# EE-4074

http://www.csc.gatech.edu/~copeland/4074/

Prof. John A. Copeland
john.copeland@ece.gatech.edu
404 894-5177

Office: GCATT Bldg 579
email or call for office visit, or call Kathy Cheek, 404 894-5696

- **Introduction**

Text: *Local and Metropolitan Networks*,
6th Edition
by William Stallings

**The class Web site is:**

http://www.csc.gatech.edu/~copeland/4603/

**On this site you will find (eventually):**

- Class calendar (test dates, etc.)
- Reading assignments
- Lecture Notes (pdf files to print)
- Homework assignments (and answers), a Q&A folder

**Homework assignments will be text files, sent by email and posted on the Web. Answers will be edited into them, and they will be returned by email to me.**

**Grades will be sent to you by email.**

# Uses of Computer Networks

## Traditional (several years old)

- Access to central databases
- Synchronization of distributed data
- Client-Server Model (request-reply)
- Collaborative work groups (e.g., Lotus Notes)

## New Uses

- Human Communication (email, games, news groups, class Web sites)
- Access to many sources of information (World Wide Web - text, image, sound, video, ...)
- Real-time information (traffic cameras)

# Communication Networks

**Problem: Use digital information generated by one computer on another computer without retyping.**

**Early solutions: Paper tape, punched cards, magnetic tape, floppy disks, cdroms, .... -> "sneaker net"**

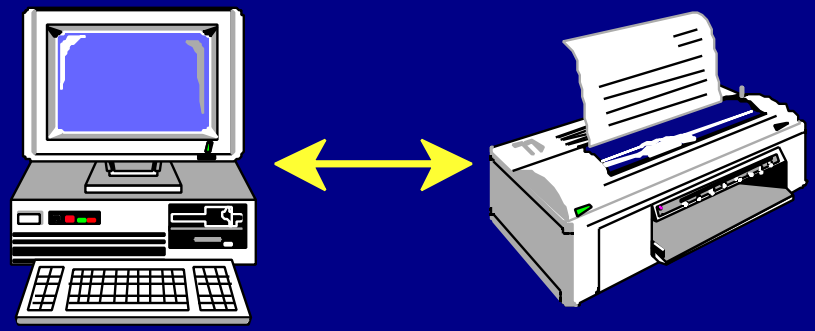
**Problem: Users want to use remote computer to access information.**

**Early solutions: Terminal directly wired to a "main frame" computer. Desktop uses a "modem" with phone dial up. Limited to one connection at a time.**

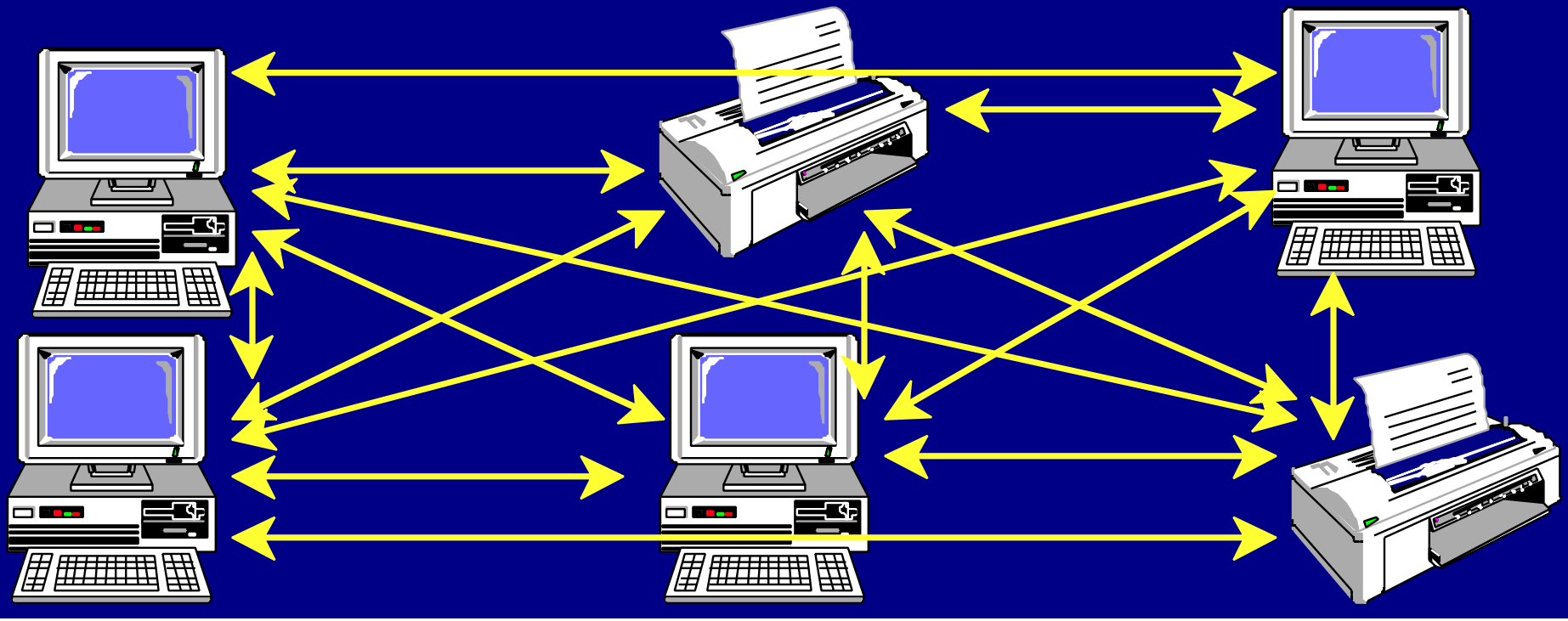
**Recent solution to both: Connection by a "real time" data communication network . Remote dial up connections to network via modem and ISDN "Terminal Adaptor" allow multiple "virtual circuits."**

# Connect devices by point to point links.

Reasonable when the number of connections are small, and distances are small.

