Censored Planet

UNIVERSITY OF MICHIGAN

Decentralized Control

A Case Study of Russia

NDSS SYMPOSIUM/2020

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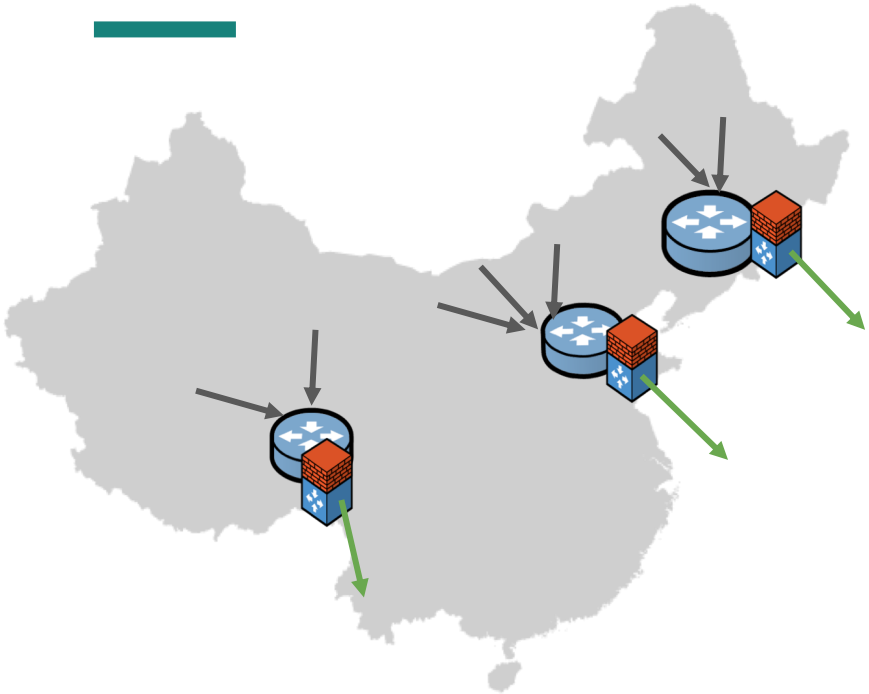
24 February 2020

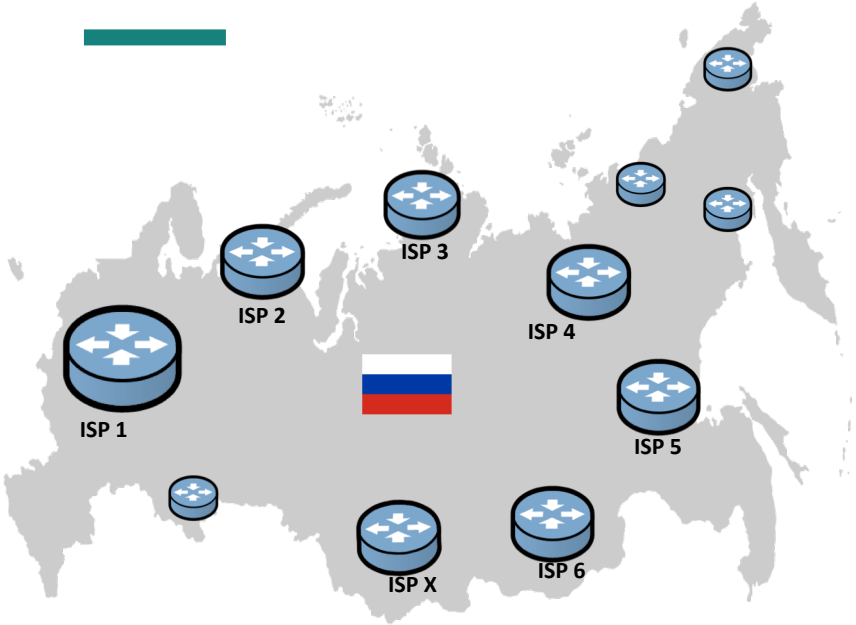
Centralized Censorship



only for illustration

- Conventionally, censorship = centralized
  - China developing the GFW over the past 17 years
  - High investment in money and time

Decentralized Censorship Infrastructure



only for illustration

- Multiple ISPs with different motivations
- From a govt perspective:
  - Synchronizing policies
  - Large scale
  - Real time filtering
- Russia has been ramping up: despite 1000s of ASes

Russia's Model: Decentralized Censorship Apparatus

- Russia is building their national censorship apparatus
- Facilitated by the commoditization of filtering technologies
- From a research standpoint:
  - Is decentralized censorship feasible to implement?
  - How effective is it?
  - Can other nations adopt it easily?

