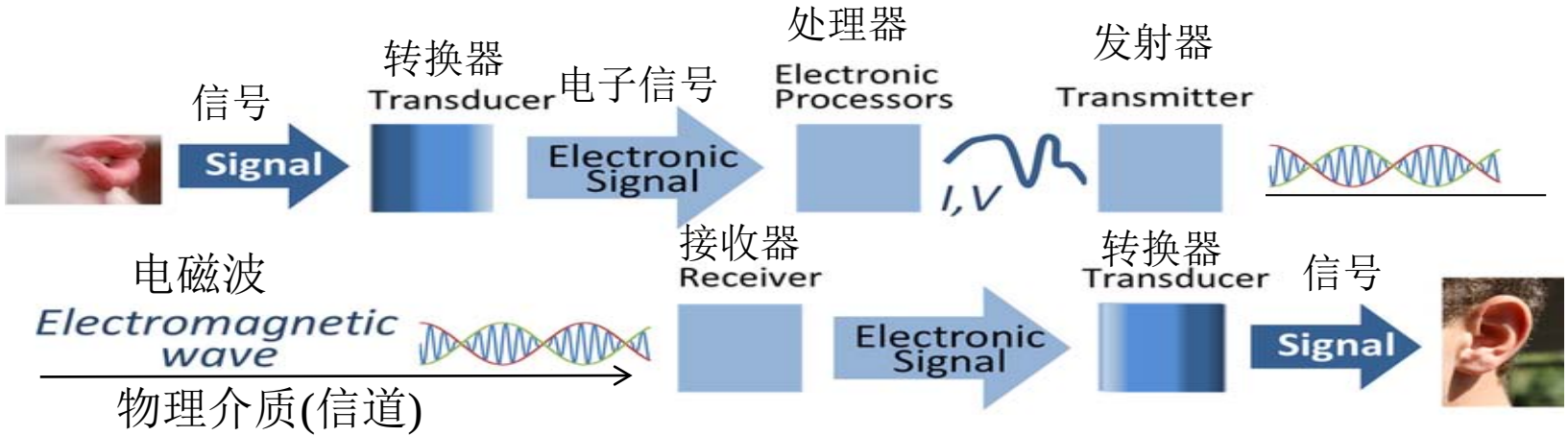
第二章 物理层


计算机科学丛书
原书第6版
计算机网络
自顶向下方法
James F. Kurose
Keith W. Ross
Computer Networking
A Top-Down Approach Sixth Edition
KUROSE ROSS
PEARSON
China Machine Press

本章内容

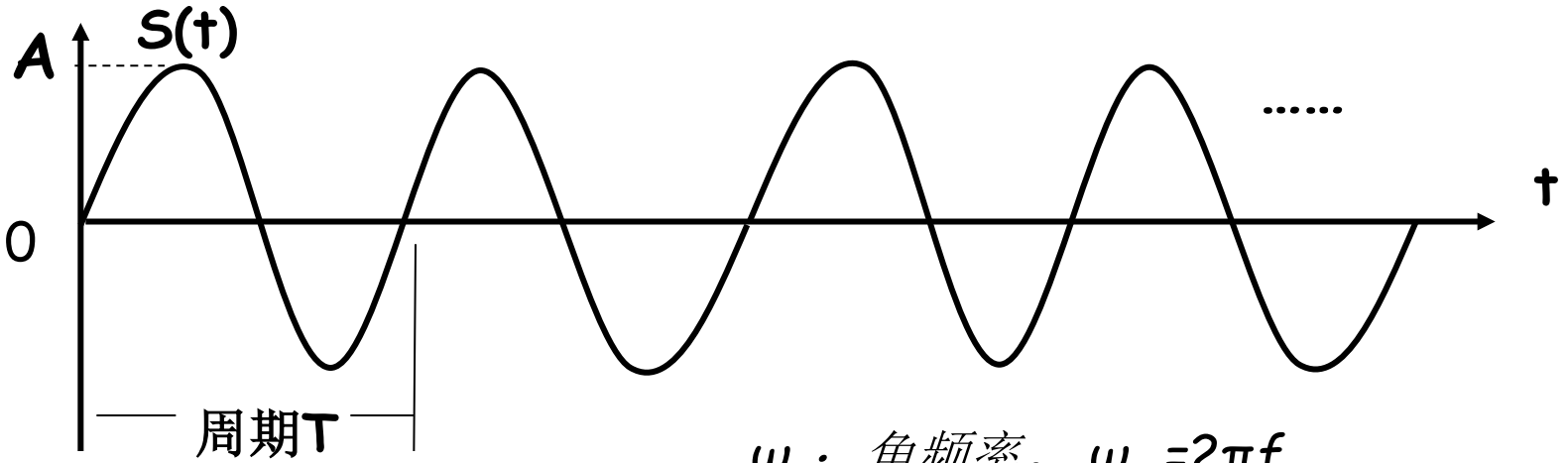
- 通信系统
- 正弦波信号
- 频移键控
- 曼彻斯特编码
- 物理介质
- 多路复用

