FireWire Evolution

A white paper

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ABSTRACT

The purpose of this white paper is to comment on FireWire evolution, especially in reference to FireWire 800 development. Topics of discussion include: historical elements of FireWire; early thinking on FireWire 800; high and low points of FireWire 800 as perceived in today's marketplace with a conclusion focusing on the prognostication of external storage technology.

PART 1

AN INTRODUCTION

In the summer of 2002, my company (WiebeTech LLC) exhibited at the MacWorld show in New York City. Our product line of storage enclosures were competing well in the marketplace, and many of our products were successful because they had FireWire ports. We had the good fortune to have our trade show booth directly next to Oxford Semiconductor.

Oxford's claim to fame is that they are one of the larger suppliers of FireWire bridging silicon on this planet, having scored market gold with the well known OXFW911 FireWire bridge. The 911 is the bridging brainpower behind many of the most popular FireWire 400 storage enclosures sold at that time, and still holds that position of prominence even today. As a result, the 911 has significant market share, is preferred by many savvy consumers, and has delivered substantial revenue to Oxford Semiconductor (based, not surprisingly, in Oxford, England.)

All Macs produced today allow attachment to FireWire peripherals, and so do many Windows / Linux PCs. FireWire is a significant feature within many digital video cameras. FireWire, particularly FireWire 400, had been very kind to Oxford Semiconductor and to Apple Computer.

Oxford had certainly been bootstrapped from far off the radar to a position of industry prominence with its 911 product success. In hopes of more market gains, Oxford was paying much attention to a new industry FireWire specification, which built on all of the successes of FireWire 400 while immediately doubling transfer rates from 400 to 800 Mbps. The improved FireWire specification was known as '1394b' and ultimately came to be known to consumers as FireWire 800. (Technically, the 1394b spec covers much more than just doubling transfer speeds – cable connections were redesigned – groundwork for even faster speeds was laid – some of these details are important; some of them aren't and will safely be ignored by this paper.)

In an effort to jump start this next generation FireWire 800 technology, Oxford brought samples of FireWire 800 bridging silicon to the show. They earnestly and keenly hoped that Apple would introduce a computer with FireWire 800 ports at that show; but it wasn't to be.

FireWire 800 was a much anticipated technology, for these reasons:

1) FireWire 400 was faster than any other external drive connection technology (EG: USB1 and USB2) but was still slower than the underlying drive transfer rate. In other words, FireWire 400 was a bottleneck to the external hard drive. It was always faster to install the hard drive inside the computer. This irritating fact was mitigated by the Oxford 911, which did a much better job of FireWire transfer rates than first generation FireWire devices, such as the Oxford 900.

2) It would help improve and differentiate the Apple platform by doubling the transfer rate performance to external storage devices.

3) The flaws of FireWire 400 had become the fodder of discussion groups, as a result of blown firewire drives and blown motherboard ports, especially in Apple computers. FireWire 800 promised to resolve most of these issues. Please reference a prior white paper on the topic: http://www.wiebetech.com/pressreleases/FireWirePortFailures.htm

4) FireWire 800 had a bevy of new features that would prevent port blowouts.

5) FireWire 400 had evolved to the point where further gains in storage performance could only be achieved by a jump to the next higher technology; ergo: FireWire 800.

6) FireWire 800 was creating a critical fear that FireWire 400 devices (and host computers featuring FireWire 400 ports) would soon be obsolete. This fear was certainly rattling around inside my head, but was also evident in end users.

7) FireWire 800 was perceived as an important stepping stone along the path to even greater speeds, including FireWire 1600 and FireWire 3200.

It was an interesting trade show, but it certainly wasn't the show that Oxford wanted. Apple brought absolutely nothing that suggested that FireWire 800 was part of their current or future product plans, which left Oxford (the biggest silicon advocate of FireWire 800) in an empty position. The storage manufacturers, along with Oxford, left the show wondering what might happen next, and when it would happen.

