



Tudo que você precisa saber sobre o sistema DWDM

Rinaldo Vaz

Especialista em redes ópticas de longa distância, sistemas DWDM, redes MPLS/IP e roteamento inter-AS

Empresa: INOCMON



→ **Quem somos?**

- **Especialistas em padrões e processos na operação de redes DWDM e MPLS/IP**

→ **Nosso objetivo?**

- **Reduzir custos operacionais com ferramentas inteligentes**
- **Desenvolver pilares sólidos para um crescimento ilimitado da rede**

→ **Importância de observar os pontos abordados**
















→ **Importância de observar os pontos abordados**

- **Projeto 1: R\$ 8 milhões**
- **Projeto 2: R\$ 7 milhões**
- **Projeto 3: R\$ 9 milhões**
















→ Importância de observar os pontos abordados

- Alinhamento automático de canais
- OTDR
- Expansão para canais de 100G para 200G
- OSA via gerência
















→ Importância de observar os pontos abordados

	AUTO ALIGN	OTDR	OSA	100G	200G	PREÇO FINAL
PROJETO 1						R\$ 8.000.000,00
PROJETO 2						R\$ 7.000.000,00
PROJETO 3						R\$ 9.000.000,00

→ AJUSTE 1 DE PROPOSTAS

	AUTO ALIGN	OTDR	OSA	100G	200G	PREÇO FINAL
PROJETO 1						R\$ 9.800.000,00
PROJETO 2						R\$ 11.000.000,00
PROJETO 3						R\$ 9.000.000,00

→ AJUSTE 2 DE PROPOSTAS

	AUTO ALIGN	OTDR	OSA	100G	200G	PREÇO FINAL
PROJETO 1						R\$ 6.200.000,00
PROJETO 2						R\$ 7.000.000,00
PROJETO 3						R\$ 5.500.000,00

**UM SÁBIO CHINÊS
UMA VEZ DISSE:**

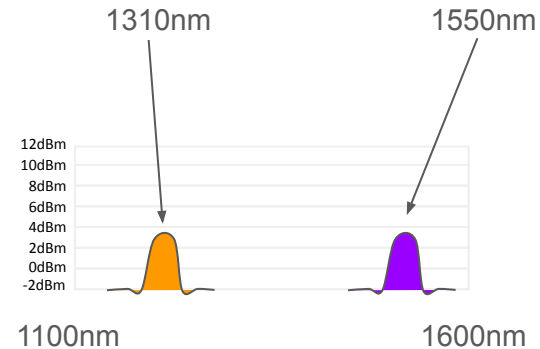


“O barato pode sair caro”

WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

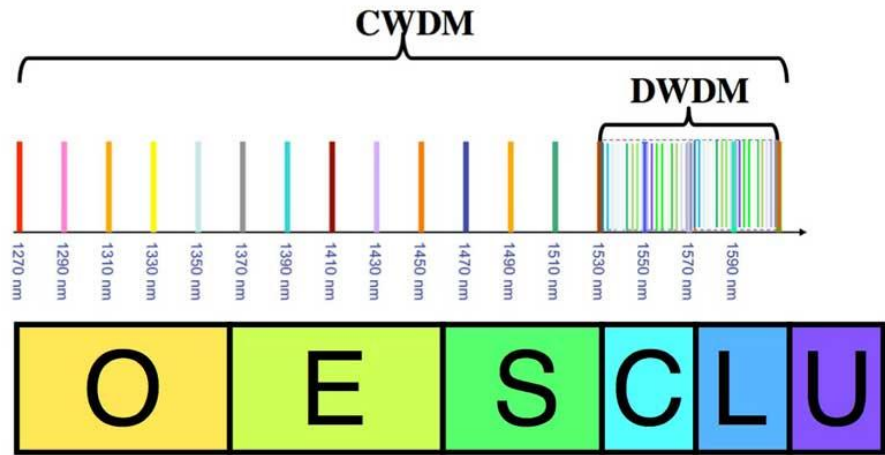
→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ Exemplo de WDM:



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ Exemplo de CWDM e DWDM:



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ Desvantagens do CWDM

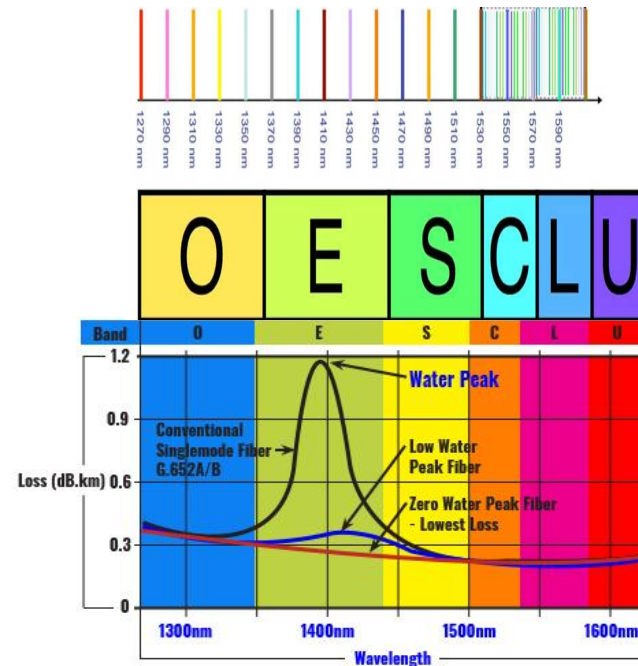
- Poucos canais
- Curtas distâncias
- ~~Problema do pico d'água~~



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ Desvantagens do CWDM



- ~~Problema do pico d'água~~



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ Desvantagens do DWDM

- Custo mais alto do laser (?)

Hot	Hot
	
C17 C18 C19 C20 C21 +40	1470nm 1490nm 1510nm +5
C17-C61 10G DWDM SFP+ 100GHz, 80km ZR Industrial, C21 Wavelength	1470nm-1610nm 10G CWDM SFP+, 80km ZR Industrial, 1470nm Wavelength
Semtech EML Industrial ≤1.8W ITU ...	Semtech EML BOX ≤1.8W Industrial...
R\$ 1,901.00	R\$ 2,218.00
Pre-order, Ship by 22 Oct, 2024	Pre-order, Ship by 18 Nov, 2024
49 Solds 26 Reviews	17 Solds 24 Reviews

→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS



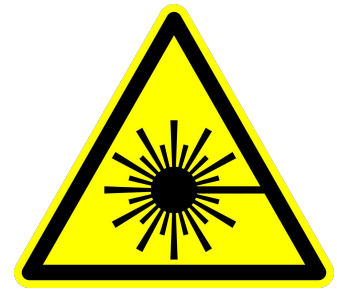
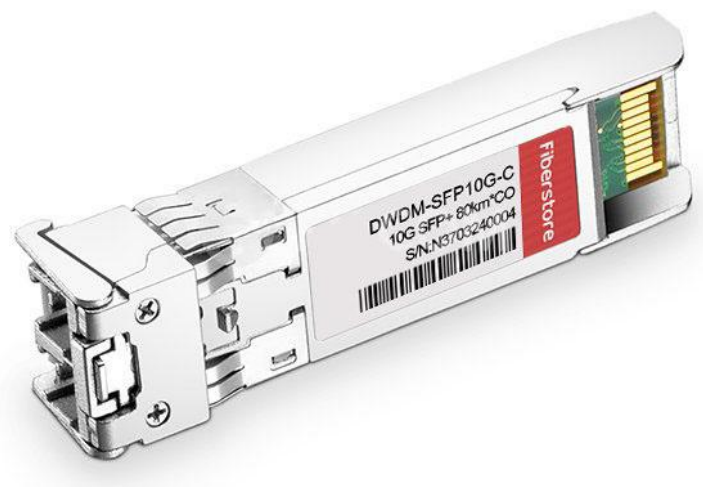
→ Se é passivo é CWDM e se é ativo é DWDM?





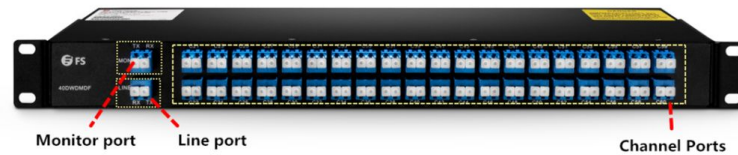
→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ LASERS



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

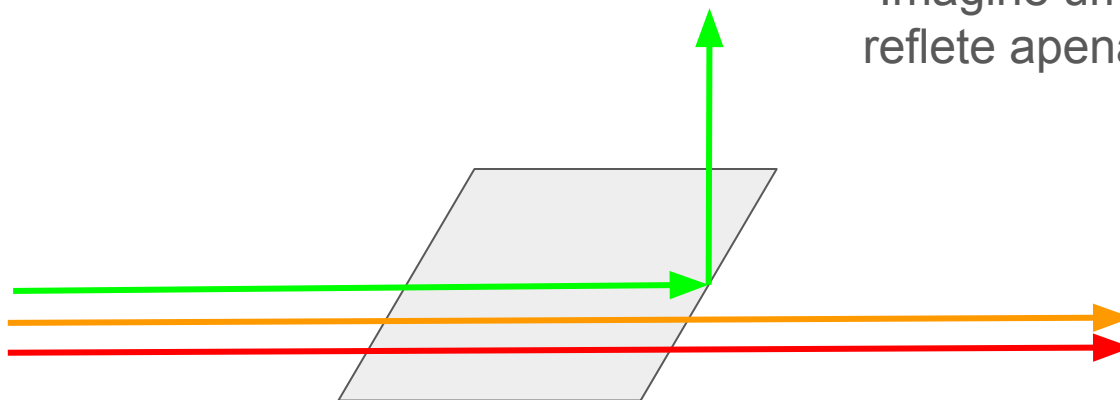
→ MUX/DEMUX



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS



→ MUX/DEMUX

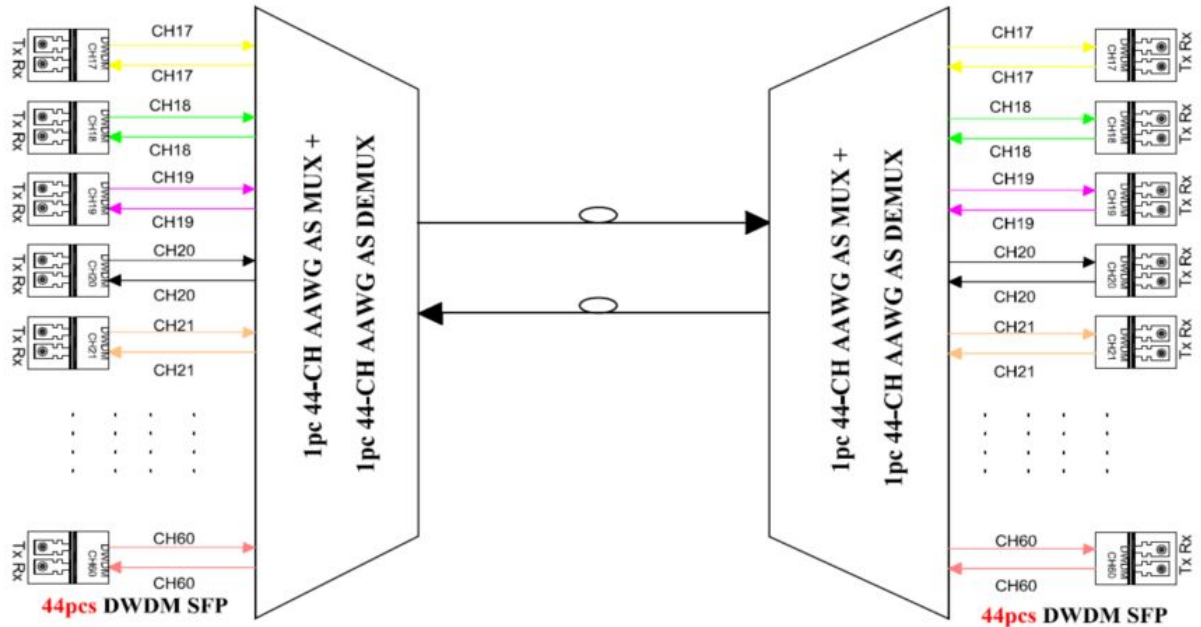


Imagine um espelho que reflete apenas a cor verde

→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ MUX/DEMUX

- comum

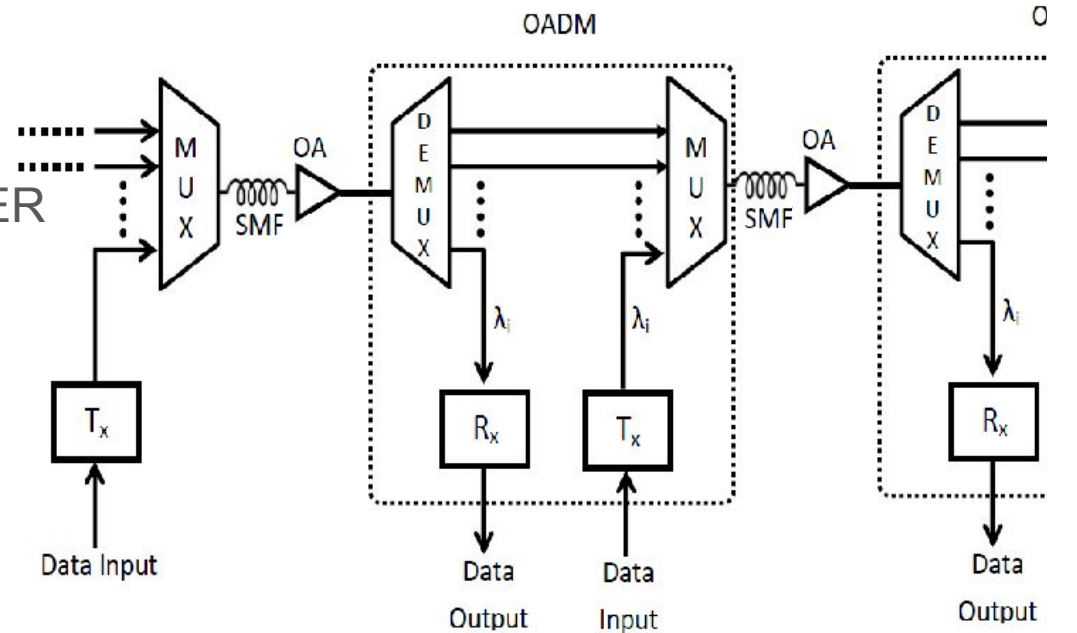




→ MUX/DEMUX

- OADM

OPTICAL ADD DROP MULTIPLEXER



CH 20 ← → CH 20 CH 20 ← → CH 20

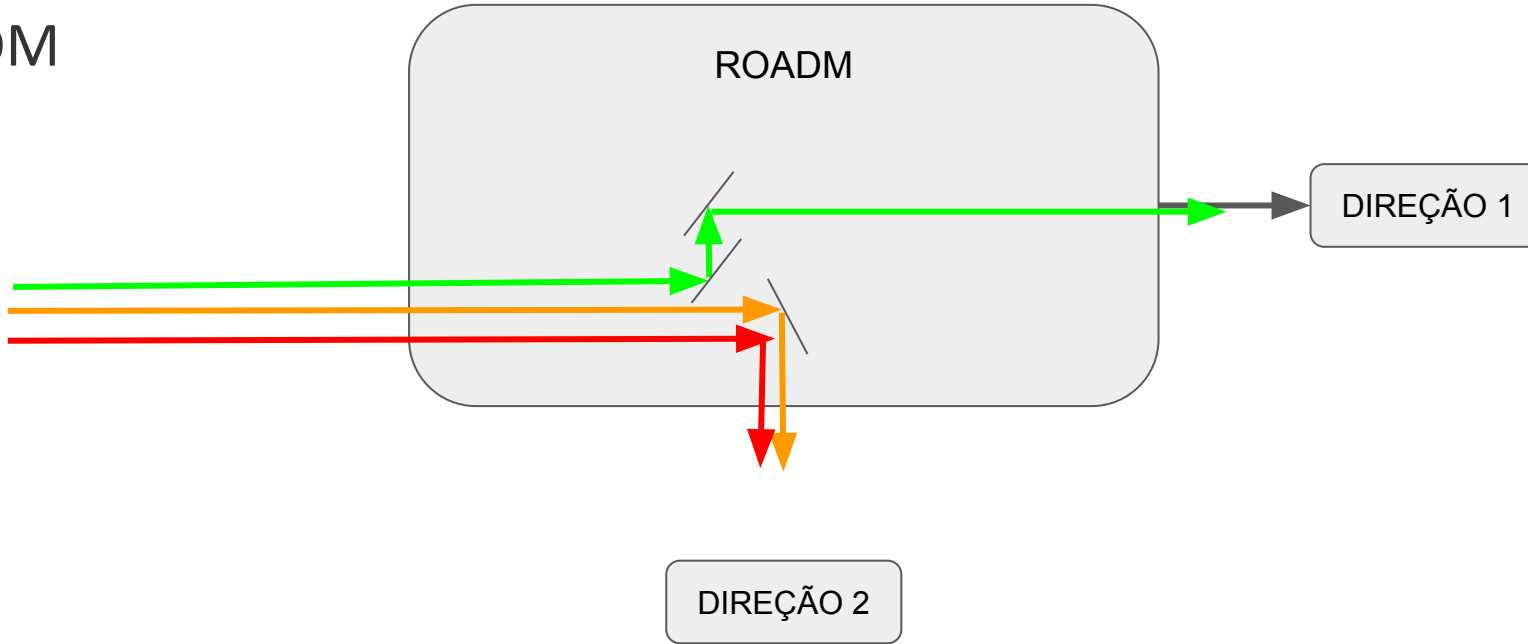


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→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ MUX/DEMUX

- ROADM



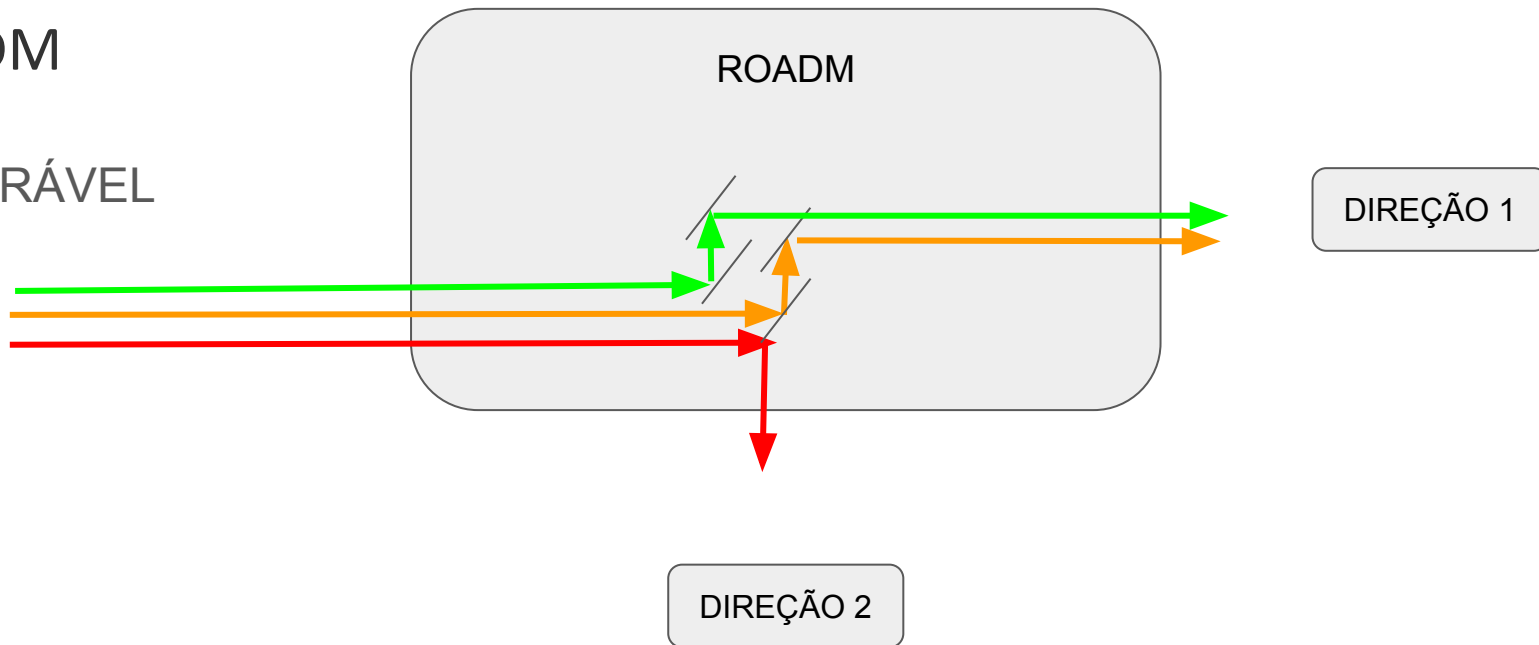
→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS



→ MUX/DEMUX

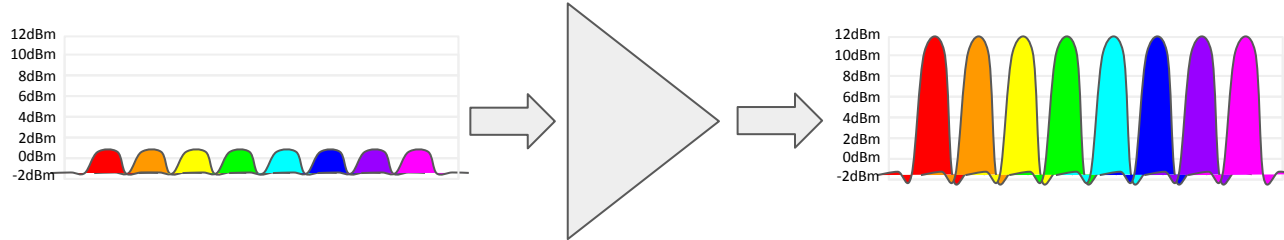
- ROADM

RECONFIGURÁVEL



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ AMPLIFICADORES

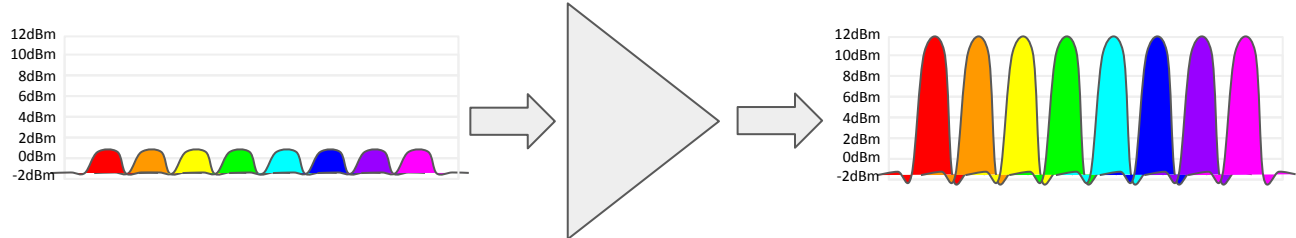


EDFA

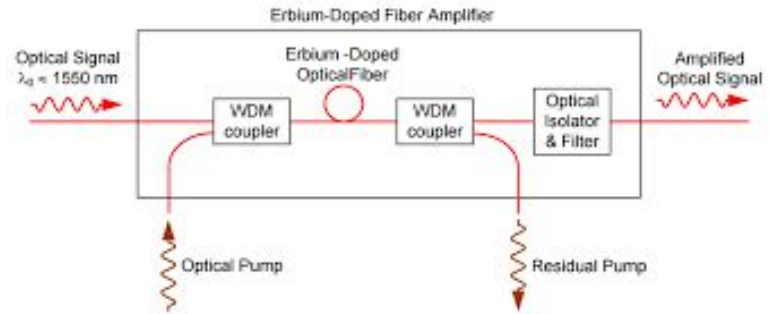


→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ AMPLIFICADORES



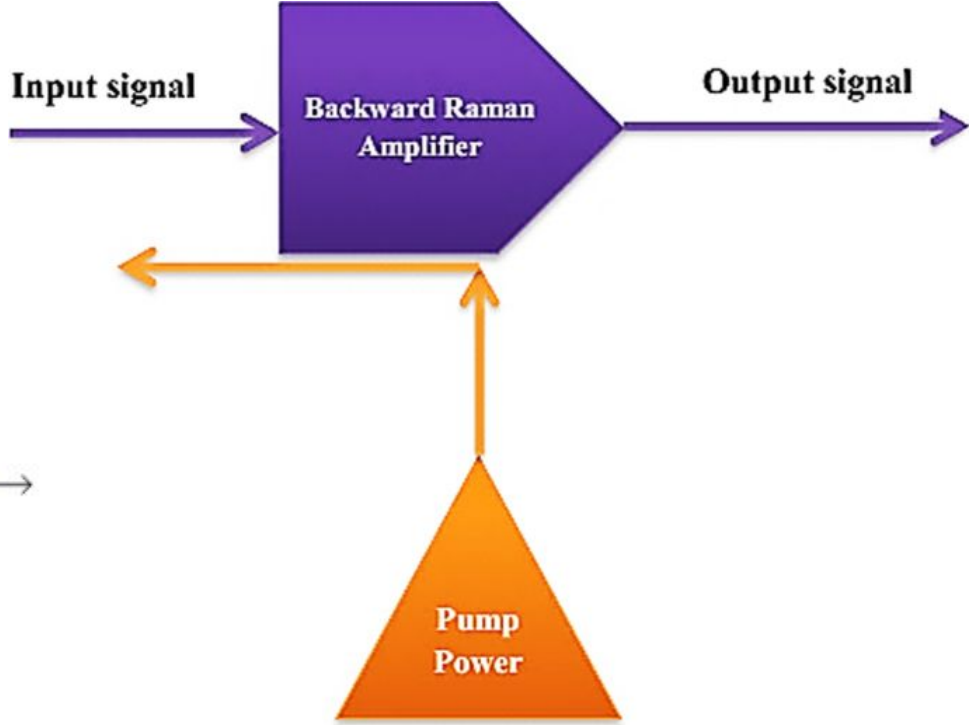
EDFA



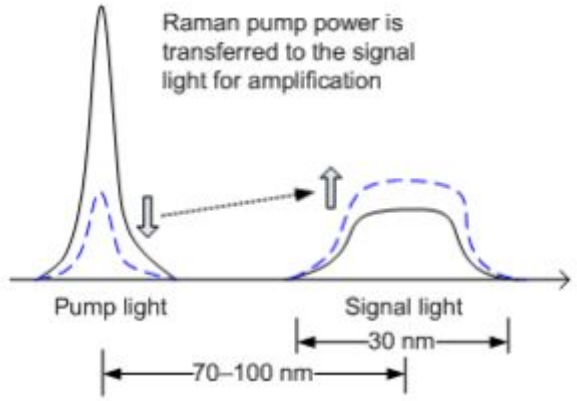


→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ AMPLIFICADORES



RAMAN

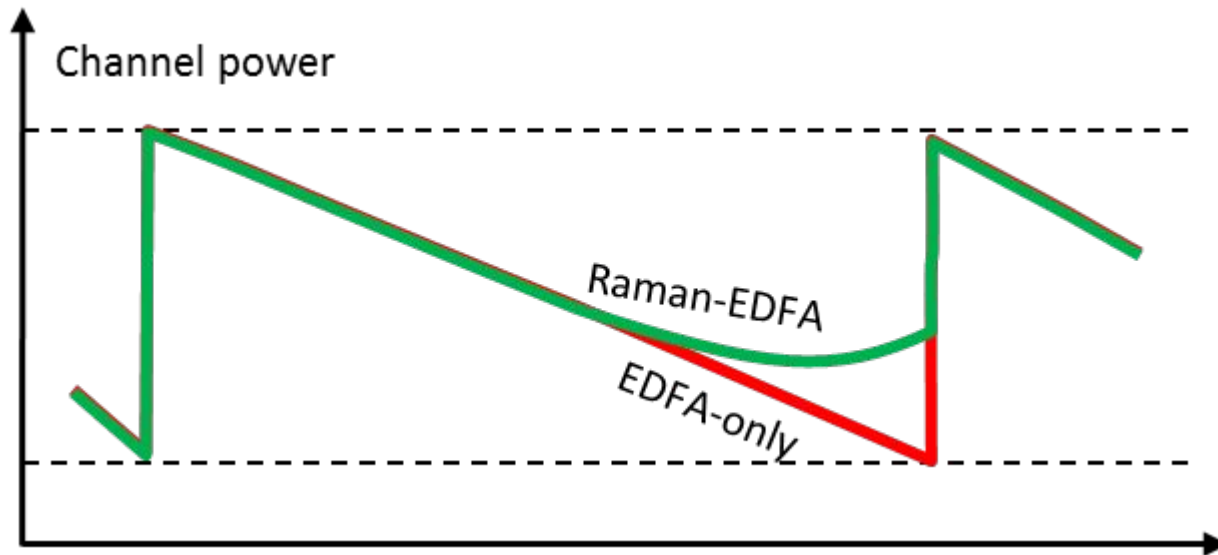


→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

iNOCmon

→ AMPLIFICADORES

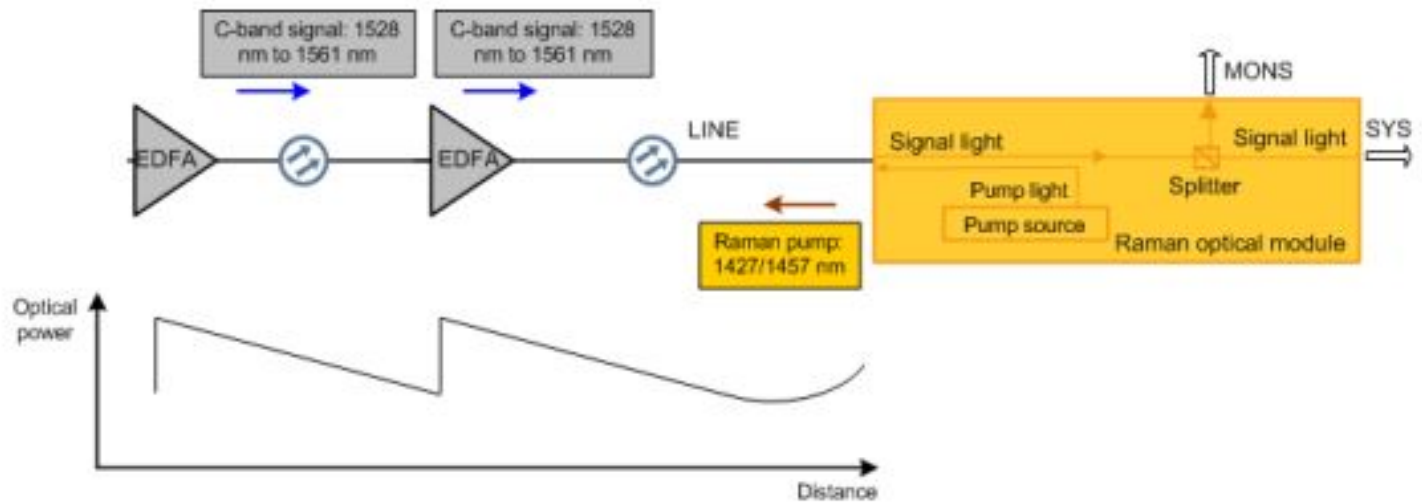
RAMAN



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ AMPLIFICADORES

RAMAN

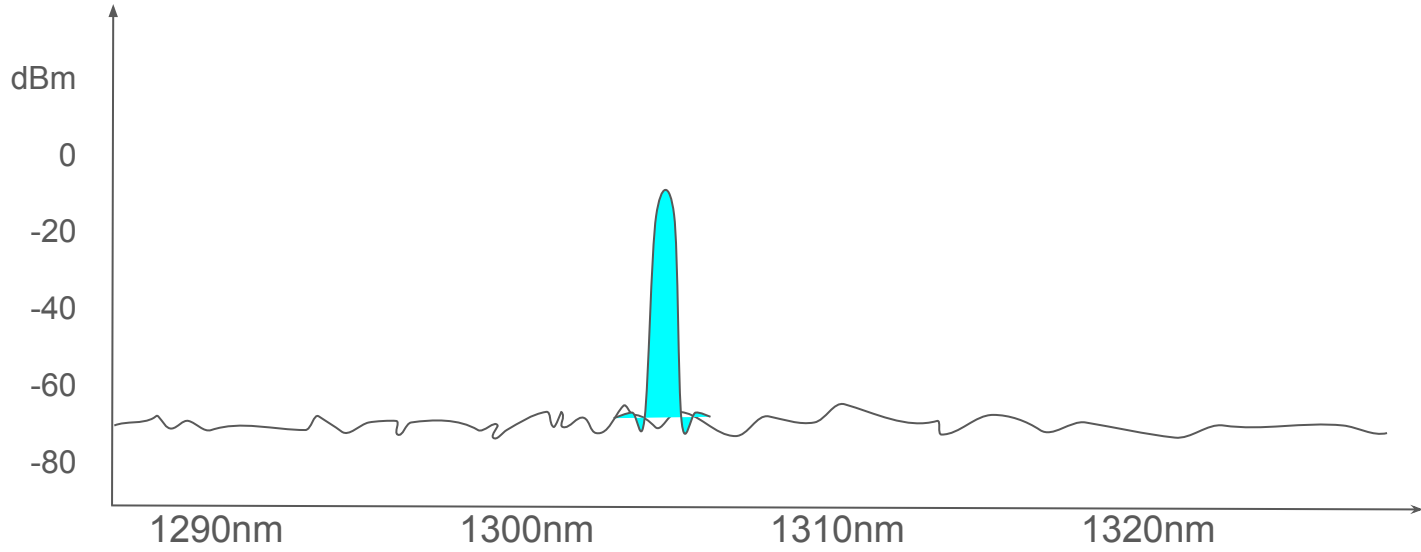




SINAIS ÓPTICOS NO DOMÍNIO DA FREQUÊNCIA

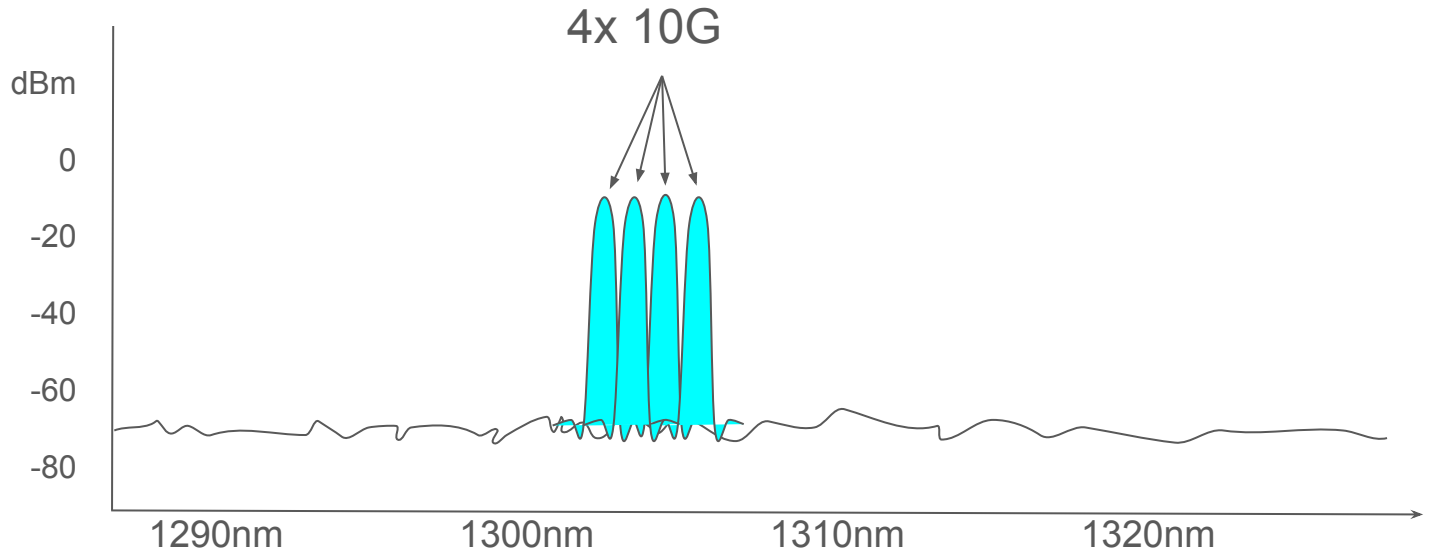
→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ 10G Ethernet (sfp+)



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

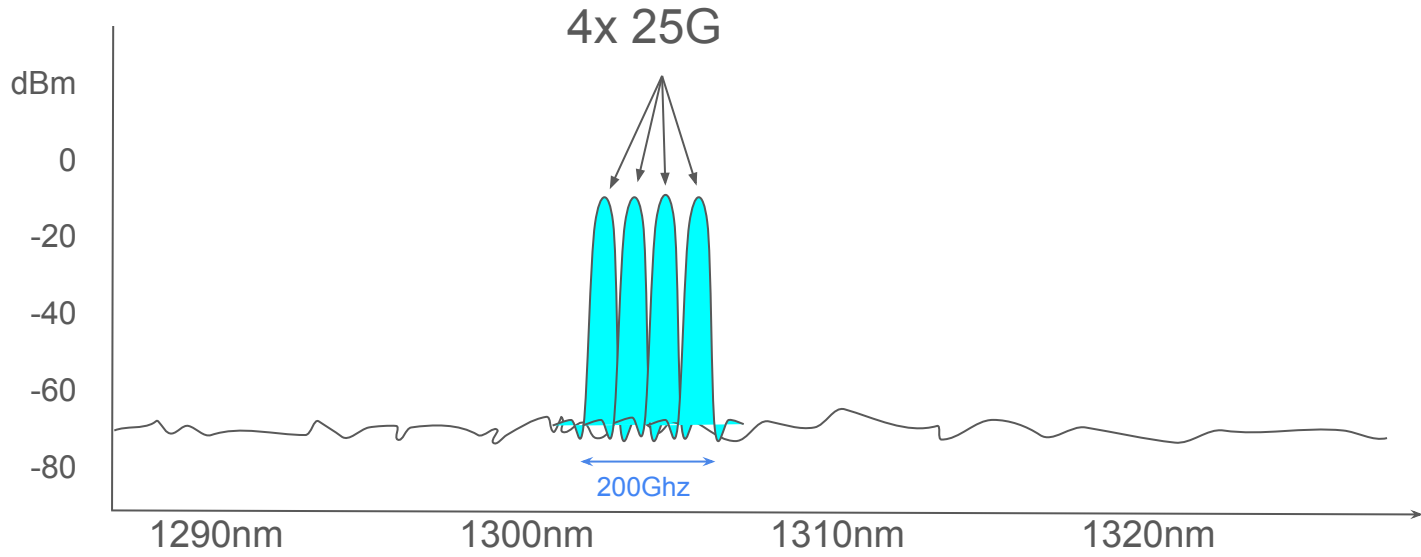
→ 40G Ethernet (Qsfp+)



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ 100G Ethernet (Qsfp28)

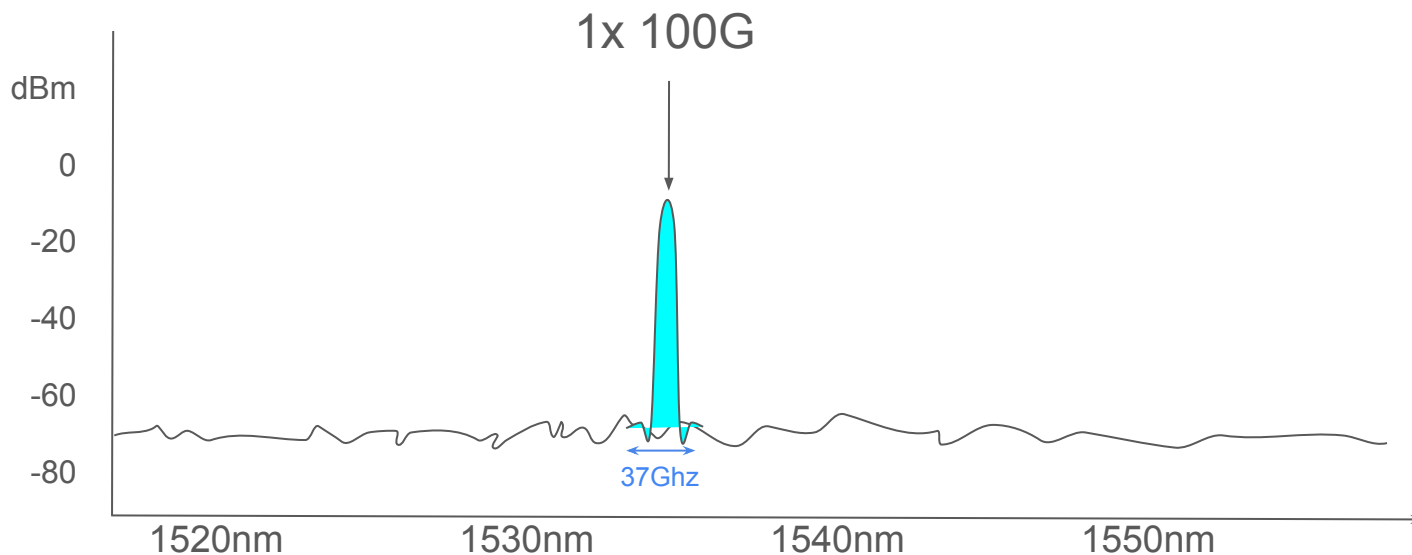
<https://smartoptics.com/wp-content/uploads/2024/02/ds-tq2030-oxxc-so-qsf28-100g-o-band-dwdm-40km-r6.1.pdf>



