Effect of anycast on K-root

Some early results

K root anycast deployment

- 3 global nodes (BGP transit)
  - LINX
    - ... 5459 25152 25152 i
  - AMS-IX
    - ... 25152 25152 25152 i
  - Tokyo (since 5/2005)
    - ... 25152 25152 25152 25152 i

- ~10 local nodes (announced with no-export)

- Future nodes will be global
  - Miami (live as we speak?)
  - India
  - West coast?

Node structure

- 2 machines running nsd, switches, routers

- Production IP: OSPF load balancing
  - K-root IP address: 193.0.14.129

- Service interfaces
  - Normally firewalled, don’t reply to queries
    - LINX: 193.0.16.1, 193.0.16.2
    - AMS-IX: 193.0.17.1, 193.0.17.2
    - ...

- Management interfaces, ...

Why anycast?

- Reasons for anycasting:
  - Provide resiliency and stability
  - Reduce latency
  - Spread server and network load, contain DOS attacks
  - ...

- Is it effective?

Latency

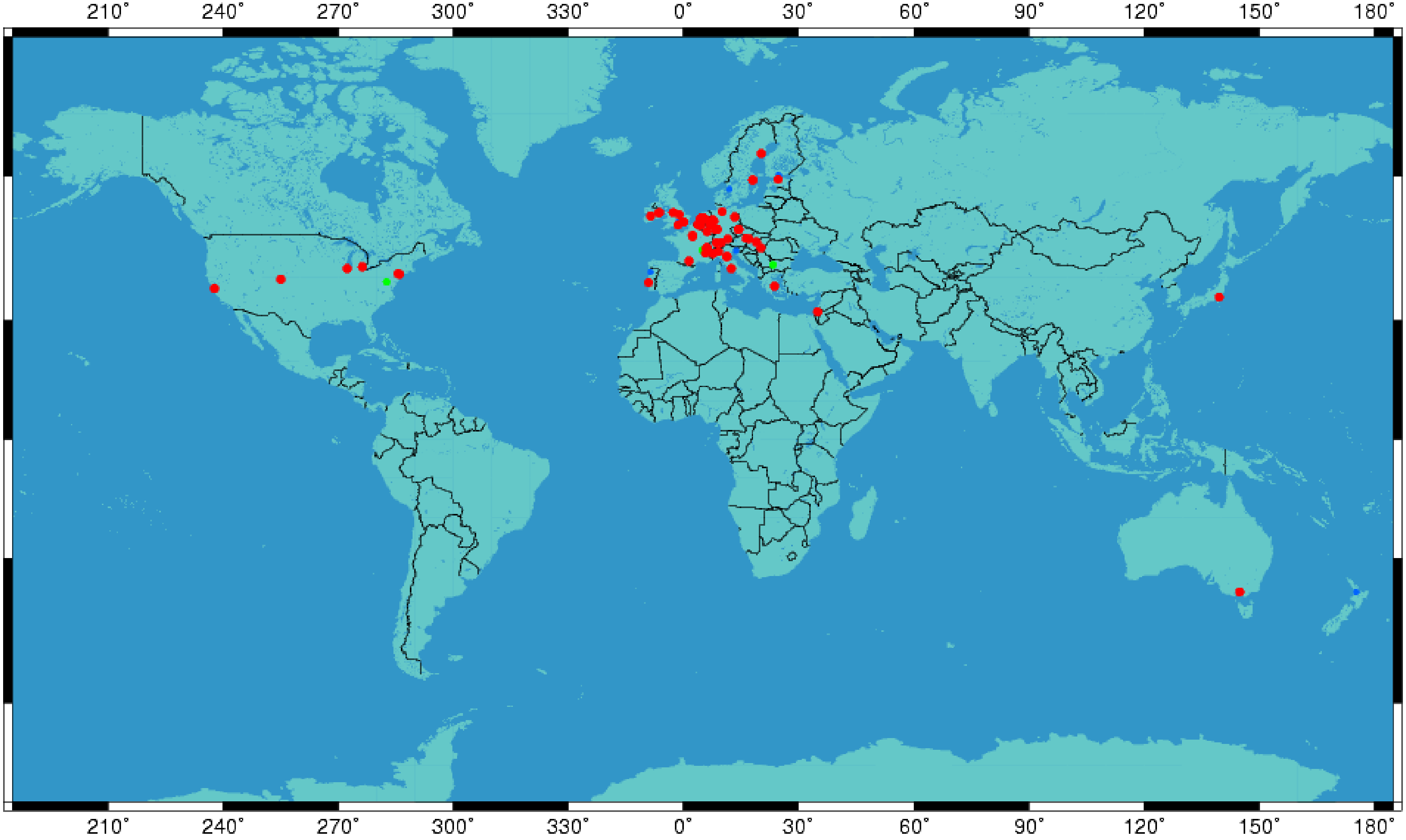
Latency comparison

- Ideally, BGP should choose the instance with the lowest RTT.
- Does it?

