



IPv6 at RIPE NCC

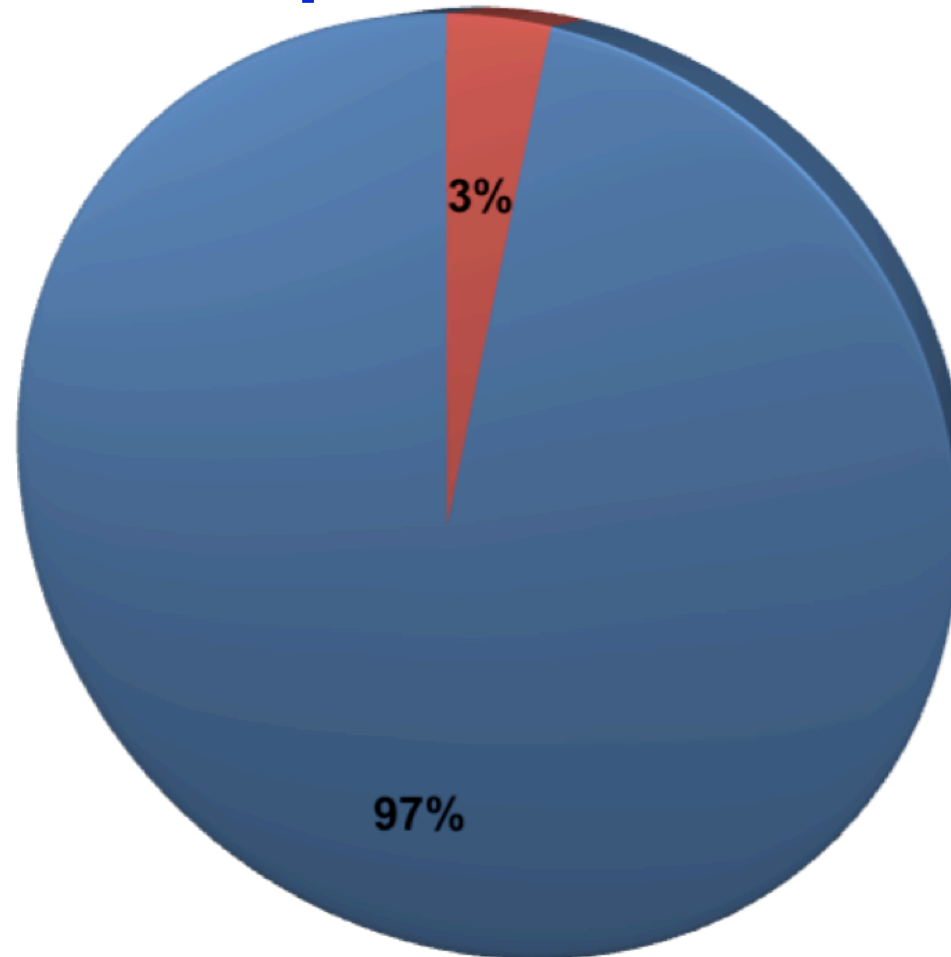
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We like statistics



People at this meeting who have seen this presentation before



● Has seen before ● Has not seen before



**At the RIPE NCC
IPv6
is very important**



2001:610:240:40::104



RIPE NCC services without support for IPv6



RIPE NCC services without IPv6

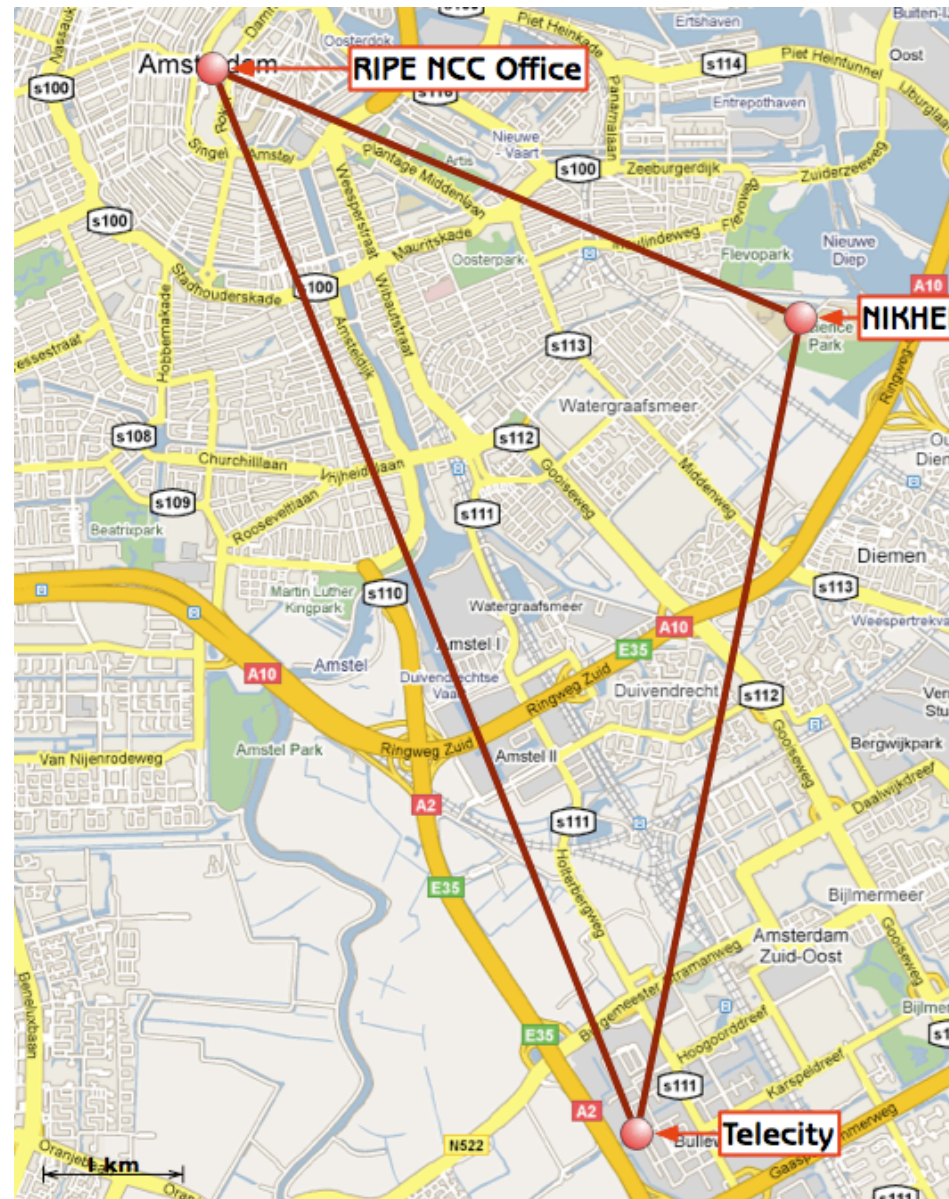
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The Network - Background

- The RIPE NCC network connects three locations in Amsterdam using Gigabit Ethernet over dark fibre:
 - The Office (Singel 258)
 - NIKHEF (Kruislaan 409)
 - Telecity (Kuiperbergweg 13)
- AMS-IX connection at NIKHEF and Telecity
- Switched layer 2 network carrying multiple VLANs

The Network - Background





RIPE NCC network

- /42 IPv6 Assignment from SURFnet since 2002
- L2 switching with Foundry switches
- Routing on Juniper M7i's
- Cluster of Juniper Netscreen ISG2000 firewalls
- IPv6 to the M7i's
 - using the same (Gigabit) AMS-IX connections as for IPv4
- Open peering policy at the AMS-IX
 - 1:3 IPv6 to IPv4 peer ratio



The Network - What Happened?