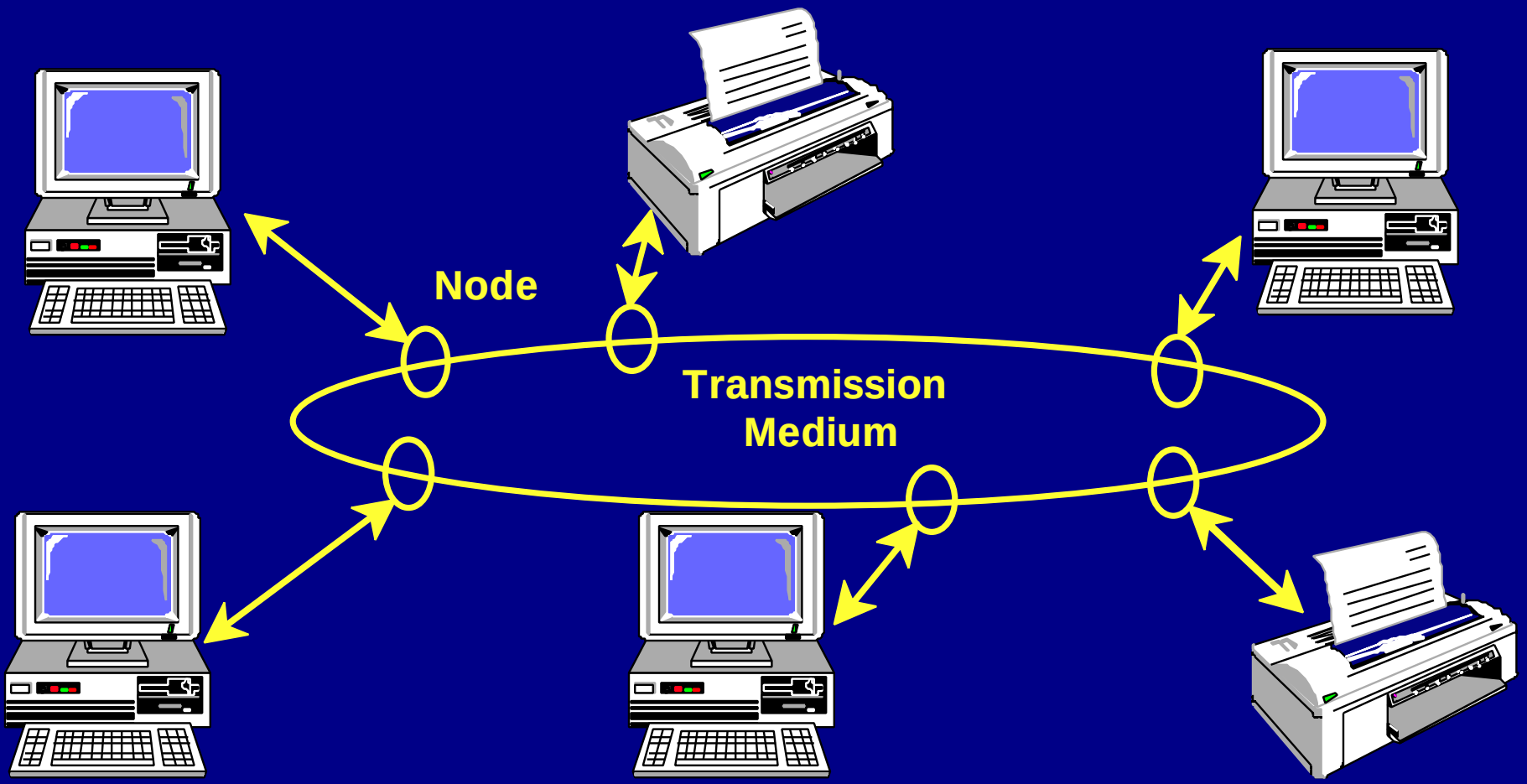


Not reasonable when the number of connections are large, and distances are large. C = n*(n-1)/2.

