

# IEEE802.3ap

## TX and RX Return Loss Simulations and Proposals for KX, KX4, KR Specifications

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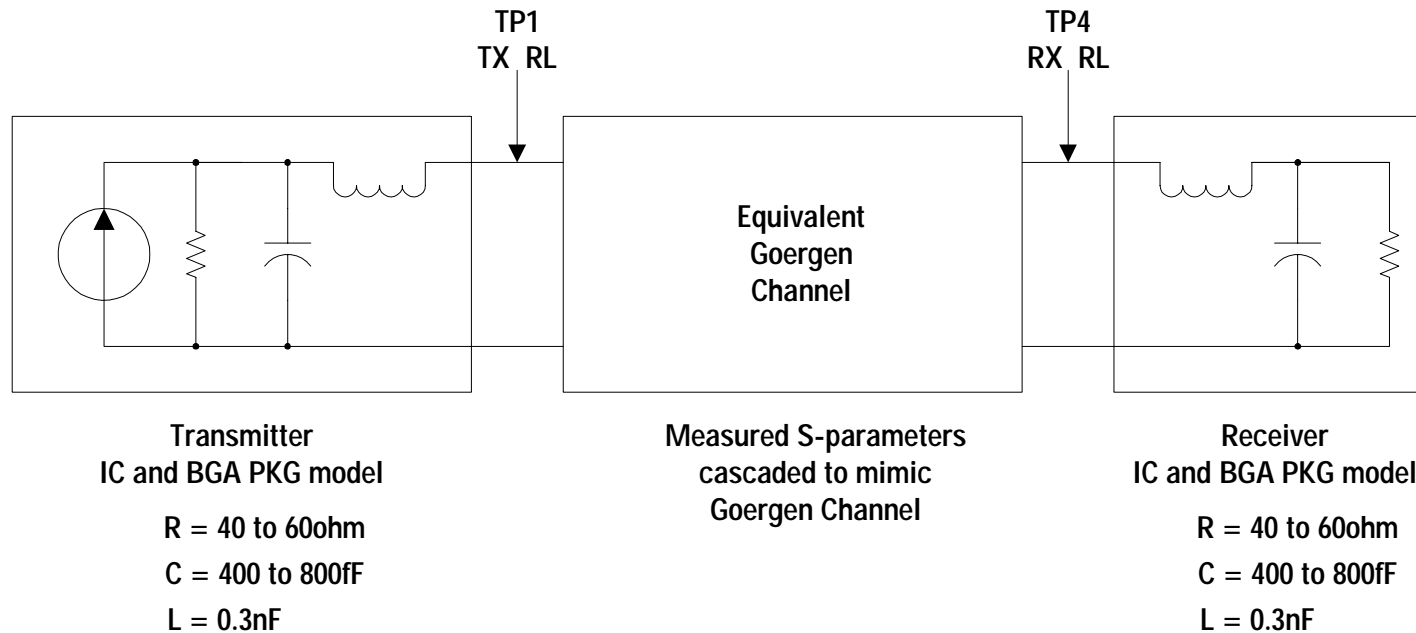
# Objective

Perform appropriate simulations on realistic package and channel models to complete the return loss specifications for the TX and RX on 10GBASE-KX, KX4, and KR port types.

- Define models and simulation parameters
- Review Results
- Conclusion and Proposal



# Simulation Models



These are simplified representative circuits. Actual simulations were performed with differential circuits

