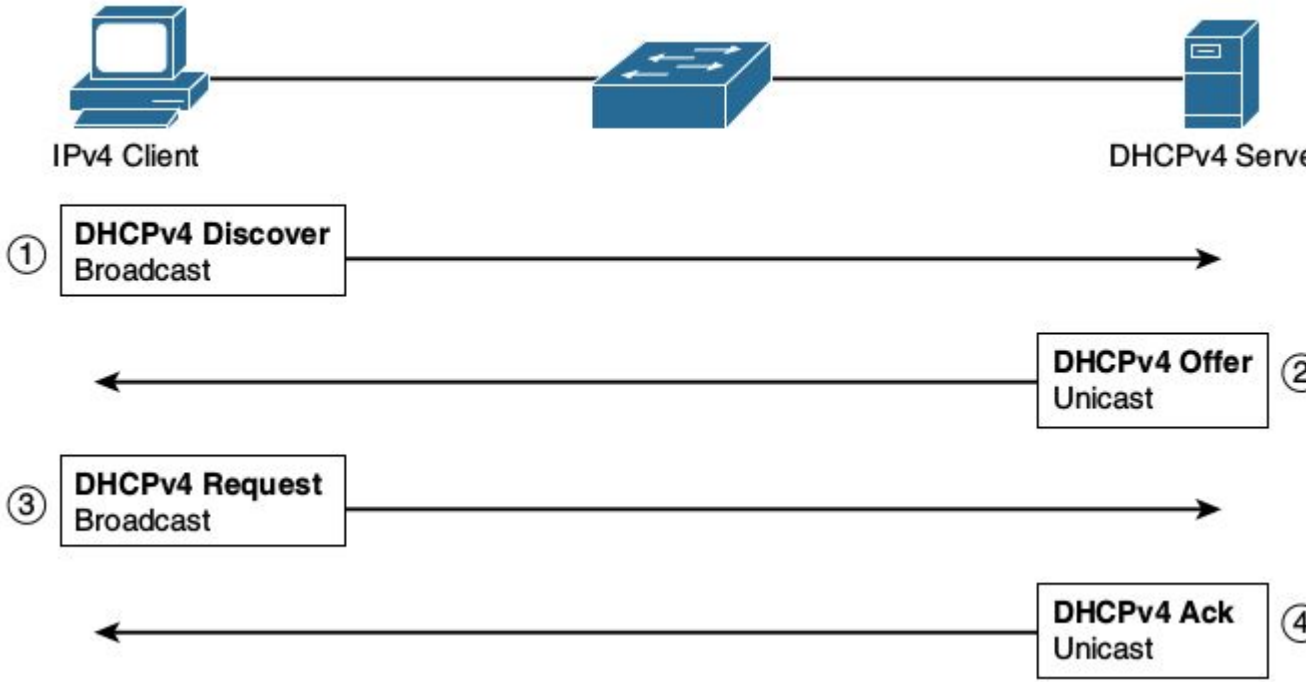
IPv6 - Dynamic Address Assignment

Dynamic Address Assignment

- Dynamic IPv6 address allocation provides a method for devices to create or obtain **their global unicast addresses and other addressing information.**
- IPv4 - DHCP
- IPv6 - SLAAC, DHCPv6

DHCPv4

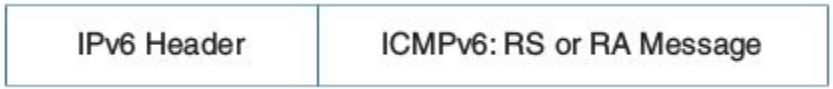

IPv4 Client
DHCPv4 Serve
1
DHCPv4 Discover
Broadcast
DHCPv4 Offer
Unicast
2
3
DHCPv4 Request
Broadcast
DHCPv4 Ack
Unicast
4

IPv6 - Dynamic Address Assignment

- The three methods for dynamic IPv6 addressing:
  - Stateless Address Autoconfiguration (SLAAC)
  - SLAAC and a stateless DHCPv6 server
  - Stateful DHCPv6 server

