

Mike was pleased.

"That sounds like something which would be helpful."

"Be sure you look at all the variable length strings, not just the OS's device name."

"I will discuss all of them with the guys at the office."

"Are there any issues other than the squishing?"

The silence told George that another round or two of revisions would win him enough needed converts.



### 4 GBS 'AD HOC' FEBRUARY 6

QLogic hosted at the Waterfront Hilton in Huntington Beach.

Although the formal billing was an FCIA (Fibre Channel Industry Association) meeting, this activity deserved classification as a PHY (Physical Interface) working group. It had been scheduled at 08:00 so FC-0 techies could attend before the PHY (Physical Interface) Modeling Working Group met at 09:00.

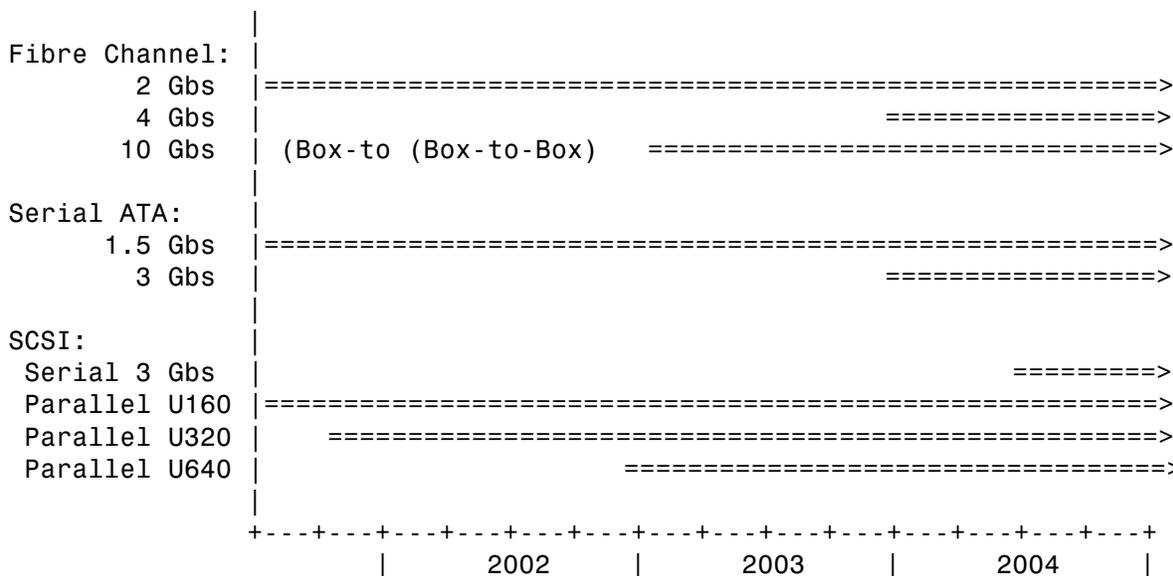
Company	Name	Company	Name
Agilent	L. Fritz	JNI	R. DeCruz
	L. Golob		K. Foss
Aristos Logic	A. Zagorski		M. Woithe
Compaq	D. Fraser	LSI Logic	M. Jenkins
	B. Ham		C. Ridgeway
	M. Hamel	McData	P. Dougherty
	B. Pagano	Molex	J. Neer
Connectivity Slns	B. Kembel	QLogic	T. Caan
Cypress Semi	E. Grivna		B. George
EMC	G. McSorley		S. Jones
ENDL	D. Allan		E. Kohlway
Emulex	A. Huang		D. Wallace
	B. Nixon	ST uElectronics	M. Jensen
Fujitsu CPA	M. Fitzpatrick	Seagate	J. Coomes
Gadzoox	T. Dicenzo		A. Kramer
Hewlett Packard	B. Schober		G. Lutz
I-Tech	J. Tetzlaff		M. Miller
	S. Wirtz		W. Whittington
IBM	C. Fovrnier	Storcase	H. Oppenheimer
	M. Hoard		C. Wong
	G. Penokie	Sun Microsystems	V. Novak
Infineon	R. Johnson	Tyco/AMP	D. Vermeersch
Infinity I/O	J. Kramer	Unisys	W. Gentry
Intel	R. Taborek	Vixel	T. Hammond-Doel
Vixel	D. Lewis	Wavecrest	D. Petrich
	J. Nelson	Xyratex	N. Brownlow
Volex NA	M. Kaarg		

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Leader Mike Fitzpatrick (Fujitsu CPA) kicked off with a presentation which set the stage for what was to follow. His overview of what disk drive interfaces were doing showed what was being planned through 2004.



