

Considering all Noise Sources over a single data and
power pair
IEEE802.3bp Task Force
Channel Definition ad-hoc

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Yair Darshan, Microsemi
ydarshan@microsemi.com



Objectives

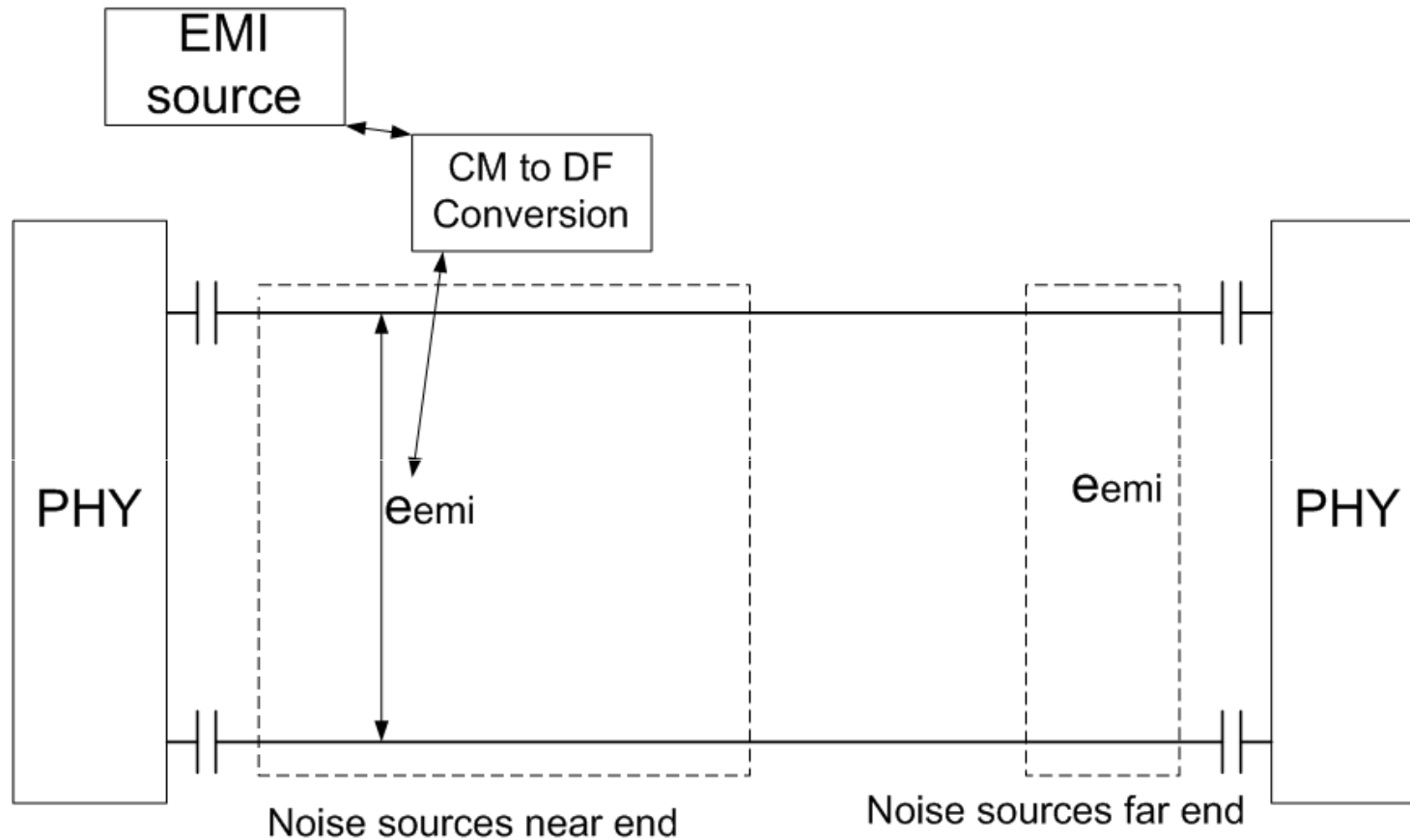
- To ensure that we cover all potential noise sources over the data pair for specifying the total differential maximum noise over the data pair.

