

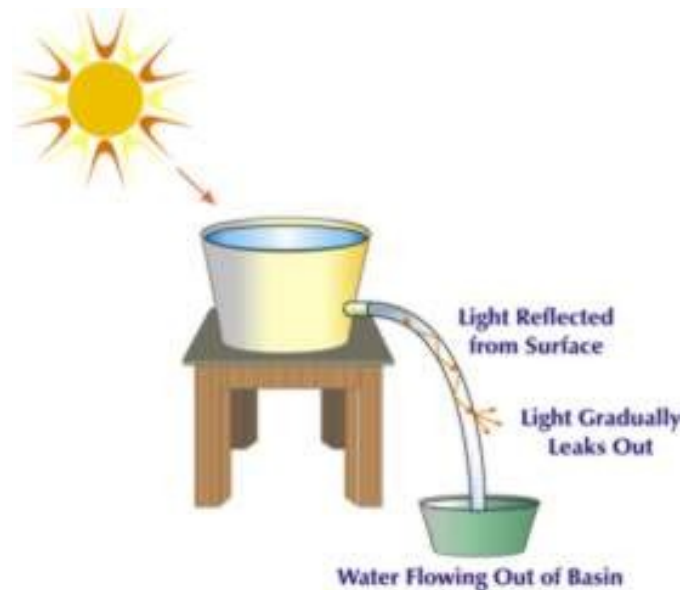
# History of Fiber Optics

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The Sage Group*

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# 1854 – John Tyndall

- First Guided transmission of light
- Used basin with hole in bottom to direct stream of water.
- Sunlight was refracted through the stream of water.



# 1880 – William Wheeling

- Used mirrored pipes to carry light from one source to many rooms.
- Did not take off because of Edison's incandescent light bulb gained widespread popularity.

# 1880 – Alexander Graham Bell



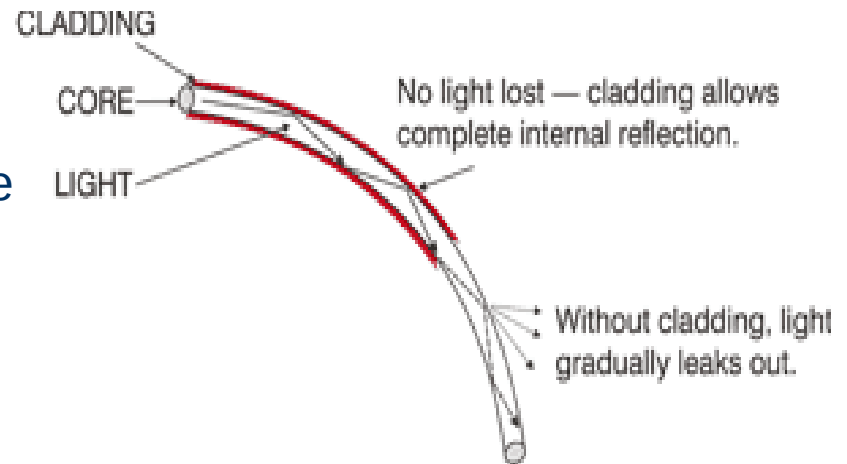
- Invented the photophone, a device to carry voice signals through the air instead of wires.
- While the photophone did not materialize, it became the forerunner to a networking technology called Free Space Optics, or FSO. FSO uses lasers and detectors to transmit data between buildings without wires.

# 1920 – First attempt with optical transmissions

- John Logie Baird (England) and Clarence W. Hansell (U.S.) jointly file patent for a method to carry television images through transparent pipes.
- Images were transmitted in 1933. It was a very short distance, but the quality was very, very low.

# 1954 – Invention of modern optical fiber

- Abraham van Heel covered a bare glass fiber with a transparent coating.
- This coating, later called cladding, had a lower refractive index than the bare fiber.
- The result was that the light was contained in the fiber and did not leak out.



# 1960 – Medial Imaging & Invention of the Laser



- Fiberscope allowed for the inspection of boilers and medical imaging.
- Laser was invented this year.
- Optical Fibers had losses of 1 dB/meter.

<http://www.spectrum-instruments.com/products/optical/industrial.shtml>

# Telephone company demands

- Telephone companies were interested in optical fiber.
- Possible bandwidth increases were possible with the invention of the videophone.
- Telephone companies wanted losses of no more than 10 – 20 dB/km.



