

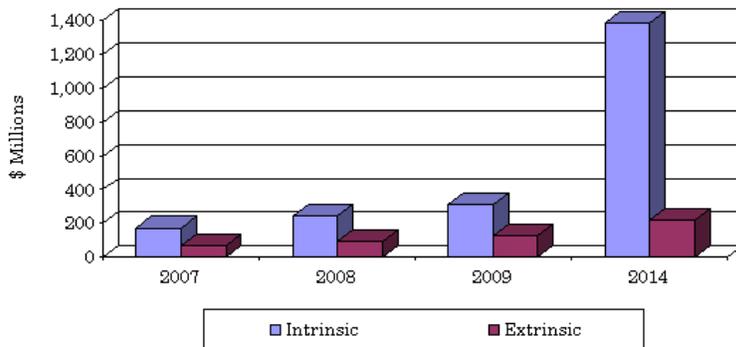
# Fiber Optic *FOS<sub>2</sub>* SENSORS & SYSTEMS

Monthly Newsletter on Worldwide Developments in Fiber Optic Sensors & Systems

Vol. 22 No. 10

October 2008

**U.S. Market for Fiber Optic Sensors, by type, 2007–2014**  
(\$ Millions)



Source: BCC Research

## NEW PRODUCTS

### **KVH receives approval to begin shipping fiber-optic gyros for use in remote weapon stations**

KVH Industries Inc. announced that it received permission from its primary customer to begin shipments of its DSP-3100 fiber-optic gyros (FOGs) for use in remote weapons stations, and has initiated full rate production.

With its all-fiber design and patented Digital Signal Processing (DSP) technology, KVH's DSP-3100 FOG offers high reliability, superior accuracy and performance, and exceptional vibration, shock, and acceleration survivability at

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an affordable cost. KVH's fiber-optic guidance and sensor systems are used in an array of commercial and defense-related stabilization, navigation, autonomous vehicle, and precision guidance applications.

KVH's fiber-optic gyro resource page — <http://www.fiberopticgyro.com> — offers additional details regarding KVH's fiber-optic gyro solutions.

### **Photon Control commissions first set of downhole fiber-optic sensors for heavy oil production**

Photon Control Inc. announced successful commissioning of its first commercial set of downhole fiber-optic sensors for heavy oil production in Alberta.

The set was ordered by a leading oil producer for installation in a large oil sand operation with heavy oil recovery based on steam-assisted gravity drainage (SAGD).

The set of downhole fiber-optic sensors was installed in September 2008 and provides data on temperature and pressure from hundreds of meters below the surface.

The data from the Photon processing unit is transferred to the producer's data collecting system (DCS) via ModBus and is further processed remotely.

The producer is reporting to Photon it is pleased with the performance of Photon technology. The producer spent a number of years with other providers of fiber-optic sensors, however, technical issues did not allow commissioning of the counterpart solutions.

SAGD is the most advanced process for heavy oil recovery used in Canada and its use is rapidly expanding in other countries. A number of SAGD wells have been already drilled and hundreds of new wells are completed every year in Canada alone.

The producer provided heavy installation equipment, machinery and personnel needed

for deployment and operation of the sensors in the harsh SAGD environment.

It was the absence of this logistical support which hindered Photon's attempts in penetrating the oil production business in the past.

Mr. Ivan Melnyk, the company's chief technology officer, commented, "This first commercial installation of our fiber-optic sensors for a downhole application is a critical step for entry into the massive downhole instrumentation market.

We have spent considerable time developing superior technology that overcomes technical challenges such as long distance, temperature drift and the hydrogen aging effect."

Photon's technology is capable of measuring extremely high pressure, over 20,000 psi, at very high temperatures and depths of many kilometers.

This can be used for controlling parameters and monitoring of processes in oil and gas production, exploration, drilling, and well-testing.

Photon brings the advantage of its technology into the energy sector in the same fashion as it achieved in the semiconductor capital equipment business which has benefited from Photon technology for over four years.

### **Active pixel CMOS flat panel array from Hamamatsu**

Hamamatsu Photonics introduce the C9728DK-10, an x-ray-sensitive, "active pixel CMOS" image sensor. Each separate pixel in the Megapixel (1056x1056) image format has an individual amplifier, providing extremely low noise readout.

