IPv6 over Wireless and Wireless ND (WiND)

draft-thubert-6man-ipv6-over-wireless

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How to build an IID for autoconf: lots of work

- **RFC 2464 (IPv6 / Eth) and 4291: Address Architecture**
  - Defines IPv6 Adresses (LinkLocal vs. ULA vs. GUA, Unicast, Anycast, unspecified, loopback…)
  - Interface ID (IID) based on EUI-64 (derived from MAC address) => deprecated by RFC 8064
- RFC 5292 provides Modern Address Text Representation
  - e.g., 2001:db8:aaaa:bbbb:cccc:dddd::1
- **RFC 4941 SLAAC Privacy Extensions (still a need for stable IIDs)**
- RFC 7136 Significance of IPv6 IID (meaning none)
- **RFC 7217 Stable and Opaque IIDs (enable private static IIDs)**
- RFC 7721 Privacy Considerations / RFC 8065 for 6lo / IOT
- **RFC 8064 Recommendation on Stable IPv6 Interface Identifier**
- updates RFC 2464, RFC 2467, RFC 2470, RFC 2491, RFC 2492, RFC 2497, RFC 2590, RFC 3146, RFC 3572, RFC 4291, RFC 4338, RFC 4391, RFC 5072, and RFC 5121 !!!!!!!

Basic IP abstractions for IPv6: taken for granted

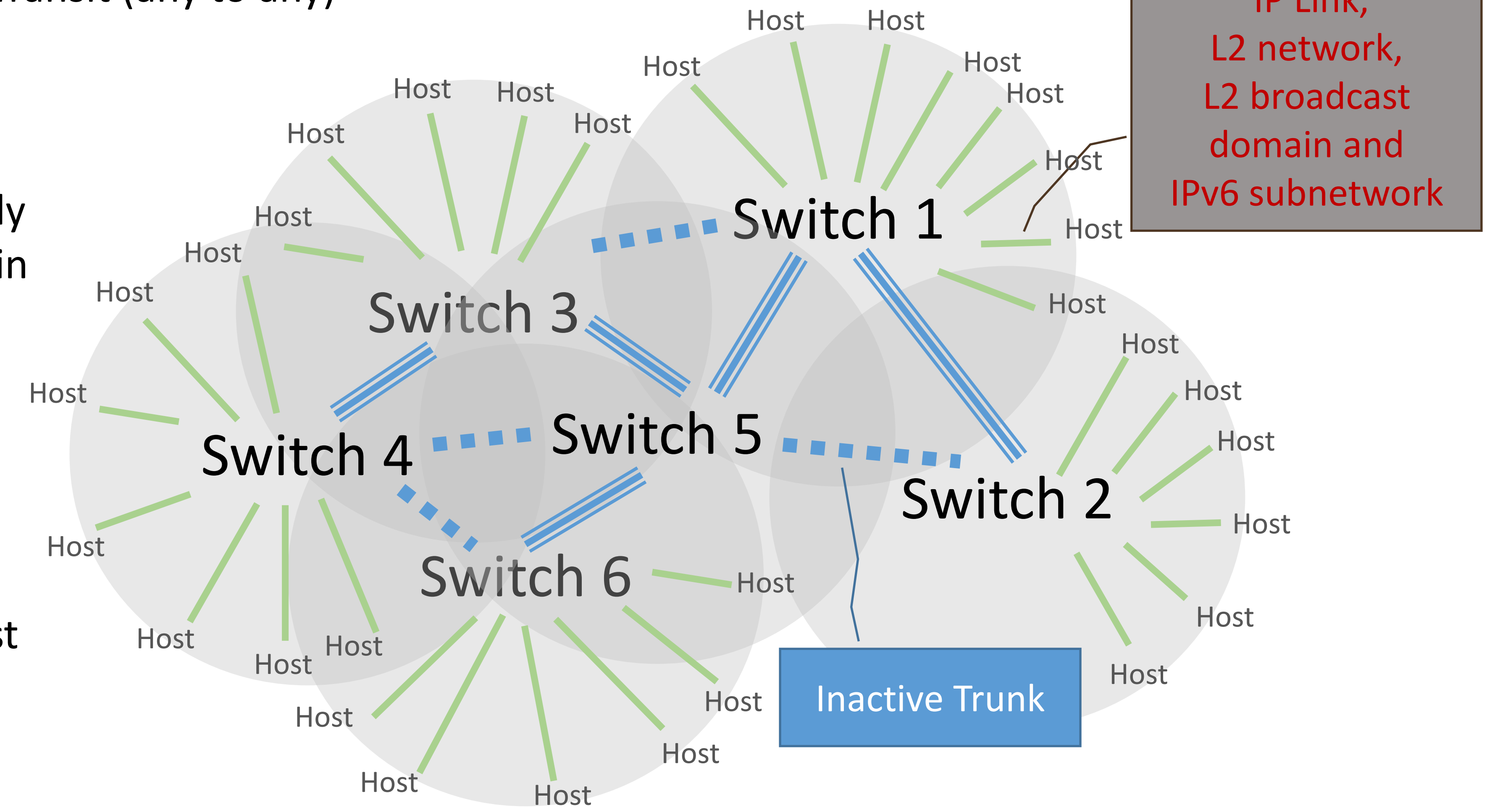
- IP Link is Transit (any to any)

