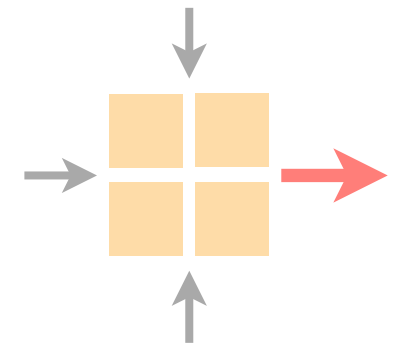


Communication Networks

Spring 2021



Rüdiger Birkner

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

ETH Zürich

March 4 2021

Your TAs for the semester



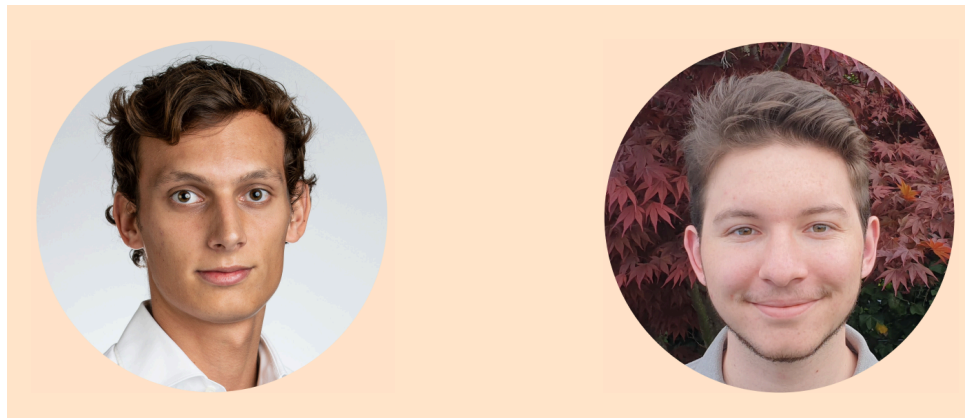
Coralie



Tobias



Rüdiger



Hendrik

Lukas

comm-net@ethz.ch

A typical exercise session

Introduction of current exercise

Brief overview and some hints

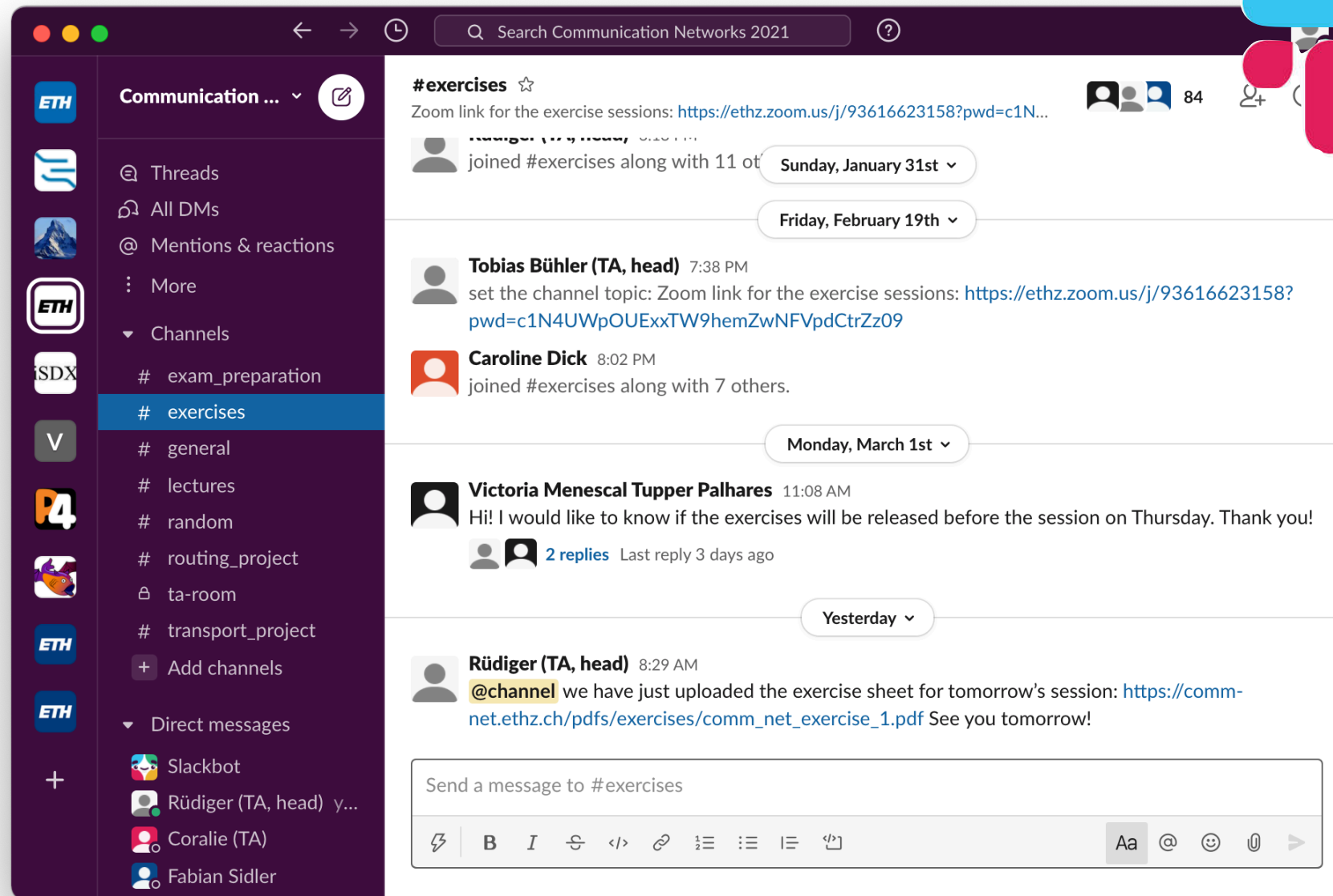
Interactive part (discuss solutions, demos)

