Understanding Routing-Induced Censorship Changes Globally

Abhishek Bhaskar, Paul Pearce

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Censorship Measurement

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Censorship Measurement

- Internet Censorship is pervasive

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- Significant effort into studying global censorship

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Outside-In Censorship Measurement

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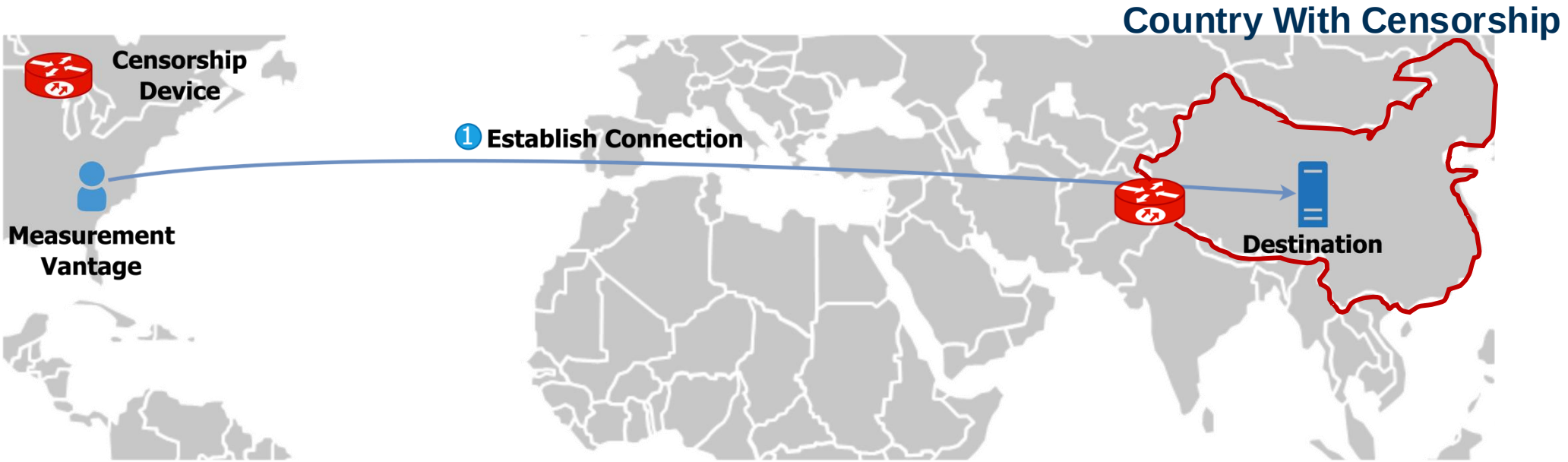

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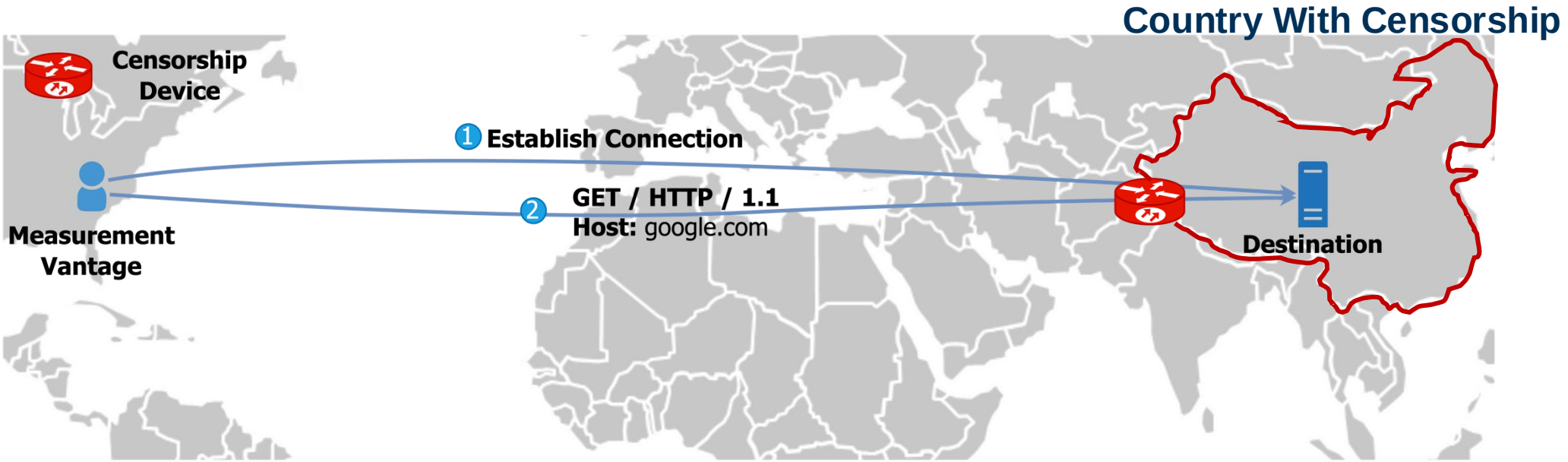

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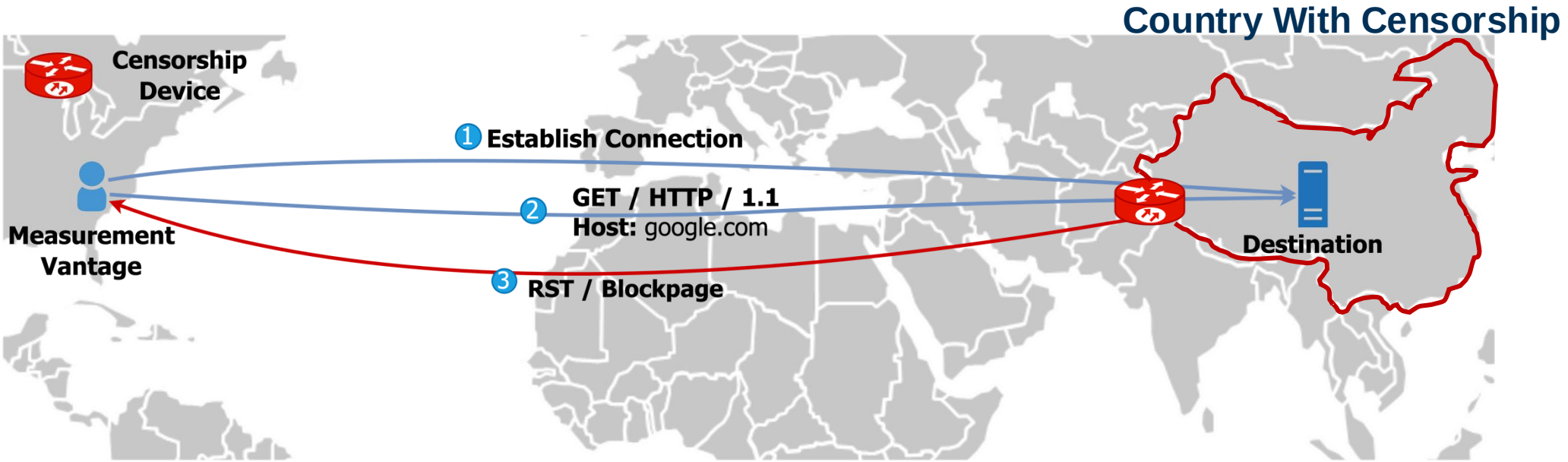

Outside-In Censorship Measurement

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Equal-Cost Multi-Path (ECMP) Routing

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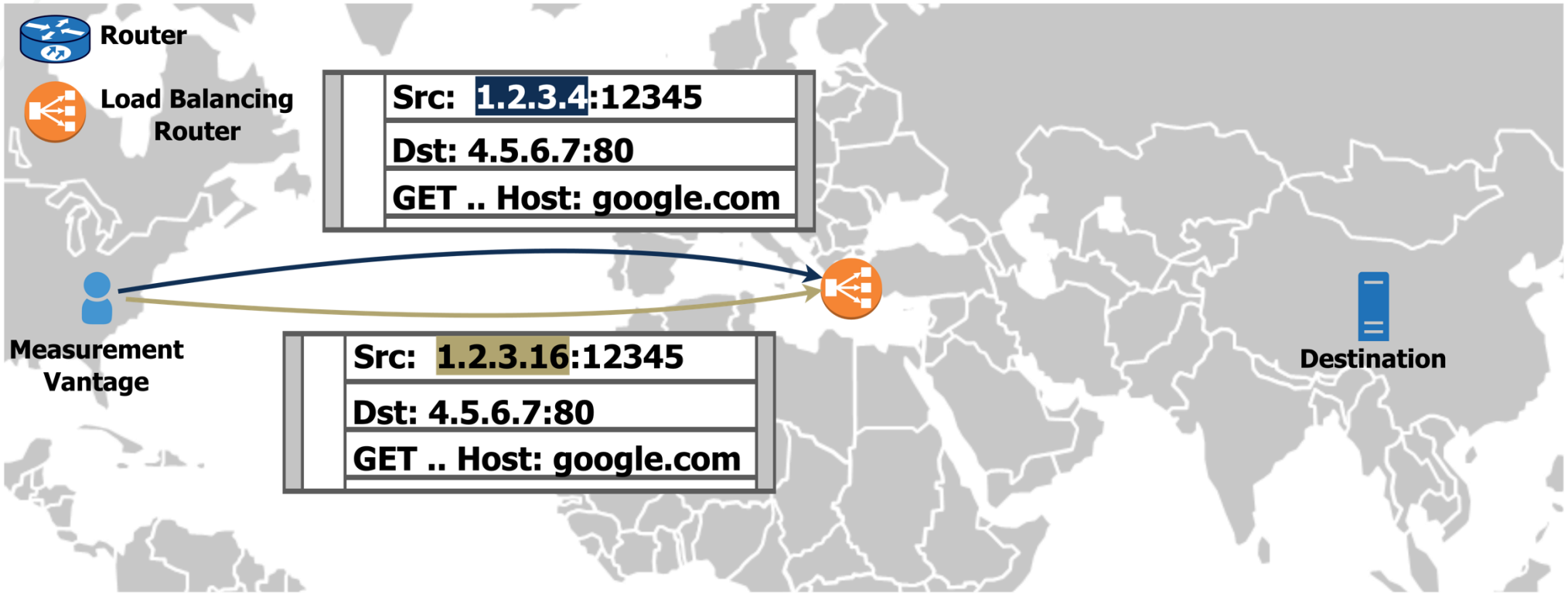

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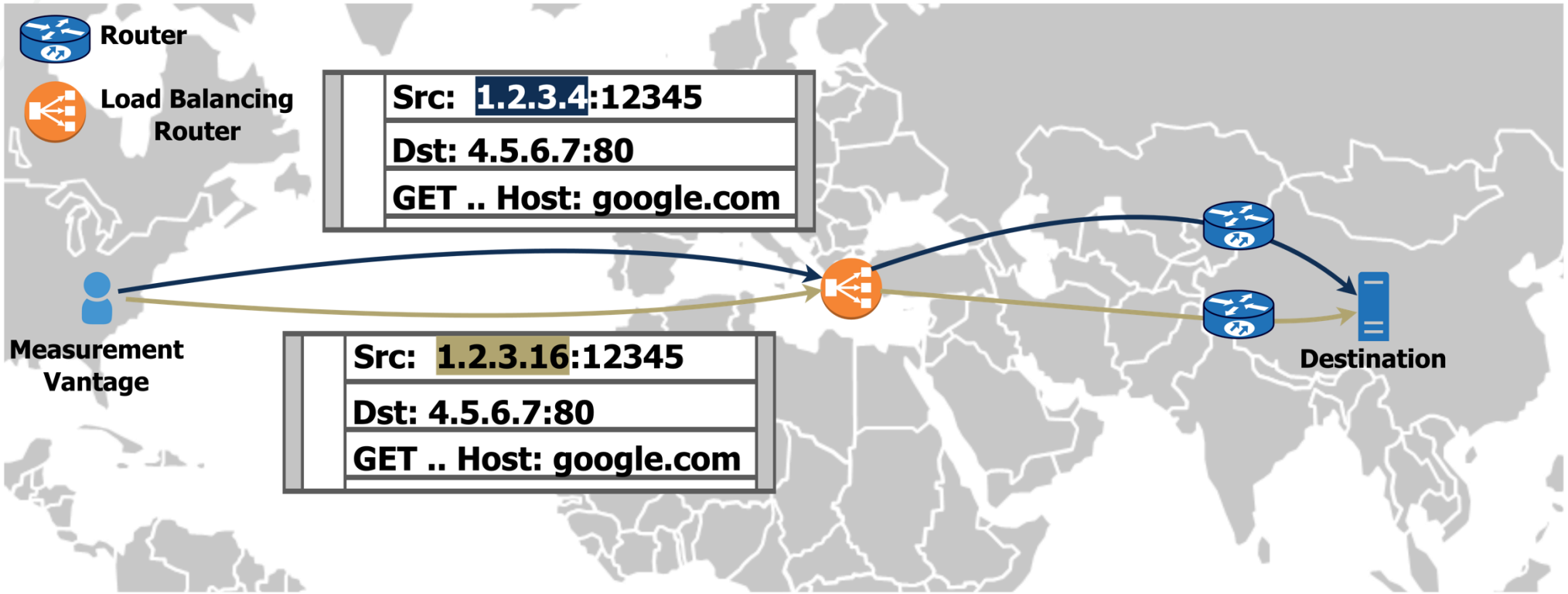

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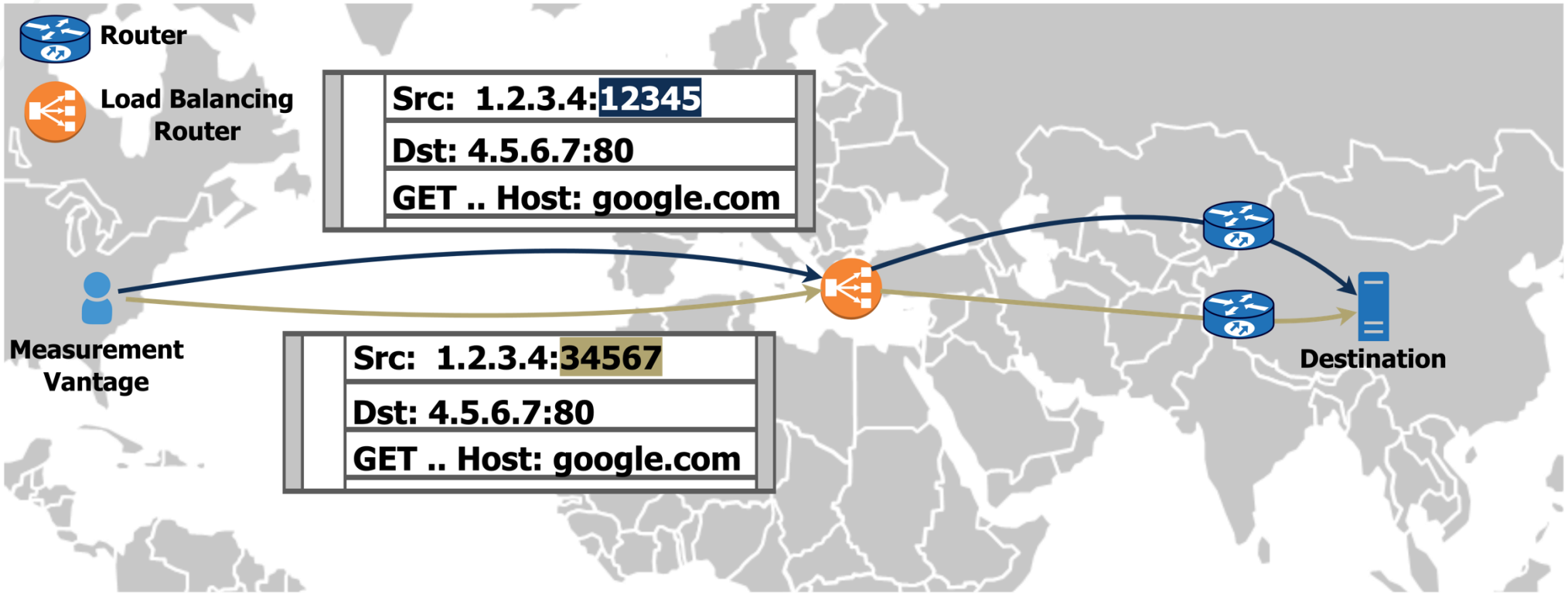

