

# Welchen Mehrwert bietet OM5 in Highspeed Netzen?

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ENERGY LEADING TECHNOLOGY AND BEST IN CLASS R&D CAPABILITIES EXTENDED PRODUCT OFFERING WORLDWIDE LEADER  
CUSTOMER SERVICE LINKING THE FUTURE WORLDWIDE LEADER ENHANCE CUSTOMER SERVICE LINKING TH  
WORLD LEADER IN RENEWABLE ENERGY GLOBAL LEADER OF THE CABLE INDUSTRY WORLDWIDE LEADER IN RENEWABLE ENERGY  
LEADING TECHNOLOGY STRONGER PLATFORM LEADING TECHNOLO  
APPLICATIONS TOGETHER WE ARE ONE WORLDWIDE LEADER ONE COMPANY TO LEAD THE WORLD WORLDWIDE LEADER

# AGENDA

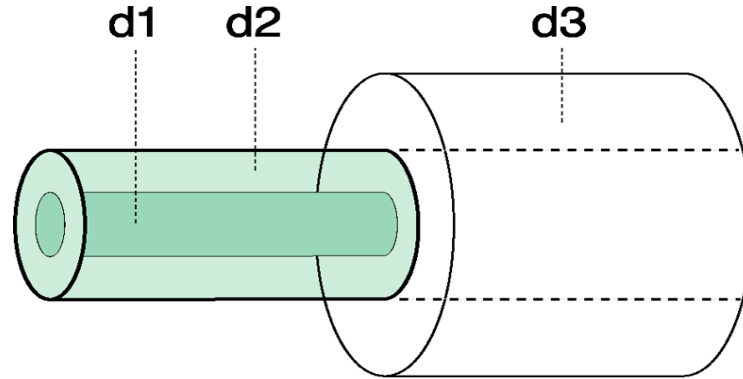
- Lichtwellenleiter Grundlage
- Neue MM-Systeme
- SWDM Vorteile
- OM5
- LWL-Verkabelung mit OM5

# Lichtwellenleiter Grundlage

# Faser Aufbau

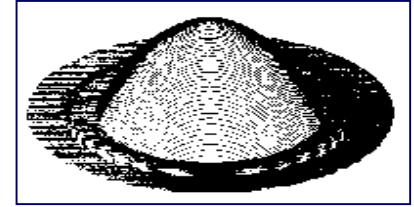
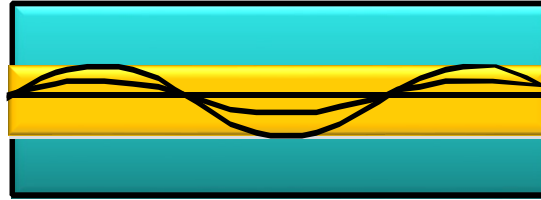
Die Glasfaser besteht aus:

- Glasfaserkern d1:
  - 62.5  $\mu\text{m}$ , 50  $\mu\text{m}$  für MMF
  - 9  $\mu\text{m}$  für SMF
- Glasfasermantel d2:
  - 125  $\mu\text{m}$
- Schutzschicht (Primärcoating) d3:
  - 250  $\mu\text{m}$

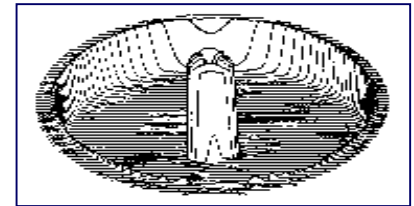


# FASERBAUFORMEN

- **Multimodefasern** führen eine Vielzahl von „Lichtstrahlen“ (Moden). Um das Problem der Modendispersion zu vermeiden, werden sogenannte Gradientenindexprofile angewandt.

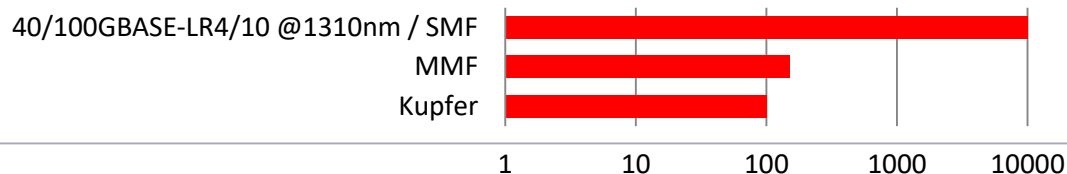


- **Singlemodefasern** führen lediglich einen einzigen „Lichtstrahl“. Modendispersion kann nicht auftreten, jedoch erfordert der geringe Kerndurchmesser, sehr eng tolerierte Verbindungstechniken.