### Stay the Course

Bill Ham (Compaq) came armed for a fight and was well prepared with a multi-faceted presentation.

"I want to ensure the next Fibre Channel interface stays at 4.25 Gbs as stated in FC-PI-2.

"Even though this has been a background discussion for several quarters it does not seem to be settled for some people."

"The next step was decided last year but uncertainties keep being raised, making things unstable."

"A stable strategy for Fibre Channel's disk interface is just as important as a stable strategy for external, box to box applications."

Bill tilted at the chart of transfer rates.

"Fibre Channel at 2 Gbs is the most powerful interface in the market today and it is now shipping in significant volumes."

"No matter which way you measure it, 2 Gbs is least 33% faster than Ultra 160 SCSI which is the best SCSI interface presently available."

Note: Although he did not direct this shot at Mike, Bill was obviously in disagreement with how U320 was positioned on the introductory chart.

"If Dual Port and Duplex is accounted for, 2 Gbs is 500% (800/160) faster than Ultra 160 and even when Ultra 320 SCSI becomes available it will still be 250% faster."

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"Not too shabby...., especially where Dual Port is needed."  
"2 Gbs is perhaps the single most important feature that differentiates Fibre Channel from other data transport technologies."  
"No other shipping technology is close."

With artillery in place, Bill launched his assault.

"Fibre Channel migration does not require revolutionary and incompatible speed improvements to reach the next step in performance."  
"Compaq is in no hurry to increase the transfer rate as early as Mike has shown it in his overview."  
"Fibre Channel has a beautiful architecture from the customer's point of view, but the beauty can be erased if decisions are made without taking the whole problem into consideration."  
"The only serious issues which exist are:  
- Availability of support chips for PBCs (Port Bypass Circuits), HBAs (Host Bus Adapters), and switches  
- FUD (Fear Uncertainty and Doubt) around 4.25 Gbs practicality  
- Possible benefits from a smaller form factor, which has the downside of causing incompatibility with the present generation."  
- Mindshare erosion and lack of development energy going into 4.25 Gbs because of marketing efforts by competing technologies."

An exuberant Bill offered strategies to keep Fibre Channel in first place.

"Fibre Channel disks are not facing a speed crisis this week!"  
"Three key tactics can be employed to mitigate transfer rate limitations before moving to a higher Fibre Channel speed:  
- Limit the number of disks on a loop to the number that can be contained within a single array enclosure (aka one row of a cabinet).  
- Only streaming video or similar applications place serious demands on the transfer rate, and that is not the most important SAN (Storage Area Network) workload.  
- Move away from the loop architecture by using barebone switches instead of PBCs in disk arrays to configure a point to point subsystem."  
"Compaq is in no big rush to get to the next step. We do not need a 4.25 Gbs disk drive for at least a couple of years, maybe even longer."

It may be stretching things to say the audience was enthralled, but it would be fair to say the room was quiet and attentive.

"When we do move to the next step, the move needs to be worthwhile!"  
"A marginal increase in bit rate, and by that I mean anything less than 2X carries lots of baggage with little payback."  
"Compatibility with the installed Fibre Channel base cannot be compromised lest we open the door to non-Fibre Channel technologies."  
"Once you lose backwards compatibility the whole momentum of Fibre Channel dies!"  
"Tyco and Molex have both presented data that the SCA-2 (Single Connector Attach -2) is fine for speeds well in excess of 4.25 Gbs."

