Introduction to Networks and the Internet

CMPE 80N

Winter 2004

Lecture 2

Last class…

- *What's a computer network?*
- *Why networks?*
- *Examples of networks:*
  - *Postal system.*
  - *Telephone network.*
- *Telephone network:*
  - *Voice.*
  - *Real-time.*

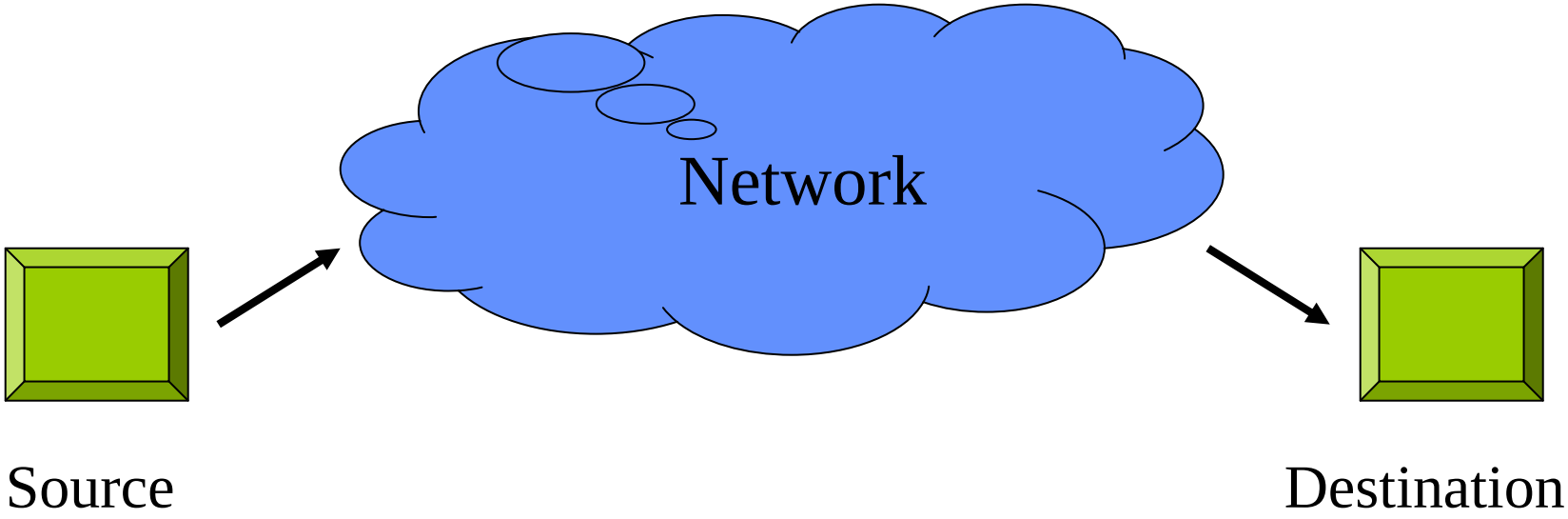
Last class (cont'd)

- *The evolution of the telephone system.*
- *Addressing.*
- *Data networks.*

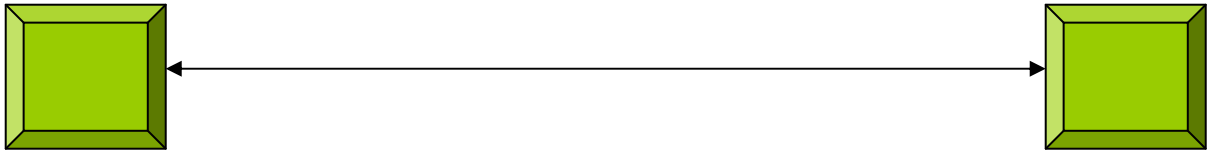
Data Networks

- *Components:*
  - *End systems (or hosts),*
  - *Routers/switches/bridges, and*
  - *Links (twisted pair, coaxial cable, fiber, radio, etc.).*

