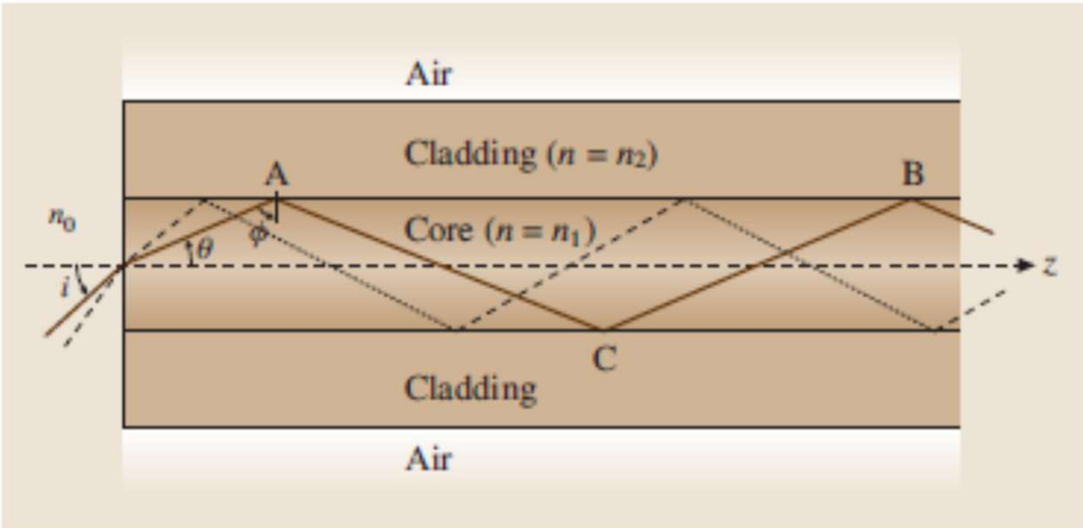
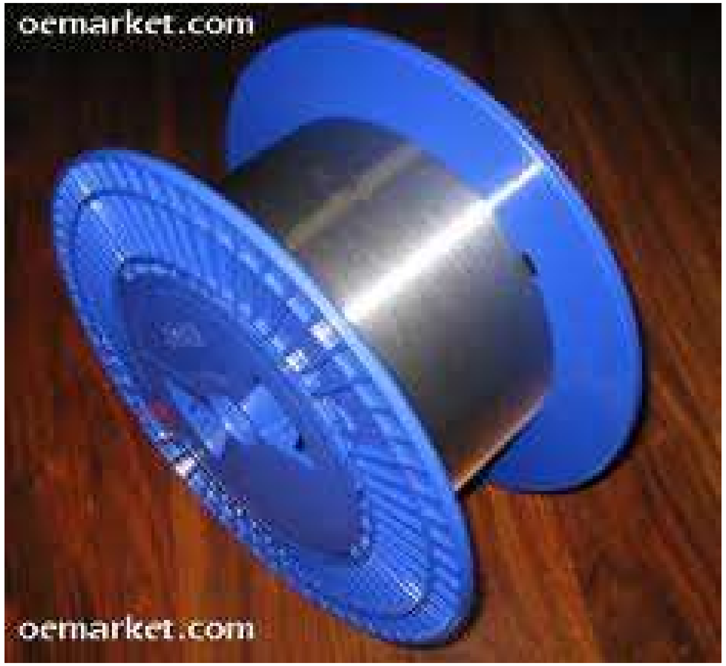
Základy vláknové optiky

