Network Layer
Part I

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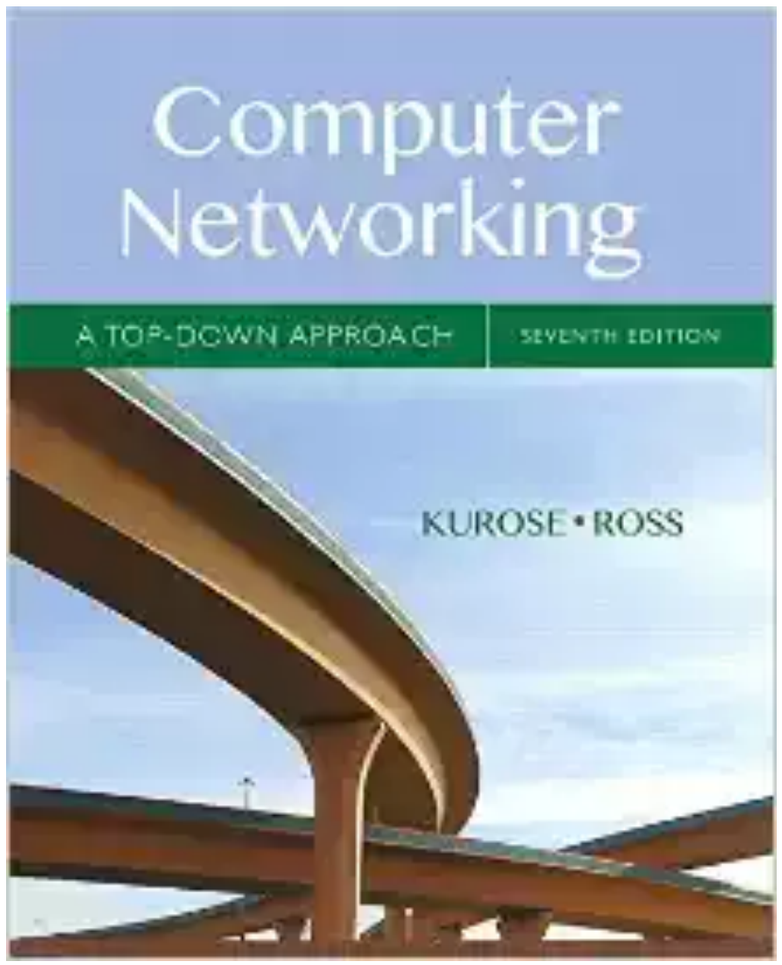
"Got a beat up glove, a homemade bat,
and a brand new pair of shoes …"

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.

Reading Along ...



- Network layer is chapters 4 & 5

Two Key Network-Layer Functions

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analogy: getting from CLE to LAX via ORD

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Two Key Network-Layer Functions

- forwarding: move packets from router's input to appropriate router output
- routing: determine route taken by packets from source to dest.
  - routing algorithms

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Two Key Network-Layer Functions