通信系统



- 模拟传输(analog transmission): 模拟信号(analog signal), 放大器(amplifier)
- 数字传输(digital transmission): 数字信号(digital signal), 中继器(repeater)

正弦波信号

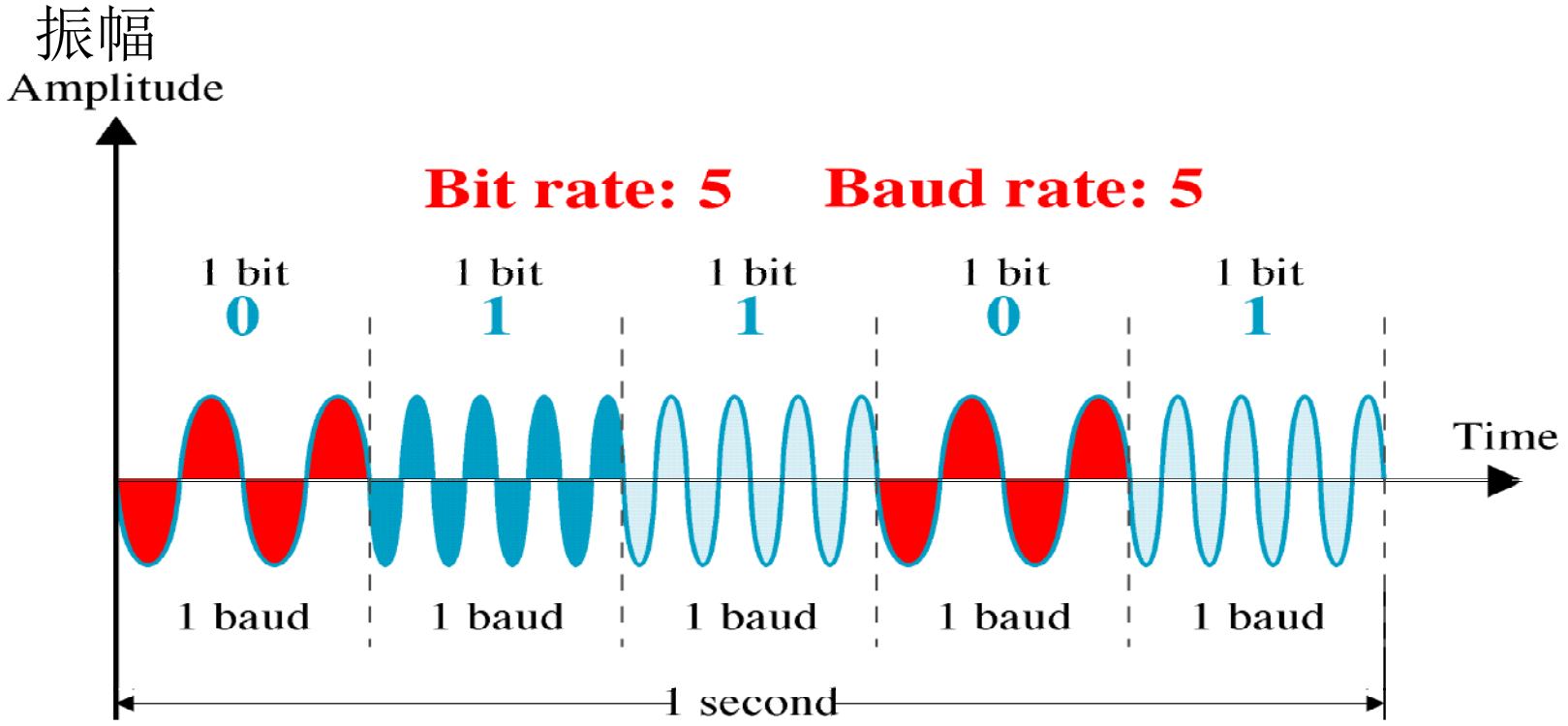


$S(t)=A\sin(\omega_c t+\varphi)$

载波信号一般采用正弦波信号

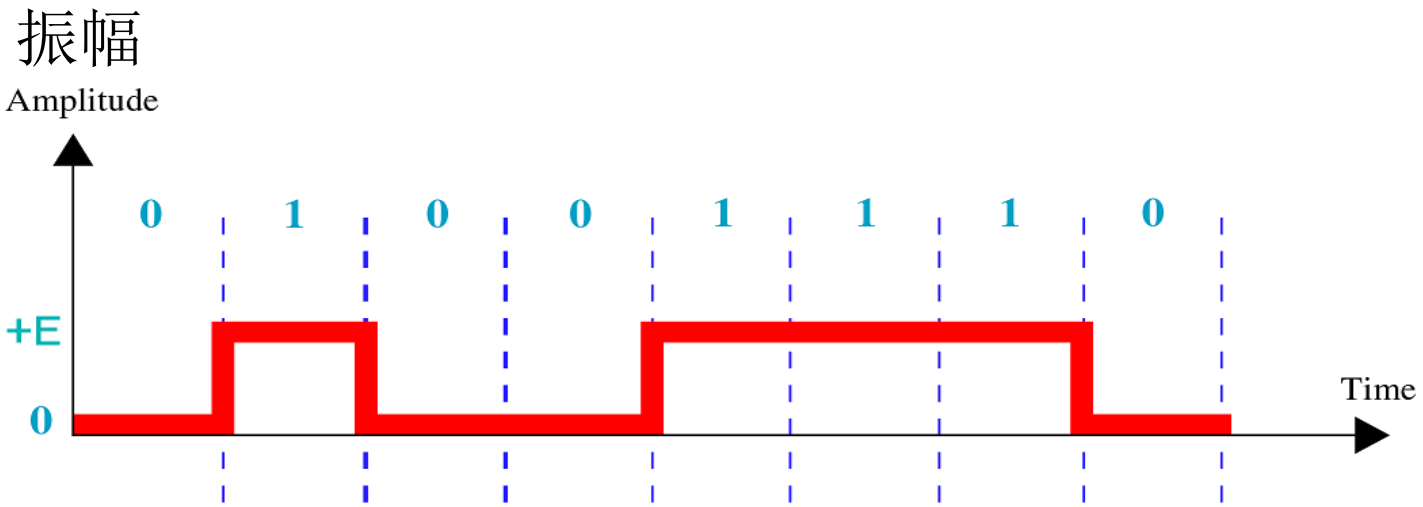
ω_c: 角频率。 $\omega_c = 2\pi f$
f: 频率(frequency) $=1/T$
T: 周期(period)
A: 振幅(amplitude)
φ: 相位(phase) (初相)。本例为0。

频移键控 (Frequency-Shift Keying, FSK)

