

# 6Watch: Gauging the Global Rollout of IPv6

Lixia Zhang

UCLA



# Why 6Watch

- ◇ Rolling out IPv6: A Great Challenge facing the entire Internet community
- ◇ What we can help: measurement, monitoring, diagnosis
  - ✧ IPv6 address allocations
  - ✧ IPv6 routing announcements
  - ✧ the topological connectivity of IPv6-enabled networks, and
  - ✧ IPv6 reachability in the data plane



# The 6Watch Team

6 watch   cyclops6   eyep6   topo6   6spider   6views

## Members

Participating institutions

- University of California, Los Angeles
- Colorado State University
- University of Oregon

Collaborating institutions

- Tsinghua University

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<http://6watch.net/>



# What We Measure and Monitor

6 watch

cyclops6

eyep6

topo6

6spider

6views



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## About

The 6watch project aims to develop an IPv6 monitoring system that will track IPv6 address allocations, IPv6 routing announcements, the topological connectivity of IPv6-capable networks, and IPv6 reachability in the data plane, all at the global scale. Each of these metrics is useful in tracking IPv6 deployment, and the combination of control plane and data plane metrics has the potential to provide a comprehensive overview of IPv6 deployment successes and obstacles.

Our goal is to establish this website as the "goto" website for IPv6 deployment which can (1) provide the latest snapshot of IPv6 rollout; (2) help identify open issues and potential obstacles to facilitate IPv6 deployment; and (3) cumulate pointers to other related efforts and information sources. To achieve (1) and (2) we are moving forward with the following specific tasks.

**cyclops6:** this is **cyclops** for IPv6, which provides information on AS level connectivity and BGP routing information over the AS topology.

**eyeP6:** this is EyeP for IPv6 (EyeP website is forthcoming; for preliminary information, please see Lucas Wang's talk at NANOG49 "**EyeP: Visualizing IPv4 Address allocation and usage**")

**topo6:** this is BGP data collection for IPv6, including all historical IPv6 routing data since the beginning of RouteViews and RIPE's BGP data collection.

**6spider:** this is IPv6 data plane crawling to measure IPv6 reachability and detect potential issues.

**6views:** this is AS-level topology estimates for IPv6 derived from BGP routing tables; twin brother for our project **Internet Topology Collection**.



# University of Oregon Route Views Project

[Advanced Network Technology Center](#)  
University of Oregon

[NEWS: announcing route-views.sydney.routeviews.org](#)

[MAINTENANCE: PAIX and WIDE FORMAT UPDATES August 10, 2010](#)

[MAINTENANCE: ARCHIVE2 Maintenance August 11, 2010](#)

## • Introduction and Goals

The University's Route Views project was originally conceived as a tool for Internet operators to obtain real-time information about the global routing system from the perspectives of several different backbones and locations around the Internet. Although other tools handle related tasks, such as the various Looking Glass Collections (see e.g. [NANOG](#), or the [DTI NSPIXP-2 Looking Glass](#)), they typically either provide only a constrained view of the routing system (e.g., either a single provider, or the route server) or they do not provide real-time access to routing data.

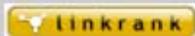
While the Route Views project was originally motivated by interest on the part of operators in determining how the global routing system viewed *their* prefixes and/or AS space, there have been many other interesting uses of this Route Views data. For example, NLANR has used Route Views data for [AS path visualization](#) (see also [NLANR](#)), and to study [IPv4 address space utilization](#) ([archive](#)). Others have used Route Views data to map IP addresses to origin AS for various topological studies. [CAIDA](#) has used it in conjunction with the [NetGeo](#) database in generating geographic locations for hosts, functionality that both [CoralReef](#) and the [Skitter](#) project support.

Other analyses using route-views data include:



• [Cyclops](#) A useful system for detecting routing anomalies involving your network.

• [BGP::Inspect](#) An indexed subset (5 peers) of routeviews data with a simple query interface.



• [linkrank](#) A tool for visualizing BGP routing changes



**Cyclops** beta  
an open eye to your netGlobal Visibility [▶](#)Critical Infrastructure [▶](#)Anomalies [▶](#)

## Critical Infrastructure

### DNS TLDs

Top Level Domain: 

Name server's IPv6 address bits:

  
e.g., 2001:4860:

Server name:

  
e.g., HIPPO.RU.AC.ZA

Origin AS:

  
e.g., 52

### *i* Tips

Cyclops keeps track of routes to DNS name servers of top level domain(TLDs) and root servers. Root zone information is extracted from [Internic](#). You can query announcements by TLD, name server ip address, name server name or ASN originating the route.