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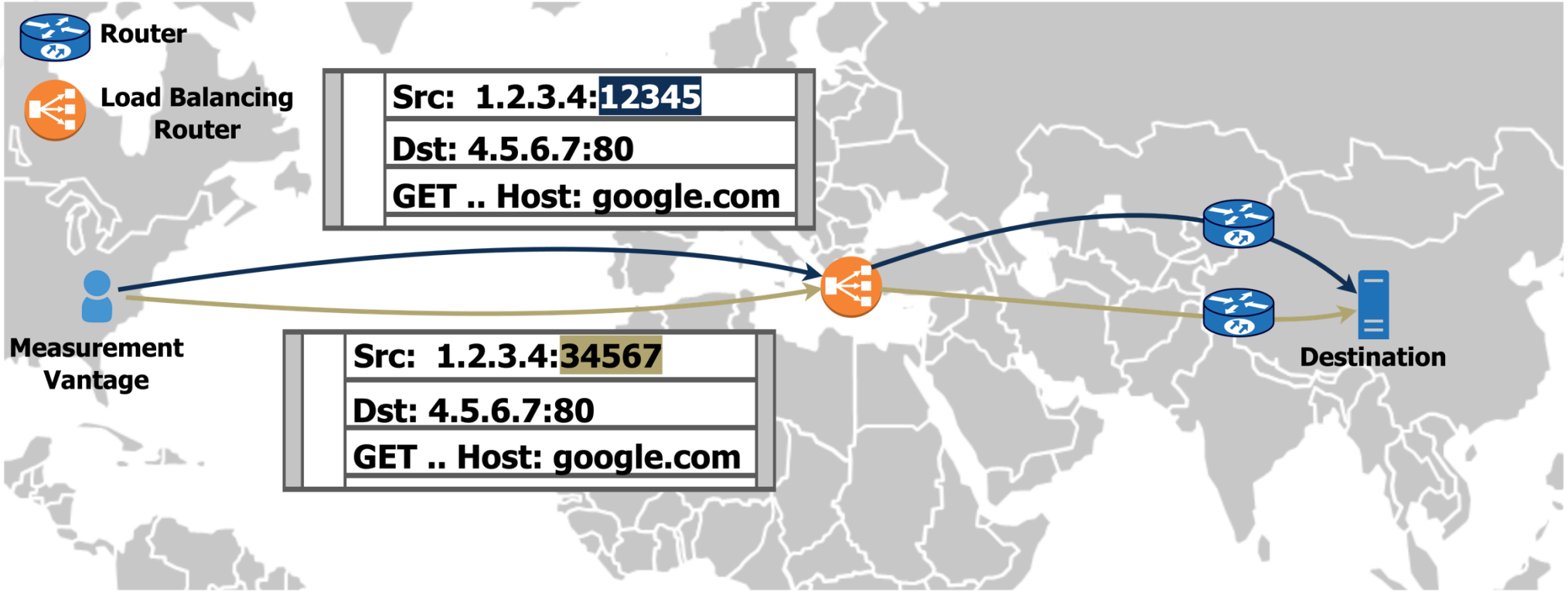

- **Diamond-Miner** [2] found that **18% of divergences span ASes**

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- Prior works have observed non-determinism in censorship results

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- **Important to rule out measurement artifacts as potential cause for variation**

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- Study the impact of ECMP routing on **global outside-in censorship measurement**

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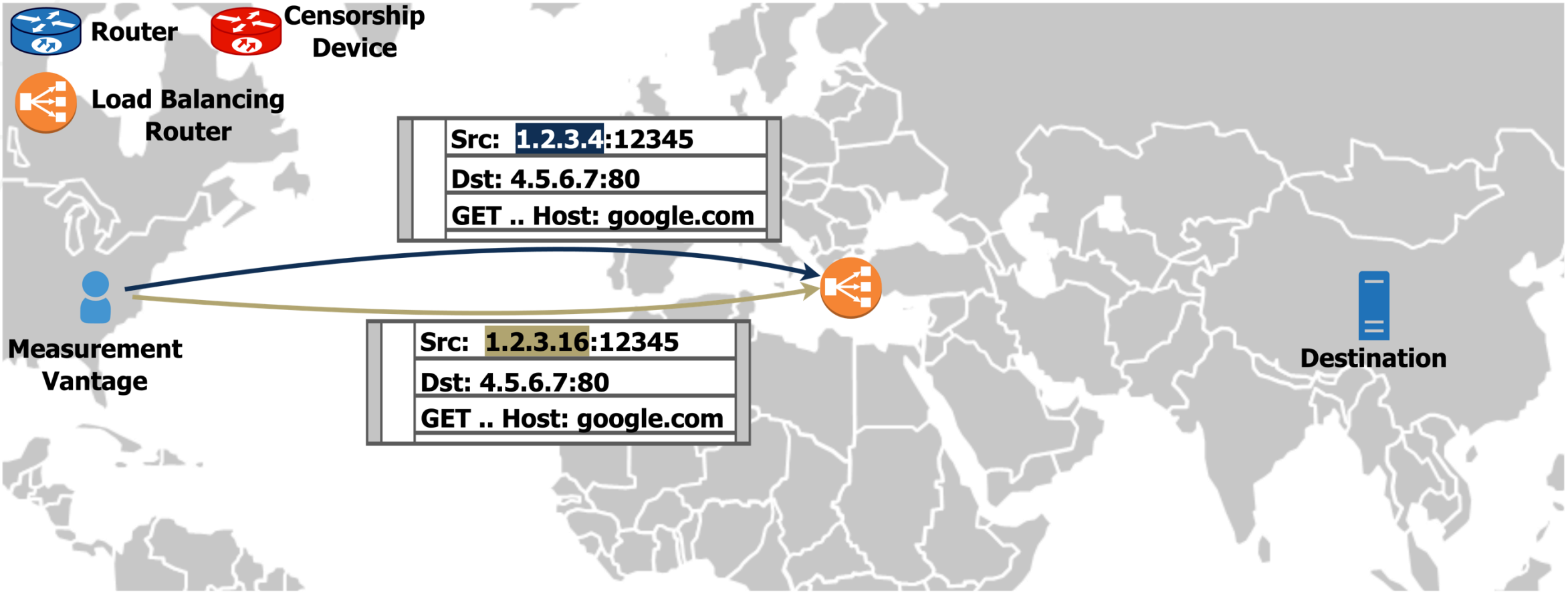

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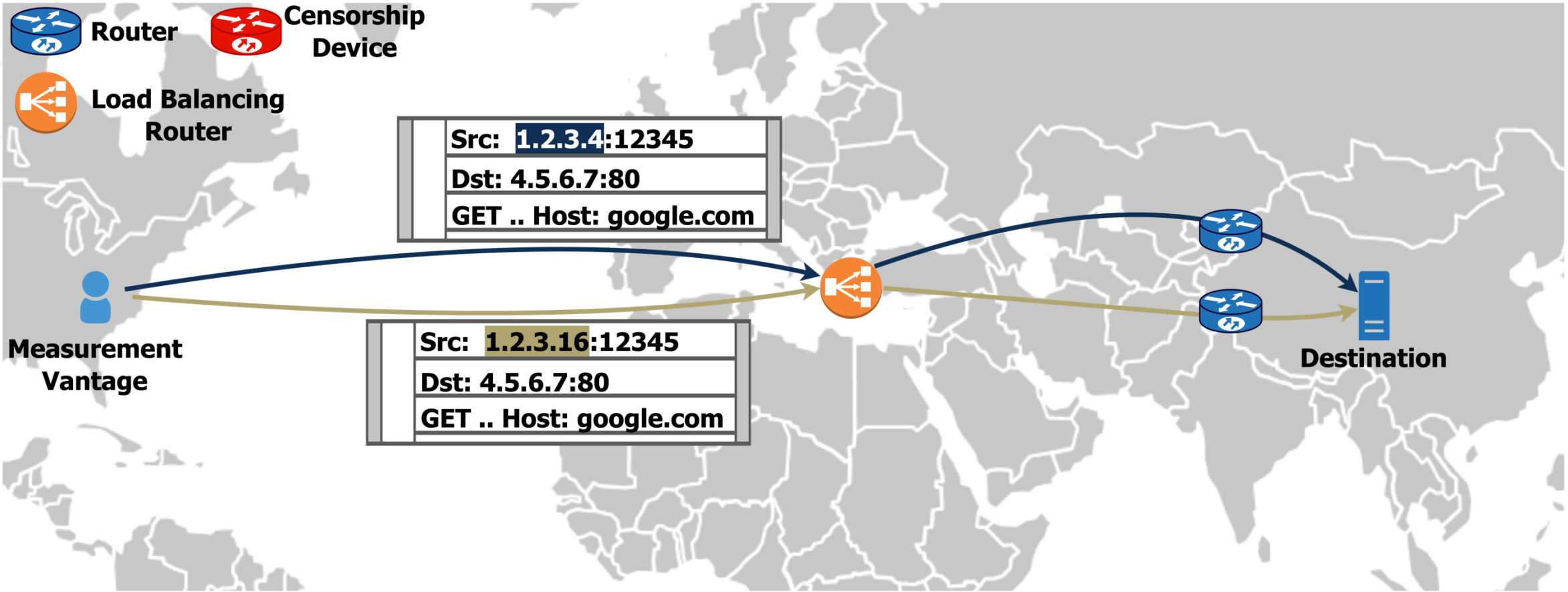

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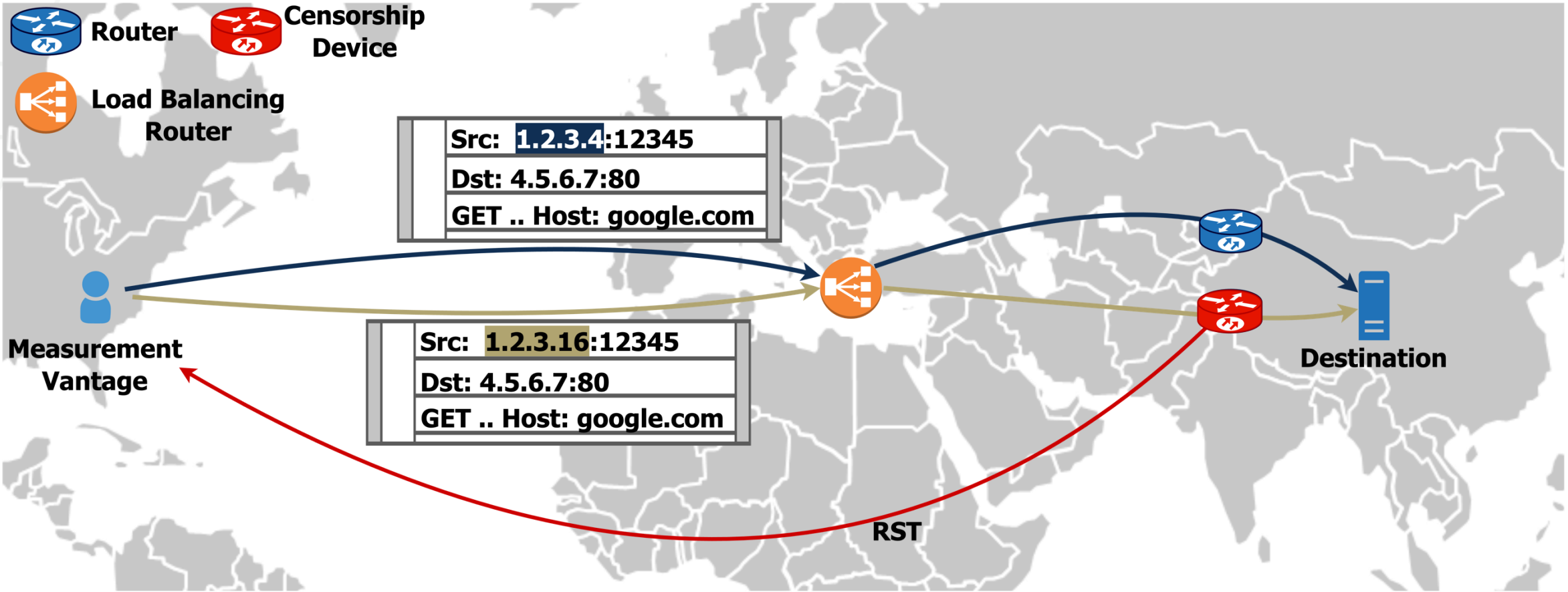

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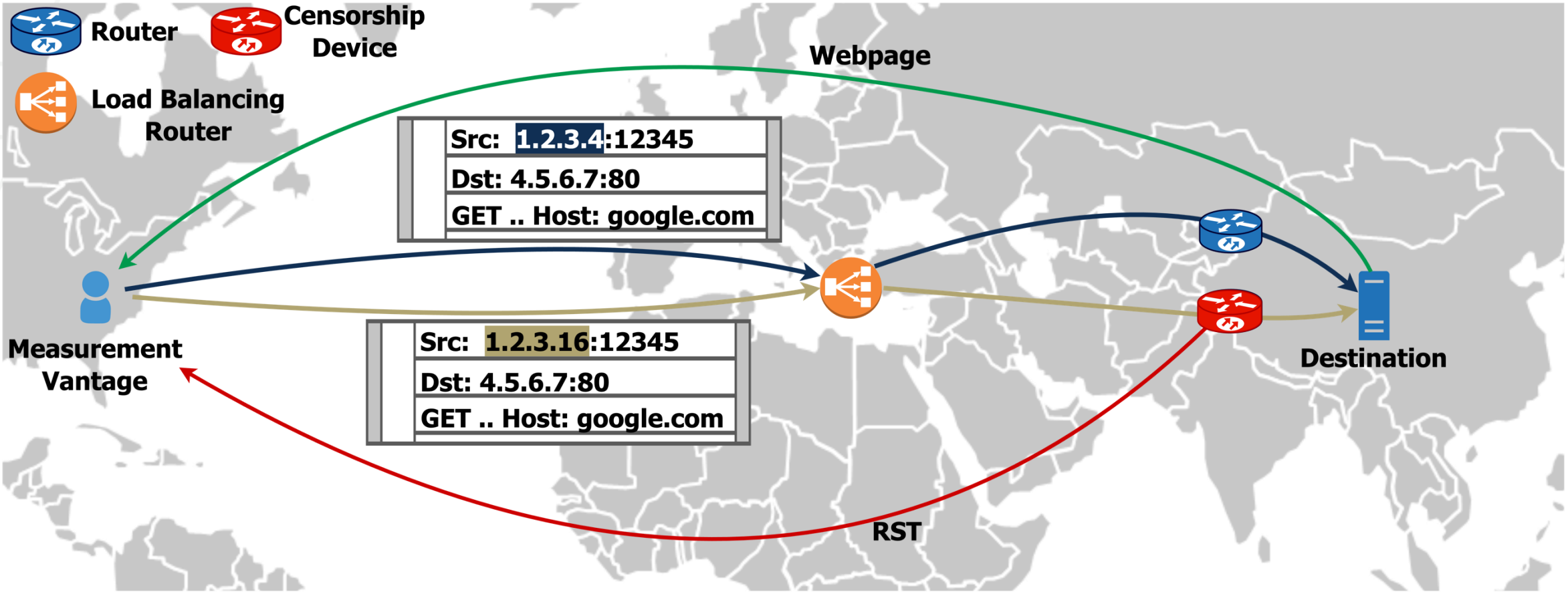

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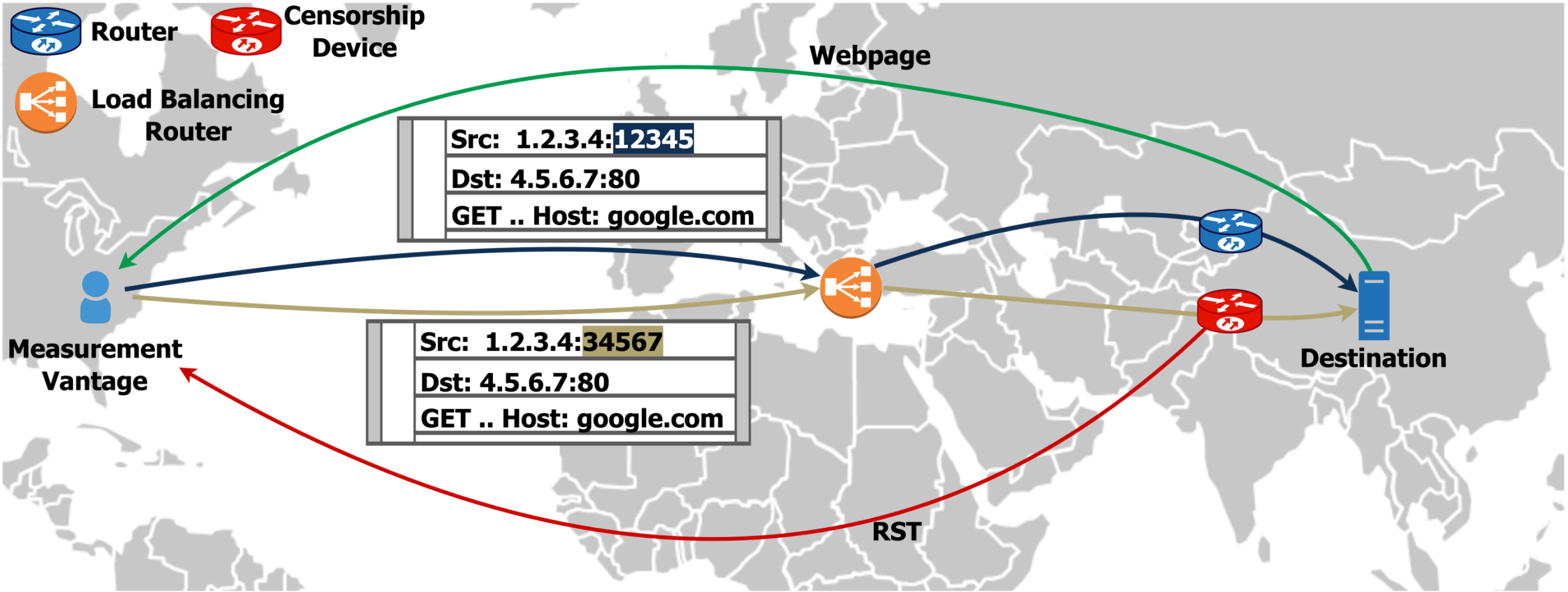

