The Transport Layer

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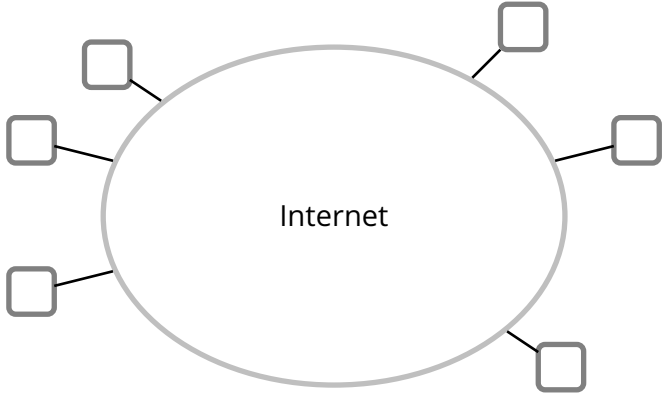
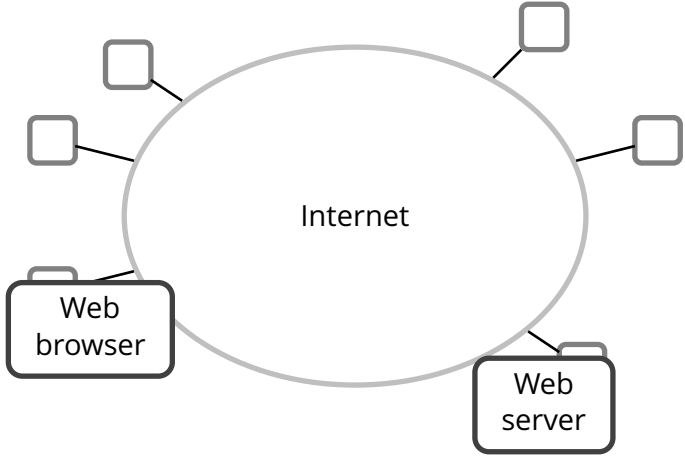
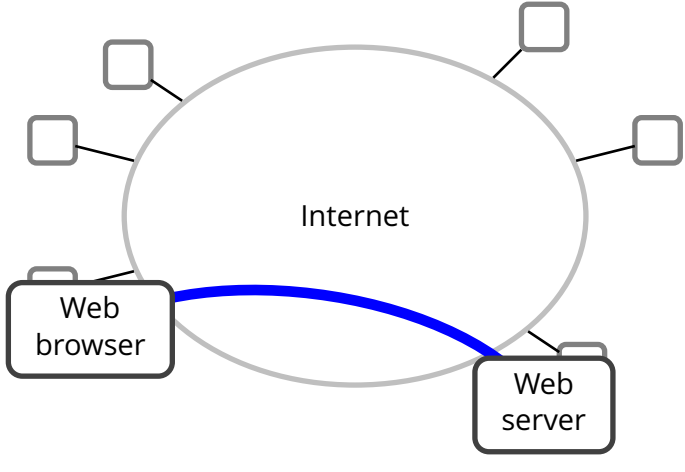
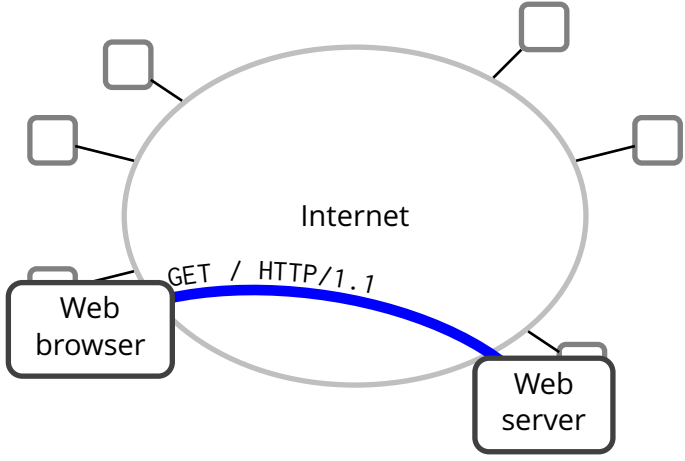
Outline

