Lecture 10b - IPv6 Address Types

Type: Lecture
Materials: Empty
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1. IPv6 Address Types

There are three types of IPv6 addresses:

- Unicast
- Multicast
- Anycast.

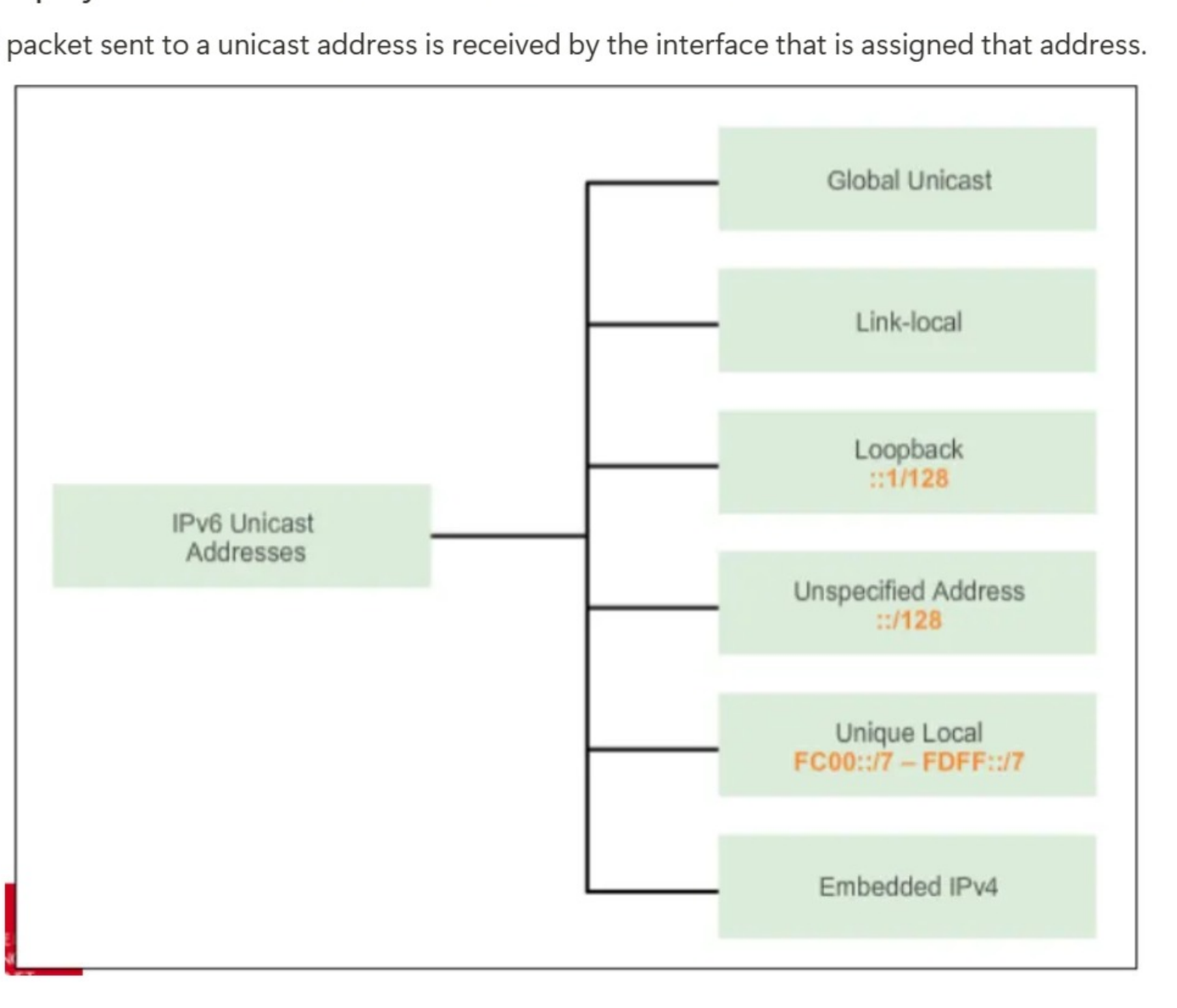
💡 **Note:** IPv6 does **not** have **broadcast** addresses

