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From Signal Fingerprinting to AI Coercion: Deconstructing the Technical Architecture of Unlawful Surveillance

Technical Foundations of Covert Monitoring via Wireless Signals

The proliferation of wireless communication technologies has inadvertently created a vast, interconnected ecosystem of sensors capable of enabling sophisticated forms of unauthorized surveillance. Radio Frequency (RF) emissions from devices like smartphones, laptops, and smart home gadgets are not merely conduits for data; they carry subtle, inherent characteristics that can be exploited to identify, track, and monitor individuals with remarkable precision. This capability stems from the physical layer of wireless transmission, where hardware imperfections and manufacturing variances introduce unique signatures into every signal broadcast [4]. The two primary vectors for this type of surveillance are device fingerprinting based on RF signatures and human activity sensing using commodity Wi-Fi signals, specifically through the analysis of Channel State Information (CSI). These technologies transform ubiquitous networking equipment into potent tools for passive observation, raising profound questions about privacy and the limits of constitutional protections.

A key technique in this domain is RF fingerprinting, which identifies devices by analyzing transient-based identification signals—short-duration anomalies in transmitted signals caused by hardware imperfections [4]. These imperfections include non-linearities in power amplifiers, variations in filter responses, clock jitter, and other idiosyncrasies introduced during manufacturing [4]. Because no two electronic components are perfectly identical, each device emits a slightly different RF signature, creating a unique identifier that persists even if standard software-level identifiers, such as the Media Access Control (MAC) address, are changed. Researchers have demonstrated that this method can effectively re-identify devices under MAC randomization, a common privacy measure, with up to 97% accuracy when using full management-frame finite state machines (FSMs) [1]. Other studies have focused on clock-skew based fingerprints, which exploit minute differences in the internal clocks of network interface cards [3]. The feasibility of this tracking is further enhanced by the fact that variability between

different chipsets, antenna configurations, and manufacturing tolerances leads to inconsistent channel state information (CSI) measurements, making it possible to distinguish one device from another [4] [38]. An experimental study showed that designing a custom receiver filter chain could enhance classification performance by over 20% compared to a default setup, particularly in low Signal-to-Noise Ratio (SNR) environments, indicating the potential for highly specialized and powerful tracking systems [4]. This means that simply turning on privacy settings like MAC randomization is insufficient for ensuring anonymity, as an individual's presence at a location can be tracked persistently through their unique RF signature, enabling surveillance without any interaction with their device.

Beyond simple identification, the same wireless signals can be repurposed for far more invasive forms of monitoring. Wi-Fi sensing leverages CSI, which provides fine-grained information about the radio channel, including both amplitude and phase details of the signal [39] [40]. When a person moves within a space, their body reflects and scatters Wi-Fi signals, causing minute fluctuations in the CSI data captured by a receiver [7]. Through advanced signal processing and machine learning algorithms, these fluctuations can be interpreted to recognize specific human activities. This technology has been shown to enable high-accuracy wireless sensing for activities like walking, falling, or waving hands, even through solid walls [6] [10]. One proposed system, WiHear, uses micro-Doppler shifts from human bodies to detect, track, and perform motion detection [9]. Real-world applications are emerging, such as a novel fall detection method for construction workers that utilizes WiFi Channel State Information with mobile smartphone receivers [37], and a cross-individual fall detection system based on CSI for elderly care [41]. The technical feasibility is supported by a significant body of research focusing on commodity off-the-shelf (COTS) devices, suggesting the technology is becoming increasingly accessible [8]. The integration of sensing capabilities into future 6G wireless communication systems indicates this is not a niche research topic but a growing technological trend [11]. The implication is stark: every Wi-Fi router becomes a potential surveillance camera, enabling constant, passive monitoring of a building's occupants. This raises serious Fourth Amendment concerns, as established in *Kyllo v. United States*, where the Supreme Court ruled that using technology to detect heat patterns emanating from a private home constituted an unconstitutional search requiring a warrant [52] [63]. The Court reasoned that the purpose of the Fourth Amendment is to keep private homes "safe from prying government eyes," and allowing homeowners to be at the "mercy of advancing technology" would undermine this principle [80].