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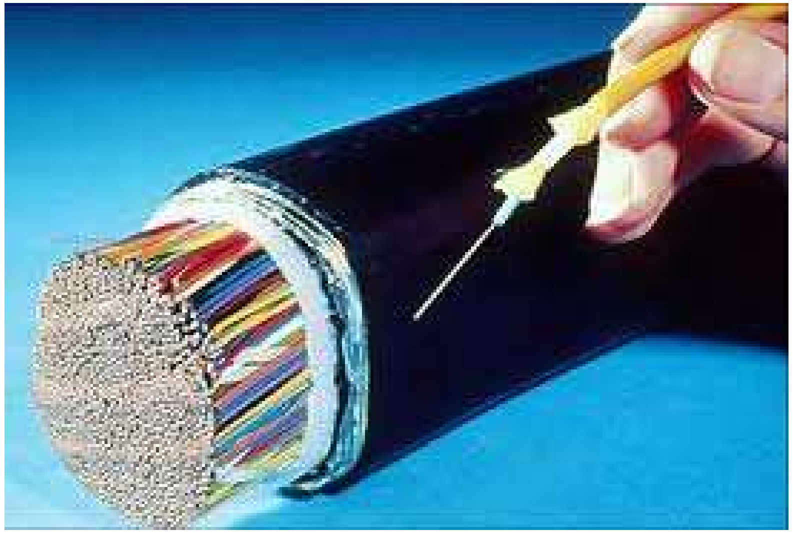
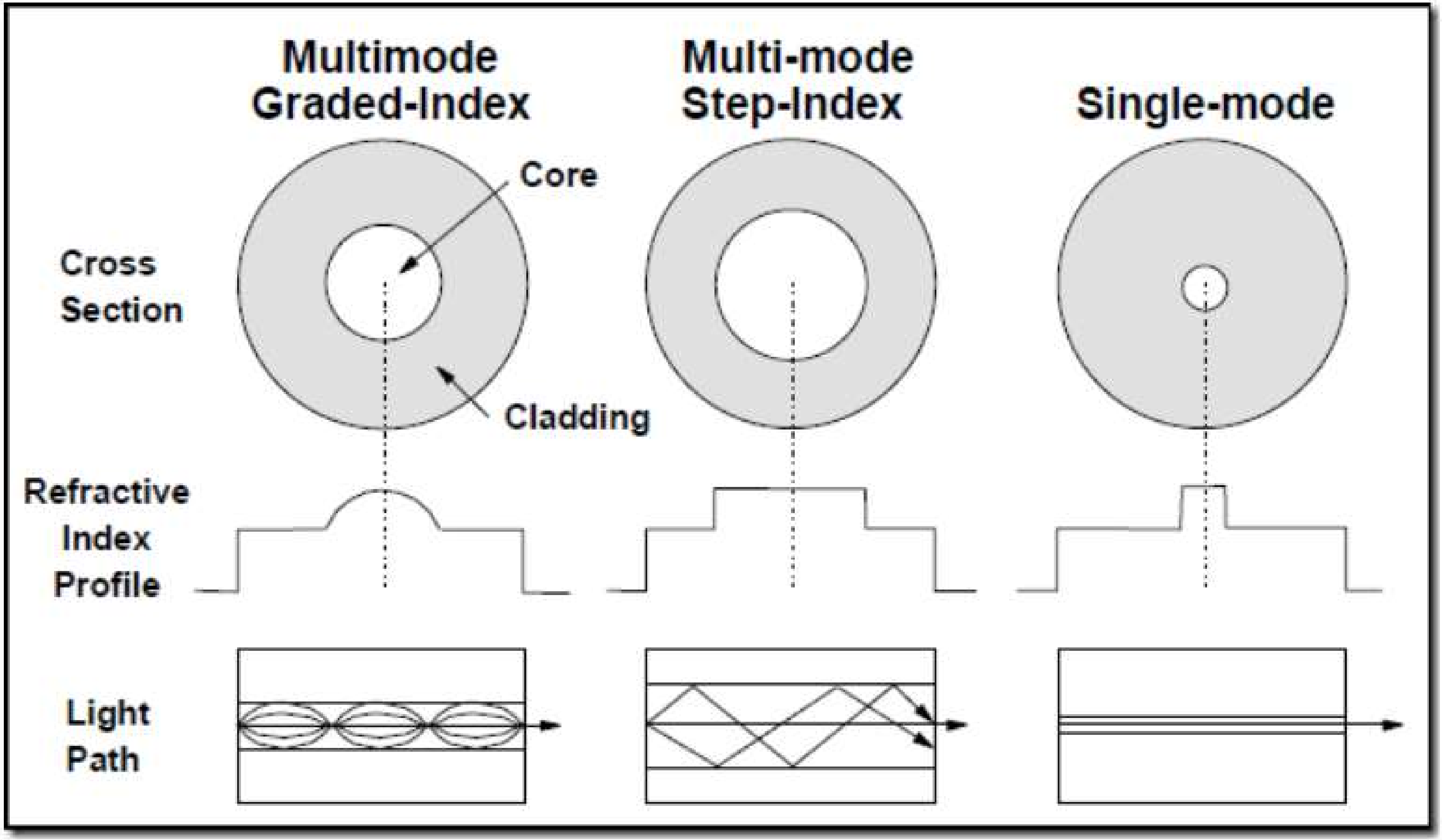
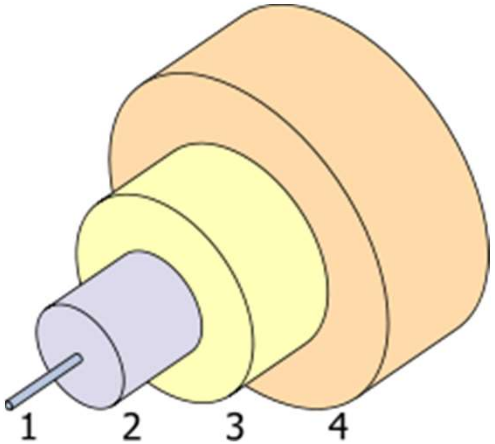


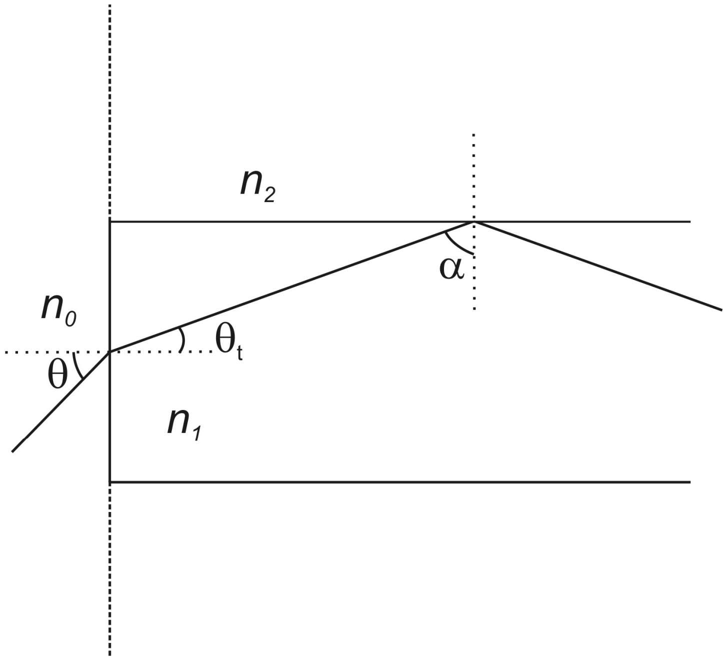


Obvyklé typy vláken

Jednomodové vlákno



1.- Core 8-10 μm
2.- Cladding 125 μm
3.- Buffer 250 μm
4.- Jacket 400 μm



$$\sin \alpha_c = \frac{n_2}{n_1}$$

$$\theta_t + \alpha = \frac{\pi}{2}$$

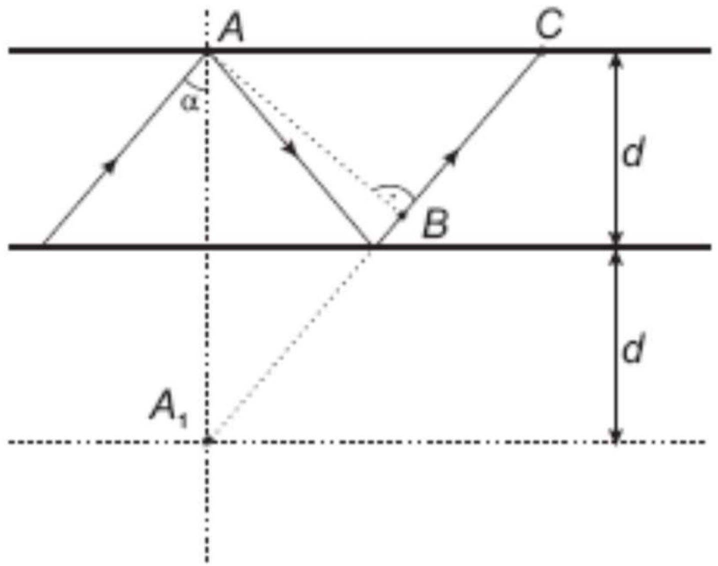
$$n_0 \sin \theta = n_1 \sin \theta_t$$

$$n_0^2 \sin^2 \theta_{\max} = n_1^2 - n_2^2$$

$$NA = n_0 \sin \theta_{\max} = \sqrt{n_1^2 - n_2^2}$$

křemenné vlákno se skokovou změnou indexu lomu (*n1* = 1,53, a *n2* =1,51)
NA=0,247 a pro n_0 = 1,0 vychází akceptační úhel 14º