### *q* Quick lookup

ASN or AS Name:  IP address or DNS name:  

Total of 14 row(s) (page 1/1)

TLD	NS address	NS name	Prefix	Origin ASN	AS name	First seen	Last seen ↓	Lifetime
.	2001:7fe:0:0:0:0:53	i.root-servers.net.	2001:7fe::/33	29216	I-ROOT DNS root name server i.root-servers.net.	2010-09-13 16:24:46	2010-09-21 12:10:13	7 days
.	2001:7fe:0:0:0:0:53	i.root-servers.net.	2001:7fe::/32	29216	I-ROOT DNS root name server i.root-servers.net.	2010-09-13 16:24:46	2010-09-21 12:10:13	7 days
.	2001:dc3:0:0:0:0:35	m.root-servers.net.	2001:dc3::/32	7500	M-ROOT-DNS WIDE Project	2010-09-13 16:24:46	2010-09-21 12:10:13	7 days
.	2001:503:ba3e:0:0:0:2:30	a.root-servers.net.	2001:503:ba3e::/48	26415	VERISIGN-INC Verisign	2010-09-13 16:24:41	2010-09-21 12:00:05	7 days
.	2001:500:2f:0:0:0:0:f	f.root-servers.net.	2001:500:2e::/47	3557	ISC-CALIFORNIA Internet Systems Consortium, Inc.	2010-09-13 16:24:41	2010-09-21 12:00:05	7 days
.	2001:500:2f:0:0:0:0:f	f.root-servers.net.	2001:500:2f::/48	3557	ISC-CALIFORNIA Internet Systems Consortium, Inc.	2010-09-14 22:00:01	2010-09-21 12:00:05	6 days
.	2001:500:1:0:0:0:803f:235	h.root-servers.net.	2001:500:1::/48	668	ASN-ASNET-NET-AS - Defense Research and Engineering Network	2010-09-13 05:45:05	2010-09-21 12:00:05	8 days
.	2001:503:c27:0:0:0:2:30	j.root-servers.net.	2001:503:c27::/48	26415	VERISIGN-INC Verisign	2010-09-13 16:24:41	2010-09-21 12:00:05	7 days
.	2001:7fd:0:0:0:0:0:1	k.root-servers.net.	2001:7fd::/32	25152	K-ROOT-SERVER AS of the k.root-servers.net DNS root server	2010-09-13 05:45:05	2010-09-21 12:00:05	8 days
.	2001:500:3:0:0:0:0:42	l.root-servers.net.	2001:500:3::/48	20144	L-ROOT - ICANN	2010-09-13 05:45:05	2010-09-21 12:00:05	8 days
.	2001:500:2f:0:0:0:0:f	f.root-servers.net.	2001:500:2f::/48	1280	ISC-AS1280 Internet Systems Consortium, Inc.	2010-09-14 20:47:13	2010-09-21 12:00:00	6 days
.	2001:7fd:0:0:0:0:0:1	k.root-servers.net.	2001:7fd::/48	25152	K-ROOT-SERVER AS of the k.root-servers.net DNS root server	2010-09-15 00:00:00	2010-09-21 08:00:06	6 days
.	2001:500:2f:0:0:0:0:f	f.root-servers.net.	2001:500:2e::/47	1280	ISC-AS1280 Internet Systems Consortium, Inc.	2010-09-15 00:00:01	2010-09-21 08:00:01	6 days
.	2001:500:2f:0:0:0:0:f	f.root-servers.net.	2001:500:2f::/48	30132	ISC-AMS1 ISC, Amsterdam, Netherlands	2010-09-15 00:00:00	2010-09-21 08:00:00	6 days

**Cyclops** beta  
an open eye to your net

Global Visibility ▾

Critical Infrastructure ▾

Anomalies ▾

## Global Visibility

**AS Connectivity** [Prefix Origins](#)

Viewing mode: \* Snapshot ▾

Date: \* 2010-09-21

ASNs: 174  
one or multiple ASNs, e.g., 52,7018

Only ASes of type: All ▾

Only links of type: All ▾

 Degree higher than 50 Lifetime higher than 2 days Hide links disappeared more than 100 days[Connectivity lookup](#)

### *i* Tips

You can look at the neighbor ASes of the Cyclops eye using two different modes: **Snapshot** and **Diff**. In snapshot mode, a complete list of neighbors is displayed; in diff mode, only new peerings (appearances) and depeerings (disappearances) that occurred between start date and end date are shown. The **link weight** A->B is the number of routes that A uses to route through B, averaged over hundreds of routers with full tables over time.