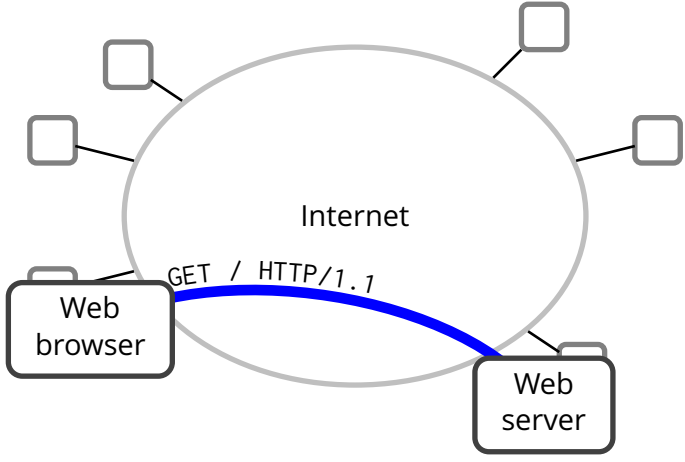
- Basic concepts in transport-layer protocols
- Multiplexing/demultiplexing
- UDP message format
- Reliable transfer


Internet


Internet
Web
browser
Web
server


Internet
Web
browser
Web
server


Internet
GET / HTTP/1.1
Web
browser
Web
server



Primitive communication between applications

Type of Service

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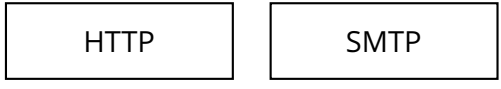

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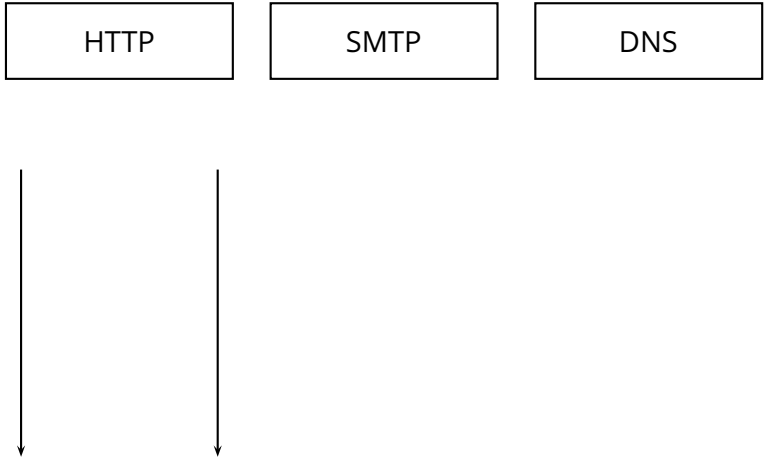

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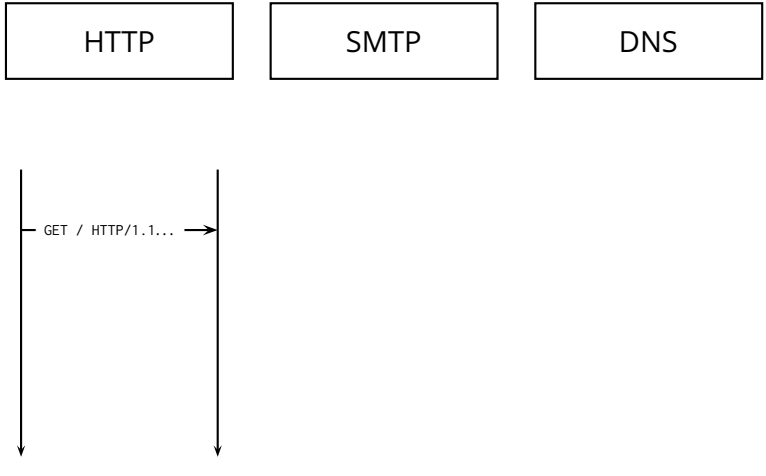

