

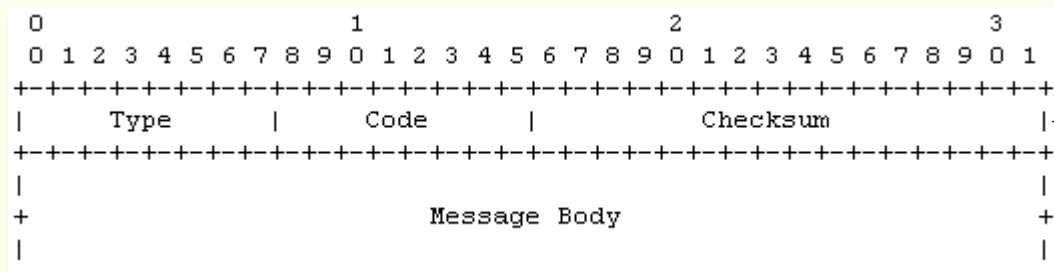
IPv6

ICMPv6 and autoconfiguration

- Internet Control Message Protocol v6
 - Error management and diagnostic functions
- New functionalities (!)
 - Neighbour Discovery protocol (ND)
 - determine link-layer addresses of neighbours attached to the same link (was ARP & RARP with IPv4)
 - find routers
 - keep track of which neighbours are reachable
 - detect changed link-layer addresses
 - Multicast group membership management (was IGMP with IPv4)
 - Mobility support (MIPv6)
 - ...

Message format

- Type & Code
 - Identify the type of message, e.g.
 - Type=1,Code=0: Destination Unreachable, No route to destination
- Checksum
 - Used to detect data corruption
- Message body
 - Original packet (error messages) or
 - Additional data (informational messages)



NO CONFUSION
IP QWRY
VA MESS

ICMPv6 message classes

- Error messages
 - Destination Unreachable (type 1)
 - Packet Too Big (type 2)
 - Time Exceeded (type 3)
 - Parameter Problem (type 4)
- Informational messages

Neighbour Discovery protocol



Hop Unit = 255 → E' IL MASSIMO, SE RICEVO UNO DI QUESTI MESSAGGI
 CON UN HOP UNIT MINORE DI 255 LO SOTTO
 PERCHÉ QUESTI MESSAGGI DEVONO ESSERE

Message number	Message type	Description
128	Echo Request	RFC 4443. Used for the ping command. STESSO COM-
129	Echo Reply	
...		
133	Router Solicitation	→ TRA HOST E ROUTER RFC 4861. Used for neighbor discovery and autoconfiguration. TRA DUE NODI VARIE FUNZIONIERI DIVERSE
134	Router Advertisement	
135	Neighbor Solicitation	
136	Neighbor Advertisement	
137	Redirect Message	REDIREZIONE ENTRA A LUN
...		
155	Routing Protocol for Low-Power Network Messages	RFC 6550

NEIGHBOR
 DISCOVERY

Neighbour Discovery protocol

- Address Resolution ^(ARP v4) TRANSLATES VALUE OF DESTINATION
IN LINK-LOCAL ADDRESS → NOW E'
ARP
- Stateless Address Autoconfiguration (SLAAC)
- Router Discovery (RD) ↳ CREATES THE NEIGHBORHOOD ROUTER
ROUTER DISCOVERY -
- Neighbor Unreachability Detection (NUD) ↳ POSSIBILITY OF WORKING ON A NETWORK
SI COMPONENTS
CAN ROUTER
(WIRING, DHCP)
- Duplicate Address Detection (DAD) ↳ FOR SCOPE
ROUTER NOT
RESPONSE
- Redirection ↳ DIRECTION ON ROUTER OF USAGE ON A NETWORK
FOR WIRING

• ROUTER DISCOVERY: 1. ROUTER WUHAU MESSAGE ADVERTISEMENT
(ROUTER ADVERTISEMENT) ALER ALER ROUTER
VERSIONE UN-SOURCED → PER FARE RICONOSCERE

VERSIONE SOURCED → 1. ROUTER WUHAU MESSAGE SOURCED
(ROUTER SOURCED) PER CONFERME
AD UN MODO SE E' UN ROUTER O NO.

