

# Photonics

The technology of generating and harnessing light and other forms of radiant energy whose quantum unit is the photon. The science includes light emission, transmission, deflection, amplification and detection by optical components and instruments, lasers and other light sources, fiber optics, electro-optical instrumentation, related hardware and electronics, and sophisticated systems. The range of applications of photonics extends from energy generation to detection to communications and information processing.

*from the Photonics Dictionary at Photonics.com*

# Photonics

- Photonics was coined in analogy with Electronics
  - Electronics: The generation and control of electrons
  - Photonics: The generation and control of photons
- Compared with “Optics”, photonics has more emphasis on guided waves and optoelectronic devices
- Photonics has much in common with optical communications technology
- For a detailed definition, look at the table of contents in a book on photonics or a class syllabus

# OPTICS

# ELECTRONICS

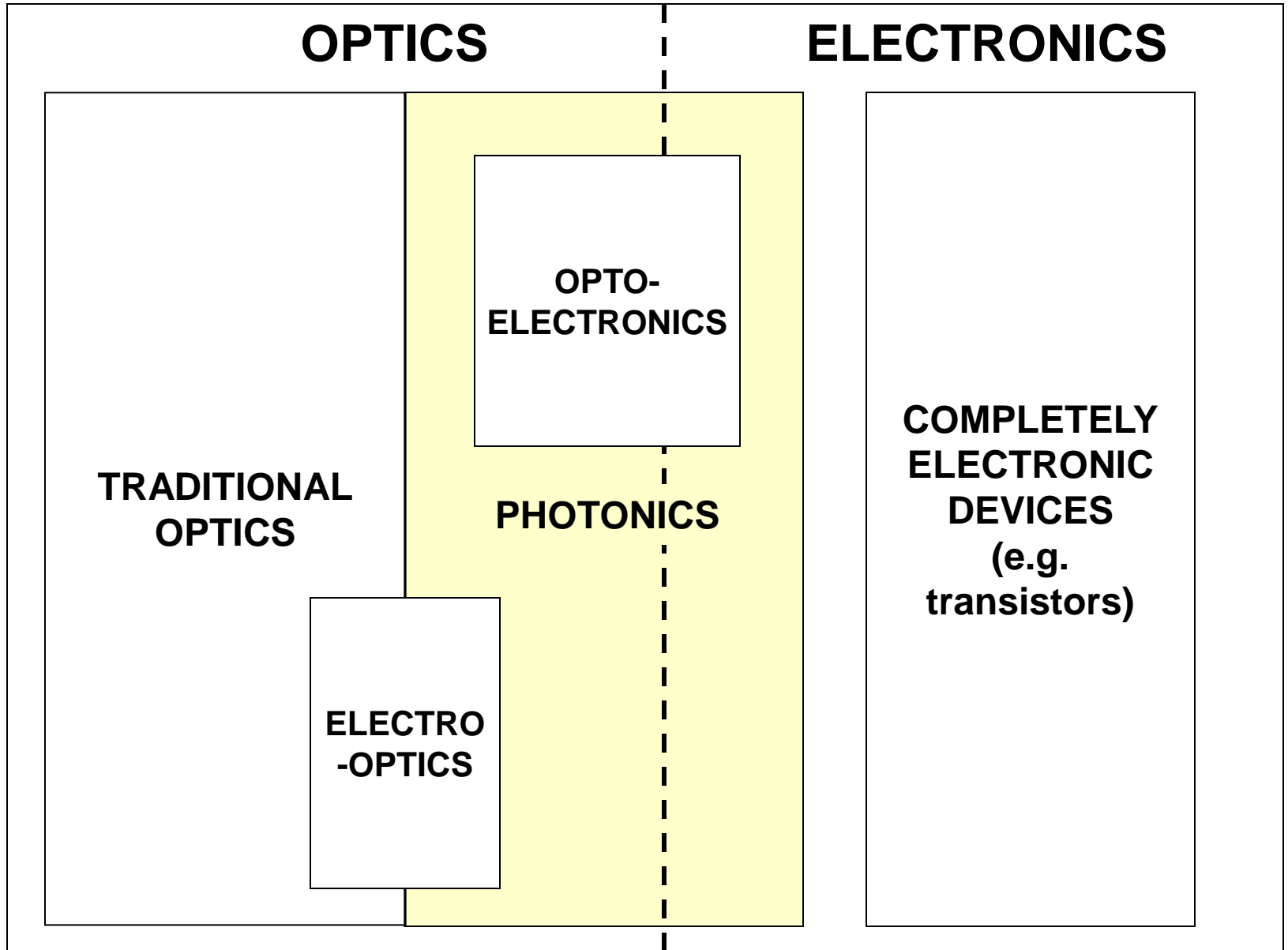
TRADITIONAL  
OPTICS

OPTO-  
ELECTRONICS

PHOTONICS

ELECTRO  
-OPTICS

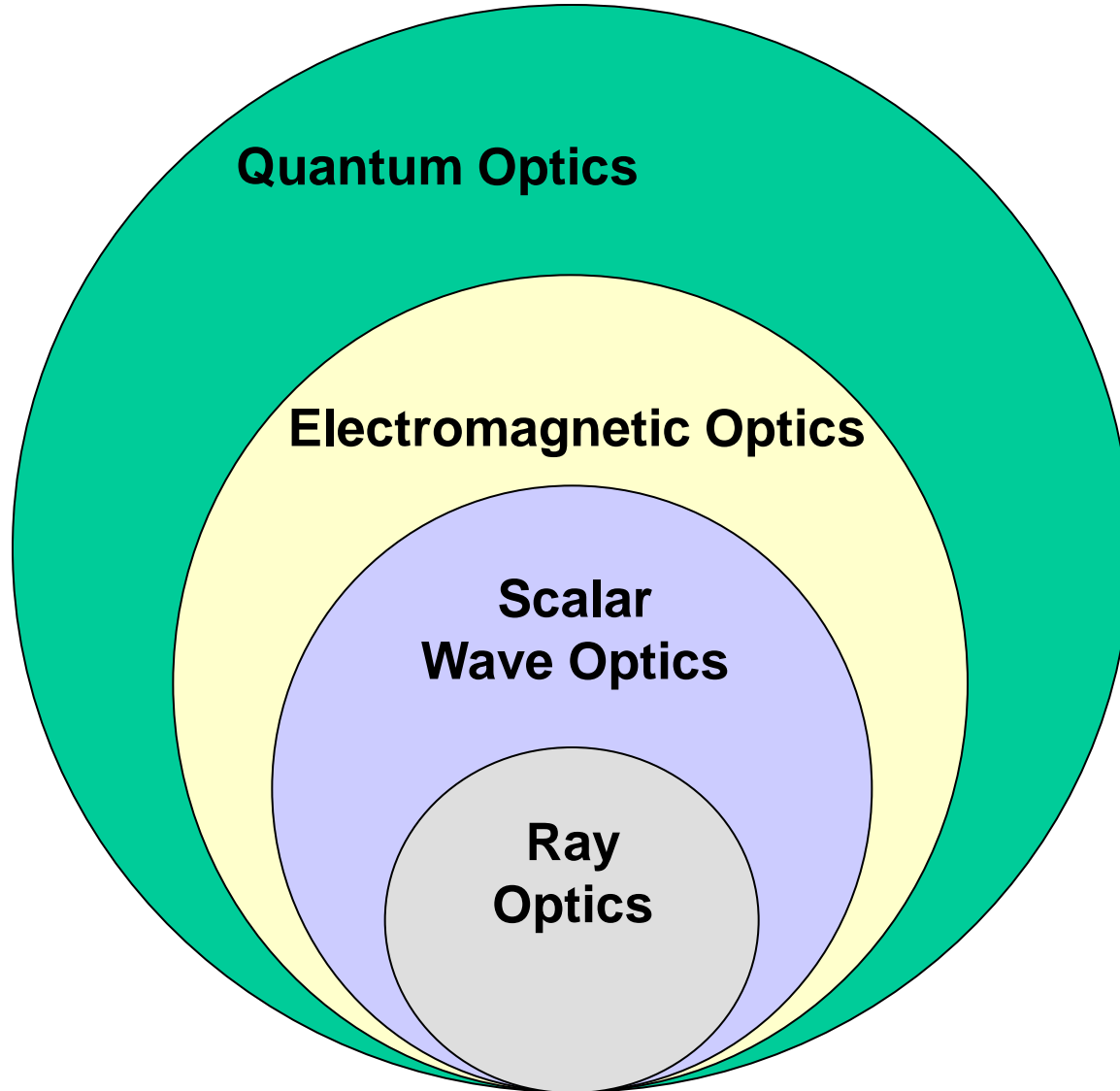
COMPLETELY  
ELECTRONIC  
DEVICES  
(e.g.  
transistors)



