Nexans

TECHNOLOGY / MARKET WATCH
December 2006 through May 2007

DATA COMMUNICATIONS COMPETENCE CENTER

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This document summarizes key advances in several specific technologies and markets that may impact Nexans' Telecom LAN business.

1.0 General Market Trends

Plans to deploy voice-over-IP are on the rise, but issues still remain with the top five being network reliability, voice quality, security, network manageability and service guarantees, according to a recent survey conducted by BT INS.

Sam Houston State University found what seems to be a great way to cut costs in a new VoIP system. Its senior voice analyst decided to replace its existing Nortel PBX and its small Cisco IP PBX CallManager with an open-source Asterisk VoIP system. The new platform costs one-third that of the CallManager/Cisco IP solution. This is due mainly to eliminating the Cisco licensing fees.

While Internet traffic is expected to grow 45 to 50 percent per year until 2010 according to IGI, experts are divided as to whether the applications will outstrip the fiber capacity. According to Network World, video file sharing is the major bandwidth hog, but the existing fiber networks can handle the current demand. Heavy Reading recently delivered a report that says LH DWDM sales have grown 30-percent and "the bandwidth glut ends."

Network World interviewed Cisco's chief development officer in February and discussed the company's R&D spending. While Cisco has been a leader in enterprise switching products for many years, its current trend is to focus on service provider R&D. Cisco's business is 45-percent enterprise, 25-percent service provider and five percent consumer electronics.

Researchers at MIT and CERN can now collaborate on Internet2 over as many as 72 10G channels. MIT is now leasing fiber from Boston to New York City in order to become a regional optical network player.

Google believes that the IT industry is stuck in "maintenance" mode and this is stifling innovation. According to the search-engine giant, basic IT functions like security need to be outsourced so internal resources can be used to develop new IT tools.

According to Equinix, an Internet exchange carrier in California, Internet traffic is doubling every 12 to 14 months so 100-Gigabit Ethernet is needed now. Cisco claims that video applications like YouTube, HDTV and medical imaging files are driving the demand.

There is a new Ethernet startup switch manufacturer named Woven Systems which has thrown the conventional switch fabric out the window. The company claims its EFX 1000 switch has the highest port density and capacity in the industry. It uses 10GBASE-CX4 interfaces "which mimic Fibre Channel and Infiniband performance, but with less cost and better manageability." The switch is specifically targeted for data centers.

Ethernet is making inroads in the access environment with legacy T1 and T3 services being replaced by "midband Ethernet." Hatteras Networks has imbedded a TDR into it's products in order to pre-qualify existing copper loops for Ethernet transport.

According to industry analyst firm, Fleck, the connector and cable assembly industry is growing at more than 10-percent per year rates again due to Internet connectivity and 10-Gigabit Ethernet applications.

Google has announced three new sites for large data centers – Charleston and Columbia, South Carolina and rural Oregon.

2.0 Copper LAN Cabling

2.1 Market

Category 7 is starting to take hold in switching applications with the announcement of Nexans and Bel Stewart jack development. The partnership will produce a board-mount GG45 connector.

2.2 Technology

An interesting research project being conducted by the National Renewable Energy Laboratory (NREL) and Lawrence Berkeley National Laboratory has yielded some results that may impact key renewable energy technologies such as solar cells as well as other developing technologies like quantum computing and nanoelectronics. The work centers around something called a "nanoscale coaxial cable." It consists of GaN and GaP materials that "are combined into a wire, the structure as a whole assumes its own band gap, which is very different

from that of either component but much more appropriate for solar energy applications. In a related research project at Boston College, physicists have been able to transmit visible light through a cable much smaller than its wavelength, which up until now, was thought to be impossible.

2.3 10-Gigabit

At the BICSI conference in early 2007, several cable manufacturers introduced smaller augmented Category 6 cables.

In the first quarter of 2007, all of the top cabling-system manufacturers demonstrated that their 10-Gigabit solutions could support 10GBASE-T by running with SolarFlare's chips.