FAST FORWARD TO JANUARY, 2003…

Fast forward to January, 2003, San Francisco. Another MacWorld, a different city than the last show. This time, the sequence of events went a little more to Oxford's hopes and desires. Apple introduced two new Powerbooks: a 12 inch midget and a 17 inch beauty. The larger of the two new machines featured a FireWire 800 port. Several different storage manufacturers, WiebeTech included, announced storage products based on FireWire 800 technology, all based on Oxford's FireWire 800 bridging silicon (the Oxford OXUF922). Apple had been kind enough to provide beta software to WiebeTech and other drive manufacturers which enabled these products. As a result, FireWire 800 was officially a reality and a factor in the marketplace. Later in the month, Apple introduced a desktop computer with FireWire 800 ports as well. It appeared that this new connectivity methodology was late but well launched.

Preliminary performance results showed that FireWire 800 was significantly faster than FireWire 400, but not double the speed. FireWire 800 required new cables and connectors, but the redesigned connectors in FireWire 800 helped resolve some of the issues that had plagued many FireWire 400 products and host ports.

FIREWIRE 400 HISTORY

FireWire 400 technology has been broadly accepted into personal and corporate computing. First adopted by Apple Computer and later adopted by the Windows / Linux community, it is now ubiquitous. Today, many new personal computers feature at least one FireWire 400 host socket; all shipping Apple computers have FireWire 400. Any serious system from the Windows side of the personal computer marketplace features FireWire 400; many off the shelf Wintel motherboards have built in support for FireWire as well. FireWire (in particular, FireWire 400) is without argument a major success and is shipping on tens of millions of computers, every year.

Steve Jobs and his team at Apple deserves direct credit for charismatically taking FireWire to the user. In January 1999, Jobs announced the end-of-line for SCSI, and introduced the first FireWire equipped CPU (the G3 Tower) at Macworld San Francisco. Show attendees will remember the compelling demonstration of Jobs demonstrating a VST Technologies FireWire drive playing a QuickTime® movie, with full support for hot-plug, and then holding up a 6-ounce, one-half inch thick portable VST drive he pulled from his pocket.

The Jobs demo of the VST portable FireWire drive at the Macworld kickoff keynote presentations was met with cheers from the crowd. (Perhaps one of the people who remembers it the best was Vince Fedele, CEO of VST Technologies; whose booth was swamped during the Expo after having VST's product featured in a Steve Jobs keynote– a pivotal day for Vince and VST!

The VST drive had a visually compelling mixture of ornamental and industrial design, and sophisticated miniaturization, helping to reinforce the importance of the moment. (VST was subsequently acquired by SmartDisk, and the well identified VST brand was thereafter killed by the acquiring company.)

Early capacities of FireWire drives started in the neighborhood of 1 or 2GB; I really don't remember; I wasn't paying a great deal of attention at the time. (In this early period of FireWire development, I was the CEO of Newer Technology, a manufacturer of Macintosh CPU upgrade products.) The overall performance technology had to be very low (perhaps because FireWire 400 actually started at FireWire 100 or 200 speeds) but also because of the slow performance of the underlying disk mechanisms used at that time and the slow performance of the available silicon bridges, such as the original FireWire 400 bridge from Oxford, which was called an Oxford '900' bridge.

Sony also promoted their variation of FireWire, which they called 'iLink'. Several other silicon companies produced a variety of devices, such as host side FireWire controllers (which is the complementary product to a FireWire storage bridge) and FireWire 'PHY' devices, which allowed FireWire bridges and hosts to connect to FireWire ports. PHYs also enabled the development of FireWire hubs.

With this broad acceptance of FireWire 400, quite a few hiccups and problems occurred. The most glaring flaws of FireWire 400 were:

1) FireWire 400 was faster than any other external drive connection technology (EG: USB1 and USB2) but was still slower than the underlying drive transfer rate. In other words, FireWire 400 was a bottleneck to the external hard drive. It was always faster to install the hard drive inside the computer. This irritating fact was mitigated by the Oxford 911, which did a much better job of FireWire transfer rates than first generation FireWire devices, such as the Oxford 900.

