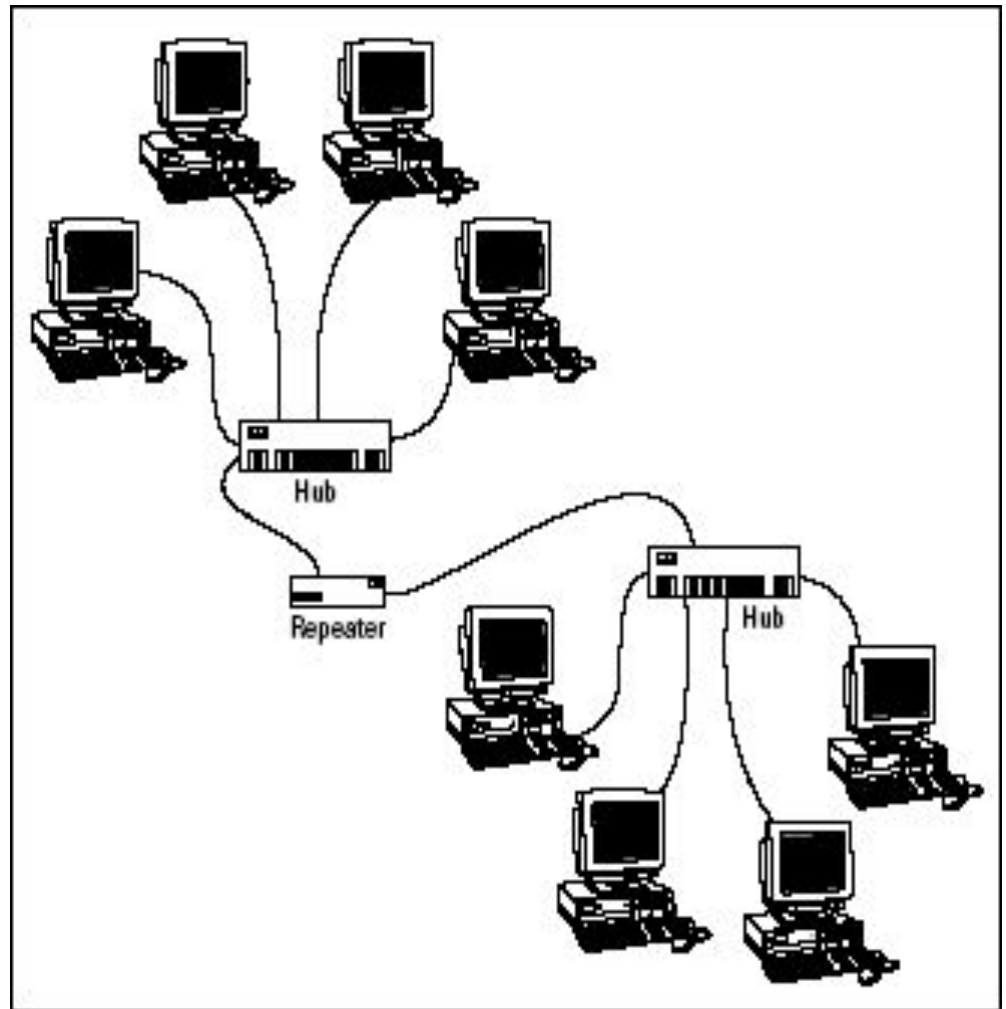
Bridge

connects multiple network segments (networks)
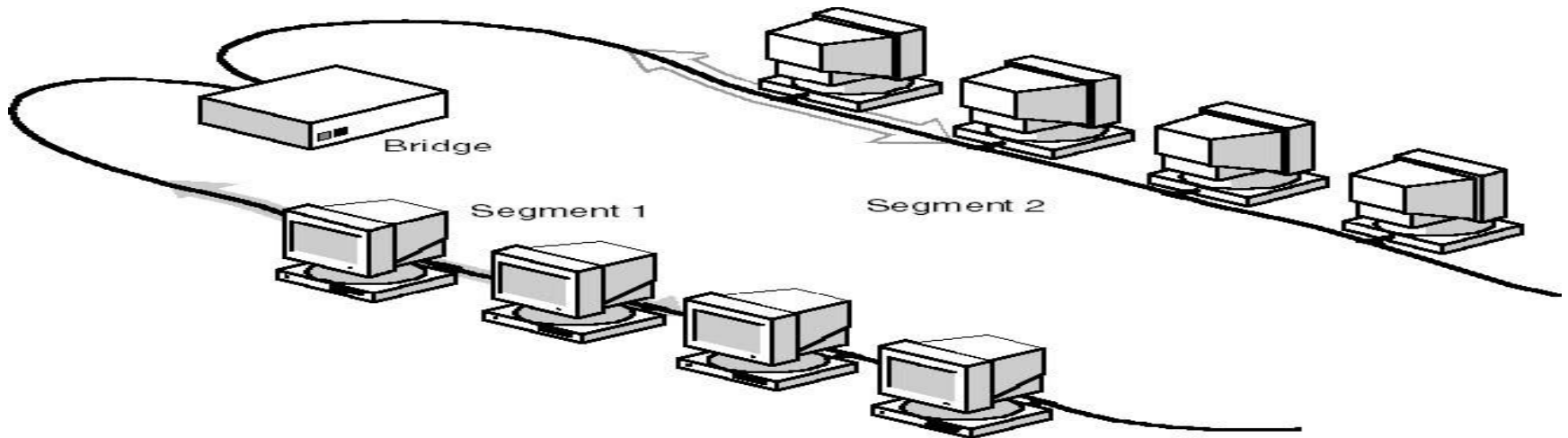
based on MAC addresses
                Layer 2 device

Bridge and collision domains

Its job is simply to help ensure that the "scope" of collisions was made smaller
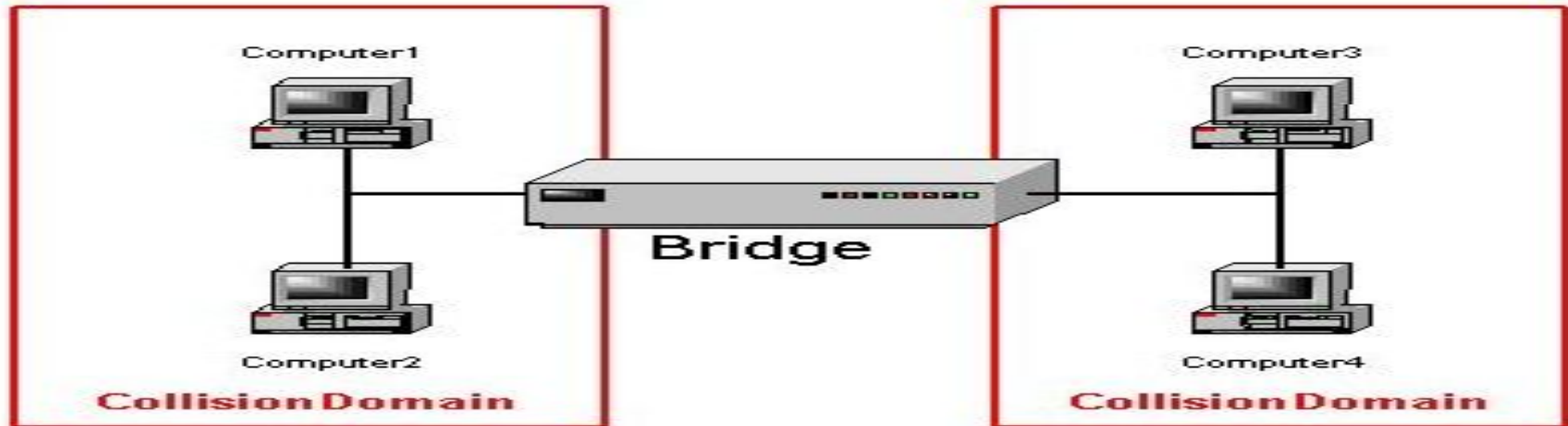
In the diagram

Bridge and media types

maybe one a wired one and the other a wireless one

connections between different media types of network

Bridge Sample

Power Adapter socket
Only use the power adapter that is supplied with this OfficeConnect hub. Do not use any other adapter.

AUI port (Hub 4C only)
Allows 10Mbc
to be connect
transceiver au
port.

different media types
onnecting a
les the 10BASE-2

Four 10BASE-T RJ-45 ports
Use 10BASE-T cable with RJ-45 connectors. You can connect the OfficeConnect hub to any workstation or piece of equipment that has a 10BASE-T port. Refer to "Connecting Hubs Using 10BASE-T" on page 14.

POWER   COAX   AUI   Uplink   Normal   4   1x

10BASE-2 port (Hub 4C only)
Can be used to connect your hub to other OfficeConnect hubs and equipment with 10BASE-2 cabling.
If used, it is effectively a fifth port. Refer to "Connecting Hubs Using 10BASE-

Uplink/Normal switch
Affects the operation of port 4. For correct usage, refer to "Connecting Hubs Using 10BASE-T" on page 14.

10Base2, 10Base5
10Base-T

21

Switch
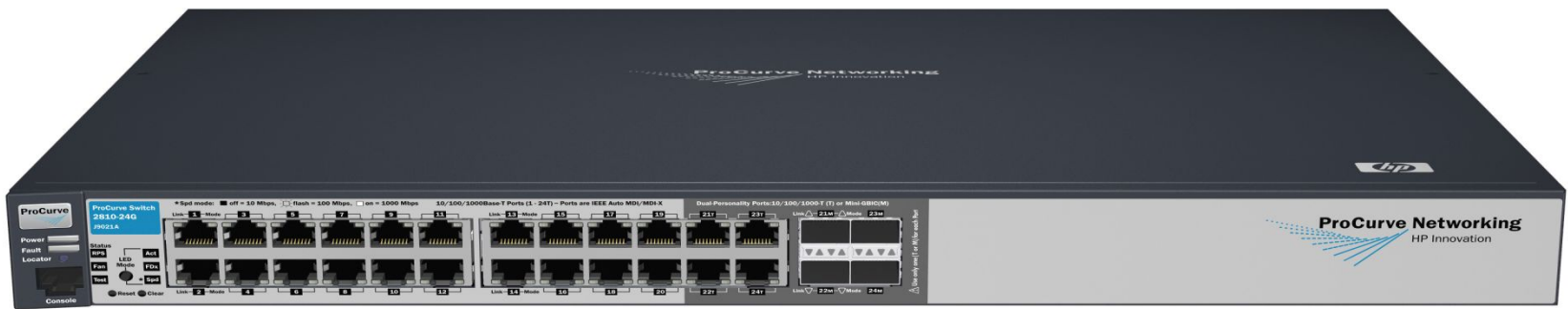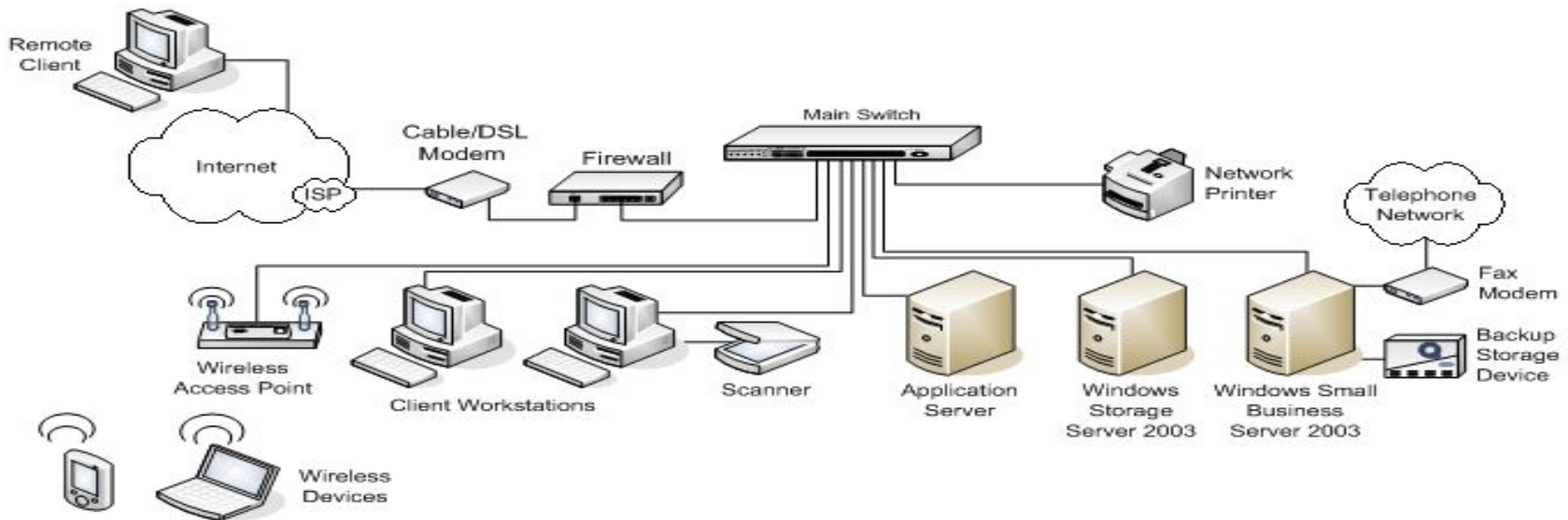
that connects devices together on a computer network

- **Switch provide:**
- **Connect network devices**
- **Network segmentation (VLANs)**
- **Remote management**
- **Communication security**

Connect network devices

multiport bridge

based on the MAC address

Network segmentation (VLANs)

