“Current Practices” Model Anatomy

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Contributors:

- Jeff Lynch, Praveen Patel: IBM
- John D'Ambrosia: Tyco Electronics
- Moshe Goldstein: Asis
- Mahamud (Misty) Khandokar, Michael Munroe: Elma Bustronic Corporation
- A bunch of Intel Folks….

Supporters

- **John D'Ambrosia: Tyco Electronics**
- **Liam Quinn/Jimmy Pike: Dell Computers**
- **Moshe Goldstein: Asis**
- **Mahamud (Misty) Khandokar, Michael Munroe: Elma Bustronic Corporation**
- **Nitish Amin and Apoorv Srivastava: Vittesse**
- **Stan McClellan :Hewlett Packard**

Agenda

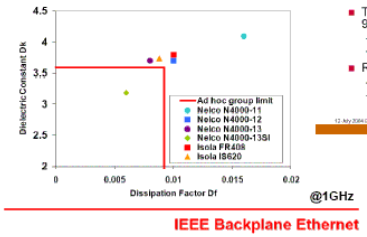
- Background Information
- Industry Required channel configurations and their Characteristics
- Potential installed market size in 2007
- Summary

Channel Ad-hoc study results…An observation.

Definition of "Improved FR-4"

Material Map

- Results from Nelco N4000-13SI
  - improved FR-4

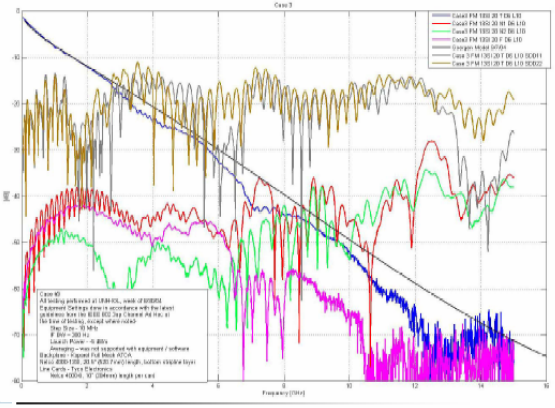


My Thoughts on 'Improved FR-4' in reference to IEEE802.3ap

- Improved FR-4 (Mid Resolution Signal Integrity):
  - 100Mhz: Dk ≤ 3.60; Df ≤ .0092
  - 1Ghz: Dk ≤ 3.60; Df ≤ .0092
  - 2Ghz: Dk ≤ 3.50; Df ≤ .0115
  - 5Ghz: Dk ≤ 3.50; Df ≤ .0115
  - 10Ghz: Dk ≤ 3.40; Df ≤ .0125
  - 20Ghz: Dk ≤ 3.20; Df ≤ .0140
- Temperature and Humidity Tolerance (0-70degC, 10-90% non-condensing):
  - Dk:+/- .04
  - Df: +/- .001
- Resin Tolerance (standard +/-2%):
  - Dk:+/- .02
  - Df: +/- .0005

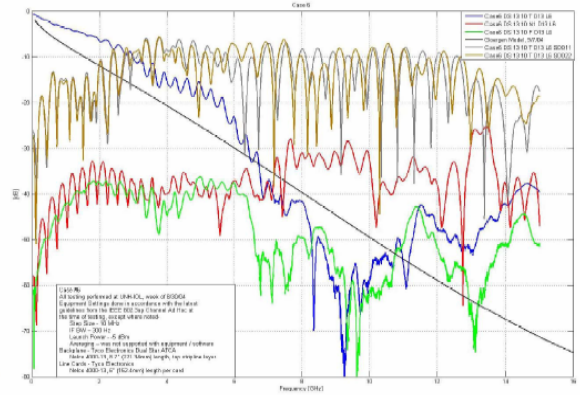
Definition adopted via TF Motion July 2004 (Y:41, N:0, A:6)

Case #3



40" Trace NO STUB -FAILS..

Case #6



22" Trace with Stubs FAILS..

