Decentralized Control
A Case Study of Russia

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Centralized Censorship

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

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

Characterizing the Blocklist

- 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
- 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

DNS Manipulation

Local DNS Resolver

domain.com

GET a.b.c.d

VPS/Probe

a.b.c.d
Conducting Direct Measurements

Keyword Based Manipulation → GET domain.com
VPS/Probe → domain.com
Conducting Direct Measurements

- IPs in List and Subnet
- VPS/Probe
- TCP SYN to Port 80
- a.b.c.d
Conducting Remote Measurements

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

MM: Measurement Machine at UMich
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!*


Ой!

Доступ к информационному ресурсу ограничен на основании Федерального закона от 27 июля 2006 г. N°149-ФЗ "Об информации, информационных технологиях и о защите информации."

Узнать причину.
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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Remote Measurements Results

- 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.
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**