Discovering IPv6 with Wireshark

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Rolf Leutert

Network Consultant & Trainer | Leutert NetServices | Switzerland

SHARKFEST **'10**

Stanford University

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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

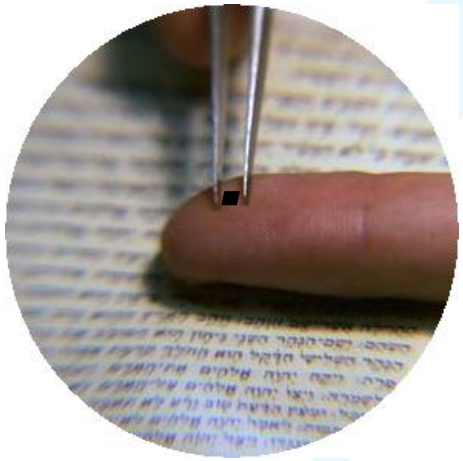
IPv4 address, 32 bits 192.168.20.30

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 millimeter^2

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 km^2)

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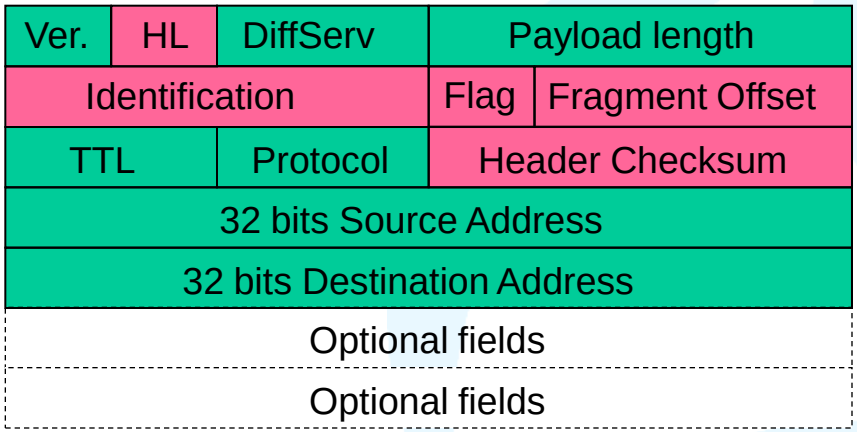
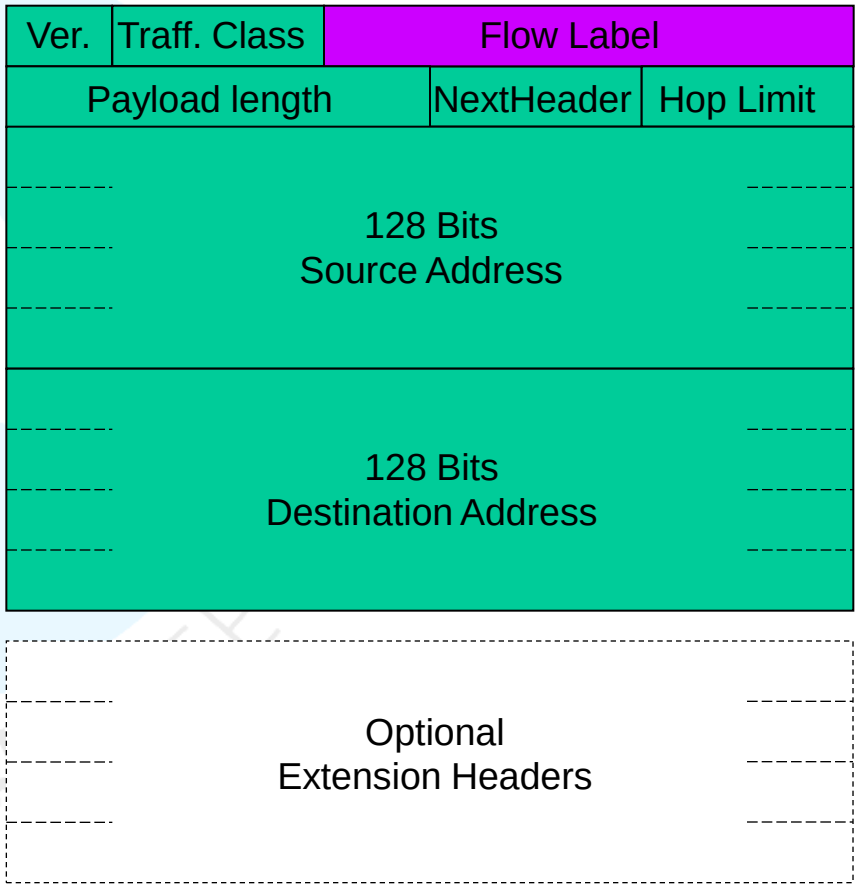
IPv6 Routing Protocols

IPv6 Headers & Extensions

IPv4 Header
(20 Bytes without options)



IPv6 Header
(40 Bytes without extensions)




Fields changed

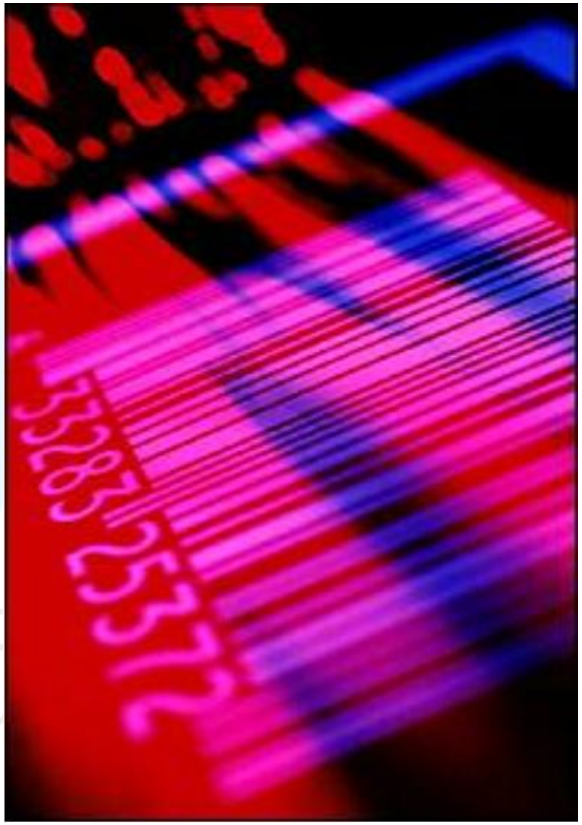

Fields removed


Fields added

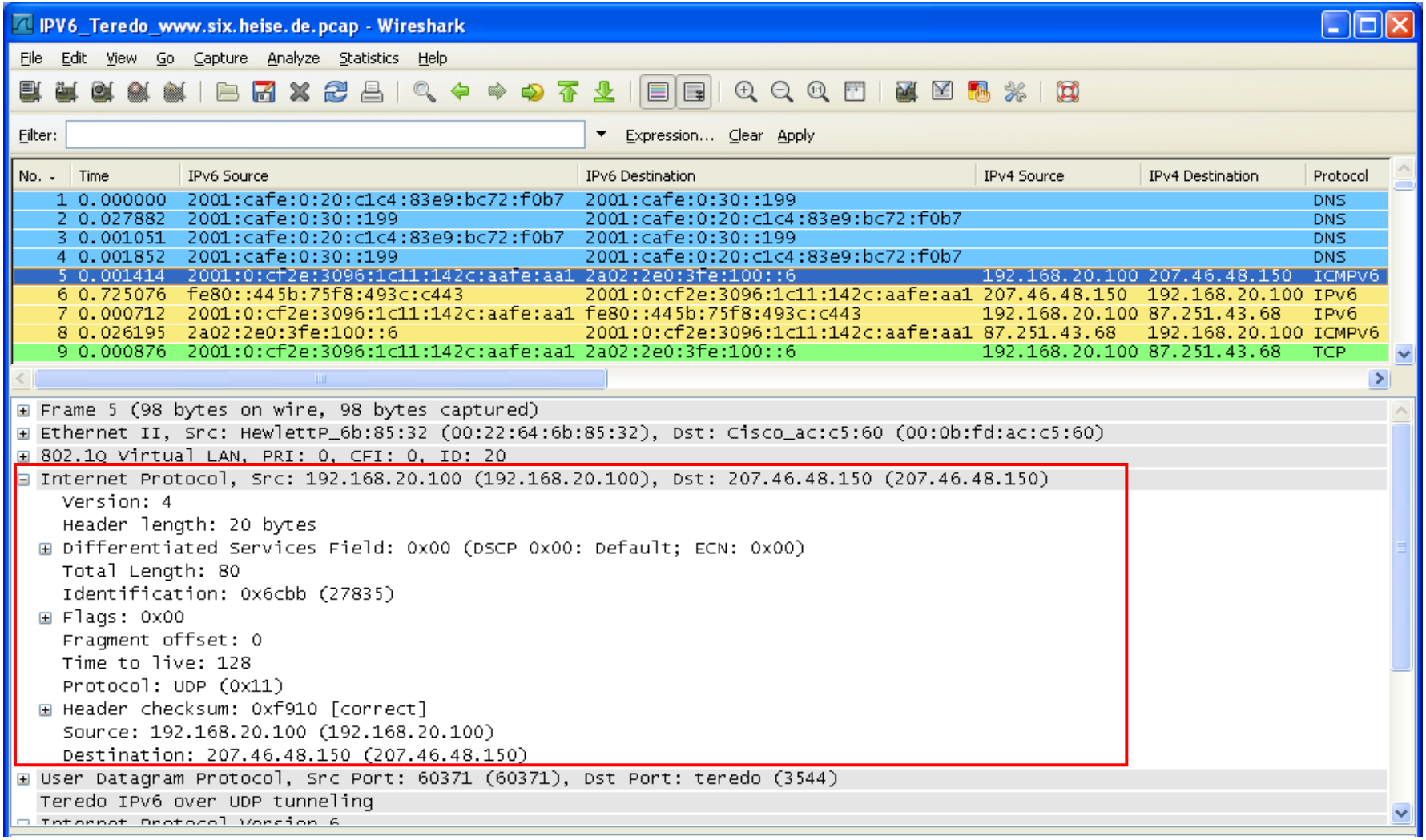
IPv6 Header & Extensions

IPv6 Flow Label

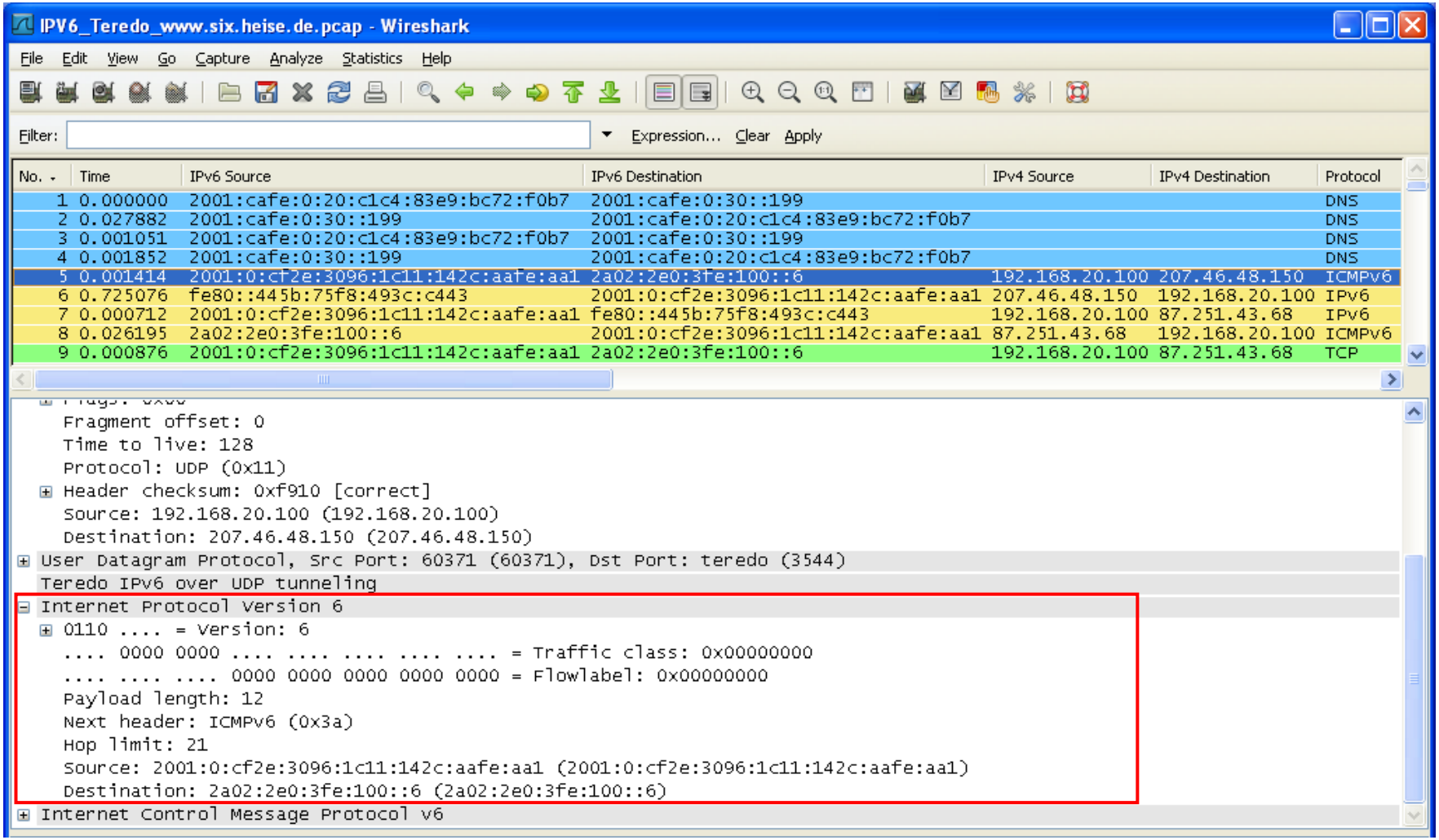
- A Flow is a sequence of packets sent from a particular source to a particular destination
- A Flow Label could significantly speed up packet processing on routers
- RFC 3697 defines the use of the 20 bit IPv6 Flow Label initiated by the source nodes
- A Flow path needs to be established on all routers 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

