



Aplikace WDM v datových centrech

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IEEE 802.3 40G a 100G

- **40GBASE-SR4** **100/150 m** **OM3/OM4**
- **40GBASE-FR** **2 km** **OS1/OS2**
- **40GBASE-LR4** **10 km** **OS1/OS2**
- **40GBASE-ER4** **30 (40) km** **OS1/OS2**

- **100GBASE-SR10** **100/150 m** **OM3/OM4**
- **100GBASE-SR4** **70/100 m** **OM3/OM4**
- **100GBASE-SWDM4** **100 m** **OM5, mimo standard IEEE**
- **100GBASE-LR4** **10 km** **OS1/OS2**
- **100GBASE-ER4** **30 (40) km** **OS1/OS2**
- **100GBASE-PSM4** **500 m** **SM, mimo standard IEEE**
- **100GBASE-CWDM4** **2 km** **SM, mimo standard IEEE**

Nový standard MM vlákna – OM5

- **WBMMF (WideBand MultiMode Fiber) – vlákno pro WDM**
- **Dne 5. října 2016 bylo rozhodnuto komisí ISO/IEC tento typ vlákna označovat jako OM5.**
 - “The standard specifies 50/125-micron laser-optimized fiber that is optimized for enhanced performance for single-wavelength or multi-wavelength transmission systems with wavelengths in the vicinity of 850nm to 950nm. The actual operating band is from 850 to 953nm. The effective modal bandwidth for this new fiber is specified at the lower and upper wavelengths: 4700 MHz.km at 850nm and 2470 MHz.km at 953nm.”
 - OM5 fiber specifications are already published by the Telecommunications Industry Association as [TIA-492AAAE](#), and are in late-stage ballot within the IEC to be published as IEC 60793-2-10 edition 6.
- **Pro podporu 400GBASE-SR16 na 100m = 16x25 Gbit/s**

Ethernet singlemode 40G

- **40GBASE-LR4** **2 m až 10 km**
- **40GBASE-ER4** **2 m až 30 (40) km**
 - Čtyři vlnové délky á 10 GBit/s
 - CWDM rastr 1270/1290/1310/1330 nm

87.6 Wavelength-division-multiplexed lane assignments

The wavelength range for each lane of the 40GBASE-LR4 PMD is defined in Table 87-5. The center wavelengths are members of the CWDM wavelength grid defined in ITU-T G.694.2 and are spaced at 20 nm.

Table 87-5—Wavelength-division-multiplexed lane assignments

Lane	Center wavelength	Wavelength range
L ₀	1271 nm	1264.5 to 1277.5 nm
L ₁	1291 nm	1284.5 to 1297.5 nm
L ₂	1311 nm	1304.5 to 1317.5 nm
L ₃	1331 nm	1324.5 to 1337.5 nm

Zdroj:



Ethernet singlemode 100G

- **100GBASE-LR4** 2 m až 10 km
- **100GBASE-ER4** 2 m až 30 (40) km
 - Čtyři vlnové délky á 25 Gbit/s
 - DWDM rastr, odstup 800 GHz

88.6 Wavelength-division-multiplexed lane assignments

The wavelength range for each lane of the 100GBASE-LR4 and 100GBASE-ER4 PMDs is defined in Table 88-5. The center frequencies are members of the frequency grid for 100 GHz spacing and above defined in ITU-T G.694.1 and are spaced at 800 GHz.

Table 88-5—Wavelength-division-multiplexed lane assignments

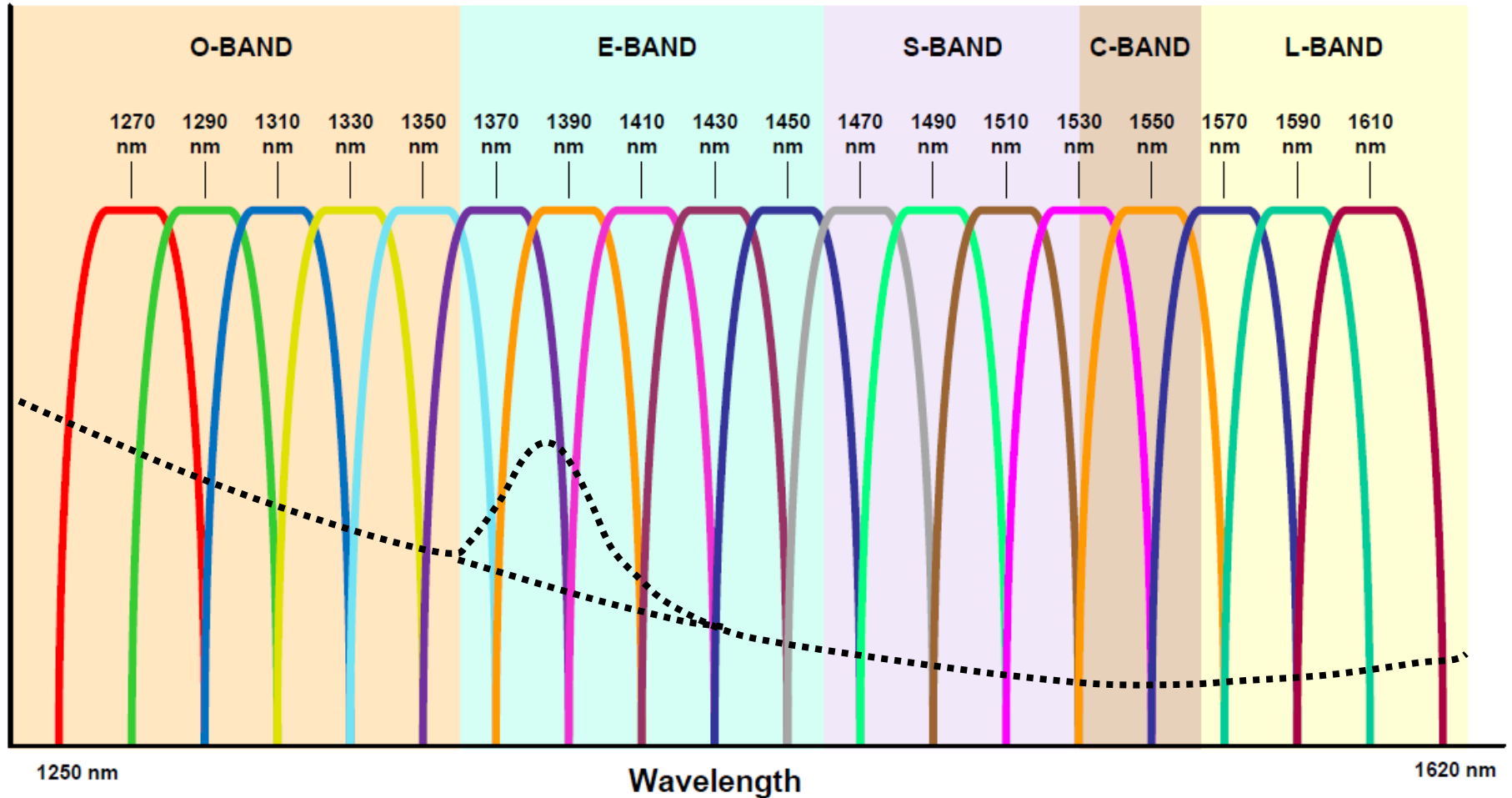
Lane	Center frequency	Center wavelength	Wavelength range
L ₀	231.4 THz	1295.56 nm	1294.53 to 1296.59 nm
L ₁	230.6 THz	1300.05 nm	1299.02 to 1301.09 nm
L ₂	229.8 THz	1304.58 nm	1303.54 to 1305.63 nm
L ₃	229 THz	1309.14 nm	1308.09 to 1310.19 nm



