

Discovering IPv6 with Wireshark

June 16, 2010

Rolf Leutert

Network Consultant & Trainer | Leutert NetServices | Switzerland

SHARKFEST '10










Stanford University

June 14-17, 2010



Trace files and coloring rules can be copied from circulating memory stick

Session Agenda

-  Introduction
-  IPv6 Header & Extensions
-  Address format, notations & types
-  Address Autoconfiguration
-  Neighbor discovery, Router discovery
-  Host configuration with DHCPv6
-  New DNS AAAA record
-  Transition technologies, ISATAP, Teredo, 6to4
-  IPv6 Routing Protocols

Introduction

IPv4 to IPv6 address space comparison

- There are **many changes** from IPv4 to IPv6
- The most obvious is the length of the IP address from **32 to 128 bits**
- **4 times** the number of bits **is not 4 times** the number of addresses
- It means **doubling** the address space with each additional bit (96x)
- About **$3,4 * 10^{38}$** possible addressable nodes
- More than **10^{27}** addresses **per person** on the planet

IPv4 address, 32 bits 192.168.20.30

IPv6 address, 128 bits 2001:0DB8:0000:0000:0000:0000:1428:57AB

network prefix

interface identifier

Introduction

IPv4 to IPv6 address space comparison



Let's assume, the whole IPv4 address space (2^{32}) with **4.2 Billion addresses** is represented by an area of **1 millimeter²**

How big would be the corresponding area with IPv6?

The equivalent area would be:

155 Millions of Earth surfaces!!!

(Earth surface area is 510 Million km²)



Session Agenda

Introduction

IPv6 Header & Extensions

Address format, notations & types

Address Autoconfiguration

Neighbor discovery, Router discovery

Host configuration with DHCPv6

New DNS AAAA record

Transition technologies, ISATAP, Teredo, 6to4

IPv6 Routing Protocols

IPv6 Headers & Extensions

IPv4 Header
(20 Bytes without options)

Ver.	HL	DiffServ	Payload length	
Identification			Flag	Fragment Offset
TTL	Protocol	Header Checksum		
32 bits Source Address				
32 bits Destination Address				
Optional fields				
Optional fields				

IPv6 Header
(40 Bytes without extensions)

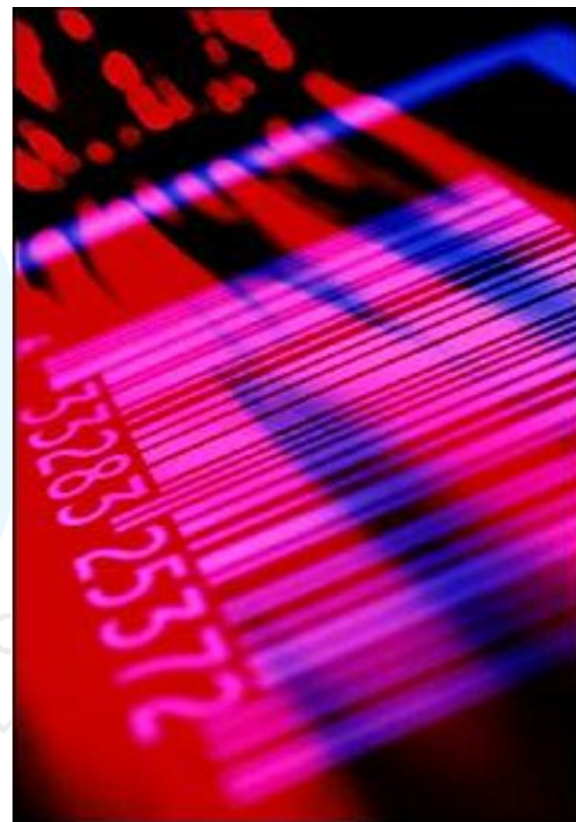
Ver.	Traff. Class	Flow Label		
Payload length		NextHeader	Hop Limit	
128 Bits Source Address				
128 Bits Destination Address				
Optional Extension Headers				

- Fields changed
- Fields removed
- Fields added

IPv6 Header & Extensions

IPv6 Flow Label

- A **Flow** is a **sequence of packets** sent from a particular source to a particular destination
- A **Flow Label** could significantly **speed up** packet processing on routers
- RFC 3697 defines the use of the 20 bit **IPv6 Flow Label** initiated by the **source nodes**
- A **Flow path needs to be established** on all routers on the path from the source to the destination (e.g. RSVP)
- Not all flow process **details** are defined at this point of time



IPv6 Header & Extensions

The image shows a Wireshark capture of IPv6 traffic. The main pane displays a list of packets. Packet 5 is highlighted in blue and contains an ICMPv6 message. Packet 6 is highlighted in yellow and contains an IPv6 packet. Packet 7 is highlighted in yellow and contains an IPv6 packet. Packet 8 is highlighted in green and contains an ICMPv6 message. Packet 9 is highlighted in green and contains a TCP packet.

No.	Time	IPv6 Source	IPv6 Destination	IPv4 Source	IPv4 Destination	Protocol
1	0.000000	2001:cafe:0:20:c1c4:83e9:bc72:f0b7	2001:cafe:0:30::199			DNS
2	0.027882	2001:cafe:0:30::199	2001:cafe:0:20:c1c4:83e9:bc72:f0b7			DNS
3	0.001051	2001:cafe:0:20:c1c4:83e9:bc72:f0b7	2001:cafe:0:30::199			DNS
4	0.001852	2001:cafe:0:30::199	2001:cafe:0:20:c1c4:83e9:bc72:f0b7			DNS
5	0.001414	2001:0:cf2e:3096:1c11:142c:aafe:aa1	2a02:2e0:3fe:100::6	192.168.20.100	207.46.48.150	ICMPv6
6	0.725076	fe80::445b:75f8:493c:c443	2001:0:cf2e:3096:1c11:142c:aafe:aa1	207.46.48.150	192.168.20.100	IPv6
7	0.000712	2001:0:cf2e:3096:1c11:142c:aafe:aa1	fe80::445b:75f8:493c:c443	192.168.20.100	87.251.43.68	IPv6
8	0.026195	2a02:2e0:3fe:100::6	2001:0:cf2e:3096:1c11:142c:aafe:aa1	87.251.43.68	192.168.20.100	ICMPv6
9	0.000876	2001:0:cf2e:3096:1c11:142c:aafe:aa1	2a02:2e0:3fe:100::6	192.168.20.100	87.251.43.68	TCP

The packet details pane for packet 6 shows the following structure:

- Frame 5 (98 bytes on wire, 98 bytes captured)
- Ethernet II, Src: HewlettP_6b:85:32 (00:22:64:6b:85:32), Dst: Cisco_ac:c5:60 (00:0b:fd:ac:c5:60)
- 802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 20
- Internet Protocol, Src: 192.168.20.100 (192.168.20.100), Dst: 207.46.48.150 (207.46.48.150)
 - Version: 4
 - Header length: 20 bytes
 - Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
 - Total Length: 80
 - Identification: 0x6cbb (27835)
 - Flags: 0x00
 - Fragment offset: 0
 - Time to live: 128
 - Protocol: UDP (0x11)
 - Header checksum: 0xf910 [correct]
 - Source: 192.168.20.100 (192.168.20.100)
 - Destination: 207.46.48.150 (207.46.48.150)
- User Datagram Protocol, Src Port: 60371 (60371), Dst Port: teredo (3544)
- Teredo IPv6 over UDP tunneling
- Internet Protocol Version 6

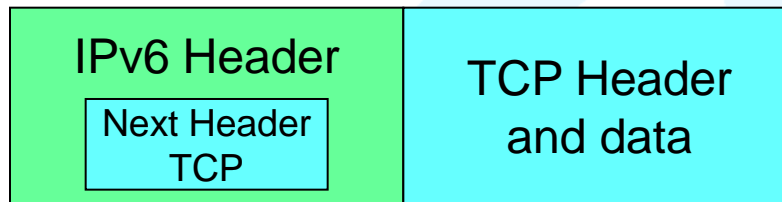
IPv6 Header & Extensions

The screenshot shows the Wireshark interface with a packet capture of IPv6 traffic. The packet list pane shows several packets, with packet 9 selected. The packet details pane shows the following structure:

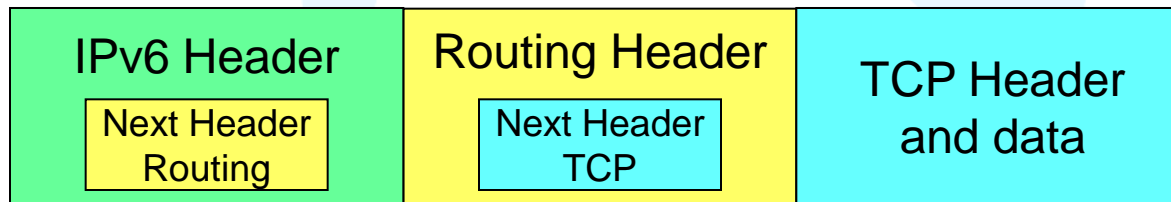
- Fragment offset: 0
- Time to live: 128
- Protocol: UDP (0x11)
- Header checksum: 0xf910 [correct]
- source: 192.168.20.100 (192.168.20.100)
- Destination: 207.46.48.150 (207.46.48.150)
- User Datagram Protocol, Src Port: 60371 (60371), Dst Port: teredo (3544)
- Teredo IPv6 over UDP tunneling
- Internet Protocol Version 6
 - 0110 = Version: 6
 - 0000 0000 = Traffic class: 0x00000000
 - 0000 0000 0000 0000 = Flowlabel: 0x00000000
 - Payload length: 12
 - Next header: ICMPv6 (0x3a)
 - Hop limit: 21
 - source: 2001:0:cf2e:3096:1c11:142c:aafe:aa1 (2001:0:cf2e:3096:1c11:142c:aafe:aa1)
 - destination: 2a02:2e0:3fe:100::6 (2a02:2e0:3fe:100::6)
- Internet Control Message Protocol v6

IPv6 Header & Extensions

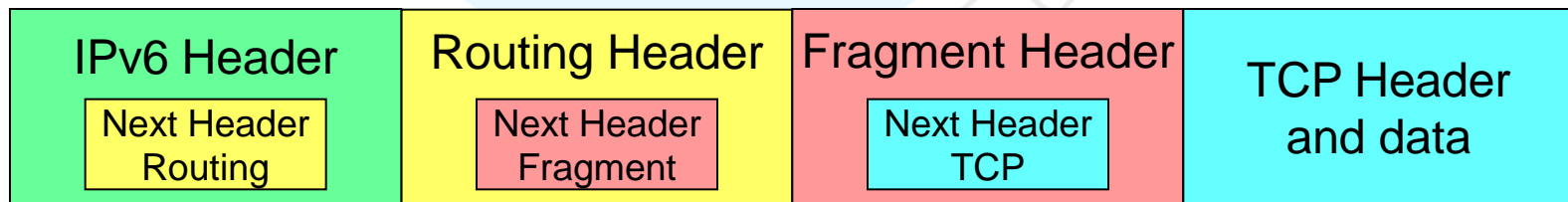
- IPv6 offers **modular header composition** adding optional information
- Basic IPv6 header can be followed by **one ore more extension headers**



Basic header



Basic header with one extension



Basic header with two extension

+

Session Agenda

Introduction

IPv6 Header & Extensions

Address format, notations & types

Address Autoconfiguration

Neighbor discovery, Router discovery

Host configuration with DHCPv6

New DNS AAAA record

Transition technologies, ISATAP, Teredo, 6to4

IPv6 Routing Protocols

Address format & notation

IPv6 supports different address notation formats

2001:0DB8:0000:0000:0000:0000:1428:57AB standard notation
2001:0db8:0000:0000:0000:0000:1428:57ab notation is **case insensitive**

2001:db8:0:0:0:0:1428:57ab **leading zeros** can be suppressed
2001:db8::1428:57ab **consecutive zeros** can be compressed with **::**

2001:0:0:100:0:0:0:20 zero compression **only once** in an address
2001::100::20 **invalid** address
2001:0:0:100::20 **valid** address
2001::100:0:0:020 **valid** address

fe80::5efe:192.168.20.100 **mixed** notation, compressed

2001:db8::/64 represents the **network** 2001:db8:0:0::
2001:db8::1428:57ab/128 represents a **single host** address

Address types

Four types of addresses are defined in IPv6

- **Unicast**
 - 2xxx
fdxx
 - Worldwide unique addresses
Locally valid addresses
- **Multicast**
 - ffxx
 - play an important role in IPv6,
they also replace Broadcasts
- **Anycast**
 - 2xxx
 - are unicast addresses reserved
or assigned to special functions
- **Special Addresses**
 - reserved for special purposes
like DHCP, Loopback etc.
- **No Broadcast anymore**
 - replaced by multicasts, this is
valid for layer 2 and layer 3

Address types

Unicast

- Global
 - 2xxx Blocks managed by RIPE NCC (Europe)
 - Range 2001:/16 Global unicast addresses (former public)
 - Reserved 2002:/16 6to4 address space
 - Reserved 3ffe:/16 old 6Bone address
- Local
 - Link-Local fe80:/64 former IPv4 169.254.0.0/16 APIPA
 - Local fc00:/8 Centrally Assigned Unique Local Address (ULA-central)
 - fd00:/8 Unique Local Address (ULA, not routed in the Internet, former IPv4 private)
 - Site-Local fec0:/10 deprecated, do not use anymore

Address types

Multicast prefixes and scopes

- Interface-local Scope
- Link-local Scope
- Site-local Scope
- Global Scope

ff00:: /8
ff01:: /64
ff02:: /64
ff05:: /64
ff0e:: /64

Multicast hosts

::1	All nodes	::b	All mobile agents
::2	All routers	::c	SSDP
::3	unassigned	::d	All PIM router
::4	DVMRP router	::e	RSVP-encapsulation
::5	OSPF IGP	::16	LLMNR
::6	OSPF IGP DR	::101	NTP server
::7	ST router	::1:1	Link name
::8	ST hosts	::1:2	All DHCP relay agents
::9	All RIP routers	::1:3	DNS & LLMNR
::a	All EIGRP routers	::1:ffxx:xxxx	Solicited node multicast

Address types

Anycast

- These type of addresses can be used to reach certain functions which are assigned to different servers (i.e. Root Server)
- Anycast addresses are unicast and are routed to the nearest server

RIPE NCC Root Server	2001:7fd::1	193.0.14.129
VeriSign Root Server	2001:503:c27::2:30	192.58.128.30
6to4 Relay		192.88.99.1

Special Addresses

- Unspecified
0:0:0:0:0:0:0:0/128 or ::/128
used as source address only
- Loopback
::1/128 (former IPv4 127.0.0.1)
local host or loopback address
- Default Gateway
::/0 used as gateway of last resort