SMC Networks announced that it will use SolarFlare's chips in their 10-Gigabit copper switches. This equipment is expected to be available in the summer of 2007.

Many industry analysts seem skeptical about 10GBASE-T's adoption rate before the chip manufacturers solve the power consumption issues. According to the Linley Group, "the first generation of 10GBASE-T products are burning 10 to 12 watts." The firm predicts that there will not be much real adoption "until the switch vendors release their second-generation wares… sometime in the second half of 2008." In the mean time, several vendors have announced 10GBASE-T NICS including Neterion, Chelsio, Tehuti and SolarFlare.

2.4 Video

In early 2007, Berk-Tek and Ortonics/Legrand introduced its NetClear Electronic Safety and Security Program. It consists of replacing traditional coaxial cable with UTP-based structured cabling systems for closed-circuit television security systems.

3.0 Optical Technologies

3.1 Market

Further consolidation of the optical module market occurred early in 2007 with JDSU acquiring Picolight and CyOptics purchasing Apogee Photonics.

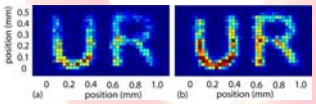
FTM Consulting released a report in February that says "fiber to eclipse copper in 'structured cabling systems' by 2008."

3.2 Technology

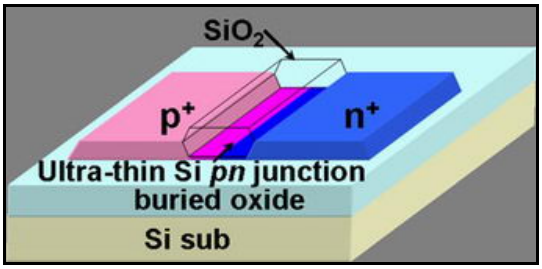
Silicon/CMOS photonics is getting ever more close to actual reality with one company in particular – Luxtera – set to release products in 2007. There are three key factors for this technology to come to fruition in networking applications:

1) CMOS is transparent to light at wavelengths longer than 1300 nm "with the most optical coupling efficiency achieved at 1500 to 1600 nm.
2) The holographic lens' surface area of the CMOS chip must closely match the cross-sectional area of the fiber. That means that SMF is the most suitable media.
3) Both transmitters and receivers are physically located very close to each other on the die so the traditional LC connectors are too large and not an appropriate long-term interface.

Is optical storage possible? Researchers at the University of Rochester think so. They have developed a new technique that stores and retrieves digital images from a single photon pulse. The image, shown below, was produced by a single pulse of light. As many as 100 of such pulses can fit into a 100 mm cell.

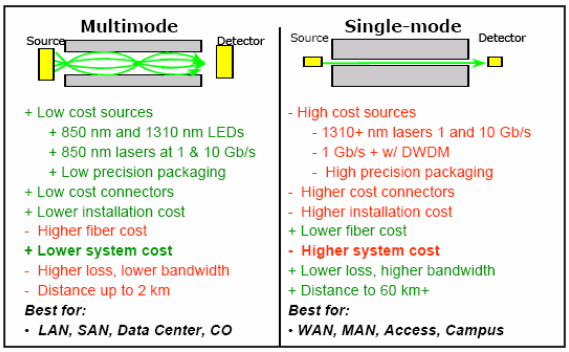


Similar to Intel's silicon photonics, Hitachi has built what it is calling a light-emitting transistor. It transfers, detects and controls an electrical signal all on a single nanometer-sized chip. It seems that the industry is getting ever so close to integrating optical and electronic devices. A graphic of the device is shown below.



3.3 Fiber

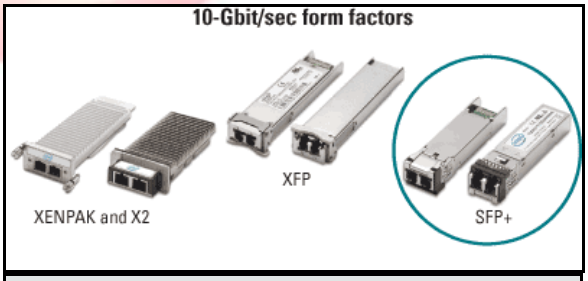
OFS recently did a comparison of MMF and SMF. The following graphic shows a summary of the conclusions.