- L2 network switched Ethernet

- The switches autonomously form a L2 broadcast domain (e.g., Spanning Tree Protocol)

- IPv6 Subnet deployed over the broadcast domain

- Congruent with L2 broadcast domain



- **This is really IPv4's ways**

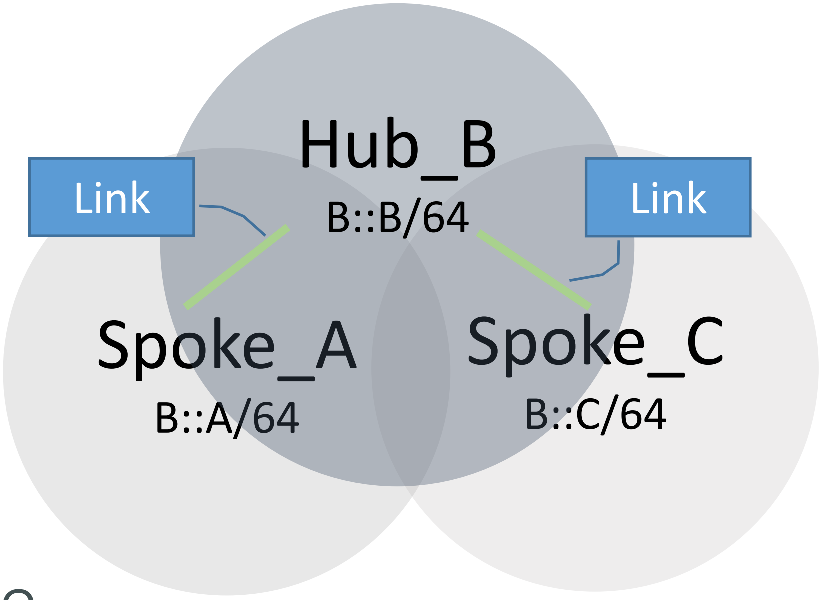
  That IPv6 ND inherited unwittingly

  And it's damn limiting for deploying IPv6 in modern networks

L2 Links, L3 Link, Interfaces, broadcast domain, Subnet

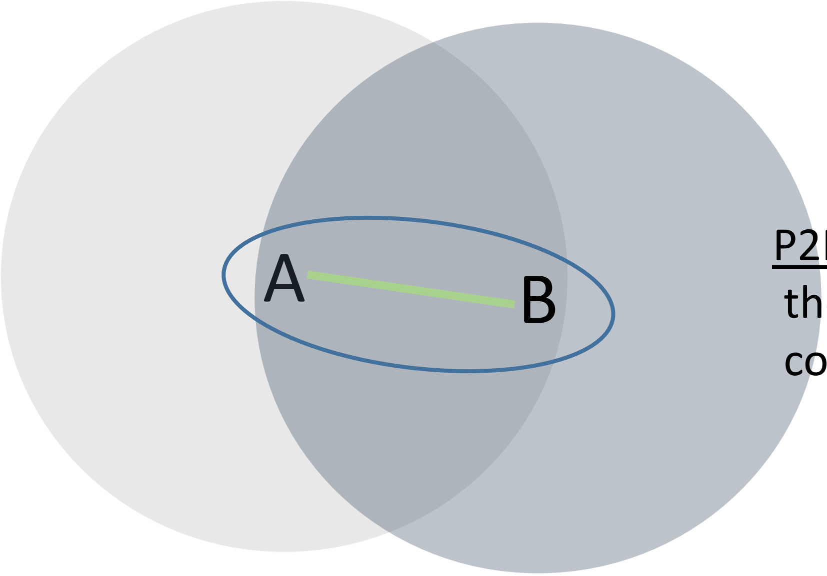
- Wireless raises questions
- All we have is the classical model inherited from IPv4
- Where all is congruent, subnet = link = broadcast domain
- But it does not have to be
- Because the world is not like that (anymore)
- And the old view is damaging (energy wise, bandwidth wise)

