The Network Layer

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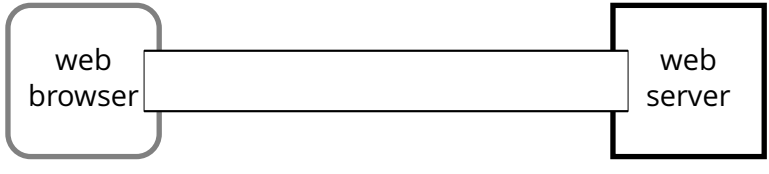
April 22, 2020

Outline

- Basic network-layer architecture of a datagram network
- Introduction to forwarding
- Introduction to routing
- General architecture of a router
- Switching fabric and queuing
- Internet network-layer protocol
- The Internet protocol (IP)
- Fragmentation

web
browser
web
server


web
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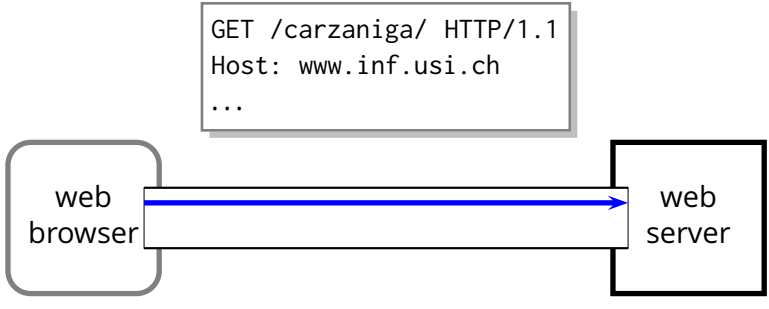
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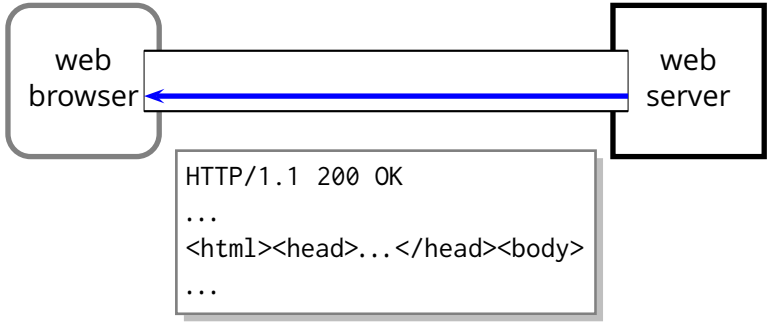
Host: www.inf.usi.ch
...
web
browser
web
server


web
browser
web
server
HTTP/1.1 200 OK
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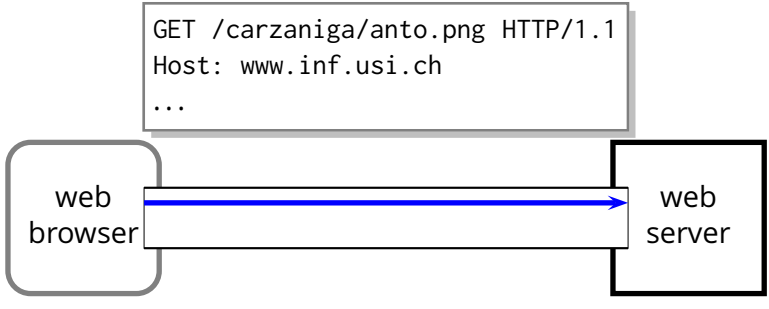
...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Host: www.inf.usi.ch
...
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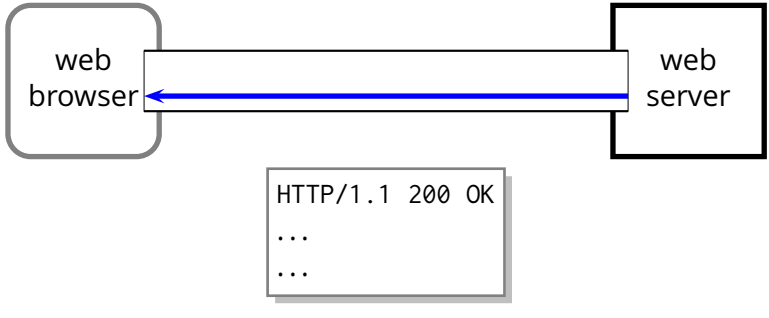
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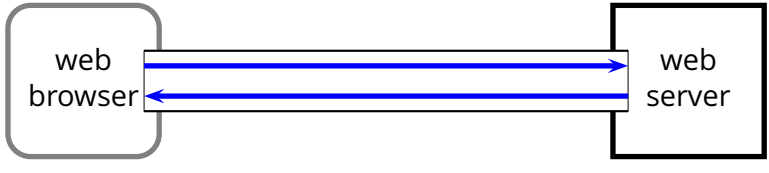
Transport Level



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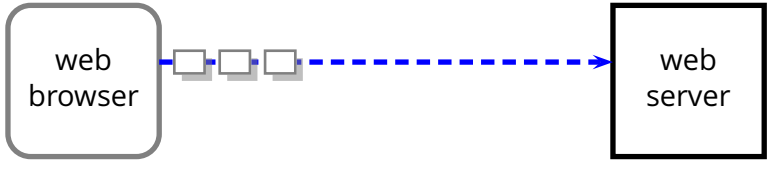

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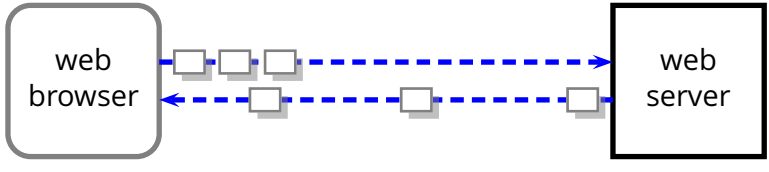

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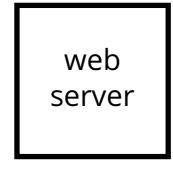
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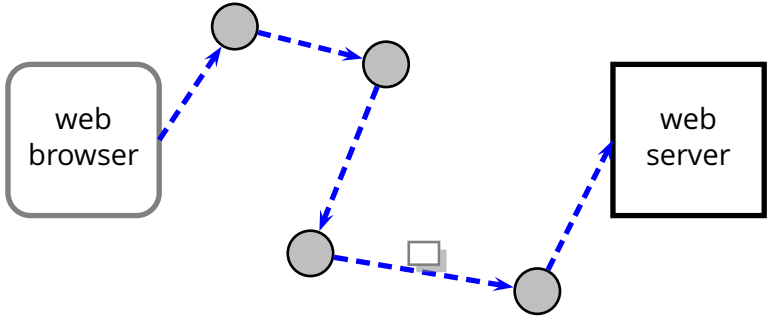
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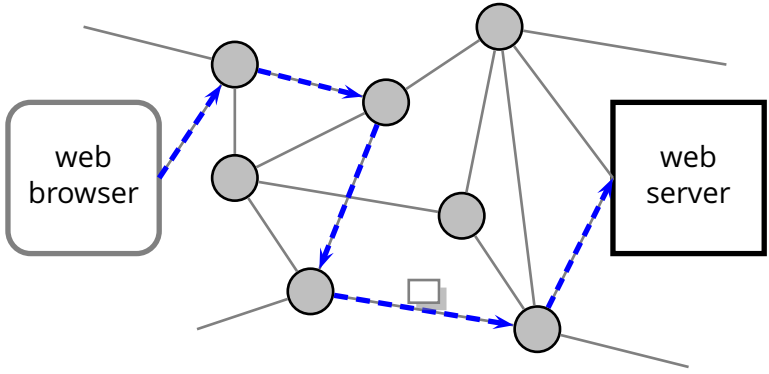
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Router

