

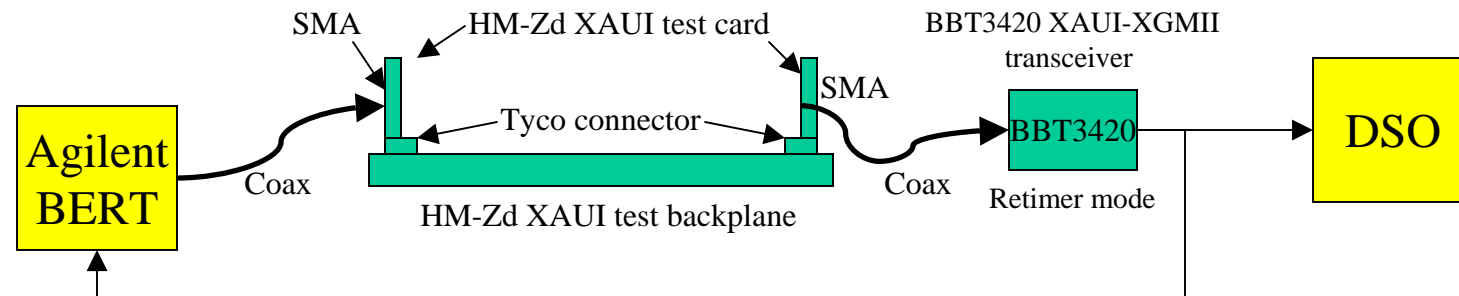
# XAUI with equalization over backplane

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# Motivation

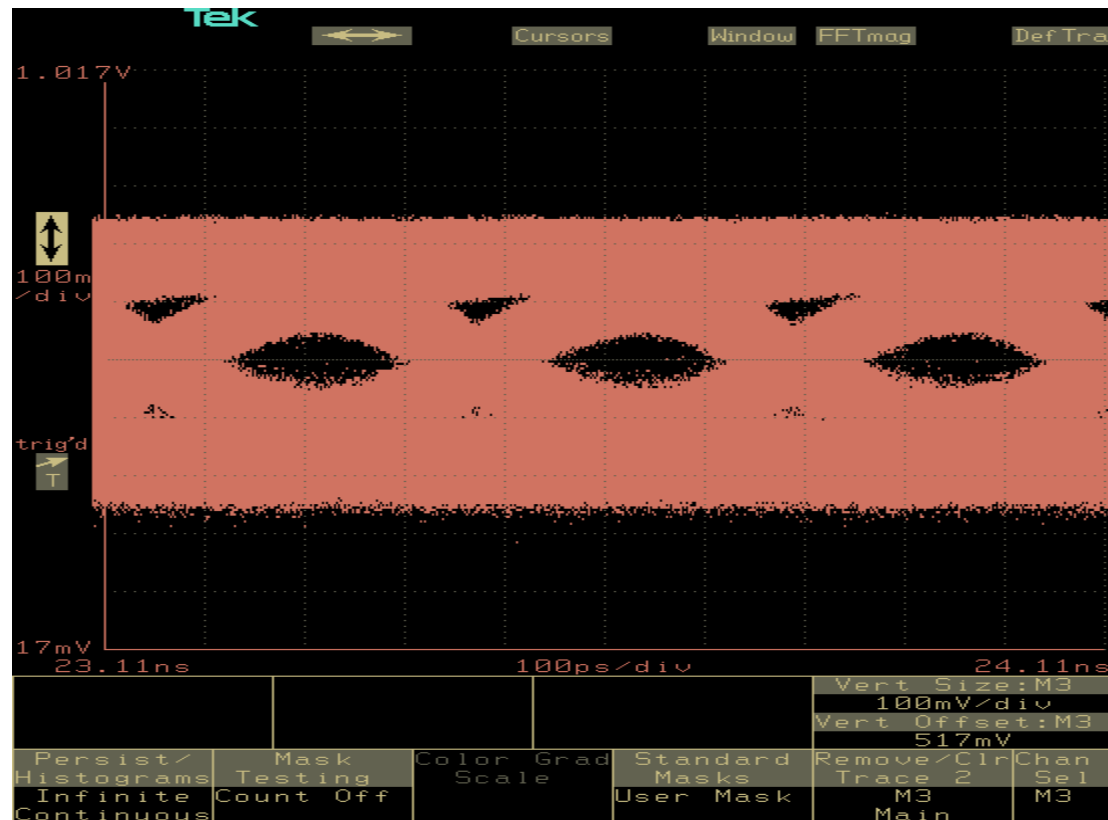
- 4 lanes copper technology available
  - XAUI: no Tx pre-emphasis, no Rx equalization
    - supports short distance <20-inch
  - CX4: with both Tx pre-emphasis and Rx equalization
    - supports long distance >15m twin-ax
  - Backplane 40-inch is in between
- Rx equalization driving capability on 40-inch backplane
  - Lower EMI
  - Knob is on receive end, easier to setup adaptive system

