Application Layer
Part 4

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Case / ICSI

EECS 325/425
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"I don't really want to stop the show,
But I thought that you might like to know,
That the singer's going to sing a song,
And he wants you all to sing along."

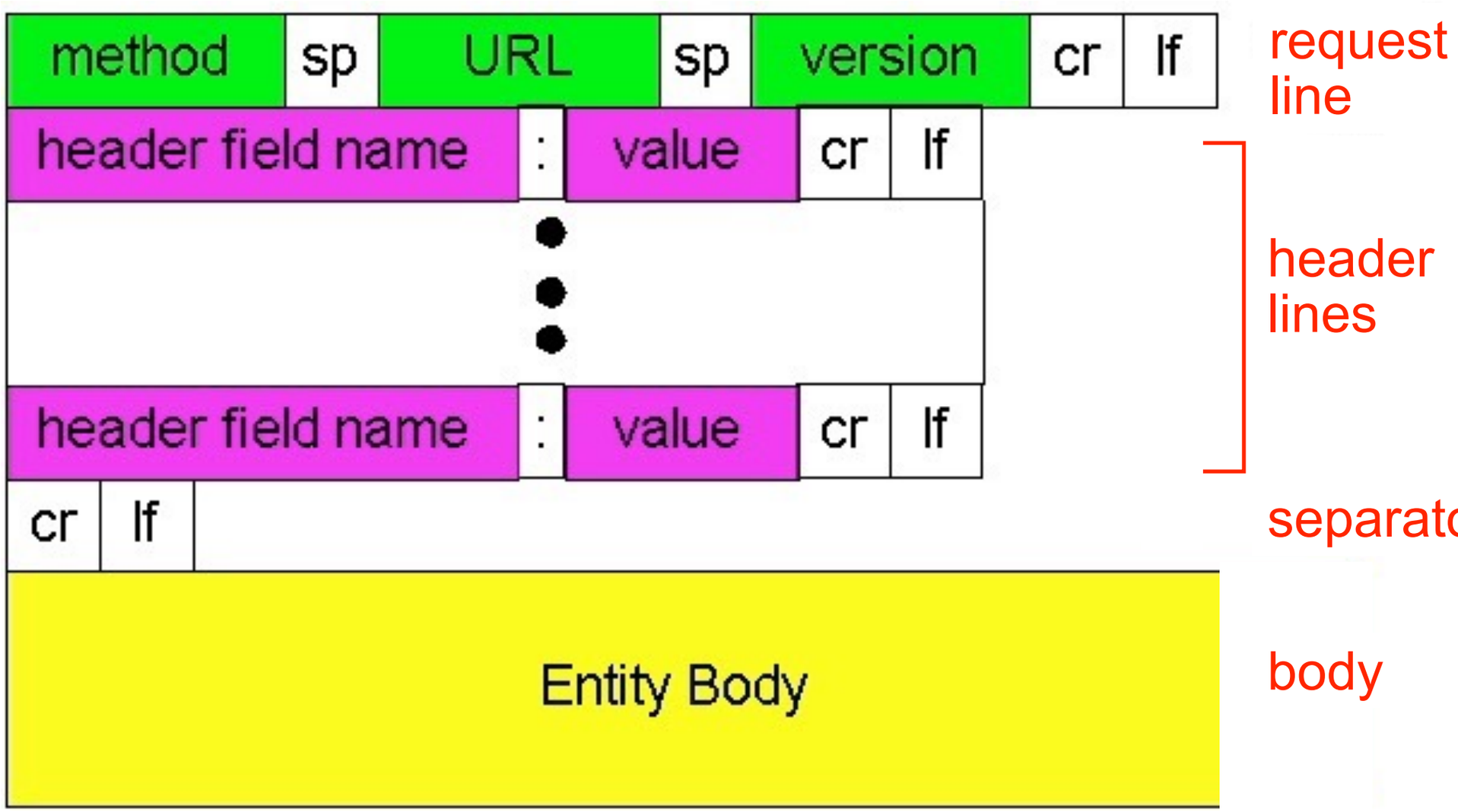
Many of these slides are more-or-less directly from the slide set developed by Jim Kurose and Keith Ross for their book “Computer Networking: A Top Down Approach, 5th edition”.

The slides have been lightly adapted for Mark Allman’s EECS 325/425 Computer Networks class at Case Western Reserve University.

Beyond Basic HTTP

- HTTP is a *big* protocol / ecosystem with many extensions and variants
- Let's consider a few examples (not exhaustive in any way)

HTTP request message: general format



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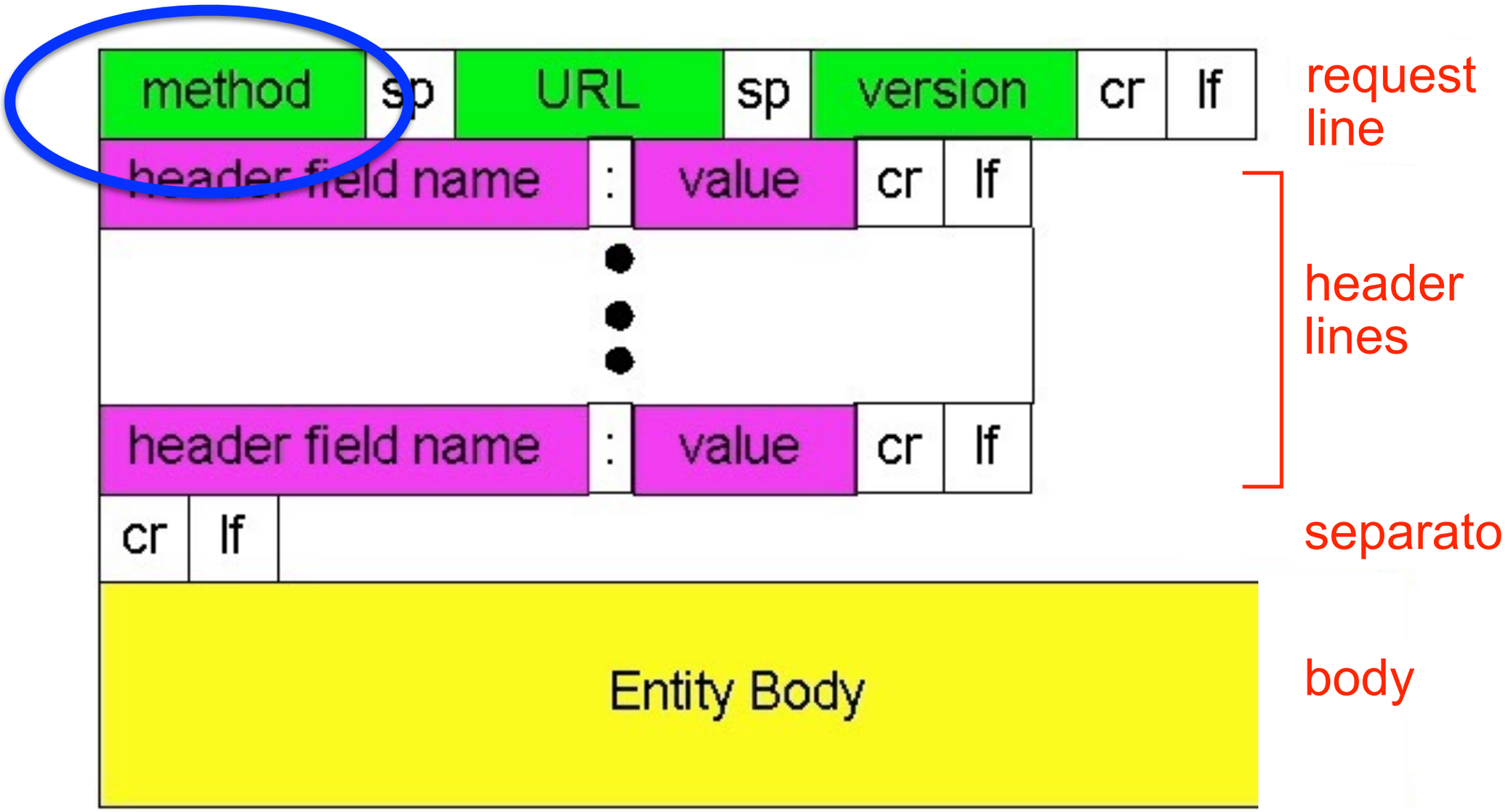

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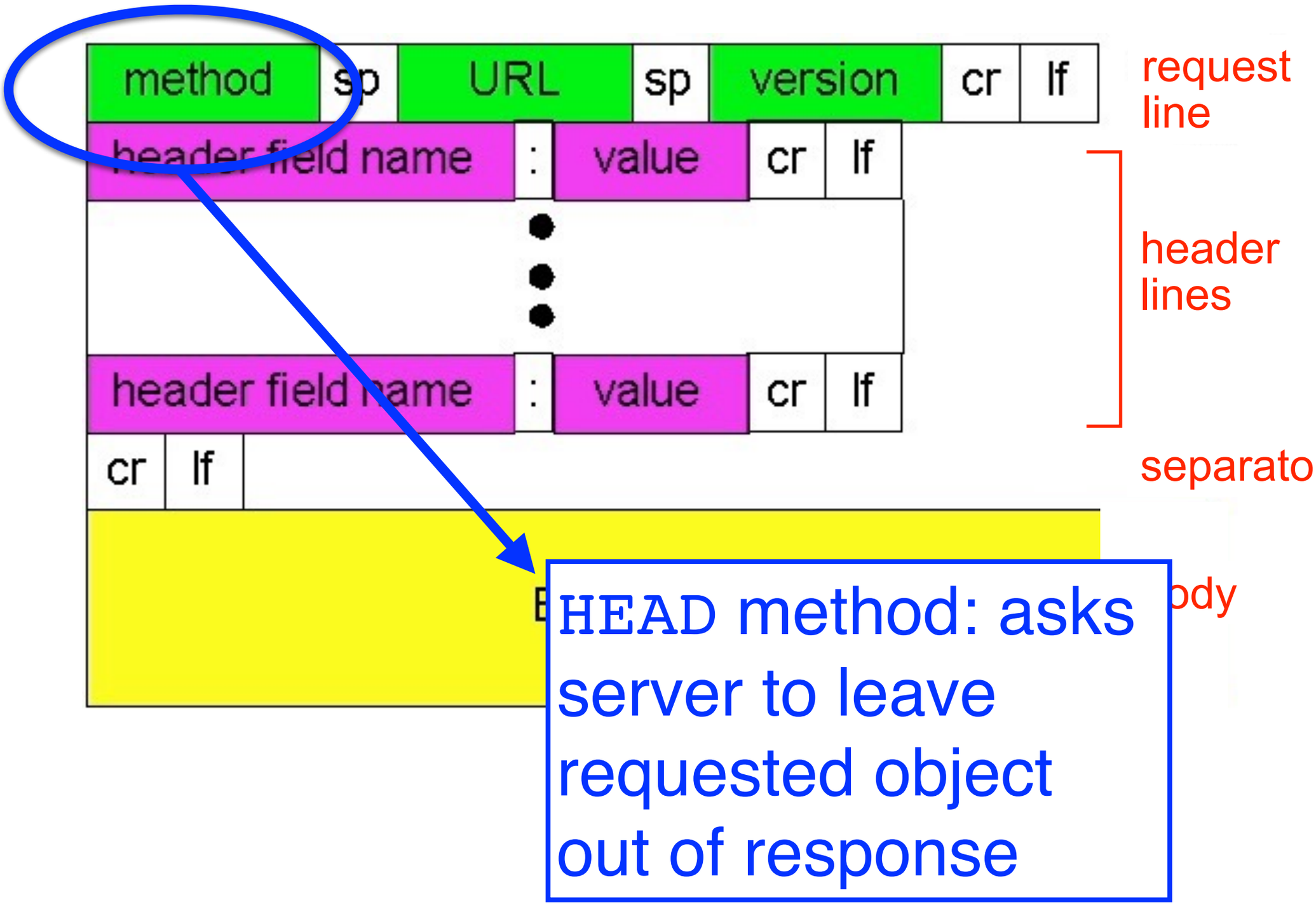

HTTP response message

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HTTP/1.1 200 OK\r\n
Date: Sun, 26 Sep 2010 20:09:20 GMT\r\n
Server: Apache/2.0.52 (CentOS)\r\n
Last-Modified: Tue, 30 Oct 2007 17:00:02 GMT\r\n
ETag: "17dc6-a5c-bf716880"\r\n
Accept-Ranges: bytes\r\n
Content-Length: 2652\r\n
Keep-Alive: timeout=10, max=100\r\n
Connection: Keep-Alive\r\n
Content-Type: text/html; charset=ISO-8859-1\r\n
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Conditional GET

- Goal: don't send object if cache has up-to-date cached version
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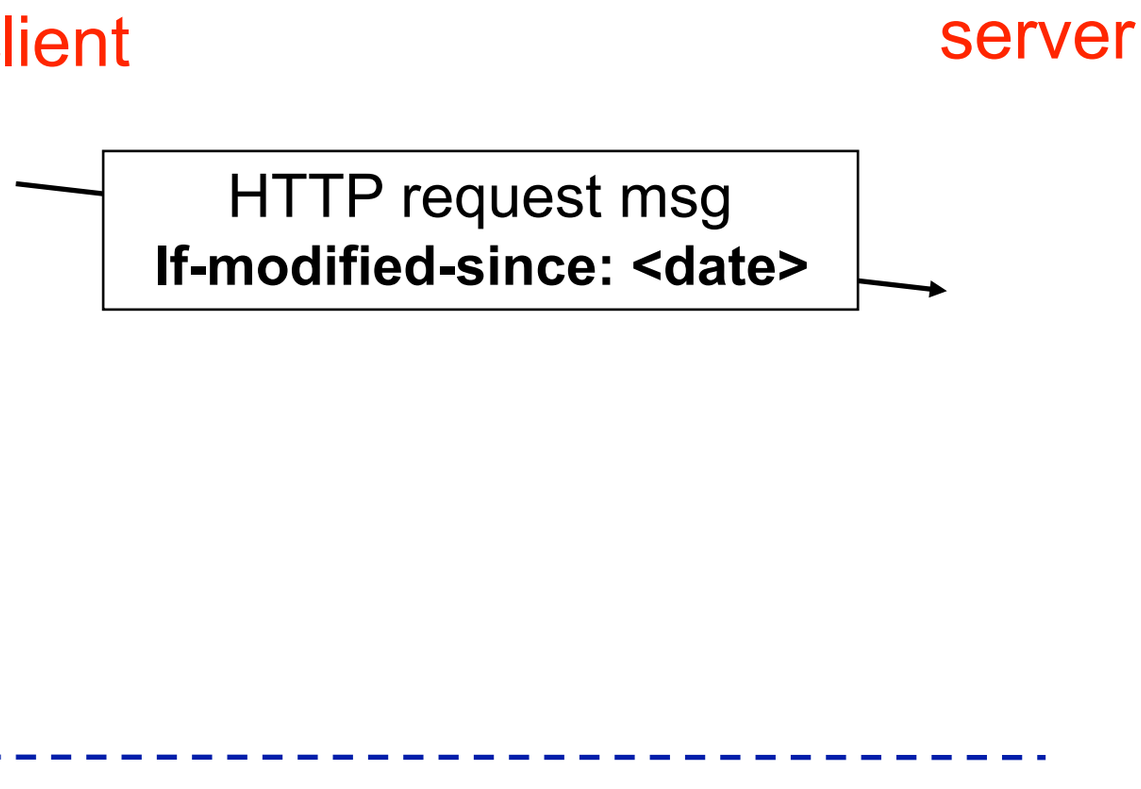

