Microsoft Support WebCasts
Live and On Demand.

Introduction to Internet Protocol Version 6

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Hotel Novotel, Surabaya, 28 April 2010

IPv6 implementations from Microsoft

- Microsoft® Windows Server® 2003
- Microsoft® Windows Server ®2008
- Microsoft Windows® XP Service Pack 1 (SP1), Windows XP Service Pack 2 (SP2) and Windows XP Service Pack 3 (SP3)
- Windows CE .NET version 4.1 and later versions
- Microsoft Windows Vista Service Pack 1 (SP1) and Windows Vista Service Pack 2 (SP2)
- Microsoft Windows 7
  - Installed and enabled by default

Problems with IPv4

- Public address space becoming exhausted
- Large routing tables for Internet backbone routers
- Configuration could be simpler
- IP-layer security is not required
- Need better support for prioritized delivery

Problems with IPv4

- • IPv4 has been designed early in the 70s
- • Many « add-ons» to the protocol :
  - – Mobileip
  - – QoS
  - – Security (IPsec)
  - – Others
- Using one « add-ons » -> easy
- Using two at the same time -> difficult
- Using three or more -> acrobatic !!!!

Problems with IPv4

During the 80s, addresses delegation without optimisation and without aggregation

- Possible solution : IP renumbering and unused address space redistribution
- **Consequences :**
  - Large routing table on the backbone
  - Unthinkable for some sites

Problems with IPv4

- ***IPv4 address shortage (current situation)***
- Fact #1 : Few consequence in North America « Internet heaven »!
- Fact #2 : Major problem for every other countries around the world
  - China requested addresses to connect 60000 schools and got one class B
  - Several countries in Europe, Africa and
- Asia are using one class C for a whole country

Problems with IPv4

- ***IPv4 address shortage (current situation)***
  - Some ISP in these countries are providing private addresses to their clients (Suedish ISP using NAT)
  - Internet users move from PPP connectivity to xDSL/cable modem (ratio users by IP address is changing from 10:1 to 1:1)
  - ISP are delegating only few address space to their corporate client s
  - Temporary solution --> NAT (but unfortunatly permanent)

Problems with IPv4

IPv4 address shortage in the future

- • Internet growth in some regions :
  - – Asia (2.5 billions people)
  - – Eastern Europe (250 millions)
  - – Africa (800 millions)
  - – South and Central America (500 millions)
- • Growth of the applications that need IP addresses globally scoped, unique and routable (VoIP, videoconferencing, games)

IPv6 features

- New header format
- Large address space
- Efficient and hierarchical addressing and routing infrastructure
- Stateless and stateful address configuration

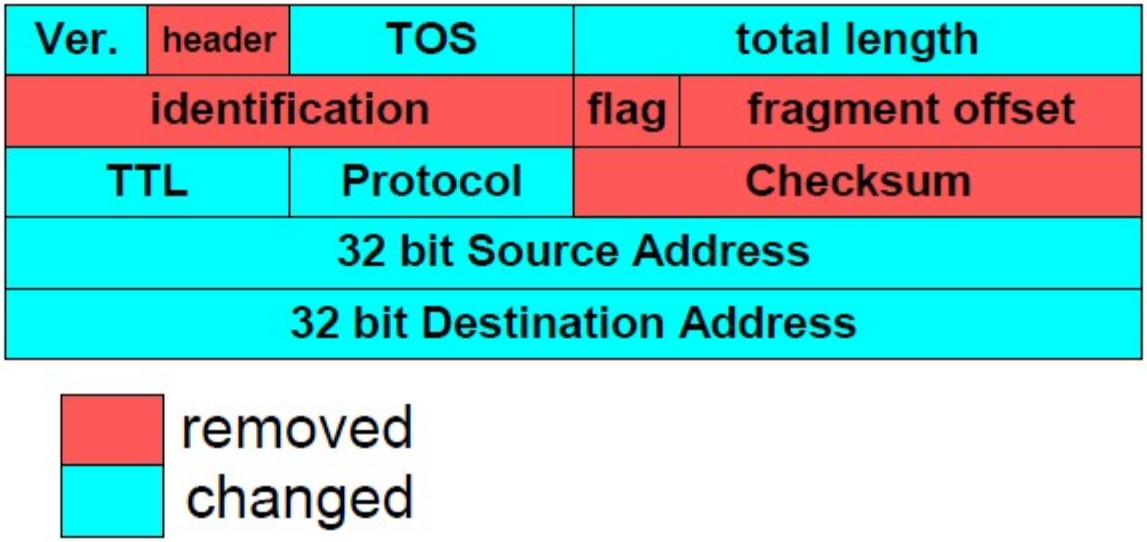
IPv6 features (2)

- Built-in security
- Better support for prioritized delivery
- New protocol for neighboring node interaction
- Extensibility

IPv6 features

Basic specifications

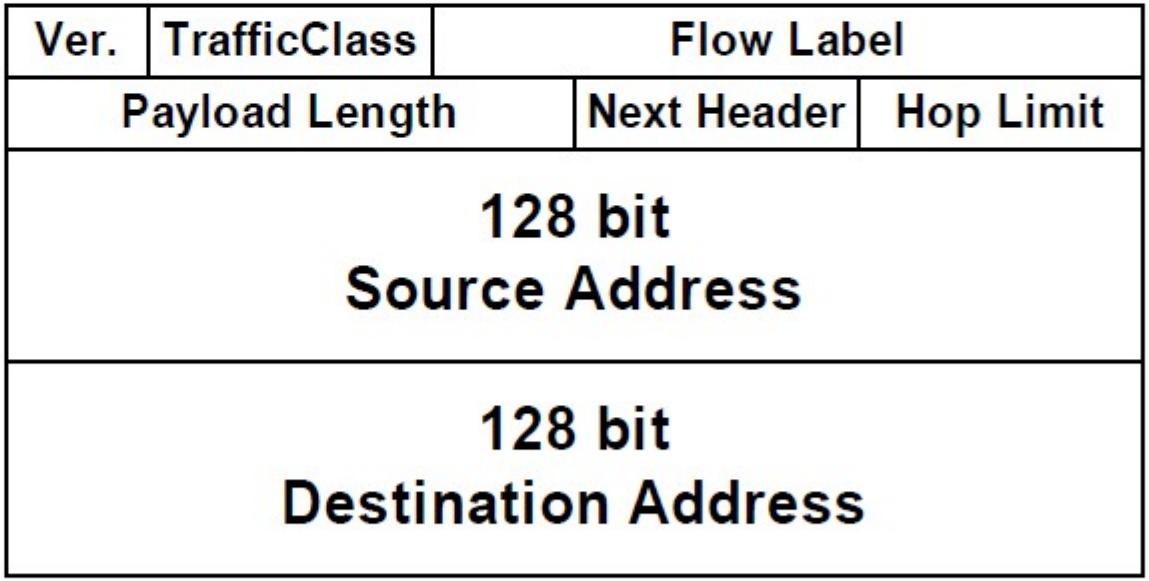
- IPv4 packet description (20 bytes + options)



IPv6 features

Basic specifications

- RFC2460
- IPv6 packet description (40 bytes)



SETUP IPv6 di CLIENT

- IPv6 di desain supaya bisa plug-n-play tanpa perlu melakukan setup peng'alamat'an secara manual. Di sini router difungsikan sebagai server untuk melakukan advertisement alamat IPv6 ke networknya. Client (dengan segala macam tipe OS) akan langsung mendapatkan alamat IPv6 dari router yang melakukan advertisement tersebut.

IPv6 di Windows XP SP1

Windows XP SP1 secara default sudah memasukkan stack IPv6 dalam sistemnya, hanya saja kita harus mengaktifkannya secara manual. Untuk mengaktifkannya langkah-langkahnya adalah sebagai berikut:

IPv6 di Windows XP SP1 (cara 1)

1. Dari menu Run, jalankan DOS Prompt dengan perintah cmd.exe.

2. Dari DOS prompt, ketikkan “ipv6 install”.

3. Restart komputer jika diperlukan, terkadang hal ini tidak perlu di lakukan jika host Windows XP sudah mendapat alamat IPv6 dari router di atasnya.

IPv6 di Windows XP SP1 (cara 1)

4. Cek apakah alamat IPv6 sudah didapat di client dengan mengetikkan “ipv6 if 4″ dari DOS prompt.

5. Lakukan pengecekan dengan perintah-perintah “ipv6 if”, “ping6″, “tracert6″ dari komputer lokal ke host di luar, misal ke www.mugi.or.id.

IPv6 di Windows XP SP1 (cara 2)

1. Log on to the computer with a user account that has privileges to change network configuration.

2. Click **Start**, click **Control Panel**, and then double-click **Network Connections**.

3. Right-click any local area connection, and then click **Properties**.

4. Click **Install**.

IPv6 di Windows XP SP1 (cara 2)

5. In the **Select Network Component Type** dialog box, click **Protocol**, and then click **Add**.

6. In the **Select Network Protocol** dialog box, click **Microsoft IPv6 Developer Edition**, and then click **OK**.

7. Click **Close** to save changes to your network connection.

IPv6 di Windows XP SP1

Cara lain untuk mengaktifkan stack IPv6 di windows XP adalah dengan mengetikkan “c:\netsh interface ipv6 install” dari menu Run di Start menu.

Cara yang ini juga berlaku sama bagi Windows XP sp 1, sp 2, juga yang Tanpa SP.

IPv6 di Windows XP SP1

Masalah:

Windows XP stop responding when connected to the Internet, After you successfully installed Advanced Networking Pack on Windows XP.

Penyebab :

It cause the Advanced Networking Pack included IPv6 Protocol. After the installation, IPv6 protocol and related services were started by default.

IPv6 di Windows XP SP1

Solusinya:

To solve the problem immediately, Please follow the steps that listed below.

1.Use Administrator account to logon Windows XP. Go to Control Panel, and then open Network Connection. Right Click the network interface card that connected to the internet. Click properties. In the network interface card properties select IPv6 and then press Uninstall to remove IPv6 Protocol on the network interface card. Restart the computer.

2. Use Administrator account to logon Windows XP, Go to Control Panel, and then open Administrative Tools. Open Services. Disable and Stop the IPv6 related services.

IPv6 di Windows XP SP2

1. Log on to the computer with a user account that has privileges to change network configuration.

2. Click **Start**, click **Control Panel**, and then double-click **Network Connections**.

3. Right-click any local area connection, and then click **Properties**.

4. Click **Install**.

IPv6 di Windows XP SP2

5. In the **Select Network Component Type** dialog box, click **Protocol**, and then click **Add**.

6. In the **Select Network Protocol** dialog box, click **Microsoft TCP/IP version 6**, and then click **OK**.

7. Click **Close** to save changes to your network connection.

Alternately, from the Windows XP desktop, click **Start**, point to **Programs**, point to **Accessories**, and then click **Command Prompt**. At the command prompt, type **netsh interface ipv6 install**.

IPv6 di Windows XP

Pertanyaan:

Why does the IPv6 protocol for Windows XP with SP1 display as "Microsoft IPv6 Developer Edition"?

Jawaban :

Despite the displayed name, the IPv6 protocol for Windows XP with SP1 is a production-capable and supported protocol in the same way as the IPv6 protocol for Windows XP with SP2 and Windows Server 2003. Microsoft developers were unable to change the name of the protocol in Windows XP SP1 due to the impact of the change for localized versions of Windows XP. In Windows XP with SP2, the name of the IPv6 protocol has been changed to "Microsoft TCP/IP version 6".

IPv6 di Windows 2003 Server

- Untuk mengaktifkan stack IPv6 di windows 2003 Server langkah-langkahnya sama dengan windows XP SP1.

Atau :

- Click Start, click Control Panel, and then double-click Network Connections.
- Right-click any local area connection, and then click Properties.
- Click Install.
- Click Protocol, and then click Add.
- Click Microsoft TCP/IP version 6, and then click OK.
- Click Close to save changes to your network connection.

IPv6 di Windows 2003 Server

How to Configure IPv6 :

Configuring IPv6 with Manual Addresses

1. Click Start, point to Programs, point to Accessories, and then click
   Command Prompt.
2. At the command prompt, type netsh, and then press ENTER.
3. Type interface ipv6, and then press ENTER.
4. Type the following command, and then press ENTER:
   add address [interface=]string [address=]ipv6address

This command uses the following values

[interface=]*string*: Specifies the name for the interface.

[address=]*ipv6address*: Specifies the IPv6 address.

NOTE: Additional parameters are available for this command. Type add address /? at the netsh interface ipv6 command prompt to view the additional parameters.

