SPACE, SATELLITES, AND DEMOCRACY:

IMPLICATIONS OF THE NEW SPACE AGE FOR DEMOCRATIC PROCESSES AND RECOMMENDATIONS FOR ACTION

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FOREWORD

Satellite technology has long been considered a potential tool for supporting democratic processes, including back in 2006 by the National Democratic Institute (NDI), which used GPS coordinates to monitor polling station activity in the Palestinian Territories.[1] Since then, various projects have utilized satellite technology to enhance democratic processes.[2,3] However, the high costs and technical expertise often associated with this technology have limited its widespread adoption as a regular component of democracy-related work.

Moreover, the rapid pace of technological change and innovation in this arena has left much of the democracy and human rights community underprepared or unprepared to harness the opportunities or address the dangers that new developments in this field pose to civic spaces and the global democratic environment. As newer, low-cost technologies emerge and are deployed to address critical infrastructure gaps, governments and nonprofits around the world are exploring how to use these technologies more effectively.[4] In light of these developments, it is important for the democracy community to assess the impact that such technologies will have on democratic systems and actors.

Advances in satellite communications technology present a double-edged sword for global democracy. Expanded remote connectivity can facilitate greater civic engagement, information sharing, and transparency—empowering citizen journalists, human rights monitors, voter education efforts, and election oversight, especially in underserved regions. However, these innovations also raise concerning risks like threatening privacy, enabling surveillance, and increasing digital inequity if improperly governed.

Responsible use of space capabilities' democratic potential requires a multistakeholder approach, promoting collaboration across governments, civil society, technologists, and industry. The democracy and human rights community must proactively address the impact of emerging space capabilities on the work we do every day. This requires engaging in dialogues to gain deeper insights into technological capabilities, forging strategic partnerships across public and private sectors to pilot innovative approaches that harness these technologies for civic engagement and human rights, and conducting research with diverse communities to understand how space capabilities are employed by various actors and the resulting impacts on daily life and democratic processes.

By combining these efforts—from dialogue and experimentation to collaboration and research—we can develop adaptive policies that keep pace with rapid innovations while safeguarding democratic and human rights principles. Through this comprehensive approach, we can shape the integration of space capabilities to strengthen, rather than undermine, the foundations of human rights and democracy, ensuring that these powerful tools serve the greater good of our societies.

— Moira Whelan, Director, Democracy and Technology

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OUTDATED SPACE GOVERNANCE FRAMEWORKS POSE CHALLENGES FOR DEMOCRACY AND HUMAN RIGHTS. A CREATIVE MIX OF NON-BINDING AGREEMENTS, INDUSTRY STANDARDS, AND INTERNATIONAL COLLABORATION CAN HELP TO IMPROVE SPACE GOVERNANCE.

Multilateral agencies have historically led global space governance, with the United Nations Outer Space Treaty establishing a foundational framework. However, no new binding international rules have come out in over fifty years. Gridlock in multilateral governance and a lack of convergence in national space policies have hindered efforts to establish a cohesive regulatory framework internationally.

Revitalizing multilateral efforts to modernize binding international space laws should be a priority. In the interim, industry standards and non-binding agreements can help internalize norms and best practices. Stakeholders should seek more opportunities for cooperation even amidst rising strategic competition, fostering a stable and responsible space governance regime globally.

SATELLITE ISPS ARE SUBJECT TO LOCAL REGULATORY OVERSIGHT AND PRESSURES. A NUANCED UNDERSTANDING OF STAKEHOLDER ROLES AND DEPENDENCIES IS CRUCIAL FOR EFFECTIVELY WEIGHING RISKS AND OPPORTUNITIES.

Satellite internet service providers (ISPs) face multiple pressures and dependencies. They are subject to local government regulations and have critical dependencies in both hardware production and launch capabilities, as well as in securing their spectrum and landing rights. These factors can jeopardize their license to operate when providers are perceived as enabling censorship circumvention or other activities deemed sensitive by local authorities.

Understanding country-specific factors is crucial for organizations leveraging satellite technology for human rights and democracy initiatives, as it informs potential opportunities, risks, and necessary partnerships in different operational contexts.

THE SURGE IN PRIVATE INVESTMENTS HAS HELPED TO DEMOCRATIZE ACCESS TO SATELLITE TECHNOLOGY. WHILE THIS OFFERS NEW OPPORTUNITIES, THE PROLIFERATION OF COMMERCIALLY AVAILABLE SPACE CAPABILITIES RAISES SIGNIFICANT ETHICAL AND SAFETY CONCERNS.

The rapid commercialization of space technology has dramatically lowered barriers to accessing satellite capabilities, including sophisticated imaging and remote sensing tools. While innovative, this has created a complex landscape where powerful surveillance and monitoring capabilities are increasingly accessible to a wide range of actors. Policymakers should draw lessons from emerging regulations in the surveillance-for-hire industry, implementing similar safeguards for satellite technology providers.

This could include mandating human rights impact assessments and incorporating rights protections into service agreements at the national level, and fostering more robust international frameworks that prioritize human rights considerations.

LIMITED AWARENESS OF SATELLITE TECHNOLOGY AND OUTDATED REGULATIONS HINDER EFFECTIVE OVERSIGHT. MULTISTAKEHOLDER COLLABORATION CAN ENHANCE TRANSPARENCY AND MODERNIZE REGULATORY FRAMEWORKS.

The technical nature of satellite technology results in a knowledge gap among many legislators and democracy advocates, leading to limited discussion of related possibilities and threats in public discourse. While legislative bodies have access to research services and expert staff, these resources are often overwhelmed by rapid technological changes, and civil society organizations typically lack access to such expertise entirely. Consequently, privacy and surveillance regulations struggle to keep pace with advancing space capabilities, creating varying degrees of regulatory gaps across jurisdictions.

Additionally, satellite owners and operators often lack transparency in crucial areas such as operational practices, ground station locations in key countries, data collection methods, information sharing policies, and deployment of technologies like traffic shaping and optimization. Enhanced transparency measures, including public disclosures of satellite capabilities and data practices, are needed to address these issues, alongside ongoing multistakeholder dialogues. Privacy and surveillance regulations should also be modernized across jurisdictions to better account for emerging space capabilities.

ESTABLISHED SPACEFARING NATIONS DOMINATE SPACE ACTIVITIES WHILE GLOBAL COMMONS PRINCIPLES REMAIN CONTESTED. INCLUSIVE GOVERNANCE APPROACHES CAN PROMOTE MORE EQUITABLE AND SUSTAINABLE SPACE UTILIZATION.