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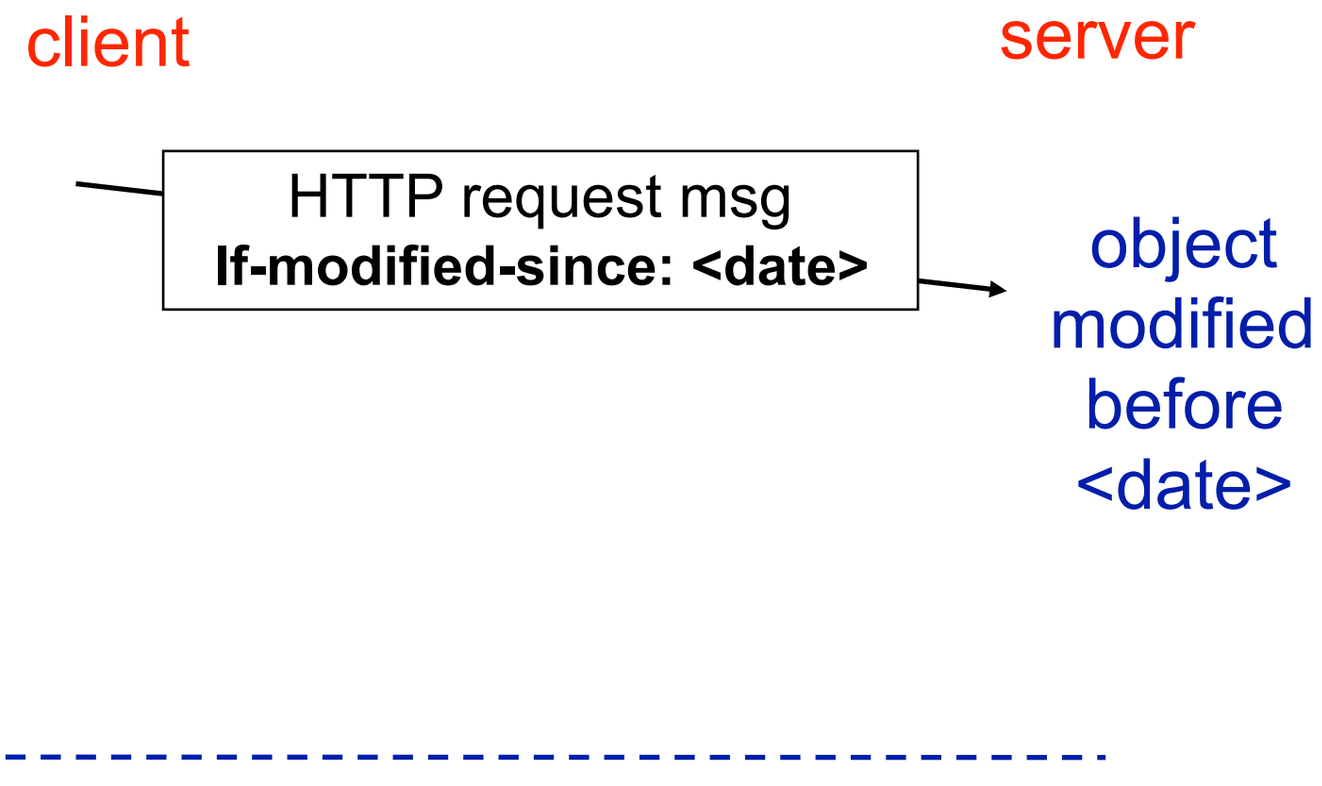

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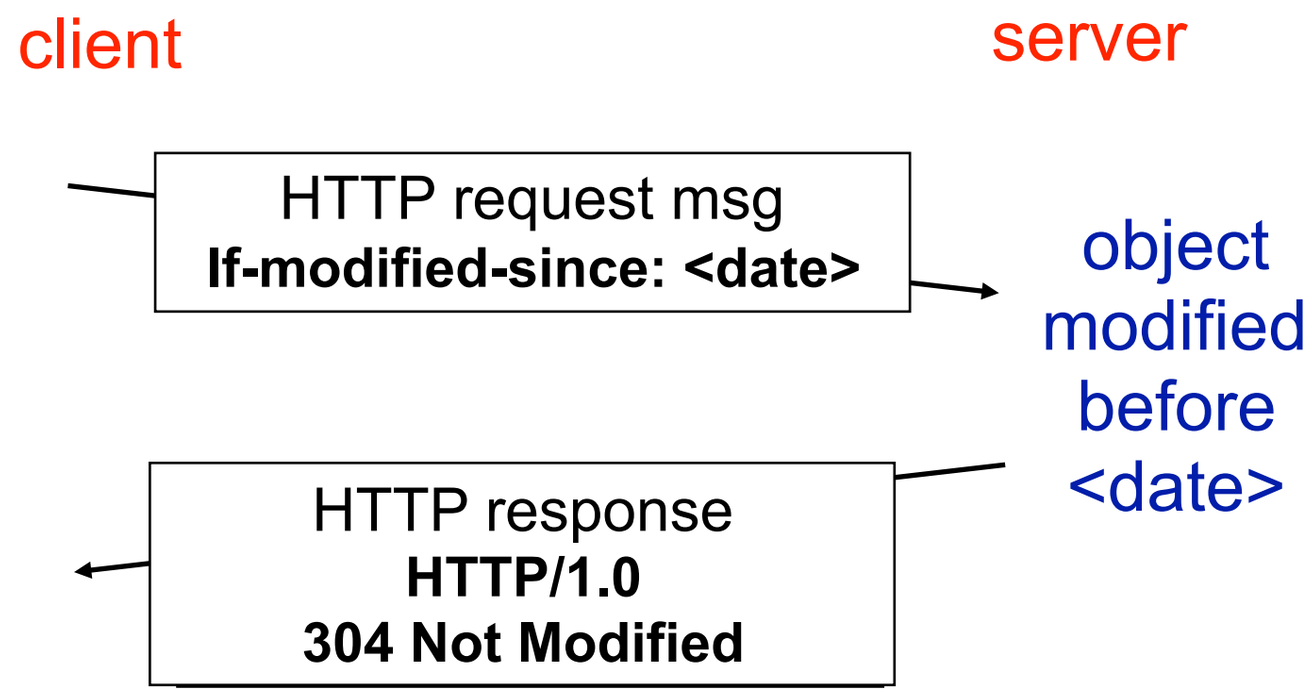

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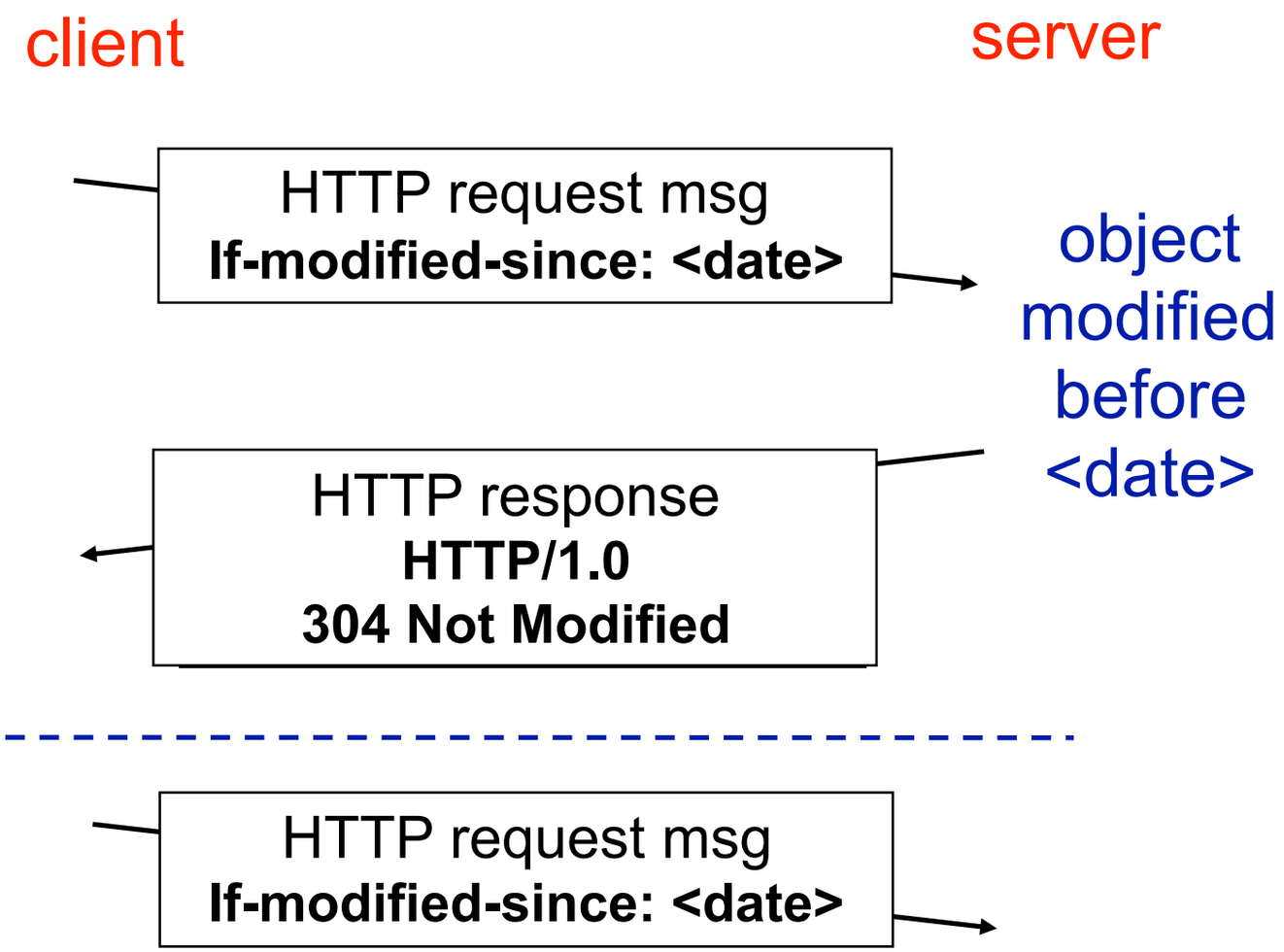

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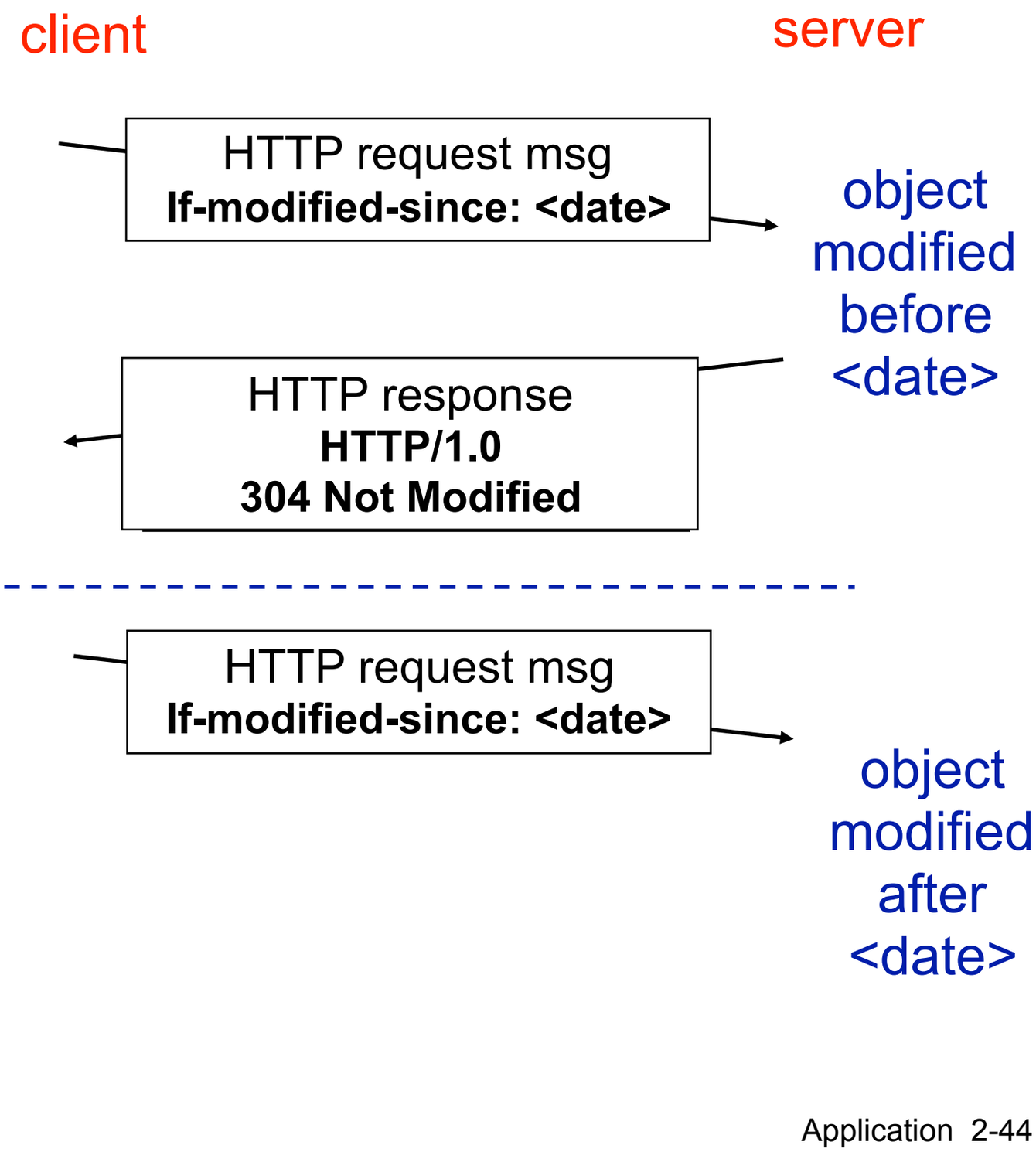

