

FROM SATELLITES TO SIMS: A LAYERED TAXONOMY OF NETWORK SHUTDOWN CIRCUMVENTION TECHNOLOGIES USED IN ADVERSARIAL SETTINGS

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BACKGROUND AND GOALS

As network shutdowns become increasingly prevalent -with 283 shutdowns in 2023 marking the highest number of shutdown incidents in a single year- their use as weapons to quell protest and within inter-country conflicts (see Russia/Ukraine and Palestine/Israel) is also increasing, emphasising **that the need for resilient communication solutions is more critical than ever** (Access Now, 2023).

There is a history of affected populations using the tools at their disposal to circumvent these shutdowns, but a comprehensive study of the **security and privacy** implications of these does not yet exist. The goals of this paper are as follows:

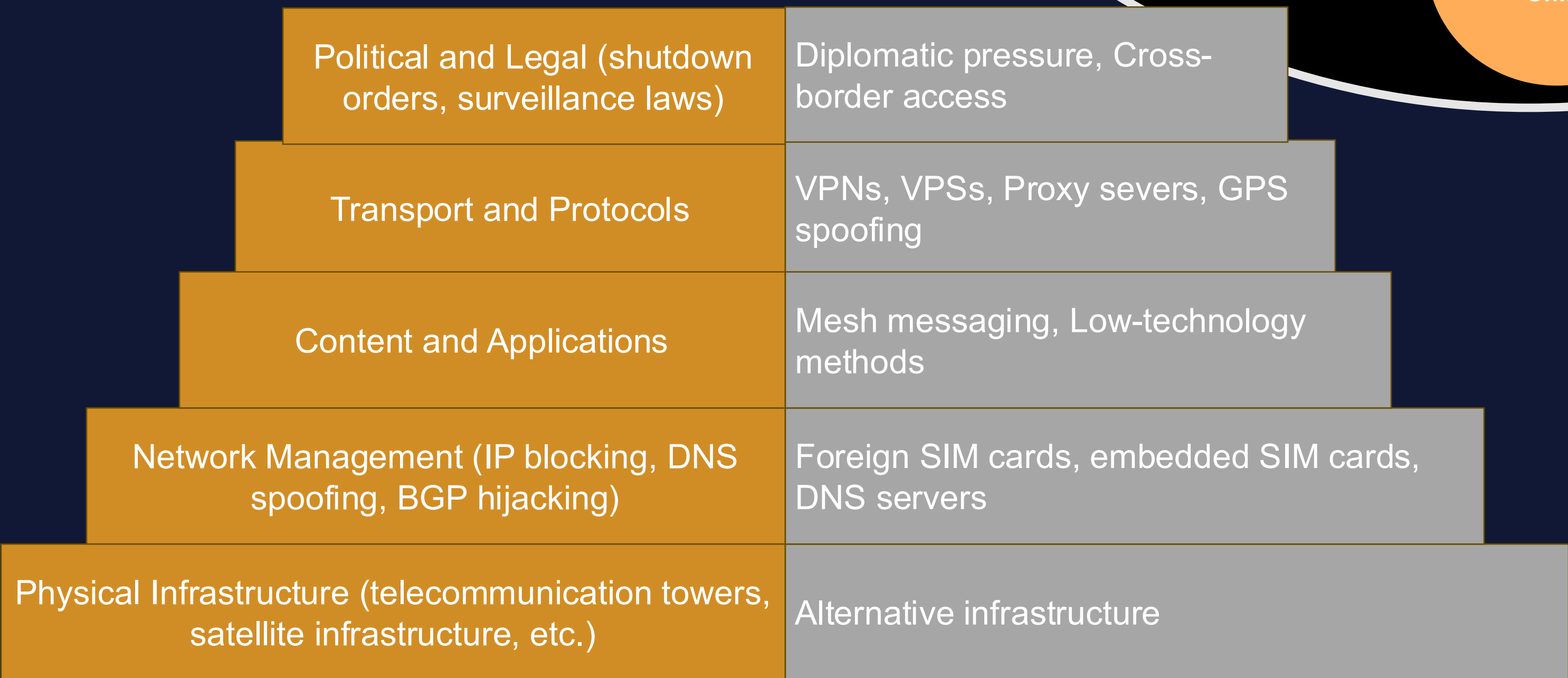
- 1 To systematically extract and classify existing circumvention technologies
- 2 To critically assess the effectiveness of these technologies in adversarial settings, identifying user safety implications
- 3 To investigate the socio-political and infrastructural factors that shape the operational success of these technologies in adversarial settings

A MULTI-LAYERED ECOSYSTEM

- This taxonomy adapts and extends the **layered model** proposed by Lehr et. al (2019) for the internet ecosystem
- We recontextualise it to analyse both **network shutdown mechanisms** and **circumvention strategies**.

Unlike traditional models that focus solely on technical infrastructure, this framework incorporates political, legal, and socio-technical dimensions, reflecting the complexities that exist within a network shutdown.

