



TNE10006/TNE60006: Networks and Switching



IPv6 Address Types



Outline

- IPv6 Address Types
- Unicast Address
 - Global
 - IPv6 Subnets
 - Link Local
 - Loopback/Unspecified
 - Unique local
 - Embedded IPv4
- Multicast Addresses
 - Scope
 - Assigned Multicast
 - Solicited Multicast



IPv6 Address Types

IPv6 Address Types

There are three types of IPv6 addresses:

- Unicast
- Multicast
- Anycast.

Note: IPv6 does not have broadcast addresses



IPv6 Addressing

Reserved Addresses

- A portion of the IPv6 address space is reserved for various uses, both present and future.

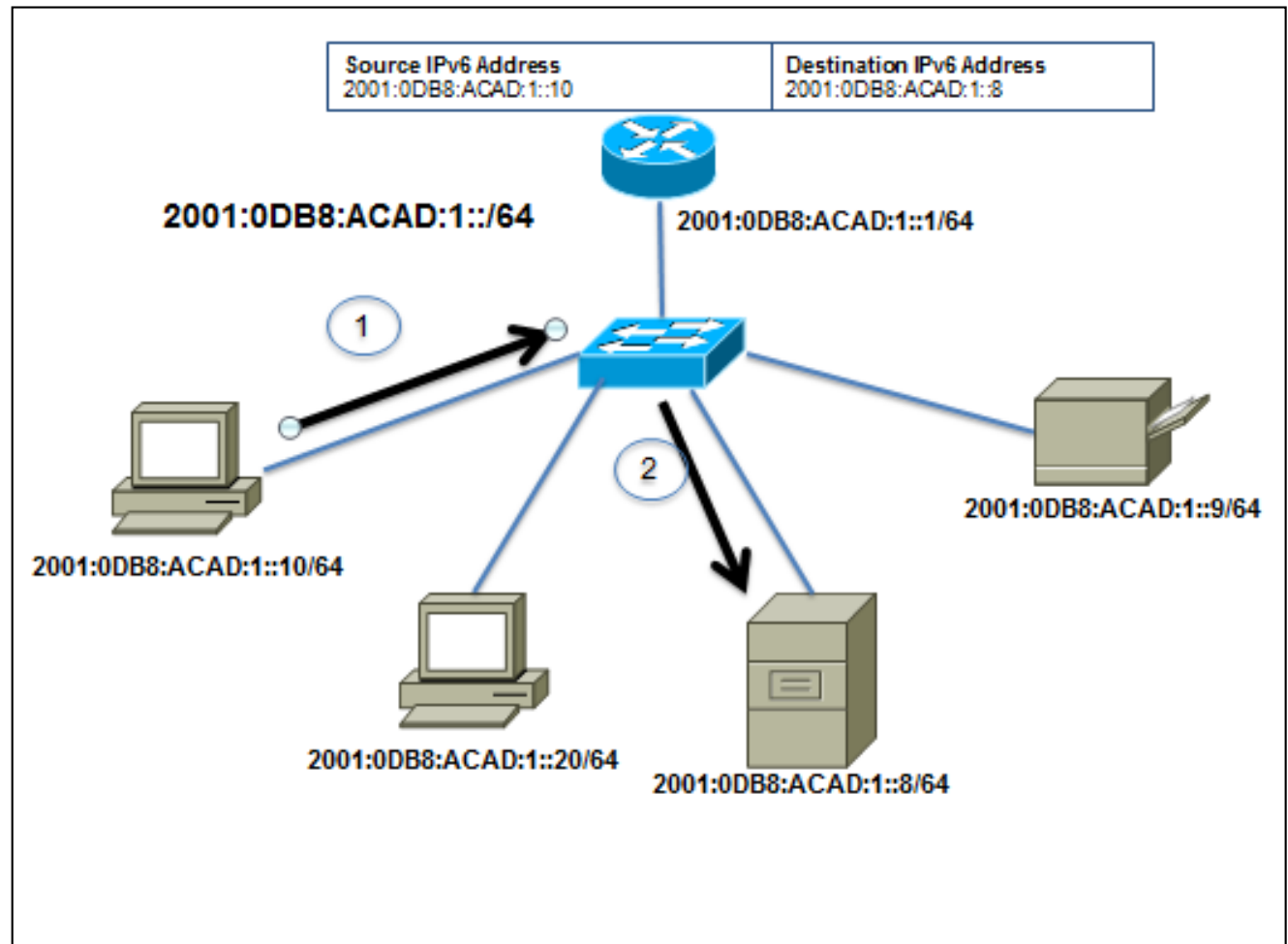
Address Type	High Order Bits (Binary)	High-Order Bits (Hex)
Unspecified	00...0	::/128
Loopback	00...1	::1/128
Multicast	11111111...	FF00::/8
Link Local Unicast	1111111010	FE80::/10
Global Unicast	001	2xxx::/4 or 3xxx::/4
Reserved (Future Global unicast)	Everything Else	



