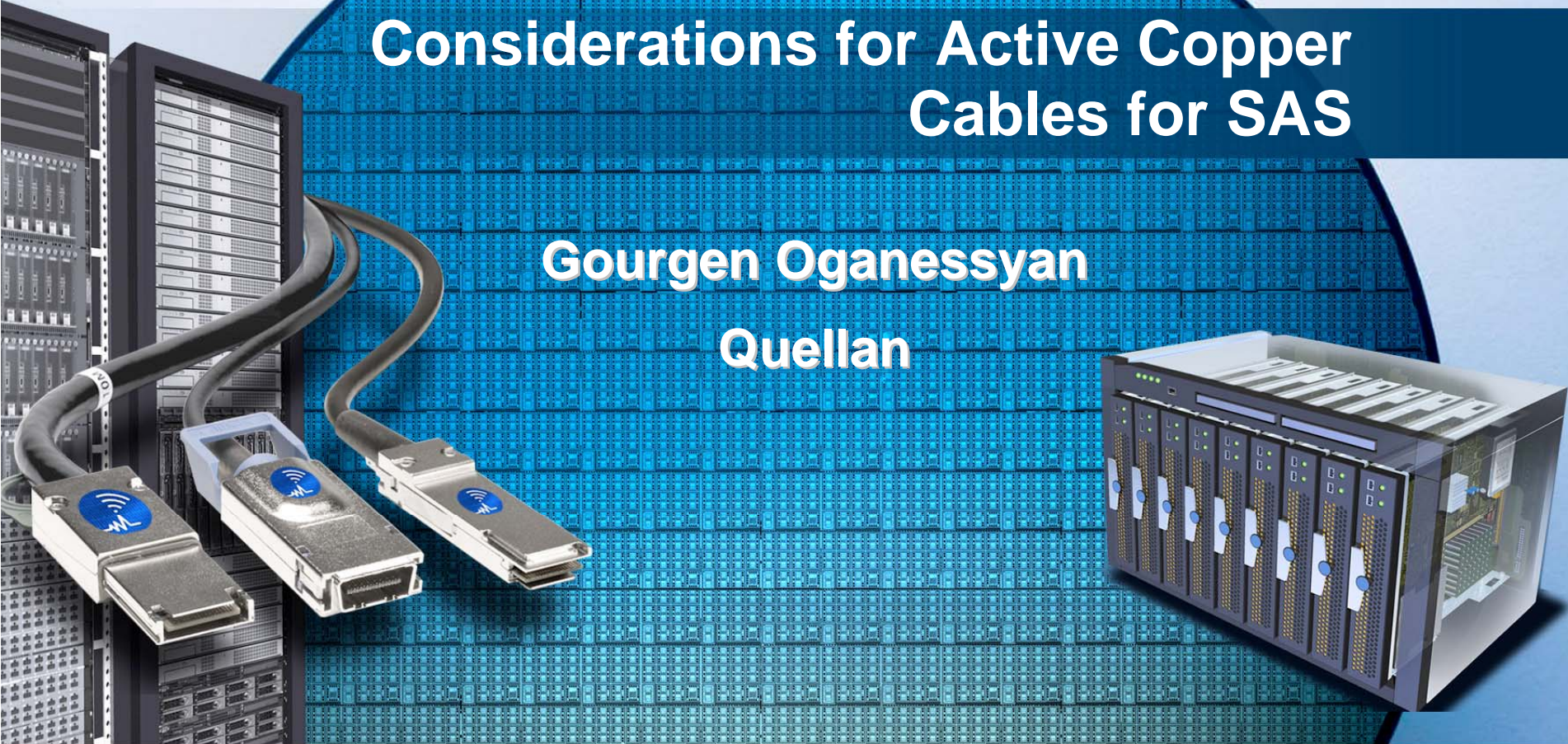


T10/08-033r0

Considerations for Active Copper Cables for SAS

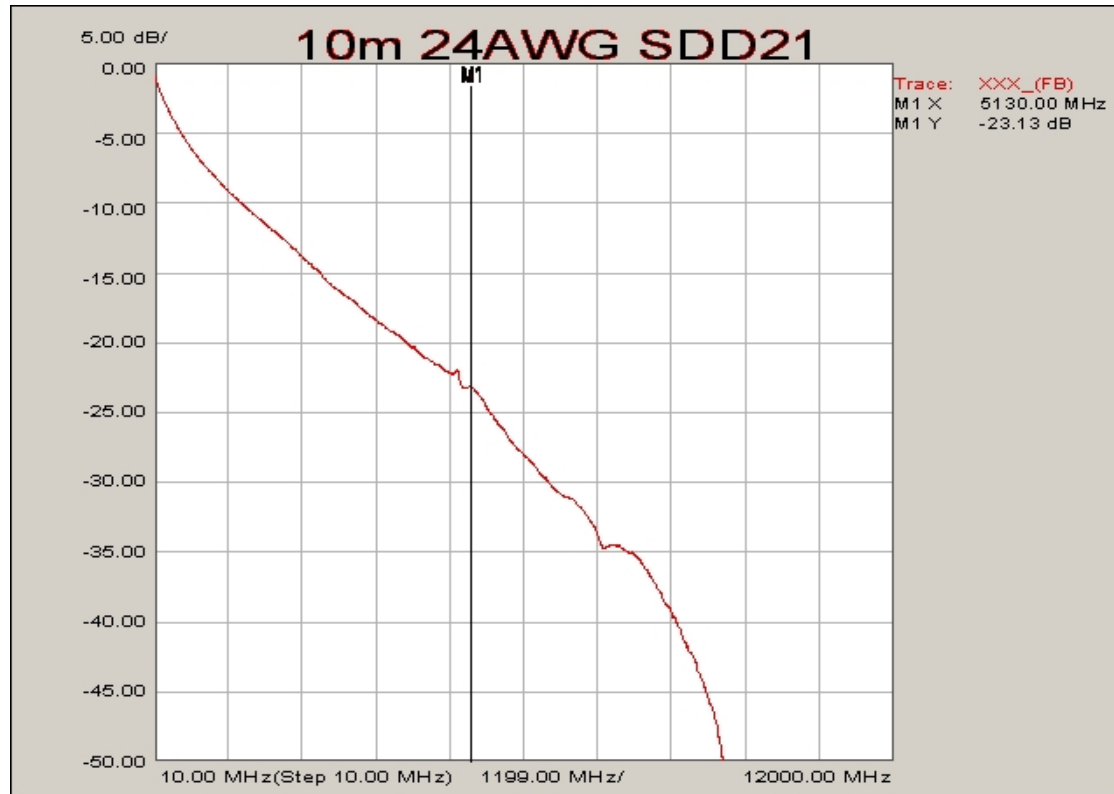
Gourgen Oganessyan
Quellan



Background

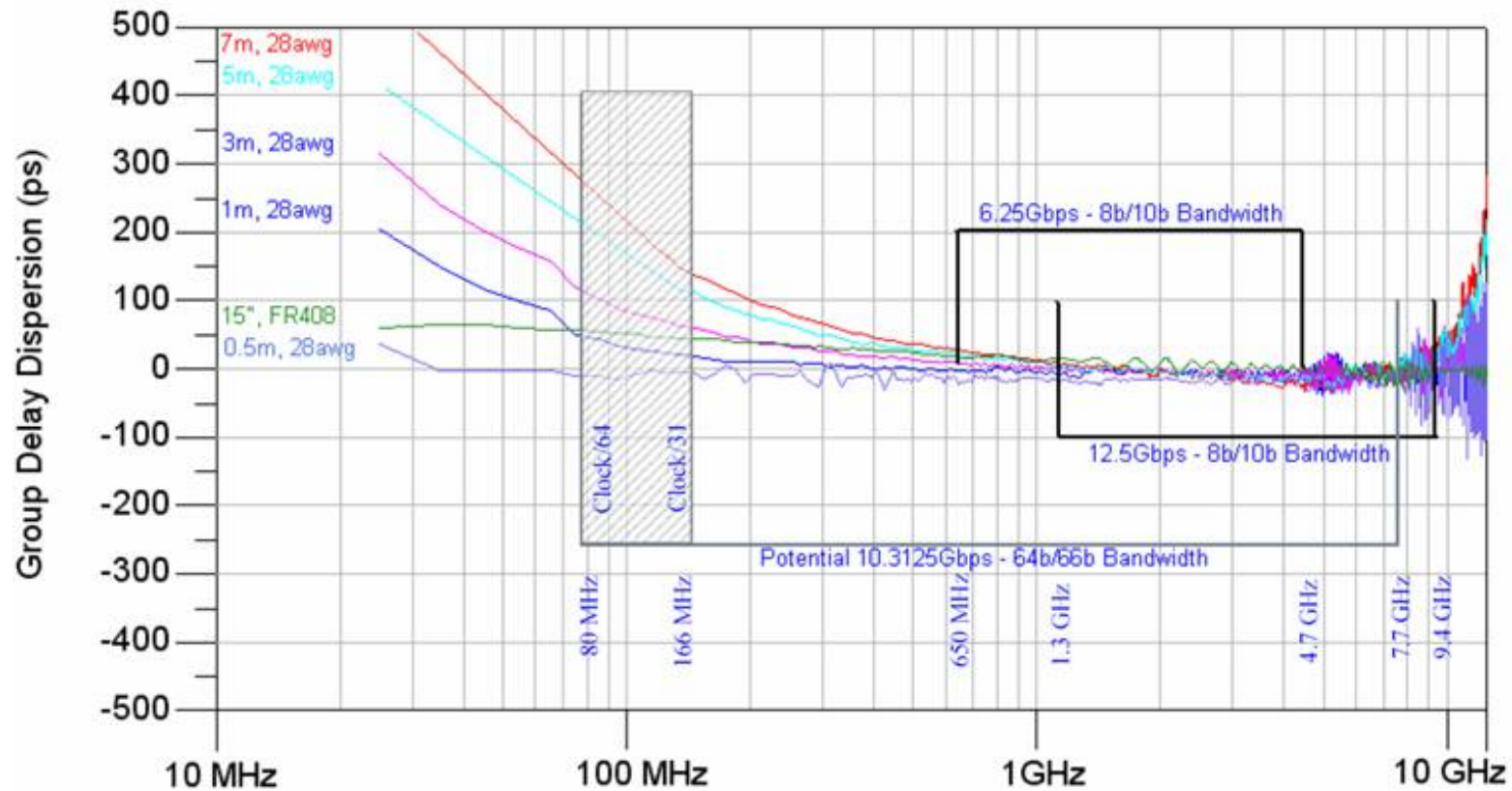
- System designers need the flexibility to implement longer cable reaches (<10 meters), while using thinner cable gauges – to reduce cable weight, improve cable management, increase airflow in the data centers.
- Active cables have proven to be an economical, low-power, low-latency and high-performance option to support longer reaches and thinner wire gauges.
- Growing use by the industry in the InfiniBand, 10GBASE-CX4, PCIe, QSFP and other applications. Several silicon vendors have products.
- Consider the active cable option for SAS-2 and SAS-3

