

Native Packet Optical

PL NOG , Warszawa 16 03 2011

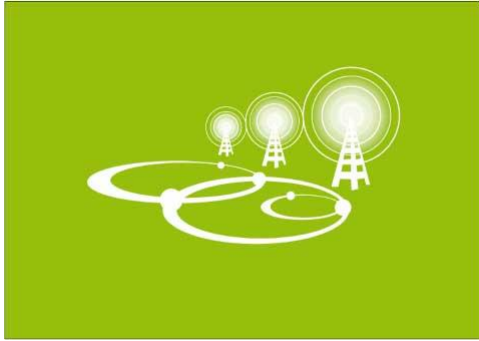
Robert Bondarenko
Country Manager POL, CZ, SK
Jarosław Kucio
Solution Manager EE

Transmode in a nutshell

- Founded 2000; headquartered in Stockholm
- Major investors include
 - POD Holding, Amadeus, Harbourvest, European Equity Partners.
- Core competence in Optical Networks
 - WDM (Wavelength Division Multiplexing)
 - Metro Networks (incl. Core, Regional & Metro Access)
- Providing solutions for
 - triple-play backhaul for dsl and CATV
 - mobile backhaul, broadband backhaul
 - Ethernet, SAN, SDH/SONET transport
- Sales
 - 2006 378M SEK (\$56M/€41M)
 - 2007 459M SEK (\$68M/€50M)
 - 2008 607M SEK (\$89M/€66M)
 - 2009 570M SEK (\$75M/ €54M)
- Profitable since 2007
 - Strong balance sheet
 - No debt



Transmode support all major applications



Mobile Backhaul



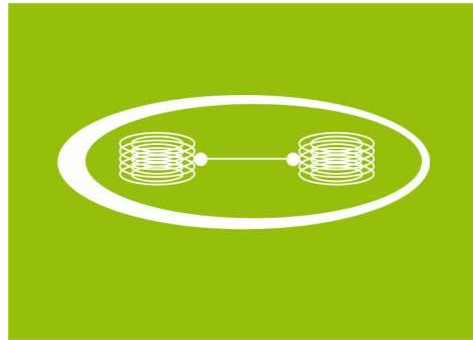
Broadband Backhaul



Business Ethernet



CATV Backhaul



SAN Solutions



Core Networking



Transmode Portfolio

TM-series

CWDM and DWDM for Carrier Class metro networks



TM-Series chassis

- **Metro/Access & Regional Networks.**
- **Multi-Service** and Multi-Reach platform supporting from few km to >1500km
- Seamless integration of **CWDM** and **DWDM** and single fiber solutions giving highest utilization of existing fiber infrastructure
- **Layer 2 and Layer 1** in one combined solution for Carrier Ethernet capable metro networks

TS-series

CWDM and DWDM for enterprises and smaller ISPs

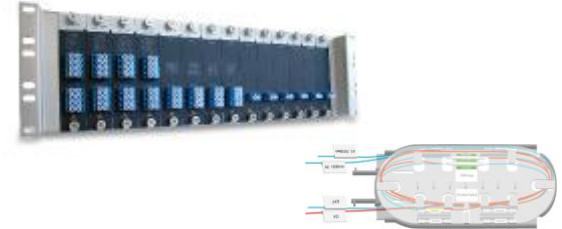


TS-Series chassis

- **Active & passive equipment for Metro/Access Networks.**
- Modular architecture allowing pay-as-you-grow
- Small and compact system with low power consumption
- Easy to install – easy to use through robustness and true plug and play
- Highly scalable in size and functionality

TG-series

Passive optical CWDM for improved efficiency in large networks



TG-series chassis

- Reducing the number of active aggregation locations lowering operational costs and power consumption
- High port density for small footprints
- Robust solution for tough environments
- Flexible upgrade of capacity per customer through passive filters
- Up to 100km reach from core handover down to DSLAM/CPE

Common Management system and Customer Service

TM-series

CWDM and DWDM for Carrier Class metro networks



TM-Series chassis

TS-series

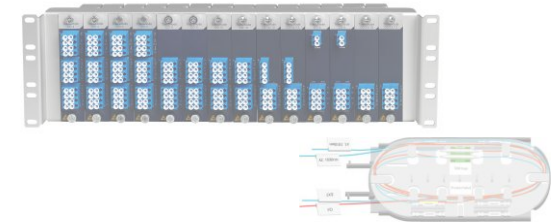
CWDM and DWDM for enterprises and smaller ISPs



TS-Series chassis

TG-series

Passive optical CWDM for improved efficiency in large networks



TG-series chassis

TNM – Transmode Management System

a cost-effective and Carrier Class network manager for Transmode's optical network

- Reduces operational expenses through centralized OAM and timesaving features
- Supports end-to-end service management through topology awareness and capability to correlate optical circuits with performance and fault information
- Provides easy integration with higher order management systems

Supported by Transmode Customer Services

References in Poland



EXATEL



upc



- ✓ **EXATEL**
- ✓ **CWDM & DWDM series TS &TM**
- ✓ **More than 200 nodes**

- ✓ **UPC**
- ✓ **Country Backbone 40CH, Dual and Single fiber DWDM TM systems**

- **ATM**
- ✓ **DWDM TM North Poland Backbone, CWDM from TS series**

- **Hawe**
- ✓ **DWDM TM East Poland Backbone, 40CH**

- ✓ **Vectra**
- ✓ **Single/dual fiber DWDM TM systems**

- ✓ **ZEB, ZKE, ZEORK**
- ✓ **CWDM system series TM, TS**

- ✓ **ZEP TECH**
- ✓ **DWDM backbone application**

- ✓ **BRE Bank**
- ✓ **Integrated solution using C/DWDM with TM & TS elements**

- **TKP**
- ✓ **CWDM system**

- **NASK, KPSI**
- ✓ **TM series platforms**

Today, we have more than 300 customers in all segments

Cable Operators



Mobile Operators



Utilities



Alternative Service Providers



Incumbent Operators



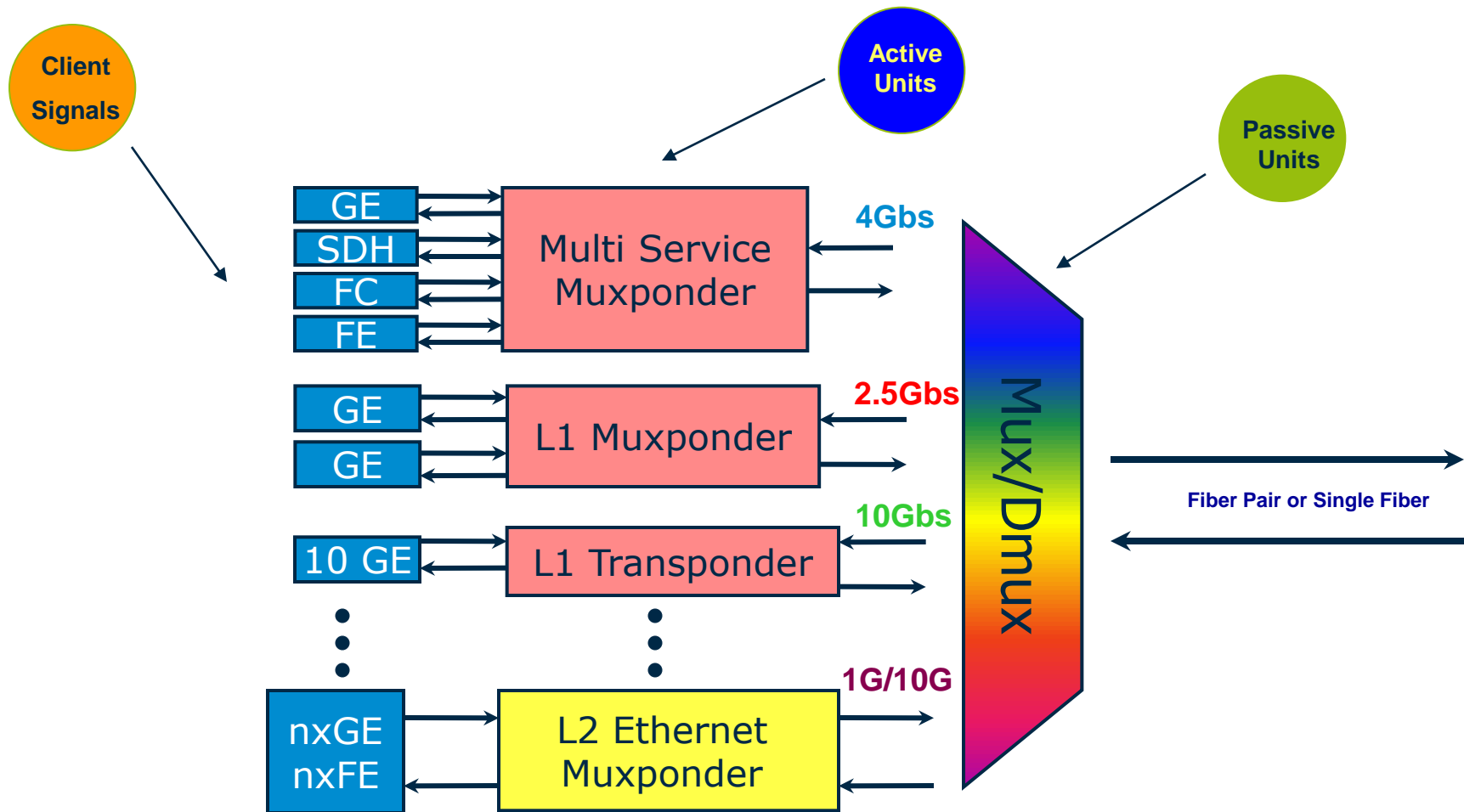
Enterprises



Po co to robimy ?

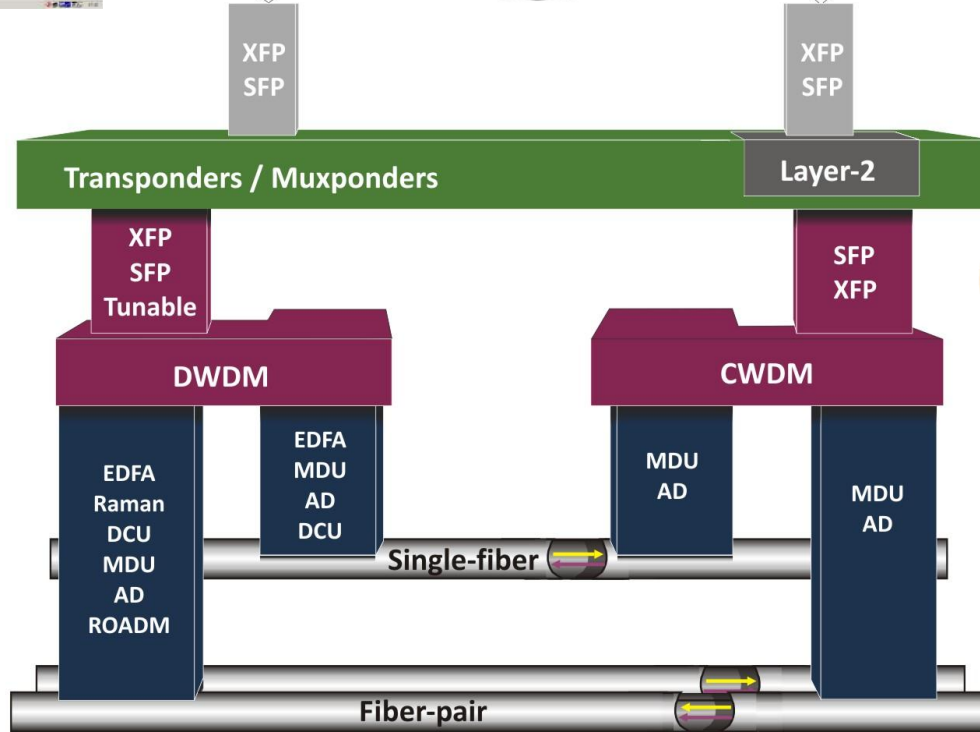
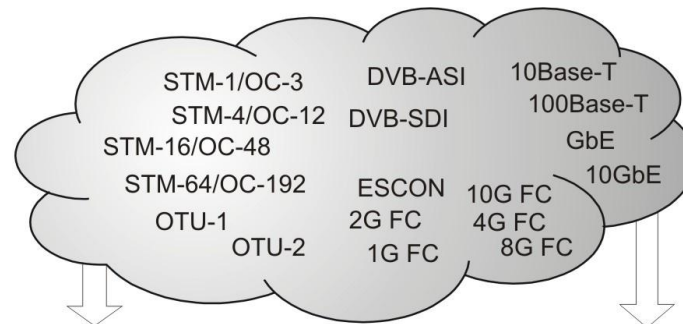
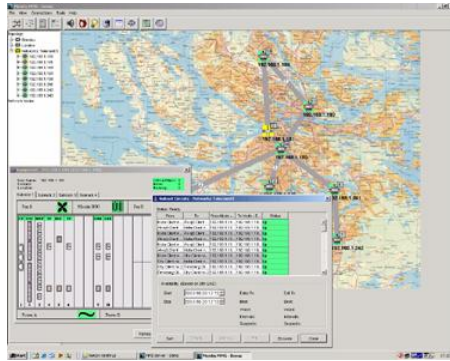
- **aby przesłać więcej światłowodem**
 - różne sygnały (GbE, SDH, FC, ...)
 - jedno włókno / różne systemy
- **aby przesłać dalej światłowodem**
 - specjalistyczna optyka, wzmacniacze, pompy, kompensacja dyspersji
- **aby zagregować ruch przed zajęciem pasma**
 - TDM (multipleksacja GbE, FC, SDH, E1)
 - L2 (ingress traffic control, L2 aggregation)

