

ETHERNET LAN



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EtherNet



REALPARS

Ethernet

The term Ethernet refers to a family of standards that together define the **physical and data link layers** of the world's most popular type of LAN.

The different standards vary as to the speed supported, with speeds of 10 megabits per second (Mbps), 100 Mbps, and 1000 Mbps (1 gigabit per second, or Gbps) being common today. The standards also differ as far as the types of cabling and the allowed length of the cabling.

For example, the most commonly used Ethernet standards allow the use of inexpensive unshielded twisted-pair (UTP) cabling, Fiber-optic cabling might be worth the cost in some cases, because the cabling is more secure and allows for much longer distances between devices.

OSI

Ethernet
IEEE 802.3

| | |
|---|--------------|
| 7 | Application |
| 6 | Presentation |
| 5 | Session |
| 4 | Transport |
| 3 | Network |
| 2 | Data Link |
| 1 | Physical |

OSI REFERENCE TO ETHERNET

OSI Model for Ethernet/IP

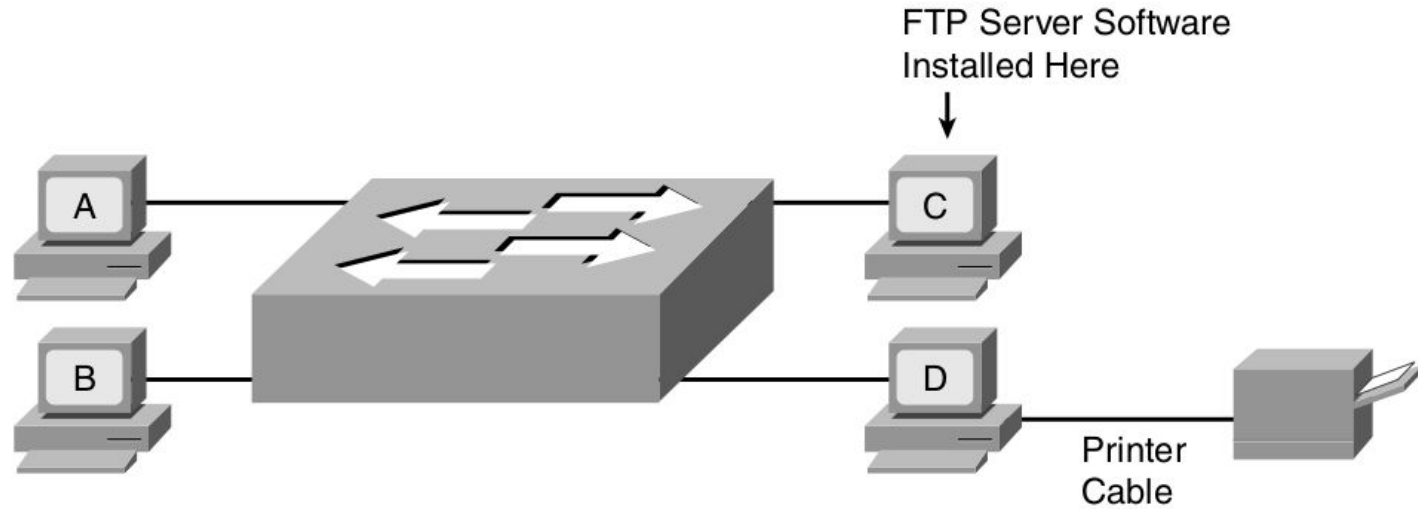
| | | | |
|---|--------------|---------------------------|-----|
| 7 | Application | Device Profile | |
| 6 | Presentation | Explicit/Implicit Message | |
| 5 | Session | Connection Management | |
| 4 | Transport | UDP | TCP |
| 3 | Network | IP | |
| 2 | Data Link | Ethernet MAC | |
| 1 | Physical | Ethernet Physical | |

Basics

To build and create a modern LAN using any of the UTP-based types of Ethernet LANs , you need the following components:

- Computers that have an Ethernet network interface card (NIC) installed
- Either an Ethernet hub or Ethernet switch
- UTP cables to connect each PC to the hub or switch

Typical Modern Lan



Ethernet DLL

The Institute of Electrical and Electronics Engineers (IEEE) has defined many Ethernet Standards since it took over the LAN standardization process in the early 1980s. Most of the standards define a different variation of Ethernet at the physical layer, with differences in speed and types of cabling. Additionally, for the data link layer, the IEEE separates the functions into two sublayers:

- The 802.3 Media Access Control (MAC) sublayer
- The 802.2 Logical Link Control (LLC) sublayer

Today's Most Common Types of Ethernet

| Common Name | Speed | Alternative Name | Name of IEEE Standard | Cable Type, Maximum Length |
|--------------------|--------------|-----------------------------|------------------------------|-----------------------------------|
| Ethernet | 10 Mbps | 10BASE-T | IEEE 802.3 | Copper, 100 m |
| Fast Ethernet | 100 Mbps | 100BASE-TX | IEEE 802.3u | Copper, 100 m |
| Gigabit Ethernet | 1000 Mbps | 1000BASE-LX, 1000BASE-SX | IEEE 802.3z | Fiber, 550 m (SX) 5 km (LX) |
| Gigabit Ethernet | 1000 Mbps | 1000BASE-T | IEEE 802.3ab | 100 m |

Features of ETHERNET LAN

File transfers: A computer could install a file transfer server, thereby allowing other computers to send and receive files to and from that computer. For example, PC C could install File Transfer Protocol (FTP) server software, allowing the other PCs to use FTP client software to connect to PC C and transfer files.

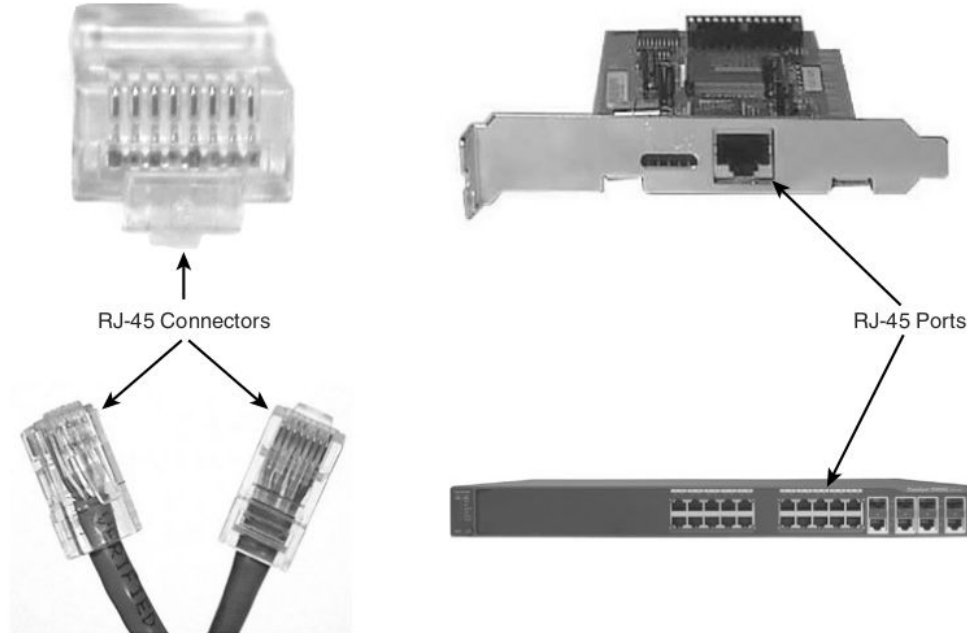
Gaming: The PCs could install gaming software that allows multiple players to play in the same game. The gaming software would then communicate using the Ethernet.

Cont..

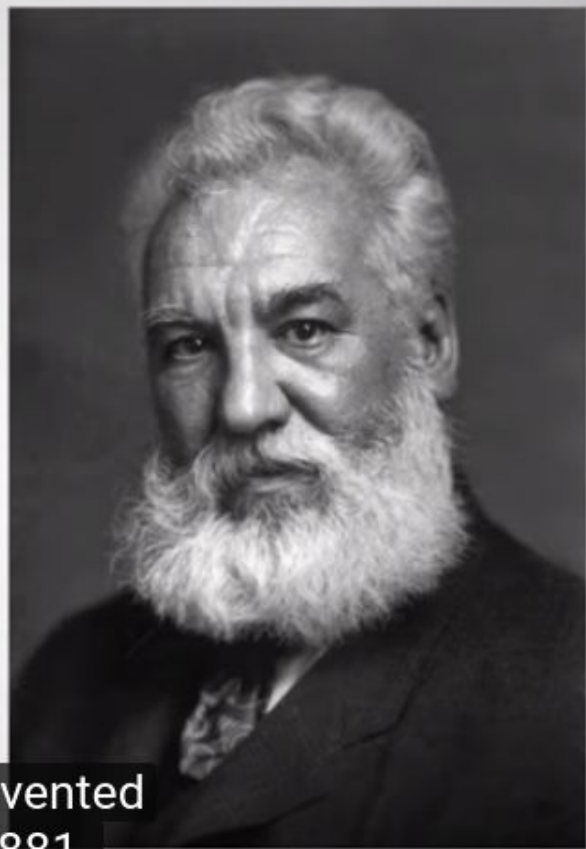
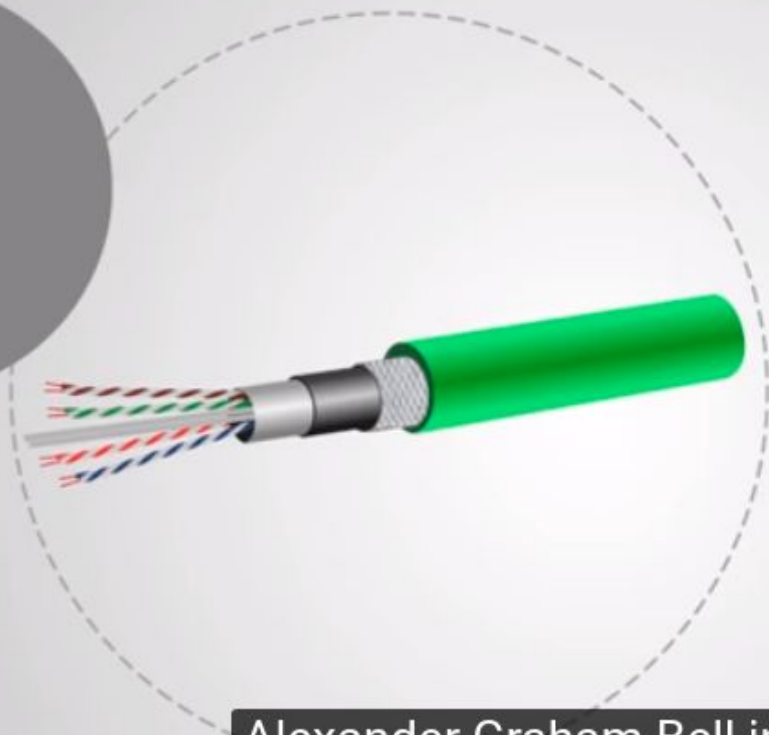
File sharing: Each computer can be configured to share all or parts of its file system so that the other computers can read, or possibly read and write, the files on another computer. This function typically is simply part of the PC operating system.

Printer sharing: Computers can share their printers as well. For example, PCs A, B, and C in Figure 3-1 could print documents on PC D's printer. This function is also typically part of the PC's operating system.

RJ-45 Connectors and Ports



NOTE The RJ-45 connector is slightly wider, but otherwise similar, to the RJ-11 connectors commonly used for telephone cables in homes in North America.



Alexander Graham Bell invented
twisted pair wiring in 1881.

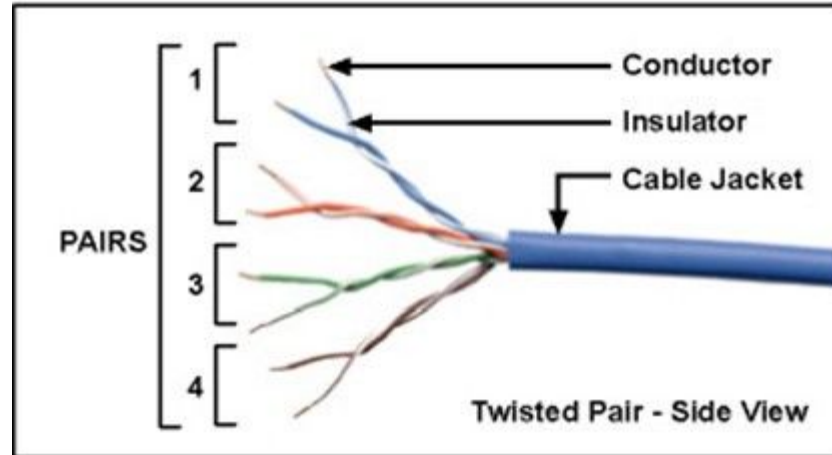
Difference Between Twisted Pair Cable and Coaxial Cable

Cabling

A wire or cable is an indispensable element in communication system for connecting optical devices like optical transceivers, router and switch. Recently the most common cable types deployed in communication system are **fiber optic cable, twisted pair cable and coaxial cable**. Both twisted pair cable and coaxial cable are copper cables

Twisted Pair

Twisted pair cables as the names implies, consists of a pair of cables twisted together, which has been utilized in telecommunication field for a long time. The twisting can avoid noise from outside sources and crosstalk on multi-pair cables, so this cable is best suited for carrying signals. Basically, twisted pair cable can be divided into two types: unshielded twisted-pair (UTP) and shielded twisted-pair (STP).