- Measure RTTs from the Internet to:
  - Anycasted IP address (193.0.14.129)
  - Service interfaces of global nodes (not anycasted)
- Compare results

- Just to make sure this is apples to apples:
  - Are AS-paths to service interfaces the same as to production IP?
  - According to the RIS, “mostly yes”

Probe locations: TTM (bias?)



Method

- Send DNS queries from all test-boxes
  - For each K-root IP:
    - Do a “dig hostname.bind”
    - Extract RTT
    - Take minimum value of 5 queries
  - Compare results of anycast IP with those of service interfaces

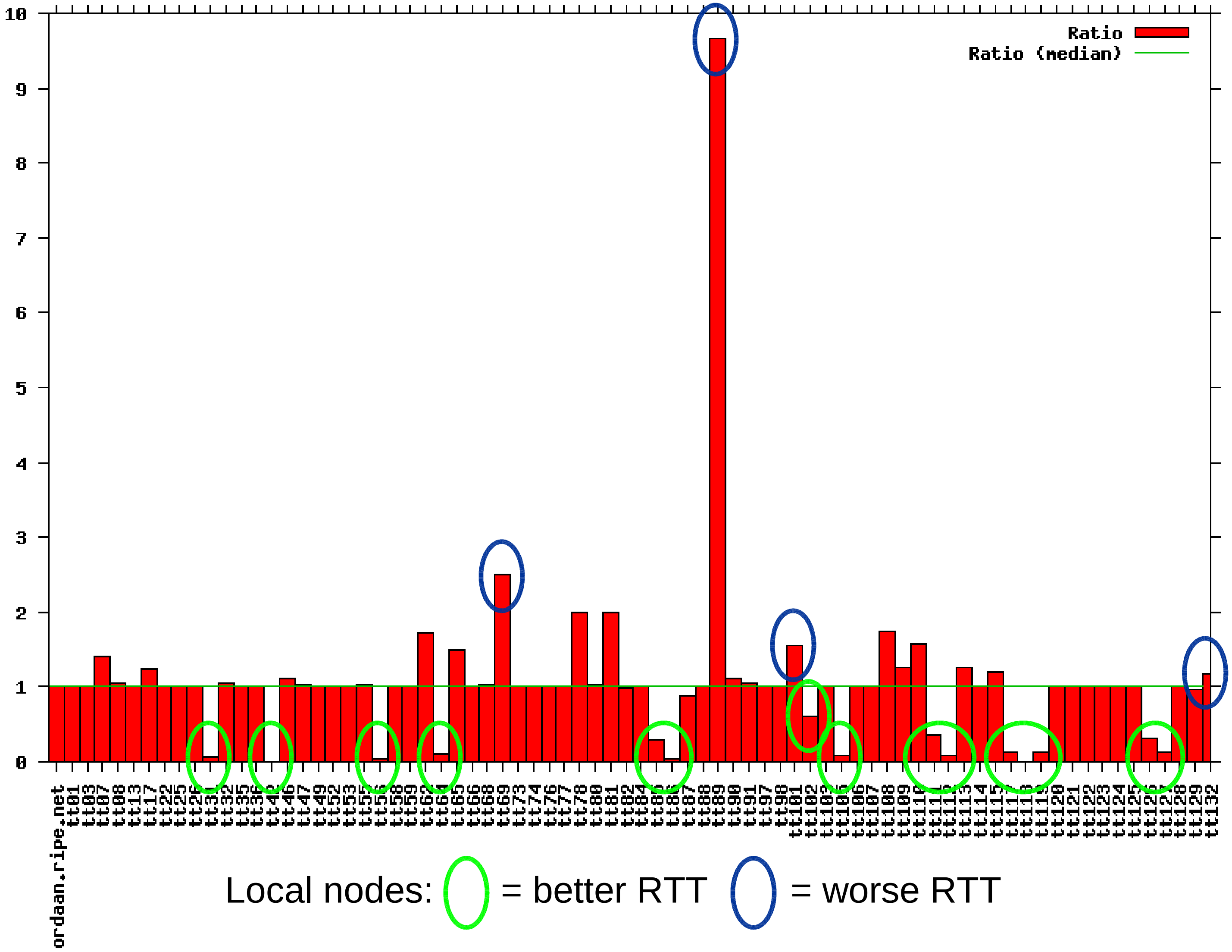
- $\alpha = RTT_K / \min(RTT_i)$

  $\alpha \approx 1$: BGP picks the right node

  $\alpha > 1$: BGP picks the wrong node

  $\alpha < 1$: local node?