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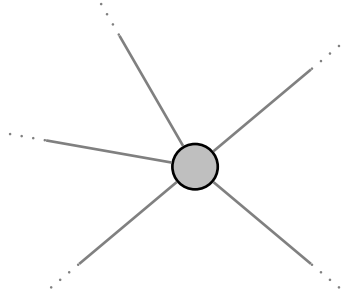

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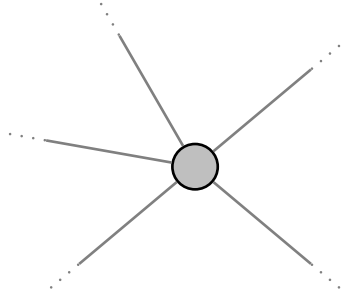

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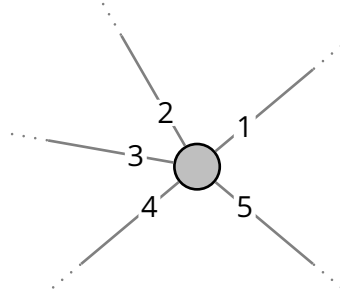

- Fundamental component of the network layer
- A *node in a graph*
- A finite set of input/output (physical) connections
  - a.k.a., ***interfaces*** or ***ports***

Focus: “Datagram” Networks

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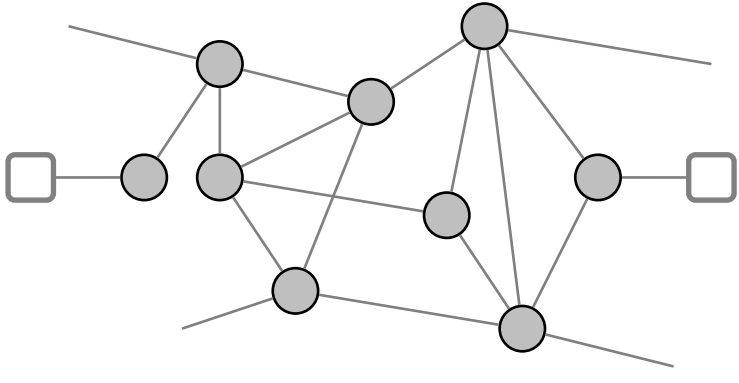

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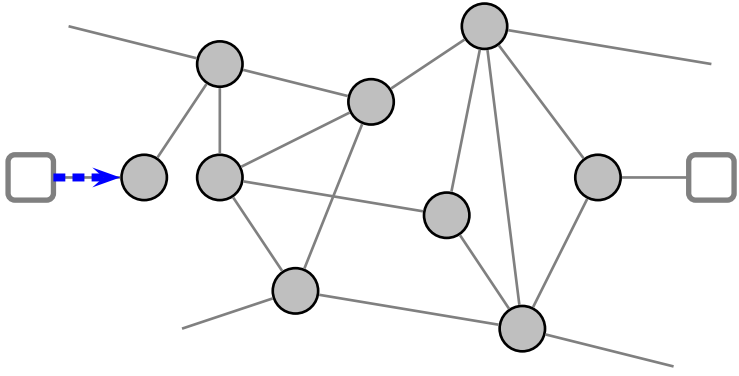

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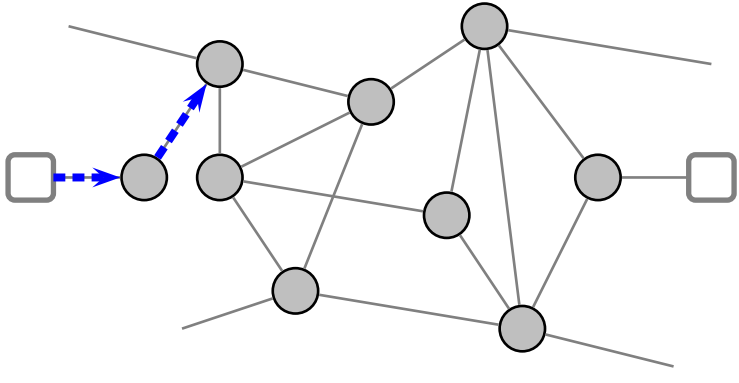

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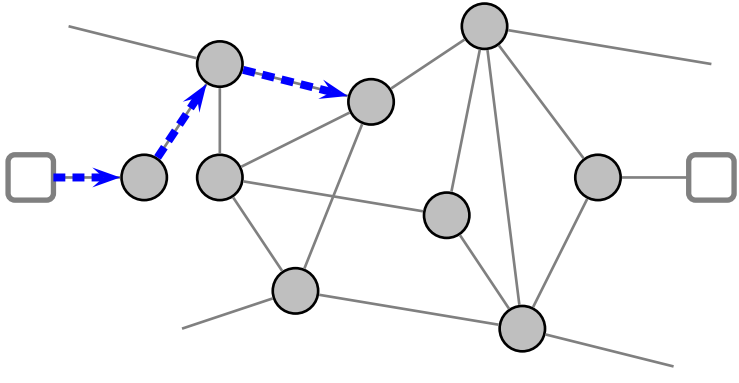

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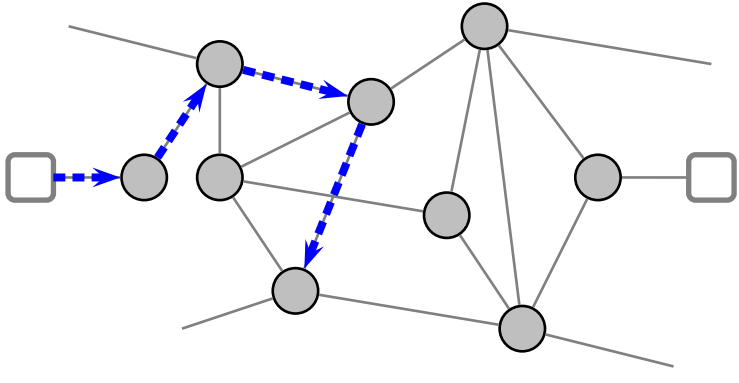

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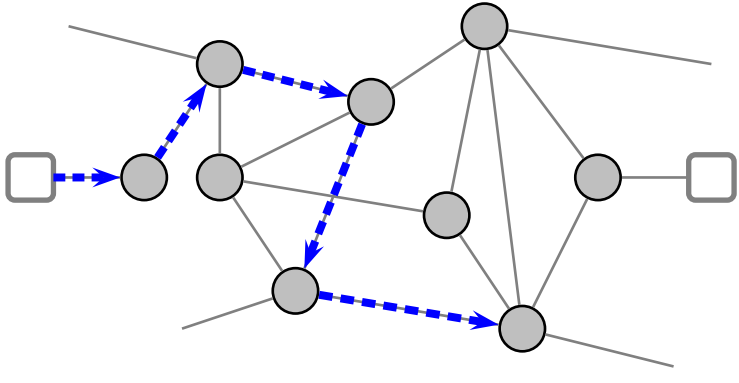

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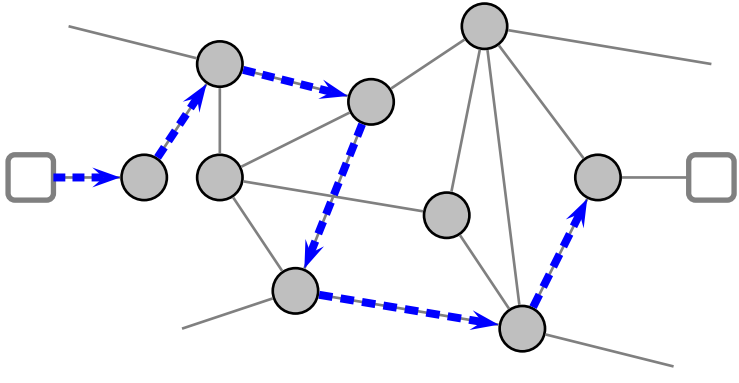

