PacketLight™ NETWORKS

Solutions for Data Center Interconnect (DCI)

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About PacketLight

- Established in 2000
- Develop state-of-the-art optical transport systems
  - DWDM/CWDM
  - OTN layer
  - Layer-1 encryption (FIPS 140-2 certified, CCEAL2 certified), QKD
- Solutions for data, storage, voice and video transport applications
- Compliant with international standards
- Green products
- Design & manufacturing in Israel
- Member of the RAD group

COMMON CRITERIA CERTIFIED EAL2+

FIPS VALIDATED 140-2

Certificate 4582

The RAD Group

Coordinated Strategy | Shared Sales Channels | Joint Development & Technology

5,310
employees

$
$1.8B
revenue in 2022

More than 100
startups in 40 years

RAD
Your Network's Edge®
The Service Assured Solutions Company
Established: 1981

PacketLight NETWORKS
DWDM and OTN Solutions
Established: 2000

RADWIN
Sub-6GHz Wireless Backhaul
Established: 1997

RAD COM
Network Test Solutions
Established: 1991*

radware
Integrated Application Delivery
Established: 1997*

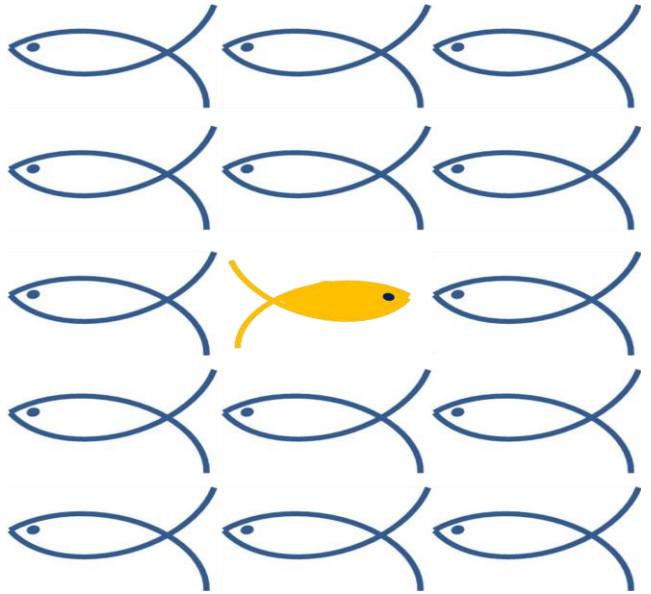
CERAGON
Wireless Mobile Backhaul
Established: 1996*

Bynet
DATA COMMUNICATIONS LTD
Group Distributor in Israel and Worldwide System Integrator
Established: 1975

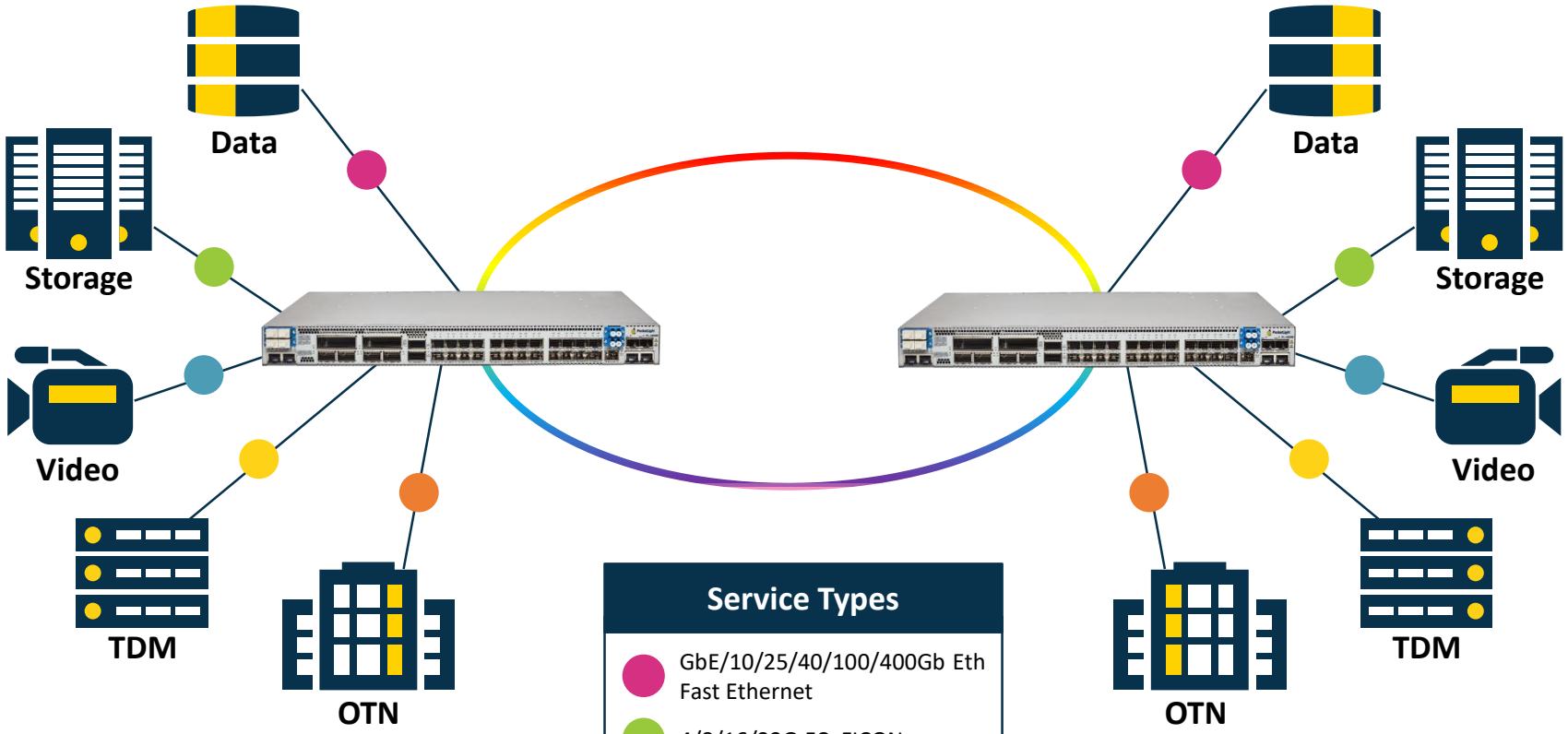
*Publicly Traded Company

PacketLight Differentiators

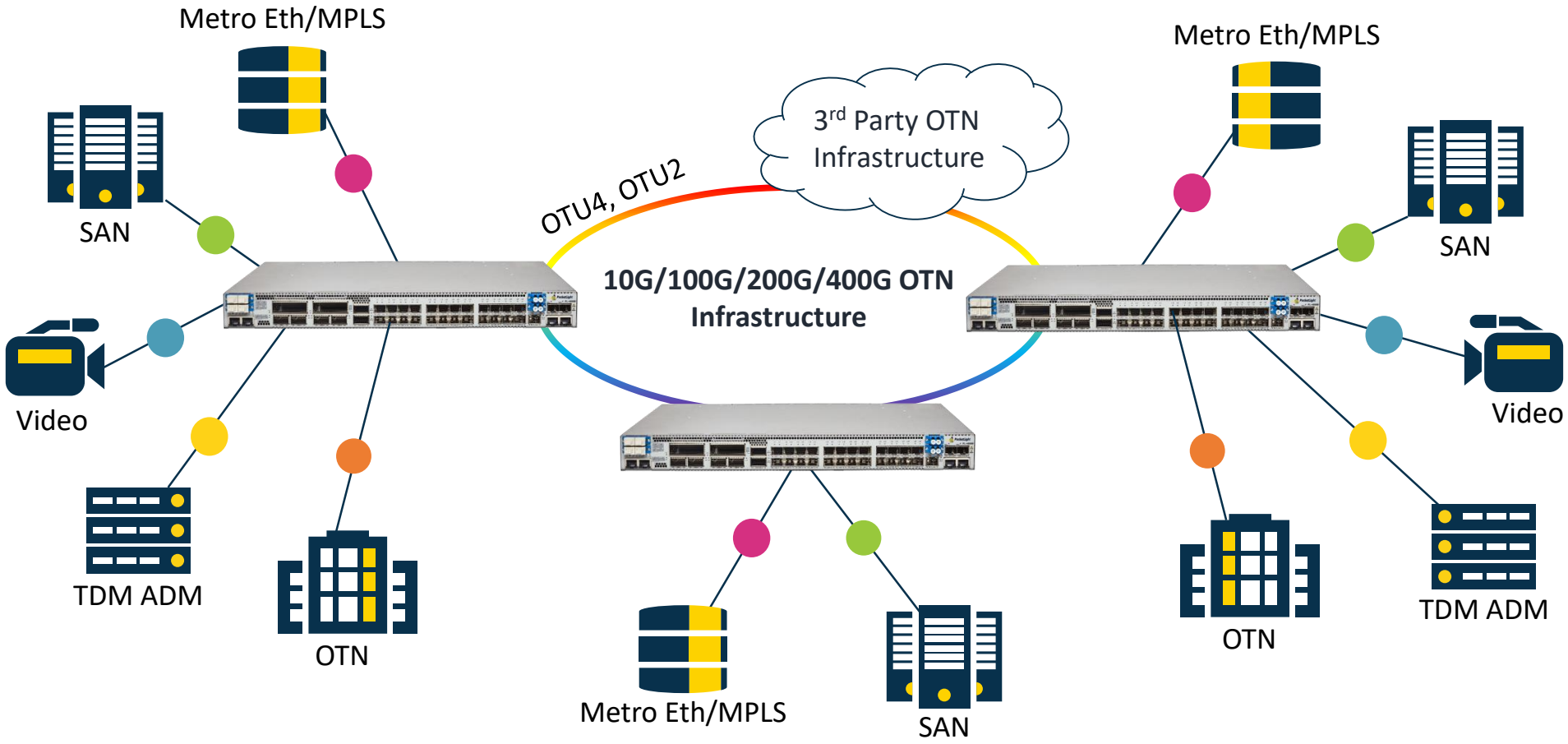
- Compact, low power 1U solutions
- Carrier-class feature set
- Flexible mix of services
- No port licensing
- Simple deployment and configuration
- Cost-effective stackable solution
- Transports up to 400G per wavelength



Building Agile DWDM, CWDM Infrastructure



Building OTN + DWDM Metro/Access Networks



Service Types

- GbE/10/25/40/100/400Gb Eth Fast Ethernet
- 4/8/16/32G FC, FICON
- 3G HD-SDI, HD-SDI, SD-SDI, 12G-SDI, DVB-ASI
- SONET, SDH/PDH, STM-1/4/16/64, OC-3/12/48/192
- OTU2/OTU2e/OTU3/OTU4