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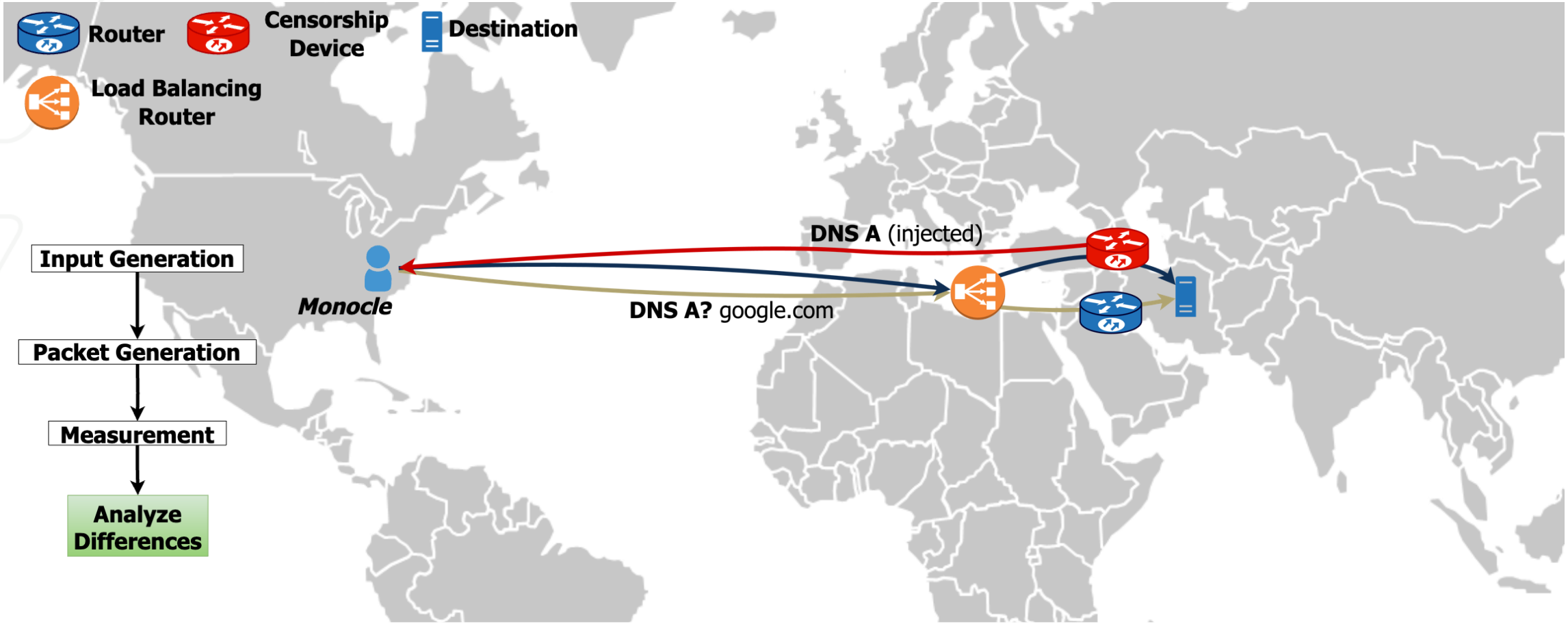

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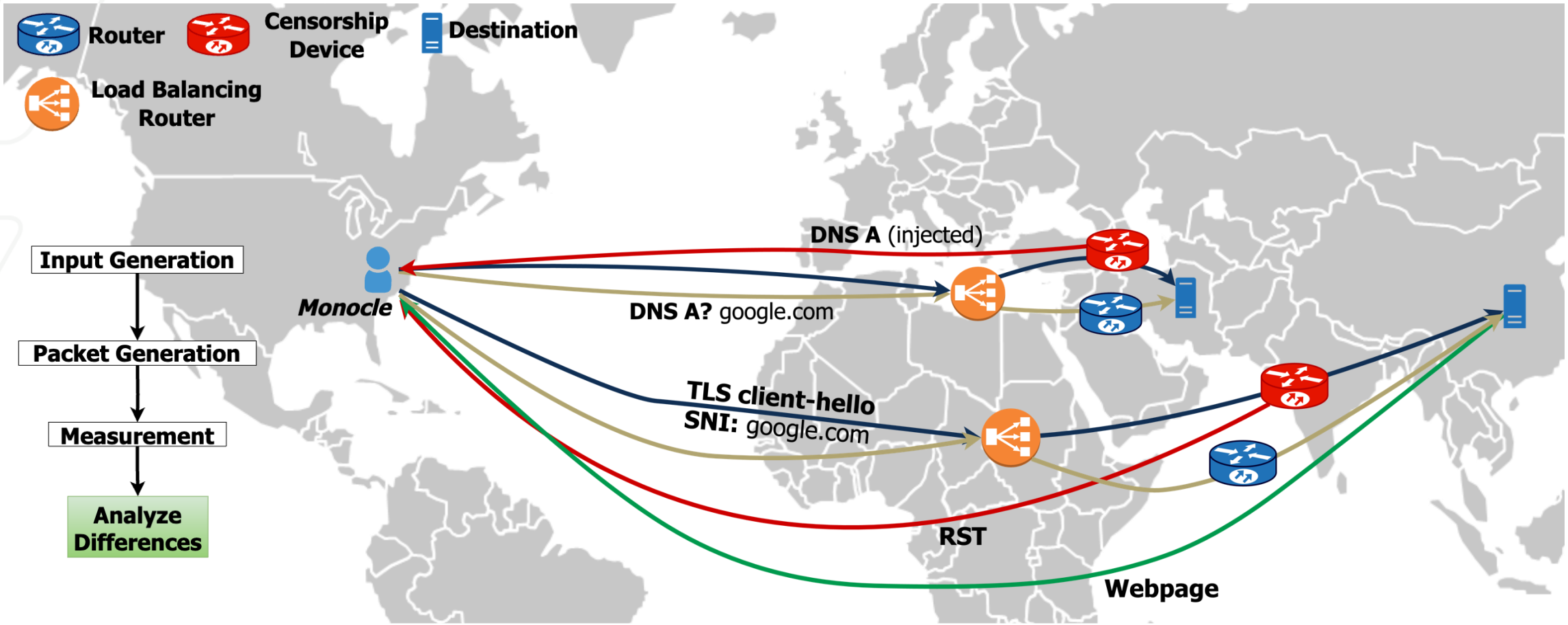

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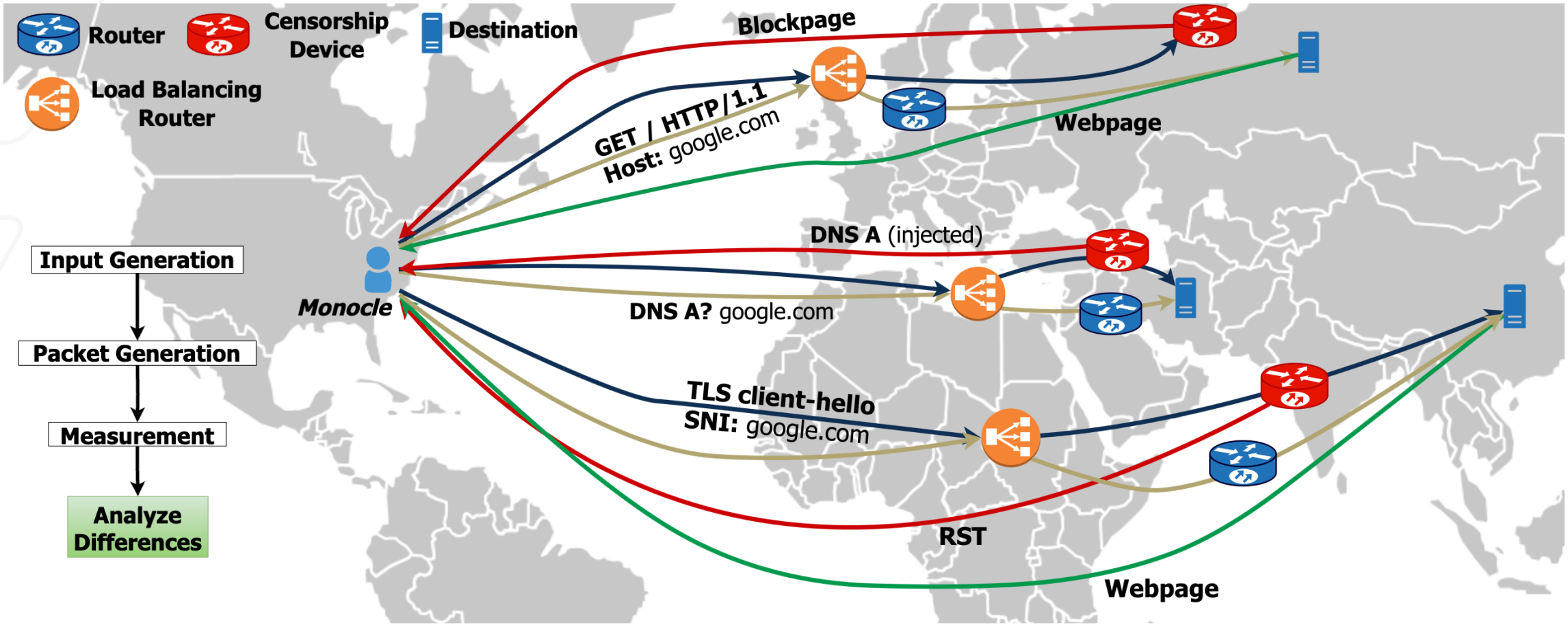

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Route-Aware Traceroute

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  - We build route-stable network paths (UDP and TCP)

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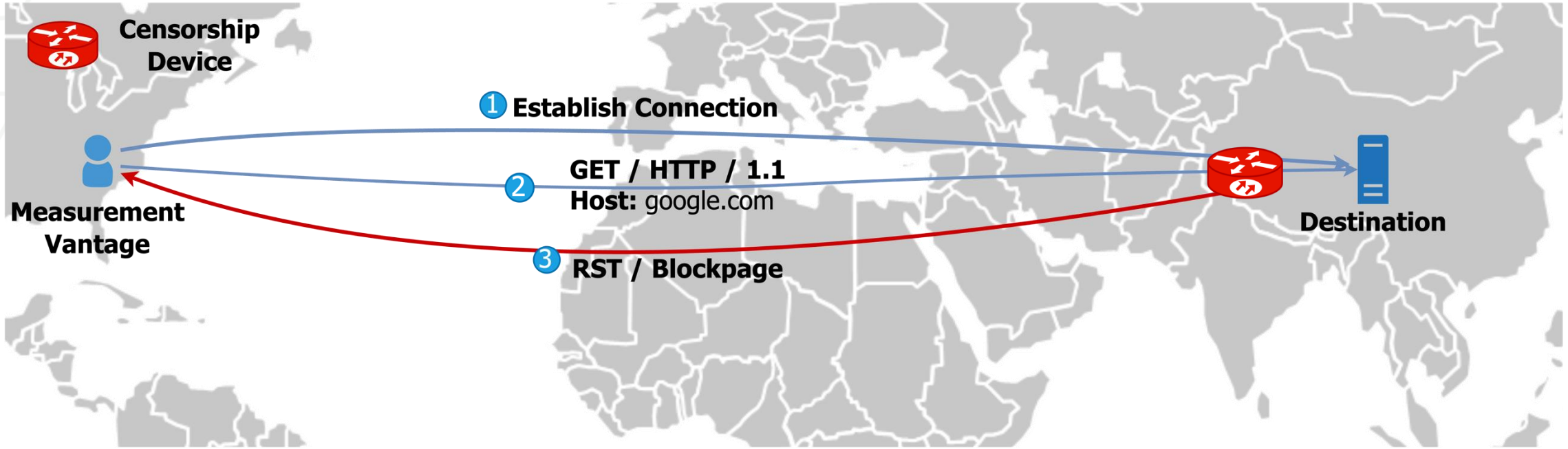

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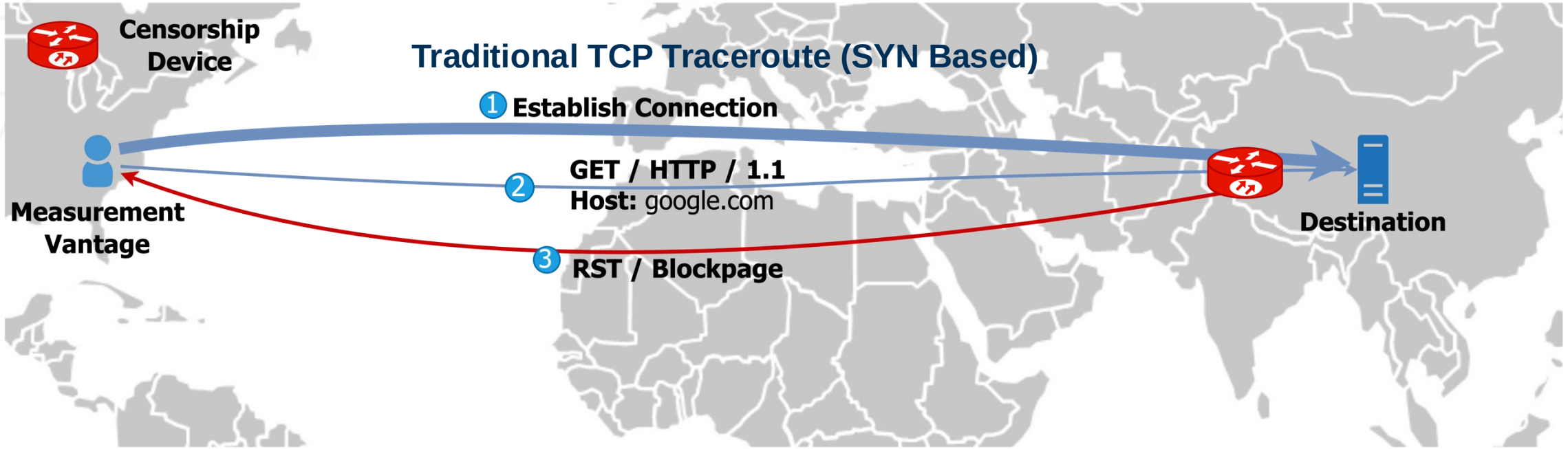

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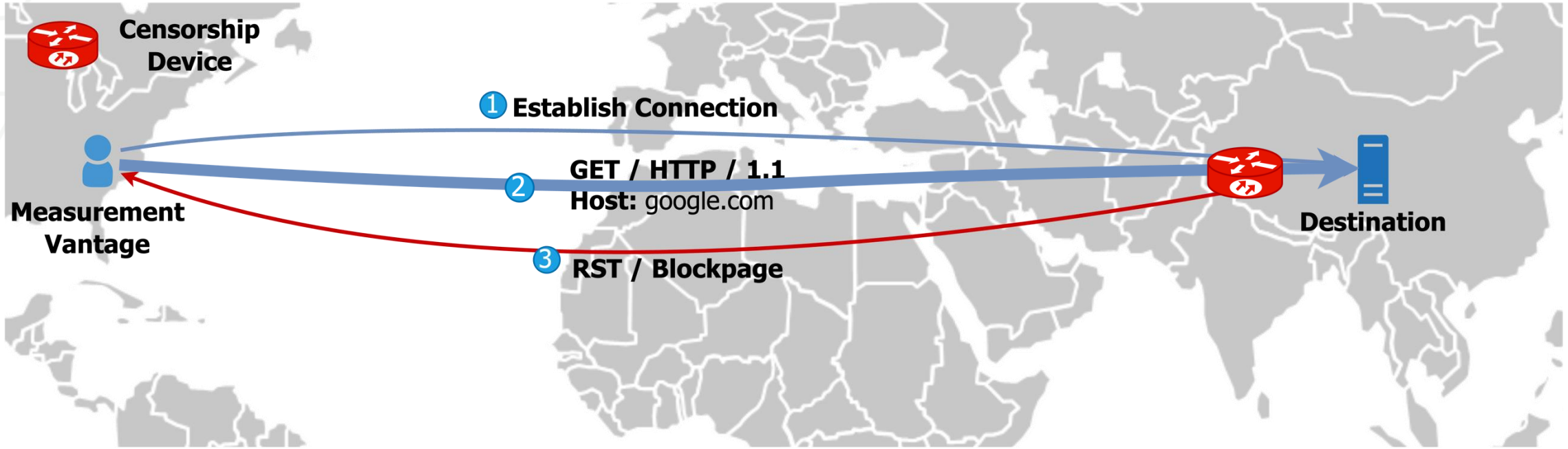

- Challenging as sensitive packet is **deep inside TCP connection**

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Questions we want to answer

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- How do results contextualize with prior work?

