

Outer Space: The Use of Outer Space in Armed Conflict and its Effects on Civilian Infrastructure

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ABSTRACT

The increasing militarisation of outer space and the growing dependence of modern societies on space-based technologies have created significant legal, security, and humanitarian challenges for the international community. Outer space assets, including communication satellites, navigation systems, meteorological satellites, and Earth-observation technologies, play essential roles in civilian infrastructure, economic activities, emergency response, and military operations. Their integration into contemporary armed conflicts has heightened the vulnerability of civilian populations to the direct and indirect consequences of attacks against space-based systems. This article examines the use of outer space in armed conflict and its effects on civilian infrastructure, with particular emphasis on the applicability and adequacy of existing international legal frameworks. It analyses the relevance of the Outer Space Treaty 1967, the United Nations Charter, and international humanitarian law in regulating military activities in outer space and protecting civilian objects against the effects of hostilities. The article further explores the consequences of interference with or destruction of space-based assets for telecommunications, electricity distribution, banking and financial services, transportation, healthcare, humanitarian assistance, and disaster management. It highlights the difficulties associated with distinguishing civilian from military uses of dual-purpose space systems, determining when a space-based asset constitutes a lawful military objective, and establishing responsibility for harmful conduct in an increasingly congested and technologically complex space environment. The article argues that although existing international law provides important principles governing the peaceful use of outer space and the conduct of hostilities, uncertainties remain regarding the application of international humanitarian law to space operations, particularly those involving dual-use satellites and their supporting infrastructure. It recommends clearer international rules, enhanced transparency and confidence-building measures, stronger protection for essential civilian space services, and improved international cooperation to prevent the escalation of hostilities into outer space. The article concludes that preserving the security and sustainability of outer space is indispensable to protecting civilian infrastructure, maintaining international peace and security, and safeguarding the humanitarian interests of present and future generations.

KEYWORDS: Outer Space, Armed Conflict, International Humanitarian Law, Civilian Infrastructure, Military Satellites, Dual-Use Space Systems.

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1. INTRODUCTION

Outer space has increasingly become an important domain of international relations, scientific exploration, national security and contemporary armed conflict. Since the beginning of the space age, the development of satellite technologies has transformed the manner in which States communicate, conduct military operations, monitor environmental changes, manage transportation systems and deliver essential public services. Although the exploration and use of outer space were initially associated predominantly with scientific advancement and peaceful cooperation, the growing integration of space-based technologies into military operations has created new legal and humanitarian challenges. Modern armed forces depend extensively on satellite communications, navigation systems, meteorological information, remote sensing and intelligence-gathering capabilities to support operational planning and

decision-making. Consequently, outer space has become both an enabling environment for military operations on Earth and a potential arena for activities capable of producing significant consequences for civilian populations and infrastructure.¹

The increasing strategic importance of outer space must be understood against the background of the international community's longstanding commitment to ensuring that space activities remain consistent with international law and the interests of all States. The *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies* 1967, commonly known as the Outer Space Treaty, establishes fundamental principles governing the exploration and use of outer space. Article I provides that outer space shall be explored and used for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development. Article III further requires States Parties to conduct their activities in the exploration and use of outer space in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding.² These provisions establish an important legal foundation for evaluating military activities in outer space. However, the treaty does not comprehensively prohibit every form of military activity in space, and its express prohibition concerning weapons is principally directed at nuclear weapons and other weapons of mass destruction.³ This distinction has become increasingly significant as States develop advanced space capabilities and consider the military implications of satellite interference, cyber operations and other activities directed against space-based systems.

The central concern is not merely the possibility of hostilities occurring physically in outer space but also the consequences of military operations involving space systems for civilian infrastructure on Earth. Contemporary societies rely on satellite services for numerous activities that are essential to the maintenance of public safety, economic stability and human welfare. Satellite communications support telecommunications networks and emergency communication services, while satellite navigation contributes to aviation, maritime transportation, logistics and the synchronisation of critical technological systems. Earth-observation satellites assist in weather forecasting, agricultural planning, environmental monitoring and disaster management. Space-based capabilities may also support electricity distribution, banking transactions, financial markets and humanitarian relief operations. Accordingly, the disruption or destruction of space systems can have consequences extending far beyond the immediate military objective of an operation.⁴

The International Committee of the Red Cross (ICRC) has drawn particular attention to the humanitarian implications of military operations in, or in relation to, outer space. In its 2022 working paper on the constraints imposed by international law on military operations in outer space during armed conflicts, the ICRC observed that attacks against space systems could have significant consequences for civilians because essential services on Earth increasingly depend on those systems.⁵ The concern is especially pronounced where a single satellite or supporting ground facility provides services to both military organisations and civilian users. An operation directed against a satellite employed for military communications, for instance, could also disrupt civilian telecommunications, transportation systems and emergency services. Similarly, interference with satellite navigation or timing services could affect activities dependent on reliable positioning and synchronisation. The resulting harm may therefore extend to persons who have no direct involvement in hostilities and whose access to essential services depends on the continued availability of space-based infrastructure.⁶

¹ International Committee of the Red Cross (ICRC), 'Constraints under International Law on Military Operations in Outer Space during Armed Conflicts' (5 May 2022) <https://www.icrc.org/en/document/constraints-under-international-law-military-space-operations> accessed 12 October 2026.

² Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (adopted 19 December 1966, opened for signature 27 January 1967, entered into force 10 October 1967) 610 UNTS 205, arts I and III.

³ *ibid* art IV. Article IV prohibits placing in orbit around the Earth any objects carrying nuclear weapons or other weapons of mass destruction, installing such weapons on celestial bodies, or stationing them in outer space in any other manner. It also provides for the use of the Moon and other celestial bodies exclusively for peaceful purposes, including a prohibition on establishing military bases and installations, testing weapons of any kind and conducting military manoeuvres on celestial bodies. It does not impose a blanket prohibition on every military activity in outer space.

⁴ ICRC, 'The Potential Human Cost of the Use of Weapons in Outer Space and the Protection Afforded by International Humanitarian Law' (ICRC Position Paper, 2022) *International Review of the Red Cross* <https://international-review.icrc.org/articles/the-potential-human-cost-weapons-in-outer-space-and-protection-afforded-by-ihl-icrc-position-paper-915> accessed 12 October 2026.

⁵ ICRC, 'Constraints under International Law on Military Operations in Outer Space during Armed Conflicts' (*supra*).

⁶ ICRC, 'Military Operations in Space' <https://www.icrc.org/en/law-and-policy/military-operations-space> accessed 12 October 2026.

A further complication arises from the dual-use character of many space systems. A space object is described as dual-use where it serves both civilian and military purposes. Commercial communication satellites, global navigation systems and Earth-observation platforms may provide services to private businesses, government institutions, humanitarian organisations and armed forces simultaneously. This convergence of civilian and military functions creates difficult questions concerning the legal status of space objects during armed conflict. Under international humanitarian law (IHL), an object ordinarily devoted to civilian purposes may become a military objective where, by its nature, location, purpose or use, it makes an effective contribution to military action and its total or partial destruction, capture or neutralisation, in the circumstances ruling at the time, offers a definite military advantage.⁷ Nevertheless, the military use of a satellite does not automatically establish that every civilian service provided by that satellite loses legal protection. The assessment must be undertaken in accordance with the applicable legal criteria and the circumstances of the particular operation. This is essential because the potential consequences of disabling a dual-use satellite may extend to civilian infrastructure in several States simultaneously.

The legal implications of military activities in outer space must also be examined within the broader framework of international law governing the use of force and the conduct of hostilities. Article 2(4) of the Charter of the United Nations prohibits the threat or use of force against the territorial integrity or political independence of any State, or in any other manner inconsistent with the purposes of the United Nations.⁸ The prohibition is relevant to military operations involving outer space just as it is to operations conducted in other domains. Where an operation involving a space system constitutes a use of force, its lawfulness must be assessed under the applicable rules of the Charter, including the requirements governing self-defence under Article 51 where invoked. In addition, the Outer Space Treaty requires States to conduct their space activities in accordance with international law.⁹ The legal assessment of military space operations therefore cannot be separated from the general principles governing international peace and security.

Where military operations occur in the context of an armed conflict, international humanitarian law imposes further restrictions designed to protect civilians and civilian objects against the effects of hostilities. The principles of distinction, proportionality and precaution are particularly relevant to operations involving space-based infrastructure. The principle of distinction requires parties to an armed conflict to distinguish between civilians and combatants, as well as between civilian objects and military objectives. The prohibition against directing attacks against civilian objects is reflected in Article 52(1) of Additional Protocol I to the Geneva Conventions of 1949. The principle of proportionality prohibits an attack expected to cause incidental civilian death, injury or damage to civilian objects that would be excessive in relation to the concrete and direct military advantage anticipated.¹⁰ The obligation to take feasible precautions in attack requires those planning or deciding upon an attack to take all feasible measures to avoid, and in any event minimise, incidental civilian harm.¹¹ These principles are relevant not only to attacks against satellites themselves but also to military operations directed against ground stations, satellite control facilities and other components of space systems where the operations form part of an armed conflict.

The application of these principles, however, presents distinctive difficulties. Unlike many conventional military targets, space-based systems may support geographically dispersed civilian users and essential services across national boundaries. The consequences of disabling a satellite may not be confined to the territory of the State operating it or to the immediate location of a military engagement. Moreover, the effects of interference may be difficult to predict, particularly where several interconnected systems depend on the same satellite services. An operation intended to disrupt military communications could therefore produce unintended consequences for civilian emergency response, medical facilities, commercial transportation or electricity networks. The assessment of proportionality and the selection of feasible precautions must consequently take account of reasonably foreseeable indirect effects on civilians and civilian objects, subject to the applicable legal rules and the circumstances of the operation. The growing complexity of these issues has prompted renewed attention to the interpretation and practical implementation of existing IHL obligations in relation to military space operations.¹²

The environmental consequences of military operations in outer space constitute another important dimension of the problem. The destruction of satellites through physical means may generate space debris capable of damaging other operational satellites and increasing risks to the long-term sustainability of the space environment. Such debris may threaten systems used for civilian communications, navigation, weather monitoring and disaster management, including systems operated by States that are not parties

⁷ Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I) (adopted 8 June 1977, entered into force 7 December 1978) 1125 UNTS 3, art 52(2).