Session Agenda

Introduction

IPv6 Header & Extensions

Address format, notations & types

Address Autoconfiguration

Neighbor discovery, Router discovery

Host configuration with DHCPv6

New DNS AAAA record

Transition technologies, ISATAP, Teredo, 6to4

IPv6 Routing Protocols

Address Autoconfiguration

IPv6 Stateless Address Autoconfiguration (SLAAC)

- An IPv6 host will **autoconfigure** a link-local address for each interface
- Prefix for link-local address is **fe80::/64**
- Interface ID is either derived from **MAC address** or a **random value**

Ethernet MAC address

00	30	64	6b	85	32
----	----	----	----	----	----

IPv6 address: EUI-64 format

fe 80	00 00	00 00	00 00	02	30	64	ff	fe	6b	85 32
-------	-------	-------	-------	----	----	----	----	----	----	-------

IPv6 address: privacy format

fe 80	00 00	00 00	00 00	9c 4a	e7 8a	20 38	d4 d1
-------	-------	-------	-------	-------	-------	-------	-------

random value

Address Autoconfiguration

IPv6 Stateless Address Autoconfiguration (SLAAC)

- If a router is present, host will also **autoconfigure global address**
- Prefix will be obtained from router, example **2001:db8::/64**
- Interface ID is either derived from **MAC address** or a **random value**
- Router indicates in advertisement if **stateful configuration** may be used

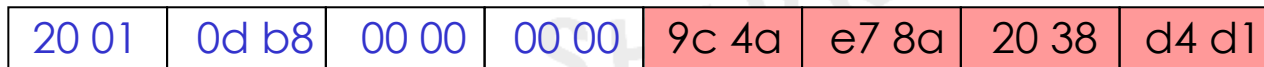
Ethernet MAC address

00	30	64	6b	85	32
----	----	----	----	----	----

IPv6 address: EUI-64 format



IPv6 address: privacy format



random value

Address Autoconfiguration

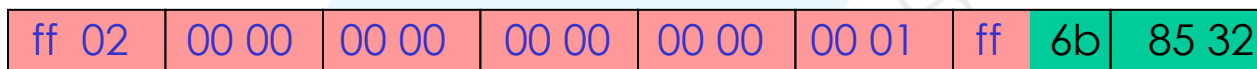
Solicited Node Multicast Address (SNMA)

- Probably the **most strange** part of IPv6 addressing
- An IPv6 host forms a SNMA for **each own unicast address** in use
- The SNMA address is used for **Neighbor Discovery** (replacement of ARP)
- The SNMA address is **derived from** each **unicast address** in use

Hosts unicast address



Hosts SNMA address



SNMA prefix `ff02:0:0:0:0:1:ff00/104`

24 bits

SNMA derived from unicast address: `ff02::1:ff6b:8532`

IPv6 Interfaces

- We have to get used, that a host has **many IPv6 addresses**
- Most hosts support **Dual Stack Architecture** for IPv4 and IPv6
- IPv6 is **self-configuring**, but it also allows **manual configuration**

IPv6 Client



```
C:\windows\system32>ipconfig /all
```

Physical interfaces:

- Ethernet interface
- Wireless LAN interface
- Bluetooth interface

Logical interfaces:

- Loopback pseudo-interface
- ISATAP tunneling interface
- TEREDO tunneling interface
- 6to4 interface

IPv6 Interfaces

- IPv6 hosts and router have the following addresses:

IPv6 Host



- Link-Local address for each interface
- SNMA for each own IPv6 address
- All-nodes multicast address
- Loopback address
- Assigned unicast address (if a router is present)
- Optional Multicast addresses of other groups

IPv6 Router

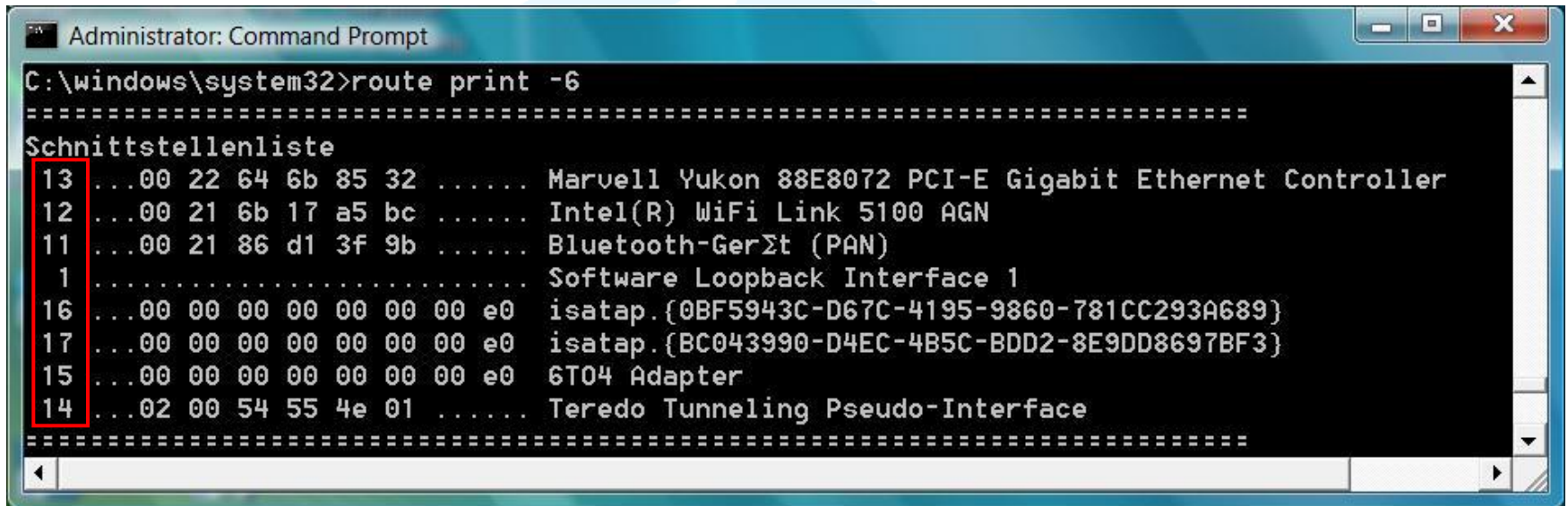


An IPv6 router has in addition:

- Subnet-router anycast address
- All-router multicast address
- Optional other anycast addresses
- Optional Multicast addresses of other groups

IPv6 Interfaces

- In Windows Vista/7, each IPv6 interface is numbered with unique 'Zone ID'



```
Administrator: Command Prompt
C:\windows\system32>route print -6
=====
Schnittstellenliste
13 ...00 22 64 6b 85 32 ..... Marvell Yukon 88E8072 PCI-E Gigabit Ethernet Controller
12 ...00 21 6b 17 a5 bc ..... Intel(R) WiFi Link 5100 AGN
11 ...00 21 86 d1 3f 9b ..... Bluetooth-Gerät (PAN)
1 ..... Software Loopback Interface 1
16 ...00 00 00 00 00 00 00 e0 isatap.{0BF5943C-D67C-4195-9860-781CC293A689}
17 ...00 00 00 00 00 00 00 e0 isatap.{BC043990-D4EC-4B5C-BDD2-8E9DD8697BF3}
15 ...00 00 00 00 00 00 00 e0 6T04 Adapter
14 ...02 00 54 55 4e 01 ..... Teredo Tunneling Pseudo-Interface
=====
```

- A link-local address is automatically configured with the address prefix **fe80::/64** for each physical or logical IPv6 interface
- If a **router** is available, a **global address** is configured on interface

IPv6 Interfaces

```
Administrator: Command Prompt
IPv6-Routentabelle
=====
Aktive Routen:
If Metrik Netzwerkziel Gateway
13 286 ::/0 fe80::20b:fdff:feac:c560
16 281 ::/0 fe80::5efe:192.168.20.1
1 306 ::1/128 Auf Verbindung
14 18 2001::/32 Auf Verbindung
14 266 2001:0:d5c7:a2d6:281b:276f:3f57:ff32/128 Auf Verbindung
13 38 2001:cafe:0:20::/64 Auf Verbindung
13 286 2001:cafe:0:20::113/128 Auf Verbindung
13 286 2001:cafe:0:20:222:64ff:fe6b:8532/128 Auf Verbindung
13 286 2001:cafe:0:20:8d2d:33b4:5455:ad15/128 Auf Verbindung
16 33 2001:cafe:0:40::/64 Auf Verbindung
16 281 2001:cafe:0:40:0:5efe:192.168.0.205/128 Auf Verbindung
13 286 fe80::/64 Auf Verbindung
14 266 fe80::/64 Auf Verbindung
16 281 fe80::5efe:192.168.0.205/128 Auf Verbindung
17 296 fe80::5efe:192.168.10.100/128 Auf Verbindung
13 286 fe80::222:64ff:fe6b:8532/128 Auf Verbindung
14 266 fe80::281b:276f:3f57:ff32/128 Auf Verbindung
1 306 ff00::/8 Auf Verbindung
14 266 ff00::/8 Auf Verbindung
13 286 ff00::/8 Auf Verbindung
=====
```

