

Conversion from Packet Error Rate (PER) to Bit Error Rate (BER) by modelling CCK bit errors.

The 11 Mbps CCK implementation encodes a byte stream using 2^8 different out of 2^{16} symbols of 8 chips each.

Notations:

PER	=	Packet Error Rate
BER	=	Bit Error Rate
SER	=	Symbol Error Rate
N	=	Packet length in bytes
NS	=	Packet length in symbols

Assumptions:

1. An erroneously interpreted symbol will produce any of the other symbols with equal probability.
2. Symbol errors are considered to be independent of each other.
3. The 1 Mbps preamble and header are not CCK encoded and are assumed error-free. They are ignored in the discussion below.
4. One byte corresponds to one symbol exactly: $NS=N$.

From assumption 1 it follows that one erroneous symbol on average contains: $(8 * 128)/(256-1) = 4.016$ erroneous bits. From this it follows that:

$$(a) \quad BER = SER * (4.016/8 \text{ chips}) = SER * 0.502$$

From assumption 2 the rate of errorless packets $(1-PER)$ depends on the rate of errorless symbols $(1-SER)$ in the following way:

$$(b) \quad (1-PER) = (1-SER)^{NS}$$

or, using (a) and assumption 4:

$$(c) \quad PER = 1 - (1 - (1.992 * BER))^N$$

For a BER of $1E-5$ (as required for FCC approval), and a packet size of a 1000 bytes, this leads to a PER of 0.02 (which is 2%).

A PER of 8% corresponds with a BER of $4.2E-5$.