

IPv4 / IPv6 Performance Measurement Panel

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The Environment

We use Google Ads to deliver test scripts to a very broad cross-section of Internet Users

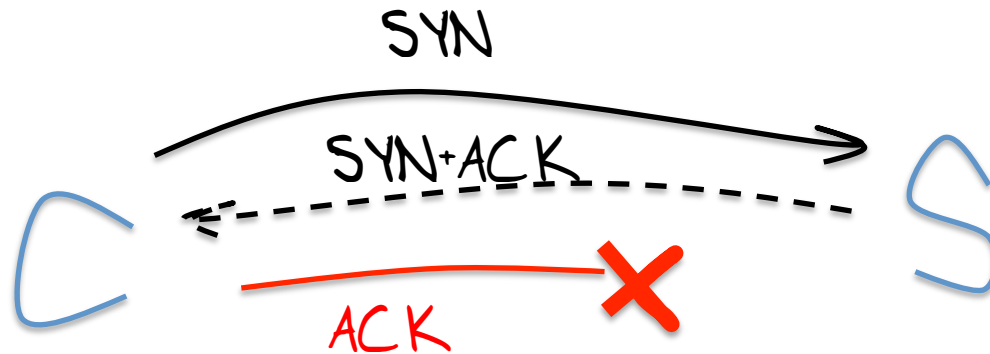
- We use a script that requests dual-stack end clients to fetch unique V6 and a V4 URLs from our servers

(servers located in the US, Germany and Australia)

- We have some 300,000 - 400,000 ads delivered per day
- We packet dump all activity on the server

