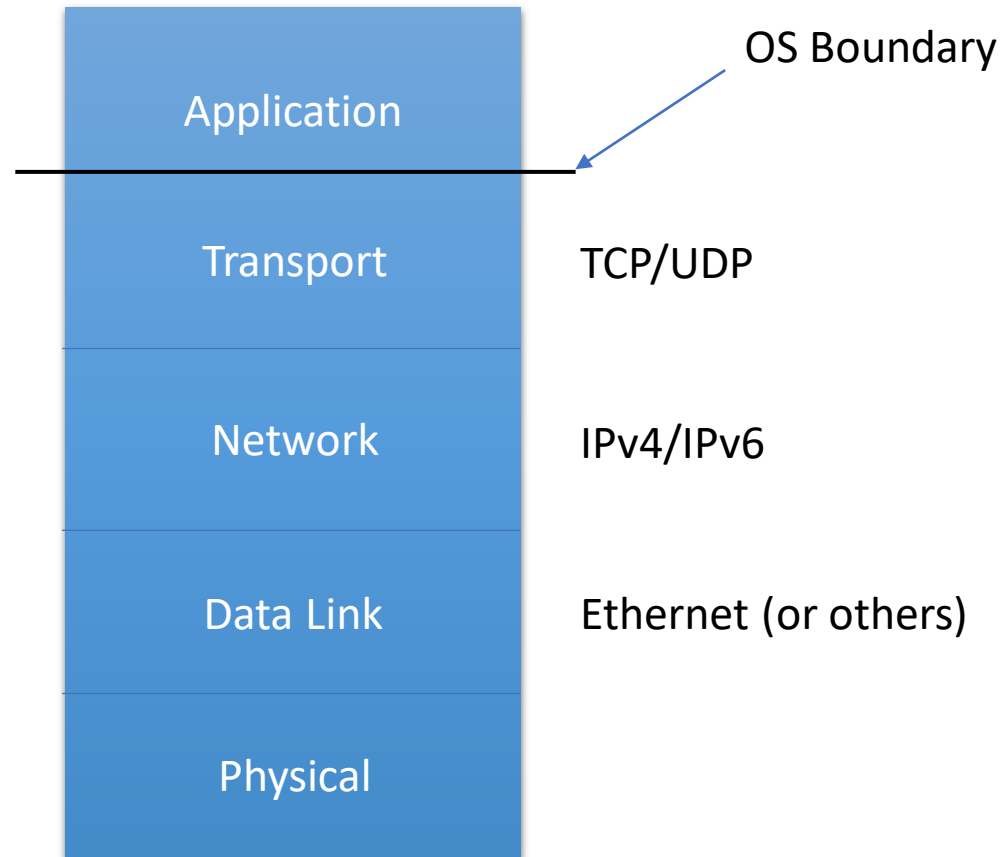# Basic Networking Concepts

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Layered Model (Protocol "Stack")

Layered Model

- Each layer independent of the others
  - … in theory, but not 100% true in real life
- Each layer calls upon services of the layer below it
  - TCP prepares a segment and asks IP to send it encapsulated in an IP packet
  - IP prepares a packet and asks Ethernet to send it encapsulated in a frame
  - The physical layer transmits the frame
  - … all in reverse for receiving
- TCP/IP only one option
  - OSI transport layer consists of four protocols: TP1, TP2, TP3, and TP4
  - Novell NetWare once used SPX/IPX instead of TCP/IP

Focus of CIS-3210

- We focus on Layer 2 (Data Link): Switching
  - A "link" is a collection of machines in the same broadcast domain
  - … meaning when one machine does a *link-level broadcast*, all machines in the same broadcast domain hear it
  - We will consider VLANs and related technologies (e.g., layer 3 switches)
- We focus on Layer 3 (Network): Routing
  - We will use IPv4 and IPv6 (but don't forget that other protocols exist!)
  - We will consider both interior and exterior routing protocols
  - We will consider security issues
  - We will consider quality of service (QoS) issues somewhat

IPv4 Network Address (CIDR style)

- IPv4 addresses are 32-bits written as four 8-bit numbers (in decimal) separated by dots: 155.42.107.97
  - Addresses refer to network interfaces, not machines. A machine might have multiple network interfaces (real or virtual) and thus multiple IP addresses
- Each link has a "network address" defined as a prefix used by all interfaces connected to that link: 155.42.107.0
  - … but how much of the address above is network address? The netmask can tell us: addr = 155.42.107.0 netmask = 255.255.255.0
  - … in CIDR style: 155.42.107.0/24
  - Consider the address 155.42.107.97/24. This has a network (link) part of 155.42.107.0 and a host part of 97.

More IPv4 Addresses

- Each network (link) has a broadcast address formed by setting the host part to all one bits: e. g. 155.42.107.255/24.

- The actual network address (host part set to all zero bits) isn't used for an interface.

- All remaining addresses on a link are available to assign to interfaces: 155.42.107.1/24 to 155.42.107.254/24.

- Commonly a router (or "gateway") is configured at the ".1" address. *This is not a requirement*, just a convenience, and it's not universal.

IPv6 Addresses

- IPv6 is technically a different network protocol from IPv4
  - Adds several new features: more efficient routing, better security (backported to IPv4), and a MUCH larger address space: 128 bits
- Addresses are written in hex, with 16-bit sections separated by colons: 2601:19b:c401:5e90:4b70:9a3f:a82e:6cdc
- Zero sections can be replaced with "::" like this: fe80::f498:7f45:6a99:d01d.
- Prefixes that start with FE80::/10 are "link local" and never routed.

Routers vs Switches