$e_n(f)$ = Maximum Noise Vs Frequency Requirement



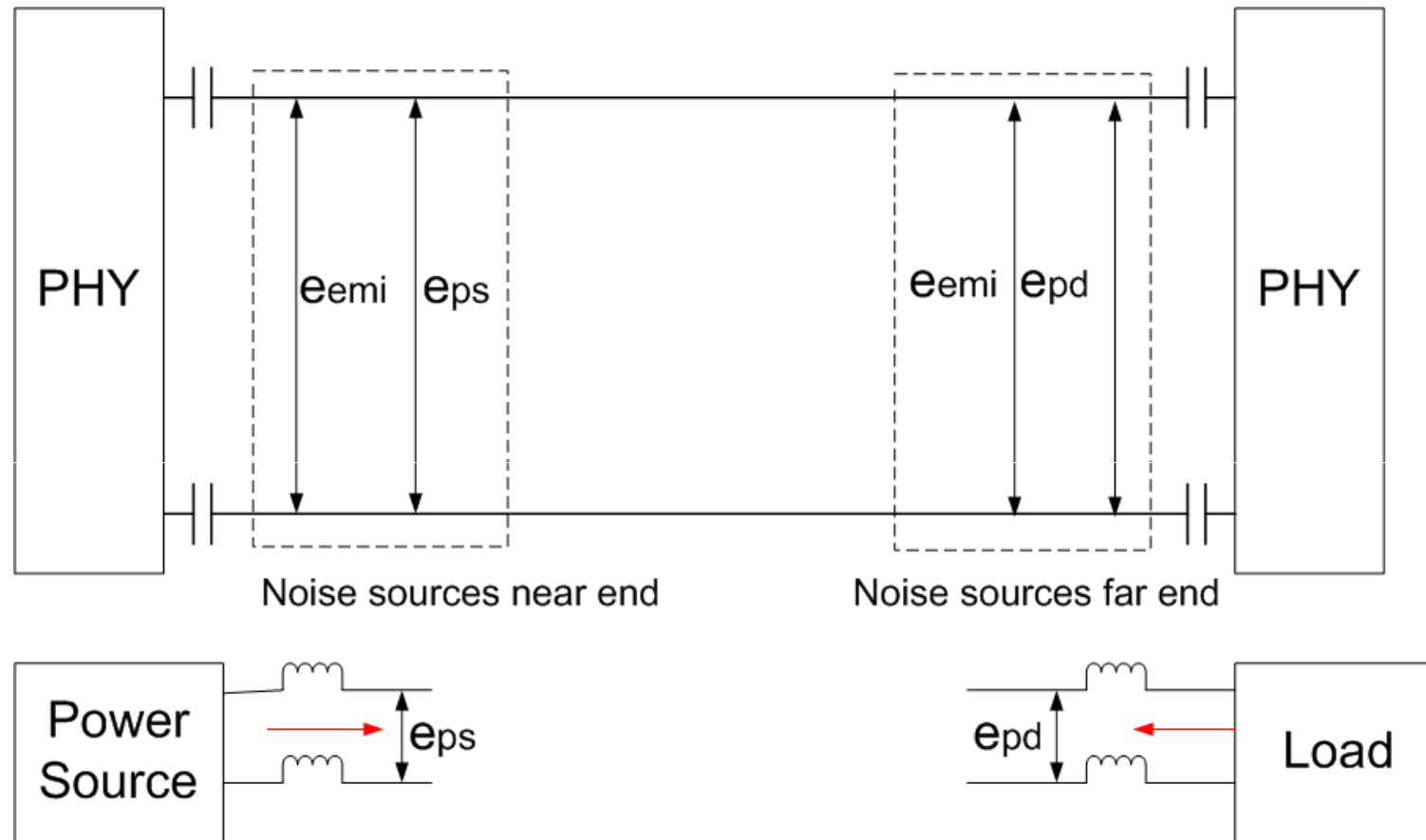
- *We need to know the maximum rms noise. e_n as function of frequency in which data specification is met.*