The noise is at least six times lower than existing conventional passive type CMOS flat panel sensors from Hamamatsu.

Using a CDS (Correlated Double Sampling) circuit and a direct deposition (DD)

columnar structure CsI scintillator, the C9728DK-10 can create high quality true 14-bit digital video signals.

The specific DD CsI scintillator construction eliminates the need for focusing lenses or tapered fiber optics associated with use of CCD sensors, which can cause image distortion and/or peeling problems in the field.

This very low noise sensor is therefore suitable for x-ray diffraction pattern imaging and other scientific x-ray imaging requiring very low noise.

Hamamatsu also supplies a range of sealed and open type micro-focus x-ray sources for high resolution x-ray imaging applications.

For further information, visit [www.sales.hamamatsu.com](http://www.sales.hamamatsu.com).

### **FISO launches the smallest commercially available fiber-optic pressure sensor for the medical market**

FISO Technologies Inc., a subsidiary of Roctest Ltd and a manufacturer of fiber-optic sensors and measurement systems for challenging and demanding applications, announced the production release of the FOP-M260, the smallest commercially available fiber-optic pressure sensor and the first one below the size of a 1 French catheter.

This new sensor, based on MOMS technology, has a diameter of 260 microns (0.010 inches) and accounts for a 50 percent size reduction over the current FOP-MIV pressure sensor.

The development of this sensor is a significant step and provides an immediate solution to situations where the FOP-MIV size was a limitation.

The sensor will be officially launched at the Medical Design & Manufacturing "MD&M" exposition, which will be held on October 22-23 at the Minneapolis Convention Center, Minneapolis, Minnesota.

The FOP-M260 sensor shows better thermal performance and better stability than previous generations. Similarly to the previous fiber-optic pressure sensors designed for the medical market, the FOP-M260 is compatible with FISO's EVOLUTION product line.

By using the White-Light Fabry-Perot Interferometry technology, which has been deployed for more than a decade in challenging applications such as aerospace & defense, medical and process control, FISO customers are assured of accurate and reliable measurements in all field conditions.

"FISO is a unique reference for the medical market, where its sensors are integrated into medical devices. Combined with the FOP-MIV and the soon commercially available FOP-F125, the FOP-M260 fiber-optic miniature pressure sensor is part of the most extensive offer in the market," said Maxim Vachon-Savary, product line manager at FISO Technologies. "The design of the FOP-M260 is similar to the FOP-MIV and will be easily integrated into FISO automatic assembly line, allowing FISO to reach the same high volume than the FOP-MIV, representing tens of thousands of units per year".

For more information, visit <http://www.fiso.com>

### **Broadband light sources**

Safibra presents a wide range of standard SLED sources OFLS-B with different wavelengths ranging from 750- to 1600nm, with different power (up to 25mW in SM fibers) and with bandwidth (from 20nm up to 120nm) values according to customer's need.

Optical sources are designed in two various packaging according to cooling. In addition to standard products, SAFIBRA can also offer devices designed and performed according customer's requirements to match customer's needs. Optical source can be

operated in continual mode (CW) or it could be also modulated — internally or externally.

The OFLS-B series are universal optical fiber light sources optimal for fiber-optic sensor applications, telecommunication measurements, component testing, instrumentation, fiber-optic gyroscopes and medical imaging applications.

Safibra light sources could be also used for research and development and thanks to very competitive pricing is also attractive for teaching and learning purposes, labs, universities and research institutions.

### **PXI BraggSCOPE**

FiberSensing released a new PXI Measurement Unit for fiber Bragg grating (FBG) sensors — the FS 1600 PXI BraggSCOPE.

The unit is based on the company's platform BraggSCOPE and can be used in any standard 3U PXI chassis to interrogate sensors without the need of any other external devices such as optical source or detection modules.

This compact instrument fits in only two slots and can have single or dual parallel channels, allowing the simultaneously acquisition of up to eight sensors (four sensors per channel).

This capacity can be further increased by adding FiberSensing's PXI Optical Switches (OSW 1x4 and OSW 1x8, one slot).