- IPv4 support remains robust and reliable
- IPv6 support was good on the Juniper routers
 - lacked some features (e.g. VRRP)
 - we were used to having this with IPv4
 - subsequent JunOS releases have fixed these issues
- IPv6 support on the Netscreen firewalls
 - could have been better ...



The Firewalls (1)

- “Full dual-stack support” in ScreenOS 5.4.0
 - does not mean it is reliable
 - does mean that we can open cases with Juniper
- One main problem initially:
 - firewalls would stop passing any IPv6 traffic
 - requiring a reboot to recover...
 - debugged with Juniper
 - patched version of ScreenOS



The Firewalls (2)

- Juniper provided a patch
 - ScreenOS 6.2.0r1cu3.0
- Experience
 - firewall would now crash
 - causing a transparent failover
 - IPv6 stopped working
- Result
 - better... but still not entirely satisfactory



The Firewalls (3)

- More debugging with Juniper..
 - ScreenOS 6.2.0r1cu4.0 installed in Jan 09
 - All fine since then...



Load Balancers

- Load balancers for some service
 - running on a cluster of F5 BigIP 3400s
 - could originally only do v6-to-v4 proxy for IPv6
- Recent software updates
 - full IPv4 and IPv6 load balancing
- We still do some v6-to-v4 proxying



Server Infrastructure

- Most servers run Linux:
 - Slackware
 - Debian
 - CentOS
- Some other operating systems for particular roles
- Your milage with these systems and IPv6 will vary



Router Advertisements, etc.

- Handling of RA's (or the lack thereof)
 - various issues with different system OSes
 - most accept the link-local address of the router as a default gateway
 - others need to have the global IPv6 address of the gateway statically configured
- A case of trial and error
 - depends on OS, kernel, etc



Router Advertisements, etc.

- RAs enabled from routers/firewalls
- For service LANs:
 - “Managed address configuration” bit set
 - Some OSes ignore this and have to be configured to ignore RAs
- Office LANs
 - Workstations get configured using stateless auto-configuration



IPv6 at RIPE meetings



IPv6 at RIPE Meetings

- Two Juniper J2320 routers
 - Provide resilient dual-stack network
 - Also a couple of older Cisco routers for other purposes
- IPv6 connectivity depends on the meeting location
 - most hosts can now offer native IPv6 connectivity
 - contingency: tunnel back to Amsterdam



IPv6 at RIPE Meetings

- IPv6 Experiment at RIPE 56 in Berlin
 - In May 2008
 - Two IPv6-only networks
 - Experiment and demonstration of NAT-PT and DNS-ALG

- One hour where wireless had no IPv4



Building an IPv6-Only Network

- Three Options:
 - IPv6-only with no transition mechanisms
 - Only those parts of the Internet which have transitioned to IPv6 are accessible
 - No access to IPv4-only sites
 - Not particularly interesting
 - IPv6-only with NAT-PT and DNS ALG
 - For everything except Windows XP
 - IPv6, local IPv4-based resolver and NAT-PT and DNS ALG
 - Just for Windows XP
- For RIPE 56 (Berlin) we built the last two



NAT-PT and DNS-ALG experiences

- Setup took:
 - 20 hours of hard work
 - Two experienced network engineers
 - One Cisco engineer with access to the developers of the implementation
 - Careful match of settings and software version
- But it worked!
- With about 4Mbps, cpu load on C7301 went to 10%



DNS ALG

- Doesn't work if an application forces an IPv4 or IPv6 transport
 - ping/ping6
 - traceroute/traceroute6
- The usual NAT problems...
 - protocols which embed IP addresses
 - need some additional form of proxy for these



Various services



Services (1)

- Web
 - Straight forward Apache2 installation
 - About 3% of connections come over IPv6
- Email
 - Supported with “off the shelf” packages
- FTP
 - Firewall issues with Extended Passive Mode and IPv6
 - Resolved in the latest ScreenOS releases



Services (2)

- LIR Portal
 - IPv6 proxy on load balancers
- RIPE database
 - Native IPv6
 - Average of ~7500 queries per minute
 - ~21 queries per minute over IPv6: about 0.27 %



DNS



DNS services

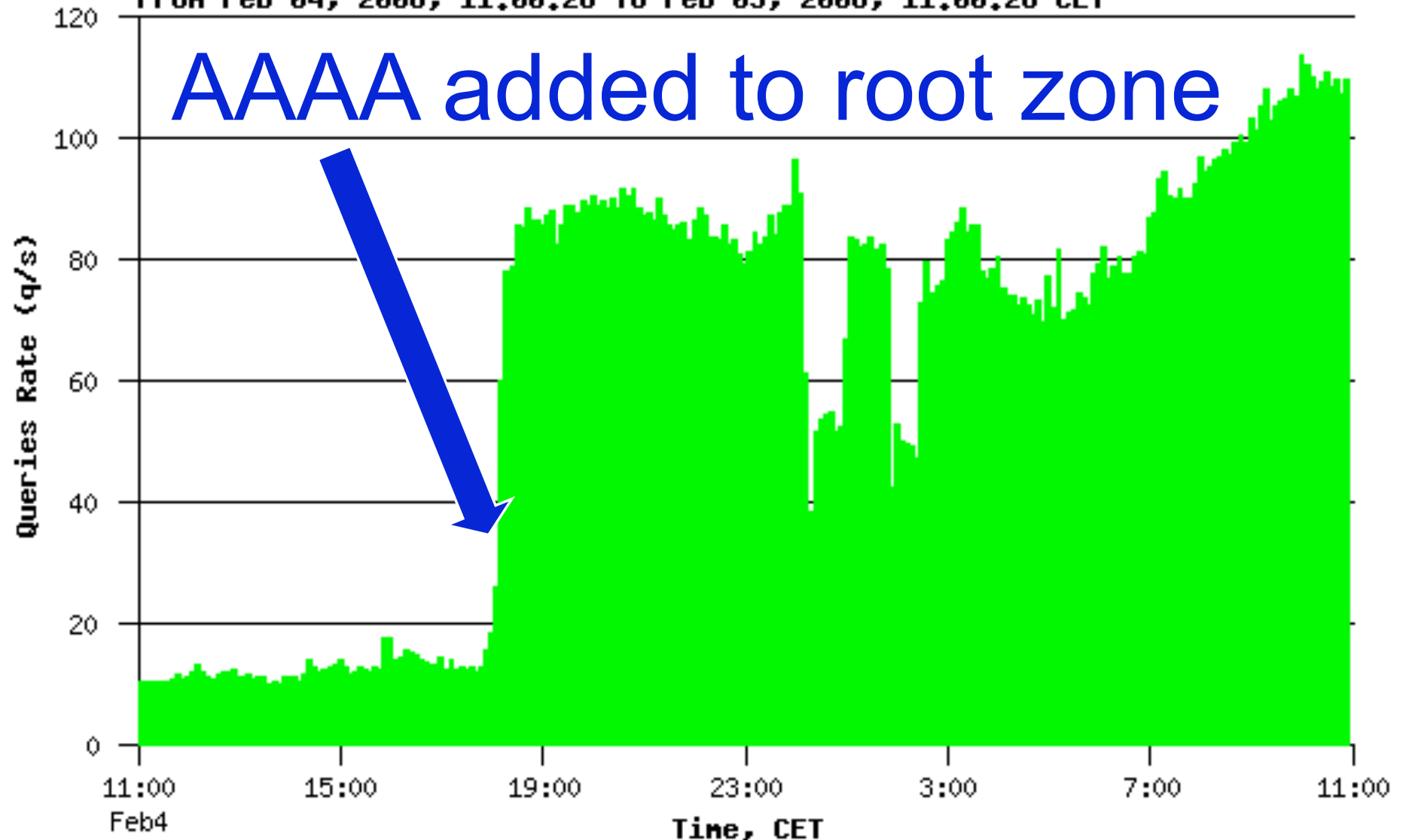
- K-root server:
 - AAAA for k-root in root zone since Feb 2008
 - 1% of queries come over IPv6
 - 25% of queries is for AAAA
 - 10 anycast nodes with IPv6
- Reverse delegation:
 - Authoritative for /8s administered by RIPE NCC
 - Delegates down to holders of IP space
 - Also 1% of queries over IPv6



