Computer Networks I Lecture 5 - Link Layer Topology

Fall 2022

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Network Topology

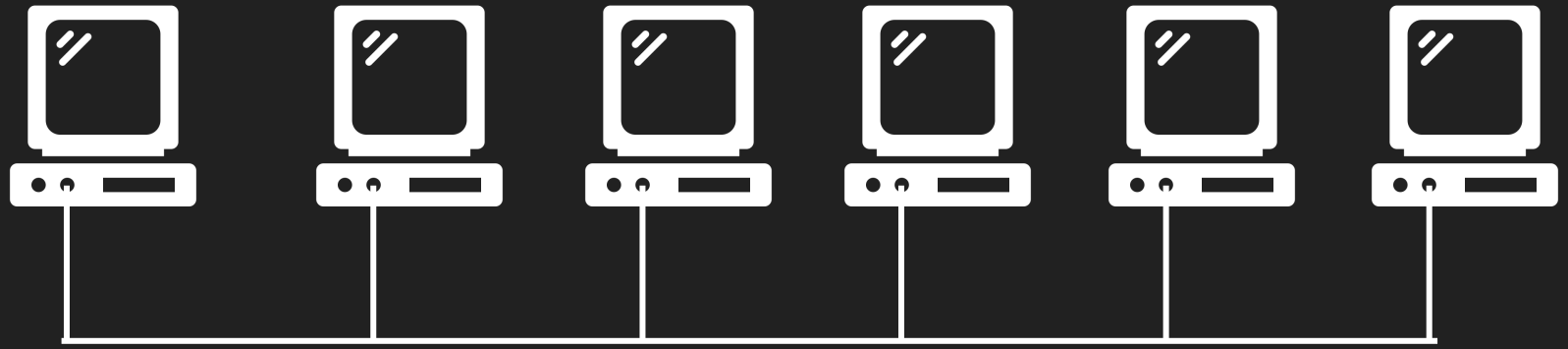
Network Topology is the name for the arrangement of all connected devices.

At layer 2, this means we care about how physical links are arranged.

Connections may be:

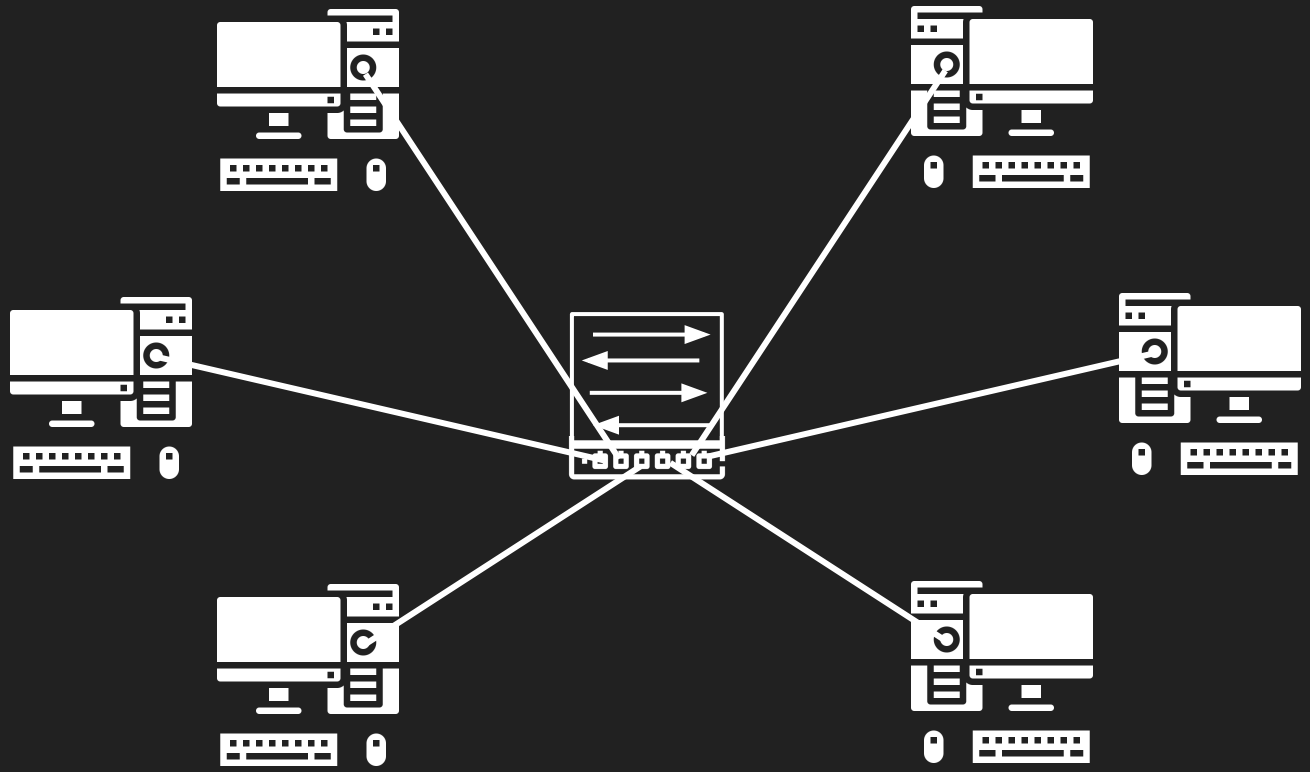
- One-to-one (ex. A single ethernet cable between two computers)
- Many-to-one (ex. Many devices on a WiFi network)
- Many-to-many (ex. Using an ethernet switch)

