Privacy at the Border

Multiple Issues

- Border searches of computers, phones, and other devices

- Right to be forgotten

- Location-specific content

- Censorship

Searching Devices at the Border

Searching Devices at the Border

- What might the government want?

  - Only contraband?

  - Other information?

- What is technically feasible to collect?

  - What is feasible to collect under what circumstances?

- Device types: phones, tablets, computers, flash drives

Constraints

- Technical

- Time

  - Regular search or "enhanced" search?

Laptops

- Generally easy to boot a laptop from an external drive and run code to scan the file system

  - But: the laptop's disk may be encrypted

  - But: laptop disks are big

  - But: copying *everything* to an external drive is slow because USB ports and drives might be slower than the internal drive

External USB Drives

- Moderately easy to scan—not that big

- But—some people have many of them

- But—may be encrypted

Scanning Phones

- Much harder—phones are more closed, especially iPhones

- But—more data:

  - Location data

  - App-specific data

- Approach: use mobile device forensic tools (MDFT) or (for Android) privileged app

- Again: speed is an issue

Data of Interest

- Contacts

- Text messages*

- Phone call history*

- Email contacts and content*

- Photos? Videos? These are *very* large

*May be obtainable from provider via suitable legal process—but that isn't a border search
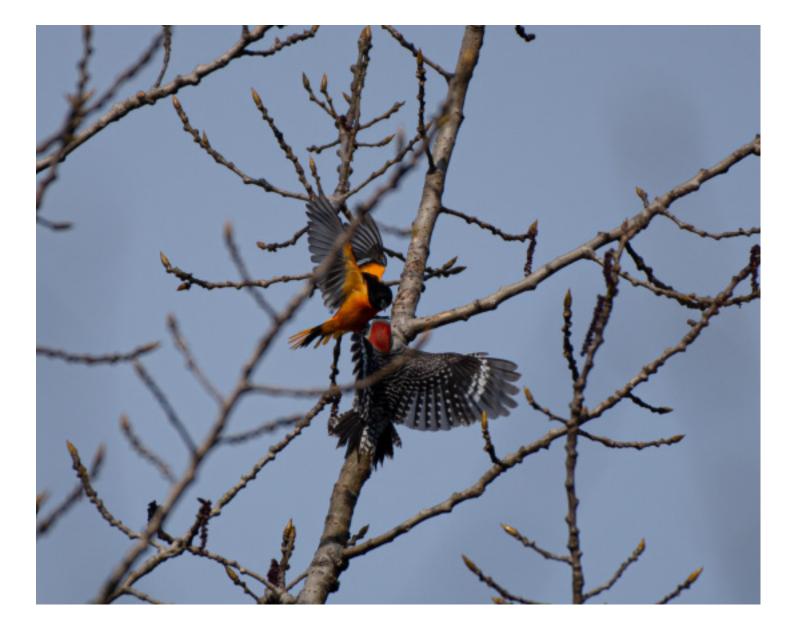
Scanning Photos for Contraband

- One major target for border scans: child sexual abuse material (CSAM)

- By definition these are contraband and illegal per se

- Can these be scanned at the border? How?

Scanning Photos for Contraband

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- By definition these are contraband and illegal per se

- Can these be scanned at the border? How?

- Cryptographic hashes?