System Design xWDM

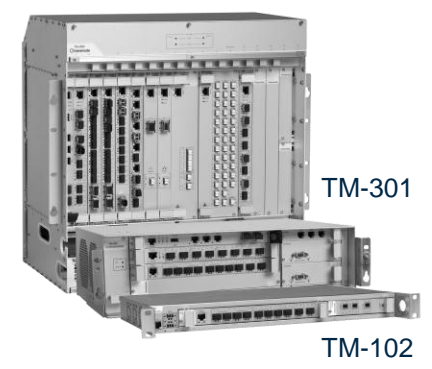


- Multiplexing of lower data rates into separate channel makes the transmission capacity of xWDM system fully utilized

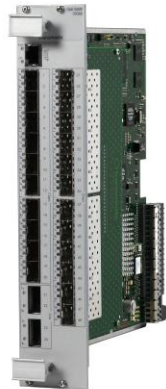
TM-Series, General Structure



LOW POWER DESIGN



Transponders / muxponders / CPUs



- **Transponders (iWDM, SDH/SONET, OTN)**
One client signal per line wavelength.
Line rates; 2.5G, 4G, 8G, 10G, 40G (100G Dec 2011)
- **Muxponders (iWDM, SDH/SONET, OTN)**
TDM-multiplexing of up to 10 clients per line wavelength
Line rates; 2.5G, 4G, 10G, 40G (100G Dec 2011)
- **Ethernet Muxponders, EMXP's**
Native Ethernet Aggregation/switching
Line rates; FE, GbE, 10GbE-LAN
- **Ethernet Demarcation Units**
CPE devices with advanced Layer-2 functionality (e.g. MEF)
Line rates; FE, GbE
- **MultiService Mobile Access**
Unique solution for E1/T1 and Ethernet transport
Line rates; 2.5G (4G April 2011) between Access unit & Hub

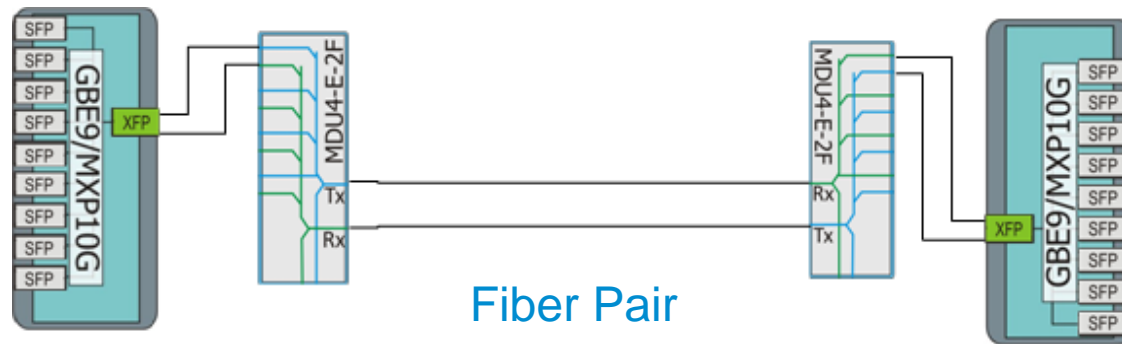
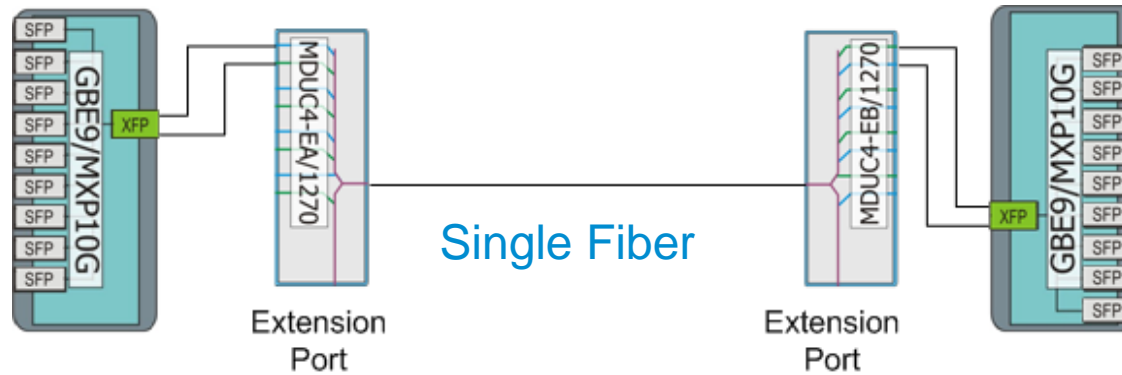
Layer-1 Transport

Making light make sense

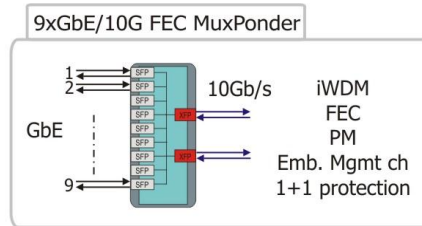
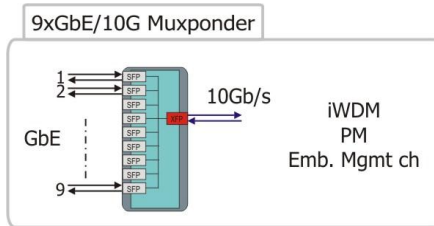


How to transport $n \times$ GE on one or two fibers ?

9xGE over single/dual fiber



Layer-1 Muxponder Units for 1GbE services



9xGbE/10G MuxPonder

- 9x GbE (TDM multiplex)
- iWDM framing
- Line rate equal to 10GbE-LAN
- Full, transparent GbE pipes
- XFP on Line, SFP on Clients
- Embedded Management channels
- PM 15min/24h G.826
- GbE utilization
- Client loop-back (far-end)

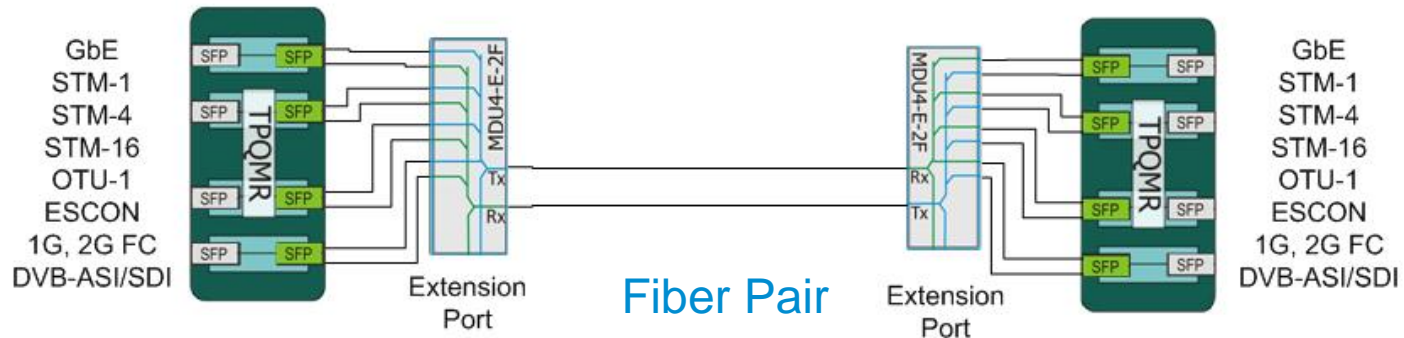
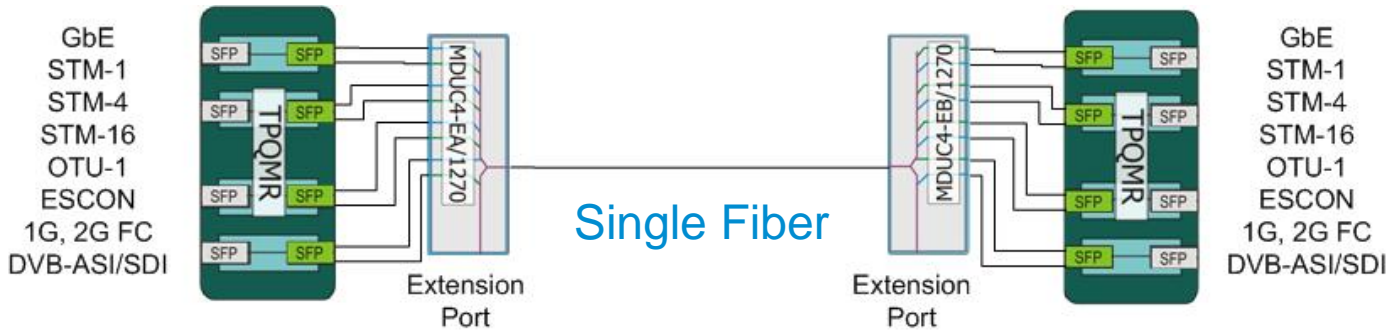
9xGbE/10G FEC MuxPonder

- 9x GbE (TDM multiplex)
- iWDM framing
- Dual Line ports
- FEC coding
- 1+1 Line protection
- Full, transparent GbE pipes
- XFP on Line, SFP on Clients
- Embedded Management channels on line ports
- VLAN management support in client ports
- PM 15min/24h G.826
- GbE utilization
- Client loop-back (far-end)



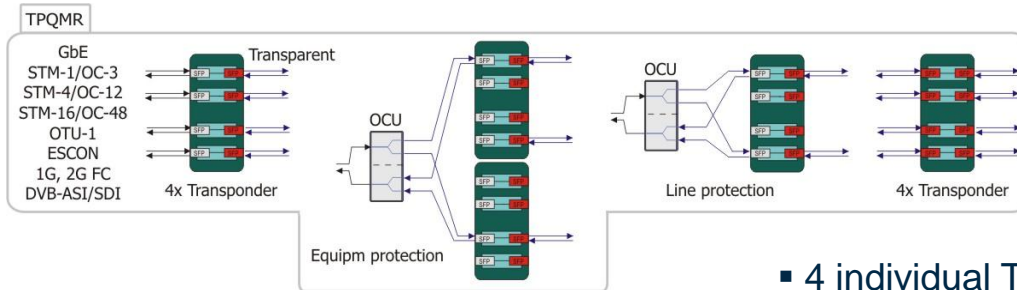
Key characteristics: Transparent transport , High capacity, 1+1 protection, long reach Applications; GbE backhaul, wholesale

4xAny over single/dual fiber



Layer-1 MultiService Traffic Unit

Quad MultiRate Transponder



Data and sync Transparent Transport of

- STM-1, -4, -16
- OC-3, -12, -48
- GbE, 100Base-T
- DVB-SDI, DVB-ASI
- 1G FC, 2G FC, ESCON

IBM System Storage Proven



- 4 individual Transponders, CWDM/DWDM
- Automatic protocol recognition
- Transparent 100Mb/s to 2.7Gb/s
- Optical reach up to ~800km in amplified DWDM networks
- 40/80km CWDM SFP's
- No mgmt channels
- Basic PM 15min/24h G.826
- Supports client/equipment protection

Key characteristics: Cost-efficient, transparent transport of multiple services Applications; Whole-sale, DSLAM backhaul, Access networks etc



