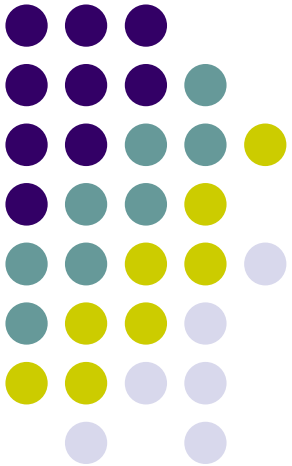
Semester 2 Module 1 WANs and Routers

Yuda college of business

James Chen

ydjames@ydu.edu.tw

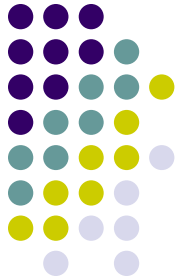


Outline

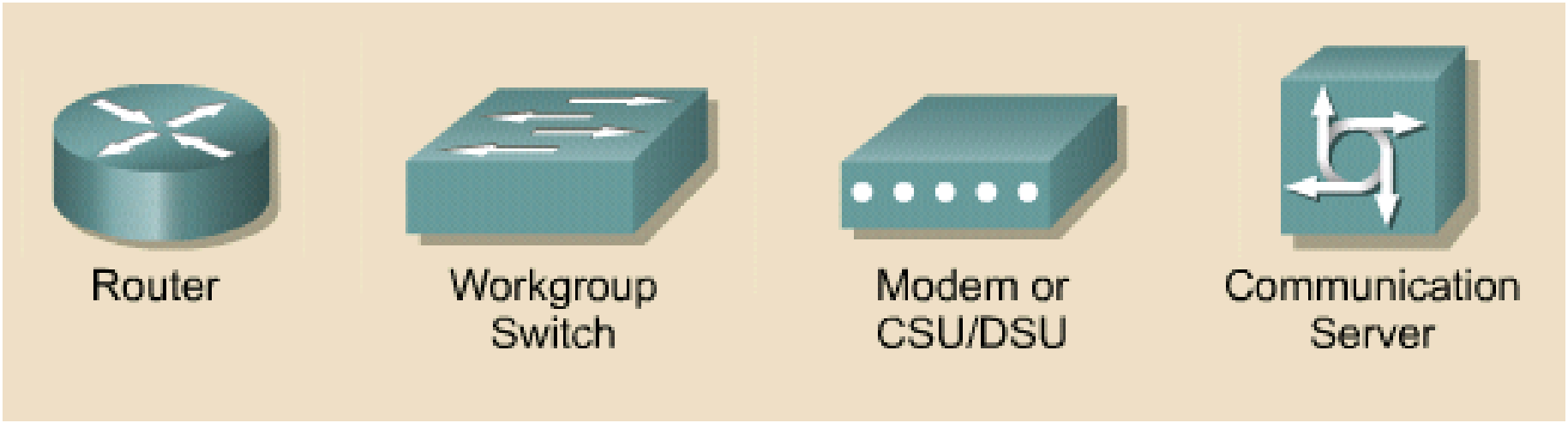
- WANs
- Routers

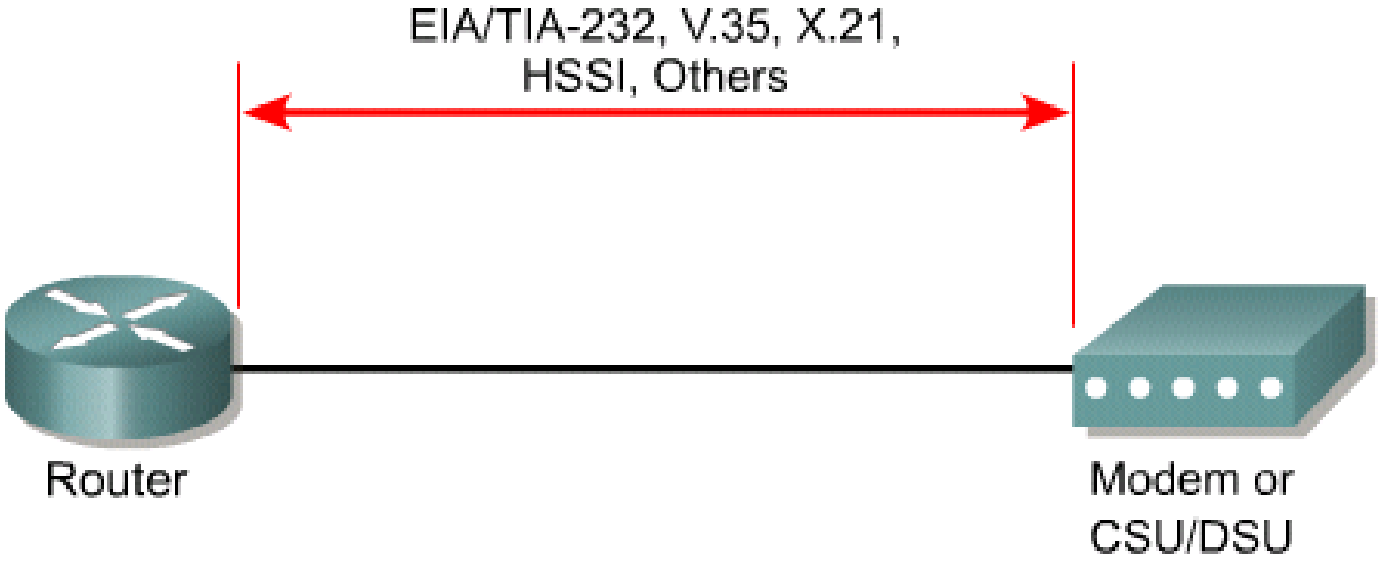
Introduction to WANs

- A wide-area network (WAN) is a data communications network spanning a large geographic area such as a state, province, or country.
- A WAN operates at the physical layer and the data link layer of the OSI reference model.



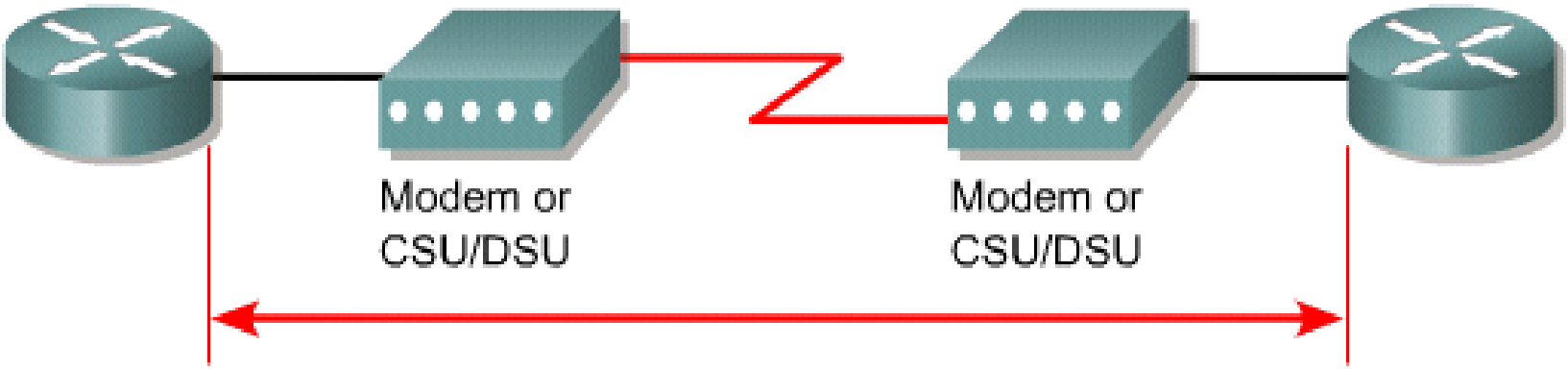
- Devices in WANs:
  - Routers offer many services, including internetworking and WAN interface ports.
  - Switches in the WAN provide connectivity for voice, data, and video communication.
  - Modems include interface voice-grade services, channel service units/digital service units (CSU/DSUs) that interface T1/E1 services, and Terminal Adapters/Network Termination 1 (TA/NT1s) that interface Integrated Services Digital Network (ISDN) services.
  - Communication servers concentrate dial-in and dial-out user communication.


Router
Workgroup Switch
Modem or CSU/DSU
Communication Server



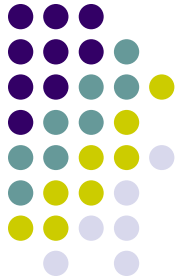
DTE	DCE
Data Terminal Equipment User device with interface connecting to the WAN link	**Data-Circuit Terminating Equipment** End of the WAN provider's side of the communication facility

WAN data link protocols

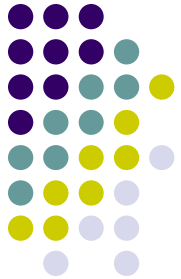


- HDLC – High-Level Data Link Control
- Frame Relay – Successor of X.25
- PPP – Point-to-Point Protocol
- ISDN – Integrated Service Digital Network (data link signal)

Introduction to routers in a WAN



- A router is a special type of computer.
- It has a CPU, memory, a system bus, and various input/output interfaces.
- However, routers are designed to perform some very specific functions that are not typically performed by desktop computers.



