Drongo

CoNEXT ‘17

Incheon, South Korea

CDN & Caching Session

Speeding Up CDNs with Subnet Assimilation *from the Client*

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Northwestern University

Bird’s Eye View

- What is Drongo?
- Why we need Drongo
- Performance Analysis
- Thoughts & Conclusions
- Questions

What is Drongo?

What is Drongo?

It’s a bird!

What is Drongo?

It’s a bird!

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What is Drongo?

It’s a **system that allows *end-users* to enhance the QoS** (quality of service) they get from Content Distribution Networks (**CDN**s)

What is Drongo?

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(in this talk, QoS = ***latency***)

Why Latency?

Why Latency?

- Latency is **time**

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- Latency is **time**
- Latency is **money**
  - Google (Marissa Mayer), Amazon (Greg Linden)
    - Web 2.0 Summet, glinden.blogspot.com

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- Latency is **money**
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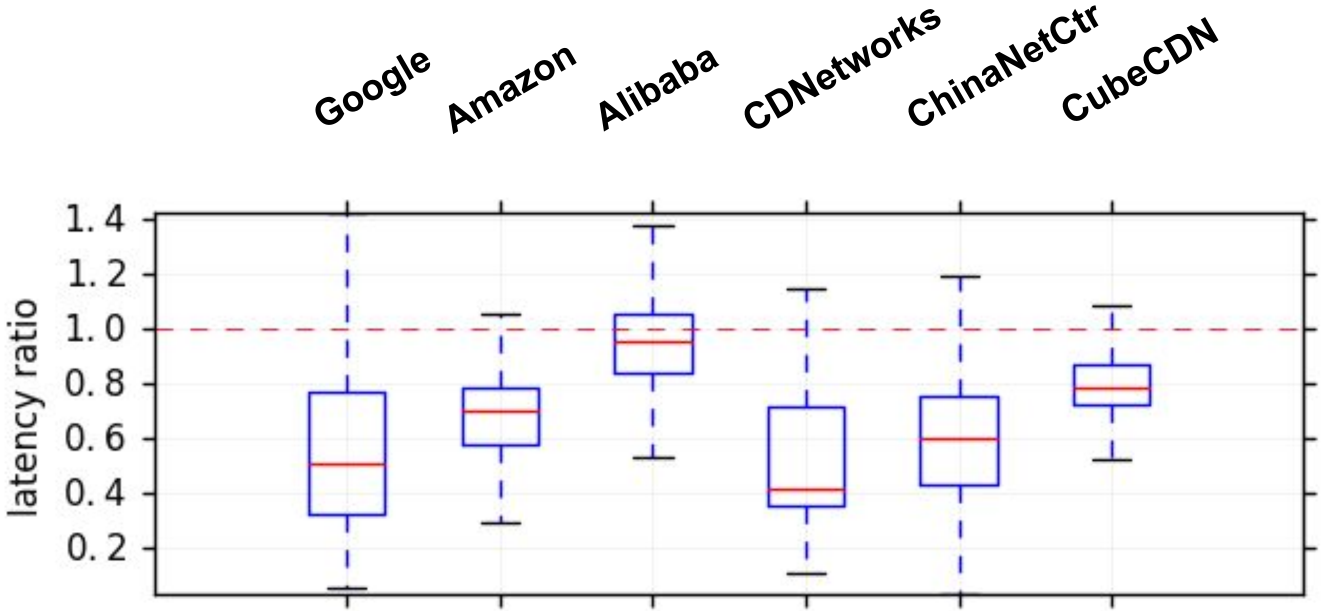
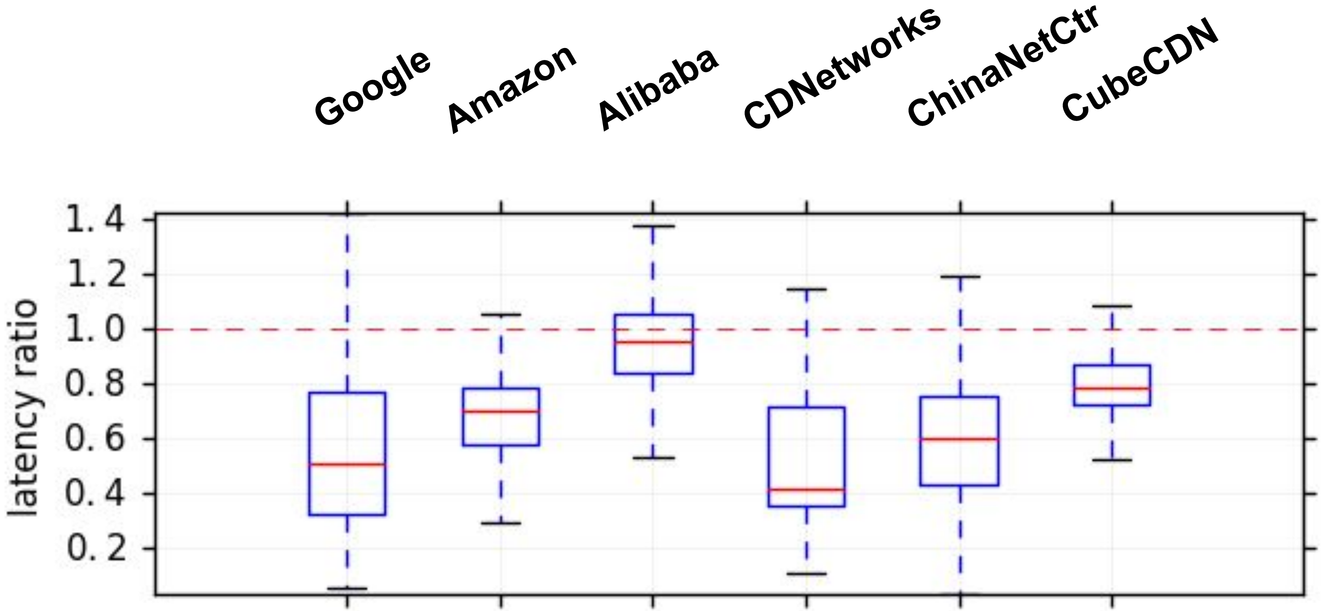
- Latency is the **bottom line**
    - "What we have found running our applications at Google is that latency is as important, or more important, for our applications than relative bandwidth," Amin Vahdat (Google)

Drongo helps you (the end user) *lower* your own latency!

Drongo's Effect on Latency



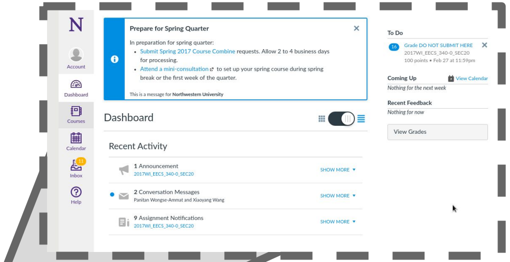
Drongo's Effect on Latency



ONLY client-side changes

Example Scenario

Provider wants to serve client



Prepare for Spring Quarter

In preparation for spring quarter:

- Submit Spring 2017 Course Combine requests. Allow 2 to 4 business days for processing.
- Attend a mini-consultation to set up your spring course during spring break or the first week of the quarter.

This is a message for **Northwestern University**

Dashboard

Recent Activity

1 Announcement
2017WI_EECS_340-0_SEC20
SHOW MORE ▾

2 Conversation Messages
Panitan Wongse-Ammat and Xiaoyang Wang
SHOW MORE ▾

9 Assignment Notifications
2017WI_EECS_340-0_SEC20
SHOW MORE ▾

To Do

16 Grade DO NOT SUBMIT HERE
2017WI_EECS_340-0_SEC20
100 points • Feb 27 at 11:59pm

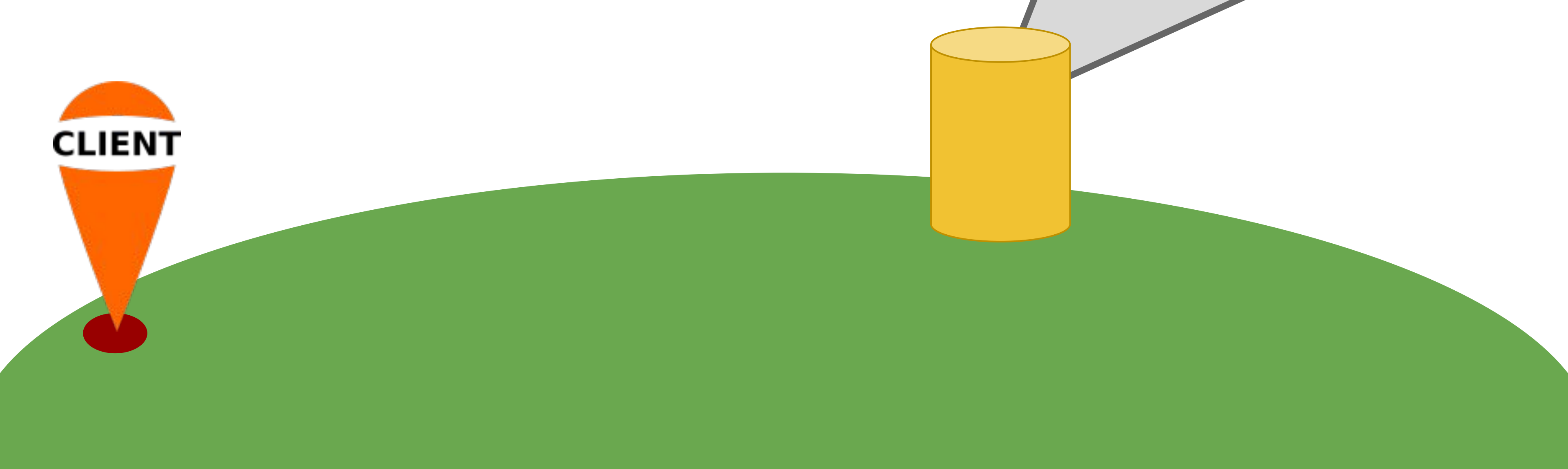
Coming Up View Calendar

Nothing for the next week

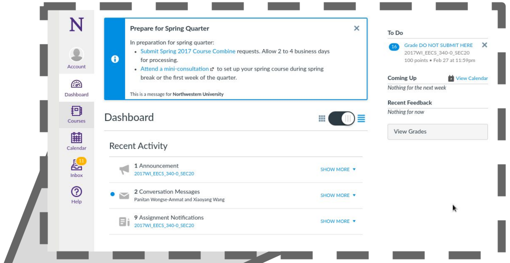
Recent Feedback

Nothing for now

View Grades



Client is far



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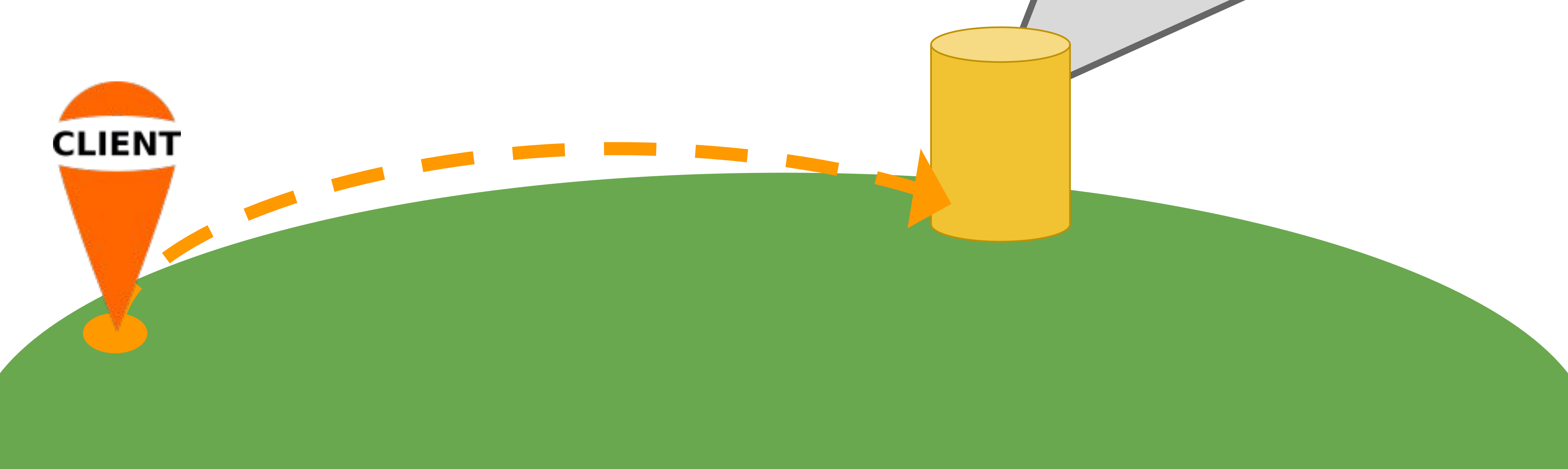
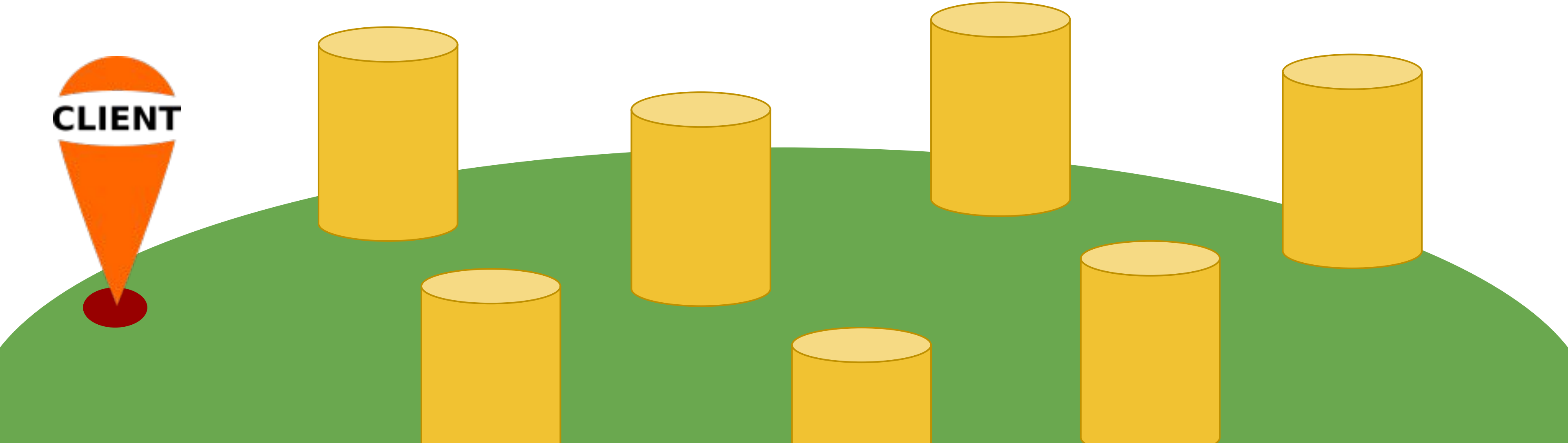
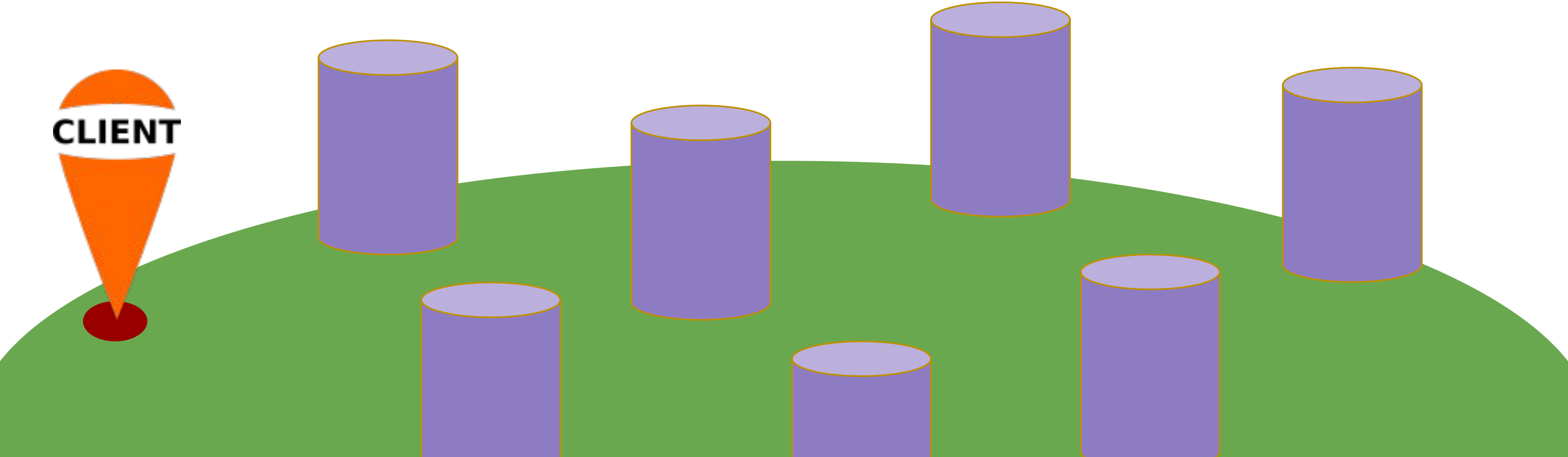


CDN = more replica locations

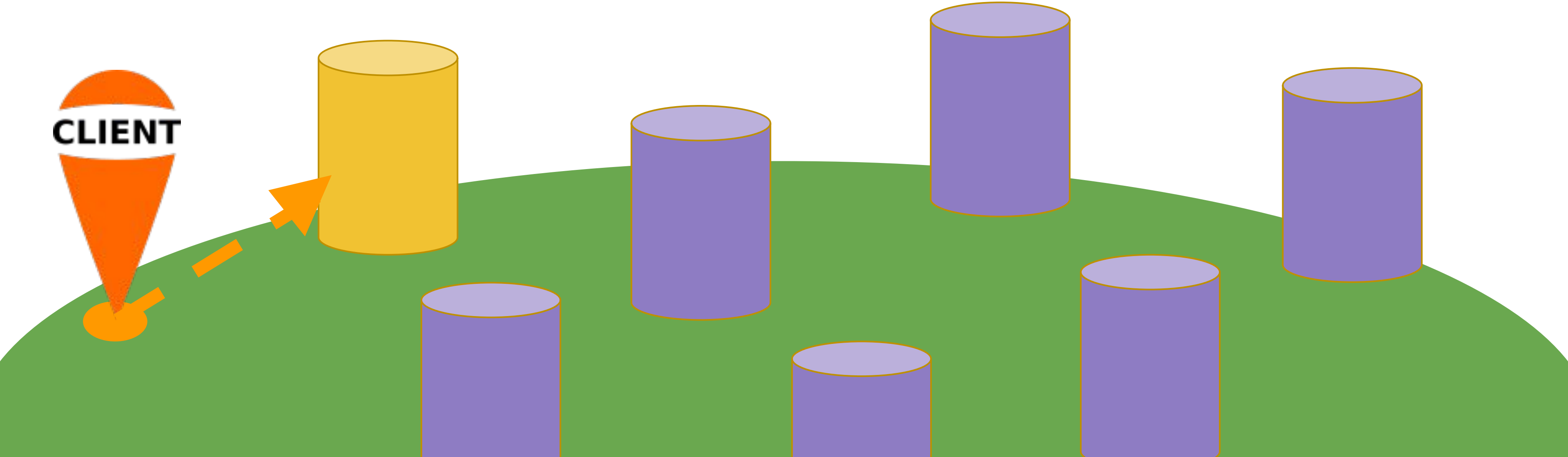


DNS Redirection

Which **replica** serves the client?

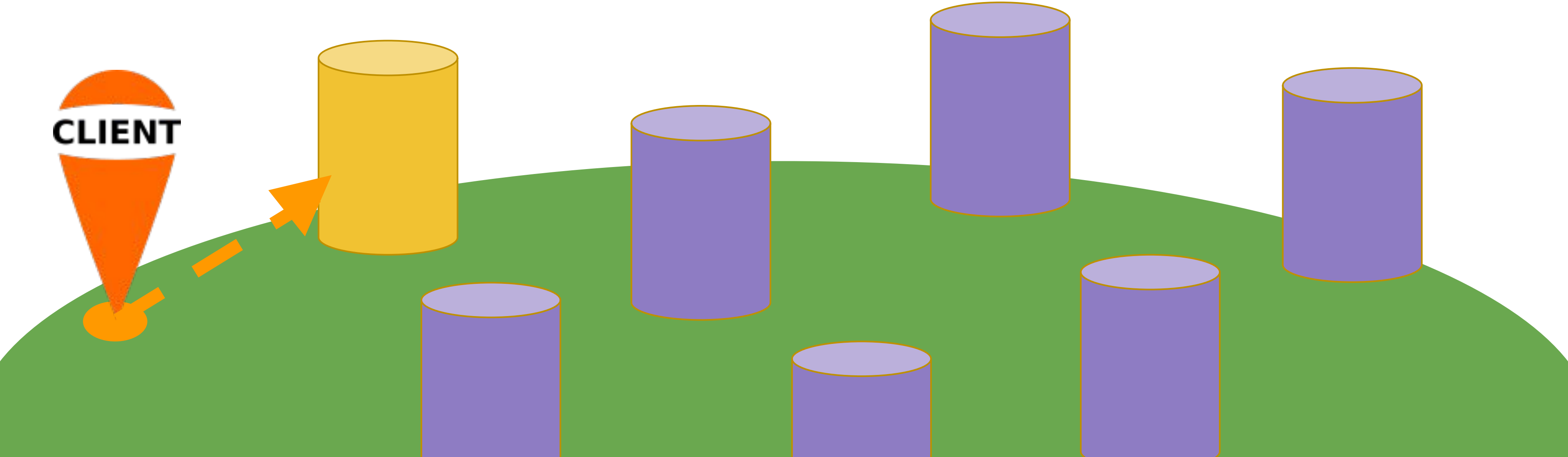


Choose the “closest” server

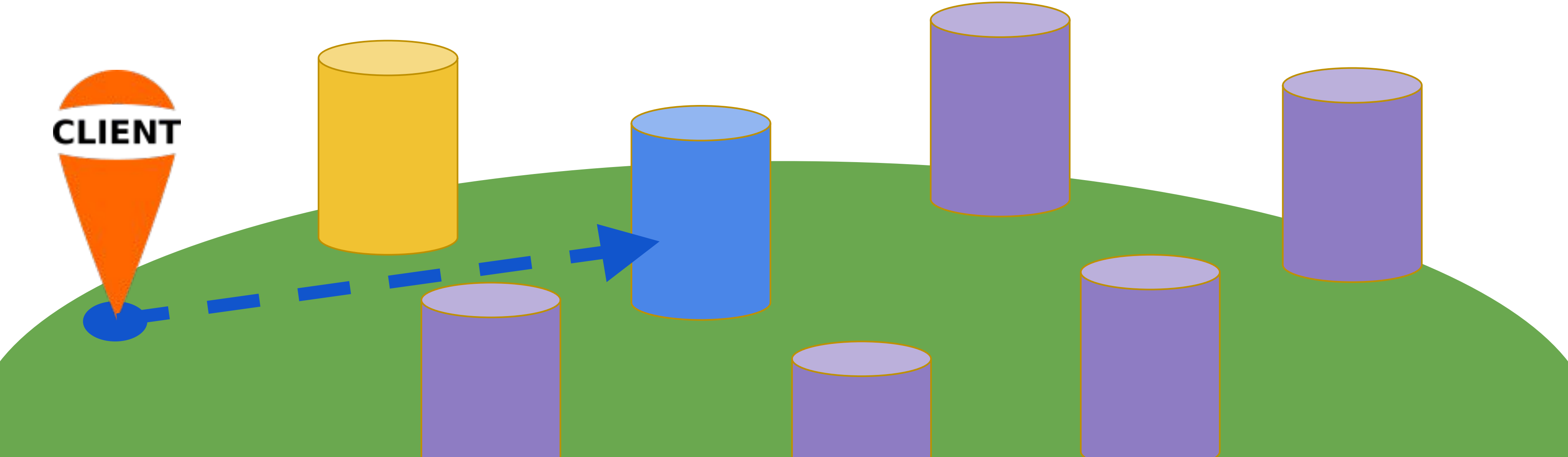


Choose the “closest” server

This choice is **nontrivial**!



