

**18-315 Fall 2004**

**Introduction to Optical Communication Systems**

**Jimmy Zhu, ABB Professor in Engineering**

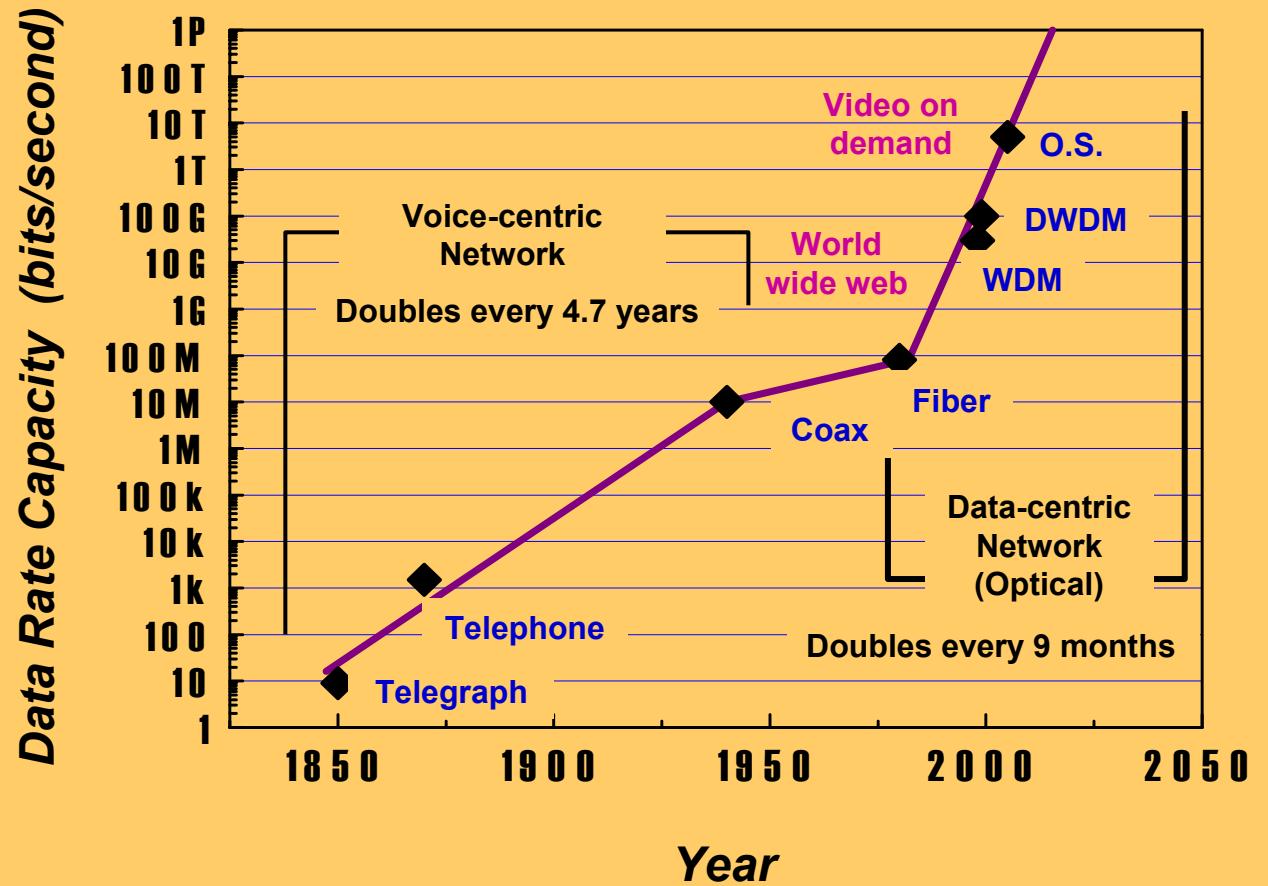
**Course Objective:**

**Provide a basic understanding of present optical communication systems and components, as well as future engineering challenges.**

# Bandwidth Explosion



Source: Agilent Technologies





## **Facts**

A single optical fiber is capable of transmitting  $2 \times 10^{12}$  bits of data per **second**, which is equivalent to

simultaneously carry more than **30,000,000** phone conversations, or

**200,000** users download (upload) information at **10 Mbits/second** data rate at same time, or

download all **380** CDs (each with 1 hour long music) in **1 second** , or

download **30** DVD movies in **1 second** .

**Present dense wavelength division multiplexing (DWDM) technology is realizing the full potential of a single optical fiber !**

A optical fiber cable may contain up to 200 fibers.



