Broadcasting and multicasting

9강

Broadcasting

- Only in IPv4

- All broadcast IP addresses are mapped to ff:ff:ff:ff:ff:ff on the link layer
  - Limited
  - Directed
    - E.g. 10.0.0.127 with subnet mask 255.255.255.128

Broadcasting

- Try ping –b 255.255.255.255 on Linux
  - Not possible on Windows
  - Try directed broadcast (IPv4) and see what happens on Wireshark with filter “icmp”
    - Then execute “arp –a”
  - Try “ping -6 ff02::1” and see what happens on Wireshark with filter “icmpv6”

Multicasting

- More complex than broadcasting

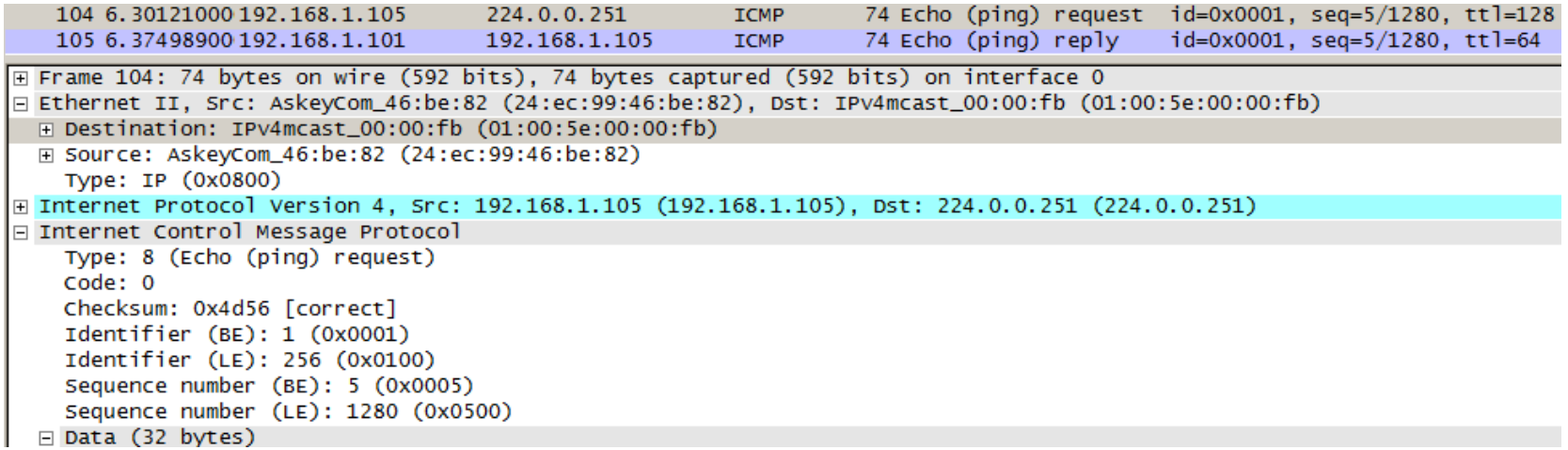
- Models
  - Any source multicast (ASM) : does not care who sent it, only destination address matters to receive a multicast packet
  - Source specific multicast (SSM) : additionally checks the source for filtering

Multicast address translation

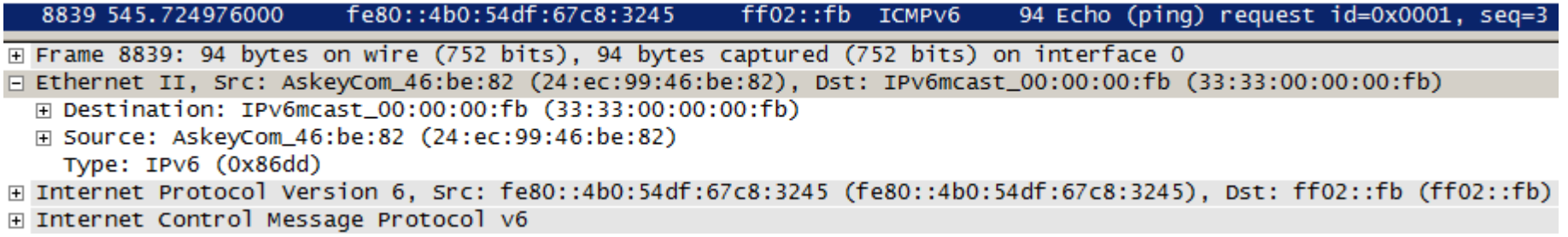
- IPv4: Figure 9-2
  - 32:1 mapping → needs additional filtering
- MAC address for IANA
  - 01:00:5e:00:00:00 ~ 01:00:5e:7f:00:00