Numerická apertura



Obr. 17.2 Planární vlnovod – k výkladu vedených modů

$$A_1B = 2d\cos\alpha$$

$$2n_1k_0d\cos\alpha + \Delta\varphi = 2m\pi \qquad m = 0,1,\ldots,M$$

$$\Delta\varphi \approx 0 \qquad 2n_1k_0d\cos\alpha_c \approx 2M\pi \qquad M \approx \left\{\frac{2d}{\lambda_0}NA\right\}_{CELÁ\ ČÁST}$$

Existence módů v optickém vlnovodu

Jen poznámka!

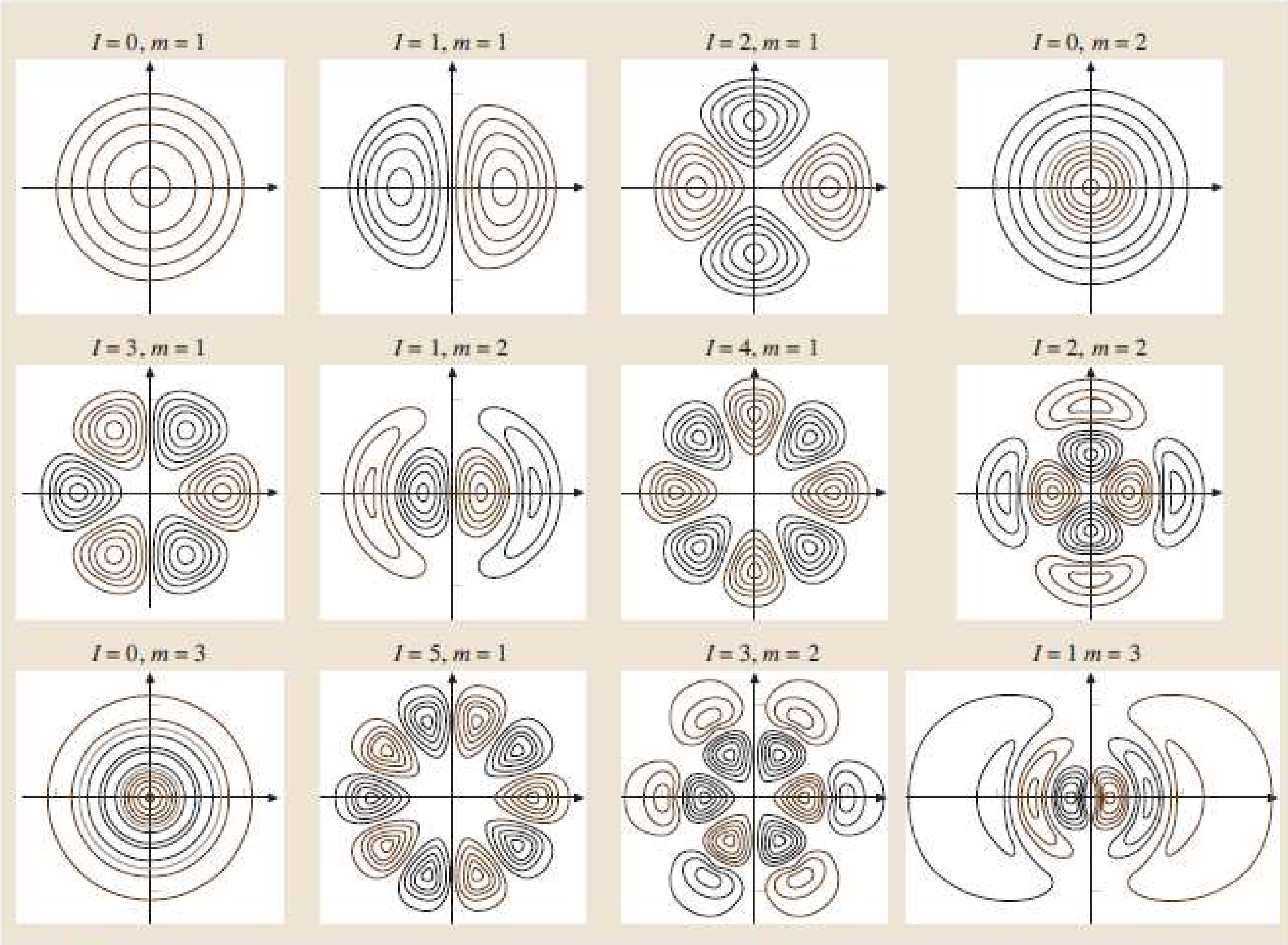


Fig. 8.73 Field patterns of some low-order guided modes (after http://www.rp-photonics.com/fibers.html, Rutger Paschotta, Date of last access: January 5, 2007)

$$\nabla^2\Psi = \frac{n^2}{c^2}\frac{\partial^2\Psi}{\partial t^2}$$

$$\frac{\partial^2\psi}{\partial r^2} + \frac{1}{r}\frac{\partial\psi}{\partial r} + \frac{1}{r^2}\frac{\partial^2\psi}{\partial\phi^2} + \left[k_0^2 n^2(r) - \beta^2\right]\psi = 0$$

$$\Psi(r, \phi, z, t) = R(r)\,\mathrm{e}^{\mathrm{i}(\omega t - \beta z)}\begin{cases}\cos l\phi \\ \sin l\phi\end{cases}$$

$$\Psi(r, \phi, z, t) = \psi(r, \phi)\;\mathrm{e}^{\mathrm{i}(\omega t - \beta z)}$$

$$r^2\frac{\mathrm{d}^2R}{\mathrm{d}r^2} + r\frac{\mathrm{d}R}{\mathrm{d}r} + \left\{\left[k_0^2 n^2(r) - \beta^2\right]r^2 - l^2\right\}R = 0$$

Útlum vlákna

$$ÚTLUM = 10\log_{10}\left(\frac{P_1}{P_2}\right)$$

$$\alpha[\mathrm{dB/km}] = \frac{10}{L[\mathrm{km}]}\log\left(\frac{P_{\mathrm{in}}}{P_{\mathrm{out}}}\right)$$

