Lecture 2.b

Networking 1

Protocol Stacks

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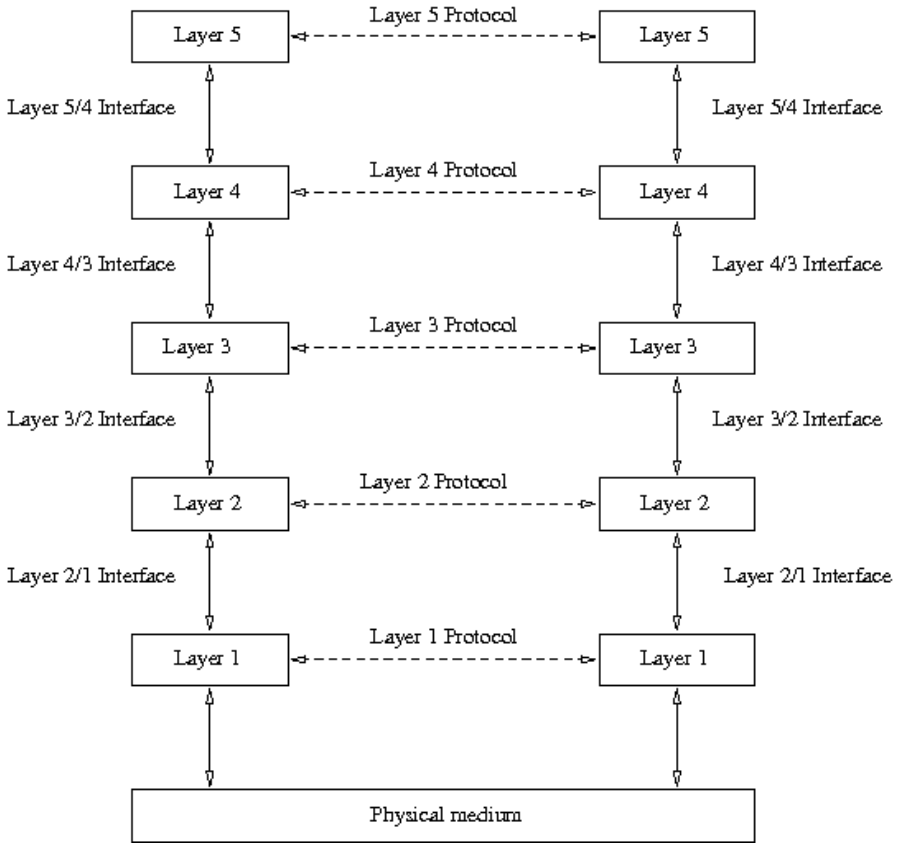
Protocol Hierarchies

