Studying Transnational Routing Detours through Surveillance States

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Characterizing and Avoiding Routing Detours

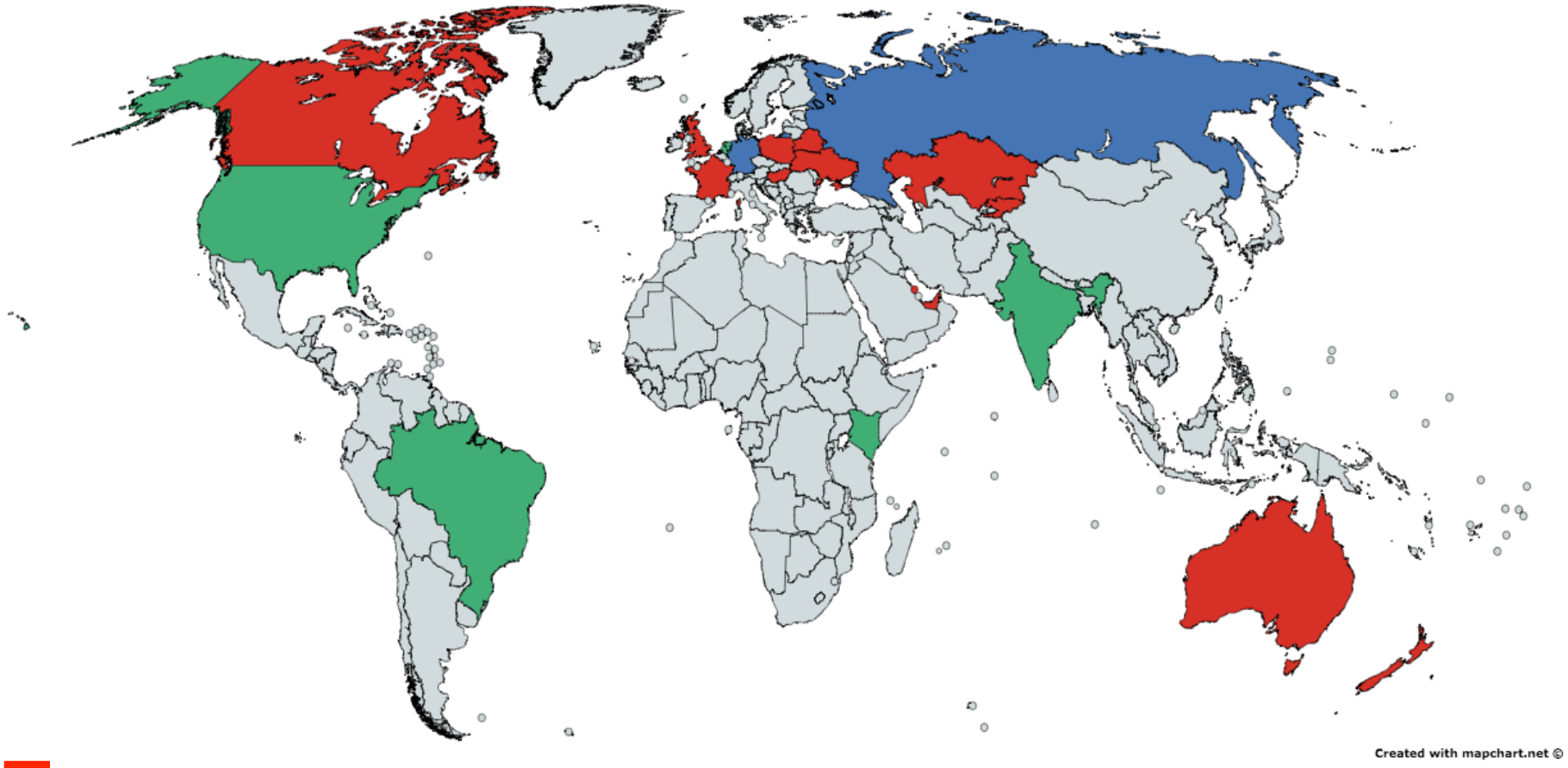
Characterizing detours

- Which countries are Internet paths to popular destinations currently traversing?
- Does local traffic leave the country? To where?

Avoiding detours

- Can end-users avoid certain countries to popular destinations?
- Can end-users keep more local traffic local?

Current State of Surveillance



Surveillance States
Reactions against Surveillance
Studied Countries

Characterizing and Avoiding Routing Detours

Characterizing detours

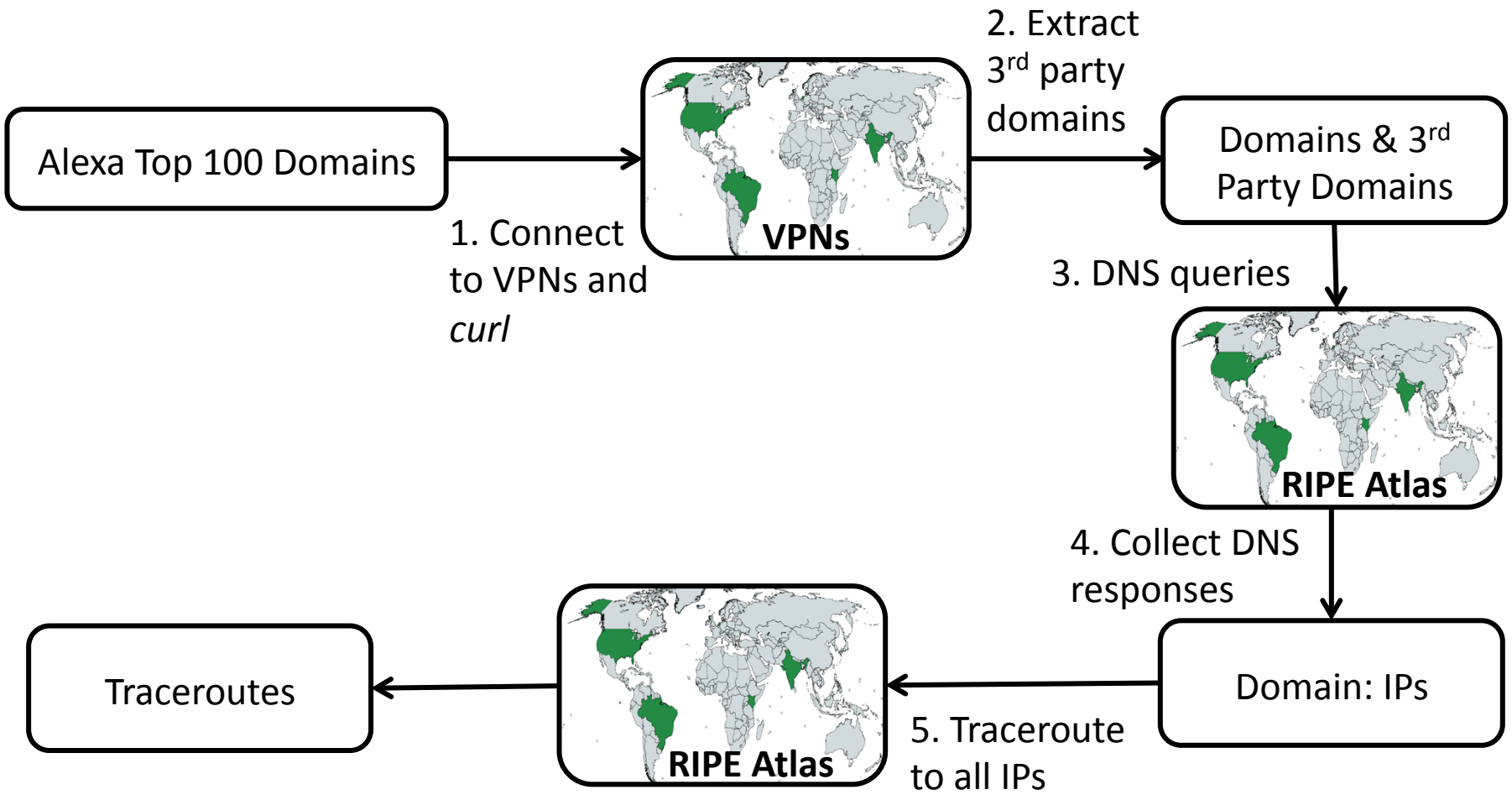
- Which countries are Internet paths to popular destinations currently traversing?
- Does local traffic leave

The most common destination and transit country among all five countries studied is the United States.

Avoiding detours

- Can end-users avoid certain countries to popular destinations?
- Can end-users keep more local traffic local?

Measurement Study: Experiment



Where are popular domains hosted?

Terminating in Country	Brazil	Netherlands	India	Kenya	United States
Brazil	.169	-	-	-	-
Canada	.001	.007	.015	.006	-
United States	.774	.454	.629	.443	.969
France	.001	.022	.009	.023	.001
Germany	.002	.013	.014	.028	.001
Great Britain	-	.019	.021	.032	.002
Ireland	.016	.064	.027	.108	.001
Netherlands	.013	.392	.101	.200	.024
Spain	.001	-	-	-	-
Kenya	-	-	-	.022	-
Mauritius	-	-	-	.004	-
South Africa	-	-	-	.021	-
United Arab Emirates	-	-	-	.011	-
India	-	-	.053	.002	-
Singapore	-	.002	.103	.027	-

77.4% of paths that start in Brazil terminate in the United States

Which countries are on the path to popular domains?

84.4% of paths that start in Brazil have the United States on the path

Transiting Country	Brazil	Netherlands	India	Kenya	United States
Brazil	1.00	-	-	-	-
Canada	.013	.007	.016	.008	.081
United States	.844	.583	.715	.616	1.00
France	.059	.102	.104	.221	.104
Germany	.005	.050	.032	.048	.008
Great Britain	.024	.140	.204	.500	.006
Ireland	.028	.106	.031	.133	.006
Netherlands	.019	1.00	.121	.253	.031
Spain	.176	.004	-	-	-
Kenya	-	-	-	1.00	-
Mauritius	-	-	-	.322	-
South Africa	-	-	-	.334	-
United Arab Emirates	-	-	-	.152	-
India	-	-	1.00	.058	-
Singapore	-	.002	.270	.040	.003

Characterizing and Avoiding Routing Detours

Characterizing detours

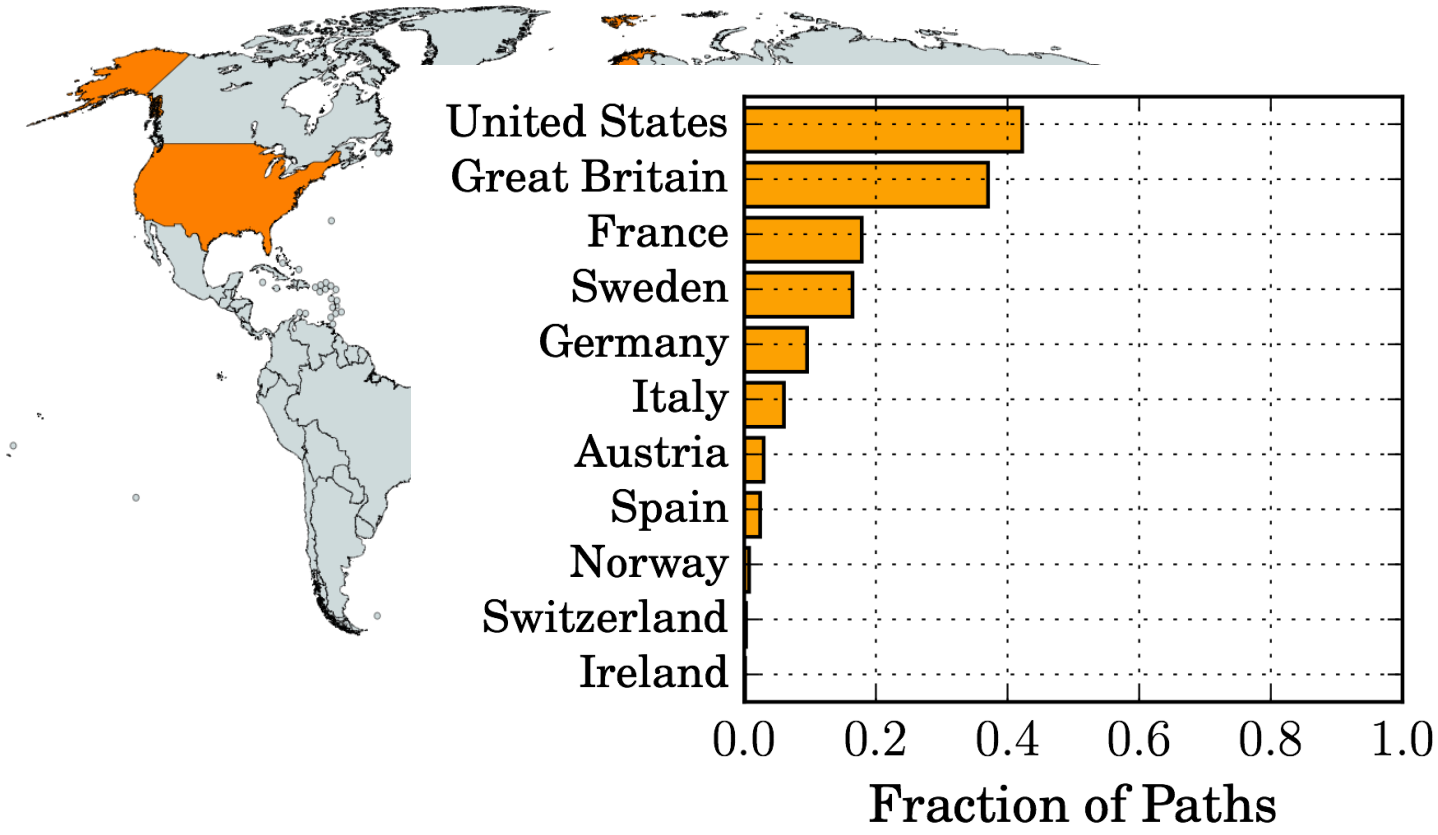
- Which countries are Internet paths to popular destinations currently traversing?
- Does local traffic leave the country? To where?

Despite having large IXPs, Brazil and Netherlands paths often trombones to the United States.

Avoiding detours

- Can end-users avoid certain countries to popular destinations?
- Can end-users keep more local traffic local?

