Studying Blackholes on the Internet with Hubble

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Global Reachability

- When an address is reachable from every other address
- Most basic goal of Internet, especially BGP
  - “There is only one failure, and it is complete partition” Clarke, *Design Philosophy of the DARPA Internet Protocols*
- Physical path $\Rightarrow$ BGP path $\Rightarrow$ traffic reaches
- **Blackhole**: when this last implication is violated in a persistent way
Want everyone to reach your website, but…

- 10,000 blackholes a week last at least 30 min.
- Many prefixes affected
- When a problem occurs, poor visibility:
  - What is going on?
  - How widespread is the problem?
  - Where is the problem originating?
Hubble System

In real-time on a global scale, automatically monitor long-lasting reachability problems and classify causes

Approach

- Synthesis of multiple information sources
  - Passive monitoring of route advertisements
  - Active monitoring from distributed vantage points
- Historical monitoring data to enable troubleshooting
- “Name and shame” classification
Problem Seen by **Hubble** on Oct. 8, 2007

1. **Target Identification**—distributed ping monitors detect when the destination becomes unreachable
Problem Seen by **Hubble** on Oct. 8, 2007

1. Target Identification-- distributed ping monitors
2. Reachability analysis-- distributed traceroutes determine the extent of unreachability
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   a) group failed traceroutes
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1. Target Identification-- distributed ping monitors
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3. Problem Classification
   a) group failed traceroutes
   b) spoofed probes to isolate direction of failure
What is the extent of blackholes?

- 3 week study starting September 17, 2007
- 31,000 blackholes involving 10,000 prefixes
- 20% lasted at least 10 hours!
- 68% were cases of partial reachability
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Classifying Problems

To aid operators in diagnosis and repair:

1. Which ISP contains problem?
2. Which routers?
3. Which destinations?

To answer first two, group failed and successful probes.

To answer third, use spoofed probes to isolate problem to forward or reverse direction.
Examples of Complete Unreachability

1)

2)

3)
Examples of Partial Reachability

4)

5)

6)
Provider AS Problem for Multi-Homed

Like Cox/USC example:
- Probes through Provider $B$ fail to reach $P$
- Some reach through Provider $A$

- More than 10% of problems
- 84% of cases, isolated direction (like Cox/USC)

Multi-homing not providing resilience to failure
Conclusions and Future Work

- **Hubble**: working real-time system
- Lots of reachability problems, some long lasting
- Historical and fine-grained data enable problem analysis
- Problems with multi-homed failover

Future Work:

- Further problem classification and notification
- Query language/ interface

http://hubble.cs.washington.edu

Work in progress— simple for now, expanding