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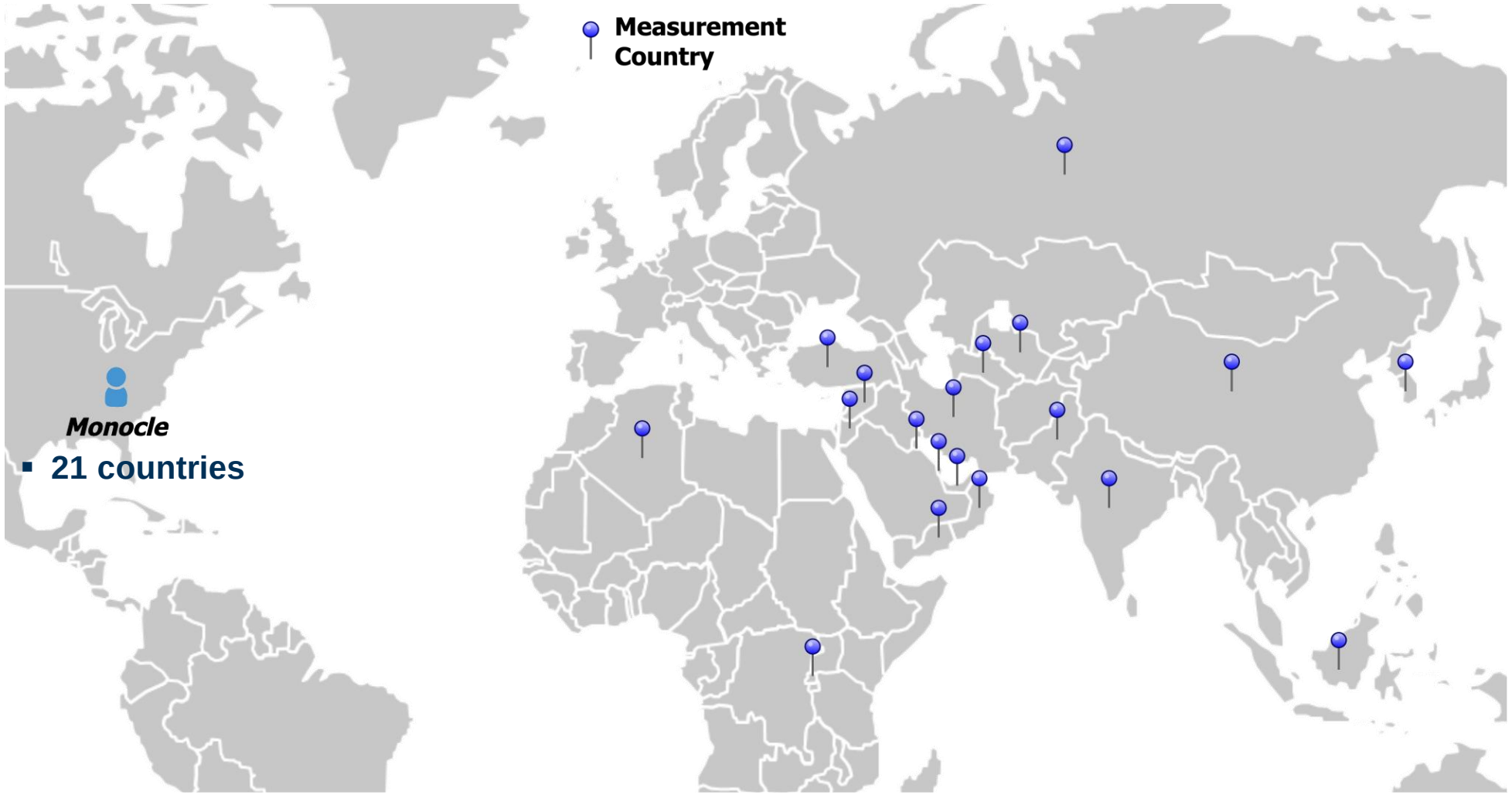
Dataset



- 21 countries

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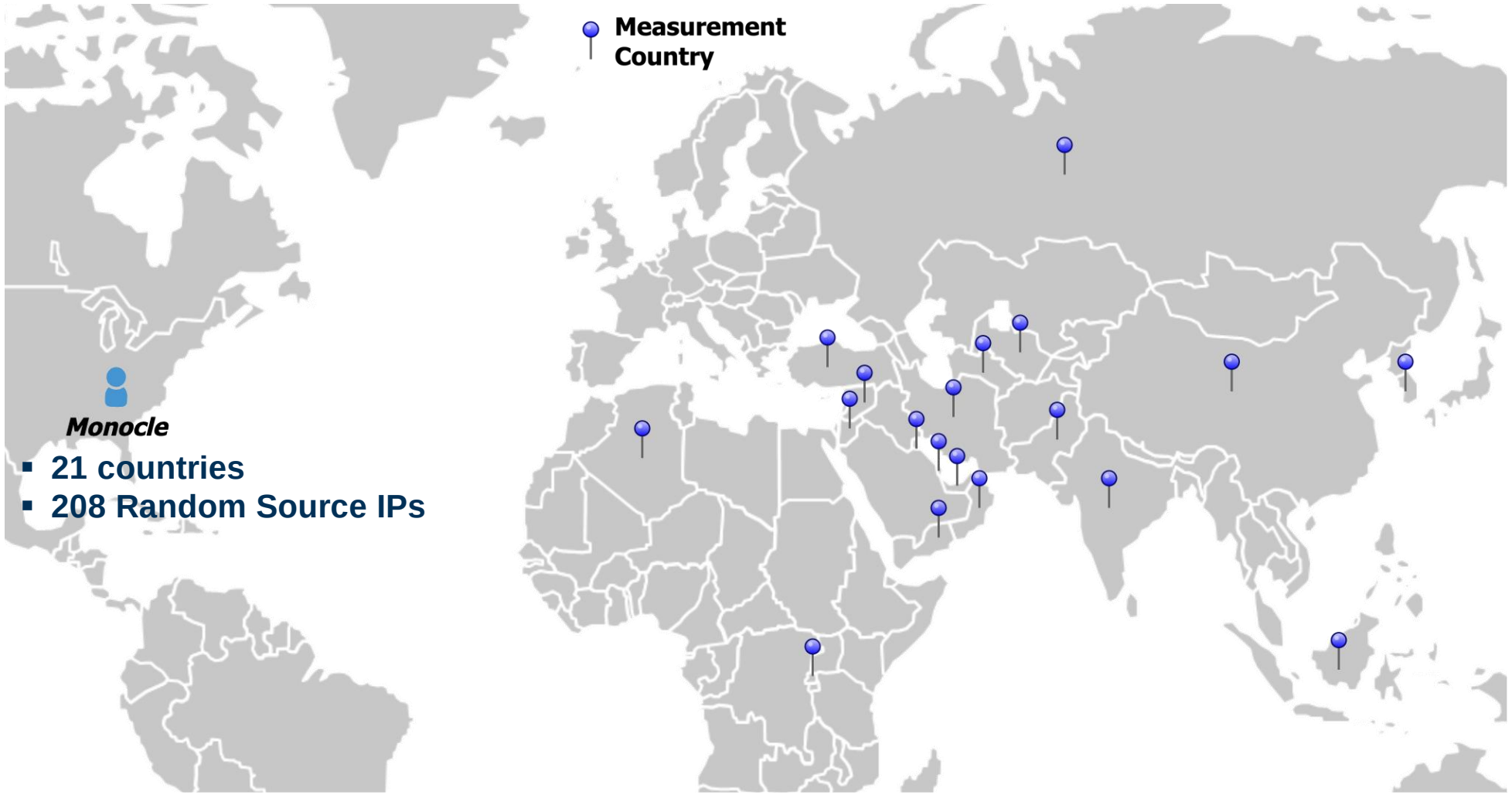

- 21 countries
- 208 Random Source IPs

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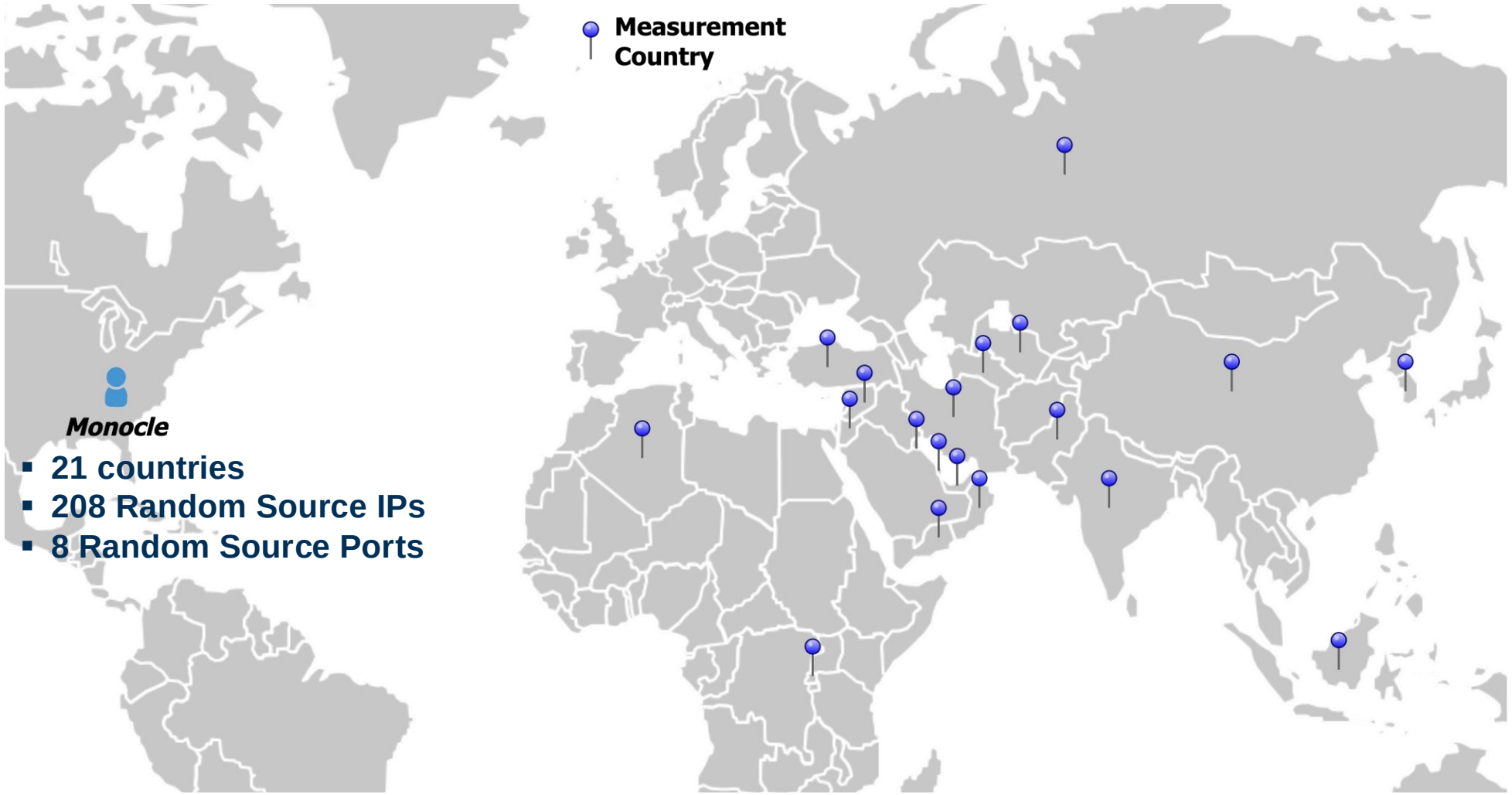

- 21 countries
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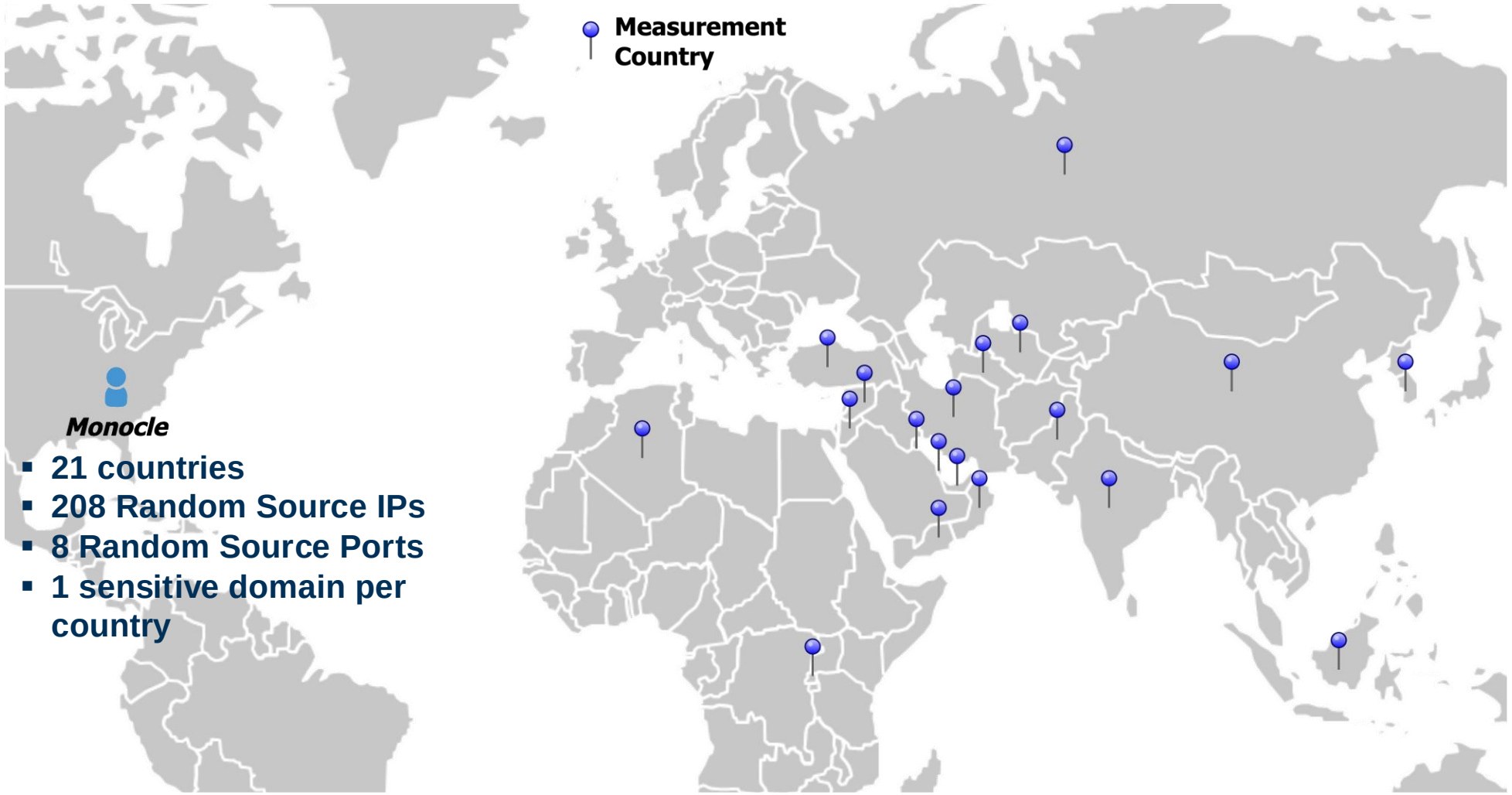

