Skew … The Rest of the Story
SCMR (signal to common mode ratio) for Channel

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December 7, 2023

Goal

- ❑ Explore the applicability of limiting skew to IEEE802.3dj standards
  - Skew has been a recurrent question for IEEE802.3dj presentations
- ❑ Segue the skew issue into common mode specifications borrowing from IEEE802.3ck

Agenda

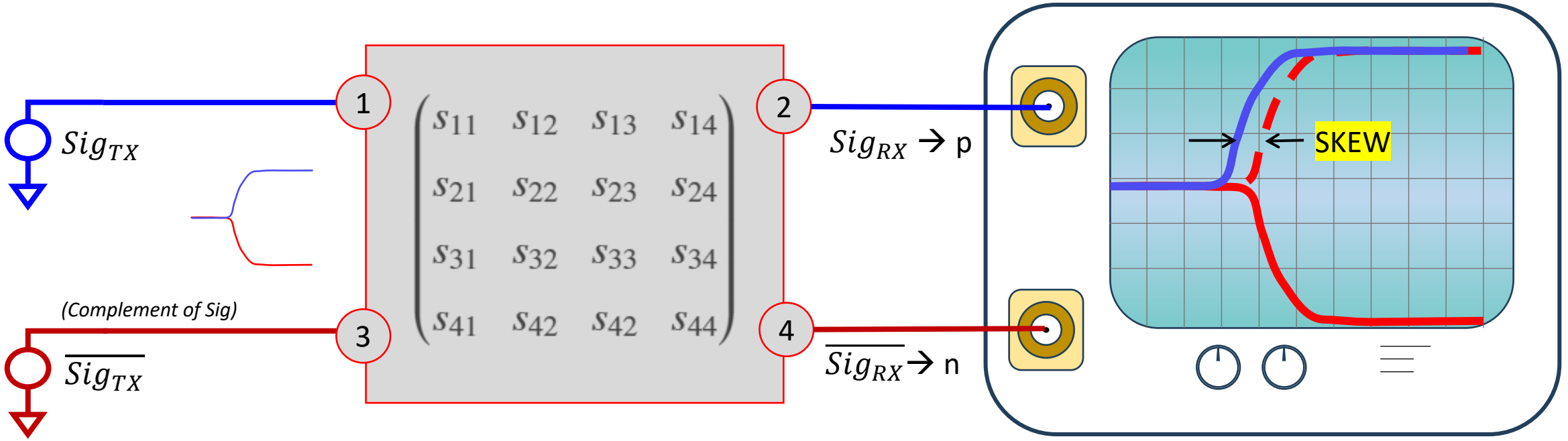
- ❑ Common perception about skew
- ❑ What do skew signal look like
  - In the context of differential signaling
- ❑ Measuring skew
- ❑ Measuring SCMR and VCM_{ch} for a channel
- ❑ Skew, SCMR, and performance examples
- ❑ Summary and recommendations

At some level, skew may be viewed like a race

But… let’s look a this a bit more technically

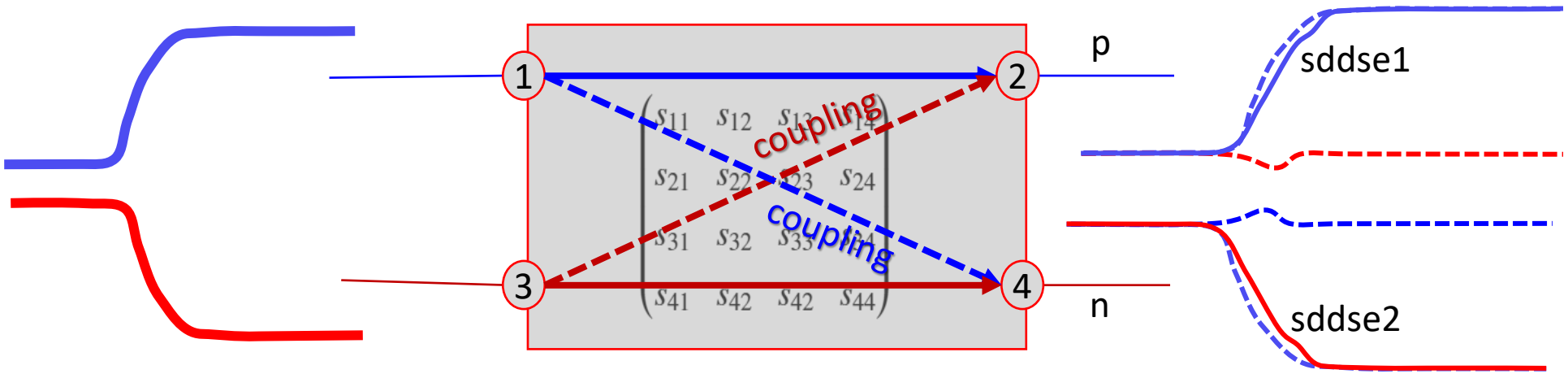
A simple way of looking at skew for differential signaling

Consider delay between a signal and it's complement



Differential Step to Single Ended Step Responses

INCLUDING THE COUPLING ARE ONE WAY TO VIEW SKEW



The differential insertion loss response is represented with the following equation,

$$sdd21 = \frac{(s21 + s43 - (s23 + s41)}{2}$$

Where port 1 and 3 are inputs and 2 and 4 are outputs of a 4-port s parameter.