⁸ Charter of the United Nations (adopted 26 June 1945, entered into force 24 October 1945) 1 UNTS XVI, art 2(4).

⁹ Outer Space Treaty (*supra*) art III; Charter of the United Nations (n 8) arts 2(4) and 51.

¹⁰ Additional Protocol I art 52(1); *ibid* art 51(5)(b).

¹¹ *ibid* art 57.

¹² G Blair Kuplic, 'Humanity on the Final Frontier: Challenges in Applying International Humanitarian Law to Modern Military Space Operations' (2025) *International Review of the Red Cross* No 928 <https://international-review.icrc.org/articles/humanity-on-the-final-frontier-928> accessed 12 October 2026.

to the original conflict.¹³ The resulting risks raise questions not only under the international legal framework governing outer space but also concerning the protection of civilian interests and the prevention of foreseeable harm. Article IX of the Outer Space Treaty requires States Parties to conduct their activities in outer space with due regard for the corresponding interests of other States Parties and to undertake appropriate international consultations where they have reason to believe that a planned activity or experiment would cause potentially harmful interference with the peaceful exploration and use of outer space by other States Parties.¹⁴ Although this provision is not a comprehensive code governing military operations during armed conflict, it illustrates the importance of international cooperation and due regard in managing activities that may affect other users of outer space.

The international community has increasingly recognised the need to address the risks associated with military operations affecting space systems and the civilian services they support. In June 2024, the ICRC published observations on a report concerning the protection of essential civilian services on Earth from disruption by military space operations. The publication emphasised the importance of strengthening the protection of critical space-based services, reducing civilian harm arising from military operations against space systems and addressing the challenges associated with the military use of commercial space capabilities.¹⁵ These concerns are significant because private companies increasingly provide satellite communications and other services that may be used by both civilian customers and military organisations. The participation of commercial providers in these activities complicates the assessment of responsibility, the identification of potential military objectives and the practical implementation of measures intended to safeguard civilian services. It also reinforces the need for States and relevant private actors to consider the foreseeable humanitarian consequences of activities involving space infrastructure.

Despite the existence of international legal rules governing outer space and the conduct of hostilities, questions remain concerning the adequacy of the existing framework in addressing the distinctive risks posed by military space operations. The Outer Space Treaty establishes important foundational principles, while the United Nations Charter regulates the threat or use of force and international humanitarian law governs the conduct of hostilities during armed conflict. Nevertheless, the practical application of these rules to dual-use satellites, cyber interference, disruptions of satellite services and attacks with transboundary consequences raises complex interpretative and operational issues.¹⁶ The problem is therefore not necessarily the complete absence of applicable law, but rather the need to clarify how existing rules apply to evolving technologies and military practices, strengthen compliance and develop additional safeguards where appropriate.

Against this background, this article examines the use of outer space in armed conflict and its effects on civilian infrastructure, focusing on the relationship between military space operations, the protection of civilians and the adequacy of the existing international legal framework. It considers the principal military uses of space-based technologies, the vulnerability of essential civilian services to disruption, and the legal implications of operations affecting satellites and their supporting infrastructure. It also evaluates the application of the Outer Space Treaty, the United Nations Charter and international humanitarian law, particularly the principles of distinction, proportionality and precaution. In addition, it considers the challenges associated with dual-use space systems, commercial satellite services, space debris and the allocation of international responsibility for harmful activities.

The article argues that the increasing dependence of civilian infrastructure on space-based technologies requires a more coherent and humanitarian-centred approach to military activities in outer space. Although existing international law provides an important basis for regulating such activities, effective protection requires greater clarity concerning the application of established rules, improved cooperation among States, stronger risk-reduction measures and appropriate safeguards for space systems essential to civilian survival and public welfare. It ultimately maintains that the protection of civilian infrastructure must remain a central consideration in the development and implementation of international rules governing the use of outer space in armed conflict.

2. APPLICABILITY AND ADEQUACY OF EXISTING INTERNATIONAL LEGAL FRAMEWORKS: OUTER SPACE TREATY 1967, THE UNITED NATIONS CHARTER, AND INTERNATIONAL HUMANITARIAN LAW

The increasing integration of outer space into military operations has raised fundamental questions concerning the applicability, interpretation and adequacy of existing international legal frameworks for regulating armed conflict and protecting civilian infrastructure. Space-based technologies have become indispensable to contemporary military operations and the functioning of

¹³ ICRC, 'The Potential Human Cost of the Use of Weapons in Outer Space and the Protection Afforded by International Humanitarian Law' (*supra*).

¹⁴ Outer Space Treaty (*supra*) art IX.

¹⁵ ICRC, *Observations on the Consultants' Report: Protecting Essential Civilian Services on Earth from Disruption by Military Space Operations* (25 June 2024) <https://www.icrc.org/en/publication/icrc-observations-consultants-report-protecting-essential-civilian-services-earth> accessed 12 October 2026.

¹⁶ ICRC, 'Constraints under International Law on Military Operations in Outer Space during Armed Conflicts' (n 1); Frans G von der Dunk, 'Armed Conflicts in Outer Space: Which Law Applies?' (2021) 97 *International Law Studies* <https://digital-commons.usnwc.edu/ils/vol97/iss1/17/> accessed 12 October 2026.

civilian society. Satellite communications, navigation and timing systems, meteorological satellites and Earth-observation platforms support essential services, including telecommunications, transportation, electricity distribution, financial transactions, healthcare, disaster management and humanitarian relief. Consequently, military operations directed against space systems may produce consequences that extend beyond the immediate military objective and affect civilian populations across national boundaries. The International Committee of the Red Cross (ICRC) has emphasised that military operations in, or in relation to, outer space do not occur in a legal vacuum but are constrained by existing international law, particularly the Charter of the United Nations, international space law and international humanitarian law (IHL).¹⁷

The central legal question is therefore not whether international law applies to military activities involving outer space, but whether the existing framework provides sufficiently clear and effective protection against the distinctive humanitarian risks associated with such activities. Three principal legal instruments and bodies of rules are particularly relevant: the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies* 1967 (Outer Space Treaty); the Charter of the United Nations 1945; and international humanitarian law, including the four Geneva Conventions of 1949, Additional Protocol I of 1977, where applicable, and customary international humanitarian law. These frameworks perform complementary functions. The Outer Space Treaty establishes foundational principles governing activities in outer space; the United Nations Charter regulates the legality of the threat or use of force between States; and IHL governs the conduct of hostilities and protects persons and objects affected by armed conflict.¹⁸

Nevertheless, the existence of these legal frameworks does not eliminate the difficulties associated with their application to contemporary space operations. Uncertainties arise concerning the military use of dual-purpose satellites, the legal consequences of cyber interference with space systems, the assessment of incidental civilian harm, the effects of space debris and the protection of essential civilian services that depend on commercial or government-operated satellites. An adequate legal assessment must therefore distinguish between the applicability of existing rules and their practical capacity to address the technological and humanitarian challenges associated with military activities in outer space.

1.2 Applicability and Adequacy of the Outer Space Treaty 1967

The Outer Space Treaty constitutes the principal foundational instrument of international space law. Adopted on 19 December 1966 and opened for signature on 27 January 1967, the Treaty entered into force on 10 October 1967.¹⁹ Its adoption reflected the international community's determination to prevent outer space from becoming an unrestricted arena for national appropriation and certain forms of military competition. Although the Treaty does not prohibit all military activities in outer space, it establishes important legal principles concerning the freedom of exploration and use, the prohibition of national appropriation, the peaceful use of celestial bodies, international responsibility and the obligation to conduct space activities consistently with international law.

1.2.1 Article I: The Exploration and Use of Outer Space for the Benefit of All Countries

Article I of the Outer Space Treaty provides that the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all humankind. It further recognises the freedom of exploration and use of outer space by all States on a basis of equality and in accordance with international law.²⁰

This provision establishes an important normative foundation for assessing military activities that threaten the availability of space-based services essential to civilian welfare. Satellite infrastructure supports a wide range of civilian activities, including communications, environmental monitoring, scientific research, disaster preparedness and emergency response. Military operations that disrupt such services may therefore undermine the broader interests that Article I seeks to advance.

The provision, however, should not be interpreted as an absolute prohibition on military uses of space. States routinely employ satellites for military communications, surveillance, navigation and intelligence gathering. Article I does not expressly prohibit these activities, nor does it independently establish a comprehensive legal regime for protecting civilian infrastructure during armed conflict. Its principal significance lies in the general principles governing the exploration and use of outer space. The protection of

¹⁷ International Committee of the Red Cross (ICRC), *Constraints under International Law on Military Operations in Outer Space during Armed Conflicts* (5 May 2022), available at ICRC working paper on military operations in outer space.

¹⁸ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (adopted 19 December 1966, opened for signature 27 January 1967, entered into force 10 October 1967) 610 UNTS 205 (Outer Space Treaty); Charter of the United Nations (adopted 26 June 1945, entered into force 24 October 1945) 1 UNTS XVI (UN Charter); Geneva Convention I–IV (adopted 12 August 1949); Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I) (adopted 8 June 1977, entered into force 7 December 1978) 1125 UNTS 3.

¹⁹ Outer Space Treaty (*supra*).

²⁰ *ibid* art I.

civilian services against military interference must consequently be assessed alongside the more specific obligations arising under the United Nations Charter, IHL and other applicable rules of international law.²¹

The adequacy of Article I is therefore limited by the generality of its language. Although its emphasis on the interests of all countries supports international cooperation and the sustainable use of space, it does not expressly identify the circumstances in which interference with a satellite carrying civilian and military services would violate international law. Additional interpretative guidance and more specific international measures may therefore be necessary to translate the Treaty's broad principles into effective protection for civilian infrastructure.

