

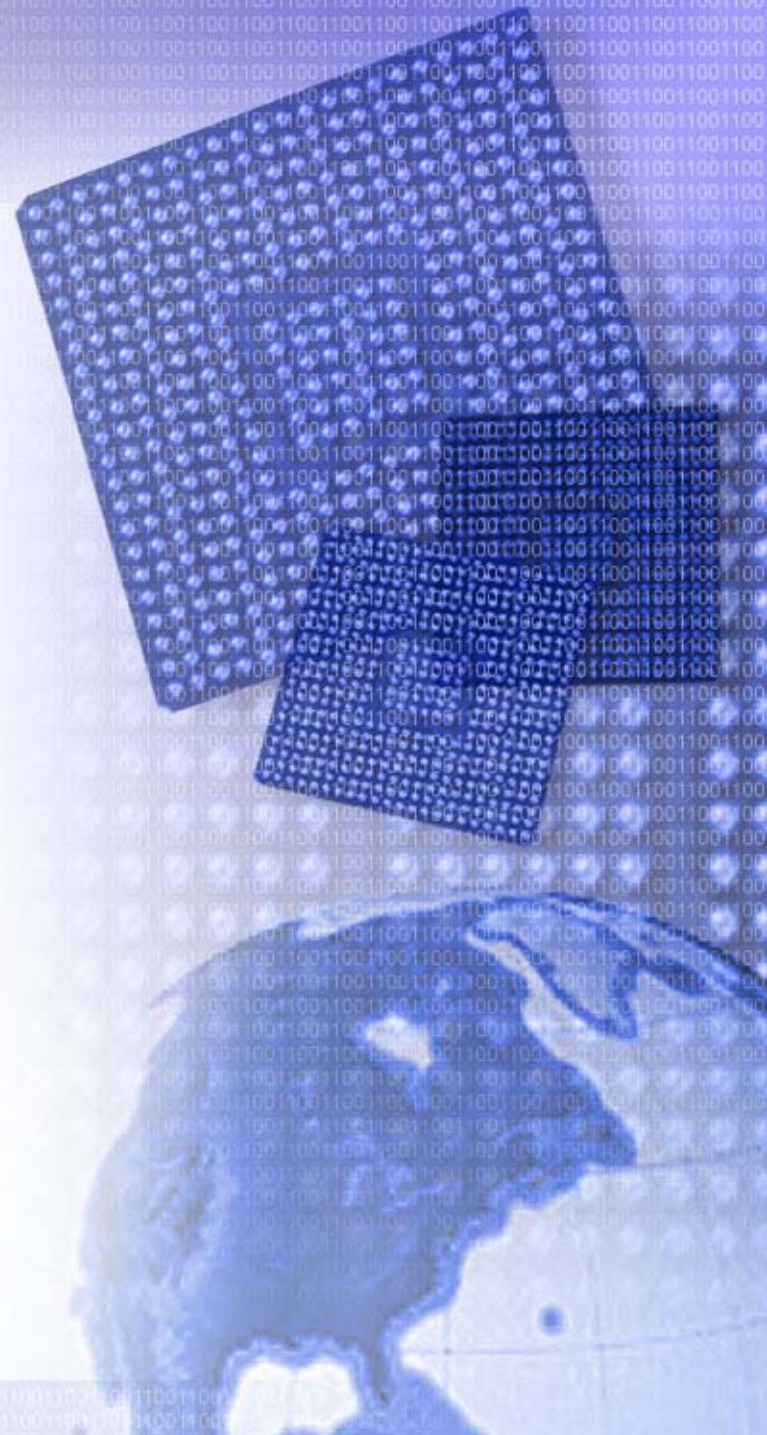


Unified Signaling Considerations

IEEE 802.3ap Task Force

10 November 2004

Brian Seemann



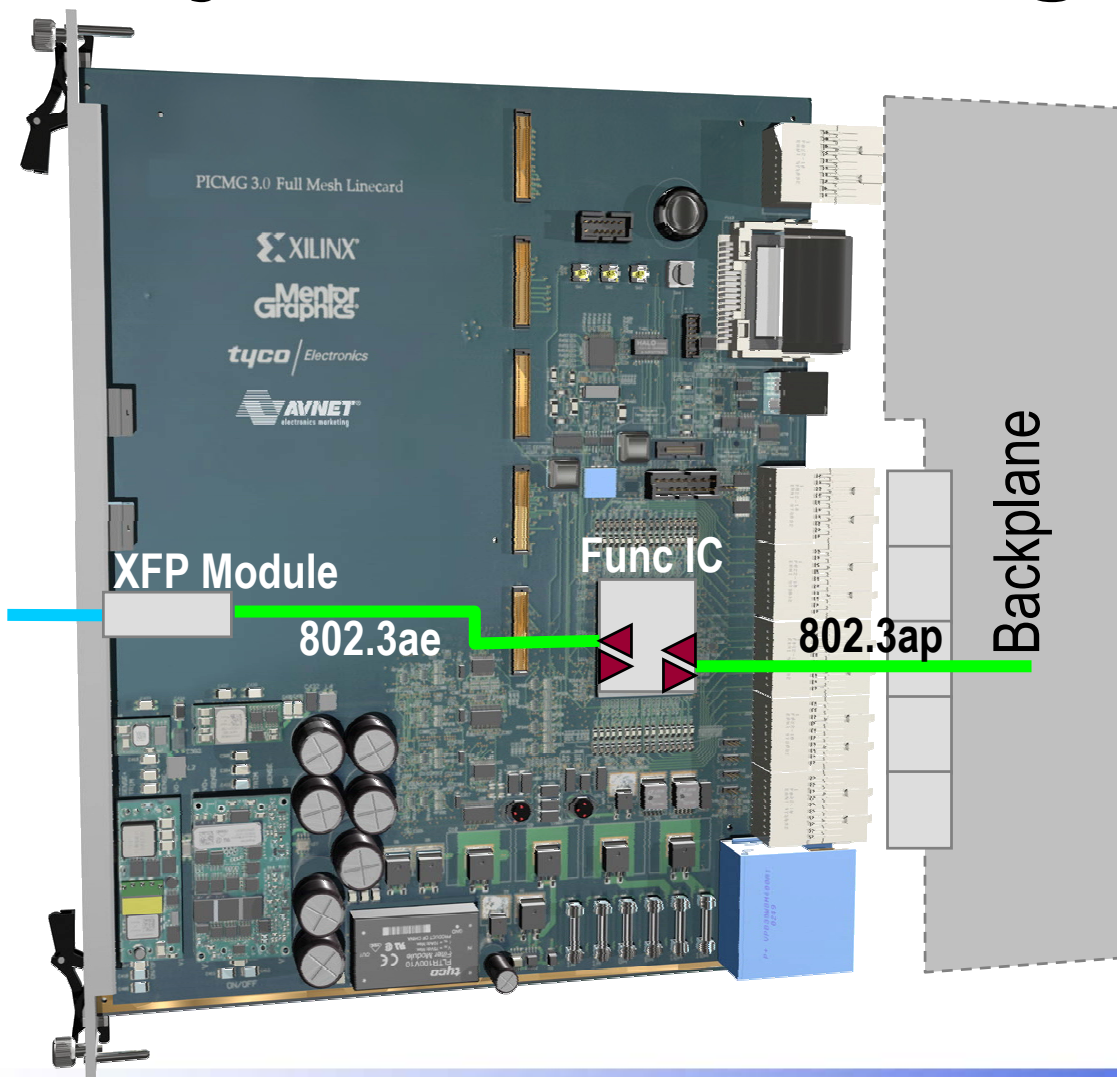
Agenda

- Market motivation for Unified Signaling
- Technical basis of convergence
- Supplier base expansion
- Scalability
- Coefficient management

Market Motivations

- Broad competitive offering
- Time to market
- Technical Tradeoffs