SR ~ step response

Assign differential to single ended responses sdds121 and sddse221 as follows:

$\text{sddse1} = \frac{(s21 - s23)}{2}$ and $\text{sddse2} = \frac{(s43 - s41)}{2}$

such that

$$sdd21 = \text{sddse1} + \text{sddse2}$$

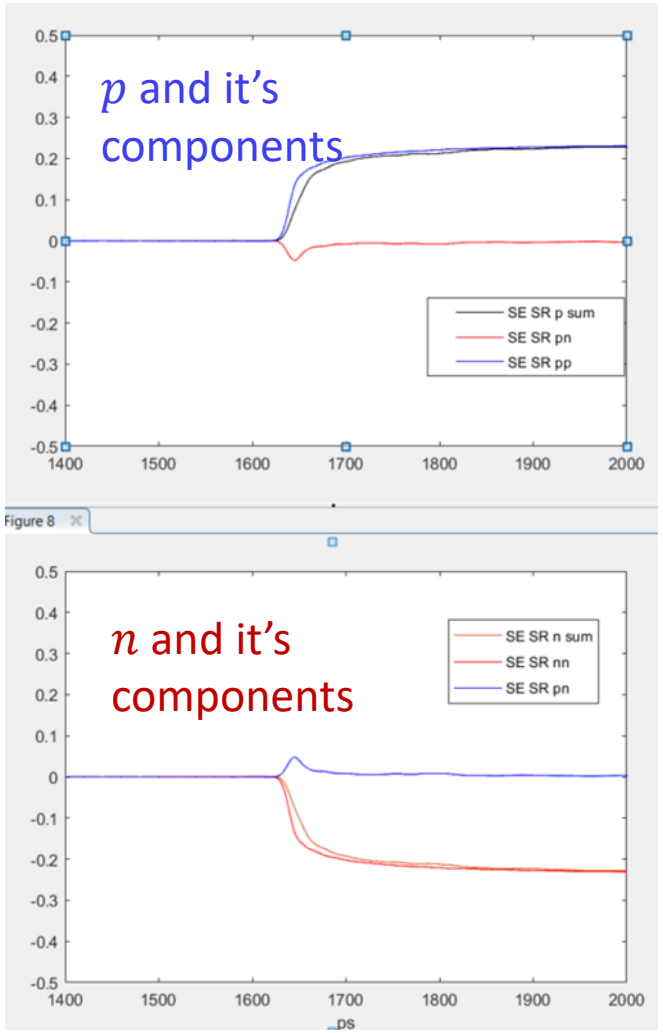
Equations are the same in the time or frequency domain

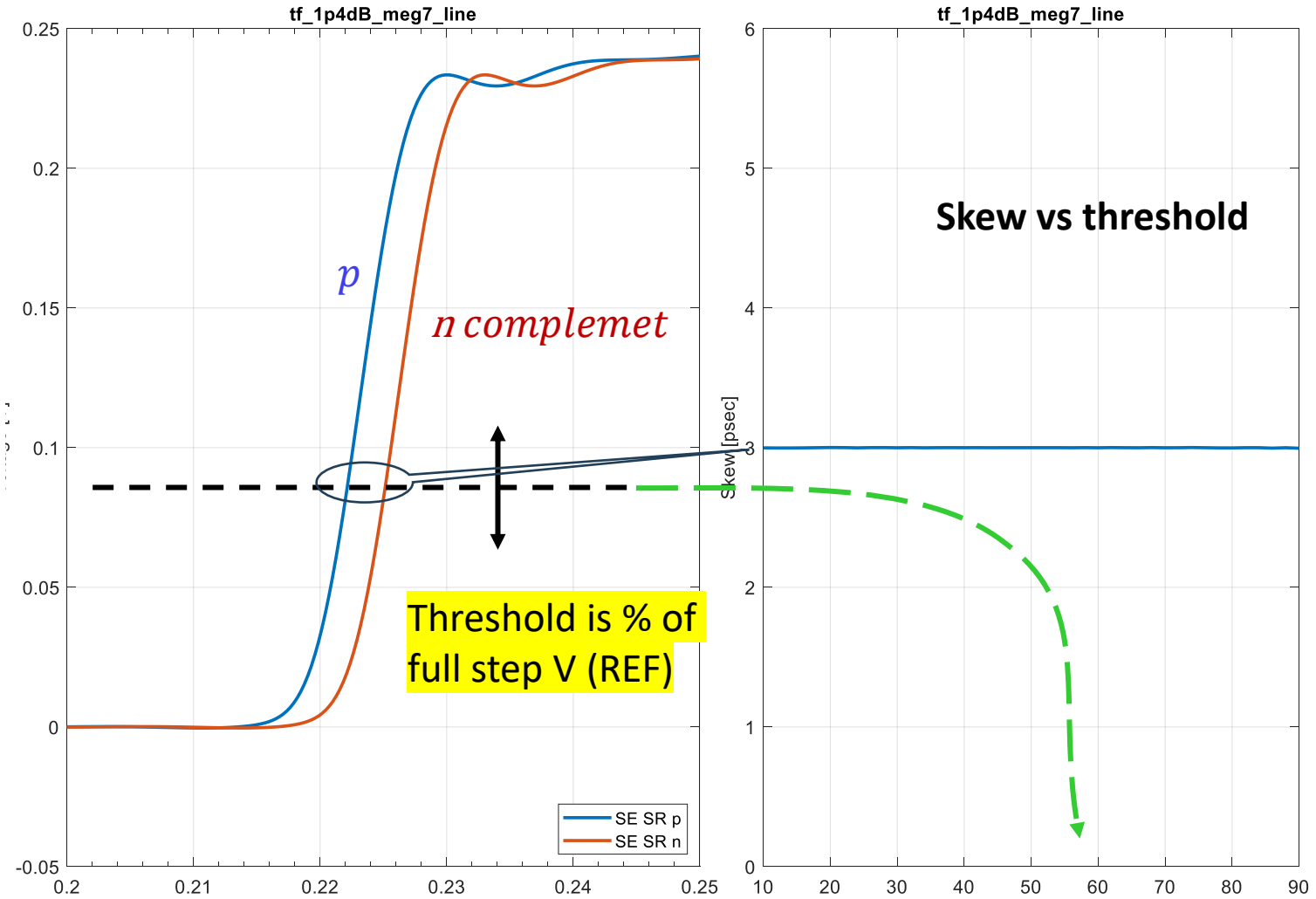
$$SR(sdd21) = \text{SR(sddse1)} + \text{SR(sddse2)}$$

