Group of Governmental Experts on Further Practical Measures for the Prevention of an Arms Race in Outer Space

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Verification for Outer Space Security*

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I. Introduction

1. The Group of Governmental Experts established under United Nations General Assembly resolution 77/250 on "Further practical measures for the prevention of an arms race in outer space" is mandated to "consider and make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including, inter alia, on the prevention of the placement of weapons in outer space".[1] In support of the work of the Group of Governmental Experts (GGE), this background paper provides an overview of the topic of verification for outer space security. The paper outlines the functions and principles of verification, takes stock of the existing verification toolbox before concluding with an illustrative compendium of verification practices across other arms control or disarmament agreements.

II. An overview of verification

2. Verification can generally be understood as an agreed process of collecting and assessing data with a view to informing judgements of a State's compliance with its treaty obligations. The process of verification can involve several activities typically entailing three phases: first, monitoring the activities of the parties to an agreement; second, undertaking technical analysis of information derived from monitoring; and third, drawing from the first two steps to reach a judgement as to whether a party is in compliance with its obligations.[2]

3. Verification inherently entails political as well as technical considerations. Although verification can draw from objective data, the determination of another States' compliance is

* The present document is being issued without formal editing.

[1] G.A. Res. 77/250, ¶8 (Dec. 30, 2022), https://undocs.org/A/RES/77/250.

[2] Almudena Azcárate Ortega & Victoria Samson (eds.), A Lexicon for Outer Space Security, UNIDIR 3.3.12 (2023) [hereinafter Space Security Lexicon] https://doi.org/10.37559/WMD/23/Space/05. See also Verification in All Its Aspects: Study on the Role of the United Nations in the Field of Verification, ¶12, U.N. Doc. A/45/372 (28 Aug. 1990) [hereinafter U.N. Doc. A/45/372] https://undocs.org/Home/Mobile?FinalSymbol=A%2F45%2F372&Language=E&DeviceType=Desktop&LangRequested=False.

frequently based on a political judgement that considers multiple factors including, but not necessarily limited to, the results of monitoring and assessment processes.[3]

4. Experience in other regimes suggests that a verification mechanism can benefit from clear treaty obligations around which a verification mechanism can be built. However, the absence of clear agreed treaty obligations does not preclude research into concepts or techniques for verification in advance of negotiated obligations. Rather, anticipatory research and dialogue on verification techniques can be complementary to the work of designing, strengthening and implementing future agreements without prejudging the outcomes of any future negotiation.[4]

A. Functions of verification

5. A verification mechanism for space security could serve a number of functions but first and foremost would enable an assessment of a State's compliance with its obligations under a specific treaty or agreement. Depending on the nature of a verification mechanism, certain provisions could provide additional benefits.

6. The verification process may generate confidence and decrease distrust amongst State Parties. Confidence can be built by including verification provisions that allow States to demonstrate their commitments clearly. Specific components of a verification regime also provide greater transparency and understanding between States. Certain provisions that establish cooperative arrangements between State Parties may provide procedures for dealing with uncertainties from unforeseen developments and false alarms.[5]

7. Verification provisions can also discourage non-compliance. For example, provisions such as guaranteed inspection rights and effective and robust monitoring systems may deter non-compliance if the political cost is deemed too high for State Parties, as evidence of non-compliance may be shared by States to public and international forums. Furthermore, an adequate verification regime may provide timely warnings of compliance problems. Providing timely warnings may deter non-compliance should States wishing to uphold the agreement decide to consult and clarify the activity in question, so as to assess diplomatic pathways towards preserving the agreement.