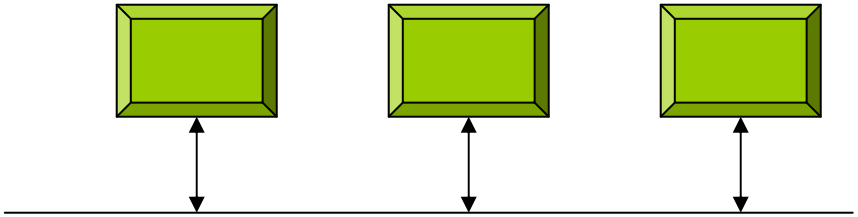
Communication Model



Connecting End Systems

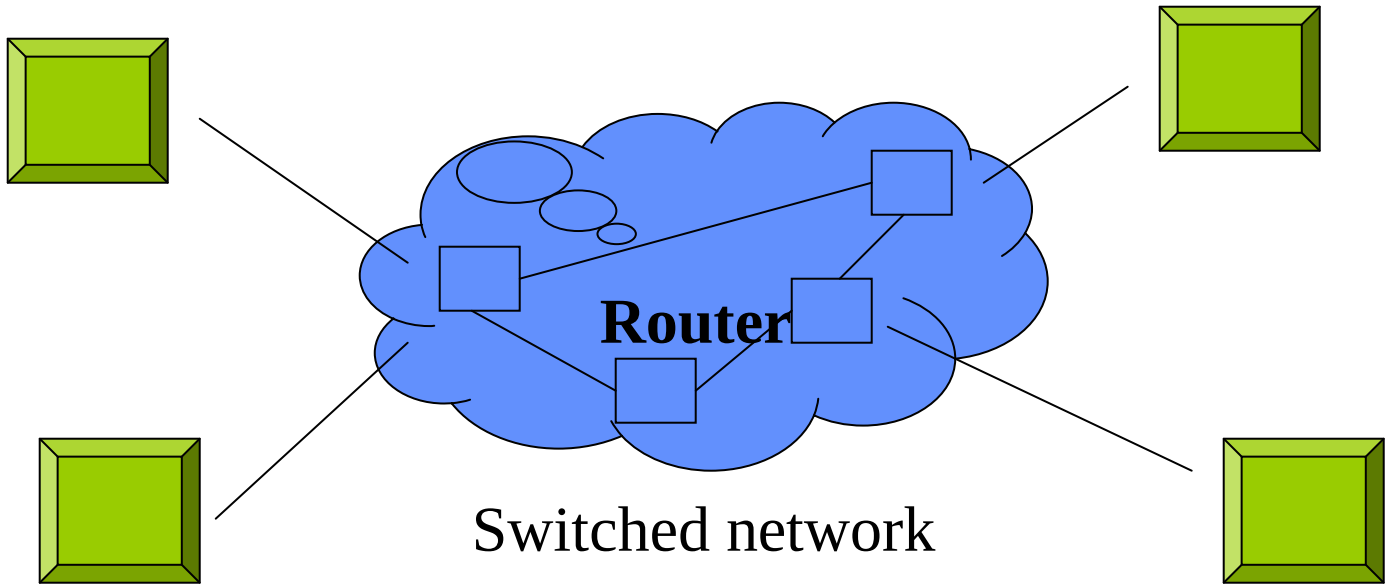


Dedicated link



Multiple access / shared medium

Connecting End Systems (cont'd)