Source: 1: OFS

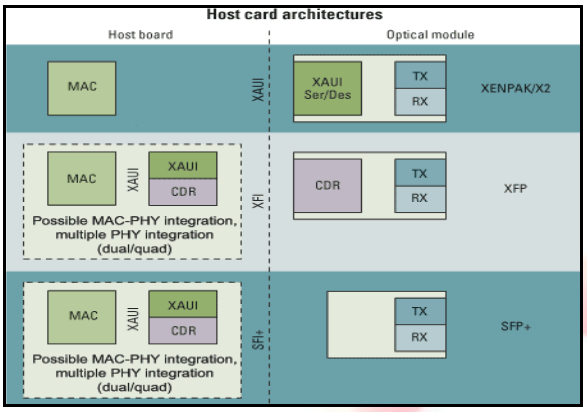
3.4 10-Gigabit

The SFP+ standard is nearing its completion and several transceiver manufacturers are now showing prototype modules. These include Picolight, OpNext, ExceLight, Avago, Finisar and JDSU. The major differences between the SFP and SFP+ modules are that the SFP+ can run data rates up to 10 Gbps and the modules do not contain the SERDES (MUX/DEMUX) and equalization (pre-emphasis and EDC) – these are moved to the host. This allows for a much more cost effective general module that can be targeted at several different 10-Gigabit markets. Below is a comparison of the different 10-Gigabit transceiver form factors:



Form factor comparison

Form factor	Size (inches)	Maximum DC power dissipation (W)	Maximum slots per line card
XENPAK	4.7x2	6	8
X2	2.7x1.6	4	16
XFP	2.7x0.7	2.5	30
SFP+	2x0.5	1	48



Several module vendors are currently sampling eight and 10-Gigabit SFP+ modules to customers.

According to Ovum-RHK, the 10-Gigabit Ethernet module market grew at 150-percent CAGR from 2003 to 2005, while the 10-Gigabit telecom market grew 40-percent.

In late 2006, another form factor optical transceiver was born – the QSFP. It is targeted at quadrupling the data rate and density of network interconnects by increasing the port density of applications running anywhere from one Gigabit to 40-Gbps. Among the first transceiver manufacturers with actual products are Emcore, Reflex Photonics and Zarlink.

3.5 Storage

The Fibre Channel market consolidation continues with Brocade acquiring McData.

Infiniband, once thought of as just a clustering protocol, is starting to make inroads into mainstream networking applications and data centers. According to several recent articles, 10-Gigabit Ethernet is bringing major changes to the way organizations buy and manage storage networks. Applications such as remote replication and disk-to-disk backup are driving ISPs, ASPs and storage service providers to purchase 10-GigE switches at the core of their networks. Evidence of some convergence in these protocols is that Brocade Communications has added 10-Gigabit Ethernet and iSCSI technology into its FC switches. In the end, customers do not care whether Ethernet, Fibre Channel or InfiniBand is running in their data centers, as long as they get the virtualization, clustering and other upper-layer functions that are required.

While 10-Gigabit Ethernet is starting to take off, FC is plugging along with 10-Gig ISLs and 8-Gig fabric products starting to emerge.

3.6 EDC

While in datacom applications, electronic dispersion compensation is being used to increase distances and reduce the cost of optical transceivers, for telecom modules, new modulation schemes seem to be the trend. Optical duobinary is the first of these new schemes to hit the market and is already helping to reduce the cost of optical networking by reducing or even eliminating the need for dispersion compensation and amplification. Even more sophisticated phase-based modulation schemes such as differential phase-shift keying (DPSK) and differential quadrature phase-shift keying (DQPSK) that have been used for many years in RF systems such as cellular telephone, are expected to emerge in the near future.

