WiFi; Basic SCH

More about WiFi

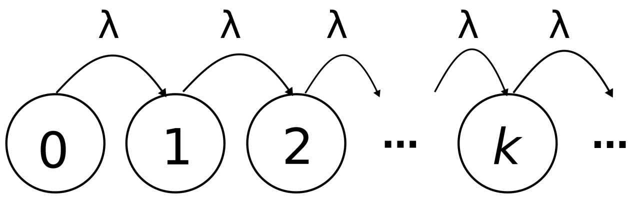
11ax: AP sets EDCA set (CWmin, CWmax, AIFSN) for the set of 11ax STAs by itself.

Primary and secondary sub-channels.

Different {CWmin, CWmax, AIFSN} for different ACs.

Introduction in queueing theory

Poisson process. We have probability of event equal to $\lambda \cdot \delta t$ in interval $[t, t+\delta t]$ for $\delta t \to 0$. Probability of coming exactly k events in interval t: $Pr(k,t) = \frac{(\lambda t)^k}{k!} e^{-\lambda t}$.



M/G/1.

FCFS – First-Come-First-Served, FIFO – is the same.

μ – how many packets should be sent in time unit in average. Denote by S random variable describing packet duration, therefore $E[S] = 1/\mu$.

ρ – "system load", $\rho = \lambda E[S]$.

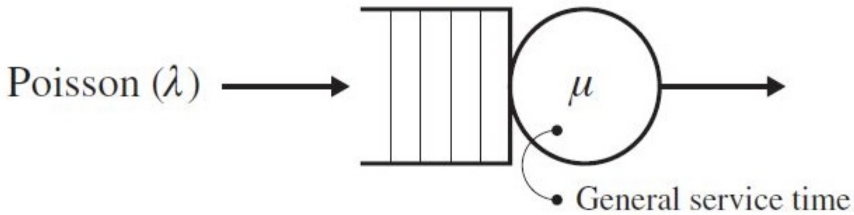


Figure 23.2. An M/G/1 queue.

Packets are not interrupted and their size is not considered: math expectation

Examples of methods: FCFS, LCFS (Last-CFS), RANDOM.

N – number of packets in system.

T – time in system.

N_Q, T_Q – N, T not in system, but in queue.

Theorem. All schedulers which

- do not interrupt packets;
- do not consider packet sizes;
- start transmission, if there is packet in queue

have equal distribution of N.

Little's law (wo/proof). $EN = \lambda ET$.

Corollary. All schedulers with properties from the theorem above have equal ET and also $ET_Q = ET - ES$.

Remind from differential equations theory

Laplace transform.

Let X be non-negative random variable. Laplace transform $\tilde{X}(s)$ is defined by formula $\tilde{X}(s) := Ee^{-sX}$.

Problems

1. (puzzled out) Should TXOP length be upper bounded?

2. (puzzled out) Let AP have opportunity set arbitrary CWmin and CWmax to each STA in BSS. There are two users in BSS. The first one wants to download file, while the second one has videocall. Which CWmin and CWmax to use for each STA?

3. Let $b_{i,k} = \lim\limits_{t \longrightarrow \infty} P\{s(t) = i, b(t) = k\}$, $i \in (0, m)$, $k \in (0, W_i - 1)$. Prove that

   (a) $b_{i,0} = p^i b_{0,0}$

   (b) $b_{m,0} = \frac{p^m}{1-p} b_{0,0}$

   (c) $b_{i,k} = \frac{W_i - k}{W_i} \cdot \begin{cases} (1-p)\displaystyle\sum_{j=0}^{m} b_{j,0} & i = 0 \\ p \cdot b_{i-1,0} & 0 < i < m \\ p(b_{m-1,0} + b_{m,0}) & i = m \end{cases}$

   (d) $b_{0,0} = \frac{2(1-2p)(1-p)}{(1-2p)(W_0+1)+pW_0(1-(2p)^m)}$

   (e) $\tau = \frac{2(1-2p)}{(1-2p)(W_0+1)+pW_0(1-(2p)^m)}$

4. Assume constant and independent collision probability of a packet transmitted by each station. Express τ in terms of p.

5. $X \sim Uniform(a, b)$. $\tilde{X}$?

6. $Exp(\lambda)$. $\tilde{X}$?