Background: Attenuation in Cable Assemblies



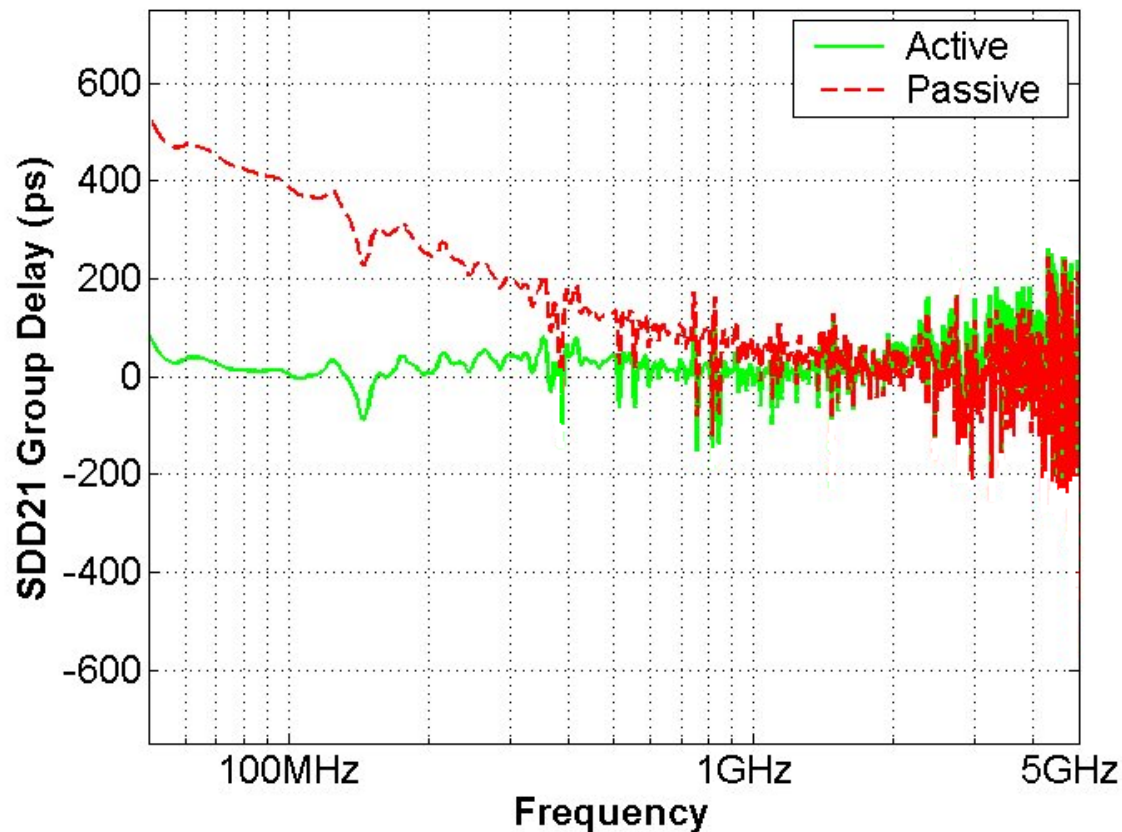
- 10M of 24-26AWG cable assemblies can be made to match the 10GBASE-KR channel model for 10 Gbps 64b/66b operation, anything longer and/or thinner will be difficult (SDD21 for a 10M 24AWGQSFP assembly shown).

