

# CSE 461 - Module 12: IPv6 Addressing

## IPv6 Address Architecture

- 128-bit addresses, written as strings like:
  - 2001:0DB8:0000:0000:0008:0800:200C:417A, or
  - 2001:DB8:0:0:8:800:200C:417A , or
  - 2001:DB8::8:800:200C:417A
- Unicast, multicast, and anycast addresses
  - No broadcast – use multicast instead
  - Multicast
    - FF::/8
    - Includes a 4 bit scope field
      - interface-local, link-local, admin-local, site-local, organization-local, global
  - Anycast – closest instance of a single address
    - *For any assigned anycast address, there is a longest prefix P of that address that identifies the topological region in which all interfaces belonging to that anycast address reside. Within the region identified by P, the anycast address must be maintained as a separate entry in the routing system (commonly referred to as a "host route"); outside the region identified by P, the anycast address may be aggregated into the routing entry for prefix P.*
    - *Example use: Packets sent to the Subnet-Router anycast address will be delivered to one router on the subnet. All routers are required to support the Subnet-Router anycast addresses for the subnets to which they have interfaces.*
- Special addresses
  - :: - the unspecified address (all 0's)
  - ::1 – the loopback address
  - FE80::/10 – link local unicast addresses
- Required addresses
  - Link-local address, loopback address, All-Nodes multicast address, Solicited-Node multicast address
  - If a router, additionally: Subnet-Router anycast, All-Routers multicast

## Obtaining an IPv6 Address

- All IPv6 addresses have a lease
  - The lease could be of infinite duration, however
- DHCPv6 exists
  - Built on IP, using autoconfigured IP addresses and anycast

- Stateless autoconfiguration exists
  - Step 1: generate link-local address
    - Host generates unique interface ID
    - Combine with link-local prefix to form tentative address
    - Verify not in use
      - Send Neighbor Solicitation packet to the Solicited Node multicast address that is derived from the link-local address, and hope there are no replies
        - Part of Neighbor Discovery Protocol (NDP)
    - Subscribe to corresponding Solicited Node multicast group
  - Step 2; try to generate global unicast addresses
    - Send Router Solicitation packet to the All-Routers multicast address
    - Responses contain network prefixes and lease lifetime information
    - Combine interface ID (the same one as in step 1) with network prefix
    - Verify not in use
    - Routers periodically send out Router Advertisements that include network prefix information
  - When first generated, global IP address is “preferred” and should be used
    - As you near lease expiration, it becomes deprecated – can be used for existing exchanges, but should not be used for any new connections/exchanges
- IPv6:
  - Separates notion of generating an address for an interface and determining the prefix of the local link
  - Allows there to be more than one prefix on the local link
  - Includes a “neighbor unreachability” analysis that allows node to detect failures (and attempt some kind of recovery)
    - Active: send a Neighbor Solicitation message to the node
    - Passive: infer from traffic you see
      - E.g., if you see a TCP ACK come back from some remote host, you can infer the local router/gateway you're using is up
    - Not allowed: anything that doesn't imply you can establish two-way communication
      - E.g., if you see an All-Nodes multicast from some neighbor, you know it can send to you but you don't know that it can hear you