

IPv6

CO1507 Introduction to Networking
Jonathan Edwards 2024





IPv6

IPv6 has several advantages over IPv4

- No more need for NAT
- Auto-configuration
- No more private address collisions
- Better multicast routing
- Simple header format
- Simplified, more efficient routing
- True quality of service (QoS), aka 'flow labelling'
- Built-in authentication and privacy support

IPv6 Address Space

- 128-bit address space
- 2^{128} addresses
- 340,282,366,920,938,463,374,607,431,768,211,456 addresses

“340 undecillion 282 decillion 366 nonillion 920 octillion, 938 septillion 463 sextillion 463 quintillion 374 quadrillion 607 trillion 431 billion 768 million 221 thousand and 456”

- 16 byte / 128-bit number
- Whereas IPv4 is a 4 byte / 32-bit number
- Only 4,496,967,296 addresses

IPv6 Notation

- IPv6 addresses are represented by 8 groups of 16-bits
- Each section of 16 bits are written in hexadecimal
- The values are separated by colons (:)
 - E.g. 2024:003A:CD3F:0000:023A:00CF:ED30:12FF
- Leading zeros can be removed to give...
 - 2024:3A:CD3F:0:23A:CF:ED30:12FF

IPv6

2024:003A:CD3F:0000:023A:00CF:ED30:12FF



IPv6 Address Compression

- We use zero compression where adjacent zeros can be collapsed to ::
- Example: 2024:0:0:0:0:0:12CD:FFF1
- Can be summarized to 2024::12CD:FFF1
- But we can only use zero compression once...
- (bad) Example: 2023::CD32::F21
- Possible expansions...
 - 2023:0:0:0:0:CD32:0:F21 or
 - 2023:0:0:0:CD32:0:0:F21 or
 - 2023:0:0:CD32:0:0:0:F21 or
 - 2023:0:CD32:0:0:0:0:F21



Compression Summary

- Remove leading zeros

2024:003A:0000:0000:023A:00CF:ED30:12FF

To give :

2024:3A:0:0:23A:CF:ED30:12FF

- Remove longest section of adjacent zeros and replace with a double colon

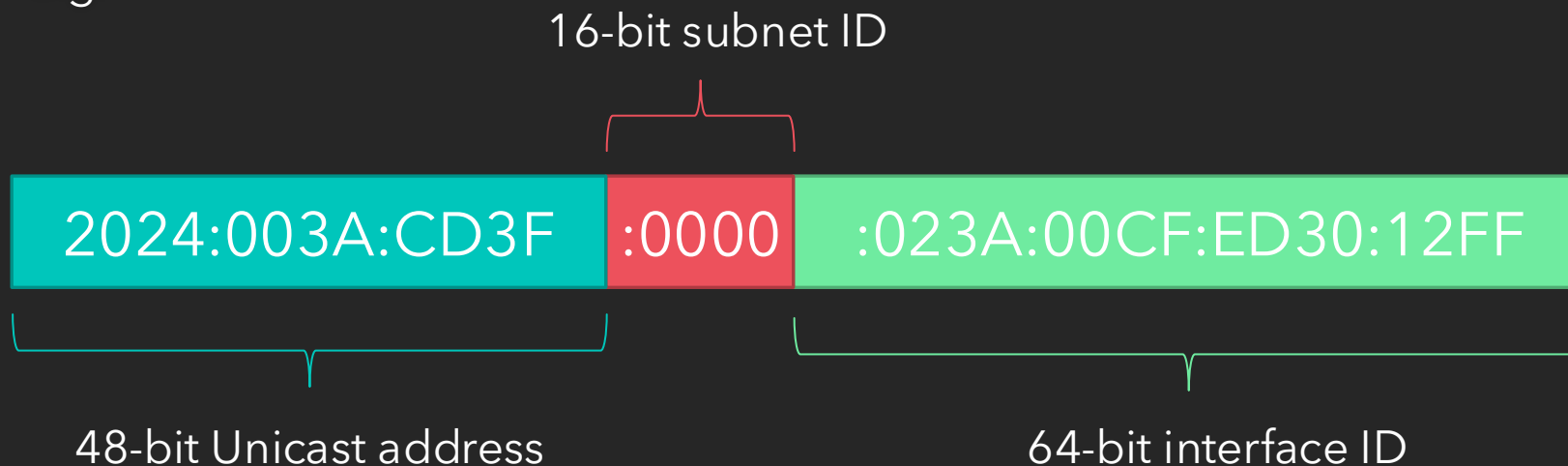
2024:3A:0:0:23A:CF:ED30:12FF

To give:

2024:3A::23A:CF:ED30:12FF

IPv6 Address Sections

- There is NO Subnet Mask with IPv6
- Just like with IPv4 CIDR the length of a “network” address can be written with a ‘/’ e.g. /64
- E.g. /64 means 64-bit network portion, 64-bit host portion
- Network portion can be split into address and subnet id
- E.g.



Types of IPv6 Address

GLOBAL UNICAST

- A bit like a public IP address in IPv4 which is routable
- $\geq$ 48-bit global prefix
- $\leq$ 16-bit subnet ID
- Prefixed 2000::/3
(/3 meaning first three bits identify the address)
- Start with 2 or 3

Types of IPv6 Address

UNIQUE LOCAL

- Not globally routable
- A bit like a IPv4 private IP address
- Prefix FC00::/7
- Start FC or FD

Types of IPv6 Address

LINK LOCAL

- These are self-assigned addresses by the host itself
- A bit like APIPA 169.254 ..
- The prefix is FE80::/10
- Not routable
- Start FE

Types of IPv6 Address

MULTICAST

- Multiple devices
- Address for groups of hosts all listening for one address
- Replace broadcast addresses in IPv4
- Prefix is FF00::/8
- Start FF

Types of IPv6 Address

ANYCAST

- IPv6 allows multiple devices to have the same anycast address
- The nearest host receives is sent the data
- Anycast don't have their own specific range
- Same prefix as global unicast
- 2000::/3

Types of IPv6 Address

GLOBAL UNICAST	2000::/3	Publicly routable
UNIQUE LOCAL	FC00::/7	Routable in a LAN
LINK LOCAL	FE80::/10	Not routable, self-assigned
MULTICAST	FF00::/8	Addresses for groups
ANYCAST	2000::/3	Shared address

Benefits of IPv6

- **Increased address space:** IPv6 provides a much larger address space than IPv4, which allows for more devices to be connected to the internet.
- **Improved security:** IPv6 includes built-in security features such as IPSec, which can help to protect against certain types of cyber-attacks.
- **Improved routing:** IPv6 allows for more efficient routing of data packets, which can help to reduce network congestion and improve overall performance.

*most of this is beyond the scope of this module.

Benefits of IPv6

- **Better support for QoS:** IPv6 includes built-in support for Quality of Service (QoS), which allows for different types of traffic to be prioritized and managed more effectively.
- **Easier network management:** IPv6 allows for more efficient and centralized management of networks, which can help to reduce costs and improve overall performance.
- **Better support for multicast:** IPv6 includes built-in support for multicast, which allows for one-to-many communication, which can be useful for things like streaming video and other types of group communication.

*most of this is beyond the scope of this module.

Delays to IPv6 Adoption

- Lack of backward compatibility: IPv6 is not backward compatible with IPv4, which means that organizations need to upgrade all their hardware and software to support it. This can be a significant investment for many organizations.
- Lack of incentives: There is currently no financial or other incentives for organizations to adopt IPv6, as IPv4 addresses are still available and can connect to the internet.
- Lack of awareness: Many organizations and individuals are not aware of the benefits of IPv6 or the need to transition to it.
- Complexity: IPv6 is a more complex protocol than IPv4, which can make it difficult to implement and configure.
- Limited support: Many network devices and software applications do not yet fully support IPv6, which can make it difficult for organizations to fully implement it.

Delays to IPv6 Adoption

- Cost: The cost of upgrading to IPv6 can be significant for many organizations, particularly for small and medium-sized businesses.
- Resistance to change: Many organizations may be resistant to change and may be unwilling to invest in upgrading their infrastructure to support IPv6.
- Limited IPv4 addresses available: Many ISPs and companies still have enough IPv4 addresses available, and they don't see a need to make the transition to IPv6 yet.
- Interoperability issues: Many IPv6 devices may not be able to communicate with IPv4 devices, which can make the transition to IPv6 more difficult for some organizations.



○ Any Questions?