VLANs provide a method for segmenting

traffic between VLANs is blocked unless the VLANs are connected by a router

Router

Interface 192.168.2.1   Interface 192.168.4.1

VLAN Trunk

VLAN 20   VLAN 40

Switch

PC
192.168.2.10/24

PC
192.168.2.12/24

PC
192.168.4.10/24

PC
192.168.4.12/24
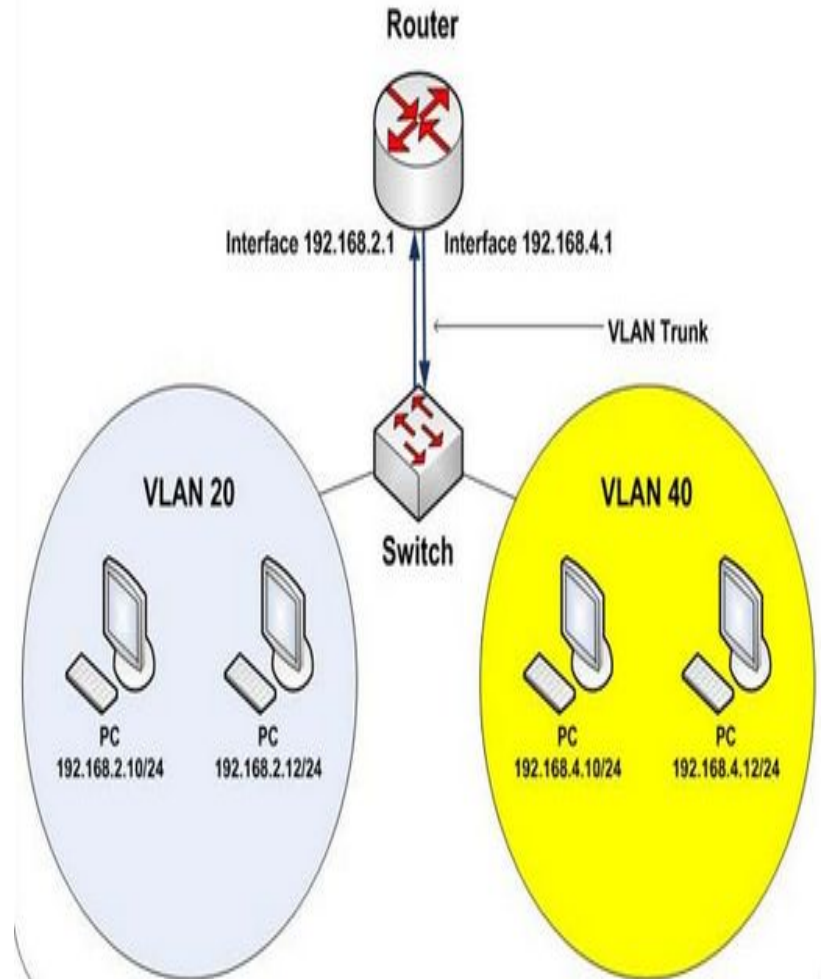
Switch and remote management

support remote management

high level of communication security

Router
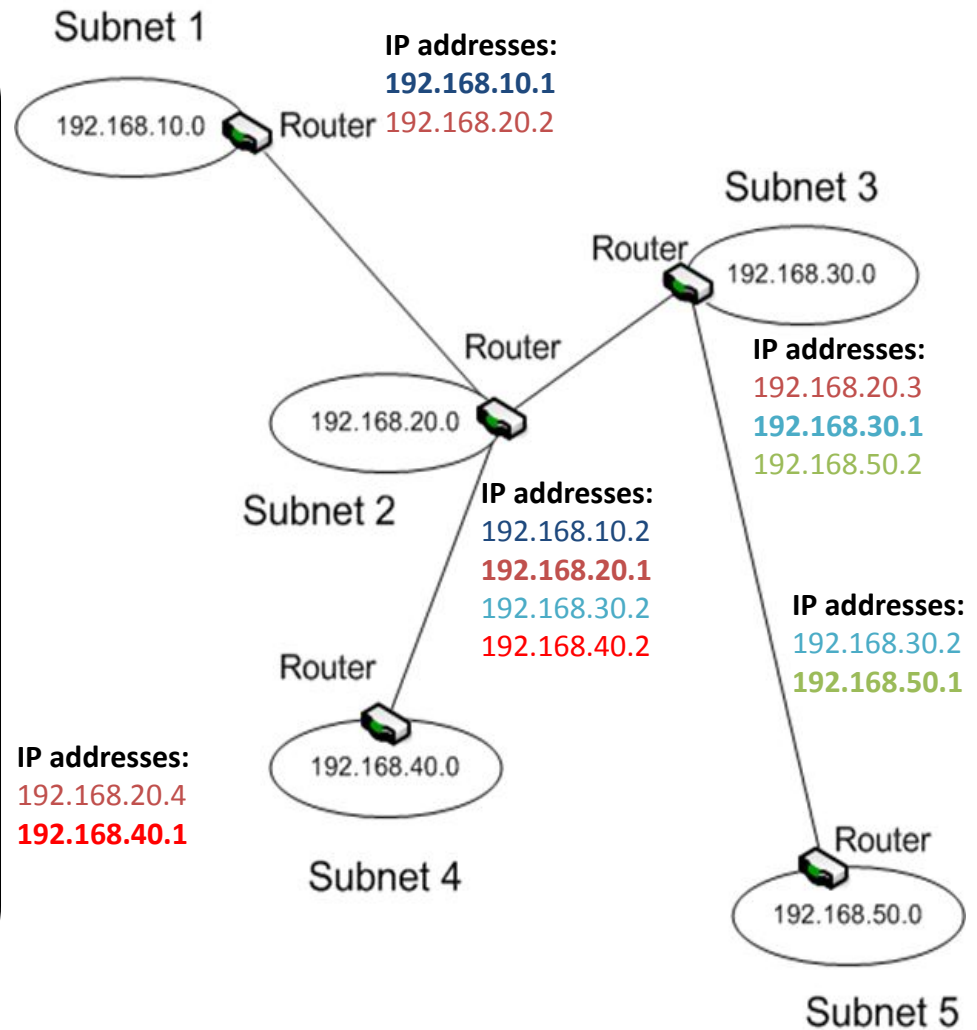
forwards data packets between computer networks

router reads the address information

Routed Network

Each router will have at least two ports

configured with a different network address

Subnet 1

192.168.10.0 Router

IP addresses:
192.168.10.1
192.168.20.2

Subnet 3

Router 192.168.30.0

IP addresses:
192.168.20.3
192.168.30.1
192.168.50.2

Router

192.168.20.0

Subnet 2

IP addresses:
192.168.10.2
192.168.20.1
192.168.30.2
192.168.40.2

IP addresses:
192.168.30.2
192.168.50.1

Router

192.168.40.0

IP addresses:
192.168.20.4
192.168.40.1

Subnet 4

Router

192.168.50.0

Subnet 5

Sample Router

(1) Power switch   (2) Power receptacle   (3) USB port

(4) Reset button

Figure
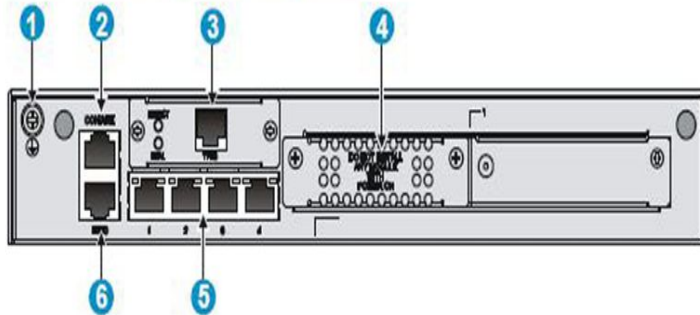
(1) Grounding screw   (2) Console/AUX port   (3) T1 port TPRI0

(4) SIC/DSIC slot   (5) Ethernet LAN ports (ETH1 to   (6) Ethernet WAN port ETH0
                     ETH4)

Access Point

Access Point

Wired network
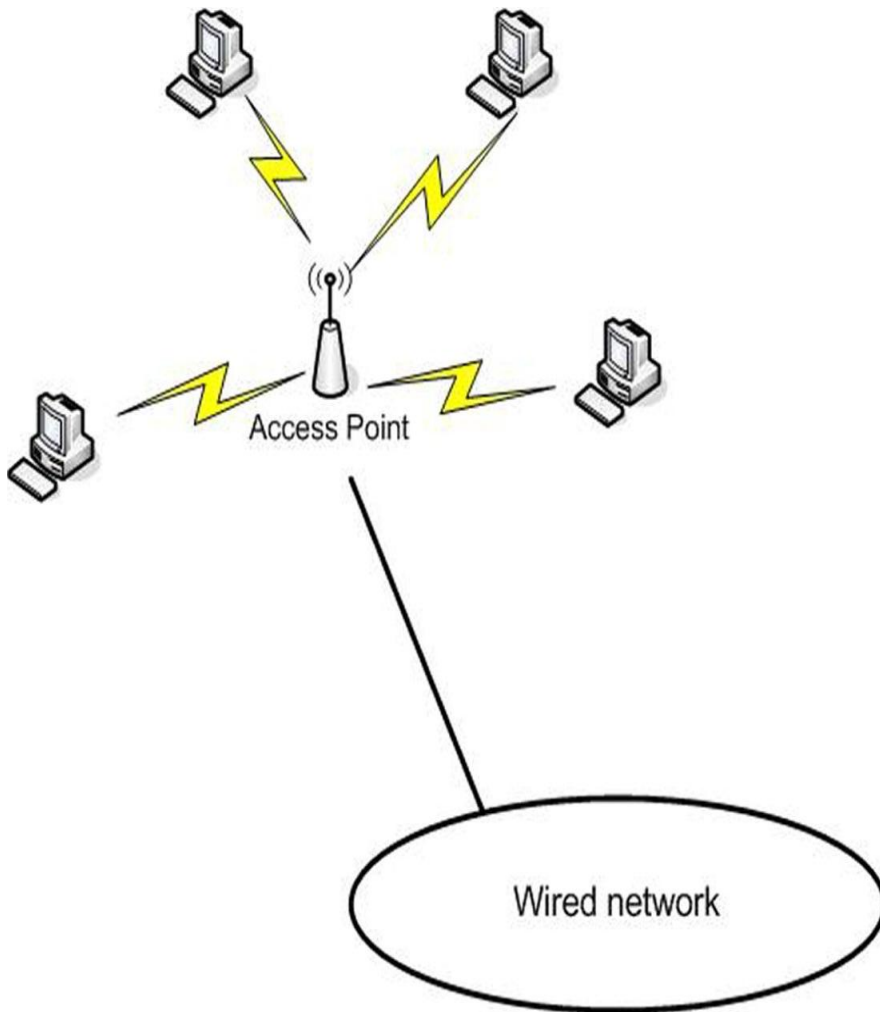
Access Point (AP)

acts as a central connection point for wireless devices

MSM460 Front View

have one or more internal radios

support both a web‑based management tool and a CLI

MSM460 Back View
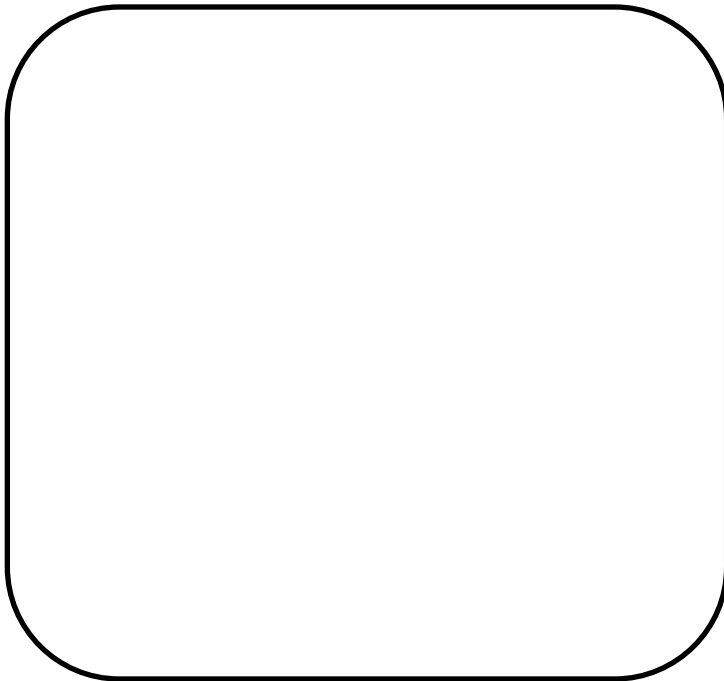
does not have a power connector