- **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	

2. Unicast Addresses

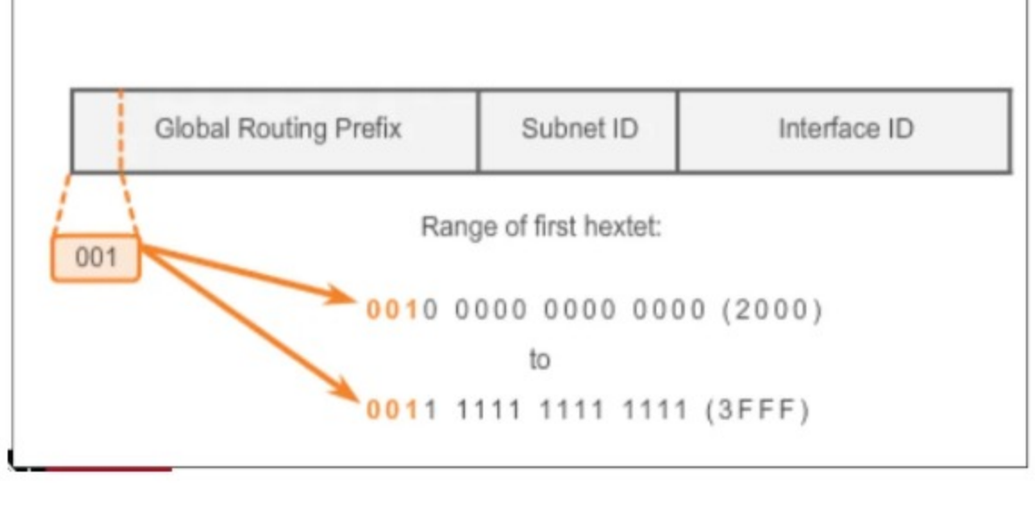
- **Uniquely** identifies an **interface** on an IPv6-enabled device.
- A packet sent to a unicast address is received by the interface that is assigned that address.



3. Global Unicast Addresses

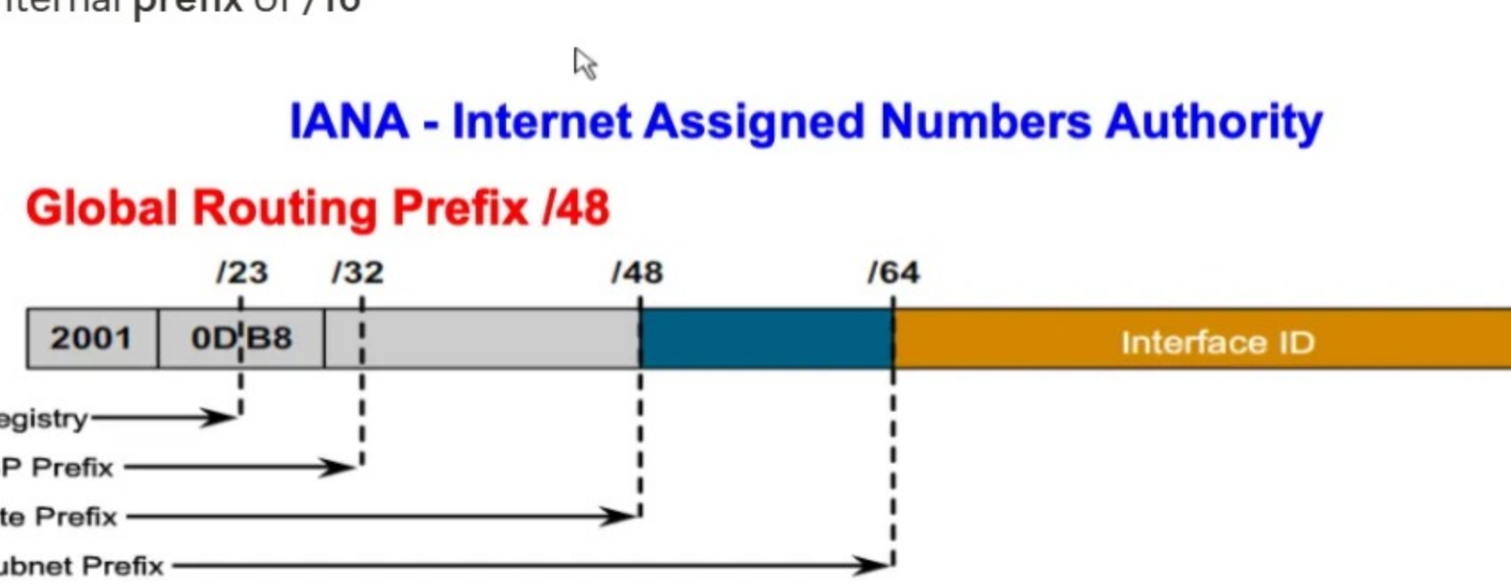
- Similar to a **public IPv4** address
- Globally **unique**
- Internet routable addresses
- Can be configured statically or assigned dynamically