➔ Need to conduct meaningful measurements

Censorship Measurement Checklist

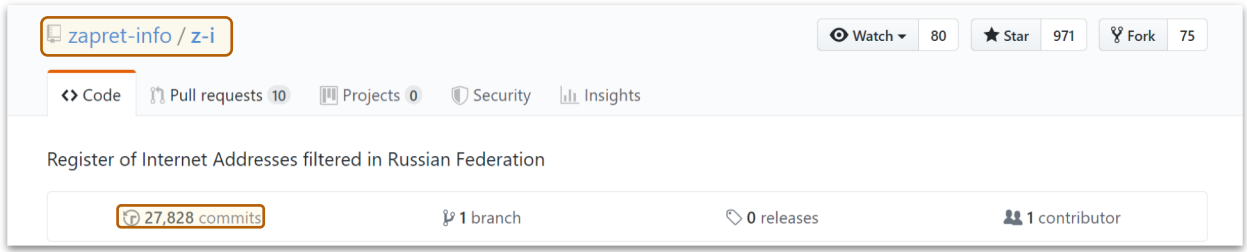
1. Identifying domains to test
2. Diverse vantage points
3. Sound control measurements

Identifying Domains to Test

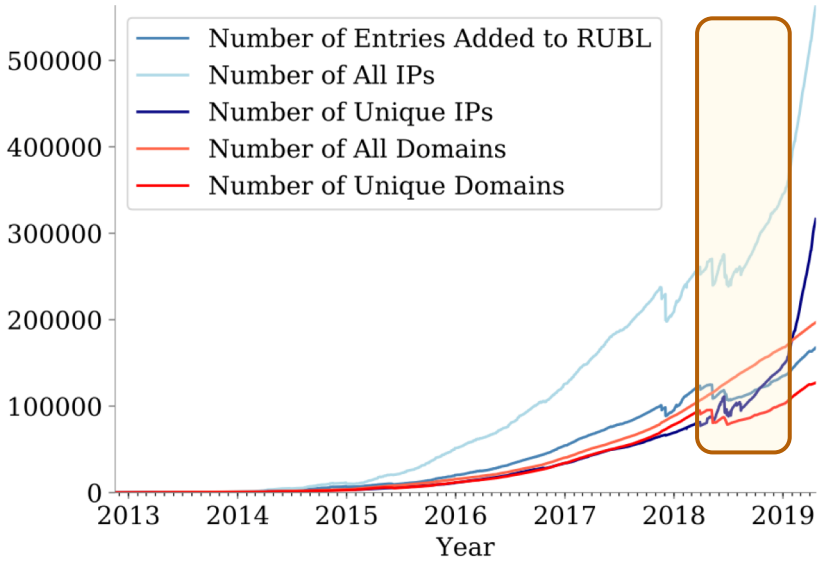
- Worked extensively with activists
- **Obtained 5 leaked digitally signed samples** of authoritative blocklist
- Pointed to repository that tracked the leaked blocklist over time

➔ Found 99% similarity between signed samples and repository entries

Signatures use GOST CN=Роскомнадзор or CN=Единая информационная система Роскомнадзора (RSOC01001), translates to “Roskomnadzor,” and “Unified Information System of Roskomnadzor.”