B. Principles of verification

8. Under the purview of the United Nations, States have developed broad principles on which verification should be based. In 1978, the General Assembly at its tenth special session included in its final document three paragraphs dedicated to verification.[6] This undertaking helped establish a widespread recognition that no verification regime will be perfect or comprehensively address issues but rather should be able to detect violations in a timely manner for State Parties to take appropriate action and to deter non-compliance.[7]

9. In 1988, the General Assembly adopted resolution 43/81 "Verification in all its aspects".[8] Part A of this resolution, "Compliance with arms limitation and disarmament agreements" demonstrated the critical relationship between effective verification and compliance and addressing concerns over non-compliance. Part B of the resolution "Study on the role of the United Nations in the field of verification" requested the Secretary-General to undertake, with the assistance of a group of qualified governmental experts, an in-depth study of the role of the United Nations in the field of verification. In accordance with the requests of the resolution a Group of Governmental Experts met and produced its report,

[3] Almudena Azcárate Ortega, Laetitia Cesari & James Revill, Constant Vigilance? Verification and Monitoring for Space Security, Space Dossier 8, UNIDIR (2023) [hereinafter UNIDIR Space Dossier 8], https://doi.org/10.37559/WMD/23/Space/04.

[4] U.N. Doc. A/45/372, supra note 2, ¶13.

[5] U.N. Doc. A/45/372, supra note 2, ¶28-30.

[6] U.N. GAOR, 10th Special Sess., 27th plen. mtg., ¶¶ 31, 50, 92, U.N. Doc. A/RES/S-10/2 (30 June 1978), https://digitallibrary.un.org/record/218448?ln=en&v=pdf.

[7] U.N. Doc. A/45/372, supra note 2, ¶35-38.

[8] G.A. Res. 43/81, 43rd Sess, on Verification in all its aspects (7 Dec. 1988), https://undocs.org/Home/Mobile?FinalSymbol=A%2FRES%2F43%2F81&Language=E&DeviceType=Desktop&LangRequested=False.

"Study on the role of the United Nations in the field of verification".[9] The 1990 General Assembly resolution 45/65, adopted without a vote, welcomed the report and requested the Secretary-General to take appropriate action within available resources on the recommendations of the Group.[10]

10. In 1988, the Disarmament Commission developed 16 principles of verification, building upon the work of the General Assembly's tenth special session.[11] These principles of verification were also endorsed by the General Assembly in Part B of resolution 43/81 and can serve as useful guidelines in the negotiation of future agreements. The 16 principles are as follows:

1. Adequate and effective verification is an essential element of all arms limitation and disarmament agreements.

2. Verification is not an aim in itself, but an essential element in the process of achieving arms limitation and disarmament agreements.

3. Verification should promote the implementation of arms limitation and disarmament measures, build confidence among States and ensure that agreements are being observed by all parties.

4. Adequate and effective verification requires employment of different techniques, such as national technical means, international technical means and international procedures, including on-site inspections.

5. Verification in the arms limitation and disarmament process will benefit from greater openness.

6. Arms limitation and disarmament agreements should include explicit provisions whereby each party undertakes not to interfere with the agreed methods, procedures and techniques of verification, when these are operating in a manner consistent with the provisions of the agreement and generally recognized principles of international law.

7. Arms limitations and disarmament agreements should include explicit provisions whereby each party undertakes not to use deliberate concealment measures which impede verification of compliance with the agreement.

8. To assess the continuing adequacy and effectiveness of the verification system, an arms limitation and disarmament agreement should provide for procedures and mechanisms for review and evaluation. Where possible, time-frames for such reviews should be agreed in order to facilitate this assessment.

9. Verification arrangements should be addressed at the outset and at every stage of negotiations on specific arms limitation and disarmament agreements.

10. All States have equal rights to participate in the process of international verification of agreements to which they are parties.

11. Adequate and effective verification arrangements must be capable of providing, in a timely fashion, clear and convincing evidence of compliance or non-compliance. Continued confirmation of compliance is an essential ingredient to building and maintaining confidence among the parties.

12. Determinations about the adequacy, effectiveness and acceptability of specific methods and arrangements intended to verify compliance with the provisions of an arms limitation and disarmament agreement can only be made within the context of that agreement.

13. Verification of compliance with the obligations imposed by an arms limitation and disarmament agreement is an activity conducted by the parties to an arms limitation and

[9] U.N. Doc. A/45/372, supra note 2.

[10] G.A. Res. 45/65, 45th Sess, on Study on the role of the United Nations in the field of verification (4 Dec. 1990), https://digitallibrary.un.org/record/104826?ln=en&v=pdf.