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

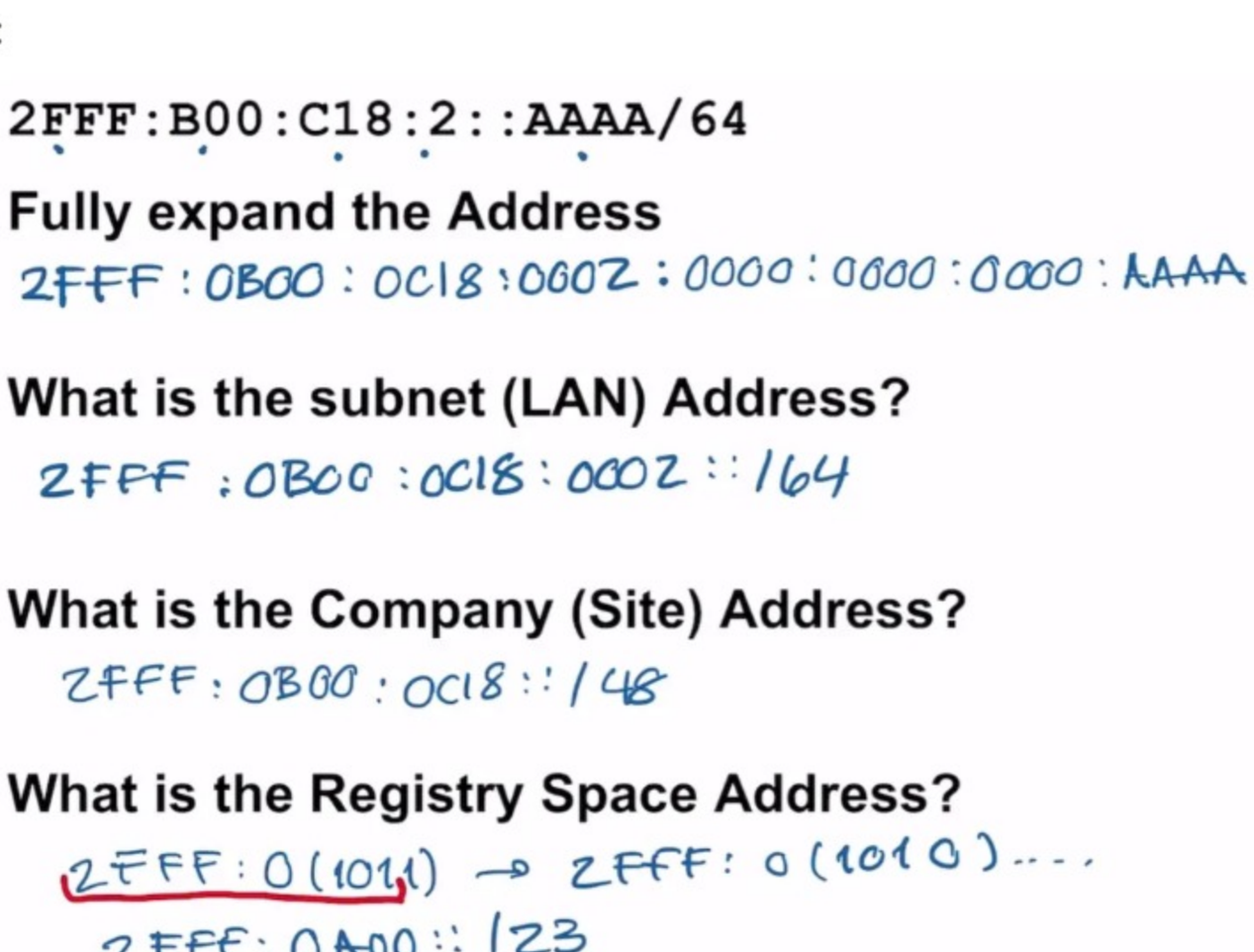


4. Global Unicast Hierarchy

- 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