Characterizing the Blocklist



We characterized:

- ➔ 7 years worth of historical data with commits of daily granularity
- ➔ Rapid growth

132,798 Domains

324,695 IPs

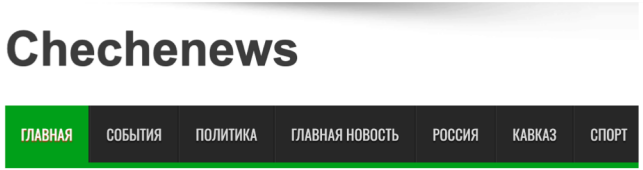
39 Subnets

Characterizing the Blocklist

- 63% websites had content in Russian, 28% in English
- Current categorization services work well for English content
  - Developed our own **topic modeling algorithm**

➔ Popular categories were gambling and pornography, also:

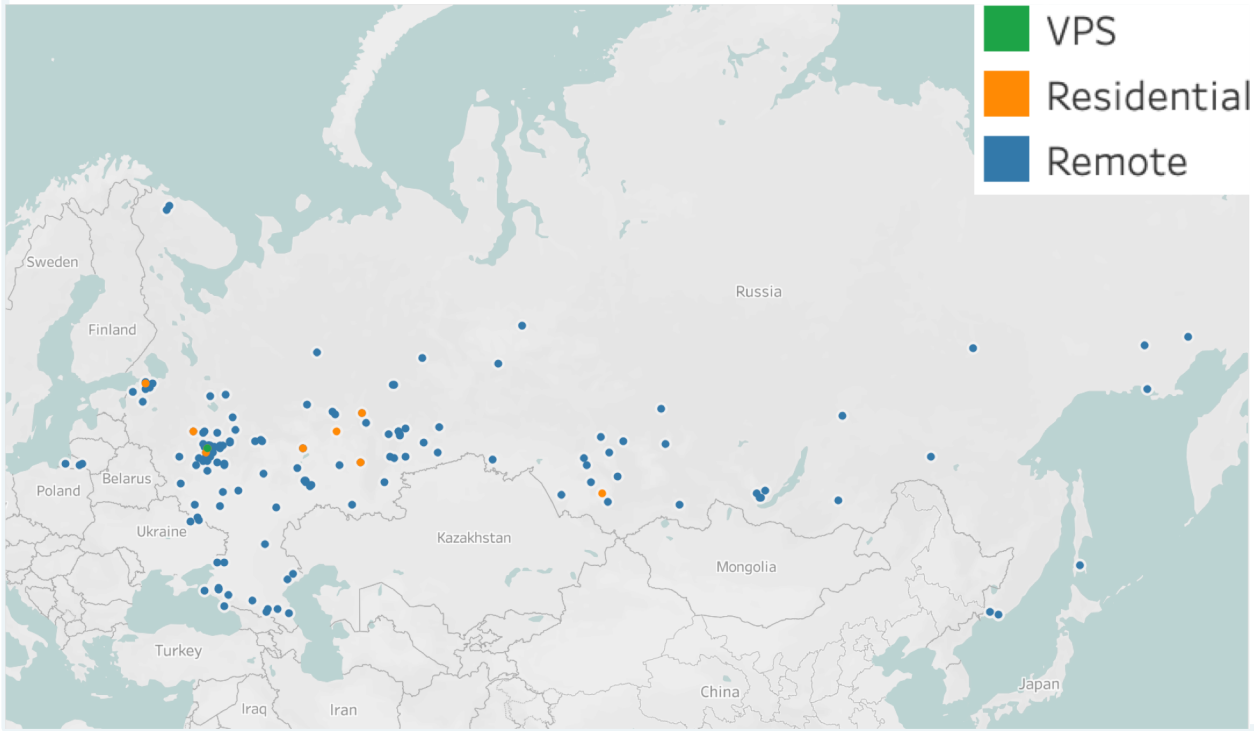
  - Russian news websites with political content
  - Circumvention websites



Censorship Measurement Checklist

1. Identifying domains to test
2. Diverse vantage points
3. Sound control measurements

Diverse Vantage Points



- Rented 6 VPSes
- Recruited 14 participants to run residential probes
  - Ethically with informed, explicit consent
- To obtain a holistic view, we obtained vantage points to run remote measurements

Censorship Measurement Checklist

1. Identifying domains to test
2. Diverse vantage points
3. **Sound control measurements**

Sound Control Measurements

- Prune away the domains and IPs that are non-responsive
- 13 geographically distributed control vantage points
- Resolved all domains and made HTTP GET requests
- Made TCP connections to port 80 to all IPs in list and subnets