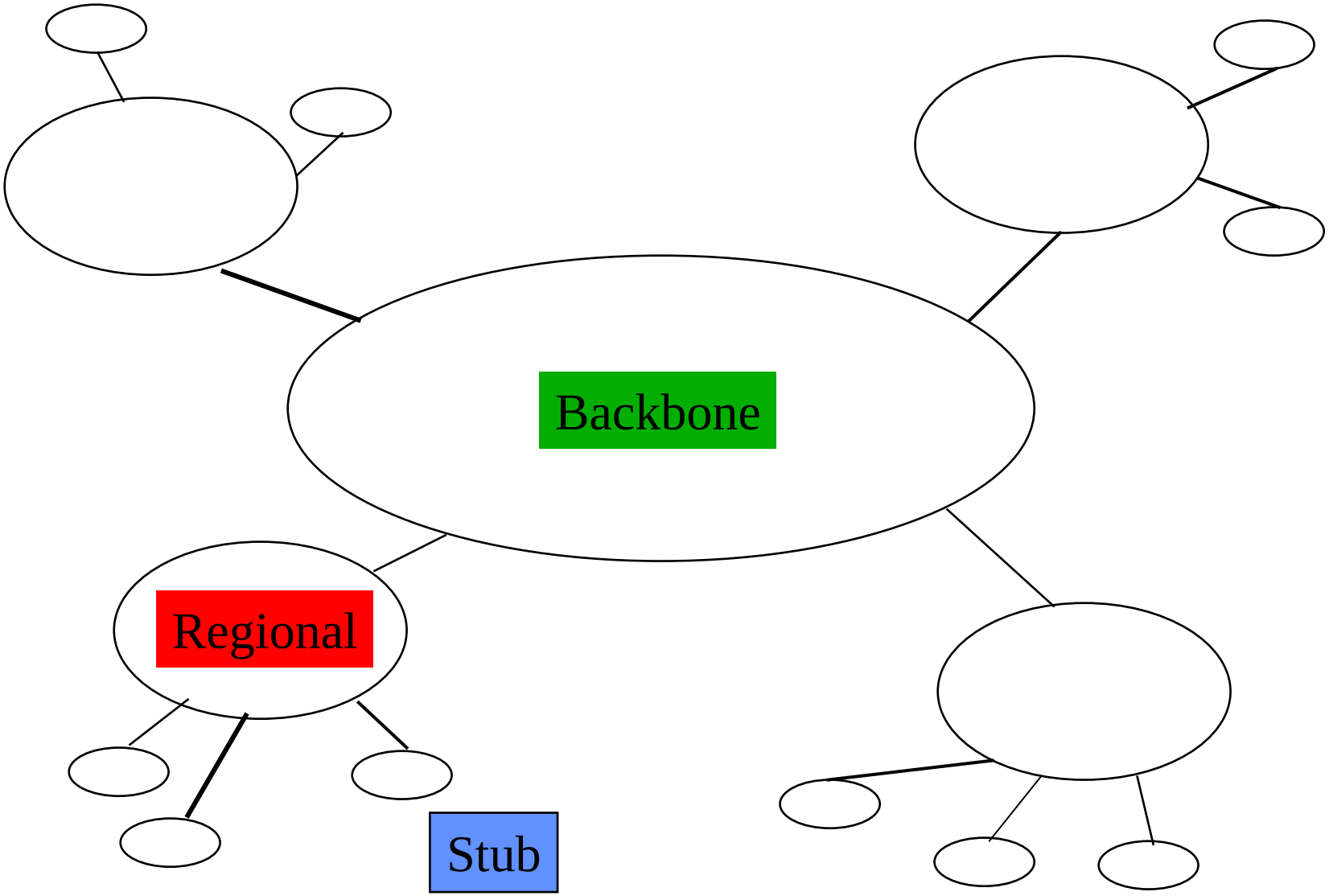


Router: switching element; a.k.a., IMPs (Interface Message Processors) in ARPAnet's terminology.

Types of Data Networks

- *Several ways to classify data networks.*
- *For example, according to "coverage":*
  - *Local Area Networks (LANs) typically provide networking capabilities within a building, campus.*
    - *Typically within 5-mile radius.*
  - *Wide-Area Networks (WANs) span greater geographic distances (e.g., world-wide).*
  - *Metropolitan Area Networks (MANs) span more restricted distances, e.g., geographic regions (e.g., Los Nettos network in Southern California, etc.)*

The Internet



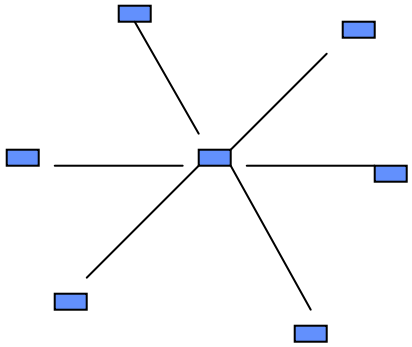
Types of Networks (cont'd)

