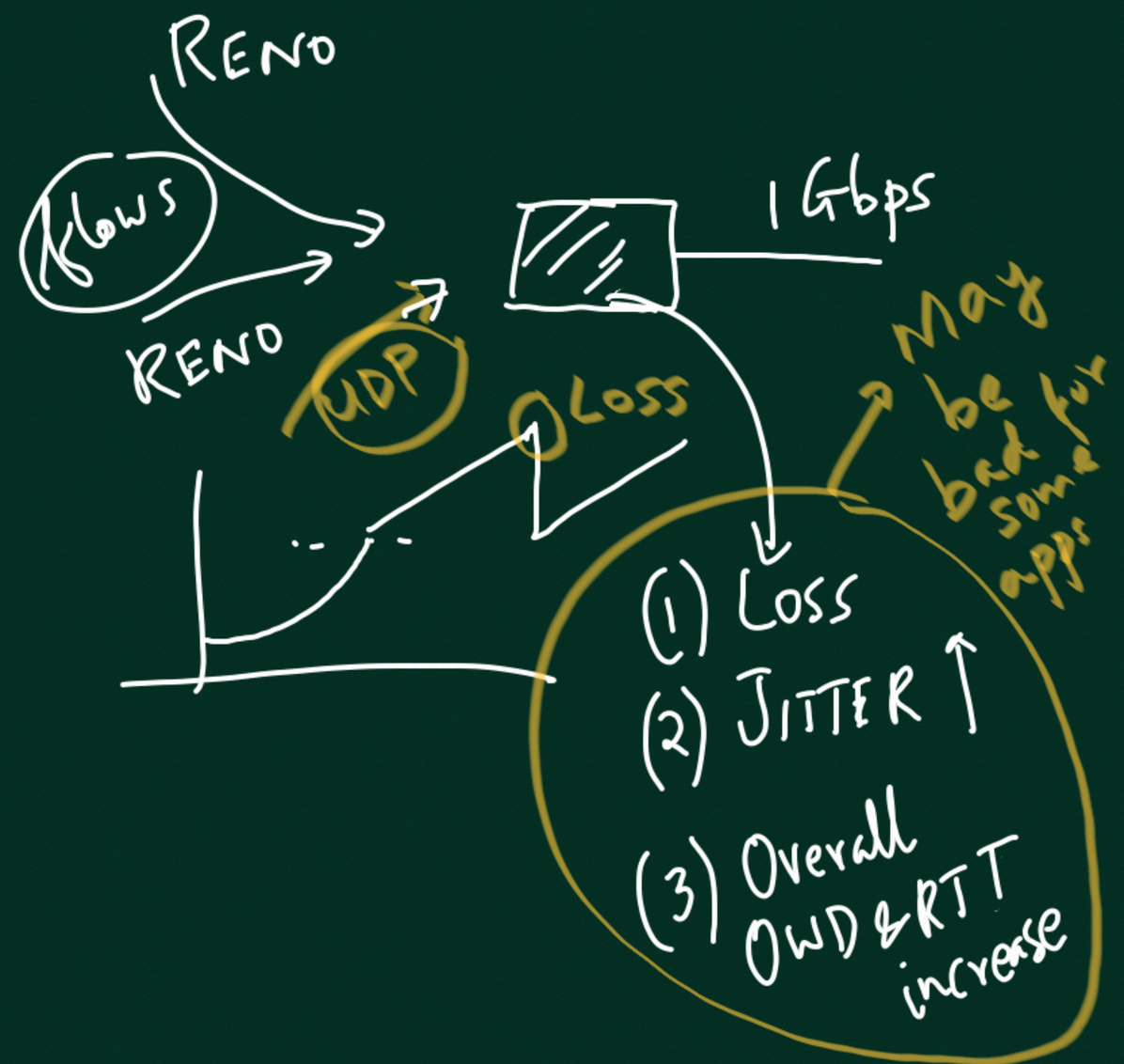
TCP TAHOE, RENO

T.D. → CW = CW/2

