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

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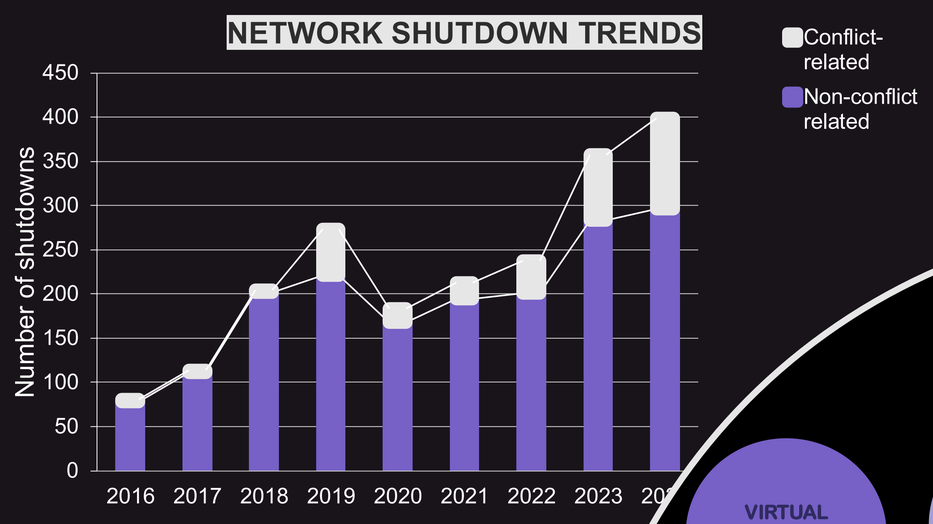
BACKGROUND AND GOALS

- The weaponization of network shutdowns has reached unprecedented levels: 2024 marked **a historic peak of 296 documented incidents, 103 of which were conflict-related, more than doubling since 2022**.
- In conflict zones (e.g., Russia/Ukraine, Palestine/Israel), shutdowns are no longer ancillary disruptions but central to military strategy: fibre optic cables are severed, ISP offices seized, satellite terminals disabled, and infrastructure destroyed. (Access Now, 2023).
- The use of widely-adopted circumvention tools like VPNs and mesh networks overlooks critical risks. **The same technologies that circumvent shutdowns often expose users to surveillance, retaliation, or physical harm.**



WHAT IS A NETWORK SHUTDOWN?

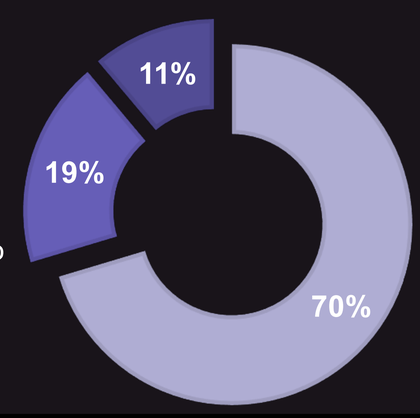
We follow Access Now (2023b) and Rydzak (2020), in defining 'network shutdown' as a **deliberate, politically-motivated disruption of entire channels of electronic communication within a given geographical area and/or affecting a predetermined group of citizens.**

This does **not** include reactive social media bans, suspension of fixed and mobile telephone services, deliberate slowdowns etc., 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.

