

Cabling and Connectors

- General media considerations
 - Broadband versus baseband
 - Baseband transmissions use digital signaling and Time Division Multiplexing (TDM)
 - Broadband transmissions use analog and Frequency Division Multiplexing(FDM)
 - Dialog modes: Simplex, half duplex and full duplex
 - Media interference
 - Electromagnetic interference (EMI) and cross talk
 - Network media vary in their resistance to the effect of EMC.
 - UTP is susceptible and fiber is resistant

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- Attenuation
 - Resistance :Coaxial cable > UTP, STP > UTP, Fiber > all
 - Maximum distance
 - Repeaters
 - Attenuation-related problems require a network analyzer to detect
- Bandwidth
 - Transmission capacity of a media
 - Data throughput is measured in bits per second(bps), Mbps, and Gbps
 - For today's application-intensive networks, Old 10Mbps is not enough, 100Mbps is very common and 1000Mbps is used too.

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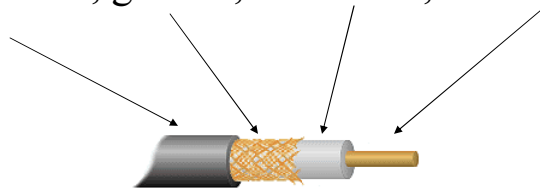
Network Media

- Carry signals between computers: Cable-based media and wireless networking.
- Cable-based media
 - Coaxial
 - Copper wire to conduct the signals electronically
 - Was the choice for LAN for many years.
 - Retiring
 - Twisted pair
 - Copper wire to conduct too
 - More popular than coaxial
 - Fiber-optic
 - Uses glass or plastic conductor and transmits the signals as light
 - High Cost. Restricted to where segment length and higher speeds are needed.
 - Server room, backbone

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Coaxial cable

- Success in both TV transmission and network implementations
- Insulation, ground, insulation, main wire



- Networks use two types of coaxial cabling: thin coaxial and thick coaxial.

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Thin coax

- More likely to be seen than thick coax
- Only .25 inches in diameter
- Prone to cable breaks.

Cable	Type
RG-58 /U	Solid Copper core
RG-58 A/U	Stranded wire core
RG-58 C/U	Military specification
RG-59	Often used for cable TV and cable modems
RG-62	Used for ARCnet specifications

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- BNC connectors: Barrel connector, T-connector, and terminators

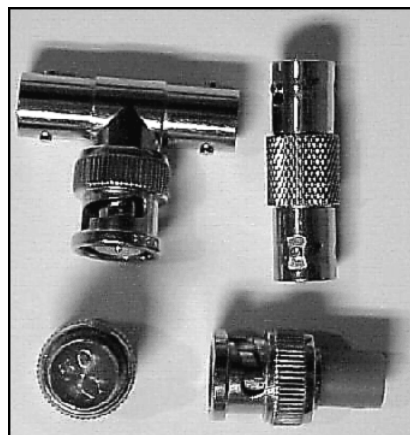


Figure 12.4
BNC Connectors

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Thick coax

- The chance you will encounter a network using thick coaxial cable is slim
- Thick coax, RG-8 is more robust and harder to damage
- More resistant to attenuation, crosstalk and EMI, found popularity to as a network backbone. Faster fiber-optic media has all and taken over in this role.
- Need vampire tap, a special connector that pierces the thick cable to copper core, and a drop cable to connect a LAN device.

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Twisted-pair cabling

- Has been around for a long time
- Created for voice transmissions
- Most widely used media for networking
 - Lighter
 - More flexible
 - Easier to install
 - Cheaper
 - Greater speeds
- Two types:
 - Unshielded twisted pair (UTP)
 - Shielded twisted pair (STP)

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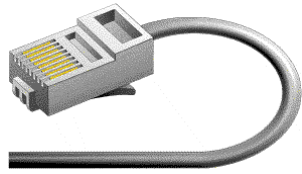
Twisted-pair cabling

- UTP is more commonplace
- STP
 - provides the extra shielding by using an insulating material wrapped around the wire
 - Greater resistance to EMI and attenuation
 - More cost

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Category	Maximum data rate	Usual application
CAT 1	Up to 1 Mbps (1 MHz)	analog voice (POTS) Integrated Services Digital Network Basic Rate Interface in ISDN Doorbell wiring
CAT 2	4 Mbps	Mainly used in the IBM Cabling System for Token Ring networks
CAT 3	16 Mbps	Voice and data on 10BASE-T Ethernet
CAT 4	20 Mbps	Used in 16 Mbps Token Ring Otherwise not used much
CAT 5	100 Mbps 1000 Mbps (4 pair)	100 Mbps TPDDI 155 Mbps ATM No longer supported; replaced by 5E
CAT 5E	1000 Mbps (10000 Mbps prototype)	100 Mbps TPDDI 155 Mbps ATM Gigabit Ethernet Offers better near-end crosstalk than CAT 5
CAT 6	Up to 400 MHz	Super-fast broadband applications Most popular cabling for new installs
CAT 6E	Up to 625 MHz (field-tested to 500 MHz)	Support for 10 Gigabit Ethernet (10GBASE-T)
CAT 7 (ISO Class F)	600-700 MHz 1.2 GHz in pairs with Siemon connector	Full-motion video Teleradiology Government and manufacturing environments Shielded system

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RJ-45 connectors

- RJ-45 are used with twisted-pair cabling.
- Resemble ordinary phone jacks (RJ-11)
- Eight wires instead of four
- Larger.
- Check out this page for how to make cat5 cable.