Link and Link Local vs. PHY broadcast domain

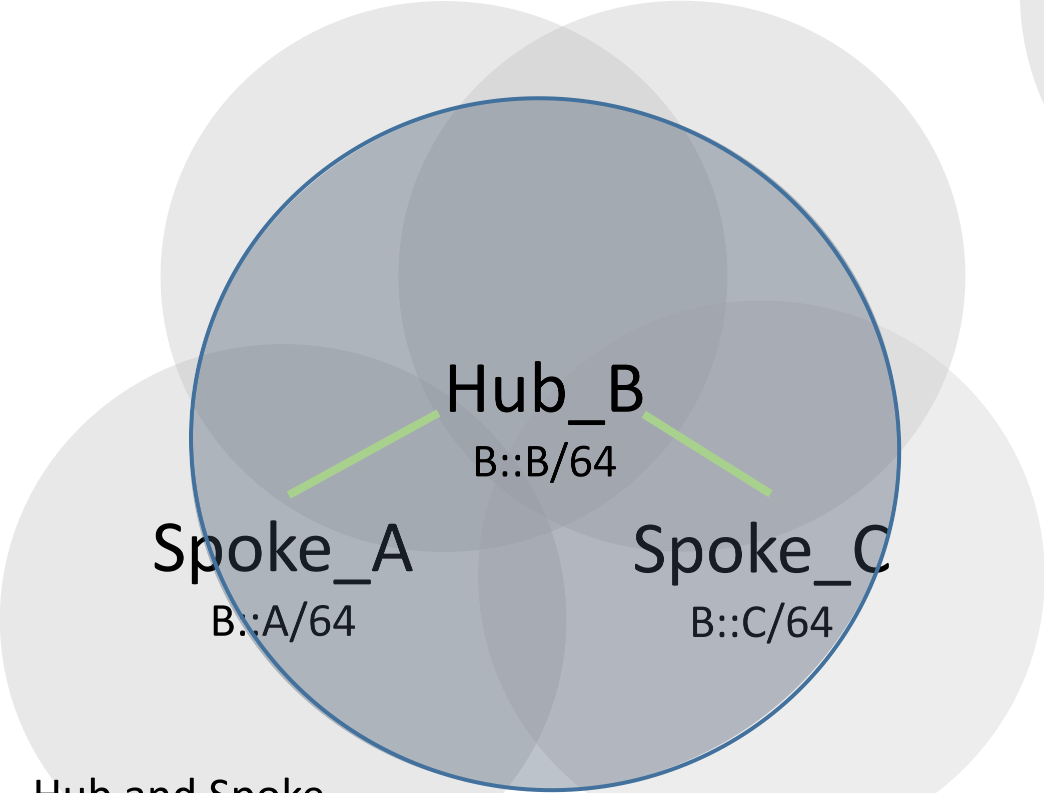


- A plain radio Interface connects to a physical radio broadcast domain (vs. a MAC-layer emulated broadcast domain)
- An IPv6 bidirectional Link can be created where radio broadcast domain overlap enough that A sees B and B sees A.
- Link-Local Addresses need to be unique for a communicating pairs only
- The IPv6 Link is usually reflexive though often asymmetrical
- The IPv6 Link is usually not transitive unless special measures taken
- As a node moves, it meets other nodes and IPv6 Links are formed

