Next Generation System Costs
A True Look

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John Mitchell – Winchester Electronics
Mike Oltmanns – Interconnect Technologies
Gautam Patel – Teradyne
Roland Roedinger - Erni
Brian Seemann – Xilinx

Presentation Outline

- Problem Statement
- Work to Date
- Project Objective
- Current Status
- Conclusions
- Next Steps

Frequently Raised Concerns

- 10Gbps NRZ data transmission in copper is too expensive because:
  - Requires backdrilling
  - Requires high speed PCB laminates
- Problem:
  - False perception that systems operating beyond 3.125Gps cannot be built cost effectively

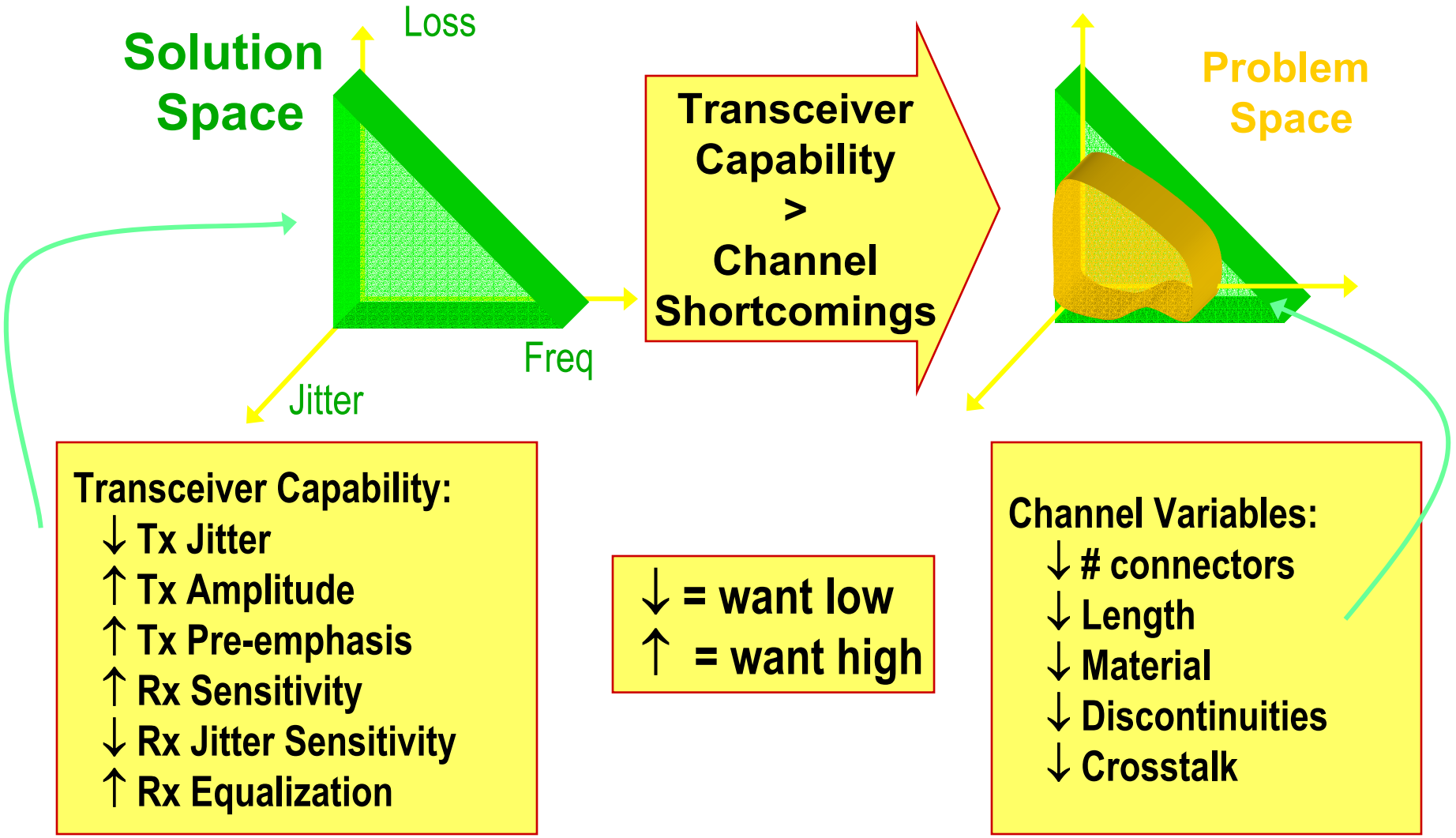
Progression of Studies to date…

- 2 years ago:
  Science of signal integrity
  - Component & Structures
- 1 year ago:
  Feasibility demonstration
  - Full backplanes
  - Selection of capable connectors
- Now:
  Reference designs
  - Architectural relevance
  - Manufacturable & cost effective