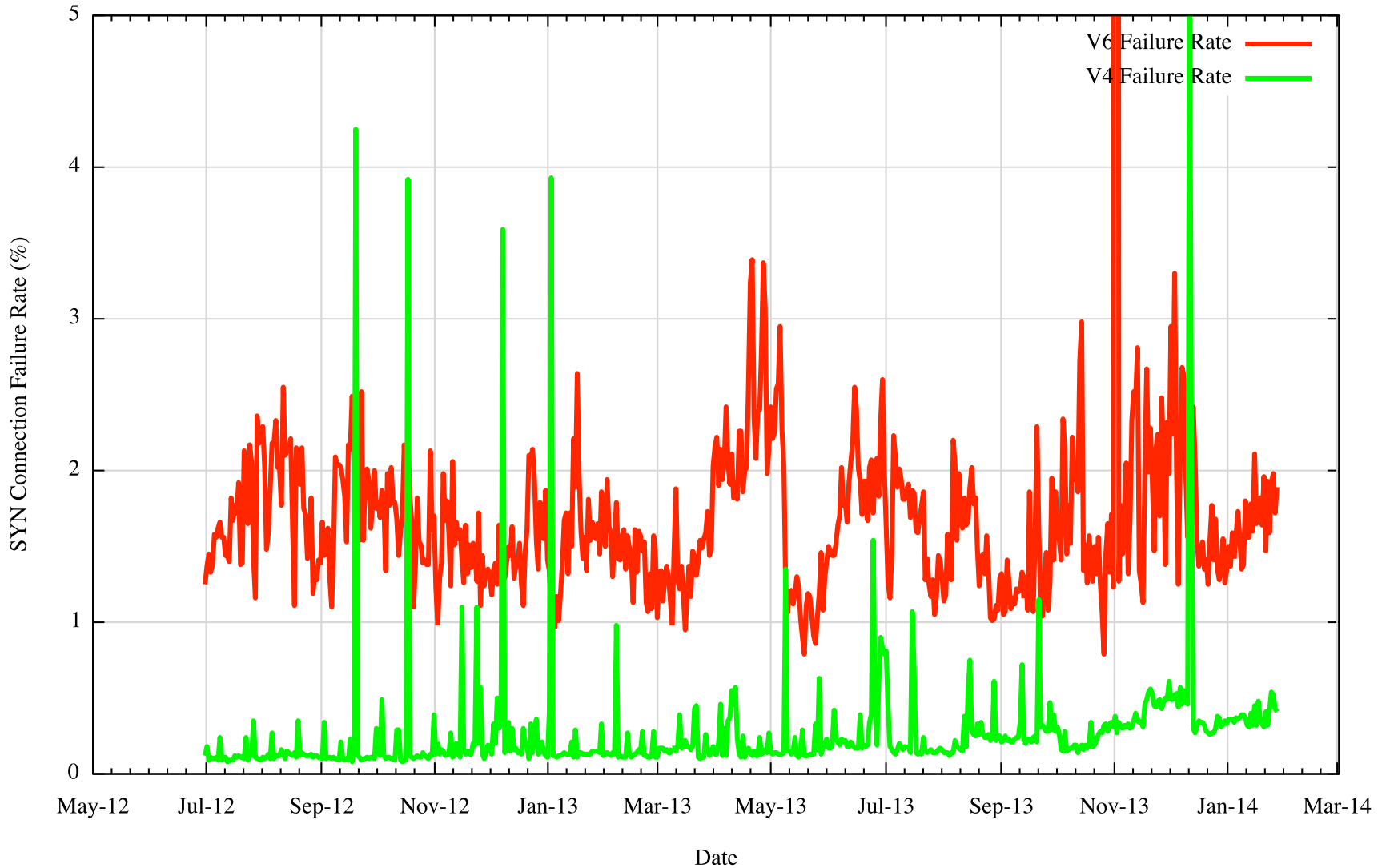
Connection Reliability

Looking at the TCP handshake, what proportion of IPv6 clients send us a SYN, but no following ACK?



Connection Reliability

Relative TCP Connection Failure Rates V6 vs V4



Connection Reliability

IPv4 failure rate: 0.1% - 0.3%

IPv6 failure rate: 1.2 – 2.1%

This appears to indicate that a visible proportion of IPv6-capable end user devices are located behind firewall/filter setups that deny incoming IPv6 packets

IPv6 Connection Failure Rate by Origin AS

This table looks at the origin AS's with more than 20 sample points – these are the origin AS's with the highest failure rates

AS	Samples	Failure Rate (%)	AS Name
14210	22	95.45	EDGECAST-DCA - EdgeCast Networks, Inc. US
132497	295	78.64	DNA-AS-AP SMARTLINK BROADBAND SERVICES PVT LTD IN
55680	53	75.47	KSI-UAJY-AS-ID Kantor Sistem Informasi Universitas Atma Jaya Yogyakarta ID
198864	341	75.37	QMW-AC-UK Queen Mary and Westfield College, University of London GB
18106	45	73.33	VIEWQWEST-SG-AP Viewqwest Pte Ltd SG
25592	51	62.75	NETIS-AS NETIS TELECOM Inc. Yaroslavl region ISP provider Russia RU
2856	27	59.26	BT-UK-AS BTnet UK Regional network GB
17660	141	58.16	DRUKNET-AS DrukNet ISP BT
22773	33	57.58	ASN-CXA-ALL-CCI-22773-RDC - Cox Communications Inc. US
17705	37	51.35	INSPIRENET-AS-AP InSPire Net Ltd NZ
55947	128	46.09	BBNL-IN Bangalore Broadband Network Pvt Ltd IN
4755	175	43.43	TATACOMM-AS TATA Communications formerly VSNL is Leading ISP IN
278	45	40.00	Universidad Nacional Autonoma de Mexico MX
53187	28	35.71	UNIVERSIDADE ESTADUAL DE CAMPINAS BR
23148	108	27.78	TERREMARK Terremark US
1930	4808	25.21	RCCN Rede Ciencia Tecnologia e Sociedade (RCTS) PT
10429	60	25.00	Telefonica Data S.A. BR
17832	73	23.29	SIXNGIX-AS-KR Korea Internet Security Agency KR
45133	39	23.08	SINGAPORE-POLYTECHNIC-AS-AP Singapore Polytechnic SG
21366	50	22.00	KYMP KYMP OY FI

IPv6 Connection Failure Rate by Origin AS

This table looks at the origin AS's where we have the highest number of samples

AS	Samples	Failure Rate (%)	AS Name
786	458,143	1.22	JANET JISC Collections And Janet Limited GB
15169	106,221	0.08	GOOGLE - Google Inc. US
8708	75,393	5.70	RCS-RDS RCS & RDS SA RO
7922	57,659	1.84	COMCAST-7922 - Comcast Cable Communications, Inc. US
7018	50,489	1.22	ATT-INTERNET4 - AT&T Services, Inc. US
2516	50,358	0.16	KDDI KDDI CORPORATION JP
12322	38,125	5.02	PROXAD Free SAS FR
6147	32,512	1.75	Telefonica del Peru S.A.A. PE
22394	27,237	0.34	CELLCO - Cellco Partnership DBA Verizon Wireless US
23910	23,372	2.98	CNGI-CERNET2-AS-AP China Next Generation Internet CERNET2 CN
4739	19,398	0.77	INTERNODE-AS Internode Pty Ltd AU
3303	17,319	4.45	SWISSCOM Swisscom (Switzerland) Ltd CH
4773	13,963	0.57	MOBILEONELTD-AS-AP MobileOne Ltd. Internet Service Provider Singapore SG
19782	8,172	0.06	INDIANAGIGAPOP - Indiana University US
7575	7,863	3.84	AARNET-AS-AP Australian Academic and Research Network (AARNet) AU