Router Discovery

- Routers send out Router Advertisement messages at regular intervals to the multicast *all-nodes* address (FF02::1)

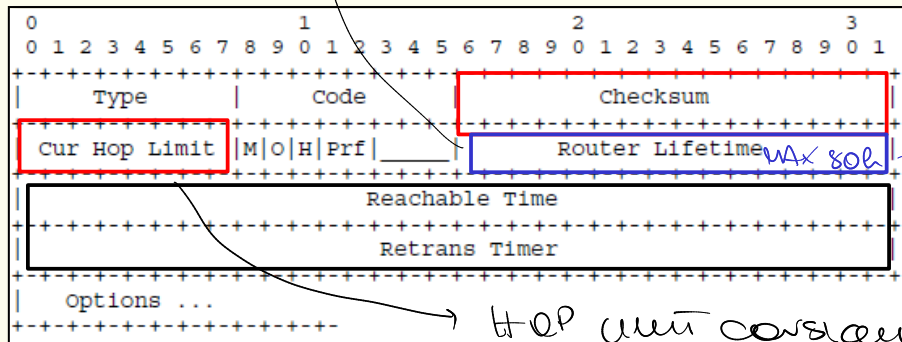
0										1										2										3					
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1				
Type 134										Code										Checksum															
Cur Hop Limit										M O H Prf _____										Router Lifetime															
										Reachable Time																									
										Retrans Timer																									
options ...																																			



Router discovery

SOLO STATELESS, non posso
considerare who router
valida per sempre

Ø = SOLO UN ROUTER HA NON USAREI CODE RATION



Costa si darrebbe usarsi su questo link

• M flag (1bit)

– 0: stateless

autoconfiguration (NAD) (SAAC)

– 1: stateful (DHCPv6)

• Prf flag (2 bits)

– Default router preference

• Options

– Source link-layer address

– MTU → per questo link non

– Prefix information

• 0 bit: dice qualcosa sul state
two se si trova solo a ricevere

Costo di tutto questo

- Type=134, Code=0
- Cur Hop Limit
 - Default value for hop count field; zero if unspecified
- Time
 - Configuration params

• 4 bit: router IPv6

Router discovery

- Prefix Information option

- L flag

IL PREFIXO E' LA DIA
L'UNICA RAGIONE
ESSERE USATO PER APNE

– On-link determination

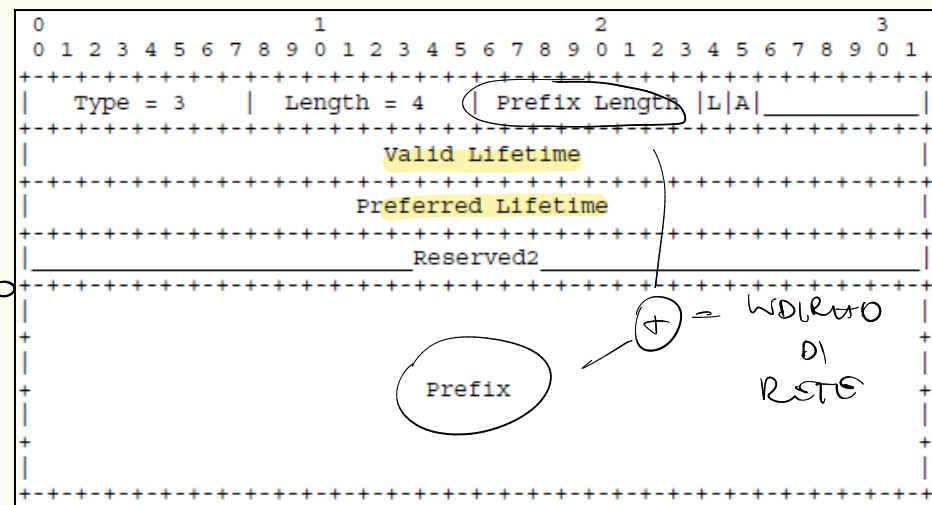
SE LA DESTINAZIONE E

- A flag

LA SOSTITUIRE SARA' SEMPLICE
STESSO UNO

– Autonomous address
configuration

- Address lifetime



- we send values
ASP.NET CAUTIONS

```

0                               1                               2                               3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Type            |          Code            |          Checksum            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                               Reserved                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Options ...      |
+-+-+-+-+-+-+-+-+

```

ICMPv6 POSSONO ESSERE SCAMBIATI

Sono solo stesso len -



No.	Source	Destination	Protocol	Info
9	fe80::c000:11ff:fe50:0	ff02::1	ICMPv6	Router Advertisement from c2:00:11:50:00:00

