Communication Networks

Spring 2019

Rüdiger Birkner

https://comm-net.ethz.ch/

ETH Zürich

March 7 2019

Don’t hesitate to ask questions

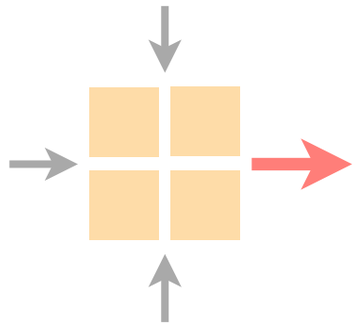
also over Slack (email) after the session

Main contact persons:

Tobias	Eng. & Ger.
Alexander	Eng. & Ger.
Rüdiger	Eng. & Ger.
Hendrik	Eng. & Ger.
Eric	Eng. & Ger.

Communication Networks

Exercise 2



Quick recap and task 2.4

Time for you to solve the tasks

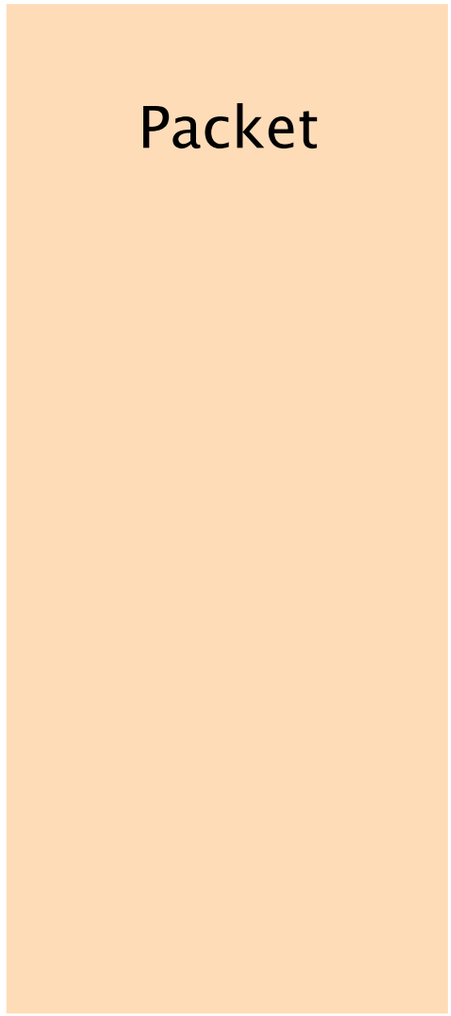
More recap and discussion of task 2.2

Solutions will be published next week

routing

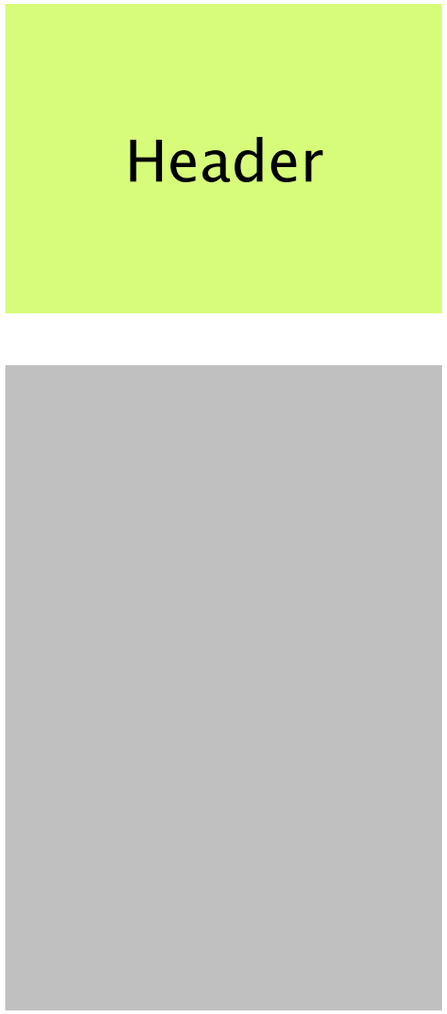
How do you guide IP packets
from a source to destination?