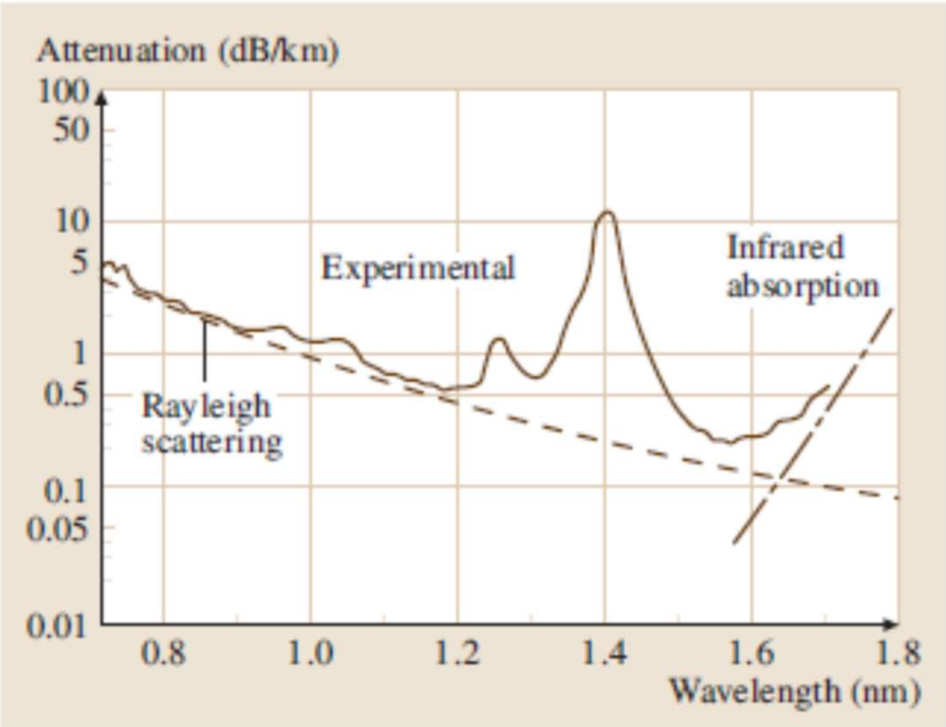


Fig. 8.69 Attenuation spectrum of a typical silica optical fiber (after [8.231])

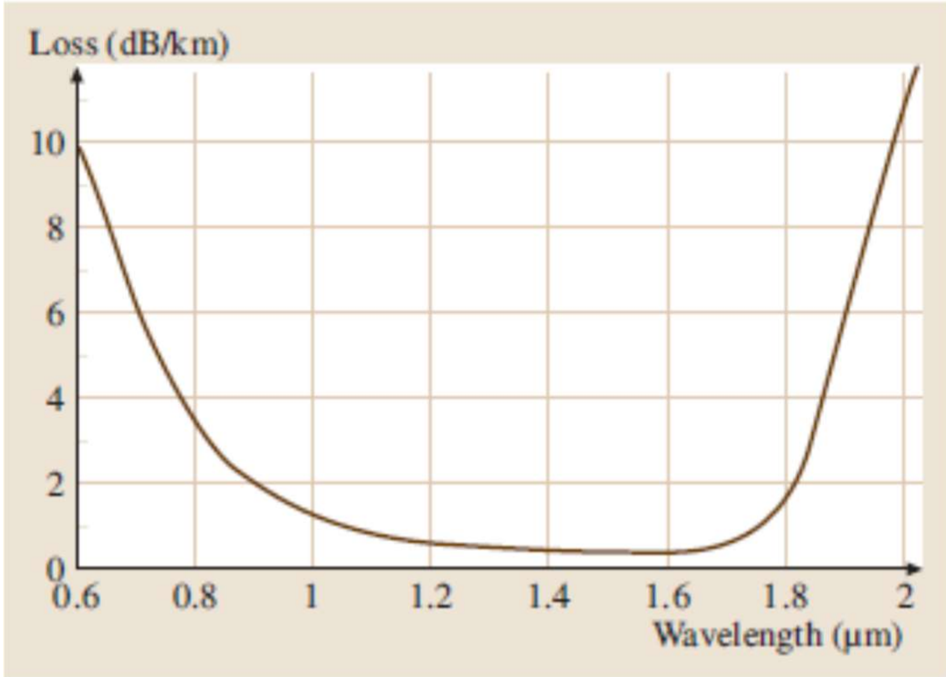
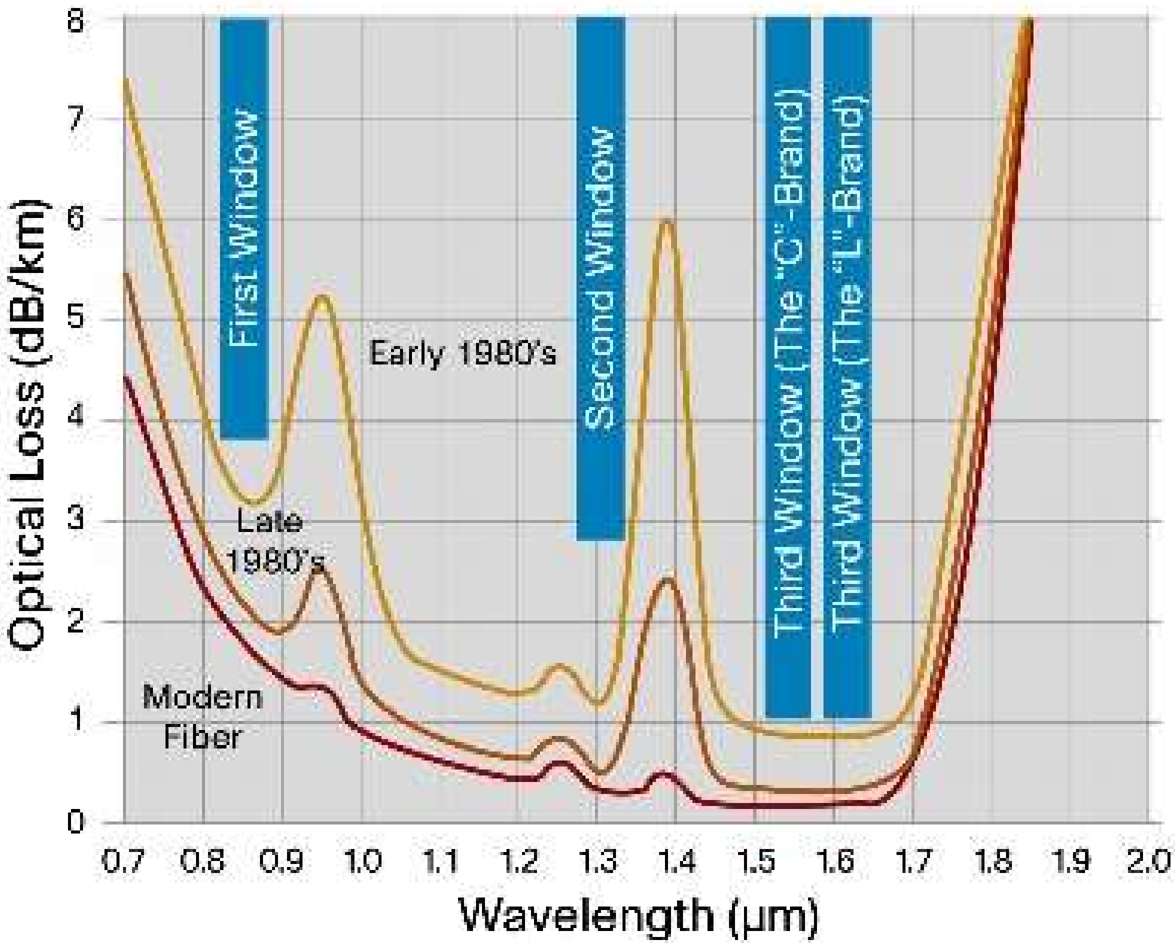
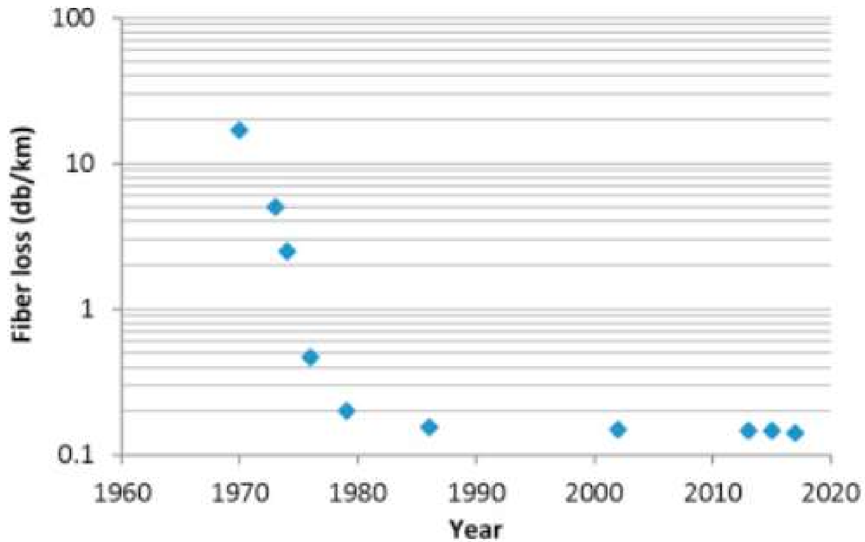