IPv6 - Dynamic Address Assignment

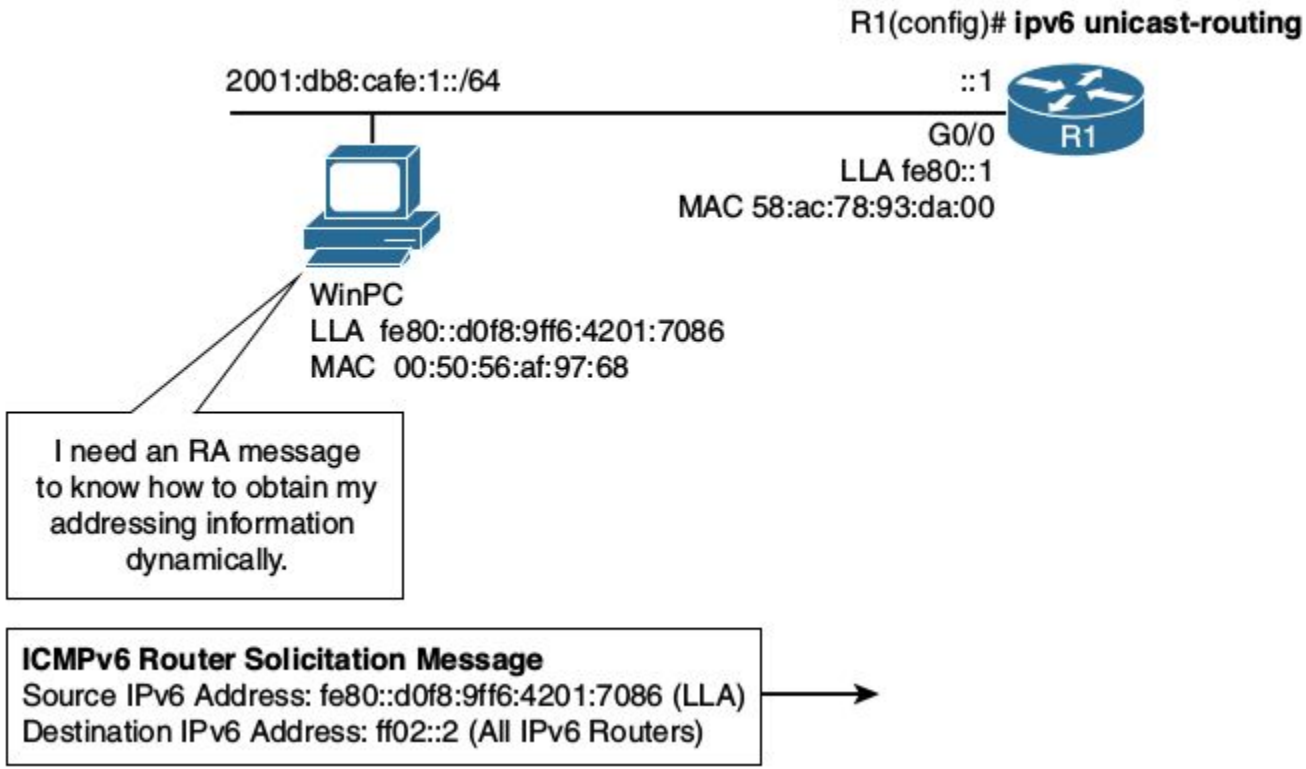
- Makes use of ICMPv6 messages
  - Router Solicitation
  - Router Advertisement
- **Recall :** ***ICMPv6 NDP messages*** *such as Router Solicitation and Router Advertisement messages are ICMPv6 messages* ***encapsulated in IPv6.***



Router Solicitation Message

- A host sends a Router Solicitation message when it needs to know how to dynamically obtain its addressing information.
  - During startup and is the default on most host operating systems.

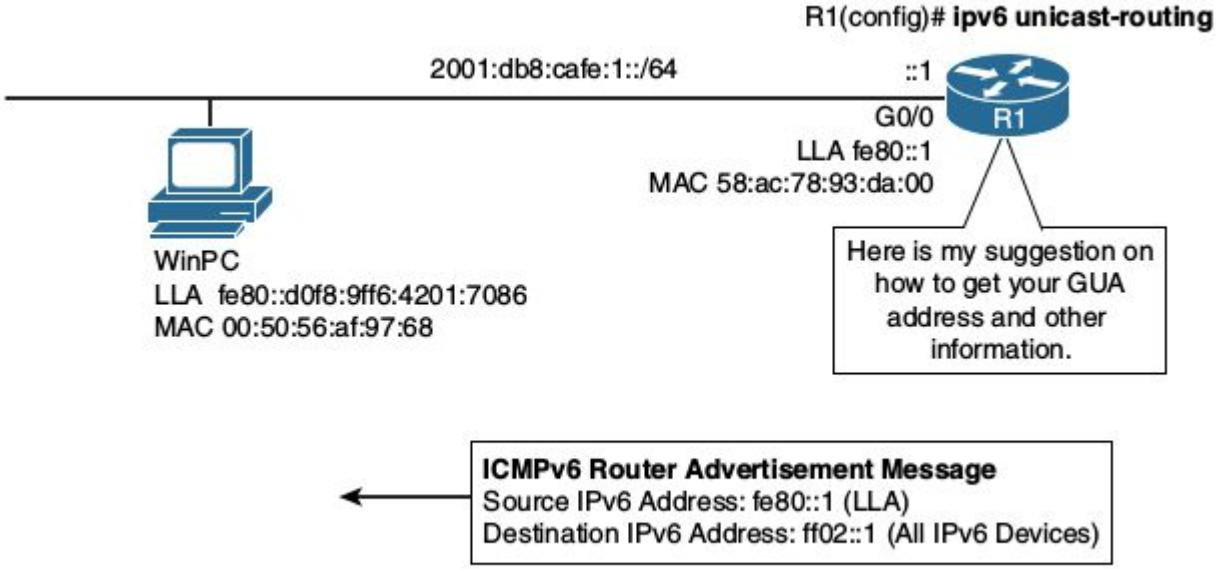
Router Solicitation



Router Advertisement Message

- The **RA message is a suggestion** to devices on the link about how to obtain their addressing information dynamically.
- The RA message includes **prefix, default router, and other configuration information.**
- The RA message (Unsolicited) is sent to the all-IPv6 devices multicast address, ff02::1.
- The RA message can be unicast if it is a response to RS.

Router Advertisement Message



Router can be configured to send RA message as unicast in response to RS message.