Let us know, if we should discuss specific topics

Time to solve the exercise

We are available on Slack/Zoom

We'll use **Slack** (a chat client)
to discuss about the course and assignments



Web, smartphone and desktop clients available

Our website: <https://comm-net.ethz.ch>
check it out regularly!

The screenshot shows a web browser window with the URL `comm-net.ethz.ch`. The page title is "Communication Networks" with a green "Spring 2021" tag. The logo for "Networked Systems ETH Zürich — seit 2015" is in the top right. The "News" section lists updates from Jan 4 to Mar 2, mentioning online materials and Zoom sessions. The "Timeline" section features a calendar from Feb 21 to May 30, showing "Semester progress" with a blue bar, "Lectures" with red vertical markers, "Exercises" with yellow vertical markers, and "Projects" with green bars for "Internet Routing" and "Reliable Transport".

Communication Networks

Spring 2021

Networked Systems
ETH Zürich — seit 2015

News

- Mar 2: Materials for the first exercise session are now [online](#). Join the [exercise session on Zoom](#) (nethz login)
- Feb 28: Materials for the second lecture are now [online](#). Join the [lecture on Zoom](#) (nethz login)
- Feb 21: Materials for the first lecture are now [online](#). Join the [lecture on Zoom](#) (nethz login)
- Jan 4: Website for 2021 goes live!
Stay tuned for more content

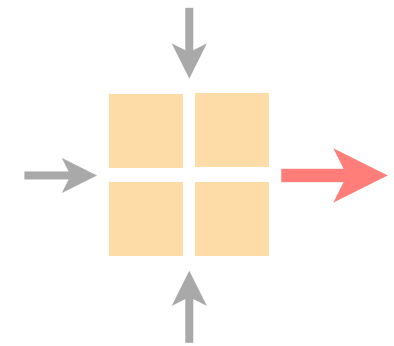
Timeline

	Feb 21	Feb 28	Mar 7	Mar 14	Mar 21	Mar 28	Apr 4	Apr 11	Apr 18	Apr 25	May 2	May 9	May 16	May 23	May 30
Semester progress	[Blue bar from Feb 21 to Mar 14]														
Lectures															
Exercises															
Projects						Internet Routing					Reliable Transport				

Slides, exercises, projects, extra readings, previous exams, ...