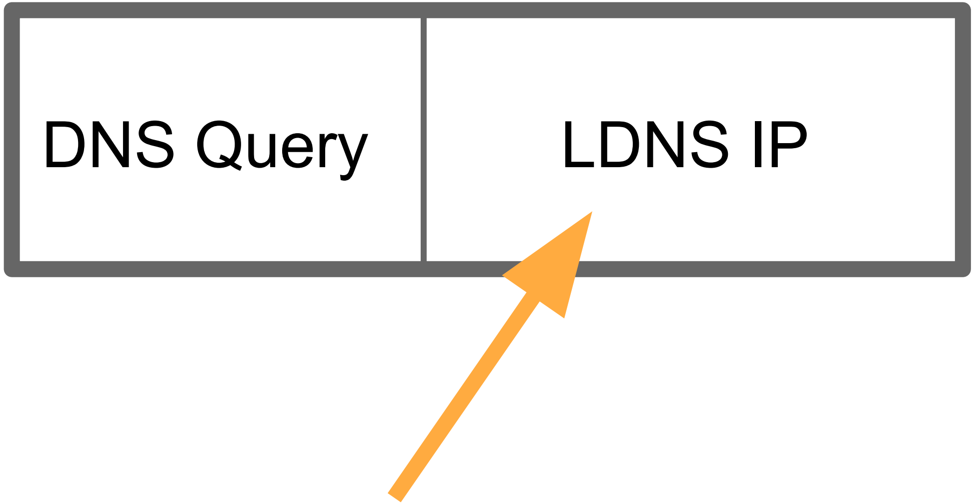
Often Suboptimal Choices!



Maybe just a far LDNS...

[Chen - SigComm ’15; Huang - SigComm CCR ‘12; Alzoubi - WWW ‘13; Rula - SigComm ‘14 …]

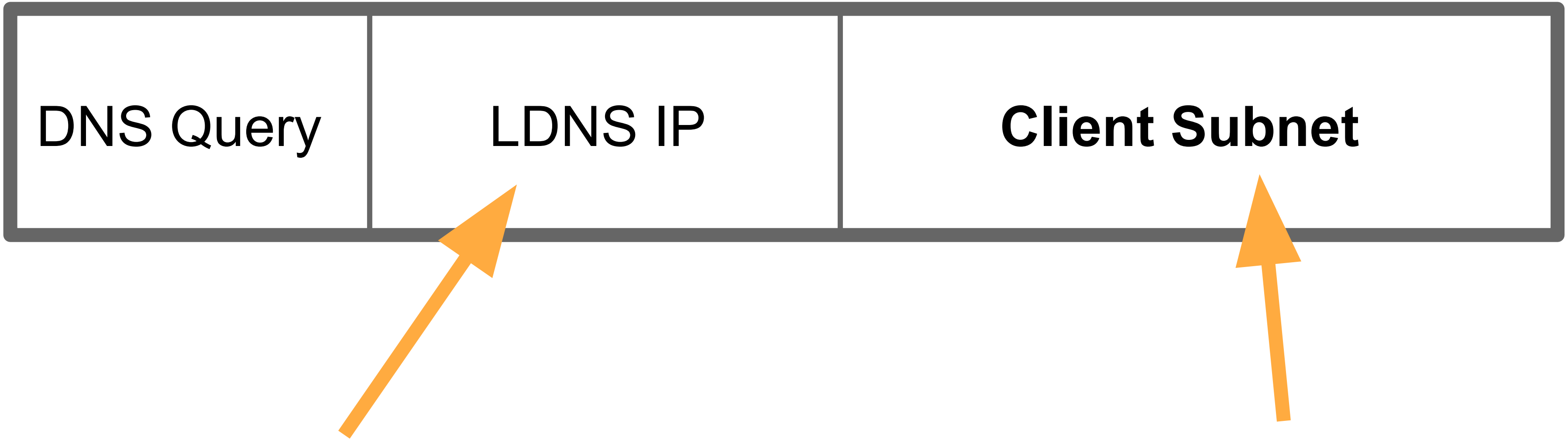
Ordinary DNS Query



DNS Query	LDNS IP

Somewhere in California

EDNS0 Client-Subnet extension (ECS)

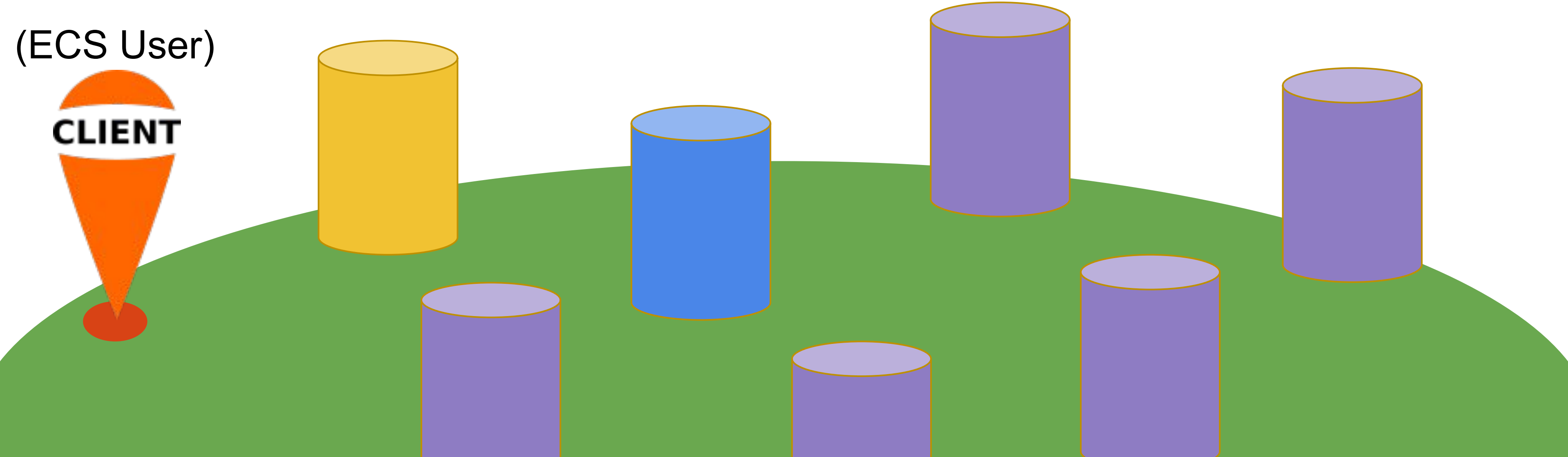


DNS Query	LDNS IP	**Client Subnet**

Somewhere in California

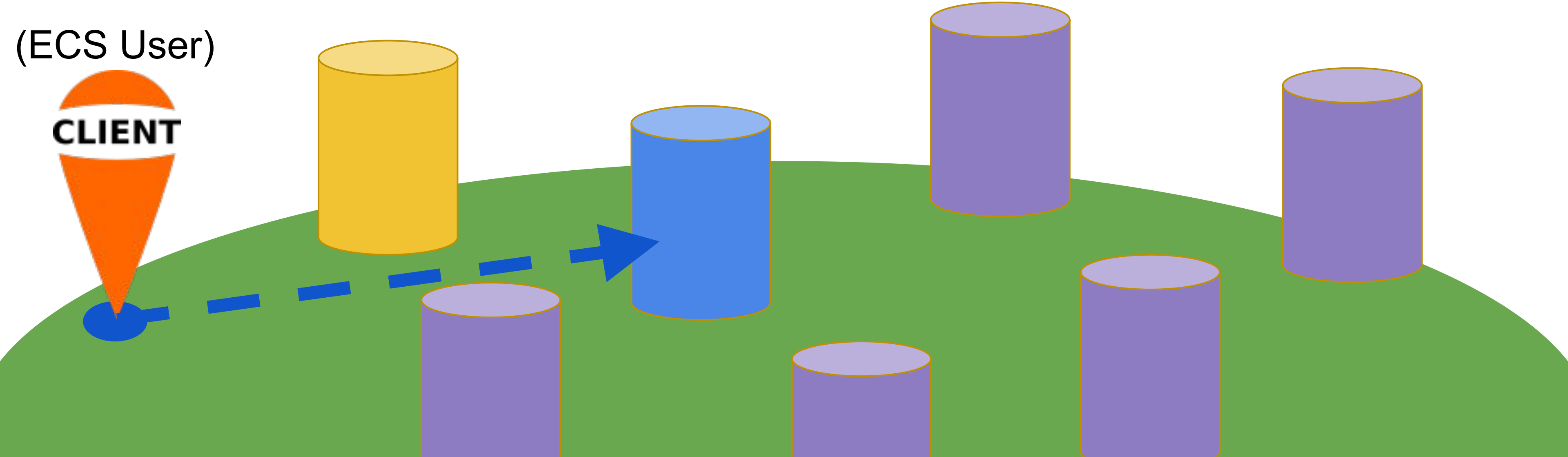
Actually somewhere in New York

We used ECS:



We used ECS:

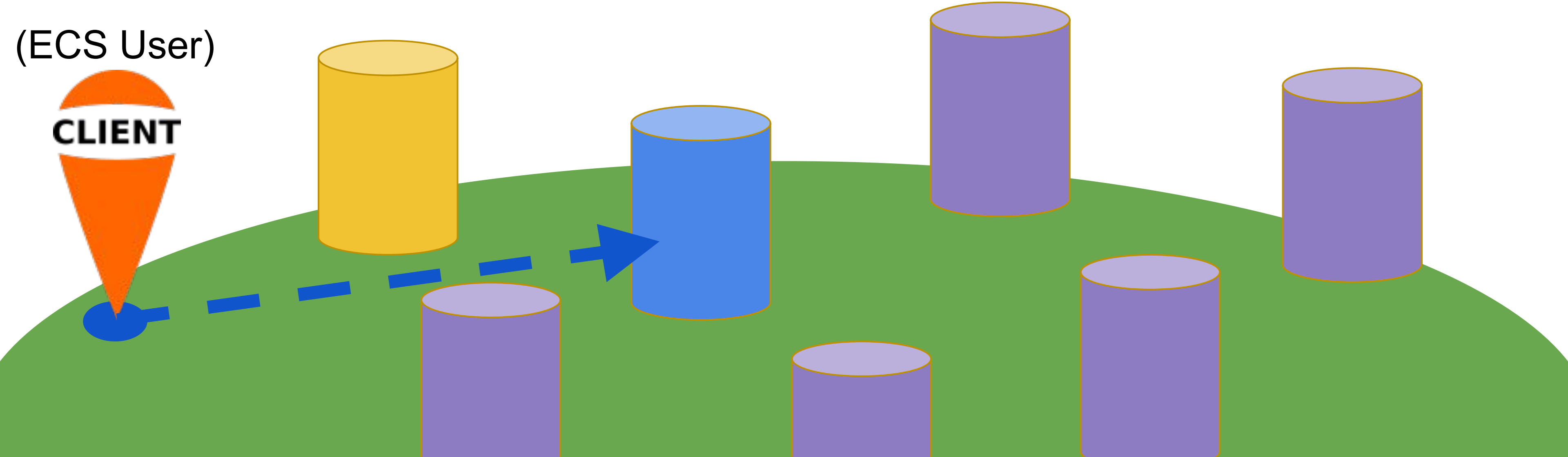
This still happens



We used ECS:

This still happens

… frequently



Really? …

Really? …

YES!
We measured it!

How did we measure it?

How did we measure it?

search

Find subnets directed to different replicas

Subnet Assimilation

DNS Query	LDNS IP	**Client Subnet**

Subnet Assimilation

DNS Query	LDNS IP	~~Client Subnet~~ Other Subnet

How did we measure it?

search

Find subnets directed to different replicas

measure

Perform pings and downloads to each replica

How did we measure it?

search

Find subnets directed to different replicas

measure

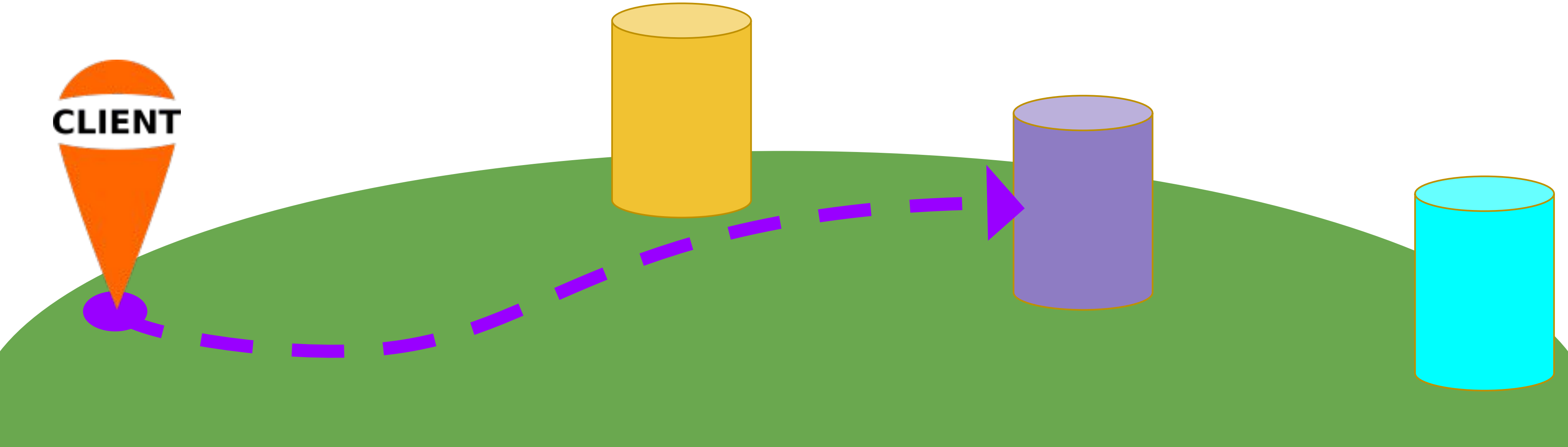
Perform pings and downloads to each replica

compare

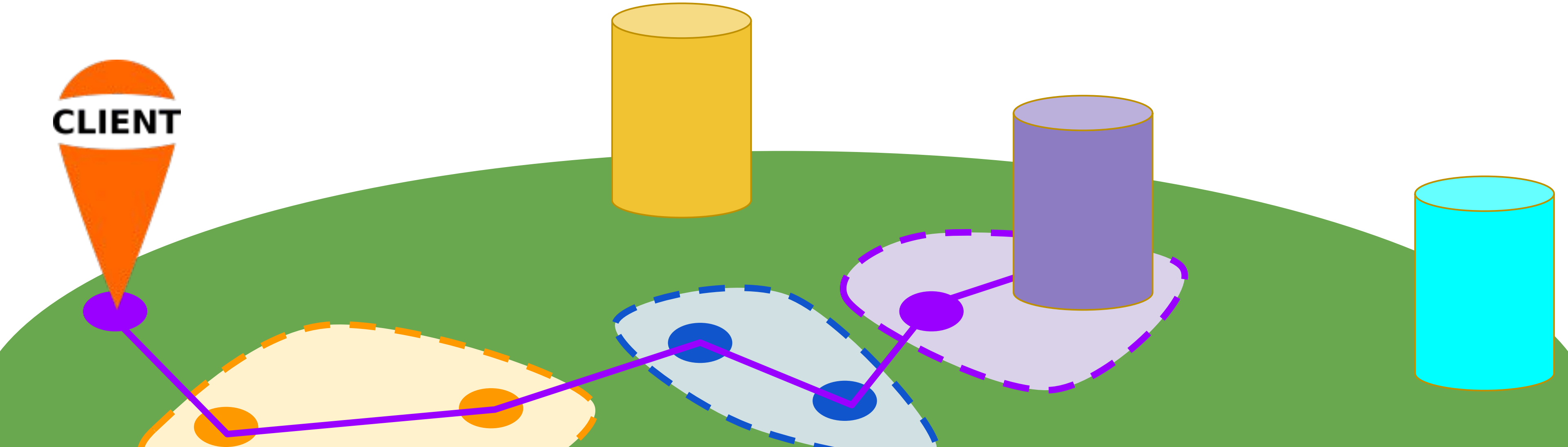
Identify which subnet resulted in the “best” replica

1. Get "Default" Choice

(use **client's** own subnet for ECS)

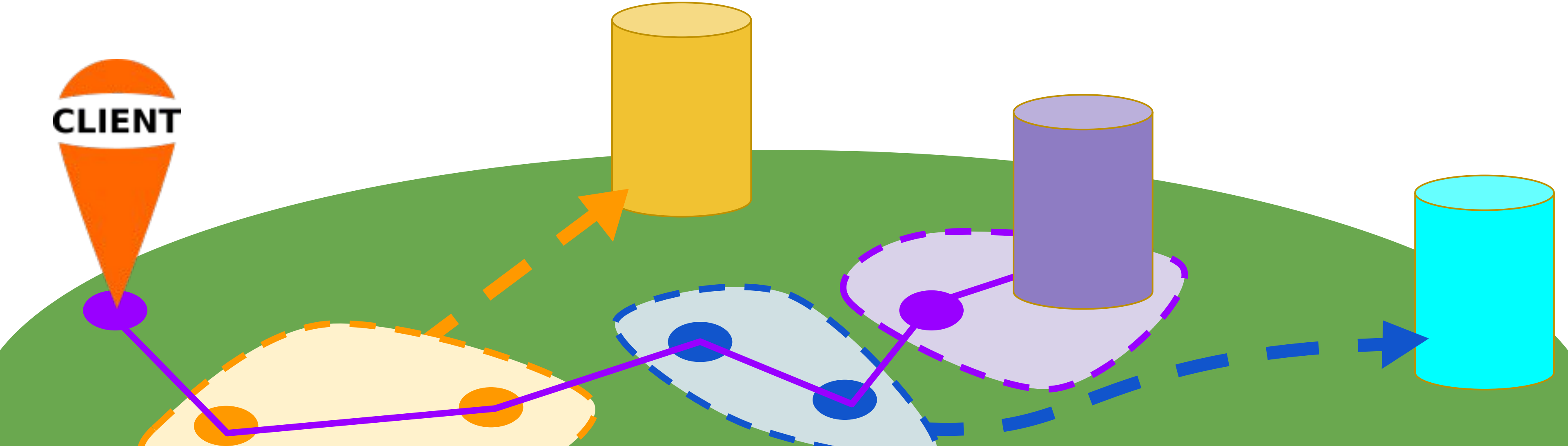


2. Traceroute to default choice

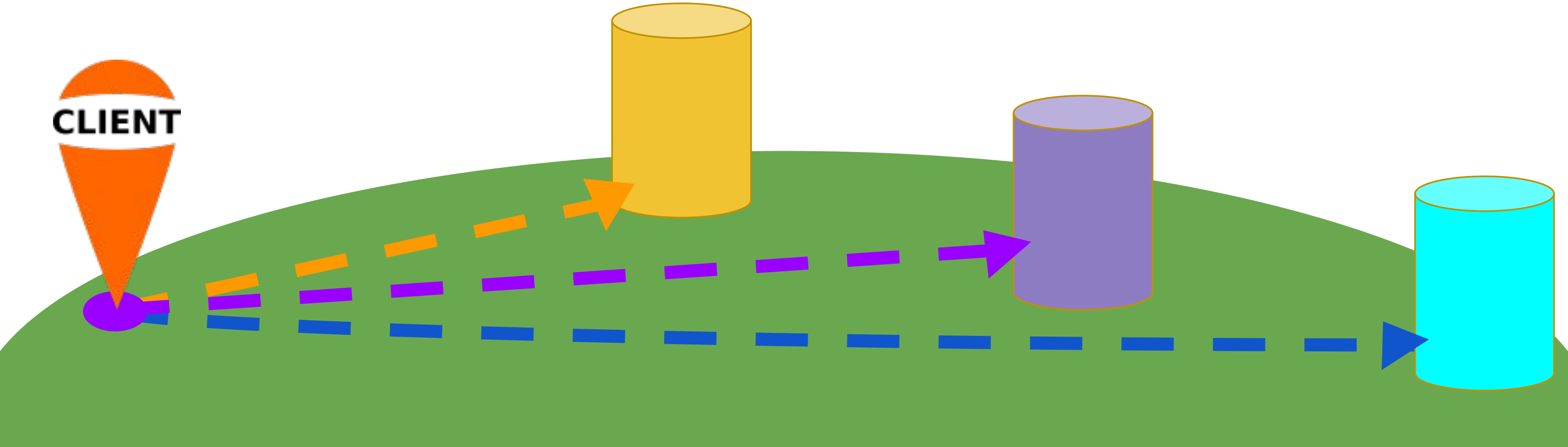


3. Get Hop Subnet Choices

(use **hops’** subnets for ECS)

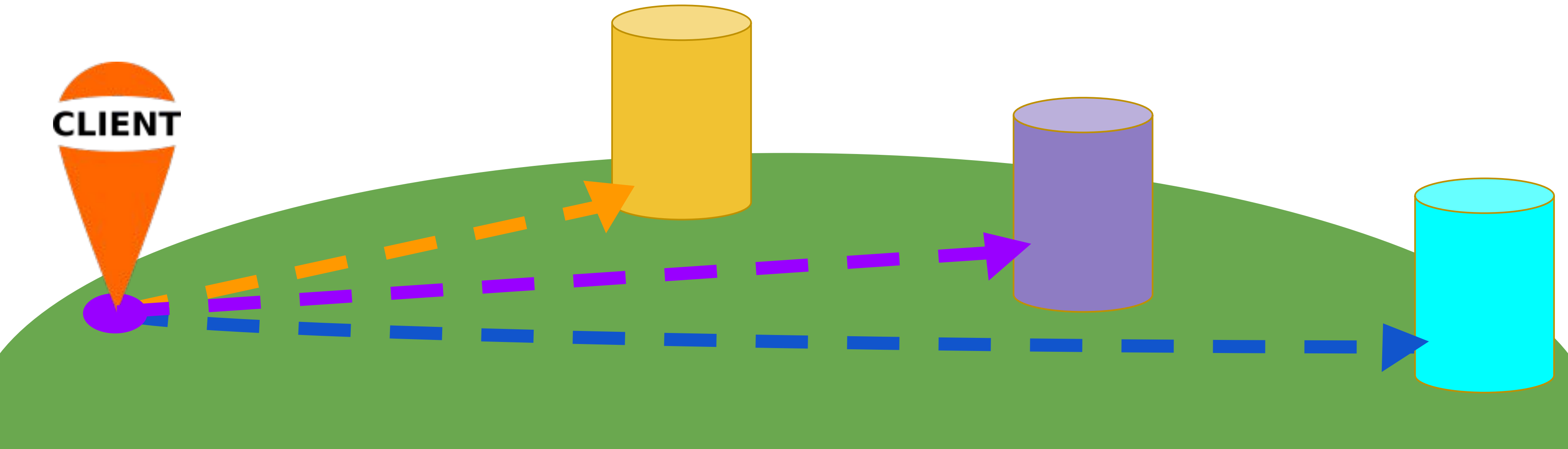


4. Measure Latencies



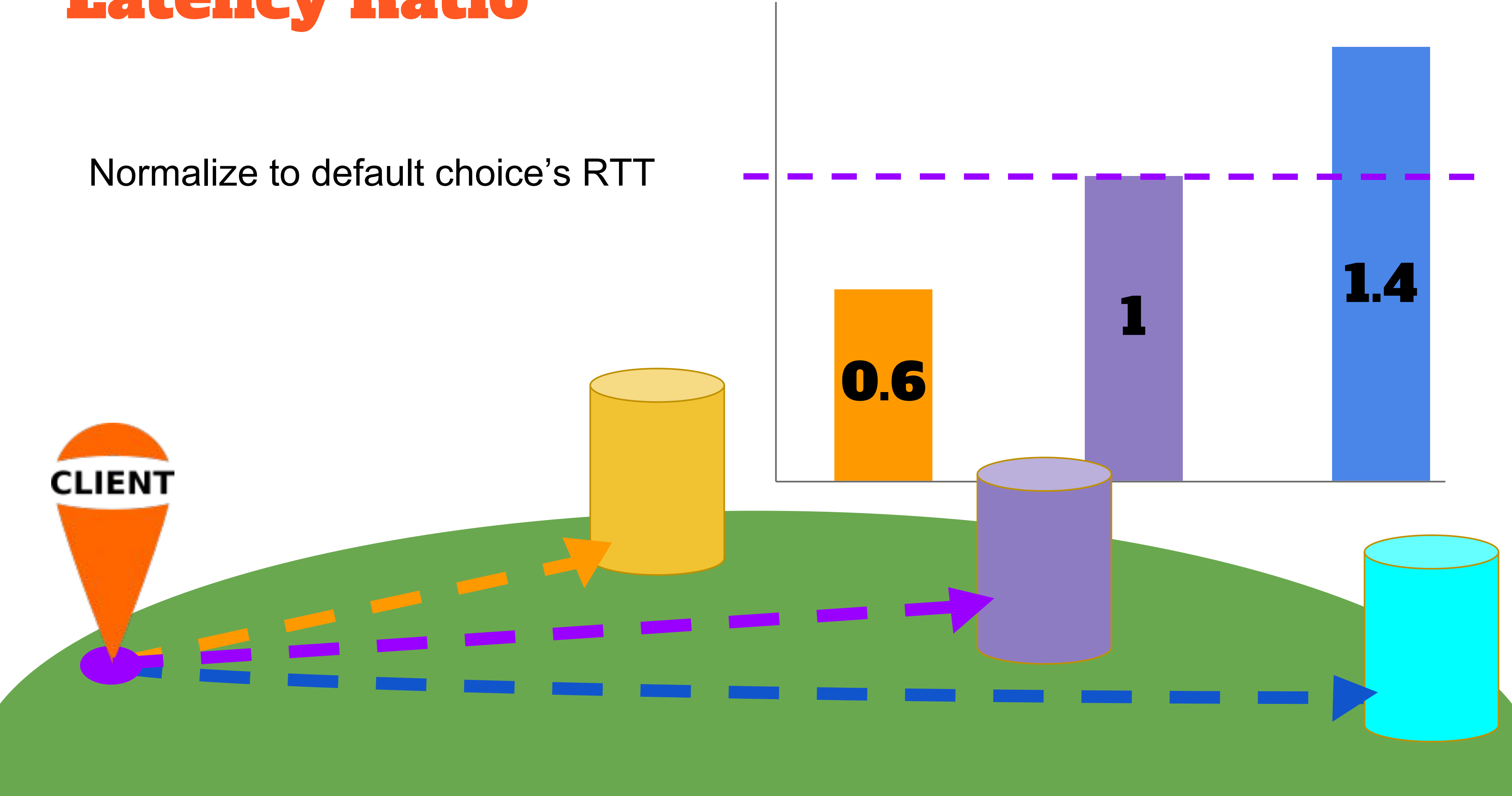
4. Measure Latencies

Steps 1-4: a “trial”

