6 Watch: Monitoring IPv6 Deployment and Connectivity

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Many Positive Trends For IPv6
Growth in IPv6 ASNs

From http://6watch.net/6views.html
Growth in IPv6 Prefixes

From http://6watch.net/6views.html
And Many More IPv6 Activities

• DNS Requests for IPv6 Records
  – AAAA records 2\textsuperscript{nd} most popular type at top level DNS servers
    • Above MX/NS/etc and behind only A records
  – A6 records are the 4\textsuperscript{th} most popular type!
    • Proves nothing is ever obsolete in the Internet 😊

• IPv6 growing in importance with IPv4 exhaustion issues, World IPv6 Day, etc.
  – Hopefully don’t need to convince this group
Objectives For This Talk

• Introduce the 6Watch Monitoring System
  – Understand how the numbers are generated
  – BGP Data From Oregon RouteViews
  – DNS Data From SecSpider
  – New Data and Control Plane Integration
• Show How 6Watch Could Help You
• Request Your Help In Data Collection
The 6Watch Team

• University of Oregon/Oregon RouteViews
  – Dave Meyer
  – John Kemp

• UCLA
  – Lixia Zhang

• Colorado State
  – Dan Massey
6Views BGP Monitoring

- Shows IPv6 Routing Table Growth
- Shows Growth in IPv6 Origin ASNs
- Allows One to infer IPv6 Connectivity and AS Level Topologies
How BGP Data Collection Works (1/3)

- ISPs around the world offer to provide BGP data
- Agree data can be made publically available to any operator or researcher

AT&T
Hurricane
Telstra
WIDE
Tiscali
Level3
IIJ
And Many Many More

Sprint
France Telecom
RUSnet
NepalIX
KDDI
CERNET
Telefónica

04/26/2011 NSF IRNC 6Watch
How BGP Data Collection Works (2/3)

- Monitoring projects deploy collectors at exchange points
- ISP routers peer with collectors
- To the ISP router, the collector is just another BGP peer (e.g. router)
  - Only the collector never announces any routes!
How BGP Data Collection Works (3/3)

- All Route Updates Are Logged
  - 15 minute intervals
  - http://archive.routeviews.org/bgpdata/
- Collector also archives routing table of each peer router
  - 2 hour intervals
BGP Data Collection and IPv6

- IPv6 Peering With Routers
  - 80+ Routers Peer Using IPv6
- IPv6 Tables Reported By Routers
  - Updates and routing tables list IPv6 Prefixes
- Allows One To Count IPv6 Prefixes, Size of v6 BGP table, Deduce v6 connectivity from AS Path in updates, etc.
New Feature: Real-Time Data

- Developed new BGP monitoring software (BGPmon)
  - Improves how collectors work
    - Can support more peers
    - Create collection meshes
  - Can Now Get Data in Real-Time (both v4 and v6)!

http://bgpmon.netsec.colostate.edu/

Routers To Monitor

BGP Data Collectors

Resulting Streaming Service

Oregon IX

LINX

Sydney
BGP Message Example

• “Bits off the wire” between two BGP speakers:
  – 4001010040020C020536D900D10D1C10866E0F400304C02BD98D18BD5533
    • Not easy to analyze. RFC 4271 has all details.

