IAC-20- E7,1,4,x60406

PROTECTING THE DARK SKIES OF THE EARTH FROM SATELLITE CONSTELLATIONS UNDER INTERNATIONAL SPACE LAW

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Abstract

Satellite Constellations are network of satellites that function together simultaneously to offer permanent global coverage, Navigation, High Band width internet connectivity or ensure Internet access to remote places on the Earth. The Satellite constellations are generally small, large in number and are preferably operated closer to earth in Low Earth Orbit/Medium Earth Orbit to provide faster connectivity. Considering these incentives, both Space Faring countries and Private Organizations are geared up to launch more of such Satellite Constellations in the near future. However these Satellite Constellations are far brighter and visible in the night sky than other satellites and therefore a rapid increase in the number of Satellite constellation in the Earth's orbit threatens the natural dark skies of the earth. The bright trails of these satellites constellations on the Dark skies in large numbers can interfere with
Astronomical Observations, Earth based Telescopes and can even hinder searches for potentially Asteroids/comets. To protect the night skies of Earth from these bright and innumerable satellite constellations, this paper will discuss the legal measures available under International Space law. Firstly, this paper will emphasize how the extension of the "Equitable Access principle" under Article 44 of the ITU Constitution to Low Earth Orbits and Medium Earth Orbits will help in regulating the number of Satellite Constellations operating in such orbits thereby potentially reducing the disturbances caused to Dark skies of the earth . Secondly, this paper will analyse how the concept of "Milestones based launching" of Satellite constellations as agreed under WRC 2019 can help in offering mitigation measures. Thirdly, this paper will analyse the importance of a comprehensive licensing policy by National Agencies such as Federal Communication Commission of U.S etc. with regards to Satellite Constellations to consider the potential environmental impact caused by these Satellites in the Dark Skies and thereby prevent its pollution. Finally considering that Outer Space activities are governed in accordance with International law under Article III of the Outer Space Treaty 1967, this paper will evaluate the applicability of World Heritage Convention 1972 to protect Dark Skies of the Earth and thereby obligate the majority of space faring countries that are parties to this convention to refrain from its pollution.

Keywords: **Astronomy, Satellite Constellations, Starlink, Dark Skies, International Telecommunication Union (ITU)**

Acronyms/Abbreviations (in order of appearance)

LEO- Low Earth Orbit
MEO- Medium Earth Orbit
AAS- American Astronomical Society
UN- United Nations
ITU- International Telecommunication Union
WARC- World Administrative Radio Conference
WRC- World Radio Conference (*formerly* WARC)
RR- Radio Regulations
GSO- Geostationary Orbit
UNCOPUOS- United Nations Committee on Peaceful Uses of Outer Space
OST- Outer Space Treaty, 1967
IAU- International Astronomical Union
STS- Scientific and Technical Subcommittee
LSC- Legal Subcommittee
MIFR- Master International Frequency Register
FCC- Federal Communication Commission (USA)
NEPA- National Environmental Policy Act (USA)
C.F.R. - Code of Federal Regulation (USA)
UDHRFG- Universal Declaration of Human Rights for Future Generations
UNESCO- United Nations Educational Scientific and Cultural Organization
OUV- Outstanding Universal Value
AWHI- Astronomy and World Heritage Initiative
WHC- World Heritage Convention

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1. Introduction

A satellite constellation comprises of a number of similar satellites having similar type and function, designed to be in similar or complementary orbits for a shared purpose, under shared control.[1] While orbiting Earth, these satellites are aligned with the Sun for extracting Solar Energy. As a result, they tend to reflect the sun rays back to the observers on Earth known as Flares, causing them to appear bright and

visible.[2] These flares leave a bright trail of light in Dark skies affecting the natural features of dark skies.

1.1 Why are these Satellite Constellations launched?

Satellite Constellations are launched to provide constant and continuous network coverage, spanning large geographical area.

Currently, Satellite Constellations such as Starlink operated by Space-X[3] have already launched these and further Softbank backed OneWeb and Amazon's Project Kuiper are in contention to launch these to LEO with a plan to offer Internet access to rural and remote areas including the Arctic/ Antarctica.[4] This becomes important especially in post pandemic era where dependence of Internet has rapidly surged.

