Announcement

OTDR Remote Fiber Test/Monitoring
Global Market Forecast & Analysis

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ElectroniCast Consultants
OTDR Remote Fiber Test/Monitoring
Global Market Forecast & Analysis

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Report Description

This ElectroniCast forecast of Optical Time Domain Reflectometer (OTDR)-
based devices used for remote continuous or periodic/scheduled remote
testing/monitoring of optical fiber lines.

Market Forecast by Device-Type This report provides the review of 2015 and a
6-year (2016-2021) forecast of the consumption value, volume (quantity) and
average selling price of the following devices, used for remote testing/monitoring
of optical fiber lines:

- Embedded OTDR Transceivers / Small Form Factor Pluggable (SFP) or
  other module-type
- Portable OTDRs & Multiple Test Units with Initial Capability or Modules
- Bench/Rack OTDR-Based Remote Test Units (RTU) and Multiple Test
  Units with Initial and Add-On OTDR Modules

Market Forecast by Region The market review and forecast is segmented
into the following geographic regions:

- Global Summary
  - America (North, Central, South America)
  - EMEA (Europe, Middle East, Africa)
  - APAC (Asia Pacific Region)
Market Forecast by Application  The ElectroniCast global (hand-held) OTDR market is segmented into the following major application categories:

- Telecommunications / Multi-Media (Telco, CATV, ISP)
- Datacom / Enterprise (Data Centers / Other)
- Harsh Environment
- Power Utilities, plus "Other Miscellaneous"

Market Forecast by Function  The market forecast data are segmented by the following functions:

- Consumption Value (US$, million)
- Quantity (number/by 1,000 units)
- Average Selling Prices (ASP $, each)

Optical Time Domain Reflectometers  Optical time-domain reflectometers (OTDRs) are used for final link commissioning, as a troubleshooting device to find faults, splices, and bends in fiber optic cables, with an eye toward identifying light loss. Light loss is especially important in fiber optic cables because it can interfere with the transmission of data. An OTDR can detect such light loss and pinpoint trouble areas, facilitating the maintenance and repair process.

Remote Fiber Test Systems  Remote Fiber Test Systems (RFTS) enable operators to constantly monitor fibers and receive immediate alerts of breaks, degraded provide the location, so the service team can efficiently locate and address the issue. A central computer is used to control the operation of OTDR-like test components located at key points in the fiber network. These test components will scan the fiber to locate problems. If a problem is found, its location is noted and the appropriate Operations Systems (OSs) are notified to begin the repair process. Also, this market forecast covers continuous ("active") testing/monitoring OTDR embedded (integrated) transceivers.
Information Base for the Market Forecast

Primary Research  This study is based on analysis of information obtained continually since 1994, but updated through the end of December of 2016. During this period, ElectroniCast analysts performed interviews with authoritative and representative individuals in the fiber optics industry plus private networks, telecommunications, military/aerospace and other communication industries, power utilities; instrumentation/laboratory – R&D and factory/manufacturing, from the standpoint of both suppliers and users of fiber optic test units. The interviews were conducted principally with:

- Engineers, marketing personnel and management at manufacturers of fiber optic test equipment, fiber optic sensors, fiber optic fusion splice equipment, mechanical splice, connectors, transceivers, as well as laser diodes and photodiodes, application-specific ICs, packages, ferrules and cables, substrate materials, optical waveguide and other components used in the fabrication of optoelectronic transceivers, optical fiber, fiber optic cable assemblies and installation apparatus.

- Design group leaders, engineers, marketing personnel and market planners at major users and potential users of cable, cable assemblies, connectors, installation apparatus, passive devices and transceivers, such as telecommunication transmission, switching and distribution equipment producers, data communications equipment producers (switches, hubs, routers), computer and workstation producers, weapon system, aircraft and spacecraft electronic equipment producers, optical instrumentation system producers and others.

- Other industry experts, including those focused on standards activities, trade associations, and investments.

The interviews covered issues of technology, R&D support, pricing, contract size, reliability, documentation, installation/maintenance crafts, standards, supplier competition and other topics. Customers also were interviewed, to obtain their estimates of quantities received and average prices paid, as a crosscheck of vendor estimates. Customer estimates of historical and expected near term future growth of their application are obtained. Their views of use of new technology products were obtained.

