

UXPi Technical Specification

IEEE 802.3 Backplane Ethernet Study Group
Technical Feasibility of 10Gbps Backplane
Communication

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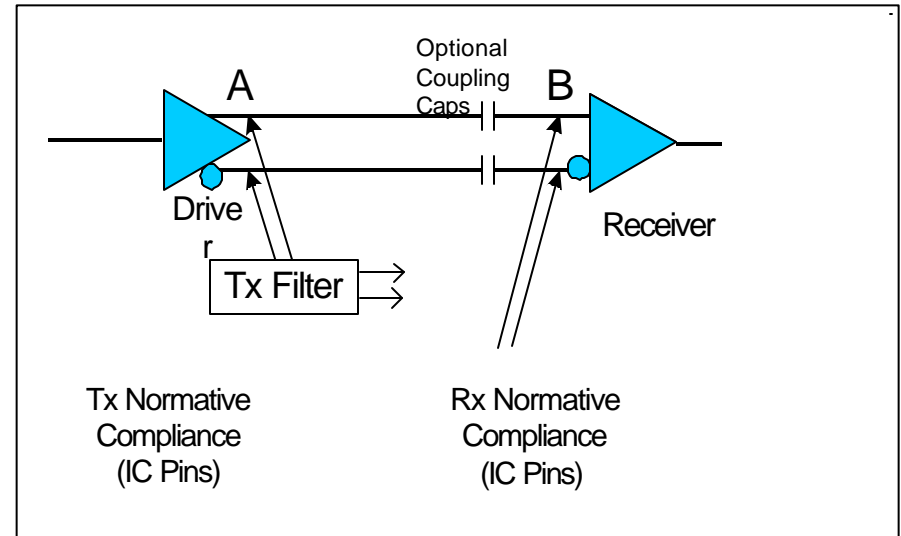


General Application

- 10Gbps over a single lane
- Intra-system (within box) communication
- Planar copper media on PC boards
 - Reasonable design practices
 - Likely extendable to cable
- Boards linked via late-model connectors
- CMOS transceiver implementation

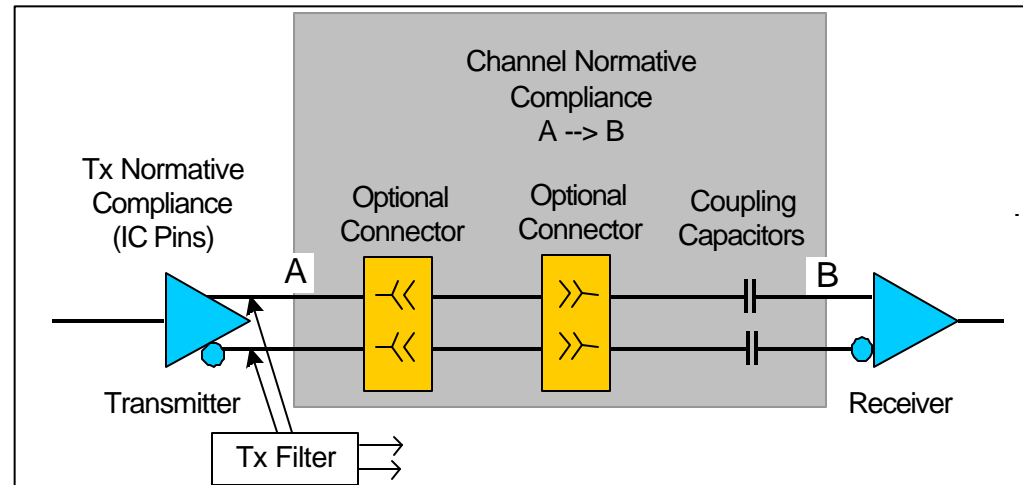
Target Applications

- Short Reach
 - Short signal paths
 - Low power
 - Little or no equalization
 - Few or no connectors
 - Need for DC coupling
 - Operation over cheaper, higher-loss printed circuit material
 - Small transmitted signal
 - Accommodates XFP application



Target Applications

- Long Reach
 - Long signal paths
 - e.g. backplane
 - Complex equalization
 - closed receiver eye
 - Up to two connectors
 - Operation over a combination of lower-loss and higher-loss printed circuit material
 - Hot insertion (hot-plug)
 - Large transmitted signal