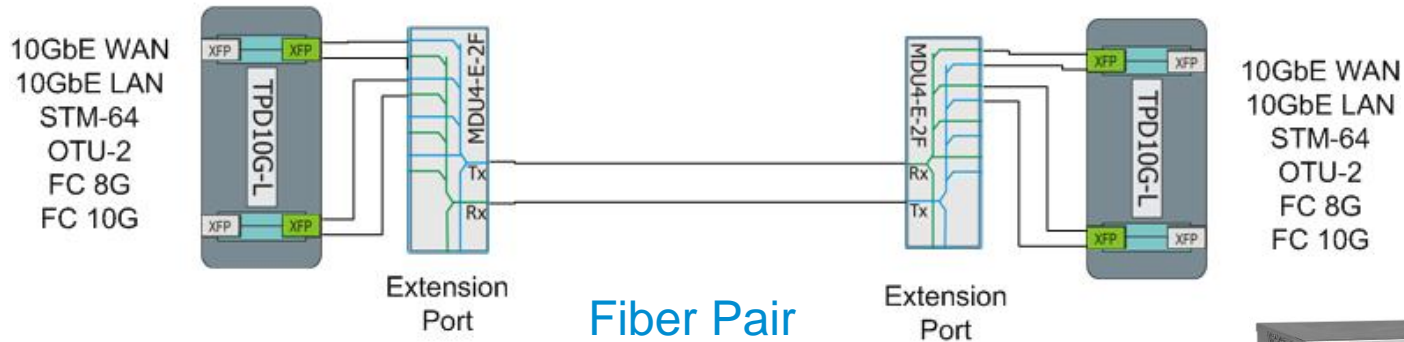
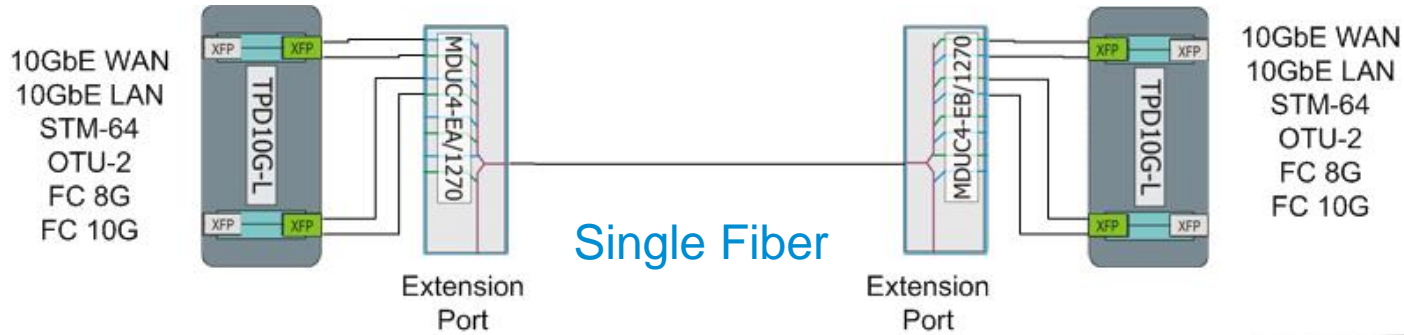
- BNC-SFP for
- DVB-SDI (270Mb/s & 1,485Gb/s)
 - DVB-ASI (270Mb/s)



SFP with BNC connector

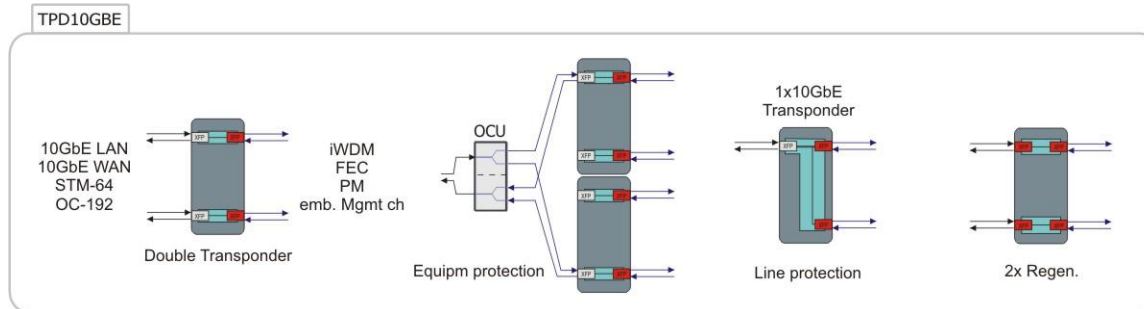
DIN 1.0/2.3 & BT Type 54 cable connectors. STM-1 electrical interface G.703, ES1, CMI encoded signal

2x10G over single/dual fiber



Layer-1 Traffic Unit for 10Gb/s services

Double 10G FEC Transponder



Two traffic images:

1. Two individual Transponders with FEC on line
2. Two regen Transponders

Features:

- 10GBE-LAN/WAN + STM-64/OC-192 clients
- Equipment protection (<20ms)
- 1+1 Line prot (<20ms)
- Long-haul capabilities via FEC
- iWDM framing giving embedded mgmt channels and PM
- PM 15min/24h G.826
- Client Loop-back (near/far-end)
- XFP on Line & Client



Key characteristics: MultiService, MultiApplication 10G Transponder, FEC Applications; Long-haul transport of 10G Ethernet & SDH/SONET Services

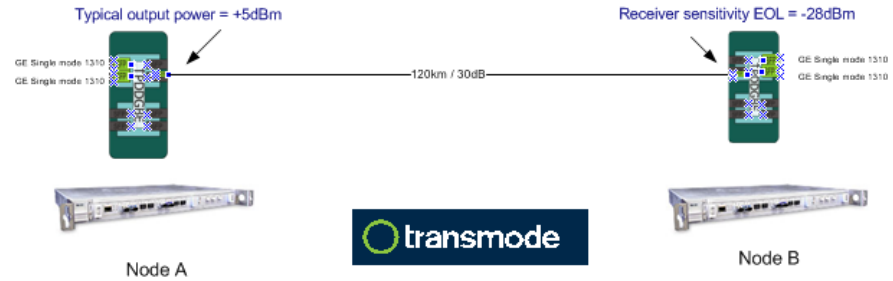
TRANSMODE & NEC DWDM IMPLEMENTATION FOR VECTRA IN POLAND

REQUIREMENTS

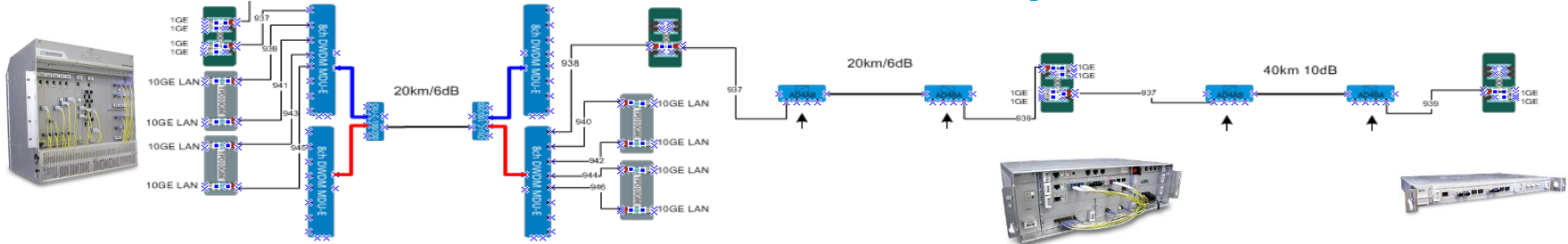
- Single Fiber DWDM
- 4/8/16 channel DWDM System
- 9xGE, 2xGE and 10GE services
- Installation Services
- Technical Support

OFFERED EQUIPMENT

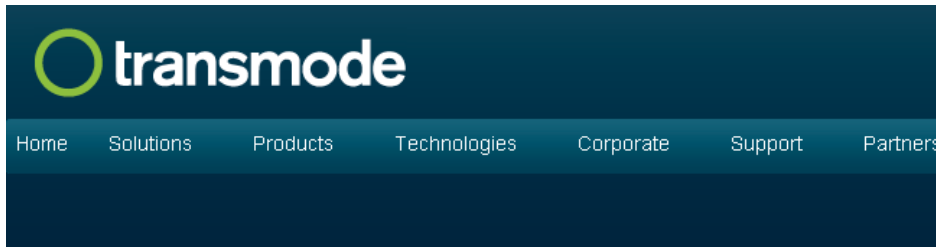
- **DWDM LAYER :** TRANSMODE TM-3000 / TM-301/TM-102
- **Management System**
Transmode TNM/ENM



Single Fiber Solution



Also Enterprises demand higher capacity



Virgin Media Business answers need for speed with launch of 10Gbit/s point-to-point services

Virgin Media Business today announced that it is bringing faster, stronger and better communications to the doorstep of businesses by upping the speed of its Ethernet Extensions and High Capacity Services. The enhanced point-to-point services will give organisations access to dedicated connectivity which has the capacity to move gigabits of information at lightening fast speed.

Dedicated High Capacity Services is a point-to-point service that can support up to 40 x 10Gbit/s circuits between two sites. Able to cope with massive volumes, the service provides a connection that ensures low latency transmissions and provides the most advanced connectivity across multiple protocols in the business-to-business telecoms market. It is ideal for public sector and financial services organisations that rely on guaranteed service uptime to transfer critical data.

Alongside this, the enhanced 10Gbit/s Ethernet Extension Service is all about simplicity. As a dedicated link across the Virgin Media Business fibre network, customers can connect multiple sites up to 35Km apart and easily integrate their equipment at the other end. Like High Capacity Services, Ethernet Extensions are proactively managed by Virgin Media Business. Wholesale customer organisations can order Ethernet Extensions online via the company's customer portal.

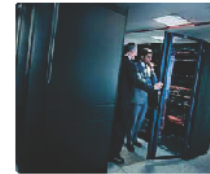
"Businesses are facing a tsunami of data that needs to get from A to B without delay. Data volumes are only going to increase, as is the demand for instant, faultless communication. In today's business world, time is not a luxury that organisations have," said Mark Heraghty, managing director, Virgin Media Business. "Our superior connections have been designed for applications that are bandwidth-hungry and time sensitive.



Datasheet
Site to Site Connectivity

High Capacity Services

Handling the big stuff



Your business relies heavily on the network and its ability to tackle seriously high levels of data traffic. It has to work all day, every day, even though gigabits of information are being moved every second. And a lot of that information hasn't got time on its side. It has to get from A to B right now.

All of this would be easier to do with a super-fast, always-on fibre-optic network. A lifeline that's able to cope with massive volumes, multi-protocol connectivity and low-latency transmissions.

That's where our High Capacity Services come in. Our solutions have been designed for Storage Area Networking, WAN environments and other data transmission needs where bandwidth-hungry and time-sensitive information is involved.

You also won't have the eye-wateringly high cost of installing and maintaining your own network. And with our High Capacity Services, you'll always have the latest and greatest technology capability. Put simply, no matter how much the world's data technology advances, you'll be right there, keeping up.

High Capacity. Higher Productivity.

Our High Capacity Services are ideal for businesses that handle huge amounts of data, and where low latency is an absolute must. The benefits can be used on various kinds of business solutions, including:

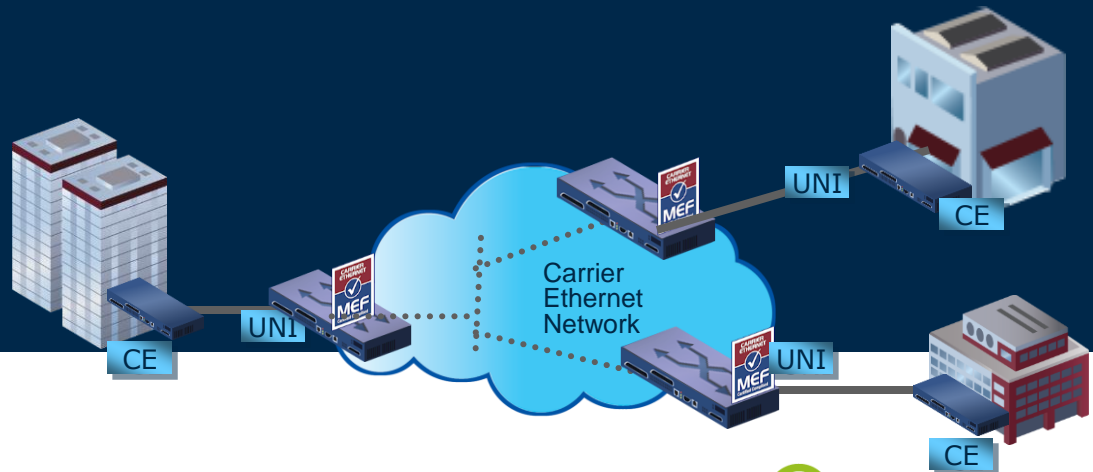
- Connecting multi-protocol storage environments over long distances
- Extending your LAN environment across the UK, at 1Gbit/s or faster.