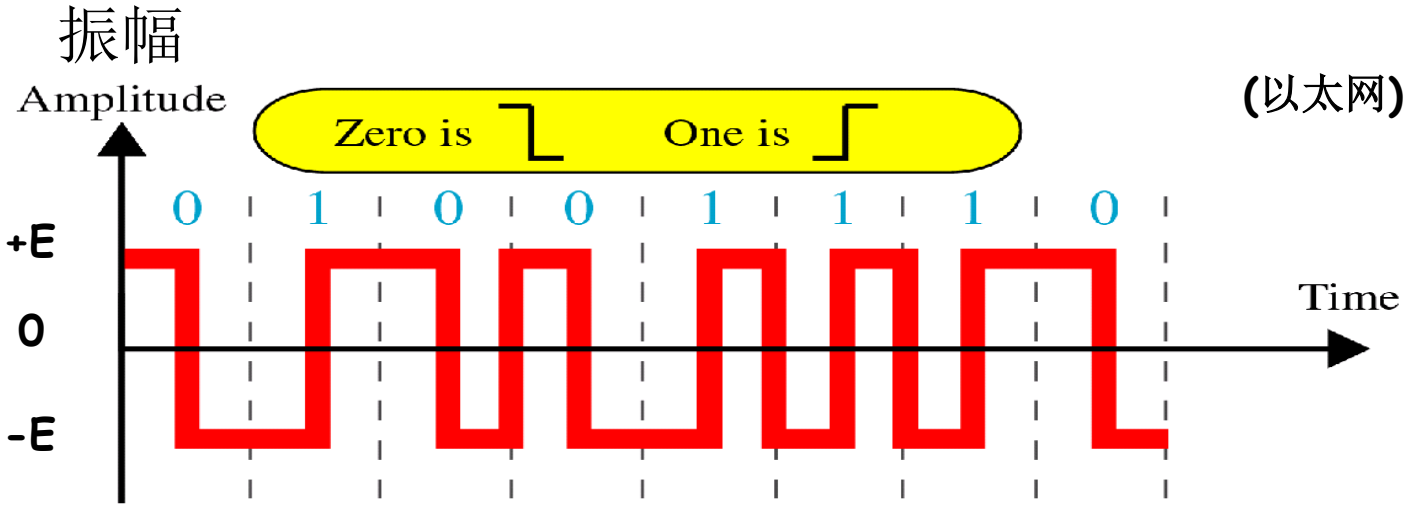


2FSK

单极编码

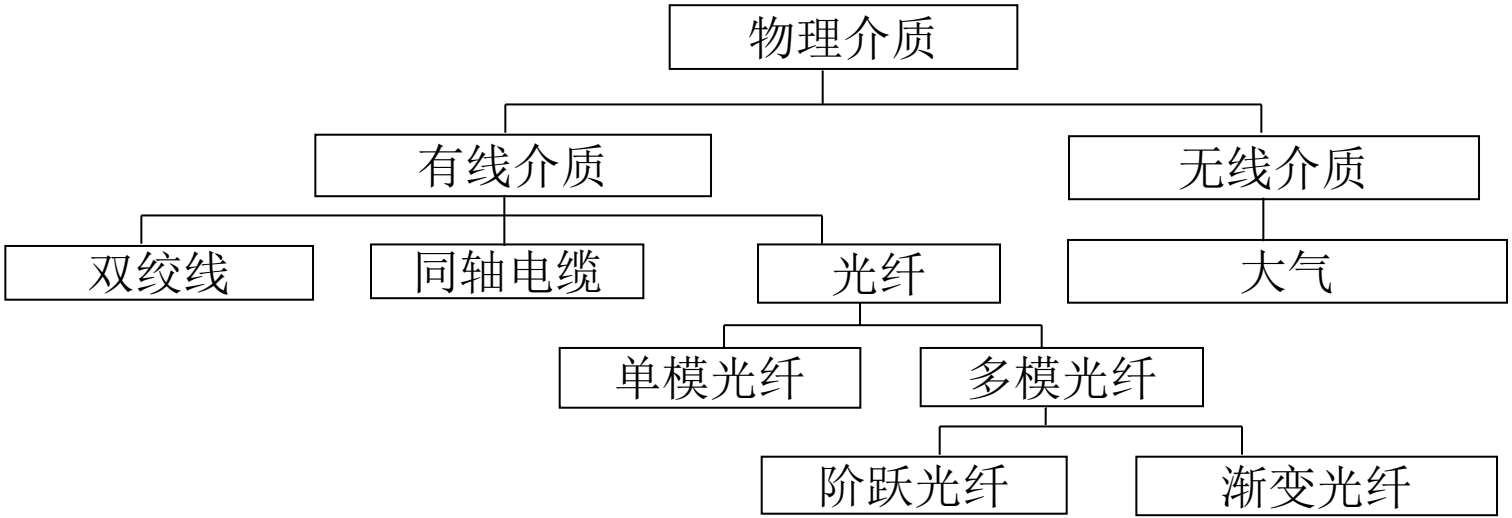


曼彻斯特编码 (Manchester Encoding）



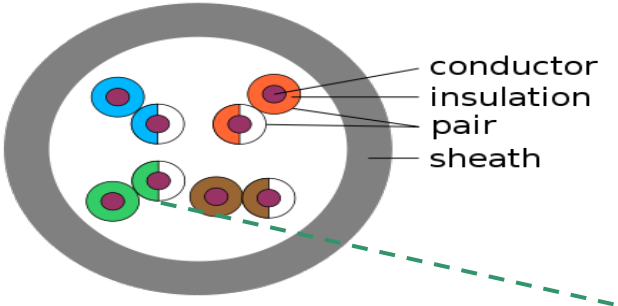
曼彻斯特码的编码规则(以太网)是：0 → 10， 1 → 01

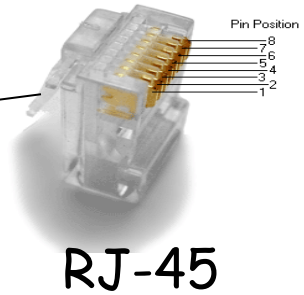
物理介质



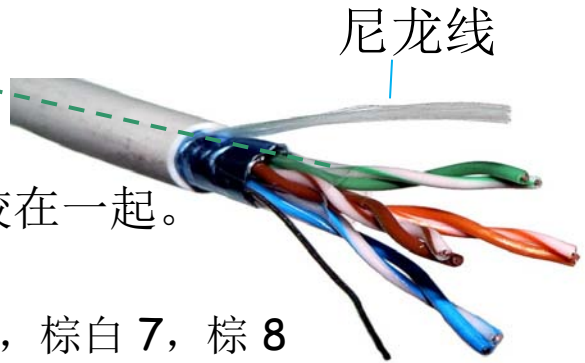
非屏蔽双绞线 (Unshielded Twisted Pair)