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"LSI Logic and Cypress claim that CMOS chip technology is quite capable of supporting well over 4.25 Gbs. atSpeed has reported over 10 Gbs though that may be more of a stretch than we should make."

"Backplanes are more than capable of supporting 4 Gbs at usable lengths, 3.1875 Gbs XAUI (10 Gbs Attachment Unit Interface) uses at least 50 cm of etch without any equalization and 4.25 Gbs is only 30% faster than that."

"Test equipment can handle 4.25 Gbs except for some protocol analyzers which can easily be upgraded."

"There is no intrinsic need to change the 150 Ohm termination needed for backward compatibility with legacy backplanes, though source termination is probably a good idea."

"Frequency agility in copper for 1/2/4 is relatively easy, but we need the precise 2X separation in speeds. Optical agility has yet to be proven."

Bill turned to the past for inspiration.

"The historical principles for successful evolution of previously existing data transport interfaces are:

- Minimal software changes
- Physical compatibility with the previous generation
- Communicate over the same cable plant, possibly at reduced length
- Able to automatically step down to previous generation parameters."

"The past is full of examples, look at all the generations of parallel SCSI and ATA (AT Attachment)."

"The only thing we need to carry on the tradition is identify at least one 4.25 Gbs PBC, host and switch chip supplier in the next couple of years."

Chewing on the interface was not Bill's only theme.

"The 3.5" form factor is industry's workhorse, but if 2.5" should ever become attractive for some reason yet to be determined, then it needs to have the SCA-2 connector mounted in a place that allows use with legacy 3.5" backplanes and packaging shells."

In his finale, Bill slammed the reason the get together had been called.

"If for some reason a 3X Fibre Channel interface was adopted, the 3X would have to be 3.1875 Gbs (not 3.0 or 3.125) for speed agility to work."

"I can guarantee you there will be significant marketing confusion because most folks will fail to grasp that all 3 Gbs stuff is not created equal."

"Fibre Channel would lose its place as leader of the pack in the performance space."

"Using the same speed as other interfaces doesn't save any part numbers, there are connector, firmware, and speed incompatibilities."

"The cost for a robust Fibre Channel drive has nothing to do with Fibre Channel, it is the special firmware and state of the art HDAs (Head Disk Assemblies) you need for enterprise class applications."

"There is no free lunch, no matter what you do with the interface."

"We cannot afford to 'burn' up speeds without good cause because the speed negotiation algorithm can only handle four speeds."

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"Leave the next generation disk interface at 4.25 Gbs!"  
"We don't need to invite competition into the installed base of Fibre Channel systems."  
"We don't need marginal speed improvements."  
"We don't need to boost the transfer rate until 2006."  
"We don't need to pay the cost of more difficult mindshare and marketing."  
"Keep Fibre Channel the enterprise technology of choice, and at 4.25 Gbs."

Not exactly Hamlet, but quite a soliloquy for an engineer.

### It Can be Done

Mike Fitzpatrick introduced Mike Jenkins (LSI Logic) as having the solution people wanted to hear, but the latter Mike immediately set everyone straight about his view of where technology stood.

"There are a number of applications for 3 Gbs Integrated Serdes today, and specifications are in place for the 10 GbE (Gigabit Ethernet) XAUI and the 10 GFC (Gigabit Fibre Channel) XAUI."  
"Other standards expected to use this speed are SATA (Serial ATA), and behind that comes Serial Attached SCSI which intends to leverage the SATA PHY layer."  
"Basically, there is broad interest in the 3 Gbs transfer rate."

There was a sense in the room that Mike was leading up to a disappointment.

"LSI Logic will support 4.25 Gbs if the market requires it."  
"The technology can handle it. Design of an integrated SERDES (Serializer-Deserializer) Serdes could begin in 1H 2002 and customer silicon would be available during 1Q 2003."

That was the good news, next came the bad news.

