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WIFI DL: Waiting delay in presence of transmission errors

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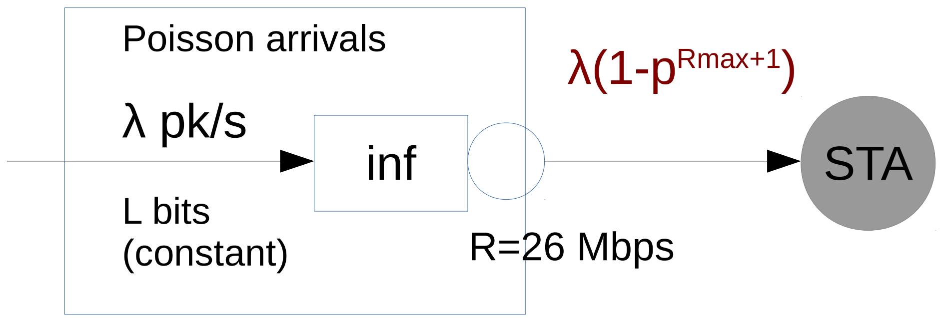
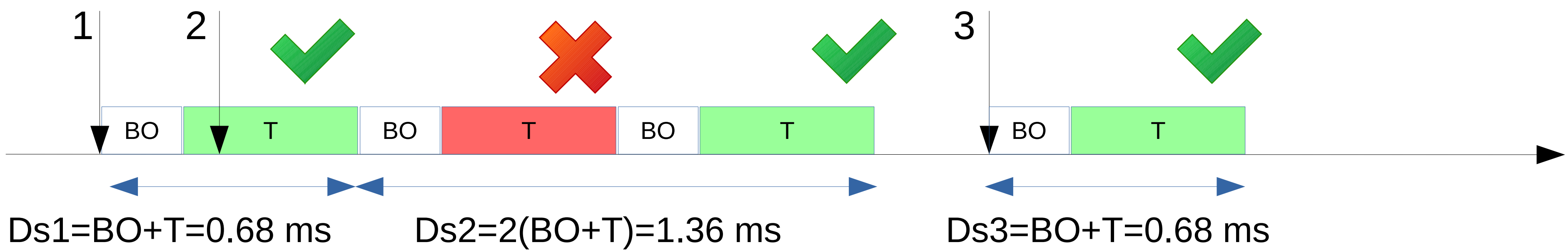


A packet is received with errors with probability p

The maximum number of retransmissions Is $R_{max} = 2$

BO =0.0675 ms
T = 0.613 ms (L=12000 bits)



What is the average number of transmissions per packet?

What is the average number of transmissions per packet?
With $R_{max} = 2$

Transmissions	Retransmissions	Probability
1	0	(1-p)
2	1	p(1-p)
3	2	1-(1-p)-p(1-p)= =1-1+p-p+pp=pp

Regardless the outcome of the 3rd transmission

If the 3rd transmission is correct, perfect.
If the 3rd transmission is erroneous, we drop the packet.

Dropping probability = p^{Rmax+1}

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What is the average duration of a transmission? Let us assume p=0.1

Transmissions	Probability	Duration (ms)
1	0.9	0.68
2	0.09	1.36
3	0.01	2.04

E[Ds] = 0.9·0.68 + 0.09·1.36 + 0.01·2.04 = 0.7548 ms
E[D^2s] = 0.9·0.68E-3^2 + 0.09·1.36E-3^2 + 0.01·2.04E-3^2 = 6.24E-7 s^2

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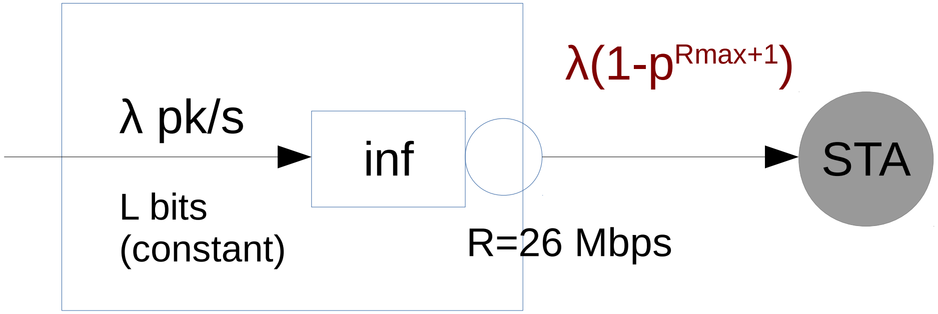

B=12 Mbps (input flow)

λ=1000 pk/s

a= λ · E[Ds](with errors) =
= 1000 · 0.7548E-3 = 0.75

$E[D_q]=\lambda\ E[D^2s]/(2(1-a)) = 1000 \cdot\ 6.24E-7 / (2(1-0.75)) = 0.0012480\ s = 1.2\ ms$

E[D] = 0.7548 + 1.2 = 1.9548 ms

Throughput $=\lambda(1-p^{Rmax+1})$ = 1000 (1-0.1^3) = 999 pk /s

Exercise: repeat the exercise without errors, and compare the E[D] value between the two cases.

a = λ E[Ds](without errors) = 1000 * 0.68E-3 = 0.68 Erlangs

$E[D_q]=\lambda\ E[D^2s]/(2(1-a)) = 1000 \cdot\ (1+0^2)(0.68E-3^2) / (2(1-0.68)) = 7.22E-4\ s = 0.722\ ms$

E[D] = 0.68 + 0.72 = 1.4 ms

Throughput = 1000 pk/s

Can we calculate the average service delay for any value of R_{max} ?

Transmission	Retransmission	Probability	Duration
1	0	1-p	Ds
2	1	p(1-p)	2Ds
3	2	p^2(1-p)	3Ds
...	...	...	...
i	i-1	p^i(1-p)	iDs
...	...	...	...
R_{max}+1	R_{max}	p^R_{max}	(R_{max}+1)Ds

What is the effect of R_{max} and p in the AP performance?

If with p=0 a system is stable… increasing p can it become unstable?
Can R_{max} be used to guarantee stability in that case?