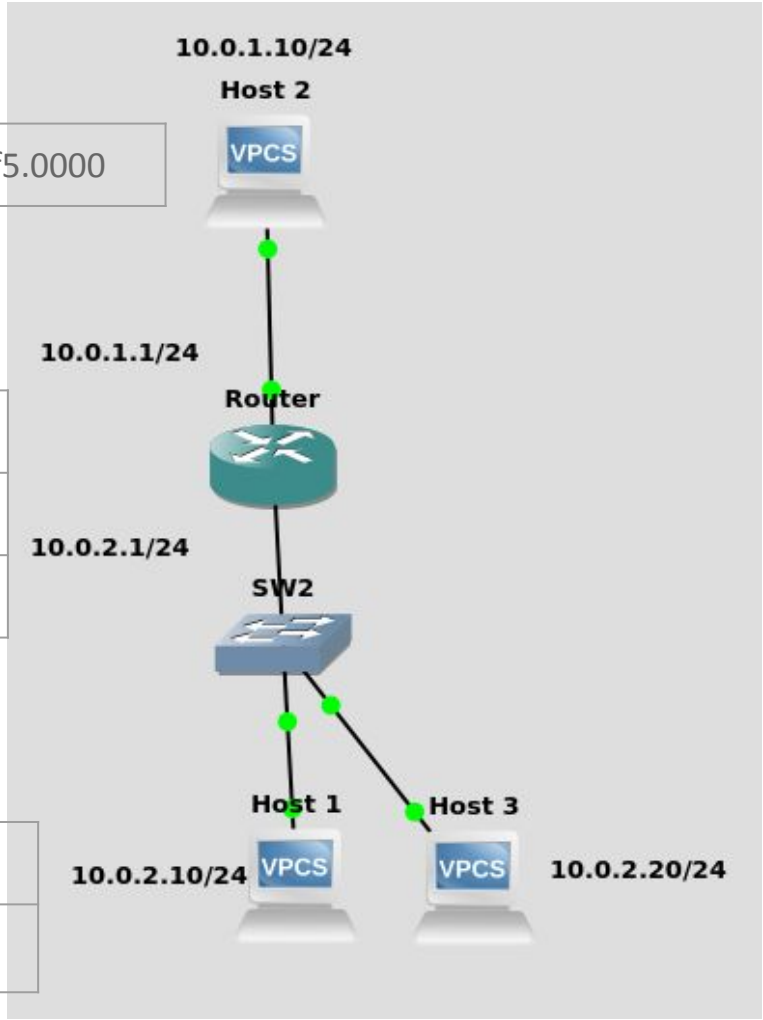
# ARP and NDP

The idea of ARP was to find the matching MAC address to an IP address, so the host could make a direct delivery to the next hop.

| | |
|---|---|
| 10.0.1.1 | c403.18f5.0000 |

| | |
|---|---|
| 10.0.1.10 | c454.443c.481f |
| 10.0.2.10 | fcf8.ae9a.c3f6 |
| 10.0.2.20 | 14da.e9c7.4a6e |

| | |
|---|---|
| 10.0.2.1 | c403.18f5.0000 |
| 10.0.2.20 | 14da.e9c7.4a6e |



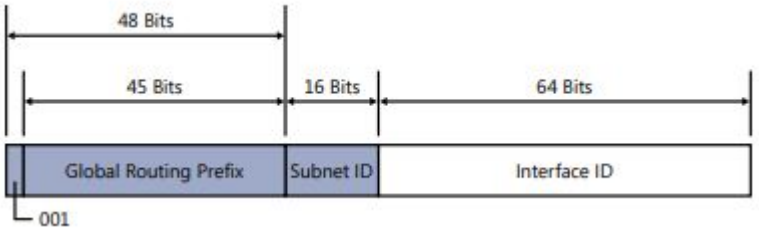
# IPv6

address space:
IPv4 (32 bits): 4.294.967.296
IPv6 (128 bits): 340.282.366.920.938.463.463.374.607.431.768.211.456

notation
hexadecimal notation is used, every value is 4 bits
Example: 2001:0DB8:0000:2F3B:02AA:00FF:FE28:9C5A
you can compress ceros to make the address even shorter:
Example: FF02:0:0:0:0:0:0:2 becomes FF02::2
Keep in mind that you can apply zero compression only once! Writing FF02::ABCD::2 is not allowed.