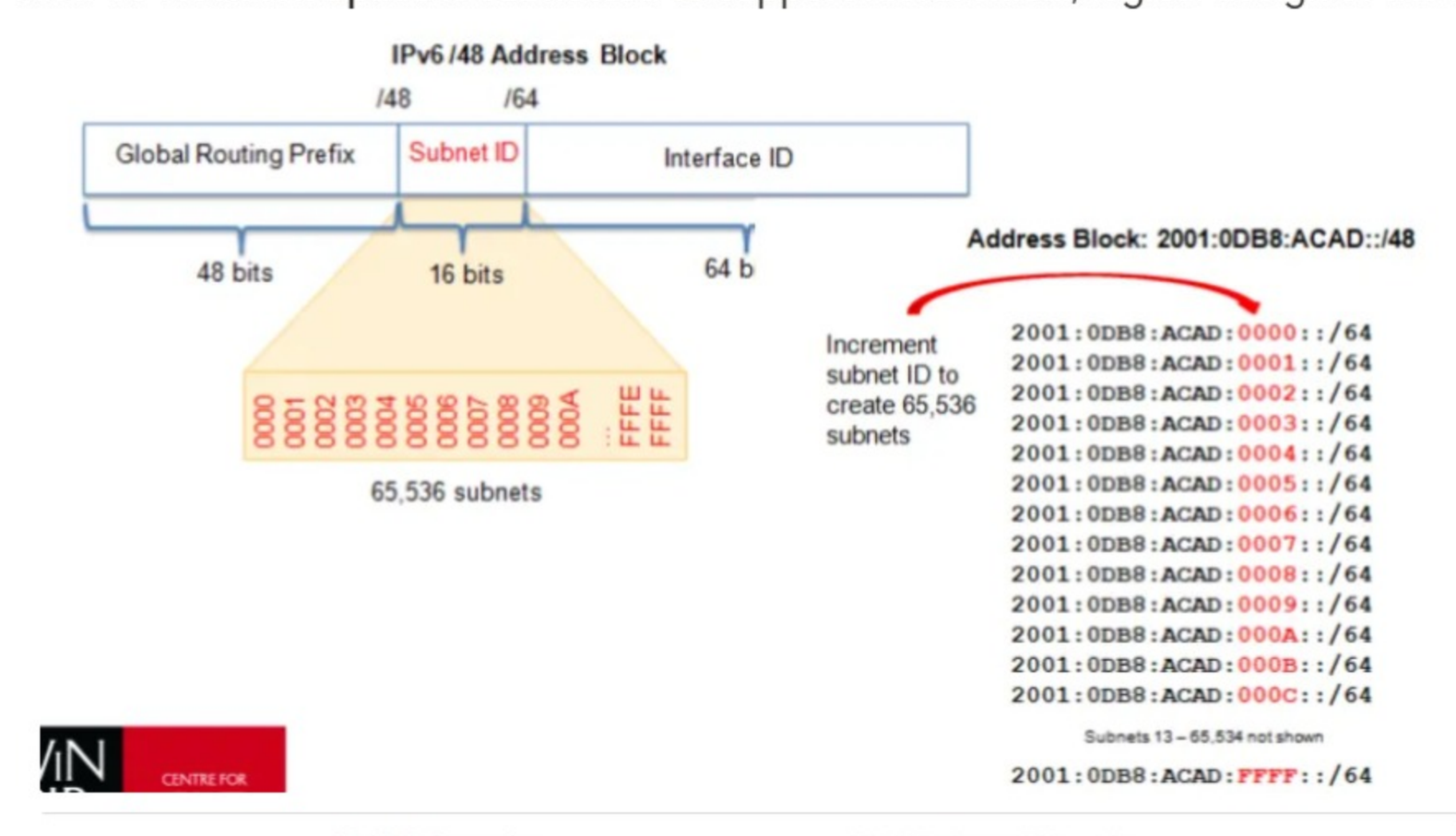


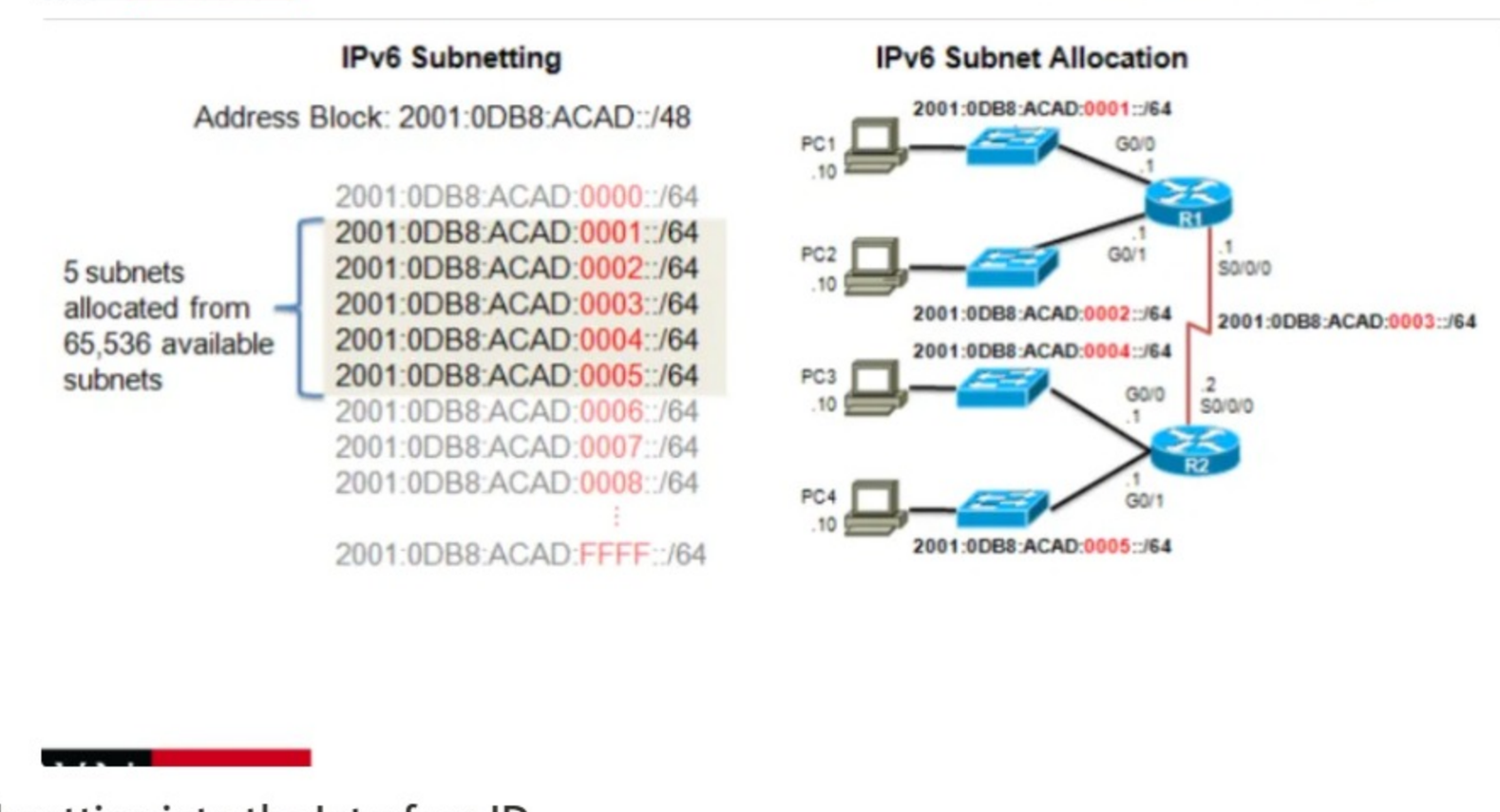
- An example:



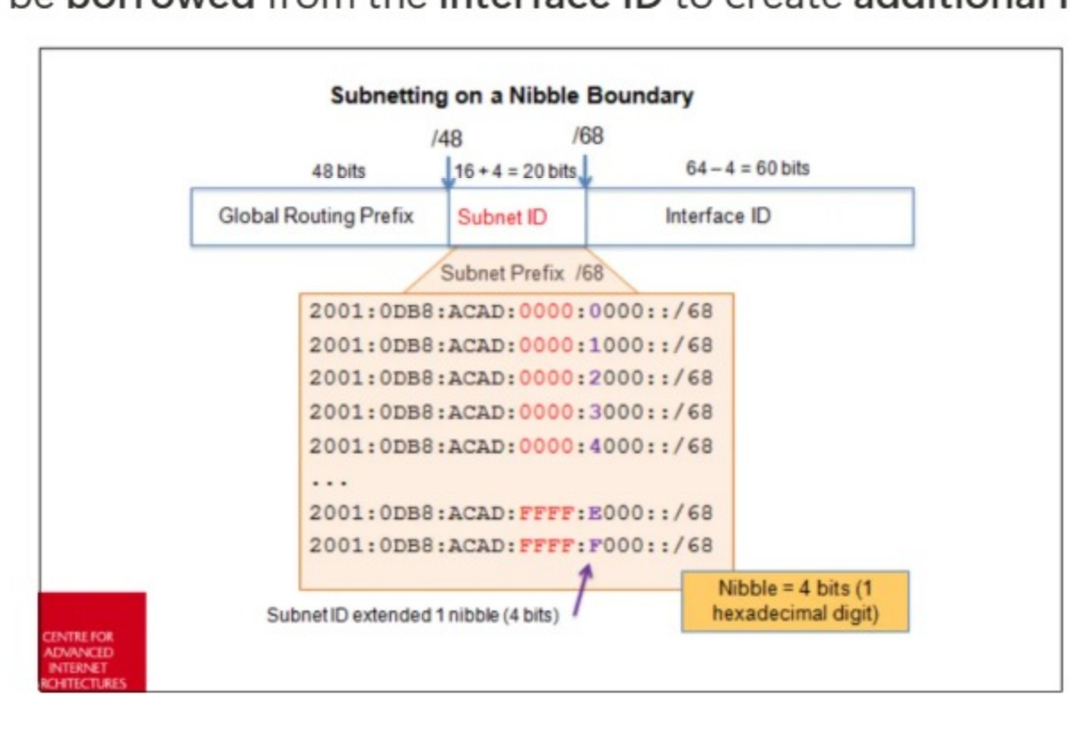
5. IPv6 Subnetting

- **Subnet ID:**
  - An **IPv6 Network Space** is **subnetted** to support **hierarchical**, logical design of the network





