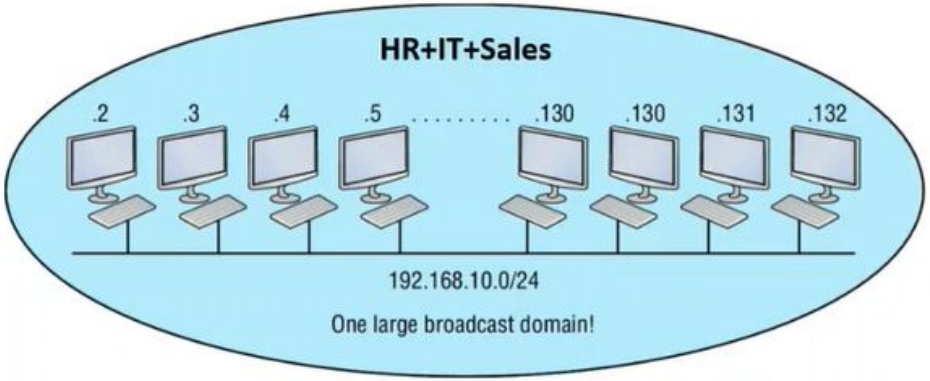
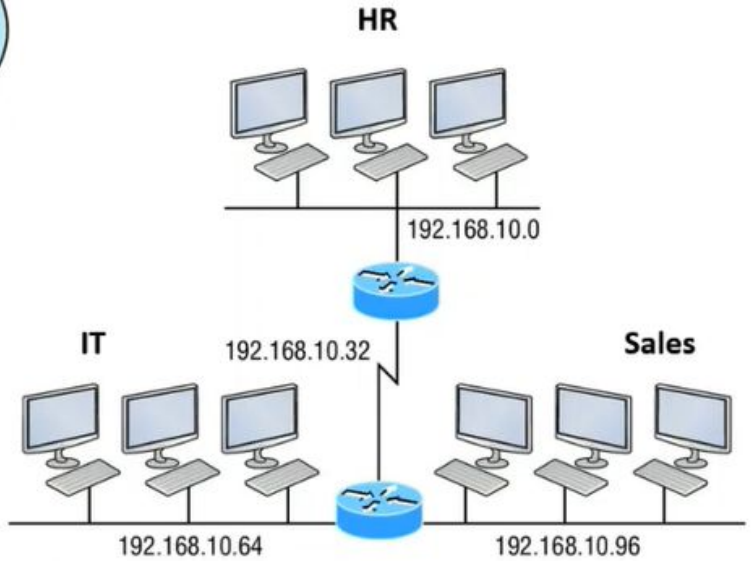
week5

Subnetting 子网划分

Why you need subnetting 为什么需要子网划分

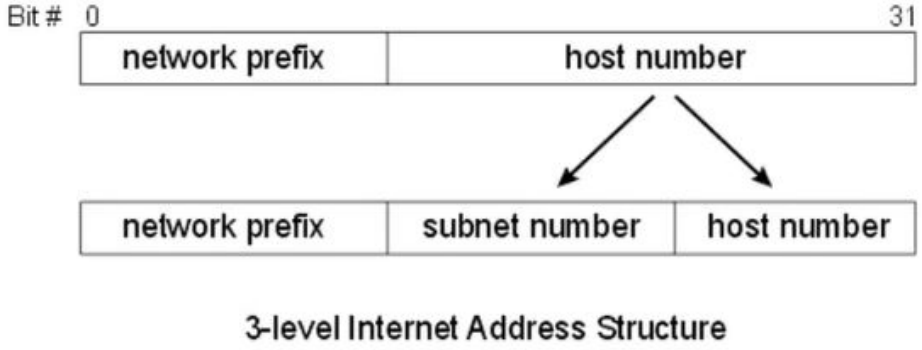


1. More Secure 更安全
2. Easier to Manage 更容易管理
3. Save IP Address 节省地址空间



How to create subnets 如何创建子网

- Take bits from the host portion of the address and reserving them to define the subnet address instead. 从地址的主机部分借去某些位，然后保留它 们以定义子网地址。
- Create subnets will change the IP address range from **Classful** (Class A, B, C) to **Classless.** 创建子网会将IP地址范围从**有类**（A，B，C类）更改为**无类**