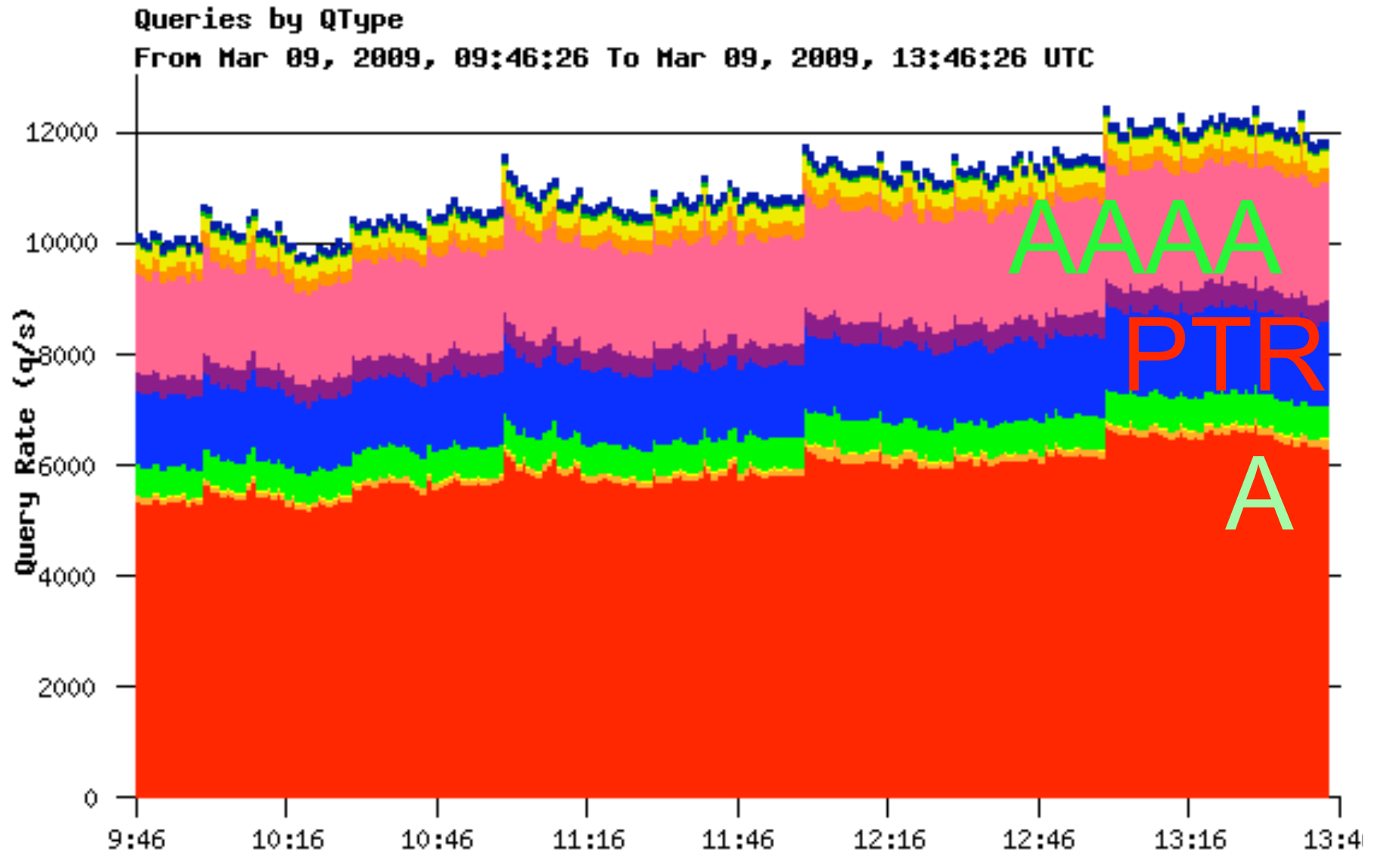
DNS services – K-root IPv6 queries

IP Version Carrying DNS Queries

From Feb 04, 2008, 11:00:26 To Feb 05, 2008, 11:00:26 CET



DNS services – K-root





IPv6 DNS

- Experiences
 - “It just works.”
 - No problems observed, no strange bugs seen
- Challenge
 - get IPv6 transit for K-root nodes
- Continuously monitored by DNSMON