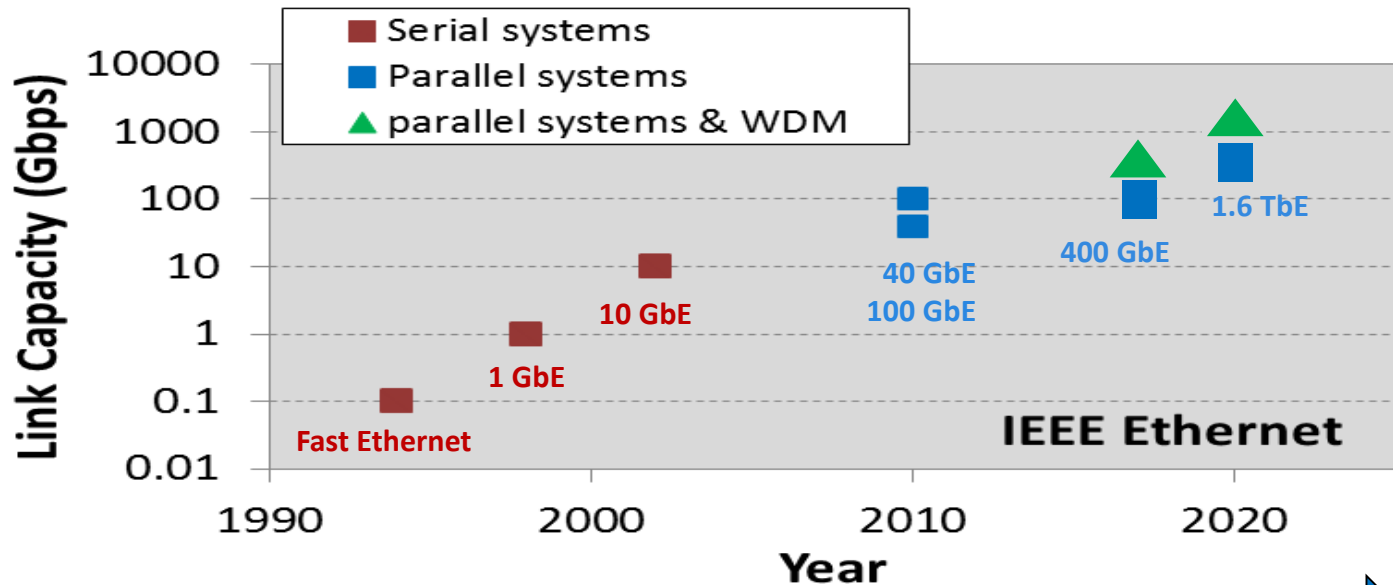
# ETHERNET für 1 – 25 Gbps

Data rate	Ethernet PMD	Max. Distance	Passive Network	Lanes
1 Gbps	1000Base-T	100 m	Copper	1
	1000Base-SX	550 m (1100 m)	MMF	1
	1000Base-LX	5 km	SMF	1
10 Gbps	10GBase-T	100 m	Copper	1
	10GBase-SR	400 m (550 m)	MMF	1
	10GBase-LR	10 km	SMF	1
	10GBase-ER	40 km	SMF	1
25 Gbps	25GBase-T	50 m	Copper	1
	25GBase-SR	100 m	MMF	1
	25GBase-LR	10 km	SMF	1
	25GBase-ER	30 km	SMF	1



# Neue MM-Systeme

# Entwicklung kurzer Reichweiten-MM-Systeme (-SR)



WDM ist die  
praktischste  
Multiplextechnik



## 400 Gbps

Data Rate	IEEE PMD	Links	Fibres
10G	10GBASE-SR	1 x 10G	2
40G	10GBASE-SR4	4 x 10G	8
40G WDM	40GBASE-SWDM4	1 x 4 $\lambda$ x 10G	2
100G	100GBASE-SR10	10 x 10G	20
	100GBASE-SR4	4 x 25G	8
100G WDM	100GBASE-SWDM4	1 x 4 $\lambda$ x 25G	2
400G	400GBASE-SR16	16 x 25G	32
400G WDM	400GBASE-SWDM4	4 x 4 $\lambda$ x 25G	8

Multimode-Systeme mit WDM (SWDM) unterstützen die aufkommenden IEEE-Anwendungen für die nächsten 10 Jahren!