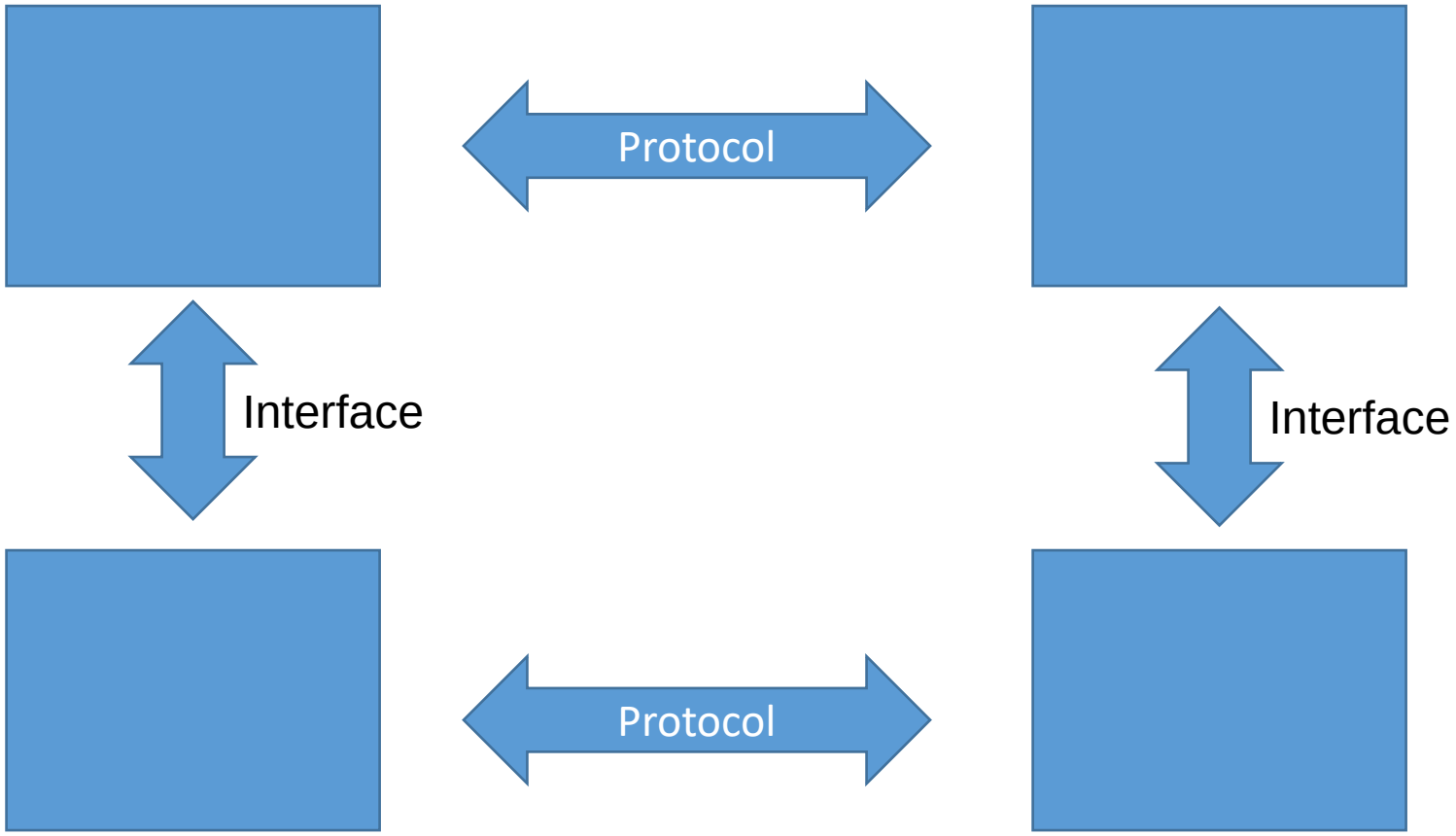
- Reduce the complexity of network communication design
- Organise network communication as a series of layers



Layers

- Layering the model allows us to solve a different problem at each layer.
  - Each layer builds on services of the layer below and offer its functionalities to other higher levels through an ***interface***
  - Higher layers are shielded from lower level implementation details (***transparency)***
- Physical communication takes place at the lowest layer.
- Logically layer n on one machine carries on a conversation with layer n on another machine
  - Equivalent layers are known as peers
  - Notice though that the actual communication takes place down the layer stack
- Rules and conventions used in a logical conversation are called the layer n protocol

Layers



Headers 1

- Each entity may add some additional information intended only for its peer
  - Each translator may include translator's notes and clarifications, or if there are several translators working on either side, a translator name
  - Secretary may attach a cover sheet to the fax, or a greeting in the email message
- These extra pieces of information are stripped away by each peer on the other side before passing the message on to the higher layer

Protocol Suite/Stack

- A set of related protocols that are designed for compatibility is called a **protocol suite**

- Protocol suite designers:
  - Analyse communication problem
  - Divide problems into sub-problems
  - Design a protocol for each sub-problem

