Lec03_layering

Glossary:

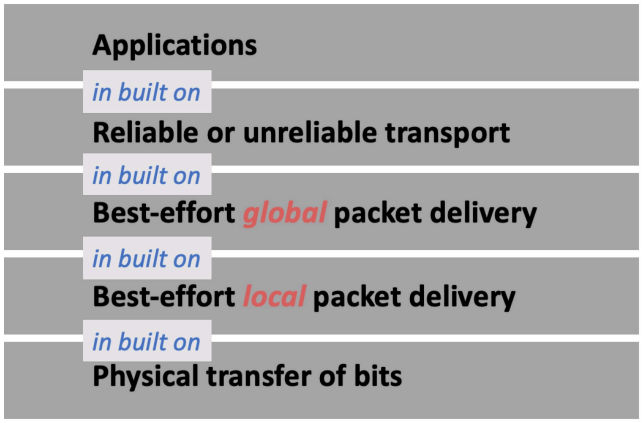
1. *OSI*: Open systems Interconnection

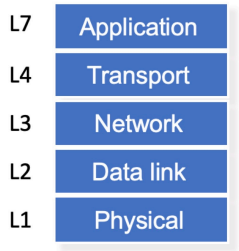
Layers in Internet

Three step to set up a communication:

1. **Decompose** the problem in to tasks;
2. **Organize** these tasks;
3. **Assign** tasks to entities (who does what).

Then, back to the Internet, by decomposition, we have the tasks in the left and by organization we have layers in the right.





Then under the construction of OSI, we have two more layers Session (L5) and Presentation (L6) layer. Session and Presentation layers are often implemented as part of the application layer.

Layers

- Layer: a part of a system with well-defined interfaces to other parts.
- One layer interacts only with layer above and layer below.
- Two layers interact only through the interfaces between them.
- Communication between peer layers on different systems is defined by protocols. (this communication is not a real communication, which means it does not establish a real physical connection directly between peer layers, but through the interactions with layers below.)

Protocol

- An agreement between parties (in the same later) on how to communicate.
- Defines the syntax of communication. In the syntax, header is the instruction on how to process payload. Each protocol defines the format of its headers.

- Also defines the semantics.
- Protocol exist at many levels, hardware, and software. (But there is only **ONE** network layer protocol -- IP.)

Assignment

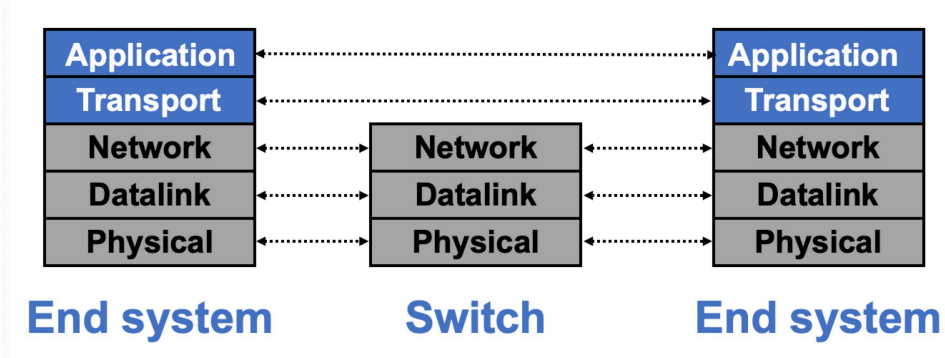
At the end system

- Bits arrive on wire, must make it up to application. Therefore, all layers must exist at host!
- The specific part of end system: application contains web server, browser, mail, game, etc; transport and network layer are typically part of the operating system; datalink and physical layer are hardware/firmware/driver.

In the network

- Bits arrive on wire → physical layer (L1);
- Packets must be delivered across links and local networks → datalink layer (L2);
- Packets must be delivered between networks for global delivery → network layer (L3)
- The network does not support reliable delivery. But Transport layer (and above) at end systems support
- Switches implement only physical and datalink layers (L1, L2)
- Routers implement the network layer too (L1, L2, L3).

Therefore, the lower three layers implemented everywhere and top two layers implemented only at hosts (of end systems).

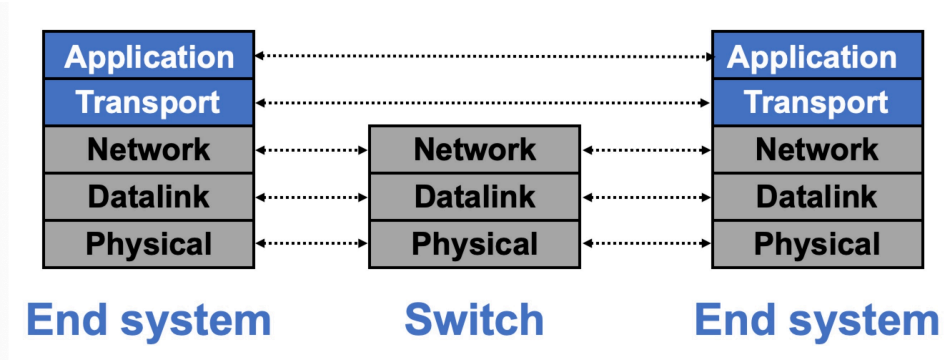


Switches vs. Routers

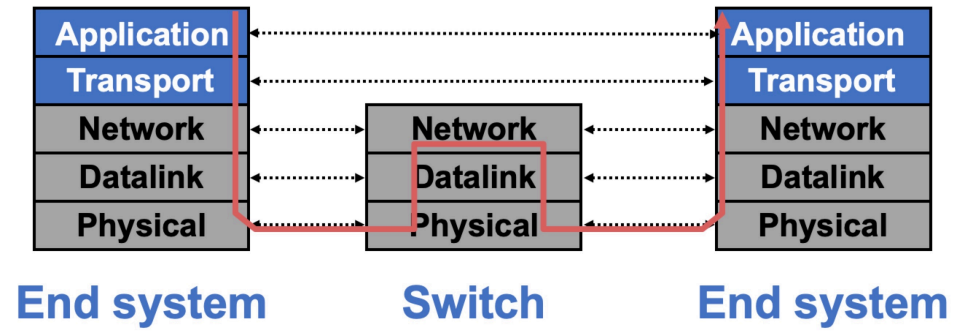
- Switches do what routers do but don't participate in **global** delivery, just local **delivery**. So switches only need to support L1 and L2, routers also need to support L3.
- However, almost all boxes support network layer these days.

Logical and physical communication

- Logical: a layer interact with its peers corresponding layer.



- Physical: communication goes down to physical network then up to relevant layer.



Pros and cons of layering

- Pros: 1. reduce complexity; 2. improve flexibility.
- Cons: 1. Higher overheads; 2. cross-layer information often useful.

Implication of hourglass (IP is the only protocol of network layer)

1. Single network-layer protocal (IP).
2. Allows arbitrary networks to interoperate. Any network that supports IP protocol can exchange packets.
3. Decouples application from low-level networking technologies. Applications function on all networks.
4. Supports simultaneous innovations above and below IP.
5. But changing IP itself is hard (e.g., IPv4 to IPv6).

End-to-end arguments

- Dumb network and smart applicaiton
- Functions that can be completely and correctly implemented only with the knowledge of application end host, should not be pushed into the network
- Sometimes necessary to break this for performance and policy optimizations
- Fate sharing: fail together or don't fail at all
- This argument encourage us to keep IP simple.