

Ex. 1

0101 1111 1000 1000 (w_1, w_2, w_3, w_4)
 w_1, w_2, w_3, w_4

$$w_1 = 0101$$

$$w_2 = 1111$$

$$w_3 = 1000$$

$$w_4 = 1000$$

$$\begin{array}{r} w_1 \\ + w_2 \\ \hline \end{array}$$

$$\begin{array}{r} 0101 \\ + 1111 \\ \hline \end{array}$$

$$\begin{array}{r} 0100 \\ + 1 \\ \hline \end{array}$$

$$\begin{array}{r} 0101 \\ \hline \end{array}$$

$$\begin{array}{r} S \\ + w_3 \\ \hline \end{array}$$

$$\begin{array}{r} 0101 \\ + 1000 \\ \hline \end{array}$$

$$\begin{array}{r} 1101 \\ \hline \end{array}$$

$$\begin{array}{r} 1101 \\ \hline \end{array}$$

$$\begin{array}{r} S \\ + w_4 \\ \hline \end{array}$$

$$\begin{array}{r} 1101 \\ + 1000 \\ \hline \end{array}$$

$$\begin{array}{r} 0101 \\ \hline \end{array}$$

$$\begin{array}{r} 0110 \\ \hline \end{array}$$

$$\text{Checksum} = 1001$$

$$= 1's \text{ comp (sum)}$$

Ex. 2

$$\text{distance from earth to a distant planet} = 5 \times 10^8 \text{ km}$$

$$\text{Frame size} = 15 \text{ Kbits}$$

$$\text{Speed of light} = 3 \times 10^8 \text{ m/s}$$

$$\text{Bit rate} = 8 \text{ Mbps}$$

$$\text{Speed in m} = 5 \times 10^{12} \text{ m}$$

$$1 \text{ km} = 1 \times 10^3 \text{ m}$$

$$S = 15 \text{ Kbits} \rightarrow 1.5 \times 10^4$$

$$b_r = 8 \text{ Mbps} \rightarrow 8 \times 10^6 \text{ bps}$$

$$1 \text{ Mbps} = 1 \times 10^6 \text{ bps}$$

$$a) T_g (\text{throughput}) = \frac{S}{2T_p + T_t}$$

$$E(\text{efficiency}) = \frac{T_g}{b_r}$$

$$T_p = \frac{d}{v} (\text{propagation})$$

$$T_t = \frac{S}{b_r} (\text{transmission})$$

$$T_p = \frac{d}{v} = \frac{5 \times 10^{12}}{3 \times 10^8} = 16,666.666667$$

$$T_t = \frac{S}{b_r} = \frac{1.5 \times 10^4}{8 \times 10^6} = .001875$$

$$T_g = \frac{1.5 \times 10^4}{2(16,666.666667) + .001875}$$

$$= \frac{1.5 \times 10^4}{33,333.33522}$$

$$= 0.444444975$$

$$b.) nT_t = T_t + 2(T_p)$$

$$n = \frac{T_t + 2(T_p)}{T_t}$$

$$= \left(\frac{1.5 \times 10^4}{8 \times 10^6} \right) + 2 \left(\frac{5 \times 10^{12}}{3 \times 10^8} \right)$$

$$\left(\frac{1.5 \times 10^4}{8 \times 10^6} \right)$$

$$= \frac{33,333.33522}{.001875}$$

$$= 17,777,778.78$$

$$\boxed{1.777 \times 10^7}$$

$$S = \text{packet size}$$

$$T_p = \text{propagation time}$$

$$T_t = \text{transmission time}$$

$$V = \text{Speed}$$

$$E = \frac{.444444975}{8 \times 10^6}$$

$$\frac{0.000000556}{5.6 \times 10^8}$$

$$C.) T_p = \frac{8 \cdot 10^9}{3 \cdot 10^8}$$

$$= 26,666.666667$$

$$T_g = \frac{S}{T_t + 2(T_p)}$$

$$= \frac{1.5 \cdot 10^4}{\left(\frac{1.5 \cdot 10^4}{8 \times 10^6} \right) + \left(2 \cdot \frac{8 \cdot 10^9}{3 \cdot 10^8} \right)}$$

$$\left(\frac{1.5 \cdot 10^4}{8 \times 10^6} \right) +$$