3-level Internet Address Structure

192	168	1	0	Range
11000000	10101000	00000001	00000000	0-255
11000000	10101000	00000001	00000000	0-127
11000000	10101000	00000001	10000000	128-255

Subnet Mask 子网掩码

- 192.168.1.1
- 192.168.1.129
- 192.168.1.254

Class	Format	Default Subnet Mask
A	network.node.node.node	255.0.0.0
	11111111.00000000.00000000.00000000	
B	network.network.node.node	255.255.0.0
	11111111.11111111.00000000.00000000	
C	network.network.network.node	255.255.255.0
	11111111.11111111.11111111.00000000	
Classless	**Format**	**Subnet Mask**
	11000000. 10101000. 00000001.00000000 11000000. 10101000. 00000001.10000000	255.255.255.128
	11111111.11111111.11111111.10000000	

Subnet Mask 子网掩码

IP	Mask
192.168.1.1	255.255.255.0
192.168.1.129	255.255.255.0
192.168.1.254	255.255.255.0

IP	Mask
192.168.1.1	255.255.255.128
192.168.1.129	255.255.255.128
192.168.1.254	255.255.255.128

IP	Mask
192.168.1.1	255.255.255.252
192.168.1.129	255.255.255.252
192.168.1.254	255.255.255.252

Classless Inter-Domain Routing (CIDR) 无类别域间路由

- “Slash Notation”
- 254 - /31 - 11111110
- 255 - /32 - 11111111
- Prefix

Subnet Mask	Binary	CIDR Value
255.0.0.0	11111111	/8
255.128.0.0	11111111.1	/9
255.192.0.0	11111111.11	/10
255.224.0.0	11111111.111	/11
255.240.0.0	11111111.1111	/12
255.248.0.0	11111111.11111	/13
255.252.0.0	11111111.111111	/14
255.254.0.0	11111111.1111111	/15
255.255.0.0	11111111.11111111	/16
255.255.128.0		/17
255.255.192.0		/18
255.255.224.0		/19
255.255.240.0		/20
255.255.248.0		/21
255.255.252.0		/22
255.255.254.0		/23
255.255.255.0		/24
255.255.255.128		/25
255.255.255.192		/26
255.255.255.224		/27
255.255.255.240		/28
255.255.255.248		/29
255.255.255.252	11111111.11111111.11111111.11111100	/30

Subnet Mask with CIDR 子网掩码和CIDR

IP	Mask	CIDR
192.168.1.1	255.255.255.0	/24
192.168.1.129	255.255.255.0	/24
192.168.1.254	255.255.255.0	/24

IP	Mask	CIDR
192.168.1.1	255.255.255.128	/25
192.168.1.129	255.255.255.128	/25
192.168.1.254	255.255.255.128	/25

IP	Mask	CIDR
192.168.1.1	255.255.255.252	/30
192.168.1.129	255.255.255.252	/30
192.168.1.254	255.255.255.252	/30

/30, /31 and /32

- Subnet Mask 255.255.255.255 - 11111111.11111111.11111111.11111111 - /32 means a host 这个子网掩码 /32 代表主机本身
- /30 subnet has 2 IP for hosts (example 192.168.1.0/30) /30子网有2个IP分配给主机
  - $2^2 = 4$
  - 192.168.1.0 = network address 网段地址
  - 192.168.1.1 = host address (odd) 主机地址（奇数）
  - 192.168.1.2 = host address (even) 主机地址（偶数）
  - 192.168.1.3 = broadcast address 广播地址
  - Tips - the lower IP is always odd, and the higher is always even 诀窍：低的地址总是奇数的，高的地址总是偶数的
- /31 subnet has 2 IP for hosts as well (example 192.168.1.0/31) - this apply to Point-to-Point link only /31 子网同样有2个ip分配给主机，这个仅应用于点对点连接
  - 192.168.1.0 = host address (even) 主机地址（偶数）
  - 192.168.1.1 = host address (odd) 主机地址（奇数）
  - Tips - the lower IP is always even, and the higher is always odd 诀窍：低的地址总是偶数的，高的地址总是奇数的

Subnet Zero 零号子网

Router#sh running-config

Building configuration…

Current configuration : 827 bytes

!

hostname Pod1R1

!