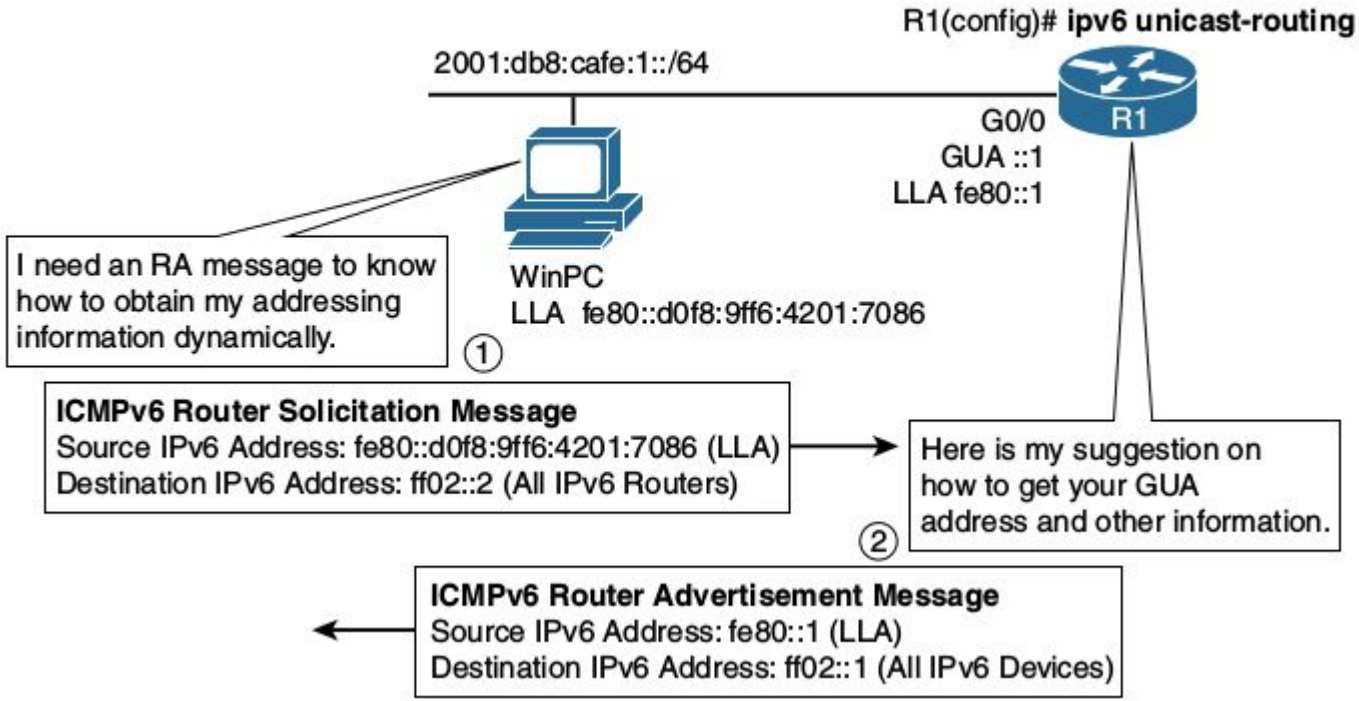
Router Advertisement Flags

- M : Managed Address Configuration
  - M=1 Do the Stateful Configuration. Contact DHCPv6.
  - M= 0 Default Value.
- O : Other Configuration flag
  - O=1 Get additional information (like DNS details) from DHCPv6
  - O=0 Default Value.
- If neither M nor O flags are set, this indicates that no information is available via DHCPv6.

Router Advertisement Flags

- Address Autoconfiguration flag (A flag) :
  - A=1, Use SLAAC to create GUA.
- Prf : Default Router Preference flag (is also defined now)
  - Prf=00 Default value indicates Medium
  - Prf=01 High
  - Prf=11 Low
  - Prf=10 Reserved
- There are flags to support address assignment in mobility as well.

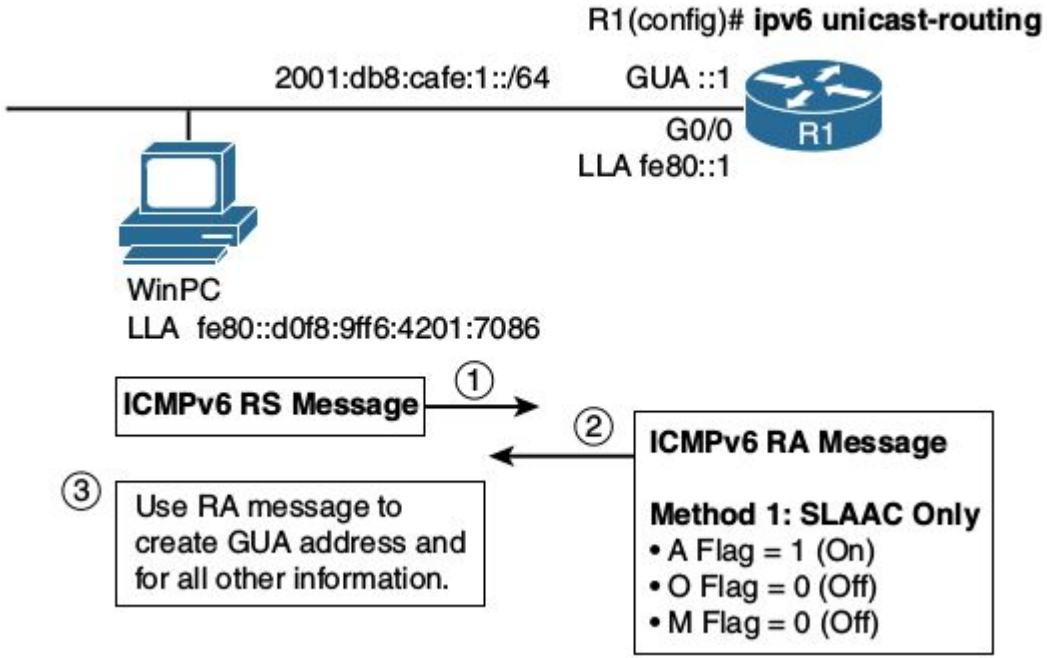
RS and RA Messages:



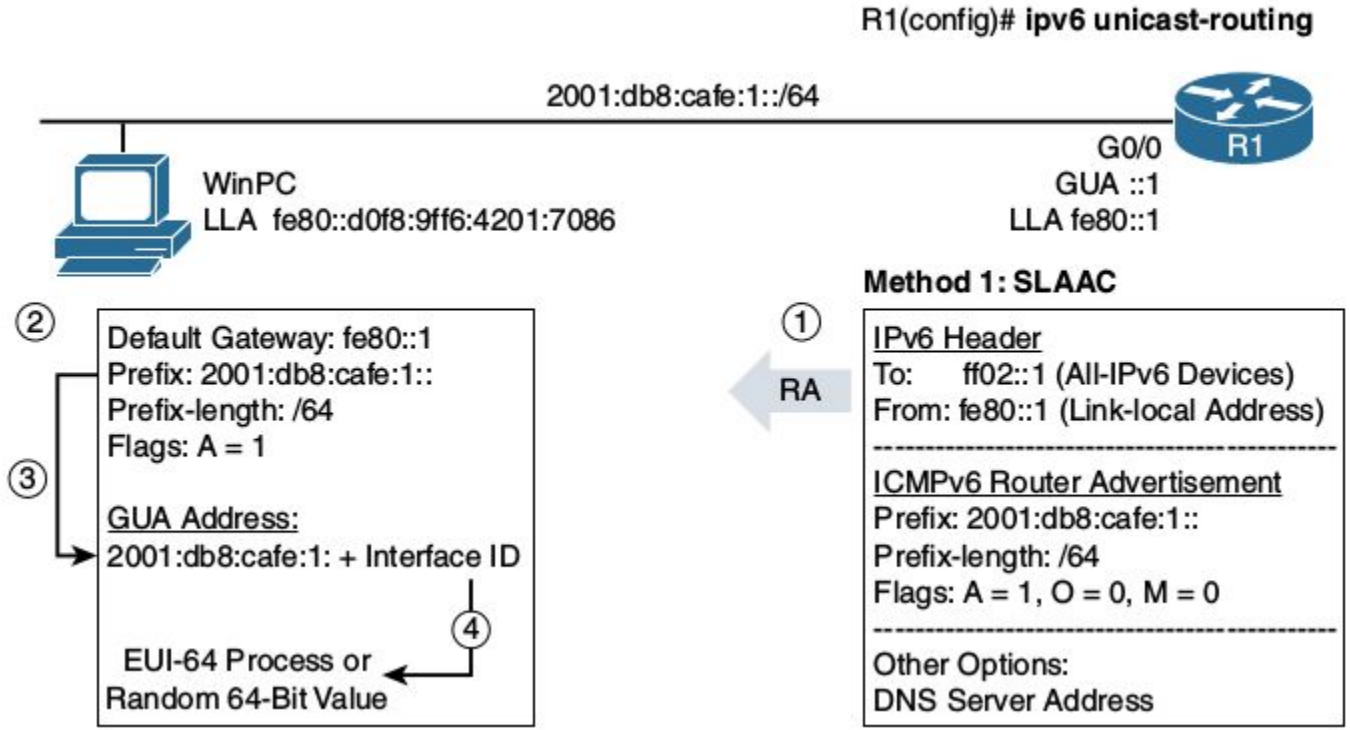
Flags for different methods:

RA Address Allocation Method	A Flag (SLAAC)	O Flag (Stateless DHCPv6)	M Flag (Stateful DHCPv6)
Method 1: SLAAC (default)	1 (on)	0 (off)	0 (off)
Method 2: SLAAC and stateless DHCPv6	1 (on)	1 (on)	0 (off)
Method 3: Stateful DHCPv6	0 (off)	N/A	1 (on)