Problem Statement

- **IEEE "informative" models "FAILS" a few channel configurations of "interest"**
- **Some of the current channel models assumptions are unrealistic:**
  - **Nelco4000-13 or Nelco4000-13SI as PCB material**
  - **"No stub" design ("counter boring" required)**
  - **No discussion of Impedance discontinuities yet**
- **Channel models to be "unencumbered" by current products (e.g. next gen. XAUI) or cost impacts**
- **No data to suggest that "reasonable" silicon solution is not "doable" for "cost effectively designed high volume" channels (e.g. ATCA and Next gen. Enterprise backplanes)**
  - **On the contrary, demos show that silicon solutions might work for such channel**

Current Mask does not meet HVM systems' requirements

Anatomy of “Next Gen” “Current Practices” Channels:

Components:								Comment
	Length	Material	Via (RX/TXside)	Width /Separation	Zo	Trace Sep	Stub	
Blade								
Enterprise Servers	2 - 6"	N4000-6	4/2	7 mil / 10 mil	100 +/-15%	11 mil	<60mil	No consensus on Counter boring
ATCA Servers	2 - 6"	N4000-6	4/2	6 mi / 8 mil	100 +/-15%	11 mil	<60mil	No counter boring
Switches								
Enterprise Switches	4 - 10"	N4000-6	4/2	5mil / 5 mil	100 +/-15%		<60 mil	No counter boring
ATCA Switches	4 - 10"	N4000-6	4/2	5mil / 5 mil	100 +/-15%		<60 mil	Not aware of 4000-13 material or counter
IO Cards	4 - 10"	N4000-6	2-Apr	5 mil / 5 mil	100+/-15%	11 mil	<60 mil	
Mezzanine Module / Daughter Card	1-4"	N4000-13?	4/2	8mil / 10 mil	100 +/- 10%?	11 mil	<50 mil	Better Material & counter boring??
Backplane								
Enterprise	2" - 12"	N4000-6	0	7 mil / 10 mil	100 +/-10%	40 mils	<70mils	Stripline
ATCA Star	1.2" - 12"	N4000-13	0	8 mil / 11 mil	100 +/-10%	35 mil	10mil - 195mil	Pin stub, Stripline
ATCA Mesh	2.5" - 6"	N4000-6	0	8mil / 10 mil	100 +/-10%			Pin Stub, Stripline, 7 slots
ATCA Full Mesh	2 - 21"	??	0	??	100 +/-10%	??	??	
Connector								
ATCA	HmZD							
Enterprise	??							

Represents most ATCA™ and HV Enterprise Server Systems

“Must Consider” Channel Configurations:

- Case 1: Enterprise: (Server N4000-6, BP 4000-6, Stubs)
  - Min trace: “Server” 2” + Backplane 2” + Switch 4”
  - Max Trace: “Server” 8” + Backplane 12” + Switch 10”
  - Use stub and max. impedance spread amongst the components
- Case 2: ATCA Star: (Server N4000-6, BP 4000-13, Stubs)
  - Min trace: “Server” 2” + Backplane 2” + Switch 4”
  - Max Trace: “Server” 6” + Backplane 12” + Switch 10”
  - Use stub and max. impedance spread amongst the components
- Case 3: ATCA Small Mesh: (IO N4000-6, BP 4000-6, stubs)
  - Min trace: “IO” 2” + Backplane 2” + “IO” 2”
  - Max Trace: “IO” 8” + Backplane 10” + “IO” 8”
  - Use stub and max. impedance spread amongst the components
- **Strong Desire:**
  - Longer channels: 30” or more

10G design “optimization” possibilities within “current practices”