Zdroj:

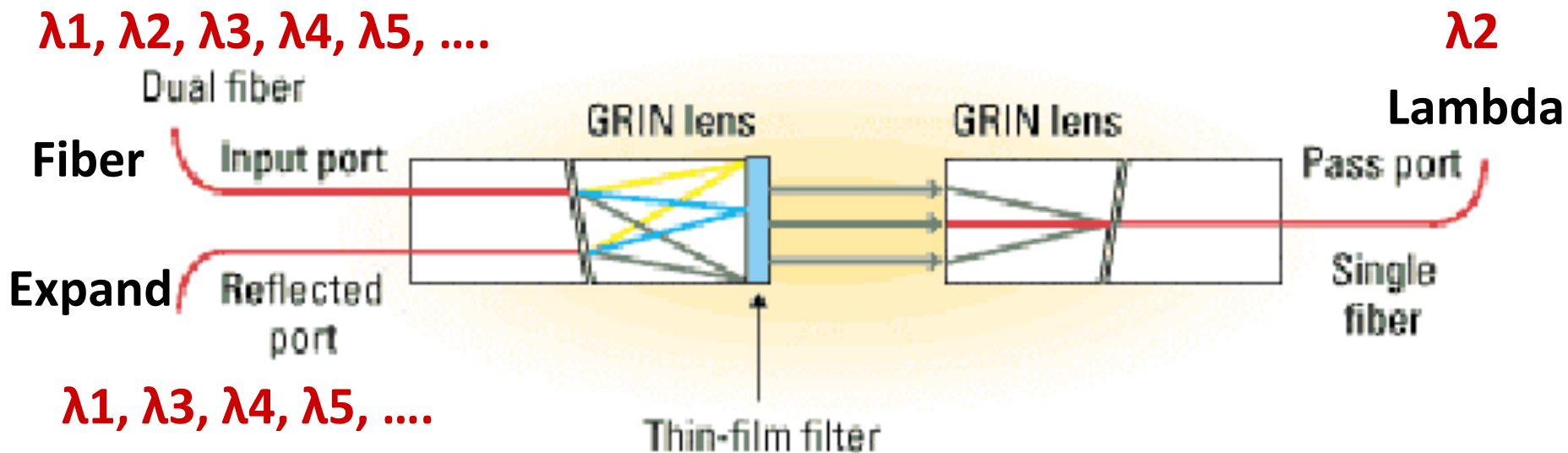
Technologie CWDM

CWDM Wavelength Grid as Specified by ITU-T G694.2

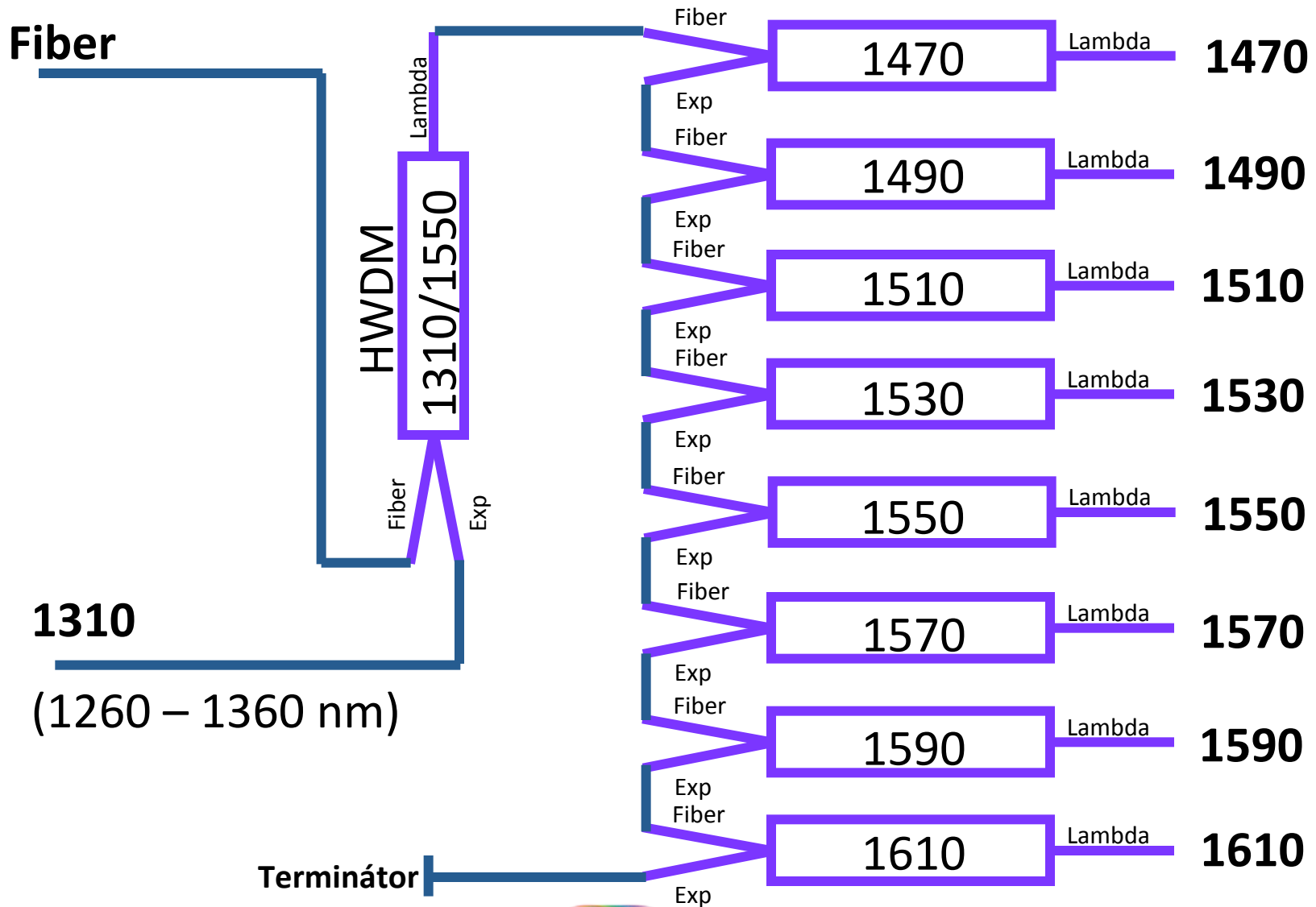


Konstrukce CWDM filtrů

- Použití technologie tenkovrstvých filmů
- Menší počet vrstev než pro DWDM, nižší cena

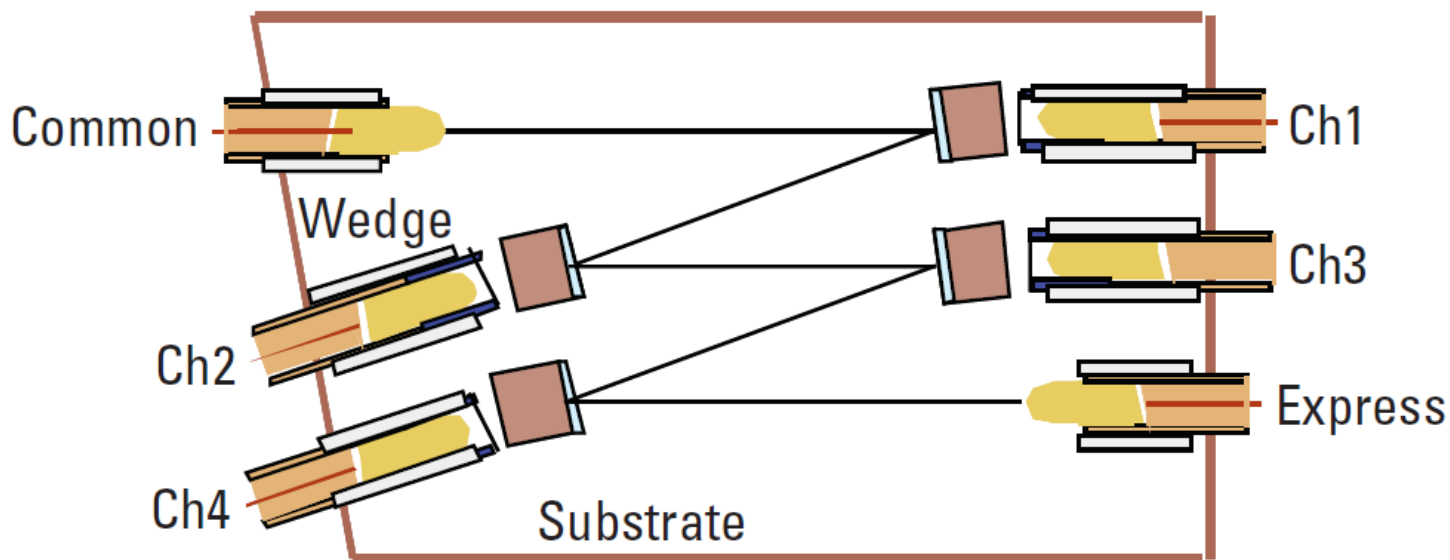


8ch Mux/Demux + 1310(5ch)