In future these operators are vying to launch innumerous satellite constellations and connect them like a web engulfing the earth.[5] According to AAS, such innumerable launches of Satellite constellations can congest the LEO and may increase the number of objects in the space from approx. 15,000 in the last 60 years to 5 times more within 5 years.[6]

Hence such striking numbers of Bright satellites continuously orbiting the earth will destroy the tranquility and experience of Dark Skies.

1.2 What are the impacts of these Satellite Constellations on the Dark Sky?

So what is Dark Sky? According to Oxford Dictionary, Dark Sky denotes or locates a place where the darkness of the night sky is relatively free of interference from artificial light.[7] They are prerequisite for astronomers to view distant objects in outer space[8] and serve as a critical scientific resource for understanding the mysteries of the universe.[9]

These Satellite constellations will affect the Astronomers, Photographers Observatories, scientific groups and stargazers including students and kids with endless aspirations. The light pollution caused by the Satellite Constellations will impact:- The nature and result made by Astronomical observatories and Ground based telescopes that have wide apertures such as Vera C Rubin Observatory in Chile[10]; Searches for potentially hazardous asteroids/comets[11]; Rare astronomical events for example, the observations of the rare Neowise comet were recently affected by these bright trails; Discovery of new Phenomena and Scientific progress including studies concerning the origin of Universe[12] and Mankind's access to clear and unpolluted visibility of things belonging to this Universe.[13] These Satellite Constellations will also affect Radio Astronomy due to the uncontrollable increase in Radio Interferences.[14]

While the operations of satellites are regulated in accordance with the UN Space treaties, the ITU in coordination with National administrations deal with the Orbital slot allocation for these Satellites and the legality surrounding its usages.
Hence this paper shall offer the following suggestions within these regimes to ensure that the Dark skies of the Earth remains protected from the Satellite Constellations.

2. Extending Equitable Access Principle to Low Earth Orbit and Medium Earth Orbits

2.1 Role of ITU in Orbital Slot Allocation.

The ITU started as International Telegraphic Union in 1865 being the oldest specialized agency of UN.[15] After the launch of Sputnik in 1957, Satellites became integral for Telecommunications. Thus in 1959 ITU added Space activities within its ambit and allocated orbital slots and spectrums to countries based on "First Come First Serve Basis". In 1971, at the WARC, various non-space faring countries complained that the GSO, a scarce and beneficial orbit[16] will become perennially occupied by Active Space Faring countries denying the former, access to the GSO if status quo prevailed. Thereby in 1973, the ITU in Article 33 (now Article 44) of its Convention,[17] declared the GSO as a limited Natural resource and that countries must have equitable access to it in accordance to the special needs of developing countries and geographical situation of particular countries. Henceforth the orbital slots in the GSO are allocated to each applicant based on *Equitable Access Principle* enshrined in Article 44 of the ITU Convention through two different Procedures namely Planned and Coordinated Procedures. Under the Planned Procedure the ITU has divided the world into 3 regions and has reserved bandwidth and GSO slots to each country.[18] This ensures that each country is reserved of an orbital slot regardless of its spacefaring capabilities.
All the Non-GSO Belts however are allocated solely on the Coordinated Procedure. This follows a first come first served approach of the applicants, emphasizing on efficiency and utilization of the orbital slot by such Satellite operator applicant.[19]
Over the years, Non-GSOs became prime areas of commercialization, resulting in the increase of Satellites operating in LEO and MEO.[20] This prompted the ITU in 1998 to amend Article 44 of the

ITU convention to state that all orbits and not only GSO are scarce and limited natural resources.[21] This mandated all satellite operators to use any orbit around the earth in a Rational and efficient manner.

2.2 Protecting Dark Skies as a part of Space Sustainability.

At the same period of ITU's inclusion of Space activities, in 1967, the OST came into force.[22] In its Article I, the OST declared Outer Space as "Province of Mankind" and that all space activities are to be for the *"benefit and in interest of all countries"*.[23] Further Article II OST prohibited exclusive appropriation of Outer Space by any Country and thereby established equal rights for all countries to access Outer Space.[24] These terms *"benefits and in interest"* under Article 1 have often been scrutinized, however it was proposed that these terms are to be interpreted in a general sense rather than attach a specific or monetary value to it.[25] Under such interpretation of Article I, the Satellite operator are obliged to protect the Dark Skies from light pollution, at least for the general benefit and interest of the Countries and communities on earth.