Fig. 8.70 Loss spectrum of an optical fiber with ultimately low water content. Note that the low-loss window extends from 1250 nm to 1650 nm (≈ 50 THz) and such fibers are now available commercially (after [8.232])

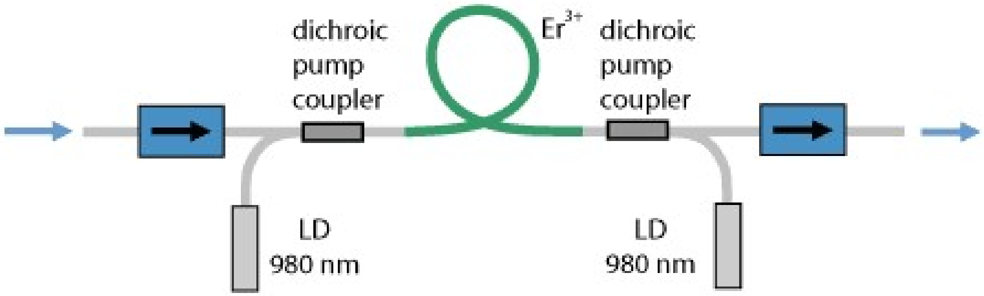
0,17–0,25 dB/km pro vlnovou delku 1,55 µm

