A Bestiary of Blocking
The Motivations and Modes behind Website Unavailability

Sadia Afroz
ICSI and UC Berkeley

Mobin Javed
LUMS

Vern Paxson
ICSI and UC Berkeley

Shoaib Asif Qazi
LUMS

Shaarif Sajid
LUMS

Michael Carl Tschantz
ICSI

Abstract
This paper examines different reasons the websites may vary in their availability by location. Prior works on availability mostly focus on censorship by nation states. We look at three forms of server-side blocking: blocking visitors from the EU to avoid GDPR compliance, blocking based upon the visitor’s country, and blocking due to security concerns. We argue that these and other forms of blocking warrant more research.

1 Introduction
We often conceptualize the Internet as one global and shared infrastructure comprehensively connecting people from every part of the world. In practice, however, different users experience different Internets. The differences in experience can arise for various reasons, such as ISPs creating restricted “walled gardens” for their customers, governments censoring access to resources, copyright regulations restricting access to protected content, and web servers blocking unwanted access. These partitionings of the Internet in terms of the way content is served to different end users reflect instances of the “balkanization”1 of the Internet into a “splinternet”.

Currently, a large body of research exists on understanding access restrictions by authoritarian states for censorship (e.g., [50] [14] [32] [17] [38] [41] [13] [5] [44] [46] [30] [37] [4] [18] [3] [11] [53] [19]). Other forms of access restriction, often controlled by algorithms running on a website’s servers or CDNs, have received much less empirical exploration.

Herein, we explore forms of that blocking that do not fit into the quintessential conceptualization of censorship—we leave it to the reader to decide which count as censorship. After enumerating various types of blocking (Section 2), we present measurements for three such forms of blocking. We show that the number of pages unavailable from three locations in the EU increased after the EU’s General Data Protection Regulation (GDPR) went into effect (Section 3). We also look for, and find, other blockpages explicitly listing geography as the reason for blocking (Section 4). Finally, we look for blockpages and practices suggesting security concerns (Section 5).

While many of these issues have been discussed, and in some cases measured, in isolation, we believe this work to be the first to consider the range the blocking in a systematic manner. We also discuss the difficulties of separating out each form from the others, which is further complicated by the possibility of a single block corresponding to more than one form. Our contributions are, admittedly preliminary: our list of blocking types is incomplete and tilted toward location-based blocking; our measurement studies are small-scale. Nevertheless, we believe there to be value in laying out this space of research opportunities while highlighting the risks of claiming to measure only a single phenomenon given the lack of isolation between the types of blocking we consider.

Prior Work. We know of no prior works laying out the space of forms of blocking, the goal of this work. However, there are numerous papers looking at various forms of blocking in isolation. Thus, rather than have a dedicated prior work section, we will cover these works where we discuss the form of blocking they cover, mostly in the next section.

2 Types of Blocking
Suppose you run a test to find that a website will load in the US but not in China. If the website is politically sensitive, it is not unreasonable to suspect censorship, but numerous other possibilities exist.

---

1 For a critical discussion of the term see Maurer [34].
Perhaps the first thing to check is nature of the block: was it just a transient network failure? did DNS fail? is there a CAPTCHA? a blockpage providing an explanation? a blockpage without an explanation? or an error message? For example, while CAPTCHAS can be annoying, they seem like an unlikely choice for censorship since they, when working as designed, merely slow down the accessing of data. Each of the others seem like stronger indications of censorship, including, to a lesser extent, even blockpages claiming the cause to be something else, since censors may mislead.

Another factor to check is what the blocking is targeting. The blocking could be targeting something other location, such as the OS or browser used, automated bots loading pages, or being logged out of a service. For example, some websites block Tor [29,43]. Keeping these factors and other factors consistent across the two locations can help rule them out, leading to location-based blocking becoming the most likely explanation.

Questions will still remain about what sort of location is targeted by the block. The targeted location might be geographic, such as a campus, sub-national region, country, or super-national region. Alternatively, the targeted location might be defined in terms of network topology: an IP address, an IP address range, a network, or an AS. One can also ask whether the blocking is whitelisting or blacklisting. In whitelisting, a website aims to serve its content to only visitors within its region. In blacklisting, a website aims to exclude certain regions. Determining the target of the block and its mode of operation can be tricky. For example, a large enough blacklist will look like a whitelist, and blocking enough IP addresses individually will eventually block a whole range or even a whole country.

