# LAN Technology

## Other Protocols

***Arash Habibi Lashkari***
***PHD of Computer Science - Information Security***
***July 2010***

# *Other Protocols*

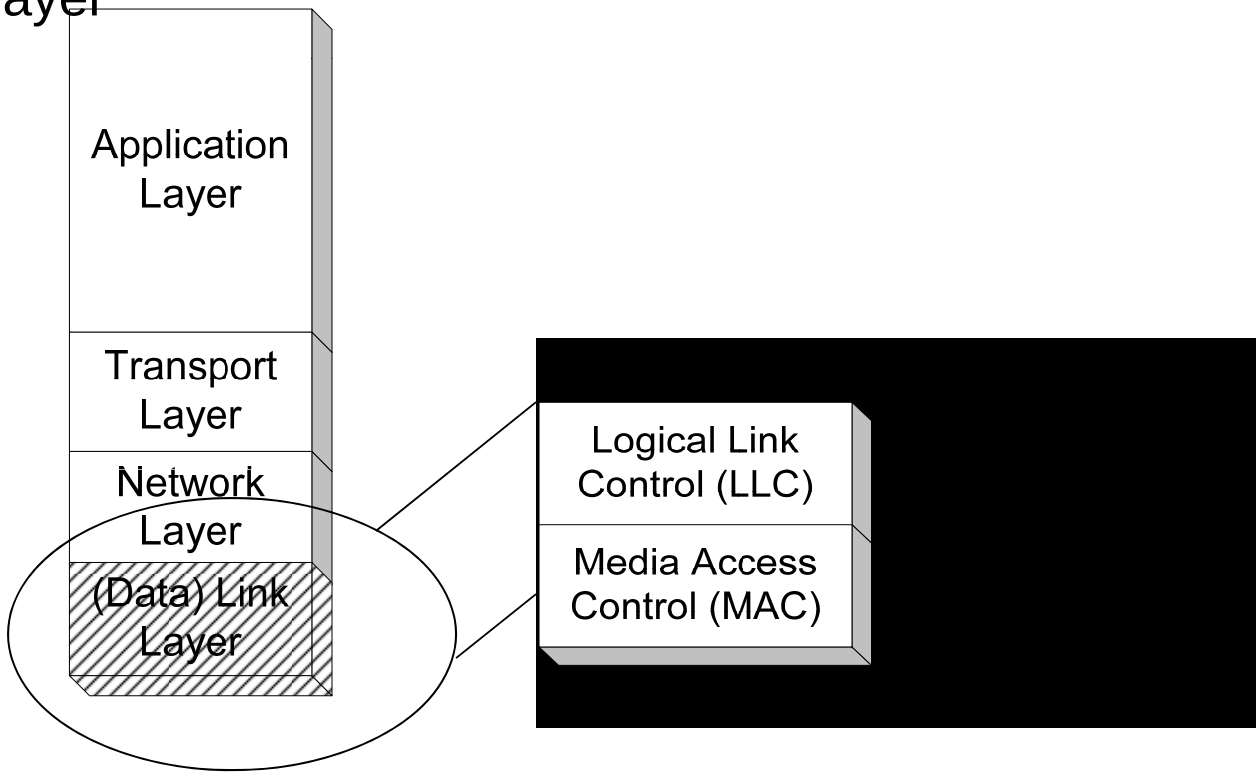
Outlines:

- FDDI: Fiber Distributed Data Interface
- Token Ring: IEEE 802.5 LAN Protocol
- LLC: Logic Link Control (IEEE 802.2)
- SNAP: Sub-Network Access Protocol
- STP: Spanning Tree Protocol (IEEE 802.1D)

# *TCP/IP Suite and OSI Reference Model*

The TCP/IP protocol stack does not define the lower layers of a complete protocol stack

In this lecture, we will address how the TCP/IP protocol stacks interfaces with the data link layer



# *Data Link Layer*

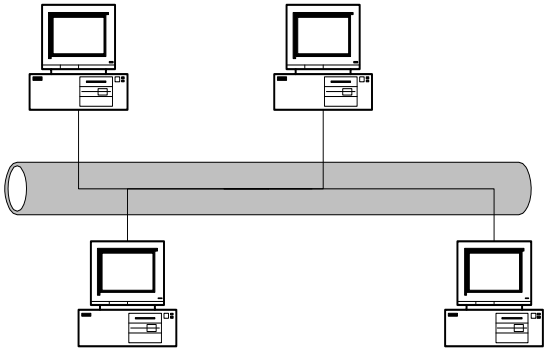
The main tasks of the data link layer are:

- Transfer data from the network layer of one machine to the network layer of another machine
- Convert the raw bit stream of the physical layer into groups of bits ("frames")

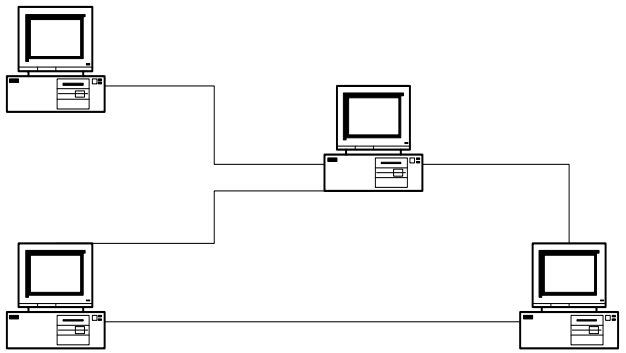
# *Two types of networks at the data link layer*

Broadcast Networks: All stations share a single communication channel

Point-to-Point Networks: Pairs of hosts (or routers) are directly connected



Broadcast Network



Point-to-Point Network

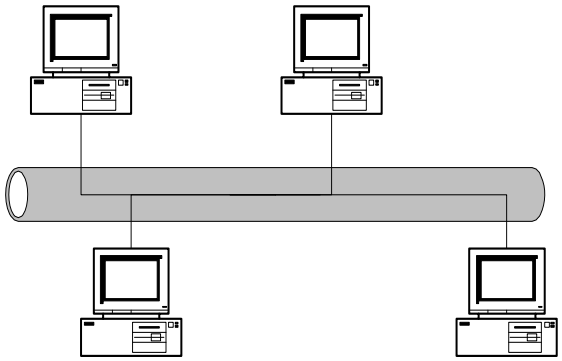
Typically, local area networks (LANs) are broadcast and wide area networks (WANs) are point-to-point

# *Local Area Networks*

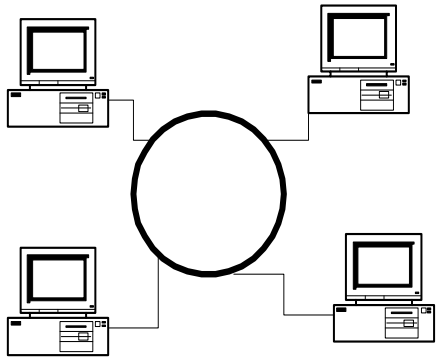
Local area networks (LANs) connect computers within a building or a enterprise network

Almost all LANs are broadcast networks

Typical topologies of LANs are **bus** or **ring** or **star**



Bus LAN



Ring LAN

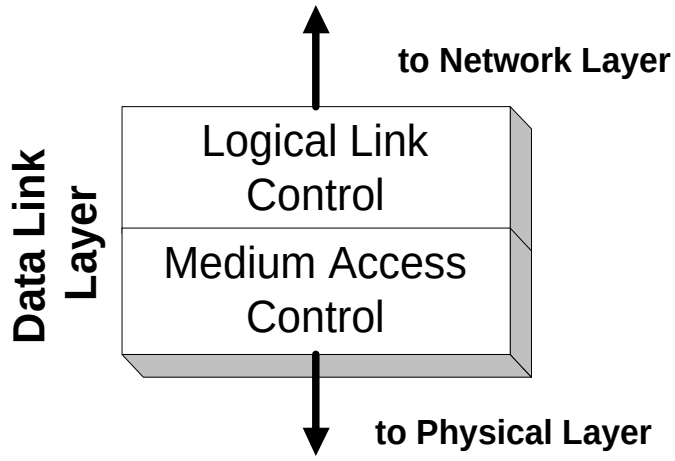
# *MAC and LLC*

In any broadcast network, the stations must ensure that only one station transmits at a time on the shared communication channel

The protocol that determines who can transmit on a broadcast channel are called Medium Access Control (MAC) protocol