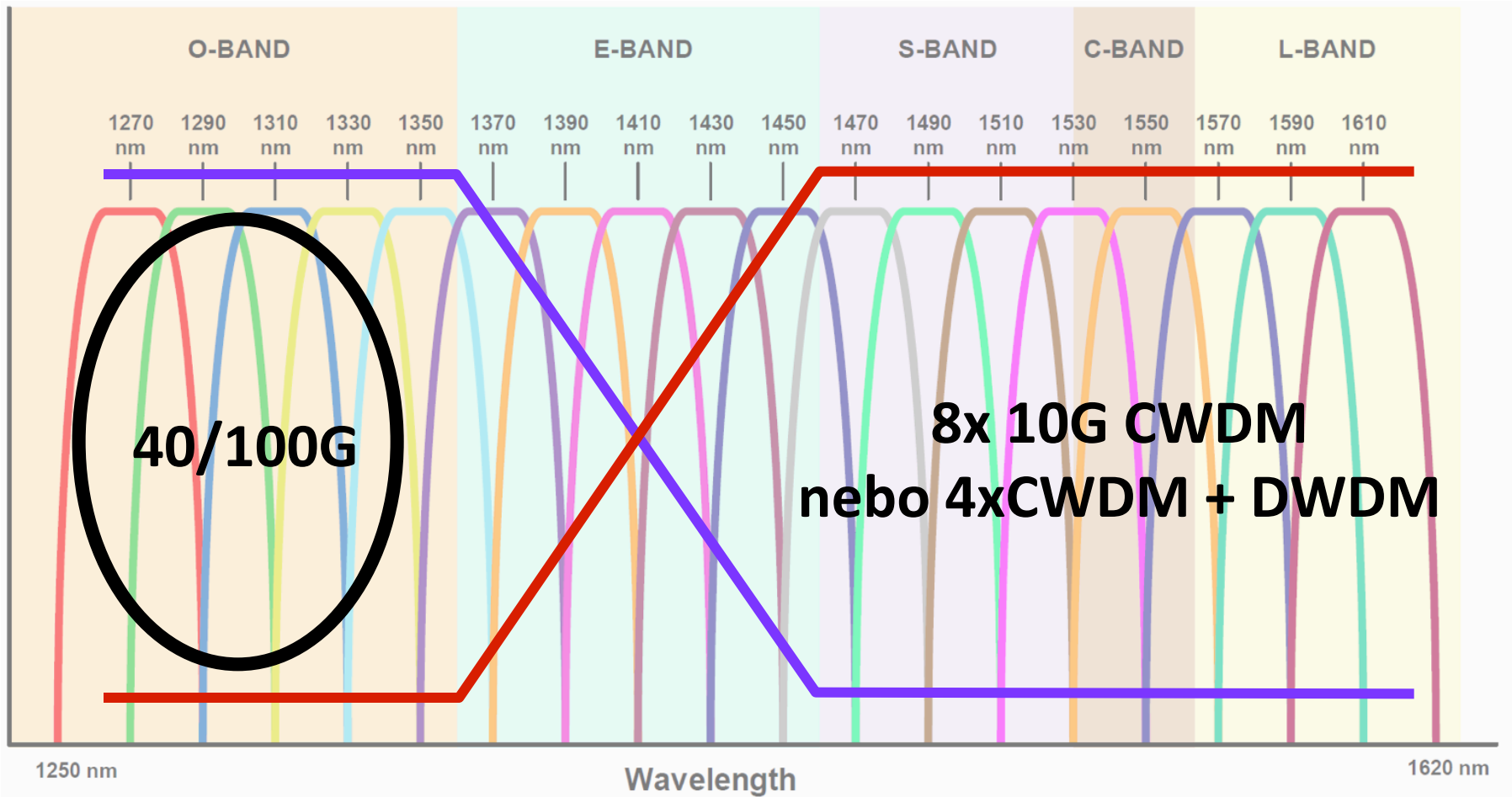
Konstrukce CWDM filtrů

Compact CWDM multiplexer/demultiplexer layout



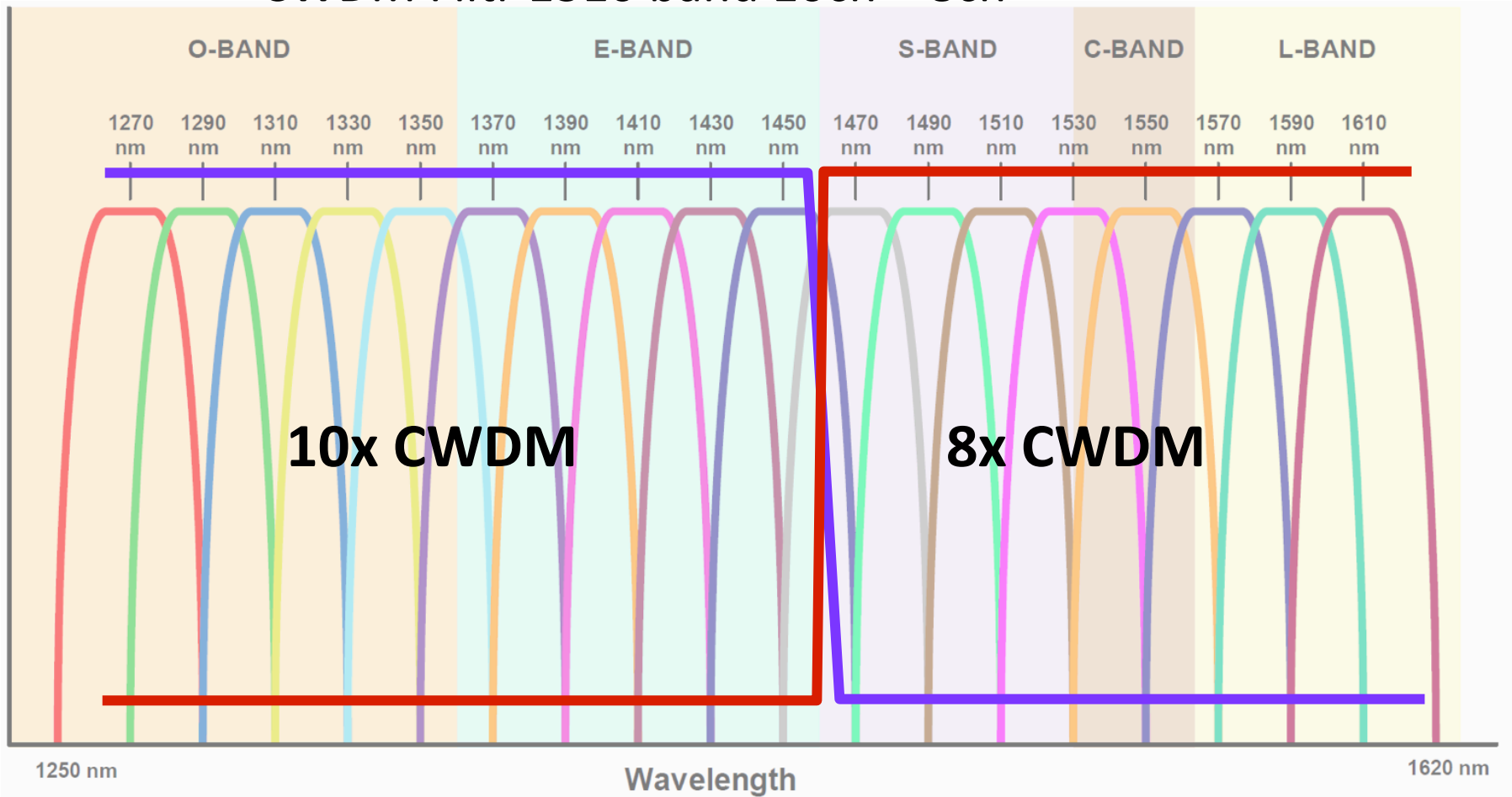
Aplikace 8x CWDM + 40/100G LR4

CWDM Filtr 1310 band (1260-1360 5ch) + 8ch

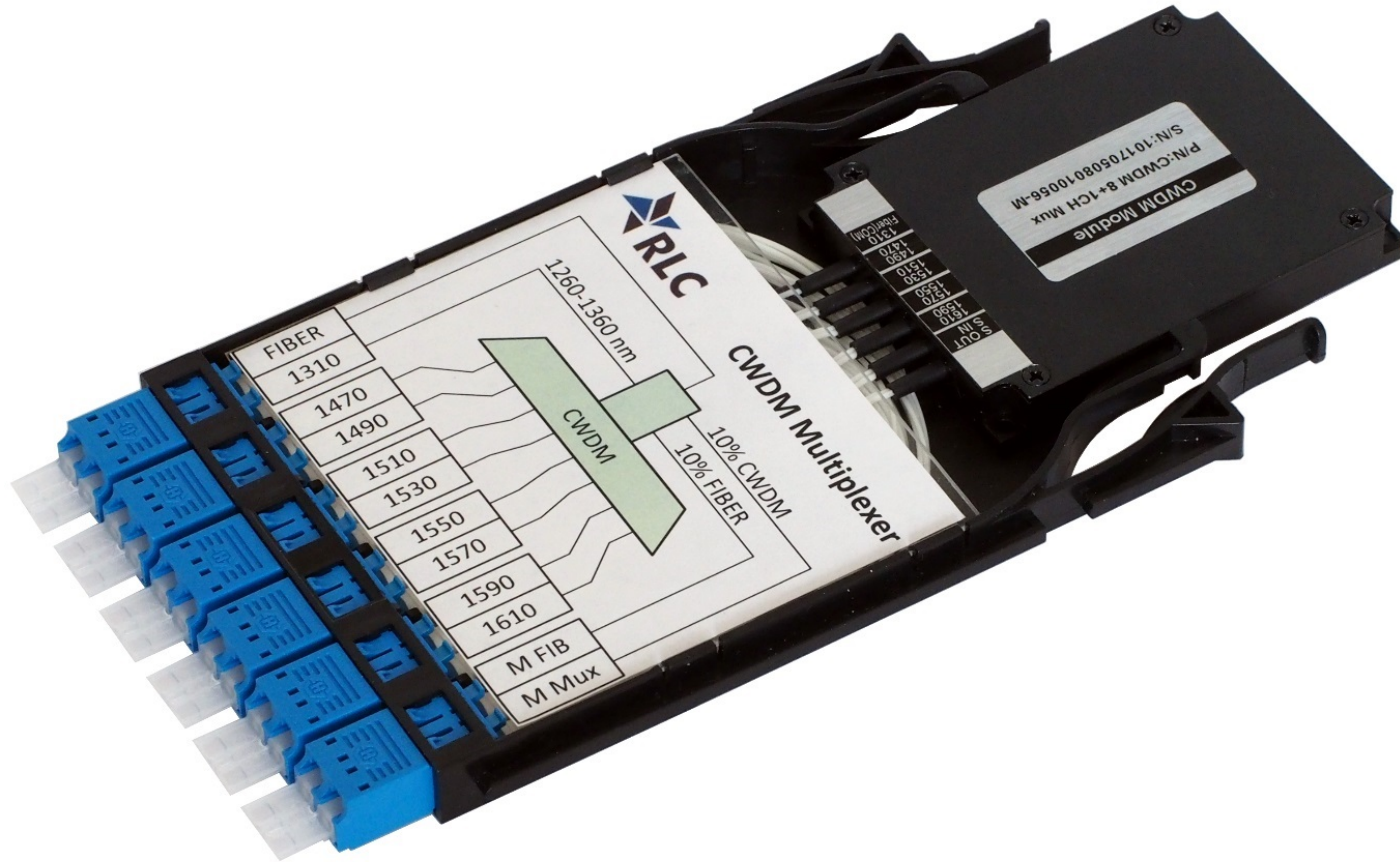


Aplikace 10x + 8x CWDM

CWDM Filtr 1310 band 10ch + 8ch

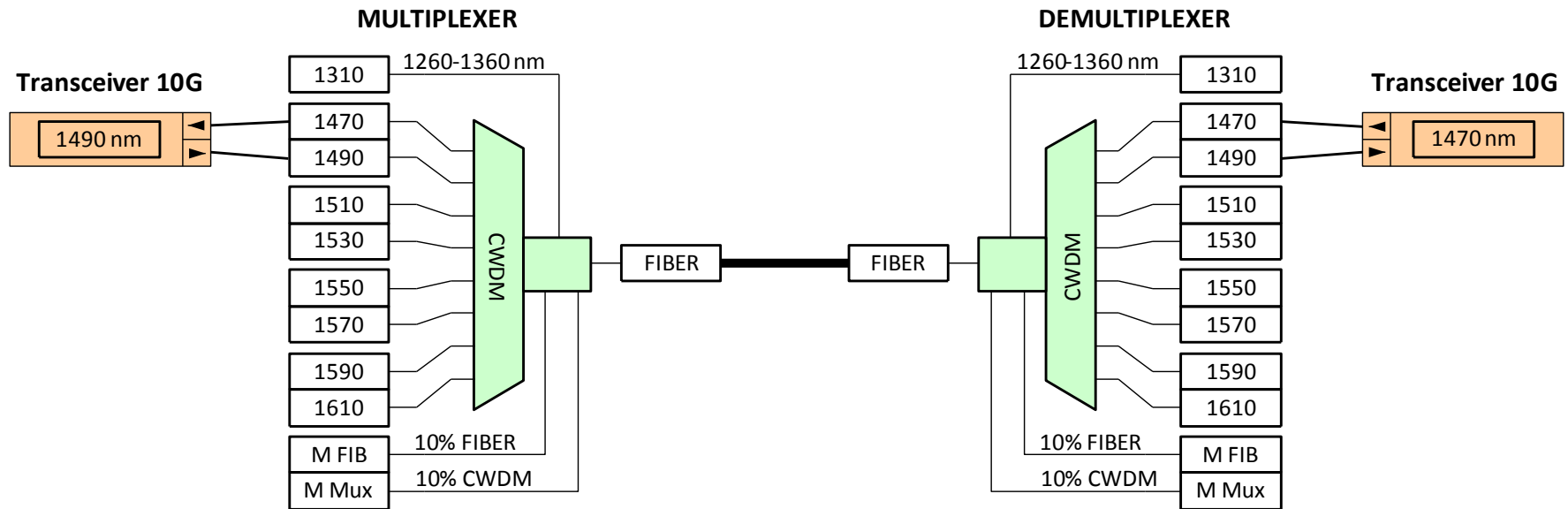


Cross Connect – IANOS Huber+Suhner

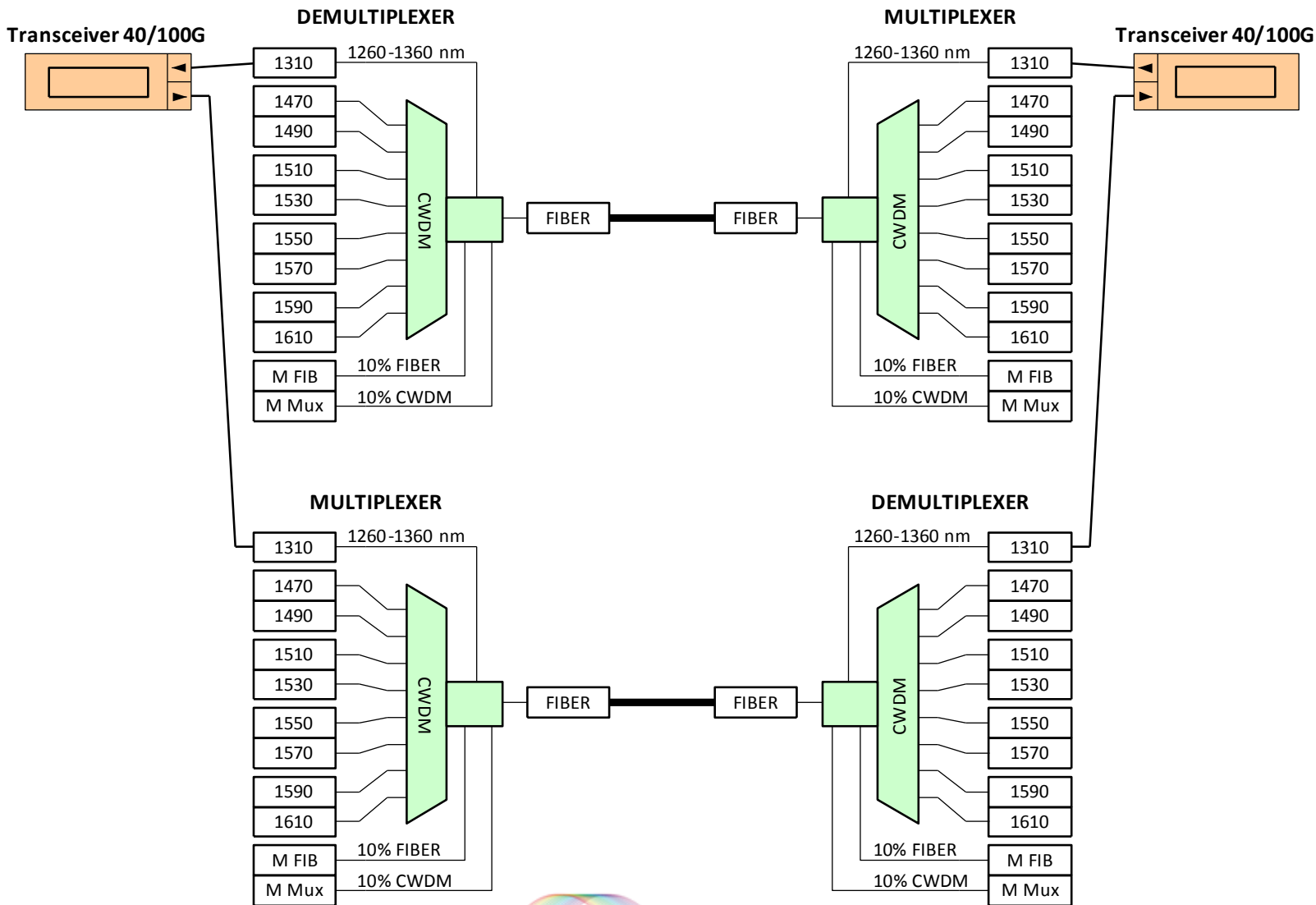


12 kazet CWDM Cross Connect 8ch pro 1U 19“