Product Portfolio

Transponders

PL-4000T: 4 x 400G Transponder/Muxponder

PL-4000G 4.8T Transponder

PL-2000T: 800G Transponder

PL-1000TN: 6 x 8G/10G OTN Services

PL-1000TE: 8 x 1G-16G services

PL-8000T: 3.2T Transponder/ADM

COMING SOON

Muxponders

PL-4000M: 600G Muxponder

PL-2000GM: 2x100G Long Haul ADM

PL-2000ADS: 200G ADM Short Haul

PL-2000M: 200G Muxponder/Transponder

PL-2000: 20G ADM

PL-8000M: 2x800G Muxponder

COMING SOON

Infrastructure

PL-1000D: Diagnostics

PL-1000RO: WSS ROADM

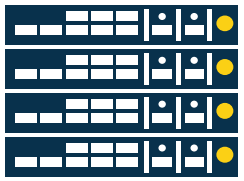
PL-1000IL: Optical Amplifiers

PL-1000R: Raman Amplifier

PL-300: Passive Solutions

Comprehensive Feature Set

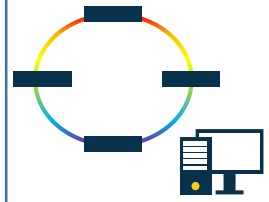
PacketLight NETWORKS


Disaggregated Stackable Chassis


OTN Layer


Up to 96 WL Mux/Demux


EDFA, Raman


Remote Management OSC/GCC


Layer-1 Encryption QKD


FlexGrid WL


Network Diagnostics


Muxponders Family


Optical Protection

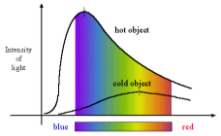

Single or Dual Fiber


MNG Firewall

800G per λ


LightWatch NMS SNMP MIB REST / NETCONF


Performance Monitoring

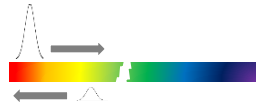


CWDM/DWDM


ROADM

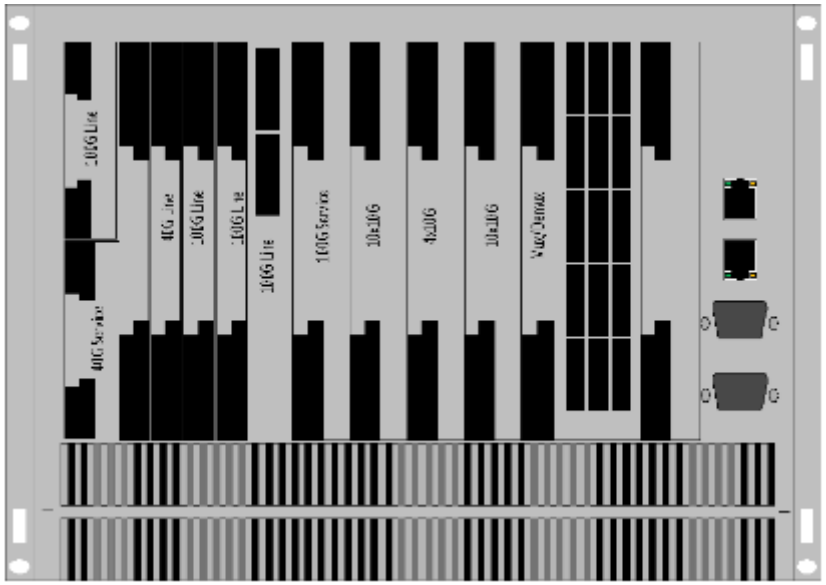

Network Protocols


OSA


OTDR OSC OTDR

Chassis vs Stackable

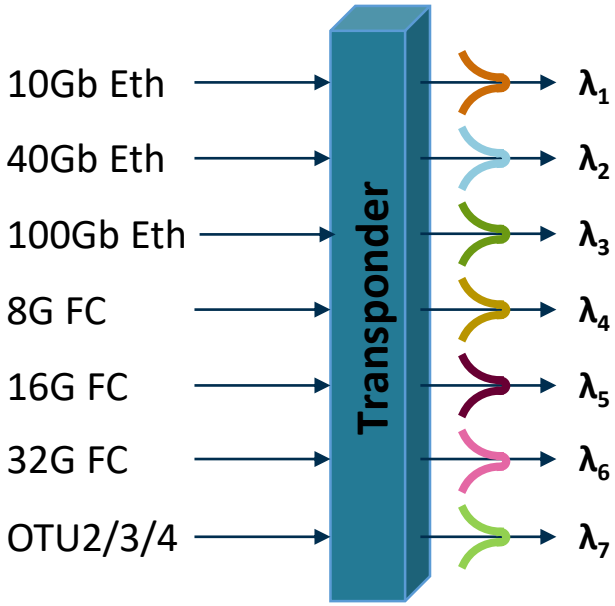
- Consumes space and high energy
- Cannot adapt to previously existing rates
- Needs to be replaced to adapt to newer, higher capacity services

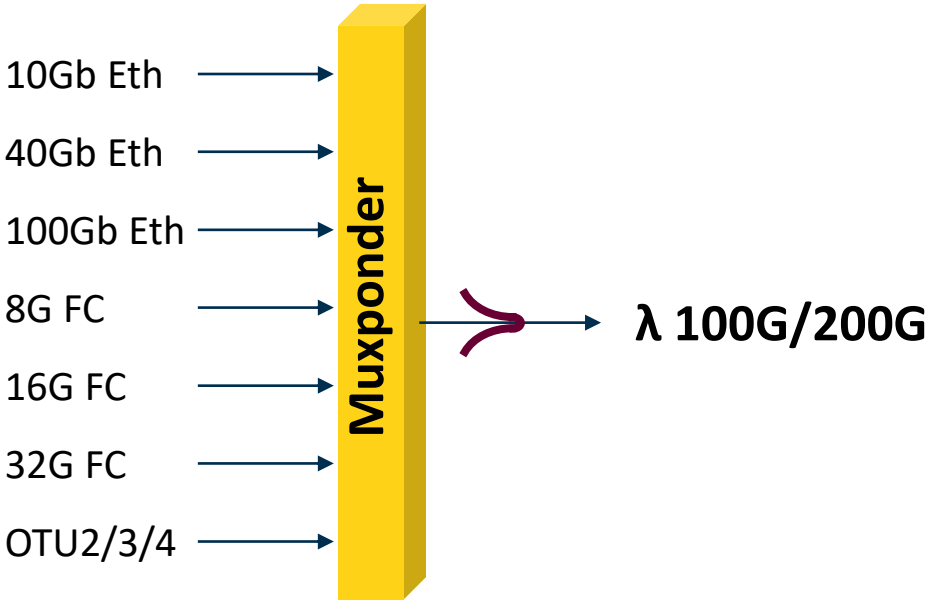


- Easily supports existing infrastructure
- Quickly add higher capacity services
- Easy to adapt new WDM technologies
- Unlimited growing path

Stackable approach provides more flexibility for future growth and faster ROI

Spectral Efficiency Of Wavelength 100G/200G

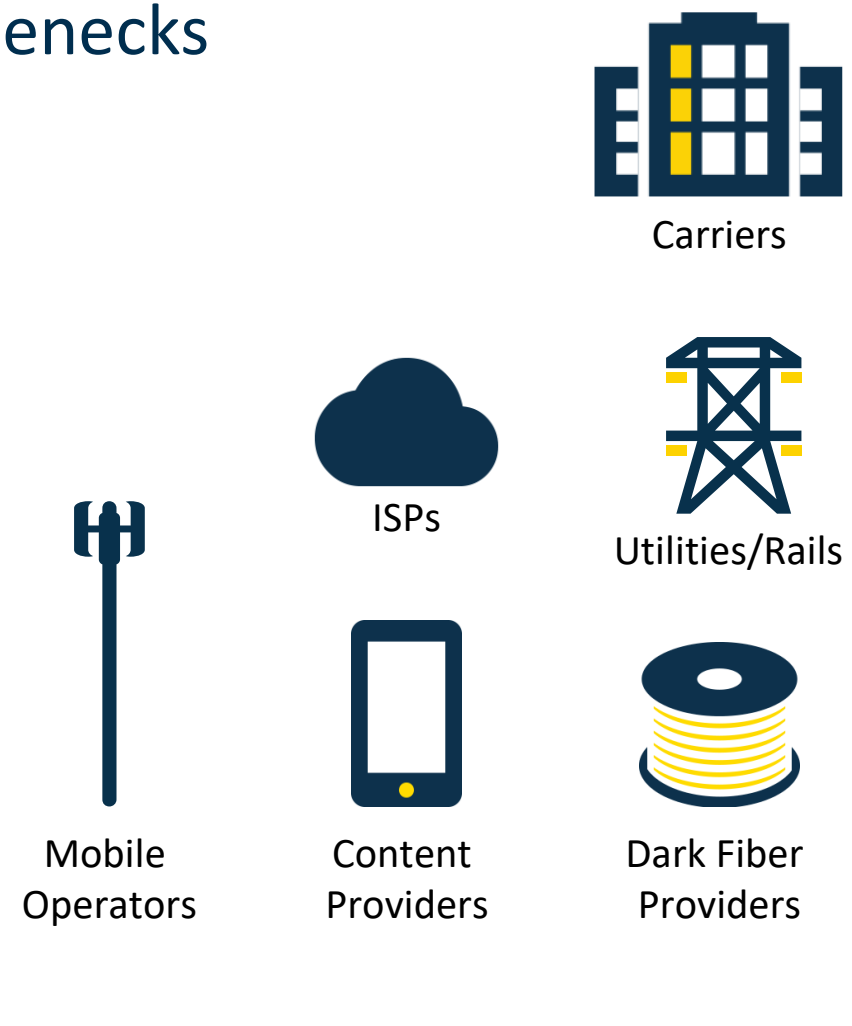




Muxponders increase fiber capacity by a factor of up to 20

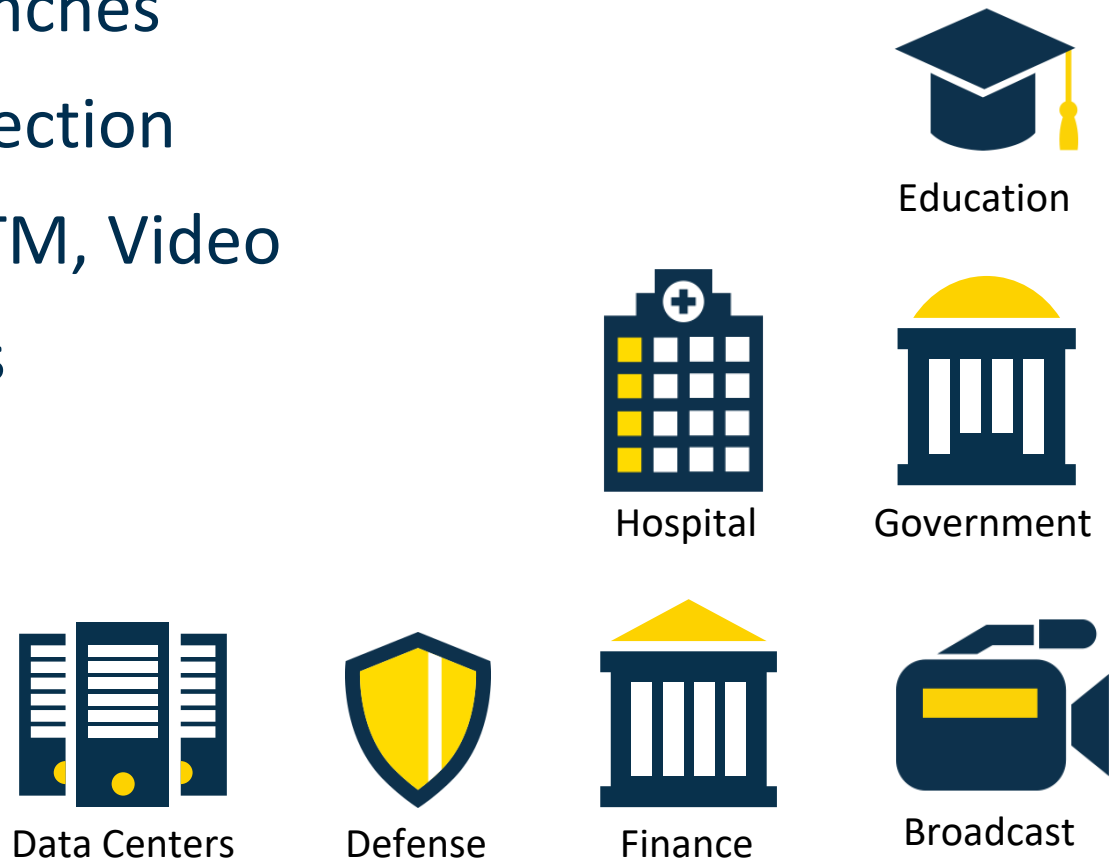
Applications for Service Providers

- High capacity, metro/long-haul backbone
- Alien wavelength solutions - relieve bottlenecks
- Extend existing backbone
- Managed services for enterprises
- Offer encryption services
- Last mile aggregation solution
- Layer-1 Encryption services



Applications for Enterprise

- Data center interconnect (DCI)
- Connectivity between office branches
- Layer-1 encryption for data protection
- Mix of services - Ethernet, FC, STM, Video
- Build easy to manage backbones
- Campus / ring connectivity



Challenges for Data Centers

- Build high capacity, low latency network
- Ability to support unique mix of services
- High level data security and compliance with encryption regulations
- Data and storage (FC) synchronous replication
- High network availability with full hardware redundancy
- Low OPEX backbone that is easy to maintain and grow

Benefits of WDM Solutions for Data Centers

- High capacity backbone of up to 1.6T services
- Flexible mix of services GbE/10/40/100Gb Ethernet, and 8/16/32G FC
- Layer-1 encryption to ensure secure connectivity for all data
- Ultra-low latency for redundant, transparent data transport
- Low power consumption & low form factor guarantee low OPEX
- Pay-as-you-grow scalable architecture that enables quick and easy growth
- Easy to deploy and operate
- EMS/NMS - for easy configuration, management, and monitoring

Benefits of PacketLight Encryption Solution

- Encryption ensures:
  - Confidentiality
  - Data integrity
  - Authentication
- Secures all data transmitted over fiber
- Ideal for low latency applications
- Interfaces with existing DWDM infrastructure and Telco OTN networks
- No need to change or upgrade Layer-2/3 switch/routers
- Transparent, maintaining full bandwidth of all traffic