The analyst then considered customer expectations of near term growth in their application, plus forecasted economic payback of investment, technology trends and changes in government regulations in each geographical region, to derive estimated growth rates of quantity and price of each product subset in each application. These forecasted growth rates are combined with the estimated baseline data to obtain the long-range forecasts at the lowest detailed level of each product and application.
Secondary Research   A full review of published information was also performed to supplement information obtained through interviews. The following sources were reviewed:

- Professional technical journals and papers
- Trade press articles
- Technical conference proceedings
- Product literature
- Company profile and financial information
- Additional information based on previous ElectroniCast market studies
- Personal knowledge of the research team

In analyzing and forecasting the complexities of the world region markets for fiber optic test and measurement products, it is essential that the market research team have a good and a deep understanding of the technology and of the industry. ElectroniCast members who participated in this report were qualified.

Bottom-up Methodology   ElectroniCast forecasts are developed initially at the lowest detail level, and then summed to successively higher levels. The background market research focuses on the amount of each type of product used in each application in the base year (last year: 2015), and the prices paid at the first transaction from the manufacturer. This forms the base year data. ElectroniCast analysts then forecast the growth rates in component quantity use in each application, along with price trends, based on competitive, economic and technology forecast trends, and apply these to derive long term forecasts at the lowest application levels. The usage growth rate forecasts depend heavily on analysis of overall end user trends toward optical communication equipment usage and economic payback.

Cross-Correlation Increases Accuracy   The quantities of fiber optic test equipment, fiber optic fusion splice devices/equipment, fiber cable, connectors, sensors, transceivers, transport terminals, optical add/drop MUX, photonic switches and other products used in a particular application are interrelated. Since ElectroniCast conducts annual analysis and forecast updates in each fiber optic related product field, accurate current quantity estimates in each application are part of this corporate database. These quantities are cross-correlated as a “sanity check.”

ElectroniCast, each year since 1985, has conducted extensive research and updated our multiple-client forecasts of each fiber optic component category. As technology and applications have advanced, the number of component subsets covered by the forecasts has expanded impressively.
About ElectroniCast

ElectroniCast, founded in 1981, specializes in forecasting technology and global market trends in fiber optics communication components and devices, as well providing market data on light emitting diodes used in lighting.

As an independent consultancy we offer multi-client and custom market research studies to the world’s leading companies based on comprehensive, in-depth analysis of quantitative and qualitative factors. This includes technology forecasting, markets and applications forecasting, strategic planning, competitive analysis, customer-satisfaction surveys and marketing/sales consultation.

ElectroniCast, founded as a technology-based independent consulting firm, meets the information needs of the investment community, industry planners and related suppliers.

Director of Study

Stephen Montgomery, MBA in Technology Management, President at ElectroniCast Consultants. He joined ElectroniCast in 1990 and has specialized in photonics and fiber optic components market & technology forecasting at ElectroniCast for over 25-years. He has given numerous presentations and published a number of articles on optical communication markets, technology, applications and installations. He is a member of the Editorial Advisory Board of LIGHTWAVE magazine (PennWell Publishing) and writes a monthly article covering the optical communication industry for OPTCOM Magazine in Japan (Kogyo Tsushin Co., Ltd.).

Proprietary Statement

All data and other information contained in this data base are proprietary to ElectroniCast and may not be distributed or provided in either original or reproduced form to anyone outside the client’s internal employee organization, without prior written permission of ElectroniCast.

