A Study of 10G-KR Channel Evolution and Its Signaling Implications at 25 Gbps

Mike Li

For The IEEE 802.3 100Gb/s Ethernet Electrical Backplane and Twinaxial Copper Cable Assemblies Study Group,
IEEE 803.2 Plenary
Mar 14-17, 2011, Singapore

ALTERA®

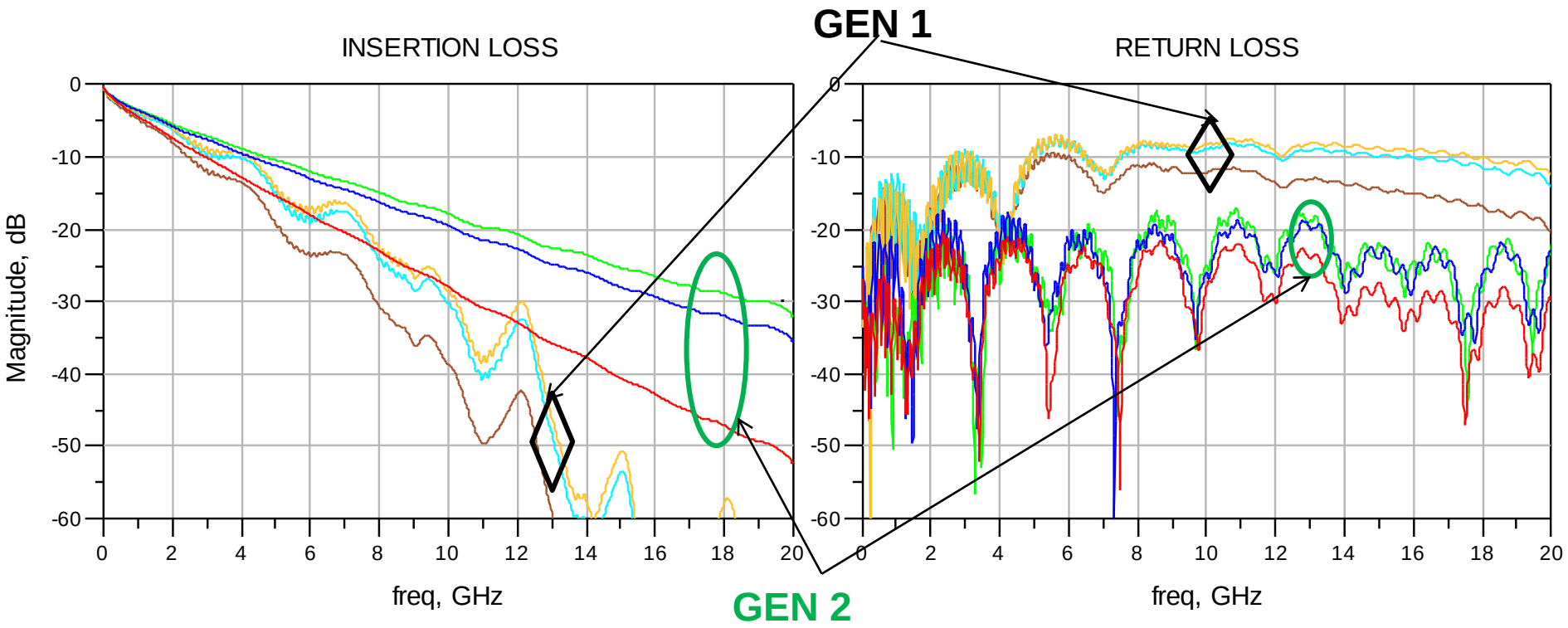
Objectives/Motivations

- 10G-KR channel (including PCB and connector) has been evolved and advanced in the past a few years
- As the channel electrical properties got improved, their implications to the link signaling and solution space also evolved
- This study intends to carry out quantitative study and analysis on the solution space as channel evolves and as the data rate increased to 25 Gbps

Assumptions and Scopes

- Channel
  - 10G-KR Gen1 and Gen2
- Signal data rate
  - 25 Gbps
- Tx and Rx equalization capabilities
  - Tx: FIR (5-taps)
  - Rx: CTLE (20 dB) + DFE (5-taps)
- Signal modulation
  - PAM-2
- Altera's PELE simulator
  - Data pattern: prbs2^7-1
  - Vod: 800 mVpp