The draft model below places shutdown dimensions on the left and circumvention strategies on the right:



REFERENCES

Access Now (2022) *A taxonomy of internet shutdowns: the technologies behind network interference*. Available at: <https://www.accessnow.org/wp-content/uploads/2022/06/A-taxonomy-of-internet-shutdowns-the-technologies-behind-network-interference.pdf> [Accessed 28 January 2025].

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Lehr, W., Clark, D. and Bauer, S. (2019) 'Regulation when platforms are layered', *International Telecommunications Society (ITS)*. Available at: <https://www.econstor.eu/handle/10419/205193> [Accessed 10 April 2025].

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WHAT IS A NETWORK SHUTDOWN?

We follow Access Now (2023b) and Rydzak (2020), in defining 'network shutdown' as a **deliberate, politically-motivated disruption of entire channels of electronic communication within a given geographical area and/or affecting a predetermined group of citizens**.

This does not include reactive social media bans, suspension of fixed and mobile telephone services, deliberate slowdowns, and only considers complete shutdowns of Internet connectivity.

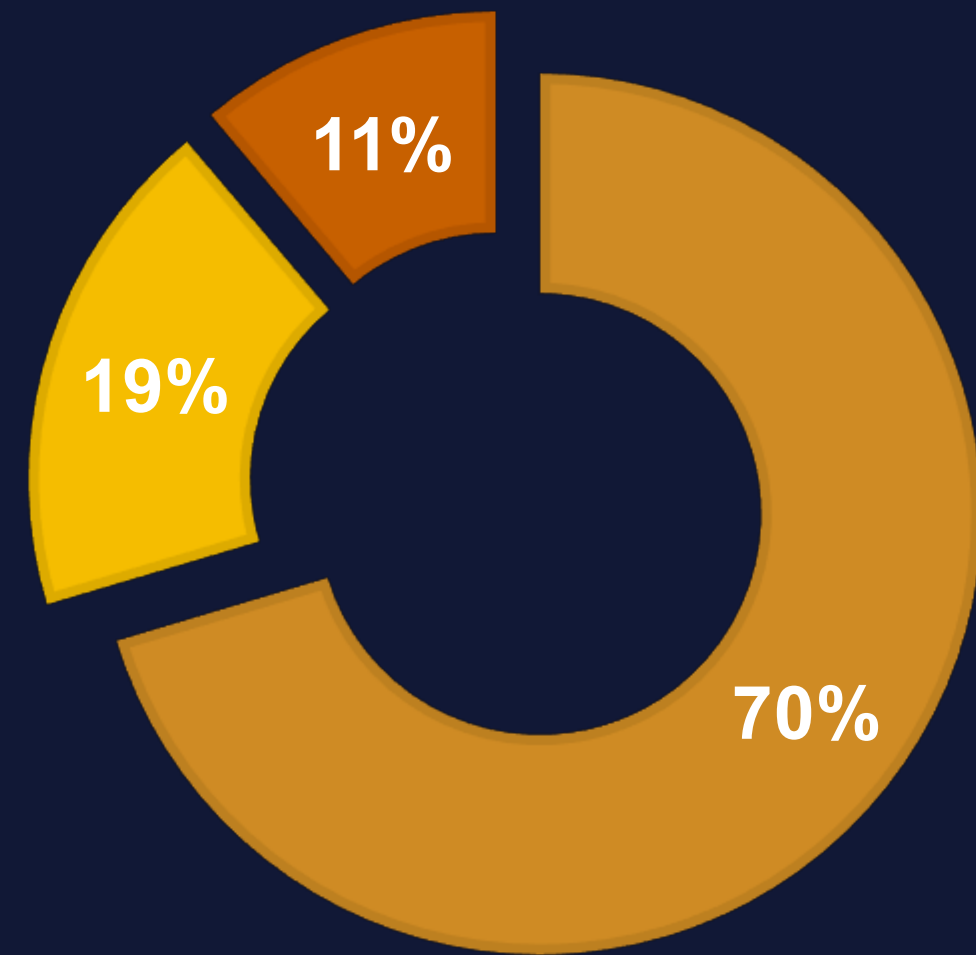
HOW IS A SHUTDOWN IMPLEMENTED?

We drew upon Access Now's (2022) taxonomy of technologies behind a shutdown, cross-referenced these with the literature collected, mapped all 27 papers to an implementation method.

We found that 70% of shutdowns were implemented through a **manipulation of network routing**, 19% through **physical damage to communications infrastructure** and 11% through a specific form of **throttling** which makes it appear as though internet access is available, but the level of interference is enough to make the service or resource effectively useless.

SHUTDOWN IMPLEMENTATION METHODS

- Routing
- Fundamental Infrastructure Shutdown
- Rogue Infrastructure Attack



CIRCUMVENTION TECHNOLOGIES



CRITERIA

- An important facet of this research is the emphasis that these circumvention technologies **must have an aim beyond simply regaining connectivity**.
- In situations of protest or conflict, one can argue that forcibly reconnecting to the network without consideration of and resilience to the **specific security and privacy concerns of each context**, including the monitoring or surveillance of users, can pose a greater threat than that posed by disconnection alone.

In that vein, this research extracts a set of **criteria by which to assess each technology**, through a system of coding.

We compile the technical social and political contexts into which shutdowns are introduced. A draft of these criteria is below:

