Utilities Special

The optical access market, and as part of it, the utility telecom market, are expected to be amongst the fastest growing and most lucrative markets in the years to come. In this "Utilities Special", we will summa - rize some of MRV Communications' proven solutions for optical transportation networking (i.e., Railroad, Highway, Gas Pipeline) as well as utilities and energy access networks (Electric/Gas/Oil).

eWDM - Optical Ethernet

CityLEC Utilities Application – Services by Municipal Providers

De Facto:

Municipal power, water and gas boards are stepping into offering carrier's carriers and broadband services in metro and access area in addition to their traditional services.

Problem:

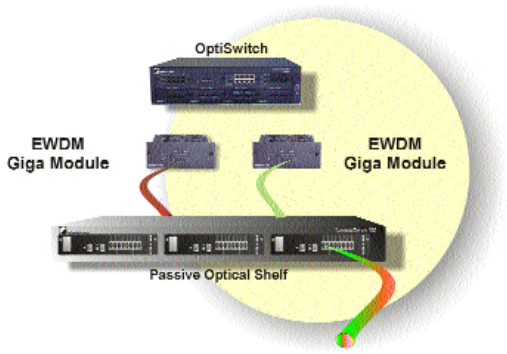
Digging and fiber installation may cause high cost invest- ments and numerous problems. In addition, the optimization of the fiber use, to avoid un-profitability of investments and resources, becomes a must.

In order to provide Carrier-to-Carrier Lambda services, or ISP Optical Ethernet Access Services (or ISP to ISP) as well as Storage (SAN) and SONET services, the municipality has to build a flexible network and make the most advantageous use of its fiber.

Solution:

To obtain this objective, MRV offers to package up to 16 Gigabit Ethernet channels onto a single pair of fiber using the OptiSwitch eWDM technology with Quality of Service (QoS). The solution enables to transmit POP to POP Optical Gigabit services as well as lambda services based on all-optics ADD/DROP multiplexers. To optimize the use of the fiber infrastructure and achieve SAN and SONET integration, we offer the LambdaDriver™ modular WDM solution or the Fixed FiberDriver™ WDM solution to get transparent inte- gration of network services.

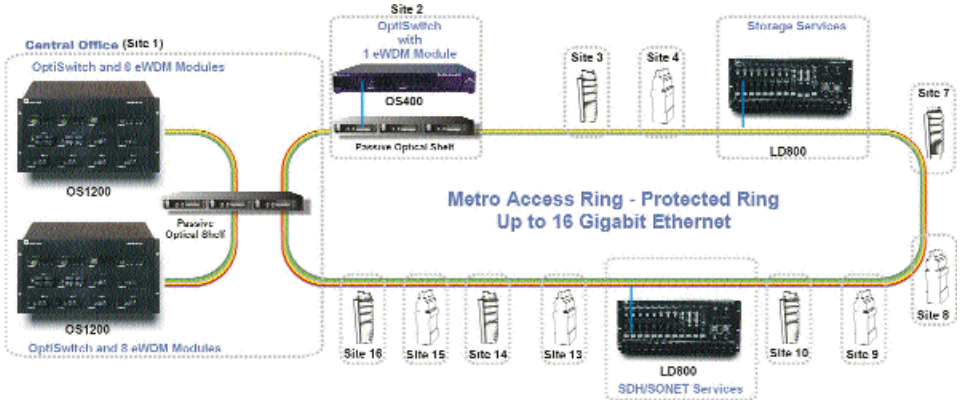
eWDM
The real optical ethernet



__eWDM__ components building block: The service enabler __OptiSwitch__ with WDM Gigabit modules. And the all-optics __Passive Optical Shelf__ with OADMs and MUXs

eWDM – Ethernet with WDM

MRV's eWDM innovative solution provides a simple, yet extremely flexible and efficient way to deploy Optical Gigabit Ethernet services. The Colors (wave- lengths) originating directly from the OptiSwitch modules, the all-optics multiplexer/OADM needs only multiplex the received wavelengths, with no need for Optical-Electrical-Optical (O-E-O) conversions who usu- ally have to "translate" gray transmission from tradi- tional switch into colors to be then multiplexed.
The combination of Colored Ethernet and WDM tech- nologies allows for the design of a flexible and highly available multi-service network. It extends existing fiber-based infrastructure transparently over a broad- band network and optimizes the use of fiber investme



