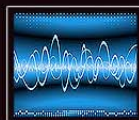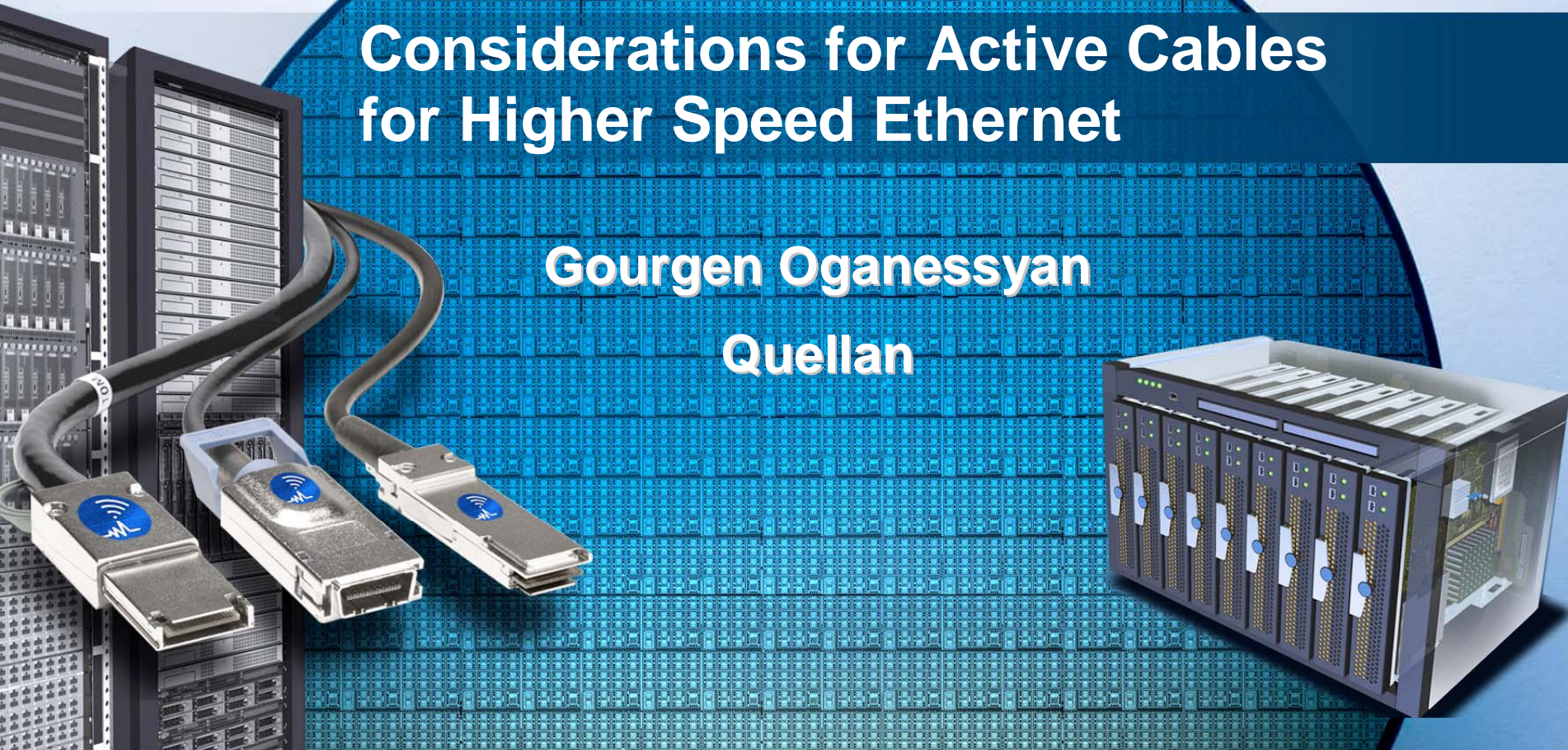# Considerations for Active Cables for Higher Speed Ethernet

## Gourgen Oganessyan

## Quellan

the noise cancellation company

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## Supporters:

- **Joel Goergen, Force10**

- **Jim McGrath, Molex**

- **Tom Palkert, Luxtera & Xilinx**

- **Joe O'Brien, Efficere**

- **Ed Cady, Meritec**

- **Greg McSorley, Amphenol**

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# Background

- **40G Ethernet Copper Objective:**
  - **Support At least 10 meters over a copper cable assembly**
  - **Support a BER better than or equal to $10^{-12}$ at the MAC/PLS service interface.**