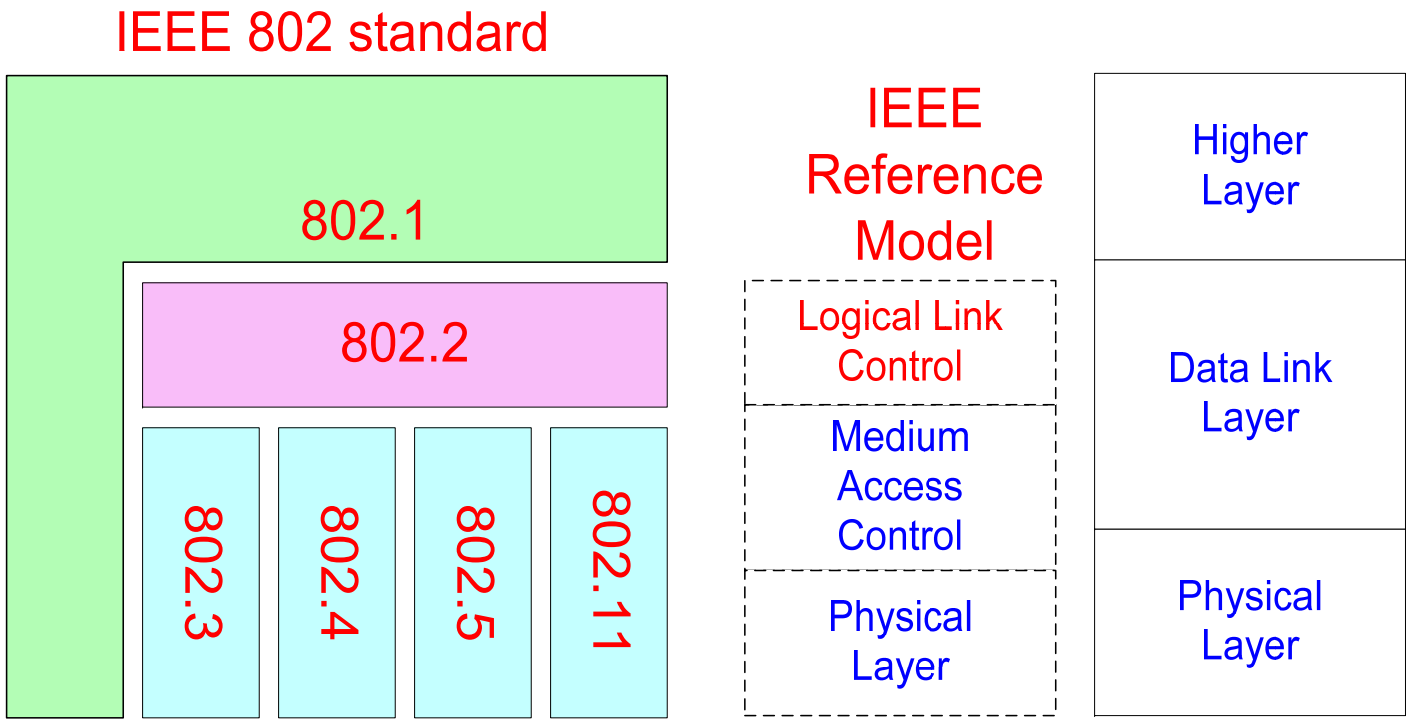
The MAC protocol are implemented in the MAC sub layer which is the lower sub layer of the data link layer

The higher portion of the data link layer is often called Logical Link Control (LLC)



# *IEEE 802 Standards*

IEEE 802 is a family of standards for LANs, which defines an LLC and several MAC sublayers



# *Ethernet*

Speed: 10Mbps -10 Gbps

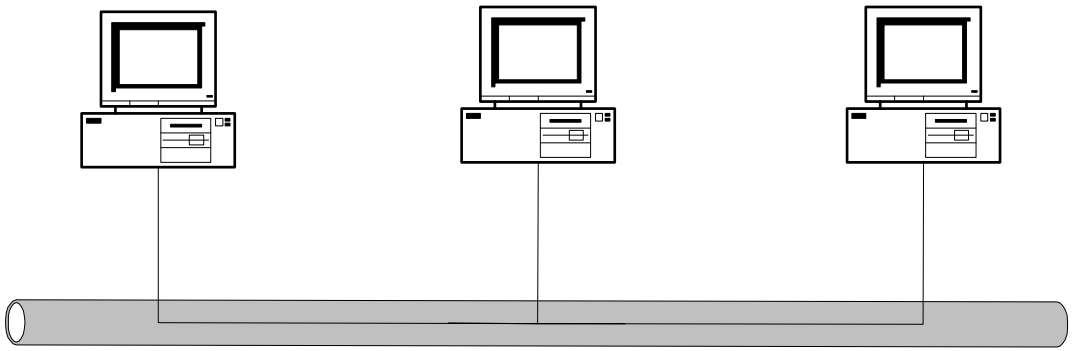
Standard: 802.3, Ethernet II (DIX)

