Intro to LAN/WAN

Introduction (contd)

Home Network Categories

- Computers (desktop PC, PDA, shared peripherals)
- Entertainment (TV, DVD, VCR, camera, stereo, MP3)
- Telecomm (telephone, cell phone, intercom, fax)
- Appliances (microwave, fridge, clock, furnace, airco)
- Telemetry (utility meter, burglar alarm, babycam).

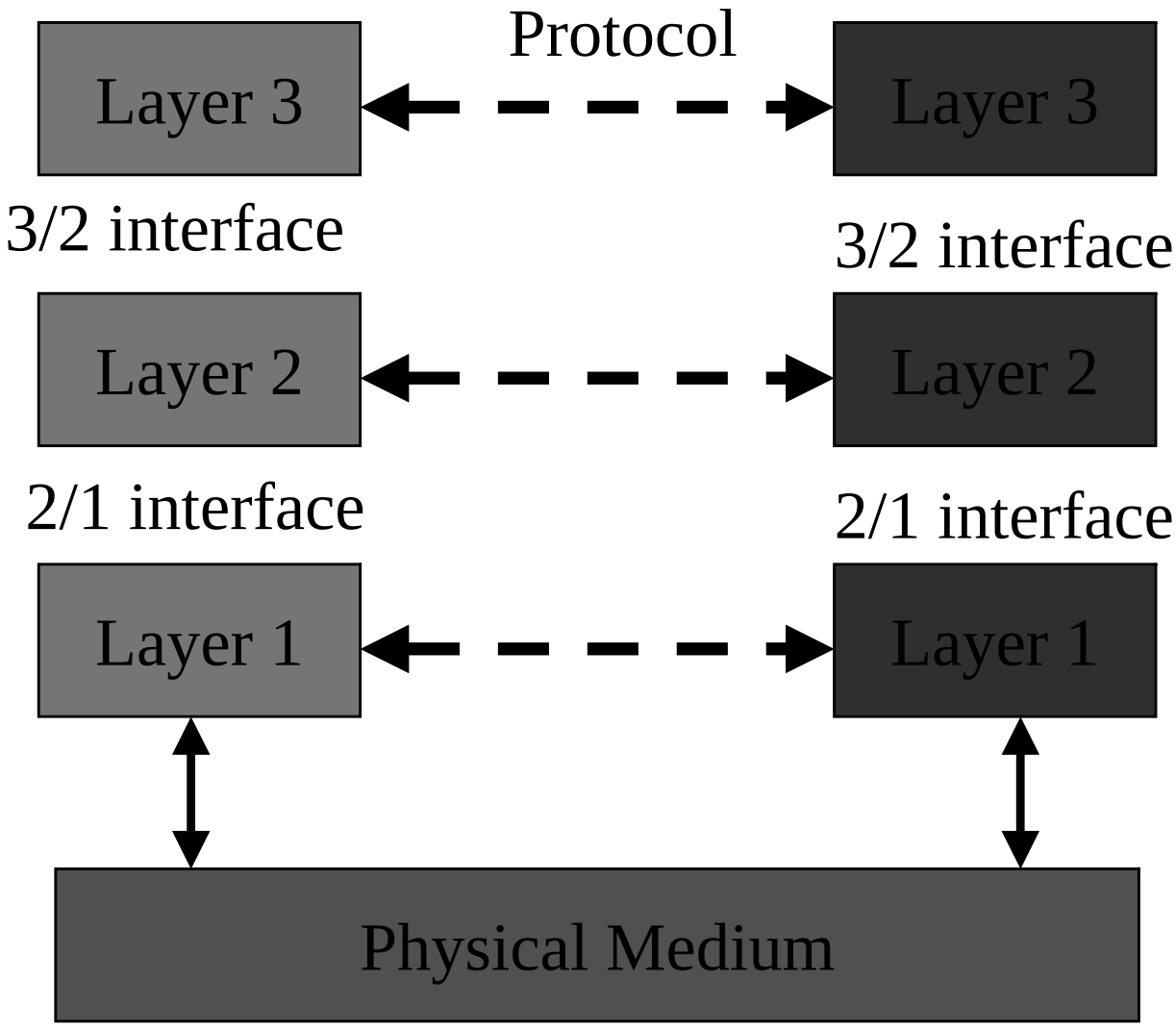
Internetworking

- The connection of different types of networks
- The *Internet*

Implementing Networks

- Need software abstraction to make hardware convenient
- Complex problem (remember OS?)
  - Where do we start?
  - Divide-and-Conquer!
- Layer up from hardware
- Only bare amount needed
- Increasingly sophisticated services

Layering

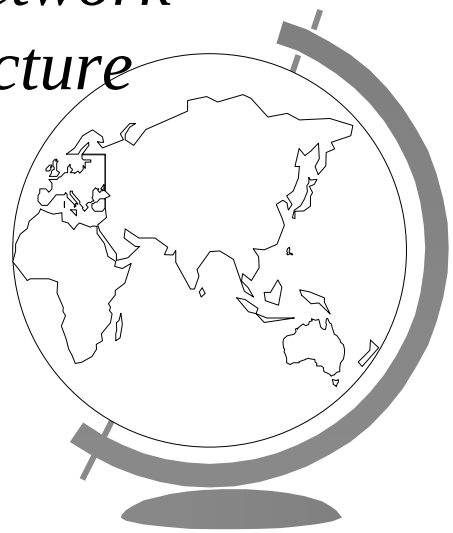


Virtual Communication

Abstraction

Transparency

Layers and protocols form *network architecture*

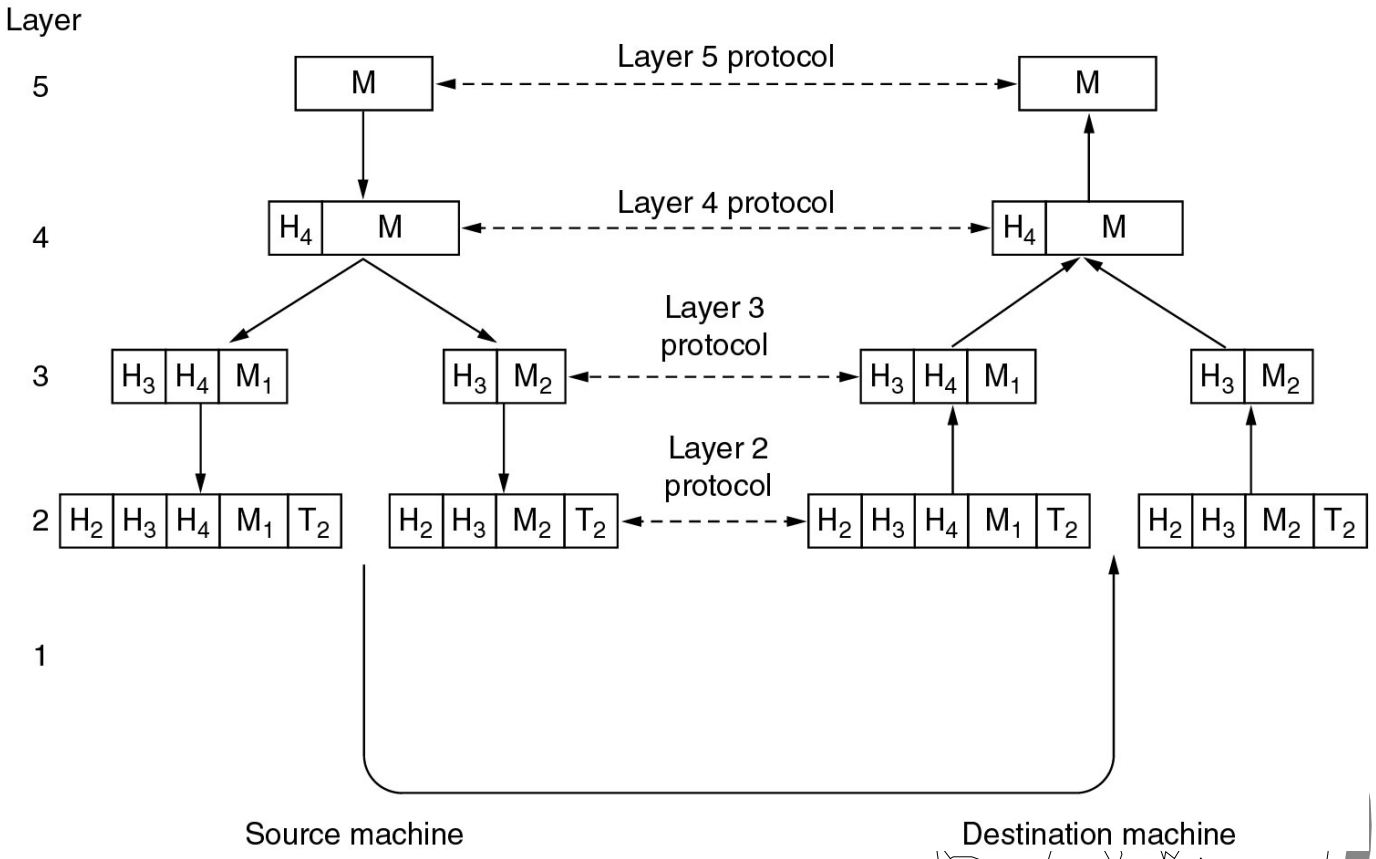


Design Issues for the Layers

- Addressing
- Error Control
- Flow Control
- Multiplexing
- Routing

Network Architecture

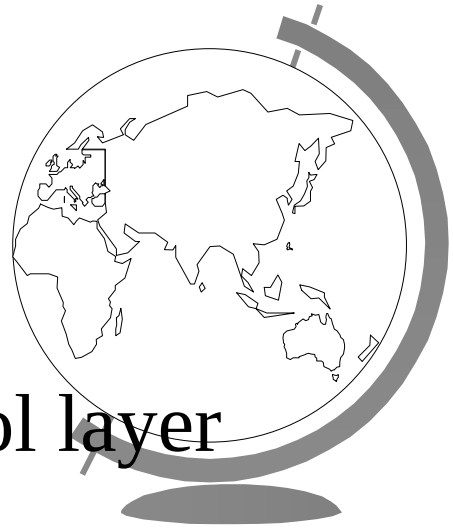
- Two fundamental concepts
  - *messages*
  - *Encapsulation*



- Figure: example of information flow supporting virtual communication in layer 5.

Messages

- Each layer deals with messages
- Have maximum size (ex Ethernet 1500 bytes), 100s-1000s bytes
- Have *control* or *header*
  - used to synchronize with the remote peer
