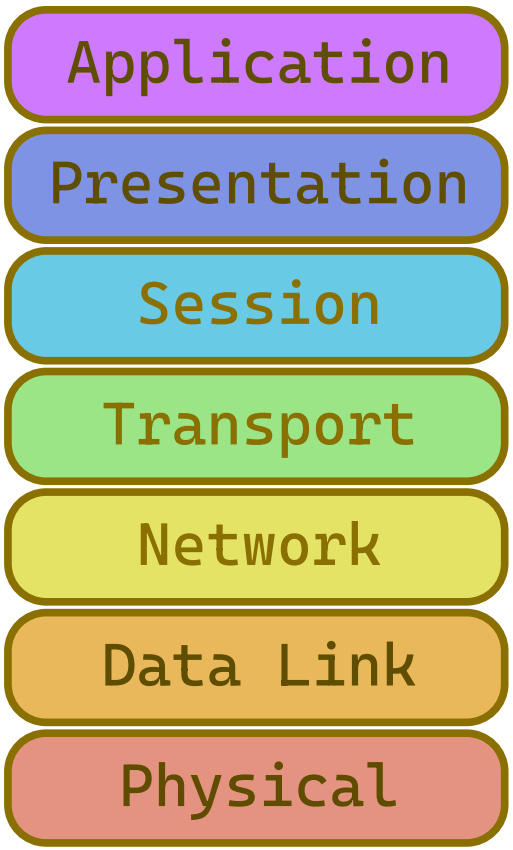
Channel Coding

ARQ and Reliability

November 4, 2021

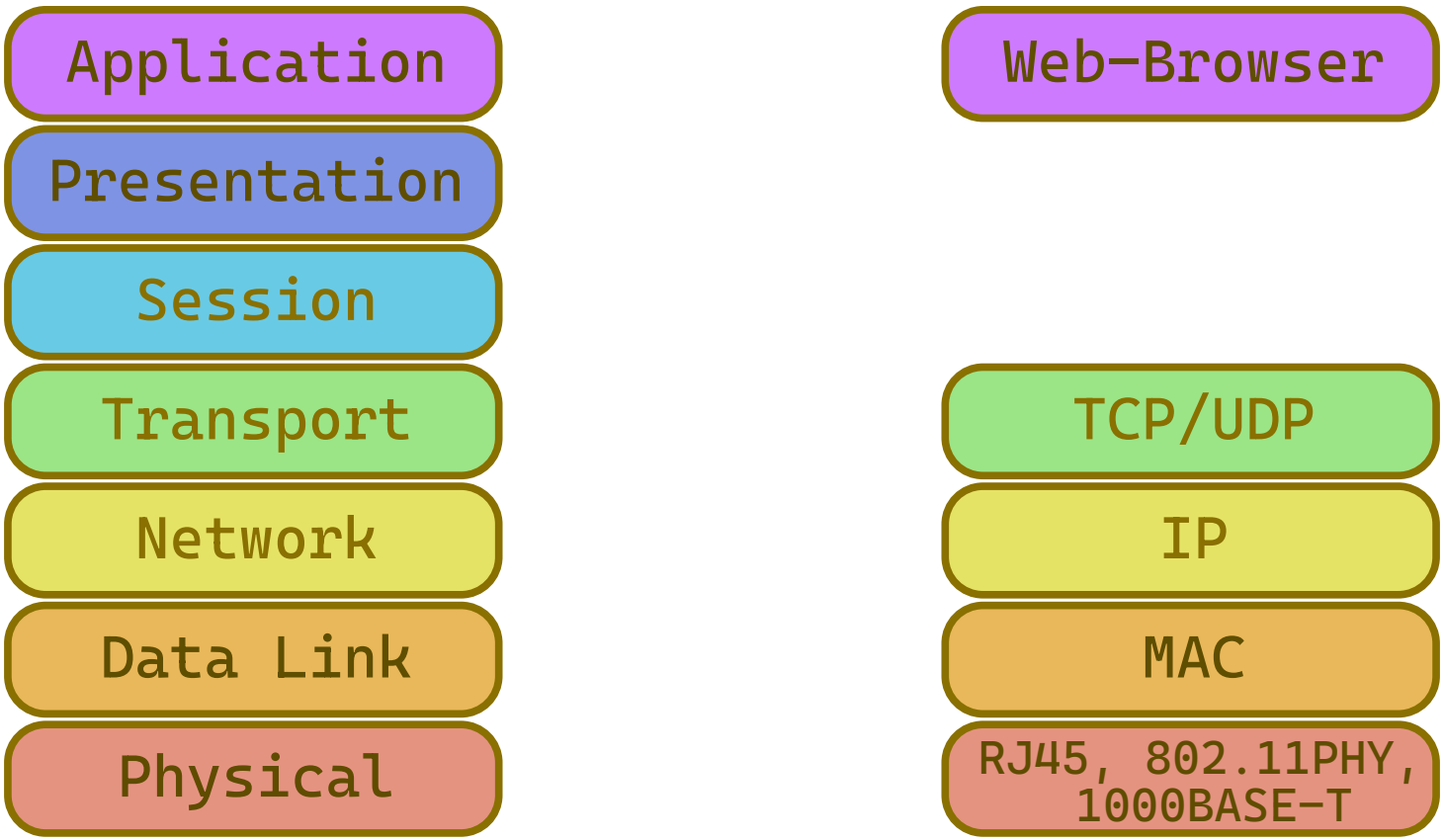
Recall

The Open Systems Interconnection model (OSI)