- Retransmit lost Segment
- Fast recovery

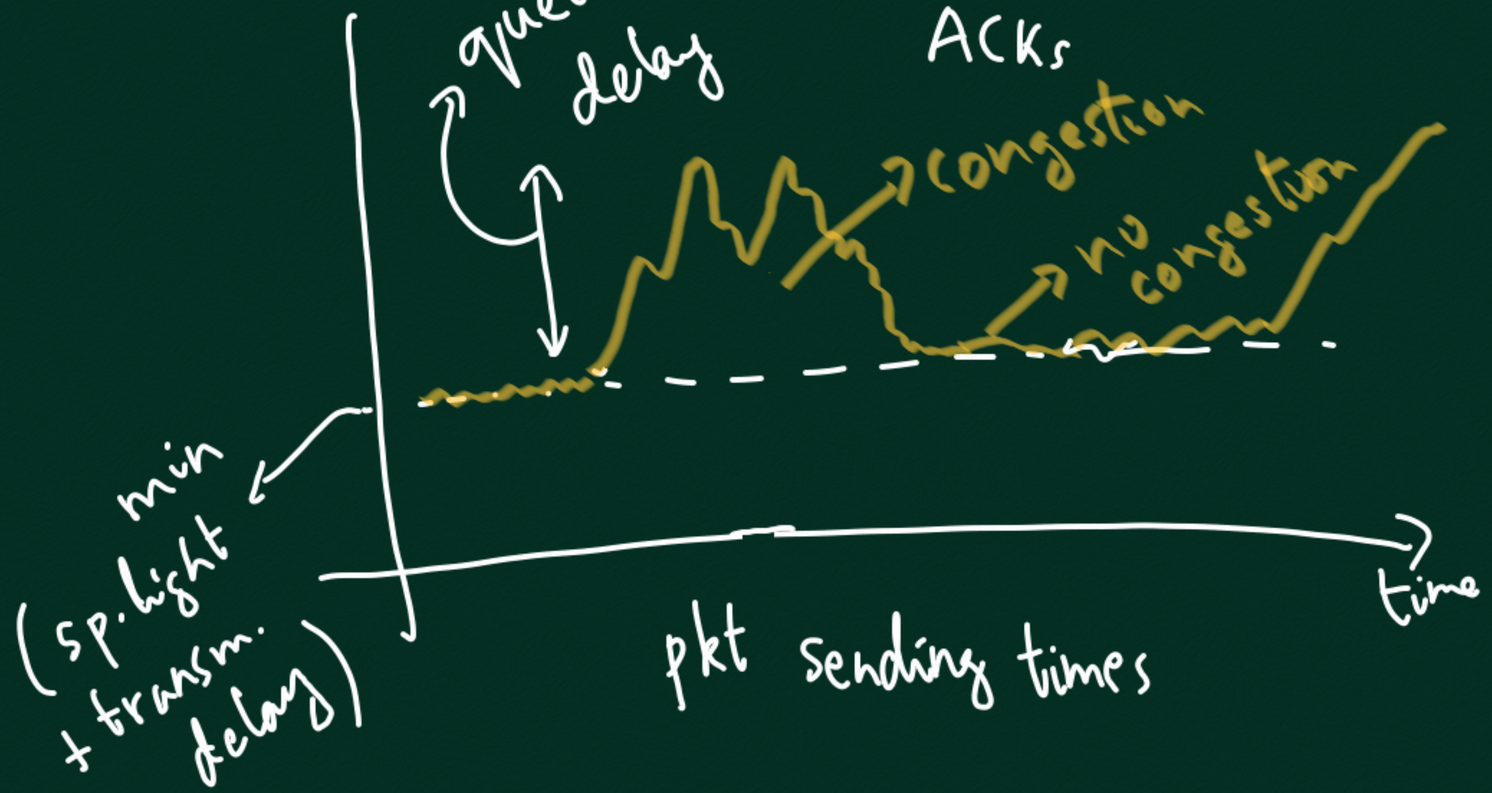
Fast retrans.