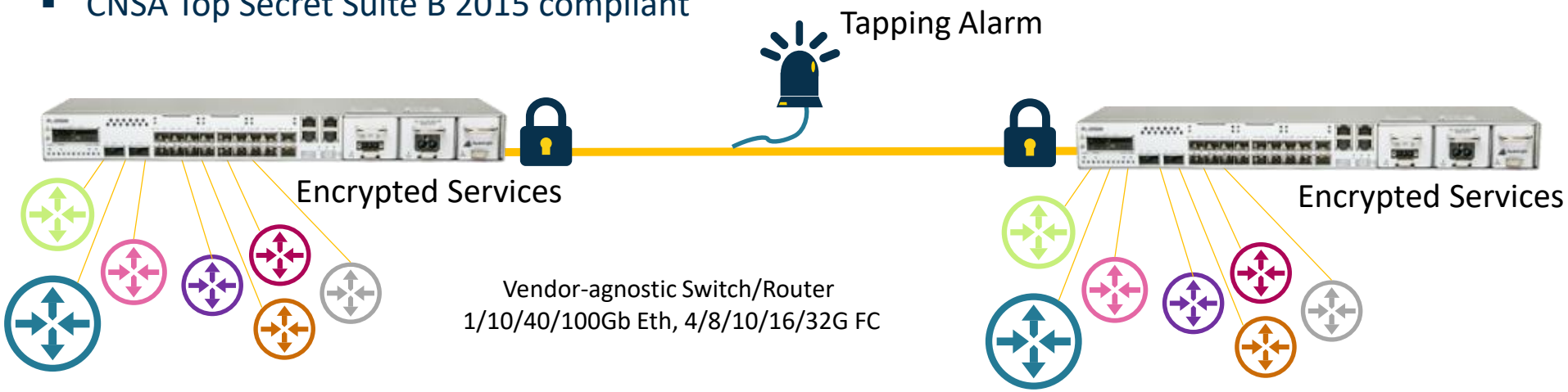
PacketLight Layer-1 Encryption Solution

- Software-based activated by license
- No additional license cost after initial investment
- No additional hardware or software required
- Configured per uplink or individual service ports
- Easy set up and configuration
- Complete control in the hand of the user
- Automatic fiber tapping detection and alarm
- FIPS 140-2 Level 2 certified
- Common Criteria EAL2 certified
- CNSA Top Secret Suite B 2015 compliant

COMMON CRITERIA CERTIFIED EAL2+

FIPS VALIDATED 140-2

Certificate #3529



Layer-1 Fiber Security

Physical Layer

- Optical power monitoring per service
- Automatic detection of fiber tapping

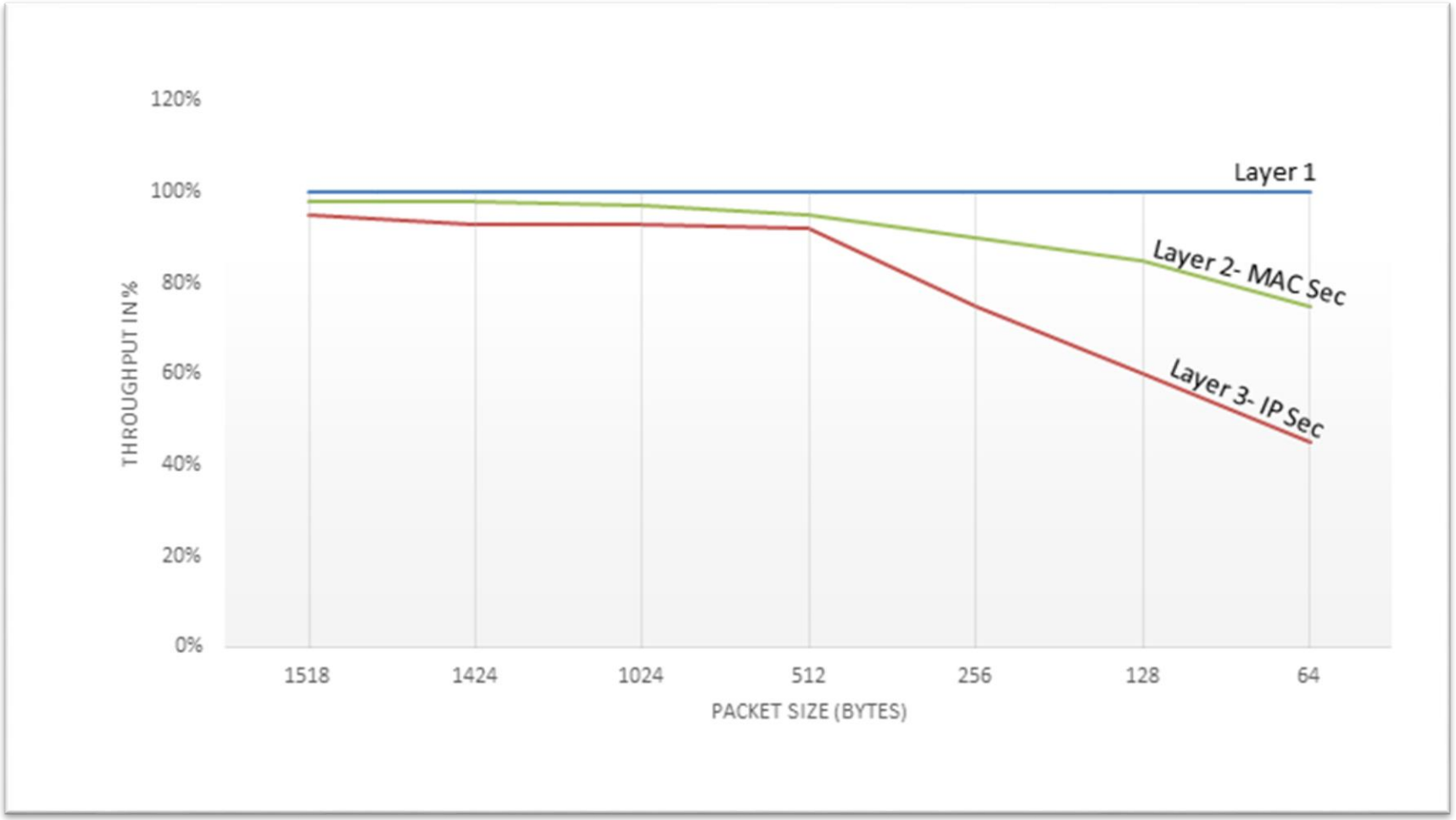
Data Plane

- Layer-1 transparent full bandwidth encryption
- GCM-AES-256 (advanced encryption standard)
- Diffie-Hellman Key Exchange
- Authentication using SHA-384

Management Plane

- SNMPv3
- Radius
- Management firewall
- HTTPS
- Secure shell

Layer-1 Full Throughput Performance

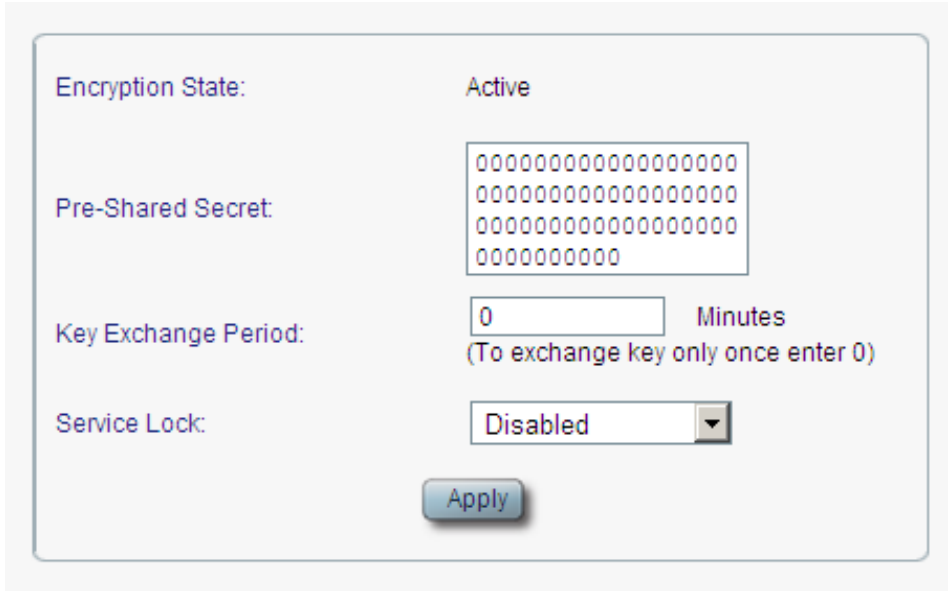


Encryption Functionality

Requirement	Function	Algorithm	FIPS 140-2	CNSA
Crypto Algorithm	Encryption algorithm	GCM-AES-256	FIPS 197 and SP800-38D	Yes
Key Management	Key establishment	Elliptic Curve Cryptography Cofactor Diffie-Hellman (ECC CDH)	SP 800-56A	Yes
Key Message Authentication	Message digest with pre-shared secret	Secure Hash Algorithm 2 (SHA-384)	FIPS 180-4	Yes
Self Tests	Integrity tests	On power up check digestion for software encryption modules and run test vectors with known answers (KAT)	Yes	N/A
Random Number Generator	Used for keys generation	True Random (TRNG) with FDK-100, and Deterministic random bit generator (DRBG)	SP800-90	N/A
Access Control	Authentication	Role based, user/password authentication	Yes	N/A
	Physical security	Tamper evidence	Yes	
EMI/EMC	FCC Part 15 Class A	N/A	Yes	N/A
Services	Supported services	10G/40G/100GbE, 8G/10G/16G/32G FC, OC192/STM64, OTU2/OTU2e/OTU4	N/A	N/A

Crypto Officer Functionality

- Roll based separation of crypto officer and network administrator
- Crypto officer per client service
- The only user allowed to change his own password
- The only user with access to the Encryption tab with
  - Pre-Shared Secret information
  - Key Exchange Period
- In all other terms the behavior of the crypto officer user is like a read-only user for the GUI and CLI
- Remote login via the web GUI over HTTP/HTTPS.
- Service Lock – prevents the admin from changing the service type from encrypted to non-encrypted
- For locked encrypted service, no change of service type
- Any locked services, prevent restore-to-factory-defaults, load a previously saved configuration file or switch between SW loads



Selected Case Studies

Case Study: Managed Services

Challenges

- Encrypt 2 data centers
- Full hardware redundancy with 2 fiber paths
- Scalable to 32G FC and 100GbE

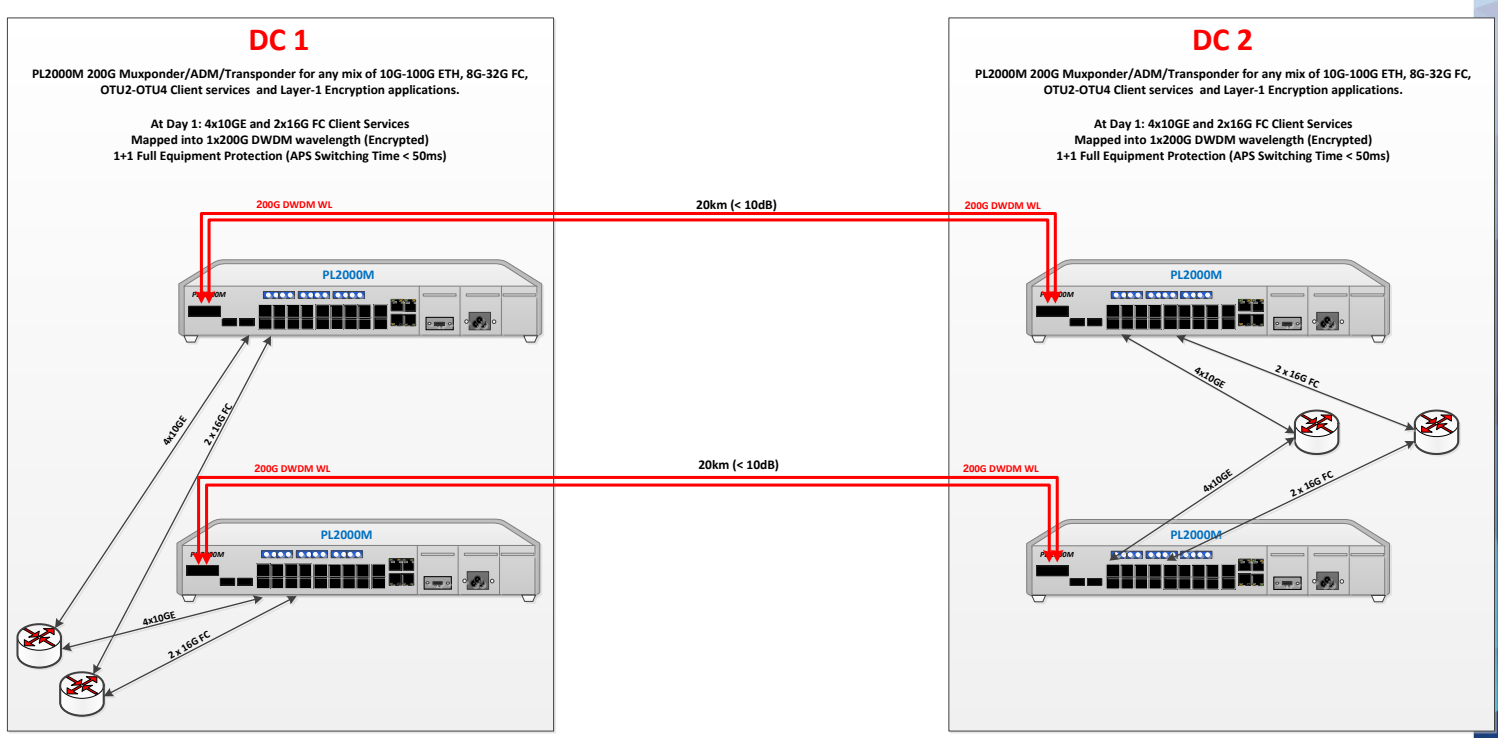
Where: Netherlands
What: Multi-tenant Data Center
Services: 2x16G FC, 4x10GbE
Distance: 20 km

Solution

- Dual muxponder solution (PL-2000M)
- Quick upgrade to 32G FC
- Additional 10 x mix of services available
- Encryption per service port or uplink

Success!