Latency comparison



Local nodes: ○ = better RTT ○ = worse RTT

Local worse than global?

```
$ cat tt89
193.0.14.129 k2.denic 29 k2.denic 30 k2.denic 29 k2.denic 30 k2.denic 29
193.0.16.1 k1.linx 4 k1.linx 3 k1.linx 3 k1.linx 3 k1.linx 3
193.0.16.2 k2.linx 3 k2.linx 3 k2.linx 3 k2.linx 3 k2.linx 4
193.0.17.1 k1.ams-ix 12 k1.ams-ix 11 k1.ams-ix 12 k1.ams-ix 13 k1.ams-ix 13
193.0.17.2 k2.ams-ix 12 k2.ams-ix 13 k2.ams-ix 11 k2.ams-ix 12 k2.ams-ix 13
```

(This example has since been fixed)

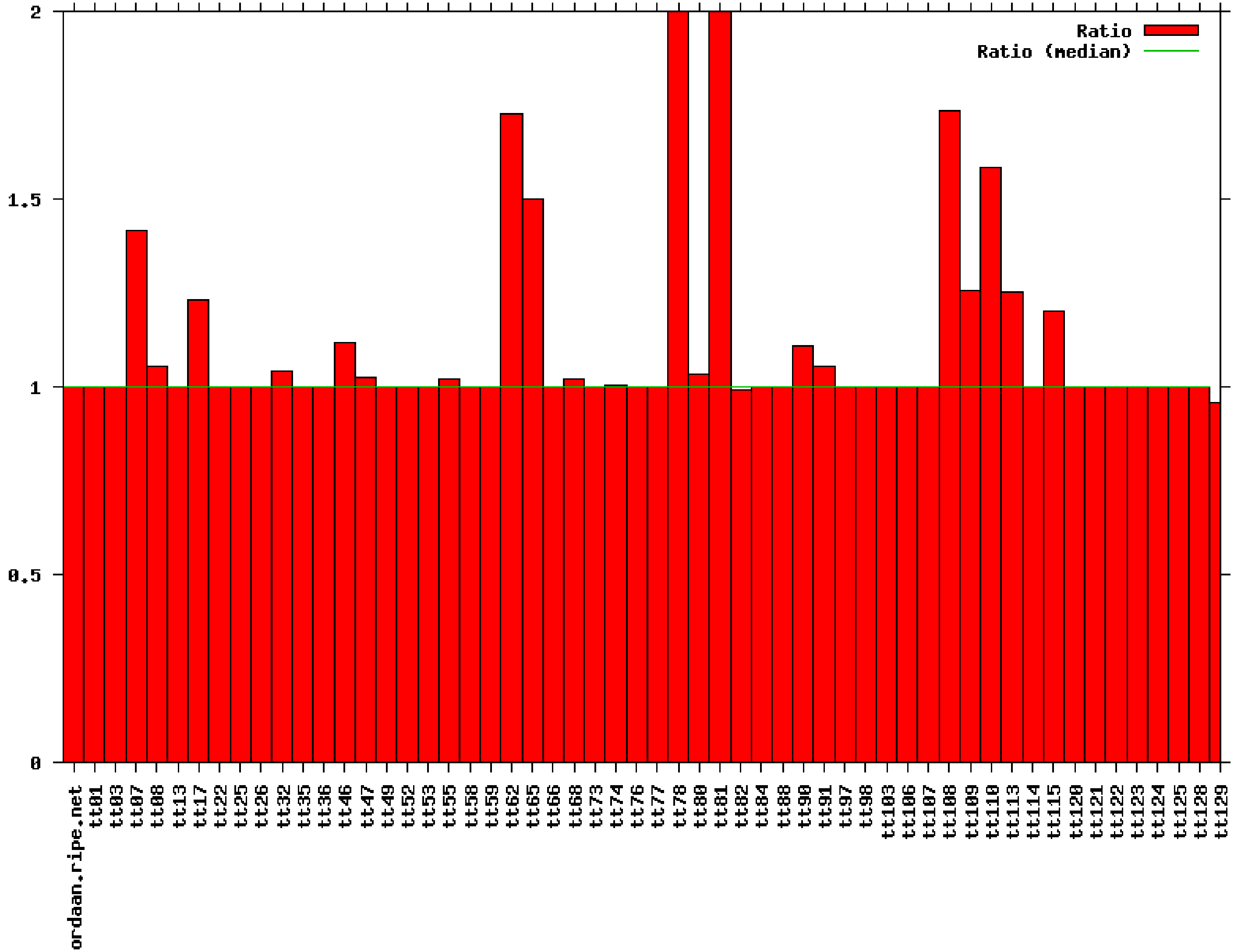
- What’s going on here? Perhaps:
  - Local node announcements don’t necessarily leak
  - But they do get announced to customers

    …and customers of customers

    …where they compete with announcements from global nodes

    …which lose out due to prepending

Latency comparison (global)