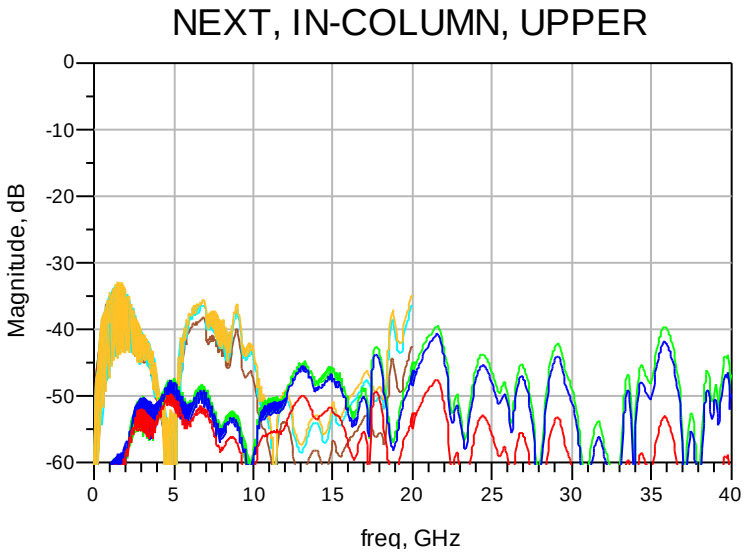
10G-KR Channel, Gen1 vs Gen2 (1/3)

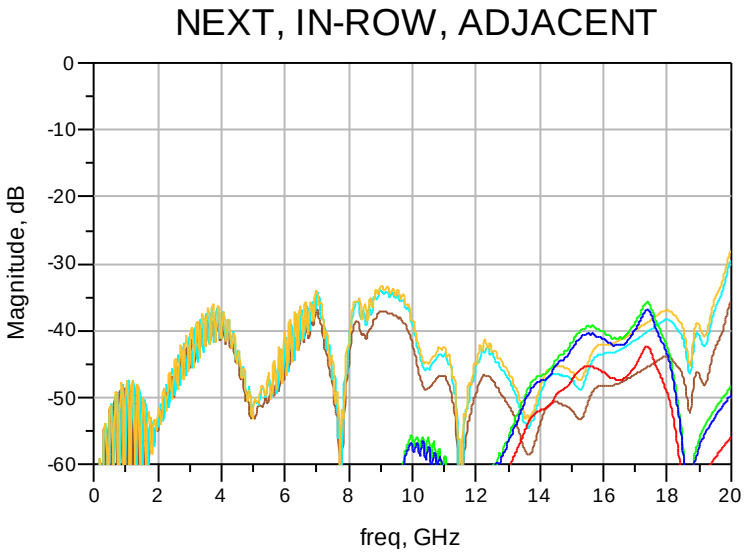


Gen 1 : NELCO4000-6, [Er=3.93, TanD=0.016@15GHz]
Gen 1 : NELCO4000-13SI, [Er= 3.32, TanD=0.01@15GHz]
Gen 1 : MEGTRON-6, [Er=3.58, TanD=0.008@15GHz]

Gen 2 : NELCO4000-6, [Er=3.93, TanD=0.016@15GHz]
Gen 2 : NELCO4000-13SI, [Er= 3.32, TanD=0.01@15GHz]
Gen 2 : MEGTRON-6, [Er=3.58, TanD=0.008@15GHz]

10G-KR Channel, Gen1 vs Gen2 (2/3)