IPv6 Connection Failure Rate for US + CA Nets

AS	Samples	Failure Rate (%)	AS Name
14210	22	95.45	EDGECAST-DCA - EdgeCast Networks, Inc. US
22773	33	57.58	ASN-CXA-ALL-CCI-22773-RDC - Cox Communications Inc. US
23148	108	27.78	TERREMARK Terremark US
237	265	21.13	MERIT-AS-14 - Merit Network Inc. US
5707	24	20.83	UTHSC-H - The University of Texas Health Science Center at Houston US
812	1139	17.12	ROGERS-CABLE - Rogers Cable Communications Inc. CA
11351	471	15.50	RR-NYSREGION-ASN-01 - Time Warner Cable Internet LLC US
2055	325	14.46	LSU-1 - Louisiana State University US
174	25	12.00	COGENT Cogent/PSI US
12271	1850	11.24	SCRR-12271 - Time Warner Cable Internet LLC US
11426	209	9.09	SCRR-11426 - Time Warner Cable Internet LLC US
1312	527	8.54	VA-TECH-AS - Virginia Polytechnic Institute and State Univ. US
10796	669	7.77	SCRR-10796 - Time Warner Cable Internet LLC US
1280	97	6.19	ISC-AS1280 Internet Systems Consortium, Inc. US
11427	2102	4.52	SCRR-11427 - Time Warner Cable Internet LLC US
3356	316	4.43	LEVEL3 Level 3 Communications US
12222	24	4.17	AS12222 Akamai Technologies US
20001	4505	3.26	ROADRUNNER-WEST - Time Warner Cable Internet LLC US
6939	4592	3.11	HURRICANE - Hurricane Electric, Inc. US
33522	37	2.70	CPANEL-INC - cPanel, Inc. US

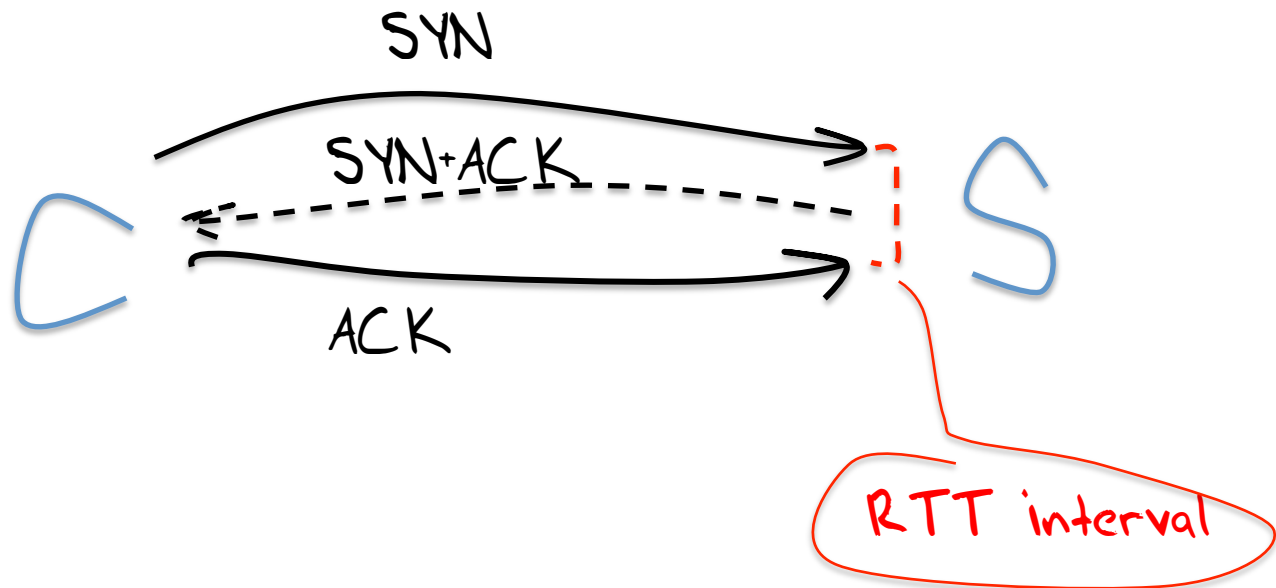
RTT Measurements

Data performance is highly dependent on the RTT across the data connection

Is IPv6 faster or slower than IPv4 in terms of an RTT comparison?

