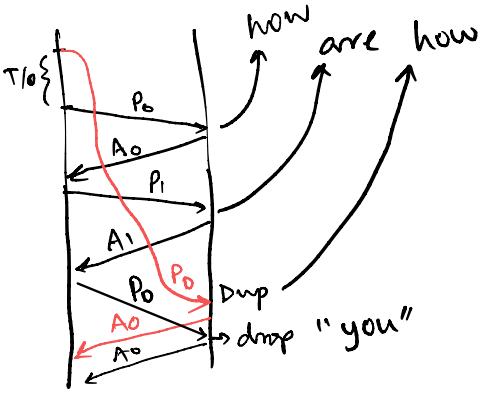
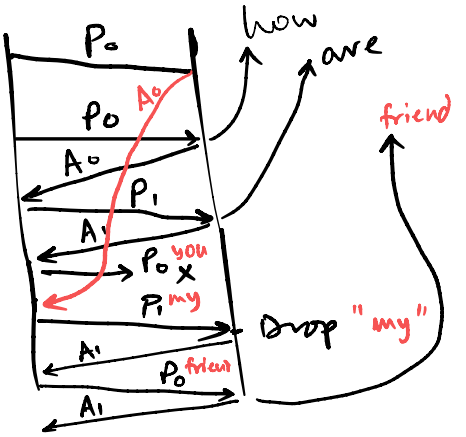
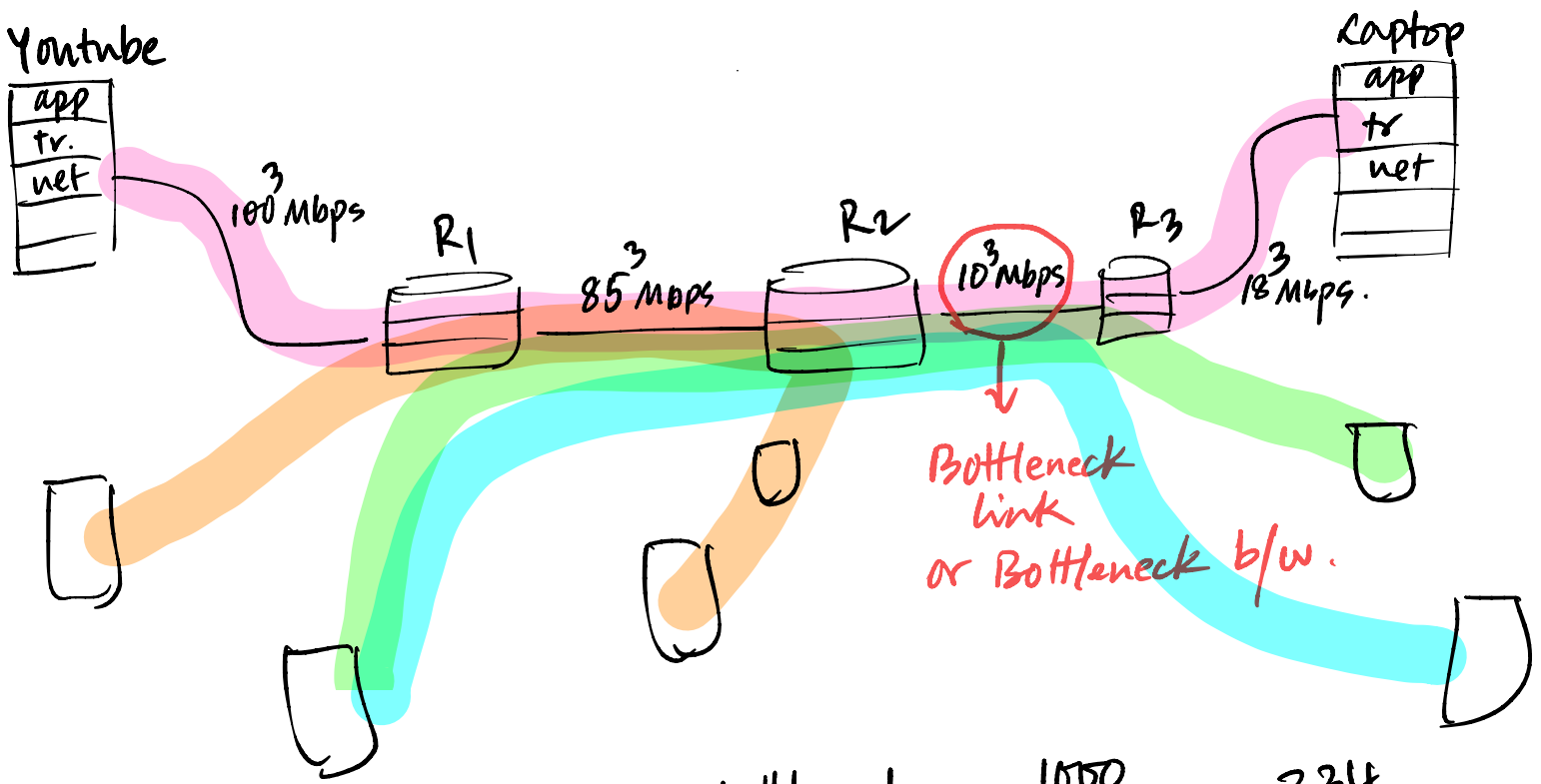
Transport Layer :