→ ISSUE: Designed to Cause congestion



TCP VEGAS

RTT



S.S. ⟶ as in Reno

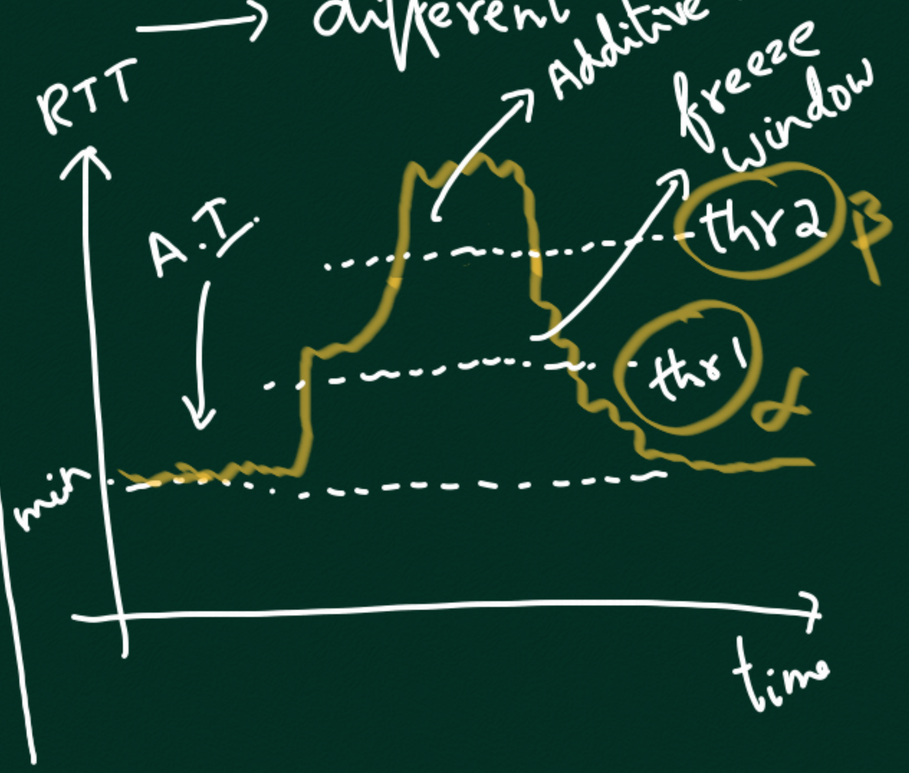
T.O. ⟶ — " —

T.D. Loss ⟶ — " —

Congestion Avoidance

→ (CW > SS_thresh)

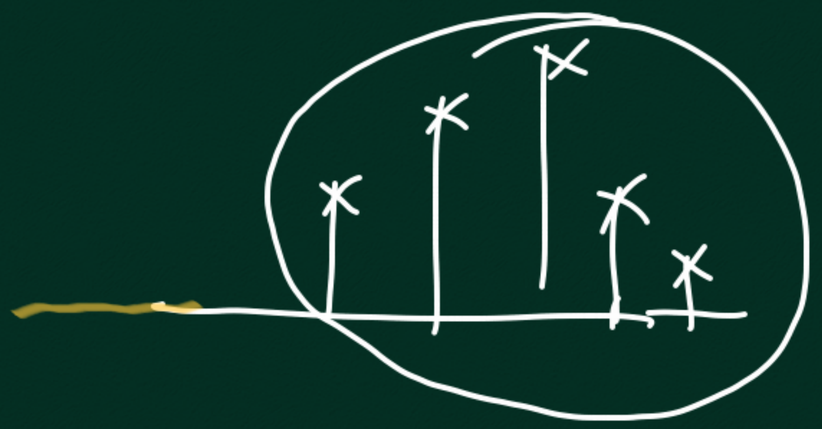
⟶ different RTT



VEGAS RULES (FOR CONG. AVOIDANCE)

BaseRTT — min. observed RTT in some recent time window (W: Window)