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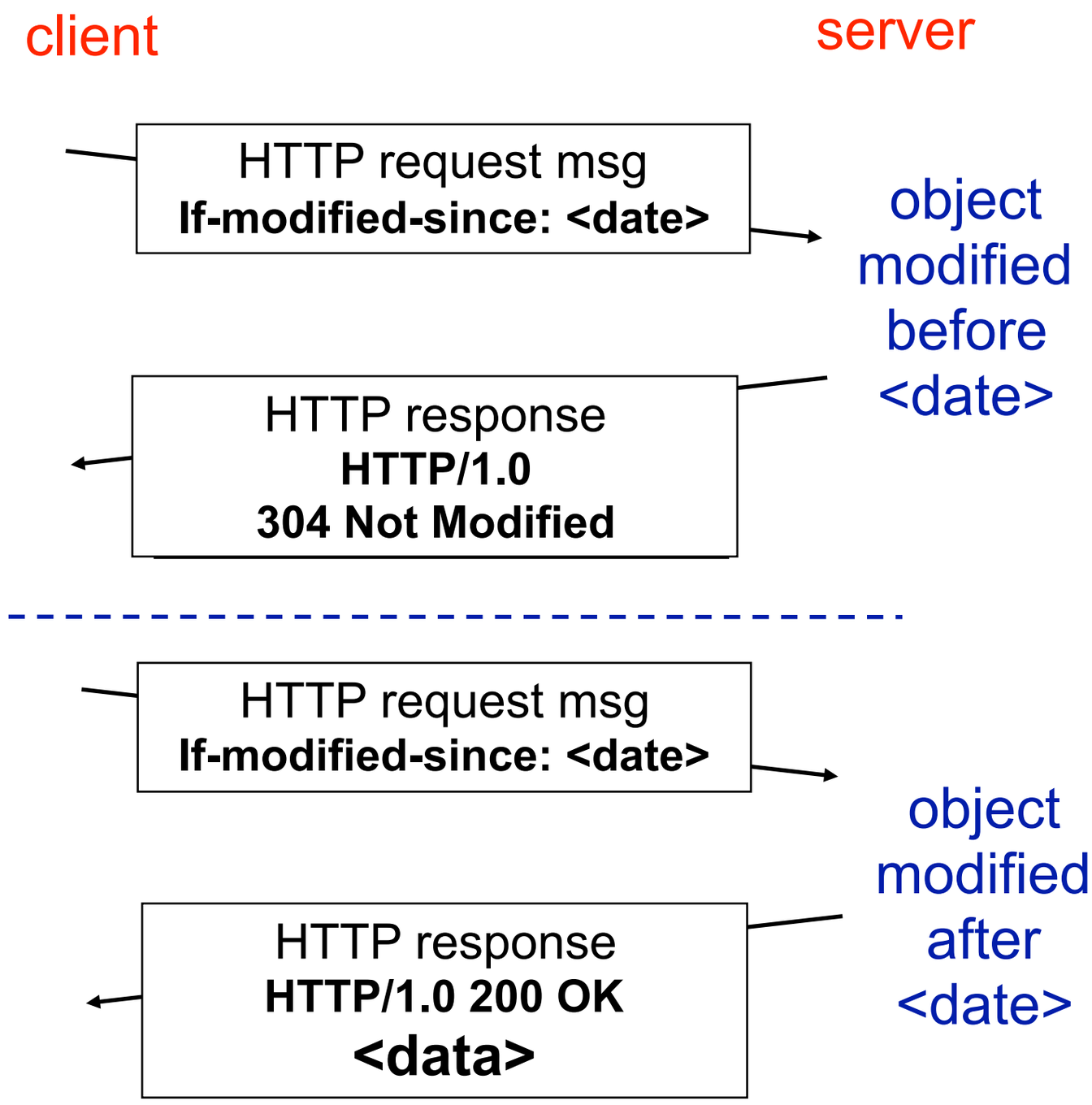
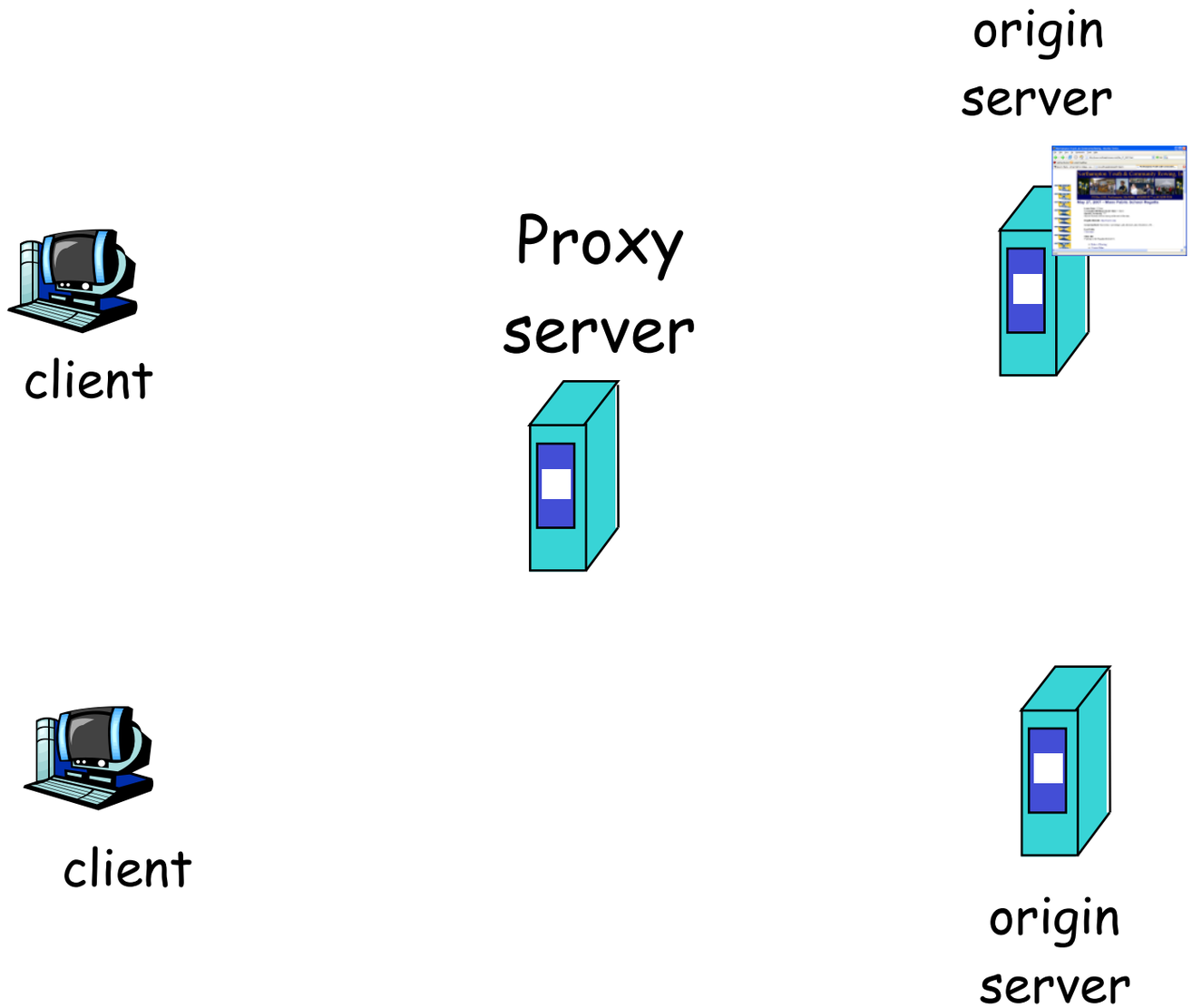


Web caches (proxy server)

Goal: satisfy client request without involving origin server



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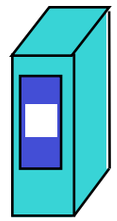

origin server

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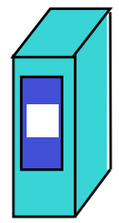

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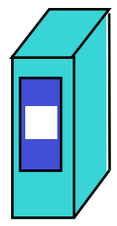

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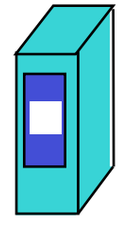

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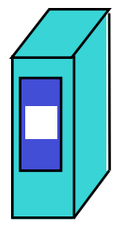

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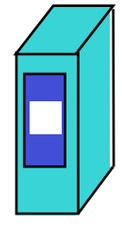

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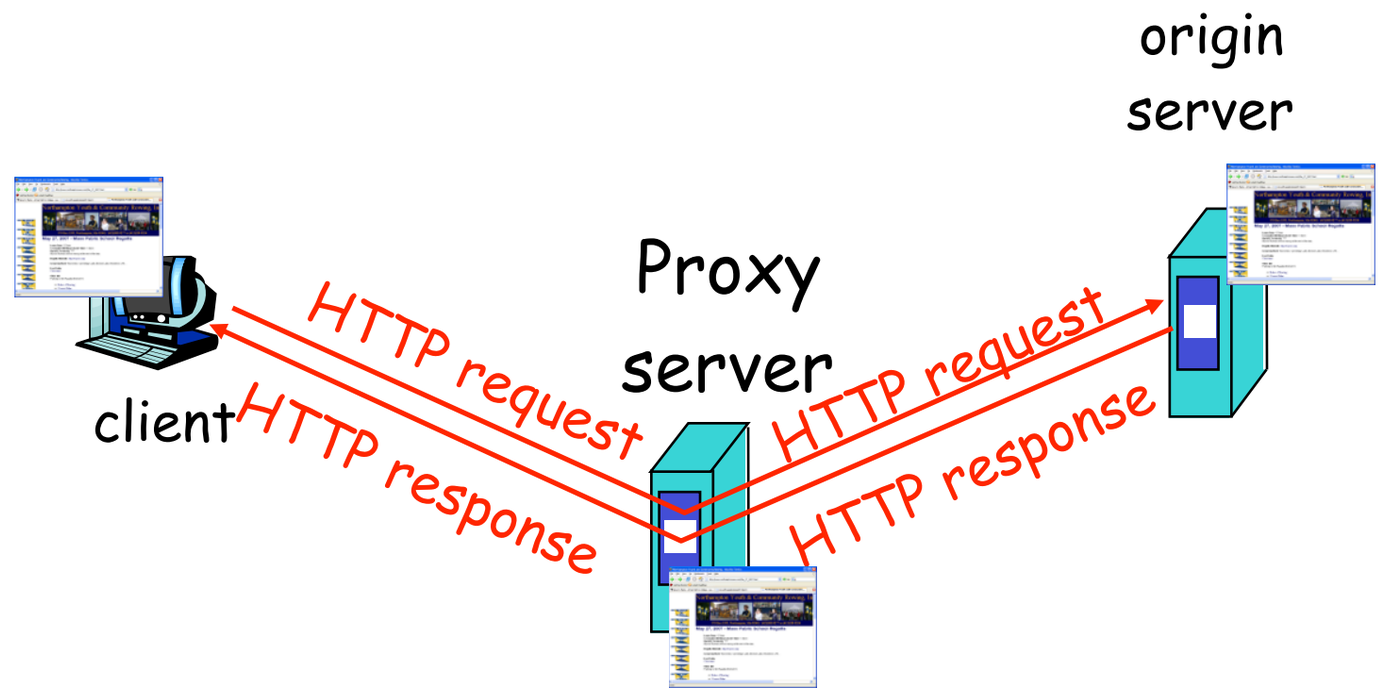

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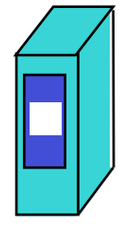

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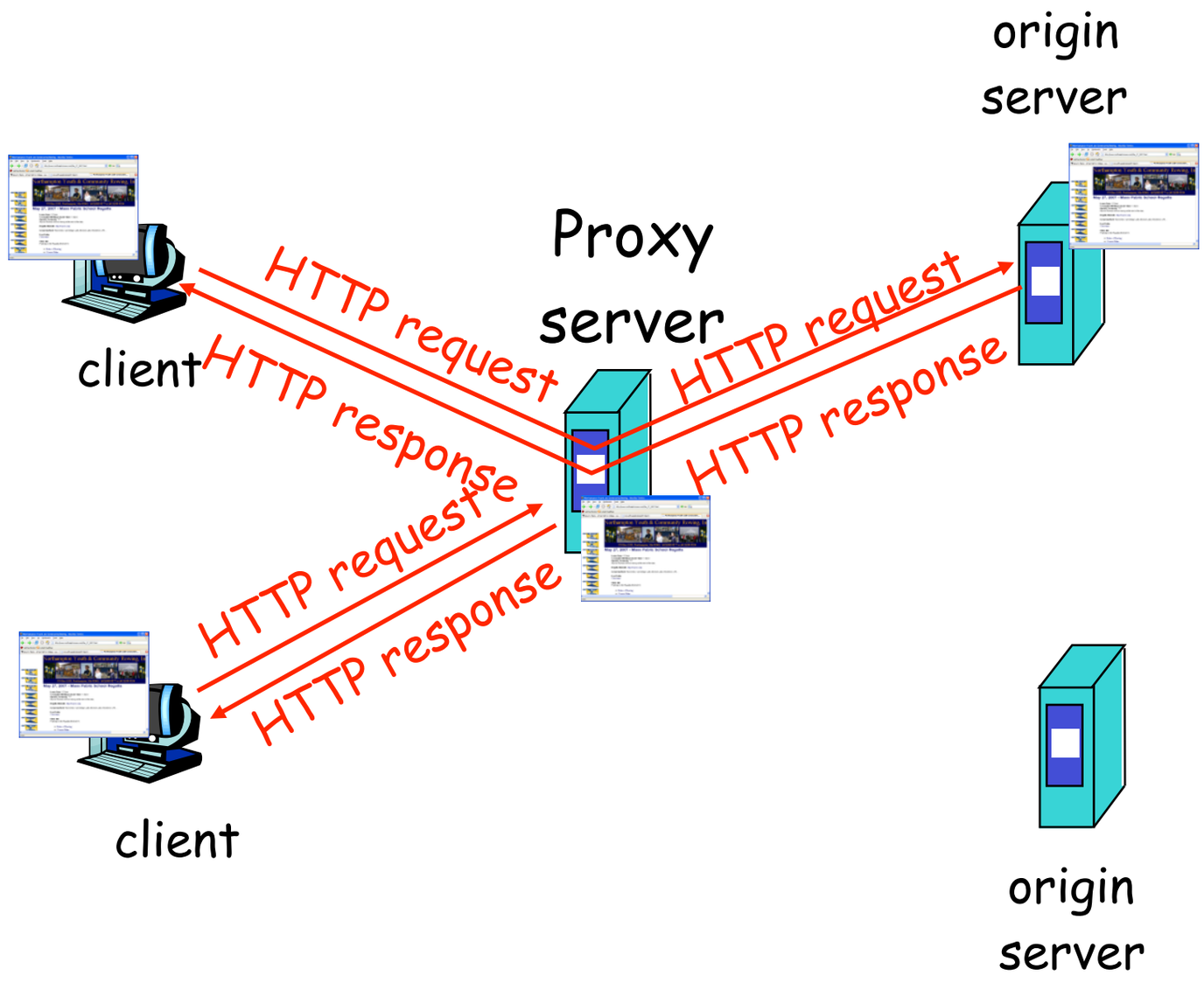