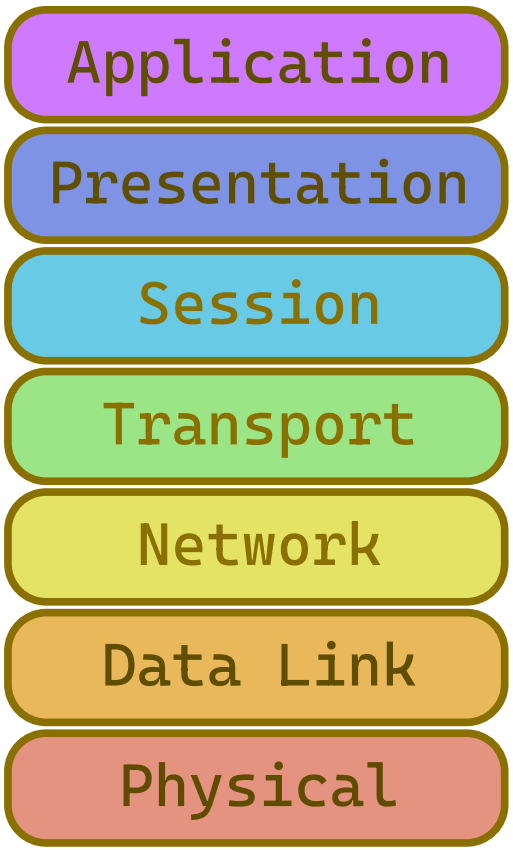
Recall

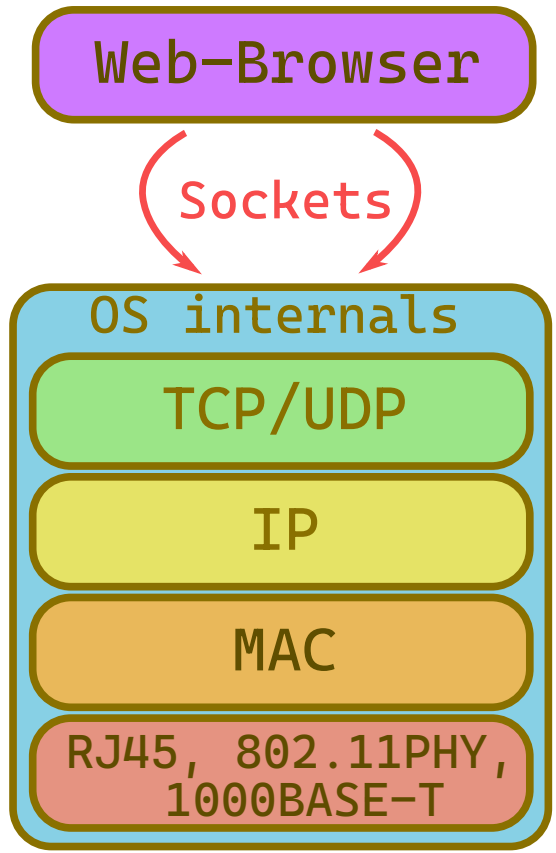
The Open Systems Interconnection model (OSI)



Recall

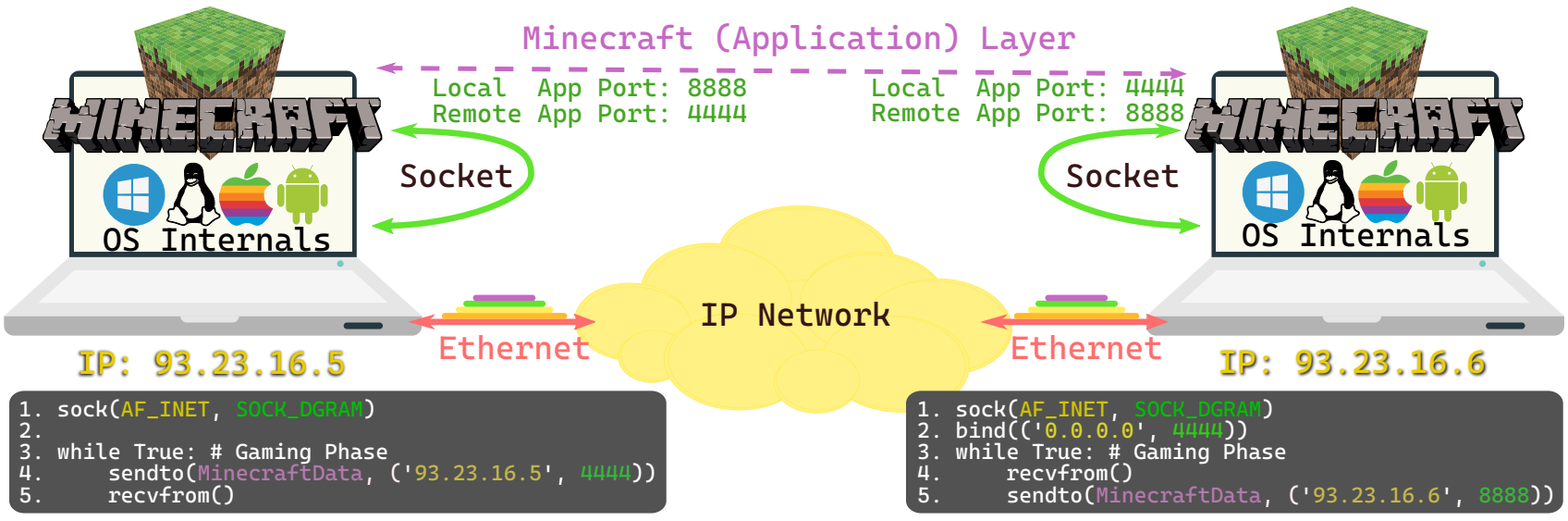
The Open Systems Interconnection model (OSI)





