Rules

Chapter 2

[1] Max Data Rate of a Channel (Noiseless) = $2B\log_2 V$ bits/sec

(Noisy) = $B\log_2(1+S/N)$

[2] $\frac{S}{N} = 10\log_{10}(S/N)$

[3] $\text{delta}f = \frac{c * \text{delta}\lambda}{\lambda^2}$

[4] Prop. Speed in Copper / Fiber $= 2\times10^8$ m/sec

Chapter 3

[1] Hamming Codes: to detect $\boxed{d}$ errors you need hamming distance $= d+1$

to Correct $\boxed{d}$ errors you need hamming distance $= 2d+1$

[2] No. of Checkbits needed to Correct single errors: $m+r+1 \leq 2^r$

[3] Bandwidth delay Product = BW (bit/sec) * oneway transit time (Prop delay)

[4] $BD = \frac{\text{BW delay Product}}{\text{Frame Size}}$

[5] Window Size $= 2BD+1$

[6] utilization $\leq \frac{w}{2BD+1}$

Chapter 4

[1] Queuing Theory Allocation (Static Channel)

$T = \frac{1}{\mu C - \lambda}$

$\frac{1}{\mu}$: frame avg. length (bits)

C: Capacity (bps)

T: Time delay

λ: average arrival rate (frames/sec)

After dividing the Channel into N Subchannels (FDM) $T = NT$

N: num of Subchannels

[2] Pure Aloha Throughput:

$G = N +$ retransmissions

→ low load $G \approx N$

→ high load $G > N$

$\therefore G \geq N$

$P_0 = e^{-2G}$ → The Probability that a frame won't Suffer a Collision

Vulnerability Period $= 2t$

Throughput $S = Ge^{-2G}$

Max Throughput is at $G = 0.5$ → $S = \frac{1}{2e}$, Channel utilization ≈ 18%

3 Slotted Aloha

Throughput $S = Ge^{-G}$

Vulnerability period = t

Probability of successfully transmitting one frame $P_K = \underbrace{e^{-G}}_{\text{Prob it'll avoid Collision}} \underbrace{(1 - e^{-G})^{K-1}}_{\text{Prob. of Collision}}$

K: no. of attempts

Expected no. of Transmissions per line typed at a terminal:

$$E = \sum_{1}^{\infty} K P_K$$

$$E = \sum_{1}^{\infty} K e^{-G} (1 - e^{-G})^{K-1}$$

$$E = e^{G}$$

4 Collision Free Protocols

① Bitmap

low numbered Station waits 1.5N on average

high numbered Station waits 0.5N on average

efficiency at low load $= \frac{d}{d+N}$

efficiency at high load $= \frac{d}{d+1}$

Max delay $= N + (N-1)d$

② Binary Countdown

efficiency $= \frac{d}{d + \log_2 N}$, but if the Sender's Address is part of the data frames $d/d = 100\%$

5 Limited Contention Protocols

Probability of Successful Transmission with optimal $P = 1/K$ $P_r = \left[\frac{K-1}{K}\right]^{K-1}$

Adaptive Tree Walk Protocol

The optimal level to begin Searching $i = \log_2 q$

The expected no. of Stations below a specific node at level i is $2^{-i}q$

6 Ethernet

Minimum frame Size $= \frac{\text{round trip time}}{\text{1 bit trans. time}}$

OR // $=$ BW * round trip time

Scanned with CamScanner

7 Classic ethernet Performance

$A = kp(1-p)^{k-1}$

A : Prob that some station acquires the channel in a particular slot
k : Stations ready to transmit
P : each station transmits during a contention slot with Prob P

Mean no. of Slots / Contention = $\sum_{0}^{\infty} J \underbrace{A(1-A)^{J-1}}_{\text{Prob. that contention interval has J slots}} = \frac{1}{A}$

A is max when $p = \frac{1}{k}$

When $k \to \infty$, $A \to \frac{1}{e}$

Channel efficiency $= \frac{P}{P + 2\tau/A}$

$2\tau/A \to$ The mean contention interval

$2\tau/A$ = (mean no. of slots/contention) * slot time (2τ)

$= \frac{\text{Frame time}}{\text{Frametime} + \text{Cont. interval}}$

$= \frac{1}{1 + 2BLe/CF}$, $P = F/B$

F : Frame length L : Cable length
B : BW C : prop. speed

8 Wireless LAN

Prob of Sending a Frame Correctly $= (1-p)^n$ — n → Frame size, p → error rate

Chapter 5

1 Hierarchical Routing

optimal no. of levels for a N router network = $\ln N$

2 Traffic Throttling

queuing delay $d_{new} = \underbrace{\alpha}_{\text{EWMA}} d_{old} + (1-\alpha) S$ — S → queue length

3 Token Bucket

$S = \frac{B}{M - R}$

S : burst length
M : max. o/p rate (byte/sec)
B : bucket capacity (bytes)
R : Token Arrival rate (byte/sec)

4 Weighted Fair queuing

$F_i = \max(A_i, F_{i-1}) + L_i/W$

A_i : arrival time
F_{i-1} : Finish time of the Previos
L_i : Length
W : Weight

Other Rules

CSMA/CD : $T_{tr} = 2T_p$

min size of Frame = bandwidth * T_{tr}

to detect collisions : Frame transmission time $\geq$ 2 Prop. delay

Baud rate = Bit rate / Bits per Symbol

Prop delay $= \frac{\text{distance}}{\text{speed}}$

efficiency $= \frac{T_{tr}}{T_{tr} + T_p}$

effective BW = efficiency * BW