Couche Liaison de données

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UNIVERSITÉ DE NAMUR

Ex. 1 – ICMPv6

```
Frame 1319: 102 bytes on wire (816 bits), 102 bytes captured (816 bits) on interface 0
Ethernet II, Src: Vmware_9d:2a:f5 (00:50:56:9d:2a:f5), Dst: IPv6mcast_01 (33:33:00:00:00:01)
Internet Protocol Version 6, Src: fe80::250:56ff:fe9d:2af5, Dst: ff02::1
Internet Control Message Protocol v6
    Type: Router Advertisement (134)
    Code: 0
    Checksum: 0x46e7 [correct]
    Cur hop limit: 64
    Flags: 0x00
    Router lifetime (s): 1800
    Reachable time (ms): 0
    Retrans timer (ms): 0
    ICMPv6 Option (Prefix information : 2001:6a8:3900:20::/64)
        Type: Prefix information (3)
        Length: 4 (32 bytes)
        Prefix Length: 64
        Flag: 0xc0
        Valid Lifetime: 2592000
        Preferred Lifetime: 604800
        Reserved
        Prefix: 2001:6a8:3900:20::
```

```
Frame 1416: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
Ethernet II, Src: Dell_ff:24:ce (d4:be:d9:ff:24:ce), Dst: Vmware_9d:2a:f5 (00:50:56:9d:2a:f5)
Internet Protocol Version 6, Src: fe80::d6be:d9ff:feff:24ce, Dst: 2001:6a8:3900:20::1
Internet Control Message Protocol v6
    Type: Neighbor Solicitation (135)
    Code: 0
    Checksum: 0x1175 [correct]
    Reserved: 00000000
    Target Address: 2001:6a8:3900:20::1
    ICMPv6 Option (Source link-layer address : d4:be:d9:ff:24:ce)
        Type: Source link-layer address (1)
        Length: 1 (8 bytes)
        Link-layer address: Dell_ff:24:ce (d4:be:d9:ff:24:ce)
```

```
Frame 1417: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0
Ethernet II, Src: Vmware_9d:2a:f5 (00:50:56:9d:2a:f5), Dst: Dell_ff:24:ce (d4:be:d9:ff:24:ce)
Internet Protocol Version 6, Src: 2001:6a8:3900:20::1, Dst: fe80::d6be:d9ff:feff:24ce
Internet Control Message Protocol v6
    Type: Neighbor Advertisement (136)
    Code: 0
    Checksum: 0x250a [correct]
    Flags: 0xc0000000
    Target Address: 2001:6a8:3900:20::1
```

```
Frame 1422: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
Ethernet II, Src: Vmware_9d:2a:f5 (00:50:56:9d:2a:f5), Dst: Dell_ff:24:ce (d4:be:d9:ff:24:ce)
Internet Protocol Version 6, Src: fe80::250:56ff:fe9d:2af5, Dst: 2001:6a8:3900:20:226::2a
Internet Control Message Protocol v6
    Type: Neighbor Solicitation (135)
    Code: 0
    Checksum: 0xb02b [correct]
    Reserved: 00000000
    Target Address: 2001:6a8:3900:20:226::2a
    ICMPv6 Option (Source link-layer address : 00:50:56:9d:2a:f5)
        Type: Source link-layer address (1)
        Length: 1 (8 bytes)
        Link-layer address: Vmware_9d:2a:f5 (00:50:56:9d:2a:f5)
```

```
Frame 1423: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0
Ethernet II, Src: Dell_ff:24:ce (d4:be:d9:ff:24:ce), Dst: Vmware_9d:2a:f5 (00:50:56:9d:2a:f5)
Internet Protocol Version 6, Src: 2001:6a8:3900:20:226::2a, Dst: fe80::250:56ff:fe9d:2af5
Internet Control Message Protocol v6
    Type: Neighbor Advertisement (136)
    Code: 0
    Checksum: 0x7216 [correct]
    Flags: 0xc0000000
    Target Address: 2001:6a8:3900:20:226::2a
```

Ex. 1 – ICMPv6

FF02::1/128 **All nodes multicast group : Toutes les interfaces IPv6 actives sur le lien local.**

L'adresse MAC de destination commence toujours par **33:33 + l'identifiant du groupe** (les 32 derniers bits de l'adresse mac) -> 33:33:**00:00:00:01** = ff02::**1**

```
Frame 1319: 102 bytes on wire (816 bits), 102 bytes captured (816 bits) on interface 0
Ethernet II, Src: Vmware_9d:2a:f5 (00:50:56:9d:2a:f5), Dst: IPv6mcast_01 =ff02::1
(33:33:00:00:00:01)
```

Adresse de lien local : adresse privée (définie sur le lien uniquement) basée sur **EUI64**
-> **fe80**::0250:56**ff**:**fe**9d:2af5 (Inversion du 7ème bit)

```
Internet Protocol Version 6, Src: fe80::250:56ff:fe9d:2af5, Dst: ff02::1
Internet Control Message Protocol v6
    Type: Router Advertisement (134)
    Code: 0
    Checksum: 0x46e7 [correct]
    Cur hop limit: 64
    Flags: 0x00
    Router lifetime (s): 1800
    Reachable time (ms): 0
    Retrans timer (ms): 0
    ICMPv6 Option (Prefix information : 2001:6a8:3900:20::/64)
        Type: Prefix information (3)
        Length: 4 (32 bytes)
        Prefix Length: 64
        Flag: 0xc0
        Valid Lifetime: 2592000
        Preferred Lifetime: 604800
        Reserved
        Prefix: 2001:6a8:3900:20::
```

Le paquet RA informe les hôtes du même segment réseau concernant:

- **La route par défaut**.
- **SLAAC** (Stateless Address Auto Configuration) (**M=0** et **O=0**) :
  - Options : préfixe IPv6, MTU…
- La présence d'un service **DHCPv6 sans état** (**M=0** et **O=1**).
- La présence d'un service **DHCPv6 avec état** (**M=1** et **O=1**).

Phase d'auto-configuration (SLAAC) :
Annonce du préfixe global par le routeur

Ex. 1 – ICMPv6

Neighbor Solicitation permet à un nœud de :

- **déterminer l'adresse de lien local de son destinataire** (=Ipv4 ARP).
- vérifier si le **destinataire est accessible**
- Vérifier, durant la phase d'auto-configuration de l'adresse ipv6, si cette dernière est **déjà utilisée** par ses voisins.

```
Frame 1416: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
Ethernet II, Src: Dell_ff:24:ce (d4:be:d9:ff:24:ce), Dst: Vmware_9d:2a:f5
(00:50:56:9d:2a:f5)
Internet Protocol Version 6, Src: fe80::d6be:d9ff:feff:24ce, Dst: 2001:6a8:3900:20::1
Internet Control Message Protocol v6
    Type: Neighbor Solicitation (135)
    Code: 0
    Checksum: 0x1175 [correct]
    Reserved: 00000000
    Target Address: 2001:6a8:3900:20::1
    ICMPv6 Option (Source link-layer address : d4:be:d9:ff:24:ce)
        Type: Source link-layer address (1)
        Length: 1 (8 bytes)
        Link-layer address: Dell_ff:24:ce (d4:be:d9:ff:24:ce)
```

Adresse globale du routeur VmWare

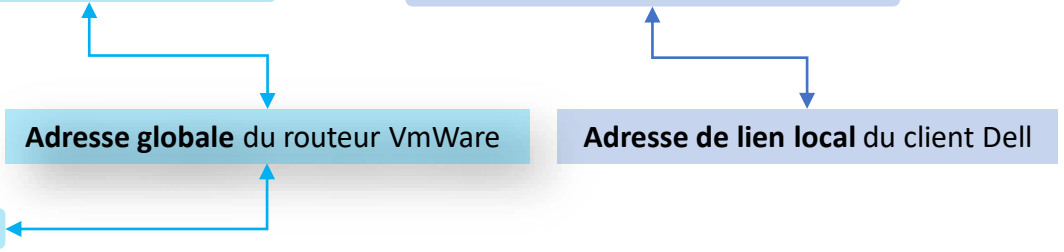
Adresse de lien local du client Dell

Résolution d'adresse (± ARP):

Requête (NS) demandant l'adresse MAC correspondant à l'adresse 2001:6a8:3900:20::1 ?