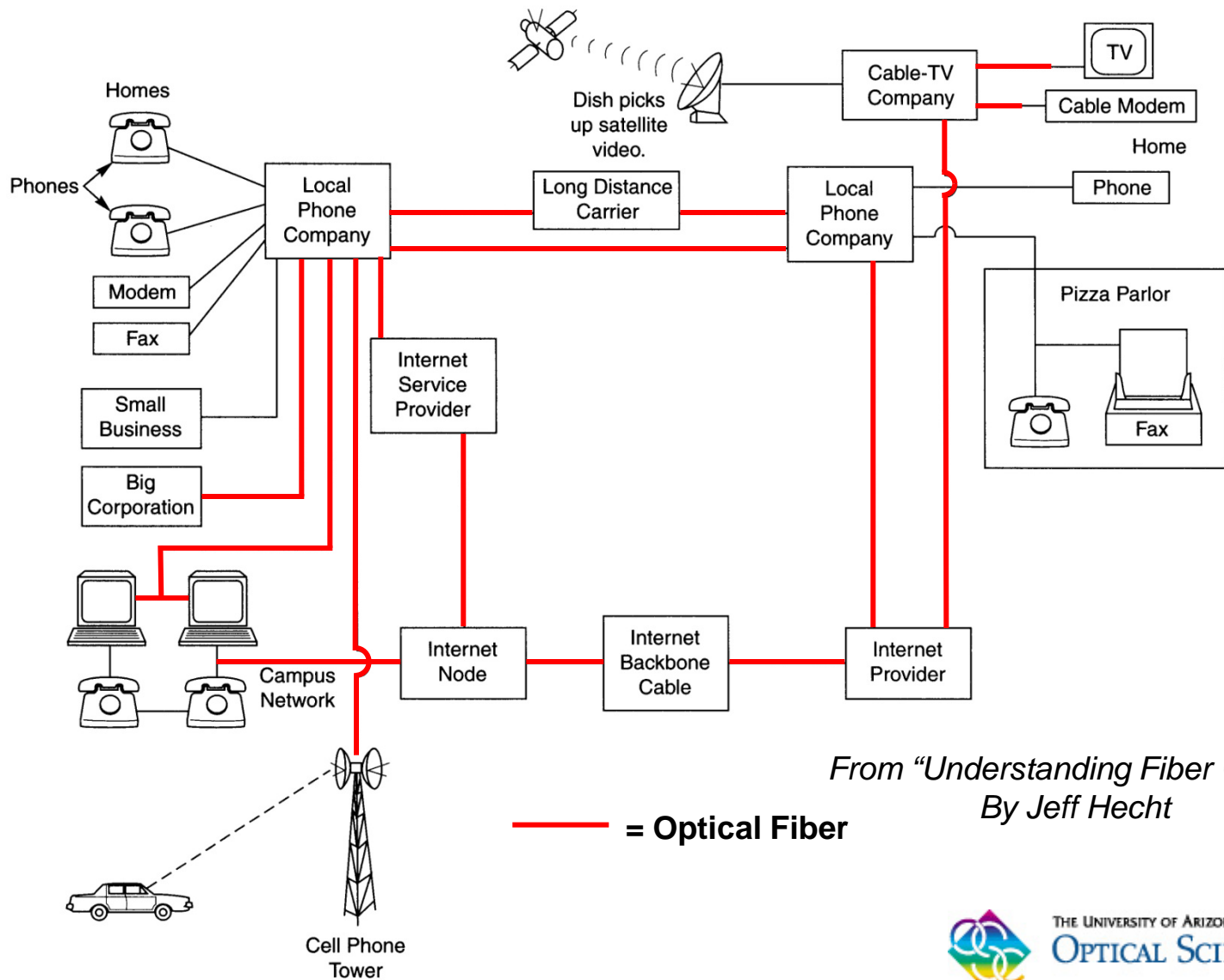
# Areas Included in Photonics

- **Optoelectronics:** Devices that are essentially electronic in nature but involve light (e.g. light emitting diodes, liquid-crystal display, and array photodetectors)
- **Electro-optics:** Devices in which electrical effects play a role (e.g. lasers, and electro-optic modulators and switches)
- **Quantum Electronics:** Devices and systems that rely principally on the interaction of light with matter (e.g. lasers and nonlinear optical devices used for optical amplification and wave-mixing)
- **Lightwave Technology:** Devices and systems that are used in optical communications and optical signal processing