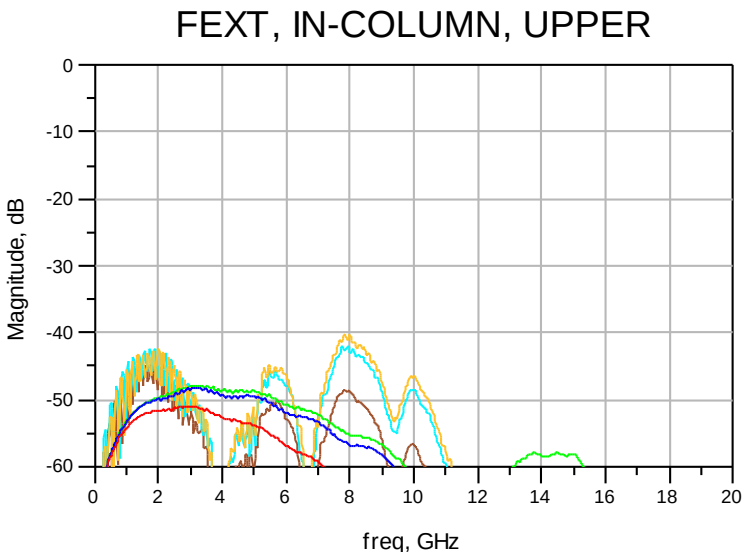


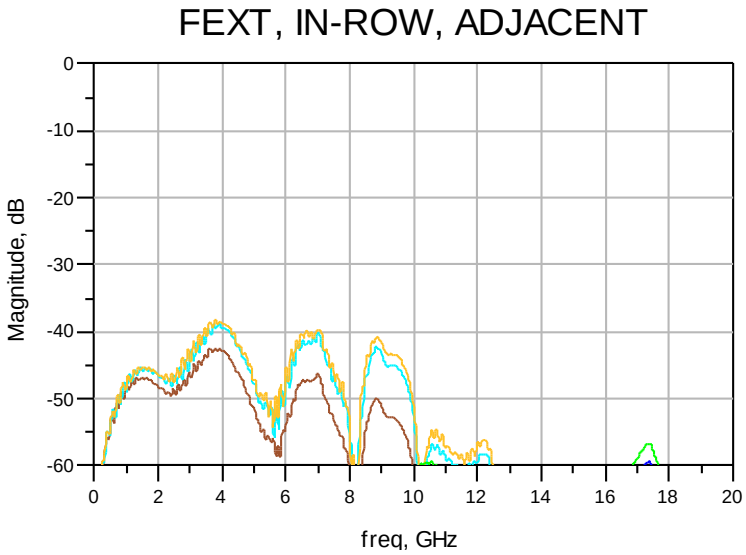


Gen 1 : NELCO4000-6, [Er=3.93, TanD=0.016@15GHz]
Gen 1 : NELCO4000-13SI, [Er= 3.32, TanD=0.01@15GHz]
Gen 1 : MEGTRON-6, [Er=3.58, TanD=0.008@15GHz]

Gen 2 : NELCO4000-6, [Er=3.93, TanD=0.016@15GHz]
Gen 2 : NELCO4000-13SI, [Er= 3.32, TanD=0.01@15GHz]
Gen 2 : MEGTRON-6, [Er=3.58, TanD=0.008@15GHz]

10G-KR Channel, Gen1 vs Gen2 (3/3)