IPv6 di Windows 2000 SP4

- Instalasi IPv6 di windows 2000 berbeda dengan di windows XP. Terlebih dahulu harus diinstall Microsoft IPv6 Technology Preview. Teknologi tersebut bisa dicari di Internet dengan mengunduh file file tpipv6-001205.exe
- Langkah-langkah berikutnya ialah tahapan pemasangan dengan cara sebagai berikut:

IPv6 di Windows 2000 SP4

1. Simpan file tpipv6-001205.exe ke folder lokal (misal, C:\IPv6TP).

2. Jalankan tpipv6-001205.exe dan extract ke lokasi yang sama.

3. Dari folder hasil ekstraksi, jalankan Setup.exe -x and extract file-filenya ke sebuah subfolder dari folder saat ini(misal, C:\IPv6TP\files).

4. Edit file Hotfix.inf di C:\IPv6TP\files dengan text editor (misal notepad).

IPv6 di Windows 2000 SP4

5. Di bagian [Version] dari file Hotfix.inf, ubah baris NTServicePackVersion=256 ke NTServicePackVersion=1024, kemudian simpan file hasil editan.

6. Jalankan file Hotfix.exe di folder C:\IPv6TP\files.

7. Restart komputer jika instalasi selesai.

8. Sesudah komputer di restart, lakukan langkah ulang untuk point 3 saja.

IPv6 di Windows 2000 SP4

9 . Sesudah selesai, cek apakah alamat IPv6 sudah didapat di client dengan mengetikkan “ipv6 if 4″ dari DOS prompt. Jika sudah mendapat alamat IPv6 dengan prefix 2001:d30:: (merupakan alamat IPv6 untuk network ITB) maka komputer anda sudah aktif IPv6 nya.

10. Lakukan pengecekan dengan perintah-perintah “ipv6 if”, “ping6″, “tracert6″ dari komputer lokal ke host di luar, misal ke www.mugi.or.id.

Untuk instalasi IPv6 di windows 2000 SP3, ubah nilai seperti pada point 5 menjadi “768″, sedang untuk windows 2000 SP2 ubah nilai point 5 menjadi “512″.

IPv6 di Windows Vista / Seven

The changes to IPv6 in Windows Vista and Windows Server 2008 are the following:

Dual IP layer architecture

- Installed and enabled by default
- Graphical user interface (GUI)-based configuration
- Full Support for IPsec
- Multicast Listener Discovery version 2 (MLDv2) support
- Link-local Multicast Name Resolution (LLMNR) support
- Literal IPv6 addresses in Uniform Resource Locators (URLs)
- Support for ipv6-literal.net names
- IPv6 over the Point-to-Point Protocol (PPP)
- Dynamic Host Configuration for IPv6 (DHCPv6) support
- Random interface IDs

IPv6 di Windows Vista / Seven

Nah sekarang kita mau ngeset IPnya, pertama secara otomatis didapatkan dari stateless autoconfiguration yang diterima dari router advertisement dan stateful autoconfiguration dari DHCPv6. Ketikkan pada command prompt :

C:\Documents and Settings\komputer>ipv6 renew

Sedangkan secara manual kita dapat menggunakan netsh jika pada Windows XP tapi jika menggunakan Vista bisa langsung lewat GUI

IPv6 di Windows Vista / Seven

Sebelum mencoba menggunakan netsh pertama kita pahami dulu interfacenya. Jika IPv4 interfacenya bisa kita isi eth0, S1 atau lainnya.
Tapi berbeda jika menggunakan IPv6 ada 7 intefacenya. Karena kita sekarang masih dalam tahap transisi dari IPv4 ke IPv6, masih banyak orang yang menggunakan jaringan IPv4.

Jadi dalam perbedaan Internet protokol tersebut maka kita perlu melewatkan IPv4 pada jaringan IPv6 atau sebaliknya.
Ada beberapa metode antara lain dual stack, tunneling dan translasi. Metode tunneling sendiri ada beberapa metode yaitu teredo tunneling, ISATAP tunneling, 6to4 dan 6over4.

IPv6 di Windows Vista / Seven

- Untuk interfacenya antara lain adalah :
  1. Interface 7 adalah Teredo Tunneling
  2. Interface 6 adalah fisik (Ethernet)
  3. Interface 3 adalah 6to4 Tunneling
  4. Interface 2 adalah Automatic Tunneling
     dengan alamat embedded IPv4
  5. Interface 1 adalah loopback

- Yang terlihat ada 5 interface tapi sebenarnya ada 7 (2 diantaranya yaitu interface 4 dan 5 tidak tampak karena merupakan interface VMware pada kondisi disable).

IPv6 di Windows Vista / Seven

- Untuk melihat interface tersebut bisa kita ketik dalam cmd :

  C:\Documents and Settings\komputerku>ipv6 if

  Nah.. sekarang kita mulai menggunakan netsh, ketikkan aja

  C:\Documents and Settings\Hari Nityananda>netsh

  lalu mulai masuk

  netsh>

IPv6 di Windows Vista / Seven

- Netsh adalah fasilitas skript baris perintah (command-line scripting utility) Untuk OS windows yang memungkinkan pengguna memodifikasi konfigurasi jaringan komputer yang sedang berjalan.

- Kalo mau mulai dan kita tidak tau apa apa bisa ketikkan netsh>? , nanti akan keluar perintah yang bisa kita gunakan. Langsung aja kita konfigurasi manual IPv6 dalam komputer kita.

Kadang kalo sedang bingung, atau saat lupa. Cukup ketik: netsh>help

IPv6 di Windows Vista / Seven

- ketikkan :

netsh>interface ipv6
netsh interface ipv6> add address
InterfaceNameOrIndex IPv6Address
[[type=]unicastanycast]
[[validlifetime=]Minutesinfinite]
[[preferredlifetime=]Minutesinfinite]
[[store=]activepersistent]

contohnya :netsh interface

ipv6>add address interface=5
address=2002:1110:4029::4

IPv6 di Windows Vista / Seven

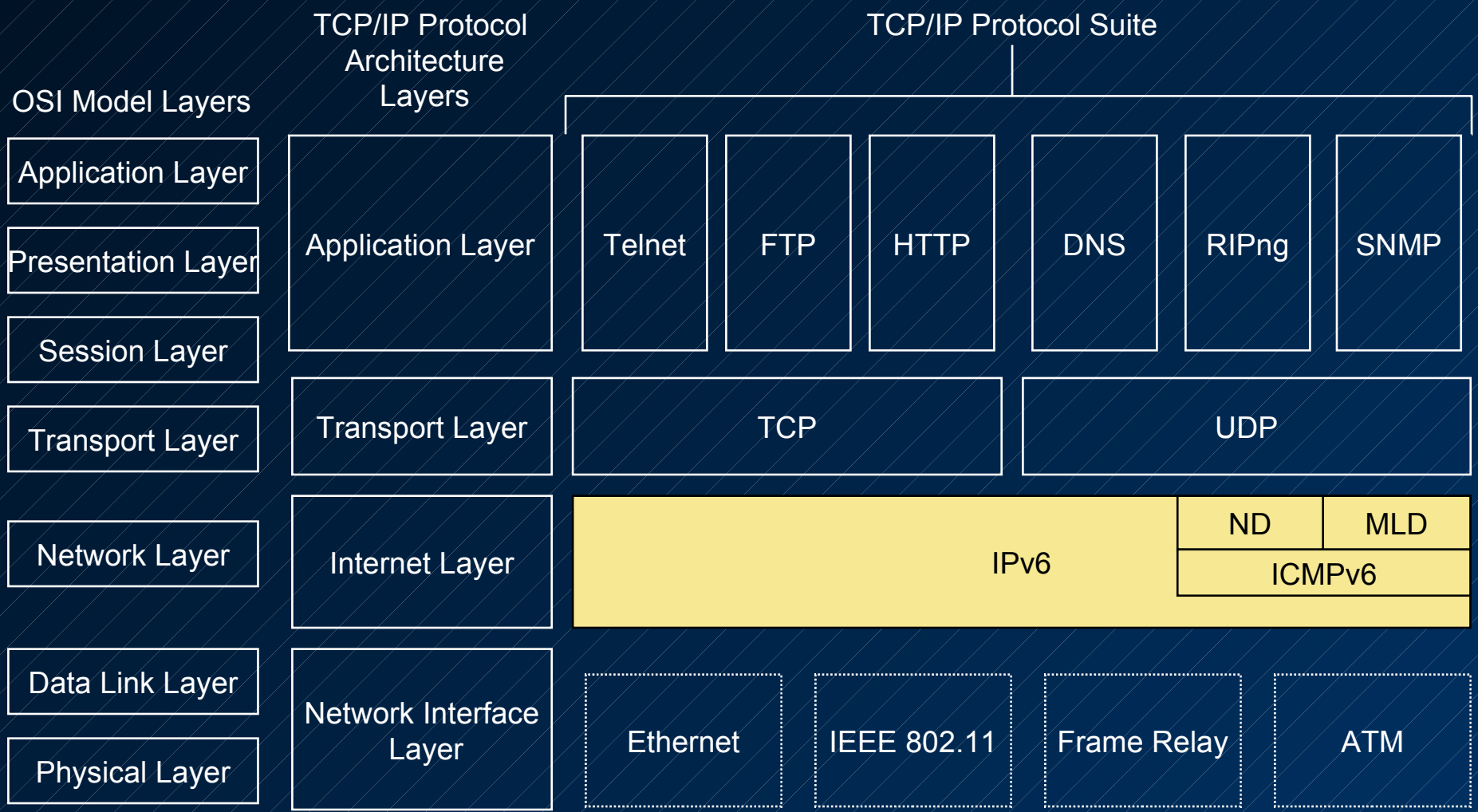
- atau bisa juga netsh interface

  ipv6>"Local Area Connection" fec0::1a49:2aa:ff:fe34:ca8f

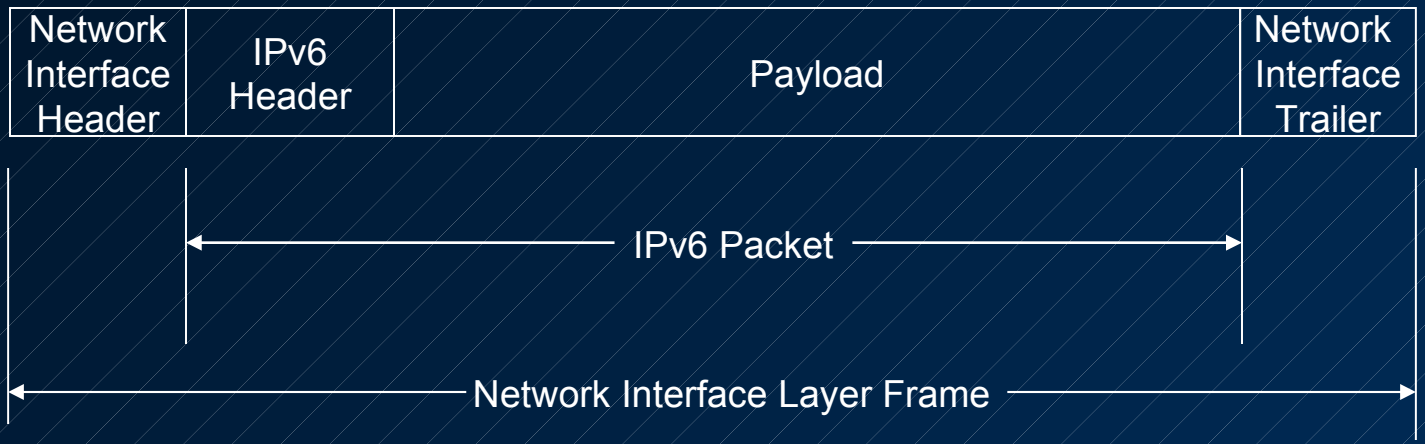
  untuk menghapusnya

  :netsh interface ipv6>delete address interface=5 address=2002:1110:4029::4

TCP/IP protocol architecture with IPv6



An IPv6 packet



IPv6 packets over LAN media

- Ethernet II encapsulation
  - Uses EtherType value of 0x86DD
- IEEE 802.x encapsulation
  - Uses Sub-Network Access Protocol (SNAP) header and EtherType value of 0x86DD

IPv6 addressing

- The IPv6 address space
- IPv6 address syntax
- IPv6 address prefixes
- Unicast IPv6 addresses
- Multicast IPv6 addresses
- IPv6 interface identifiers
- DNS support

The IPv6 address space

- 128-bit address space
  - 2^{128} possible addresses
  - 340,282,366,920,938,463,463,374,607,431,768,211,456 addresses (3.4×10^{38})
- 6.6×10^{23} addresses for every square meter of the Earth's surface
- 128 bits were chosen to allow for flexibility in creating multilevel, hierarchical, routing infrastructure