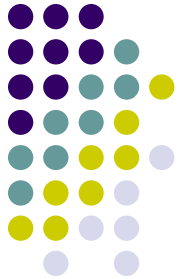
- Just as computers need operating systems to run software applications, routers need the Internetwork Operating System software (IOS) to run configuration files.
- These configuration files contain the instructions and parameters that control the flow of traffic in and out of the routers.

- The main internal components of the router are
  - random access memory (RAM),
  - nonvolatile random-access memory (NVRAM),
  - flash memory,
  - read-only memory (ROM), and
  - interfaces.

RAM

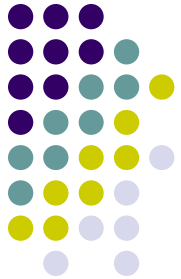
- Stores routing tables
- Holds ARP cache
- Holds fast-switching cache
- Performs packet buffering (shared RAM)
- Maintains packet-hold queues
- Provides temporary memory for the configuration file of the router while the router is powered on
- Loses content when router is powered down or restarted

NVRAM



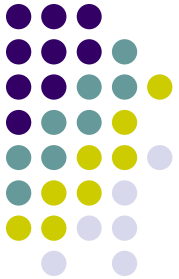
- Provides storage for the startup configuration file
- Retains content when router is powered down or restarted

Flash memory



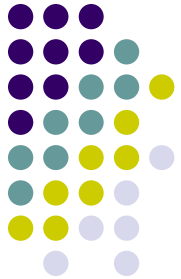
- Holds the operating system image (IOS)
- Allows software to be updated without removing and replacing chips on the processor
- Retains content when router is powered down or restarted
- Can store multiple versions of IOS software
- Is a type of electronically erasable, programmable ROM (EEPROM)

ROM

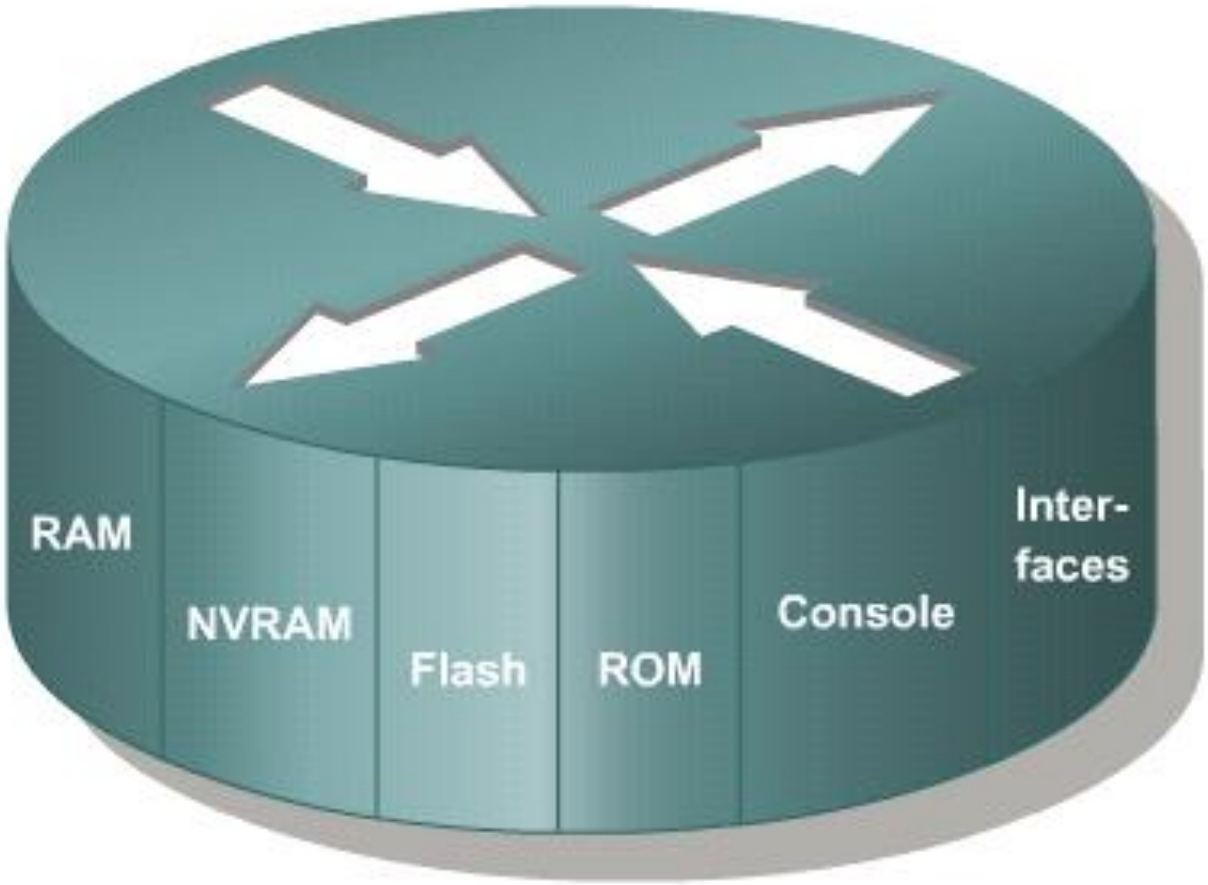


- Maintains instructions for power-on self test (POST) diagnostics
- Stores bootstrap program and basic operating system software
- Requires replacing pluggable chips on the motherboard for software upgrades

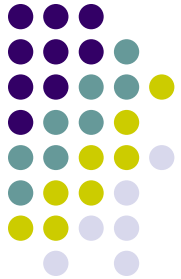
Interfaces



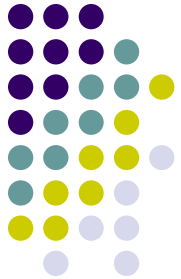
- Connect router to network for frame entry and exit
- Can be on the motherboard or on a separate module


RAM
NVRAM
Flash
ROM
Console
Inter-
faces

Router LANs and WANs

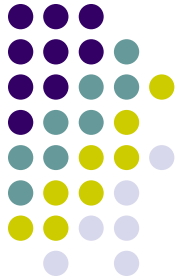


- While a router can be used to segment LANs, its major use is as a WAN device.
- They operate at Layer 3 of the OSI model, making decisions based on network addresses.
- The two main functions of a router are the selection of best path for and the switching of frames to the proper interface.



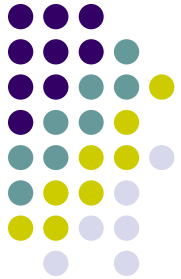
- A correctly configured internetwork provides the following:
  - Consistent end-to-end addressing
  - Addresses that represent network topologies
  - Best path selection
  - Dynamic or static routing
  - Switching