- **Skew measurements for differential applications are measured between sddse1 and sddse2 and**
- **NOT between s21 and s43**

Graphical view of skew use n complement

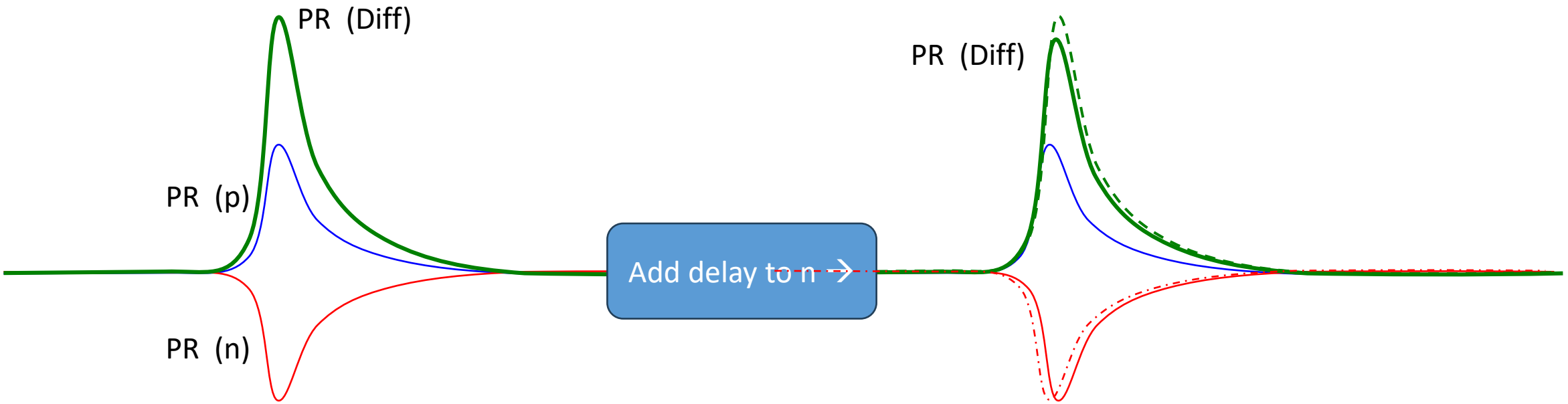
STEP RESPONSES OF 60 MILS OF LIGHTLY COUPLED MEG7 TRANSMISSION LINE





Skew can increase differential loss

RESULTING IN A PULSE PEAK REDUCTION AND SIGNAL LOSS



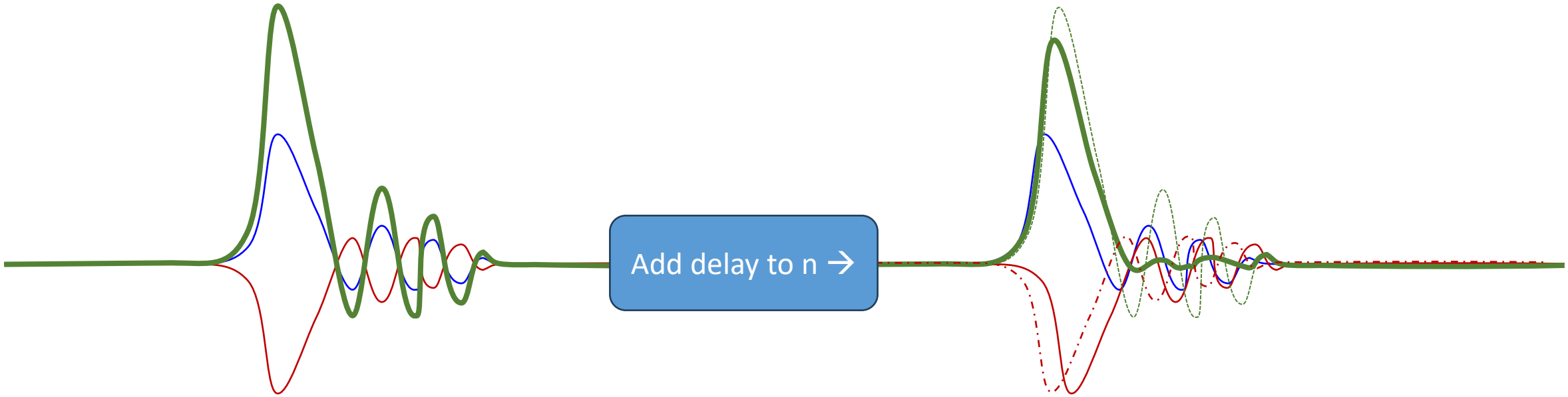
Skew effects ISI as well

CONSTRUCTIVE OR DESTRUCTIVE … IT DEPENDS

- This skew causes pulse loss

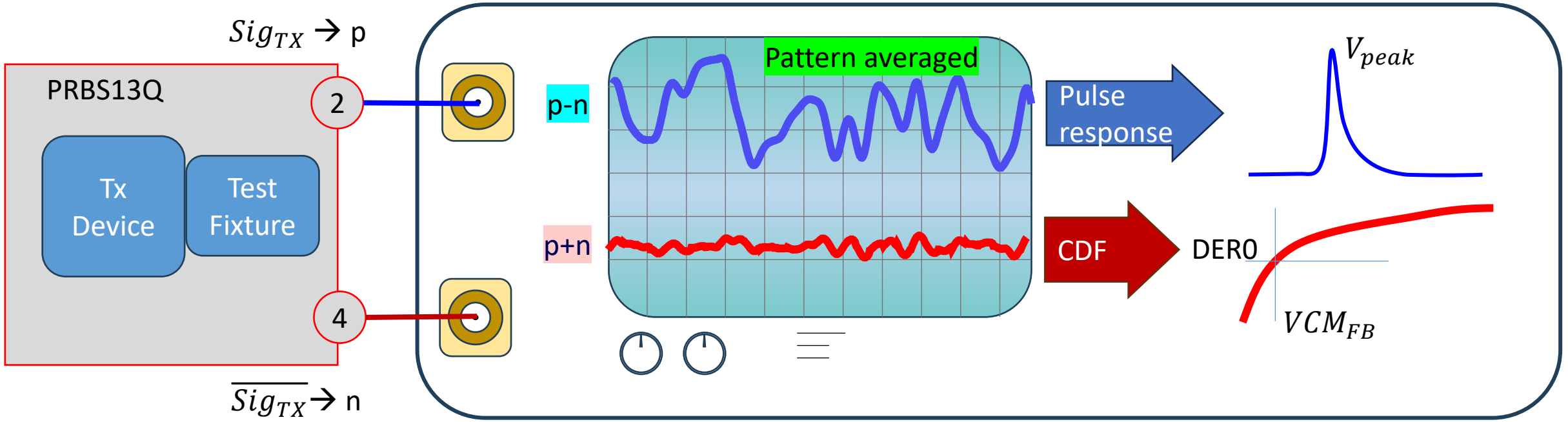