¿what about masks?
There are no masks in IPv6. Prefix notation is used, like this FF02::/64
Usually,
El /64 se utiliza siempre para redes que tienen hosts conectados. Si en la práctica hay un prefijo menor, se trata de una supernet.

¿y las direcciones privadas?
2001:DB8:4D1C:221A::/64 pública
FD0E:2D:BA9:221A::/64 privada



## NDP (Neighbor discovery protocol)- Funcionalidades

- IP autoconfiguration
- automatic neighbour and router discovery
- duplicate address detection
- automatic detection of dns servers
- check availability of hosts and routers
- map IP addresses with MAC addresses

## Mensajes empleados por NDP

1. Neighbor Solicitation: send to obtain information about possible neighbors or to confirm neighbor health.
2. Neighbor Advertisement: Answer to Neighbor Solicitations
3. Router Solicitation: sent to obtain information about network routers.
4. Router Advertisement: send as an answer to router solicitations and to assure periodically that routers are reachable.
5. Redirect: send if there is more than one router in the network and there is a more efficient next-hop address.

# Link local address

- starts like this FE80::/64 - the last 48 bits equal the Mac address
- Every interface has his own link local address assigned automatically.
- the link local address is NOT routable.
- important for virtual machines without real MAC address.

*Basically, it is a second, non routable IP address which can include the MAC.*

- reach all nodes in the local network segment FF02::1
- reach all routers in the local network segment FF02::2

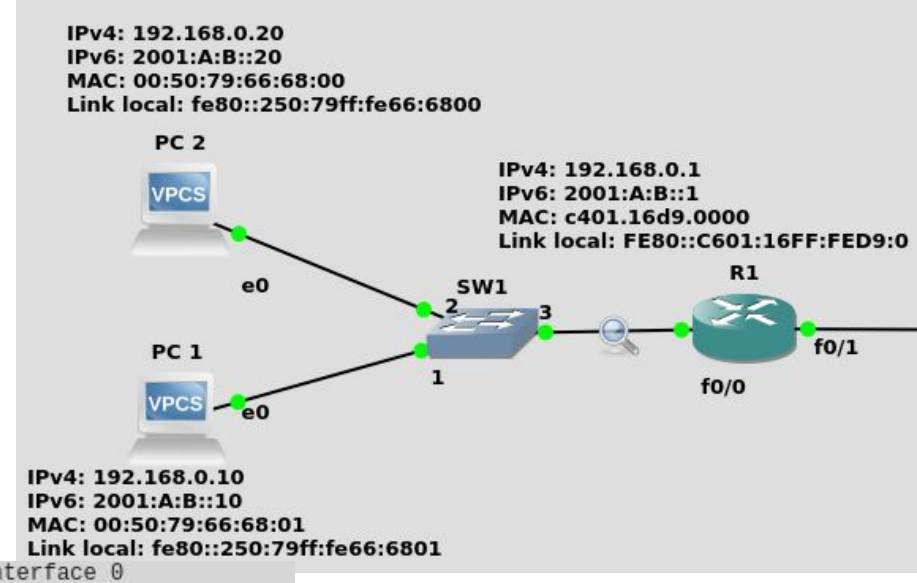
# Router solicitation

Discover routers in your local network segment. (Equivalent to router discovery in ICMPv4)

Layer 2:

Source: MAC of the source host.

