Benchmarking The Neighbor Discovery Protocol

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W. Cerveny
Arbor Networks
Ron Bonica & Reji Thomas
Juniper Networks
Motivation

• For IPv6, Neighbor Discovery (ND) replaces the Address Resolution Protocol (ARP)
  • IPv6 ND is based upon ICMPv6

• IPv4 subnetworks are typically numbered small address blocks
  • /24 contains 255 elements
  • ARP scaling is not an issue

• IPv6 subnetworks are always numbered from /64 or larger
  • /64 contains 18,446,744,073,709,551,616 elements
  • ND scaling is an issue
  • RFC 6583 demonstrates that a port scan can be fatal to a naïve ND implementation
Approach

• **Baseline Test**
  • Send a stream that does not stress ND through DUT
  • Every packet in stream carries the same destination address
  • No loss should be observed

• **Scaling**
  • Send a stream that stresses ND through the DUT
  • Stream is identical to baseline in every way except that it carries many destination addresses
  • Loss will be observed
Results

- **METRIC**: NDP-MAX-NEIGHBORS
  - How many addresses can the stream carry before loss is observed
- **Observation**: What happens when NDP-MAX-NEIGHBORS is exceeded
  - Implementation crashes?
  - New neighbors cannot be acquired, but connectivity to previously acquired neighbors remains stable?
  - New neighbors can be acquired, but connectivity to previously acquired neighbors is lost?
Scaling Test Procedure Details

• NDP configured with RFC 4861 defaults
• Counters (2 per destination address)
  • One on transmit interface, one on receive interface
  • Both reset on first receive (allow for initial packet loss)
• Test procedure
  • Start flow with single destination
  • Set N to 2
  • Until N is equal to \( \text{MAX-NDP-NEIGHBORS} \times 1.1 \)
    • Set timer
    • Add a destination to the flow
    • Wait for reception of first packet with new destination or timer to expire
• Counters reflect loss for each destination
Next Steps

• WG Last Call