[11] U.N. Secretary-General, A compilation of all texts of principles, guidelines or recommendations on subject items adopted unanimously by the Disarmament Commission, U.N. Doc. A/51/182/Rev.1 (9 June 1999), https://digitallibrary.un.org/record/278370?ln=en&v=pdf.

disarmament agreement or by an organization at the request and with the explicit consent of the parties, and is an expression of the sovereign right of States to enter into such arrangements.

14. Requests for inspections or information in accordance with the provisions of an arms limitation and disarmament agreement should be considered as a normal component of the verification process. Such requests should be used only for the purposes of the determination of compliance, care being taken to avoid abuses.

15. Verification arrangements should be implemented without discrimination, and, in accomplishing their purpose, avoid unduly interfering with the internal affairs of State parties or other States, or jeopardizing their economic, technological and social development.

16. To be adequate and effective, a verification regime for an agreement must cover all relevant weapons, facilities, locations, installations and activities.

III. Verification for outer space security

11. Despite the challenges of establishing adequate and effective verification regimes, a number of verification tools and techniques for verification have been developed since the late 1980s and lessons have been learned from experiences with verification-related mechanisms.[12]

12. Furthermore, the international governance framework for outer space already includes certain measures that could feed into any verification mechanism and inform future efforts towards establishing any agreements. In understanding the current toolbox and taking stock of existing tools and processes, States Parties to relevant agreements can take advantage of current legal mechanisms and established State practice to strengthen and develop regimes for existing and future obligations.

A. Existing means and mechanisms for verification of outer space activity

13. Adequate and effective verification regimes are dependent upon the level of confidence and trust a State has in its own means of collecting accurate and timely data, as well as in the information or data acquired through cooperative arrangements. To this end, it is important to understand the current toolbox that could help in verifying outer space activity.

- Space Situational Awareness (SSA): generally understood to be the knowledge, characterization and the practice of tracking space objects and their operational environment to understand their current position, as well as to predict their future positions.[13] SSA encompasses a wide range of data gathering practices including: ground-based radar, telescopic observation, space-based optical sensors, and radio frequency data.[14] These data practices work in conjunction to provide among other things satellite tracking, space surveillance, space overflight information, re-entry tracking, detection and cataloguing of objects, and orbital awareness.[15] Despite the advancements of SSA, it is not without its challenges. Cube- and micro-satellites as well as large constellations and small-scale debris are more difficult to track using SSA. States also face issues over maintaining persistent and comprehensive monitoring of space objects. States also need to ensure the chain of custody of any SSA data and strengthen mechanisms to detect false and corrupted forms of data.[16]

[12] UNIDIR Space Dossier 8, supra note 3.

[13] Space Security Lexicon, supra note 2, at 2.3.1. https://doi.org/10.37559/WMD/23/Space/05. See also Space Situational Awareness, Aerospace Corporation, https://aerospace.org/ssi-space-situational-awareness (last visited July 13, 2024).

[14] Yang Shihang, Xin Jin, Baichun Gong, & Fei Han, Space-Based Passive Orbital Maneuver Detection Algorithm for High-Altitude Situational Awareness, 11 Aerospace 563 (2024), https://doi.org/10.3390/aerospace11070563.

[15] For more information on the SSA capabilities of certain States, see Table 2 in UNIDIR Space Dossier 8, supra note 3.

[16] UNIDIR Space Dossier 8, supra note 3.