- Integrate-ability

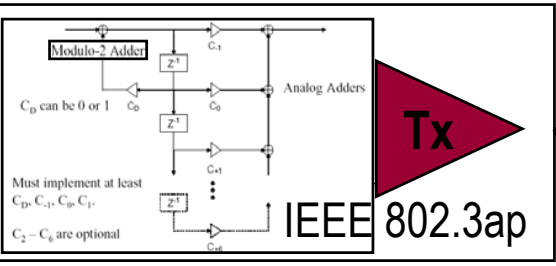
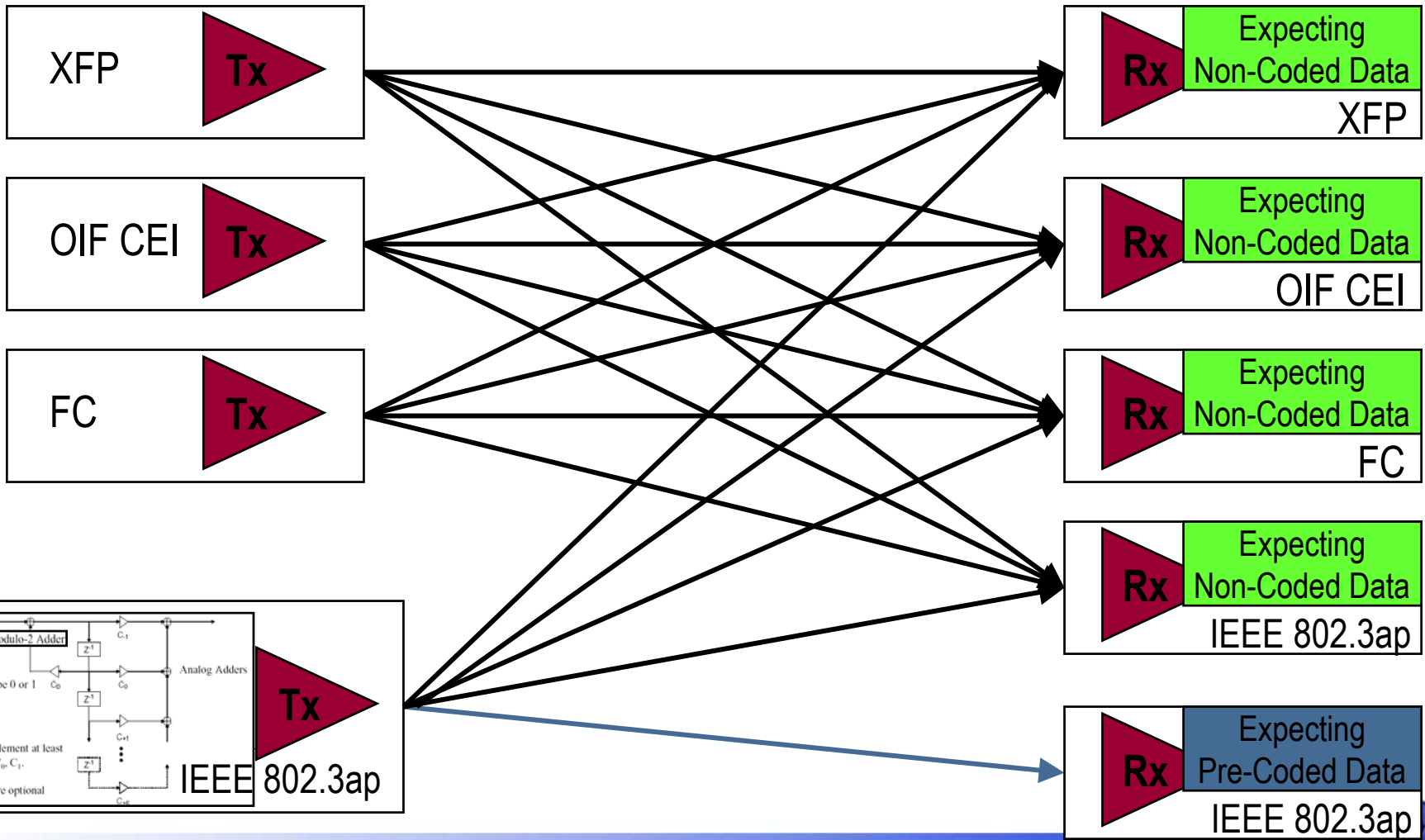
Unified Signaling Supports Adjacent and Emerging 10G PHYs



Example:

Functional ICs with
Unified Signaling
802.3ap transceivers
support communication
with 802.2ae LAN and
WAN PHY

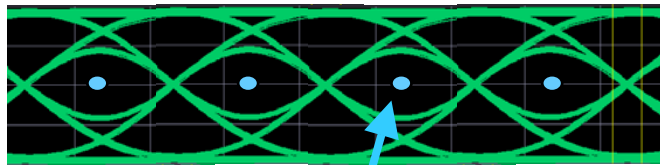
Inter-Market Compatibility



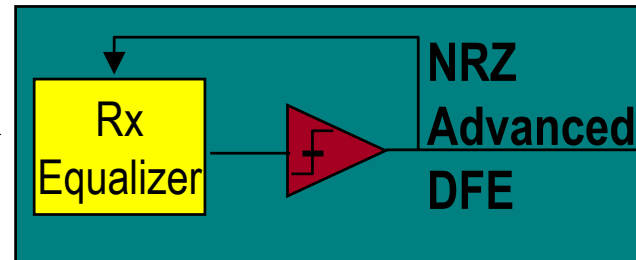
Unified Signaling:

Presenting a Common Signal at channel output

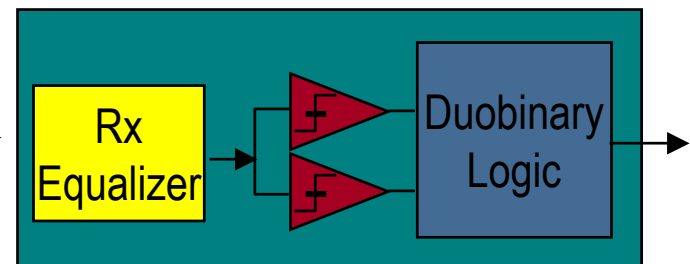
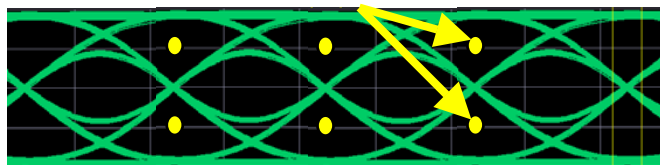
Two Commonly Expected Implementations:



Traditional NRZ Sampling Point 

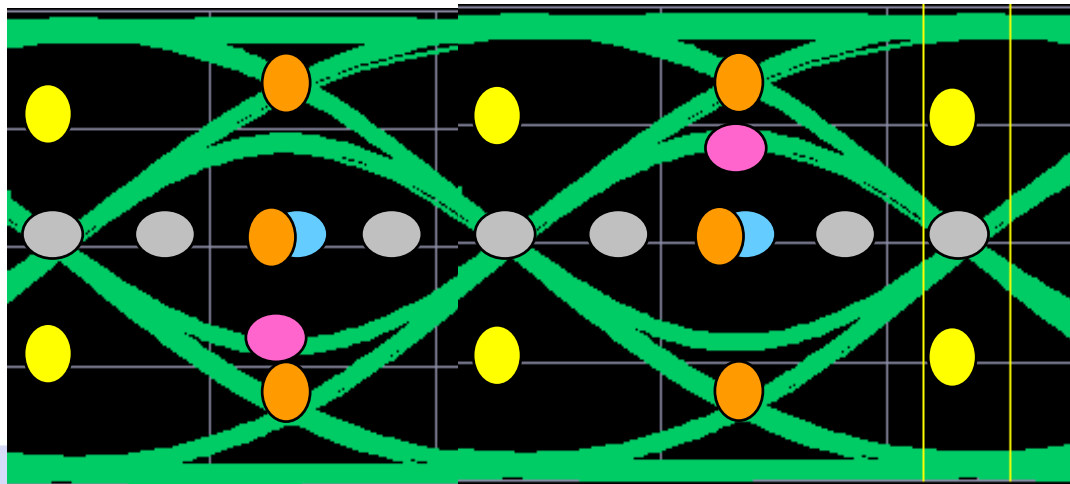


Duobinary Sampling Points 

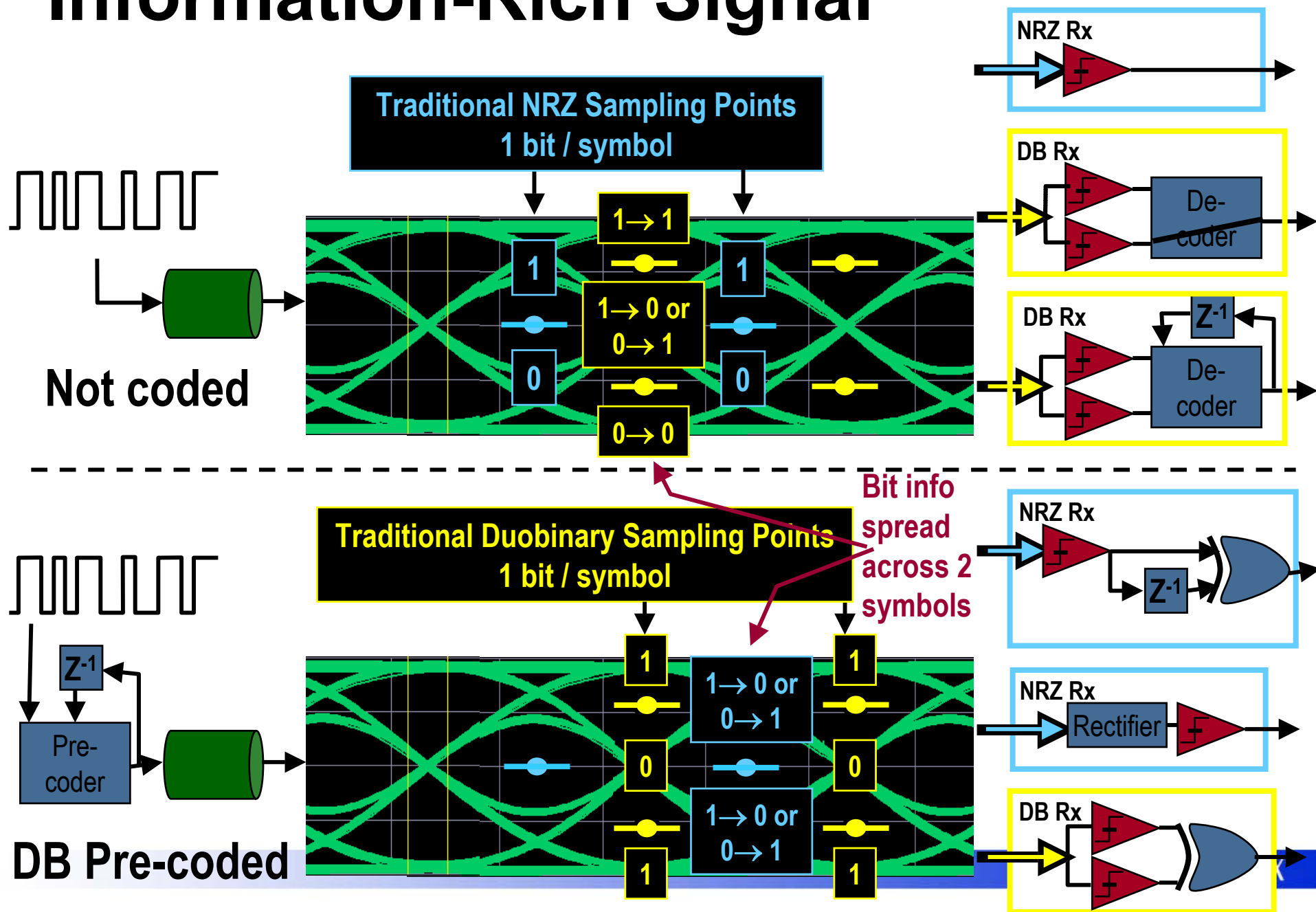


Technical Basis

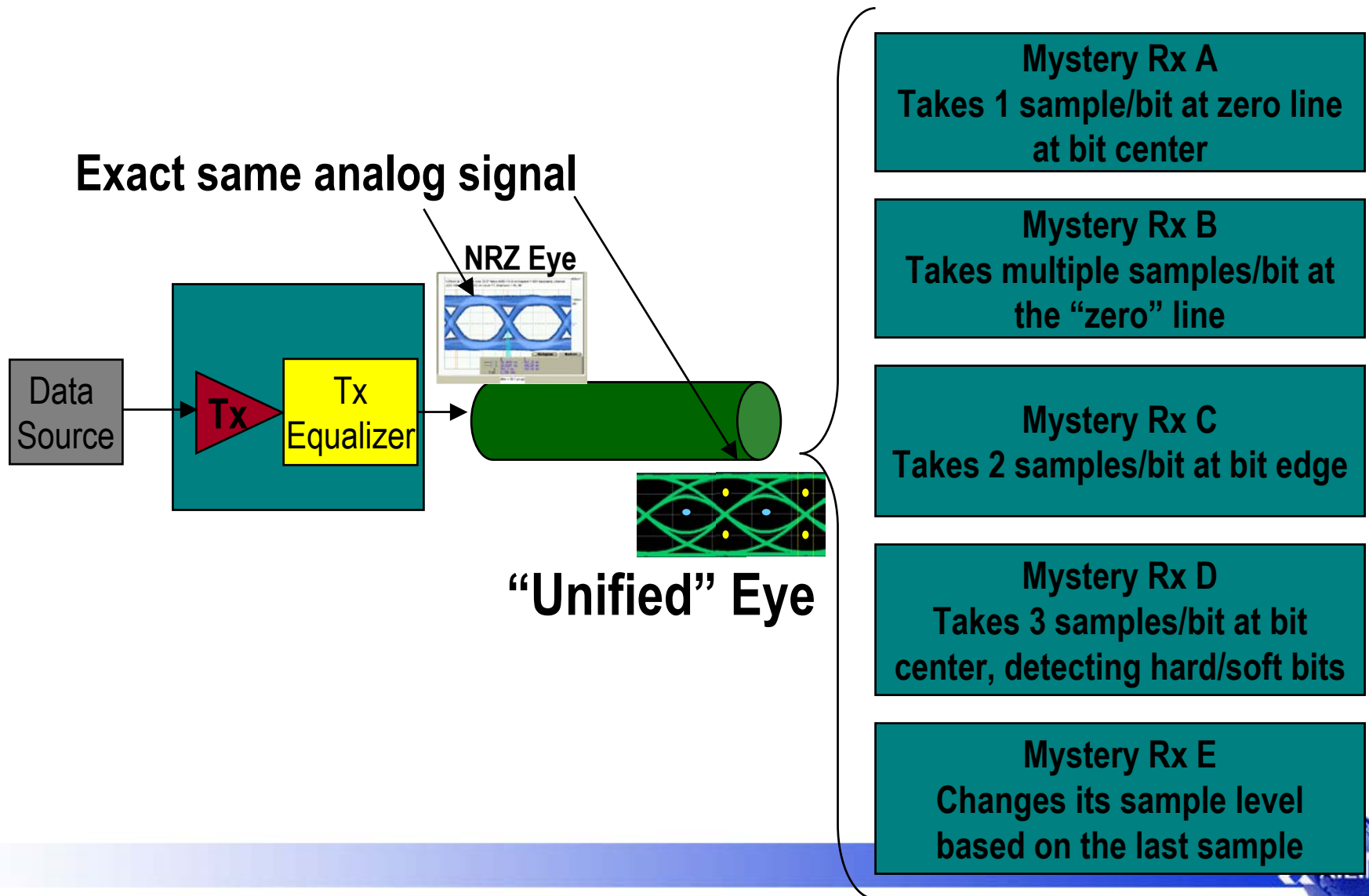
- Unified waveform efficiently conveys information
- Numerous information-rich places to sample
- Allows numerous Rx methods to operate