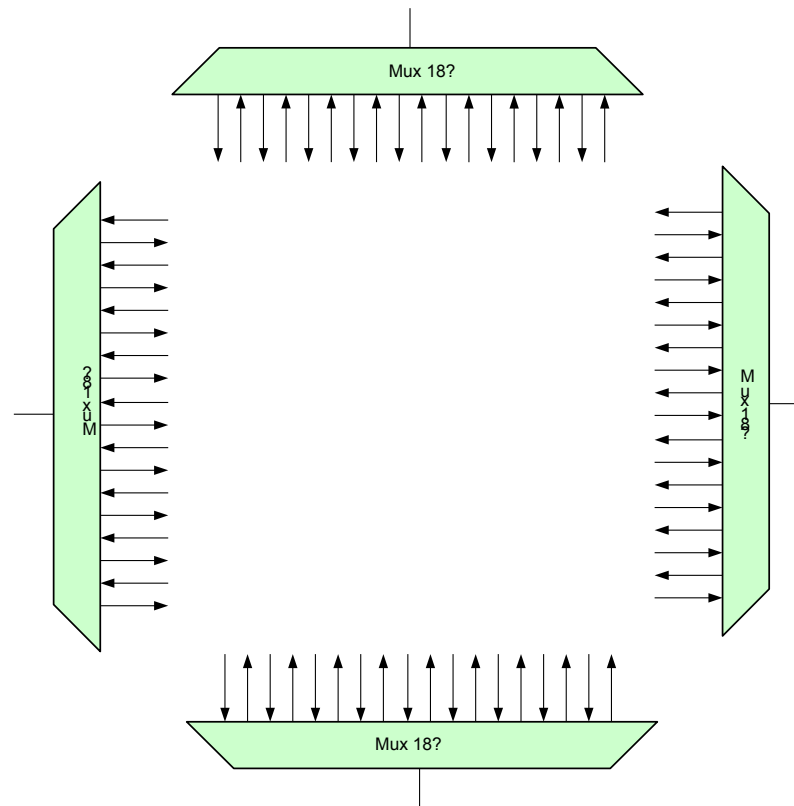
CWDM Cross Connect – 1 vlákno



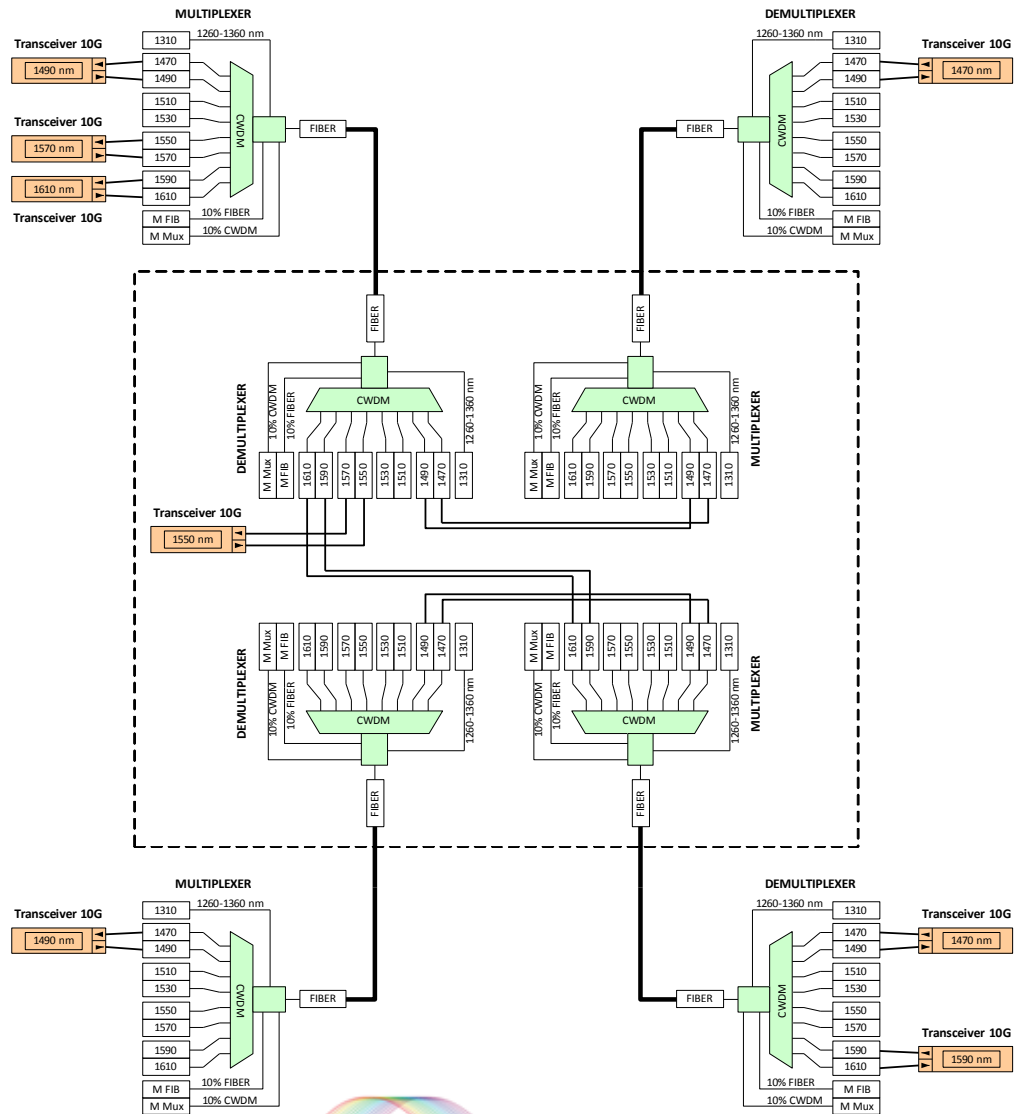
CWDM Cross Connect – 2 vlákna



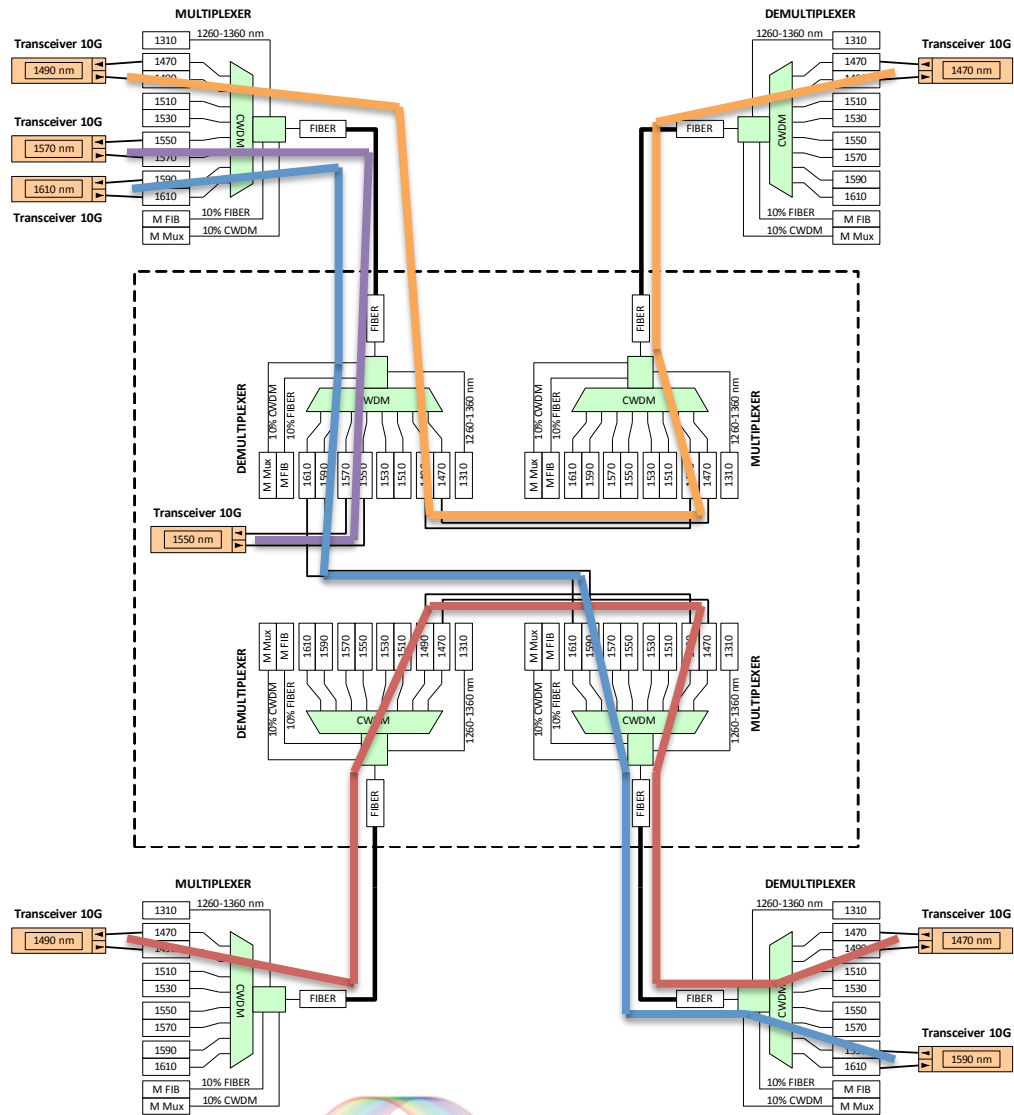
Cross Connect - „Manual“ ROADM



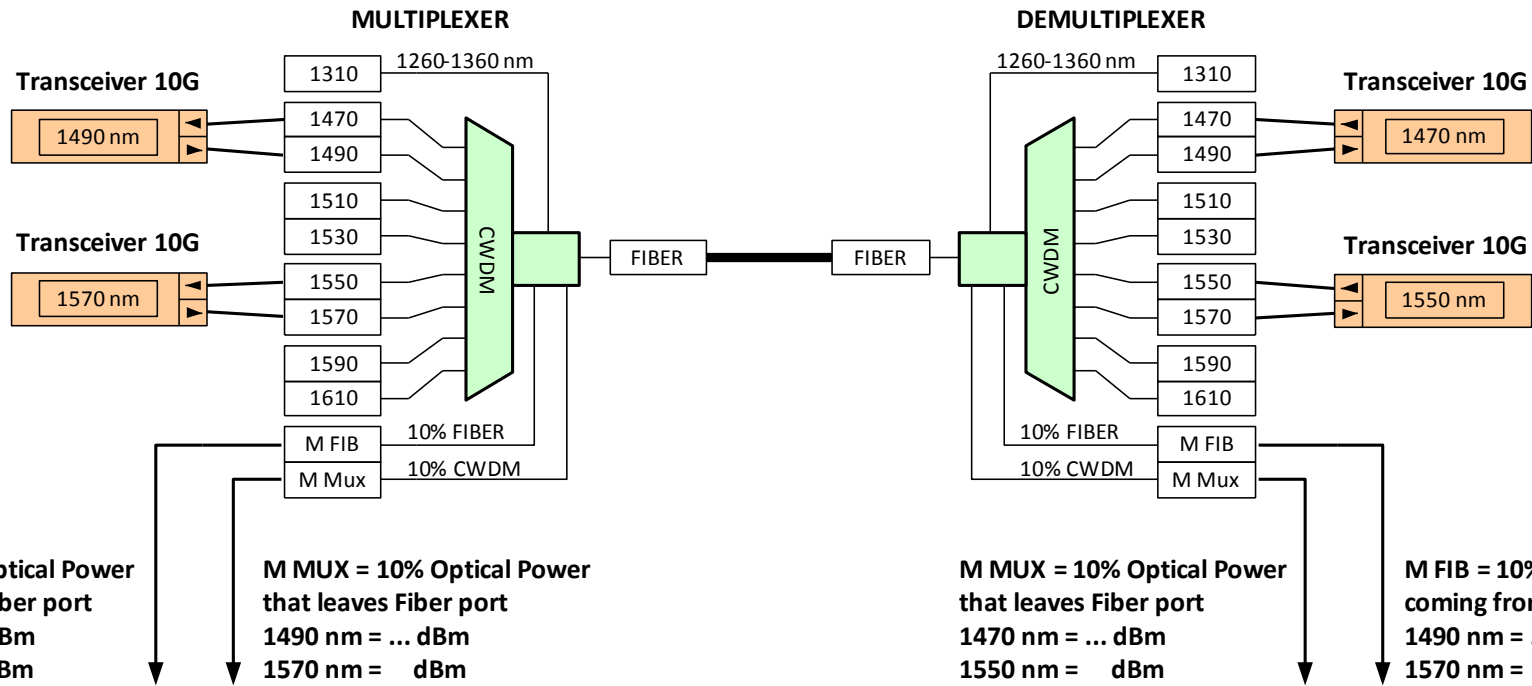
CWDM Cross Connect – aplikace



CWDM Cross Connect – aplikace



CWDM Cross Connect – měření



Optical CWDM Power Meter



Optical CWDM Power Meter

CWDM Cross Connect – parametry

Parameters	Unit	Specifications		