IPv6 Address Types

Unicast Addresses

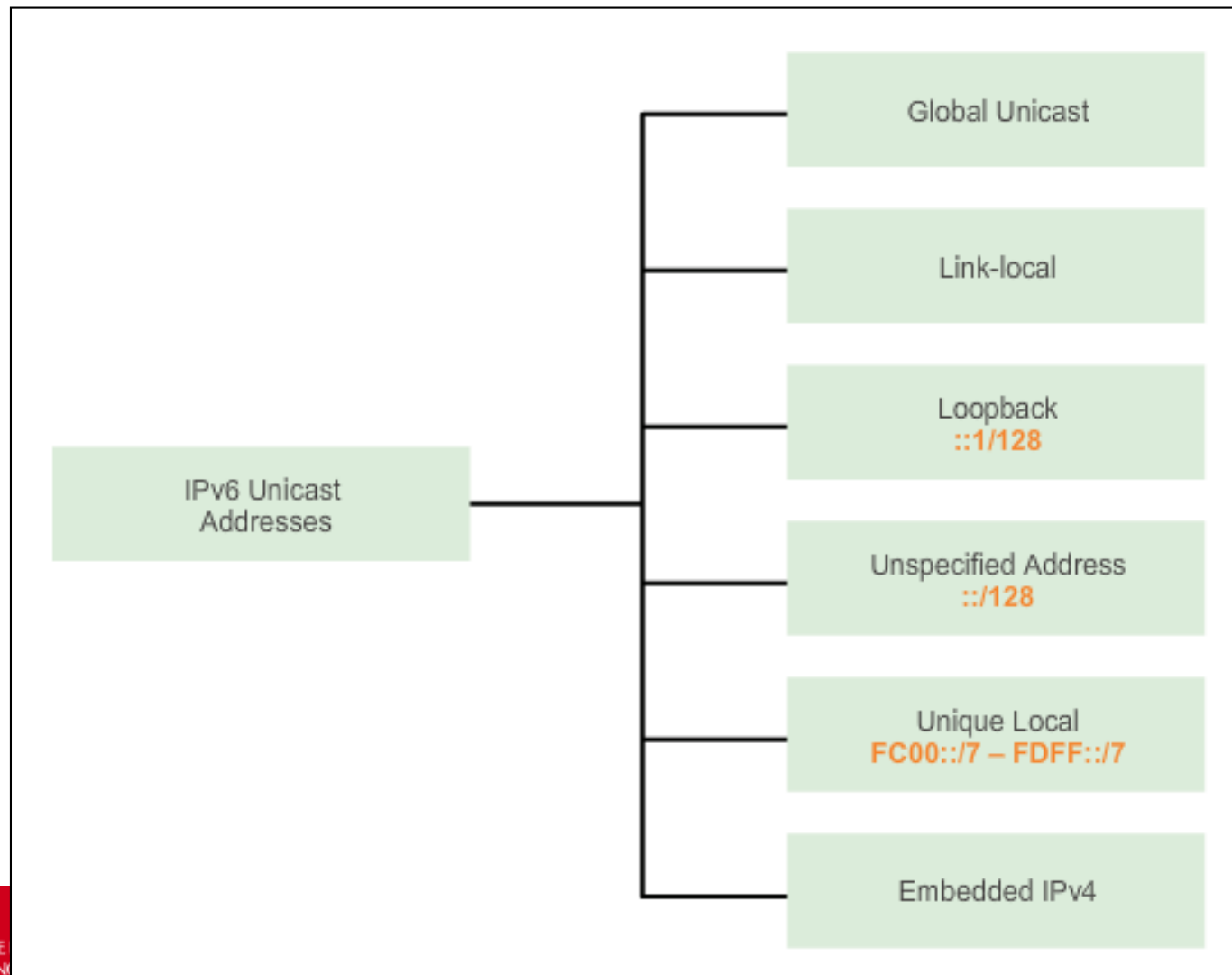
- Uniquely identifies an interface on an IPv6-enabled device
- A packet sent to a unicast address is received by the interface that is assigned that address





IPv6 Address Types

Unicast Addresses





IPv6 Addressing

Global Unicast Addresses

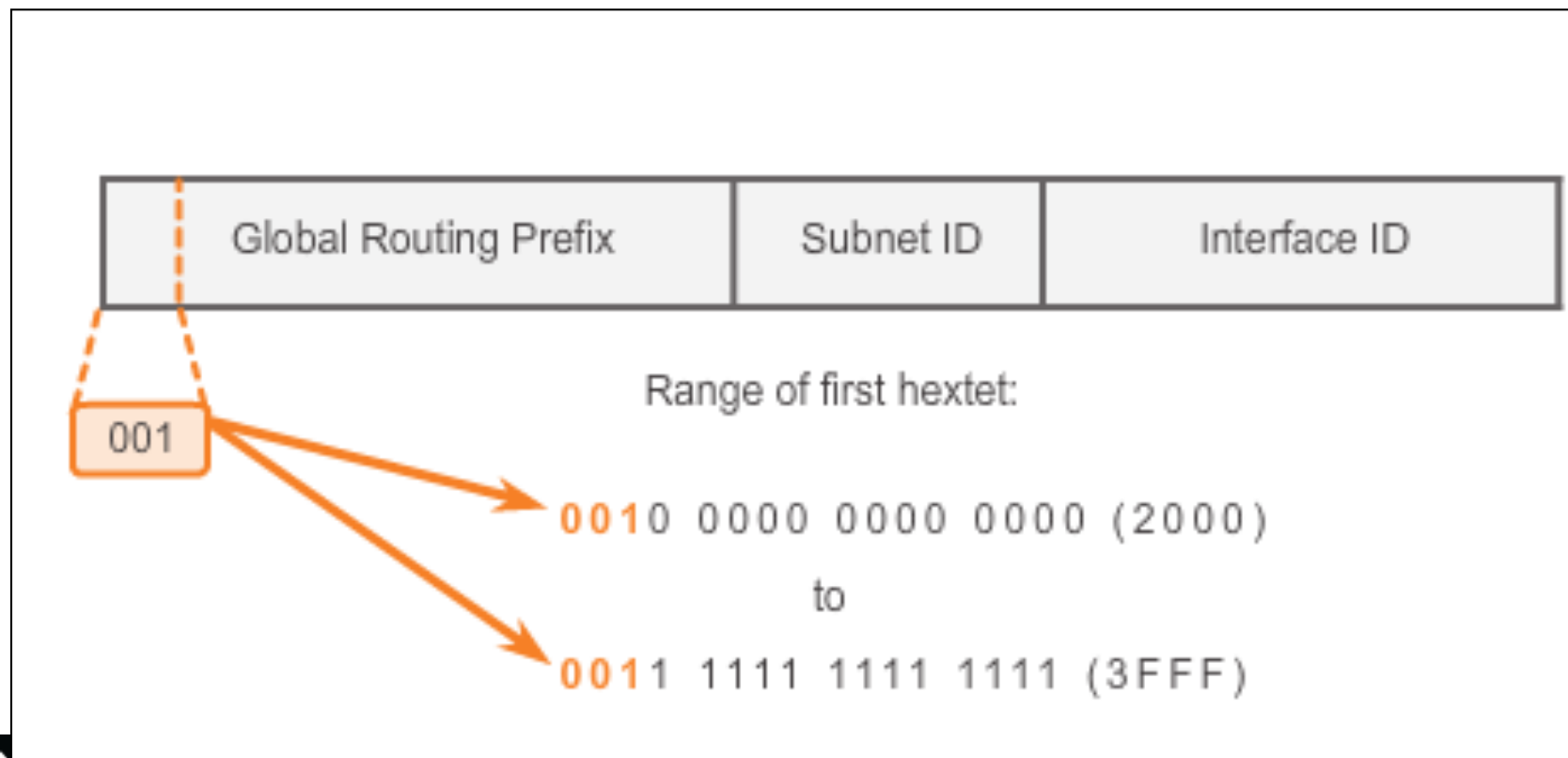
- Similar to a public IPv4 address
- Globally unique
- Internet routable addresses
- Can be configured statically or assigned dynamically