3.7 Beyond 10-Gigabit

CIR released a report in late 2006 that highlighted massive growth in the beyond 10-Gigabit market for both Ethernet and SONET/SDH. The industry analyst firm sees "exotic new chips" emerging that combine lasers with amplifiers and receivers and mux/demux functions. Other findings point towards perhaps a new paradigm in optical transceiver modules utilizing silicon photonics.

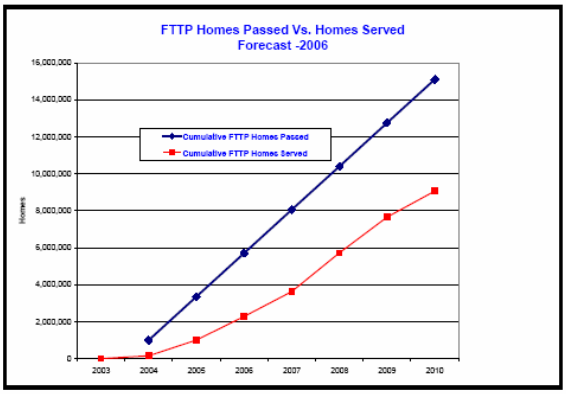
In December 2006, feasibility of 100-Gigabit Ethernet systems was verified by several companies' collaboration efforts. Finisar provided prototype parallel-optics transceivers for Infinera's DTN optical systems to run on Level 3 Communications Internet2 fiber infrastructure from Chicago to New York City. A high-definition video conference was demonstrated.

Apogee Photonics announced CWDM lasers in support of 100-Gigabit Ethernet. The startup is developing 20- and 25-Gigabit EMLs at 1310 nm, which are expected to be generally available by the end of 2007 – way before the IEEE specification is finalized.

Yet another communications industry MSA group has formed called X40. The founding companies include Aeluros, Broadcom, Emcore Finisar, Infinera, Juniper Networks, MergeOptics, Tyco Electronics and Vitesse Semiconductor. The main objective is to develop "an integrated, data-agnostic, multi-rate optical transceiver, intended to support a range of 40-Gigabit links." The form factor is expected to be similar in size to XENPAK and will contain four transmit and four receive channels multiplexed onto two fibers. Implementations of these are expected to use 1310 nm CWDM lasers to reach 10 km.

4.0 FTTx

IGI Consulting in conjunction with B&C Consulting released a report on high-speed access for fourth quarter 2006. The following is an excerpt from this report that shows trends for FTTx.



Another market analyst firm, Ditterner, released a report in March that shows that the Japanese market is growing much faster than either Europe or North America. In 2006, there were more than 5.4-million FTTH subscribers in Japan and this number is supposed to grow to more than 23 million by 2010. The US is supposed to surpass Europe in 2007 mainly due to Verizon's FiOS deployment. This acceleration of subscribers is expected to result in "every tenth broadband household" to be connected to the Internet through optical cable, according to another industry analyst firm, Fraunhofer ISI.

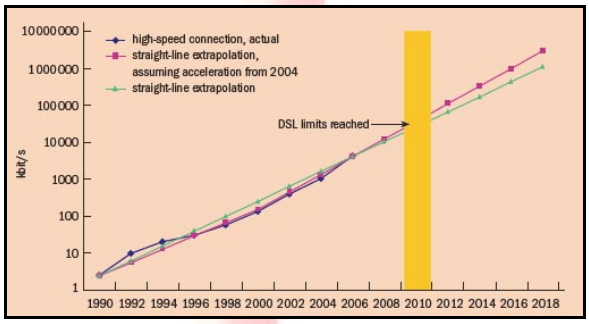
Virtually all FTTH/FTTP networks are based on variations of PON architectures. The following table shows the FTTH PON standards comparison.