UTP





RJ-45



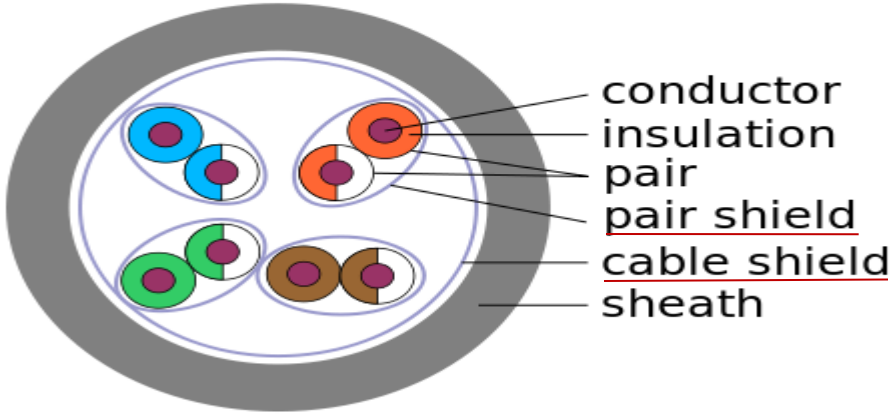
- 四对线: 绿 绿白，橙 橙白，蓝 蓝白，棕棕白
- 每对线先逆时针绞在一起，然后所有线对再逆时针绞在一起。
- 标准568A：绿白 1，绿 2，橙白 3，蓝 4，蓝白 5，橙 6，棕白 7，棕 8
- 标准568B：橙白 1，橙 2，绿白 3，蓝 4，蓝白 5，绿 6，棕白 7，棕 8

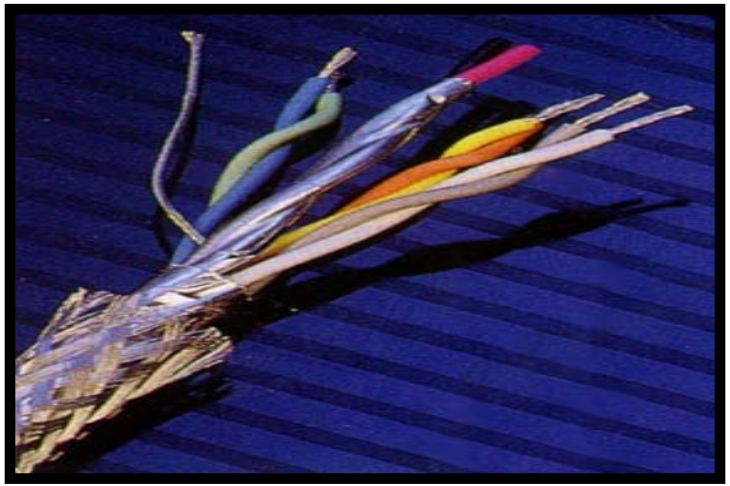
UTP Categories

UTP Category	Max Speed Rating	Description
1	—	Used for telephones, and not for data
2	4 Mbps	Originally intended to support Token Ring over UTP
3	10 Mbps	Can be used for telephones as well; popular option for Ethernet in years past, if Cat 3 cabling for phones was already in place
4	16 Mbps	Intended for the fast Token Ring speed option
5	1 Gbps	Very popular for cabling to the desktop
5e	1 Gbps	Added mainly for the support of copper cabling for Gigabit Ethernet
6	1 Gbps+	Intended as a replacement for Cat 5e, with capabilities to support multigigabit speeds

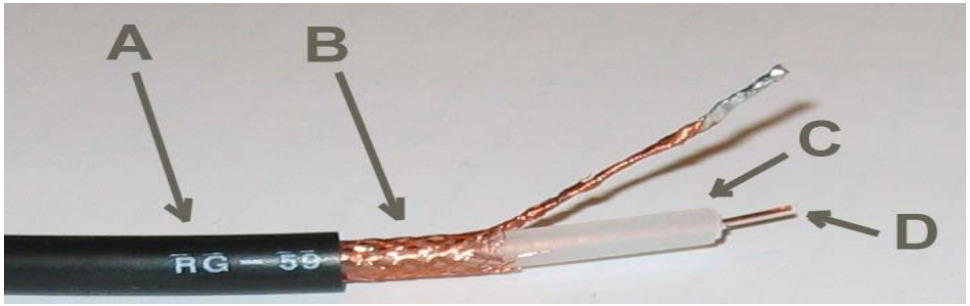
屏蔽双绞线 Shielded Twisted Pair

STP





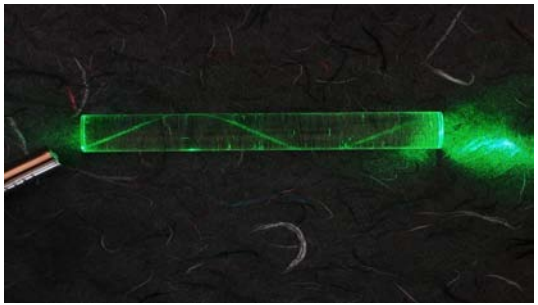
同轴电缆



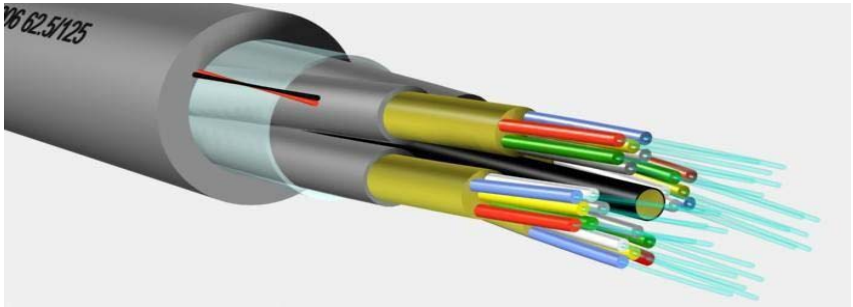
A: 外层塑料护套
B: 铜网屏蔽层(接地)
C: 内绝缘体
D: 铜芯(信号)

光纤 (1)

- 在玻璃纤维传输光脉冲，每个脉冲一比特