IPv6 Address Types

Global Unicast Addresses

Currently, only global unicast addresses with the first three bits of 001 or 2000::/3 are being assigned





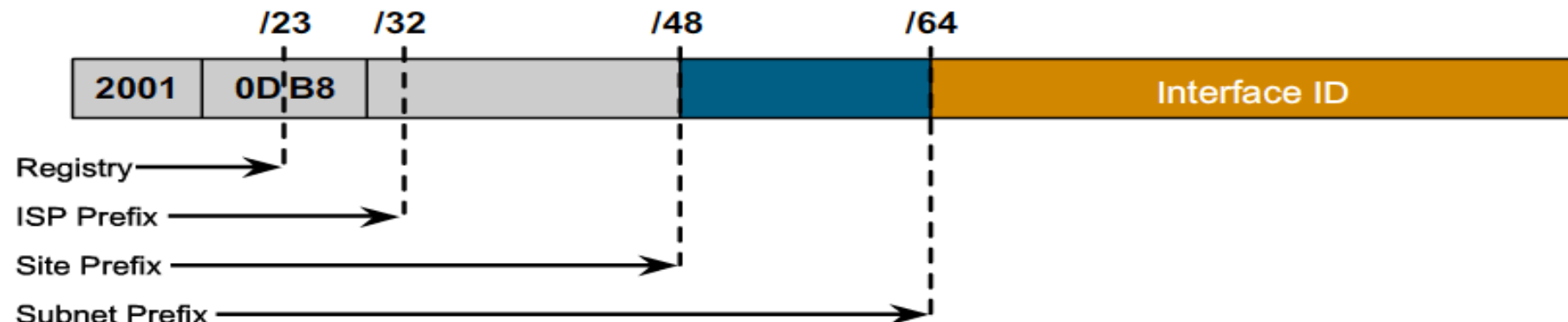
IPv6 Addressing

Global Unicast Hierarchy

- IPv6 has an address format that enables aggregation upward to the ISP
- Global unicast addresses typically consist of a 48-bit global routing prefix and a 16-bit subnet ID
- Organizations use a 16-bit subnet field to create a local addressing hierarchy
- This field allows an organization to use up to 65,535 individual subnets
- IANA internal prefix of /16

IANA - Internet Assigned Numbers Authority

Global Routing Prefix /48



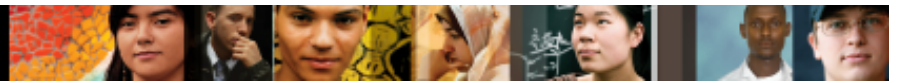


IPv6 Addressing

Global Unicast Hierarchy

2001: 0DB8:0001:0001:0290:27FF:FE3A:9E9A

Owner	Address Details	Bits Allocated
IANA Allocated Space	2001::/16	16 bits
Registry Space	2001:0C00::/23	7 bits
ISP Prefix	2001:0DB8::/32	9 bits
Site Prefix	2001:0DB8:0001::/48	16 bits
Subnet Prefix	2001:0DB8:0001:0001::/64	16 bits
Host Address	2001:0DB8:0001:0001:0290:27FF:FE3A:9E9A/64	64 bits