Furthermore, given that geographic blocks are likely implemented by blocking IP address ranges assigned to the targeted country, targeting can be considered at multiple levels from specification to implementation. Nevertheless, in Section 4 we are able to find country-based blocking with high confidence by finding blockpages that confess to it. Censorship could target any of these notions of location, but the blacklisting of a whole country (the government’s own country) is the most characteristic of censorship.

Another factor is where in the network the blocking is happening. The paragon of censorship is a government-operated middlebox at the national border. However, other possibilities exist. The ISP of the client might be doing the blocking (e.g., 17), or the ISP of the server hosting the tested website, or the website itself. A combination of examining how the block operates and additional measurements can sometimes determine which of these possibilities it is [17,48,4,1].

However, even determining where in the network the blocking is happening does not definitively reveal whether censorship is in action. Suppose, you find that the blocking is done by the ISP of your client in China. This could be because the government of China ordered the block or because the ISP is performing some sort of traffic filtering, in violation of net neutrality, to raise more revenue or cut costs.

Alternatively, suppose you find that the website’s server is doing the blocking. At first, this might seem to be a clear indication that the block is for some reason other than censorship, such as concerns over abuse. However, this could still be an instance of China censoring the website, just in the more roundabout manner of pressuring the website into blocking visitors from China. Indeed, Western companies have altered their websites for Chinese visitors to comply with China’s demands [10]. Alternatively, it could be the server’s country doing the censorship by ordering the blocking of visitors from China as part of economic sanctions [6,23].

In fact, government orders are behind many sorts of server-side blocking that might or might not strike the reader as censorship. A recent example is the passage of SESTA, a US law holding websites liable for some third-party content facilitating prostitution, which has lead to a website geo-blocking the US [8]. An example we will explore is websites blocking the EU to avoid GDPR compliance (Section 5). Where to draw the line as to which count as censorship is unclear to us, but server-side censorship of one form or another is possible.

With this mind, it is clear that censorship is not merely an issue of where the blocking is happening or who is doing it, but rather one of why the blocking is happening, that is, upon whose orders. In some cases, the roles might be switched from what is expected. For example, arguably, copyright is a form of censorship in which the copyright holder gets a government to enforce its claim [43,40,2]. In theory, a website could pay a government to implement a regional block to reduce abuse or increase its market share, leading to an odd form of hybrid government–corporate censorship.

Before concluding that censorship has happened, other possible motivations behind the block should be considered. Table 1 provides a partial list of different forms of blocking. One possibility is security concerns, such as fraud and abuse, which is associated with certain countries [9,11]. We look at such blocking in Section 5. Another possibility is concerns over the costs of serving traffic to some countries, which can be seen as a wasted expense for companies not targeting that market. This issue can be exacerbated by the serving of traffic to the developing world sometimes being more expensive than serving it to the developed world [1].

With profits in mind, companies may engage in blocking to increase revenue, by charging extra fees to
Table 1: Examples of Motivations behind Location-based Blocking. Those marked with * denote location in the network topology instead of geo-location. ** denotes cases where we use a non-location-based block due to not finding a location-based one.

| Server (including CDNs) | Middlebox (ISPs, governments) |
|------------------------|-------------------------------|
| Political censorship   | Bowing to China’s demands [10] | Great Firewall of China (lots) |
| Economic sanctions     | US websites blocking Cuba [6] & Iran [23] | |
| Third-party liability  | Blocking US due to SESTA [8] | |
| Copyright              | YouTube blocking in Germany [43, 40] | ISPs blocking the Pirate Bay [2] |
| Other compliance       | GDPR [8] | |
| Security               | Blocking countries assoc. w. fraud [9, 1, 15] | Net-neutrality [28]* |
| Hosting costs          | CDN fees [1] | Overloaded rural links [27, 49] |
| Revenue                | Price discrimination [35, 36, 45, 24] | |
| Unintentional          | Slash-dotting [47]** | |

access some regions or by blocking competitors, violations of net neutrality [28]. While not blocking, some websites have engaged in price discrimination, which can also negatively affect some visitors based upon their location [35, 36, 45, 24].

