

SOLARFLARE
Communications

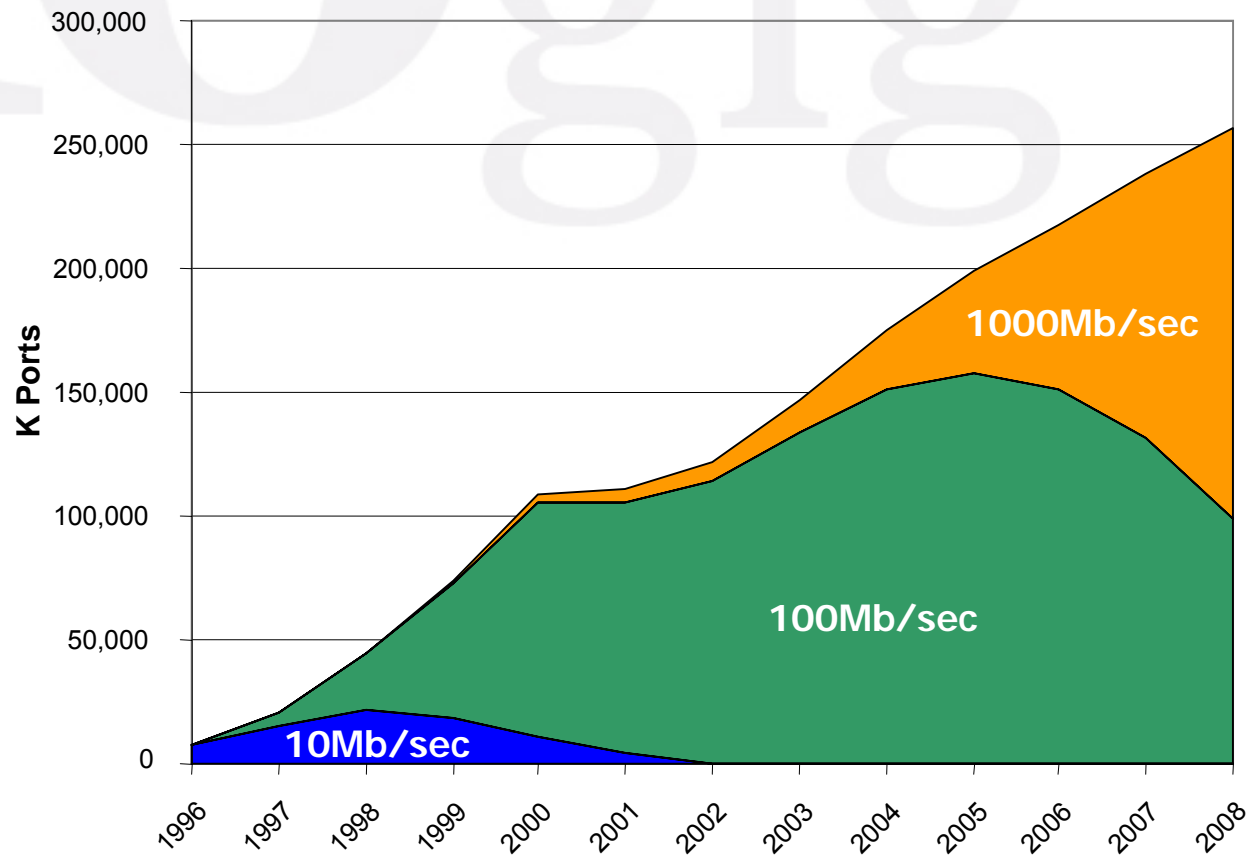
Copper at the Speed of Light: 10GBASE-T

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Founder & CTO



Historical Ethernet Speed Transitions: Inevitable Market Shifts

Switched Ethernet Ports (volume)