Most popular physical layers for Ethernet:

| | |
|---|---|
| 10Base5 | **Thick Ethernet:** 10 Mbps coax cable |
| 10Base2 | **Thin Ethernet:** 10 Mbps coax cable |
| 10Base-T | 10 Mbps Twisted Pair |
| 100Base-TX | 100 Mbps over Category 5 twisted pair |
| 100Base-FX | 100 Mbps over Fiber Optics |
| 1000Base-FX | 1Gbps over Fiber Optics |
| 10000Base-FX | 1Gbps over Fiber Optics (for wide area links) |

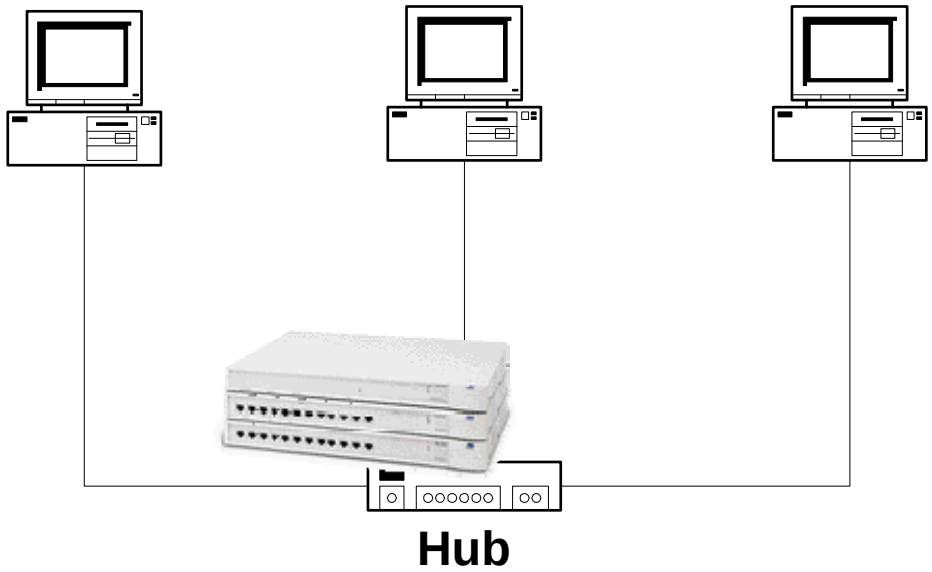
# *Bus Topology*

10Base5 and 10Base2 Ethernets has a bus topology



# *Star Topology*

Starting with 10Base-T, stations are connected to a hub in a star configuration



# *Ethernet Hubs vs. Ethernet Switches*

An **Ethernet switch** is a packet switch for Ethernet frames

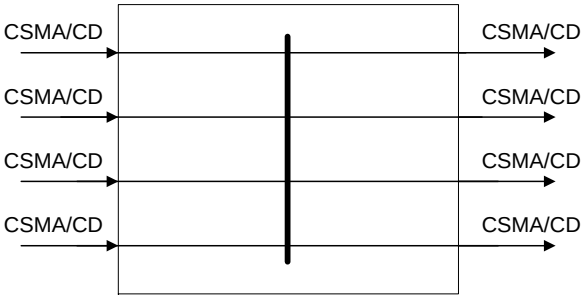
Buffering of frames prevents collisions.

Each port is isolated and builds its own collision domain

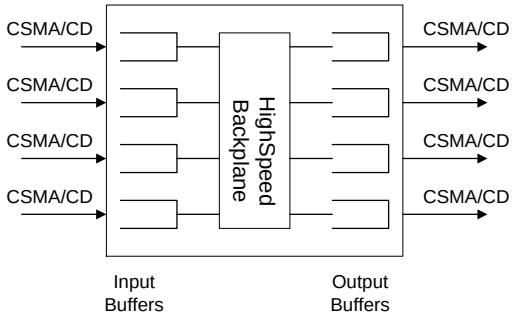
An **Ethernet Hub** does not perform buffering:

Collisions occur if two frames arrive at the same time.