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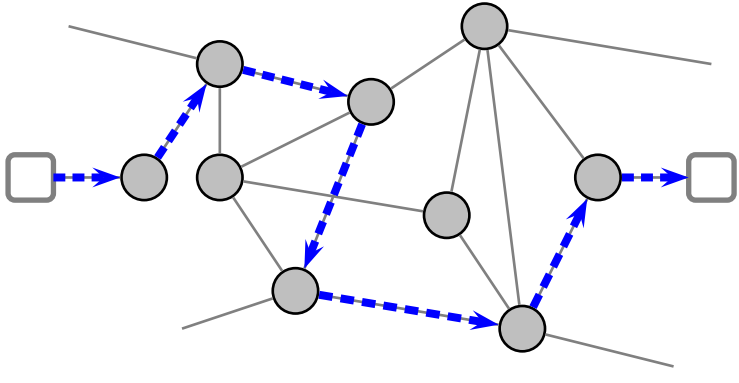

- Potentially *multiple paths* for the same source/destination

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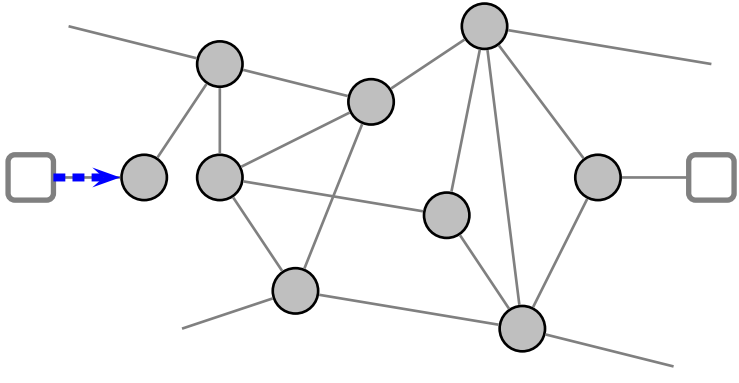

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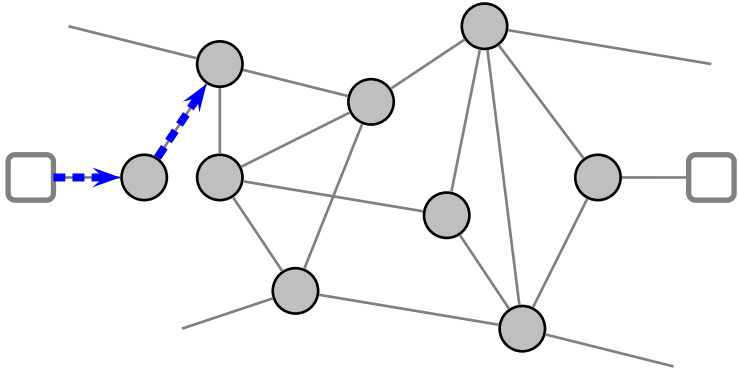

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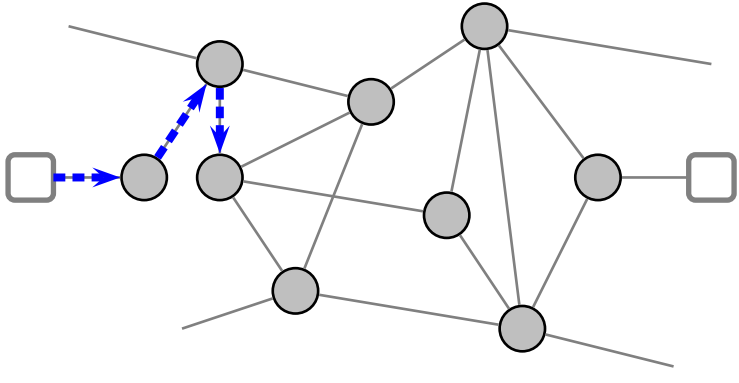

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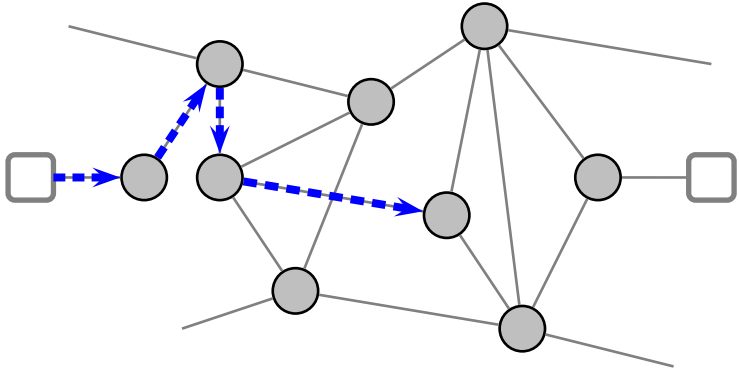

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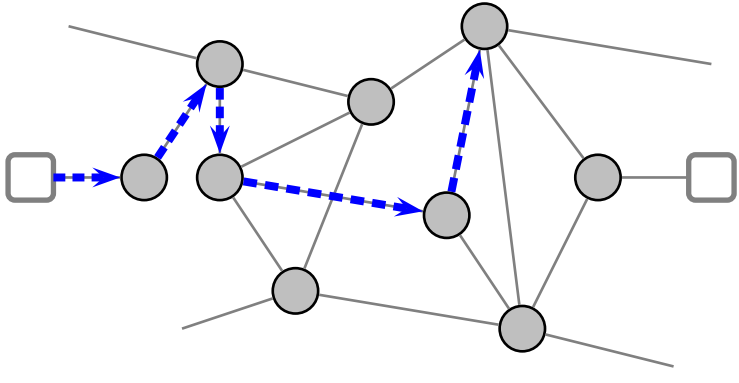

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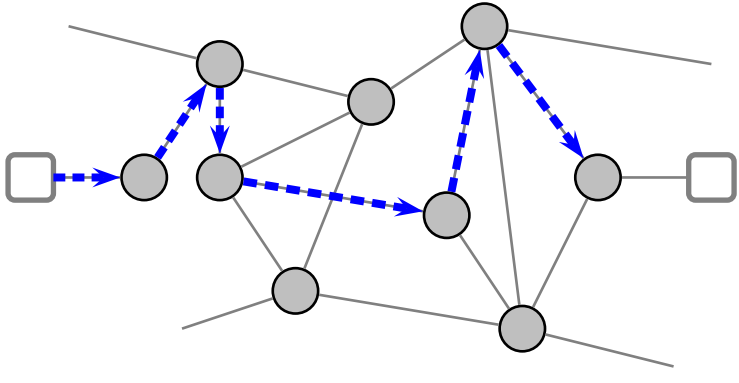

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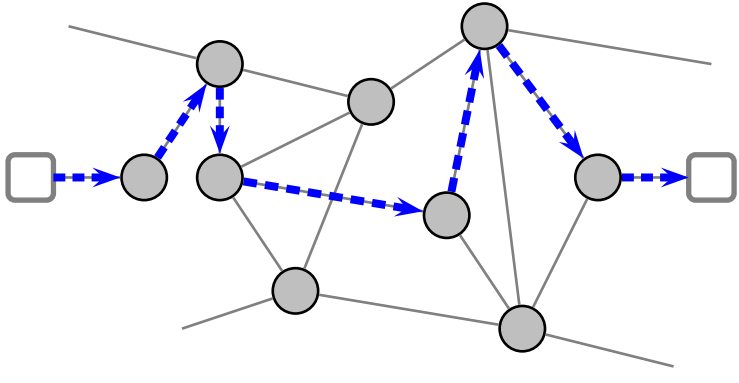