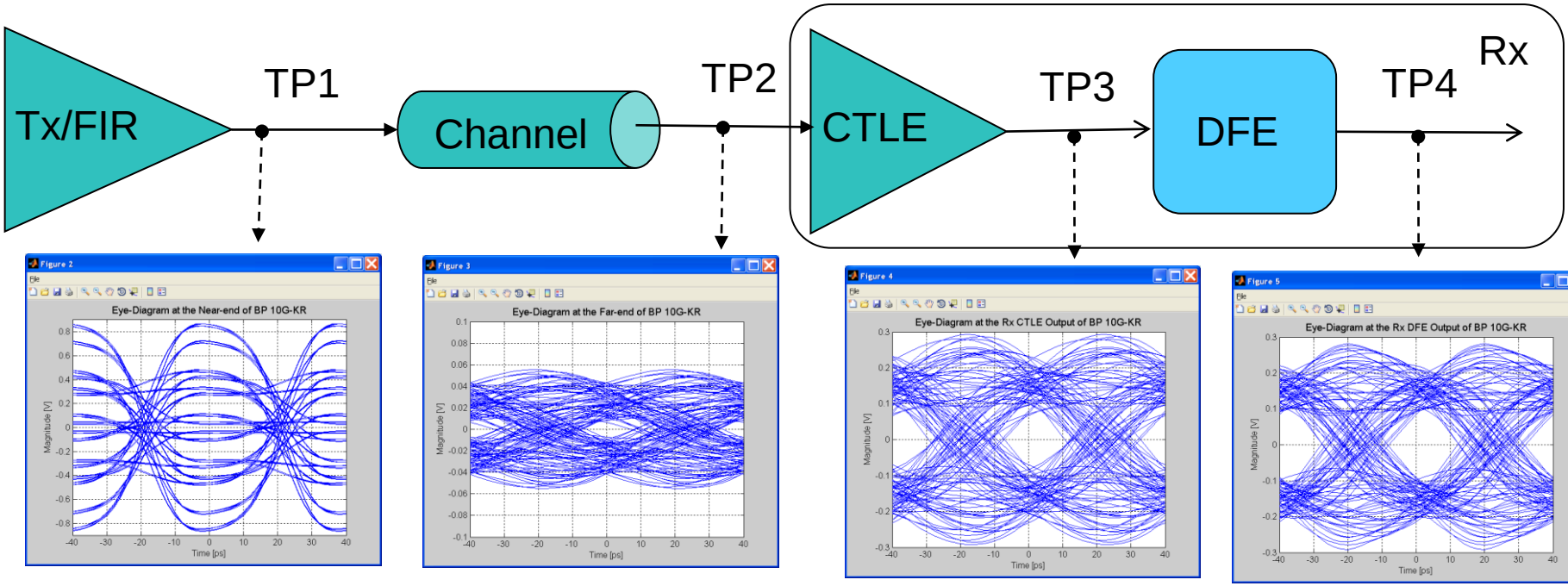
Gen 1 : NELCO4000-6, [Er=3.93, TanD=0.016@15GHz]
Gen 1 : NELCO4000-13SI, [Er= 3.32, TanD=0.01@15GHz]
Gen 1 : MEGTRON-6, [Er=3.58, TanD=0.008@15GHz]

Gen 2 : NELCO4000-6, [Er=3.93, TanD=0.016@15GHz]
Gen 2 : NELCO4000-13SI, [Er= 3.32, TanD=0.01@15GHz]
Gen 2 : MEGTRON-6, [Er=3.58, TanD=0.008@15GHz]

