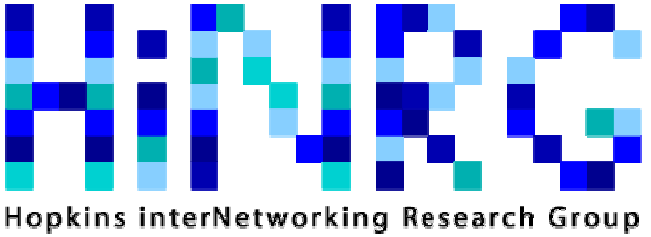

On the Use of Anycast in DNS

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Background

- What is Anycast?
  - Client transparent mechanism to route packet to *one of multiple* servers in anycast group
  - Implemented via announcements of the same address prefix from multiple origins (IGP+EGP)
  - Deployed in top-level DNS nameservers
    - Reduction in query latency
    - Scalability
    - Availability
    - Resistance to DDoS attacks

Goal

- Measure the impact of anycast on DNS
  - Response times
  - Availability in terms of number and duration of outages
  - Constancy of server selection
  - Effectiveness of localization

What we tested

- Base Case: Unicast server
  - Test-case: B-Root (local load balancing)
- Anycast Configurations
  - Hierarchical
    - Test-Cases: F-Root (26 servers), K-Root (7 servers)
      - Explore the effect of number and locations of servers
  - Flat
    - Test-Case: UltraDNS (8 servers *)

Measurement Methodology

- Measurements using PlanetLab
- Special DNS queries to the anycast address from each PL site every [25-35] seconds
- Period of study: 3 weeks from Sept 19, 2004 to Oct 8, 2004
- Definitions
  - Outage: Period of time when queries are unanswered (multiple of meas. period)
  - Flip: Client switches from one server to another

Continent	% of PL nodes
South America	0.5
Australia	1.8
Asia	15.8
Europe	16.7
North America	65.2

Response Times

- Anycast servers have lower response times
- UltraDNS TLD1 has the lowest query latency
- Among the rest, F-Root is the best
  - Reason: high geographic diversity
- Response times have high deviations
  - Due to instability as we will see later

Server	Mean (ms)	Median (ms)	Std. dev (ms)
Hypo. Unicast*			
min{TLD1.TLD2}*	69	51	173
TLD1	96	54	207
F-Root	75	70	85
TLD2	104	85	237
B-Root	115	95	121
K-Root	140	121	104