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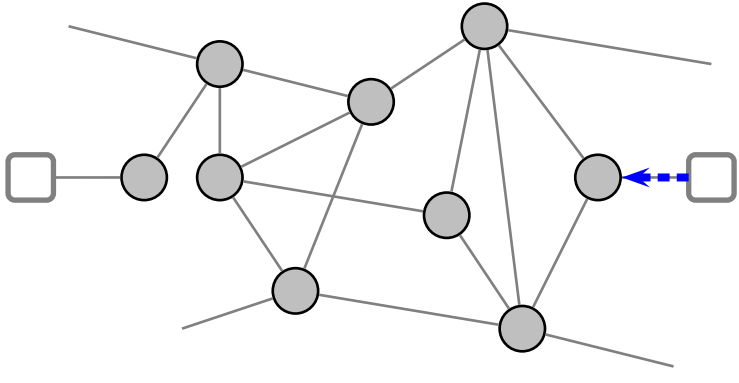

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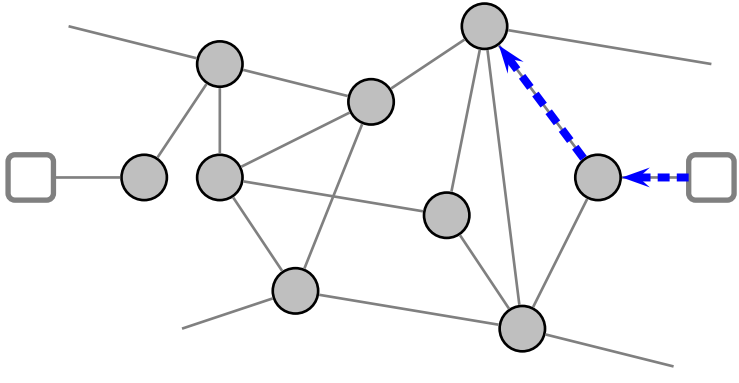

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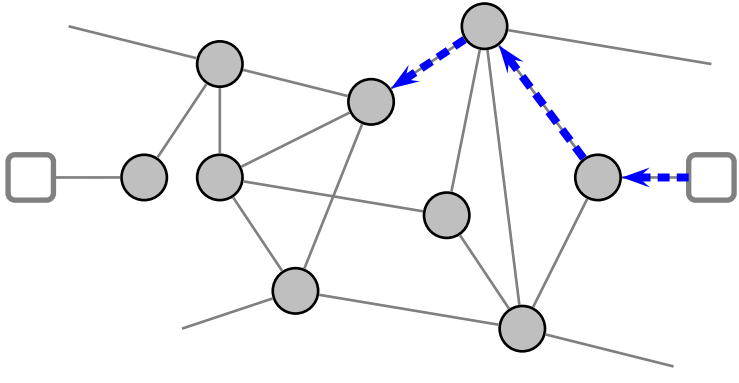

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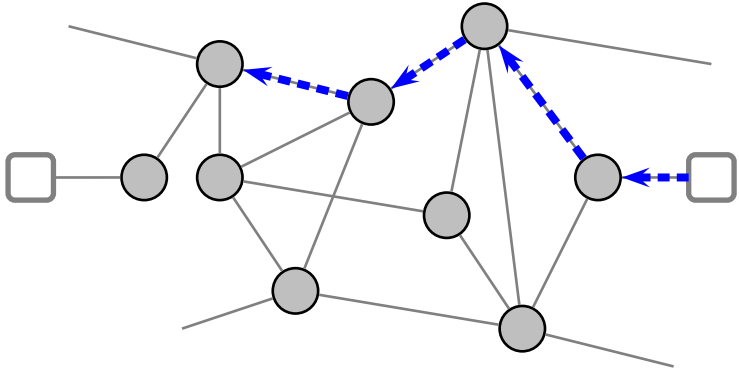

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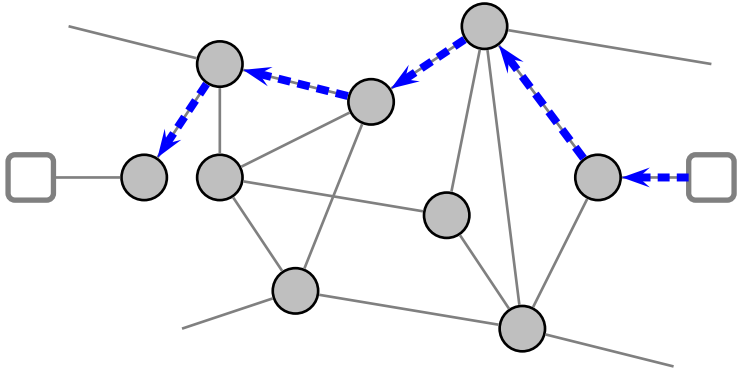

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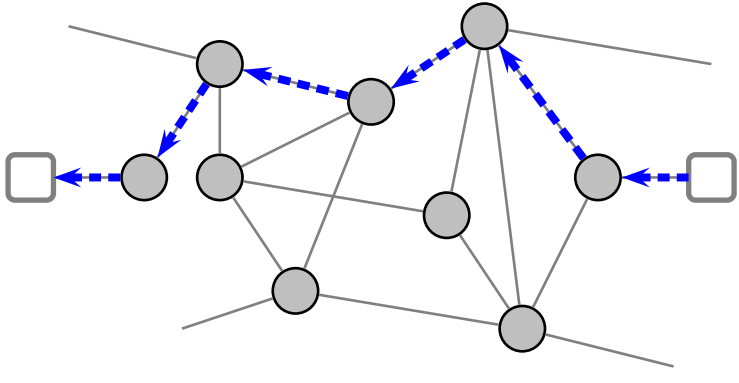

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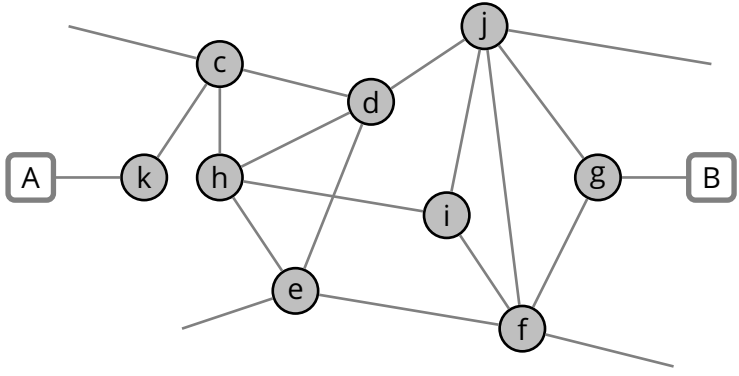

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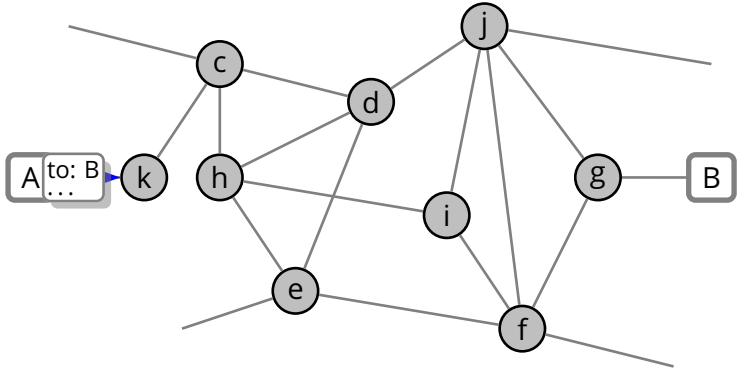