Think of IP packets as envelopes



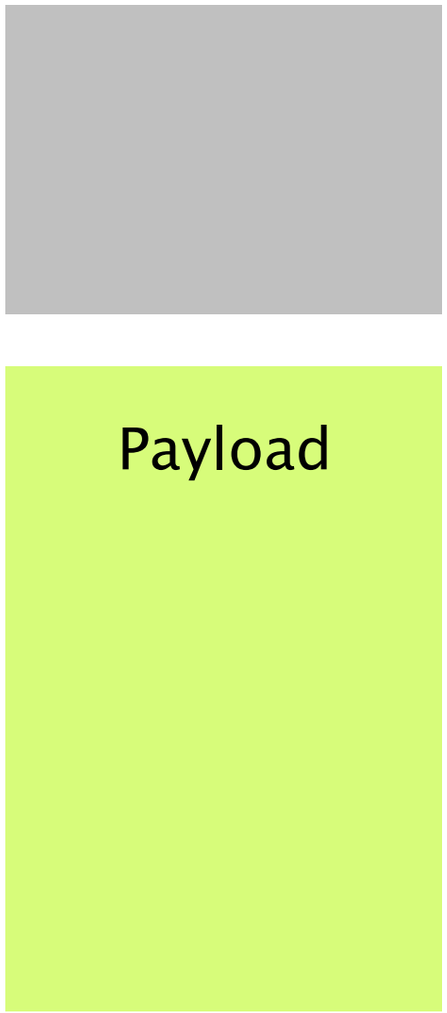
Like an envelope,

packets have a header

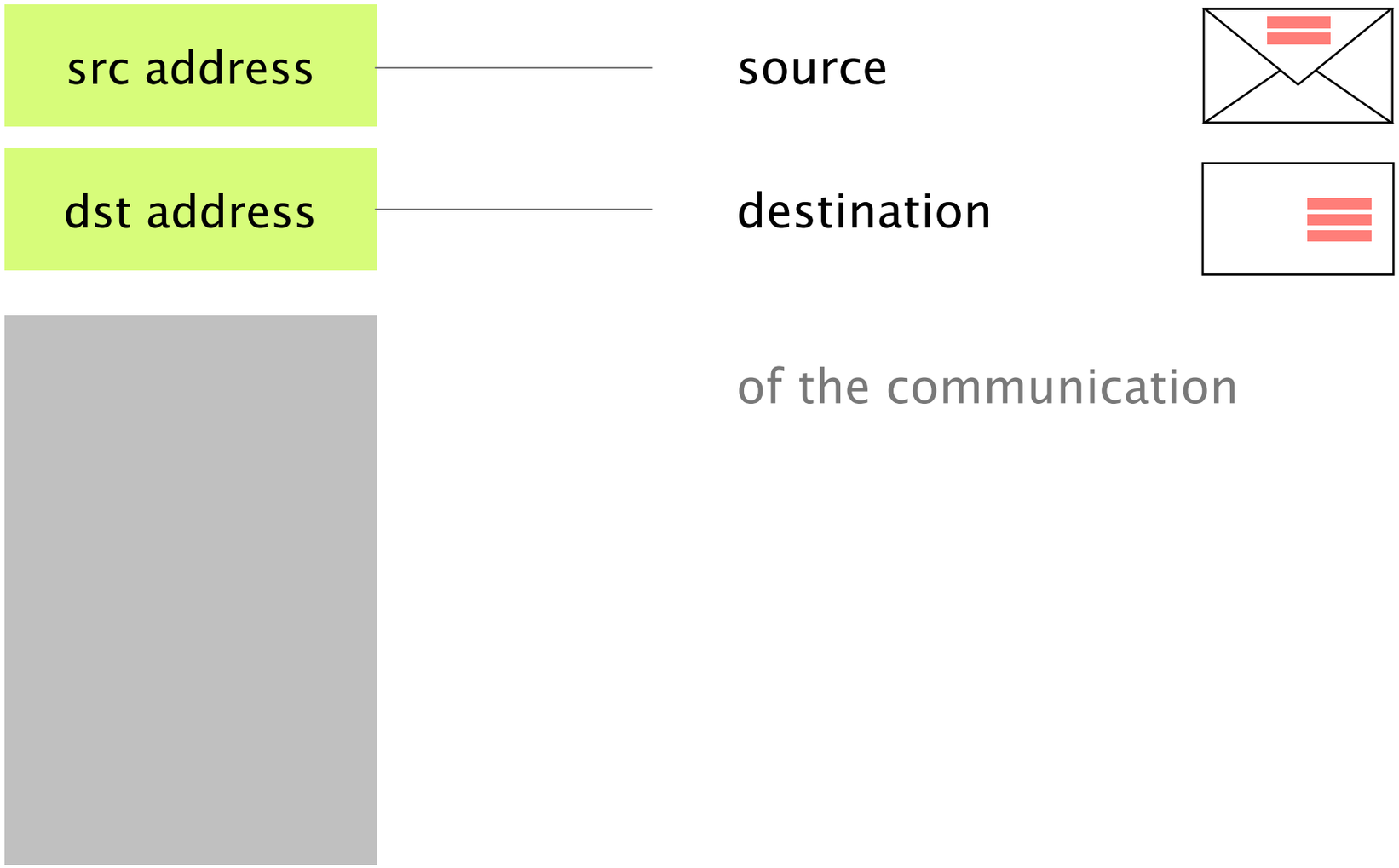


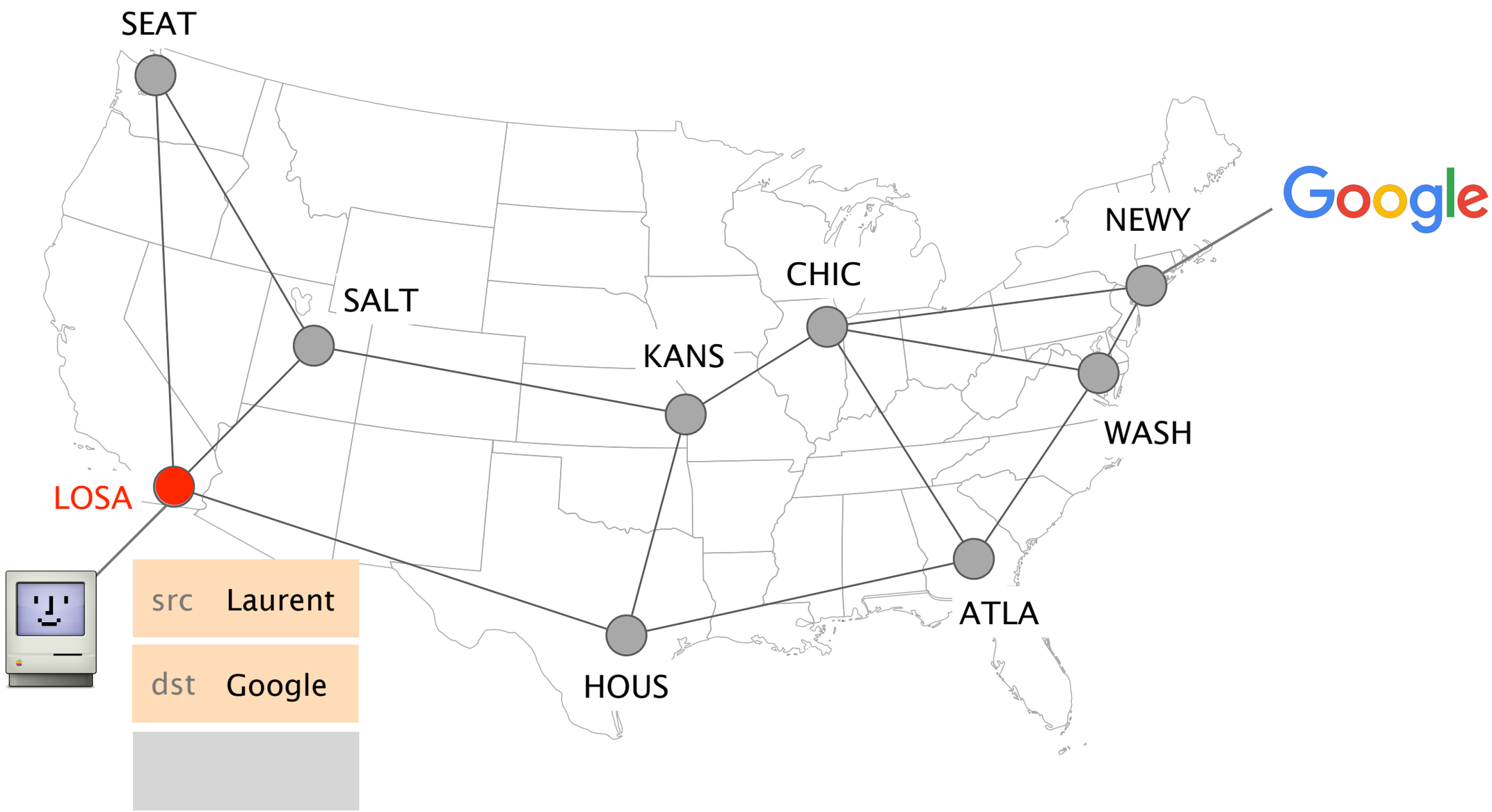
Like an envelope,