The BraggSCOPE platform integrates a high power compact erbium broadband source that allows sampling rates up to 20kS/s to be attained simultaneously for the eight sensors, with resolution below 1pm.

The accuracy is better than  $\pm 20\text{pm}$ , for an operation temperature range of 10 degrees C up to 40 degrees C.

The unit is provided with a LabVIEW driver, which allows the user to directly access data from each FBG sensor (time stamp and Bragg wavelengths). Optionally, the standard

Graphical User Interface application for FiberSensing's measurement units, the i-LOG FS 9100, can also be installed on the controller whenever a VGA output is available.

With this configuration, the user can easily configure, acquire and visualize signals from all sensors, as well as store, fetch, and transmit processed data. It also allows the user to control additional PXI Optical Switch modules used in combination with the PXI BraggSCOPE.

The i-LOG FS 9100 combined with the PXI BraggSCOPE allows the simultaneous assessment of signals generated by both electrical and fiber Bragg grating sensors.

This "hybrid" characteristic makes the FS 1600 particularly suited for research and test laboratories where PXI controllers are already used to address electrical sensors. With this new product, Engineers and Technicians can immediately start to take advantage of FBG sensing technology with a reduced initial investment.

### **CONTRACTS**

#### **Opsens receives sensor order from major Canadian oil sands operator**

Opsens Inc. announced an order from Nexen Inc., a Canadian-based global energy company, for its OPP-W fiber-optic pressure and temperature sensor.

The order, to equip three Nexen Long Lake well pairs with Opsens's proprietary technology, is being managed by Opsens's wholly owned Edmonton-based unit, Opsens Solutions Inc.

"This new order builds on our previous successful installations and operation of OPP-W sensors in the oil sands and further demonstrates the growing interest in our technology from operators using the Steam Assisted Gravity Drainage (SAGD) process," said Gaétan Duplain, president of Opsens

Solutions. "We look forward to working with Nexen and are confident that we will help them optimize their SAGD operations."

"Nexen understands the importance of robust, reliable, reservoir-surveillance technologies for optimizing operations in high-temperature environments," said Bill MacFarlane, manager of technology integration at Nexen.

"We are pleased to be working with Opsens Solutions to evaluate OPP-W technology to assist us at our Long Lake Project."

Long Lake, a 50/50 joint venture between Nexen and OPTI Canada Inc. is Canada's fourth major integrated oil sands project, and the first to integrate in situ bitumen recovery with gasification and onsite upgrading.

Facility construction was completed earlier this year, and the SAGD operation is currently producing bitumen feedstock.

Opsens Solutions is targeting the Western Canada oil sands market, where SAGD is becoming the key production process and there is a potential for the installation of Opsens sensors in multiple oil wells. Opsens monitoring systems provide continuous acquisition of downhole pressure and temperature, allowing SAGD operators to control steam injection and fluid production.

This information is critical for optimizing bitumen recovery rates, reducing operating costs, managing steam chamber growth and managing safe steam injection pressures.

### **Arctic Shuttle Tanker to receive smart fibers monitoring**

Under a contract with our Korean partners Global Maritime Engineering, numerous SmartWeld strain and temperature sensors have been delivered to monitor the ice pressure and loads on the hull of a Samsung Heavy Industry Arctic Shuttle Tanker.

Together with a number of FBG acceleration sensors and high speed W5 instrumentation, the system will provide a unique insight into the performance of the hull of this new class of ice-breaking carrier.

### **Wavefield Inseis and Optoplan awarded contract for permanent seismic system**

Wavefield Inseis ASA has been awarded a contract to supply an ocean-bottom seismic sensor system for reservoir monitoring at the ConocoPhillips' operated Ekofisk field in the North Sea. The contract will be executed through the Trondheim based company Optoplan AS, a fully owned subsidiary of Wavefield Inseis. Marine installation is planned for 2010 with the installation contract to be awarded at a later date.

For more information, please visit [www.wavefield-inseis.com](http://www.wavefield-inseis.com).

