EECS 3213 Formula & Data Sheet.

1 Names, Acronyms, Structures:

A/D: analog-to-digital converter
ADC: analog-to-digital converter
A-to-D: analog-to-digital converter
ARQ: Automatic repeat requests (stop & wait, go-back-N, selective-repeat)
ASK: Amplitude Shift Keying
BER: Bit Error Rate
bps: bits-per-second
Bps: bytes-per-second
CDMA: Code Division Multiple Access
CRC: cyclic redundancy check
CSMA: Carrier Sense Multiple Access
CSMA-CD: Carrier Sense Multiple Access with Collision Detection
1-P CSMA: one-persistent CSMA
n-P CSMA: non-persistent CSMA
p-P CSMA: p-persistent CSMA
DNS: Domain Name System
FDMA: Frequency Division Multiple Access
FSK: Frequency Shift Keying
GFP: Generic Framing Procedure
HTTP: Hypertext Transfer Protocol
IP: Internet Protocol
ISI: Intersymbol Interference
NRZ: Non-Return to Zero
PSK: Phase Shift Keying
QAM: Quadrature Amplitude Modulation
SDMA: Space Division Multiple Access SNR: Signal-to-Noise Ratio TCP: Transmission Control Protocol
TDMA: Time-Division Multiple Access
UDP: User Datagram Protcol
OSI Reference Model Layers: Application → Presentation → Session → Transport → Network → Data Link → Physical
WDM: Wavelength Division Multiplexing

2 Constant and Units

$c = 3 \times 10^8$ m/s (in free space), $c = 2 \times 10^8$ m/s (in media)
1 Å $= 10^{-10}$ m
1 μm $= 10^{-6}$ m
1 m $= 10^{-3}$ km
1 nm $= 10^{-9}$ m
1 s $= 10^3$ ms
kbps $= 10^3$ bps
Mbps $= 10^6$ bps
Gbps $= 10^9$ bps
kBps $= 2^{10}$ Bps
MBps $= 2^{20}$ Bps

3 Equations

$$\log_x y = \frac{\log_a y}{\log_a x}, \ \log_x(a \cdot b) = \log_x(a) + \log_x(b), \ \log_x(y^z) = z \log_x(y)$$

$$C = W_c \log_2(1 + \text{SNR})$$

$$y = \int_a^b x \mathrm{d}x = \left.\frac{x^2}{2}\right|_a^b = (b^2 - a^2)/2, y = \int_a^b x^2 \mathrm{d}x = \left.\frac{x^3}{3}\right|_a^b = (b^3 - a^3)/3$$

$$y(t) = a_0 + \sum_{k=1}^{\infty} a_k \cos(2\pi f_0 \cdot k \cdot t) + \sum_{k=1}^{\infty} b_k \sin(2\pi f_0 \cdot k \cdot t)$$

$$f_0 = \tfrac{1}{T}, a_0 = \tfrac{1}{T}\int_0^T y(t)\mathrm{d}t, a_k = \tfrac{2}{T}\int_0^T y(t) \cdot \cos(2\pi f_0 \cdot k \cdot t)\mathrm{d}t, b_k = \tfrac{2}{T}\int_0^T y(t) \cdot \sin(2\pi f_0 \cdot k \cdot t)\mathrm{d}t$$

$$\text{SNR [dB]} = 10 \log(\text{SNR})$$

$$\text{SNR [dB]} = 6m - 7.2 \text{ (if } [V/\sigma_x = 4)]$$

$$\text{SNR [dB]} = 6m + 10 \log\left(\frac{3\sigma_x^2}{V^2}\right)$$

$$\sigma_e^2 = \tfrac{\Delta^2}{12}, \Delta = \frac{2V}{M} = \frac{2V}{2^m}$$

$$2(\cos x)^2 = 1 + \cos(2x), 2\cos(x) \cdot \sin(y) = \sin(x + y) - \sin(x - y), 2\cos(x) \cdot \cos(y) = \cos(x + y) + \cos(x - y)$$

$$A\cos(x) + B\sin(y) = \sqrt{A^2 + B^2}\cos(x + \tan^{-1}(B/A))$$

$$|A_c|^2 = 10^{-kd}, |A_c|^2 = (d/r_o)^{-n}, r_0 = \lambda/(4\pi)$$

$$f = v/\lambda, B \approx \frac{v\Delta\lambda}{\lambda_1^2}$$

$$\text{binomial coefficient} = \binom{n}{k} = \frac{n!}{k!(n-k)!}, (1-p)^{n_f} \approx e^{-pn_f}$$

$$\eta_{SW} = \frac{1 - n_0/n_f}{1 + \frac{n_a}{n_f} + \frac{2(t_{prop} + t_{proc})R}{n_f}}(1 - P_f)$$

$$\eta_{GBN} = \frac{1 - n_0/n_f}{1 + (W_S - 1)P_f}(1 - P_f)$$

$$\eta_{SR} = (1 - \frac{n_0}{n_f})(1 - P_f)$$

$$f_n/f_s = N/M, \Delta f = f_n - f_s = f_n - (M/N)f_n, f_r = f_n - \Delta f$$

$$t_{RTT}(new) = \alpha t_{RTT}(old) + (1 - \alpha)\tau_n$$

$$d_{RTT}(new) = \beta d_{RTT}(old) + (1 - \beta)|\tau_n - t_{RTT}|$$

$$t_{out} = t_{RTT} + 4d_{RTT}$$

$$\eta_{max} = \frac{L}{L + 2t_{prop}R} = \frac{1}{1 + 2a}$$

$$a = \frac{t_{prop}}{L/R}$$

$$\eta_{CSMACD} = \frac{1}{1 + 6.44a}$$

$$\rho = \lambda X$$

$$S = GP_{success}, P_{success} = (1-p)^{2n} = (1 - \frac{G}{n})^{2n} \to e^{-2G}$$

$$\rho_{max} = \frac{X}{X + t_{prop} + 2et_{prop}} = \frac{1}{1 + (2e + 1)a}$$