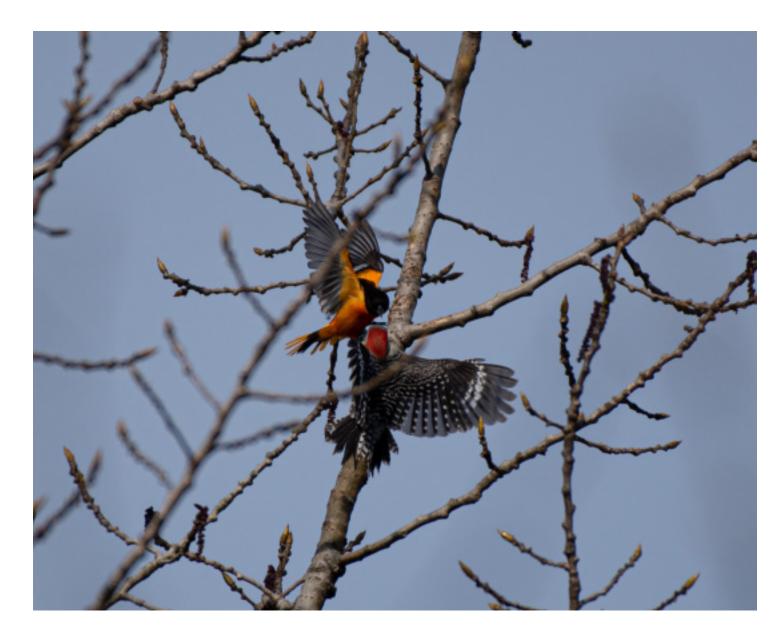 - Don't need to have copies of the CSAM at every border crossing
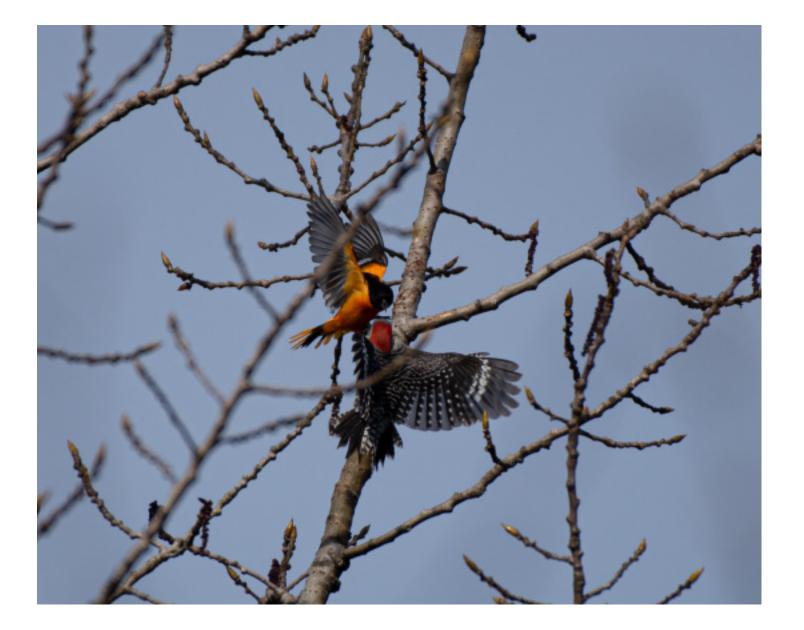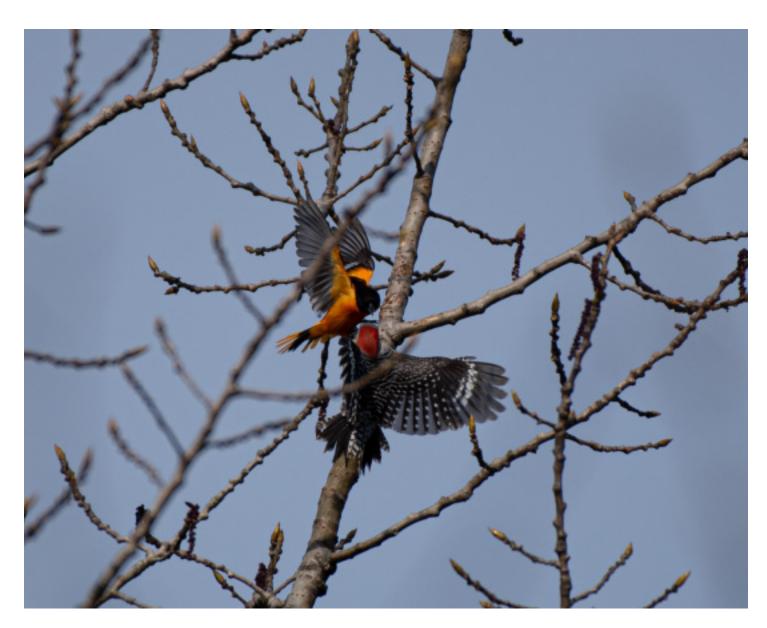
Three Images, Two Identical…

Three Images, Two Identical—and Their Hashes

4db948efe7218fa51969991d9dcbbb06
09678549929b2553b19032455ed946cf

708b5bd8320dca9b332cd60e3b1998e4
950fc7a4d542a15a7ad4285d82b5bd72

2ac91b4662b4ff68dc8d044ad57d5118
47b0797c838a225ca35cef4d96e34429

The images look identical—but the hashes are all different!

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It's the Metadata

20c20

< Modify Date   : 2021:02:19 13:55:23

> Modify Date   : 2021:02:19 13:55:35

134c134

< Metadata Date   : 2021:02:19 13:55:23-05:00

> Metadata Date   : 2021:02:19 13:55:35-05:00

142c142

< Document ID   : xmp.did:0eb91a7c-f60a-4a51-88f4-3a402bcde621

> Document ID   : xmp.did:cc9a1add-cbf9-4d63-9243-28585f24ffee

145c145

< Instance ID   : xmp.iid:0eb91a7c-f60a-4a51-88f4-3a402bcde621

> Instance ID   : xmp.iid:cc9a1add-cbf9-4d63-9243-28585f24ffee

It's the Metadata — So Let's Delete It!