# The proposal that started it all

- Charles K. Kho was an engineer with Standard Telecommunications Laboratories.
- He proposed in 1966 that communications were possible with single mode fiber.
- This presentation was made to the Institute of Electrical Engineers (now IEEE)
- Attenuation of less than 20 dB/km was possible with optical fiber

# 1970 – Corning Glass Invents Optical Fiber

- Inventors: Keck, Maurer, Schultz
- Single mode fiber at 633 nm wavelength
- Attenuation below 20 dB/km

# 1977 – Phone Companies Use Optical Fiber

- Used multimode fibers at first
- Transmission rates of 6.2 Mb/s and 45 MB/s
- First generation systems: 850 nm wavelength; 2 dB/km attenuation
- Second generation systems: 1300 nm wavelength; 0.4 dB/km

# 1980 – Bell Labs Proposes First Fiber Transatlantic Cable

- TAT-8 transatlantic cable proposed
- Uses single mode fiber
- Speed: 565 Mb/second over 2-pair fiber

# 1984 – Everything Changes

- Modified Final Judgment splits AT&T into seven Regional Bell Operating Companies
- First wave of deregulation hits telephone industry
- Microwave Communications Inc. (MCI) looks to single mode fiber for its communications
- MCI terrestrial systems operate at 1300 nm at 400 Mb/sec. Amplifiers are spaced every 50 kilometers.

# 1988

- AT&T activates TAT-8
- 1300 nm becomes standard for fiber optic systems.

# 1992

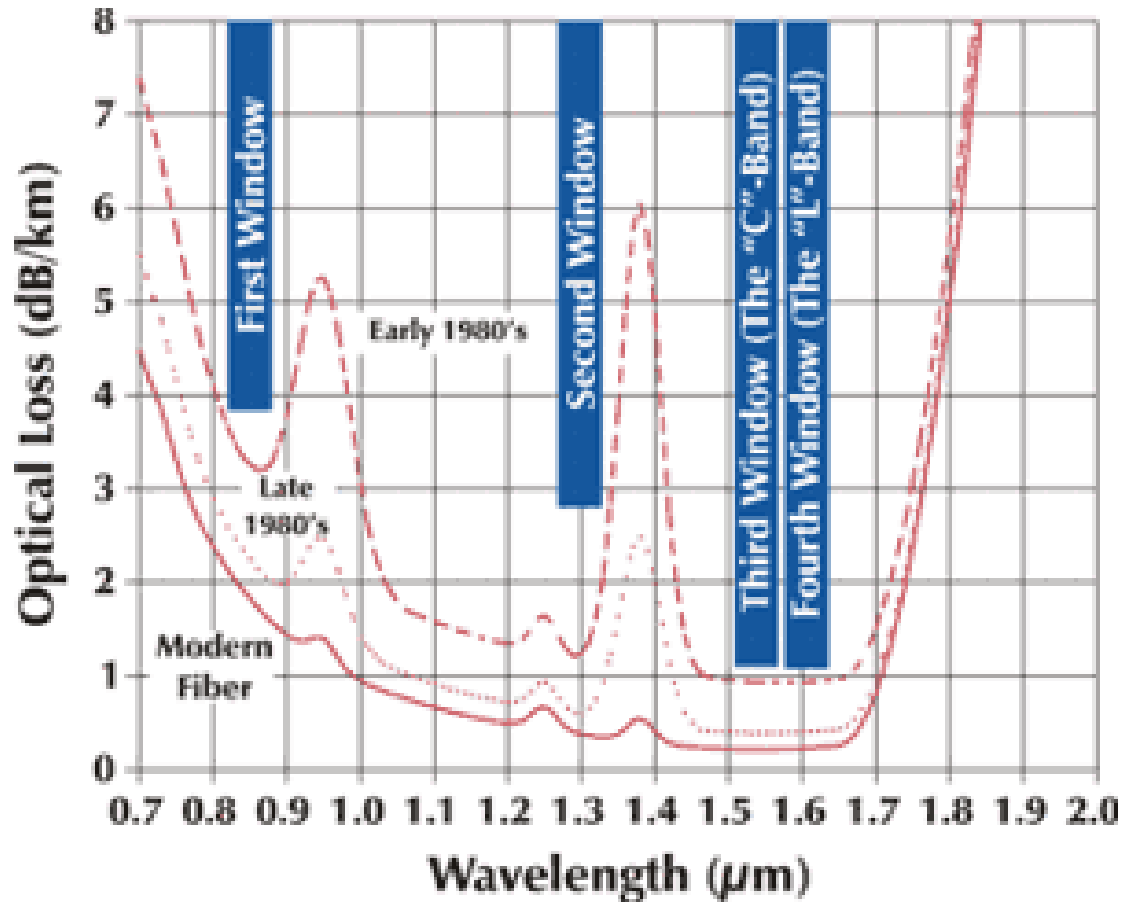
- 1550 nm systems appear for the first time.
- Transatlantic cable TAT-10 activated
- Fiber attenuation now at 0.2 dB/km at 1550 nm

# New optical amplifiers appear

- Erbium Doped Fiber Amplifiers are now available.
- EDFAs allow for optical amplification without conversion to electrical and back again.
- Wave Division Multiplexing now possible.