Sockets

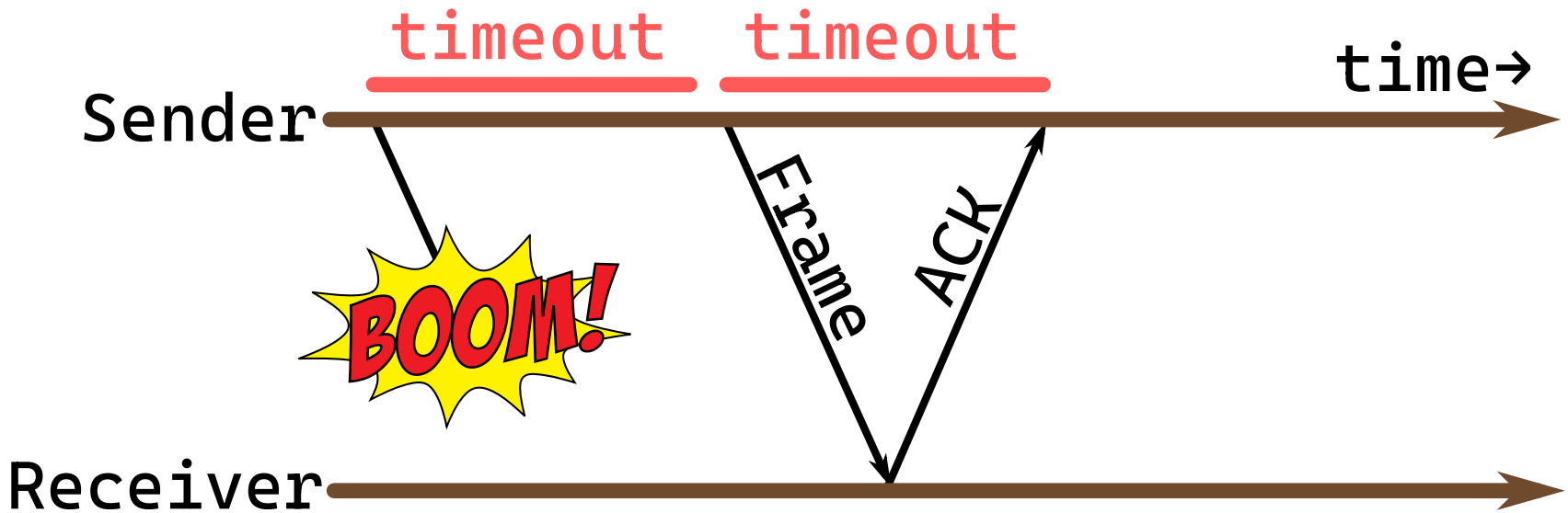
Network stack from users perspective



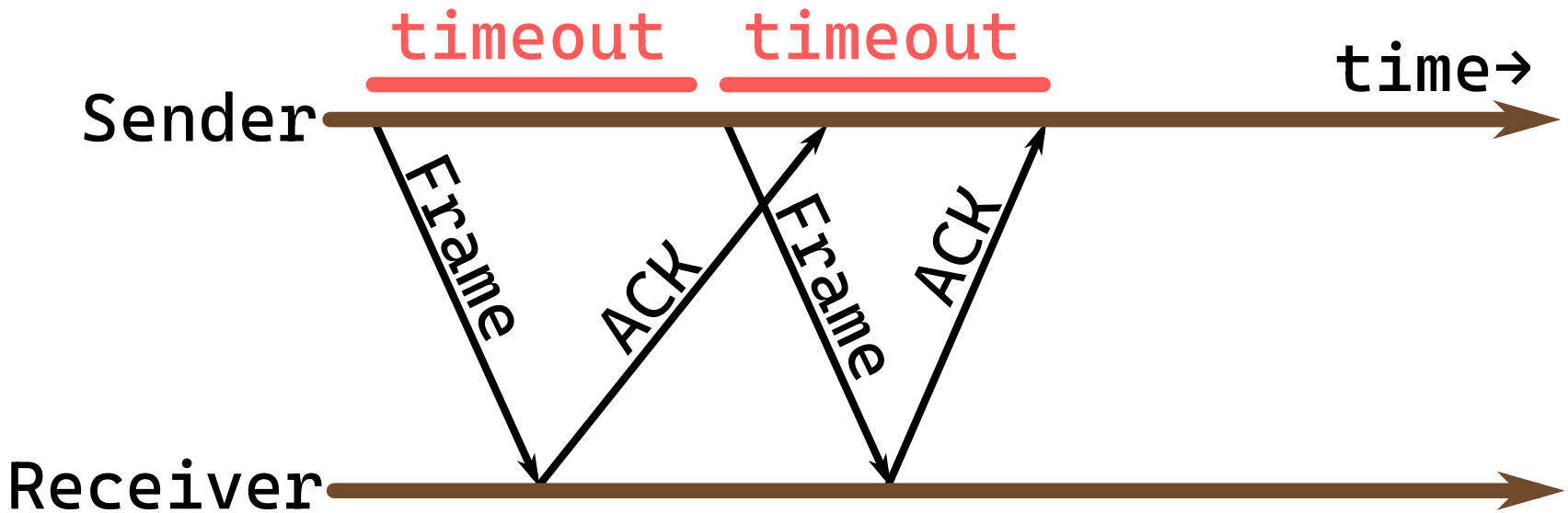
ARQ

Why do we need ARQ?