ElectroniCast, in addition to multiple-client programs, conducts proprietary custom studies for single clients in all areas of management planning and interest. Other independent consultants, therefore, are considered directly competitive. ElectroniCast proprietary information may not be provided to such consultants without written permission from ElectroniCast Consultants.
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Agilent Technologies (Keysight Technologies)
Alicat-Lucent (Nokia)
Anritsu
CETC International Company, Limited
Corning Incorporated (Corning Cable Systems)
Digital Lightwave Incorporated
EXFO Incorporated
Fiber Instrument Sales, Inc. (FIS)
Fluke Networks (Danaher Corporation)
GAO Fiber Optics
Greenlee Textron Inc. (subsidiary of Textron Inc.)
Huawei Technologies Co., Ltd.
IDEAL Industries, Incorporated
Kingfisher International
Legend Corporation (MSS Fiber Systems)
Luciol Instruments SA (Luciol)
Luna Technologies (Luna Innovations Incorporated)
Nanjing Jilong Optical Communication Co., Ltd
NanoTronix Company, Limited
OPTOKON a.s.
Photon Kinetics, Inc
Precision Rated Optics (PRO)
PROMAX Electronica S.L.
Qingdao E-Jiajun Optical & Electrical Info Company, Limited
Shaanxi Aitelong Technology Co., Ltd
Shenzhen Tellid Communication Tech. Co., Ltd. (Tellid)
Sun Telecom
Sunrise Telecom Incorporated
Techwin (China) Industry Co., Ltd
Terahertz Technologies Inc. (TTI)
VeEX Incorporated
Viavi Solutions Inc. (JDSU)
Wilcom Incorporated
Yokogawa Electric Corporation

3.2 Selected SFP Optical Transceiver/Related Companies

Accelink Technologies Co., Ltd.
Belden Inc (Hirschmann)
Cisco Systems, Inc.
Finisar Corporation
FLEXOPTIX GmbH
Foxconn Interconnect Technology Inc. (FIT)
Fujitsu Optical Components Limited
Huawei Technologies Co., Ltd.
IntegraOpticws
Juniper Networks Inc.
Lumentum Operations LLC
Menara Networks
NEC Corporation
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NeoPhotonics
Nokia
Oclaro Inc.
Optical Zonu Corporation (OZC)
Reflex Photonics Inc.
Source Photonics
Sumitomo Electric Industries, Ltd.
10Gtek
Transition Networks

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Global
America
EMEA
APAC

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APAT Optoelectronics Components Co., Ltd.
United Technologists Europe Limited / UTEL Laboratories
CFS - city fibre systems GmbH
Florida International University (FIU)
Nokia Siemens Networks (NSN)
Optixsoft
Fiberstore
Infinera
Optical Zonu Corporation
DPS Telecom
Florida LambdaRail (FLR)
Ciena Corporation
Google / Google Fiber
BT Research & Innovation
Arista Networks, Inc.
Transition Networks
NeoPhotonics
Nokia
Padtec
Telcordia
Sprint
Telecommunications Industry Association (TIA)
International Electrotechnical Commission (IEC)
Verizon
International Telecommunications Union (ITU)
MTN (South Africa)
Viavi Solutions
Yokogawa Electric Corporation
EXFO
AFL
Facebook
Broadband Forum
AT&T
IEEE
Metro Ethernet Forum
Society of Cable and Telecommunications Engineers (SCTE)
NTT Docomo
Indiana Fiber Network, LLC (IFN)
RCN Business
Comcast
KDDI Corporation
Nissho Electronics
Cisco Systems
Ericsson
Fujitsu Limited
GE Digital Energy
Huawei Technologies Co. Ltd.
NEC Corporation
Companies/Organizations – Mentioned in This Report - Continued

Nokia-Siemens Networks
Tellabs
IBM
Intel
ZTE Corporation
GE Energy Japan
Pitney Bowes
Equinix
SEIKO Advanced Components
NHK Science & Technology Research Laboratories (STRL)
Consumer Electronics Association
PCI Industrial Computer Manufacturers Group (PICMG®)
U.S. Federal Communication Commission
Avaya Inc.
Brocade Communications Systems
Dell / EMC
Emulex
QLogic Corporation
Berk-Tek; Nexans Company and Ortronics/Legrand
Juniper Networks
FTTH Councils of Europe, the Americas, and Asia-Pacific
Acacia Communications
CenturyLink, Inc
Frontier Communications
Charter Communications
Level 3 Communications
Birch Communications
Zayo Group
GIQcity
LUS Fiber
Cox Cable
LightSpeed
BTES (Bristol)
MUS FiberNET
Burlington Telecom
Vermontel
TUB (Tullahoma Utilities Board)
US Internet
Cedar Falls Utilities
Gigabit Squared
CondoInternet
Sonic.net
Greenlight (City of Wilson)
Arvig (ISP)
Fibersphere
Bloomer Telephone Company
Utopia Gigabit
General Communications Inc (GCI)
Comporium Broadband
West Carolina Tel (WCTel)
Cincinnati Bell
NATCO Communications
RG Fiber
Companies/Organizations – Mentioned in This Report-Continued