Considering such Space activities, one of the main factors that make Outer Space and its benefits accessible to all people and the future generations is Space Sustainability.

Space Sustainability denotes the ability of all humanity to continue using Outer Space for peaceful purposes and socio economic Benefits in the Long Term.[26] It focuses on preserving outer space for the benefit of all countries. Considering the importance of space Sustainability the UNCOPUOS in its recent Space Sustainability report considered a presentation by IAU regarding the impact of Satellite Constellations on Astronomy on its Agenda for "Long Term Sustainability of Outer Space Activities".[27] Therefore this inclusion indicates the relevance of protecting the Dark Skies as a part of Space Sustainability by the ITU and member states.

The ITU has been a founding observer and active participant to UNCOPUOS's STS and LSC, playing a key role in Long Term Sustainability of Outer Space and its Activities.[28] In view of it both the OST and ITU ensure that Outer Space and its benefits remains open to all countries and its people, regardless of their space exploration abilities. As witnessed in the previous part, the ITU has been open to transitions and offering measures when there are problems impeding the interest of Developing countries as well as Space sustainability. One of such measures was in the ITU RR 2016 post WRC 2015. It stated that filings for orbital slots must be accompanied by "Coordinated efforts" that should consider the potential stakeholders activities actively or passively impacted by the proposed satellite.[29] These coordinated efforts run up to 7 years[30] and obliges satellite operator to take measures that will refrain them from causing Radio interferences to other satellites in orbit.[31]
However despite ITU's pledge to ensure Space Sustainability and facilitate needs of Radio Astronomy[32] it is doubtful whether the aforementioned Coordinated Procedure will be sufficient in protecting both Optical and Radio Astronomy, considering in future there will be hordes of Satellite Constellations congesting the LEO and MEO, resulting in saturation of the radio-frequency spectrum and interferences.[33]

Therefore the only solution in the future is to reduce the number of Satellite constellations in LEO and MEO in an equitable manner.

2.3 Can the Extension of Equitable Access Principle to LEO and MEO help in protecting the Dark Skies of Earth?

Despite the reference to the term "Equitable" in many International Treaties there hasn't been a single attempt to define it and it does make sense.[34] This is because Equity as a concept differs with countries, legal systems and even Time, thus there cannot be a general and all-encompassing definition.[35]

According to Black's Law Dictionary, "Equitable" means "Just, fair, and right, in consideration of the facts and circumstances of the individual case".[36] So an approach can be termed "Equitable" if it is "Fair" and "Just" based on the circumstance and case in hand. For example, during 1970s, it was deemed "Equitable" by the ITU to preserve the GSO to enable access for each country regardless of its concurrent space abilities. Thus, The Equitable access principle under Article 44 ensured that countries lacking space faring capabilities aren't denied an opportunity to access space in the future.

Moving to the present, it looks likely that commercialization of Telecommunications is slowly shifting from the GSO to the LEOs and MEOs.[37] Research indicates that LEOs and MEOs to be occupied by swarms of Satellite Constellations in the next 10-20 years.[38] As discussed this huge shift will cause a variety of problems and therefore it requires an "Equitable" approach to deal with the above circumstances in a Fair and Just manner. In such a

case it will be contrary to "Equitable" if the Satellite constellations continue ruining the Dark skies for Astronomy from earth, impeding the primary access developing countries have to Outer Space, i.e. through Observatories and Ground Based Telescopes.[39] Simultaneously it will not be Equitable if it prohibits or hinders Satellite Constellation Industry which has potential to become a panacea to global connectivity and security. Further, the ITU also can't replicate The Planned Procedure it uses for GSO Satellites as per Article 44 of the ITU convention as GSO and LEO/MEO are characteristically distinct and the functions of satellites in both of these orbits are varied.[40] Nor can the ITU continue to allocate Non-GSOs based on the first come first served approach, neglecting the concerns in hand.

In that case the author suggests that the ITU must allocate Non-GSOs based on an Equitable Access Principle considering 2 factors namely;

a) A capping on the number of orbital slots per Satellite based on the bare minimum requirement by the satellite operators to efficiently operate the Satellite constellation network.
b) The capabilities of the Satellite operators to perform Mitigation measures to protect the Dark Skies from their Bright trails as well as minimize interference to safeguard Radio Astronomy.

This will ensure that only trustworthy and capable satellite operators can place their satellite constellations in the Orbits.