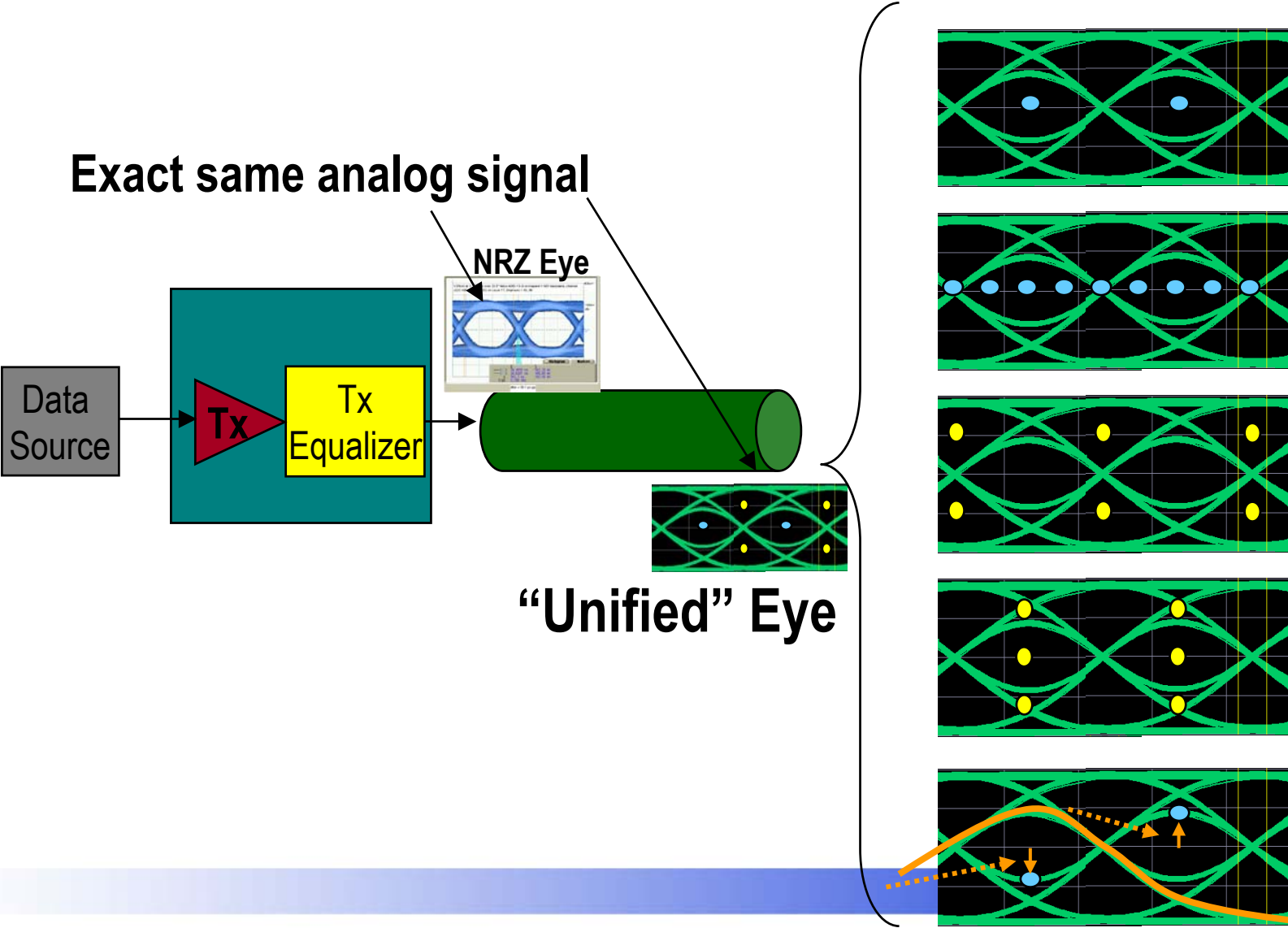
Information-Rich Signal



However, there are many ways to detect the signal



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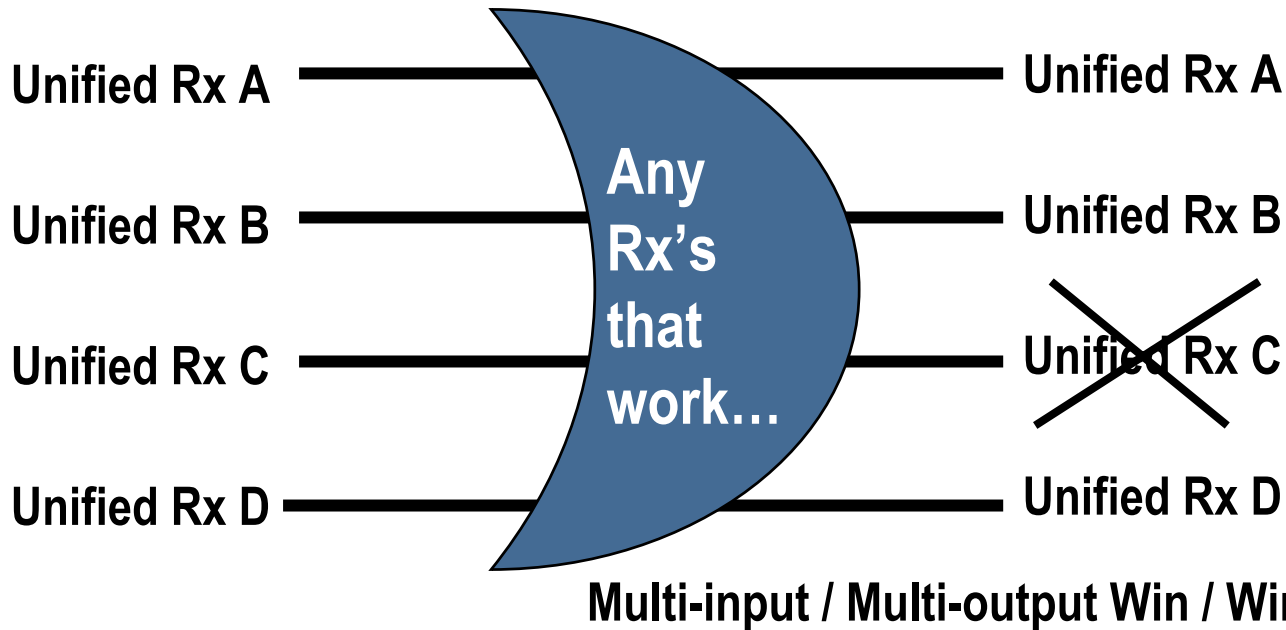


One Destination, Many Paths

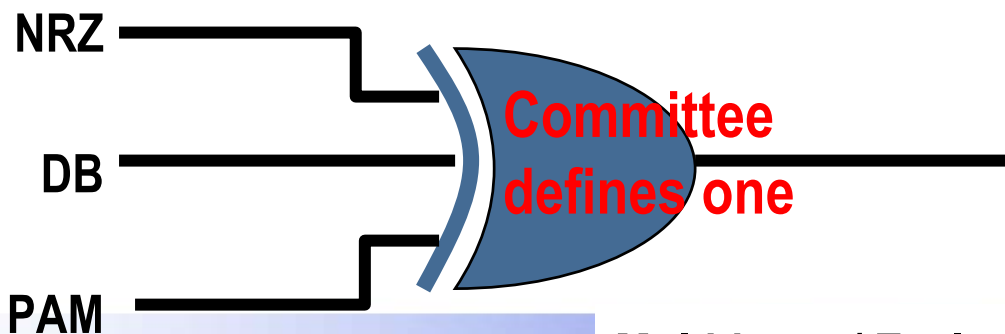
- One Destination:
 - To deliver valid bits out of a common signal
- Many Paths:
 - Many methods to recover and deliver the bits
 - Some well-established, some emerging
- Don't constrain how each company is able to deliver product to the destination
 - Different technology assets
 - Different process technologies & maturities
 - Different adjacent functionalities (IC functions)
 - Different cost & power constraints

Signaling Selection & Implementation

Objective is to get as many suppliers to deliver compliant product as soon as possible