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS



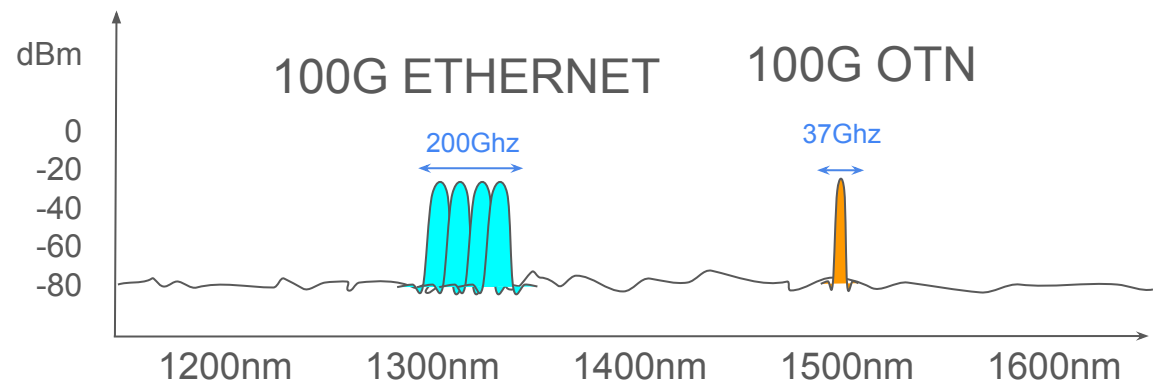
→ 100G OTN





→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ 100G ETHERNET x 100G OTN



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ SISTEMAS FLEXGRID

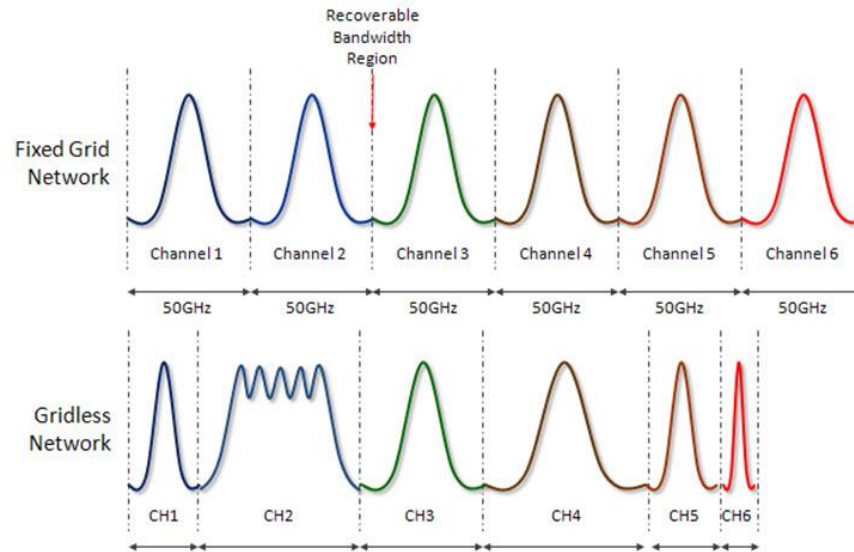
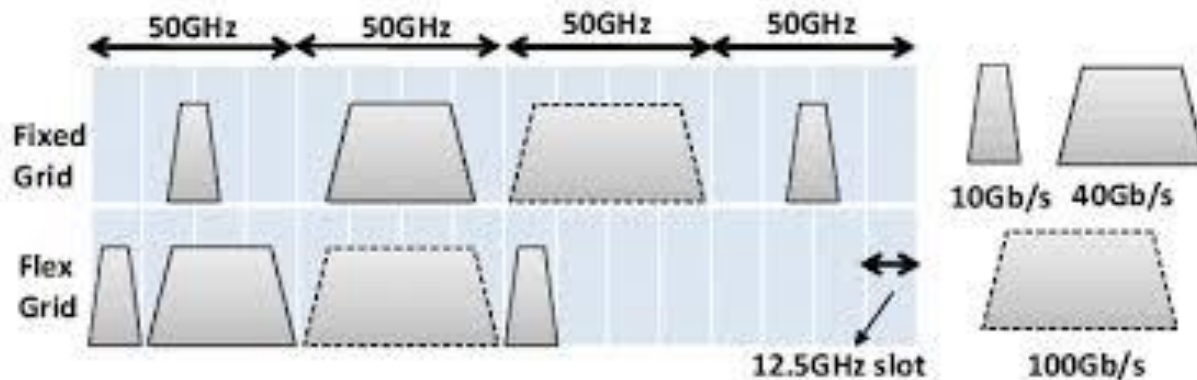


Figure 1 – Fixed Grid vs. Gridless Networking

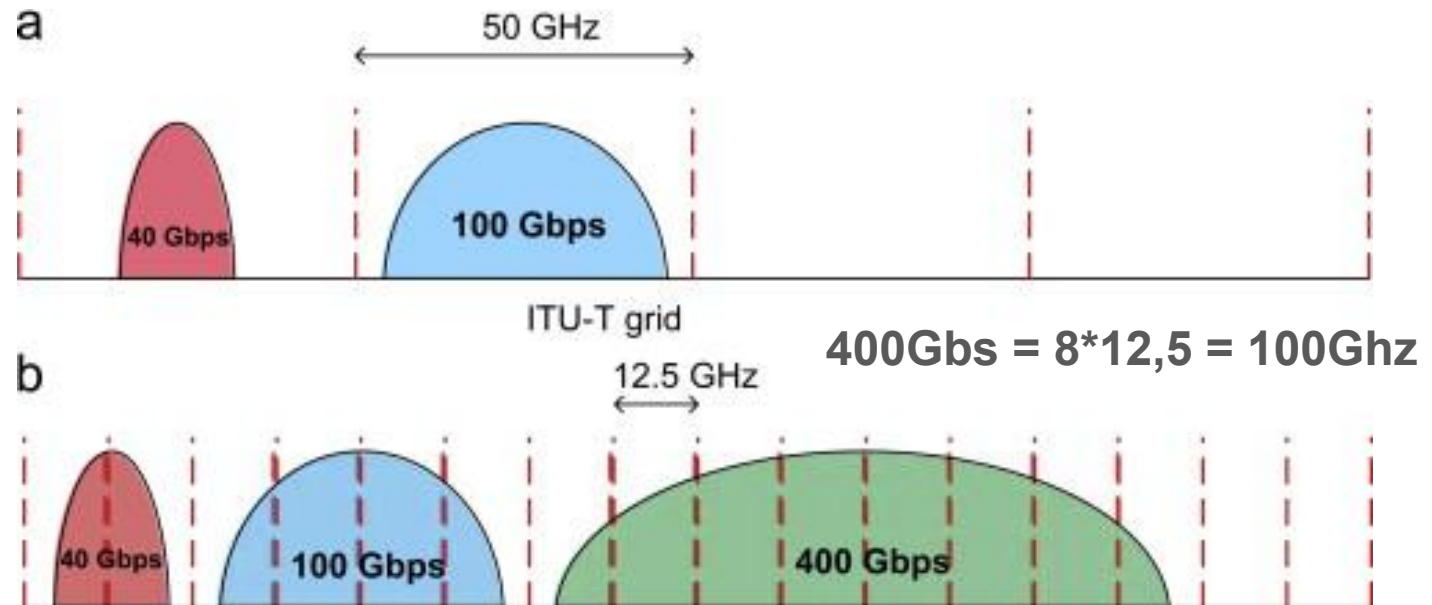
→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ SISTEMAS FLEXGRID



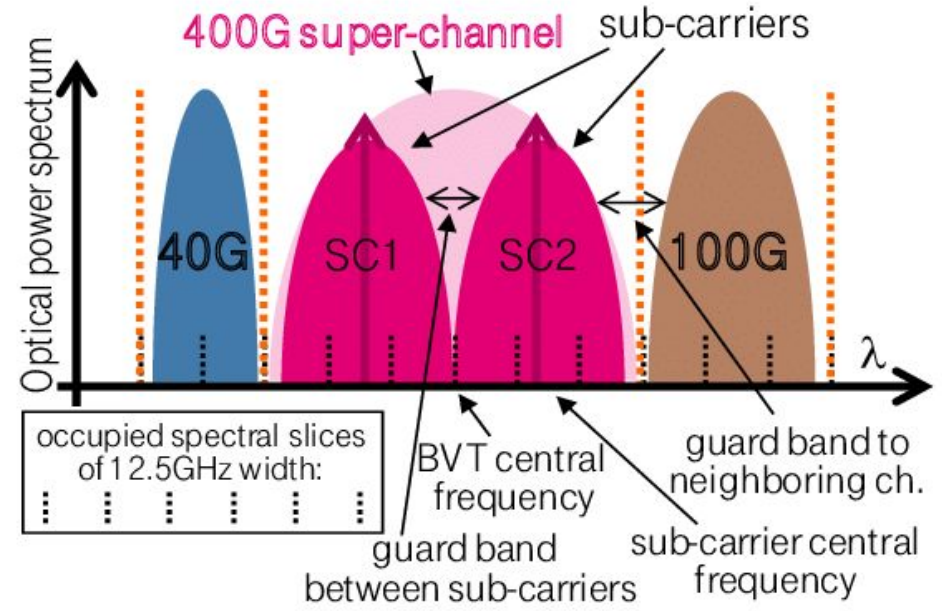
→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ 400G OTN (flexgrid)



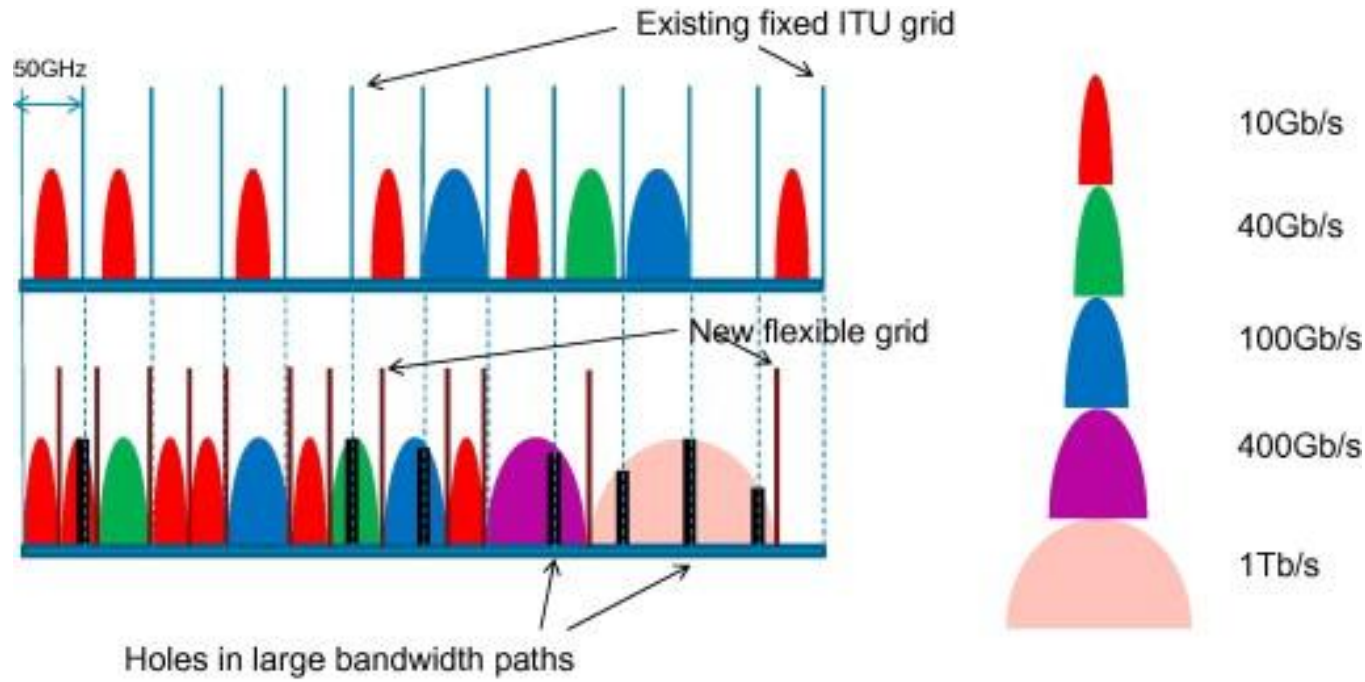
→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ 400G OTN (flexgrid)



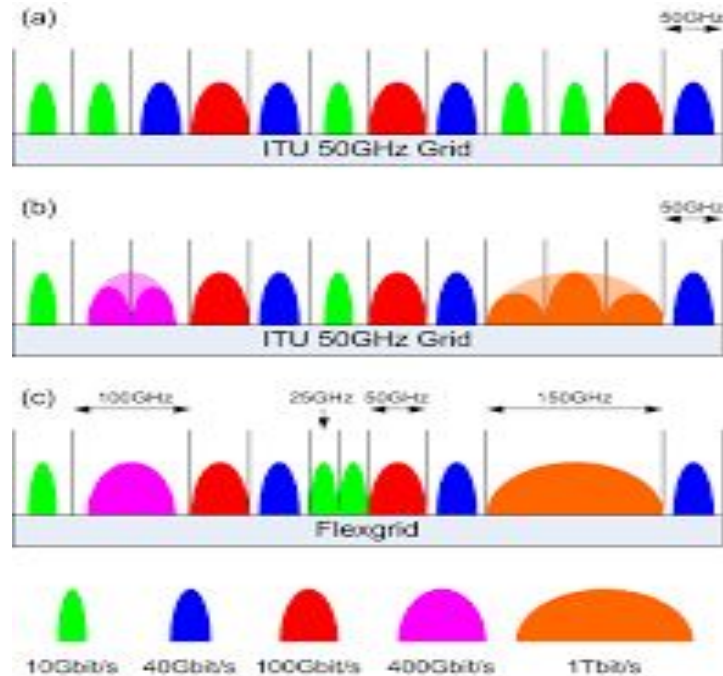
→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ FLEXGRID



→ WDM, CWDM, DWDM E ALGUNS DOS SEUS ELEMENTOS

→ FLEXGRID





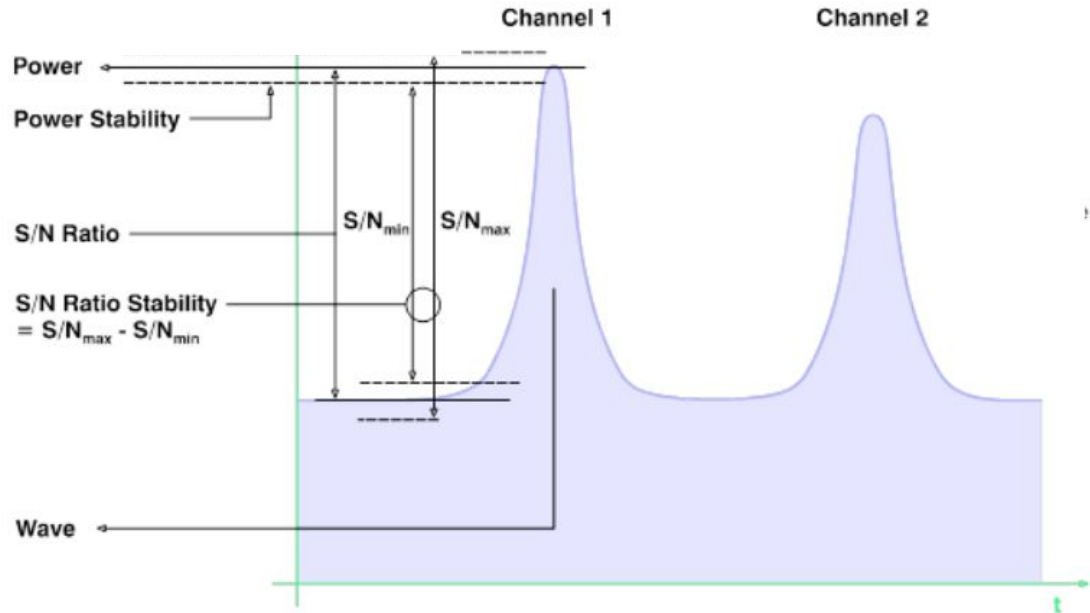
→ A EVOLUÇÃO NA LARGURA DE BANDA SE DÁ PELO AUMENTO NA EFICIÊNCIA NO USO DO ESPECTRO



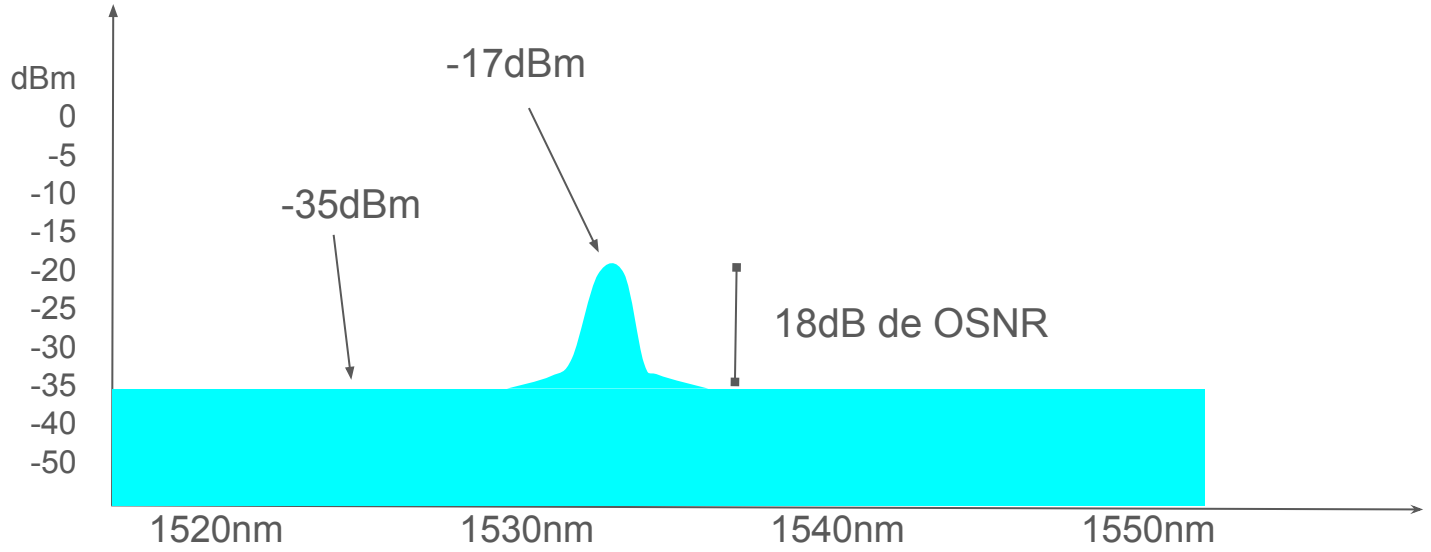


COMPORTAMENTO DOS SINAIS

→ Optical Signal-To-Noise Ratio (OSNR)



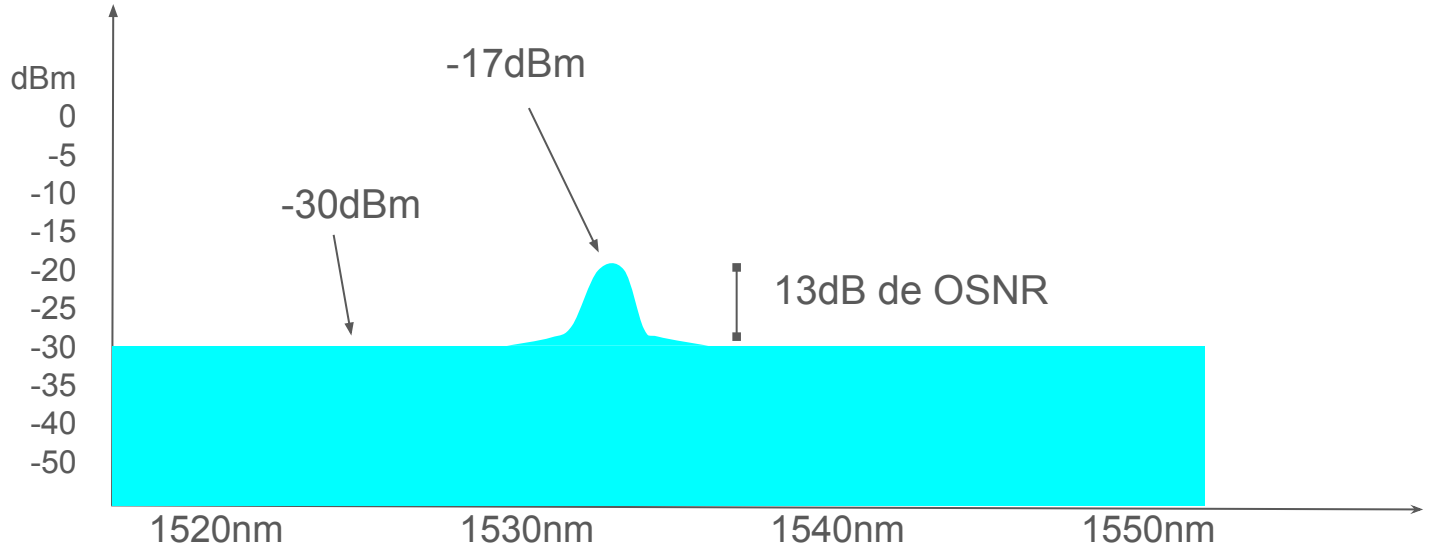
→ Optical Signal-To-Noise Ratio (OSNR)



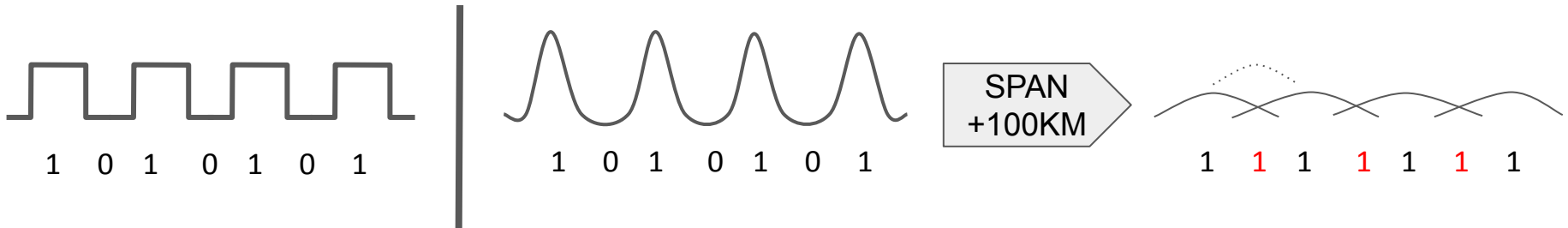


→ COMPORTAMENTO DOS SINAIS

→ Optical Signal-To-Noise Ratio (OSNR)



→ DISPERSÃO CROMÁTICA DO SINAL



→ COMPORTAMENTO DOS SINAIS

→ DISPERSÃO CROMÁTICA DO SINAL

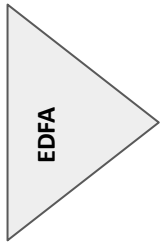


FIBRA INTERNA DE
DISPERSÃO NEGATIVA



→ COMPORTAMENTO DOS SINAIS

→ PROCESSO DE AMPLIFICAÇÃO DO SINAL



Amplificador
Ganho: **16 dB**
Potência máxima de saída: **20 dBm**



- Um sinal que antes media -1 agora está em -10 .
Esse sinal aumentou ou diminuiu?