← unicast

Frame 9: 118 bytes on wire (944 bits), 118 bytes captured (944 bits) on interface 0

Ethernet II, Src: c2:00:11:50:00:00 (c2:00:11:50:00:00), Dst: IPv6mcast_00:00:00:01 (33:33:00:00:00:01)

Internet Protocol Version 6, Src: fe80::c000:11ff:fe50:0 (fe80::c000:11ff:fe50:0), Dst: ff02::1 (ff02::1)

Internet Control Message Protocol v6

Type: Router Advertisement (134)
 Code: 0
 Checksum: 0x809b [correct]
 Cur hop limit: 64

Flags: 0x00

- 0... .. = Managed address configuration: Not set
- .0... .. = Other configuration: Not set
- ..0... .. = Home Agent: Not set
- ...0 0... = Prf (Default Router Preference): Medium (0)
-0... = Proxy: Not set
-0... = Reserved: 0

Router lifetime (s): 1800 → Qui INFORMATION
 Reachable time (ms): 0
 Retrans timer (ms): 0
 NOS E' VAREDA

ICMPv6 option (Source link-layer address : c2:00:11:50:00:00)

Type: Source link-layer address (1)
 Length: 1 (8 bytes)
 Link-layer address: c2:00:11:50:00:00 (c2:00:11:50:00:00)

ICMPv6 option (MTU : 1500)

Type: MTU (5)
 Length: 1 (8 bytes)
 Reserved
 MTU: 1500

ICMPv6 option (Prefix information : 2001:db8:cafe:b0::/64)

Type: Prefix information (3)
 Length: 4 (32 bytes)
 Prefix Length: 64

Flag: 0xc0

- 1... .. = On-link flag(L): Set
- .1... .. = Autonomous address-configuration flag(A): Set
- ..0... .. = Router address flag(R): Not set
- ...0 0000 = Reserved: 0

Valid Lifetime: 2592000
 Preferred Lifetime: 604800
 Reserved

Prefix: 2001:db8:cafe:b0:: (2001:db8:cafe:b0::)

→ SOURCE IP - USO A QUE ADDRESS
 PER COSTRUIRE IL WORKING -

IL ROUTER STA USANDO A
 PROPRIA STANDARD PER A
 CREARE QUE' WORKING

NON BROADCAST
 MA RESCUECAST

QUANDO PROCESSO IL WORKING
 POSSO PER LA PROPRIA RAGIONE
 NEL WORKING WORKING

PER FORZARE IL ADDRESS RAGIONE
 QUEL WORKING, POSSO USARE
 SOURCEID

→ GLOBAL UNICAST

Address configuration

- Stateful (DHCPv6)

- Stateless

- Autoconfiguration, without any manual configuration of the host

W QUALSASI TIPO DI CENSO
 D'INIZIO IP DEVO CONSERVARE
 CENSO SA O IN INIZIO D'INIZIO

LA SECCA
 CONSERVATIVA

- The interface ID is generated from the MAC address (or randomly chosen)