- **Currently interconnect and cable technology available to support serial 10 Gbps data transmission over up to 10m of twin-axial cable**

- **Technology of 10GBASE-KR may be leveraged here.**

- **System designers need the flexibility to implement longer reaches (<10 meters), while using thinner cable gauges – to reduce cable weight, improve cable management, increase airflow in the data centers.**

- **Active cables have proven to be an economical, low-power, low-latency and high-performance option to support longer reaches and thinner wire gauges.**

- **Growing use by the industry in the InfiniBand, 10GBASE-CX4, PCIe, QSFP and other application. Several silicon vendors have products.**

- **Consider keeping the active cable option open for 40GE/100GE**

# Background: Attenuation in Cable Assemblies
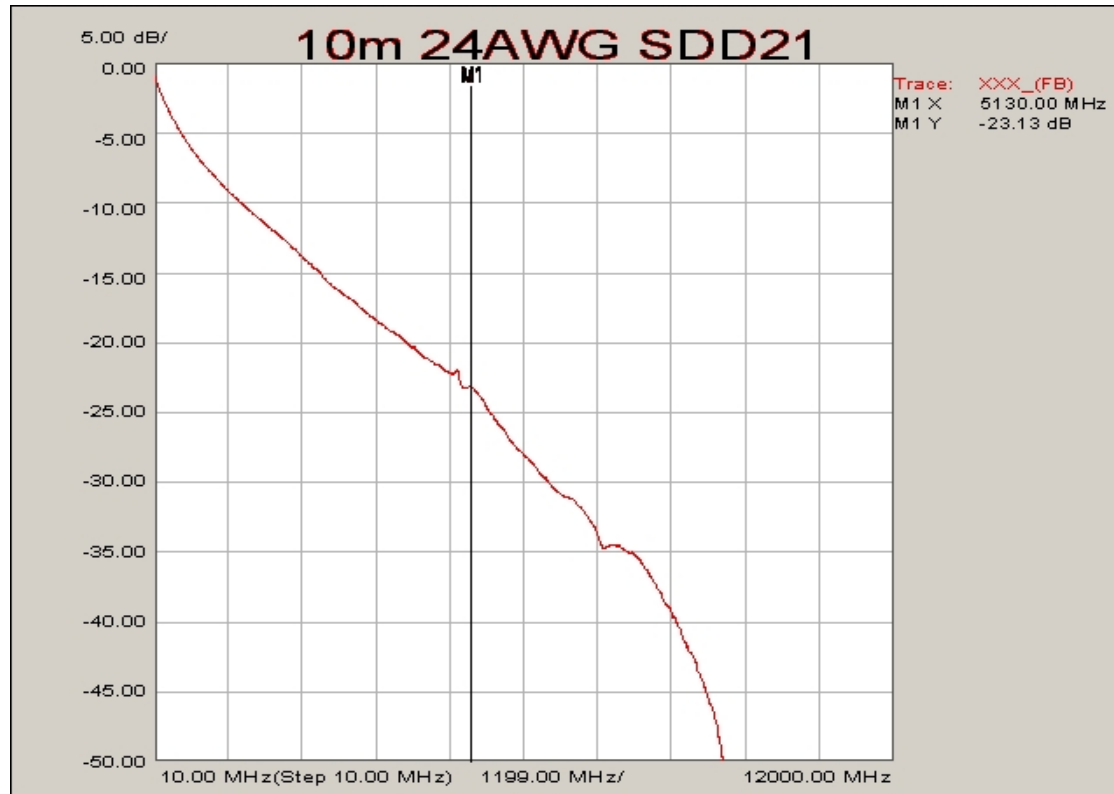


- 10M of 24-26AWG cable assemblies can be made to match the 10GBASE-KR channel model, anything longer and/or thinner will be difficult (SDD21 for a 10M 24AWGQSFP assembly shown).