**Hub**




**Switch**




# *Ethernet and IEEE 802.3: Any Difference?*

There are two types of Ethernet frames in use, with subtle differences:

***"Ethernet" (Ethernet II, DIX)***

An industry standards from 1982 that is based on the first implementation of CSMA/CD by Xerox.

Predominant version of CSMA/CD in the US.

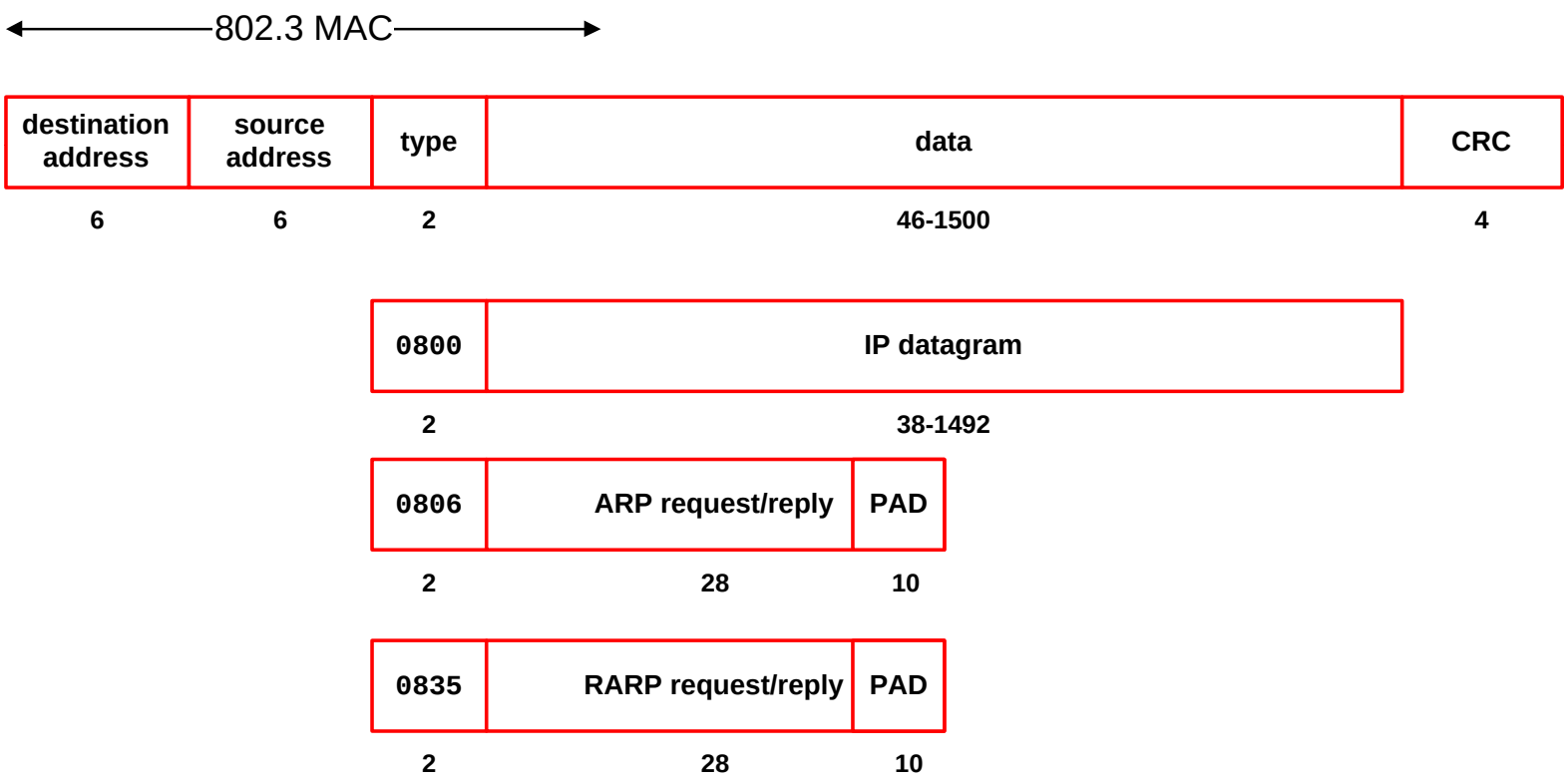
**802.3:**

IEEE's version of CSMA/CD from 1985.