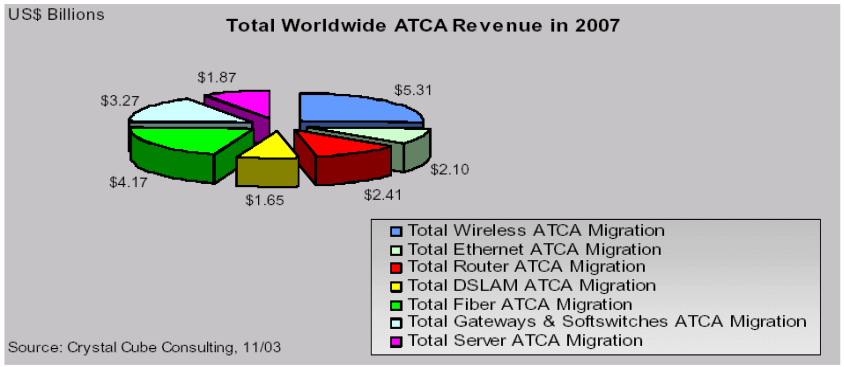
- Minimize stub effects using “lower layer” routing for most line cards
  - Not possible for Switches and backplanes
- “Best possible” placement, layout and rout geometry to reduce resonance/ripple effects
  - driver placement w.r.t. to connector to “move” the resonance points
  - quad routs for layer reduction and hence reduction of stub length

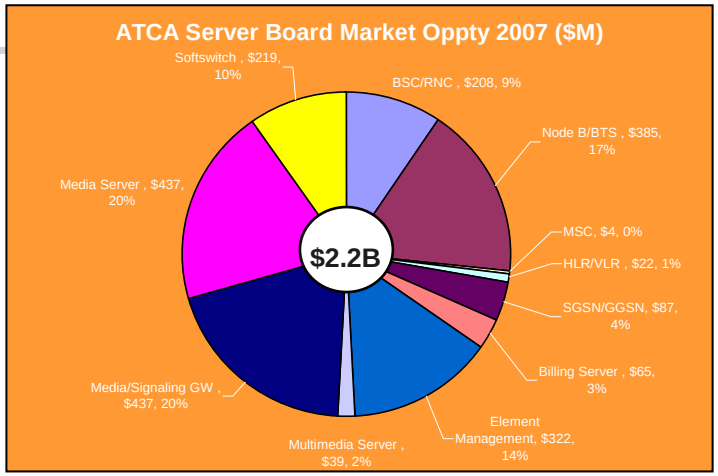
Difficult Choices:

- N4000-13 or N4000-13SI material for “Blades” products
  - Cost, qualification, wide availability are major issue
  - Enterprise backplane is still an open question
- “Zero” stub design
  - Counter boring for high volume segment
    - Cost, qualification, availability, TTM
  - Even with counter boring stubs most likely will “exist”
- “Fork lifting” Backplanes
  - Changing the backplane is the last thing end users would do

Potential ATCA™ Market in '06-'07

Figure 15. Worldwide ATCA Projection of Revenue in 2007 by Market Segment





Source: RHK ATCA Whitepaper 10/03

Figure 21. Graphical Illustration of Worldwide Server ATCA Revenue 2002 - 2007

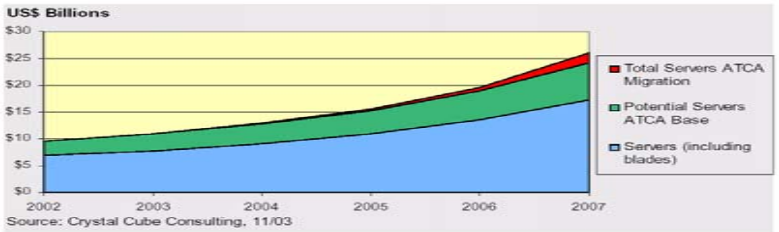
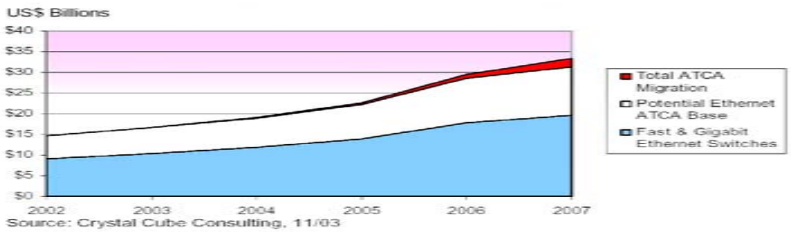
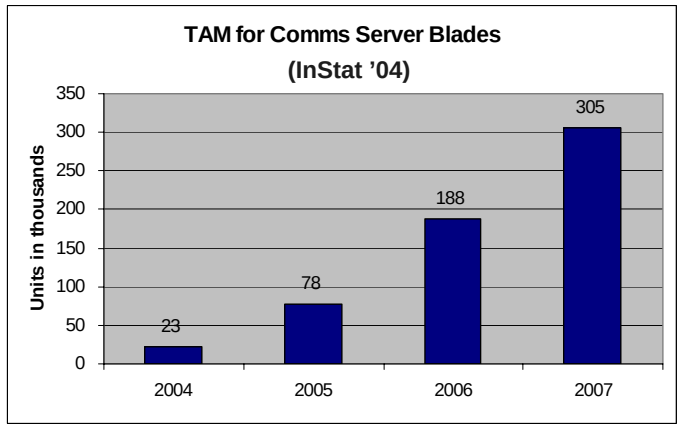