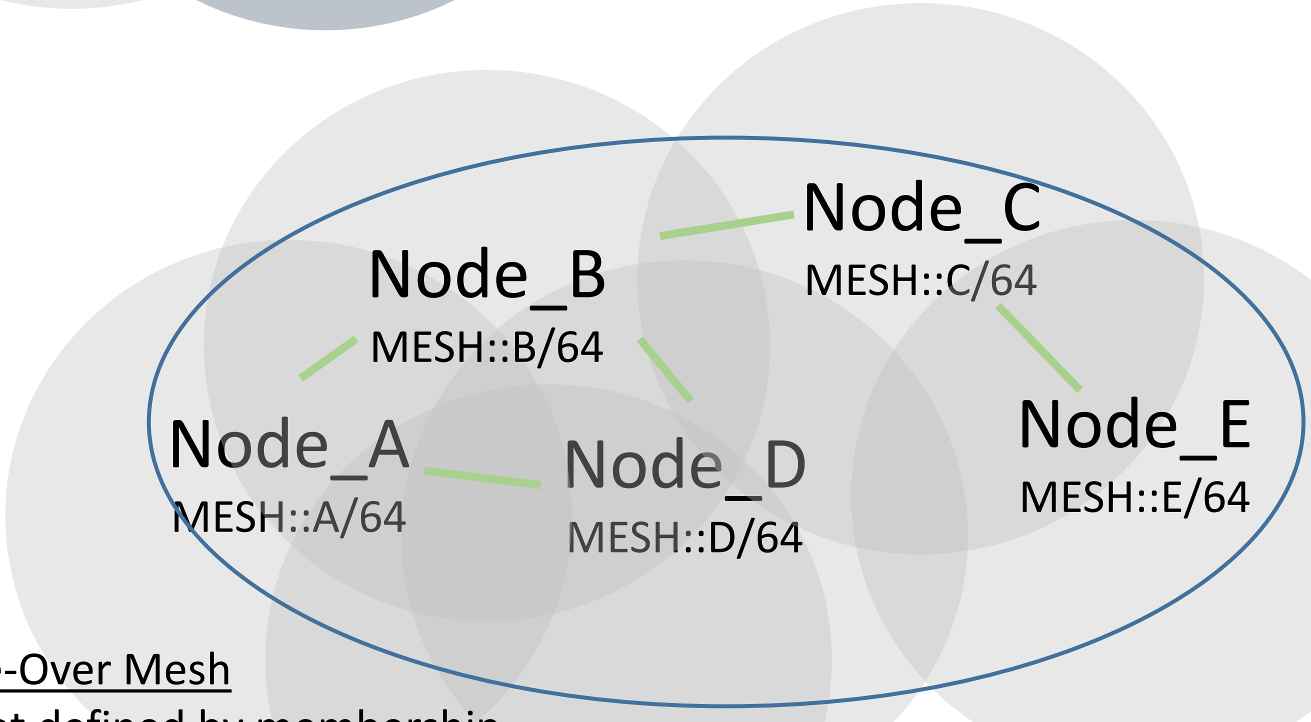
SubNet models



P2P
the simplest subnet model
congruent with IP Link

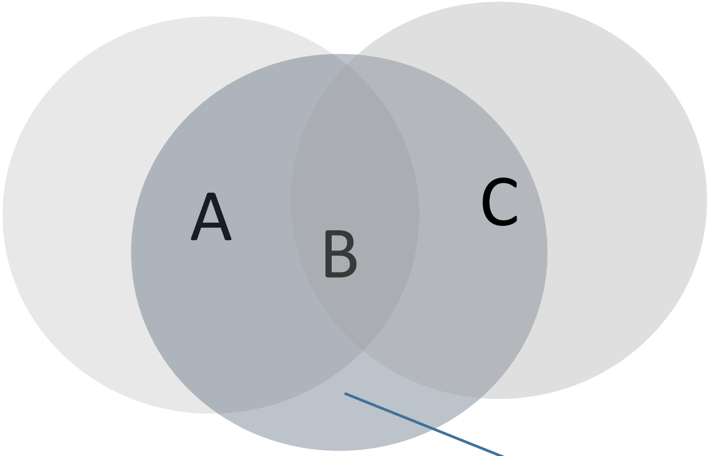


Hub and Spoke
Subnet Congruent with Hub broadcast domain
HUB_B maintains state for visitors for their registration lifetime and relays packet
Needs not-onlink model and central router