# Descriptions of Optical Phenomena

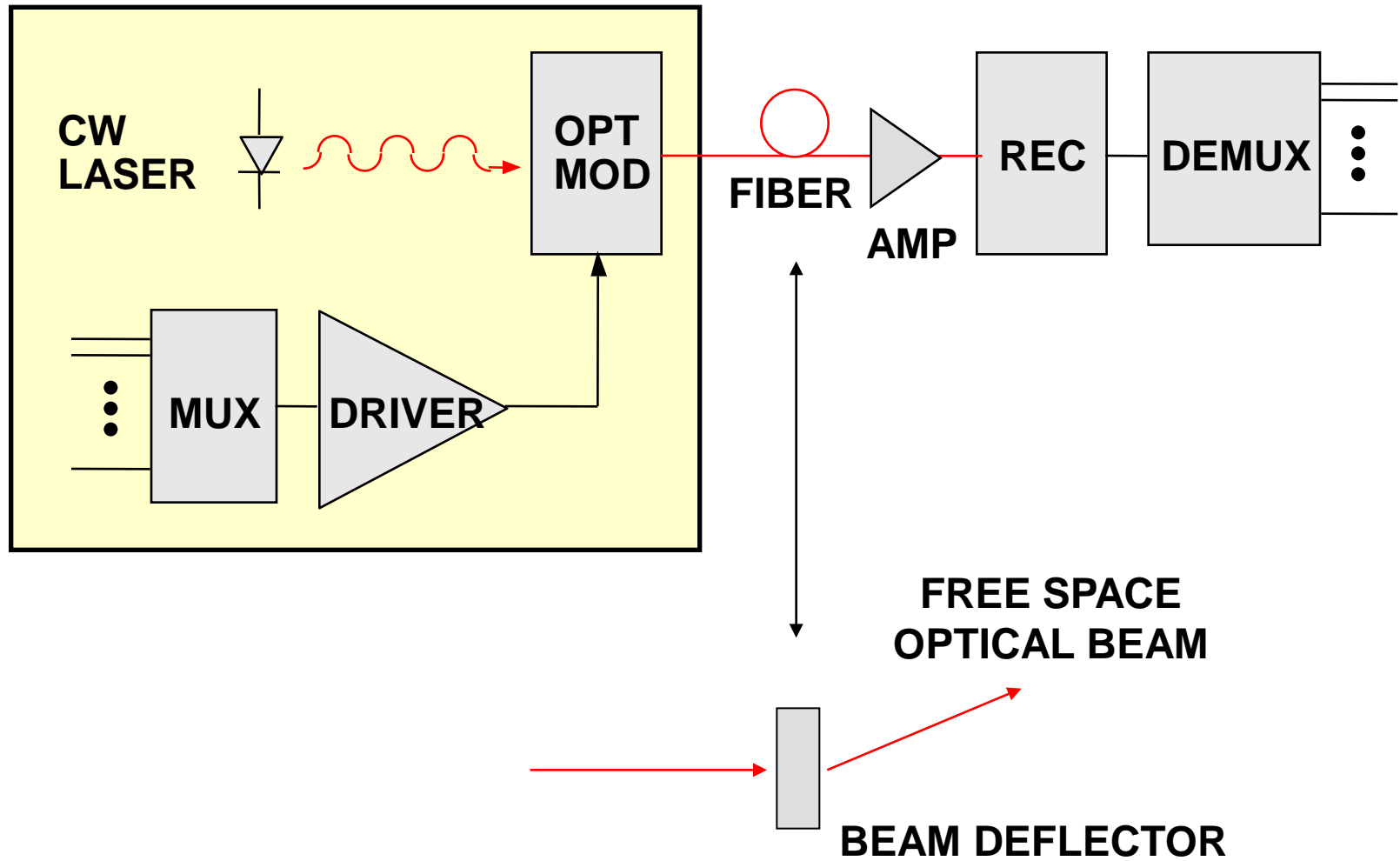


# THE GLOBAL TELECOMMUNICATIONS NETWORK

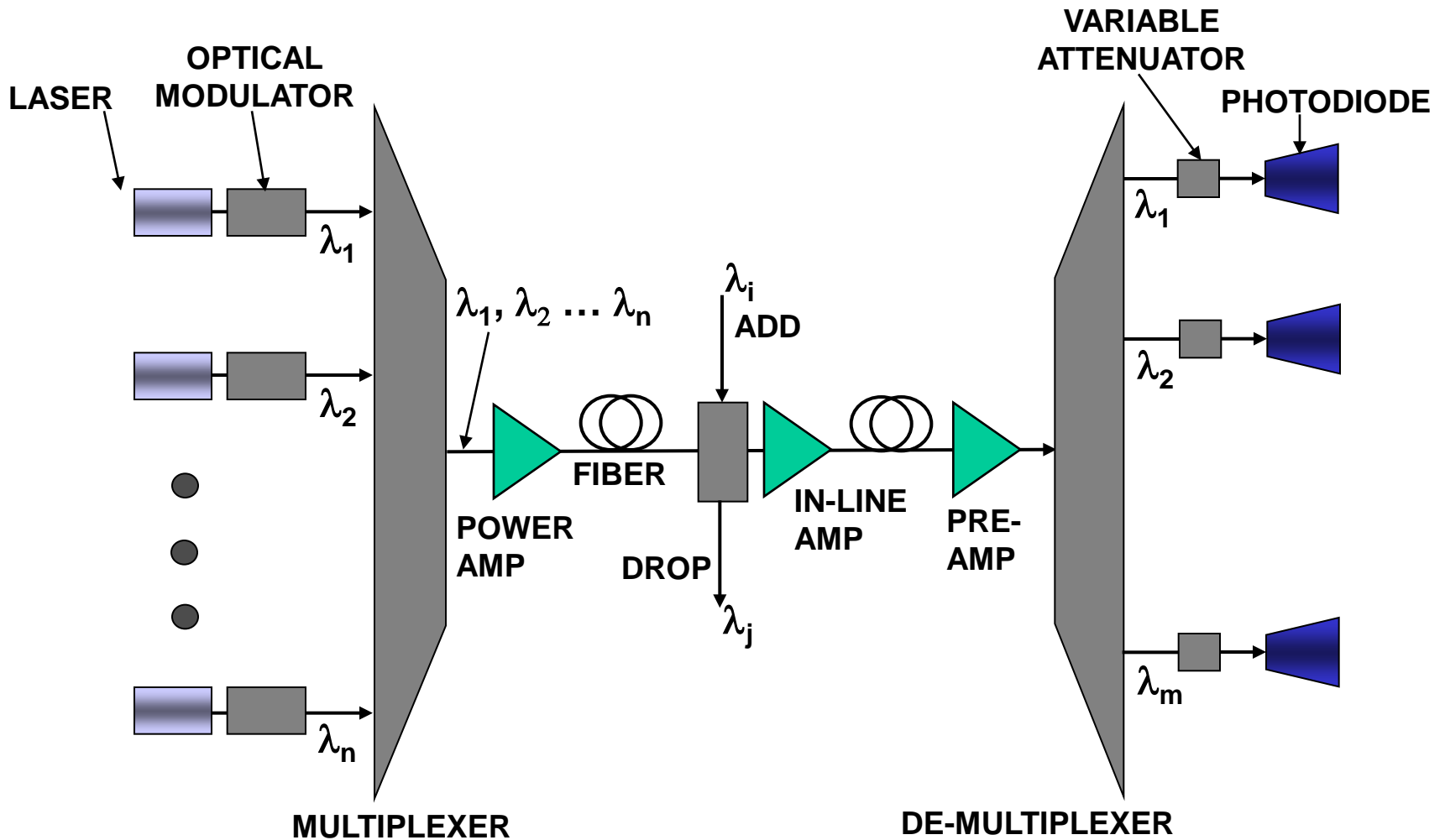