Industry wins race when many suppliers finish race early



Industry loses race when few suppliers finish race early

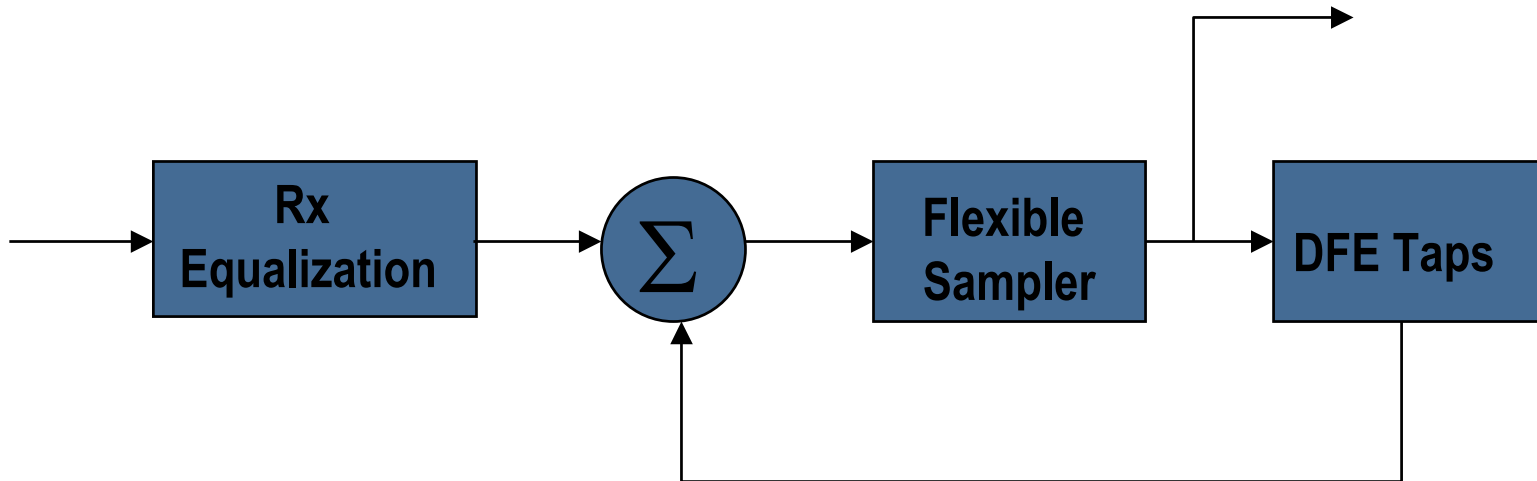
Multi-input / Exclusive-output Win / Lose

What exactly does Unified Signaling Mean?

- True Statements:
 - All transmitters talk to all receivers
 - All receivers must operate over the required channels
 - Transmitter's equalization is programmable
 - Transmitter equalization has a required operating region and granularity
- Not True Statements
 - All receivers are both NRZ and Duobinary
 - Standard dictates implementation details, such as...
 - Number of Rx DFE taps
 - Rx Sampling levels
 - Rx jitter
 - Rx SNR at slicer

Implementation Trade-offs

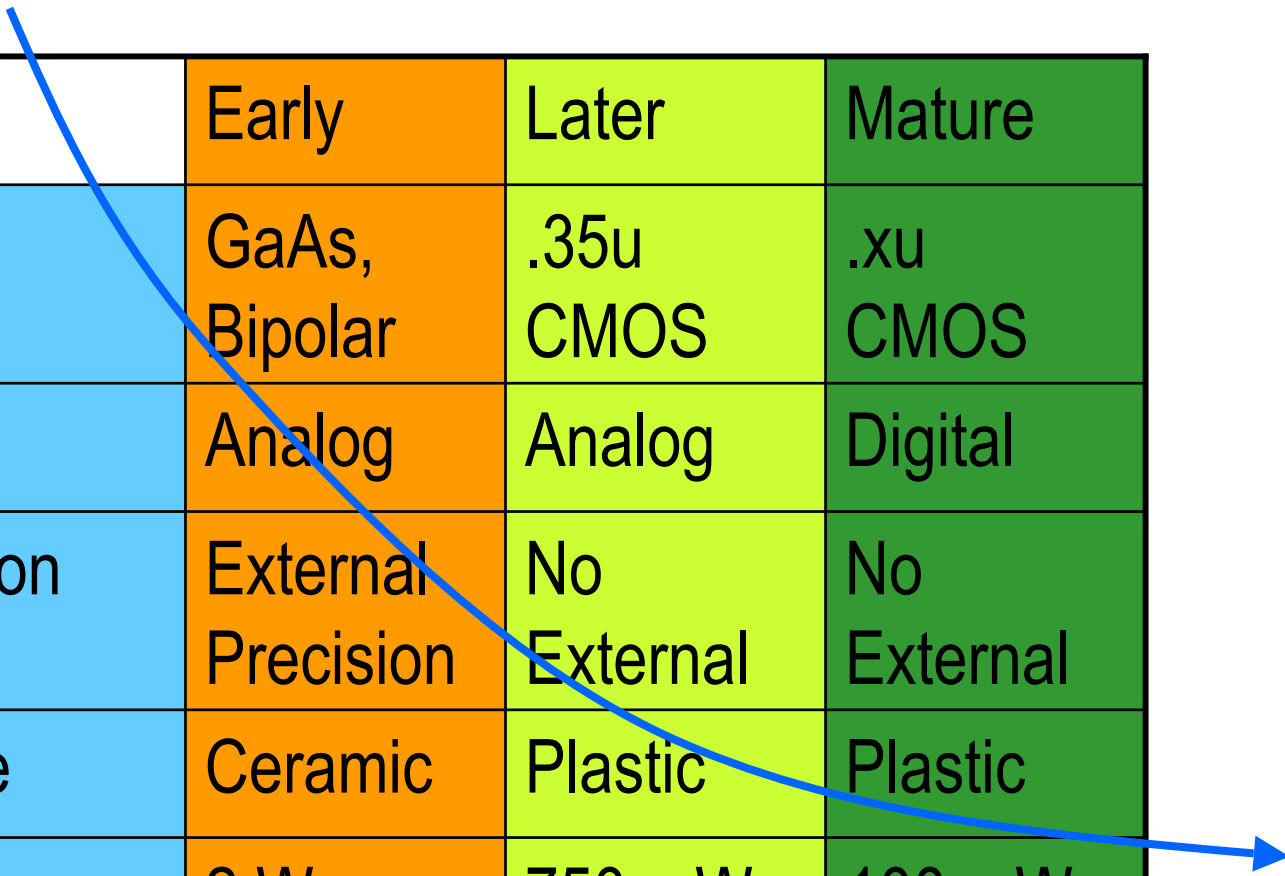
- Don't constrain implementers' trade-offs between these different blocks...