- Data Exchanges, Declarations, and Notifications: making information on space activities available through some form of data exchanges, declarations and/or notifications would constitute an integral part of a verification process. Exchanges of data on location, number, characteristics and status of equipment limited by any future treaty, as well as the notifications of launches can support SSA data in providing a more holistic view of a State's space activity. Moreover, proposals, such as UN General Assembly resolution 62/101[17] on recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects and the 2013 report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities[18], have been put forward to strengthen data exchanging practices by cataloguing space objects in a manner that provides more detailed information than that found in the UN Register, including information on the geostationary orbit location, changes of status in operations, approximate date of decay or re-entry, and the date and physical conditions of moving a space object to a disposal orbit.[19] However, submitted information may be difficult to verify independently, and any information exchanged may be either unwittingly or unscrupulously subject to gaps or omissions.
- Earth Observation: process of acquiring observations of the Earth's surface and atmosphere via remote sensing.[20] Earth observation data is most common in the form of digital imagery provided by satellites, although aerial platforms and drones can also sometimes be used. Imagery may be gathered through passive systems which operate in the visible, infrared, thermal infrared, and microwave portions of the electromagnetic spectrum and are designed to detect electromagnetic emissions from constituents of the Earth's surface and atmosphere through techniques, such as multi-spectral, panchromatic, hyper-spectral.[21] However, most passive sensors cannot penetrate dense cloud coverage and thus have limitations. Imagery may also be collected through active means, such as Synthetic Aperture Radar, where a transmitter sends out a specific electromagnetic signal and a sensor receives the interaction of the signal with the Earth's surface.[22] Most active systems operate in the microwave band of the electromagnetic spectrum giving them the ability to penetrate the atmosphere under most conditions.
- On-site Activities: like data exchanges, on-site activities can support other data collecting techniques and help reach a more comprehensive understanding of a State's space activity and corroborate other forms of data. On-site activity could include inspections of facilities[23], interviews with facility personnel, short notice inspections, inspection of launch vehicles or spacecraft, and monitoring of launch during both pre-launch and on-launch stages.[24] On-site activities, however, are the most intrusive component of verification regimes. As such, on-site activities would require consideration of several factors including, among other things, rules and procedures for on-site activities, access agreements, equipment, confidentially clauses, inspectorate trainings, and the protection of proprietary information.

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[17] G.A. Res. 62/101, 62nd Sess. On Recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects (17 Dec. 2007), https://digitallibrary.un.org/record/614200?v=pdf.

[18] Report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities, U.N. Doc. A/68/189 (29 July 2013), https://digitallibrary.un.org/record/755155?ln=en&v=pdf.

[19] UNIDIR Space Dossier 8, supra note 3.

[20] Space Security Lexicon, supra note 2.

[21] Newcomers Earth Observation Guide, European Space Agency, https://business.esa.int/newcomers-earth-observation-guide#ref_2.1 (last visited 13 July 2024).

[22] Id.

[23] Recent examples of voluntary on-site visits include the international observation visit to the Naro Space Center as organized through the Hague Code of Conduct against Ballistic Missile Proliferation, Ministry of Foreign Affairs of the Republic of Korea (21 Mar. 2024), https://www.mofa.go.kr/eng/brd/m_5676/view.do?seq=322482&srchFr=&srchTo=&srchWord=&srchTp=&multi_itm_seq=0&itm_seq_1=0&itm_seq_2=0&company_cd=&company_nm=.

[24] UNIDIR Space Dossier 8, supra note 3.

- Open-source Data: the growth of publicly available information, especially in the form of digital information, has increased the amount and types of data to be considered in any future verification regime. Moreover, open-source data has also facilitated global citizen monitoring and open-source intelligence analyst communities. Although such communities and methods cannot serve as a substitute for formal verification processes, they can help fill gaps in monitoring capacities as well as provide global coverage on a range of space activity across all vectors. Open-source data can include a range of sources including: public information, catalogues and databases on the movement of satellite or other space assets; public information on the movements of military units or personnel associated with military space programmes; patent data pertaining to space technologies; social media; global trade and economic data relating to outer space technologies; and other official materials or documentation which may disclose information pertaining to space activities.[25] Open-source data and intelligence data are, however, not consistently available across all states. Moreover, the process of collecting open-source data varies with inconsistencies in chains of custody of data and potential for individual biases in the collection and interpretation of data. Therefore, States will need to carefully consider the extent to which open-source intelligence methods are integrated into a verification regime and what additional requirements this may entail.