Figure 20. Graphical Illustration of Worldwide Ethernet ATCA Revenue 2002 - 2007





Potential Installed Base is Multi-Billions of $$

Summary

- "Current Practices" design represent a big market for 10G
  - Considering channels with stubs and "non enhanced" materials is required
- Upgrade path to 10G for new XAUI capable designs required
  - Potentially a big market in 2007
- Ignoring "other" channels at this stage puts us into major risk of:
  - competing with "XAUI" and other solutions over longer period
  - Intermediate 10G serial "derivative" products being developed, creating interoperability issues and a potential "fractured" market
- Should gather more data both from channel and silicon designs for a final "normative" channel mask recommendation

Quotes:

“Nortel supports legacy channels with significant via stubs (no counter boring). ATCA backplanes should be used as a reference for 10G standards"

Brian Parlor

Nortel Networks

“Ericsson supports a channel model that supports legacy backplane with length of 35"-40" built with FR4 and no back-drilling"

Arne Alping

Ericsson Research

Backup

High Performance/Low volume Channels

- ATCA “large” Mesh: (30+”)
- These platforms lead the “technology” tread-mill
  - 4000-13SI and counter boring might be “acceptable”

Cost is not an issue for these platforms

Cost and Manufacturing Info

PCB Material Related

	N4000-6	N4000-13	N4000-13SI
Relative Cost	1	1.25 -1.47	1.65 -2
Substrate Lead Time	Base	Add 1 to 2 Weeks	Add 1 to 2 Weeks
Lamination Cycle time	1	1.6 – 3	1.6 - 3

Back drilling Related

	V1	V2	V3
Set up Cost	1	3x	TBD
20 – 1000 at 3 heights	1 unit Per hole	150X – 50X	TBD
PCB Cost Impact (wrt to no CB)	2x	4x	TBD
Lead Time	0	+ Few days	TBD

- Both 4000-13 and 13SI are cost prohibitive for Line cards
- 4000-13SI very hygroscopic
  - Requires extra capital and processes for cleaning
  - need extended press process
  - Impedance variations over Temp and humidity unknown (Nelco suggesting use of 4000-13FR instead!)
- Back drilling adds additional setup cost and turn around delay
  - Cost impact varies widely from very low to outrageous

AdvancedTCA* Products

- 50+ Product demos at Supercomm 2004
- 33 Companies, 122 Products*

Force* Launches ATCA blades

DTI* Launches UP ATCA Platform

Fujitsu-Siemens* Announces ATCA plans

ADLink* Launches ATCA blades

RadiSys* Launches Quad svr ATCA blades

Kontron* launches ATCA blades

Intel Launches ATCA Product suite

Kontron Announces ATCA plans

Force Launches ATCA system

Portwell* Launches ATCA blades

CCPU* Launches ATCA strategy

**Based on product roadmaps and stated product plans from ecosystem companies, which are subject to change. Ecosystem growth is a directional estimate. *Other brands and names may be claimed as the property of others.