Router role in a WAN

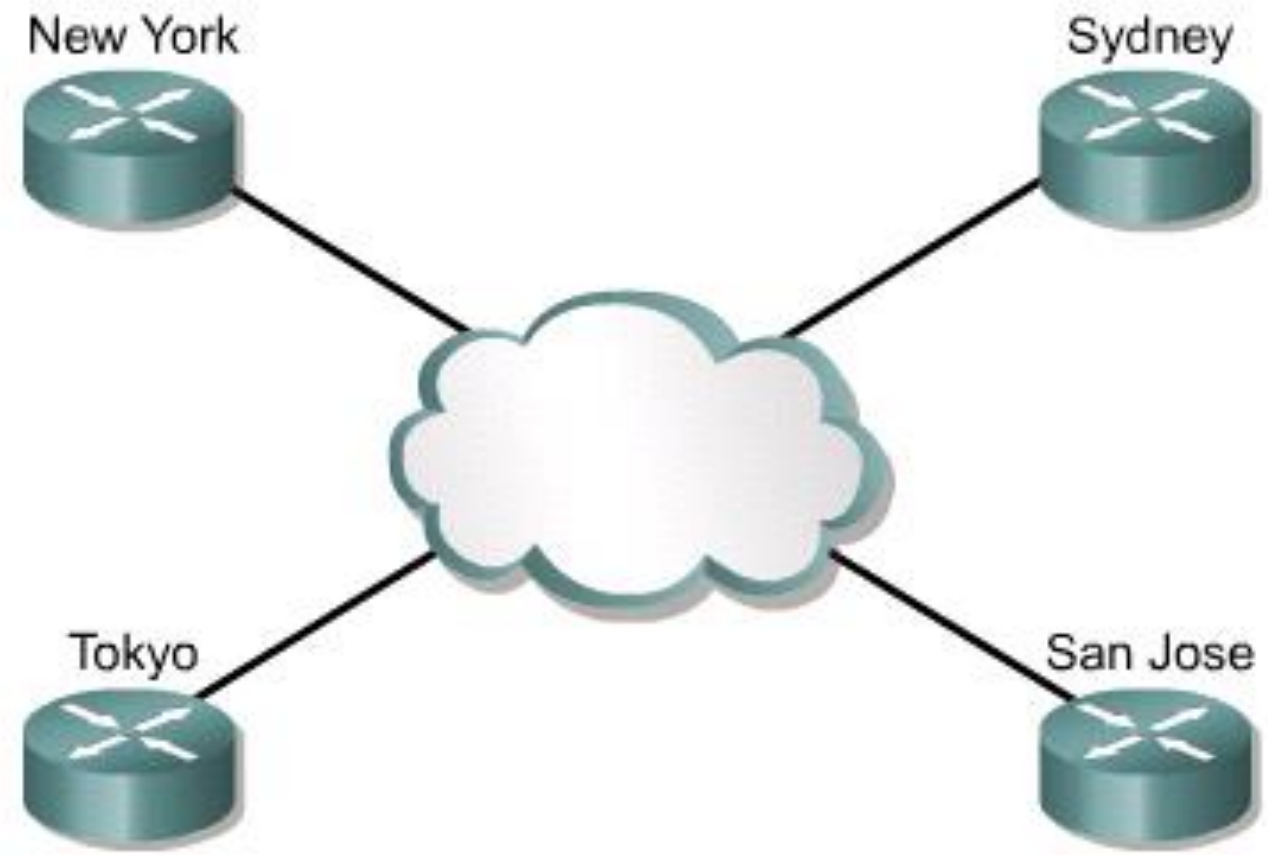


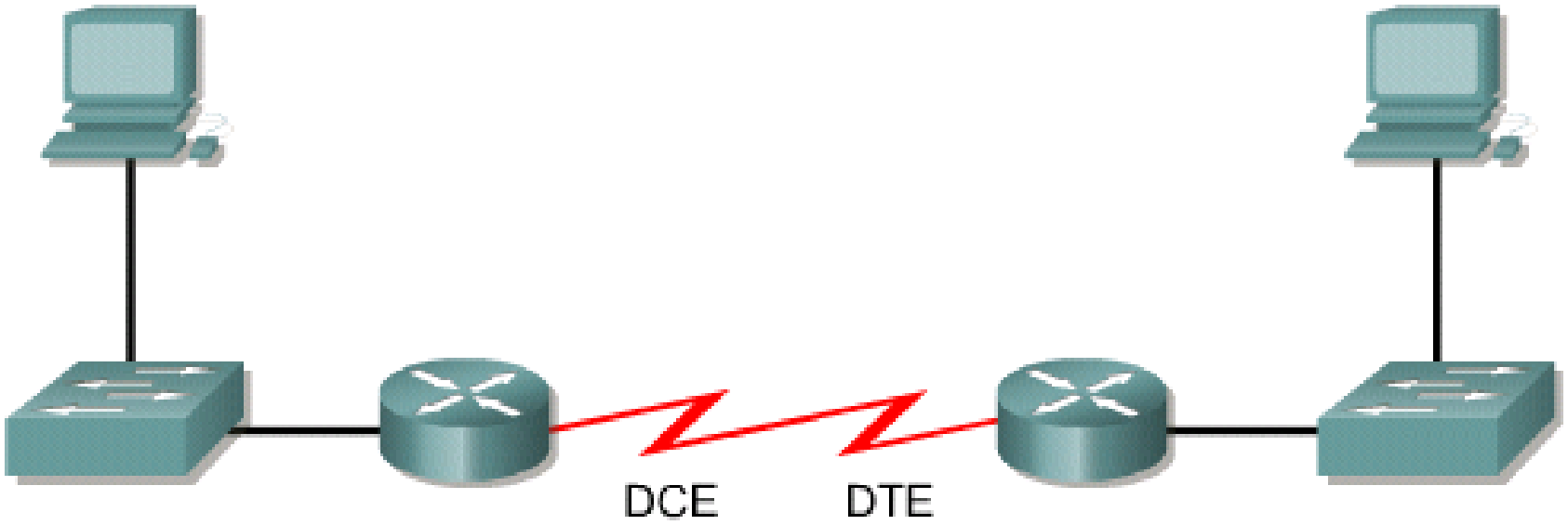
- One of the roles of a router in a WAN is to route packets at Layer 3.
- When a router uses the physical and data link layer standards and protocols that are associated with WANs, it is operating as a WAN device.
- The primary WAN roles of a router are therefore not routing, but providing connections to and between the various WAN physical and data-link standards.

Academy approach to hands-on labs



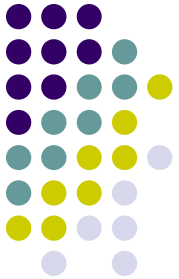
- In the academy lab, devices that make up the WAN cloud are simulated by the connection between the back-to-back DTE-DCE cables.
- The connection from one router interface s0/0 to another router interface s0/1 simulates the whole circuit cloud.


