EVALUATION OF RANDOM JITTER DUE TO RIN

Presentation for

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EVALUATION OF RANDOM JITTER DUE TO RIN

- **High Transmitter jitter puts stress on receiver due to horizontal eye closure**
- **Draft Values for transmitter jitter to be studied**
- **DJ due to driver circuit and LASER behavior**
- **RJ due to transmit side noise**
  - RIN
  - Clock noise
  - Other sources?

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EVALUATION OF RANDOM JITTER DUE TO RIN

- Assumptions
  - 20% to 80% rise time of pulse is 30 ps (for 10 Gbit/s, 1 UI = 100 ps)
  - Power Spectral Density (PSD) of RIN is -125 dB/Hz (see Tables 52-9, 52-16, 52-23)
    - optical noise power relative to signal OMA
    - 1-sided PSD
  - Noise bandwidth = 7.5 GHz
- Based on first assumption, the 100% rise time is:
  - (100 / (80-20))(30 ps) = 50 ps = 0.5 UI
- RIN PSD in relative optical noise power per Hz is
  - $10^{-125/10}$ Hz^{-1} = 3.162 * 10^{-13} Hz^{-1}
- Therefore, total relative optical noise power is
  - (3.162 * 10^{-13} Hz^{-1})(7.5 * 10^{9} Hz) = 2.372 * 10^{-3}

EVALUATION OF RANDOM JITTER DUE TO RIN (Cont.)

- Electrical signal level is proportional to optical power level
  - Therefore, electrical amplitude relative noise is $2.372 * 10^{-3}$
- Bit slope is 0.5 UI for 100% amplitude variation
  - Therefore, above variation due to amplitude noise corresponds to variation in time of $(2.372 * 10^{-3})(0.5 \text{ UI}) = 1.186 * 10^{-3}$ UI
- Optical noise power was an average power measurement
  - Therefore, the above jitter is is an average phase variation (average positive minus average absolute value of negative)
  - This variation occurs on each of the bit slopes (i.e., bit slope between current and preceding bit and between current an succeeding bit)
  - Therefore total average positive jitter minus average absolute value of negative jitter is twice the above value, or $2.372 * 10^{-3}$ UI
  - Multiply by 1/2 to get average absolute value of jitter, or $1.186 * 10^{-3}$ UI
    - This is approximately equal to the RMS jitter

EVALUATION OF RANDOM JITTER DUE TO RIN (Cont.)

- RMS jitter due to RIN = (approximately) 1.186 * 10^{-3} UIrms = (approximately) 0.0012 UIrms
- This is small compared to the RJ in Table 52-28 for the BERT mask, of 0.015 UIrms
  - smaller by more than a factor of 10

CONCLUSION OPEN ISSUES FOR RANDOM JITTER VALUES

- RMS jitter due to RIN smaller by more than a factor of 10 than the value current in the draft
- High Jitter generation places additional stress on Receiver

Issues to be solved

- Other RMS jitter source contribution to be investigated
  - Clock noise: What would be an appropriate clock quality definition
  - Other sources of RJ ??
    Is DJ generated by random signal RJ or DJ?