### Quick lookup

ASN or AS Name:  IP address or DNS name: 

Total of 178 row(s) (page 1/6)

Eye	ASN	AS name	Type	Relation	Degree	First seen	Last seen ↓	Lifetime	Weight (From)		Weight (To)		Prefix
									Avg	Delta	Avg	Delta	
174	7018	ATT-INTERNET4 - AT&T WorldNet Services	Unknown	Unknown	0	2010-09-21 12:40:25	2010-09-21 12:40:25	0 days					2607:f6b0::/32
174	6189	EPFL-AS - Enoch-Pratt Free Library	Unknown	Unknown	0	2010-09-21 12:24:50	2010-09-21 12:40:25	0 days					2607:f6b0::/32
174	3549	GBLX Global Crossing Ltd.	Unknown	Unknown	0	2010-09-12 22:20:02	2010-09-21 12:39:53	8 days					2607:f6b0::/32
174	30798	TNNET-AS TNNet Oy	Unknown	Unknown	0	2010-09-21 12:39:47	2010-09-21 12:39:47	0 days					2001:40e8::/32
174	2914	NTT-COMMUNICATIONS-2914 - NTT America, Inc.	Unknown	Unknown	0	2010-09-12 22:52:41	2010-09-21 12:39:30	8 days					2001:40e8::/32
174	3257	TISCALI-BACKBONE Tiscali Intl Network BV	Unknown	Unknown	0	2010-09-12 23:23:51	2010-09-21 12:39:28	8 days					2001:40e8::/32
174	3356	LEVEL3 Level 3 Communications	Unknown	Unknown	0	2010-09-12 22:20:28	2010-09-21 12:39:26	8 days					2001:40e8::/32
174	7078	MONMOUTH - Monmouth Internet	Unknown	Unknown	0	2010-09-13 16:24:55	2010-09-21 12:39:19	7 days					2607:fee8::/32
174	22302	INOC - INOC, LLC	Unknown	Unknown	0	2010-09-15 00:00:00	2010-09-21 12:39:19	6 days					2607:f058::/32
174	1273	CW Cable and Wireless plc	Unknown	Unknown	0	2010-09-12 23:03:47	2010-09-21 12:39:19	8 days					2607:f058::/32
174	1239	SPRINTLINK - Sprint	Unknown	Unknown	0	2010-09-12 23:17:42	2010-09-21 12:39:09	8 days					2607:f6b0::/32

## topo6

Currently, in most of the available BGP data collections (RIBs and UPDATES) IPv6 and IPv4-related information is mixed. To perform any historical analysis in IPv6 space requires downloading and parsing of huge amount of unrelated information.

The goal of 6views project is to filter out IPv6-related information from all available data sources and make it available to the research community.

## Data sources

We process all available files (RIBs and UPDATES) in ongoing fashion from the following archives:

[Route Views](#),  
[RIPE-RIS](#),  
[Abilene](#),  
[Packet Clearing House](#)

## Description of IPv6 separation

Each MRT file is parsed using [libbgpparser](#)

MRT record selection criteria:

- MRT record has type BGP4MP and
  - o MRT record has subtype BGP4MP\_STATE\_CHANGE or BGP4MP\_STATE\_CHANGE\_AS4, or
  - o MRT record has subtype BGP4MP\_MESSAGE or BGP4MP\_MESSAGE\_AS4 and
    - § BGP message has type OPEN, NOTIFICATION, KEEPALIVE, or ROUTE\_REFRESH, or
    - § BGP message has type UPDATE and
      - BGP message has attribute MP\_REACH\_NLRI or MP\_UNREACH\_NLRI with AFI\_IPv6 prefix, or
- MRT record has type TABLE\_DUMP and subtype AFI\_IPv6, or
- MRT record has type TABLE\_DUMP\_V2 and
  - o MRT record has subtype PEER\_INDEX\_TABLE, RIB\_IPV6\_UNICAST, RIB\_IPV6\_MULTICAST, or RIB\_GENERIC
- MRT has other type, or
- parsing error occurred

If MRT record is selected, it is written in the output file without any modifications.