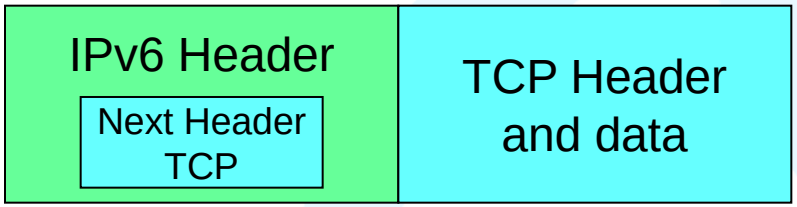


IPv6 Header & Extensions

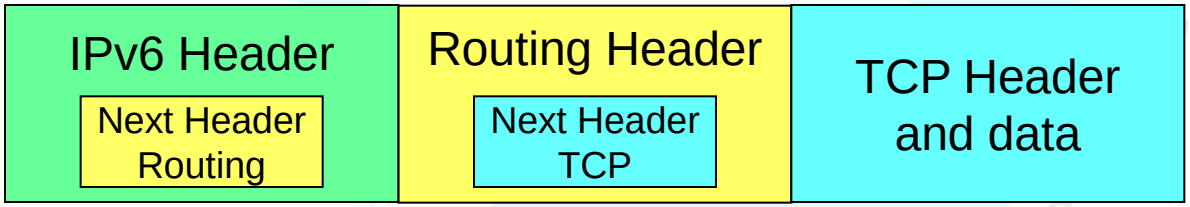


IPv6 Header & Extensions

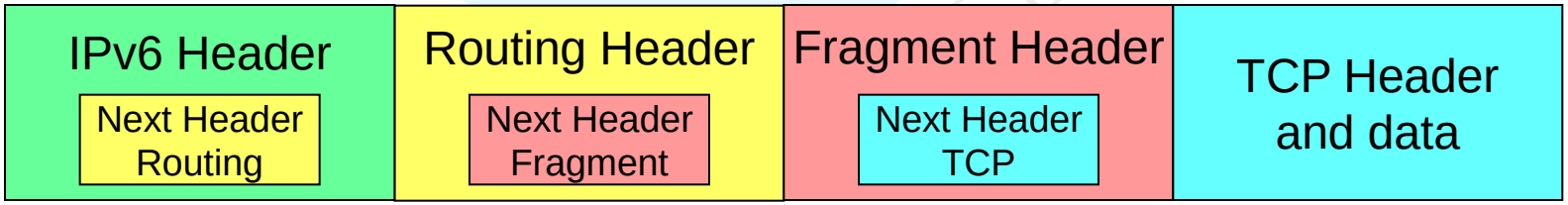
- IPv6 offers modular header composition adding optional information
- Basic IPv6 header can be followed by one ore more extension headers



Basic header



Basic header with one extension



Basic header with two extension +

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

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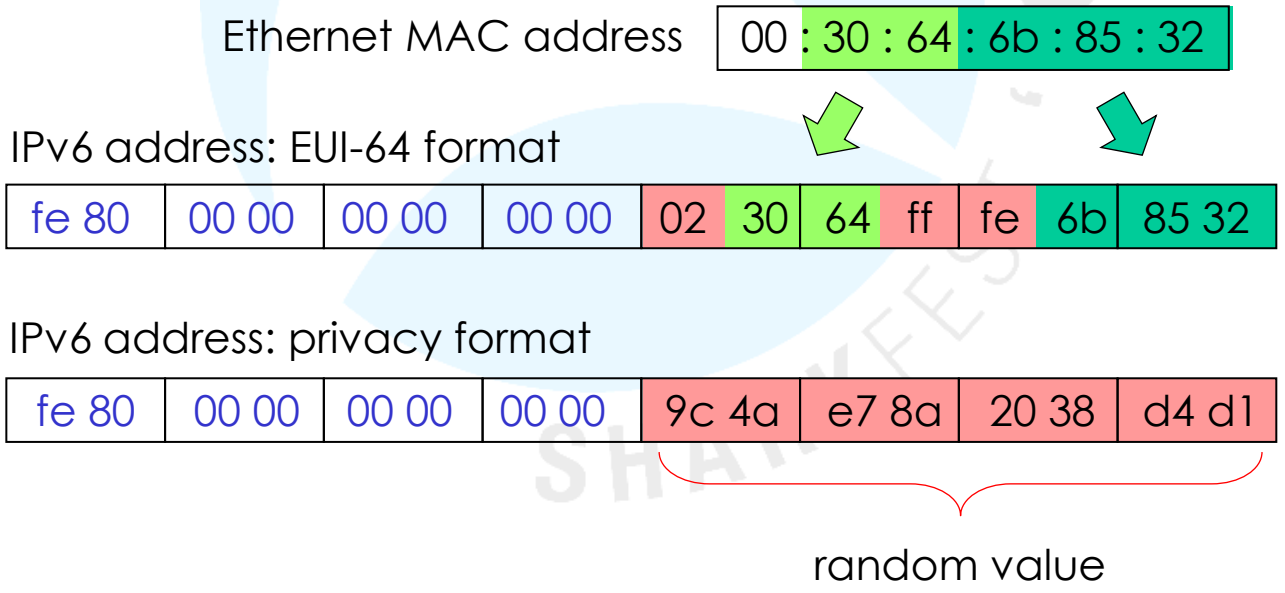
IPv6 Routing Protocols

Address Autoconfiguration

IPv6 Stateless Address Autoconfiguration (SLAAC)

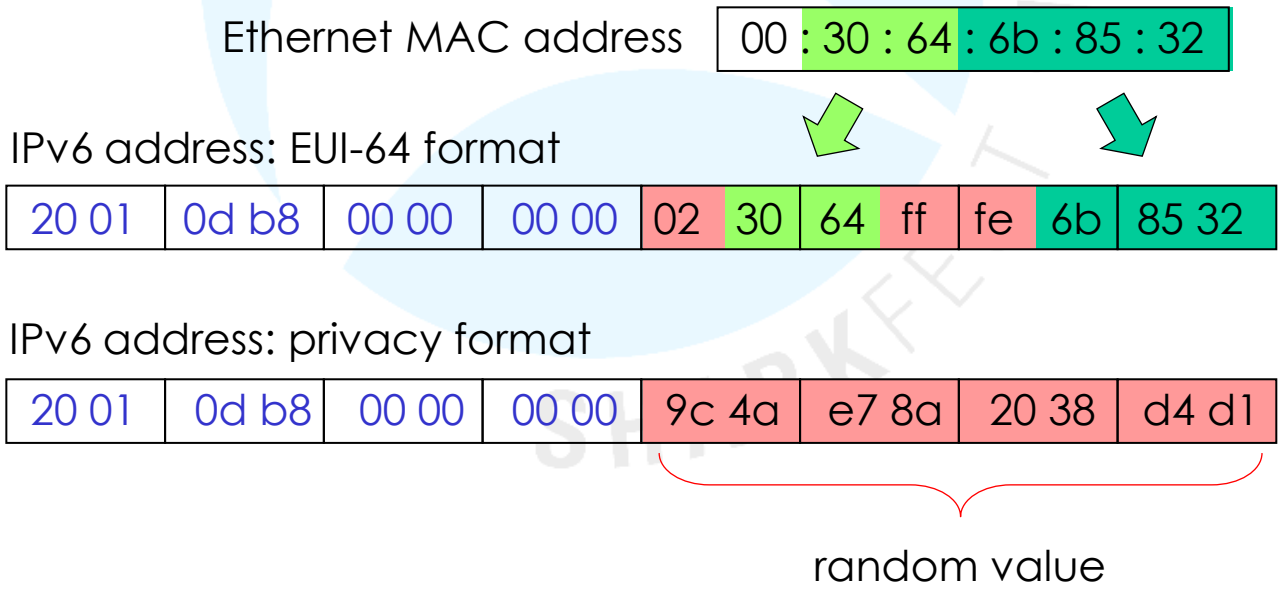
- An IPv6 host will autoconfigure a link-local address for each interface
- Prefix for link-local address is fe80::/64
- Interface ID is either derived from MAC address or a random value



Address Autoconfiguration

IPv6 Stateless Address Autoconfiguration (SLAAC)

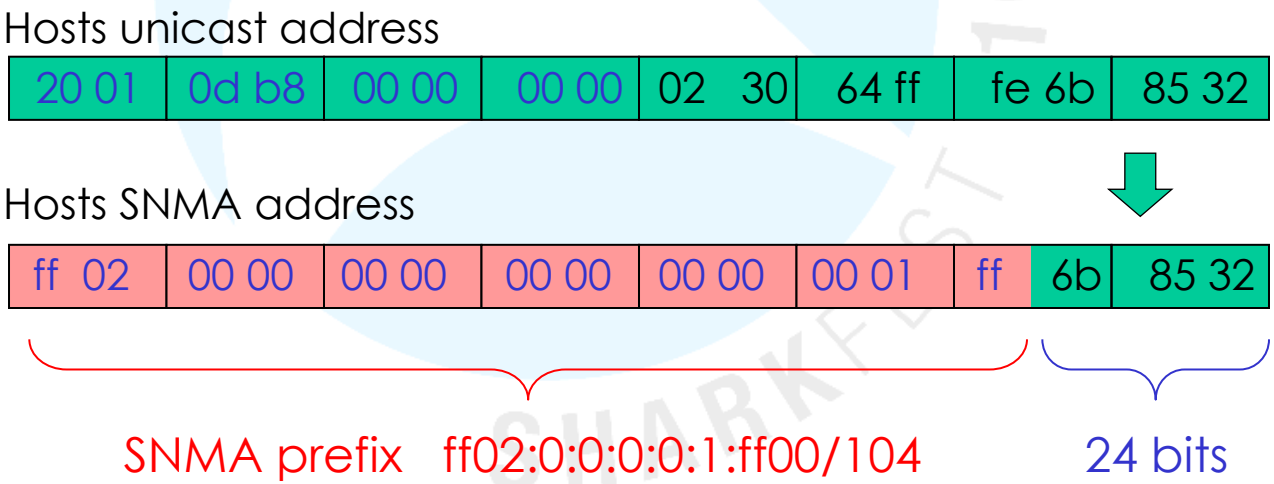
- If a router is present, host will also autoconfigure global address
- Prefix will be obtained from router, example 2001:db8::/64
- Interface ID is either derived from MAC address or a random value
- Router indicates in advertisement if stateful configuration may be used



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



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

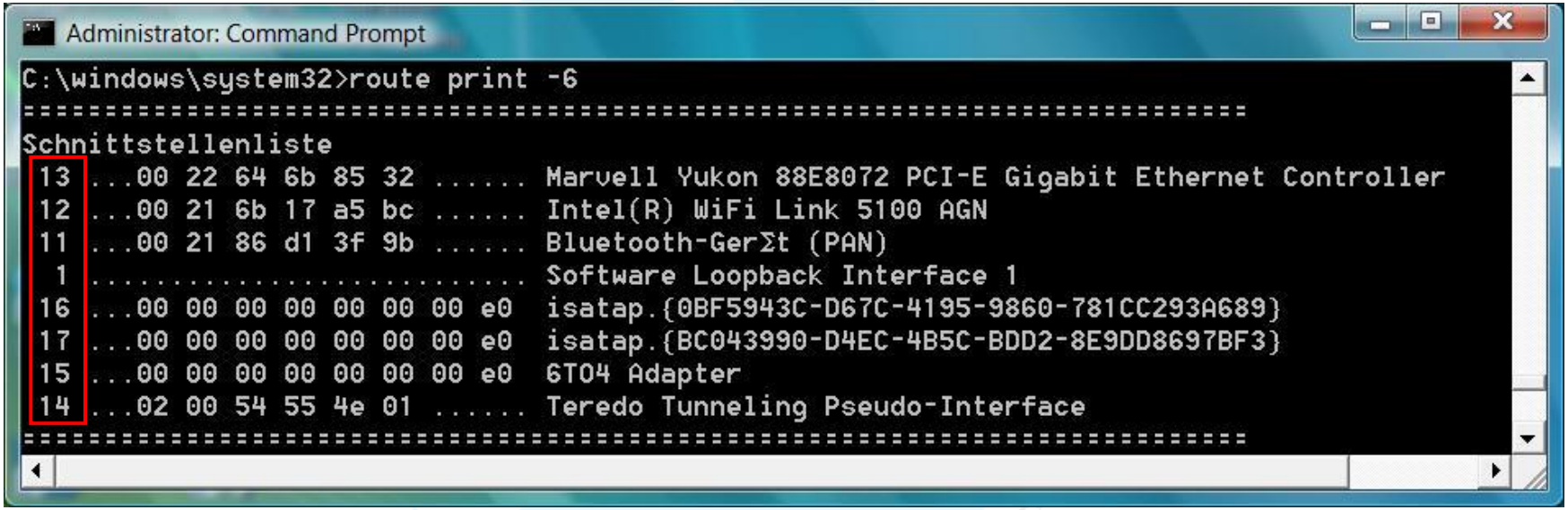
IPv6 Router

An IPv6 router has in addition:

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

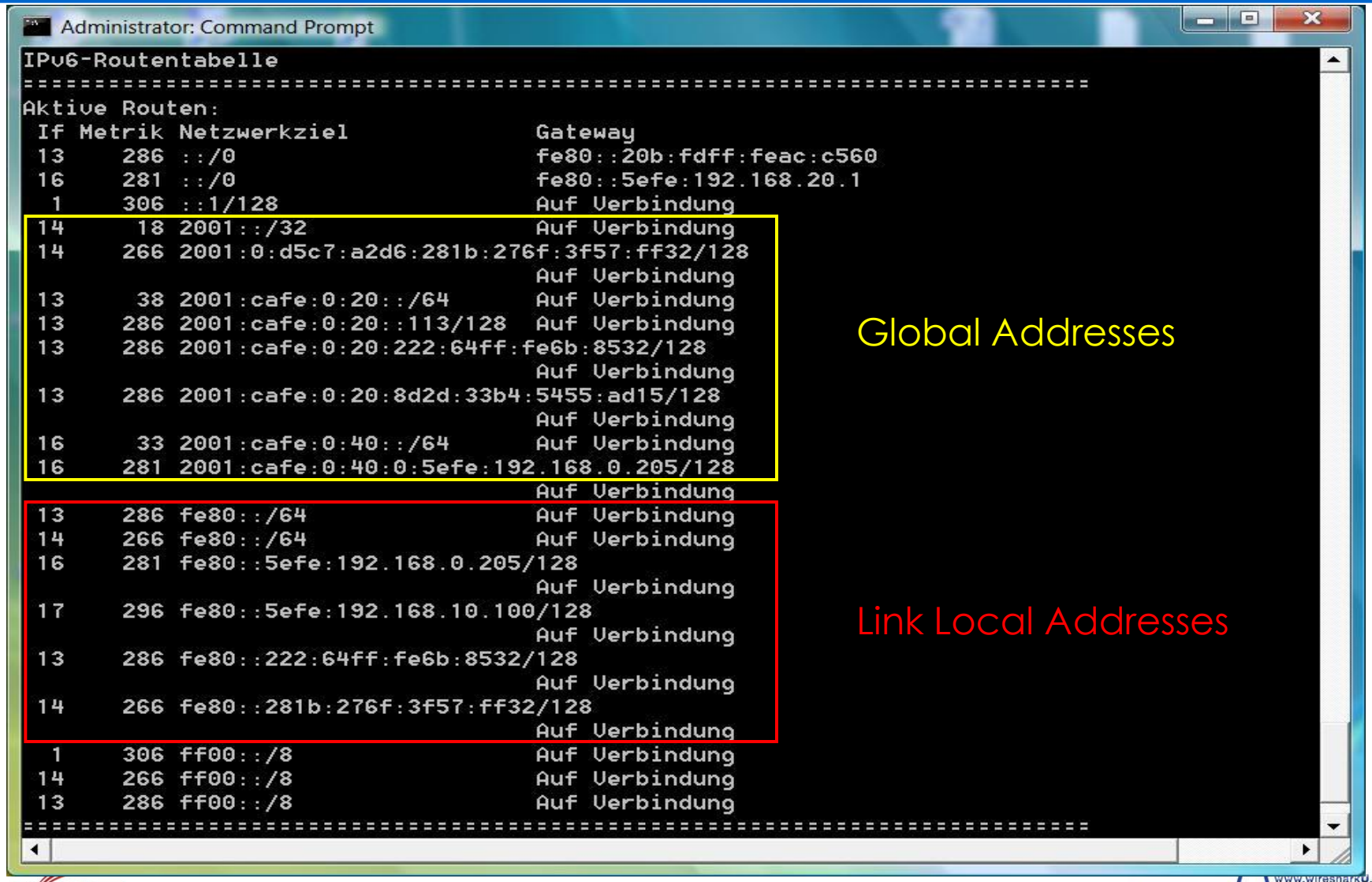
IPv6 Interfaces

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



- 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



Global Addresses

Link Local Addresses

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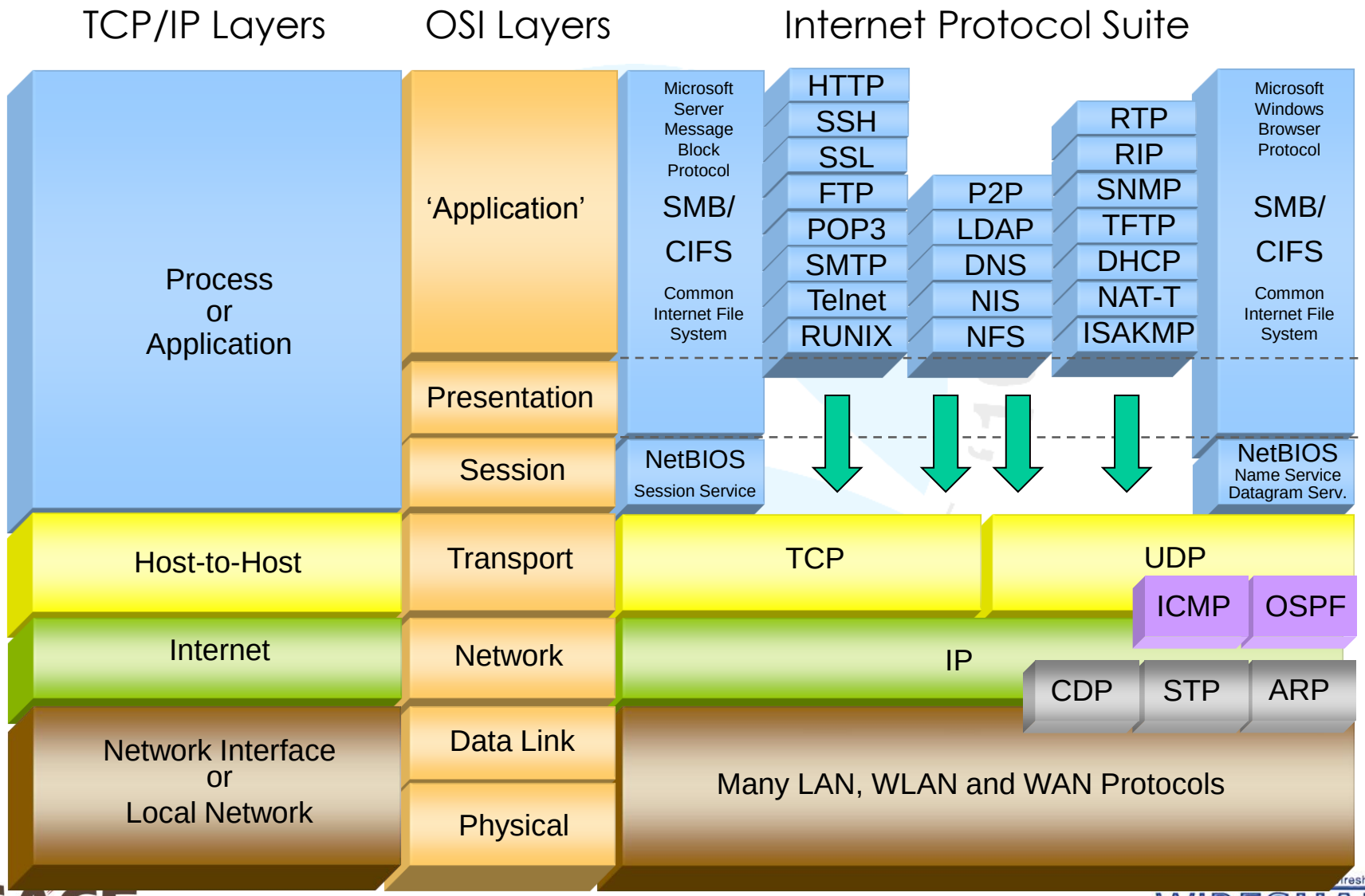
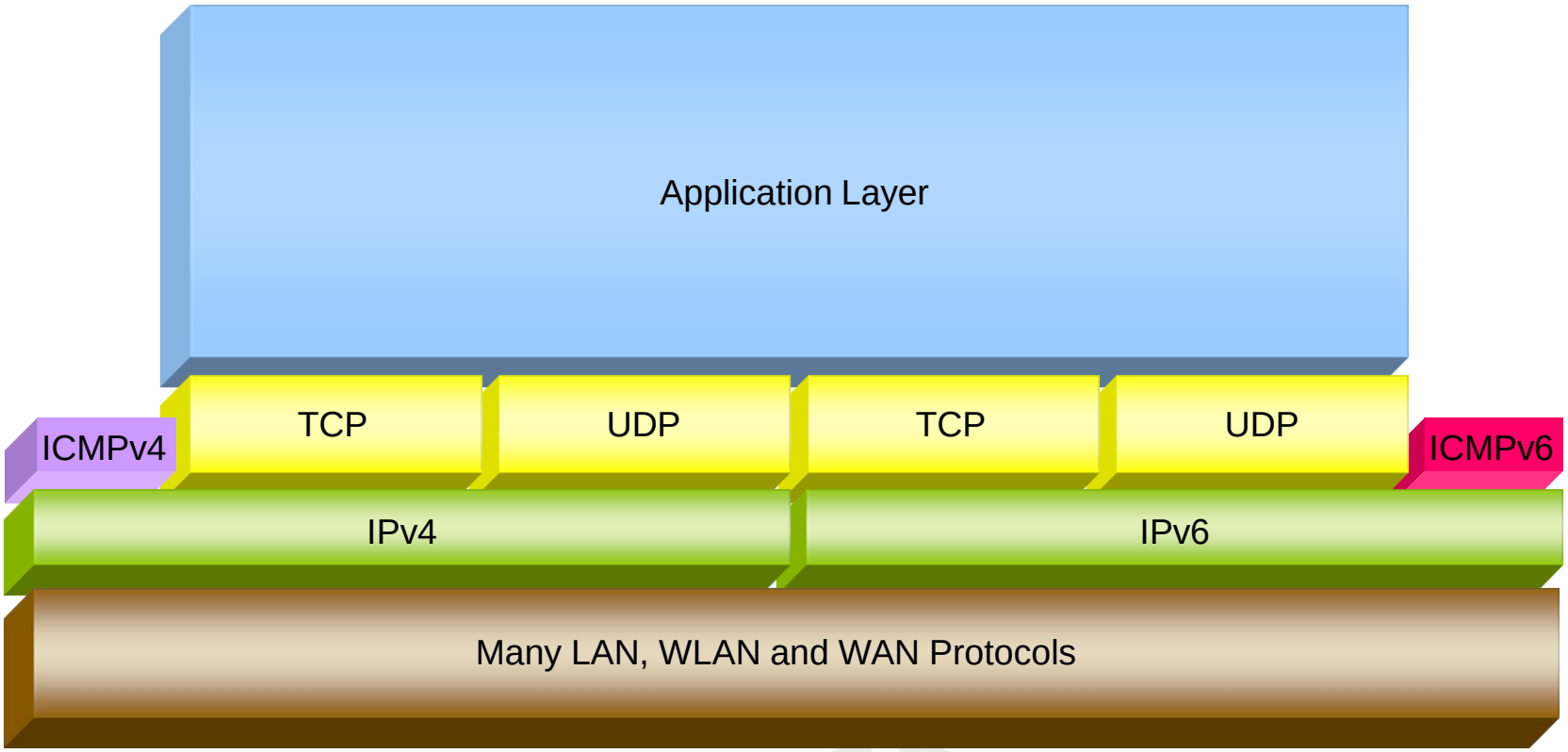
IPv6 Routing Protocols