		Min	Typ	Max
Operating Wavelength CWDM 8ch by ITU	nm	1470	ITU ± 6.5	1610
1310 port Bandwidth	nm	1260		1360
Insertion Loss CWDM Port (1470, ..., 1610nm)	dB		1.9	3.0
Insertion Loss CWDM Ports MUX+DEMUX	dB		3.8	4.5
Insertion Loss 1310 Port	dB		0.7	1.1
Insertion Loss 1310 Ports MUX+DEMUX	dB		1.5	2.2
Insertion Loss monitor port 10% M FIB	dB		10.0	11.3
Insertion Loss monitor port 10% M MUX	dB		10.0	11.3
Channel Ripple	dB			0.5
Polarization Dependent Loss	dB			0.2
Polarization Mode Dispersion (PMD)	ps			0.2
Isolation (Adjacent)	dB	30		
Isolation (Non-Adjacent)	dB	40		
Directivity	dB	50		
Return Loss	dB	45		
Operating Temperature	°C	-5		+75
Storage Temperature	°C	-40		+85
Maximum Optical Power	mW			300

CWDM Cross Connect – útlumy

Typ linky, délka a počet Mux+Demux	Útlum Mux +Demux	Útlum vlákna	Útlum konektorů	Rezerva	Celkový útlum [dB]
1310 nm, 300 m, 1x M+D	1 x 2.2	0.3 x 0.4	0.8	1.0	4.1
1310 nm, 1 km, 1x M+D	1 x 2.2	1.0 x 0,4	0.8	1.5	4.9