# Test set-up



- DUT: Tyco HM-Zd XAUI test backplane, BBT3420 XAUI-XGMII transceiver (in XAUI-XGMII-XAUI retimer mode)
- Traces on data path: 30" FR4 on backplane, 4" FR4 on linecards, >3" FR4 on BBT3420 evaluation board, >1m coax cable
- Connectors on data path: 2x Tyco connector, 4x pairs of SMA connectors
- Test criteria: <math>10^{-12}</math> BER per lane, or >5min error free operation per lane

# Eye at receiver



- Eye diagram of a PRBS-31 data pattern after the data path

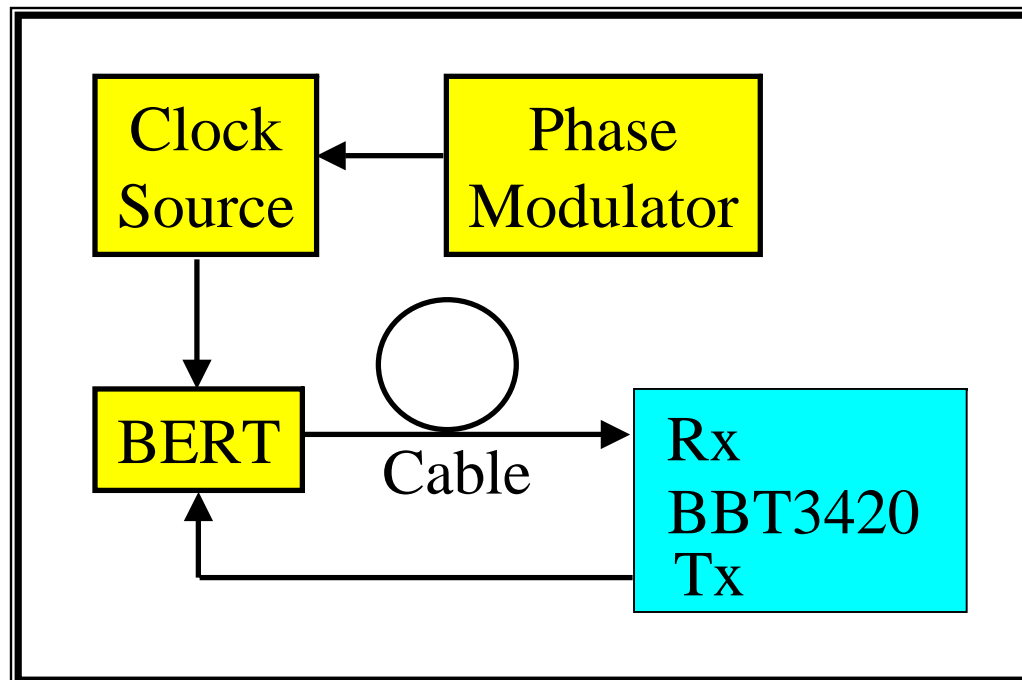
# Equalization requirements

Data Pattern	Boost Equalization for Error-free Operation with 34-inch Back-plane (0-F'h)															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
PRBS-7				OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
PRBS-10					OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
PRBS-15					OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
PRBS-23						OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
PRBS-31						OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK

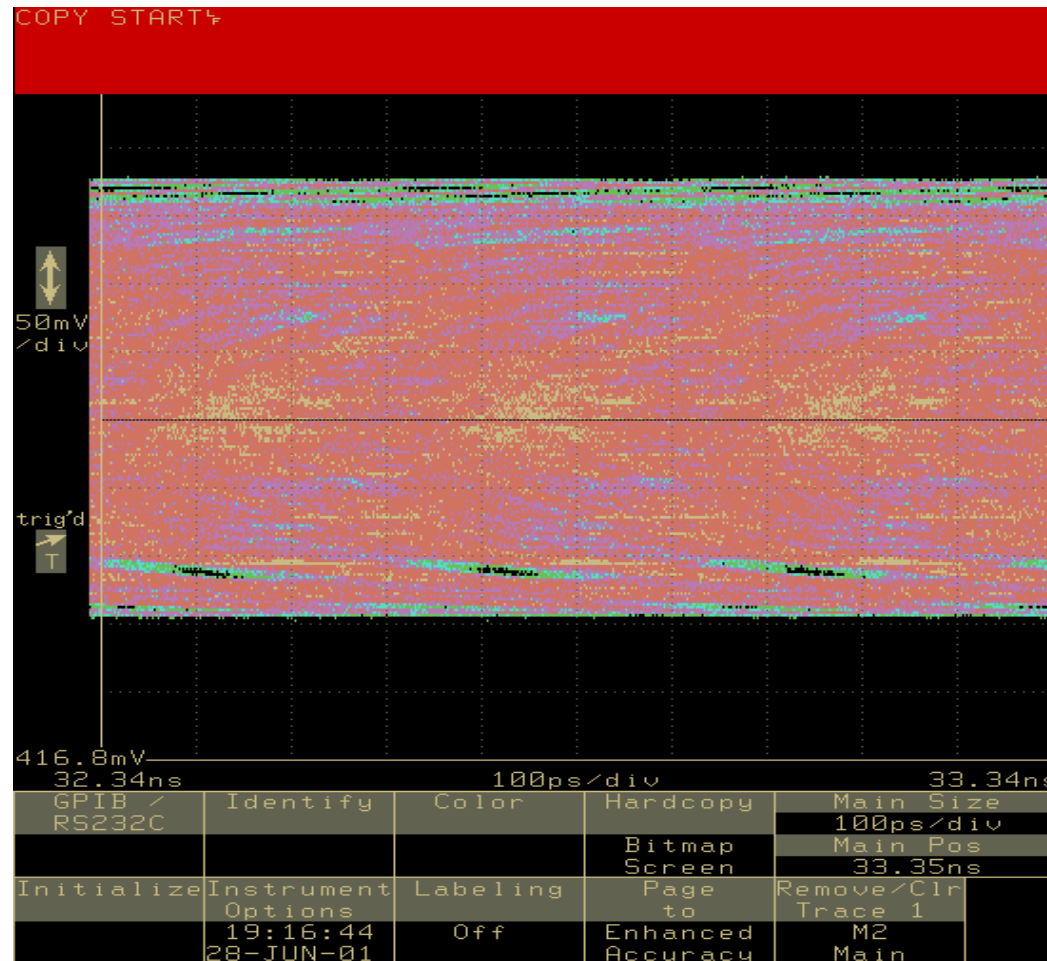
- Maximum equalization boost ~7dB, corresponding to boost setting of 0F'h
- Equalizer boost still has margin for the data path

# Receive equalization characterization

- Comparing to Tx pre-emphasis, Rx equalization hard to characterize
- Internal eye margin measurement can be performed with out-of-band jitter tolerance measurement



# Jitter tolerance result



- 500mV single-ended peak-peak PRBS-7 pattern at 3.125Gbps after 20-meter Belden 8262 coaxial cable, with 0.5UI high-frequency sinusoidal phase modulation.
- BBT3420 recovers it with  $<10^{-12}$  BER per lane, i.e., 0.5UI internal eye-opening

# Summaries

- 10G 4-lane backplane support with receive equalization only is feasible over certain backplanes.
- A CX4-like specification with both Tx pre-emphasis and Rx equalization will cover more generalized backplanes.
- Programmable boost on the receive side eases implementation of an adaptive system.
- Equalization performance can be characterized with out-of-band jitter tolerance measurement.