Hostcount++

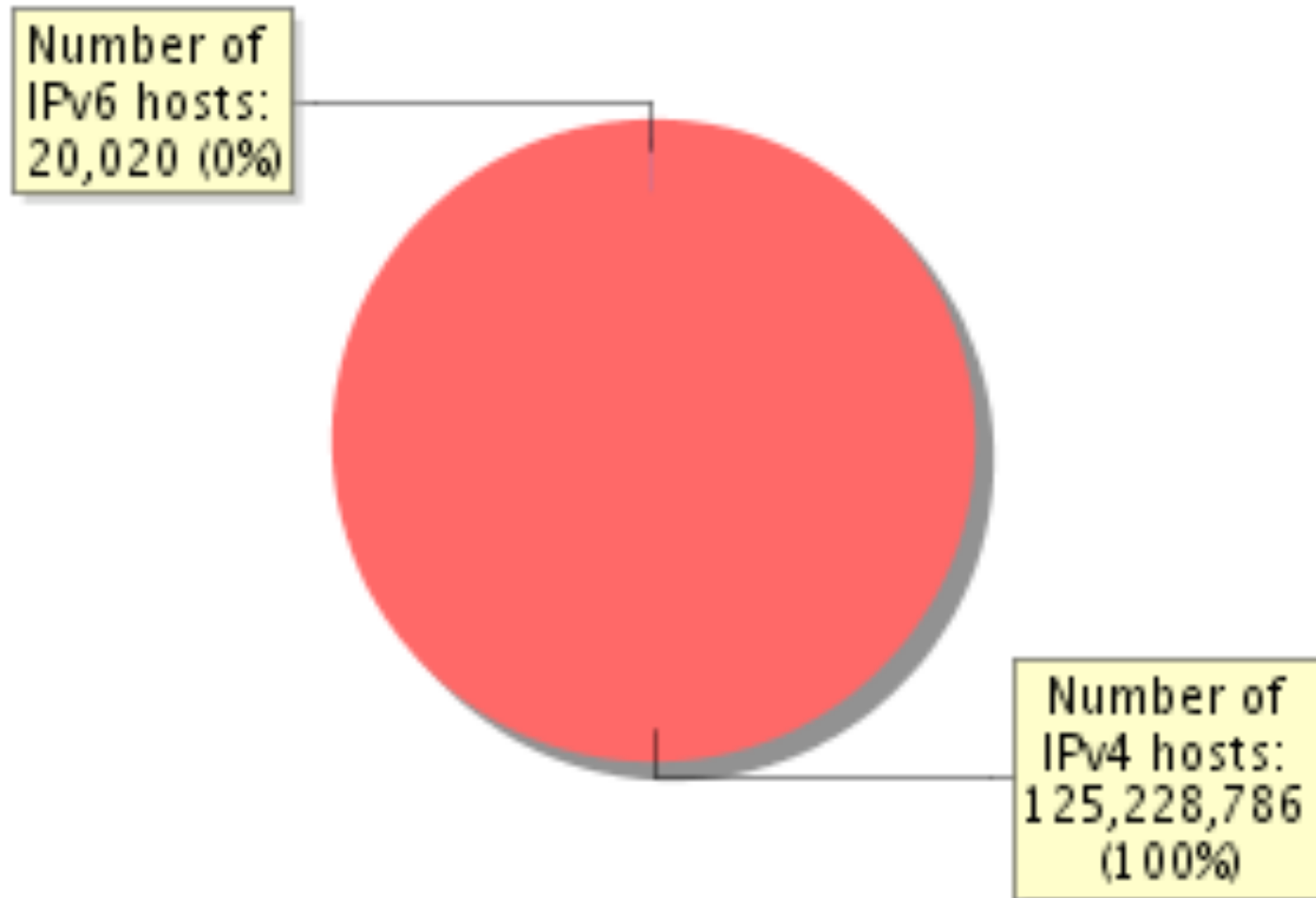


Hostcount++

- Counts hosts in the RIPE NCC service region
- Walks through (the relevant part of) the DNS tree
- Sources:
 - Zone transfers for IPv4 and IPv6
 - Reverse tree for IPv4
(Reverse IPv6 tree is too large.)
- No zone transfer means no IPv6 count!
- Help us count IPv6:
 - Allow 193.0.0.0/22 for zone transfer