98,098 Domains	121,025 IP Addresses	31 Subnets

Common Types of Blocking

1. TCP/IP Blocking
2. DNS Manipulation
3. Keyword Based

Conducting Measurements

Direct Measurement

From datacenter VPSes and residential probes

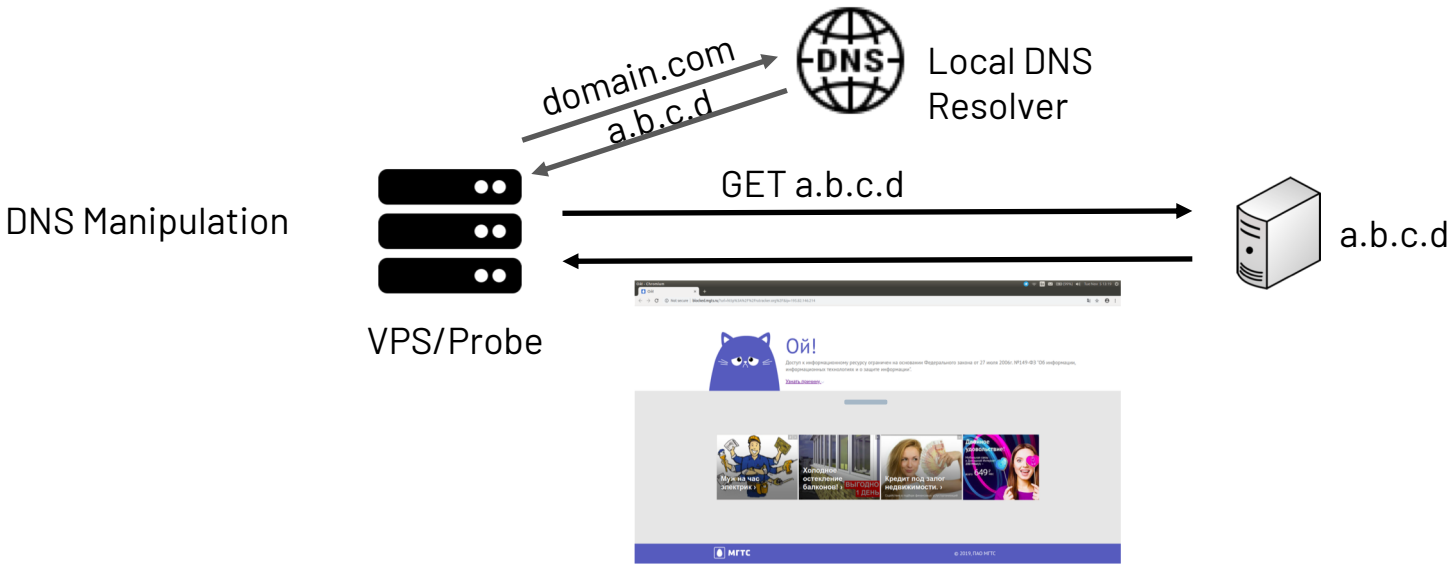
- In-depth measurement
- Limited scale

Remote Measurement

From the remote measurement vantage points

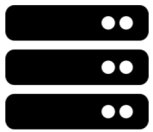
- Large scale measurements
- Helps corroborate results for **domains** on the list

