IGMP Snooping

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Transmitting packets on a switched LAN

- **Unicast**
  - Only on the port toward the destination

- **Broadcast**
  - Flooding (Forward on every interface but receiving one)
  - Limited amount of traffic anyway
  - No other solutions

- **Multicast**
  - Flooding
  - What about delivering 50 courses in HDTV in real-time (20Mbps each)?
  - Scalability problems
  - Possible alternative: knowing member’s location for each group
GMRP: GARP Multicast Registration Protocol

- GARP instantiation (Generic Attribute Registration Protocol)
  - GARP: meta-protocol that allows to register generic per-PC attributes in a VLAN
- Defined in IEEE 802.1D
- Allow
  - Station to communicate their membership group to the switch
  - Switch to communicate to adjacent switches from which group they must collect frames
GARP: details

- Insert or delete miscellaneous attributes in the internal entity of the device called GID
  - GID (GARP Information Distribution) is a finite state machine that defines the registration and declaration current state for each attribute’s value
  - Attribute’s registration or deletion takes place only in the port receiving the GARP PDU holding the declaration
    - Registration can take place in the ports that STP has Blocked
- GIP (GARP Information Propagation)
  - Entity responsible for information propagation between GARP Participant
    - internally in a single bridge
    - between different bridges (based on type 1 LLC)
GARP: entities and architecture
IGMP snooping: prelude

- GMRP barely used
  - Defined years ago, supported by most of switches
  - Not supported by applications/OS
  - Why should we complicate network operativeness and management with an additional protocol?

- The problem has already been solved in multicast IP
  - IGMP (Internet Group Management Protocol)
  - Multicast routing protocols

- Why should we define another mechanism?
  - Assuming that all the traffic is IPv4
  - IGMP is not a standard, but a commonly used technology
Mapping IP–MAC multicast on Ethernet

- A single multicast MAC address corresponds to $2^5$ IP addresses

```
1110 x_{27}x_{26}x_{25}x_{24}x_{23}x_{22}x_{21}x_{20}x_{19}x_{18}x_{17}x_{16} \ldots x_0
```

Bits which may generate collisions on the MAC address

```
01-00-5E
```

Multicast IP address

```
0x_{22}x_{21}x_{20}x_{19}x_{18}x_{17}x_{16} \ldots x_0
```

Multicast MAC address for IP

MAC addresses reserved by IEEE for IP multicast:
01-00-5E-00-00-00 - 01-00-5E-7F-FF-FF (addresses Global – Group)
IP multicast addresses

- Do not require IGMP
  - 224.0.0.0 - 224.0.0.255: Reserved for special “well-known” multicast addresses

- Do require IGMP
  - 224.0.1.0 - 238.255.255.255: Globally-scoped (Internet-wide) multicast addresses
  - 239.0.0.0 - 239.255.255.255: Administratively-scoped (local) multicast addresses
IGMP on traditional LAN

Host Membership Query (H,h)

Host Membership Report (G,g)

Host Membership Report (F,f)
IGMP snooping: mechanisms (1)

- Switches must be able to distinguish between “well-known” multicast addresses and dynamic addresses
  - The first ones do not require IGMP
- Sending and receiving multicast packet must be preceded by
  - A message coming from the mrouter
  - The registration to the group identified by its IP address $G$
    - Send IGMP host membership report message
    - Transmitted in level 2 multicast frame addressed to multicast MAC $g$ of IP address $G$
IGMP snooping: mechanisms (2)

- Switches snoop
  - *Host membership query* messages
    - Learn which interface is toward the mrouter
  - *Host membership report* messages
    - Learn on which interfaces are currently members of group $g$
- Update their multicast forwarding tables
- Send one HMR message on the “uplink” toward the mrouter
  - This message is not propagated on other interfaces in order to be able to discover all the listeners
IGMP snooping on a switch

<table>
<thead>
<tr>
<th>Group</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>(all)</td>
<td>1</td>
</tr>
<tr>
<td>Green</td>
<td>1,3</td>
</tr>
<tr>
<td>Blue</td>
<td>1,6</td>
</tr>
<tr>
<td>Orange</td>
<td>1,7,8</td>
</tr>
</tbody>
</table>
IGMP snooping on a switched LAN

Host Membership Query (H,h)

Host Membership Report (F,f)

Host Membership Report (I,i)

Forwarding table

Forwarding table

Forwarding table

Forwarding table

Forwarding table

Forwarding table

Forwarding table

Forwarding table

Forwarding table

Forwarding table
Forwarding of multicast packets

- Well-known addresses
  - Forwarded on all the ports (flooding)
- Dynamic addresses
  - Forwarded only to the ports set in the multicast table
Conclusions

- Not a standard, but works smoothly
  - Although it is a violation of the OSI model
    - Switches are required to recognize also part of the IP
- Be careful to IPv6 and other L3 protocols
  - In this case, the only option is to disable IGMP snooping