Internet Control Message Protocol version 6 (ICMPv6)

IPv4

- Internet Control Message Protocol version 4 (ICMP)

IPv6

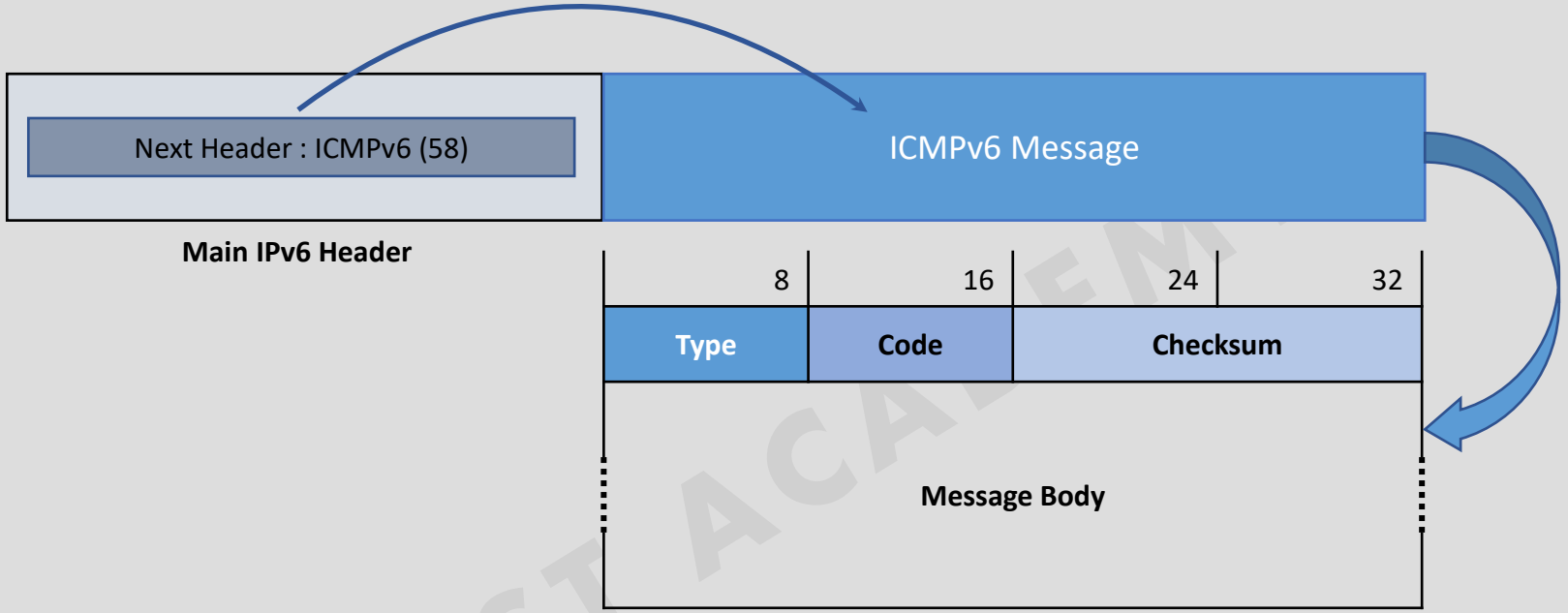
- Internet Control Message Protocol version 6 (ICMPv6)
  - Neighbor Discovery Protocol (NDP)
  - Multicast Listener Discovery (MLD)

It is used by **operating systems** or some **utilities** such as **Ping** and **Traceroute** to send **informational messages** or **error messages** between devices.

ICMPv6 Message Types

Error messages	Informational Messages		
	Used by Ping utility	Used for Multicast Listener Discovery (MLD)	Used by Neighbor Discovery (ND)
▪ Destination Unreachable.	• **Echo Request**	• Multicast Listener Query	• **Router Solicitation (RS)**
▪ Packet Too Big.	• **Echo Reply**	• Multicast Listener Report	• **Router Advertisement (RA)**
▪ Time Exceeded.		• Multicast Listener Done	• **Neighbor Solicitation (NS)**
▪ Parameter Problem.			• **Neighbor Advertisement (NA)**
			• Redirect message

ICMPv6 : General Message Format



❖ **Type (8 bits):** Indicates the type of ICMPv6 message, such as Echo Request.