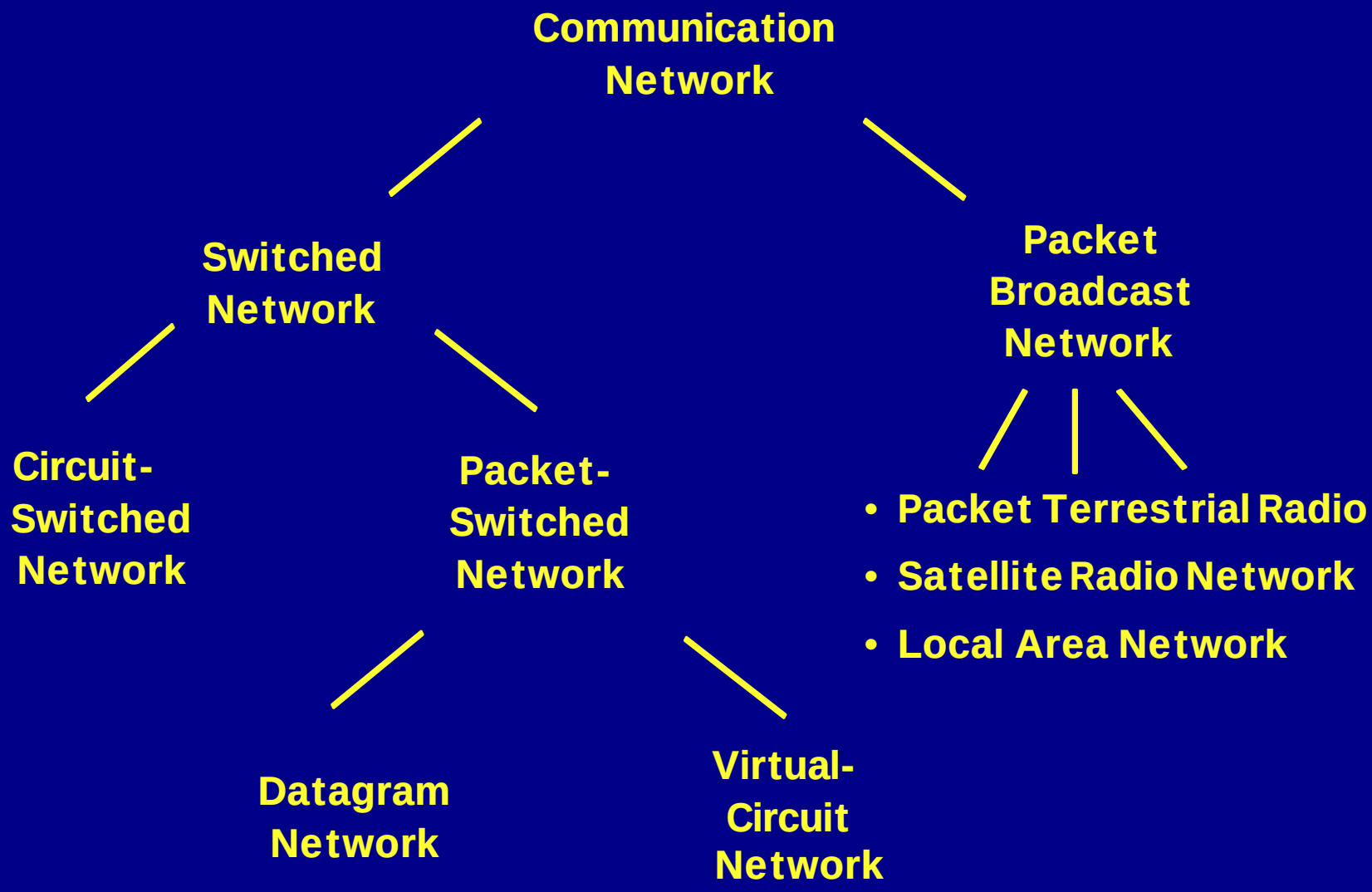


# Data Communication Network

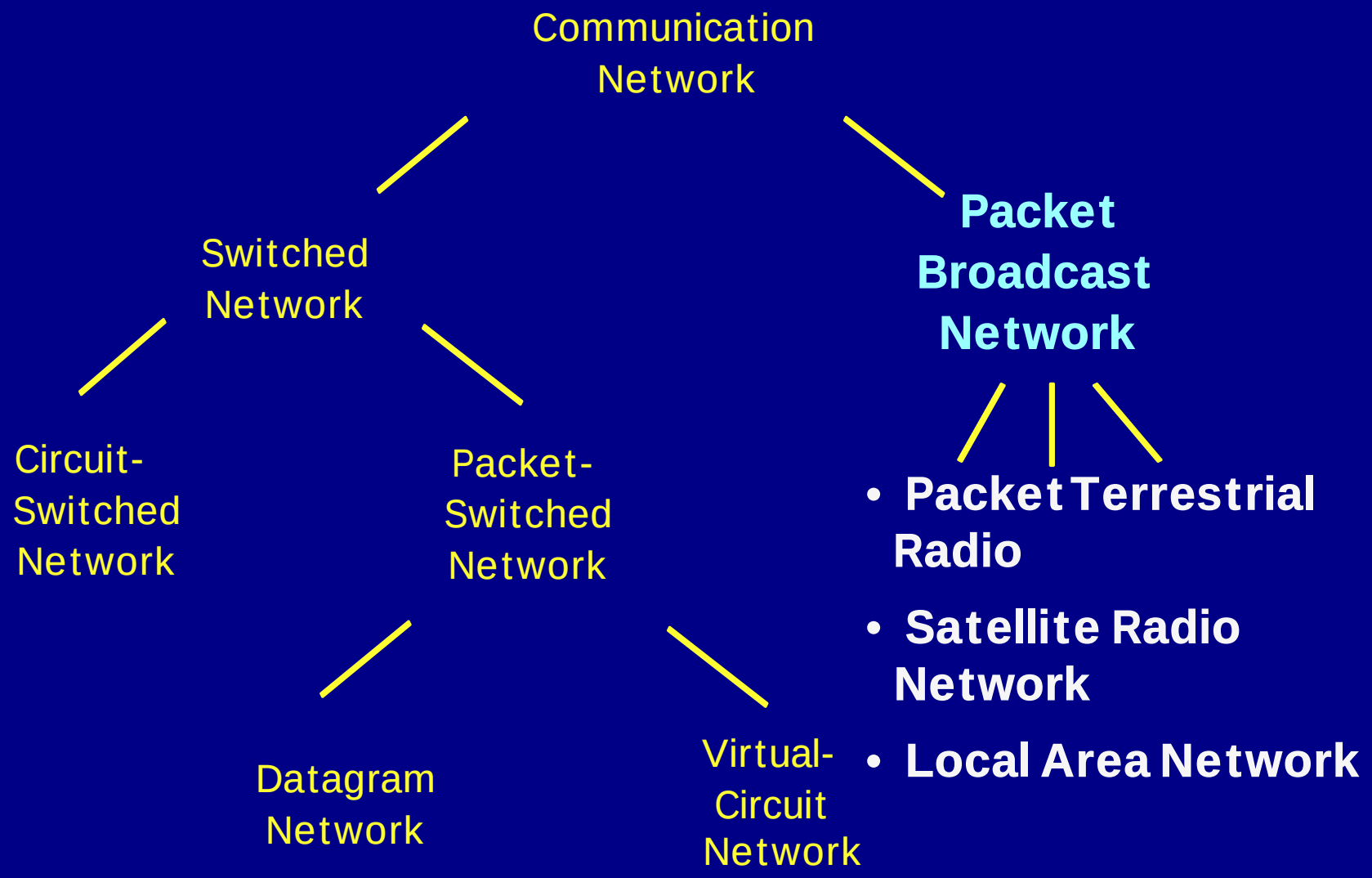
Connect each device (station, host, server) to a "node". Nodes do not generate information; only transport information (bits) to/from other nodes