Communication Networks

Exercise 1



Overview current assignment

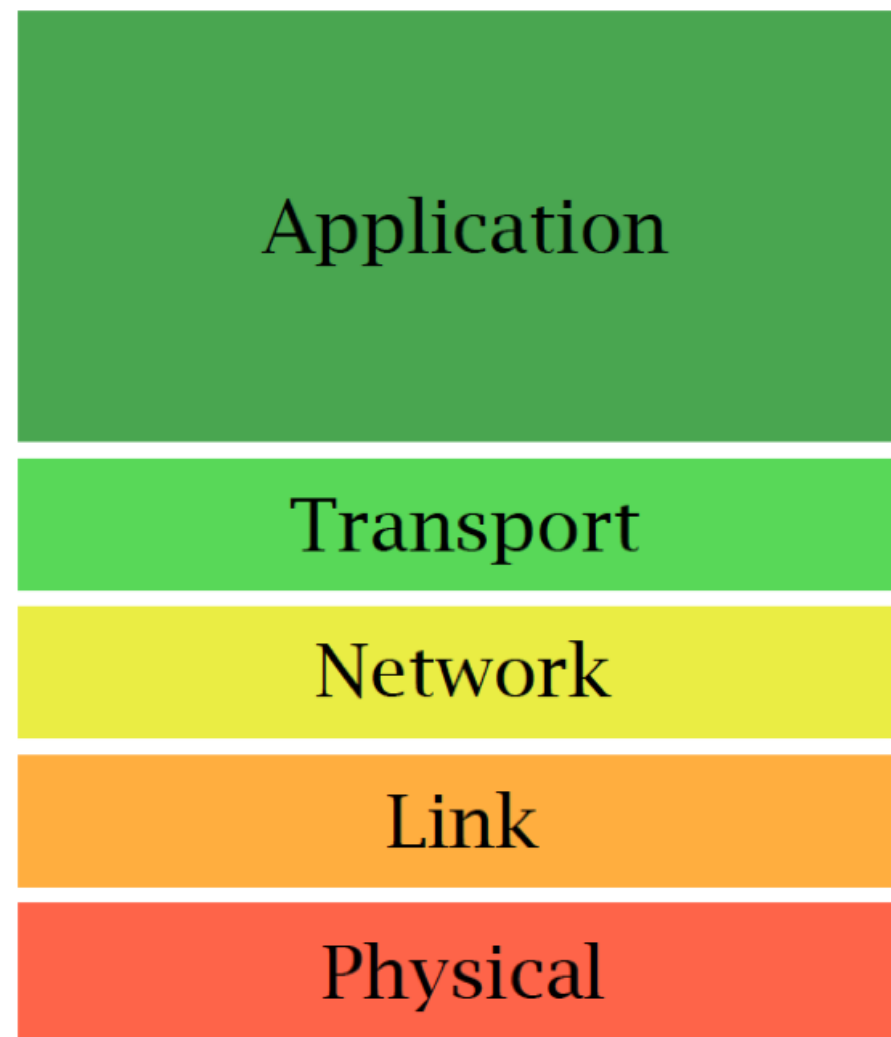
Discussion of Task 5

Time for you to solve the tasks

Solutions will be published next week