Global Addresses

Link Local Addresses

Session Agenda

Introduction

IPv6 Header & Extensions

Address format, notations & types

Address Autoconfiguration

Neighbor discovery, Router discovery

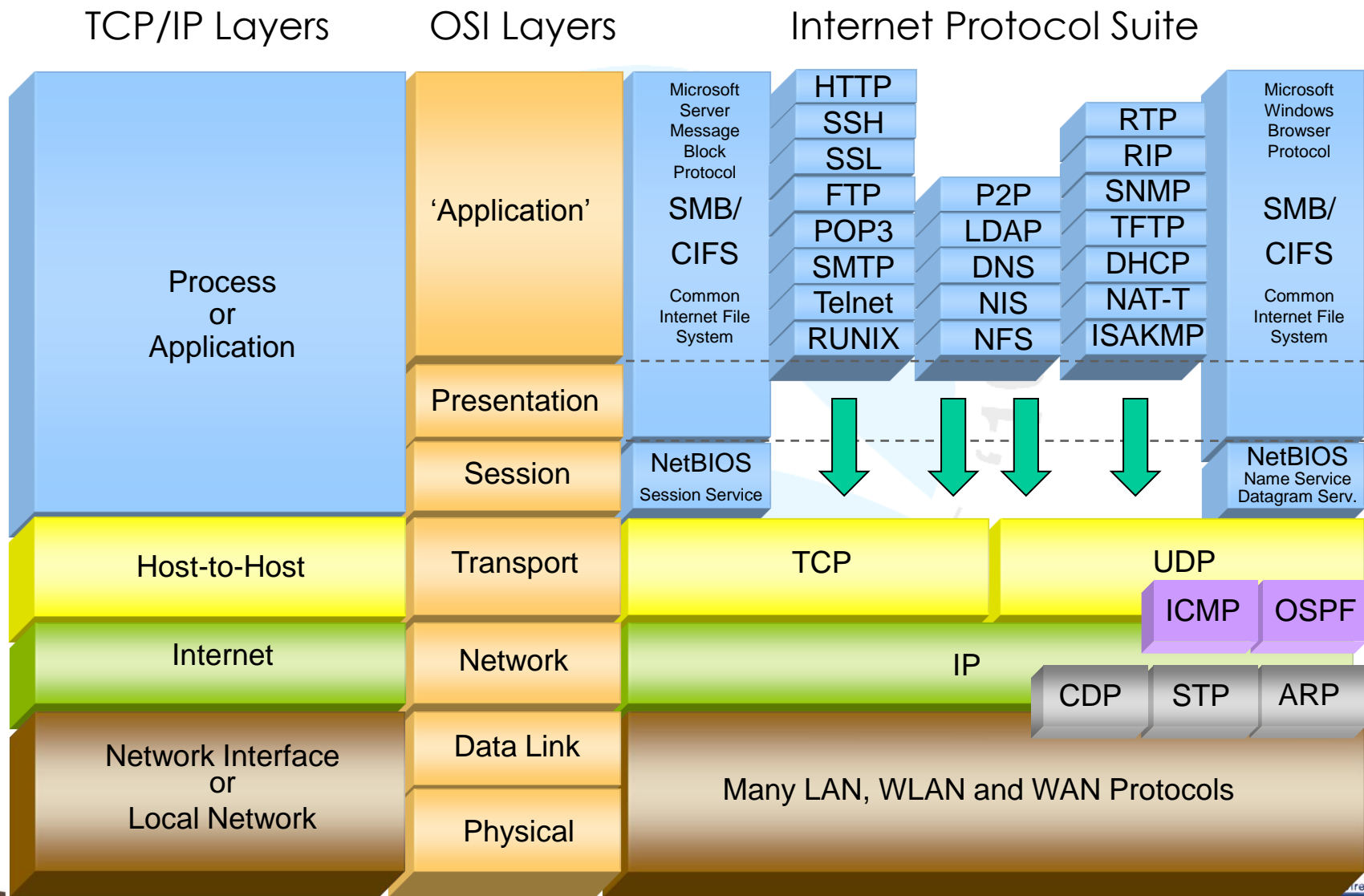
Host configuration with DHCPv6

New DNS AAAA record

Transition technologies, ISATAP, Teredo, 6to4

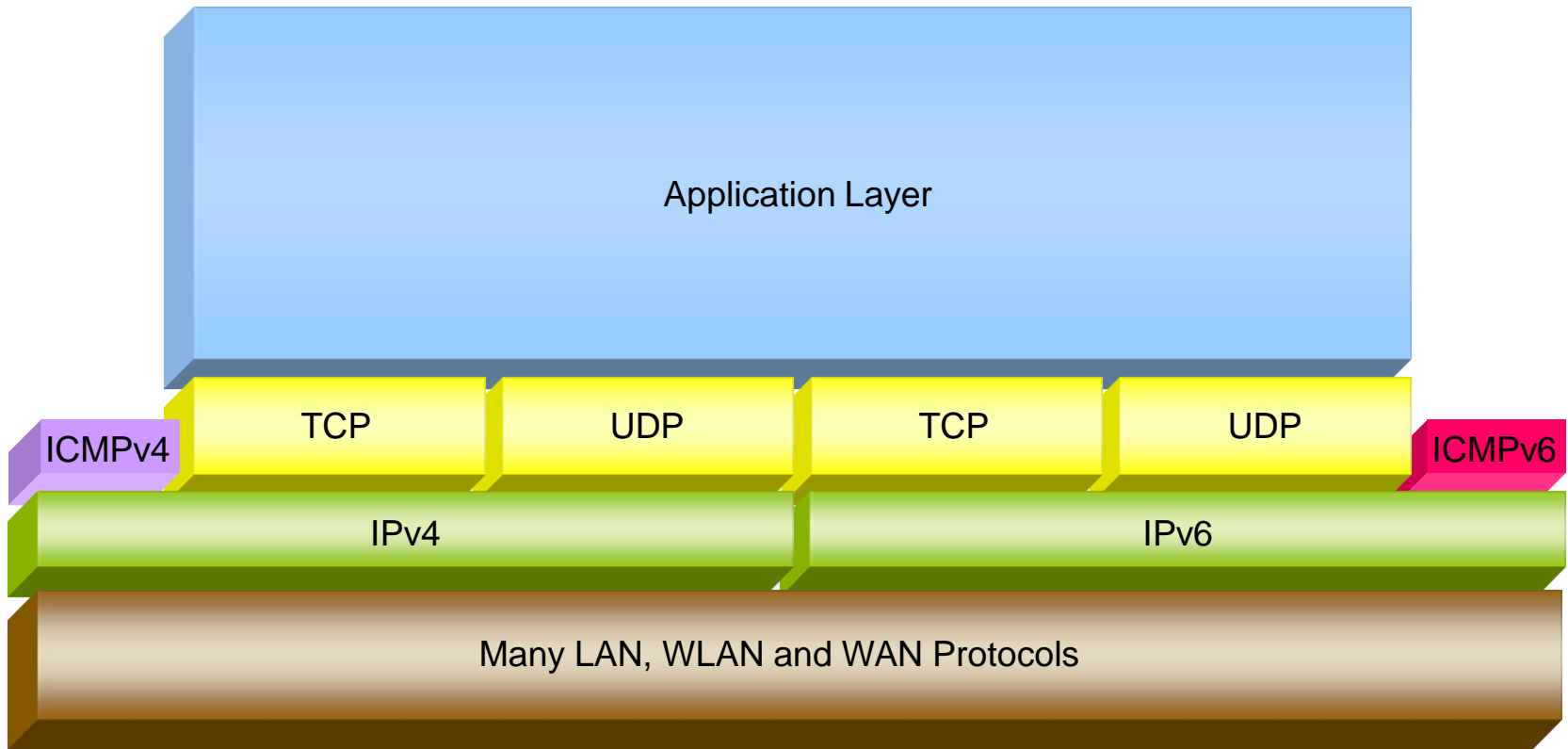
IPv6 Routing Protocols

TCP/IP Protocols



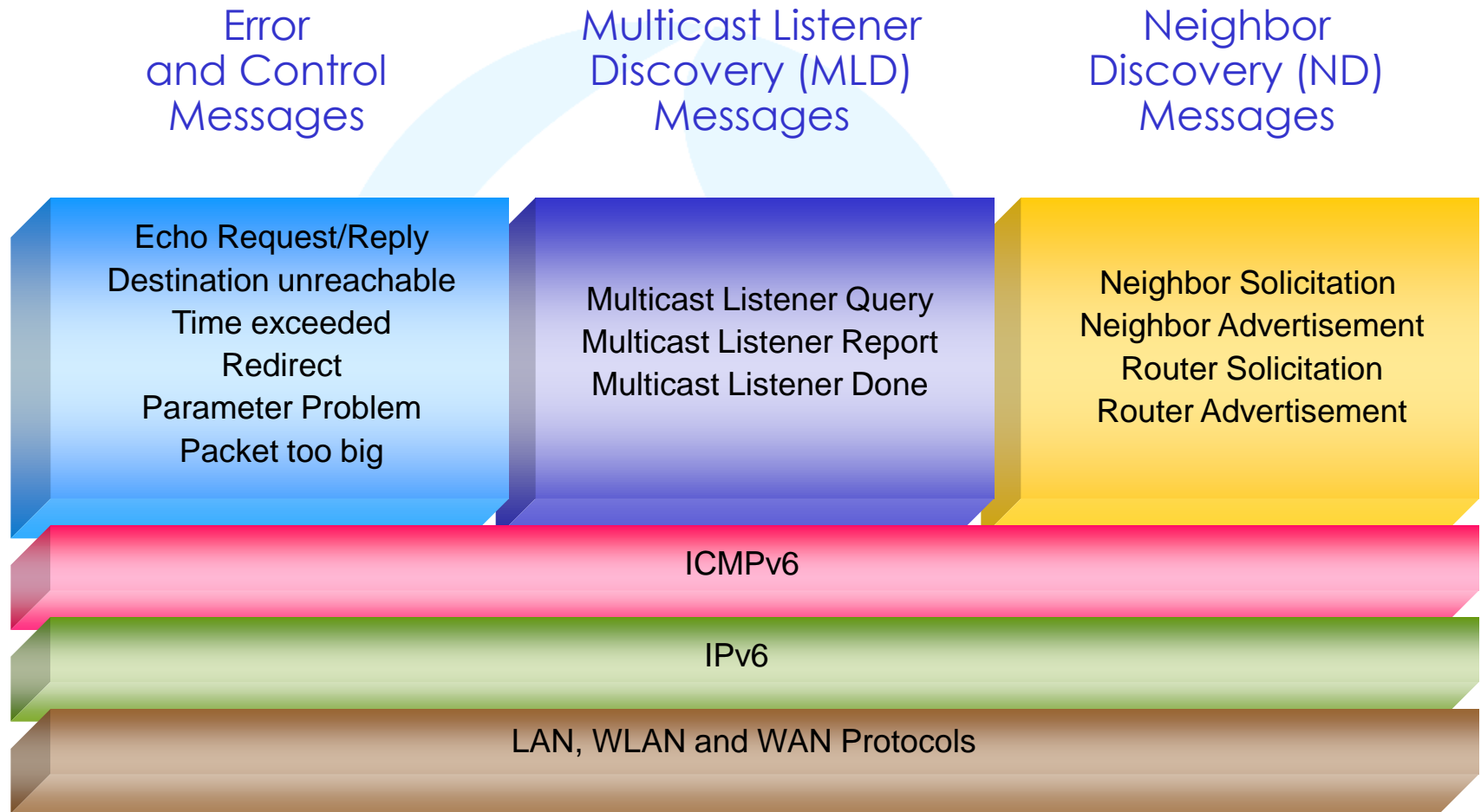
TCP/IP Protocols

Dual stack implementation



- **Internet Control Message Protocol v6** (ICMPv6) plays an important role
- Many new ICMPv6 messages have been defined

ICMPv6 Messages

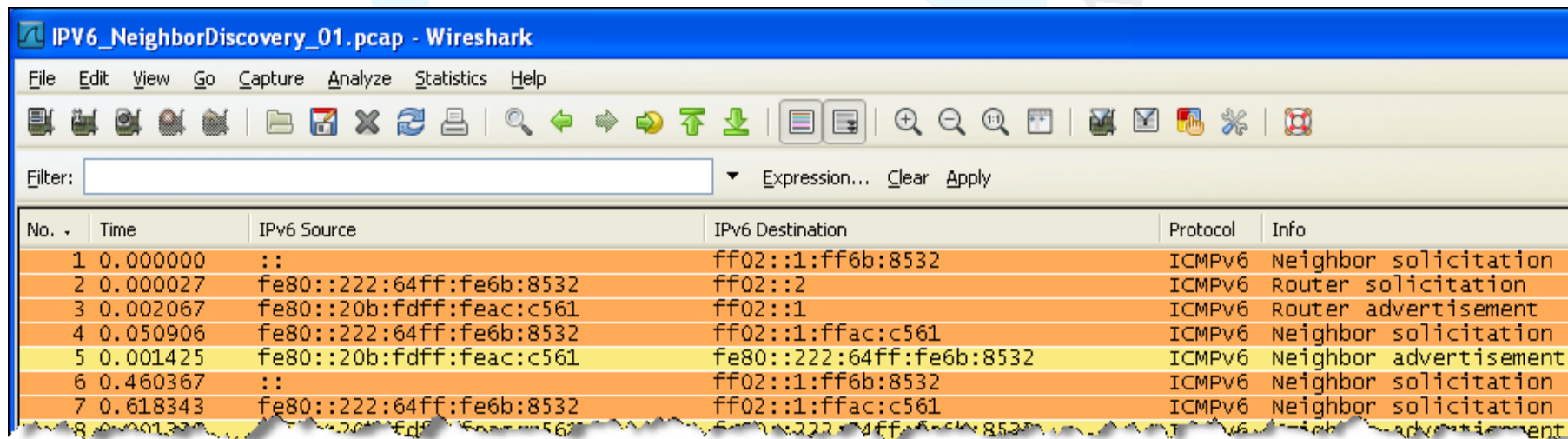


Neighbor Discovery (ND)

The initial client startup process includes the following steps:

Frame

- 1 Link-Local autoconfiguration and Duplicate Address Detection
- 2 Router Discovery
- 3 Prefix acquisition and global address autoconfiguration
- 4/5 Default router neighbor discovery
- 6 Duplicate Address Detection with acquired global address

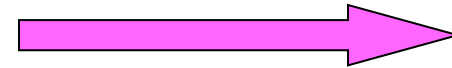


The image shows a Wireshark capture of IPv6 Neighbor Discovery (ND) protocol frames. The capture is titled "IPv6_NeighborDiscovery_01.pcap - Wireshark". The interface includes a menu bar (File, Edit, View, Go, Capture, Analyze, Statistics, Help), a toolbar with various icons, and a filter field. The main display area shows a list of frames with the following columns: No., Time, IPv6 Source, IPv6 Destination, Protocol, and Info.

No.	Time	IPv6 Source	IPv6 Destination	Protocol	Info
1	0.000000	::	ff02::1:ff6b:8532	ICMPv6	Neighbor solicitation
2	0.000027	fe80::222:64ff:fe6b:8532	ff02::2	ICMPv6	Router solicitation
3	0.002067	fe80::20b:fdff:feac:c561	ff02::1	ICMPv6	Router advertisement
4	0.050906	fe80::222:64ff:fe6b:8532	ff02::1:ffac:c561	ICMPv6	Neighbor solicitation
5	0.001425	fe80::20b:fdff:feac:c561	fe80::222:64ff:fe6b:8532	ICMPv6	Neighbor advertisement
6	0.460367	::	ff02::1:ff6b:8532	ICMPv6	Neighbor solicitation
7	0.618343	fe80::222:64ff:fe6b:8532	ff02::1:ffac:c561	ICMPv6	Neighbor solicitation
8	0.001320	fe80::20b:fdff:feac:c561	fe80::222:64ff:fe6b:8532	ICMPv6	Neighbor advertisement

Neighbor Discovery (ND)

Duplicate Address Detection (DAD)



Neighbor Solicitation Message

Source

Destination

::

ff02::1:ff68:8532

Target fe80::222:64ff:fe6b:8532

Neighbor Solicitation Message

Source

Destination

::

ff02::1:ff1c:b3b0

Target fe80::12d:d6a8:dd1c:b3b0

VISTA/7-Client
(random option = **off**)



Physical Address (MAC) 0022:6468:8532

Link Local Address fe80::222:64ff:fe68:8532

Solicited Node Multicast ff02::1:ff68:8532

VISTA/7-Client
(random option = **on**)



Physical Address (MAC) 0022:6468:8532


Link Local Address fe80::12d:d6a8:dd1c:b3b0

Solicited Node Multicast: ff02::1:ff1c:b3b0

Neighbor Discovery (ND)

Router Solicitation

VISTA/7-Client
(random option = off)




MAC 0022:6468:8532

LLA fe80::222:64ff:fe68:8532

SNMA ff02::1:ff68:8532

VISTA/7-Client
(random option = on)



MAC 0022:6468:8532

LLA fe80::12d:d6a8:dd1c:b3b0

SNMA ff02::1:ff1c:b3b0



Router Solicitation Message

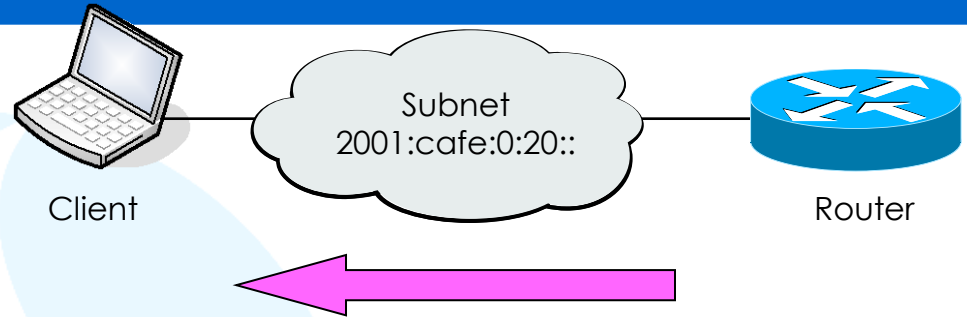
Source	Destination
fe80::222:64ff:fe68:8532	ff02::2
Info: Link-layer address 00:22:64:6b:85:32	

Router Solicitation Message

Source	Destination
fe80::12d:d6a8:dd1c:b3b0	ff02::2
Info: Link-layer address 00:22:64:6b:85:32	

Neighbor Discovery (ND)

Router Advertisement



Router Configuration:



```
ipv6 unicast-routing

interface FastEthernet0/1
  ipv6 address 2001:CAFE:0:20::/64 eui-64

MAC                                000b:fdac:c561

LLA                                fe80::20b:fdff:feac:c561

Global Addresses
  2001:cafe:0:20:20b:fdff:feac:c561

SNMA                                ff02::1:ffac:c561
```

Router Advertisement Message

Source	Destination
--------	-------------

fe80::20b:fdff:feac:c561

ff02::1

Info: Link-layer address 00:0b:fd:ac:c5:61

Info: Flags Not managed, Not other

Info: MTU size 1500 bytes


Info: Prefix length 64

Info: Prefix 2001:cafe:0:20::

Neighbor Discovery (ND)

Neighbor Solicitation

VISTA-Client
(random option = off)




MAC 0022:6468:8532

LLA fe80::222:64ff:fe68:8532

SNMA ff02::1:ff68:8532

Def.GW fe80::20b:fdff:feac:c561

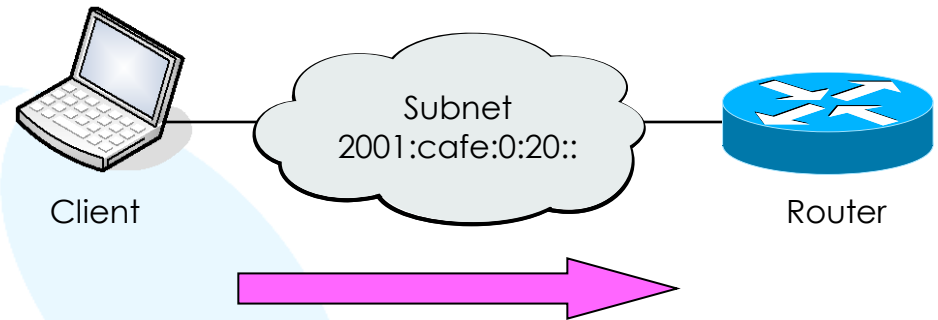
Router Configuration:



MAC 000b:fdac:c561

LLA fe80::20b:fdff:feac:c561

SNMA ff02::1:ffac:c561



Neighbor Solicitation Message

Source

Destination

fe80::222:64ff:fe68:8532


ff02::1:ffac:c561

Info: Link-layer address 00:22:64:6b:85:32

Neighbor Discovery (ND)

Neighbor Advertisement

VISTA-Client
(random option = off)




MAC 0022:6468:8532

LLA **fe80::222:64ff:fe68:8532**

SNMA ff02::1:ff68:8532

Def.GW fe80::20b:fdff:feac:c561

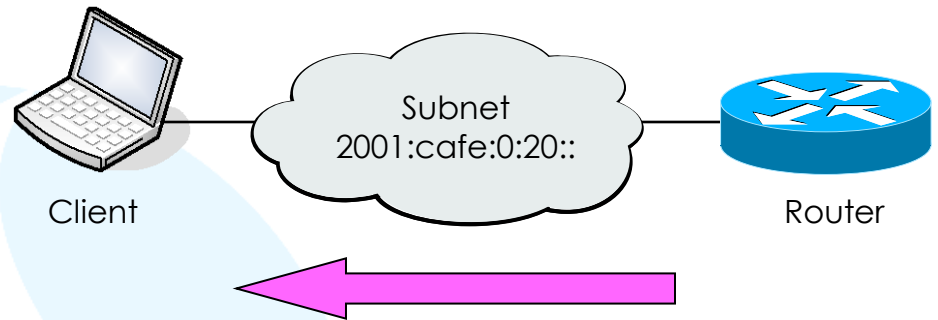
Router Configuration:



MAC 000b:fdac:c561

LLA **fe80::20b:fdff:feac:c561**

SNMA ff02::1:ffac:c561
ff02::1:ff00:1



Neighbor Advertisement Message

Source

Destination

fe80::20b:fdff:feac:c561


fe80::222:64ff:fe68:8532

Info: Target: fe80::20b:fdff:feac:c561

Info: Link-layer address 00:0b:fd:ac:c5:61

Neighbor Discovery (ND)

Duplicate Address Detection (DAD)



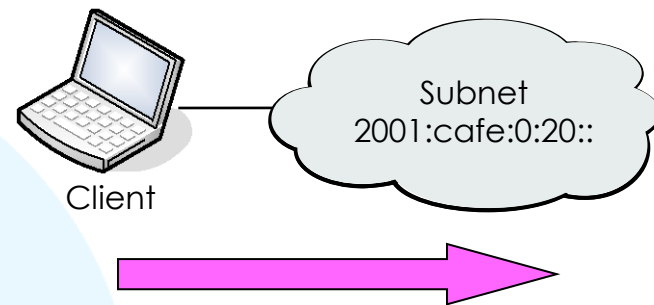
VISTA-Client
(random option = off)

Physical Address (MAC) 0022:6468:8532
Link Local Address fe80::222:64ff:fe68:8532

Global Address
2001:cafe:0:20:222:64ff:fe6b:8532

Solicited Node Multicast ff02::1:ff68:8532

Standard Gateway fe80::20b:fdff:feac:c561



Neighbor Solicitation Message

Source

Destination

::

ff02::1:ff68:8532

Info: Target

2001:cafe:0:20:222:64ff:fe6b:8532

- At this state, the client is configured with [Link Local Address](#), [Global Unicast Address](#), and [Default Gateway](#) and is ready to communicate.
- Client is still **missing** parameters like **DNS, Domain Suffixes etc.**

Session Agenda

Introduction

IPv6 Header & Extensions

Address format, notations & types

Address Autoconfiguration

Neighbor discovery, Router discovery

Host configuration with DHCPv6

New DNS AAAA record

Transition technologies, ISATAP, Teredo, 6to4

IPv6 Routing Protocols

Host configuration with DHCPv6

Despite Address Autoconfiguration, DHCP plays an important role in IPv6 environment. It is required to provide clients with additional parameters like DNS server address and many other options.

DHCPv6 offers different level of control over the workstations:

Client parameters	Stateless Auto Address Config. RFC2462	Stateless DHCP Service for IPv6 RFC3736	Stateful DHCPv6 RFC3315
Subnet Prefix & Mask	From Router Advertisements (O-Flag=0 M-Flag=0)	From Router Advertisements (O-Flag=1 / M-Flag=0)	From Router Advertisements (O-Flag=1 / M-Flag=1)
Interface Identifier	Auto Configuration	Auto Configuration	From DHCPv6 Server
DNS, NTP address etc.	Manual Configuration	From DHCPv6 Server	From DHCPv6 Server

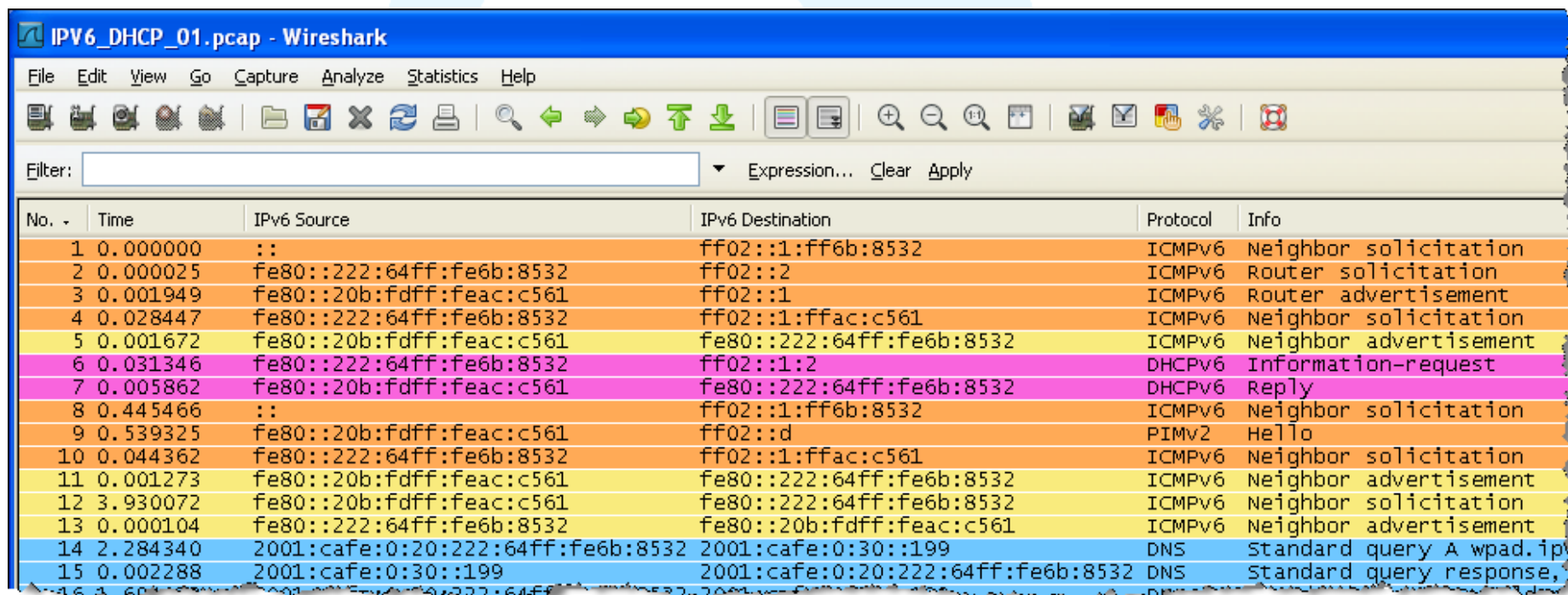
O = Other Flag / M = Managed Flag

Host configuration with DHCPv6

During this phase, the client is supplied with additional parameters:

Frame #

- 2 Router Discovery
- 3 Router Advertisement with 'Other Flag' set
- 6 Client contacts DHCP server
- 7 DHCP server delivers additional parameter like DNS, suffixes etc.

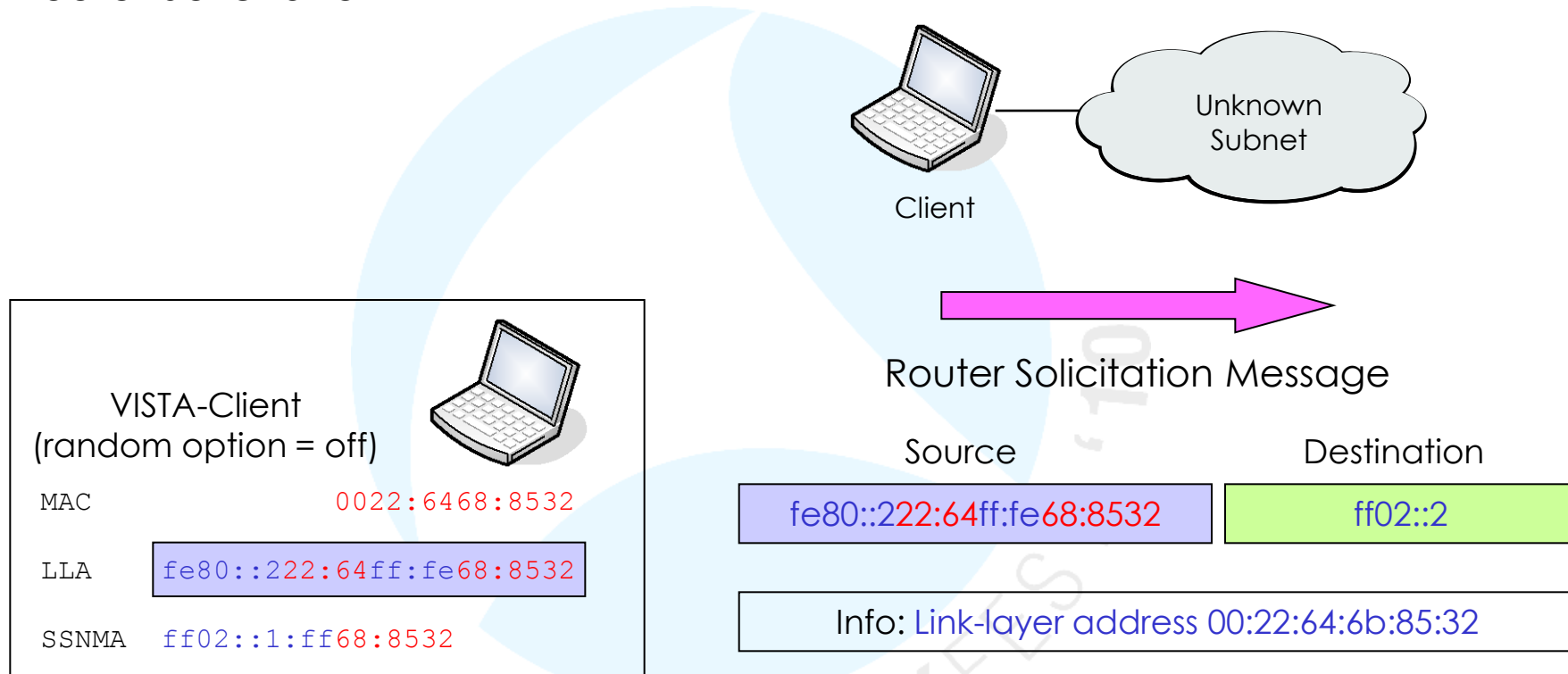


The image shows a Wireshark capture of IPv6 DHCPv6 traffic. The interface includes a menu bar (File, Edit, View, Go, Capture, Analyze, Statistics, Help), a toolbar with various icons, and a filter field. The main display area shows a list of network packets with columns for No., Time, IPv6 Source, IPv6 Destination, Protocol, and Info. The packets are color-coded: orange for ICMPv6, yellow for ICMPv6, pink for DHCPv6, and blue for DNS.

No.	Time	IPv6 Source	IPv6 Destination	Protocol	Info
1	0.000000	::	ff02::1:ff6b:8532	ICMPv6	Neighbor solicitation
2	0.000025	fe80::222:64ff:fe6b:8532	ff02::2	ICMPv6	Router solicitation
3	0.001949	fe80::20b:fdff:feac:c561	ff02::1	ICMPv6	Router advertisement
4	0.028447	fe80::222:64ff:fe6b:8532	ff02::1:ffac:c561	ICMPv6	Neighbor solicitation
5	0.001672	fe80::20b:fdff:feac:c561	fe80::222:64ff:fe6b:8532	ICMPv6	Neighbor advertisement
6	0.031346	fe80::222:64ff:fe6b:8532	ff02::1:2	DHCPv6	Information-request
7	0.005862	fe80::20b:fdff:feac:c561	fe80::222:64ff:fe6b:8532	DHCPv6	Reply
8	0.445466	::	ff02::1:ff6b:8532	ICMPv6	Neighbor solicitation
9	0.539325	fe80::20b:fdff:feac:c561	ff02::d	PIMv2	Hello
10	0.044362	fe80::222:64ff:fe6b:8532	ff02::1:ffac:c561	ICMPv6	Neighbor solicitation
11	0.001273	fe80::20b:fdff:feac:c561	fe80::222:64ff:fe6b:8532	ICMPv6	Neighbor advertisement
12	3.930072	fe80::20b:fdff:feac:c561	fe80::222:64ff:fe6b:8532	ICMPv6	Neighbor solicitation
13	0.000104	fe80::222:64ff:fe6b:8532	fe80::20b:fdff:feac:c561	ICMPv6	Neighbor advertisement
14	2.284340	2001:cafe:0:20:222:64ff:fe6b:8532	2001:cafe:0:30::199	DNS	standard query A wpad.ip
15	0.002288	2001:cafe:0:30::199	2001:cafe:0:20:222:64ff:fe6b:8532	DNS	standard query response,

