Networks

The OSI Model

The seven OSI layers are

1. Physical
2. Data Link
3. Network
4. Transport
5. Session
6. Presentation
7. Application

Networks

The OSI Model: Physical Layer

The *physical layer* (PHY) or *layer 1* is the hardware layer and deals with the transmission of bits over a channel

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Generally, anything to do with choices regarding hardware

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A typical MAC layer sends the data as a sequence of *frames* (recall the packet nature of the Internet). A frame is a chunk of bytes, maybe tens or thousands of bytes long

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The OSI Model: Data Link Layer

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In real implementations, this layer is often strongly intertwined with the physical layer and we tend to talk about both of them together

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And *quality of service*: e.g., ensuring there is always enough bandwidth to stream a video

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Curiously, reliability is not always a requirement of a network!

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In general, a session is just some logically connected set of exchanges that have some unified identity

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The OSI Model: Session Layer

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This may have been through deliberate choice; but it's equally likely they just didn't think about it

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In particular, it decides on representations of data, such as characters, integers and floating point values, colours, sounds and so on so that the source and destination can agree on the data communicated

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The OSI Model: Presentation Layer

So if the source wants to send the number 42, the presentation layer deals with encoding this in a suitable way as (say) some bits, which are then transmitted (passed to layer 5)

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They can agree on “42” regardless of how each host chooses to represent integers internally

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Built on top of these protocols are the applications that the users see, e.g., Firefox or Chrome for the Web, Outlook or Thunderbird for email

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Layering Models

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And in a way that it can be untransformed back again

Networks

Layering Models

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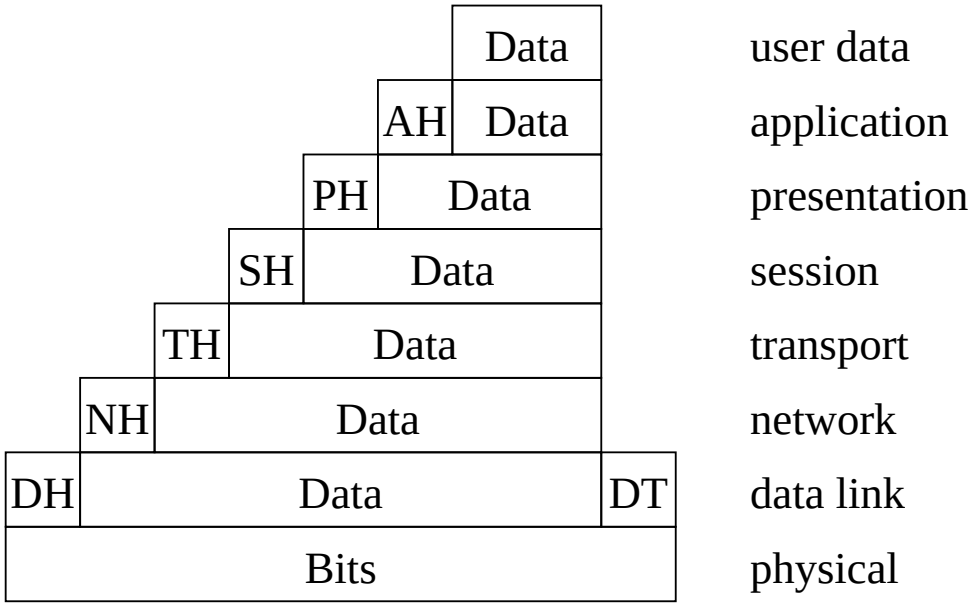
- do some arbitrarily complicated manipulation
- do nothing at all!