# Background: Group Velocity Dispersion
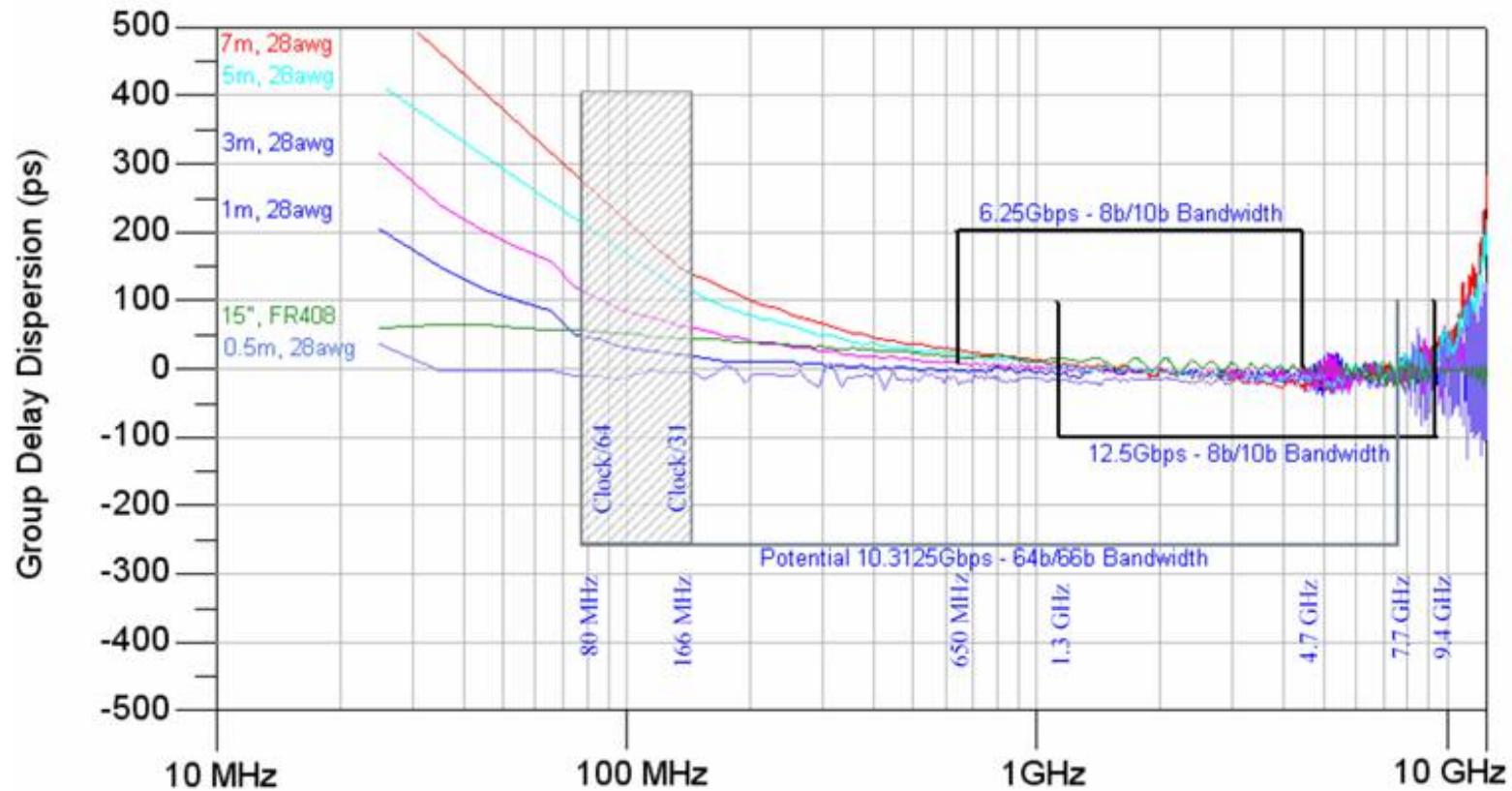


- Matching Attenuation is not enough: adapting 10GBASE-KR signaling (64b/66b) to cable assemblies will run into the Group Velocity Dispersion Issue (graph courtesy of Patrick Casher, Molex)