Fundamental Technical Challenges

- Channels – closed eye at Receiver
 - High attenuation
 - High crosstalk
 - Wide variability
- Silicon constraints
 - Limited transistor f_t
 - Limited signal amplitude
 - Packaging effects
- System-level constraints
 - Manufacturability / Cost
 - Power

Multi-Stakeholder Solution

- Each is Necessary, but not sufficient
 - 10G-capable...
 - Silicon/package
 - Connectors
 - Signal launches
 - Routing approach
 - Board material
- ...Requires specification that contemplates whole picture

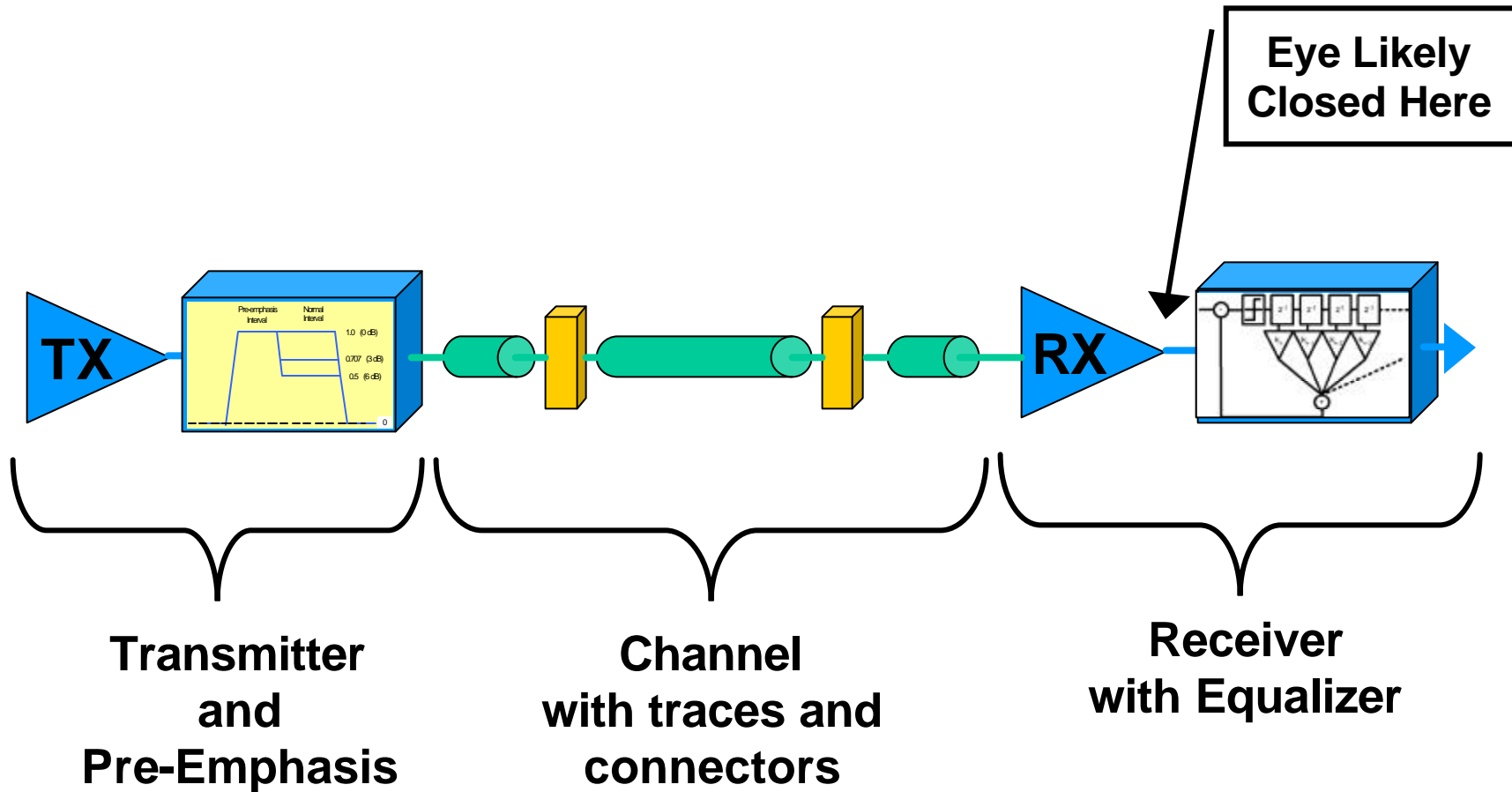
Major Assumptions/Requirements

- Physical/Electrical layer specification only
- Protocols