BTC Broadband
Jackson Energy Authority (JAE)
Troy Cable
Paul Bunyan Communications
Farmers Telecommunications Cooperative (FTC)
DuoCounty Telecom
Hawaiian Telcom
Plateau Fiber
United Communications
IdeaTek
Citizens Fiber
Twin Valley Communications
ValuNet FIBER
Wicked Broadband
Co-Mo Electric Cooperative, Inc.
Midcontinent
C spire
Fastfiber
Nextlight
Teléfonos de México (Telmex) / Telcel / Telmex Fibra Óptica de Telmex
América Móvil
Instituto Federal de Telecomunicaciones (IFT)
Secretariat of Communication and Transportation (SCT)
Federal Telecommunications Institute (IFETEL)
Axtel Extremo
Iusacell Enlace
Total Play
Megacable Holdings S. A. B. de C.V
International Standards Organization – ISO
Administracion Nacional de Telecomunicaciones (Antel)
Telefonica
Vivo Participacoes / TVA
Union of South American Nations (UNASUR)
BNDES
Banco del Sur
Integration of Regional South American Infrastructure (IIRSA)
Cosiplan
ISA
Claro
Movistar
TIM (Telecom Italia Mobile)
LT Amazon is a consortium of –
Linhas de Xingu Transmissora de Energia S.A.
Linhas de Macapá Transmissora de Energia S.A.
Manaus Transmissora de Energia S.A.
Perusat
Unidad Reguladora de Servicios de Comunicaciones (URSEC)
TeleCuba Communications Inc
Alcatel-Lucent / Nokia
Compañía Anónima Nacional Teléfonos de Venezuela (CANTV)
CFE Telecommunications
Canadian Radio-television and Telecommunications Commission (CRTC)
Primus
Companies/Organizations – Mentioned in This Report-Continued

TekSavvy
Bell / Bell Aliant
MTS / Manitoba Telecom Services Inc
SaskTel
Telus
Rogers Communications Inc
Shaw
Orascom Telecom
European Competitive Telecoms Association (ECTA)
Orange Business Services
Rostelecom
MTS
China Unicom
Samsung / Samsung Fiber Optics
Regional Commonwealth in the field of communications (RCC)
Pacific Telecommunications Council (PTC)
International Cable Protection Committee (ICPC)
Internet Corporation for Assigned Names (ICAN)
Japan - National Institute of Information and Communications Technology (NICT)
U.S. National Telecommunications and Information Administration (NTIA)
TE Connectivity Ltd. / TE Subcom
Brunei International Gateway Sendirian Berhad (BIG)
China Mobile International Ltd. (CMI)
China Telecommunications Corporation (China Telecom)
China Telecom Global Limited (CTG)
Donghwa Telecom Co. Ltd (DHT) (a subsidiary of Chunghwa Telecom, Co., Ltd.)
Globe Telecom, Inc.
KDDI Corporation
Singapore Telecommunications Limited (Singtel)
PT Telekomunikasi Indonesia International
TOT Public Co., Ltd. (TOT).
MENA / Orascom Telecom Media and Technology
Etisalat
Telekom Romania (Romtelecom and Cosmote)
Metroweb
Telecom Italia
Accelink Technologies Co. Ltd.
Wuhan Telecommunications Devices Co. Ltd (WTD)
Wuhan HuaGong Optics Tech Co. Ltd (HG Genuine)
FiberHome Technologies
Tsinghua Holdings Technology and Innovation (THTI)
21Vianet Group (21Vianet)
Infocomm Development Authority of Singapore (IDA)
Deutsche Telekom AG
NTT West Corporation / NTT East
Global Cloud Xchange (Reliance Communications)
Ericsson
Radius Infratel
Bharat Broadband Network Limited (BBNL)
Finolex Cables Limited
RIT Technologies
ADC Krone
Belden CDT
Companies/Organizations – Mentioned in This Report-Continued