- *Classification according to type of connection.*
  - *Dedicated link.*
  - *Shared medium (multiple access).*
  - *Switched point-to-point.*

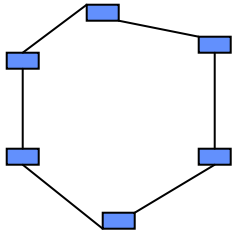
Types of Networks (cont'd)

- *Classification according to topology…*
- *What is network topology?*
  - *The way network elements are interconnected.*

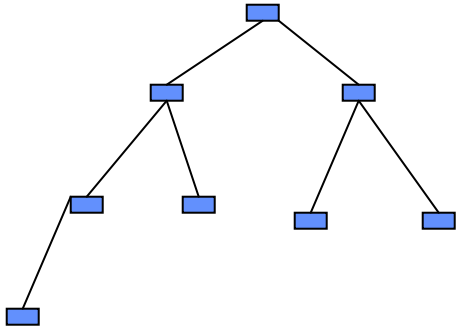
Network Topologies: Examples



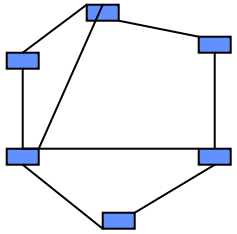
Star



Ring



Tree



Irregular

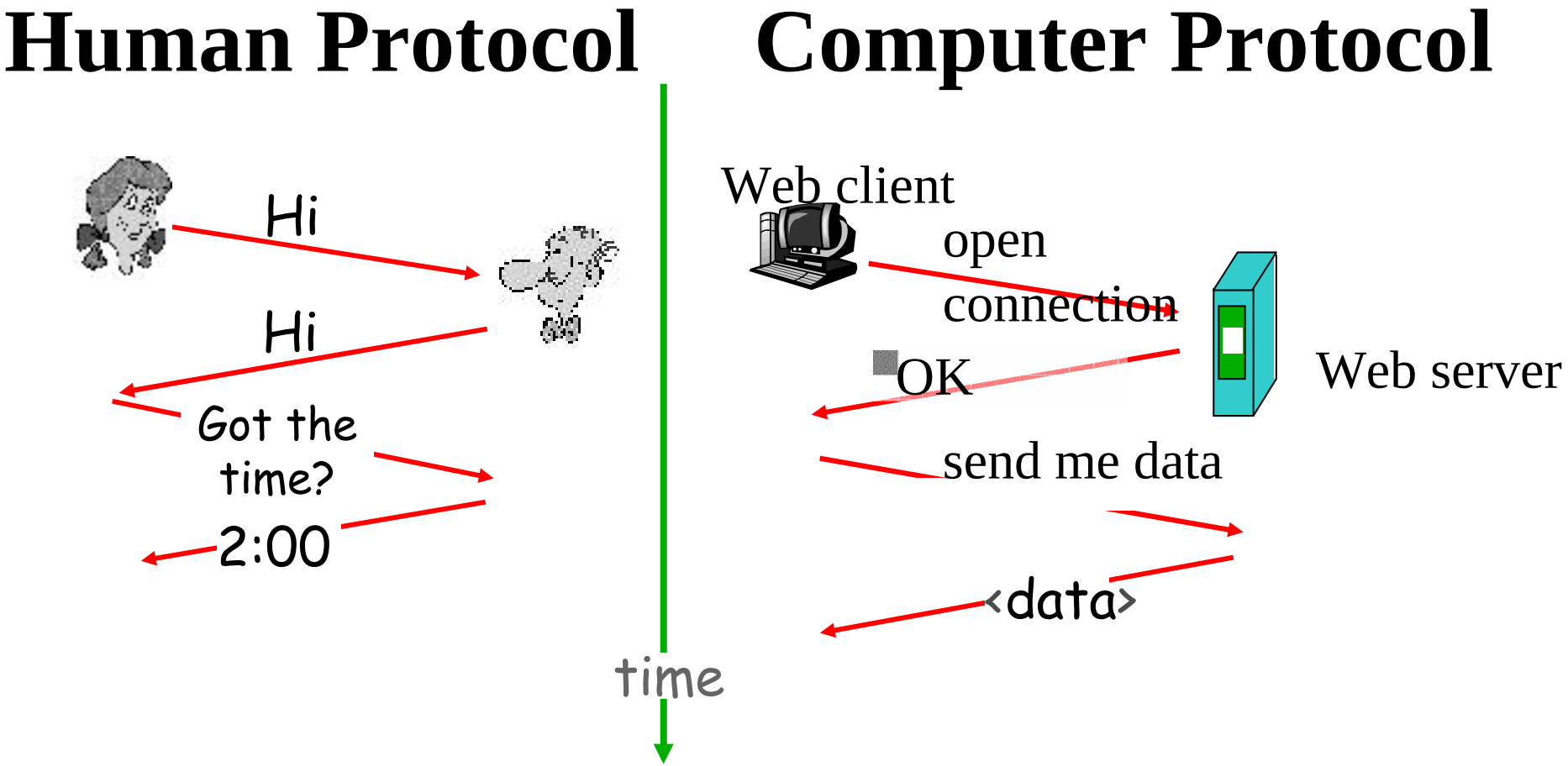
More Concepts…

- *Network protocols.*
- *Layering.*
- *Network architecture.*

Network Protocols

- *Diplomats use rules, called **protocols**, as guides for formal interactions.*
- *A **communication protocol** is a set of rules that specify the format and meaning of messages exchanged between computers across a network.*
- *A set of related protocols that are designed for compatibility are called **protocol suite.***