RTT — current (smoothed) estimate of RTT



Suppose no congestion, then RTT = BaseRTT

$$\text{Expt Rate} = \frac{W}{\text{BaseRTT}}$$

$$\text{Actual Rate} = \frac{W}{RTT}$$

$$\text{Diff} = \text{Expt Rate} - \text{Actual Rate}$$

$$= W\left[\frac{1}{\text{BaseRTT}} - \frac{1}{RTT}\right]$$

$$= W\left[\frac{RTT - \text{BaseRTT}}{(\text{BaseRTT})(RTT)}\right]$$

queuing delay

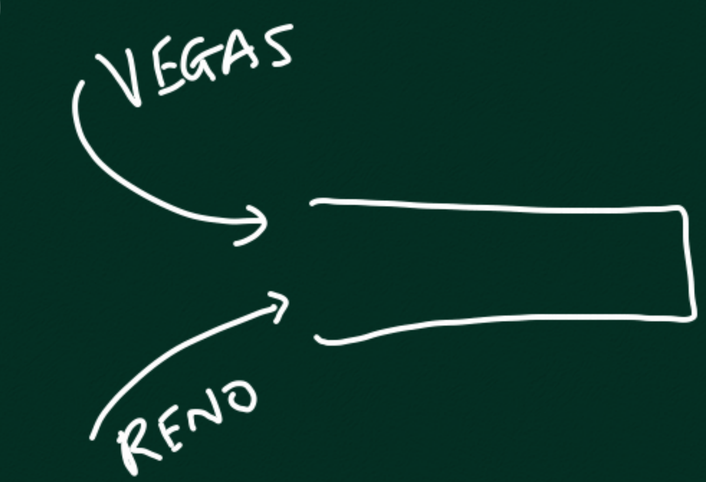
If $Diff < \alpha \Rightarrow$ A.I. (as in Reno)

$\alpha \leq Diff < \beta \Rightarrow$ Freeze window

$\beta \leq Diff \Rightarrow$ Decrease W by 1MSS per RTT

Suggested $\alpha = 30$kbps

$\beta = 60$kbps



RTT

Queue fills up (LOSS)

Diff=β

Diff=α

BaseRTT

time

VEGAS

RENO

IGNORING SLOW START

Cong. Window

W1

T.D.

Reno (A.I.)

Reno (A.I.)

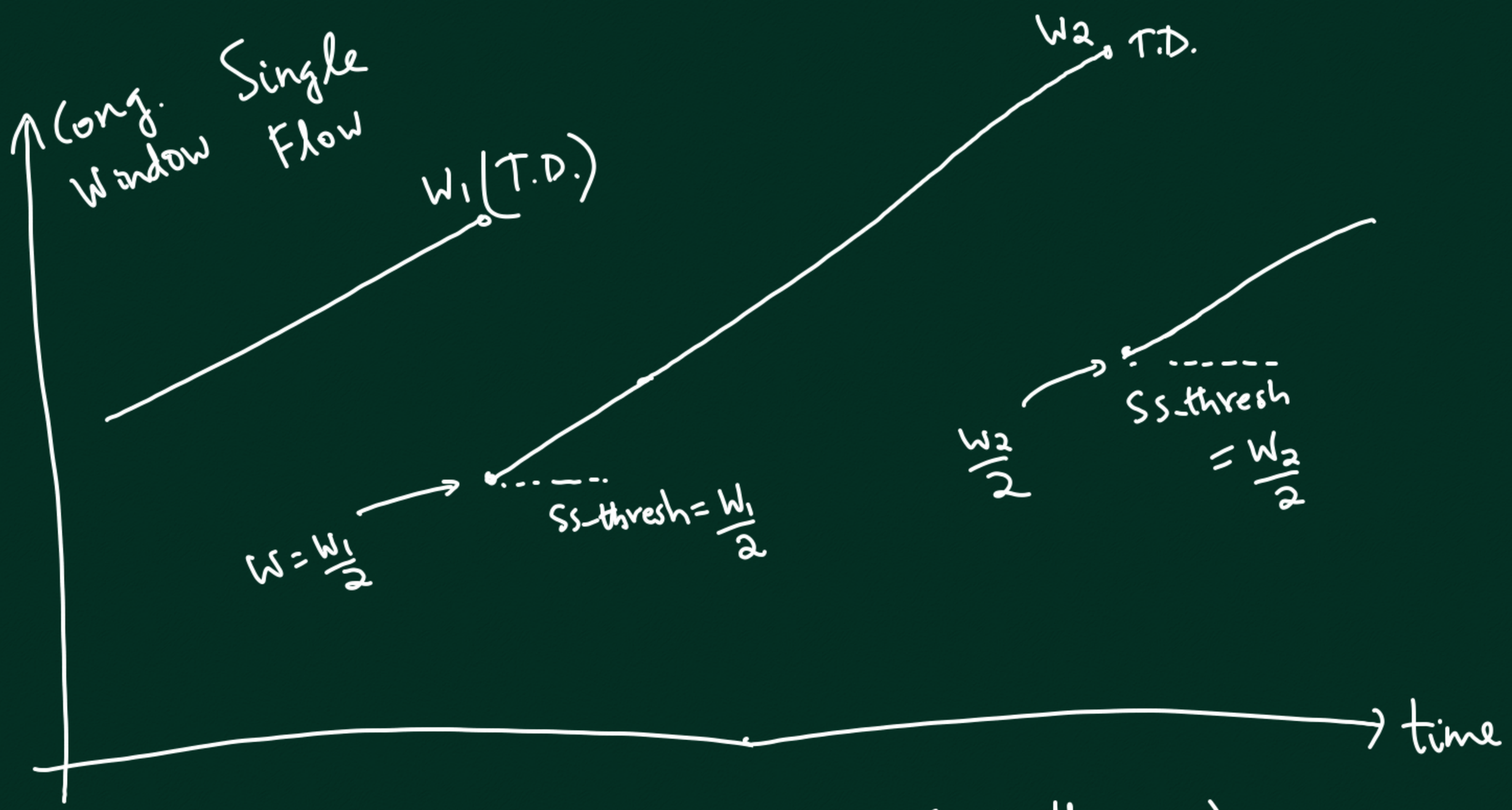
A.D.