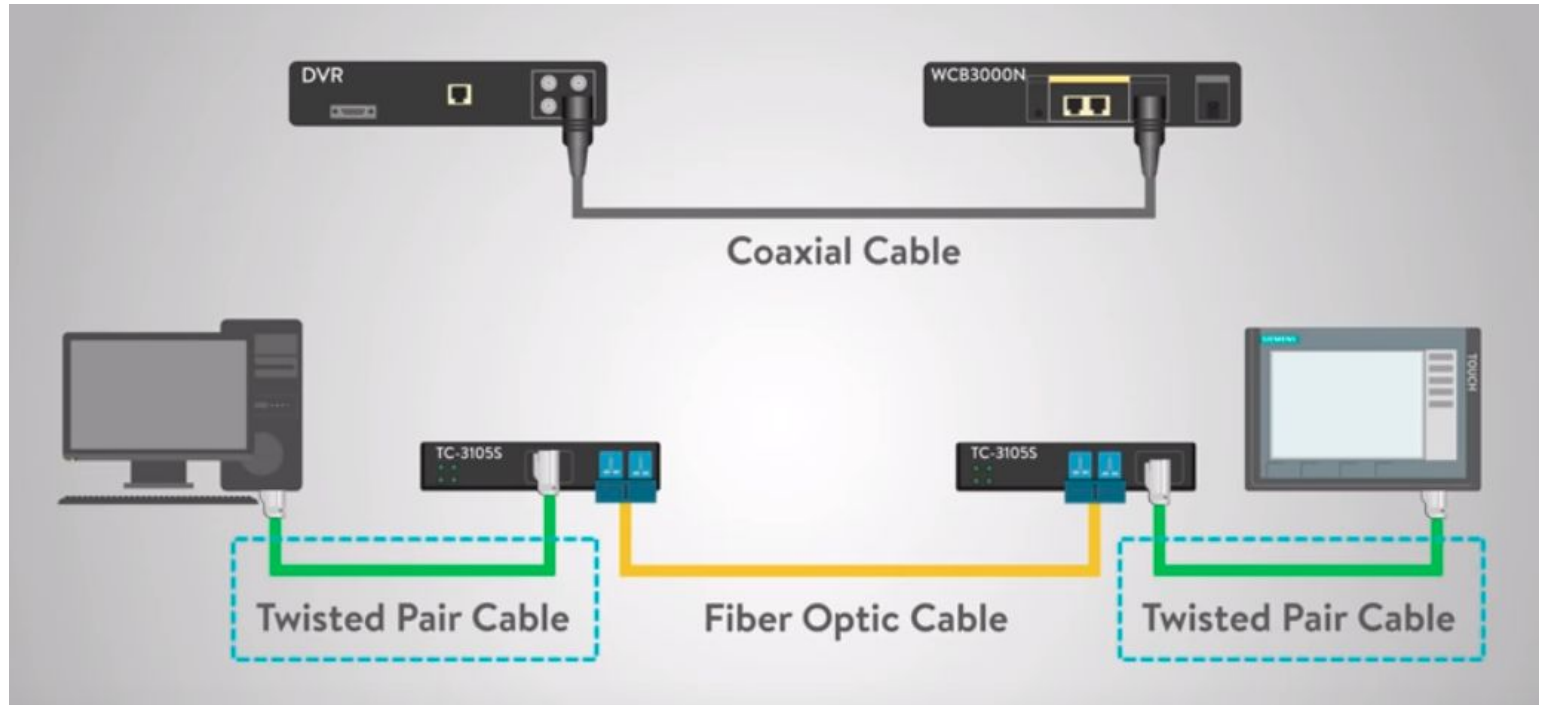


Coaxial cables

Coaxial cable is composed of an inner solid conductor surrounded by a paralleled outer foil conductor that is protected by an insulating layer. A coaxial cable has over 80 times the transmission capability of the twisted-pair. Coaxial cable has also been the mainstay of high speed communication and has also been applied to network with 10 Gigabit links data centers, because it is proved to be cost efficient for short links within 10 m and for residential network.

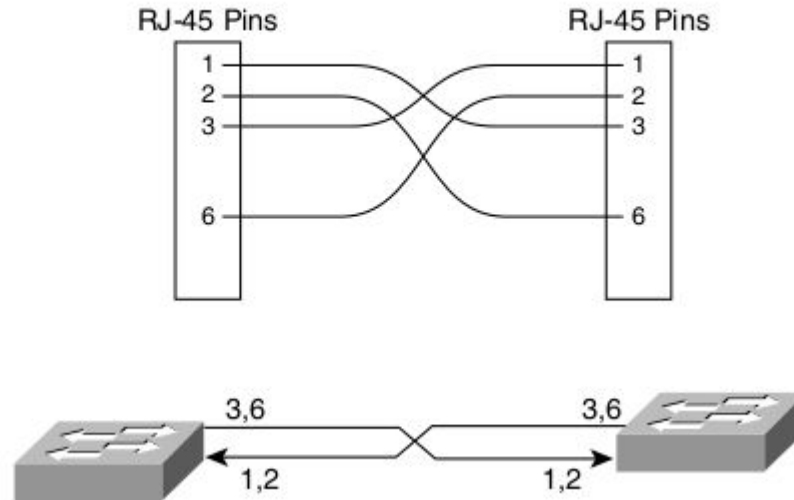


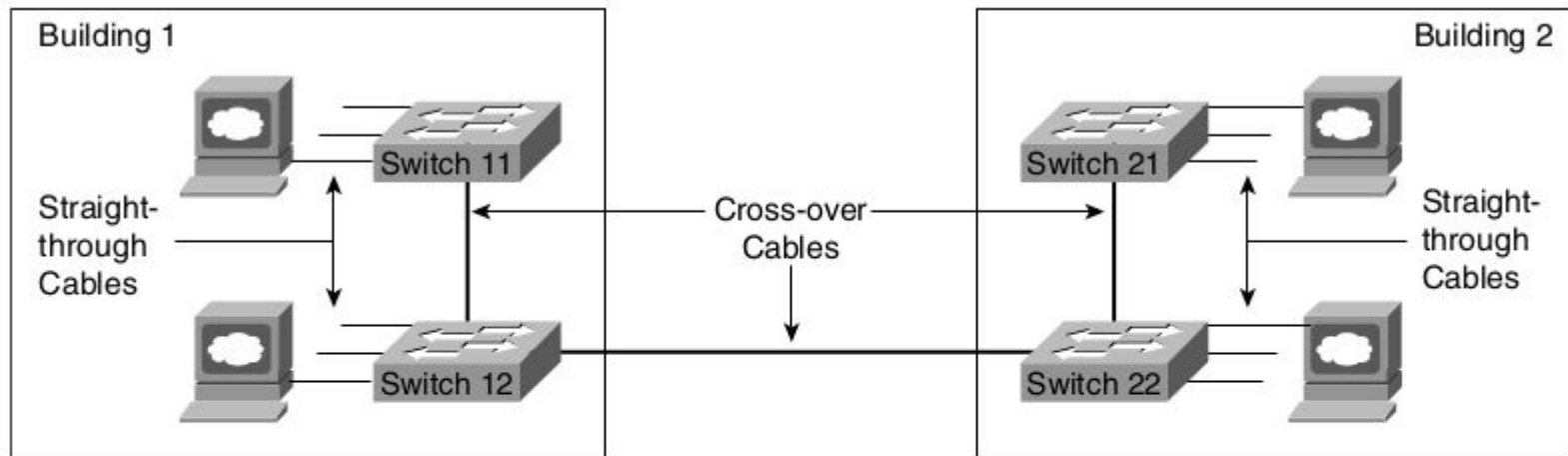
Basic design and topology are used regardless of speed or cabling type.