### **Wavefield Inseis awarded three-year contract by ONGC**

Wavefield Inseis announced that they have been awarded a long term contract for 3D seismic services by ONGC. Commencing during the fourth quarter this year, the contract is for a program of 3D surveys offshore India to be acquired each season through to 2011. The total contract value is in excess of \$170 million.

The first season's program will be acquired by the Geowave Commander, which will be mobilized from Europe.

This significantly increases Wavefield's market share in the region and will strengthen their Singapore office operation.

Earlier in the year, Wavefield acquired a 2D project offshore India, and this valuable operational experience should have a positive impact on this first large 3D contract in the country.

Commenting on the award, CEO Atle Jacobsen stated "This is not only our first 3D in

India, this 3 year contract is also our largest to date and our first with ONGC for whom we are delighted and proud to be providing services on such a prestigious project.”

For more information, please visit [www.wavefield-inseis.com](http://www.wavefield-inseis.com).

## BUSINESS

### FiberSensing joins the NextGenPCF Consortium

FiberSensing has recently become part of NextGenPCF Consortium. Together with FOS&S, the company will contribute with its solid know-how in the development and manufacturing of advanced optoelectronic instruments and sensing systems to do the commercial valorization of the technology developed by Bath and IPHT for the gas sensor and by INESC for the interrogation unit.

Next Generation Photonic Crystal Fibers (NextGenPCF) is a research project funded by the Information Society Technologies (IST) program of the European Commission's 6th Framework. NextGenPCF started on June 2006 and is to run for three years.

NextGenPCF arises from the observation that progress and continuing technological development in many fields will depend on new ways of producing and guiding light, and mastering its interaction with the environment. Actors in healthcare require lasers at new wavelengths or broadband sources for diagnosis. Telecom players look for more flexible amplifiers and for easy-to-install, low-cost fibers. The environmental sensor industry is searching for sensitive gas detector systems.

The objective of NextGenPCF is to enhance the Europe excellence in PCF related science but above all to turn this excellence in science into technological excellence and key competitive advantages for the European firms. In that aim NextGenPCF integrate the key

industrial and academic actors from raw material to final users. The technological developments carried out in the scope of NextGenPCF will be applications driven. It will insure a relevant return of investment for the project.

The integration of the actors will avoid redundant work. Particularly the convergence of fiber specifications will be encouraged to limit the number of specific development. It will largely contribute to the cost competitiveness of the products.

For more information on the consortium visit <http://www.nextgen-pcf.eu>.

## PLASTIC OPTICAL FIBER SENSORS

### Papers on POF Sensors Presented at POF 2008

The International Conference on Plastic Optical Fibers (POF 2008) held at the Santa Clara Convention Center on August 25-28, 2008 was the largest POF conference to date with over 200 registrants from 15 countries, 20 exhibitors, and 8 sponsors.

The program included six tutorials on August 25, and conference and exhibits on Aug 26-28. Over 70 papers were presented at the conference.

The following are selected papers on POF sensors presented at the conference. Copies of the proceedings and tutorial notes are available from Information Gatekeepers at either [www.igigroup.com](http://www.igigroup.com) or [www.pof2008.com](http://www.pof2008.com).

### Improvements of the distributed strain sensor based on optical time domain reflectometry measurement in polymer optical fibers

Philipp Lenke, Sascha Liehr, and Katerina Krebber, Federal Institute for Materials Research and Testing (BAM)

*Abstract*— Sensing characteristics of standard polymer optical fibers (POF) are further

studied using the optical time domain reflectometry (OTDR) technique.

The level of the backscattering inside POF, which highly increases at locations where strain is applied to the fiber, is further investigated with respect to spectral behavior, strain rate and span of time from the stretching event. An algorithm to overcome the problem of the decrease of spatial resolution as a result of pulse broadening due to modal dispersion, is proposed.

The research is carried out on the background of the development of a new strain sensor that is integrated in technical textiles.

#### INTRODUCTION

The use of Standard-POF as a distributed strain sensor has some unique features qualifying the proposed measurement technique for some new applications. Standard-POF can be strained more than 45 % and exhibit a maximum increase of the level of scattering at the strained fiber section of a factor of more than 200.