 - Characteristics specified via frequency content and statistics
 - Specific standards accommodated, but not specified
- BER better than 10^{-15}
- 100 ohm differential impedance channel
- Coupling
 - AC Coupling for Long Reach
 - AC and DC coupling for short reach
- Interoperability between Short & Long Reach

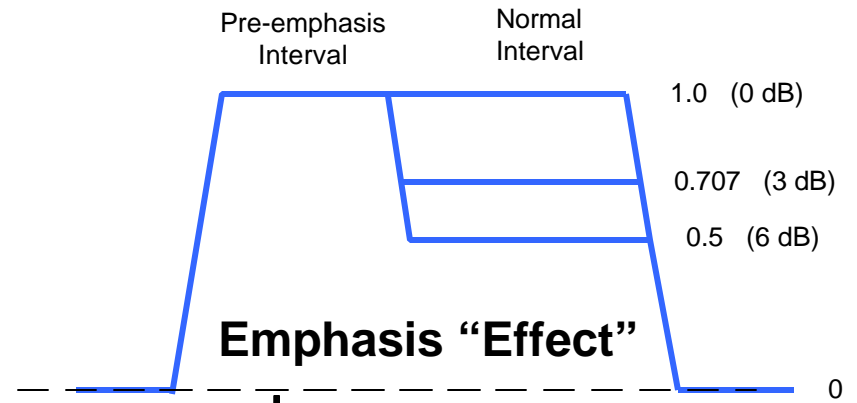
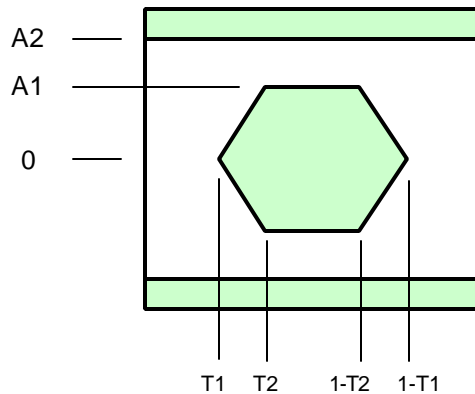
Compliance Strategy

- Specify transmit levels, emphasis and jitter
- Specify bounds for channel performance
- Infer receiver performance via:
 - *“Receiver must be able to receive any signal transmitted by a compliant transmitter through a compliant channel”*

