CEG3185 Final Exam Annex

Nyquist formula: $C=2B\log_2 M$

Shannon Capacity: $C=B\log_2(1+SNR)$

$P_{dBm}=10\log_{10}(P_{mW}/1mW)$

Thermal Noise power spectral density: $N = kTB$ where $k=1.381*10^{-23}$ J/K

Fourier Series

$$x(t) = a_0 + \sum_{n=1}^{\infty} a_n \cos(2\pi f_0 t) + \sum_{n=1}^{\infty} b_n \sin(2\pi f_0 t)$$

$$f_0 = \frac{1}{T}$$

$$a_0 = \frac{1}{T}\int_S^{S+T} x(\tau)\, d\tau$$

$$a_n = \frac{2}{T}\int_S^{S+T} x(t)\cos(2\pi n f_0 t)dt$$

$$b_n = \frac{2}{T}\int_S^{S+T} x(t)\sin(2\pi n f_0 t)dt$$

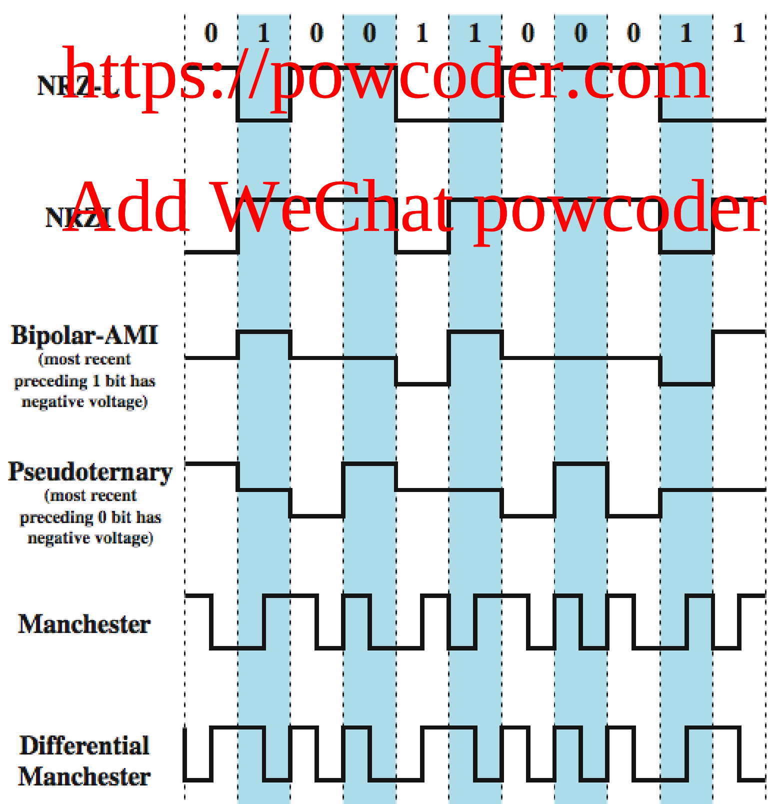
$$Attenuation\ L = 10log_{10}(\frac{4\pi d}{\lambda})^2 \quad in\ dB$$