IPv6 Addressing

Global Unicast Hierarchy

2FFF:B00:C18:2::AAAA/64

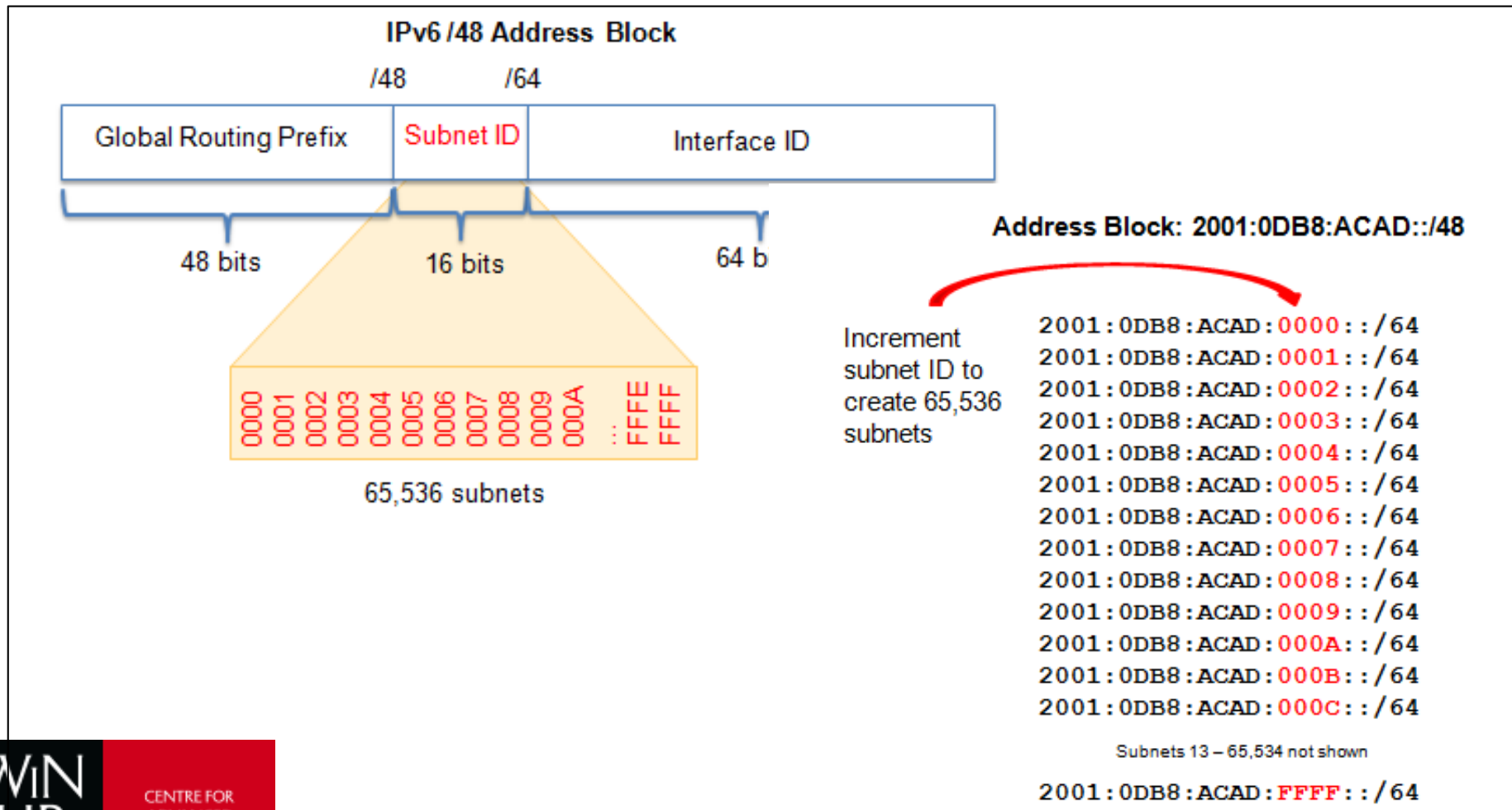
- 1. Fully expand the Address**
- 2. What is the subnet (LAN) Address?**
- 3. What is the Company (Site) Address?**
- 4. What is the Registry Space Address?**



IPv6 Subnet Prefix

Subnet ID

An IPv6 Network Space is subnetted to support hierarchical, logical design of the network





IPv6 Subnet Prefix Subnet ID

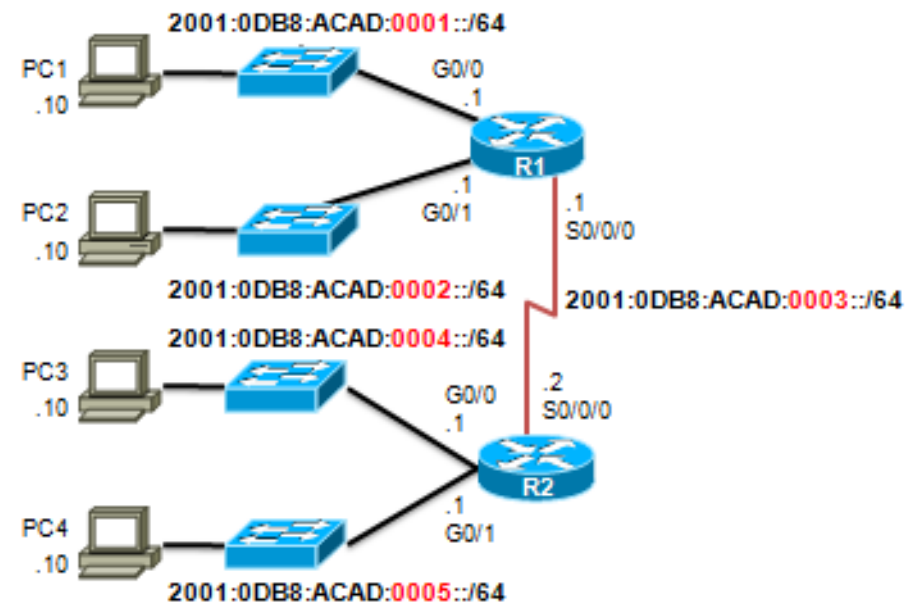
IPv6 Subnetting

Address Block: 2001:0DB8:ACAD::/48

5 subnets
allocated from
65,536 available
subnets

2001:0DB8:ACAD:0000::/64
2001:0DB8:ACAD:0001::/64
2001:0DB8:ACAD:0002::/64
2001:0DB8:ACAD:0003::/64
2001:0DB8:ACAD:0004::/64
2001:0DB8:ACAD:0005::/64
2001:0DB8:ACAD:0006::/64
2001:0DB8:ACAD:0007::/64
2001:0DB8:ACAD:0008::/64
⋮
2001:0DB8:ACAD:FFFF::/64