0,35–0,6 dB/km pro vlnovou delku 1,3 µm

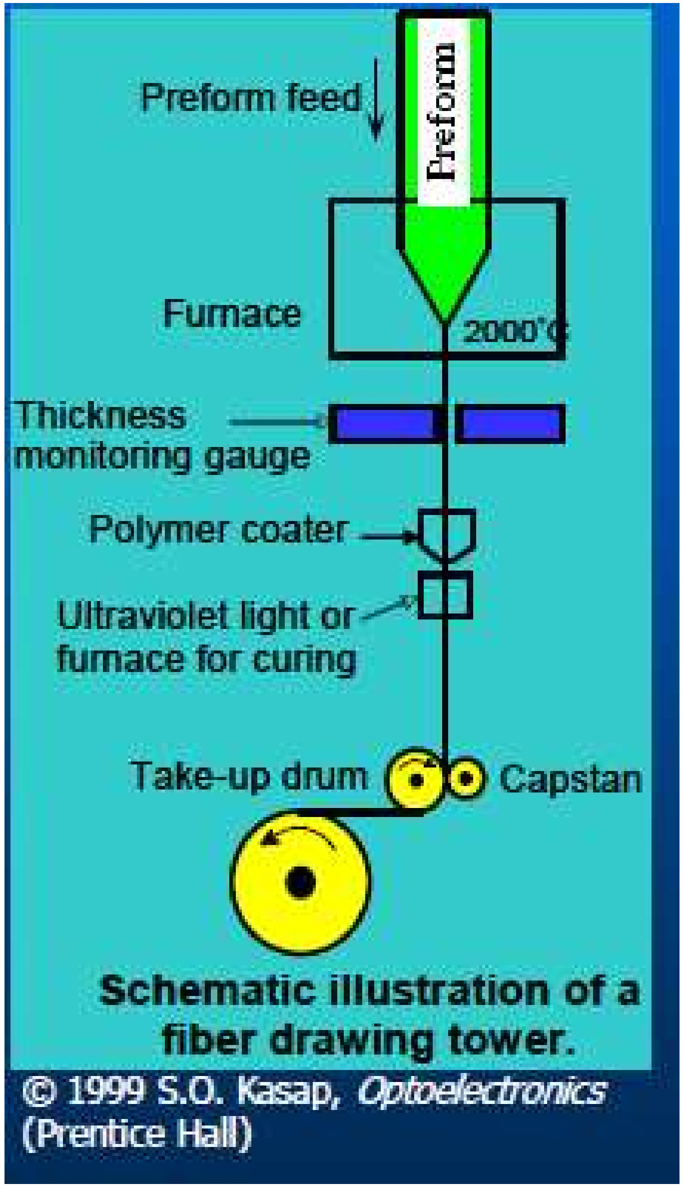




útlum



zesilovač



Tažení vlákna

