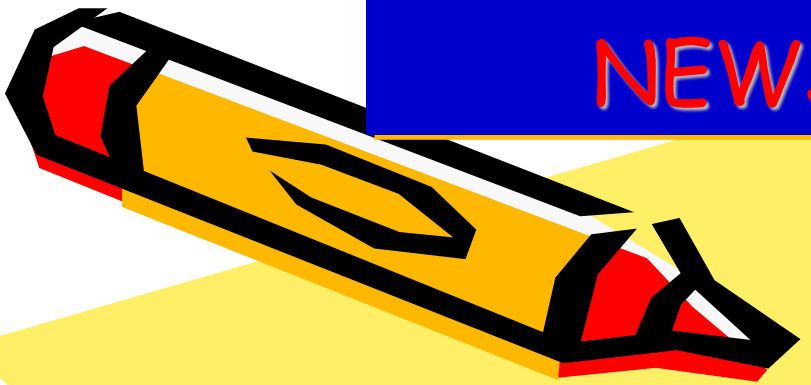
NEWS FOR MULTICAST!



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Multicast Technology

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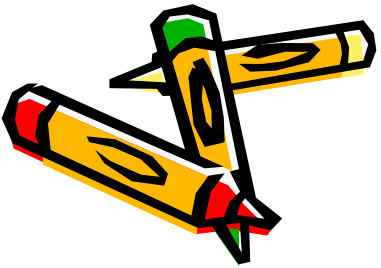
The implementation of multicast needs to meet the basic requirements

- (1)There needs to be a mechanism that uniquely identifies a multicast group. IP network through multicast addressing technology to achieve.
- (2) A mechanism that requires multicast group members to join or exit multicast groups. IGMP is used to manage multicast group members.
- (3) Multicast router protocol that efficiently transmits multicast packets to each group member over an IP network.

Multicast technical topics

- 1 Fundamentals of multicast technology
- **2 IGMP**
- 3 Multicast routing technology



7 summary of multicast

7.1 unicast, multicast, and broadcast

7.2 hardware broadcast

7.3 origin of broadcast hardware

7.4 multicast of ethernet

7.5 difference between mulaticast and broadcast

7.6 features of IP multicast

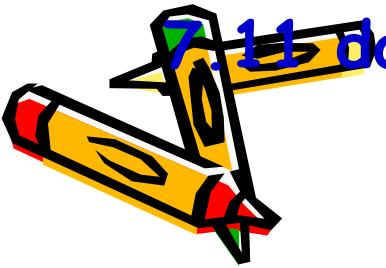
7.7 application of multicast

7.8 The conceptual component of broadcasting

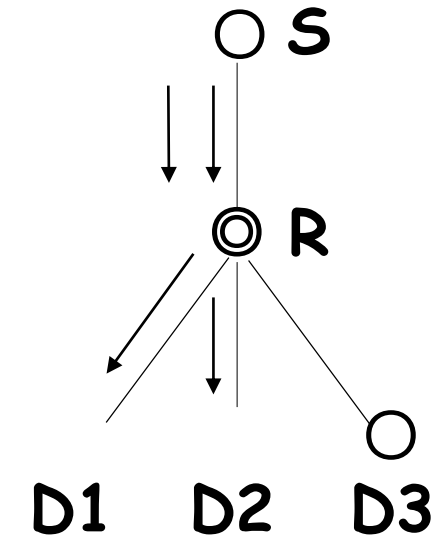
7.9 address of IP multicast

7.10 transfer of IP multicast packet

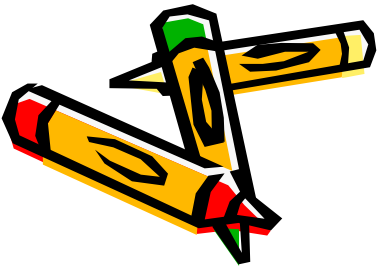
7.11 domain of multicast



7.1 unicast, multicast, and broadcast



(a) Realize multicas(
with unicast



differecne?

7.2 hardware broadcast

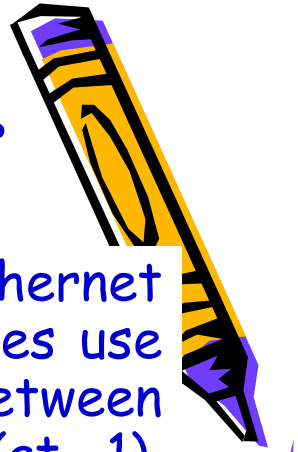
- In a network connected by switches and point-to-point connections, the software must have the ability to broadcast, that is, to forward packets through separate connections until all switches receive a copy.
- The Ethernet hardware address for 48-bit full 1 represents the broadcast address. The network card can recognize the hardware address and broadcast address, and then receive Ethernet frames whose destination address is the hardware address and broadcast address.
- The main drawback of broadcasting is the consumption of resources.In addition to using network bandwidth, each broadcast makes all the computers on the network consume network resources.

•How did multicasting start?

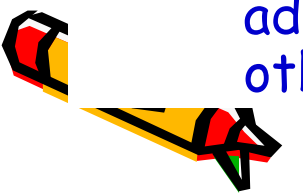
- **Difference between multicast and broadcast?**
- Multicast allows each node to choose whether or not it participates in a particular multicast group.
- After configuring the network interface hardware that identifies the multicast address, all computers in the group receive a copy of any group sent to the multicast address.
- Any kind of addressing can be considered as a special multicast addressing. But multicast is no substitute for other conventional addressing forms. Because the underlying mechanism of its forwarding and delivery is substantially different in implementation.
- Unicast and broadcast addresses identify one or a group of computers connected to a physical network segment.So the forwarding depends on the network topology.
- Multicast addresses identify any group of receivers, so the forwarding mechanism must propagate the group to all network segments.

Lots of Ethernet, multicast of its hardware?

7.4 Multicast of Ethernet

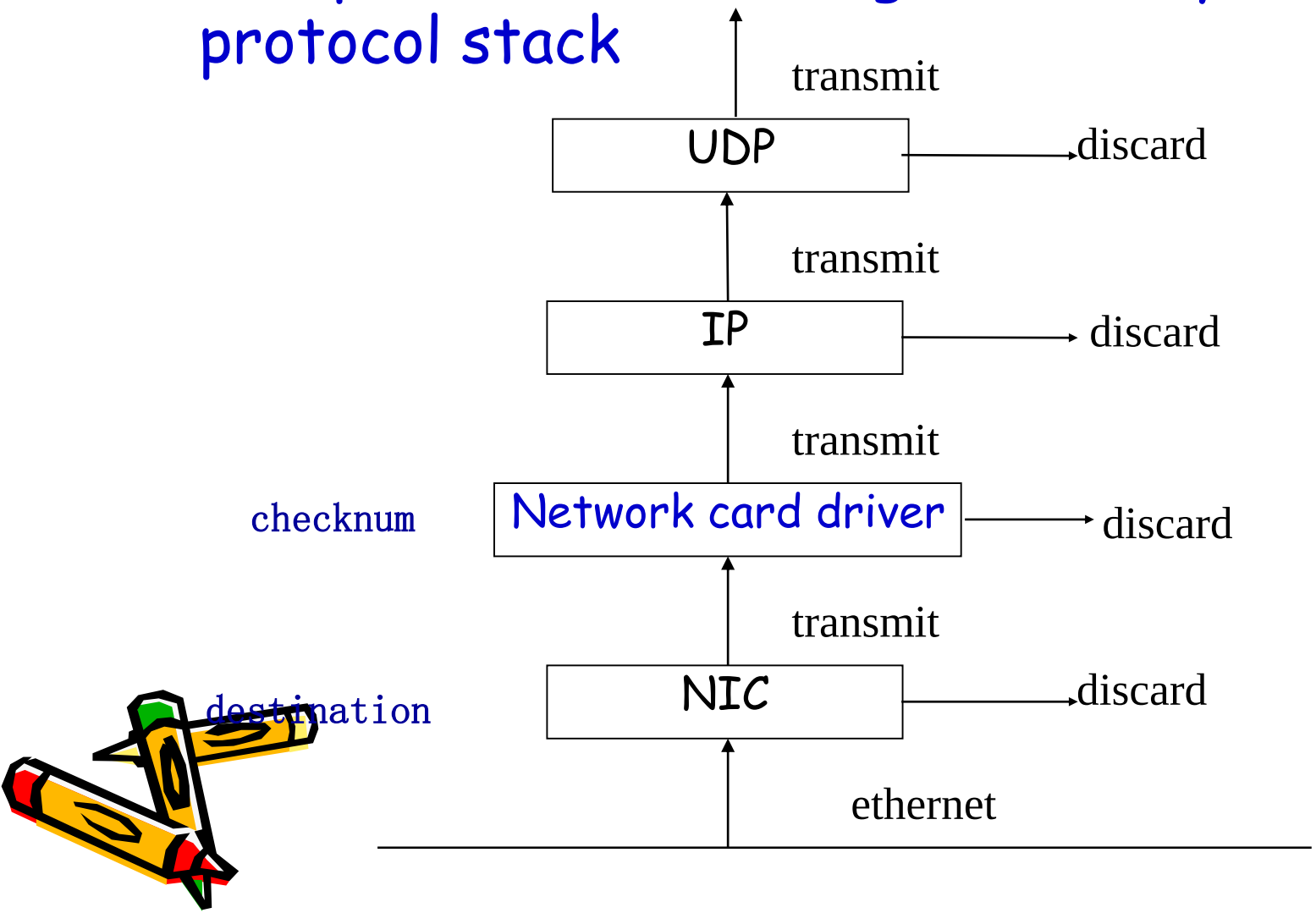


- Ethernet has hardware multicast capability. Half of all Ethernet addresses are reserved for multicast. Multicast addresses use the lowest bit of the highest byte to distinguish between unicast addresses (at 0) and multicast addresses (at 1). Multicast address can be expressed as: 01-00-00-00-00-00....Ethernet broadcast address denoted as?
- **FF:FF:FF:FF:FF:FF**。
- After the Ethernet card is initialized, can receive Ethernet frames sent to the computer's network card address, or Ethernet broadcast frames. The network card driver software can be used to reconfigure the network card, so that it can also identify one or more multicast addresses.
  - For example, after the driver is configured with Ethernet multicast address: 01-5e-00-00-00-01, the network card interface can receive Ethernet frames sent to the computer's unicast address, broadcast address or multicast address, and the hardware will ignore the packets sent to other multicast addresses.



7.5 difference in multicast and broadcast

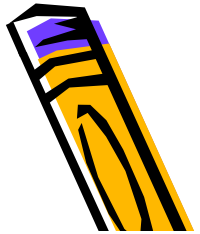
- The process of filtering frames by the protocol stack



Multicast technology can effectively reduce network bandwidth

- Using broadcasts increases the processing burden on hosts that are not interested in broadcasting data.
- If there are 50 hosts on the network but only 20 participate in UDP broadcasts, each time a broadcast datagram is sent to the network, the remaining 30 hosts have to process the broadcast datagram.The broadcast datagrams received are not discarded until the UDP layer.These 30 hosts discard the broadcast datagram because they do not use the destination port.
- With multicast, the host can join one or more multicast groups.Thus, NIC receives only those multicast frames of the multicast group on which the host is located.
- Multicast does not produce as many broadcast messages as it does broadcasts, nor does it require a sender to send a message to each receiver as unicast does.Therefore, multicast technology can effectively reduce the network bandwidth of some applications.

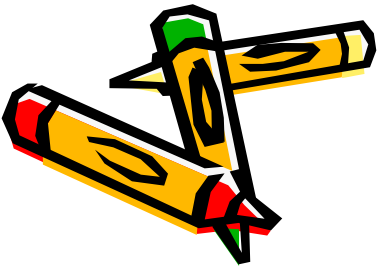
7.6 IP Multicast's feature



- Multicast group address. Each multicast group has a unique multicast address.
- ✓ The number of multicast groups. The address of up to 2^{28} multicast groups can be defined.
- ✓ Dynamic multicast group membership. Hosts can join or leave groups at any time. A host can be any number of members of a multicast group.
- ✓ Use of hardware. If the physical hardware supports multicast, the IP multicast is transmitted by hardware multicast. If the hardware does not support multicast, IP multicast is implemented using broadcast or unicast.
- ✓ Network forwarding. Multicast group members can connect to multiple physical networks, so special multicast routers need to forward IP multicast packets.
- ✓ Delivered services. IP multicast USES the best service available from IP. Multicast groups can be lost, delayed, duplicated, and arrived unordered.
- ✓ Membership and transport. Any host (including non-multicast group members) can send packets to any multicast group; Group relationships are used only to determine whether the host can receive packets sent to the multicast group.

