IPv6 Traffic% and Packet Loss Rate – An Update

HotRFC Talk, IETF 118

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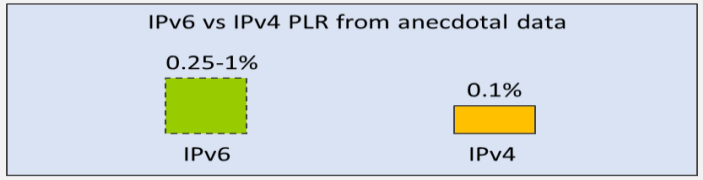
What We've Learned after the Previous Talk

Then

- Reported 2 problems in HotRFC Talk 117
  - IPv6 traffic% = IPv6 user% * IPv6 content% * IPv6 connectivity%
    = 41% * 67% * 100% = **27%**
    greatly exceeding reported traffic% below

IETF 117	Traffic %	Date	Source
AMS-IX	5.0%	2023 07	https://stats.ams-ix.net/sflow/ether_type.html
Akamai	16.4%	2022 06	Value derived combining two independent posts

- IPv6 PLR (packet loss rate) much higher than IPv4 PLR

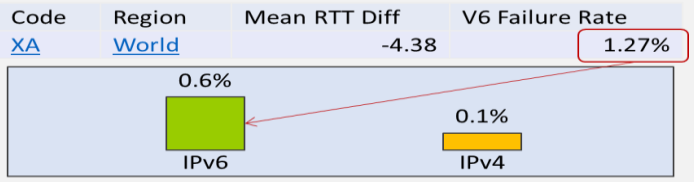


Now

- IXP IPv6 traffic% not including CDN → not representative
- Traffic% available: FB, China-IPv6, Cloudflare
- User% available: Google, APNIC, Akamai
- Stats may not be what are claimed (i.e. is it traffic% or user% or connection%)
- What matters is IPv6-usability% = IPv6 traffic% / (IPv6 user% * IPv6 content%)
  - If IPv6 equally usable as IPv4, then IPv6 traffic% = IPv6 user% * IPv6 content% → IPv6-usability%=100%
  - If IPv6-usability% > 100%, IPv6 more usable than IPv4
  - If IPv6-usability% < 100%, IPv6 less usable than IPv4
  - Anecdotal IPv6-usability calculated from a single company stats for Dual-Stack content (with caveats, please take with grain of salt, contact author for full disclosure)

	World	USA	Canada	Germany	UK	Australia	NZ	India	Indonesia	South Africa	Egypt	Argentina	Brazil
Traffic%	37%	60%	41%	56%	36%	35%	31%	69%	13%	1.70%	4%	18%	48%
User%	41%	48%	37%	73%	44%	29%	20%	71%	15%	1.50%	5%	20%	48%
Content%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
IPv6-usability%	90%	125%	111%	77%	82%	121%	155%	97%	87%	113%	80%	90%	100%

- IPv6 PLR (packet loss rate) ~0.6%, derived from TCP failure rate of 1.27% (involving 2 packets) reported by APNIC, 6x of IPv4 PLR, clearer indicator of connectivity problem



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More on What We Learned, and What Problems Remain

Learned

- IPv6 requirements on residential CPEs dated – v6ops will update CPE requirement RFC 7084
- ISP deployment of IPv6 is mostly in overlay not so much in underlay
- BCP for enterprise IPv6 deployment is needed – please contribute
- Networks in vertical industries are far from using IPv6 – many applications & devices not supporting IPv6
- Maybe more productive to focus on “Converting Residual IPv4” than on IPv6

Problems

- At 0.6%, IPv6 PLR is 6x of IPv4’s
- The reasons for high IPv6 PLR (presented in IETF 117) are still relevant
  - Packet drop with EHs,
  - NCE exhaustion causing packet drop
  - Rate limiting to prevent /64 scanning causing NCE exhaustion
  - Long headers causing congestion/drop at mobile backhaul links
  - Fragmentation-related drops
  - Flash renumbering-related drops
  - Note: Firewall/middleboxes may create PLR asymmetricity between clients/servers
- Does high IPv6 PLR imply some IPv6 issues not yet known?
  - Possibly. Please join Nalini Elkins’ talk at v6 side meeting (Thur Nov. 9, 9:30-11:00)

We will Continuously Improve IPv6 Operations. Please Contribute

- Do you agree: IPv6-usability% = IPv6 traffic% / (IPv6 user% * IPv6 content%) is good for comparing IPv6 with IPv4?
- Provide IPv6 traffic stats from operators & enterprises
- Measure IPv6 PLR in various scenarios
  - Inside enterprise & operator's AS, at IXPs, at content providers
  - Identify root causes of high IPv6 PLR
- Co-author drafts about issues and solutions
  - One theory: is IPv6 PLR mostly from transit points & FW/middle boxes? What can be done to prove/disprove that?
- Help to convert "Residual IPv4"
  - Residual IPv4 users & content – we know where they are but what can be done?
  - Many IPv4 residuals in vertical industries (e.g. railways). Call for people with vertical domain knowledge to contribute

Disclaimer: IPv6 has shorter latency and other benefits over IPv4, but this talk focuses on the issues so as to improve