Our High Capacity Services use Wave Division Multiplexing technology, so your network acts like an adrenalin-charged multi-tasker. The system runs faster and supports multiple applications over a single connection. The network is also more reliable, so your business can stay up and running – all day and all night.

The Telecoms 2.0 Company

Layer-2 Networking Ethernet Aware Transport

Using TM-series



Making light make sense

Traffic units, Layer-2; Native Ethernet

Ethernet Muxponers; EMXP's

R15

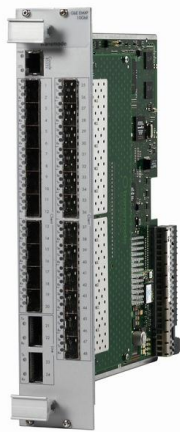


EMXP10/II

TM-101 / 102 chassi

- 10G Access
- GbE Edge

R15



EMXP22/II

TM-301 / 3000 chassi

- Aggregation
- Port density

R16



EMXP80/II

TM-301 / 3000 chassi

- Hub handoff
- 10G Aggregation



EDU/2P, EDU/5P

- Ethernet Demarcation (MEF)
- SLA features, aggregation

CPE

R15

Optimized for Ethernet Transport!

- Having the **right** feature set for edge/access & metro
- Replace expensive switches/routers that have more functionality than needed.
- Using available slots in transport equipment; i.e. less space, less power, less OPEX
- Reduce port count on core routers; i.e. less cost

R15=June 2010
R16=Dec 2010

Po co to wszystko ?

Zarządzane usługi klienckie L2

- ingres traffic control & SLA monitoring
- resilience

Lepsze wypełnienie sieci - niższe koszty

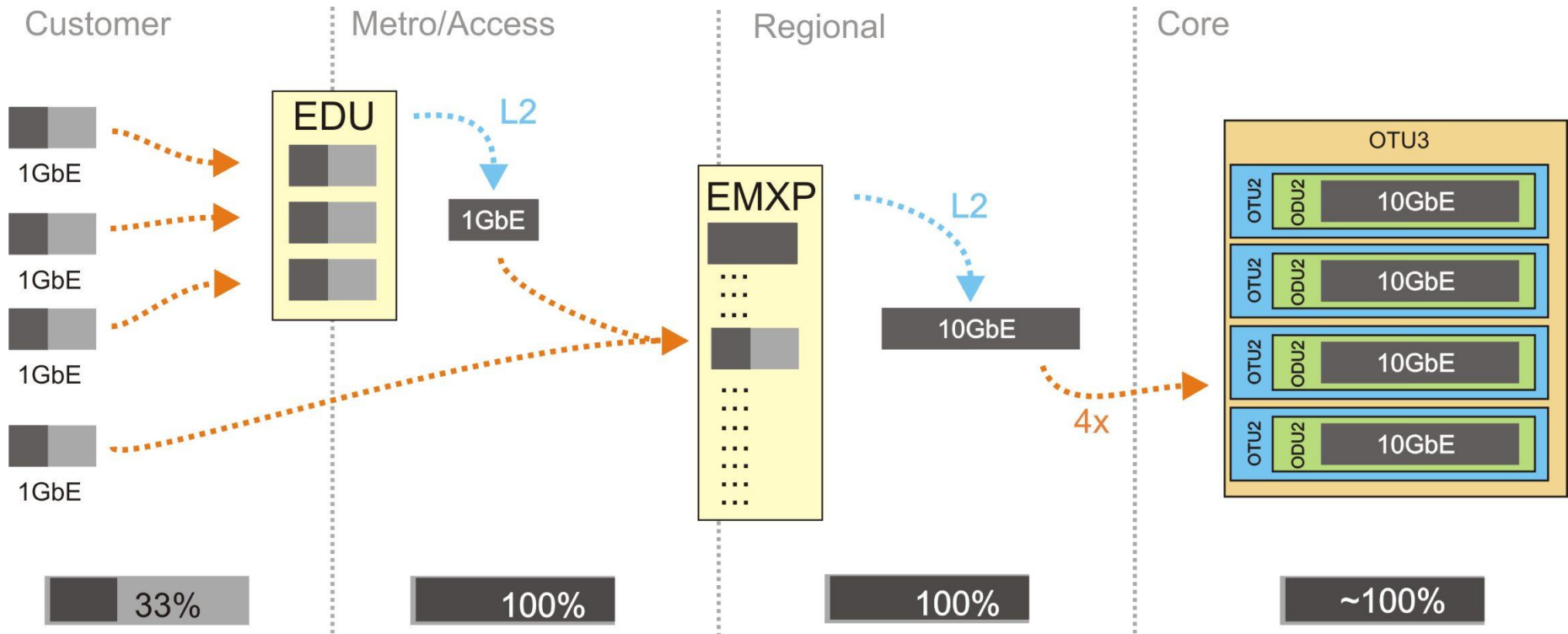
- Fill up your pipe !

Uniwersalność

- No jitter / minimum latency –voice, data, video, clock

Packet aggregation is key to fill the pipes

Optimized for Transport



- Ethernet should be handled natively so pipes can be filled

Layer-2, star configuration

Ethernet Service Creation

- Service Mapping
- Bandwidth Policing
- Wire-speed Filtering
- Zero-Latency Traffic Shaping and switch free aggregation

Ethernet Service Assurance

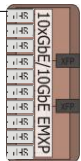
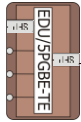
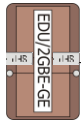
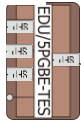
- SLA meters
- In-service Throughput Testing
- In-service layer 1-2-3-4 loopbacks
- Per-Flow Statistics

Ethernet Service Provisioning

- E-LINE, E-LAN and E-Tree
- Service Multiplexing
- Service Aware Aggregation
- Resilience

Ethernet Service Management

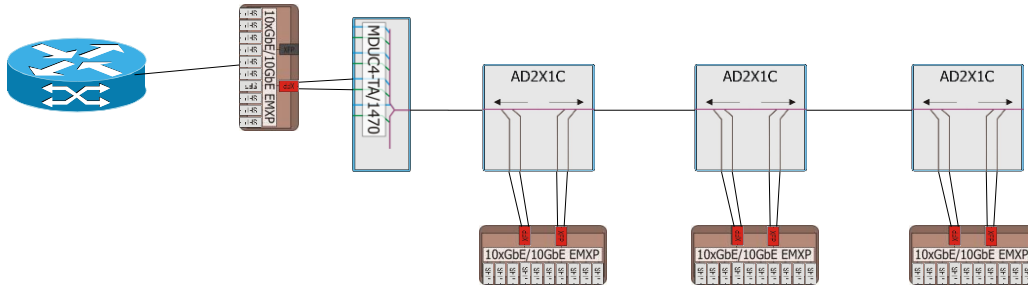
- Inband-management
- Interoperable CFM and PM
- Network Management Integration



10GBE LAN

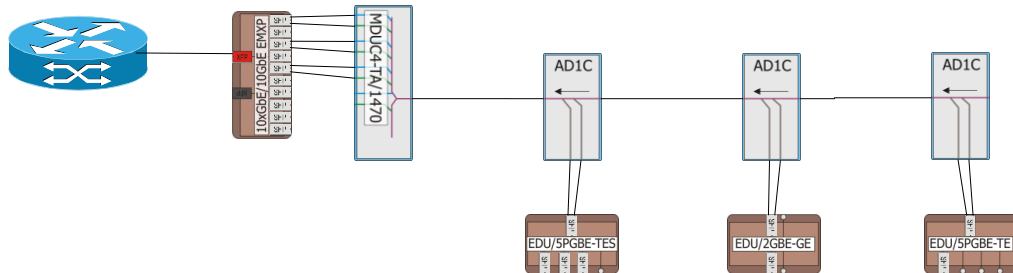


Layer-2, Chain network



Shared wavelength for one chain

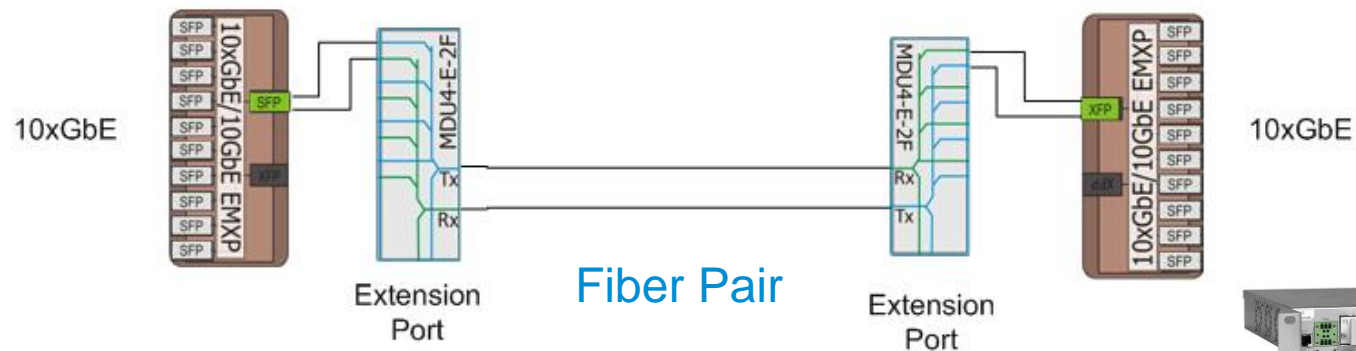
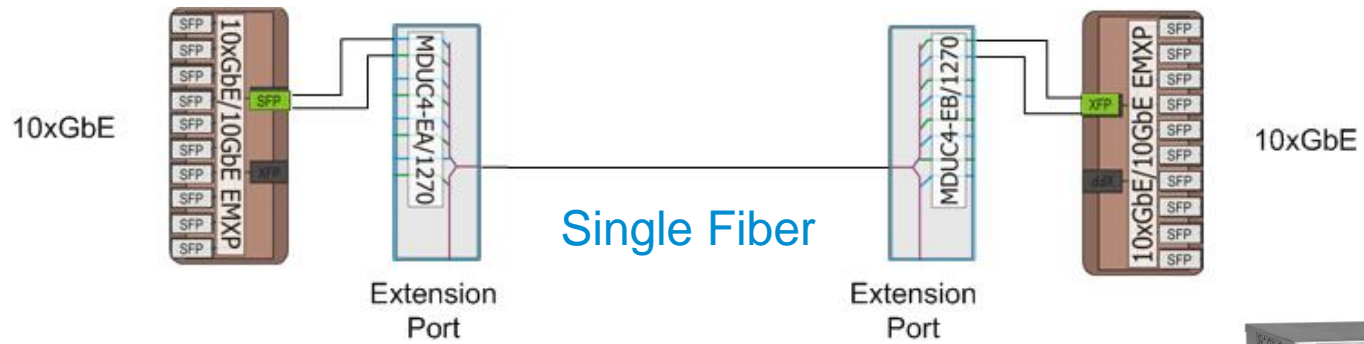
- 1GbE or 10GbE shared line rate
- Configurable bandwidth per node (CIR, EIR, CBS, EBS)
- VLAN management channel
- L2 Performance monitoring
- 1G or 10G uplink
- EMXP in TM-102 in access nodes
- Traffic from any to any possible



