Advances in Lightwave Telecommunications

1. Wavelength change 0.85 to 1.3 and 1.55μm
   Reduced loss and dispersion
2. Single-mode lasers, fibers & couplers
   Eliminated modal dispersion
3. Dispersion compensated/shifted fiber
   reduced bulk dispersion at 1.3 and 1.55μm
4. Advanced design lasers
   DFB, DBR, MQW -reduced emission linewidth and dispersion
   permited WDM
   Tunable lasers - facilitated DWDM
   VCSELs - improved fiber coupling, permitted laser surface arrays
5. High-speed modulators and photodiodes
   permitted wider-bandwidth signals
6. Optical amplifiers
   permitted greater spacing between repeaters
7. Linking of lightwave and microwave systems
   permitted nationwide/international mobile communication

Commercial optical fiber communications links (pre-1980)

Company	Location	Length	Performance data
AT&T	Atlanta	10.9 km	44.7 Mbit/s 144 fibers, 6.2 dB/km
GTE	Long Beach	9 km	1.5 MHz/s 6 fibers, 6.2 dB/km
ITT-STL	Harlow	9 km	140 Mbit/s 4 fibers, 5 dB/km
Teleprompter	So. Cal.	240 m	CATV trunk 10K subscribers
Rediffusion Ltd.	Hastings	1.4 km	CATV trunk 34K subscribers
AT&T	Chicago	2.5 km	44.7 Mbit/s 12 fibers 8.5 dB/km
British Telcom	Brownhills-Walsall Croydon-Vauxhall London-Vauxhall	Total length 28 km	8 Mbit/s
GEC	London Subway	7 km	8 Mbit/s
Philips	Eindhoven to Helmond	14 km	140 Mbit/s 12 fibers, graded index, 1920 telephone channels/fiber
Siemens	Frankfurt/Main Oberursel	15.4 km	34 Mbit/s
Thomson-CSF	Paris	7 km	34 Mbit/s, 50 fibers, graded index 30,000 telephone channels
Martin Marietta Data Systems	Orlando, Fla.	9.2 km	45 Mbit/s
Israeli Post Office (Fibronics Fibers)	Tel-Aviv	2.7 km	8 fibers, 148 MHz, 6 dB/km loss at 0.82 μm

Commercial optical fiber communications links (post-1980)

Company	Location	Length	Performance data
Pacific Telephone Co.	Sacramento, San Jose Stockton, Oakland San Francisco	Total length 270 km	
AT&T	Cambridge, MA Richmond, VA	1250 km	wavelength-division multiplexed 270 Mbit/s
AT&T	California Coast	830 km	wavelength-division multiplexed 270 Mbit/s
AT&T	Atlanta (1982)	65km	432 Mbit/s, 6048 channels WDM (1335 & 1275 nm) single mode fiber, no repeater
AT&T	Atlanta (1984)	119 km	420 Mbit/s, 6000 channels single mode laser, 1500 nm single mode fiber, no repeater
AT&T	5 intercity links Phila.-Pittsburgh Pittsburgh-Cleveland Dallas-Houston San Antonio-Seguin Atlanta-Charlotte		432 Mbit/s, 6048 channels single mode laser, 1300 nm two single mode fibers (no WDM) repeater spacing 74 km
NTT (F400-M) commercial	Asahikawa to Kagoshima (main trunk)	4000 km	1.3μm, single mode 40 Km repeater spacing 445 Mbit/s, Ge APD completion 1985
Field trial			1.55μm, single mode InGaAs APD 80-120km repeater spacing 5760 telephone channels
NTT (F1.6G) Field Trial		4000 km	1.6 Gbit/s DFB laser 1.3μm-40km re. sp. 1.55μm-80-120-km re.sp. 23,040 telephone channels
NTT (FS-400 M)		1000 km (2 sections)	Submarine cable
Telecom Australia	Perth to Adelaide	2800 km	565 Mbit/s single mode 1.3 and 1.55μm completion 1989
International Consortium- (TAT-8)	New Jersey to Widemouth, UK Penmarch, France	6687 km	Submarine cable 40,000 telephone channels 55km repeater spacing single mode, 1.3μm 274 Mbit/s completion 1988