Human and Computer Protocols

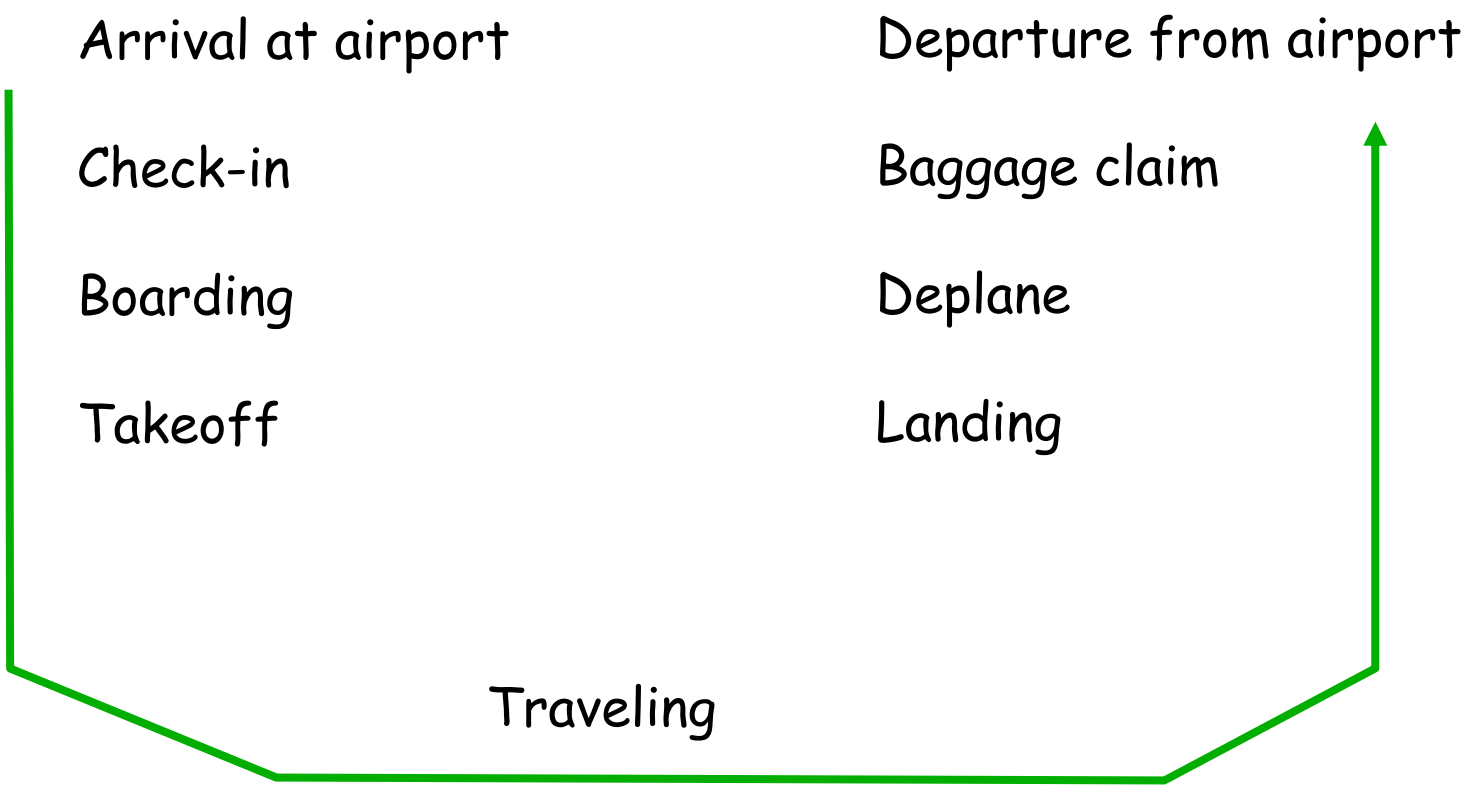


Layering

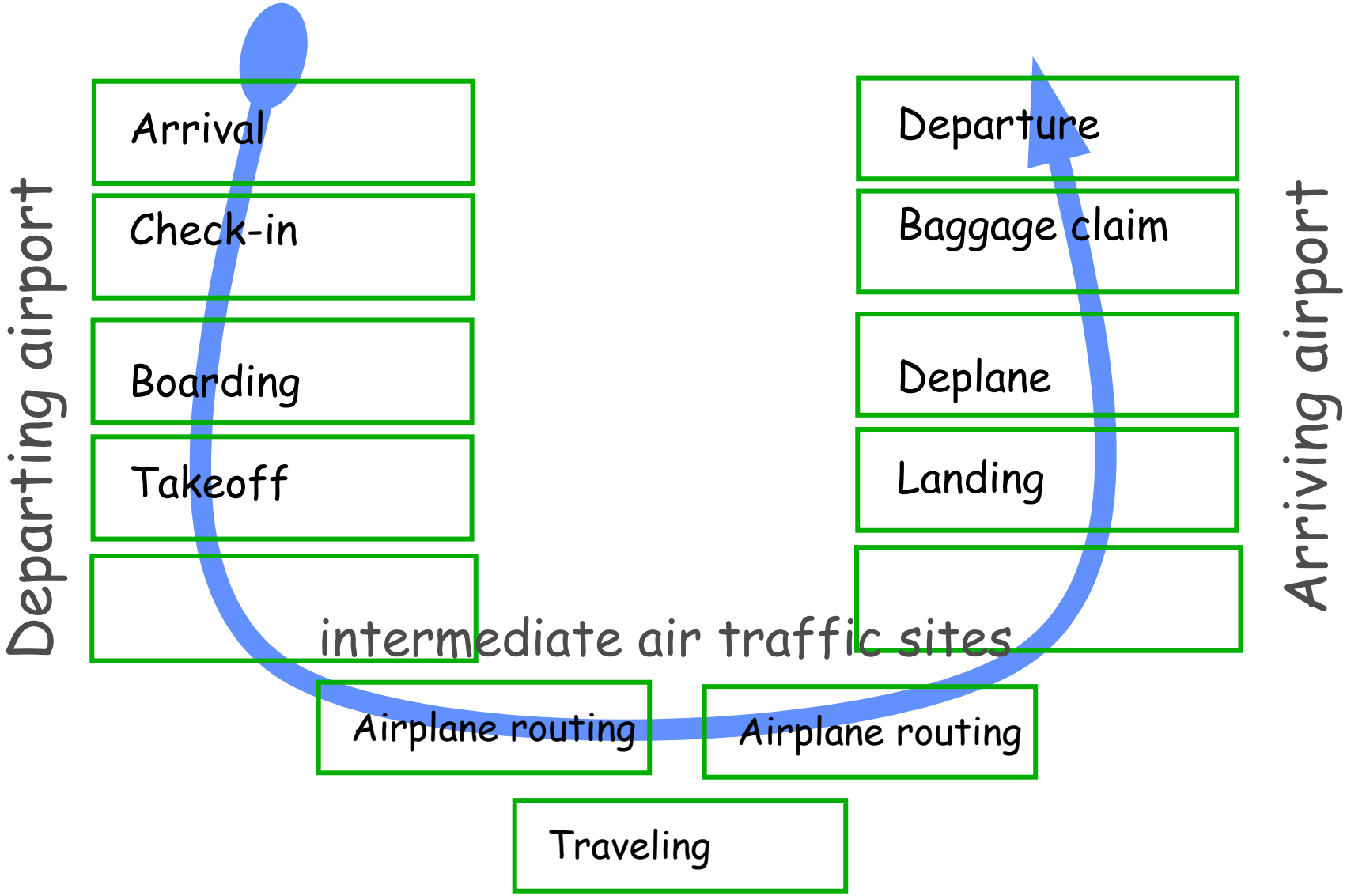
- *What is it?*
- **Building complex systems is hard!**
  - **Approach: “Divide and conquer”.**
  - **Split job into smaller jobs, or layers.**
- *Analogy to other fields.*
  - *Building a house: digging, foundation, framing, etc.*
  - *Car assembly line…*
- *Basic idea: each step dependent on the previous step but does not need to be aware of how the previous step was done.*