14. As evidenced, there exists today a robust range of tools to support verification for outer space security. However, it is important to note the limitations of existing techniques and that none of the above tools or sources of data are significant as standalone measures. Political and regulatory circumstances may limit the availability of SSA data and Earth Observation data for those who do not have their own capabilities. Political inhibitions may also hinder exchanges in information and cooperative verification arrangements such as on-site activity. In the absence of some agreed mechanism for the findings of facts related to any allegation, States may find unilateral claims and declarations difficult to verify. In consideration of such limitations, establishing avenues for consultations may help States clarify information and it is important to use verification techniques in conjunction to help reinforce the process where there may be gaps and vulnerabilities.[26]

B. Possible verification-related provisions in existing international outer space law

15. Several provisions exist within the international legal space framework which can aid verification efforts. These include but are not limited to:

- Outer Space Treaty, article IX: the Outer Space Treaty[27] includes provisions for State Parties to undertake consultations should State Parties have "…reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties" or to request consultations in the event that State Parties have "…reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space".[28] The exchange of information that results from activating the consultations mechanism can aid in building confidence in relation to space activities.

- Outer Space Treaty, article X: the Outer Space Treaty includes provisions for State Parties to "…consider on a basis of equality any requests by other States Parties to the Treaty to be afforded an opportunity to observe the flight of space objects launched by those States. The nature of such an opportunity for observation and the conditions under which it could be afforded shall be determined by agreement between the States

[25] Id.
[26] Id.
[27] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410; 610 U.N.T.S. 205; 6 I.L.M. 386 [hereinafter Outer Space Treaty].
[28] Id., art. IX.

concerned."[29] This provision, while not as intrusive as on-site launch inspections, could provide the opportunity for States to generate confidence in their data collection, such as space situational awareness data, by collating data from one's own national technical means of verification and that of the other State, assuming the request has been granted. In the case of State Parties without their own means to observe space object flight, the provision affords the opportunity to coordinate such an observation.

- Outer Space Treaty, article XI: the Outer Space Treaty stipulates that State Parties, "…agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of [activities in outer space, including the moon and other celestial bodies]."[30] This provision supports information sharing and data exchange efforts between State Parties.
- Outer Space Treaty, article XII: the Outer Space Treaty includes provisions for on-site visits with respect to activity on celestial bodies. Specifically stating, "All stations, installations, equipment and space vehicles on the moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited."[31] Assuming the coordination of such on-site visits in the future took place, State Parties could generate greater confidence in other states' adherence to the obligation outlined in article IV forbidding, "the establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies".[32]
- Registration Convention, article VI: the Registration Convention[33] includes provisions for cooperative arrangements in the event that a State Party is unable to identify a space object which has caused harm or may cause harm. Specifically, "Where the application of the provisions of this Convention has not enabled a State Party to identify a space object which has caused damage to it or to any of its natural or juridical persons, or which may be of a hazardous or deleterious nature, other States Parties, including in particular States possessing space monitoring and tracking facilities, shall respond to the greatest extent feasible to a request by that State Party, or transmitted through the Secretary-General on its behalf, for assistance under equitable and reasonable conditions in the identification of the object. A State Party making such a request shall, to the greatest extent feasible, submit information as to the time, nature and circumstances of the events giving rise to the request."[34]
- Moon Agreement, article 5: the Moon Agreement[35] establishes provisions for information sharing and data exchange, specifically through requiring State Parties to give, to the greatest extent feasible and practicable, "information on the time, purposes, locations, orbital parameters and duration shall be given in respect of each mission to the moon as soon as possible after launching, while information on the results of each mission, including scientific results, shall be furnished upon completion of the mission."[36]
- Moon Agreement, article 15: the Moon Agreement establishes provisions for on-site visits specifically stating that, "…all space vehicles, equipment, facilities, stations and installations on the moon shall be open to other States Parties. Such States Parties

[29] Id., art. X.
[30] Id., art. XI.
[31] Id., art. XII.
[32] Id., art. IV.
[33] Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15.
[34] Id., art. VI.
[35] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3, 18 I.L.M. 1434 [hereinafter Moon Agreement].
[36] Id., art. 5.

shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited."[37] Furthermore, article 15 establishes provisions for consultations in the event that a State Party has reason to believe that another State Party is not fulfilling its obligations.