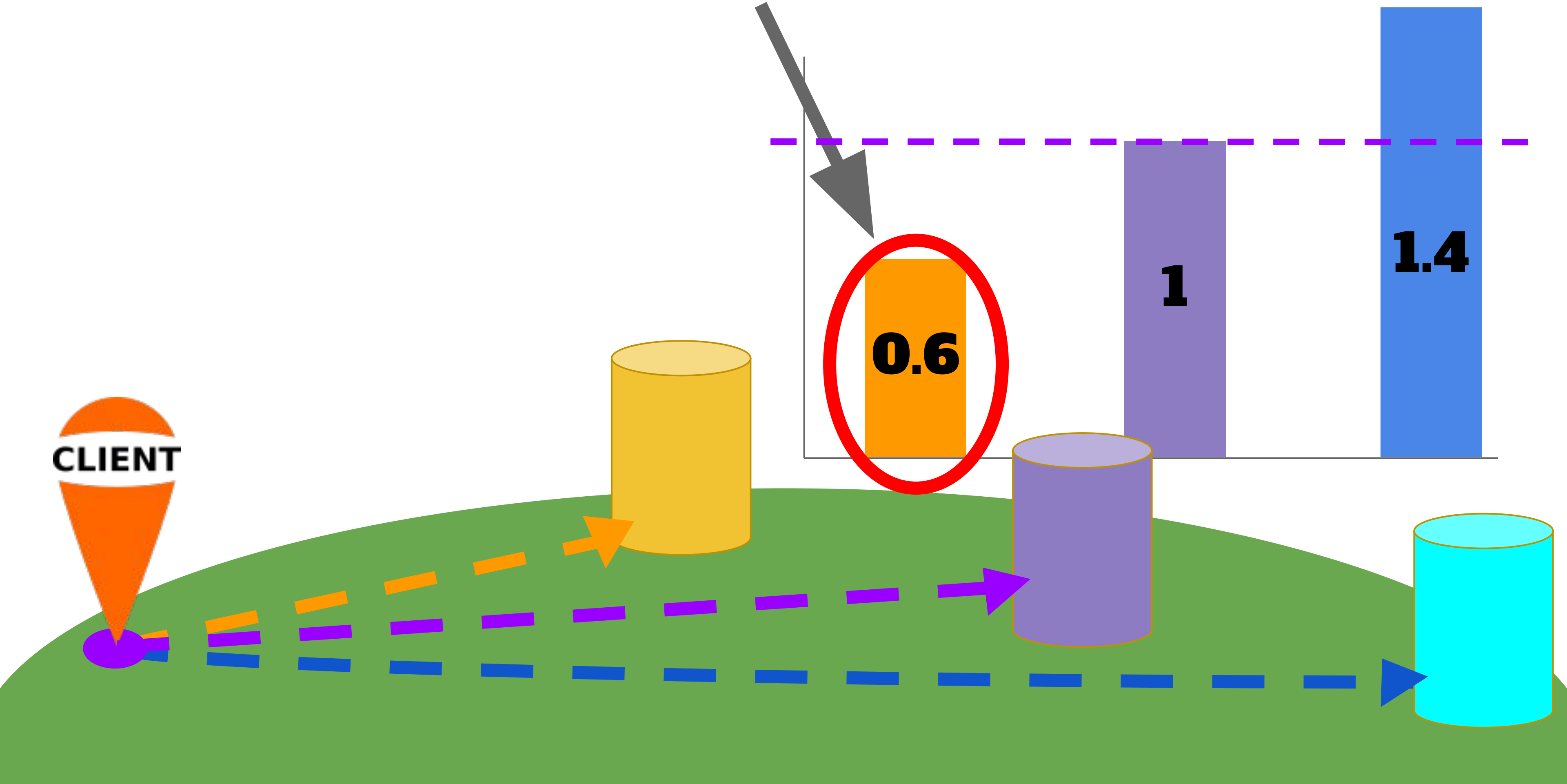


Latency Ratio

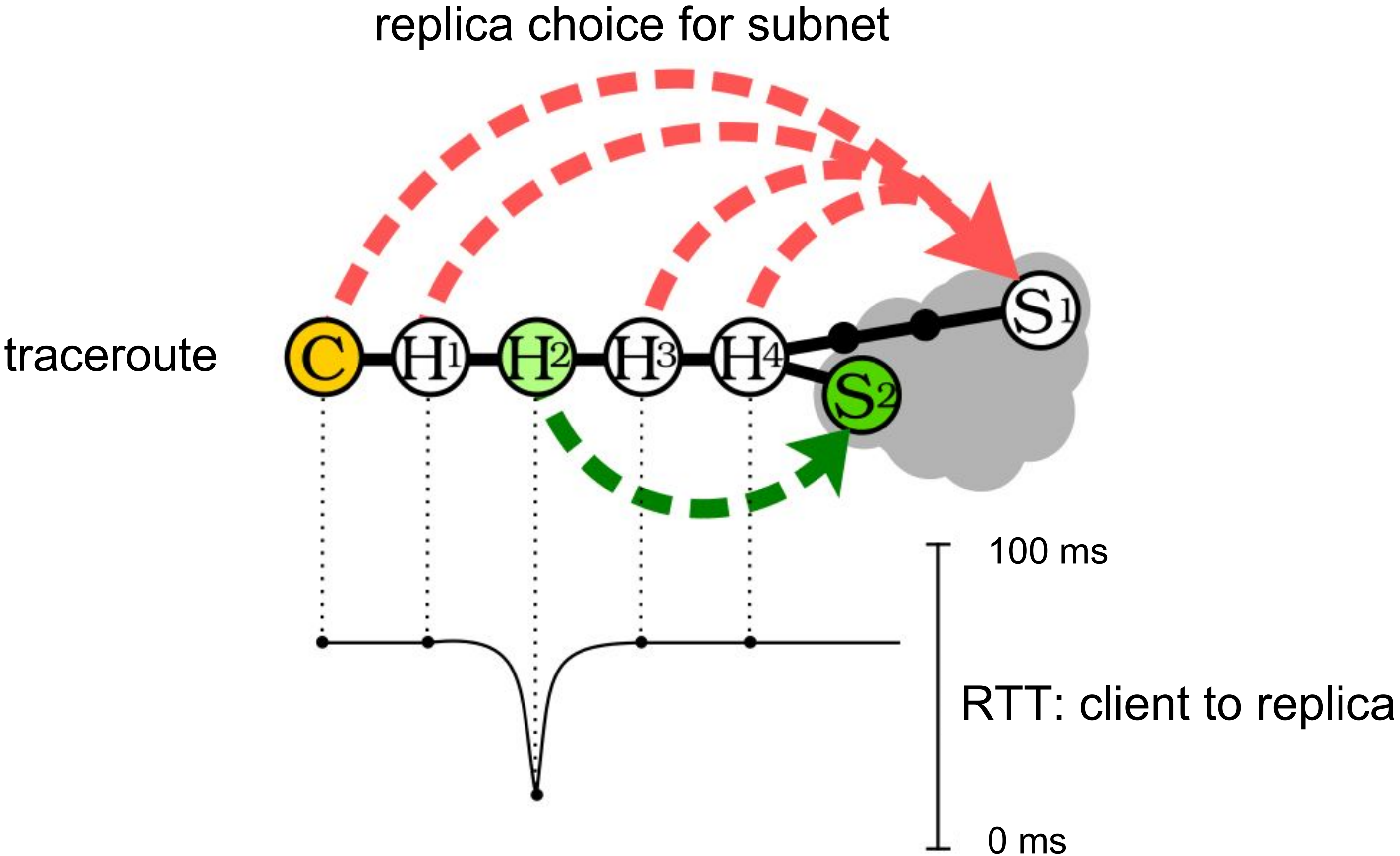
Normalize to default choice’s RTT



We're looking for this



Valley = better choice from hop subnet



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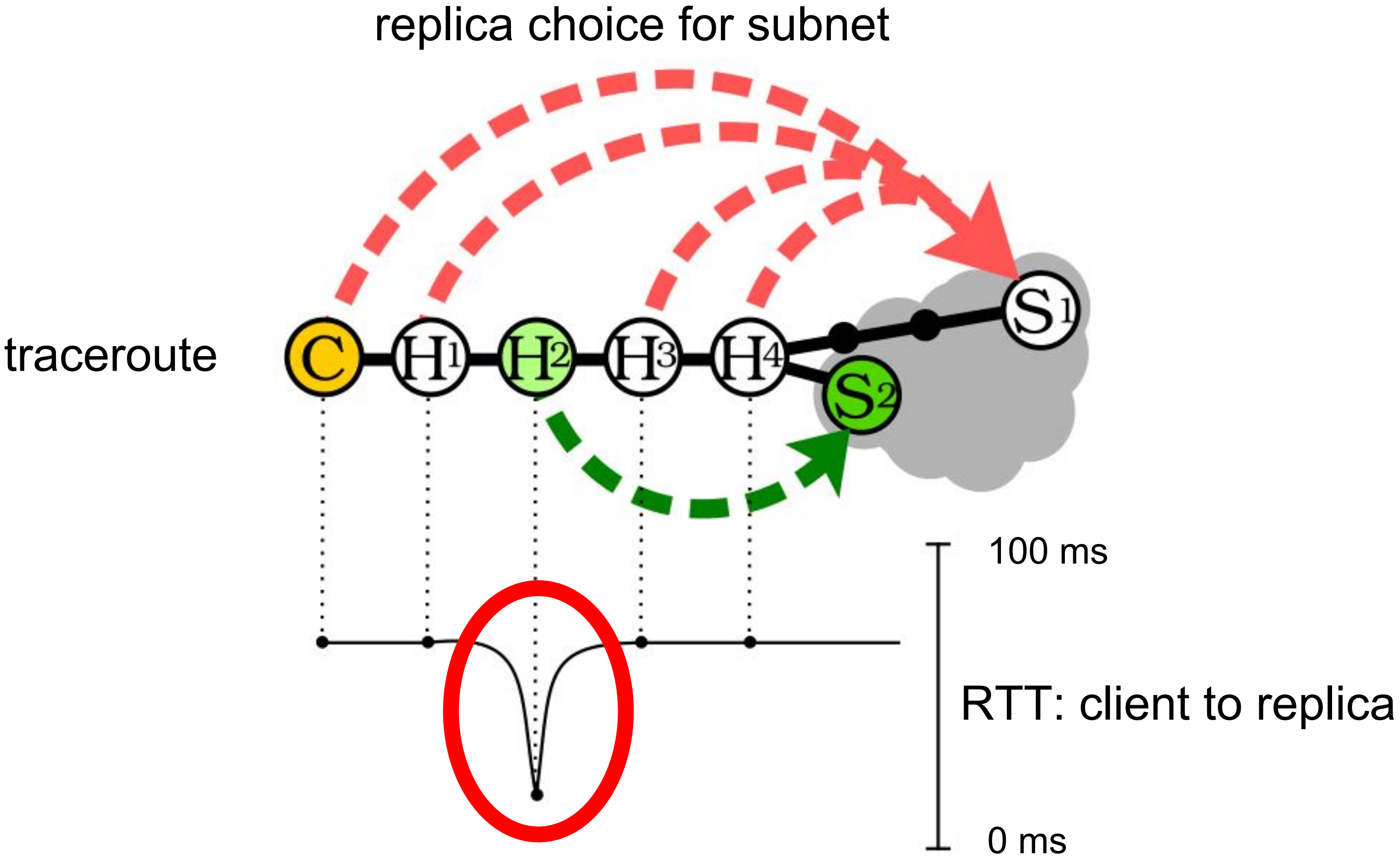
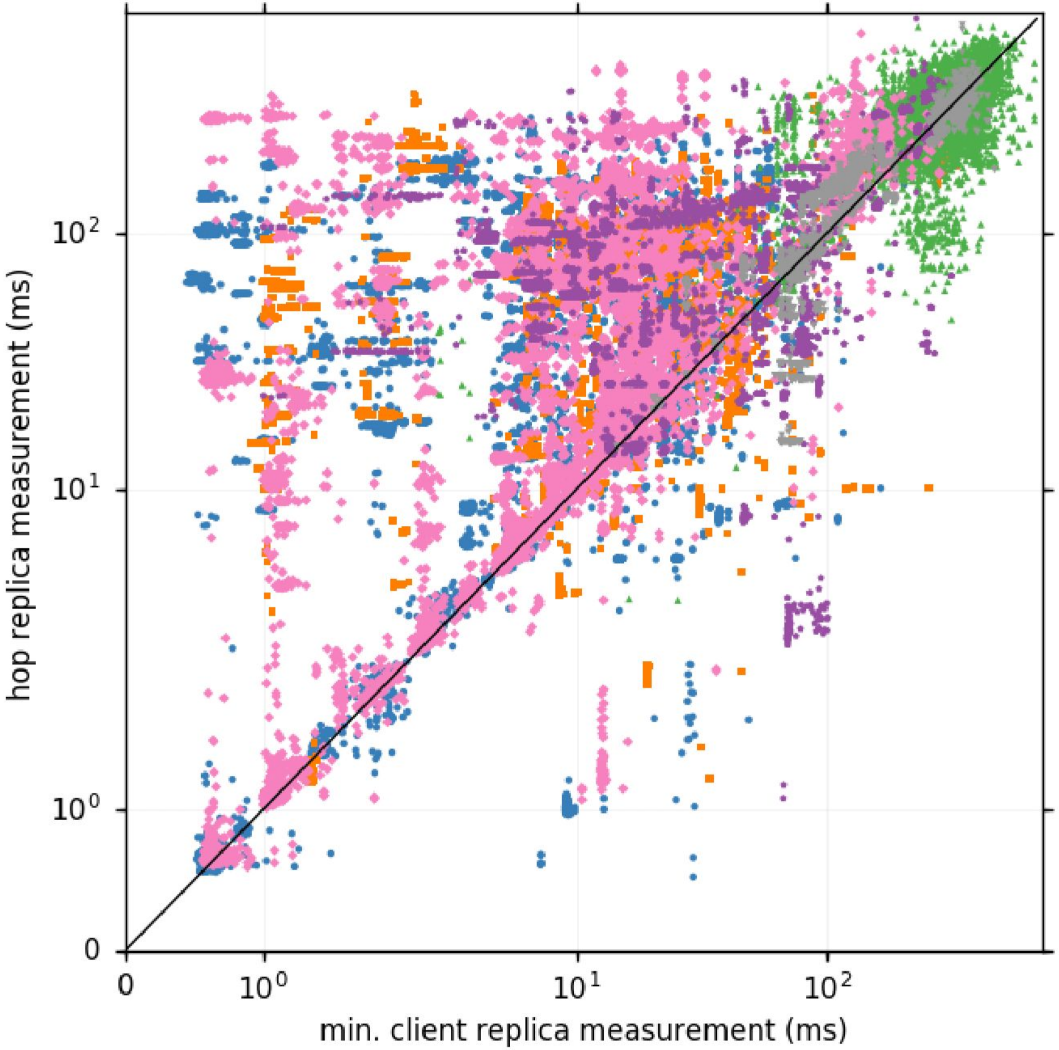


PlanetLab Sees Valleys!



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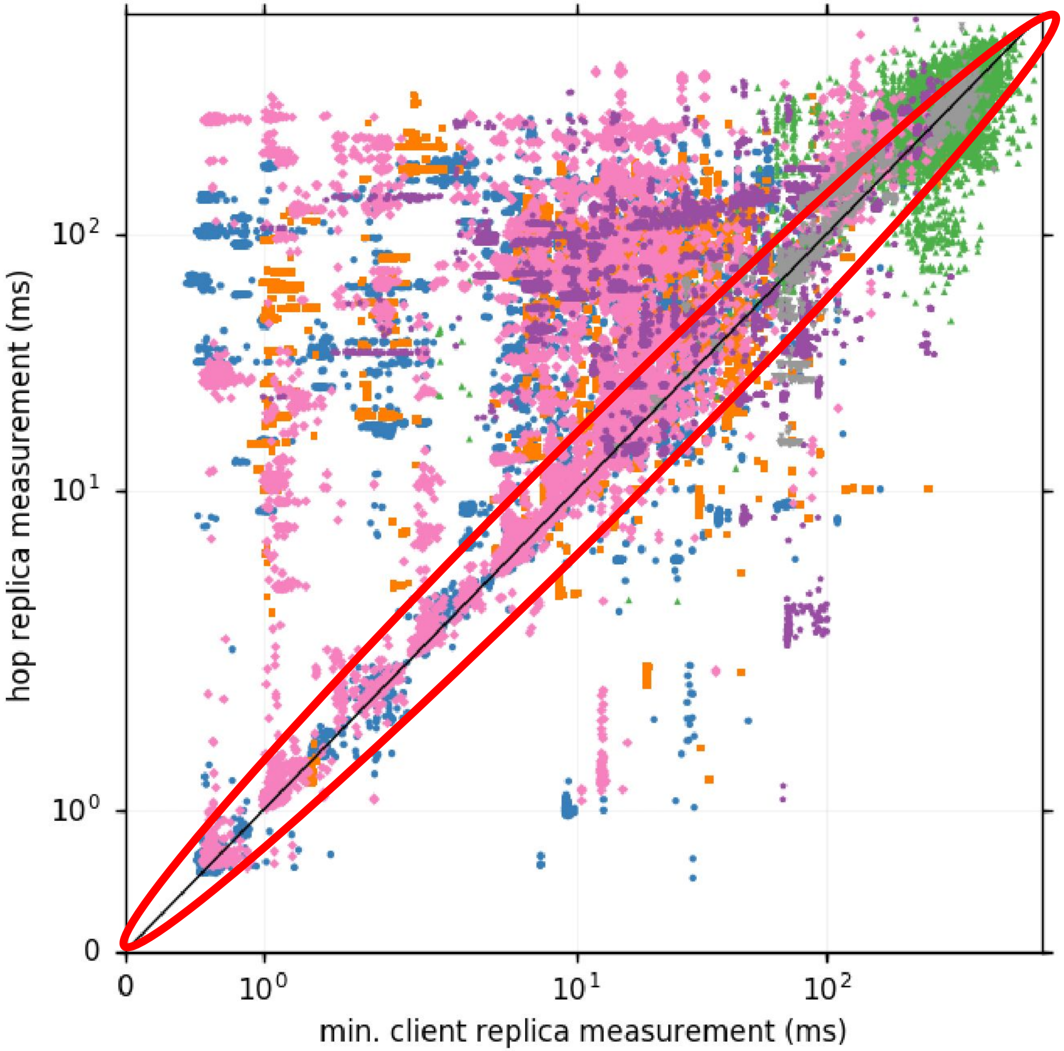
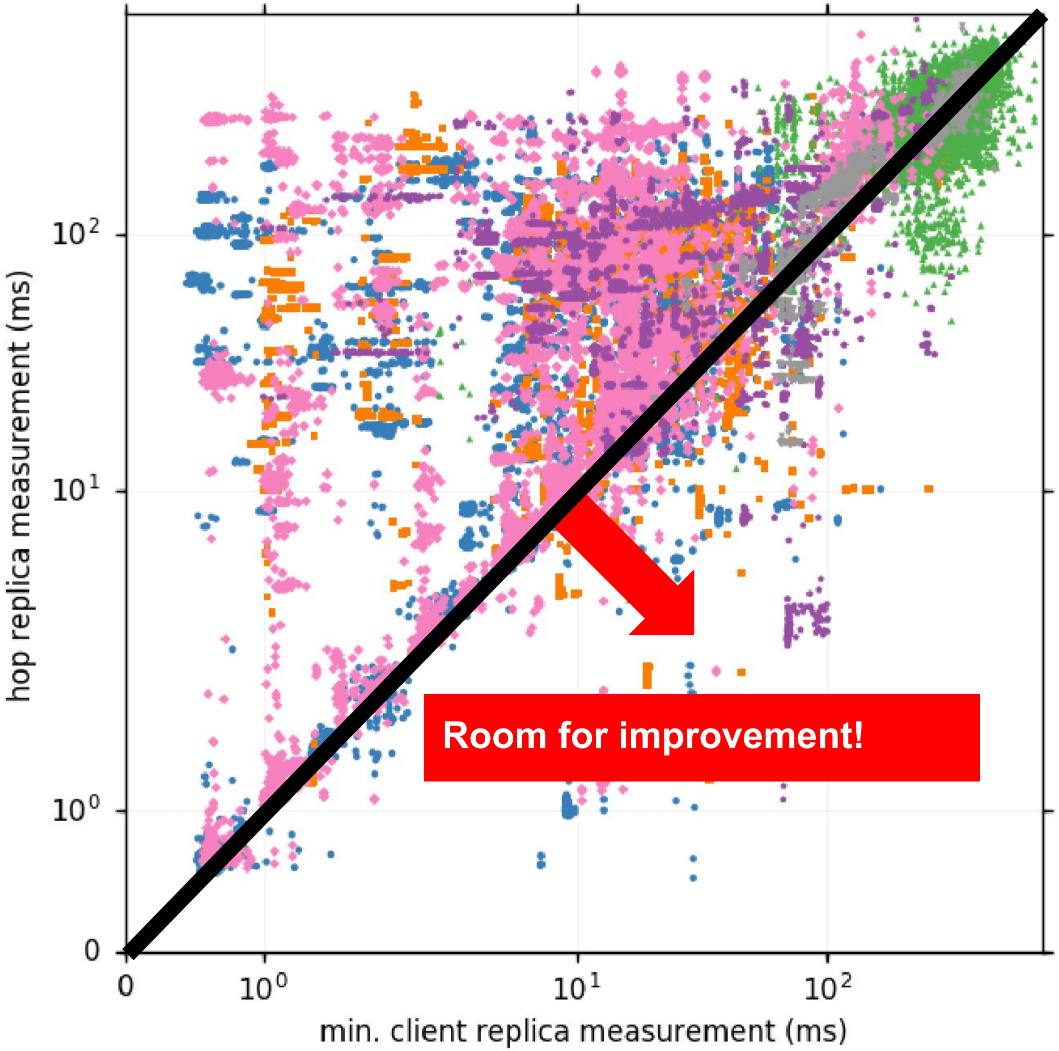


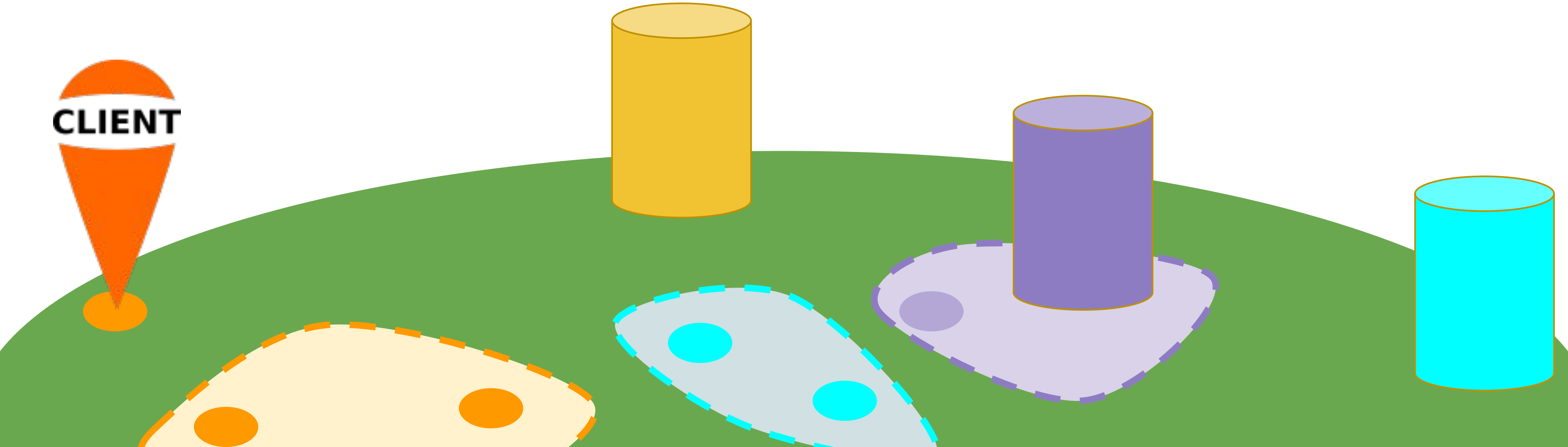
PlanetLab Sees Valleys!