Finally, blocks can be unintentional, for example, from misconfiguration or failures caused by lacking enough bandwidth [47, 27, 49].

Above, we mentioned numerous forms of blocking, but they are not independent of one another. For example, some serve as implementation approaches for others. Measurement studies must take care not to conflate forms of blocking. The obvious way of doing so is to just ignore the differences. Less obvious is conflation by attempting identify a form using proxies for it without making assumptions explicit, such as assuming that no server-side blocking is censorship. Developing methods for distinguishing between blocking types could also aid the blocked users, who currently struggle to understand what is happening and why [21].

3 GDPR-Motivated Geo-blocking

The EU’s General Data Protection Regulation (GDPR) contains a wide range of provisions designed to protect the privacy of people who use online services and to give them more control over their data [20]. Complying with some of the provisions may require a major shift in how some websites store and process data about their visitors. (See Lomas [31] for an overview.) For example, in general, visitors have the right to access, correct, and delete data about themselves. Implementing these abilities can create an implementational headache given systems engineered to use and store data indiscriminately. Furthermore, getting it correct is high stakes, with fines of €20M or 4% of a company’s global annual revenue. Given the uncertainty and stakes, some websites have decided to exit the European market, at least for the time being [25, 26]. To partly quantify this effect, we analyze the differences in availability of a convenience sample of websites before and after GDPR went into effect.

From our prior work [1], we re-used a data set showing the availability of 7081 websites, which we collected to study a different facet of server-side blocking. These websites form the union of various Alexa top 500 lists: the global list, the lists for ten countries, and the lists for nine categories of websites. For each URL, we measured it from three locations in the EU via a VPN: London, United Kingdom; Sofia, Bulgaria; and Frankfurt, Germany. From each location, we use one of the measurements of the URLs before GDPR came into effect. The crawler used in these measurements attempted DNS resolution for each URL, logging any errors. For those that resolved, it used Python’s Requests package to request the webpage, logging errors, status codes, and content. See our prior work for details [1].

After GDPR came into effect, we re-used our measurement infrastructure of to take a second measurement of each URL. We took the data and analyzed it for changes in website availability.

Using error logs and status codes, we found 74 websites that, for all three European locations, sent an HTTP status code of 200 OK when accessed before May 25 and non-200 status after May 25, 2018. Out of the 74 websites, 40 responded with a 403 Forbidden status code and a block page explicitly mentioning “Blocked due to GDPR” (Table 2). Seven websites used the HTTP status code 451 Unavailable For Legal Reasons (Table 3), the code named for a novel on censorship [7]. All of 47 of these websites with explicit blockpages are local
news websites, incidentally, a plausible target of censorship as well. One website, brownells.com asks users to visit their EU website, www.brownells.eu. The remaining 27 websites do not provide any explicit blockpages and use rather vague status codes and connection errors. For example, the online gaming website addictinggames.com returns an empty page with a 404 Page Not Found status code, the math tutoring website webmath.com refuses the TCP connection, and the reality website 99acres.com responded with a 412 Pre-condition Failed error code.

Providing context to our findings, looking online, we found services aiming to make it easy to block all EU visitors [39, 12].

### 4 Country-based Blocking

Cloudflare, a CDN, is an interesting subject of study, not only because it hosts many websites, but because it provides more information than many explaining why it blocks, on the behalf of the website owner, certain requests. In this section and the next, we analyze Cloudflare’s block notices looking for country-based and then security-motivated blocking. We emphasize that we selected Cloudflare not because we believe it to engage in such blocks any more than any other host, nor because we believe it should be singled out for criticism. Rather, we selected Cloudflare since prior work has found it blocking Tor based on abuse [29] and because of the information that Cloudflare provides about blocks, a commendable feature.

We start by finding sites hosted by Cloudflare. We resolved the top 1M Alexa domains, and identified those hosted by Cloudflare by performing whois lookups on the resolved IP addresses and keeping those containing “Cloudflare” in the AS name. We identified 85,421
Cloudflare-hosted URLs in this fashion.

Next, for each of these Cloudflare-hosted URLs, we retrieved the website from five vantage points: Pakistan (home network), Scotland (VPN), South Africa (cloud), Ukraine (VPN), and US (institutional network). The US crawler experienced failure, limiting its collection of 77,935 URLs.