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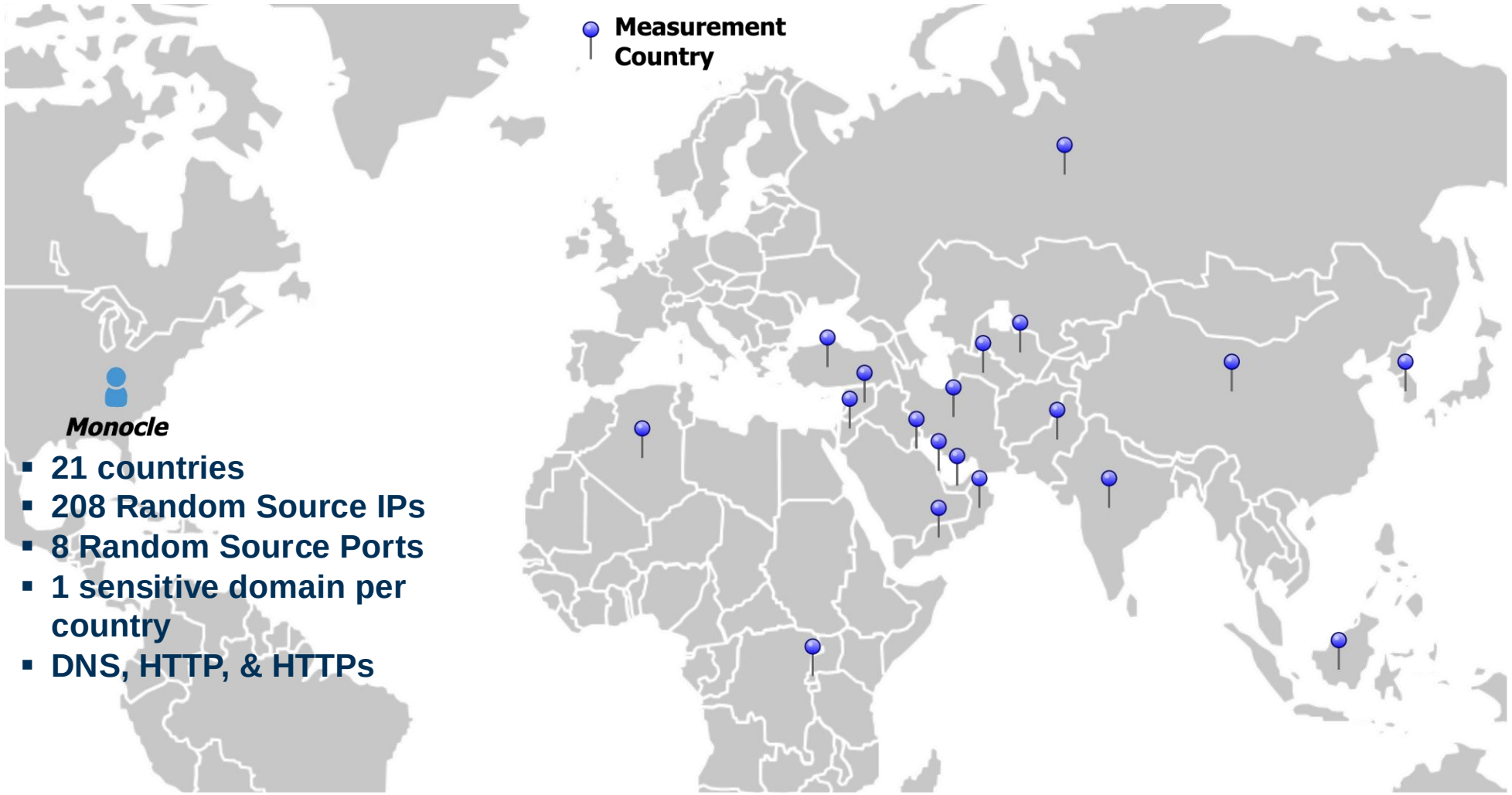

- 21 countries
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- DNS, HTTP, & HTTPs

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Path Diversity of Global Censorship Measurement

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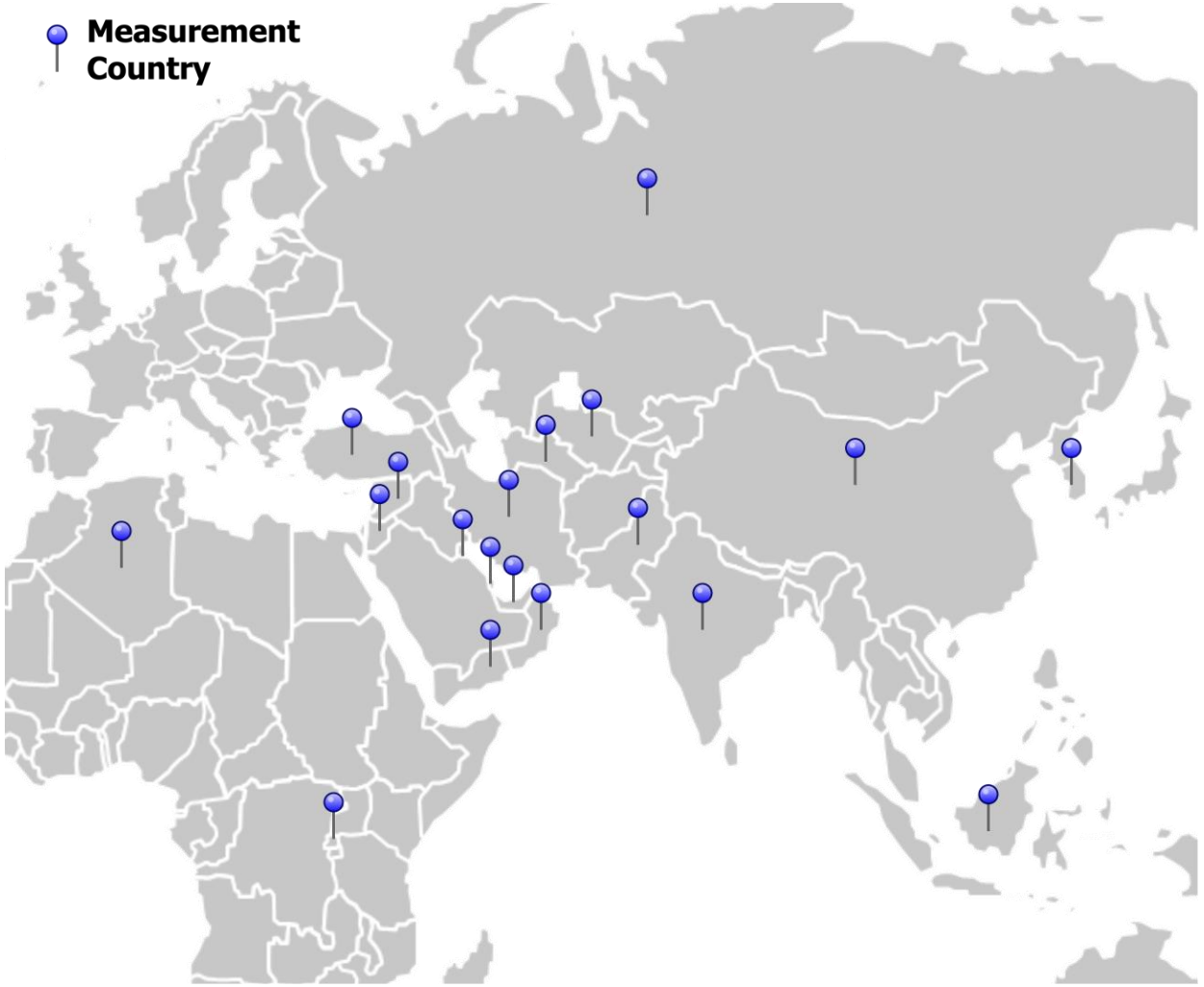
- Also observed **differing impact across protocols** for some countries

High-Level impact of ECMP on global censorship measurement results?

- **17 out 21** countries impacted



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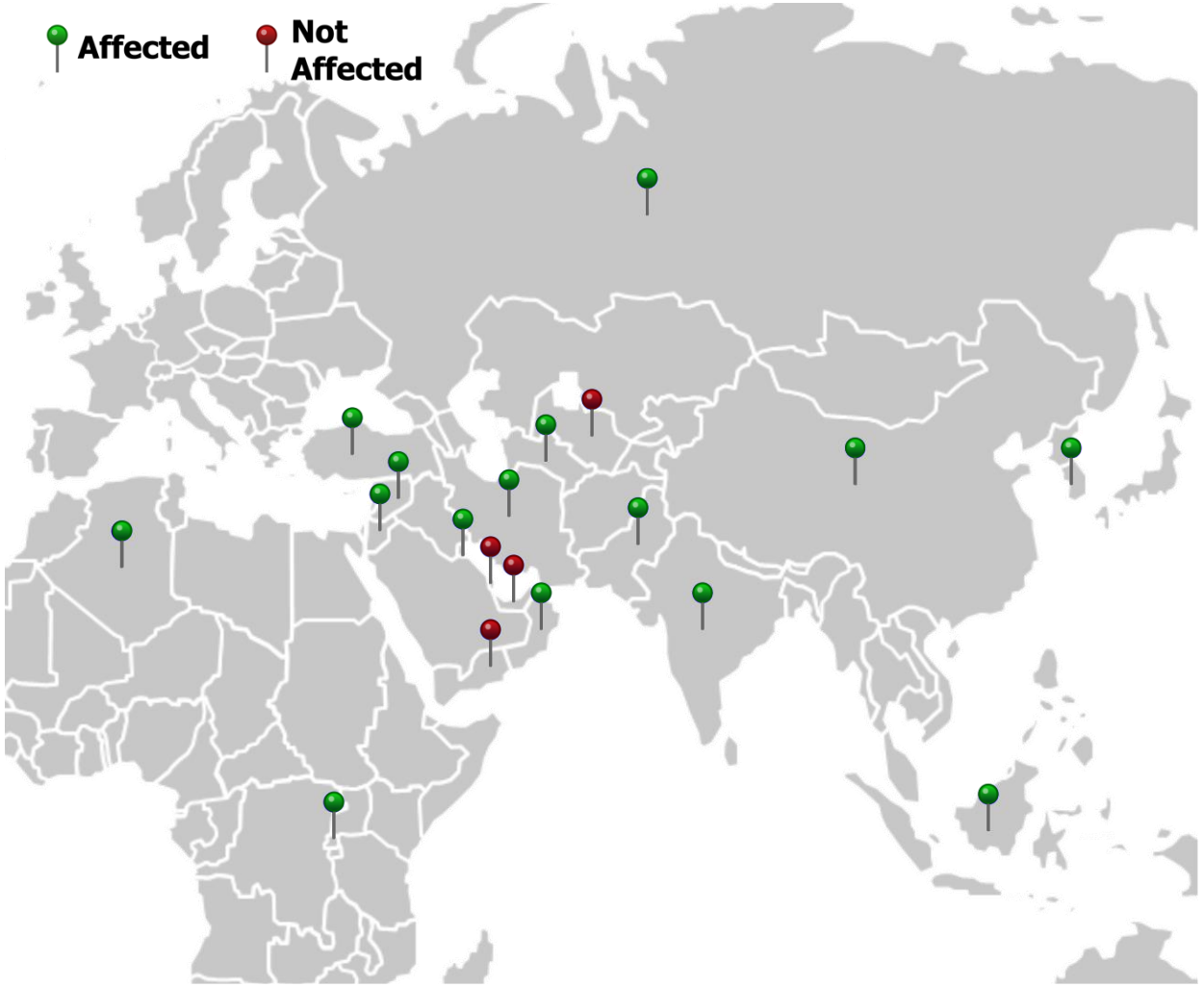

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High-Level impact of ECMP on global censorship measurement results?

- **17 out 21** countries impacted

- Extent of impact **varies by *country* and *protocol***
  - ranges from 100% to <1% (of destinations)

Country	Protocol	Destinations	Destinations Affected (%)
India	HTTP	3289	99%
	HTTPS	3316	100%
Jordan	HTTPS	231	<1%

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- **17 out 21** countries impacted

- Extent of impact **varies by *country* and *protocol***
  - ranges from 100% to <1% (of destinations)

- Impact can vary for **different protocols *within* a country**

Country	Protocol	Destinations	Destinations Affected (%)
Russia	DNS	105	65%
	HTTP	1808	47%
	HTTPS	2526	15%

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How do changes in the packet influence censorship results?

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  - Source IPs

	Context	Parameter	Impact
Source IP	China (HTTPS)	**1.2.3.8:**XXXX	
		1.2.3.23:XXXX	

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	Context	Parameter	Impact
Source IP	China (HTTPS)	**1.2.3.8:**XXXX	
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Source IP and Source Port	Bangladesh (HTTP)	**1.2.3.8:12345**	
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Source Port	Iran (DNS)	1.2.3.X:**12345**	
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- Indicates different forms of ECMP routing

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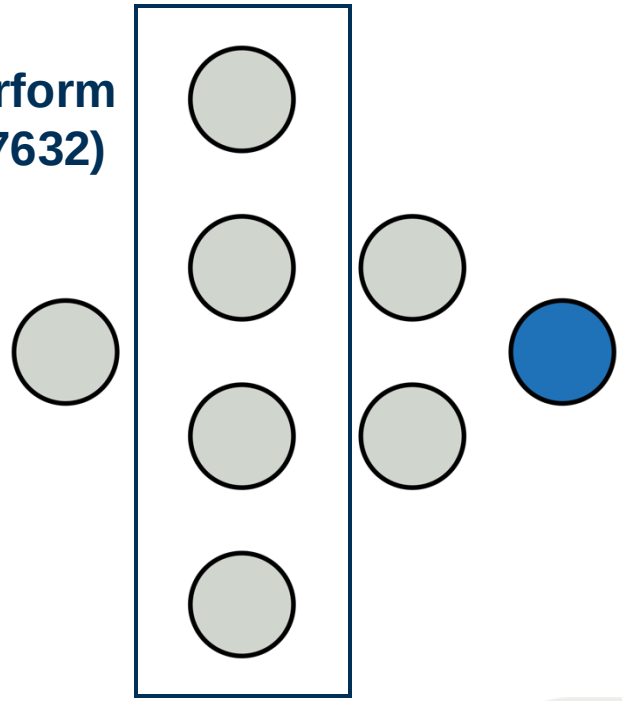
Indonesia (HTTPS)

AS known to perform censorship (AS7632)



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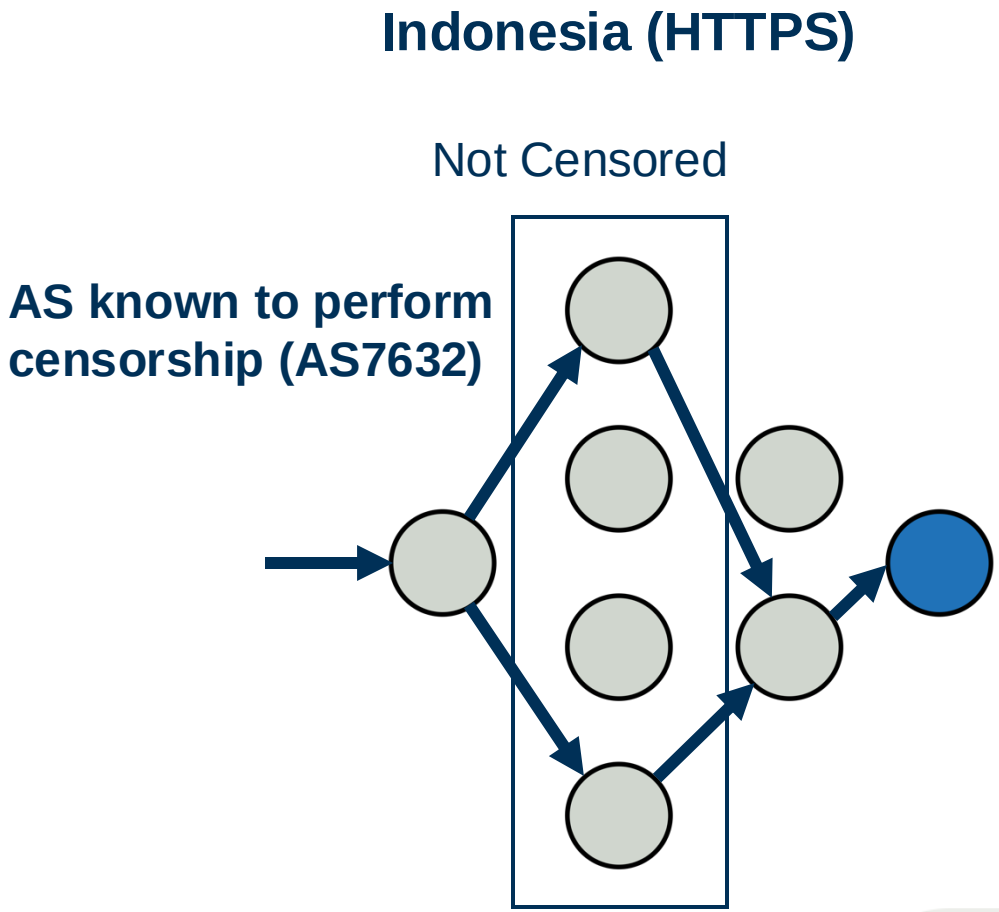