1310 nm, 5 km, 1x M+D	1 x 2.2	5.0 x 0.4	0.8	2.0	7.0
1310 nm, 300 m, 2x M+D	2 x 2.2	0.3 x 0.4	1.6	1.0	7.1
1310 nm, 1 km, 2x M+D	2 x 2.2	1.0 x 0,4	1.6	1.5	7.9
1310 nm, 5 km, 2x M+D	2 x 2.2	5.0 x 0.4	1.6	2.0	10.0
CWDM, 300 m, 1x M+D	1 x 4.5	0.3 x 0.25	0.8	1.0	6.3
CWDM, 1 km, 1x M+D	1 x 4.5	1.0 x 0.25	0.8	1.5	7.0
CWDM, 5 km, 1x M+D	1 x 4.5	5.0 x 0.25	0.8	2.0	8.5
CWDM, 300 m, 2x M+D	2 x 4.5	0.3 x 0.25	1.6	1.0	11.6
CWDM, 1 km, 2x M+D	2 x 4.5	1.0 x 0.25	1.6	1.5	12.3
CWDM, 5 km, 2x M+D	2 x 4.5	5.0 x 0.25	1.6	2.0	13.8

Připravované produkty Cross Connect

- **Pásmový filtr 1260 – 1460 / 1460 – 1520 nm (10ch / 8ch)**
- **CWDM 10ch - spodní pásmo 1270 – 1450 nm**
- **CWDM 4 ch + DWDM C band**
- **DWDM 40 ch**

- **Analyzér TAP – splitter 30/70, 50/50**
 - Vydělení signálů pro monitoring / analýzu / sběr dat
 - Multimode OM4, Singlemode
 - Pro 40G/100G SR4

Pozvánka na školení

Optické sítě v DataCentrech 40/100/200 Gbit/s a jejich měření

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