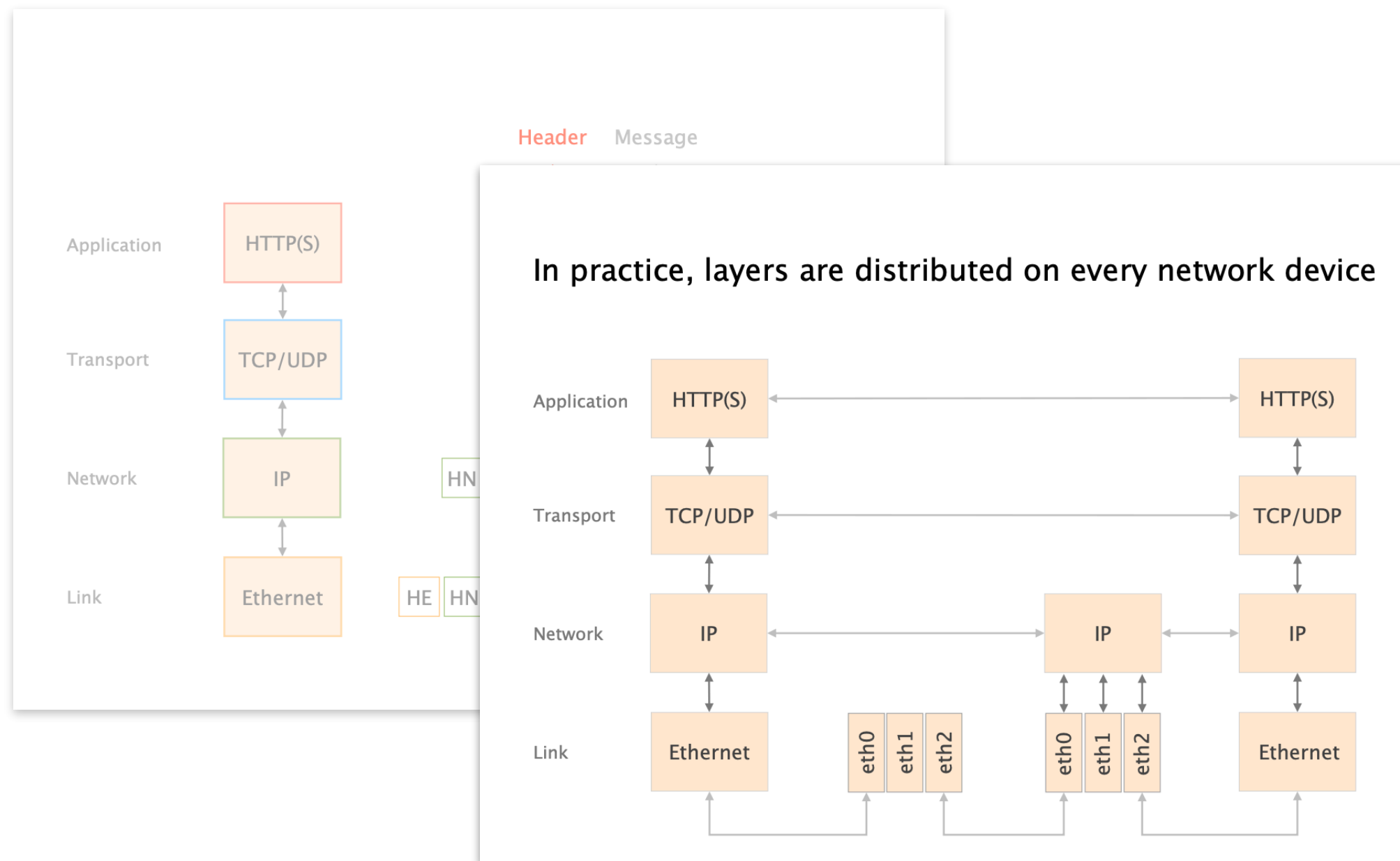
Task 1: Layer Model

Internet protocol stack

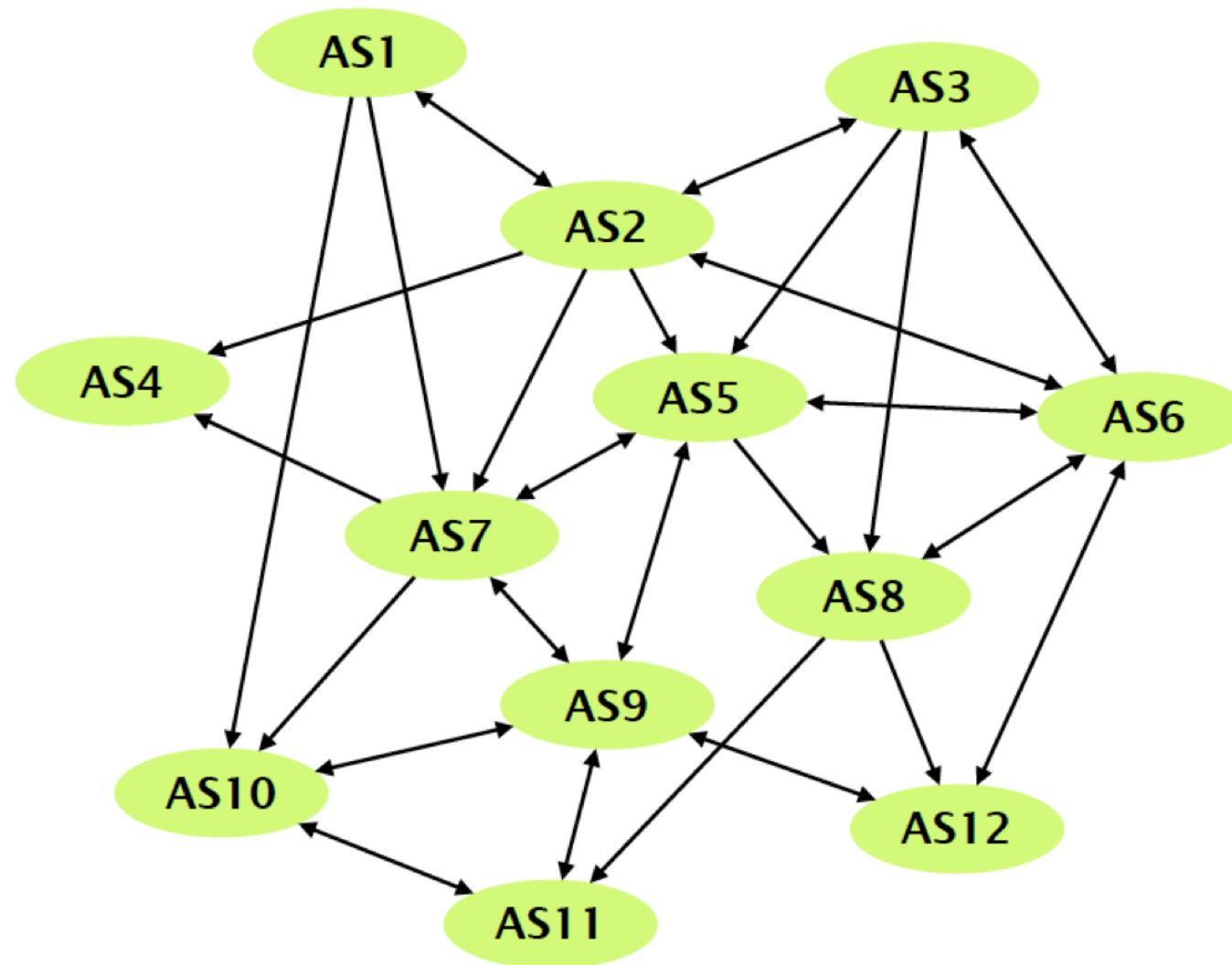


Slides: Week 2, 17–36

Network protocols are organised in layers

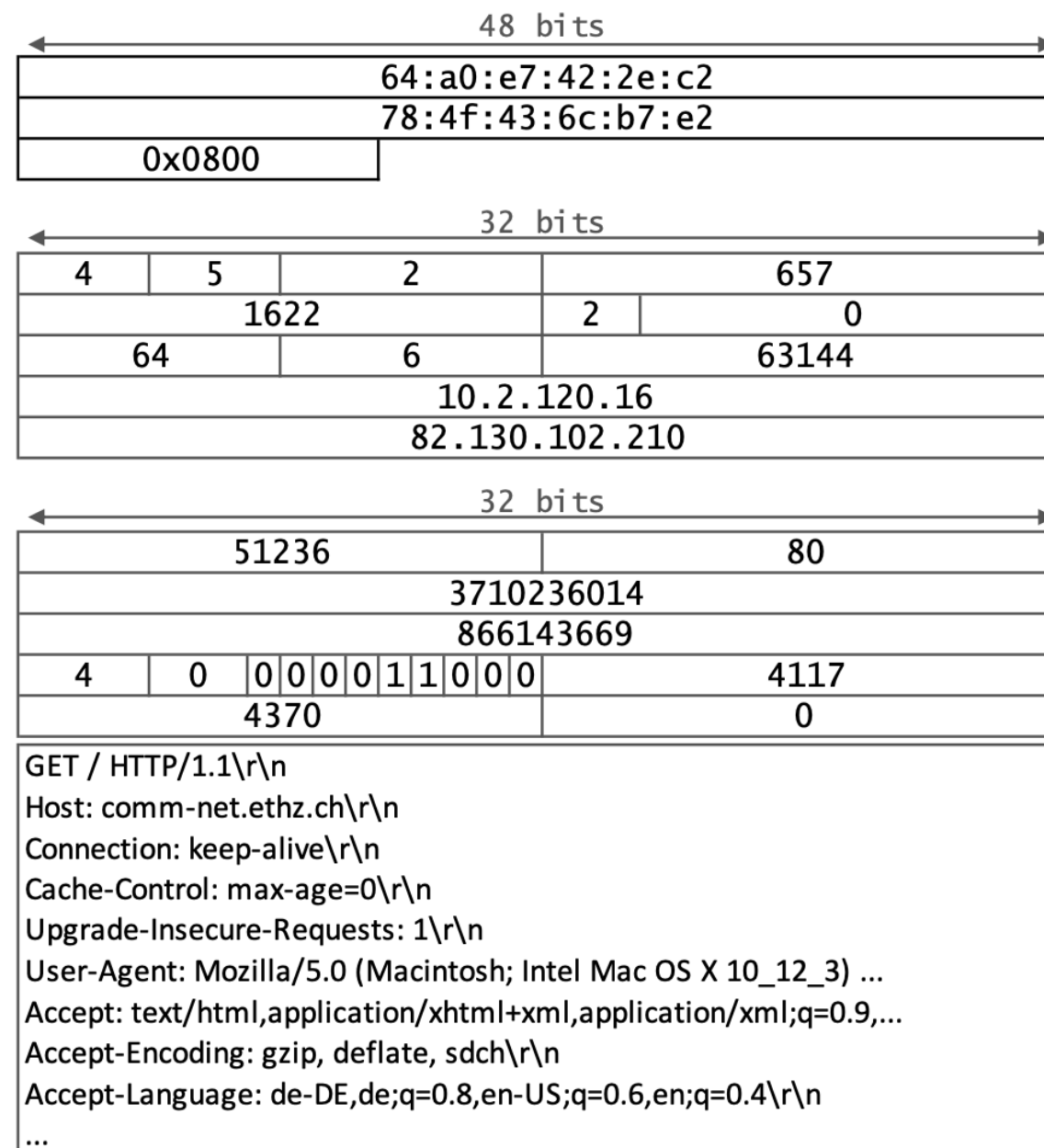