W2

W1/2

W2/2

time



TCP Reno → 1988 – 2012 (default by many OSes)

TCP CUBIC → now default (Linux/MacOs.)

HIGH-SPEED NETWORKS

→ 10^4 MSS (optimal)

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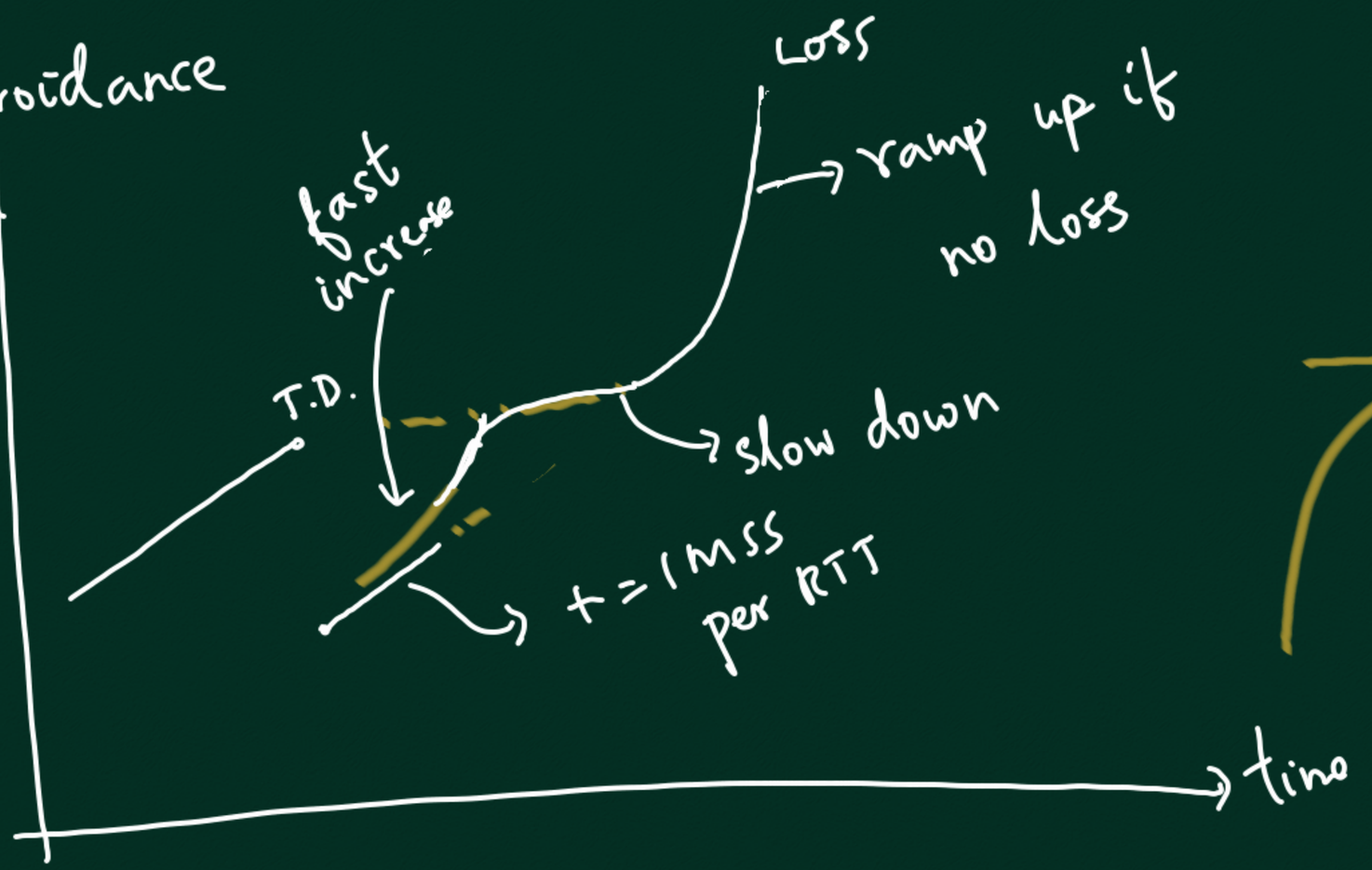
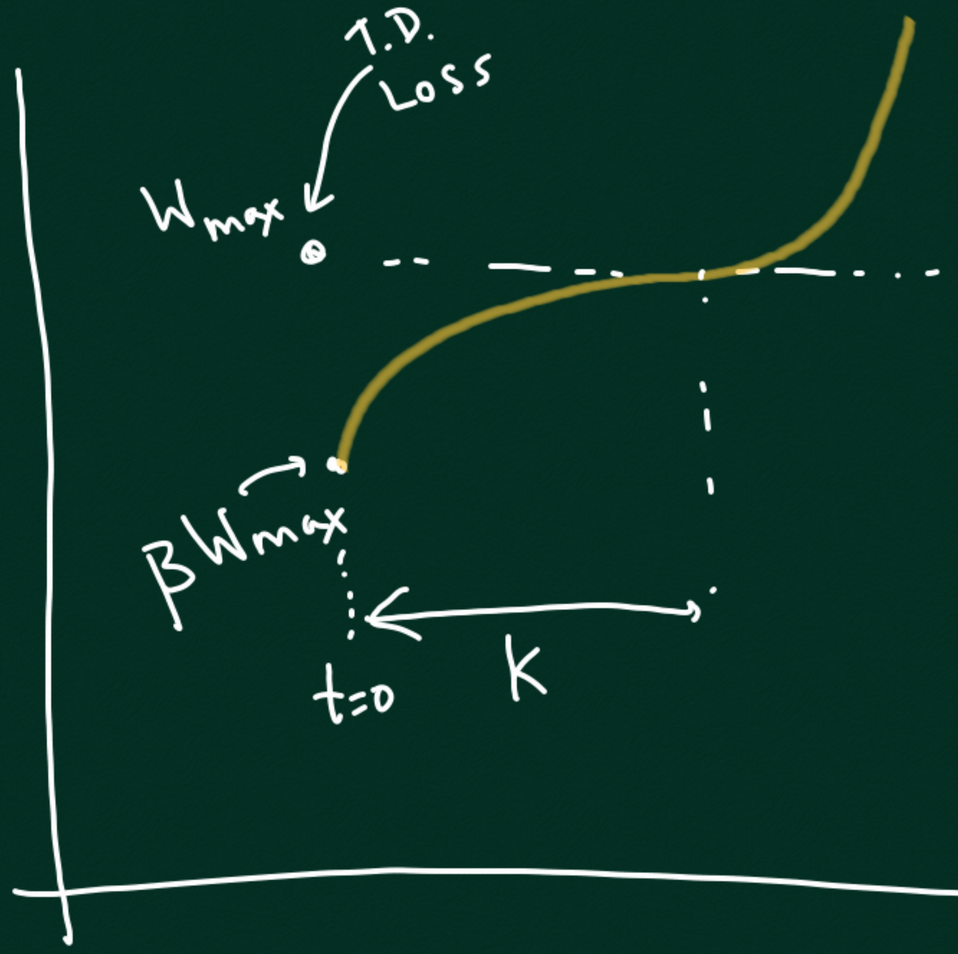
Cong. Avoidance





$$cwnd = C(T-K)^3 + W_{max}$$

at time T after loss event

$$K = \left[\frac{W_{max}(1-\beta)}{C}\right]^{1/3}$$

at $T=0$

$$cwnd = -W_{max}(1-\beta) + W_{max}$$

$$= \beta \cdot W_{max}$$

$\beta = 0.7$, $C = 0.4$

at $T=K$

$cwnd = W_{max}$