"Industry needs to validate 4.25 Gbs."  
"Will there be enough demand to justify implementing it?"  
"The infrastructure has to be there, with all the pieces required:  
- PBCs  
- Cables and Connectors  
- HBAs or 10 Gbs to 4 Gbs bridges  
- PCB (Printed Circuit Board) technology."  
"Another challenge that has to be considered is the transmission distance, especially if you want to keep the same cable plant."

Note: The concern about transmission distance was a red herring. The problem being discussed was disk drives in a cabinet, where distances are measured in inches, not metres.

The conclusion was a warning shot.

"There is very limited development funding in all segments of industry."

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"You have to decide whether you can afford what you want."

### Face the Facts

Mike Miller (Seagate) was standing only a few feet away from Bill Ham when he began, and could feel himself under close scrutiny.

"Arbitrated Loop is a shared media environment, so the interface speed has to be some multiple of the internal transfer rate to prevent bottlenecks in the system."

"When the transfer rate was chosen back in 1993, 1 Gbs could support a reasonable number of drives on a loop."

"Internal transfer rates have been growing at a rate faster than interface transfer rates but they are now starting to level off."

"If we want to stay with a shared media environment a higher speed than 2 Gbs is essential."

Bill must have been thinking, so far so good, but he was wary as Mike moved on to his next point.

"Power consumption is an increasing problem as higher performance drives push the envelope, but when form factors shrink we are asked to reduce power while still improving performance."

"Continually increasing interface speeds are a problem in this kind of situation, the solution is to migrate away from shared media."

Thus far, Mike and Bill had been in agreement, but not for much longer.

"Seagate and other companies have been promoting 4 Gbs as the next Fibre Channel interface speed for drives but based on general industry trends we need to re-address this direction."

"The fact is that industry is focused on 10 Gbs as the next speed, look at 10 GFC and 10 GbE."

"These are multi-lane designs using 3.xx Gbs PHY layers."

"SATA and SAS (Serial Attached SCSI) have 3 Gbs on their roadmaps."

"The only group driving a 4 Gbs PHY layer is Fibre Channel."

This set things up for a series of questions.

"Where do we need to go?"

"Should we go it alone and continue to drive 4 Gbs?"

"Is there enough incentive for component manufacturers to develop unique 4 Gbs components?"

Mike answered his own rhetorical questions with negative answers before he began his concluding remarks with the punchline.

"Seagate would like to propose we realign the next Fibre Channel interface rate to the speeds of other interfaces on the roadmap."

"That would give us a succession of:

- 1.06 Gbs
- 2.12 Gbs
- 3.18 Gbs
- 6.36 Gbs."

"There are lots of advantages to realigning to these speeds:

- Leverage the infrastructure of supplier support at 3.xx
- 3.xx Gbs transceivers are available today
- The migration of 2 Gbs PBCs & Repeater/Retimer circuits would be easier
- The migration of optical components will be simplified
- Connectors have been tested at 3 Gbs
- It is possible to develop host chips that talk multilane 3 Gbs for 10 Gbs operation and single lane 3 Gbs to support drives."

As if to head off the pending criticism, Mike wrapped up with another series of questions related to time to market.

"Do you want to get to market two years sooner with 3 Gbs?"

"Do you want to get 3 Gbs Fibre Channel ahead of SATA and SAS?"

"Do you want to get 4 Gbs Fibre Channel behind SATA and SAS at 3 Gbs?"

### Bedlam

Perhaps bedlam is a little strong, but be assured, there were many opinions around the room waiting to be shared. Although there had been a handful of interruptions throughout the presentations, for the most part the room had waited to hear the speakers out before diving in. In chronological terms, opinions were voiced after Bill Ham and Mike Jenkins spoke, but as these were repeated again after Mike Miller, they have been aggregated together.

Underlying most of the opinions was the knowledge that Compaq wanted to stay the course at 4.25 Gbs and EMC wanted to switch to 3.1875 Gbs.

Dennis Petrich (Wavecrest) confirmed Bill Ham's position on testers.

"Our current equipment is capable of 4 Gbs operation, although it has been designed to use at 3 Gbs."

"To test 4 Gbs we would develop a new model, designed to be good up to 5 Gbs."

