Timeouts: Beware Surprisingly High Delay

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Outline

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1. Introduction

- Paper addresses researchers who work with active probing of hosts on the internet
- Hypothesis: timeouts generally used in research are too short (~ 3 seconds)
- Goal: find a reasonable timeout value to use in this field of study

2. Importance of Probe Timeouts

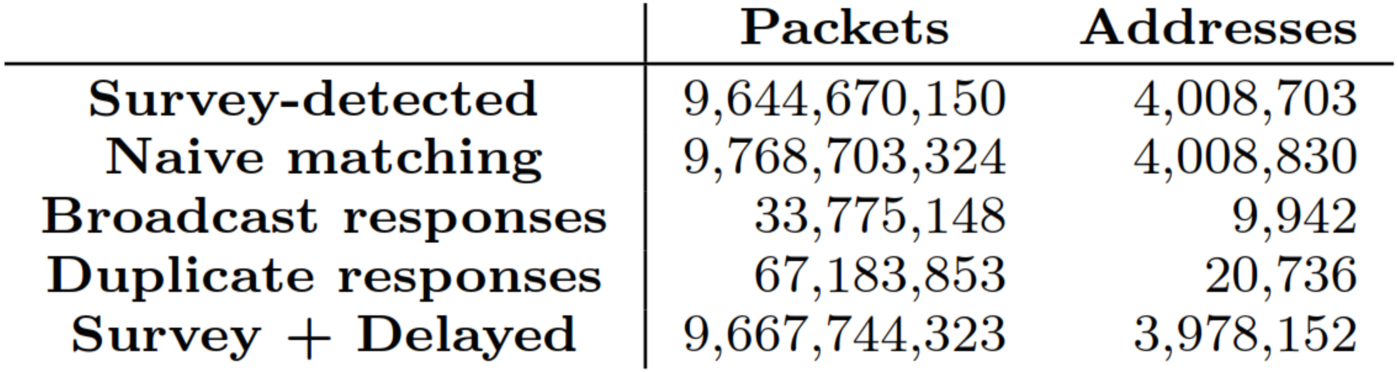
- Paper argues: active probing timeout values need to be selected carefully → influence data measurably
- Too short timeouts:
  - Packets delayed due to congestions? → Host declared offline falsely
- Too long timeouts:
  - More states need to be maintained on the researchers side
  - Hardware limitations might weigh in

3. Datasets Overview

- ISI survey data set
  - Internet wide survey, 24.000 /24 blocks (1% of globally allocated IPs)
  - Each survey: probe all 256 addresses once each 11min for 2 weeks
  - 103 surveys completed between 04/2006 and 02/2015
- Data format
  - Matched responses: answer came in under 3 seconds
  - Unmatched responses: answer took longer than 3 seconds
    - Delayed
    - Broadcast responses (response from different IP than request)
    - DoS responses (cases where hosts answered with >4 packets)

4. The Recommended Timeout Value

- Combined dataset
  - Originally matched + later matched packets
  - Broadcast/Duplicate addresses are filtered out



	Packets	Addresses
Survey-detected	9,644,670,150	4,008,703
Naive matching	9,768,703,324	4,008,830
Broadcast responses	33,775,148	9,942
Duplicate responses	67,183,853	20,736
Survey + Delayed	9,667,744,323	3,978,152

- Data collected from newly forged dataset
  - To detect 95% of pings from 95% of addresses → ~5 second timeout
  - Delay of 1% of pings from 1% of addresses > 145 seconds

4. The Recommended Timeout Value

- Answer to research question:
  - **60 second timeouts** or no timeout value at all if possible
    - covers 98% of echo replies from 98% of addresses
    - ≈ 96% of all responses
  - Compromise between wait time and detection rate

5. Do long Ping Times really exist?

- Are extreme ping times (> 100 sec) real? Or a byproduct of:
  - ISI probing scheme?
  - Errors in data sets?
  - Discrimination of ICMP in relation to TCP/UDP?

➔ Own study on long ping times using own TCP/UDP test and ZMap & Scamper

5. Do long Ping Times really exist?

- TCP/UDP testing
  - Send ICMP/TCP/UDP probes 20 minutes apart

  → No discrimination
- Scamper study
  - Pick high-latency addresses from ISI dataset (2000 IPs)
  - Ping each address 1000 times
  - Results:
    - Most latencies < 10 seconds
    - But 0.17% of responses took > 100 seconds

    → Latency prone addresses change, but…

    … existence of extremely high delays verified!

5. Do long Ping Times really exist?

- ZMap data
  - Request & response-data from 04/2015 to 07/2015
  - Results:
    - 5% of responses took > 1 second
    - 0,1% of responses took > 75 seconds
    - Again: existence of extremely high latencies verified!
- Additional Findings
  - Timeout required to catch 90% of responses:
    - 2007: ~2 seconds
    - 2011: ~5 seconds

    → Latencies increased over the years

6. Why do Pings take so long?

- Use Maxmind to find geographic location and Autonomous System of high-latency hosts
    - Are Satellite links the cause of ultra high delays?
        - Satellites have a theoretical minimum latency of 500ms
        - The highest ping measured was 517 seconds high
        - But 99% of satellite pings are < 3 seconds

→ Satellites are not the cause of extremely high latency

6. Why do Pings take so long?

- Also found with Maxmind
    - Most high latency hosts are in cellular Autonomous Systems

- 2 Categories
    - Latencies > 1 second → “Turtle”
    - Latencies > 100 seconds → “Slow Turtle”

- South America & Asia account for 75% of all Turtles
- 1/4 of all South American and 1/3 African hosts is also a Turtle

6. Why do Pings take so long?

- What is the source of Turtles in cellular ASes?
  - First ping behavior:

extraordinary temporary, initial latency due to MAC-layer time slot negotiation or device wake-up

- What is the source of slow turtles?
  - No real source, only 2 main patterns:
    - latencies steadily decay
    - latencies continuously high and loss in between

7. Conclusion

- Latencies are higher than expected…
- …and have been increasing over the years
- Latencies are NOT part of measurement choices (ICMP)
- NOT due to vantage points
- NOT due to probing schemes
- NOT caused by satellite per se
- Often caused by initial communication over cellular ASes

7. Conclusion

- Key takeaways:
  - Listen long echo responses! Host might just be slow, not offline
  - Design probing with 60 second timeout or no timeout at all

Discussion