

网络协议简介与 Linux 网络应用

Down-Top Method

本群最菜

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① Data Link Layer

② Network Layer

1 Data Link Layer

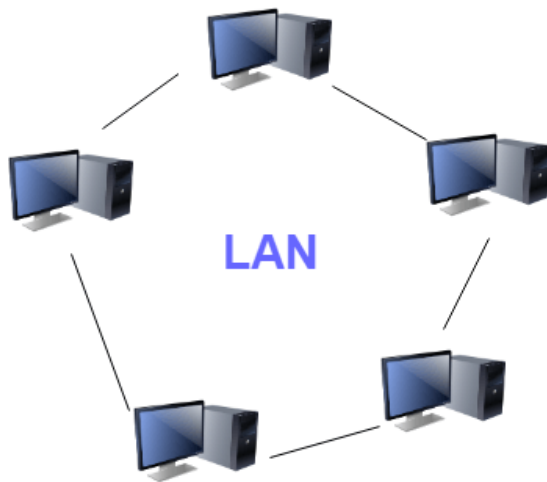
2 Network Layer

Dual Computer Interconnection



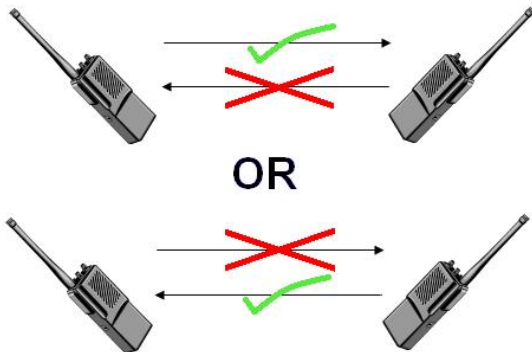
Practice:

Multiple Computer Interconnection



Ethernet Hub

Half Duplex



Full duplex



Broadcast storm

1 Data Link Layer

2 Network Layer

Problems with Dual Computer Interconnection

Difficult to extend. e.g.

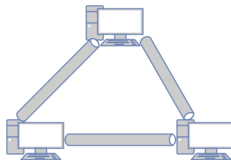


图: Ring Network

to extend each end it requires an additional port on all other ends.(which is unaffordable,let alone large scale network)

A Solution

How about connecting each end to a single cable?

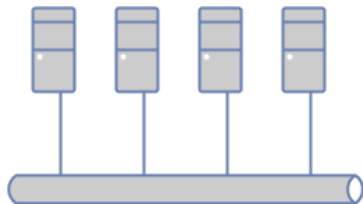


图: Bus

In this case every single machine is connected to all other ends.
The device to achieve this type of connection is a **Hub**

A Solution

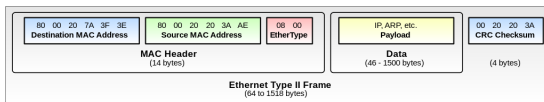


New Problems arise

In this case, multiple ends communicate over the same cable. They need to distinguish from each other.

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In this case, multiple ends communicate over the same cable. They need to distinguish from each other. Let start by giving names, in Network this is called a MAC address.



Enlarge the scale

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Exp-Backoff.

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But it doesn't help that much.

Upgrading the Hub

There was a simple idea. What if we separate the ends from a single wire? We can achieve this by applying some upgrades to the Hub. Empower the hub with memory to avoid broadcasting to all ends in the network.

Address	Interface	Time
1F-88-63-D1-04-D7	2	9:39
80-51-40-2D-7A-EF	1	9:32
02-02-F2-B3-FE-D0	3	9:36
95-AA-47-53-5B-1E	4	9:38
...

图: Mac Table



图: Switch

The Behaviour of the Switch

```
for each Port A:
  for each MAC frame it received on Port A:
    lookup the Switch Table
    if found:
      if it belongs to Port A itself:
        do nothing
      else:
        Forward The MAC frame to corresponding Port
    else:
      Broadcast the Frame to all other Port except A
```

The Problem Still Exists

In the status quo, Consider a large-scale network.

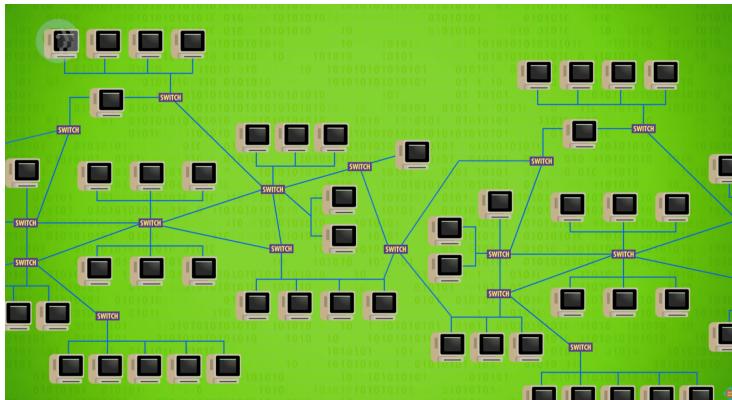


图: Burdened Switch

A closer look

For each Switch, we notice that in order to Send MAC frames to a far end it needs to maintain too much information (and we must, Why?)

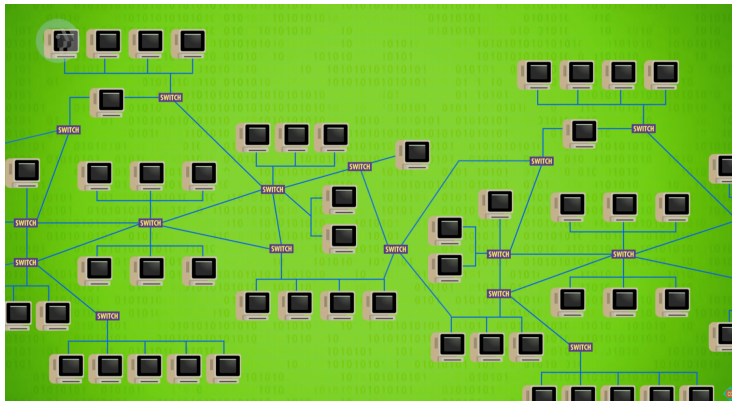
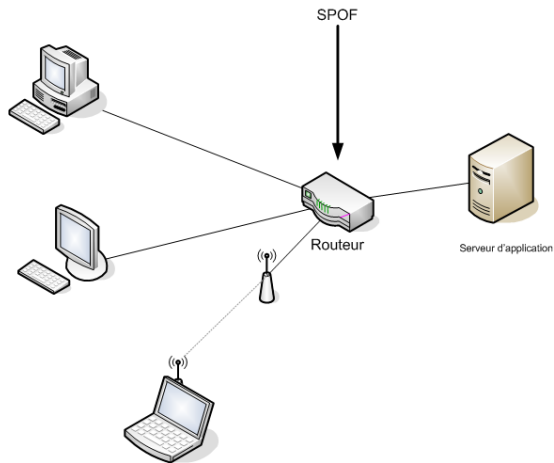
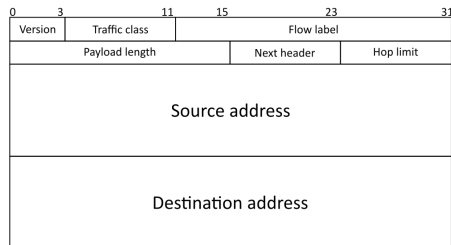
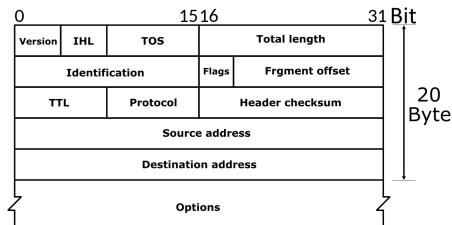


图: Burdened Switch

Router



IP Protocol



IPv4 Address

32-bit number

four 8-bit fields that are separated by periods

192.168.1.1

Classless Inter-Domain Routing

Ex.