3. Adopting a Milestone Based Approach

As discussed above, an "equitable approach" should be fair and just. This means that the approach should ensure that every relevant stakeholder receive adequate time and opportunity to resolve disputes.

The Milestone based launching approach recently agreed by the WRC 2019 at Sharm el Sheikh in Egypt deals with the deployment of Non-GSO Satellite constellations. Considering the large number of satellites under Satellite constellations, the ITU felt that with just one satellite recorded, it could be treated as full deployment of all these satellites, regardless of whether the recorded orbits and frequencies are occupied and used.[41] Such events would encourage practices such as Spectrum Warehousing, leading to accumulation of Paper Satellites in the orbit.

Thus in order to protect the rights of satellite operators to the assigned orbits and simultaneously mandate full deployment of satellites to prevent Spectrum warehousing, after the 7 years period of regulations involving Advance Publication Information Filing (API), Coordination Request, Notification Filing and Declaration of Bringing into Use (BFIU), it was decided that operators will follow The Milestone Based approach spanning for the next 7 years wherein these Satellite operators will ensure 10% deployment of total satellites within 2 years of BFIU, 50% deployment within 5 years of BFIU and finally 100% within 7 years of BFIU.[42] It is basically (7 years of regulation + 7 years of milestone based launching).

The inability of the satellite operator to meet these milestones will have necessary implications with the MIFR Recordings done by ITU under Article 13.6 of the RR.[43]

Although the Milestone based approach was brought to prevent Frequency Radio Spectrum Warehousing and ensure proper coordination and operational requirement of Satellite constellations, the author believes that the basic concept of this approach can be helpful in tackling the light pollution caused by these Satellite Constellations.

3.1 How can Milestone Based Launching help in Mitigation efforts by Satellite operators?

(i) Offer necessary intervals for the satellite operators to coordinate with ITU, National Administrations and especially astronomical societies and scientific communities that are impugned. Analyzing the case of Starlink Constellations, initially neither the observers nor the operators thought about this impact.[44] Only after deployment in the Dark skies that people grew attentive about the disruptions. It implies that regardless of innumerable simulations, the actual impact of the light pollution caused by the satellite constellations can only be ascertained when they are deployed and thus for coordination and mitigation, deployment must be followed by sufficient time period for the operators to engage with the stakeholders.

(ii) Offers time for the operators to ascertain the impact of light pollution caused by their first batch of satellites and thereby make necessary amends for the subsequent batches. It is important when Operators mitigate on a trial and error basis just like how Space-X claimed recently while working to darken their satellites.[45] Considering the heavy cost of

satellite designing, such intervals will also help Satellite operators to deal with the financial aspect of these measures.

(iii) Offers time for National Administrations and ITU to review the Environmental Impact of the Satellite Constellations.

(iv) Prevents simultaneous/ single launch of all the Satellites, deterring congestion of the LEO and MEO and thereby preventing exacerbation of the impact of light pollution in the dark skies. It is suggested by Satcon Report that satellites at orbital altitude of 600kms or greater are likely to cause problems to the Dark skies.[46] Thus avoiding simultaneous launches will temporarily reduce the number of satellites above the 600km orbital altitude threshold.

(v) Dilutes the argument for a Moratorium on such projects by offering sufficient time for both the regulators and the Satellite operators to develop consensus on some legislation/regime. Considering 7 years of regulatory period and an additional 7 years of periodical launching, this time will facilitate convergence of Stakeholders [for ex: the Satcon1 indicated the desire of all stakeholders to cooperate] rather than confronting each other with legal suits. Further considering the heavy cost and time involved in manufacturing and operating a Satellite constellation[47], a concept for Moratorium will not be "equitable" in protecting the Right to exploration, use and free access of Outer Space as enshrined under Article I of the OST.

This Milestone based approach currently has been planned only for Non-GSO satellites for specific frequency bands and services and is intended to tackle spectrum warehousing. In the Future, the ITU can try to suitably modify and extend this approach to all the Non-GSO frequency bands and services to tackle the light pollution caused by these Satellite constellations. Further reiterating the aforementioned example, it needs to be understood that whatever mitigation Space-X did to reduce the brightness of their satellites (Darkened the coating of Satellite to reduce albedo effect) was out of goodwill.[48] While this posture indicates the willingness of Companies to help, it also signals a lack of regulation obliging the Satellite operators.