- IPv6: Figure 9-3

IPv6 multicast address



- Fig. 9-3
- 2^{80}:1 mapping to 33:33 + lowest 32 bits of group address



Sending and receiving multicast datagrams

- Sending
  - Look at routing table (“route print -4”, or -6)
- Receiving: process
  - Joins or leaves
  - Membership is associated with an interface

Receiving multicast datagrams

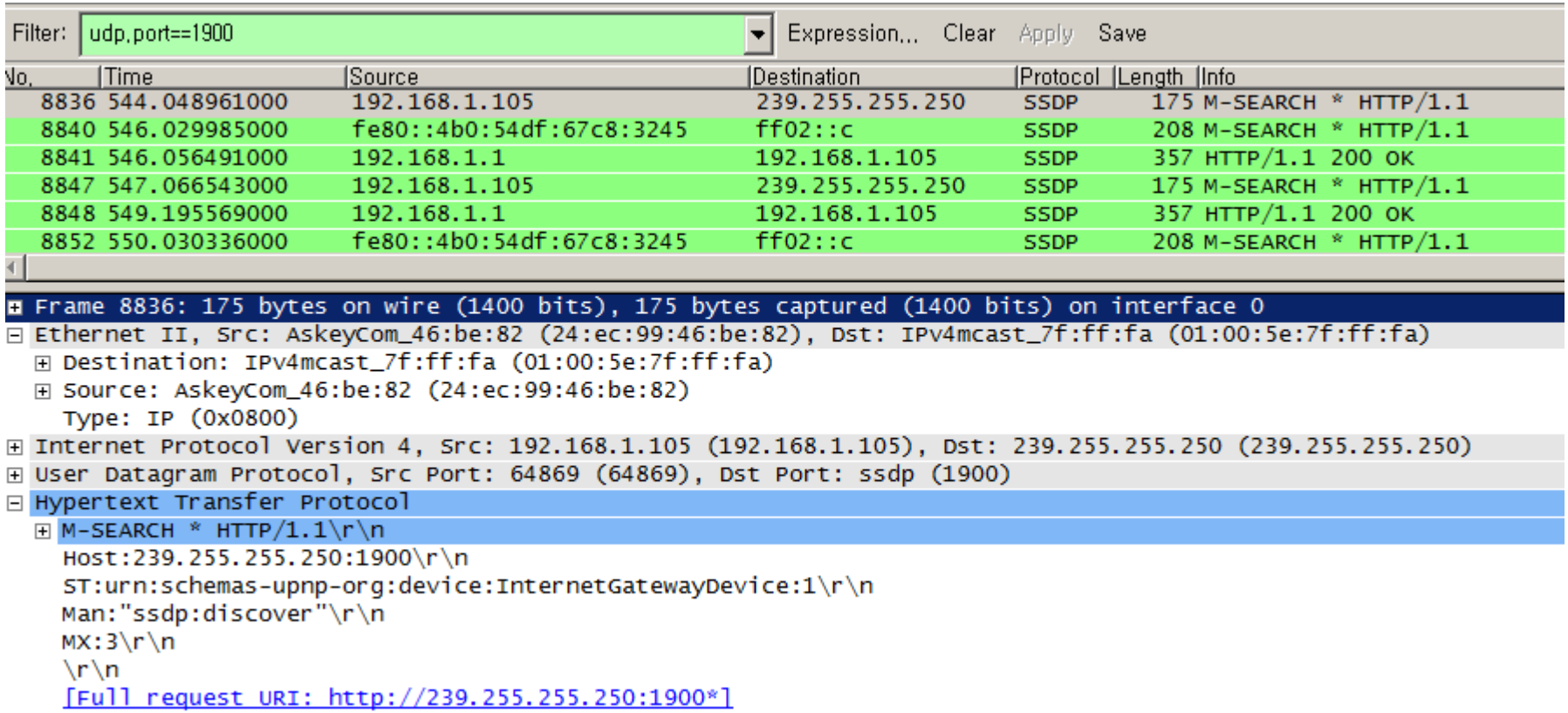
- Try “netsh interface ipv6 show joins”

```
C:\Users\hyogon>netsh interface ipv6 show joins

인터페이스 1: Loopback Pseudo-Interface 1

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   3  예    ff02::c

인터페이스 14: 무선 네트워크 연결

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   0  예    ff01::1
0                   0  예    ff02::1
0                   3  예    ff02::c
0                   1  예    ff02::1:3
0                   1  예    ff02::1:ffc8:3245

인터페이스 23: isatap.kornet

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   1  예    ff02::1:ffa8:169

인터페이스 18: 무선 네트워크 연결 2

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   0  예    ff01::1
0                   0  예    ff02::1
0                   1  예    ff02::1:ff4b:1340
```

```
C:\Users\hyogon>netsh interface ip show joins

인터페이스 1: Loopback Pseudo-Interface 1

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   3  예    239.255.255.250

인터페이스 14: 무선 네트워크 연결

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   0  예    224.0.0.1
0                   1  예    224.0.0.252
0                   1  예    224.0.0.253
0                   4  예    239.255.255.250

인터페이스 18: 무선 네트워크 연결 2

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   0  예    224.0.0.1

인터페이스 13: 로컬 영역 연결

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   0  예    224.0.0.1

인터페이스 15: Bluetooth 네트워크 연결 2

범위       참조  마지막  주소
---------  ----------  ----  ----------------------------------
0                   0  예    224.0.0.1
```