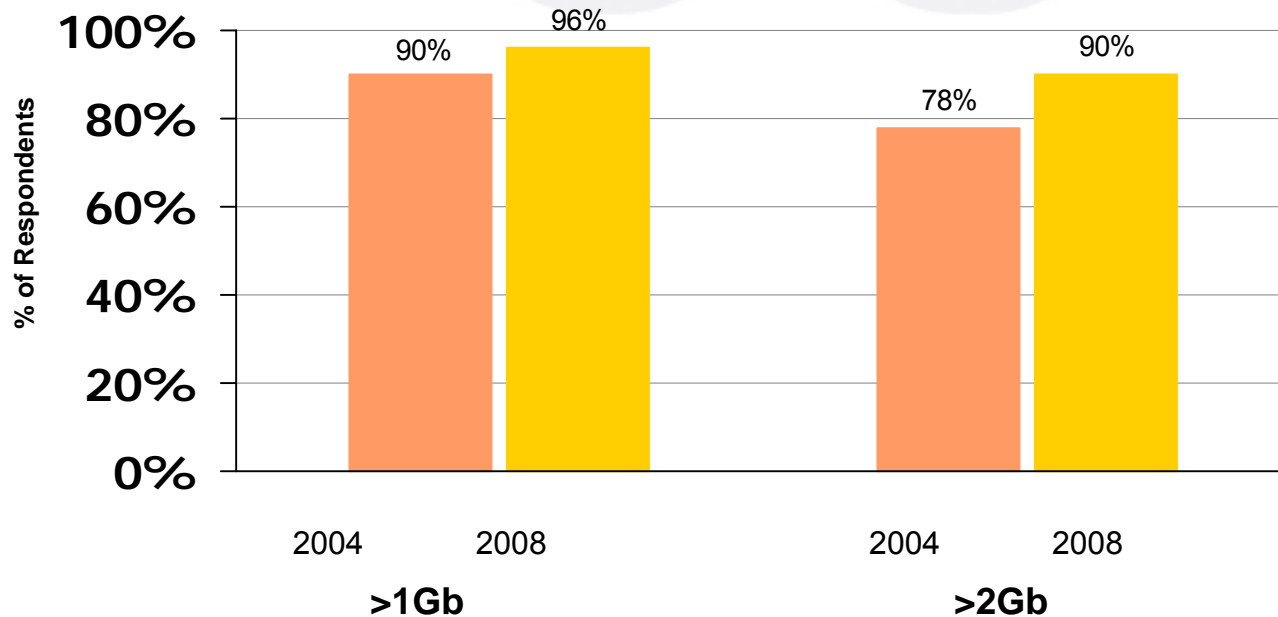
Source: Dell'Oro

End Users Demand Higher Bandwidth Now

“It is easier to overprovision than to manage. IT managers will buy more bandwidth than buy software to optimize their current bandwidth.”

–Industry Analyst

Demand for high bandwidth today and in 2008
(Percent of respondents with peak data rate needs of >1Gb & >2Gb)



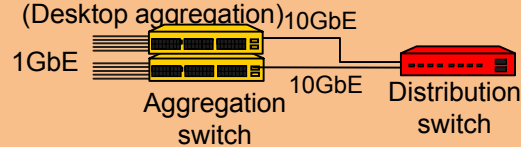
Source: Mercer Management Consulting, "Ethernet Technologies in the Enterprise LAN," April 2004; n = 293.

10GBase-T: Opportunity spaces

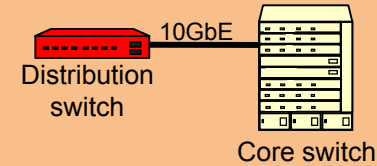
Desktop to wiring closet



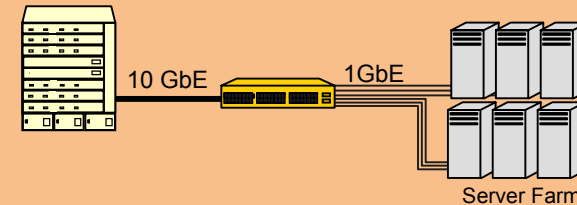
Wiring Closet Switch to Distribution Switch



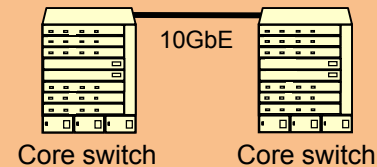
Distribution Switch to Core Switch



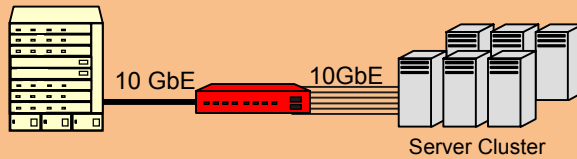
Server Aggregation



Core Switch to Core Switch



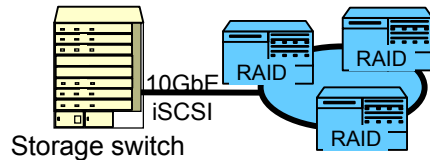
Clustered Servers



Direct Server-to-Switch Connection



Storage to Core Switch (SAN)