- ➢ **Error messages**: Type = **0 to 127**
- ➢ **Informational messages**: Type = **128 to 255**

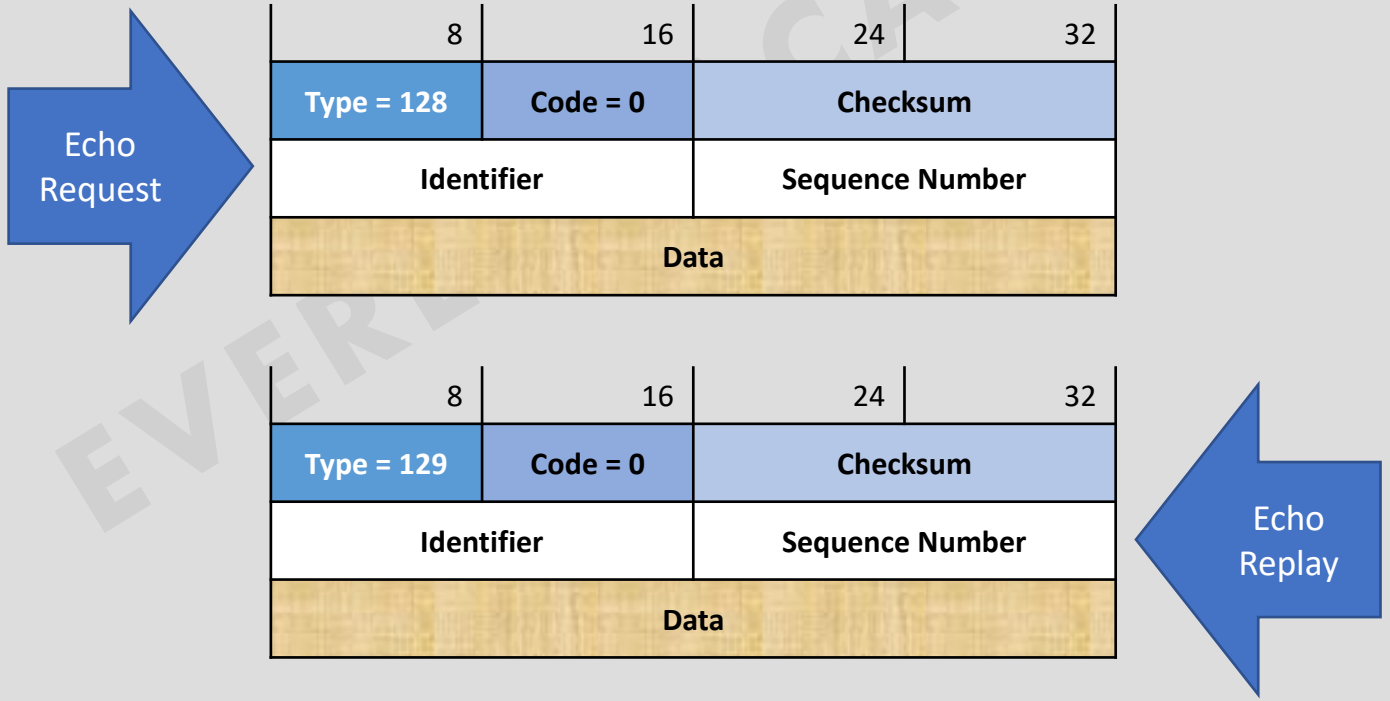
❖ **Code (8 bits):** Provides more granularity for the Type field. Its meaning depends on the message type.

❖ **Checksum (16 bits):** Used to detect data corruption in the ICMPv6 message and parts of the IPv6 header.

Echo Request and Echo Reply messages

- **Echo Request and Echo Reply** are two ICMP messages used by **ping**, a very common TCP/IP utility

- A device sends an **Echo Request** to prompt the destination to return an **Echo Reply** to verify network layer connectivity.



Neighbor Discovery Protocol (NDP, ND)

- Neighbor Discovery includes similar processes as in IPv4, such as *address resolution*, *router discovery*, and *redirect*.

- ND includes new functionality such as *prefix discovery*, *Duplicate Address Detection (DAD)*, and *Neighbor Unreachability Detection (NUD).*

- Neighbor Discovery (ND) uses **five informational messages.**

❖ *Router - device* messages used for **dynamic address allocation**:

Router Solicitation (RS) message	Type = **133**
Router Advertisement (RA) message	Type = **134**

❖ *Device - device* messages used for **address resolution**:

Neighbor Solicitation (NS) message	Type = **135**
Neighbor Advertisement (NA) message	Type = **136**

❖ *Router - device* messages used for **better first-hop selection**:

Redirect message	Type = **137**

Neighbor Discovery Protocol (NDP, ND)

❖ Router and prefix discovery:

- **Router Solicitation** and **Router Advertisement messages** assist a device in automatically determining its network **prefix**, **default gateway**, and **other configuration information**, known as **Stateless Address Autoconfiguration (SLAAC).**

❖ Address resolution:

- **Neighbor Solicitation** and **Neighbor Advertisement messages** assist a device in determining the **Layer 2 data link address** of another device on its network when it knows its IPv6 address.