192.168.1.0/24 equals 192.168.1.0 - 192.168.1.255

192.168.0.0/23 equals 192.168.0.0 - 192.168.1.255

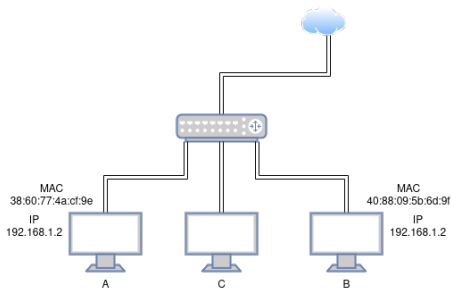
10.0.0.0/8 equals 10.0.0.0 - 10.255.255.255

https://en.wikipedia.org/wiki/Classless_Inter-Domain_Routing#IPv4_CIDR_blocks

A router is a networking device that forwards data packets between computer networks.

A router is connected to two or more data lines from different IP networks. When a data packet comes in on one of the lines, the router reads the network address information in the packet header to determine the ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey.

To Be more intuitive



Host A wants to communicate with IP 192.168.1.4, After checking the routing table which says this address requires no routing, but A doesn't know the MAC of IP 192.168.1.4.

Host A: (Broadcast) Who is 192.168.1.4? Please Respond to MAC 38:60:77:4a:cf:9e

Host B: (To A's MAC) This is 192.168.1.4

Host A: [Taking notes] and after some time, A refreshes this 'note'

Kernel IP routing table

```
bilichenchina@ss-lask: ~  
172.23.193.0/27 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.193.128/27 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.198.0/24 dev dn42_maraun proto bird scope link src 172.23.3.97 metric 32  
172.23.199.96/28 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.200.0/24 dev dn42_maraun proto bird scope link src 172.23.3.97 metric 32  
172.23.207.24/29 dev dn42_maraun proto bird scope link src 172.23.3.97 metric 32  
172.23.215.128/27 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.215.160/27 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.220.0/24 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.220.96/28 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.220.112/28 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.220.128/28 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.222.64/27 dev dn42_maraun proto bird scope link src 172.23.3.97 metric 32  
172.23.222.96/27 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.222.128/28 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.222.160/28 dev dn42_arnie proto bird scope link src 172.23.3.97 metric 32  
172.23.226.0/29 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.226.8/29 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.233.0/24 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.234.0/28 dev dn42_maraun proto bird scope link src 172.23.3.97 metric 32  
172.23.234.32/28 dev dn42_maraun proto bird scope link src 172.23.3.97 metric 32  
172.23.234.96/27 dev dn42_arnie proto bird scope link src 172.23.3.97 metric 32  
172.23.234.192/27 dev dn42_maraun proto bird scope link src 172.23.3.97 metric 32  
172.23.234.224/27 dev dn42_maraun proto bird scope link src 172.23.3.97 metric 32  
172.23.235.0/25 dev dn42_yang proto bird scope link src 172.23.3.97 metric 32  
172.23.235.128/25 dev dn42_yang proto bird scope link src 172.23.3.97 metric 32  
172.23.236.0/25 dev dn42_yang proto bird scope link src 172.23.3.97 metric 32  
172.23.248.224/28 dev dn42_arnie proto bird scope link src 172.23.3.97 metric 32  
172.23.250.32/27 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32  
172.23.250.64/27 dev dn42_moecast proto bird scope link src 172.23.3.97 metric 32
```

图: Linux Routing Table

Manipulating routing table

e.g.

```
ip route show
```

```
ip route add <CIDR> [via IP] dev <interface>
```

```
ip route del <CIDR> [via IP] dev <interface>
```

Multi-Table Routing

e.g.

```
ip route add <CIDR> [via IP] dev <interface> table <table_id>
ip rule show
ip rule add fwmark lookup <table id>
ip rule del
```

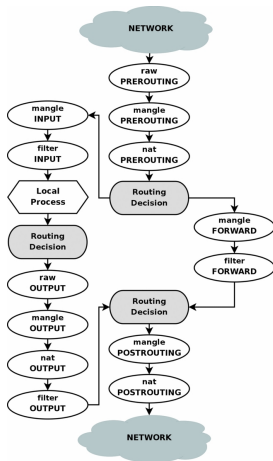



图: iptables