The development of norms and agenda-setting for space technology remains dominated by entrenched space powers, mostly from the Global North. Combined with contested views of space as a global commons, this dominance creates challenges for establishing shared norms around space exploitation. These dynamics have also created conflicting interpretations of what constitutes acceptable behavior in space, as highlighted by growing concerns over space debris and long-term space accessibility.

There's a need for more inclusive multistakeholder dialogue that actively amplifies Global South voices, recognizing space as a global commons. While the UN's Committee on the Peaceful Uses of Outer Space (COPUOS) has historically sought input from non-spacefaring nations, further efforts are required to shape equitable norms for long-term space exploitation and reconcile the interests of different global communities.

Image: NASA/Chris Swanson

INTRODUCTION

The dawn of a new space age is upon us, marked by unprecedented engagement from both state and private actors. Driven by technological innovations such as reusable rockets and miniaturized satellites, this era presents a double-edged sword for global democracy. On one side, democratized access to space offers powerful tools for enhancing civic processes. Satellite technology now enables real-time election monitoring, improved communication in remote areas, and more effective public infrastructure planning. It also equips democratic actors with means to document human rights abuses and circumvent authoritarian internet restrictions. However, the accessibility of these technologies also raises

significant concerns. The potential for privacy infringements and misuse by authoritarian regimes or malicious actors casts a shadow over these advancements.

This report discusses the opportunities and risks that space and satellite technologies pose to democracy, human rights, and civic processes globally. It examines the current regulatory and normative frameworks governing space activities and highlights key considerations for stakeholders navigating this increasingly competitive domain.

It is essential that the global democracy community be familiar with emerging trends in space and satellite technology and their implications for the future. Failure to do so will leave the community unprepared to harness the opportunities or address the challenges that space capabilities present. It would also cede influence over the development of global norms and standards in this arena to states and private sector interests alone and, in turn, ensure those standards are not rooted in democratic norms and human rights, but rather in principles such as state sovereignty and profit maximization.

Space financing has historically been dominated by government funding, reflecting the strategic, scientific, and prestige-driven nature of space exploration. While private sector involvement is growing, particularly in areas like satellite communications and Earth observation,[5] state financing remains crucial for large-scale missions, cutting-edge research, and overcoming the enormous technical and financial barriers inherent in space activities.

While such issues around financing of the commercial space industry are important and should not be ignored in a comprehensive assessment of the future of space and the impact of satellite technology, an analysis of these factors falls outside the scope of this report. Instead, this paper focuses on examining the recent advances in space capabilities from the perspective of the democracy and human rights community with the goal of fostering informed dialogue and decision-making to ensure that the benefits of the new space age are harnessed responsibly, in service of democratic values and human rights.

METHODOLOGY

This report was informed by desk research and interviews with subject-matter experts, as well as insights from discussions that took place during a one-day “Space and Democracy” workshop hosted by NDI in Washington, D.C. in March of 2024. The event was facilitated in partnership with The Aerospace Corporation, a federally funded research and development center (FFRDC). The proceedings of the workshop took place under the Chatham House Rule. The insights and ideas summarized in the report are those of participants during the event.

SPACE GOVERNANCE AND NORMATIVE FRAMEWORKS

Among the most critical factors in determining how space technologies like satellites are used in practice are the regulatory and normative frameworks that govern space. This governance architecture plays a key role in setting guardrails for engagement in space and defines the normative environment in which state and non-state actors operate.

CURRENT STATE OF SPACE GOVERNANCE

International rules for space and the use of satellites are needed to ensure future generations are able to access and benefit from space-based capabilities. Regulations and norms are particularly important for controlling against the risk of conflict in space as well as threats like orbital overcrowding—Earth's orbits may be massive in terms of total volume, but orbits are finite resources. With over 12,000 satellites in orbit currently and tens of thousands more to be launched in the coming years, the risks of crowded orbits are only expected to rise.[6] The absence of effective multilateral governance in this arena would make it more difficult for there to be sustainable and equitable use of space and satellite technology.

International space law can be separated into two categories: binding mechanisms, like treaties, standards, and national regulations, and non-binding agreements that convey voluntary ideals on which international consensus is more difficult to achieve.[7] Multilateral institutions, such as the United Nations Office of Outer Space Affairs (UNOOSA), have long been the main facilitators of global space governance and law. This office was originally established to help governments build the infrastructure needed to support global space activities. It maintains a registry of objects launched into space and helps form additional international organizations to address specific issue areas in space regulation. UNOOSA was also responsible for designating the International Telecommunications Union (ITU) as the UN's specialized agency for information and communication technologies, including satellite technology. One responsibility of the ITU is to ensure that nation states use satellite orbits equitably and efficiently. To that end, the ITU provides UN member states with orbit slots, and member states then license the use of their assigned slots based on national regulations.[8]

Most activities in space are governed by the 1967 Outer Space Treaty (OST). This treaty—which has 115 state parties as of October 2024—sets out broad principles to guide the behavior of national governments and their citizens.[9] This treaty assures freedom of exploration and the use of space by all humankind, and binds signatories to use space only for peaceful purposes.[10]

The OST is one of five major UN space treaties that collectively form the foundation of the global space governance system, alongside the Rescue Agreement, Liability Convention, Registration Convention, and the Moon Treaty.[11]

The process of joining a treaty such as the OST typically involves two steps: signing and ratification. A state first signs the treaty, signaling its preliminary endorsement. Ratification follows as a formal act, where a state officially commits to being bound by the treaty's terms. This commitment is implemented through national legislation, ensuring that the state's space activities, including those conducted by its citizens, comply with the international obligations outlined in the ratified treaty. Through ratification, states integrate these international commitments into their domestic legal framework.

Despite efforts by countries like Russia and the U.S. to align national laws to international commitments, governments are increasingly focusing on their own space policies to address contemporary challenges and the growth of commercial space activities. This shift reflects the absence of new binding international rules for over fifty years. The U.S., for example, has initiated a series of Space Policy Directives and the Artemis Accords to provide a modern framework for international space governance.[12]

THE ARTEMIS ACCORDS

The Artemis Accords[13] are a set of non-binding agreements led by the U.S. that aim to establish international cooperation and guidelines for the peaceful and responsible exploration of space, particularly around the National Aeronautics and Space Administration's (NASA) Artemis program, which seeks to return humans to the Moon and eventually explore Mars.

The Accords emphasize principles like transparency, interoperability, the protection of space heritage, and the sustainable use of space resources, while encouraging cooperation between governments and private entities. They build on the Outer Space Treaty but aim to update space governance for modern space activities. As of October 2024, there were over forty-five country signatories to the Accords.[14]

These agreements represent a significant and productive step to help create more alignment in policy among like-minded nations at a time when achieving more comprehensive international action is difficult.