1.2.2 Article III: The Application of International Law to Outer Space Activities

Article III of the Outer Space Treaty provides that States Parties shall carry out activities in the exploration and use of outer space in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding.²²

Article III is particularly important because it confirms that outer space is not a legal vacuum. The fact that a military operation involves a satellite, a space-based communication link or a ground facility supporting space activities does not exempt the operation from applicable rules of international law. Where military operations take place in the context of an armed conflict, the relevant legal framework may include the United Nations Charter, IHL, the law of neutrality and applicable rules governing State responsibility.²³

The provision also supports the application of IHL to military operations involving outer space. Although the principal IHL treaties were not drafted specifically to address contemporary satellite networks or the complex relationships between space-based and terrestrial infrastructure, the general applicability of IHL is not dependent on the existence of detailed rules addressing every new technology. The International Court of Justice (ICJ), in its *Legality of the Threat or Use of Nuclear Weapons* advisory opinion, affirmed that the established principles and rules of humanitarian law apply to all forms of warfare and all kinds of weapons, including those of the future.²⁴ This reasoning supports the application of established IHL rules to military operations involving space systems when the relevant legal conditions are satisfied.

Nevertheless, Article III does not itself explain how every existing rule should be applied to the technical characteristics of outer space. Questions concerning the assessment of indirect civilian harm, the targeting of dual-use satellites and the consequences of cyber operations against space infrastructure may require careful interpretation of the applicable rules. The provision therefore establishes a strong legal foundation but does not remove the need for clarification concerning the practical application of international law to emerging space technologies.

1.2.3 Article IV: The Prohibition of Certain Weapons in Outer Space

Article IV of the Outer Space Treaty prohibits States Parties from placing in orbit around the Earth any objects carrying nuclear weapons or other weapons of mass destruction, installing such weapons on celestial bodies or stationing them in outer space in any other manner. It further provides that the Moon and other celestial bodies shall be used exclusively for peaceful purposes and prohibits the establishment of military bases, installations and fortifications, the testing of weapons of any kind and the conduct of military manoeuvres on celestial bodies.²⁵

Article IV represents one of the Treaty's most significant arms-control provisions. By prohibiting the placement of nuclear weapons and other weapons of mass destruction in orbit, it establishes an express limitation on certain particularly dangerous forms of military activity in outer space. The prohibition is relevant to the protection of civilian infrastructure because the deployment or use of such weapons could threaten civilian populations and essential services on an extensive scale.

However, the provision does not establish a comprehensive prohibition on conventional weapons in outer space or on all military activities involving satellites. Nor does it expressly prohibit every form of interference with space-based infrastructure. Military satellites may therefore operate within the limits of the Treaty, while particular operations against them remain subject to other applicable rules of international law.²⁶

This limitation has become increasingly significant because contemporary threats to space systems are not confined to the placement of conventional weapons in orbit. They may include electronic interference, cyber operations, directed-energy activities and attacks against ground-based facilities supporting satellite services. Such activities must be assessed under the applicable provisions of the Outer Space Treaty, the United Nations Charter, IHL and other relevant rules rather than treated as automatically prohibited or permitted by Article IV alone.

²¹ ICRC, *Constraints under International Law on Military Operations in Outer Space during Armed Conflicts* (supra).

²² Outer Space Treaty art III.

²³ ICRC, *Constraints under International Law on Military Operations in Outer Space during Armed Conflicts* (supra).

²⁴ *Legality of the Threat or Use of Nuclear Weapons* (Advisory Opinion) [1996] ICJ Rep 226, para 86.

²⁵ Outer Space Treaty art IV.

²⁶ ICRC, 'Military Operations in Space', available at ICRC: Military Operations in Space

The adequacy of Article IV is therefore qualified. It establishes important prohibitions but does not comprehensively regulate the range of military capabilities capable of disrupting space-based services. The provision's focus on weapons of mass destruction and military activities on celestial bodies leaves other questions to be resolved through the broader international legal framework.

1.2.4 Article VI: International Responsibility for National Space Activities

Article VI of the Outer Space Treaty provides that States Parties bear international responsibility for national activities in outer space, whether such activities are carried out by governmental agencies or by non-governmental entities. It further requires the activities of non-governmental entities to be authorised and continuously supervised by the appropriate State.

This provision is important in the context of commercial satellite operators and privately owned space infrastructure. Modern space systems frequently involve cooperation between governments, commercial service providers and other private entities. A satellite may supply communication services to military organisations while simultaneously serving civilian customers, including hospitals, transportation operators and emergency-response agencies.

Article VI establishes a framework for State responsibility in relation to national space activities, including those conducted by private entities. Nevertheless, its operation must be distinguished from the separate legal rules governing the international responsibility of States for internationally wrongful acts. The precise legal consequences of a particular activity depend on the applicable obligations, the relevant facts and the rules governing attribution and responsibility.²⁷

The provision does not mean that a State is automatically internationally responsible for every harmful act committed by a private satellite operator. Rather, it establishes responsibility for national activities under the Treaty and requires authorisation and continuing supervision of non-governmental activities. Whether a particular act is attributable to a State or constitutes a breach of an international obligation must be determined under the applicable legal rules.

Accordingly, Article VI provides an important institutional basis for supervising commercial space activities, but its adequacy in protecting civilian infrastructure depends partly on effective domestic regulatory systems, appropriate supervision and compliance with other applicable international obligations.

1.2.5 Article IX: Due Regard, Consultation and Harmful Interference

Article IX requires States Parties to conduct their activities in the exploration and use of outer space with due regard to the corresponding interests of other States Parties. It also provides for appropriate international consultations where a State has reason to believe that a planned activity or experiment would cause potentially harmful interference with the peaceful exploration and use of outer space by other States Parties.²⁸

This provision is particularly relevant to the transboundary consequences of military operations involving space infrastructure. A satellite may provide services to users in several countries, and interference with its operation may disrupt civilian activities far beyond the territory of the State against which a military operation is directed. Similarly, the generation of space debris may threaten the operational safety of unrelated satellites and thereby affect the long-term availability of civilian services.

Article IX supports a cooperative approach to the management of risks associated with space activities. Its emphasis on due regard and consultation provides a basis for considering the interests of other States when activities may affect their use of outer space. Nevertheless, the provision does not establish a detailed system of advance notification, binding military deconfliction or comprehensive protection for civilian satellite services during armed conflict.

Its adequacy is consequently limited by the absence of a detailed operational regime governing all forms of interference with space systems. Although Article IX provides an important legal principle, further agreements and confidence-building measures could help clarify how States should identify risks, communicate concerns and reduce the likelihood of harm to civilian infrastructure.²⁹

Assessment of the Outer Space Treaty: The Treaty remains a foundational instrument for the governance of outer space. Its principal strength lies in establishing general principles applicable to States' space activities and expressly incorporating international law through Article III. However, it does not provide a comprehensive code regulating the conduct of hostilities involving satellites or specifically addressing all risks to civilian infrastructure. Its provisions must therefore operate alongside the United Nations Charter, IHL and other applicable rules. The principal challenge is not the complete absence of legal regulation, but the need to clarify and strengthen the practical application of existing obligations to contemporary military space operations.

1.3 Applicability and Adequacy of the United Nations Charter 1945

The Charter of the United Nations establishes the fundamental legal framework governing the use of force in international relations. Its relevance to outer space is reinforced by Article III of the Outer Space Treaty, which expressly requires States Parties to conduct space activities in accordance with international law, including the Charter.³⁰ The Charter is particularly important where a State

²⁷ International Law Commission, *Articles on Responsibility of States for Internationally Wrongful Acts* (2001), arts 2, 4, 5 and 8.

²⁸ Outer Space Treaty art IX.

²⁹ ICRC, *Preliminary Recommendations on Reducing Space Threats* (2023), available at ICRC preliminary recommendations on reducing space threats.

³⁰ Outer Space Treaty art III.

uses force against another State's satellite, conducts an operation against space-based infrastructure or undertakes activities in outer space as part of an armed confrontation.

The legal analysis must, however, distinguish between the *jus ad bellum*, which governs the lawfulness of resorting to force, and IHL, which governs the conduct of hostilities once an armed conflict exists. A military operation may raise questions under both bodies of law, but compliance with one does not automatically establish compliance with the other.

1.3.1 Article 2(4): Prohibition of the Threat or Use of Force

Article 2(4) of the United Nations Charter requires all Members to refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any State, or in any other manner inconsistent with the purposes of the United Nations.

The prohibition is relevant to military operations involving outer space. The use of force is not excluded from the Charter merely because the operation is directed against a satellite rather than against territory or military personnel on the ground. An operation involving the destruction or disabling of another State's space infrastructure must therefore be assessed in light of the nature, scale, effects and circumstances of the conduct, as well as the applicable legal rules.

Not every form of interference with a satellite necessarily constitutes a use of force under Article 2(4). Cyber operations, electronic interference and other non-kinetic activities may raise difficult questions concerning the threshold at which conduct amounts to a prohibited use of force. Their legal character must be determined by reference to the circumstances of the particular case and the relevant rules of international law.³¹

Where an operation does amount to a use of force, the question arises whether it is prohibited or justified under a recognised exception to Article 2(4). An attack against a satellite belonging to another State cannot be assumed to be lawful merely because the satellite supports military activities. Equally, the fact that the operation occurs in outer space does not independently establish its unlawfulness. The applicable legal assessment must consider the Charter, the circumstances of the operation and any other relevant international obligations.

Article 2(4) is therefore an important safeguard against unlawful interstate violence involving space infrastructure. Nevertheless, its general formulation does not provide a comprehensive set of technical rules for assessing every form of satellite interference, particularly where the consequences are indirect, disputed or difficult to quantify.

1.3.2 Article 51: The Right of Self-Defence

Article 51 of the United Nations Charter preserves the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations, until the Security Council has taken the measures necessary to maintain international peace and security.