2) Sony (and a few others) insisted on the iLink non-bus powered variation of the host FireWire port. As a result, transportable drives (such as the VST product) would only work on Apple products, but not on most Windows based laptop computers which used the iLink style port. This split the usability of FireWire peripherals into two camps: those that required host power (such as portable pocket drives) and those that did not (such as desktop storage devices, which got their power from a separate AC adapter).

3) Continuing on the theme of unfortunate differentiation, FireWire actually got triple branded with three different major trademarks: FireWire (the big name); IEEE1394 (the specification name); and iLink (the Sony name). All of them meant essentially the same thing, but from the consumer's perspective, the pie was divided. Would that FireWire drive work on an iLink host? Perhaps… unless it required bus power… These confusions continue to this day.

4) FireWire 400 devices had a difficult time in controlling radiated radio interference, or RFI. This issue was transparent to consumers but potentially nasty for peripheral manufacturers.

5) FireWire 400 devices had a bad habit of blowing ports. This problem has been detailed in many different places on the web. For a period of time, Apple had a silent warranty which included a repair and upgrade to the motherboard, resolving many of the problems which users encountered. One of the causes of these blown ports was FireWire cables plugged in backwards into FireWire ports. Another of the causes was start up power and voltage surges on the FireWire cables. The engineers and architects behind the original FireWire 400 specification might argue that more careful adherence to the original specification by peripheral manufacturers might have reduced the blown port tragedies in the field. True enough, but this was poorly understood by many within the industry, especially in the early years.

6) FireWire 400 cables were officially limited to a length of about 15 feet. This eliminated an entire class of products from entering the marketplace. A simple example of an impossible scenario might be a FireWire camera, remotely located outside a building, attached to a computer within the building. It just couldn't be done with conventional FireWire 400 cabling.

The users wanted faster external drives than what FireWire 400 could deliver; Apple and others wanted a resolution to the rest of the glitch list as well. Future generations of FireWire technology (starting with FireWire 800) clearly offered the answers.

PART 2

THE PROMISE AND THE REALITY OF FIREWIRE 800

Upon introduction, Apple touted the features and benefits of FireWire 800. Quoting excerpts from an Apple affiliated website, still posted as of this writing: "With its high data-transfer speed, FireWire is the interface of choice for today's digital audio and video devices, as well as external hard drives and other high-speed peripherals. Now transferring data at up to 800 MBps [SIC], FireWire 800 delivers more than double the effective bandwidth of the USB 2.0 peripheral standard. That means you can send more than a CD's worth of data every ten seconds… Using professional-grade glass optical fiber, FireWire 800 can burst data across 100 meter cables… [FireWire 800] reduces

delays in arbitration… FireWire 800 just works… While USB 2.0 allows at most 2.5W of power – enough for a simple, slow device like a mouse – FireWire devices can provide or consume up to 45W of power, plenty for high-performance disk drives and rapid battery charging… FireWire on Every Mac…

FireWire 800 was setup to be everyone's answer to personal storage requirements.

It's interesting to analyze the claims of FireWire 800, along with some of the general expectations within the marketplace. This is done by looking at the expectations associated with FireWire 800, and comparing that to the current realities within the market.