## 40 – 100 Gbps

Data rate	IEEE PMD	Max. Distance	Passive Network	Lanes
40 Gbps	40GBase-T	30 m	Copper	1
	40GBase-SR4	150 (190**) m	MMF	4
	40GBase-SWDM4	440* (300**) m	MMF	1
	40GBase-FR	2 km	SMF	1
	40GBase-LR4	10 km	SMF	4
	40GBase-ER4	40 km	SMF	4
100 Gbps	100GBase-SR4	100 m	MMF	4
	100GBase-SR10	150 (190**) m	MMF	10
	100GBase-SWDM4	150* (300**) m	MMF	1
	100GBase-CWDM4	2 km	SMF	1
	100GBase-LR4	10 km	SMF	4
	100GBase-ER4	40 km	SMF	4



WDM  
Technology

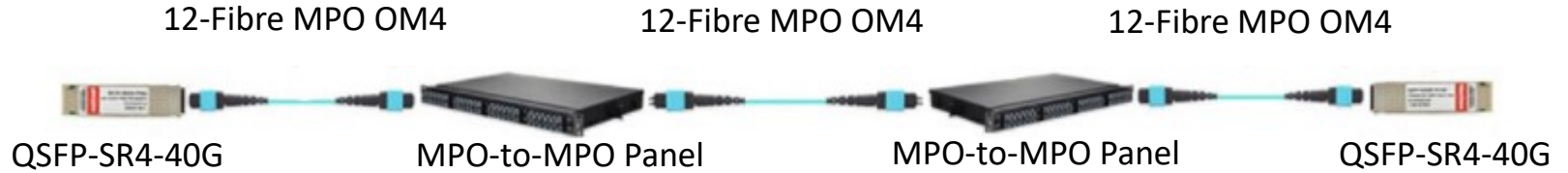


\*Finisar getestet Werte

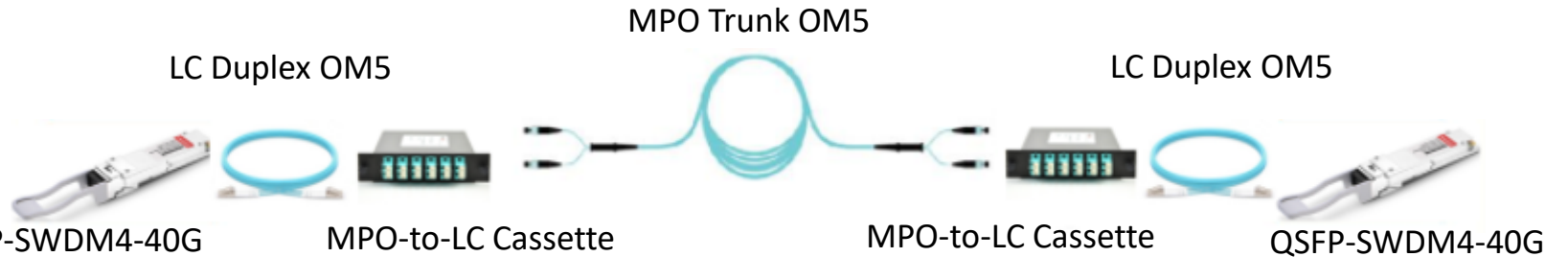
\*\*Prysmian getestet Werte

# SWDM Vorteile

# 40GBASE-SR4 vs. 40GBASE-SWDM4 Kostenvergleichung



KOSTEN = 4X + X + 10X + X + 10X + X + 4X = 31X



KOSTEN = 8.4X + 0.2X + 1.5X + 4X + 1.5X + 0.2X + 8.4X = 24.2X

# SM vs. MM Aktivkomponente Kostenvergleich

Data Rate	IEEE PMD	Passive Network	Lanes	Transceiver Cost (€)	100 m Link	300 m Link
40 Gbps	40GBase-SR4	MMF	4	QSFP – X	OM3, OM4, OM5	-
	40GBase-SWDM4	MMF	1	QSFP – 2.1X	OM3, OM4, OM5	OM5
	40GBase-LR4	SMF	4	QSFP – 2.3X	SMF	SMF
100 Gbps	100GBase-SR4	MMF	4	QSFP – 4.5X	OM4, OM5	-
	100GBase-SR10	MMF	10	CFP/CXP – 5.7X	OM3, OM4, OM5	-
	100GBase-SWDM4	MMF	1	QSFP – 4.6X	OM4, OM5	OM5
	100GBase-CWDM4	SMF	1	QSFP – 9.2X	SMF	SMF
	100GBase-LR4	SMF	4	QSFP – 7.3X	SMF	SMF