The provision is relevant where a State claims that military action involving another State's space systems is necessary in response to an armed attack. For example, a State may argue that an operation against a satellite forms part of its response to an attack that has significantly impaired its military capabilities or threatened its security. Such a claim must nevertheless satisfy the applicable legal requirements for self-defence.

The existence of a hostile act involving space infrastructure does not automatically establish that the threshold of an armed attack has been met. Nor does the invocation of self-defence provide unrestricted authority to conduct military operations against space-based assets. The legality of a response must be assessed under the applicable requirements of the Charter, including necessity and proportionality as developed in the law of self-defence.³²

Furthermore, the lawfulness of resorting to force must be distinguished from the lawfulness of the methods employed during the resulting hostilities. Even where a State lawfully resorts to self-defence, its military operations remain subject to applicable IHL obligations. An operation that is justified under Article 51 may still violate IHL if it is directed against a civilian object, causes excessive incidental civilian harm or fails to comply with the applicable precautions in attack.

This distinction is especially important where a satellite provides both military and civilian services. The claim that disabling the satellite would offer a military advantage does not, by itself, establish that the operation satisfies all relevant legal requirements. The nature of the military objective, the foreseeable consequences for civilians and the applicable rules governing the conduct of hostilities must be considered separately.

1.3.3 Articles 33 and 39: Peaceful Settlement and the Maintenance of International Peace and Security

Article 33 of the United Nations Charter requires parties to a dispute likely to endanger the maintenance of international peace and security to seek a solution by peaceful means, including negotiation, enquiry, mediation, conciliation, arbitration, judicial settlement, resort to regional agencies or arrangements, or other peaceful means of their choice. Article 39 empowers the Security Council to

³¹ ICRC, *Constraints under International Law on Military Operations in Outer Space during Armed Conflicts* (supra).

³² *Military and Paramilitary Activities in and against Nicaragua* (*Nicaragua v United States of America*) (Merits) [1986] ICJ Rep 14, paras 176 and 194–95; *Oil Platforms* (*Islamic Republic of Iran v United States of America*) (Merits) [2003] ICJ Rep 161, paras 43, 73 and 76.

determine the existence of any threat to the peace, breach of the peace or act of aggression and to make recommendations or decide what measures shall be taken in accordance with Articles 41 and 42.

These provisions are relevant to the prevention and management of disputes involving outer space. Allegations of interference with satellites, threats against space infrastructure or harmful activities directed at another State's space systems may generate diplomatic tensions and increase the risk of escalation. Peaceful dispute-settlement mechanisms and collective security measures can help States address such disputes without resorting to unlawful force.

However, the Charter does not establish a specialised international tribunal with exclusive jurisdiction over disputes involving military space operations. Nor does it prescribe a complete technical framework for investigating every incident involving satellite interference. Effective implementation therefore depends on the willingness of States to cooperate, provide relevant information and use existing international institutions and peaceful dispute-settlement procedures.

Assessment of the United Nations Charter: The Charter provides an essential framework for regulating the resort to force in outer space. Its prohibitions and exceptions apply independently of the physical domain in which military activity occurs. Its principal limitation is that it does not comprehensively regulate the technical conduct of military operations against space systems or provide detailed rules for protecting civilian infrastructure from indirect harm. These matters are addressed principally through IHL and other applicable international legal rules.

1.4 Applicability and Adequacy of International Humanitarian Law

International humanitarian law constitutes the principal body of international law regulating the conduct of hostilities during armed conflict and protecting persons who are not, or are no longer, participating in hostilities. Its application does not depend on whether military operations take place on land, at sea, in the air, in cyberspace or in outer space. Where the relevant conditions for the existence of an armed conflict are satisfied, the applicable IHL rules govern military operations conducted in, from, to or through outer space, as well as operations against space systems whose effects extend to civilian infrastructure on Earth.³³

The ICRC has emphasised that IHL applies to military operations involving outer space during armed conflict and that the humanitarian consequences of such operations must be assessed under the established rules protecting civilians and civilian objects.³⁴ This approach is consistent with the general principle that IHL applies to new technologies and methods of warfare without requiring a separate treaty for every new operational domain.

However, the applicability of IHL must be distinguished from the question of whether every detailed rule can be applied straightforwardly to every space operation. The technical characteristics of satellites, their supporting ground infrastructure, the use of commercial systems and the potentially widespread consequences of interference create practical and interpretative challenges. These challenges require careful application of existing legal principles rather than an assumption that outer space is either wholly unregulated or governed by an entirely separate body of humanitarian law.

1.4.1 The Principle of Distinction and the Protection of Civilian Objects

The principle of distinction requires parties to an armed conflict to distinguish between civilians and combatants and between civilian objects and military objectives. Parties may direct attacks only against military objectives and must not direct attacks against civilians or civilian objects as such.³⁵

Article 52(1) of Additional Protocol I defines civilian objects negatively as all objects that are not military objectives. Article 52(2) provides that attacks must be strictly limited to military objectives and defines military objectives as those objects which, by their nature, location, purpose or use, make an effective contribution to military action and whose total or partial destruction, capture or neutralisation, in the circumstances ruling at the time, offers a definite military advantage. These rules are also supported by customary IHL, subject to the relevant scope of the customary obligations.

Applied to outer space, the principle of distinction requires a case-specific assessment of the legal status of the space object or supporting infrastructure that is proposed to be attacked. A satellite used exclusively for civilian communications would ordinarily be a civilian object. A satellite that makes an effective contribution to military action may, depending on its use and the circumstances, qualify as a military objective if the remaining elements of Article 52(2) are satisfied.

However, the fact that a satellite has some military function does not mean that every component of a wider space system or every service delivered through that satellite automatically becomes a military objective. The relevant legal assessment must identify the object or system being targeted and determine whether it satisfies the applicable criteria.

³³ ICRC, 'How Would IHL Apply to Hostilities in Outer Space?' (2 November 2023), available at ICRC analysis of IHL and hostilities in outer space.

³⁴ ICRC, *The Potential Human Cost of the Use of Weapons in Outer Space and the Protection Afforded by International Humanitarian Law* (ICRC Position Paper, 2022), available at ICRC position paper on weapons in outer space and IHL.

³⁵ Additional Protocol I arts 48 and 52(1).

The difficulty becomes more pronounced where a single satellite supports military communications while also providing services to hospitals, commercial transportation operators, humanitarian organisations and emergency-response agencies. An attack may therefore affect civilian services even where the immediate target makes a contribution to military action.

The principle of distinction does not necessarily prohibit an attack against every dual-use satellite. Rather, it requires that the object satisfy the legal definition of a military objective and that the attack comply with all other applicable IHL obligations.³⁶ This approach is essential to avoid treating the presence of any military use as sufficient justification for disregarding civilian interests.

1.4.2 The Principle of Proportionality and Incidental Civilian Harm

The principle of proportionality prohibits an attack that may be expected to cause incidental civilian death, injury or damage to civilian objects that would be excessive in relation to the concrete and direct military advantage anticipated. This prohibition is reflected in Article 51(5)(b) of Additional Protocol I and is also recognised as a rule of customary IHL.³⁷

The principle is particularly significant in outer space because interference with a satellite may have consequences for numerous civilian users and interconnected terrestrial systems. For example, disabling a satellite that supports military communications may also affect civilian telecommunications, aviation services, emergency response or other activities dependent on satellite connectivity. The proportionality assessment must be conducted prospectively, on the basis of the information reasonably available to those planning or deciding upon the attack at the relevant time. It must consider the expected incidental harm to civilians and civilian objects in relation to the concrete and direct military advantage anticipated.³⁸ The assessment is not a mathematical comparison between civilian harm and military advantage, nor does the existence of civilian consequences automatically render an attack unlawful. The question is whether the expected incidental harm would be excessive in relation to the anticipated military advantage under the applicable legal standard.

A distinctive challenge in the space environment is the assessment of indirect effects. Disruption of a satellite may impair other systems that depend on its services, potentially producing consequences for civilian infrastructure beyond the immediate target. The ICRC considers that foreseeable direct and indirect incidental harm or damage to civilian objects should be considered when assessing the lawfulness of military operations against space systems.³⁹ The precise scope of the legally required assessment depends on the applicable rules and the circumstances, including the foreseeability of the relevant consequences.

The adequacy of the proportionality principle is therefore not necessarily undermined by the absence of space-specific treaty provisions. Rather, the principal difficulty lies in applying the established rule to complex and interdependent systems where the full consequences of interference may be uncertain. Improved technical information, impact assessment and cooperation between military and civilian service providers can assist in identifying foreseeable harm and supporting compliance with the principle.

1.4.3 The Obligation to Take Precautions in Attack

Article 57 of Additional Protocol I requires those who plan or decide upon an attack to take all feasible precautions to avoid, and in any event to minimise, incidental loss of civilian life, injury to civilians and damage to civilian objects. Among other things, those responsible must do everything feasible to verify that the objectives to be attacked are military objectives, take all feasible precautions in the choice of means and methods of attack, and cancel or suspend an attack if it becomes apparent that the target is not a military objective or that the attack would violate the applicable proportionality rule.⁴⁰

The obligation to take precautions is highly relevant to military operations against satellites, ground stations and supporting communication links. Before conducting an operation, those responsible should, to the extent feasible, assess the nature of the target, its military function, the civilian services it supports and the foreseeable consequences of disabling or damaging it.

Where appropriate and feasible, precautionary measures may include selecting methods of interference that reduce risks to civilian users, choosing alternative military objectives, limiting the scope or duration of an operation, or postponing an attack until additional information is available. The particular precautions required depend on the circumstances and the measures that are feasible at the relevant time.

The ICRC has also recommended that States consider segregating military uses of space systems from civilian uses, particularly where systems are necessary for essential civilian services or the protection of persons and objects specifically protected under international law.⁴¹ Although this recommendation is not itself a universally binding treaty obligation, it provides a practical approach to reducing the risk that military operations will disrupt civilian infrastructure.

³⁶ ICRC, *Constraints under International Law on Military Operations in Outer Space during Armed Conflicts*.

³⁷ Additional Protocol I (n 2) art 51(5)(b); Jean-Marie Henckaerts and Louise Doswald-Beck, *Customary International Humanitarian Law, Volume I: Rules* (Cambridge University Press 2005), Rule 14.

³⁸ Additional Protocol I art 57(2)(a)(iii).

³⁹ ICRC, *The Potential Human Cost of the Use of Weapons in Outer Space and the Protection Afforded by International Humanitarian Law* (supra).

⁴⁰ Additional Protocol I art 57(2)(a)–(b).

⁴¹ ICRC, *Preliminary Recommendations on Reducing Space Threats* (supra).

The adequacy of the precautionary principle depends significantly on access to reliable technical information and the capacity to assess the consequences of military operations. Where a satellite provides multiple services through complex networks, the information available to decision-makers may be incomplete. Greater transparency, improved technical assessment and appropriate arrangements between military and commercial operators can help reduce these difficulties.

1.4.4 The Prohibition of Indiscriminate Attacks

International humanitarian law prohibits attacks that are indiscriminate. Article 51(4) of Additional Protocol I identifies categories of attacks that are indiscriminate, including attacks that are not directed at a specific military objective, employ means or methods that cannot be directed at a specific military objective, or employ means or methods whose effects cannot be limited as required by the Protocol.⁴²

This prohibition may be relevant to operations against space systems where the methods employed cannot be sufficiently controlled to distinguish military objectives from civilian objects or where their effects cannot be limited in accordance with IHL.

For example, an operation directed at disabling a space-based system may raise serious legal concerns if its effects cannot be confined to the intended military objective and are expected to affect civilian infrastructure indiscriminately. The legal assessment must nevertheless be based on the actual capabilities and foreseeable effects of the method employed, rather than on the mere fact that the operation involves outer space.

The prohibition does not mean that every operation affecting both civilian and military systems is automatically indiscriminate. The applicable rule requires a careful assessment of whether the attack can be directed at a specific military objective and whether its effects can be limited as required by law.

Its adequacy in the space environment depends on effective assessment of technical capabilities, operational consequences and the possibility of controlling the effects of the operation. These considerations reinforce the need for improved technical expertise and practical guidance on applying existing IHL rules to space-based infrastructure.

1.4.5 The Protection of Essential Civilian Services and Humanitarian Infrastructure

An additional question concerns the protection of space systems that support essential civilian services or facilitate the functioning of persons and objects specifically protected under IHL. Satellite services may be important to medical facilities, humanitarian organisations, emergency-response systems and other services on which civilian survival and welfare depend.

The protection of medical units and transports, humanitarian relief operations and other specially protected persons and objects arises under specific IHL provisions, depending on the circumstances.⁴³ The fact that such activities rely on a space-based service does not automatically confer the legal status of a specially protected object on every satellite or ground facility supporting them. Nevertheless, the foreseeable consequences of disrupting those services may be highly relevant to the application of distinction, proportionality and precautions.

In its preliminary recommendations on reducing space threats, the ICRC has called on States not to conduct or support military operations or other activities designed or expected to disrupt, damage, destroy or disable space systems necessary for essential civilian services and the protection and functioning of persons and objects specifically protected under international law. It has also recommended measures to segregate military and civilian uses of space systems and to improve the resilience of satellite services supporting humanitarian relief and emergency response.⁴⁴

These recommendations provide a significant policy contribution to the development of more effective safeguards for civilian infrastructure. However, they should be distinguished from existing binding treaty obligations. Their implementation depends on State acceptance, practical arrangements and, where appropriate, the development of additional international norms or legal instruments.

1.4.6 Cyber Operations and Non-Kinetic Interference with Space Systems

Modern military operations may affect space systems without physically destroying a satellite. Cyber operations, electronic interference and other non-kinetic activities may disrupt communications, interfere with satellite control or impair the availability of services provided through space infrastructure.

The absence of physical destruction does not automatically remove such conduct from the scope of international law. Where a cyber or electronic operation occurs in the context of an armed conflict, its legal assessment depends on the applicable rules and the operation's nature, purpose and effects.⁴⁵ An operation that disables a satellite or disrupts essential civilian services may raise issues under IHL even where the space object remains physically intact.

⁴² Additional Protocol I art 51(4); Henckaerts and Doswald-Beck, Rule 11.

⁴³ Geneva Convention I (1949) arts 19–26; Geneva Convention IV (1949) arts 18–22; Additional Protocol I arts 12, 15, 70 and 71, subject to their respective conditions of application.

⁴⁴ ICRC, *Preliminary Recommendations on Reducing Space Threats* (supra).

⁴⁵ ICRC, 'Military Operations in Space' (supra).

However, not every cyber operation constitutes an attack for the purposes of IHL, and the classification of particular forms of interference remains subject to legal interpretation. The analysis must distinguish between operations that amount to attacks under the applicable rules and other forms of conduct that may nevertheless be regulated by international law.

This issue is particularly important for civilian infrastructure because the disruption of a satellite service may impair essential functions without producing readily visible physical damage. The assessment of harm must therefore take account of the actual effects on civilian systems and services, within the limits of the applicable legal rules.

Assessment of international humanitarian law: IHL provides the most direct legal framework for assessing the protection of civilians and civilian infrastructure during armed conflict. Its principles of distinction, proportionality, precautions and the prohibition of indiscriminate attacks are applicable to military operations involving space systems when the relevant legal conditions are satisfied. Nevertheless, effective implementation is complicated by dual-use infrastructure, uncertainty concerning indirect effects, technical complexity and the difficulty of obtaining reliable information about civilian dependencies. These challenges support the development of more detailed interpretative guidance, practical safeguards and risk-reduction measures.

1.5 Overall Assessment: The Relationship Between the Three Legal Frameworks

The Outer Space Treaty, the United Nations Charter and international humanitarian law should not be treated as competing legal regimes. They operate at different but complementary levels.

First, the United Nations Charter regulates the legality of the threat or use of force in international relations. It establishes the general prohibition on the use of force and recognises limited circumstances in which force may be lawful, including individual or collective self-defence under Article 51 and action authorised by the Security Council under the Charter.

Secondly, the Outer Space Treaty provides the foundational rules governing the exploration and use of outer space. Article III expressly connects space activities with the broader body of international law, while Articles IV, VI and IX address particular matters relating to weapons of mass destruction, State responsibility for national space activities and due regard for the interests of other States.

Thirdly, IHL regulates the conduct of hostilities during armed conflict and provides protections for civilians and civilian objects. Its rules govern the selection of targets, the assessment of incidental civilian harm and the precautions required when conducting military operations involving space systems.

These regimes must be applied together where relevant. A State cannot rely on the existence of a military objective under IHL to establish automatically that its resort to force complies with the United Nations Charter. Equally, a lawful resort to force does not exempt a State from its obligations under IHL. Similarly, compliance with particular provisions of the Outer Space Treaty does not remove the obligation to comply with other applicable rules of international law.⁴⁶

The principal weakness of the existing framework lies in the challenges of implementation and interpretation rather than in a total absence of applicable law. Contemporary space systems are technically complex, frequently operated by commercial entities and often used for both civilian and military purposes. Their disruption may have consequences extending across national boundaries and affecting multiple essential services. The relevant legal rules must therefore be applied in a manner that takes account of the foreseeable humanitarian consequences of military operations without disregarding the specific requirements and limitations of each applicable rule.

The ICRC has accordingly emphasised that international efforts to reduce threats to space systems should reaffirm existing legal obligations and develop measures that strengthen, rather than undermine, the established international legal framework.⁴⁷ Such measures may include greater transparency concerning military space activities, improved communication between States, arrangements to reduce the risk of harmful interference, stronger safeguards for essential civilian services and further clarification of how existing IHL obligations apply to military operations involving space systems.

Ultimately, the adequacy of the existing legal framework should be assessed by reference to both its normative foundations and its practical implementation. The Outer Space Treaty establishes the basic principles governing space activities; the United Nations Charter regulates the resort to force; and IHL protects civilians and civilian objects during armed conflict. Although these frameworks provide a substantial legal basis for addressing military operations involving outer space, their effective application requires States to clarify disputed interpretative questions, improve technical assessment and cooperate in reducing foreseeable harm to civilian infrastructure.

3. CONSEQUENCES OF INTERFERENCE WITH OR DESTRUCTION OF SPACE-BASED ASSETS

The increasing dependence of contemporary societies on space-based technologies has made the protection of satellites and their supporting infrastructure an important concern of international law, international security and humanitarian protection. Space-based assets, including communication satellites, navigation and timing systems, meteorological satellites, Earth-observation platforms

⁴⁶ Outer Space Treaty art III; UN Charter arts 2(4) and 51; Additional Protocol I arts 48, 51, 52 and 57.

⁴⁷ ICRC, *Preliminary Recommendations on Reducing Space Threats* (*supra*).

and associated ground facilities, support numerous civilian and military activities. Their importance extends beyond the conduct of military operations to the functioning of essential civilian infrastructure, including telecommunications, electricity distribution, transportation, banking, healthcare, environmental monitoring and emergency response. Consequently, interference with, damage to, destruction of or disabling of space-based assets during armed conflict may produce consequences that extend far beyond the immediate military objective, potentially affecting civilian populations and essential services across national boundaries.⁴⁸

The International Committee of the Red Cross (ICRC) has expressed concern that military operations directed against space systems may disrupt essential civilian services because of the increasing convergence between military and civilian uses of satellite technologies. According to the ICRC, military forces increasingly depend on space-based capabilities, while civilian institutions and commercial operators rely on many of the same systems for essential services.⁴⁹ This interdependence creates a significant humanitarian challenge: an operation intended to impair an adversary's military capabilities may simultaneously disrupt services upon which civilians depend for communication, transportation, healthcare, access to information and other basic needs.