"The 4 Gbs schedule is no problem, you can rest assured test equipment will be available in time."

Mike Jenkins threw in the monkey wrench.

"What about PBCs and transceivers?"

Bill Pagano (Compaq) was fed up with the naysayers.

"If this group would just make it's mind up, there would be more interest on the part of component vendors."

"It's all this fooling around which creates uncertainty."

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"I've spoken to component vendors, and they have assured me that if we want the parts, they will provide them."

"Yeah, but you're Compaq, they'll promise you anything."

"Maybe so, but they better not break that promise!"

"Whatever we can get, everybody else can too."

Skip Jones (QLogic) was exasperated.

"Let's get one thing straight here, there is not enough development time or money to develop two next generation Fibre Channel interfaces."

"If you guys want HBAs, there better be only one that we need to build."

"This industry isn't strong enough to support 3 Gbs and 4 Gbs in the same timeframe."

"Pick one or get none."

At this point, the penny dropped for a number of listeners. The situation had been presented as alternatives but if neither side acquiesced then there would be a stalemate. Vendors would have to pick sides or sit on the sidelines. A few might pick sides because of an OEM (Original Equipment Manufacturer) relationship, but they would be unlikely to make a wholehearted commitment.

Although the above makes it seem like a rational and short discussion, the reality was much lengthier and far more tortuous. The points made were all variations on the same themes, colored by the perspective of each speaker's technical perspective. The conclusion was predictable.

"This is a technical discussion, and everyone is looking for a technical reason to select 3 Gbs or 4 Gbs."

"There are no barriers to implementing one or the other, despite the roadblocks each side has erected against the other."

"The dilemma is real because no one is right or wrong, everyone who spoke is right based on their set of assumptions."

"Searching for a technical answer is a waste of time."

"If the top 10 integrators could agree on what they wanted, this room can salute and get the job done."

"The problem is that Compaq wants 4 Gbs some time down the road and EMC wants 3 Gbs as soon as possible."

"Where do the other integrators stand?"

George Penokie (IBM) supported Bill Ham.

"IBM wants 4 Gbs, anything else is a waste of time."

"Are you representing the disk drive division or systems, George?"

"Disk drives."

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Time had run out, and Mike Fitzpatrick summarized the session.

"No one has made an overwhelming case to favor one speed over the other."

"Although there may be infrastructure advantages to 3 Gbs today, there is no absolute certainty it will not exist for 4 Gbs."

"We need to poll other integrators, and find out where they stand."

### Postscript

Mike Fitzpatrick and Mike Miller both used the abbreviation SAS, something that STA (SCSI Trade Association) would like to discourage. STA is being overly cautious if the concern is trademarks. The likelihood of confusing Serial Attached SCSI with any of the following is remote [inconceivable?].

- o Swiss Academy of Sciences ([www.naturalsciences.ch](http://www.naturalsciences.ch)) was founded in 1815, so has first rights on using the initials as an acronym.
- o Statistical Analysis Systems ([www.sas.com](http://www.sas.com)) is the world's largest private software company with revenues >\$1B/year, 8,000 employees, 156 offices worldwide, and 37,000 customer sites. The initials are registered as a trademark, but only in association with the company's products.
- o Special Air Services ([home3.inet.tele.dk/jdj/spec\\_ops/count/uk\\_sas.htm](http://home3.inet.tele.dk/jdj/spec_ops/count/uk_sas.htm)) is one of the best respected military special forces in the world. You may have seen these guys on TV or in a movie, nobody messes with them.
- o Scandanavian Airlines ([www.sas.se](http://www.sas.se)) flies in Europe as well as across the Atlantic and has a reputation for good service.
- o Surfers Against Sewage ([www.sas.org.uk](http://www.sas.org.uk)) is a serious club despite the name. It is an environmental pressure group which has taken on and won cases against the UK Government, Water Industry, and earned the respect of legislators.
- o San Antonio Spurs ([www.nba.com/spurs](http://www.nba.com/spurs)) is a basketball team in Texas.
- o SAS Audio Labs ([www.sasaudiolabs.com](http://www.sasaudiolabs.com)) is where music comes alive

There are several societies and schools using the acronym of SAS.