Ex. 1 – ICMPv6

```
Frame 1417: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0
Ethernet II, Src: Vmware_9d:2a:f5 (00:50:56:9d:2a:f5), Dst: Dell_ff:24:ce
(d4:be:d9:ff:24:ce)
Internet Protocol Version 6, Src: 2001:6a8:3900:20::1, Dst: fe80::d6be:d9ff:feff:24ce
Internet Control Message Protocol v6
    Type: Neighbor Advertisement (136)
    Code: 0
    Checksum: 0x250a [correct]
    Flags: 0xc0000000
    Target Address: 2001:6a8:3900:20::1
```



Résolution d'adresse (± ARP):
Réponse (NA) de l'interface possédant l'adresse globale 2001:6a8:3900:20::1

Ex. 2 – UDP / ICMPv4

```
Frame 45: 73 bytes on wire (584 bits), 73 bytes captured (584 bits) on interface 0
Ethernet II, Src: Dell_ff:24:ce (d4:be:d9:ff:24:ce), Dst: HewlettP_63:6d:2d (b8:af:67:63:6d:2d)
Internet Protocol Version 4, Src: 138.48.32.150, Dst: 138.48.4.10
User Datagram Protocol, Src Port: 56559 (56559), Dst Port: domain (53)
Domain Name System (query): Standard query 0xd203 A www.unamur.be

Frame 47: 246 bytes on wire (1968 bits), 246 bytes captured (1968 bits) on interface 0
Ethernet II, Src: HewlettP_63:6d:2d (b8:af:67:63:6d:2d), Dst: Dell_ff:24:ce (d4:be:d9:ff:24:ce)
Internet Protocol Version 4, Src: 138.48.4.10, Dst: 138.48.32.150
User Datagram Protocol, Src Port: domain (53), Dst Port: 56559 (56559)
Domain Name System (response): Standard query response 0xd203 A www.unamur.be A 138.48.4.201 NS ns2.belnet.be NS ns2.unamur.be NS
ns6.unamur.be NS ns1.belnet.be NS ns1.unamur.be A 138.48.2.17 A 138.48.2.18 AAAA 2001:6a8:3900:30::7e:2a

Frame 49: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: Dell_ff:24:ce (d4:be:d9:ff:24:ce), Dst: HewlettP_63:6d:2d (b8:af:67:63:6d:2d)
Internet Protocol Version 4, Src: 138.48.32.150, Dst: 138.48.4.201
Internet Control Message Protocol
    Type: 8 (Echo (ping) request)
    Code: 0
    Checksum: 0xb507 [correct]
    Identifier (BE): 32607 (0x7f5f)
    Identifier (LE): 24447 (0x5f7f)
    Sequence number (BE): 1 (0x0001)
    Sequence number (LE): 256 (0x0100)
    Timestamp from icmp data: Dec 12, 2016 09:17:49.000000000 CET

Frame 50: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: HewlettP_63:6d:2d (b8:af:67:63:6d:2d), Dst: Dell_ff:24:ce (d4:be:d9:ff:24:ce)
Internet Protocol Version 4, Src: 138.48.4.201, Dst: 138.48.32.150
Internet Control Message Protocol
    Type: 0 (Echo (ping) reply)
    Code: 0
    Checksum: 0xbd07 [correct]
    Identifier (BE): 32607 (0x7f5f)
    Identifier (LE): 24447 (0x5f7f)
    Sequence number (BE): 1 (0x0001)
    Sequence number (LE): 256 (0x0100)
    Timestamp from icmp data: Dec 12, 2016 09:17:49.000000000 CET
    Data (48 bytes)
```

Ex. 2 – UDP

```
Frame 45: 73 bytes on wire (584 bits), 73 bytes captured (584 bits) on interface 0
Ethernet II, Src: Dell_ff:24:ce (d4:be:d9:ff:24:ce), Dst: HewlettP_63:6d:2d
(b8:af:67:63:6d:2d)
Internet Protocol Version 4, Src: 138.48.32.150, Dst: 138.48.4.10
User Datagram Protocol, Src Port: 56559 (56559), Dst Port: domain (53)
Domain Name System (query): Standard query 0xd203 A www.unamur.be
```

Requête DNS (std : UDP) :
Demande de l'adresse IPv4 associée au nom DNS "www.unamur.be" au NS 138.48.4.10

```
Frame 47: 246 bytes on wire (1968 bits), 246 bytes captured (1968 bits) on interface 0
Ethernet II, Src: HewlettP_63:6d:2d (b8:af:67:63:6d:2d), Dst: Dell_ff:24:ce
(d4:be:d9:ff:24:ce)
Internet Protocol Version 4, Src: 138.48.4.10, Dst: 138.48.32.150
User Datagram Protocol, Src Port: domain (53), Dst Port: 56559 (56559)
Domain Name System (response): Standard query response 0xd203 A www.unamur.be A
138.48.4.201 NS ns2.belnet.be NS ns2.unamur.be NS ns6.unamur.be NS ns1.belnet.be NS
ns1.unamur.be A 138.48.2.17 A 138.48.2.18 AAAA 2001:6a8:3900:30::7e:2a
```

Requête DNS (std UDP) :
Réponse du NS contenant l'adresse IPv4 et l'adresse IPv6 associée au nom DNS "www.unamur.be"

Ex. 2 – ICMPv4

```
Frame 49: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: Dell_ff:24:ce (d4:be:d9:ff:24:ce), Dst: HewlettP_63:6d:2d
(b8:af:67:63:6d:2d)
Internet Protocol Version 4, Src: 138.48.32.150, Dst: 138.48.4.201
Internet Control Message Protocol
    Type: 8 (Echo (ping) request)
    Code: 0
    Checksum: 0xb507 [correct]
    Identifier (BE): 32607 (0x7f5f)
    Identifier (LE): 24447 (0x5f7f)
    Sequence number (BE): 1 (0x0001)
    Sequence number (LE): 256 (0x0100)
    Timestamp from icmp data: Dec 12, 2016 09:17:49.000000000 CET
```

Requête Ping (echo request) :
Emetteur : 138.48.32.150
Destinataire : 138.48.4.201

Type	Description
0	Echo reply
3	Destination inaccessible
4	Source quench (étouffée)
5	Redirection nécessaire
8	**Demande d'écho**
11	TTL expiré
12	Problème de paramètre
13	Requête de timestamp (horodateur)
14	Réponse de timestamp (horodateur)