- ENMOD, article V: the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques[38] not only establishes the right to consultations if problems arise in relation to objectives of the Convention but also lays down a framework for any State Party to convene a Consultative Committee of Experts to make appropriate findings of fact and provide expert views relevant to any problem raised pursuant to paragraph 1 of article V of the Convention by the State Party requesting the convening of the Committee.[39]

IV. Verification across disarmament fields

16. Given the complexities that accompany verification, taking stock of verification-related provisions across different fields may help inform discussions in outer space security. The following table serves as an illustrative compendium of the verification components applied to other areas.[40]

[37] Id., art. 15.

[38] Convention on the Prohibition of Military or Any Hostile Use of Environmental Modification Techniques, May 18, 1977, 31 U.S.T. 333, 1108 U.N.T.S. 151.

[39] Id., art. V.

[40] This table draws from a larger compendium project undertaken by UNIDIR for the Group of Governmental Experts to further consider nuclear disarmament verification issues. Illustrative Compendium of Past and Present Verification Practices, UNIDIR, U.N. Doc. GE-NDVF/2022/WP.10 (Feb. 10, 2023).

Treaty	*Objectives and Definitions*	*Data Exchanges, Declarations, or Notifications*	*Inspections or Investigations*	*Monitoring*	*Consultative Mechanisms*
ABM Treaty, 1972-2002.[41]	The ABM Treaty limited the number of deployed ABM systems, prohibited national missile defenses and the deployment of ABM system components. The treaty described the parameters of ABM systems that were permitted.[42]	The ABM Treaty did not include declarations or routine notifications. The treaty made provisions for ad-hoc elimination and relocation notifications.		Parties agreed to use national technical means of verification (NTM). Parties committed not to interfere with the NTM of the other, nor impede verification by concealment measures.	Parties agreed that compliance concerns would be referred to the bilateral Standing Consultative Commission (SCC).
INF Treaty, 1987-2019.[43]	The INF Treaty eliminated and prohibited all deployed and non-deployed intermediate-range missiles and launchers. The treaty defined intermediate range missiles as ground-launched ballistic or cruise missiles with ranges of between 1,000-5,500km. The Treaty and MOU defined treaty-limited systems and terms (i.e., deployment area).	Under the INF Treaty, Parties provided detailed baseline information listing numbers, location, deployment areas, and technical data on systems and facilities. The treaty also included location restrictions for non-deployed treaty-limited systems. And parties were obliged to provide notifications on inter alia, data updates (changes in location, status, numbers) and eliminations.	The INF treaty made provision for extensive on-site routine and short-notice inspections including baseline inspections, closeout inspections, elimination inspections, quota inspections, and continuous portal monitoring inspections.	Parties agreed to use NTM of verification and committed not to interfere with the NTM of the other, nor impede verification by concealment measures. In addition, both parties agreed to continuous perimeter and portal monitoring.	Parties agreed that compliance concerns would be referred to the bilateral Special Verification Commission.

[41] For further information, see Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty), USSR-U.S., May 26, 1972, 944 U.N.T.S. 13, and Protocol to the ABM Treaty, USSR-U.S., July 3, 1974, 1042 U.N.T.S. 424, available at https://media.nti.org/documents/abm_treaty.pdf.

[42] See ABM Treaty, Id., art. II, https://media.nti.org/documents/abm_treaty.pdf

[43] For more information, see Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (with Memorandum of Understanding Regarding the Establishment of the Data Base for the Treaty Between the USSR and the U.S. on the Elimination of Their Intermediate-Range and Shorter-range missiles), USSR-U.S., Dec. 8, 1987, 1657 U.N.T.S. 2, available at https://media.nti.org/documents/inf_treaty.pdf, https://nuke.fas.org/control/inf/text/inf3.htm, https://nuke.fas.org/control/inf/text/inf3.htm.