→ Um sinal que antes media -1 agora está em -10.
Esse sinal aumentou ou diminuiu?

$$-1 - 9 = -10$$

$$-1\text{dBm} - 9\text{dB} = -10\text{dBm}$$

UM SÁBIO CHINÊS
UMA VEZ DISSE:



“Não vá medir a fibra
antes de saber que -10 é
menor que -1 ”

→ COMPORTAMENTO DOS SINAIS

iNOCmon

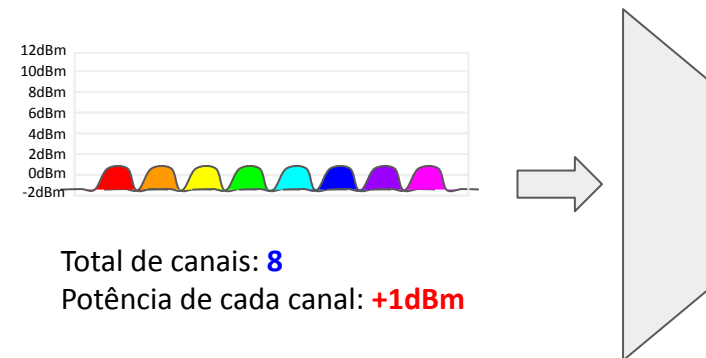
→ PROCESSO DE AMPLIFICAÇÃO DO SINAL

DIFERENÇA ENTRE
GANHO (dB) x MAX-OUT (dBm)



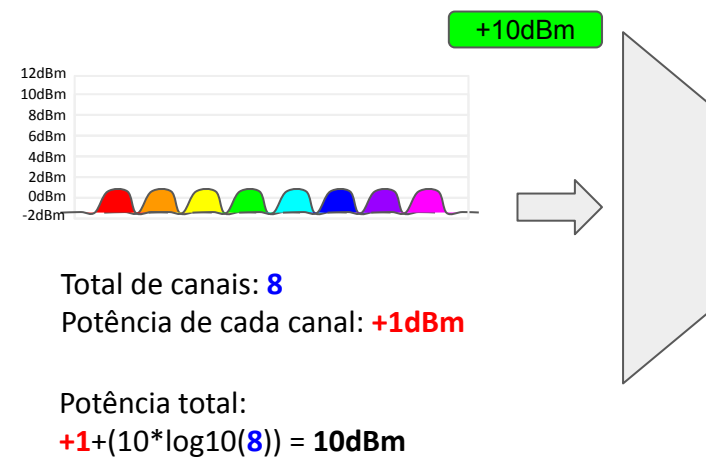
→ COMPORTAMENTO DOS SINAIS

iNOCmon

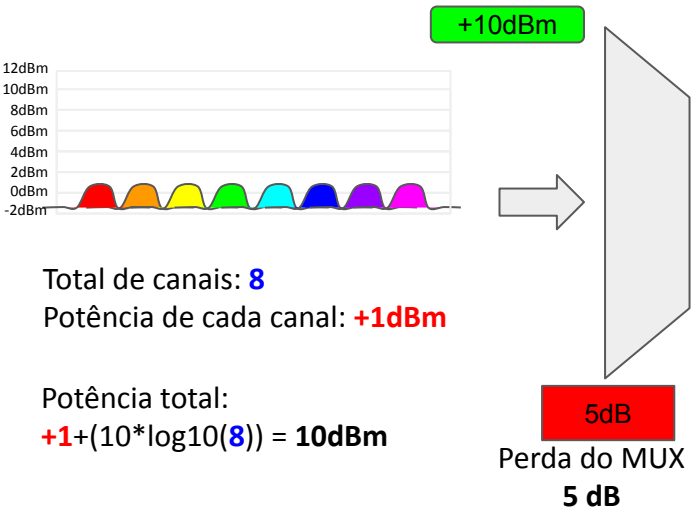


→ COMPORTAMENTO DOS SINAIS

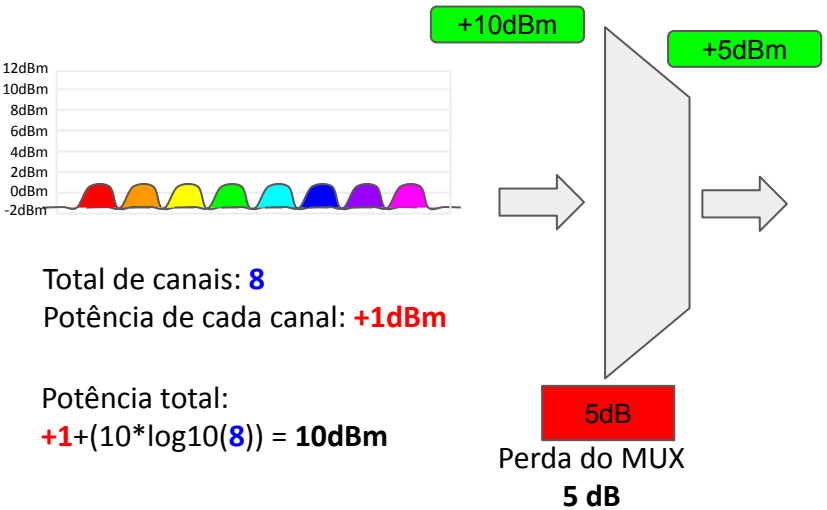
iNOCmon



→ COMPORTAMENTO DOS SINAIS



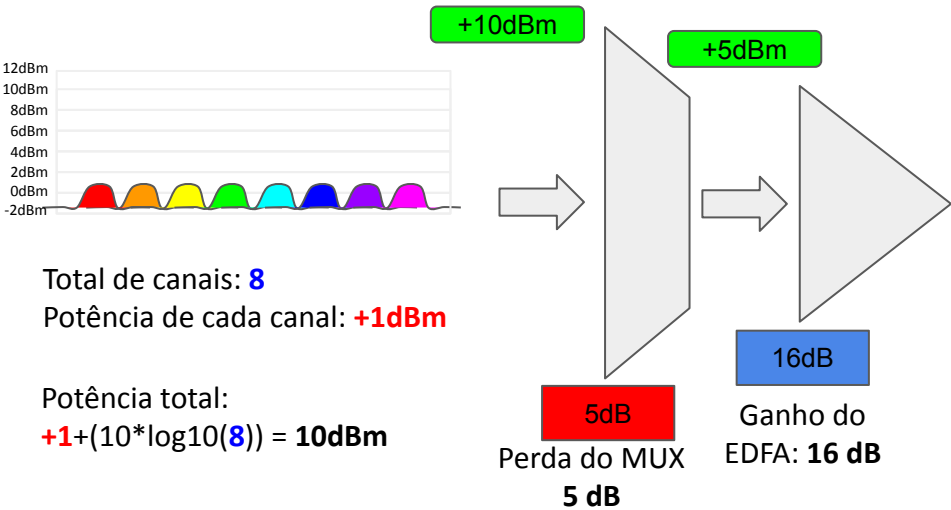
→ COMPORTAMENTO DOS SINAIS



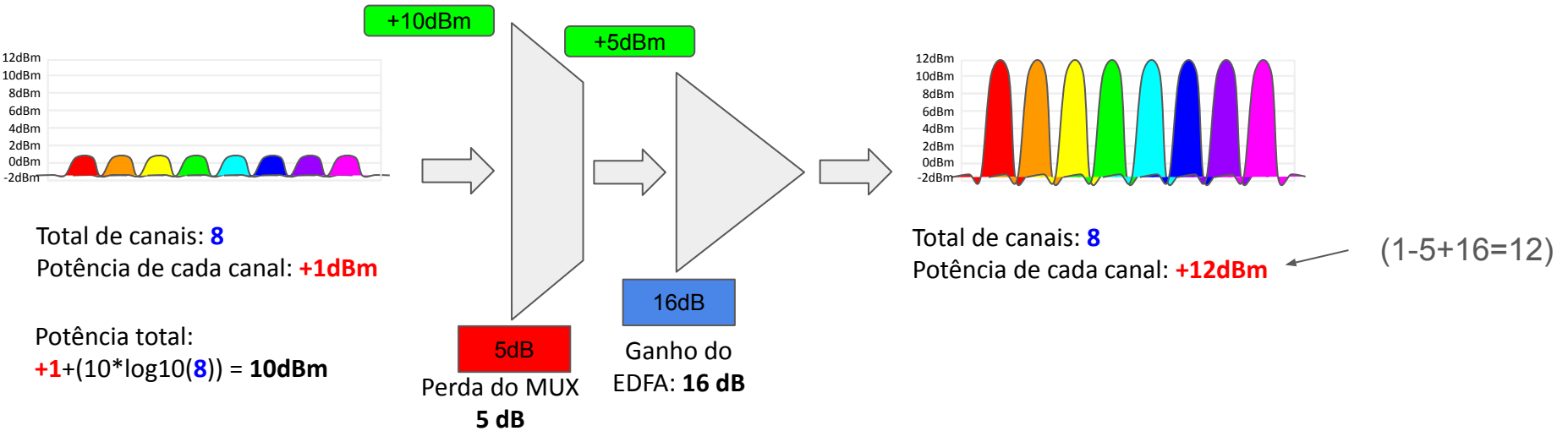
→ COMPORTAMENTO DOS SINAIS

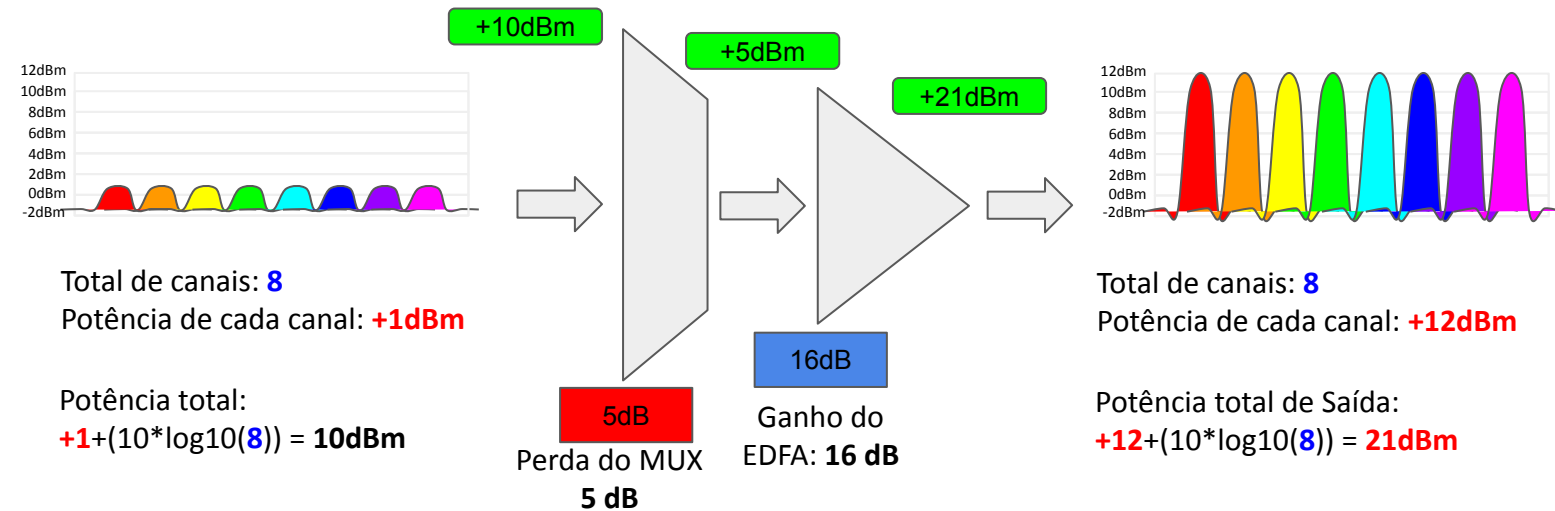


iNOCmon

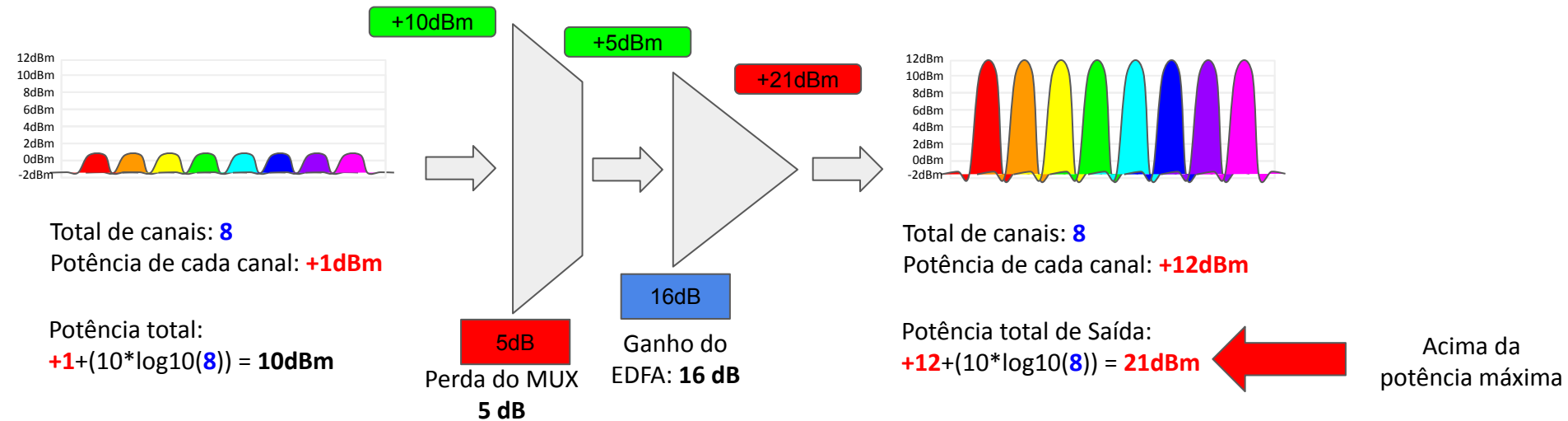


→ COMPORTAMENTO DOS SINAIS





→ COMPORTAMENTO DOS SINAIS





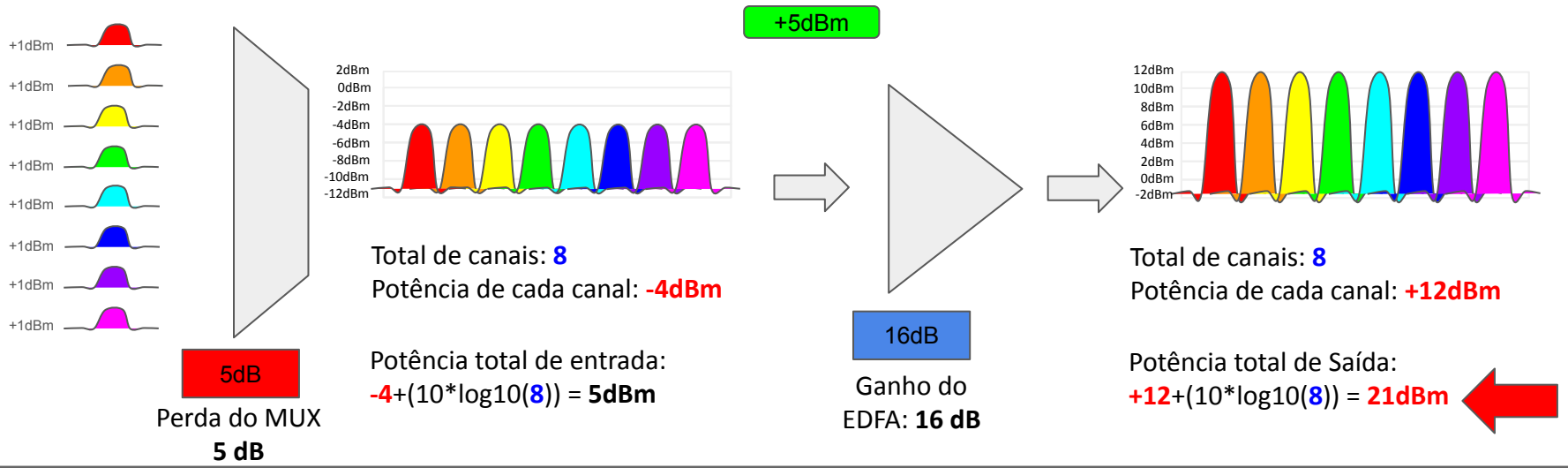
iNOCmon

→ COMPORTAMENTO DOS SINAIS

→ REDUZINDO A POTÊNCIA NA ENTRADA DO MUX

→ COMPORTAMENTO DOS SINAIS

→ REDUZINDO A POTÊNCIA NA ENTRADA DO MUX OU BOOSTER

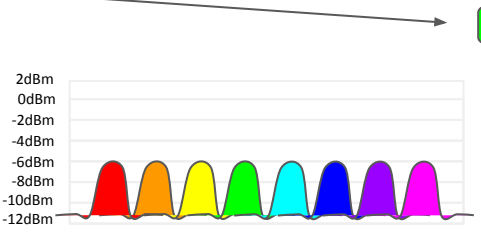
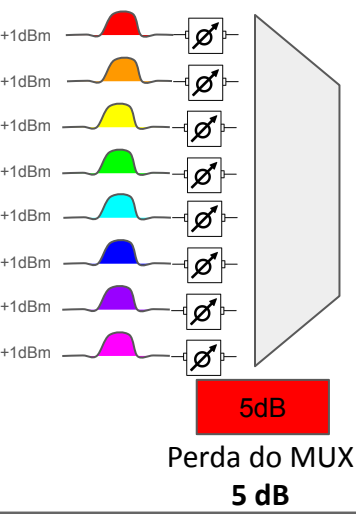


→ COMPORTAMENTO DOS SINAIS

→ REDUZINDO A POTÊNCIA NA ENTRADA DO MUX OU BOOSTER

+1dBm - 2dB = -1dBm (CADA CANAL)

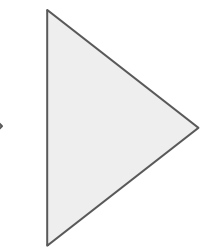
Atenuadores: 2 dB



Total de canais: 8
Potência de cada canal: -6dBm

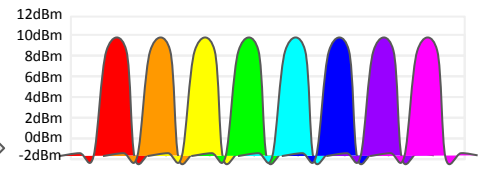
Potência total de entrada:
 $-6 + (10 * \log_{10}(8)) = 3\text{dBm}$

+3dBm



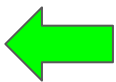
16dB
Ganho do EDFA: 16 dB

+19dBm

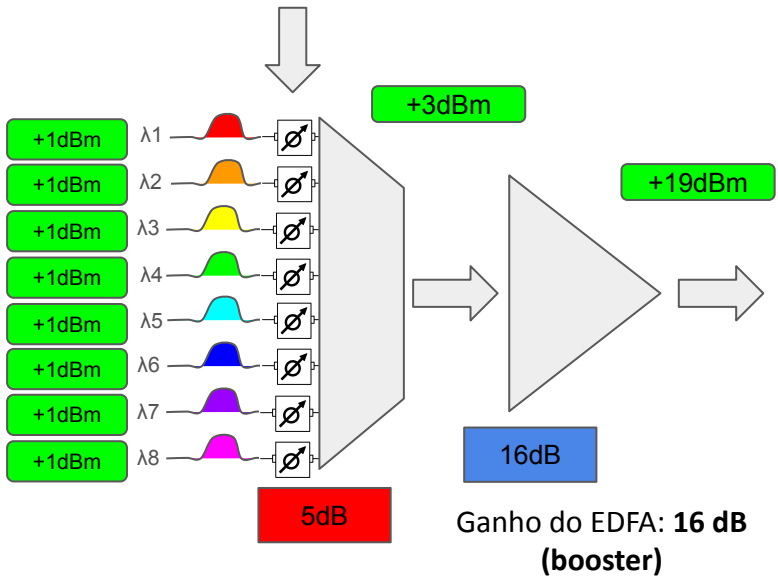


Total de canais: 8
Potência de cada canal: +10dBm

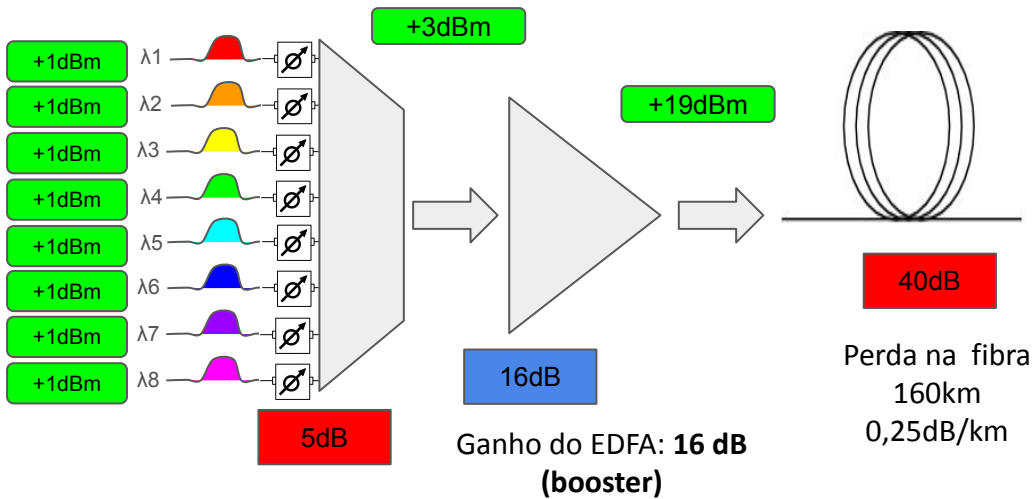
Potência total de Saída:
 $+10 + (10 * \log_{10}(8)) = 19\text{dBm}$