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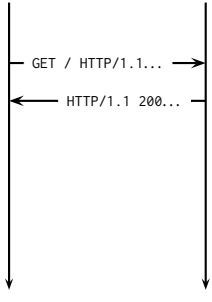

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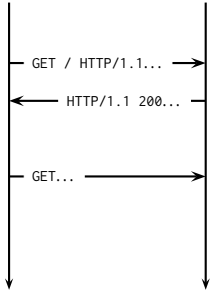

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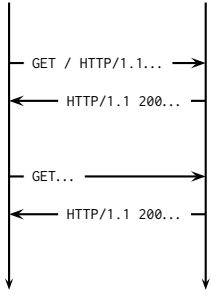

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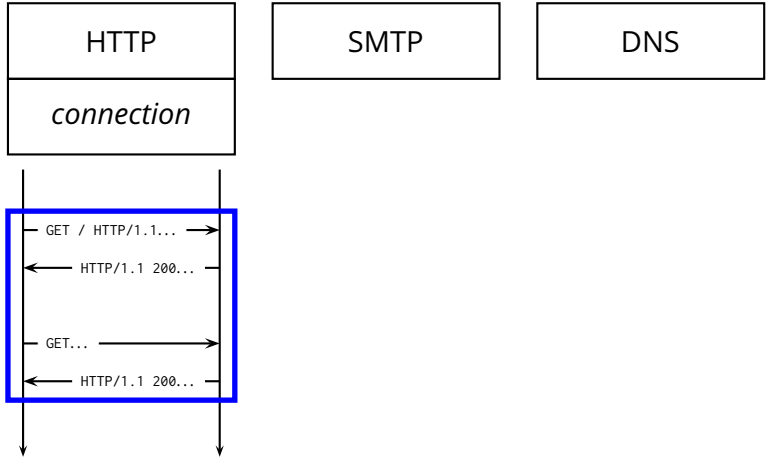

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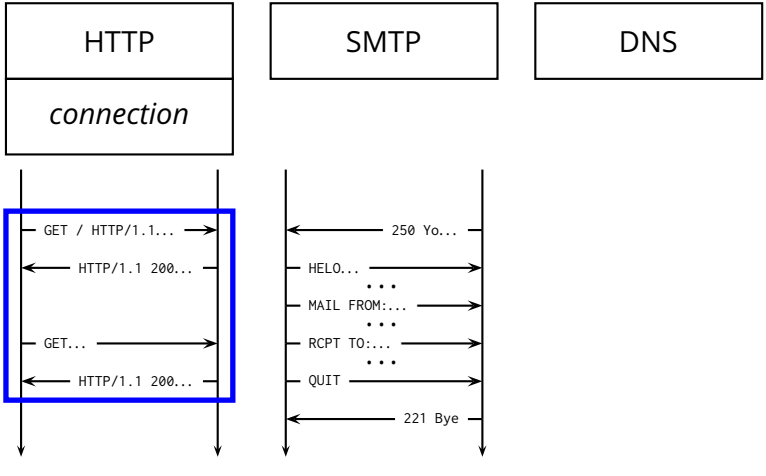

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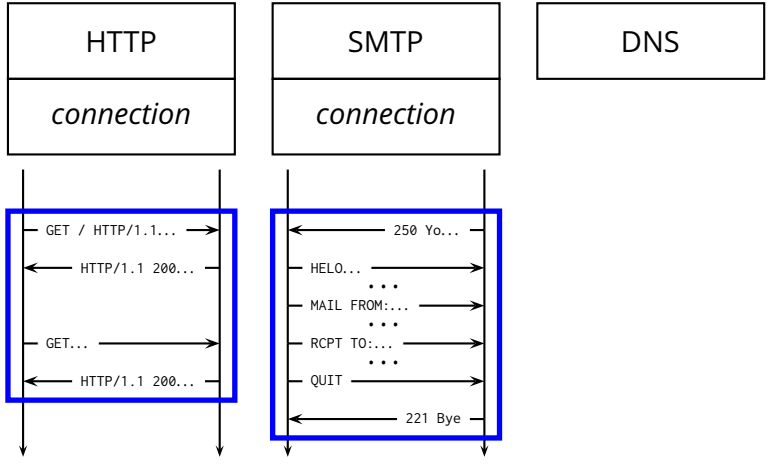

