

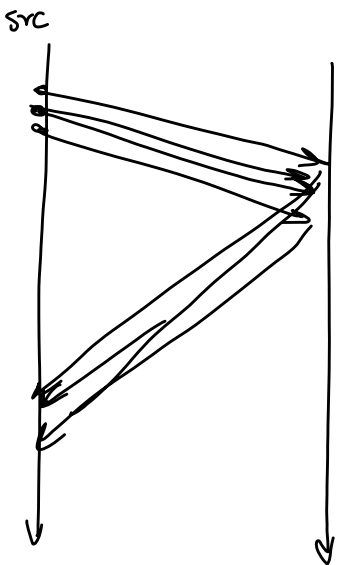
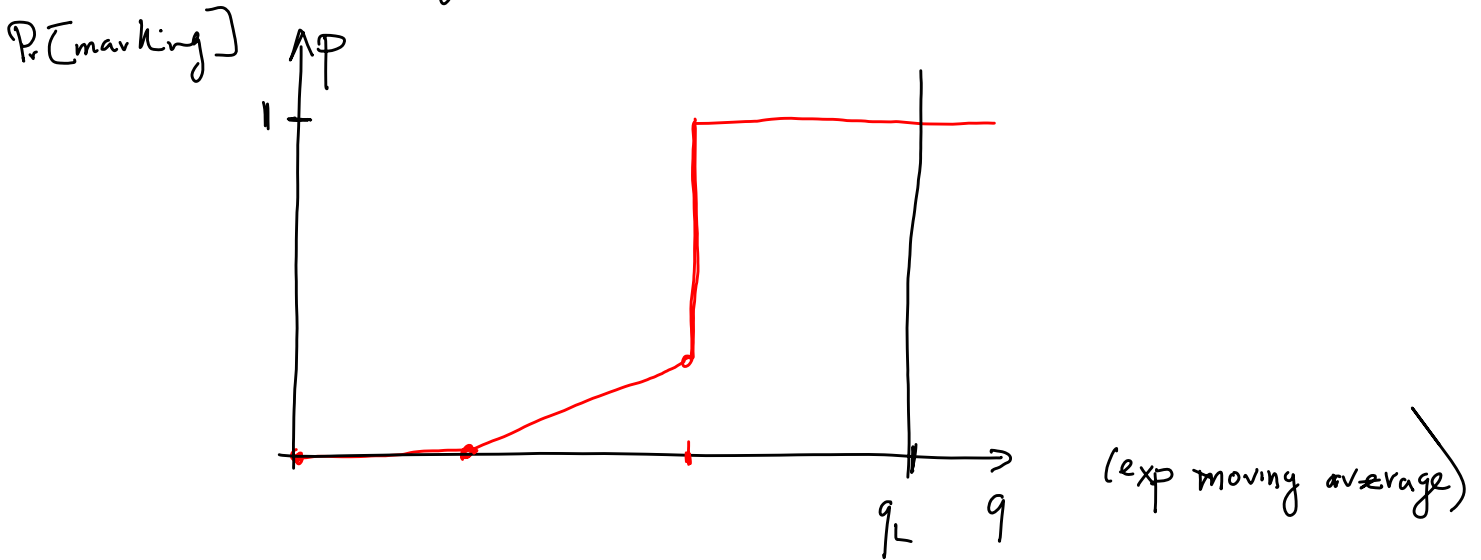
Lecture 12

Note Title

2/7/2005

AQM

RED: Random Early Detection

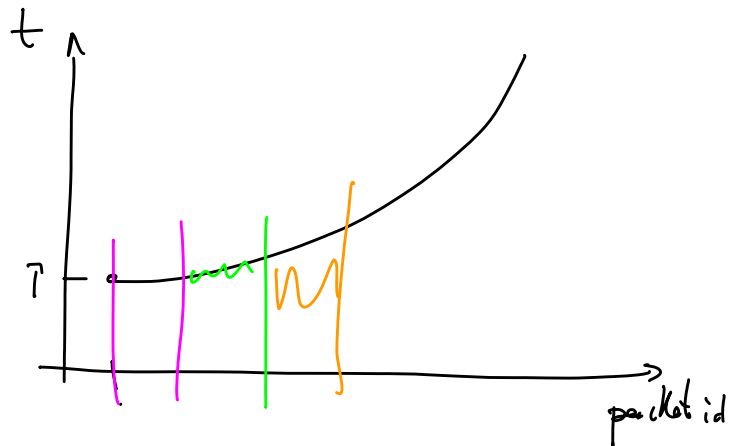
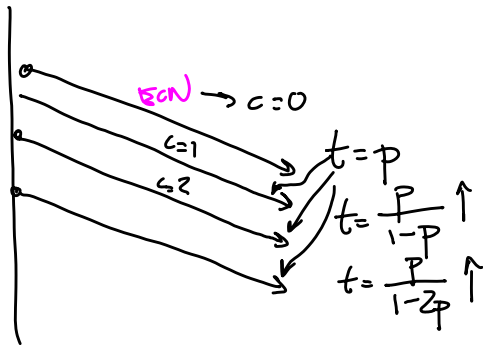


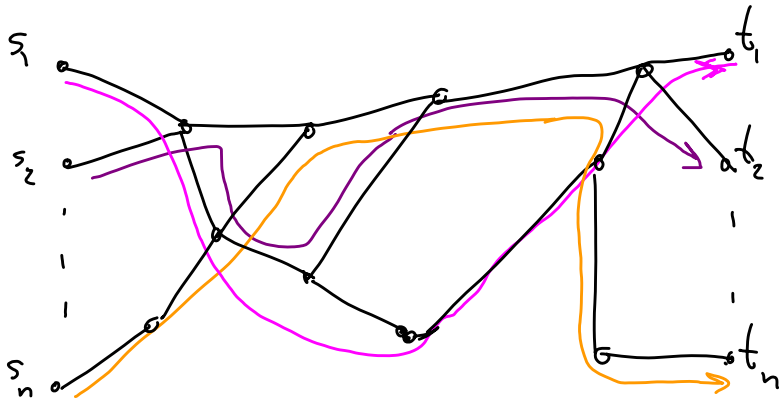
TCP flows are sometimes busy

$$\text{True Pr[marking]} = \frac{P}{1 - c \cdot p} = t$$

$c = \#$ packets enqueued since the last marked packet

FRED (Flow RED): per-flow marking probability





Assumptions

1. Unique end-to-end path
2. All flows simultaneously active

x_i = rate of flow from s_i to t_i
 $U_i(x_i)$ = utility of flow i on rate x_i

$$\begin{aligned} &\max \sum_i U_i(x_i) \\ &\text{s.t. } \sum_{i \in S(l)} x_i \leq c_l \quad \forall l \in E \\ &x_i \geq 0 \end{aligned}$$

Eg. (a) $U_i(x_i) = x_i \Rightarrow$ max flow

Unfairness

$x_1 = 5$	$x_1' = 10$
$x_2 = 5$	$x_2' = 0$

(b) $U_i(x_i) = \log x_i$

Δ	1 Mbps	\rightarrow	10 Mbps		
	0		1		= 1
	1		10		= 9
Δ	1 Gbps		1.009 Gbps		
	3		3.0...		$\ll 1$
					= 9

Lagrangian relaxation:

$$L(\underline{x}, \underline{p}) = \sum_i U_i(x_i) - \sum_{\ell} p_{\ell} \left(\sum_{i \in S(\ell)} x_i - c_{\ell} \right).$$