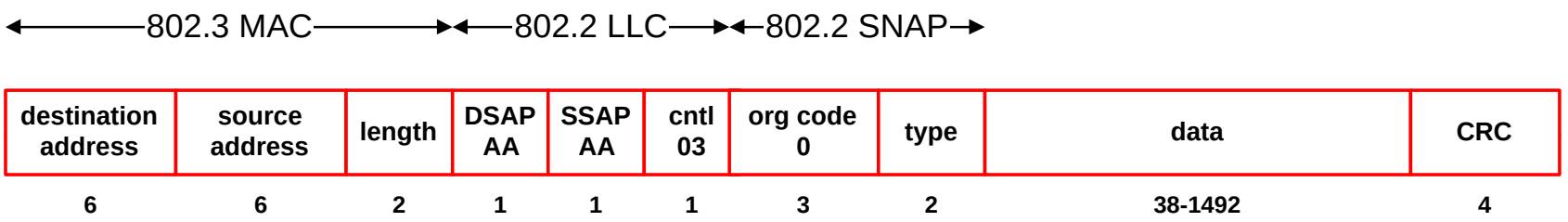
Interoperates with 802.2 (LLC) as higher layer.

**Difference for our purposes:** Ethernet and 802.3 use different methods to encapsulate an IP datagram.

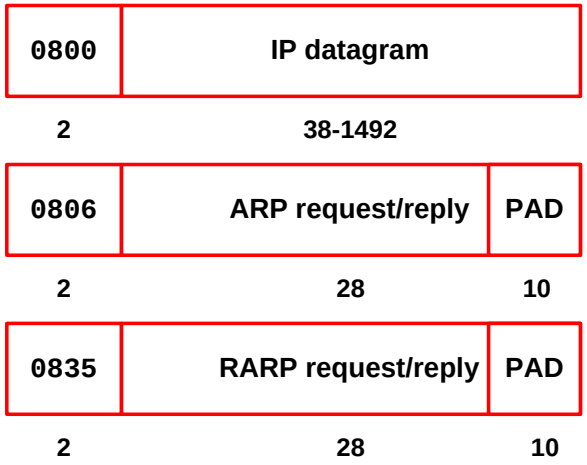
# *Ethernet II, DIX Encapsulation (RFC 894)*



# *IEEE 802.2/802.3 Encapsulation (RFC 1042)*



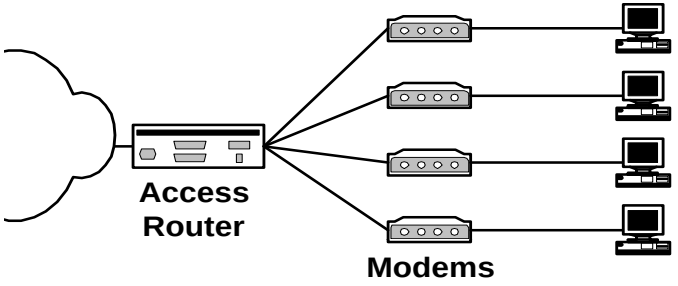

- **destination address, source address:**
  MAC addresses are 48 bit
- **length**: frame length in number of bytes
- **DSAP, SSAP**: always set to `0xaa`
- **Ctrl:** set to 3
- **org code:** set to 0
- **type field** identifies the content of the data field
- **CRC:** cylic redundancy check



# *Point-to-Point (serial) links*

Many data link connections are point-to-point serial links:

- Dial-in or DSL access connects hosts to access routers
- Routers are connected by high-speed point-to-point links