20c20

< Modify Date   : 2021:02:19 13:55:23

> Modify Date   : 2021:02:19 13:55:35

134c134

< Metadata Date   : 2021:02:19 13:55:23-05:00

> Metadata Date   : 2021:02:19 13:55:35-05:00

142c142

< Document ID   : xmp.did:0eb91a7c-f60a-4a51-88f4-3a402bcde621

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145c145

< Instance ID   : xmp.iid:0eb91a7c-f60a-4a51-88f4-3a402bcde621

> Instance ID   : xmp.iid:cc9a1add-cbf9-4d63-9243-28585f24ffee

$ dd if=s_DSC_3536.jpg bs=1k skip=50 | shasum -a 256
87+1 records in
87+1 records out
89560 bytes transferred in 0.047579 secs (1882341 bytes/sec)
948fe5063284bb2ded32bab6094bce1ed1a45875a8cb7a88bba2b1cc692d6050 -
$ dd if=s_DSC_3536-2.jpg bs=1k skip=50 | shasum -a 256
87+1 records in
87+1 records out
89560 bytes transferred in 0.026664 secs (3358834 bytes/sec)
948fe5063284bb2ded32bab6094bce1ed1a45875a8cb7a88bba2b1cc692d6050 -

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Trivial Image Changes

- There are many image changes that don't materially affect perception but do change the hash: scaling, cropping, minor color tweaks, etc.

- Answer: a *semantic hash*, e.g., PhotoDNA

- But—there is no published data on how PhotoDNA works

  - Is it robust?

  - Does it produce false positives? False negatives? Under what conditions?

- And: who controls addition of photos to the database of contraband?

Arithmetic…

- For exact matches, hash every image or file in your database

  - How many are there? Assume 100,000,000

- Shorten the hashes to 64 bits—8 bytes

  - Odds of a false positive: 1 in 2^{64}, i.e., practically impossible

- Can you store 800,000,000 bytes at every customs point? Of course! And searching that table is also very, very fast

- Scanning time: for 110K photos, about 200 GB, I hashed them all in ~8 minutes, and there are shortcuts, e.g., checking size first

Searching Devices

- Some searches are feasible

- Detailed ones take too long, and may require an enhanced search

Right to Be Forgotten

The Right to be Forgotten

- Sometimes, people don't want items about them indexed by search engines

    - Example: minor crimes, long ago

- A matter of privacy: the right to control how much one is willing to "share its personal information with others"

- But—retaining and "speaking" such information is free speech

- Conflict of rights: free speech versus privacy

The EU

- Currently the law within the EU: EU citizens can request that information about them be removed from search engines

  - Does not apply to prominent people, major stories, etc.

- Enforceable *only* within the EU—information about such people need not be suppressed outside the EU

- Such orders are probably not enforceable in US courts

- How does Google know where you are?

The Economics of the Right to be Forgotten

- There is no requirement that the original data be removed, only that search engines delist it

- If you know where to look, you can still find it

- If you're well-resourced enough, you can build tools to search all likely places

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Location and National Requirements

Location

- How does a website know where you are?

  - It can ask you, or it can do IP geolocation

- You can lie—and you can spoof IP geolocation

  - Apps? Are they hack-proof? How does a server know it's talking to the genuine app?

  - If it matters, stronger measures are needed, e.g., some states' legal online gambling apps use WiFi geolocation
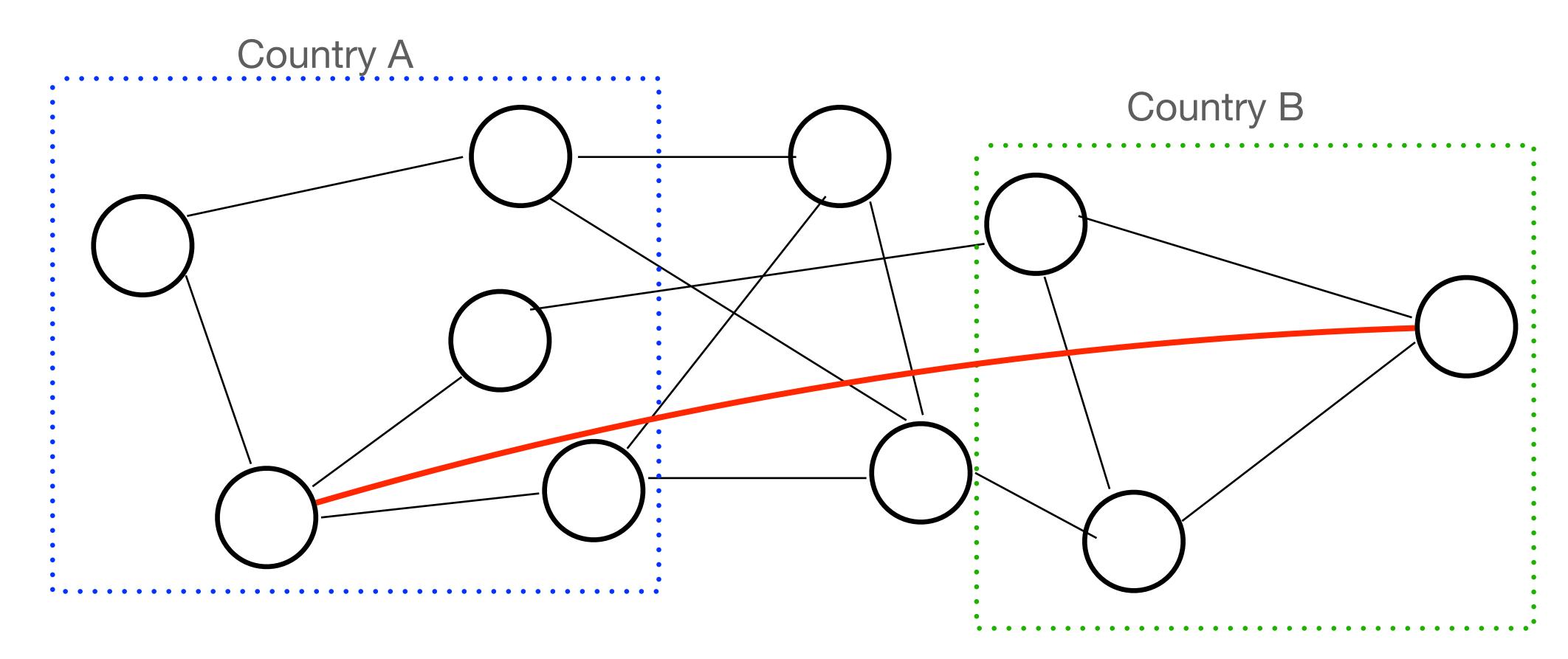
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Virtual Private Networks