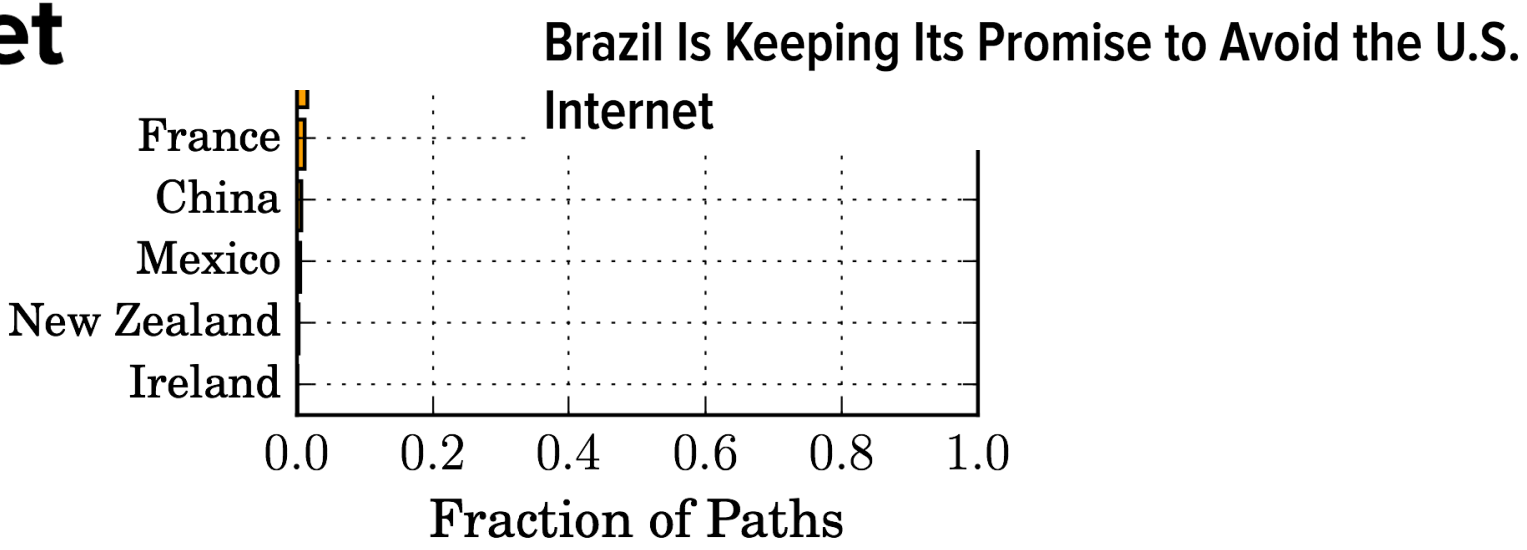
Netherlands: Where is local traffic going?



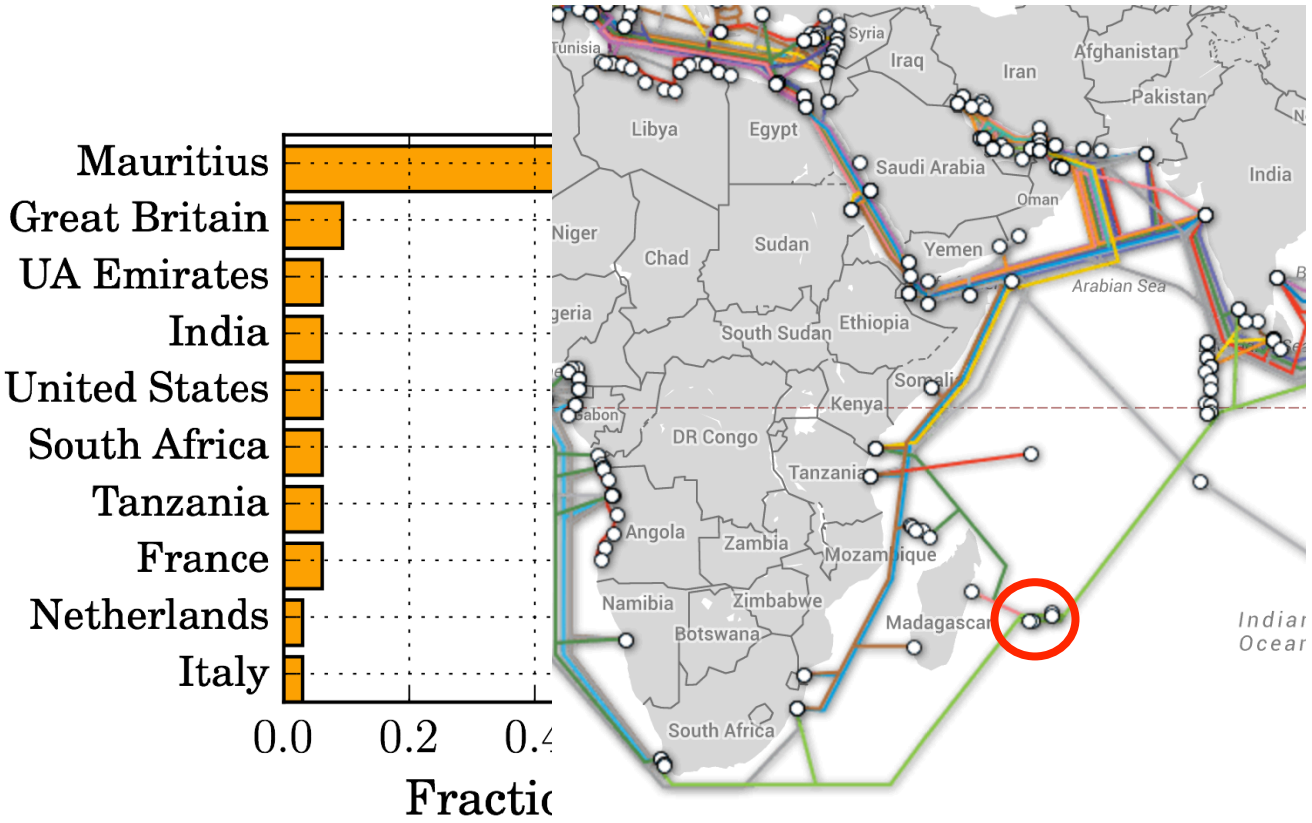
Brazil: Where is local traffic going?

