3) a) For block size of 1000 the minimum number of check bits is 10 from:

$$m + r + 1 \leq 2^r$$

$$1000 + 10 + 1 \leq 2^{10}$$

if the error rate is n, the probability of an error in any given block is $1000 \times n$.

The total size of the block with parity bit is 1001

Thus: 1001 is the original transmission
(1000n) 1001 is the amount of bits retransmitted on average for error rate n

$$1001 + (1000n)1001 < 1010$$
$$1001(1000n) < 9$$
$$1000n < 0.008991009$$
$$n < 8.99 \times 10^{-6}$$

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3) b) $\underline{T1} = 1.544 \times 10^6$ bits/sec
length = 3000 km = ~~3000000 m~~
frame size = 512 bits/frame
propagation = 3000 km $\times$ **6** nsec/km = 18ms
bit capacity of wire = 1.544×10^6 bits/sec $\times 18 \times 10^{-3}$ s
$\qquad\qquad = 2.7792 \times 10^4$ bits
frame capacity of wire = $\dfrac{2.7792 \times 10^4 \text{ bits}}{512 \text{ bits/frame}} = 54.28125 \approx 54$ frames

~~bits~~ BD = 54 frames
$\omega = 2(54) + 1 = 109$
6 bits are required for sequence number