IPv6 Subnet Allocation

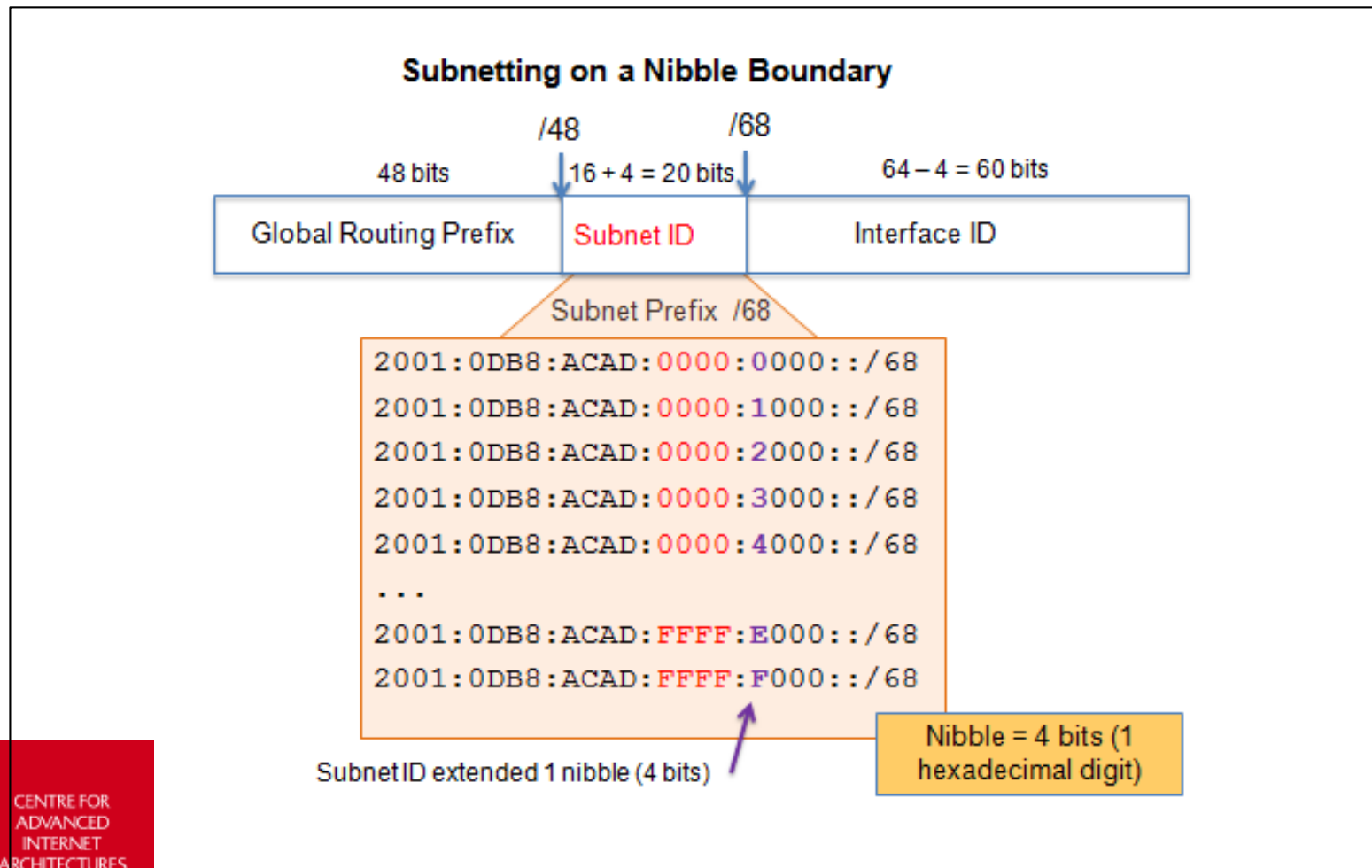




IPv6 Subnetting

Subnetting into the Interface ID

IPv6 bits can be borrowed from the interface ID to create additional IPv6 subnets