Brazil begins laying its own Internet cables to avoid U.S. surveillance

Brazil looks to break from US-centric Internet



Kenya: Where is local traffic going?



Characterizing Routing Detours: Summary

- Routing detours often transit surveillance states – especially the United States
- Local traffic doesn't always stay local

- **Is it possible to avoid certain countries by tunneling traffic through relays?**

Characterizing and Avoiding Routing Detours

Characterizing detours

- Which countries are Internet paths to popular destinations currently traversing?
- Does local traffic leave the country? To where?

Yes, but it's more difficult to avoid the United States than it is to avoid any other country.

Avoiding detours

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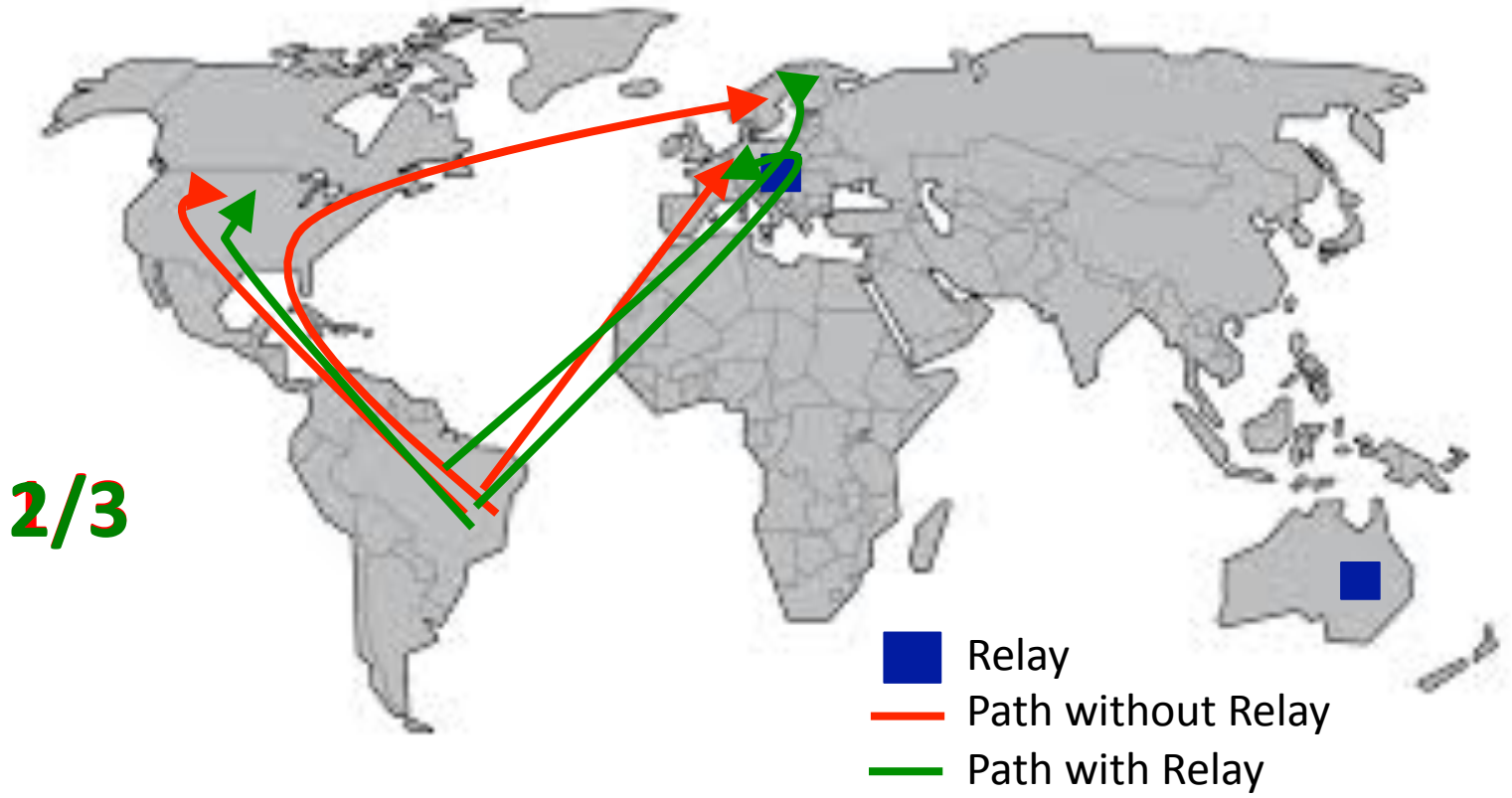
Country Avoidance