RAMIFICATIONS FOR THE GLOBAL COMMUNITY

The absence of new regulations and accepted norms means that the international community relies upon rules from the middle of the twentieth century to deal with the complexities of today. There are critical gaps in existing space regulations that must be addressed to tackle current and future threats to space operations.[15] A lack of alignment in domestic space policies among spacefaring nations adds further complexity. One major challenge is that not all countries see space as a global commons. While the U.S. and many Western nations are largely in agreement on space norms, inconsistencies in national policies among China, Russia, and India—the other key space powers—create uncertainty. This misalignment hinders responsible commercial space development, as differing rules and regulations lead to conflicting interpretations of what qualifies as acceptable behavior in space,[16] ultimately threatening the concept of space as a shared global resource.

Furthermore, the fragmentation of domestic space policies may lead to space operators adopting "flags of convenience"—a convention often seen in commercial shipping whereby ship owners register ships in countries with lower standards or fewer controls—in order to get around more stringent space regulations.[17] In the absence of global rules that set common standards for engagement in space and use of space technology, space operators and the commercial industry tend to favor voluntary, non-binding industry best practices and self-governance.

Moving forward, this will likely discourage states from putting in place tough regulations to avoid losing out on economic gains from the commercial space industry, and will further compound the threat to space as a commons and make it easier for bad actors to abuse space technologies.

Several factors inhibit action to fill these gaps. One challenge is the general lack of awareness and transparency associated with space technology like satellites. Regulators, legislators, and the public are generally unaware of the extent to which satellites are used today—whether in smart devices or in the Internet of Things (IoT) universe.[19] Additionally, there is a lack of transparency from satellite operators regarding their operational practices, ground station locations, data collection, and technology deployment, including traffic shaping and privacy impacts. This opacity complicates the challenges posed by satellite operations and data handling. This means that the potential harm that current trends could do to human rights around the world is not a topic of broad public debate. Relatedly, regulations at the national level are not keeping pace with the growing adoption of satellite technology, nor are space capabilities treated as part of domestic privacy and electronic surveillance data frameworks, despite their relevance.[20]

Finally, countries generally prioritize national interests over a commitment to international rules and norms. As a result, space is increasingly seen as just another arena of competition in the ongoing contest for global influence between great powers.[21]

THE ISS AND THE SHADOW OF COLLABORATION

Space exploration has historically fostered international collaboration, as demonstrated by the International Space Station (ISS), where rival nations worked together successfully despite geopolitical differences. Launched in 1998, the ISS was a product of collaboration between the United States, Russia, the European Space Agency (ESA), Japan, and Canada.

It stands as one of the most successful feats of international space cooperation[22] and has created great value in space exploration and scientific research, including for monitoring climate change.[23] Although collaboration on the ISS has persisted in the face of worsening relations between Moscow and Washington, it has not been immune to rising tensions. Russian officials have suggested that U.S. sanctions on Russia could jeopardize the countries' joint work on the ISS.[24]

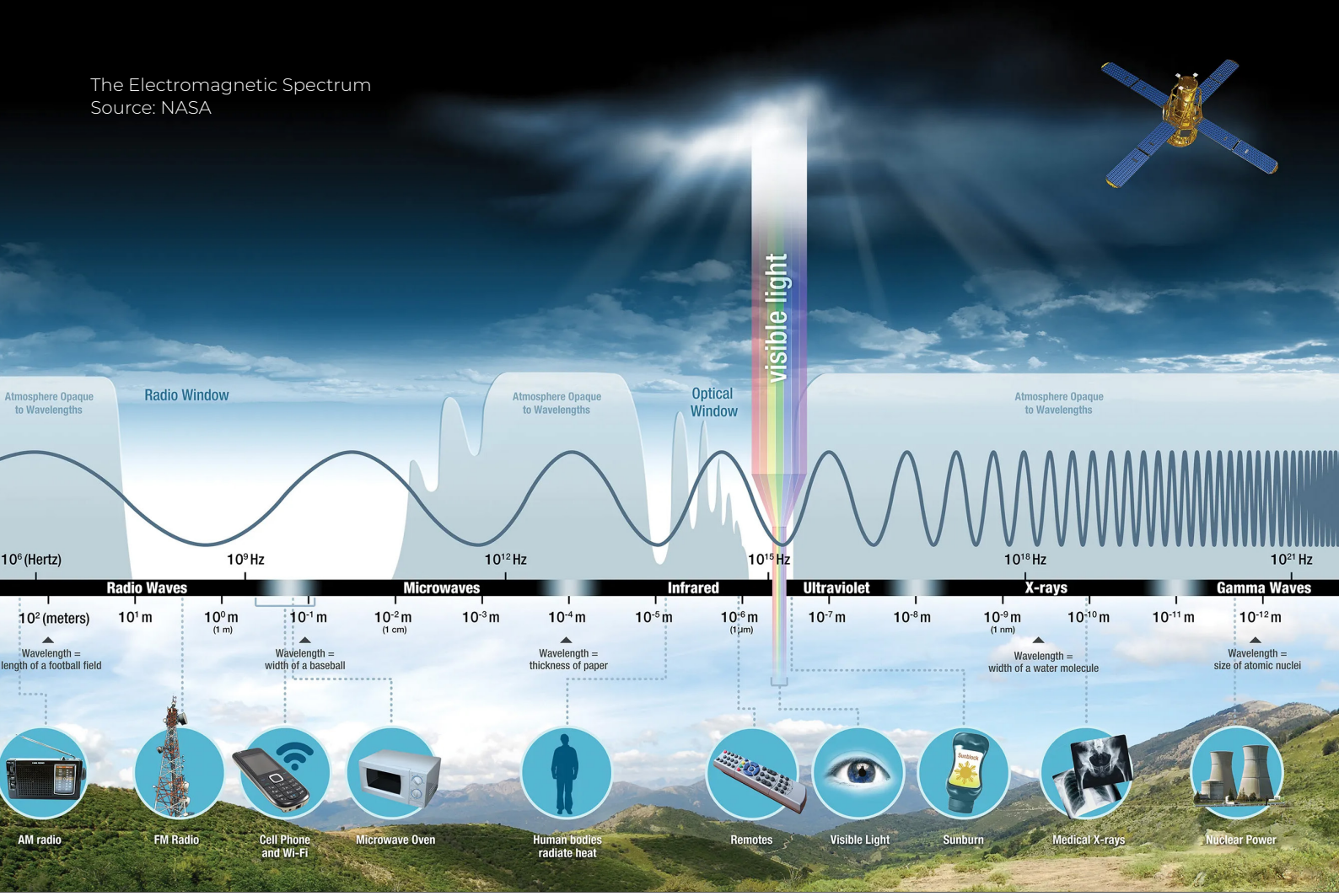
This kind of collaboration is less common in today's environment of heightened strategic competition, with world powers such as Russia and China developing their own space stations.[25] The ISS is set to be decommissioned in 2030, with NASA shifting to commercial space stations in low Earth orbit and focusing its efforts on deep space exploration missions to the Moon and Mars through its Artemis program.[26]

The nature of global space partnerships is likely to change after the ISS era and involve a more complex ecosystem of players with varying capabilities, goals, and collaborative arrangements.