- forwarding: move packets from router's input to appropriate router output
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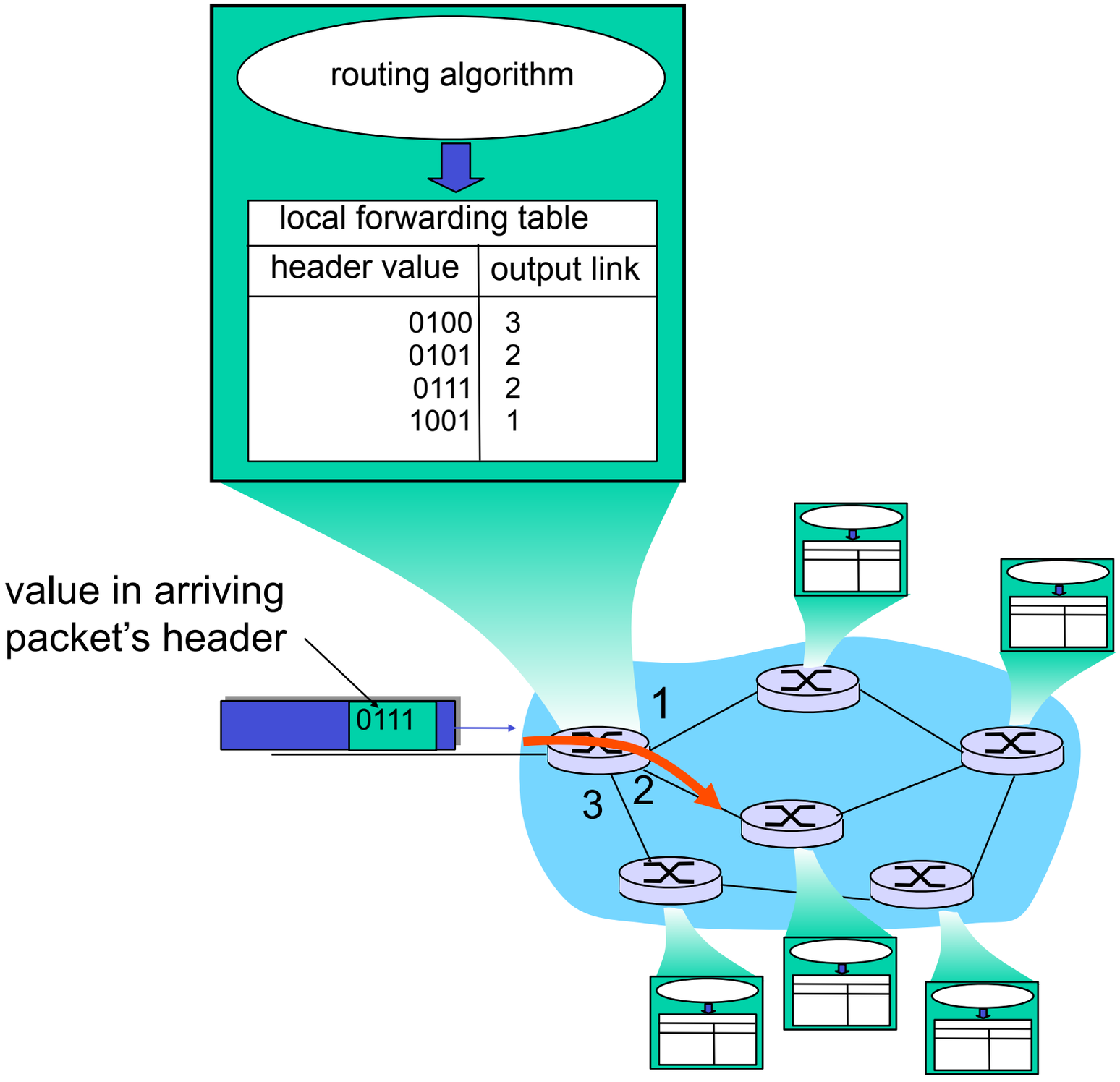
analogy: getting from CLE to LAX via ORD

- forwarding: process of getting through single interchange (i.e., ORD)
- routing: process of planning trip from source to dest (i.e., from CLE to LAX)

Interplay between routing and forwarding



Network service model

Q: What sort of service model should we use for the "channel" transporting datagrams from sender to receiver?

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example services for a flow of datagrams:

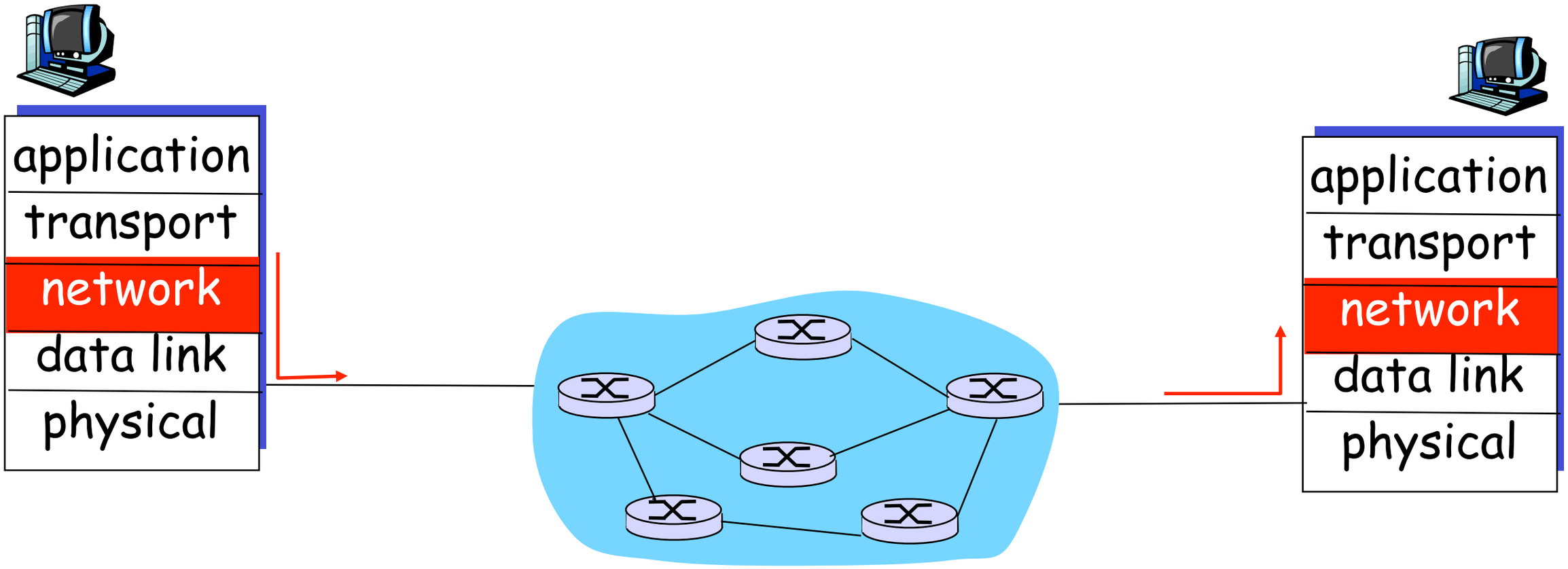
- in-order datagram delivery
- guaranteed minimum bandwidth to flow
- restrictions on changes in inter-packet spacing

Network service model

- Q: What service model does the Internet use?
  - minimalist
  - no guarantees on delivery, bandwidth, timing, ordering

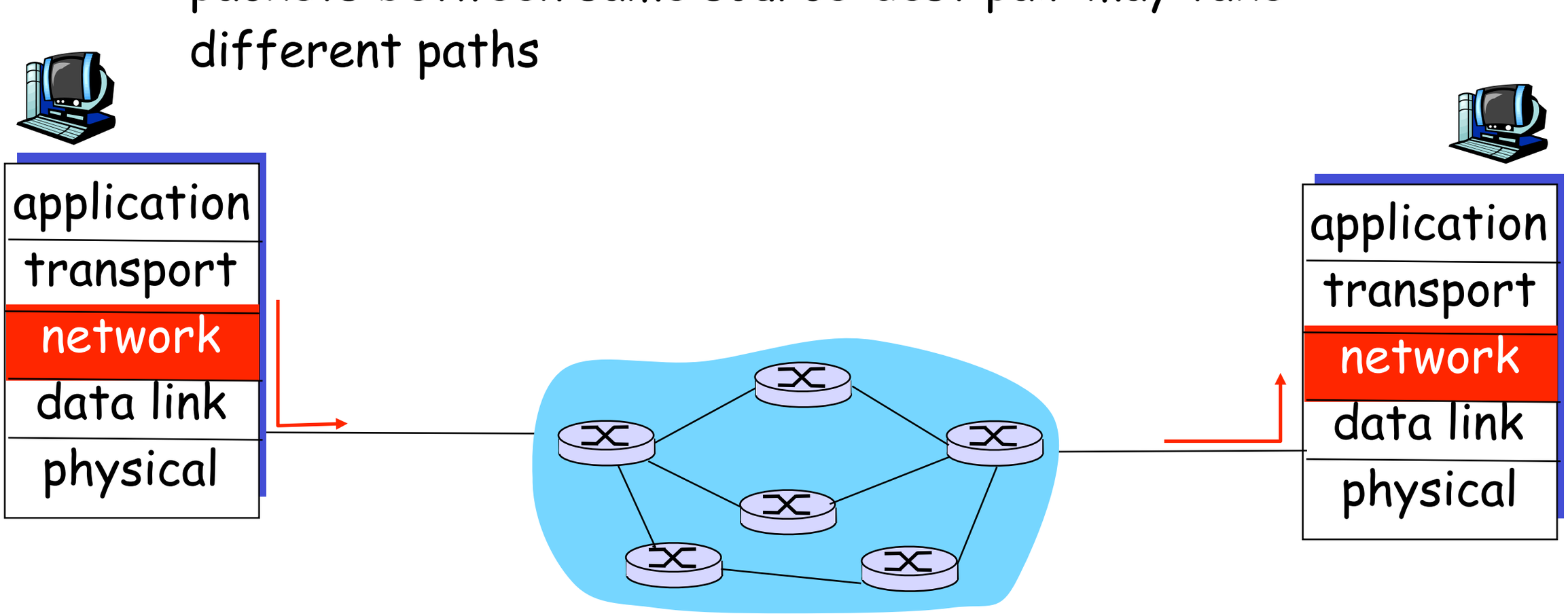
- The Internet uses the "best effort" model
  - keeps with the notion of a "thin waist"