Wireless Router

(1) Power switch (2) Power receptacle (3) USB port
(4) Reset button

Figure 8 A
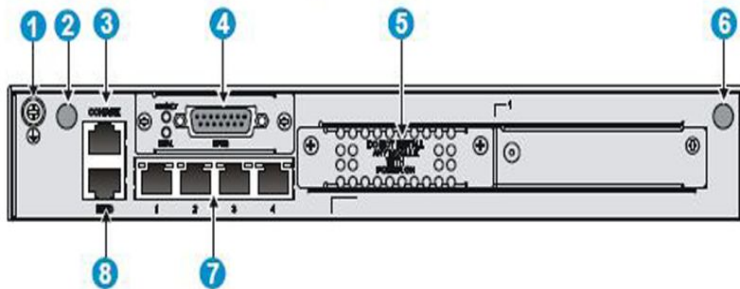
(1) Grounding screw   (2) Antenna port   (3) Console/AUX port
(4) E1 port EPRIO   (5) SIC/DSIC slot   (6) Antenna port
(7) Ethernet LAN ports (ETH1 to   (8) Ethernet WAN port ETH0
ETH4)

combines bridge, router, switch, and AP functionality

is not routing wireless signals

Wireless Router Use

give you an easy way to share a high-speed Internet connection
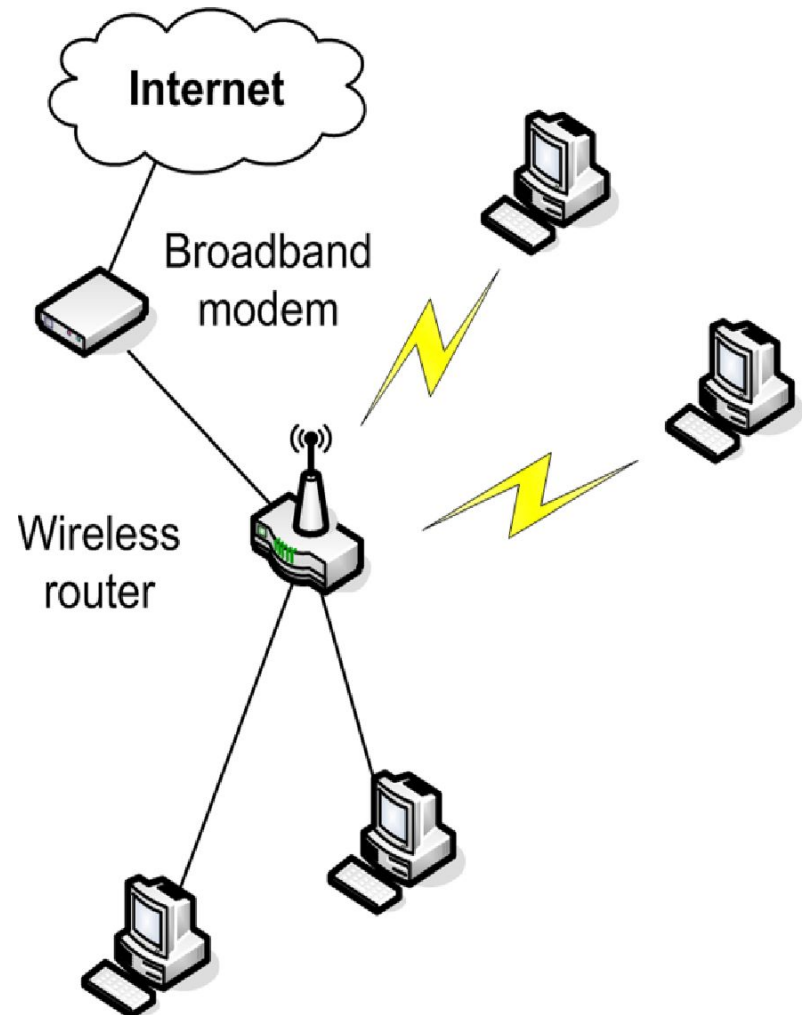
Summary

- **Network adapter**
- **Repeater**
- **Hub**
- **Bridge**
- **Switch**
- **Router**
- **Access point**
- **Wireless router**

Hardware Fundamentals

Switch Basics

catalog.onliner.by

HP E3500-24G-PoE

console port

USB port

20

10/100/1000 Base‑T ports.

8 ports HP refers to as dual-personality ports

- **4 ports support mini‑GBIC or 10/100/1000 Base‑T, giving you the option of wired or fiber optic media.**
- **4 ports, if a transceiver is inserted, giving you the option of fiber optic media.**

HP 5406zl-48G switch

10/100/1000 module with 24 ports

Management module

Console port

USB Auxiliary port

Six module slots labeled A-F
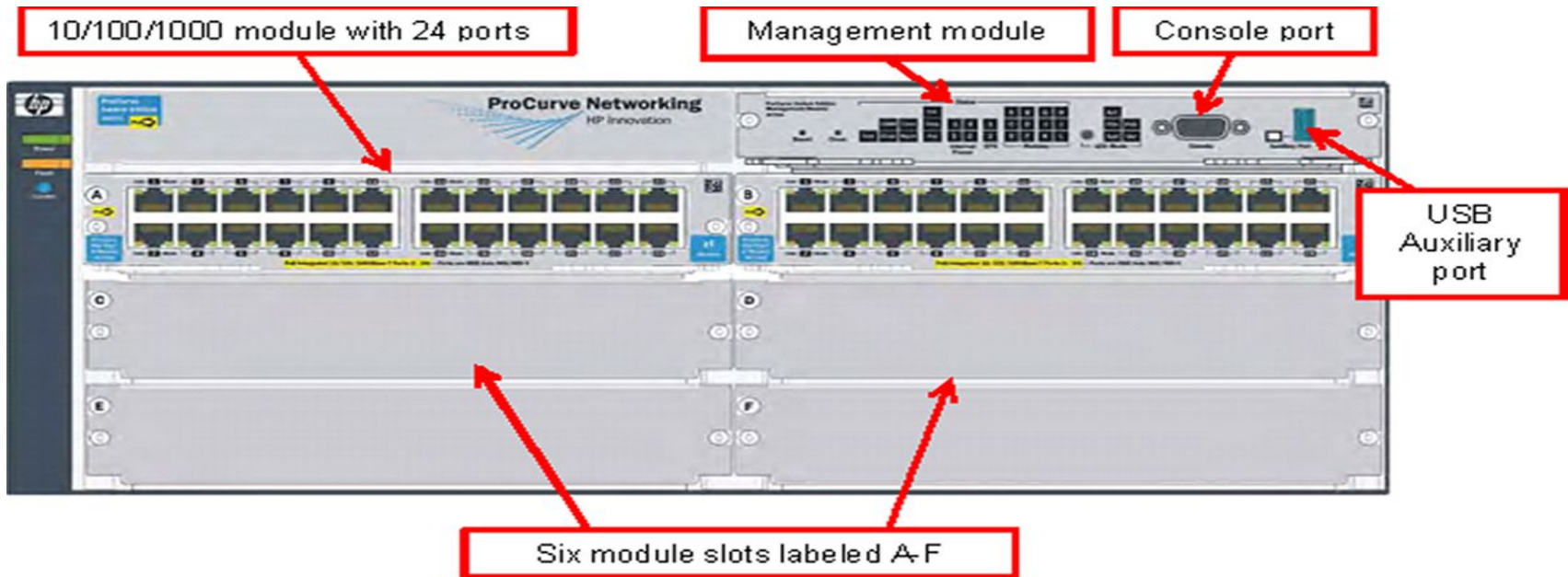
up to six modules. **The management module hosts the console and USB ports.**

HP 5406zl-48G switch

You could install additional port modules, as needed

In many switches, the modules are hot‑swappable.

- **Refers to device components and modules that can be changed out without powering down the device. One module can be changed with one of the same type while the remaining modules stay up and operational.**

Sample Module
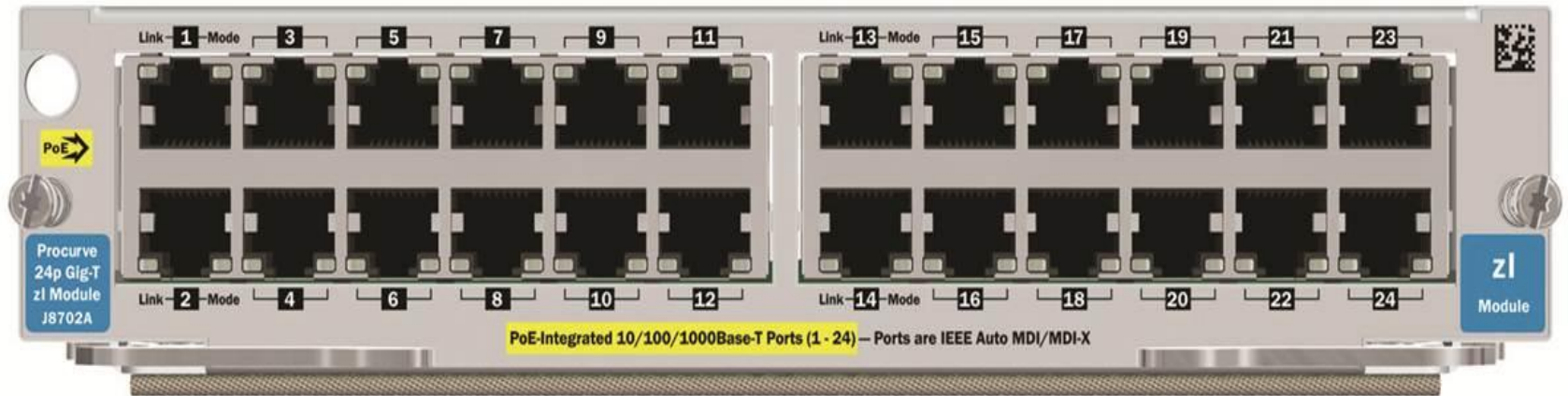
has 24 ports

The ports in a module are referred to by slot identifier

Switch management options

have three management interface options

- **Command line interface (CLI) (console port or over the network);**
- **Menu interface (console port or over the network);**
- **Web interface (over the network only).**

Switch management options

The Command line interface (CLI)

The menu interface

The web interface

Summary

- CLI
- Menu interface
- Web interface

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Hardware Fundamentals

Console Connection

console port

console cable
supplied with the
switch

PC running a
terminal emulator
program, or a VT-
100 terminal
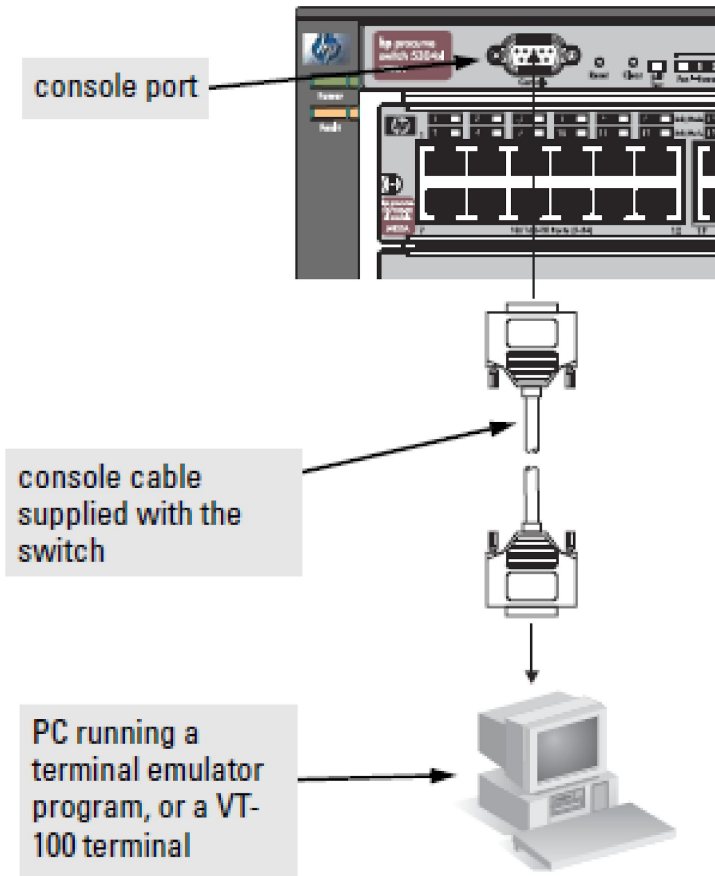
connecting to the console port

CLI Levels

Operator Level — HP Switch>

enable

exit

Manager Level — HP Switch#

config

exit / end

Global Configuration Level — HP Switch(config)#

vlan 1

exit / end

VLAN Context Configuration Level — HP Switch(vlan-1)#

Interface, router and other Context Configuration Levels function in the same way as the VLAN level. See CLI help or manual for more information.
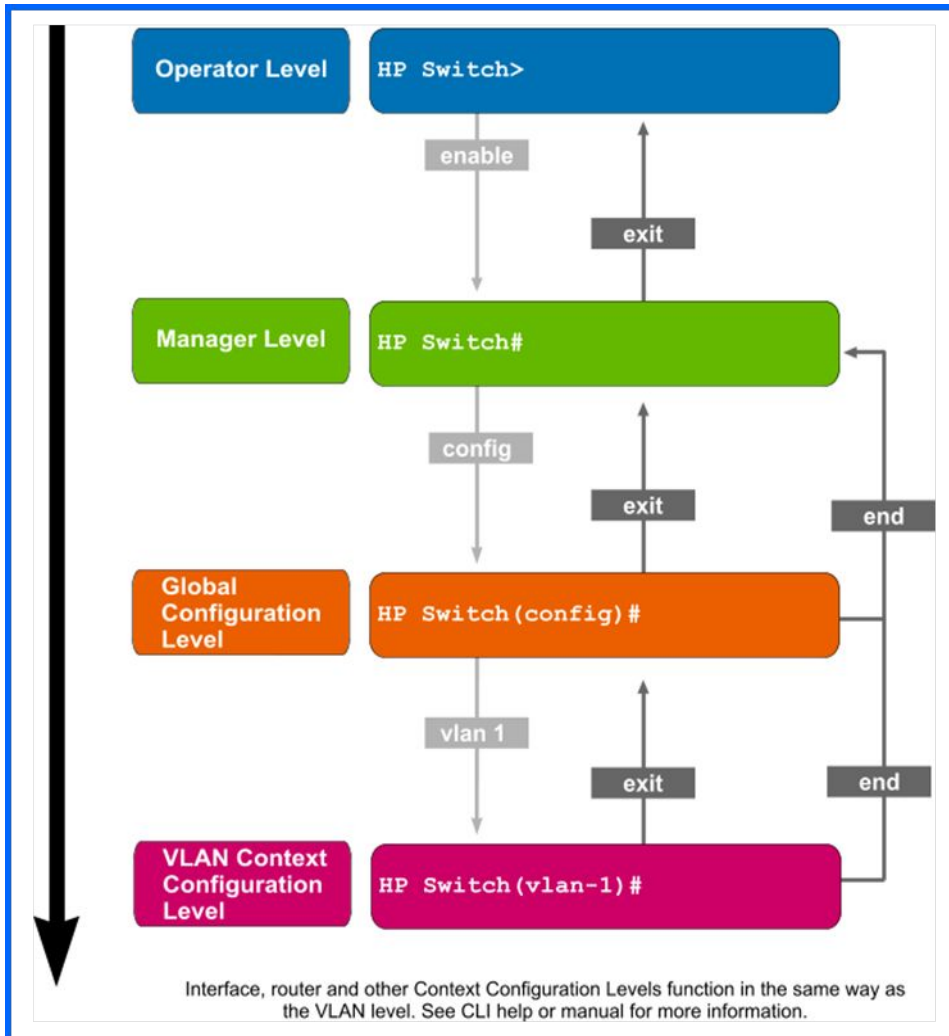
manager level operator level