Prime Objective

- Provide data regarding the manufacturability and relative cost of various standard operations and materials available for improving signal integrity
- Develop standard and relevant metrics for evaluating the costs of next generation systems
- Determine lowest cost configuration for 10Gbps

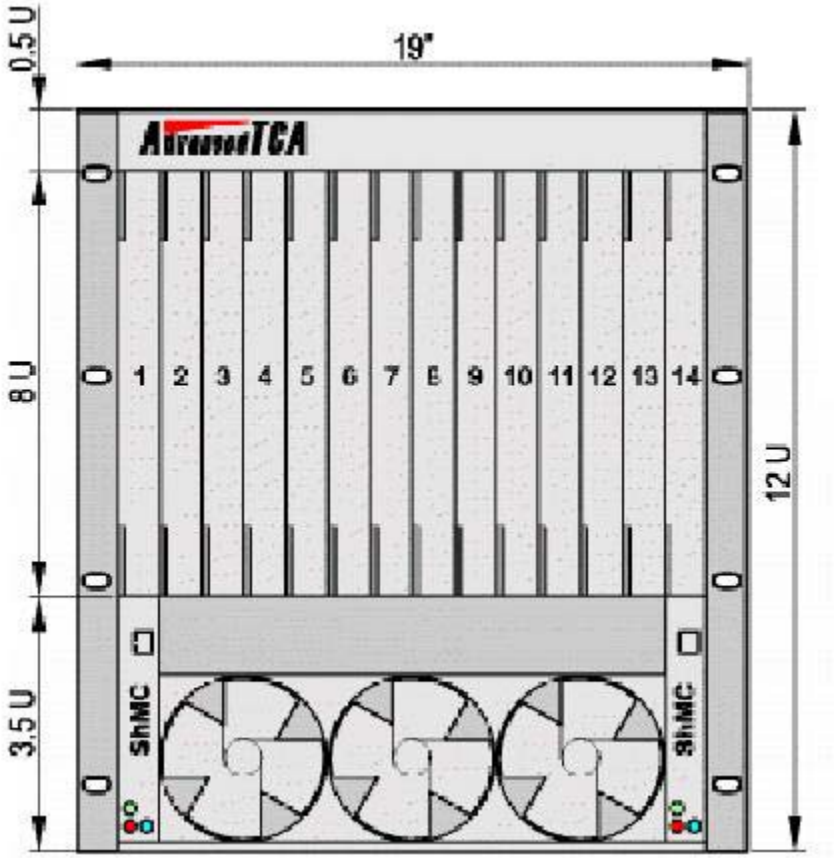
Specification Challenge: Transceiver/Channel Tradeoff



Methodology

- Use the industry standard Advanced TCA footprint to establish a baseline for cost of 2.5Gbps backplane PCBs for both Dual Star and Full Mesh configurations
- Extrapolate the Advanced TCA footprint for various configurations for both Dual Star and Full Mesh backplane PCBs
- Evaluate the incremental cost of signal integrity improvements
- Determine relative costs compare to baseline

