Further work on
S/N Budget Channel specification

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Note, for this presentation we use the term S/N Budget to refer to the method described in:

www.ieee802.org/3/100GCU/public/mar11/moore_01_0311.pdf

as updated by:

www.ieee802.org/3/bj/public/mar12/moore_01_0312.pdf

Outline:

1. Goals for a channel spec
2. Proposed method
3. Does the method meet the goals

Goals for a channel spec for IEEE802.3bj

It should be:

1. More accurate than previous methods and leave less margin on the table:
2. Allow tradeoffs between channel impairments
3. Minimize worst case piled on worst case.
4. Independent of specific Rx architecture which contains closely held IP.
5. Easy enough to implement so that it will actually get used.
6. Something that can be fully described in a spec of reasonable length.

It would be desirable if it also:

7. Allowed the Tx, channel, and Rx specs to be “closed”.
8. Provides useful insights into how a channel can be improved.
9. Was intuitively clear to most SI engineers.

Proposed method of specification to meet the goals:

Signal to noise ratio budget

The budget consists of:

1. Signal measure
2. Noise measure
3. Implementation margin

1. A signal measure: dibit response

a. It is the correct measure for an perfect DFE Rx with no linear equalization.
b. No one is really going to use a perfect DFE Rx with no linear equalization.
c. A perfect pure DFE is in some sense a nearly optimum receiver, so it reasonable to expect competitive receivers to perform somewhat like one in practice.
d. Dibit gain is close to but slightly smaller than pulse Gain.
e. Dibit gain is a little harder to compute than pulse gain but it is DC free and therefore less dependent on good extrapolation to DC.

1. A noise measure

a. ICN just like clause 85.
b. Treat ILD, a known problem but traditionally difficult to treat quantitatively, as an additional crosstalk like term.
c. Treat mismatch at channel-transmitter and channel-receiver interfaces as more crosstalk like terms.
   - This finally gives a rational basis for specifying receiver and transmitter return Loss.
d. The combination will be treated as Gaussian.

1. Fudge factors to:

   a. Account for various effects not included in the budget.
   b. Account for the difference between what is theoretically possible and what is technically feasible.
   c. Add margin to the spec

   These fudge factors will need to be determined empirically and refined over the period of spec development. The fudge factor so far presented are Implementation Noise Penalty and Implementation Amplitude Penalty.

Does the method meet the stated goals?

It should be:

1. More accurate than previous methods and leave less margin on the table:
    a. Allow tradeoffs between channel impairments
    b. Minimize worst case piled on worst case.

The budget method allows clearly understood tradeoffs between channel loss, channel ripple, and crosstalk. It does not assume that worst case ILD and worst case crosstalk occur together.

It should be:

1. Independent of some Rx architecture which contain closely held IP.

The perfect pure DFE model is used for justifying using dibit gain but since we do not expect any real receiver to fit that model the fudge factors will need to account for differences and will be unspecific as to what the difference is.

It should be:

1. Easy enough to implement so that it will actually get used.

The tool “qikSN” which embodies the S/N budget method is suitable for mass scanning of channels. I used it to produce the results shown later in this presentation.

It should be:

1. Something that can be fully described in a spec of reasonable length.

Others have been able to recreate, and even find bugs in, my simulations using just the contents of moore_01_0311.pdf. Adam Healey, our editor, is coauthor of moore_01_0311.pdf, he should be able to make the spec equally clear.

It would be desirable if it also:

1. Allowed the Tx, channel, and Rx specs to be “closed”.

   The channel Thru gain and total noise should be easy to coordinate with Rx interference tolerance spec thereby closing the spec.

It would be desirable if it also:

1. Provides useful insights into how a channel can be improved.

The S/N budget calculates the noise contribution due to: ILD, NEXT, FEXT, Tx re-reflection, Rx re-reflection, and Tx-Rx re-reflection providing insight into the penalties associated with design decisions.

It would be desirable if it also:

1. Was intuitively clear to most SI engineers.

The S/N budget works in mostly in the frequency domain where most SI engineers feel comfortable. Signal budgets are used in other communications specs.

Conclusion:

S/N budget would be an appropriate way of specifying channels for IEEE802.3bj