SATELLITE TECHNOLOGY AND CURRENT LANDSCAPE

The world of satellite technology stands at a pivotal moment in history, where advances in miniaturization and launch capabilities have transformed space-based operations. This shift has sparked a global race among major space-faring nations to develop vast satellite constellations, with competing initiatives from the United States, China, Russia, and other emerging space powers all vying to establish dominance in orbital infrastructure.

These new low Earth orbit (LEO) networks promise lower latency communications, enhanced Earth observation capabilities, and improved global connectivity, while fundamentally reshaping the economics and accessibility of space-based services.



The Electromagnetic Spectrum
Source: NASA

SATELLITE TECHNOLOGY AND SERVICES

Satellites generally provide a few main services, which can be used for different purposes. Among these services are Earth observation capabilities, including imaging as well as the capture of near real-time video, navigation and telecommunications.[27]

To provide these services satellites rely on electromagnetic radiation–electric and magnetic fields that travel as waves through space. The electromagnetic (EM) spectrum spans from radio waves to gamma rays, with satellites utilizing different portions of this spectrum for their specific functions. While the human eye can only detect a small portion —visible light (wavelengths between 380-700 nanometers)—satellites are equipped with advanced instruments that can observe and utilize a much broader range of electromagnetic radiation.

Navigation satellites broadcast precise timing signals that form the foundation of global positioning systems.

These satellites, operated by systems such as GPS (United States), Galileo (European Union), GLONASS (Russia), and BeiDou (China), enable devices to calculate accurate location by measuring signal travel times from multiple satellites. Navigation satellites enable location services used in everyday navigation and timing applications.

Earth observation satellites use different types of imaging technologies to monitor Earth. This includes visible light sensors that capture high-resolution photographs similar to those in mapping services and aerial photography, infrared sensors that detect heat signatures and features invisible to the human eye, revealing thermal patterns on Earth's surface, and Synthetic Aperture Radar (SAR) technology which transmits and receives microwave signals, allowing satellites to 'see' through clouds, darkness, and vegetation. SAR technology is so precise that it can detect surface movements as subtle as one centimeter.[28]

Communication satellites function as orbital relay stations, transmitting signals between points on Earth to enable global internet connectivity, telecommunications, and broadcasting services. These include modern satellite networks, such as Starlink, which deploy numerous satellites in LEO to provide widespread, high-speed communications coverage, particularly in remote and hard-to-reach places.[29]

A NEW WAVE OF SATELLITES

LEO satellites are distinct from other types of satellites in a few important ways. As their name suggests, these satellites operate closer to Earth, with the full LEO range extending up to about 1,200 miles (2,000 km) in altitude. However, the new wave of satellites, such as SpaceX's Starlink, typically orbit at or below 350 miles.[30] As a result, LEO satellites have smaller coverage areas and, in turn, tend to operate in "constellations"—groups of satellites, ranging from a few to hundreds, that work together to achieve a mission[31]. Advances in satellite technology and rocket design have made LEO satellites more cost-effective to produce, deploy, and operate.

The key factors influencing launch costs are the rocket's lift capability and the extent to which its components are designed for reusability.[32]

In addition to being smaller and—in relative terms—cheaper, the new wave of LEO satellites that has emerged in recent years also provides satellite internet service that is far superior to what has existed in the past. Until recently, most satellites offering internet service were in geostationary orbit, over 22,000 miles away from the Earth. This often resulted in unimpressive speeds and latency.[34]

Because LEO satellites circumnavigate the planet at a much lower height, they are able to provide speed and latency on par with cable connections, and that may rival fiber optic connections in the near future.[35] Furthermore, this new wave of satellites does not require substantial infrastructure investment—all that is needed is a relatively small transmitter—further lowering the barriers to entry to use them.

Additionally, recent innovations in both satellite technology and smartphone hardware now enable phones to connect directly to satellites, providing crucial communication during emergencies.[36]

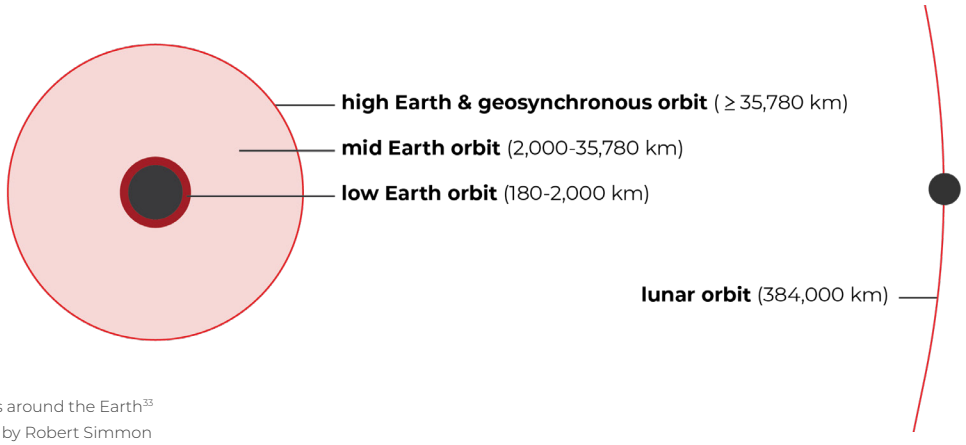


Diagram of orbits around the Earth[33]
NASA illustration by Robert Simmon

THE RACE TO LEO CONSTELLATIONS

In the United States, private sector investment has transformed space capabilities, particularly in low Earth orbit. Companies like SpaceX, Rocket Lab, and Amazon are driving innovation, revolutionizing launch economics through reusable rocket technology. Pioneered by SpaceX's orbital class rocket Falcon 9, rocket reusability has made mega-constellations like Starlink economically viable, spurring parallel innovations in satellite miniaturization and mass production techniques.[37] As a result, Amazon's Project Kuiper is set to deploy more than three thousand satellites. SpaceX already has over six thousand satellites in orbit (as of October 2024), with plans to have more than forty thousand in the coming years.[38] Leveraging this network, the company has already started offering Direct-to-Cell services, enabling standard cell phones to connect directly with satellites for text, voice, and data services, particularly in remote areas or in emergency situations.[39]

This private sector-led approach to innovation will continue to accelerate satellite deployment capabilities as even larger and more capable rockets become operational.[40] Backed by U.S. government support, private sector innovation has helped to establish American leadership in orbital launches globally.