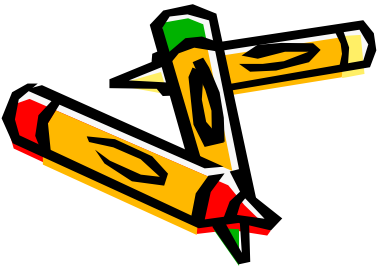
7.7 IP Multicast's application

- IP multicast technology effectively solves the problem of single-point sending and multi-point receiving. It realizes the efficient data transmission from point to point in IP network, which can save network bandwidth and reduce network load.
- The multicast feature of network can be used to provide some new value-added services.
- With the increasing number of multimedia services in IP network, multicast has great market potential and will be popularized gradually.



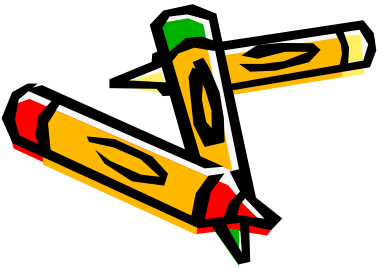
Multicast offers new value-added services

- Distance learning
- Video conference
- Information release: the company sends information to customers
- Internal resource sharing: information is distributed in distributed databases in different places.
- MOOC services



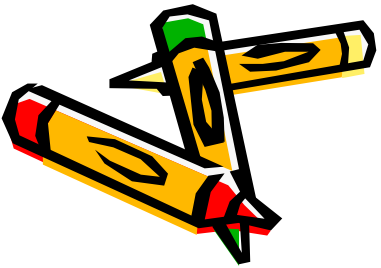
7.8 7.8 The conceptual component of broadcasting

- The multicast needs three conceptual components:
- Multicast addressing method
- Effective notification and delivery mechanisms
- Effective internetwork forwarding.



7.9 IP Multicast's ADDR.

- 7.9.1 IP multicast group address format
- 7.9.2 mapping of IP multicast group address to Ethernet multicast address



7.9 IP Multicast's ADDR.

- A multicast group is a collection of nodes that can receive and send to a particular multicast group. Multicast groups have the following characteristics:

✓ A multicast group can span multiple networks.

✓ Multicast groups have no limit on the number of hosts.

✓ Hosts can join or leave a multicast group at any time.

✓ A host can belong to different multiple multicast groups at the same time.

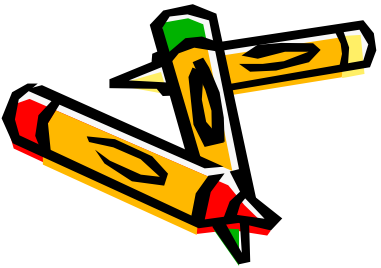
✓ Non-member hosts can send IP multicast groups to any multicast group.

✓ IP multicast router forwards IP multicast packets to its destination node.

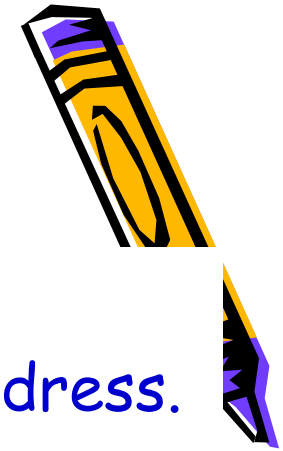
7.9.1 IP multicast group address format

- Each IP multicast group can be uniquely identified with a class D IP address
- Each multicast group has a unique multicast address (class D address: 224.0.0.0-239.255.255.255). Some are permanent, others are temporary; Can only be used as the destination address
- Number of groups. 。 2^{28}

1110	Multicast ID（28 BYTE）



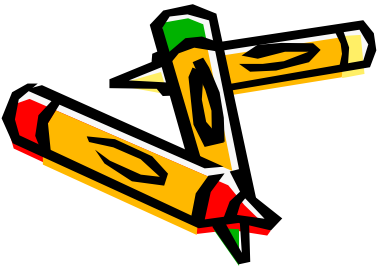
Two group ADDR.