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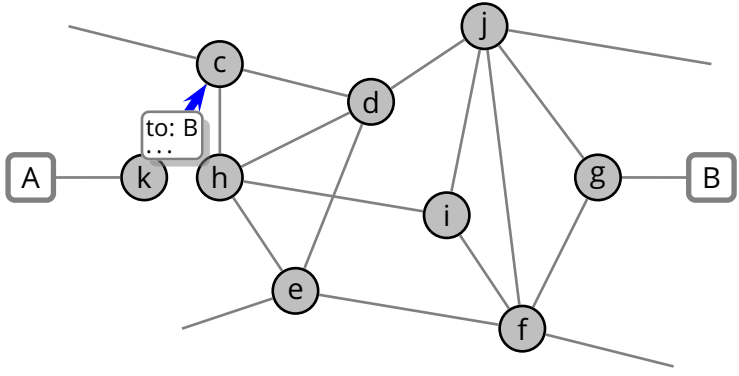

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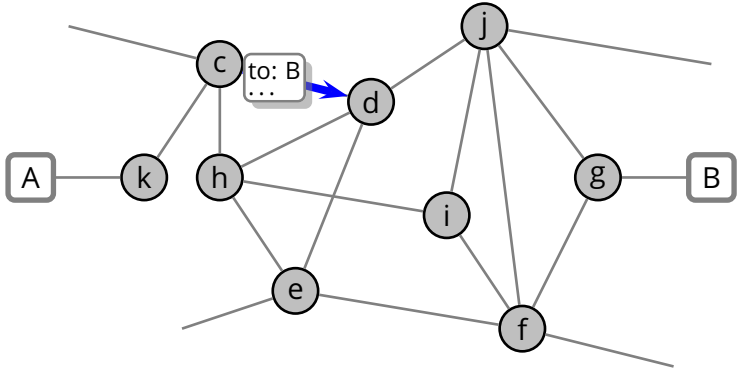

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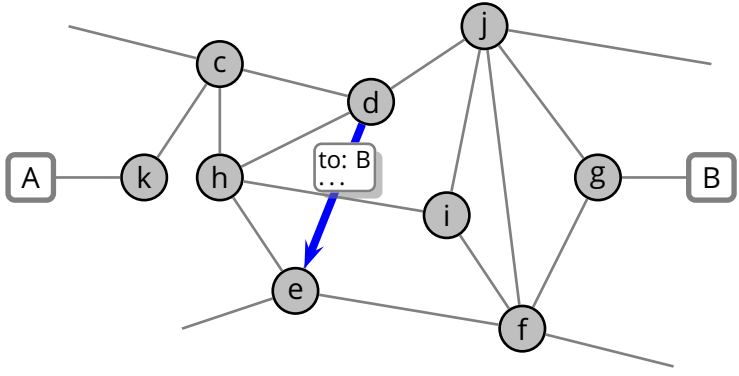

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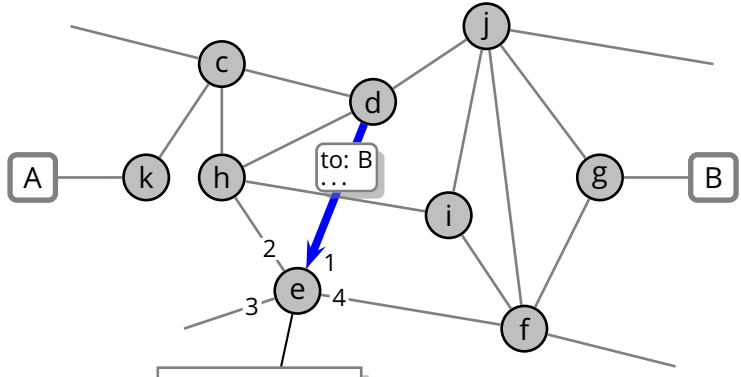

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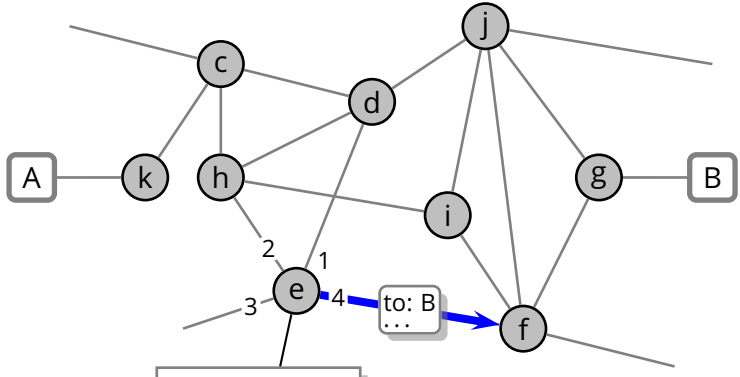

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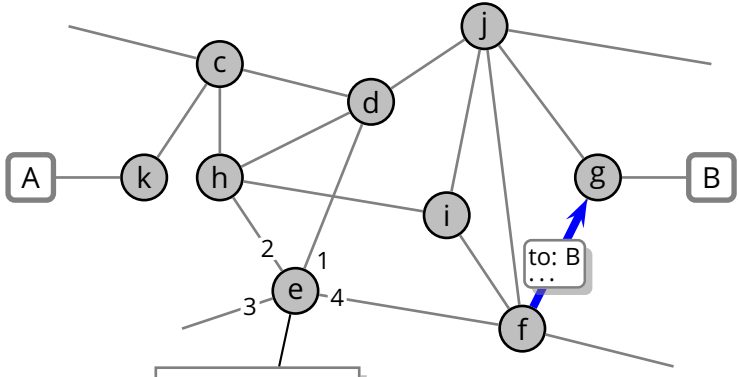

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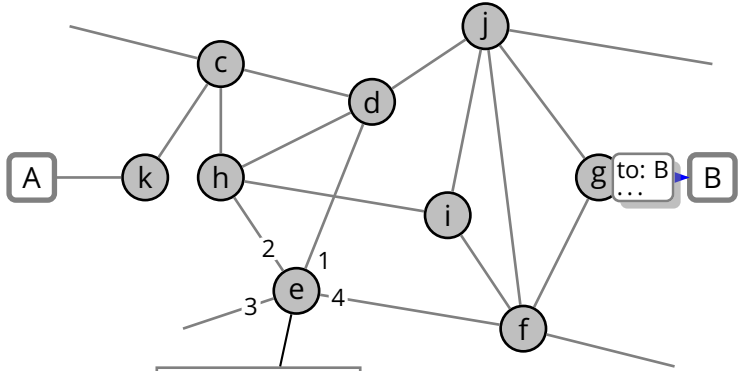

