Next Steps for COM (Channel Operating Margin)

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Agenda

- ❑ Preface
- ❑ Review COM and Pulse Responses
- ❑ COM Reference Model with Rx_{FFE}[i]
- ❑ Discussion for Rx_{FFE} in Annex 93A (COM)
- ❑ Optimization of Rx_{FFE}
- ❑ Straw poll

[i] *Rx_{FFE} – Receiver Feed Forward Equalizer*

Preface

- ❑ Numerous presentations (healey_3dj_01_2305, shakiba_3dj_01_230223, etc) discuss using MLSE[ii] with COM
- ❑ A common theme was that the use of MLSE in COM requires the addition a Rx_{FFE}
- ❑ Inclusion of Rx_{FFE} into COM is a first step for specifying MLSE for COM
- ❑ This contribution will focus on these first steps for the RX_{FFE}
  - More details on the RX_{FFE} implementation, assumptions, configuration, etc will be provided in the near future

[ii]*MLSE – Maximum Likelihood Sequence Estimation*

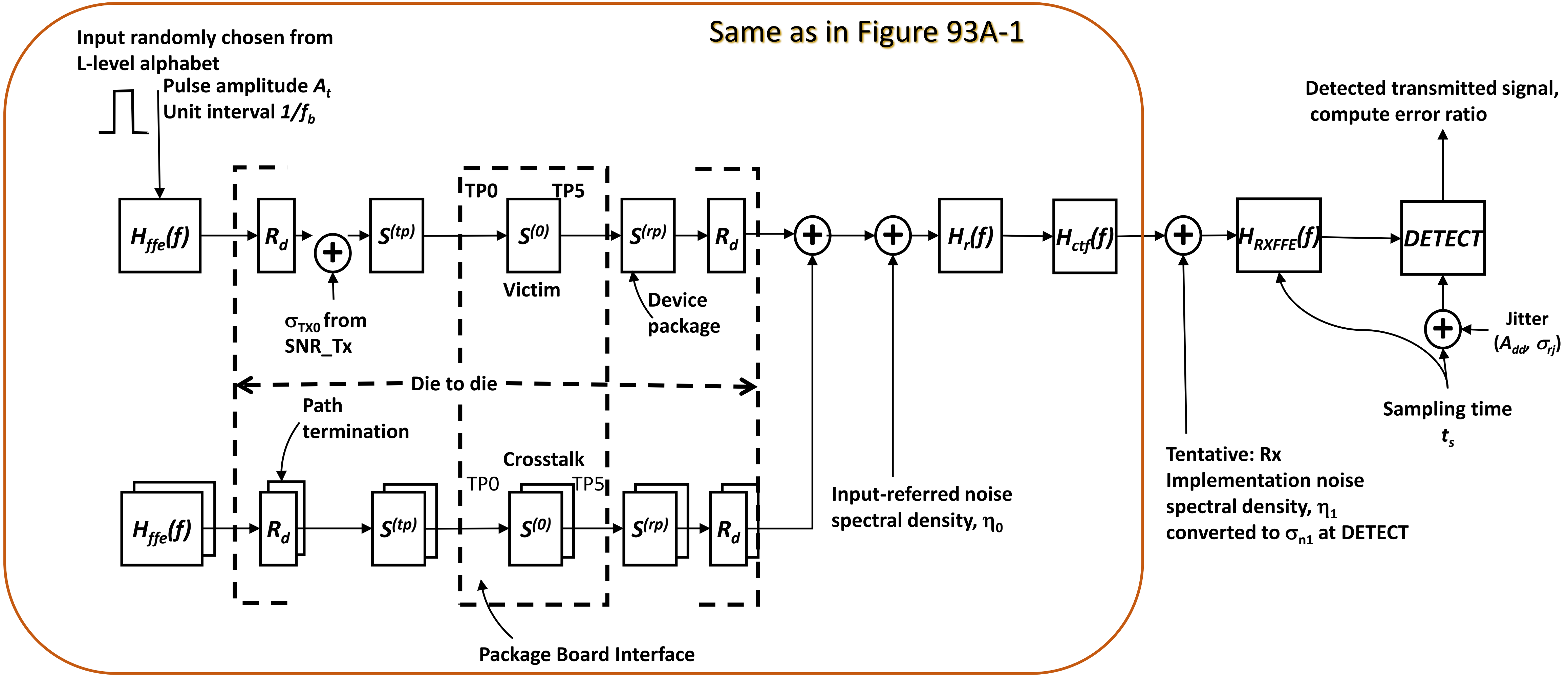
High level Review of COM

THE RELATION BETWEEN COM AND PULSE RESPONSES (ANNEX 93A)

- COM (Channel Operating Margin) is computed from equalized pulse responses
  - And other parameters
  - Derived from differential channel s-parameters
- Thru (ISI) channel response is $h^{(0)}(t)$ i.e., the pulse response, PR
  - The pulse response $h^{(k)}(t)$ is derived from the voltage transfer function $H^{(k)}(f)$ (see 93A.1.4) using Equation (93A-24)
    - $h^{(k)}(t) = \int_{-\infty}^{\infty} X(f) H^{(k)}(f)\ \exp(j2\pi f t)\, dt$ (93A-24)
      - Where: $X(f) = A_t T_b sinc(f T_b)$, $Tb = 1/fb$ and A_t is a path transmitter amplitude

Example COM Reference Model with RX_{FFE}

FOR CONSIDERATION



Key Changes for Rx_{FFE} in Annex 93A (COM)

- Consider an update to the COM reference model, figure 93A-1
  - See slide 6
- Provide for implementation noise, η_1
- Include another term, $H_{rxffe}(f)$, the receiver FFE response, into the voltage transfer function, $H^{(k)}(f)$
  - $H^{(k)}(f) = Hffe(f)\, H_t(f)\, H_{21}{}^{(k)}(f)\, Hr(f)\, Hctf(f)\, H_{rxffe}(f)$
- Provide a receiver equalizer description like the transmitter equalizer in sub-section 93A.1.4.2 .
- Reuse the specified COM FOM for the determination of the variable equalizer parameters settings

An Optimization of Rx_{FFE}

- Consider including σ_{N1} in FOM equation (93A-36)
  - $FOM = 10\ log10\left(\frac{A_S^2}{\sigma_{TX}^2+\sigma_{ISI}^2+\sigma_J^2+\sigma_{XT}^2+\sigma_N^2+\sigma_{N1}^2}\right)$
  - This represents an aggregate of additional noise due to ADC and DSP
  - Proposals are in development and forthcoming soon
- Compute the pulse response $h_{(0)}^{(k)}(t)$ of signal path k for a given c(–3), c(–2), c(–1), c(1), g_{DC}, and g_{DC2} using the procedure defined in 93A.1.5.
  - If Rx_{ffe} is not called out in the referring section, $H_{rxffe}(f) = 1$
  - If Rx_{ffe} is called out in the referring section, FOM is computed using $h^{(k)}(t)$
    - While refining the sample point (t_s) between $\pm\frac{T_b}{2}$
    - For a specified number or pre and post cursor taps
  - Discussion and review are needed

Summary

- Several changes to COM are needed to support the RX_{FFE} functionality
- An example reference model for consideration was provided
- Reviewed the key changes for COM to use an RX_{FFE}
  - Providing a path forward to MLSE
- Optimization steps, including the sample point, will be brought forward soon

Thank You!

Straw Poll

I would support the direction of the RXFFE changes to Annex 93A (COM) on slides 6, 7, and 8

a) Yes
b) No
c) NMI
d) Abstain