Datagram networks



Datagram networks

- no call setup at network layer
- routers: no state about end-to-end connections
  - no network-level concept of "connection"
- packets forwarded using destination host address
  - packets between same source-dest pair may take different paths



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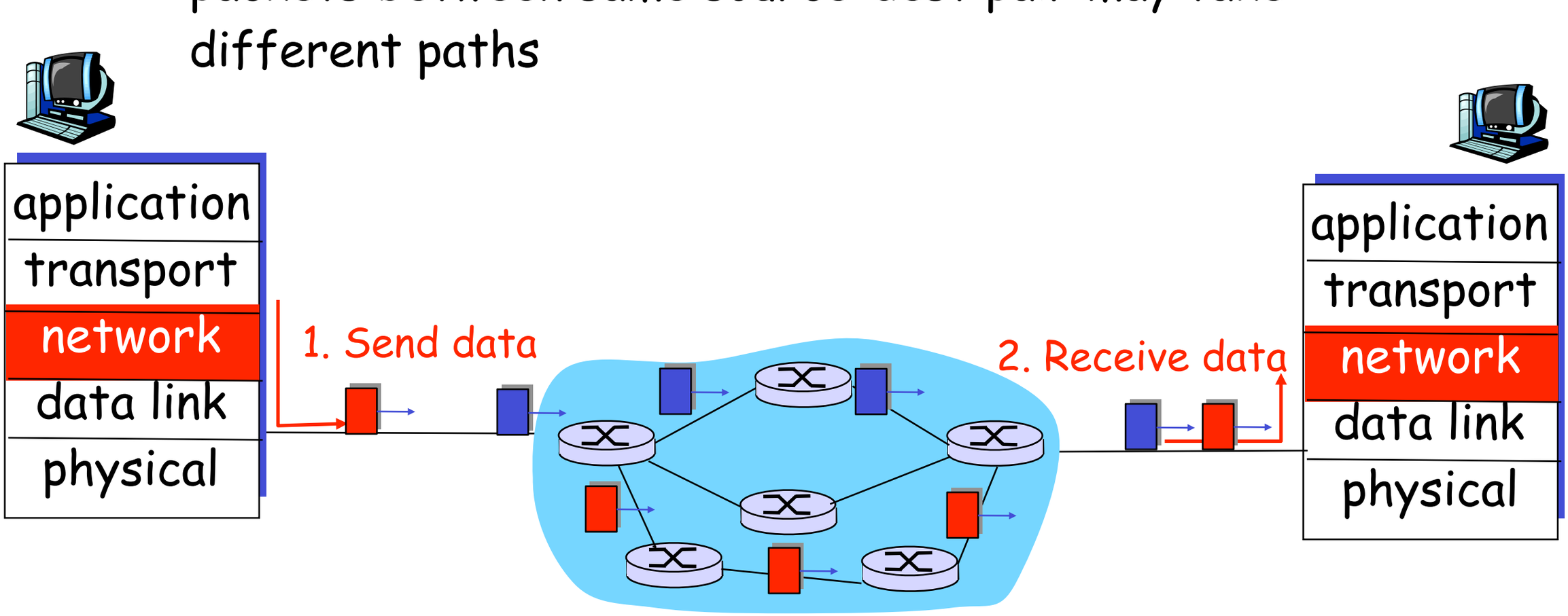


Datagram networks

- Fundamentally "dumb"
  - again, supports "thin waist"

- Keep the smarts at the edges?
  - why?