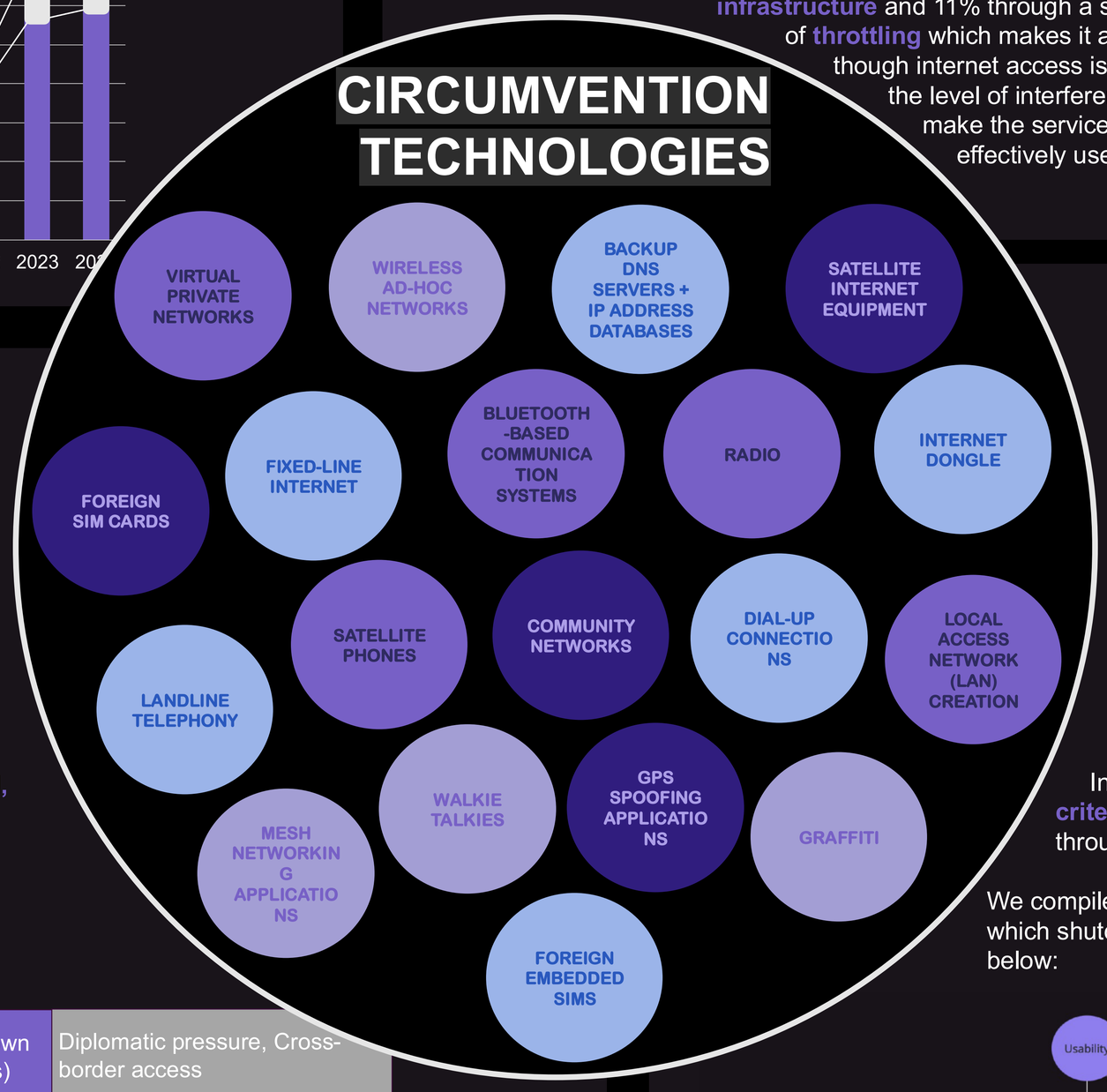


A MULTI-LAYERED ECOSYSTEM

- 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**.
- Traditional models focus solely on technical infrastructure, but 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:

Political and Legal (shutdown orders, surveillance laws)	Diplomatic pressure, Cross-border access
Transport and Protocols	VPNs, VPSs, Proxy severs, GPS spoofing
Content and Applications	Mesh messaging, Low-technology methods
Network Management (IP blocking, DNS spoofing, BGP hijacking)	Foreign SIM cards, embedded SIM cards, DNS servers
Physical Infrastructure (telecommunication towers, satellite infrastructure, etc.)	Alternative infrastructure

