Organization of air travel: a different view

Layers: each layer implements a service
- via its own internal-layer actions
- relying on services provided by layer below
Layered air travel: services

- Counter-to-counter delivery of person+bags
- Baggage-claim-to-baggage-claim delivery
- People transfer: loading gate to arrival gate
- Runway-to-runway delivery of plane
- Airplane routing from source to destination
Distributed implementation of layer functionality

Departing airport
- ticket (purchase)
- baggage (check)
- gates (load)
- runway takeoff
- airplane routing

Arriving airport
- ticket (complain)
- baggage (claim)
- gates (unload)
- runway landing
- airplane routing

Intermediate air traffic sites
- airplane routing
- airplane routing
- airplane routing
Why layering?

Dealing with complex systems:

- explicit structure allows identification, relationship of complex system's pieces
  - layered reference model for discussion
- modularization eases maintenance, updating of system
  - change of implementation of layer’s service transparent to rest of system
  - e.g., change in gate procedure doesn’t affect rest of system

- layering considered harmful?
Internet protocol stack

- **application**: supporting network applications
  - FTP, SMTP, STTP
- **transport**: host-host data transfer
  - TCP, UDP
- **network**: routing of datagrams from source to destination
  - IP, routing protocols
- **link**: data transfer between neighboring network elements
  - PPP, Ethernet
- **physical**: bits “on the wire”
Layering: logical communication

Each layer:
- distributed
- “entities” implement layer functions at each node
- entities perform actions, exchange messages with peers
Layering: logical communication

E.g.: transport
- take data from app
- add addressing, reliability check info to form “datagram”
- send datagram to peer
- wait for peer to ack receipt
- analogy: post office
Layering: physical communication
Protocol layering and data

Each layer takes data from above
- adds header information to create new data unit
- passes new data unit to layer below

source

destination

message
segment
datagram
frame