Destination: MAC 33:33:00:00:00:2 multicast




```
Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits) on interface 0
Ethernet II, Src: Private_66:68:01 (00:50:79:66:68:01), Dst: IPv6mcast_02 (33:33:00:00:00:02)
  Destination: IPv6mcast_02 (33:33:00:00:00:02)
  Source: Private_66:68:01 (00:50:79:66:68:01)
  Type: IPv6 (0x86dd)
Internet Protocol Version 6, Src: ::, Dst: ff02::2
  0110 .... = Version: 6
  .... 0000 0000 .... .... .... .... .... = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)
  .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
  Payload length: 8
  Next header: ICMPv6 (58)
  Hop limit: 255
  Source: ::
  Destination: ff02::2
  [Source GeoIP: Unknown]
  [Destination GeoIP: Unknown]
Internet Control Message Protocol v6
```

Layer 3:

source: IPv6, LL, o ::

destination: ff02::2

(reach all routers in local network segment)

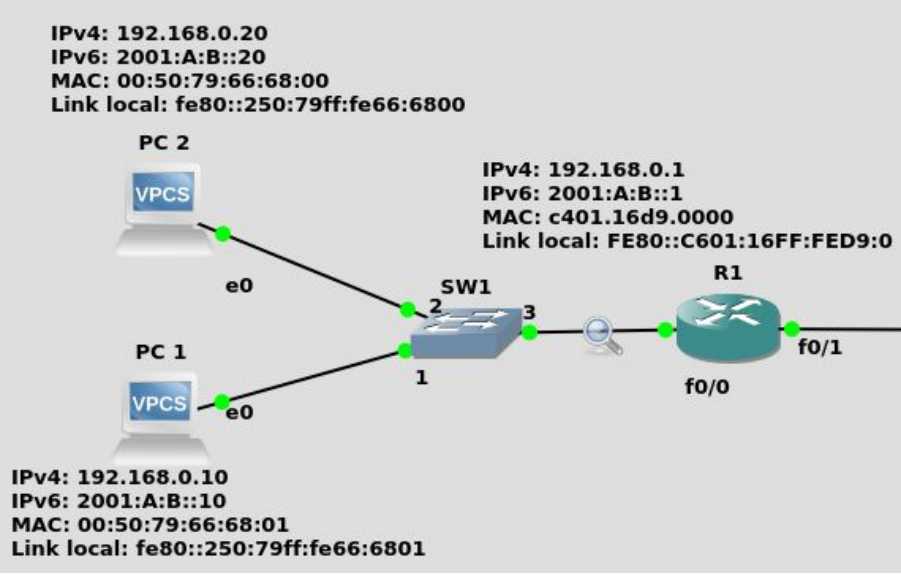
# Router Advertisement

send pseudo-periodically or as an answer to a solicitation.

layer 2

Source: the routers mac address.

Destination: MAC of the petitioner or multicast MAC to reach every node 33:33:00:00:00:01




```
▸ Frame 56: 118 bytes on wire (944 bits), 118 bytes captured (944 bits) on interface 0
▾ Ethernet II, Src: c4:01:16:d9:00:00 (c4:01:16:d9:00:00), Dst: IPv6mcast_01 (33:33:00:00:00:01)
    ▸ Destination: IPv6mcast_01 (33:33:00:00:00:01)
    ▸ Source: c4:01:16:d9:00:00 (c4:01:16:d9:00:00)
      Type: IPv6 (0x86dd)
▸ Internet Protocol Version 6, Src: fe80::c601:16ff:fed9:0, Dst: ff02::1
▸ Internet Control Message Protocol v6
```

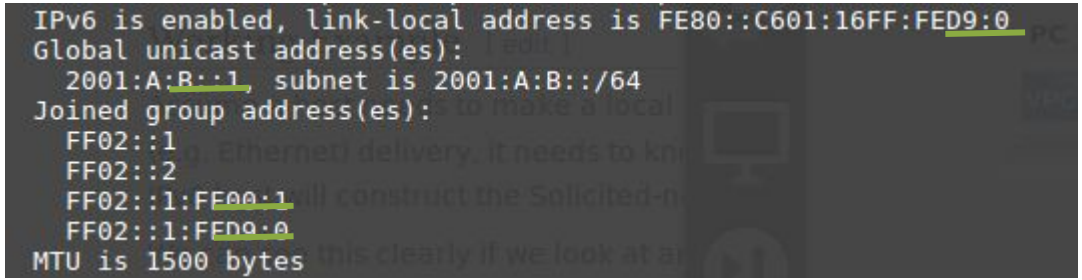
layer 3

source: IPv6/LL of the router

destination: IPv6/LL of the petitioner or reaching all nodes in the local segment.