- o Society for Amateur Scientists ([www.sas.org](http://www.sas.org))
- o Society for Applied Sociology ([www.appliedsoc.org](http://www.appliedsoc.org))
- o Society for Applied Spectroscopy ([www.s-a-s.org](http://www.s-a-s.org))
- o Society for Archaeological Sciences ([www.wisc.edu/larch/sas/sas.htm](http://www.wisc.edu/larch/sas/sas.htm))
- o Society of American Silversmiths ([www.silversmithing.com](http://www.silversmithing.com))
- o School of Arts and Sciences at Univ of Pennsylvania ([www.sas.upenn.edu](http://www.sas.upenn.edu))
- o School of Advanced Study ([www.sas.ac.uk](http://www.sas.ac.uk))
- o Singapore American School ([www.sas.edu.sg](http://www.sas.edu.sg))

### 4 GBS STUDY GROUP CONFERENCE CALL FEBRUARY 20

It is unusual to cover a telecon group, but the passions are running hot on whether the magic number is 4 Gbs or 3 Gbs for the next evolution of Fibre Channel. Although not located accurately by chronology, it fits better here as it follows up on what happened during T11 week.

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Company	Name	Company	Name
Agilent	L. Fritz	LSI Logic	C. Ridgeway
Compaq	B. Ham	MTI	R. Ramos
EMC	T. Linnell	Seagate	G. Lutz
	G. McSorley		M. Miller
ENDL	D. Allan	Vixel	J. Nelson
Fujitsu CPA	M. Fitzpatrick		T. Hammond-Doel
IBM	G. Penokie	Xyratex	P. Levine
LSI Logic	M. Jenkins		

Mike Fitzpatrick (Fujitsu CPA) thanked everyone for calling in, and kicked off the telecon with a quick recap of the '3 vs 4' issues. The key topic was how to get enough information to make a decision on which direction made the most sense.

"All the vendors who make Fibre Channel drives are on the line. The two buyers are Compaq and EMC, and they are split 50/50 on the way to go."

"If you guys talk to your top 10 customers you'll have covered 90% of the market, so go ask them and come back to tell us what they think."

"What good will that do?"

"The first thing they will do is ask back 'what can we have?'."

The vendors agreed that maybe something could be gained by talking with their customers, and the conversation moved on to configuration alternatives.

Unlike loops which share bandwidth, switches are multipliers of bandwidth and nobody disagreed with the ability of a backplane switch to resolve any and all performance issues. However, the possibility of conversion to the new topology covered the gamut from optimism to pessimism.

By way of observation, accomplishments occur much more rapidly when there is no alternative. So long as there is a chance to hang on 'one more time' to an existing environment of packaging and service tools, some integrators will stick with speed improvements. In simplistic terms, that gives impetus to the adopt 3 Gbs as soon as possible brigade. The more progressive element opposes this and wants to adopt switches instead and delay the move to a higher speed until sometime later, maybe even never.

There are issues of cost with switches. In a switched configuration, the penultimate is one data path per drive whereas on a loop the cost of the data path is shared between all the drives on the loop. The two extremes are the ratios of HBAs (Host Bus Adapters) to drives of 1/125 vs 63/63. The term of HBA is somewhat of a misnomer as the full functionality of an HBA is not required, so a term like SMC (Speed Matching Controller) would be more suitable. The term is not as relevant as the fact that it costs less.

The key to a backplane switch is low cost, and a derisive comment drew a snappy retort from Tom Hammond-Doel (Vixel).

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"The promise of a cheap backplane switch has haunted Fibre Channel since its inception. The loop was a desperation measure to lower the cost of attaching disk drives, because there was no chance of getting one."

"Would you be interested in a white paper on the subject?"

"There is a solution available right now that meets your criteria."

Mike Fitzpatrick asked for a copy to distribute.

"It's on the way, Mike, check your In basket."