# Background: Group Velocity Dispersion
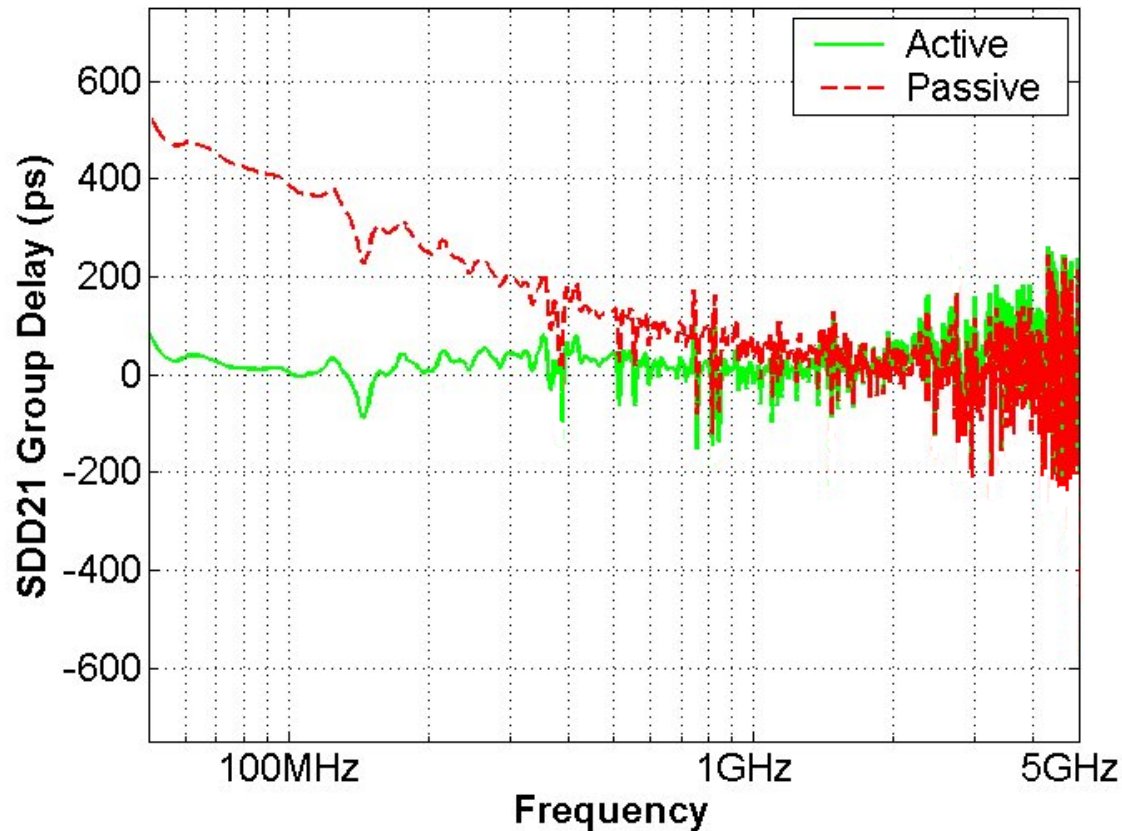


- A well designed active cable can help mitigate the Group Velocity Dispersion problem.