RTT Estimate

Measuring the time interval for the completion of the TCP handshake



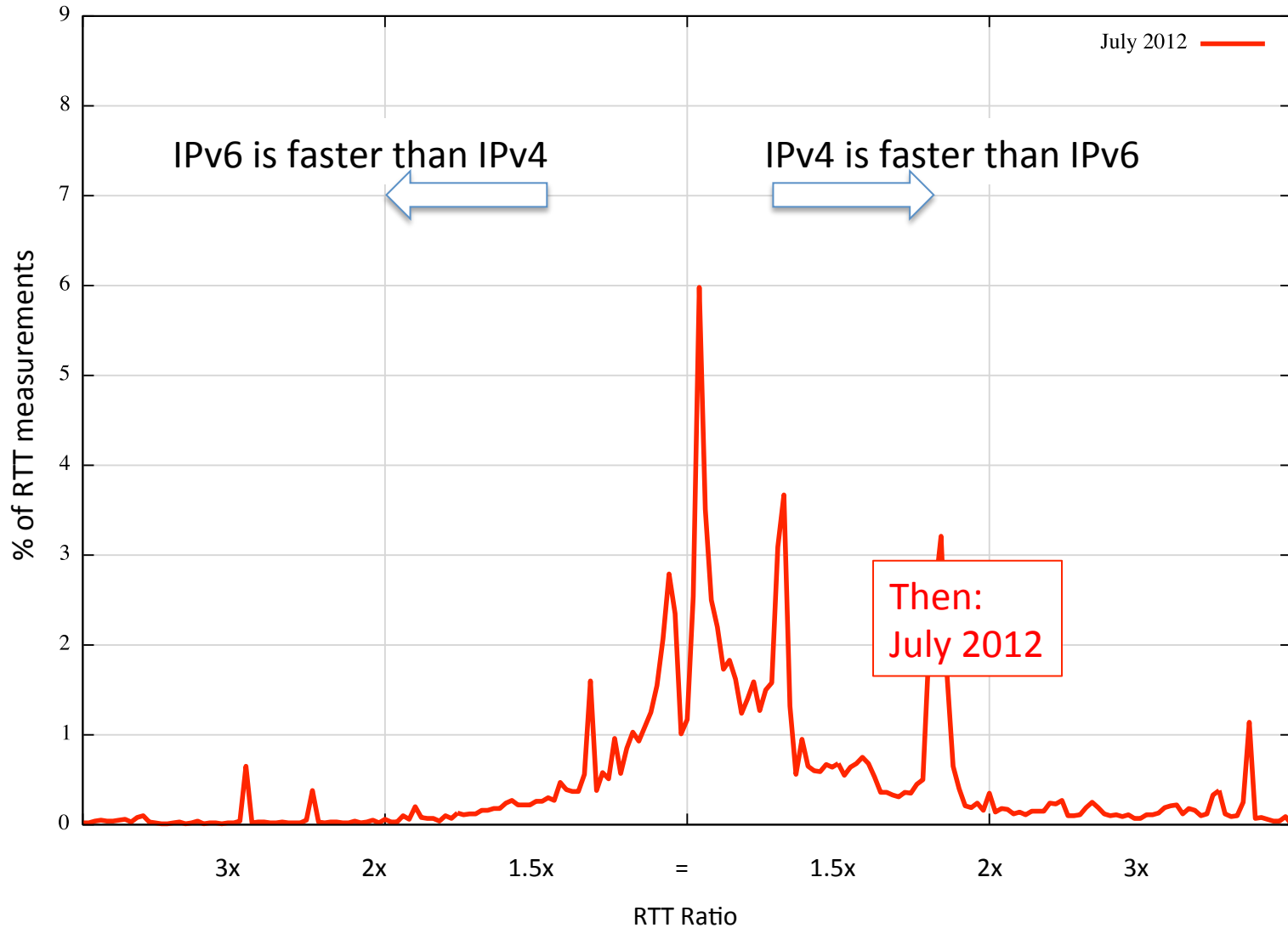
Paired RTT Distribution

Take the TCP handshake and measure the elapsed time at the server between the initial SYN and the following ACK packet