Ex. 2 – ICMPv4

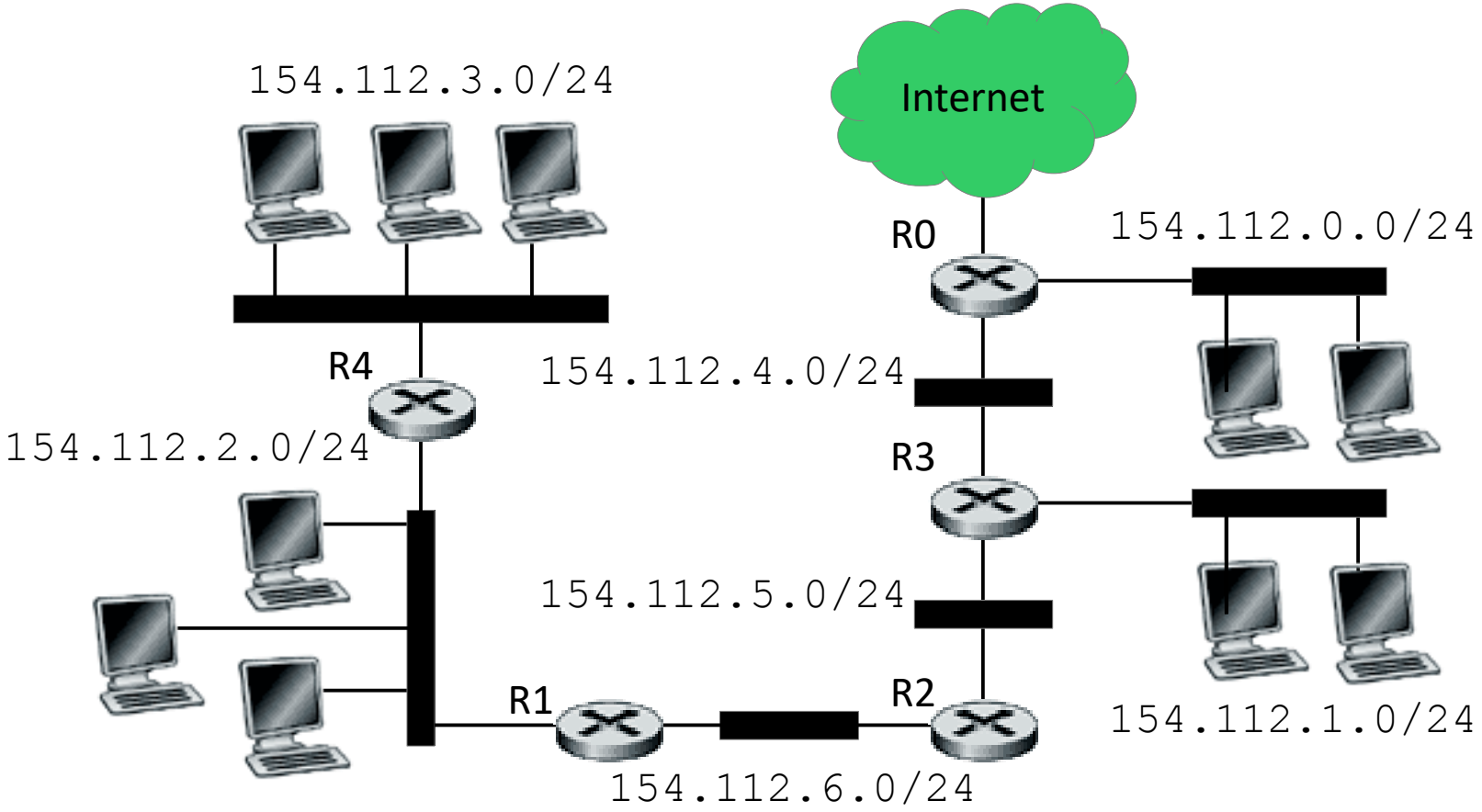
```
Frame 50: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: HewlettP_63:6d:2d (b8:af:67:63:6d:2d), Dst: Dell_ff:24:ce
(d4:be:d9:ff:24:ce)
Internet Protocol Version 4, Src: 138.48.4.201, Dst: 138.48.32.150
Internet Control Message Protocol
    Type: 0 (Echo (ping) reply)
    Code: 0
    Checksum: 0xbd07 [correct]
    Identifier (BE): 32607 (0x7f5f)
    Identifier (LE): 24447 (0x5f7f)
    Sequence number (BE): 1 (0x0001)
    Sequence number (LE): 256 (0x0100)
    Timestamp from icmp data: Dec 12, 2016 09:17:49.000000000 CET
    Data (48 bytes)
```

Requête Ping (echo reply) :
Emetteur : 138.48.4.201
Destinataire : 138.48.32.150
Réponse de la requête précédente.

Type	Description
0	**Echo reply**
3	Destination inaccessible
4	Source quench (étouffée)
5	Redirection nécessaire
8	Demande d'écho
11	TTL expiré
12	Problème de paramètre
13	Requête de timestamp (horodateur)
14	Réponse de timestamp (horodateur)

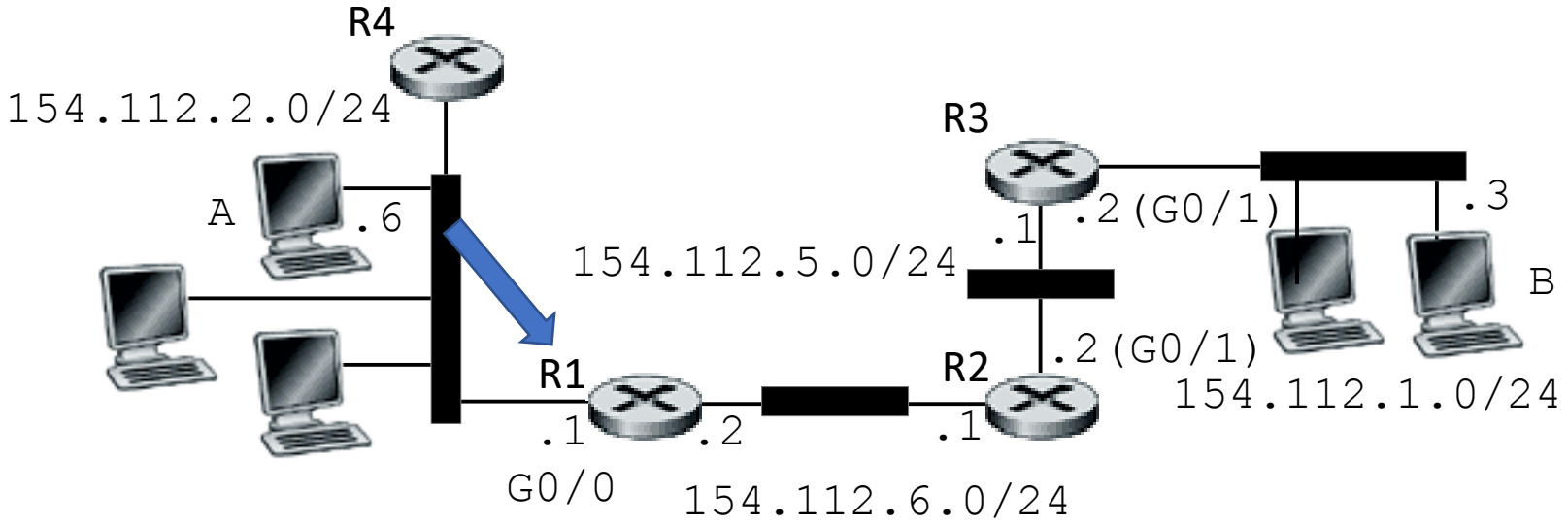
Ex. 3 – *Forwarding*

Supposons que le terminal 154.112.2.6 veuille émettre un paquet IP vers la machine d'adresse IP 154.112.1.3. On suppose que toutes les caches ARP sont vides. Indiquez quelles sont les trames Ethernet échangées avec, pour chaque trame, les adresses Ethernet source et destination et, pour les trames qui contiennent un paquet IP, les adresses IP source et destination.



Ex. 3 – *Forwarding*

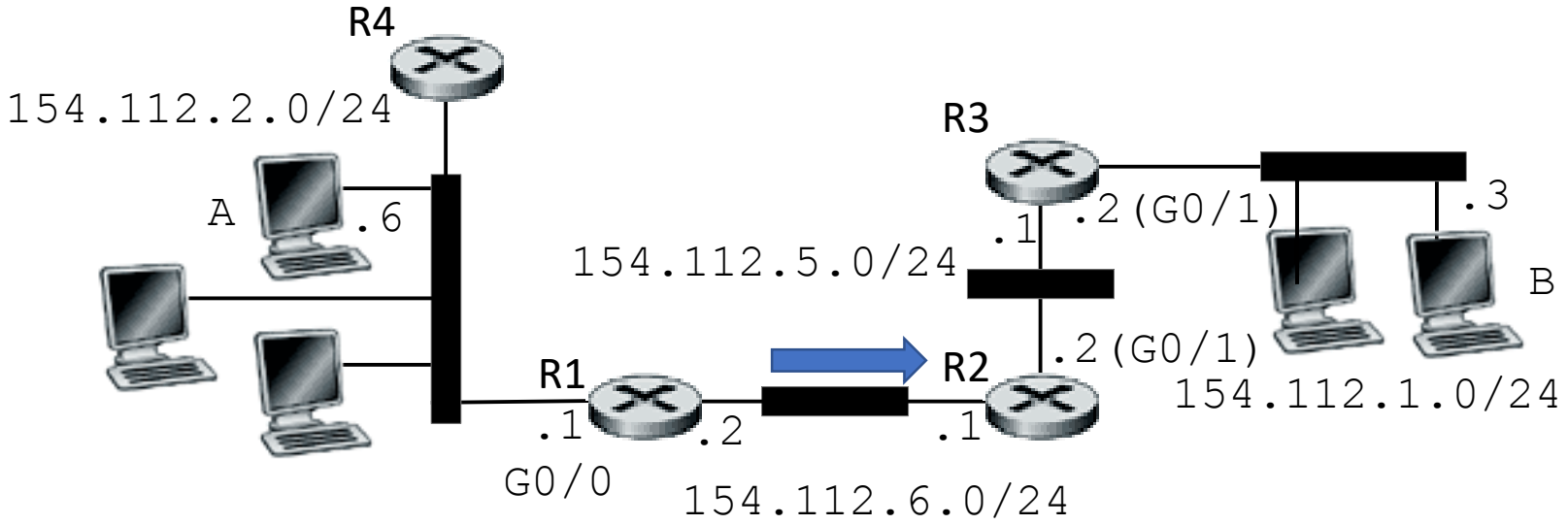
Supposons que le terminal 154.112.2.6 veuille émettre un paquet IP vers la machine d'adresse IP 154.112.1.3. On suppose que toutes les caches ARP sont vides. Indiquez quelles sont les trames Ethernet échangées avec, pour chaque trame, les adresses Ethernet source et destination et, pour les trames qui contiennent un paquet IP, les adresses IP source et destination.



	L2 source	L2 Destination	L3 source	L3 Destination
Requête ARP de A	mac_A	ff:ff:ff:ff:ff:ff	Who has 154.112.2.1 (passerelle)	
Réponse de R1 (G0/0)	mac_R1_G0/0	mac_A	MAC de R1_G0/0	
Emission du paquet depuis A	mac_A	mac_R1_G0/0	IP_A	IP_B
R1_G0/0 vers R1_G0/1	Désencapsulation L2 et L3 -> nouvelles entêtes L2 et L3 (TTL-1, nv CRC)			

Ex. 3 – *Forwarding*

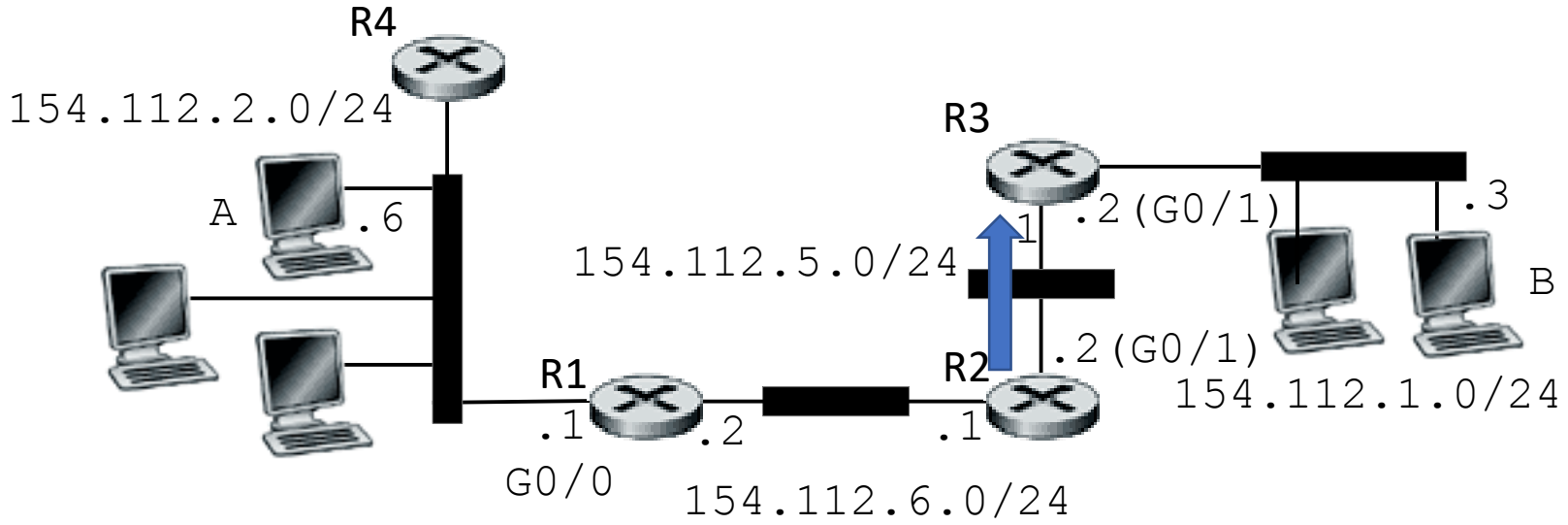
Supposons que le terminal 154.112.2.6 veuille émettre un paquet IP vers la machine d'adresse IP 154.112.1.3. On suppose que toutes les caches ARP sont vides. Indiquez quelles sont les trames Ethernet échangées avec, pour chaque trame, les adresses Ethernet source et destination et, pour les trames qui contiennent un paquet IP, les adresses IP source et destination.



	L2 source	L2 Destination	L3 source	L3 Destination
Requête ARP de R1 (G0/1)	mac_R1_G0/1	ff:ff:ff:ff:ff:ff	Who has 154.112.6.1 (passerelle)	
Réponse de R2 (G0/0)	mac_R2_G0/0	mac_R1_G0/1	MAC de R2_G0/0	
Emission du paquet depuis R1 (G0/1)	mac_R1_G0/1	mac_R2_G0/0	IP_A	IP_B
R2_G0/0 vers R2_G0/1	Désencapsulation L2 et L3 -> nouvelles entêtes L2 et L3 (TTL-1, nv CRC)			

Ex. 3 – *Forwarding*

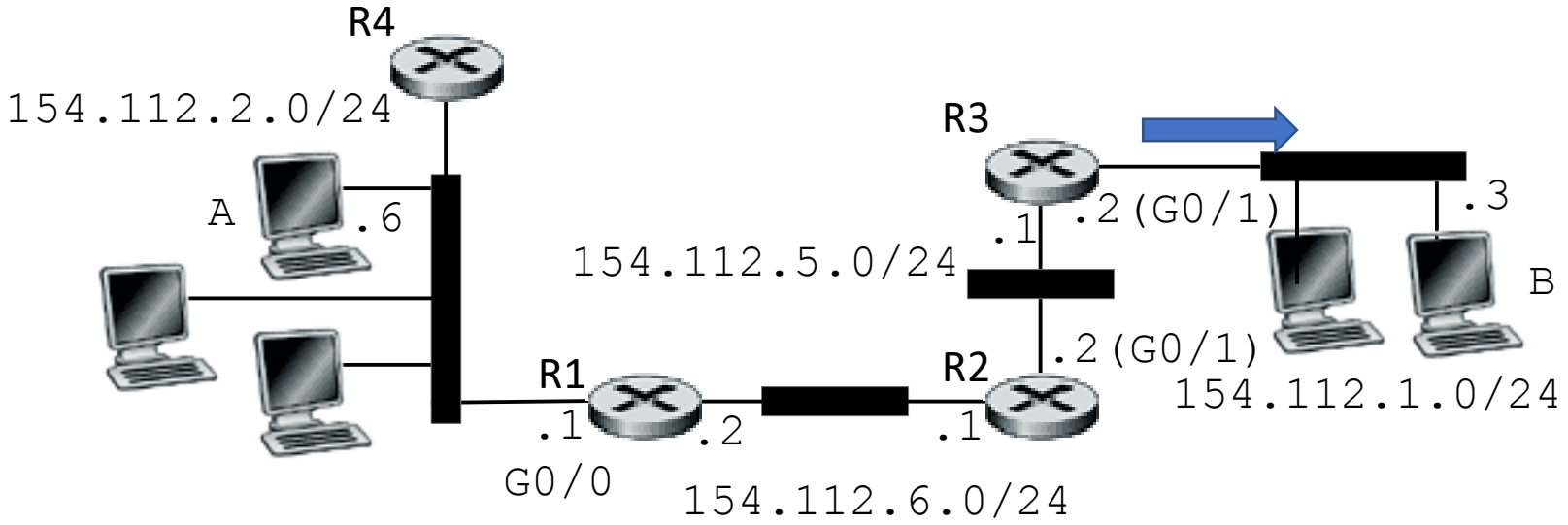
Supposons que le terminal 154.112.2.6 veuille émettre un paquet IP vers la machine d'adresse IP 154.112.1.3. On suppose que toutes les caches ARP sont vides. Indiquez quelles sont les trames Ethernet échangées avec, pour chaque trame, les adresses Ethernet source et destination et, pour les trames qui contiennent un paquet IP, les adresses IP source et destination.



	L2 source	L2 Destination	L3 source	L3 Destination
Requête ARP de R2 (G0/1)	mac_R2_G0/1	ff:ff:ff:ff:ff:ff	Who has 154.112.5.1 (passerelle)	
Réponse de R3 (G0/0)	mac_R3_G0/0	mac_R2_G0/1	MAC de R3_G0/0	
Emission du paquet depuis R2 (G0/1)	mac_R2_G0/1	mac_R3_G0/0	IP_A	IP_B
R3_G0/0 vers R3_G0/1	Désencapsulation L2 et L3 -> nouvelles entêtes L2 et L3 (TTL-1, nv CRC)			

Ex. 3 – *Forwarding*

Supposons que le terminal 154.112.2.6 veuille émettre un paquet IP vers la machine d'adresse IP 154.112.1.3. On suppose que toutes les caches ARP sont vides. Indiquez quelles sont les trames Ethernet échangées avec, pour chaque trame, les adresses Ethernet source et destination et, pour les trames qui contiennent un paquet IP, les adresses IP source et destination.



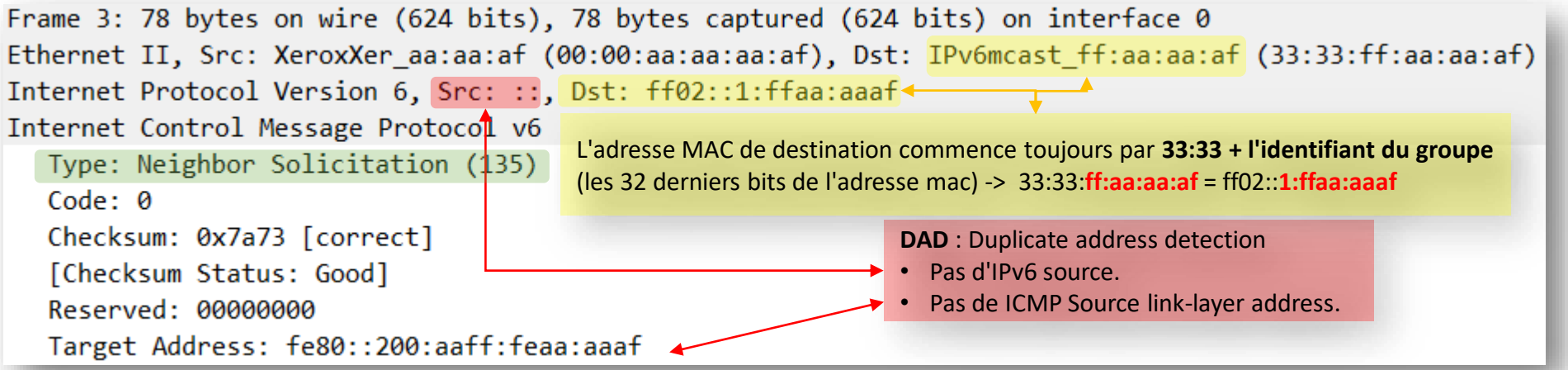
	L2 source	L2 Destination	L3 source	L3 Destination
Requête ARP de R3 (G0/1)	mac_R3_G0/1	ff:ff:ff:ff:ff:ff	Who has 154.112.1.3 (destination)	
Réponse de B	mac_B	mac_R3_G0/1	MAC de B	
Emission du paquet depuis R3 (G0/1)	mac_R3_G0/1	mac_B	IP_A	IP_B

IPv6 - Address Resolution and DAD

No.	Time	Source	Destination	Protocol	Length	Info
3	3.275861	::	ff02::1:ffaa:aaaf	ICMPv6	78	Neighbor Solicitation for fe80::200:aaff:feaa:aaaf
4	4.267246	fe80::200:aaff:feaa…	ff02::1	ICMPv6	86	Neighbor Advertisement fe80::200:aaff:feaa:aaaf (ovr) is at 00:00:aa:aa:aa:af
5	4.277320	fe80::200:aaff:feaa…	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
6	5.541249	fe80::200:aaff:feaa…	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
8	7.271471	fe80::200:aaff:feaa…	ff02::2	ICMPv6	70	Router Solicitation from 00:00:aa:aa:aa:af
9	7.281520	fe80::200:11ff:fe11…	ff02::1	ICMPv6	118	Router Advertisement from 00:00:11:11:11:11
10	7.291614	::	ff02::1:ffaa:aaaf	ICMPv6	78	Neighbor Solicitation for 2001:db8:cafe:0:200:aaff:feaa:aaaf
12	8.303003	2001:db8:cafe:0:200…	ff02::1	ICMPv6	86	Neighbor Advertisement 2001:db8:cafe:0:200:aaff:feaa:aaaf (ovr) is at 00:00:aa:aa:aa:af

Trame 3 : **DAD**, interrogation du lien afin d'assurer l'unicité de l'adresse de lien local "fe80::200:aaff:feaa:aaaf". Sans réponse du lien, A assigne sa nouvelle adresse à son interface.
Trame 4 : **NA**, annonce de l'adresse de lien local "fe80::200:aaff:feaa:aaaf".
Trame 5-6 : message MLDv2 demandant l'exclusion du **Solicited Node multicast** "ff02::1:ffaa:aaaf".
Trame 8 : **RS**, demande d'information aux routeurs du lien local.
Trame 9 : **RA**, annonce du préfix et du MTU par le routeur.
Trame 10 : **DAD**, interrogation du lien afin d'assurer l'unicité de l'adresse unicast globale "2001:db8:cafe:0:200:aaff:feaa:aaaf". Sans réponse du lien, A assigne sa nouvelle adresse à son interface.
Trame 12 : **NA**, annonce de l'adresse unicast globale "fe80::200:aaff:feaa:aaaf".

IPv6 - Address Resolution and DAD



Trame 3 : **DAD**, interrogation du lien afin d'assurer l'unicité de l'adresse de lien local "fe80::200:aaff:feaa:aaaf".

Sans réponse du lien, Il assigne sa nouvelle adresse à son interface.

FF02::1:FFxx/104	**Les Solicited Node multicast : Ensemble de périphériques partageant les 24 derniers bits.** **(Evite de contacter toutes les machines connectées)**

IPv6 - Address Resolution and DAD

```
Frame 4: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
Ethernet II, Src: XeroxXer_aa:aa:af (00:00:aa:aa:aa:af), Dst: IPv6mcast_01 (33:33:00:00:00:01)
Internet Protocol Version 6, Src: fe80::200:aaff:feaa:aaaf, Dst: ff02::1
Internet Control Message Protocol v6
   Type: Neighbor Advertisement (136)
   Code: 0
   Checksum: 0x578f [correct]
   [Checksum Status: Good]
 v Flags: 0x20000000, Override
      0... .... .... .... .... .... .... .... = Router: Not set
      .0.. .... .... .... .... .... .... .... = Solicited: Not set
      ..1. .... .... .... .... .... .... .... = Override: Set
      ...0 0000 0000 0000 0000 0000 0000 0000 = Reserved: 0
   Target Address: fe80::200:aaff:feaa:aaaf
 > ICMPv6 Option (Target link-layer address : 00:00:aa:aa:aa:af)
```

L'adresse MAC de destination commence toujours par **33:33 + l'identifiant du groupe** (les 32 derniers bits de l'adresse mac) -> 33:33:**00:00:00:01** = ff02::**1**

Trame 4 : **NA**, annonce de l'adresse de lien local "fe80::200:aaff:feaa:aaaf".

Le flag "override" permet la mise à jour d'un cache éventuel.

FF02::1/128	**All nodes multicast group : Toutes les interfaces IPv6 actives sur le lien local.**

IPv6 - Address Resolution and DAD

```
Frame 5: 90 bytes on wire (720 bits), 90 bytes captured (720 bits) on interface 0
Ethernet II, Src: XeroxXer_aa:aa:af (00:00:aa:aa:aa:af), Dst: IPv6mcast_16 (33:33:00:00:00:16)
Internet Protocol Version 6, Src: fe80::200:aaff:feaa:aaaf, Dst: ff02::16
Internet Control Message Protocol v6
   Type: Multicast Listener Report Message v2 (143)
   Code: 0
   Checksum: 0x6f55 [correct]
   [Checksum Status: Good]
   Reserved: 0000
   Number of Multicast Address Records: 1
 > Multicast Address Record Changed to exclude: ff02::1:ffaa:aaaf
```

Trame 5-6 : message MLDv2 demandant l'exclusion du **Solicited Node multicast** "ff02::1:ffaa:aaaf".

FF02::16/128	**MLDv2 reports** : Groupe multicast sur le lien local.

IPv6 - SLAAC

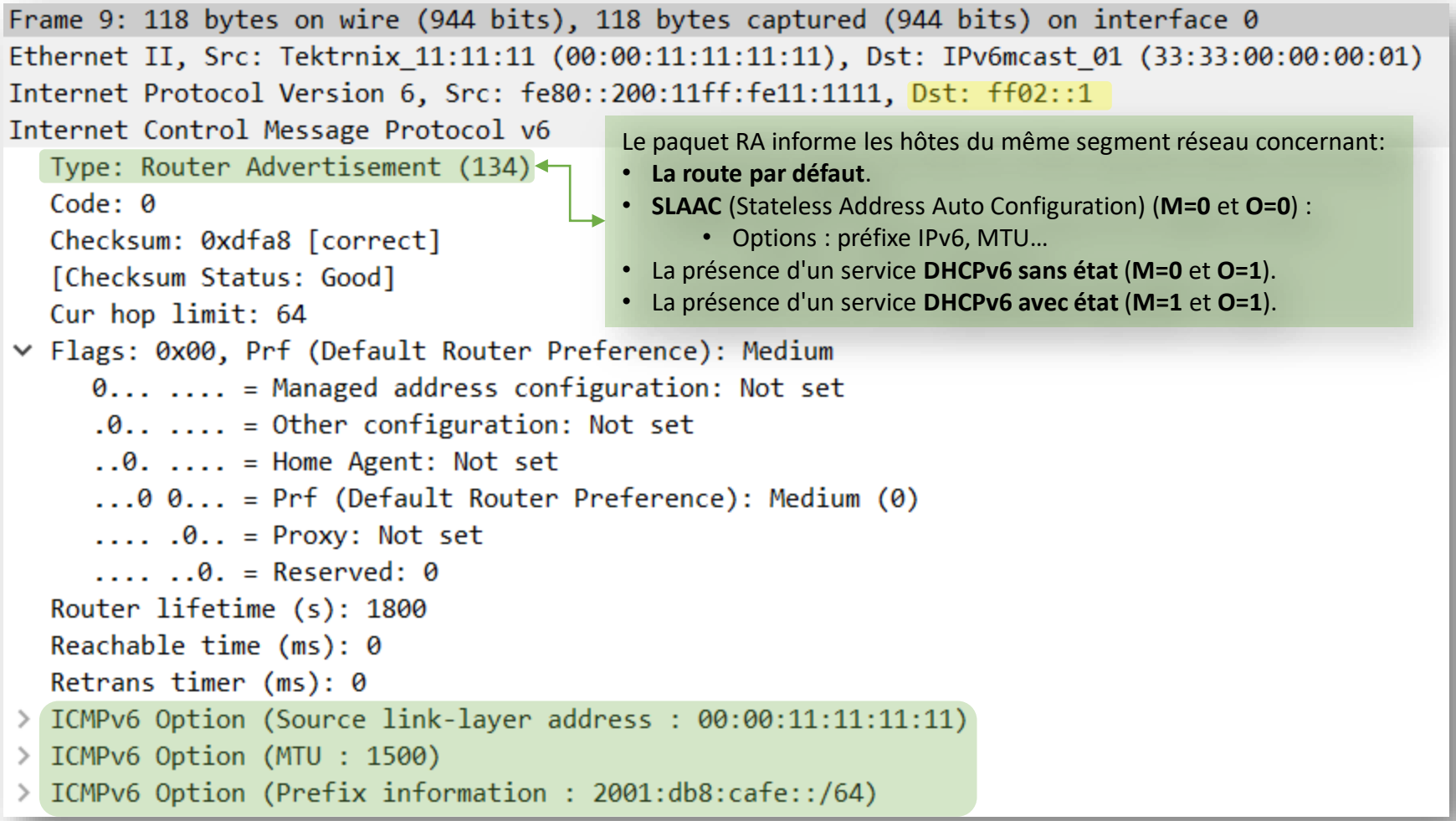
```
Frame 8: 70 bytes on wire (560 bits), 70 bytes captured (560 bits) on interface 0
Ethernet II, Src: XeroxXer_aa:aa:af (00:00:aa:aa:aa:af), Dst: IPv6mcast_02 (33:33:00:00:00:02)
Internet Protocol Version 6, Src: fe80::200:aaff:feaa:aaaf, Dst: ff02::2
Internet Control Message Protocol v6
  Type: Router Solicitation (133)
  Code: 0
  Checksum: 0xd079 [correct]
  [Checksum Status: Good]
  Reserved: 00000000
v ICMPv6 Option (Source link-layer address : 00:00:aa:aa:aa:af)
    Type: Source link-layer address (1)
    Length: 1 (8 bytes)
    Link-layer address: XeroxXer_aa:aa:af (00:00:aa:aa:aa:af)
```

All Routers mulitcast group

Trame 8 : **RS** : Phase d'auto-configuration (**SLAAC**) : Demande d'information de configuration aux routeurs du lien local.

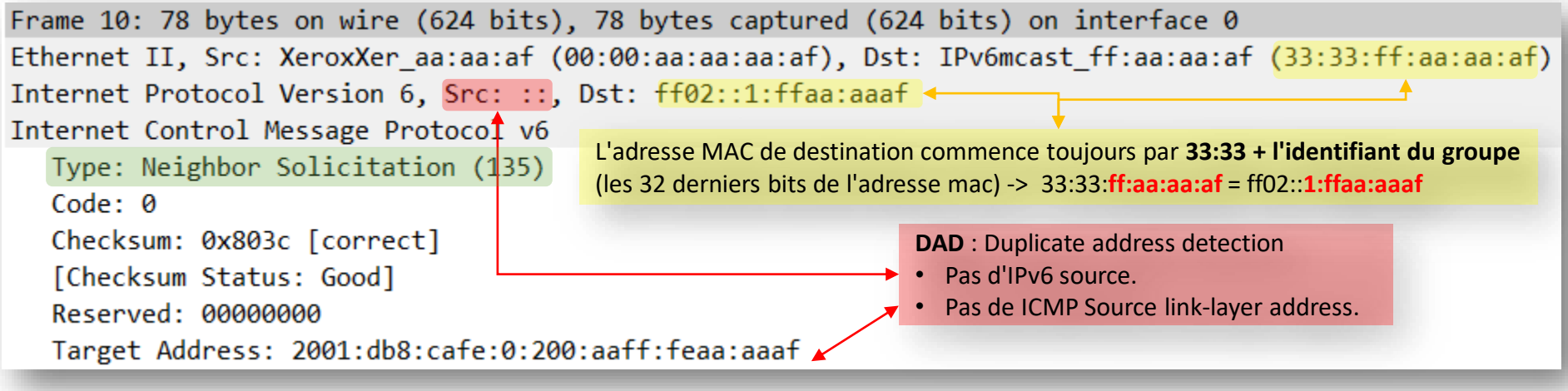
FF02::2/128	**All Routers mulitcast group : Tous les routeurs IPv6 actifs sur le liens local.**

IPv6 - SLAAC



Trame 9 : Phase d'auto-configuration (SLAAC) : **RA**, annonce du préfixe global et du MTU par le routeur.

IPv6 - SLAAC



Trame 10 : **DAD**, interrogation du lien afin d'assurer l'unicité de l'adresse unicast globale "2001:db8:cafe:0:200:aaff:feaa:aaaf". Sans réponse du lien, il assigne sa nouvelle adresse à son interface.

IPv6 - SLAAC

```
Frame 12: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
Ethernet II, Src: XeroxXer_aa:aa:af (00:00:aa:aa:aa:af), Dst: IPv6mcast_01 (33:33:00:00:00:01)
Internet Protocol Version 6, Src: 2001:db8:cafe:0:200:aaff:feaa:aaaf, Dst: ff02::1
Internet Control Message Protocol v6
   Type: Neighbor Advertisement (136)
   Code: 0
   Checksum: 0x6321 [correct]
   [Checksum Status: Good]
 > Flags: 0x20000000, Override
   Target Address: 2001:db8:cafe:0:200:aaff:feaa:aaaf
 v ICMPv6 Option (Target link-layer address : 00:00:aa:aa:aa:af)
      Type: Target link-layer address (2)
      Length: 1 (8 bytes)
      Link-layer address: XeroxXer_aa:aa:af (00:00:aa:aa:aa:af)
```

Trame 12 : **NA**, annonce de l'adresse unicast globale "fe80::200:aaff:feaa:aaaf".

Le flag "override" permet la mise à jour d'un cache éventuel.