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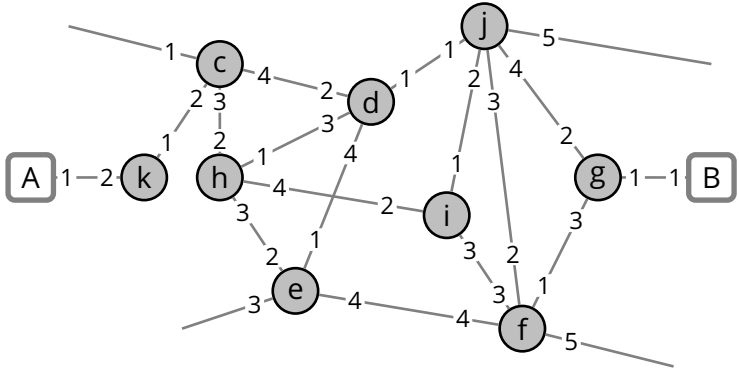
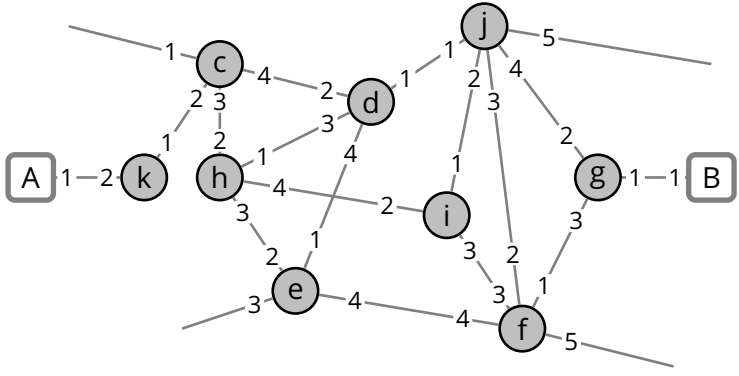
- Simple design: “forwarding table”
- Issues
  - how big is the forwarding table?
  - how fast does the router have to forward datagrams?
  - how does the router build and maintain the forwarding table?

Routing


A
B
c
d
e
f
g
h
i
j
k



router k	
A	2
B	1

...

Router Functions

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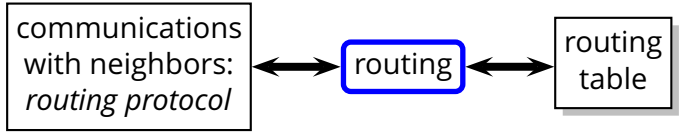

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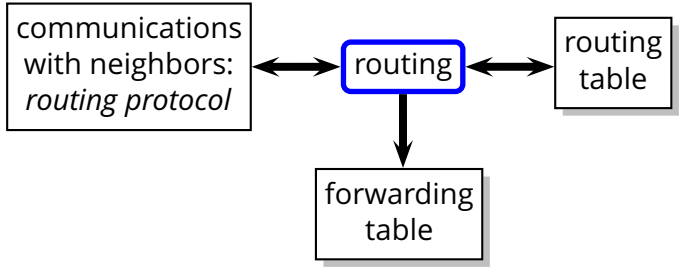

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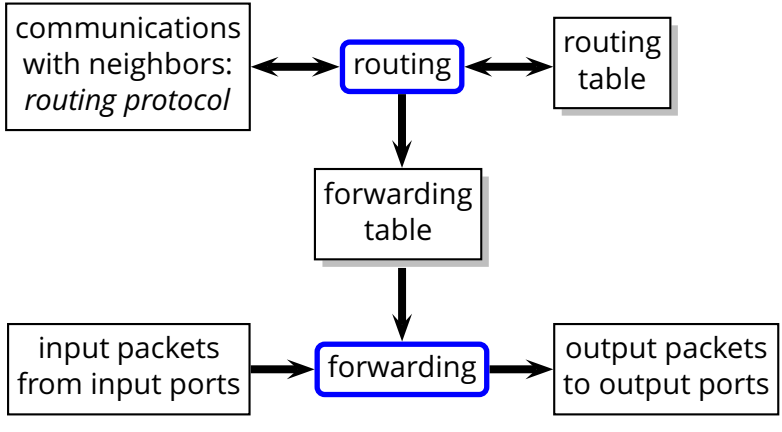

Anatomy of a Router

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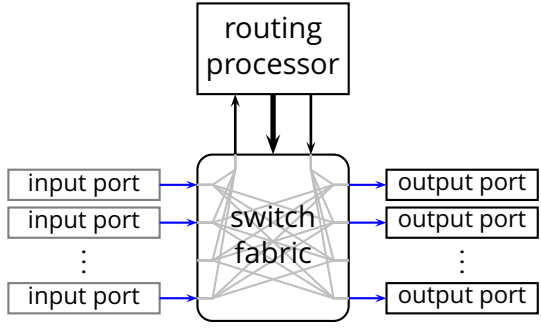

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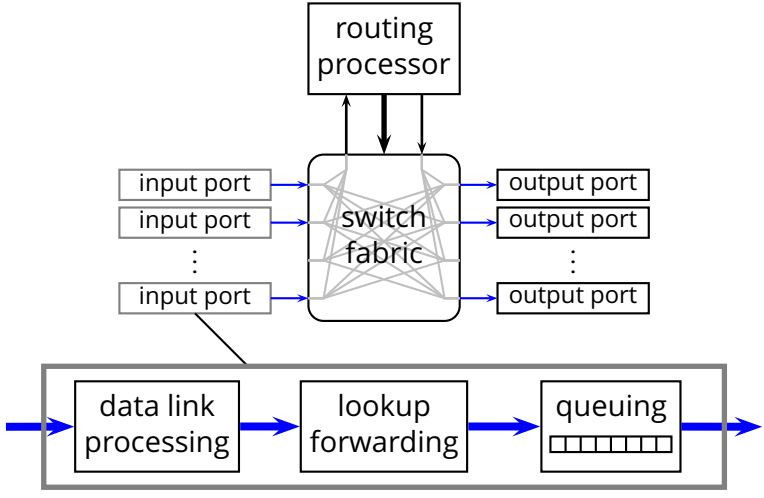

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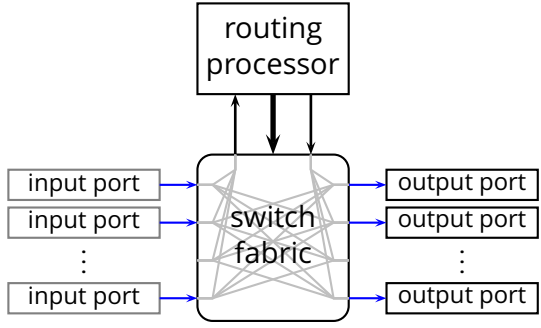

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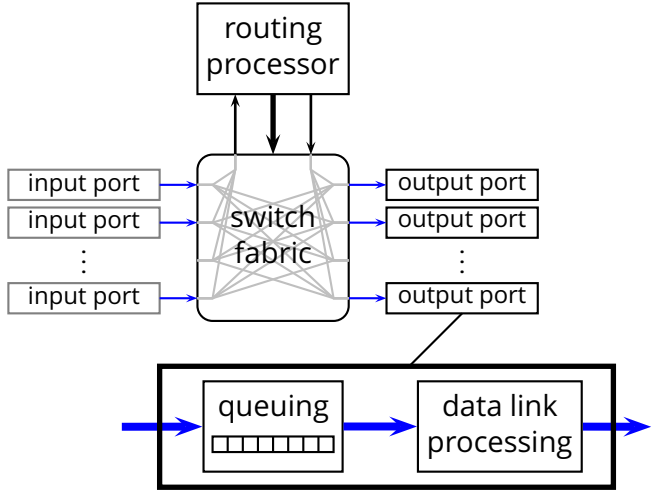

Queuing

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  - *active queue management:* a set of policies and algorithms to decide when and how to drop or mark packets in the attempt to prevent congestion

Internet Network Layer

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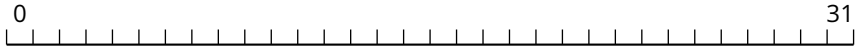
IPv4 Datagram Format



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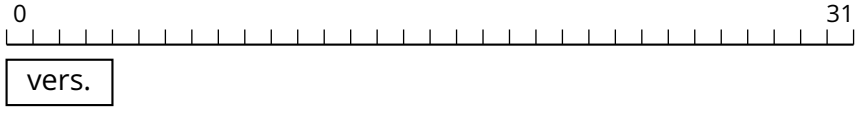