- 172.16.0.0/16 by default the Class B address 172.16.0.0/16 默认为B类地址
- If network 172.16.0.0/16 is subnetted by borrowing three bits from the host portion 如果网络172.16.0.0/16通过从主机部分借用3个比特来进行子网划分
- Subnet 172.16.0.0/19 is called Subnet Zero 子网172.16.0.0/19称为零号子网
- Note that this subnet address is identical to network address 172.16.0.0 请注意，此子网地址与网 络地址172.16.0.0相同
- Prior to IOS 12.0, by default, did not allow an IP address belonging to subnet zero to be configured on an interface 在IOS 12.0之前，默认情况下不允 许在接口上配置属于零号子网的 IP地址
- Cisco has turned this command on by default starting with Cisco IOS version 12.x 从Cisco IOS版本12.x开始，Cisco默认情况下已打开此命令。

Subnet Address	Subnet Mask	Broadcast Address	Valid Host Range
172.16.0.0	255.255.224.0	172.16.31.255	172.16.0.1 to 172.16.31.254
172.16.32.0	255.255.224.0	172.16.63.255	172.16.32.1 to 172.16.63.254
172.16.64.0	255.255.224.0	172.16.95.255	172.16.64.1 to 172.16.95.254
172.16.96.0	255.255.224.0	172.16.127.255	172.16.96.1 to 172.16.127.254
172.16.128.0	255.255.224.0	172.16.159.255	172.16.128.1 to 172.16.159.254
172.16.160.0	255.255.224.0	172.16.191.255	172.16.160.1 to 172.16.191.254
172.16.192.0	255.255.224.0	172.16.223.255	172.16.192.1 to 172.16.223.254
172.16.224.0	255.255.224.0	172.16.255.255	172.16.224.1 to 172.16.255.254

The class of the network subnetted and the number of subnets obtained after subnetting have no role in determining subnet zero. **It is the first subnet obtained when subnetting the network address.** 子网划分的网络类别和子网划分后获得的子网数量在确定零号子网中没有作用。**它是对网络地址进行子网划分时获得的第一个子网。**