Background: Group Velocity Dispersion



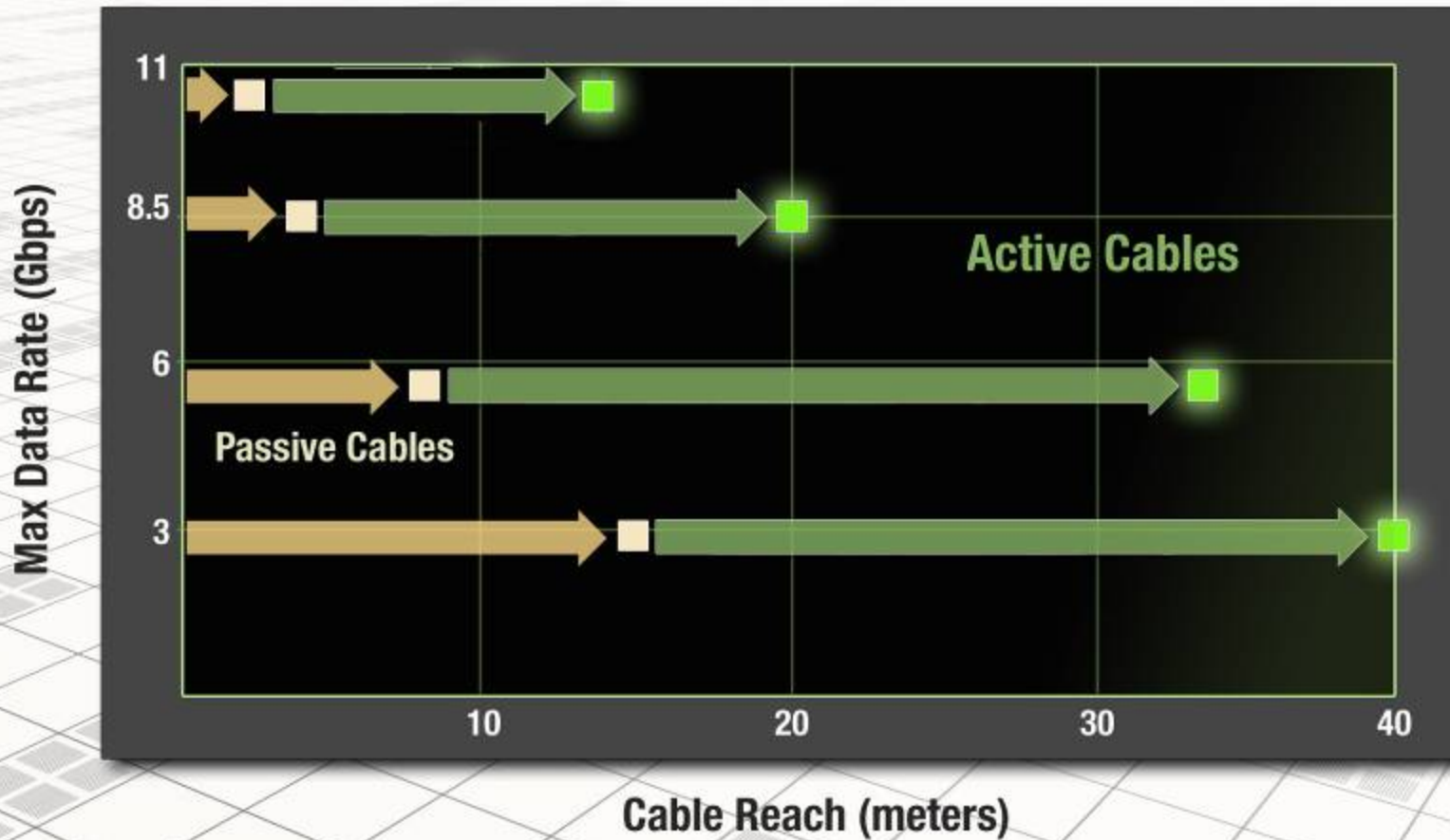
- Matching Attenuation is not enough: adapting 10GBASE-KR signaling (64b/66b) to cable assemblies will run into the Group Velocity Dispersion Issue (graph courtesy of Patrick Casher, Molex)

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).