The possibility of real distributed sensing proves to be a valuable advantage especially for the monitoring of geotechnical soil structures, where the distribution of deformation cannot be predicted well. It could be shown that Standard-POF is well suited for integration into technical textiles due to their robustness. Field installation of these sensor equipped textiles under rough conditions at construction sites has proved their feasibility.

The large strain range of Standard-POF predestinates the proposed sensor for its application in creeping slopes and soil dams. However some of the attributes of the proposed sensor have not been sufficiently investigated up to now.

The factor by which the level of scattering increases is dependent on strain, strain rate and span of time from the stretching event. The level of scattering partly relaxes when constant strain

is applied to the POF. These influences are studied and interpreted in the paper.

To obtain additional information on the deformation of the sensor fiber, the shift of Fresnel reflections along the fiber is evaluated. Furthermore, the spectral behavior of the strain induced scatter increase is studied for standard-POF.

The maximum stretchability of standard-POF and the graded index POF OM-Giga was studied for different strain rates. Results for the strain-induced scatter increase in graded index POF, which show a maximum stretchability that is strongly dependent on strain rate, are presented in section III.

Pulse broadening due to modal dispersion in standard-POF limits the spatial resolution of the strain sensor. In section IV we propose an algorithm which can significantly increase the spatial resolution by a deconvolution of the recorded OTDR trace and the shape of the pulse propagating in the fiber, based on the assumption that few spatially smooth changes of strain are more likely to occur than many abrupt changes.

#### Liquid Level Measuring Sensor System Using 1000 $\mu$ m Plastic Fiber

Raka Biswas and Abhijit Chakravarty,  
Florida Institute of Technology

*Abstract*— This paper presents a liquid level detection sensor using 1000  $\mu$ m plastic fiber. Intensity based gap sensor is built creating multiple gaps, each of length 2mm on a plastic fiber. In fiber – air – fiber interfaces, optical power coupled from one fiber into another fiber is less than the power coupled in case of fiber – liquid – fiber interfaces as air is optically less dense any liquid. When the unit is immersed into a tank of water or any other liquid, the gap between two fibers are filled with that liquid resulting in formation of fiber – liquid – fiber interfaces. Optical power coupled from one fiber to the other

increases due to higher refractive index of liquid. As the liquid level increases more fiber – liquid – fiber interfaces are formed along the sensing unit and there is a net increase of coupled optical power, resulting in increase of voltage level at the detector.

The variation in voltage at the detector with increase in liquid level is recorded and analyzed by using a three layer model at the fiber – liquid – fiber interfaces that constitute the gaps in the plastic fiber.

### **Photonic Polymer Crystal Fiber with Open Star Cross Section for Sensing**

E.F. Chillcce, W.M. Faustino, C.L. Cesar, and L.C. Barbosa, State University of Campinas

*Abstract*—Photonic Crystal Fibers (PCFs) can be used to build highly sensitive chemical and biological optical sensors due to long optical paths provided by these fibers. For that, the evanescent field of the guided light must overlap the region with the substance to be sensed.

This would be difficult with usual geometry of today's PCFs even for gases, which would have to be pumped into the fiber. An open to the air optical fiber would be ideal for this application. We have fabricated a Polymethylmethacrylate (PMMA) open optical fiber with a star shape cross section by the extrusion method.

For this purpose a granular PMMA material, inside a cylindrical stainless steel chamber, was extruded at 230C with 5Kg/cm<sup>2</sup> pressure through a 9mm star shape dye in a Chemat tower until a 0.5mm diameter fiber.

The star cross section fiber surface was painted separately with Buriti oil and Europium chelate [Eu(DBM)<sub>3</sub>phen], where DBM and phen are dibenzoylmethane and 1,10 phenanthroline respectively], dissolved in CH<sub>2</sub>Cl<sub>2</sub> and heptane. The 613nm typical Eu<sup>3+</sup>-ions and 490-800nm broadband Buriti luminescence spectra are

observed when pumped with a 355nm nanosecond pulsed laser.

### **POF Gas Sensing System with POF Humidity Calibrator**

Mitsuhiro Komatsu, Satoshi Honma, Masayuki Morisawa and Shinzo Muto, Graduate School of Medicine and Engineering, University of Yamanashi, E-mail: muto@es.yamanashi.ac.jp

*Abstract*—Combustible gases such as methane and propane are widely used in many homes and factories. However, accidents caused by gas leakage become a menace to everyday life. Therefore, development of safety and highly sensitive gas leakage sensor is required strongly.

From these backgrounds, we have studied about the development of plastic optical fiber (POF) gas leakage sensor and system, because POFs have many advantages such as safety, low-cost, lightweight, and immunity to electromagnetic noise. In this paper, the POF sensing system for multi-point gas leakage and influence of humidity to this system have been studied.

The POF-type gas sensor head, which has a gas-sensitive gladding layer coated by a swelling polymer, was fabricated. The refractive index  $n_2$  of the sensitive cladding layer was set at slightly larger than PMMA core with  $n_1$ . Therefore, in the initial state without gas leakage, the sensor head operates as a leaky-POF.

On the other hand, when exposed to combustible gases, the decrease in  $n_2$  is caused by attachment of gas molecules. Then, the POF sensor head changes its structure from leaky-type to guided-one and the output light intensity increases remarkably.

Measuring this change in transmitted light intensity, detection of gas concentration can easily be obtained. In fact, for the experiment

of one-point gas leakage, gas concentration below 1% could easily be detected for both methane and propane.

Using these properties, the POF multi-point gas sensing system was easily constructed. In the experiment using three LEDs of blue, green and red, three-points gas sensing was tested and was confirmed to be useful. However, through these experiments, it was also confirmed that this system receives influence of humidity. So, further improvement of the POF gas-sensing system with POF humidity calibrator is proposed and discussed in this paper.

### INTRODUCTION

Recently, combustible gases named as LP gas and City gas are widely used at factories and ordinary homes. As is known well, LP gas puts liquefied gas in a cylinder, and City gas supplies the evaporated gas to the consumer by the conduit. So, the accident of gas poisoning or a gas explosion was often caused, and this has exerted the threat on everyday life. To prevent these accidents, development of quick and highly sensitive gas leakage sensor is required strongly.

Conventional gas leakage sensors using electrical properties such as semiconductor-type are not inherently safe. In addition, accidental incorrect operation often occurs in electromagnetically noisy environment. Therefore, some flammable gas sensors using optical determination have also been proposed. In the conventional optical determination, the gas-analysis method by infrared absorption is used. However, the determination methods require the laser light source of the specific wavelength which is in agreement with molecular vibration. Such a light source is very expensive, and it is therefore difficult to bring production costs down.

From such a background, we have studied about the development of a simple and

safety flammable gas leakage sensor using a plastic optical fiber (POF). This gas leakage sensor is fabricated by substituting the cladding layer of POF to sensitive one which causes swelling against combustible gases. When such gases are exposed to the sensor head, this POF type sensor head changes from leaky to guided one because the refractive index in the sensitive cladding layer decrease by attachment of gas molecules.

Then it becomes possible to measure the gas concentration by observing change in output light intensity. Based on these processes, we succeeded to detect low concentration flammable gas less than 1%. The greatest characteristic of this sensor is not to choose a light wavelength in visible region. Therefore, it can use low-cost LEDs with various wavelengths.

So, in this paper, the multi-point measurement system for the flammable gas leakage using combination of plural POF-sensors is proposed. First, the light sources with different wavelength are prepared and coupled into the POF sensor heads. Then, the output light from the each sensor heads is multiplexed into the POF by coupler, and is transmitted to a surveillance center with a spectroscopy. From signals with each wavelength, the place where the gas leakage happened and its concentration can be known. That is, many gas leakages are found in the one surveillance center. In addition, this system has advantages such as low-cost and immunity to electromagnetic noise. Target flammable gases are propane-based LP gas and methane-based City gas.

### MARKET INTELLIGENCE

#### **US market for fiber-optic sensors worth \$1.6 billion in 2014**

According to a new technical market research report, "Fiber-Optic Sensors"

(IAS002D), from BCC Research, the U.S. market for fiber-optic sensors (FOSs) was worth \$235.0 million in 2007 and an estimated \$330.0 million in 2008. This will increase to \$430.0 million in 2009 and \$1.6 billion in 2014, for a compound annual growth rate (CAGR) of 30.0 percent.