- Fast turn up of new services
- Low CAPEX and OPEX
- Scalable
- Simple maintenance and support



Case Study: Managed Services

Challenges

- Encrypt 2 DCs, and provide full hardware redundancy with 2 fiber paths
- Easy and cost-effective upgrade to 32G FC and 100GbE

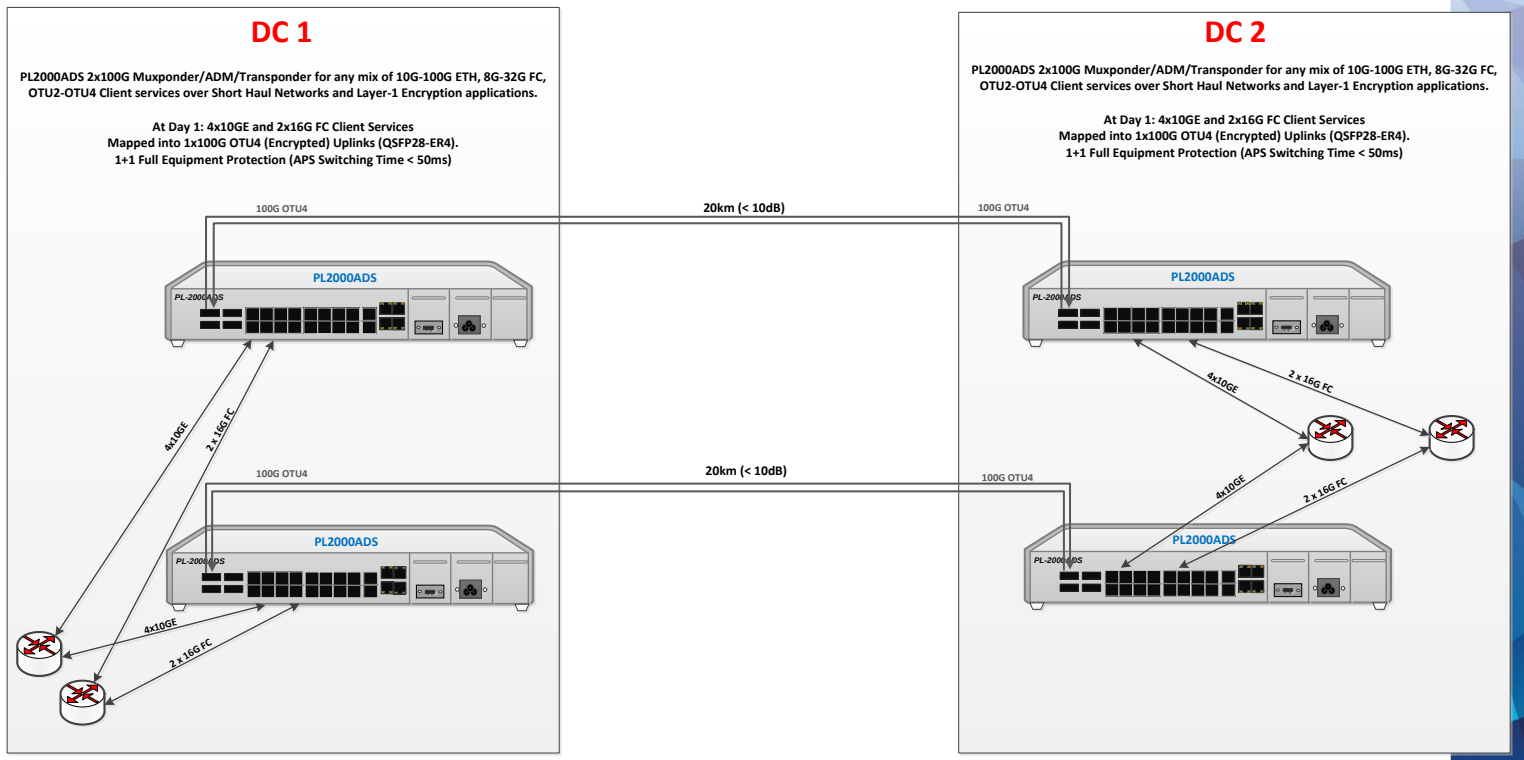
Solution

- Dual PL-2000ADS non-coherent muxponder
- Quick upgrade to 32G FC w/o additional cost
- Encryption per service port or uplink
- Low cost solution

Success!

- Fast turn up of new services
- Low initial CAPEX
- Simple maintenance and support

Where: Netherlands
What: Multi-tenant Data Center
Services: 2x16G FC, 4x10GbE
Distance: 20 km



Case Study: Data Center Connectivity

Challenges

- Encrypt 2 data centers
- Full hardware redundancy with 2 fiber paths
- Scalable to additional 100GbE

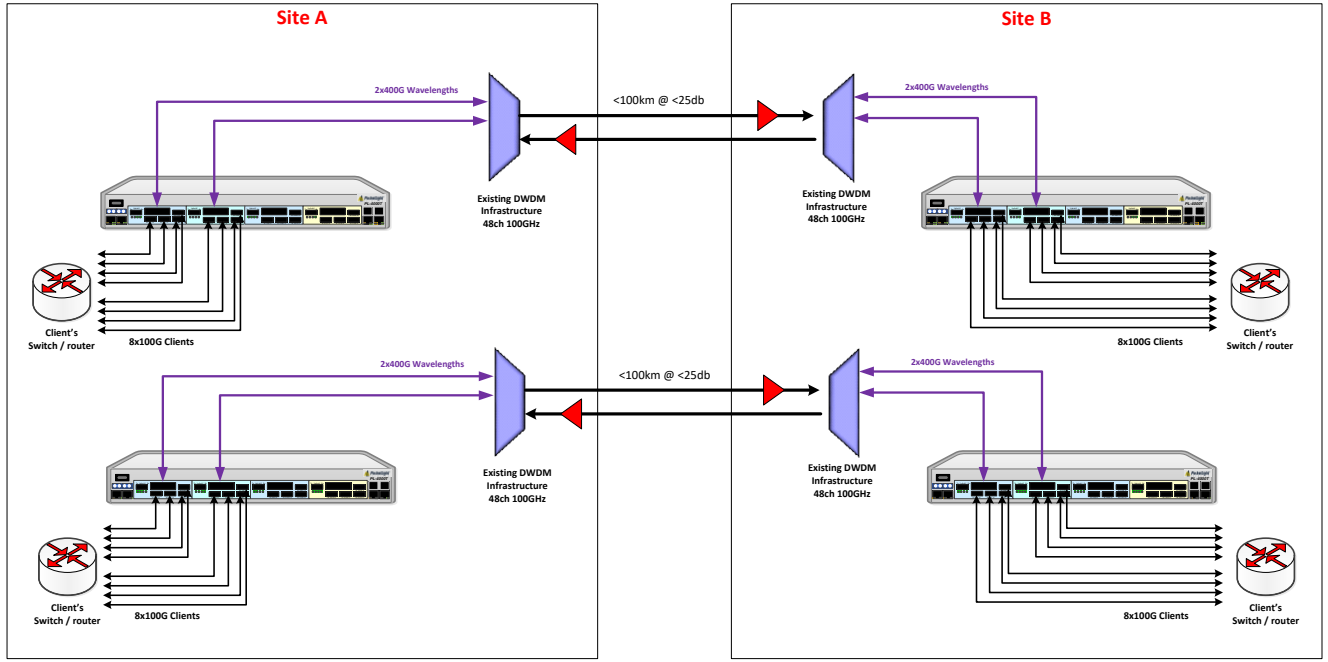
Solution

- Dual transponder solution (PL-4000T)
- Fully redundant
- Encryption per service port or uplink

Success!

- Fast turn up of new services
- Low CAPEX and OPEX
- Scalable
- Simple maintenance and support

Where: Netherlands
What: Single-tenant Data Center
Services: 8x100GbE
Distance: 20 km



Case Study: Redundant/Secured connectivity

Challenges

- Connect 2 DCI's, while protecting fiber paths through 2 fiber paths
- Easy and cost-effective upgrade to 32G FC and 100GbE

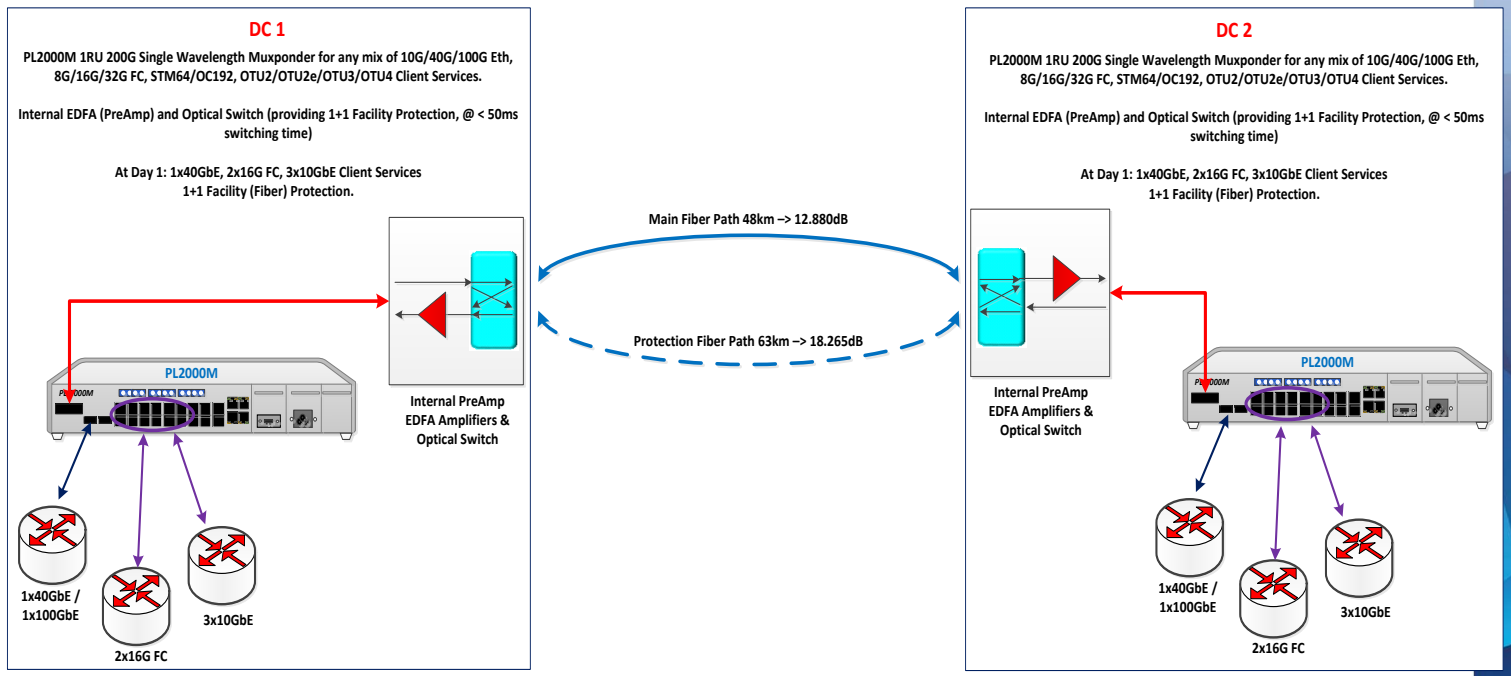
Solution

- Single PL-2000M muxponder at each site
- Quick upgrade to 32G FC, & 100GbE
- Embedded optical switch for fiber protection

Success!