- The prefix is learned from the Router Advertisement message → Router Discovery

- The address goes through different states

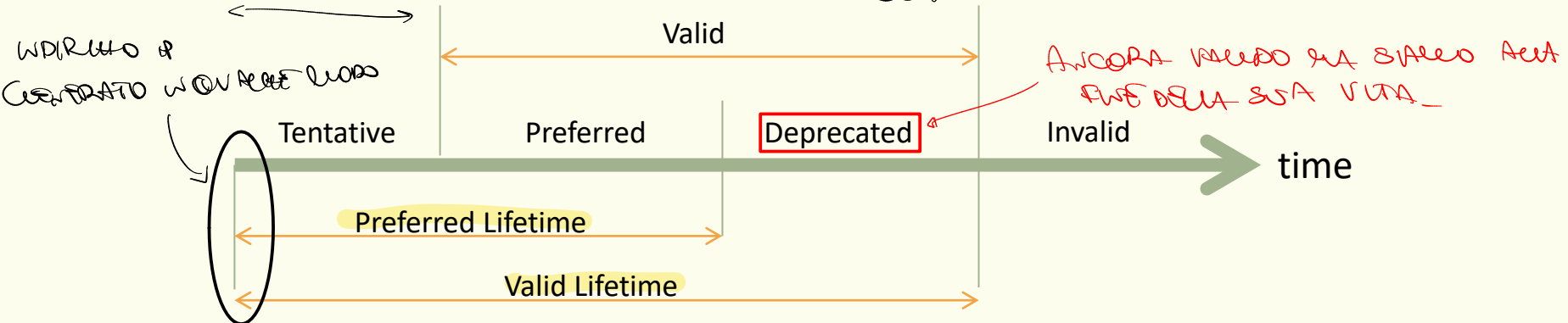
- Tentative, Preferred, Deprecated

Address lifetime



- Tentative address
 - Uniqueness on a link is being verified → *WIRATO ANCORA NON VALEDO*
 - An interface discards received packets addressed to a tentative address, but accepts Neighbor Discovery packets
- Preferred address → *VALEDO*
 - Use by upper-layer protocols is unrestricted
- Deprecated address
 - Use is discouraged, but not forbidden
- Valid address
 - A preferred or deprecated address

QUANTO TEMPO CI VOCE PER VERIFICARE UNICITA'



Address autoconfiguration

- A link-local address is generated appending the interface identifier to the link-local prefix FE80::/10
 - The link-local address is tentative
- A NS message is sent out to check Duplicate Address Detection
 - The link-local address becomes preferred
- A RS message is sent out to the *all-routers* address
- For each prefix in RAs with the A flag set, an address is generated
 - The address is tentative, DAD should be performed
- The address becomes preferred until its lifetime expires

Address autoconfiguration

u NODD NON HA UN WDRMHO VAUDO

SELECTED NON RECENT ABST ADDRESS
NON OENL NODD 18M4

c'è @vlecon Auro c'te

QUESTO WDRMHO?

No.	Source	Destination	Protocol Info
1	::	ff02::1:ff10:aef	ICMPv6 Neighbor solicitation for fe80::d4e4:d1e6:c310:aef USA
2	fe80::d4e4:d1e6:c310:aef → ORA S' PREFERED	ff02::2	ICMPv6 Router Solicitation
3	fe80::d4e4:d1e6:c310:aef	ff02::16	ICMPv6 Multicast Listener Report Message v2
4	fe80::c000:11ff:fe50:0	ff02::1	ICMPv6 Router Advertisement from c2:00:11:50:00:00
5	fe80::d4e4:d1e6:c310:aef	ff02::16	ICMPv6 Multicast Listener Report Message v2
6	::	ff02::1:ff10:aef	ICMPv6 Neighbor Solicitation for 2001:db8:cafe:b0:d4e4:d1e6:c310:aef
7	::	ff02::1:ff1c:4c99	ICMPv6 Neighbor Solicitation for 2001:db8:cafe:b0:a43d:d55b:d1c:4c99
8	fe80::d4e4:d1e6:c310:aef	ff02::16	ICMPv6 Multicast Listener Report Message v2
9	fe80::d4e4:d1e6:c310:aef	ff02::1	ICMPv6 Neighbor Advertisement fe80::d4e4:d1e6:c310:aef
10	2001:db8:cafe:b0:d4e4:d1e6:c310:aef	ff02::1	ICMPv6 Neighbor Advertisement 2001:db8:cafe:b0:d4e4:d1e6:c310:aef
11	2001:db8:cafe:b0:a43d:d55b:d1c:4c99	ff02::1	ICMPv6 Neighbor Advertisement 2001:db8:cafe:b0:a43d:d55b:d1c:4c99

Frame 1: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0

Ethernet II, Src: CadmusCo_dd:ed:d3 (08:00:27:dd:ed:d3), Dst: IPv6mcast_ff:10:0a:ef (33:33:ff:10:0a:ef)

Internet Protocol Version 6, Src: :: (::), Dst: ff02::1:ff10:aef (ff02::1:ff10:aef)

Internet Control Message Protocol v6

Type: Neighbor Solicitation (135)

Code: 0

Checksum: 0xfc5c [correct]

Reserved: 00000000

Target Address: fe80::d4e4:d1e6:c310:aef (fe80::d4e4:d1e6:c310:aef)

u NODD HA CENRATO 2 WDRMHO ;

① CENRATO A PANTHE DAE LEE

② CENRATO RANDOM

Details of packet 4 (RA) are in the previous slide

ADVERTISEMENT D ENTRADA CEE WDRMHO

CONTROLO ENTRADA

References

- RFC 4443, “Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification,” 2006
- RFC 4861, “Neighbor Discovery for IP version 6 (IPv6)”, 2007
- RFC 4862, “IPv6 Stateless Address Autoconfiguration,” 2007