ARQ
Acknowledgement

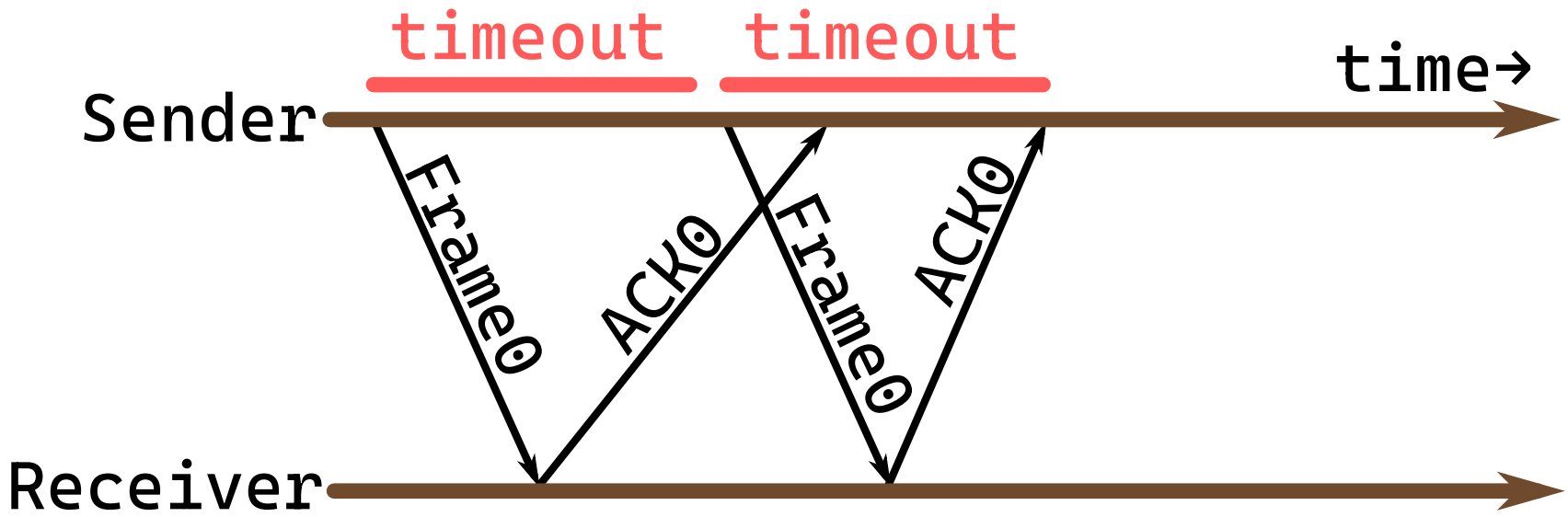


ARQ
Timeout problem

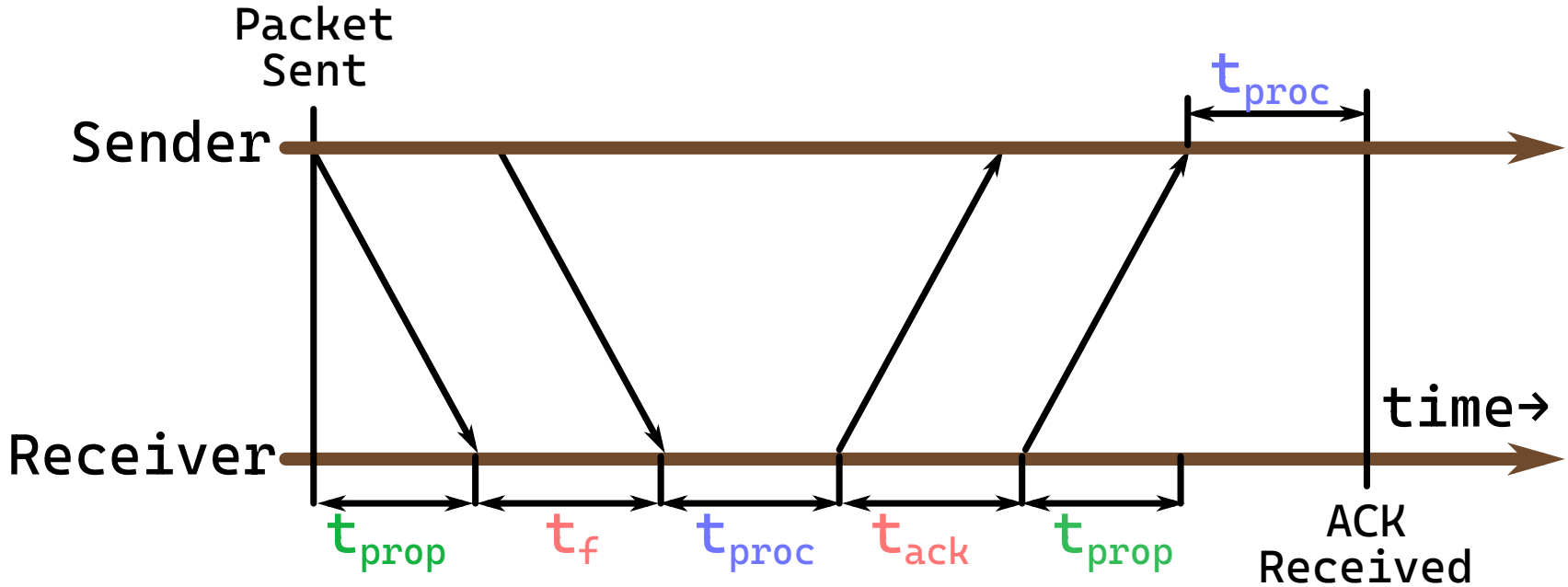


ARQ

Sequence number. Stop-and-wait.



ARQ
Frame Timing



$$t_0 = 2t_{prop} + t_f + 2t_{proc} + t_{ack} = RTT + 2t_{proc} + \frac{n_f + n_{ack}}{Rate}$$