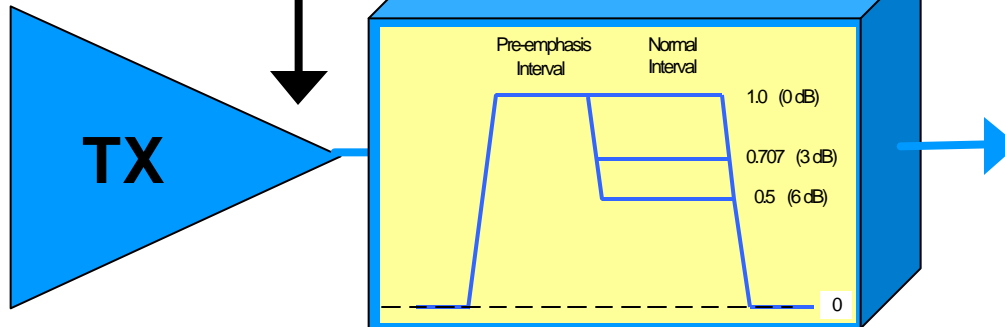
Reference Model



Transmitter Compliance

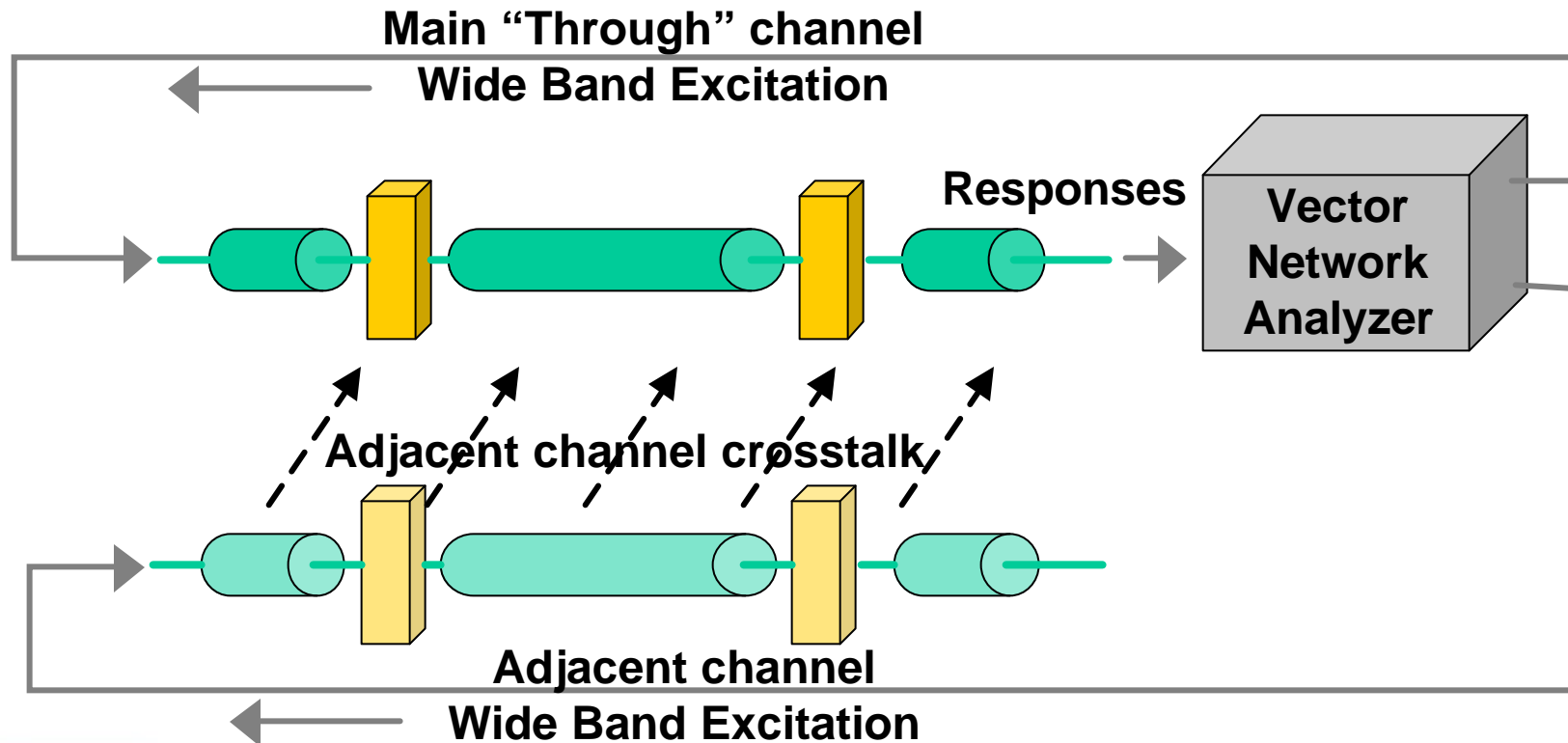


**"Before Emphasis"
Amplitude and Jitter