The global configuration level (config context) **and VLAN context configuration level**

CLI Current Configuration

Telnet 192.168.1.110

```
HP J4850A ProCurve Switch 5304XL
Firmware revision E.10.37

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 Computer Software clause at 52.227-7013.

           HEWLETT-PACKARD COMPANY, 3000 Hanover St., Palo Alto, CA 94303

We'd like to keep you up to date about:
   * Software feature updates
   * New product announcements
   * Special events

Please register your products now at:  www.ProCurve.com

Press any key to continue
```
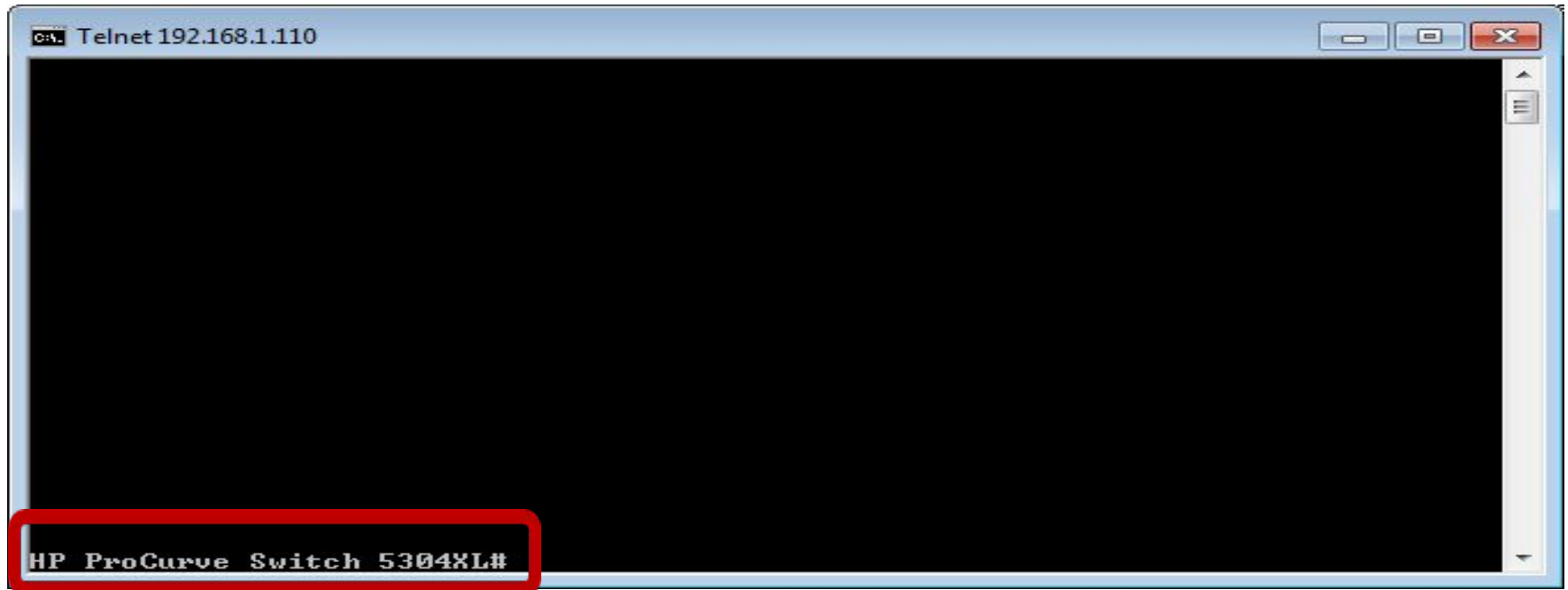
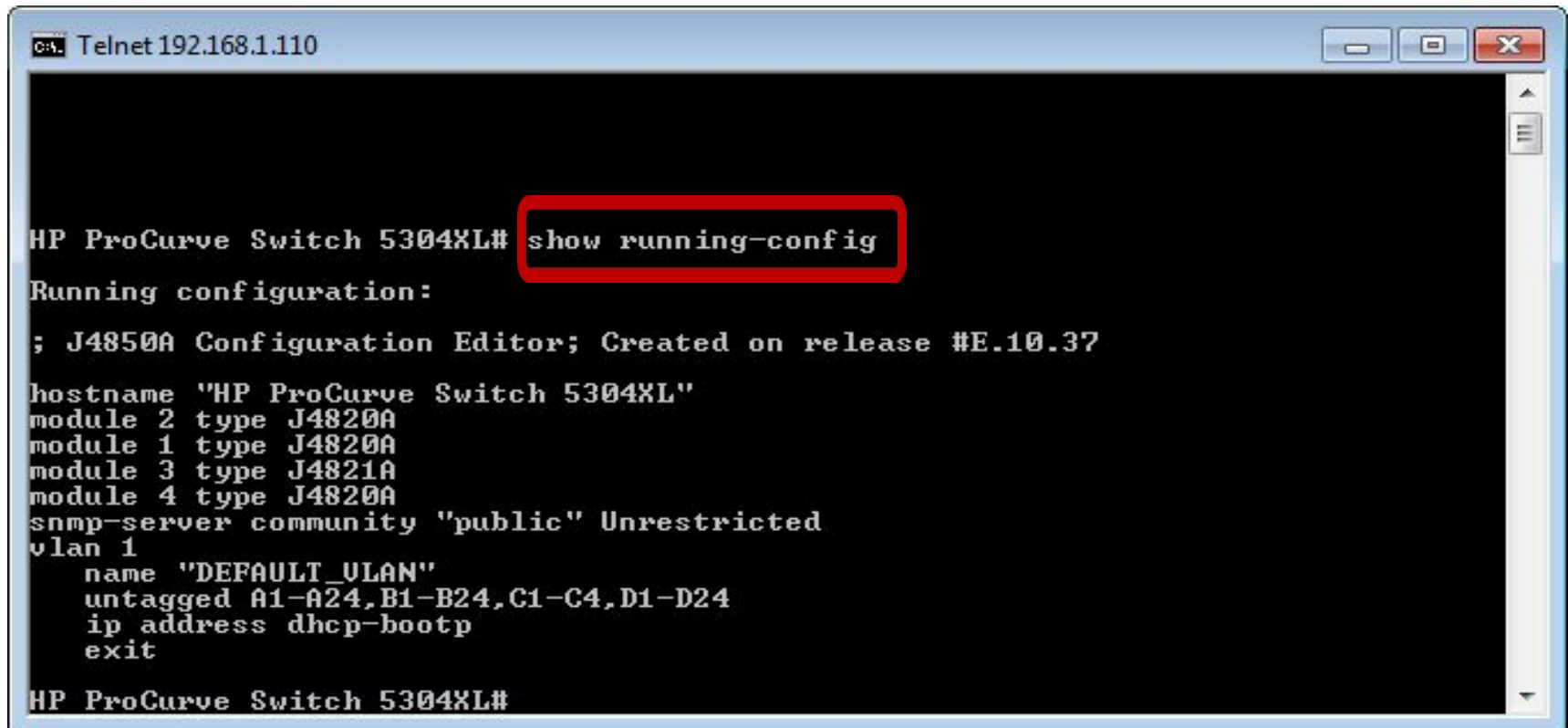# Default Prompt

connect in manager level

CLI Active Configuration

show running-config.
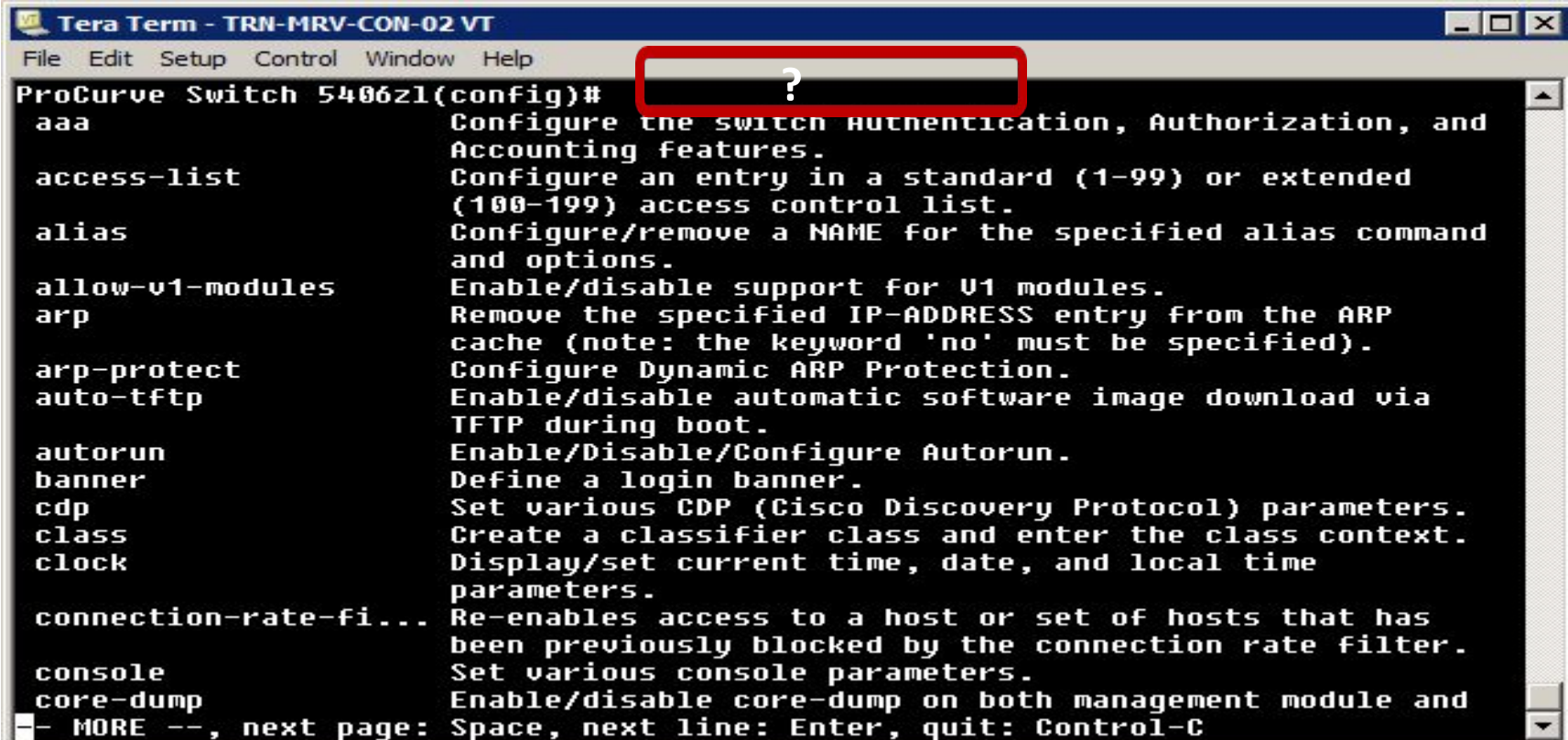
CLI Manager Command List