  - contain “instructions” that tell the remote peer what to do with the message
- Have *data* portion
  - arbitrary bytes
  - not of interest in this particular protocol layer



Encapsulation

- Layer N takes data from layer N+1 (above it)
  - encapsulates entire layer N+1 message in the data portion of the layer N
  - it should never look inside the data portion of the message!
- When the remote peer receives a message
  - it strips off the header information and passes only the data to the next higher layer

Connection-Oriented and Connectionless Services

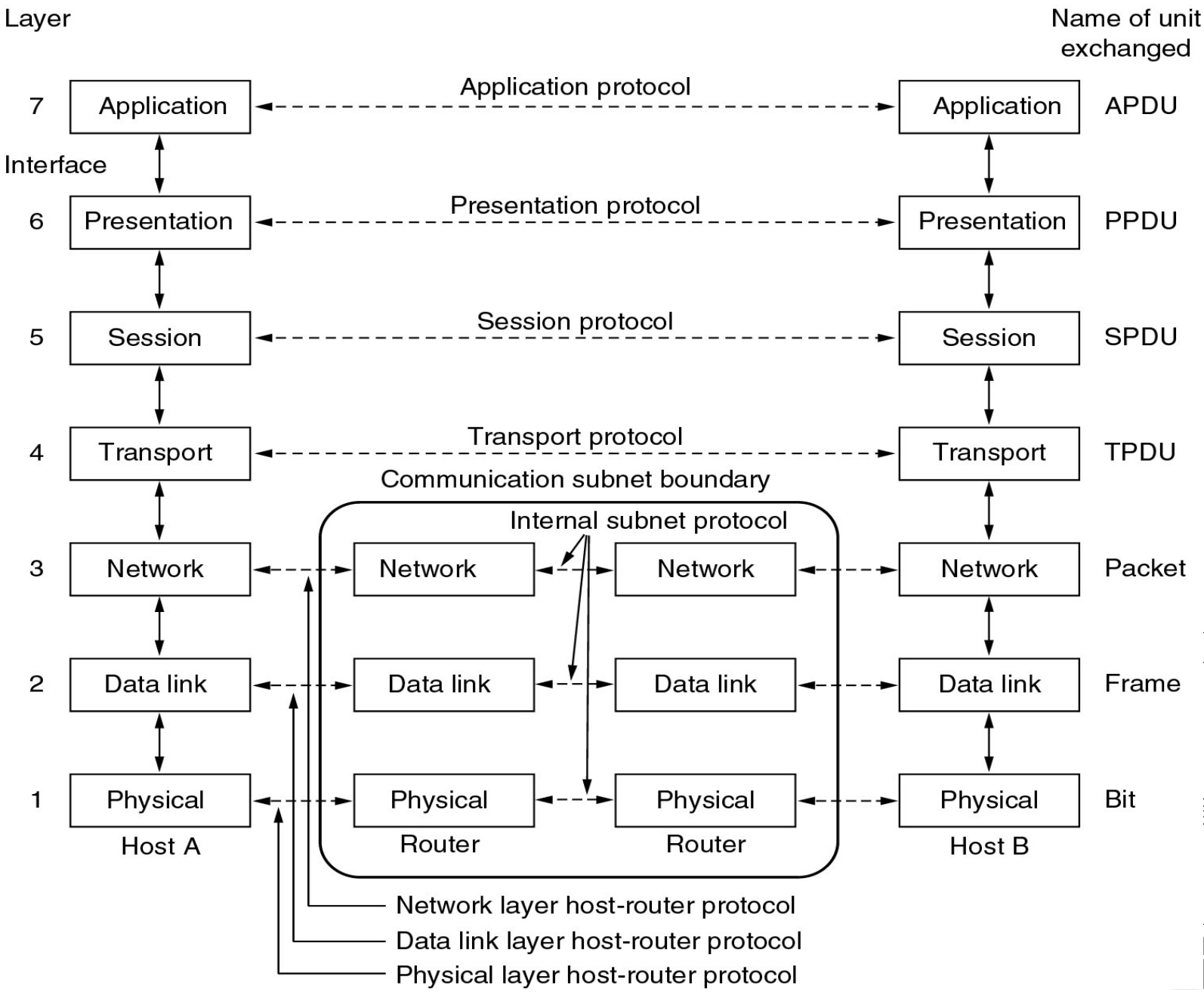
- Six different types of service (section 1.3.3).