<http://www.tomax7.com/aplus/cat5.htm>

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Fiber-optic cable

- Use light transmissions
- EMI, crosstalk and attenuation become no issue.
- Well suited for data, video and voice transmissions
- Most secure of all cable media
- Installation and maintenance procedures require skills
- Cost of cable
- Cost of retrofitting of existing network equipment because incompatible with most electronic network equipment

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Fiber-optic cable

- Single mode fiber:
 - A single direct beam of light, allowing for greater distances and increased transfer speeds.
- Multimode fiber:
 - Many beams of light travel through the cable
 - This strategy weakens the signal, reducing the length and speed the data signal can travel.

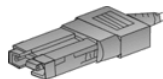
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Fiber-optic connectors

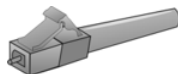
There are a variety of connectors and several ways of connecting these connectors, such as bayonet, snap-lock, and push-pull connectors. A couple here:



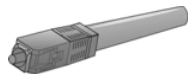
FC



MIC, Standard FDDI connector



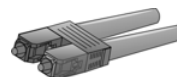
LC



SC



ST



SC duplex

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Wireless media

- Three types:
 - Radio wave
 - Infrared
 - Microwave
- Speeds of wireless solutions don't keep pace with cable solutions
- Installation and maintenance are far more complicated and costly.
- Some solutions require line-of-sight, such as infrared and microwave.

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IEEE 802.3 standards

- IEEE 802.3 standards defines a range of networking systems that are bases on the original Ethernet standard.
- 10Base2
 - Speed 10Mbps
 - Total segment length of 185m (roundup to 2, which is the number in 10Base2) using RG-58 coaxial cable.
 - Allow a maximum of five segments with only three of those segment populated.

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IEEE 802.3 standards

- 10Base5
 - 10Mbps
 - Physical bus topology
 - Allow 500 meters
- 10BaseT
 - 10Mbps
 - Twisted-pair cabling, UTP 3,4,5
 - Star topology

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IEEE 802.3 standards

Standard	Cable type	Segment Length	Connector	Topology
10Base2	Thin Coaxial	185 meters	BNC	Physical bus
10Base5	Thick Coaxial	500 meters	Vampire Taps	Physical bus
10BaseT	Category 3,4,5 twisted pair	100 meters	RJ-45	Physical star

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IEEE 802.3 standards

- Fast Ethernet, IEEE 802.3u specifications, three variations.
- 100BaseTX
 - Most widely implemented
 - Use two pairs of wire in cat5, can also use STP.
 - Segment 100 meters
- 100BaseT4
 - Can use category 3 or 4 to perform 100Mbps transfer
 - Use all four pairs of wire of cat3,4,5. Not full-duplex.
- 100BaseFX
 - 100 Mbps over fiber-optic cable
 - Maximum segment length 412 meters over multimode fiber and 10,000 meters over single mode fiber.

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Fast Ethernet

Standard	Cable Type	Segment Length	Connector	Topology
100BaseTx	Category 5 UTP	100 meters	RJ-45	Physical star
100BaseT4	Category 3,4,5 UTP	100 meters	RJ-45	Physical star
100BaseFX	Multimode/Single-mode fiber-optic cable	412/Multimode fiber-optic 10,000/single-mode fiber-optic	SC,ST ,MIC	Physical star

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Gigabit Ethernet

- IEEE 802.3z and 802.3ab
- 802.3z
 - 1000BaseLX- use long wave length laser
 - 1000BaseSX - use short wave length laser
 - 1000BaseCX – Over STP, 25 meters
- 802.3ab
 - Over cat5 UTP cable.
 - Each of the four pairs transmit 250Mbps, total 1000Bbps.

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Gigabit Ethernet

Standard	Cable Type	Segment length	Connector
1000BaseLX	Multimode/ single-mode fiber	550/multimode 5000/single-mode	Fiber connectors
1000BaseSX	Multimode fiber	550 meters using 50 Micron multimode fiber	Fiber connectors
1000BaseCX	STP twisted pair	25 meters	9-pin shielded connector, 8-pin fiber channel type 2 connector
1000BaseT	Category 5 UTP	100 meters	RJ-45

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