Interference with space-based assets may occur through different means, including electronic interference, cyber operations, disruption of satellite command-and-control systems, physical attacks against satellites and attacks against ground-based infrastructure supporting satellite operations. The consequences depend on the nature of the operation, the affected system, the duration of the disruption, the extent of civilian dependence on the system and the availability of alternative services.⁵⁰ Some forms of interference may produce temporary service interruptions, while the destruction of a satellite or supporting infrastructure may result in prolonged disruption and wider consequences for interconnected systems. Destructive operations may also generate space debris, potentially threatening other satellites and increasing the risks associated with the long-term use of particular orbital environments.⁵¹

The legal implications of these consequences must be considered within the framework of existing international law. The Outer Space Treaty 1967, the Charter of the United Nations and international humanitarian law provide important legal foundations for assessing military activities involving space systems. In particular, the principles of distinction, proportionality and precaution under international humanitarian law are relevant where interference with or destruction of space-based assets occurs in the context of an armed conflict.⁵ The existence of military uses for a particular satellite does not automatically remove the legal protection of all civilian services provided through it, nor does the absence of physical destruction necessarily mean that an operation cannot cause serious humanitarian harm.

This section examines the principal consequences of interference with or destruction of space-based assets, with particular emphasis on civilian infrastructure, essential public services, humanitarian operations, environmental sustainability, international security and the application of international humanitarian law.

2.2 Disruption of Telecommunications and Communication Infrastructure

One of the most immediate consequences of interference with space-based assets is the disruption of telecommunications and communication infrastructure. Communication satellites support services in geographically remote areas, facilitate international connectivity and provide alternative communication channels where terrestrial networks are unavailable, damaged or inadequate. They may also support emergency communications, maritime operations, aviation services and communication networks used by humanitarian organisations.⁵²

During armed conflict, the disruption of communication satellites may impair the ability of civilians to communicate with family members, obtain emergency information, contact medical services and receive warnings concerning impending dangers. Communities in areas where terrestrial telecommunications infrastructure has been damaged or is limited may be particularly vulnerable because satellite services can provide an important alternative means of communication.

⁴⁸ International Committee of the Red Cross (ICRC), *The Potential Human Cost of the Use of Weapons in Outer Space and the Protection Afforded by International Humanitarian Law* (ICRC Position Paper, 2022), available at ICRC Position Paper on Weapons in Outer Space.

⁴⁹ ICRC, *Protecting Essential Civilian Services on Earth from Disruption by Military Space Operations* (25 June 2024), available at ICRC Report on Civilian Services and Military Space Operations.

⁵⁰ ICRC, *Constraints under International Law on Military Operations in Outer Space during Armed Conflicts* (5 May 2022), available at ICRC Working Paper on Military Operations in Outer Space.

⁵¹ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (adopted 19 December 1966, opened for signature 27 January 1967, entered into force 10 October 1967) 610 UNTS 205, arts III and IX; Charter of the United Nations (adopted 26 June 1945, entered into force 24 October 1945) 1 UNTS XVI, arts 2(4) and 51; Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I) (adopted 8 June 1977, entered into force 7 December 1978) 1125 UNTS 3, arts 48, 51, 52 and 57.

⁵² ICRC, *Protecting Essential Civilian Services on Earth from Disruption by Military Space Operations* (supra).

The consequences may extend to public institutions and essential service providers. Hospitals may experience difficulties communicating with referral centres, emergency responders may face delays in coordinating assistance, and humanitarian organisations may encounter obstacles in maintaining contact with field personnel. Businesses and public authorities may also experience interruptions where their communication systems depend on affected satellite services.

The humanitarian significance of these disruptions lies in their potential to impede access to information and assistance during periods of heightened civilian vulnerability. The ICRC has emphasised that the disruption of space-based services may affect the delivery of humanitarian assistance and the functioning of essential civilian services on Earth.⁵³ The seriousness of the consequences depends on the availability of alternative communication channels, the duration of the interruption and the extent to which affected communities rely on the particular satellite system.

From a legal perspective, the consequences of interference with communications infrastructure may be relevant to the assessment of civilian harm under international humanitarian law. Where an operation occurs during an armed conflict, those planning or deciding upon an attack must consider the reasonably foreseeable incidental effects on civilians and civilian objects in accordance with the applicable rules. Article 57 of Additional Protocol I to the Geneva Conventions requires feasible precautions to avoid, and in any event minimise, incidental civilian harm. Accordingly, the assessment of a military operation against a communication satellite should not be confined automatically to the physical condition of the satellite; it may also need to consider the foreseeable consequences for civilian communications and essential services.

However, not every communication disruption constitutes an attack or necessarily violates international humanitarian law. The legal assessment depends on the nature of the conduct, the applicable rules and the circumstances of the operation. Nevertheless, the potential humanitarian consequences demonstrate why civilian communications should receive careful consideration in the planning and assessment of military activities involving space systems.

2.3 Disruption of Navigation, Positioning and Timing Systems

Navigation and timing satellites provide services that are essential to numerous civilian activities. Global navigation satellite systems support positioning, navigation and timing functions used in aviation, maritime transportation, road logistics, agriculture and emergency response. Their timing functions are also important to the synchronisation of telecommunications networks, financial systems and certain electricity infrastructure.⁵⁴

Interference with these systems may therefore produce consequences extending beyond the immediate loss of navigation information. For example, disruptions affecting satellite navigation may complicate the operation of transport systems that depend on accurate positioning. Aviation and maritime operators may need to rely on alternative navigation arrangements, while logistics providers may experience difficulties in tracking vehicles, coordinating deliveries and maintaining operational schedules.

The timing functions of satellite systems are equally important. Certain communications networks, financial systems and electricity infrastructure rely on precise time synchronisation. A disruption to satellite timing services may therefore affect the operation or reliability of systems that depend on accurate timing information, particularly where alternative arrangements are limited or unavailable. The precise effects will vary according to the design of the affected infrastructure, its dependence on satellite signals and the availability of backup systems.⁵⁵

Such disruptions may also have humanitarian implications. Delays in transporting medical supplies, difficulties coordinating emergency responses and interruptions to the movement of essential goods can affect civilian welfare during armed conflict. Where navigation services support humanitarian transportation, interference may complicate the delivery of relief supplies to affected communities.

The legal significance of these consequences is particularly apparent where military operations affect systems serving both military and civilian users. Under Article 52(2) of Additional Protocol I, an object may qualify as a military objective only if it satisfies the applicable criteria concerning its contribution to military action and the definite military advantage anticipated from its destruction, capture or neutralisation.⁵⁶ Even where a particular space-based asset qualifies as a military objective, the operation remains subject to the principles of proportionality and precaution.

Consequently, the military utility of a navigation satellite does not eliminate the need to assess the foreseeable civilian consequences of interfering with it. The relevant legal analysis must consider the particular target, the expected military advantage, the reasonably foreseeable civilian harm and the feasible precautions available in the circumstances.

⁵³ ICRC, 'War, Law and Outer Space: Pathways to Reduce the Human Cost of Military Space Operations' (15 August 2023), available at ICRC Analysis of Humanitarian Consequences of Military Space Operations.

⁵⁴ ICRC, *The Potential Human Cost of the Use of Weapons in Outer Space*.

⁵⁵ *ibid*.

⁵⁶ Protocol I art 52(2).

2.4 Effects on Electricity Distribution and Critical Infrastructure

Space-based services contribute to the monitoring, coordination and operation of certain critical infrastructure systems, particularly those that rely on satellite communications, remote sensing or precise timing. Electricity networks, telecommunications systems, water-management facilities and other infrastructure may use satellite services as part of their operational arrangements.⁵⁷

Interference with the space-based services supporting these systems may therefore impair particular functions, depending on the technical configuration of the infrastructure. For example, disruption of satellite communications may affect remote monitoring or communications with facilities in geographically isolated areas. Interference with timing signals may also affect components of infrastructure that depend on precise synchronisation.

Nevertheless, it is important to avoid assuming that the disruption of a satellite will necessarily cause a nationwide electricity blackout or the collapse of an entire infrastructure network. The consequences depend on the extent of the system's reliance on the affected satellite, the availability of terrestrial alternatives, the effectiveness of backup arrangements and the duration of the interruption.⁵⁸

Where disruption does affect electricity, water or sanitation services, the humanitarian consequences may be considerable. Electricity is essential to the functioning of hospitals, water-treatment facilities, food-storage systems and emergency services. Interruptions to water distribution and sanitation can increase public-health risks, while prolonged electricity outages may impair medical treatment and the preservation of essential supplies.

The relationship between satellite disruption and harm to civilian infrastructure therefore requires a context-specific assessment. The destruction of a space-based asset may be the initial event, but the resulting effects can extend through interconnected civilian systems. Where such effects are reasonably foreseeable, they may be relevant to the application of the rules governing proportionality and precautions in attack.⁵⁹

From a policy perspective, these risks support stronger resilience measures for critical infrastructure, including diversified communications arrangements, alternative timing sources and contingency planning for disruptions affecting space-based services. Such measures cannot eliminate every risk, but they may reduce the likelihood that interference with a single satellite system will produce widespread civilian disruption.

2.5 Consequences for Healthcare and Medical Services

Healthcare infrastructure may be affected by the disruption of space-based communication, navigation and Earth-observation services. Medical institutions and emergency-response organisations may rely on satellite connectivity to communicate with remote facilities, coordinate assistance, monitor conditions in affected areas and support the movement of personnel and medical supplies.⁶⁰ In armed-conflict situations, where terrestrial infrastructure may already have been damaged, the loss of satellite services can compound existing difficulties. Emergency medical teams may encounter communication problems, humanitarian organisations may experience delays in coordinating operations, and facilities in remote areas may have fewer alternative means of maintaining connectivity.