Conducting Direct Measurements



Conducting Direct Measurements

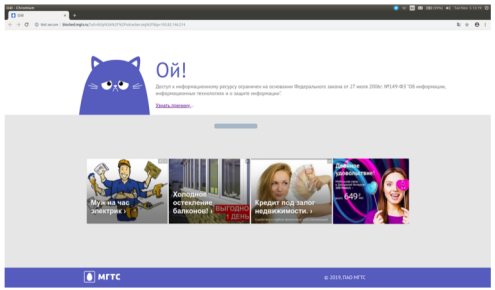
Keyword Based Manipulation



VPS/Probe

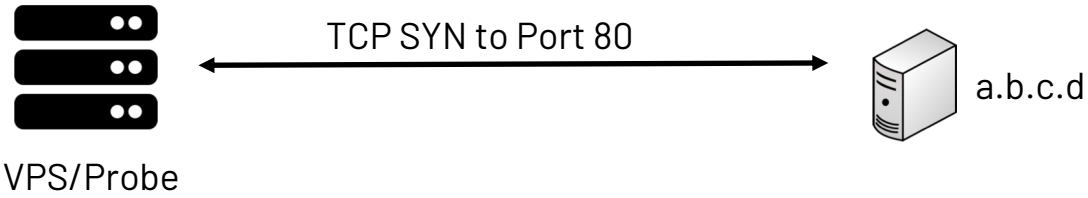
GET domain.com

domain.com

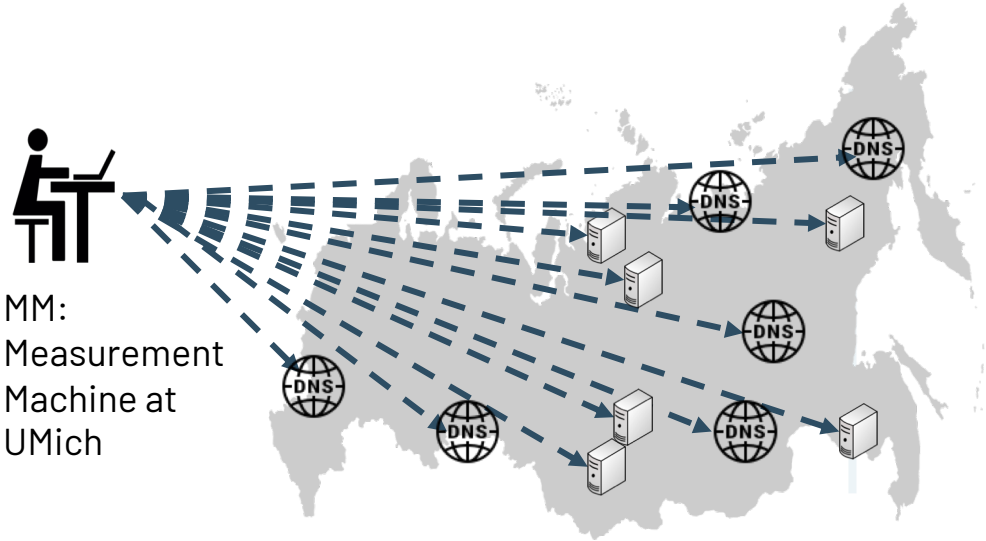


Conducting Direct Measurements

IPs in List and Subnet



Conducting Remote Measurements



MM: Measurement Machine at UMich

- Ran remote measurements using **Quack** and **Satellite** to corroborate results
- Over 1000 vantage points in total

This is the first comprehensive, in-depth study that:

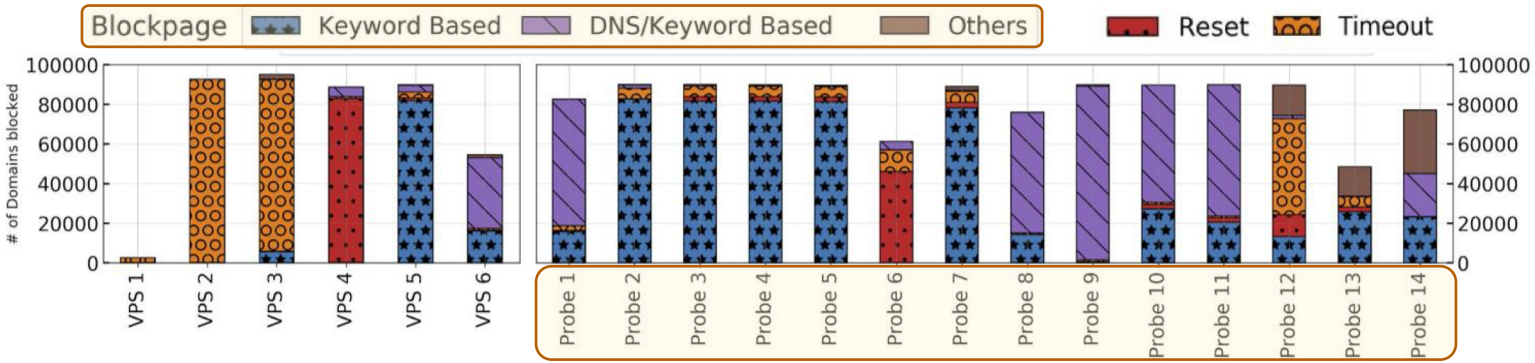
- ➔ uses an **authoritative blocklist** to investigate feasibility of decentralized information control and,
- ➔ combines views from **data centers, residential, and remote vantage points** to obtain a holistic view of censorship in a country.

