Performance Modeling of Computer Systems and Networks

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Multiserver and Priority scheduling

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Assumptions:
- Arrival rate 1 j/s random
- Average demand Z=4x10^5 oxat, expo, do not know size

Possible configurations:
- 1 server of capacity C=10^6 oxat/s
- Dual-core of C/2 each one

QoS requirements:
- Average waiting $T_Q < 0.15$ s
- For at least 35% of arrivals average response time $T_S < 0.5$ s

Def.
$E(S) = Z/C = 0.4$ s

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QoS requirements:
- Average waiting $T_Q < 0.15$ s

Analytical models
priority scheduling

$\lambda =$ 1 j/s, $E(S) = 0.4$ s ⟹ $\rho =$ 0.4

- 1 server of capacity C=10^6 oxerat/s

$E(T_Q) = 0.26$ s $E(T_Q)^{\text{Abstract-P}} = 0.2243$ s

- Dual-core of C/2 each one

$$E(S_i) = \frac{Z}{\frac{C}{2}} = 2\frac{Z}{C} = 2E(S) = 0.8\ s$$

$$E(T_Q)_{Erlang} = \frac{P_Q E(S)}{1-\rho} = 0.15238 \text{ s}$$

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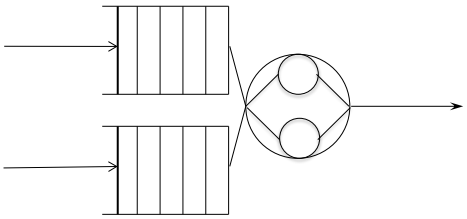

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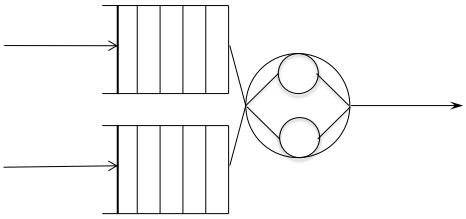
Multiserver with priority classes



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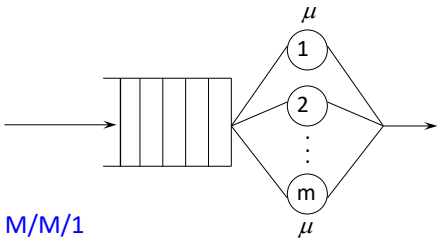
The *Erlang* formula



M/M/m

$$E(T_Q)_{Erlang} = \frac{P_Q E(S)}{1-\rho}$$

M/M/1

$$E(T_Q)_{KP} = \frac{\rho E(S)}{1-\rho} = \frac{E(S_{rem})}{1-\rho}$$

$$E(S) = \frac{E(S_i)}{m}$$

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Multiserver with priority classes

$$E(T_Q) = p_1 \frac{\rho_1 E(S)}{(1-\rho_1)} + p_2 \frac{\rho E(S)}{(1-\rho)(1-\rho_1)}$$

$$E(T_Q) = p_1 \frac{P_{Q1} E(S)}{(1-\rho_1)} + p_2 \frac{P_Q E(S)}{(1-\rho)(1-\rho_1)}$$

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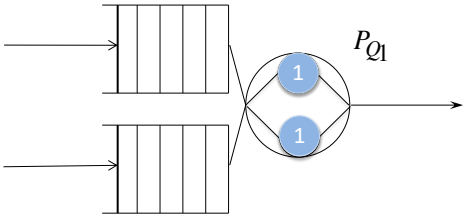
Multiserver with priority classes



m=2
p_1=0.35
p_2=0.65
ρ = 0.4
ρ_1=0.14
ρ_2=0.26

$$P_{Q1} = Erlang(\rho_1) = 0.03438$$

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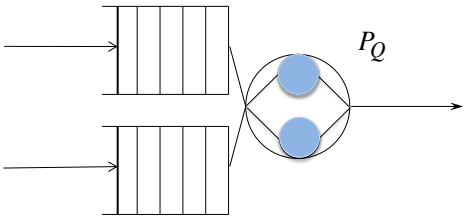
Multiserver with priority classes



$$P_{Q1} = Erlang(\rho_1) = 0.03438 \qquad P_Q = 0.22857$$

$$E(T_Q) = p_1 \frac{P_{Q1} E(S)}{(1-\rho_1)} + p_2 \frac{P_Q E(S)}{(1-\rho)(1-\rho_1)} = 0.12077$$

QoS requirements:

- Average waiting $T_Q < 0.15$ s **!!**

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QoS requirements:

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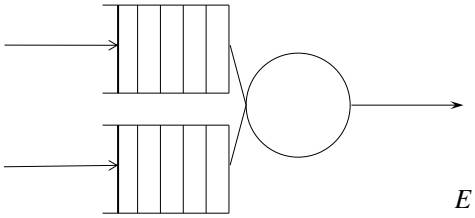
Abstract-P



p_1=0.35
p_2=0.65
$\rho = 0.4$
ρ_1=0.14
ρ_2=0.26

$$E\left(T_{S1}\right) = 0.4651162$$