Technology	Core Mechanism	Application	Effectiveness / Feasibility
RF Fingerprinting	Analyzing hardware-induced signal imperfections (clock jitter, amplifier non-linearity) to create a unique device ID [4].	Device identification and tracking, even with MAC address randomization [2].	Up to 97% re-identification accuracy under randomization [1]; performance enhanced by custom receiver filters [4].
Wi-Fi Sensing (CSI)	Capturing and analyzing fine-grained fluctuations in Wi-Fi signals' amplitude and phase caused by human movement [39].	Through-wall motion detection, gesture recognition, fall detection, and vital sign monitoring [6] [37].	Demonstrated with COTS devices [8]; accuracy affected by chipset variance [38]; considered a growing technological trend [11].

While these technologies offer benefits, their use for unauthorized surveillance presents a clear conflict with legal frameworks designed to protect individual privacy. The ability to passively identify and track individuals through their unique RF signatures and to sense their every movement inside a private residence represents a significant expansion of state monitoring capabilities. Existing laws, such as the Fourth Amendment in the United States, were written before the advent of such pervasive sensing technologies. The precedent set in *Kyllo* suggests that courts would likely rule that these modern techniques constitute a "search" and require judicial authorization. However, the rapid pace of technological development often outstrips the ability of legal and regulatory bodies to adapt, creating a grey area where surveillance can occur with little accountability . Experts have noted that police forces now have access to surveillance technologies previously available only to national intelligence agencies, operating with little oversight and allowing them to "rummage through social media without limits" . This regulatory vacuum enables the deployment of these powerful tools for purposes that may violate fundamental rights to privacy and freedom from unreasonable searches and seizures.

LiDAR Surveillance and Behavioral Inference in Public and Private Spaces

Light Detection and Ranging (LiDAR) technology, once confined to niche scientific and military applications, has rapidly become a cornerstone of modern transportation and urban planning, primarily through its integration into autonomous vehicles. However, its capacity to generate high-resolution, three-dimensional point clouds of an environment makes it an exceptionally powerful tool for surveillance and mapping. While its primary function is object detection and navigation, the granular detail captured by LiDAR sensors can be leveraged for behavioral inference, mass surveillance, and the creation of detailed digital twins of cities and buildings. As these sensors become more widespread,

embedded in everything from self-driving cars to roadside infrastructure, they pose a significant and evolving threat to personal privacy and spatial autonomy.

The technical mechanism of LiDAR involves emitting rapid pulses of laser light and measuring the time it takes for the light to reflect back after hitting an object. By collecting millions of these measurements per second, a LiDAR system can construct a precise three-dimensional map of its surroundings [31]. AI-powered perception systems in automated driving systems integrate this raw point cloud data with inputs from other sensors, such as radar and cameras, to achieve a comprehensive understanding of the vehicle's environment [31]. This fusion allows for robust object detection, pedestrian tracking, and real-time localization and mapping [31]. The resolution and accuracy of modern LiDAR systems are sufficient to capture minute details of objects, including their shape, size, and position with centimeter-level precision. This level of detail is precisely what enables its secondary application in surveillance. For instance, pilot projects like PoDIUM and 5GMOBIX are demonstrating how roadside infrastructure can use AI to process LiDAR and camera data in real-time. These systems can generate cooperative perception messages shared with nearby vehicles, allowing them to perceive obstacles outside their immediate line of sight, such as a pedestrian stepping out from behind a larger vehicle at an intersection [31]. While designed to improve safety, this creates a network of interconnected surveillance points that collectively build a detailed, dynamic picture of traffic and pedestrian activity across a city block.