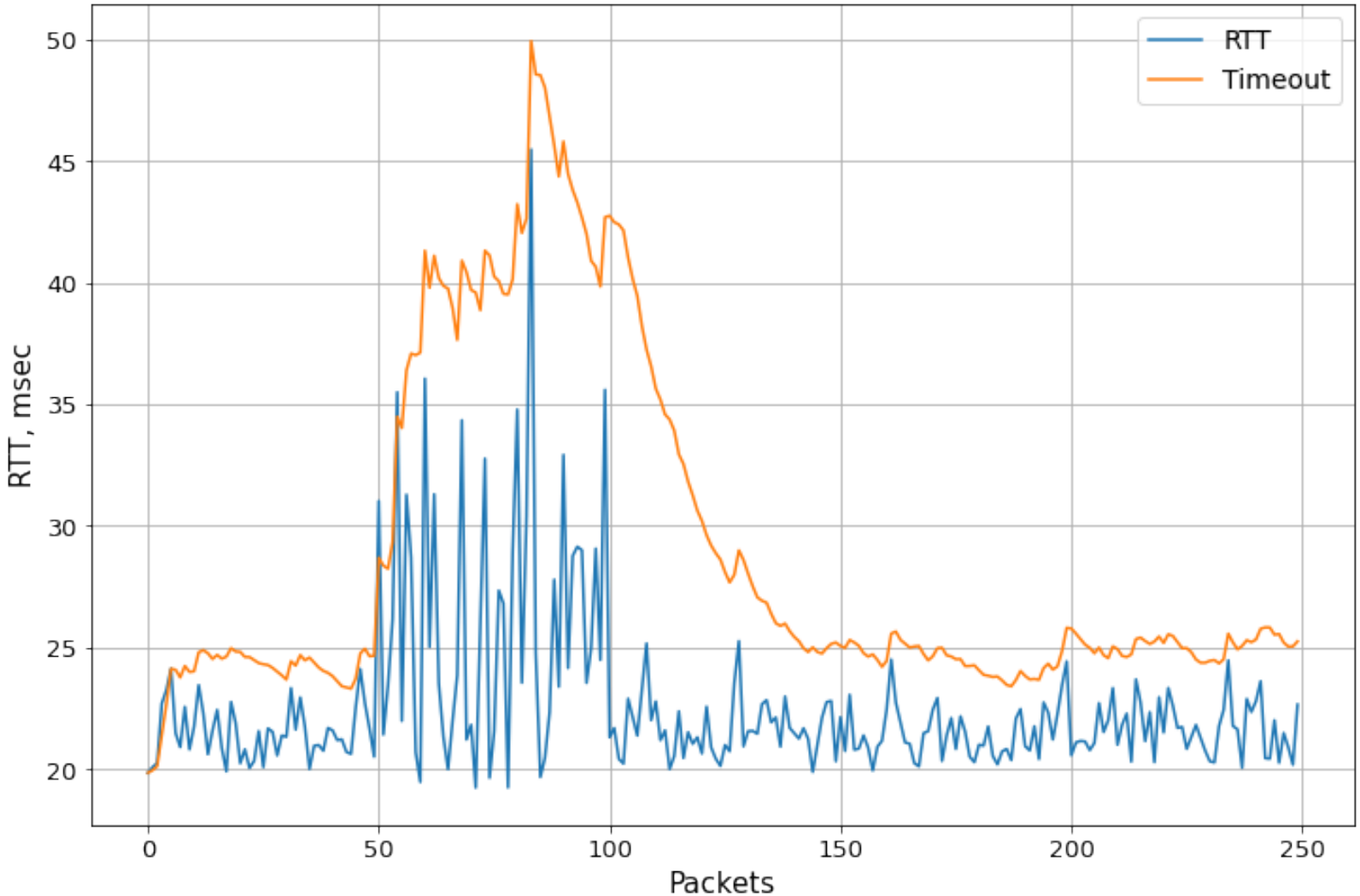
- Which timeout should we choose?
  - Not too big
  - Not too small
- Easy to define for specific LAN. Little variation.
- Difficult over the Internet. High variation.