*From "Understanding Fiber Optics"  
By Jeff Hecht*

# OPTICAL COMMUNICATIONS LINK



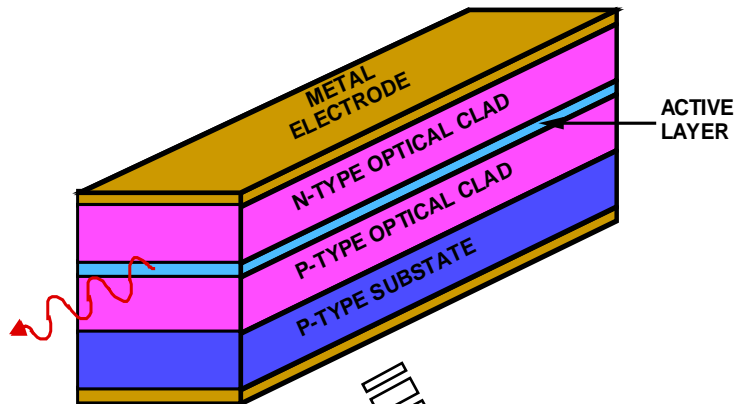
# AN OPTICAL COMMUNICATIONS LINK USING WAVELENGTH DIVISION MULTIPLEXING



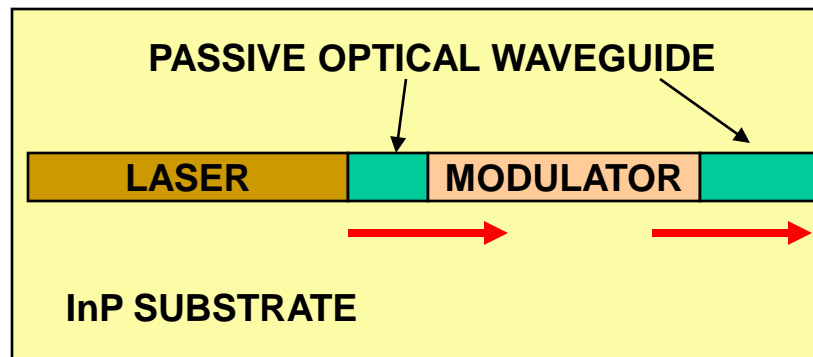
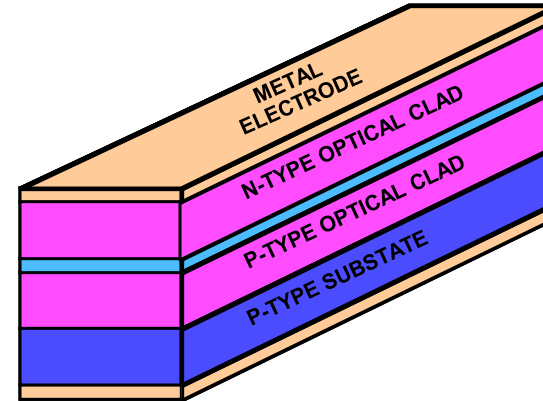