Connectix cabling systems
SIMON Electric
KT (South Korea)
SK Telecom (Hanaro Telecom)
LG Uplus (Powercom)
PCCW-HKT Telephone Limited and Hong Kong (HKT) Limited,
New World Telecommunications Limited
Wharf T&T Limited
Hutchinson Global Communications Limited
Hong Kong Broadband Network Limited
Towngas Telecommunications Fixed Network Limited
ComNet Telecom (HK) Limited
TraxComm Limited
HKC Network Limited
Hong Kong Cable Television Limited
Reach Networks Hong Kong Ltd & Reach Cable Networks Limited
Telstra International HK Limited and Reach Global Services Limited
Verizon Hong Kong Limited
SmarTone Communications Limited
Cable and Wireless Global Network (Hong Kong) Limited
TEPCO Fiber Optic Network Company - Japan
CSL Limited
Infocomm Development Authority (IDA)
Korea - ETRI (Electronics and Telecommunications Research Institute)
StarHub
Netco Singapore Pte. Ltd.
Ministry of Internal Affairs and Communications (MIC) - Japan
Ministry of Industry and Information Technology (MIIT) - China
CHT (Chunghwa Telecom)
Far Eastern Telecommunications Group
Taiwan Mobile
J-Power Systems
APBW
Brand-Rex
Vibo
Chunghwa Telecom Co., Ltd.
PCCW Limited
Fuji Media
Nishinippon Computers
Microsoft
Hong Kong Polytechnic University (PolyU)
Southwest Jiaotong University
Dalian Jiaotung University

Chapter 2

AT&T
NTT
Deutsche Telekom
British Telecom
France Telecom
Cable and Wireless
EXFO Inc.
Companies/Organizations – Mentioned in This Report–Continued

AFL (NOYES)
OpenNet
Verizon Communications
US – Department of the Air Force (Air Force Materiel Command, AFMETCAL)
SCIENTEX Inc. – Japan
NASA
Lumo Energy
EnergyAustralia
Origin Energy
TRUenergy
Powercor
Click Energy
AGL
Alinta
Citipower
ETSA Utilities
Western Power
Country Energy
Energex
Integral Energy
ActewAGL
Ergon Energy
Power and Water
Eletrobrás
AES Eletropaulo
CPFL Energia
Celesc
CEMIG
CESP
Copel
Light S.A.
CEEE
Energisa
Electrabel
State Grid Corporation
China Southern Power Grid
Hong Kong - Hongkong Electric
CLP Power
Companhia de Electricidade de Macau
CEZ Group
Egyptian Electric Holding Company
Ethiopian Electric Power Corporation
Fortum
E.ON
RWE
EnBW
PPC (DEI)
Orkuveita Reykjavíkur
NTPC
KPTCL
MSEB
Tata Power
BSES Rajdhani Power Ltd New Delhi
Companies/Organizations – Mentioned in This Report-Continued

Perusahaan Listrik Negara
Enel
Edison
A2A
ACEA
Hera
Sorgenia
Kansai Electric Power
Tokyo Electric Power
Chubu Electric Power
Chugoku Electric Power
Hokuriku Electric Power
Hokkaido Electric Power
Kyushu Electric Power
Tohoku Electric Power
Shikoku Electric Power
Okinawa Electric Power
J-POWER
Tenaga Nasional Berhad
Genesis Energy
Meridian Energy
Mighty River Power
Transpower
Meralco
Singapore Power
Eskom
Korea Electric Power Corporation
Endesa, Iberdrola
Vattenfall
Taiwan Power Company
Electricity Generating Authority of Thailand
Provincial Electricity Authority
Metropolitan Electricity Authority
EDF Energy
E.ON UK
National Grid
RWE Power
Scottish Power
Scottish and Southern Energy
Drax Power
Good Energy
Ecotricity
Alkane Energy
Ovo Energy
United States of America
Pacific Gas & Electric
Southern California Edison
Florida Power & Light
Consolidated Edison
Georgia Power
Virginia Electric & Power
DTE Energy
Public Service Electric & Gas
Companies/Organizations – Mentioned in This Report–Continued