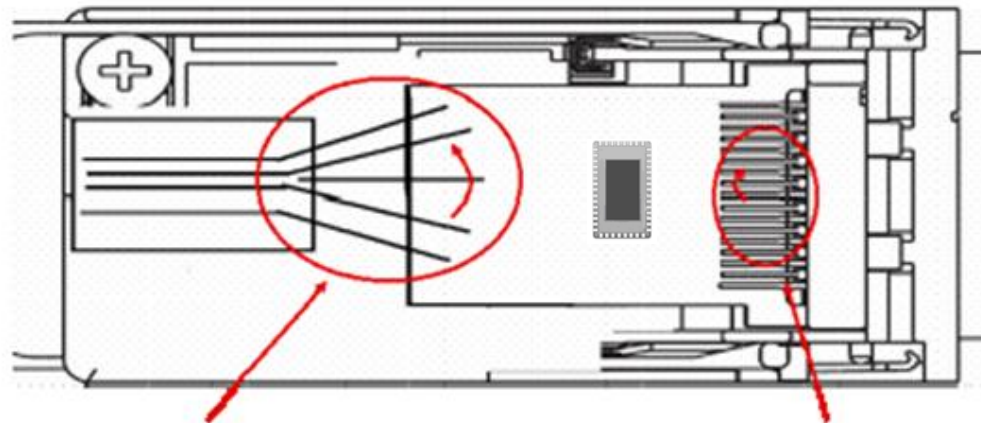
Active Cable Overview



Active Cable Reach Extension

Active Cable Overview

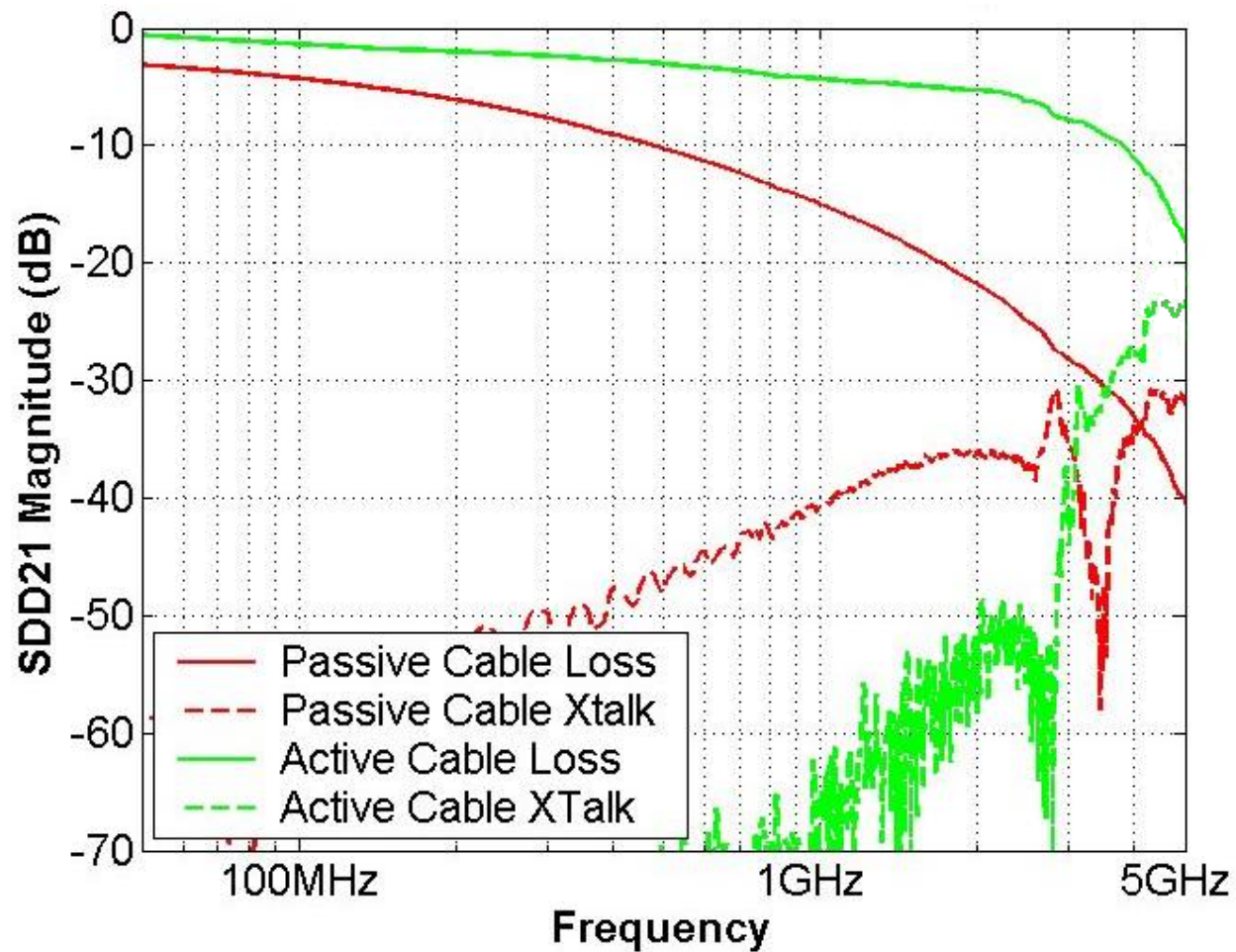
- How active cables improve the channel (Two-Fold Improvement of SNR):
 - Boost received signal
 - Reduce Crosstalk (NEXT) impact by placing the equalizer inside the cable assembly:



Cable Crosstalk
(generally small)