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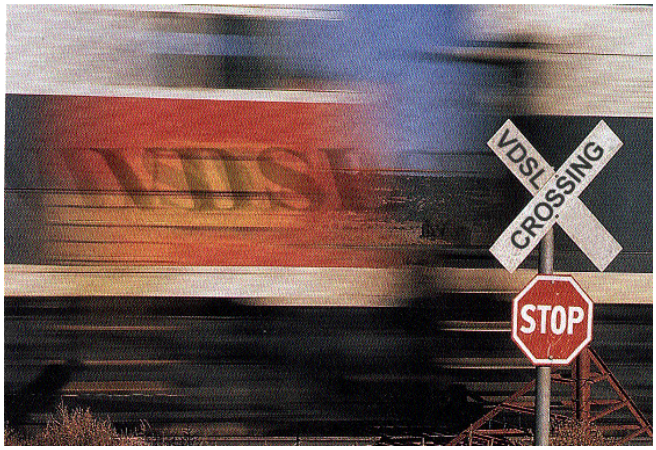
Optical Ethernet Circuit Technology



Ethernet Circuit – Service Enabler Technology

Ethernet Circuit is MRV's service enabler technology, It is an advanced access technology that enables end-to-end QoS communication in carrier class networks. The Ethernet Circuit technology is part of MRV's OptiSwitch product line and it enables networks providers who use high quality access networking infrastructure to offer a variety of services to support networking features such as intrusion control, rate limiting, MPLS VPNs and optical wireless transmission. By implementing the Ethernet Circuit technology, utilities carriers can support Service Level Agreements with subscribers of their network services.

Unlike regular LAN switches, OptiSwitch™ Ethernet Circuit switches have the ability to recognize frames as belonging to a specific stream of information, a circuit, and attach to this stream a variety of parameters related to the way these frames are to be handled across the network, including rate limitation, intrusion control and end-to-end QoS and traffic engineer.

This technology is designed to allow carriers to enjoy the revenue from services, which traditionally required circuit-switching technology, as well as from new services, which require Ethernet and IP switching technology.

As a service enabler technology, the Ethernet Circuit, enables the construction of multiple integrated Voice, Video and Data streams of information. It also allows for the manipulation of various parameters that define these information streams and characterize the transport of the streams through the network.

This Ethernet Circuit technology empowers carriers with a new class of profit-making services and products, while dramatically reducing the cost of ownership.

Multifunctional xWDM Transmission

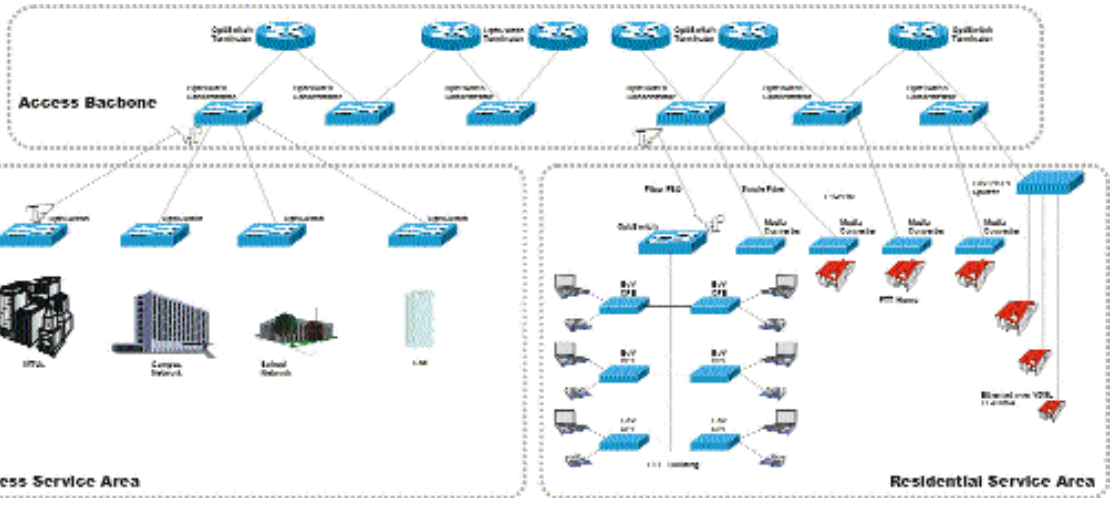
MRV, a leader in optical technology for more than two decades, provides a flexible optical solution for metro and access networks applications. The solutions support DWDM technologies as well as CWDM with 16 wavelengths. The technology enables the transmission of any data rate between 10 Mbps and 2.5 Gbps, covering almost any network protocol, including Fiber Channel, ESCON, Fast Ethernet, Gigabit Ethernet and SONET, in Point-to-Point, Bus and Ring topologies, using MUX/OADM and advanced protection technologies.