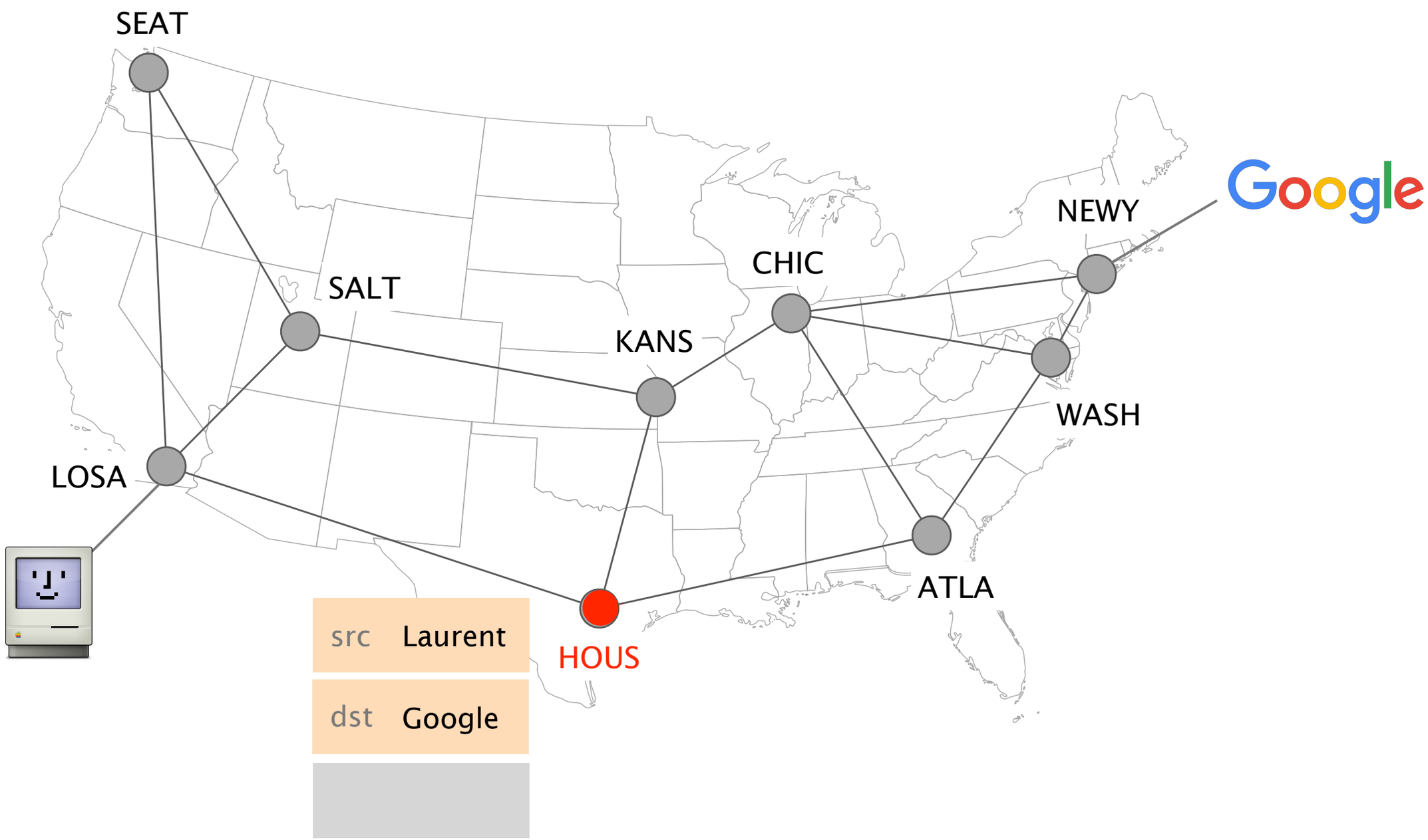
packets have a payload

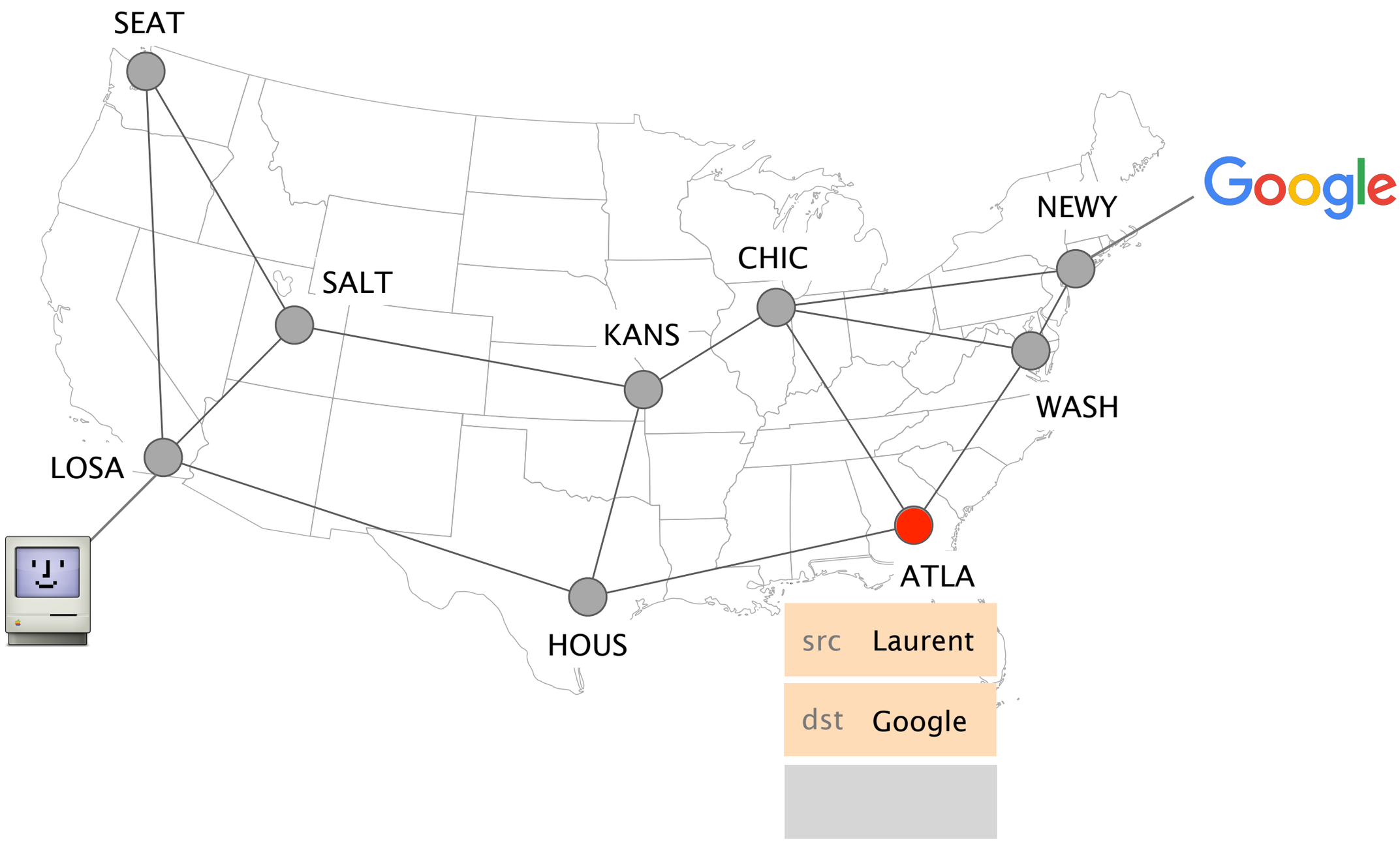


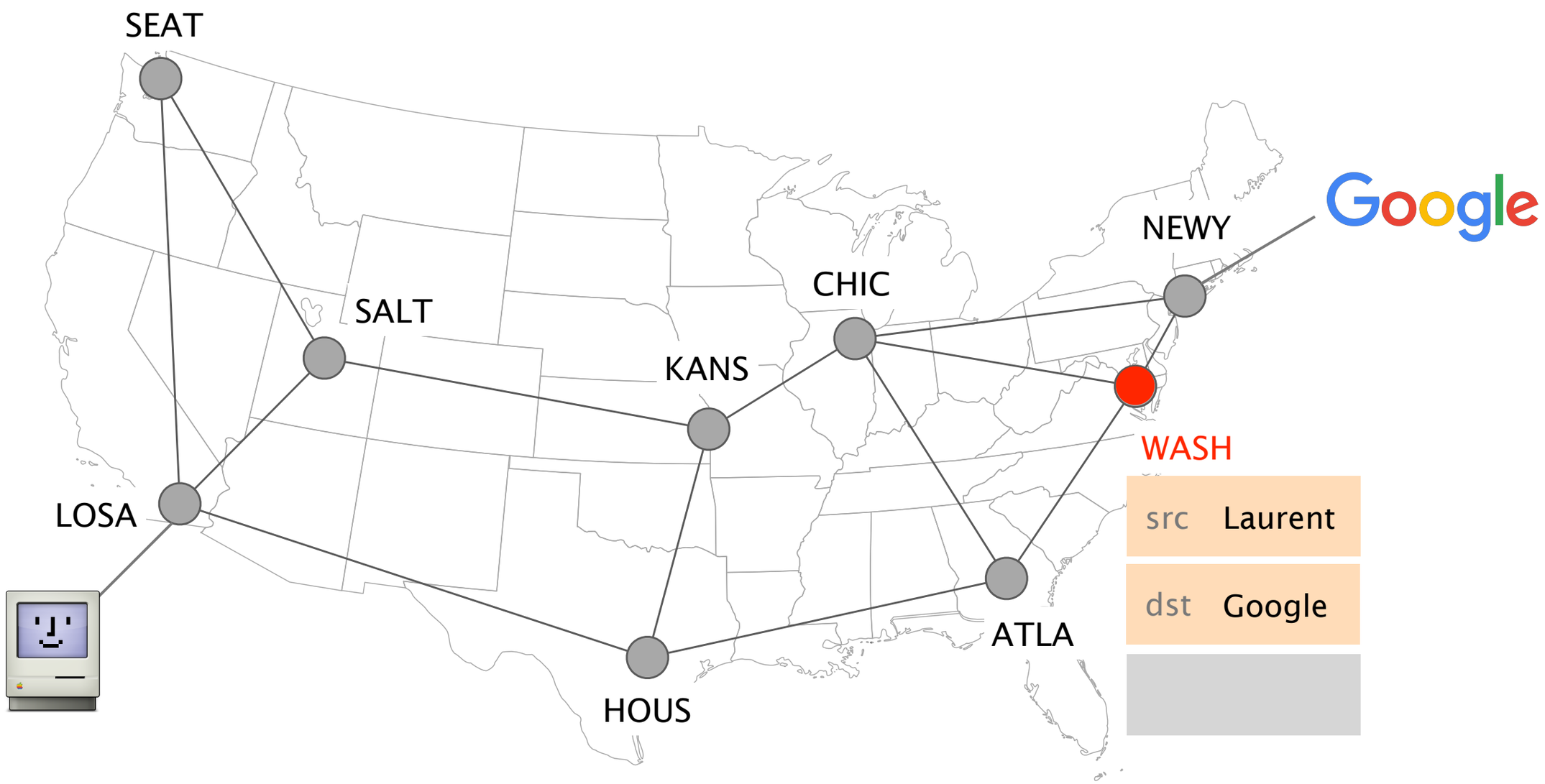
The header contains the metadata needed to forward the packet