EMI noise source



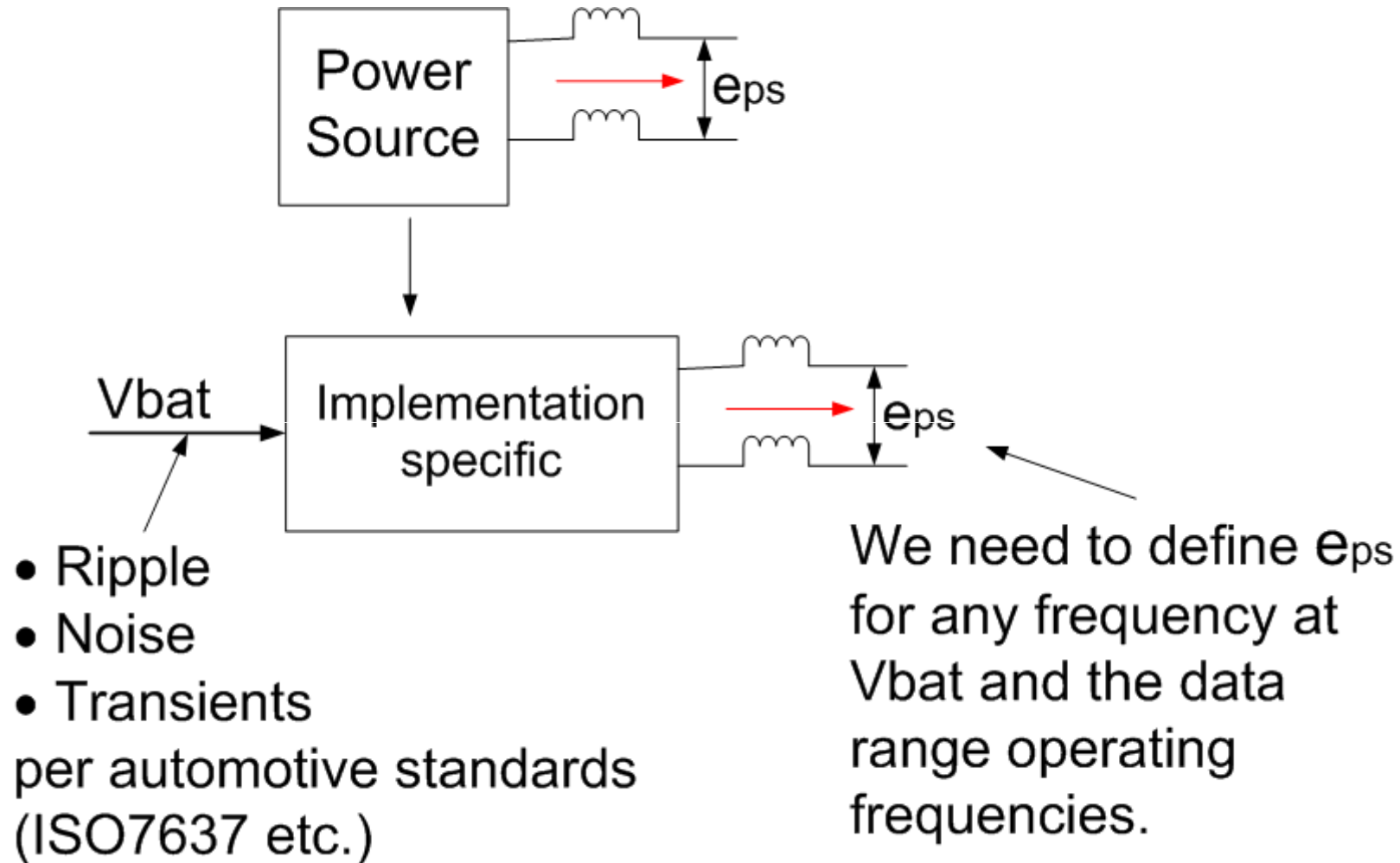
- EMI is one of the noise sources that generate DM noise