Receiving multicast datagrams

- SSDP



Host address filtering

- 32:1 (v4) or 2^{80}:1 (v6) mapping → NIC can't filter perfectly
  - Host (device driver in kernel) filtering is required
- Check is made at the interface

IGMP and MLD

- First, read the separate slide set provided on the course site: "IP multicast"
  - Discussions will proceed with the assumption that you read it

IGMP and MLD

- No IGMP in IPv6
  - ICMPv6 implements it
  - The part is called Multicast Listener Discovery (MLD)
- This happens on the first hop (edge) only!
  - Not further inside the Internet
  - TTL=1
  - IP Router Alert option

IGMP and MLD

- (Multicast) router needs to know whether or not there is a subscriber on its subnet
  - Not the number of subscribers
- Uses link layer multicast to deliver
- IGMPv2 ~ MLDv1
  - IGMPv3 ~ MLDv2

IGMP and MLD

- IGMPv1
  - Only join
  - Leave is implicit: timer expiry w/o membership refresh
- IGMPv2
  - Leave: to reduce leave latency
- IGMPv3
  - SSM support
  - Backward compatibility with v1/v2
    - E.g. reverts to earlier versions if detected
    - Suppression, message format

IGMP and MLD

- MLD
  - Uses Hop-by-Hop extension header to hold Router Alert option

IGMP and MLD

- Processing rules for
  - Group member host
    - Report changes in interest
    - Respond to periodic queries
  - Multicast router
    - Send queries to ascertain membership
      - Any group, group-specific, source-specific
    - Interact with multicast routing protocols

IGMP and MLD: member processing

- Reports contain a vector of group records
  - Group record = type (see Table 9-1) + multicast addr + list of sources
    - Source filtering: include or exclude mode
  - Fig. 9-8

Source filtering

- Include mode
  - Only sources from which traffic should be accepted
  - Leave = include(none)
- Exclude mode
  - Ones to be filtered out
  - Simple join = exclude (none)

Source filtering

- Table 9-1

- When using SSM, types 0x02 and 0x04 are not used
  - Only a single source is assumed for any group

IGMP and MLD: router processing

- Fig. 9-10 (query)

```
Internet Group Management Protocol
  IGMP Version: 3
  Type: Membership Query (0x11)
  Max Response Time: 10.0 sec (0x64)
  Header checksum: 0xec5f [correct]
  Multicast Address: 0.0.0.0 (0.0.0.0)
⊟ QRV=2 S=Do not suppress router side processing
    .... 0... = S: Do not suppress router side processing
    .... .010 = QRV: 2
  QQIC: 60
  Num Src: 0
```

- General query
  - Group address = 0
  - Sent to 224.0.0.1

```
Internet Group Management Protocol
  IGMP Version: 3
  Type: Membership Query (0x11)
  Max Response Time: 1.0 sec (0x0a)
  Header checksum: 0x06ad [correct]
  Multicast Address: 224.5.6.7 (224.5.6.7)
⊟ QRV=2 S=Do not suppress router side processing
    .... 0... = S: Do not suppress router side processing
    .... .010 = QRV: 2
  QQIC: 60
  Num Src: 0
```

- Source specific query
  - Sent to the group to be terminated

IGMP and MLD: router processing

- S indicates that they are to suppress the normal timer updates they perform upon hearing a Query

- At most QRV queries are sent, QQIC seconds apart

1	0.000000	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,
2	60.419651	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,
3	76.225901	128.59.7.10	224.0.0.22	IGMP	V3 Membership Report
9	80.896138	128.59.7.10	224.0.0.22	IGMP	V3 Membership Report
50	121.059344	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,
56	126.638186	128.59.7.10	224.0.0.22	IGMP	V3 Membership Report
94	163.550592	128.59.7.10	224.0.0.22	IGMP	V3 Membership Report
99	167.131038	128.59.7.10	224.0.0.22	IGMP	V3 Membership Report
114	181.383109	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,
175	241.855098	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,
237	302.338737	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,
243	362.354512	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,
244	423.086334	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,
245	483.318097	128.59.7.1	224.0.0.1	IGMP	V3 Membership Query,