TCP/IP Protocols



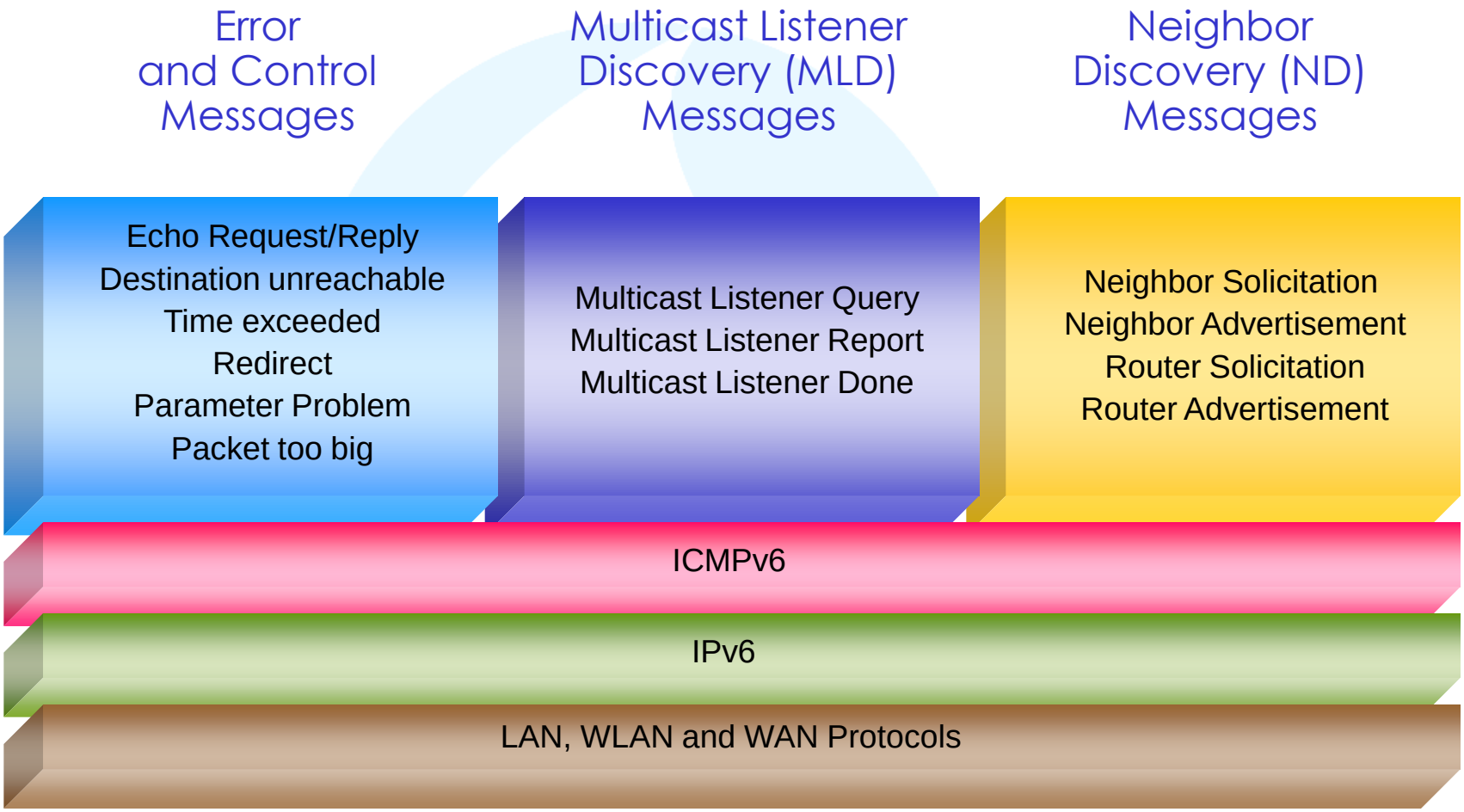
TCP/IP Protocols

Dual stack implementation



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

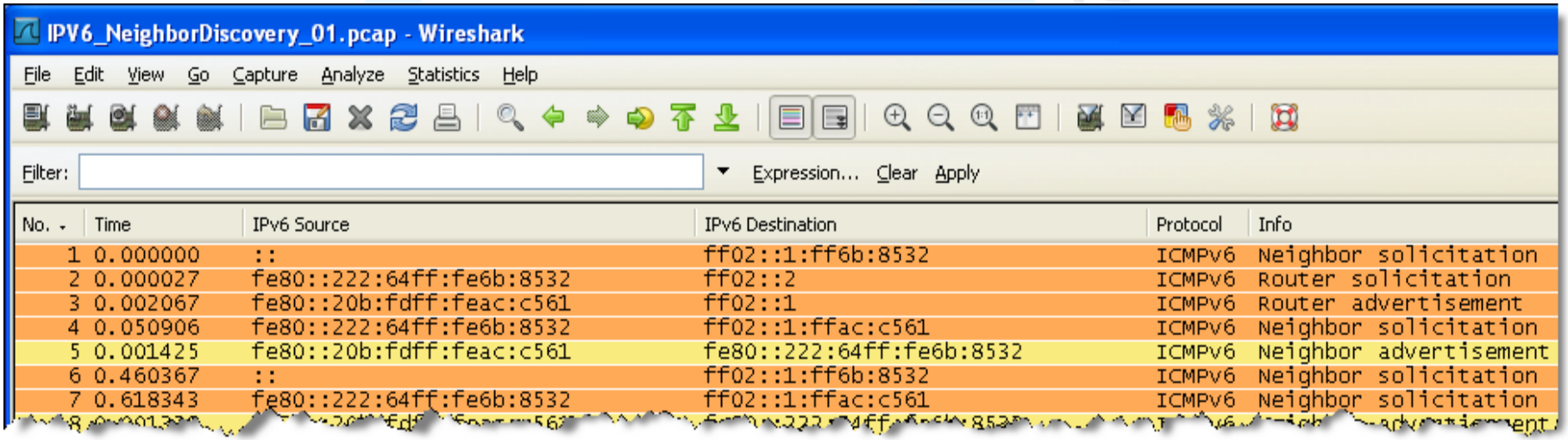
ICMPv6 Messages



Neighbor Discovery (ND)

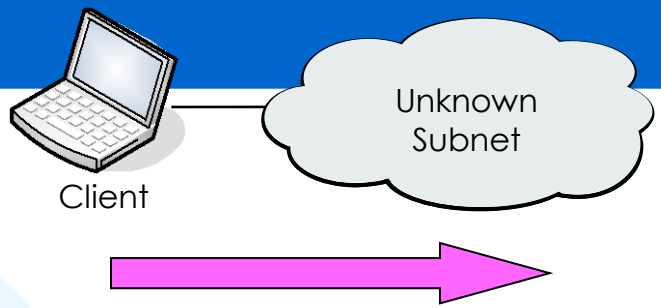
The initial client startup process includes the following steps:

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



Neighbor Discovery (ND)

Duplicate Address Detection (DAD)



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
```

Neighbor Solicitation Message

Source	Destination
::	ff02::1:ff68:8532

Target fe80::222:64ff:fe6b: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
```

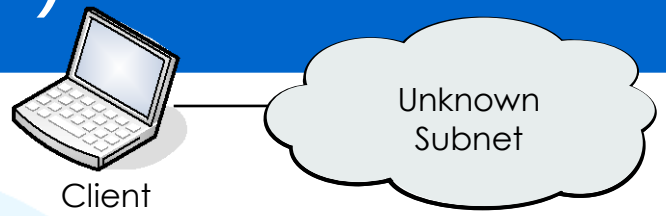
Neighbor Solicitation Message

Source	Destination
::	ff02::1:ff1c:b3b0

Target fe80::12d:d6a8:dd1c: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

Router Solicitation Message

Source	Destination
fe80::222:64ff:fe68:8532	ff02::2

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

VISTA/7-Client
(random option = on)

MAC 0022:6468:8532

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

SNMA ff02::1:ff1c:b3b0

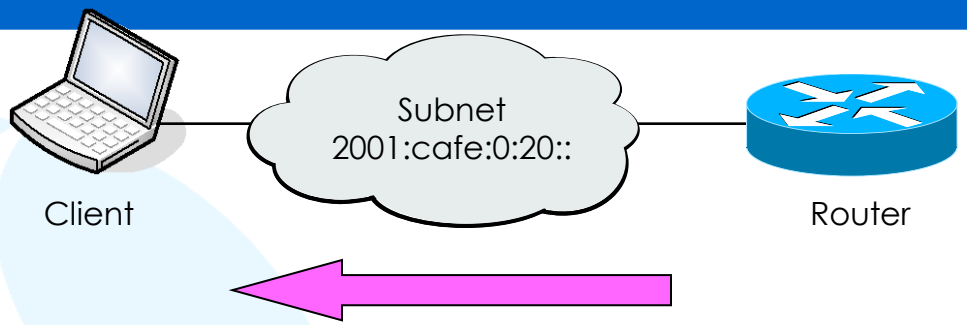
Router Solicitation Message

Source	Destination
fe80::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

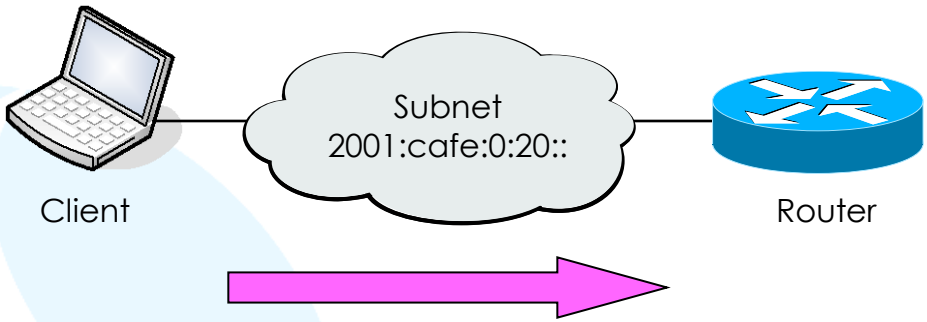
Info: MTU size 1500 bytes

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

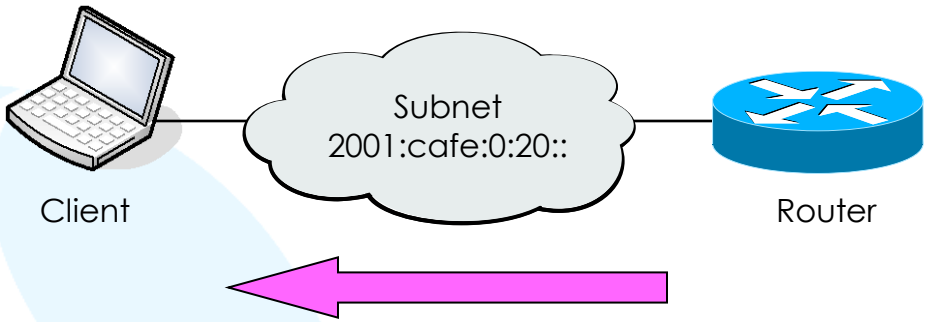
Neighbor Solicitation Message

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

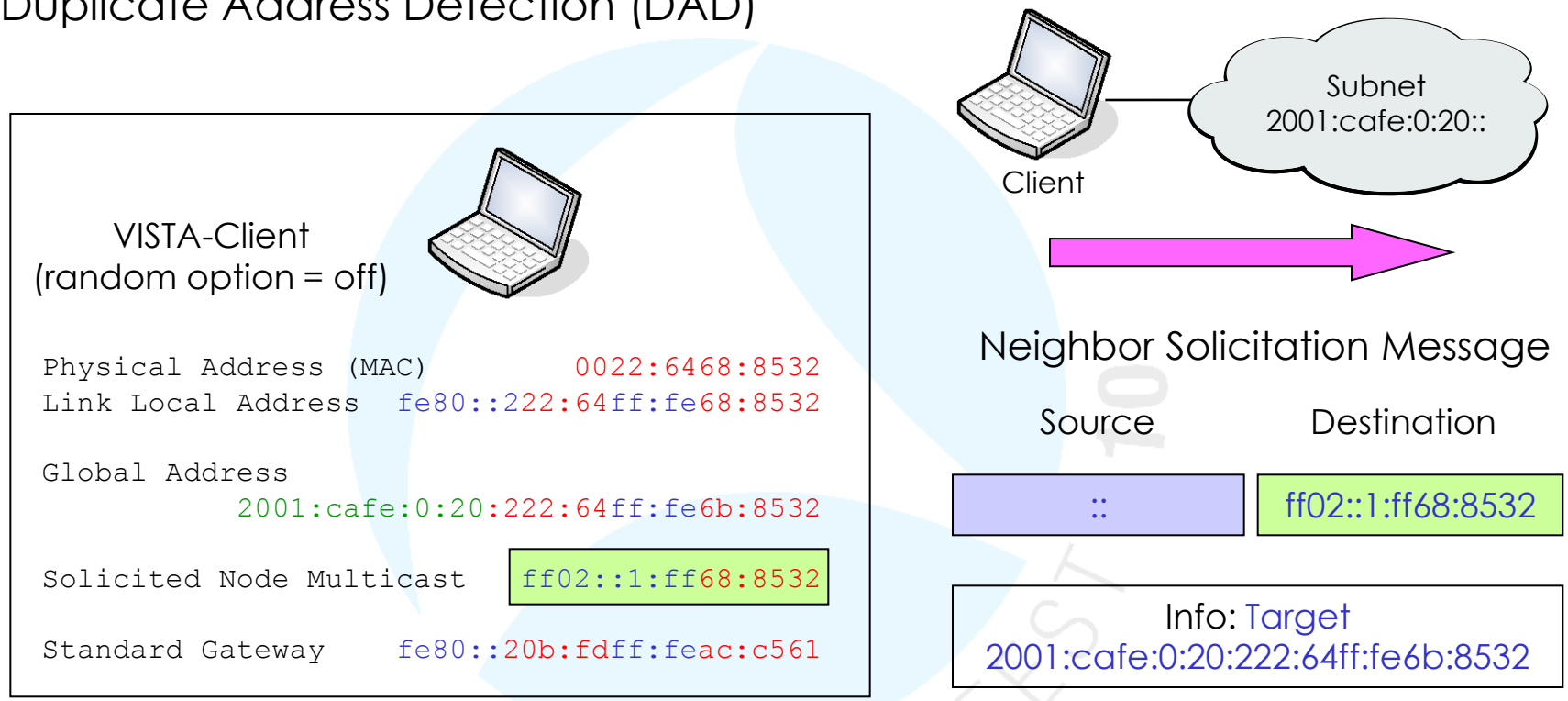
Source	Destination
fe80::20b:fdff:feac:c561	fe80::222:64ff:fe68:8532

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

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

Neighbor Discovery (ND)

Duplicate Address Detection (DAD)



- 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.