- IP addresses are customarily assigned to *interfaces*

- An interface is some way to speak IP to the outside world: Ethernet, WiFi, etc.

- You can create *virtual interfaces*—set up a software connection to some other host

- These virtual interfaces can acquire an IP address from the remote node—and appear there
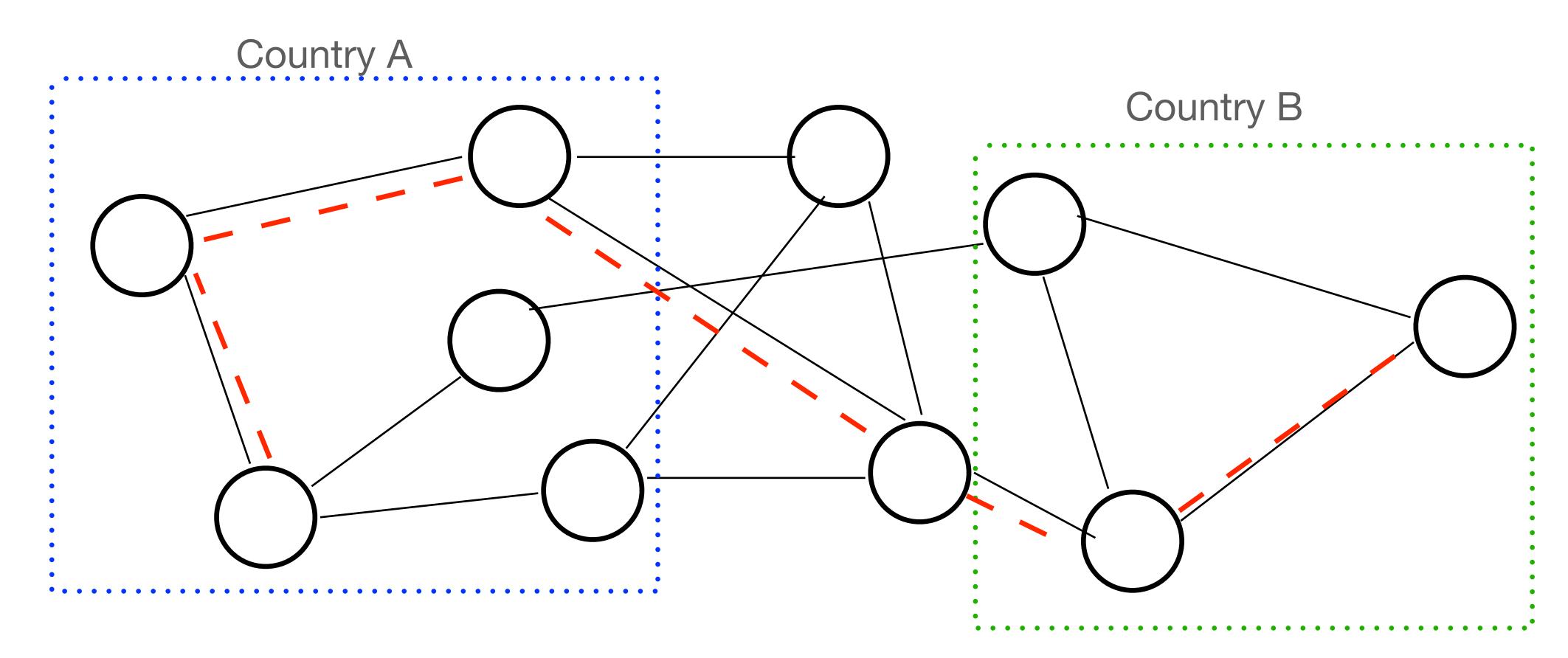
A Virtual Link

Country A

Country B

These virtual links are often, but not always, encrypted

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A Virtual Link: Hop by Hop

Country A

Country B

These links are just ordinary network connections

VPN Limits

- You have to trust the VPN provider

- Commercial VPN providers are well known, and are often blocked

  - Netflix et al. have geographic limits on their licensed content

- Slower

Censorship

Content Censorship

- National censorship requirements

  - Lèse-majesté laws in Thailand

  - Content insulting Erdoğan in Turkey

  - Nazi content in most of Europe

  - Information on criminal trials in Canada

  - More…

- How is blocking done? How is scanning done?

Routing

- Remember that ISPs route packets

- An ISP can refuse to send packets to particular destinations
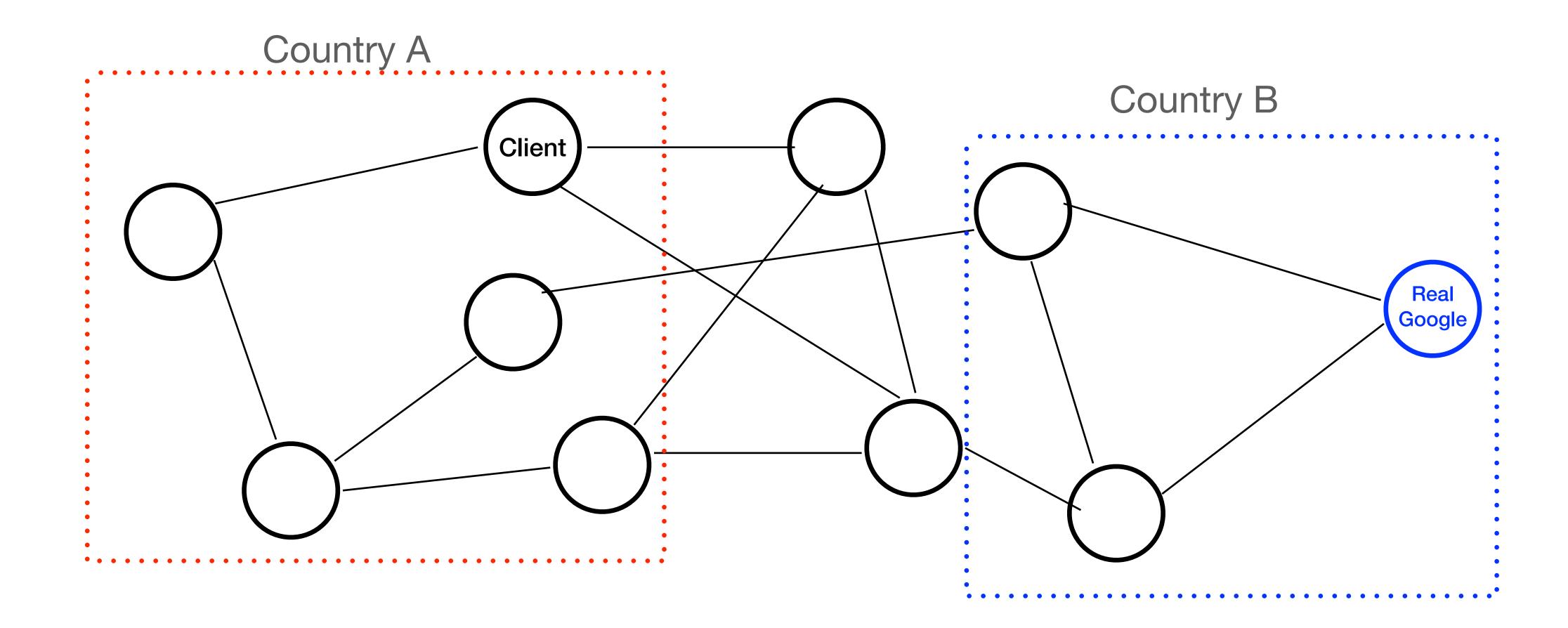
- Example: Pakistan has blocked YouTube

