Measuring the Effectiveness of Happy Eyeballs

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getaddrinfo(...) behavior:
- returns list of endpoints in an order that prioritizes IPv6 upgrade path
- order is dictated by [RFC 6724] and /etc/gai.conf
- if IPv6 is broken, application is unresponsive in order of seconds

getaddrinfo(...) preference:
1) native IPv6 routes
   ...
2) native IPv4 routes
   ...
3) IPv4-IPv6 Transitioning routes
motivation

happy eyeballs algorithm [RFC 6555]:

- initiate a TCP connect(...) with the first endpoint, give it 300ms
- switch over with a TCP connect(...) to a different address family otherwise
- the competition runs fair after 300ms

does the algorithm help improve the user experience?
developed a simple TCP happy eyeballs [RFC 6555] probing tool

uses getaddrinfo(...) to resolve service names to endpoints
uses non-blocking connect(...) to connect to all endpoints of a service
uses a short-delay between connection attempts to avoid SYN floods
the service name resolution time is not accounted in the output
can produce either human-readable or machine-readable output
file locking capability

>> ./happy -q 1 -m www.google.com www.facebook.com
HAPPY.0;1360681039;OK;www.google.com;80;173.194.69.105;8626
HAPPY.0;1360681039;OK;www.google.com;80;2a00:1450:4008:c01::69;8884
HAPPY.0;1360681039;OK;www.facebook.com;80;2a03:2880:10:6f01:face:b00c::8;170855
HAPPY.0;1360681039;OK;www.facebook.com;80;31.13.72.39;26665
measurement trials

- dual-stacked web service name list:
  - HE.net maintains a list of top 100 dual-stacked service names
  - they use 1M service names from Alexa Top Sites
  - some domains we expect are missing from the list
  - some services only provide a IPv6 endpoint on prepending a www
  - HE.net does not follow CNAMEs (for e.g. wikipedia.org)
  - Amazon has made 1M service name list public
  - we use it and script it ourselves to explicitly follow CNAMEs

- measurement agents:
  - native IPv6, 6in4, Teredo, IPv6 tunnel broker endpoints, native IPv4
  - located at Bremen, Amsterdam, Braunschweig

- measurement cycle length:
  - 1 month
how does IPv6 compare in performance to IPv4?
TCP connection establishment times

Native IPv6 [Bremen]

IPv4 connectivity via DFN [AS 680]
IPv6 connectivity via DFN [AS 680]

Native IPv6 [Braunschweig]

IPv4 connectivity via Gaertner Datensystems [AS24956]
IPv6 connectivity via Gaertner Datensystems [AS24956]
to what extent is IPv6 preferred when connecting to a dual-stacked service?
IPv6 preference levels

Native IPv6 [Bremen]

- IPv4 connectivity via DFN [AS 680]
- IPv6 connectivity via DFN [AS 680]

Teredo IPv6 [Amsterdam]

- IPv4 connectivity via LambdaNet Communications
- IPv6 connectivity via Teredo
how slow is a happy eyeballed winner to that of a loser?
winner slowness to loser

Native IPv6 [Bremen]

IPv4 connectivity via DFN [AS 680]
IPv6 connectivity via DFN [AS 680]

Native IPv6 [Braunschweig]

IPv4 connectivity via DFN [AS 680]
IPv6 connectivity via DFN [AS 680]
what are repercussions of reducing the IPv6 advantage from 300ms to 10ms
happy eyeballs advantage: 10ms

Native IPv6 [Bremen]

IPv4 connectivity via Deutsche Telekom AG [AS3320]
IPv6 connectivity via Deutsche Telekom AG [AS3320]

Native IPv6 [Bremen]

IPv4 connectivity via Deutsche Telekom AG [AS3320]
IPv6 connectivity via Deutsche Telekom AG [AS3320]
conclusion

- higher connection times and variations over IPv6
- will never use Teredo IPv6 unless IPv4 connectivity is broken
- 300ms advantage leaves 1% chance to prefer IPv4 (even though faster)
- IPv6 happy eyeballed winner is rarely faster than IPv4 route
- 10ms advantage helps remove outliers where IPv6 connectivity is bad

request:
- happy must be run from a wider standpoint to get a more comprehensive picture
- looking for hosts with native IPv6 connectivity to host our happy test.
- send me your shipment address*, and we ship you a SamKnows probe.

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