IPv6 address syntax

- IPv6 address in binary form

  00100000000000010000110110111000000000000000000000010111100111011
  00000010101010100000000011111111111111100010100010011100010110 10

IPv6 address syntax (2)

- IPv6 address in binary form

  00100000000000010000110110111000000000000000000000010111100111011
  00000010101010100000000011111111111111100010100010011100010110 10

- Divided along 16-bit boundaries

  0010000000000001 0000110110111000 0000000000000000 0010111100111011

  0000001010101010 0000000011111111 1111111000101000 1001110001011010

IPv6 address syntax (3)

- IPv6 address in binary form

  0010000000000001000011011011100000000000000000000010111100111011
  0000001010101010000000011111111111111100010100010011100010110 10

- Divided along 16-bit boundaries

  0010000000000001 0000110110111000 0000000000000000 0010111100111011

  0000001010101010 0000000011111111 1111111000101000 1001110001011010

- Each 16-bit block is converted to hexadecimal and delimited by using colons
  - 2001:0DB8:0000:2F3B:02AA:00FF:FE28:9C5A

IPv6 address syntax (4)

- IPv6 address in binary form

  00100000000000010000110110111000000000000000000000010111100111011
  00000010101010100000000011111111111111100010100010011100010110 10

- Divided along 16-bit boundaries

  0010000000000001 0000110110111000 0000000000000000 0010111100111011

  0000001010101010 0000000011111111 1111111000101000 1001110001011010

- Each 16-bit block is converted to hexadecimal and delimited by using colons
  - 2001:0DB8:0000:2F3B:02AA:00FF:FE28:9C5A
- Suppress leading zeros within each block
  - 2001:DB8:0:2F3B:2AA:FF:FE28:9C5A

Compressing zeros

- Typical IPv6 addresses contain long sequences of zeros
- A single contiguous sequence of 16-bit blocks set to 0 can be compressed to “::”

Compressing zeros (2)

- Typical IPv6 addresses contain long sequences of zeros
- A single contiguous sequence of 16-bit blocks set to 0 can be compressed to "::"
- Examples
  - FE80:0:0:0:2AA:FF:FE9A:4CA2 becomes FE80::2AA:FF:FE9A:4CA2
  - FF02:0:0:0:0:0:0:2 becomes FF02::2

Compressing zeros (3)

- Typical IPv6 addresses contain long sequences of zeros
- A single contiguous sequence of 16-bit blocks set to 0 can be compressed to "::"
- Examples
  - FE80:0:0:0:2AA:FF:FE9A:4CA2 becomes FE80::2AA:FF:FE9A:4CA2
  - FF02:0:0:0:0:0:0:2 becomes FF02::2
- You cannot use zero compression to include part of a 16-bit block
  - FF02:30:0:0:0:0:0:5 does not become FF02:3::5, but FF02:30::5

IPv6 address prefixes

- Always use ***address/prefix-length*** notation
  - Also known as CIDR notation
- Examples
  - 2001:DB8:0:2F3B::/64 is a subnet prefix for a subnet
  - 2001:DB8::/48 is an address prefix for a summarized route
  - FF00::/8 is an address prefix for an address range

Types of IPv6 addresses

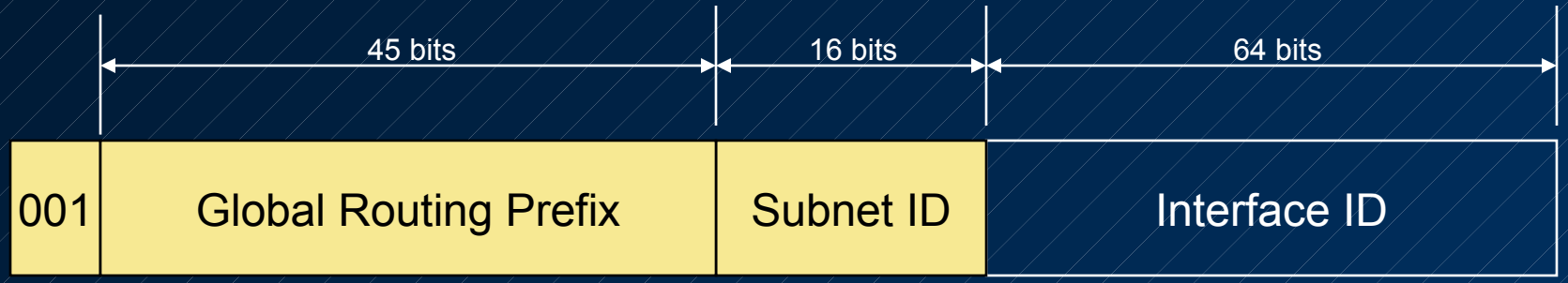
- Unicast
  - Address of a single interface
  - Delivery to single interface
- Multicast
  - Address of a set of interfaces
  - Delivery to all interfaces in the set
- Anycast
  - Address of a set of interfaces
  - Delivery to a single interface in the set
- No more broadcast addresses

Unicast IPv6 addresses

- Global addresses
- Link-local addresses
- Site-local addresses
- Unique local addresses

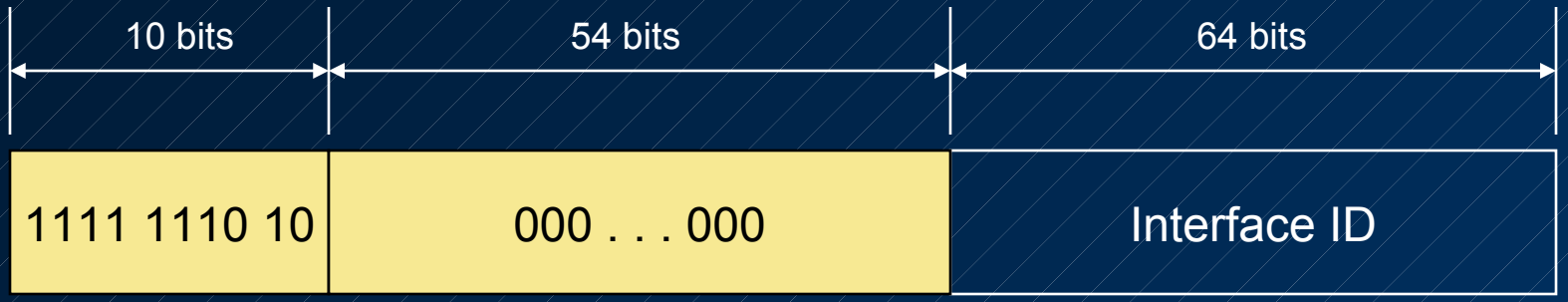
Global addresses

- Address scope is the whole IPv6 Internet
  - Equivalent to public IPv4 addresses
- Defined in RFC 3587
- Structure
  - Global Routing Prefix
  - Subnet ID
  - Interface ID



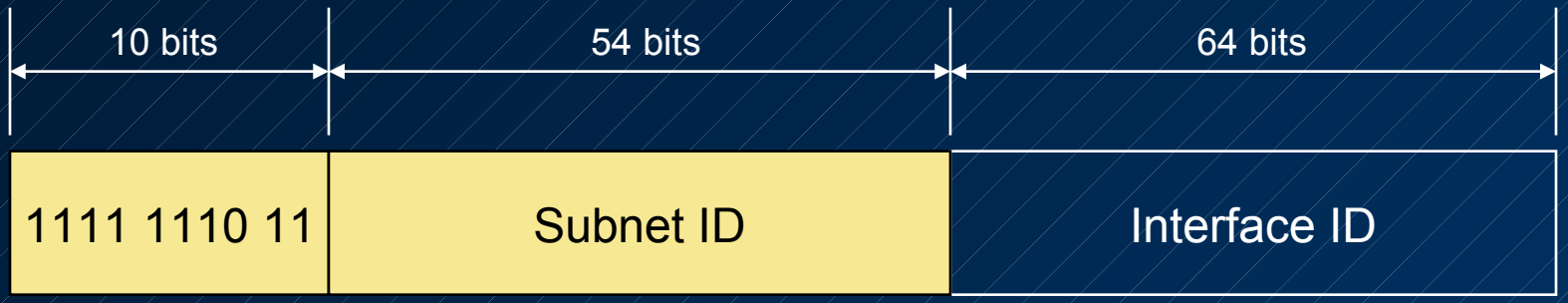
Link-local addresses

- Address scope is a single link
  - Equivalent to APIPA IPv4 addresses
- FE80::/64 prefix
- Usage
  - Single subnet, routerless configurations
  - Neighbor Discovery processes



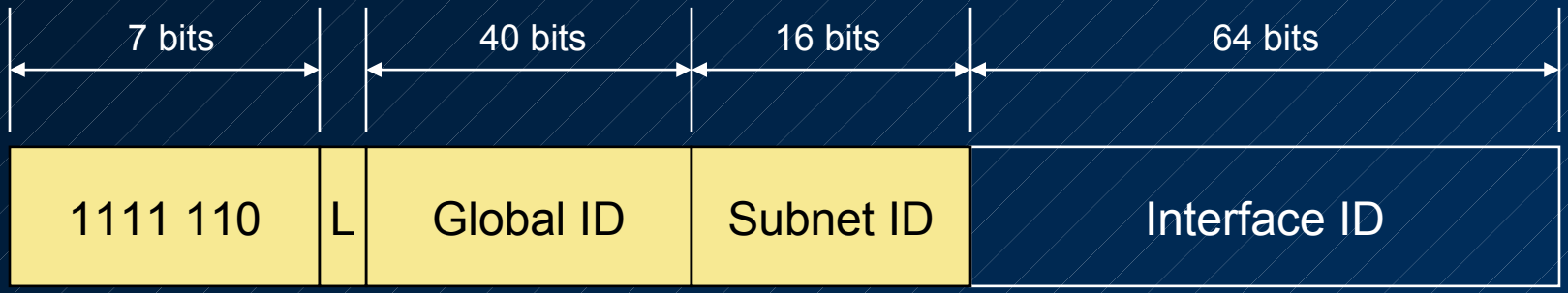
Site-local addresses

- Address scope is a single site
  - Equivalent to private IPv4 addresses
- FEC0::/10 prefix
- Used for intranets that are not connected to the IPv6 Internet
- Recently made obsolete, but supported for current implementations



Unique local addresses

- Private to an organization, yet unique across all the sites of the organization
- FD00::/8 prefix
- Replacement for site-local addresses
- Global scope, no zone ID required

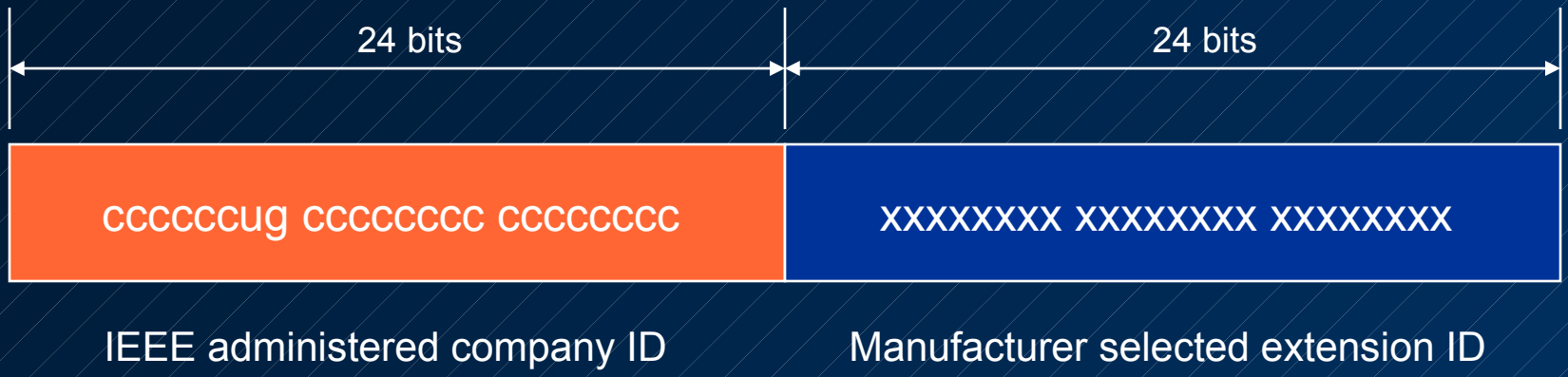


IPv6 interface identifiers

- Interface identifiers are based the following items.
  - Extended Unique Identifier (EUI)-64 address
    - Either assigned to a network adapter card or derived from IEEE 802 (MAC) addresses
  - A randomly generated value that changes over time
  - A value assigned by a stateful address configuration protocol such as Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
  - A value assigned during the establishment of a Point-to-Point Protocol connection
  - A manually configured value