New York
Sydney
Tokyo
San Jose

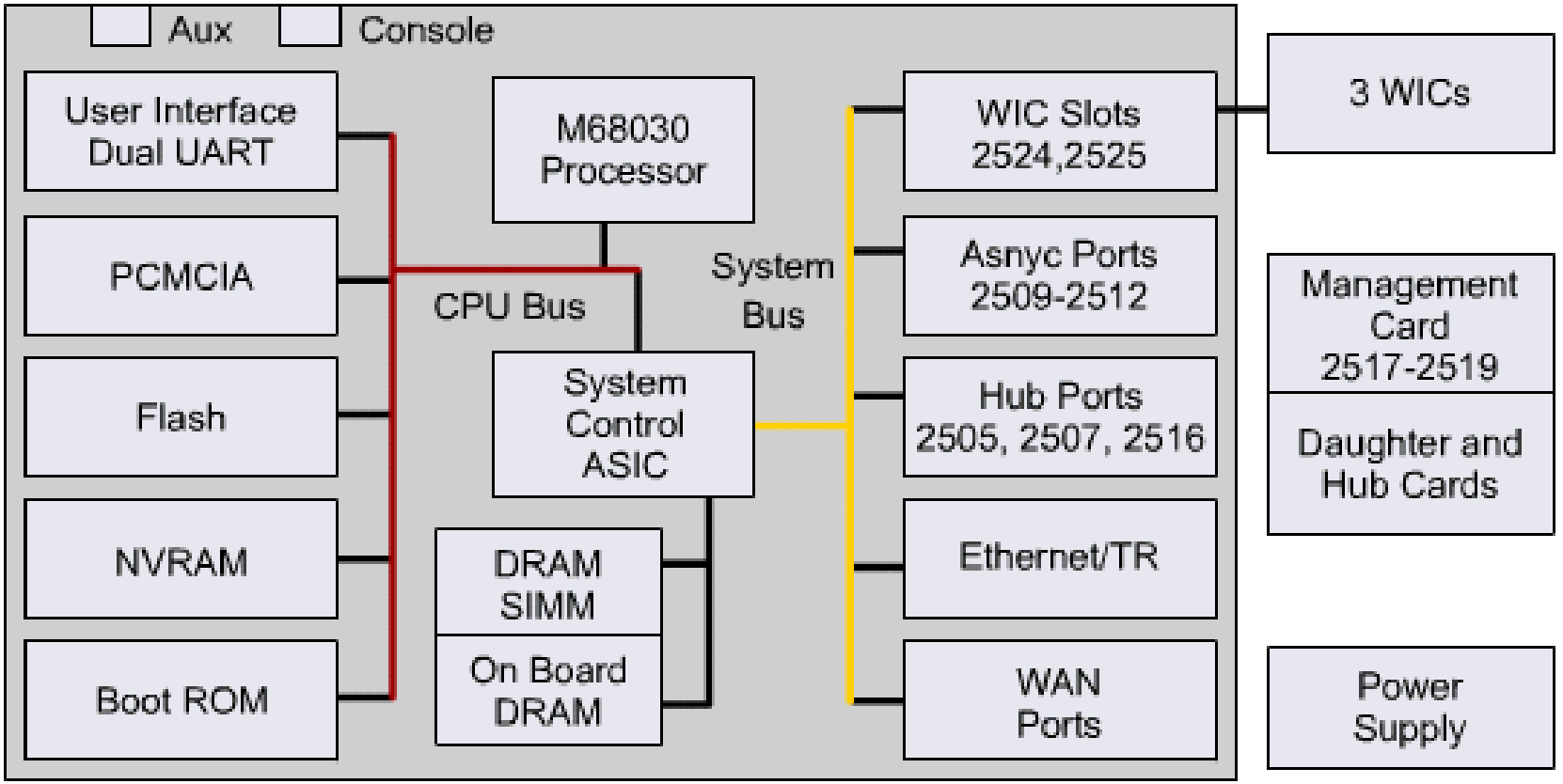

DCE
DTE

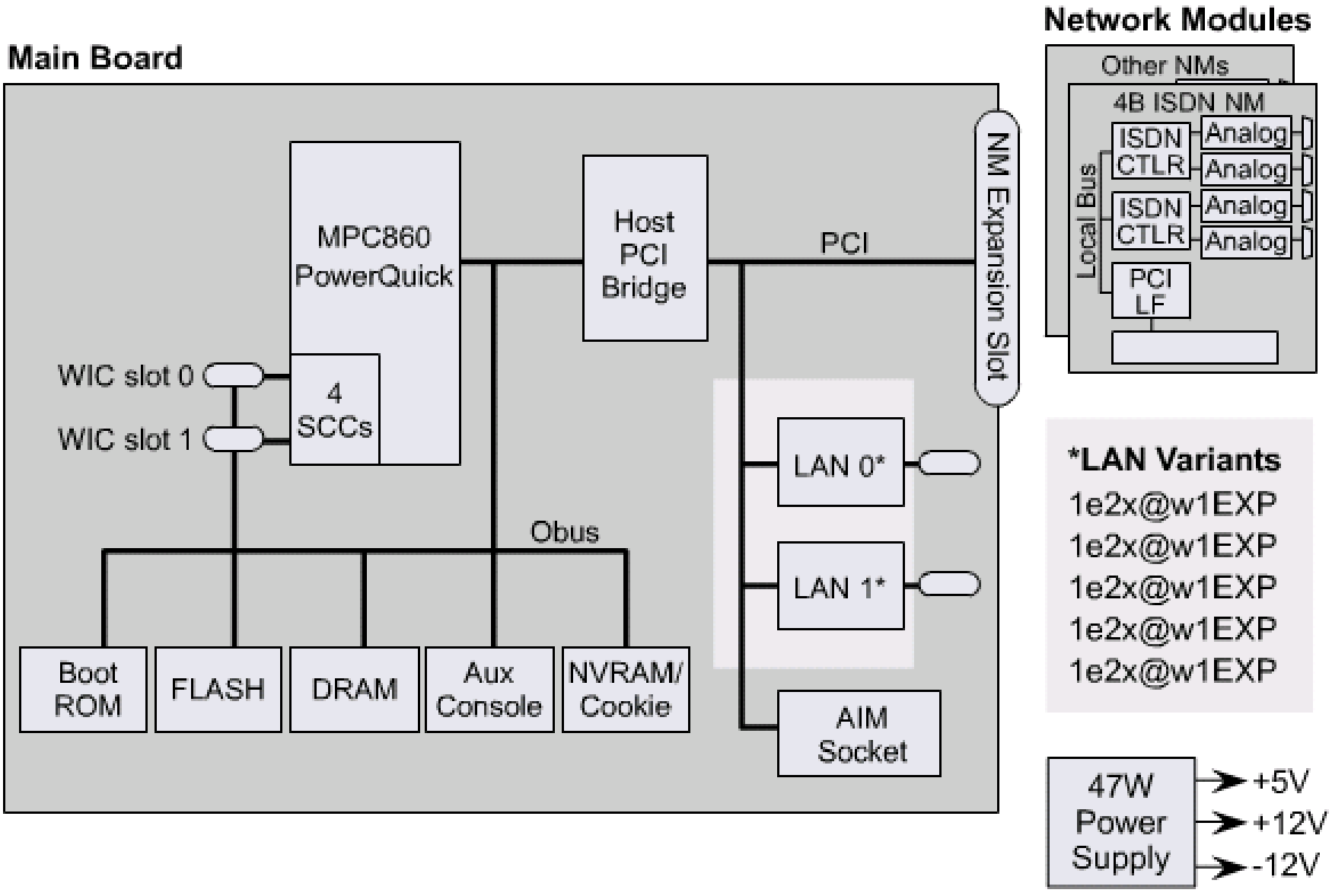
Outline

- **WANs**
- **Routers**

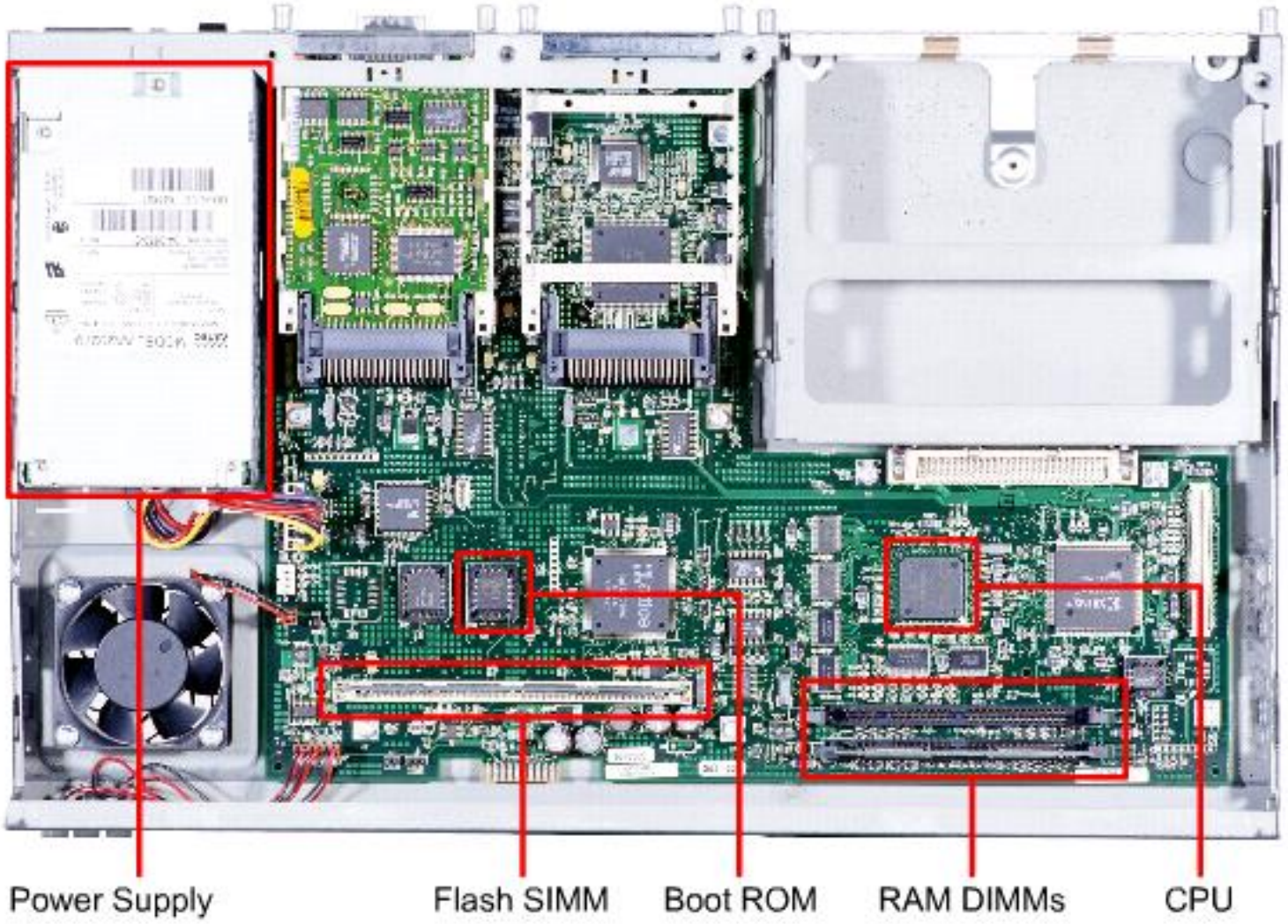


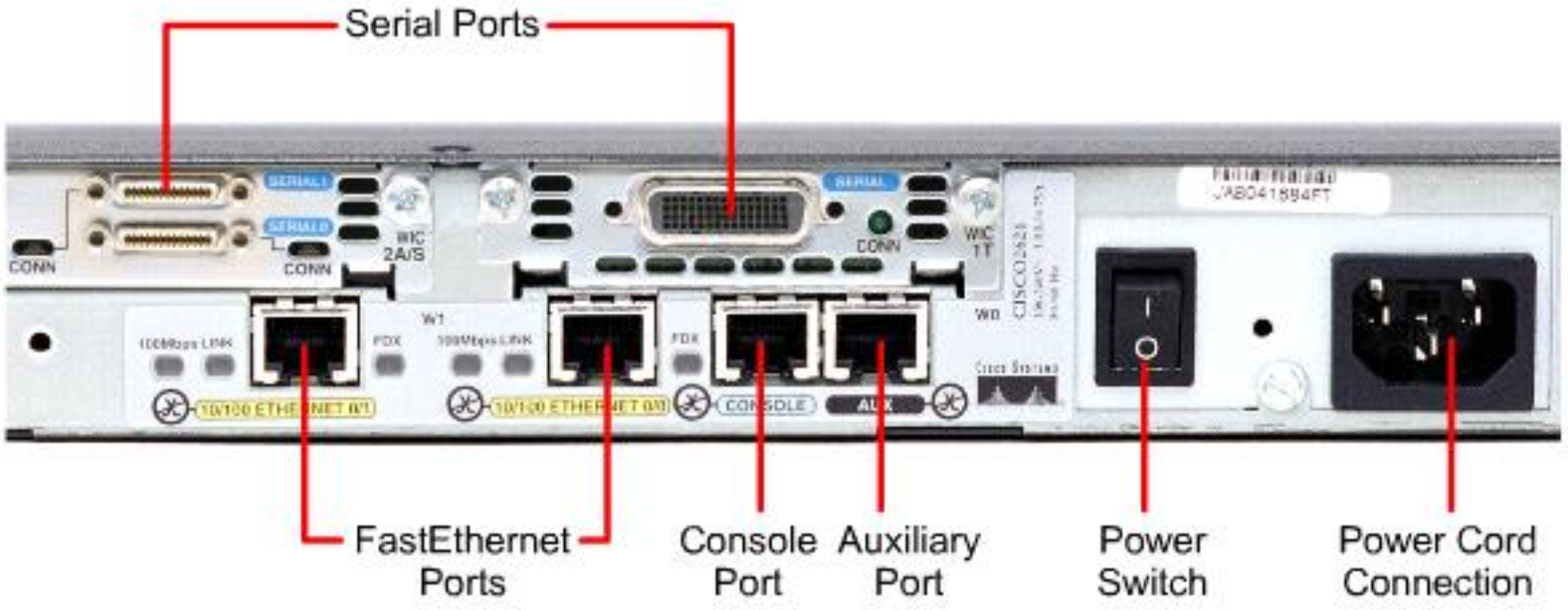
Router internal components



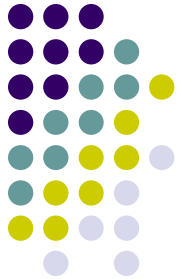

Main Board
MPC860
PowerQuick
4
SCCs
WIC slot 0
WIC slot 1
Host
PCI
Bridge
PCI
NM Expansion Slot
Obus
Boot
ROM
FLASH
DRAM
Aux
Console
NVRAM/
Cookie
LAN 0*
LAN 1*
AIM
Socket
Network Modules
Other NMs
4B ISDN NM
ISDN
CTLR
ISDN
CTLR
Analog
Analog
Analog
Analog
Local Bus
PCI
LF
*LAN Variants
1e2x@w1EXP
1e2x@w1EXP
1e2x@w1EXP
1e2x@w1EXP
1e2x@w1EXP
47W
Power
Supply
+5V
+12V
-12V

Router physical characteristics

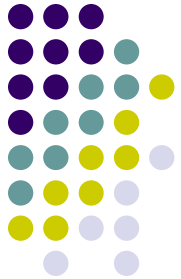