Tx-Rx distance in terrestrial microwave

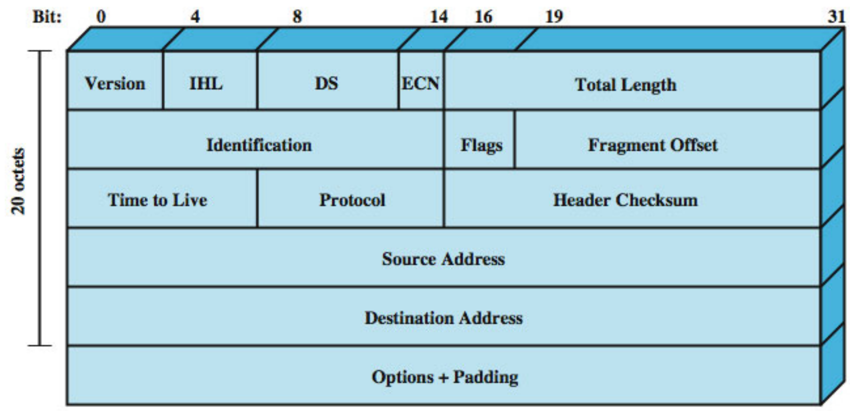
$$d = 3.57(\sqrt{Kh_1} + \sqrt{Kh_2})$$

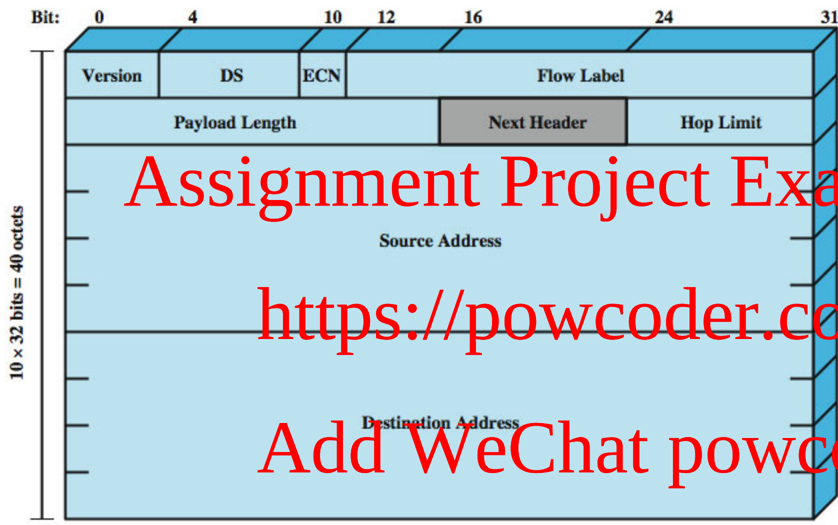
- h_1 = *height of antenna one*
- h_2 = *height of antenna two*
- *K = 4/3 (adjustment factor)*

Signal Encoding Waves



IPv4 and IPv6 headers strcuture





Jacobson's Algorithm

$$SRTT(K+1) = (1-g) \times SRTT(K) + g \times RTT(K+1)$$

$$SERR(K+1) = RTT(K+1) - SRTT(K)$$

$$SDEV(K+1) = (1-h) \times SDEV(K) + h \times \left|SERR(K+1)\right|$$

$$RTO(K+1) = SRTT(K+1) + f \times SDEV(K+1)$$

Dijkstra's Algorithm

- Step 1: Initialization
  - *T* = {*s*}: *Set of nodes so far incorporated*
  - L(n) = w(*s*, n) for n Ï *s*
  - w(i,j): aggregate link cost from node "i" to node "j"
  - initial path costs to neighboring nodes are simply link costs
- Step 2: Get Next Node
  - find neighboring node not in *T* with least-cost path from *S*
  - incorporate node into *T*
  - also incorporate the edge that is incident on that node and a node in *T* that contributes to the path
- Step 3: Update Least-Cost Paths

  - L(n) = min[L(n), L(x) + w(x, n)] for all n Ï T
  - if latter term is minimum, path from s to n is path from s to x concatenated with edge from x to n

Bellman-Ford's Algorithm

- Step 1 [Initialization]

  - $L_0(n) = \infty$, for all $n \neq s$
  - $L_h(s) = 0$, for all h
  - "h" corresponds to length of path
- Step 2 [Update]
  - for each successive $h \geq 0$
    - for each $n \neq s$, compute: $L_{h+1}(n)={}^{\min}{}_j[L_h(j)+w(j,n)]$
  - connect n with predecessor node j that gives min
  - eliminate any connection of n with different predecessor node formed during an earlier iteration
  - path from s to n terminates with link from j to n

Useful mathematical formulas

$$\sum_{n=1}^{\infty} n x^{n-1} = \frac{1}{(1-x)^2}$$

$$\binom{n}{k} = \frac{n!}{(n-k)!\,k!} = \binom{n}{n-k}$$

$$n! = n * (n-1) * (n-2) * (n-3) * \ldots\ldots * 3 * 2 * 1$$

$$(a+b)^n = a^n + \binom{n}{1} a^{n-1} b^1 + \binom{n}{2} a^{n-2} b^2 + \binom{n}{3} a^{n-3} b^3 + \cdots + \binom{n}{n-1} a^1 b^{1n-1} + b^n = \sum_{j=0}^{n} \binom{n}{j} a^{n-j} b^j$$

$$1 + X + X^2 + X^3 + \ldots + X^K = \frac{1 - X^{K+1}}{1 - X}$$

$$\sum_{i=1}^{\infty} X^i = \frac{X}{1-X}$$

$$\sum_{i=1}^{\infty} i X^i = \frac{X}{(1-X)^2}$$

$$1 + 2 + 3 + 4 + \ldots . + K = \frac{K(K+1)}{2}$$

Poisson Process:

Probability of having ***n*** arrivals within a time duration τ, when the arrival rate is λ:

$$P\{n\} = e^{-\lambda\tau} \frac{(\lambda\tau)^n}{n!}, n = 0,1,2, \ldots .$$

Probability distribution of event occurrence interracial time :

$$P(t \geq \tau) = e^{-\lambda\tau}$$