Gen1 Simulation Results

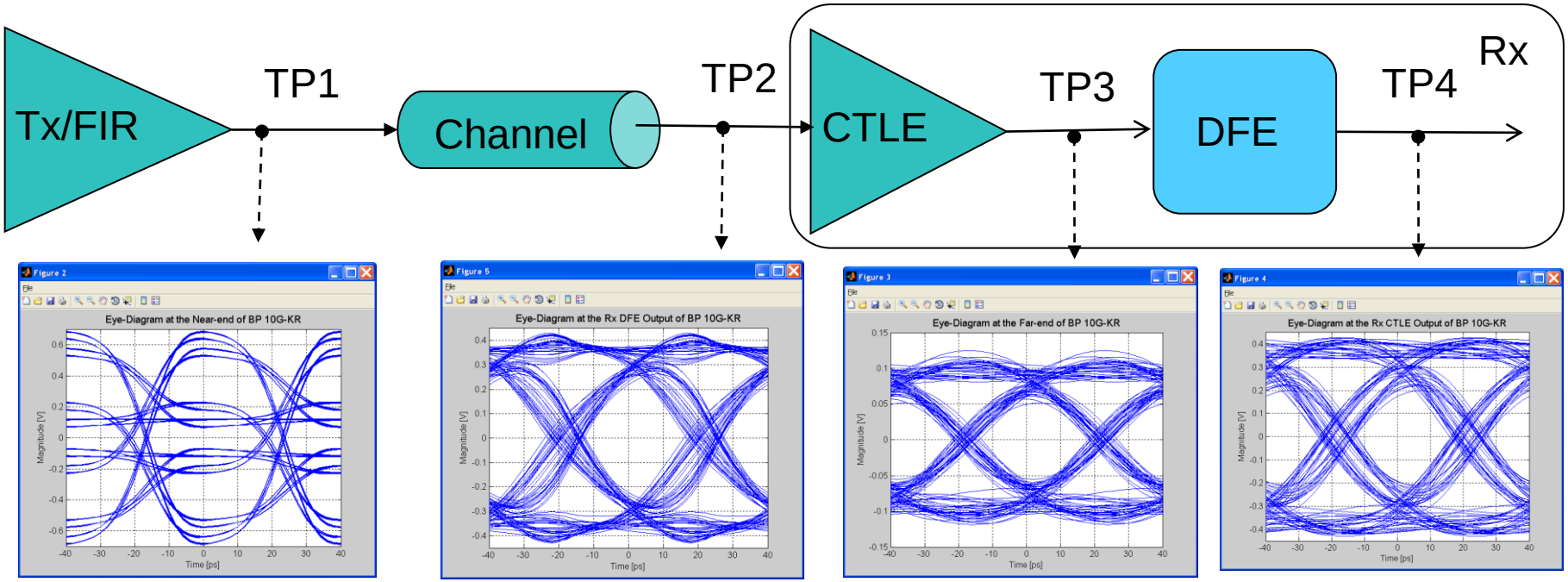
- No solution can be found

Gen2 Simulation Results: Nelco4000-6 (1/2)



@TP4, {EW(UI), EH(v), EOA(UI*v)}=
{0.50441, 0.19000, 0.04792}

Gen2 Simulation Results: Megtron-6 (2/2)



@TP4, {EW(UI), EH(v), EOA(UI*v)}=
{0.70943, 0.48800, 0.17310}

Summary

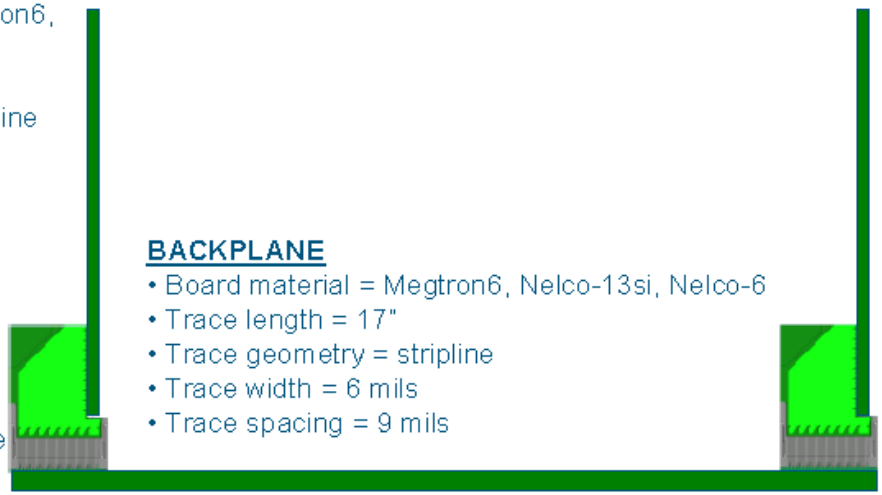
- No solution can be found for 10G-KR Gen1 channels for PAM-2 signaling at 25 Gbps, under EQ conditions of 5-tap Tx FIR, 20dB CTLE, and 5-tap DFE
- Solutions are found for 10G-KR Gen2 channels with PAM-2 signaling at 25 Gbps, under EQ conditions of 5-tap Tx FIR, 20dB CTLE, and 5-tap DFE
- To enable 25 Gbps signaling over the 10G-KR Gen1 channels, different signaling techniques are needed (e.g., signal modulation with PAM-M, and M>2)
- For 10G-KR Gen2 channels to work at 25 Gbps, no new modulation techniques are needed

Backup Slides

CHANNEL SET-UP

DAUGHTER CARD
- Board material = Megtron6, Nelco-13si, Nelco-6
- Trace length = 5"
- Trace geometry = stripline
- Trace width = 6 mils
- Trace spacing = 9 mils

CONNECTOR
- Gen1, Gen2
- Vertical Header
- Right Angled Receptacle



BACKPLANE
- Board material = Megtron6, Nelco-13si, Nelco-6
- Trace length = 17"
- Trace geometry = stripline
- Trace width = 6 mils
- Trace spacing = 9 mils

DAUGHTER CARD FOOTPRINT
- PCB Thickness = 126mils (gen2), 93mils (gen1)
- counterbored (gen2), non-counterbored (gen1)

BACKPLANE FOOTPRINT
- PCB Thickness = 200mils
- counterbored (gen2), non-counterbored (gen1)

Acknowledgements

- The channel data is kindly provided by Tyco Electronics
- We thank Megha Shanbhag and Nathan Tracy of Tyco Electronics for their assistants/helps in preparing this presentation

Thank You !