Treaty	*Objectives and Definitions*	*Data Exchanges, Declarations, or Notifications*	*Inspections or Investigations*	*Monitoring*	*Consultative Mechanisms*
New START, 2010-2026.[44]	New START limits the number of deployed strategic nuclear delivery vehicle's (SNDVs) to 700, deployed warheads to	Under New START Parties are obliged to provide detailed baseline information listing numbers, types, locations and technical data related	New START includes provisions for extensive on-site inspections. The treaty	Parties agreed to use NTM and committed not to	Parties agreed that compliance concerns are to be referred to the
Treaty	Objectives and Definitions	Data Exchanges, Declarations, or Notifications	Inspections or Investigations	Monitoring	Consultative Mechanisms
	1,550, and deployed and non-deployed launchers to 800 units. The protocol defines treaty-limited systems, provided the procedure for determining the number of deployed intercontinental ballistic missile (ICBM) and submarine-launched ballistic missile (SLBM) warheads, and defined counting rules for bombers and their weapons.	to systems and facilities. Parties are also obliged to exchange telemetric data on some ballistic missile launches. The treaty further requires notifications on inter alia: data updates (changes in location, status, numbers); conversions and eliminations; new facilities; new types of SNDVs; changes to categorisation of facilities and deployed status of systems. New START includes location restrictions for deployed and non-deployed treaty-limited systems.	includes inspections to verify declared data (numbers, types, and the number of deployed warheads) of SNDVs at deployment sites. It also includes inspections at storage, conversion and elimination facilities and confirmed conversion and elimination of SNDVs. Challenge inspections are not included.	interfere with NTM of the other, nor impede verification by concealment measures.	Bilateral Implementation Commission.[45]
CWC, 1993.[46]	The CWC prohibits the development, production,	CWC States Parties are obliged to provide various declarations	The Verification Annex includes provisions for	Part III of the Verification Annex	Article IX includes provision for consultation and

[44] For more information, see the Treaty Between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (New START), Apr. 8, 2010, Rus.-U.S. See also Protocol to the New START, https://www.nti.org/wpcontent/uploads/2021/09/new_start_protocol.pdf.

[45] The Bilateral Implementation Commission was created by the START II Treaty, see Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms, Jan. 3 1993, Rus.-U.S., https://www.nti.org/wp-content/uploads/2021/09/start_2_treaty.pdf.

[46] For more information, see Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, opened for signature Jan. 13, 1993, 1975 U.N.T.S. 45, available at https://www.opcw.org/chemical-weapons-convention.

Treaty	*Objectives and Definitions*	*Data Exchanges, Declarations, or Notifications*	*Inspections or Investigations*	*Monitoring*	*Consultative Mechanisms*
	acquisition, stockpiling, retention, transfer or use of chemical weapons. The convention contains an intent-based definition of chemical weapons. Annex II identifies specific chemicals for the application of verification measures. Part I of the Verification Annex provides definitions of verification-specific terms.	including initial declarations and annual declarations of past activities.	onsite challenge inspections, which are available for clarifying and resolving issues concerning possible non-compliance. Challenge inspections have not been used, but mechanisms have been used to find facts related to an event and investigate allegations of CW use.	provides for continuous monitoring, including through the use of on-site instruments.	cooperation on any matter which may be raised relating to the object and purpose, or the implementation of the CWC.
BWC, 1972.[47]	The BWC prohibits the development, production,	No declarations are required under the BWC, but States Parties are	Article VI makes provision for States Parties to request	No international monitoring process per se.	Article V obligates States Parties to consult and cooperate in solving
Treaty	Objectives and Definitions	Data Exchanges, Declarations, or Notifications	Inspections or Investigations	Monitoring	Consultative Mechanisms
	acquisition, transfer, stockpiling and use of biological and toxin weapons. Article I contains an intent-based definition of biological and toxin weapons.	politically bound to submit CBMs covering biodefense and outbreaks of disease, among other things, were introduced in 1987 to prevent or reduce the occurrence of ambiguities, doubts, and suspicions around BWC compliance.	the UN Security Council investigate alleged breaches of the BWC. Article V also includes provision for consultation and cooperation through appropriate international procedures within the UN framework.	Monitoring is largely undertaken through national technical means.	any problems which may arise in relation to the objective of, or in the application of the provisions of, the Convention.

[47] For more information, see The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, opened for signature Apr. 10, 1972, 1015 U.N.T.S. 163, available at https://www.un.org/disarmament/biological-weapons/.