Ethernet over VDSL (EoV) Access

MRV's award winner Ethernet Over VDSL (EoV) solution provides wire speed Ethernet Broadband Access for high bandwidth connectivity over standard telephone cabling. Using emerging access technologies such as EoV, carriers can deliver broadband services such as Broadband Internet Access, Video-on-Demand, Virtual Private Networking (VPN), Voice over IP (VoIP) and others.

The solution consists of a customer premises unit (CPE), a VDSL splitter and a hybrid 4/8-port Ethernet over VDSL module from MRV's OptiSwitch™ service enabler family. This provides a full duplex (symmetric), QoS (including rate limitation per flow) 15 Mbps EoV link over standard telephone lines, and can reach distances of up-to 2400 m (with the special LR-EoV technology). In addition, EoV includes built in automatic diagnostics and provisioning tools.

- FTTx
- Remote Management
- Security
- QoS
- MPLS VPN
- ISP Optical Access
- Carrier Transportation



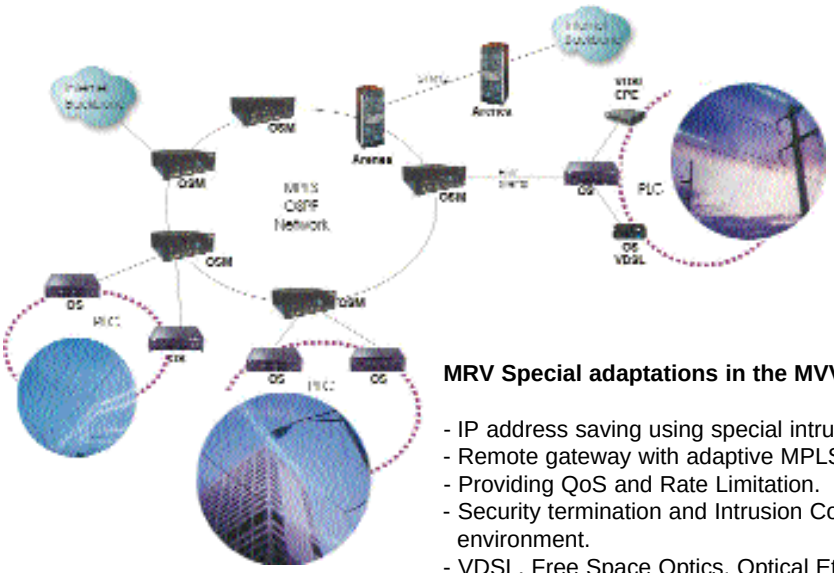
MRV

adaptive optical ethernet technology
&
Power Line Comunications

Case Study

MaNet – MVV

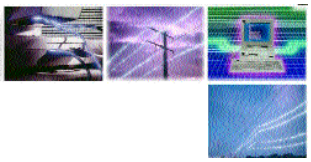
The Hype about "Vype ": The German power utility, MVV, commences supply of broadband services to its customers marketed under the name of Vype.
September 2001 marked the official launch of the German power utility, MVV, campaign for entry into the telecommunications market with access services. The solution integrates Power Line Communication (PLC) and MRV adaptive Optical Ethernet technology to allow service enabler network infrastructure.



Following the successful pilot project using MRV's OptiSwitch, TereScope (Free Space Optics) and Ethernet over VDSL (EoV) systems, MaNet, MVV's telecommunications subsidiary, started the commercial implementation of access services to its Mannheim customers on July 1st. Promising results obtained during this initial stage accelerated the speed of implementation. MVV expects an infrastructure for 40,000 households in Mannheim to be laid down with 3,000 households actually receiving the services. By the end of 2002, the infrastructure will be ready for connection of broadband services to 130,000 households. MVV's huge product campaign allowed the Mannheim public to access as much information as required, in addition to testing out the technology first hand by surfing via the power line at high speed. Of course, there was also the possibility to subscribe to the service.

MRV Special adaptations in the MVV Network:

- IP address saving using special intrusion technology.
- Remote gateway with adaptive MPLS VPNs capabilities.
- Providing QoS and Rate Limitation.
- Security termination and Intrusion Control in a shared environment.
- VDSL, Free Space Optics, Optical Ethernet and Power Line Communication (PLC) integration.
- Mobility (on the PLC shared network) without session loss, using unique tunneling capabilities.
- OptiSwitch Master with full MPLS support including MPLS L2VPN tunnels and interior MPLS LSP.