# Classification of Communication Networks

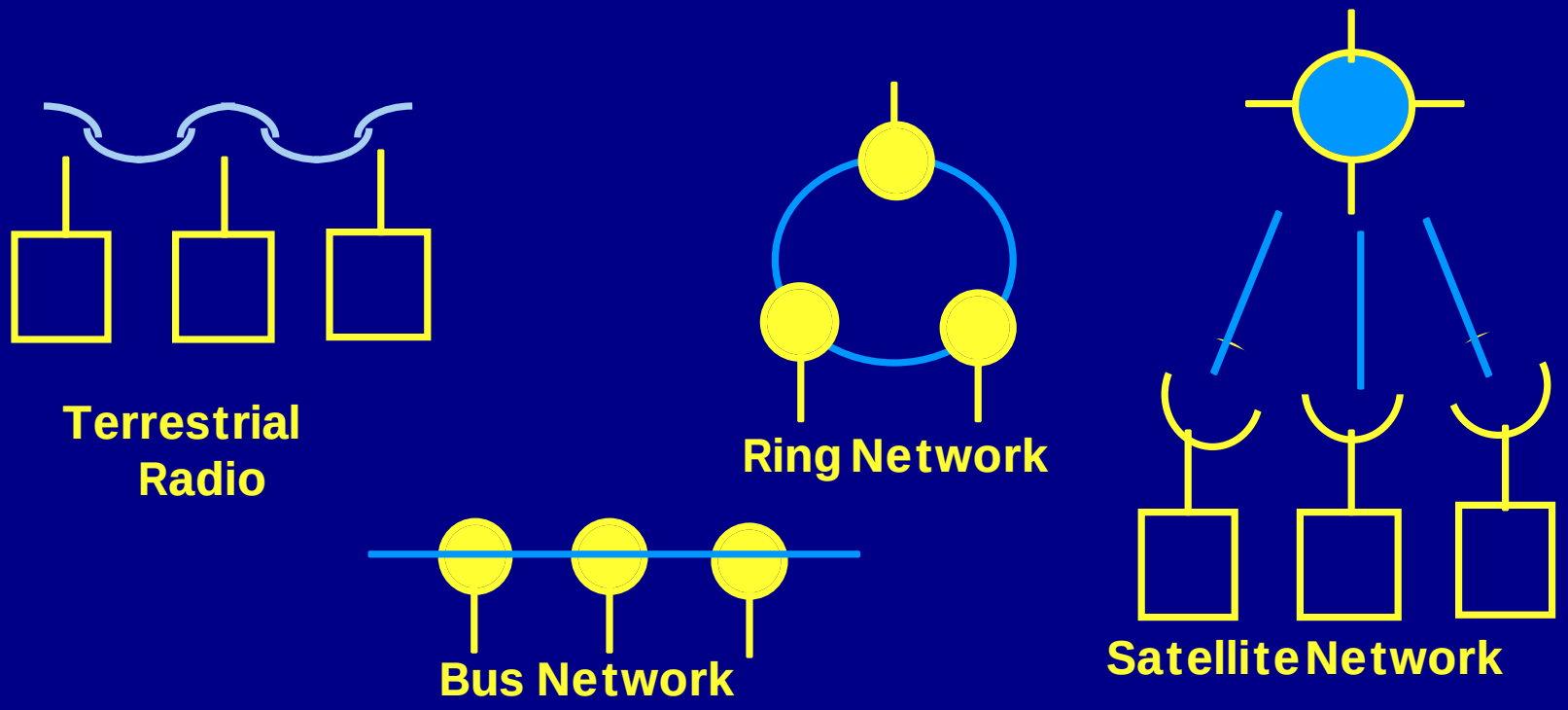


# Classification of Communication Networks

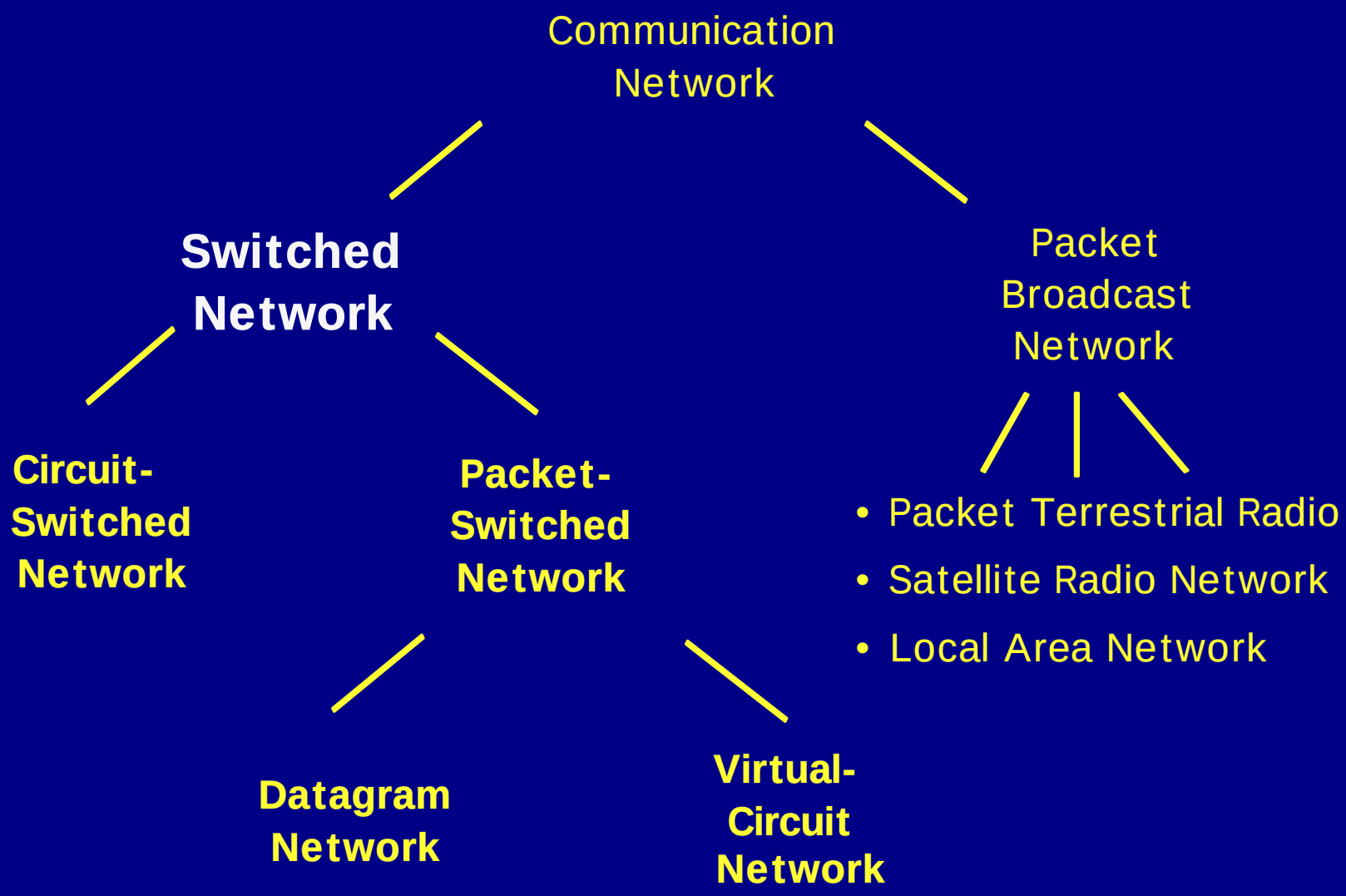


# Packet Broadcast Network

- In a Broadcast Network, there are no intermediate switching nodes.
  - Each station has a transmitter/receiver that communicates over a medium shared by other stations.
  - Transmission from any station is received by all other stations.