We then classified the responses. By examining the blockpages themselves and Cloudflare’s documentation [22, 15], we determined that a response with an HTTP status code of 403 and a body that referenced Cloudflare’s own error code 1009 indicates blocking by country. Table 4 shows a breakdown of the responses by both this code and others, some of which will be relevant to the next section.

We found 524 websites using country-based blocking by Cloudflare under error code 1009. We also found one website using country-based blocking by a different service provider, Dell’s SonicWall, which the website motorcar.com used in addition to Cloudflare. The error message for SonicWall’s 403 blockpage says “Sorry this content is not available in your country due to GDPR”, shown in Figure 1, proving to be an instance of both GDPR and country-based blocking.

Interestingly, 32 websites were country blocked in the US, with 21 giving a Cloudflare 1009 error. We manually checked all 32 and found five that would load, including one that was a 1009 error to the crawler. A different website with a 1009 error was aquapro.biz. It was blocking countries and manually unavailable in the US, but consistently misidentified our country in an inconsistent manner, seemingly to assign us other countries at random. The remaining 1009 errors explicitly blocked the US. (For an example, see Figure 2.)

While the rate of country blocks varied from country to country, this comparison is complicated by the fact that different countries had different success rates at getting any response from the server. For example, Pakistan had an abnormally high rate of DNS errors, possibly due to network failures or censorship. This difference might hide a much higher rate of blocks in Pakistan than in Scotland. Alternatively, Scotland using a VPN and Pakistan using a home network might hide the difference. However, Scotland and Ukraine can be compared on a fairly even basis for both of these factors. For them, we see a large difference with Ukraine receiving more blocks.

5 Security-motivated Blocking

Using the same data set, we also looked for security-motivated blocking. While we recognize that some country-based blocks may have security as its motivation, we exclude those that we found to explicitly claiming to be security-based blocks to focus on those not yet discussed. We look at other types of blocking that could have been motivated by security concerns, while admitting that we cannot be sure of the real motivations behind a block.

Again, Cloudflare’s documentation helped us know where to look [22, 15]. The most indicative error code of security concerns is 1010, described as “bad browser”, which happens when “The source of the request was not legitimate or the request itself was malicious” [22]. Cloudflare also uses error code 1012 to deny access “based on malicious activity detected from your computer or your network (ip_address)” [16]. We also included error codes indicating an IP block, although those could be used for non-security reasons.

Finally, we looked at restrictions short of outright blocking. Namely, Cloudflare will sometimes make users solve a CAPTCHA before showing them the page. Cloudflare will also use a “browser challenge” on visitors it suspects of being a bot, which we looked for (see Figure 3).

Table 4 shows how common each of these, and other, outcomes are. As with country-based blocking, comparing across countries is confounded. Looking again at the well matched pair of Scotland and Ukraine, we see a large difference, with Ukraine receiving more blocks,
Table 4: Blockpage types for 85,421 Cloudflare-hosted domains from various vantage points.

| Blocktypes / Vantage point | Status | Description                  | Ukraine (VPN) | Scotland (VPN) | Pakistan (Home) | South Africa (Cloud) | USA (Inst.) |
|----------------------------|--------|------------------------------|--------------|----------------|------------------|---------------------|-------------|
| No HTTP Response           | n/a    | Timed out                    | 579          | 542            | 607              | 577                 | 540         |
|                            | n/a    | DNS error                    | 45           | 112            | 4096             | 4                   | 66          |
|                            | n/a    | Other connection errors      | 147          | 959            | 132              | 70                  | 525         |
| Geo-blocking totals        | 313    | Cloudflare: country or region blocked (1009) | 257          | 161            | 162              | 88                  | 21          |
|                            | 403    | SonicWall Geo-IP filter      | 1            | 1              | 0                | 1                   | 0           |
|                            | 403    | Other blockpage mentioning geo-blocking | 40           | 11             | 3                | 3                   | 0           |
|                            | 200    | Other blockpage mentioning geo-blocking | 15           | 1              | 13               | 11                  | 10          |
|                            | 451    | Unavailable For Legal Reasons | 0            | 1              | 0                | 0                   | 1           |
| Abuse-blocking totals      | 3431   | Cloudflare: IP Blocked (1006, 1007, 1008) | 23           | 5              | 6                | 5                   | 1           |
|                            | 200    | Cloudflare: IP Blocked (1006, 1007, 1008) | 2            | 2              | 2                | 2                   | 1           |
|                            | 503    | Cloudflare: Browser Verification | 1519         | 1091           | 1111             | 1124                | 985         |
|                            | 200    | Cloudflare: Browser Verification | 2            | 2              | 3                | 2                   | 3           |
|                            | 403    | Cloudflare: CAPTCHA Challenge | 1874         | 309            | 746              | 395                 | 257         |
|                            | 403    | OctoNet HTTP filter: VPN / TOR Block | 3            | 0              | 0                | 0                   | 0           |
| Misconfigurations totals   | 8      | Cloudflare: DNS points to invalid IP (1000, 1002) | 8            | 8              | 6                | 9                   | 8           |