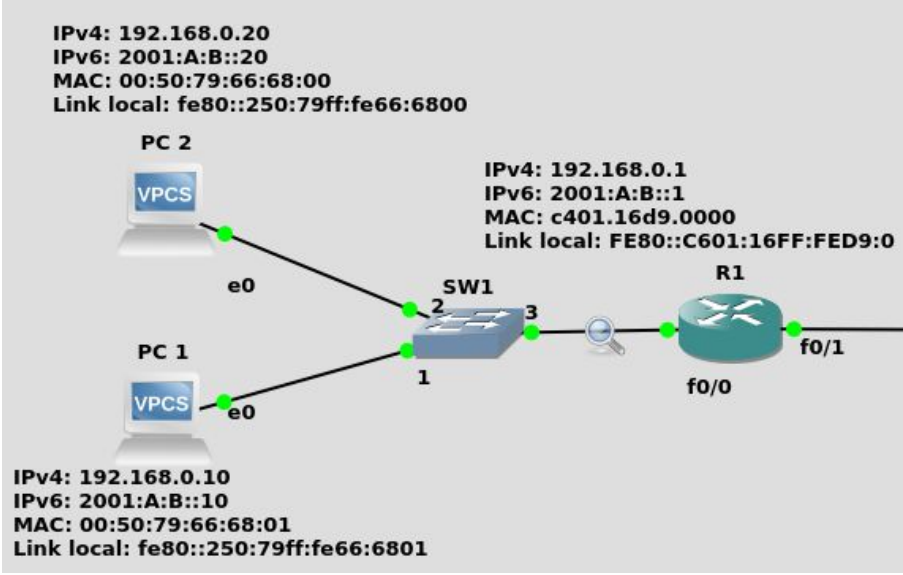
# Solicited node multicast address

Every interface does subscribe to its own multicast address group. The address is composed by the following prefix: ff02::1:ff00:0/104 and the last 24 bits of the IP address. It is very likely that every group ends up having only one member.



# Neighbor Solicitation

send to obtain a neighbors MAC or to verify he is still reachable.




<u>layer 2</u>
source: MAC of the petitioner
destination: destination MAC or multicast MAC address with the solicited node multicast address.
33:33:FF:xx:xx:xx  (Los últimos 24 bits de la IP)

<u>layer 3</u>
source: IPv6, LL ó :: of the petitioner.
destination: destination IP or solicited node multicast address of the destination.

```
▸ Frame 150: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
▾ Ethernet II, Src: Private_66:68:01 (00:50:79:66:68:01), Dst: IPv6mcast_ff:00:00:20 (33:33:ff:00:00:20)
    ▸ Destination: IPv6mcast_ff:00:00:20 (33:33:ff:00:00:20)
    ▸ Source: Private_66:68:01 (00:50:79:66:68:01)
      Type: IPv6 (0x86dd)
▸ Internet Protocol Version 6, Src: 2001:a:b::10, Dst: ff02::1:ff00:20
▸ Internet Control Message Protocol v6
```