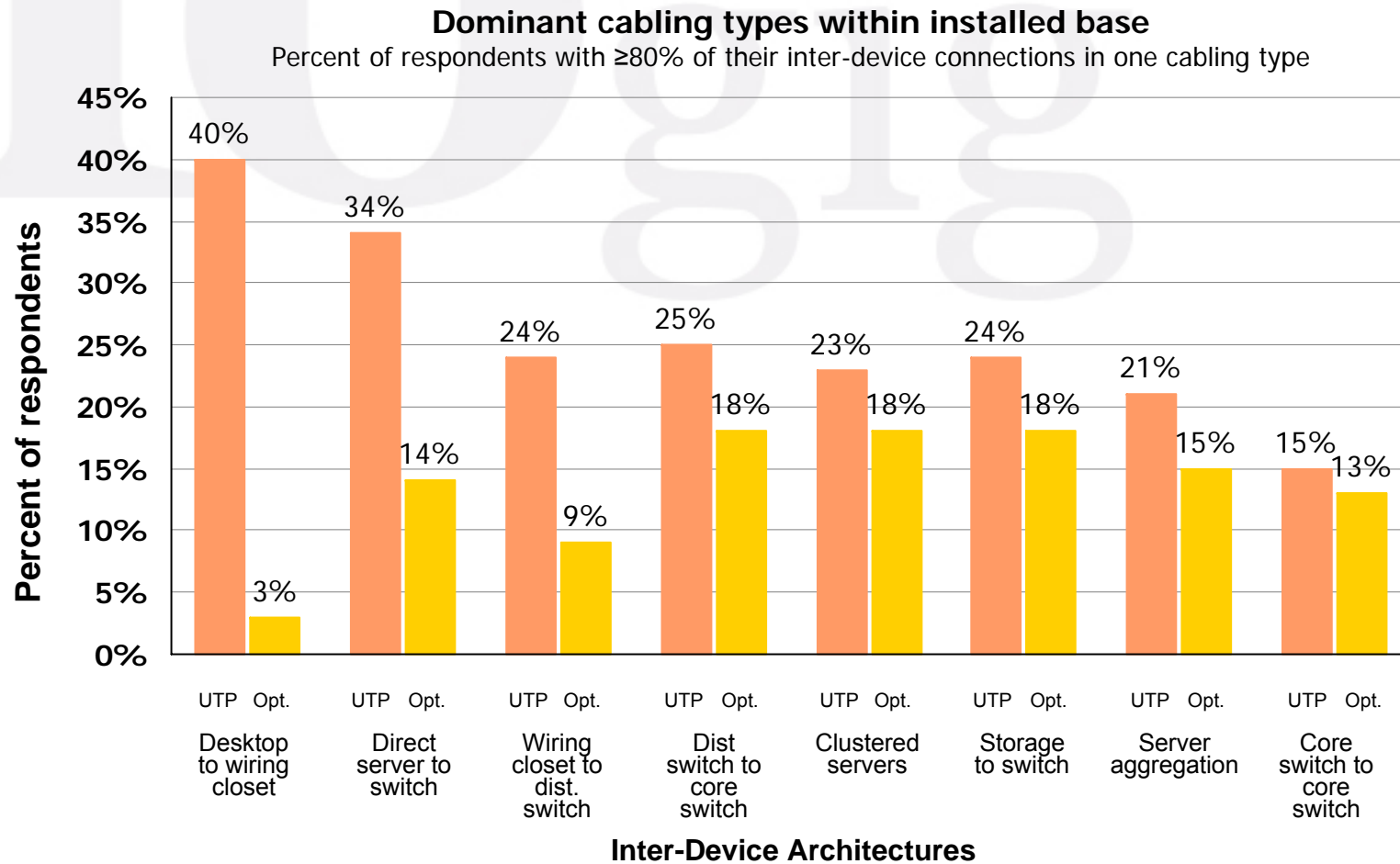


Server to
switch

Switch to
switch

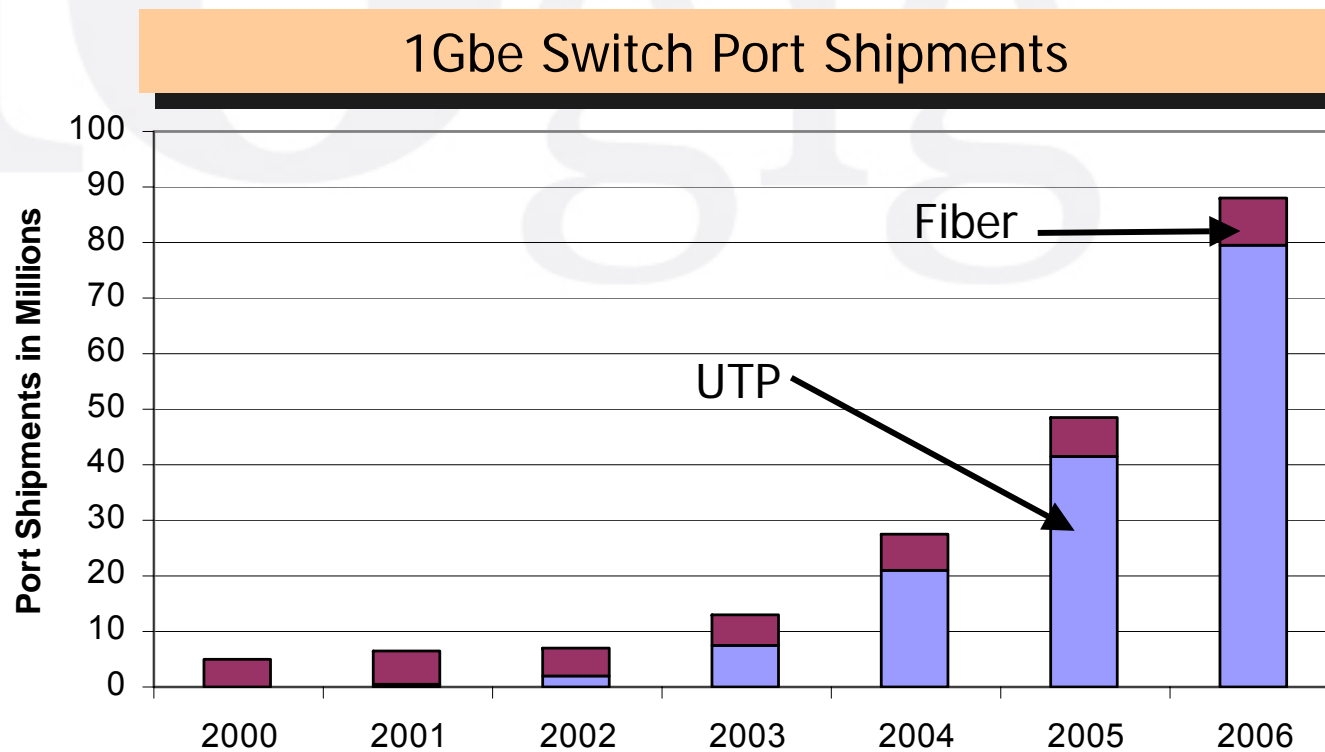


UTP is the Prevalent Media Type in Every Inter-Device Architecture



Source: Mercer Management Consulting, "Ethernet Technologies in the Enterprise LAN," April 2004; n = 293.

Rapid 1Gbe UTP Dominance



Source: Dell'Oro, Ethernet Forecast, July 2004

Note: Switch Ports Only

Why UTP Wins Over Alternatives

Optical Modules

- **Expensive** terminations requiring skilled labor to install
- **One per port**
- **Mechanical assembly** of many complex technologies
 - VCSELs, PIN diodes, laser drivers, transimpedance amps and SerDes chips
- Operate at **only one data rate**

15m Duplex Optical Cable: \$70



CX-4

- **No** field terminations
- **Expensive**, hard to use cabling
- **Short** reach (15m-30m)
- **Prevents patch panel** connections