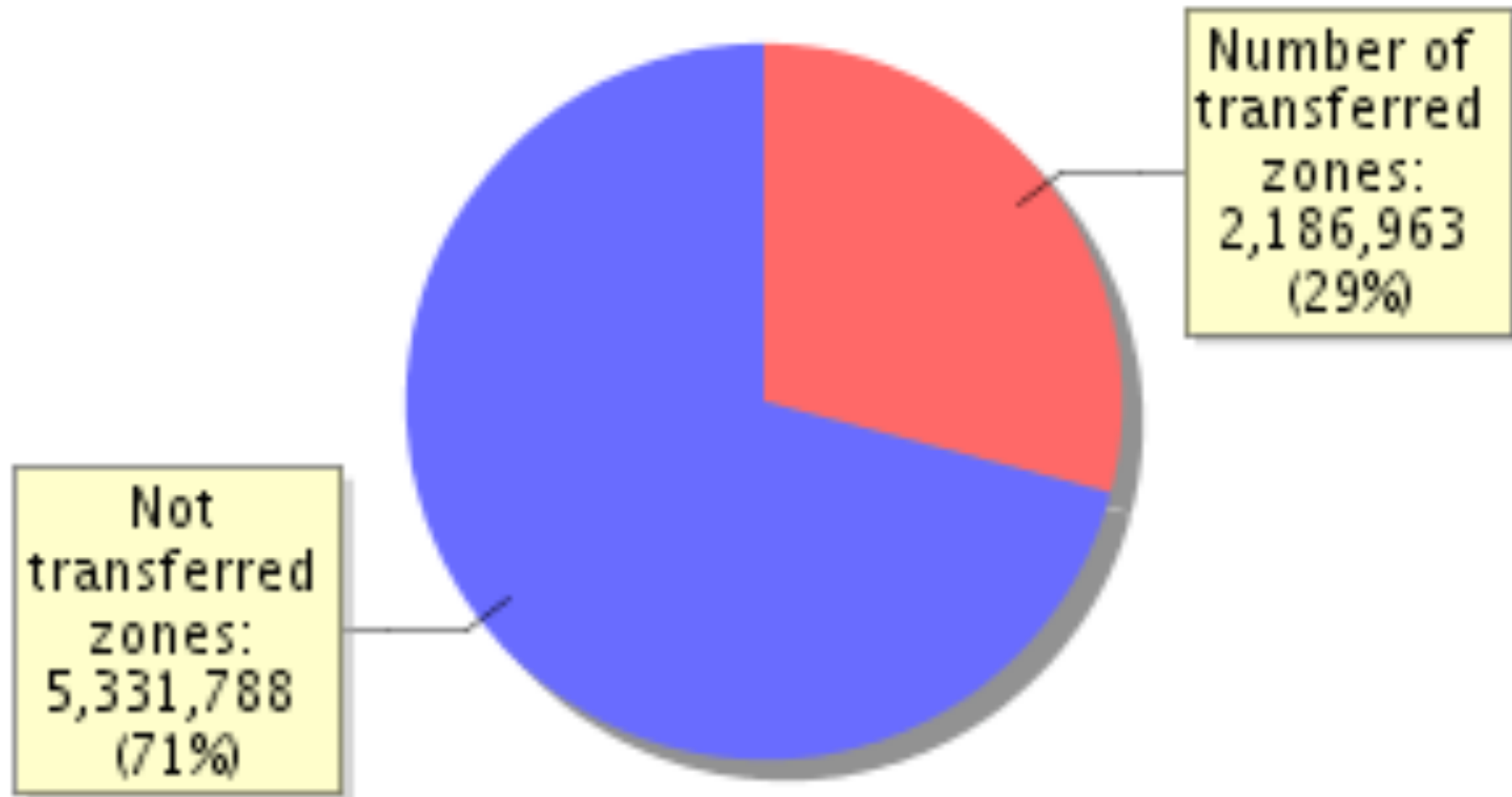


RIPE NCC service region data



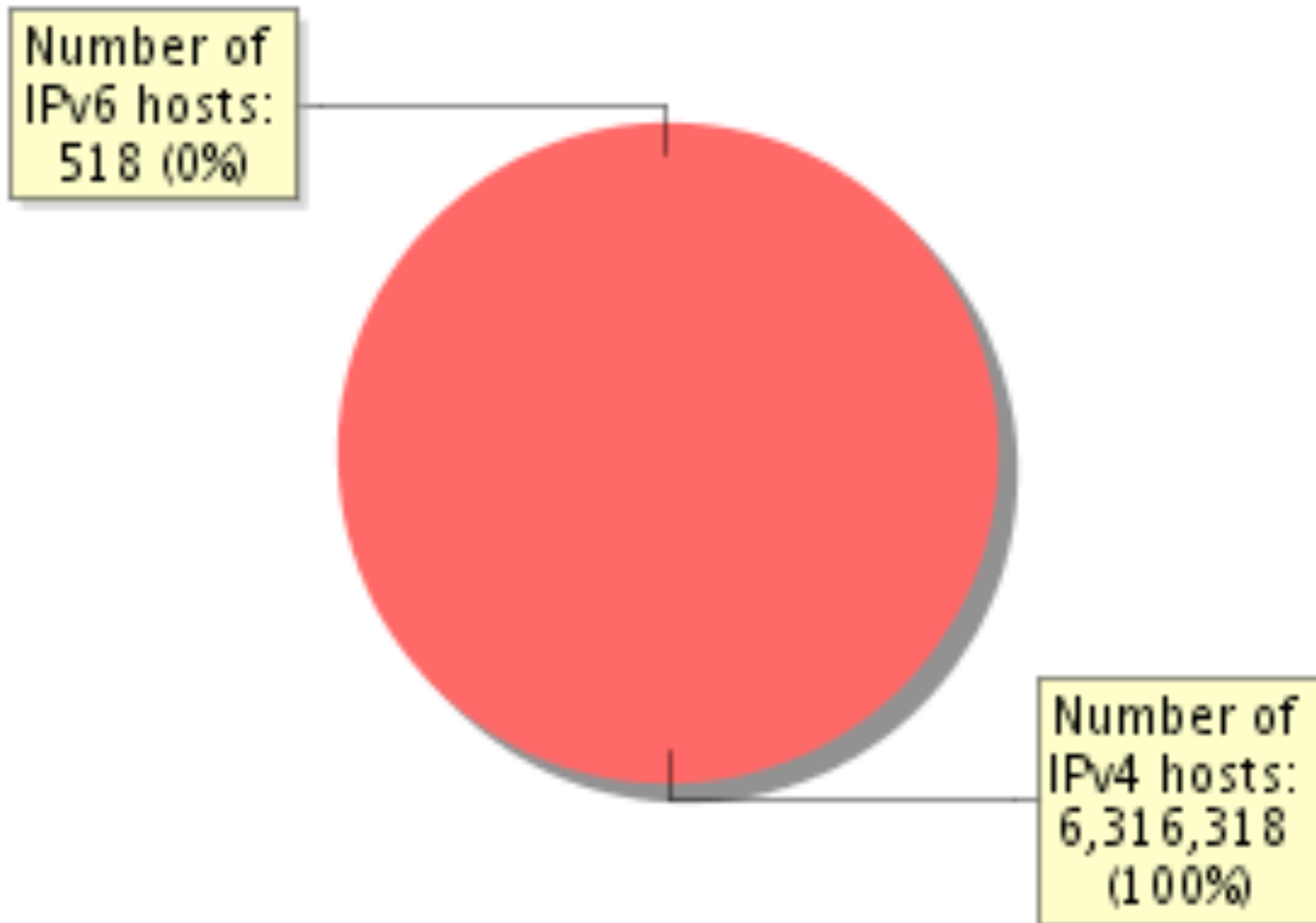


RIPE NCC service region data



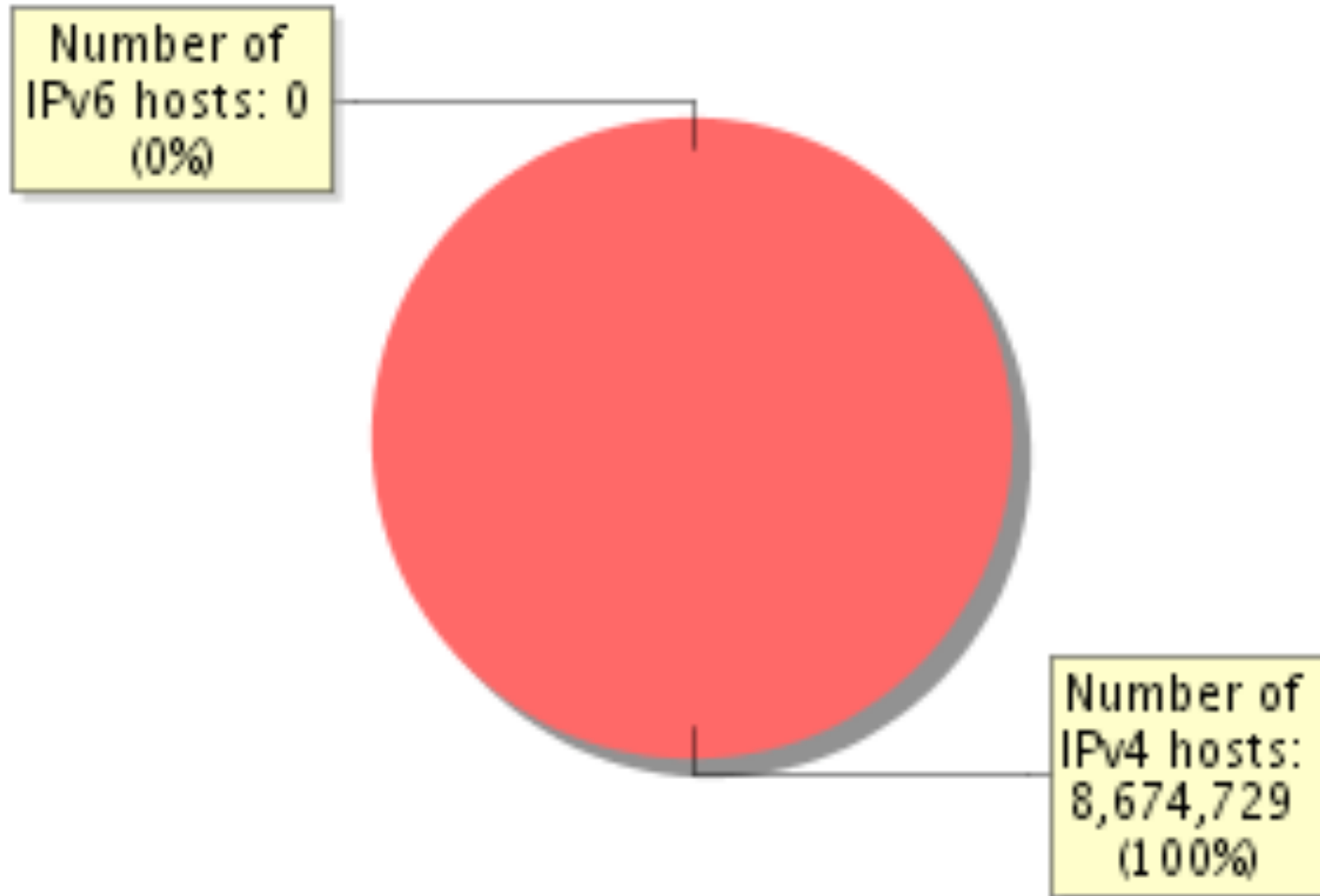


Hostcount++ – data for .uk



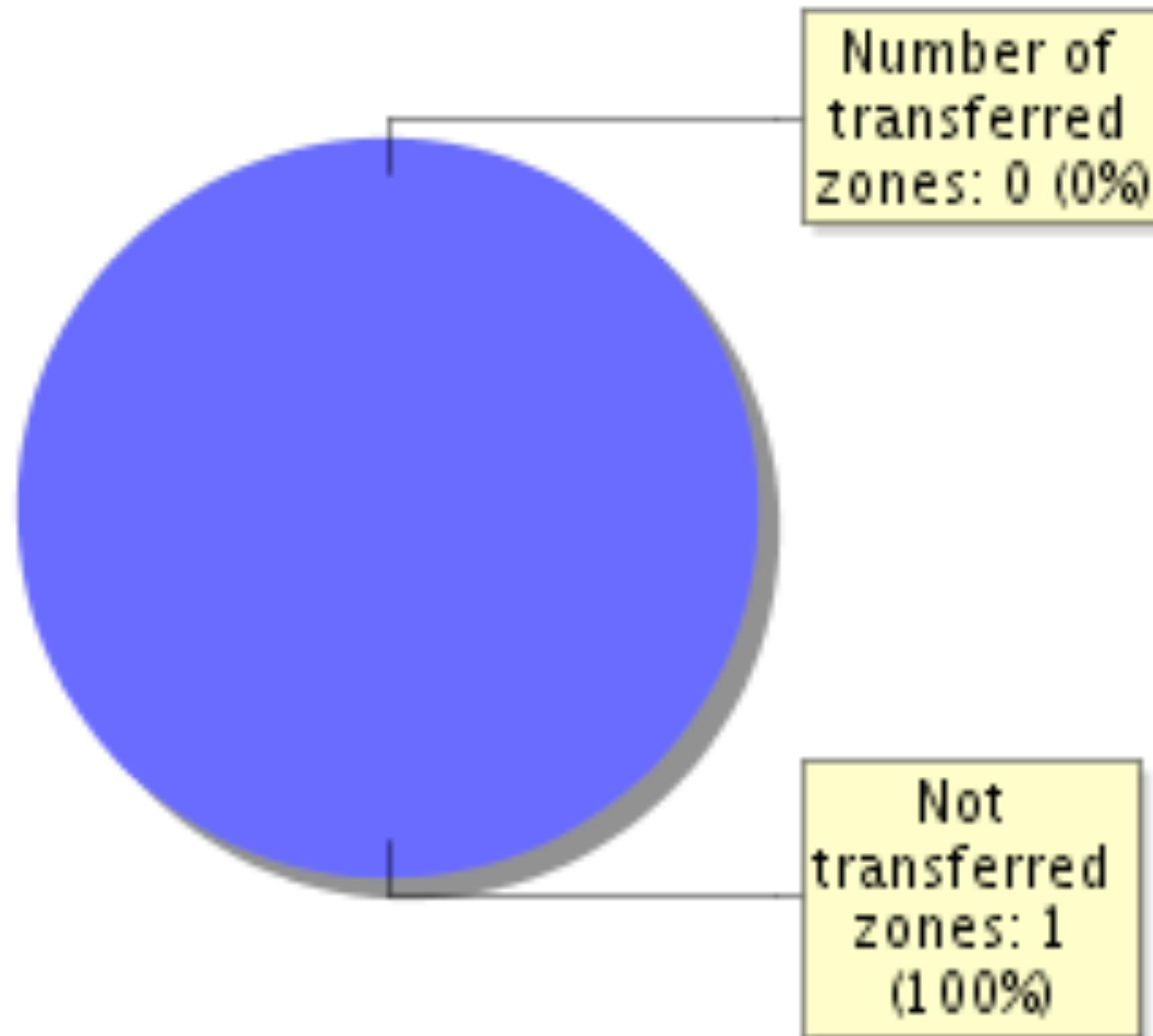


Hostcount++ – data for .nl





Hostcount++ – data for .nl



Routing Information Service (RIS)



Routing Information Service (RIS)

- Collects BGP routing data
 - using collectors all over the world
 - historical overview kept forever
- IPv4 since Dec 1999, IPv6 since Nov 2002
 - 12 out of 15 collectors have IPv6 peers
- Data presented here based on a subset!
 - Taken from LINX collector