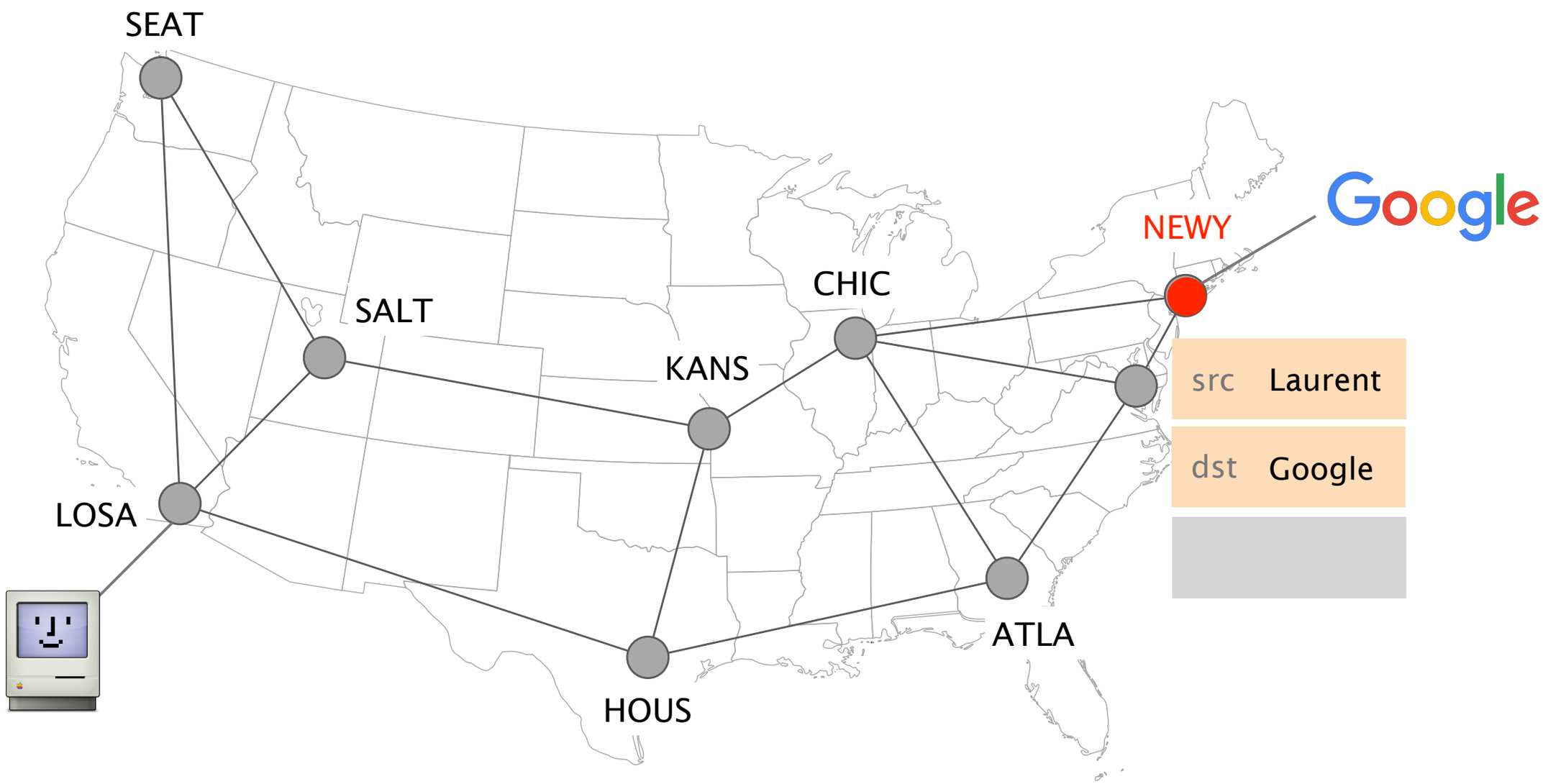


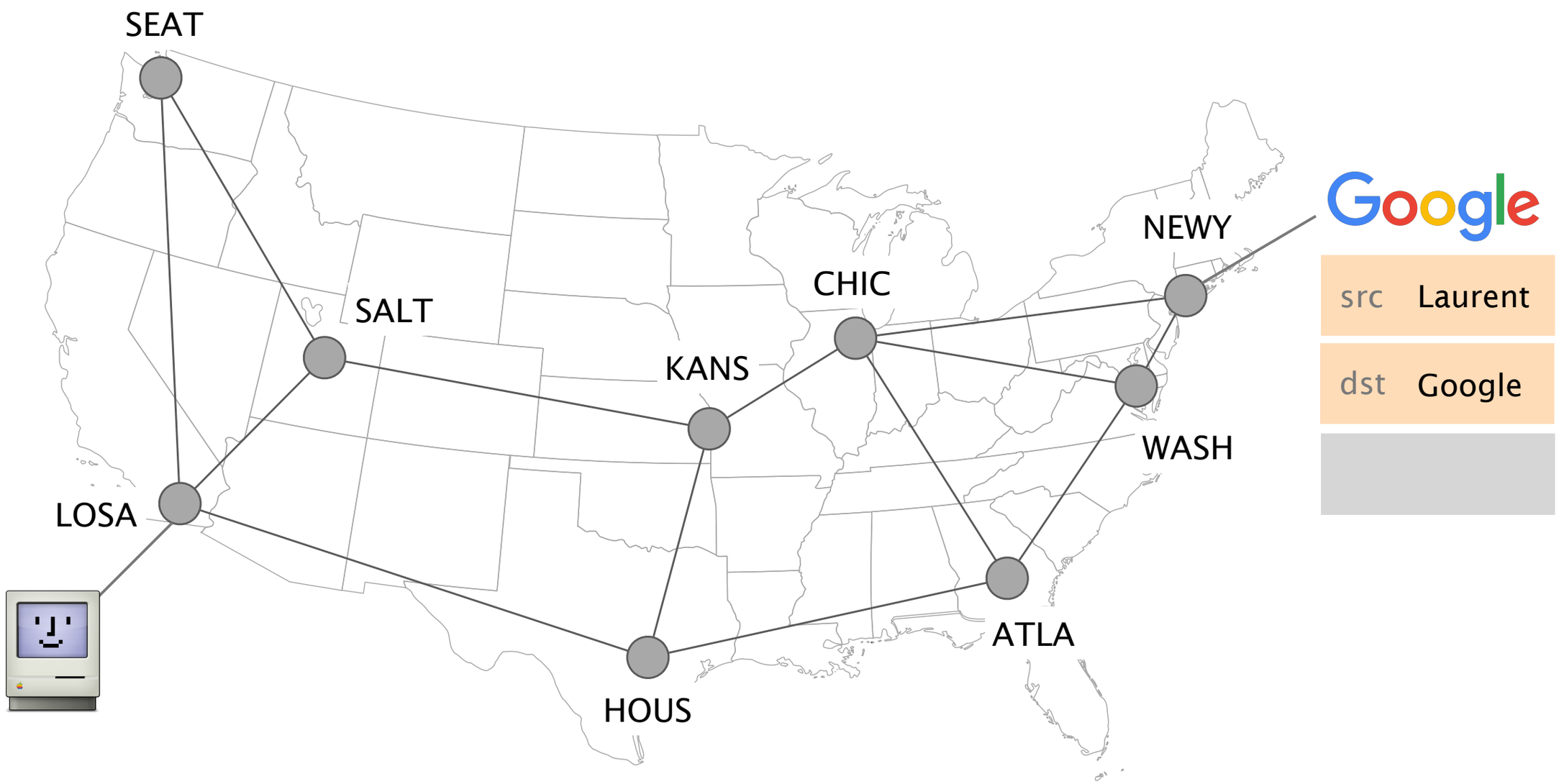

SEAT
SALT
KANS
CHIC
NEWY
WASH
LOSA
ATLA
HOUS
Google
src Laurent
dst Google


SEAT
SALT
KANS
CHIC
NEWY
WASH
LOSA
ATLA
HOUS
Google
src Laurent
dst Google

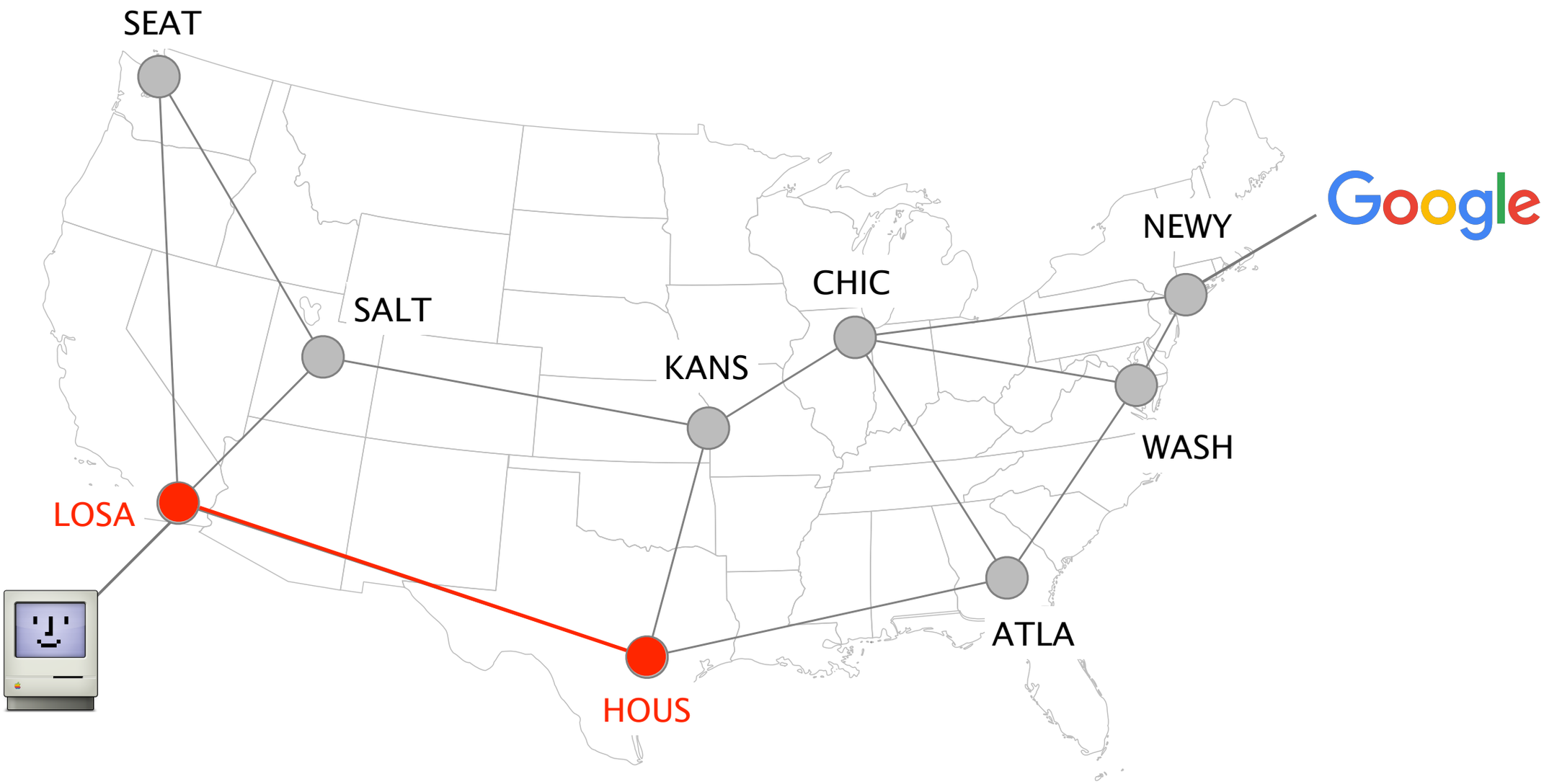

SEAT
SALT
KANS
CHIC
NEWY
WASH
LOSA
HOUS
ATLA
Google
src Laurent
dst Google


SEAT
SALT
KANS
CHIC
NEWY
WASH
LOSA
HOUS
ATLA
Google
src Laurent
dst Google


SEAT
SALT
KANS
CHIC
NEWY