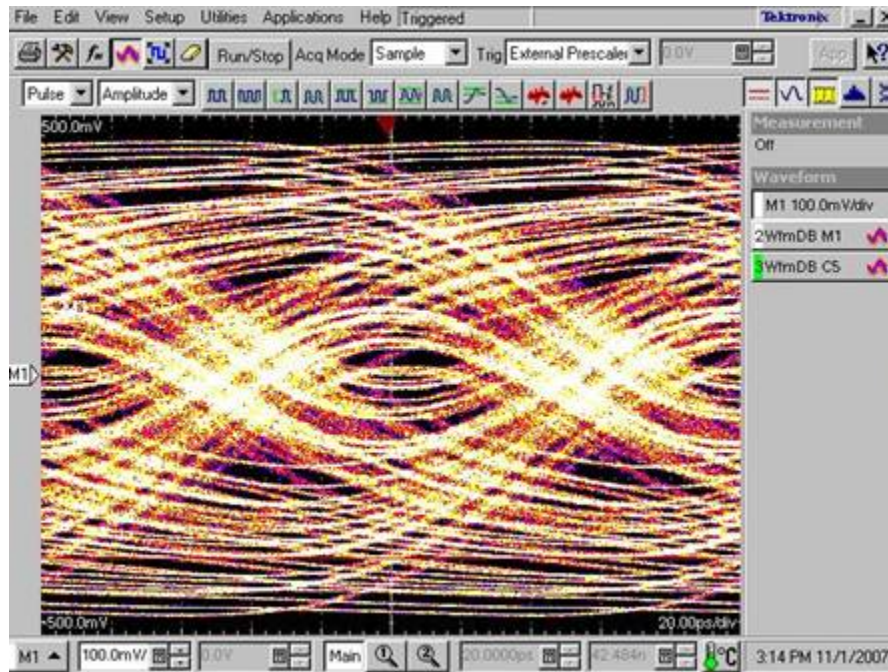
Connector NEXT
(minimized in active cables)

Active Cable Overview

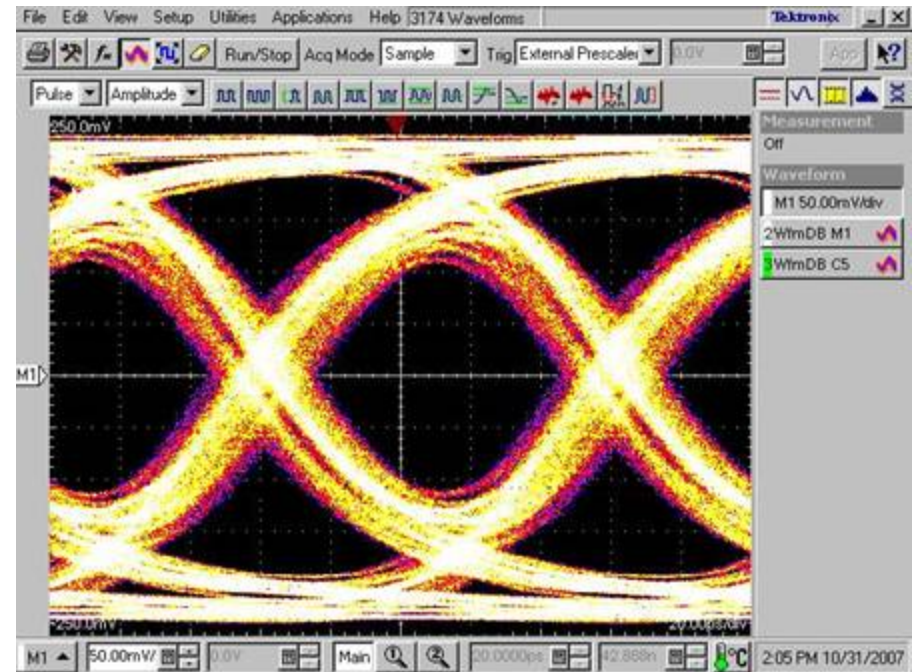


Comparison of SNR for passive (red) and active (green) 10m 30AWG cable assemblies

Active Cable Overview



(a)