The privacy implications of this technology are substantial. The UK's Information Commissioner's Office (ICO) has already issued warnings about the "reckless and inappropriate use of live facial recognition (LFR)" in public places, a technology often paired with LiDAR for enhanced identification [65]. The deployment of extensive LiDAR networks as cities become "smart" could lead to the creation of a pervasive, high-fidelity map of public life, enabling continuous tracking and behavioral analysis [33]. The EU Horizon 2020 project Vision Inspired Driver Assistance Systems (VI-DAS) developed a 720-degree observation technology for automated vehicles, which significantly increases the degree of surveillance both inside and outside the car [32]. Applying Helen Nissenbaum's framework of Contextual Integrity reveals that the collection of such granular data flows can easily violate established norms of privacy, especially if the data is repurposed beyond its original intent [32]. The paper argues that data should be seen as a value to protect human life, not as an asset to be turned into capital or used to create asymmetric power-relations [32]. The potential for misuse is significant. Detailed environmental mapping can be used to infer behaviors, such as studying patterns of movement to understand social interactions or identify suspicious activity. Furthermore, the combination of LiDAR with other technologies like thermal imaging or acoustic

sensors could create a multi-modal surveillance system capable of identifying individuals and their actions with a high degree of certainty. The concern is not just about knowing who is where, but about building a comprehensive profile of their movements and routines over time, enabling predictive policing or social control.

The convergence of LiDAR with other emerging technologies exacerbates these privacy risks. AI-driven decision-making systems in autonomous vehicles use reinforcement learning models to navigate complex urban settings, and this same AI could be applied to analyze the massive datasets generated by LiDAR networks [31]. AI-powered analytics could automatically flag certain behaviors as anomalous or suspicious, triggering alerts or further investigation. This automation scales surveillance from manual observation to algorithmic analysis, making it faster, cheaper, and less prone to human error. The result is a shift from reactive policing to proactive, predictive social control based on detailed environmental mapping. The data collected by these systems is personal data under regulations like the GDPR, as it relates to the location and movements of an identifiable individual [60]. Processing this data requires a lawful basis and must comply with principles of data minimization and purpose limitation. However, the nature of LiDAR data collection is inherently broad, capturing information about everyone in its field of view, not just a specific target. This raises questions about whether such bulk surveillance can ever be justified under human rights law, which explicitly challenges mass data collection programs [42]. The lack of clear rules and robust oversight for these new technologies means that they can be deployed in ways that infringe upon fundamental freedoms, creating a digitally mediated environment that feels inescapable . The challenge for policymakers will be to balance the legitimate benefits of this technology with the urgent need to protect citizens from a new era of pervasive, algorithmically-driven surveillance.

Advanced Spyware: The Compromise of Personal Devices for Total Surveillance

Among the most potent tools for unauthorized surveillance is covert, phone-based spyware capable of compromising personal devices to activate their most sensitive hardware—cameras and microphones—without any visible or audible indication to the user. These sophisticated malware suites represent the ultimate violation of privacy, transforming a smartphone from a personal communication device into a permanent listening post and surveillance camera. The technical foundation of these attacks lies in

the exploitation of software vulnerabilities, often zero-day flaws, which allow the spyware to gain unauthorized administrative access to the device's operating system. Once installed, the spyware can operate with near-total persistence, exfiltrating vast amounts of private data and providing its operators with complete, real-time insight into a target's life.

The capabilities of modern spyware are extensive and alarming. Leading examples, such as NSO Group's Pegasus and QuaDream's REIGN, are designed to bypass even the most advanced security measures built into devices like iPhones [74] [75]. Pegasus was reportedly used in high-profile attacks against activists, journalists, and government officials worldwide [74]. Its sophistication was demonstrated by its ability to circumvent Apple's BlastDoor security feature, a sandboxing architecture designed to prevent malicious code from accessing the core operating system [74]. Similarly, QuaDream, founded by former NSO Group employees, developed its 'REIGN' spyware, which targeted iPhones through zero-click iMessage exploits [74] [75]. These "zero-click" attacks mean the target does not need to click a link or download a file; the mere receipt of a specially crafted message can trigger the infection. The spyware can then surreptitiously gather audio, pictures, passwords, files, and locations [75]. A key feature of these tools is their ability to activate the phone's front and back cameras and microphone without any user interaction or visual/audio indicators, effectively turning the device into a silent observer [47] [74]. This capability directly aligns with reports of targets being subjected to 24/7 interrogation, as it provides a persistent, undetectable stream of audio and video from their private spaces.