Route-Over Mesh
Subnet defined by membership
requires an IGP inside the subnet

IPv6 ND Unmet Expectations



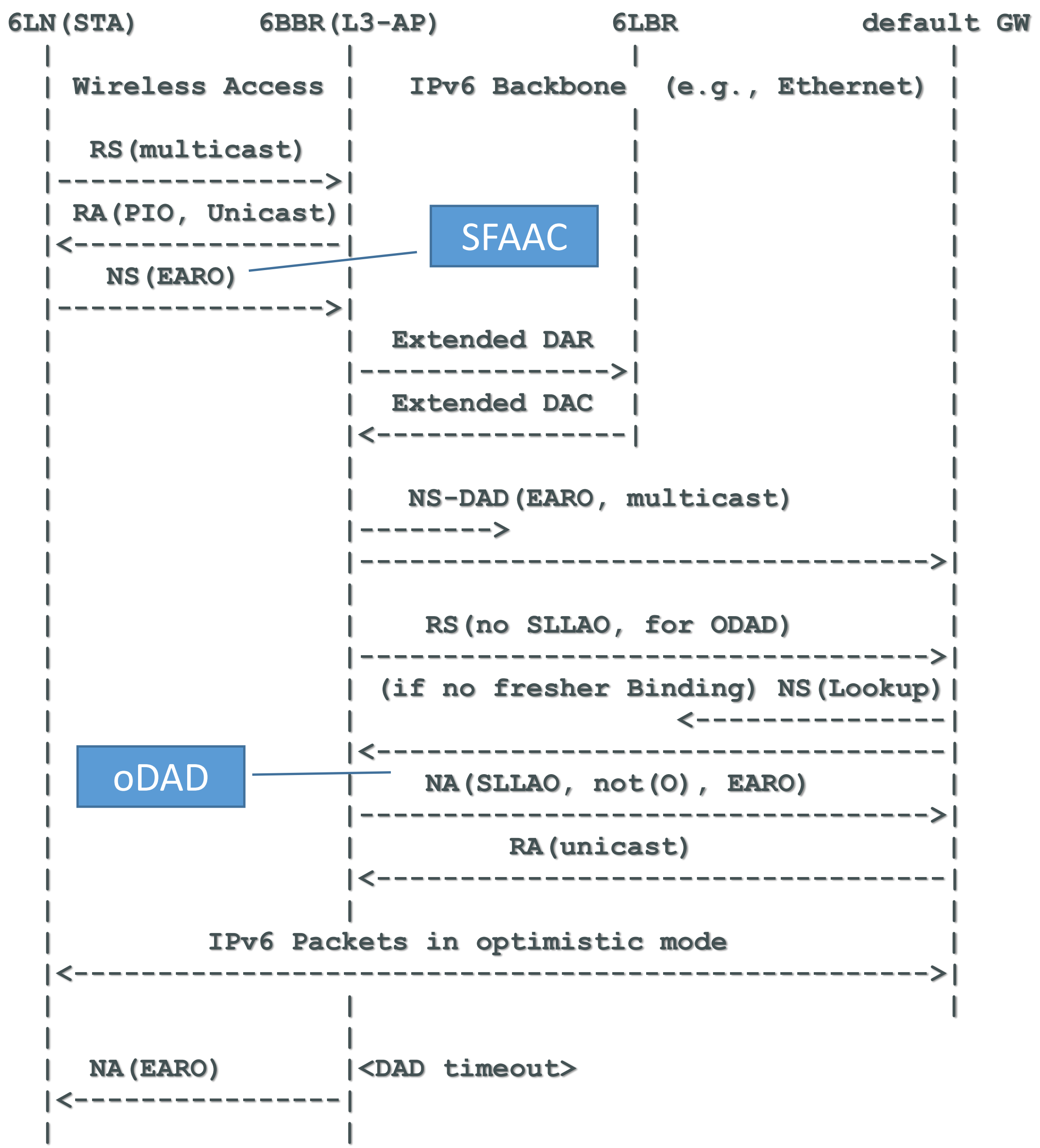
- IPv6 ND is designed for P2P and Transit Links
  - Wireless is mostly symmetrical and non-transitive
  - Requires extensions for NBMA (when no MAC-layer emulated transitive properties such as IEEE 802.11 BSS/ESS)
- IPv6 ND over MAC-layer transit emulation is not wireless friendly
  - E.g., over L2R, learning bridges, Wi-Fi Infrastructure Mode
  - Broadcast intensive (no support for multicast)
- Other mismatches
  - Fast Roaming ‘11r’ (ND has no sense of order of events)
  - Intermittent Connectivity (occasionally fails NUD, DAD and lookup)
  - Fast Initial Link Setup ‘11ai’ (ND is reactive, causes loss of first packets)
  - Increased sensitivity to DoS attacks (Use ND to trigger broadcasts remotely)

Non transitive:
B can talk to A and C
but A and C cannot
see reach other

WiND General Design

- Registration for guaranteed service
  - Even with intermittent connectivity
  - DAD protection on behalf for lifetime
  - Extensible for lookup, prefix adv …
- Routing vs. Bridging Proxy (RFC 8929)
  - Bridging advertises the SLLA of the 6LN
  - Routing hides the 6LN and routes
  - Routing keeps L2 stable
- Model
  - Link is broadcast domain
  - Subnet <> Link

  => Not on-link and routing



6LoWPAN ND (IPv6 Stateful Address Autoconfiguration)