Layer 2 Switching Basic 二层交换基础

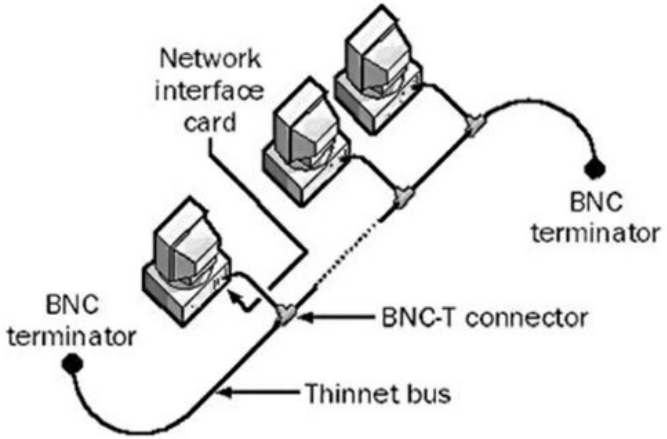
Repeater 中继器

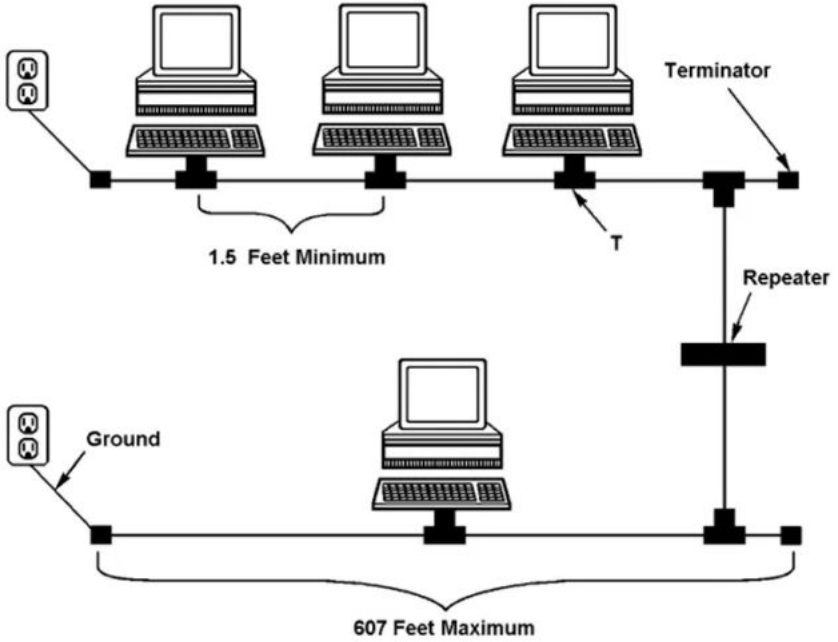
- Repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network. 转发器在物理层运行。它的工作是在信号变得太弱或损坏之前，在同一网络上重新生成信号，以延长信号可以在同一网络上传输的长度。
- When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength. It is a 2 port device. 当信号变弱时，他们会一点一点地复制信号并以原始强度对其进行再生。这是一个2端口设备。

Thinnet:

Coaxial cable used in Ethernet local area networks

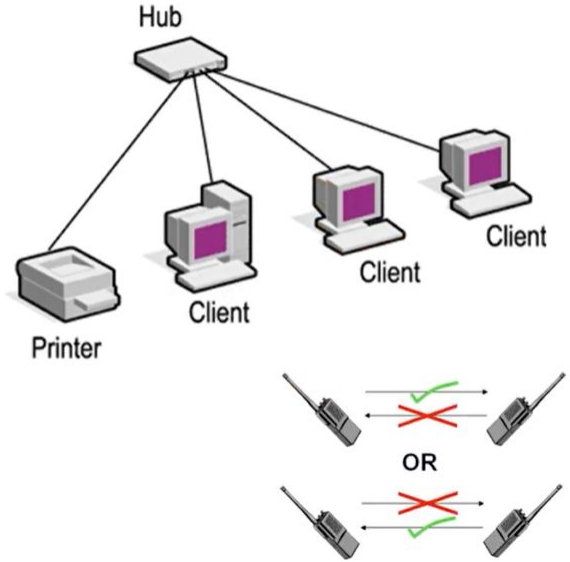
以太网局域网中使用的同轴电缆

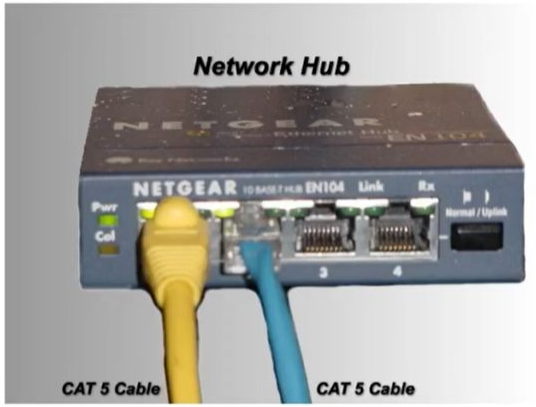




Hub 集线器

A hub is basically a multiport repeater. Hubs cannot filter data, so data packets are sent to all connected devices. Hub runs at half-duplex only. 集线器基本上是多端口中继器。集线器无法过滤数据，因此数据包将发送到所有连接的设备。集线器仅在半双工模式下运行。