One by one, here are the discussion points:

1) Transfer rates. FireWire 800 theoretically supports a transfer rate of 800 million bits per second (Mbps), which is the same as 100 million bytes per second (MBps). FireWire 800 has actually delivered transfer rates which peak at around 50 to 74MBps. This is pretty good performance and exceeds the native performance of many IDE and SATA disk drives. Achieving this level of performance currently requires a RAID implementation of some sort, so that two drives simultaneously pump out the data, maxing the FireWire 800 connection. A rough edge is that transfer rates have not been symmetrical: Read transfers from FireWire 800 storage devices are almost always faster than write transfers to the same device. The maximum read transfer rate of a FireWire 400 storage peripheral (about 35MB/sec) compared with the maximum read transfer rate of a FireWire 800 storage peripheral (typically about 55MB/sec) means that most consumers perceive FireWire 800 as being 60% faster than the older FireWire 400 peripherals. All in all, though, FireWire 800 has won this performance war. Perhaps one of the greatest benefits of FireWire 800 is that it has opened up a new marketplace of FireWire 800 storage peripherals which support Standard Definition video editing. An excellent example of this is WiebeTech's BayDock 800 or ToughTech 800 storage enclosures.

2) Length of cables. All of the long distance promise ('… 100 meter cables') of FireWire 800 utilizes expensive fiber optic cable. Solutions are available which support this claim, albeit with relatively few takers because of the high cost. Entry level long distance optical solutions for FireWire currently cost about $1000, absolutely eliminating all consumers and many professional applications from these extended distance applications. The cost of this technology cuts like a fine knife through the marketplace; separating good ideas with high price points from truly marketable, broadly acceptable solutions. Fiber optic, in current implementations, is NOT what the market was looking for. A real miss for FireWire 800 and FireWire in general.

3) Bus powering. One of FireWire's most touted benefits is the ability to attach and bus power devices without having to use yet another power adapter wall wart. While FireWire 800 really didn't advance the state of the art in this department, the rare references to high power peripherals (45W, as stated in the quotation, above) have often left people with the errant impression that FireWire 400 or 800 can power some hefty devices. It can't. Apple has never delivered any computer with a published specification capable of supplying more than 15W of power on a FireWire port; and to the best of my knowledge, no other computer system manufacturer has delivered such a high power port. As a result, FireWire users have been forced to be content with portable FireWire drives which are bus powered. WiebeTech used to produce a series of bus powered 3.5 inch enclosures as well, which worked well with certain drives and with Apple computers. Unfortunately, they did not prove to be a universal solution and were discontinued. Certain 3.5 inch hard drives consume considerably more than 15W, while most FireWire hosts provide considerably less than 15W. None provide 45W. A solution to this power shortage would be a FireWire 800 powered hub, and such a device has been proposed. However, the costs (especially given the anticipated low sales volume) dictate that once again, it would not result in a general purpose consumer solution. On this point, FireWire scores a B grade, exceeding the pitiful performance of all USB products, which at best score a D grade. The iLink variation of FireWire still does not provide bus power, and never will.

4) Port blowouts. This issue has died out. A definite win for FireWire 800. (I have seen one example of a blown FireWire 800 connector, caused by a reversed insertion of the connector.) FireWire 800 works well and doesn't blow out ports like FireWire 400, although it still occurs.

5) Relative cost of technology. FireWire 800 gets a "D" grade on this point. Unit costs go down when spread over greater volumes of product, and when multiple sources of supply are able to freely obtain technology licenses and produce those products. In the case of FireWire 800, the cost of technology has been carried by those users who choose to buy FireWire 800 equipped computers. It's evident to everyone at this point that Apple does not intend to put these ports on consumer machines, just on higher end computers. As a result, costs have been spread over a smaller base of computers. Other cost glitches include the high cost of FireWire 800 connectors; the high cost of silicon associated with the FireWire 800 bridge; the high cost of specialized FireWire 800 PHY devices and the high cost of FireWire 800 host silicon devices.

The hype associated with FireWire 800 (before its introduction) seemed to induce a variety of vendors to overprice the various pieces of hardware necessary to implement the entire technology. As a result, delivered FireWire 800 products remain expensive. Another factor which increased the cost of FireWire 800 products was very high levels of stability required in certain

components within a FireWire 800 peripherals. The Ferrari effect carried over into overdesign of some of the FireWire 800 specific components. For instance, the Oxford OXUF922 FireWire 800 bridge also included a USB2 bridge, thus obligating that all purchasers of storage enclosures using FireWire 800 also pay for the extra burden of having USB2 connectors and silicon in the same enclosure. It still seems a little incongruous, to have FireWire 800 storage enclosures which also feature a USB2 port. This pairs the highest performance external storage technology with the slowest available technology.