	Service	Example
Connection-oriented	Reliable message stream	Sequence of pages
	Reliable byte stream	Remote login
	Unreliable connection	Digitized voice
Connection-less	Unreliable datagram	Electronic junk mail
	Acknowledged datagram	Registered mail
	Request-reply	Database query

Reference Models

- The OSI Reference Model
- The TCP/IP Reference Model
- A Comparison of OSI and TCP/IP
- A Critique of the OSI Model and Protocols
- A Critique of the TCP/IP Reference Model

OSI Reference Model

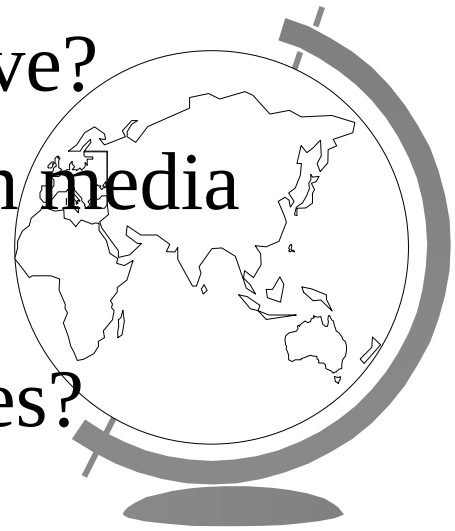


OSI Reference Model

- Standard attempt
- 7 layers:
  - Physical Layer
  - Data Link Layer
  - Network Layer
  - Transport Layer
  - Session Layer
  - Presentation Layer
  - Application Layer
- Layers self-contained
- Minimize messages across boundaries

Physical Layer

- Transmitting raw bits over a “wire”
  - Make sure a “1” bit is sent as a 1
- EE/ECE problem:
  - How many volts represents a “1” or “0”?
  - How long does a bit time last?
  - How many pins does the connector have?
  - How many wires does the transmission media have?
  - Are pulses electrical or optical or waves?



Data Link Layer

- Communication between two machines
- Transforms raw transmission of physical layer into error-free channel
- Divides physical layer physical layer into *frames*
  - messages containing data and control information
- Handles lost, damaged, and duplicate frames (hop by hop)
- Handles slowing down a fast transmitter
  - *flow-control*

Network Layer

- Controls operation of the *subnet*
  - communication between hosts
- Routes *packets* from source to destination
  - not guaranteed delivery
- Handles *congestion*
  - too many packets in network
- Handles *addressing*
  - Which machine?