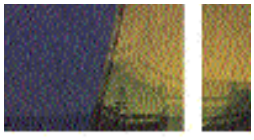


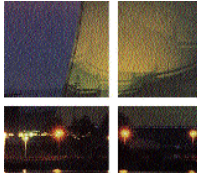
MRV Products

MRV PRODUCTS

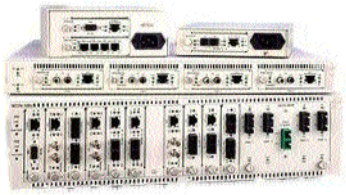
The OptiSwitch™ product line is a unique integration of Ethernet multi-layer systems, QoS routers and carrier circuit switches, with its choice of seven chassis (hosting from one to 24 expansion slots or ports) and over 50 different module types. It is an exclusive combination of hardware features with Ethernet pricing and simplicity of operation.
OptiSwitch™ is designed to provide fiber optic based solutions and support applications such as Carrier-to Carrier, ISP connectivity, Fiber-to-the-x coupled with Voice, Video and Data Solutions.
OptiSwitch™ enables the provision of legacy telephony services together with advanced IP communication on a single optical access infrastructure.

The OptiSwitch Master™ family is a carrier-class chassis, designed as an intelligent edge system. It merges the functions of a Router, a fully capable MPLS system, a Subscriber Management System and an IP security platform. It uses state-of-the-art high-end network processors that enable QoS and Traffic Engineering based services. This creates a highly flexible solution that can implement changes in the hardware functionality through software download



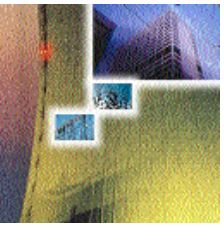


The Fiber Driver™ family of product enhances campus, enterprise or city deployment solutions with a seamless integration of media conversion capabilities to allow for handling a variety of other legacy protocols, such as voice and storage protocols.



The LambdaDriver™ is a multi-functional modular Wavelength Division Multiplexing (WDM) system that can create up to 16 independent virtual fiber optic links over a single pair of fibers. It is available with 8 or 16 hot-swappable transponders chassis.
It is also ideal to optimize the use of the fiber infrastructure and achieve SONET, Ethernet and SAN integration, LambdaDriver™ modular WDM solution transparently.

TereScope™ - Free Space Optics
The TereScope™ product line provides optical wireless connectivity with data speeds from 1.5 Mbps to 2.5 Gbps. The TereScope is an optical transceiver, which sits on rooftops (or behind windows) and provides fiber-like connection speeds.
TereScope provides higher potential capacity, license free and protocol independent transmission, at lower costs, over the air for Building-to-Building connectivity, ring or mesh topology and hybrid integrated wired/wireless solutions.



Why is MRV ideal for Utilities?

For years, MRV has been the proven and successful pioneer in integrating cutting-edge Optical Ethernet, WDM technology with VPN, QoS and Traffic Engineering (TE) technologies for transportation pipes, and FTTx access solutions, offering an exceptional variety of multimedia broadband services, built with a variety of advanced optical building blocks, including:
- **OptiSwitch™** - service enabling modular systems, supporting the Optical Ethernet and eWDM technologies
- **LambdaDriver™** and **FiberDriver™** WDM systems
- **TereScope™** Free Space Optics (FSO) product line providing optical wireless links
- Full management through the advanced monitoring and provision **MegaVision Web™** system

MRV focuses on what today's Utilities Broadband Networks and CitiLecs really need. The flexible combination of its various advanced optical technologies, customized for utilities networks requirements take the service-enabling functionality to the next level, enriching and expanding the Utilities operator networks and CitiLecs while enabling greater network control of security, speed and in cost effective solutions.

About MRV Communications, Inc.

MRV Communications is a world-class provider of high-bandwidth, low-cost Ethernet access solutions. These solutions include last-mile Ethernet, Ethernet over VDSL, Free-Space Optics (FSO), Media Conversion and Wave Division Multiplexing. MRV markets its products in more than 50 countries to existing and emerging service providers, as well as to enterprises requiring service aware broadband networks. As a leader in optical technology, with years of field proven success, MRV projects division is fully committed to 24x7 direct support and response to all projects needs and to taking care of special adaptation of its products to fit the Utilities Broadband Networks requirements in order to optimize the network utilization, support the whole spectrum of services and help the operator gain more revenue by providing more services to more customers more quickly.
For more information, visit www.mrv.com.