LOSA
HOUS
ATLA
Google
src Laurent
dst Google


SEAT
SALT
KANS
CHIC
NEWY
WASH
LOSA
HOUS
ATLA
Google
src Laurent
dst Google

Let’s zoom in on what is going on between two adjacent routers



LOSA

HOUS

IF#2

IF#4

IF#2

IF#4

Data-Plane

Data-Plane

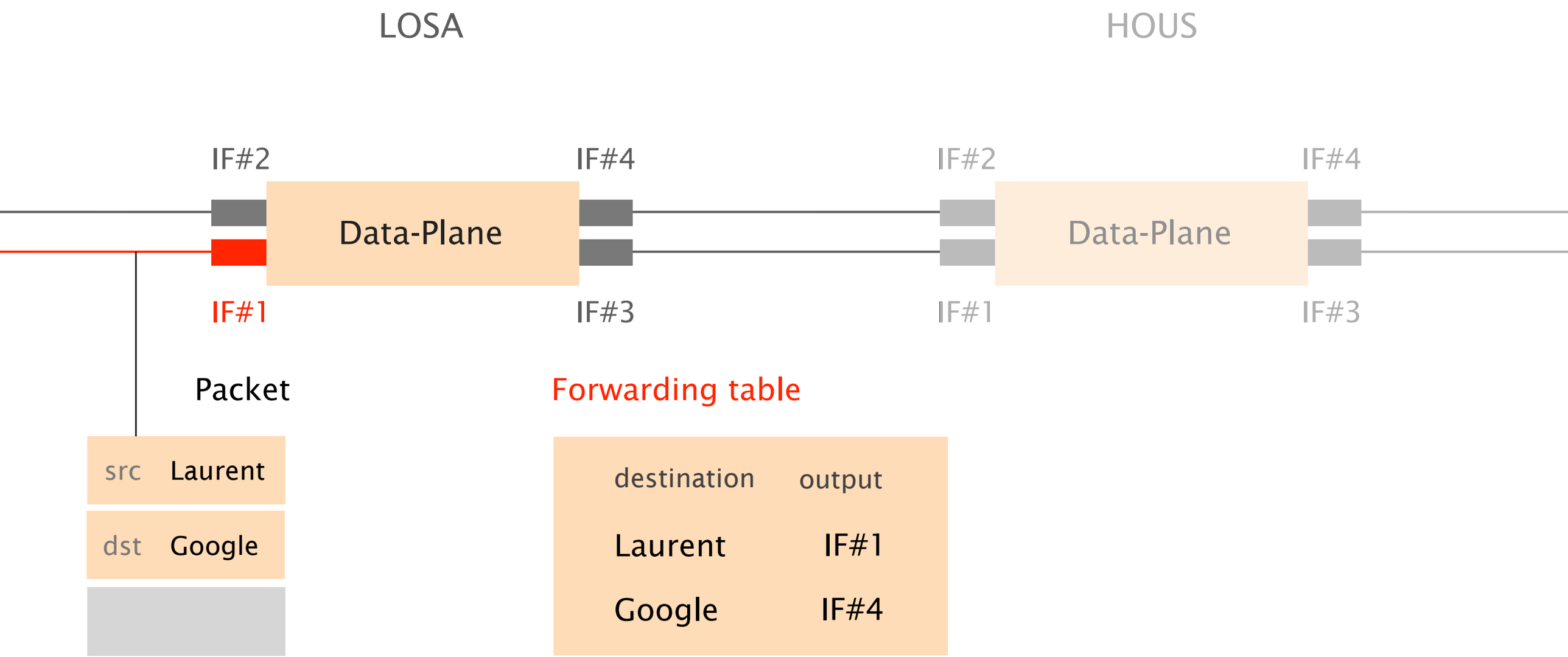
IF#1

IF#3

IF#1

IF#3

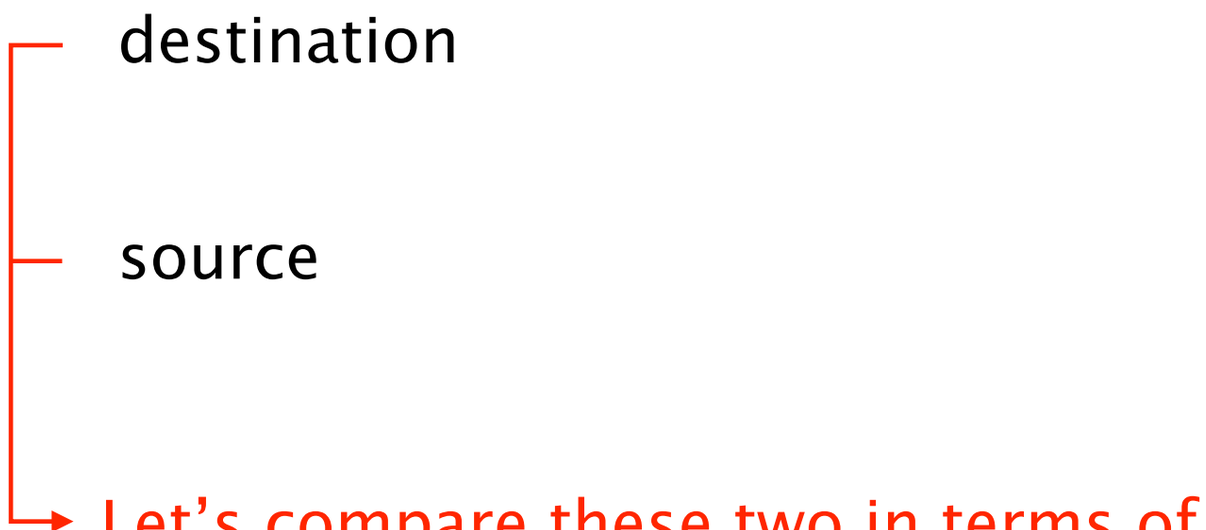
Upon packet reception, routers locally look up their forwarding table to know where to send it next