- ● **Google**: 20.24%
- ● **Amazon**: 14.02%
- ● **Alibaba**: 33.68%
- ● **CDNetworks**: 15.61%
- ● **ChinaNetCenter**: 27.42%
- ● **CubeCDN**: 38.58%

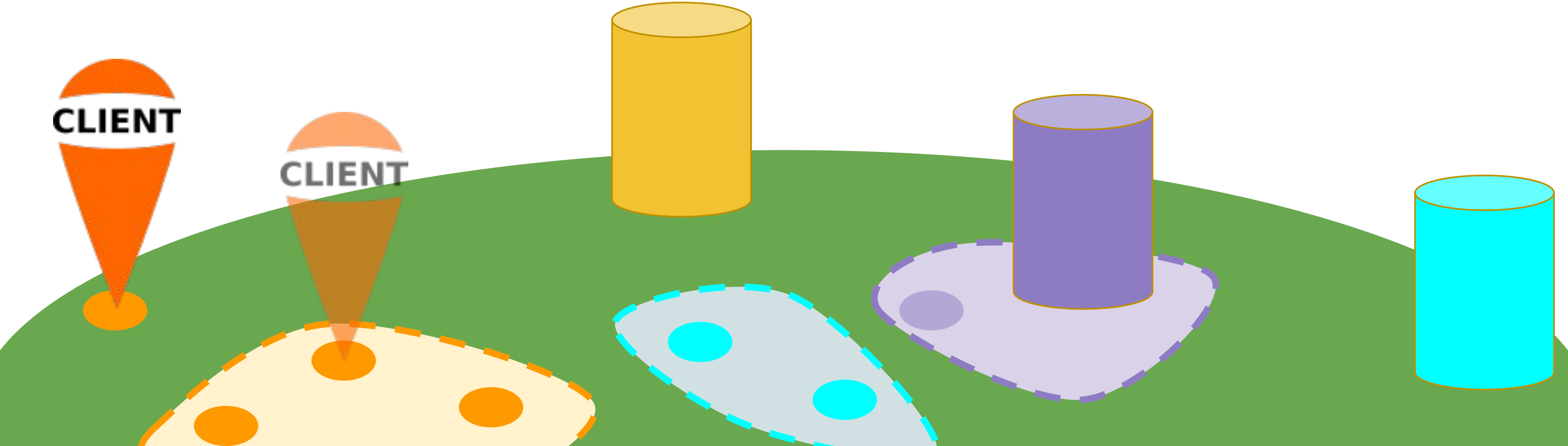


Room for improvement!

5.

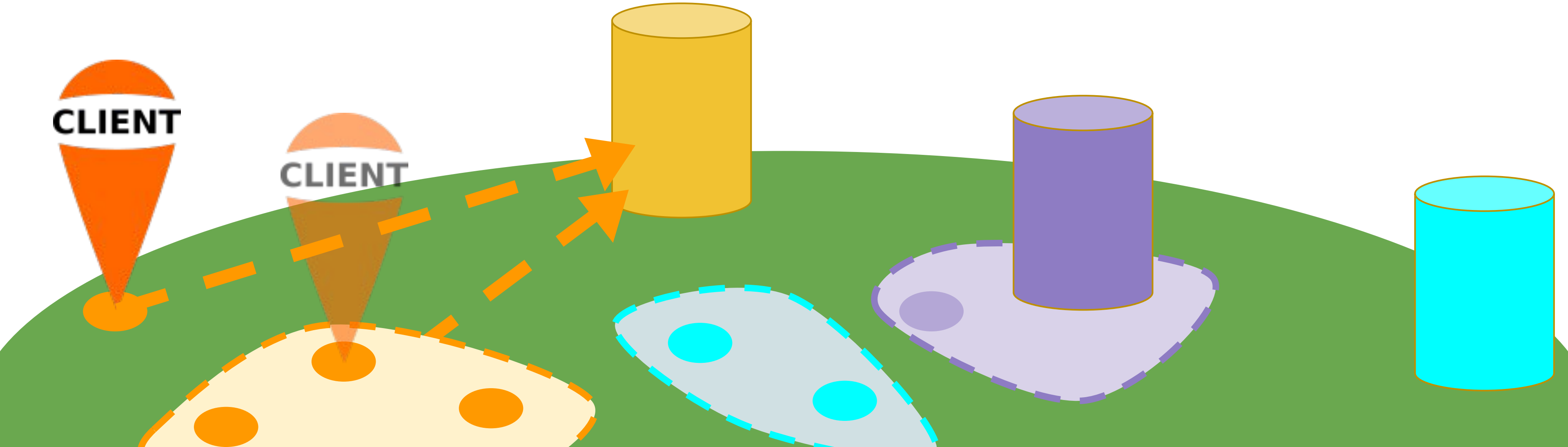


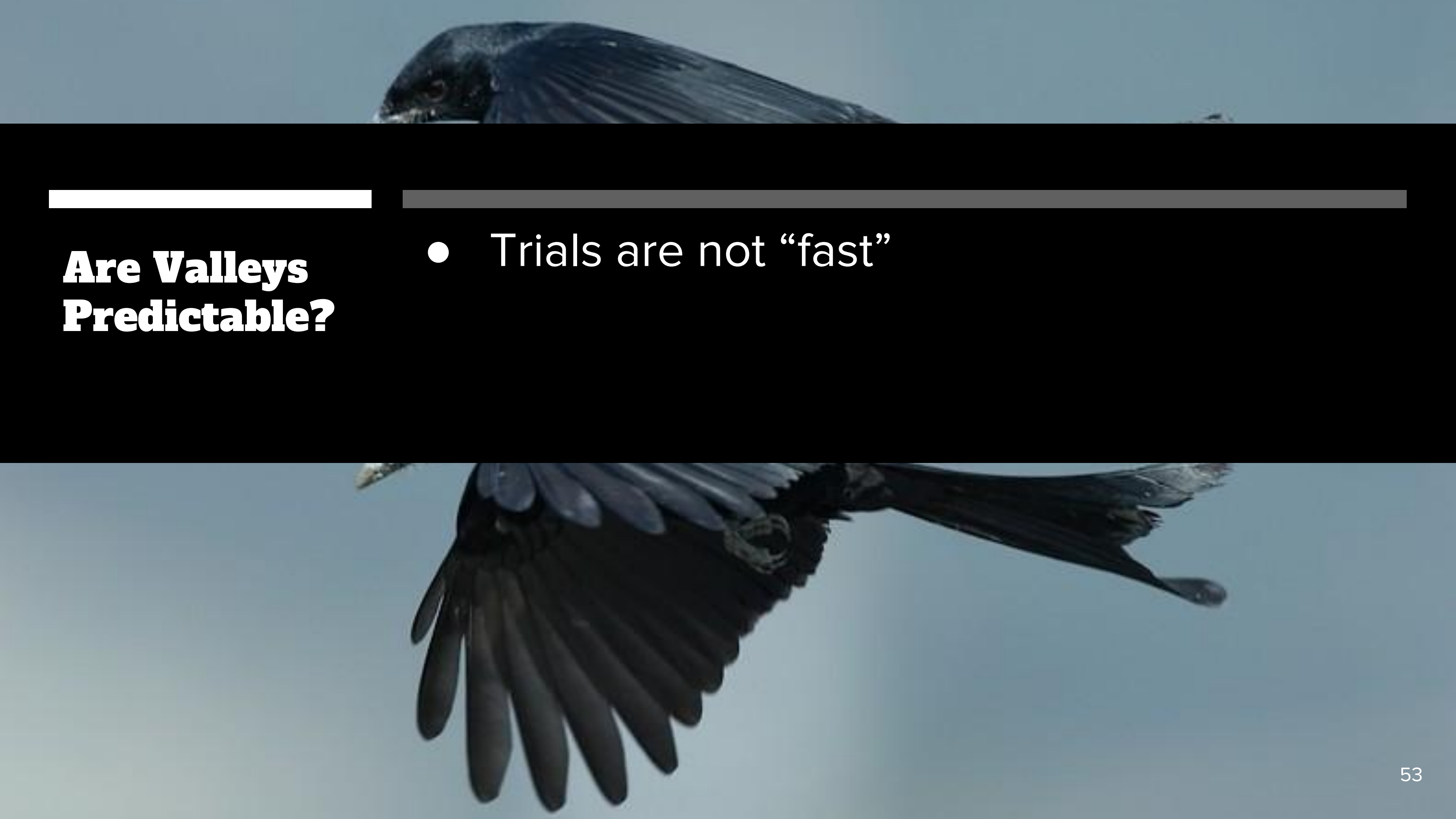
5. Use best subnet for ECS



5. Use best subnet for ECS

Get best mapping!





Are Valleys Predictable?

- Trials are not “fast”

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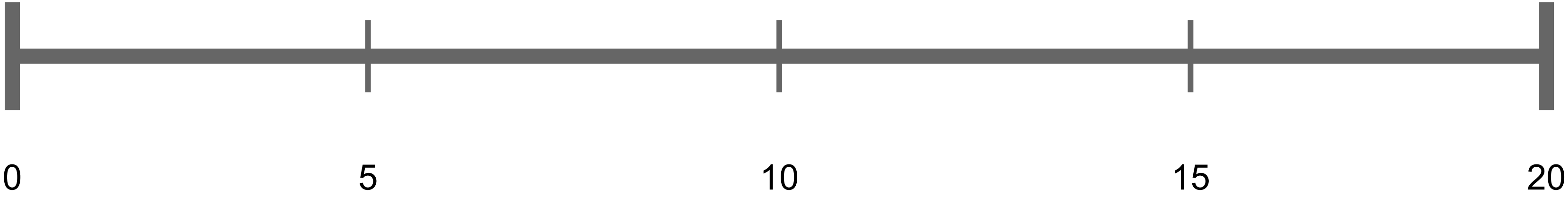
- Trials are not “fast”
- We want valleys “on the fly”

Are Valleys Predictable?

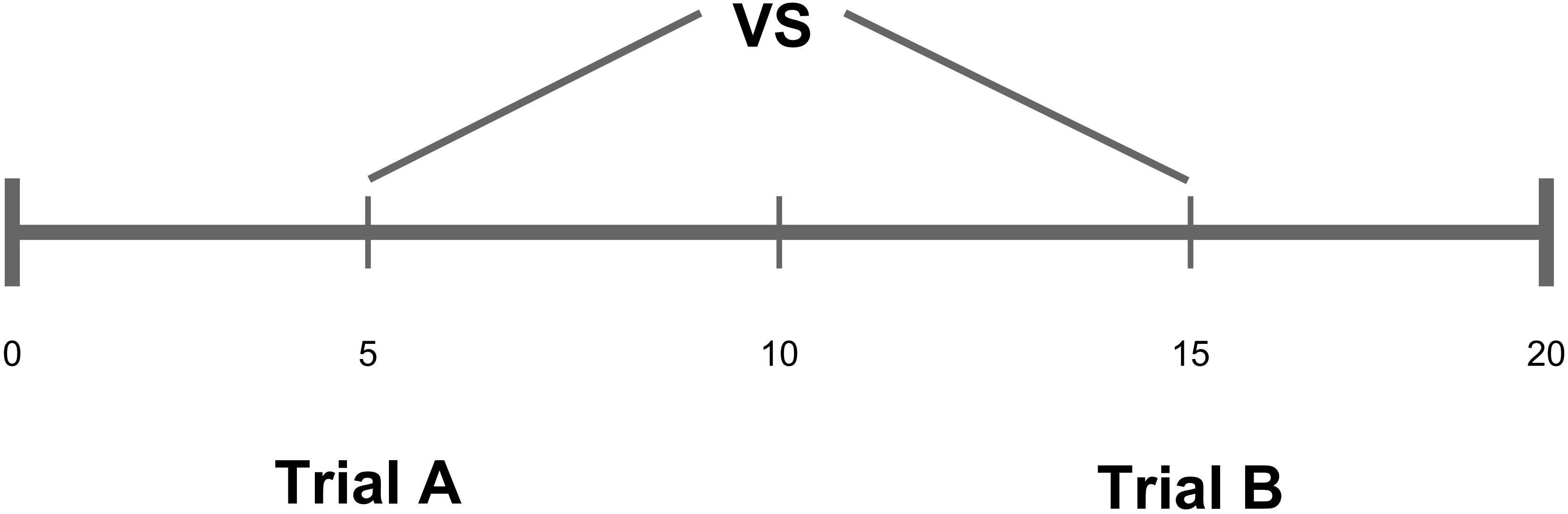
- Trials are not “fast”
- We want valleys “on the fly”
- We **need** to find valley-prone subnets

Testing Persistence

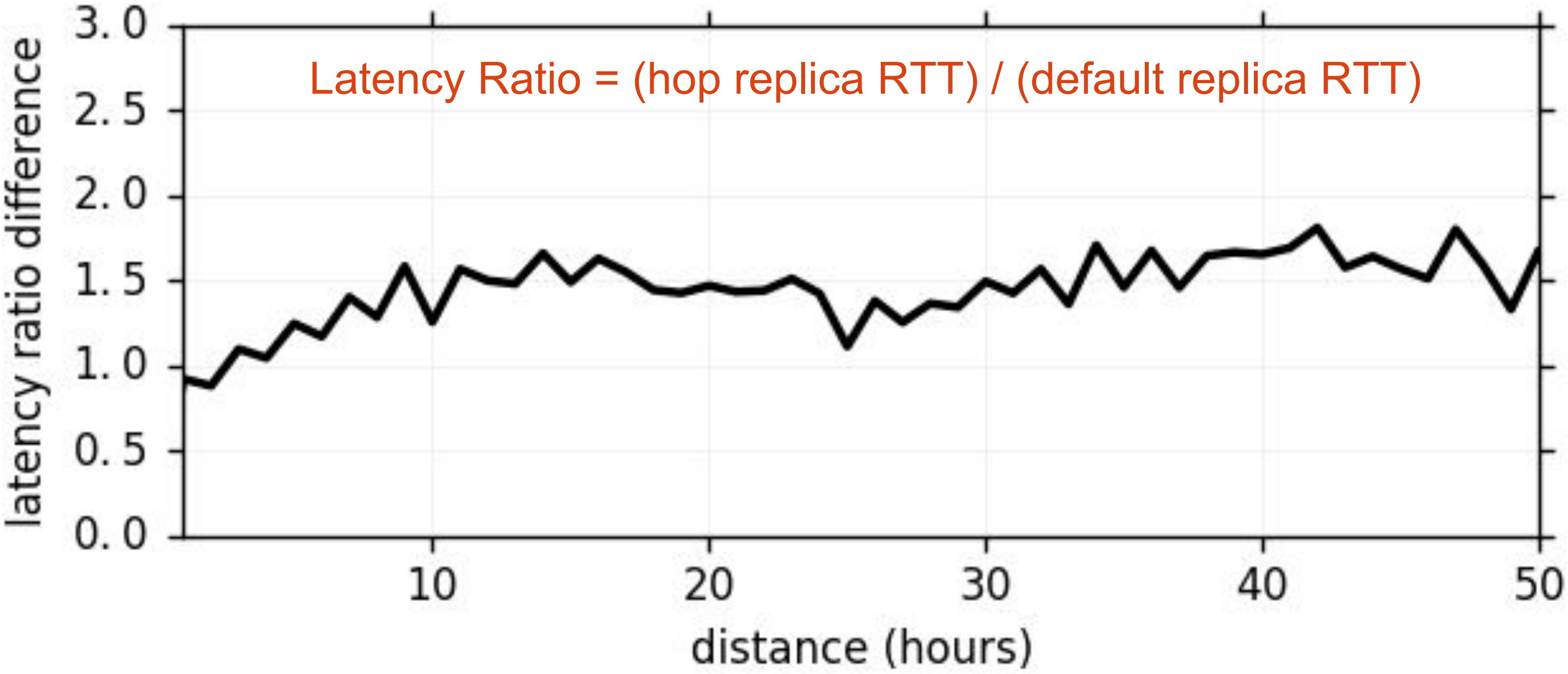
consecutive trials



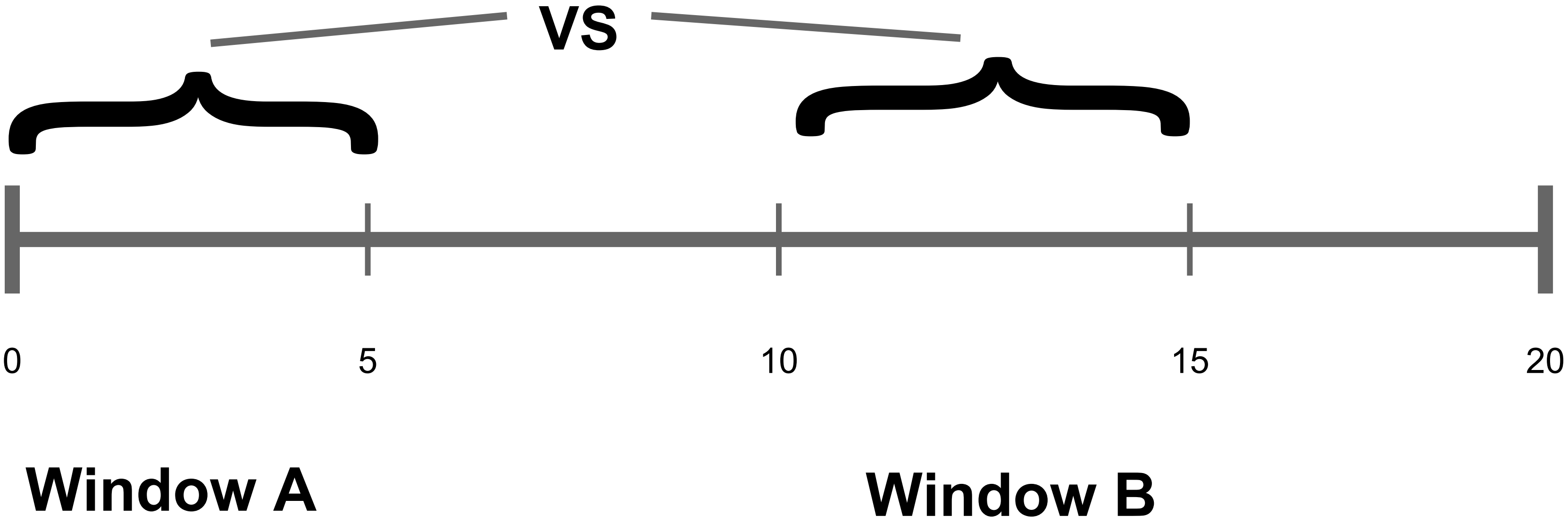
Testing Persistence



Latency Ratio Difference Over Time


Latency Ratio = (hop replica RTT) / (default replica RTT)

Testing Persistence



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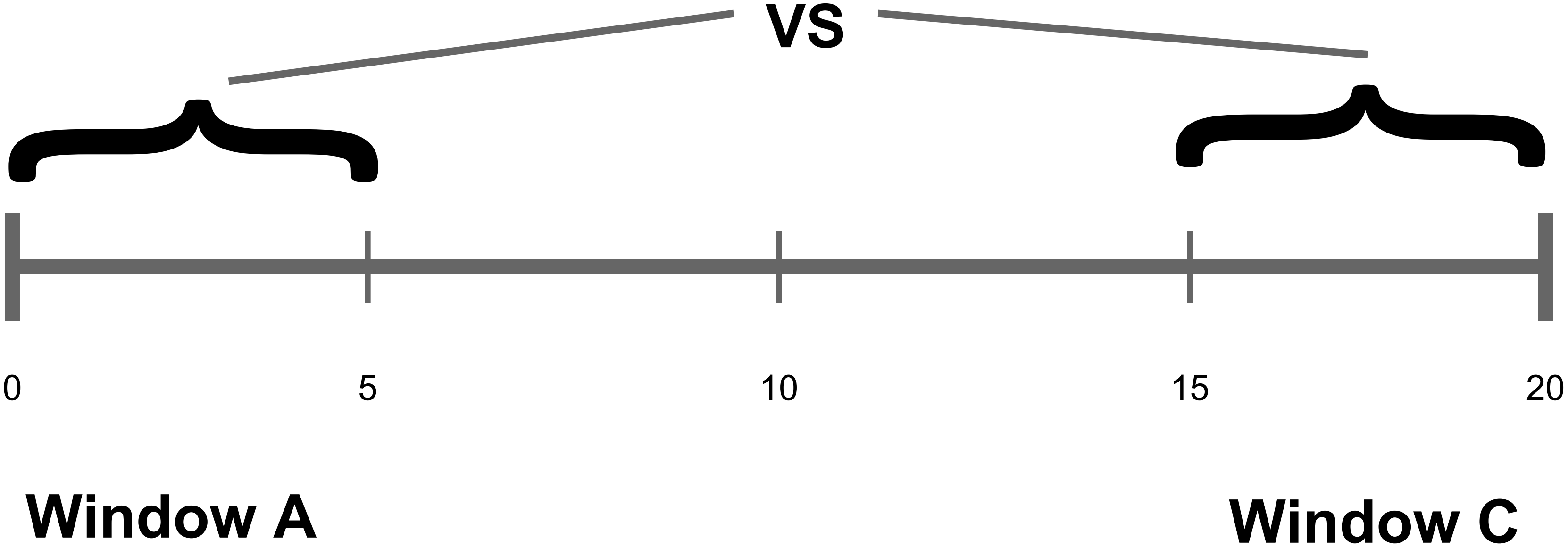