15m CX-4: \$200



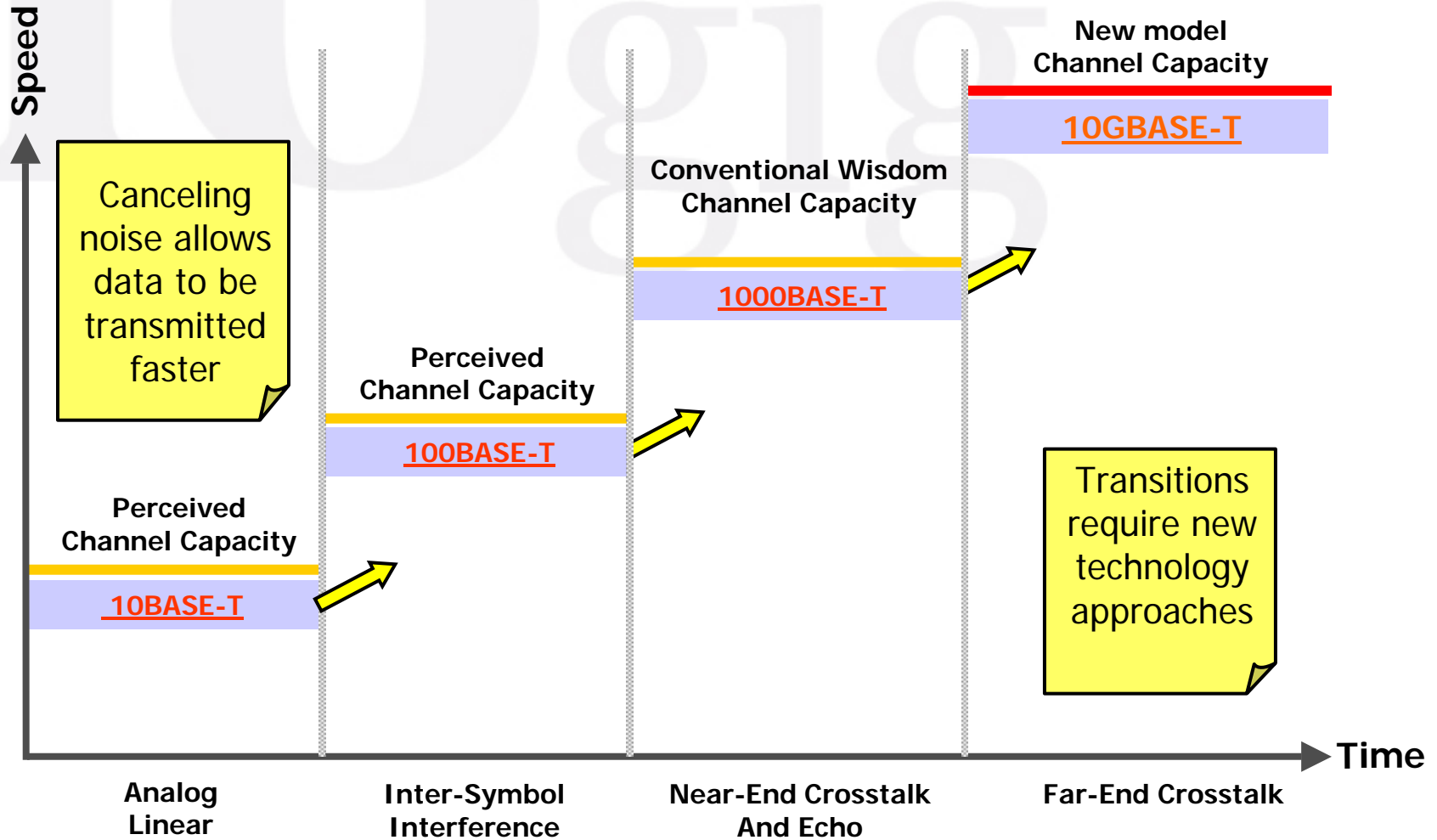
10GBASE-T

- RJ45 is **inexpensive** and easily terminated the field
- Capable of **multi-port-on-a-chip** implementations
- Implemented in **vanilla CMOS**
- **Rate adaptive** – drives early future proofing
- Enables **higher density** line cards

