Update for the IPPM Framework: Adding Support for IPv6 and IP Options

(IP Options and IPv6 Updates for IPPM's Active Metric Framework: Packets of Type-P and Standard-Formed Packets)

draft-ietf-ippm-2330-ipv6-01

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Background

- **The IPPM Framework (RFC2330)** identifies two **key prerequisites for valid measurements:**

1. **Valid measurement packets**
   - **“Standard-formed”** packets
   - “…all metric definitions … include an implicit assumption that the packet is *standard formed*”...
   - Explicit criteria catalogue
2. **Result may depend on measurement packet type**
   - Distinct treatment of measurement packets along the path
   - Abstract term: **packet of Type-P**
   - Measurement is representative for any type (Type-P) vs. result is valid for ICMP-packets-64-byte-payload

Motivation and History

- Any {RFC|draft|metric} that references **IPv6 is out of scope of the RFC2330 IPPM framework!**
  - RFC2330, sec. 15 "…includes a valid IP header: **the version field is 4** (later, we will expand this to include 6)"…

- **Trigger:** GEN-ART review of RFC 2679-bis

  Input by Brian Carpenter: **no IPv6 coverage**
  - RFC 2679-bis only vs. IPPM update
  - Decision for IPPM update
- **IPv6-support for IPPM "outsourced" to dedicated draft**
  - Precondition for –bis RFCs to pass GEN-ART and IESG review
  - More documents pending in the queue (active-passive, PDM, …)
  - Avoid replication: one document can do the update for all.

Status @IETF98

- **Adoption as IPPM WG item**, July 2016
- Extensive comments from Fred Baker and Marius Georgescu:
- Extension Headers covered in Type-P and Standard Formed packet sections
- Load balancer as an example of Class C (equal treatment)
- Examples where Type-P *changes from Src to Dst.
- IP address family coexistance means more circumstances to discuss (v4 v6 transition).
  - Major new section covers NAT, v4v6, Header Compression

Status @IETF98

- Discussion needed
  - Handling of large packets in IPv6 (including fragment extension headers, PMTUD, PLMTUD),
  - Extent of coverage for 6LO and IPv6 Header Compression, and
  - The continued need to define a "minimal standard-formed packet".
  - IPv6 header treatment in intermediate nodes
- Concluding that, WGLC…

Handling of large packets in IPv6

- Path MTU Discovery (PMTUD)
- Packetization Layer Path MTU Discovery (PLMTUD)
- **Adopt RFC2330 IPV4 fragment handling procedure for IPv6 fragments, too**
  - Fragments are NOT standard formed
  - Use of non-fragmented packets for measurements only.
  - Scope of IPPM framework metrics excludes fragmented IP(v4) packets.
  - Accepting IPv6 fragments would mean reviewing and updating **ALL** existing metrics

6lo and IPv6 Header Compression

- If we do not include them explicitly, 6lo and ROHC IPv6 packets are out of scope of the IPPM (like IPv6 is right now).
- 6lo and IPv6 HC rely on state to be stored in gateway nodes (ingress, egress)
  - 6lo and ROHC modify Type-P
  - Distinct MTUs, physical-layer support, encryption,…
  - IPv6 addresses mapped to 6LoWPAN addressing scheme
    - No source, destination IPv6 addresses available
- Conclusion: 6LoWPAN for further study
  - **Considered out of scope for this draft**
  - No more work

Minimal Standard-Formed Packet

- **Definition** of minimal standard-formed packet
  „A particular type of standard-formed packet often useful to consider is the "minimal IP packet from A to B" - this is an IP packet with the following properties:
  - *It is standard-formed.*
  - *Its data payload is 0 octets.*
  - *It contains no options."*
  - "*Note that we do not define its protocol field…"*
- **Who has used this definition?**
  - Practical use (router handling of „undefined" protocol?)
  - IANA allocation: „no transport header"?
- Proposal: **remove** definition of **minimal standard-formed packet** for IPv4 and IPv6

IPv6 Extension Header Treatment

- IPv6 extension header treatment in intermediate nodes
  - Subject to discussions in v6ops
- Inspection/addition/removal of extension headers useful in the context of IPPM
  - Restricted to closed (enterprise) segments?
  - In-situ OAM (ioam)
- Challenges:
  - Extension header modifications change Type-P
  - Treatment in subsequent nodes (Segment routing?)
- **Proposal: allow**, point out challenges/drawbacks

Status and Next Steps

- Proposals (solutions) presented for all open topics.
- Asking for WG and list feedback on proposals
- Integrate changes into document.
- Following: draft ready for WGLC.

BACKUP

Recap RFC 2330 Definitions: Type-P

RFC 2330, Sec. 13:

- "A fundamental property of many Internet metrics is that the **value of the metric depends on the type of IP packet(s)** used to make the measurement…"
- …"Whenever a metric's value depends on the type of the packets involved in the metric, the **metric's name will include either a specific type or a phrase such as "type-P".**
- …"**Generic notion of a "packet of Type-P"…**
  - Fully defined (port-http-tcp-connectivity-50byte-payload)
  - Partially defined (UDP packet)
  - Generic (Type-P)
- **Type-P becomes part of any metric definition**
  - Example: Define "*IP-Type-P-connectivity*" metric instead of "*IP- connectivity*" metric

RFC 2330 **Update**: Type-P

- Mention **special treatment of packets**
  - Diffserv, ECN, Router alert, extension headers, …
- Identify case when **Type-P changes along the path**
  - Type and length changes because of IPv4 <-> IPv6 translation, or IPv6 extension headers adding or removal
  - Modified values SHOULD be noted and reported with the results
- Discuss possible **impact of NAT** along path
  - Unpredictable impact on delay
  - Stateful NAT: state created on first packet: delay penalty
- RFC2330 Note: **class C equivalence** for path (MAP RG!)
  - …"it would be very useful to know if a given Internet component treats equally a class C of different types of packets. If so, then any one of those types of packets can be used for subsequent measurement of the component. This suggests we devise a metric or suite of metrics that attempt to determine C."

Recap RFC 2330 Definitions: Std-Formed

RFC 2330, Sec. 14:

- "…all **metric definitions** … include an **implicit assumption that the packet is *standard formed*"...**
- "…a packet is standard formed if it meets all of the following **criteria**:…"
  - Length (IP header) = sizeof (IP header) + sizeof(payload)
  - Valid IP header: "**version field is 4 (later, we will expand this to include 6)**" (quote RFC2330!)
  - Header length >= 5, checksum is correct, no IP fragment.
  - Src and dest addr. correspond to the hosts in question.
  - TTL sufficiently large or 255
  - No IP options unless explicitly noted.
  - If transport header is present: valid checksum and fields.
  - Length B: 0 <= B <= 65535 …

RFC 2330 **Update**: Std-Formed Packet

- **IPv4 and IPv6** allowed
- Basic requirements (aggregated IPv4 and IPv6):
  - Valid IP header
  - Not an IP fragment.
  - Source and Destination addresses intended.
  - Transport header: valid checksum and valid fields
- Separate discussion of IPv4 and IPv6
  - IPv4 unchanged
- IPv6
  - Version field 6, total length including extension headers
  - Extension headers: none or correct types and correct order, extension header parameters conforming with IANA
  - Note controversies (RFCs 6564 and 7045) : intermediate nodes inspect/add/delete/change IPv6 extension headers

Next Steps

- **Urgent need to update IPPM for IPv6**
  - RFCs and documents in queue depend on it!
  - Draft scope and structure is stable
  - Feedback and Input requested

- **Call for adoption as IPPM WG item.**

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