Figure 3: Cloudflare’s Browser Challenge in Action

CAPTCHAs, browser verifications. Between the two, only Ukraine was accused of being a VPN or Tor despite both using the same VPN provider. The VPN/Tor blockpages came not from Cloudflare, but from OctoNet HTTP filter.

6 Conclusions

We have laid out a space of blocking that includes, but also exceeds, what we normally think of as censorship. We looked at three such forms of blocking in some detail. One of them, country-based blocking, is directly tied to location. It is more of an approach for implementing blocking than a motivation for blocking, raising the question of why the blocking is happening. The other two forms we measured are more like motivations than implementation approaches. The first, avoiding GDPR compliance, is, however, directly related to location in that the websites are blocking visitors from the EU for being from the EU. The third, security-motivated blocks, differs in that it does not need to be implemented using locations. However, we do find large differences in how common security-based blocks are from one location to the next, even when using the same VPN service to send requests from each location. While we studied three forms of blocking, they were far from independent of one another. While each of our studies were small scale, we hope they stimulate further research on these issues.

Deciding exactly which of these count as censorship is politically fraught, and we will not attempt to do so. We do take the stance that research should cover all forms of blocking that can adversely affect some users, particularly, when those effects are concentrated on people from certain countries. Furthermore, we believe the chilling effects on website availability of even well-intentioned laws to be an interesting subject of measurement. While we may wish for a world with both the robust privacy protections of the GDPR and an Internet free from balka-
nization, currently, a tradeoff is evident. The blocking of EU visitors precipitated by a privacy law may even have an outsized effect on Tor given the outsized number of Tor exits in the EU. This serves as an example of how the forms of blocking do not just have interdependencies between themselves but also with privacy. The presence of these interdependencies should be kept in mind when attempting to measure censorship to avoid false positives.

Acknowledges We thank David Fifield for allowing us to use his code for categorizing block pages. We gratefully acknowledge funding support from the National Science Foundation (Grants 1518918 and 1651857) and UC Berkeley’s Center for Long-Term Cybersecurity. The opinions in this paper are those of the authors and do not necessarily reflect the opinions of any funding sponsor or the United States Government.

References

[1] AFROZ, S., TSCHANTZ, M. C., SAJID, S., QAZI, S. A., JAVED, M., AND PAXSON, V. Exploring server-side blocking of regions. ArXiv 1805.11606 (May 2018).

[2] ALBANESIUS, C. U.K. high court orders ISPs to block the Pirate Bay. PC Mag (Apr. 2012), https://www.pcmag.com/article2/0,2817,2403749,00.asp

[3] ANONYMOUS. Towards a comprehensive picture of the Great Firewall’s DNS censorship. In Free and Open Communications on the Internet (2014), USENIX.

[4] ARYAN, S., ARYAN, H., AND HALDERMAN, J. A. Internet censorship in Iran: A first look. Free and Open Communications on the Internet, Washington, DC, USA (2013).

[5] BAMMANN, D., O’CONNOR, B., AND SMITH, N. A. Censorship and deletion practices in Chinese social media. First Monday 17, 3 (Mar. 2012).

[6] BISCHOF, Z. S., RULA, J. P., AND BUSTAMANTE, F. E. In and out of cuba: Characterizing cuba’s connectivity. In Proceedings of the 2015 Internet Measurement Conference (New York, NY, USA, 2015), IMC ’15, ACM, pp. 487–493.

[7] BRADBURY, R. Fahrenheit 451. Ballantine Books), 1953.