Advanced TCA Mechanical Footprint

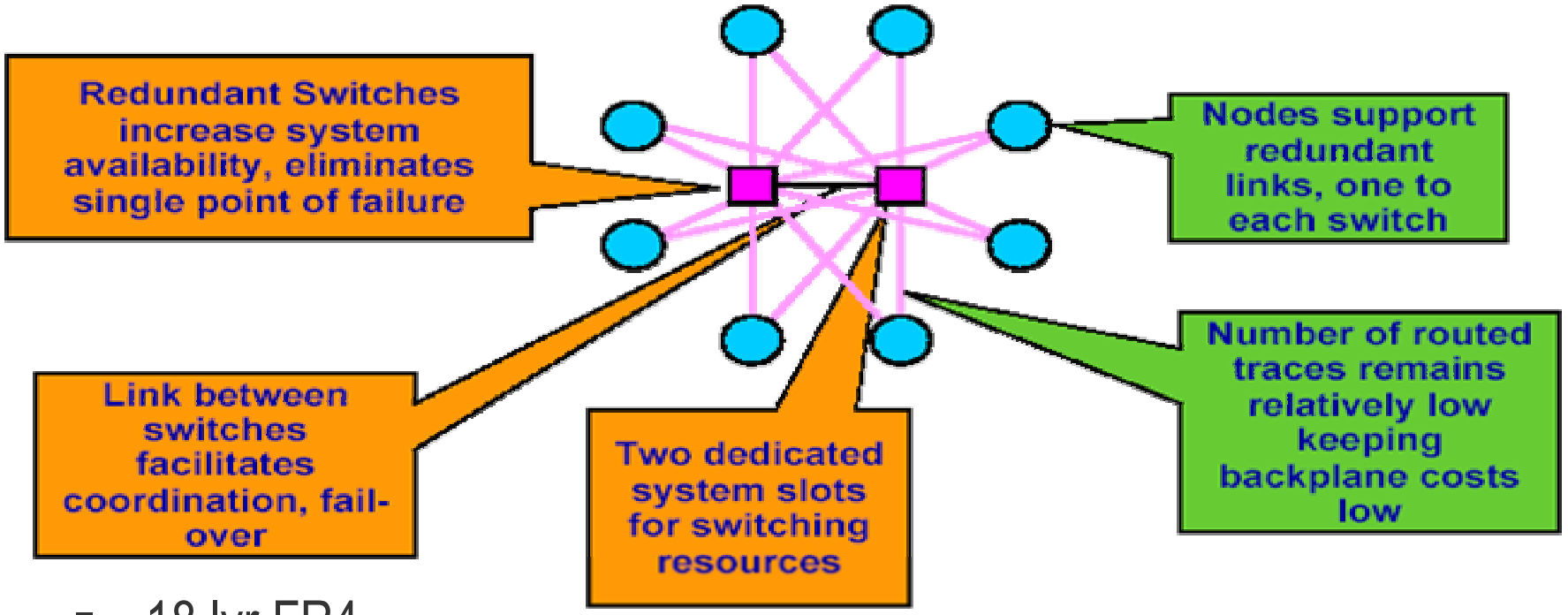


- 14 slot configuration used for baseline in 19” chassis
  - Many configurations available
- Backplane Dimensions: 14” x 18.5”

Backplane PCB Cost Drivers

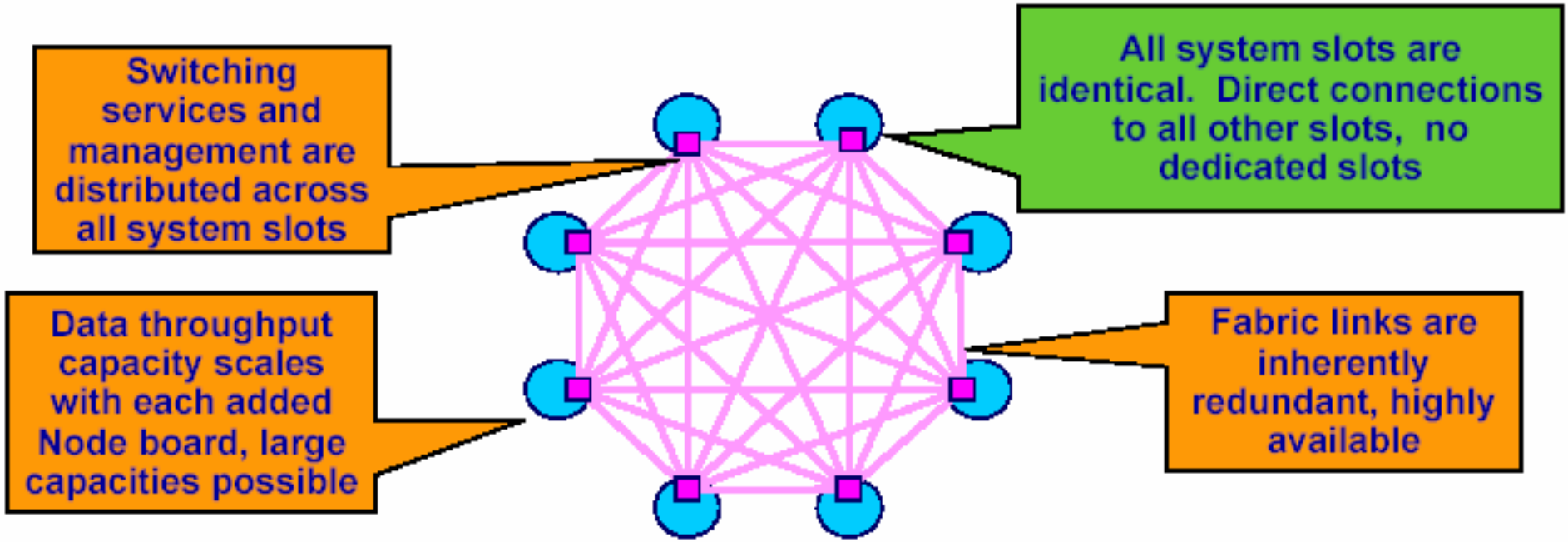
- Number of Layers
- Laminates
- Aspect ratio and number of drills
- Number of Drilling Operations
- Panel Size and Utilization
- Volume