6) OS X operating system support. Another miss for FireWire 800. Many users wanted to send fiery missiles to Apple and Oxford Semiconductor for failing to properly ascertain the results of shipping buggy operating system software and firmware in late October of 2003. The resulting flame war between these two companies in the internet press was one of the most interesting things I've been able to observe within the storage industry. Apple took high ground and looked far more professional in their public dissemination of date, while Oxford looked surprised and bruised.

A brief recap of those circumstances: Apple issued a new release of OSX which suddenly caused certain FireWire 800 storage devices to destroy their data. Grief ensued; users slit their wrists as volumes of unbacked up data went down the digital toilet; Apple mobilized an internal disaster team to try and replicate user errors (with hopes of resolving the problem); and Oxford flamed Apple publicly from the Oxford's website. Even though it was a very significant problem, it was still inaccurately reported and overblown by some websites. It taught some users an unfortunate and invaluable lesson about having adequate backups. Everyone learned.

I recall clearly receiving a call at home one evening from my Oxford sales representative, detailing what had just happened and promising updated firmware. Several of us went to work, issuing a news release within hours and posting the new firmware on our website. Lacie and other storage vendors released the firmware nearly simultaneously; Apple identified affected third party products (such as WiebeTech's) on their website; they also updated their OS a few weeks later; and the event faded into history. Unfortunately, it left a black eye on external storage devices and FireWire 800 in particular.

7) Windows XP operating system support. The experience of Windows XP and FireWire 800 has been every bit as interesting as the Apple OS X affair, but not as widely publicized. MicroSoft's recent distribution of Service Pack 2 for Windows broke the normal operation of most FireWire 800 devices in an unusual way. The FireWire 800 storage devices still worked, just very slowly. Service Pack 2 forces FireWire transfer rates to slow down to $1/8^{th}$ normal speed but otherwise function normally. This means that transfer rates are limited to about 12 MB/sec. Fortunately, there is an easy solution, which is to

update the firmware within the FireWire 800 enclosures. (users of WiebeTech FireWire 800 devices and Windows XP with Service Pack 2 should contact our support department for a firmware upgrade, please send an email to: support@wiebetech.com) The installation of the firmware restores FireWire 800 speeds to Windows XP. This is a very important point: the firmware upgrade makes FireWire 800 storage enclosures into very zippy storage enclosures under Windows XP.

8) Future FireWire upgrades. The official specification for FireWire 800 is the 1394b spec, which as mentioned early in this paper actually encompasses many things, including FireWire 800, FireWire 1600 and FireWire 3200. Of course users are not really aware of these technology extensions, and they appear unlikely to ever hear much of them. FireWire 1600 looks stillborn… perhaps 'stillborn' is too strong of a word: there's no evidence of FireWire 1600 anywhere in the womb. FireWire 3200? Completely nonexistent today. The reason that this is important is there are already storage technologies competing within these speed ranges. SATA has been shipping for a long time at speeds of 1.5GB/sec (roughly equivalent to FireWire 1600) and SATA II devices are being announced right now with speeds of 3GB/sec.

   MacAddict magazine recently predicted in print (Nov 2004 issue, page 22) that no FireWire 1600 devices or hosts will see the light of day. I agree.