More about Web caching

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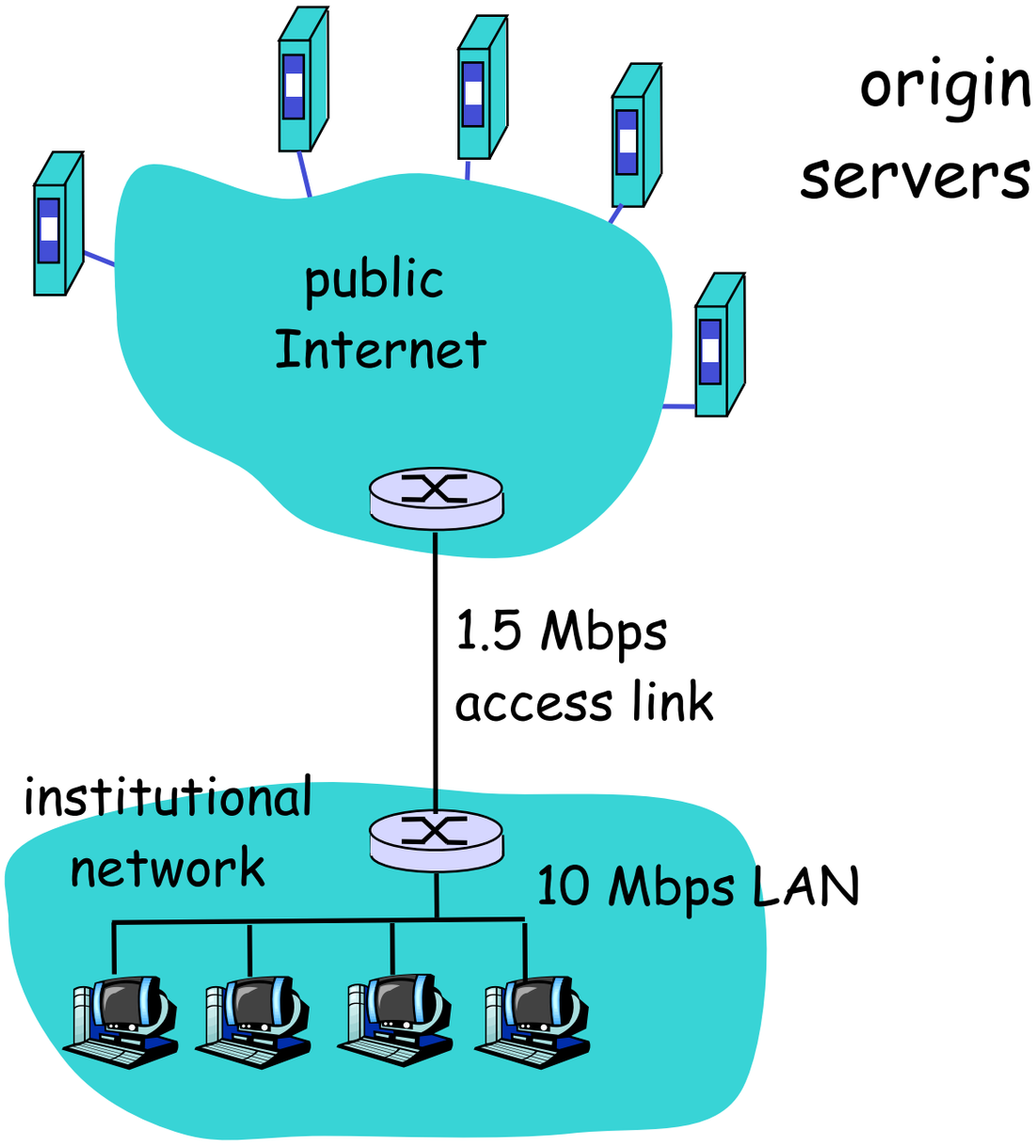
- Internet dense with caches: enables "poor" content providers to effectively deliver content

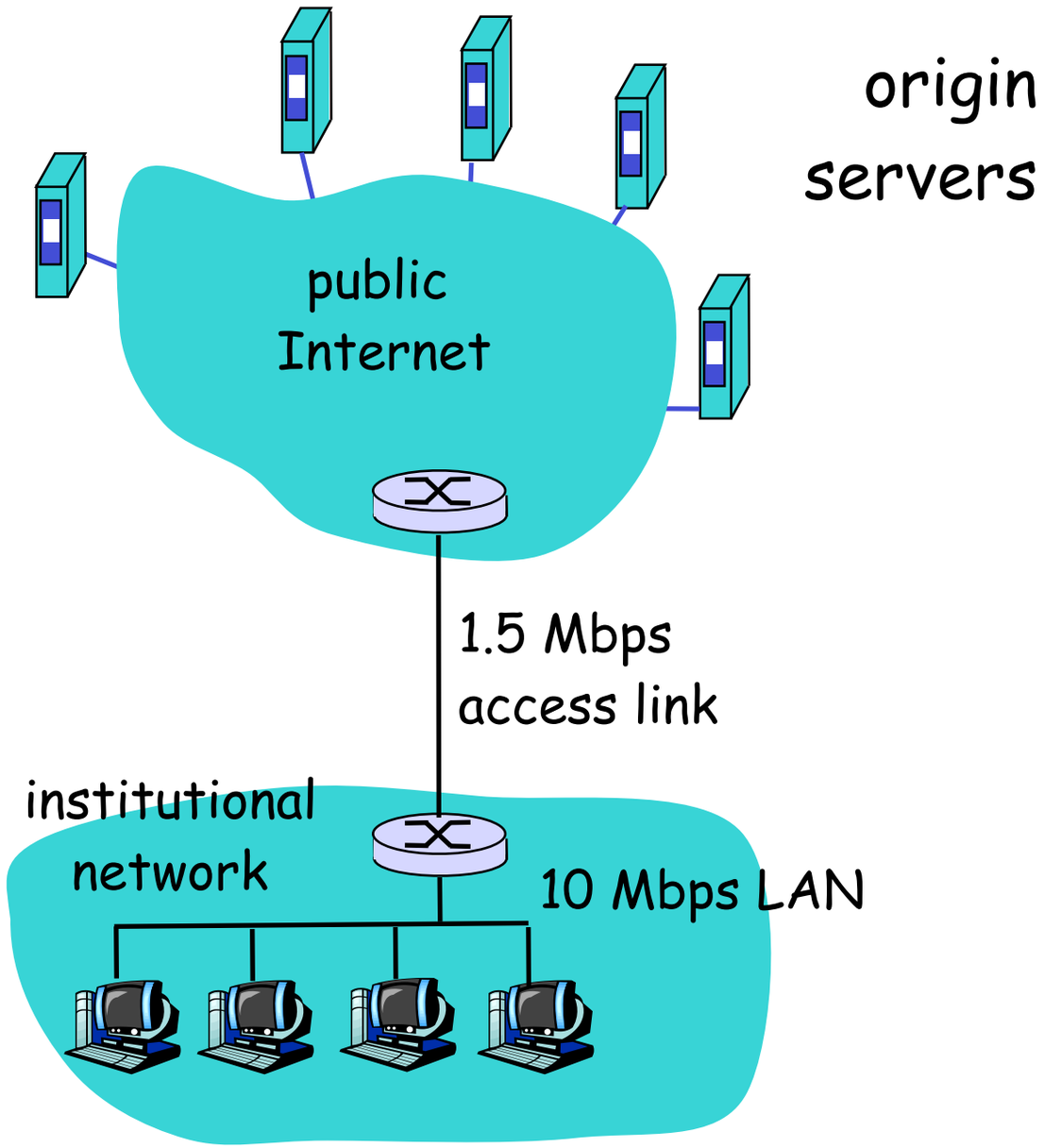
Caching example



Caching example

assumptions

- average object size = 100,000 bits
- avg. request rate from institution's browsers to origin servers = 15/sec
- delay from institutional router to any origin server and back to router = 2 sec



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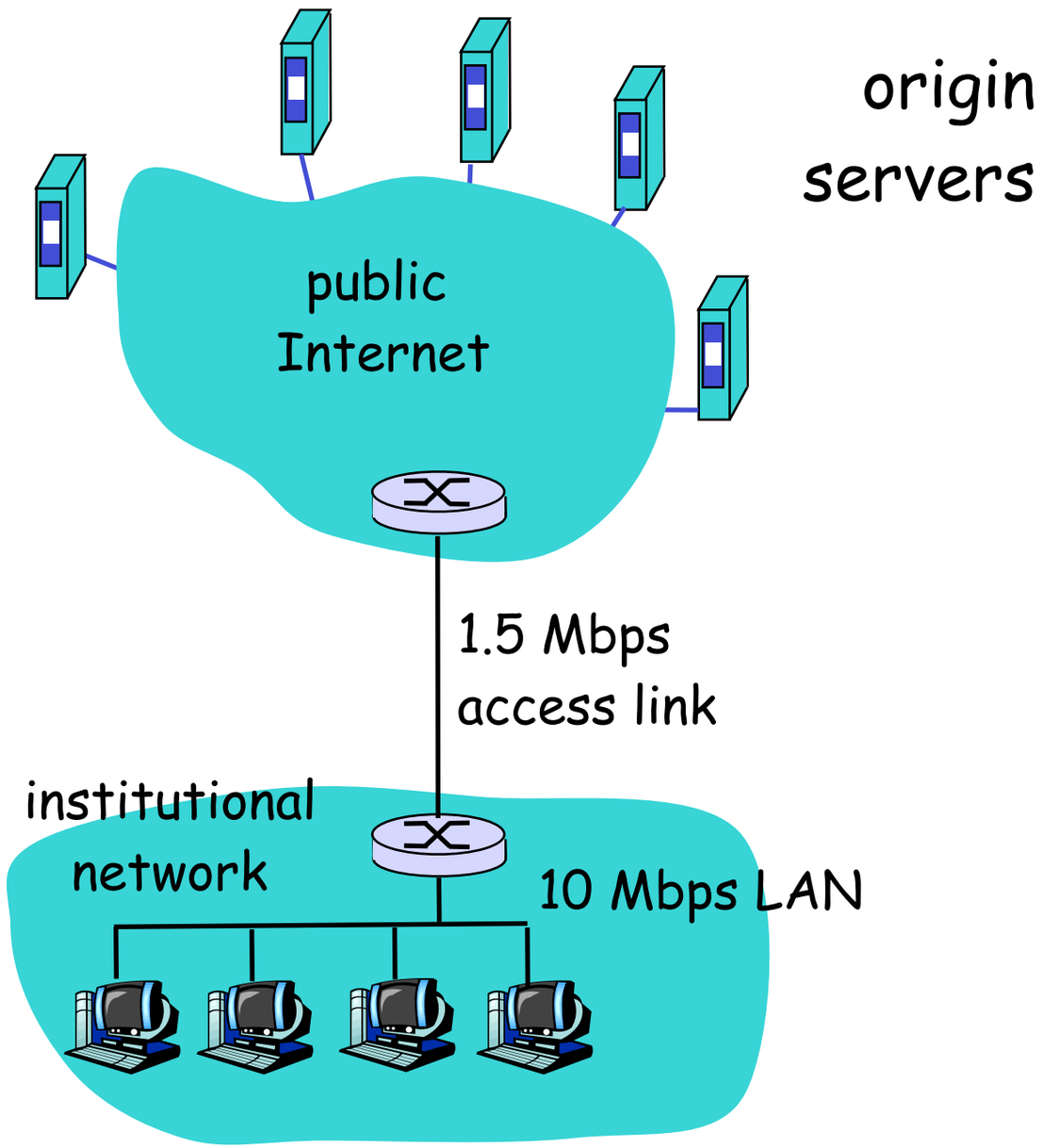

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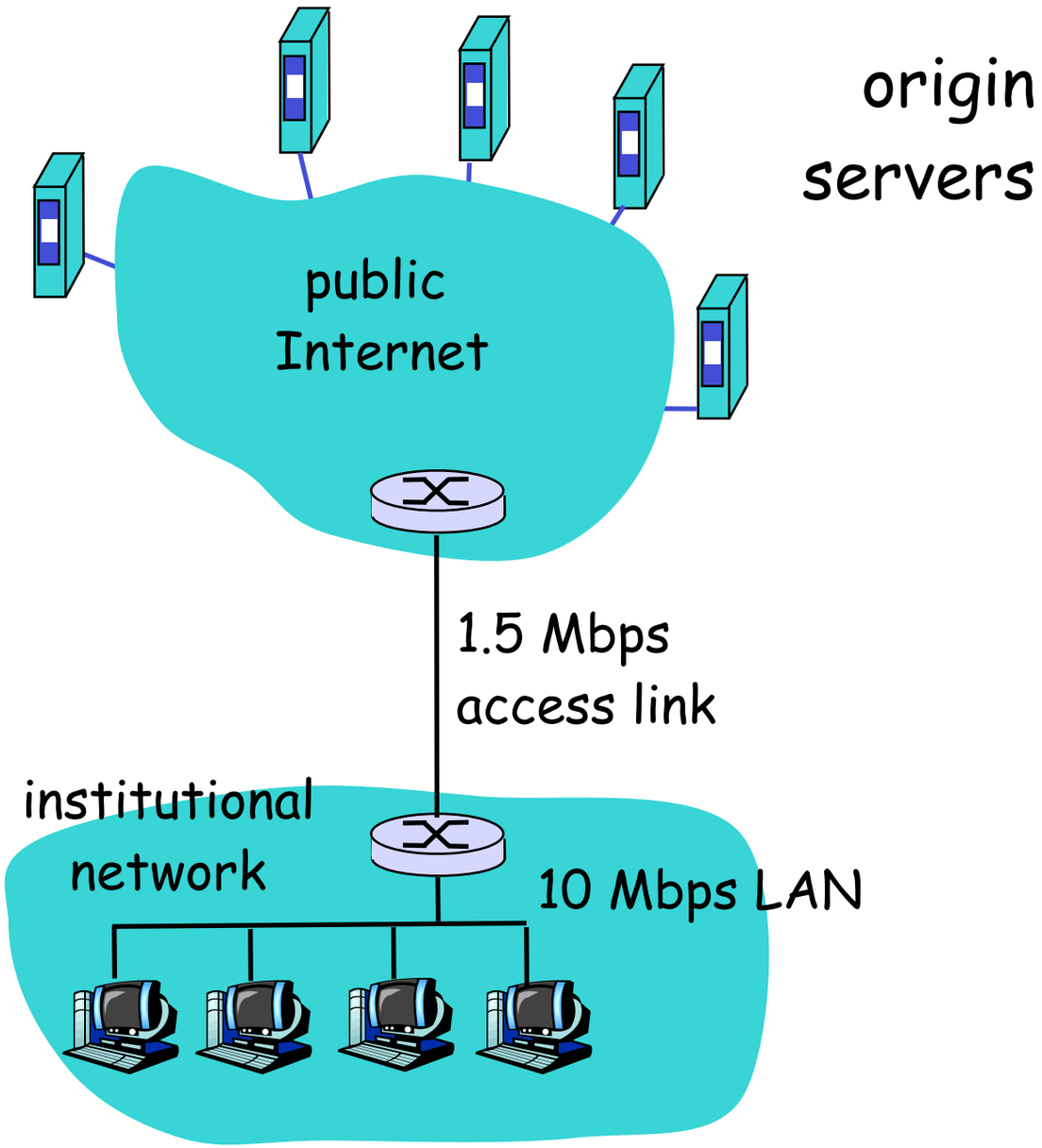