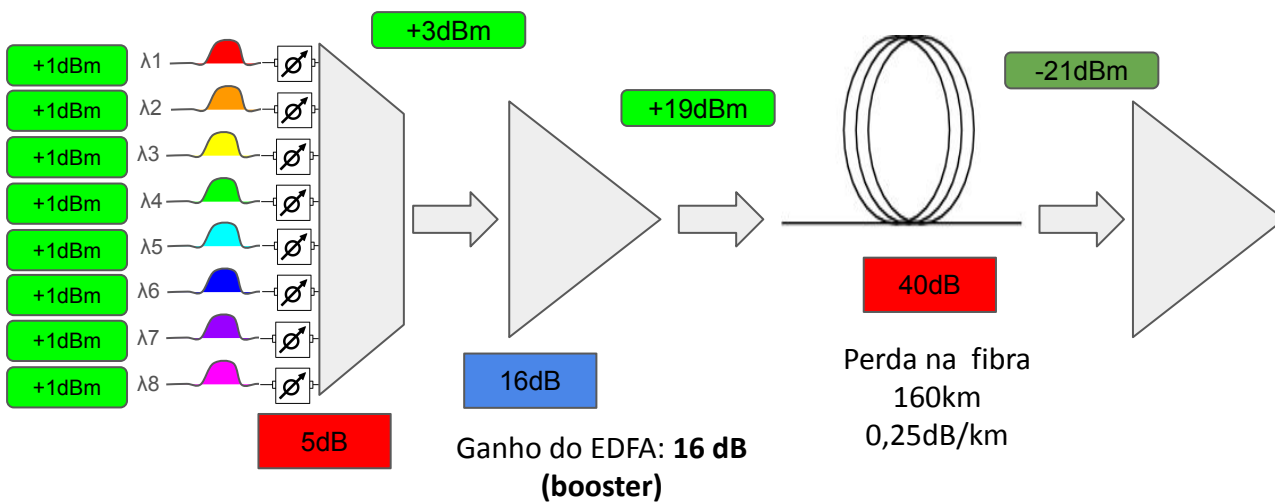
→ COMPORTAMENTO DOS SINAIS



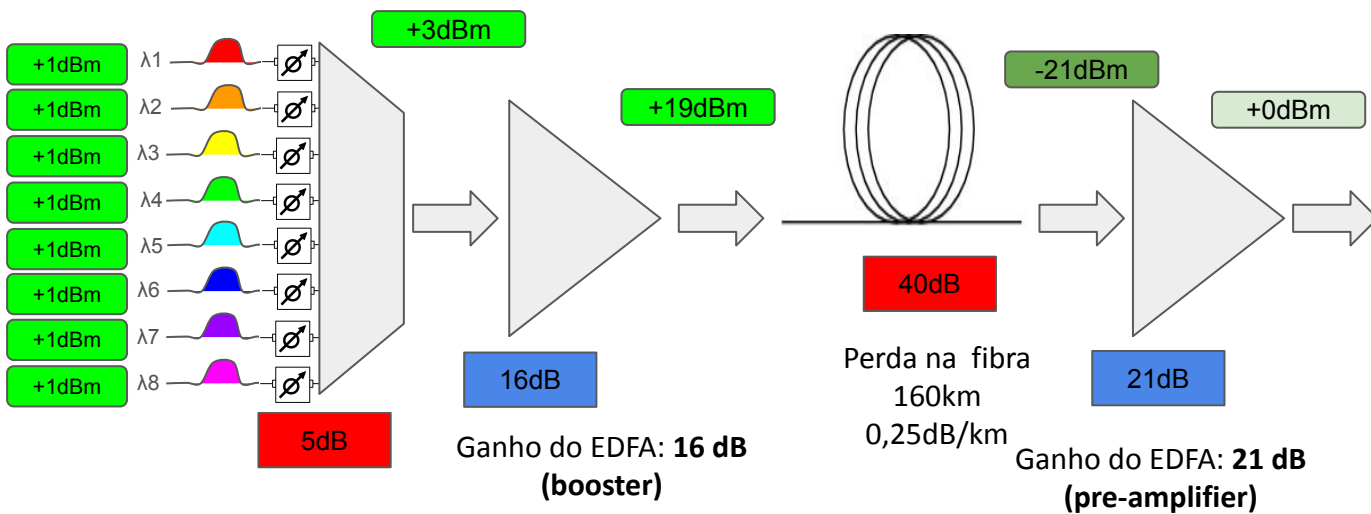
→ COMPORTAMENTO DOS SINAIS

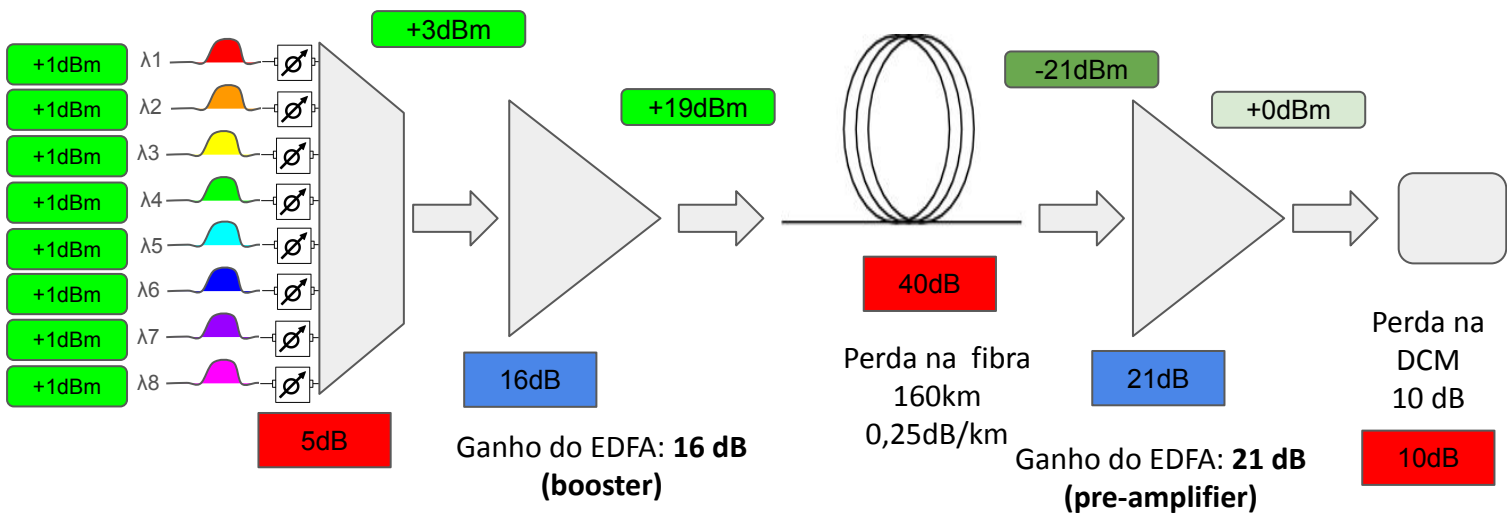


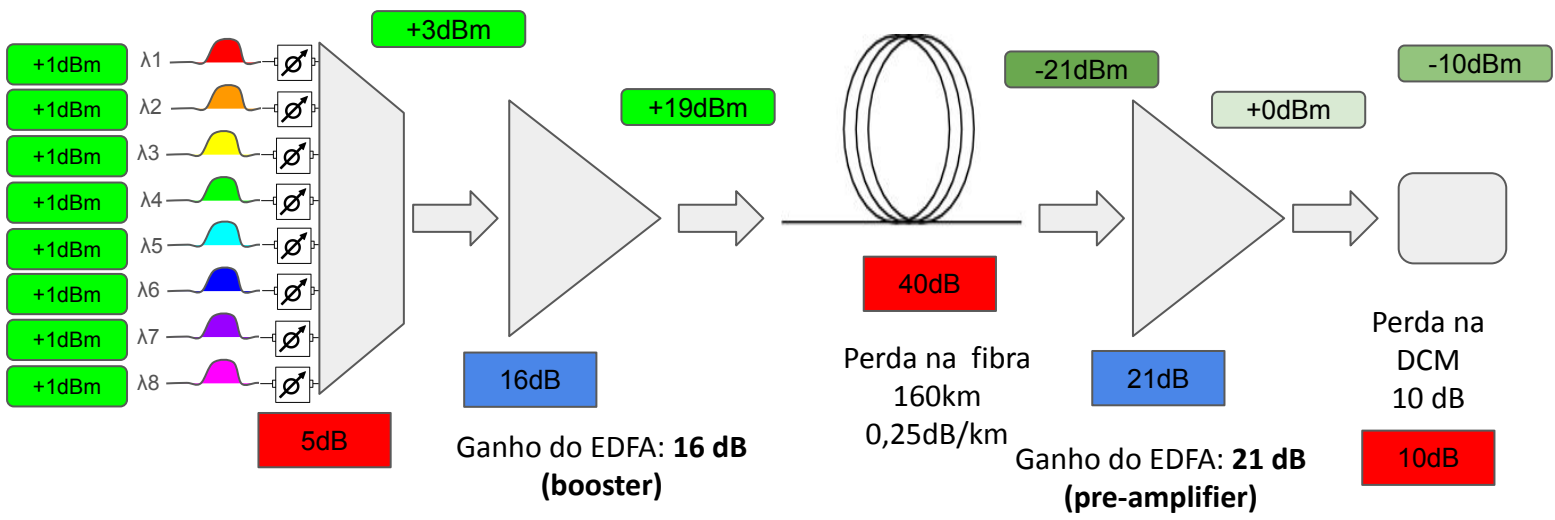
→ COMPORTAMENTO DOS SINAIS



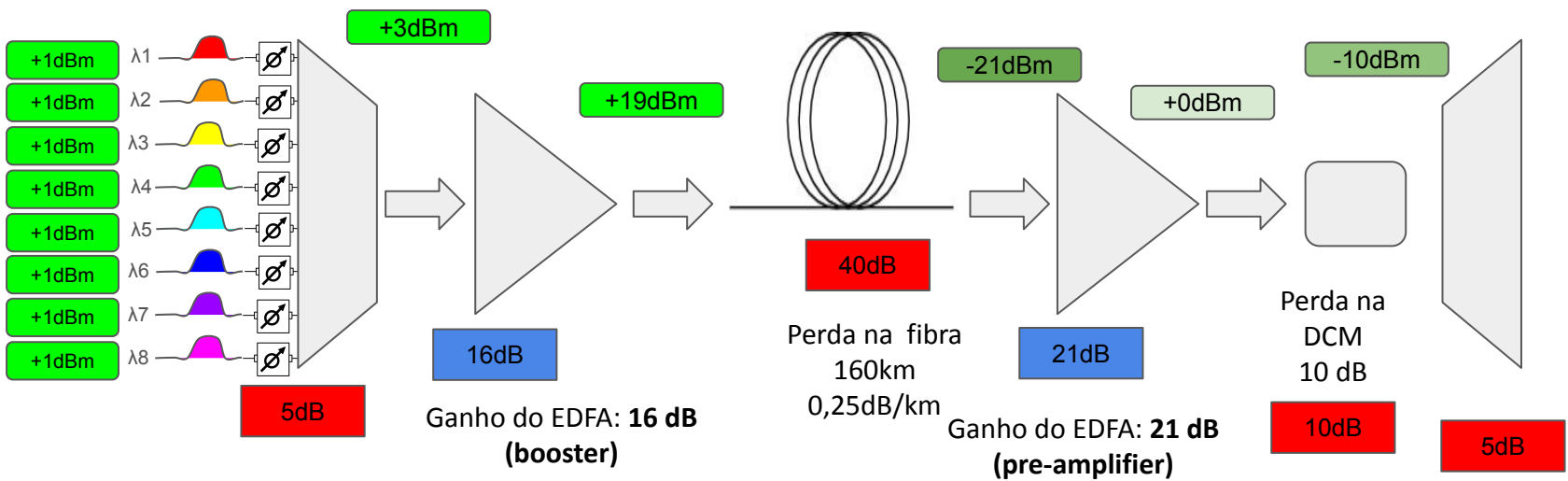
→ COMPORTAMENTO DOS SINAIS



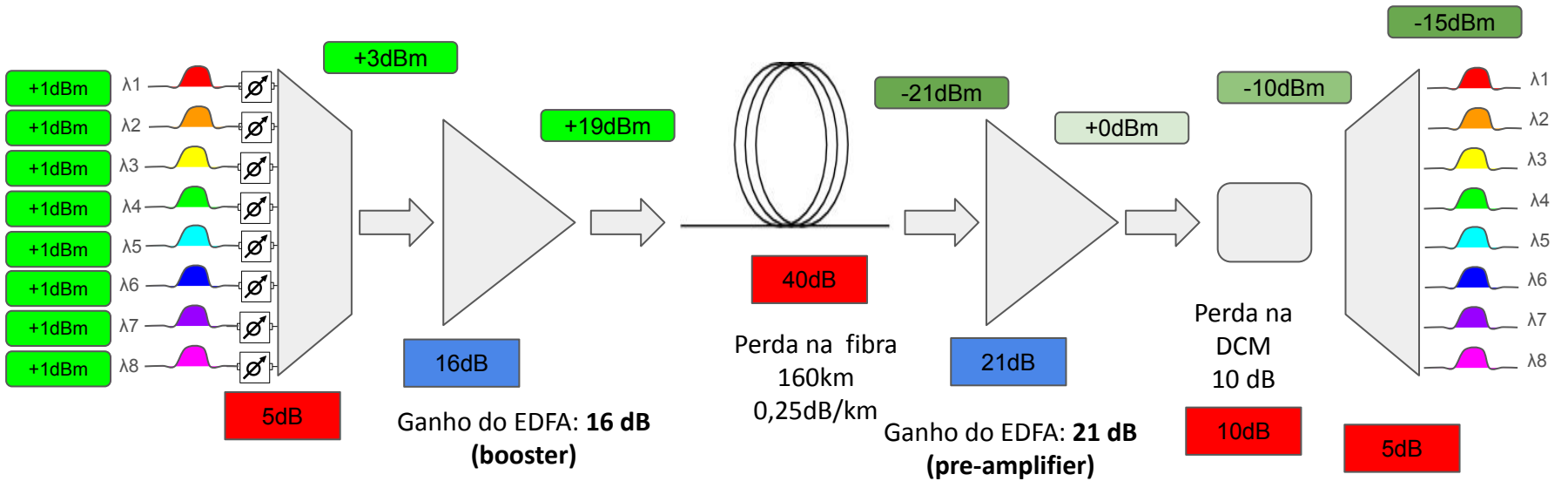




→ COMPORTAMENTO DOS SINAIS

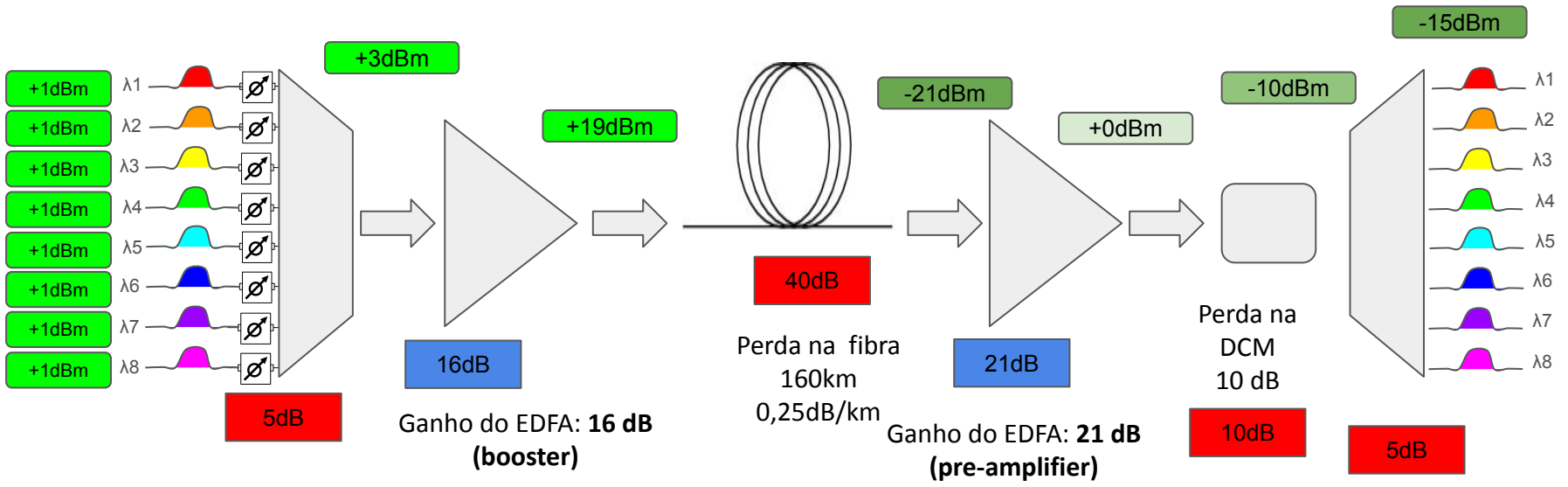


→ COMPORTAMENTO DOS SINAIS



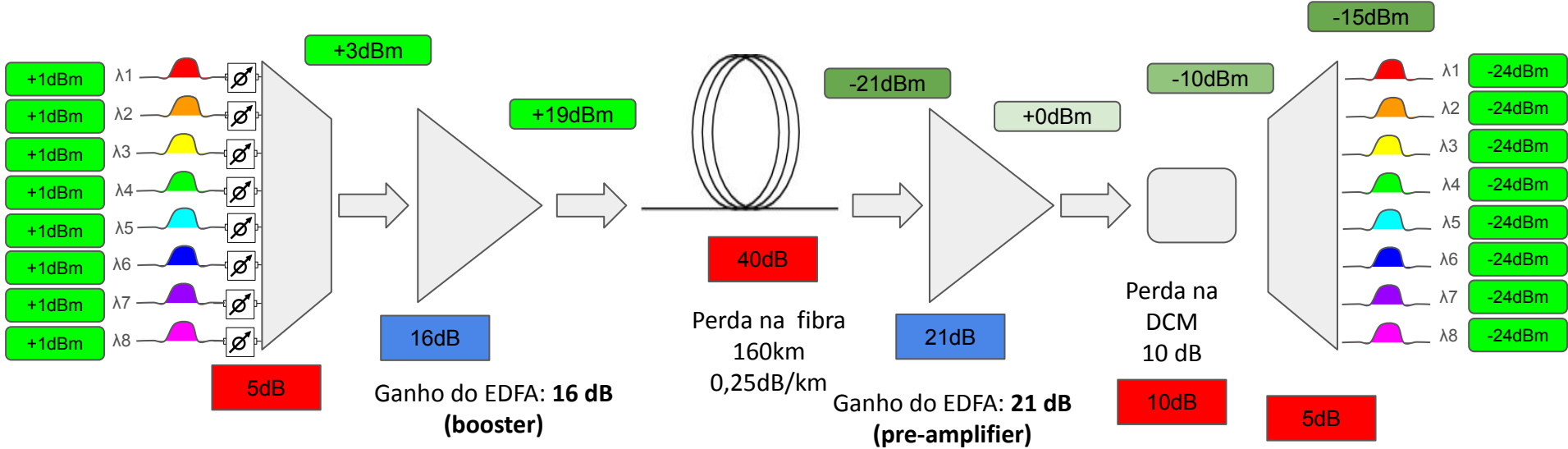
→ COMPORTAMENTO DOS SINAIS

Potência total de Saída:
 $-15 - (10 * \log_{10}(8)) = -24 \text{dBm}$

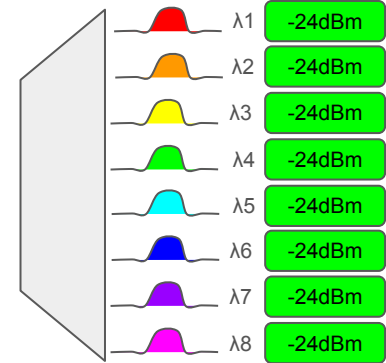
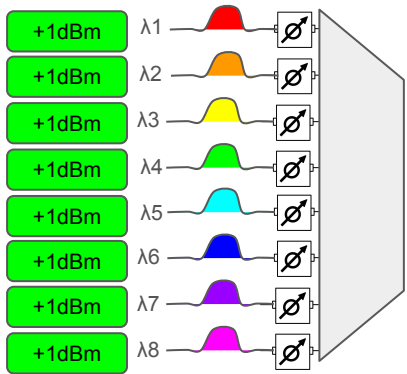