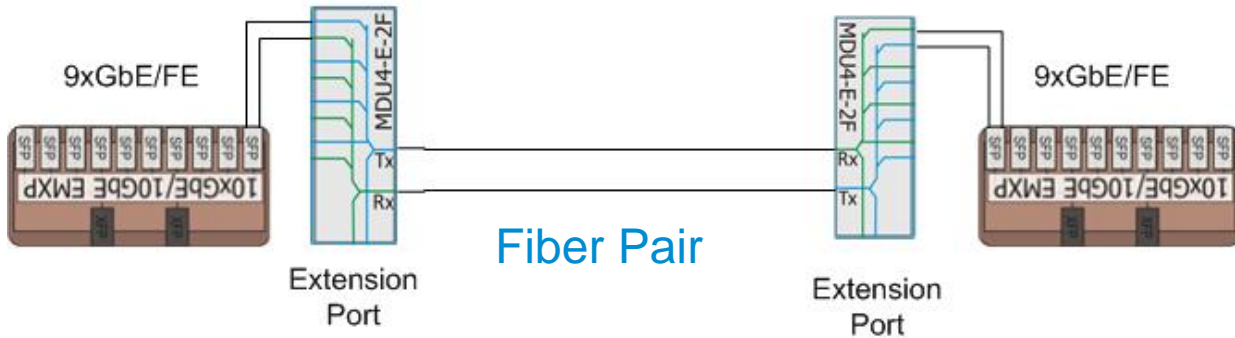
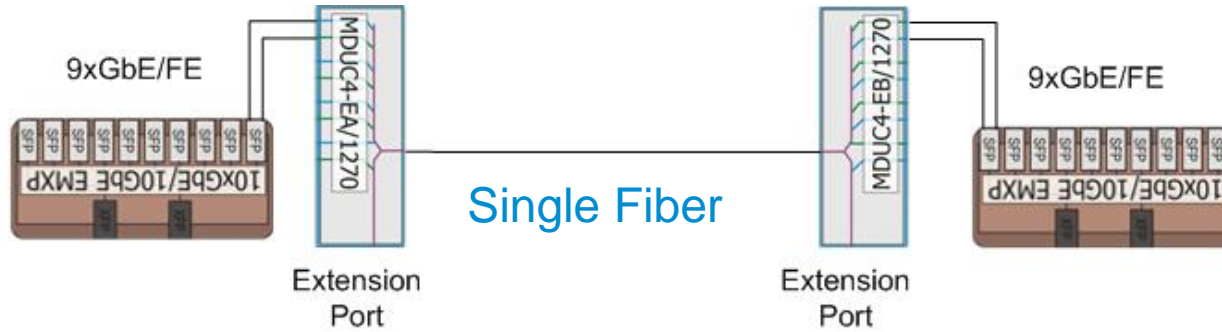
Dedicated wavelength per node

- 1xGbE per lambda
 - Configurable bandwidth per node (CIR, EIR, CBS, EBS)
- 1G or 10G uplink
- VLAN management channel
- L2 Performance monitoring
- Stand-alone EDUs in access nodes
- Traffic between access nodes must be switched in hub

L2 Aggregation over single/dual fiber

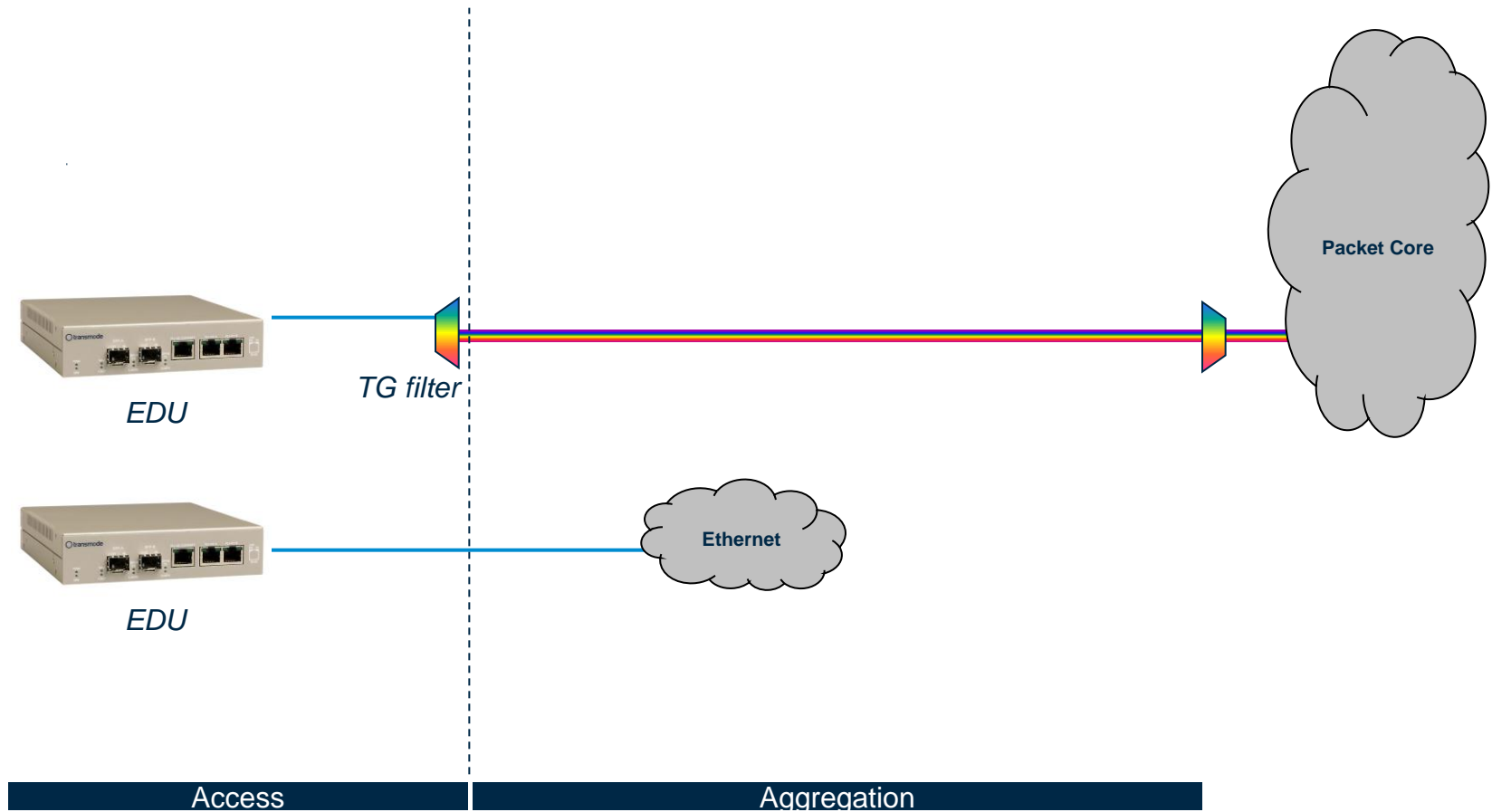


L2 Aggregation over single/dual fiber

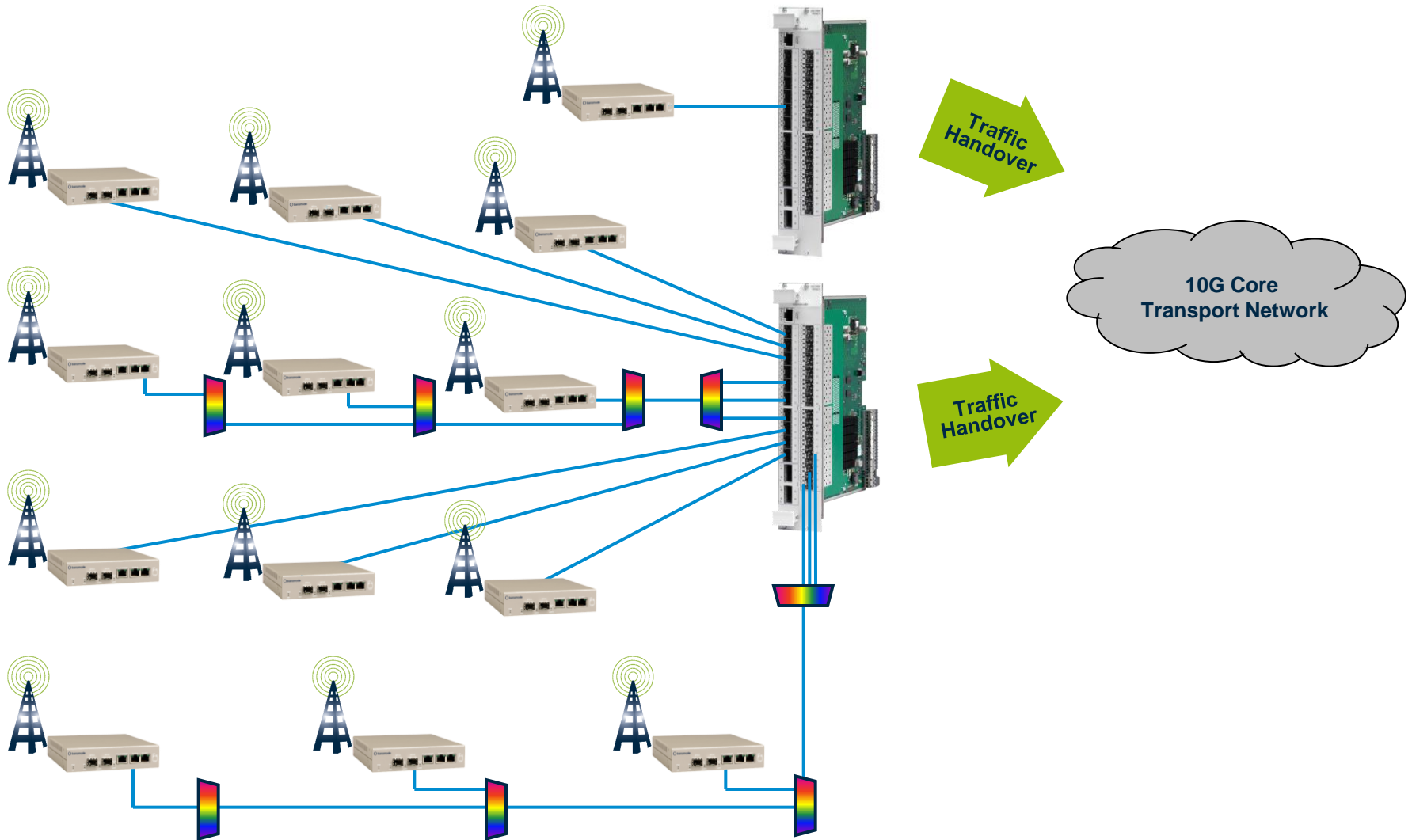


L2 application, EDU only

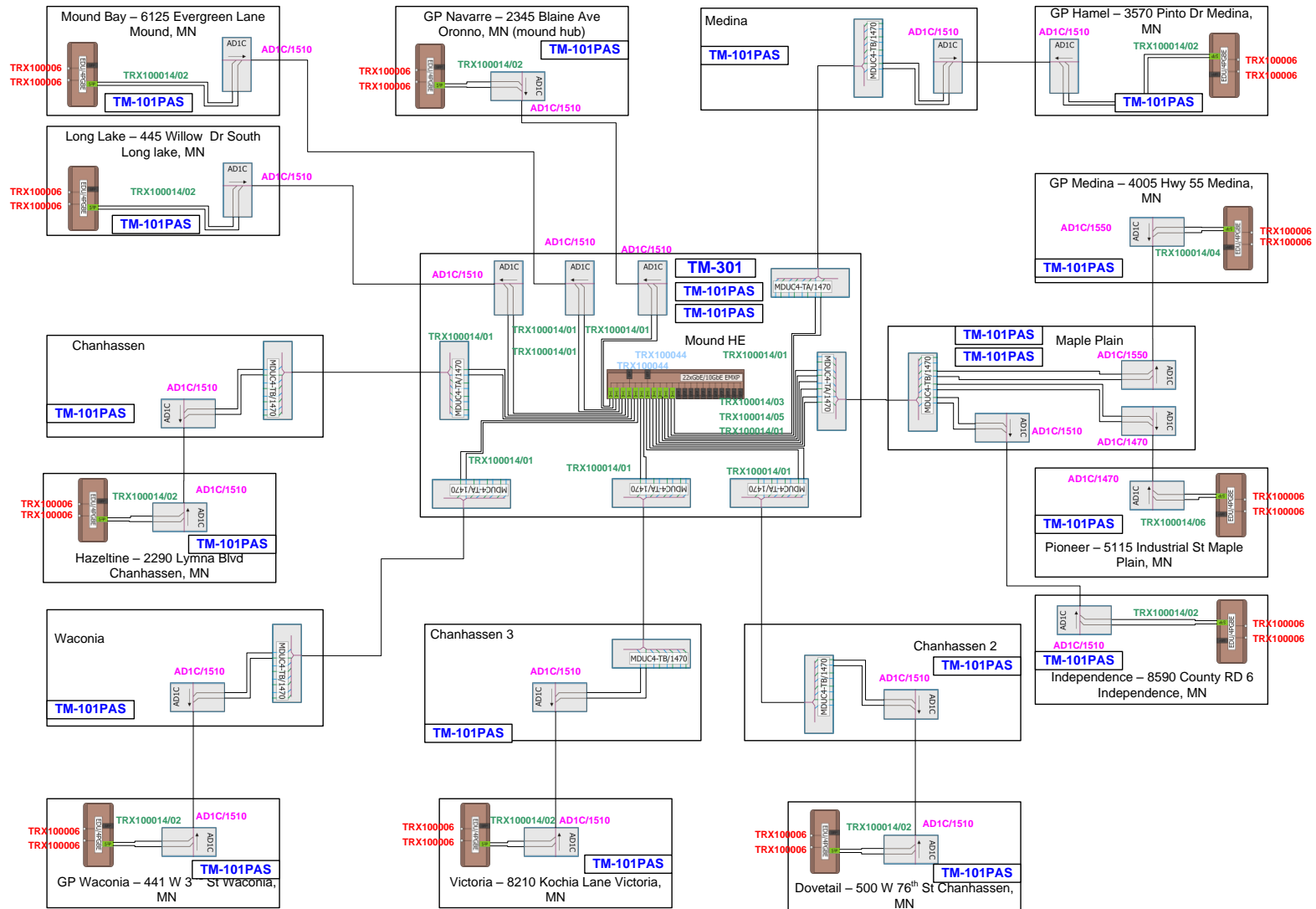
Transport of Ethernet services using EDUs only