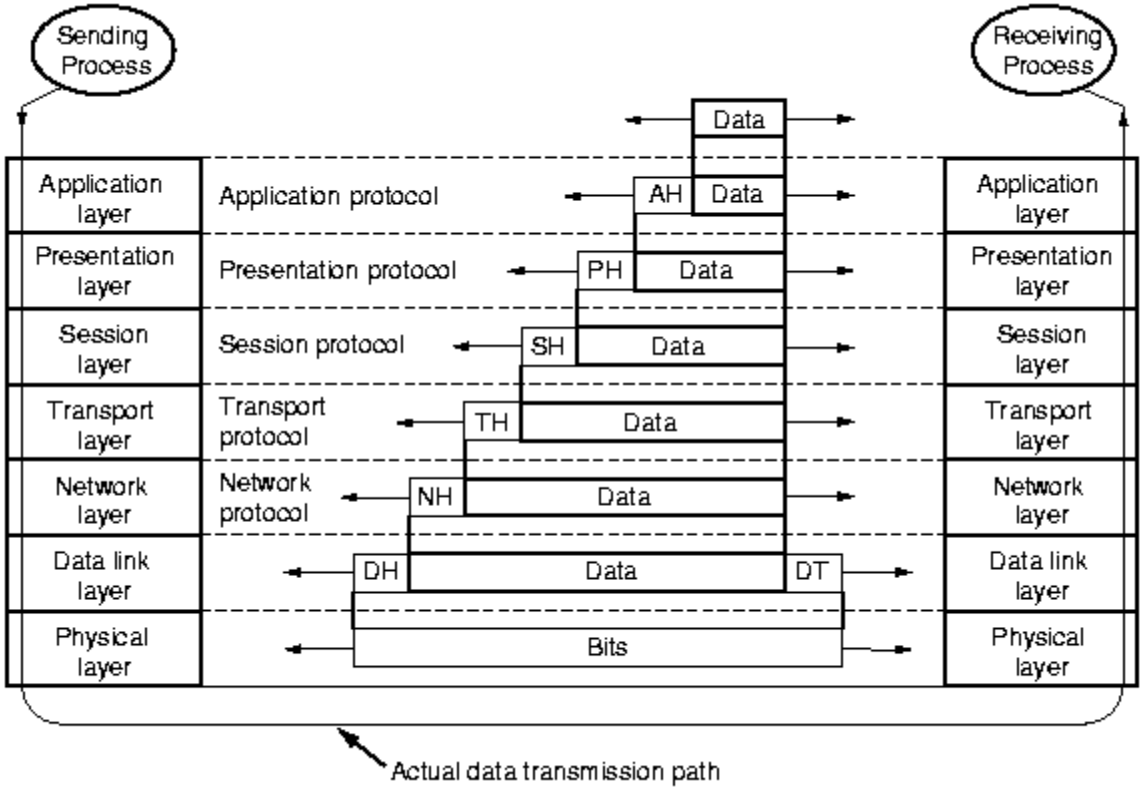
- A well-designed protocol suite
  - Is **efficient and effective** - solves the problem without redundancy and makes the best use of network capacity
  - Allows replacement of individual protocols without changes to other protocols (this is called “**modularity**")

Why layering ?