IPv6 Unicast Addressing

Link-Local Unicast Addresses

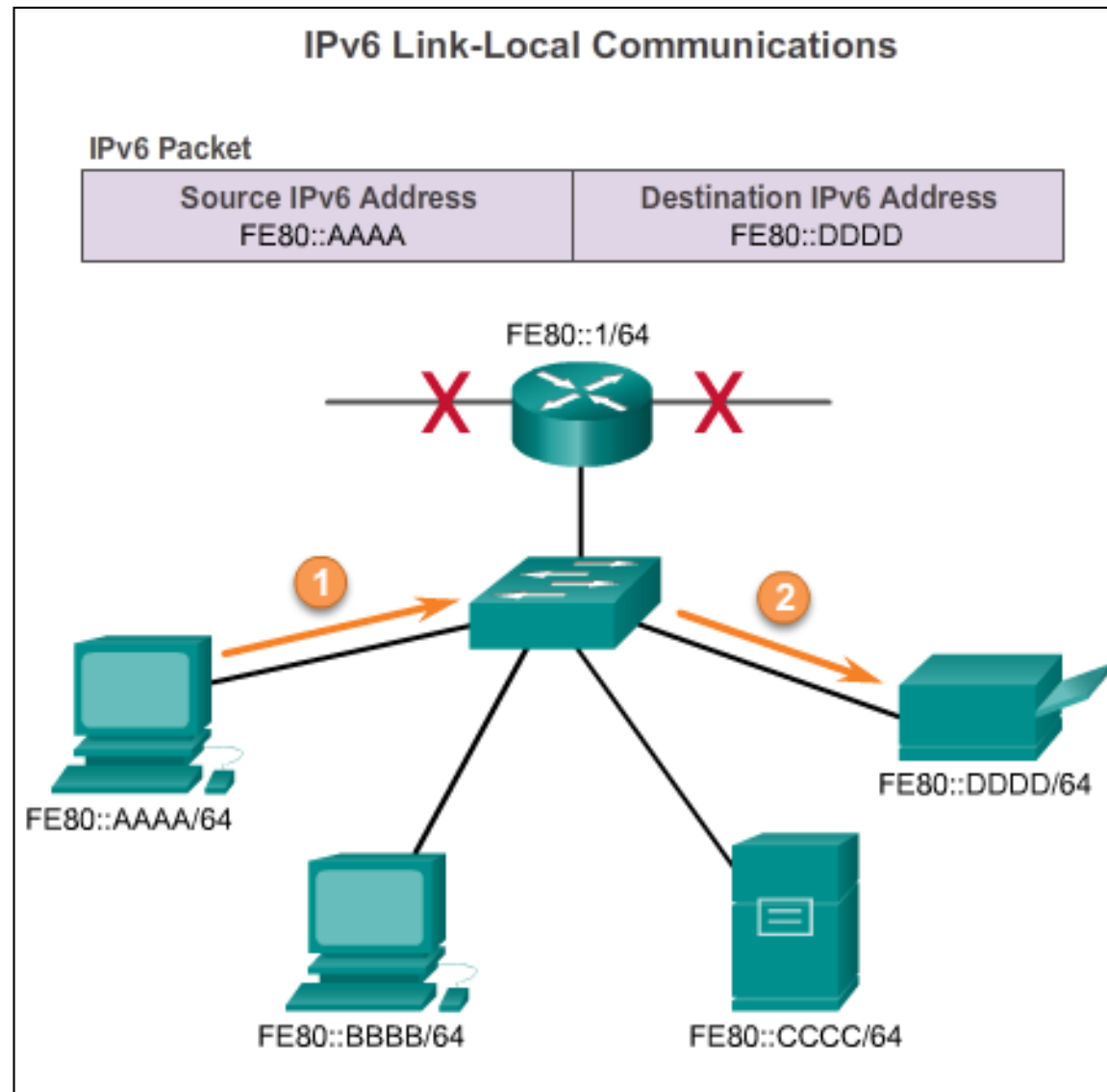
- Every IPv6-enabled interface is **REQUIRED** to have a link-local address
- After a global unicast address is assigned to an interface, the host automatically generates its link-local address
- Enables a device to communicate with other IPv6-enabled devices on the same link and only on that link
- Link-local address of the router is the default gateway
- Used by routers to identify the next-hop router when forwarding IPv6 packets



IPv6 Addressing

Link-Local Unicast Addresses

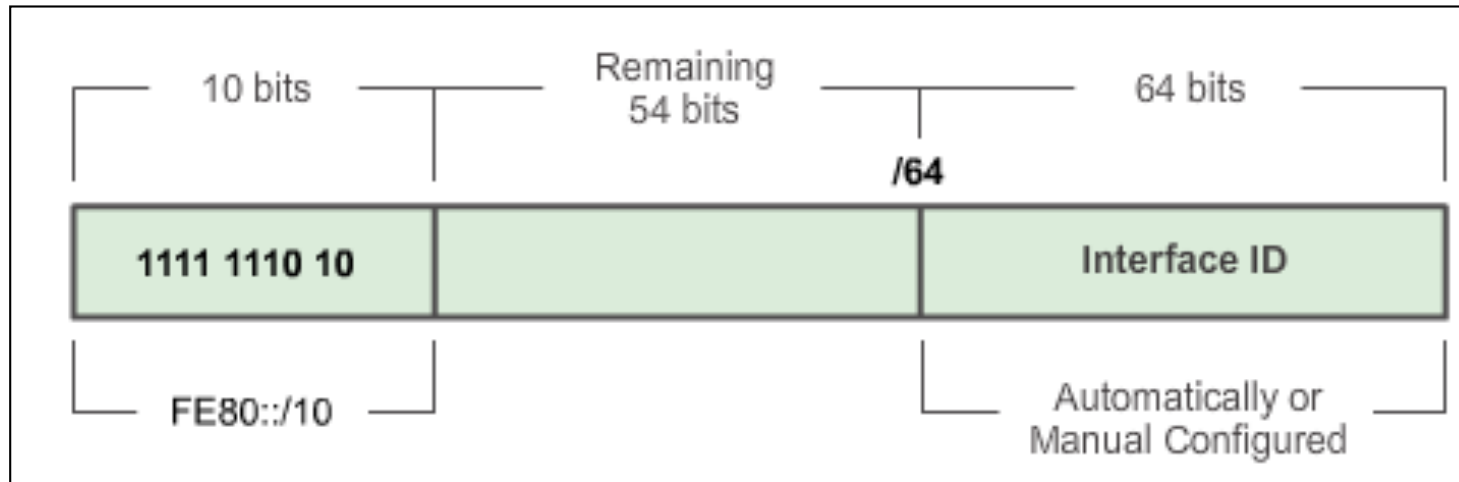
Packets with a source or destination link-local address cannot be routed beyond the link from where the packet originated





IPv6 Addressing

Link-Local Unicast Addresses



- FE80::/10 range, first 10 bits are 1111 1110 10xx xxxx
- Interface ID is taken from Global Unicast address
- Can be automatically generated using EUI-64 or random number



IPv6 Addressing

Loopback/Unspecified Addresses

Loopback

::1/128 or ::1

- Used by a host to send a packet to itself and cannot be assigned to a physical interface

Unspecified

::/128 or ::

- Cannot be assigned to an interface – only used as a source address
- An unspecified address is used as a source address when the device does not have a permanent IPv6 address or when the source address is irrelevant



IPv6 Addressing

IPv6 Unicast Addresses

Unique Local

- Similar to private addresses for IPv4
- Used for local addressing within a site or between a limited number of sites
- In the range of FC00::/7 to FDFF::/7

IPv4 Embedded

- Not covered in CCNA
- Aid for transition
- IPv4 compatible
::a.b.c.d
- IPv4 mapped
::FFFF:a.b.c.d