Compliance Mask**



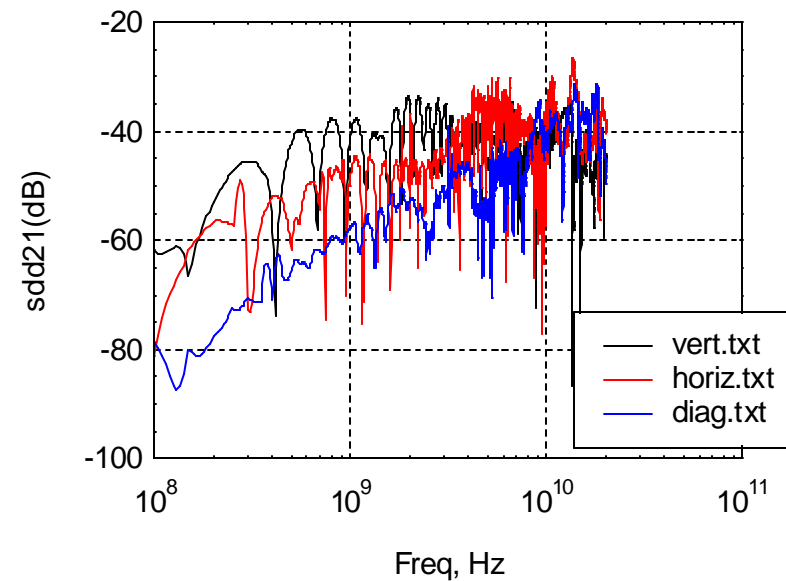
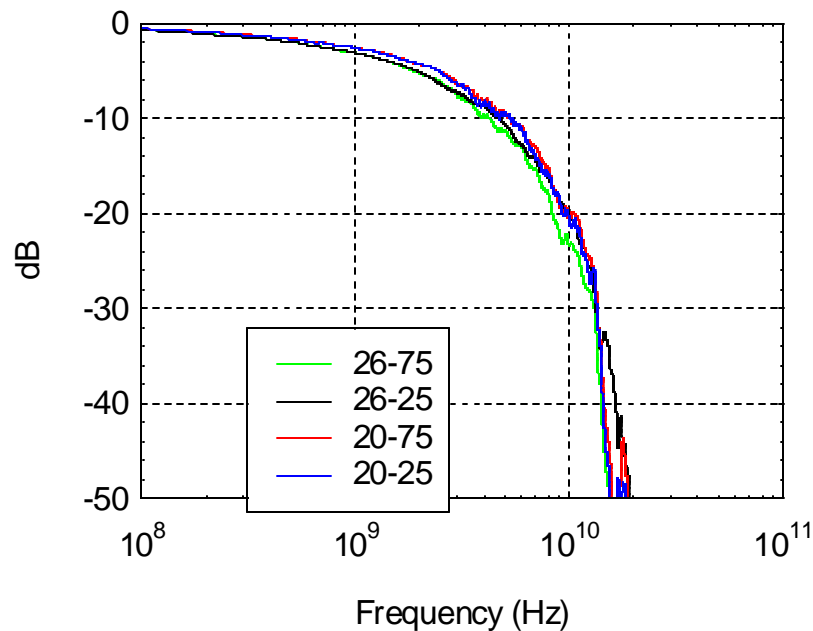
Channel Characterization