In a rare display of agreement on factors, Bill Ham (Compaq) and Tom Linnell (EMC) concurred on the point that the PCI-X (Peripheral Component Interconnect Extended) bus is capable of handling transfers up to 8 Gbs. There were side issues about the need for receiver manipulation (filtering or pre-compensation) but no barriers.

There were two very clear opinions put forth.

- o Mike Miller (Seagate) represented the immediate solution is desirable camp, wanting to move towards immediate adoption of 3 Gbs to gain time while the topology shift occurred from loop to switch. Mike emphasized that the physical size of drives is going to decrease, so despite boosts in recording density, transfer rates at the outer rim are going to fall rather than rise.
- o The other camp is prepared to move directly to a switched topology, which will add longevity to 2 Gbs drives that are presently available. It is conceivable that by continuously reducing the number of drives per data path that there may never be any need for a 3 Gbs or 4 Gbs speed boost. The time for a speed change could either be delayed until other disk technologies on the 1.5/3.0 path need 6 Gbs operation, or nothing will be needed because drive transfer rates never exceed 2 Gbs.

Mike Miller could not accept the status quo in interface speed.

"Transfer rates are going to slow down their rate of increase, but 2 Gbs is not fast enough."

"A shift to 3 Gbs will be sufficient to hold us."

With transfer rate being a bone of contention, one of the voices called for the drive vendors to lay out their plans for future rates. Even over the phone line, one could sense the instant chill of reluctance. It was up to Mike Fitzpatrick to break ranks.

"None of us are going to reveal those kinds of details."

"C'mon Mike, everyone knows where you guys want to be."

"The analysts predict exactly what you will have next year and every year for the next five years by drawing a straight line on graph paper."

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"Okay okay, I'll put together a generic chart of the likely transfer rates of future products. At least we will all be on the same page to argue over next time around."

Note: The white paper forwarded by Tom Hammond-Doel described the InSpeed technology which can be used to build cheap (sub-\$25) non-blocking crossbar switch ports. It is for embedded applications, so there is no embodiment per se. Since there are basic loop capabilities built in, the port can be used to control small loops. This allows subsystems to be configured with one port per data path and as many drives as needed on a loop.

### SECURITY STUDY GROUP FEBRUARY 6

QLogic hosted at the Hilton Waterfront in Huntington Beach.

Company	Name	Company	Name
Akara	N. Wanamaker	Lightsand	M. Rajagupul
Ancot	J. Dedek	LSI Logic	D. Ridolfo
Andiamo	C. DeSanti		D. Weber
	F. Maino	McDATA	L. Hofer
Boeing	M. Foster		S. Kipp
Brocade	J. Kleinsteiber		M. O'Donnell
	S. Wilson	MTI	R. Ramos
Cipher Solutions	V. Ahuja	NGS	G. Warden
Class Constructors	D. Gunawardena	QLogic	C. Carlson
Compaq	D. Fraser	SAN Valley	L. Lamers
Connectivity Slns	B. Kembel	Sanera Systems	A. Maunder
Crossroads	J. Tyndall	Santa Barbara Nwks	C. Tracy
Data Device	T. Decker		B. Tusiray
	J. Gelish	Sony	J. Mendiola
	M. Randazzo		M. Nguyen
Emulex	B. Nixon	StorageTek	M. Gaffney
ENDL	R. Weber	Sun Microsystems	V. Novak
General Dynamics	R. Pedersen	Systran	A. Frarday
HDS	A. Edmonds	True Focus	H. Truestedt
Hewlett Packard	P. Spasic	Unisys	W. Gentry
IBM	R. Dugan	Veritas	R. Cummings
Inrange	G. Koellner	Vixel	K. Hirata
Karthika Tech	C. Kent		J. Nelson
	D. Thanos	Zyfer	C. Helbig
Lightsand	A. Helland		

### Project Proposal

Your reporter's ears must have been affected by wax when he had overheard talk of a Technical Report on Fibre Channel Security.

Mike O'Donnell (McDATA) did the unveiling honors.

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