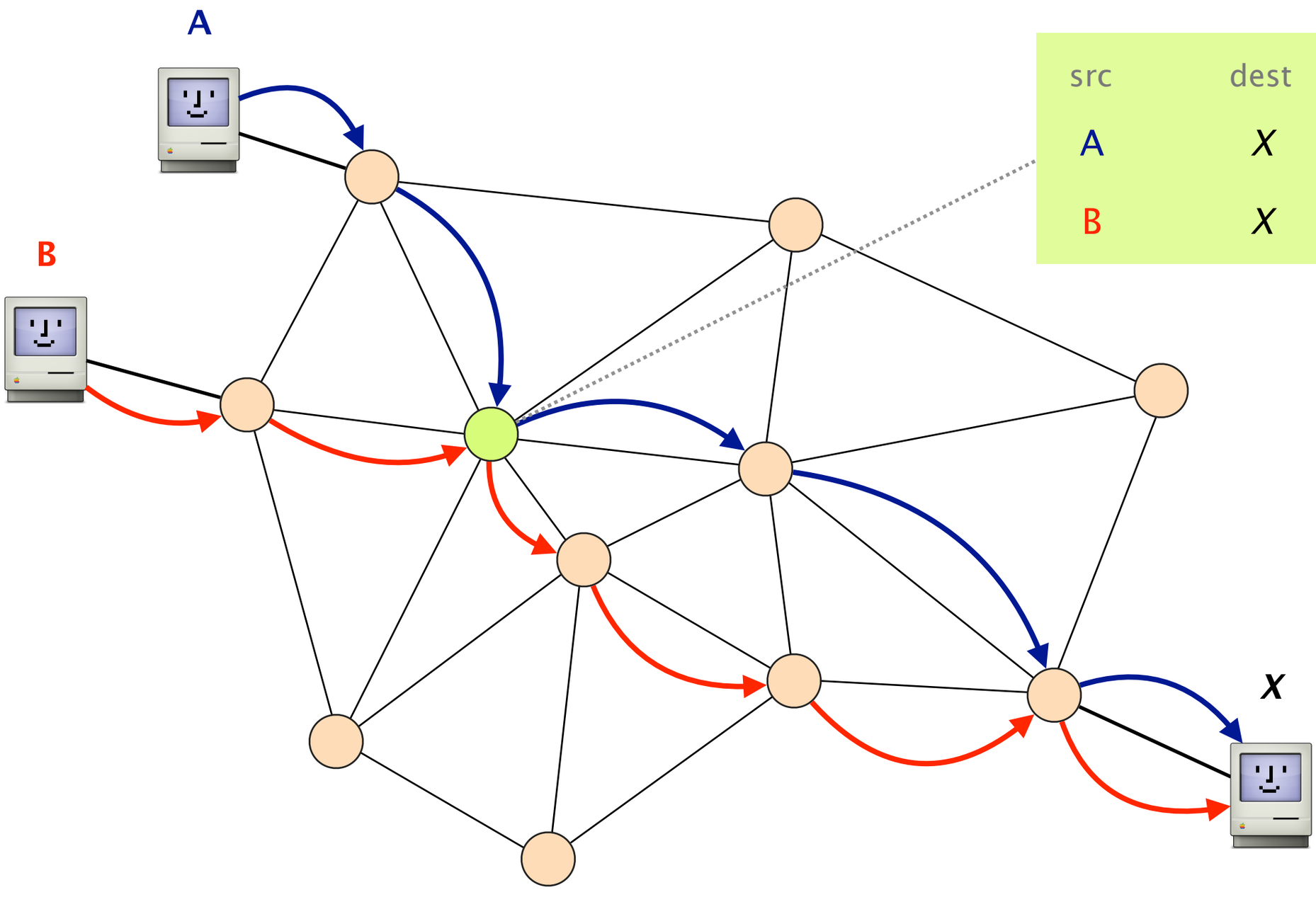
Forwarding decisions necessarily depend on
the destination, but can also depend on other criteria

criteria	destination	mandatory (why?)
source		
input port		
+any other header		

Task 2.4: (Source-and)-Destination-Based Routing



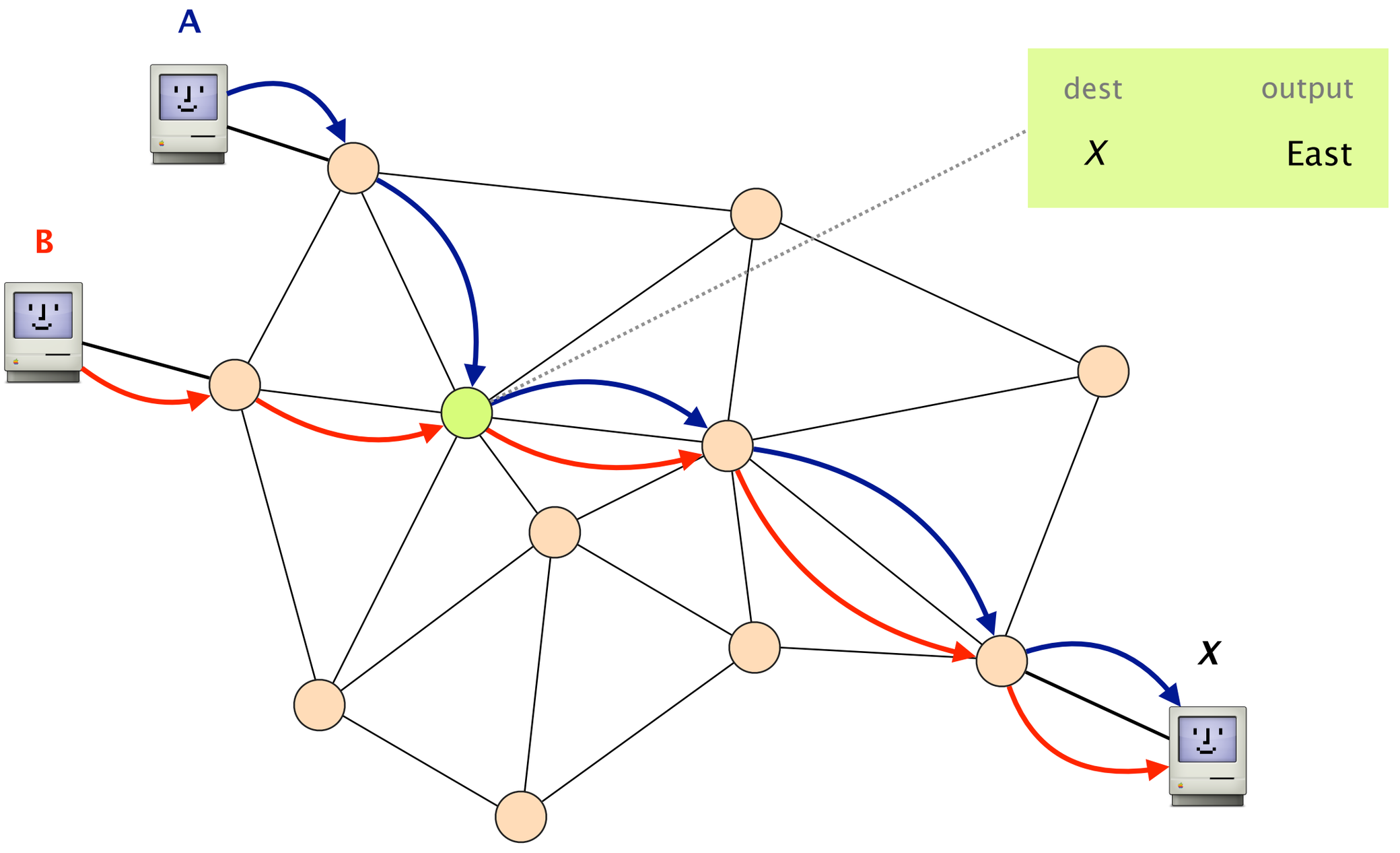
With source- & destination-based routing,
paths from different sources can differ



src	dest	output
A	*X*	East
B	*X*	South-East

With destination-based routing,

paths from different source coincide once they overlap



While forwarding is a *local* process,
routing is inherently a *global* process

How can a router know
where to direct packets
if it does not know what
the network looks like?