Treaty	*Objectives and Definitions*	*Data Exchanges, Declarations, or Notifications*	*Inspections or Investigations*	*Monitoring*	*Consultative Mechanisms*
CTBT, 1996.[48] (Not entered into force)	The CTBT prohibited nuclear explosions by everyone, everywhere. The treaty does not explicitly define a nuclear explosion.	The CTBT does not require declarations, but States will be obliged to provide voluntary notifications of chemical explosions greater than 300 tonnes TNT equivalent. Under the treaty States, will be obliged to exchange certain forms of seismological, hydroacoustic and infrasound data.	The treaty contains a mechanism for conducting ad-hoc on-site inspections if necessary.	Parties agreed to use NTM and committed not to interfere with NTM of others. The International Monitoring System and the International Data Centre provide additional information relevant to monitoring.	Parties agreed that compliance concerns would be referred to the multilateral Comprehensive Nuclear Test-Ban Treaty Organization (CTBTO). The treaty includes a dispute settlement procedure of recourse within CTBTO or at the International Court of Justice.
IAEA Safeguards applied under NPT, 1968.[49]	The NPT requires non-weapon states to place all source and special fissionable material (as defined in the IAEA Statute) under IAEA safeguards to prevent their use for non-peaceful uses. Each non-weapon state concludes a separate safeguard agreement with the IAEA.	Parties provide detailed baseline declarations on the numbers, location, and technical data of nuclear material facilities and an inventory of special fissionable materials. Notification about transferring nuclear material in and out of State, any changes to nuclear facilities and inventory, including unaccounted for material.	Ad-hoc, routine, and short notice on-site inspections included baseline inspections, special inspections inventory inspections, data update inspections, material transfer verification inspections, and complementary safeguard visits.	Tags, seals, sensors, data recorders and other monitoring equipment. There are provisions for continuous monitoring if necessary.	The IAEA Secretariat will normally attempt to resolve anomalies and compliance concerns. If necessary, concerns are communicated to the IAEA Board of Governors. The Board makes a determination of noncompliance if appropriate and reports it to Member States, UNSC, and UNGA. INFCIRC/153 included a dispute settlement procedure creating an arbitral tribunal at the International Court of Justice.

[48] For more information, see Comprehensive Nuclear Test Ban Treaty, Sept. 24, 1996, 35 I.L.M. 1439, available at https://www.ctbto.org/the-treaty/treaty-text/.

[49] See Treaty on the Non-proliferation of Nuclear Weapons (NPT), Jul. 1, 1968, 729 U.N.T.S. 161. For more on the IAEA Safeguards under the NPT, see Ionut Suseanu, The NPT and IAEA Safeguards, IAEA Bulletin Vol. 62-4 (Dec. 2021), available at https://www.iaea.org/bulletin/the-npt-and-iaea-safeguards.

V. Conclusion

17. This background paper provides an illustrative overview of verification to aid this Group in fulfilling its mandate to consider and make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including, inter alia, on the prevention of the placement of weapons in outer space. Given the complexities that accompany verification, taking stock of verification provisions across different fields may help inform discussions in outer space security.

18. Verification can generally be understood as a process of assessing State compliance with obligations under an agreement. The process of verification includes monitoring, the collection of information, analysis of collected information, and coming to an informed judgement as to whether obligations of an agreement are being met. Verification may further help assess the implementation of an agreement, generate confidence, provide State Parties with procedures for dealing with uncertainties, provide timely warnings and discourage non-compliance.

19. Despite the challenges of establishing adequate and effective verification regimes, the existing international governance framework for outer space already includes certain provisions that could support future verification-related activities. Moreover, there is a range of tools that could be applied to develop a system of verification of outer space activity, including: space situational awareness; data exchanges, declarations, and notifications; Earth observation; on-site activities; and open-source data.

20. However, even with the emergence of advanced technological capabilities, no single standalone measure will provide a comprehensive picture of outer space activity and technical and capacity limitations remain. As such, development of a multilaterally agreed verification mechanism will require further work at the political level, however, there remains value in further research in parallel to determine policy options available to verify space activities.