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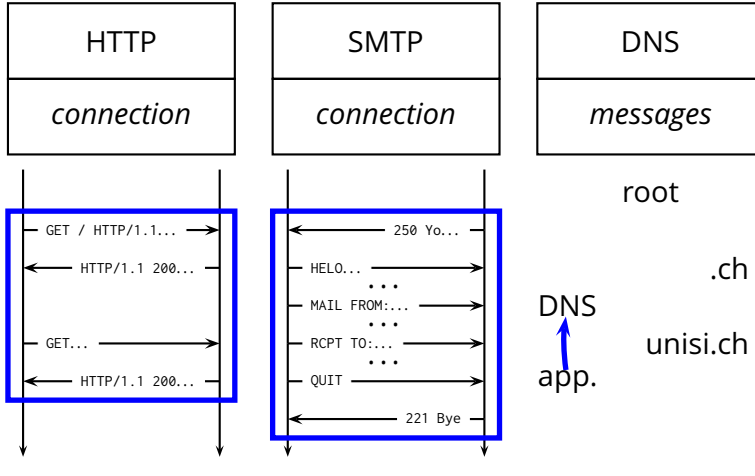

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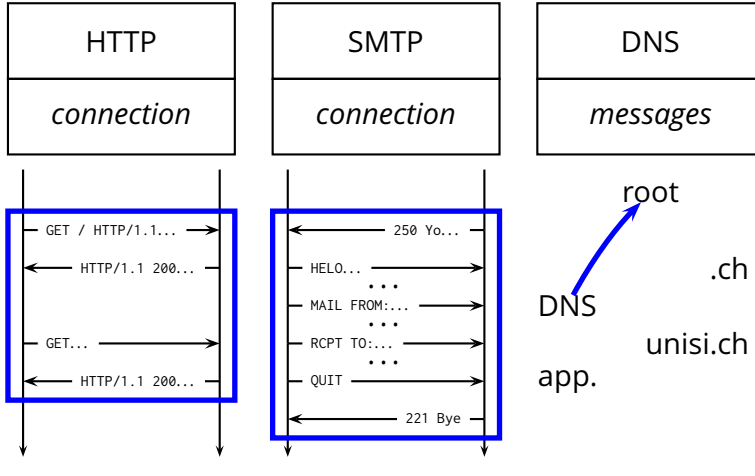

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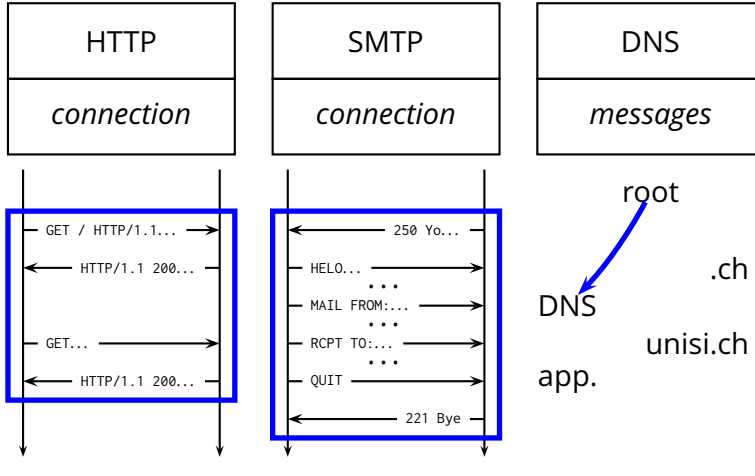