Latency: conclusions

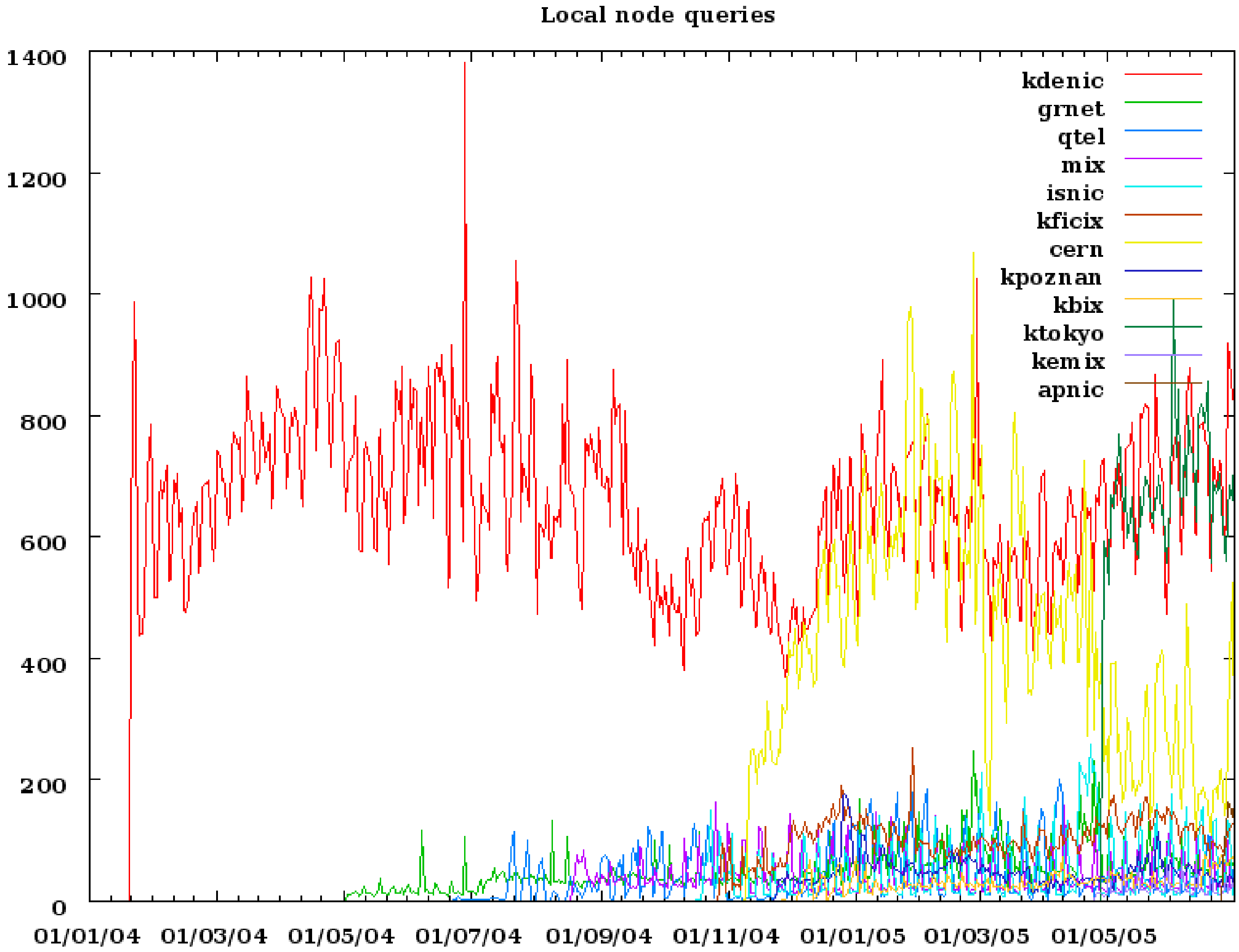
- Local nodes “confuse” the situation due to transit and prepending
- But all in all, BGP does a surprisingly good job
  - Even though the AS-paths are of different lengths!
- This contrasts with other work (Ballani & Francis)
  - Perhaps it is because K only has two global nodes
  - Will it get worse when more nodes are deployed?