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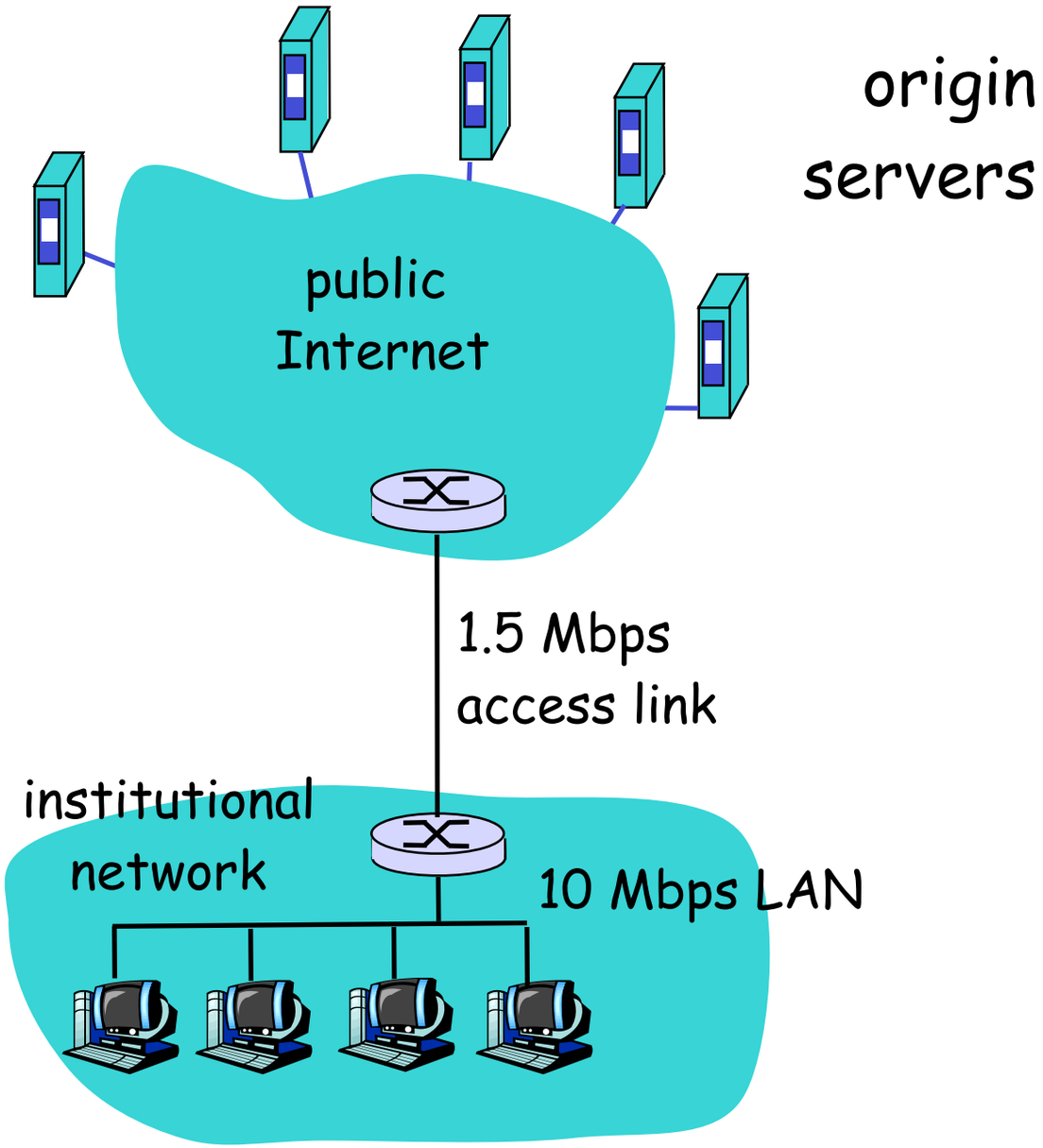

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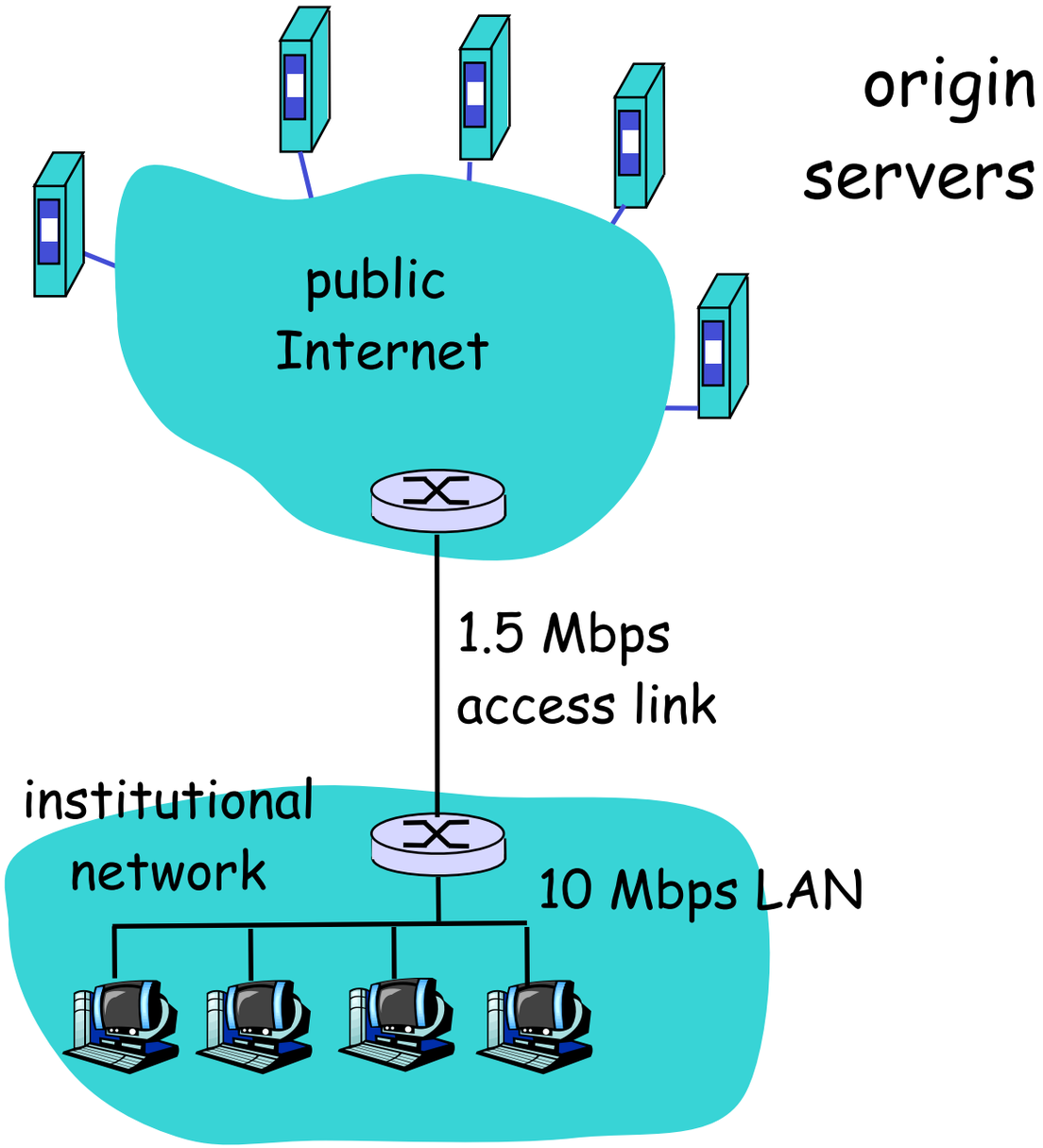
- total delay = Internet delay + access delay + LAN delay

  = 2 sec + seconds + milliseconds



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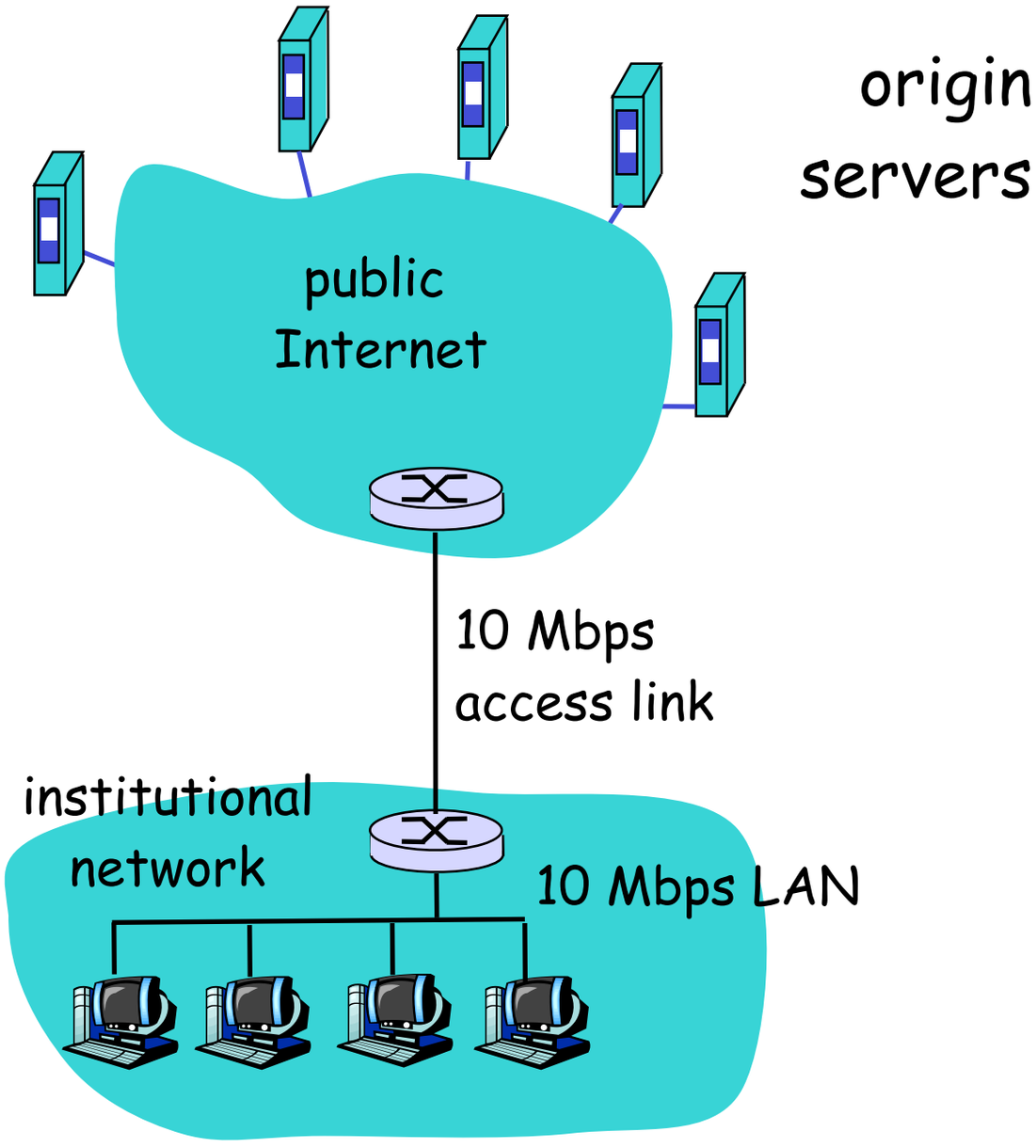

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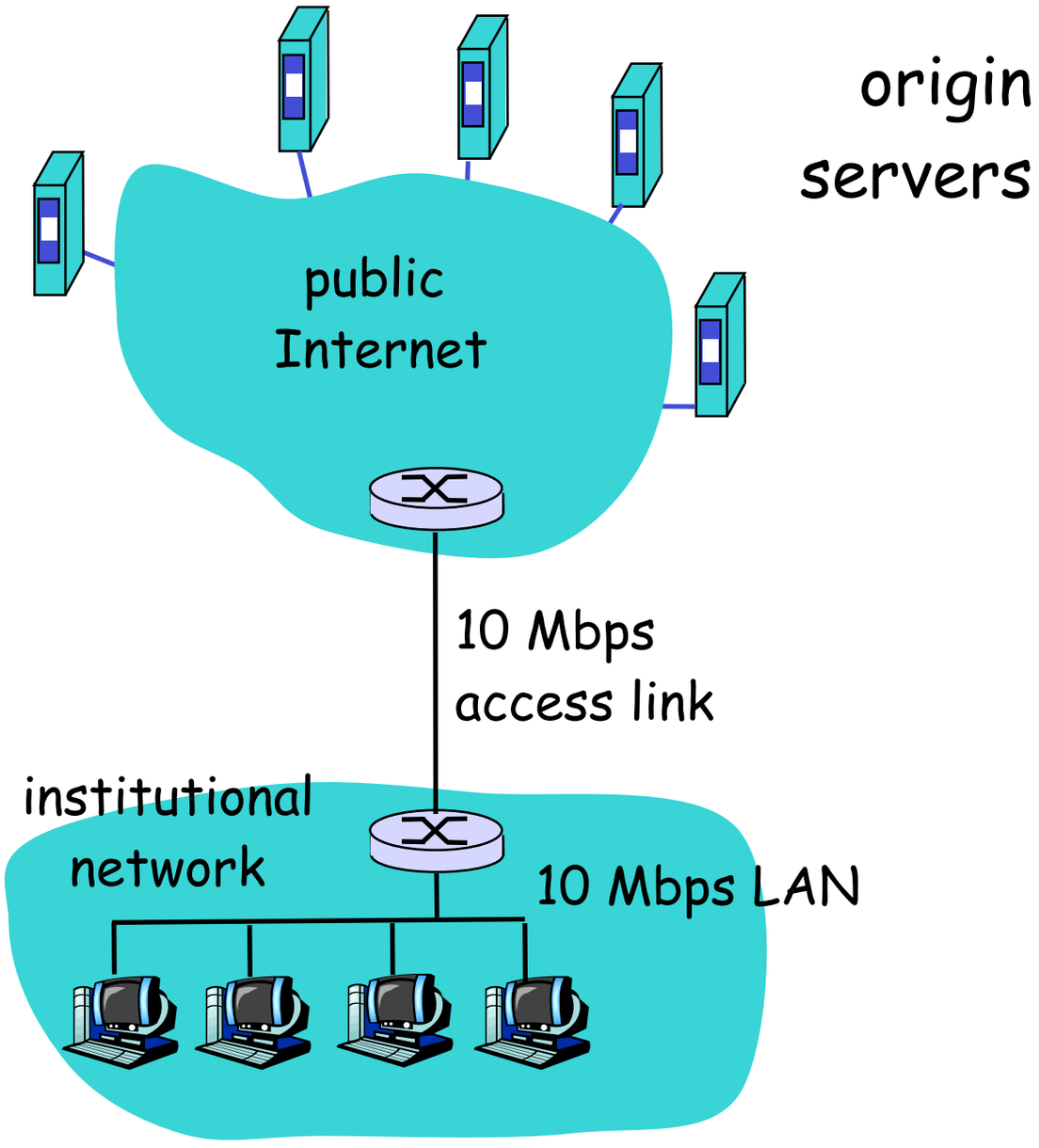
possible solution