• How we can represent BGP message in human readable format?
  – Extensible Markup Language (XML)
    • Extensible and easy to use data format.
    • It is widely used for the representation of arbitrary data structures.
    • It is common for XML to be used in interchanging data over the Internet (RFC 3023).
XML-Based Format for Representing BGP Messages (XFB)

```xml
<ASCII_MSG>
  <LENGTH>53</LENGTH>
  <TYPE value="2">UPDATE</TYPE>
  <UPDATE>
    <ATTRIBUTE>
      <LENGTH>12</LENGTH>
      <TYPE value="2">AS_PATH</TYPE>
      <AS_PATH>
        <AS_SEG type="AS_SEQUENCE" length="5">
        </AS_SEG>
      </AS_PATH>
    </ATTRIBUTE>
    <ATTRIBUTE>
      <LENGTH>28</LENGTH>
      <TYPE value="14">MP_REACH_NLRI</TYPE>
      <MP_REACH_NLRI>
        ......
      </MP_REACH_NLRI>
    </ATTRIBUTE>
    <ATTRIBUTE>
      <PREFIX label="DPATH" afi="IPV6" afi_value="2" safi="UNICAST" safi_value="1"> 2001:468:d01:33/96 </PREFIX>
    </ATTRIBUTE>
  </UPDATE>
</ASCII_MSG>

BGP message total length
BGP message type, according to RFC 4271
BGP AS Path data
Not difficult, right?

Multi-protocol Support for v6
Announced Prefix

Real-Time BGP Data Access
XML Data from one v6 Peer

Real-Time BGP Data Access
But BGP Is Not Sufficient…

- BGP Data Only Shows Control Plane
  - Do all announced routes work?
  - Can they be reached from v4 and/or reach v4?
- 6Views Enhances BGP with Data Plane
  - But how to test? Ping? Look for websites?
  - Our solution: DNS!
DNS IPv6 Monitoring

• Network doesn’t work unless DNS works!
• Can v6 DNS resolver reach v6 DNS server?
• Can v4 DNS resolver reach v6 DNS server?
• Can v6 DNS resolver reach v4 DNS server?
SecSpider DNS Monitoring

- Developed by Eric Osterweil (now at Verisign)
- Designed to Track DNSSEC Deployment
- Monitors secure DNS zones from multiple locations
How DNS Data Collection Works (1/3)

- Sites around globe agree to host DNS pollers
- Master coordinator with redundancy directs pollers
- Back-end DB tracks all data collected
How DNS Data Collection Works (2/3)

- Master decides what to query
  - Ex: poller in China, query for www.rmv6tf.org AAAA
  - Coordinator specifies exact query to send, including all header bits, OPT RRs, etc.

- Master decides who to query
  - Ex: poller in China, send that query to 2a01:e0b:1:64:240:63ff:fee8:6155

- Poller only sends query and relays back response
How DNS Data Collection Works (3/3)

• Master Communicates with Poller over DNS
  – Master creates exact query to send
  – Adds a DNS OPT RR that specifies the desired DNS server
  – Sends Query (with OPT RR) to Poller

• Poller Listens For Queries
  – Strips off OPT RR to find server
  – Sends Query to Server
  – Forwards Reply to Master

• Master/Poller Channel Secured With TSIG
  – Ensures only master can direct poller
DNS Data Collection and IPv6

• Instruct v6 Pollers to Query v6 DNS Servers
  – Test both DNS functionality and connectivity between v6 networks
• Instruct v6 Pollers to Query v4 DNS Servers
  – Test both DNS functionality and v6 to v4 connectivity
• Instruct v4 Pollers to Query v6 DNS Servers
  – Test both DNS functionality and v6 reachability from v4
Why Might All This Matter to You?

• RouteViews BGP Data Already Widely Used in Many IPv6 Numbers You See Now
  – New real-time data enables new types of measurements
  – New IPv6 specific data archives makes analyzing IPv6 data easier
    • (don’t have to sift out lots of IPv4 cruft)
  – DNS Data (release in summer) will add data plane results (and DNS results1)
Why Might All This Matter to You?

• Can provide your site real-time IPv6 connectivity monitoring
  – 6Cyclops will track your IPv6 connectivity and notify you of routing incidents that impact your prefix
  – 6Spider can track your IPv6 DNS service and notify you of DNS and data plane connectivity issues

• Interested in free monitoring services?
  – Contact bgpmon@netsec.colostate.edu
A Request For Your Help

• Help Finding Your IPv6 DNS Servers
  – 6Spider Pollers Query IPv6 DNS Servers
  – Load is on order of 1-2 queries per day
  – Standard DNS query, as from any resolver
  – Requires nothing at the server…

• But we need to find the server to query it
  – Crawling DNS is slow…
  – If you run a v6 DNS authoritative server, could you point us at the address?
  – Contact bgpmon@netsec.colostate.edu
Even More Generous Help

• Hosting a 6Spider Poller
  – More IPv6 6Spider DNS Pollers Needed
  – Involves installing Poller software (RDNSD)
  – Configure TSIG key to ensure only master can control poller
  – Only sends and receives (UDP) DNS queries
  – Contact bgpmmon@netsec.colostate.edu
Even More Generous Help

• Additional Peering For IPv6 Data Collection
  – If you are already peering with RouteViews, Thank You!
  – If not, could you consider peering with a BGPmon data collector?
  – More data provides the community with a better picture of IPv6 rollout
  – Contact bgpmon@netsec.colostate.edu
Questions?

bgpmon@netsec.colostate.edu