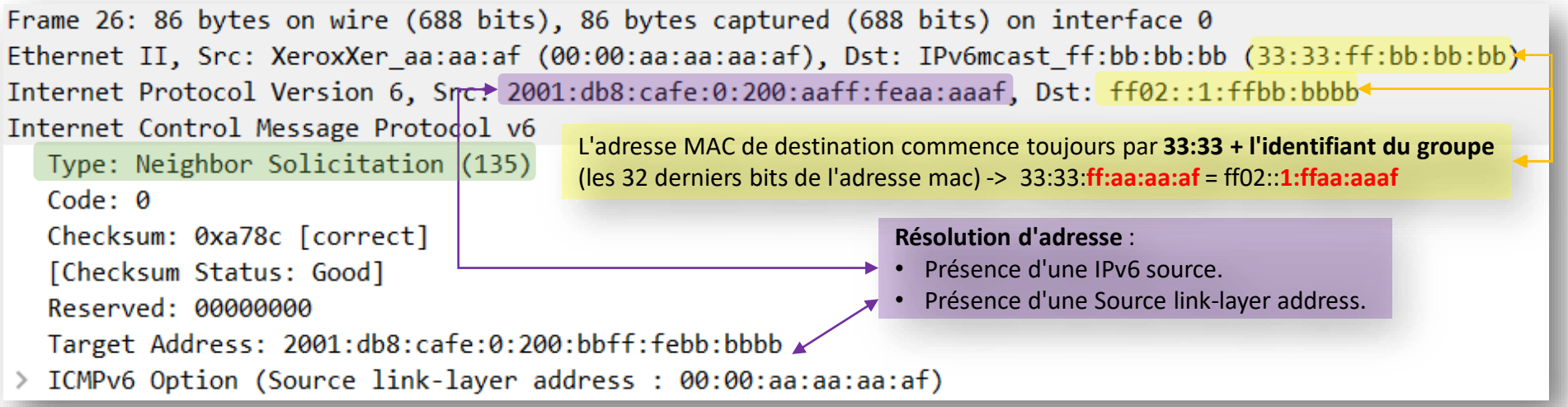
IPv6 - ARP replacement mecanism

No.	Time	Source	Destination	Protocol	Length	Info
17	100.469795	fe80::200:11ff:fe11:1111	ff02::1	ICMPv6	118	Router Advertisement from 00:00:11:11:11:11
26	158.373218	2001:db8:cafe:0:200:aaff:feaa:aaaf	ff02::1:ffbb:bbbb	ICMPv6	86	Neighbor Solicitation for 2001:db8:cafe:0:200:bbff:febb:bbbb from 00:00:aa:aa:aa:af
27	158.383211	2001:db8:cafe:0:200:bbff:febb:bbbb	2001:db8:cafe:0:200…	ICMPv6	86	Neighbor Advertisement 2001:db8:cafe:0:200:bbff:febb:bbbb (sol, ovr) is at 00:00:bb:bb:bb:bb
28	158.393320	2001:db8:cafe:0:200:aaff:feaa:aaaf	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) request id=0x188c, seq=0, hop limit=64 (reply in 29)
29	158.403409	2001:db8:cafe:0:200:bbff:febb:bbbb	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) reply id=0x188c, seq=0, hop limit=64 (request in 28)
30	158.413577	2001:db8:cafe:0:200:aaff:feaa:aaaf	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) request id=0x188c, seq=1, hop limit=64 (reply in 31)
31	158.423755	2001:db8:cafe:0:200:bbff:febb:bbbb	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) reply id=0x188c, seq=1, hop limit=64 (request in 30)
32	158.433828	2001:db8:cafe:0:200:aaff:feaa:aaaf	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) request id=0x188c, seq=2, hop limit=64 (reply in 33)
33	158.443997	2001:db8:cafe:0:200:bbff:febb:bbbb	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) reply id=0x188c, seq=2, hop limit=64 (request in 32)
34	158.453971	2001:db8:cafe:0:200:aaff:feaa:aaaf	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) request id=0x188c, seq=3, hop limit=64 (reply in 35)
35	158.464083	2001:db8:cafe:0:200:bbff:febb:bbbb	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) reply id=0x188c, seq=3, hop limit=64 (request in 34)
36	158.474135	2001:db8:cafe:0:200:aaff:feaa:aaaf	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) request id=0x188c, seq=4, hop limit=64 (reply in 37)
37	158.484287	2001:db8:cafe:0:200:bbff:febb:bbbb	2001:db8:cafe:0:200…	ICMPv6	114	Echo (ping) reply id=0x188c, seq=4, hop limit=64 (request in 36)
39	163.368670	fe80::200:bbff:febb:bbbb	2001:db8:cafe:0:200…	ICMPv6	86	Neighbor Solicitation for 2001:db8:cafe:0:200:aaff:feaa:aaaf from 00:00:bb:bb:bb:bb
40	163.378765	2001:db8:cafe:0:200:aaff:feaa:aaaf	fe80::200:bbff:febb…	ICMPv6	78	Neighbor Advertisement 2001:db8:cafe:0:200:aaff:feaa:aaaf (sol)

Trame 26 : **NS**, demande de l'adresse MAC correspondant à l'adresse "2001:db8:cafe:0:200:bbff:febb:bbbb".
Trame 27 : **NA**, Annonce de son adresse MAC par l'interface utilisant l'adresse "2001:db8:cafe:0:200:bbff:febb:bbbb".

Trame 39 : **NS**, demande de l'adresse MAC correspondant à l'adresse "2001:db8:cafe:0:200:aaff:feaa:aaaf".
Trame 40 : **NA**, Annonce de son adresse MAC par l'interface utilisant l'adresse "2001:db8:cafe:0:200:aaff:feaa:aaaf".

IPv6 - ARP replacement mecanism



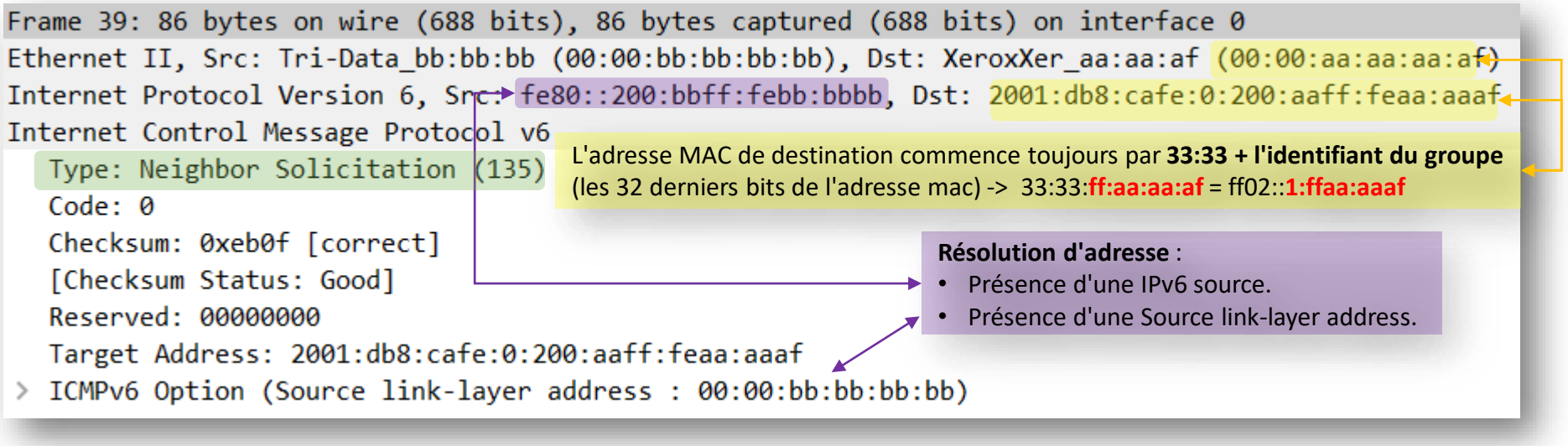
Trame 26 : **NS**, demande de l'adresse MAC correspondant à l'adresse "2001:db8:cafe:0:200:bbff:febb:bbbb".

IPv6 - ARP replacement mecanism

```
Frame 27: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
Ethernet II, Src: Tri-Data_bb:bb:bb (00:00:bb:bb:bb:bb), Dst: XeroxXer_aa:aa:af (00:00:aa:aa:aa:af)
Internet Protocol Version 6, Src: 2001:db8:cafe:0:200:bbff:febb:bbbb, Dst: 2001:db8:cafe:0:200:aaff:feaa:aaaf
Internet Control Message Protocol v6
   Type: Neighbor Advertisement (136)
   Code: 0
   Checksum: 0x6cbb [correct]
   [Checksum Status: Good]
> Flags: 0x60000000, Solicited, Override
   Target Address: 2001:db8:cafe:0:200:bbff:febb:bbbb
> ICMPv6 Option (Target link-layer address : 00:00:bb:bb:bb:bb)
```

Trame 27 : **NA**, Annonce de son adresse MAC par l'interface utilisant l'adresse "2001:db8:cafe:0:200:bbff:febb:bbbb".

IPv6 - ARP replacement mecanism



Trame 39 : **NS**, demande de l'adresse MAC correspondant à l'adresse "2001:db8:cafe:0:200:aaff:feaa:aaaf".

IPv6 - ARP replacement mecanism

```
Frame 40: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0
Ethernet II, Src: XeroxXer_aa:aa:af (00:00:aa:aa:aa:af), Dst: Tri-Data_bb:bb:bb (00:00:bb:bb:bb:bb)
Internet Protocol Version 6, Src: 2001:db8:cafe:0:200:aaff:feaa:aaaf, Dst: fe80::200:bbff:febb:bbbb
Internet Control Message Protocol v6
   Type: Neighbor Advertisement (136)
   Code: 0
   Checksum: 0x2290 [correct]
   [Checksum Status: Good]
 > Flags: 0x40000000, Solicited
   Target Address: 2001:db8:cafe:0:200:aaff:feaa:aaaf
```

Trame 40 : **NA**, Annonce de son adresse MAC par l'interface utilisant l'adresse "2001:db8:cafe:0:200:aaff:feaa:aaaf".