❖ Duplicate Address Detection (DAD):

- **Neighbor Solicitation** and **Neighbor Advertisement messages** are used to determine whether a configured unicast address is already in use by another device.

❖ Neighbor Unreachability Detection (NUD):

- **Neighbor Solicitation** and **Neighbor Advertisement messages** are used to determine whether a neighbor is reachable from the perspective of the device.

NDP - Neighbor MAC Discovery - Lab

MAC Address → 00E0.A3B6.B12D
Link-Local → FE80 ::2E0:A3FF:FEB6:B12D

MAC Address → 0002.4A26.7CBE
Link-Local → FE80::202:4AFF:FE26:7CBE

IPv6 Packet	Source IP	FE80::2E0:A3FF:FEB6:B12D	**Neighbor Solicitation (NS)**
	Destination IP	FF02::1:FF26:7CBE	Type : 135
IPv6 Packet	Source IP	FE80::202:4AFF:FE26:7CBE	**Neighbor Advertisement (NA)**
	Destination IP	FE80 ::2E0:A3FF:FEB6:B12D	Type : 136
IPv6 Packet	Source IP	FE80::2E0:A3FF:FEB6:B12D	**Echo Request**
	Destination IP	FE80::202:4AFF:FE26:7CBE	Type : 128
IPv6 Packet	Source IP	FE80::202:4AFF:FE26:7CBE	**Echo Reply**
	Destination IP	FE80 ::2E0:A3FF:FEB6:B12D	Type : 129

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	PC1	ICMPv6
	0.000	--	PC1	NDP
	0.001	PC1	PC2	NDP
	0.002	PC2	PC1	NDP
	0.002	--	PC1	ICMPv6
	0.003	PC1	PC2	ICMPv6
	0.004	PC2	PC1	ICMPv6

Reset Simulation | Constant Delay | Captured to: 0.004 s

Play Controls

Event List Filters - Visible Events

ACL Filter, ARP, BGP, Bluetooth, CAPWAP, DHCP, DHCPv6, DNS, EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP, HTTPS, ICMP, ICMPv6, IPSec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NETFLOW, NTP, OSPF, OSPFv6, PAgP, POP3, PPP, PPPoED, PTP, RADIUS, REP, RIP, RIPng, RTP, SCCP, SMTP, SNMP, SSH, SYSLOG, TACACS, TCP, TFTP, Telnet, UDP, USB, VTP

Edit Filters | Show All/None

Time: 00:06:38.990 PLAY CONTROLS: Event List | Realtime | Simulation

4331 4321 1941 2901 2911 819IOX 819HGW 829 1240 PT-Router PT-Empty 184

1941

Scenario 0 | New | Delete | Toggle PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic

SLAAC with NDP RS and RA - Lab

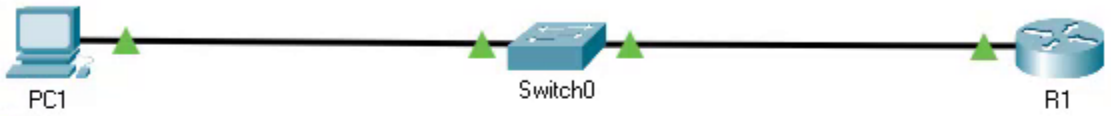
MAC Address → 0001.C9E5.3147

Link-Local → FE80::201:C9FF:FEE5:3147

MAC Address → 0001.6391.8401

Link-Local → FE80::201:63FF:FE91:8401

GUA → 2001:AAAA:AAAA:AAAA:1111:1111:1111:1111



IPv6 Packet	Source IP	FE80::201:C9FF:FEE5:3147	Router Solicitation (RS)
	Destination IP	FF02::2 (All-Routers)	Type : 133

IPv6 Packet	Source IP	FE80::201:63FF:FE91:8401	Router Advertisement (RA)
	Destination IP	FF02::1 (All Nodes)	Type : 134

IPv6 Packet	Source IP	2001:AAAA:AAAA:AAAA:201:C9FF:FEE5:3147	Neighbor Solicitation (NS)
	Destination IP	FF02::1:FFE5:3147	Type : 135

```
R1# enable
R1# conf t
R1(config)# ipv6 unicast-routing
R1(config)# interface gig 0/0
R1(config-if)# ipv6 address 2001:AAAA:AAAA:AAAA:1111:1111:1111:1111/64
R1(config-if)# no shutdown
R1(config-if)# end
R1# show ipv6 neighbors
```