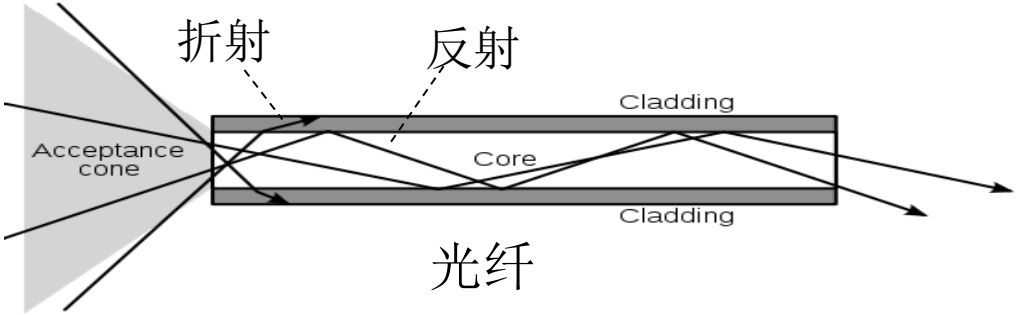
单根光纤



光缆

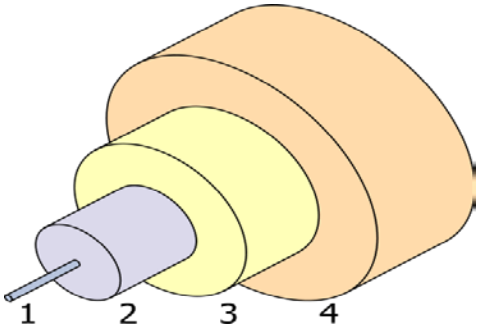
光纤(2)

全反射条件: 入射角大于临界角



一条典型单模光纤的结构:

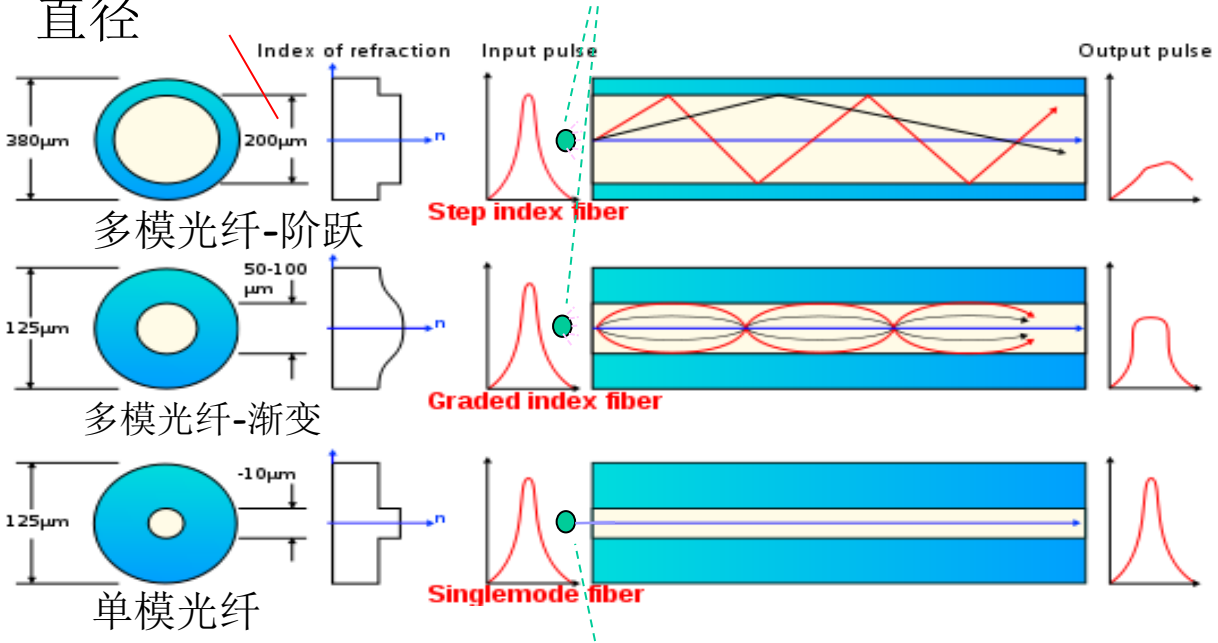
1. 纤芯: 直径8 μm
2. 覆层:直径125 μm
3. 缓冲曾:直径250 μm
4. 护套:直径400 μm