The Domain Name System

- The DNS maps hostnames to IP addresses

- If you can block or spoof DNS traffic, you can give the wrong address

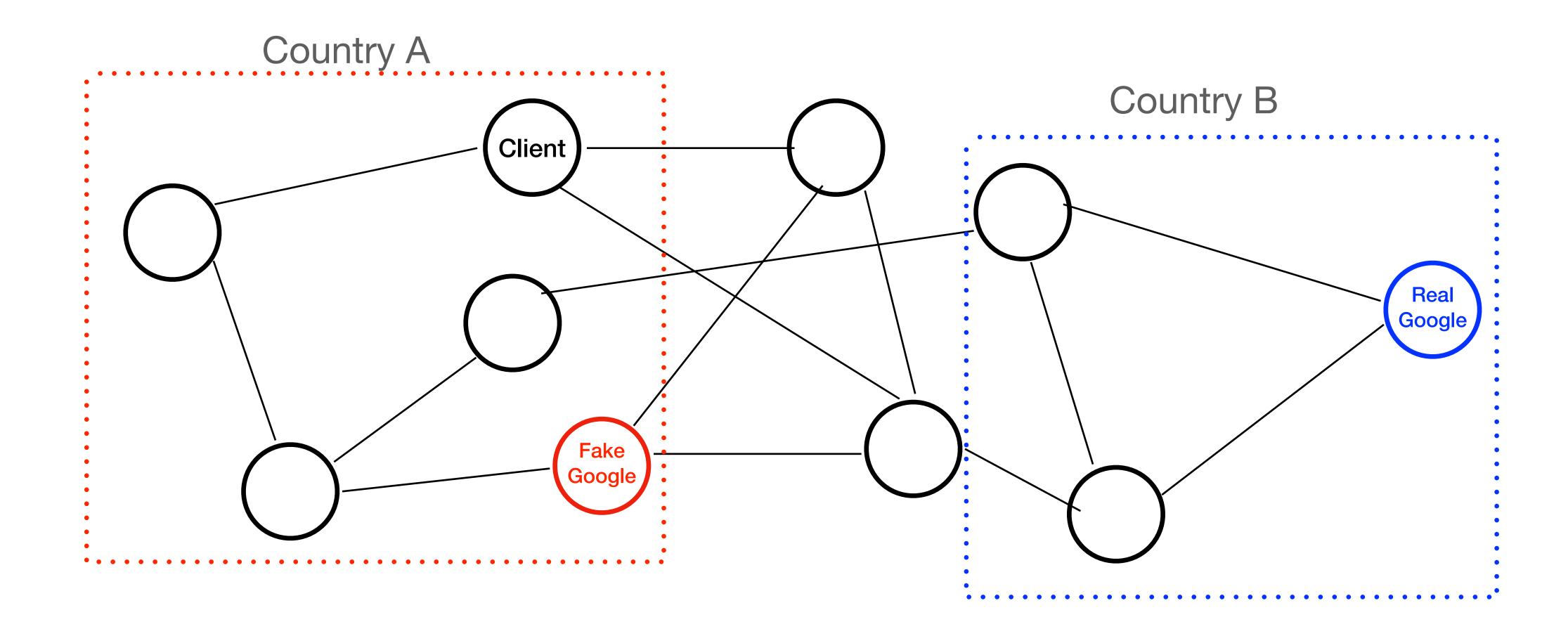- Send requests to forbidden websites to an error—or warning—page