The market is broken down into extrinsic and intrinsic fiber-optic sensors. Intrinsic FOSs have the larger share of the market, generating \$170.0 million in 2007 and an estimated \$238.0 million in 2008.

This segment is expected to generate \$306.0 million in 2009 and \$1.4 billion in 2014, for a CAGR of 35.0 percent.

The extrinsic FOS segment was worth \$65.0 million in 2007 and an estimated \$92.0 million in 2008. This should increase to \$124.0 million in 2009 and \$219.0 million in 2014, for a CAGR of 12.0 percent.

Fiber-optic sensors are an enabling technology that adds value to larger systems. FOS make it possible to measure strain, temperature and pressure in conditions under which other sensor technologies fail.

FOSs are an important part of systems designed to monitor optical networks, oil reservoirs and the condition of pipelines and bridges.

FOS also allow geologists to create three dimensional maps of underground rock formations and reservoirs.

Defense and oil and gas services are the largest current markets for fiber-optic sensors. Perimeter security for critical installation and monitoring options for borders are a growing market. Biomedical applications are a developing future market, if the new devices can perform as promised and if they win regulatory approval.

The cost-performance ratio remains a limitation to the adoption of the technology because the high price must be justified for the new proposed uses.

One new challenge on the horizon is the variety of new wireless technologies that offer the potential to provide some the bandwidth advantages at lower cost and with higher flexibilities.

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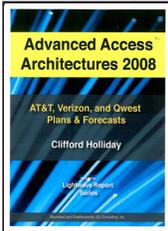
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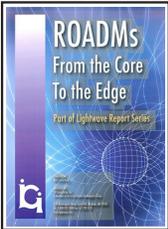
## New!! IGI CONSULTING REPORTS FOR 2008



### Advanced Access Architectures 2008

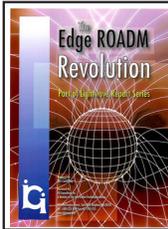
In addition to providing complete background on Advanced Access Architectures (AAAs), this report is going to focus on the progress to date of AAAs (or in some cases the lack thereof), changes in architecture, and especially how we are changing our forecasts (and why) for Advanced Access Architectures (AAAs) development. It is also introducing for the first time extensive cost analysis of the various forms of AAAs, and comprehensive traffic (bandwidth) requirements analysis and forecasts affecting AAAs.

Release : September 15, 2008 Pricing Includes 20% Fall Discount  
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### ROADMs FROM THE CORE TO THE EDGE

To date, the ROADM revolution has been largely confined to the core, and to some extent to the major metro parts of the network. As we see the need for more and more wavelength services such as Internet Protocol television (IPTV). Video on Demand (VOD), high-speed data, business services, etc., the carriers are experiencing a need for wavelength control out to the edge of network. This need has given rise to a new class of ROADMs-Edge ROADMs. These are less capable than the core variety-smaller and, most importantly, cheaper. This report revises the market deploys, and technologies of edge ROADMs and is a complete rewrite of previous studies  
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### New!! R-OADM Revolution

This report details where the industry is in beginning the new ROADM revolution from the "core to the Edge." This revolution will bring ROADMs to virtually every central office and head end in the US, and in many parts of the world. The forecast included herein detail that expansion.

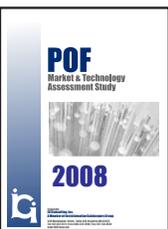
A number of component vendors are leading the way in this sea change for the networks as well as a few leading system vendors already selling products which are profile in this report  
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### COMPONENTS FOR R-OADM 2008

This report focuses on the component and subassembly market impact from R-OADNs. It contains ROADM system level forecasts,, discussion of the ROADM concept,technical material describing how the components are used in ROADMs, and listing and description of many vendors in this market. The report also includes market forecast of components/subassembliesuch as wavelength, blokers, mux/splitters, WSSs, demux/combiners, tunable lasers, tunablefilters, switches, and monitoring devices. Obviously many, or all, of these have other uses, but this report only includes their use in R-OADM.

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This report is intended for both those companies in the market and those considering or planning to enter the market.

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