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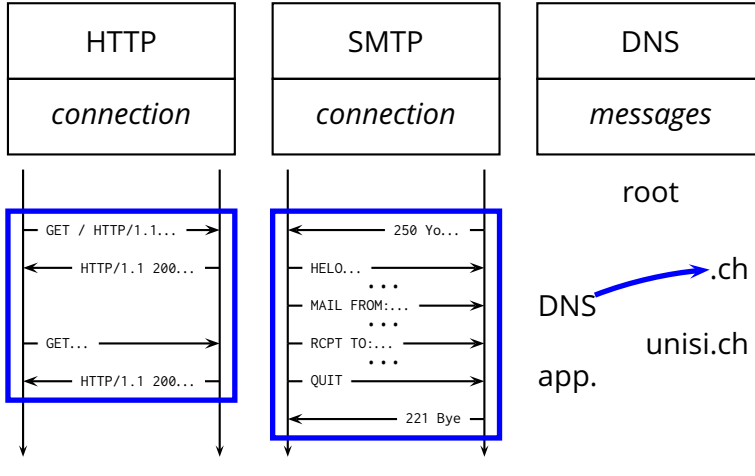

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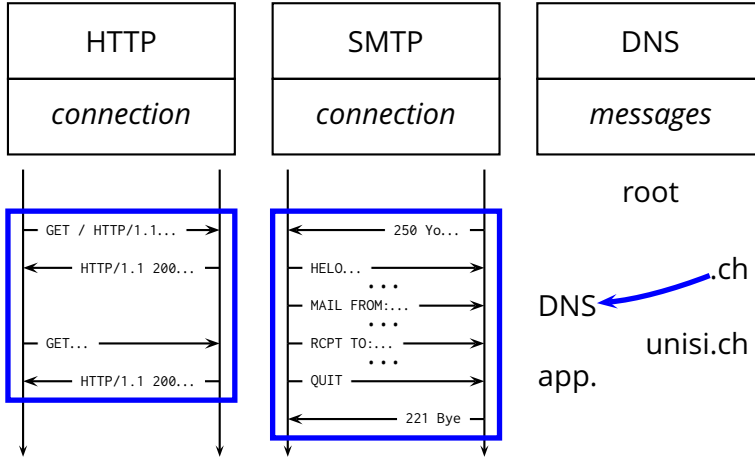

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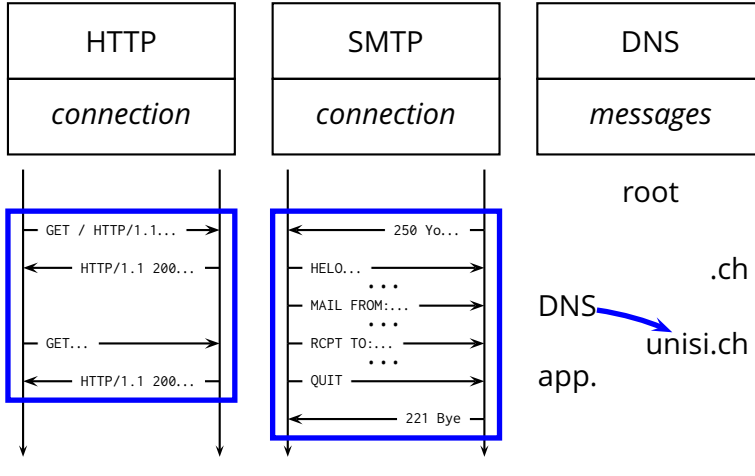

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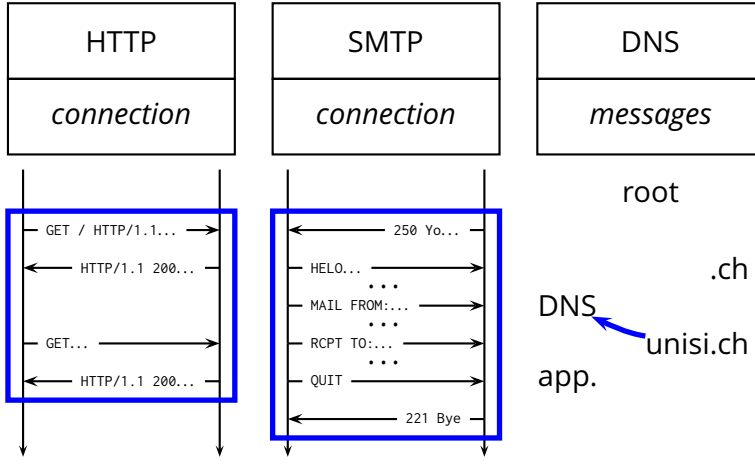