[8] BRODKIN, J. “erotic review” blocks US Internet users to prepare for government crackdown. Ars Technica (Apr. 2018), https://arstechnica.com/tech-policy/2018/04/erot ic-review-blocks-us-internet-users-to-prepare-for-government-crackdown/

[9] BURRELL, J. Invisible users: Youth in the Internet cafés of urban Ghana. Mit Press, 2012.

[10] CARSTEN, P. Microsoft denies global censorship of China-related searches. Reuters (Feb. 2014), https://www.reuters.com/article/us-microsoft-bing-censorship-idUSBREA100CP20140212

[11] CHAABANE, A., CHEN, T., CUNCHE, M., CRISTOFARO, E. D., FRIEDMAN, A., AND KAAFAAR, M. A. Censorship in the wild: Analyzing Internet filtering in Syria. In Internet Measurement Conference (2014), ACM.

[12] CIMPANI, C. New service blocks EU users so companies can save thousands on GDPR compliance. Bleeping Computer (May 2018), https://www.bleepingcomputer.com/news/security/new-service-blocks-eu-users-so-companies-can-save-thousands-on-gdpr-compliance/

[13] CITIZEN LAB. Behind Blue Coat: Investigations of commercial filtering in Syria and Burma. https://citizenlab.org/2011/11/behind-blue-coat/ Nov. 2011.

[14] CLAYTON, R., MURDOCH, S. J., AND WATSON, R. N. M. Ignoring the Great Firewall of China. In Privacy Enhancing Technologies (Cambridge, England, 2006), Springer, pp. 20–35.

[15] CLOUDflare. Error pages, troubleshooting, cloudflare support. https://support.cloudflare.com/hc/en-us/sections/200820298-Error-Pages Accessed May 29, 2018.

[16] CLOUDFLARE DAMON. 1012 error: Access denied. Cloudflare support page: https://support.cloudflare.com/hc/en-us/articles/200171986-1012-Error-Access-Denied Jan. 2017.

[17] CRANDALL, J. R., ZINN, D., BYRD, M., BARR, E., AND EAST, R. ConceptDoppler: A weather tracker for Internet censorship. In Computer and Communications Security (Alexandria, VA, USA, 2007), ACM, pp. 352–365.

[18] DALEK, J., HASELTON, B., NOMAN, H., SENFT, A., CRETENISHHATA, M., PILL, P., AND DEEBERT, R. J. A method for identifying and confirming the use of URL filtering products for censorship. In Internet Measurement Conference (2013), ACM.

[19] ENSAFI, R., FIFIELD, D., WINTER, P., FREAMSTER, N., WEAVER, N., AND PAXSON, V. Examining how the Great Firewall discovers hidden circumvention servers. In Internet Measurement Conference (New York, NY, USA, 2015), ACM, pp. 445–458.

[20] EUROPEAN COMMISSION. General data protection regulation (GDPR). Regulation (EU) 2016/679, L119, May 2016.

[21] GBEBHART, G., AUTHOR, A., AND KOHNO, T. Internet censorship in Thailand: User practices and potential threats. In European Symposium on Security & Privacy (2017), IEEE.

[22] GONLAG, M. What are the types of threats? Cloudflare Support page: https://support.cloudflare.com/hc/en-us/articles/204191230-what-are-the-types-of-threats May 2018. Accessed May 29, 2018.

[23] GROLL, E. How Washington helps Tehran control the Internet. Foreign Policy (Jan. 2018), http://foreignpolicy.com/2018/01/04/how-washingto n-helps-tehran-control-the-internet/

[24] HANNAK, A., SOELLER, G., LAZER, D., MISLOVE, A., AND WILSON, C. Measuring price discrimination and steering on e-commerce web sites. In Proceedings of the 2014 Conference on Internet Measurement Conference (New York, NY, USA, 2014), ACM, pp. 305–318.

[25] HERN, A., AND WATERSON, J. Sites block users, shut down activities and flood inboxes as GDPR rules loom. The Guardian (May 2018). https://www.theguardian.com/technology/2018/may/24/sites-block-eu-users-before-gdpr-takes-effect

[26] HILL, R. US websites block netizens in Europe: Why are they ghosting EU? it’s not you, it’s GDPR. The Register (May 2018). https://www.theregister.co.uk/2018/05/25/tronc_chicago_tribune_la_times_gdpr_lock_out_eu_users/

[27] JOHNSON, D. L., PEJOVIC, V., BELDING, E. M., AND VAN STAM, G. Traffic characterization and internet usage in rural africa. In Proceedings of the 20th International Conference Companion on World Wide Web (New York, NY, USA, 2011), WWW ’11, ACM, pp. 493–502.