Fast turn up of new services
Low initial CAPEX
Low OPEX
Scalable per customer needs
Simple maintenance and support

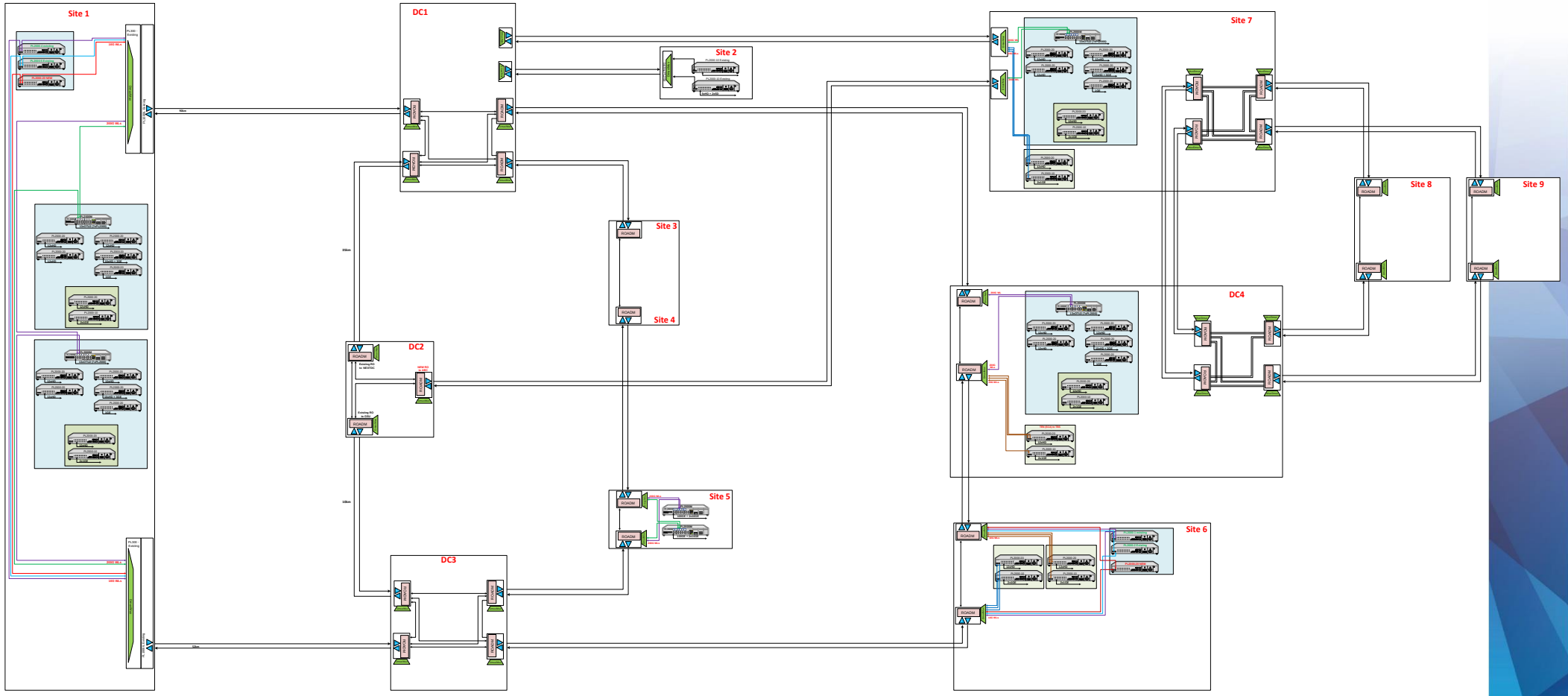
Where: Belgium
What: Single-tenant Data Center
Services: 1x40GbE, 1x100GbE, 2x16G FC, 3x10GbE
Distance: 40 km



MediaHub Australia DWDM OTN 48x200G Backbone

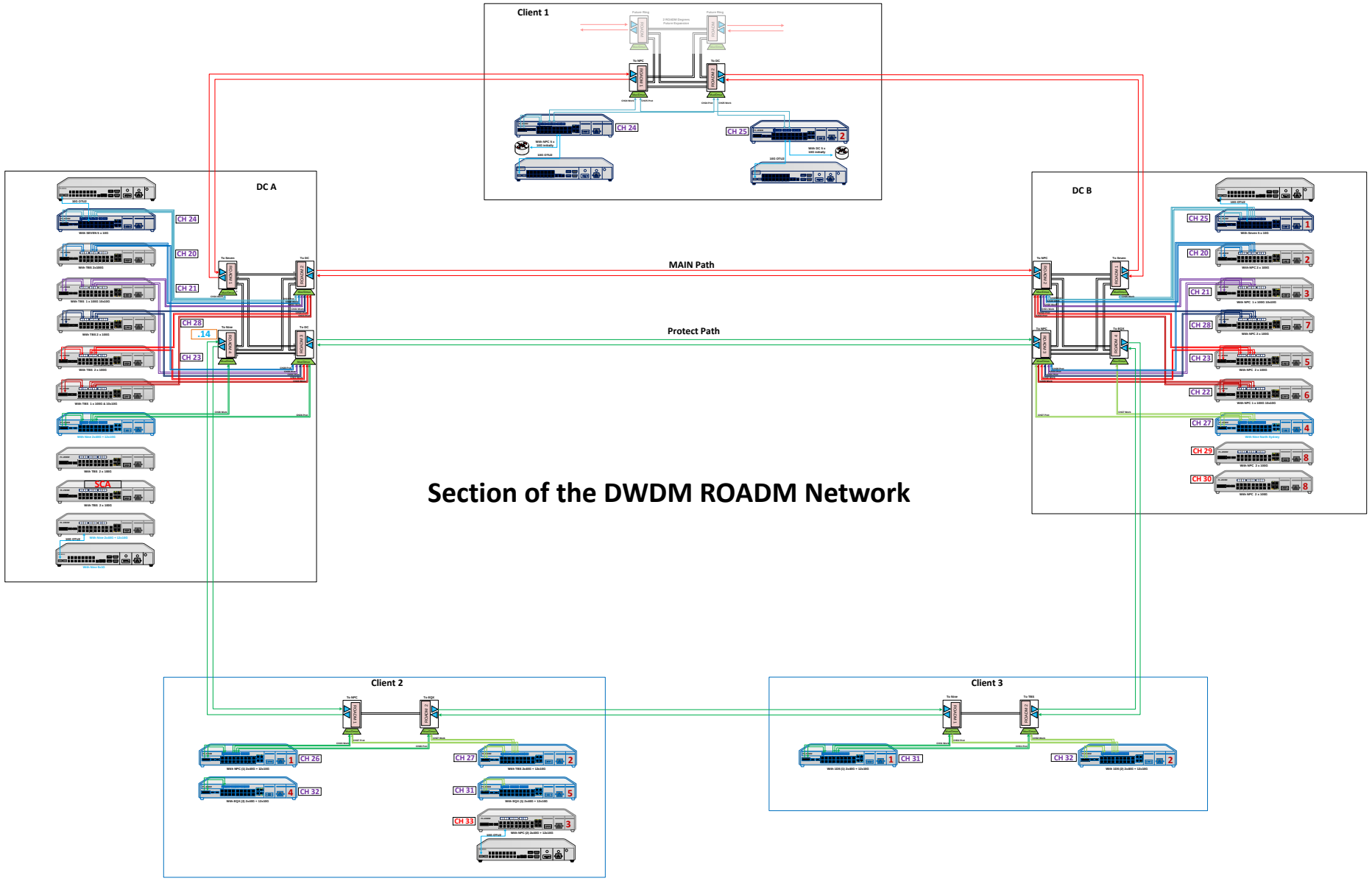
DWDM ROADM OTN backbone across NSW, connecting over 20 sites and transferring over 400 metro and regional TV and Radio channels, live Video feeds, voice, 100G/40G/10G/1G data and 32G/16G/8G storage services over 200G and 10G DWDM wavelengths.

The network is built with PacketLight's PL1000RO, PL1000IL, PL1000TN, PL2000, PL2000M, PL300 devices.



Section of the DWDM ROADM Network

Nine & Seven Networks DWDM OTN 48x200G Backbone



Section of the DWDM ROADM Network

DWDM ROADM OTN backbone across Sydney Metro, connecting Seven's, Nine's Network studios, Playout Centers and Data Centers, transferring live IP Video, 100G/40G/10G data and 32G/16G/8G storage services, and streaming services over 200G DWDM wavelengths.

The network is built with PacketLight's PL1000RO, PL2000, PL2000M, PL2000T, and PL300 devices.

Case Study: Connecting offices to DC

Challenges

- Connect 2 offices to central data center
- Transmit 1 x GbE
- Add more services easily
- CPE equipment – easy to deploy & maintain

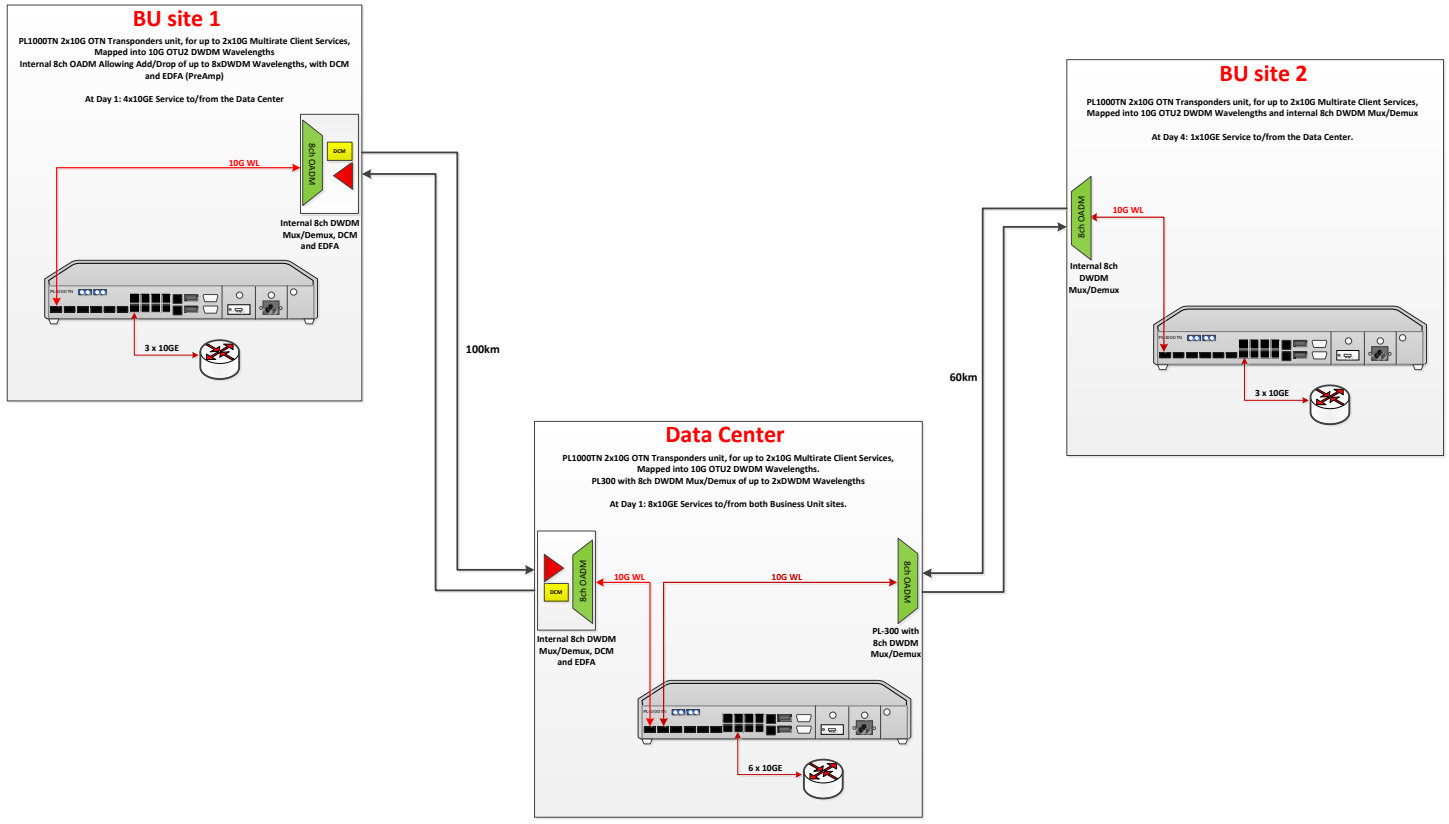
Solution

- Transponder at each site (1 x PL-1000TN)
- Integrated solution - mux/demux & EDFA
- Ready to transmit 1 x 10GbE
- Scalable by adding 2 x 10GbE

Success!