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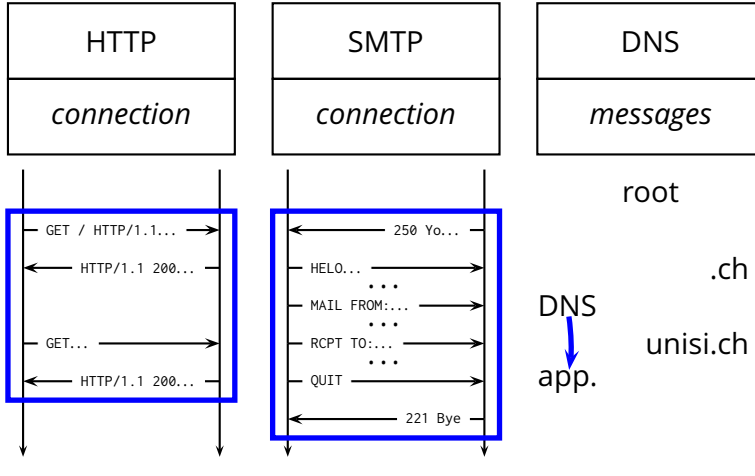

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- Terminology
  - transport-layer packets are called ***segments***
- Basic assumptions on the underlying network layer
  - every host has one unique *IP address*
  - best-effort delivery service
    - no guarantees on the integrity of segments
    - no guarantees on the order in which segments are delivered

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- ***Reliable data transfer***
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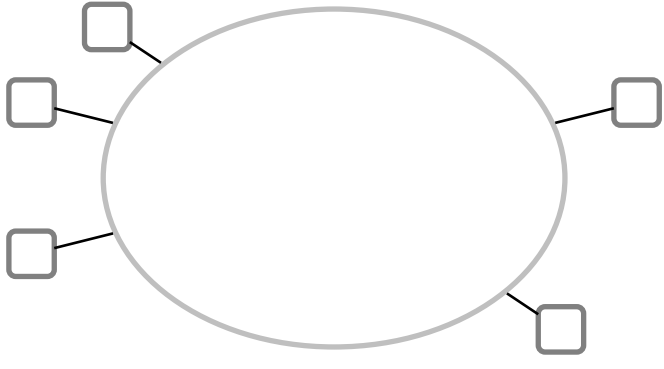
- ***Connections***
  - i.e., streams
  - can be seen as the same as ordered delivery
- ***Congestion control***
  - i.e., end-to-end traffic (admission) control so as to avoid destructive congestions within the network

Multiplexing/Demultiplexing



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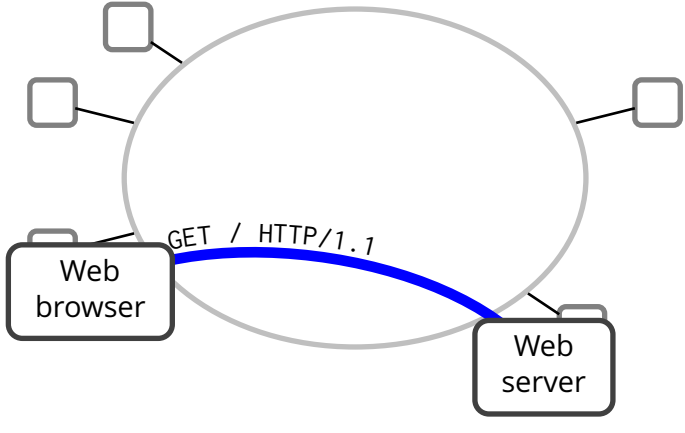

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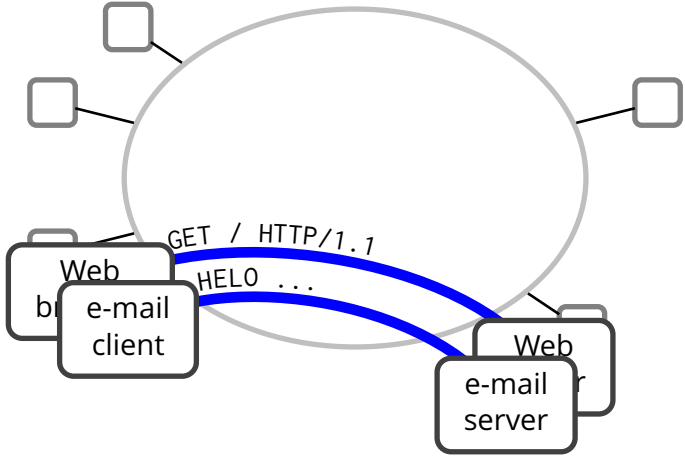