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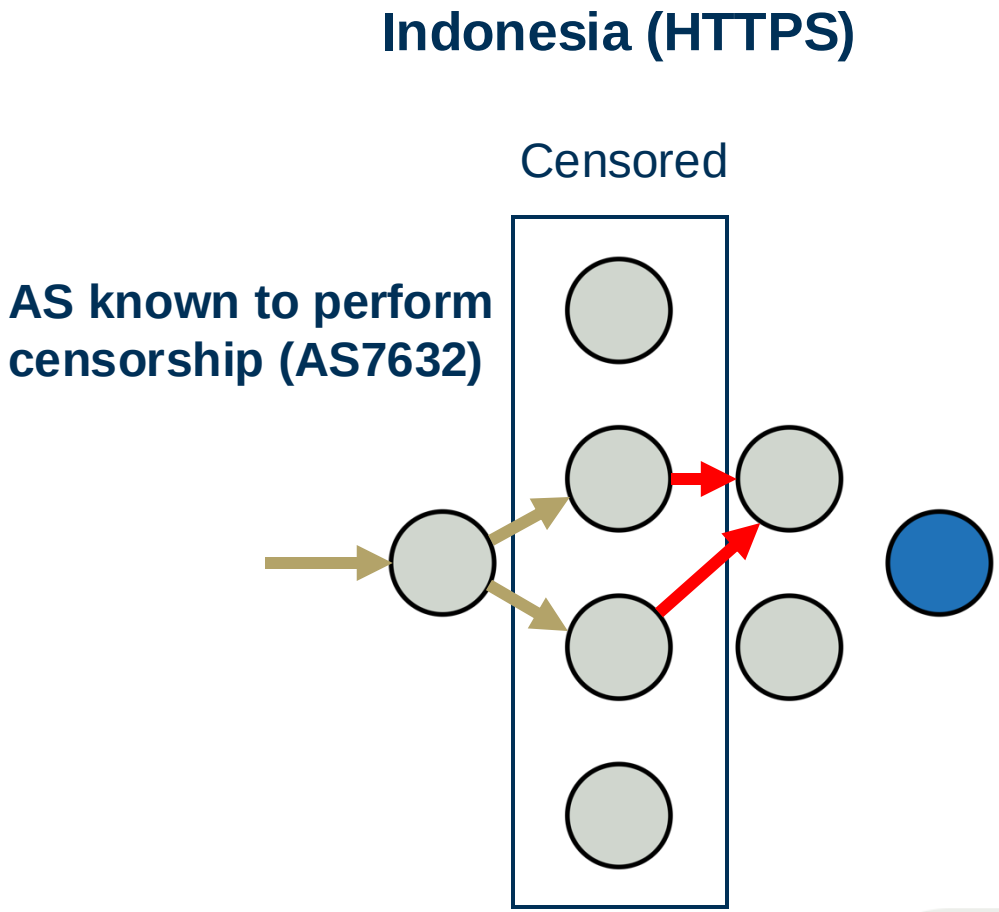

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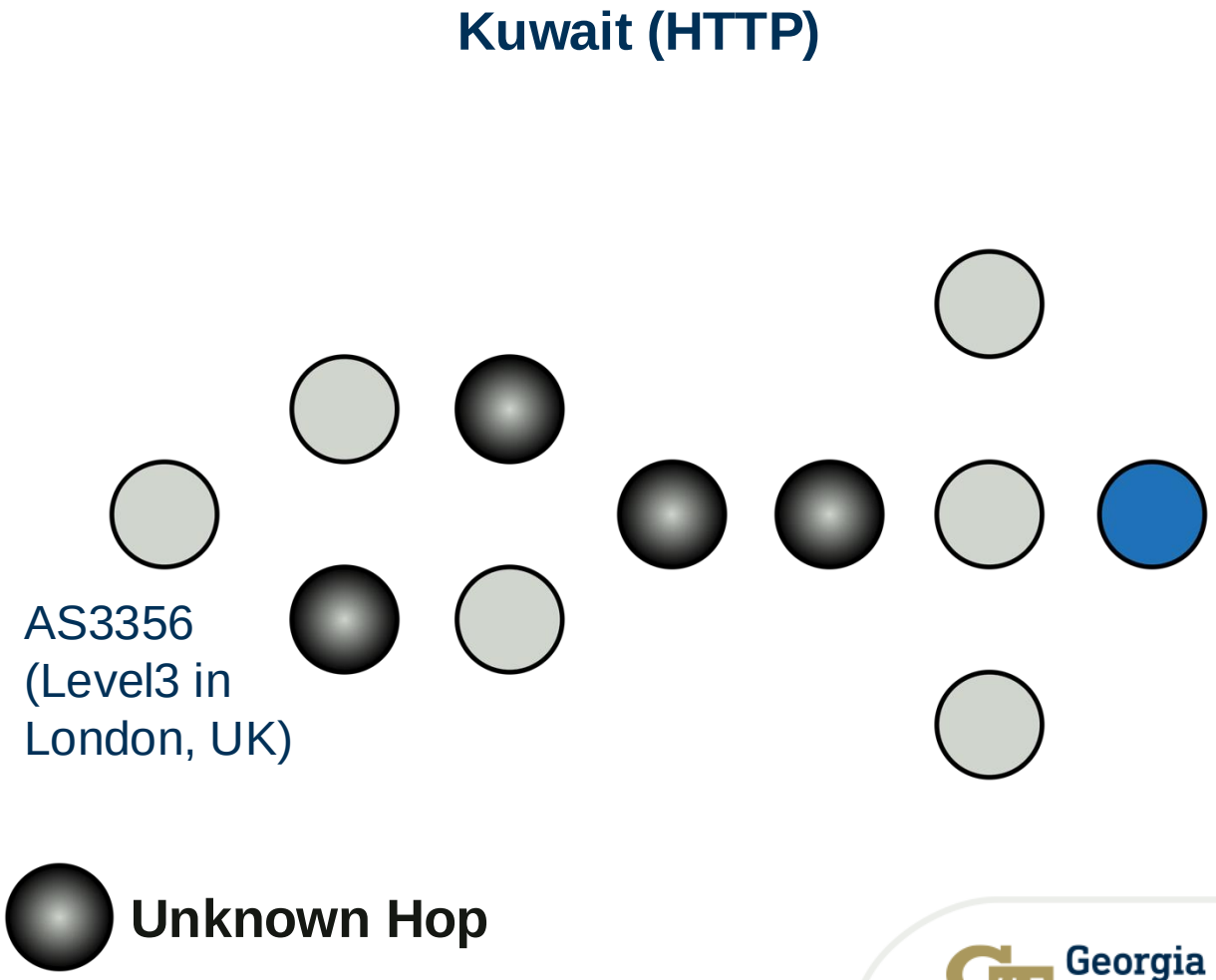

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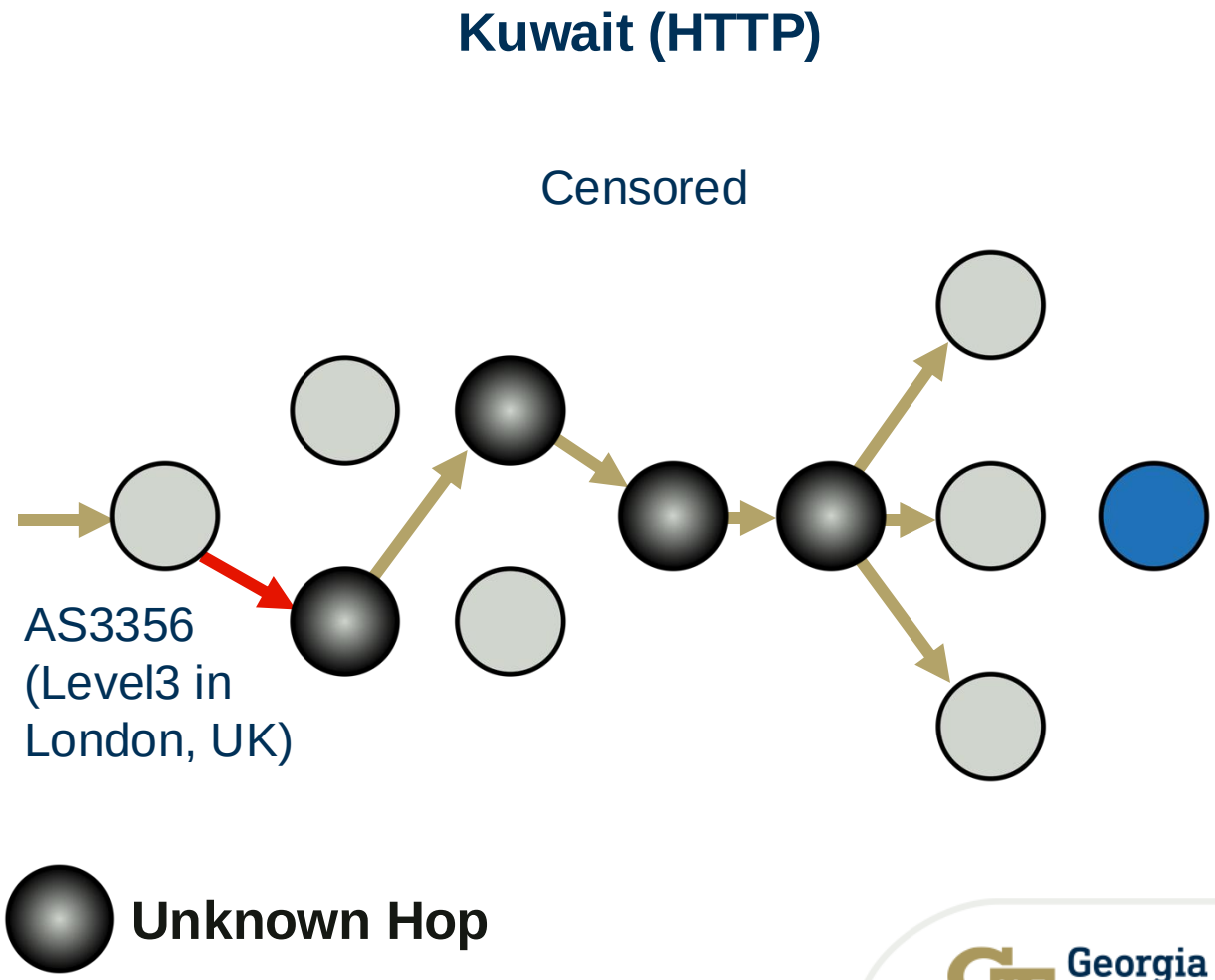

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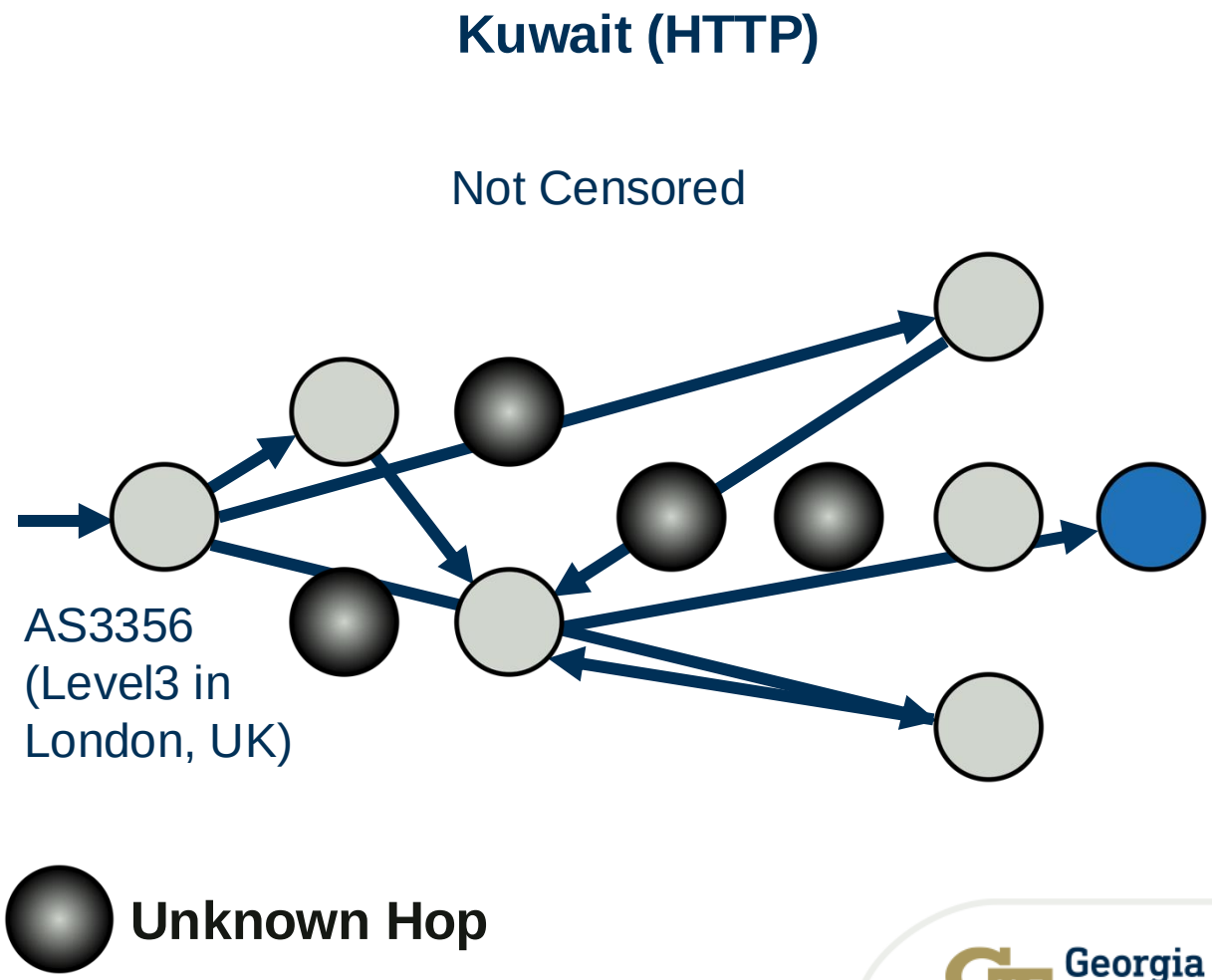

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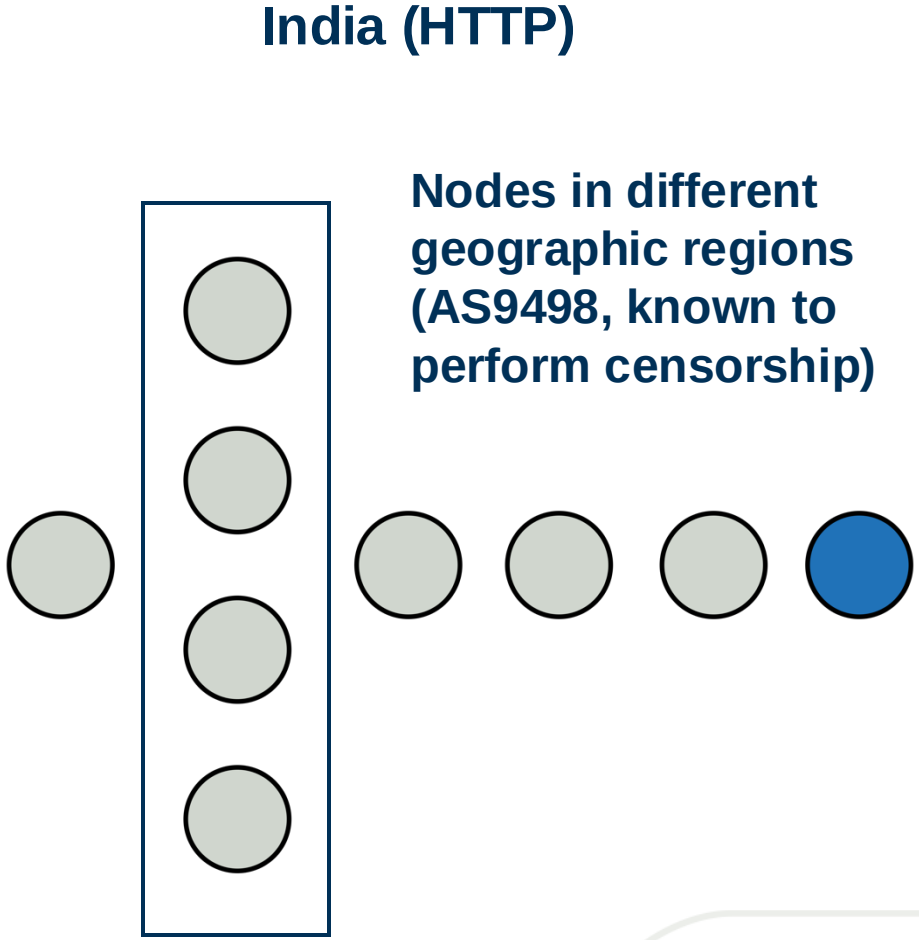