Load balancing

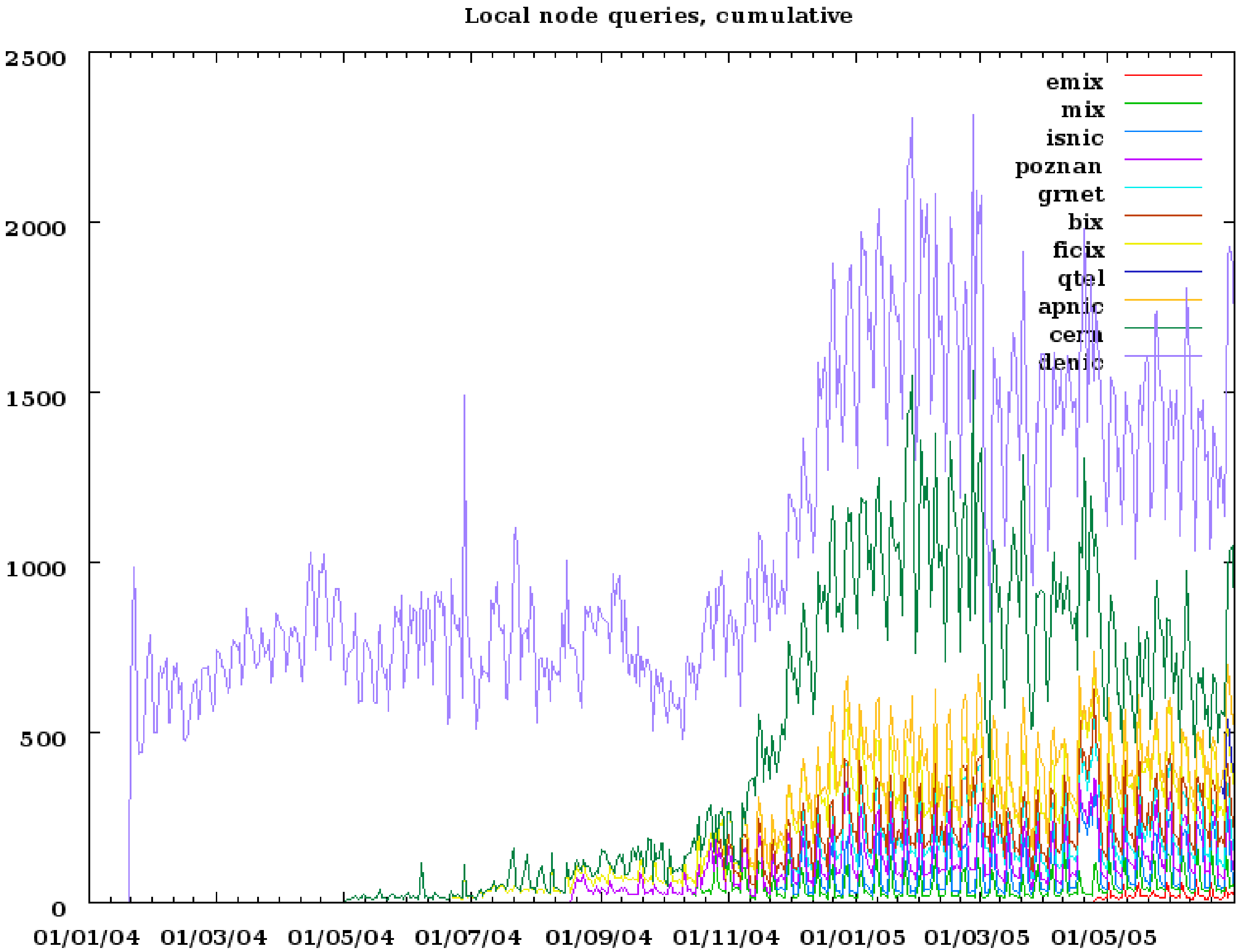
Usefulness of local nodes

- How much traffic does a local node get?
- Do local nodes take load off the global nodes?
- Where do local queries come from?
  - From the global K nodes?
  - From the other root servers?