- Example: 10m 30 AWG Cable: Group velocity dispersion compensated down to 20 MHz (plot courtesy of Andrew Kim, Quellan).
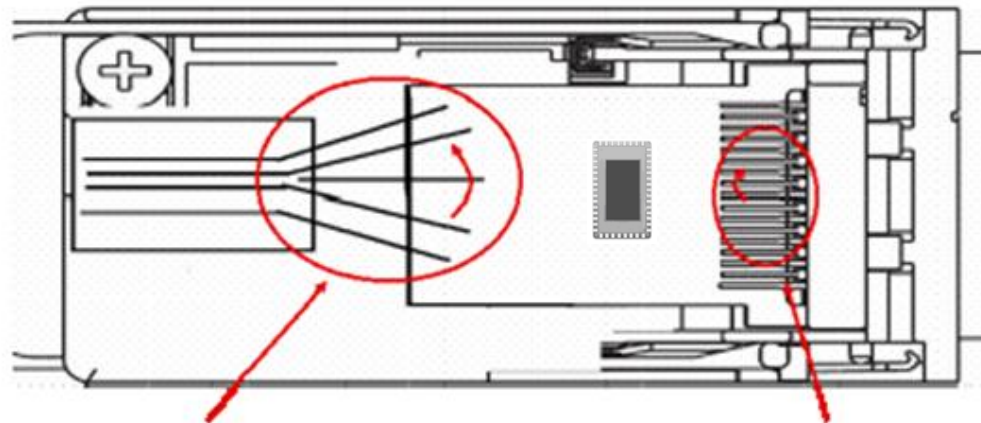
# Active Cable Overview
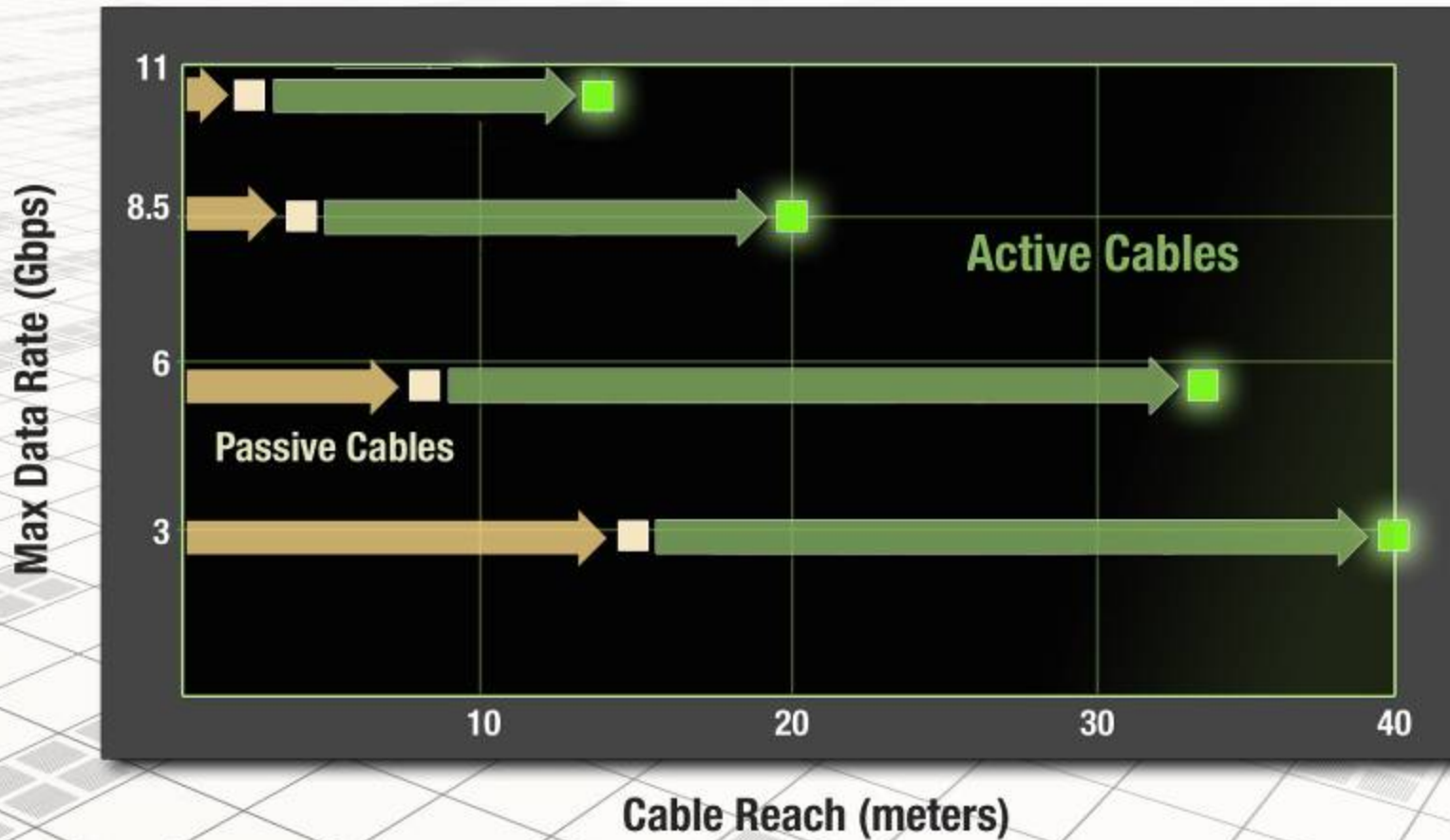