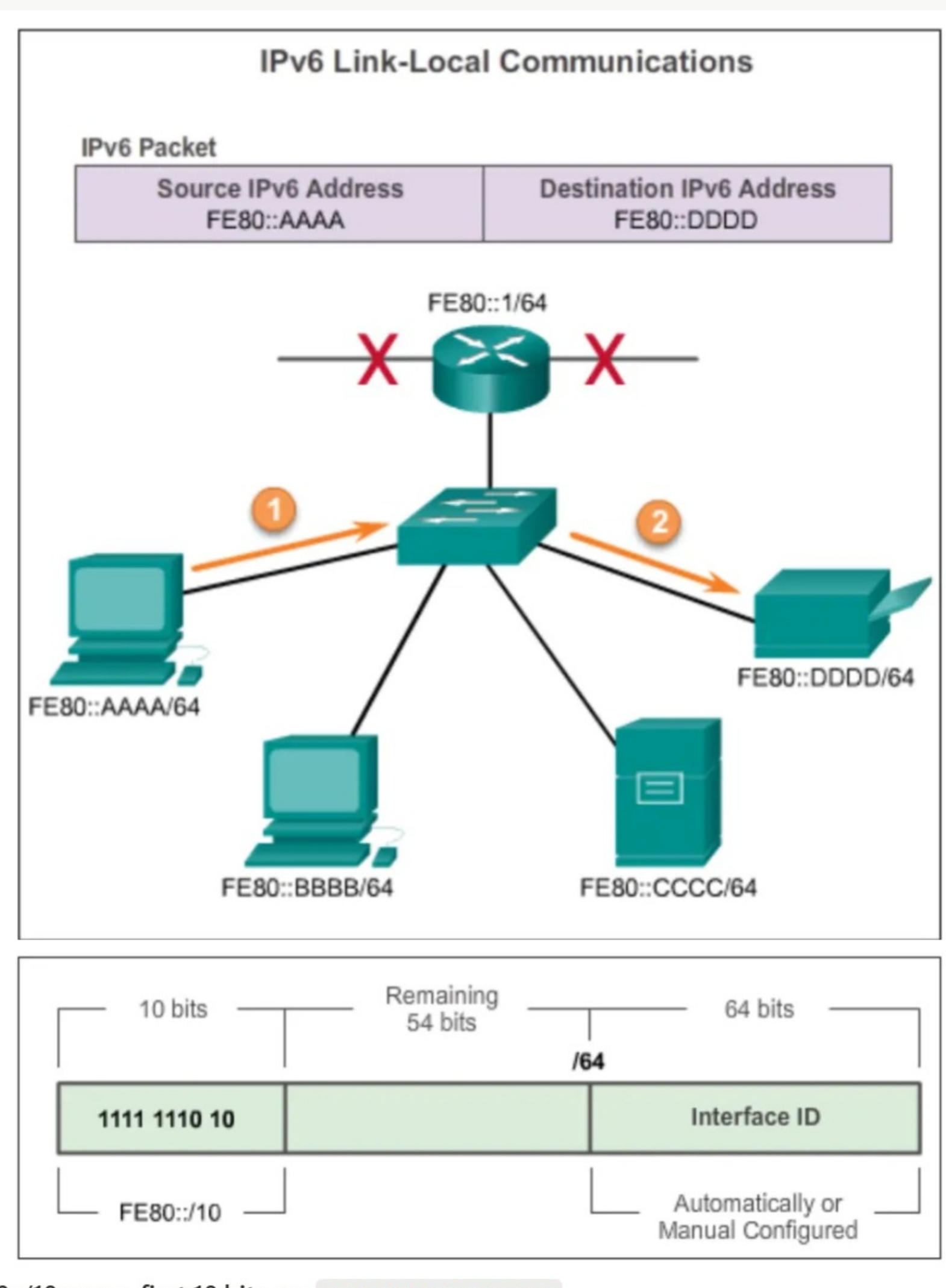
- **Subnetting into the Interface ID**
  - **IPv6 bits** can be **borrowed** from the **interface ID** to create **additional IPv6 subnets**