Faking the Destination

Country A

Country B

Client

Real Google

Faking the Destination

Country A
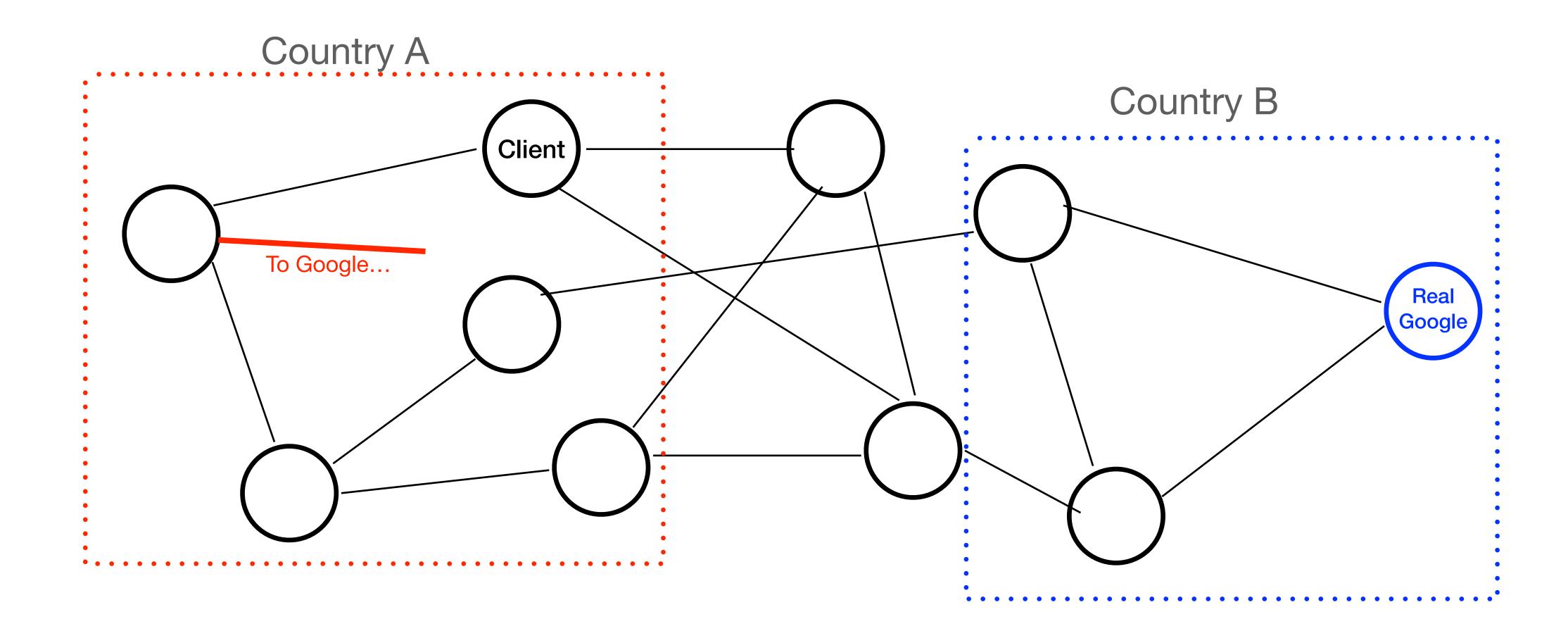
Country B

Client

Fake Google

Real Google

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Certificates?

- In theory, certificate checks prevent spoofing

- However…

  - A government-mandated certificate authority (e.g., in Kazakhstan) can issue fake certificates

  - A hacked CA (Diginotar and Comodo) can issue fake certificates

  - Many users will click through the warnings

  - You don't need a certificate to simply block the service

Discarding the Traffic

Country A

Country B

Client

To Google…

Real
Google

CS
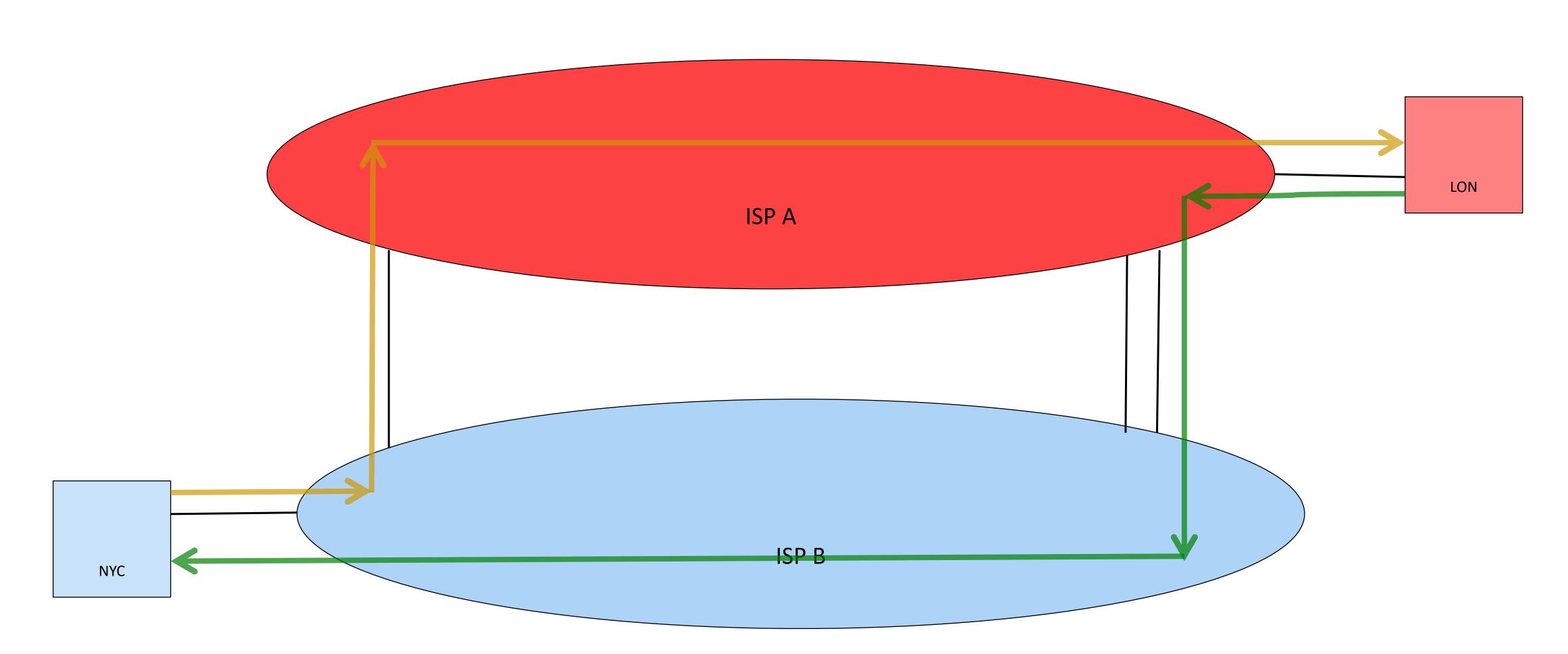@CU

Filtering and Scanning

- It's difficult, but possible, over the network

  - Link speeds are high

  - Messages are broken up into *packets*

  - It's hard to know context

  - Asymmetric routing

Outbound and Inbound Paths Differ

ISP Topology

- International Internet connectivity from the US is based on the economic and engineering choices of the ISPs

