IPv6 over Wireless and Wireless ND (WiND)

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

Pascal Thubert
IETF 115
London
How to build an IID for autoconf: lots of work

• RFC 2464 (IPv6 / Eth) and 4291: Address Architecture
  • Defines IPv6 Addresses (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
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
• **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**

**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

**P2P**
The simplest subnet model congruent with IP Link
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-prefix-registration**
Extends RFC 8505 for prefixes

**draft-thubert-6lo-unicast-lookup**
Provides a 6LBR on the backbone to speed up DAD and lookup
Coexistence with classical ND
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