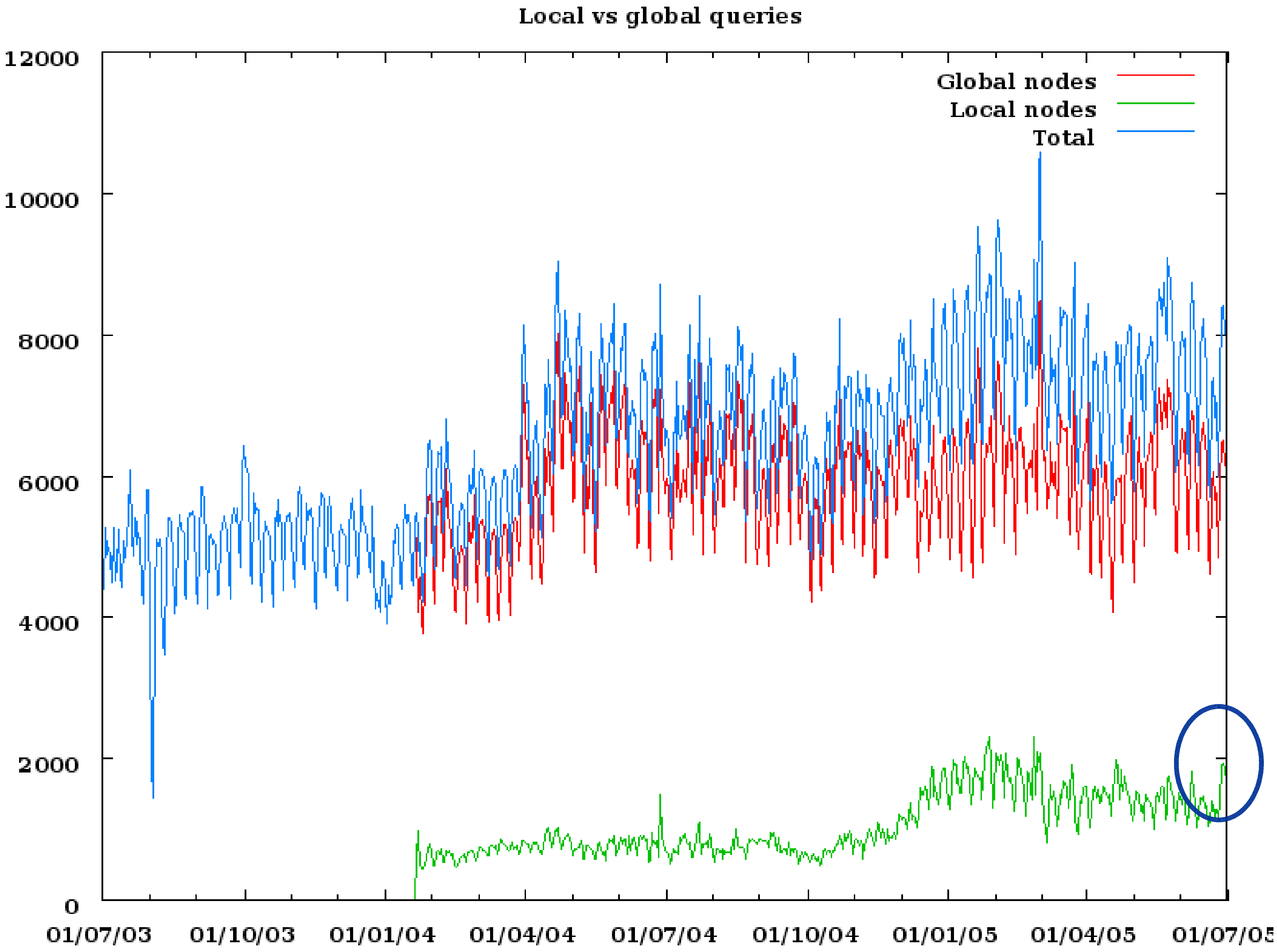
Local queries



Local queries (cumulative)



Local vs global



~23%

Load balancing: conclusions

- The traffic a local node gets depends on where it is
- Wide variation
- Location must be chosen carefully to maximise usefulness

- Local nodes do take load off the global nodes
  - but not much
- Increase in local traffic does not correspond to decrease in global traffic
  - Traffic mostly seems to come from the other roots

Stability

Instance switches

- Didn’t measure resiliency
  - Pretty much a given: the more servers there are,
    - the more they can withstand
    - the more localised the impact of an attack
- What about stability?
  - The more routes competing in BGP, the more churn
  - Doesn’t matter for single-packet exchanges (UDP)
  - Does matter for TCP queries
- How frequent are instance switches?

Detecting instance switches

- Measure at the server
- Look at instance switches that actually occur

- Procedure:
  - Look at packet dumps
    - At the time, there were only 2 global nodes
  - Extract all port 53/UDP traffic
  - For each IP address, remember where it was last seen
  - If the same IP is seen elsewhere, log a switch

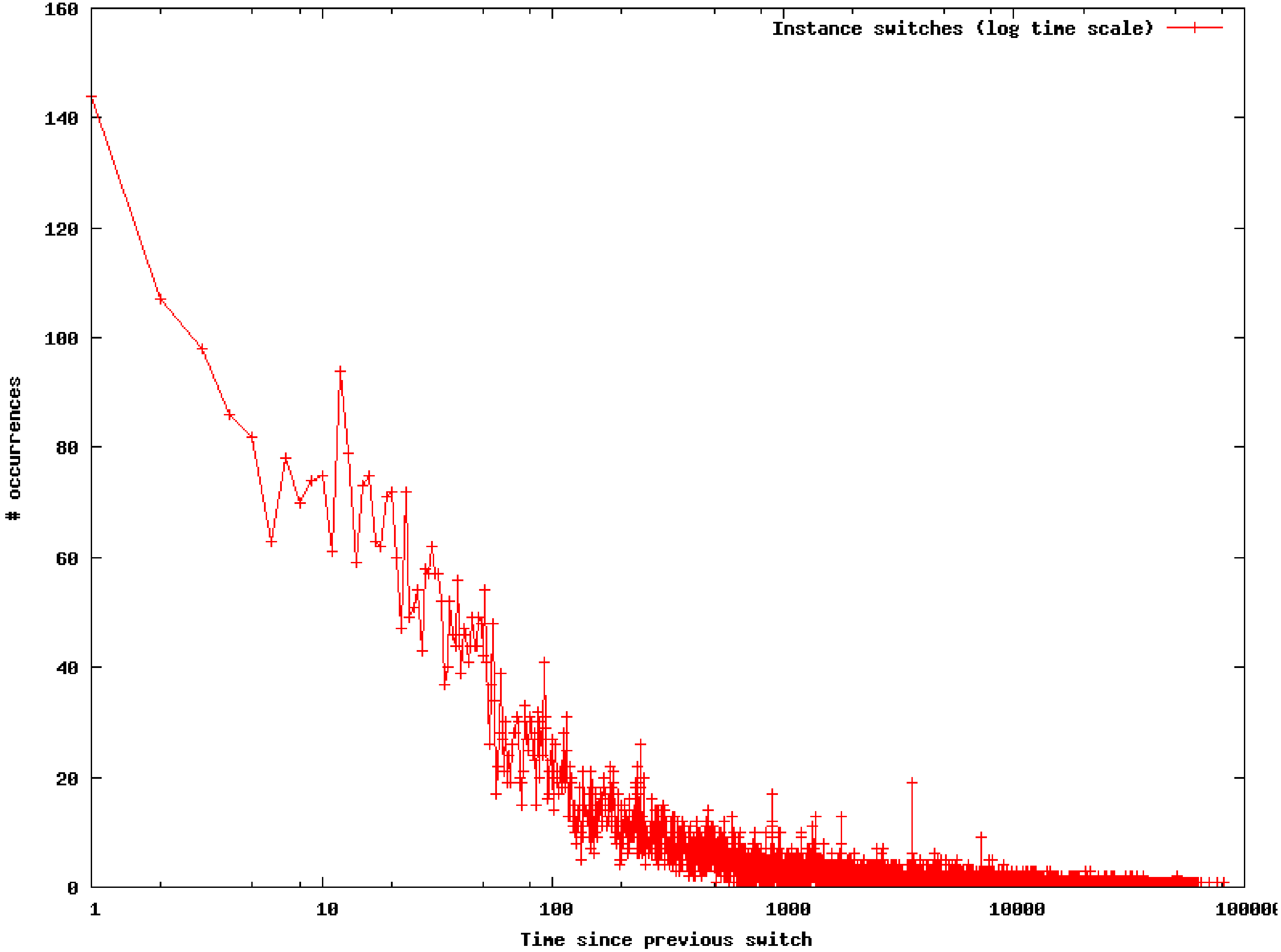
- Caveats:
  - K nodes are only NTP synchronized