- Bottleneck
- Available
- Packet pair
- Transport (1st princ.) :
  - How are you
    - No error
    - Bit error
      - Coding Basics
      - Ack error = Dup
      - NACK error OK
    - Seq #
      - 2 enough?
    - Bit error and pkt loss
      - Timeout
    - Bit error + pkt loss + Delay = Worry
      - Show dup + loss.
      - Increase seq. # space.

Dup



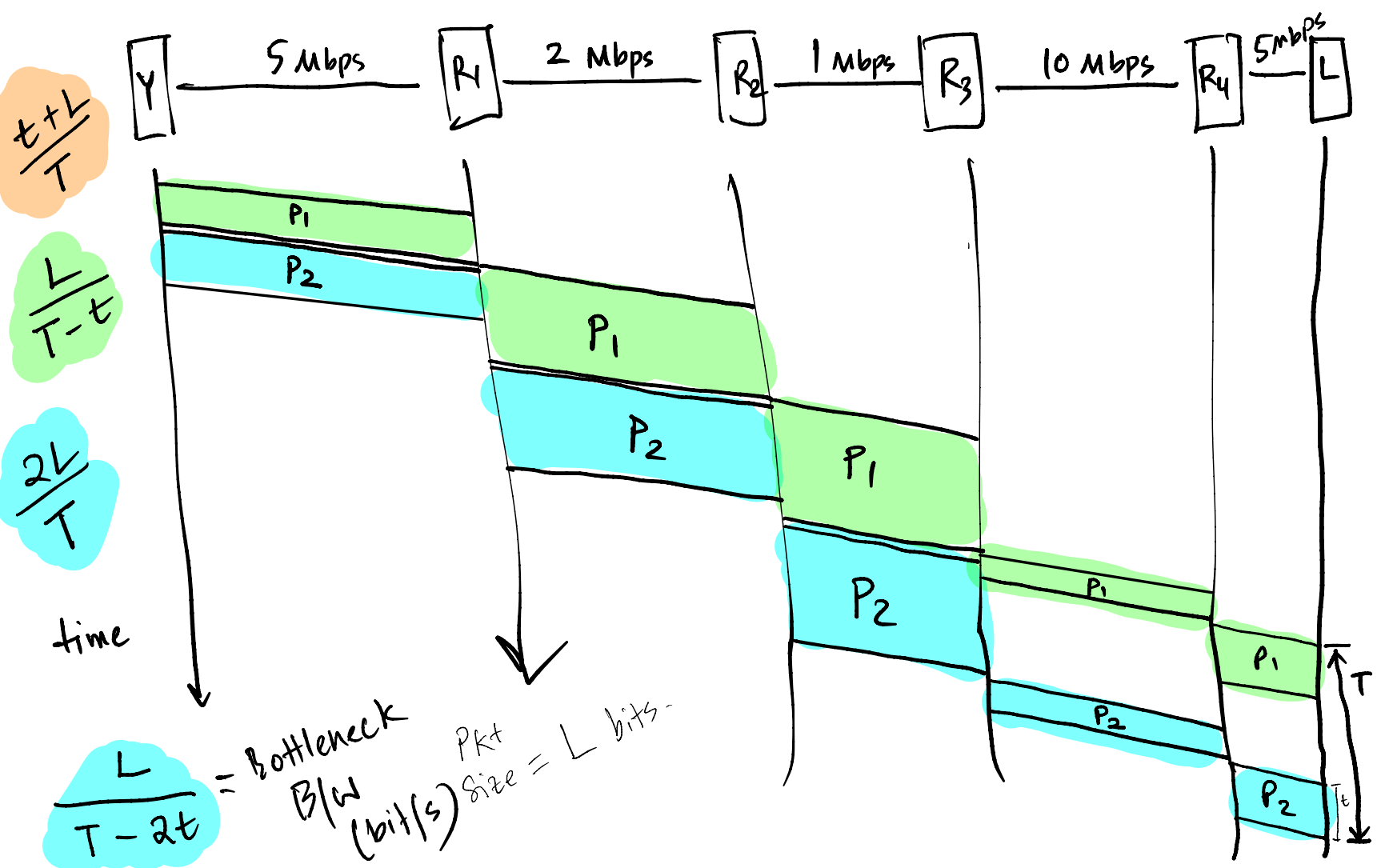




New bottleneck = $\frac{1000}{3} = 334$

Available B/w = $\frac{1000}{3}$

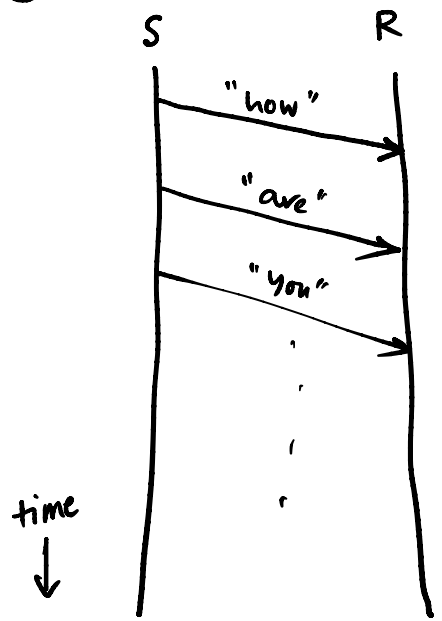
Available B/w ≠ Bottleneck B/w / # of flows through bottleneck link.


$\frac{t+L}{T}$
$\frac{L}{T-t}$
$\frac{2L}{T}$
time
$\frac{L}{T-2t}$ = Bottleneck B/W (bit/s)
Pkt Size = L bits.
S
5 Mbps
R1
2 Mbps
R2
1 Mbps
R3
10 Mbps
R4
5Mbps
L
P1
P2
T
t