Results

- ➔ Domains (Direct and Remote)
- ➔ IPs and Subnets (Direct)

Measurement Results for Domains

- Residential probes observe **high** level of blocking
- Significant difference in both **types and amount** of blocking between data center and residential vantage points
- Residential ISPs are more likely to inject **informative blockpages**



Measurement Results for Domains

- Only few data center VPSes observe blocking
- Data center networks less likely to inject blockpages, instead use resets and timeouts
- Residential ISPs:
  - Inject notices **citing the law** in blockpages
  - Sometimes even include **advertisements**!

Akado - Chromium

Akado

Not secure | blocked.akado.ru/?

Tue Nov 5 13:29

акадо телеком

Доступ к информационному ресурсу ограничен на основании Федерального закона от 27 июля 2006 №149-ФЗ «Об информации, информационных технологиях и о защите информации».

Адрес сайта Единого реестра доменных имен, указателей, страниц сайтов в сети Интернет и сетевых адресов, позволяющих идентифицировать сайты в сети Интернет, содержащие информацию, распространение которой в Российской Федерации запрещено: http://blocklist.rkn.gov.ru/ Адрес Реестра нарушителей авторских прав: http://nap.rkn.gov.ru/reestr/

Ой! - Chromium

Ой!

Not secure | blocked.mgts.ru/?

Ой!

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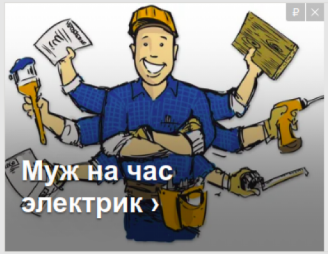
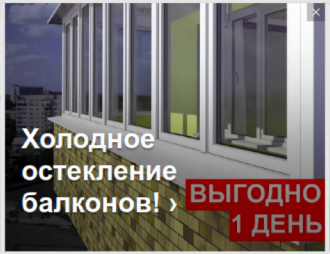
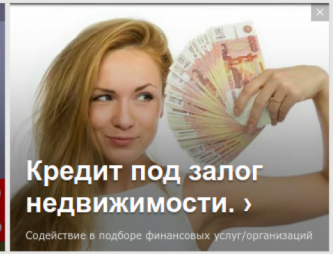
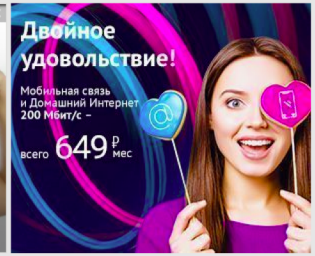
Узнать причину









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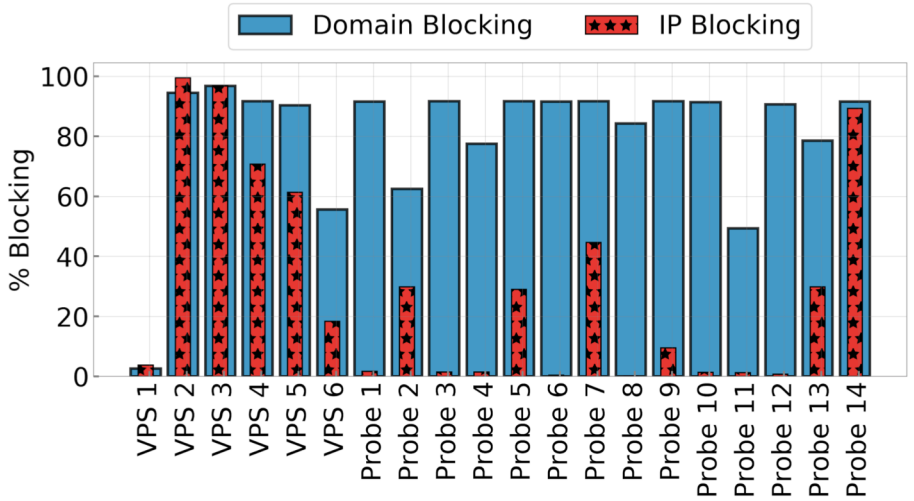
Remote Measurements Results