6. 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**

💡 **Packet** with a **src** or **dest link-local address** will ***never*** be **forwarded** by the router **outside** its **local network segment.**



- **FE80::/10** range, **first 10 bits** are `1111 1110 10xx xxxx`
  ⇒ First hextet range from `FE80` to `FEBF`, which were reserved for link-local unicast
- **Remaining 54 bits** of the **subnet** portion will be set to 0
- **Interface ID** is taken from **Global Unicast address**
- Can be automatically generated using **EUI-64 (on Cisco devices)** or random number

7. 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**
- In **IPv4**, there is **a range** for **loopback**, but in **IPv6**, it's **only 1** address.

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**

8. 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**

  ⇒ The **unique local addresses** in IPv6 will **not be translated** to a **global IPv6** addresses.
- 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`

9. 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 Multicast Address** can **only be used** as the **destination** for IPv6 packet, **never** be the source.

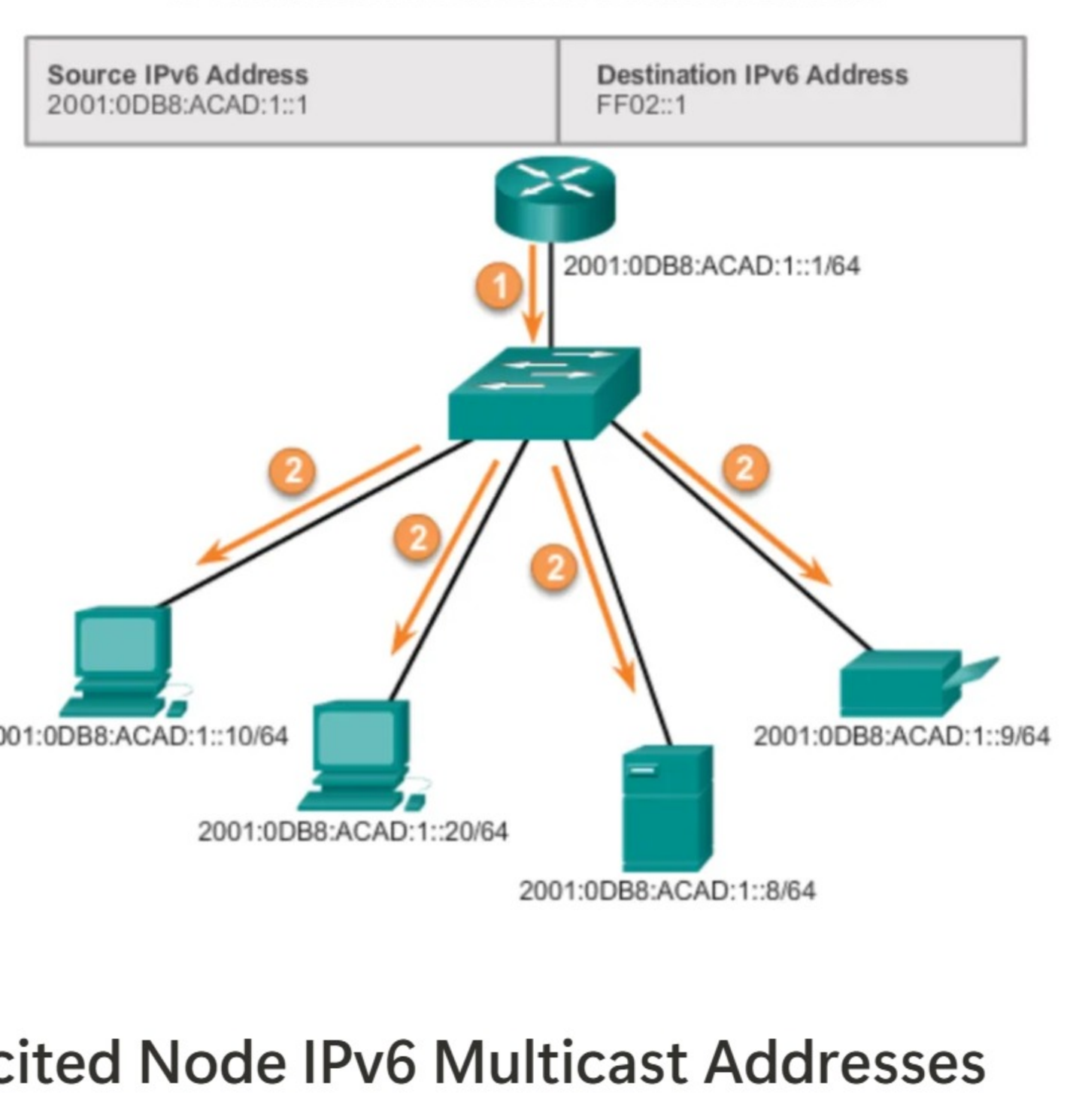
- **Multicast Scope:** define in the bits 9-16