IEEE 802 addresses

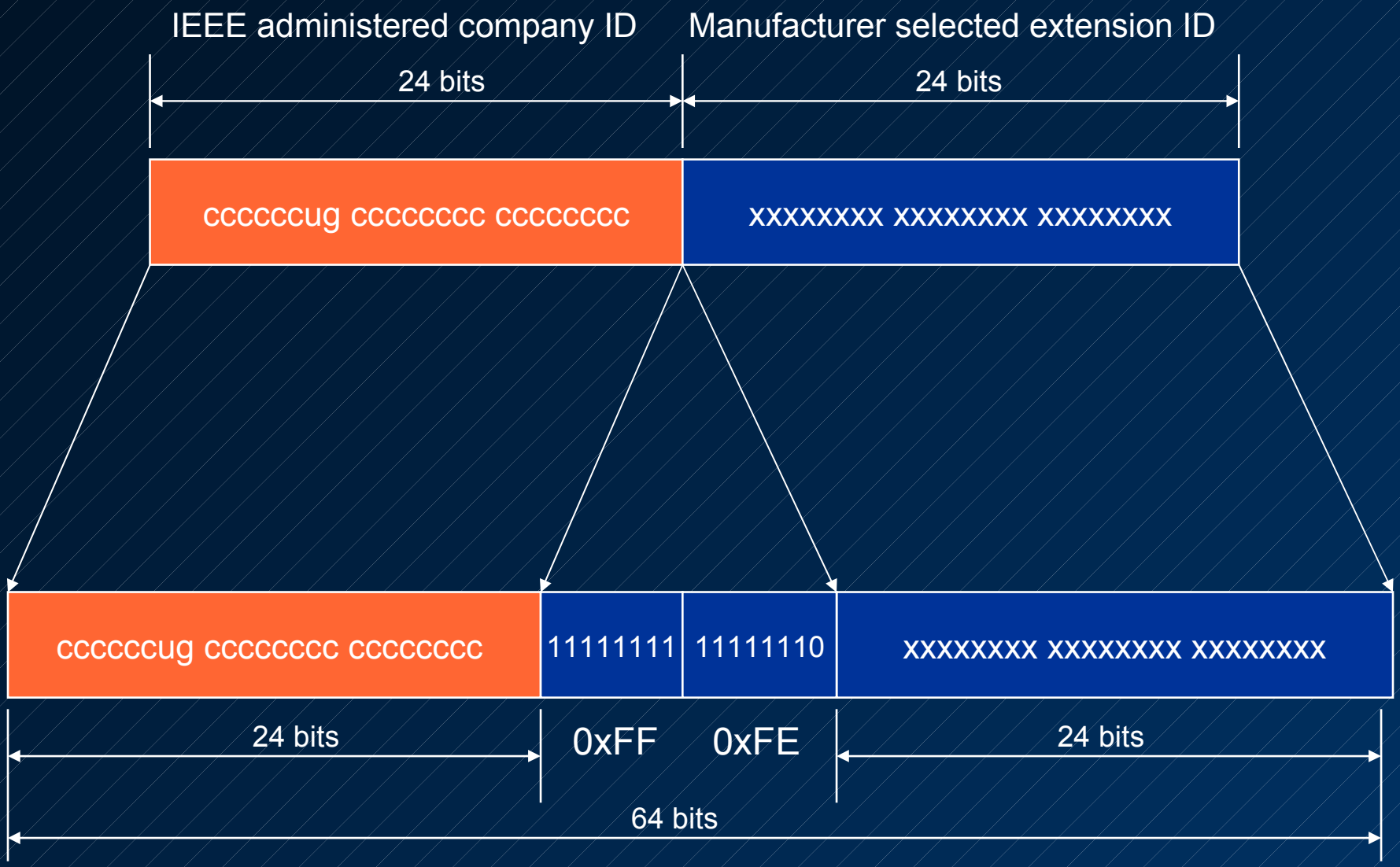
- Company ID
- Extension ID
- u bit – Universally (=0)/Locally (=1) Administered
- g bit – Unicast (=0)/Group (=1) Address



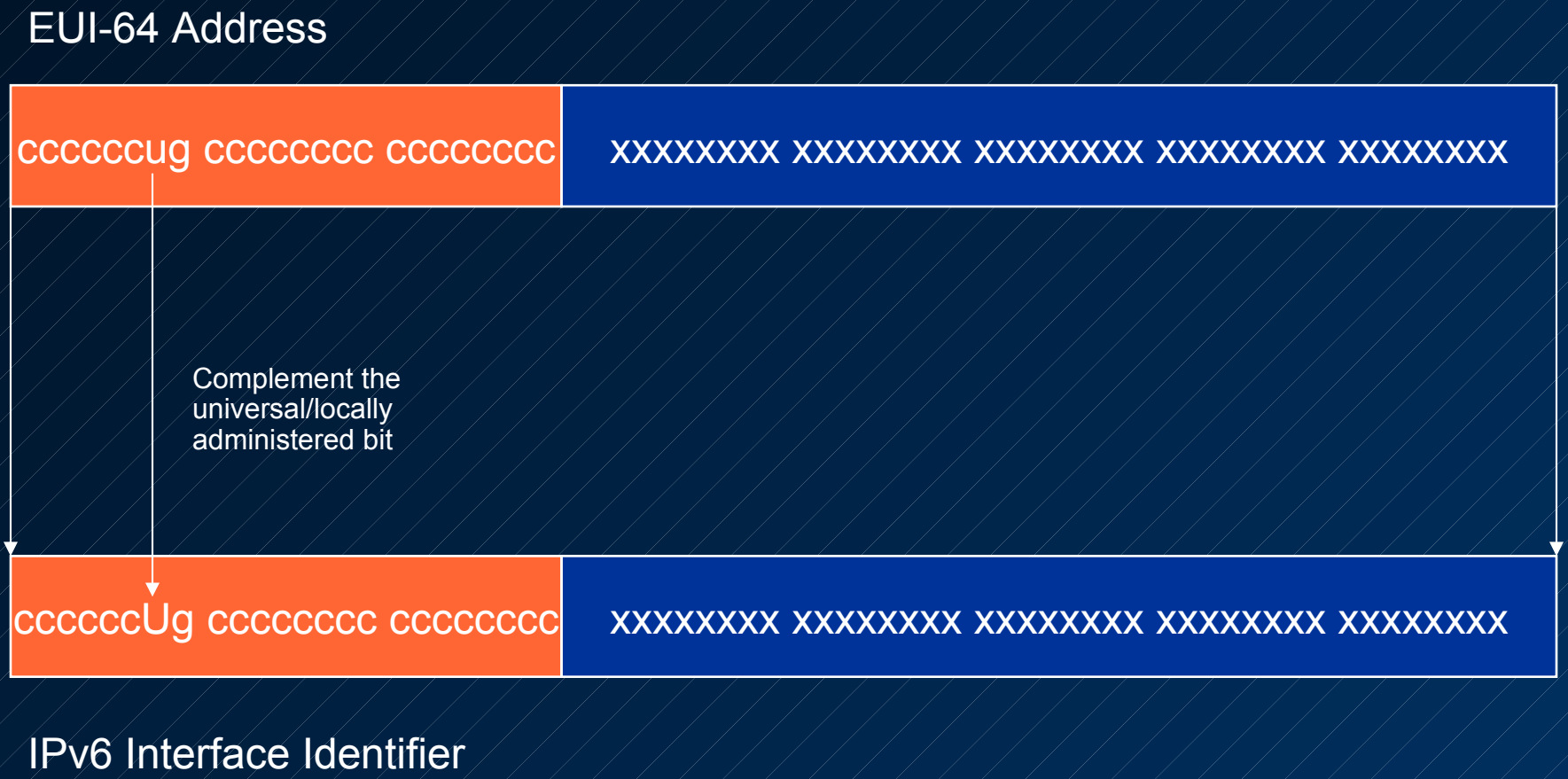
IEEE EUI-64 addresses

- Extended Unique Identifier
- Company ID
- Extension ID

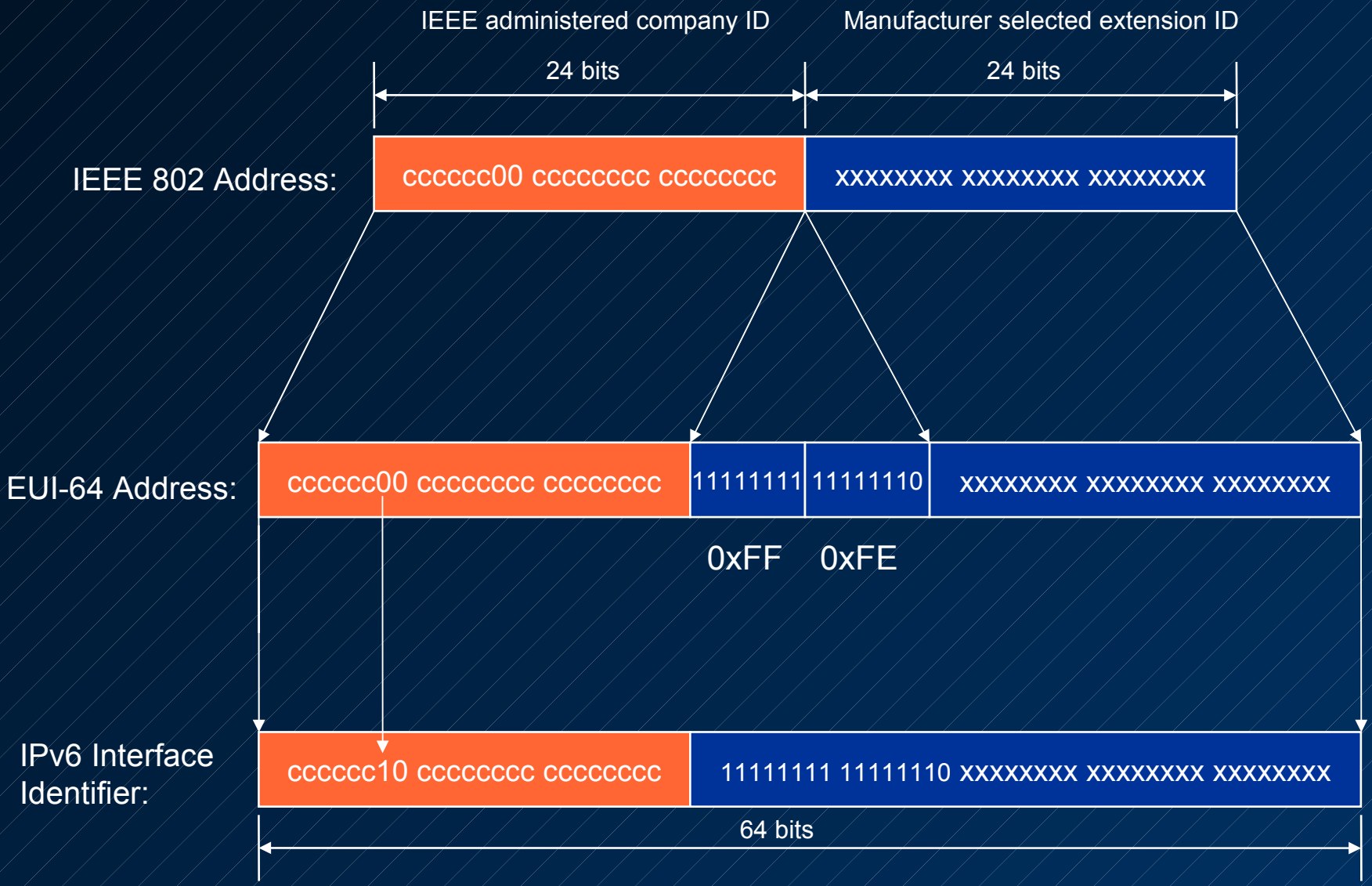
Mapping IEEE 802 addresses to EUI-64 addresses