type ? or press the Tab key

```
Tera Term - TRN-MRV-CON-02 VT                                    _ □ ×
File   Edit   Setup   Control   Window   Help
ProCurve Switch 5406zl(config)#                    ?
 aaa                    Configure the switch Authentication, Authorization, and
                        Accounting features.
 access-list            Configure an entry in a standard (1-99) or extended
                        (100-199) access control list.
 alias                  Configure/remove a NAME for the specified alias command
                        and options.
 allow-v1-modules       Enable/disable support for V1 modules.
 arp                    Remove the specified IP-ADDRESS entry from the ARP
                        cache (note: the keyword 'no' must be specified).
 arp-protect            Configure Dynamic ARP Protection.
 auto-tftp              Enable/disable automatic software image download via
                        TFTP during boot.
 autorun                Enable/Disable/Configure Autorun.
 banner                 Define a login banner.
 cdp                    Set various CDP (Cisco Discovery Protocol) parameters.
 class                  Create a classifier class and enter the class context.
 clock                  Display/set current time, date, and local time
                        parameters.
 connection-rate-fi...  Re-enables access to a host or set of hosts that has
                        been previously blocked by the connection rate filter.
 console                Set various console parameters.
 core-dump              Enable/disable core-dump on both management module and
-- MORE --, next page: Space, next line: Enter, quit: Control-C
```
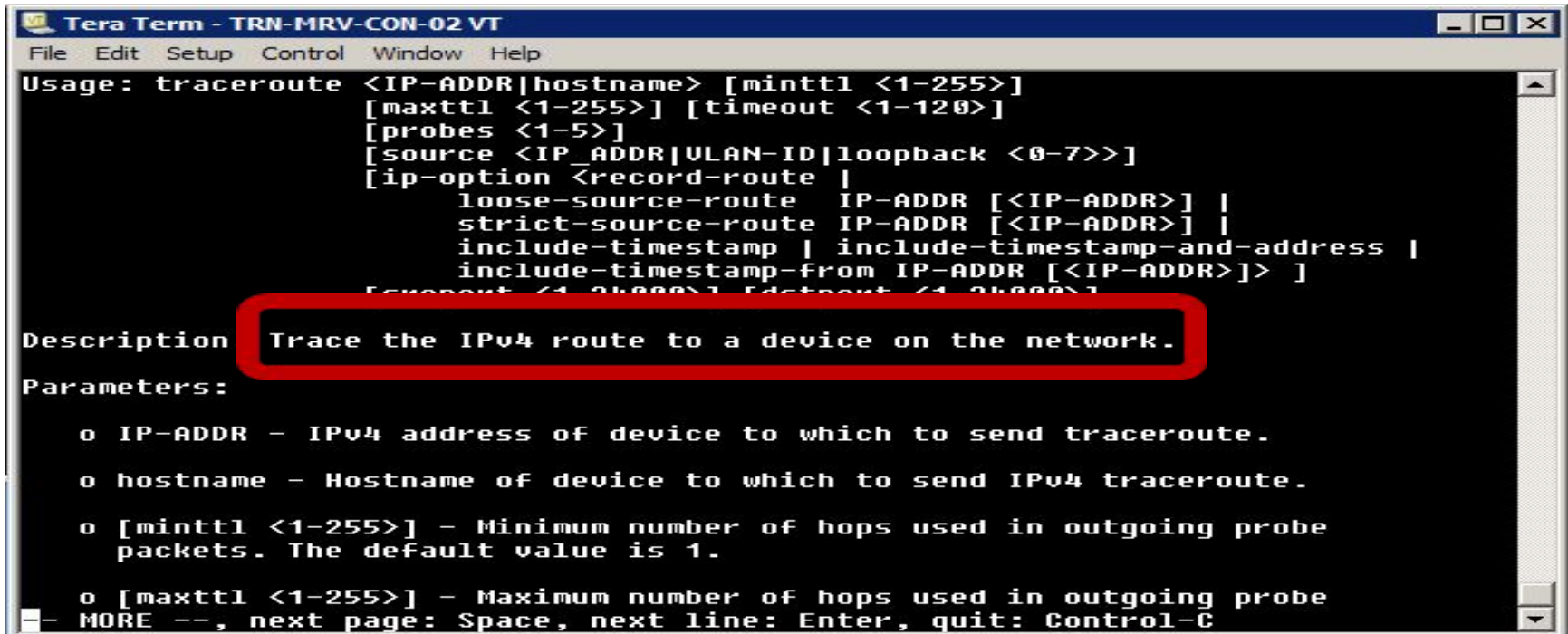
Command Help

by *help*, ?, or *<tab>*

If you want to know more about the traceroute command you would run: *traceroute help*
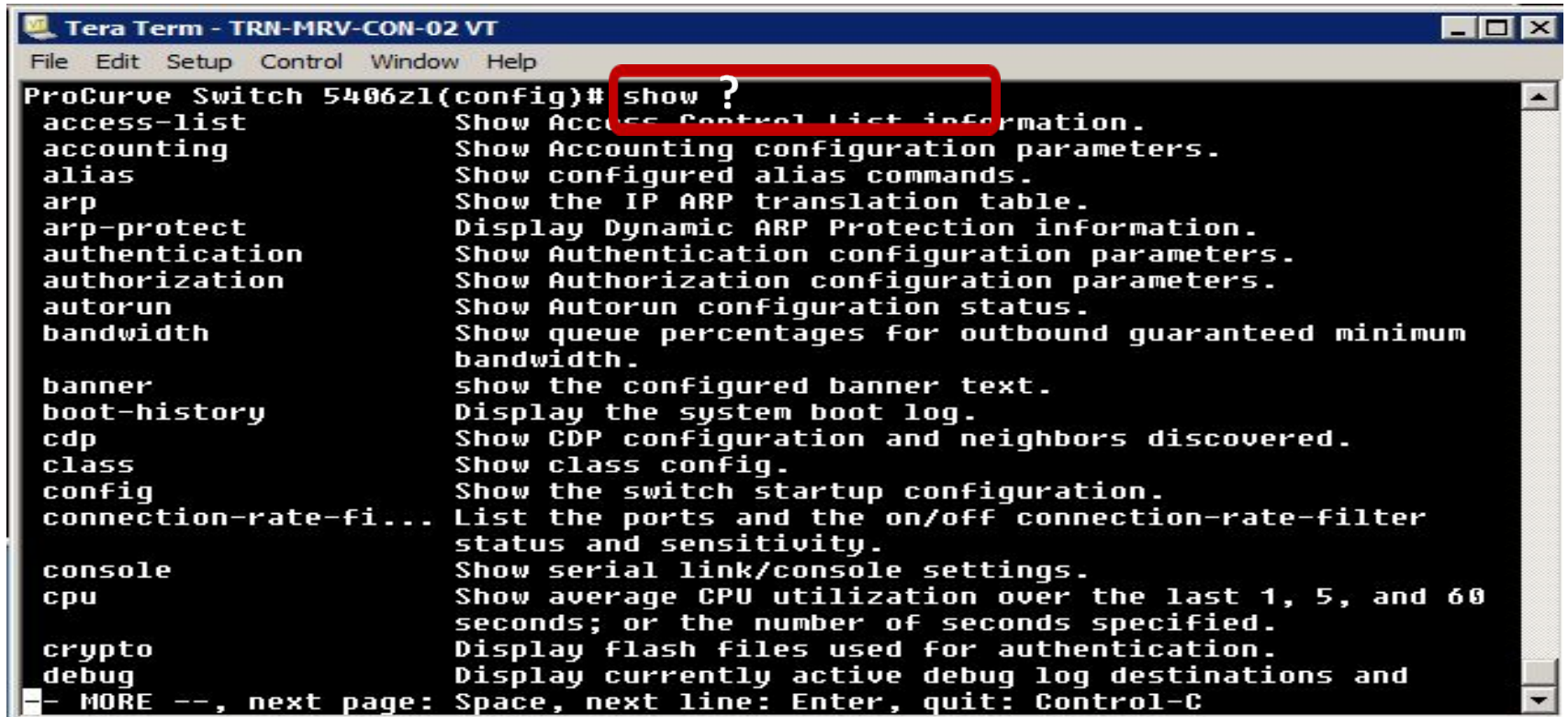

```
Tera Term - TRN-MRV-CON-02 VT
File  Edit  Setup  Control  Window  Help
Usage: traceroute <IP-ADDR|hostname> [minttl <1-255>]
                  [maxttl <1-255>] [timeout <1-120>]
                  [probes <1-5>]
                  [source <IP_ADDR|VLAN-ID|loopback <0-7>>]
                  [ip-option <record-route |
                       loose-source-route  IP-ADDR [<IP-ADDR>] |
                       strict-source-route IP-ADDR [<IP-ADDR>] |
                       include-timestamp | include-timestamp-and-address |
                       include-timestamp-from IP-ADDR [<IP-ADDR>]> ]

Description  Trace the IPv4 route to a device on the network.

Parameters:

  o IP-ADDR - IPv4 address of device to which to send traceroute.

  o hostname - Hostname of device to which to send IPv4 traceroute.

  o [minttl <1-255>] - Minimum number of hops used in outgoing probe
    packets. The default value is 1.

  o [maxttl <1-255>] - Maximum number of hops used in outgoing probe
- MORE --, next page: Space, next line: Enter, quit: Control-C
```

Show Commands

the *show* command

type ? or press the Tab key

```
Tera Term - TRN-MRV-CON-02 VT                                          _ □ ×
File   Edit   Setup   Control   Window   Help
ProCurve Switch 5406zl(config)#  show ?
 access-list             Show Access Control List information.
 accounting              Show Accounting configuration parameters.
 alias                   Show configured alias commands.
 arp                     Show the IP ARP translation table.
 arp-protect             Display Dynamic ARP Protection information.
 authentication          Show Authentication configuration parameters.
 authorization           Show Authorization configuration parameters.
 autorun                 Show Autorun configuration status.
 bandwidth               Show queue percentages for outbound guaranteed minimum
                         bandwidth.
 banner                  show the configured banner text.
 boot-history            Display the system boot log.
 cdp                     Show CDP configuration and neighbors discovered.
 class                   Show class config.
 config                  Show the switch startup configuration.
 connection-rate-fi...   List the ports and the on/off connection-rate-filter
                         status and sensitivity.
 console                 Show serial link/console settings.
 cpu                     Show average CPU utilization over the last 1, 5, and 60
                         seconds; or the number of seconds specified.
 crypto                  Display flash files used for authentication.
 debug                   Display currently active debug log destinations and
-- MORE --, next page: Space, next line: Enter, quit: Control-C
```
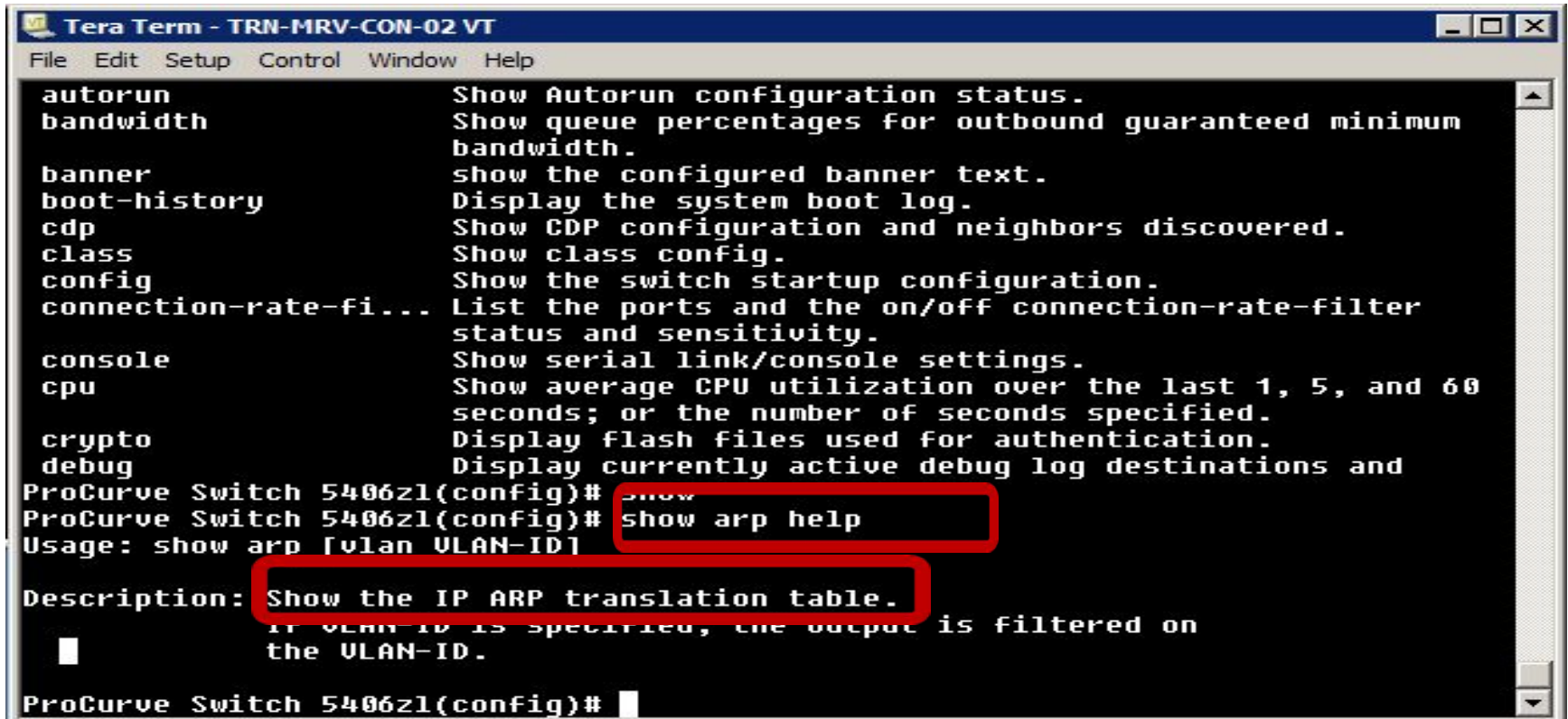
Show Command Help

type *show*, the command name, *help*, and then press the Enter key
show arp help

Show command examples

show vlans

show ip route

Show command examples

show interface

Link Layer Discovery Protocol (LLDP)

