Archipelago
Measurement Infrastructure

Updates

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Introduction

* Archipelago (Ark) is CAIDA’s active measurement infrastructure
  * in production since Sep 2007
* focusing on
  * easy development and rapid prototyping
  * dynamic and coordinated measurements
  * measurement services (service-oriented architecture)
* please see AIMS’09 talk for greater details
Architecture

* measurement nodes ("monitors") located worldwide
  * standard rack-mounted servers
  * many thanks to the organizations hosting Ark boxes
  * special thanks for finding hosting sites:
    * Emile Aben (RIPE)
    * Sebastian Castro Avila (.nz Registry Services)
    * Hyunchul Kim (Seoul National University)
Monitor Deployment

• 54 monitors in 29 countries (13 new since AIMS-2)

<table>
<thead>
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<th>Continent</th>
<th>Count</th>
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<tbody>
<tr>
<td>North America</td>
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<td>South America</td>
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<tr>
<td>Asia</td>
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<tr>
<td>Oceania</td>
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<table>
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<td>military research</td>
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<tr>
<td>commercial network</td>
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<td>network infrastructure</td>
<td>5</td>
</tr>
<tr>
<td>community network</td>
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</table>

70% academic or research
30% commercial
Measurements

* IPv4 Routed /24 Topology (and AS Links)
* IPv6 Topology
* DNS Names & Query/Response Traffic
* Alias Resolution
IPv4 Routed /24 Topology

• ongoing large-scale topology measurements
  • ICMP Paris traceroute to every routed /24 (9.04 million)
    • about 138 /8-equivalents of routed space (as of Dec 2010)
  • running scamper
    • written by Matthew Luckie of WAND, University of Waikato

• dynamically divide up the measurement work among members of monitor teams
  • 3 teams active
  • 17/18-member team probes every /24 in 2 days at 100pps
    • only one monitor probes each /24 per cycle (== one pass through all /24’s)
IPv4 Routed /24 Topology

data availability per monitor (row)
IPv4 Routed /24 Topology

- collected from Sep 2007 to Jan 2011 (41 months):
  - 10.1 billion traceroutes; 4.0 TB data
  - 1312 cycles
- collecting every month now:
  - ~432 million traceroutes; ~173 GB data
- IPv4 topology data is key input into other datasets
  - e.g., AS links and alias resolution
IPv6 Topology

- ongoing large-scale IPv6 measurements
  - 9.0 million traces since Dec 2008
- 16 monitors
  - 5 in US, 7 in Europe, 3 Asia, 1 Oceania
- ICMP Paris traceroute to every routed prefix
  - each monitor probes a random destination in every routed prefix in every cycle
    - 3,972 prefixes <= /48 (as of Dec 2010)
  - probing rate intentionally reduced to 2 days per cycle
Alias Resolution

* goal: determine which interfaces belong to the same router

* MIDAR
  * RadarGun-inspired approach
    * find addresses that share an IP ID counter
  * paper coming soon (~Mar 2011)
  * three runs in Jan, Apr, and July 2010:

<table>
<thead>
<tr>
<th></th>
<th>addr</th>
<th>aliases (pairs)</th>
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<tbody>
<tr>
<td>Jan</td>
<td>1.1M</td>
<td>425k</td>
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<td>Apr</td>
<td>1.5M</td>
<td>1.32M</td>
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<td>Jul</td>
<td>1.9M</td>
<td>1.68M</td>
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Developments

* RADclock deployments
  * collaboration with Julien Ridoux and Darryl Veitch
  * highly accurate (sub-ms) software-based time synchronization
    * far better than NTP, especially with 200ms RTT to time server
  * deployed RADclock on 23 monitors + Ark servers

http://www.synclab.org/radclock/
Developments

- experimental on-demand topology measurements
  - remote programmatic access to perform on-demand traceroute/ping measurements from any Ark monitor
    - controlled 3rd-party access to Ark infrastructure without login account
Developments

* exploring scalable query system for topology data
  * want easier and faster access to data
    • traceroute and ITDK data
  * support queries from researchers in the community
    • alternative to downloading raw data (too much to download)
  * experimenting with Tokyo Cabinet and Dystopia
    • Tokyo Cabinet: non-SQL datastore
    • Tokyo Dystopia: full-text search engine
  * future: Hadoop, cloud computing, other non-traditional datastores

http://fallabs.com/tokyodystopia/
Developments

* topostats

* programs that calculate 31 graph statistics
* handles millions of nodes for many statistics
* example stats:
  * average neighbor degree
  * assortative coefficient
  * mean clustering, clustering coefficient
  * top clique size
  * node coreness, core size, fringe size
  * distance, eccentricity, radius, node/edge betweenness

www.caida.org/tools/utilities/topostats
Collaborations

* Rob Beverly
  * MIT Spoofer Project: added IPv6 support
  * Beverly, et. al, “Primitives for Active Internet Topology Mapping: Toward High-Frequency Characterization,” in IMC 2010
    * conducted on-demand traceroute measurements

* Matthew Luckie
  * using Ark monitors for various topology measurements
  * Luckie, et. al, “Measured Impact of Crooked Traceroute,” in ACM SIGCOMM CCR, Jan 2011
Collaborations

* Benoit Donnet and Pascal Mérindol
  * mrinfo measurements
  * Mérindol, et. al, “MERLIN: MEasure the Router Level of the INternet,” in submission.
Future Work

* release mper, Marinda, MIDAR, and other Ark software under GPL
* deploy RADclock on all monitors
* improve infrastructure to allow more collaborators to use Ark
Thanks!

For more information or to request data:
www.caida.org/projects/ark

For questions, or to offer hosting: ark-info@caida.org