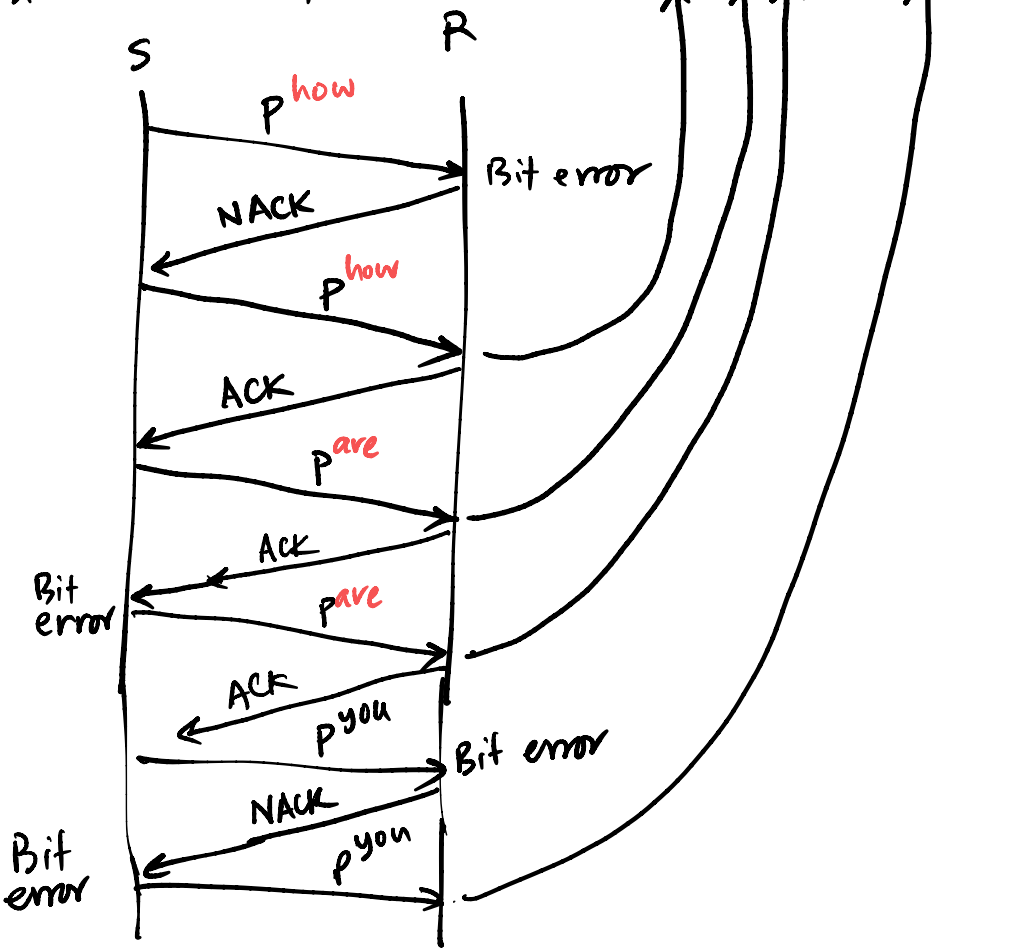
Transport Layer : Reliable transfer protocol design

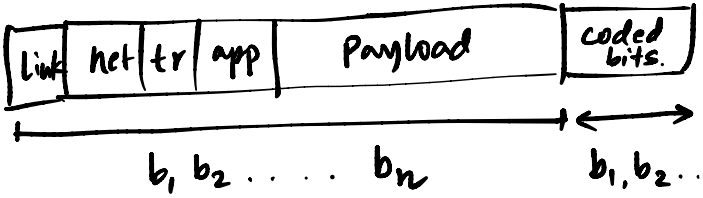
"how are you my friend"

① No error at all.



② Bit errors in the packets.





$m < n$

$$b^{(t)}_{1:m} = f\left(b^{(t)}_{1:n}\right)$$

When receiver receives $b^{(r)}_{1:n+m}$, it seperates out the last m bits and checks if

$$b^{(r)}_{n+1:n+m} = f\left(b^{(r)}_{1:n}\right)$$

Both sender and receiver have a pre-agreed function $f(\cdot)$.

$b_1 \quad b_2 \quad b_3 \quad \cdots \quad b_{10} \qquad n = 10$

$$a_1^1 b_1 + a_2^1 b_2 + \cdots a_{10}^1 b_{10} = b_{11}$$

$$a_1^2 b_1 + a_2^2 b_2 + \cdots a_{10}^2 b_{10} = b_{12}$$

$$\vdots \qquad\qquad\qquad\qquad \vdots$$

$$a_1^m b_1 + a_2^m b_2 + \cdots a_{10}^m b_{10} = b_{10+m}$$

$$\Rightarrow \begin{bmatrix} a_1^1 & a_2^1 & \cdots & a_{10}^1 \\ a_1^2 & a_2^2 & & a_{10}^2 \\ \vdots & \vdots & & \vdots \\ a_1^m & a_2^m & & a_{10}^m \end{bmatrix} \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_{10} \end{bmatrix} = \begin{bmatrix} b_{11} \\ b_{12} \\ b_{13} \\ \vdots \\ b_{10+m} \end{bmatrix}$$