Frequency domain S-parameter characterization



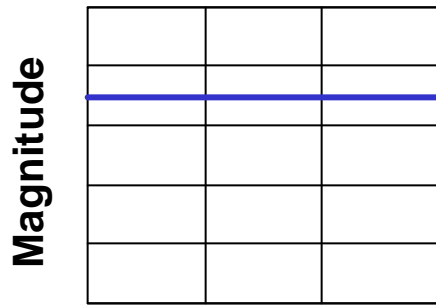
Example S-Parameter Responses

Through and Crosstalk

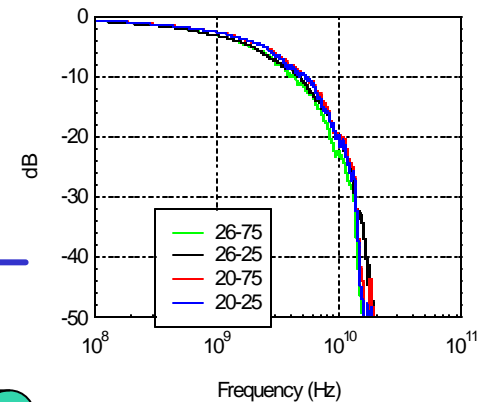


Using Inverse FFT of Measured Frequency Response to Synthesize Pulse Response

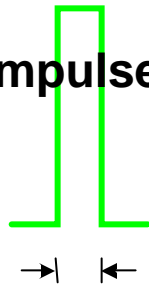
Wide Band Excitation



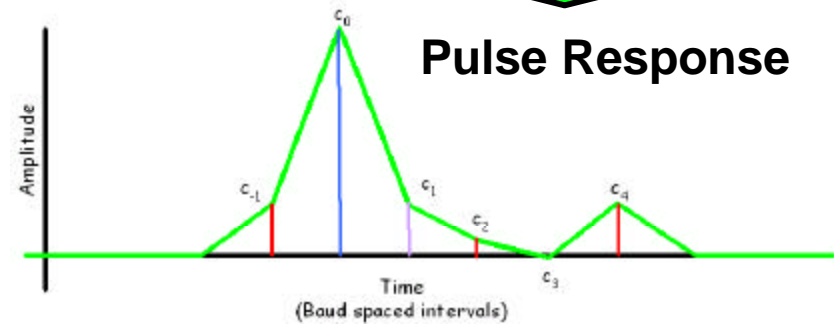
Frequency Response



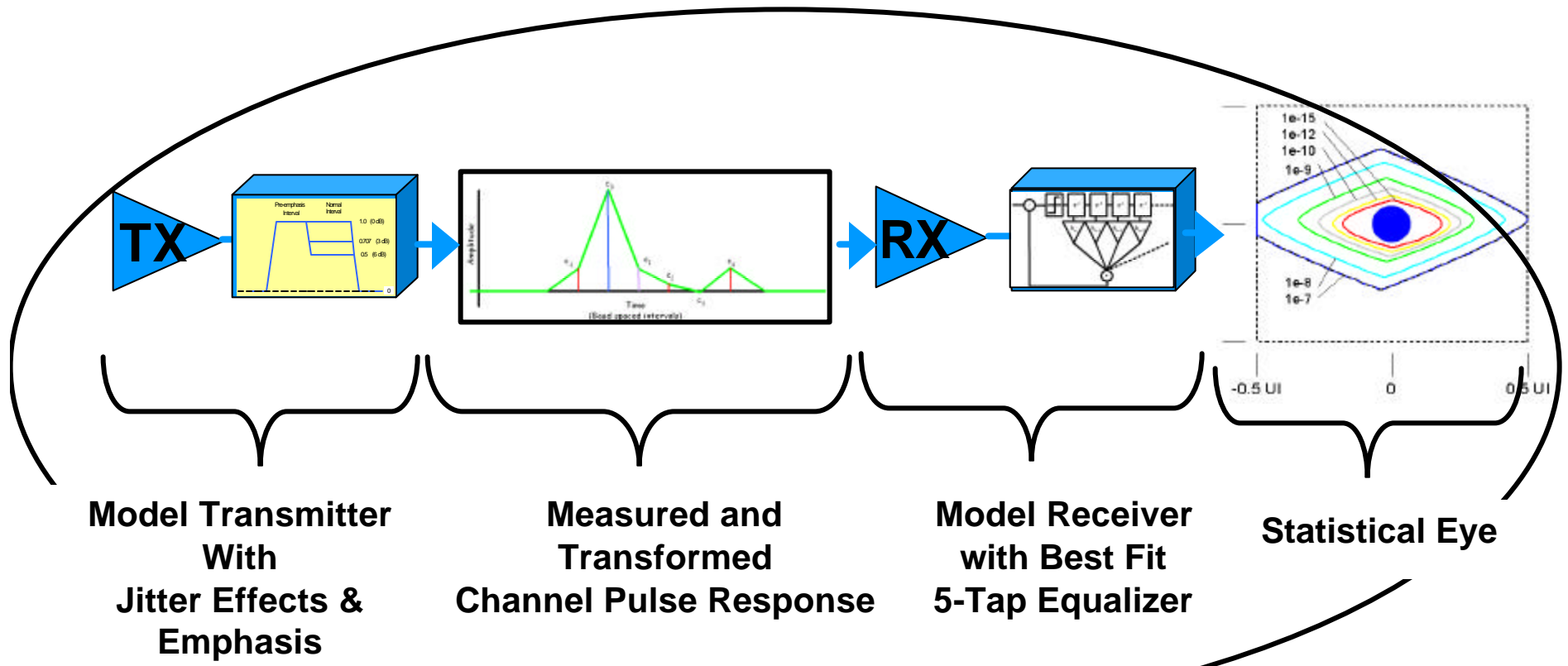
Unit Impulse Excitation



Pulse Response



Executable Model for Channel Compliance



All this is a software algorithm... that can be implemented in Test Equipment

Statistical Eye Concept

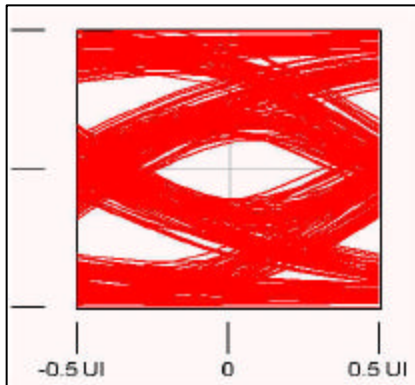


Figure 1 – Typical real time oscilloscope eye. Variation is representative of an underlying probability.