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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

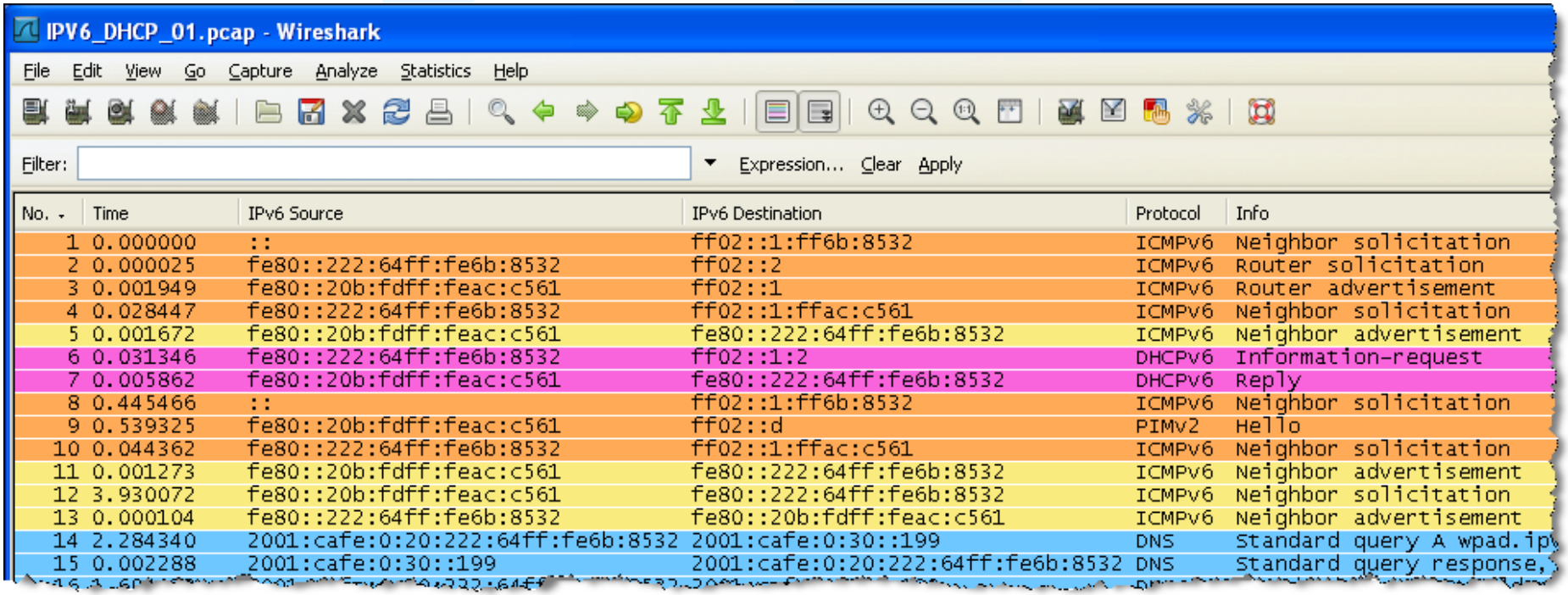
O = Other Flag / M = Managed Flag

Host configuration with DHCPv6

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

Frame #

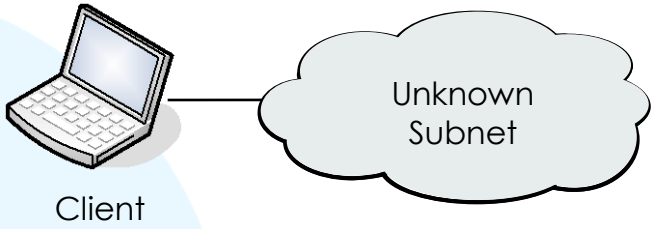
- 2 Router Discovery
- 3 Router Advertisement with 'Other Flag' set
- 6 Client contacts DHCP server
- 7 DHCP server delivers additional parameter like DNS, suffixes etc.



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



VISTA-Client
(random option = off)

MAC 0022:6468:8532

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

SSNMA ff02::1:ff68:8532

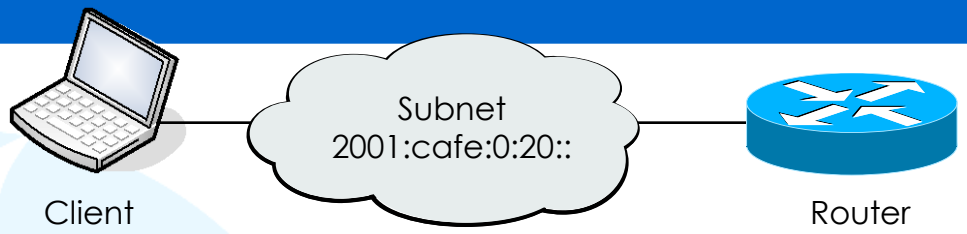
Router Solicitation Message

Source	Destination
fe80::222:64ff:fe68:8532	ff02::2

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

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

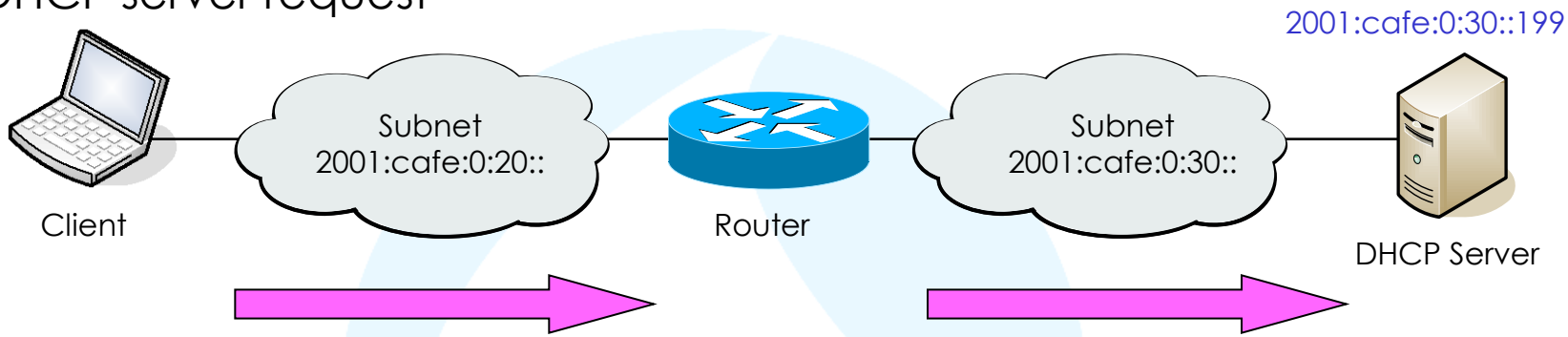
Info: MTU size 1500 bytes

Info: Prefix length 64

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

Host configuration with DHCPv6

DHCP server request



DHCP Information-request

DHCP Relay-forward

Source	Destination
fe80::222:64ff:fe68:8532	ff02::1:2

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

Info: Vendor-class-data

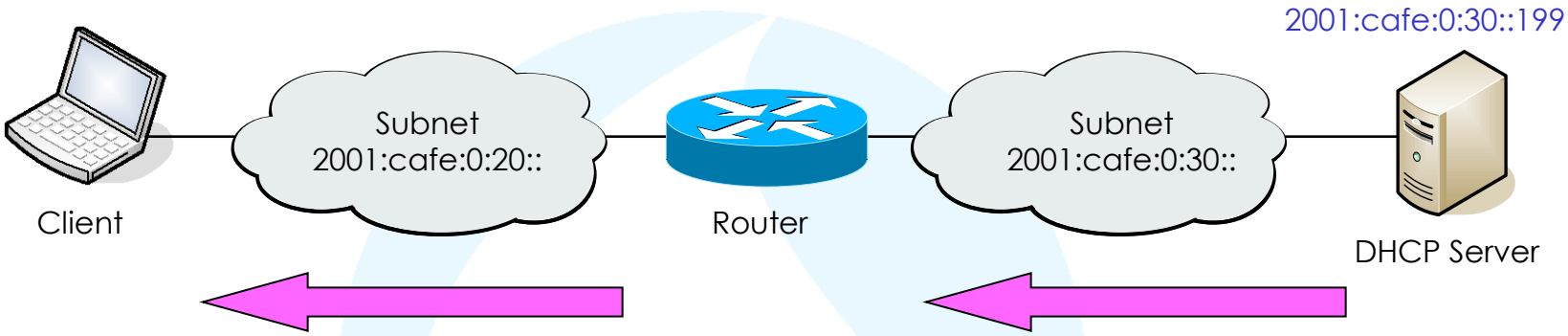
Option Request: Domain Search List

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

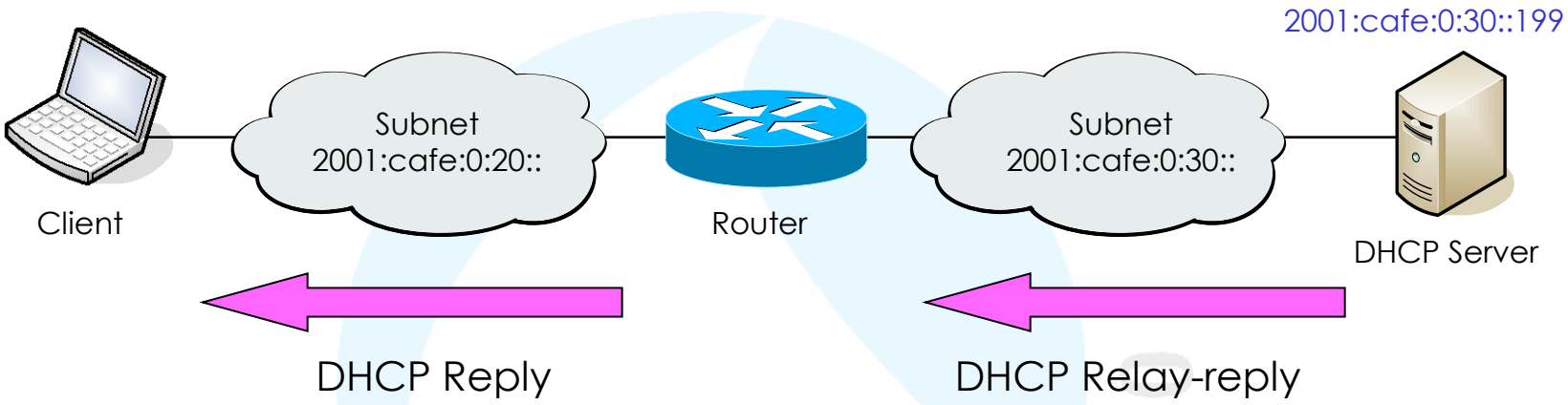
Option Domain Search List
yourdomain.ch ipv6.ch dummy.ch

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.i
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 _lda

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

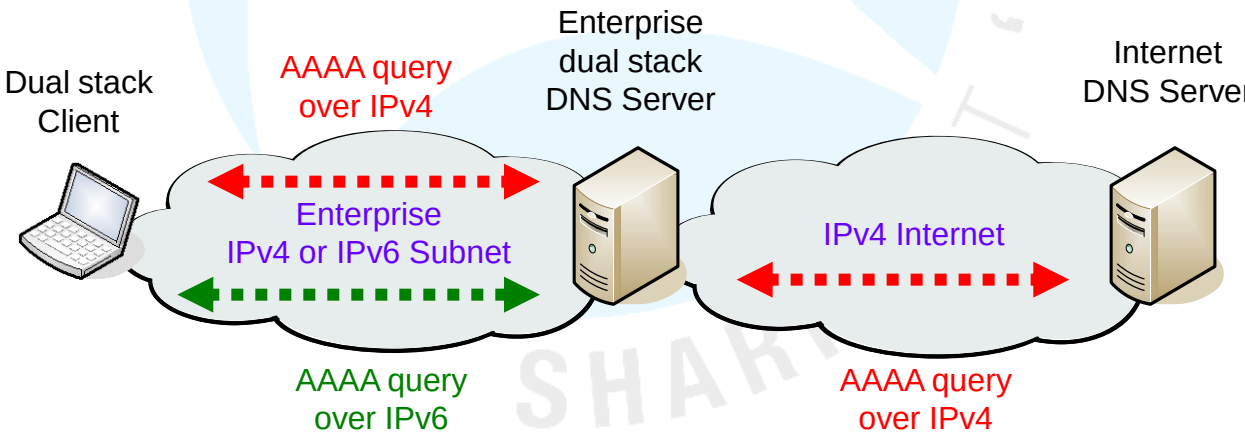
Transition technologies, ISATAP, Teredo, 6to4

IPv6 Routing Protocols

IPv6 Domain Name System (DNS)

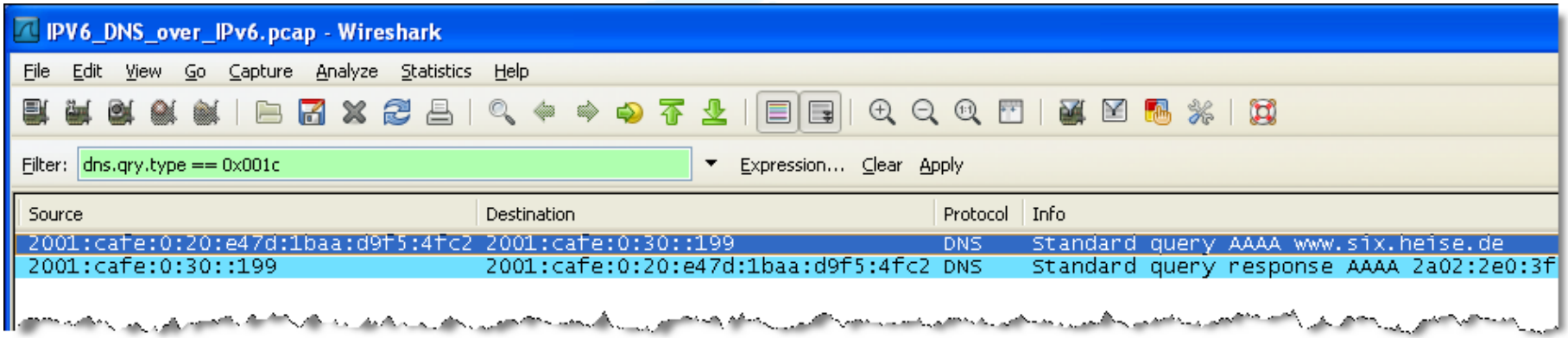
New AAAA resource record

- 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

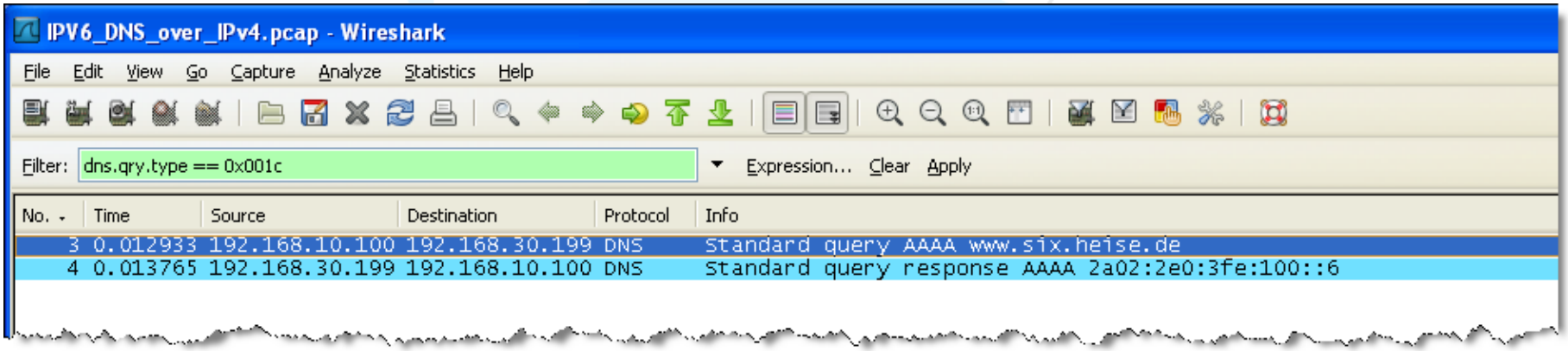


IPv6 Domain Name System (DNS)