15m Cat 6: \$15

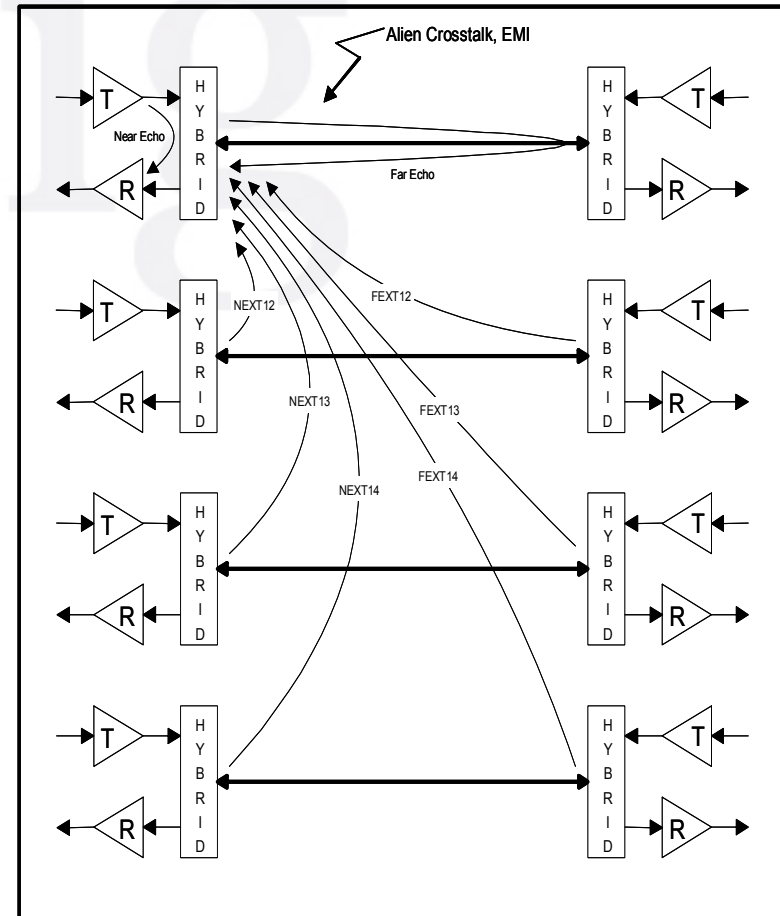


Technology Behind Ethernet Evolution

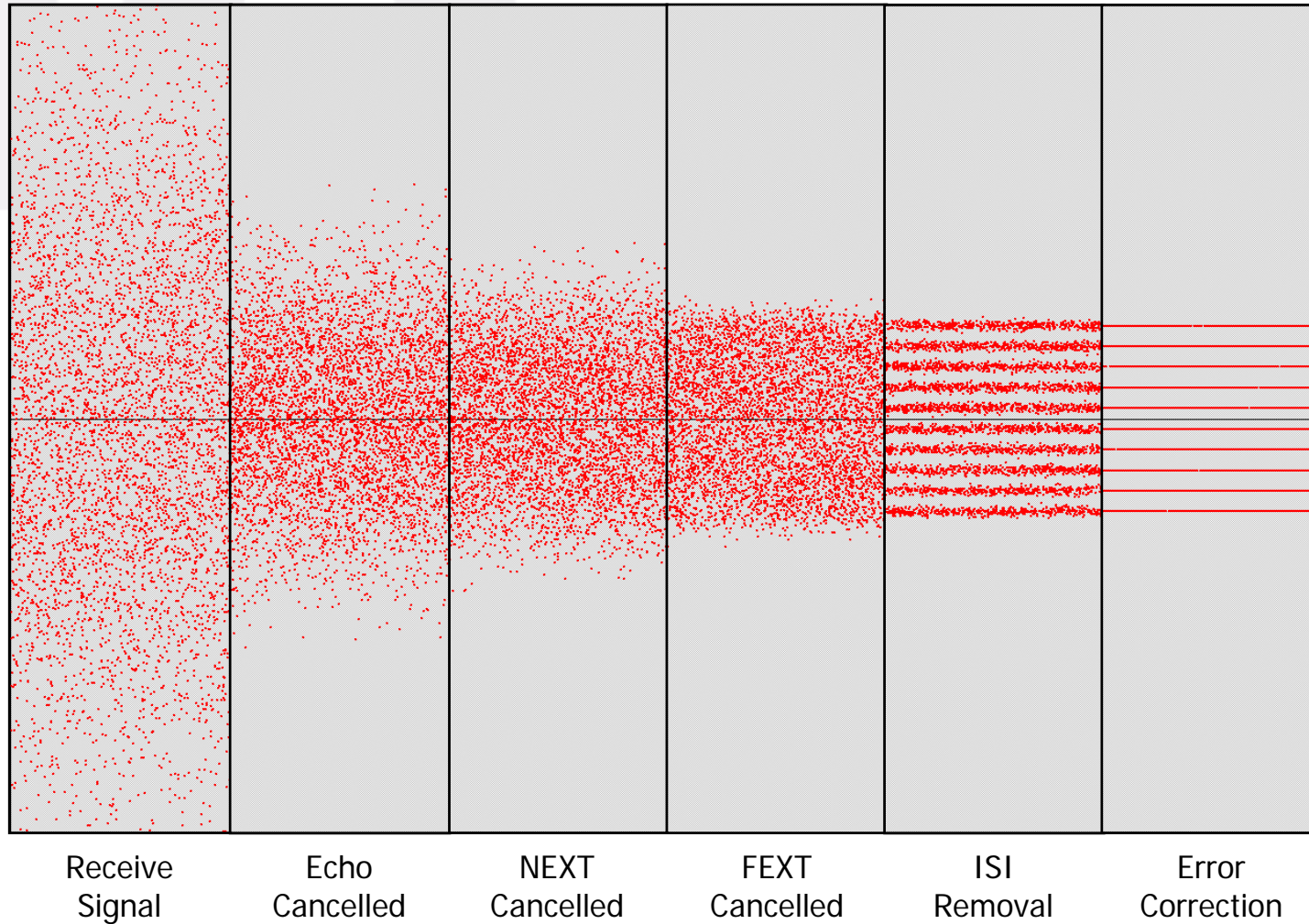


Why is 10G on UTP so difficult?

- Very small receive signals swamped by...
- Many sources of noise:
 - Far-End Echo
 - Near-End Crosstalk (NEXT)
 - Far-End Crosstalk (FEXT)
 - Inter-symbol interference (ISI)
 - Electromagnetic Interference (EMI)



Noise Cancellation



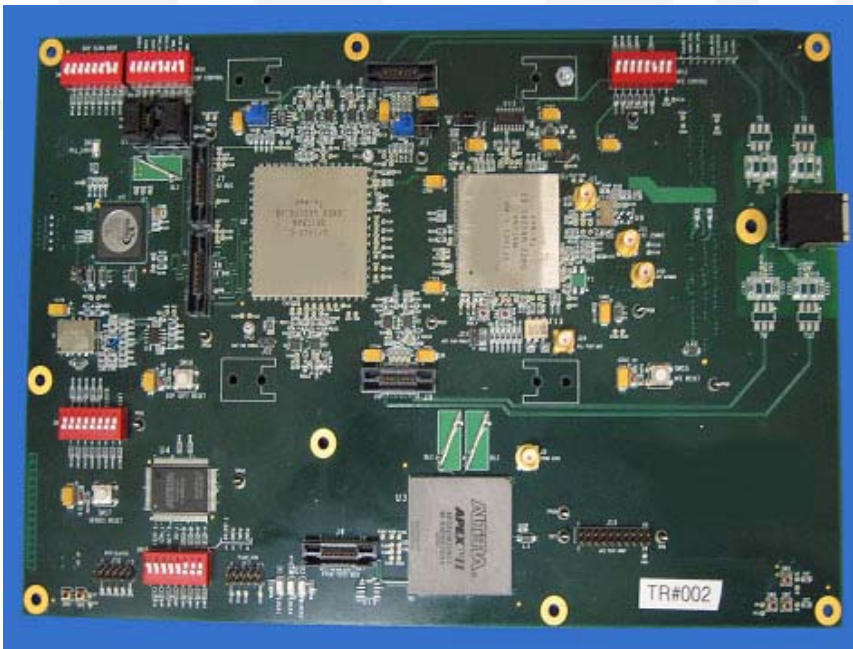
From Skepticism to Standards

- Experts said 10 Gigabit on LAN wiring was impossible...
- IEEE 802 studied feasibility for 1 year in "Study Group"
- IEEE 802.3 launches 802.3an Task Force to standardize 10GBASE-T
 - At least 55m on existing Category 6 wiring
 - Longer distances based on qualification
 - Up to 100m on Enhanced Category 6 wiring
- TIA TR-42 launches cabling standards projects to support 10GBASE-T
 - TSB-155 to qualify existing cabling
 - Project SP-3-4426-AD10 for "new" Augmented Category 6