PON Standards Comparison

	BPON	EPON	GPON
Standard	ITU G.983	IEEE 802.3ah	ITU G.984
Downstream speeds	155Mbps, 622Mbps (now), 1.2Gbps (upcoming)	1.25Gbps	1.24Gbps, 2.5Gbps
Upstream speeds	155Mbps or 622Mbps	1.25Gbps	155Mbps, 622Mbps, 1.2Gbps, 2.5Gbps
Downstream wavelength	1,480–1,500nm	1,500nm	1,480–1,500nm
Upstream wavelength	1,260–1,360nm	1,310nm	1,260–1,360nm
Layer 2 support	ATM	Ethernet	Ethernet over GEM and/or ATM
Voice support	TDM over ATM	TDM over packet	TDM over ATM/IP or native TDM
Video support	RF overlay (over 1,550nm) and/or IP video	IP video	RF overlay (over 1,550nm) and/or IP video
Maximum PON splits	32	16	64
Distance	<20km (~12 miles)	<20km (~12 miles)	<60km (~37 miles)

Source: IDC, 2005

The figure below shows the predicted speed versus time chart for FTTH.



Source: 2 optics.org

5.0 Definitions of Acronyms

Abbreviation	Description	Abbreviation	Description
10-GigE	10-Gigabit Ethernet	Mbps	Megabit per second
AMR	Automatic Meter Reading	MEF	Metro Ethernet Forum
AP	Access Point	MEMs	Micro-Electro-mechanical machines
APD	Avalanche Photo-Diode	MIMO	Multiple Input, Multiple Output
ASIC	Application Specific Integrated Circuit	MMF	Multi-mode Fiber
ATM	Asynchronous Transfer Mode	MOCVD	Metal-Oxide Chemical Vapor Deposition
AXT	Alien Crosstalk	MOCVD	Metallo-Organic Chemical Vapor Deposition
BPL	Broadband Power Line Communications	mph	Miles Per Hour
BPON	Broadband Passive Optical Network	MPLS	Multi-Protocol Label Switching
CAGR	Cumulative Average Growth Rate	MSA	Multi-source Agreement
CALA	Central America, Latin America	MSO	Multiple System Operator
CAT7	Category 7 cable	MSPP	Multi-service Provisioning Platform
CATV	Cable Television	MUSE	Multi-service access Everywhere
CD	Chromatic Dispersion	MUX/DEMUX	Multiplexer/Demultiplexer
CEPCA	Consumer Electronics Communications Alliance	NA	North America
CMOS	Complimentary Metal Oxide Silicon	NE	Network Element
CWDM	Coarse Wavelength Division Multiplexing	NFOEC	National Fiber Optics Engineering Conference
DARPA	Defense Advanced Research Agency	NIC	Network Interface Card
DCF	Dispersion Compensated Fiber	NIST	National Institute of Standards and Technology
DFB	Distributed FeedBack Laser	nm	nanometer
DISA	Defense Information Systems Agency	OADM	Optical Add/Drop Multiplexer
DQPSK	Differential Quadrature Phase-shift Keying	OC-x	Optical Carrier
DSL	Digital Subscriber Line	OEM	Original Equipment Manufacturer
DVD	Digital Video Diskette, Digital Versatile Disk	OEO	Optical-to-Electrical-to-Optical
DWDM	Dense Wavelength Division Multiplexing	OFC	Optical Fiber Communications Conference
EA-ILM	Electro-Absorptive Integrated Laser Modulator	OIF	Optical Internetworking Forum
EAM	Electro-Absorptive Modulator	ONT	Optical Network Termination
ECOC	European Conference on Optical Communication	OPERA	Open PLC European Research Alliance
EDC	Electronic Dispersion Compensation	OSA	Optical Sub-assembly
EFM	Ethernet in the First Mile	OTDR	Optical Time Domain Refectometer
EM	Equipment Manufacturer	PBX	Private Branch Exchange
EoDWDM	Ethernet over DWDM	PC	Personal Computer
EoMPLS	Ethernet over MPLS	PCI	Peripheral Computer Interface
EOS	Ethernet Over SONET	PIC	Photonic Integrated Circuit
EPG	Electronics Product Group	PIN	*p* Intrinsic *n* detector
EPON	Ethernet Passive Optical Network	PLC	Photonic Lightwave Circuit
ER	Extended Reach	PLC	Power Line Communications
ESCON	Enterprise Systems Connectivity	PMD	Polarization Mode Dispersion
ETSI	European Telecommunications Standards Institute	POF	Plastic Optical Fiber
FBG	Fiber Bragg Grating	PON	Passive Optical Network
FC	Fibre Channel	QoS	Quality of Service