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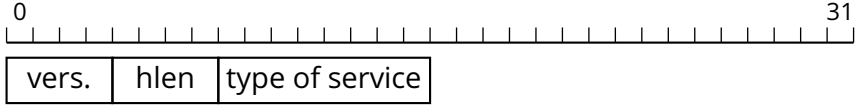

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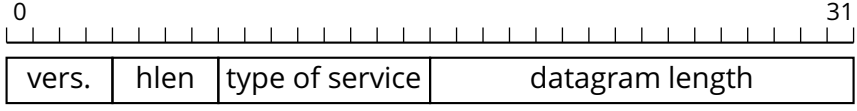

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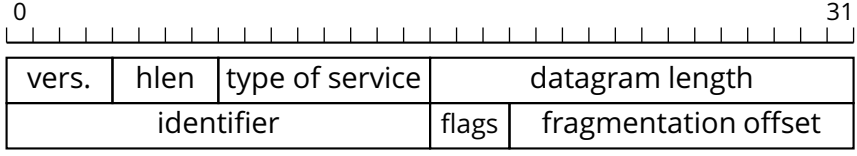

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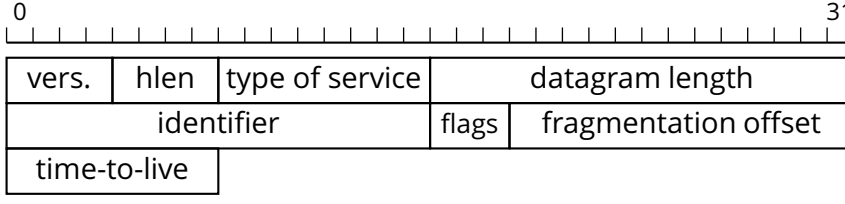

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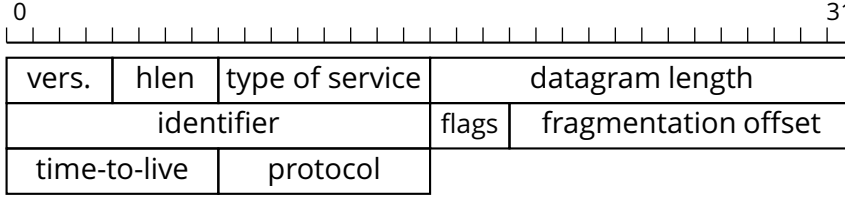

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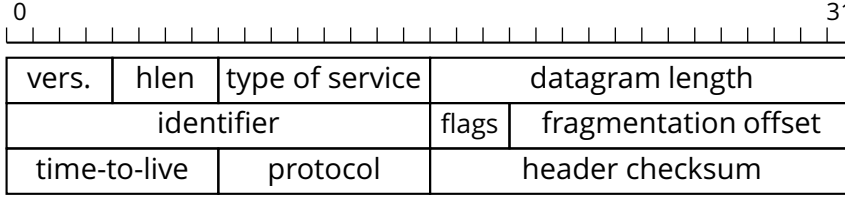

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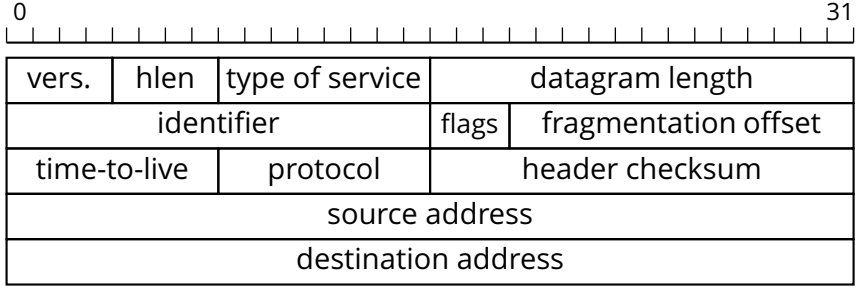

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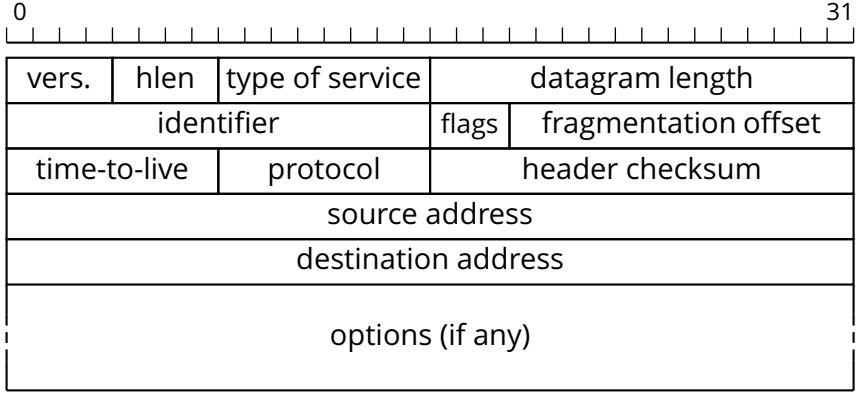

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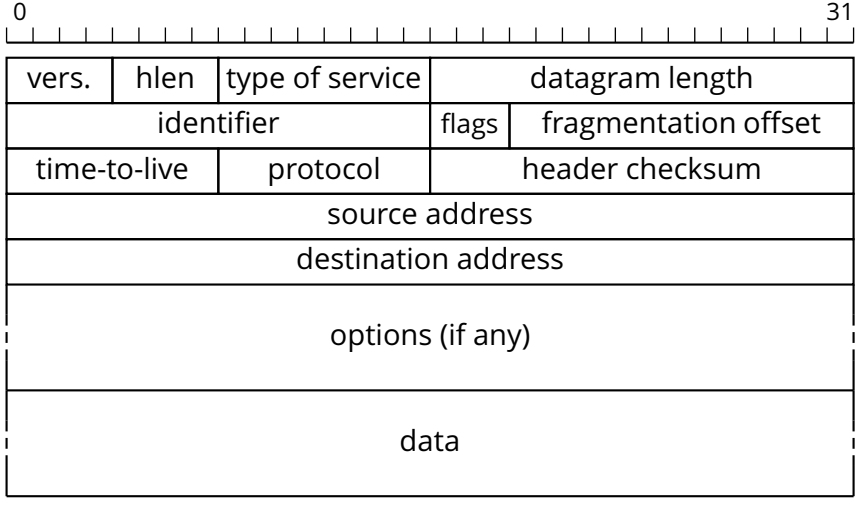
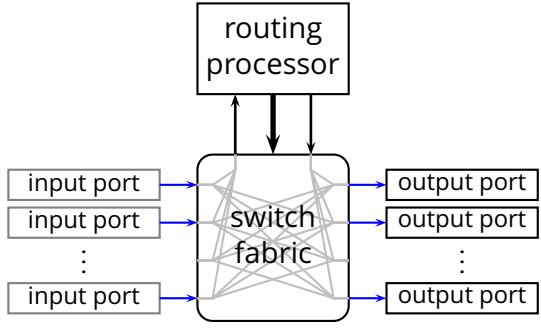