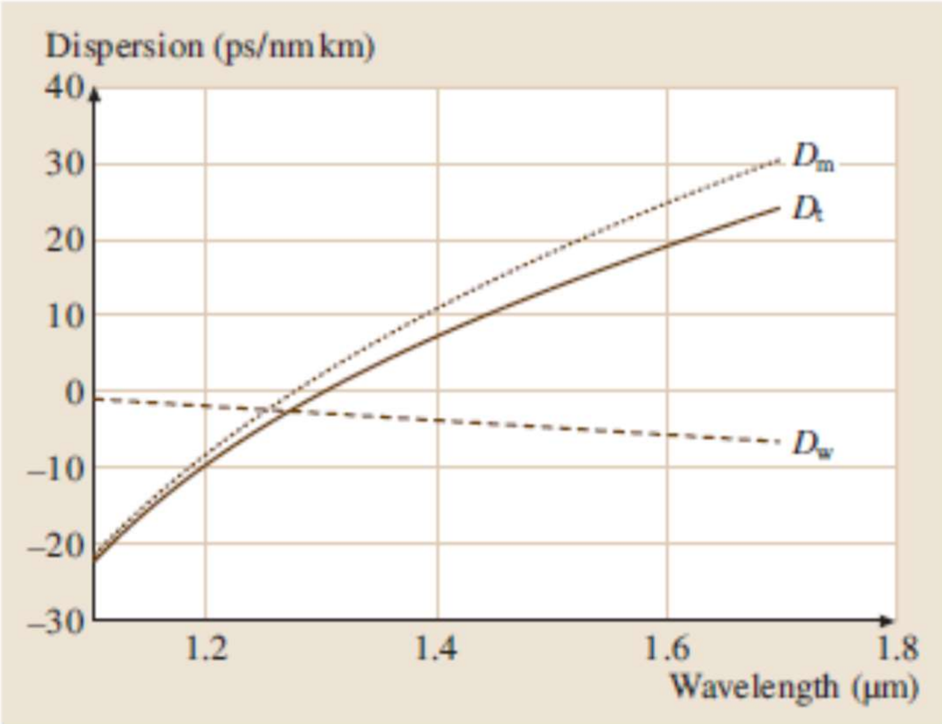
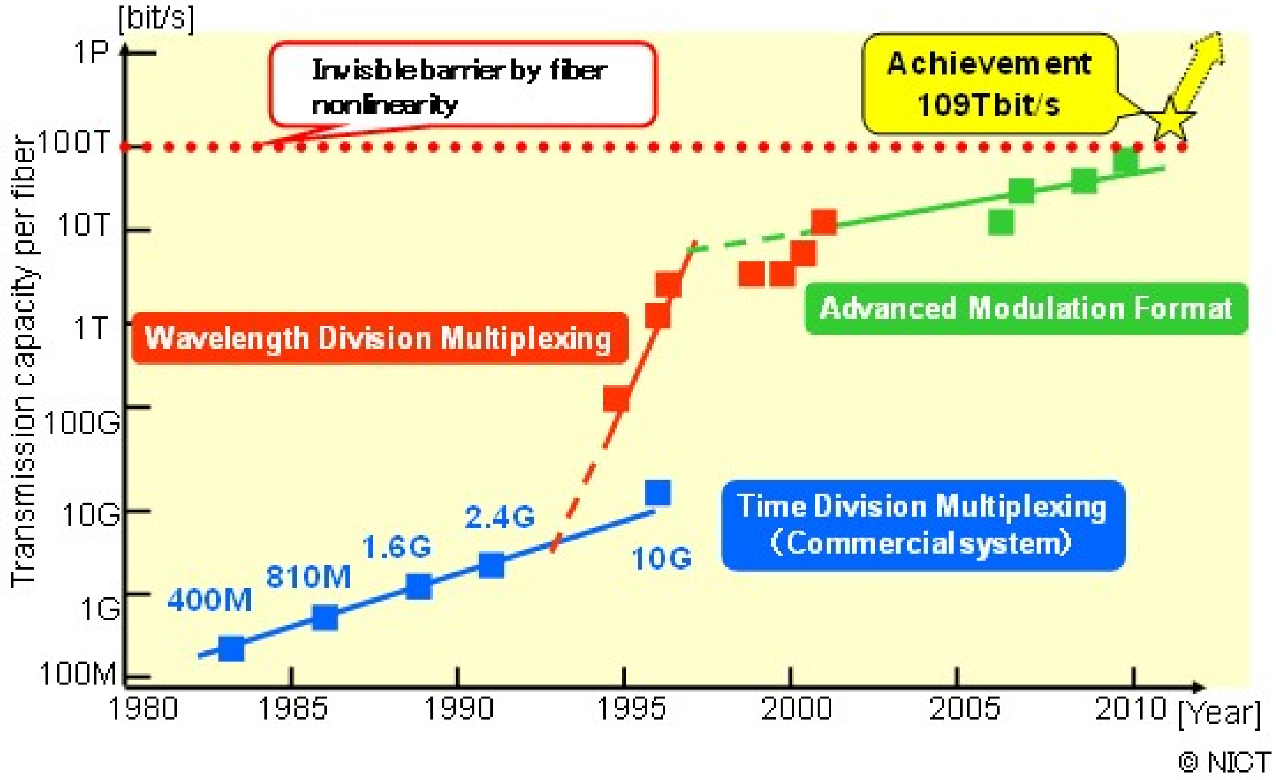
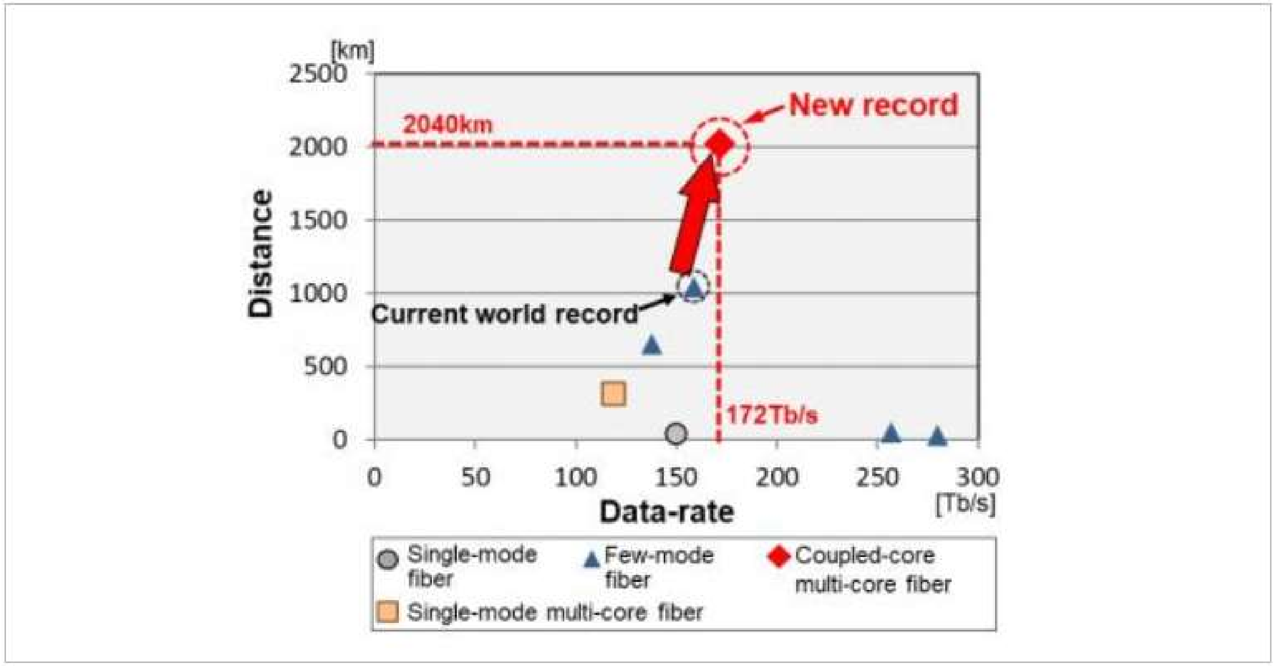


