

40G Ethernet – Closer Than Ever to an All-Optical Network

According to CIR's latest report on high-speed LANs -- [40/100 GIG MARKETS: 2010 AND BEYOND](#) – the 40G Ethernet transceiver market will have exceeded \$600 million by 2015, but for the first time in the history of Ethernet, twisted-pair will play no role in this growth. However, the reasons why fiber is expected to take such a big role in the near-term future of 40 G Ethernet have less to do with high performance of fiber and more to do with the growing failures of traditional copper solutions.

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We are getting close to the tipping point in data centers and LANs. After many years of predicting this would happen, twisted-pair copper (Category cabling) is finally nearing the end of its useful life. CIR has been covering the high-speed networking space for decades and for most of that time, the story has always been the same. A new high-speed data networking standard appears and the trade press goes to town on how this will lead to fiber everywhere. But that's not what actually happens.

Instead, the standard breeds new products and at first it really looks as if it will be fiber everywhere from here on out. However, as maturity sets in, someone, somewhere finds a way to run the standard over copper and fiber optics are driven into niches. Those with a long memory will, for example, recall that 100 Mbps Ethernet was once considered likely to be a fiber-optic standard and is now sold in the multi-millions as an almost exclusively copper standard.

For almost as long as it has been in existence, CIR has been an advocate of the idea that datacom component and module markets will be driven by pragmatic – cost/performance – related factors. For this reason we have always tended to give copper the benefit of the doubt in our forecasts, because, as we have seen, there has historically been a very good reason for doing so.

However, this assumption no longer seems to be valid. *In CIR's research for its recently published report, 40/100 GIG MARKETS: 2010 AND BEYOND we have come to the conclusion that the long-term trends in the use of copper have begun to change in a very significant way. What we found is that there is little*

support for the 40GBASE-T variant; and we believe that there are not enough end users or equipment manufacturers who see the value in pursuing it for it to become a substantial part of the high-end LAN market. This is not to say that at 40 G, datacom has somehow exceeded the limits of technical feasibility. This does not seem to be the case. Research being conducted by Penn State University (and others) and cabling companies (Nexans, Siemon) show that 40 G copper LANs are “feasible.” We note also that, although there is a twin-ax copper solution defined for 40G, our projections suggest that by 2015 it will contribute only 7 percent of the revenues being derived from 40 G LANs.

But while it is still early for this market and attitudes may change, in CIR’s view, there are many challenges copper beyond 10G must address before adequate market support for standardization will occur. These challenges strongly favor a surge in the penetration of fiber in the LAN and data center in the very near future.

Before discussing the current challenges for copper, it is perhaps worth noting that the reasons that CIR expects fiber to grow are not the usual ones that have been provided for fiber’s growth for so many years. These older arguments have essentially said that we need fiber for longer distances at higher data rates. All this is hard to argue with, because it is basically a matter of physics. But the majority of networks remain copper because it is the most cost-effective solution for short-reach needs. And no one is expecting some massive leap forward in the distances that need to be covered by cabling in data centers.

Similarly, while history of fiber optics is usually presented as a search to support higher data rates, the inconvenient truth is that users that actually need 40 or 100G are few: they include Google, Facebook, Amsterdam Internet Exchange and the like. Most enterprises are just starting to look at upgrading to 10G, but must rationalize the cost to do so. Higher data rates for most companies are on their roadmaps, but more than three years out.

Instead of the traditional arguments for fiber, CIR believes that a number of new factors will drive fiber into the data center/LAN:

- **High power consumption of copper:** When originally released in 2007, 10GBASE-T ports consumed about 14W of power due to their very complicated digital signal processing (DSP) chips. This was entirely too much power consumption to put in a switch port. Today, some chip manufacturers have

finally achieved below 5W power consumption so switch manufacturers are finally starting to implement them – Cisco recently released a 10GBASE-T blade for its popular Catalyst 6509 data center switch. This should enable the 10G market, which will in turn facilitate 40 and 100G implementations. However, even 4W per port is still high when compared to less than 1W for laser-optimized multi-mode fiber (LOMF) ports. *Power consumption did not seem to matter all that much a decade ago. But with data center managers watching every watt of power consumption now, using fiber might be a better solution for the long-term.*

- **Reliability of 10GBASE-T ports/CAT6A cabling in question:** Even with 10GBASE-T ports claiming to be compliant to the standard, there have been some reliability issues. Early installations could not actually support 100m operation and CAT6A cable was susceptible to external noise – like from cell phones according to one CIR source. It still is not clear if these issues have been resolved. Many end users have chosen to use either shielded CAT6A or CAT7 to mitigate noise issues. *While reliability problems may well be resolved in the end, CIR views this as a big deal simply because one of the major drivers that has made Ethernet so successful in the past is the fact that it so reliable. It is this fact that has enabled Ethernet to become widespread, even at the residential level where there is typically no expertise on installing data equipment.*
- **Cabling density a growing menace in data centers:** 10GBASE-T copper cabling has posed many challenges for network managers. CAT6A or CAT7 that are needed for 100m operation are typically more than 0.050” larger in diameter than standard CAT6. This does not sound like a lot, but it drastically impacts how many cables will fit in tray above racks or below a raised-floor and in conduit. Not to mention issues that may arise from blocked cooling airflow. Fiber does not have this issue. *In many data centers, the physical bulk of copper cabling is the single biggest reason why the data center manager is turning to fiber.*
- **The economics of copper is deteriorating cost:** Traditionally, copper ports have started at an order of magnitude less expensive than their fiber cousins. But, *taking into consideration power consumption, cooling gains and space savings that fiber brings to the data center, payback for using it instead of copper is starting to seem reasonable; where electrical power costs are rising rapidly.*

Data center managers are also increasingly moving to fiber because the copper 10GBASE-T has taken so long (more than eight years) to develop and implement and due to its inherent higher power consumption. Meanwhile, preliminary product offerings for 40G systems are starting to appear – Mellanox released a network adapter in late 2009 and both Force10 and Extreme Networks announced 40G interfaces at the recent Interop trade show. Transceiver vendors like Avago Technologies, Finisar, Hitachi Cable and Luxtera now have some paying customers for their 40G AOC products that have been on the market for several months now.

Such is the life-cycle of Ethernet networks and the most recent incarnation will be no different except that, in CIR's view, it will increasingly be more optical and much less copper.

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