# Fiber-Optical Long-Haul Routes

Source: KMI

### NORTH AMERICAN FIBEROPTIC LONG-HAUL ROUTES PLANNED AND IN PLACE



### TERRESTRIAL AND UNDERSEA FIBEROPTIC ROUTES PLANNED OR IN PLACE



### WORLDWIDE UNDERSEA FIBEROPTIC ROUTES PLANNED AND IN PLACE



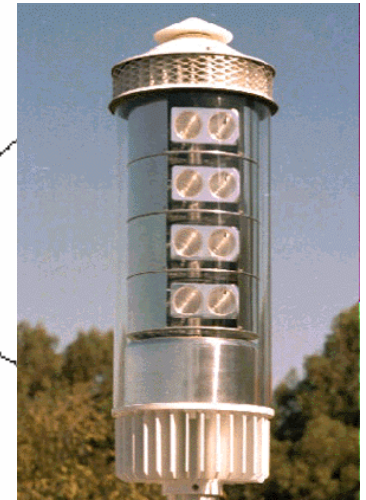
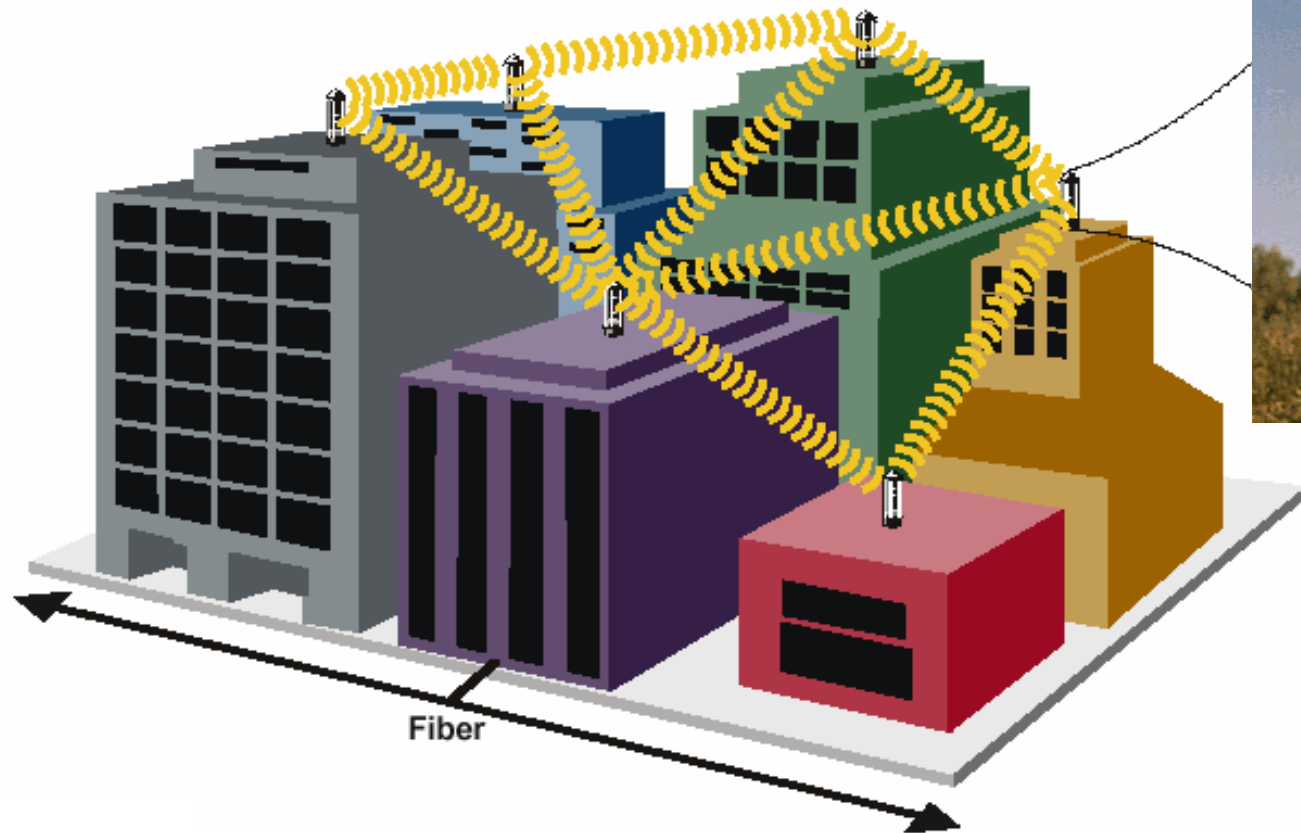
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# Metro Optical Network