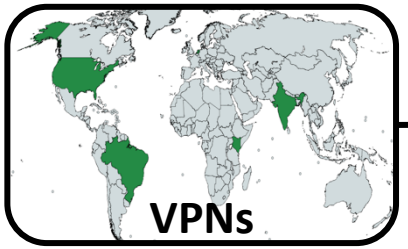
- *Country Avoidance* = fraction of paths that do not pass through Country X



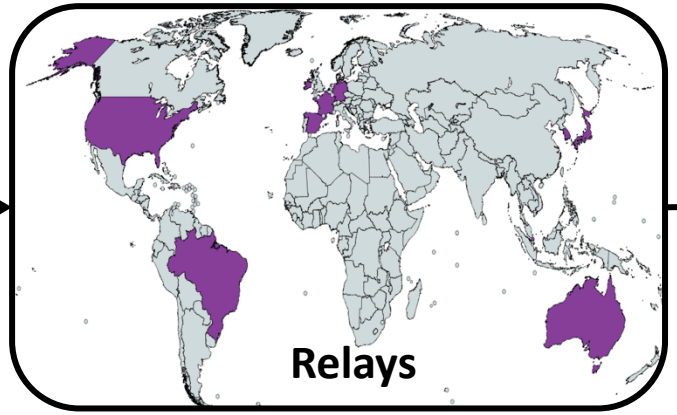
Avoidance Study: Experiment

Client to Relay Path:

to VPNs



2. Traceroute to relay IPs

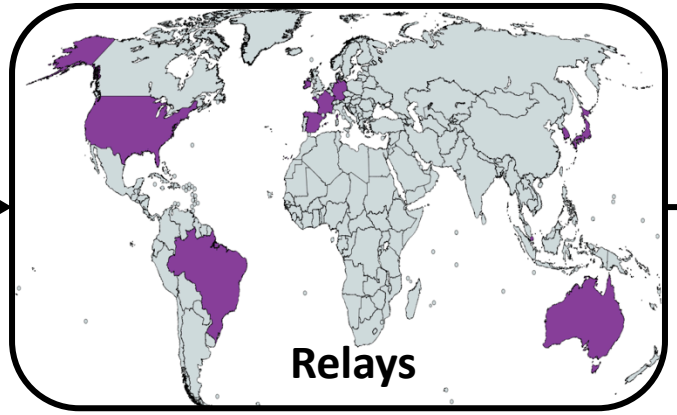


Traceroutes

Relay to Server Path:

Domain: IPs

1. *ssh* to relays



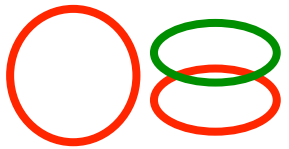
2. Traceroute to all IPs

Traceroutes

Can clients avoid countries more often?

Yes – many countries are almost completely avoidable for the top 100 domains

	No Relay	Relays	No Relay	Relays	No Relay	Relays	No Relay	Relays	No Relay	Relays
Country to Avoid	*Brazil*		*Netherlands*		*India*		*Kenya*		*United States*	
Brazil	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Canada	98	1.00	99	1.00	98	98	99	99	.92	1.00
United States	.15	.62	.41	.63	.28	.65	.38	.40	0.00	0.00



Characterizing and Avoiding Routing Detours

Characterizing detours

- Which countries are Internet paths to popular destinations currently traversing?
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Tromboning Brazilian paths decreased from 13.2% to 9.7%.