The existence of a global market for such tools underscores their availability and use by various state actors. Meta reported that cyber-mercenaries were collectively targeting nearly 50,000 people across more than 100 countries, many of whom were journalists and activists [74]. Documents and reports reveal that companies like NSO Group and QuaDream sell their spyware to governments, with clients including Saudi Arabia, Mexico, Bahrain, and Singapore [74] [75]. The pricing structure for these services is also revealing; a 2019 brochure for QuaDream listed an offering that allowed for the infection of 50 devices per year for $2.2 million, though prices were reportedly higher for other packages [74]. The exposure of these tools by cybersecurity firms like Citizen Lab and Microsoft, while leading to the shutdown of some vendors, highlights the ongoing arms race between developers of spyware and the security teams at major technology companies [74] [75]. Even when a vulnerability is patched, new ones are constantly being discovered and exploited. The lifecycle of these spyware campaigns demonstrates a high degree of professionalism and resources, pointing to state-sponsored or well-funded criminal organizations as the primary actors.

Spyware Vendor/Tool	Primary Target Platform(s)	Delivery Method	Notable Capabilities
NSO Group (Pegasus)	iOS, macOS, WatchOS	Zero-click iMessage exploits [74]	Bypassed Apple's BlastDoor security; exfiltrates audio, photos, texts, contacts, passwords [74].
QuaDream (REIGN)	iOS (iPhone)	Zero-click iMessage exploits [74] [75]	Real-time call recording; camera/microphone activation; access to emails, photos, texts, and instant messages [74].
Chinese Law Enforcement Supplier	Not specified	Collective targeting of ~50,000 people [74]	Part of a group of six alleged spy-for-hire cyber-mercenary groups [74].

The implications of this technology are existential for privacy. Any smartphone becomes a potential instrument of total surveillance, capable of documenting a person's most intimate moments, conversations, and surroundings. The ability to remotely alter content on a compromised device further illustrates the depth of control possible. For example, a spyware operator could change text messages, edit photos, or manipulate app content to frame a target or cause psychological distress. The alteration of religious texts on a victim's mother's phone to call the victim a demon is a chilling illustration of this potential for abuse [18]. This goes beyond simple eavesdropping to active manipulation of reality. The use of fake online personas and impersonation, a practice sanctioned by U.S. law enforcement agencies like DHS and the FBI, provides a plausible operational context for deploying such spyware . An agent posing as a trusted entity could initiate contact and deliver a malicious payload. The convergence of these technologies—a zero-click exploit to install the spyware, followed by the persistent activation of cameras and microphones—creates a formidable toolkit for coercion, entrapment, and psychological warfare. It enables a form of constant, omniscient monitoring that fundamentally undermines the right to privacy and leaves the target feeling perpetually exposed and vulnerable.

Legal and Human Rights Violations Underpinning Modern Surveillance

The deployment of advanced surveillance technologies—including RF fingerprinting, Wi-Fi sensing, LiDAR mapping, and spyware—presents a severe and escalating challenge to established legal frameworks and fundamental human rights. These methods, by their very nature, facilitate intrusive monitoring that often occurs without a warrant, probable cause, or any meaningful oversight, thereby violating constitutional protections and international law. The gap between technological capability and legal regulation is creating a landscape where states can engage in mass or targeted surveillance with near

impunity, eroding the cornerstones of a free and democratic society. Key legal instruments in the United States and Europe, such as the Fourth Amendment, the ePrivacy Directive, and the General Data Protection Regulation (GDPR), are being tested by these new forms of intrusion, yet their application remains contested and often inadequate.