- increase bandwidth of access link to, say, 10 Mbps



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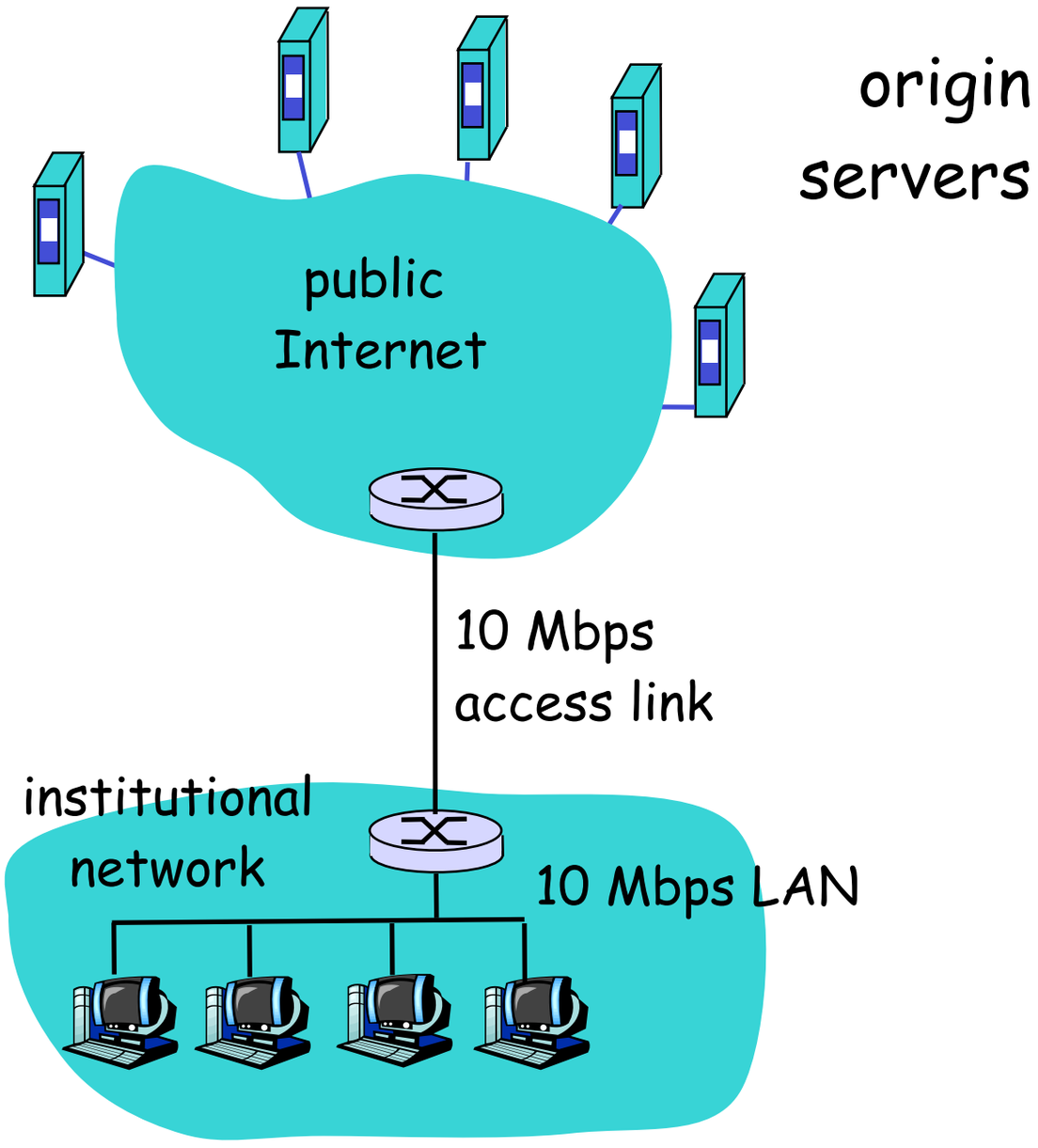

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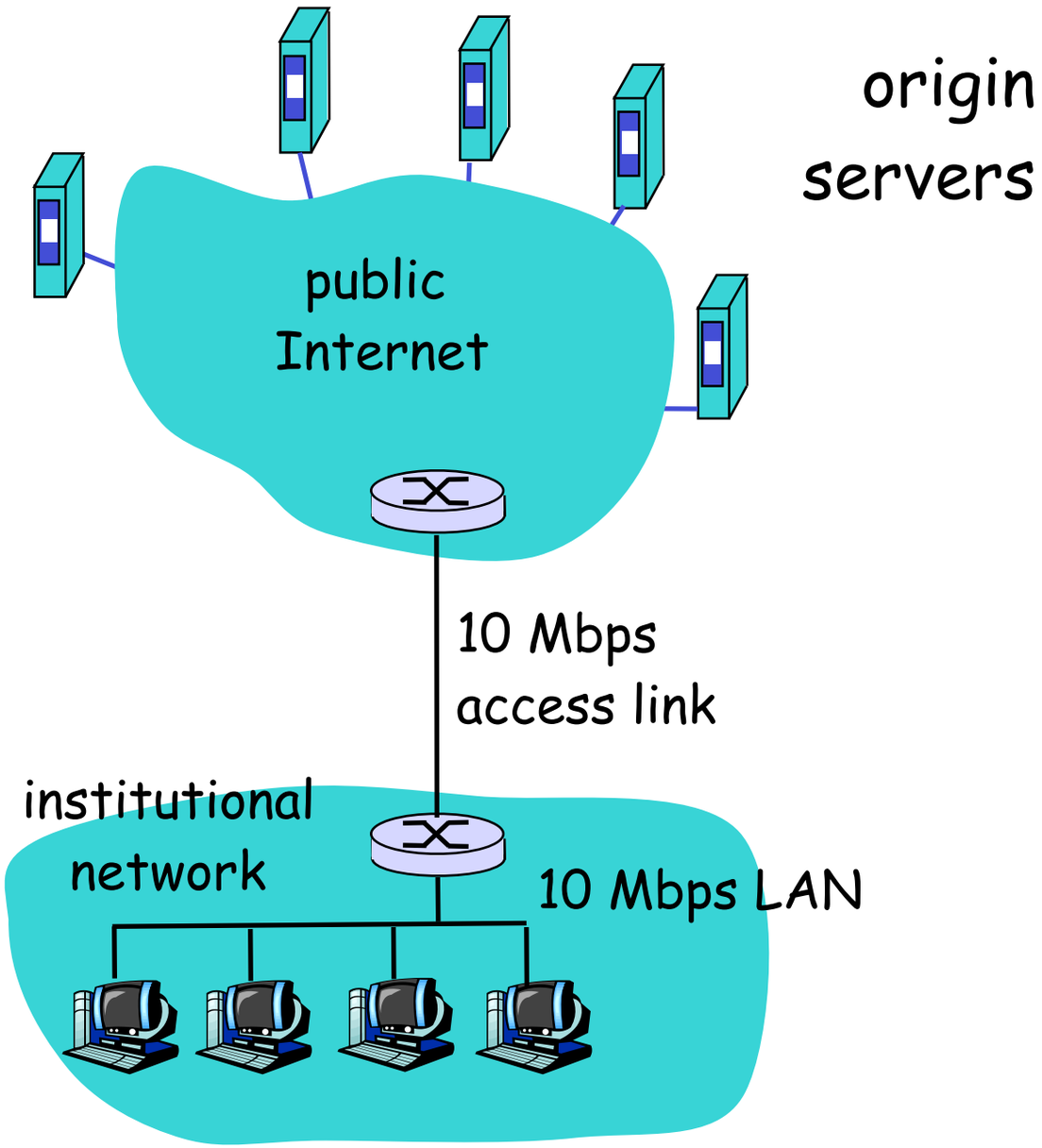

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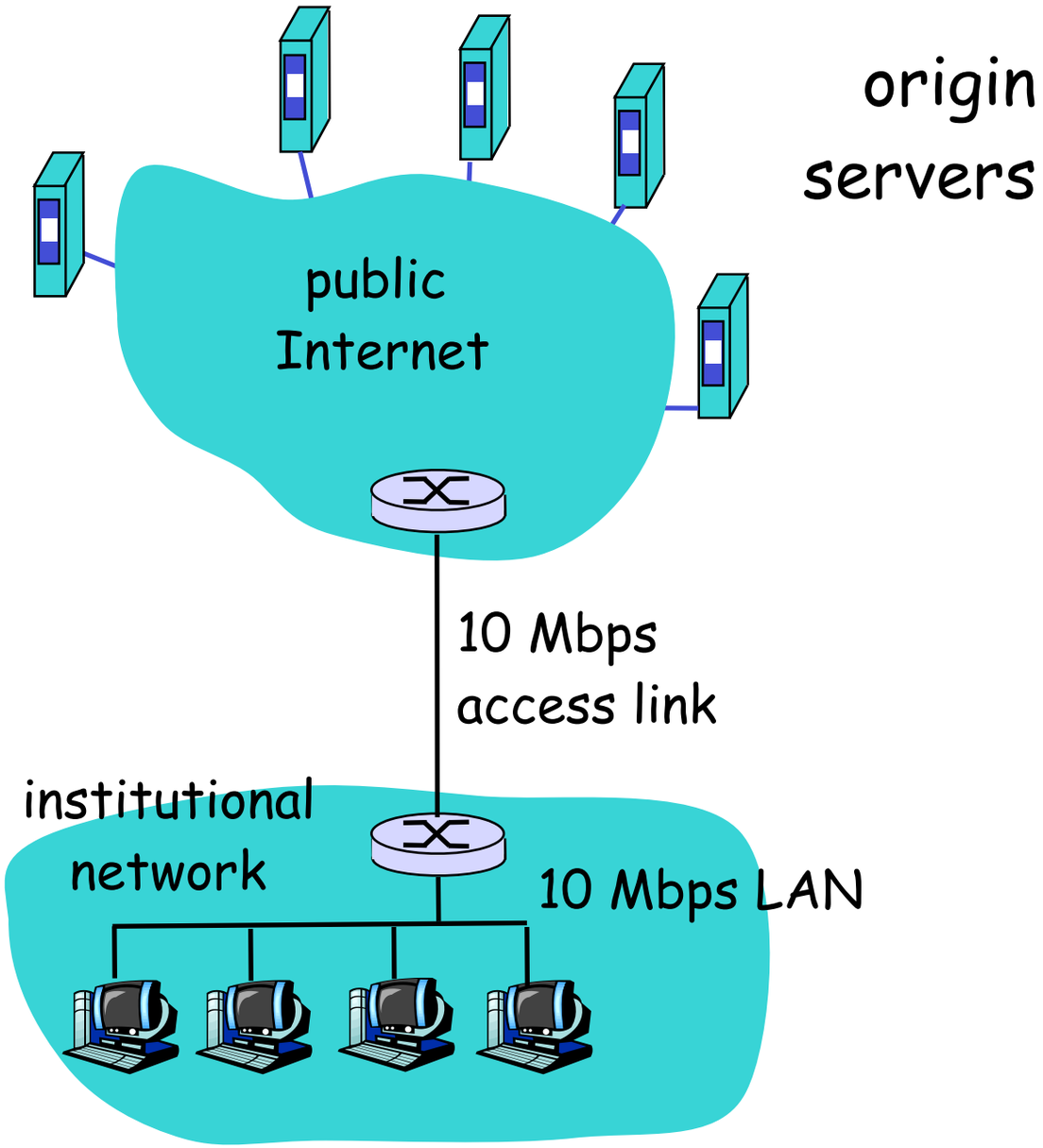