- Low CAPEX and OPEX
- Scalable
- Simple maintenance and support

Where: Belgium
What: Connecting Offices to DC
Services: 3x10GbE
Distance: 100km, 60km



Case Study: Extending Existing DWDM

Challenges

- 32G FC over Existing 3rd party DWDM
- Remote management
- CPE equipment – easy to deploy & maintain
- Full redundancy & encryption

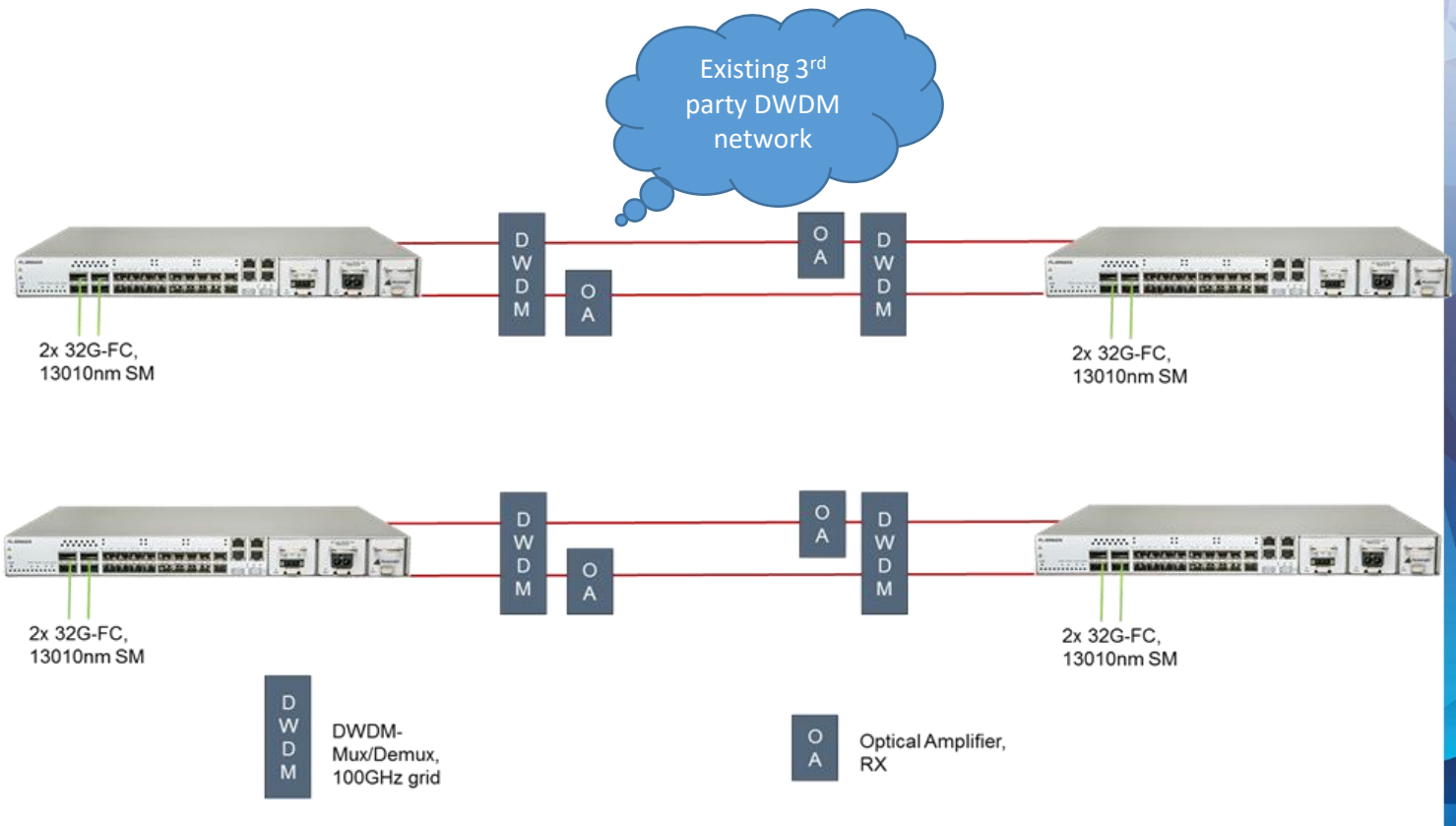
Solution

- Alien wavelength solution (2 x PL-2000ADS)
- 2 x 32G FC, fully redundant
- Use existing 3rd party mux/demux and amps
- Encryption on each FC service

Success!

- Fast turn up of new services
- Low CAPEX and OPEX
- Scalable
- Simple maintenance and support

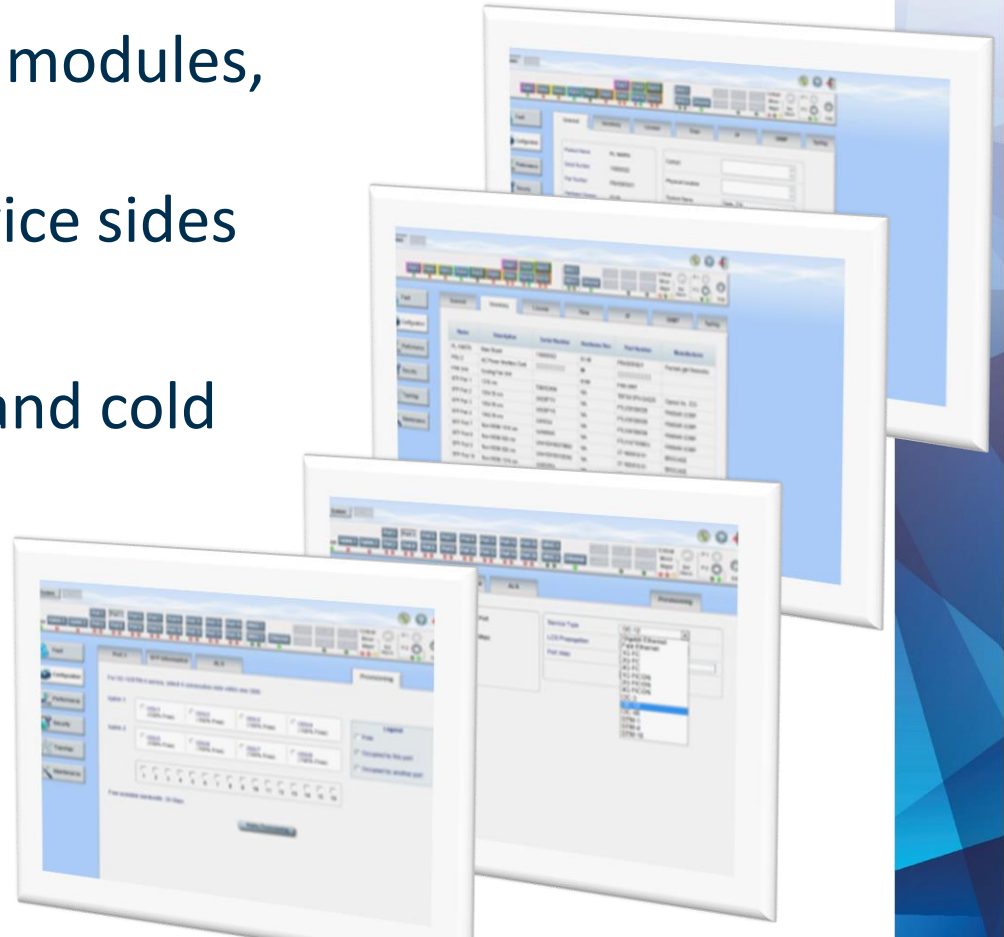
Where: Germany
What: Multi-tenant DC
Services: 4x16G FC, Encrypted
Distance: 40 km



EMS/NMS and GUI

Web-based Management System

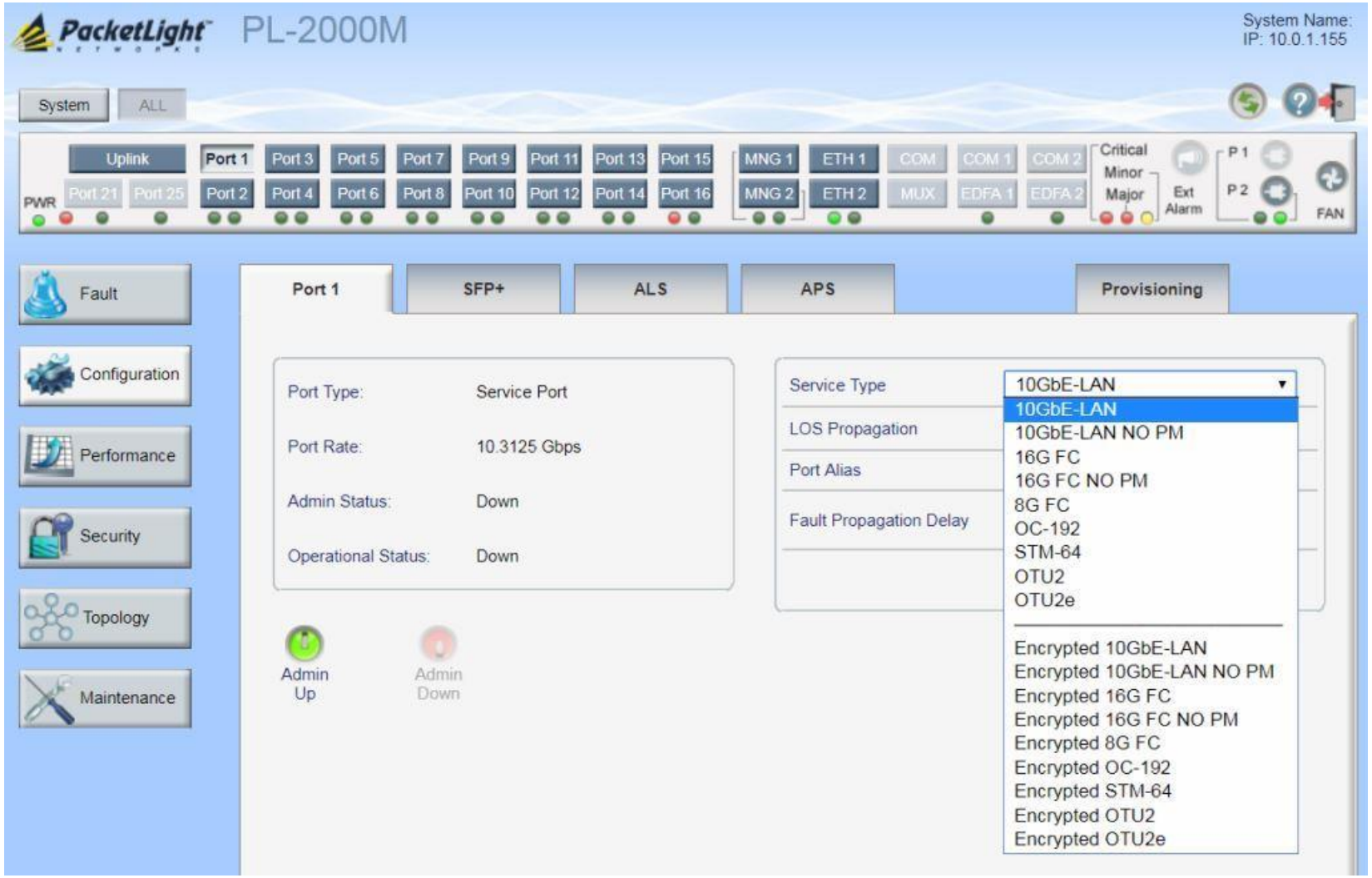
- Web-based management system
- Simple common configuration process for all product families
- Provides performance monitoring for all optical modules, Client (service) types and Line (uplink)
- Built-in troubleshooting tools both link and service sides
- Network topology view
- Maintenance services with, SW download, hot and cold restart
- Full alarm and event history, and activities log
- No extra licensing or server cost