But …

- There may also be reduction in ISI or an increase in SNR
  - Or visa versa



SCMR has been specified in IEEE802.3ck

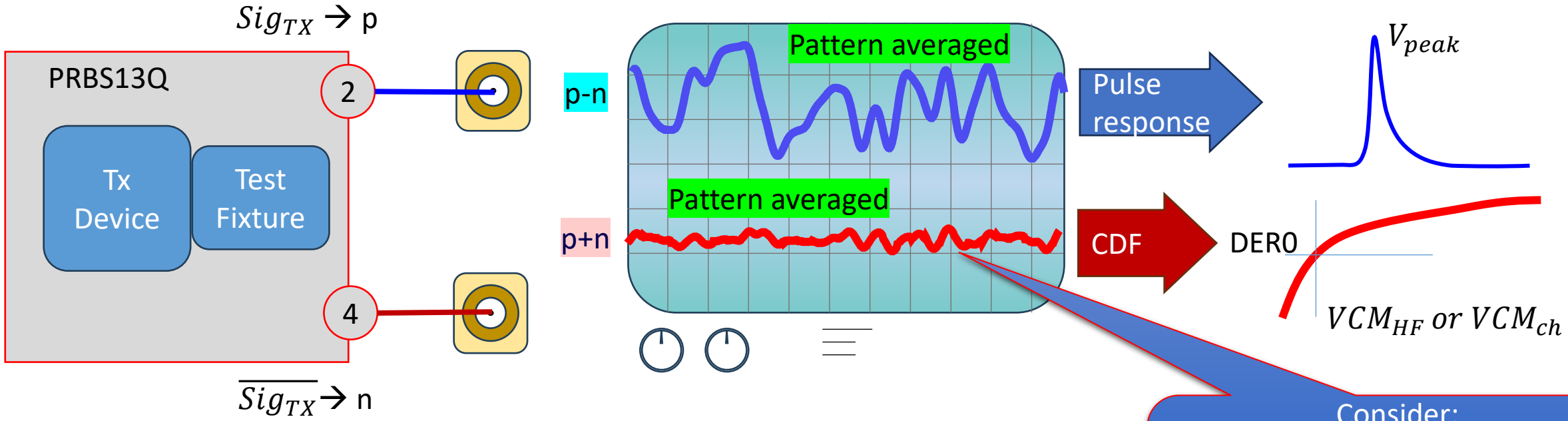
Signal to common mode ratio



$$SCMR = 20log10\left(\frac{V_{peak}}{VCM_{FB}}\right)$$

Apply SCMR to a Channel

Averaging can highlight skew

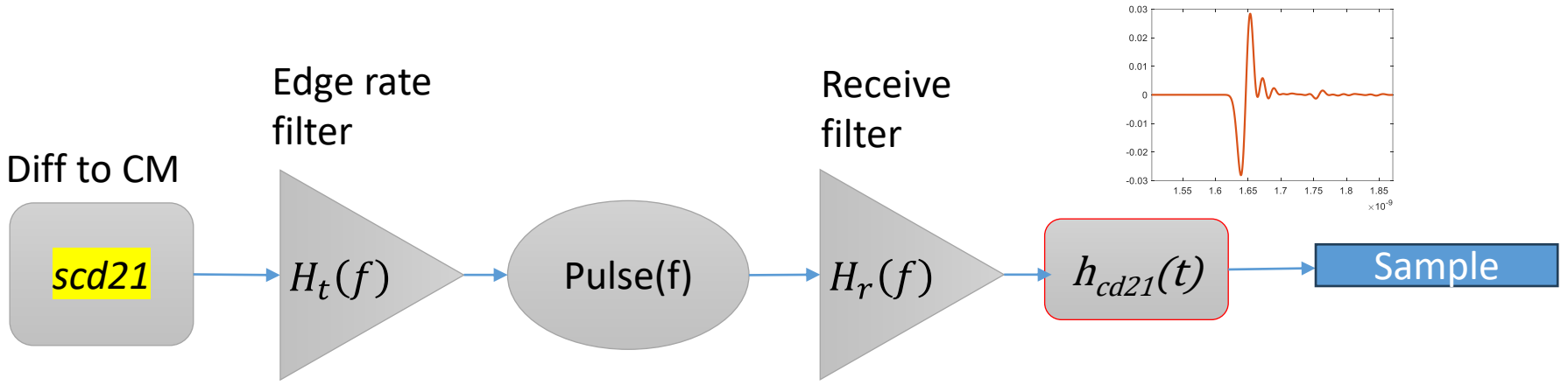


$$SCMR_{channel} = 20log10\left(\frac{V_{peak}}{VCM_{HF}}\right)$$

Consider:
A pattern averaged CM voltage
For a channel metric
The CM CDF is extracted from the
Scd21 pulse response