IPv6 Addressing

IPv6 Multicast Address Types

- IPv6 multicast addresses have the prefix FF00::/8
- There are two types of IPv6 multicast addresses:
 - Assigned multicast
 - Solicited node multicast



IPv6 Addressing

Multicast Scope

Bits 9-16

Address	Scope
FF01::/16	Node local – localhost only
FF02::/16	Link local – within Layer 2 network
FF04::/16	Admin local – Layer 3 connectivity within administrative domain
FF05::/16	Site local – Layer 3 connectivity within site domain
FF08::/16	Organisation local – Layer 3 connectivity over the whole organisation
FF0E::/16	Global – Layer 3 connectivity over the Internet



IPv6 Addressing

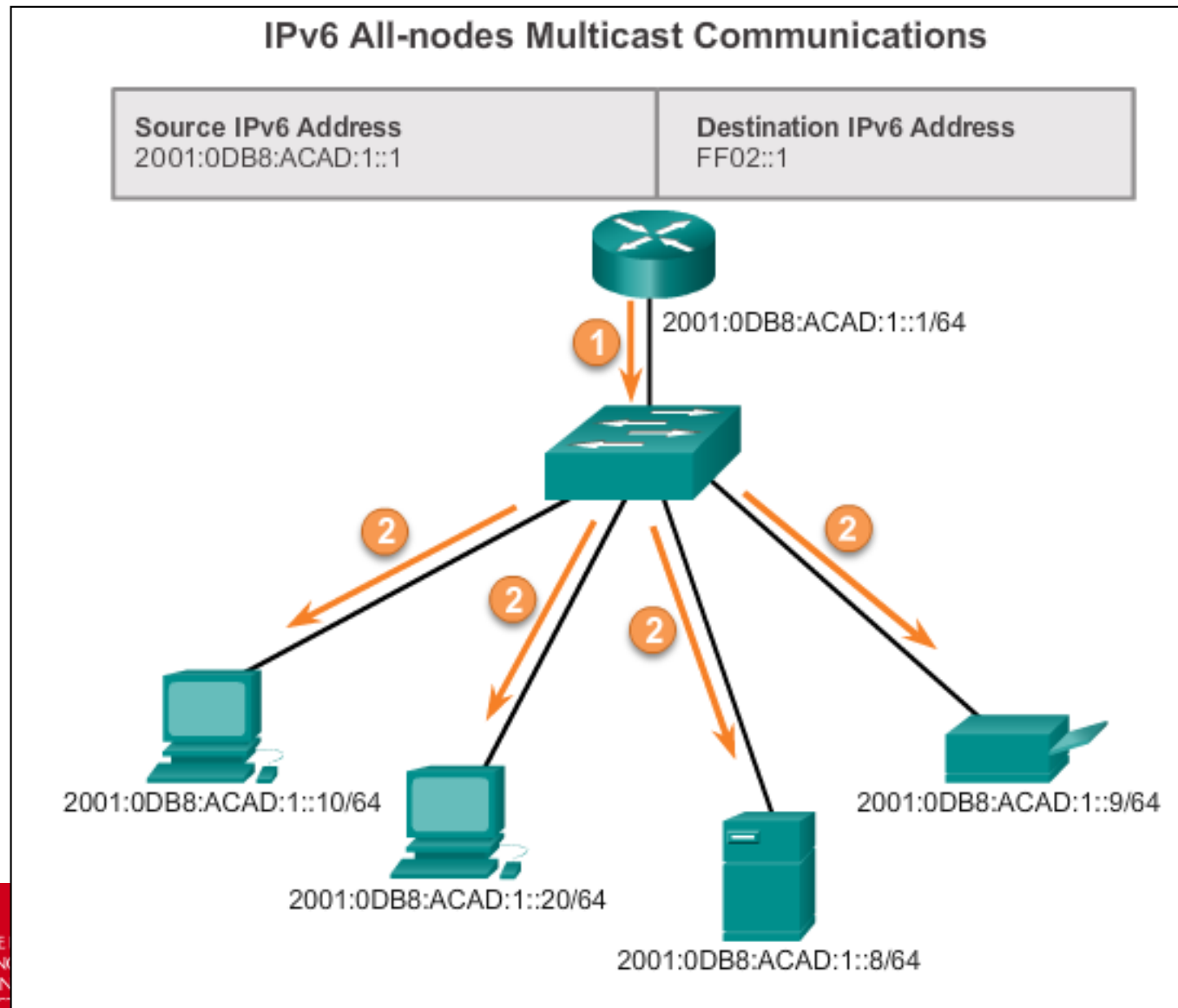
Multicast

Examples of well-known IPv6 Multicast Addresses

Address	Multicast Group
FF02::1	All Nodes
FF02::2	All Routers
FF02::5	OSPFv3 Routers
FF02::6	OSPFv3 Designated Routers
FF02::9	RIPng Routers
FF02::A	EIGRP Routers
FF02::B	Mobile Agents
FF02::C	DHCP Servers / Relay Agents
FF02::D	All PIM Routers