Avoiding detours

- Can end-users avoid certain countries to popular destinations?
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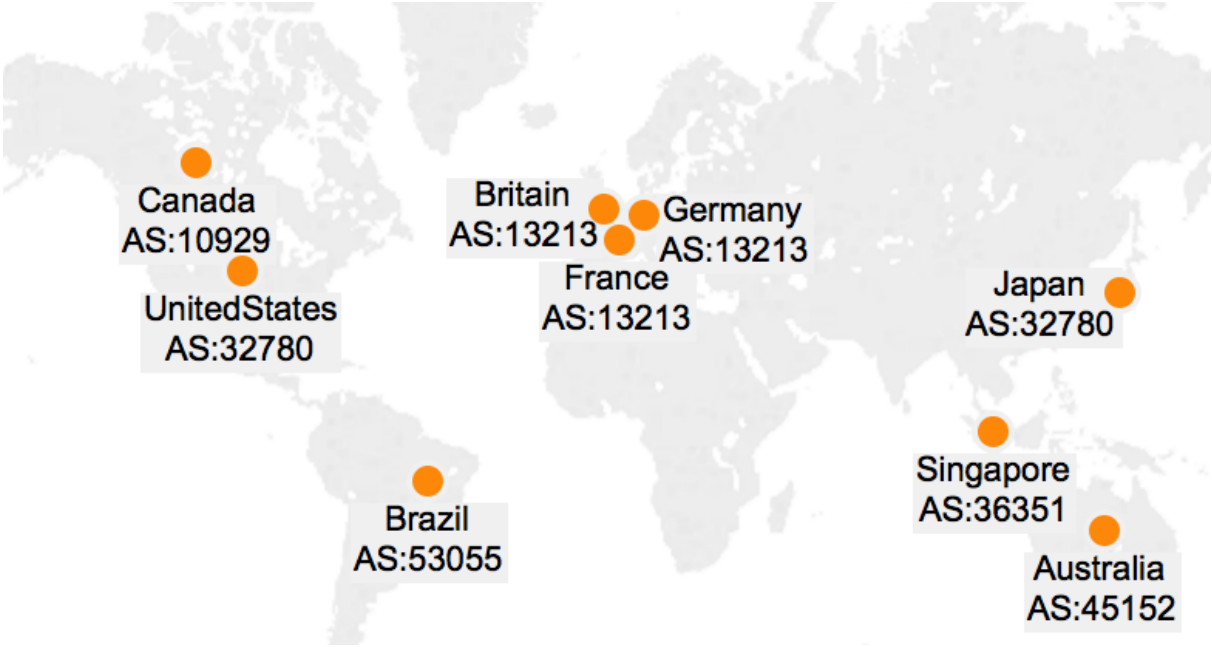
System: Routing Around Nation-States

- Developed an overlay network that:
  - Provides country avoidance
  - Is usable
  - Is scalable



System: Routing Around Nation-States

- Relays act as web proxies + conduct measurements
- Oracle triggers RIPE Atlas probes to conduct measurements
- Clients use PAC file to select appropriate relay for avoiding a country

```
function FindProxyForURL(url, host){
    if ((shExpMatch(host, "*.google.com")))
        return "PROXY 1.2.3.4:3128";
    if ((shExpMatch(host, "*.twitter.com")))
        return "PROXY 5.6.7.8:3128";
    return "DIRECT";
}
```

Future Work

- Connectivity within a country
- Relationship between IXPs and nation state routing
- Country avoidance based on IPv4 vs. IPv6 connectivity