Obtaining interface identifiers for IPv6 addresses

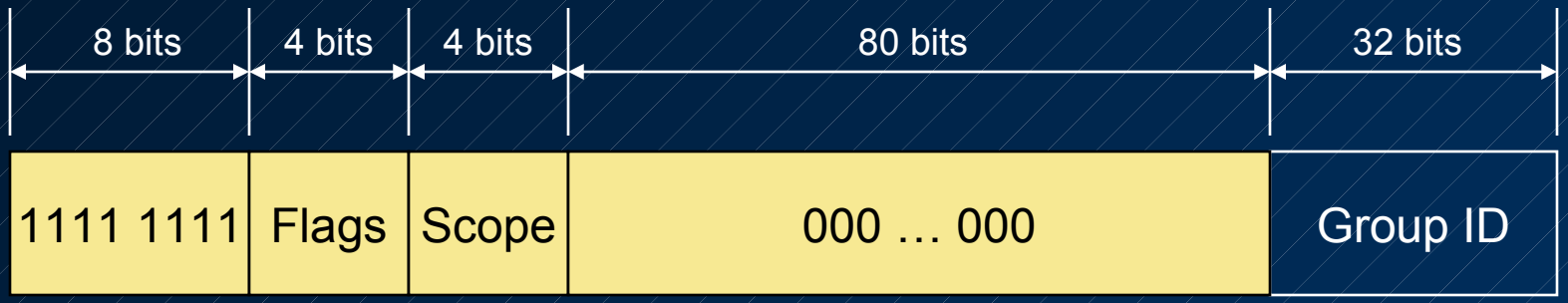


Converting IEEE 802 addresses to IPv6 interface identifiers

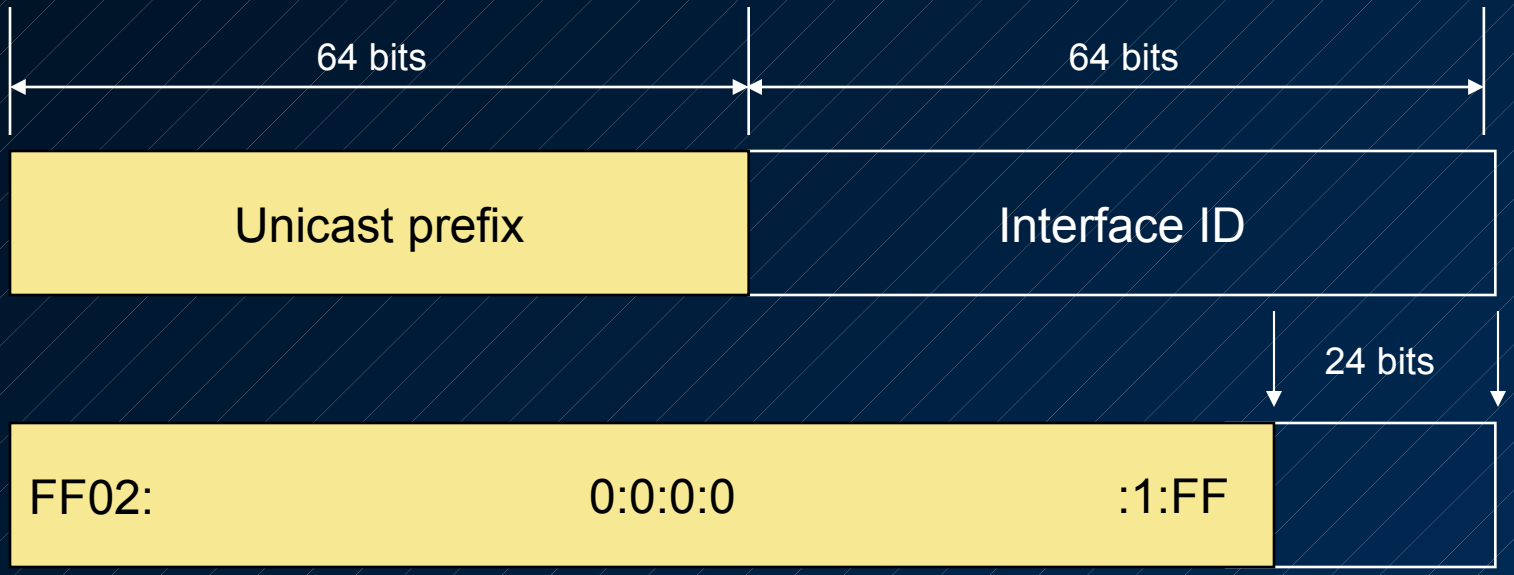


Multicast IPv6 addresses

- Flags
- Scope
- Defined multicast addresses
  - FF02::1 (Link-local scope all-nodes address)
  - FF02::2 (Link-local scope all-routers address)

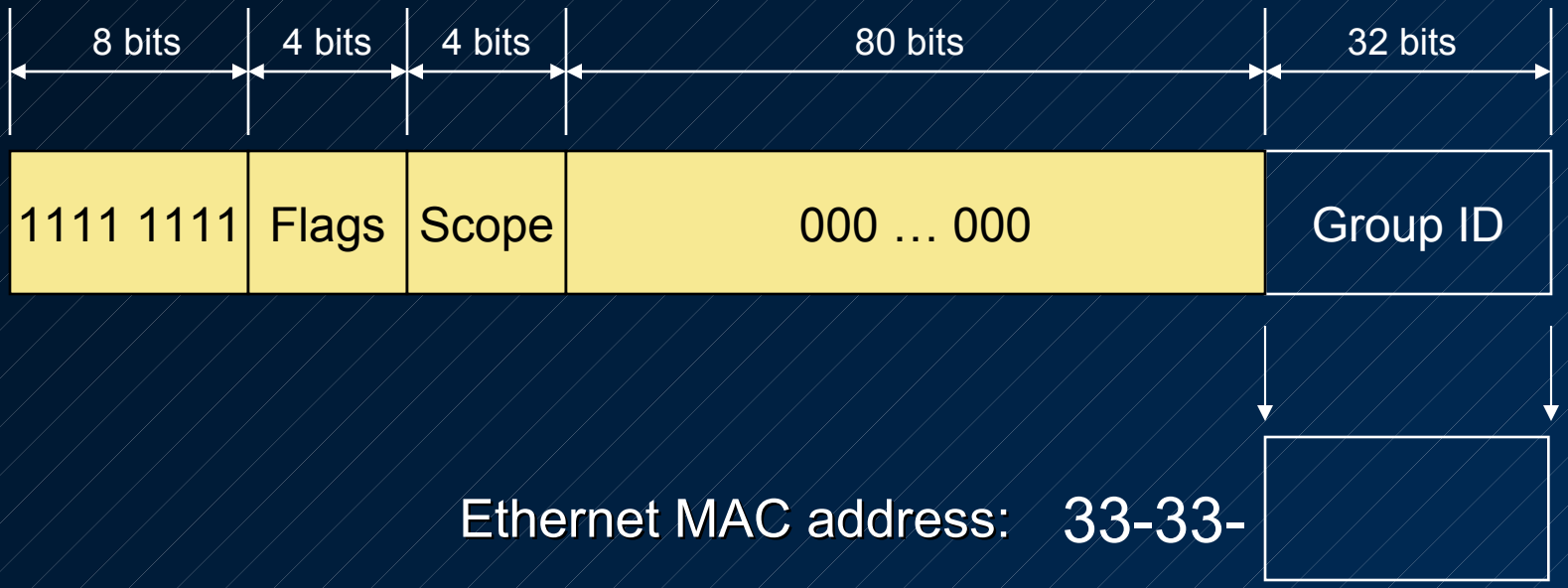


Solicited-node address



- Used for address resolution
- Example
  - For FE80::2AA:FF:FE28:9C5A, the corresponding solicited-node address is FF02::1:FF28:9C5A

Mapping IPv6 multicast addresses to Ethernet addresses



- Examples
  - For FF02::1, the corresponding Ethernet MAC address is 33-33-00-00-00-01
  - For solicited-node address FF02::1:FF28:9C5A, the corresponding Ethernet MAC address is 33-33-FF-28-9C-5A

DNS support

- Name to address records
  - AAAA record type, equivalent to IPv4 A record
  - Example record
    - host1.microsoft.com IN AAAA FEC0::1:2AA:FF:FE3F:2A1C

DNS support (2)

- Name to address records
  - AAAA record type, equivalent to IPv4 A record
  - Example record
    - host1.microsoft.com IN AAAA FEC0::1:2AA:FF:FE3F:2A1C
- Address to name records
  - New reverse domain called IP6.ARPA
  - Example record
    - FEC0::1:2AA:FF:FE3F:2A1C is FEC0:0000:0000:0001:02AA:00FF:FE3F:2A1C
    - C.1.A.2.F.3.E.F.F.F.0.0.A.A.2.0.1.0.0.0.0.0.0.0.0.0.0.0.0.C.E.F. IP6.ARPA. IN PTR host1.microsoft.com

DNS support (3)

- Name to address records
  - AAAA record type, equivalent to IPv4 A record
  - Example record
    - host1.microsoft.com IN AAAA FEC0::1:2AA:FF:FE3F:2A1C
- Address to name records
  - New reverse domain called IP6.ARPA
  - Example record
    - FEC0::1:2AA:FF:FE3F:2A1C is FEC0:0000:0000:0001:02AA:00FF:FE3F:2A1C
    - C.1.A.2.F.3.E.F.F.F.0.0.A.A.2.0.1.0.0.0.0.0.0.0.0.0.0.0.0.C.E.F. IP6.ARPA. IN PTR host1.microsoft.com
- DNS dynamic update
  - Host registers global, site-local, and unique local addresses

Source and destination address selection

- A typical IPv6 host has multiple IPv6 addresses assigned to multiple interfaces.
- When multiple IPv6 addresses are returned during DNS name resolution, IPv6 uses the following algorithms.
  - A source address selection algorithm to select the best source address to use with a destination address
  - A destination address selection algorithm to sort the list of possible destination addresses in order of preference

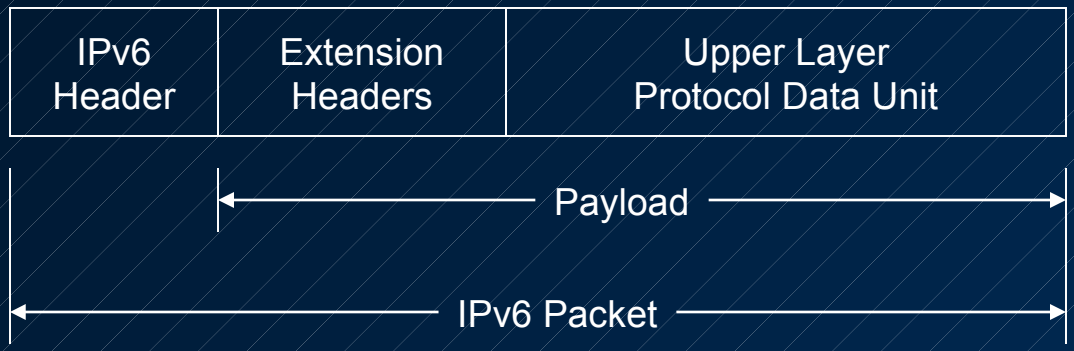
IPv4 addresses and IPv6 equivalents

IPv4 Address	IPv6 Address
Internet address classes	Not applicable
Multicast addresses (224.0.0.0/4)	IPv6 multicast addresses (FF00::/8)
Broadcast addresses	Not applicable
Unspecified address is 0.0.0.0	Unspecified address is ::
Loopback address is 127.0.0.1	Loopback address is ::1
Public IP addresses	Global addresses
Private IP addresses	Site-local addresses (FEC0::/10)
APIPA addresses (169.254.0.0/16)	Link-local addresses (FE80::/64)
Syntax: Dotted decimal notation	Colon hexadecimal notation
Masks: Dotted decimal or prefix length	Prefix length notation only
DNS forward: A resource record	AAAA resource records
DNS reverse: IN-ADDR.ARPA domain	IP6.ARPA domain