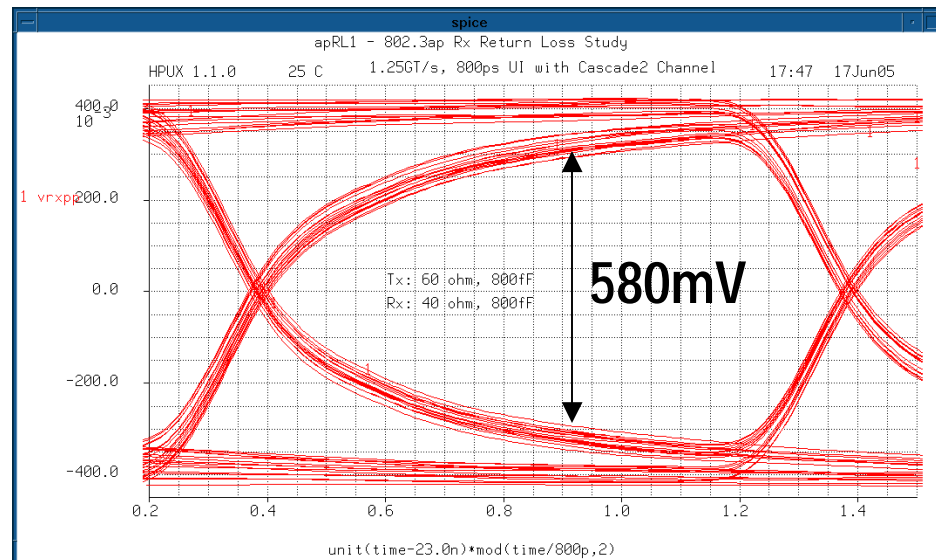
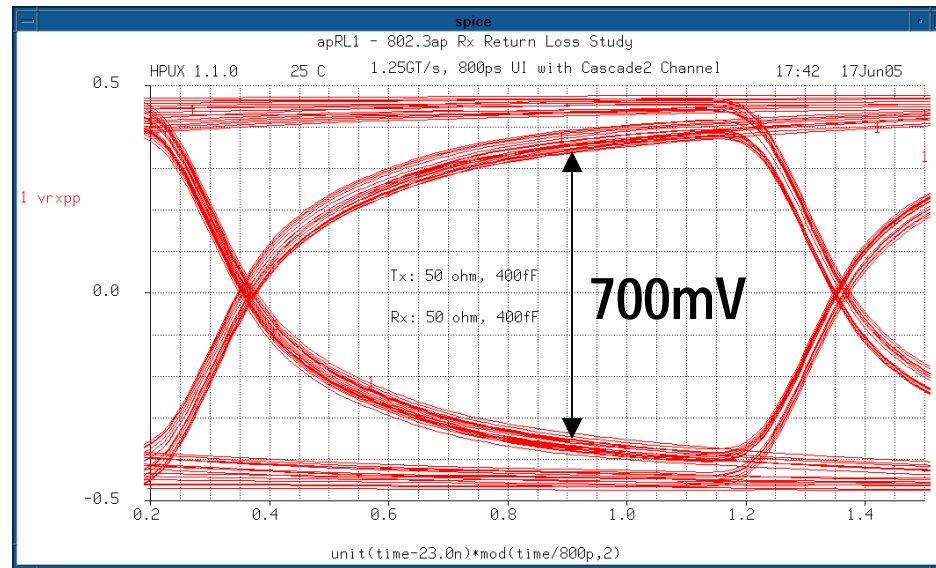
NOTE: model similar to WONG\_01\_0504 with updated values for R,L,C and channel

1. R and C were varied independently on TX and RX to uncover worse case combination for each data rate (1.25, 3.125, and 10.3125Gbps).
2. Eye diagrams and Return Loss were plotted