Demonstrated Results

Full Duplex, 10Gbe, 50m Cat5e, Error Free



AFE

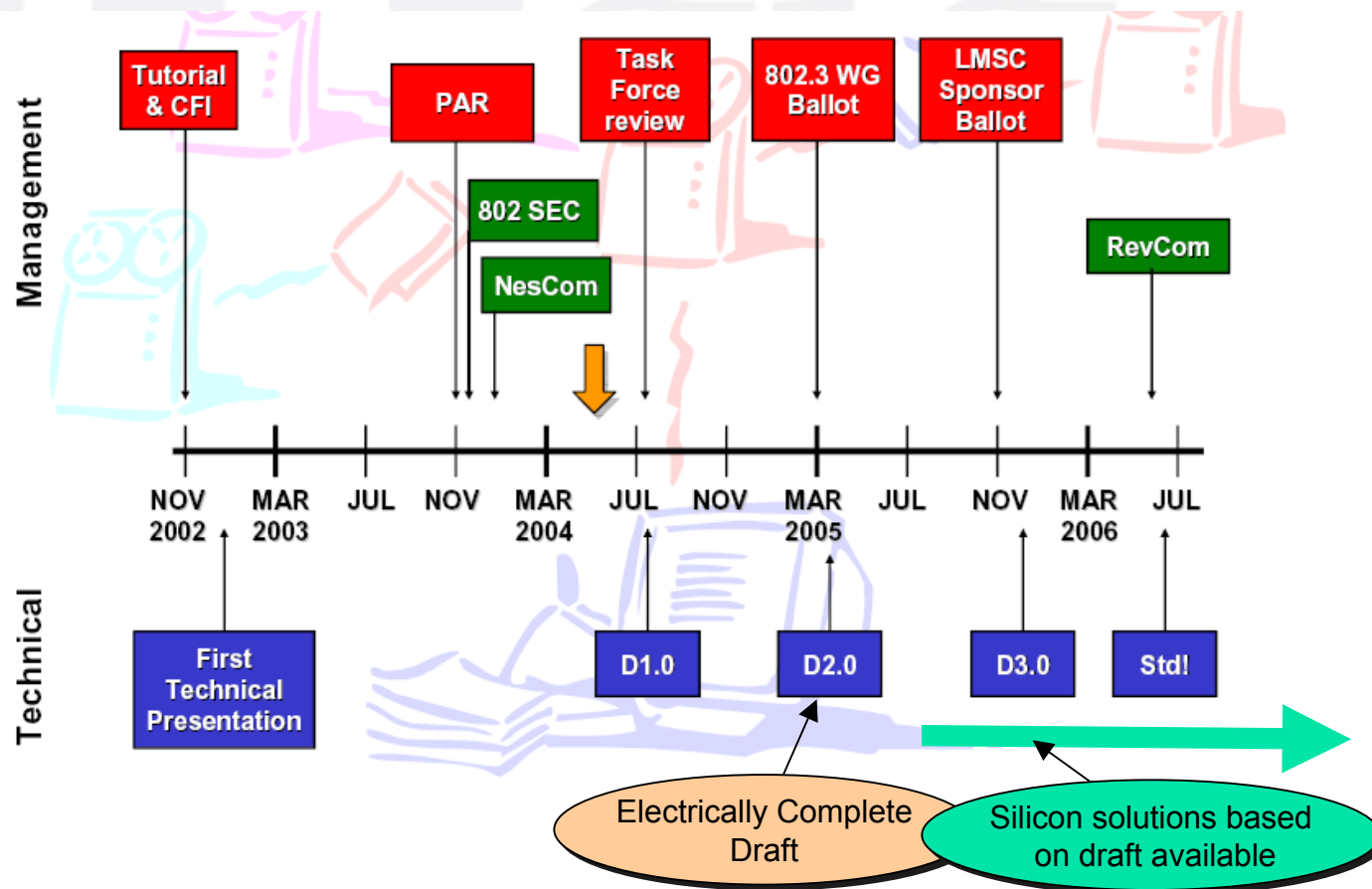
- .18um TSMC "G" CMOS process
- 4x10-bit 1Gsps ADC's
- Integrated PGA & PLL

DSP

- .13um TSMC "G" CMOS process
- 7.5M gate design includes ECHO, NEXT and FEXT cancellers, PCS, microprocessor control functions, and DAC

10Gb Full Duplex Demo Transceiver Board

IEEE 802.3an (10GBASE-T) Standard Timeline



Note: Timeline extracted from IEEE 802.org website

SUMMARY

- 10 Gigabit Ethernet in the LAN needs & prefers copper
- Silicon advances, communications advances, and cancellation of noise make ethernet on UTP LAN wiring possible
- Technology has been demonstrated
- Standards are in process
- Products are on the way!