- AAAA record query & response over IPv6



- AAAA record query & response over IPv4

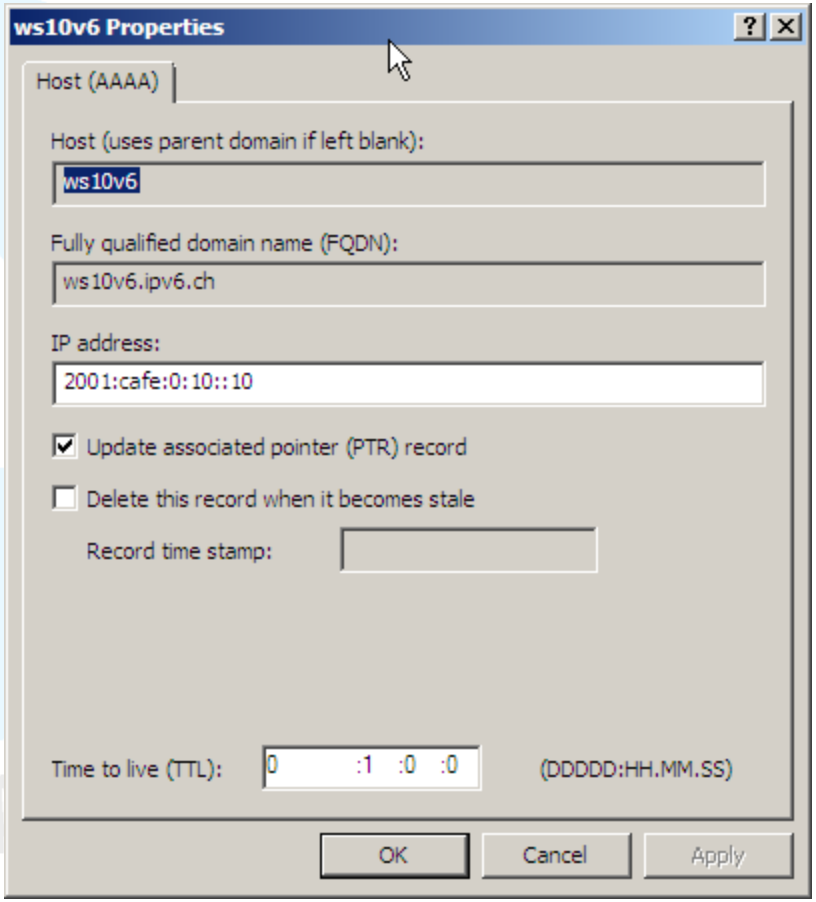


IPv6 Domain Name System (DNS)

New AAAA resource record

- Create AAAA record by entering host name and IPv6 address

- Pointer record will be created automatically if selected →



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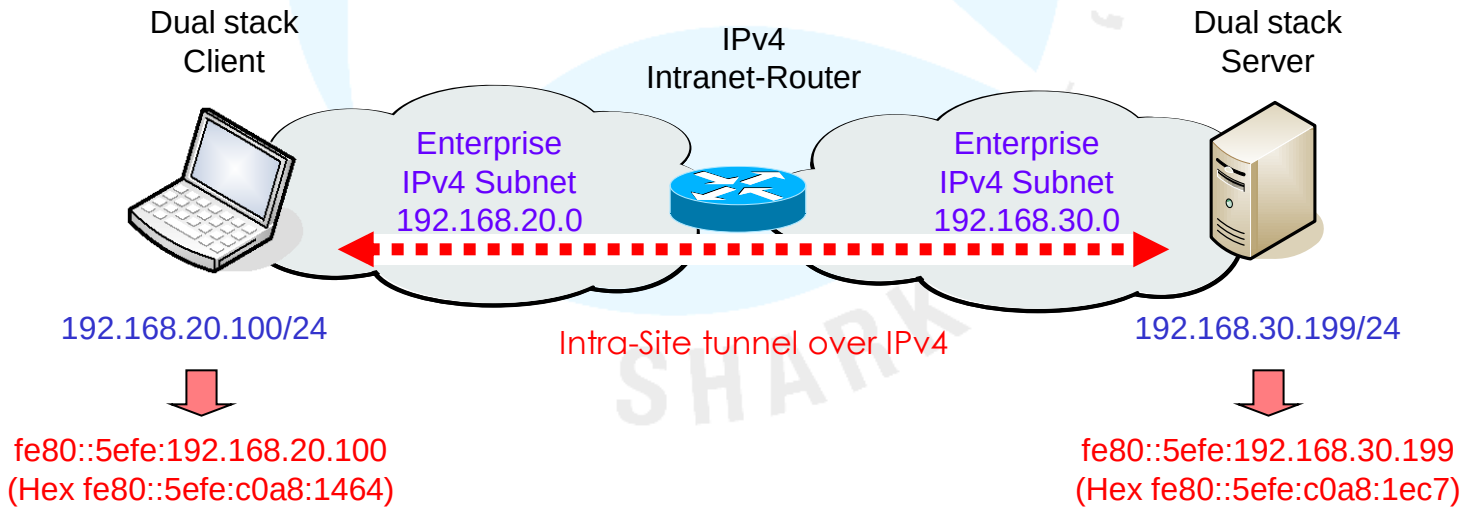
IPv6 Routing Protocols