SCMR Procedure for a Channel

using pulse response from SCD21

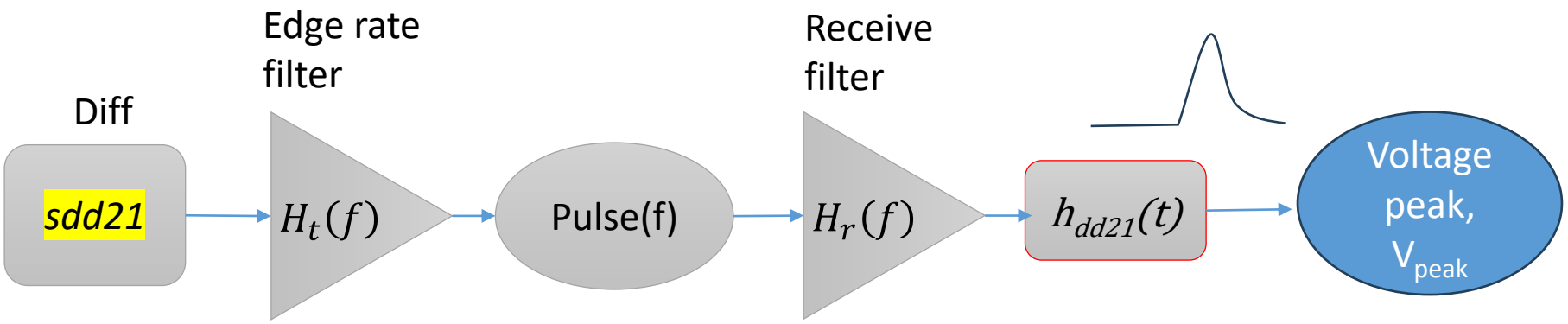


UI Subsample set 1

UI Subsample set 2

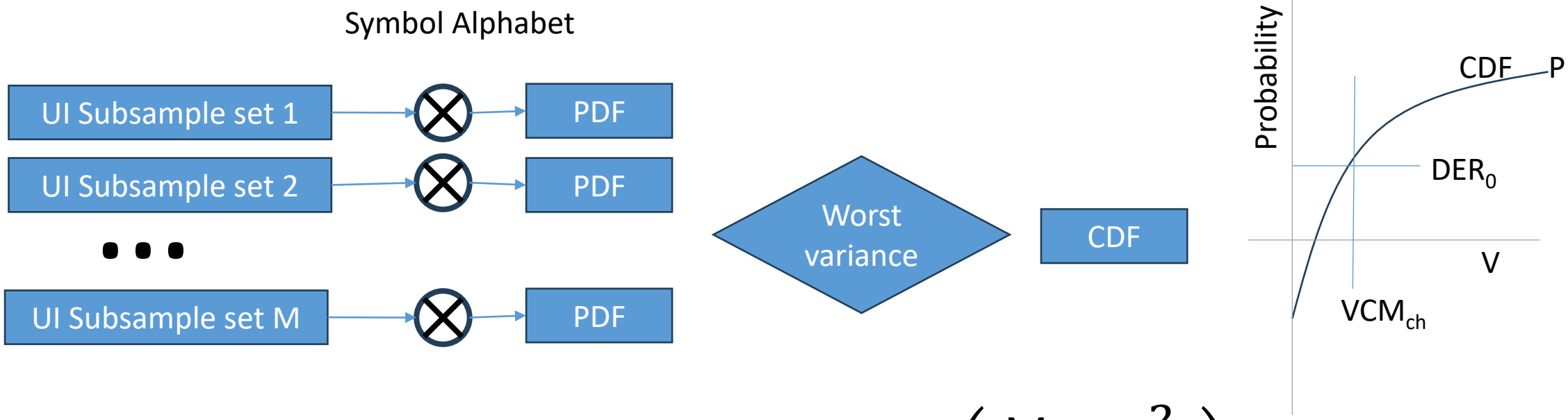
• • •

UI Subsample set M



Compute $SCMR_{ch}$