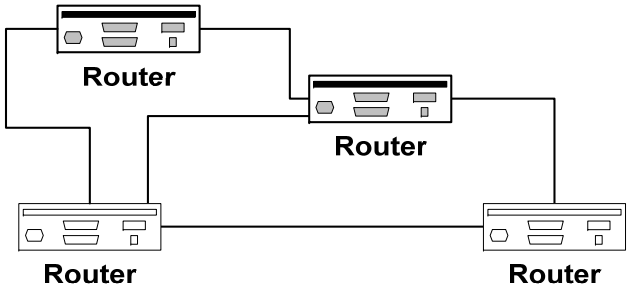



Dial-Up Access

Here, IP hosts and routers are connected by a serial cable

Data link layer protocols for point-to-point links are simple:

- Main role is encapsulation of IP data grams
- No media access control needed




Point-to-Point Links

# *Data Link Protocols for Point-to-Point links*

## SLIP (Serial Line IP)

First protocol for sending IP data grams over dial-up links (from 1988)

Encapsulation, not much else

## PPP (Point-to-Point Protocol):

Successor to SLIP (1992), with added functionality

Used for dial-in and for high-speed routers

## HDLC (High-Level Data Link) :

Widely used and influential standard (1979)

Default protocol for serial links on Cisco routers

Actually, PPP is based on a variant of HDLC

# *PPP - IP encapsulation*

The frame format of PPP is similar to HDLC and the 802.2 LLC frame format:

| flag | addr | ctrl | protocol | data | CRC | flag |
|---|---|---|---|---|---|---|
| 7E | FF | 03 | | | | 7E |
| 1 | 1 | 1 | 2 | <= 1500 | 2 | 1 |

| | |
|---|---|
| 0021 | IP datagram |
| C021 | link control data |
| 8021 | network control data |

PPP assumes a duplex circuit

Note: PPP does not use addresses

Usual maximum frame size is 1500

# *Additional PPP functionality*

In addition to encapsulation, PPP supports:

- multiple network layer protocols (protocol multiplexing)
- Link configuration
- Link quality testing
- Error detection
- Option negotiation
- Address notification
- Authentication

The above functions are supported by helper protocols:

- LCP
- PAP, CHAP
- NCP

# *PPP Support protocols*

**Link management:** The link control protocol (LCP) is responsible for establishing, configuring, and negotiating a data-link connection. LCP also monitors the link quality and is used to terminate the link.

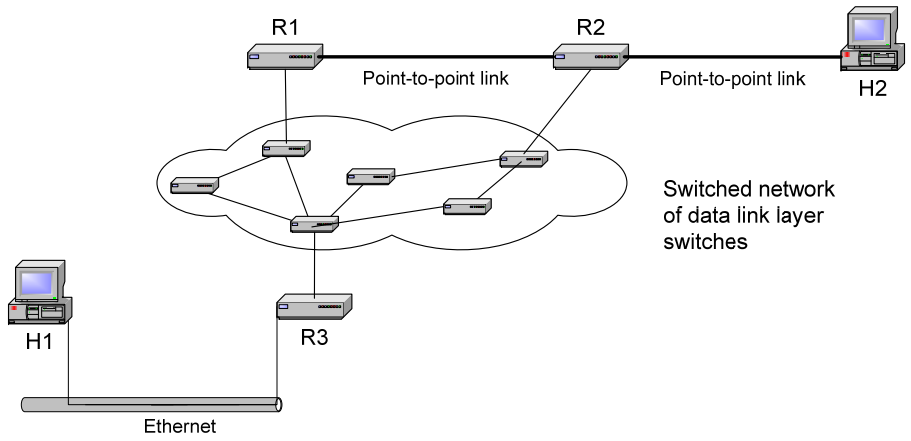
**Authentication:** Authentication is optional. PPP supports two authentication protocols: Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP).

**Network protocol configuration:** PPP has network control protocols (NCPs) for numerous network layer protocols. The IP control protocol (IPCP) negotiates IP address assignments and other parameters when IP is used as network layer.

# *Switched networks*

Some data link technologies can be used to build complete networks, with their own addressing, routing, and forwarding mechanisms. These networks are often called switched networks.

At the IP layer, a switched network may like a point-to-point link or like a broadcast link



# *Switched networks*

Data link layer technologies:

- Switched Ethernet
- ATM (Asynchronous Transfer Mode)
- Frame Relay
- Multiprotocol Label Switching (MPLS)

Some switched networks are intended for enterprise networks (Switched Ethernet), wide area networks (MPLS, Frame Relay), or both (ATM)

Some switched networks have a complete protocol suite.

# *LAB*

Simulate by Packet Tracer

# *Questions*