RIS data

- 305,000 IPv4 prefixes
- 1,800 IPv6 prefixes

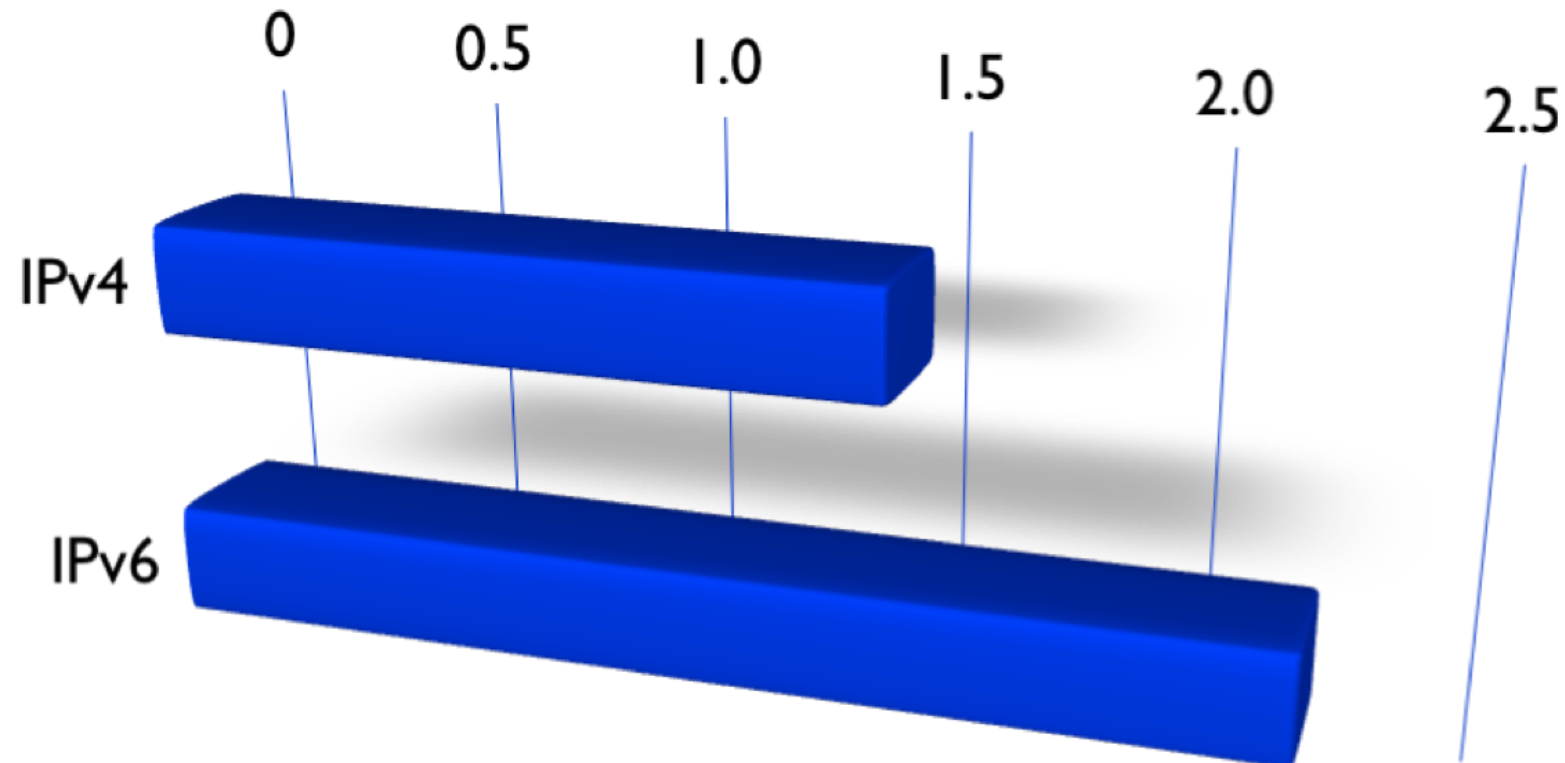
(this includes some internal prefixes, which are not seen by others)

- No surprises here



RIS data

■ Avg. updates per day per prefix



IPv6 prefixes almost 1.5 times as unstable



Test traffic measurements (TTM)



TTM

- One-way delay measurements
 - between custom boxes
 - hosted in remote networks
- Network status
 - 85 boxes online, 42 measuring IPv6

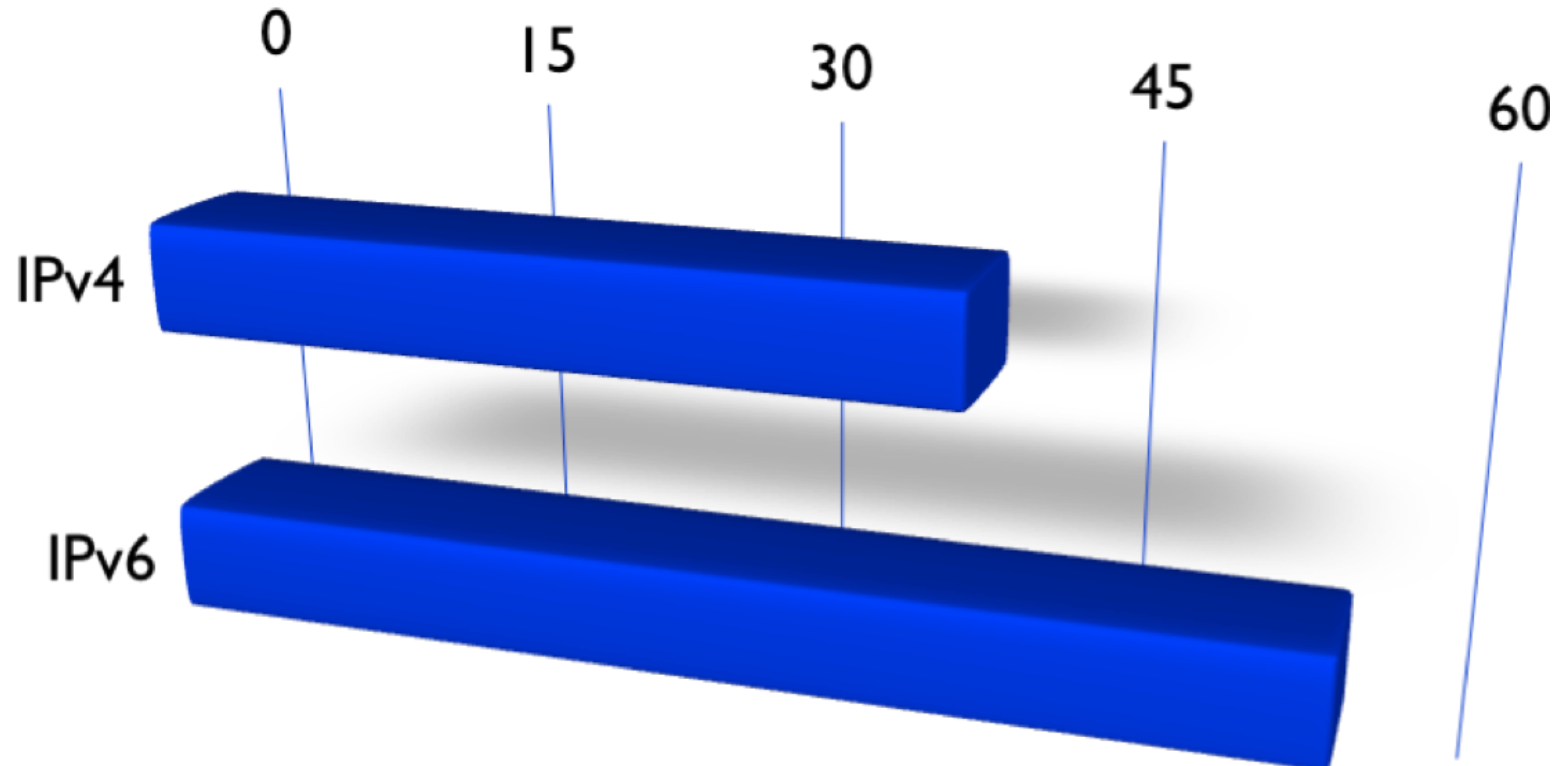
DNSMON

- Uses TTM grid
 - measures reachability and latency
 - for root and TLD name servers