- Topologies of broadcast networks:

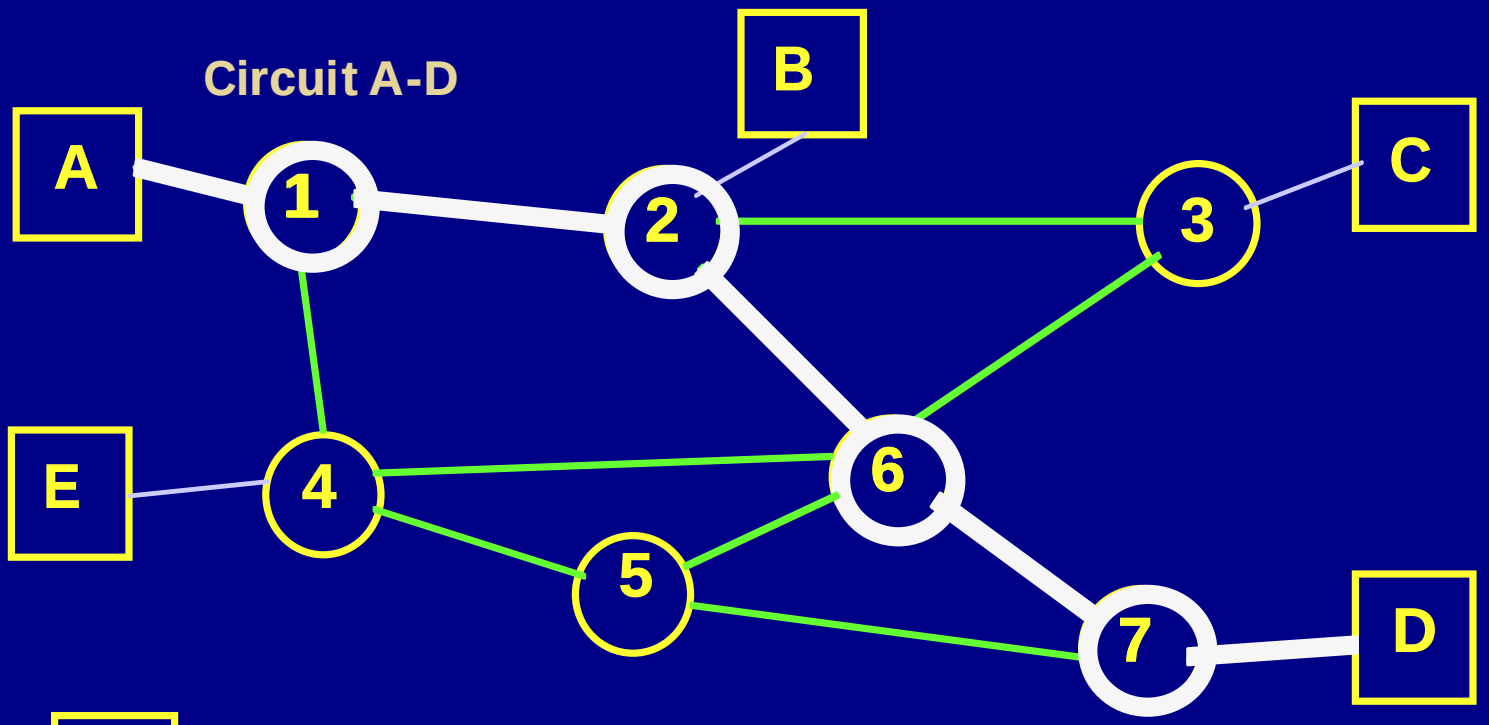


# Classification of Communication Networks



# Switched Communication Network

- A Switched Communication Network consists of an interconnected collection of switches (nodes). Data is routed from switch to switch on dedicated channels, forming a circuit (or connection). Circuits are "set up" and "taken down."