Bus Topology - The “old way” with Ethernet over Coax cable



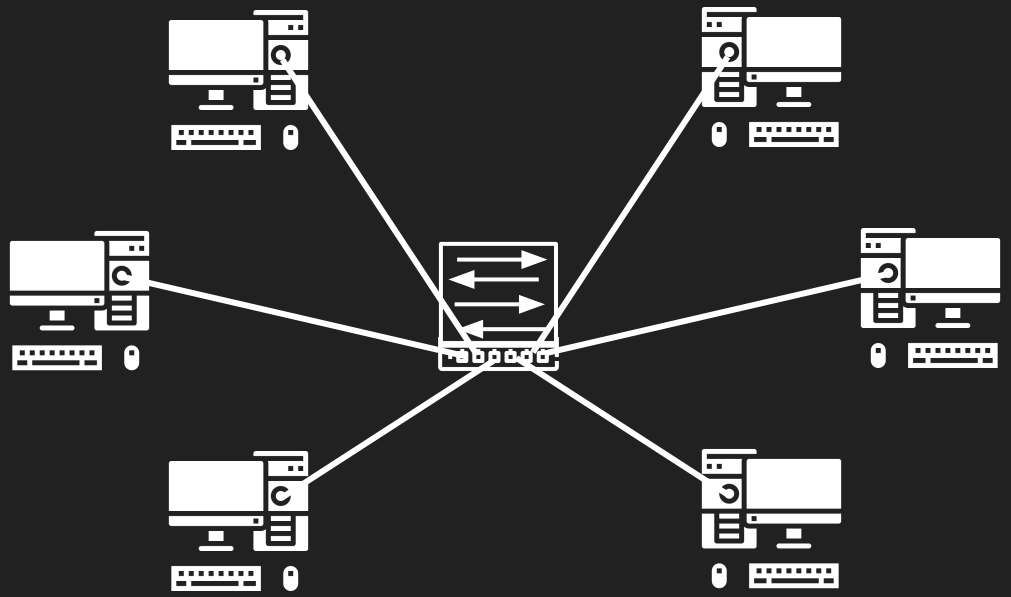
All the machines share a single “bus” wire. Everyone hears everything.
Collisions when multiple machines transmit at once

Star Topology - The normal topology today

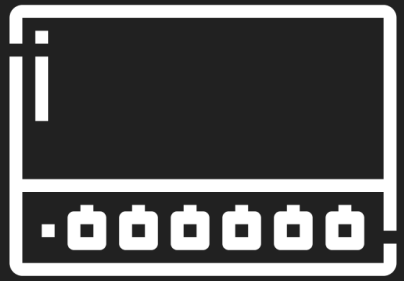


Star Topology - Nodes and Links

We call all machines ***nodes***, and the paths between them are called ***links*****.** Links may be wireless, wired, or fiber.



Switches and Hubs



We use a **switch** or **hub** to connect multiple machines.
Switches and hubs are part of the Data Link layer (Layer 2)

Hubs

- mindlessly repeat everything to everything they are attached to
- cause collisions

Switches

- more efficient - keeping track of what machine is at which physical port

Media Access Control (MAC) Addresses

A 6-byte serial number for every Network Interface Card

Not a per-computer ID, because one computer may have many NICs

Occasionally, duplicate addresses exist

- Will cause layer 2 issues of messages getting misdirected
- Often can be changed in software to correct (or create) these problems

Address Resolution Protocol - Tying to Layer 3

If you know a machine's Layer 3 address (IP address), but you have a physical connection, you need to finds its MAC address and communicate on Layer 2.

ARP Request: "WHO HAS 192.168.1.115? Tell 192.168.1.100"

- Sent to address FF:FF:FF:FF:FF:FF (broadcast address)
- Sent from the MAC address of the asker

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- Everyone listening can cache the response
- No protection against someone lying to impersonate another device!

Gateway

At the very least, client machines need to get the Layer 2 address of your **gateway** to Layer 3 of the Internet (router).

How data then traverses the Internet is a layer 3 problem

The Switching Game - Coming soon

Each player receives a MAC address, except one player who is the switch

Each player starts with a message card for another MAC address that must be delivered.

2 teams will compete for the fastest routing time, and the most delivered packets (for small bit of extra credit!)

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If the switch's "buffer" is full, it "drops" packets, ignoring them

The Switching Game

Each player receives a MAC address, except one player who is the switch

Each player starts with a message card for another MAC address that must be delivered. The message also says the source MAC address

The switch doesn’t know anyone’s MAC address at first

Links are half-duplex - all players can only hold max 1 card

The switch can store two cards (to simulate a small buffer), their eyes, and something to make notes with. [variation: switch can be played by two people]

Nobody can speak aloud except the switch :)

2 teams will compete for the fastest routing time, and the most delivered packets

Field Trip to the networking closet

Image Attribution

Computer by Andi Nur Abdillah from Noun Project 

Computer by Komkrit Noenpoempisut from Noun Project