Baseline – 2.5Gbps Dual Star Advanced TCA Backplane



- 18 lyr FR4
- 0.166” nominal thickness
- No Backdrilling
- 10:1 Max Aspect Ratio

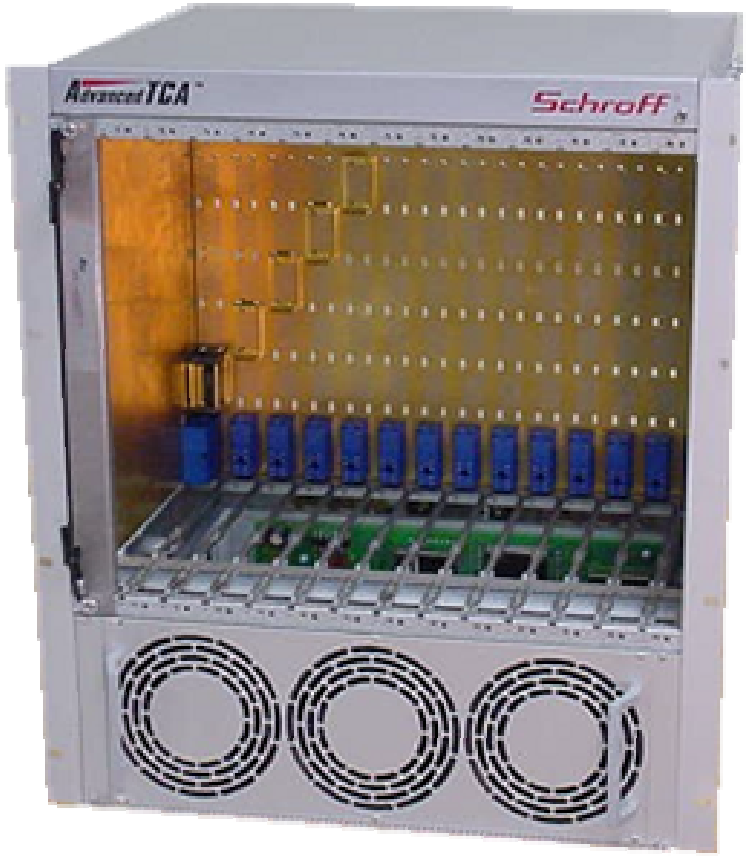
Cost versus Performance Comparison 1 – 2.5Gbps Mesh Advanced TCA Backplane



- 32 Layer – FR4
- Nominally .300” thick
- 16:1 Max Aspect Ratio

Example 10Gb/s system

Advanced TCA System Footprint but with 10Gb/s signaling



High End of Performance

- Full Mesh Mechanical Architecture
- 100% Low Loss
- Backdrilling with Ground isolation vias

- Benefits – We know it works!