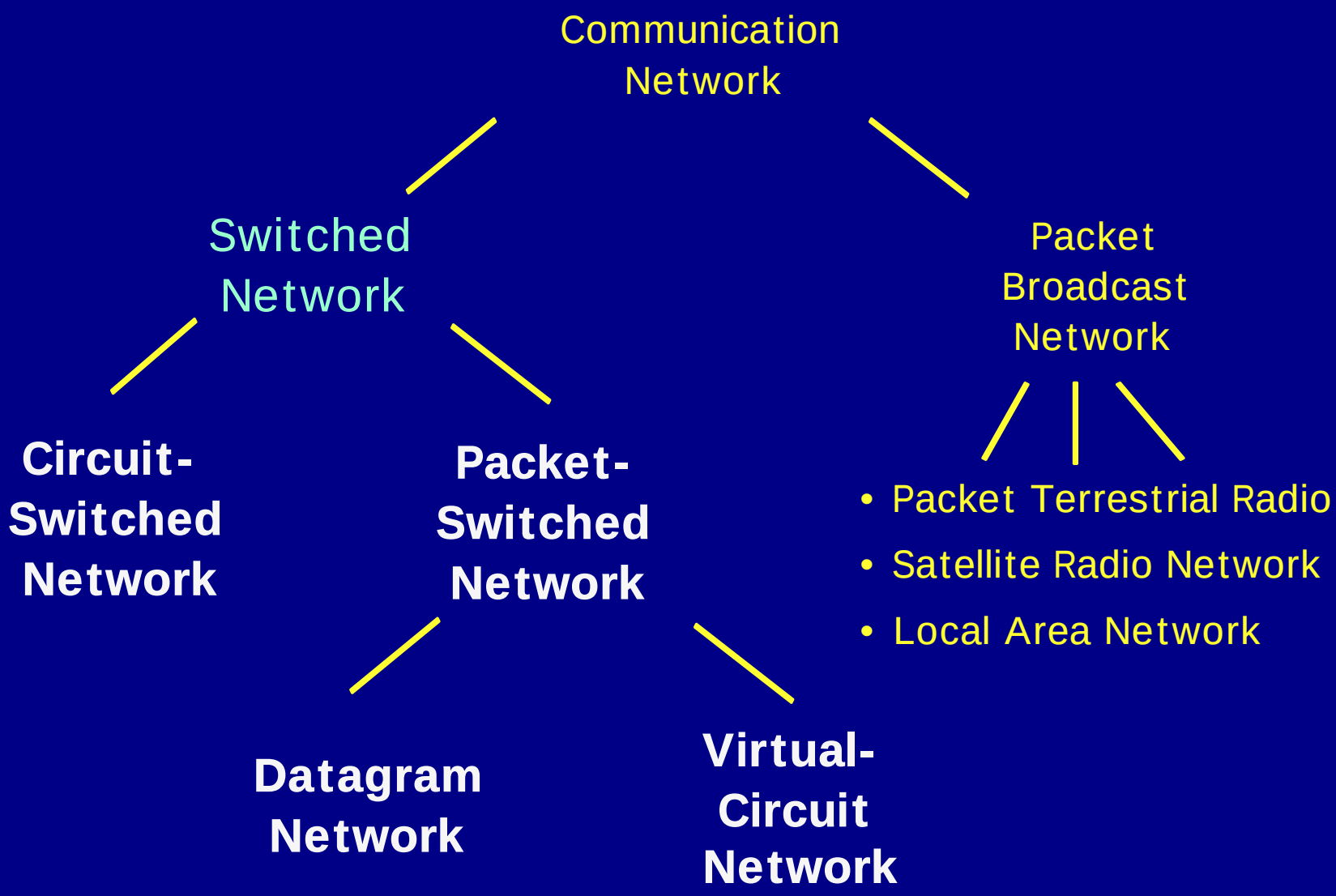

A Station

1 Switch or Node

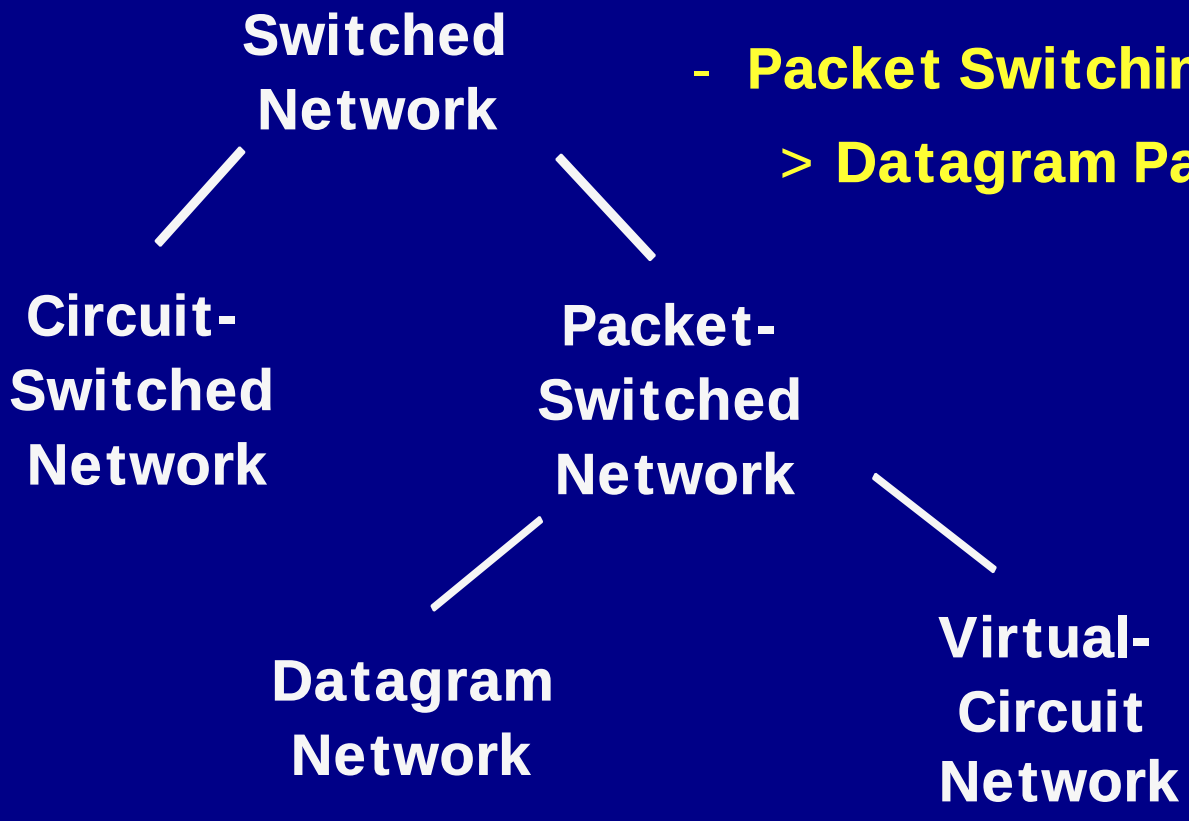
Local Connection

Trunk or Long-Haul

# Classification of Communication Networks



- The Switching Method of a Switched Communication Network is the way data are processed and routed in that network.
- The basic methods are:
  - Circuit Switching
  - Packet Switching
    - > Datagram Packet Switching