Task 2: Internet Organization



Slides: Week 1, 133–143

Task 3: Internet Communication



Look at your own traffic with Wireshark

<https://www.wireshark.org/>

Packet capturing and replaying

Similar command line tools: *tshark* or *tcpdump*

Automatically detects various protocols and packet formats

Task 4: Network Characterization



VS.



VS.



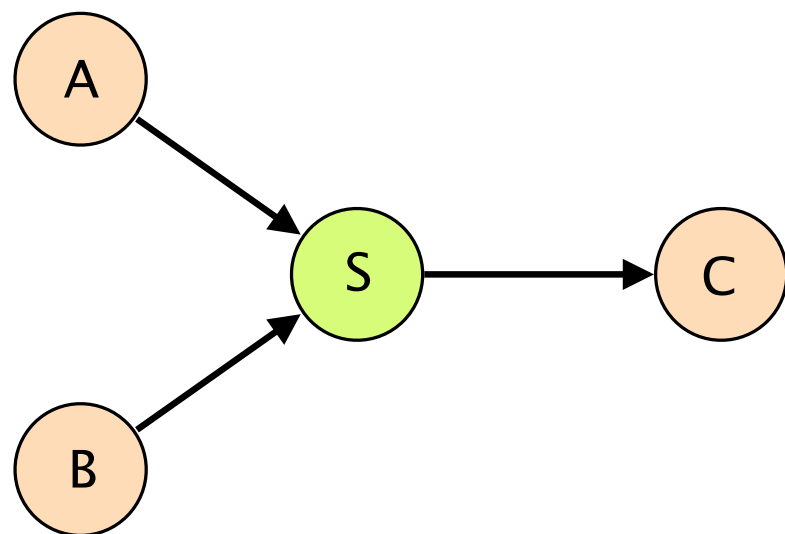
Delay? Bandwidth?