Method 1 : SLAAC



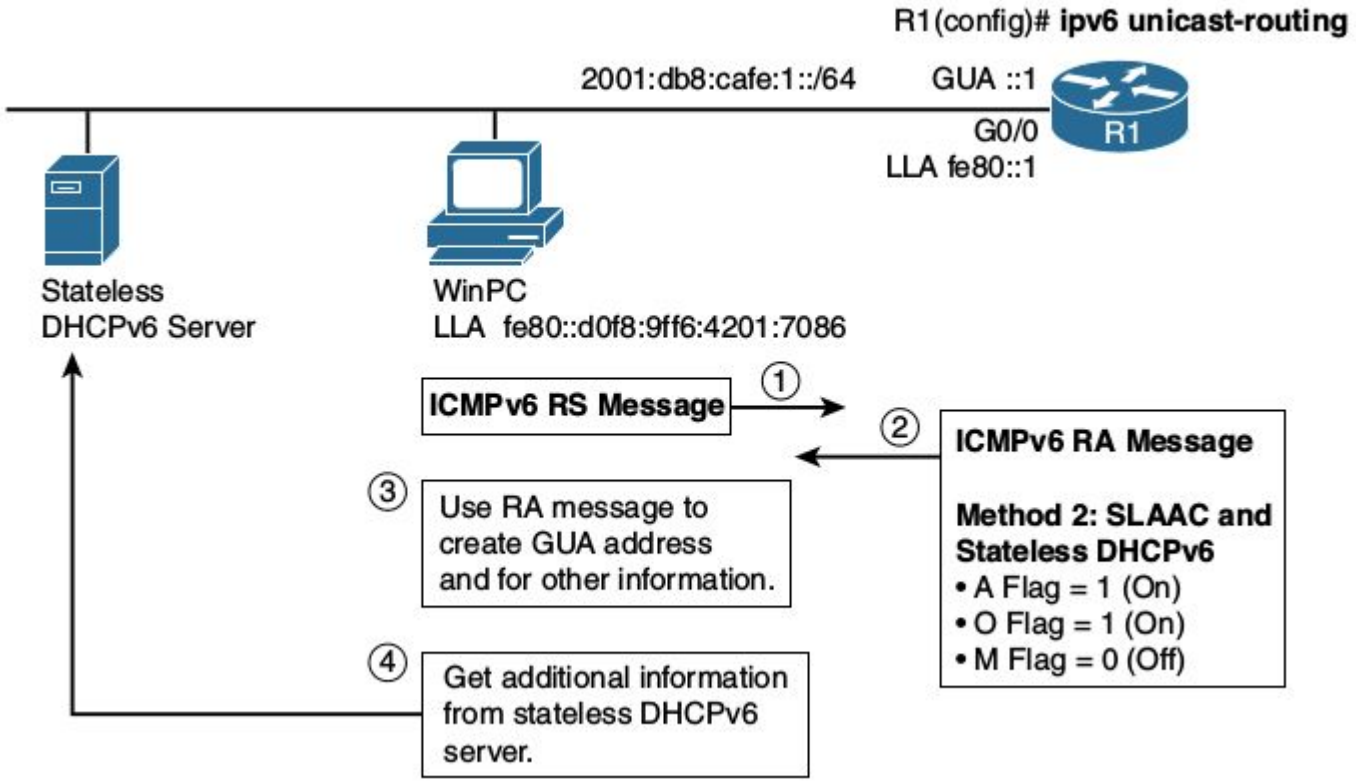
Method 1: SLAAC



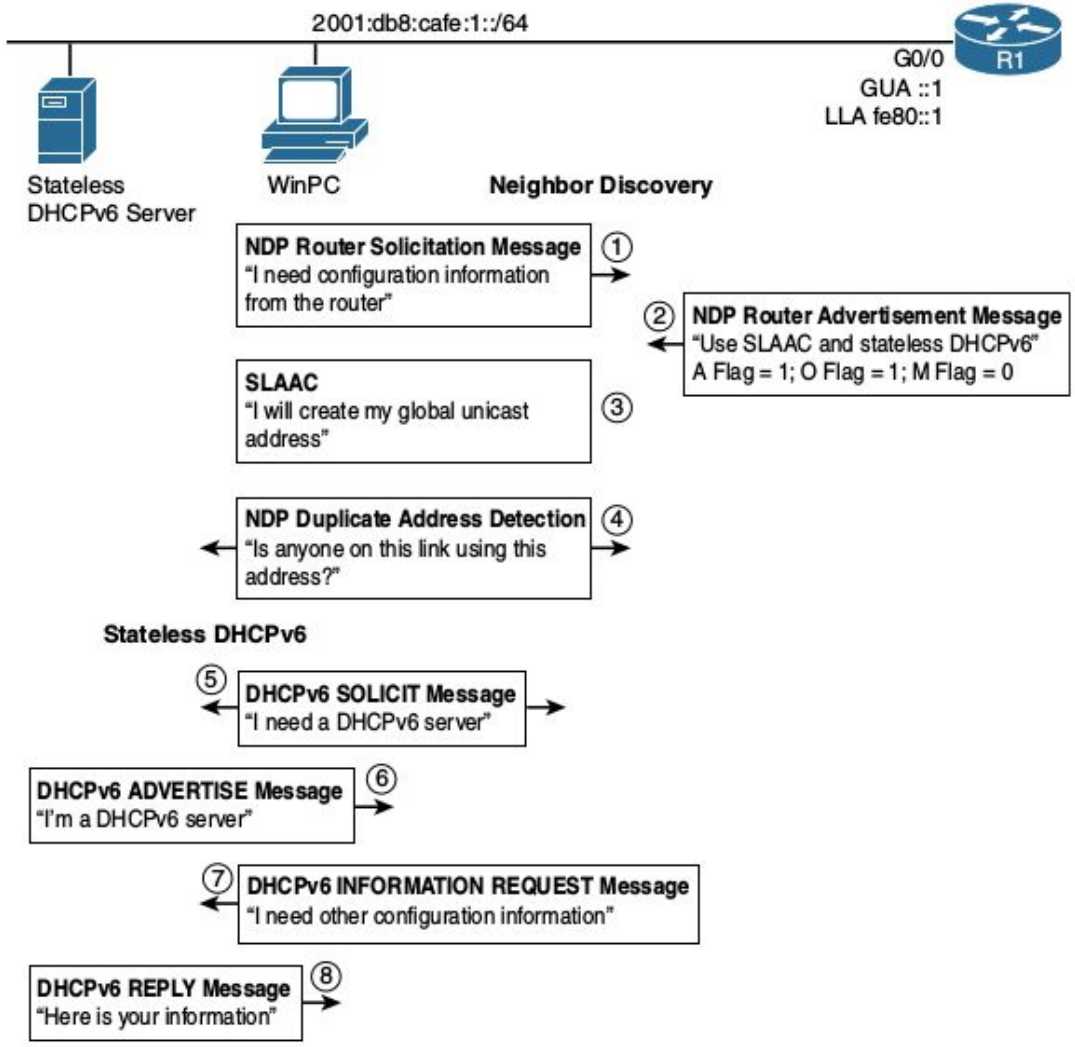
Note: DAD will be performed after GUA has been assigned

- Devices set to obtain their IPv6 address dynamically:
  - They use the prefix in the RA message to generate a global unicast address.
  - They use other information in the RA message, such as prefix length and link MTU.
  - **The RA message does not include the domain name and DNS address by default.**
  - They use the source IPv6 address of the packet, a link-local unicast address, as the default gateway address.
  - There is no other information needed from a stateless or stateful DHCPv6 server.