Simple Timeout calculation scheme[1]. Smoothed RTT + variance.

- $SRTT_{N+1} = 0.9 \cdot SRTT_N + 0.1 \cdot RTT_{N+1}$
- $Svar_{N+1} = 0.9 \cdot Svar_N = 0.1 \cdot |RTT_{N+1} - SRTT_{N+1}|$
- $Timeout_N = SRTT_N + 4 \cdot Svar_N$

[1] rfc2988

ARQ
Adaptive Timeout



Stop And Wait
Efficiency

- Probability of Failure[1]:

$$P_f = 1 - (1 - plr)^2$$

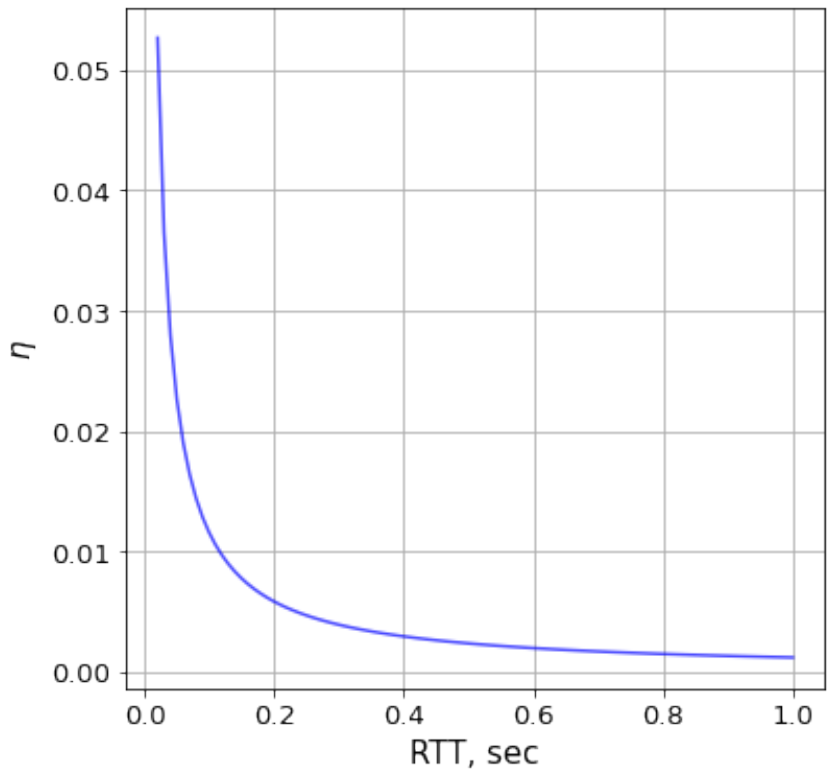
- Average total time to transmit a packet [**1**]:

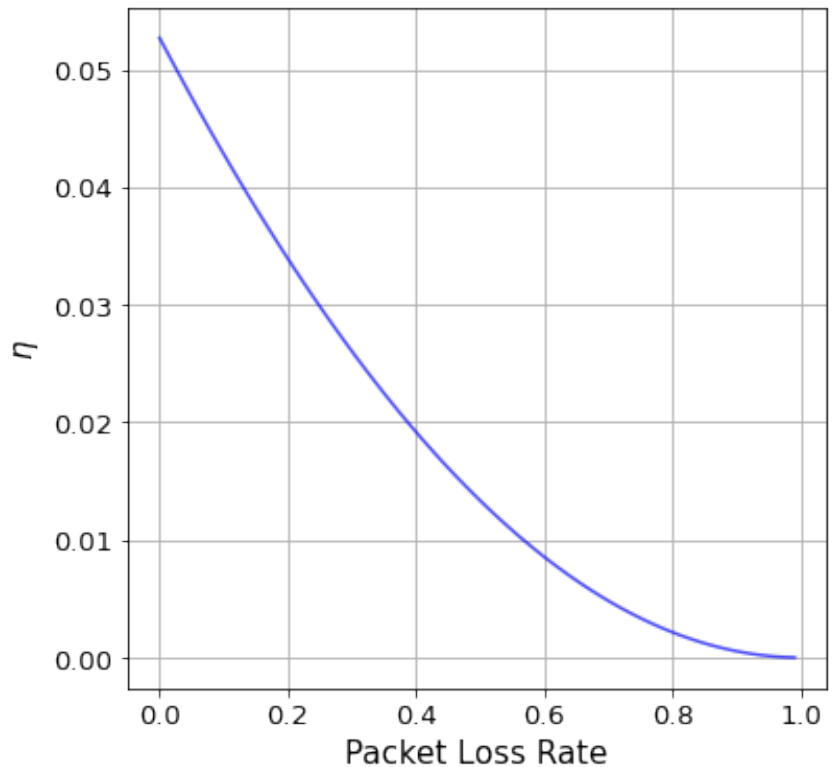
$$E[t_{packet}] = t_0 + \frac{t_{out} P_f}{1 - P_f}$$

- Effective information transmission rate: $R_{eff} = \frac{n_f - n_{headers}}{E[t_{packet}]}$
- Associated transmission efficiency: $\eta = \frac{R_{eff}}{Rate}$