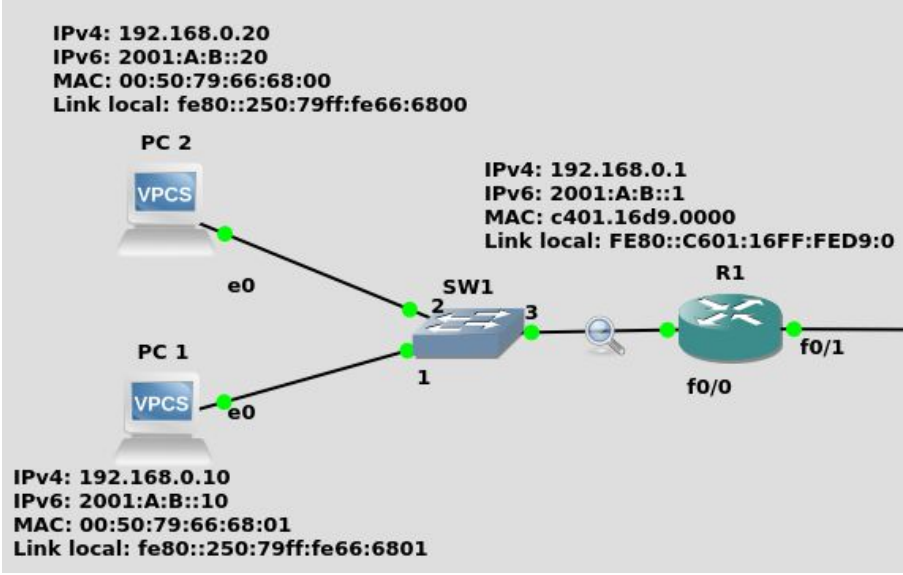
# Neighbor advertisement

send as answer to a neighbor solicitation and to inform changes about the health of neighbours.

Layer 2

source: source MAC address

destination: MAC of the petitioner, if there was no petition, a multicast address is used (33:33:00:00:00:01)




Layer 3

source: IP, LL of source

destination: IPv6, LL of the petitioner or FF02::1

```
▸ Frame 142: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
▾ Ethernet II, Src: c4:01:16:d9:00:00 (c4:01:16:d9:00:00), Dst: IPv6mcast_01 (33:33:00:00:00:01)
  ▸ Destination: IPv6mcast_01 (33:33:00:00:00:01)
  ▸ Source: c4:01:16:d9:00:00 (c4:01:16:d9:00:00)
    Type: IPv6 (0x86dd)
▸ Internet Protocol Version 6, Src: fe80::c601:16ff:fed9:0, Dst: ff02::1
▸ Internet Control Message Protocol v6
```

# Summary

| ND Message | ND Options That Might Be Included |
|---|---|
| Router Solicitation | Source Link-Layer Address option: Used to inform the router of the link-layer address of the host for the unicast Router Advertisement response. |
| Router Advertisement | Source Link-Layer Address option: Used to inform the receiving host(s) of the link-layer address of the router. |
| | Prefix Information option(s): Used to inform the receiving host(s) of on-link prefixes and whether to autoconfigure stateless addresses. |
| | MTU option: Used to inform the receiving host(s) of the IPv6 MTU of the link. |
| | Advertisement Interval option: Used to inform the receiving host how often the router (the home agent) is sending unsolicited multicast router advertisements. |
| | Home Agent Information option: Used to advertise the home agent's preference and lifetime. |
| | Route Information option(s): Used to inform the receiving host(s) of specific routes to add to a local routing table. |
| Neighbor Solicitation | Source Link-Layer Address option: Used to inform the receiving node of the link-layer address of the sender. |
| Neighbor Advertisement | Target Link-Layer Address option: Used to inform the receiving node(s) of the link-layer address corresponding to the Target Address field. |
| Redirect | Redirected Header option: Used to include all or a portion of the packet that was redirected. |
| | Target Link-Layer Address option: Used to inform the receiving node(s) of the link-layer address corresponding to the Target Address field. |

# Resources

https://en.wikipedia.org/wiki/Address_Resolution_Protocol
https://www.google.com.ar/maps?source=tldso
https://tools.ietf.org/html/rfc4861
https://es.wikipedia.org/wiki/Neighbor_Discovery
https://en.wikipedia.org/wiki/Neighbor_Discovery_Protocol
https://en.wikipedia.org/wiki/Solicited-node_multicast_address
https://www.slideshare.net/Heba_a/i-pv6-part2nd
http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/ipv6/configuration/15-2mt/ip6-15-2mt-book/ip6-neighb-disc.html
https://tools.ietf.org/html/rfc4861#section-7.2
https://www.ietf.org/proceedings/65/slides/16ng-3/sld5.htm
“Understanding IPv6”, third edition by Joseph Davies (http://www.advancedtechnologysupportinc.com/website/labfiles/network/understanding_ipv6_3rd_edition.pdf)