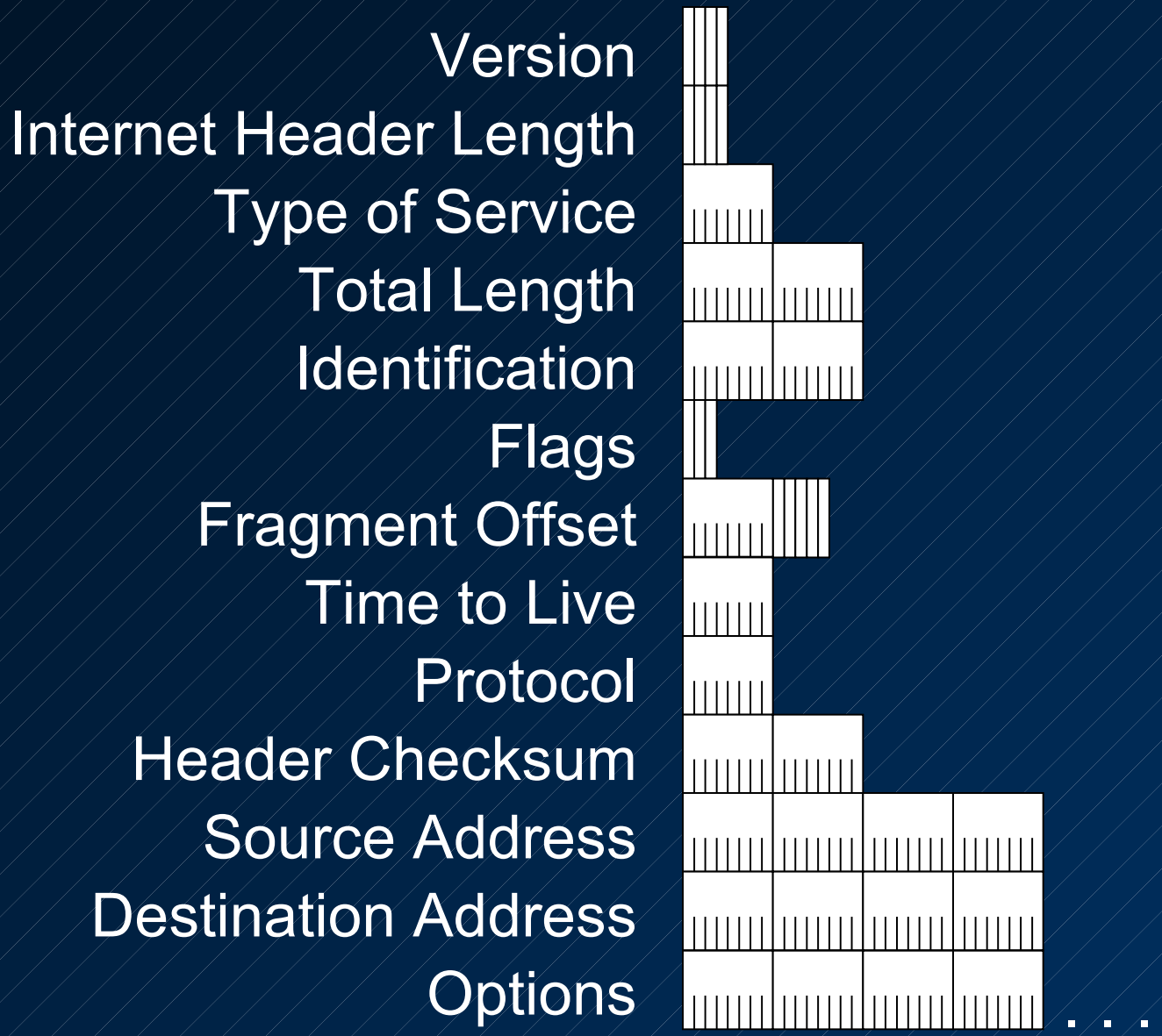
IPv6 header

- Structure of an IPv6 packet
- IPv6 header
- IPv6 extension headers

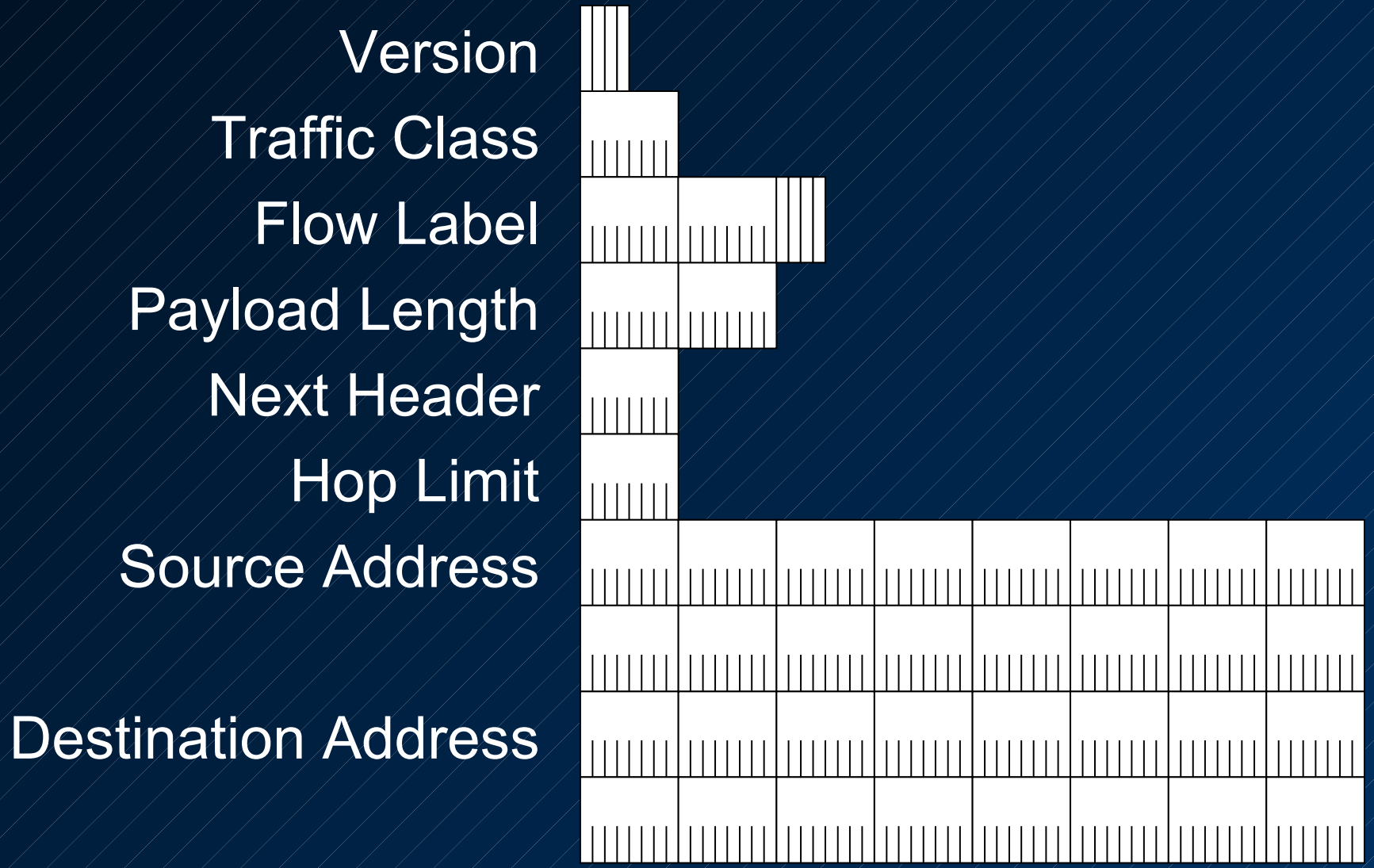
Structure of an IPv6 packet



IPv4 header


Version
Internet Header Length
Type of Service
Total Length
Identification
Flags
Fragment Offset
Time to Live
Protocol
Header Checksum
Source Address
Destination Address
Options
. . .

IPv6 header


Version
Traffic Class
Flow Label
Payload Length
Next Header
Hop Limit
Source Address
Destination Address

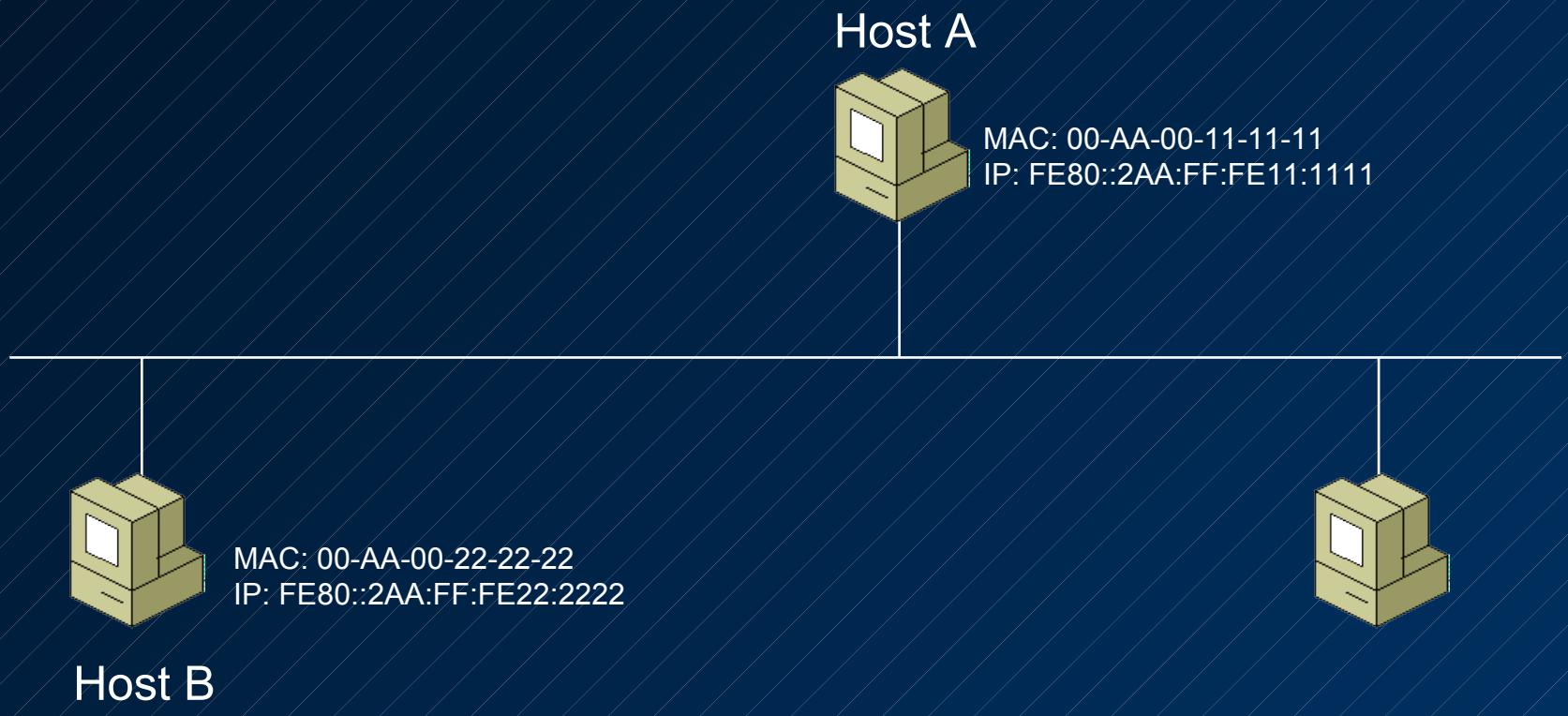
Comparing the IPv4 and IPv6 headers

IPv4 Header Field	Change in IPv6
Version	New value of 6
Internet Header Length	Removed
Type of Service	Traffic Class field
Total Length	Payload Length field
Identification	Removed to Fragment extension header
Fragmentation Flags	Removed to Fragment extension header
Fragment Offset	Removed to Fragment extension header
Time to Live	Hop Limit field
Protocol	Next Header field
Header Checksum	Removed
Source Address	Same, new 128-bit length
Destination Address	Same, new 128-bit length
Options	Removed to extension headers