Fig. 8.74 Variation of material, waveguide and total dispersion with wavelength for a standard single-mode fiber

Disperze – rozšiřování pulsů: materiálová
módová
vlnovodná



Přenosová kapacita



2020

MEETING
43rd International Conference on Optical Fiber Communications (OFC 2020)

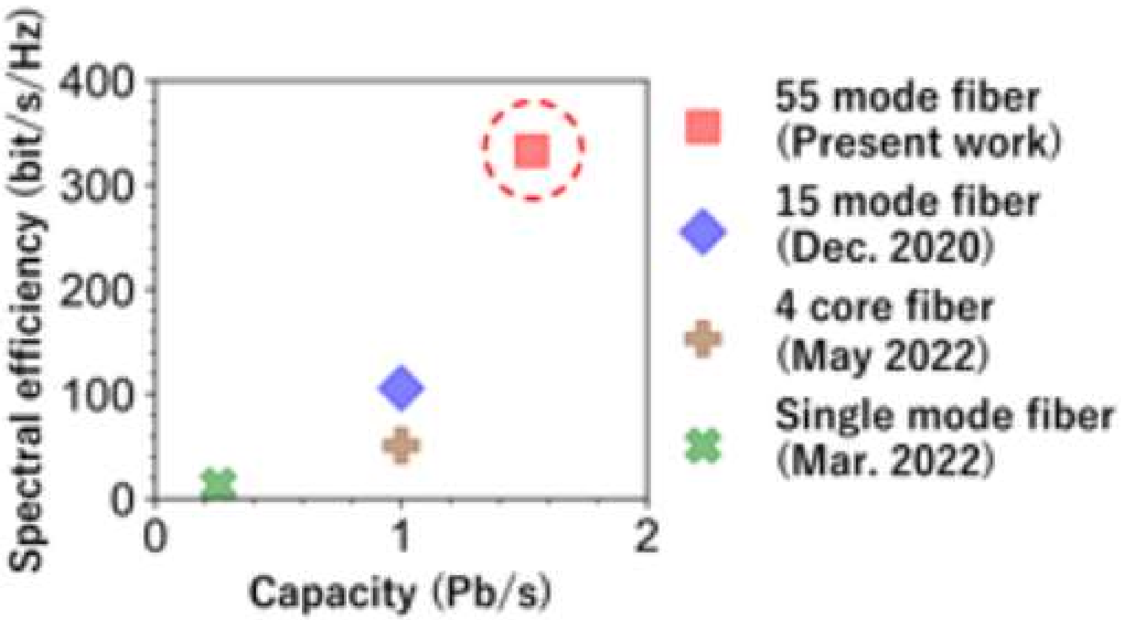
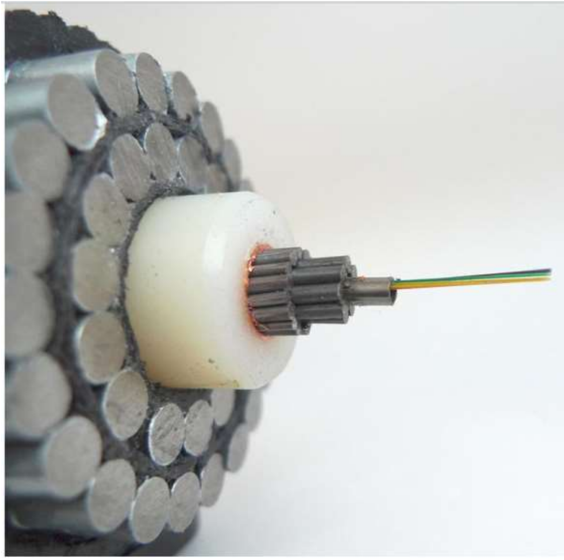
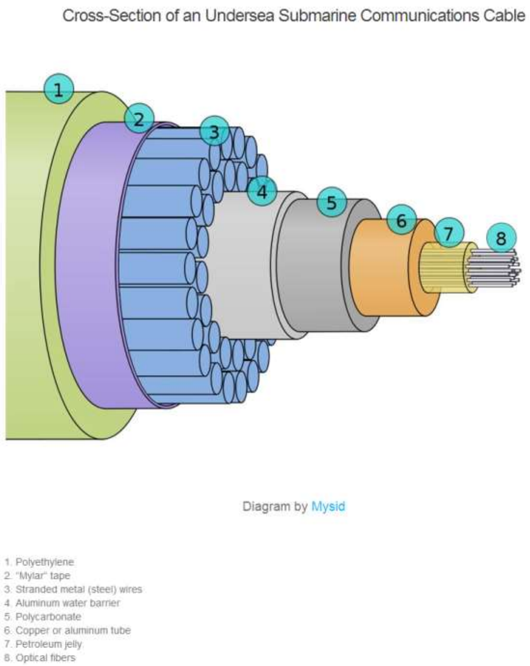
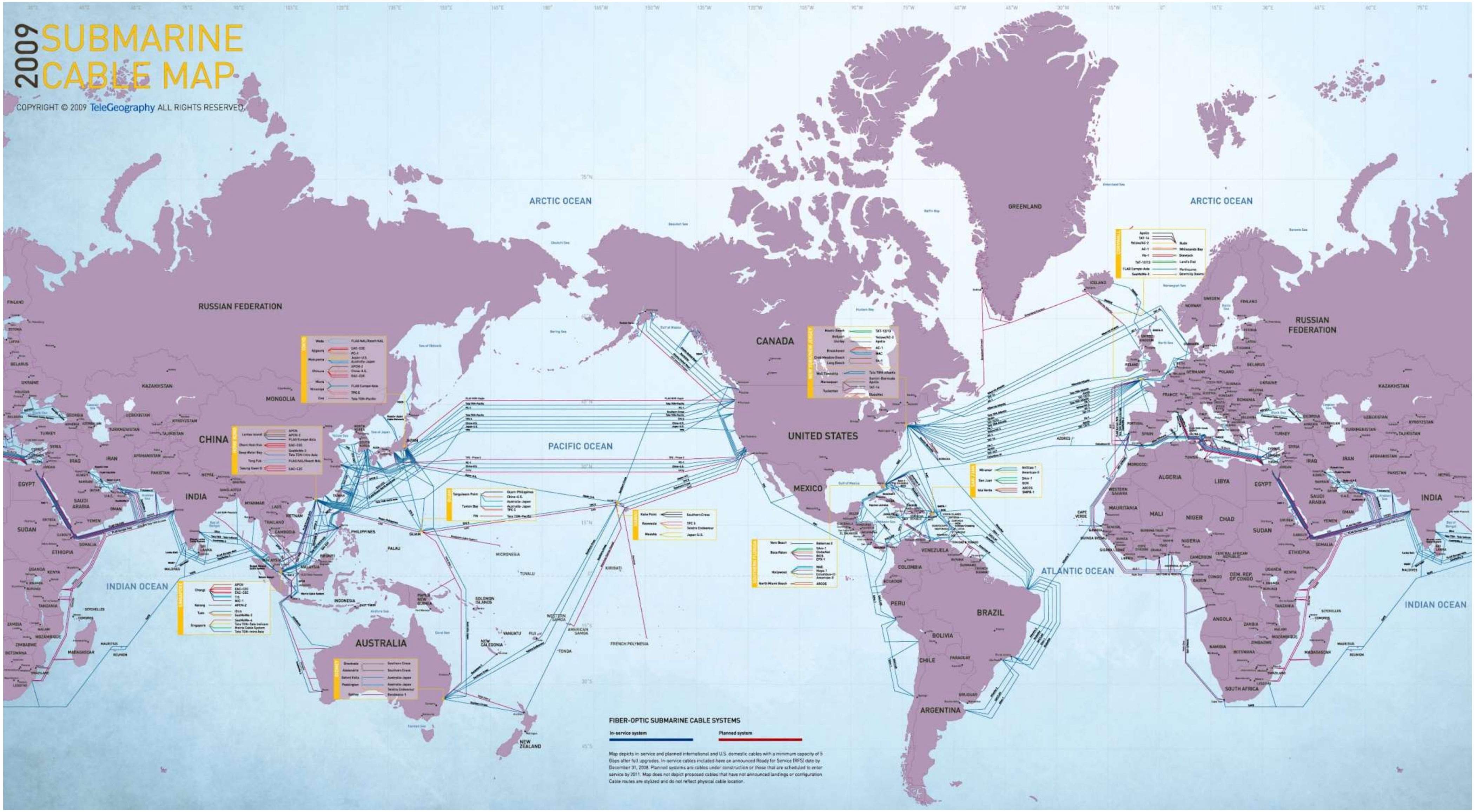


Figure 5 Comparison of spectral efficiencies in recent large-capacity transmission results achieved with standard cladding diameter optical fibers.



diameter of 69 millimeter (2.7 inches)





2009 SUBMARINE CABLE MAP
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ARCTIC OCEAN
RUSSIAN FEDERATION
CANADA
GREENLAND
ARCTIC OCEAN
RUSSIAN FEDERATION
KAZAKHSTAN
MONGOLIA
CHINA
INDIA
UNITED STATES
PACIFIC OCEAN
MEXICO
BRAZIL
ATLANTIC OCEAN
INDIAN OCEAN
INDIAN OCEAN
AUSTRALIA
NEW ZEALAND
ARGENTINA
CHILE
PERU
BOLIVIA
ALGERIA
LIBYA
EGYPT
MALI
NIGER
CHAD
SUDAN
ETHIOPIA
NIGERIA
ANGOLA
SOUTH AFRICA
FIBER-OPTIC SUBMARINE CABLE SYSTEMS
In-service system
Planned system
Map depicts in-service and planned international and U.S. domestic cables with a minimum capacity of 5 Gbps after full upgrades. In-service cables included have an announced Ready for Service (RFS) date by December 31, 2008. Planned systems are cables under construction or those that are scheduled to enter service by 2011. Map does not depict proposed cables that have not announced landings or configuration. Cable routes are stylized and do not reflect physical cable location.