# Circuit Switching

- In a circuit-switched network, a dedicated communication path is established between two stations through nodes (switches) of the network.
- Data is transported at a fixed bit rate on these paths.
- A circuit switched connection (circuit) occupies a fixed capacity (bandwidth, bits per second) of each link for the lifetime of the connection. Capacity unused by the circuit cannot be used by other circuits.
- Circuit-switched communication involves three phases:
  - Circuit establishment (Dial - call set up)
  - Data Transfer (Talk)
  - Circuit disconnect (Hang up -call take down)

Circuit-Switched Network

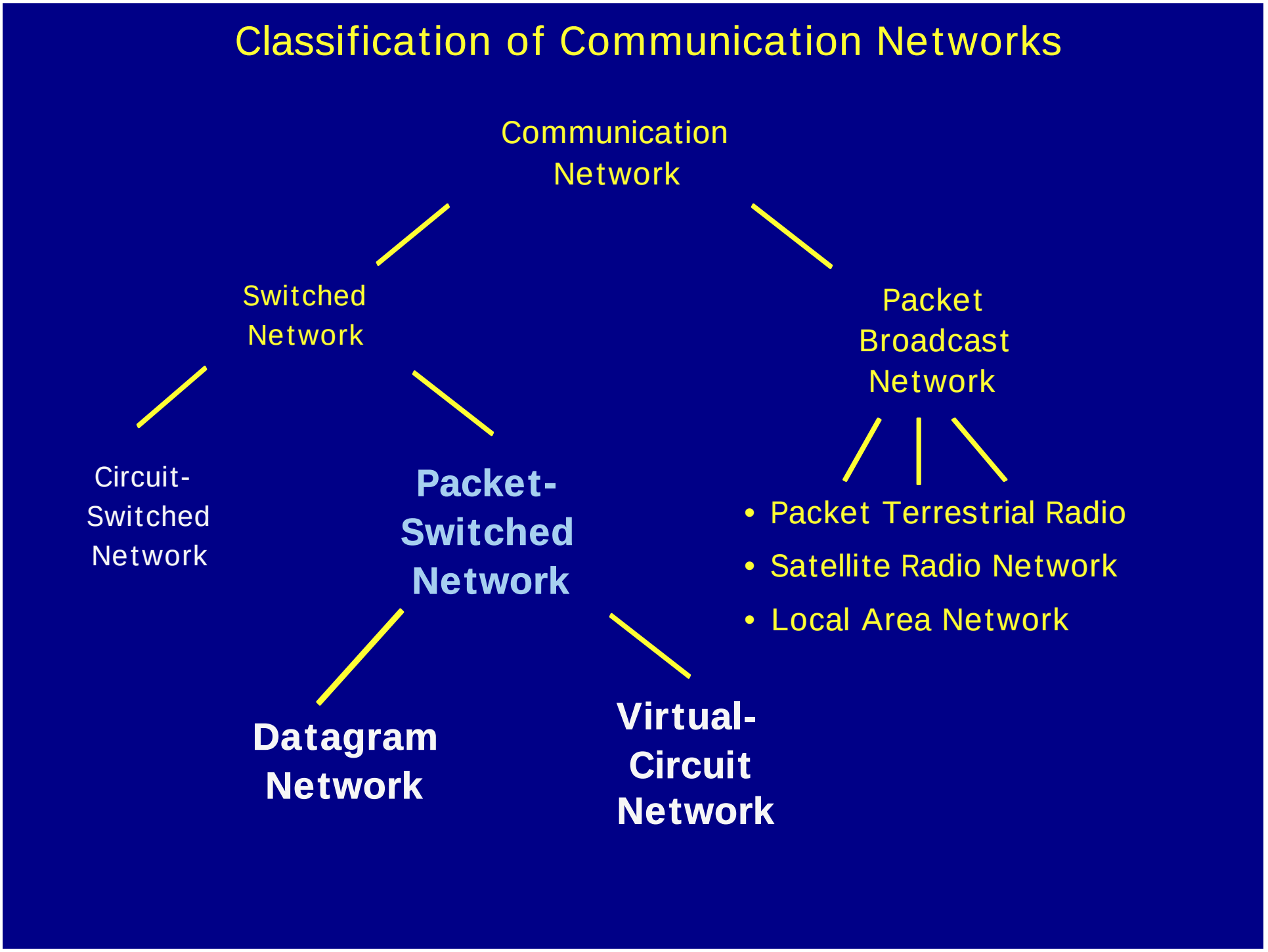
# Packet Switching

- Data are sent in a sequence of "chunks", so-called packets.
- Each packet is passed through the network from node to node along some path ( route).
- At each node the entire packet is received, stored briefly, queued with other packets going to the same next node, and then forwarded to the next node (store and forward network ).
- Choice of the next node depends on the "address" within the packet.
- The method of selection of the route depends on whether the packet is a "Datagram" or is part of a "virtual circuit."