FCC	Federal Communications Commission	RAID	Redundant Array of Independent Disks
FDDI	Fiber Distributed Data Interface	RBOC	Regional Bell Operating Company
FEC	Forward Error Correction	RL	Return Loss
FEXT	Far-end Crosstalk	ROSA	Receiver Optical Sub-assembly
FP	Fabry- Perot	RPR	Resilient Packet Ring
FTTX	Fiber To The (Home, Desk, Building)	SAN	Storage Area Network
GaAs	Gallium Arsenide	SAS	Serial-Attached SCSI
Gbps	Gigabit per second	SATA	Serial Advanced Technology Attachment
GHz	Gigahertz	SDH	Synchronous Digital Hierarchy
GIG-BE	Global Information Grid Bandwidth Expansion	SERDES	Serializer/Deserializer
GigE	Gigabit Ethernet	SFF	Small Form Factor
GI-POF	Graded Index Plastic Optical Fiber	SFP	Small Form-factor Pluggable
GPON	Gigabit Passive Optical Network	SiGe	Silicon Germanium
HBA	Host Bus Adapter	SIP	Session Initiation Protocol
HDTV	High Definition Television	SMB	Small and Medium size Businesses
HFC	Hybrid Fiber Coax	SMF	Single Mode Fiber
HPC	High Performance Computing	SOHO	Small Office Home Office
HSBI	High Speed Backplane Initiative	SONET	Synchronous Optical Networking
IC	Integrated Circuit	SP	Service Provider
IEEE	Institute of Electrical and Electronics Engineers	TDM	Time Division Multiplexing
IETF	Internet Engineering Task Force	TIA	Telecommunications Industry Association
IL	Insertion Loss	TIA	Transimpedance Amplifier
ILEC	Incumbent Local Exchange Carrier	TOSA	Transmitter Optical Sub-assembly
InP	Indium Phosphide	ULH	Ultra Long Haul
IP	Internet Protocol	UPA	Universal Powerline Association
iSCSI	IP Small Computer System Interface	UTP	Unshielded Twisted Pair
ISP	Internet Service Provider	VCSEL	Vertical Cavity Surface Emitting Laser
IT	Information Technology	VLAN	Veirtual Local Area Network
ITU	International Telecommunications Union	VOD	Video On Demand
IXC	Inter-exchange Carrier	VoIP	Voice over IP
JBOD	Just a Bunch Of Disks	VPN	Virtual Private Network
km	kilometer	WAN	Wide Area Network
LAN	Local Area Network	WDM	Wave Division Multiplexing
LOA	Linear Optical Amplifier	Wi-Fi	Wireless Fidelity
LOMF	Laser Optimized Multimode Fiber	WiMax	Wireless Maximum
LR	Long Reach	WLAN	Wireless Local Area Network
LW	Long Wavelength	XENPAK	10-Gigabit Enhanced Package
MAN	Metropolitan Area Network	XFP	10-Gigabit Form factor pluggable module

Data Communications Competence Center

Nexans' Data Communications Competence Center, located at the Berk-Tek Headquarters in New Holland, Pennsylvania, focuses on advanced product design, applications and materials development for networking and data communication cabling solutions. The Advanced Design and Applications team uses state-of-the-art, proprietary testing and modeling tools to translate emerging network requirements into new cabling solutions. The Advanced Materials Development and Advanced Manufacturing Processes teams utilize sophisticated analytical capabilities that facilitate the design of superior materials and processes. The Standardization and Technology group analyzes leading edge and emerging technologies and coordinates data communication standardization efforts to continuously refine Nexans' Technology Roadmap. An international team of experts in the fields of cable, connectors, materials, networking, standards, communications and testing supports the competence center. The competence center laboratories are a part of an extensive global R&D network that includes eight competence centers, four application centers and two research centers dedicated to advanced technologies and materials research.

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