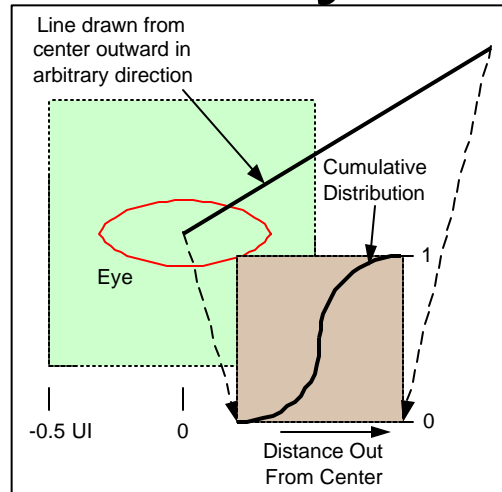


Figure 2 – Moving outward from center... probability of trace being inside increases.

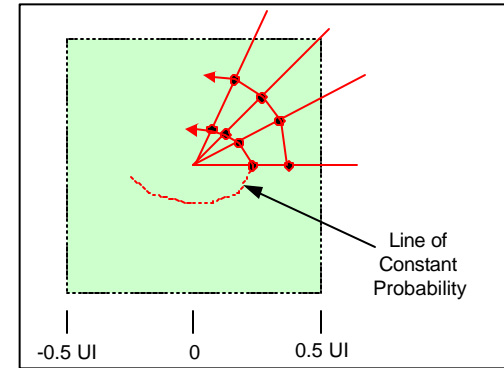


Figure 3 – Moving around the eye are lines of equal probability.

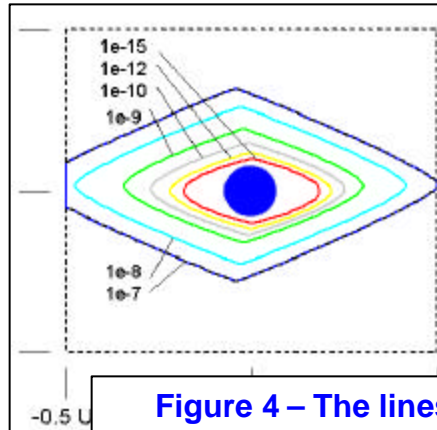


Figure 4 – The lines of equal probability form a BER surface.

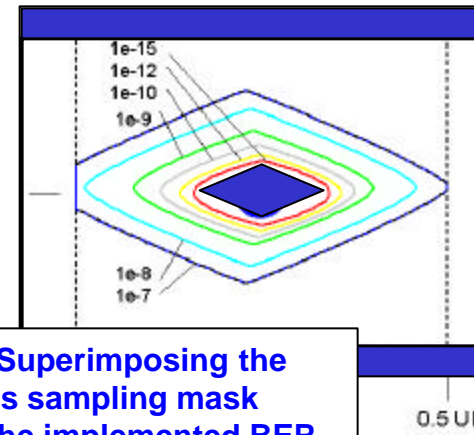


Figure 5 – Superimposing the receiver's sampling mask determines the implemented BER

Receiver Specification

- Performance is not directly specified
 - *“Receiver must be able to receive any signal transmitted by a compliant transmitter through a compliant channel”*
- This infers that:
 - Silicon Receiver must be consistent with the Model Receiver allowed in the Channel Compliance algorithm