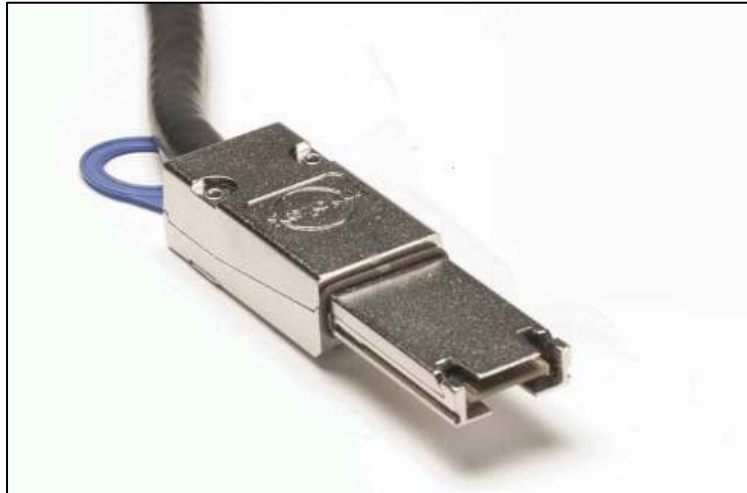


(b)

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

Interconnect Options For Active Cable

- Need power delivery to the plug connector
- A twin-ax type cable

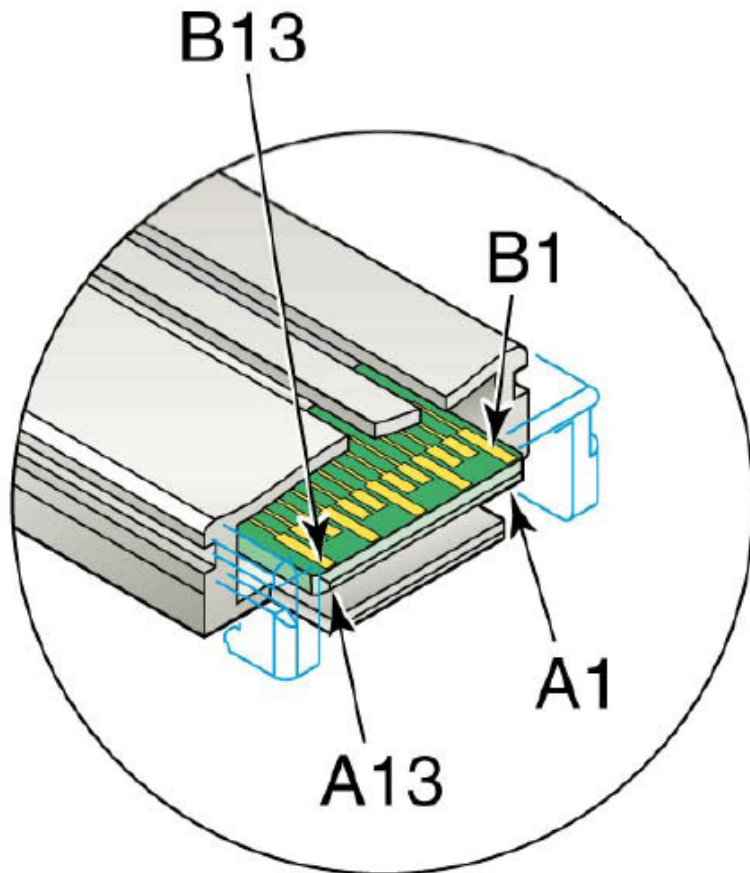


miniSAS (I-Pass)



QSFP

Active Cable with mini-SAS Connectors



- There are 10 GND pads on the Mini-SAS cable
- Use any one of the GND pins (e.g. B1) as 1.2V or 3.3V power
- Use another GND pin (e.g. B13) as voltage detection for an active cable
- A/C couple those pins to ground to preserve signal integrity

Signaling Considerations

- Most NRZ signaling protocols are compatible with active cables
- SAS-1 and SAS-2 signaling compatible with active cables.
- Line Silence support features (e.g. in Quellan Lane Extenders) support OOB signaling
- The signaling, transmitter and receiver characteristics defined in SAS-2, 10GBASE-KR, etc, 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-KR

Summary

- Active cables can be a viable technology to support mini-SAS copper cabling
- Especially important at future high data rates, e.g. SAS-3
- Current growing use in the industry demonstrates the feasibility of active cables for allowing longer reach and smaller wire gauge
- Possible to design active cables using current mini-SAS connectors by using GND pins for power; QSFP a natural option of active cables

Thank You!