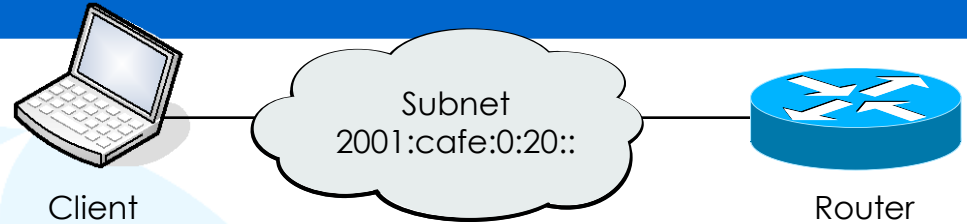
Host configuration with DHCPv6

Router Solicitation



Host configuration with DHCPv6

Router Advertisement



Router Configuration:



```
ipv6 unicast-routing

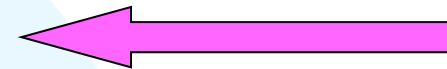
interface FastEthernet0/1
  ipv6 address 2001:CAFE:0:20::/64 eui-64
  ipv6 nd other-config-flag
  ipv6 dhcp relay destination
                                2001:CAFE:0:30::199

MAC                                000b:fdac:c561

LLA                                fe80::20b:fdff:feac:c561

Global Addresses
  2001:cafe:0:20:20b:fdff:feac:c561

SNMA                                ff02::1:ffac:c561
```



Router Advertisement Message

Source Destination

fe80::20b:fdff:feac:c561

ff02::1

Info: Link-layer address 00:0b:fd:ac:c5:61

Info: Flags Not managed, other

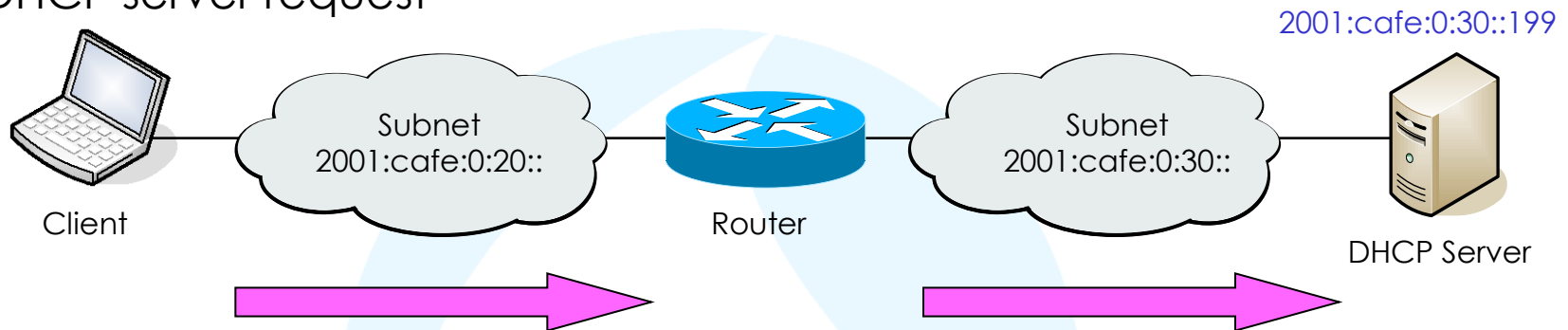
Info: MTU size 1500 bytes

Info: Prefix length 64

Info: Prefix 2001:cafe:0:20::

Host configuration with DHCPv6

DHCP server request



DHCP Information-request

Source

Destination

fe80::222:64ff:fe68:8532

ff02::1:2

Info: Link-layer address 00:22:64:6b:85:32

Info: Vendor-class-data

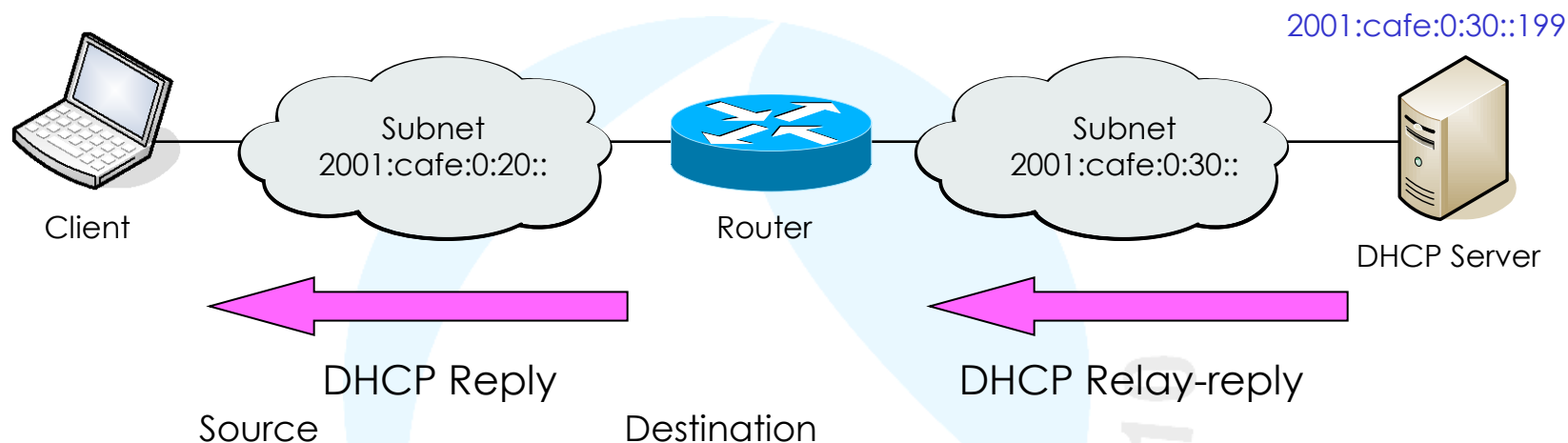
Option Request: Domain Search List

Option Request: DNS recursive name server

Option Request: Vendor-specific Information

Host configuration with DHCPv6

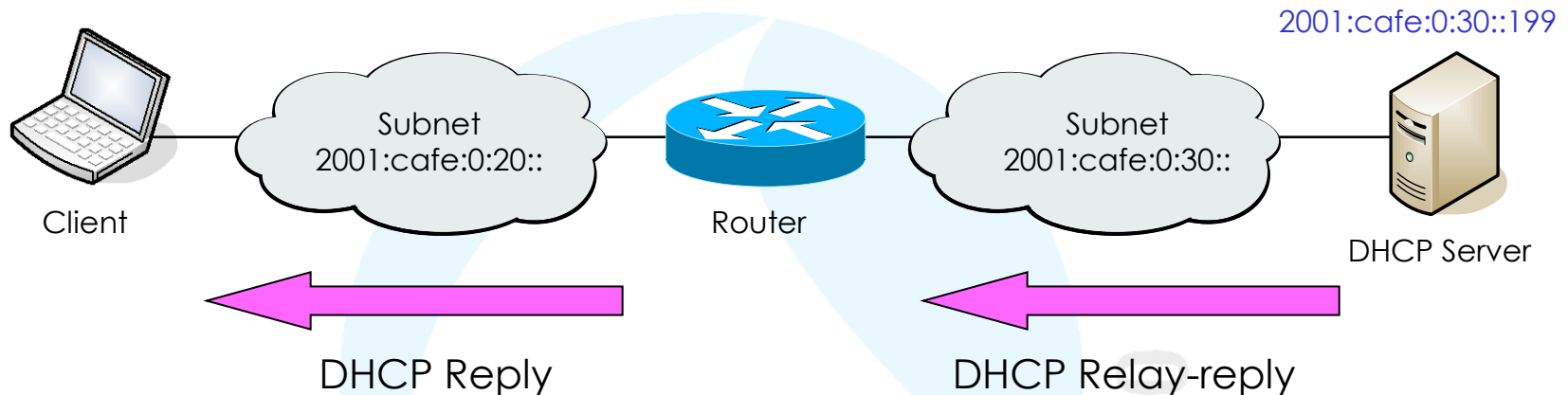
DHCP server reply



Source	Destination
fe80::20b:fdff:feac:c561	fe80::222:64ff:fe68:8532
Client ID Link-layer address 00:22:64:6b:85:32	
Option Domain Search List yourdomain.ch ipv6.ch dummy.ch	
Option DNS server address 2001:cafe:0:30::199	
Server ID Link-layer address: 00:0d:60:b0:38:63	

Host configuration with DHCPv6

DHCP server reply



IPV6_DHCP_Relay_01.pcap - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter: Expression... Clear Apply

No.	Time	IPv6 Source	IPv6 Destination	Protocol	Info
1	0.000000	2001:cafe:0:30::3	2001:cafe:0:30::199	DHCPv6	Relay-forw
2	0.000676	2001:cafe:0:30::199	ff02::1:ff00:3	ICMPv6	Neighbor solicitation
3	0.001176	2001:cafe:0:30::3	2001:cafe:0:30::199	ICMPv6	Neighbor advertisement
4	0.000041	2001:cafe:0:30::199	2001:cafe:0:30::3	DHCPv6	Relay-reply
5	4.998115	fe80::20b:fdff:feac:c560	2001:cafe:0:30::199	ICMPv6	Neighbor solicitation
6	0.000245	fe80::20ea:d4cf:1963:571f	ff02::1:ffac:c560	ICMPv6	Neighbor solicitation
7	0.001134	fe80::20b:fdff:feac:c560	fe80::20ea:d4cf:1963:571f	ICMPv6	Neighbor advertisement
8	0.000051	2001:cafe:0:30::199	fe80::20b:fdff:feac:c560	ICMPv6	Neighbor advertisement
9	2.248004	2001:cafe:0:20:222:64ff:fe6b:8532	2001:cafe:0:30::199	DNS	Standard query A wpad.ip
10	0.000274	2001:cafe:0:30::199	2001:cafe:0:20:222:64ff:fe6b:8532	DNS	Standard query response
11	1.696142	2001:cafe:0:20:222:64ff:fe6b:8532	2001:cafe:0:30::199	DNS	Standard query SRV _ldap

Host configuration with DHCPv6

At this state, the client is configured with all required parameters:



```
C:\windows\system32>ipconfig /all
```

```
Ethernet-Adapter LAN-Verbindung:
```

```
Verbindungsspezifisches DNS-Suffix: ipv6.ch
Beschreibung. . . . . : Marvell Yukon 88E8072 PCI-E Gigabit Ethernet
Physikalische Adresse . . . . . : 00-22-64-6B-85-32
DHCP aktiviert. . . . . : Ja
Autokonfiguration aktiviert . . . . : Ja
IPv6-Adresse. . . . . : 2001:cafe:0:20:222:64ff:fe6b:8532 (Bevorzugt)
Verbindungslokale IPv6-Adresse . . : fe80::222:64ff:fe6b:8532%13 (Bevorzugt)
Lease erhalten. . . . . : Samstag, 21. Februar 2009 11:46:04
Lease läuft ab. . . . . : Sonntag, 1. März 2009 11:46:03
Standardgateway . . . . . : fe80::20b:fdff:feac:c561%13
DHCPv6-IAID . . . . . : 251667044
DHCPv6-Client-DUID. . . . . : 00-01-00-01-10-D2-B9-65-00-22-64-6B-85-32
DNS-Server . . . . . : 2001:cafe:0:30::199
Suchliste für verbindungsspezifische DNS-Suffixe:
    yourdomain.ch
    ipv6.ch
    dummy.ch
```

Session Agenda

Introduction

IPv6 Header & Extensions

Address format, notations & types

Address Autoconfiguration

Neighbor discovery, Router discovery

Host configuration with DHCPv6

New DNS AAAA record

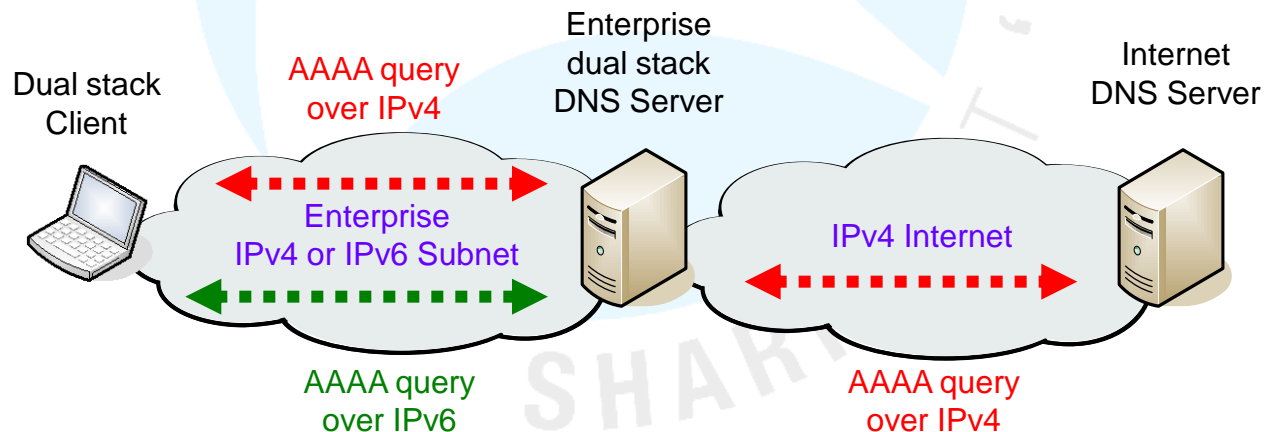
Transition technologies, ISATAP, Teredo, 6to4

IPv6 Routing Protocols

IPv6 Domain Name System (DNS)

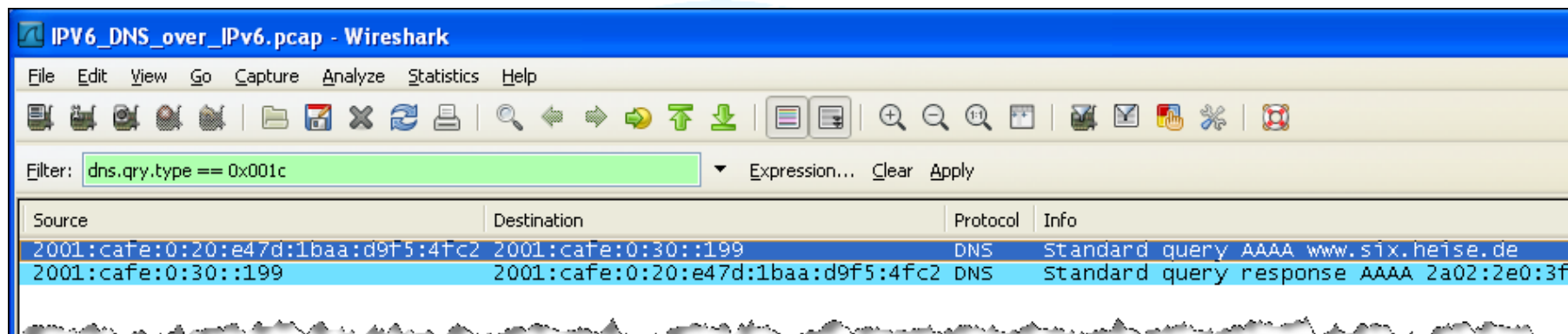
New AAAA resource record

- Due to the unhandy IPv6 address, DNS plays an **important role in IPv6**
- A new resource record type AAAA (**called quad-A**) has been defined
- During migration, DNS servers will support **dual stack IPv4/IPv6**
- IPv6 record queries and response may be transmitted over **IPv4** or **IPv6**



