Saving Extension Headers

IPv6 extension headers

- Goal: extensible networking layer protocol
- Precursor: IPv4 options
  - IPv4 had IPv4 Options as part of the header
  - Pretty quickly people realized IPv4 Options weren't an option
- IPv6 was a chance for a do over
  - Define extension headers that are place between IPv6 header and transport layer header
  - Fragmentation, Authentication, Encryption headers (latter two backported to IPv4)
  - Hop-by-Hop Options: optional data in options processed by intermediate nodes
  - Destination Options: optional data in options processed by destination*
  - Routing Header: list of intermediate nodes to visit (e.g. SRv6)

So what's the problem

- Deployment of extension headers is underwhelming :-(
  - Observations on the Dropping of Packets with IPv6 Extension Headers in the Real World (RFC7872)
  - Operational Implications of IPv6 Packets with Extension Headers (RFC 9098)
- "Chicken and the egg" problem
  - Operators drop EH because there's not useful options defined
  - Developers can develop new options because they'll just be dropped
- Size matters!
  - Long extension headers exhibit higher drop rates than short ones
  - Likely do to parsing buffer being exceeded in routers that want to filter L4 ports
- Implementation issues
  - Easy to find bugs with EH especially with protocol specific hardware offloads
  - API is difficult to use, must have root privileges
  - Obvious DoS attack vector with current model (HW and SW implementations)

Fixing extension headers

- Addressing deficiencies in the protocol specifications in IETF
  - HBH Options processing draft (not every router needs to process HBH)
  - Extension header limits draft (e.g. default limit of header chain to 128 bytes)
- Interesting use cases
  - Host-to-network signaling, Network-to-host signaling
  - SRv6, IOAM, QoS, fragmentation, telemetry, congestion reporting
- Fix (kernel) implementation
  - Checksum offload is pretty buggy with EH
  - Patch set to revamp user API
  - Apply extension header limits

Thanks!