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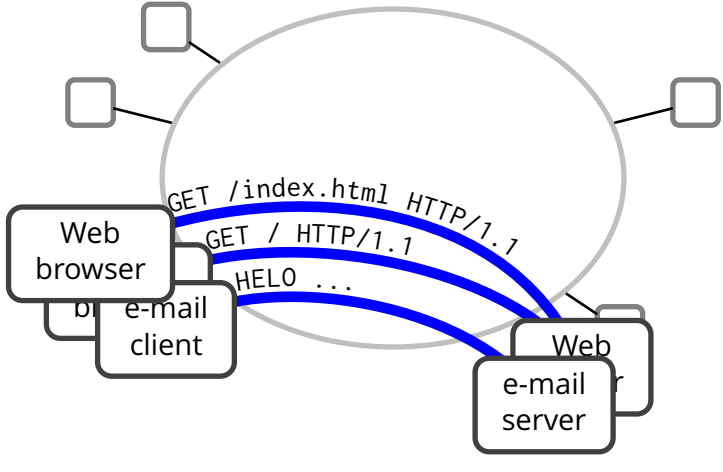

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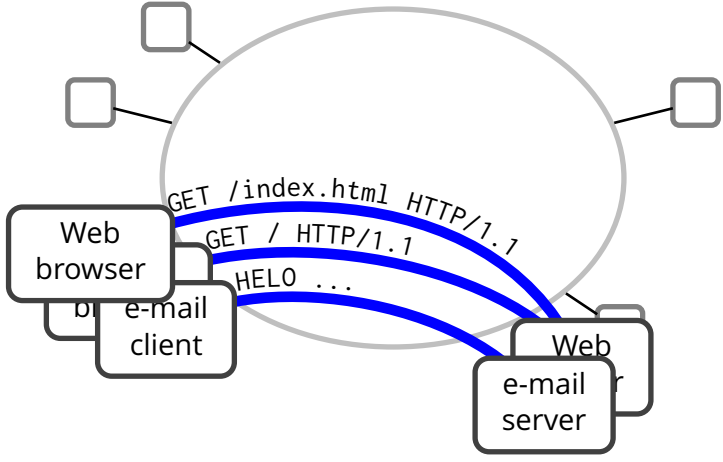
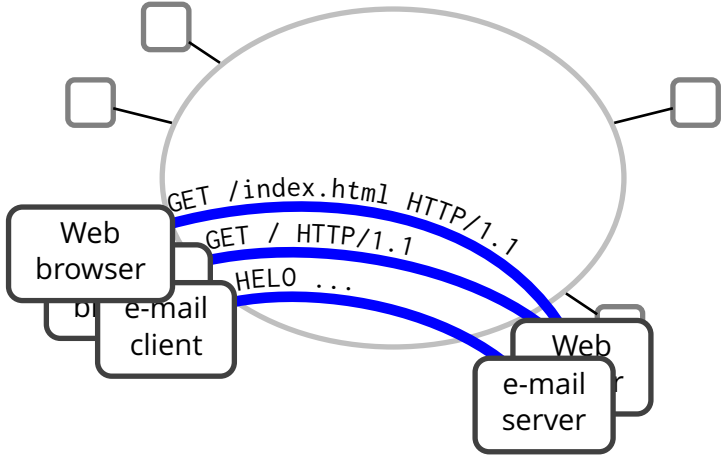


How do we distinguish all these “connections”?