## Download data

Data will be available soon

## Feedback

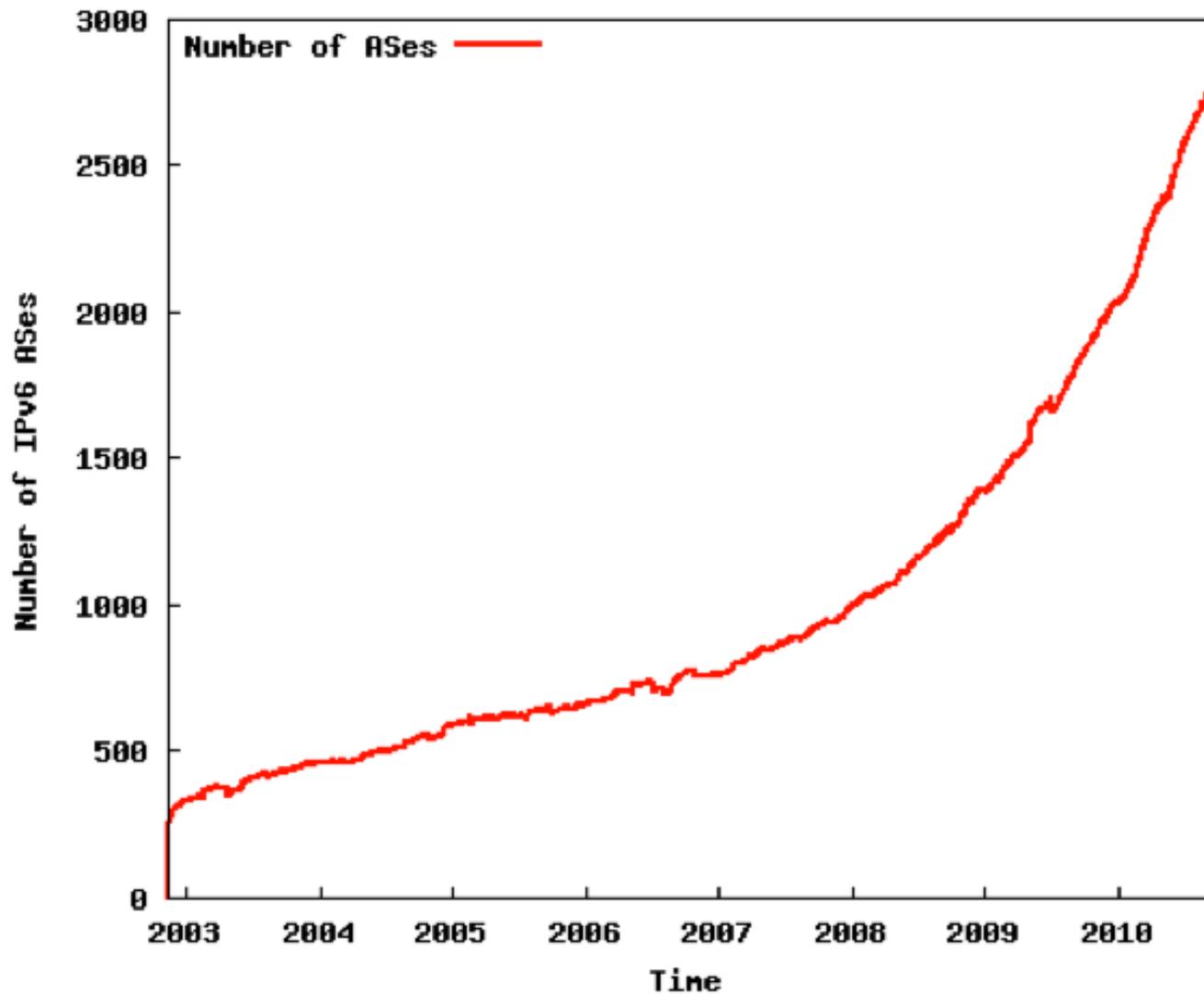
Please send any comments/questions/bug reports to [Alexander Afansyev](#) or [Jonathan Park](#).