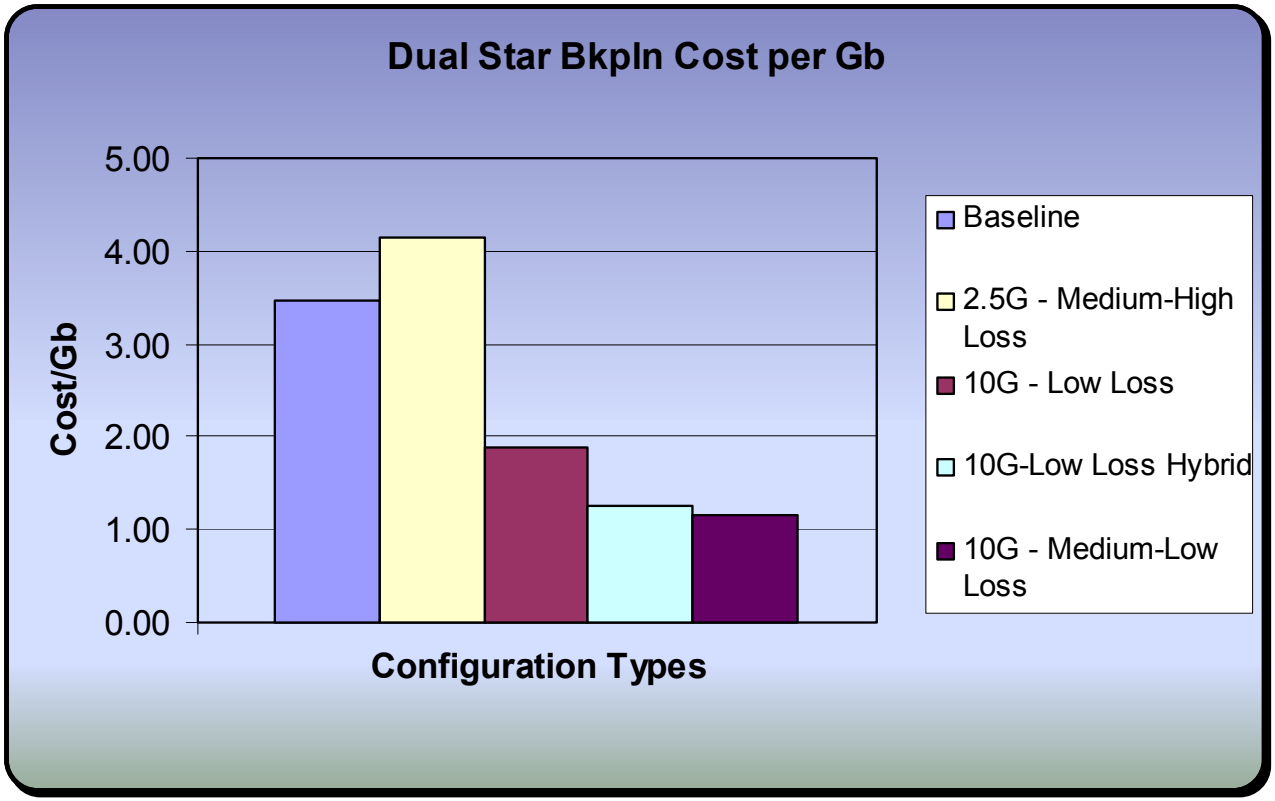
Cost Matrix Options

- ATCA Baseline-Dual Star FR4
- ATCA Mesh w/FR4
- Dual Star with Medium-High Loss
- Mesh with Medium-High Loss
- Dual Star with Medium-Low Loss
- Mesh with Medium-Low Loss
- Dual Star with Hybrid Stack 75%FR4, 25% Low Loss
- 50/50 Dual Star with Hybrid Stack FR4 and Low Loss
- Dual Star with 100% Low Loss
- Mesh with 100% Low Loss