- The relative analog and digital content in each of these boxes will change over time

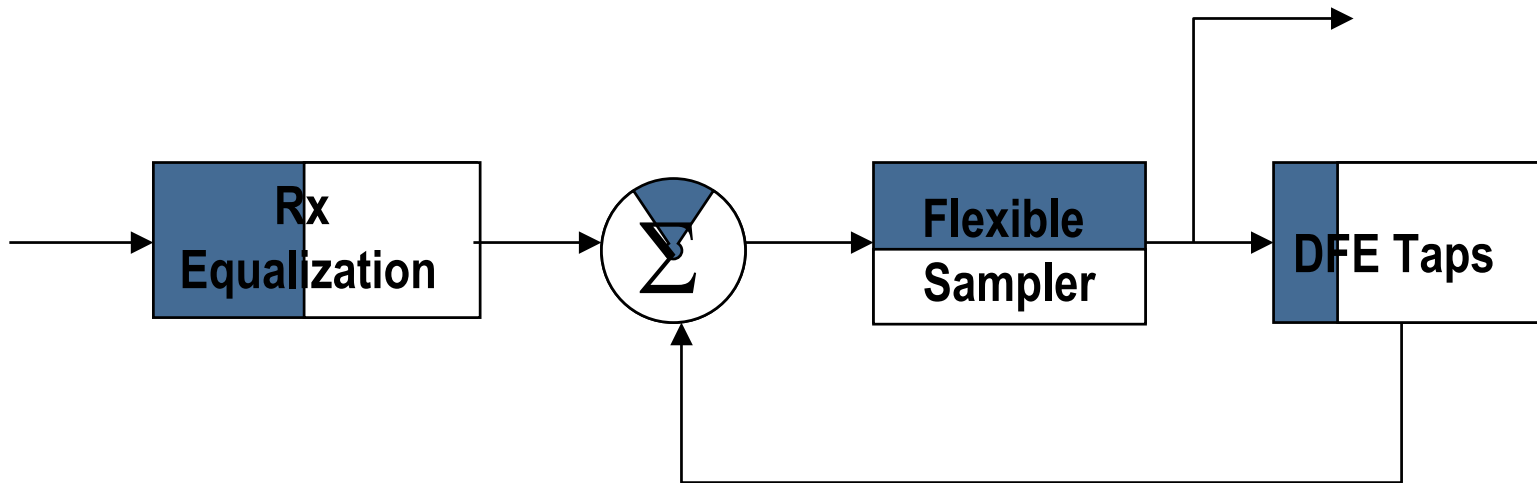
GigE Example Implementations

	Early	Later	Mature
Silicon	GaAs, Bipolar	.35u CMOS	.xu CMOS
PLLs	Analog	Analog	Digital
Integration	External Precision	No External	No External
Package	Ceramic	Plastic	Plastic
Power	2 W	750 mW	100 mW



Power Scaling

- Power vs. distance & severity
 - Able to shut down different parts for shorter/easier channels

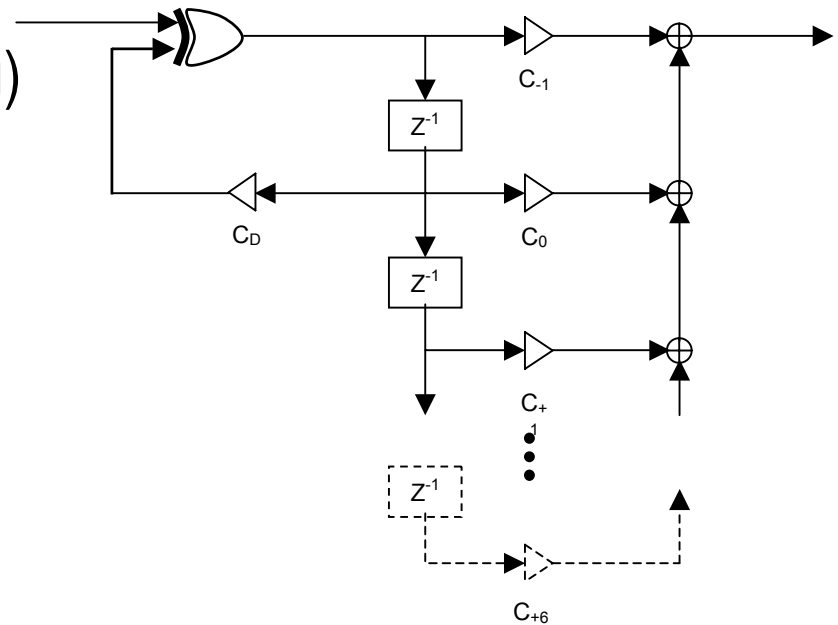


Managing Coefficients

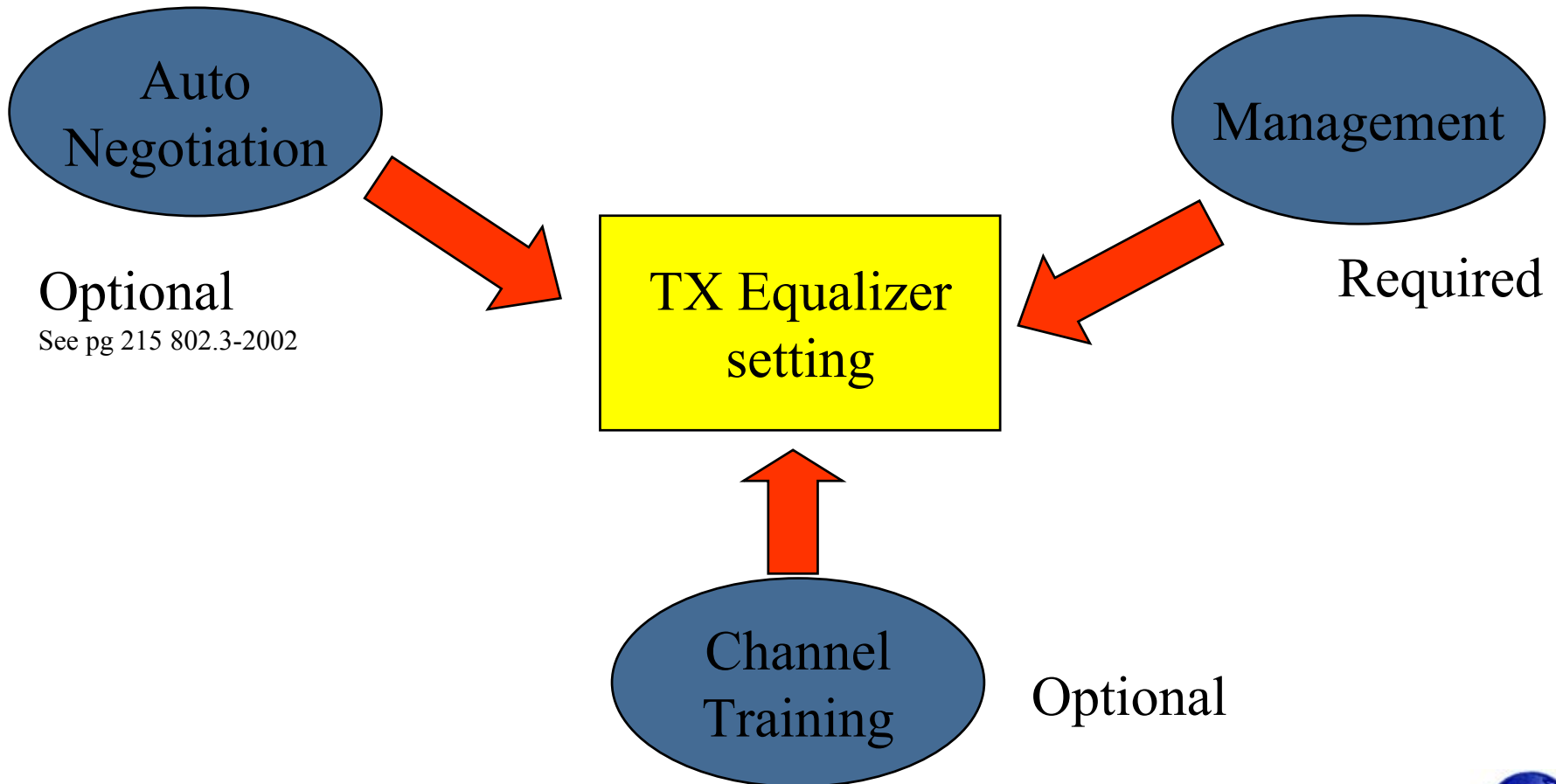
- Problem space of channels is very large and diverse
 - Any signaling method will benefit from optimal equalization adjustment
 - Tx equalization is an important tool
 - It enables delivery of the Unified Signal
 - Tx cannot be certain of channel behavior
- Multiple methods of controlling coefficients