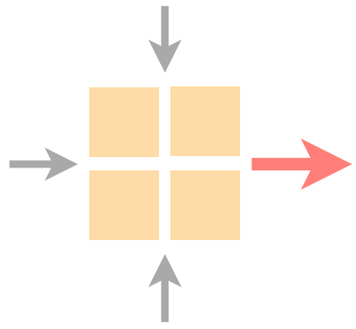
Essentially,

there are three ways to compute valid routing state

	Intuition	Example
#1	Use tree-like topologies	Spanning-tree
#2	Rely on a global network view	Link-State SDN
#3	Rely on distributed computation	Distance-Vector BGP

Communication Networks

Exercise 2



Quick recap and task 2.4

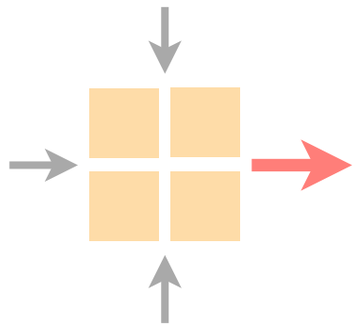
Time for you to solve the tasks

More recap and discussion of task 2.2

Solutions will be published next week

Communication Networks

Exercise 2



Quick recap and task 2.4

Time for you to solve the tasks

More recap and discussion of task 2.2

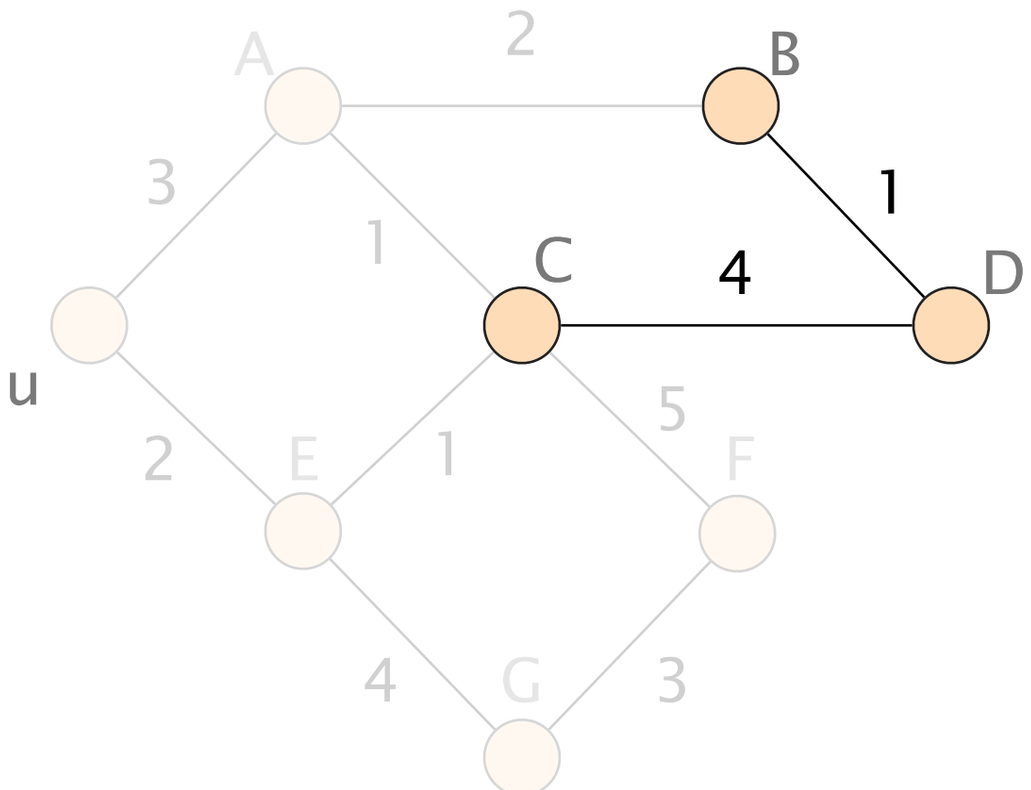
Solutions will be published next week

To build this global view

routers essentially solve a jigsaw puzzle

Initially,

routers only know their ID and their neighbors



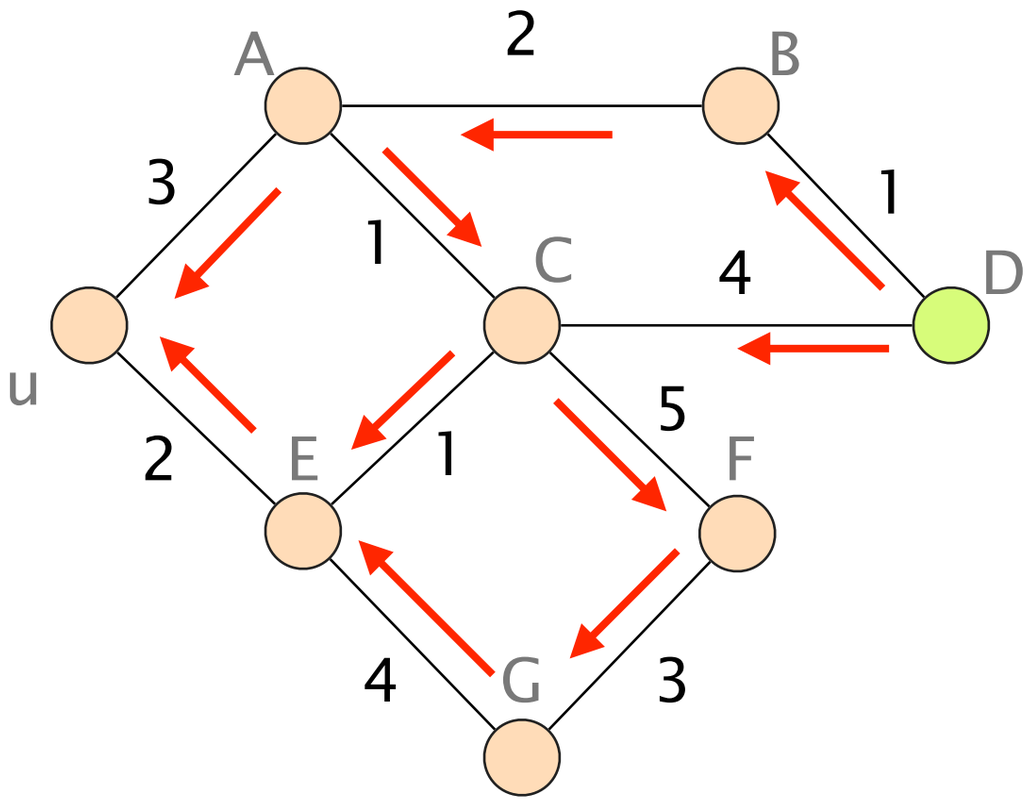
D only knows,

it is connected to B and C

along with the weights to reach them

(by configuration)

Each routers builds a message (known as Link-State) and floods it (reliably) in the entire network