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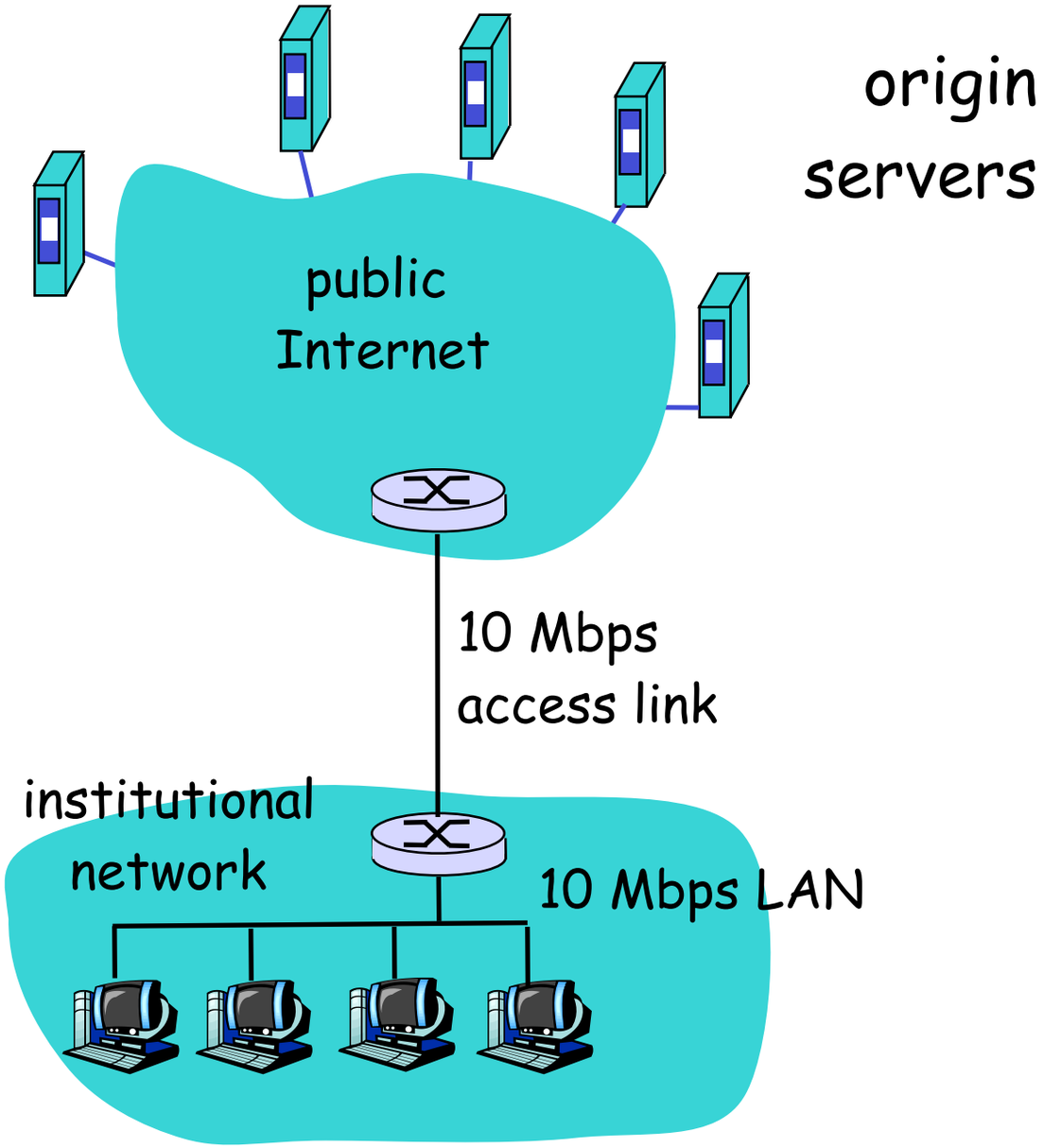
- Total delay = Internet delay + access delay + LAN delay

  = 2 sec + msecs + msecs
- often a costly upgrade



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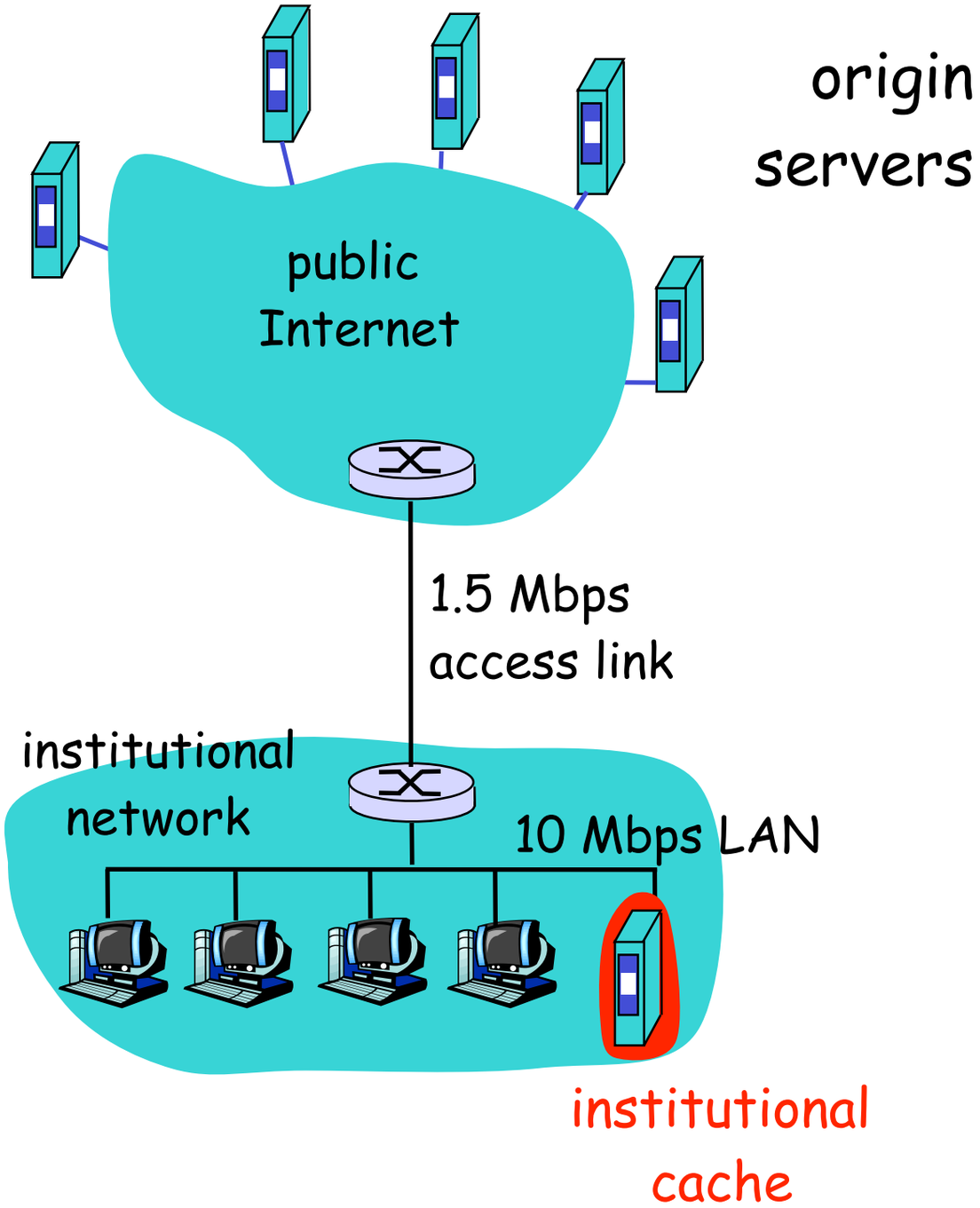

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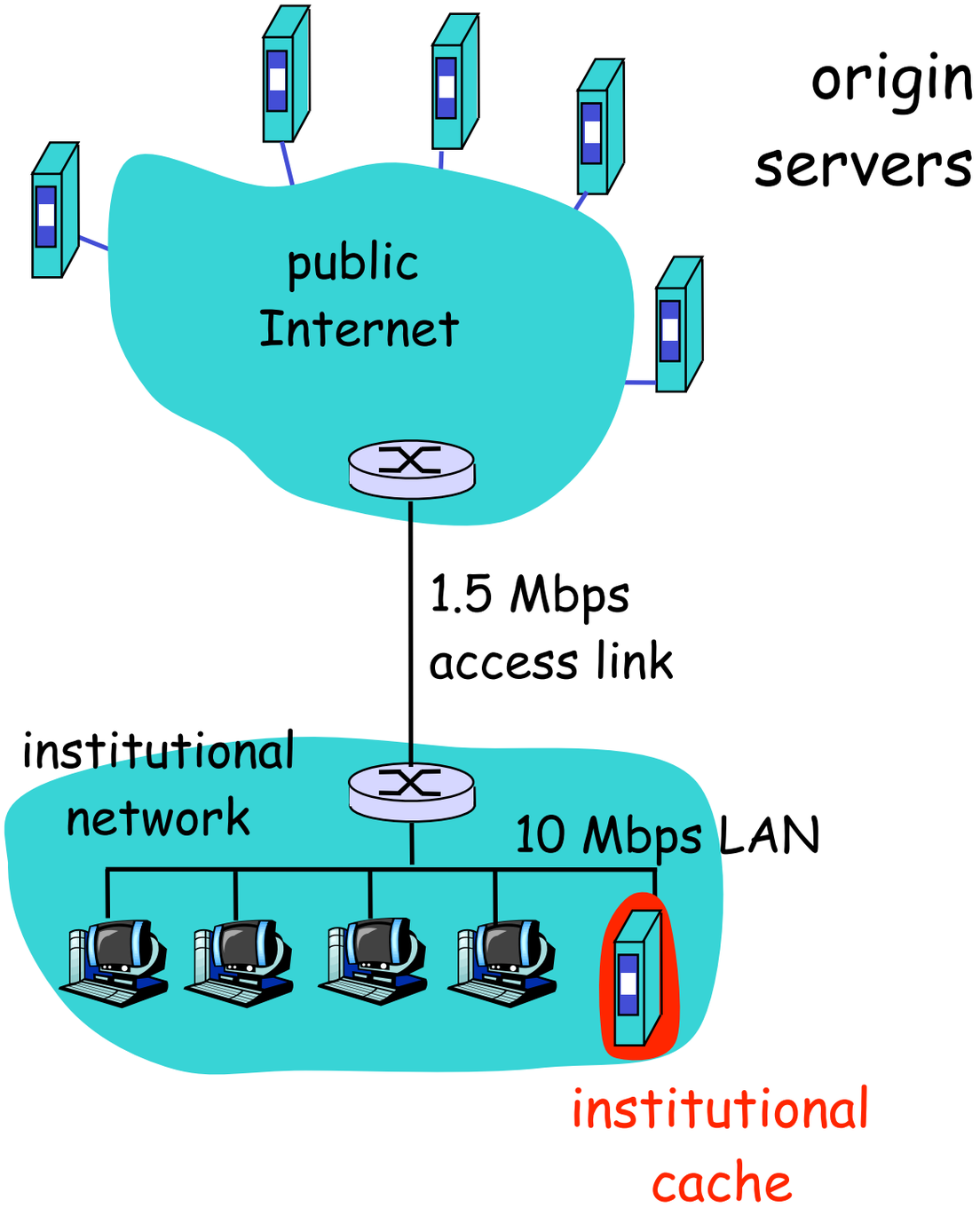

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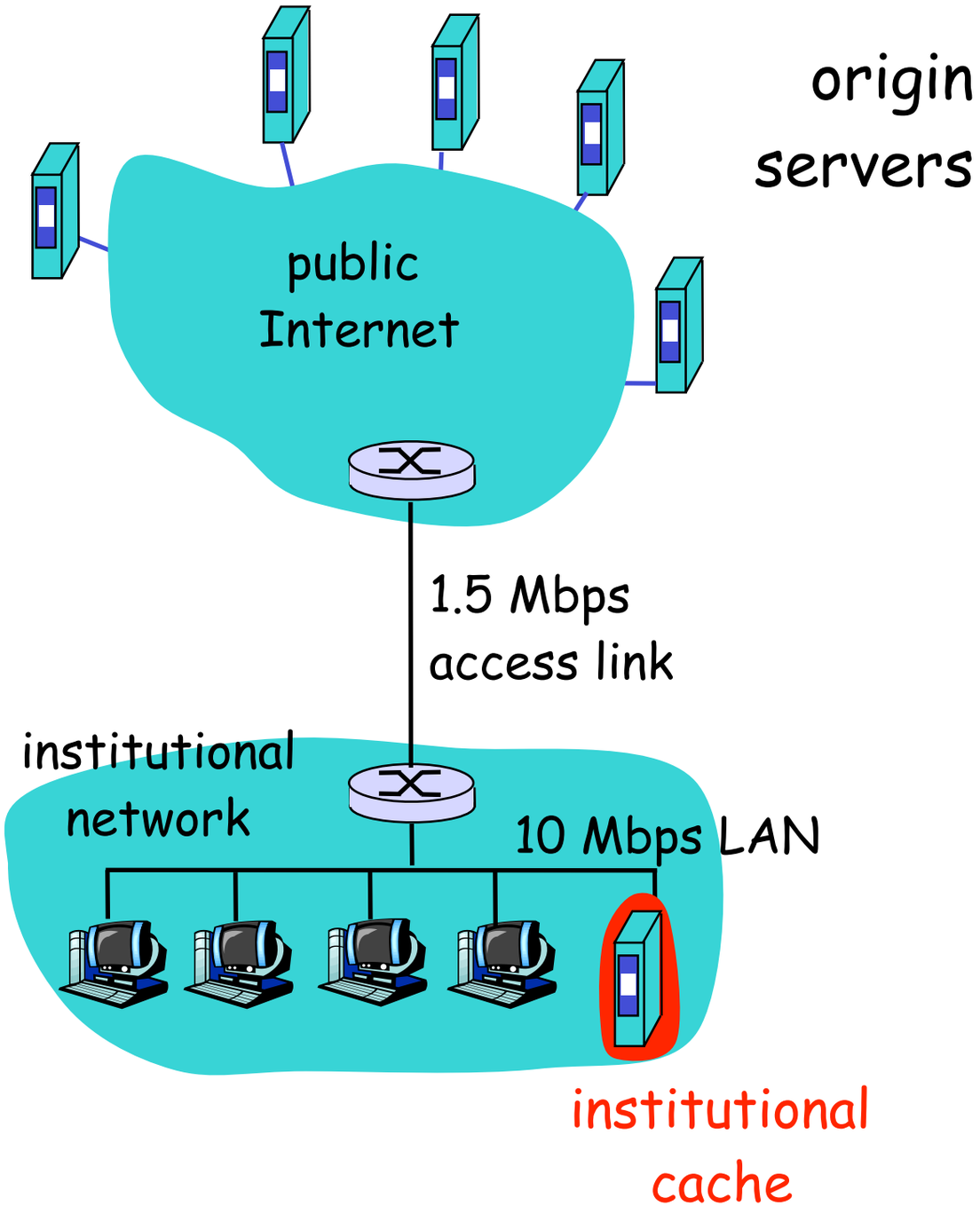