9) Ubiquitous platform support. FireWire 800 was championed by Apple, and my comments largely come from that perspective. What certain storage manufacturers wanted was support in all of Apple's new computing products. As discussed earlier, Apple has not provided this and it now seems clear that they never will. Apple's talking points on FireWire show a clear delineation between consumer applications (where FireWire 400 reigns supreme) and professional applications (of course, FireWire 800 is the correct choice). Apple is reacting to several events within their marketplace: FireWire 800 costs a lot of money to put on a computer; FireWire 800 has been accepted by only a portion of their market – largely multimedia developers; FireWire 800 is a technology which must be considered in light of other future options; FireWire 800 works well for audio and video editing and for other professional applications, but adds no significant value for most consumers. Apple is simply making prudent business decisions. For this, I find no fault on the part of Apple, and it makes me wonder what their next most prudent external storage technology decision will be.

It's time to prognosticate on the future direction of external storage technologies.

PART 3

THE ALTERNATIVES

I frequently am asked about alternative storage technologies for typical personal computer users. There are only a few which have appeal to a broad consumer base. Historically, it's just been USB (in two flavors: USB1.1 and USB2.0) followed by FireWire (also in two flavors: 400 and 800). A more recent entrant, worthy of consideration, is Network Attached Storage (NAS). Another very recent entrant into the external storage market is Serial ATA. Each of these storage methodologies has consumer features and benefits, and is worthy of discussion. FireWire has already been discussed in depth in this document, but USB, NAS and SATA are worthy of some additional discussion.

1) USB STORAGE DEVICES. USB became a very popular interface methodology for all kinds of peripherals, and has been widely adopted for such things as mice and keyboards. In the older USB 1.1 specification, it has a transfer rate of around one megabyte per second. When the USB2 spec became the technical law of the land, external storage manufacturers were quick to develop and market products which took advantage of its greatly enhanced transfer rates. Sporting a technical top end of 480 Mbps (480 million bits per second), it seemed set to score a technical knockout over FireWire 400 storage devices. However, this was not to be, because of the real world differences in measured transfer rates always and invariably ended up favoring FireWire 400 devices. As a result, USB2 storage devices are generally used by consumers who are not concerned with overall transfer rates of their data to their storage device. USB2 storage devices tend to be inexpensive, easy to use, and perfect for general purpose use. Apple was late in supplying support for USB2, but ultimately saw the future and has provided it on all recent product introductions. WiebeTech ships USB2 ports on many of its current product offerings.

2) NAS DEVICES. Several companies have been capitalized around the concept of providing cheap, easy to use Network Attached Storage devices. The vision for this group of products has been to provide storage, accessible from the desktop, attached through Ethernet and accessible via office networks. Bigger visions include accessing the NAS through a WAN, essentially enabling 'local' access to personal data anywhere the internet is available. It's a grand vision, and it has considerable appeal. The downfall of NAS has been as follows: it is often difficult in installation and setup; the lack of commonly accepted standards for cross platform use prohibits acceptance in many installations; and NAS devices generally have a high cost of ownership. One of the best examples of a usable NAS device is from Mirra (www.mirra.com) but even their product suffers from high costs and a lack of expandability. Another technology worthy of close attention is SAMBA. SAMBA is a file server protocol contained within certain Linux distributions, and it allows NAS devices to mount on a desktop in both OS X and in Windows. However, it can be complex and difficult to setup, but it is powerful. Windows support

is very good; Mac support in recent releases of OS X is atrocious and unusable. Apple has promised to strengthen SAMBA support in their upcoming Tiger release, which will be a very good thing. NAS can leverage a cheap connector, (the Ethernet connector) already present on almost all computers, along with an extremely high transfer rate (often 1Gbit). The challenge for Samba is to easily provide for its setup and management. It has the potential of being an endearing niche for personal storage users.