Cross Over Cabling

Crossover Ethernet Cable





1000BASE-T Cabling

As noted earlier, 1000BASE-T differs from 10BASE-T and 100BASE-TX as far as the cabling and pinouts. First, 1000BASE-T requires four wire pairs. Also, Gigabit Ethernet transmits and receives on each of the four wire pairs simultaneously.

Ethernet

IEEE 802.3

Physical Layer

Data Link Layer

Cabling

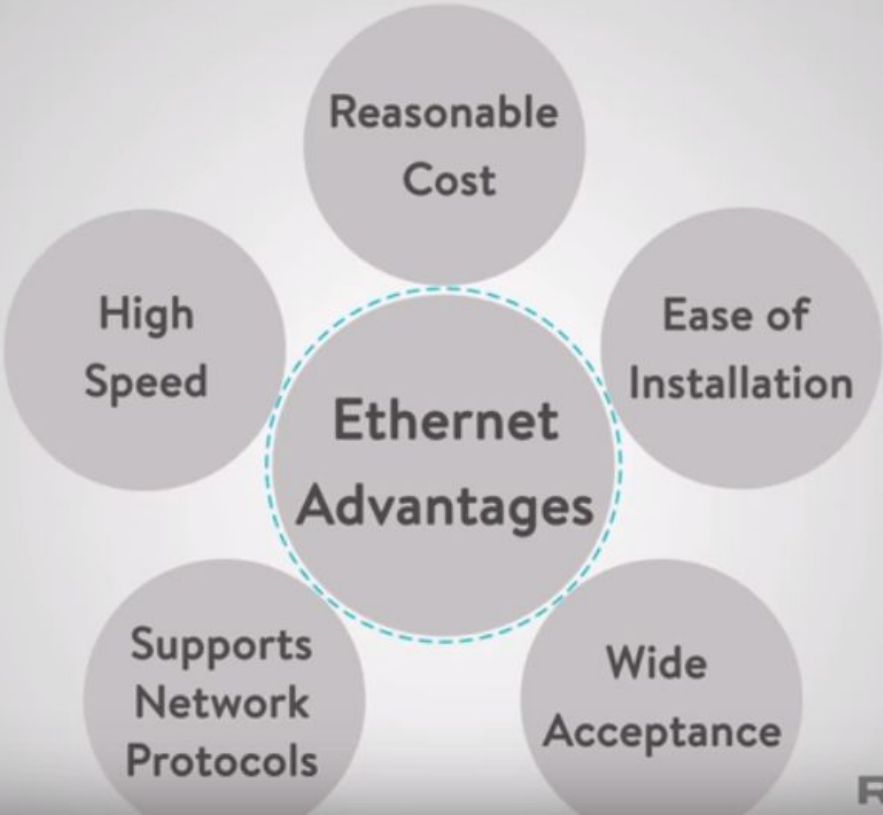
Devices

2

Data Link

Logical Link Control (LLC)

Media Access Control (MAC)



A diagram with a central circle labeled "Ethernet Advantages" surrounded by five other circles, each containing an advantage. The central circle has a dashed blue border. The surrounding circles are arranged in a pentagonal pattern. The advantages listed are: Reasonable Cost, Ease of Installation, Wide Acceptance, Supports Network Protocols, and High Speed.