L2 application, Combining EDUs and EMXPs

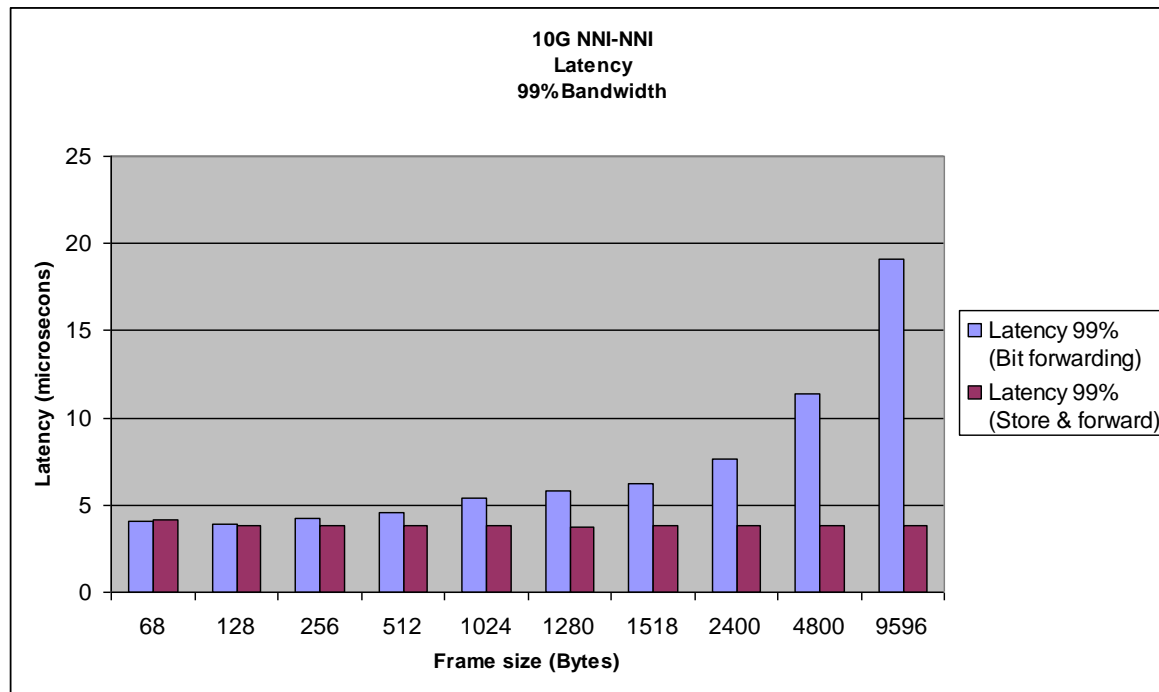


Mediacom / VZW on "passive PoP"

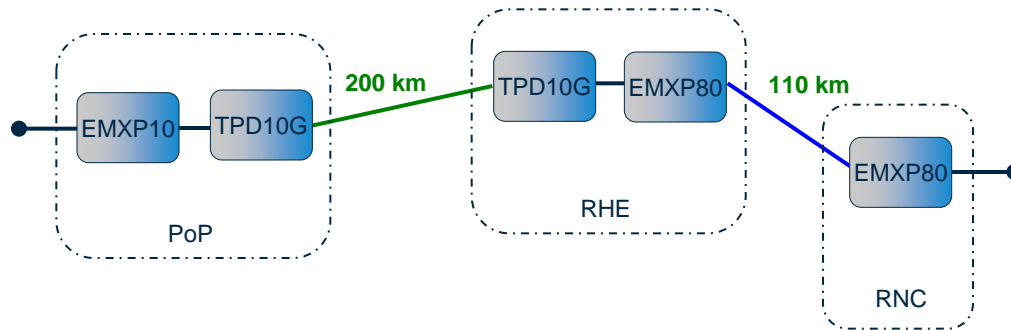


Pure Performance – EMXP / EDU family

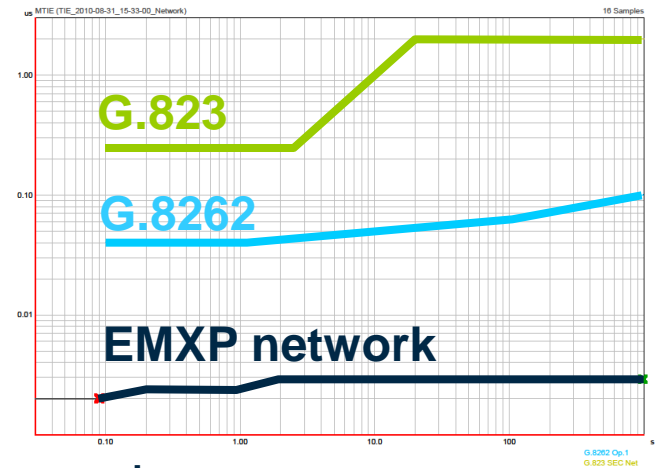
- Ultra Low latency – 1.8 us
- All packet sizes, all traffic loads, all rules, all classifiers, all queues, all
- No measurable jitter at all



Sync – Synchronous Ethernet



- SyncE outperforms alternatives
 - Magnitudes better than SONET/SDH
 - Magnitudes better than pseudo alternatives
- EMXP build with the new requirements
 - Better than 1 ppb Holdover (15 min)
 - About 70 times better than ITU-T G.8262