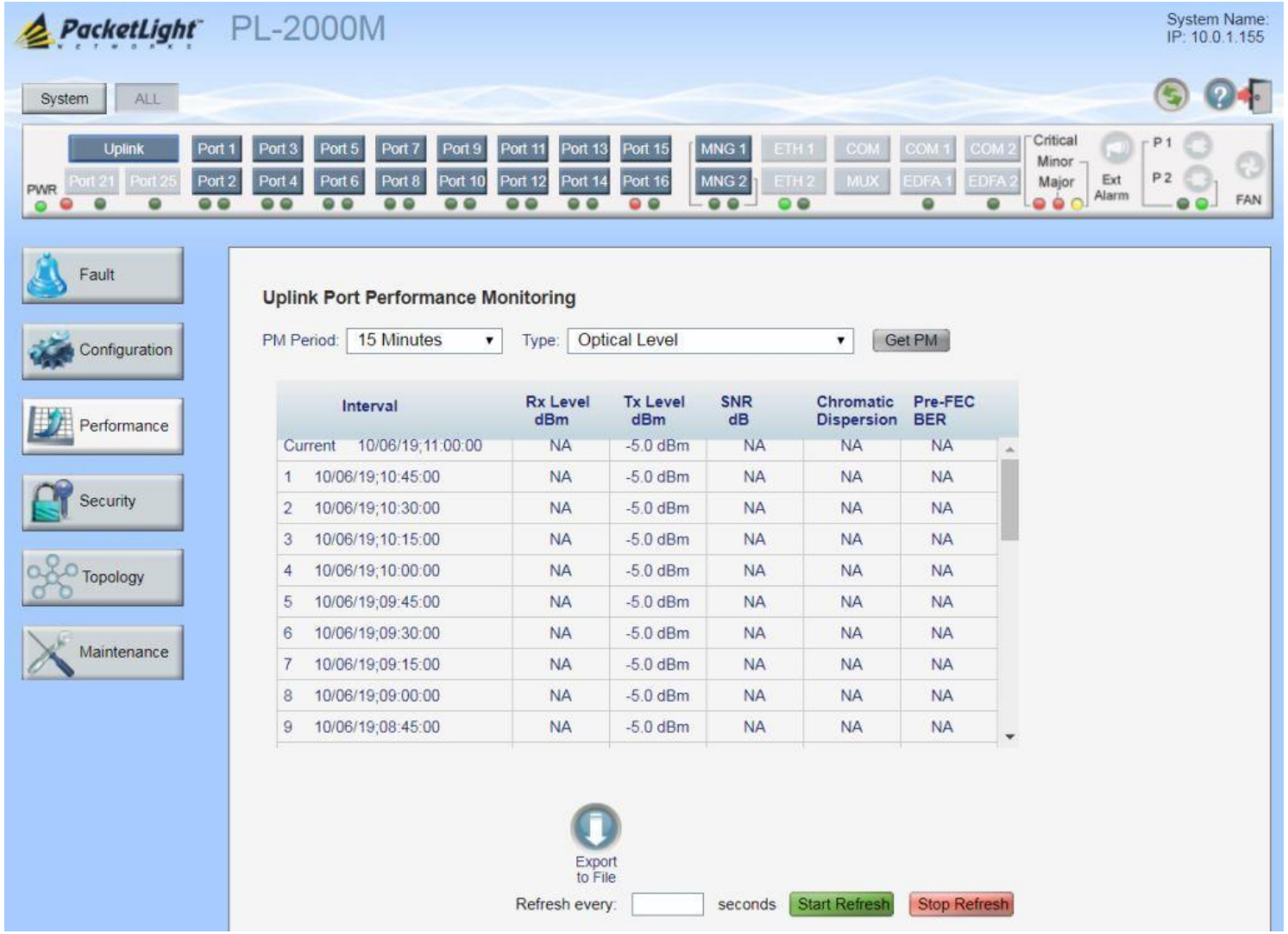
PL-2000M Uplink Configuration

PL-2000M Uplink CFP2 Configuration

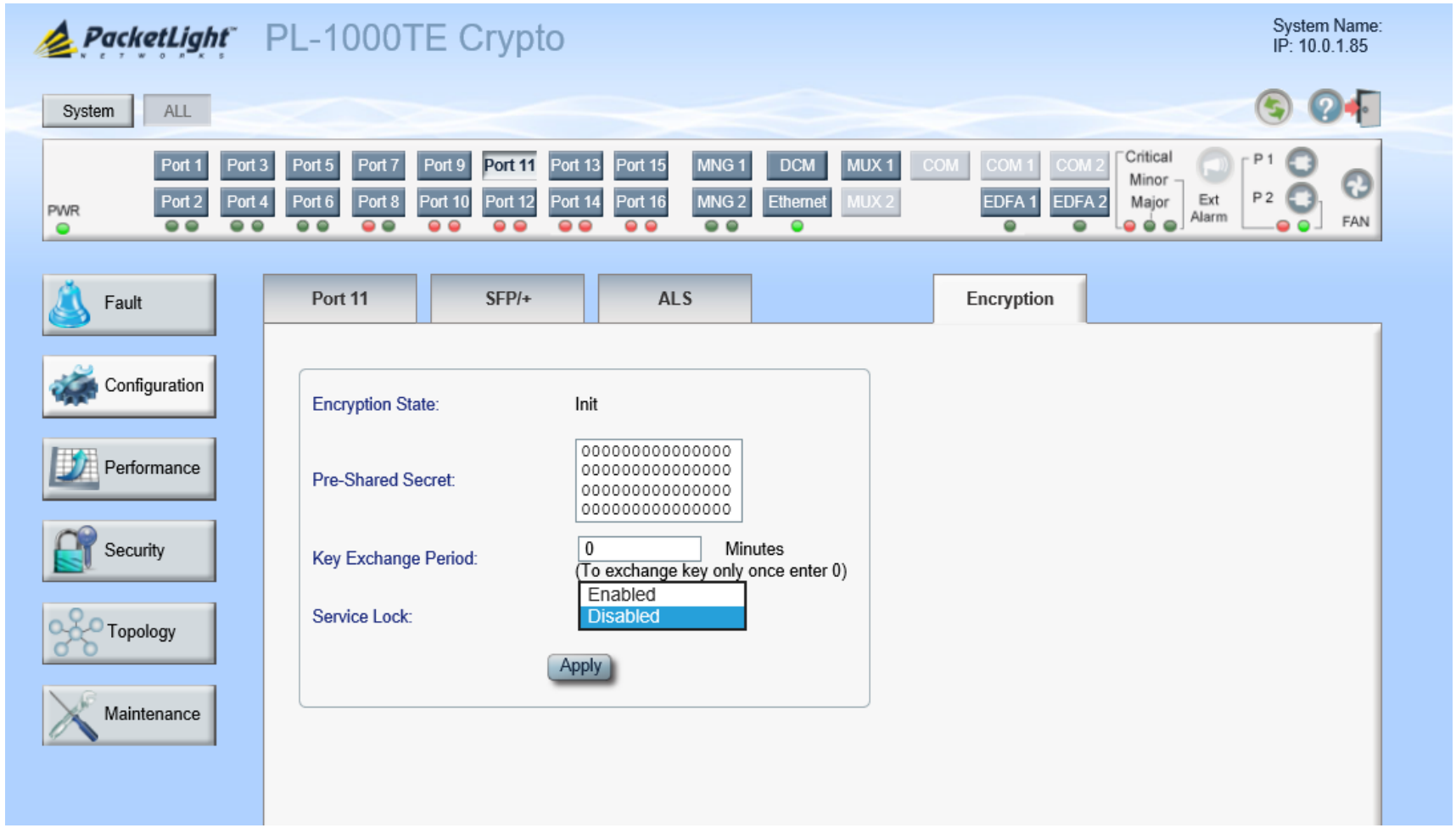
PL-2000M Port Configuration



PL-2000M Uplink Performance Monitoring

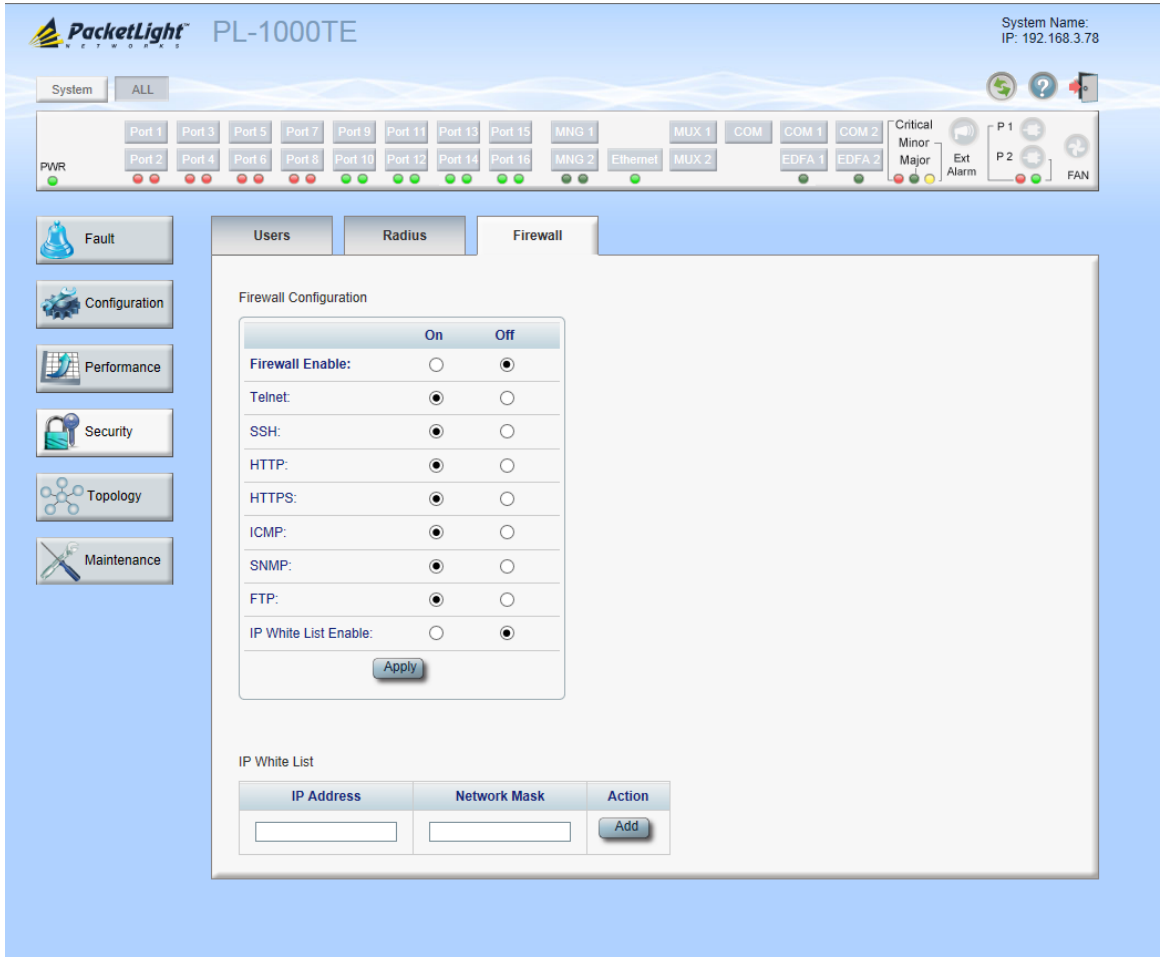


Encryption Configuration

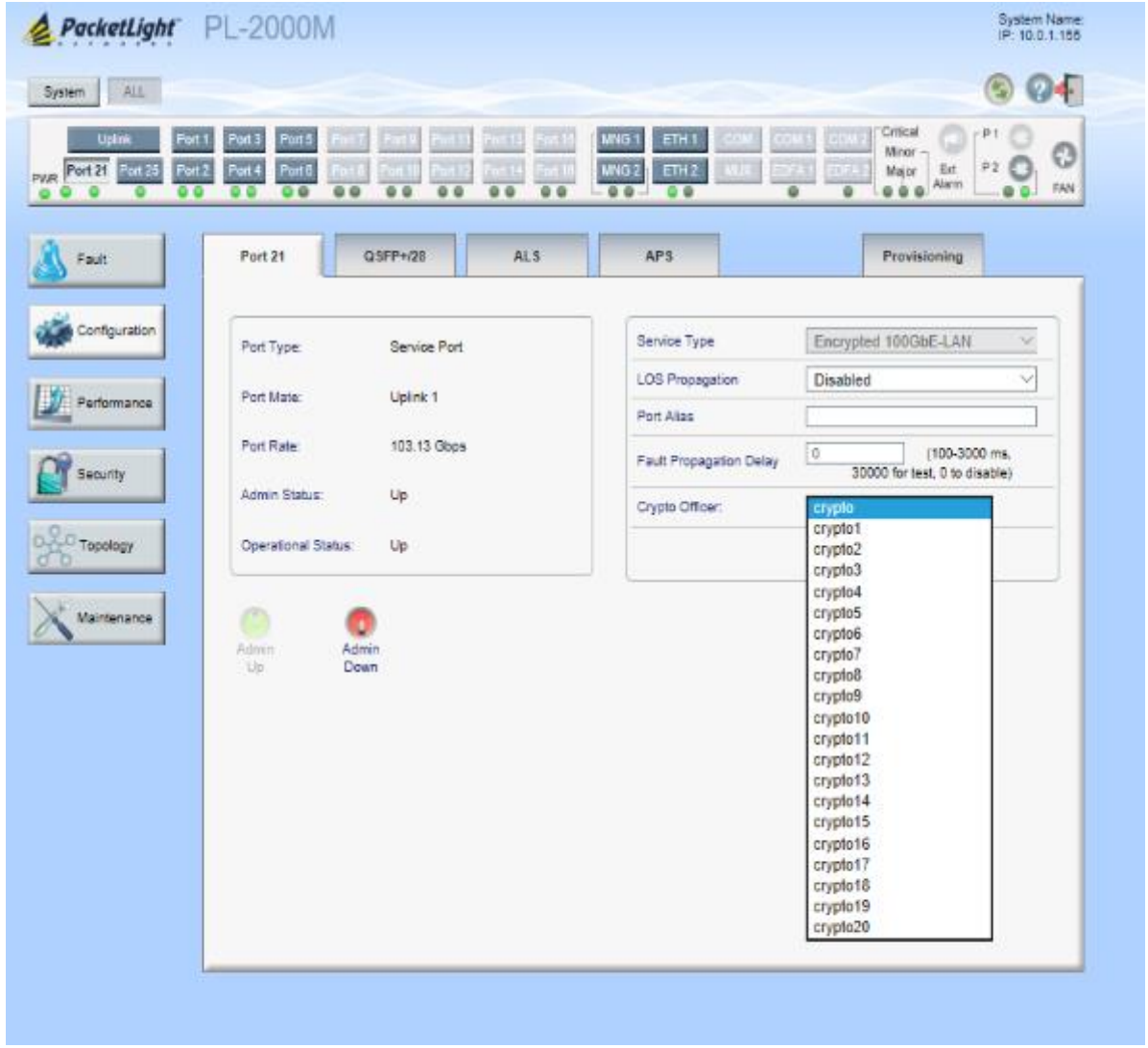


Firewall

- Built-in firewall allows blocking of any selected IP address or protocols.