光纤(3)

Source：发光二极管(Light Emitting Diode, LED)

直径



多模光纤-阶跃

多模光纤-渐变

单模光纤

	DataRate	Maximum Distance
多模光纤-阶跃	low 4Gbps	5000m
多模光纤-渐变	medium	middle
单模光纤	high > 40Gbps	50km

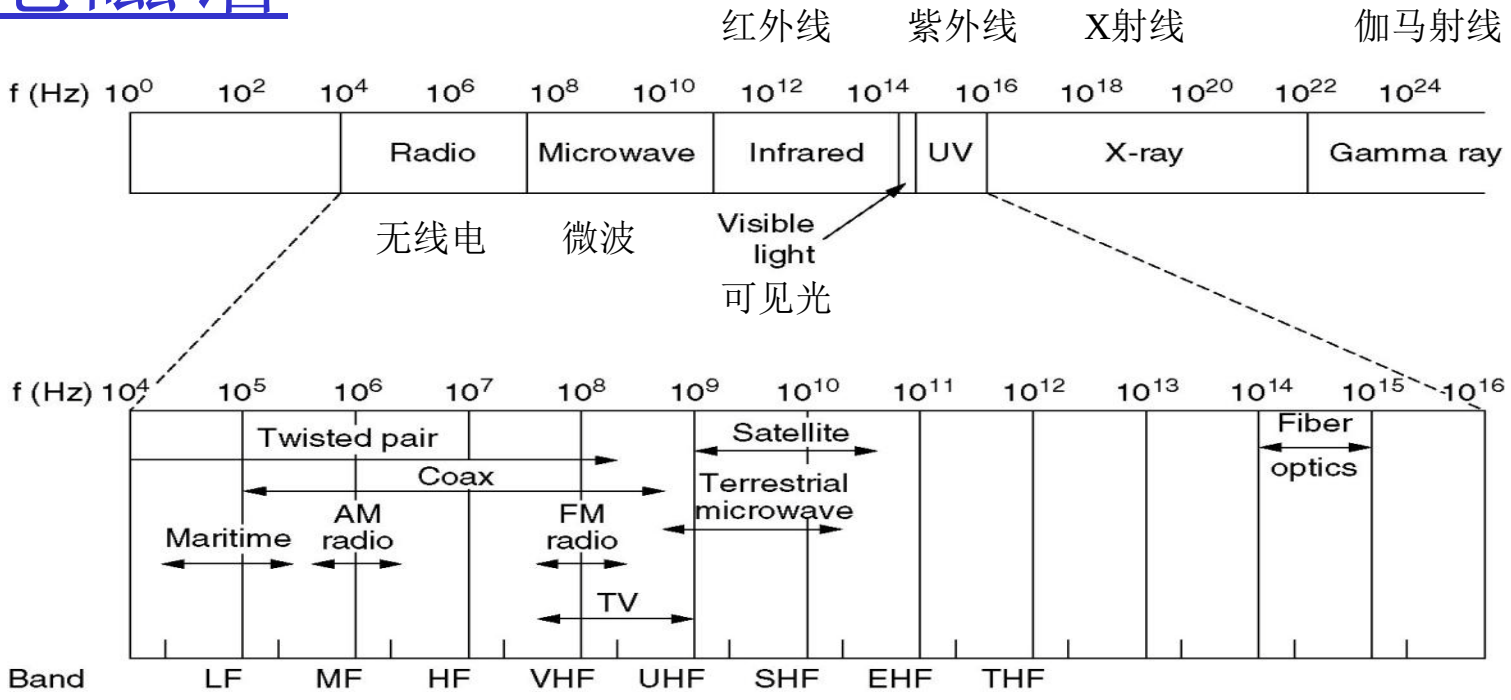
Source：注入式激光二极管(Injection Laser Diode, ILD)