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

- Examples of well-known IPv6 Multicast Addresses

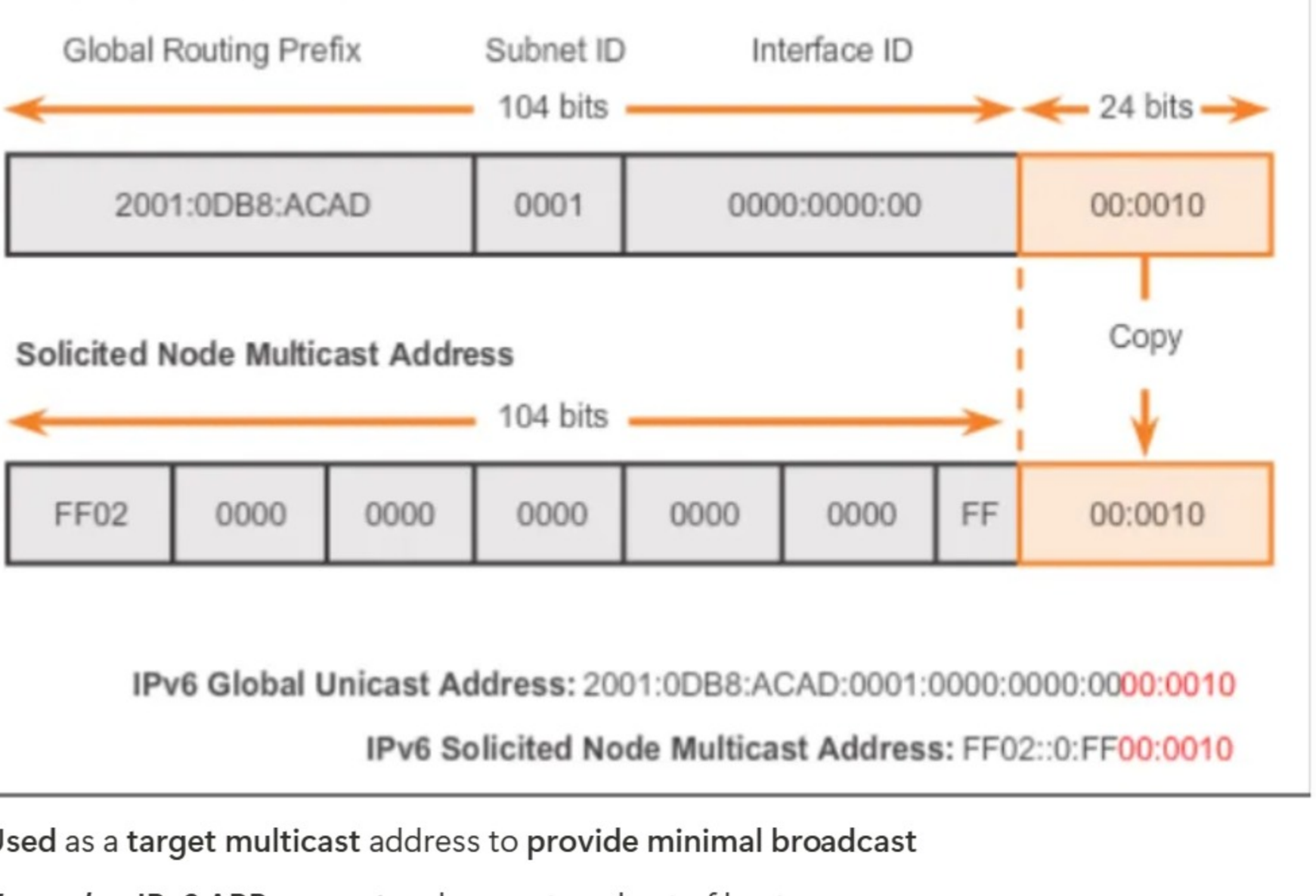
Address	Multicast Group
FF02::1	All Nodes
FF02::2	All Routers
FF02::5	OSPFv3 Routers
FF02::6	OSPFv3 Designated Routers
FF02::9	RIPng Routers
FF02::A	EIGRP Routers
FF02::B	Mobile Agents
FF02::C	DHCP Servers / Relay Agents
FF02::D	All PIM Routers

- **Parallel with IPv4 Broadcast**



10. 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**



- **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**