wander

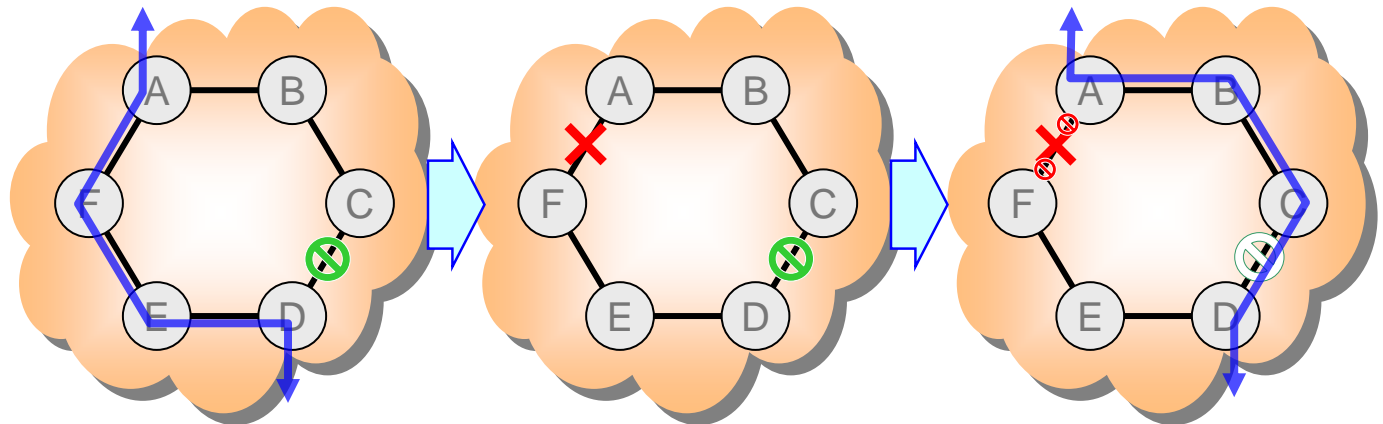


holdover

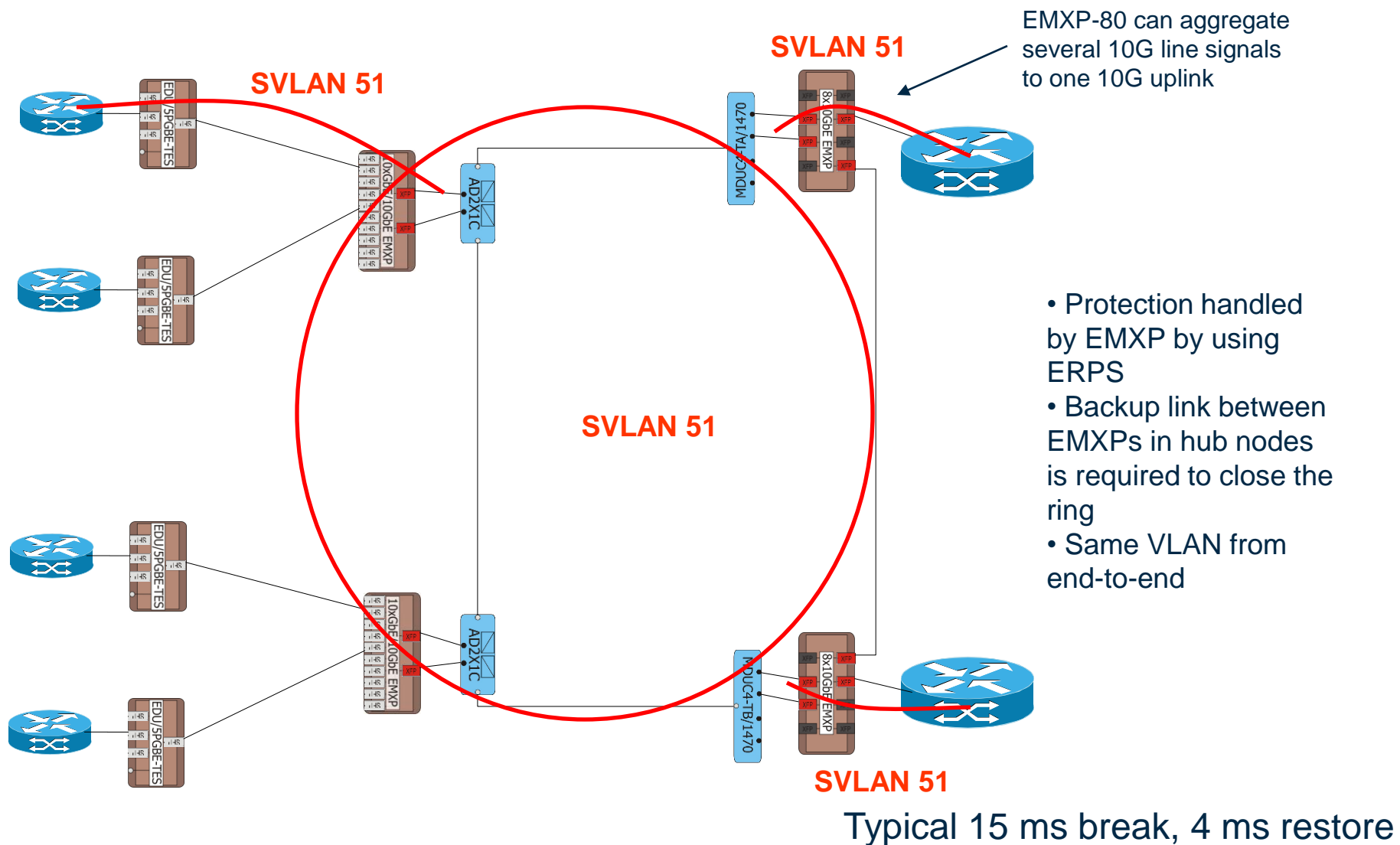
Resilience – Ring Protection

ITU-T G.8032 Ethernet Ring Protection Switching

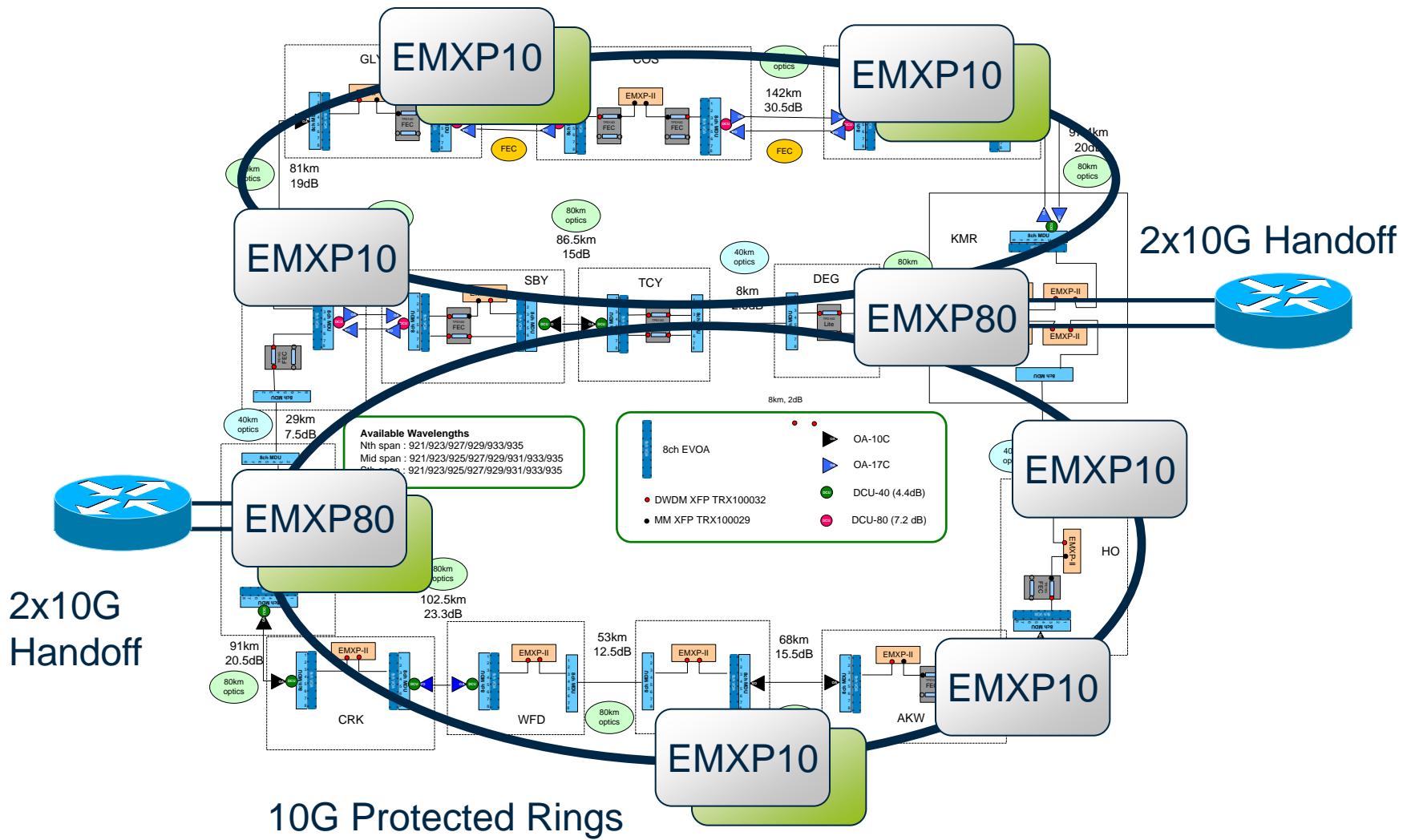
- Failure is detected by link down events or OAM defects LOS ~ 1ms / OAM ~12ms
- No impact of number of nodes
Ring Size ~ fiber latency
- Typical 15 ms break, 4 ms restore



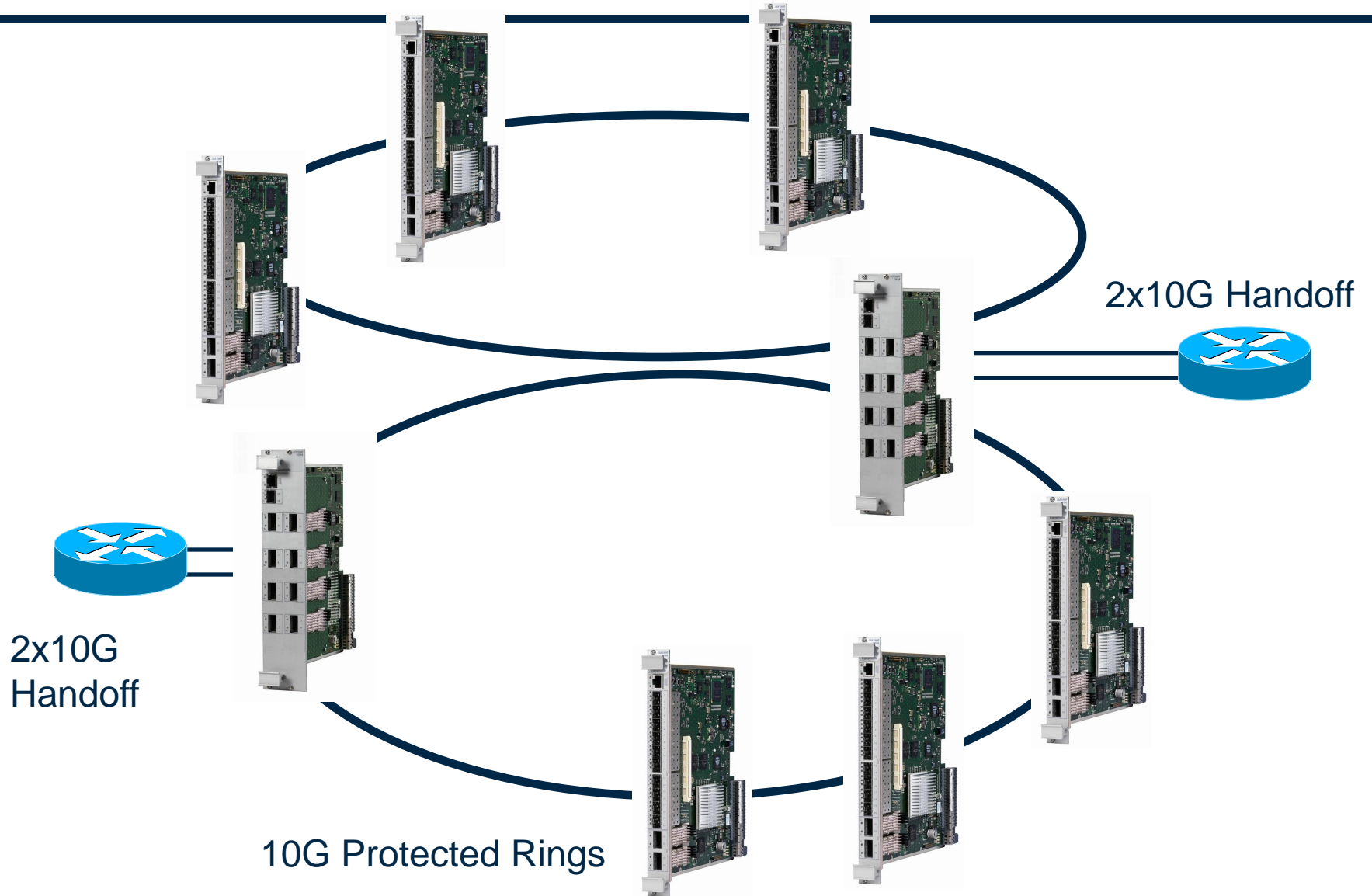
Layer-2, dual hub configuration2



ESB – O₂ Wholesale E-LINE Service



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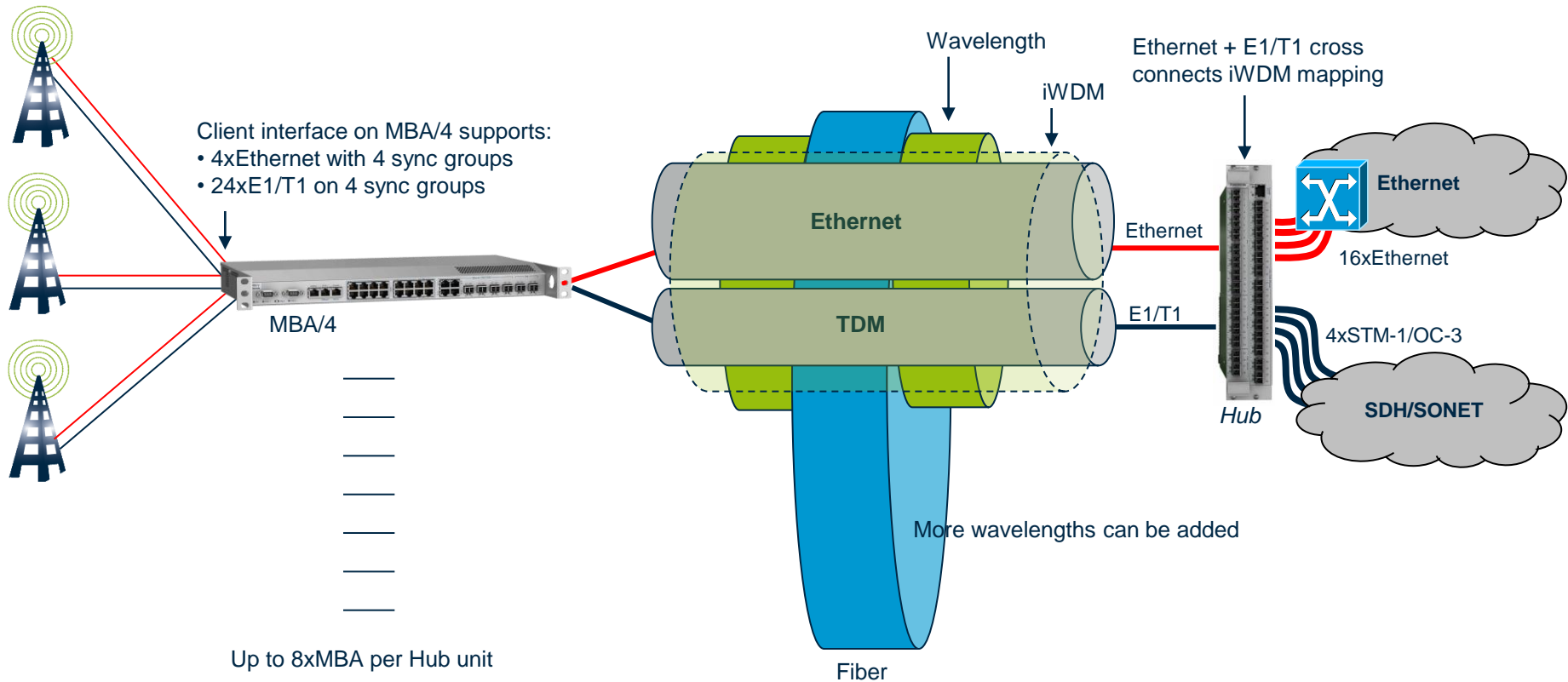


Native Packet Optical

Native Ethernet....

Native TDM....

Native transport of TDM and Ethernet traffic – Solution perspective



Transparent 4 x GbE and 16 x E1 over the same fiber pair



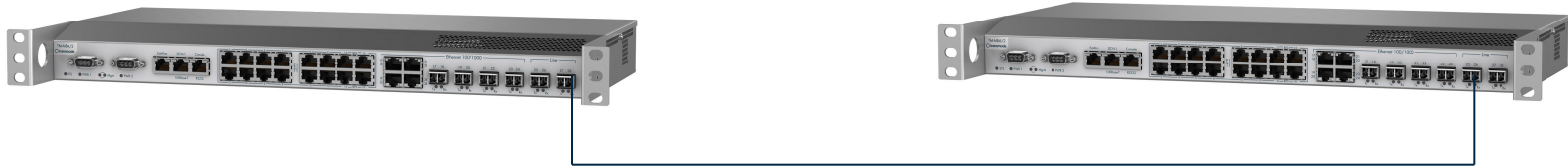
1 + 1 power

Ext alarms
& console

16 x E1

4 x GbE

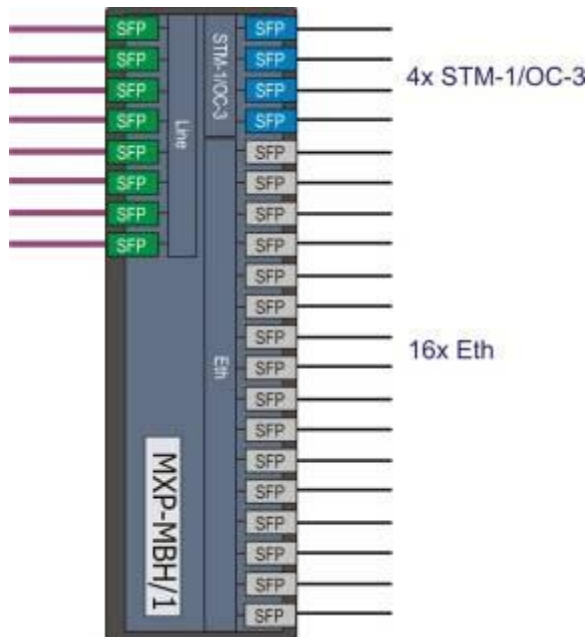
1 + 1 line



Access boxes in ptp-connection over 4G line interface

Hub unit MXP-MBH/1

MultiService Mobile Muxponder MXP-MBH/1



Contains a E1/T1 cross-connect function and four STM-1/OC-3 mappers.