Instance switches: results

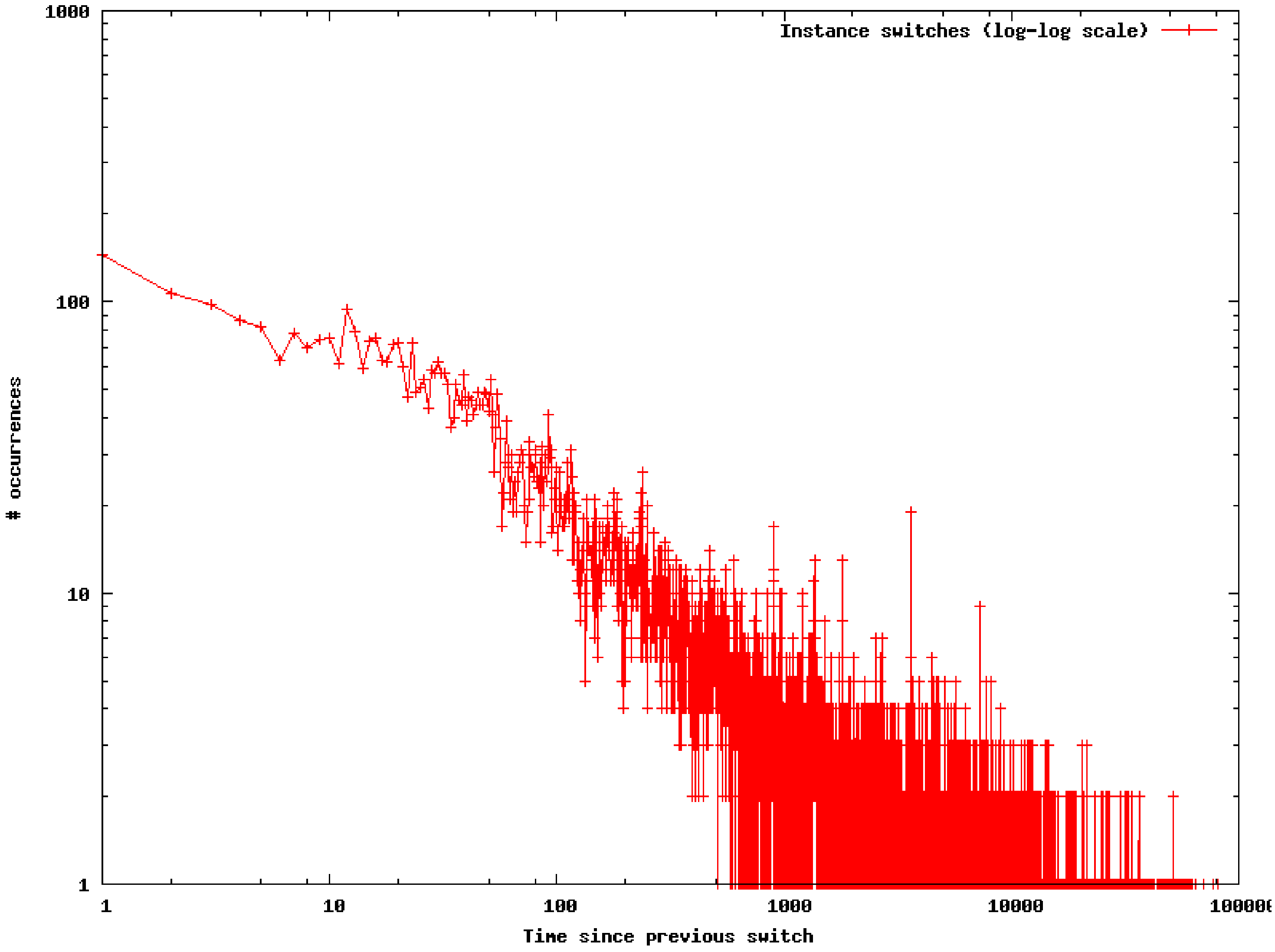
- 24 hours of data:
  - 527,376,619 queries
  - 30,993 instance switches (~0.006%)