Analogy: Air Travel

- *The problem: air travel.*
- *Decomposed into series of steps:*



More on the air travel analogy…



Layered Protocol Design

- ***Layering model** is a solution to the problem of complexity in network protocols*
- *The model divides the network protocols into **layers**, each of which solves part of the network communication problem*
  - *Each layer has its own protocol!*
- *Each layer implements a **service** to the layer above*
  - *Relying on services provided by the layers below.*

Layers

- *Layers are the different components that need to be designed/implemented when designing/implementing networks.*
- *Each layer responsible for a set of functions.*
- *Top layer relies on services provided by bottom layer.*
- *Layer makes it service available to higher layer through an* **interface***.*

Network Architecture

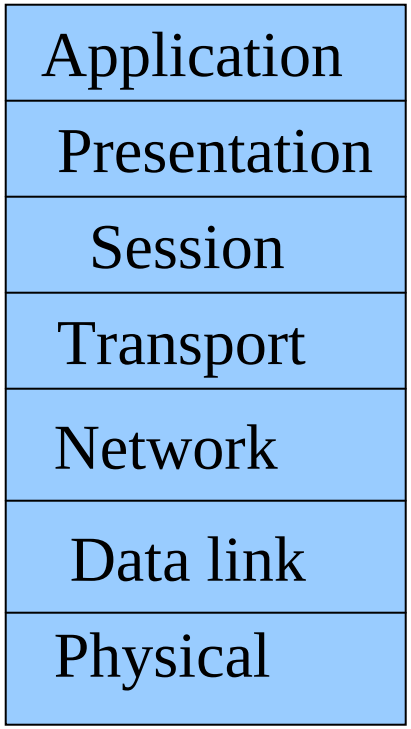
- *Set of layers, what their functions are, the services each of them provide, and the interfaces between them.*
- *A.k.a, protocol stack.*
- *Examples:*
  - *ISO-OSI 7 layer architecture.*
  - *TCP-IP architecture (Internet).*

Network Architecture

- *Set of layers, what their functions are, the services each of them provide, and the interfaces between them.*

Example 1: ISO OSI Architecture

- *ISO: International Standards Organization*
- *OSI: Open Systems Interconnection.*



Layers of Interest in ISO Model

- *Layer 7:* ***Application***
  - *Application-specific protocols (e.g. ftp, http, smtp)*
- *Layer 4:* ***Transport***
  - *Delivery of data between computers (end-to-end).*
- *Layer 3:* ***Network***
  - *Data routing across a network.*
- *Layer 2:* ***Data Link***
  - *Reliable transmission over physical medium.*
- *Layer 1:* ***Physical***
  - *Transmission of bits between two nodes.*

Example 2: TCP/IP Architecture

- *Model employed by the Internet.*