Serial Ports
FastEthernet Ports
Console Port
Auxiliary Port
Power Switch
Power Cord Connection

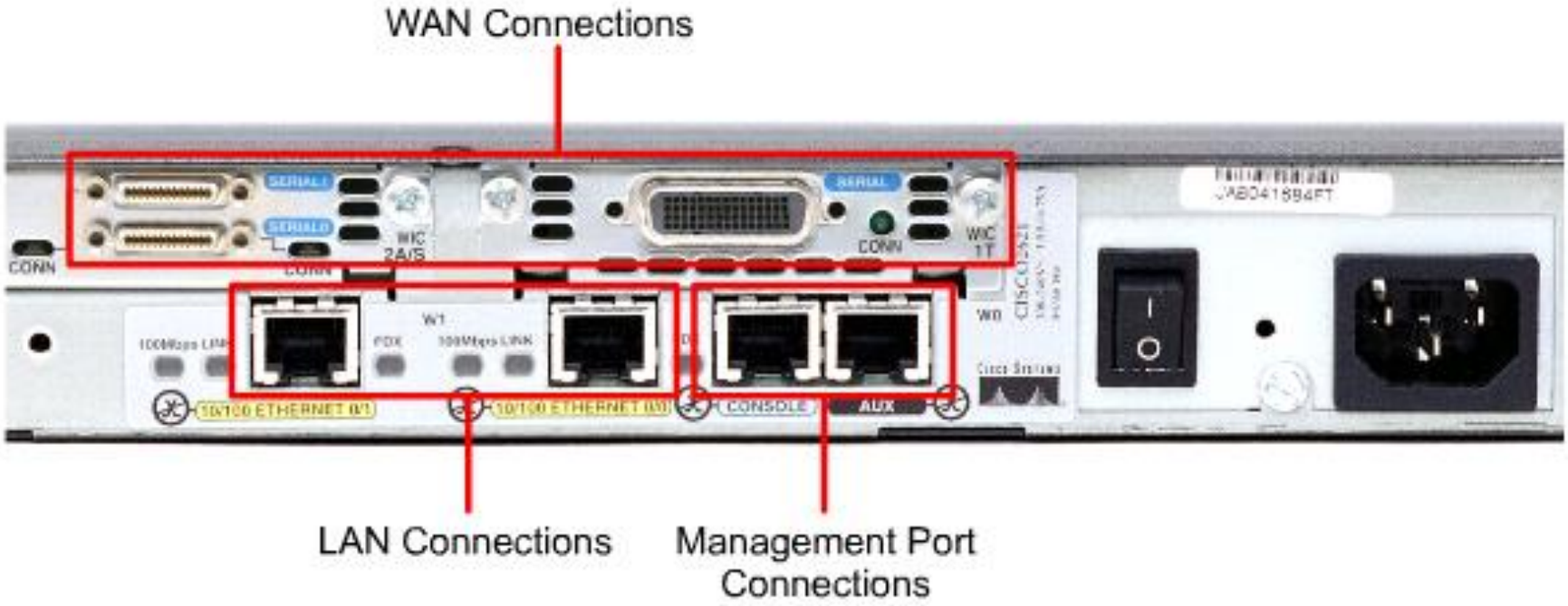
Router external connections



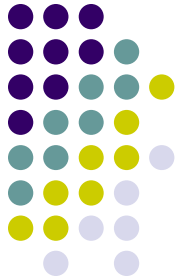
- The three basic types of connections on a router are
  - LAN interfaces,
  - WAN interfaces,
  - management ports.
- LAN interfaces allow the router to connect to the Local Area Network media.



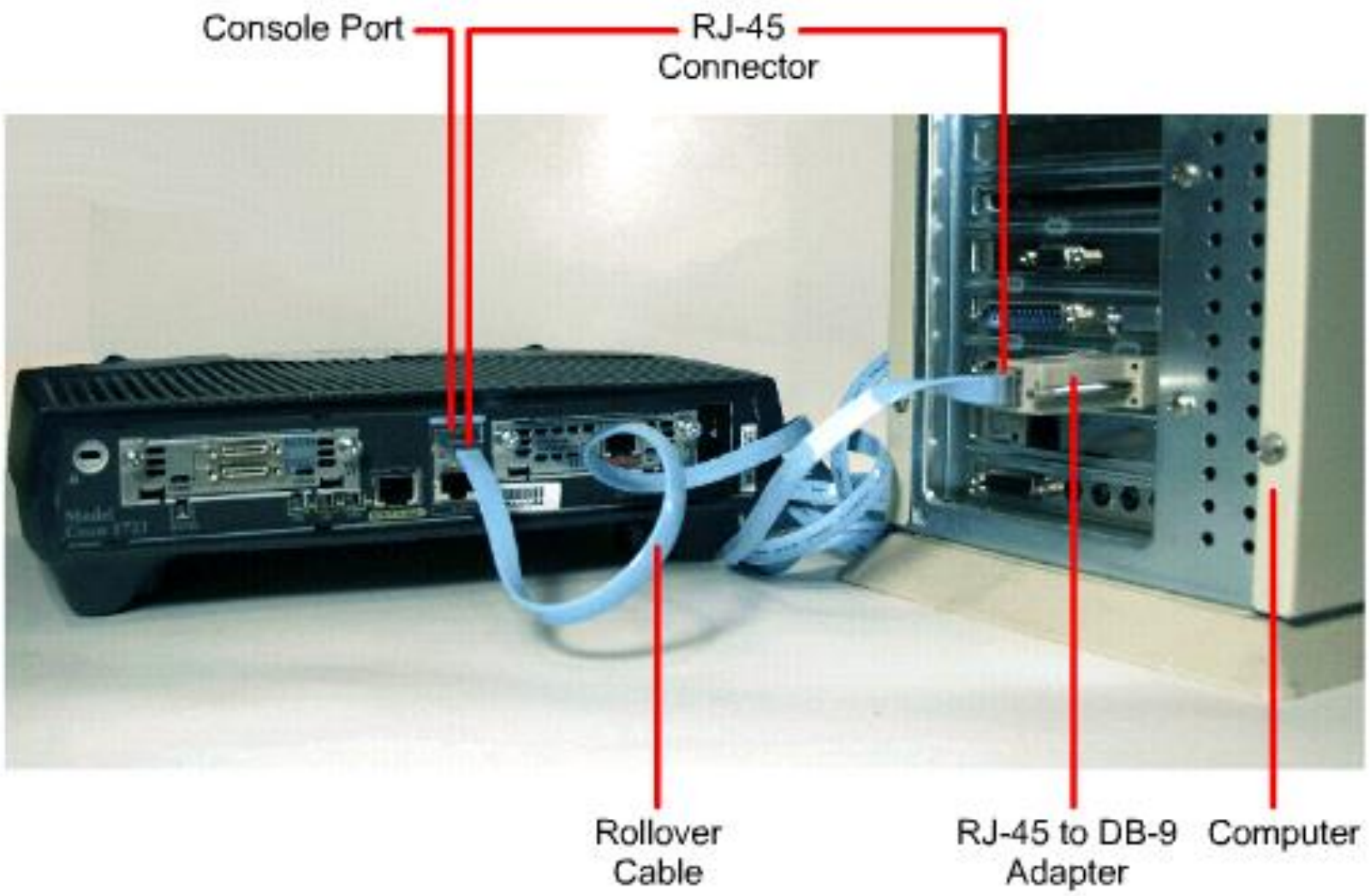
- Wide Area Network connections provide connections through a service provider to a distant site or to the Internet.
- The management port provides a text-based connection for the configuration and troubleshooting of the router.
- The common management interfaces are the console and auxilliary ports.