Task 5: Types of Delay

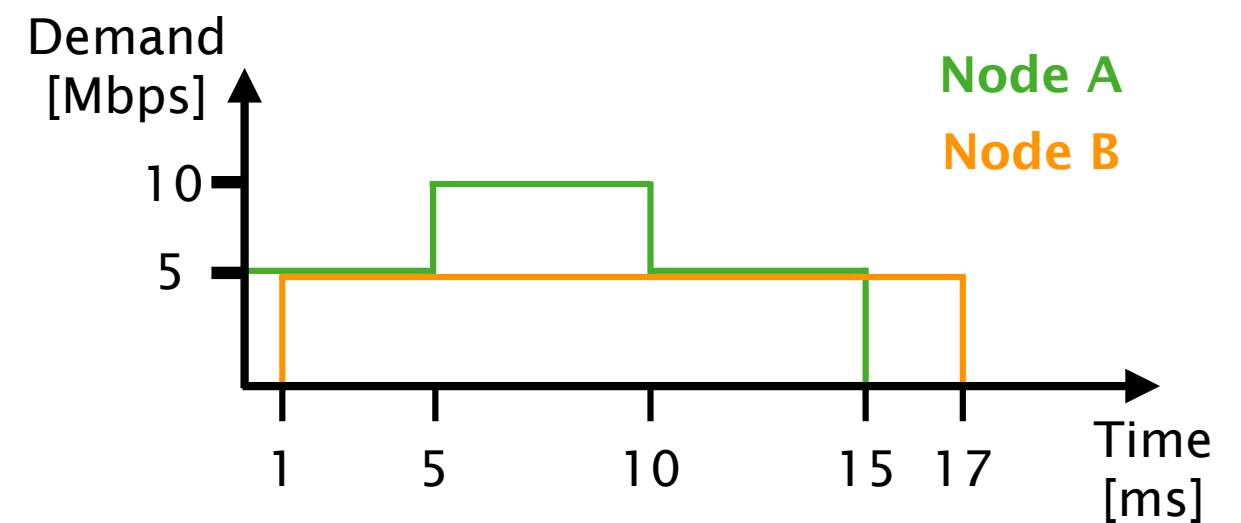


Slide: Week 2, 41

Task 6: Packet vs. Circuit Switching



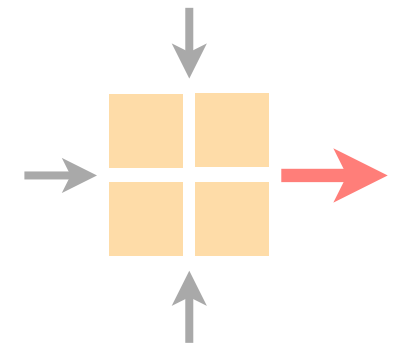
Network with a shared link



Different traffic demands

Communication Networks

Exercise 1



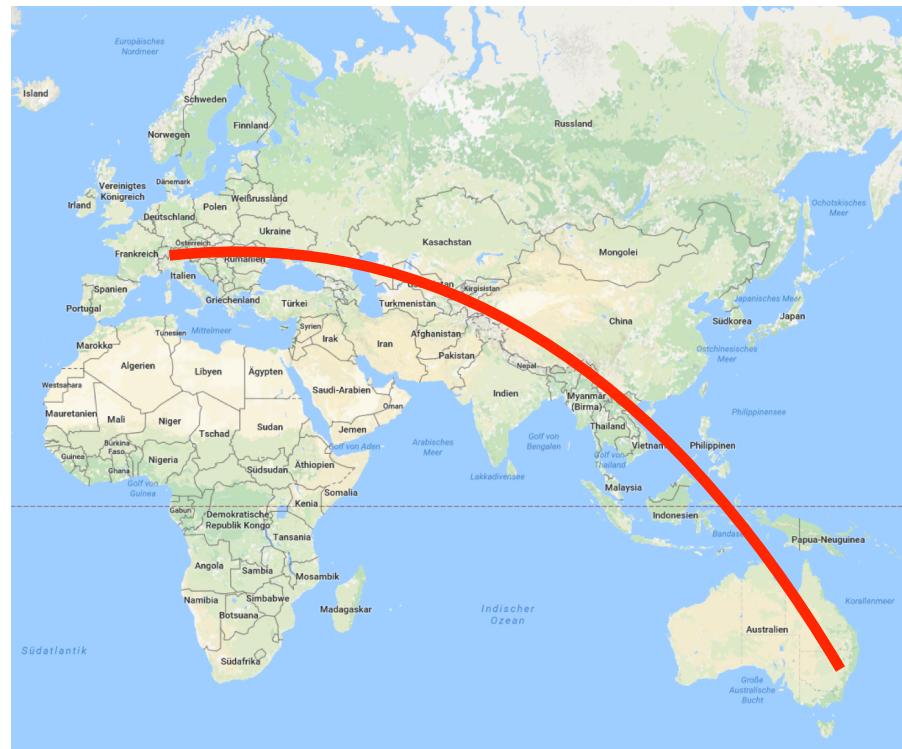
Overview current assignment

Discussion of Task 5

Time for you to solve the tasks

Solutions will be published next week

Task 5: Types of Delay



To access a website,
your data has to go from you
to the server and back.
request and response

Task 5a: Speed of Light



How long does it take
to access `sydney.edu.au`?

Distance: 16'600km

Speed: $3 \times 10^8 \text{m/s}$

Task 5a: Speed of Light

$$t = \frac{\text{distance}}{\text{speed}} = \frac{2 \times 1.66 \times 10^7 \text{m}}{3 \times 10^8 \text{m/s}} \approx 110.7 \text{ms}$$

Task 5b: Speed of the “Internet”

To test a connection, we can use ping

- c count, number of queries
- i wait, time in seconds between each packet
- s packetsize, number of data bytes to send
- S src_addr, source address to use if multiple IPs available
- ...

Task 5b: Speed of the “Internet”

test #1 ———

...

test #11 ———

```
ping sydney.edu.au
(base) rbirkner@RJBMBP ~$ ping sydney.edu.au
PING sydney.edu.au (129.78.5.8): 56 data bytes
64 bytes from 129.78.5.8: icmp_seq=0 ttl=235 time=344.896 ms
64 bytes from 129.78.5.8: icmp_seq=1 ttl=235 time=363.529 ms
64 bytes from 129.78.5.8: icmp_seq=2 ttl=235 time=338.075 ms