  - 884,010 IP's seen
  - 10,557 switching IPs (~1.1%)
- What do the switches look like?

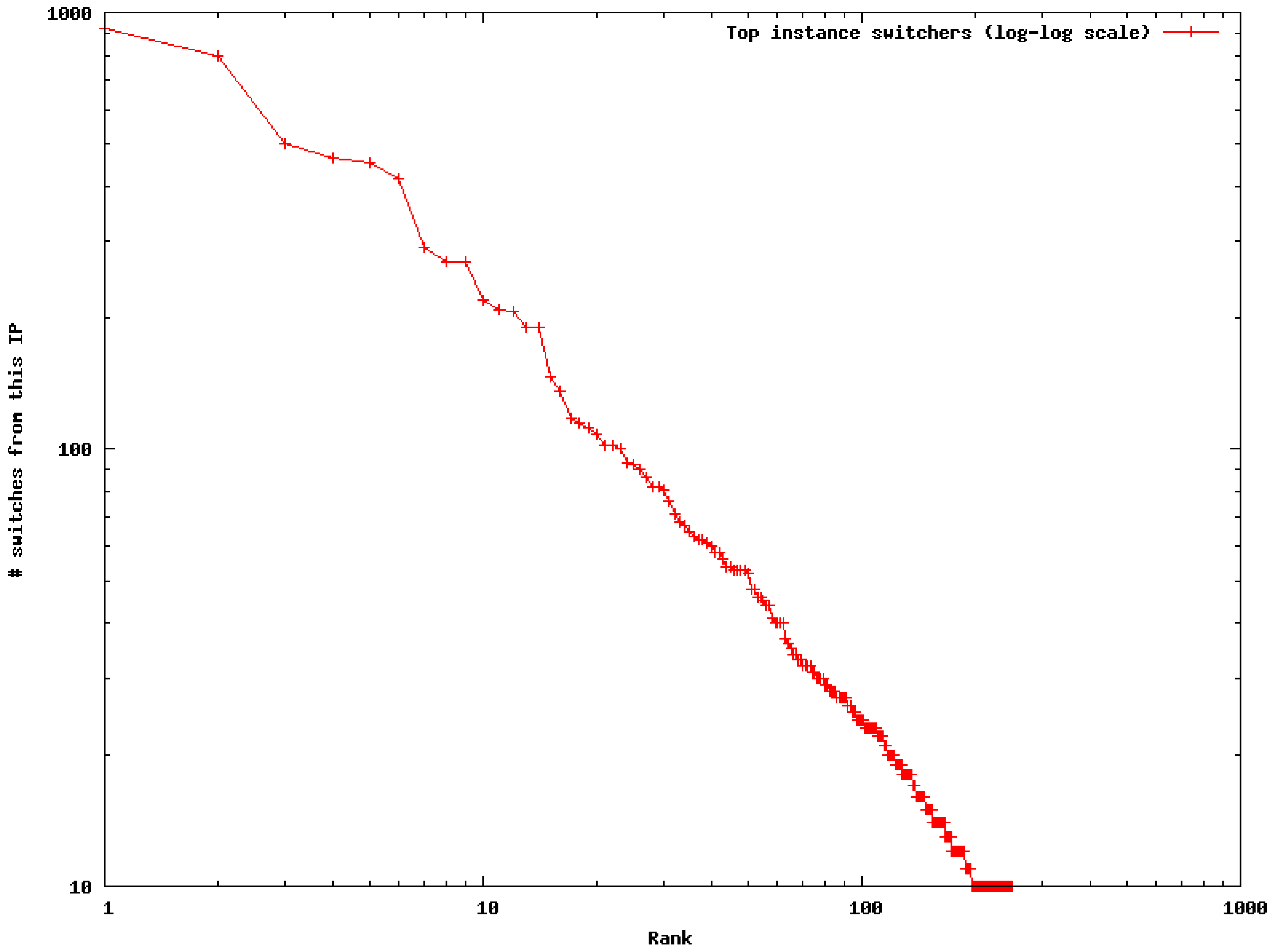
Time since last switch



Time since last switch, log-log



Top switching IPs



Stability: results

- Instance switches are rare
- Some IPs switch a lot
  - Load balancing?

- Nice power laws, but what do they mean?
- We don’t know yet
- Further analysis needed

Questions?