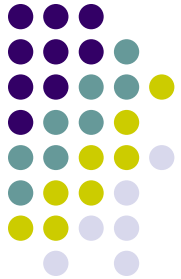

WAN Connections
LAN Connections
Management Port Connections
CONSOLE
AUX

Management port connections

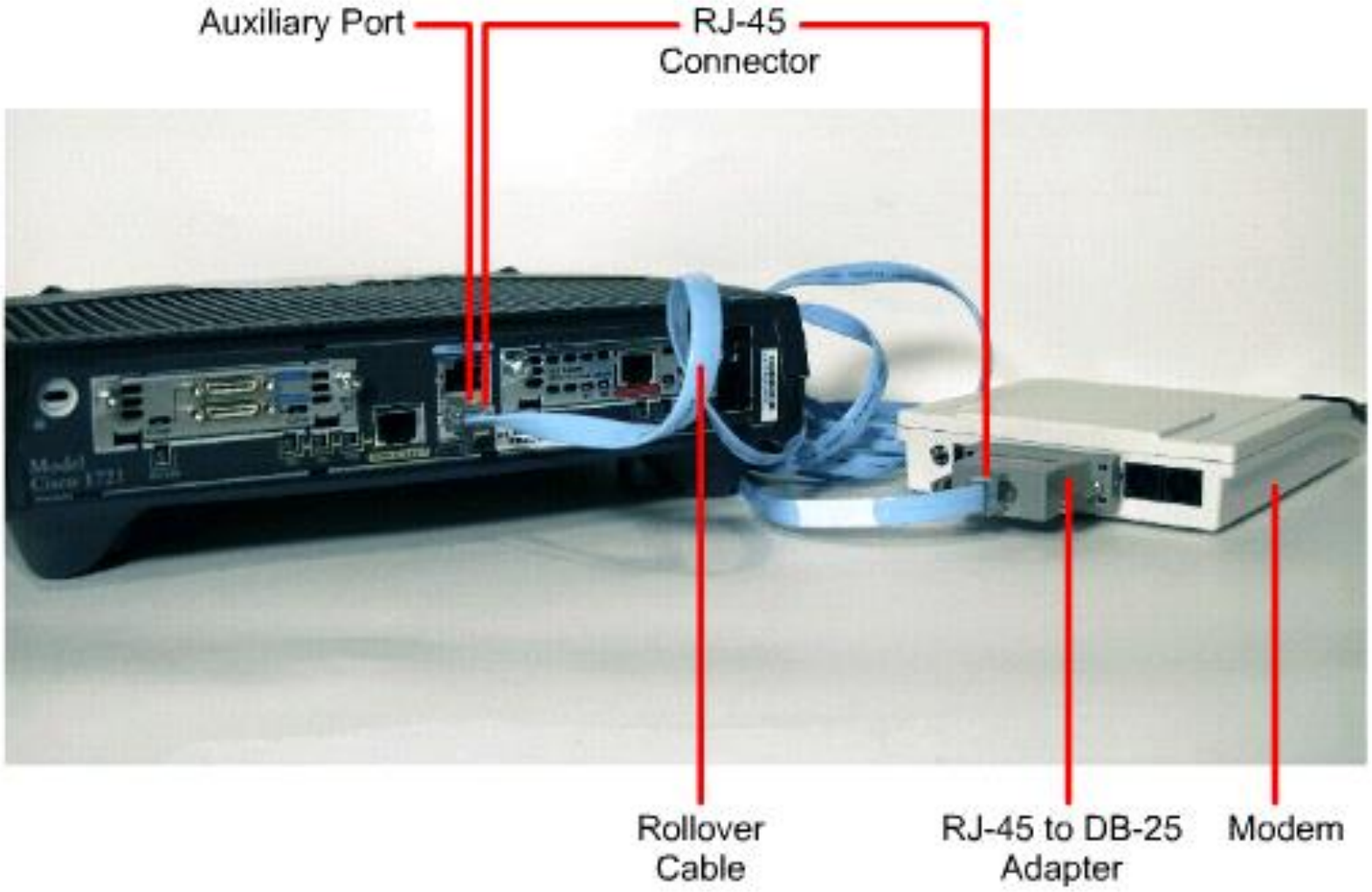


- When the router is first put into service, there are no networking parameters configured.
- To prepare for initial startup and configuration, attach an RS-232 ASCII terminal, or a computer emulating an ASCII terminal, to the system console port.
- Then configuration commands can be entered to set up the router.

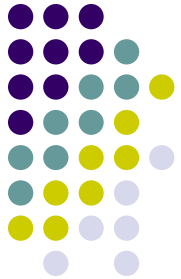

Console Port
RJ-45
Connector
Rollover
Cable
RJ-45 to DB-9
Adapter
Computer



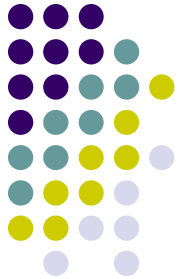
- The router can also be configured from a remote location by dialing to a modem connected to the console or auxiliary port on the router.