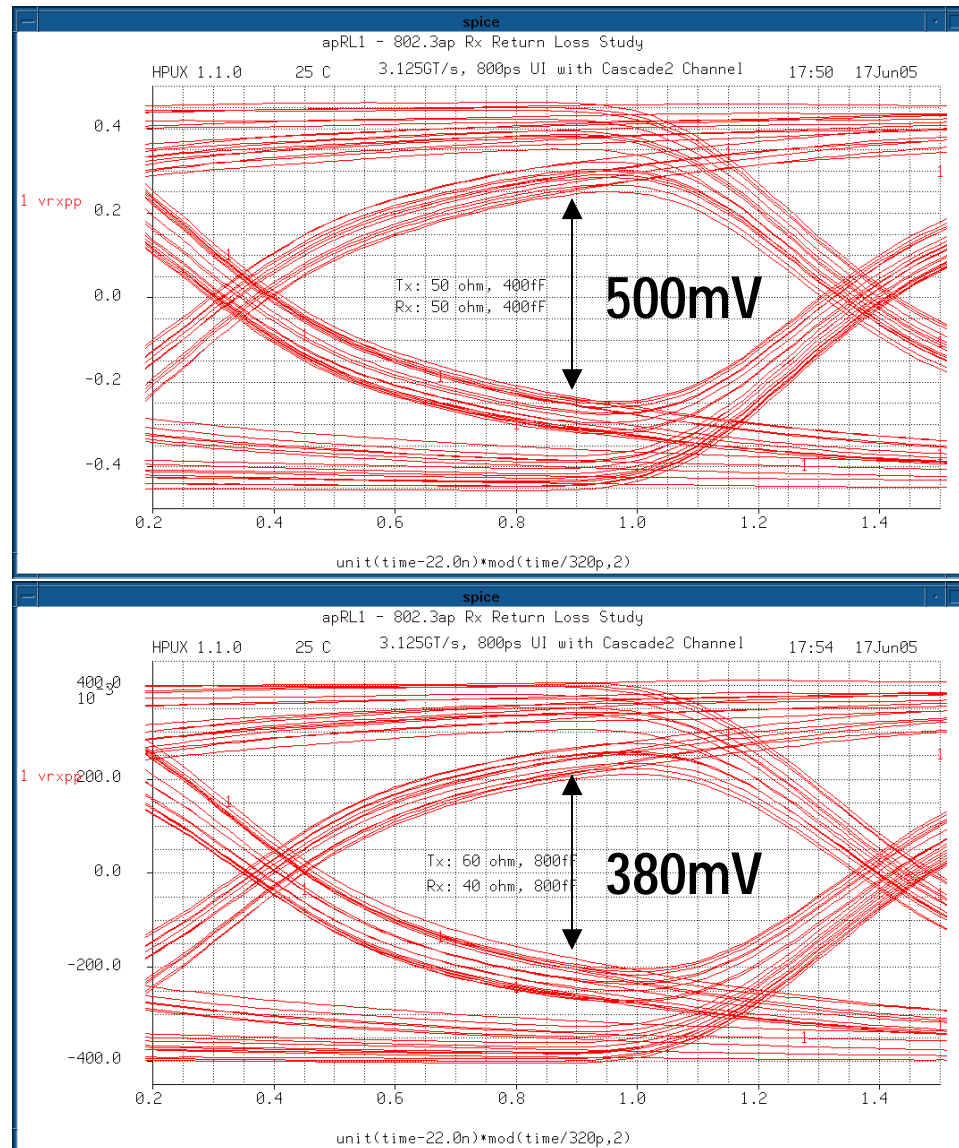
# Eye Diagrams

## 10GBASE-KX (1.25Gbps)



# Eye Diagrams

## 10GBASE-KX4 (3.125Gbps)

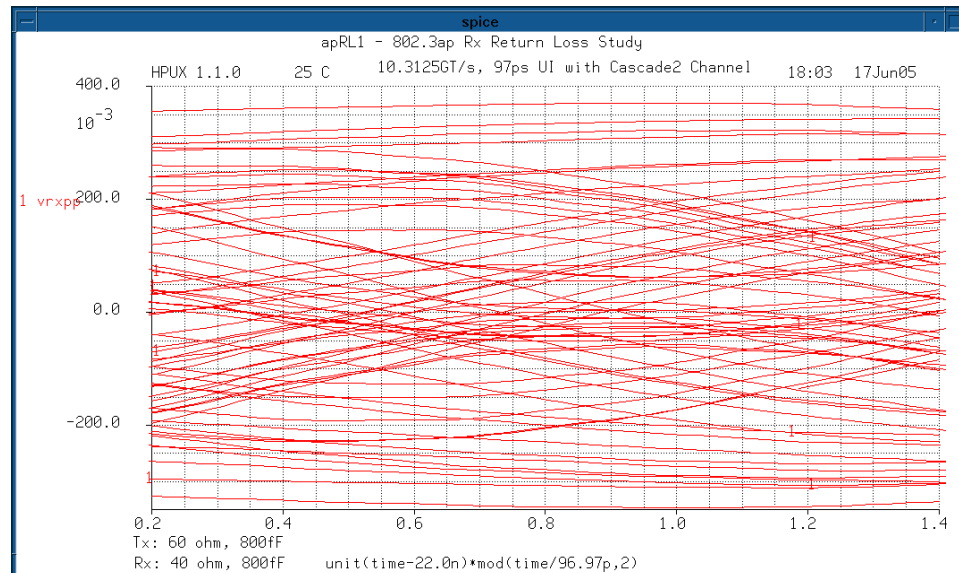
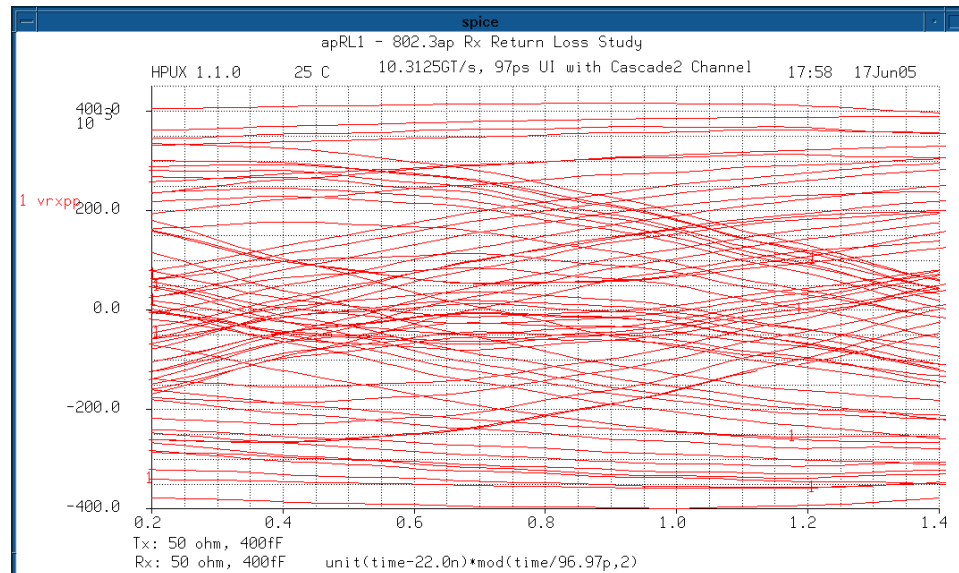