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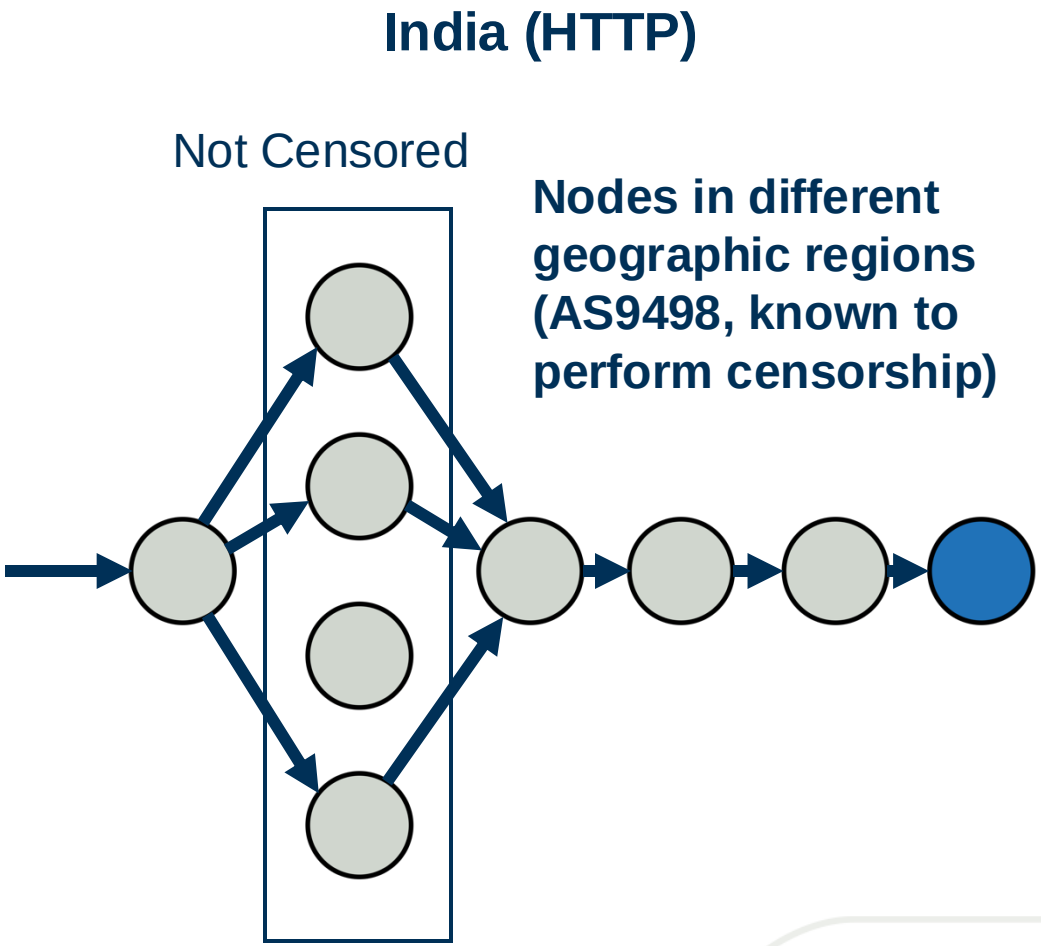

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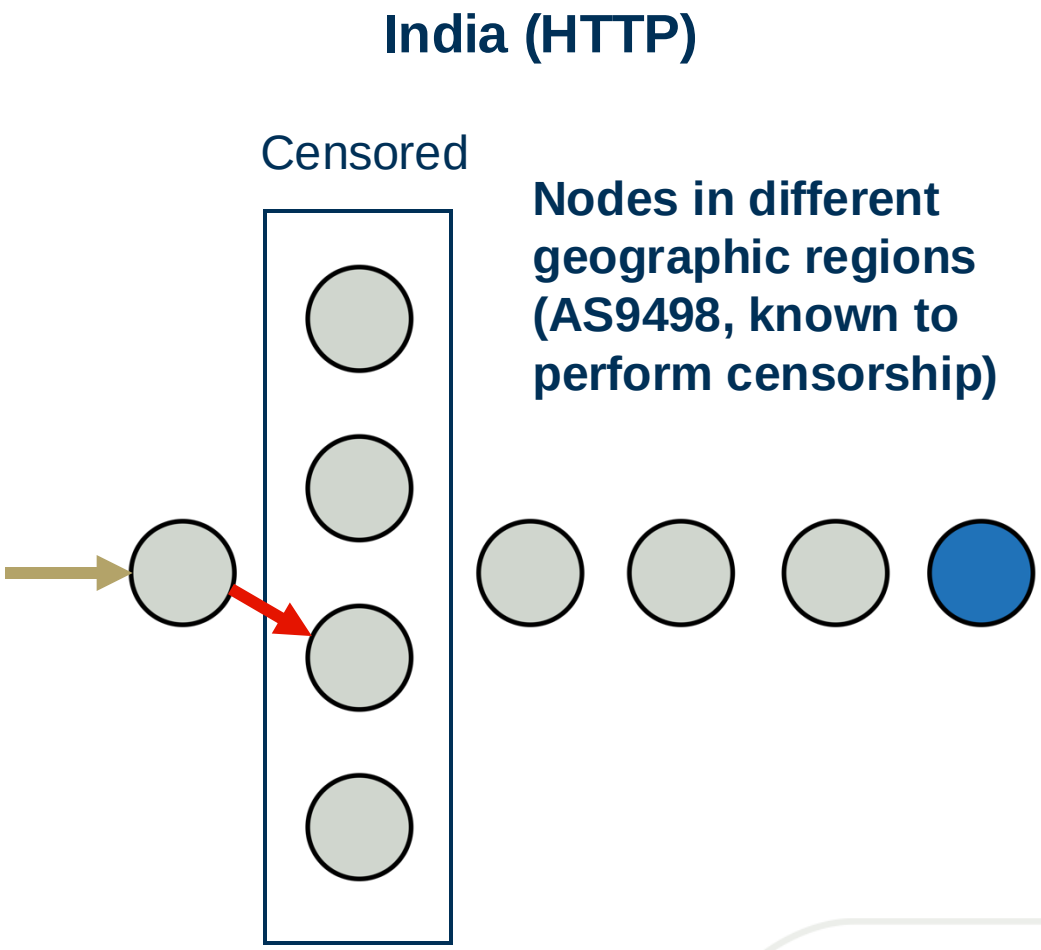

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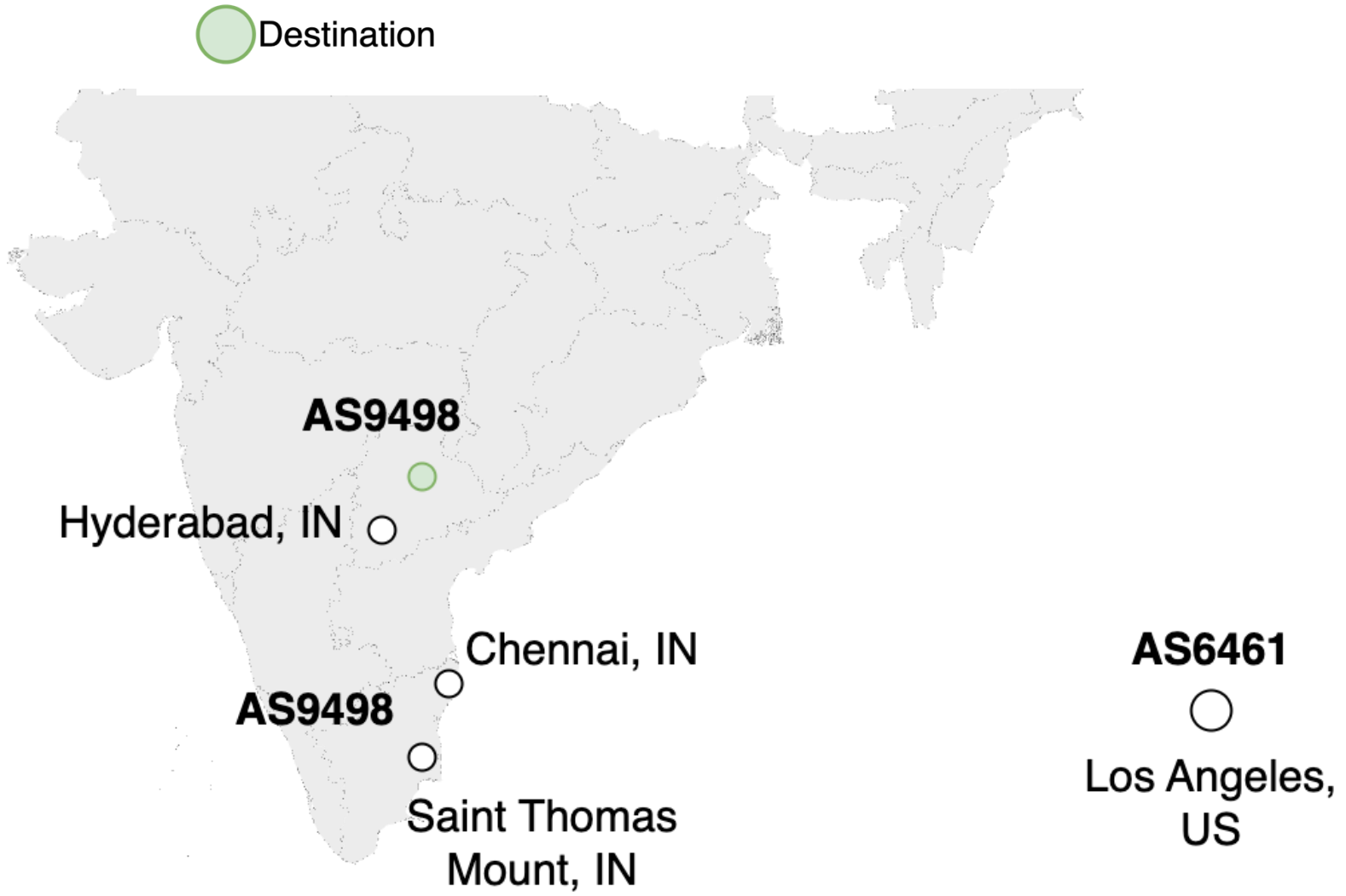

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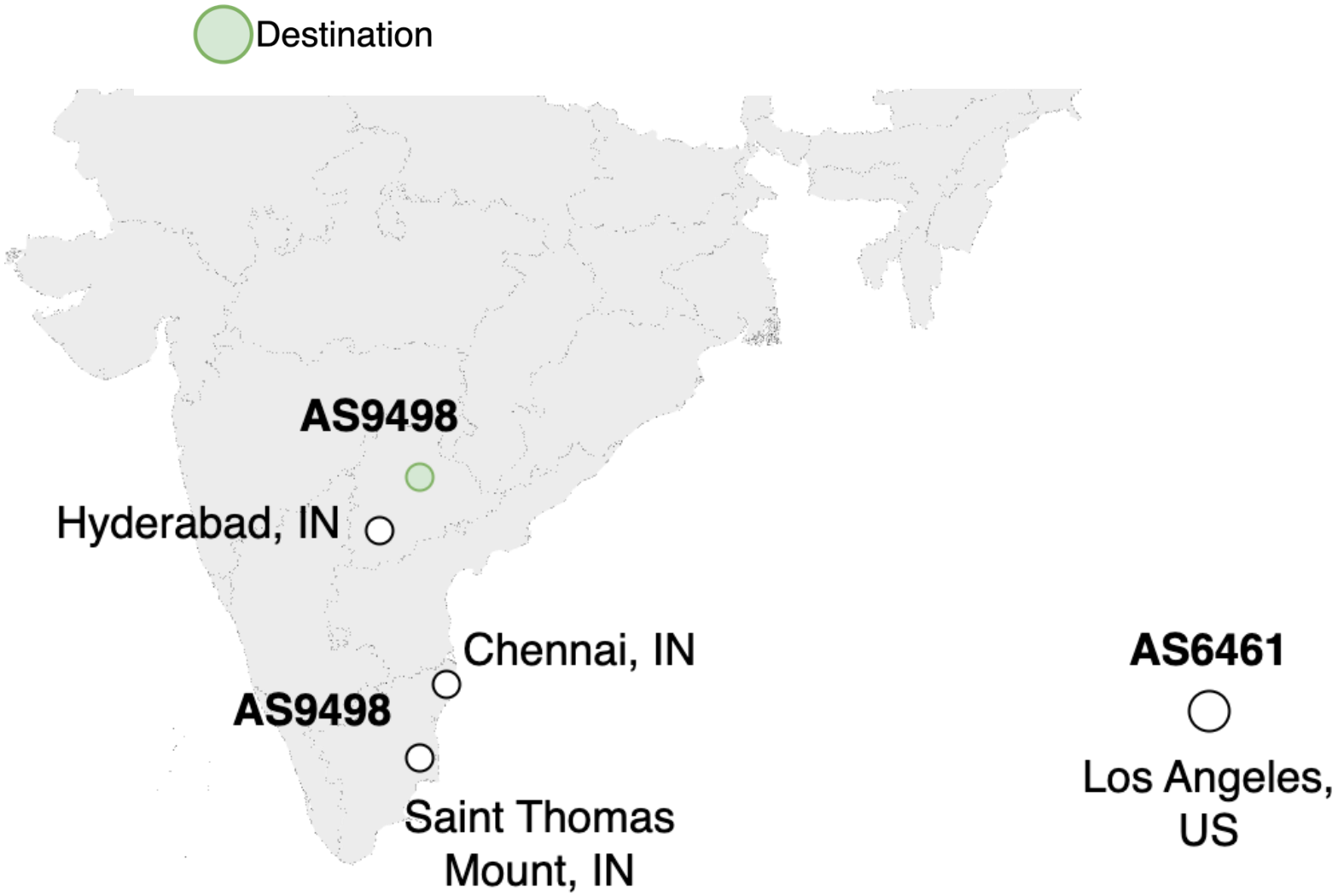

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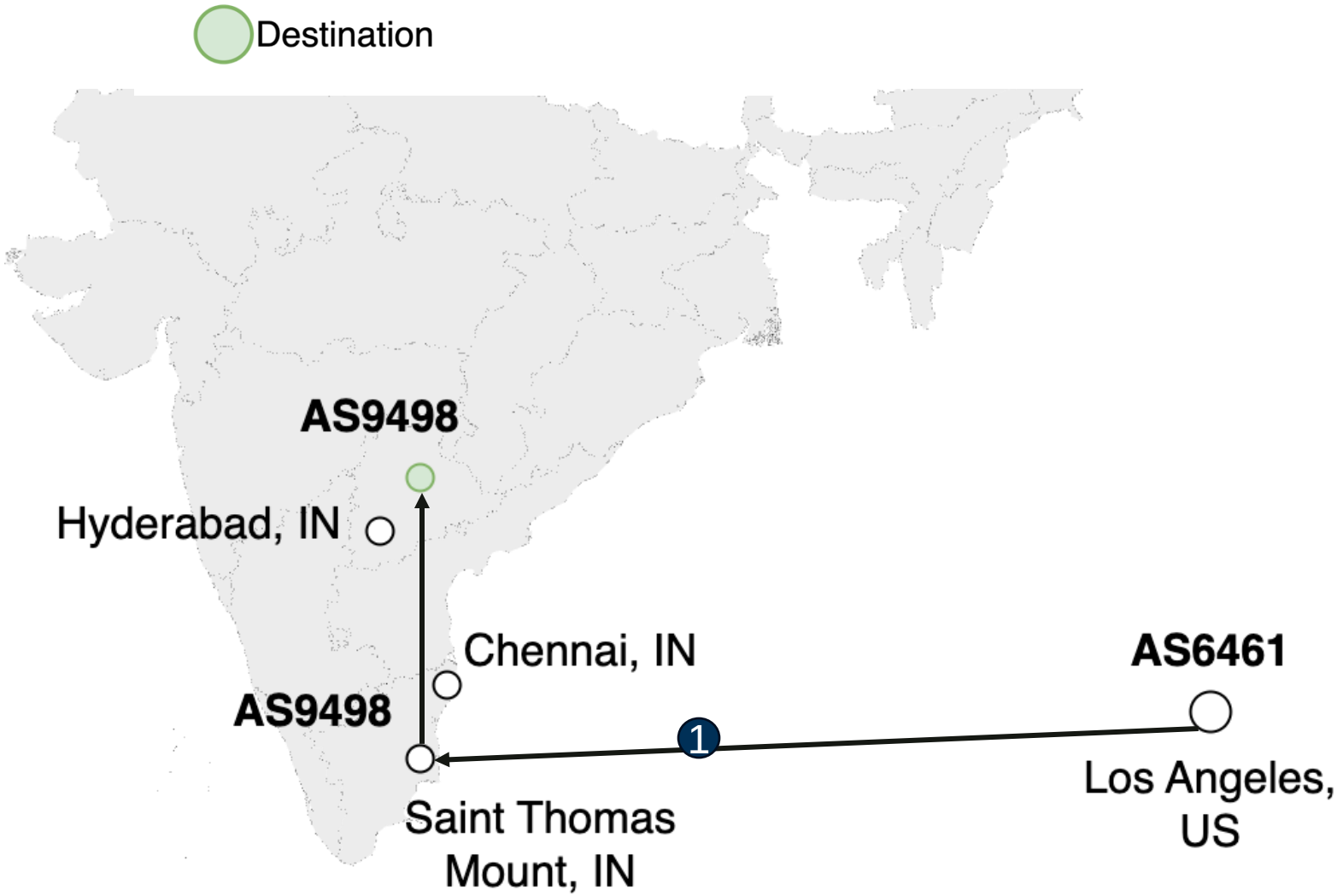