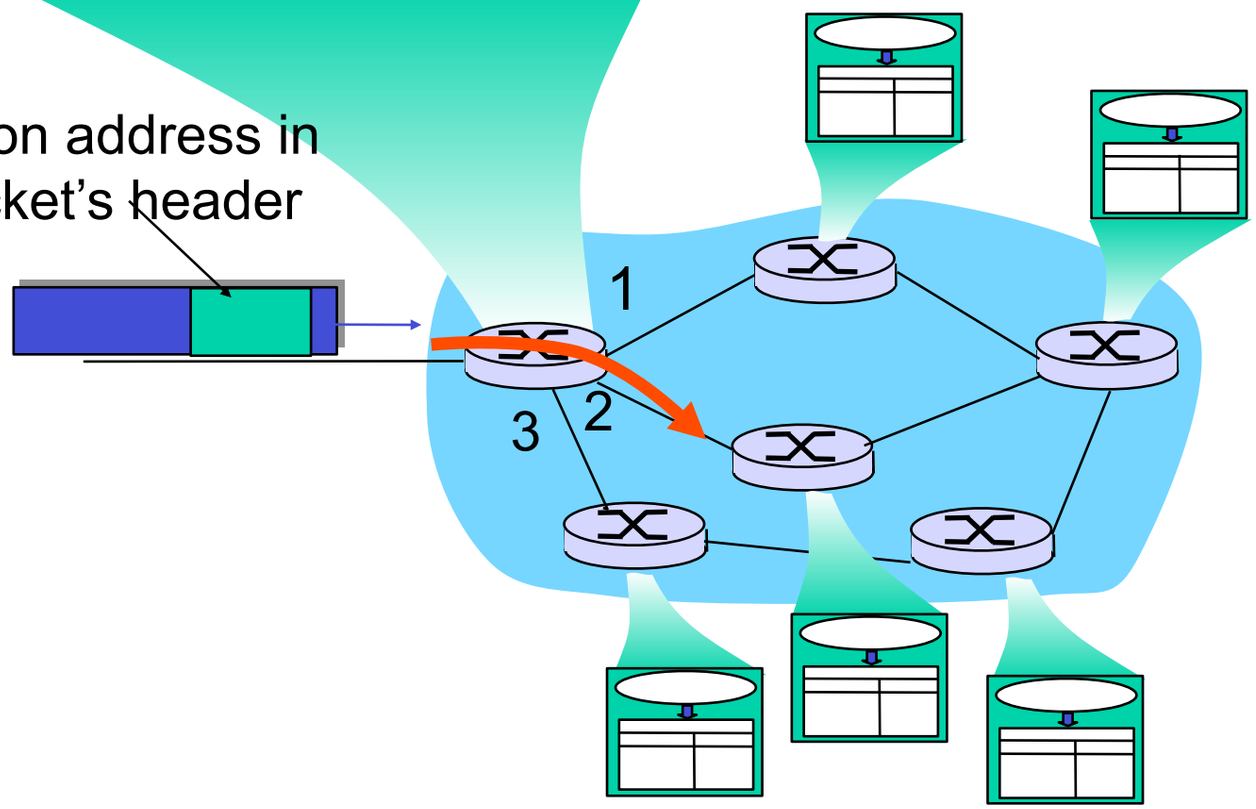
Datagram Forwarding table

routing algorithm

local forwarding table

dest address	output link
address-range 1	3
address-range 2	2
address-range 3	2
address-range 4	1

