

# IPv6 Packet Truncation

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# 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 they 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?