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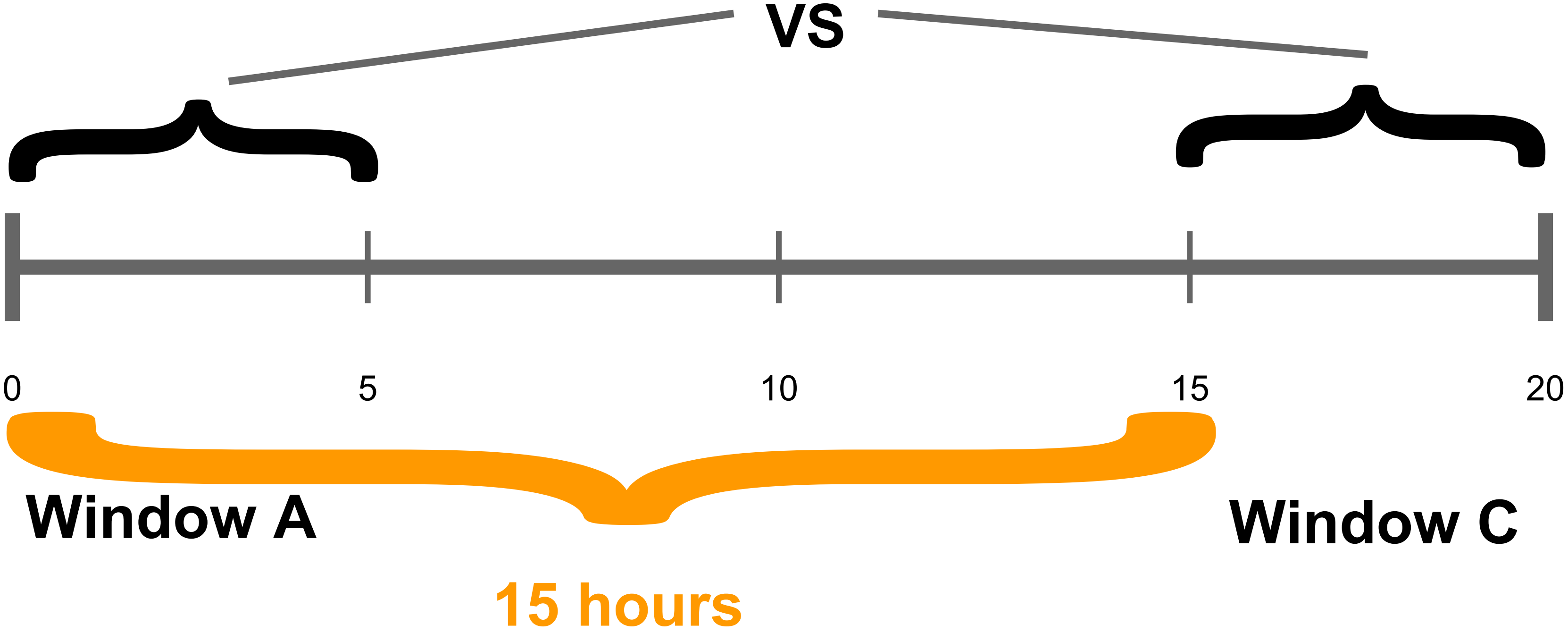

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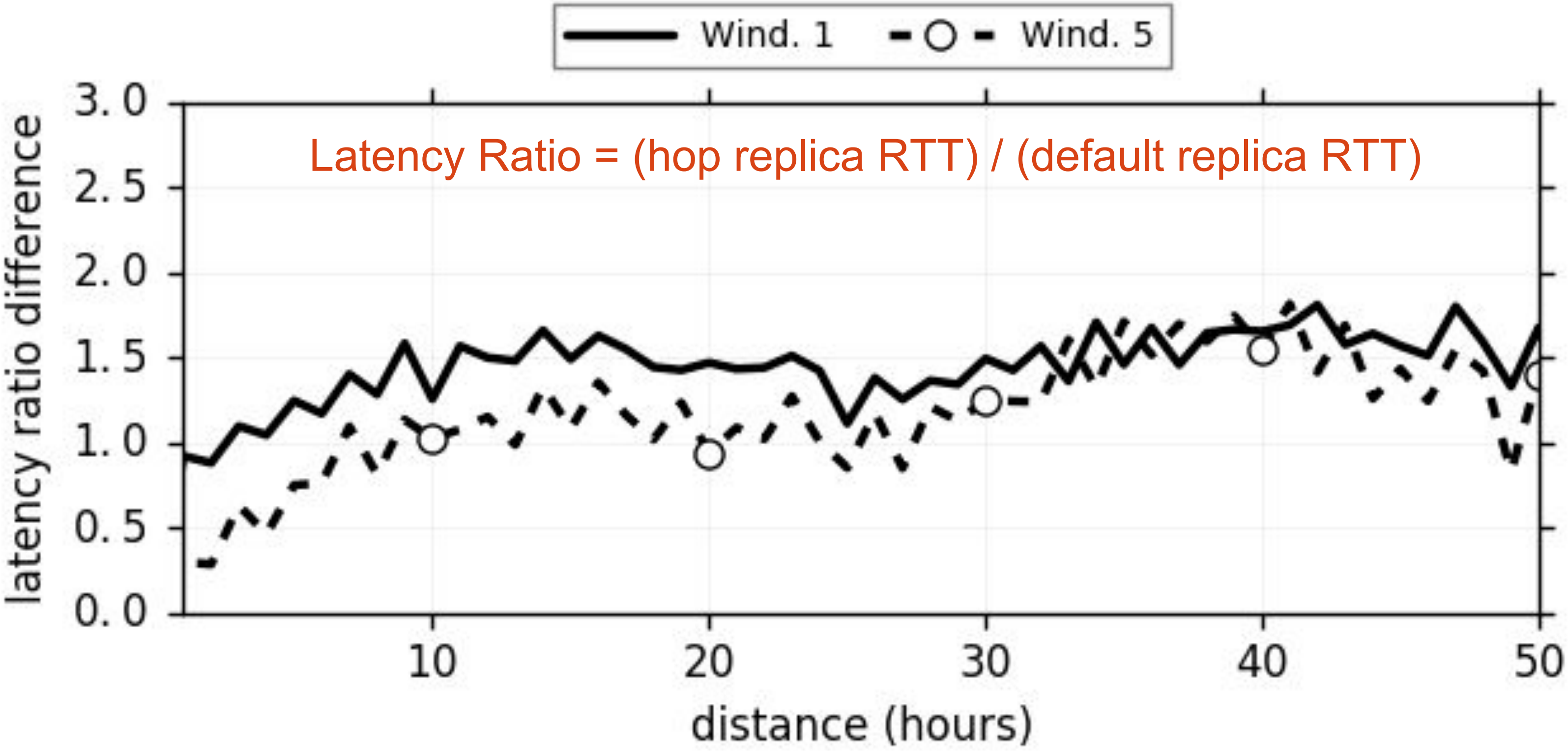

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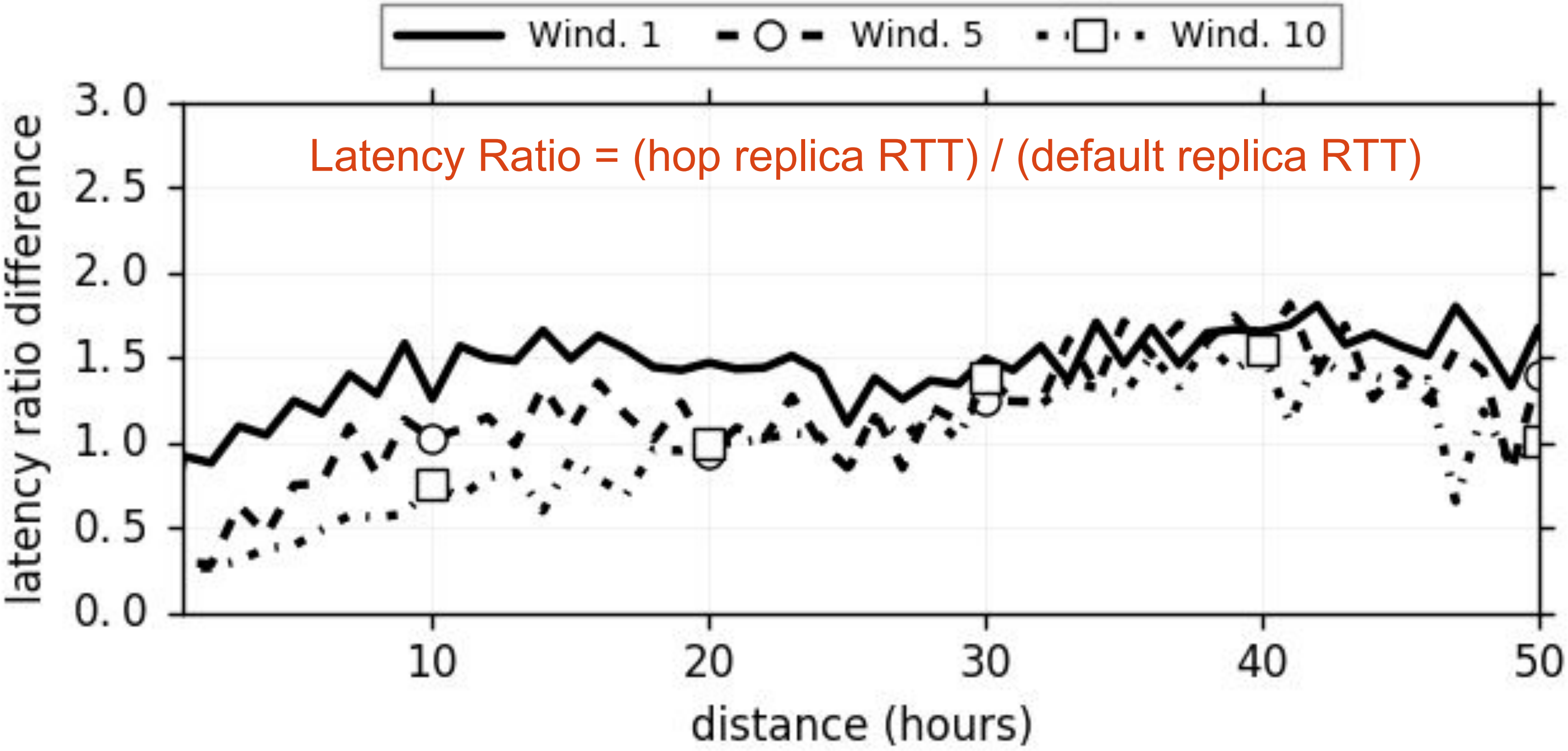

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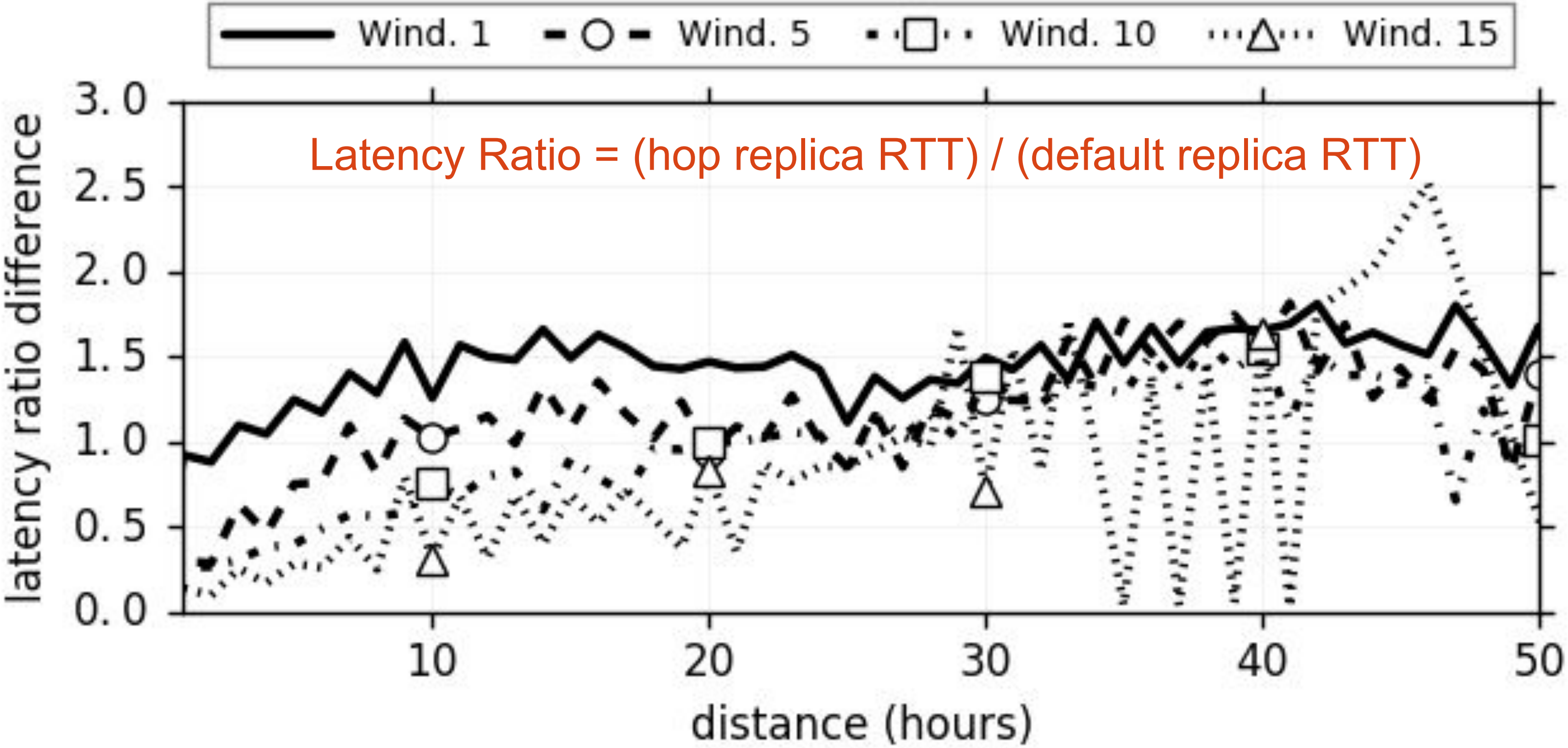
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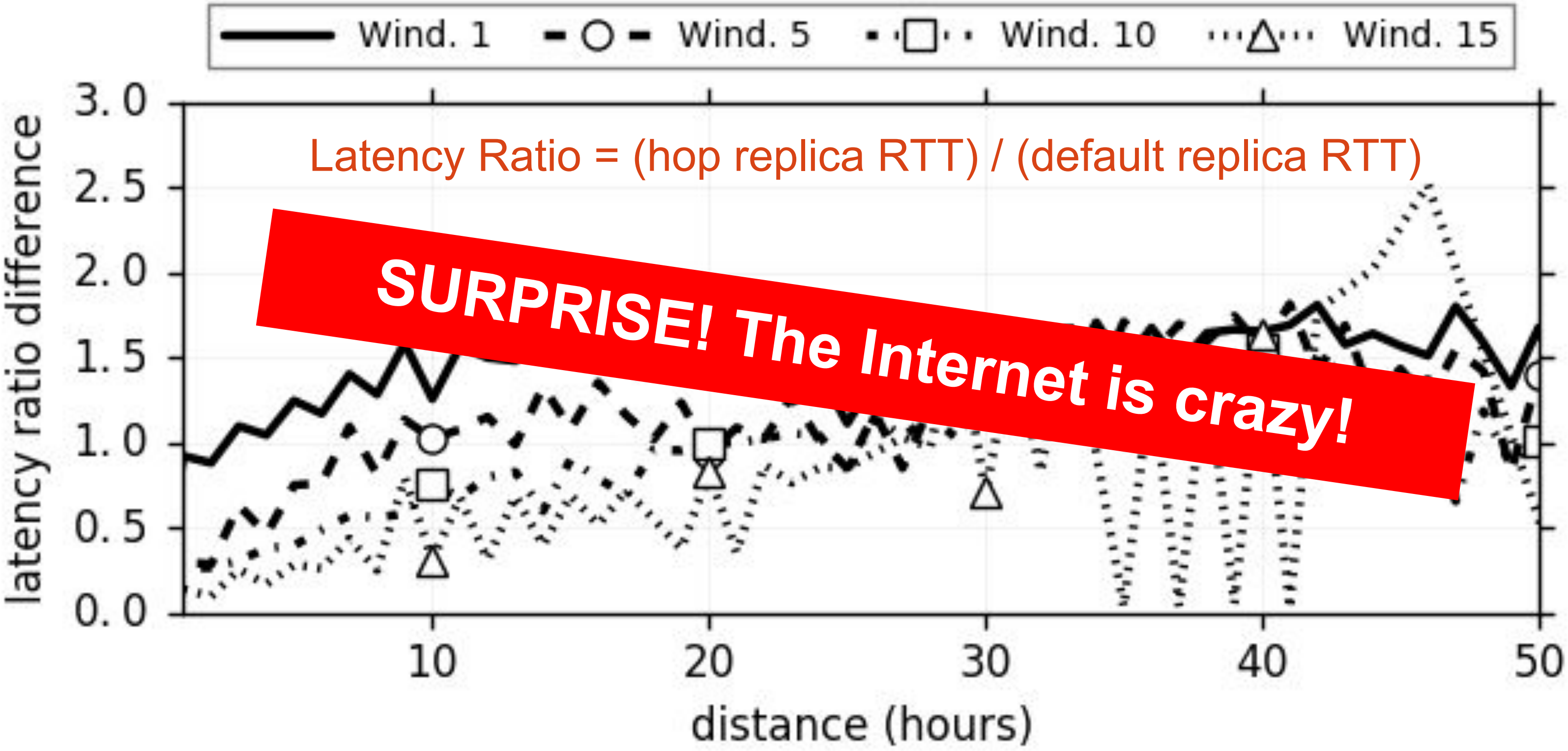


Latency Ratio = (hop replica RTT) / (default replica RTT)

SURPRISE! The Internet is crazy!

Filter: at *least* one valley

Subnet A	`{0,0,0,0,0,V,0,0,0,0,0,0,V}`
Subnet B	`{0,0,0,0,0,0,0,0,0,0,0,0,0}`
Subnet C	`{V,V,V,V,0,0,0,0,V,V,V,0,V}`