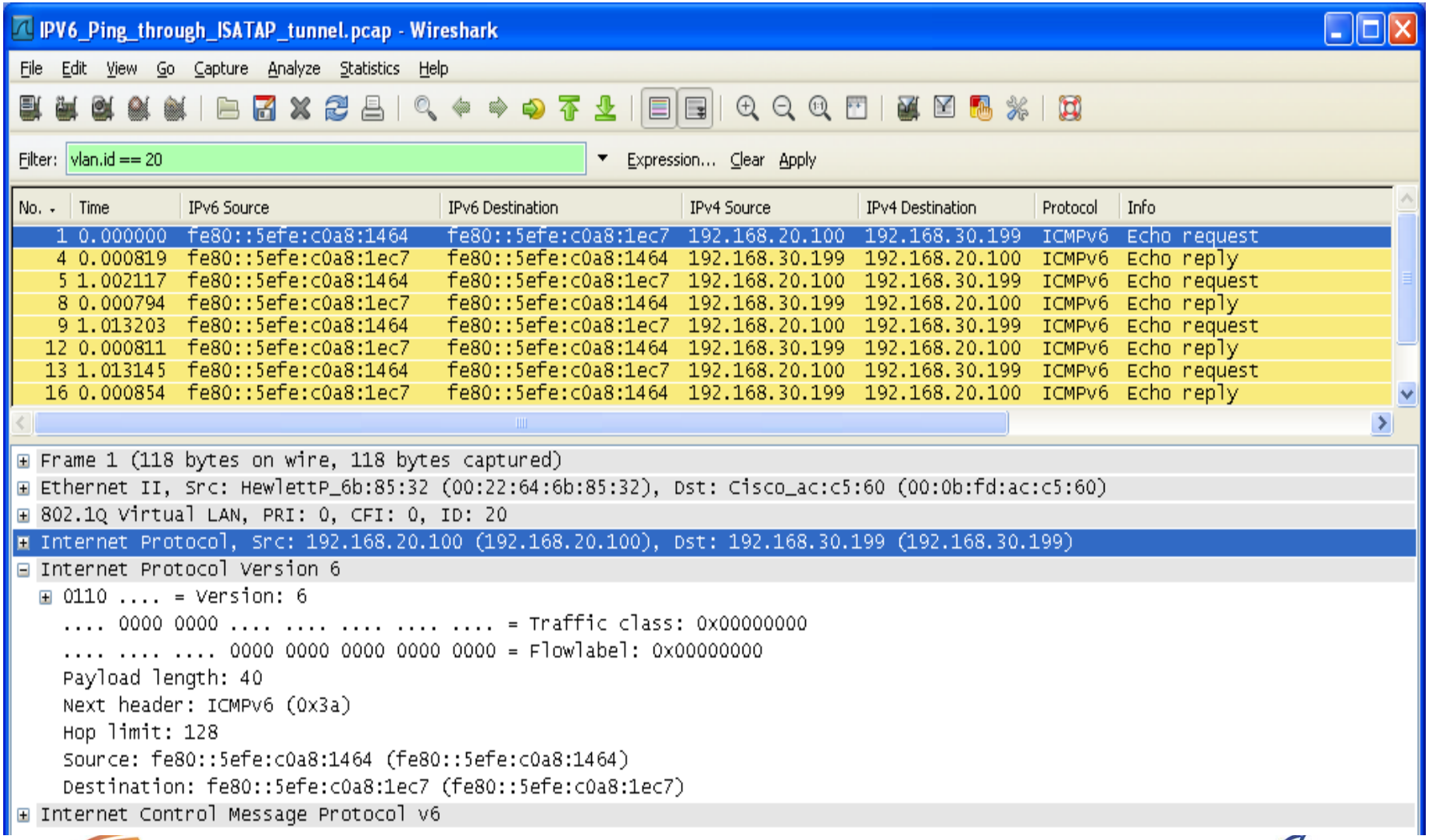
IPv6 Transition Technologies

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



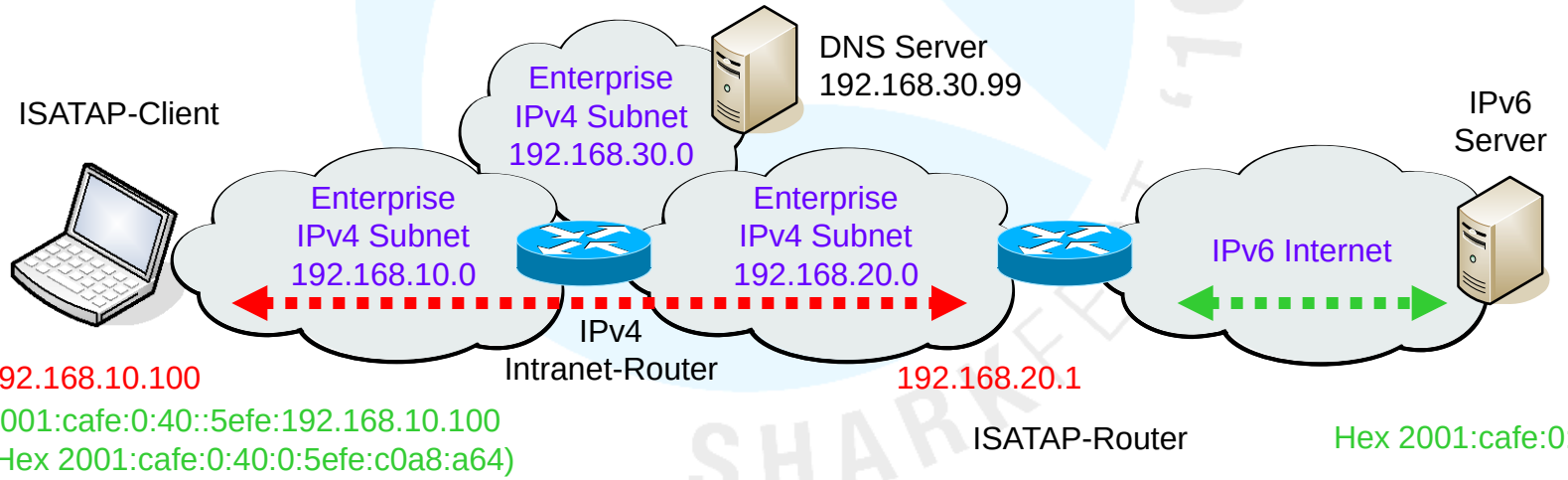
IPv6 Transition Technologies



IPv6 Transition Technologies

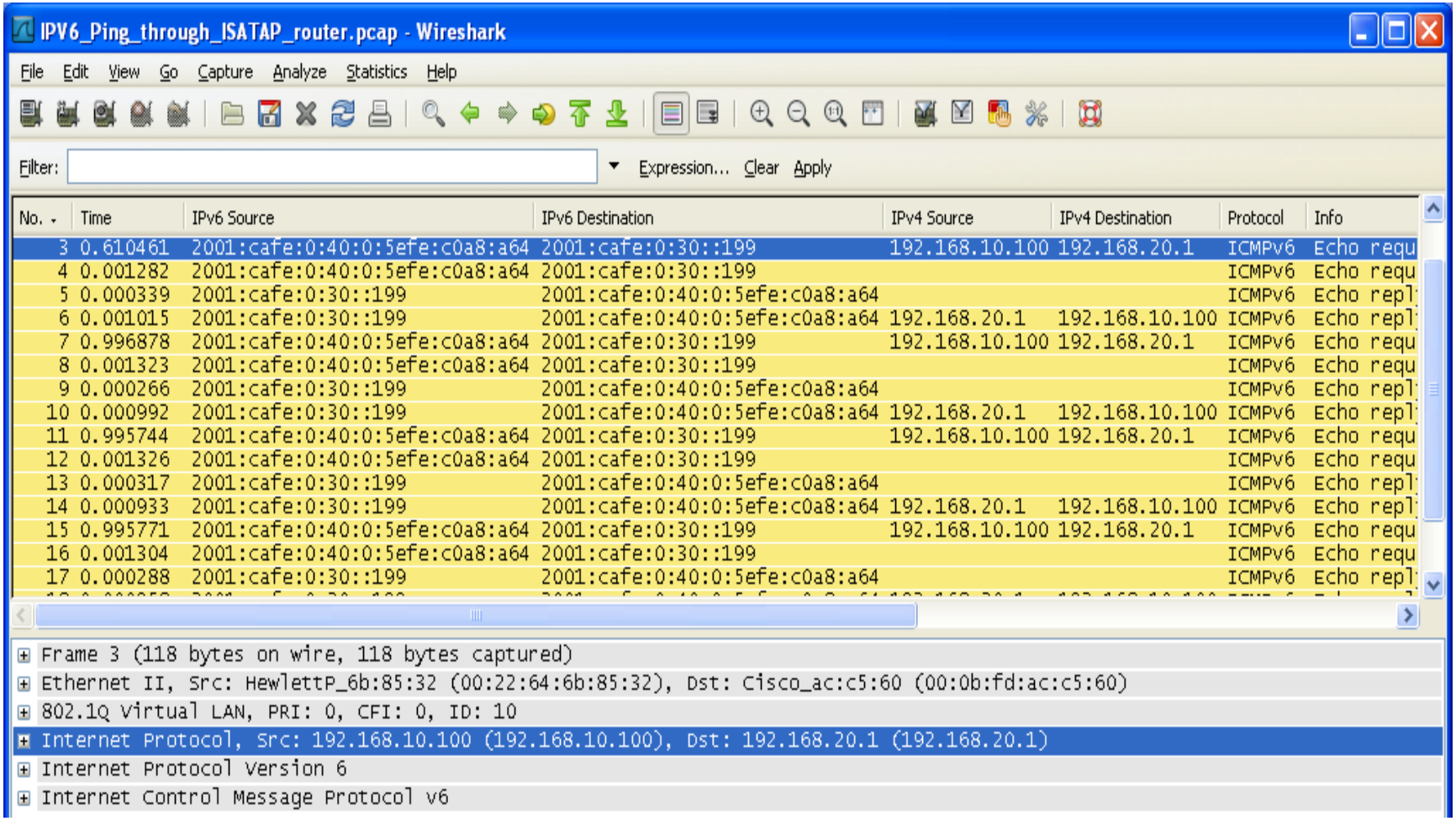
ISATAP (Intra-Site Automatic Tunnel Addressing Protocol)

- 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

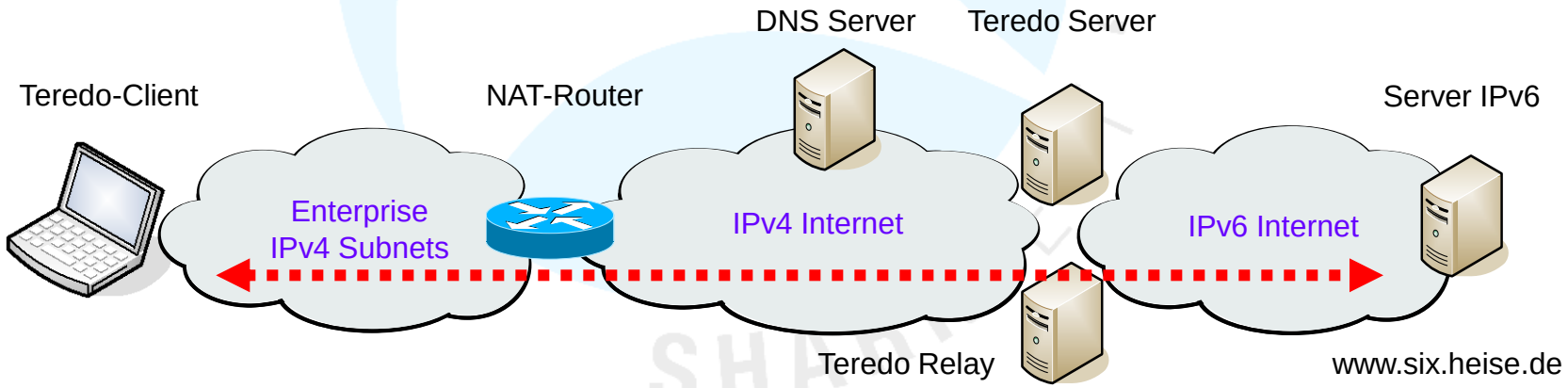
IPv6 Transition Technologies



IPv6 Transition Technologies

Teredo Tunnel

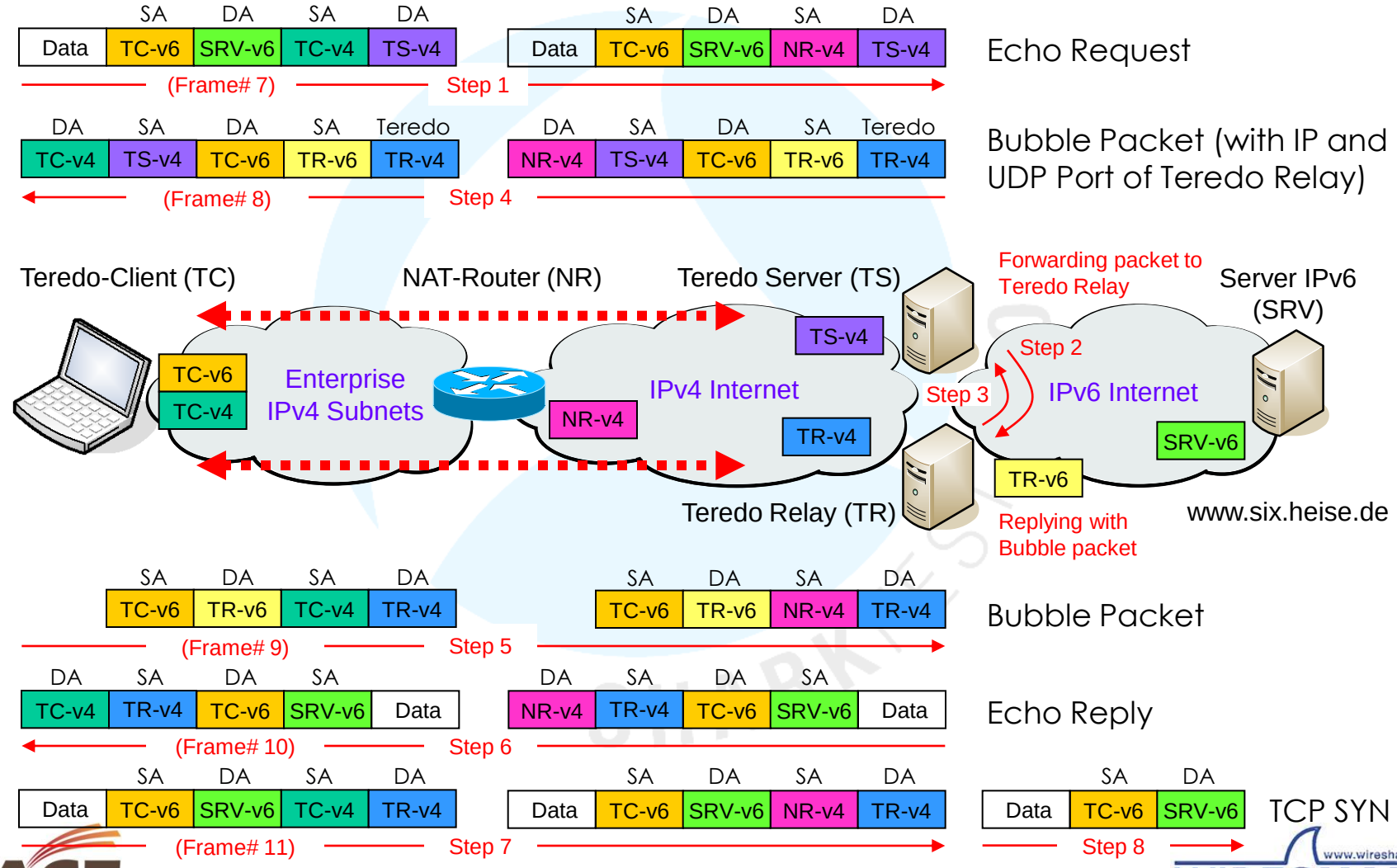
- Tunneling method named after Teredo Navalis (Schiffsbohrwurm)
- Teredo encapsulates IPv6 packets within UDP/IPv4 datagram
- Most NAT Routers can forward these packets properly
- Teredo allows a client to communicate with a native IPv6 server
- Teredo Server and Teredo Relay in the Internet care for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



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

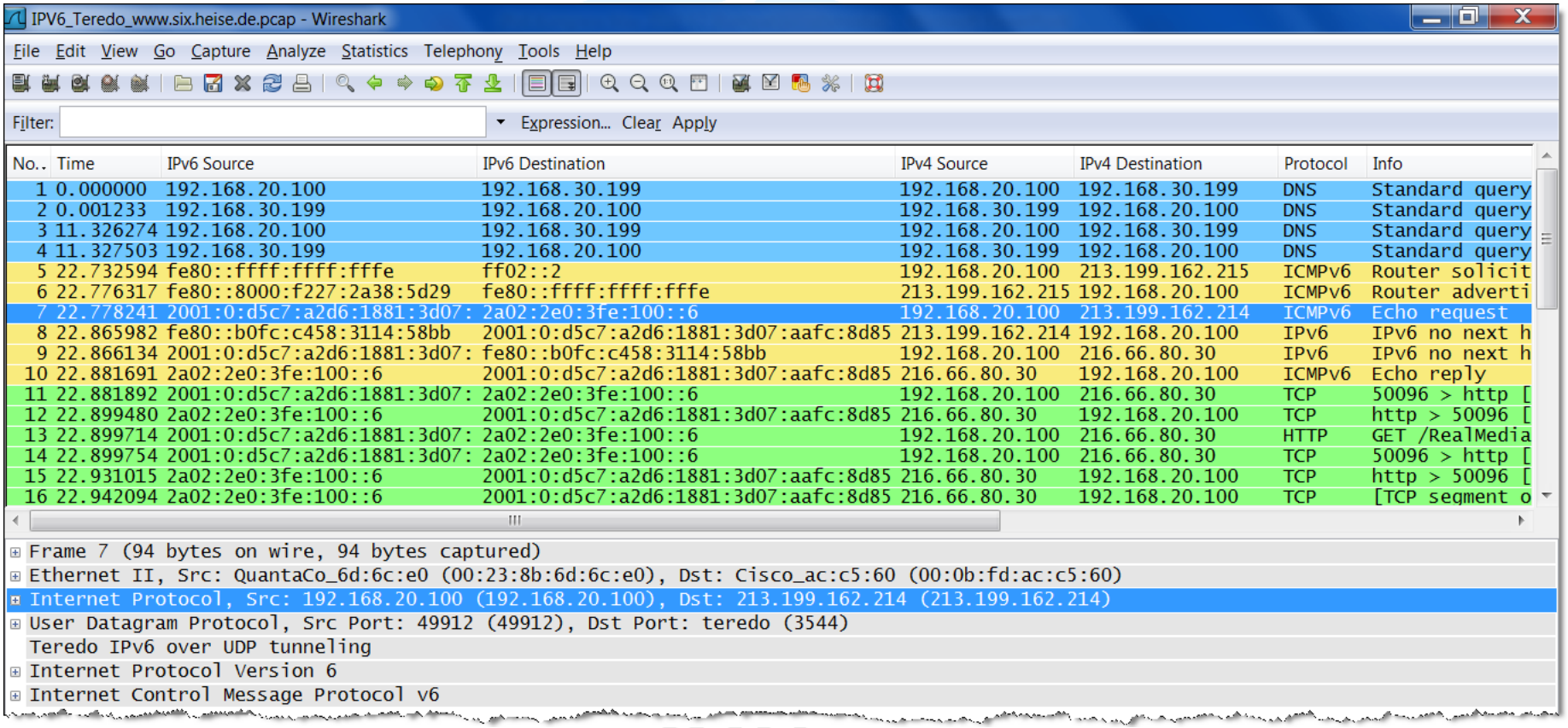
IPv6 Transition Technologies

Teredo Tunnel initialization (Trace File IPV6_Teredo_www.six.heise.de)