Power source and load noise sources

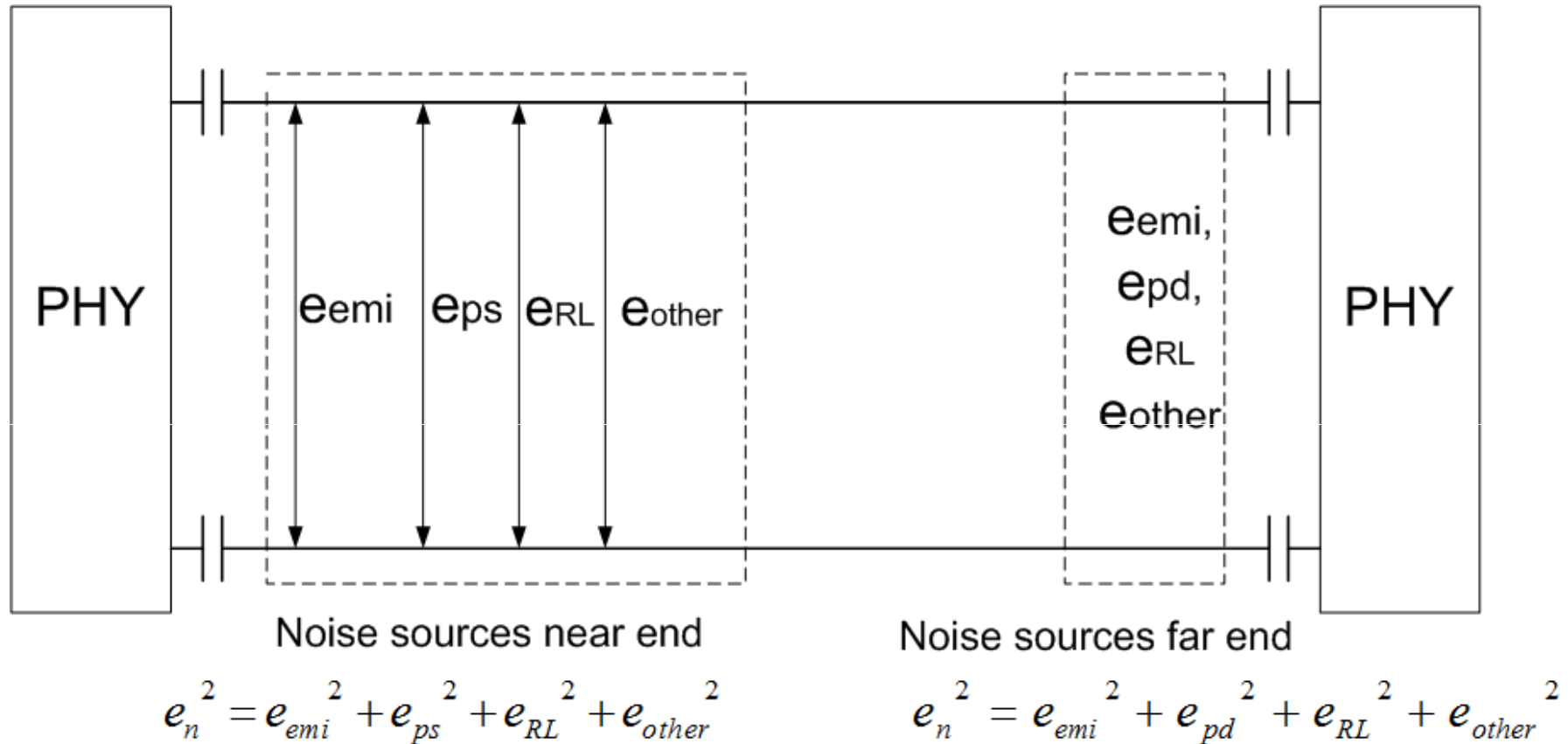


- If power is delivered over the same data pair, we have additional noise sources at near end (power supply noise) and far end (load noise e.g. DC/DC converter noise)

More about Power Source Noise



Proposed general case for noise sources



- e_{RL} is the noise generated by the return loss during transmission.
- e_{other} is other noise sources that we may add to the list including design margin

Working assumption

- e_{emi} on both ends is the same quantity
 - e_{other} is unknown noise source or a design margin
 - e_{ps} and e_{pd} are independent noise sources
 - e_{RL} on both sides is the same quantity
 - As a result:
 - Total Worst Case Noise on each end is (*): $e_n^2 \geq e_{emi}^2 + e_{ps}^2 + e_{pd}^2 + e_{RL}^2 + 2 \cdot e_{other}^2$
 - Assuming all sources have the same weight: $e_n^2 \geq 6 \cdot e^2$
 - The upper limit spec. for each noise source as function of frequency:
$$e_{rms}(f) \leq \frac{e_n(f)}{\sqrt{6}} = 0.4 \cdot e_n(f)$$
 - Which is ~7.8dB below e_n .
- (*) If there is more noise sources the model above can be extended accordingly)

More about the evaluation of spec limits

- There are other ways to plug in the design margin. Probably different ways will generate a bit different results.
- Without design margin, due to 4 known noise sources, the total noise with the same working assumptions shown previously will be:

$$e_n^2 \geq e_{emi}^2 + e_{ps}^2 + e_{pd}^2 + e_{RL}^2 = 4 \cdot e^2$$

- The upper limit spec. for each noise source as function of frequency:

$$e_{rms}(f) \leq \frac{e_n(f)}{\sqrt{4}} = 0.5 \cdot e_n(f)$$

- This is ~6dB below e_n . (not including design margin)
- The general case for the upper limit of a noise source of a list of S noise sources:

- $$e_{rms}(f) \leq \frac{e_n(f)}{\sqrt{S}}$$

Summary

- There are additional noise sources that are needed to be considered when noise limits are defined for $\mathbf{e}_{emi}(f)$ or any other noise source.
- When total $\mathbf{e}_n(f)$ is known, any noise source $\mathbf{e}_i(f)$ need to meet: $\mathbf{e}_i(f) < \mathbf{e}_n(f)$ by at least $-10 \cdot \log(S)$ [dB] for any noise source i , from a list of $i=1$ to S noise sources assuming all noise sources are given the same weight/importance ratio.

Proposed next steps

- To get $E_n(f)$ test data that ensures meeting data requirements over the specified channel.
- To generate a list of all known noise sources
- To derive the spec values for each noise source.
- It is highly practical from power source and load point of view, to define a detailed table of differential noise per frequency over the frequency range of interest.
- It is important to define the noise also for low frequencies outside the transmitting range e.g. from 1-2Hz to 1-10MHz. It will allow more flexibility and cost effective power source when power over data will be implemented.

Discussion



Thank You