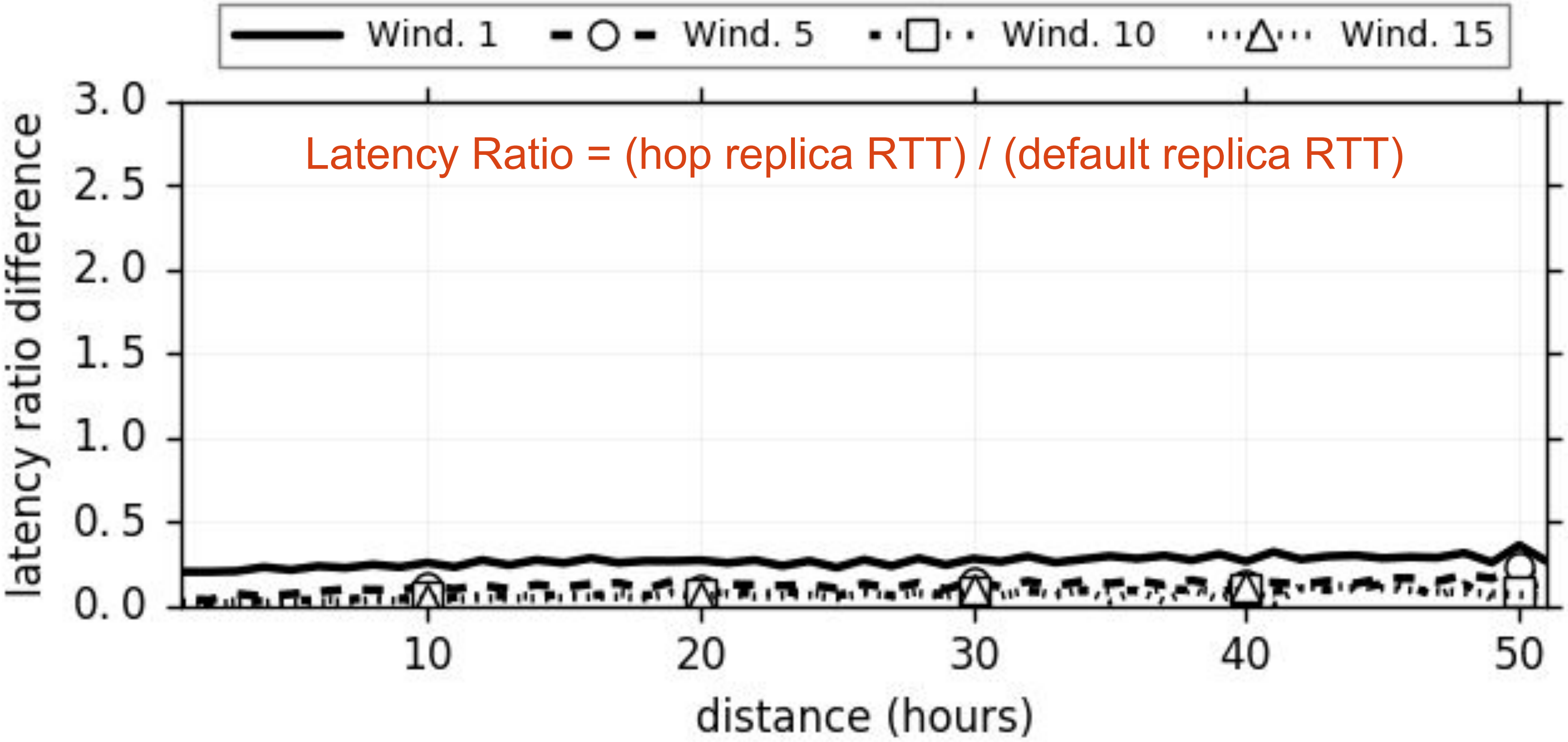
Filter: at *least* one valley

Subnet A {0,0,0,0,0,V,0,0,0,0,0,0,V}

~~Subnet B {0,0,0,0,0,0,0,0,0,0,0,0,0}~~

Subnet C {V,V,V,V,0,0,0,0,V,V,V,0,V}

Filter: at *least* one valley



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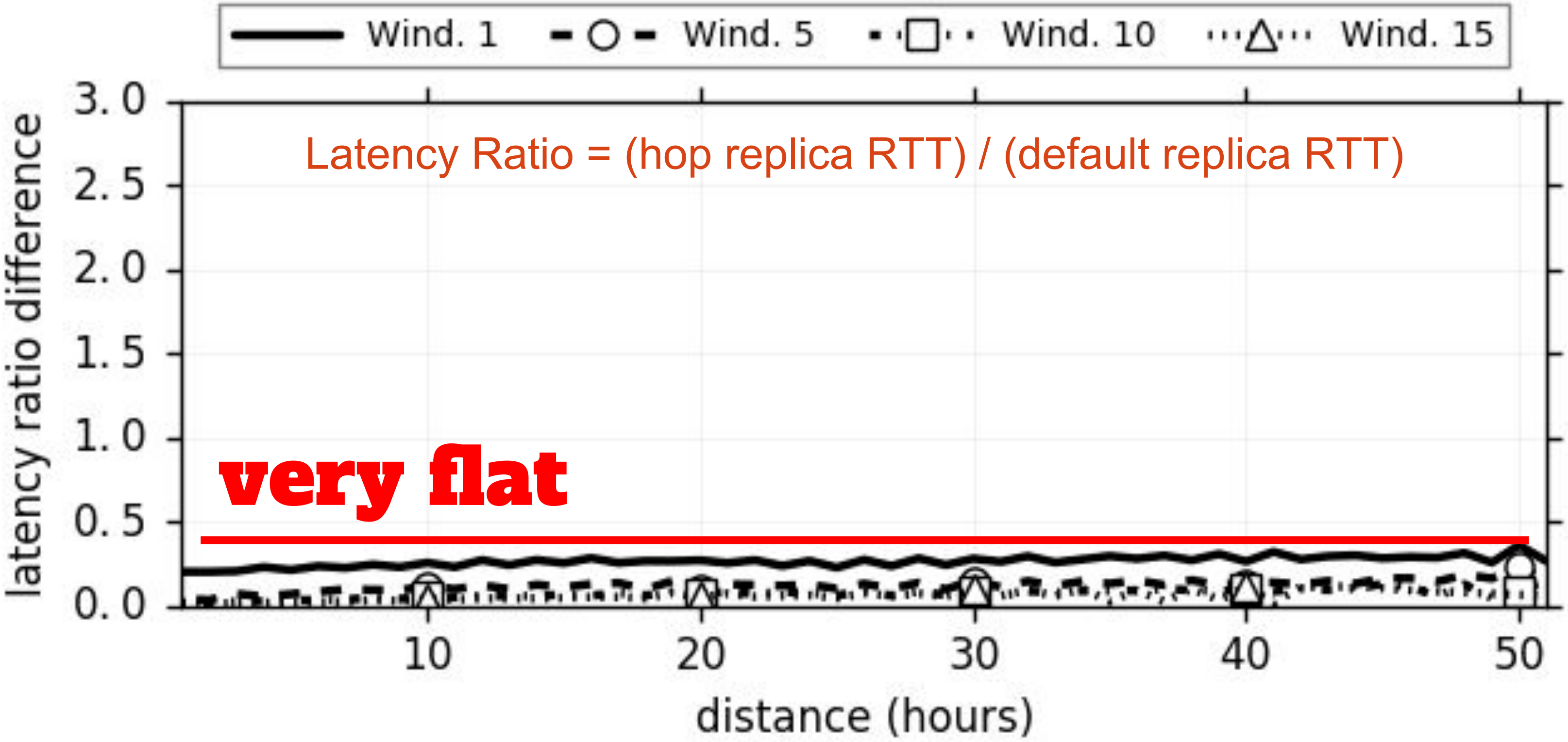
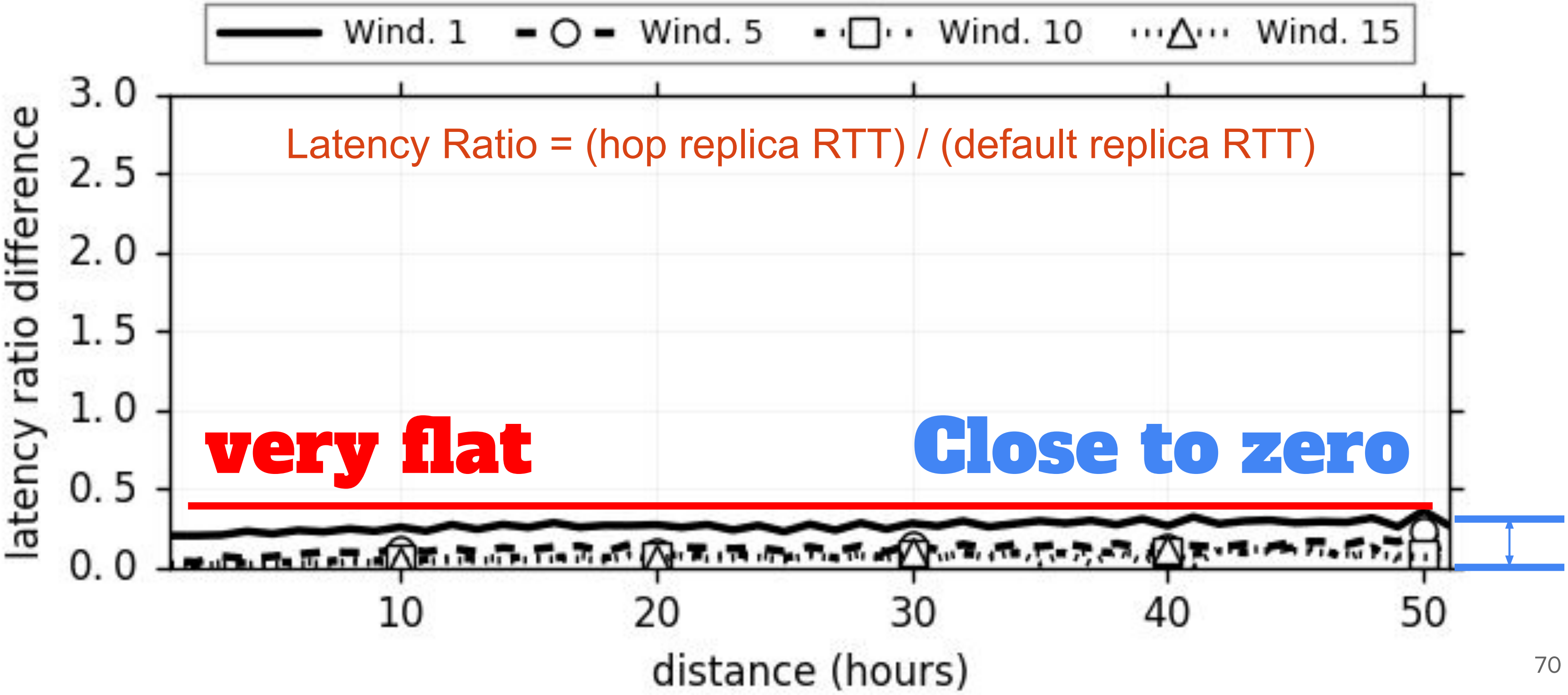


Filter: at *least* one valley



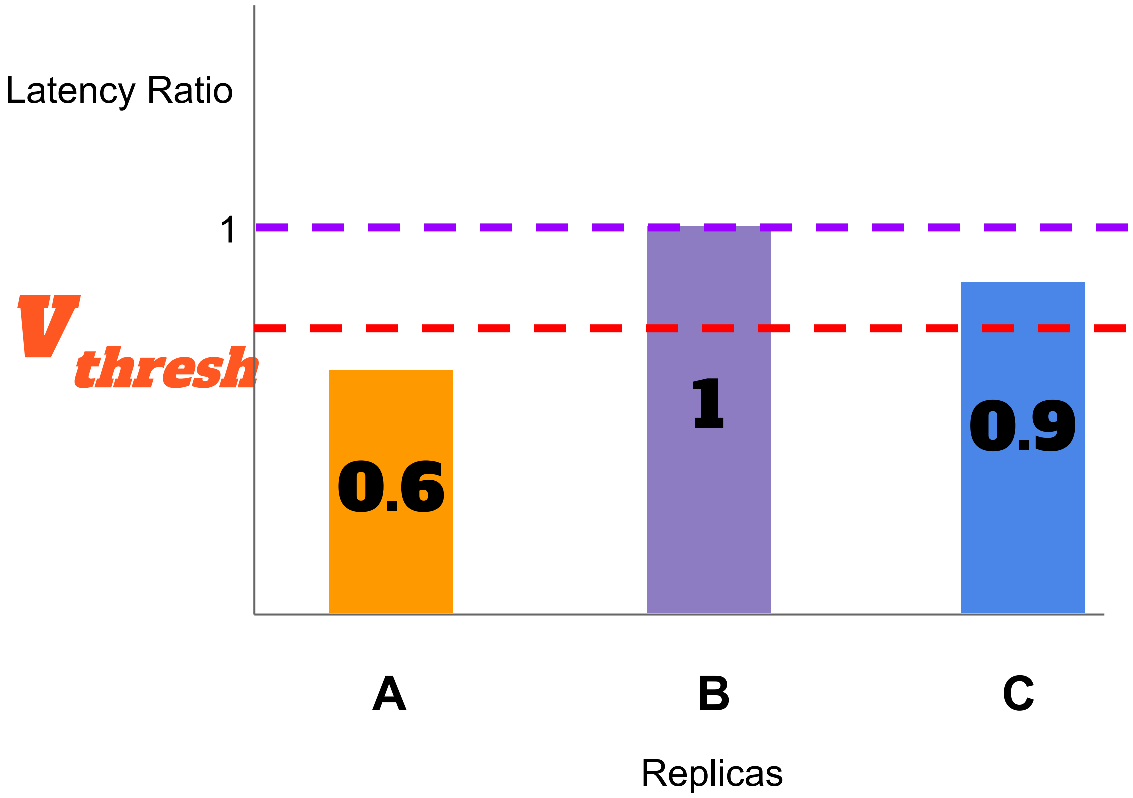
Latency Ratio = (hop replica RTT) / (default replica RTT)

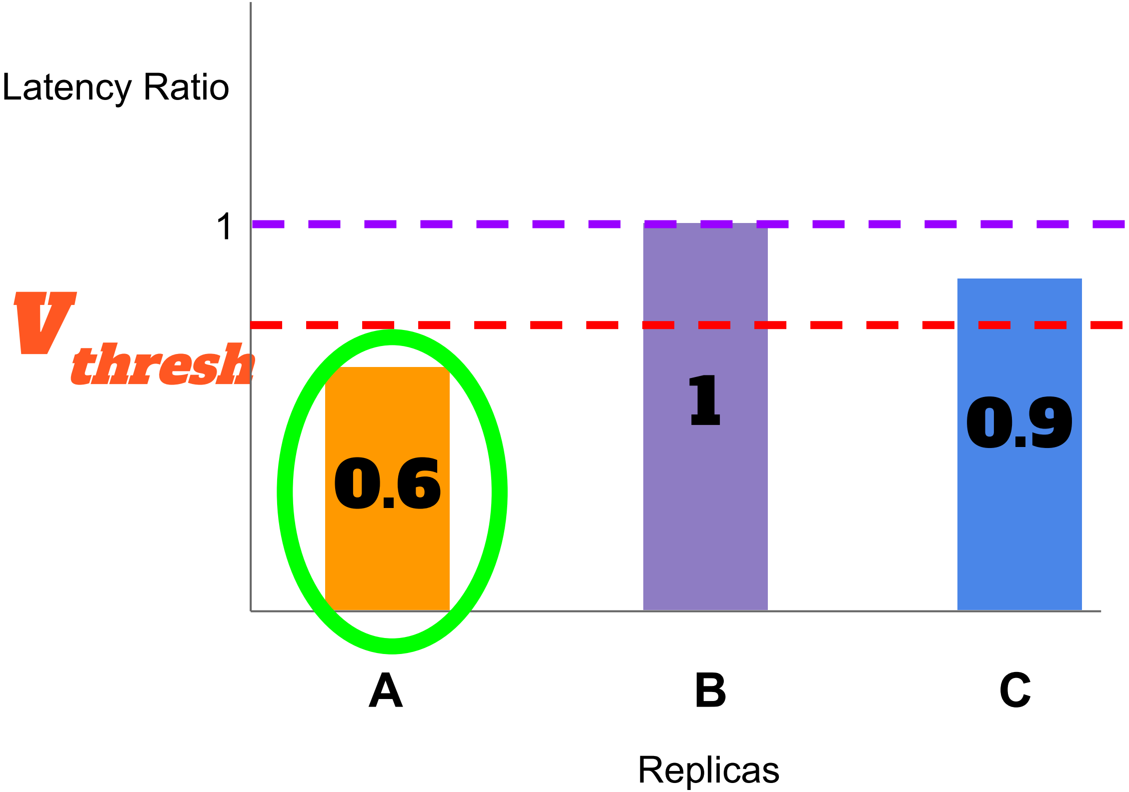
very flat

Close to zero

Parameter Exploration

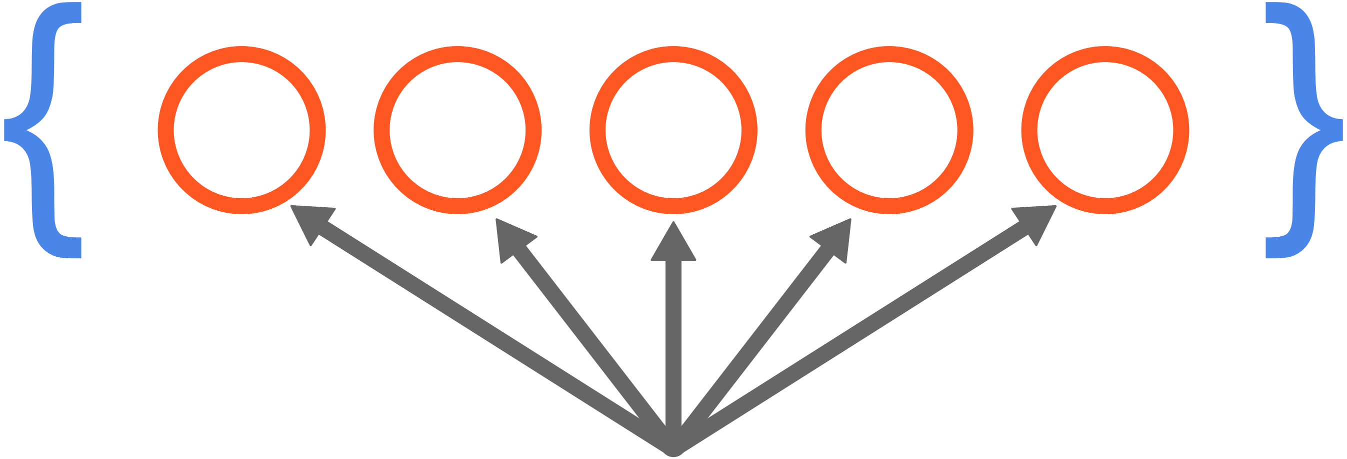
V_{thresh} = How *deep* are the valleys from *useful* subnets?


Latency Ratio
1
V_{thresh}
0.6
1
0.9
A
B
C
Replicas

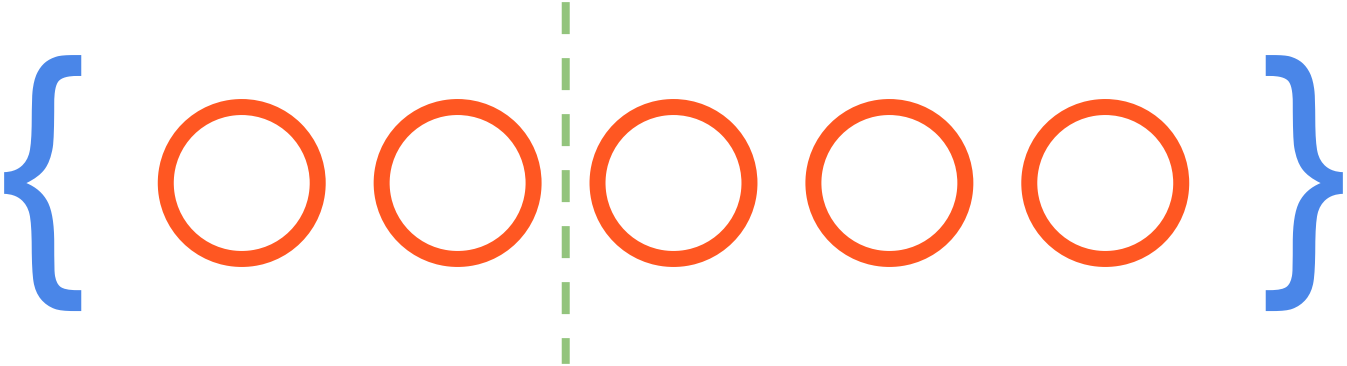

Latency Ratio
1
V_{thresh}
0.6
1
0.9
A
B
C
Replicas

V_{freq} = **How *often* do valleys occur in *useful* subnets?**

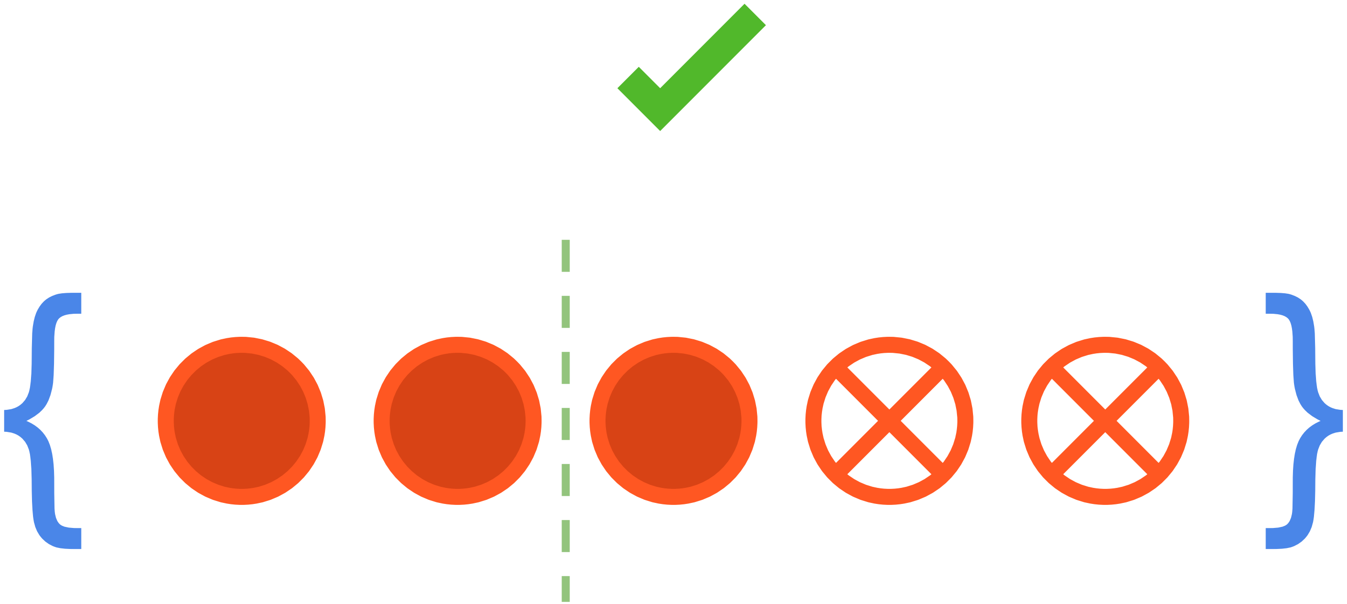
{ TRAINING WINDOW }



TRIALS

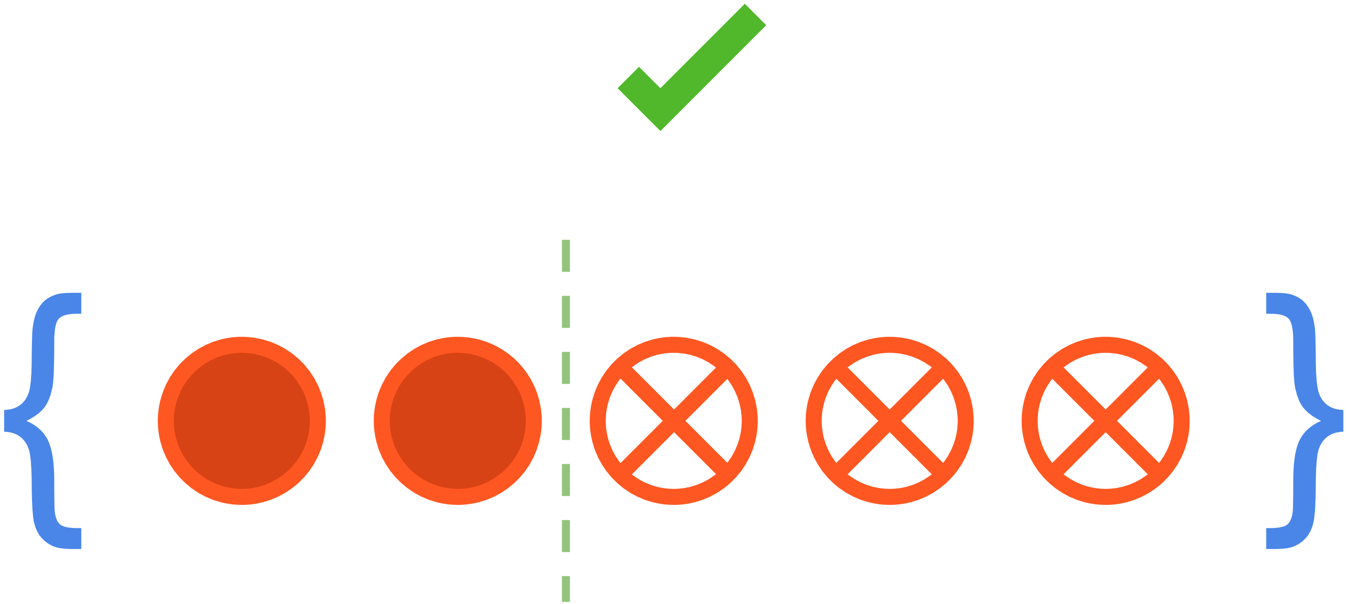


$v_{freq} = 2/5$



$V_{freq} = 2/5$

Valley-Prone Subnet



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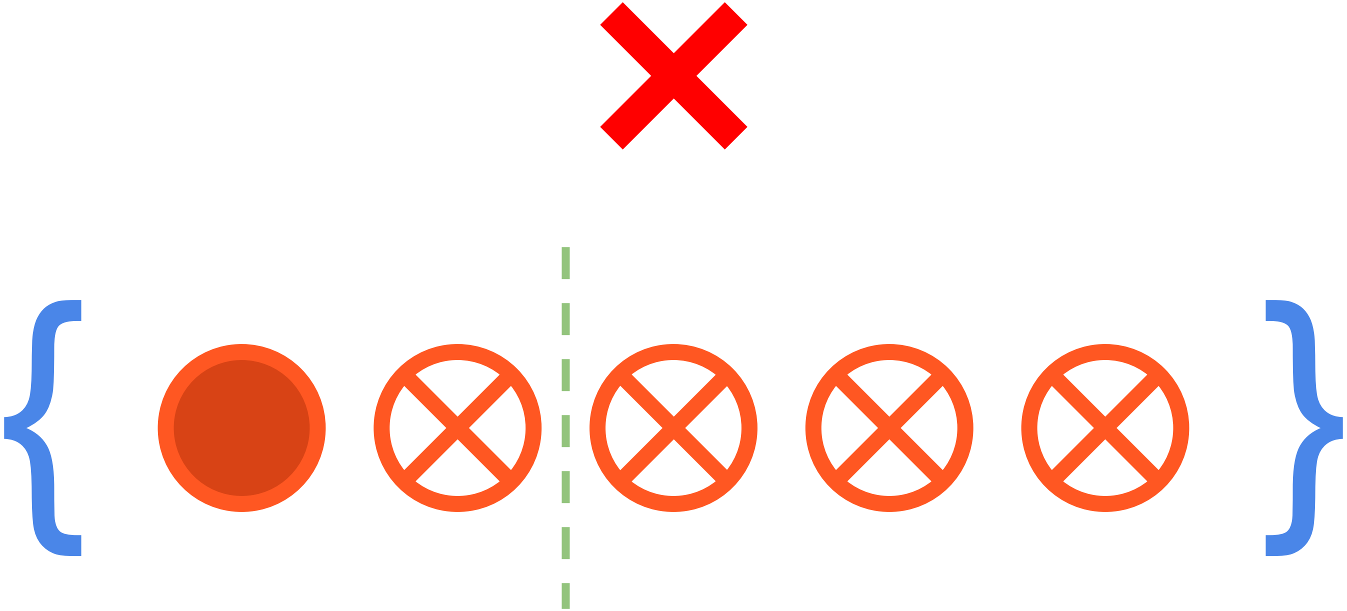
Valley-Prone Subnet



$v_{freq} = 2/5$

NOT Valley-Prone Subnet

Overview of Drongo:

1. Collect training window

Overview of Drongo:

1. Collect training window

2. Count the # of sufficiently deep valleys

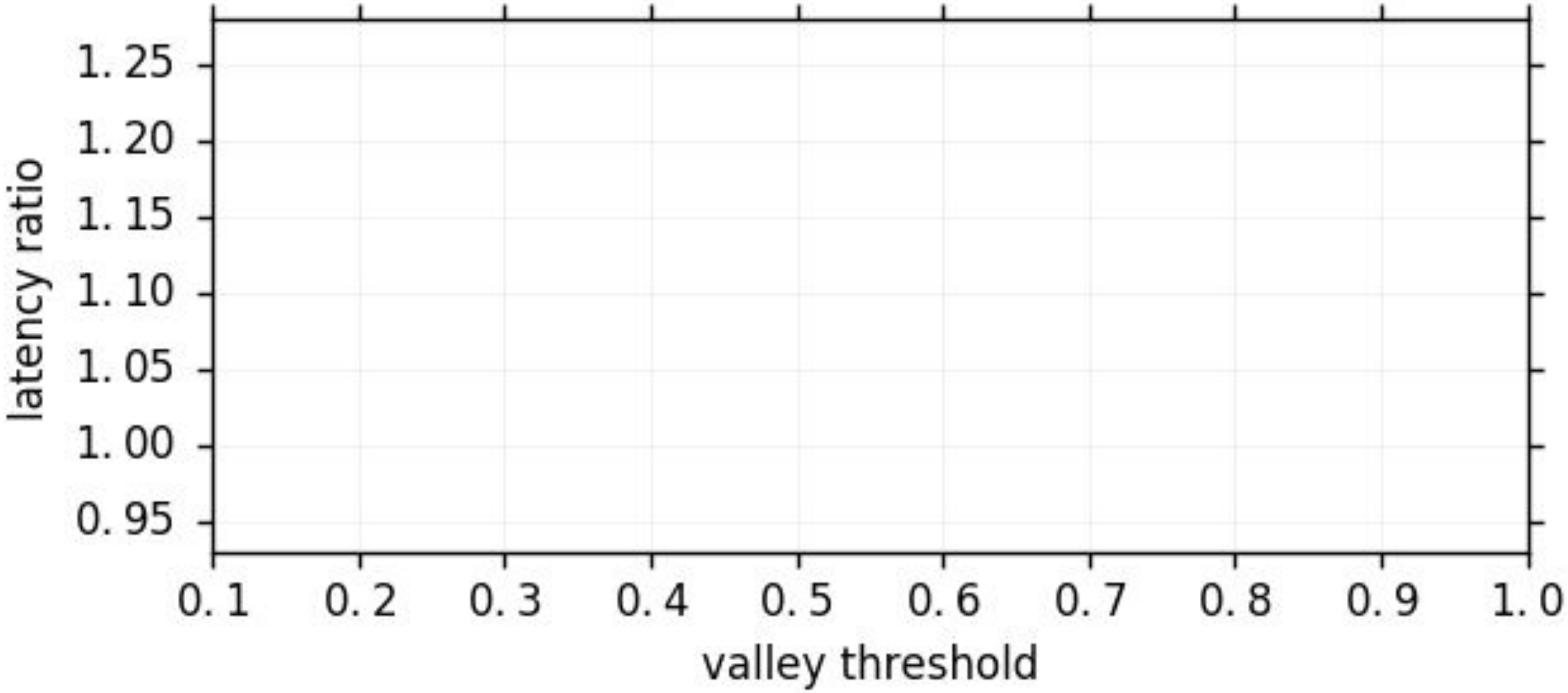
Overview of Drongo:

1. Collect training window

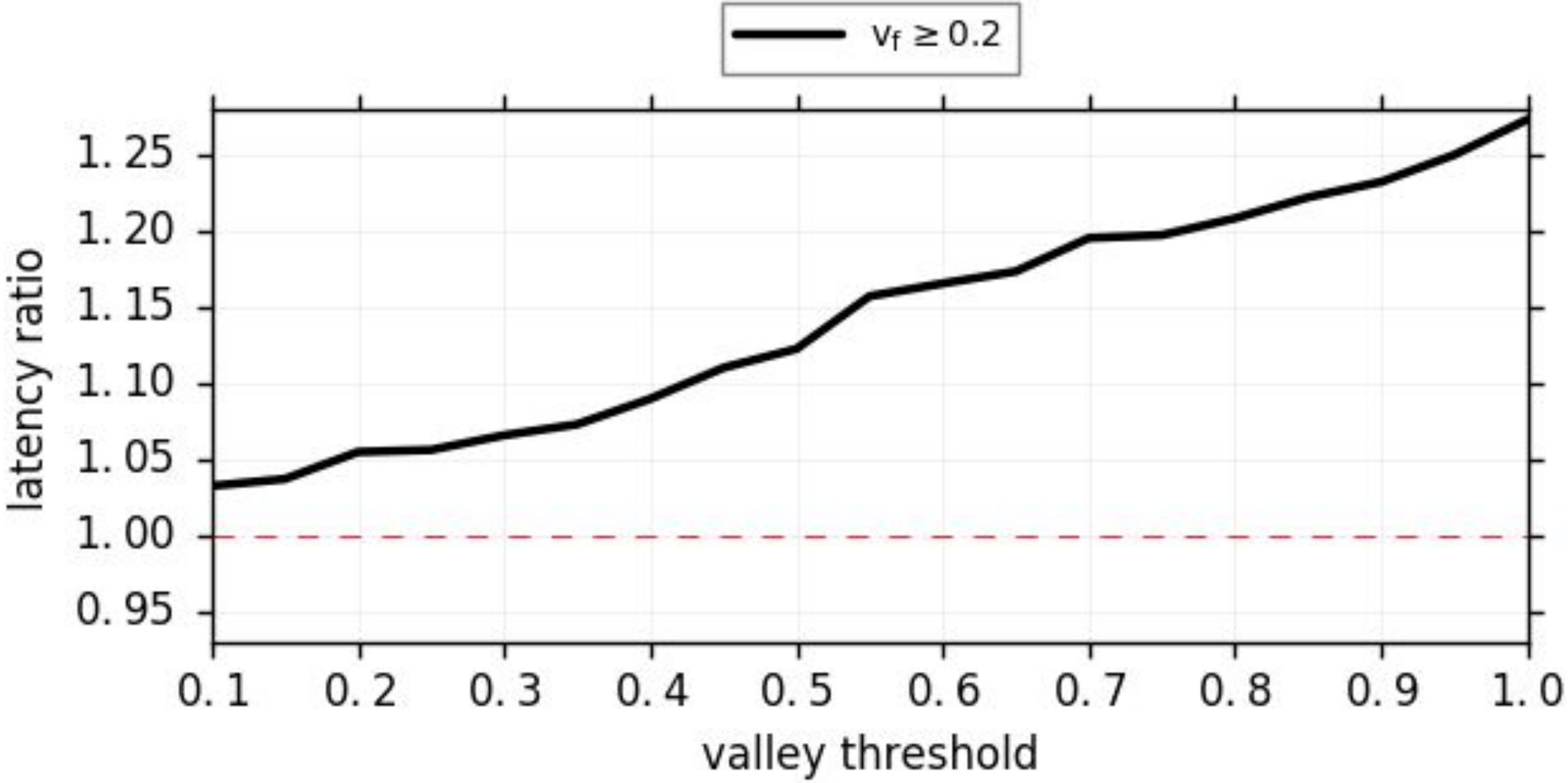
2. Count the # of sufficiently deep valleys

3. Apply subnet assimilation
   a. Training window is *already* complete
   b. Both parameters met

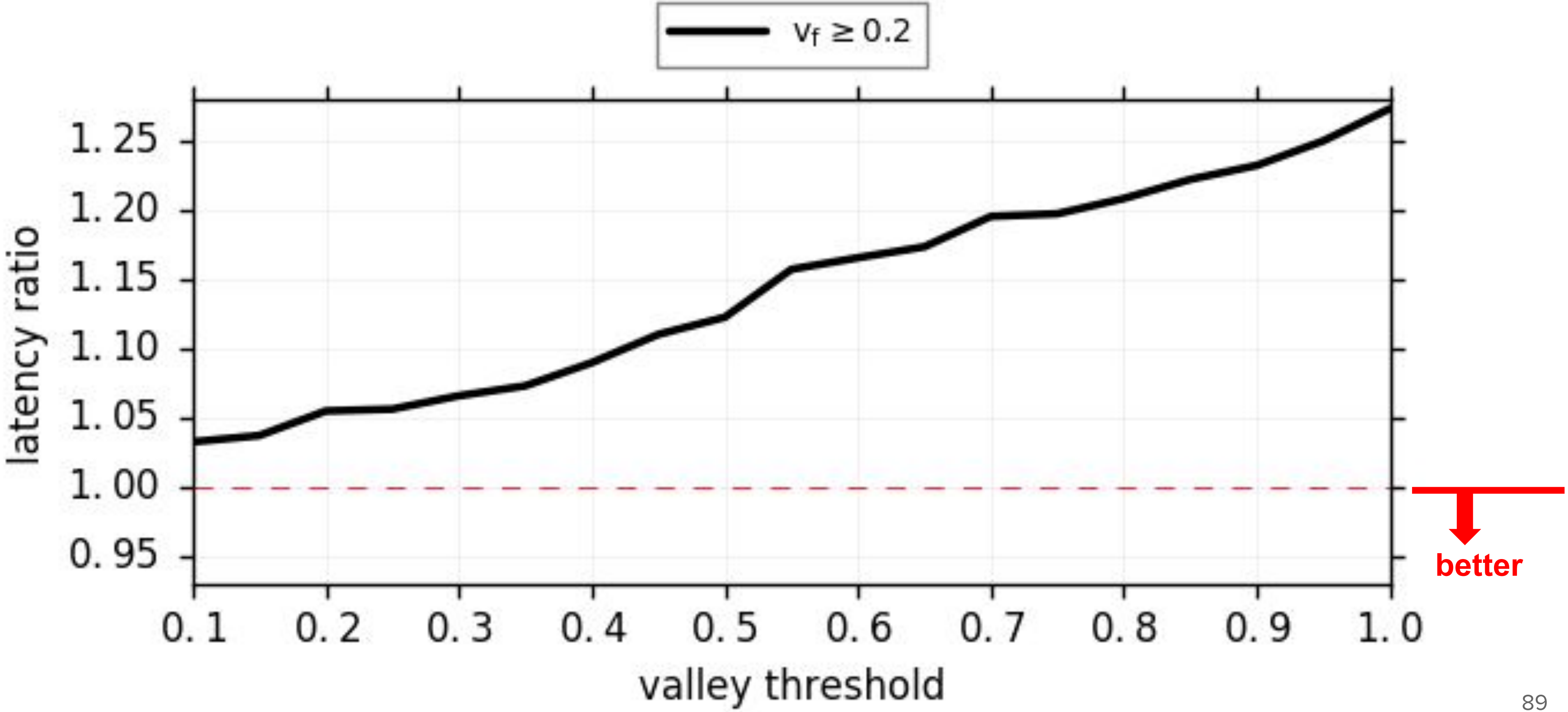
System Wide Performance



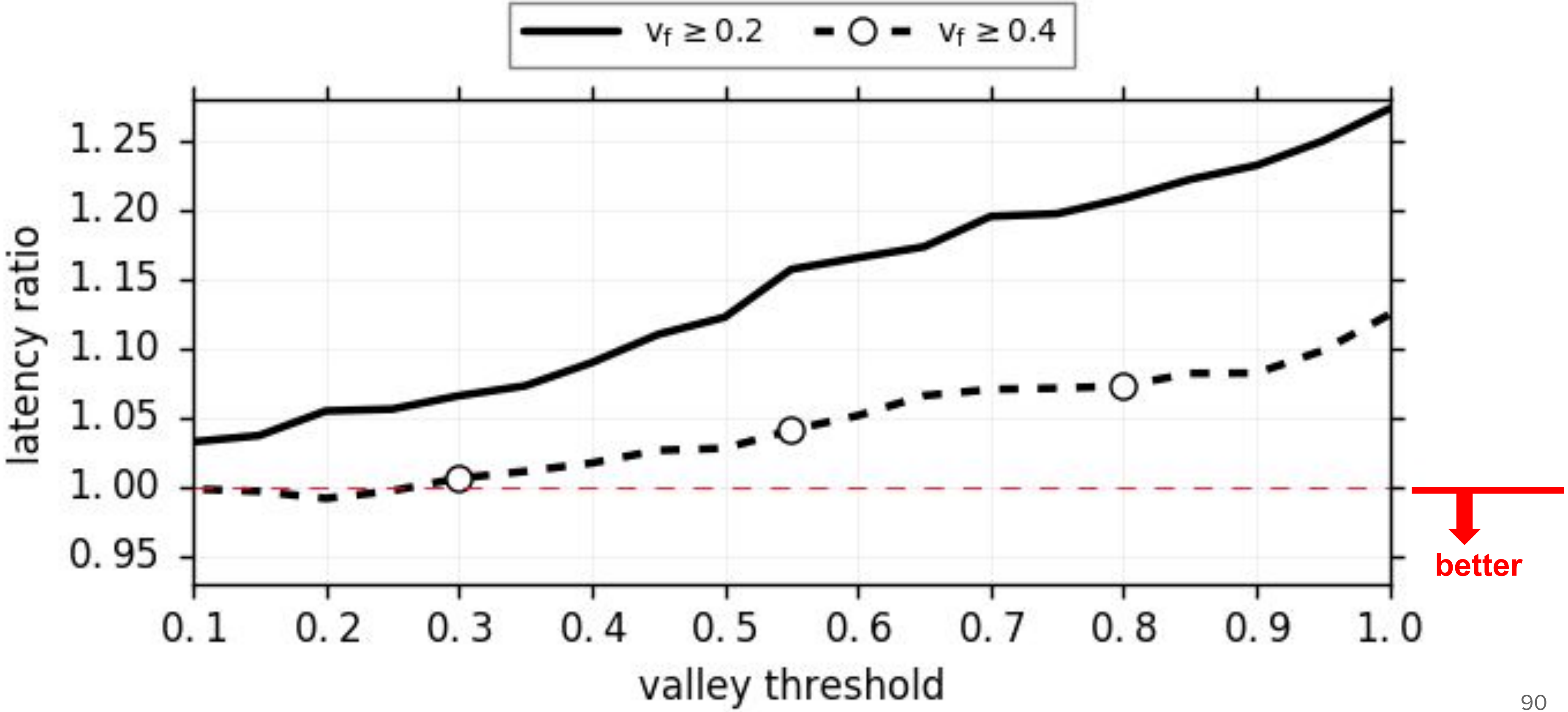
System Wide Performance



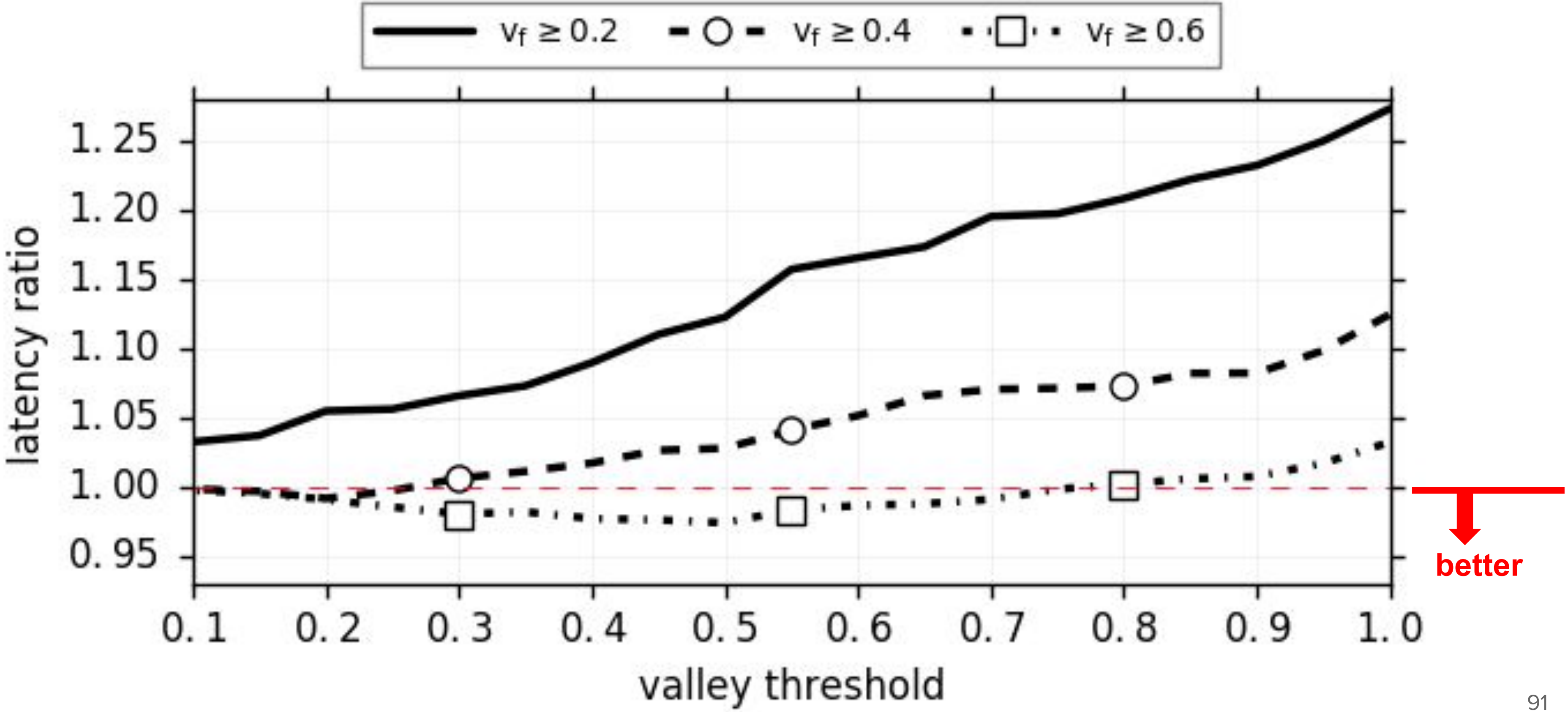
System Wide Performance



System Wide Performance



System Wide Performance



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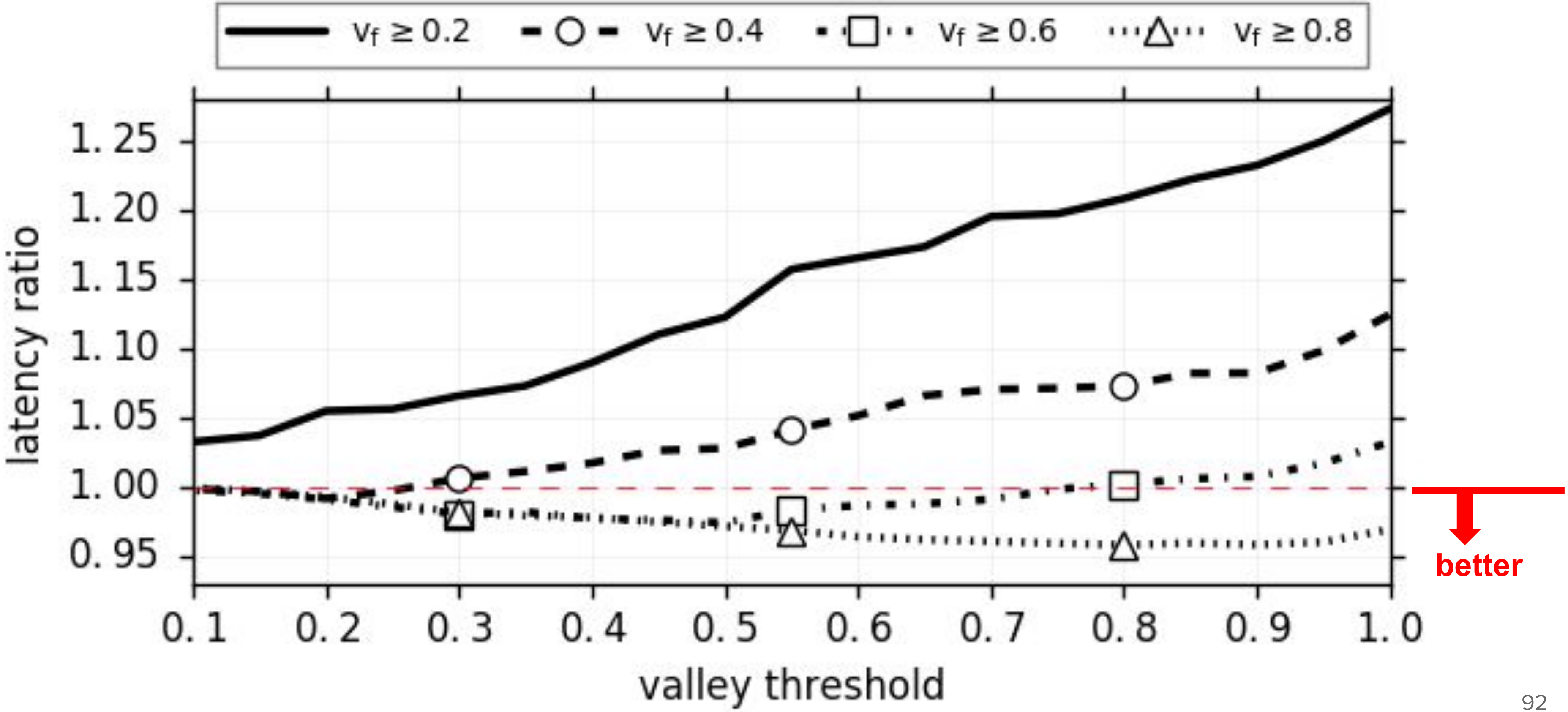
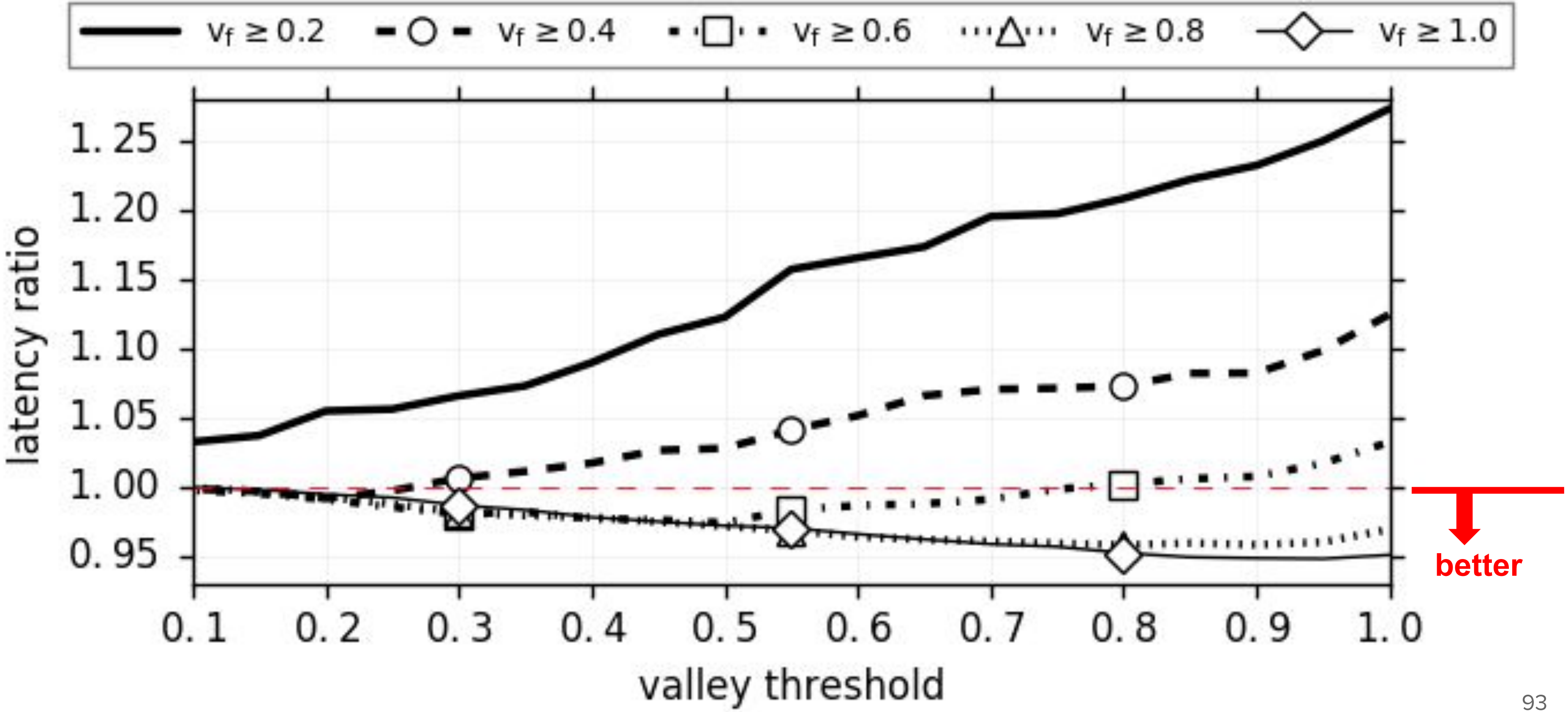
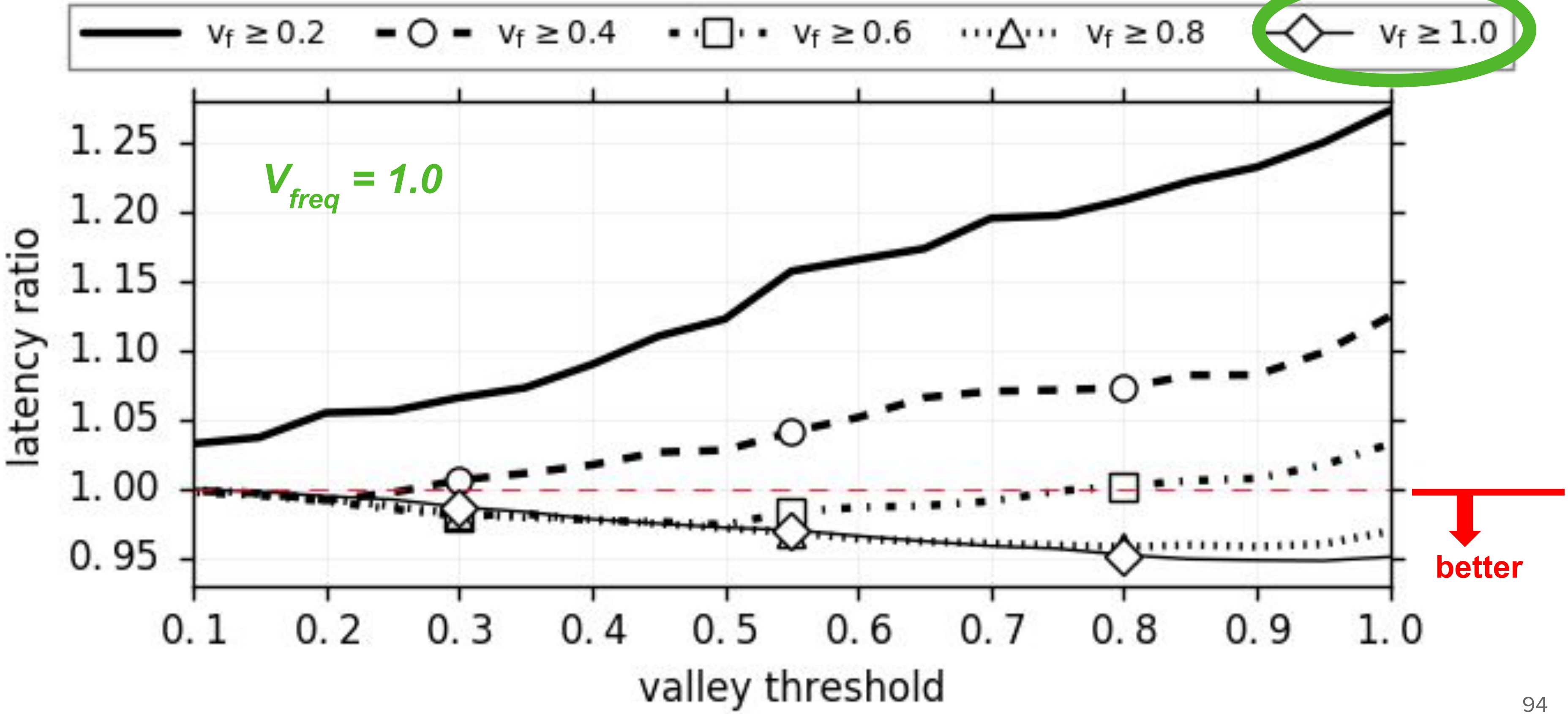


