

Note on error handling

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Introduction

In past meetings of the port task force, issues related to handling of errors have been discussed. In particular, the case where 3 single random bit errors in the coded stream cause 3 decoded bytes to be errored which may go undetected by CRC32 was studied. This brief note tries to quantify the probability of a such a case occurring.

Probability calculation

Let p be the probability of a coded bit to be in error; in other words, p represents the line bit error rate (BER). Let N be the length (in bits) of the transmitted packet. The probability for exactly n bits to be errored within this packet is:

$$P_n = [N!/(n!(N-n)!)] \cdot p^n \cdot (1-p)^{N-n}$$

This takes into account all possible combinations of having n bits in error and $(N-n)$ bits not in error.

The maximum length packet considered here is 84.31 us long (see 1394-1995 standard page 92) which at S3200 is equivalent to 32768 bytes. The packet is then 8b10b encoded so $N=327680$. Given a value of p , P_3 (probability to have exactly 3 bits in error) can be calculated. Some of these error combinations will be detected by CRC-32. In fact the probability for one of these errors to go undetected by CRC-32 is 2^{-32} (i.e. $2.33 \cdot 10^{-10}$). Therefore, the probability that three errors occur and create an errored packet which will be considered as valid is $P_u = P_3 \cdot 2^{-32}$. The plot below shows how P_u varies with the line BER p . For example, if $p = 10^{-10}$, the probability to have an undetected errored packet is $P_u = 1.36 \cdot 10^{-24}$.