Russia has also announced LEO constellation ambitions through its "Sfera" (Sphere) program. The project aims to deploy a constellation of communications and Earth observation satellites, though it has faced delays due to sanctions and funding challenges. Russia's state space agency Roscosmos plans to deploy around 264 satellites as part of this constellation by 2030. The program launched its first test satellite in October 2022,[41] marking Russia's entry into the LEO constellation race.

China is making substantial investments in its domestic space industry through state-led initiatives. The state-owned China Satellite Network Group is spearheading the development of the "Guowang" LEO constellation,[42] while other government-backed projects like Qianfan aim to launch thousands of satellites into low Earth orbit, providing broadband internet to users worldwide.[43]

With plans to deploy thousands of satellites over the coming decades, this approach not only reflects China's strategy to catch up with the United States in space capabilities, but also establishes a framework where the state maintains direct control over orbital infrastructure and the resulting data flows.

India is rapidly expanding its commercial space capabilities as well, with the private company Skyroot Aerospace successfully launching India's first privately developed rocket in 2022.[44] While the Indian Space Research Organization (ISRO) remains the cornerstone of the nation's space program, the government's space sector reforms[45] have energized private investment in the industry, particularly in small satellite technology[46].

The country aims to increase its presence in the global satellite market, though it currently lags the massive LEO constellation plans of the U,S. and China.

UNDERSEA CABLES REMAIN THE BACKBONE OF GLOBAL INTERNET INFRASTRUCTURE

Despite ambitious plans by various countries to launch more LEO satellites and build vast constellations for global connectivity, undersea cables remain the backbone of global internet infrastructure, carrying approximately 95-99% of intercontinental internet traffic.[47]

Moreover, satellite networks still depend on terrestrial infrastructure for backhaul and integration into broader networks.

This reflects the complementary nature of these technologies: cables excel at serving densely populated areas with high-capacity connections, while satellite networks are optimal for reaching remote and less populated regions where terrestrial infrastructure is impractical.

THE IMPACT ON DEMOCRACY AND HUMAN RIGHTS

The rapid advancement of satellite technology presents both opportunities and threats for democracy and human rights. While these space-based systems offer various practical applications, they also raise significant concerns about privacy and potential misuse that must be examined.

EXAMPLES OF SATELLITE TECHNOLOGY USE CASES FOR DEMOCRACY AND HUMAN RIGHTS IN DIFFERENT CONTEXTS

COUNTRY	CONTEXT	USE CASE
CHAD	Tracking Humanitarian Convoy in High Risk Environments	Asset Tracking (Monitoring Moving Objects in Real-Time)
IRAN	Information Dissemination in Closing Space	Data Broadcasting (One-Way Transmission of Data Packages)
MYANMAR	Human Rights Monitoring in Conflict Zone and Closing Space	Change Detection (Analyzing Differences in Physical Features Over Time)
PHILIPPINES	Last-Mile Connectivity	Internet Broadband
SUDAN	Human Rights Monitoring in Conflict Zone	Change Detection (Analyzing Differences in Physical Features Over Time)
UKRAINE	Crisis Connectivity in Conflict Zone	Internet Broadband
VANUATU	Elections Planning and Implementation in Complex Geography	nfrastructure Mapping (Identifying and Monitoring Fixed Structures)

USE CASES

LEVELING THE PLAYING FIELD FOR THE GLOBAL MAJORITY

The significant reduction in the cost of manufacturing and launching satellites has helped level the playing field, enabling new participants—particularly those previously priced out of satellite systems development—to engage actively. This change is especially beneficial for low and middle-income countries (LMICs), allowing them to manage the entire satellite development lifecycle, from mission design and satellite fabrication to testing, validation, and operations.

In recent years, countries such as Senegal,[49] Ghana,[50] Bangladesh,[51] and Mongolia[52] have become the latest to launch and deploy satellites of their own.

While LEO satellites are relatively more affordable to launch and use than previous generations of satellites, they remain quite expensive for much of the world. For instance, to connect to the internet using SpaceX's Starlink satellites in 2024, one must first pay for a terminal (full price of $599 USD) as well as an additional $110 USD monthly subscription fee.[53] Relative to global income levels, these costs still represent a significant financial burden; countries in the World Bank's "lower middle income" group have an average monthly Gross National Income (GNI) per capita of around $766 USD,[54] while those in the "low income" group average about $196 USD.[55]

Looking ahead, the emergence of competition from Amazon's Kuiper and United Kingdom-based OneWeb's constellations could help lower prices.

DEMOCRATIC INFRASTRUCTURE AND HUMAN RIGHTS MONITORING

Given their increased accessibility, satellites can enable greater transparency, accountability, and monitoring of democratic infrastructure. Because LEO satellites operate at a lower altitude than geostationary satellites, they provide higher resolution imagery, enabling them to better support various applications such as monitoring of elections and other democratic infrastructure.

For example, in 2020, the United Nations Development Programme (UNDP) used satellite imagery to identify and map potential locations for polling stations in Vanuatu, a small island nation with a widely distributed population.[56]

Satellite technology can also support human rights monitoring by providing evidence of human rights violations in hard-to-reach areas.

Organizations like Human Rights Watch and Amnesty International have used satellite imagery to expose and document military buildups, mass graves, and destroyed villages in conflict areas like Darfur and Myanmar.[57]

The UN refugee agency has also implemented satellite tracking systems for monitoring the real-time location and movement of humanitarian convoys in high-risk environments such as Chad, enhancing staff safety and operational efficiency.[58]

On the other hand, broader, commercialized access to satellite imagery can be utilized for surveillance, raising important ethical and safety concerns. The growth of the surveillance-for-hire spyware industry offers a relevant model[59] for fostering rights-protecting norms among providers of satellite imagery and remote sensing technology. For instance, relevant national policies could be shaped in a way that incorporates human rights impact assessments[60] or human rights protections in service agreements with providers, similar to the U.S. Executive Order regulating spyware.[61]

CONNECTIVITY IN REMOTE AREAS

Satellite technology has also been used to enhance communication networks in remote or underserved areas, expanding access to digital services and narrowing the digital divide. This trend is already taking hold in places like the Philippines, where geographically isolated populations have used satellite connections to access financial services.[62]

Recent advancements in LEO satellites are enabling users in digital deserts—areas with limited internet access—to bypass traditional connectivity methods and gain immediate access to satellite-based services.[63] This includes direct space-based 5G options that allow smartphones to connect to high-speed internet via satellite.[64]

For example, in Brazil's Amazon rainforest—one of the last areas on Earth with minimal connectivity infrastructure—hundreds of remote tribes have gained internet access through Starlink. Satellite connectivity has empowered them to communicate between villages and notify local authorities about

CONNECTIVITY IN CONFLICT ZONES

LEO satellite internet has become vital in conflict zones as conventional telecommunications infrastructure is often among the first targets when hostilities erupt.