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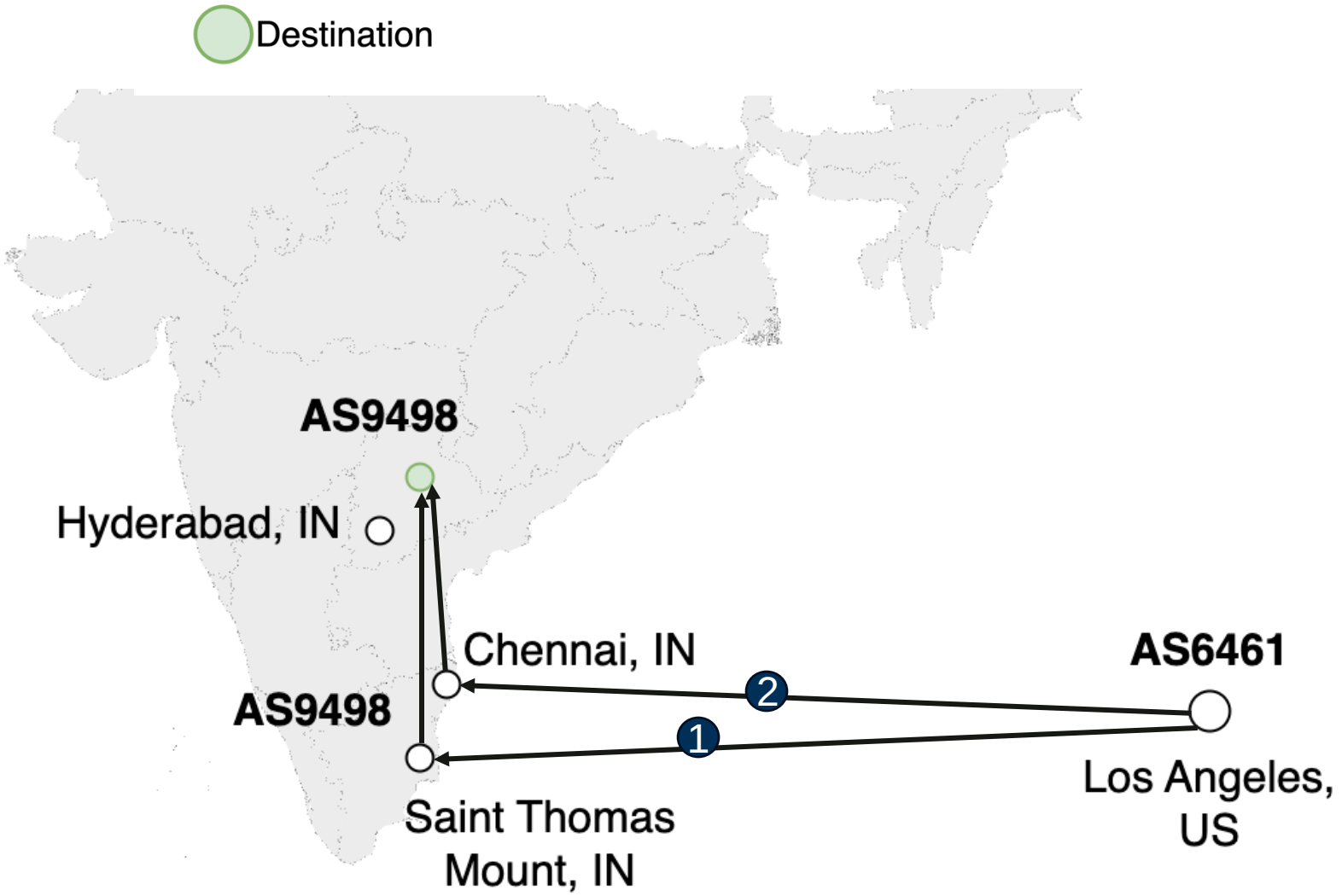

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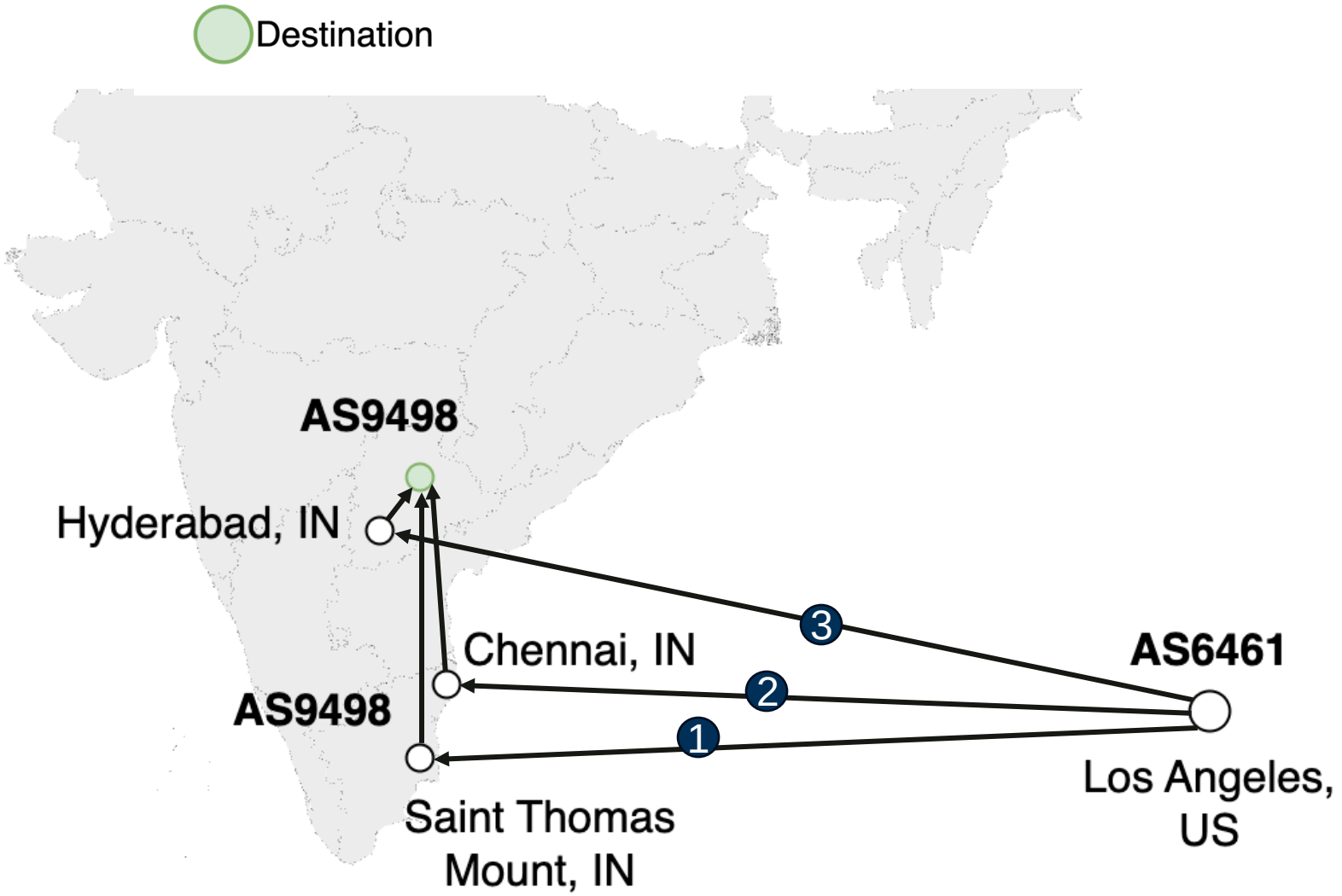

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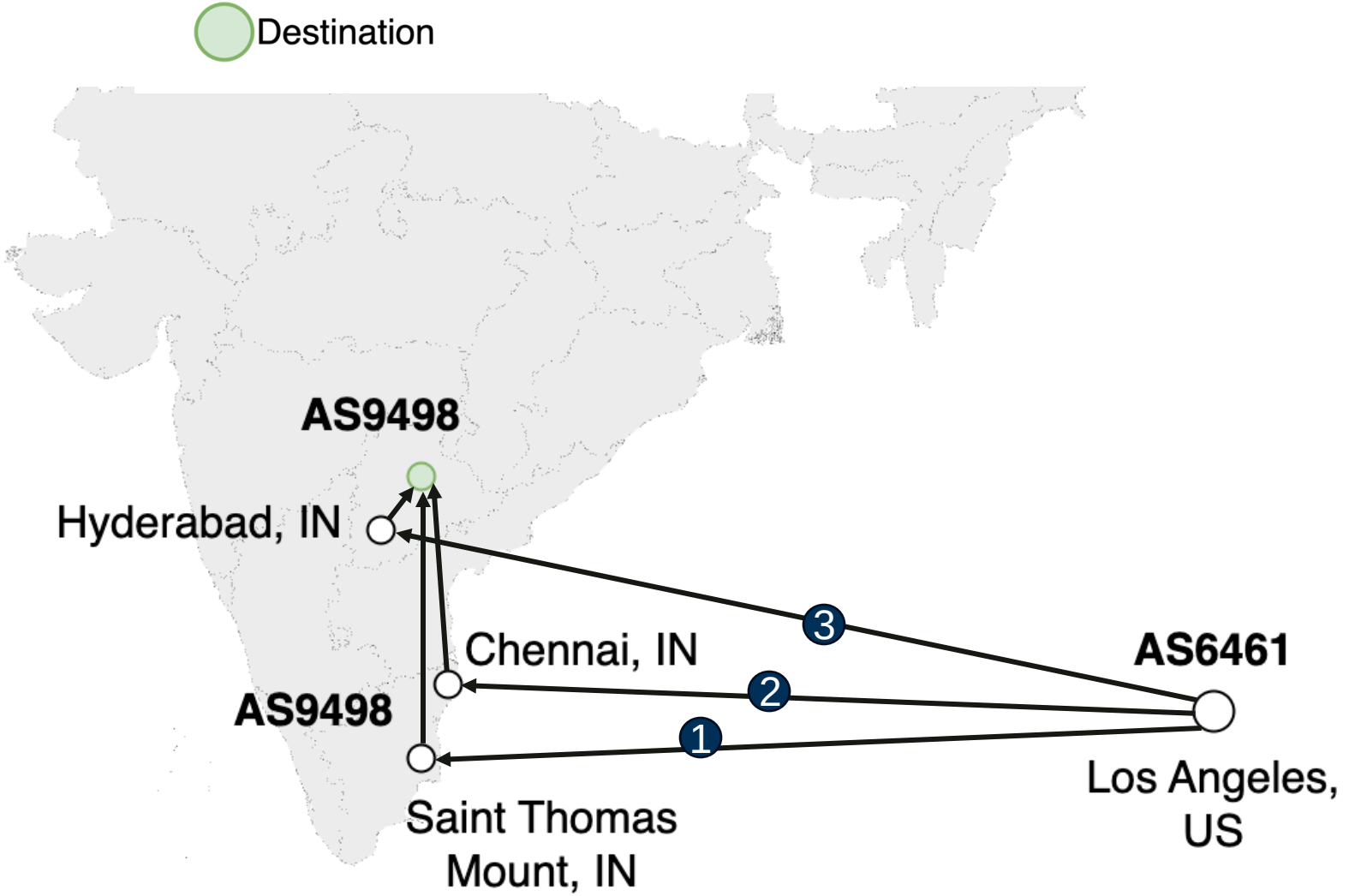

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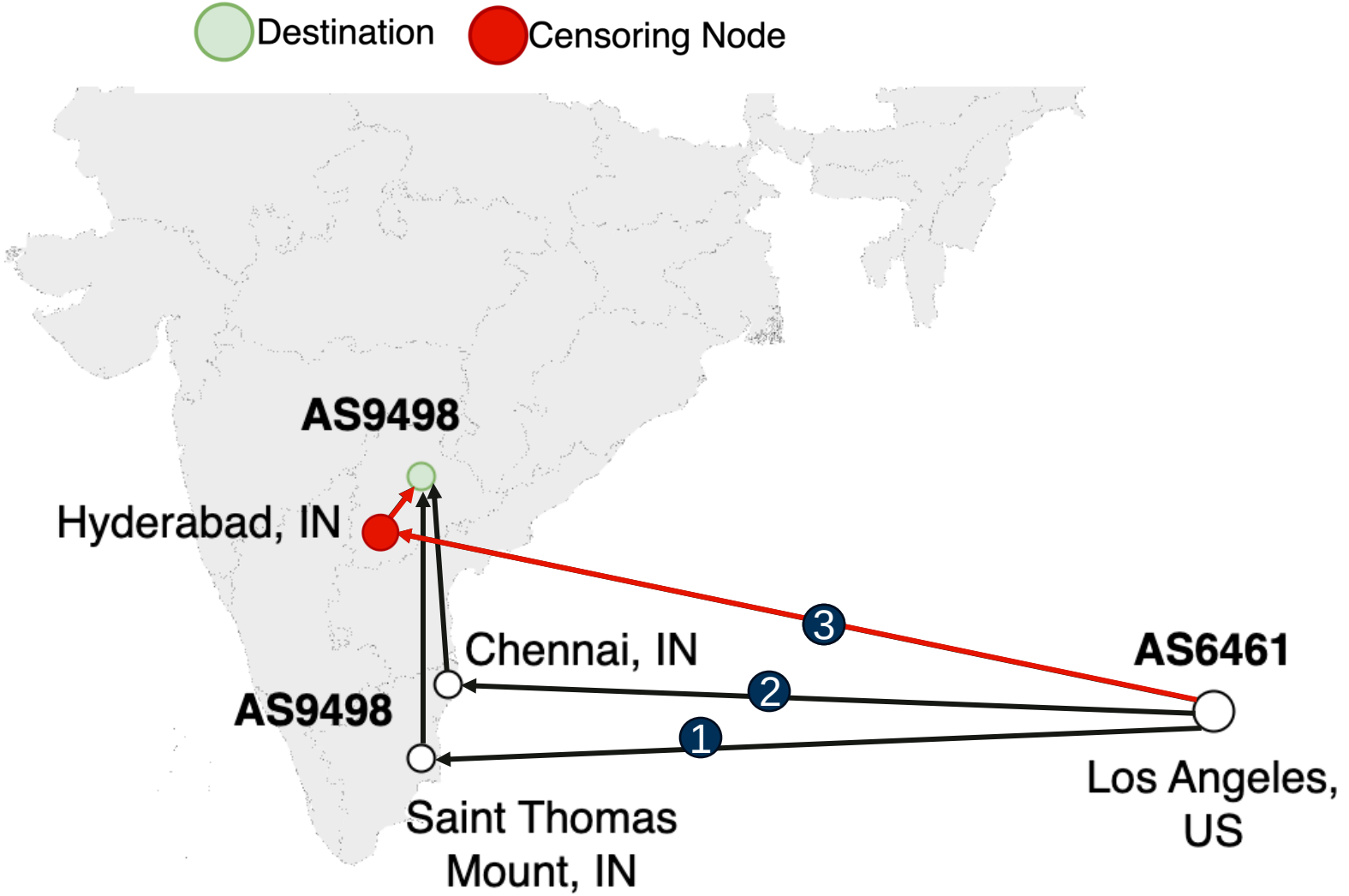

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Thank you!
Questions?

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