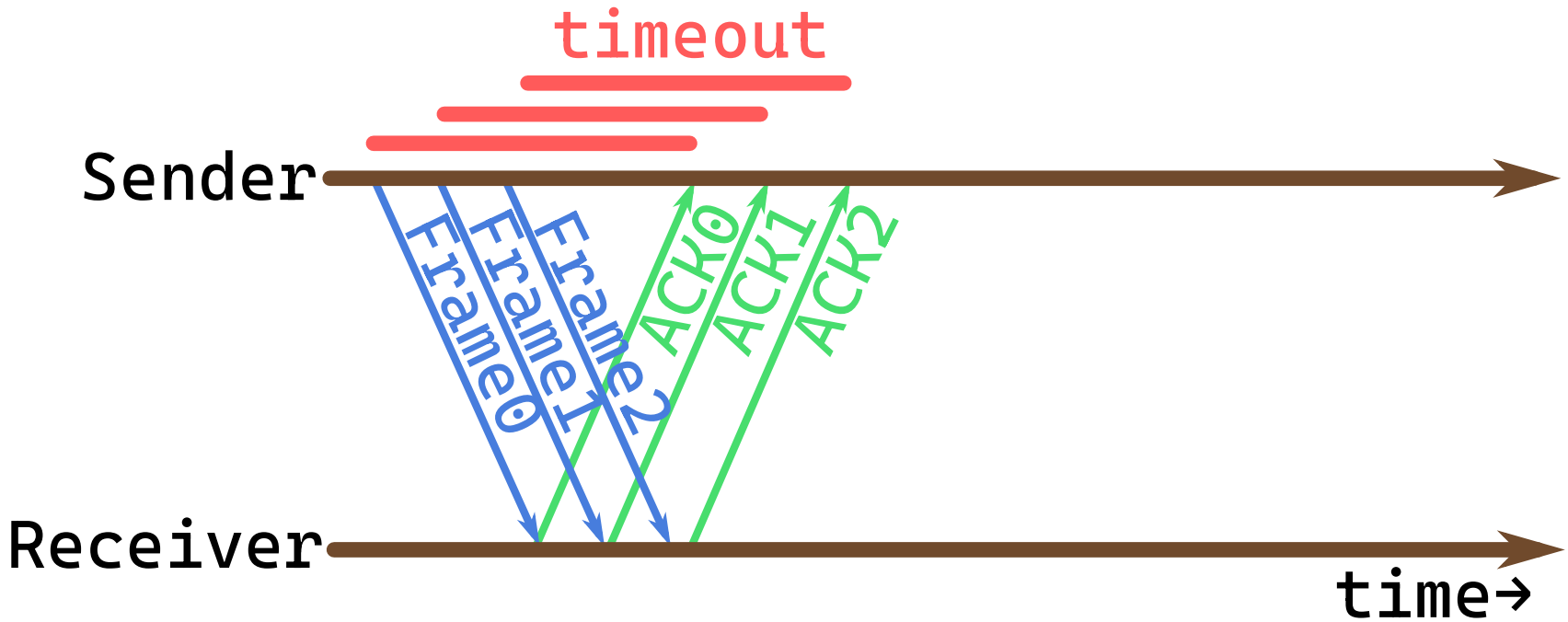
[1] plr stands for Packet Loss Rate

Stop And Wait
Efficiency

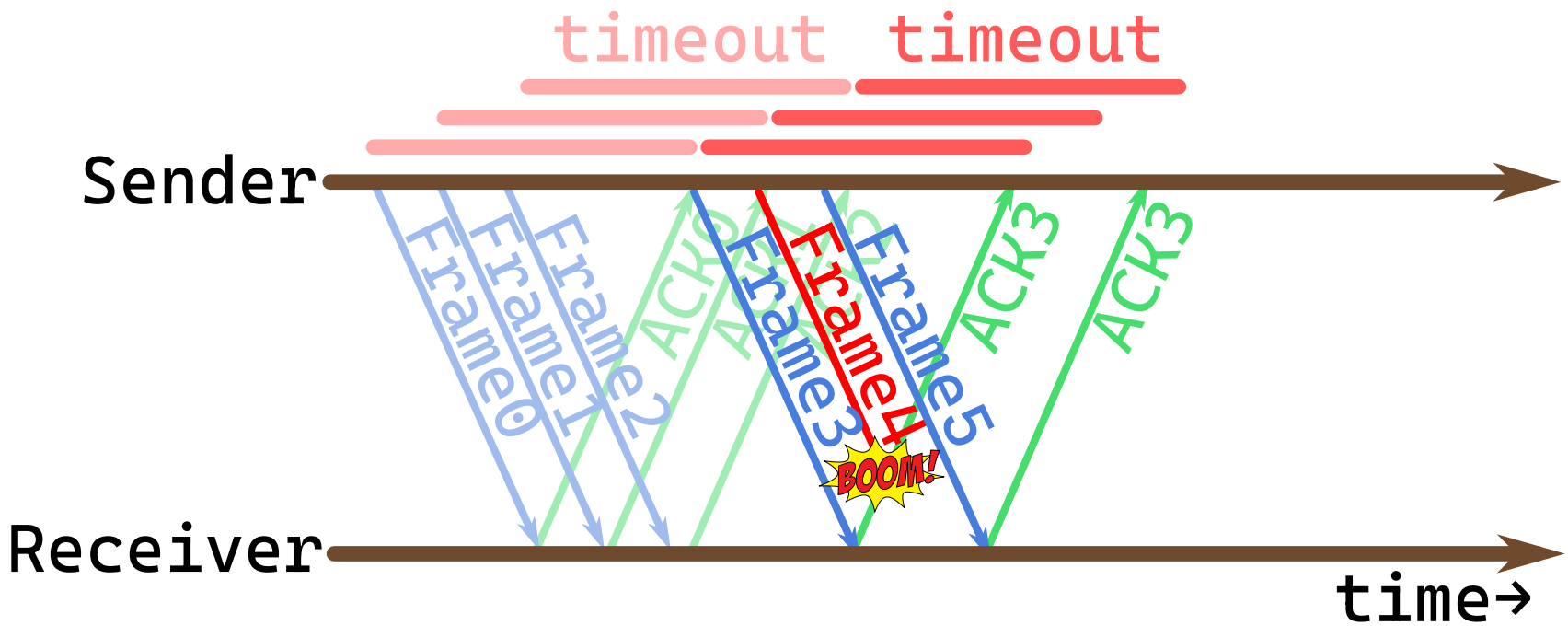




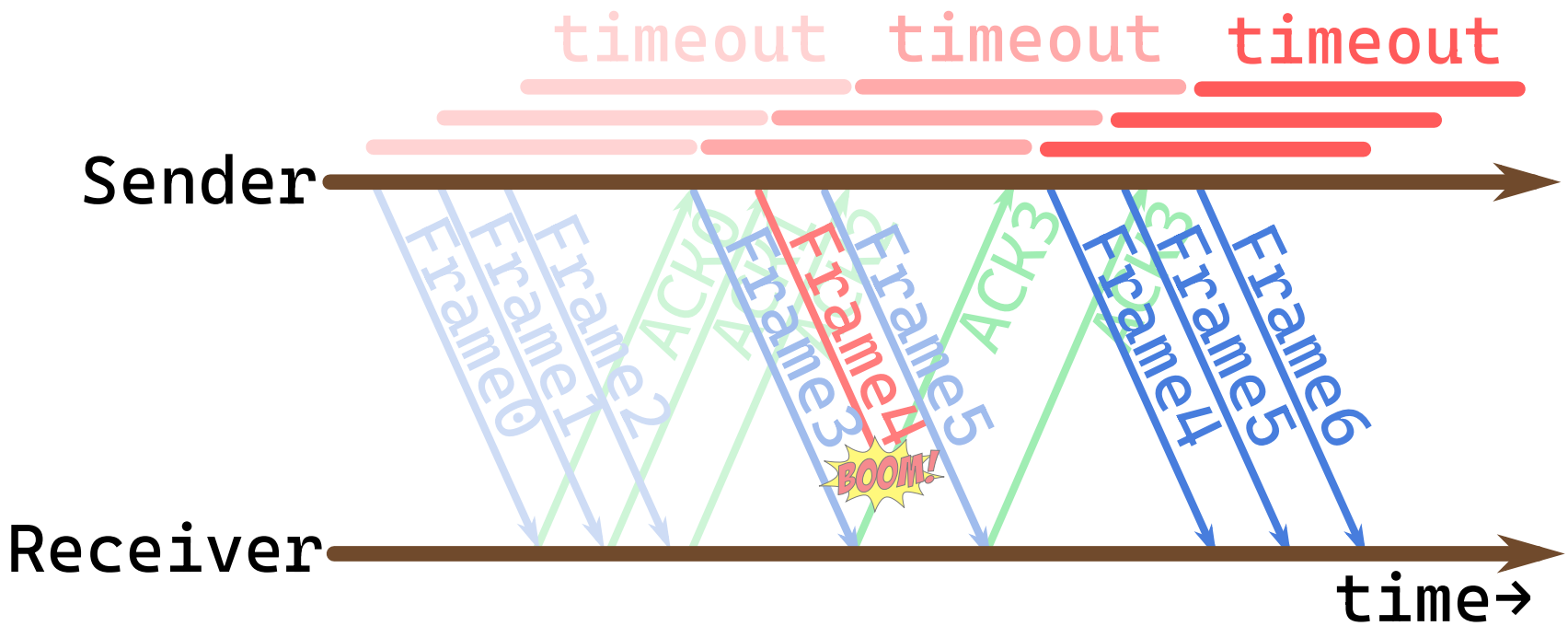
Sliding Window
Go Back N. Principle



Sliding Window
Go Back N. Principle



Sliding Window
Go Back N. Principle



Sliding Window
Efficiency of GoBack-N

- Probability of Failure[2]: $P_f = 1 - (1 - plr)^2$
- Average total time to transmit a packet [**1**]. Windows size W_s should implies to be selected so that the channel will be busy all the time.

$$E[t_{packet}] = t_f \frac{1 + (W_s - 1)P_f}{1 - P_f}$$

- Effective information transmission rate: $R_{eff} = \frac{n_f - n_{headers}}{E[t_{packet}]}$
- Associated transmission efficiency: $\eta = \frac{R_{eff}}{Rate}$

Futher readings

[1] Leon-Garcia, A., & Widjaja, I. (2000). Communication networks: fundamental concepts and key architectures (Vol. 2). New York: McGraw-Hill.

Thanks for your attention