- SWDM ermöglicht kosteneffiziente MM-Systeme bis 300 m für 40 & 100 Gbps

## 40 & 100 Gbps bei MMF

Data rate	IEEE PMD	OM3	OM4	OM5
40 Gbps	40GBase-SR4	100 m	150 (190**) m	150 (190**) m
	40GBase-SWDM4	240* m	350* m	440* (300**) m
100 Gbps	100GBase-SR4	70 m	100 m	100 m
	100GBase-SR10	100 m	150 (190**) m	150 (190**) m
	100GBase-SWDM4	75* m	100* m	150* (300**) m

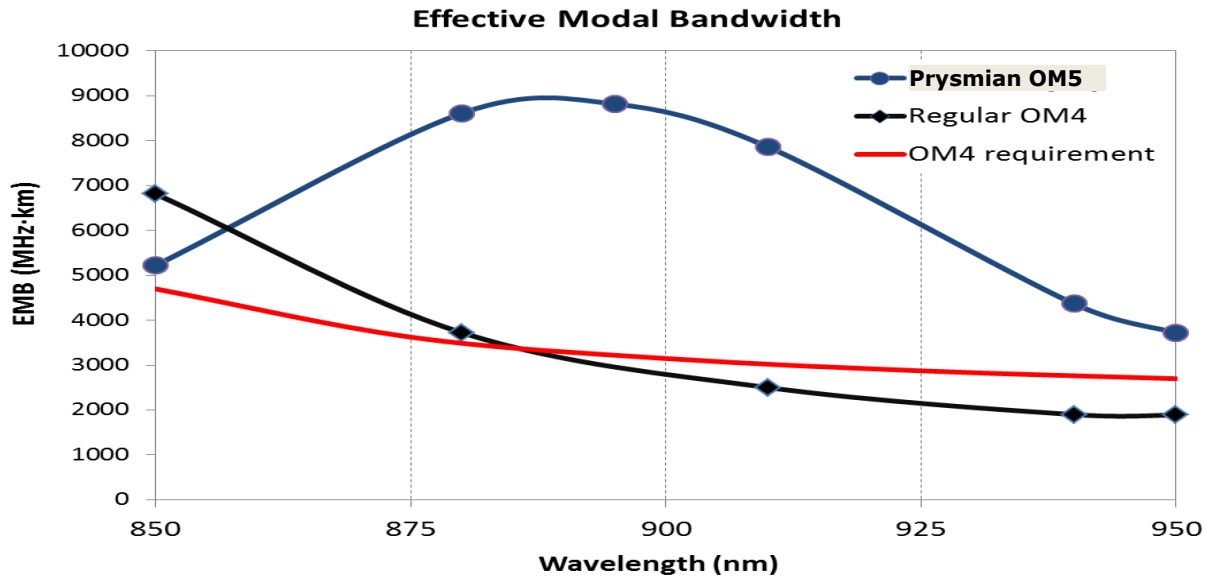
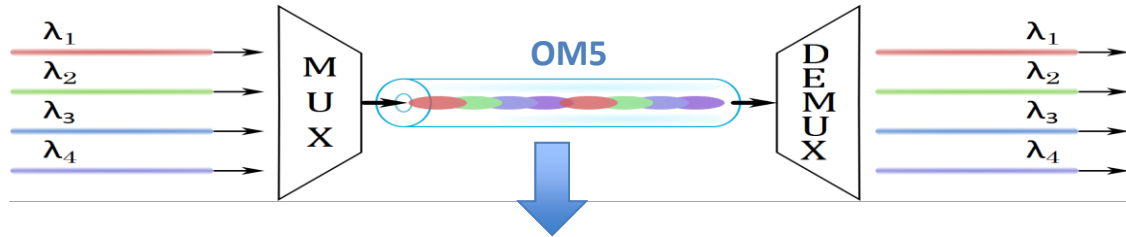
\*Finisar getestet Werte

\*\*Prysmian getestet Werte

- OM3, OM4, OM5 Fasern unterstützen 40 Gbps & 100 Gbps Geschwindigkeiten bei WDM Systeme
- OM5 wird für WDM optimiert und entwickelt

OM5

# OM5 für WDM





# Wellenlängen & Bandbreite von OM5

Lane	Center wavelength	Wavelength range	Module electrical lane
L <sub>0</sub>	850 nm	844 to 858 nm	Tx0, Rx0
L <sub>1</sub>	880 nm	874 to 888 nm	Tx1, Rx1
L <sub>2</sub>	910 nm	904 to 918 nm	Tx2, Rx2
L <sub>3</sub>	940 nm	934 to 948 nm	Tx3, Rx3