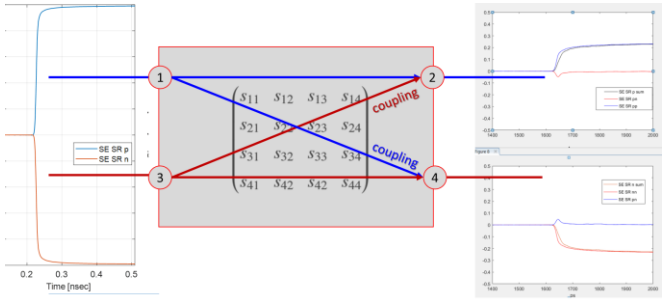
Determining VCM_{ch} voltage in process similar to determine ERL



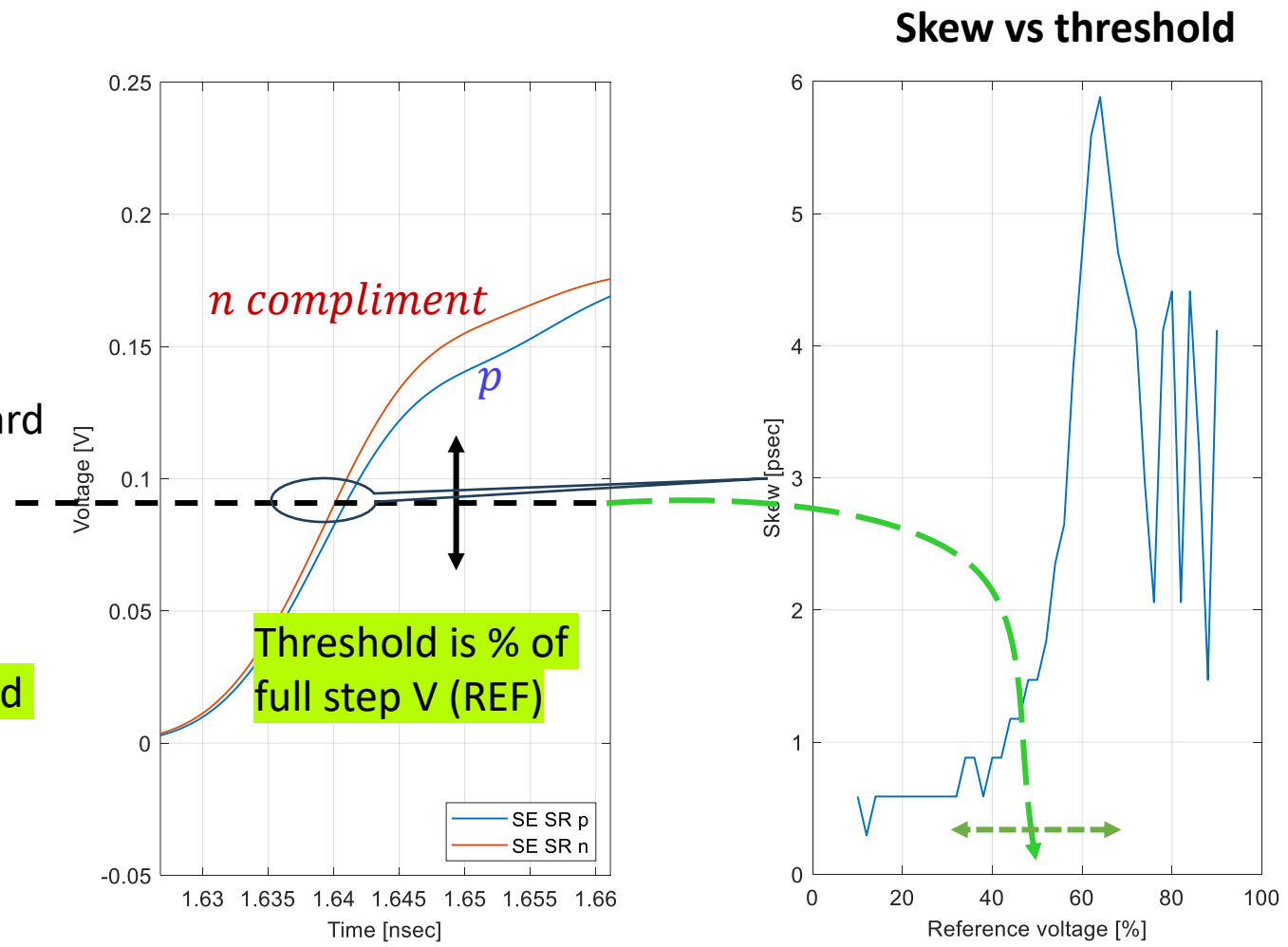
$$SCMR_{ch} = 10 * log10\left(\frac{V_{peak}{}^2}{VCM_{ch}{}^2}\right)$$

Shapes of skew responses are not all the same

THIS IS THE SHAPE OF A POSTED TWINAXIAL MODEL



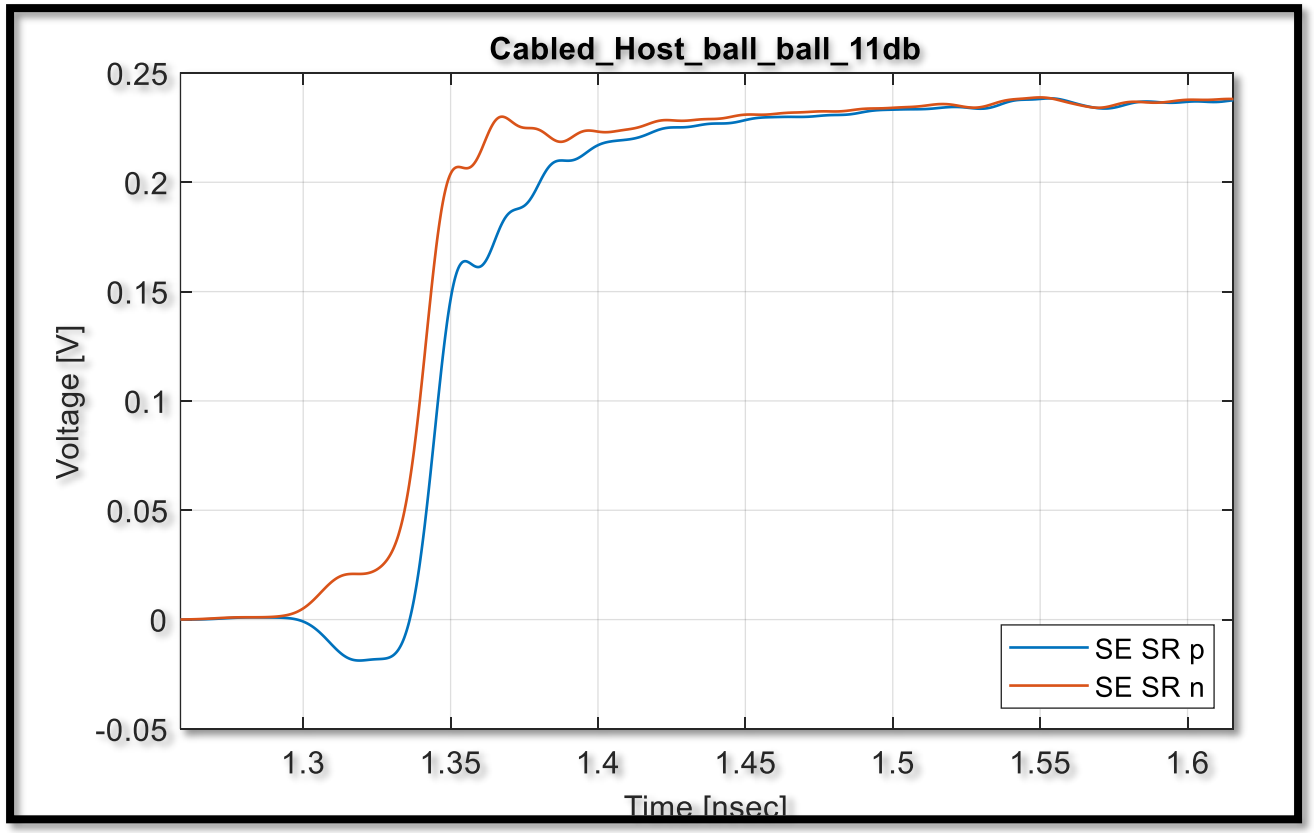
- The resultant delay is not as straight forward as simple delay
- Coupling can affect some skew
- Skew varies quite bit for different threshold choices



Use channel with skew for next slide

Example of channel with skew: **kareti_3dj_02_2309**

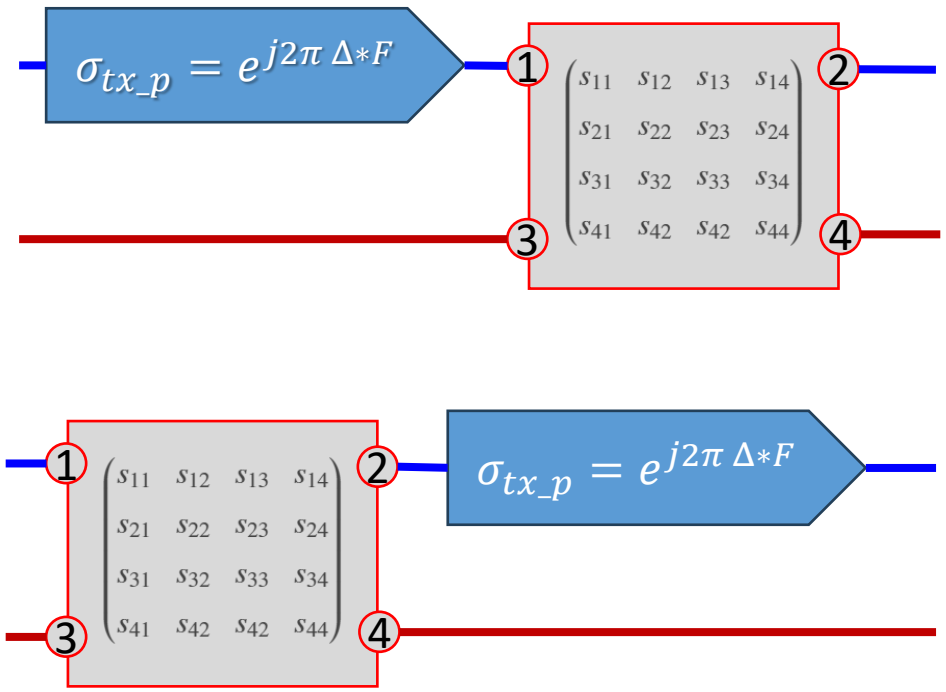
Cabled_Host_ball_ball_11db

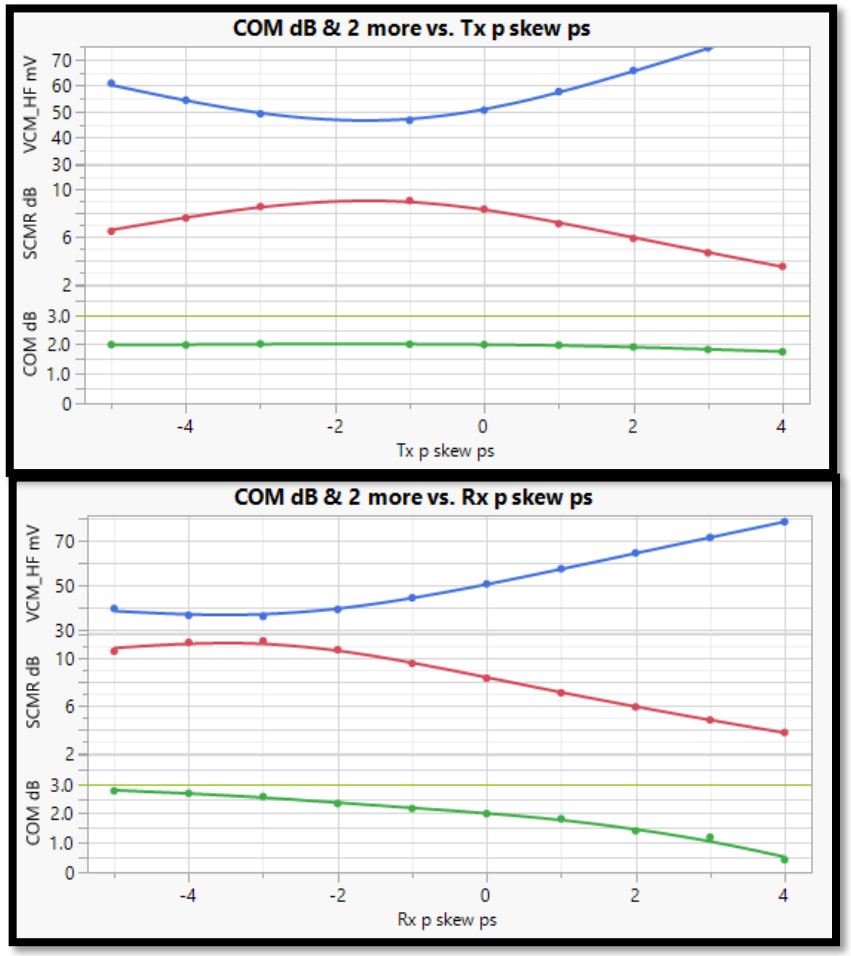


Skew is not a Communitive Property

Delay (skew) vs COM $SCMR_{HF}$ and VCM_{HF}

- A skew budgets can overestimate or underestimate the effect of channel with different skews (Δ)





Summary and recommendations

- Skew may be detrimental to performance
- The nature of skew varies from channel to channel
- Skew budgets may be overkill
- $SCMR_{CH}$ for channels may be useful analyzing skew impacts
- Future work is required to determine which skew problem we wish to solve
  - And to investigate subsequent unintended consequences

Thank You!