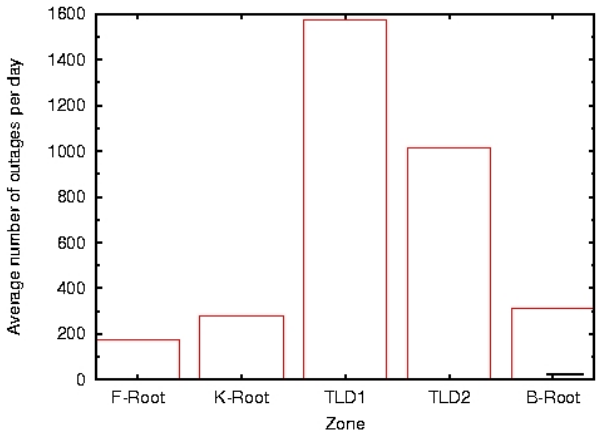
Flat vs. Hierarchical

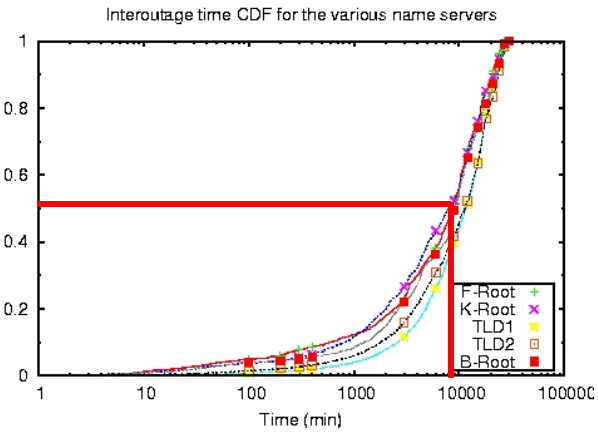
* Hypothetical cases comparison

Effect of server location

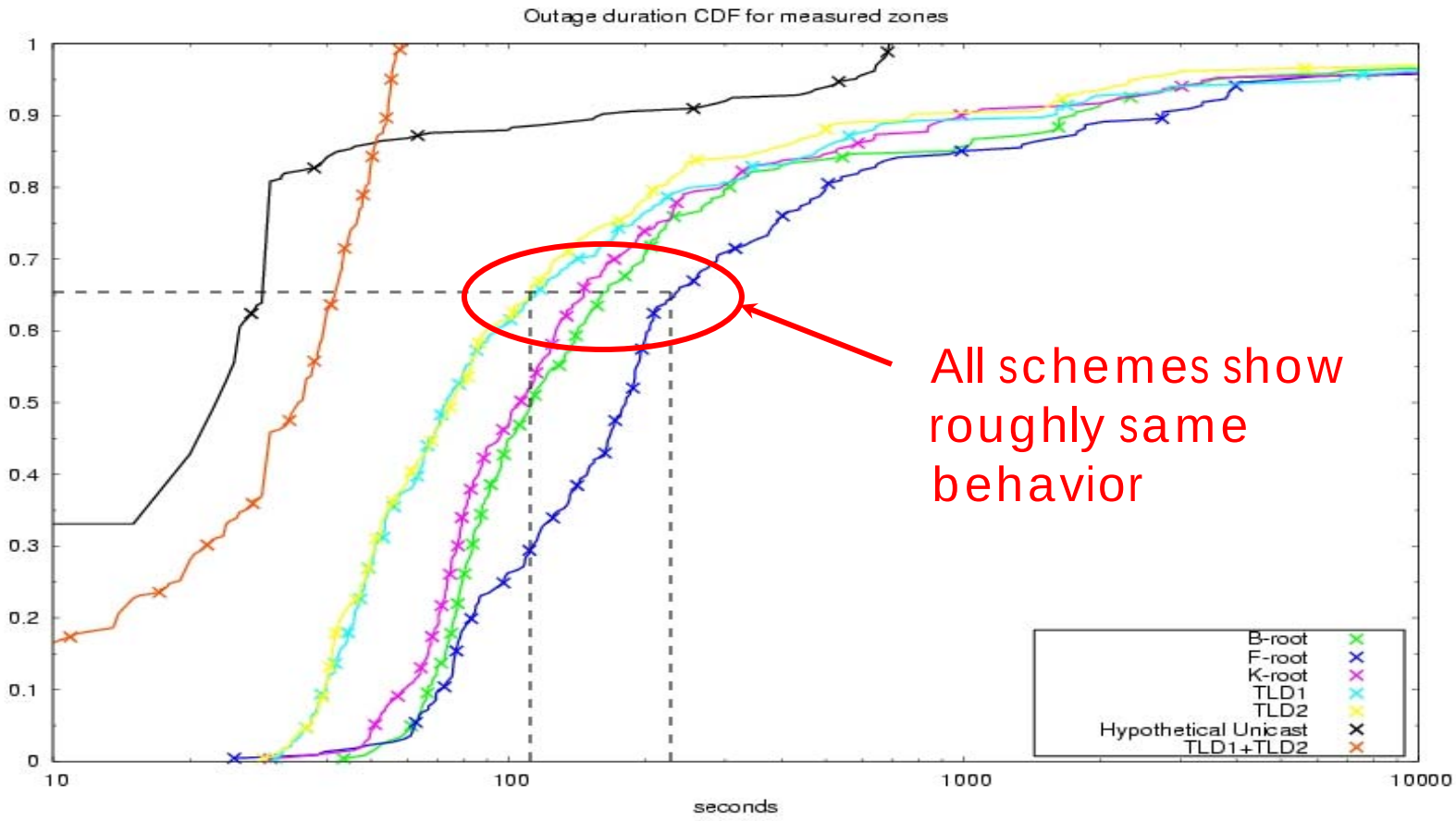
Availability

- Percentage of unanswered queries < 0.9%
- TLD1,TLD2 have the largest number of outages
- F-Root has the least
  - Reasons (speculation)
    - UltraDNS is single-homed
    - Longer Internet paths
- Average inter-outage time for same client is in the order of days