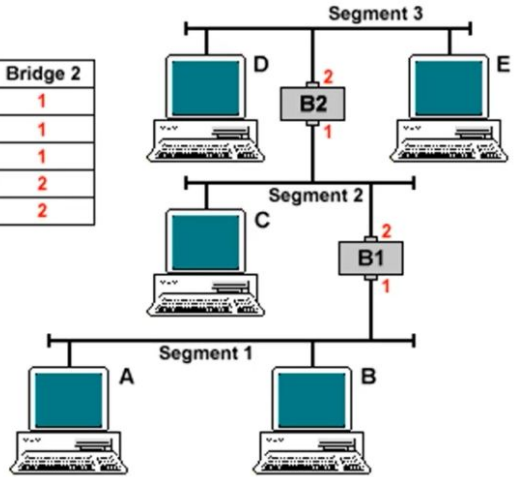




Bridge 网桥

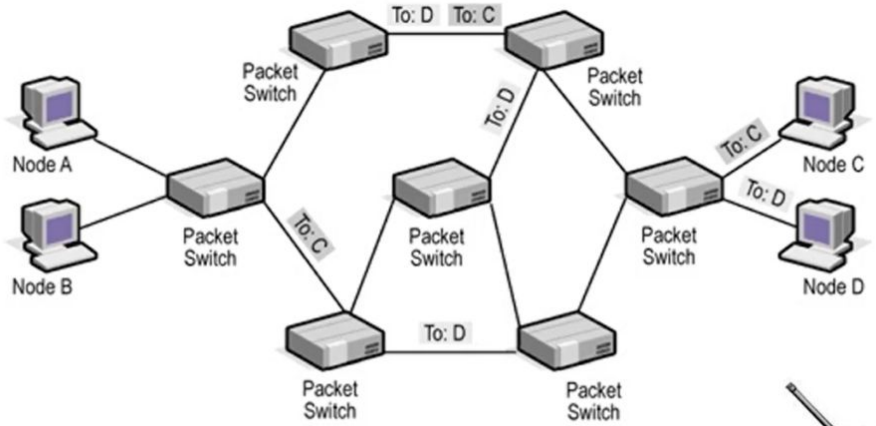
A bridge is a device can read the MAC addresses of source and destination. Bridge creates a single aggregate network from multiple communication networks or network segments. 桥是一种可以读取源和目标的MAC地址的设备。网桥从多个通信网络或网段创建单个聚合网络。

	Bridge 1	Bridge 2
A	1	1
B	1	1
C	2	1
D	2	2
E	2	2



Switch 交换机

- Switches have many ports, bridges only have small number of ports 交换机有很多端口，网桥只有少数端口
- Switches perform forwarding in hardware, while bridges perform it in software 交换机在硬件中执行转发，而网桥在软件中执行转发
- Switch can run at **full-duplex** 交换机可以**全双工**运行

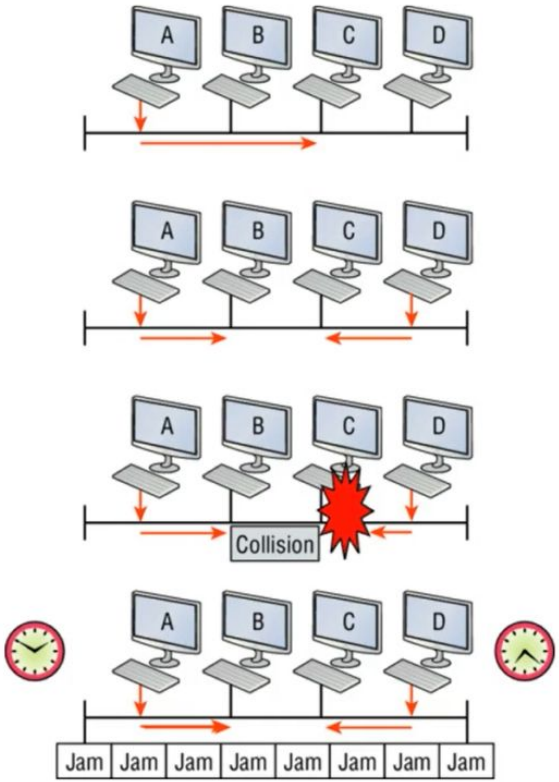


CSMA/CD 带检测的载波侦听

When a collision occurs on an Ethernet LAN, the following happens: 在以太网LAN上发生冲突时，将发生以下情况：

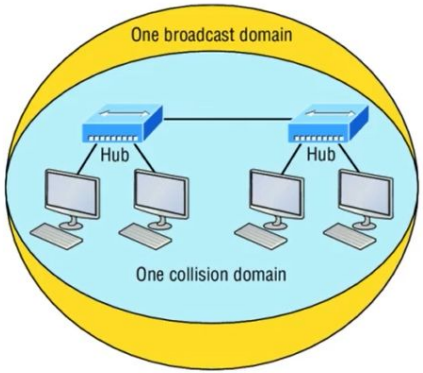
- A jam signal informs all devices that a collision occurred. 碰撞信号会通知所有设备发生了冲突。
- The collision invokes a random backoff algorithm. 这个冲突会调用随机退避算法。
- Each device on the Ethernet segment stops transmitting for a short time until its backoff timer expires. 以太网网段上的每个设备都会短暂停止传输，直到其退避计时器到期为止。
- All hosts have equal priority to transmit after the timers have expired. 计时器到期后，所有主机都具有相同的优先级进行传输。

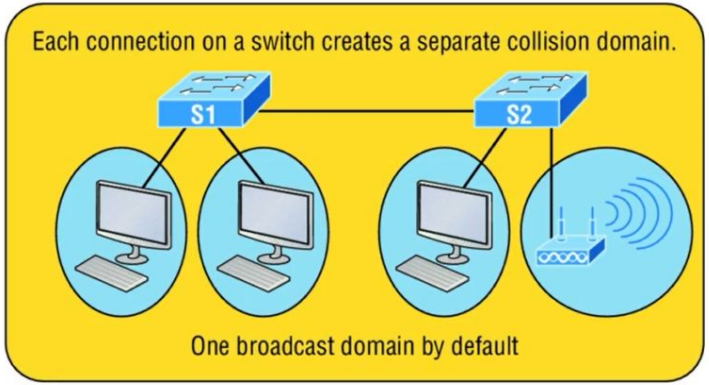
CSMA/CD is operative when device is operating in half duplex mode to avoid the collision. 当设备以半双工模式运行时，CSMA / CD运行以避免冲突。



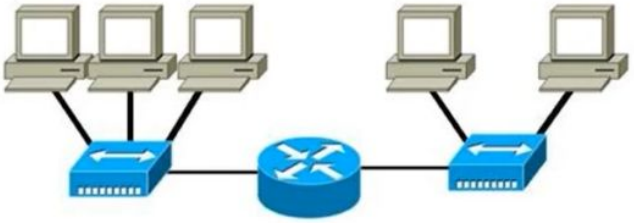
Collision and Broadcast Domain 冲突域和广播域

- Collision domain refers to a network scenario wherein one device sends a frame out on a physical network segment forcing every other device on the same segment to pay attention to it. This is bad because if two devices on a single physical segment just happen to transmit simultaneously, it will cause a collision and require these devices to retransmit. 冲突域是指一种网络场景，其中一个设备在物理网络段上发送帧，会强制同一段上的所有其他设备对其进行关注。如果同一物理段上的两个设备恰巧同时传输，则会导致冲突并要求这些设备重新传输。
- Broadcast domain refers to a group of devices on a specific network segment that hear all the broadcasts sent out on that specific network segment. 广播域是指特定网段上的一组设备，它们可以听到在该特定网段上发出的所有广播。