IPv6 Transition Technologies

Teredo Tunnel initialization



IPv6 Transition Technologies

Teredo Tunnel

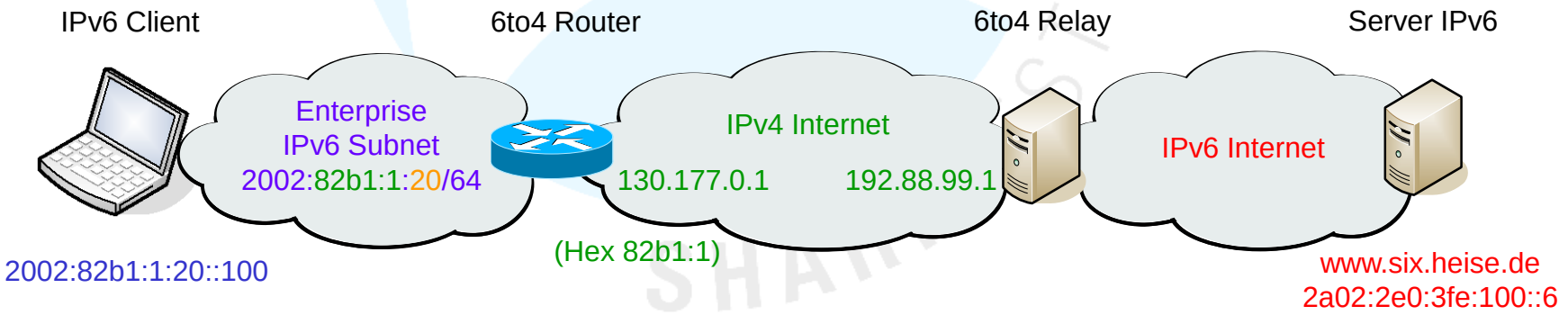
- When starting, a Windows-based computer using Teredo resolves the IPv4 address of the Teredo server teredo.ipv6.microsoft.com
- By the Router solicitation/advertisement dialog through Teredo, the client receives a valid IPv6 prefix
- When activated, the Teredo client contacts Teredo server to obtain 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

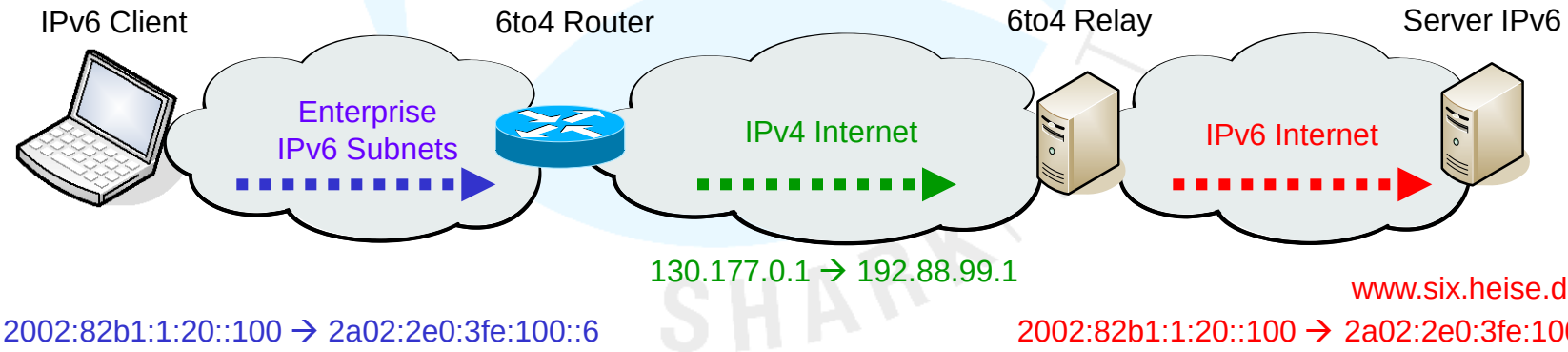


- 192.88.99.1 is the anycast address of the nearest public 6to4 relay

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



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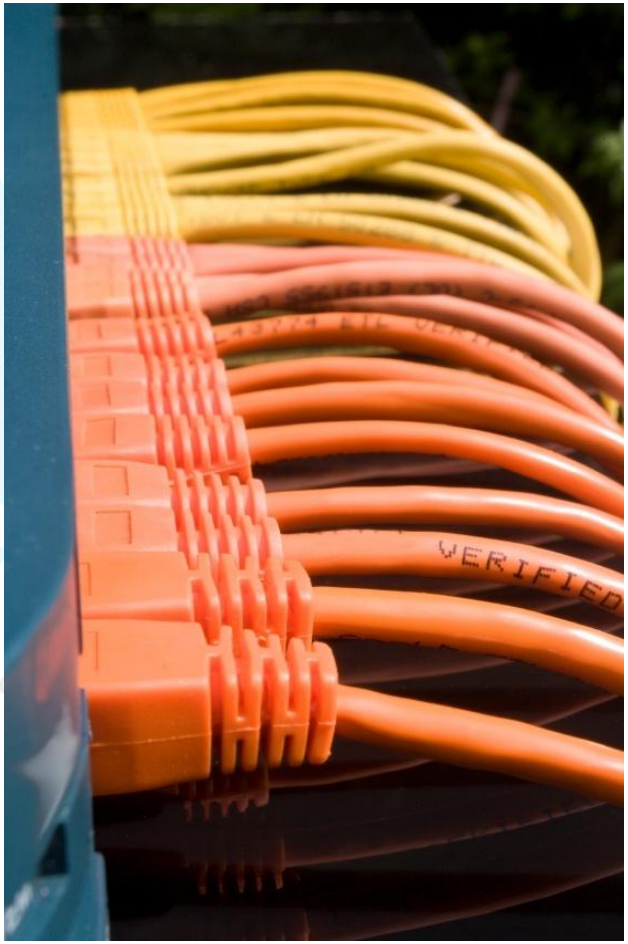
IPv6 Routing Protocols

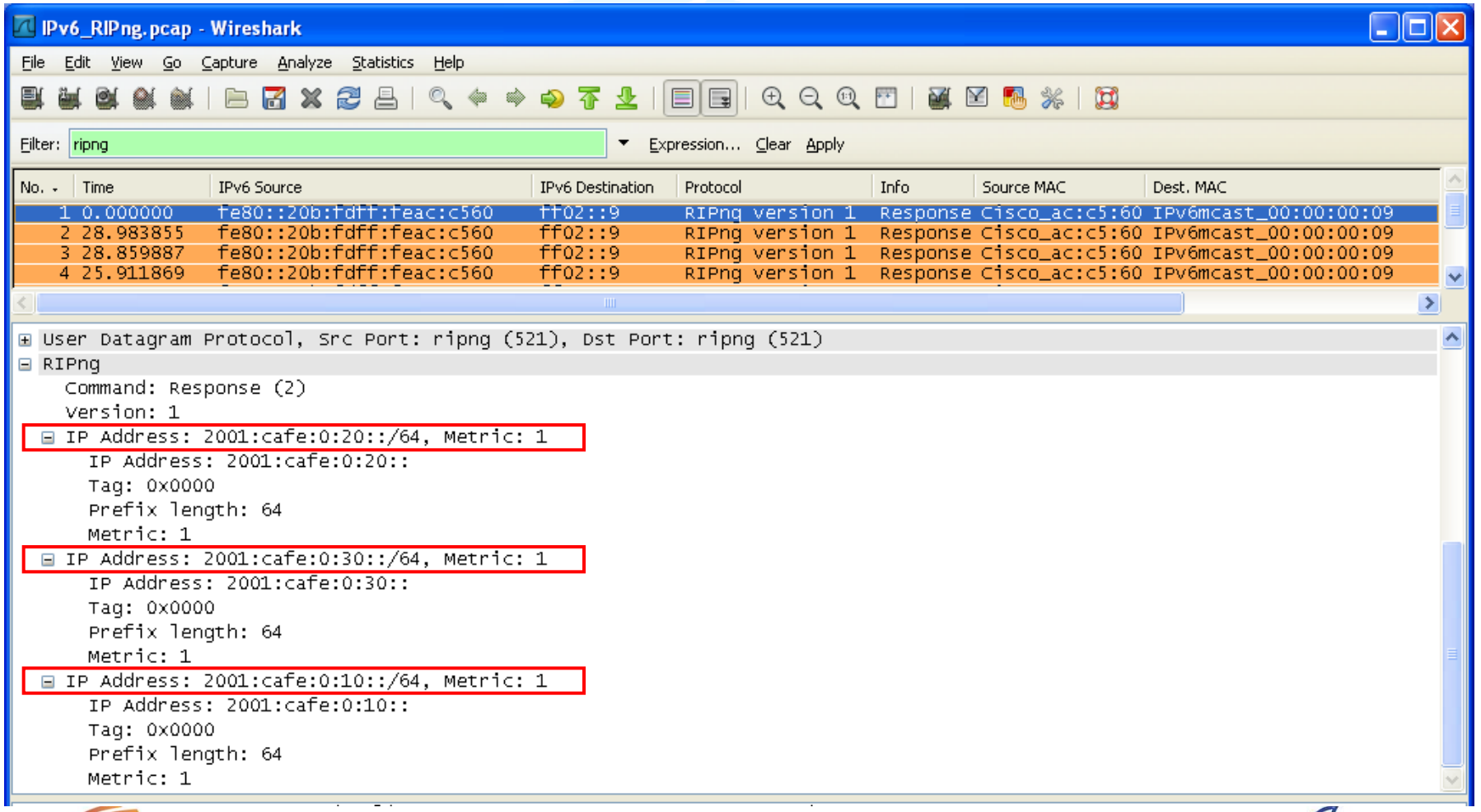
IPv6 Routing Protocols

- 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



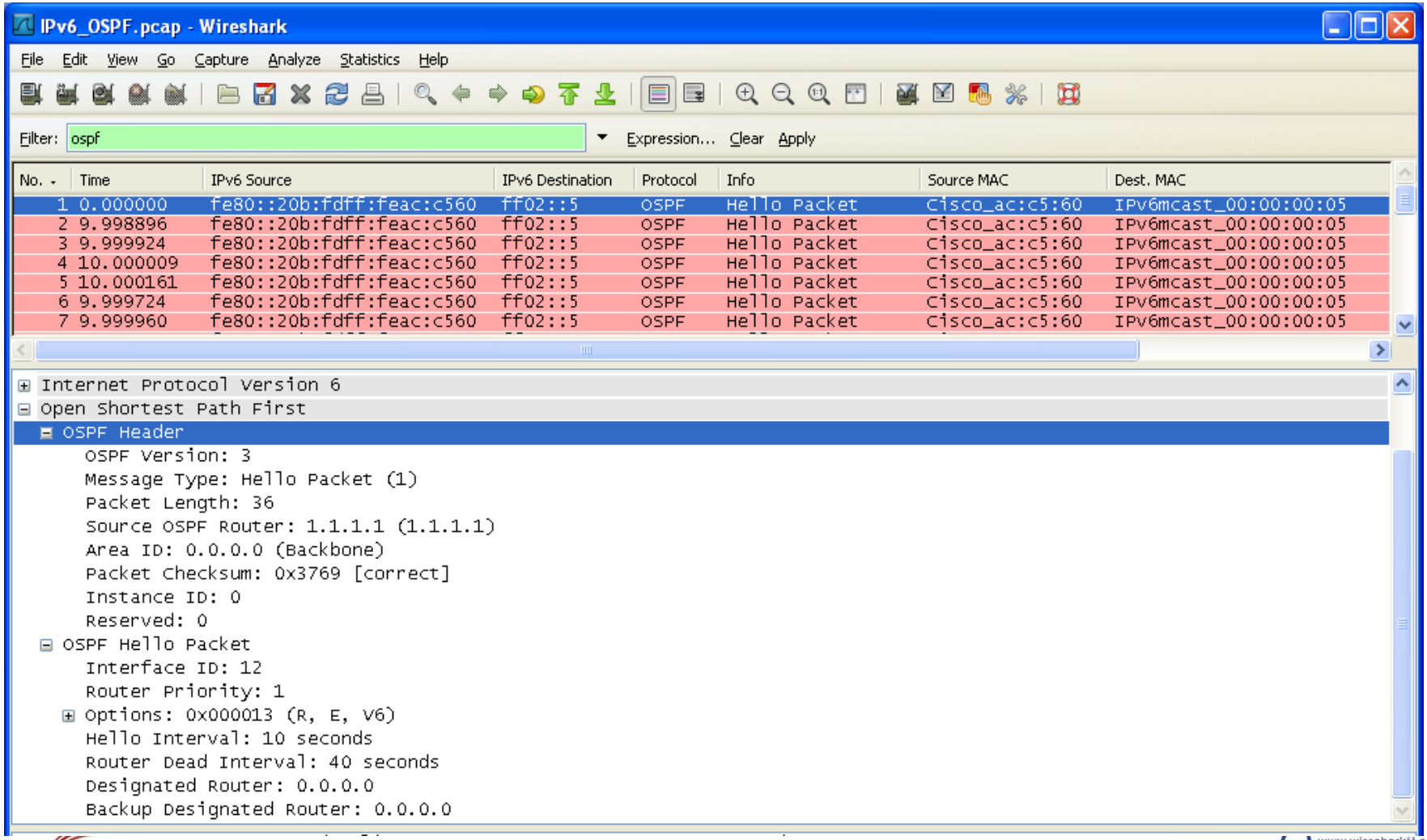
IPv6 Routing Protocols

Routing Information Protocol - next generation (RIPng)



IPv6 Routing Protocols

Open Shortest Path First - Version 3 (OSPFv3)



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

How-to get

- 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

Thank you for your attention

CACE TECHNOLOGIES

Please fill in evaluation form

www.wiresharkU.com WIRESHARK UNIVERSITY