3) SATA DEVICES. The transfer rate for first generation SATA is 1.5Ghz, nearly twice that of FireWire 800, and it has been a shipping since 2002. Recently, SATA II silicon has been introduced which support transfer rates to 3GB/sec. SATA has been adopted by every computer manufacturer, including Apple, for inclusion within desktop systems because it is fast, cheap and simpler to connect than older parallel IDE technologies, and it is the future of internal storage. It uses thin, pliant cables which are inexpensive and easy to route. The cables use copper, not fiber optics, to support its very high speed transmission rates. SATA was not designed or introduced as a technology designed to supplant FireWire or USB2 for external storage. But it certainly has the potential to be a potent external storage method, and the SATA II spec does spell out how that might happen. Connectors have been designed (and are in production); controller silicon and PCI boards have been announced; Apple has supported the original SATA spec within the G5 (look for it in more Apple models as time progresses); WiebeTech expands the drive capacity of G5s using SATA based technology in the highly popular G5Jam product (see http://www.wiebetech.com/products/G5Jam.php for a complete description of this product). Other companies have recently announced silicon which will effectively support, in a single chip, a JBOD or a striped RAID of up to 5 drives, attached via SATA II (remember, that's with transfer rates up to 3GHz) then fanning to the five drives. While these storage products may not be available now, they will be a factor in 2005 for all Windows based computer manufacturers, as well as for Apple's competitive landscape.

USB is useful, but not for high performance storage devices. NAS can be a winner, if it overcomes setup difficulties. SATA has the greatest potential of all.

In comparison to FireWire storage, all three of these storage wannabes has pluses and minuses. USB provides low cost storage, with the compromise being performance. NAS can theoretically provide high performance, but at a high price and with setup difficulty. SATA can provide the performance, but until recently lacked the external connector specifications or the ability to attach more than one SATA drive to a storage system.

PREDICTIONS

I make the following predictions:

1) FireWire 800 will be included on new professional products from Apple in 2005, but not in 2006. No other computer manufacturer will directly support FireWire 800. FireWire 800 has simply failed in too many ways to make it much beyond its infancy. The cost has been too great; the adoption has not been pervasive; the benefit for the average consumer has been too small. The bruise left by the OS X / FireWire 800 debacle in October of 2003 left a black eye, slowing acceptance of FireWire 800 at a critical period of time. Microsoft studied FireWire 800 technology for a long period of time, but has simply not provided the support necessary to make it pervasive. Microsoft does not do anything without a reason; the recent Service Pack 2 difficulties with FireWire 800 were designed to signal MicroSoft's lack of support for FireWire 800.

   Unless you are a user who is interested in very high performance storage, and is willing to pay the premium associated with it, FireWire 800 will not be the storage methodology of choice.

2) SATA, particularly the improved SATA II specification, will be adopted as an external storage technology, and displace FireWire 800 on both low end and high end computing platforms in Apple and in Windows platforms.

   This seems so obvious.

   While FireWire 800 was originally promoted by Apple, SATA has quietly won the entire rest of the market.

   FireWire promoters didn't pay it serious attention, because SATA didn't have an approved connection methodology for the support of external drives. It didn't appear to be competition for FireWire (or USB2, for that matter) but it is the biggest competition that's out there.

   SATA enclosures don't need to have additional bridging silicon within them. SATA drives are happy to directly connect to a host SATA port. This reduces overhead in every sense of the word, and reduces costs as well. SATA connectors function perfectly fine at 1.5Ghz and soon at 3.0Ghz as well, and do not have the steep cost associated with them, unlike FireWire 800 connectors, silicon, and cables. The SATA architecture has been improved to support, in hardware, multiple drives through one connection port. This will allow very large capacity storage devices to come to market, at lower costs than FireWire. I expect to see these kinds of devices soon.

   When it comes to reducing costs and increasing performance, Apple's no fool. I believe that Apple will continue to increase its use of SATA devices within and outside of its computer systems, simply because the costs of doing so are lower than implementing FireWire 1600 or FireWire 3200, SATA II will do it better, and Apple will have the opportunity to use this as a competitive

industry advantage, just like it originally tried to use FireWire 800. While Apple has occasionally been a reluctant follower of pervasive industry standards (for instance, USB 2 was only adopted by Apple last year), my impression is that it is getting smarter in this respect. The argument boils down to this: It's a prudent business decision for Apple to use a lot more SATA, including external SATA II storage. What else is there? What could be lower in cost? What would offer a better benefit to the consumer? The answer: nothing else is out there at this point in time.