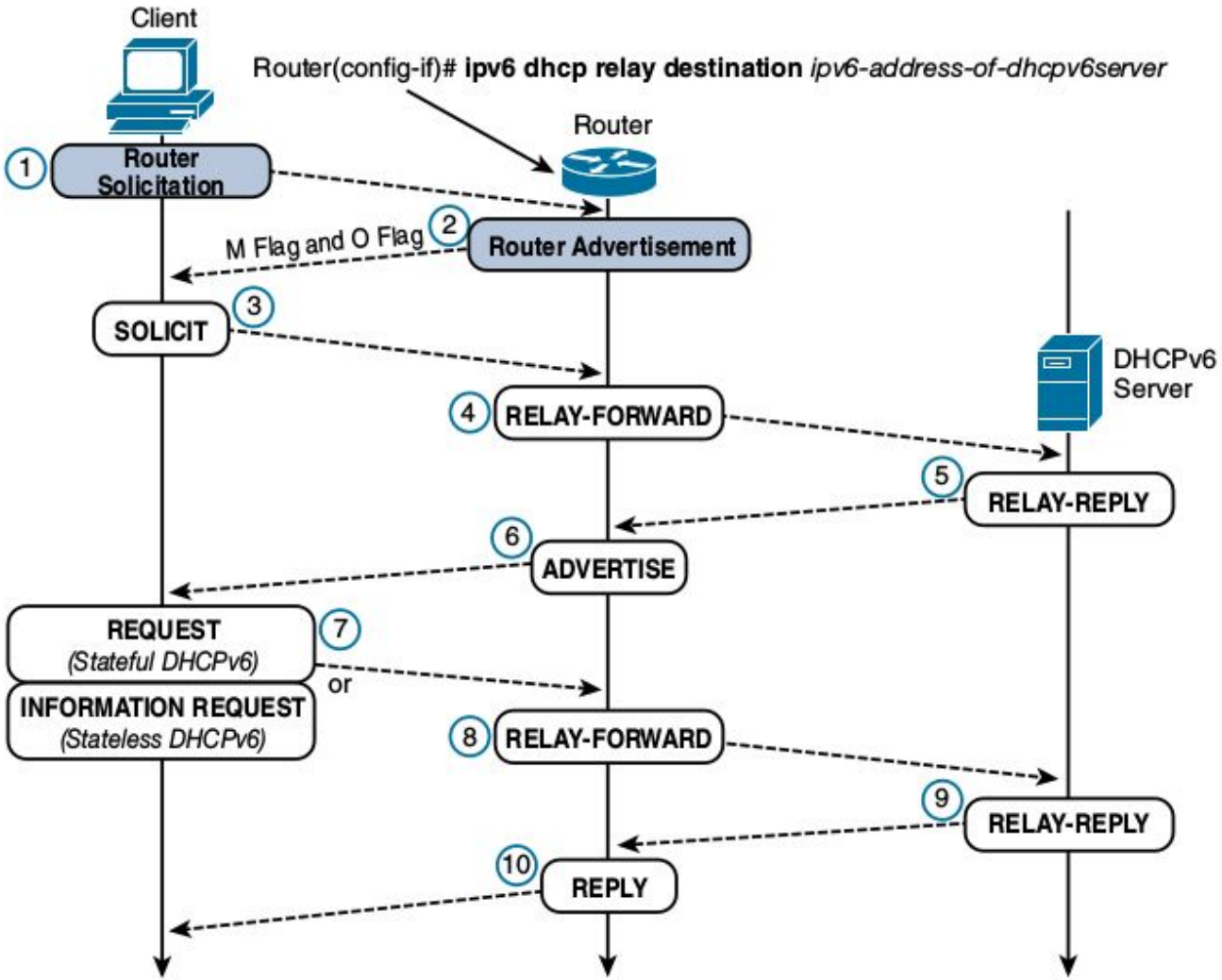
Method 2 : SLAAC and Stateless DHCPv6



Example:

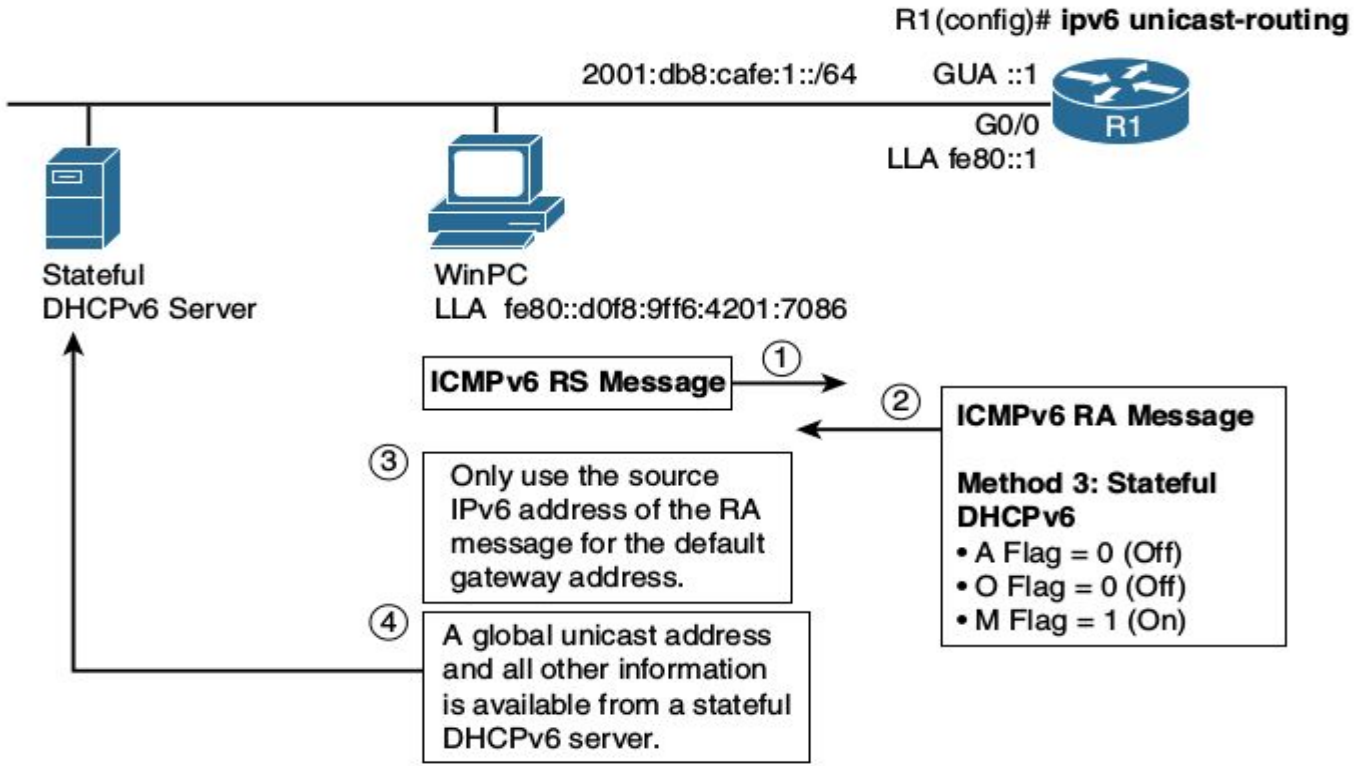

2001:db8:cafe:1::/64
G0/0
GUA ::1
LLA fe80::1
R1
Stateless DHCPv6 Server
WinPC
Neighbor Discovery
NDP Router Solicitation Message
"I need configuration information from the router"
1
2
NDP Router Advertisement Message
"Use SLAAC and stateless DHCPv6"
A Flag = 1; O Flag = 1; M Flag = 0
SLAAC
"I will create my global unicast address"
3
NDP Duplicate Address Detection
"Is anyone on this link using this address?"
4
Stateless DHCPv6
5
DHCPv6 SOLICIT Message
"I need a DHCPv6 server"
DHCPv6 ADVERTISE Message
"I'm a DHCPv6 server"
6
7
DHCPv6 INFORMATION REQUEST Message
"I need other configuration information"
DHCPv6 REPLY Message
"Here is your information"
8

DHCPv6 Server may not be in the same subnet.

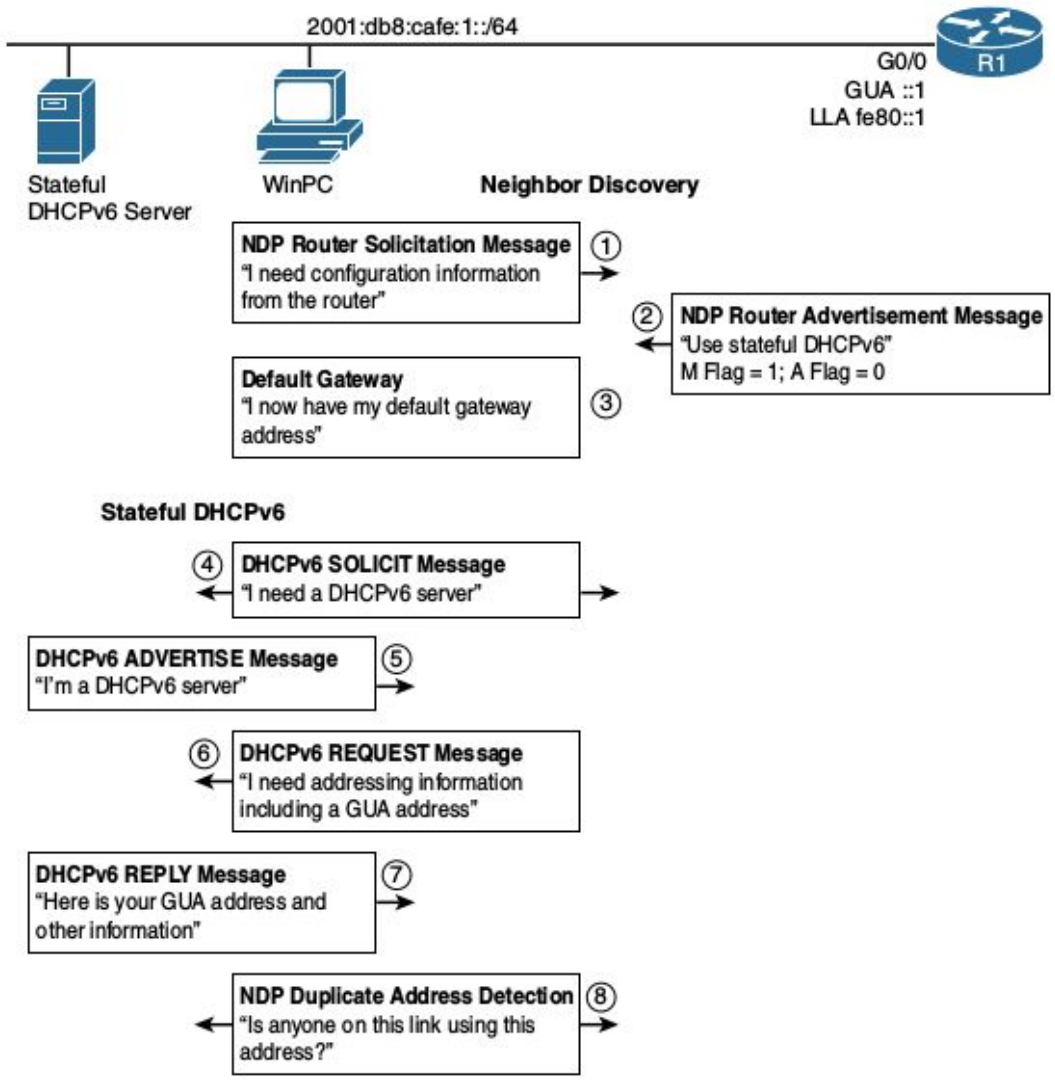


- Devices set to obtain their IPv6 address dynamically do the following:
  - They use the prefix in the RA message to generate a global unicast address.
  - They use other information in the RA message, such as prefix length and link MTU.
  - They use the source IPv6 address of the packet, a link-local unicast address, as the default gateway address.
  - **They contact a stateless DHCPv6 server for additional information, such as domain name and DNS server addresses. The RA message does not specify what information can be obtained from the stateless DHCPv6 server.**