    - Verizon Business considers North America a separate *autonomous system* (AS) (a concept for routing)
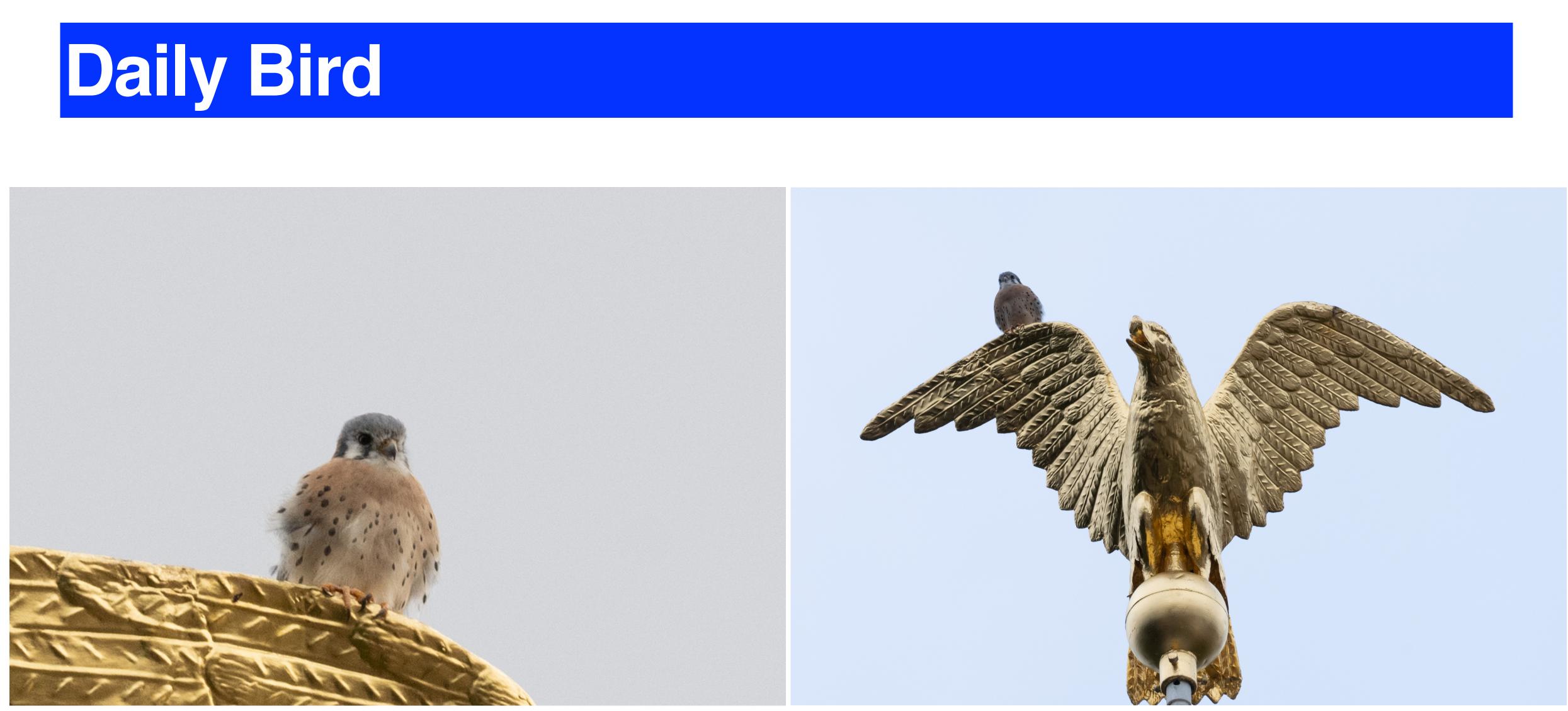
    - AT&T treats the whole planet as one AS—which makes it harder to do filtering

- Older technologies—telegraph, radio, telephone—were "facilities-based" and/or otherwise regulated, hence government permission was required for international gateways

- The early Internet grew up in a deregulatory era, and used circuits leased from telephone companies—no obvious buildings on the shoreline

Daily Bird

Kestrel falcon atop the eagle atop the flagpole on Low Plaza, October 19, 2022