[28] KARR, T. Net neutrality violations: A brief history. Free Press (Jan. 2018). https://www.freepress.net/our-response/expert-analysis/explainers/net-neutrality-violations-brief-history
[29] Khattak, S., Fifield, D., Afroz, S., Javed, M., Sundaresan, S., Paxson, V., Murdock, S. J., and McCoy, D. Do you see what I see? Differential treatment of anonymous users. In Proceedings of the Network and Distributed System Security Symposium (NDSS) (2016).

[30] Khattak, S., Javed, M., Anderson, P. D., and Paxson, V. Towards illuminating a censorship monitor’s model to facilitate evasion. In The 3rd USENIX Workshop on Free and Open Communications on the Internet (2013), USENIX.

[31] Lomas, N. WTF is GDPR? TechCrunch (Jan. 2018). https://techcrunch.com/2018/01/20/wtf-is-gdpr/

[32] Lowe, G., Winters, P., and Marcus, M. L. The great DNS wall of China. Tech. rep., New York University, 2007.

[33] Marczak, B., Weaver, N., Dalek, J., Ensafi, R., Fifield, D., McKune, S., Rey, A., Scott-Railton, J., Deibert, R., and Paxson, V. An analysis of China’s “Great Cannon”. In Free and Open Communications on the Internet (FOCI) (2015), USENIX.

[34] Maurer, T. and Morgus, R. Stop calling decentralization of the internet ‘balkanization’. Slate (Feb. 2014). In the Future Tense blog: http://www.slate.com/blogs/future_tense/2014/02/19/stop_calling_decentralization_of_the_internet_balkanization.html

[35] Mikians, J., Grygarni, L., Erramilli, V., and Laoutaris, N. Detecting price and search discrimination on the internet. In Proceedings of the 11th ACM Workshop on Hot Topics in Networks (New York, NY, USA, 2012), ACM, pp. 79–84.

[36] Mikians, J., Grygarni, L., Erramilli, V., and Laoutaris, N. Crowd-assisted search for price discrimination in e-commerce: First results. In Proceedings of the Ninth ACM Conference on Emerging Networking Experiments and Technologies (New York, NY, USA, 2013), ACM, pp. 1–6.

[37] Nabi, Z. The anatomy of web censorship in Pakistan. In Presented as part of the 3rd USENIX Workshop on Free and Open Communications on the Internet (Berkeley, CA, 2013), USENIX.

[38] Park, J. C., and Crandall, J. R. Empirical study of a national-scale distributed intrusion detection system: Backbone-level filtering of HTML responses in China. In Distributed Computing Systems (2010), IEEE, pp. 315–326.

[39] Parrilla, D. GDPR for lazy people: Block all European users with Cloudflare Workers. https://apility.io/2018/05/25/gdpr-lazy-block-european-users-cloudflare-workers/ May 2018.

[40] Paunker, P. Diese Kultur ist in Deutschland leider nicht verfügbar. Süddeutsche Zeitung (2013), http://www.sueddeutsche.de/digital/streit-zwischen-youtube-und-gema-diese-kultur-ist-in-deutschland-leider-nicht-verfuegbar-1.1584813

[41] SpakiAnakis, A., Athanasopoulos, E., and Ioannidis, S. CensMon: A web censorship monitor. In Free and Open Communications on the Internet (2011), USENIX.

[42] Singh, R., Nithyand, R., Afroz, S., Pearce, P., Tschantz, M. C., Gill, P., and Paxson, V. Characterizing the nature and dynamics of Tor exit blocking. In USENIX Security (Aug. 2017).

[43] UnblockVideos.com. YouTube region restriction statistics, check YouTube video restrictions online. https://unblockvideos.com/youtube-video-restriction-checker/ Accessed May 28, 2018.

[44] Verkamp, J.-P., and Gupta, M. Inferring mechanics of web censorship around the world. In Free and Open Communications on the Internet (2012), USENIX.