For example, Starlink has been used in Iran by protestors to organize and communicate with the rest of the world in the face of government-led internet shutdowns.

In Ukraine, satellite services have been crucial for maintaining communications both within the country and with the global community since Russia's full-scale invasion began in February of 2022. Starlink has enabled humanitarian organizations to coordinate relief efforts, local governments to deliver public services, and journalists to report in real time during conflicts and natural disasters. Yet its capabilities can also become tools for profiteering, as demonstrated in Sudan where a paramilitary group leveraged a telecommunication blackout to charge $2.5 to $6 per hour for internet access, transforming a vital service into an instrument of control.[66]

Additionally, the deployment of LEO satellites in conflict zones has sparked debates about private companies' growing influence in international conflicts[67] and their relationships with state actors.[68] The examples of Ukraine and Iran demonstrate how access to satellite internet can hinge on the decisions of a handful of companies with complex business interests.

CONNECTIVITY IN CLOSING SPACES

The expanded connectivity that satellites offer can also help populations in closed and closing spaces circumvent internet restrictions. For years, satellites have enabled connectivity in regions where the internet is censored or not widely accessible and provided an uncensored platform for free speech and information dissemination.

During the Arab Spring in 2011, for instance, satellite phones played a crucial role in bypassing government censorship,[69] LEO satellites have the potential to facilitate remote connectivity at scale and with more efficiency, at a time when more governments are restricting access to information online than ever before.[70]

However, this is not without significant real risk to the users. Satellite signals can be detected and located by malign actors, including illiberal governments, potentially exposing users in areas with limited connectivity options. This poses particular challenges in conflict zones, where satellite communications used for humanitarian operations can be misidentified as military activity, putting aid workers and beneficiaries at risk.

Additionally, providers of satellite connectivity services maintain agreements with local governments for in-country operations. For this reason, any use of LEO satellites to bypass state controls can jeopardize a company's licenses to operate in that country, such as spectrum rights and landing rights.[71] To mitigate some of these terrestrial legal restrictions, some satellite users have opted for one-way broadcasts services. For instance, in 2016, Iranians used satellite TV dishes to download daily bundles of censored files, with the help of a free anti-censorship system.[72]

POTENTIAL THREATS AND RISKS

PRIVACY AND SECURITY RISKS

Despite their potential for good, the increased accessibility of LEO satellites raises serious concerns around privacy and the potential for surveillance abuse. On a fundamental level, vulnerabilities emerge from the information that satellites can collect, whether it is high-resolution imagery that could reveal locations of persecuted communities or refugee movements, video feeds that may expose peaceful protest gatherings and put participants at risk, or geolocation data that could track human rights defenders and journalists working in restrictive environments.[73] New classes of LEO satellites may soon even be able to zoom in on and identify individual people.[74]

In contrast to years past, when satellite capabilities were the exclusive domain of spacefaring nations, access to these services has become markedly easier today as more commercial operators enter the space sector. A nation's technological prowess is becoming less of a limiting factor in acquiring surveillance capabilities due to the commercial proliferation of sophisticated technologies, including tools for signals intelligence (SIGINT)[75] and imagery intelligence (IMINT).[76] This shift poses a threat to democratic norms and human rights because such capabilities could be used for surveillance or repression, both domestically and transnationally. Illiberal actors in both government and the private sector could use these capabilities to complement broader mass surveillance programs domestically or monitor the movements of dissidents living abroad.

This situation also poses risks to individual privacy. For instance, when satellites are used to facilitate broadband access, they can transmit sensitive internet data—which can include personally identifiable information, financial data, health information, and more.[77] This data is vulnerable to monitoring, in part because few satellite ISPs employ encryption by default, meaning attackers targeting satellite communications can gain access to everything available to ISPs.[78] In the wrong hands, almost any of the information that satellites can collect could be exploited to infringe on individual privacy.[79] Also concerning is the fact that some commercial satellite companies appear to be underestimating the potential risks that their technology and services present for human rights.[80]

DEPENDENCIES IN SPACE-BASED INTERNET

Satellite ISPs are subject to most, if not all, of the legal pressures other ISPs face and in some cases they may have critical, "can't-lose" earth-station infrastructure in countries with weak human rights frameworks. They also bridge the satellite communications to terrestrial networks, and are just as liable as

any other ISP. Additionally, they have both supply chain and regulatory dependencies, including hardware production, launching capabilities, spectrum access, and signal landing rights.

This intricate web of supply chains and market dependencies that satellite ISPs rely on makes them vulnerable to censorship and surveillance demands, particularly from authoritarian regimes that can exploit these chokepoints for control. Countries can deny operating licenses or impose content filtering requirements as conditions for market access. These dependencies are crucial factors to consider, as they can make providers susceptible to various forms of external pressure or influence, which could impact the security and reliability of communications in sensitive contexts.

SATELLITE IMAGERY AND ITS LIMITS

Satellites can now precisely schedule imagery collection over specific locations, transforming how we monitor and document global events. This capability enables systematic observation of areas of interest, from tracking gradual environmental changes to documenting sudden events. Researchers studying Amazon deforestation, for example, have used time-series analysis of scheduled imagery to detect and measure forest loss patterns, providing crucial data for conservation efforts.[81]

That said, satellite imagery alone cannot tell the complete story. While satellite imagery offers a powerful birds-eye perspective, it cannot capture the full complexity of events unfolding on the ground. This limitation is particularly relevant in human rights work, where context and detail are crucial.

A multi-source approach, or data triangulation, can help establish a more complete and accurate record of events. For instance, when investigating the apparent destruction of civilian structures in the Sudanese village of Um Bartumbu, human rights groups employed this approach, combining scheduled satellite imagery with ground-level photographs, eyewitness accounts, and local reports to verify events and understand their full impact.[82] By cross-referencing different data sources, researchers can construct a more comprehensive and accurate understanding of situations.

SPACE IS A "CLOSING SPACE"

As part of the broader erosion of norms around accepted behavior in space, governments have demonstrated more willingness to use space capabilities like satellite technology for strategic purposes. While space has been an arena of competition since the days of the Cold War, up until recently nation states still largely adhered to international rules of engagement.