**Active Cable Reach Extension**

# Active Cable Overview

- How active cables improve the channel (Two-Fold Improvement of SNR):
  - Boost received signal
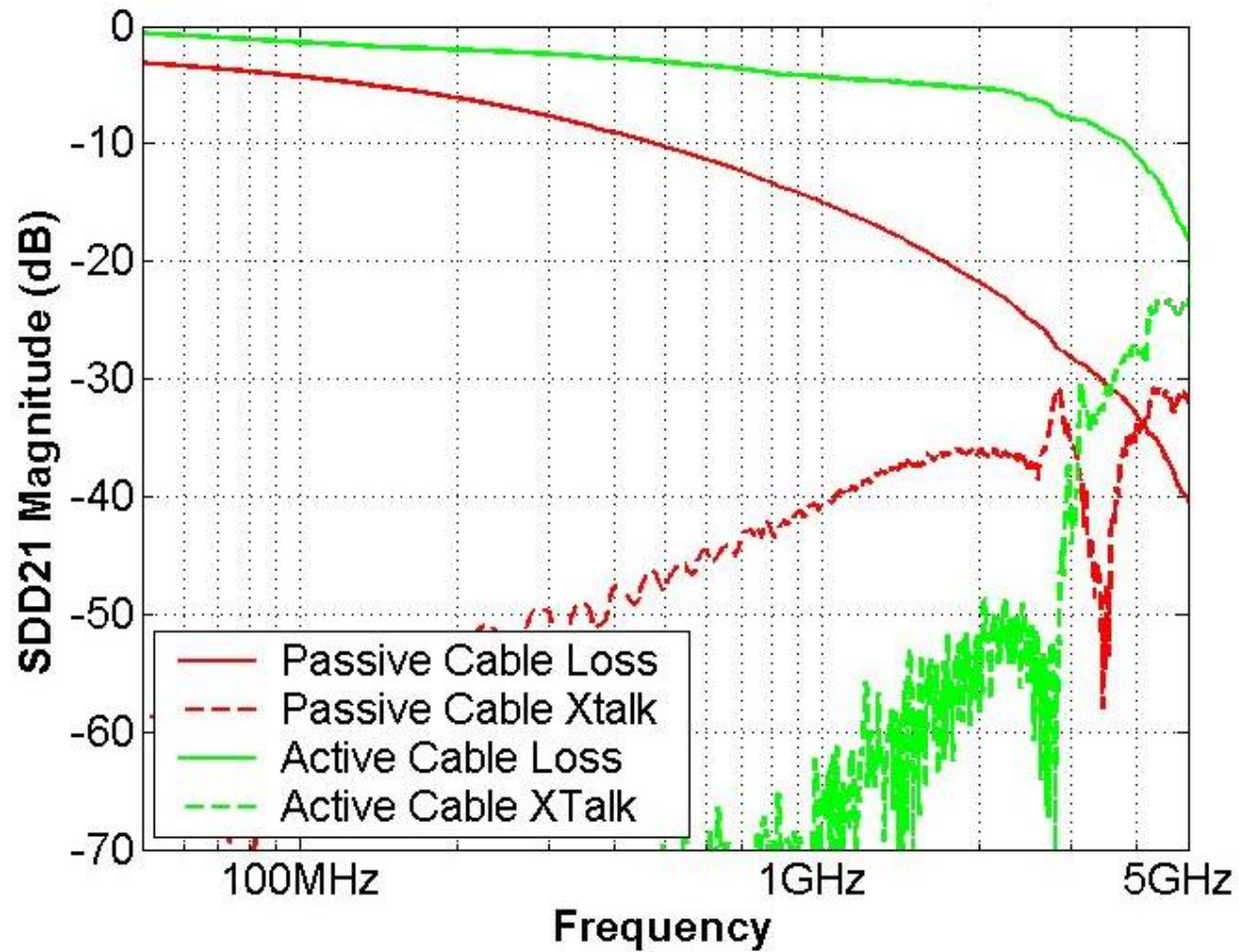  - Reduce Crosstalk (NEXT) impact by placing the equalizer inside the cable assembly:



**Cable Crosstalk**

**(generally small)**

**Connector NEXT**
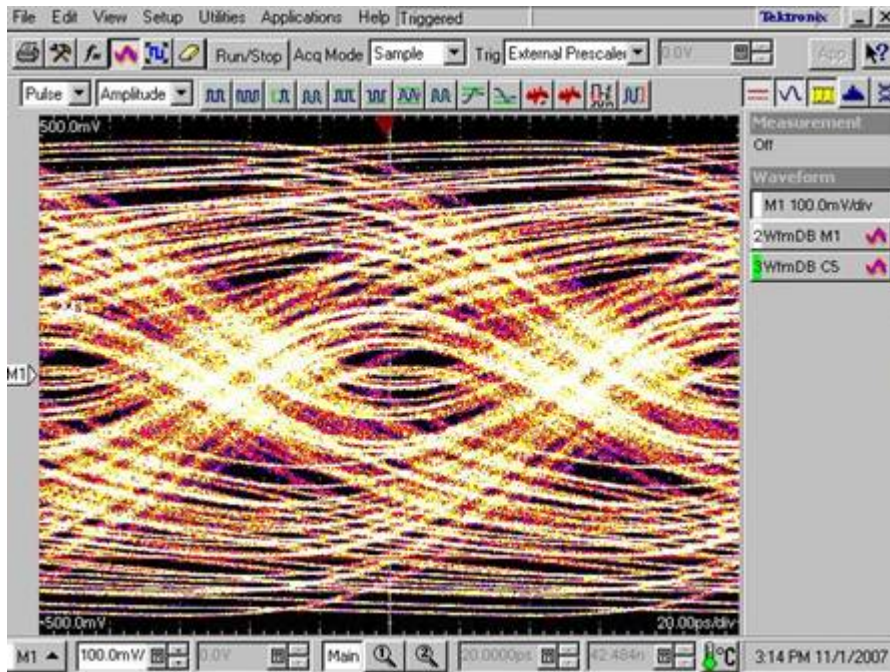
**(minimized in active cables)**

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# Active Cable Overview



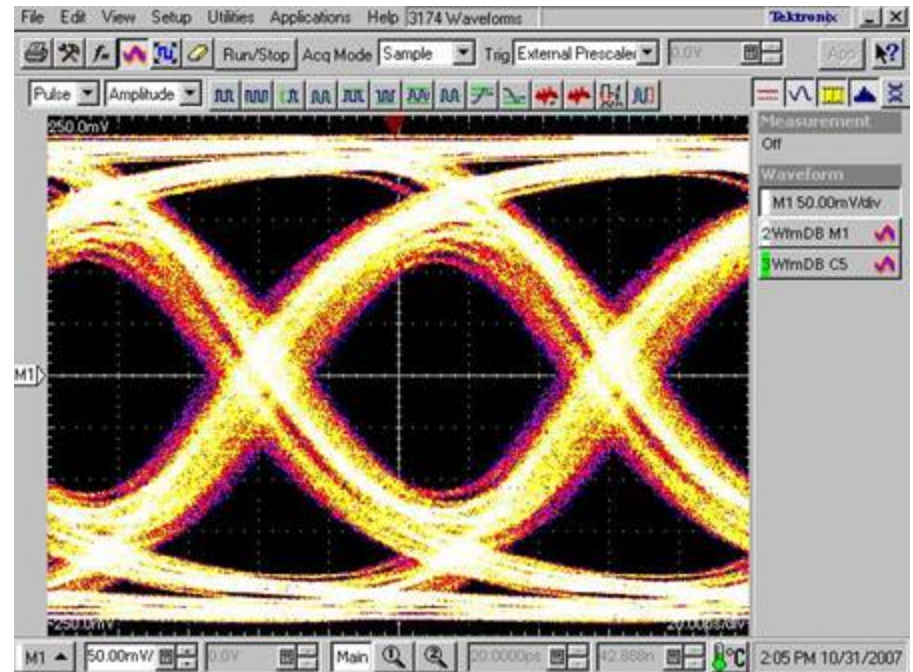**Comparison of SNR for passive (red) and active (green) 10m 30AWG cable assemblies**

# Active Cable Overview



(a)                                                                                                    (b)

**Comparison of 10 Gbps eye diagrams of passive (a) and active (b) 24AWG QSFP cable assemblies**

# Interconnect Options Supporting Active Cable

- A power delivery option to the plug connector

- A twin-ax type cable

- There are two connector candidates for a 4x10G Solution already supporting this



**QSFP**



**InfiniBand/CX4**

# Signaling Options Supporting Active Cables

- Most NRZ signaling protocols are compatible with active cables

- The signaling, transmitter and receiver characteristics defined in 10GBASE-KR should work well with active cables

- Active cables with group velocity dispersion compensation can actually help in improving transmission of stressful (long bit sequence) data patterns, such as 64b/66b of 10GBASE-R

# Summary

- **Active cables can be a viable technology to support the copper objective in 40G Ethernet**

- **Current growing use in the industry demonstrates the feasibility of active cables for allowing longer reach and smaller wire gauge**

- **Two connector standards that are possible candidates for the 4x10G solution (QSFP and CX4) already support the active cable option by providing power delivery.**

- **The option to allow active cables should be kept open for longer-reach and thinner-cable applications, and to provide margin for future requirements.**

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# Thank You!