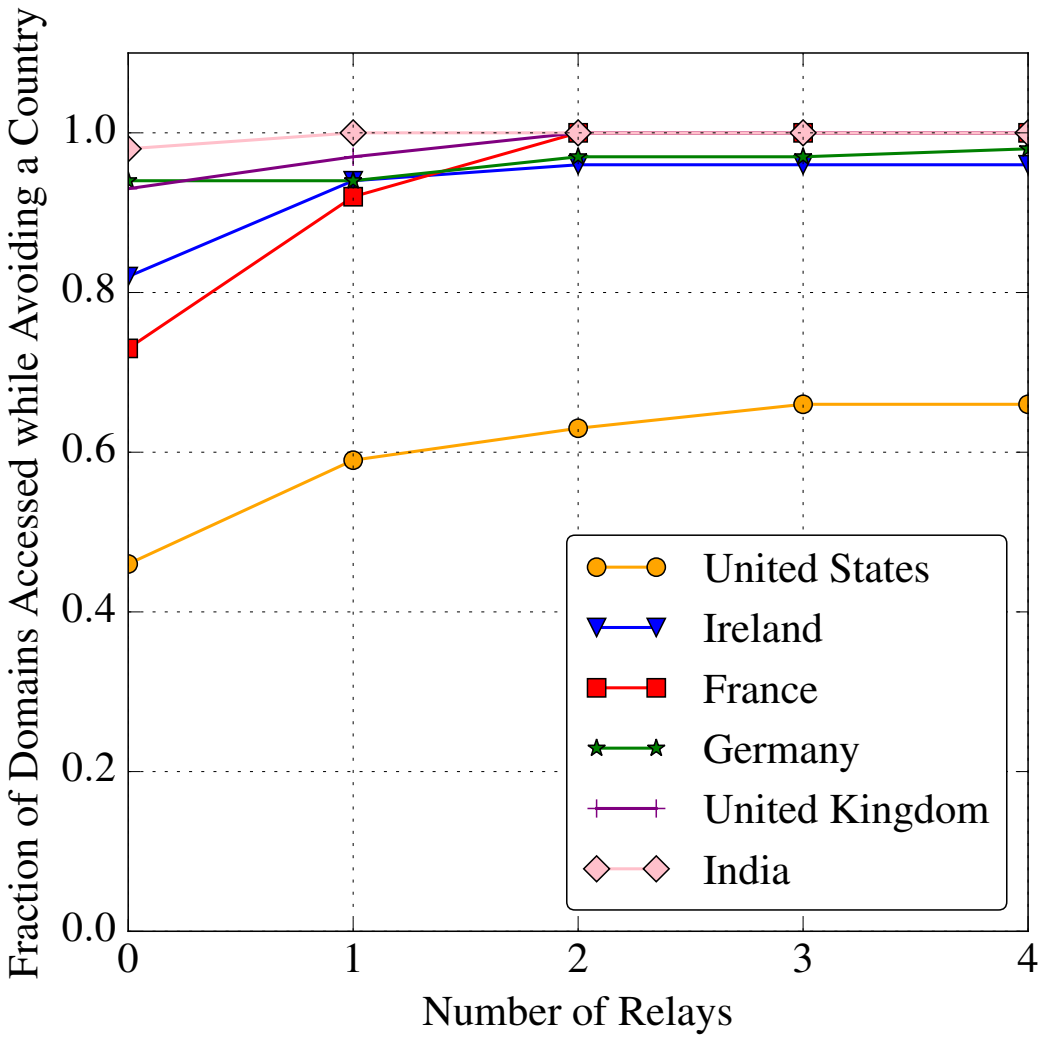
Conclusion

- Paths commonly traverse known surveillance states – 84% of paths from Brazil traverse the United States
- Relays can help prevent routing detours, but some of the more prominent surveillance states are the least avoidable
- Tromboning Brazilian paths decreased from 13.2% to 9.7% with relays.

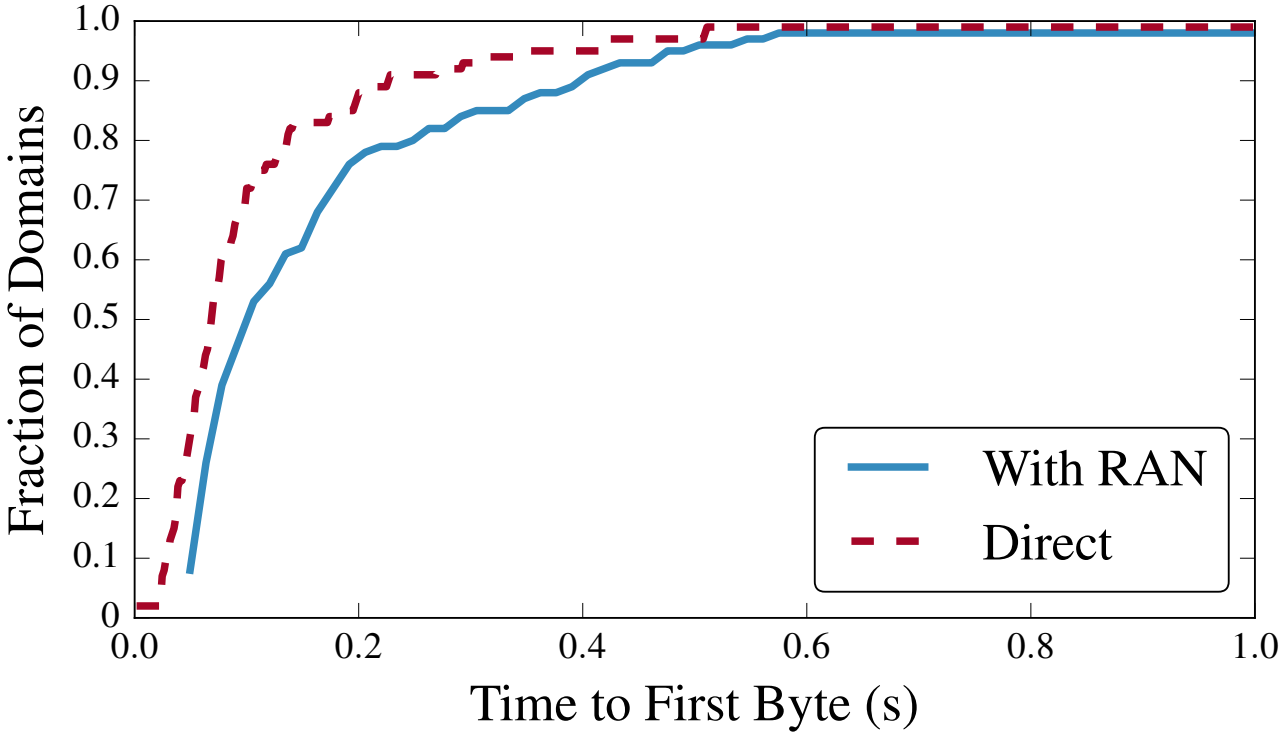
Full write-up and more data at:

ransom.cs.princeton.edu

System: Routing Around Nation-States



System: Routing Around Nation-States



Avoiding Routing Detours: Summary

- It is more difficult to avoid the United States than it is to avoid any other country
- Tromboning Brazilian paths decreased from 13.2% to 9.7%