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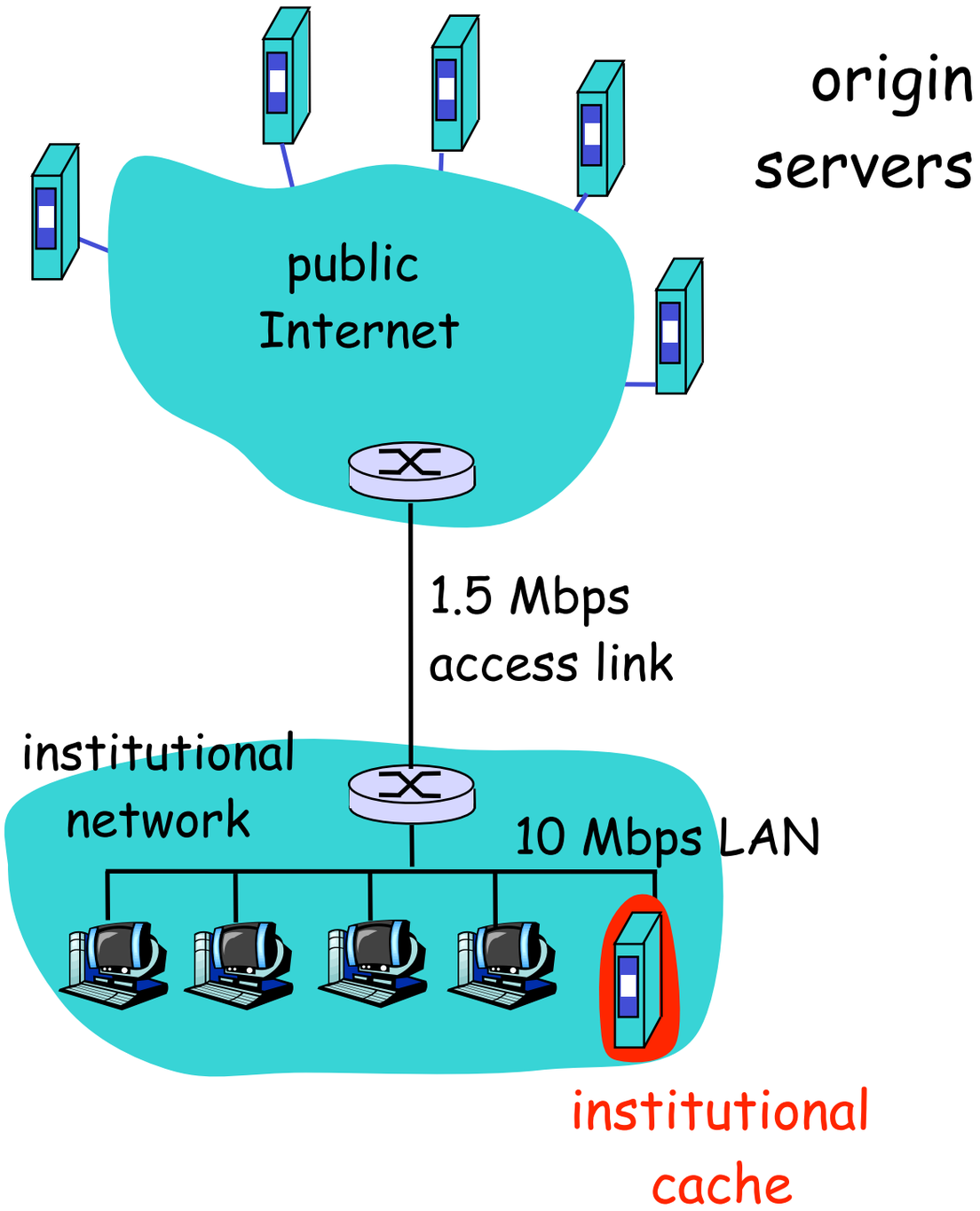
consequence

- suppose hit rate is 0.4
  - 40% requests will be satisfied almost immediately
  - 60% requests satisfied by origin server



Caching example (cont)

possible solution:

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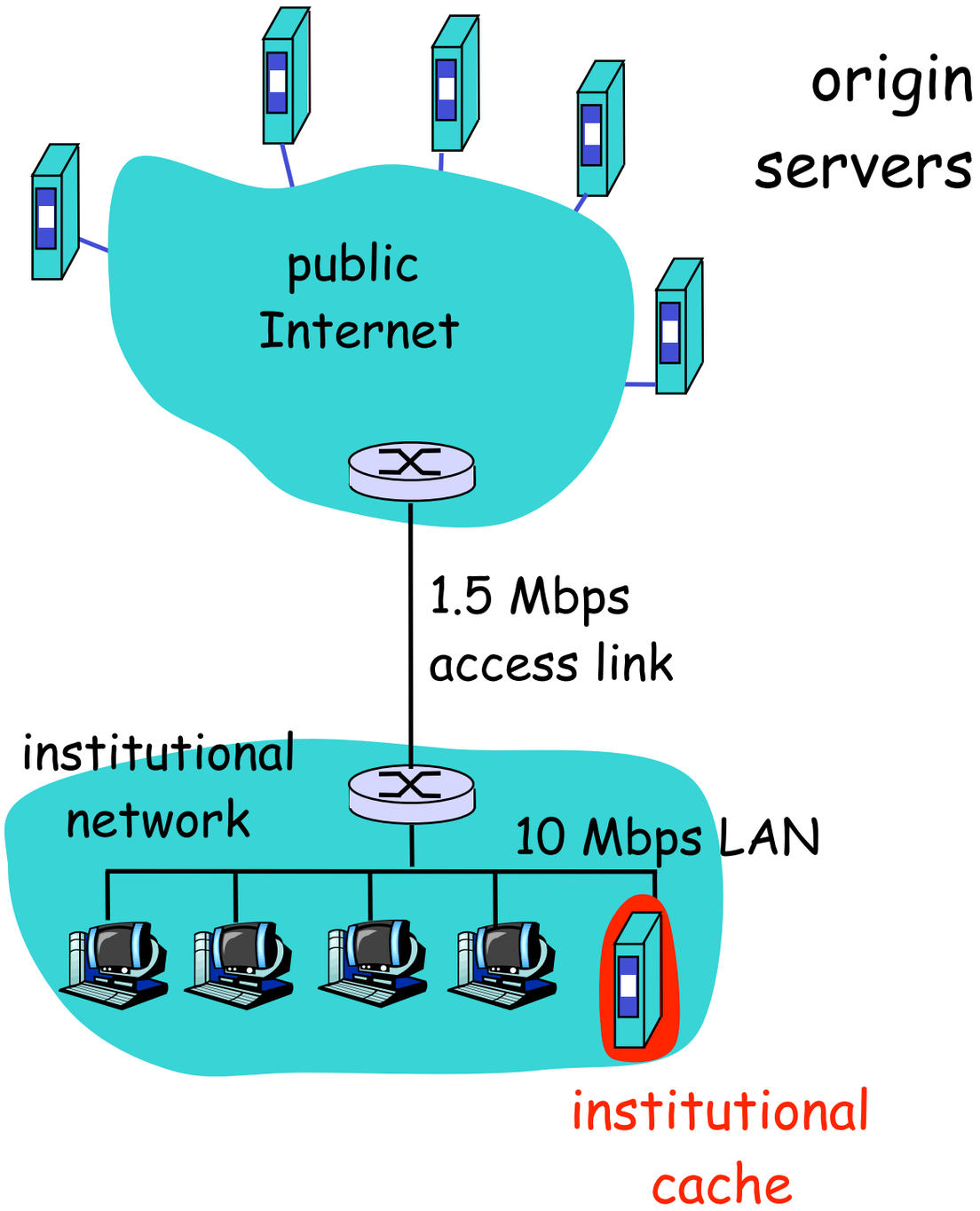

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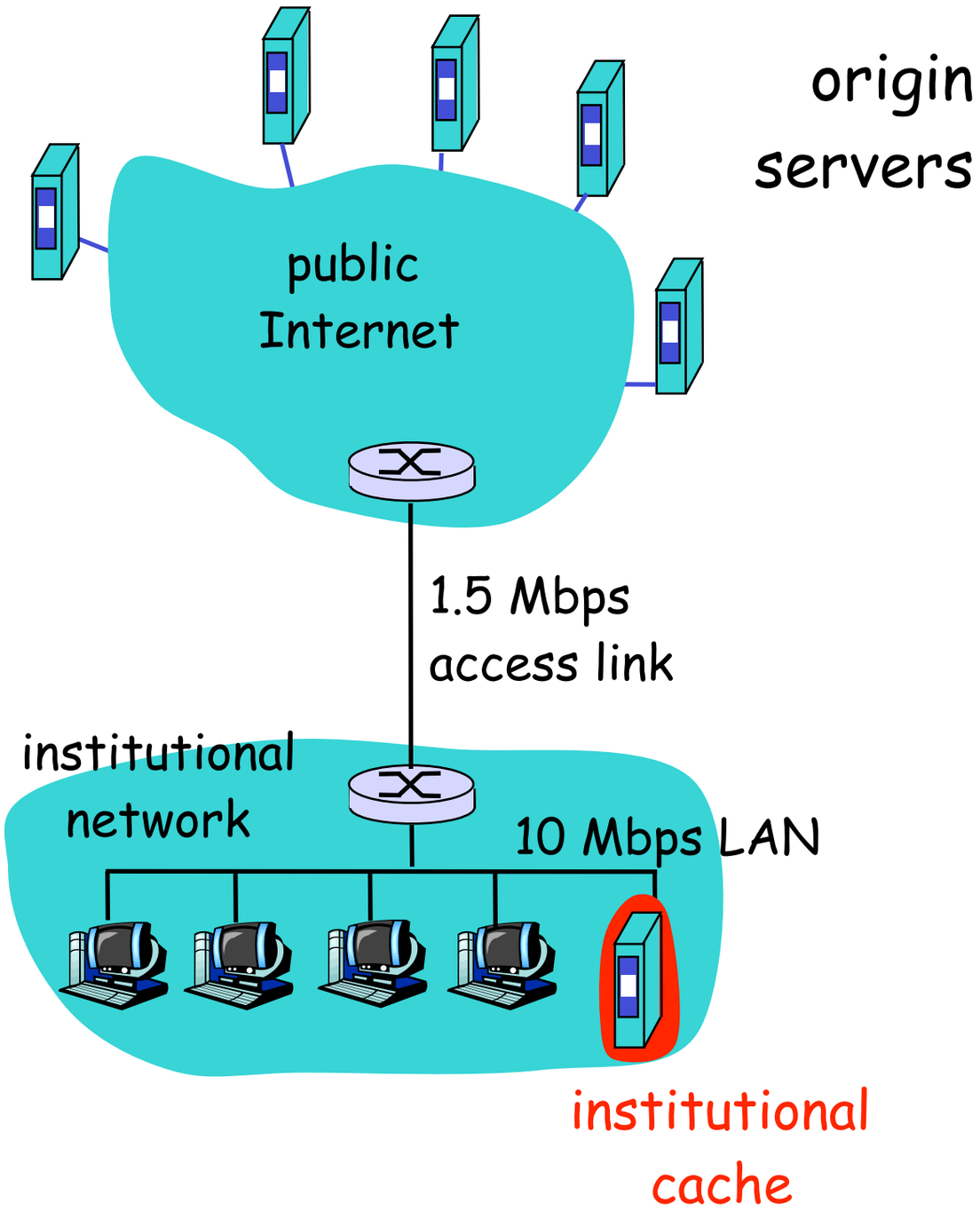
- total avg delay = Internet delay + access delay + LAN delay = 0.6*2 secs + 0.4*milliseconds < 1.4 secs



HTTP connections

basic HTTP

- one object sent over TCP connection

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persistent HTTP

- multiple objects can be sent over single TCP connection between client, server.

Non-Persistent HTTP: Response time

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definition of RTT: time for a small packet to travel from client to server and back.

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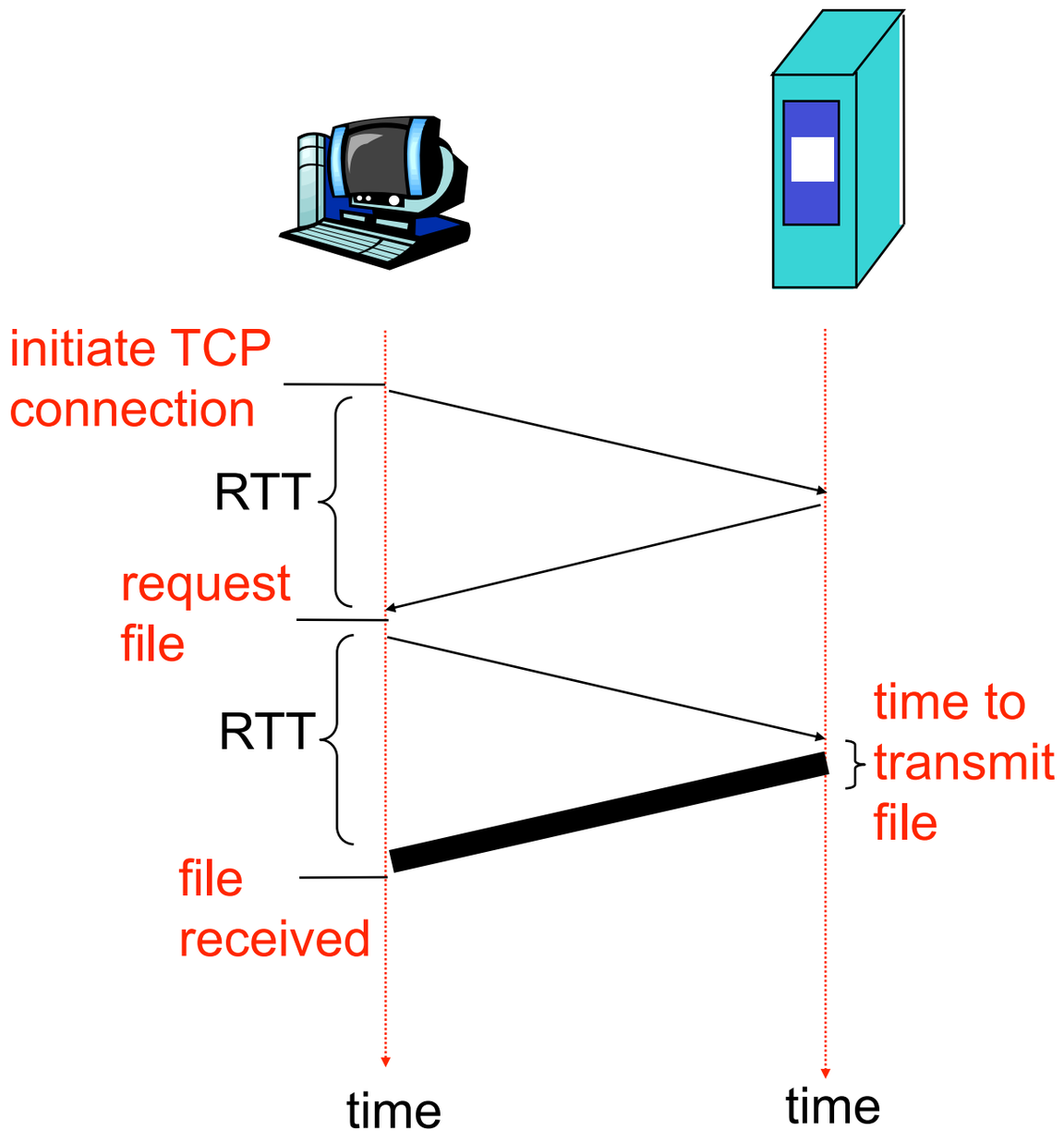

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- server leaves connection open after sending response
- subsequent HTTP messages between same client/server sent over open connection
- client sends requests as soon as it encounters a referenced object
- as little as one RTT for all the referenced objects