→ COMPORTAMENTO DOS SINAIS

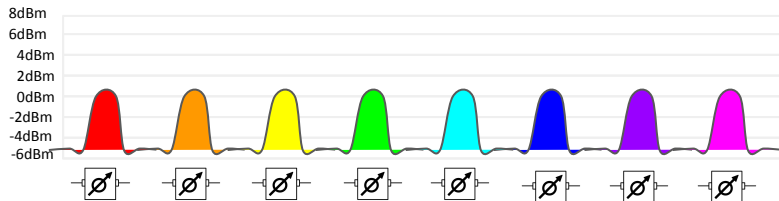
Encontrando potência individual:
 $-15 - (10 * \log_{10}(8)) = -24 \text{dBm}$



Inserindo novos canais

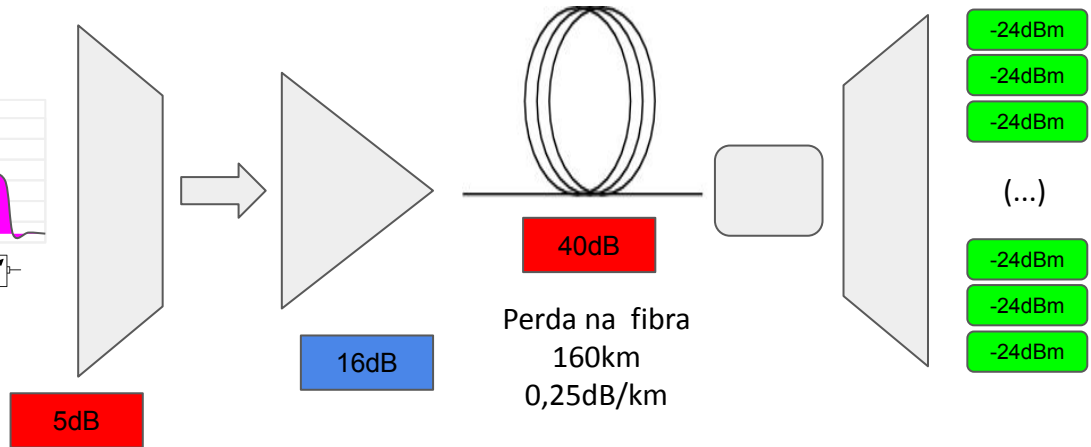


→ COMPORTAMENTO DOS SINAIS



Total de canais: **8**

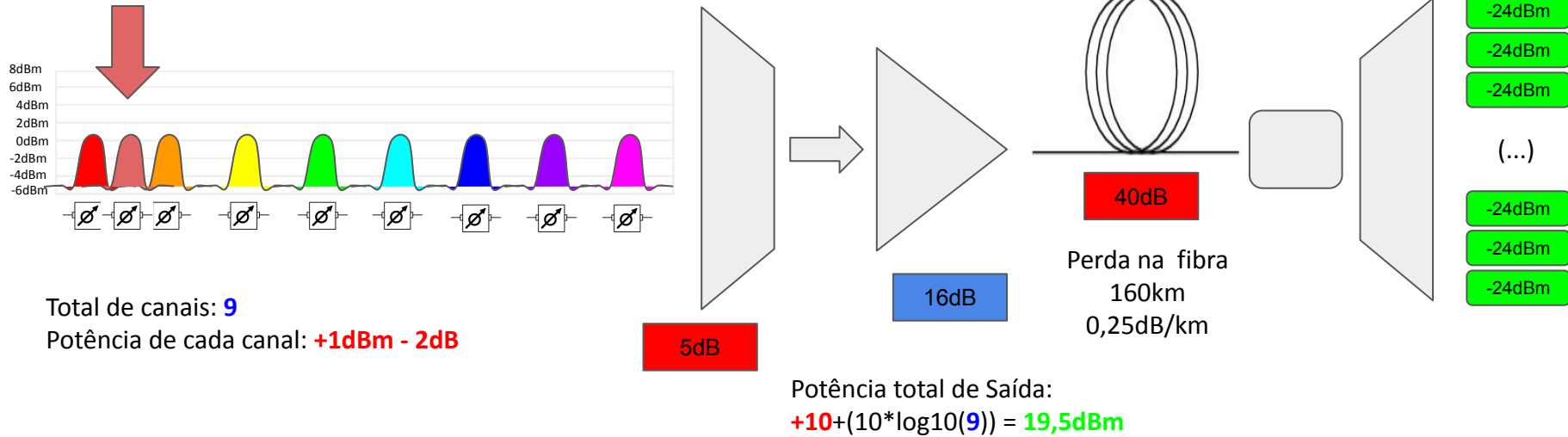
Potência de cada canal: **+1dBm - 2dB**



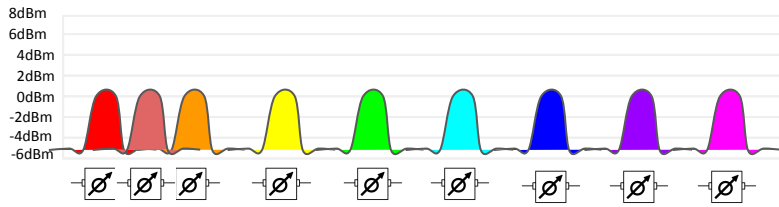
Potência total de Saída:

$$+10 + (10 * \log_{10}(8)) = 19\text{dBm}$$

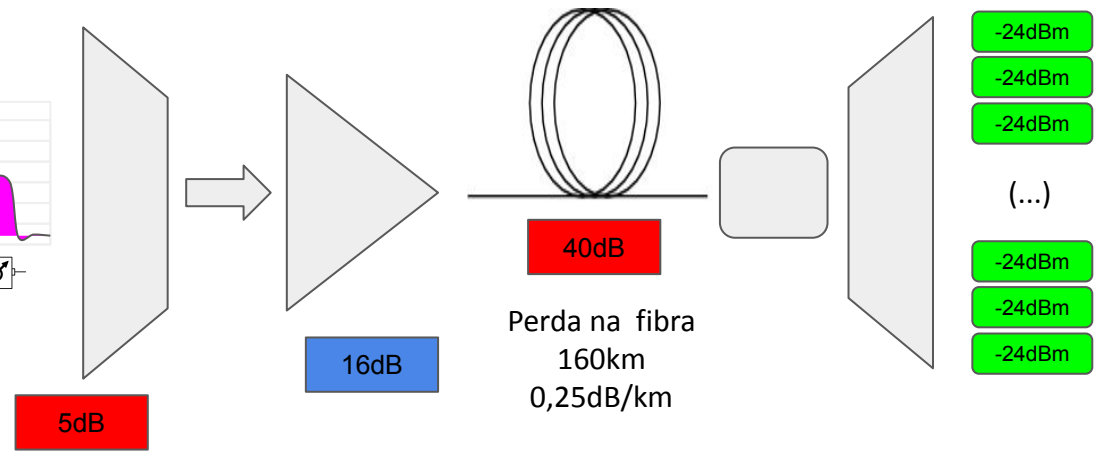
→ COMPORTAMENTO DOS SINAIS



→ COMPORTAMENTO DOS SINAIS

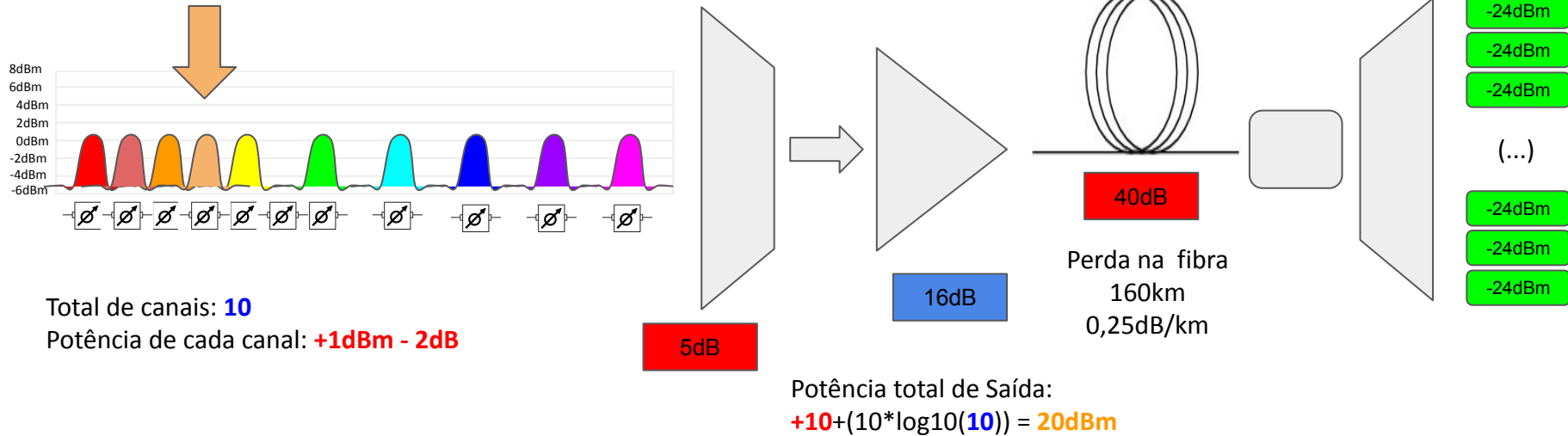


Total de canais: 9
Potência de cada canal: +1dBm - 2dB

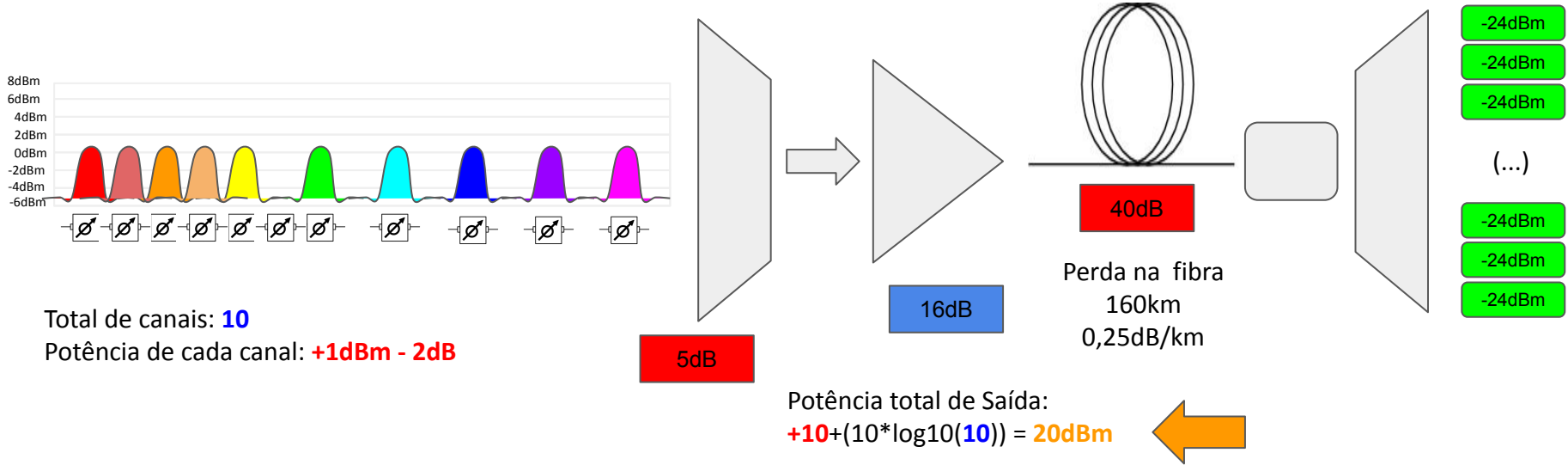


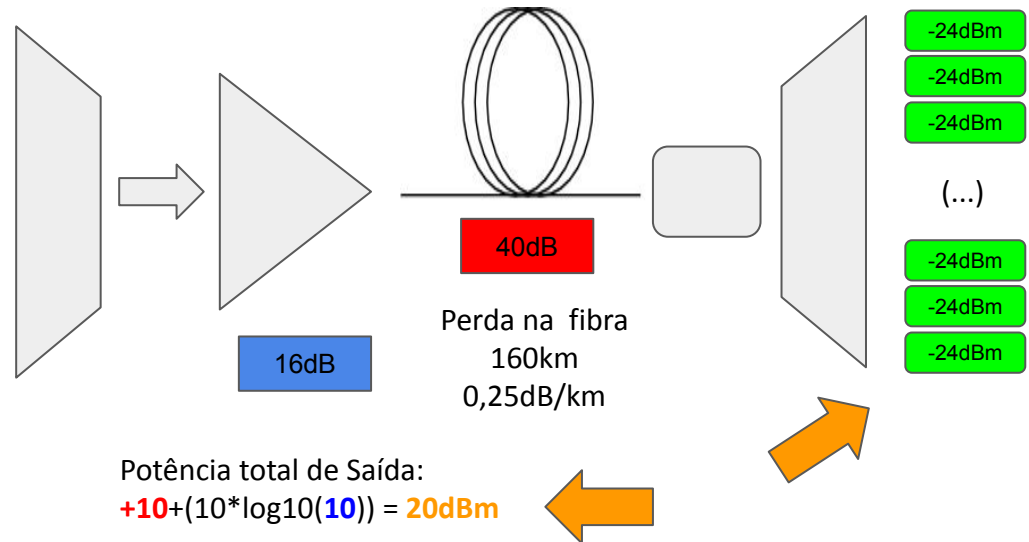
Potência total de Saída:
+10+(10*log10(9)) = 19,5dBm ←

→ COMPORTAMENTO DOS SINAIS

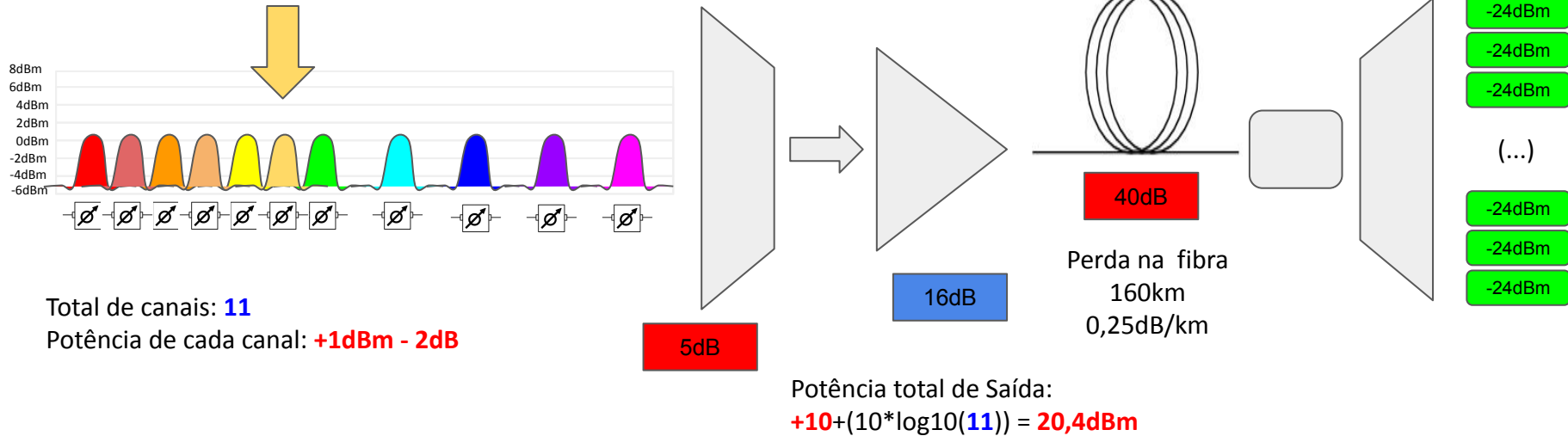


→ COMPORTAMENTO DOS SINAIS

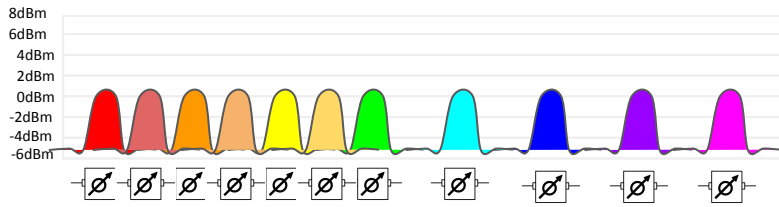




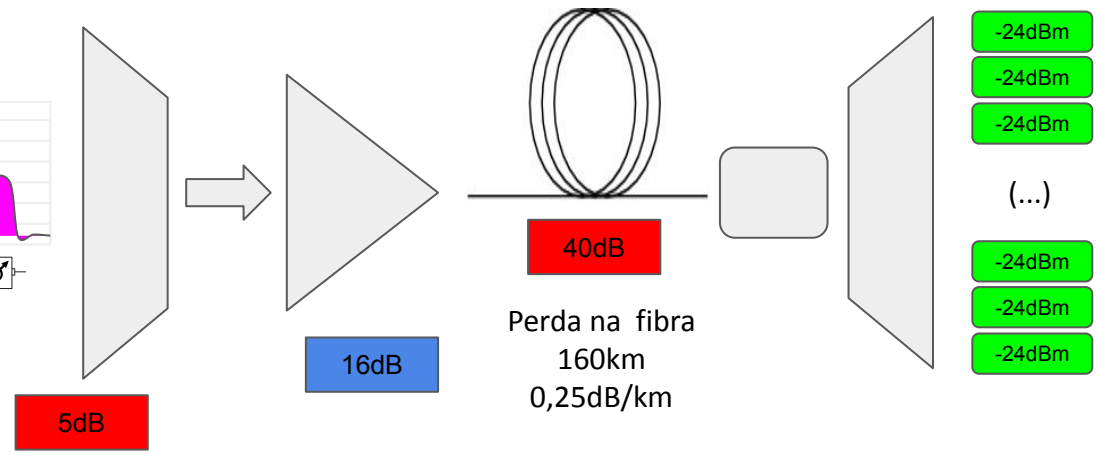
INSERINDO MAIS UM CANAL!



→ COMPORTAMENTO DOS SINAIS

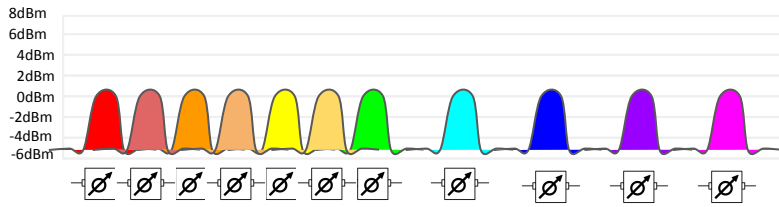


Total de canais: **11**
Potência de cada canal: **+1dBm - 2dB**

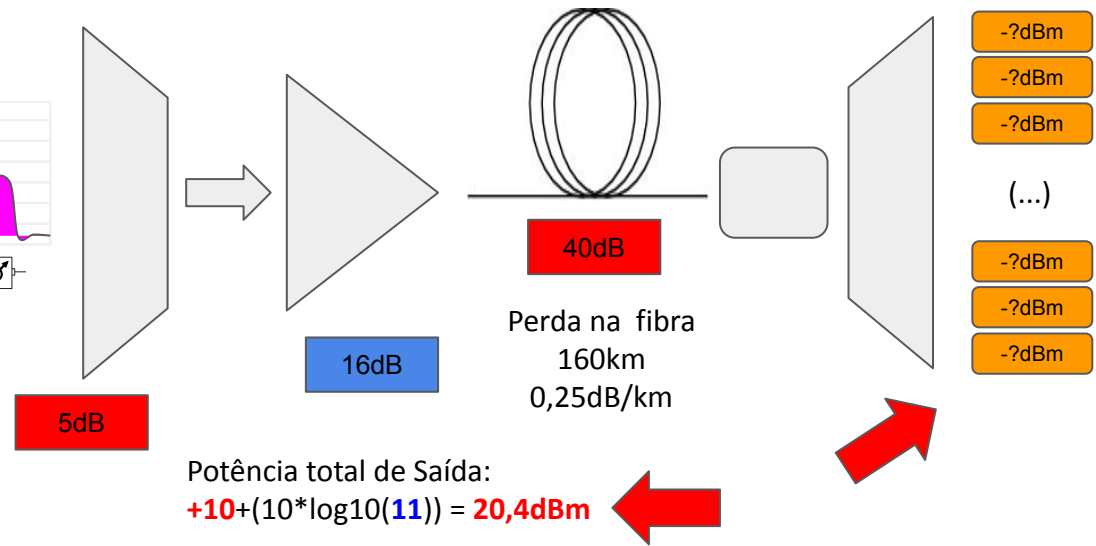


Potência total de Saída:
+10+(10*log10(11)) = 20,4dBm ←

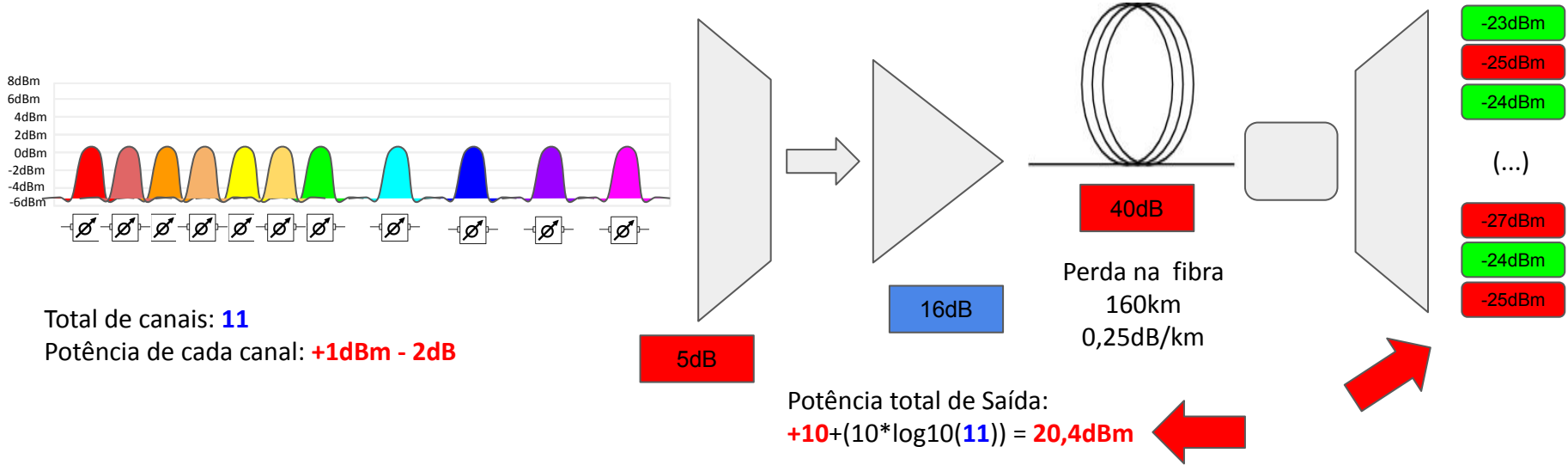
→ COMPORTAMENTO DOS SINAIS



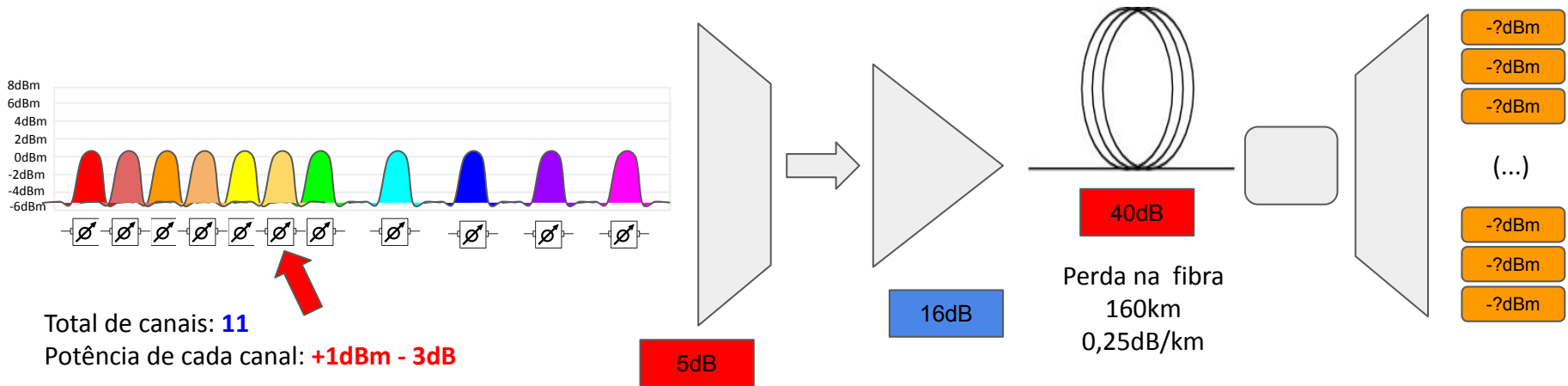
Total de canais: **11**
Potência de cada canal: **+1dBm - 2dB**