Satellite navigation may also contribute to the transportation of medical personnel and supplies, while Earth-observation services can assist humanitarian organisations in identifying affected areas and assessing the extent of damage to infrastructure. The disruption of these capabilities may consequently impede aspects of humanitarian response, particularly where alternative sources of information and communication are limited.⁶¹

The potential effects on healthcare must be considered in light of the special protections afforded to medical units, medical personnel and medical transports under international humanitarian law. The Geneva Conventions of 1949 and Additional Protocol I establish protections for medical activities, subject to the applicable legal conditions.⁶² Although these protections do not automatically confer the legal status of a specially protected medical object on every satellite that supports healthcare, the foreseeable consequences of disrupting services essential to medical activities may be relevant to the legal assessment of a military operation.

Where an attack against a space-based asset is expected to impair civilian medical services, the responsible decision-makers must consider the applicable obligations under international humanitarian law, including the principles of distinction, proportionality and

⁵⁷ ICRC, *Military Operations in Space*, available at ICRC Overview of Military Operations in Space.

⁵⁸ ICRC, *Protecting Essential Civilian Services on Earth from Disruption by Military Space Operations* (*supra*).

⁵⁹ Protocol I arts 51(5)(b) and 57.

⁶⁰ ICRC, *Protecting Essential Civilian Services on Earth from Disruption by Military Space Operations* (*supra*).

⁶¹ *Ibid.*

⁶² Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (adopted 12 August 1949, entered into force 21 October 1950) 75 UNTS 31, arts 19–26; Geneva Convention relative to the Protection of Civilian Persons in Time of War (adopted 12 August 1949, entered into force 21 October 1950) 75 UNTS 287, arts 18–22; Protocol I arts 12, 15 and 21.

precaution. The extent of the expected harm, the military advantage anticipated and the feasible measures available to minimise civilian harm will be important to the assessment.

The humanitarian implications also support practical measures to improve the resilience of medical and emergency communications. Where feasible, alternative communication systems and contingency arrangements may reduce the risk that interference with space infrastructure will prevent civilians from obtaining essential medical assistance.

2.6 Disruption of Banking, Financial Services and Commercial Activities

Modern financial systems depend on complex digital infrastructure, secure communications and accurate timing. Satellite-based timing and communication services may support certain banking transactions, financial-market operations and the synchronisation of distributed technological systems.⁶³ Interference with the relevant space-based services may therefore affect some financial and commercial activities, depending on the architecture of the affected systems and the availability of alternative arrangements.

Potential consequences include delays in particular transactions, disruptions to communication between facilities, difficulties coordinating logistics and interruptions to services that rely on satellite connectivity. Businesses operating in remote locations may be particularly dependent on satellite communication where terrestrial alternatives are unavailable.

The consequences may also extend indirectly to civilian welfare. Disruptions to commercial logistics can affect the movement of food, medicines, fuel and other essential goods. Where businesses and public institutions experience prolonged service interruptions, the effects may contribute to wider economic instability and complicate the delivery of essential services.

However, not every financial or commercial loss resulting from interference with a satellite necessarily constitutes legally cognisable civilian harm for the purposes of the proportionality rule under international humanitarian law. The legal treatment of economic consequences, indirect effects and damage to civilian objects depends on the applicable rule and the circumstances.⁶⁴ It is therefore necessary to distinguish between the broader economic impact of a military operation and the categories of incidental harm that must be considered under a particular legal obligation.

Nevertheless, the dependence of financial and commercial infrastructure on space-based services reinforces the importance of assessing the foreseeable consequences of military operations against dual-use systems. It also supports the development of contingency arrangements, diversified infrastructure and appropriate international cooperation to reduce the risk of widespread disruption.

2.7 Disruption of Humanitarian Assistance and Disaster Response

Humanitarian organisations increasingly rely on satellite communications, navigation and Earth-observation services to conduct operations in areas affected by armed conflict, natural disasters and other emergencies. These services can support needs assessments, geographical mapping, movement coordination, communications with field personnel and the delivery of relief supplies.⁶⁵

Interference with or destruction of the relevant space-based assets may therefore hinder humanitarian operations at a time when civilian needs are particularly acute. The loss of satellite imagery may complicate the assessment of damage to infrastructure, while communication disruptions may impede coordination between relief teams and affected communities. Difficulties with navigation services may also complicate the movement of humanitarian personnel and supplies in areas where terrestrial infrastructure has been damaged.

These effects may be especially serious where humanitarian organisations operate in remote areas or where armed conflict has already disrupted conventional communication networks. The resulting difficulties can reduce the speed and effectiveness of relief operations, potentially prolonging the period during which civilians lack access to food, water, medical assistance and other essential supplies.⁶⁶

International humanitarian law imposes obligations concerning humanitarian relief and the protection of persons affected by armed conflict, subject to the relevant legal conditions. Additional Protocol I contains provisions relating to humanitarian relief actions and personnel involved in their delivery.⁶⁷ The applicability of these rules depends on the circumstances, including the nature of the conflict, the status of the relevant actors and the requirements of the particular provision.

The fact that a satellite supports humanitarian operations does not automatically make it immune from every form of military interference. Nevertheless, where a military operation is expected to disrupt services essential to humanitarian relief, the foreseeable consequences may be relevant to the application of the rules governing civilian harm and precautions in attack.

⁶³ ICRC, *The Potential Human Cost of the Use of Weapons in Outer Space* (supra).

⁶⁴ Protocol I arts 51(5)(b) and 57; ICRC, *Constraints under International Law on Military Operations in Outer Space during Armed Conflicts*.

⁶⁵ ICRC, *Protecting Essential Civilian Services on Earth from Disruption by Military Space Operations* (supra).

⁶⁶ ICRC, *War, Law and Outer Space: Pathways to Reduce the Human Cost of Military Space Operations*.

⁶⁷ Protocol I arts 70 and 71.

The ICRC has accordingly recommended that States cooperate to increase the resilience of satellite services supporting humanitarian relief and emergency response during armed conflict and other emergencies.⁶⁸ Such resilience measures can help reduce the humanitarian consequences of interference with space infrastructure, although they cannot replace compliance with international legal obligations.

2.8 Creation of Space Debris and Long-Term Environmental Consequences

One of the most serious consequences of the physical destruction of space-based assets is the potential creation of space debris. Destructive collisions involving satellites or the use of kinetic anti-satellite capabilities may generate fragments that remain in orbit and pose risks to other operational spacecraft. Depending on their altitude, size, velocity and orbital characteristics, such fragments may remain in space for varying periods and threaten the safety of satellites used for civilian, commercial, scientific and military purposes.⁶⁹

The creation of debris may therefore extend the consequences of a military operation beyond the immediate target. Fragments generated by the destruction of one satellite may threaten unrelated spacecraft, including those operated by States that are not parties to the conflict. A resulting collision may generate additional fragments, potentially increasing the risks to other space objects and complicating the safe use of particular orbital regions.⁷⁰

The humanitarian significance of space debris arises partly from the dependence of civilian infrastructure on the continued availability of space-based services. Damage to communication satellites, navigation systems or Earth-observation platforms may impair services supporting transportation, emergency communications, weather forecasting and humanitarian response. Thus, the environmental consequences of destructive military operations in orbit may have indirect effects on civilians on Earth.

The ICRC has expressed concern that kinetic attacks against space objects could generate substantial quantities of debris, with unpredictable consequences for other satellites and the civilian services they provide. It has emphasised that the risk of debris and the foreseeable long-term consequences for civilian infrastructure should be considered when assessing the lawfulness of attacks against military objectives in space.⁷¹

Article IX of the Outer Space Treaty requires States Parties to conduct their activities in outer space with due regard to the corresponding interests of other States Parties and provides for international consultation where potentially harmful interference is anticipated. The Treaty also establishes broader obligations concerning international responsibility for national space activities. These provisions provide a relevant legal foundation for addressing risks associated with space activities, although they do not constitute a complete code governing the environmental consequences of military operations during armed conflict.

International humanitarian law is also relevant where an attack is expected to create debris that may harm civilian or dual-use space objects. The principles of proportionality and precaution require an assessment of the reasonably foreseeable consequences of the operation under the applicable legal rules.⁷² Where feasible, the availability of less harmful alternatives may be relevant to the precautions that must be taken.

The long-term implications extend beyond the immediate parties to a conflict. Because outer space is used by many States and commercial operators, the consequences of debris-generating activities may affect the shared space environment and the future availability of satellite services. This strengthens the case for international cooperation, responsible behaviour and measures designed to minimise debris-generating activities.

2.9 Consequences for Weather Forecasting, Environmental Monitoring and Disaster Management

Meteorological and Earth-observation satellites provide information that supports weather forecasting, environmental monitoring, agricultural planning and disaster management. Their services can assist authorities in monitoring severe weather, assessing flooding, observing environmental changes and identifying areas affected by natural disasters or armed conflict.⁷³

Interference with these systems may reduce the availability or timeliness of information needed by civilian authorities and humanitarian organisations. Disruptions to weather-related satellite services may complicate certain forecasting and monitoring activities, while the loss of Earth-observation data may impede assessments of damage to infrastructure, agricultural conditions and environmental hazards.

The consequences depend on the affected satellite, the functions it performs and the availability of alternative data sources. A disruption to one satellite does not necessarily eliminate the capacity to forecast weather or monitor the environment because such

⁶⁸ ICRC, *Preliminary Recommendations on Reducing Space Threats* (2023), available at ICRC Preliminary Recommendations on Reducing Space Threats

⁶⁹ ICRC, *ICRC Observations on the Consultants' Report* (supra).

⁷⁰ *Ibid.*

⁷¹ *Ibid.*

⁷² Protocol I arts 51(5)(b) and 57; ICRC, *ICRC Observations on the Consultants' Report* (supra).

⁷³ ICRC, *Protecting Essential Civilian Services on Earth from Disruption by Military Space Operations* (supra).

activities may rely on several satellites, ground-based observations and other data sources. Nevertheless, the loss of particular capabilities can reduce the completeness, continuity or accuracy of available information.