Address resolution

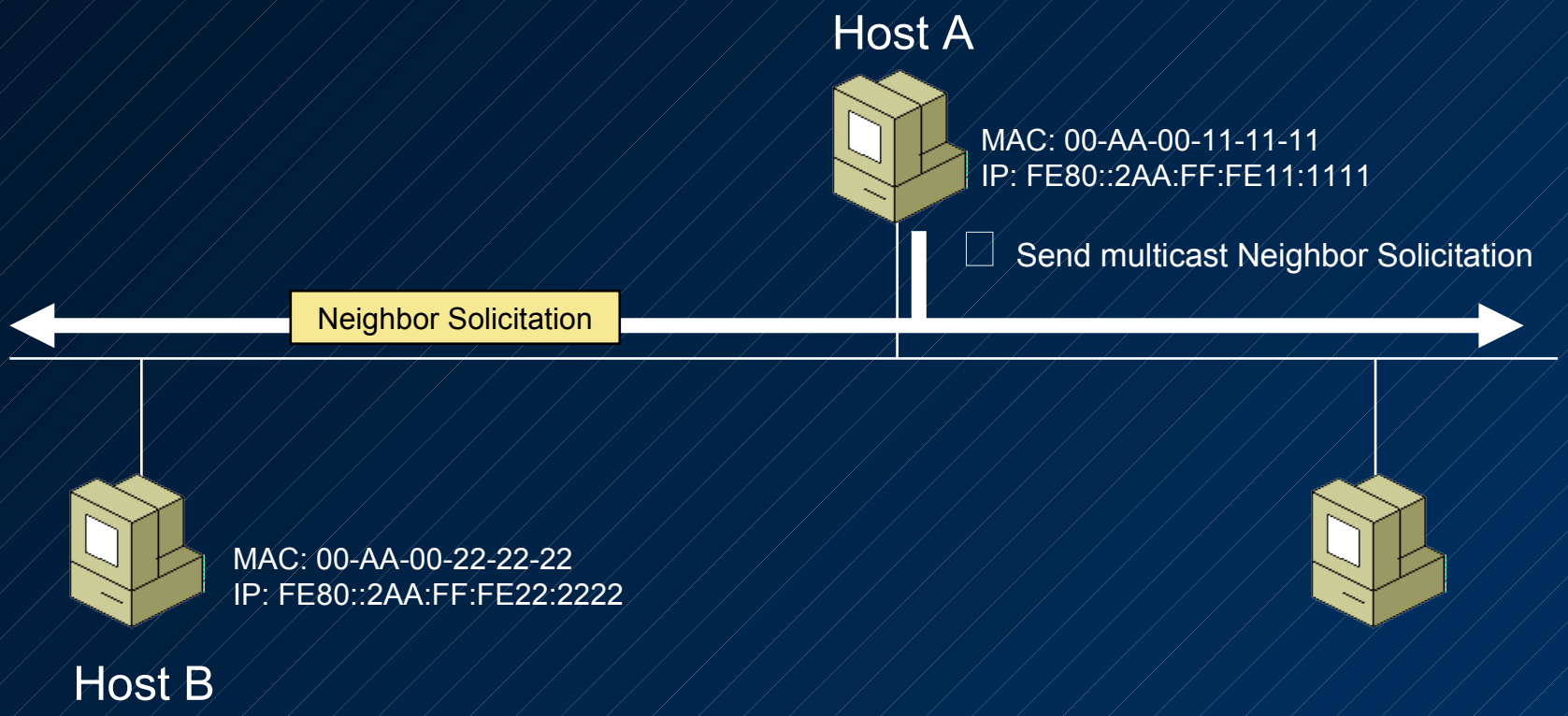
- Resolves the link-layer address of the on-link next-hop address
- Exchange of messages
  - Multicast Neighbor Solicitation message
  - Unicast Neighbor Advertisement message
- Both nodes update their neighbor caches
  - Link-layer unicast traffic can now be sent

Address resolution example
Part 1



Address resolution example (2)

Part 1



Address resolution example (3)

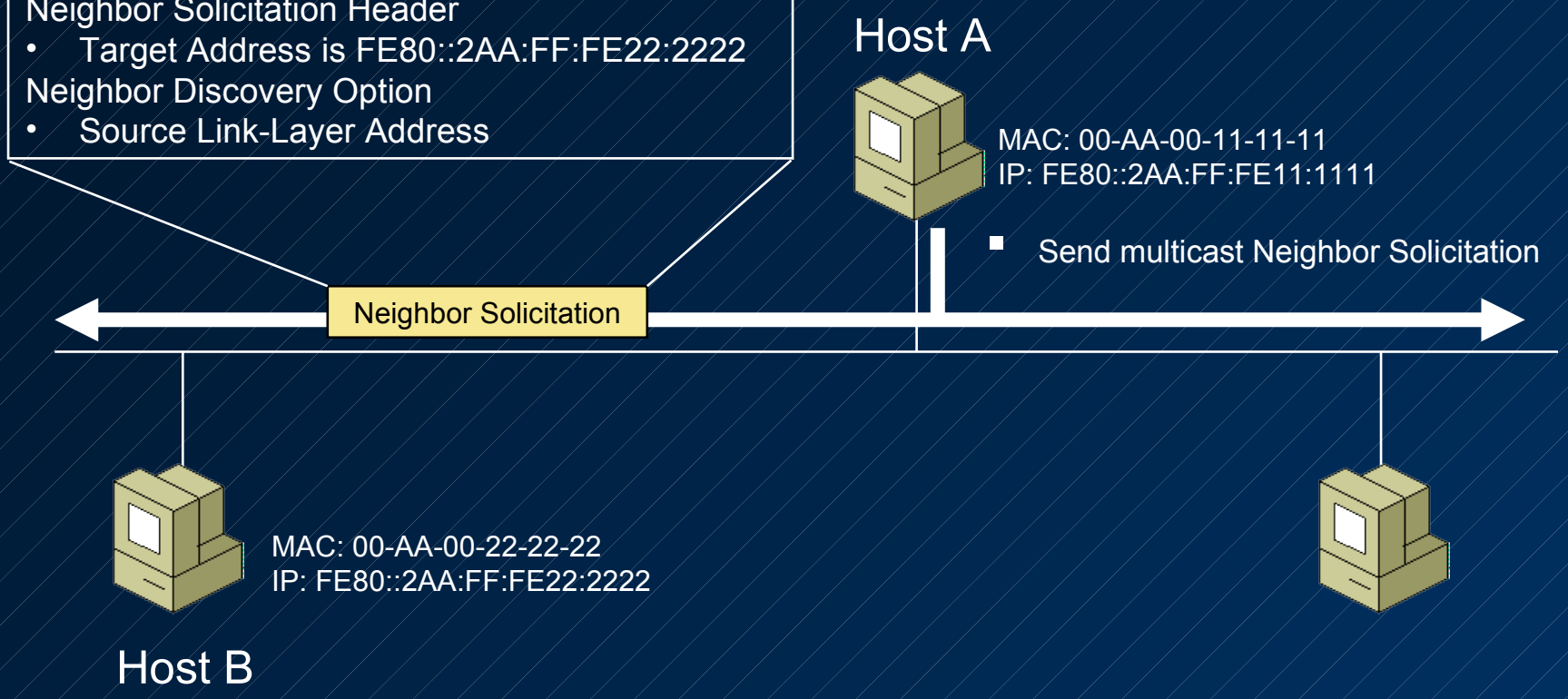
Part 1

Ethernet Header
- Dest MAC is 33-33-FF-22-22-22

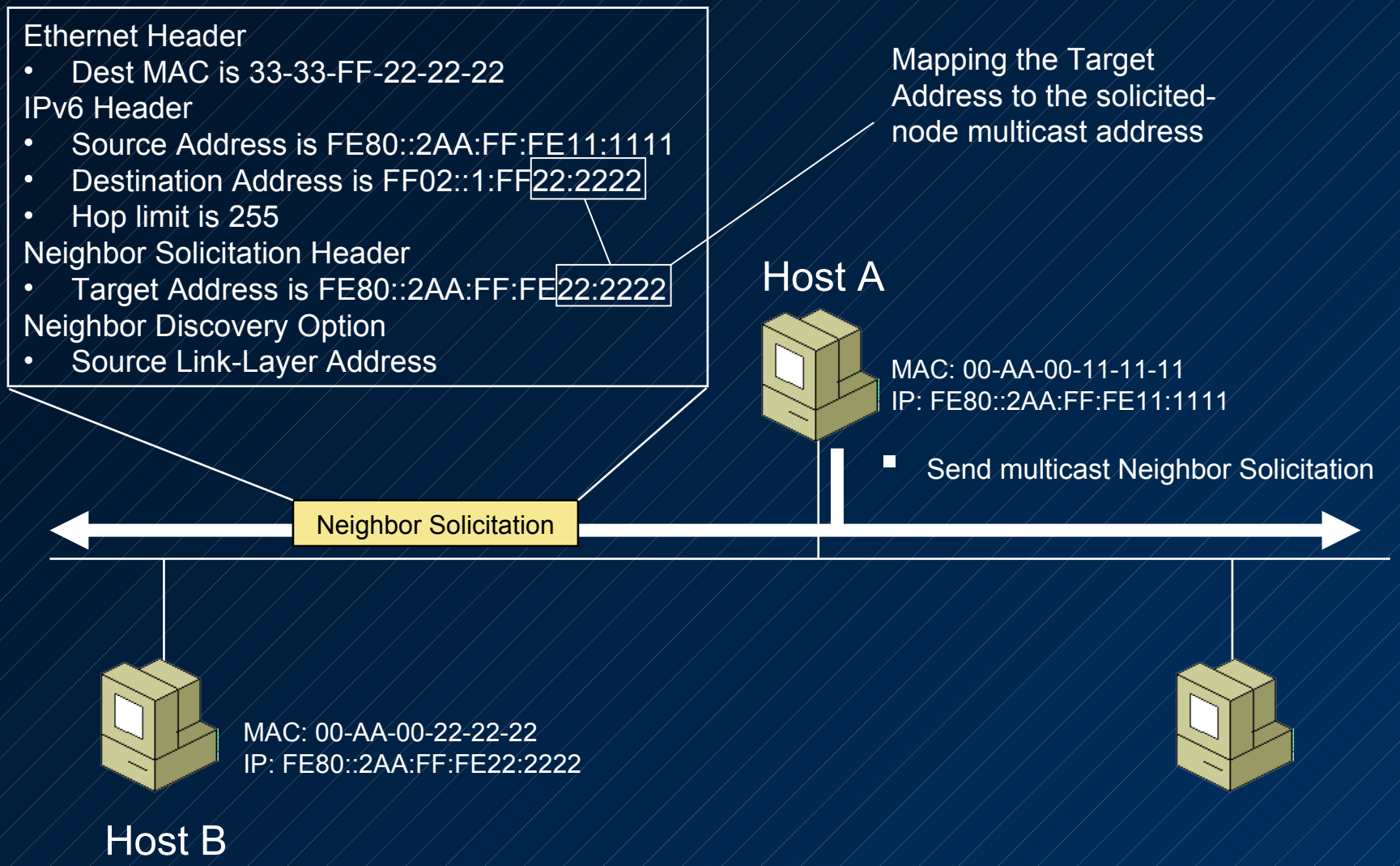
IPv6 Header
- Source Address is FE80::2AA:FF:FE11:1111
- Destination Address is FF02::1:FF22:2222
- Hop limit is 255

Neighbor Solicitation Header
- Target Address is FE80::2AA:FF:FE22:2222

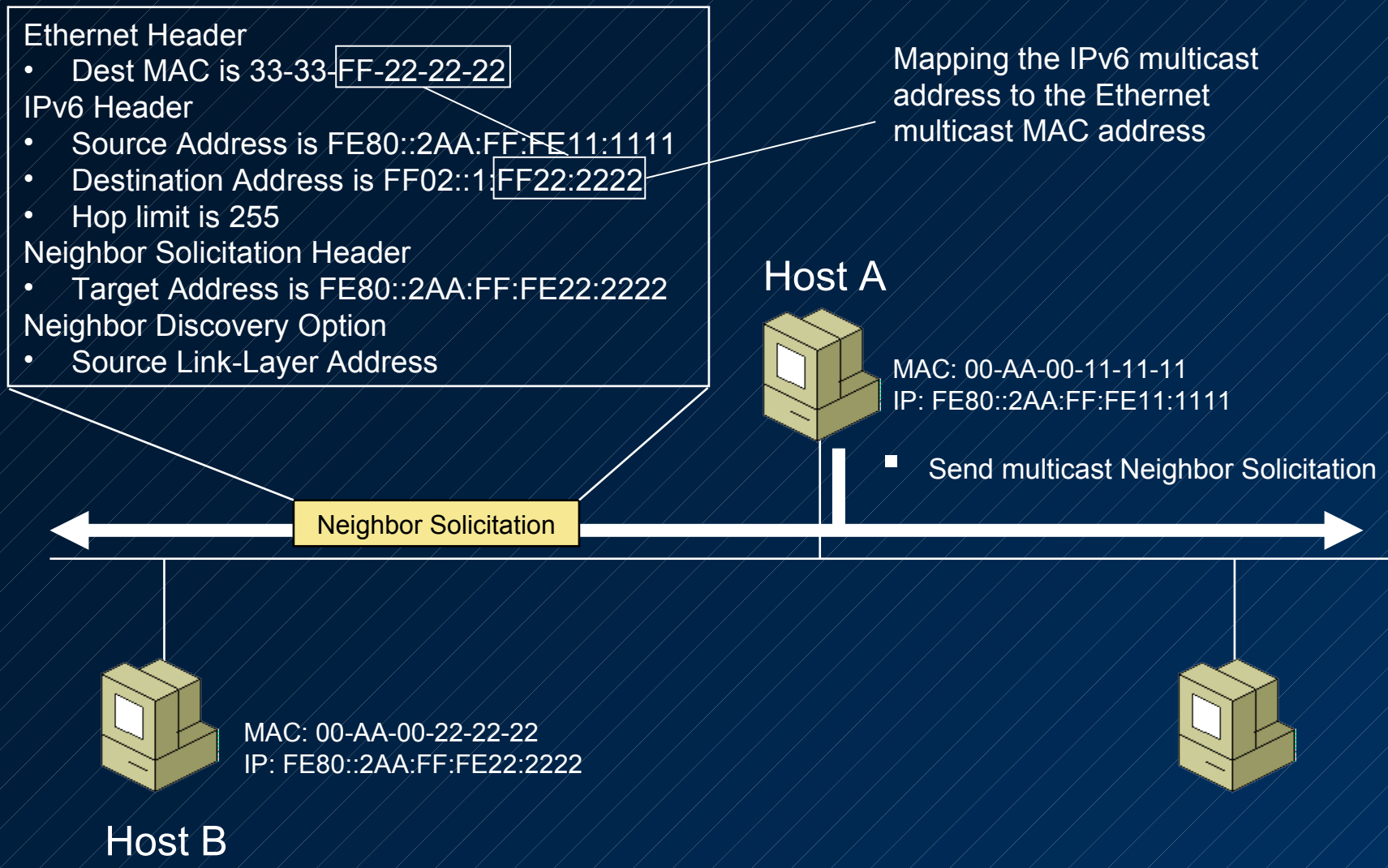
Neighbor Discovery Option
- Source Link-Layer Address