Packet-Switched Network

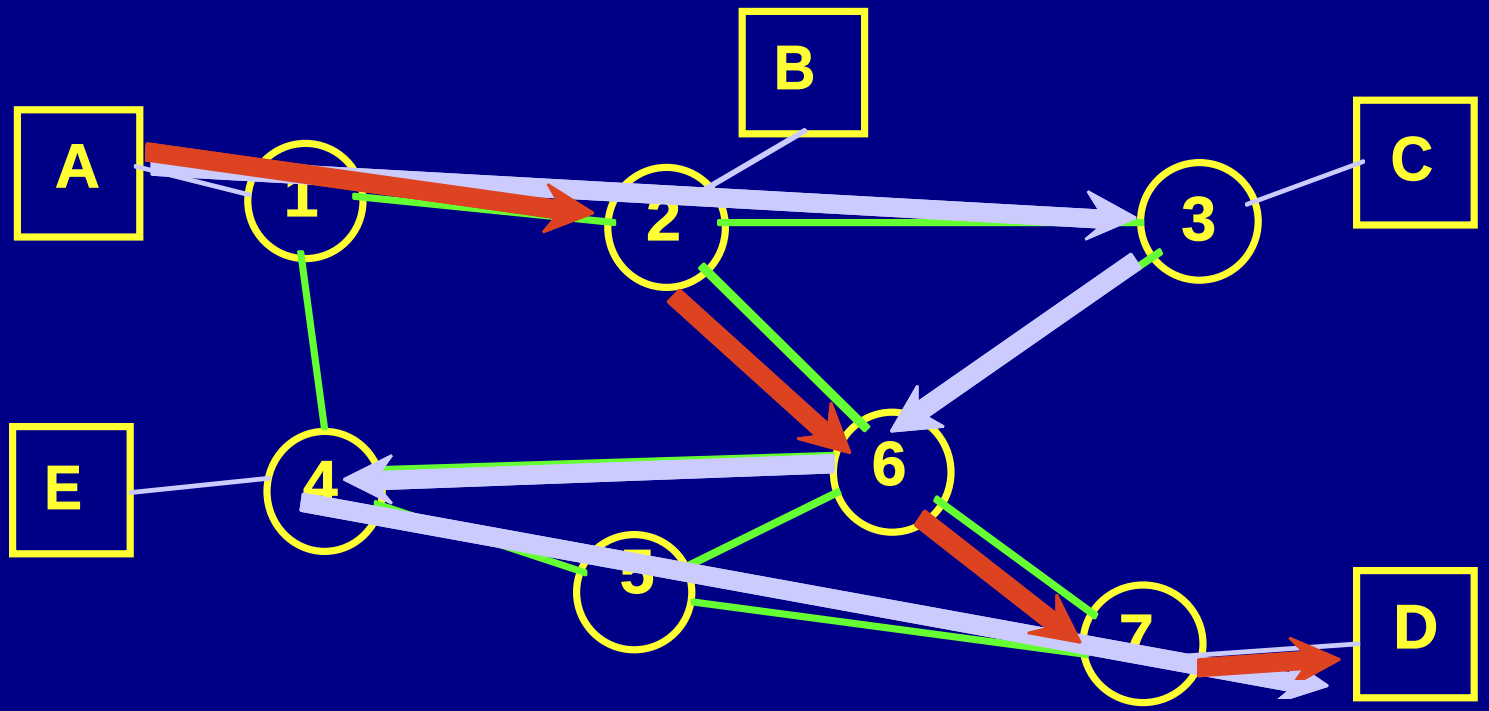

Data Packet

# Classification of Communication Networks



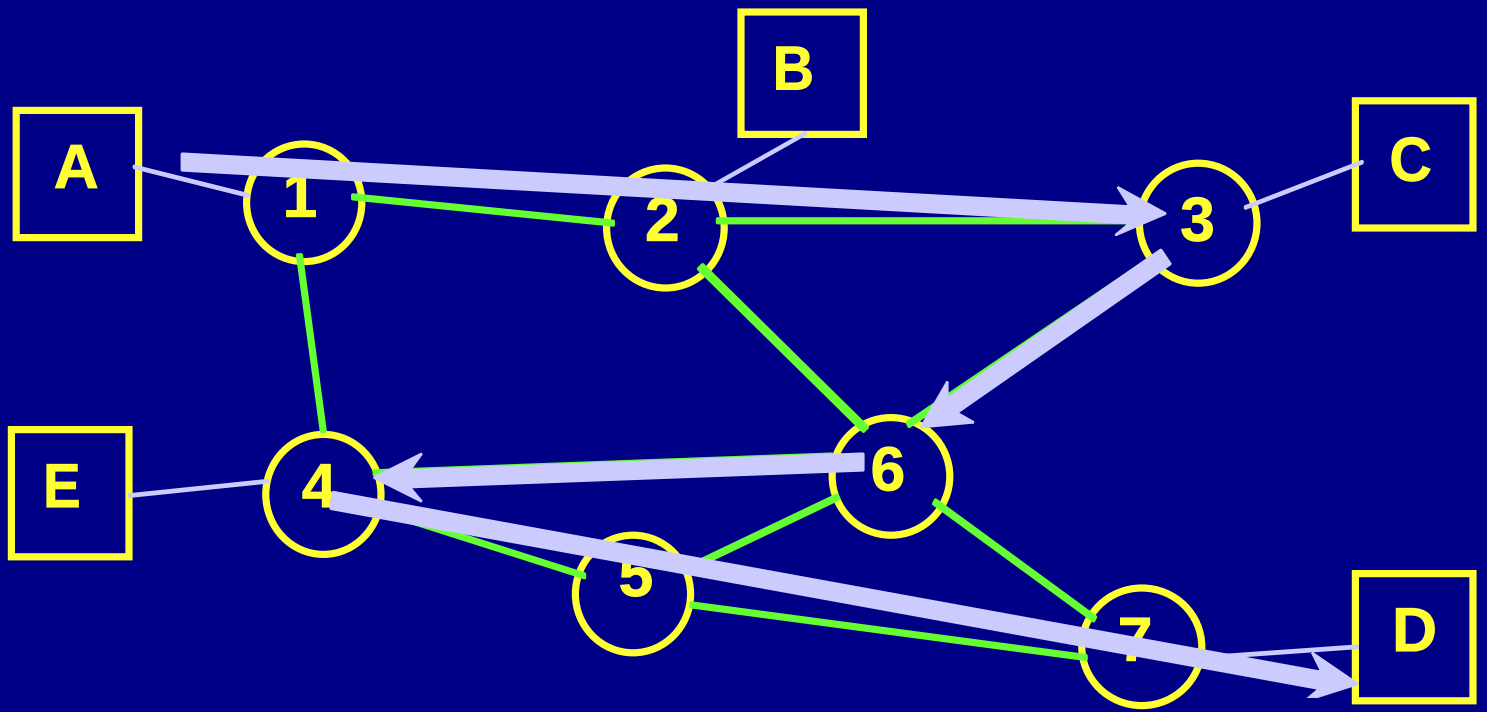
# Datagram Packet Switching

- Packets are routed independently of each other.
- Packets are called Datagrams, because they are independent messages.
- Due to independent routing, datagrams may arrive out of order (out-of-sequence delivery).



# Virtual-Circuit Packet Switching

- All packets from one packet stream (same source and destination addresses) are sent along the same path.
- Virtual-circuit switching guarantees in-sequence delivery of packets.
- Packets from different virtual circuits are interleaved.
- Circuit-switched communication involves three phases: Circuit Establishment , Data Transfer , Circuit Disconnect .



# Classification of Communication Networks