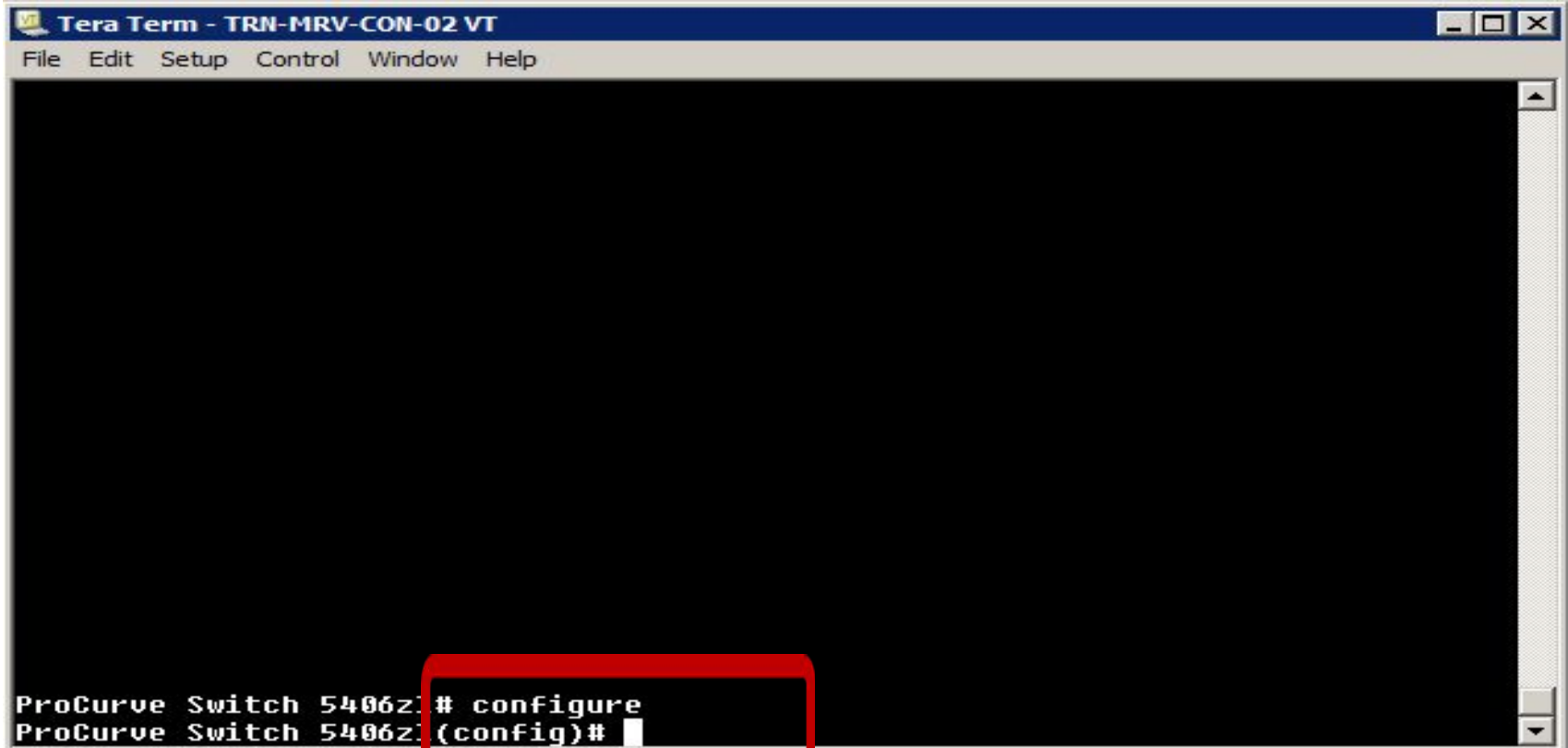**show lldp info local-device**

show lldp info remote-device

Global Configuration Context

change the command context
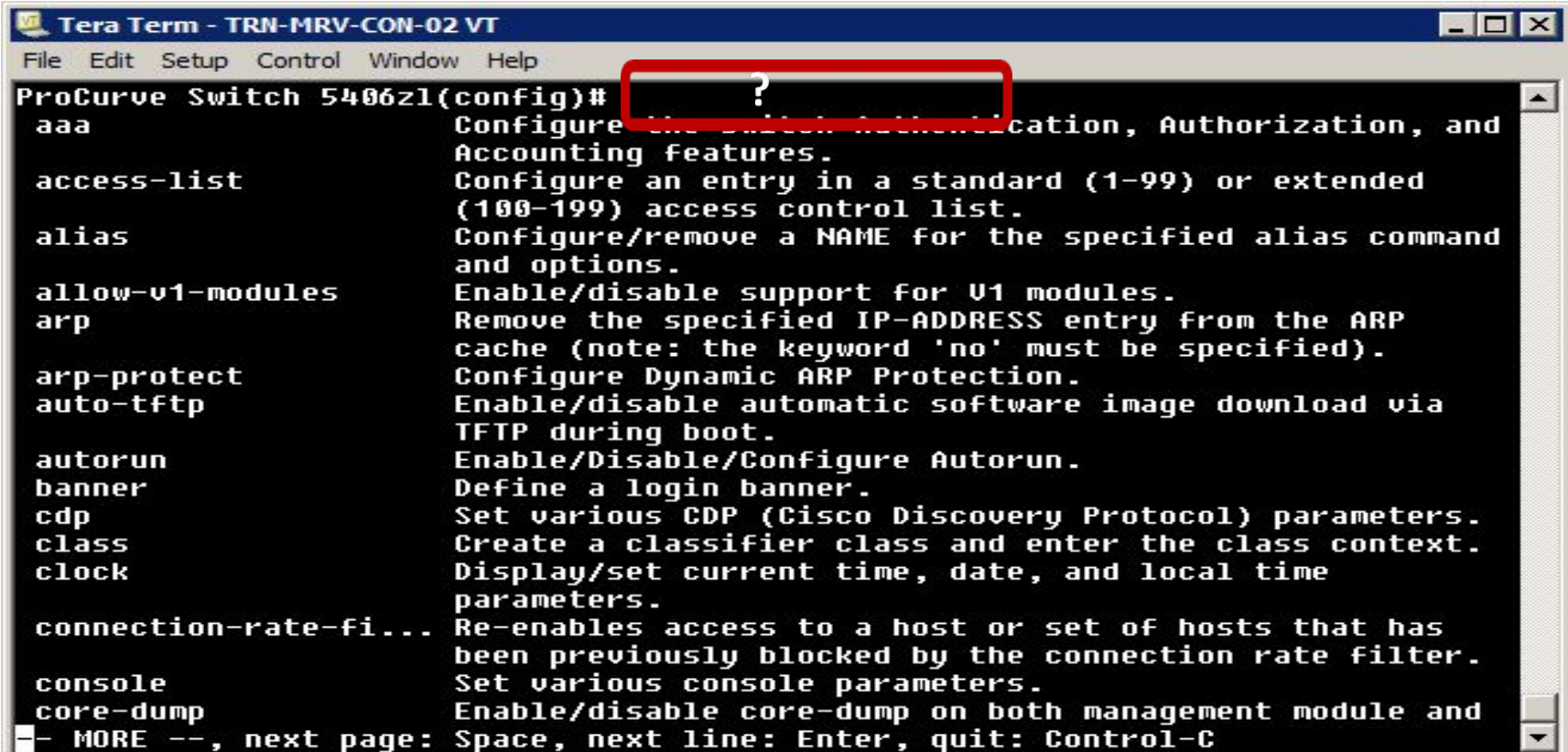the prompt changes to include
(config)


```
ProCurve Switch 5406z # configure
ProCurve Switch 5406z (config)#
```

Global Configuration Commands

if you type ?,

```
Tera Term - TRN-MRV-CON-02 VT                                    _ □ ×
File  Edit  Setup  Control  Window  Help
ProCurve Switch 5406zl(config)#         ?
 aaa                        Configure the switch Authentication, Authorization, and
                            Accounting features.
 access-list                Configure an entry in a standard (1-99) or extended
                            (100-199) access control list.
 alias                      Configure/remove a NAME for the specified alias command
                            and options.
 allow-v1-modules           Enable/disable support for V1 modules.
 arp                        Remove the specified IP-ADDRESS entry from the ARP
                            cache (note: the keyword 'no' must be specified).
 arp-protect                Configure Dynamic ARP Protection.
 auto-tftp                  Enable/disable automatic software image download via
                            TFTP during boot.
 autorun                    Enable/Disable/Configure Autorun.
 banner                     Define a login banner.
 cdp                        Set various CDP (Cisco Discovery Protocol) parameters.
 class                      Create a classifier class and enter the class context.
 clock                      Display/set current time, date, and local time
                            parameters.
 connection-rate-fi...      Re-enables access to a host or set of hosts that has
                            been previously blocked by the connection rate filter.
 console                    Set various console parameters.
 core-dump                  Enable/disable core-dump on both management module and
-- MORE --, next page: Space, next line: Enter, quit: Control-C
```

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Switch setup using the CLI

contact person for the switch, the manager password, DHCP/Bootp enable or disable, and IP address information

define a descriptive and unique hostname for your switch

Config context

hostname switch1

Manager access

password manager user-name admin

password operator user-name techie

no password all

Global configuration context commands

Config context

From there, you can enter the configuration context for a particular port

interface 10

switch1(eth-10)#

Manage ports

switch1(eth-10) -

enable

disable

speed-duplex

mdix-mode

name

VLAN context commands

vlan 1

switch1(vlan-1)#

ip address 192.168.1.14/24
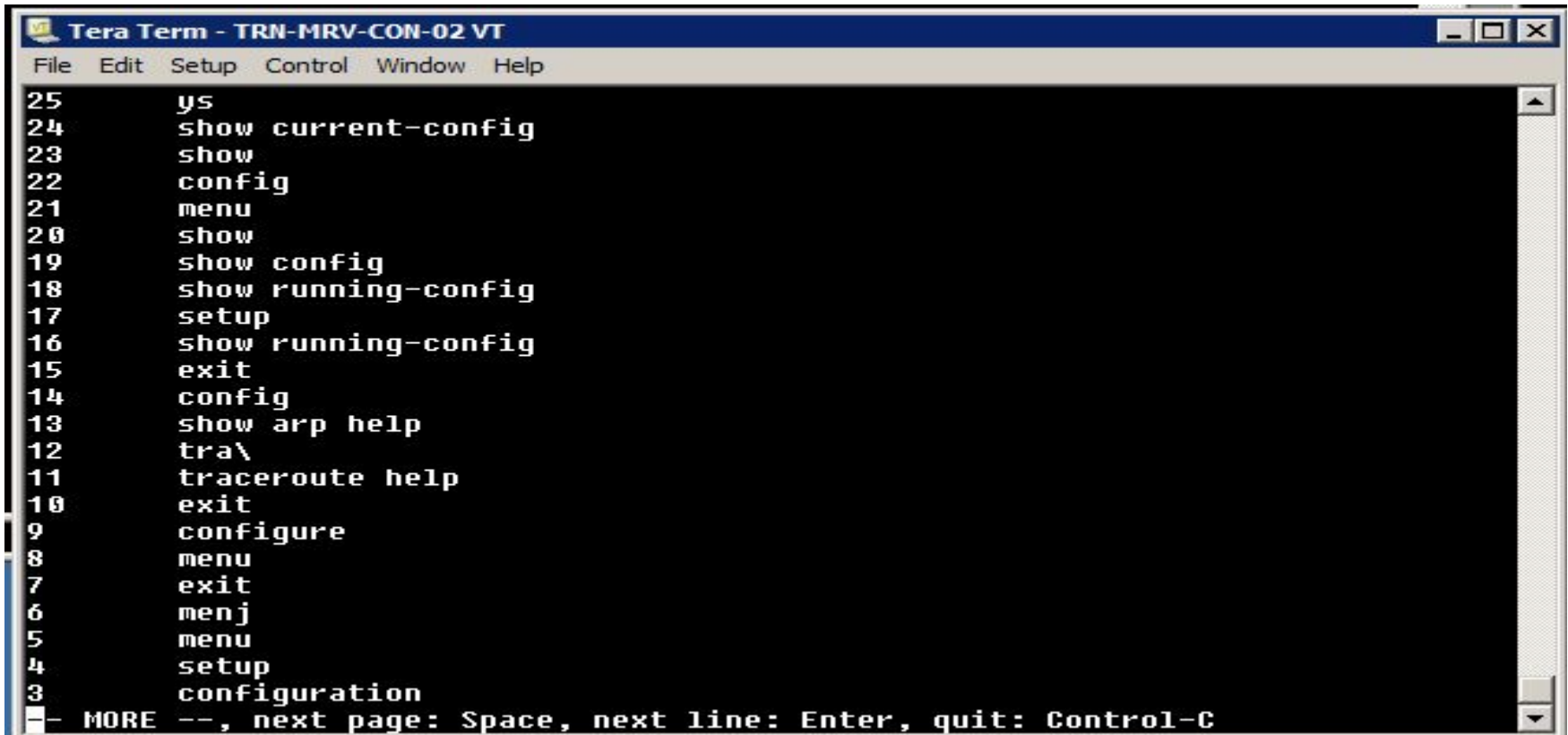
Save configuration changes

- **write memory**

Command History

show history

Command History

up and down arrows to scroll through commands history list

repeat 10

Summary

- **Operator level**
- **Manager level**
- **Global configuration level**
- **VLAN context configuration level**