# PHOTONIC INTEGRATED CIRCUITS A.K.A. INTEGRATED OPTICAL DEVICES

## SEMICONDUCTOR LASER

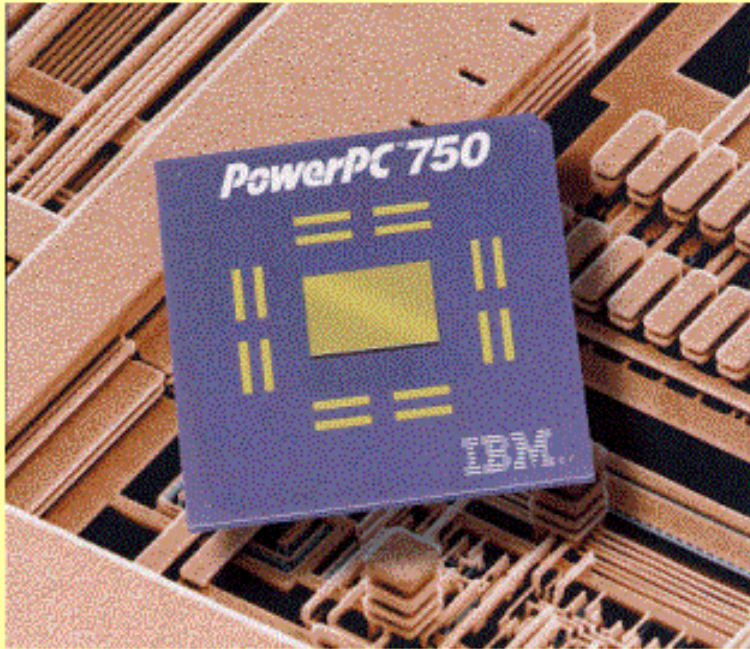


## SEMICONDUCTOR OPTICAL MODULATOR



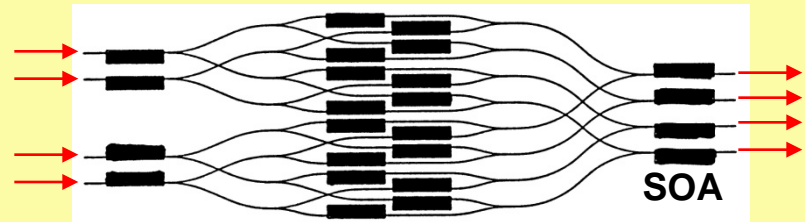
- **SMALLER SIZE**
- **LOWER COST**
- **GREATER FUNCTIONALITY**

# ELECTRONIC VS. PHOTONIC ICs



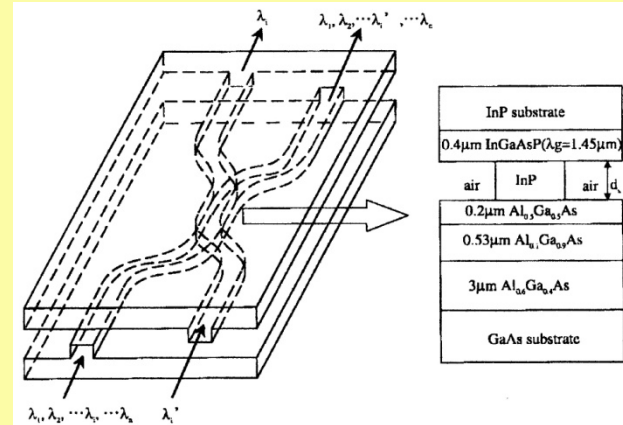
**6.35 Million Transistors  
Six Interconnect Levels**

## 4 x 4 OPTICAL CROSS-CONNECT



**24 Semiconductor Optical Amplifiers**

## FUSED VERTICAL COUPLER



**Two Interconnect Levels**

# ARRAYED WAVEGUIDE GRATING WITH SEMICONDUCTOR OPTICAL AMPLIFIERS

De-multiplexing, amplification, and equalization on one, InP chip