Auxiliary Port
RJ-45
Connector
Rollover
Cable
RJ-45 to DB-25
Adapter
Modem

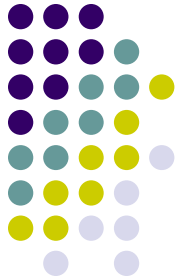
Connecting console interfaces



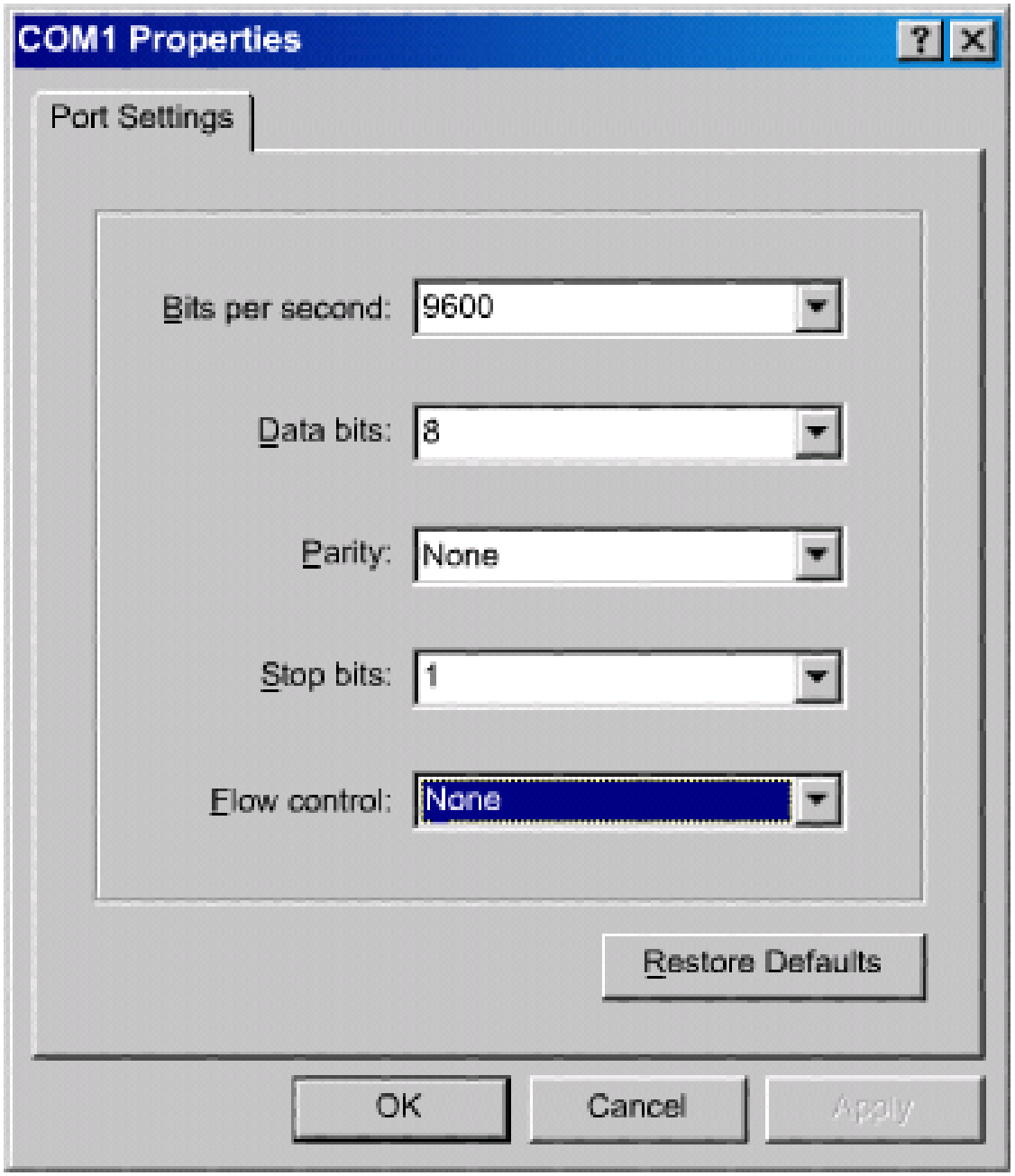
- The console port is a management port used to provide out-of-band access to the router.
- It is used for the initial configuration of the router, monitoring, and disaster recovery procedures.
- To connect to the console port, a rollover cable and a RJ-45 to DB-9 adapter are used to connect a PC.



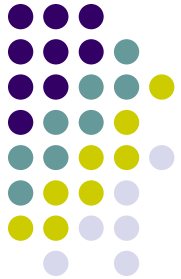
- The PC or terminal must support VT100 terminal emulation.
- Terminal emulation software such as HyperTerminal is usually used.



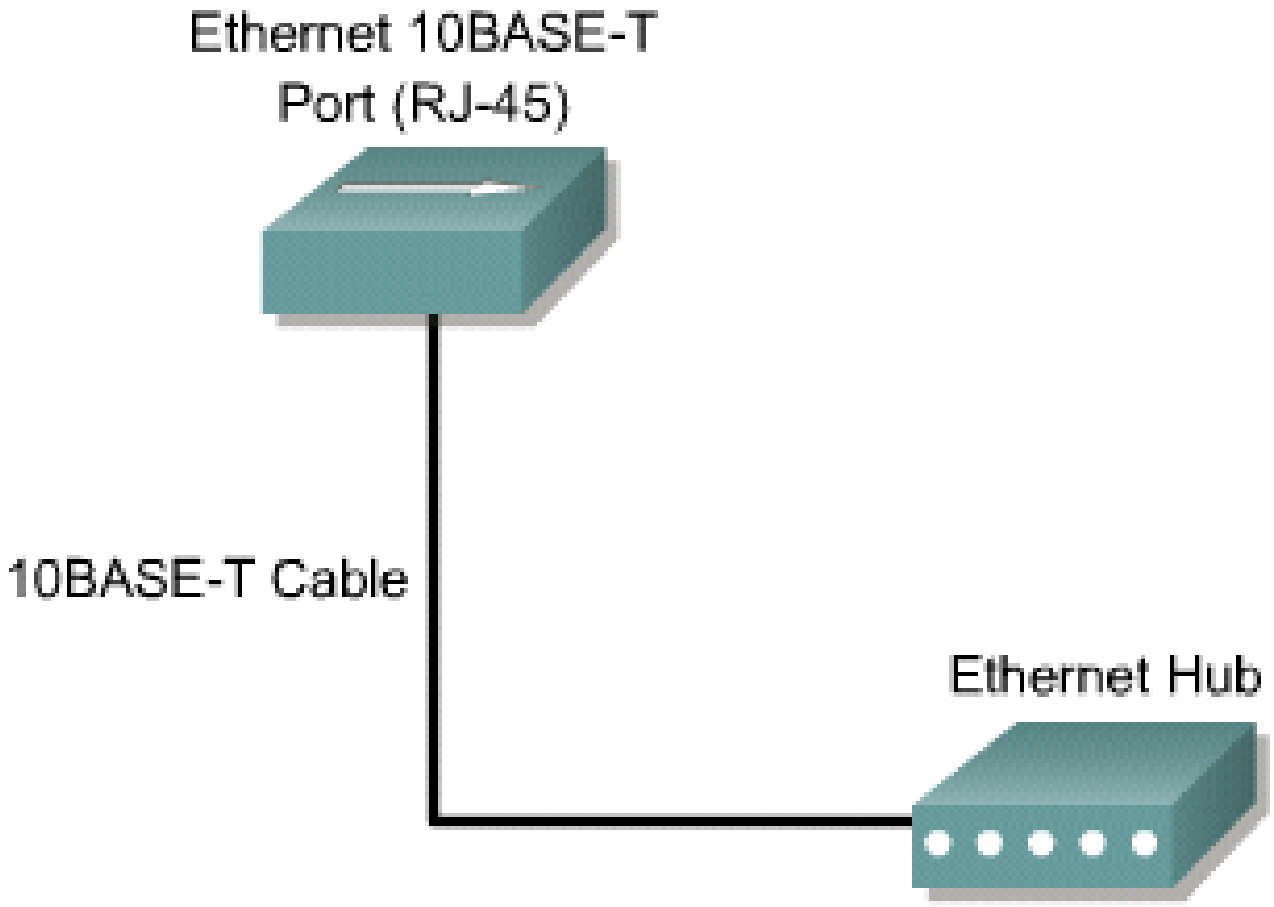
- Configure terminal emulation software on the PC for:
  - The appropriate com port
  - 9600 baud
  - 8 data bits
  - No parity
  - 1 stop bit
  - No flow control
- Connect the RJ-45 connector of the rollover cable to the router console port.
- Connect the other end of the rollover cable to the RJ-45 to DB-9 adapter.
- Attach the female DB-9 adapter to a PC.


COM1 Properties
Port Settings
Bits per second:
9600
Data bits:
8
Parity:
None
Stop bits:
1
Flow control:
None
Restore Defaults
OK
Cancel
Apply