RFC 6775 (original 6LoWPAN ND)

- Defines ARO for registration and DAD operations for stateful AAC

RFC 8505 (Issued 11/2018)

- The protocol agnostic registration for ULA/GUA for proxy ND and routing services
- Analogous to a Wi-Fi association but at Layer 3: a deterministic and query-able state for all addresses

RFC 8929 (Issued 11/2020)

- Federates 6lo meshes over a high-speed backbone
- ND proxy analogous to Wi-Fi bridging but at Layer 3

RFC 8928 (Issued 11/2020)

- Protects addresses against theft (Crypto ID in registration)

draft-ietf-6lo-multicast-registration

- Extends RFC 8505 for multicast and anycast

draft-thubert-6lo-unicast-lookup

- Provides a 6LBR on the backbone to speed up DAD and lookup
- Coexistence with classical ND

draft-thubert-6lo-prefix-registration

- Extends RFC 8505 for prefixes

NEW DRAFT

Discussion

The draft discusses the Link and Subnet models

Then discusses applicability of ND and WiND

=> 6MAN interest?

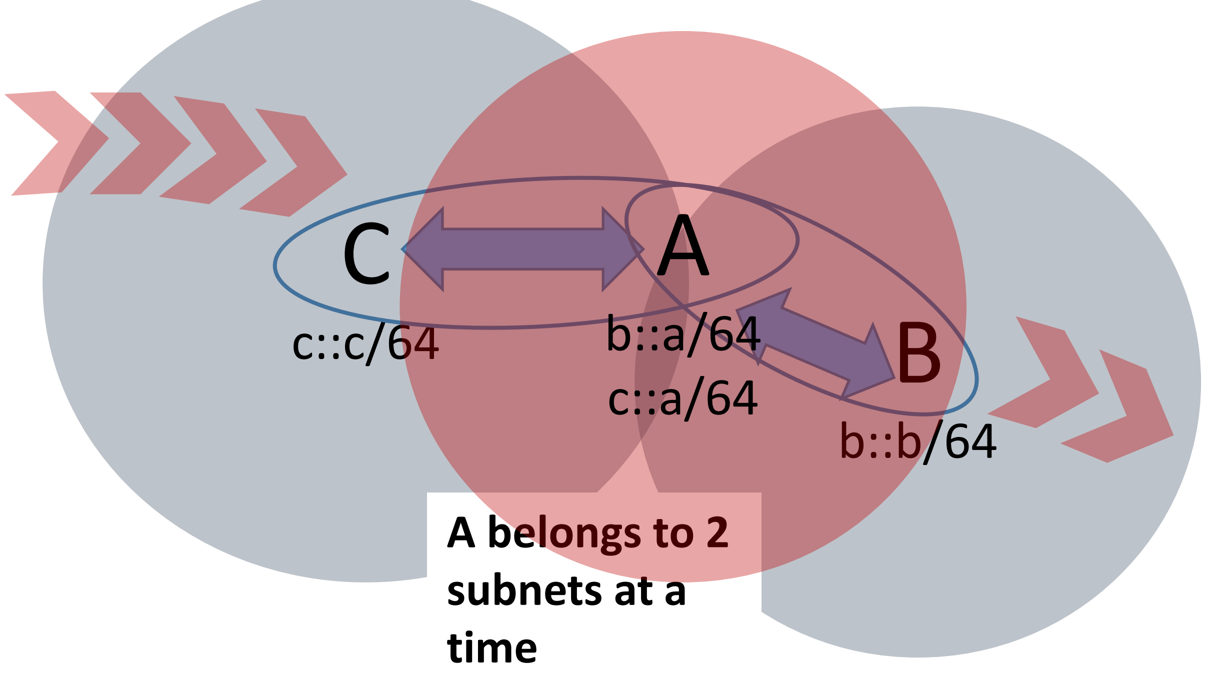
The draft is stable, authors ready to publish

=> Adoption call here? Try elsewhere?

Should 6MAN generalize RFC 8505 over foo*?

Backup

Other Things to Adjust



- Matching source IP to router
  - A must with radio mobility
    - E.g., car A attached to RSUs B & C
    - Each RSU enforcing SAVI for its prefix
    - Complies RFC 8028
  - Providing reachability back to a CoA based on its prefix
- Aggressive DNA (Detecting Network attachment)
  - Rapid discovery (advertisement interval option in RA)
  - Permanently assess reachability of DRL and prune rapidly
  - May reuse a GUA if come back within reg. lifetime