Chapter 3

AFL (NOYES / Fujikura)
Agilent Technologies (Keysight Technologies)
Alcatel-Lucent (Nokia)
Anritsu
CETC International Company, Limited
Corning Incorporated (Corning Cable Systems)
Digital Lightwave Incorporated
EXFO Incorporated
Fiber Instrument Sales, Inc. (FIS)
Fluke Networks (Danaher Corporation)
GAO Fiber Optics
Greenlee Textron Inc. (subsidiary of Textron Inc.)
Huawei Technologies Co., Ltd.
IDEAL Industries, Incorporated
Kingfisher International
Legend Corporation (MSS Fiber Systems)
Luciol Instruments SA (Luciol)
Luna Technologies (Luna Innovations Incorporated)
Nanjing Jilong Optical Communication Co., Ltd
NanoTronix Company, Limited
OPTOKON a.s.
Photon Kinetics, Inc
Precision Rated Optics (PRO)
PROMAX Electronica S.L.
Qingdao E-Jiaxun Optical & Electrical Info Company, Limited
Shaanxi Aitelong Technology Co., Ltd
Shenzhen Tellid Communication Tech. Co., Ltd. (Tellid)
Sun Telecom
Sunrise Telecom Incorporated
Techwin (China) Industry Co., Ltd
Terahertz Technologies Inc. (TTI)
VeEX Incorporated
Viavi Solutions Inc. (JDSU)
Wilcom Incorporated
Yokogawa Electric Corporation
Accelink Technologies Co., Ltd.
Belden Inc (Hirschmann)
Cisco Systems, Inc.
Finisar Corporation
FLEXOPTIX GmbH
Foxconn Interconnect Technology Inc. (FIT)
FUJITSU OPTICAL COMPONENTS LIMITED
Huawei Technologies Co., Ltd.
IntegraOptics
Juniper Networks Inc.
Lumentum Operations LLC
Menara Networks
NEC Corporation
NeoPhotonics
Companies/Organizations – Mentioned in This Report—Continued

Nokia
Oclaro Inc.
Optical Zonu Corporation (OZC)
Reflex Photonics Inc.
Source Photonics
Sumitomo Electric Industries, Ltd.
10Gtek
Transition Networks

Chapter 4

EXFO, Inc.
AFL Telecommunications Llc
Hewlett-Packard Development Company, L.P.
Adtran, Inc.
Ultra Communications
Huawei
II-VI Photonics
Nokia
Anritsu Company
Concilium Technologies (Pty) Ltd
Yokogawa Europe

Chapter 5

Avago Technologies (Broadcom)
Tata Communications
Metro-Access Group (Photonics Engineering - Research group at DTU Fotonik (Danmarks Tekniske Universitet)
Google
Fujitsu Optical Components Limited (FOC)
Equinix
US DARPA / Microsystems Technology Office
University of California, Santa Barbara (UCSB)
Ciena
Weizmann Institute of Science
Huawei, Huawei Marine Networks Co. Ltd. (Huawei Marine)
Viatel
GlobeNet
Alcatel-Lucent
NeoPhotonics
IEEE
AT&T
China Telecom
Optical Internetworking Forum (OIF)
Verizon Business
Qwest (CenturyLink)
EMCORE Corporation
Finisar Corporation
Corning; Samsung (now Corning Optical Communications)
OFS Fitel, LLC.
Intel
Samsung
Companies/Organizations – Mentioned in This Report-Continued

TSMC
Globalfoundries
Micron
SK Hynix
Toshiba
Panasonic
Sony
Qualcomm
Altera (Intel)
Fujitsu
NVidia
Xilinx
Oclaro
Furukawa Electric
Sandia Laboratories
Norfolk State University
Center for Integrated Access Networks (CIAN)
Lodz Univ of Technology
Ecole Polytechnique Fédérale de Lausanne
IntegraOptics
TE Connectivity (TE)
Cisco Systems, Inc
IBM Laboratories
Vitesse (Microsemi Corporation)
Carlos III University of Madrid
SMART Photonics
aXenic
Fujikura Limited