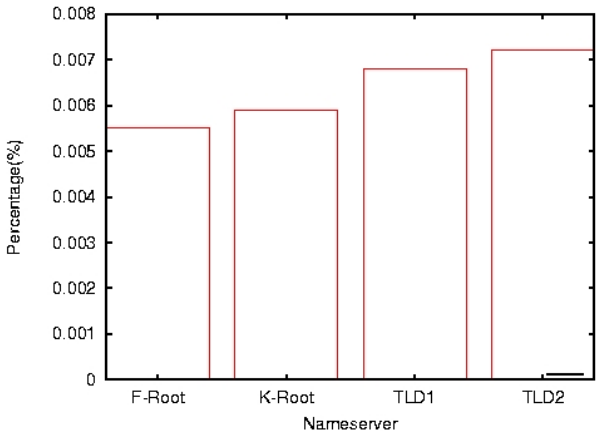


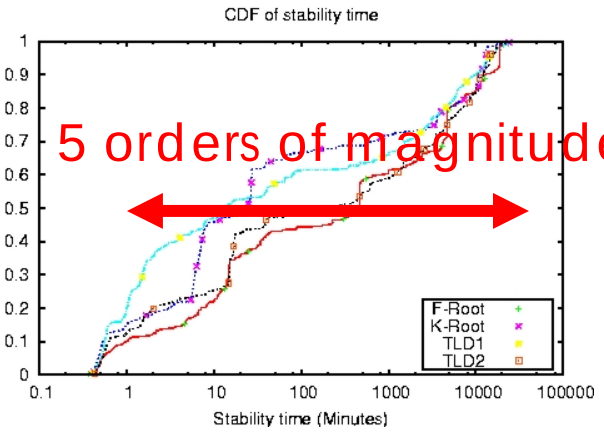
Outage Duration



Constancy

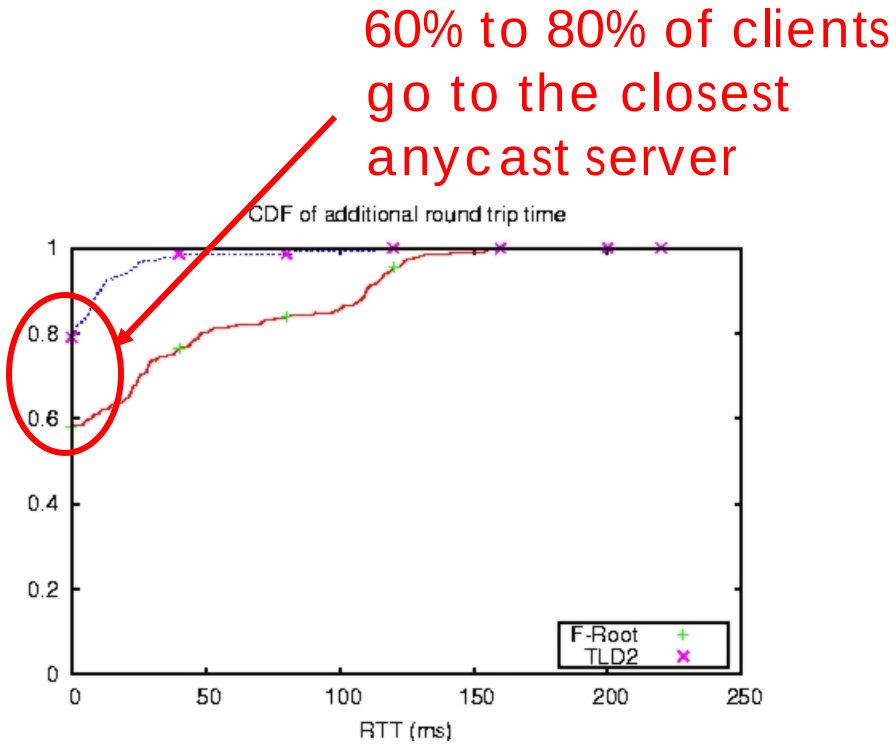
- Constancy measured by frequency of flips between servers
- TLD1, TLD2 have most flips
- F-Root, K-Root have higher percentage of flips after an outage
- Majority of flips for F-Root and K-Root are between the global nodes





Effectiveness of Localization

- Question: Does anycast lead clients to the closest server?
- Direct comparison flawed due to different routing paths for unicast and anycast addresses
- Solution:
  - Compare path used by anycast to paths to all last hop routers



Comparison of Strategies

- Hierarchical schemes have higher stability and availability
- Flat schemes are more effective in directing queries to the "closest" anycast instance
- Possible idea:
  - Tune parameter to adaptively change properties anycast scheme – Radius of announcement at each anycast node

Summary

- Anycast improves availability
- Other properties depend on the scheme used
- Trade-off between availability, stability and effectiveness of localization
- Caveats:
  - Results apply to Planet Lab environment
  - Support arguments using BGP data
  - Skew due to load on the anycast server
- For more:
  - http://www.cs.jhu.edu/~sarat/Anycast-TR.pdf