During armed conflict, these effects may compound existing civilian vulnerabilities. Reduced access to environmental information may complicate disaster preparedness, the assessment of hazardous conditions and the planning of humanitarian relief. Agricultural monitoring and related services may also be affected where they depend on the availability of particular satellite data.

The legal consequences of interfering with meteorological or Earth-observation satellites depend on the circumstances and the applicable rules. Where the relevant asset is a civilian object, it is protected against direct attack unless and for such time as it qualifies as a military objective under the applicable criteria.⁷⁴ Even where a satellite qualifies as a military objective, the foreseeable incidental effects on civilian services remain relevant to the assessment of proportionality and precautions.

The potential loss of environmental information therefore provides an additional reason to strengthen safeguards for space-based systems that support civilian safety and disaster response.

2.10 Cross-Border Effects and Risks to International Peace and Security

Space-based assets frequently serve users across multiple countries. A communication satellite may provide services to several jurisdictions, while navigation systems and Earth-observation platforms may support civilian activities well beyond the territory of the State that owns or operates them.⁷⁵ Consequently, interference with or destruction of space infrastructure may produce cross-border consequences affecting States and civilian populations that are not directly involved in the conflict.

Such consequences may include the interruption of communications, difficulties with transportation and logistics, reduced access to environmental information and disruption of services supporting humanitarian operations. Space debris may also threaten satellites belonging to third States or commercial operators whose assets were not involved in the original military confrontation.

These cross-border effects can complicate international relations and increase the risk of escalation. A State whose civilian or commercial satellite services are disrupted may suspect that another State is responsible, particularly where attribution is technically difficult or the available information is incomplete. Disagreement over the source, purpose or legal character of the interference may generate diplomatic tensions and complicate efforts to resolve the incident peacefully.

The Charter of the United Nations provides a framework for addressing disputes and regulating the use of force in international relations. Article 2(4) prohibits the threat or use of force in international relations, while Article 33 encourages the peaceful settlement of disputes likely to endanger international peace and security. These provisions are relevant to disputes involving harmful interference with space-based assets, although the legal character of a particular operation must be determined on the facts. The Outer Space Treaty also promotes international cooperation and requires States to conduct space activities with due regard to the interests of other States Parties.⁷⁶ These obligations support the development of communication arrangements, transparency measures and cooperative mechanisms designed to reduce the risks of misunderstanding and harmful interference.

The cross-border nature of space infrastructure demonstrates that the consequences of military operations in outer space cannot be evaluated solely by reference to the immediate parties to a conflict. Effective risk reduction requires international cooperation and consideration of the wider civilian and environmental interests affected by the operation.

2.11 Legal Consequences: Distinction, Proportionality and Precautions in Attack

The consequences of interference with or destruction of space-based assets have direct implications for the application of international humanitarian law. The relevant legal assessment depends on the nature of the operation, the status of the target, the expected military advantage and the reasonably foreseeable effects on civilians and civilian objects.

First, the principle of distinction prohibits directing attacks against civilian objects as such. Article 52(2) of Additional Protocol I defines military objectives by reference to their effective contribution to military action and the definite military advantage anticipated from their destruction, capture or neutralisation in the circumstances ruling at the time. A satellite used for both civilian and military purposes must therefore be assessed under the applicable criteria. Its military use does not automatically render every related component or civilian service a military objective.

Secondly, the principle of proportionality prohibits attacks expected to cause incidental civilian death, injury or damage to civilian objects that would be excessive in relation to the concrete and direct military advantage anticipated.⁷⁷ Where an operation against a space-based asset is expected to disrupt civilian telecommunications, navigation, emergency response or other essential services, those reasonably foreseeable consequences may be relevant to the proportionality assessment. The assessment must be conducted in advance on the basis of the information reasonably available to those planning or deciding upon the attack.

Thirdly, the obligation to take precautions requires those planning or deciding upon an attack to take all feasible measures to avoid, and in any event minimise, incidental civilian harm. Article 57 of Additional Protocol I includes obligations concerning the

⁷⁴ Protocol I art 52(2).

⁷⁵ ICRC, *The Potential Human Cost of the Use of Weapons in Outer Space* (supra).

⁷⁶ Outer Space Treaty arts I, III and IX.

⁷⁷ *ibid* art 51(5)(b).

verification of targets, the choice of means and methods of attack, and the cancellation or suspension of an attack where the relevant legal conditions are met. In the context of space-based assets, the implementation of these obligations may require consideration of the target's functions, the civilian services it supports, the potential consequences of disabling it and the availability of feasible alternatives.

Fourthly, the prohibition of indiscriminate attacks may be relevant where the effects of an operation cannot be sufficiently limited or where the operation cannot be directed at a specific military objective in accordance with the applicable rules.⁷⁸ The assessment must be based on the characteristics and foreseeable effects of the particular operation rather than on a general assumption that every space-based operation is indiscriminate.

These rules demonstrate that the legal assessment of military operations involving outer space must account for more than the immediate physical effects on the targeted satellite. The wider consequences for civilian infrastructure may be relevant, depending on their foreseeability and the precise legal rule being applied. At the same time, not every indirect economic or social consequence necessarily falls within the same legal category. Careful analysis is required to distinguish foreseeable incidental harm to civilians and civilian objects from more remote consequences that may be relevant to policy considerations but not necessarily to a particular IHL test.

The ICRC has recommended that States refrain from conducting or supporting military operations designed or expected to disrupt, damage, destroy or disable space systems necessary for essential civilian services and the protection and functioning of persons and objects specifically protected under international law.⁷⁹ It has also recommended feasible segregation of military and civilian uses, identification of systems that should be spared from military operations, avoidance of debris-generating counterspace activities and increased resilience for satellite services supporting humanitarian relief and emergency response. These are institutional recommendations intended to strengthen protection; they should not be confused with a claim that each recommendation already constitutes an independent, universally binding treaty rule.

The legal and humanitarian implications of interference with space-based assets therefore reinforce the importance of applying existing international law carefully and developing supplementary measures to reduce foreseeable civilian harm.

Generally, interference with or destruction of space-based assets can produce consequences that extend far beyond the immediate military objective. The disruption of satellite communications, navigation and timing services may affect telecommunications, transportation, financial systems and certain critical infrastructure. Interference with space-based services may also impede healthcare, humanitarian assistance, environmental monitoring and disaster response. Where destructive operations generate space debris, the consequences may extend over time and threaten unrelated satellites and the civilian services they provide.

The severity of these effects depends on the nature of the affected system, the extent of civilian dependence on it, the duration of the disruption and the availability of alternative arrangements. Nevertheless, the increasing convergence of civilian and military uses of space technologies creates significant humanitarian risks that cannot be adequately assessed by considering only the immediate military target.

Existing international law provides important safeguards. The Outer Space Treaty establishes foundational principles governing space activities, the United Nations Charter regulates the threat or use of force, and international humanitarian law protects civilians and civilian objects during armed conflict. In particular, the principles of distinction, proportionality and precaution require careful assessment of the legal status of space-based assets and the reasonably foreseeable consequences of military operations affecting them.

Ultimately, protecting civilian infrastructure requires effective implementation of existing legal obligations, improved assessment of foreseeable civilian harm, greater international cooperation and stronger resilience for essential space-based services. States should also pursue practical measures that reduce the risks of debris generation, harmful interference and disruption to humanitarian operations. These measures are important not only for protecting civilians during armed conflict but also for preserving the long-term availability and sustainability of outer space for the benefit of the international community.

4. CONCLUSION

The increasing militarisation of outer space and the growing dependence of civilian infrastructure on space-based technologies have created significant legal, security and humanitarian challenges. Interference with or destruction of satellites and their supporting infrastructure can disrupt telecommunications, navigation, electricity distribution, banking, healthcare, humanitarian assistance and disaster management. Such consequences may extend beyond the immediate parties to an armed conflict, affecting civilian populations and essential services across national boundaries.

Although the Outer Space Treaty 1967, the United Nations Charter and international humanitarian law provide an important legal framework for regulating military activities in outer space, challenges remain concerning dual-use satellites, foreseeable indirect

⁷⁸ *ibid* art 51(4).

⁷⁹ ICRC, *Preliminary Recommendations on Reducing Space Threats* (*supra*).

civilian harm, space debris and the protection of essential civilian services. The principles of distinction, proportionality and precaution remain fundamental to protecting civilians and civilian objects during armed conflict, including military operations involving space-based assets.

Ultimately, effective protection of civilian infrastructure requires stricter implementation of existing international legal obligations, enhanced international cooperation, improved transparency and the development of additional safeguards addressing the distinctive risks of military space operations. Preserving the security and sustainability of outer space is essential not only for international peace and security but also for protecting civilian welfare and ensuring the continued availability of vital space-based services.

5. RECOMMENDATIONS

a) **Strengthening the Existing Legal Framework:**

States should ensure effective implementation of the Outer Space Treaty 1967, the United Nations Charter and international humanitarian law in military activities involving outer space.

b) **Developing Specific International Rules:**

The United Nations should promote the development of supplementary international rules addressing satellite interference, cyberattacks against space-based assets, and the protection of civilian infrastructure during armed conflict.

c) **Protecting Civilian Infrastructure:**

Parties to armed conflicts must comply strictly with the principles of distinction, proportionality and precaution when conducting military operations against space-based assets, particularly those supporting essential civilian services.

d) **Enhancing International Cooperation:**

States should strengthen information-sharing, transparency, confidence-building measures and diplomatic cooperation to prevent misunderstandings and reduce the risk of conflict in outer space.

e) **Preventing Harmful Space Debris:**

States should adopt and implement effective measures to prevent the creation of space debris resulting from anti-satellite weapons and other destructive military activities.

f) **Ensuring Accountability:**

States and responsible individuals should be held accountable, in accordance with applicable international law, for unlawful interference with or destruction of space-based assets that causes disproportionate civilian harm.

g) **Safeguarding Essential Services:** Governments should develop resilient backup systems for telecommunications, navigation, banking, electricity, healthcare and humanitarian operations to minimise civilian harm arising from disruptions to space-based services.

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