Tx Equalization Parameters

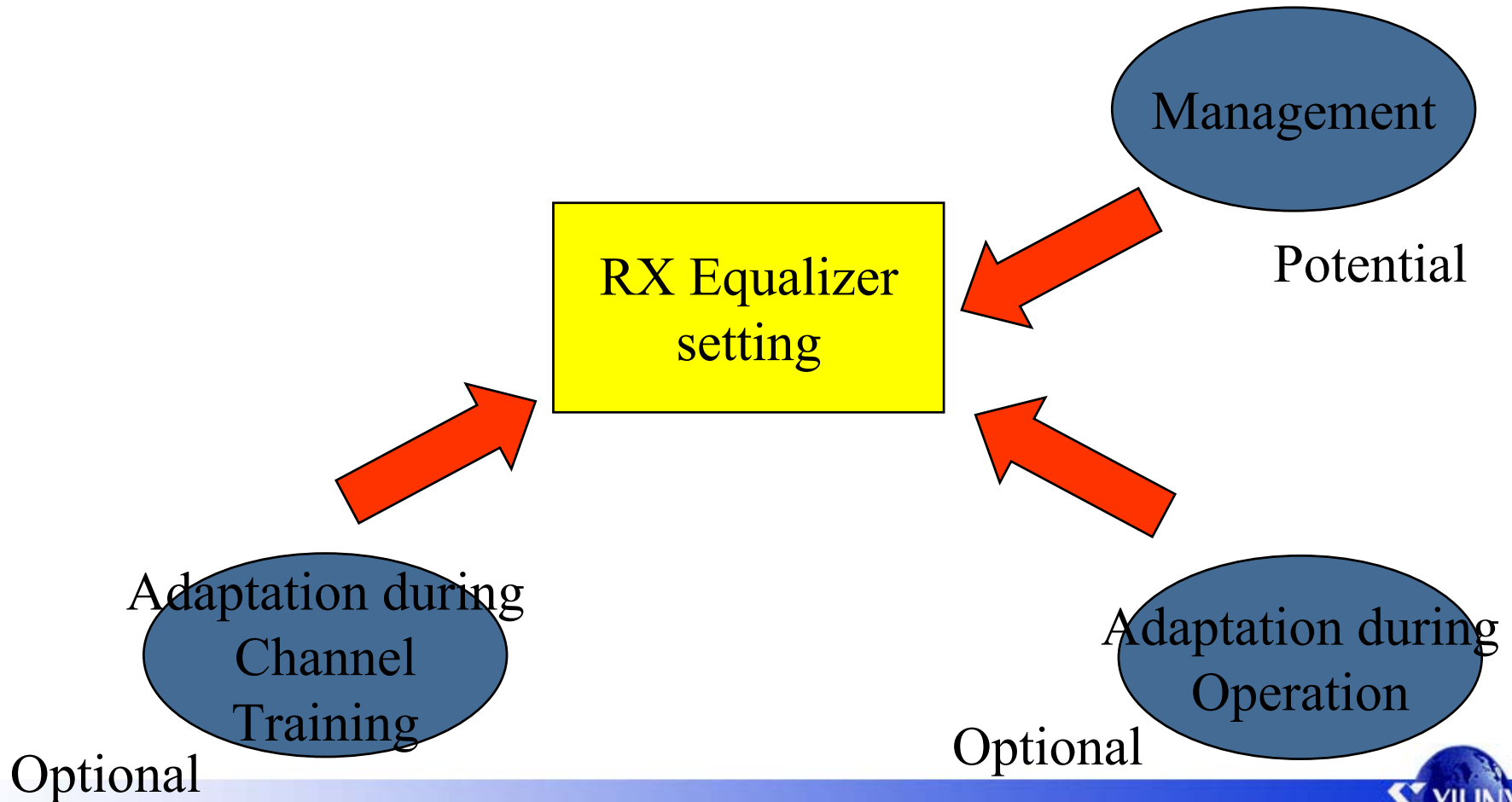
- Equalization parameters cause an interrelationship between adjacent bits
 - Linear (FFE, IIR)
 - Non-linear (DFE, Pre-Coding)



TX Equalizer Settings can be set Many ways



RX Equalizer Settings may also be set several ways



Conclusions

- Unified Signaling...
 - Broadens solution options, which...
 - Leverages vendor diversity
 - Accelerates multi-vendor transceiver product availability
 - Increases rate of cost and power reduction
 - Broadens application support:
 - 802.3ae LAN and WAN PHY
 - XFP
 - OIF CEI 10G SR & LR
 - Moves process and industry forward