SWDM MSA Technical Specifications Rev 2

	Bandwidth (MHz.km)				
Wavelength (nm)	OM1	OM2	OM3	OM4	OM5
850	200	500	2000	4700	4700
953	-	-	-	-	2470
1300	500	500	1500	1500	1500

# OM5 Normen

- Wideband OM5 MMF: **Prysmian** als erste Hersteller
- **TIA** → Genormt im Juni 2016, TIA-492AAAE
  - Sept-2017: Farbkod ist Limetten-Grün
- **ISO/IEC** → Genormt im März 2017: IEC 60793-2-10 type: A1a.4
  - ISO/IEC 11801-1:2017 Version (Verkabelung) hat jetzt OM5
- **IEEE** → 802.3 entscheidet OM5 MMF als entsprechende Fasertyp
  - Neue adhoc für MMF PMDs; unterhalten neue Normen für 200G/400Gbps Ethernet durch WDM






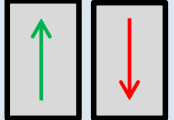
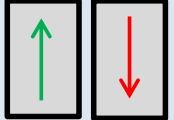
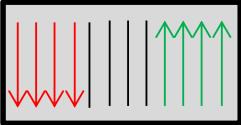
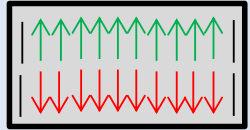
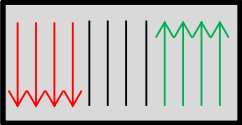


– 12 – ISO/IEC FDIS 11801-1 © ISO/IEC 2017






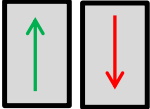
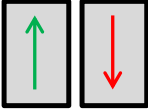
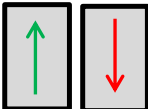
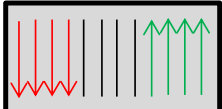
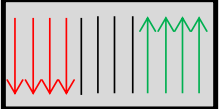
- e) addition of coaxial cabling component requirements for Category BCT-C;
- f) addition of cabled fibres of Category OS1a, and **OM5**;
- g) removal of silica optical fibre cabling;
- h) optical fibre cable OM1, OM2 and OS1 has been moved to an informative annex.

LWL-Verkabelung mit OM5

# MMF Systemvergleichung - Jetzt

Application	10GBASE-SR	25GBASE-SR	40GBASE-SR4	100GBASE-SR10	100GBASE-SR4
<b>Data Rate</b>	10 Gbps	25 Gbps	40 Gbps	100 Gbps	100 Gbps
<b>IEEE Std</b>	802.3ae	TBD	802.3ba	802.3ba	802.3bm
<b>Form Factor</b>	SFP+	TBD	QSFP+	CFP, CXP	QSFP28
<b>Fiber Type</b>	OM3/OM4	OM3/OM4	OM3/OM4	OM3/OM4	OM3/OM4
<b>Reach</b>	300/400m	70/100m	100/150m	100/150m	70/100m
<b>Link Budget</b>	1.5 dB	1.5 dB	1.5 dB	1.5 dB	1.5 dB
<b># MMF</b>	2	2	12 (8 used)	24 (20 used)	12 (8 used)
<b>Connector</b>	 LC Duplex	 LC Duplex	 12F MPO	 24F MPO	 12F MPO
<b>Schematic</b>					

# OM5 Systeme mit WDM

Application	40G WDM	100G WDM	200G WDM	400G WDM	800G WDM
Data Rate	40 Gbps	100 Gbps	200 Gbps	400 Gbps	800 Gbps
# MMF	2	2	2	8	8
Connector	 LC Duplex	 LC Duplex	 LC Duplex	 12F MPO	 12F MPO
Schematic					

# High-Density Verkabelung mit OM5

- Draka anbietet:
  - 2x1.6 mm Duplex Patchkabel → 40 & 100 Gbps
  - 2.0mm 12-Faser MPO Kabel für Break-out → 400 Gbps
- OM5 Verkabelung Farbkod ist **LIMETTEN-GRÜN** (Gemäß TIA)

Table 4 - Munsell wire and cable color limits<sup>1)</sup>

Color	Centroid	Hue Limits		Value Limits		Chroma Limits	
		From	To	From	To	From	To
Lime (LM) <sup>2)</sup>	5.5GY 8.5/10	5GY	6GY	8	9	8	> 8
1) Differences between this Table and the component limits of EIA 359-A are listed at the end of Tables D-1. These differences exist within 359-A, or between 359-A and this document, but the basis of such differences are not known 2) The color Lime defined herein applies to cable jacket and is different than the Lime color definition in TIA-598-D-1 for fiber.							



Vielen Dank für Ihre Aufmerksamkeit!



Fragen?

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