Networks

Layering Models



A possible (but unlikely) OSI encapsulation

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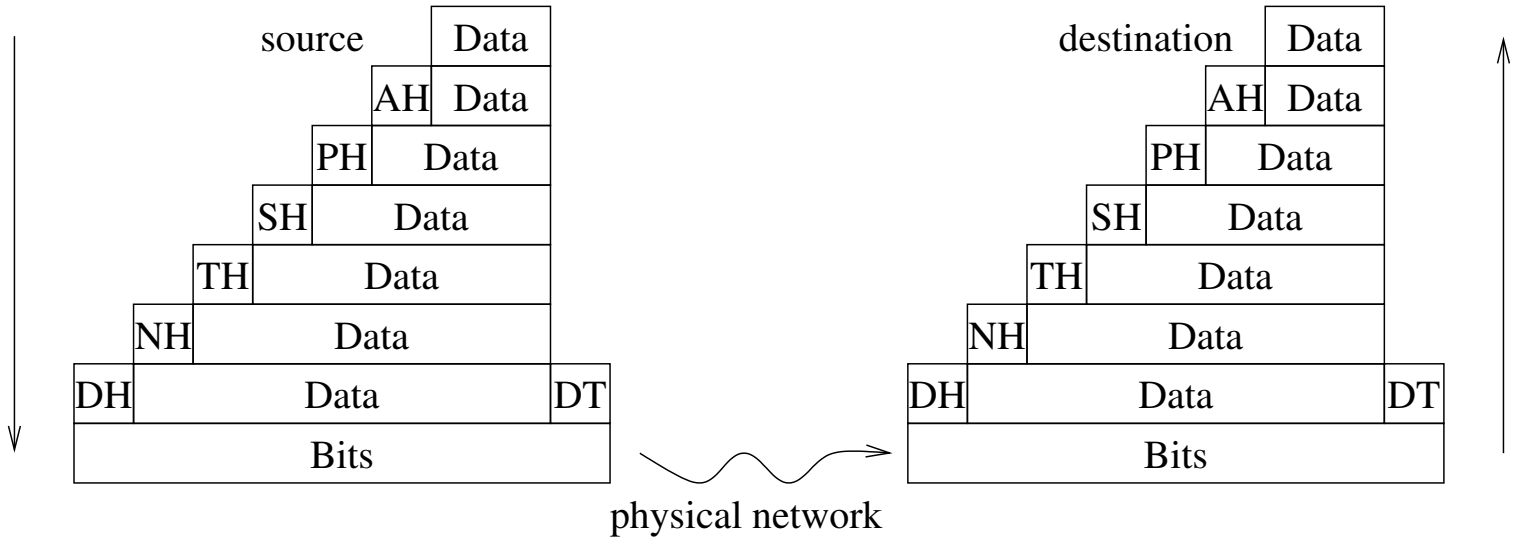
Layering Models



Data is encoded and decoded

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Encapsulation

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What do you do if your data happens to contain the value 4?

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E.g., value 4 might mean “end of transmission” and the modem should drop the connection

What do you do if your data happens to contain the value 4?

You can’t just send it, as the modem would interpret the data as a command and end the connection

Networks

Encapsulation

So you need to transform the data somehow so that “4” is never seen by the modem in the datastream

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This is why encapsulation is necessary: so data can be transmitted accurately, even if you are using weird hardware

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Byte Stuffing

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The “DB” is called an *escape character*, and its presence in the datastream means the next character is encoded, so special action must be taken

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With byte stuffing, we exchange some expansion of the data for the correct transmission of that data

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Of course, modern hardware doesn't act like early modems, but the principle remains

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Layering Models

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- It may transform the characters in some way, e.g., converting video into a transmissible format; it might prepend its own header to indicate what it has done

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Eventually, the physical layer transmits some bits

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So why do this as it seems so wasteful?

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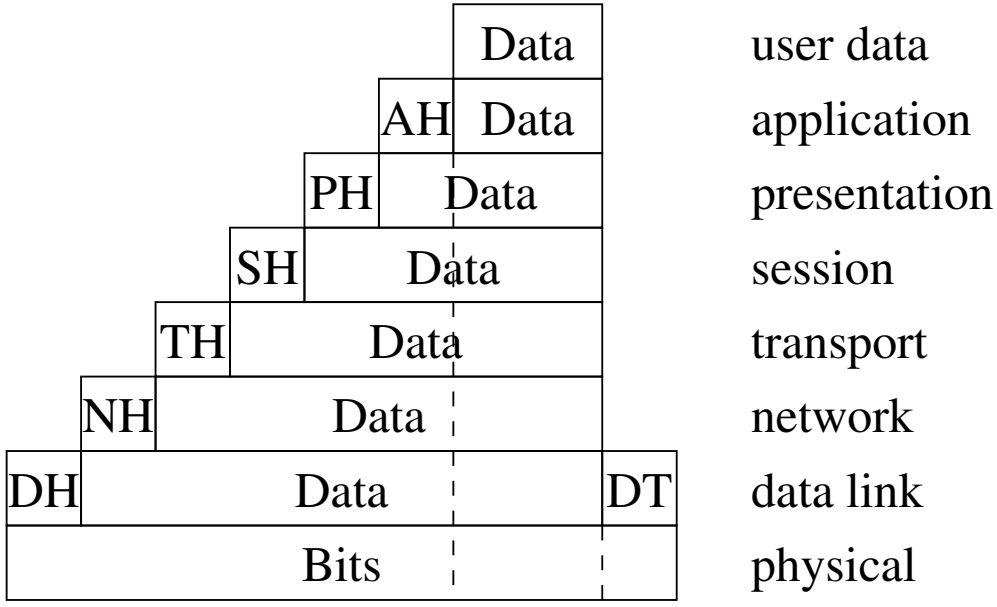

Encapsulation overhead

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Layering Models

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It also gives flexiblity

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And we can slot in the implementation for the new hardware in exactly the same way

We don't have to rewrite our email application (and Web browser, and all our other applications) because of the upgrade

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Exercise Read RFC1149

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As long as it has the right behaviour, it doesn't matter how it is actually implemented

Networks

Layering Models

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This enables useful tricks like *tunnelling*, which we shall look at later