Ethernet Advantages

Reasonable
Cost

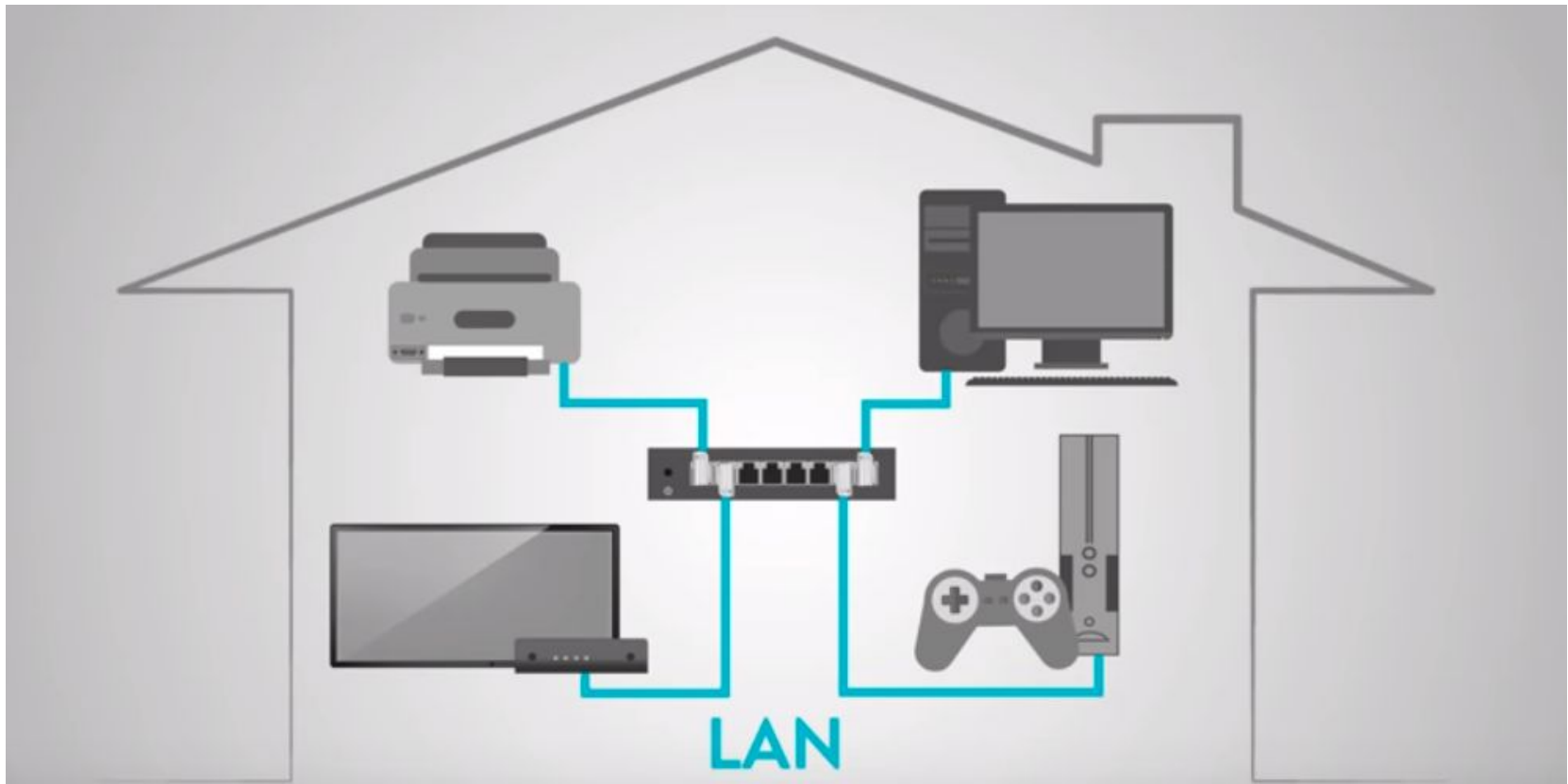
Ease of
Installation

Wide
Acceptance

Supports
Network
Protocols

High
Speed

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BASIC ENVIRONMENT

VLAN

Virtual LANs (VLAN) have an impact on many parts of a switch's logic. Frame forwarding happens per VLAN.

MAC learning adds MAC table entries, and those entries include the associated VLAN.

Virtual LAN Concepts

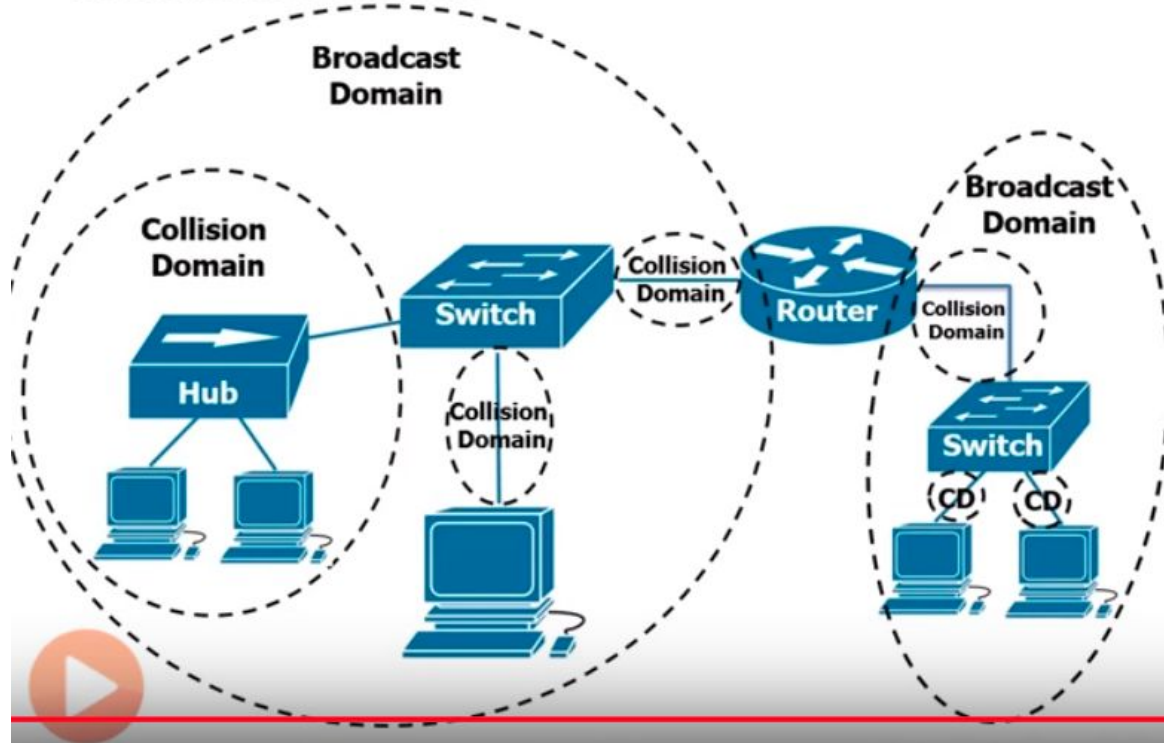
LAN includes all the user devices, servers, Switches, routers, cables, and wireless access points in one location. However, an alternative narrower definition of a LAN can help in understanding the concept of a virtual LAN:

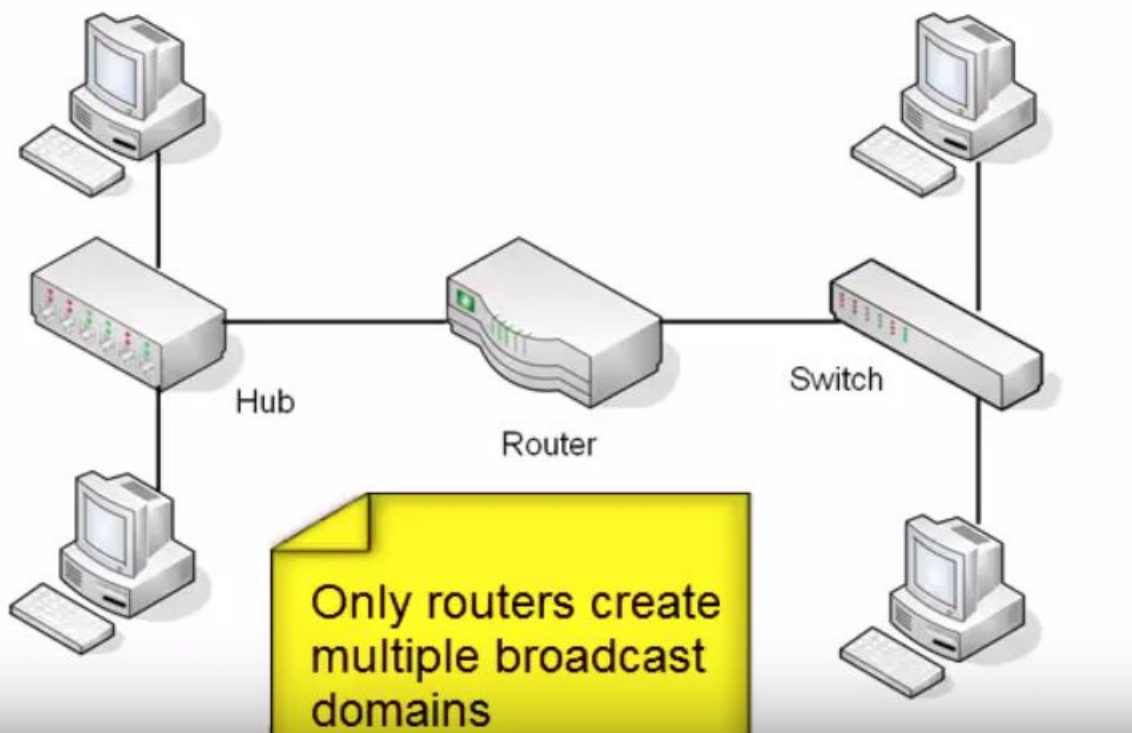
A LAN includes all devices in the same broadcast domain.

Definition

Broadcast domain: A group of devices which will receive a broadcast frame from any other member of the same group

Broadcast Domains





Broadcast Domain -----

A broadcast domain includes the set of all LAN-connected devices, so that when any of the **devices sends a broadcast frame, all the other devices get a copy of the frame**. So, from one perspective, you can think of a **LAN and a broadcast domain as being basically the same thing**.

Without VLANs, a switch considers all its interfaces to be in the same broadcast domain. That is, for one switch, when a broadcast frame entered one switch port, the switch forwarded that broadcast frame out all other ports. With that logic, to **create two different LAN broadcast domains, you had to buy two different Ethernet LAN switches**.

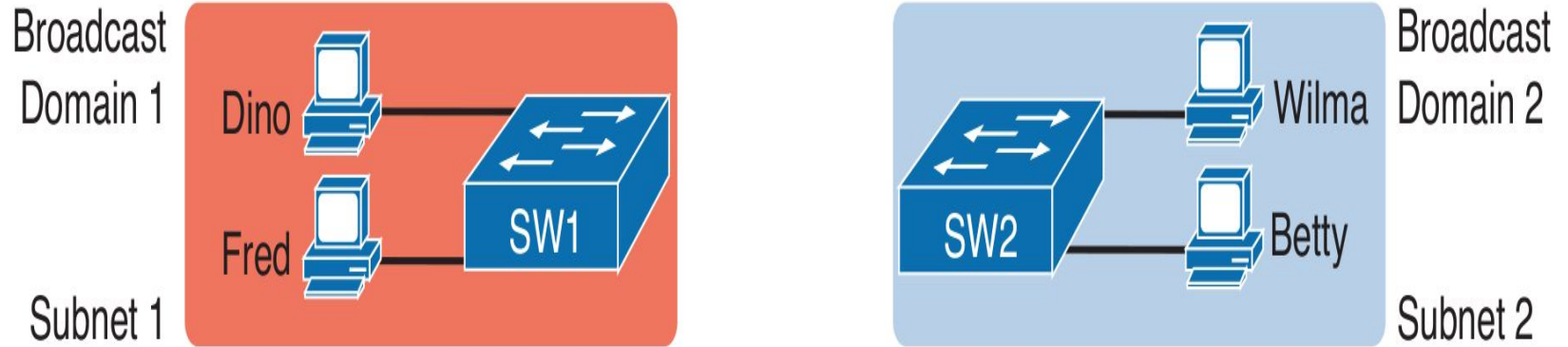


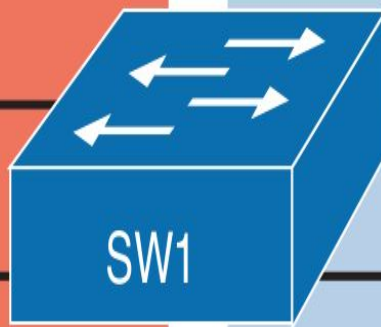
Figure 1-1 *Creating Two Broadcast Domains with Two Physical Switches and No VLANs*