Method 3 : Stateful DHCPv6

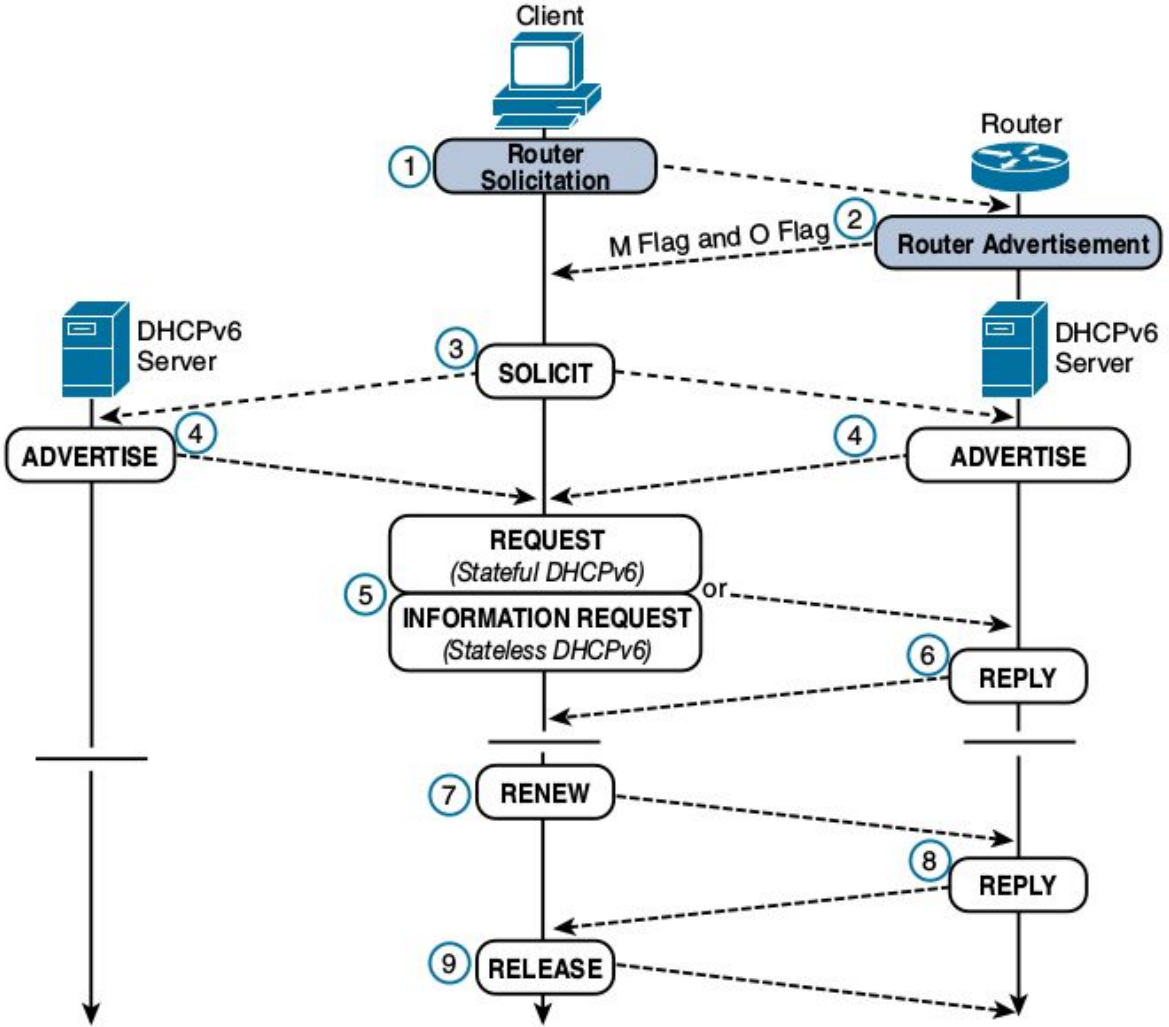


Example:


2001:db8:cafe:1::/64
G0/0
GUA ::1
LLA fe80::1
R1
Stateful
DHCPv6 Server
WinPC
Neighbor Discovery
NDP Router Solicitation Message
"I need configuration information from the router"
1
2
NDP Router Advertisement Message
"Use stateful DHCPv6"
M Flag = 1; A Flag = 0
Default Gateway
"I now have my default gateway address"
3
Stateful DHCPv6
4
DHCPv6 SOLICIT Message
"I need a DHCPv6 server"
DHCPv6 ADVERTISE Message
"I'm a DHCPv6 server"
5
6
DHCPv6 REQUEST Message
"I need addressing information including a GUA address"
DHCPv6 REPLY Message
"Here is your GUA address and other information"
7
NDP Duplicate Address Detection
"Is anyone on this link using this address?"
8

- Devices set to obtain their IPv6 address dynamically do the following:
  - They use the source IPv6 address of the packet, a link-local unicast address, of the RA message as the default gateway address.
  - They contact a stateful DHCPv6 server for a global unicast address and all other information, such as domain name and DNS server addresses.

DHCPv6 Communication



Refer : Chapter 8: Basics of Dynamic Addressing in IPv6,Cisco IPv6 Fundamental - 2nd Edition, Rick Graziani

REFERENCES

1. Cisco IPv6 Fundamental - 2nd Edition, Rick Graziani
2. Internet Protocol, Version 6 (IPv6) Specification - RFC 8200
3. IPv6 Stateless Address Autoconfiguration - RFC 4862
4. Neighbor Discovery for IP version 6 (IPv6) - RFC 4861