Each STM-1/OC-3 is a separate sync group. All E1/T1's within a STM-1/OC-3 are part of same sync group.

The cross-connect switches the E1/T1's to the desired line port (i.e. E1/T1 port at Access node)

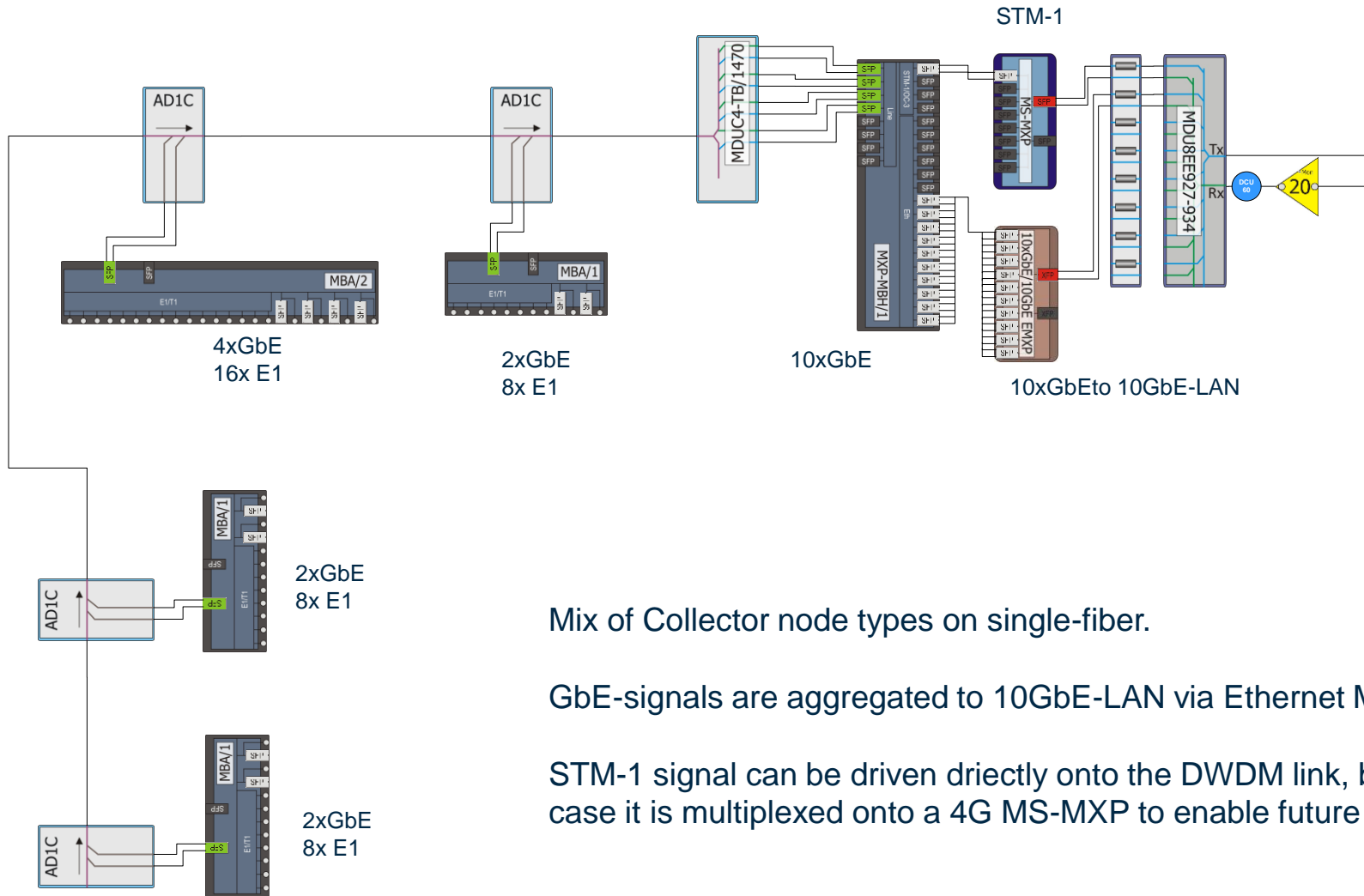
The unit has four line port pairs. Each port can be used as a singulat line port enabling up to 8 Access nodes to be connected, or up to 4 Access nodes with 1+1 line protection

Ethernet signals are carried from "port to port" via cross-connect.

All 16 Ethernet ports are sync independent (Sync-E)

One of the Eth-ports can be used as a Hub Interconnect (HiC) enabling two hub units to be connected and providing a higher concentration of E1/T1's per STM-1/OC-3

Example configs

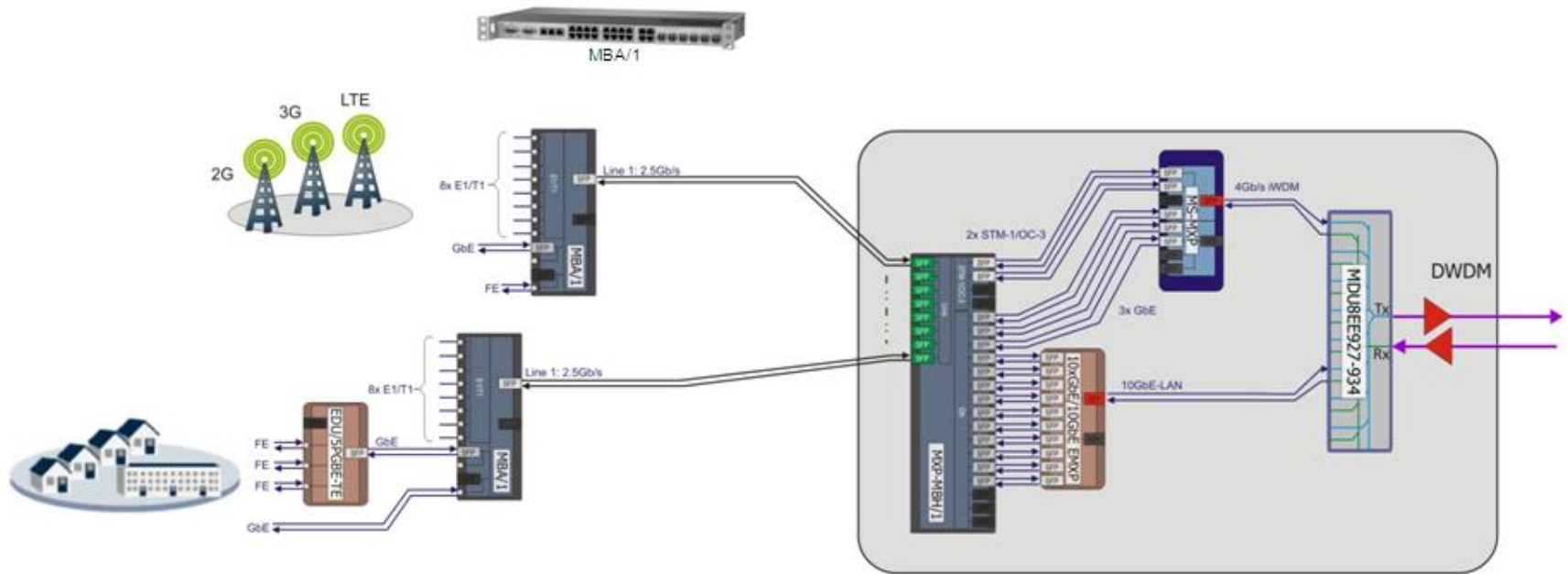


Mix of Collector node types on single-fiber.

GbE-signals are aggregated to 10GbE-LAN via Ethernet Muxponder

STM-1 signal can be driven directly onto the DWDM link, but in this case it is multiplexed onto a 4G MS-MXP to enable future upgrade.

Transparent Corporate Ethernet and Bandwidth control

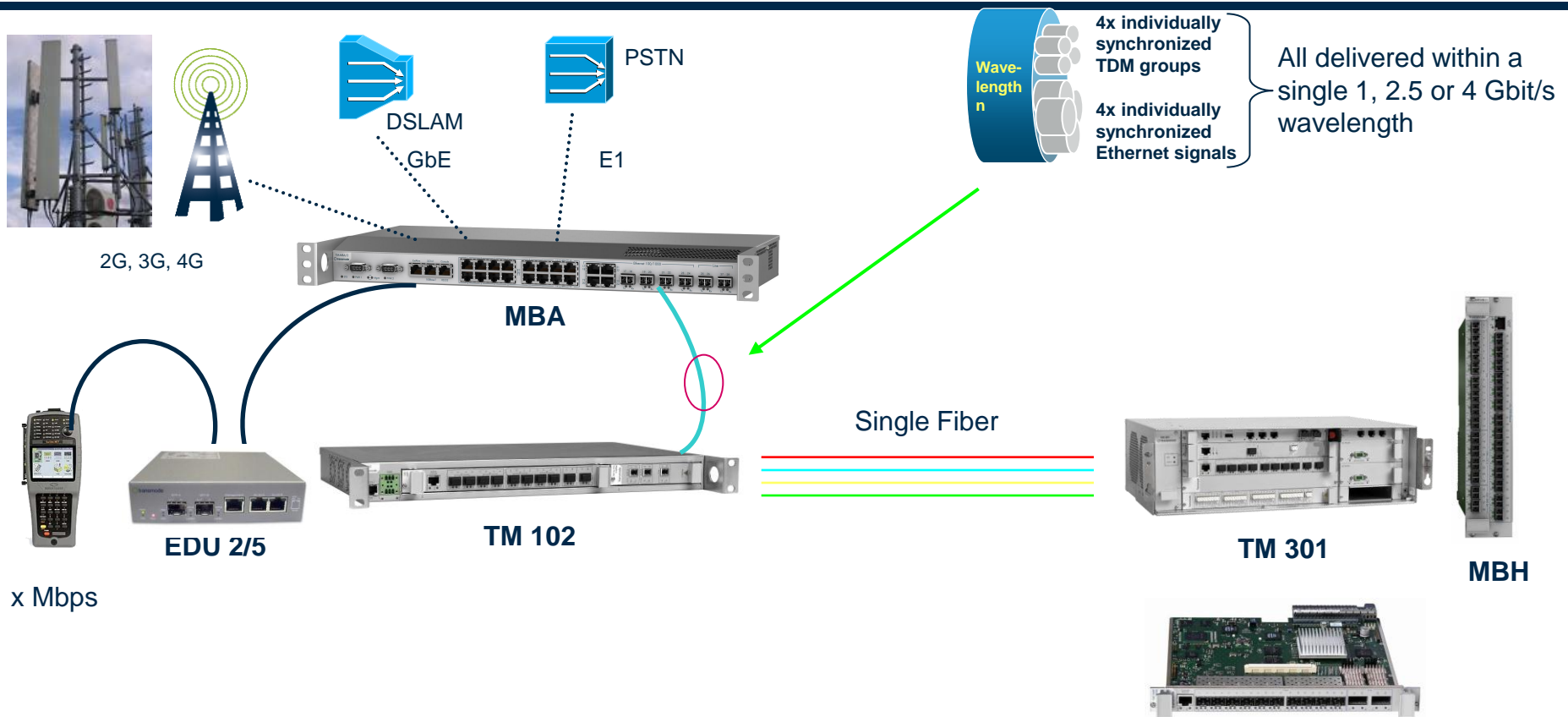


Ethernet Demarcation CPE



TM-3000 chassis

Zapraszamy na Transmode Demo



Ethernet Demarcation Unit EDU:

- Service demarcation
- Ethernet OAM
- Real-time performance monitoring
- Near-Zero latency / jitter (< 3.3 / 0.1 μ s)
- Low power design (6W)



Ethernet Muxponder Unit EMXP:

- Policing via bandwidth profiling,
- Queuing (8 queues with priority settings),
- Shaping to max and/or min BW
- Low latency / Jitter < 0.1 μ s
- Low power design (13W)

MAKING
LIGHT
MAKE SENSE

THANK YOU!