Two Broadcast Domain with Single Switch

With support for VLANs, a single switch can accomplish the same goals of the design in Figure 1-1—to create two broadcast domains—with a single switch. With **VLANs, a switch can configure some interfaces into one broadcast domain and some into another, creating multiple broadcast domains.** These individual broadcast domains created by the switch are called **virtual LANs (VLAN)**.

For example, in Figure 1-2, the single switch creates two VLANs, treating the ports in each VLAN as being completely separate. The switch would never forward a frame sent by Dino (in VLAN 1) over to either Wilma or Betty (in VLAN 2).

Broadcast
Domain 1
(VLAN 1)
Subnet 1



Broadcast
Domain 2
(VLAN 2)
Subnet 2

Physical Layer

Cabling

100 Mbps



CAT 5/5e

1 Gbps



CAT 6

10 Gbps



CAT 6a

10 Gbps

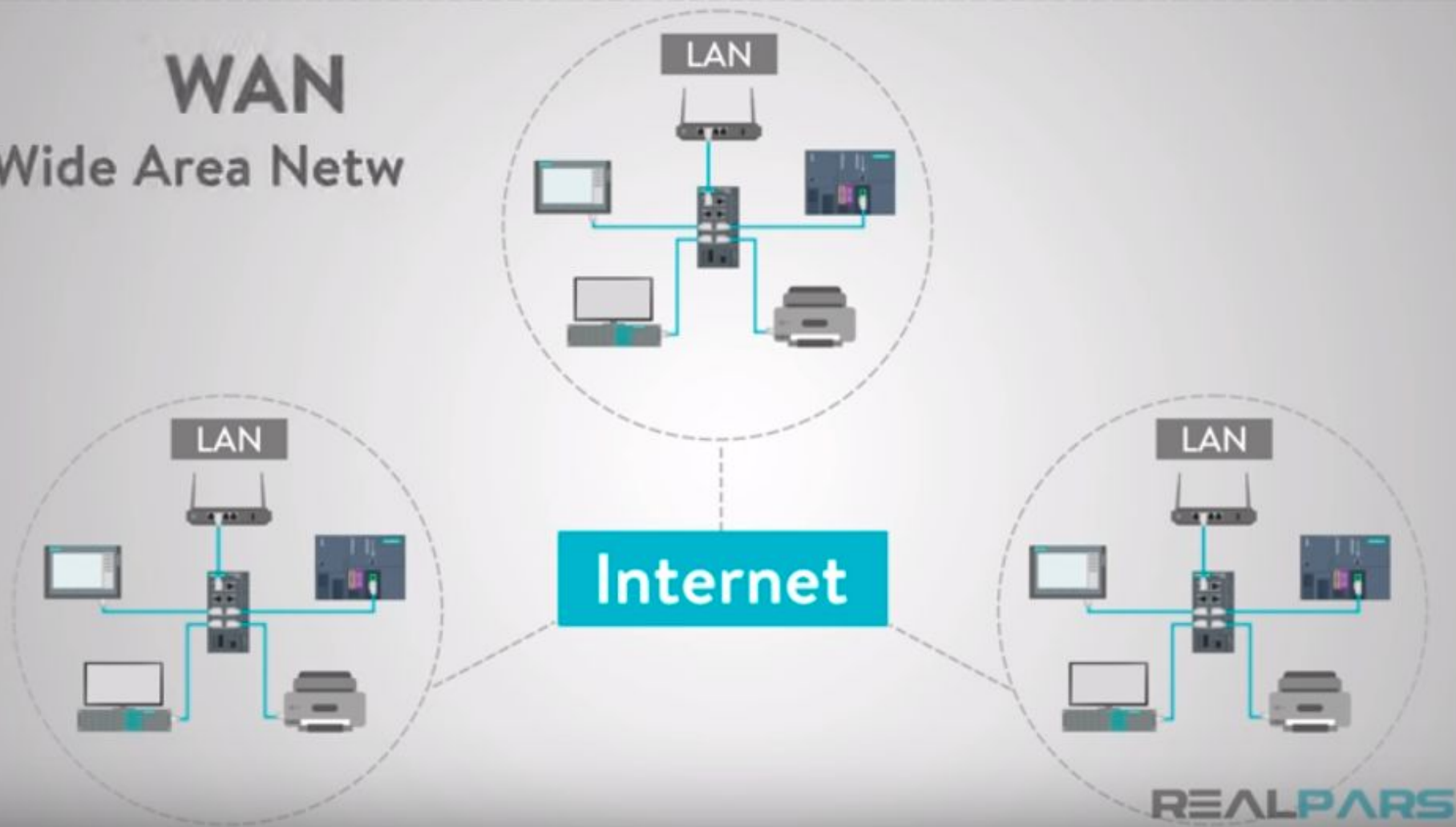


CAT 7

PL CABLING

WAN

Wide Area Netw



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