Fragmentation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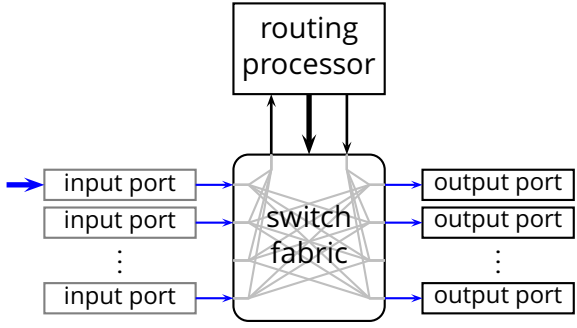
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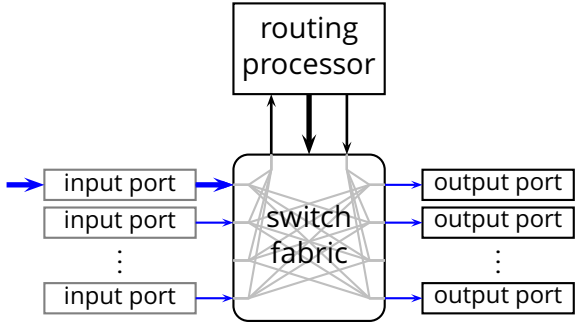
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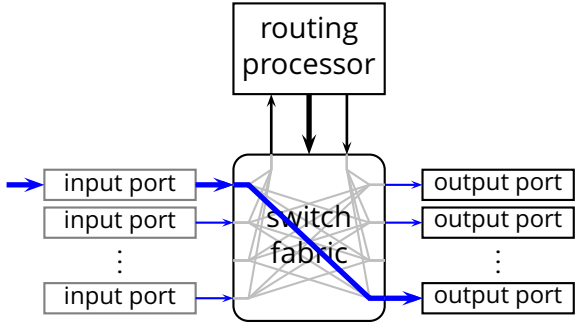
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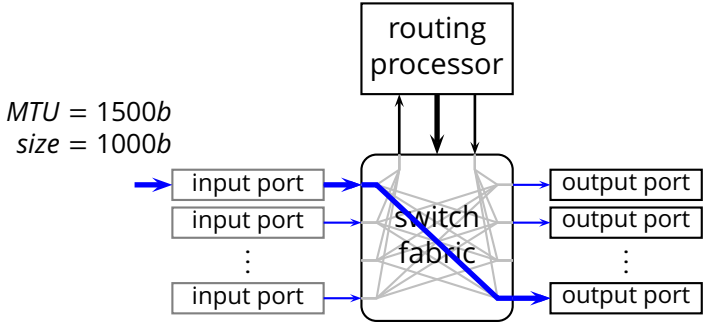

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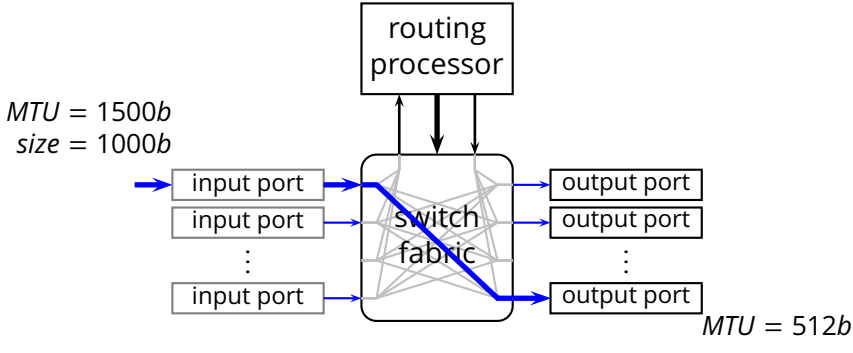

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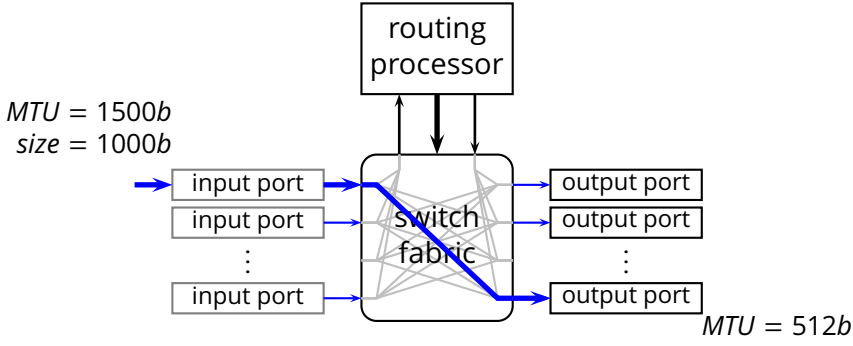

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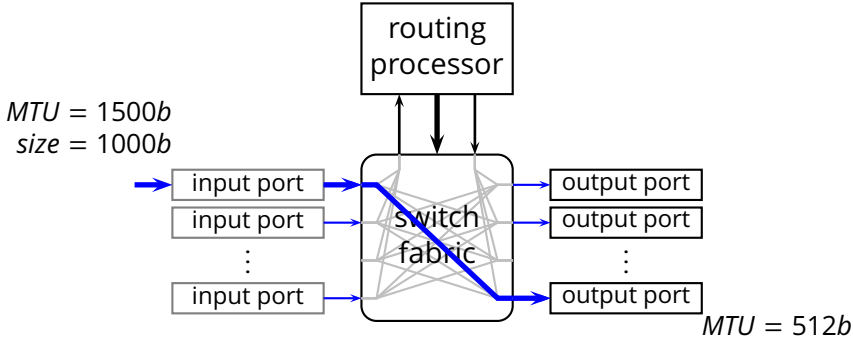

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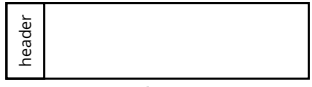
- The datagram is ***fragmented***

Fragmentation



input datagram

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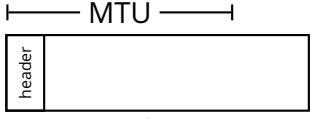

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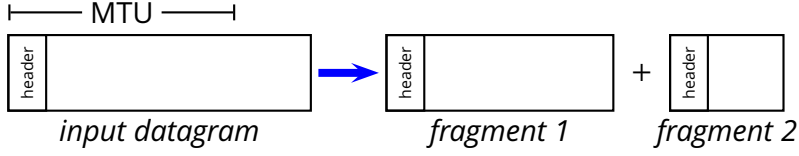

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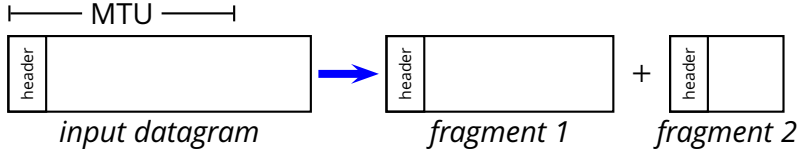

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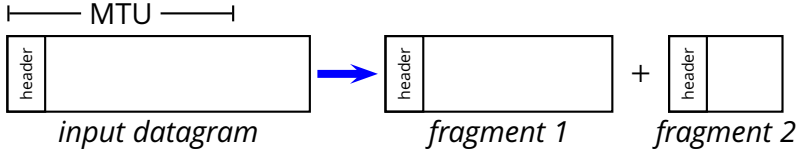

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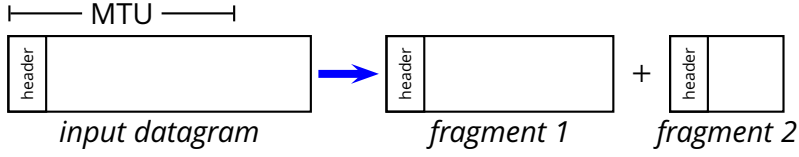

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- Requirements
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  - destination must see if and when all the fragments have been received
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identifier	*fragment offset*	*more fragments*	*header length*	*total length*
789	0	0	20	1020

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789	61	1	20	508

identifier	*fragment offset*	*more fragments*	*header length*	*total length*
789	122	0	20	44