# Eye Diagrams

## 10GBASE-KR (10.3125Gbps)

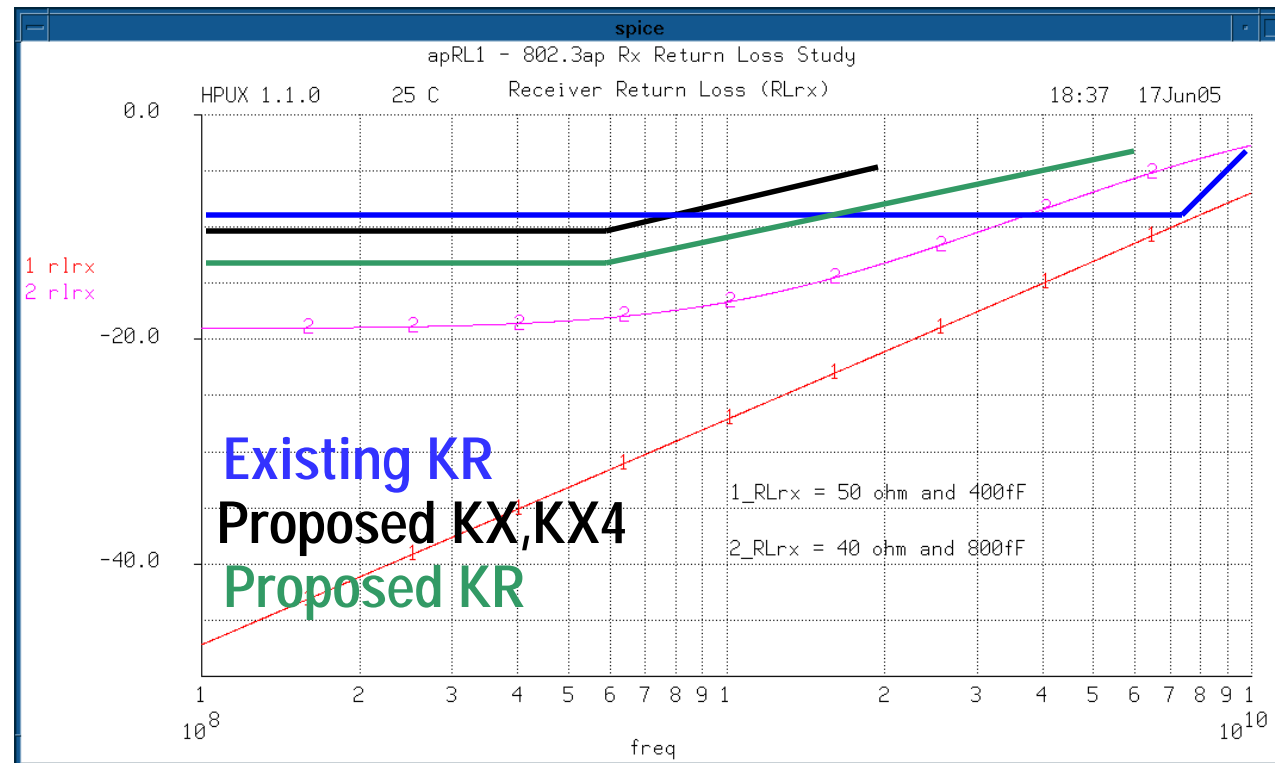
Good arguments for de-emphasis and DFE ☺