3) FireWire 400 will remain as an extremely common interface on almost all new personal connectors well into 2006.

   The reasoning behind this is clear as well. FireWire 400 peripherals are plentiful. The original FireWire standard has momentum. Many millions of FireWire 400 host sockets are added every year. Consumers already own and use millions of FireWire 400 peripherals, including video cameras ('iChat'), storage devices (such as most of WiebeTech's product line) and so on… There's no current end in sight.

   The problems of FireWire 400 have been resolved or worked around. Host ports blow out more infrequently; a cheap solution is to simply install a replaceable FireWire PCI host card. Manufacturers have revised the circuitry which protects ports; they are better designed as a result.
   FireWire 400 remains easy to use, and it's gotten cheap, as a result of its very high volumes. This is a lesson lost on FireWire 800.

4) FireWire 1600 / 3200 will never appear. This is a direct result of the botched FireWire 800 introduction.

CONCLUSION

Apple's attempt to be a standard bearer on peripheral interconnection technologies has hit a significant speed bump with FireWire 800. For FireWire 800 to have been broadly successful, it should have been promoted as a consumer technology, not as a professional technology. This would have spread costs over many more platforms, and would have allowed FireWire 800 a great chance to become ubiquitous. This did not happen, and FireWire 800 is used (and will continue to be used) mostly by professionals as a result. Users have missed out on the benefits of FireWire 800, which include speed and durability.

The alternatives are making a push for market share, and are having some success. NAS has great potential; but will have to work through some huge implementation issues. SATA is a hot technology and is on the upswing. Those who promote SATA correctly perceive that high speed interconnection technologies are best created and promoted as broad consumer technologies. This has lead to the promise of nearly immediate 3Ghz transfer rates at low costs. SATA will have a profound impact in the marketplace,

affecting the competitive landscape across Windows and Macintosh platforms. The world is changing and consumers will benefit.

Apple's role as a storage standard bearer has been diminished because of errors in the FireWire 800 rollout. While professionals and high end consumers will continue to acquire and use FireWire 800 for a long period of time, purchasing decisions will move in other directions, starting in 2005. FireWire 400 will continue to retain market share. USB2 will be popular among cost conscious consumers. NAS will offer benefits for some, but SATA will be the biggest winner, because of its low costs and high performance.

FireWire 800 is a great technology which was not supported by great planning or great marketing. It succeeded in its mission to provide a technically superior alternative to FireWire 400, but failed to gain prominence in the market. Due to a variety of errors and miscalculations in how it was marketed, it has not been a cost effective choice for consumers. It will continue to have a role of prominence for professionals, because it does work extremely well, but will be threatened by SATA and other emerging storage technologies.

<edited on 10/28/04 to correct error re: Jobs / tradeshow / Fedele>

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ABOUT THE AUTHOR AND WIEBETECH LLC

James Wiebe is the founder and CEO of WiebeTech LLC. WiebeTech, founded in July, 2000, has quickly become a significant provider of storage devices for personal computers.

James was formerly with Newer Technology, and helped guide that company to a leadership position within the Macintosh CPU marketplace. At its peak, Newer had sales in excess of $60 million per year. Many of its CPU upgrades are still in use every day in Macintosh computers around the globe. James left Newer in July of 2000, starting WiebeTech thereafter.

James is an authority on issues related to personal computer storage. WiebeTech's storage products have won major awards and positive critical reviews from many different leading personal computer magazines and websites, including PC Magazine, PC World, MacWorld, MacAddict, C/NET and many others.

If you would like to make comments concerning this whitepaper, they may be directed to James at the following address: whitepaper@wiebetech.com

James can't promise to reply to every comment but would enjoy reading your comment.