IPv6 Packet Truncation

John Leddy, Comcast
Ron Bonica, Juniper Networks

IETF102 Montreal
Introduction

- IPv6 allows fragmentation at the source only
- Source nodes can either:
  - Refrain from sending packets whose length is greater than the IPv6 minimum MTU (1280 bytes)
  - Maintain a running estimate of the PMTU and refrain from sending packets whose length exceeds that estimate
- PMTU estimation tools
  - Path MTU Discovery (PMTUD)
  - Packetization Layer PMTUD (PLPMTUD)
How PMTUD Works

- Source produces initial PMTU estimate
  - MTU of first hop along the path to the destination
  - May be larger than actual PMTU
- Source sends packets
  - Never larger than PMTU estimate
  - Possibly larger than the actual PMTU
- When packet is larger than actual PMTU
  - Intermediate node discards the packet
  - Intermediate node sends an ICMP PTB to the source
- Source updates PMTU estimate
How PMTUD Breaks

- Network cannot deliver ICMP PTB message from intermediate node
  - Poorly implemented firewall filters
    - Example: The common home router bug
  - Intermediate node does not have a viable route to source
  - Anycast issues
- Source doesn’t update PMTU estimate
- Persistent black holes
New Procedures Required

- Upper-layer protocol marks selected packets as being Truncation Eligible
- When an intermediate node cannot forward a Truncation Eligible packet because of MTU
  - Truncates the packet
  - Marks the packet as being Truncated
  - Forwards the packet to its destination
- Destination node sends ICMP feedback to the source node
New IPv6 Destination Options

- Truncation Eligible option
  - Indicates that a packet is eligible for truncation
- Truncated Packet option
  - Indicates that a packet has been truncated and is eligible for further truncation
Truncation Eligible Option

- Option Type – Value TBD by IANA
  - Act bits specify destination behavior when the option is not recognized
    - Skip over the option and continue processing the packet
    - Value - 00
  - Chg bits indicate whether Option Data can be modified on route
    - Value not consequential. TBD by IANA.
- Opt Data Len MUST be equal to 0
Truncated Packet Option

- Option Type – Value TBD by IANA
  - Act bits specify destination behavior when the option is not recognized
    - Discard packet and send ICMP Parameter Problem message to source node
    - Value - 10
  - Chg bits indicate whether Option Data can be modified on route
    - Value not consequential. TBD by IANA.
- Opt Data Len MUST be equal to 0
Source Node Procedures

• Upper-layer protocol marks packets as being Truncation Eligible
  • Truncation Eligible option
Intermediate Node Procedures

- Intermediate node attempts to forward the packet and encounters an MTU issue
  - If the packet is eligible for truncation
    - Truncate the packet
    - Update the IPv6 Payload Length
    - Overwrite all instances of the Truncation Eligible with the Packet Truncated option
    - Forward the packet to its destination
  - If the packet is not eligible for truncation
    - Discard Packet and send ICMP PTB to source
Destination Node Procedures

- Destination Node receives a packet with Truncation Eligible option
  - Skip over the Truncation Eligible option and continue to process the packet
    - Do this regardless of whether the destination node recognizes the Truncation Eligible option
  - Deliver the packet to an upper-layer protocol
Destination Node
Procedures (continued)

- Destination Node receives packet with Truncated Packet option and recognizes it
  - Send an ICMP PTB to the source node
    - ICMP PTB MTU field reflects packet length
  - By default, discard the packet
    - However, upper-layer protocols can register for delivery of truncated packets
Destination Node Procedures (continued)

- Destination Node receives packet with Truncated Packet option and does not recognize it
  - Send an ICMP Parameter Problem message to the source node
    - ICMP Parameter Problem message contains initial bytes of the original packet, including length
  - Discard the packet
    - Regardless of whether the upper-layer protocol has registered for delivery of truncated packets
Benefits of Truncation

- Use Larger MTU’s
  - Fix PMTUD
  - Provide tools that upper-layer protocols can leverage so that the can more intelligently negotiate maximum packet sizes
Fixing PMTUD

- ICMP PTB messages from the destination node are more likely to reach the source than ICMP PTB messages from an intermediate node
- By emitting a single Truncation Eligible packet, the source node can learn the PMTU to a destination
  - This is because a packet can be truncated by multiple nodes along the path to the destination
Tools For Upper-Layers

- Upper-layer protocols can use metadata from truncated packets to infer PMTU information and to negotiate maximum segment sizes.
- Upper-layer protocols can use packets that are Truncation Eligible as probes.
Next Steps

- Present to TSVWG
  - Consider requests for additional option data (e.g., pre-truncation length)
- Adopt as 6man WG item
QUESTIONS / COMMENTS?