→ COMPORTAMENTO DOS SINAIS



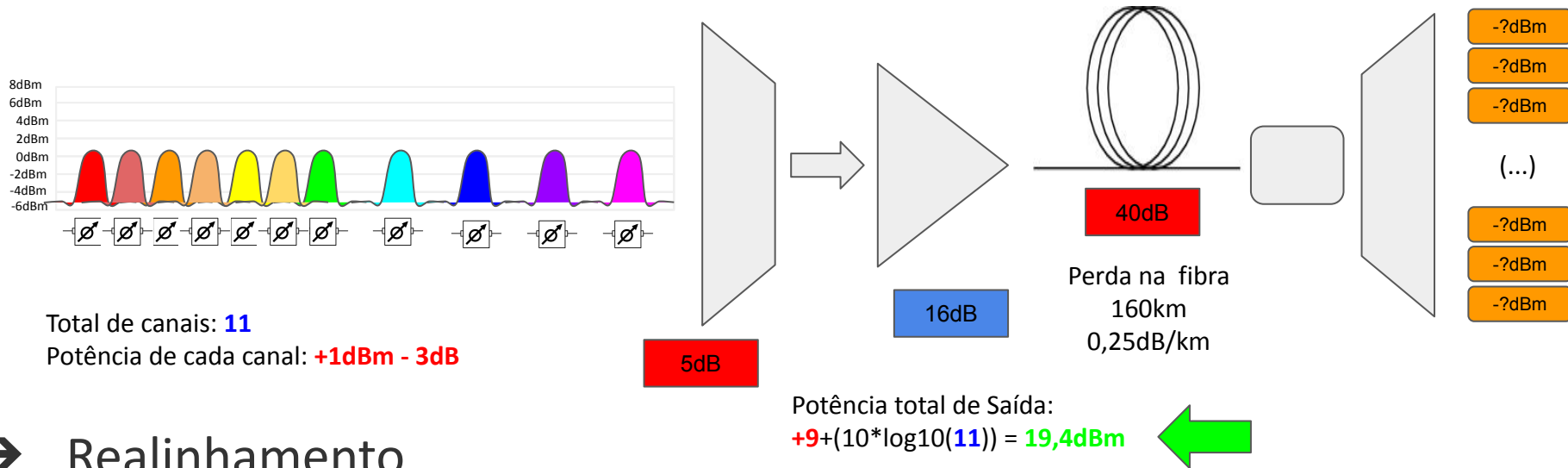
→ COMPORTAMENTO DOS SINAIS



Potência total de Saída:
 $+9 + (10 * \log_{10}(11)) = 19,4\text{dBm}$ ←

- ## → Realinhamento
- de 2 para 3 dB por canal

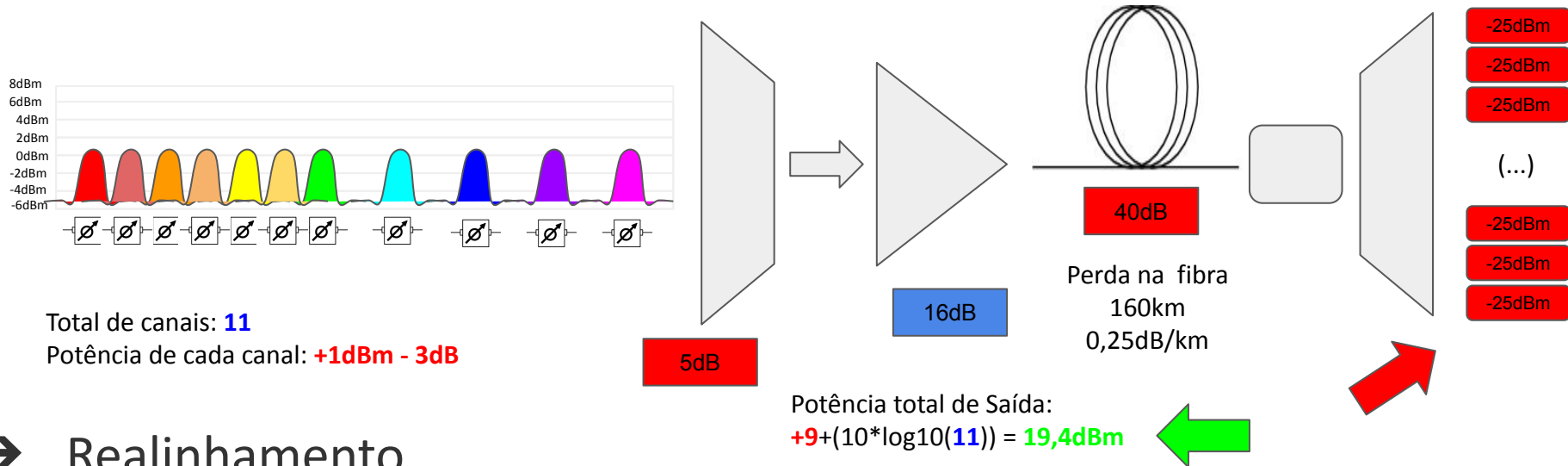
→ COMPORTAMENTO DOS SINAIS



→ Realinhamento

- de 2 para 3 dB por canal

→ COMPORTAMENTO DOS SINAIS



- ## → Realinhamento
- de 2 para 3 dB por canal

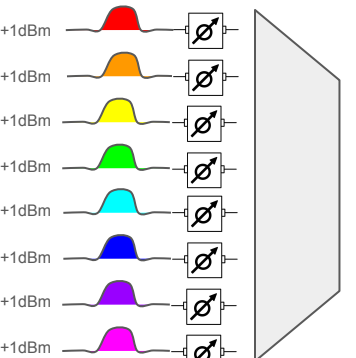


✓ MUITOS CANAIS = MUITA POTÊNCIA DE SAÍDA

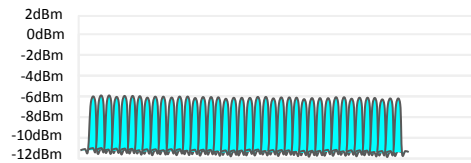
→ EXEMPLO COM 40 CANAIS

MAX-OUT = 20dBm

Atenuadores: 2 dB

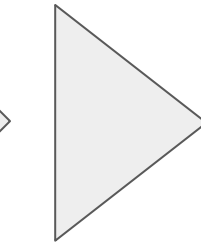


5dB
Perda do MUX
5 dB



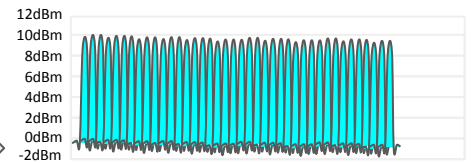
Total de canais: 40
Potência de cada canal: -6dBm
Potência total de entrada:
 $-6 + (10 * \log_{10}(40)) = 10\text{dBm}$

+10dBm

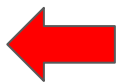


16dB
Ganho do EDFA: 16 dB

+26dBm



Total de canais: 40
Potência de cada canal: +10dBm
Potência total de Saída:
 $+10 + (10 * \log_{10}(40)) = 26\text{dBm}$





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→ COMPORTAMENTO DOS SINAIS

→ EXEMPLO COM 40 CANAIS

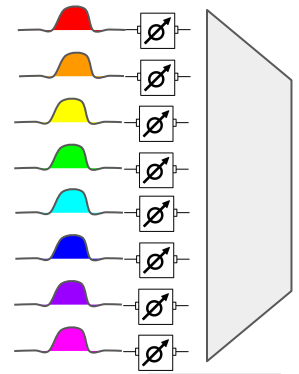
- MAX-IN: ?
- MAX-OUT: 20dBm
- GANHO: 16dB

$$\begin{aligned} \text{MAX-IN} &= \text{MAX-OUT} - \text{GANHO} \\ \text{MAX-IN} &= 20 - 16 \\ \text{MAX-IN} &= +4 \text{ dBm} \end{aligned}$$

→ COMPORTAMENTO DOS SINAIS

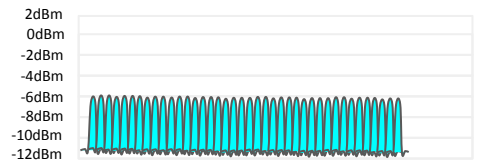
→ PRECISO ENTRAR COM MÁXIMO DE +4dBm

Atenuadores: 2 dB



5dB

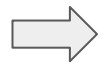
Perda do MUX
5 dB



Total de canais: 40
Potência de cada canal: -6dBm

Potência total de entrada:
 $-6 + (10 * \log_{10}(40)) = 10 \text{ dBm}$

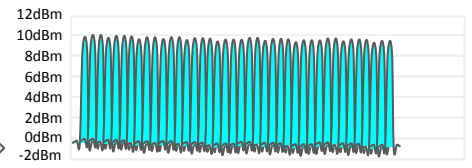
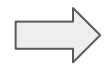
+10dBm



16dB

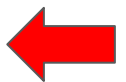
Ganho do
EDFA: 16 dB

+26dBm



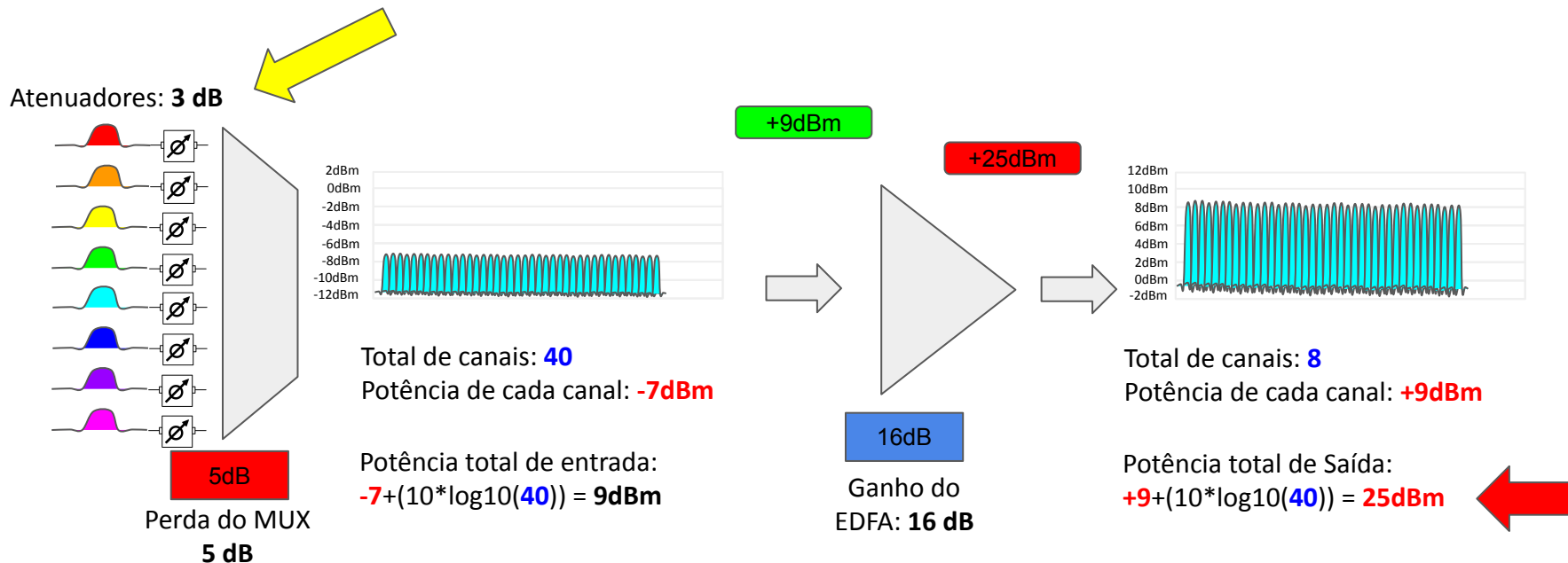
Total de canais: 40
Potência de cada canal: +10dBm

Potência total de Saída:
 $+10 + (10 * \log_{10}(40)) = 26 \text{ dBm}$



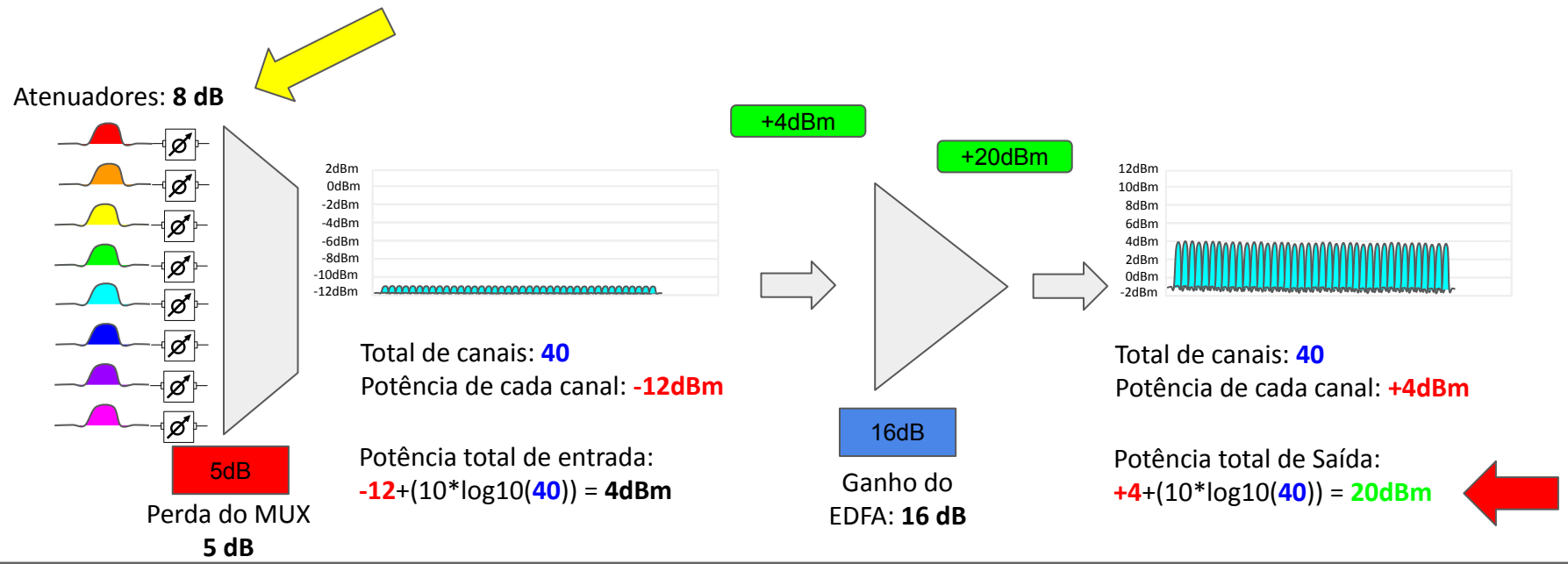
→ COMPORTAMENTO DOS SINAIS

→ PRECISO ENTRAR COM MÁXIMO DE +4dBm



→ COMPORTAMENTO DOS SINAIS

→ PRECISO ENTRAR COM MÁXIMO DE +4dBm

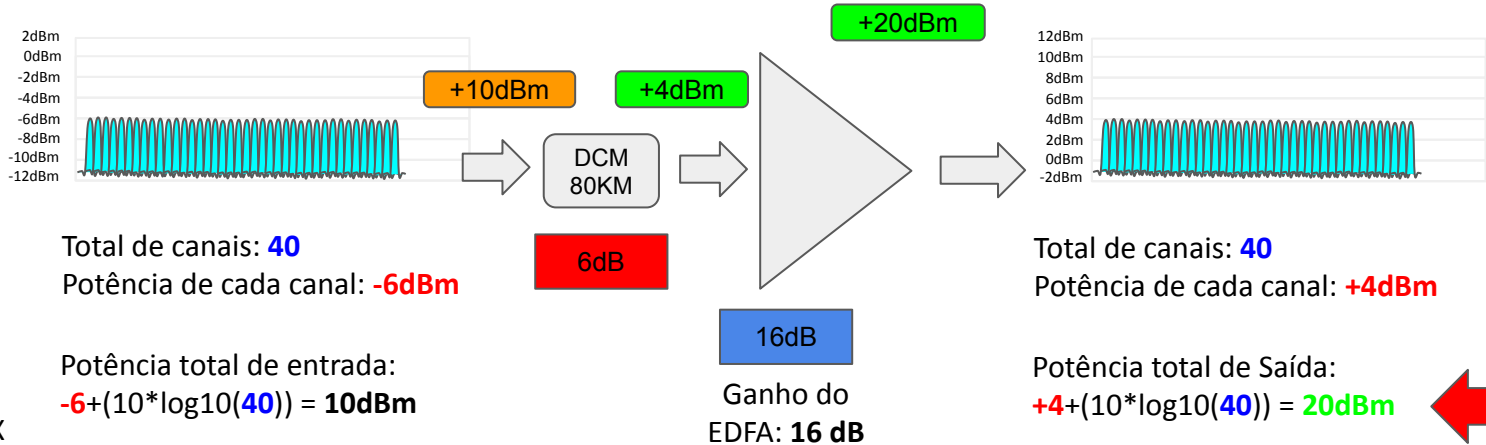
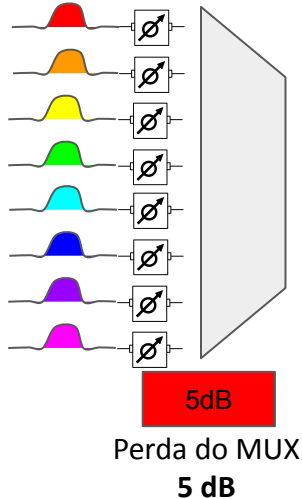