Today, however, there are indications that space is becoming what the democracy community might call a "closing space," where governance is not determined democratically and participation is limited and made more difficult thanks to hostile government behavior.[83]

Space activities are evolving in ways that challenge traditional notions of peaceful uses. There is ongoing debate across multiple fields—including space law, international relations, and security studies—about what "militarization" of space means,[84] with no universally agreed-upon definition. This controversy stems from several factors such as the dual-purpose nature of many space capabilities serving both civilian and military functions, varying interpretations among different stakeholders, the historical precedent of military-related space use since the Space Age began, and the continuous emergence of new technologies that defy existing conceptual frameworks.

Regardless of definitional consensus, the space domain faces escalating security risks.[85] For example, anti-satellite (ASAT) weapon testing has not only disrupted space activities but also created hazardous debris fields,[86] and various nations have advanced their orbital capabilities through unmanned "space planes" and satellites equipped with robot arms that could potentially pull adversaries' satellites out of orbit.[87]

These activities can restrict access to space for peaceful purposes[88] and heighten the risk of conflict. As discussed above, the way in which geopolitical tensions and rivalries have spilled over into space engagement can contribute to a splintering in resolve and desire among political actors to work together. This lowers the barriers to satellite technology being used to anti-democratic ends.

KEY COMMUNITIES AND STAKEHOLDERS

As competition for influence over the future of space intensifies and satellite technology becomes increasingly ubiquitous, several questions arise: Who exactly are the key stakeholders in this arena of competition? What are their interests and roles when it comes to using satellite technology to strengthen democracy? Where is there alignment in these interests? And what gaps in the conversation need to be filled? Generally, the key stakeholders in this conversation should include the executive branch of government, lawmakers and parliamentary entities, private sector companies, industry groups, and civil society organizations (CSOs). Each of these stakeholders have distinct interests and, in turn, will behave differently. Like with all multistakeholder systems, strengthening engagement and coordination among actors from different parts of society is essential to ensuring space-based capabilities are used to support, not diminish, human rights.

NATIONAL EXECUTIVE BODIES

When it comes to space capabilities like satellites, the attitudes and priorities of national governments tend to vary depending on the type of government at hand as well as how its national interests are defined. Democratic governments are more likely to create favorable policy environments for the use of satellite technologies to support human rights, including enacting regulations that encourage transparency, protect privacy, and ensure the responsible use of satellite data. By comparison, less free countries with authoritarian governments tend to view satellite technology as something to closely monitor and control because of the threat that it can pose—for instance, to a government-controlled information environment. As a result, these governments often put tight restrictions on how this kind of technology can be used, and by whom.[89]

That said, the approach that most governments take to space is also largely determined by their own specific interests, not strict adherence to broader philosophical principles. To that end, democratic and authoritarian governments alike are increasingly prioritizing national security interests over international norms and conventions as the competition for influence in space heats up. For instance, in response to reports of new space-based threats from China and Russia, the United States has begun to develop new satellite capabilities to protect itself in the event of conflict in space.[90] Similarly, amidst concerns of invasion by China, Taiwan has sought to develop its own satellite internet network to ensure it can maintain its communications in a time of crisis.[91]

LEGISLATIVE BODIES

Parliaments and legislative bodies are another critical part of determining the future of satellite technology use . Their roles tend to differ depending on context, as well. In democracies,[92] legislative bodies are meant to represent the interests of their constituents, and carry out a few core responsibilities. These include authorizing funding for government initiatives, including space exploration and engagement. For example, the U.S. Congress provides NASA with funds to support space engagement.[93] India's parliament is similarly responsible for funding the country's space agency, the Indian Space Research Organisation (ISRO).[94]

Engagement of legislative bodies on space issues goes well beyond funding for domestic space agencies. In the United States, Congress has passed bills such as the Commercial Space Launch Competitiveness Act, which allowed for new entrants into the commercial space market and incentivised more private sector investment in new technologies.[95] The U.S. also led in anti-satellite weapon testing regulations. The European Parliament has similarly been central to the development of European space policy and the European Union Space Programme.[97] Legislative bodies have an important role to play in facilitating dialogue among diverse stakeholders.

Although lobbyists and special interests can carry significant sway in democracies, democratic legislatures still take on the important responsibility of serving as fora for holding public hearings and consultations and ensuring that policies take into consideration a wide range of perspectives and interests.

CIVIL SOCIETY ORGANIZATIONS

CSOs play a crucial role in facilitating public dialogue, representing diverse community needs and concerns, and shaping both policy decisions and norms across governments and the private sector. In recent years, there has been a growth in the number of CSOs who engage on issues concerning space and satellite technology. Industry-focused groups like the U.S.-based Secure World Foundation advocate for space sustainability and peaceful use of space,[98] while the American Association for the Advancement of Science (AAAS) provides technical and scientific expertise. Other groups, like the Indonesia Space Science Society (ISSS)[99] engage citizens in space capabilities through collaborations with artists and scientists, while groups such as Women in Aerospace (WIA) promote women's leadership in the aerospace sector.

A distinct group of CSOs focuses specifically on leveraging satellite technology for democracy and human rights work.[100] Organizations like Human Rights Watch and Amnesty International regularly employ satellite technology in human rights and humanitarian work, including documenting human rights violations.

Greater collaboration between industry-focused and human rights-oriented CSOs could strengthen both sectors, both in integrating human rights considerations into technical discussions and standards and providing technical expertise in satellite applications.

Successful collaborations between industry and human rights CSOs already exist and could serve as models for expanded partnerships. For instance, AAAS worked with Amnesty International-USA to document petrochemical releases in Bodo, Nigeria using satellite imagery analysis.[101]

Building on such examples, increased collaboration between technical and human rights organizations would ensure satellite technology continues to advance while strengthening its applications for democracy and human rights.

PRIVATE SECTOR COMPANIES AND INDUSTRY GROUPS

Private sector companies and industry groups involved in the development and operation of space technologies have the ability to innovate and deploy satellite solutions that support human rights causes, such as providing communication services in remote or censored areas or supplying imagery and data for election monitoring. While many of these companies primarily focus on growth and innovation, some have demonstrated a commitment to social responsibility and opened up their data for non-commercial use. Maxar, for instance, provides free satellite data to support responses to natural disasters and other humanitarian crises through its Open Data Program.[102] Planet Labs has partnered with human rights organizations to track environmental destruction and human rights abuses.[103] The Space Industry for Ukraine (SIFU) initiative has leveraged the resources and innovation of space industry leaders to provide humanitarian aid to the people of Ukraine.[104]

Other industry consortia like the Satellite Industry Association (SIA) and the Commercial Spaceflight Federation play a role in shaping policies and practices that can impact the use of space technologies for democratic purposes. Their advocacy efforts can influence regulations and standards that affect the availability and use of satellite data and services. While some companies open their data for non-commercial use, others maintain strict control over their information, citing competitive advantages or security concerns.