Hardware Fundamentals

Menu interface

is easier to use select commands

limits the management commands

Launch the menu interface

menu
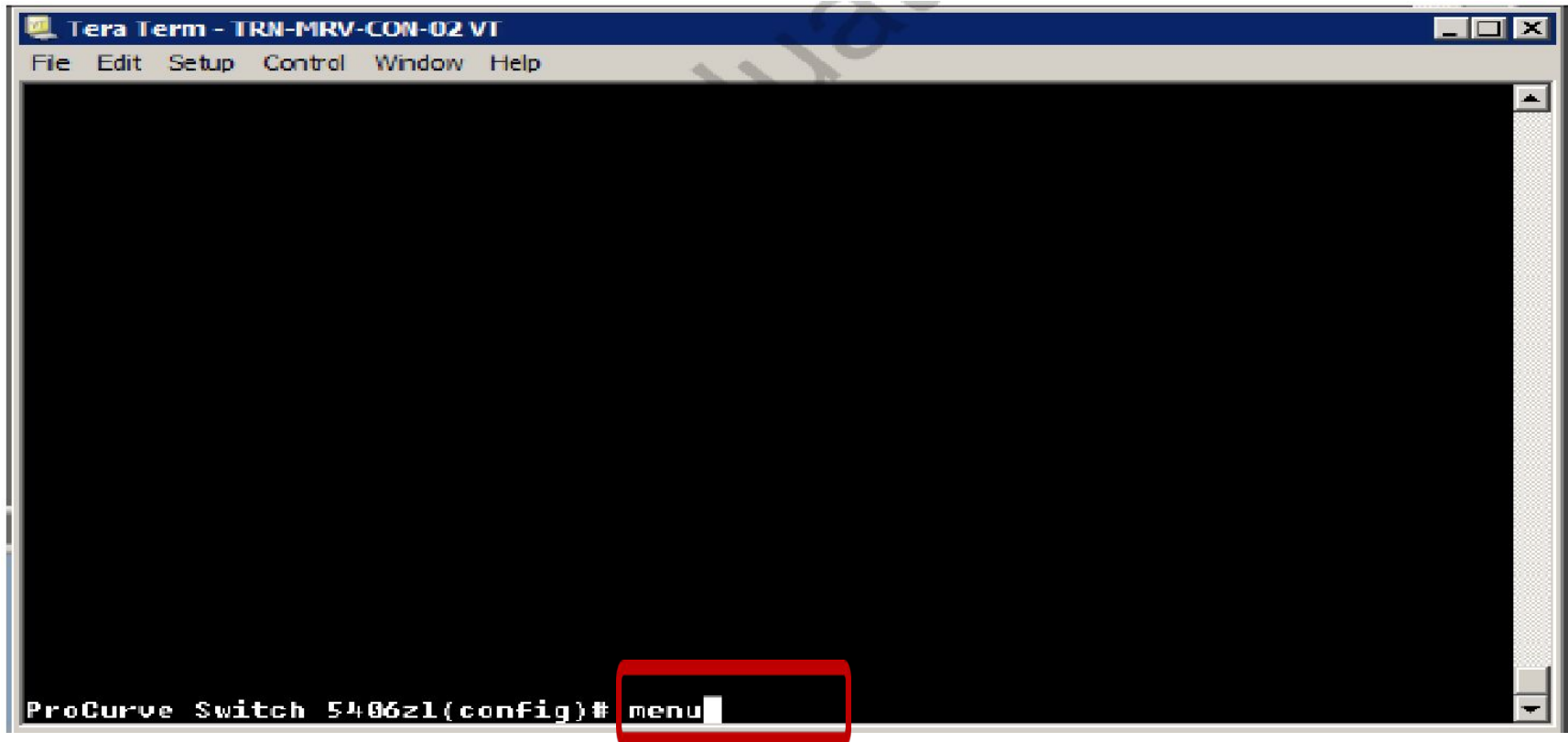
Main Menu


```
Tera Term - TRN-MRV-CON-02 VT                                    _ □ X

File   Edit   Setup   Control   Window   Help

ProCurve Switch 5406zl                              14-Mar-2012    1:26:5
========================- CONSOLE - MANAGER MODE -========================
                               Main Menu

     1.  Status and Counters...
     2.  Switch Configuration...
     3.  Console Passwords...
     4.  Event Log
     5.  Command Line (CLI)
     6.  Reboot Switch
     7.  Download OS
     8.  Run Setup
     0.  Logout




Provides the menu to display configuration, status, and counters.
To select menu item, press item number, or highlight item and press <Enter>.
```

Main Menu

- **Provides access to display screens showing switch information, port status and port counters, port and VLAN address tables.**

- **Provides access to configuration screens for displaying and changing the current configuration settings.**

- **Provides access to the screen used to set or change Manager-level and Operator-level passwords, and to delete Manager and Operator password protection.**

- **Enables you to read progress and error messages that are useful for checking and troubleshooting switch operation.**

Main Menu

- **Selects the Command Line Interface** at the same level (Manager or Operator) that you are accessing in the Menu interface.

- Performs a **"warm" reboot of the switch**, which clears most temporary error conditions, resets the network activity counters to zero, and resets the system up-time to zero.
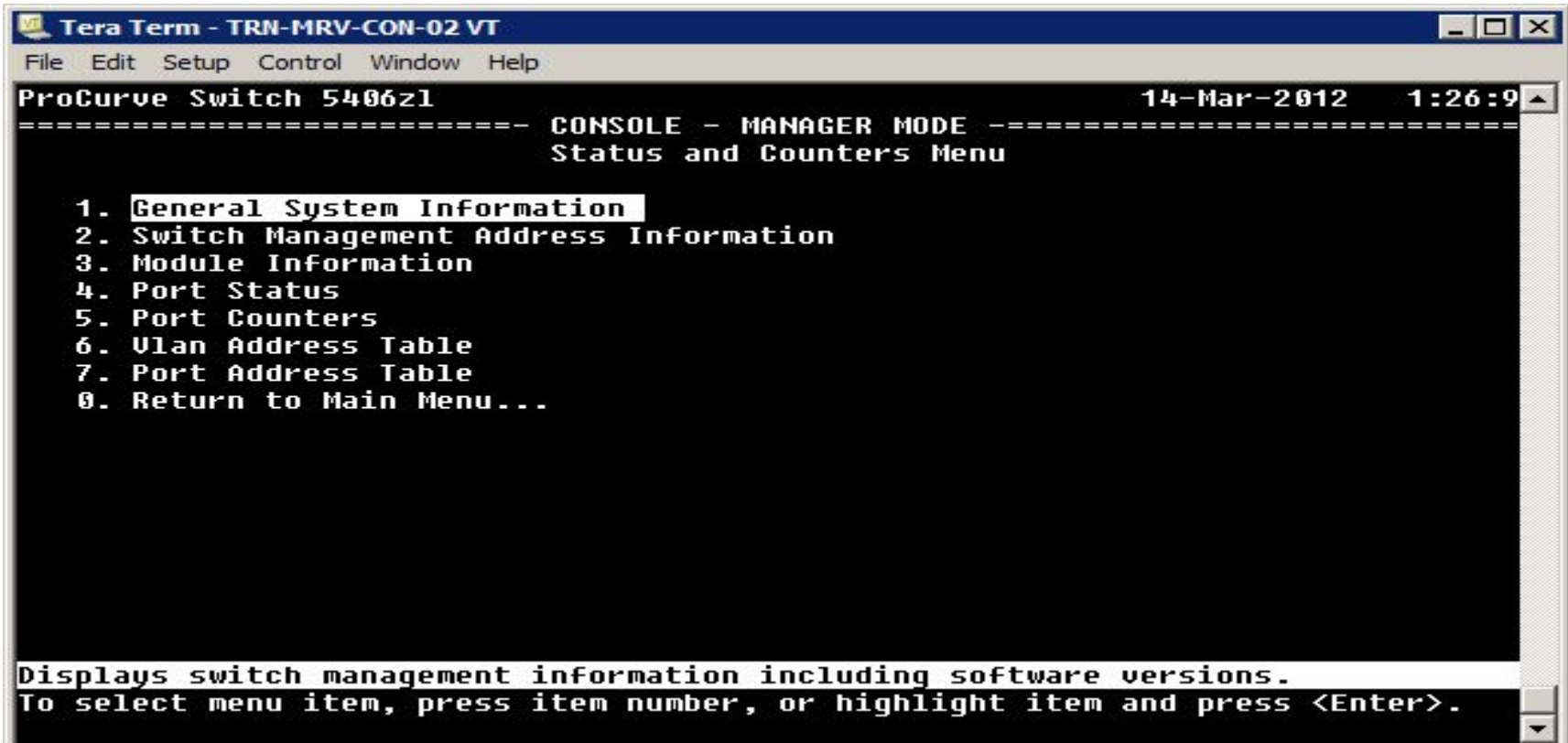
- Enables you to **download a new switch software** version to the switch.

- Displays the **Switch Setup screen for quickly configuring basic switch parameters** such as IP addressing, default gateway, logon default interface, and others.

- **Closes the Menu interface** and console session, and disconnects Telnet access to the switch.

Status and Counters Menu

For example, *Status and Counters...* takes you to *Status and Counters Menu*


```
Tera Term - TRN-MRV-CON-02 VT                                    _ □ ×
File   Edit   Setup   Control   Window   Help
ProCurve Switch 5406zl                          14-Mar-2012    1:26:9
============================- CONSOLE - MANAGER MODE -=====================
                        Status and Counters Menu

   1.  General System Information
   2.  Switch Management Address Information
   3.  Module Information
   4.  Port Status
   5.  Port Counters
   6.  Vlan Address Table
   7.  Port Address Table
   0.  Return to Main Menu...









Displays switch management information including software versions.
To select menu item, press item number, or highlight item and press <Enter>.
```

Switch Configuration

```
Tera Term - TRN-MRV-CON-02 VT                                        _ □ ✕
File  Edit  Setup  Control  Window  Help
ProCurve Switch 5406zl                              14-Mar-2012    2:14:4
============================- CONSOLE - MANAGER MODE -=====================
                        Switch Configuration Menu

    1. System Information
    2. Port/Trunk Settings
    3. Network Monitoring Port
    4. IP Configuration
    5. SNMP Community Names
    6. IP Authorized Managers
    7. VLAN Menu...
    0. Return to Main Menu...
















Configures system-level information including system identification.
To select menu item, press item number, or highlight item and press <Enter>.
                                                                        75
```

VLAN Menu


```
Tera Term - TRN-MRV-CON-02 VT                                    _ □ ×
File   Edit   Setup   Control   Window   Help

ProCurve Switch 5406zl                            14-Mar-2012    2:14:7
============================- CONSOLE - MANAGER MODE -=======================
                    Switch Configuration - VLAN Menu

    1. VLAN Support
    2. VLAN Names
    3. VLAN Port Assignment
    4. Return to Previous Menu...
    0. Return to Main Menu...

Displays the menu to activate and configure, or deactivate VLAN support.
To select menu item, press item number, or highlight item and press <Enter>.
```