D's Advertisement

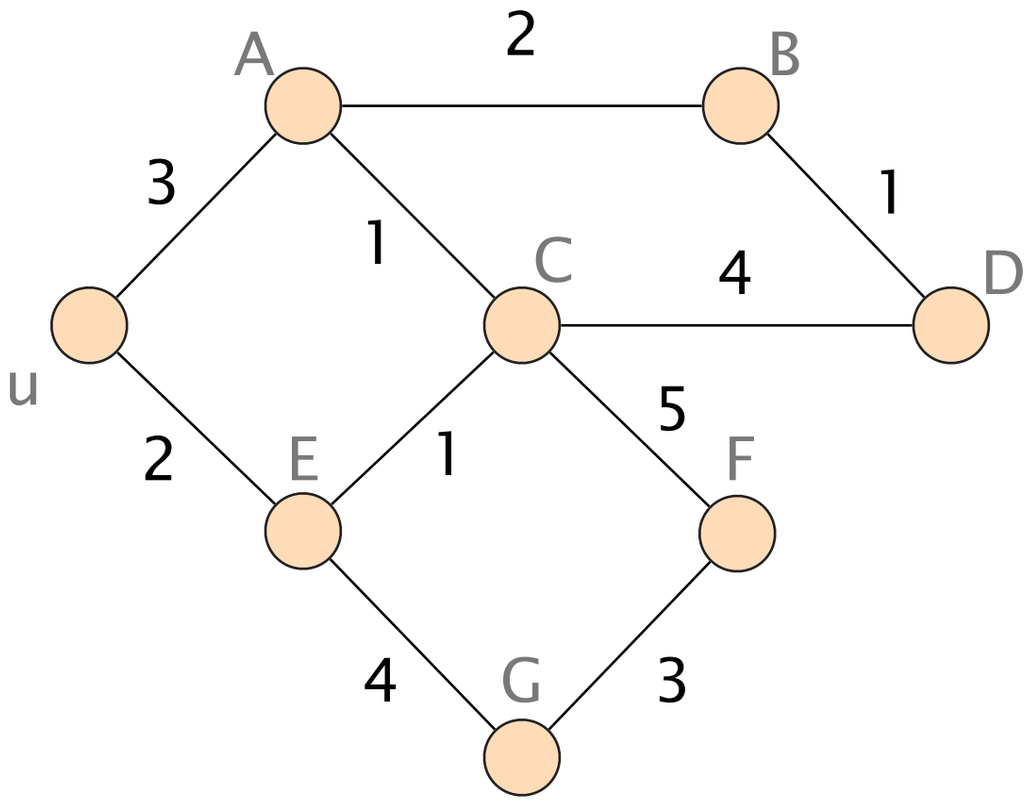
edge (D,B); cost: 1

edge (D,C); cost: 4

At the end of the flooding process,
everybody share the exact same view of the network

required for correctness

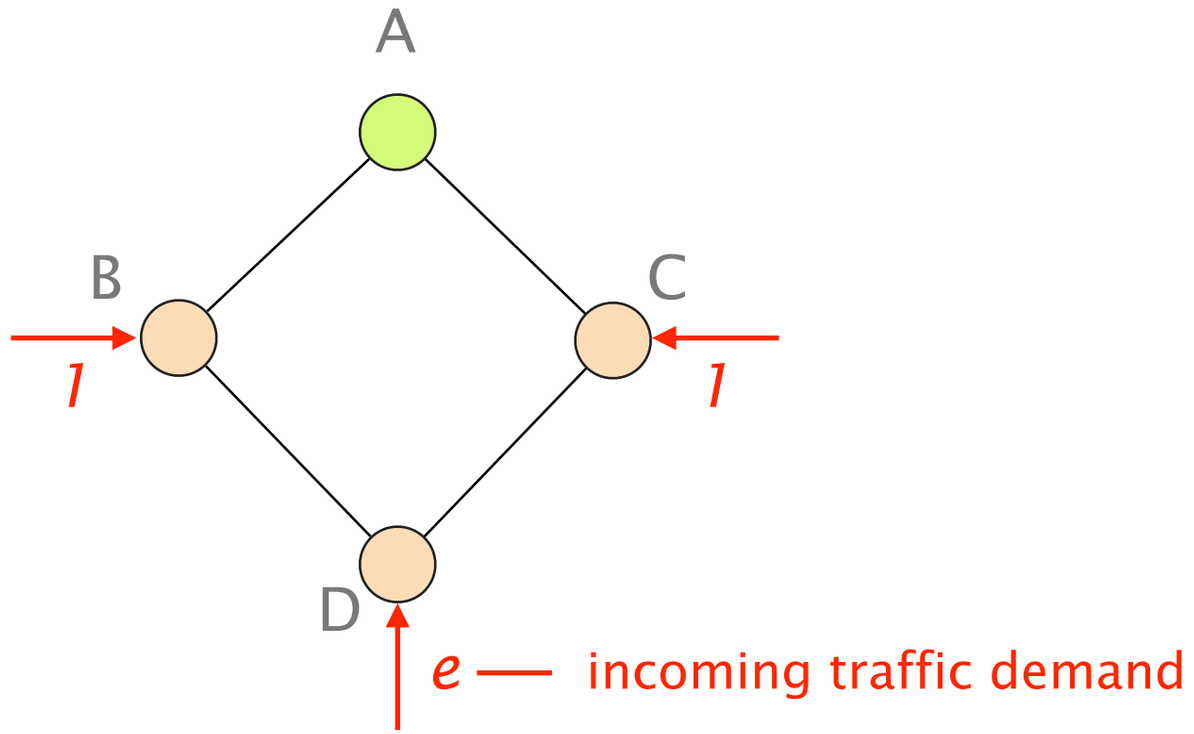
see exercise



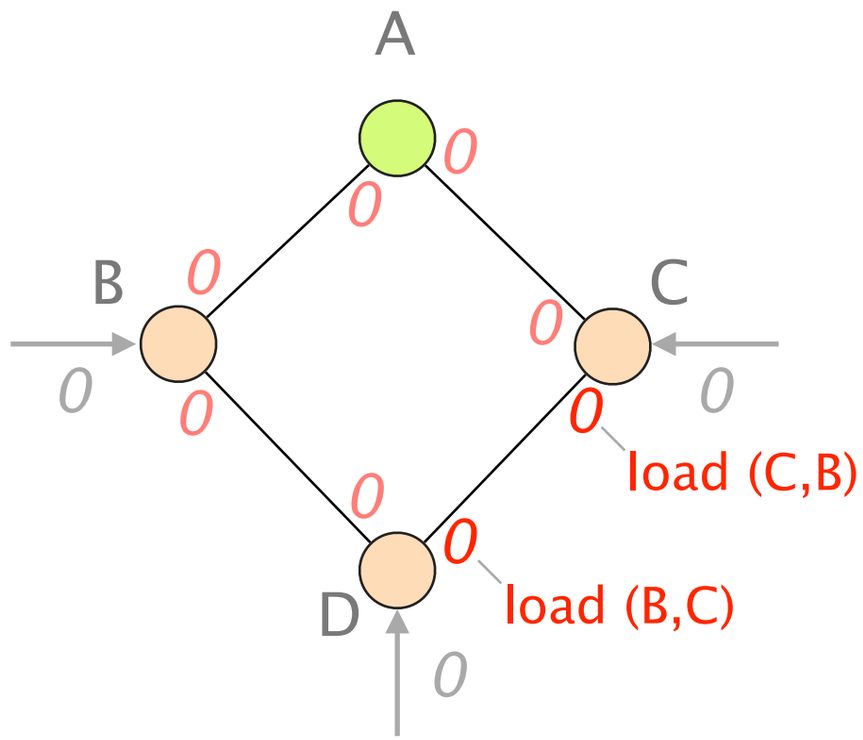
Dijkstra will always converge to a unique stable state when run on *static* weights

cf. exercice session
for the dynamic case

Task 2.4:
Dynamic weights



Unlike before,
weights are bidirectional and represent link load



The problem of oscillation is fundamental to congestion-based routing with local decisions

solution #1

Use static weights

i.e. don't do congestion-aware routing

solution #2

Use randomness to break self-synchronization

wait(random(0,50ms)); send(new_link_weight);

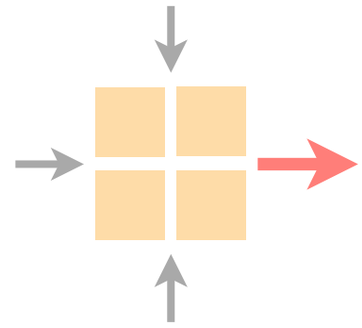
solution #3

Have the routers agree on the paths to use

essentially meaning to rely on circuit-switching

Communication Networks

Exercise 2



Quick recap and task 2.4

Time for you to solve the tasks

More recap and discussion of task 2.2

Solutions will be published next week