TTM data

Average median latency in ms between 18 boxes,
600 measurements, 5 years ago

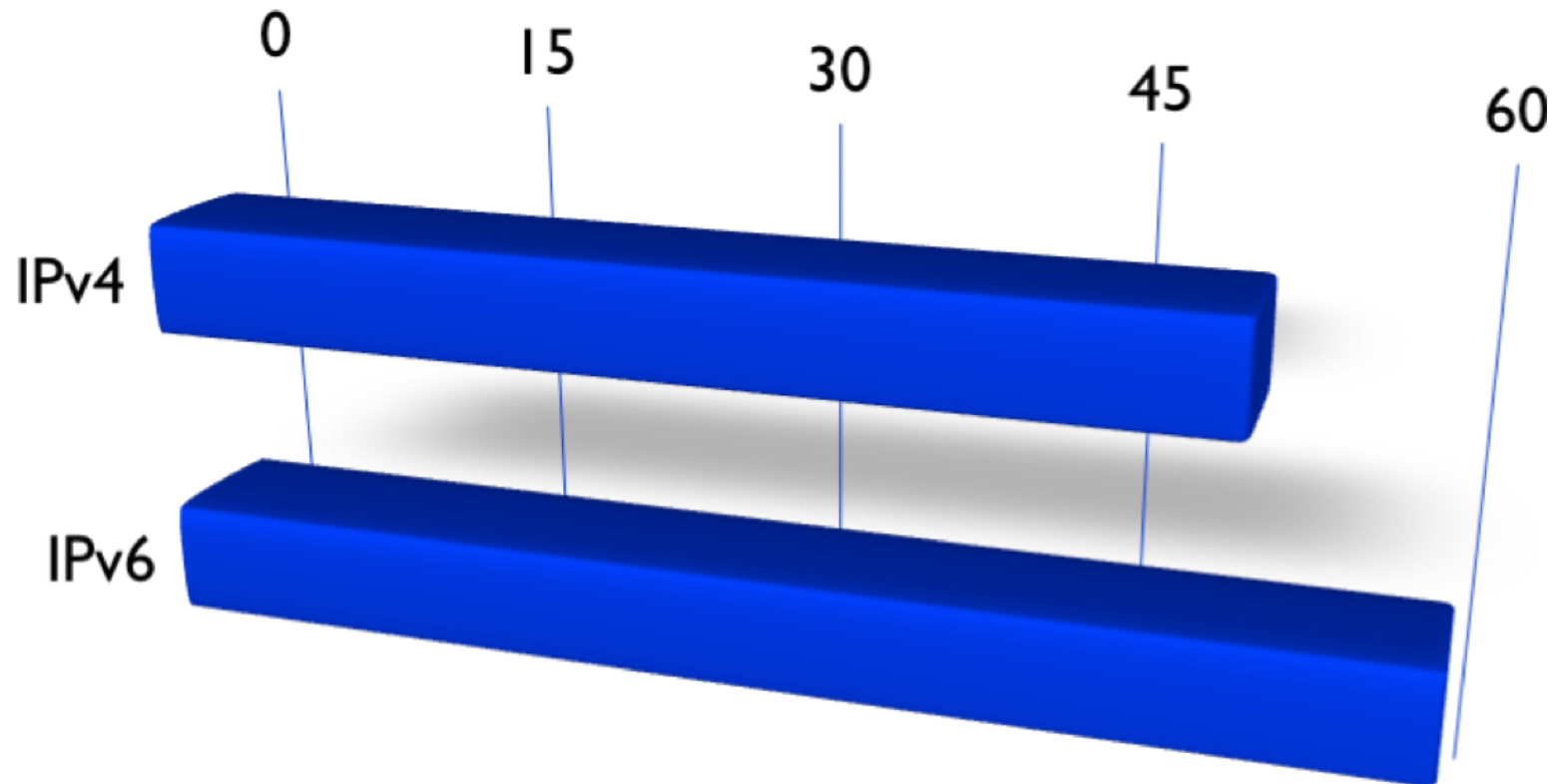


In 2004, IPv6 latency was 38% higher than IPv4



TTM data

Average median latency in ms between 36 boxes,
2000 measurements, now



IPv6 latency is 17% higher

TTM data – IPv6 tunneling in 2004

		Destination Testbox																				
		tt01	tt100	tt103	tt105	tt107	tt13	tt25	tt35	tt42	tt52	tt55	tt56	tt72	tt73	tt77	tt85	tt86	tt94	tt97	tt98	
Source Testbox	tt01		noVal	1280	1480	1500	1500	1480	1500	1500	1500	1500	1280	1500	1500	1500	1476	1476	1500	1500	1500	
	tt100	noVal		noVal	noVal	noVal	1500	noVal	1500	1280	1480	1480	1480	1480	1500	1462	1476	1476	1480	1480	1480	
	tt103	1280	noVal		1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280
	tt105	1480	noVal	1500		1476	1480	1480	1476	1480	1480	1476	1480	1476	1476	1480	1480	1480	1480	1480	1480	1480
	tt107	1500	noVal	1280	1500		1500	1280	1500	1500	1500	1500	1280	1500	1500	1462	1476	1476	1500	1500	1500	
	tt13	1500	noVal	1280	1480	1500		1480	1500	1500	1500	1500	1280	1500	1500	1500	1476	1476	1500	1500	1500	
	tt25	1476	noVal	1476	1500	1476	1476		1476	1428	1476	1476	1280	1476	1476	1476	1476	1476	1476	1476	1476	
	tt35	1480	noVal	1280	1480	1500	1500	1476		1500	1500	1500	1280	1500	1500	1462	1476	1476	1480	1480	1480	
	tt42	1500	noVal	1280	1500	1500	1500	1480	1500		1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	
	tt52	1500	noVal	1280	1500	1500	1500	1480	1500	1280		1500	1280	1500	1500	1462	1476	1476	1500	1500	1500	
	tt55	1500	noVal	1280	1500	1500	1500	1480	1500	1480	1500		1280	1500	1500	1462	1476	1476	1500	1500	1500	
	tt56	1476	noVal	1280	1476	1476	1476	1280	1476	1280	1280	1476		1476	1476	1462	1476	1476	1476	1476	1476	
	tt72	1500	noVal	1280	1500	1500	1500	1480	1500	1280	1500	1500	1280		1500	1462	1476	1476	1500	1500	1500	
	tt73	1500	noVal	1280	1500	1500	1500	1480	1500	1500	1500	1500	1280	1500		1500	1500	1500	1500	1500	1500	
	tt77	1500	noVal	1280	1500	1476	1500	1476	1476	1500	1476	1476	1280	1476	1500		1476	1476	1500	1500	1500	
	tt85	1476	noVal	1280	1500	1476	1476	1280	1476	1500	1280	1476	1280	1476	1476	1462		1500	1476	1500	1476	
	tt86	1476	noVal	1280	1500	1476	1476	1280	1476	1500	1476	1476	1280	1476	1476	1462	1500		1476	1476	1476	
	tt94	1500	noVal	1280	1480	1500	1500	1480	1500	1500	1500	1500	1280	1500	1500	1500	1476	1476		1500	1500	
	tt97	1500	noVal	1280	1480	1500	1500	1480	1500	1500	1500	1500	1280	1500	1500	1500	1476	1476	1500		1500	
	tt98	1500	noVal	1280	1480	1500	1500	1480	1500	1500	1500	1500	1280	1500	1500	1500	1476	1476	1500	1500		



Questions?

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