# Fiber Optic Cable Attenuation (Long-haul fiber)



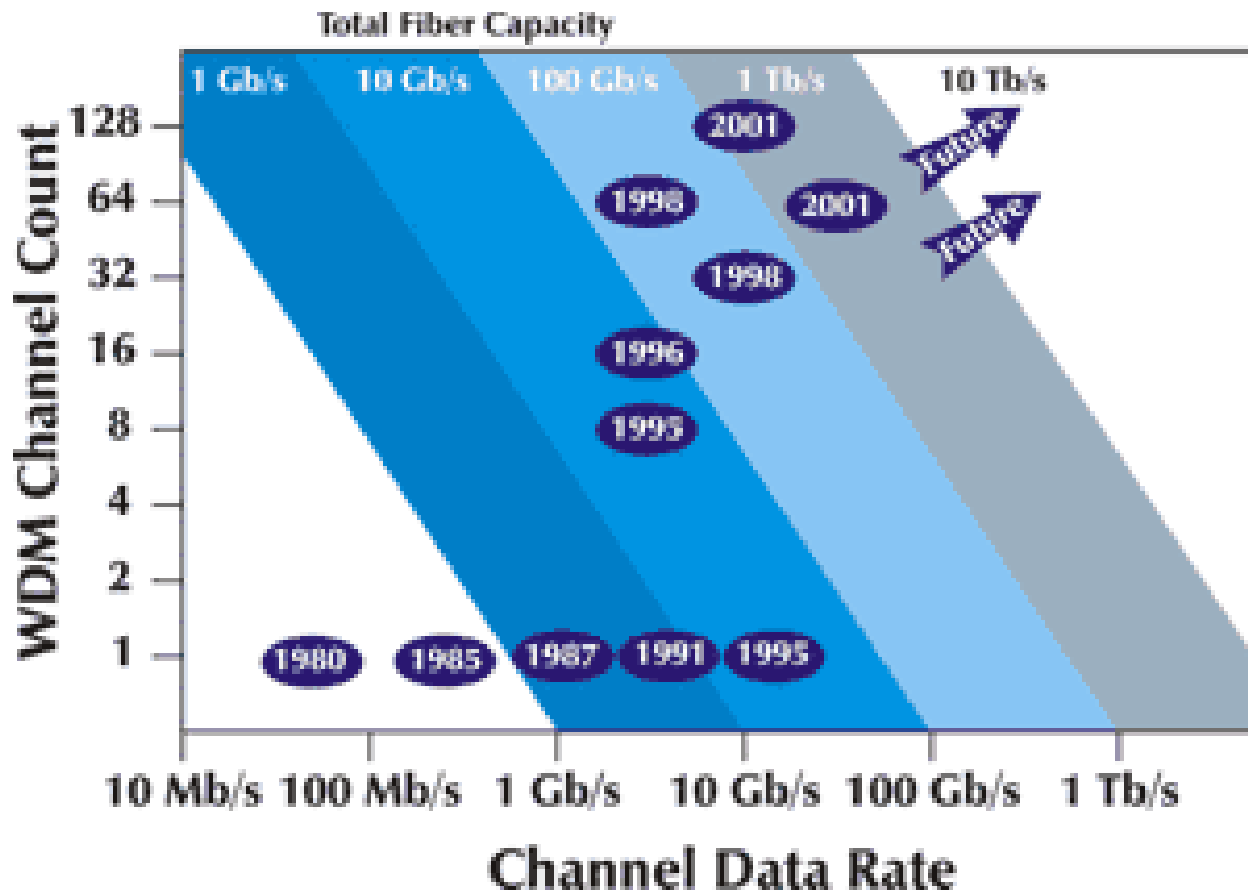
# 1996 – The Internet boom begins

- Transatlantic cable TAT-12/13 activated. Data rate is 5 Gb/second.
- Netscape, maker of the Netscape browser, goes public and starts the Dot.Com boom.
- Telecommunications Act of 1996 signed into law. The Act forces the incumbent telephone companies to open their networks to competition.
- Competitive Local Exchange Carriers open for business.