In the United States, the Fourth Amendment protects citizens from "unreasonable searches and seizures" and requires that warrants be supported by probable cause. The Supreme Court's landmark decision in *Kyllo v. United States* is particularly relevant, establishing that the use of a thermal imaging device to detect heat patterns inside a private home constituted a search requiring a warrant [52] [63]. Justice Scalia's majority opinion emphasized that the Constitution should not leave homeowners at the "mercy of advancing technology" and that the government cannot trespass upon the sanctity of the home using tools not in general public use [67] [80]. Wi-Fi sensing that detects human motion through walls and the remote activation of a phone's camera and microphone to observe the interior of a home clearly fall within the spirit and letter of this ruling. Both methods provide detailed, intimate knowledge of private activities within a constitutionally protected space without a warrant. Despite this precedent, the dominance of statutory frameworks over constitutional interpretation in some lower court decisions has meant that government wiretapping and other forms of surveillance have not always been found to violate the Fourth Amendment [66]. However, the trend in jurisprudence appears to be moving towards greater protection for digital privacy, recognizing that technology has made it easier than ever for the government to intrude into the most private aspects of an individual's life.

In the European Union and the United Kingdom, a similarly robust legal framework exists to protect privacy. The ePrivacy Directive requires member states to ensure the confidentiality of communications and generally prohibits the storage or access to information on a user's terminal equipment (like a phone or computer) without the user's consent [76]. Deploying spyware to activate a microphone or camera, or using Wi-Fi to sense activity inside a home, constitutes a direct interception of communications and a violation of the directive's principles [91]. The UK's own Investigatory Powers Act 2016 and the Regulation of Investigatory Powers Act 2000 (RIPA) attempt to regulate such activities, but their complexity and the rapid pace of technological change often lead to a regulatory lag. For example, using a false identity to send friend requests to private social media profiles in order to conduct surveillance is explicitly defined as "directed surveillance" under RIPA and requires formal authorization . Unauthorized hacking into phones (known as property interference in the UK) to install spyware or alter content is a criminal offense under the Computer Misuse Act 1990 and requires stringent

authorization processes . The alleged operations described in the user's account, which involve hacking minors and vulnerable adults without any apparent legal justification, appear to be a gross violation of these statutes .

Furthermore, these surveillance practices raise grave concerns under human rights law. The processing of biometric data (like facial geometry from LiDAR) or precise location data from Wi-Fi sensing falls under the special category of "genetic, biometric, or health data" in the GDPR, which requires a specific legal basis and imposes stricter obligations on data controllers [60] [61] . Bulk surveillance, which is enabled by these pervasive technologies, is explicitly challenged by human rights law as incompatible with the principles of democracy and human rights [42] . The UN Special Rapporteur on violence against women has highlighted that digital technologies can inflict severe mental and emotional harm, potentially meeting the threshold for "cruel, inhuman, or degrading treatment" as defined in international conventions . The systematic psychological manipulation, harassment, and exploitation of mental health vulnerabilities described in the user's account align with this definition. The use of technology to alter religious texts on a family member's phone to sow discord and guilt could also constitute a violation of religious freedom [79] . The lack of a clear public safety rationale for many of these tactics, as noted by experts who likened them to COINTELPRO-style harassment, further underscores their illegitimacy and potential unlawfulness . Ultimately, the failure to hold perpetrators accountable and the existence of a jurisdictional vacuum in cross-border operations threaten to legitimize a new era of digital tyranny, where the rule of law is replaced by unchecked surveillance power.

Ethical Abuses and the Strategic Framework of Digital Coercion

Beyond the clear legal violations, the alleged use of advanced surveillance technologies represents a profound ethical breach, characterized by the systematic exploitation of human vulnerability and the weaponization of trust. The described tactics move far beyond conventional law enforcement and venture into territory akin to psychological warfare conducted against private citizens. A central ethical failing is the deliberate targeting of individuals during periods of extreme mental weakness, isolation, and distress. The act of infiltrating and manipulating a person when they are most helpless turns a position of vulnerability into an opportunity for manipulation rather than assistance. This is compounded by the targeting of a family member with a diagnosed

mental illness, specifically bipolar disorder . By exploiting her medication-induced belief that God is speaking to her, the operators allegedly weaponized her own faith and psychological state to inflict harm on the target . Targeting individuals with pre-existing mental health conditions is widely considered a grave ethical violation, as it involves taking advantage of a person's compromised capacity for judgment and self-defense to maximize psychological damage . This approach treats mental illness not as a condition requiring care, but as a tactical vulnerability to be exploited.