64 bytes from 129.78.5.8: icmp_seq=3 ttl=235 time=318.827 ms
64 bytes from 129.78.5.8: icmp_seq=4 ttl=235 time=318.279 ms
64 bytes from 129.78.5.8: icmp_seq=5 ttl=235 time=318.923 ms
64 bytes from 129.78.5.8: icmp_seq=6 ttl=235 time=318.162 ms
64 bytes from 129.78.5.8: icmp_seq=7 ttl=235 time=318.173 ms
64 bytes from 129.78.5.8: icmp_seq=8 ttl=235 time=406.951 ms
64 bytes from 129.78.5.8: icmp_seq=9 ttl=235 time=325.697 ms
64 bytes from 129.78.5.8: icmp_seq=10 ttl=235 time=351.016 ms
```

Task 5b: Speed of the “Internet”

test #1 —

...

test #11 —

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64 bytes from 129.78.5.8: icmp_seq=10 ttl=235 time=351.016 ms
```

Destination address

Task 5b: Speed of the “Internet”

test #1 ———

...

test #11 ———

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64 bytes from 129.78.5.8: icmp_seq=9 ttl=235 time=325.697 ms
64 bytes from 129.78.5.8: icmp_seq=10 ttl=235 time=351.016 ms
```

RTT measurements

Round Trip Time
Both directions!

Task 5b: Speed of the “Internet”

ping sydney.edu.au	“expected”	$\approx 110\text{ms}$
	“observed”	$\approx 320\text{ms}$

What’s the reason for the difference?

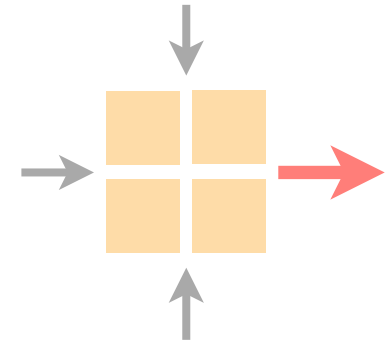
transmission, processing, queuing delay

cables don’t follow the shortest path

speed of light is reduced in fibre cables

Communication Networks

Exercise 1



Overview current assignment

Discussion of Task 5

Time for you to solve the tasks

Solutions will be published next week