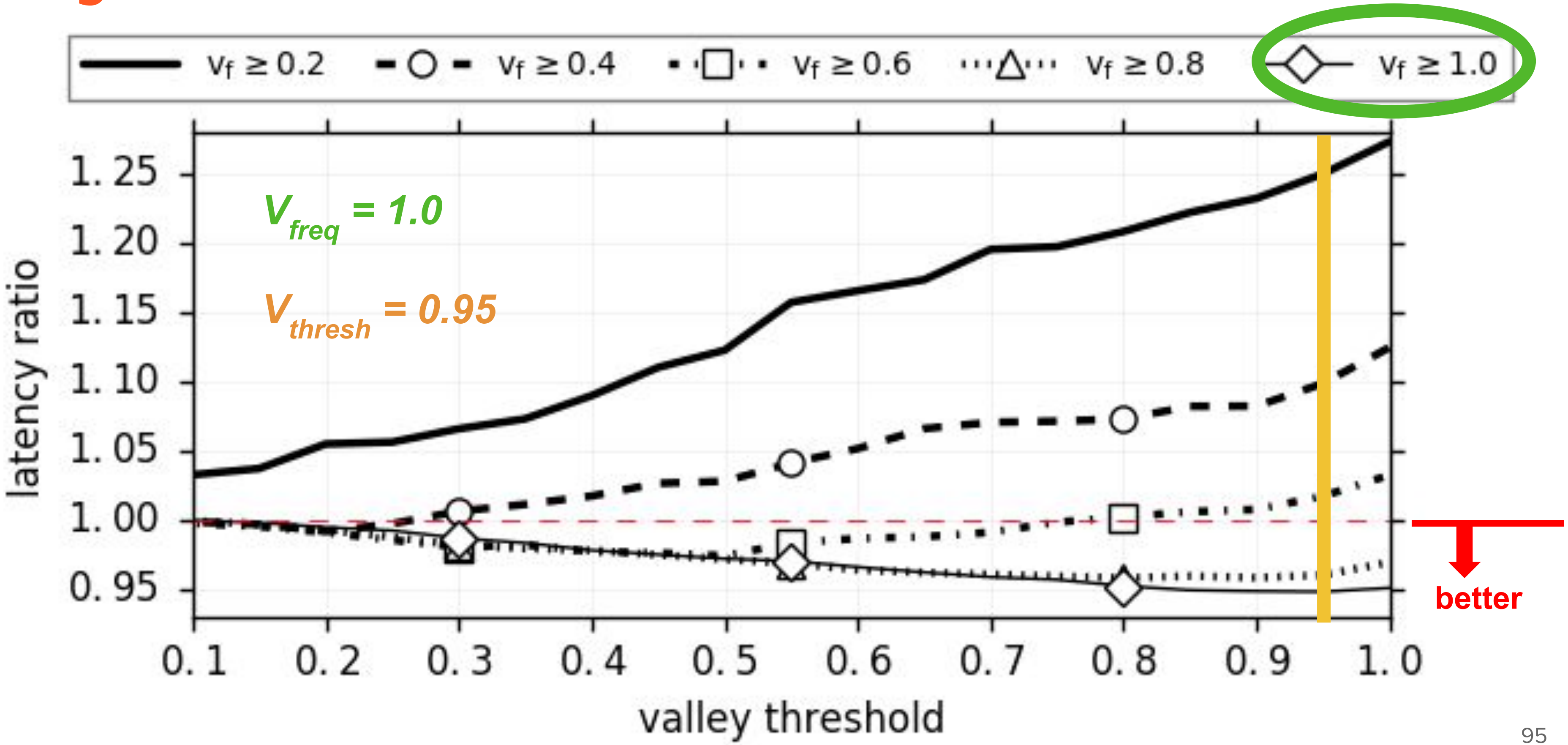
System Wide Performance



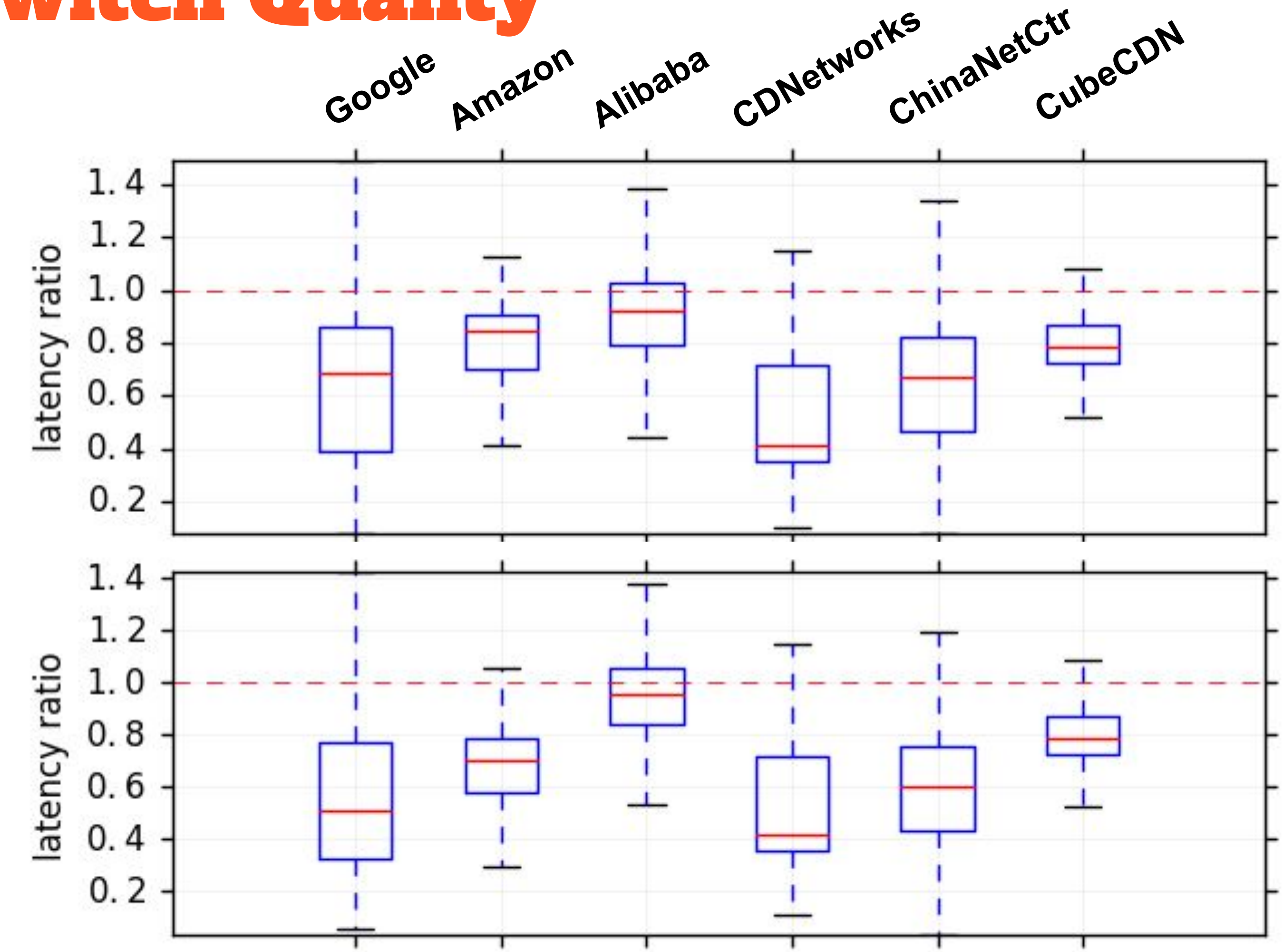
System Wide Performance



System Wide Performance



Switch Quality



Global Params

Per Prov. Params

Conclusion & Insights

- CDNs have a lot of room for improvement

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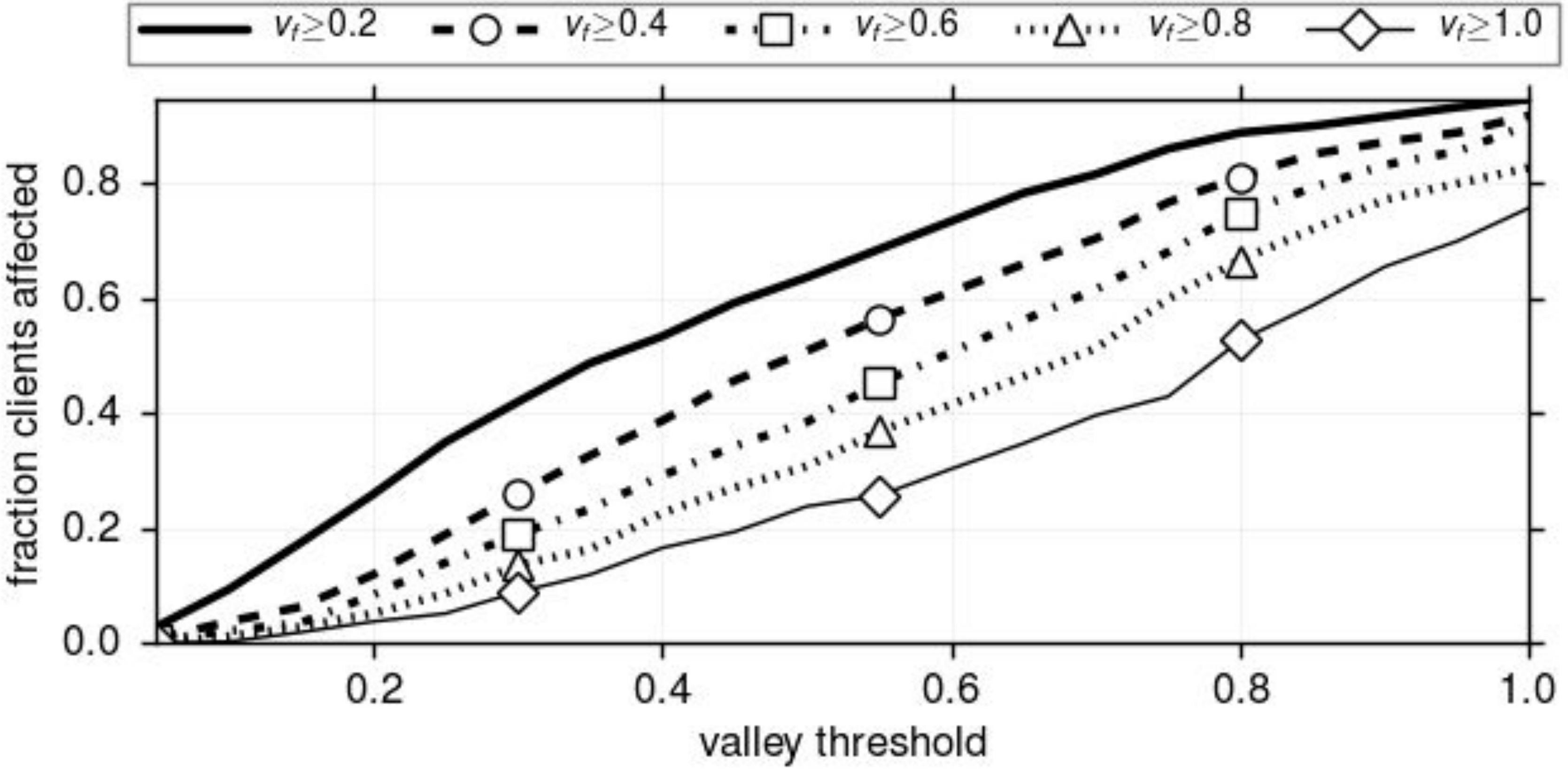
- CDNs have a lot of room for improvement
- Clients can help
- Low requirements
- Can provide 50% improvement

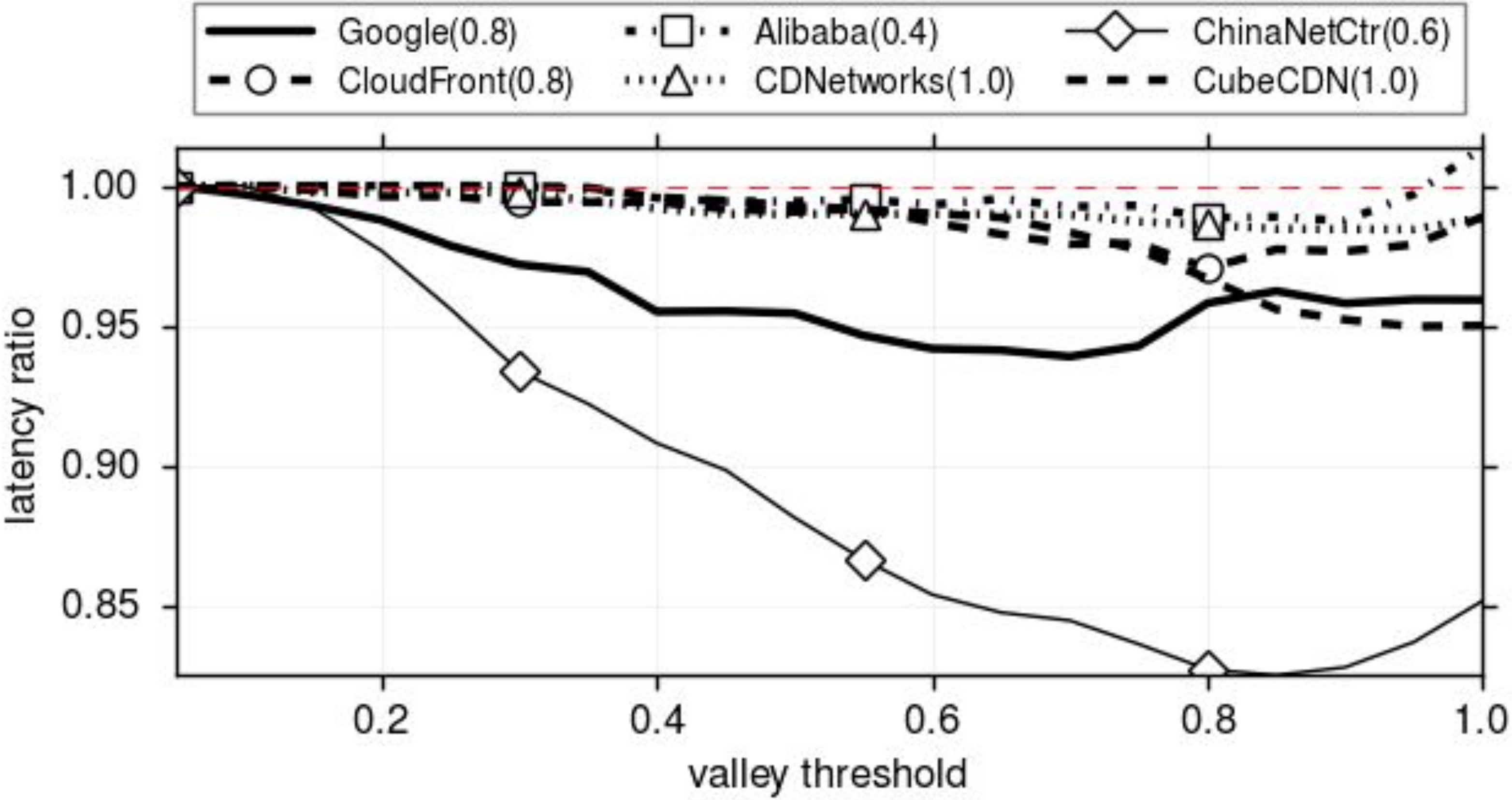
Questions?

# Clients Affected

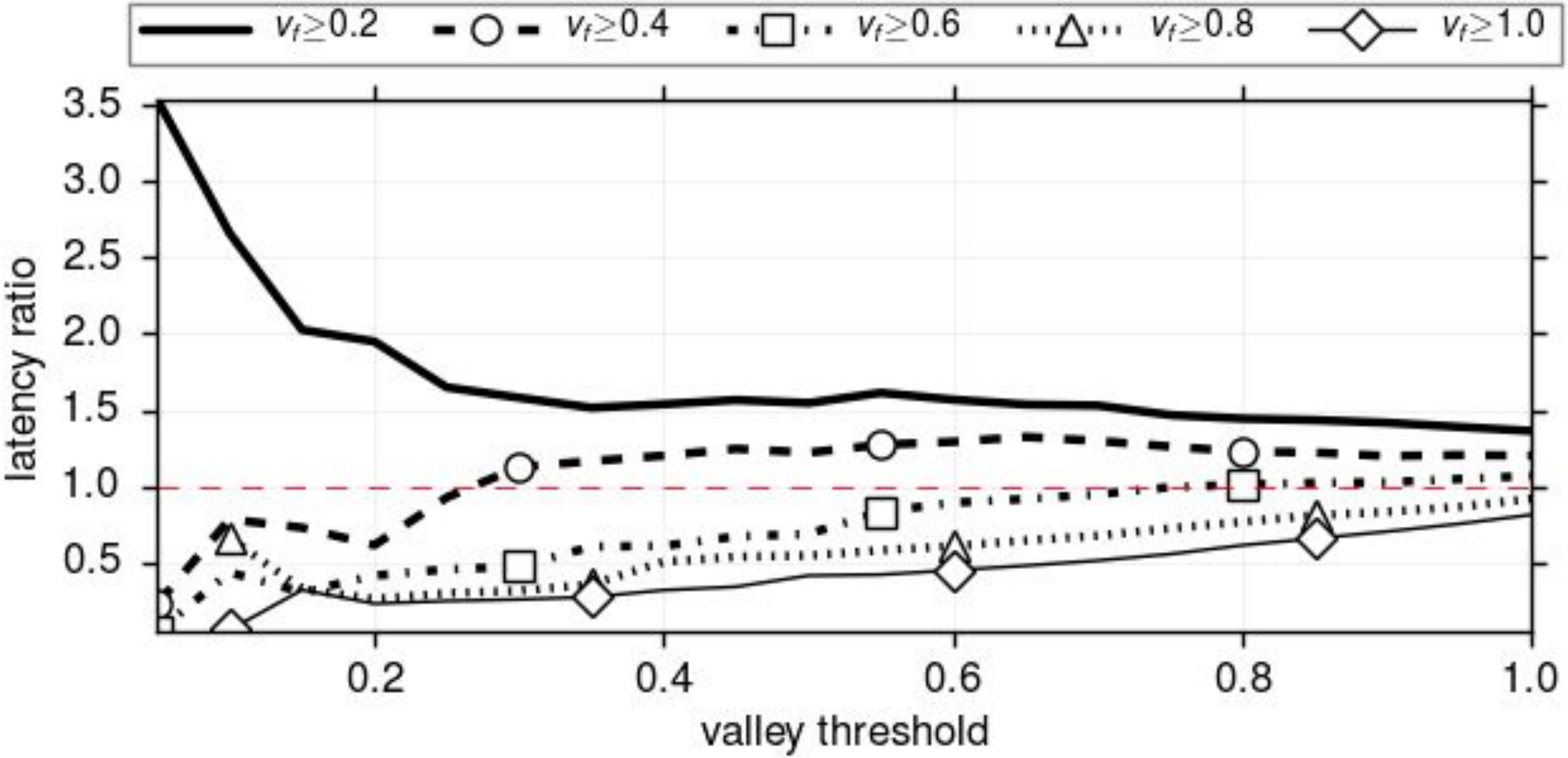


better

Per Provider Overall Performance



Performance of Drongo's choices


$v_f \geq 0.2$
$v_f \geq 0.4$
$v_f \geq 0.6$
$v_f \geq 0.8$
$v_f \geq 1.0$
latency ratio
valley threshold