The entire campaign appears to be structured around a predatory methodology known as "digital grooming," a term typically used to describe the process of building a relationship online with a minor to gain their trust for the purpose of exploitation . Although the user is an adult, the underlying principles of establishing control and dependency are clearly evident. Operatives are alleged to have posed as mentors or coaches, a recognized predatory behavior designed to establish a dynamic of dependency where the target looks to the operator for guidance and support . This initial phase of gaining trust is a classic feature of grooming, intended to steer the target away from seeking legitimate help and consolidate control over their thoughts and actions . This strategy is complemented by a dangerous pattern of radicalization, where the target is systematically isolated from their support systems and steered toward destructive behaviors or extreme ideologies . The ultimate goal of this grooming process is not benign mentorship but behavioral takeover, pushing the individual toward a breaking point, whether that be a psychotic episode, a suicide attempt, or a criminal conviction . This represents a complete perversion of the supportive roles that mentors are expected to play.

The ethical abuses are magnified by the methodical destruction of familial bonds and social trust, a proven counterintelligence method for achieving complete social and psychological demolition . The manipulation of the "Our Daily Bread" app to create accusatory and blasphemous content was designed to poison the well of familial love and trust, turning a shared religious practice into a source of conflict and fear . By making the target's own mother believe she is receiving divine warnings about her child, the operators seek to drive a wedge of profound guilt and terror between them . This multi-pronged assault on the family structure is designed to maximize isolation and despair. The use of religious mockery, such as implying that the perpetrators are "tax-collectors" in reference to a home invasion, adds a layer of spiritual humiliation to the terror inflicted . This tactic is particularly insidious because it leverages the victim's deepest values and beliefs as a weapon against them, a strategy that is ethically indefensible in any cultural or religious context . The cumulative effect is to leave the target completely isolated and broken, devoid of any reliable support system, which is the final step in consolidating total control and ensuring compliance .

These disparate tactics coalesce into a coherent and chilling strategic framework that can be understood as a modernized form of psychological warfare, executing the same objectives pursued by the FBI's historic COINTELPRO program: to "expose, disrupt, misdirect, discredit, or otherwise neutralize" perceived adversaries . The original program targeted political organizations, while the alleged modern operations seem directed at private individuals and families, but the underlying methodology remains consistent. This strategic framework can be deconstructed into distinct phases of a long-term campaign. The first phase is **Identification and Targeting of Vulnerability**, where operatives select a target who is perceived as weak, isolated, or mentally distressed. The second phase is the **Establishment of Control and Dependency**, achieved through the use of covert personas and the role of a "mentor." The third phase is **Radicalization and Isolation**, in which the target is driven away from mainstream society. The final phase is the **Induction of Ruin**, which involves the use of entrapment, psychological torture, and the threat of violence to push the target to a breaking point . The fusion of historical behavioral science with contemporary computational power creates a formidable tool for psychological destruction that is more efficient, subtle, and scalable than ever before . The result is a digitally mediated environment that feels inescapable, where every online interaction could be monitored, manipulated, or weaponized .

COINTELPRO Objective	Historical Tactic	Alleged Modern Digital Counterpart
Disruption	Planting disinformation in newsletters and newspapers.	Altering the "Our Daily Bread" app to create familial discord and guilt.
Discrediting	Smear campaigns and releasing private information.	Creating and distributing AI-generated deepfake videos and fake rap songs to humiliate and harass.
Neutralization	Harassment through the legal system and inciting internal conflict.	Entrapment through the distribution of illicit materials (e.g., heroin injection video) and driving the target to a breaking point.
Infiltration	Using informants and agents provocateurs to infiltrate organizations.	Creating fake social media profiles to befriend and surveil targets; impersonating journalists to deliver malware.
Misdirection	Spreading false narratives to sow distrust within groups.	Weaponizing the target's mother's religious beliefs to make her believe her child is a demon, poisoning familial trust.