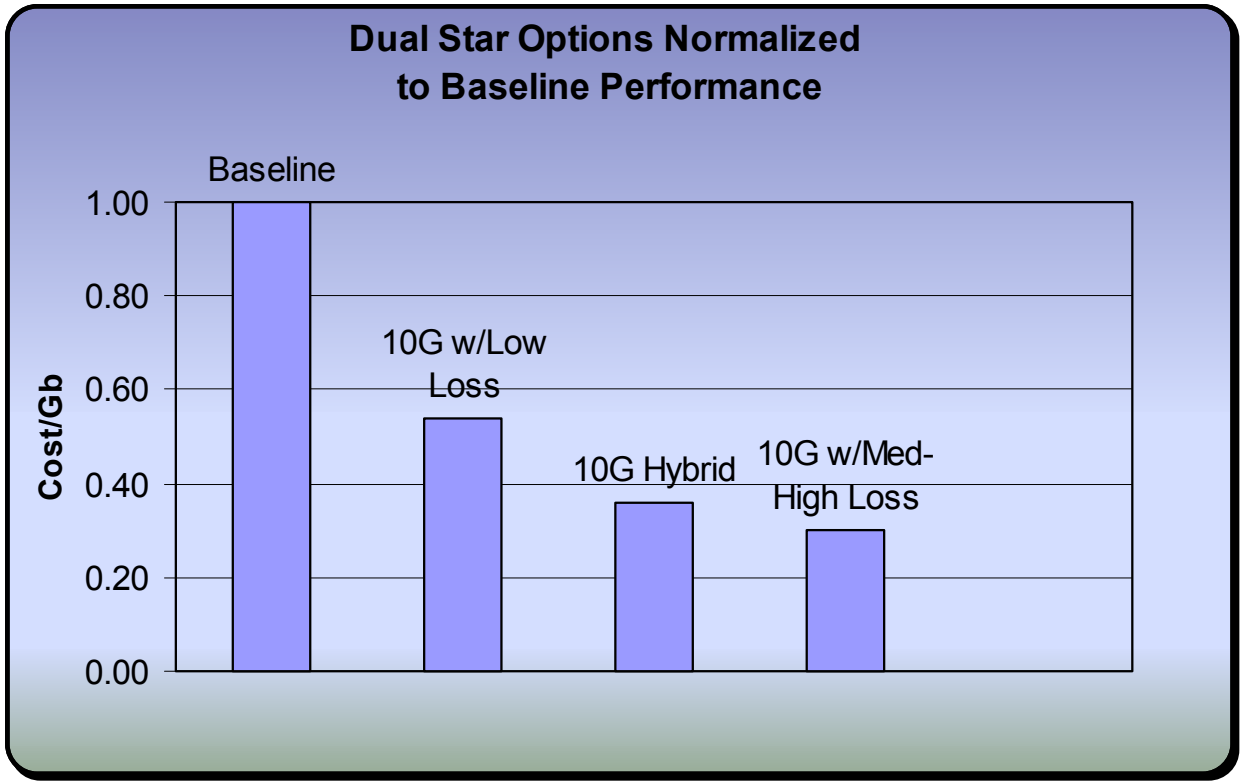
Configuration Matrix Summary

Description	# of Layers	Normalized Bkpln Cost	Bkpln Cost per Gb at 2.5Gbps	Bkpln Cost per Gb at 10Gbps
ATCA Dual Star - Baseline	18	1.00	3.4667	0.8667
ATCA Baseline, plus backdrilling	18	1.03	3.5583	0.8896
ATCA Dual Star - Mid-High Loss	18	1.20	4.1458	1.0365
ATCA Dual Star - Mid-Low Loss	18	1.33	4.6250	1.1563
ATCA Dual Star 25% Low Loss/75%FR4	18	1.44	5.0000	1.2500
ATCA Dual Star 50% Low Loss/50%FR4	18	1.68	5.8333	1.4583
ATCA Dual Star - Low Loss	18	2.16	7.5000	1.8750
ATCA Full Mesh	32	1.70	1.5560	0.3890
ATCA Mesh - Medium-High Loss	32	1.96	1.7901	0.4475
ATCA Mesh - Medium-Low Loss	32	2.19	2.0066	0.5016
ATCA Mesh - Low Loss	32	3.61	3.2967	0.8242

Bkpln Cost Comparison



Potential Cost Improvements



Conclusions

- Looking at costs relative to performance vs. direct material tells much more
- When compared to 2.5Gb/s, other options can be very cost effective
- Don’t have all the data to show most relevant metric(total cost/gigabit)
- Project is ongoing

Next Steps

- Cost Model Evolution
  - Consider other PCB cost drivers
  - Monitor Competitive material landscape
  - Compare at Total system cost(material and operating)
- Performance Feasibility
  - Build selection of options to determine minimum configuration for performance expected