Not useful for this analysis



# Return Loss

## Receiver

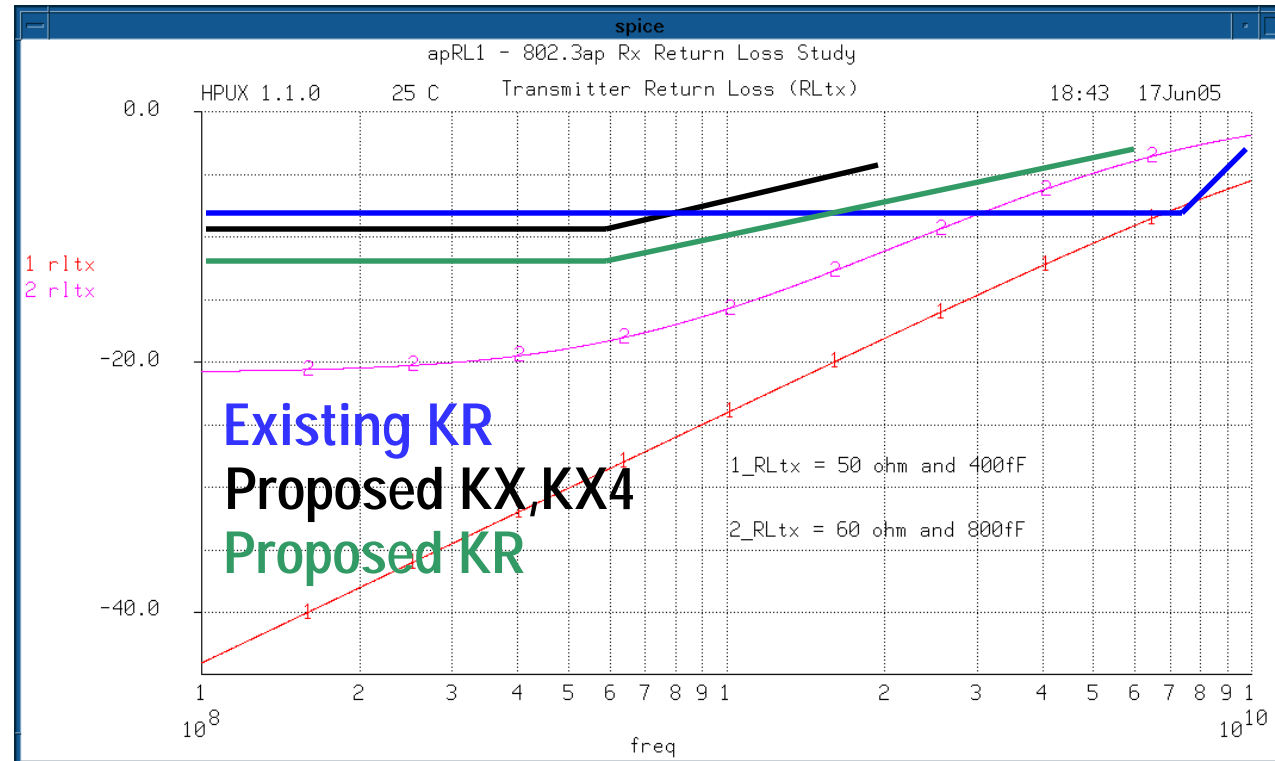


Return Loss(f)  $\geq 12\text{dB}$  for  $100\text{MHz} \leq f < 625\text{MHz}$   
 $\geq 12 - 9 \times \log(f/625\text{MHz})$



# Return Loss

## Transmitter



Return Loss(f)  $\geq 12\text{dB}$  for  $100\text{MHz} \leq f < 625\text{MHz}$

$\geq 12 - 9 \times \log(f/625\text{MHz})$



# Conclusions

- Channel model's losses isolate RX to TX C and L relationships
- TP1 and TP4 high freq return losses dominated by C variation
- Increased L beyond 0.3nH will create return loss < 3dB at 5GHz and is unacceptable
- Worst case TX is 60ohm and 800fF and is acceptable limit
- Worst case RX is 40ohm and 800fF and is acceptable limit
- KX and KX4 TX and RX return loss spec should be same as CX4
- KR TX and RX spec should change to equation on page 8

