

City University of Hong Kong
Department of Electrical Engineering

EE3009 Data Communications and Networking

Solution to Tutorial 4

1. Maximum throughput for ALOHA is 0.184.

$$\text{Maximum throughput in frames/second} = \frac{56000}{1000} \times 0.18 \approx 10$$

2. For slotted ALOHA, throughput is independent of a , therefore,
maximum throughput = $10^8 \times 0.368 = 36.8$ Mbps.

For CSMA/CD,

$$L = 1500 \times 8 = 12000 \text{ bits}$$

$$t_{prop} = \frac{2 \times 500}{2.5 \times 10^8} = 4 \times 10^{-6}$$

$$a = \frac{t_{prop} R}{L} = \frac{4 \times 10^{-6} \times 10^8}{1.2 \times 10^4} = 3.33 \times 10^{-2}$$

$$\text{maximum utilization} = \frac{1}{1 + (2e + 1)a} = 0.8235$$

maximum throughput is 82.35 Mbps.

3. $d = 100$ m from each station to the cabinet

$$v = 2 \times 10^8 \text{ m/sec}$$

$$b = 8 \text{ bits}$$

$$L = 1250 \text{ bytes} = 10000 \text{ bits}$$

$$R = 25 \text{ Mbps}$$

$$X = \frac{10000}{25 \times 10^6} = 4 \times 10^{-4} \text{ sec}$$

$$\tau' = \frac{M 2d}{v} + \frac{8M}{R} = \frac{200M}{2 \times 10^8} + \frac{8M}{25 \times 10^6} = 1.32 \times 10^{-6} M$$

$$a' = \frac{\tau'}{X} = \frac{1.32 \times 10^{-6} M}{4 \times 10^{-4}} = 3.3 \times 10^{-3} M$$

- i) When all stations are allowed an unlimited number of frames/token, $\rho_{\max} = 1$ and
 $\rho = \lambda X$. Therefore,

$$\lambda_{\max} = \frac{1}{4 \times 10^{-4}} = 2500 \text{ frames/sec.}$$

$$\text{ii) } \rho_{\max} = \frac{1}{1 + a'(1 + \frac{1}{M})}$$

$$\lambda_{\max} = \frac{1}{1 + 3.3 \times 10^{-3} M (1 + \frac{1}{M})} \times \frac{1}{4 \times 10^{-4}} = \frac{2500}{1.0033 + 0.0033M}$$

$$\text{iii) } \rho_{\max} = \frac{1}{1 + a' / M} = \frac{1}{1 + 3.33 \times 10^{-3} M / M} = 0.997$$

$$\lambda_{\max} = 0.997 \times \frac{1}{4 \times 10^{-4}} = 2492 \text{ frames/sec}$$