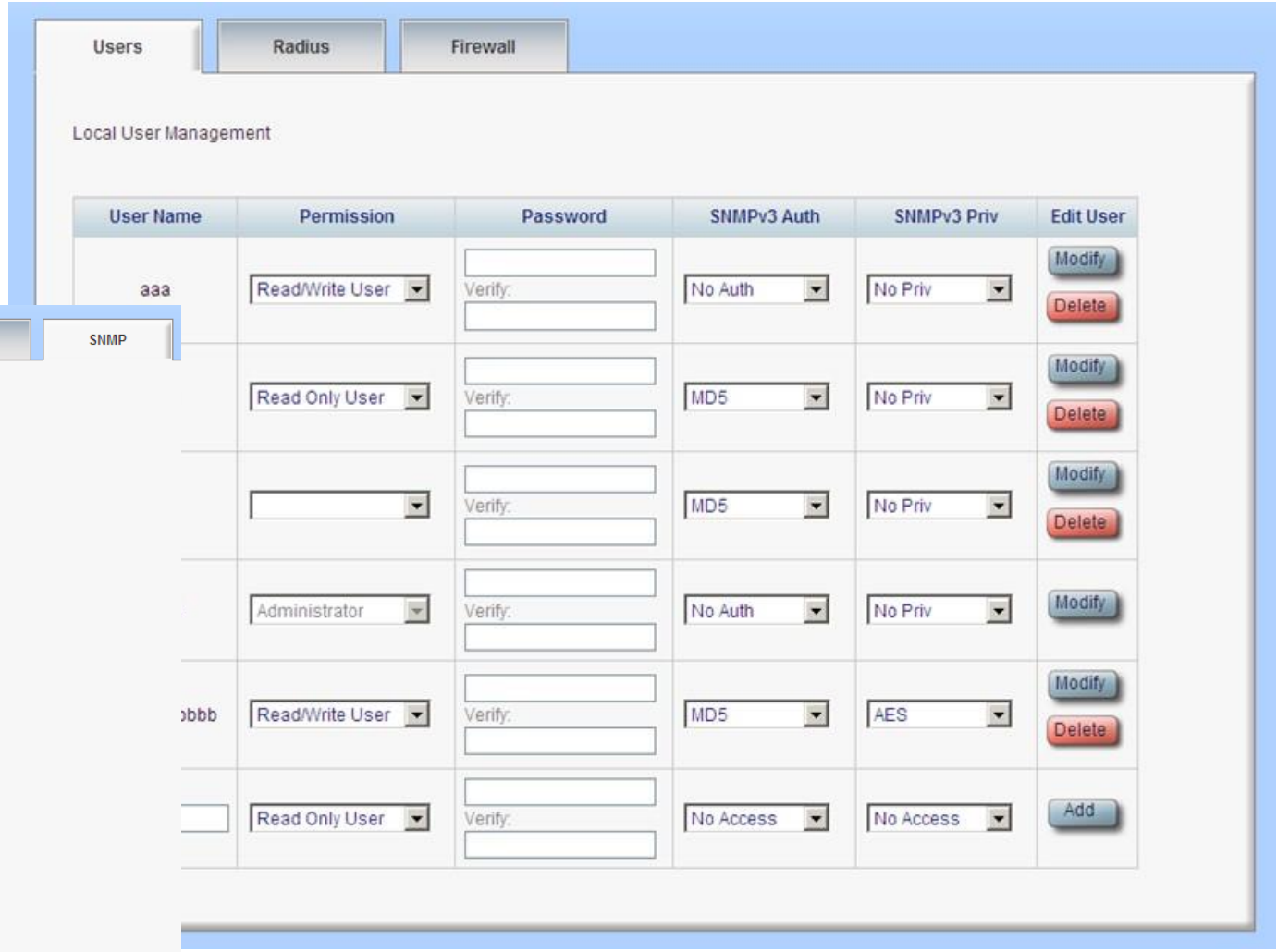


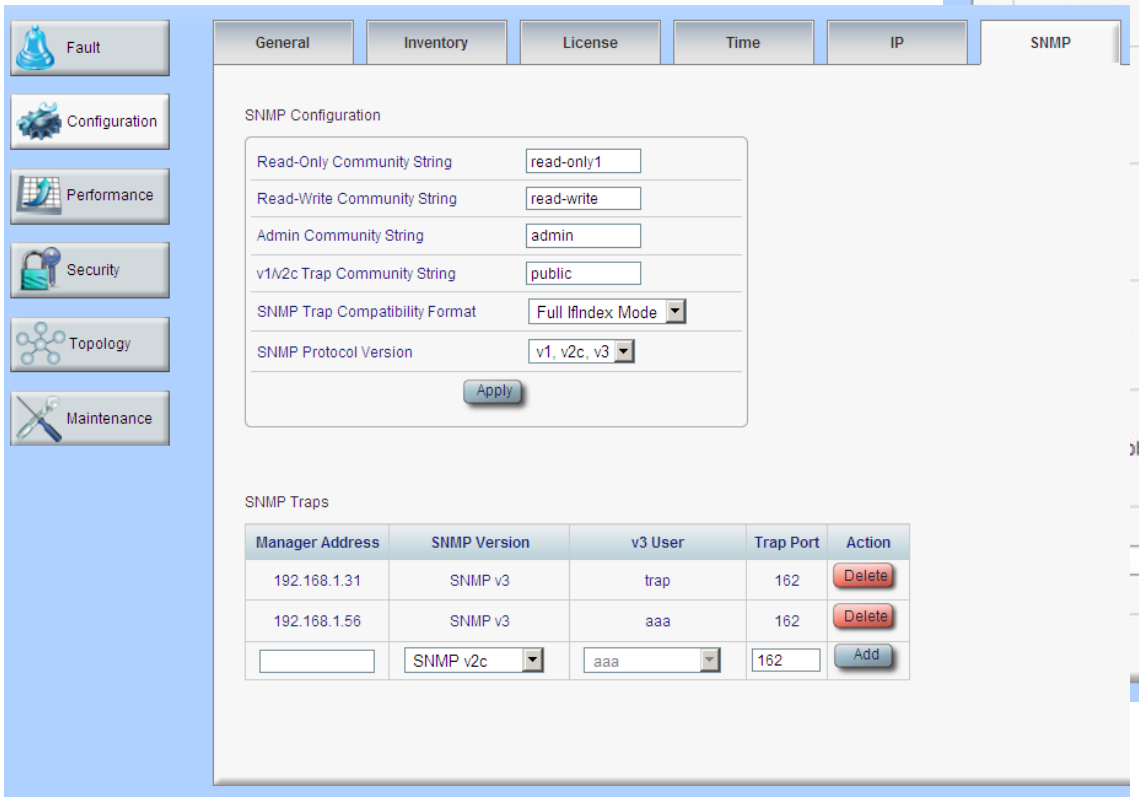
Multiple Crypto Officers



Management Security

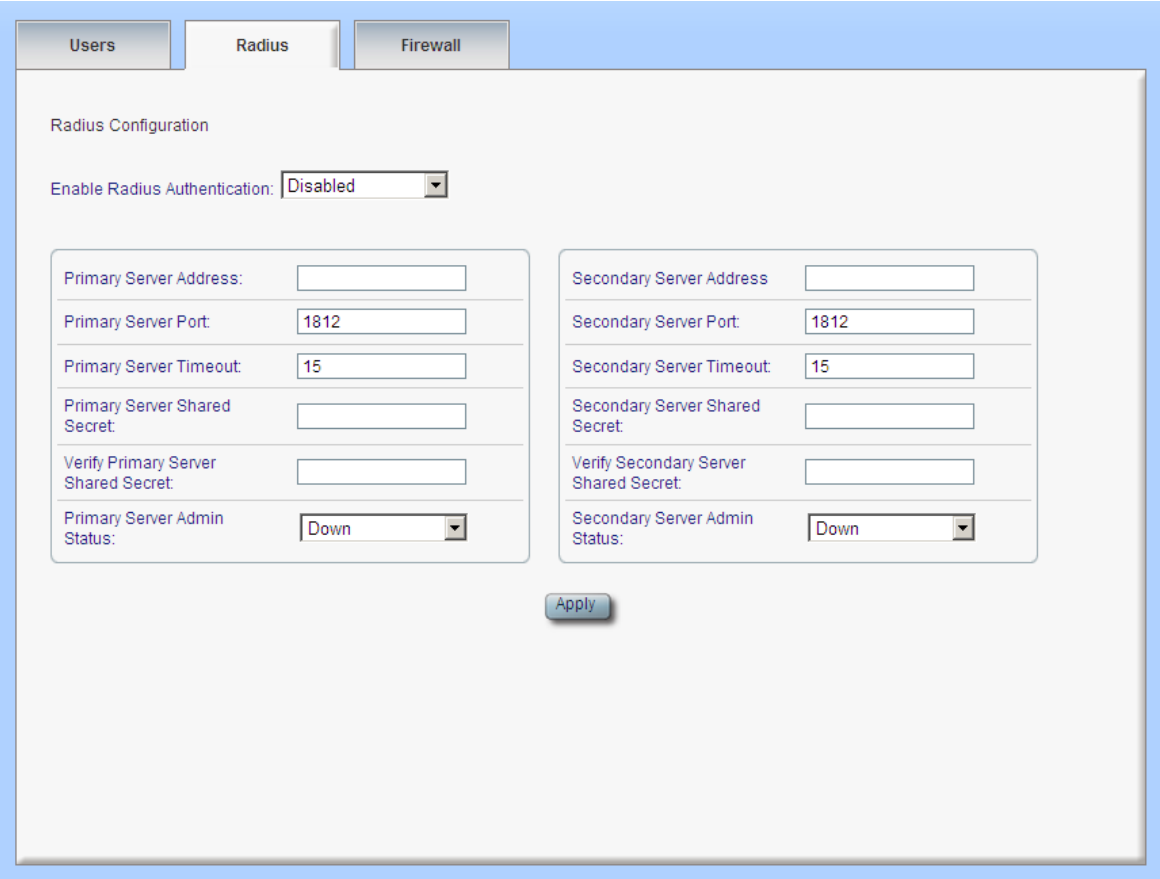
- HTTPS – Secured HTTP
- Support SNMPv3
- SSH - Secured Shell (telnet)





Radius

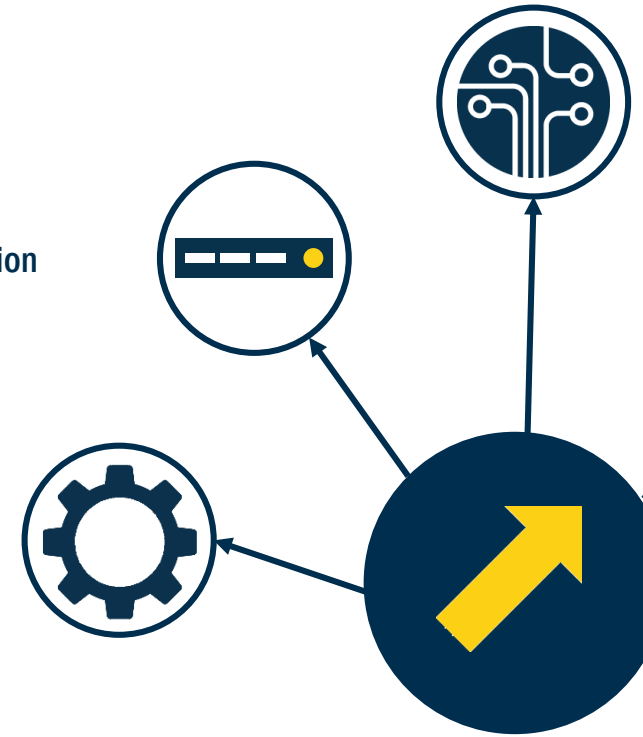
- Radius for centralized user management is supported
- Up to two Radius servers are supported for protection



PacketLight Advantages

The Technology
- State-of-the-art WDM technology
- Carrier grade features
- All building blocks for any WDM solution
- Advanced security and encryption
- Adding features per customer needs
- Flexible mix of services
- Low latency

Size
- Saves rack space
- Lower power consumption



Support
- Support from RFP to post-sale
- 24x7 technical support

Ease of Use
- No need for a WDM expert
- Easy to Install, maintain and configure

Fast ROI
- Minimal initial investment
- Maximum future growth
- Tailored to customer needs

PacketLight™ NETWORKS

20 Years of Technology Excellence