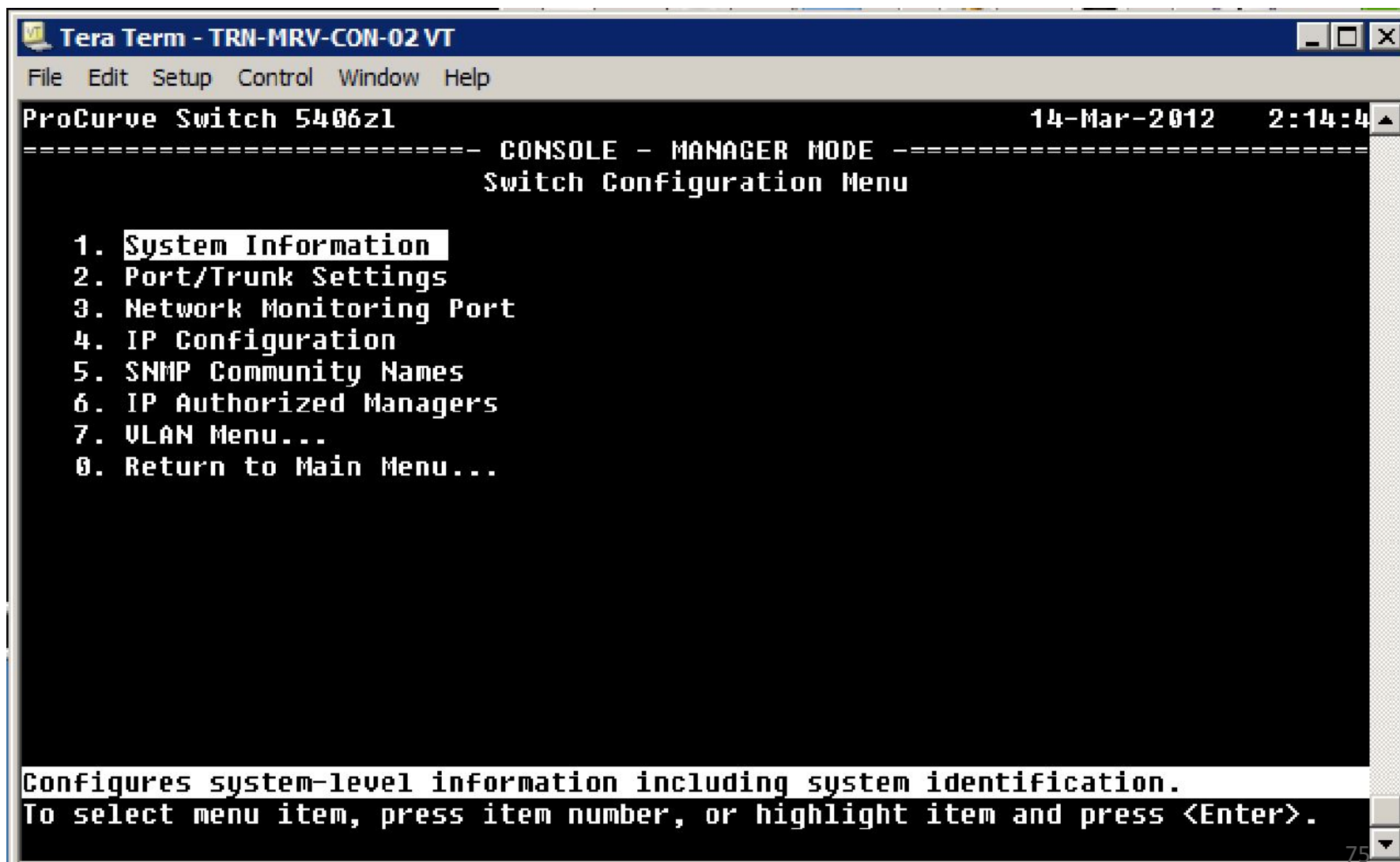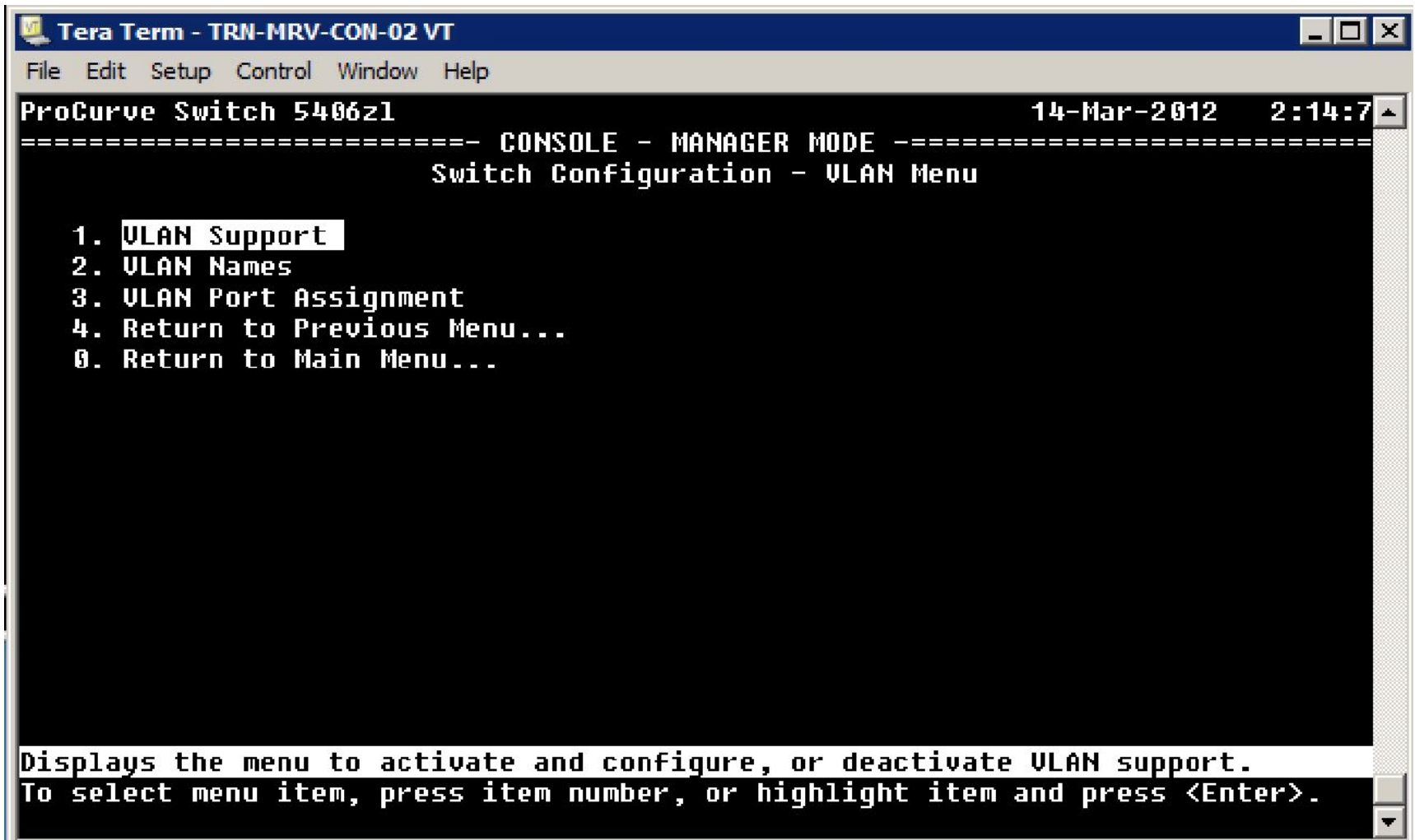# VLAN Menu – VLAN Names


```
Tera Term - TRN-MRV-CON-02 VT                                    _ □ ×

File  Edit  Setup  Control  Window  Help

ProCurve Switch 5406zl                          14-Mar-2012   2:19:5
============================- CONSOLE - MANAGER MODE -===========================
                 Switch Configuration - VLAN - VLAN Names


   802.1Q VLAN ID : 2
   Name : DBUsers















  Actions->    Cancel      Edit      Save      Help

Enter VLAN Name - up to 32 characters
Use arrow keys to change field selection, <Space> to toggle field choices,
and <Enter> to go to Actions.
```

VLAN Menu – VLAN Port Assignment

Tera Term - TRN-MRV-CON-02 VT

File   Edit   Setup   Control   Window   Help

```
ProCurve Switch 5406zl                                      14-Mar-2012   2:22:8
============================- CONSOLE - MANAGER MODE -=============================
                Switch Configuration - VLAN - VLAN Port Assignment

  Port    DEFAULT_VLAN     DBUsers      |   Port    DEFAULT_VLAN     DBUsers
  ---- +  -----------      -----------  |   ---- +  -----------      -----------
  A1   |  Untagged         No           |   A13  |  Untagged         No
  A2   |  Untagged         No           |   A14  |  Untagged         No
  A3   |  Untagged         No           |   A15  |  Untagged         No
  A4   |  Untagged         No           |   A16  |  Untagged         No
  A5   |  Untagged         No           |   A17  |  Untagged         No
  A6   |  Untagged         No           |   A18  |  Untagged         No
  A7   |  Untagged         No           |   A19  |  Untagged         No
  A8   |  Untagged         No           |   A20  |  Untagged         No
  A9   |  Untagged         No           |   A21  |  Untagged         No
  A10  |  Untagged         No           |   A22  |  Untagged         No
  A11  |  Untagged         No           |   A23  |  Untagged         No
  A12  |  Untagged         No           |   A24  |  Untagged         No

  Actions->    Cancel      Edit       Save       Help

Select the tagging mode for the port/VLAN combination.
Use arrow keys to change field selection, <Space> to toggle field choices,
and <Enter> to go to Actions.
```

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IP Configuration

```
Tera Term - TRN-MRV-CON-02 VT                                        _ □ ×
File  Edit  Setup  Control  Window  Help

ProCurve Switch 5406zl                              14-Mar-2012   2:42:5
==========================- CONSOLE - MANAGER MODE -==================
              Switch Configuration - Internet (IP) Service

  IP Routing : Disabled

  Default Gateway :
  Default TTL       : 64
  Arp Age           : 20



          VLAN                IP Config      IP Address        Subnet Mask
  -------------------- + ---------- --------------- ---------------
  DEFAULT_VLAN         | Manual        10.12.1.2         255.255.255.0
  DBUsers              | Disabled



 Actions->    Cancel      Edit      Save      Help

Select the method to enable IP access for switch management.
Use arrow keys to change field selection, <Space> to toggle field choices,
and <Enter> to go to Actions.
```
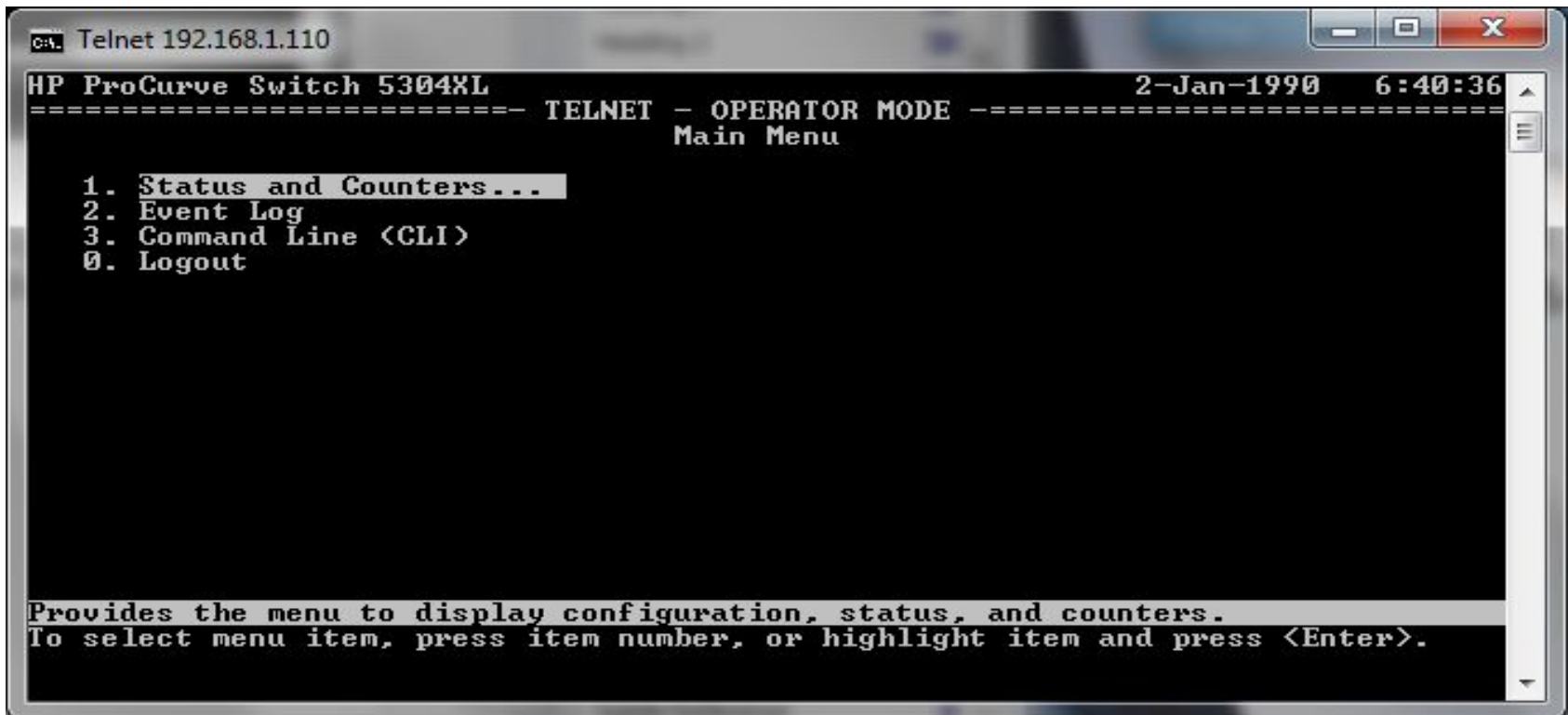
Operator Default Menu

launch the menu interface from an operator CLI prompt

Event Log

- **Information**
- **Warning**
- **Major**
- **Debug**
- **Error**

To view the event log in the CLI, run:

Show logging


```
Tera Term - TRN-MRV-CON-02 VT                                    _ □ ×
File  Edit  Setup  Control  Window  Help
 Keys:      W=Warning      I=Information
            M=Major        D=Debug E=Error
----   Event Log listing: Events Since Boot   ----
I  03/08/12  00:37:09  00061 system: -----------------------------------------
I  03/08/12  00:37:09  00063 system: System went down:   03/08/12  00:34:50
M  03/08/12  00:37:09  00064 system: Operator cold reboot from CONSOLE session.
I  03/08/12  00:37:09  02759 chassis: Savepower LED timer is OFF.
I  03/08/12  00:37:09  00092 dhcp: Enabling Auto Image Config Download via DHCP ad
             turning off auto-tftp if enabled
I  03/08/12  00:37:09  00690 udpf: DHCP relay agent feature enabled
I  03/08/12  00:37:09  02637 srcip: TACACS admin policy is 'outgoing interface'
I  03/08/12  00:37:09  02638 srcip: TACACS oper policy is 'outgoing interface'
I  03/08/12  00:37:09  02637 srcip: RADIUS admin policy is 'outgoing interface'
I  03/08/12  00:37:09  02638 srcip: RADIUS oper policy is 'outgoing interface'
I  03/08/12  00:37:09  02637 srcip: SYSLOG admin policy is 'outgoing interface'
I  03/08/12  00:37:09  02638 srcip: SYSLOG oper policy is 'outgoing interface'
I  03/08/12  00:37:09  02637 srcip: TELNET admin policy is 'outgoing interface'
I  03/08/12  00:37:09  02638 srcip: TELNET oper policy is 'outgoing interface'
I  03/08/12  00:37:09  02637 srcip: TFTP admin policy is 'outgoing interface'
I  03/08/12  00:37:09  02638 srcip: TFTP oper policy is 'outgoing interface'
I  03/08/12  00:37:09  02637 srcip: SNTP admin policy is 'outgoing interface'
I  03/08/12  00:37:09  02638 srcip: SNTP oper policy is 'outgoing interface'
I  03/08/12  00:37:09  00110 telnet: telnetd service enabled
-- MORE --, next page: Space, next line: Enter, quit: Control-C
```

Summary

Default main menu   **Operator Default Menu**

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