# 6Spider: Initial Set of Pollers



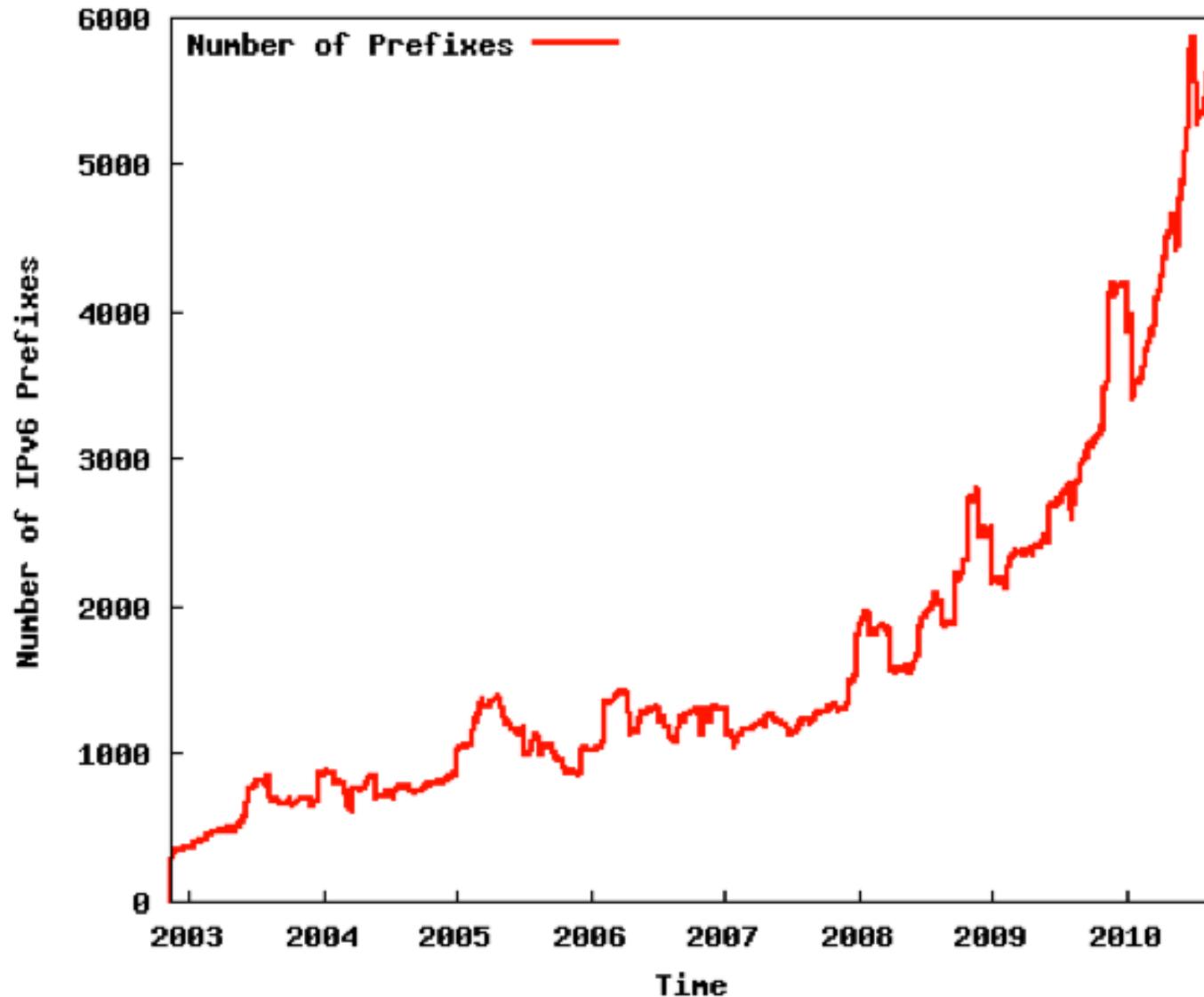


# Number of ASes Originating IPv6 Prefix Announcements Since 2002.11.11





# Number of Announced IPv6 Prefixes Since 2002.11.11



# A Repository of IPv6 Deployment Info

6 watch

cyclops6

eyep6

topo6

6spider

6views



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## Related projects

[IPv6 Wiki](#) by Jonathan Park

[IPv6 Measurements - A compilation](#) by RIPE NCC

The increased deployment of IPv6 that has accompanied the exhaustion of the free IPv4 address pool has encouraged a wide range of organisations and individuals to conduct measurements related to IPv6 data and traffic.

[Global IPv6 address statistics](#) by China Internet Network Information Center

Statistics for IPv6 address allocations for each country

[IPv6 Adoption Monitor](#) by Comcast

Shows for every scan the percentage of sites that are accessible via both IPv4 & IPv6. Note that the base number on which the percentage is taken is not constant but keeps increasing. Please refer to the raw data for details. Rankings of sites are based on the top-1M site list maintained by [Alexa](#).

[GRH: Ghost Route Hunter - IPv6 only](#) by SixXS.net

Ghost Route Hunter, GRH for short, is a tool for hunting down Ghost Routes in the IPv6 routing tables.



# Looking Forward

- ◇ Complete data plane monitoring implementation
- ◇ Correlate control plane with data plane to provide a comprehensive overview of IPv6 deployment
- ◇ Add diagnosis functions
- ◇ Evolve 6Watch website towards the goto site for IPv6 deployment

All comments, suggestions: please send to  
[6watch@lists.cs.ucla.edu](mailto:6watch@lists.cs.ucla.edu)