As the space industry continues to grow, companies should align their practices with the UN Guiding Principles on Business and Human Rights,[105] ensuring their satellite technology development and deployment respects human rights, prevents adverse human rights impacts, and provides access to remedy when violations occur. This framework could help establish industry-wide standards for responsible innovation that supports, rather than undermines, human rights and democratic values.

MULTISTAKEHOLDER AND MULTILATERAL FORUMS

The landscape of space governance extends beyond the United Nations' Committee on the Peaceful Uses of Outer Space, the primary international forum for developing space law and policy. The ITU, for example, coordinates orbital positions and spectrum allocation required for satellite communication, and is another key forum and established "battleground" for competing visions of internet and communications governance: the multistakeholder approach versus state-centric control.[106]

Other fora also play pivotal roles in shaping space norms, sharing knowledge, and facilitating coordination, focusing on applying space technology to address regional challenges such as disaster management and environmental monitoring.

These include regional organizations like the Asia-Pacific Regional Space Agency Forum, the African Association of Remote Sensing of the Environment, and the Latin American and Caribbean Space Agency. Multistakeholder fora also include global entities that facilitate international collaboration and policy development among a diverse set of industry stakeholders, such as the space advocacy group the International Astronautical Federation (IAF).

However, participation from democracy and human rights groups remains limited in these industry-focused forums.

Simultaneously, discussions about space norms are often absent from democracy-focused gatherings.

CONCLUSION AND RECOMMENDATIONS

Advances in space technology, particularly LEO satellites, offer tools for strengthening democracy through improved monitoring and communication capabilities. However, these developments present privacy concerns and risks of authoritarian misuse. To harness opportunities while managing risks, stakeholders must update regulations, develop data safeguards, and foster inclusive dialogue. The following recommendations outline actions for governments, civil society, and the private sector to align space technology governance with democratic and human rights values.

ADDRESSING REGULATORY GAPS

REVIVE INTERNATIONAL SPACE COOPERATION

Space is a shared resource of all humanity. Hence, cooperation between global space leaders should continue to be a top priority and something nation states, lawmakers, private sector companies, and CSOs collectively strive toward. Although recent years have seen more competition and, in turn, less cooperation on space-related issues, collaboration in this area (particularly between geopolitical rivals) remains the best option for ensuring space sustainability and continued access to satellite technology.

A global effort is needed to revive international space cooperation and establish consensus on space norms for the new space age. Inspiration for such an endeavor should be taken from the coalition-building and norms-building efforts that brought about the Universal Declaration of Human Rights in 1948 and the Outer Space Treaty in 1967. National governments and lawmakers bear the most responsibility for negotiating with one another and finding alignment, but commercial space operators have a critical role to play in informing these discussions as well, while CSOs can support public advocacy and norm development.

ELEVATE AND EXPAND NON-BINDING AGREEMENTS

Given the reality that no new binding international rules regulating activities in space are likely to come in the near or medium term, the global democracy community must find alternative ways to ensure that responsible behavior in space is defined by democratic norms and values. To that end, national governments should work with industry stakeholders and CSOs to further elevate and expand non-binding agreements like the Artemis Accords and best practices like the Freedom Online

Coalition's Guiding Principles on Government Use of Surveillance Technologies.[107] Similarly, greater emphasis should be placed on human rights principles within those agreements. The expansion of standards such as these should not be a substitute for broad-based international cooperation, but it would offer an avenue for action in the near term that all countries that care about peaceful cooperation in space and the responsible use of technology can and should join.

PREVENTING MISUSE OF SATELLITE TECHNOLOGY

ADVANCE DEMOCRATIC SPACE ORDER

To mitigate risks of space technology misuse and prevent authoritarian dominance in this competitive arena, democracy-minded actors should promote a democratic space order. This involves advocating for more transparency from satellite operators and owners regarding their satellites' capabilities and data collection practices, including through public registries and transparency reports, detailing how providers handle sensitive data and respond to government requests.

It also requires developing national space policies grounded in human rights and democratic principles and implementing stronger regulations, particularly for satellites collecting sensitive data. These efforts could help ensure that new space capabilities align with democratic values and respect for civil liberties.

PROMOTE RIGHTS-PROTECTING NORMS WITHIN PROVIDERS OF SPACE CAPABILITIES

Governments should implement policies that incentivize human rights protections in service provisions. This could include preferential treatment in licensing or contracting for providers that adopt robust human rights safeguards. Industry self-regulation should also be encouraged, with providers collaborating to establish ethical guidelines and best practices for data collection and dissemination. International cooperation is crucial to developing global standards that prevent a race to the bottom in terms of privacy protections.

Engagement with civil society organizations and human rights groups can help providers better understand and mitigate potential human rights impacts of their technologies. These measures, collectively, can help foster a culture of responsibility within the space and satellite industry, balancing innovation with respect for individual privacy and human rights.

PROMOTING OPENNESS AND INCLUSION

IMPROVE MULTISTAKEHOLDER COOPERATION AND COLLABORATION

It is essential to improve cooperation and coordination between all sectors of society on space and democracy issues. Space and satellite technology should be elevated within international fora such as the Internet Governance Forum (IGF) and World Summit for the Information Society (WSIS), and placed on the agenda at high-level democracy-focused gatherings.

Additionally, international multistakeholder bodies like the ITU and IGF must proactively ensure meaningful participation from the Global Majority in these discussions. The democratic community should also participate in global and regional space events, where crucial discussions on norms often take place, to gain insights and influence outcomes. Some experts have called for governments to convene a Global Summit for Space Security,[108] a proposal worthy of consideration given the growing risk of conflict in space.

This multi-level engagement approach would help stakeholders work towards a more comprehensive and inclusive framework for space governance that centers on peace and human rights.

ADDRESS COST BARRIERS TO USING LEO SATELLITES

Although using LEO satellites is relatively more affordable than it has been in the past, it remains expensive and unaffordable for much of the world, making it harder for satellite technology to provide universal internet access, despite the promise that it holds. Terminal costs remain a major barrier for end users, though increased market competition and new entrants are expected to drive these costs down over time.

Looking ahead, national governments, lawmakers, companies and CSOs should consider steps to address these barriers to access. Universal Service Fund schemes, which have successfully subsidized fiber-optic broadband access in many countries, could be adapted to support satellite internet access, particularly in remote or rural areas where satellite technology offers the most efficient connectivity solution.

Such programs, managed by national telecommunications commissions, combined with healthy market competition among providers, could help make satellite internet more accessible and affordable for underserved communities worldwide.[109]

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