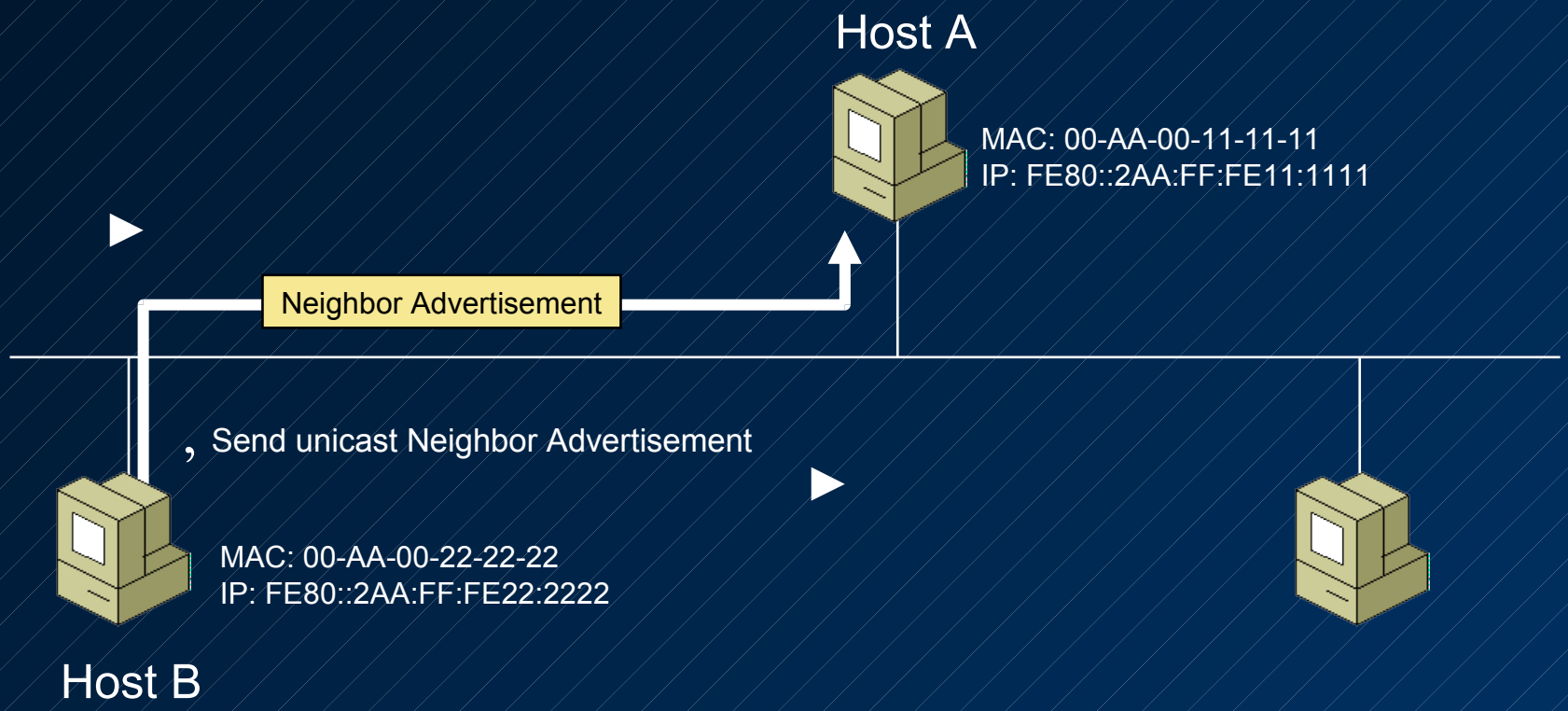
Address resolution example (4)
Part 1



Address resolution example (5)
Part 1



Address resolution example (6)
Part 2



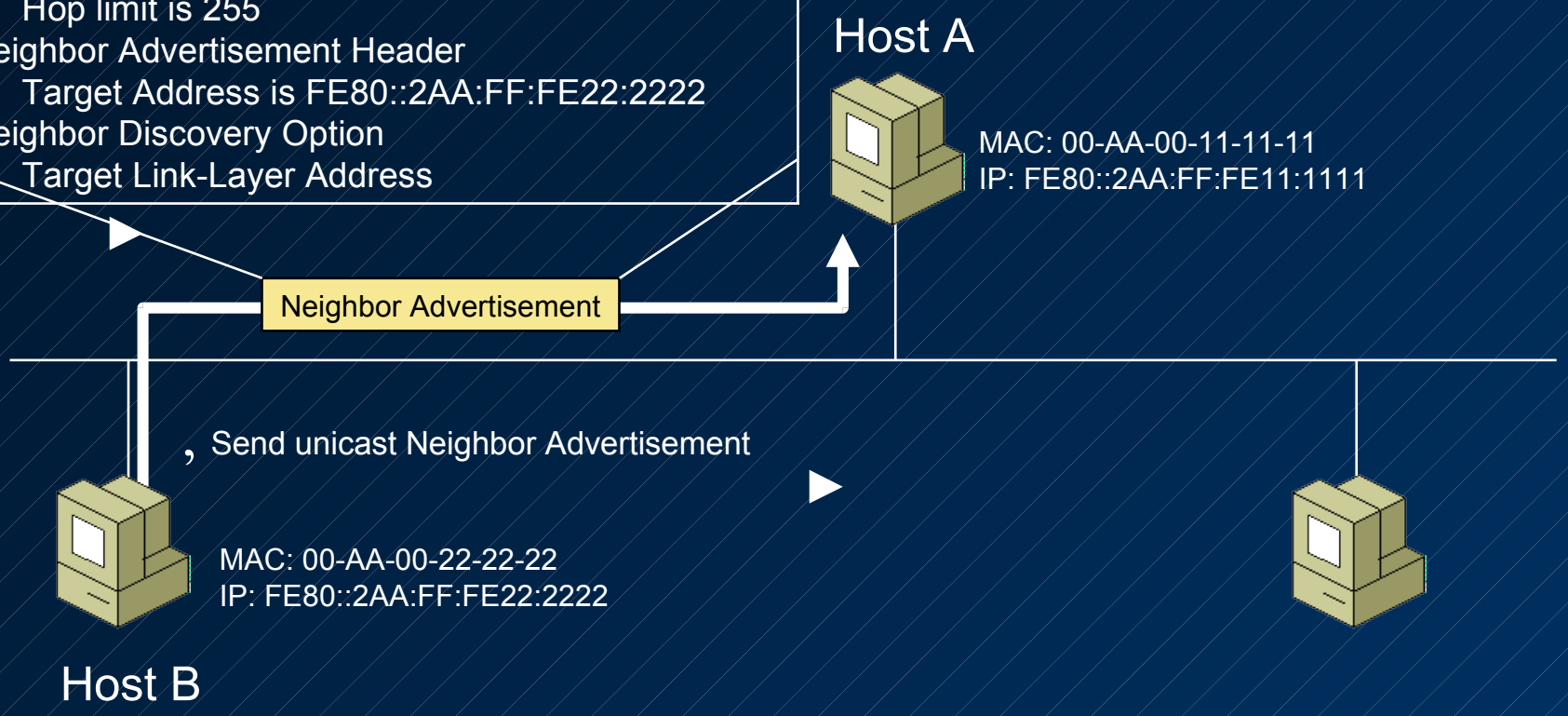
Address resolution example (7)
Part 2

Ethernet Header
- Dest MAC is 00-AA-00-11-11-11

IPv6 Header
- Source Address is FE80::2AA:FF:FE22:2222
- Destination Address is FE80::2AA:FF:FE11:1111
- Hop limit is 255

Neighbor Advertisement Header
- Target Address is FE80::2AA:FF:FE22:2222

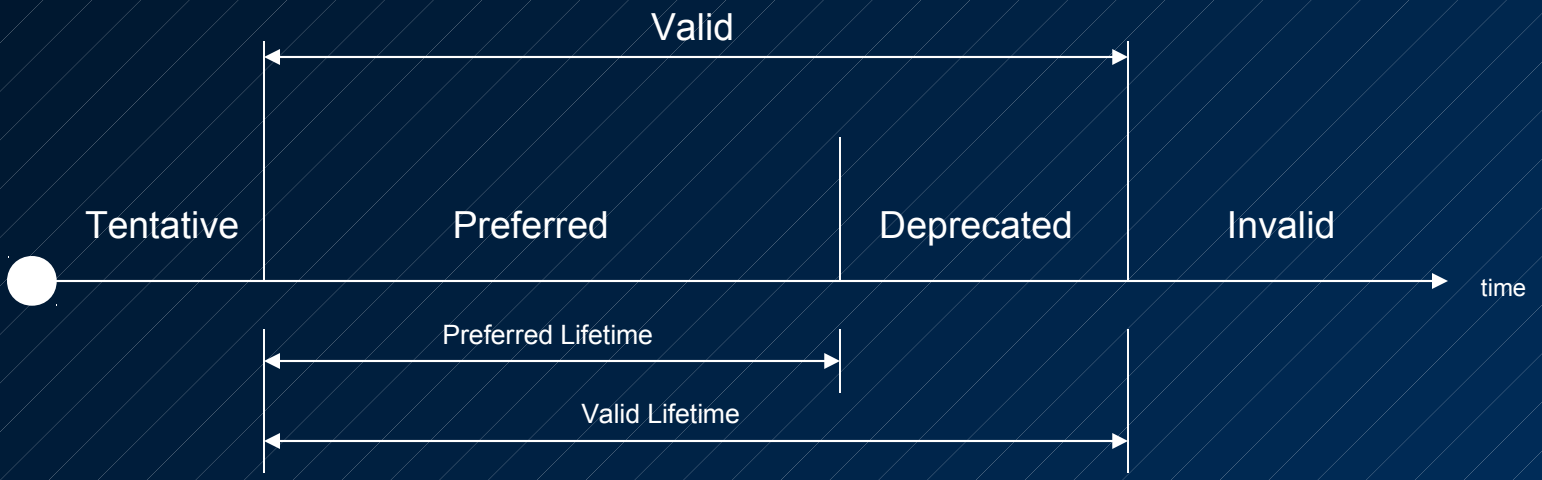
Neighbor Discovery Option
- Target Link-Layer Address



Autoconfigured address states

- Tentative
  - The address is being verified as unique
- Valid
  - An address from which unicast traffic can be sent and received
  - Preferred state
    - An address for which uniqueness has been verified, unrestricted use
  - Deprecated state
    - An address that is still valid, but is discouraged for new communication
- Invalid
  - An address for which a node can no longer send or receive unicast traffic

Autoconfigured address states (2)



Types of autoconfiguration

1. Stateless
   - Receipt of Router Advertisement messages that have one or more Prefix Information options
2. Stateful
   - Use of a stateful address configuration protocol such as DHCPv6
3. Both
   - Receipt of Router Advertisement messages and stateful configuration protocol

- For all types, a link-local address is always configured

Address autoconfiguration process

- Configure link-local address.
  - Perform duplicate address detection
- Perform router discovery.
- Use Router Advertisement message contents to determine the following items.
  - Configuration parameters
  - Stateless addresses and on-link prefixes
    - For stateless addresses, perform duplicate address detection
  - Whether to use stateful address configuration
  - Specific routes

IPv6 resources

- IPv6 Web site
  - http://www.microsoft.com/ipv6
- “Introduction to Internet Protocol version 6” white paper
  - http://www.microsoft.com/technet/ itsolutions/netw

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