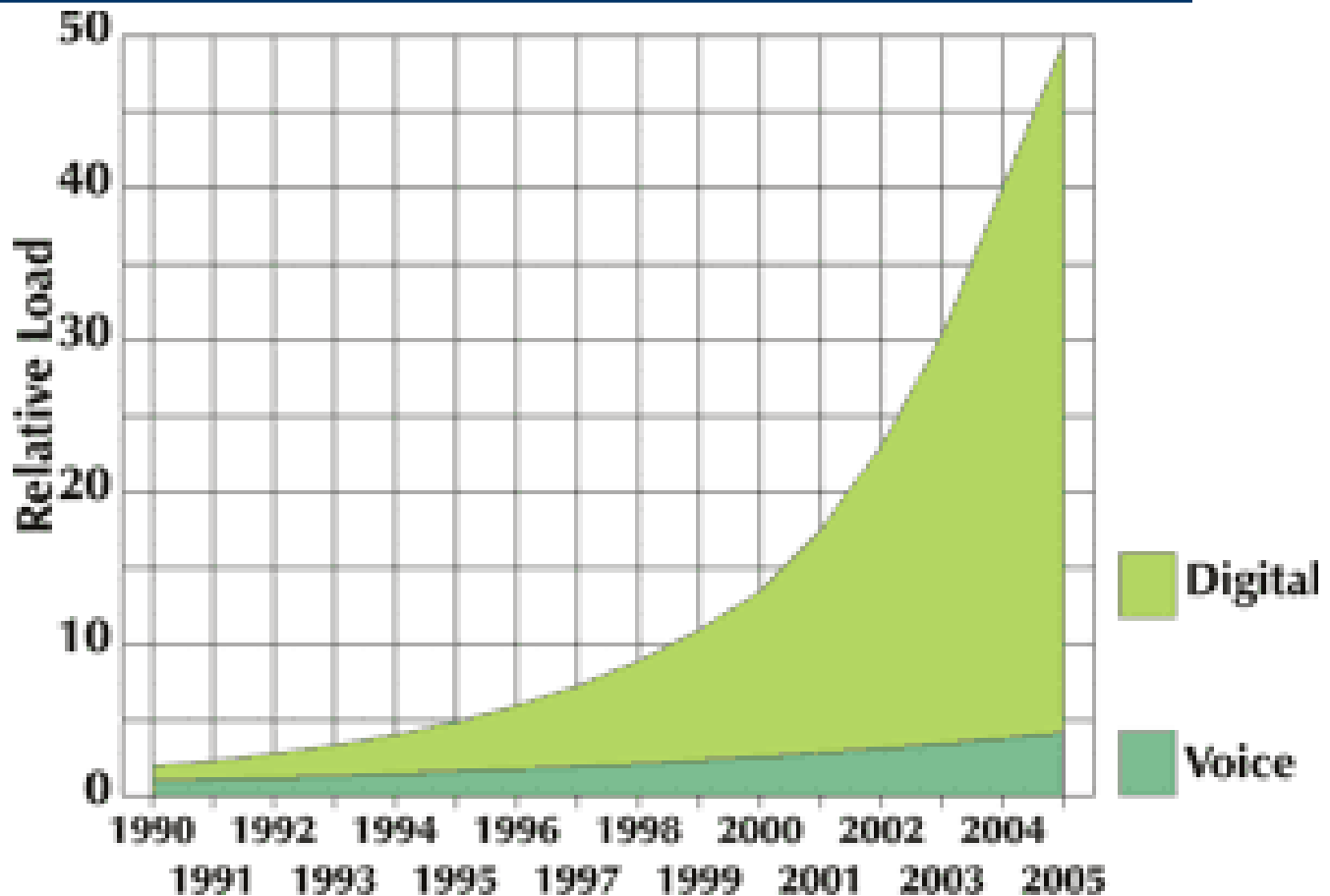
# 1998 – More innovations

- Dense Wave Division Multiplexing (DWDM) systems become widely available. Some systems have an aggregate capacity of 10 Gb/second.
- Optical fiber is placed in the ground at phenomenal rates.
- Digital Subscriber Lines become available at much faster rates than dial-up connections.
- Dot.com boom shows no signs of stopping.

# Wave Division Multiplexing Systems



# Projected Internet Growth through 2005



# 2001 – The bubble bursts

- DWDM systems can now transmit 100 waves at 10 Gb/sec. The aggregate capacity is now 1 terabit per second.
- Telecom bubble bursts
- Global Crossing, Worldcom, and Enron see heavy losses. Enron files for bankruptcy.

# 2002 – Present

- Stronger companies like Level(3) and Qwest bought up smaller players and assets of bankrupt fiber communications companies.
- More households have high speed connections than the dot.com era.
- MCI merges with Verizon. Verizon also launches FiOS, which is fiber to the home.
- SBC manages to unite four of the seven RBOCs and AT&T into one company.