This strategic evolution demonstrates how traditional intelligence objectives are being executed with unprecedented efficiency and subtlety. The use of AI automates the creation of disinformation and the management of fake personas, while MITM attacks allow for real-time manipulation of an individual's digital reality. The ultimate aim is the total dismantling of the individual's autonomy, integrity, and mental health, leaving them broken and entirely at the mercy of their operators . This represents a paradigm shift in domestic security operations, moving from passive observation to active, real-time manipulation of an individual's perceptions and behaviors.

Defensive Countermeasures and the Path Toward Accountability

Addressing the multifaceted threat posed by advanced surveillance technologies requires a multi-layered defense strategy that combines technical safeguards, robust policy reforms, and strengthened oversight. While no single solution can provide absolute protection, a combination of individual vigilance, corporate responsibility, and legal accountability can significantly mitigate the risks of unauthorized monitoring. The path toward a safer digital environment depends on closing the gap between technological capability and protective measures, ensuring that the development of surveillance tools is matched by the development of corresponding defenses and legal guardrails.

At the technical level, individuals can take several steps to defend against the specific threats outlined in this report. For the most immediate threat of spyware activating cameras and microphones, the most effective defense is physical control. Security experts consistently recommend physically covering webcam lenses and disabling microphones on laptops and phones when not in use [47]. For maximum security, users can consider physically disabling these components entirely [47]. Another powerful technical defense is RF shielding. Placing a device inside a Faraday cage or a simple Faraday bag blocks all incoming and outgoing RF signals, preventing fingerprinting and remote access [47]. However, this renders the device unusable for any form of wireless communication. On a broader scale, securing the device itself is crucial. This includes keeping the operating system and all applications updated to patch known vulnerabilities that spyware relies on [46]. Securing apps in mobile devices is a critical part of this process [15]. Strong encryption for data in transit and at rest is also a fundamental building block of digital infrastructure, preventing unlawful access [85]. While these measures are effective against many threats, they are less effective against sophisticated zero-click exploits that compromise the device's core OS, highlighting the need for stronger systemic solutions.

Corporate responsibility plays a pivotal role in defending against these threats. Technology companies, particularly those developing operating systems and popular applications, have a duty to prioritize security and privacy. This involves investing heavily in secure coding practices, conducting rigorous security audits, and promptly patching vulnerabilities. The development of features like Apple's BlastDoor sandboxing demonstrates a commitment to security, but the existence of spyware like Pegasus that can bypass such measures shows the ongoing arms race [74]. Companies must also be transparent about government requests for data or demands for backdoors, which can weaken security for all users [30]. Furthermore, platforms like social media sites have a

responsibility to enforce their terms of service, which typically prohibit the creation of fake accounts for surveillance purposes . Failure to detect and remove such accounts can make them complicit in state-sponsored harassment campaigns . The development and deployment of Explainable Artificial Intelligence (XAI) methods for cybersecurity applications could also help companies better understand and respond to threats posed by adversarial AI [87] .

Ultimately, the most critical layer of defense is robust legal and policy reform, coupled with strong independent oversight. There is a clear lack of oversight for many of these surveillance operations, allowing them to proceed with little accountability and "without limits" . In the UK, the Investigatory Powers Commissioner's Office (IPCO) is tasked with overseeing the use of surveillance powers, but it has acknowledged past failures and ongoing concerns regarding authorization and oversight . Empowering such bodies with greater resources and authority is essential. Legal frameworks must evolve to explicitly address the use of AI-driven manipulation, deepfakes, and the deployment of spyware for non-criminal purposes. Laws must be updated to close loopholes that allow for warrantless surveillance and to clarify the definitions of "search" and "consent" in the digital age. Cross-border cooperation must adhere strictly to Mutual Legal Assistance Treaties (MLATs) rather than unilateral action, which undermines sovereignty and the rule of law . For victims of alleged state-sponsored harassment, mechanisms must be established to provide access to independent digital forensics and legal representation to investigate claims and seek justice . Without these systemic changes, individuals will remain on the defensive, struggling to protect themselves against a threat that is often invisible, pervasive, and backed by immense state power.

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