IPv6 Domain Name System (DNS)

- AAAA record query & response over IPv6

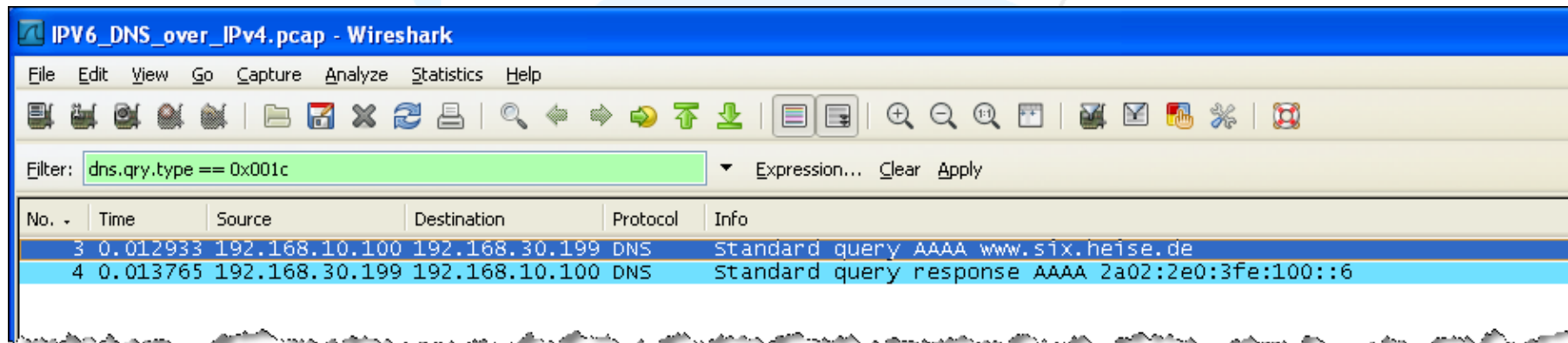


IPV6_DNS_over_IPv6.pcap - Wireshark

Filter: dns.qry.type == 0x001c

Source	Destination	Protocol	Info
2001:cafe:0:20:e47d:1baa:d9f5:4fc2	2001:cafe:0:30::199	DNS	Standard query AAAA www.six.heise.de
2001:cafe:0:30::199	2001:cafe:0:20:e47d:1baa:d9f5:4fc2	DNS	Standard query response AAAA 2a02:2e0:3f

- AAAA record query & response over IPv4



IPV6_DNS_over_IPv4.pcap - Wireshark

Filter: dns.qry.type == 0x001c

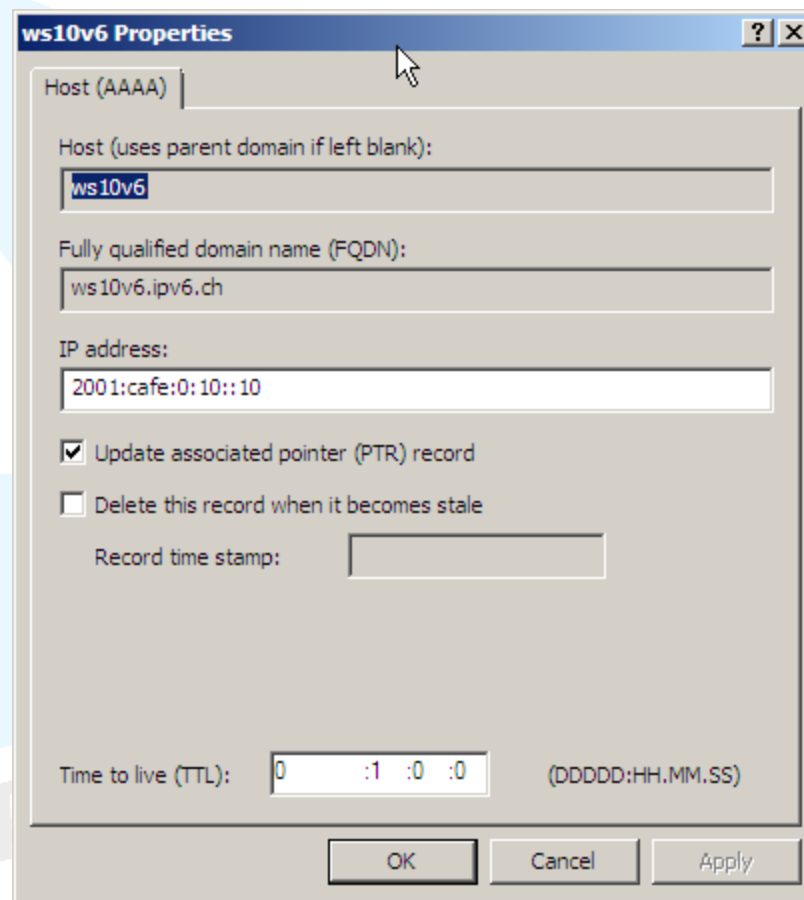
No. -	Time	Source	Destination	Protocol	Info
3	0.012933	192.168.10.100	192.168.30.199	DNS	Standard query AAAA www.six.heise.de
4	0.013765	192.168.30.199	192.168.10.100	DNS	Standard query response AAAA 2a02:2e0:3fe:100::6

IPv6 Domain Name System (DNS)

New AAAA resource record

- Create **AAAA record** by entering host name and IPv6 address

- Pointer record will be created **automatically** if selected →



The screenshot shows the 'ws10v6 Properties' dialog box with the following fields and values:

- Host (AAAA): ws10v6
- Host (uses parent domain if left blank): ws10v6
- Fully qualified domain name (FQDN): ws10v6.ipv6.ch
- IP address: 2001:cafe:0:10::10
- Update associated pointer (PTR) record
- Delete this record when it becomes stale
- Record time stamp: (empty)
- Time to live (TTL): 0 :1 :0 :0 (DDDDD:HH.MM.SS)

Session Agenda

Introduction

IPv6 Header & Extensions

Address format, notations & types

Address Autoconfiguration

Neighbor discovery, Router discovery

Host configuration with DHCPv6

New DNS AAAA record

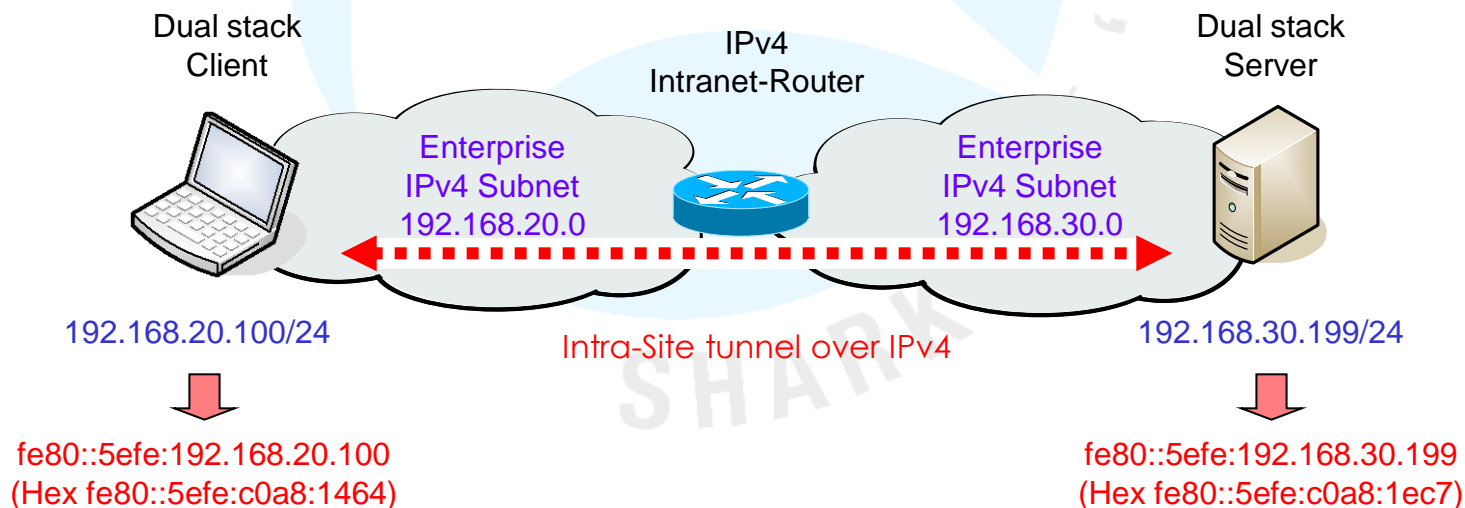
Transition technologies, ISATAP, Teredo, 6to4

IPv6 Routing Protocols

IPv6 Transition Technologies

ISATAP (Intra-Site Automatic Tunnel Addressing Protocol)

- ISATAP enables easy deployment of IPv6 in existing IPv4 infrastructure
- ISATAP hosts do not require any manual configuration
- IPv6 address contains an embedded IPv4 source or destination address
- ISATAP clients uses locally assigned IPv4 address (public or private) to create the 64-bit interface identifier



IPv6 Transition Technologies

The image shows a Wireshark capture window titled "IPv6_Ping_through_ISATAP_tunnel.pcap - Wireshark". The filter is set to "vlan.id == 20". The packet list shows several ICMPv6 Echo request and reply packets. The packet details pane is expanded to show the structure of the first packet (Frame 1), which is an Internet Protocol version 6 (IPv6) packet. The details include the traffic class, flow label, payload length, next header (ICMPv6), hop limit, source, and destination addresses.

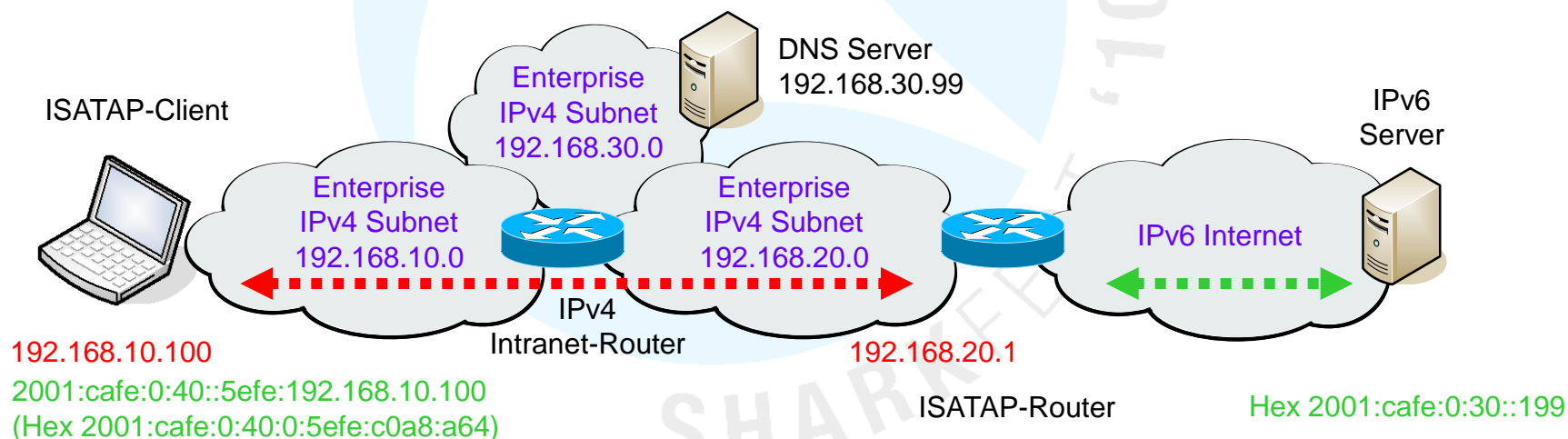
No.	Time	IPv6 Source	IPv6 Destination	IPv4 Source	IPv4 Destination	Protocol	Info
1	0.000000	fe80::5efe:c0a8:1464	fe80::5efe:c0a8:1ec7	192.168.20.100	192.168.30.199	ICMPv6	Echo request
4	0.000819	fe80::5efe:c0a8:1ec7	fe80::5efe:c0a8:1464	192.168.30.199	192.168.20.100	ICMPv6	Echo reply
5	1.002117	fe80::5efe:c0a8:1464	fe80::5efe:c0a8:1ec7	192.168.20.100	192.168.30.199	ICMPv6	Echo request
8	0.000794	fe80::5efe:c0a8:1ec7	fe80::5efe:c0a8:1464	192.168.30.199	192.168.20.100	ICMPv6	Echo reply
9	1.013203	fe80::5efe:c0a8:1464	fe80::5efe:c0a8:1ec7	192.168.20.100	192.168.30.199	ICMPv6	Echo request
12	0.000811	fe80::5efe:c0a8:1ec7	fe80::5efe:c0a8:1464	192.168.30.199	192.168.20.100	ICMPv6	Echo reply
13	1.013145	fe80::5efe:c0a8:1464	fe80::5efe:c0a8:1ec7	192.168.20.100	192.168.30.199	ICMPv6	Echo request
16	0.000854	fe80::5efe:c0a8:1ec7	fe80::5efe:c0a8:1464	192.168.30.199	192.168.20.100	ICMPv6	Echo reply

Frame 1 (118 bytes on wire, 118 bytes captured)
Ethernet II, Src: HewlettP_6b:85:32 (00:22:64:6b:85:32), Dst: Cisco_ac:c5:60 (00:0b:fd:ac:c5:60)
802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 20
Internet Protocol, Src: 192.168.20.100 (192.168.20.100), Dst: 192.168.30.199 (192.168.30.199)
Internet Protocol version 6
0110 = Version: 6
.... 0000 0000 = Traffic class: 0x00000000
.... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
Payload length: 40
Next header: ICMPv6 (0x3a)
Hop limit: 128
Source: fe80::5efe:c0a8:1464 (fe80::5efe:c0a8:1464)
Destination: fe80::5efe:c0a8:1ec7 (fe80::5efe:c0a8:1ec7)
Internet Control Message Protocol v6

IPv6 Transition Technologies

ISATAP (Intra-Site Automatic Tunnel Addressing Protocol)

- ISATAP can also be used to access **native IPv6 destinations**
- Client resolves **ISATAP router** IPv4 address through internal **DNS**
- Client request **IPv6 global unicast** prefix from ISATAP router
- Client sends **IPv6 in IPv4 embedded packets** to ISATAP router



- ISATAP router **unpacks embedded packets** and forwards them

IPv6 Transition Technologies

The image shows a Wireshark capture window titled "IPv6_Ping_through_ISATAP_router.pcap". The main pane displays a list of network packets. The columns are: No., Time, IPv6 Source, IPv6 Destination, IPv4 Source, IPv4 Destination, Protocol, and Info. The packets are ICMPv6 Echo requests and replies. The IPv6 addresses are 2001:cafe:0:40:0:5efe:c0a8:a64 and 2001:cafe:0:30::199. The IPv4 addresses are 192.168.10.100 and 192.168.20.1. The bottom pane shows the details of the selected packet (Frame 3), including Ethernet II, 802.1Q Virtual LAN, Internet Protocol, Internet Protocol Version 6, and Internet Control Message Protocol v6.

