Architecture and Framework for IPv6 over Non-Broadcast Access

draft-ietf-6man-ipv6-over-wireless

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IPv6 ND Unmet Expectations

• IPv6 ND is designed for P2P and Transit Links
  • Wireless is mostly symmetrical and non-transitive
  • Requires extensions for NBMA, 30 years-old unmet promise

• IPv6 ND over MAC-layer transit emulation is not wireless/overlay friendly
  • E.g., over L2R, learning bridges, EVPN, Wi-Fi Infrastructure Mode
  • Broadcast intensive (no support for multicast) vs. BUM

• 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)
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
What happened since London?

Conditional Adoption

- Redesigned as an Architecture document, new author (MCR)
- Really 4 docs in one (problem, Architecture, framework, applicability)
Part 1) Problem statement (pervasive)

1. Introduction
2. Acronyms
3. Issues with IPv6 ND-Based Access
   3.1. IPv6 ND and ND-Proxies
   3.2. The case of Wireless
   3.3. The case of Overlays
   3.4. Power and Sustainability
   3.5. Security and Privacy
   3.6. More Middleboxes
   3.7. More Operational Issues
   3.8. Summary of Issues

- Lack of generally accepted definition and specs
- Broadcast issues
- Silent nodes / BUM
- Not just wasted spectrum
- Woodstock vs. real world
- Affecting the capability to evolve
Part 2) Architecture (decoupling L2 and L3)

- Decoupling is the core need and value
- Need to redefine and reposition L3 concepts vs. IPv4-based intuition
- Splitting the broadcast domain => routing inside the subnet
- Concept of SGP also central, proxy a limited alternative
- Thus, the new name “SND”
Part 3) Framework (leveraging WiND Design and RFCs)

Leveraging original WiND text in adopted document

- Which RFC does what
- GAP analysis?
Part 4) Applicability statement (also pervasive)

6. SND Applicability
   6.1. Case of LPWANs
   6.2. Case of Infrastructure IEEE std 802.11 BSS and ESS
   6.3. Case of Mesh Under Technologies
   6.4. Case of DMB radios
      6.4.1. Using IPv6 ND only
      6.4.2. Using Subnet ND
      6.4.3. Example: BLE and BLE Mesh
      6.4.4. Example: 6TiSCH
   7. Coexistence with IPv6 ND

LPWANs generally do not do any ND at all

IEEE 802.11 defines a proxy ARP fct

Inefficient flooding

Works / works not

RFC 8929 defines an ND proxy
**SubNet models**

1. **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

2. **Route-Over Mesh**
   - Subnet defined by membership
   - Needs not-onlink model and central router
   - Requires an IGP inside the subnet

3. **P2P**
   - The simplest subnet model congruent with IP Link

![Diagram](image)
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-prefix-registration**
Extends RFC 8505 for prefixes

**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
Backup