Transport Layer

- Makes sure data gets delivered to a specific process on a specific machine
- *End-to-end* protocol
  - sender and receiver
- Handles retransmissions, if needed (End to end)
- Handles duplicates, if needed
- Also deals with addressing
  - Which process on a particular machine?
  - The *port* specification in a `socket`

Session Layer

- Long-term connections between processes
- Clean interface to the transport layer
  - Not OS specific (sockets in BSD Unix, or TLI in System V streams)
- Provides synchronization
  - recovering from transport layer failure
  - *token* for flow control

Presentation Layer

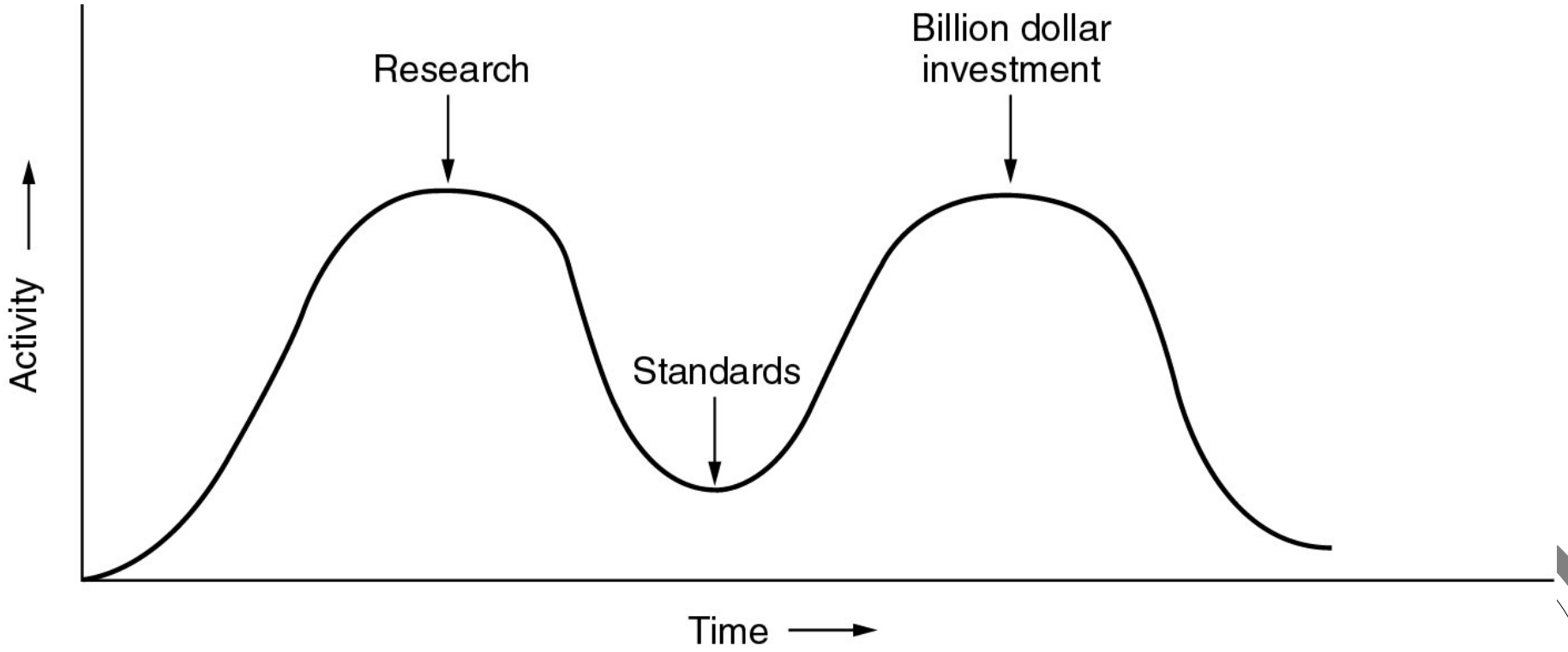
- Apply semantics to data
  - example: name, address …
- Format in agreed upon way
- General services:
  - Format data (ASCII to Unicode)
  - Compressing data
  - Encryption

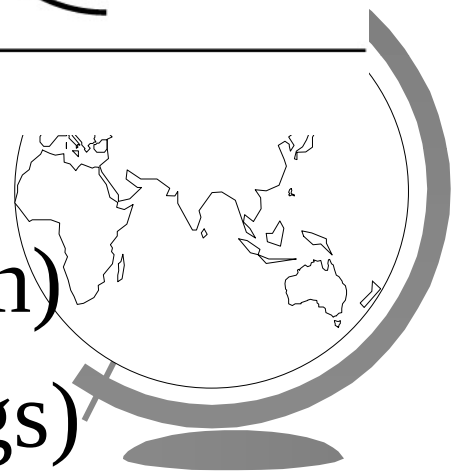
Application Layer

- The user programs themselves
  - ftp
  - telnet
  - Web browser
  - Messenger
  - SSH

Critique of OSI

- The apocalypse of the two elephants.





- Plus, bad technology (big specification)
- Plus, bad politics (pushed by govt. orgs)