- Policies of blocking are carried out at the AS level
  - High similarity of blocking
- Confirms DNS manipulation in cases where
  - Most domains resolve to the same IP and that IP hosts a blockpage

Results for IPs and Subnets

- Overall for IPs, lesser blocking compared to domains
- Residential ISPs more likely to block domains than IPs
- Different ISPs may prioritize blocking different subnets



Censorship Measurement Checklist

1

Identifying domains to test

Working with activists enabled us to obtain an authoritative test list

2

Diverse vantage points

Obtained data center, residential, and remote vantage points to get a comprehensive picture of censorship in the country.

3

Sound control measurements

Need strong controls to differentiate censorship from other failures

Decentralized Control is Effective!

Our study finds:

- Implementing effective decentralized information control is feasible
- Commoditization of censorship & surveillance technology allows for simple solution
- Russia is succeeding at building a national censorship apparatus

Spreading Censorship Trends

United Kingdom - Government providing ISPs a list of websites to block and having governing censorship bodies that correspond to various types of censored material

Indonesia - Implementing content filtering at its network borders

India - has been ramping up censorship using Supreme Court orders imposed on ISPs

United States - the repeal of net neutrality is allowing ISPs to favor certain content over others

Spreading Censorship Trends

- ➔ Report in 2019 found Russian information controls being exported to 28 countries
- ➔ Enforce **accountability and transparency**
- ➔ Need **mechanism for auditing**
- ➔ Need **empirical, data-driven** studies to inspire change

Summary

- Highlight censorship measurement complexities
- Combine perspectives from diverse vantage points
- Prove that decentralized censorship is effective
- Illustrate impact of the use of commoditized technology for censorship

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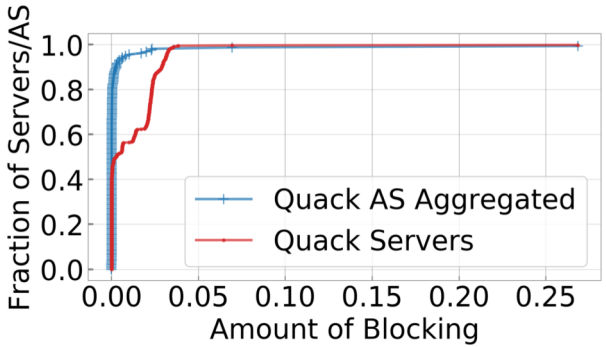
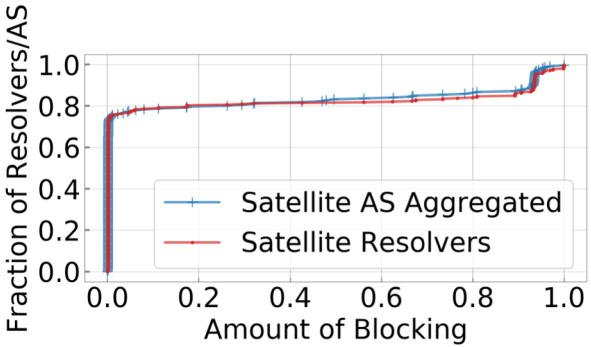
Backup Slides

Remote Measurements Results

Fraction of domains blocked at the individual vantage point as well as AS (aggregated) level



- The similarity between the lines shows that blocking is happening at the AS level.



- Our measurements using Satellite observed much more blocking compared to Quack measurements.

Topic Modeling

1. Text Extraction - Used **Beautiful Soup** to extract text from HTML
2. Language Identification - Python's **langdetect** library

Ran the rest for Russian and English separately

1. Stemming - Reduce words to stems using Snowball
2. TF-IDF - Term frequency-inverse document frequency
3. LDA analysis - Python's **gensim** and **nltk**

➔ Arrived at 20 topic word vectors each for English and Russian, then labelled manually

DNS Manipulation

- Satellite creates an array of metrics:
  [IP, HTTP Content Hash, TLS Certificate, ASN, AS Name]
- If a particular response for a domain fails **all** of these metrics, classified as **blocked**