Connection LAN interfaces

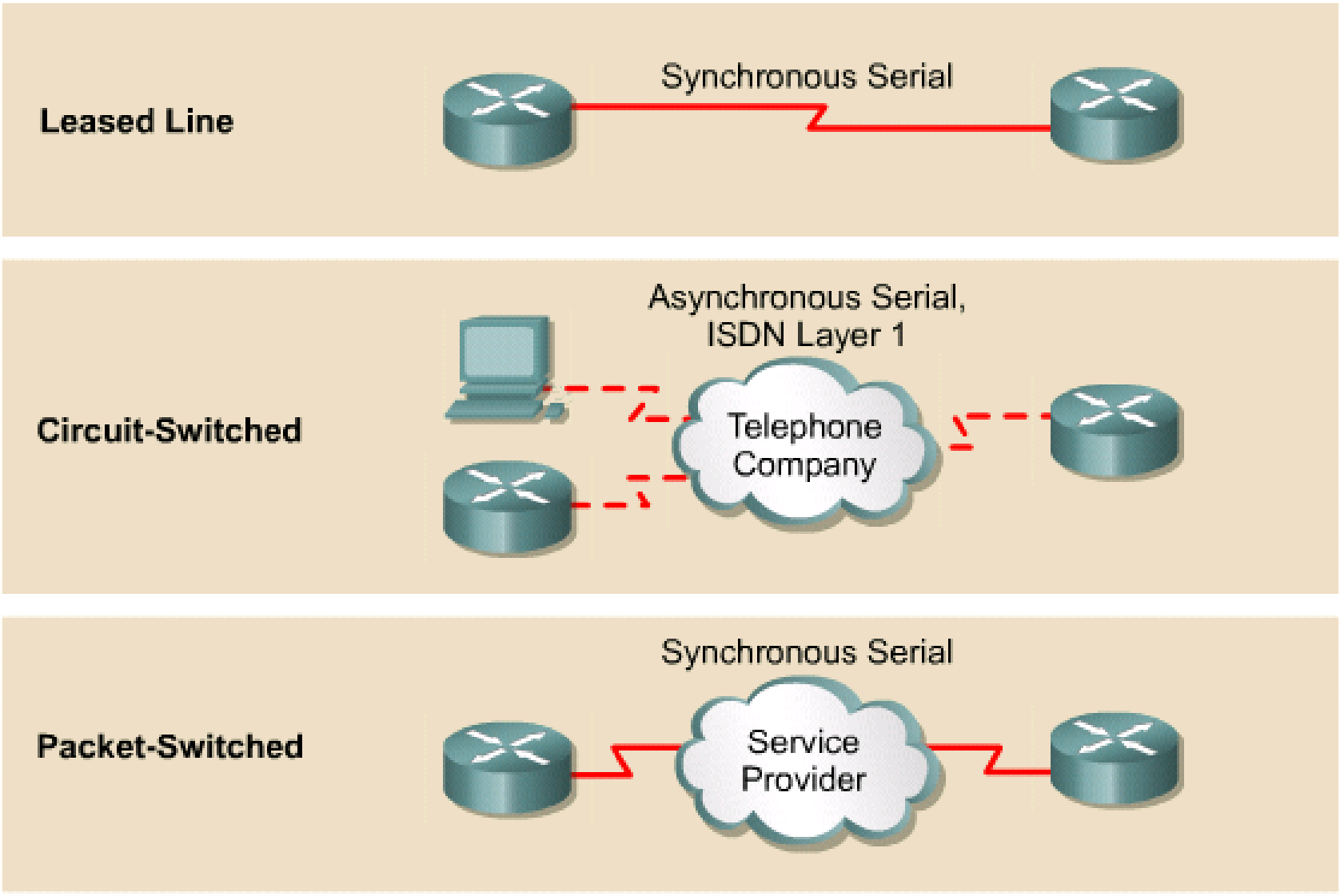


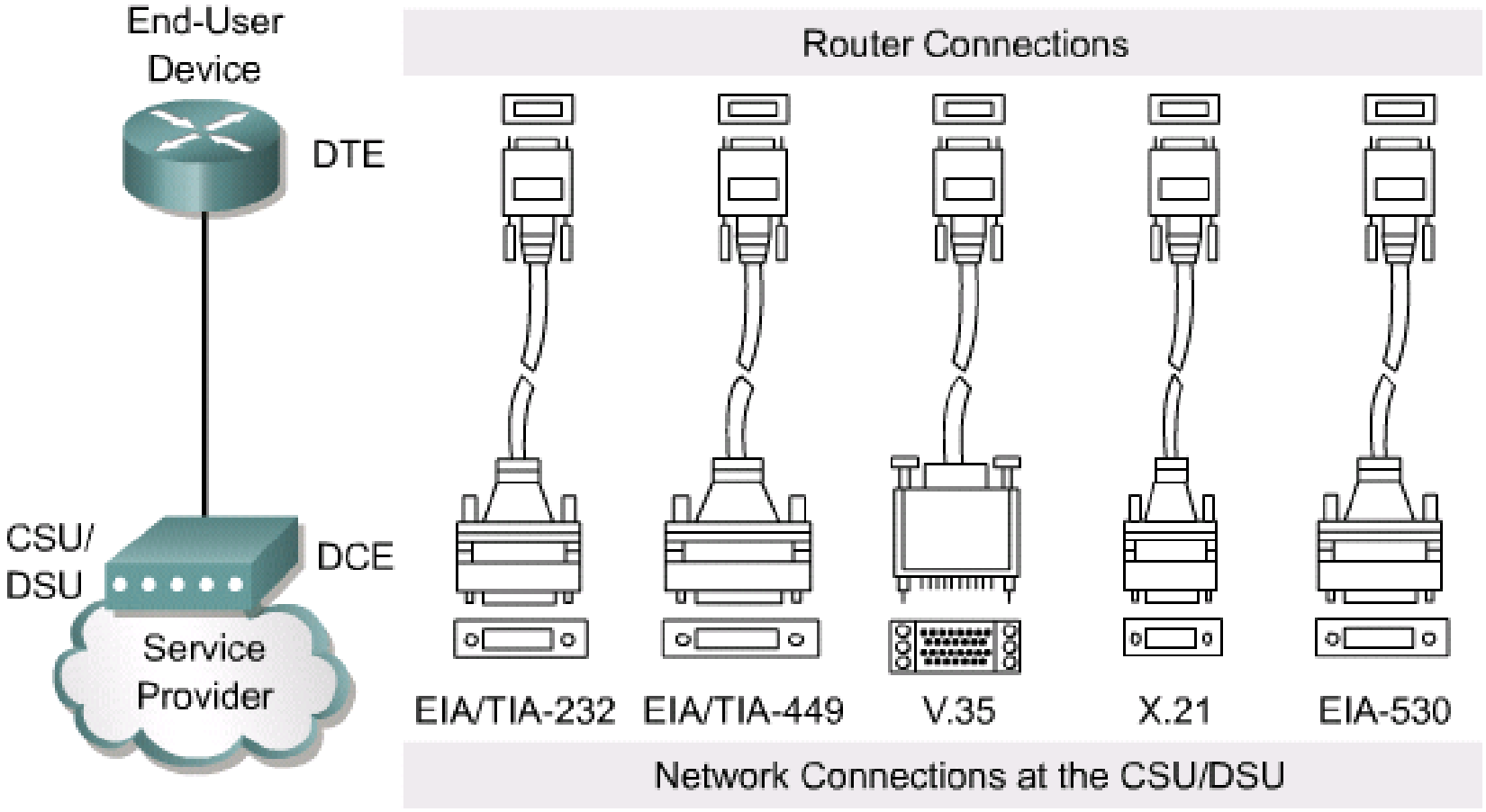
- A straight-through cable is used to make the connection.
- A 10/100BaseTX router interface requires Category 5 or better, unshielded twisted-pair (UTP) regardless of the router type.


Ethernet 10BASE-T
Port (RJ-45)
10BASE-T Cable
Ethernet Hub

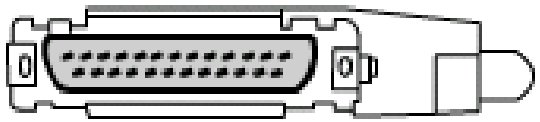
Connecting WAN interfaces

- WAN connection types
  - leased line,
  - circuit-switched,
  - packet-switched

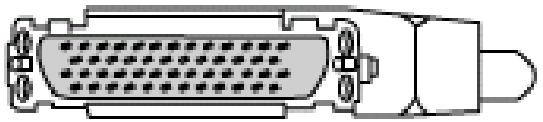

Leased Line
Synchronous Serial
Circuit-Switched
Asynchronous Serial,
ISDN Layer 1
Telephone
Company
Packet-Switched
Synchronous Serial
Service
Provider


End-User
Device
DTE
CSU/
DSU
DCE
Service
Provider
Router Connections
EIA/TIA-232
EIA/TIA-449
V.35
X.21
EIA-530
Network Connections at the CSU/DSU

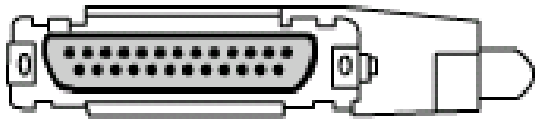
EIA/TIA-232 Male



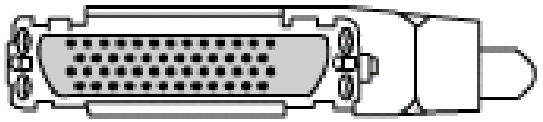
v.35 Male



EIA/TIA-232 Female

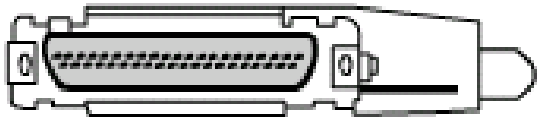


v.35 Female



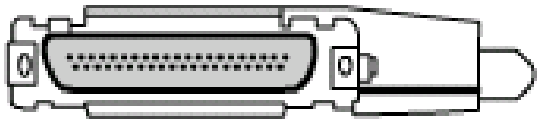
X.21 Male

EIA/TIA - 449 Male

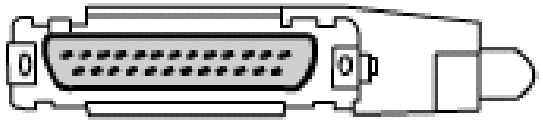
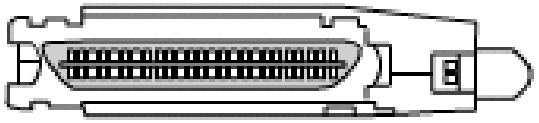


X.21 Female

EIA/TIA - 449 Female



EIA-530 Male



EIA-613 HSSI Male