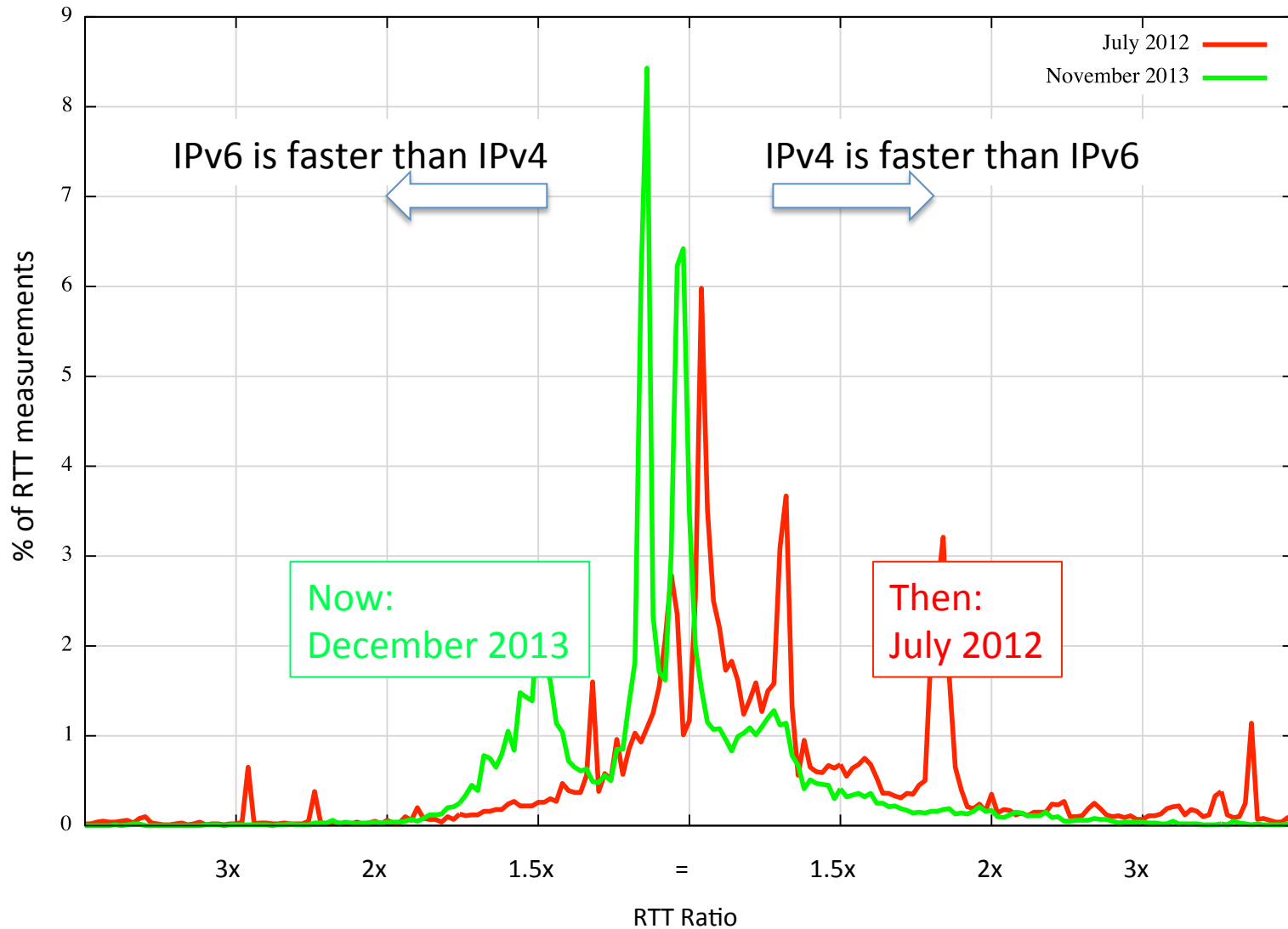
- this time value is an indicator of the RTT

Take the measurements where we have web log evidence that the IPv4 and IPv6 addresses correspond to a single experiment, and generate a ratio of the two RTT values

Paired RTT Distribution



Paired RTT Distribution



RTT Distribution

- There is a slight change in the RTT distributions over the past 12 months favoring IPv6 being slightly faster than IPv4
 - This could be due to different network paths between IPv4 and IPv6
 - Or less deployment of port 80 trapping middleware in IPv6 as compared to IPv4