CS 640: Introduction to Computer Networks

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Lecture 2
Layering, Protocol Stacks, and Standards

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Today's Lecture

- Layers and Protocols
- A bit about applications

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Network Communication: Lots of Functions Needed

- Links
- Multiplexing
- Routing
- Addressing/naming (locating peers)
- Reliability
- Flow control
- Fragmentation

How do you implement these functions?
Key: Layering and protocols

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What is Layering?

- A way to deal with complexity
  - Add multiple levels of abstraction
  - Each level encapsulates some key functionality
  - And exports an interface to other components
  - Example?
- Layering: Modular approach to implementing network functionality by introducing abstractions
- Challenge: how to come up with the "right" abstractions?

Example of Layering

- Software and hardware for communication between two hosts

- Advantages:
  - Simplifies design and implementation
  - Easy to modify/evolve

What is a Protocol?

- Could be multiple abstractions at a given level
  - Build on the same lower level
  - But provide diferent service to higher layers
- Protocol: Abstract object or module in layered structure

1. Protocols Offer Interfaces

- Each protocol offers interfaces
  - One to higher-level protocols on the same end hosts
    - Expects one from the layers on which it builds
    - Interface characteristics, e.g. IP service model
  - A "peer interface" to a counterpart on destinations
    - Syntax and semantics of communications
    - (Assumptions about) data formats
- Protocols build upon each other
  - Adds value, improves functionality overall
    - E.g., a reliable protocol running on top of IP
  - Reuse, avoid re-writing
    - E.g., OS provides TCP, so apps don't have to rewrite

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2. Protocols Necessary for Interoperability

- Protocols are the key to interoperability.
  - Networks are very heterogeneous:

Ethernet: 3com, etc.	Hardware/link
Routers: cisco, juniper etc.	Network
App: Email, AIM, IE etc.	Application

  - The hardware/software of communicating parties are often not built by the same vendor
  - Yet they can communicate because they use the same protocol
    - Actually implementations could be different
    - But must adhere to same specification
- Protocols exist at many levels.
  - Application level protocols
  - Protocols at the hardware level

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OSI Model

- One of the first standards for layering: OSI
- Breaks up network functionality into seven layers
- This is a "reference model"
  - For ease of thinking and implementation
- A different model, TCP/IP, used in practice

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