IPv6 Multicast Parallel with IPv4 Broadcast

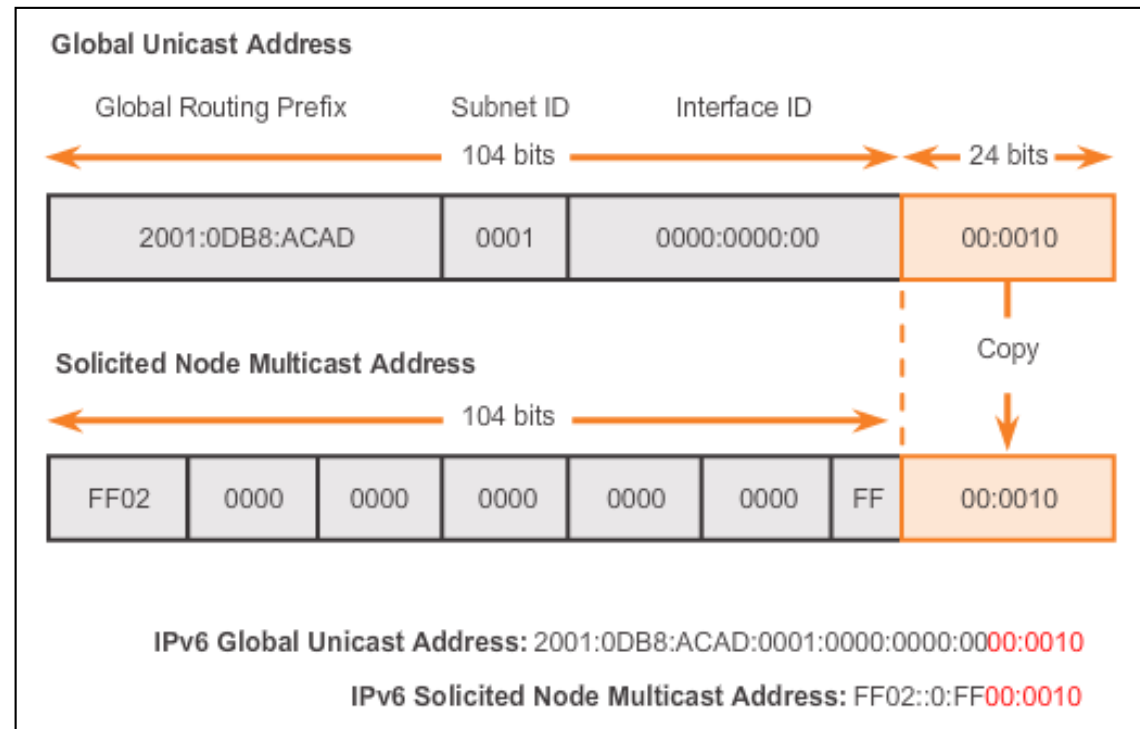




IPv6 Multicast Addresses

Solicited Node IPv6 Multicast Addresses

- Similar to the all-nodes multicast address, matches the last 24 bits of the IPv6 global unicast address of a device
- Automatically created when the global or link-local unicast addresses are assigned
- Created by combining a special FF02:0:0:0:0:0:FF00::/104 prefix with the right-most 24 bits of unicast address

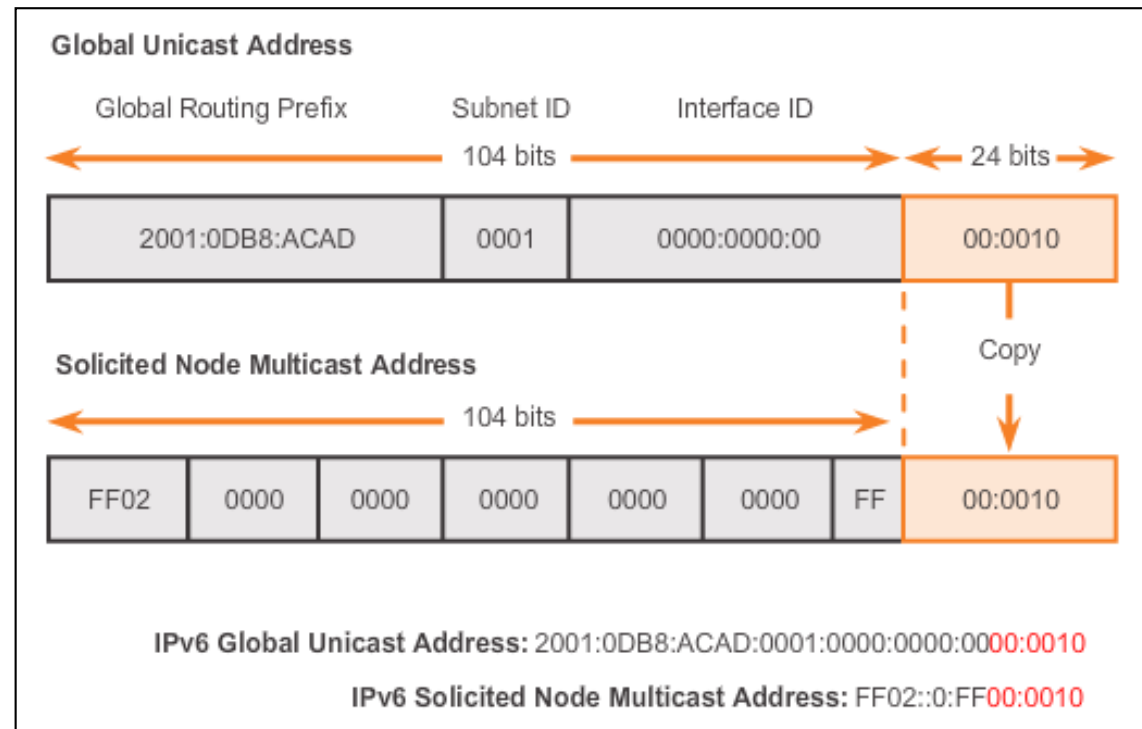




IPv6 Multicast Addresses

Solicited Node IPv6 Multicast Addresses

- Used as a target multicast address to provide minimal broadcast
- **Example** – IPv6 ARP request, only goes to subset of hosts
- To be effective, switch needs to be able to perform limited broadcasts based on IPv6 destination





IPv6 Address Types

Summary

In this lecture, we covered:

- IPv6 Address Types
- Unicast Address
 - Global
 - IPv6 Subnets
 - Link Local
 - Loopback/Unspecified
 - Unique local
 - Embedded IPv4
- Multicast Addresses
 - Scope
 - Assigned Multicast
 - Solicited Multicast