IP destination address in arriving packet's header



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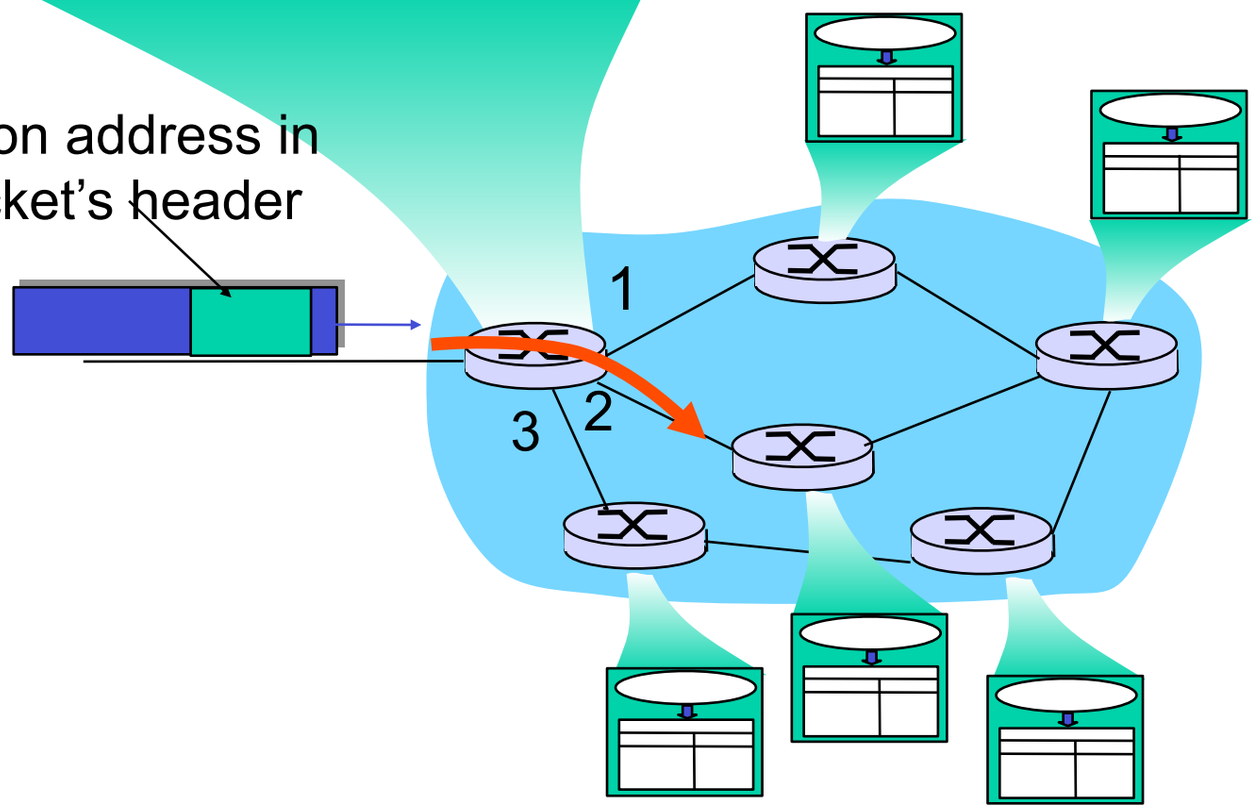
4 billion IP addresses, so rather than list individual destination address
list range of addresses
(aggregate table entries)

IP destination address in arriving packet's header



Datagram Forwarding table

Destination Address Range	Link Interface
11001000 00010111 00010000 00000000 through 11001000 00010111 00010111 11111111	0
11001000 00010111 00011000 00000000 through 11001000 00010111 00011000 11111111	1
11001000 00010111 00011001 00000000 through 11001000 00010111 00011111 11111111	2
otherwise	3

Q: but what happens if ranges don't divide up so nicely?

Datagram Forwarding table

Destination Address Range	Link Interface
200.23.16.0 through 200.23.23.255	0
200.23.24.0 through 200.23.24.255	1
200.23.25.0 0 through 200.23.31.255	2
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Q: but what happens if ranges don't divide up so nicely?

Datagram forwarding

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Datagram forwarding

Longest prefix matching

when looking for forwarding table entry for given destination address, use longest address prefix that matches destination address.

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Examples:

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Which interface?

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