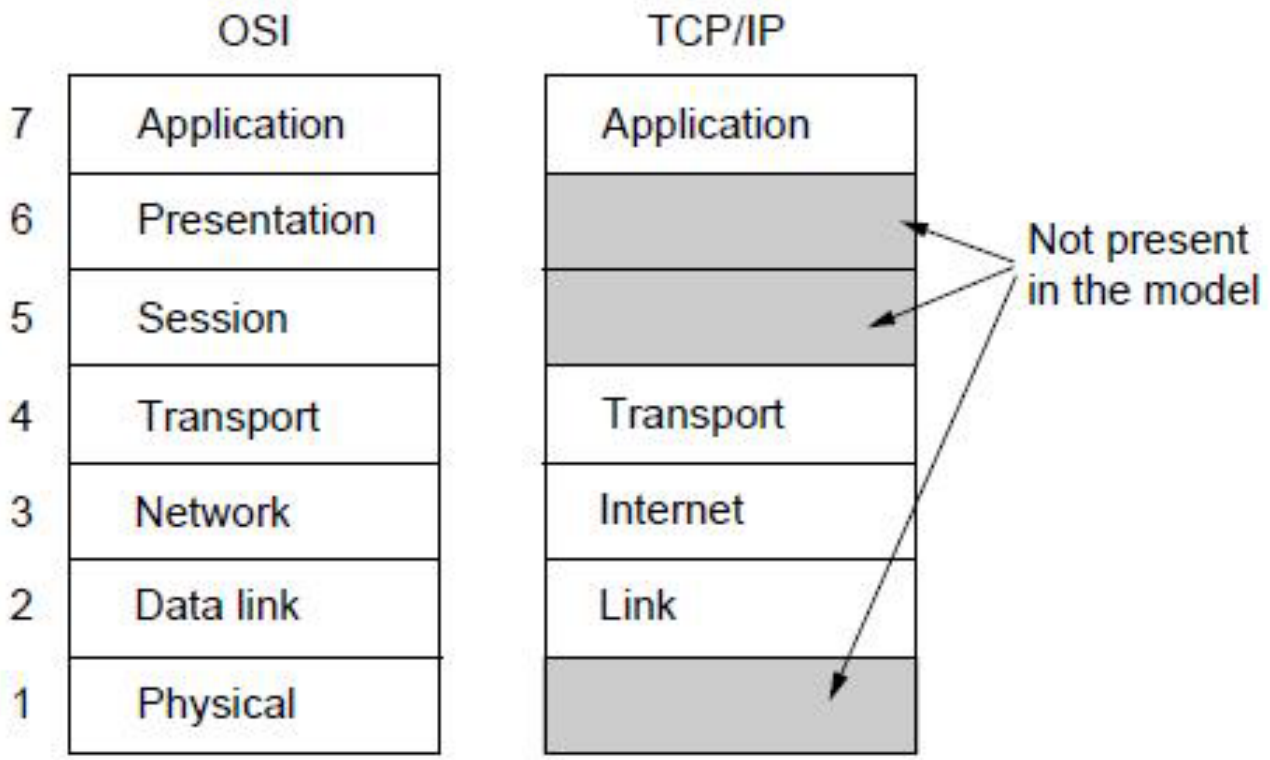
- Allows network designers to break up the complex issues in communication.
  - Explicit structure allows identification and modelling of the relationships of the pieces of a complex system
  - Generally we use the 7-layered OSI model as a reference model
  - Breaking communication task into modules eases maintenance and updating of systems
    - Change of implementation of any layers service should be transparent to rest of the system.
    - i.e. change in procedure in one layer shouldn't effect the rest of system.

OSI Reference Model

- The ISO have divided up these issues over a layered hierarchy of 7 levels called the **ISO Open Systems Interconnection (OSI) Reference Model**



OSI vs TCP/IP


OSI
TCP/IP
7
Application
6
Presentation
5
Session
4
Transport
3
Network
2
Data link
1
Physical
Application
Transport
Internet
Link
Not present
in the model

Internet Protocol Stack (TCP/IP)

- **Application**: how one particular application uses the network. This Species details of how an application program on one machine makes a request and how the application machine responds.

- **Transport**: details of reliable data transfer between two hosts (perhaps distant)
  - Fragments incoming byte stream (from application layer) into segments and passes them to the internet layer (which routes them)
  - At the destination, the receiving TCP process reassembles the segments in to an output stream
  - Handles flow control - fast sender cannot swamp a slow receiver
  - Congestion control: slows down if it detects network congestion

- **Network**: details of routing of datagrams from source to destination
  - Permit hosts to inject packets into any network and have them travel independently to the destination (often via another network)
  - Analogy with snail mail
  - IP, routing protocols

Internet Protocol Stack (TCP/IP)

- **Link**: Controls the link between adjacent nodes
  - Concerned with using physical layer to transmit chunks (frames) of information reliably from node to node
  - Handles sharing of the medium
  - Provides flow control and error handling
  - Provides frame transmission/reception service to the layer above it

- **Physical**: Implements a “bit pipe”
  - Provides unreliable bit transmission/reception service to layer above
  - Concerned with wiring and electrical standards