Multiplexing/Demultiplexing



How do we distinguish all these “connections”?
(in this case, connections between the same two hosts)

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  - outside the scope of the definition of the transport layer
  - but of course we can have “well-known” service numbers

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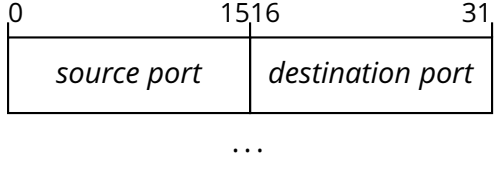

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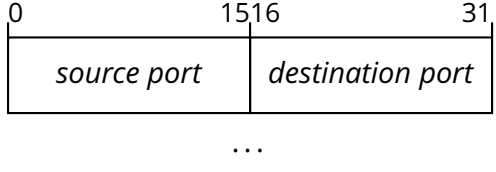

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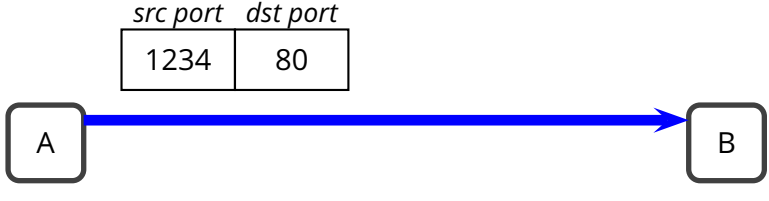

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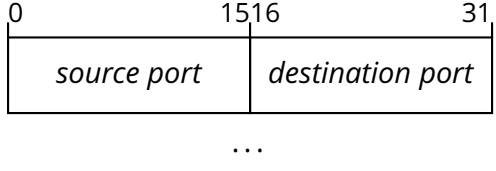

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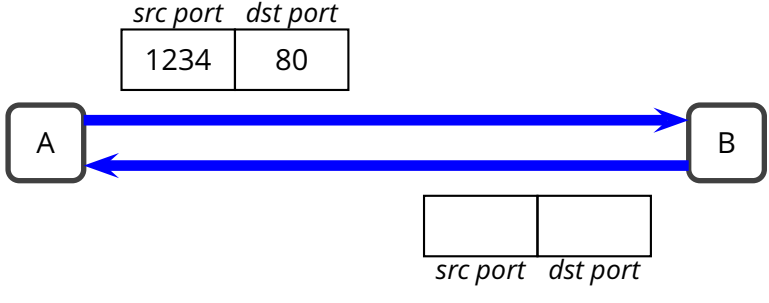

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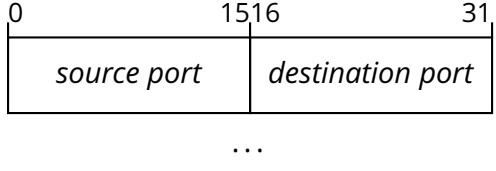

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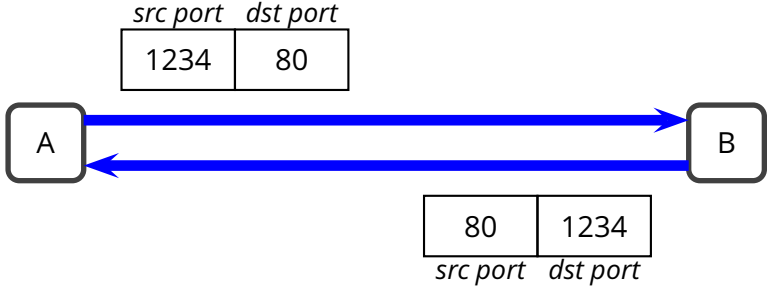

UDP Packet Format

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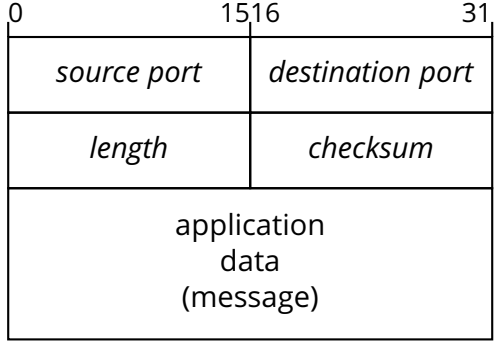

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- What should happen when the checksum doesn't check?