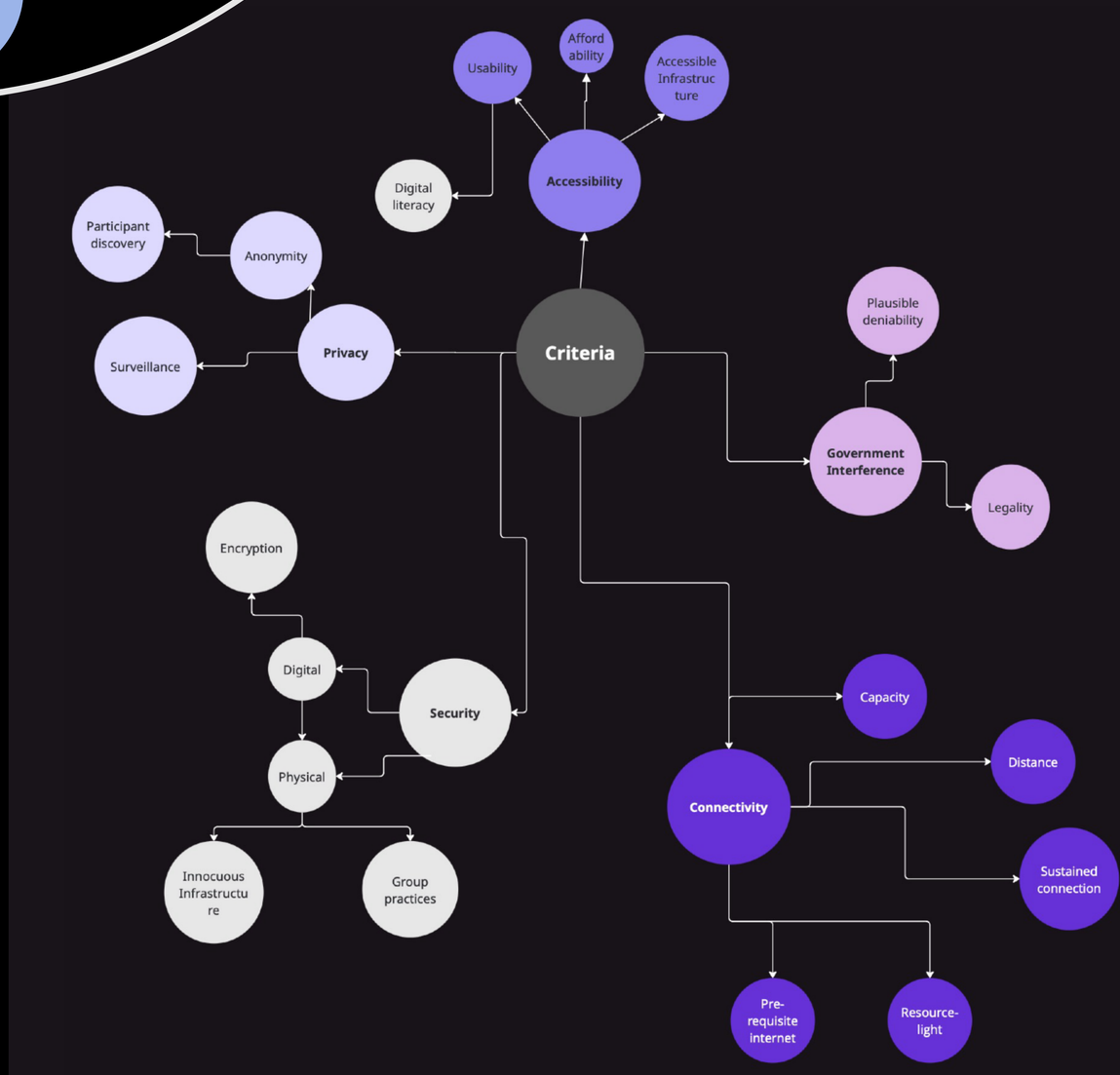


CRITERIA

- 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:



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