- Permanent group address:
- Each permanent group has a permanent group address.
- Permanent group addresses are defined by IANA.
- Temporary group addresses: they can only be used after temporary groups have been created.
- A process can require its host to join a specific group.
- A process can ask its host to leave the group.When the last process leaves a group, the host no longer belongs to that group.
- Each host records which groups its process currently belongs to.

7.9.2 Mapping of IP multicast group address to Ethernet multicast address

- For multicast, there should be multicast device support at the network hardware layer, and a method to map IP multicast addresses to physical multicast addresses is needed.



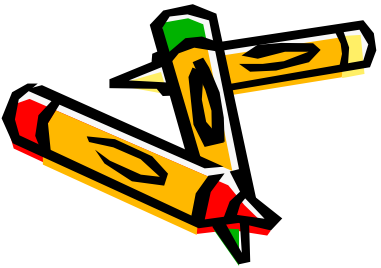
The conversion of multicast group address to Ethernet address

- IANA has an Ethernet address block of 24bit , **namely high 24bit: 00:00:5e** （**range: 00:00:5e:00:00:00 ~00:00:5e:ff:ff:ff**）。**IANA** Assigns half of them to multicast addresses 。
- **To specify a multicast address, the first byte of any Ethernet address must be 01, that is, the Ethernet range corresponding to IP multicast is:**

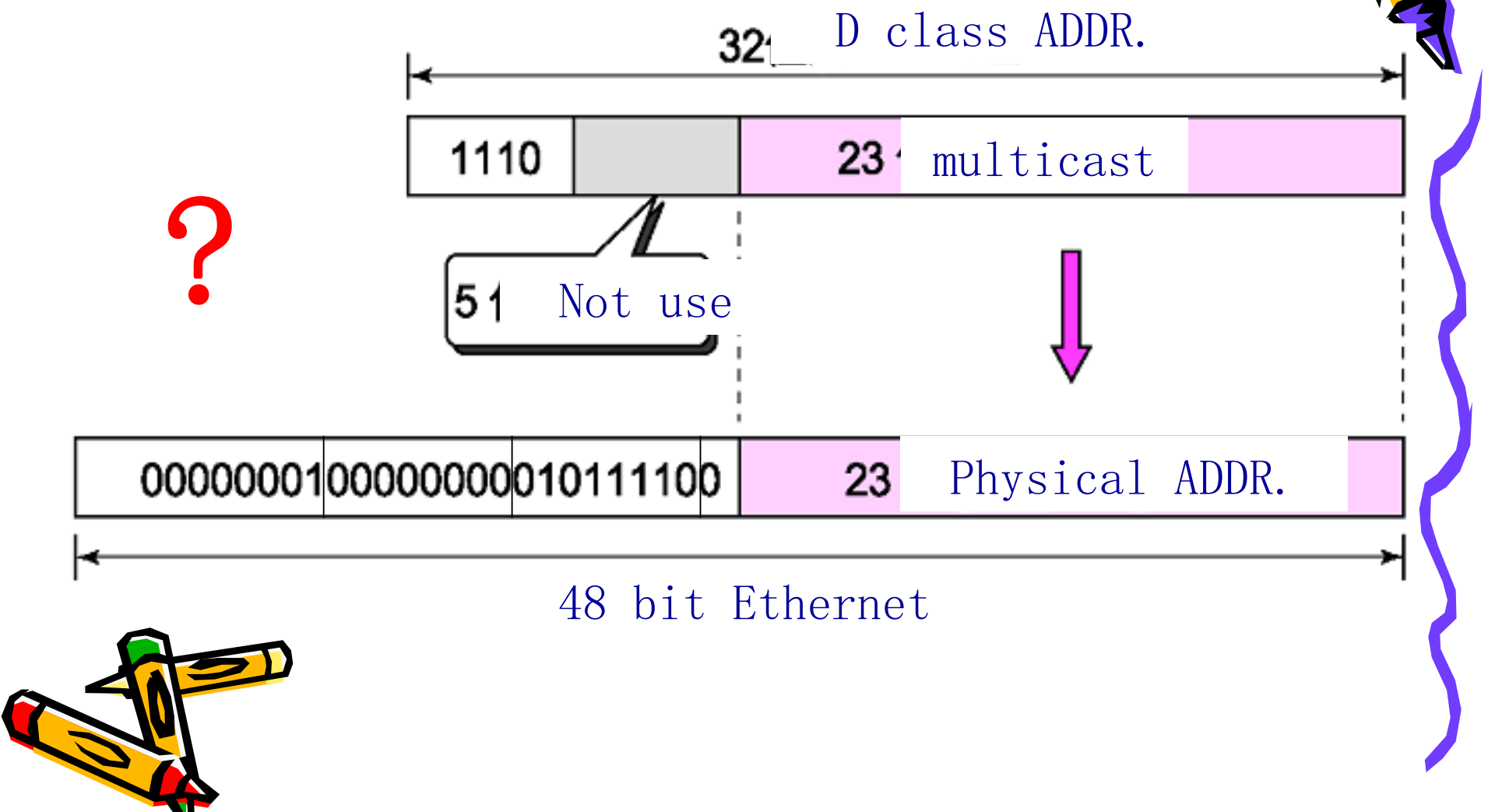
  01:00:5e:00:00:00~01:00:5e:7f:ff:ff。

IPPhysical multicast address mapping for multicast

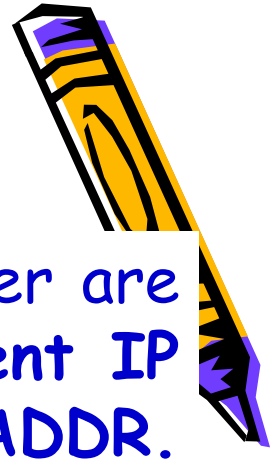
- Method of mapping class D IP multicast address to Ethernet multicast address: lower 23 bits of class D IP address to dedicated Ethernet multicast address:
- **"01.00.5E.00.00.00" 23bit,**
  - **E.g.: D class IP's multicast ADDR.224.0.0.1 is mapped to 01:00:5E:00:00:01**



Mapping between IP multicast and physical Multicast



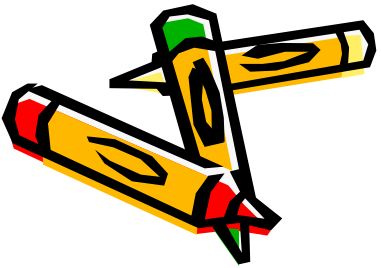
The multicast group corresponding to the Ethernet multicast address is not unique



- The highest 5 bits in the multicast group number are ignored in the mapping process. **32(2^5) different IP multicast groups are mapped to one Ethernet ADDR. E.g., Multicast Addr. 224.128.64.32（e0.80.40.20）和224.0.64.32（e0.00.40.20）?**
- **Mapped the same Ethernet ADDR. 01:00:5e:00:40:20。**
- The device driver or IP layer must filter the datagram. The network card may receive multicast data frames that the host does not want. If the network card does not provide sufficient multicast data frame filtering, the device driver must receive all multicast data frames and then filter them.

7.10 IP multicast packets are transmitted over the network

- Multicast of a single physical network is simpler
- Multicast on multiple physical networks

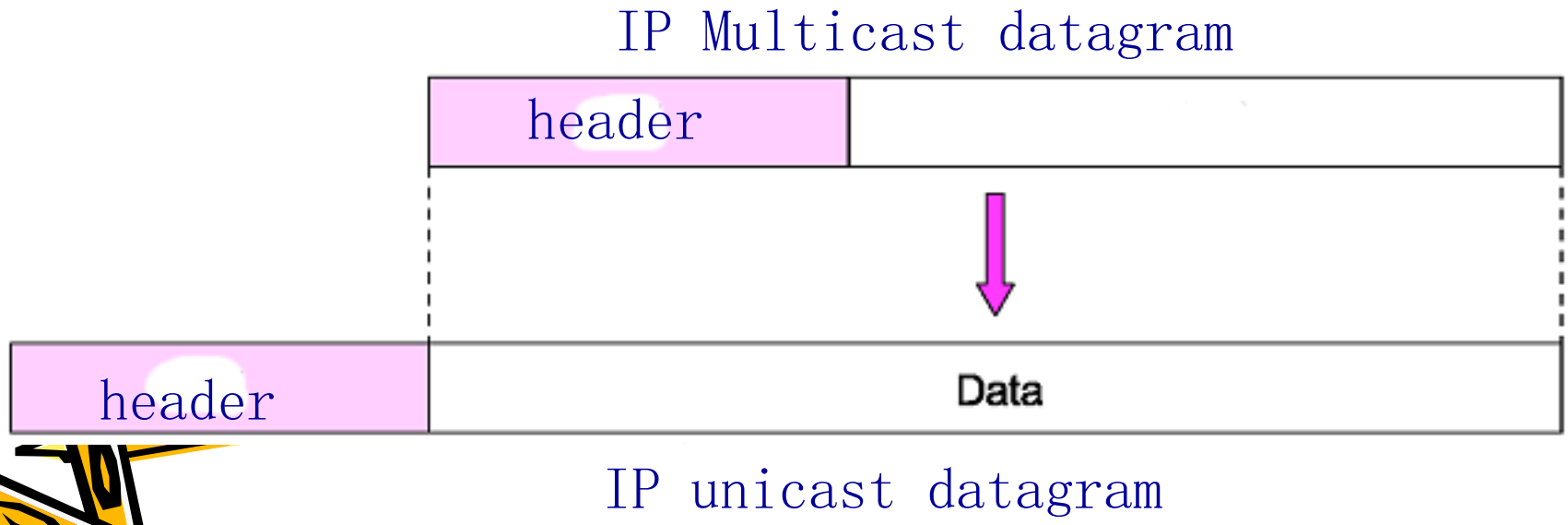


7.10 IP multicast packets are transmitted over the network

- Multicast of a single physical network is simpler.
- Multicast over multiple physical networks complexity increases when multicast is extended beyond a single physical network and multicast data needs to be forwarded through a router.
- A protocol is needed to let the multicast router know about any host that belongs to a multicast group in the network.This protocol is the Internet Group Management Protocol (IGMP).

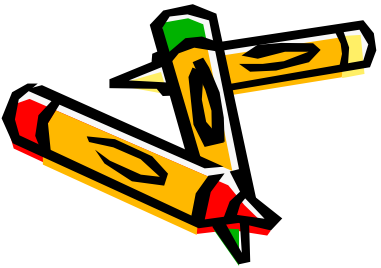
Assume don’ t support multicast…

- If the network hardware layer does not have multicast support, the tunneling technique is required.
- The multicast group is encapsulated in a unicast group, which is transformed into a multicast group at the receiving end.



7.11 Multicast domain scope

- The scope of a multicast group refers to the scope of a multicast group member. If all members are on the same physical network, the scope of the multicast group is considered restricted to one network. Similarly, if all members of a multicast group are in one organization, the scope of the multicast group is considered restricted to one organization.
- The scope of a multicast group is defined as the network set through which the multicast group will be propagated. Informally, the scope of a grouping is defined as its scope（**range**）。



TTL to control scope for multicast group

- IP uses two techniques to control the scope of multicast groups.
- The first technique uses the TTL control range for IP grouping. Set the TTL to a smaller value, limiting the IP packet forwarding distance.
- For example, for IP packets that communicate between hosts and routers on the same network, the TTL value must be 1.
- If two application processes running on one host use IP multicast communication, set TTL to 0 to prevent the grouping from leaving the host.
- extend the scope with a larger TTL value.

- The second technique of controlling the scope, known as administrative scoping, consists of some reserved address Spaces.
- These address Spaces are used only for local multicast groups within a node or organization.
- By standard, routers on the Internet cannot forward packets of other addresses in restricted Spaces.
- Therefore, in order to prevent the multicast communication between multicast group members from reaching the multicast group accidentally, the organization can assign a local scope address to the multicast group.