→ EM ALGUNS CENÁRIOS, ANTECIPAR A DCM PODE SER A MELHOR OPÇÃO



Atenuadores: 2 dB





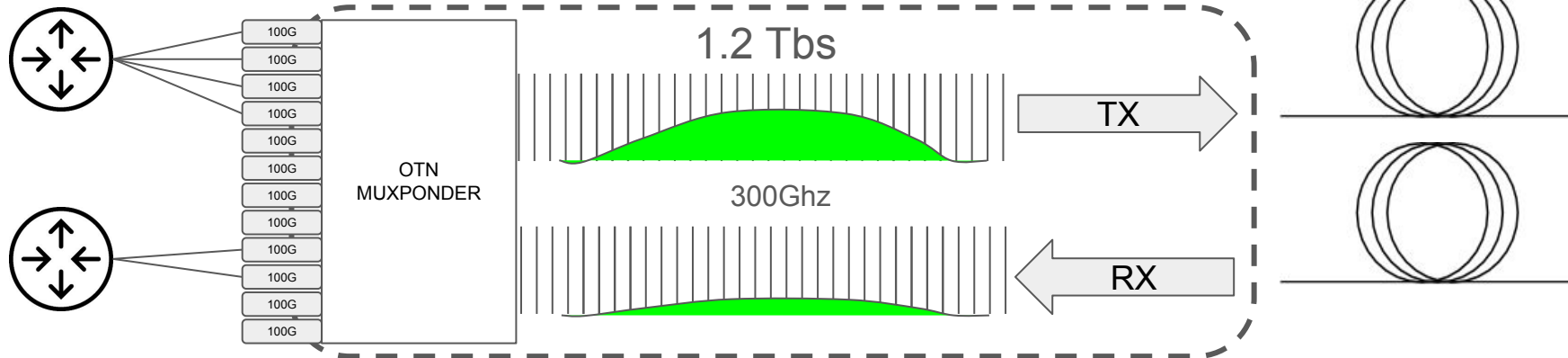
ALGUMAS SOLUÇÕES E APLICAÇÕES

→ DATA CENTER INTERCONNECT (DCI)

- SOLUÇÕES COMPACTAS
- ESPECTRO ESTENDIDO
- CAPACIDADE FIXA*

→ DATA CENTER INTERCONNECT (DCI)

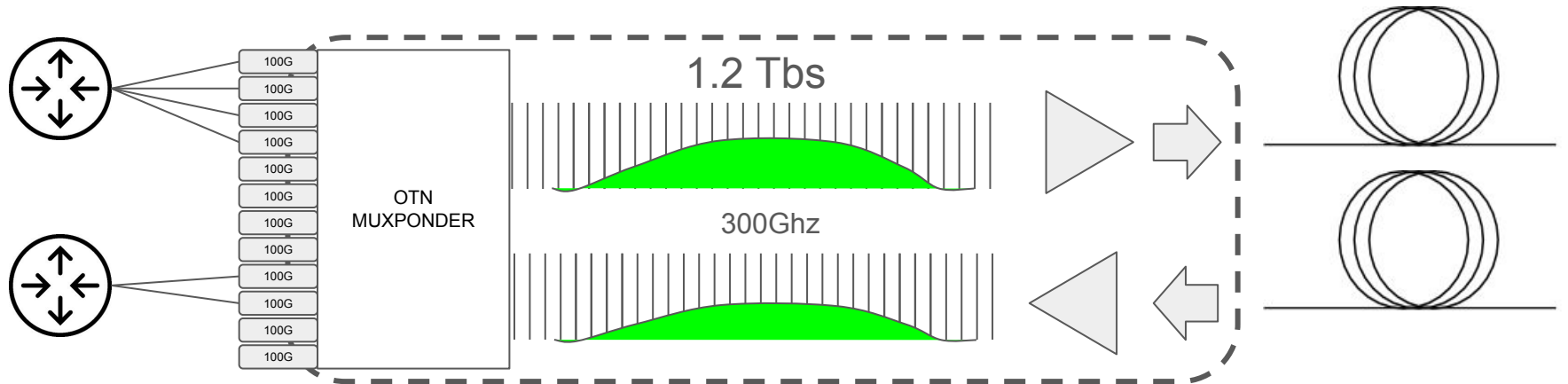
- SOLUÇÕES COMPACTAS
- ESPECTRO ESTENDIDO
- CAPACIDADE FIXA*



→ ALGUMAS SOLUÇÕES E APLICAÇÕES

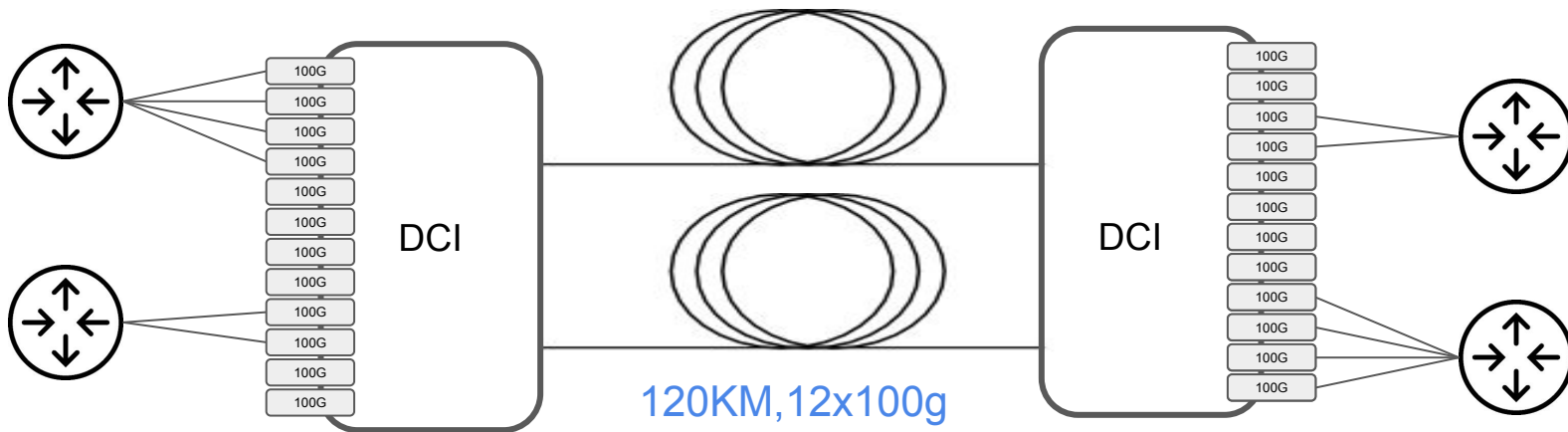
→ DATA CENTER INTERCONNECT (DCI)

- BOOSTER / PRÉ INTERNOS
- MAIORES DISTÂNCIAS



→ DATA CENTER INTERCONNECT (DCI)

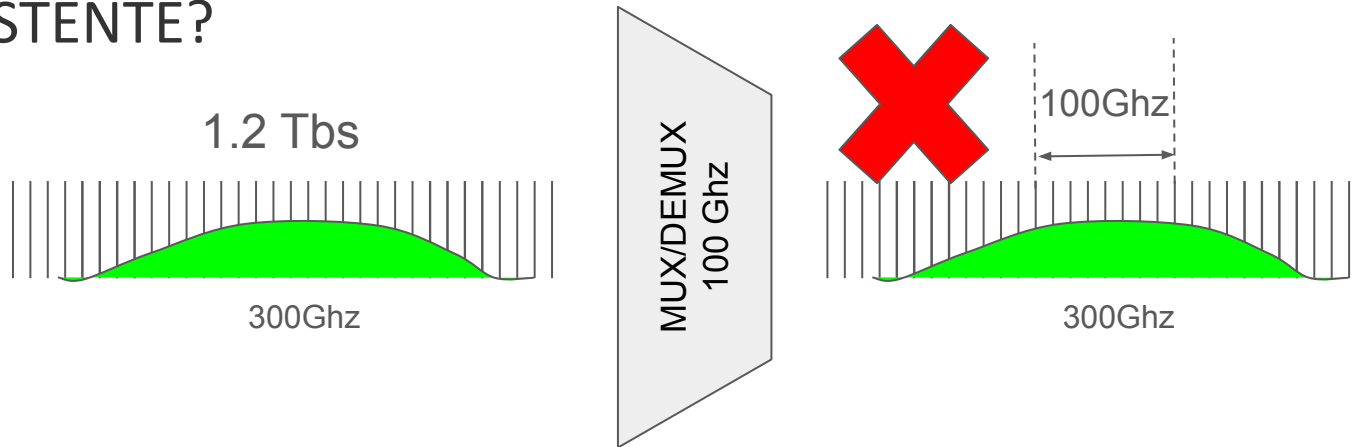
- BOOSTER / PRÉ INTERNOS
- MAIORES DISTÂNCIAS



- DATA CENTER INTERCONNECT (DCI)
- POSSO USAR O DCI EM UM SISTEMA DWDM EXISTENTE?

→ DATA CENTER INTERCONNECT (DCI)

- POSSO USAR O DCI EM UM SISTEMA DWDM EXISTENTE?



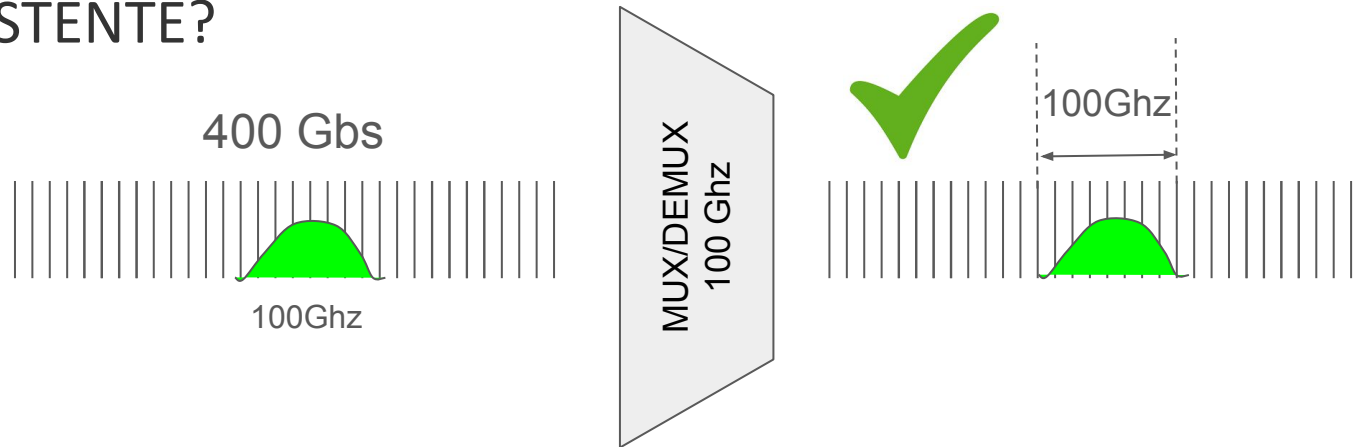
→ DATA CENTER INTERCONNECT (DCI)

- algumas soluções podem ter largura menor e/ou configurável



→ DATA CENTER INTERCONNECT (DCI)

- POSSO USAR O DCI EM UM SISTEMA DWDM EXISTENTE?



- DATA CENTER INTERCONNECT (DCI)
 - O MERCADO ATUAL JÁ PODE OFERECER SOLUÇÕES AINDA MAIS EFICIENTES!



→ EXEMPLOS SIMPLES DE SOLUÇÕES PERSONALIZADAS

- QUANTIDADE MÁXIMA DE CANAIS
- DISTÂNCIA ÓPTICA (km)
- ATENUAÇÃO MÉDIA (dB/km)

→ ALGUMAS SOLUÇÕES E APLICAÇÕES



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→ CURTÍSSIMA DISTÂNCIA - 8x 10G , 40km, 0,25dB/km

→ CURTÍSSIMA DISTÂNCIA - 8x 10G , 40km, 0,25dB/km

- TRANSCEIVERS



Cisco Compatible	DWDM-SFP10G-60.61	Vendor Name	FS
Form Factor	SFP+	Max Data Rate	10Gbps
Wavelength	1560.61nm	Max Cable Distance	40km
Connector	Duplex LC	Optical Components	EML DWDM
TX Power	-1~4dBm	Receiver Sensitivity	<-16dBm
Power Budget	14dB	Receiver Overload	0dBm
Power Consumption	<1.6W	Media	SMF
Bit Error Ratio (BER)	1E-12	Extinction Ratio	>6dB
Commercial Temperature Range	0 to 70°C (32 to 158°F)	Protocols	SFP+ MSA Compliant, CPRI, eCPRI

→ ALGUMAS SOLUÇÕES E APLICAÇÕES

→ CURTÍSSIMA DISTÂNCIA - 8x 10G , 40km, 0,25dB/km

- MUX/DEMUX



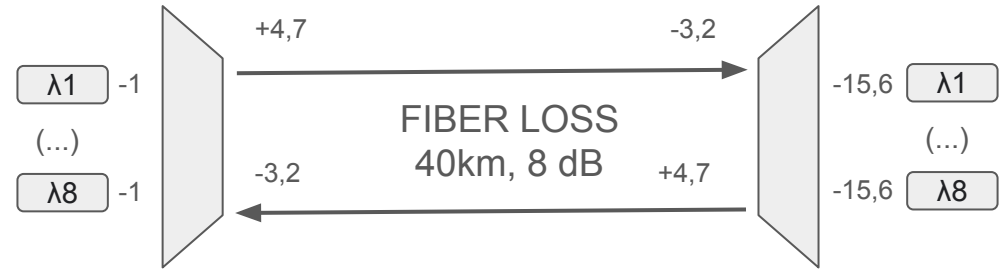
Wavelength	8 Channels C53-C60	Channel Spacing	100GHz (0.8nm)
1310nm Port Passband	1260nm-1360nm	Channel Passband	±0.11nm
Insertion Loss	≤3.3dB, 3.0dB Typical	Insertion Loss @ Exp	≤3.3dB
Insertion Loss @ 1310nm Port	≤1.3dB	Insertion Loss @ 1% Mon	≤25.2dB
Passband Ripple	≤0.5dB	Technology	TFF (Thin Film Filter)
Return Loss	≥45dB	Directivity	≥45dB
Polarization Dependent Loss	≤0.3dB	Polarization Mode Dispersion	≤0.1ps
Channel Isolation	Adjacent ≥30dB Non-adjacent ≥ 40dB	Temperature	Operating -40 to 85°C (-40 to 185°F) Storage -40 to 85°C (-40 to 185°F)
Power Handling	≤500mW	Dimensions (HxWxD)	1.73"x8.35"x10.04" (44x212x255mm)



→ ALGUMAS SOLUÇÕES E APLICAÇÕES

→ CURTÍSSIMA DISTÂNCIA - 8x 10G , 40km, 0,25dB/km

- 40 km / 0,25 dB/km ❌
- 40 km / 0,20 dB/km ✅



→ ALGUMAS SOLUÇÕES E APLICAÇÕES



→ CURTA DISTÂNCIA - 8x 10G , 80km, 0,25dB/km

→ ALGUMAS SOLUÇÕES E APLICAÇÕES

→ CURTA DISTÂNCIA - 8x 10G , 80km, 0,25dB/km

- TRANSCEIVERS



Cisco Compatible	DWDM-SFP10G-60.61	Vendor Name	FS
Form Factor	SFP+	Max Data Rate	10Gbps
Wavelength	1560.61nm	Max Cable Distance	80km
Connector	Duplex LC	Optical Components	EML DWDM
TX Power	1-5dBm	Receiver Sensitivity	<-23dBm
Power Budget	24dB	Receiver Overload	-7dBm
Media	SMF	Power Consumption	<1.6W
Bit Error Ratio (BER)	1E-12	Extinction Ratio	>8.2dB
EMC (Electro Magnetic Compatibility)	Supported	MTBF	1,000,000 Hours
Commercial Temperature Range	0 to 70°C (32 to 158°F)	Protocols	SFP+ MSA Compliant, CPRI, eCPRI

→ ALGUMAS SOLUÇÕES E APLICAÇÕES

→ CURTA DISTÂNCIA - 8x 10G , 80km, 0,25dB/km

- MUX/DEMUX



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Power Handling	≤500mW	Dimensions (HxWxD)	1.73"x8.35"x10.04" (44x212x255mm)

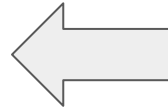
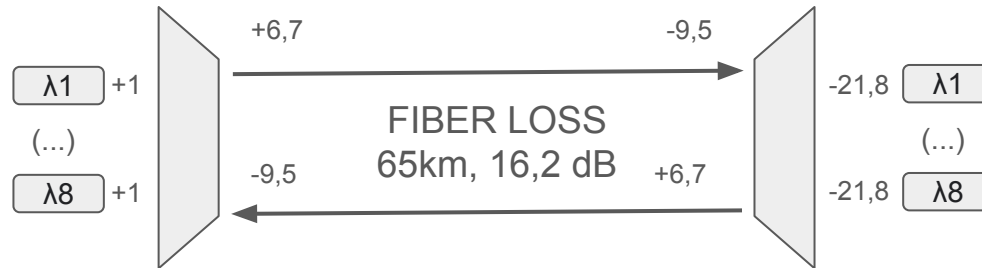
→ ALGUMAS SOLUÇÕES E APLICAÇÕES

→ CURTA DISTÂNCIA - 8x 10G , 80km, 0,25dB/km

- 80 km / 0,25 dB/km ❌

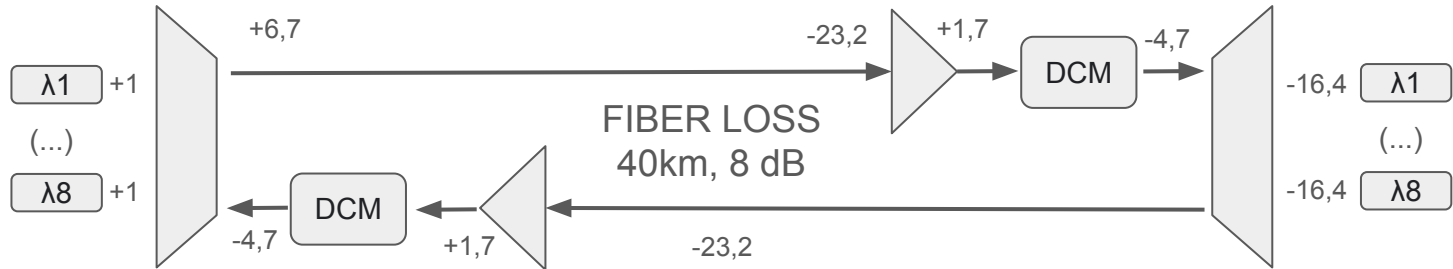
- 80 km / 0,20 dB/km ✅

- 65 km / 0,25 dB/km ✅

RISCO DE ERROS POR
DISPERSÃO

→ ALGUMAS SOLUÇÕES E APLICAÇÕES

- MÉDIA DISTÂNCIA - 8x 10G , 120km, 0,25dB/km
- 120 km / 0,25 dB/km ✓
 - PRE AMPLIFIER 25 dB
 - DCM 80km





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→ ALGUMAS SOLUÇÕES E APLICAÇÕES

→ CANAIS DE 100/200/300/400G

→ CANAIS DE 100/200/300/400G

400G DWDM Tunable Coherent CFP2 DCO
80km DOM Duplex LC/UPC SMF Optical
Transceiver Module for Transmission, Used
with D7000 Series Hot #216689

Transmission | QPSK/8-QAM/16-QAM | FEC | ≤25W | Tunable

R\$ 48,493.00

FS P/N: CFP2-DCO-400G-D

19 Sold | 0 Review | 1 Question



Tx Power Range -10-3dBm

Rx Power Range

- 100G 100ZR-OFEC-QPSK: -32-1dBm
- 100G FOIC1-OFEC-QPSK: -32-1dBm
- 200G 200ZR-OFEC-QPSK: -29-1dBm
- 200G 200ZR-OFEC-8QAM: -28-1dBm
- 200G 200ZR-OFEC-16QAM: -24-1dBm
- 200G FOIC2-OFEC-QPSK: -28-1dBm
- 200G FOIC2-OFEC-8QAM: -28-1dBm
- 200G FOIC2-OFEC-16QAM: -23-1dBm
- 300G 300ZR-OFEC-8QAM: -23-1dBm
- 300G FOIC3-OFEC-8QAM: -23-1dBm
- 400G 400ZR-CFEC-16QAM: -20-1dBm
- 400G 400ZR-OFEC-16QAM: -21-1dBm
- 400G FOIC4-OFEC-16QAM: -20-1dBm

FEC Support Yes

OSNR Sensitivity

- 100G 100ZR-OFEC-QPSK: 11.5dB
- 100G FOIC1-OFEC-QPSK: 11.8dB
- 200G 200ZR-OFEC-QPSK: 14.8dB
- 200G 200ZR-OFEC-8QAM: 17.2dB
- 200G 200ZR-OFEC-16QAM: 19.3dB
- 200G FOIC2-OFEC-QPSK: 15.7dB
- 200G FOIC2-OFEC-8QAM: 17.5dB
- 200G FOIC2-OFEC-16QAM: 20dB
- 300G 300ZR-OFEC-8QAM: 20.3dB
- 300G FOIC3-OFEC-8QAM: 20.5dB
- 400G 400ZR-CFEC-16QAM: 26dB
- 400G 400ZR-OFEC-16QAM: 23dB
- 400G FOIC4-OFEC-16QAM: 23dB



O QUE DEVO SABER ANTES DE COMPRAR?



iNOCmon

→ O QUE DEVO SABER ANTES DE COMPRAR?

→ QUANTIDADE MÁXIMA DE CANAIS NO FUTURO



iNOCmon

→ O QUE DEVO SABER ANTES DE COMPRAR?

- QUANTIDADE MÁXIMA DE CANAIS NO FUTURO
- UPGRADE DE 100/200G, 200/300G, 300/400G SEM MUDANÇA NA FOTÔNICA?

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- QUAL A MARGEM DE SEGURANÇA DO SISTEMA?

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- QUANTIDADE MÁXIMA DE CANAIS NO FUTURO
- UPGRADE DE 100/200G, 200/300G, 300/400G SEM MUDANÇA NA FOTÔNICA?
- QUAL A MARGEM DE SEGURANÇA DO SISTEMA?
- A REGENERAÇÃO PODE CUSTAR AINDA MAIS CARO

OBRIGADO!