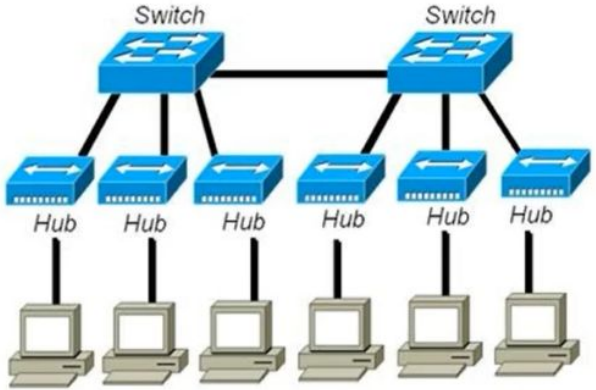




Collision and Broadcast Domain Practice 冲突域和广播域练习

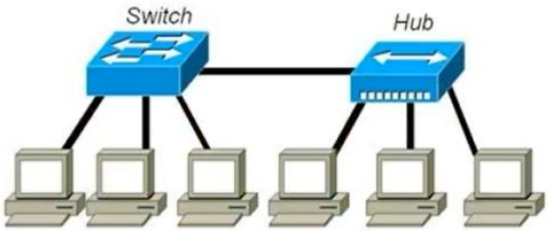


- Two broadcast domains, two collision domains 两个广播域，两个冲突域

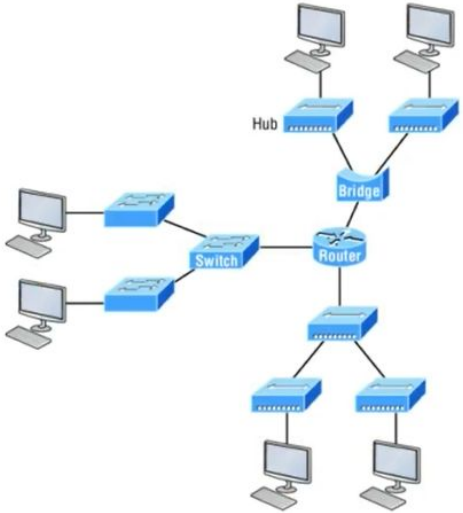


- One broadcast domain, seven collision domains 一个广播域，七个冲突域

Collision and Broadcast Domain Practice 冲突域广播域练习



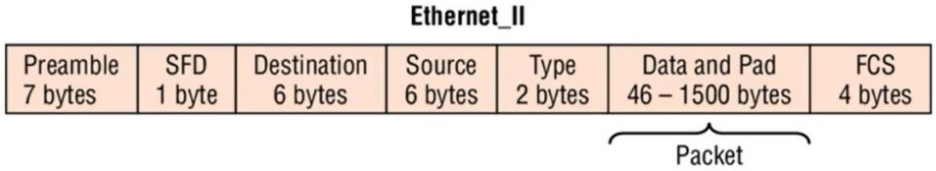
- One broadcast domain, four collision domains. 一个广播域，四个冲突域。



- Three broadcast domains, nine collision domains 三个广播域，九个冲突域

Ethernet Frames (Data Link Layer) 以太网帧（数据链路层）

The function of Ethernet stations is to pass data frames between each other using a group of bits known as a MAC frame format. 以太网站的功能是使用一种称 为MAC帧格式的一组比特在彼此之间传递数据帧。



- Destination Address: a broadcast is all 1s - all Fs in hex - and is sent to all devices 目的地址：广播全为1，或全为F（十六进制），并发送到所有设备
- Type field: IP, or 08-00 (0x800 in hex) 类型字段：IP，08-00（十六进制的0x800）

Ethernet Frames (Physical Layer) 以太网帧（物理层）

10Base-T (IEEE 802.3) 10 Mbps using category 3 unshielded twisted pair (UTP) wiring for runs up to 100 meters. Unlike with the 10Base-2 and 10Base-5 networks, each device must connect into a hub or switch, and you can have only one host per segment or wire. It uses an RJ45 connector (8-pin modular connector) with a physical star topology and a logical bus. **10Base-T（IEEE 802.3）**10 Mbps，使用3类非屏蔽双绞线（UTP）布线，可运行100米。与10Base-2和10Base-5网络不同，每个设备必须连接到集线器或交换机，并且每个网段或线路只能有一个主机。它使用具有物理星形拓扑结构和逻辑总线拓扑结构的RJ45连接器（8针模块化连接器）。