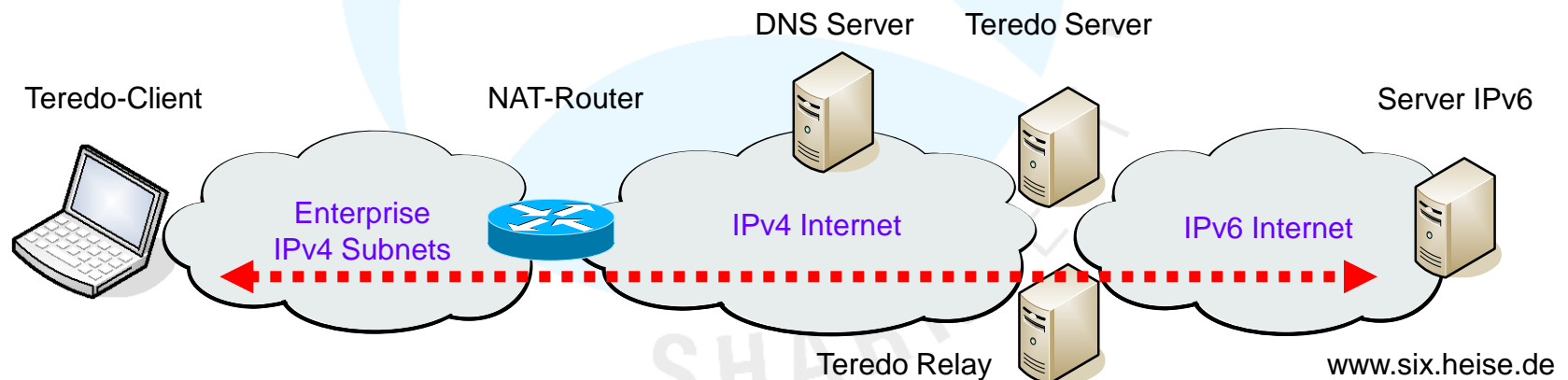
No.	Time	IPv6 Source	IPv6 Destination	IPv4 Source	IPv4 Destination	Protocol	Info
3	0.610461	2001:cafe:0:40:0:5efe:c0a8:a64	2001:cafe:0:30::199	192.168.10.100	192.168.20.1	ICMPv6	Echo requ
4	0.001282	2001:cafe:0:40:0:5efe:c0a8:a64	2001:cafe:0:30::199			ICMPv6	Echo requ
5	0.000339	2001:cafe:0:30::199	2001:cafe:0:40:0:5efe:c0a8:a64			ICMPv6	Echo repl
6	0.001015	2001:cafe:0:30::199	2001:cafe:0:40:0:5efe:c0a8:a64	192.168.20.1	192.168.10.100	ICMPv6	Echo repl
7	0.996878	2001:cafe:0:40:0:5efe:c0a8:a64	2001:cafe:0:30::199	192.168.10.100	192.168.20.1	ICMPv6	Echo requ
8	0.001323	2001:cafe:0:40:0:5efe:c0a8:a64	2001:cafe:0:30::199			ICMPv6	Echo requ
9	0.000266	2001:cafe:0:30::199	2001:cafe:0:40:0:5efe:c0a8:a64			ICMPv6	Echo repl
10	0.000992	2001:cafe:0:30::199	2001:cafe:0:40:0:5efe:c0a8:a64	192.168.20.1	192.168.10.100	ICMPv6	Echo repl
11	0.995744	2001:cafe:0:40:0:5efe:c0a8:a64	2001:cafe:0:30::199	192.168.10.100	192.168.20.1	ICMPv6	Echo requ
12	0.001326	2001:cafe:0:40:0:5efe:c0a8:a64	2001:cafe:0:30::199			ICMPv6	Echo requ
13	0.000317	2001:cafe:0:30::199	2001:cafe:0:40:0:5efe:c0a8:a64			ICMPv6	Echo repl
14	0.000933	2001:cafe:0:30::199	2001:cafe:0:40:0:5efe:c0a8:a64	192.168.20.1	192.168.10.100	ICMPv6	Echo repl
15	0.995771	2001:cafe:0:40:0:5efe:c0a8:a64	2001:cafe:0:30::199	192.168.10.100	192.168.20.1	ICMPv6	Echo requ
16	0.001304	2001:cafe:0:40:0:5efe:c0a8:a64	2001:cafe:0:30::199			ICMPv6	Echo requ
17	0.000288	2001:cafe:0:30::199	2001:cafe:0:40:0:5efe:c0a8:a64			ICMPv6	Echo repl

Frame 3 (118 bytes on wire, 118 bytes captured)
Ethernet II, Src: HewlettP_6b:85:32 (00:22:64:6b:85:32), Dst: Cisco_ac:c5:60 (00:0b:fd:ac:c5:60)
802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 10
Internet Protocol, Src: 192.168.10.100 (192.168.10.100), Dst: 192.168.20.1 (192.168.20.1)
Internet Protocol Version 6
Internet Control Message Protocol v6

IPv6 Transition Technologies

Teredo Tunnel

- Tunneling method named after **Teredo Navalis** (Schiffsbohrwurm)
- Teredo **encapsulates IPv6** packets within **UDP/IPv4 datagram**
- Most **NAT Routers** can **forward** these packets properly
- Teredo allows a client to communicate with a **native IPv6 server**
- Teredo **Server** and Teredo **Relay** in the Internet care for transitions

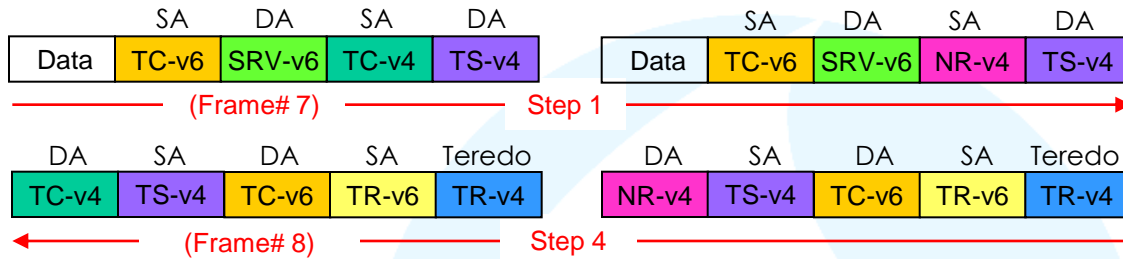


- Teredo **tunnels** are set up **automatically**, no configuration is needed.

IPv6 Transition Technologies

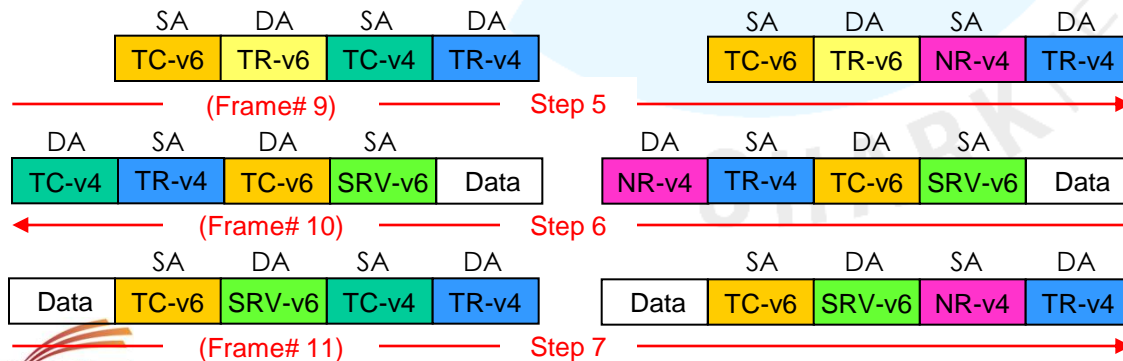
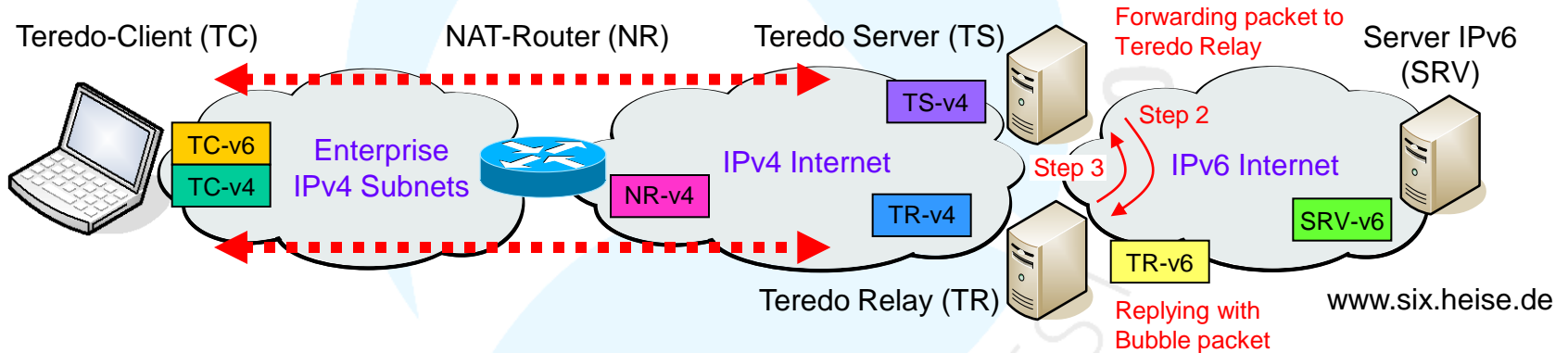
Teredo Tunnel initialization

(Trace File [IPV6_Teredo_www.six.heise.de](#))



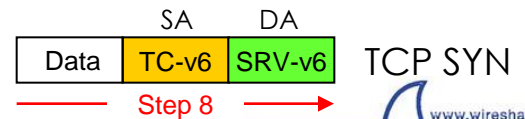
Echo Request

Bubble Packet (with IP and UDP Port of Teredo Relay)



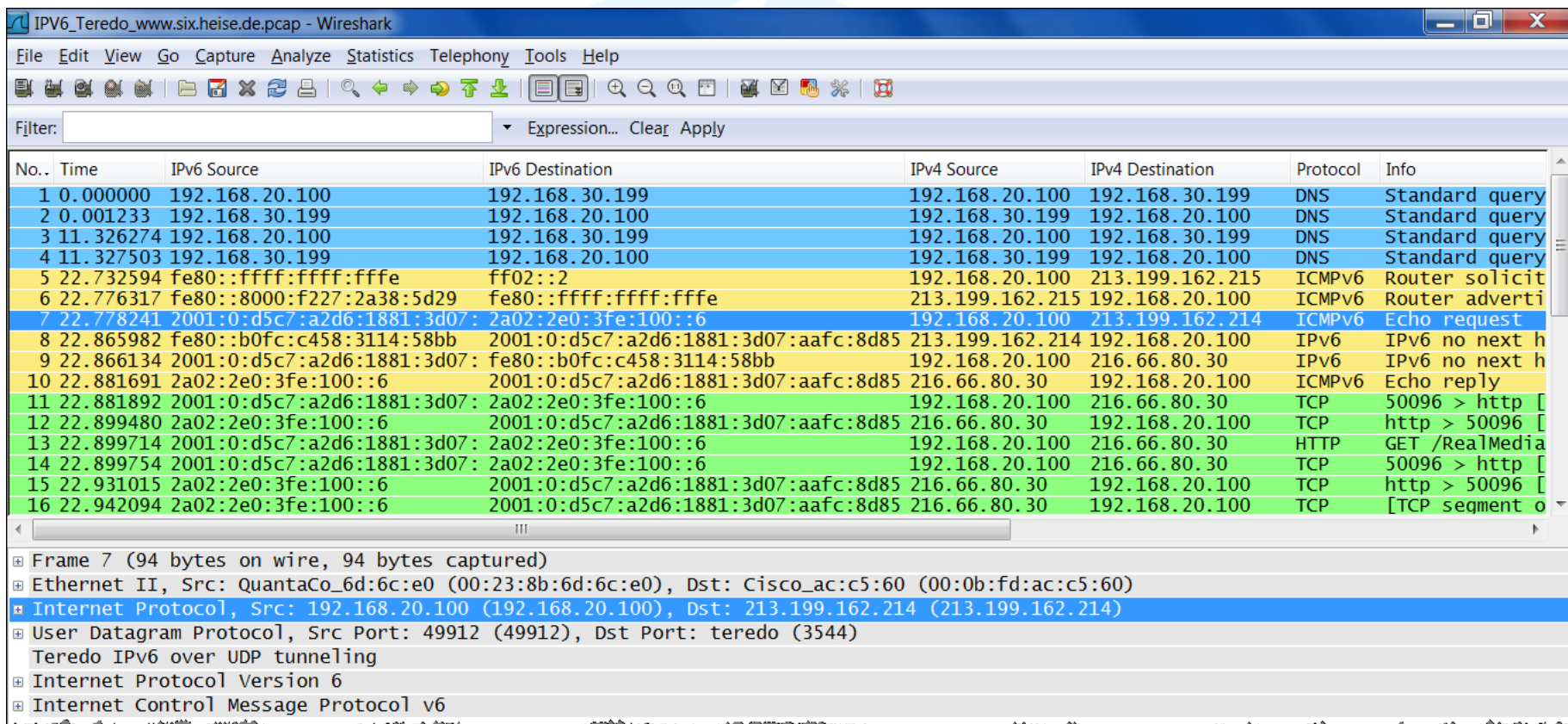
Bubble Packet

Echo Reply



IPv6 Transition Technologies

Teredo Tunnel initialization



The image shows a Wireshark capture window titled "IPV6_Teredo_www.six.heise.de.pcap - Wireshark". The interface includes a menu bar (File, Edit, View, Go, Capture, Analyze, Statistics, Telephony, Tools, Help), a toolbar with various icons, and a filter field. The main display area shows a list of network packets with columns for No., Time, IPv6 Source, IPv6 Destination, IPv4 Source, IPv4 Destination, Protocol, and Info. The packets are color-coded: blue for DNS, yellow for ICMPv6, and green for IPv6, TCP, and HTTP. Packet 7 is highlighted in blue and selected in the packet list pane below. The packet list pane shows the following details for Frame 7:

- Frame 7 (94 bytes on wire, 94 bytes captured)
- Ethernet II, Src: QuantaCo_6d:6c:e0 (00:23:8b:6d:6c:e0), Dst: Cisco_ac:c5:60 (00:0b:fd:ac:c5:60)
- Internet Protocol, Src: 192.168.20.100 (192.168.20.100), Dst: 213.199.162.214 (213.199.162.214)
- User Datagram Protocol, Src Port: 49912 (49912), Dst Port: teredo (3544)
 - Teredo IPv6 over UDP tunneling
 - Internet Protocol Version 6
 - Internet Control Message Protocol v6

IPv6 Transition Technologies

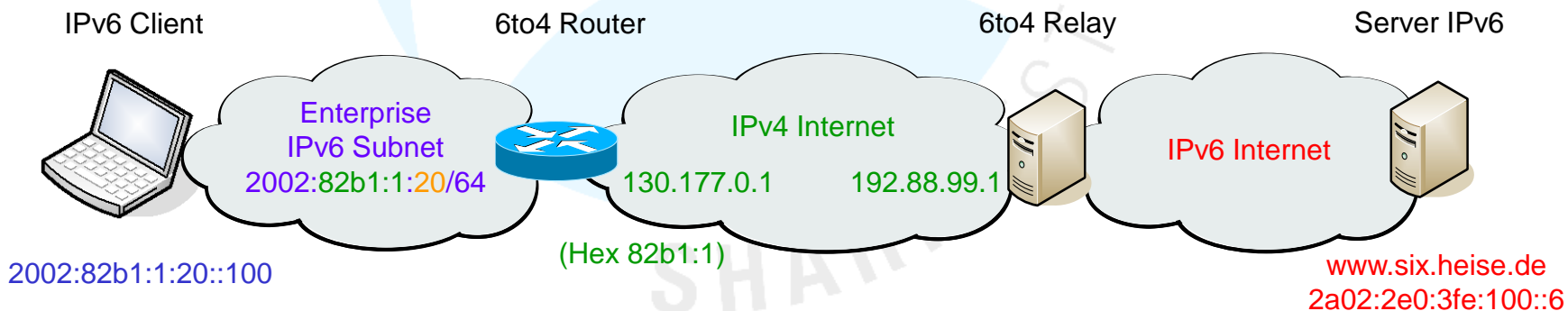
Teredo Tunnel

- When starting, a Windows-based computer using Teredo resolves the IPv4 address of the Teredo server teredo.ipv6.microsoft.com
- By the Router solicitation/advertisement dialog through Teredo, the client receives a **valid IPv6 prefix**
- When activated, the Teredo client contacts Teredo server to obtain information such as the **type of NAT** that the client is behind
- If the client has only link-local or Teredo IPv6 addresses assigned, then the DNS Client will send **only queries for A records**
- The client needs at least **one valid IPv6 address** configured (may be manually) in order to query for AAAA records
- Windows Vista Client computers will always use **IPv6 over IPv4**
- A default route may have to be configured on Teredo interface:
netsh interface ipv6 add route ::/0 14 ← Teredo Interface ID

IPv6 Transition Technologies

6to4 Tunnel

- 6to4 provides connectivity between IPv6 sites across the IPv4 Internet
- 6to4 uses the global address prefix $2002:WWXX:YYZZ::/48$
- $WWXX:YYZZ$ is the colon-hexadecimal representation of the public IPv4
- 6to4 allows to reach IPv6 Internet destinations over an IPv4 ISP
- Within a site, local IPv6 routers advertise $2002:WWXX:YYZZ:SubnetID::/64$
- Client uses announced prefix to build its own address $2002:82b1:1:20::100$

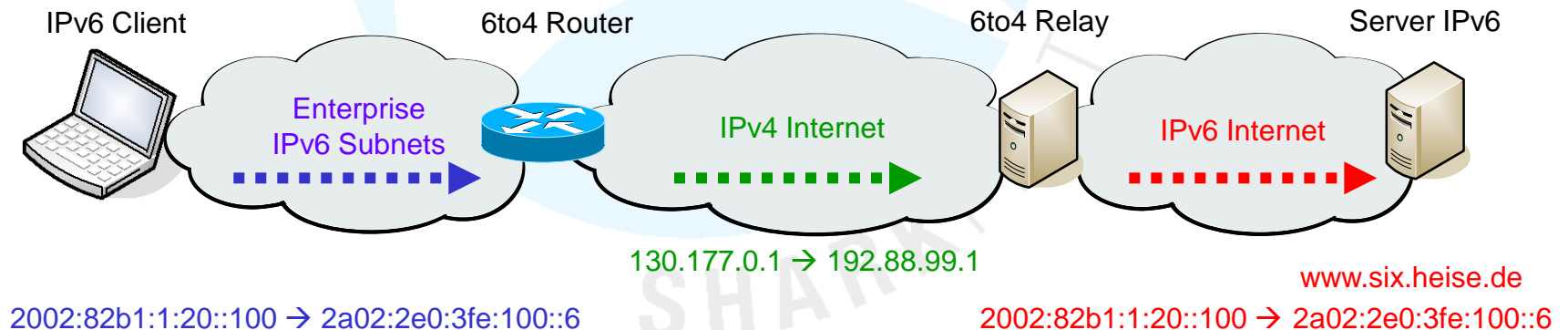


- $192.88.99.1$ is the anycast address of the nearest public 6to4 relay

IPv6 Transition Technologies

6to4 Tunnel setup

1. IPv6 client builds packet with IPv6 source and IPv6 destination address
2. Client forwards pure IPv6 packet to 6to4 router through IPv6 intranet
3. 6to4 router encapsulates packet in IPv4: source address 130.177.0.1
4. 6to4 router sends the packet to Relay anycast-address 192.88.99.1
5. 6to4 relay removes IPv4 header and forwards the pure IPv6 packet



Session Agenda

Introduction

IPv6 Header & Extensions

Address format, notations & types

Address Autoconfiguration

Neighbor discovery, Router discovery

Host configuration with DHCPv6

New DNS AAAA record

Transition technologies, ISATAP, Teredo, 6to4

IPv6 Routing Protocols

IPv6 Routing Protocols

- All major routing protocols have stable IPv6 support
- RIP, OSPF, IS-IS and BGP have been renewed or extended for IPv6
- All routing protocols can coexist with IPv4 routing protocols
- Static route configuration syntax is the same as in IPv4



IPv6 Routing Protocols

Routing Information Protocol - next generation (RIPng)

IPv6_RIPng.pcap - Wireshark

Filter: ripng

No.	Time	IPv6 Source	IPv6 Destination	Protocol	Info	Source MAC	Dest. MAC
1	0.000000	fe80::20b:fdff:feac:c560	ff02::9	RIPng version 1	Response	Cisco_ac:c5:60	IPv6mcast_00:00:00:09
2	28.983855	fe80::20b:fdff:feac:c560	ff02::9	RIPng version 1	Response	Cisco_ac:c5:60	IPv6mcast_00:00:00:09
3	28.859887	fe80::20b:fdff:feac:c560	ff02::9	RIPng version 1	Response	Cisco_ac:c5:60	IPv6mcast_00:00:00:09
4	25.911869	fe80::20b:fdff:feac:c560	ff02::9	RIPng version 1	Response	Cisco_ac:c5:60	IPv6mcast_00:00:00:09

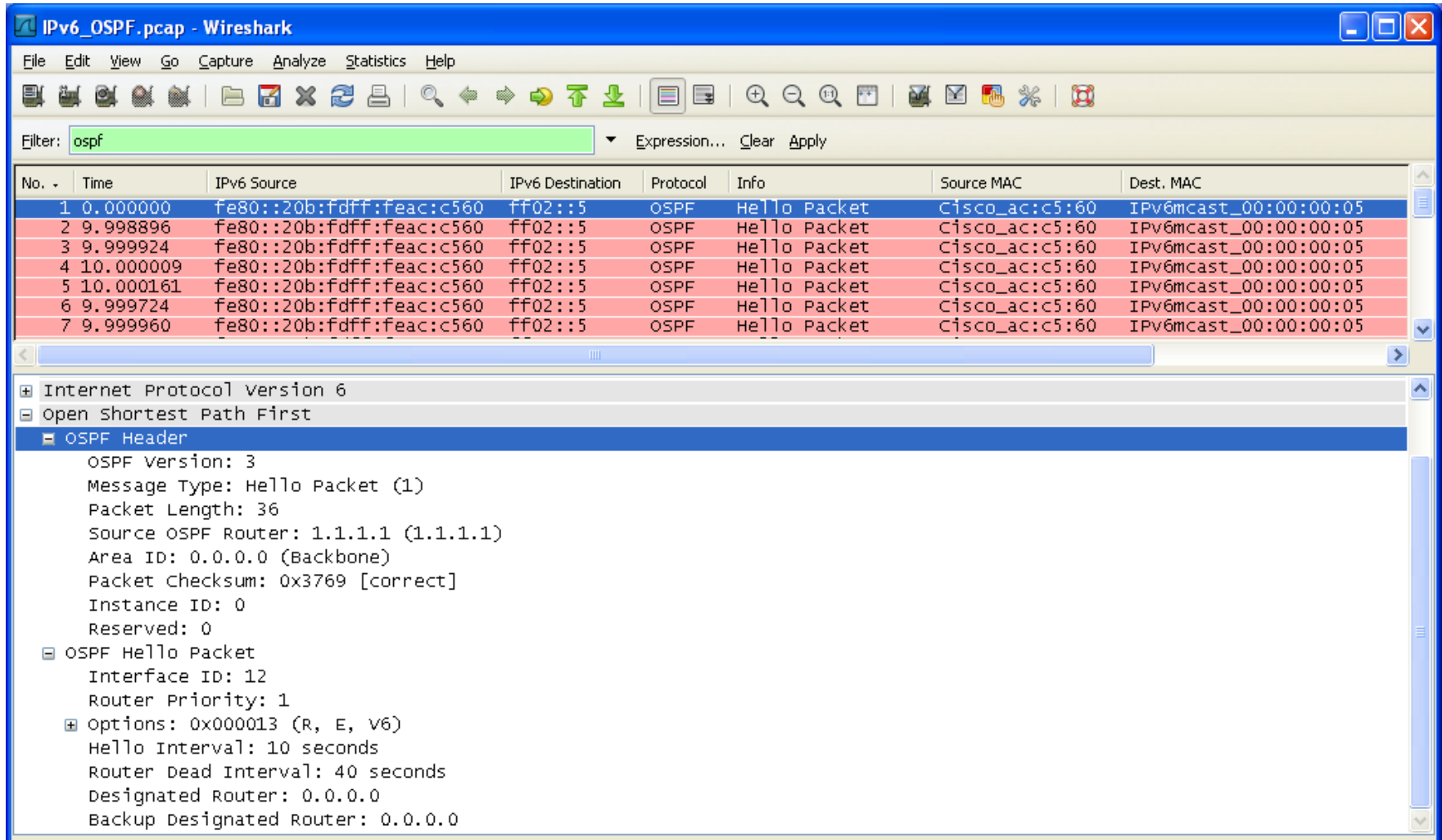
User Datagram Protocol, Src Port: ripng (521), Dst Port: ripng (521)

RIPng

- Command: Response (2)
- Version: 1
- IP Address: 2001:cafe:0:20::/64, Metric: 1
 - IP Address: 2001:cafe:0:20::
 - Tag: 0x0000
 - Prefix length: 64
 - Metric: 1
- IP Address: 2001:cafe:0:30::/64, Metric: 1
 - IP Address: 2001:cafe:0:30::
 - Tag: 0x0000
 - Prefix length: 64
 - Metric: 1
- IP Address: 2001:cafe:0:10::/64, Metric: 1
 - IP Address: 2001:cafe:0:10::
 - Tag: 0x0000
 - Prefix length: 64
 - Metric: 1

IPv6 Routing Protocols

Open Shortest Path First - Version 3 (OSPFv3)



The image shows a Wireshark capture window titled "IPv6_OSPF.pcap - Wireshark". The filter is set to "ospf". The packet list shows seven OSPF Hello Packets. The packet details pane is expanded to show the OSPF Header and Hello Packet fields.

No.	Time	IPv6 Source	IPv6 Destination	Protocol	Info	Source MAC	Dest. MAC
1	0.000000	fe80::20b:fdff:feac:c560	ff02::5	OSPF	Hello Packet	Cisco_ac:c5:60	IPv6mcast_00:00:00:05
2	9.998896	fe80::20b:fdff:feac:c560	ff02::5	OSPF	Hello Packet	Cisco_ac:c5:60	IPv6mcast_00:00:00:05
3	9.999924	fe80::20b:fdff:feac:c560	ff02::5	OSPF	Hello Packet	Cisco_ac:c5:60	IPv6mcast_00:00:00:05
4	10.000009	fe80::20b:fdff:feac:c560	ff02::5	OSPF	Hello Packet	Cisco_ac:c5:60	IPv6mcast_00:00:00:05
5	10.000161	fe80::20b:fdff:feac:c560	ff02::5	OSPF	Hello Packet	Cisco_ac:c5:60	IPv6mcast_00:00:00:05
6	9.999724	fe80::20b:fdff:feac:c560	ff02::5	OSPF	Hello Packet	Cisco_ac:c5:60	IPv6mcast_00:00:00:05
7	9.999960	fe80::20b:fdff:feac:c560	ff02::5	OSPF	Hello Packet	Cisco_ac:c5:60	IPv6mcast_00:00:00:05

Internet Protocol Version 6
Open Shortest Path First
OSPF Header
OSPF Version: 3
Message Type: Hello Packet (1)
Packet Length: 36
Source OSPF Router: 1.1.1.1 (1.1.1.1)
Area ID: 0.0.0.0 (Backbone)
Packet Checksum: 0x3769 [correct]
Instance ID: 0
Reserved: 0
OSPF Hello Packet
Interface ID: 12
Router Priority: 1
Options: 0x000013 (R, E, V6)
Hello Interval: 10 seconds
Router Dead Interval: 40 seconds
Designated Router: 0.0.0.0
Backup Designated Router: 0.0.0.0

Session Summary

- Verify IPv6 readiness of your suppliers
 - Verify IPv6 readiness of your applications
 - IPv6 can perfectly coexist with IPv4
 - Network migration can be done smoothly
 - Train yourself and your people
 - Wireshark is the perfect tool to learn and train
- Interesting IPv6 references:
- www.sixxs.net non-profit, non-cost service for Local Internet Registries (LIR's) and end users
 - www.ipv6.org how-to articles, FAQ, technical specifications, mailing list, details of IPv6-enabled applications, and links

How-to get



Thank you for your attention



© SeaPics.com