Source: Nortel Networks

e.g. 10 Gbits Ethernet

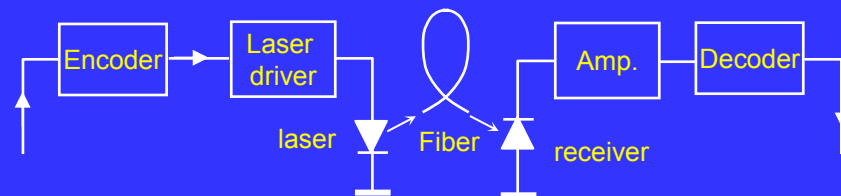
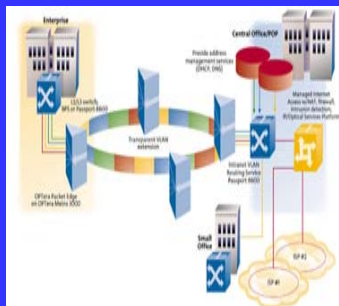


The optical wireless solution consists of a mesh network of short optical links that extend the fiber loop wirelessly to buildings outside the established fiber network.

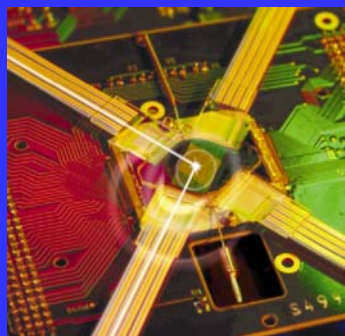


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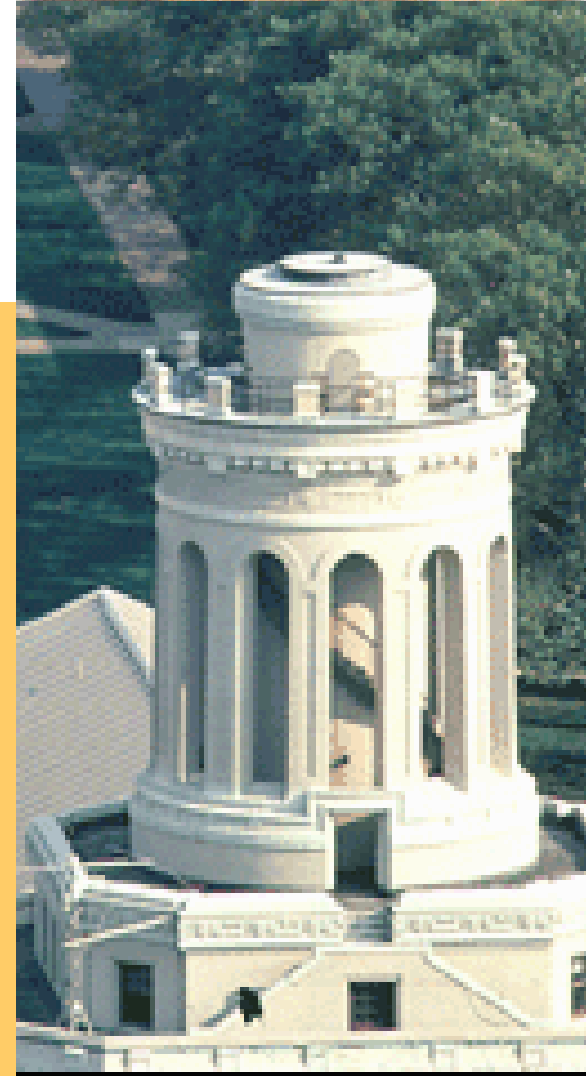
## Course Coverage



- *Light*
  - ✓ *How light carries information*
  - ✓ *Generation of light*
  - ✓ *Light traveling in a fiber*
  - ✓ *Amplification of Light*
- *Systems*
  - ✓ *Time Division Multiplexing (TDM)*
  - ✓ *Wavelength Division Multiplexing (WDM)*
  - ✓ *Optical networks*
- *Devices and Components*
  - ✓ *Fiber*
  - ✓ *LED*
  - ✓ *Semiconductor lasers*
  - ✓ *Fiber Amplifiers*
  - ✓ *Optical receivers*
  - ✓ *Optical modulators*
  - ✓ *Optical couplers and switches*



# Careers



## *This course is designed to:*

- ▶ *prepare students with up-to-date education ready for the optical communication and network industry.*
- ▶ *Provide students sufficient background knowledge for further career development in optical communication systems and networks.*
- ▶ *Stimulate students' ability for innovation.*
- ▶ *Train students' problem analyzing and problem solving abilities.*



## ***Future Optical Internet...***

*"A road to a world with  
no borders, no boundaries,  
no flags, no countries.  
Where the heart is the only  
passport you carry."  
-Carlos Santana*

***"A road to a world with no borders, no  
boundaries, no flags, no countries,  
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you carry."***

***— Carlos Santana***