100Base-TX (IEEE 802.3u) 100Base-TX, most commonly known as Fast Ethernet, uses EIA/TIA category 5, 5E, or 6 UTP twopair wiring. One user per segment; up to 100 meters long. It uses an RJ45 connector with a physical star topology and a logical bus. **100Base-TX（IEEE 802.3u）**100Base-TX，通常称为快速以太网，使用EIA / TIA 5类、超5类或6类的 UTP两对布线。每个网段只有一个用户；长达100米。它使用具有物理星形拓扑结构和逻辑总线拓扑结构的RJ45连接器。

100Base-FX (IEEE 802.3u) Uses fiber cabling 62.5/125-micron multimode fiber. Point-to-point topology; up to 412 meters long. It uses ST and SC connectors, which are media-interface connectors. **100Base-FX（IEEE 802.3u）**使用62.5 / 125微米多模光纤布线。点对点拓扑；长达412米。它使用ST和SC连接器，它们是媒体接口连接器。

1000Base-CX (IEEE 802.3z) Copper twisted-pair, called twinax, is a balanced coaxial pair that can run only up to 25 meters and uses a special 9-pin connector known as the High Speed Serial Data Connector (HSSDC). This is used in Cisco's new Data Center technologies. **1000Base-CX（IEEE 802.3z）**铜双绞线，称为twinax，是一种平衡同轴线对，只能运行25米，并使用称为高速串行数据连接器（HSSDC）的特殊9针连接器。思科的新数据中心技术中使用了此功能。

1000Base-T (IEEE 802.3ab) Category 5, four-pair UTP wiring up to 100 meters long and up to 1 Gbps. **1000Base-T（IEEE 802.3ab）**5类，四对UTP布线，最长100米，最高1 Gbps。

1000Base-SX (IEEE 802.3z) The implementation of 1 Gigabit Ethernet running over multimode fiber-optic cable instead of copper twisted-pair cable, using short wavelength laser. Multimode fiber (MMF) using 62.5- and 50-micron core; uses an 850 nanometer (nm) laser and can go up to 220 meters with 62.5-micron, 550 meters with 50-micron. **1000Base-SX（IEEE 802.3z）**使用短波长激光，通过多模光纤电缆而不是铜质双绞线电缆运行1Gbps以太网。使用62.5和50微米纤芯的多模光纤（MMF）；使用850纳米（nm）的激光，在62.5微米时可达220米，在50微米时可达550米。

1000Base-LX (IEEE 802.3z) Single-mode fiber that uses a 9-micron core and 1300 nm laser and can go from 3 kilometers up to 10 kilometers. **1000Base-LX（IEEE 802.3z）**单模光纤，使用9微米纤芯和1300 nm激光，距离从3公里到10公里。

1000Base-ZX (Cisco standard) 1000BaseZX, or1000Base-ZX, is a Cisco specified standard for Gigabit Ethernet communication. lOOOBaseZX operates on ordinary single-mode fiber-optic links with spans up to 43.5 miles (70 km). **1000Base-ZX（Cisco标准）**1000BaseZX或1000Base-ZX是Cisco针对千兆位以太网通信指定的标准。1000BaseZX在普通的单模光纤链路上运行，跨度可达43.5英里（70公里）。

10GBase-T (802.3.an) 10GBase-T is a standard proposed by the IEEE 802.3an committee to provide 10 Gbps connections over conventional UTP cables, (category 5e, 6, or 7 cables). 10GBase-T allows the conventional RJ45 used for Ethernet LANs **10GBase-T（802.3.an）**10GBase-T是IEEE 802.3an委员会提出的标准，旨在通过常规UTP电缆（5e，6或7类电缆）提供10 Gbps连接。10GBase-T允许将常规RJ45用于以太网LAN