Step-index fiber 阶跃光纤 graded-index 渐变光纤

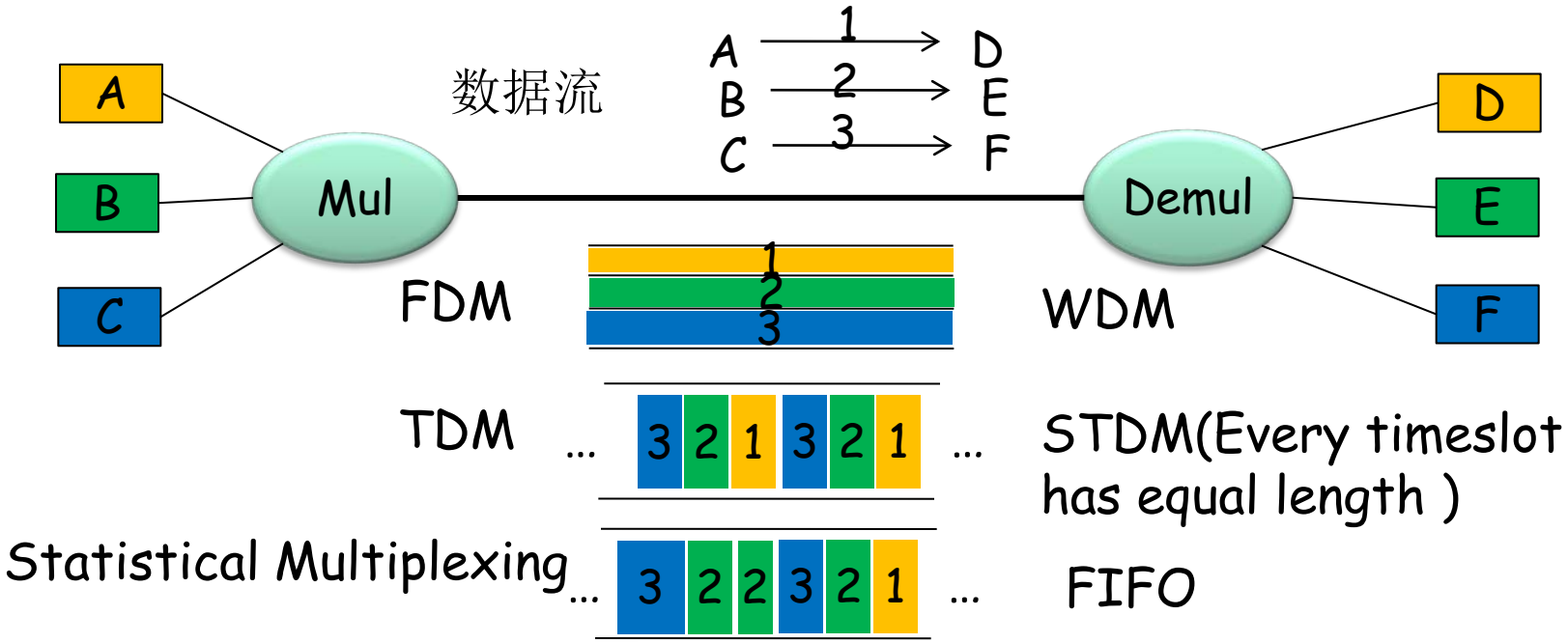
无线介质

- 地面微波
  45 Mbps channels
- WiFI
  54 Mbps(802.11g),600Mbps(802.11n),
- 3G网络
  ~ 1 Mbps
- 卫星
  1 Kbps ~ 45Mbps
  270 msec 延迟

电磁谱


红外线
紫外线
X射线
伽马射线
f (Hz) 10^0 10^2 10^4 10^6 10^8 10^{10} 10^{12} 10^{14} 10^{16} 10^{18} 10^{20} 10^{22} 10^{24}
Radio
Microwave
Infrared
UV
X-ray
Gamma ray
无线电
微波
Visible light
可见光
f (Hz) 10^4 10^5 10^6 10^7 10^8 10^9 10^{10} 10^{11} 10^{12} 10^{13} 10^{14} 10^{15} 10^{16}
Twisted pair
Coax
Satellite
Terrestrial microwave
Fiber optics
Maritime
AM radio
FM radio
TV
Band
LF
MF
HF
VHF
UHF
SHF
EHF
THF

多路复用 (Multiplexing)



TDM- 时分多路复用(Time Division Multiplexing) (STDM--Synchronous TDM)
FDM- 频分多路复用(Frequency Division Multiplexing)
WDM-波分多路复用(Wave Division Multiplexing)
CDM -码分多路复用(Code Division Multiplexing)

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