4. Emphasizing the Role of Domestic Regulators and National Policies

Over the last two decades, Private industries have considerably grown in Space Industry, with various companies acquiring capabilities that were once attainable only by States with deep pocket. However for the sake of regulation, responsibility and liability, the *Corpus Juris Spatialis* had recognized and retained Outer Space activities as National Activities. Article VI of the Outer Space Treaty emphasizes on the role of State parties to authorize and continuously supervise Space exploration performed by both Governmental and Non-Governmental Organization including Private organizations.[49] Similarly the ITU regime under Article 1.2 of its Radio Regulations also defines the role of National Administrations to discharge any obligation under the Constitution of the ITU.[50]

4.1 The case of Federal Communication Commission in U.S.A

Currently private companies in U.S.A such as Space-X and Amazon have acquired approval from their National Administration, FCC to launch more than thousand Satellites under their Satellite Constellation Projects over the next decade.[51] This has placed the role and supervision of FCC under the spotlight. The FCC like all Federal agencies in USA is required to review the environmental impact of any project before it authorizes as per NEPA 1970 under C.F.R.[52] Instead the FCC had not performed Environmental impact assessment for satellite projects in view of their effects on Earth's orbital environment and Astronomy.[53] This lack of review by the FCC has unsettled the Astronomical and Legal community and here is why they feel so.

The Legal Experts cite Title 40 Section 1508.8 of Code of Federal Regulations to contend that approval of Satellite Constellation Projects must only be done subsequent to an Environmental Assessment by the FCC as these projects have shown to cause "Detrimental Effects" on aspects of our Ecology *inter-alia* Aesthetics, Culture etc.[54]
Whereas, the FCC cites Categorical Exclusions under Title 47 Section 1.1306 of Code of Federal Regulations as the legal reason for not performing environmental review prior to the approval of such projects. This Provision mandates Environmental Review by the FCC only for specific circumstances *inter-alia* causing High intensity Lighting and Human Exposure to excessive Radio Frequency.[55]
Considering contentions from both sides, it is clear that the current domestic regulations require reforms. The FCC must regulate satellites through a comprehensive Environmental Review to protect the

Dark Skies in a similar way it protects Radio Astronomy from Frequency Interferences.

Currently Satellite manufacturers have been mandated to design spacecraft and projects that preserve the Earth orbit environment by minimizing orbital debris.[56] Similarly, domestic regulators/National Administrations must step up to ensure similar measures by Satellite manufacturers to minimize or if possible completely neutralize the negative impact they are causing to the Dark Skies.
The regulations must focus on:

(i) Firstly, Capping the Orbital Altitude of the Satellite Constellations. [Higher the Satellite greater the threat] Satcon 1 Report offers a threshold of 550-600kms as an ideal Orbital Altitude.[57]
(ii) Secondly, Reviewing the Apparent Magnitude of each Satellite in the Sky at both Dusk and Dawn.[58]
(iii) Finally, Licensing and approval based on the capabilities of the satellite operators to adhere to the aforementioned mitigation measures.

4.2 Importance of Domestic Regulations

The Author Believe that reforms in Domestic regulation will ensure;

(i) Reduction in the number of filings made by the National Administrations at the ITU. Implementing proper domestic regulations will ensure that only those projects with minimal impact and strong mitigations reach the ITU. Further, the ITU will be relieved from conducting reviews for superfluous Filings.

(ii) Domestic regulations offer "A Bottom to top approach" which can help in drafting an International regime as currently there is no regulation on Brightness of Satellites or to prevent their negative impact on astronomy. One must remember the adoption of NASA in 1957 provided impetus to the drafting and adoption of the Outer Space Treaty in 1967.

1. Considering Dark skies as World Heritage

"Astronomy compels the soul to look upwards and lead us from this world to another" - Plato

The Dark skies are cradle for astronomy and space exploration. Unpolluted Dark skies are prerequisite for accessing the planets, stars and galaxies. The Scientific, Cultural, Educational and Philosophical relevance of Dark skies cannot be ignored by this generation as it's a nature of earth inherited from our ancestors. The importance was reiterated by the UDHRFG, emphasizing on the right of Future generations to uncontaminated and undamaged earth, including Pure Skies.[59] Therefore it would be undermining if the dark skies are not protected for Mankind and its subsequent Generations.

5.1 Role of World Heritage Convention

Protection of World Heritage is monitored by the World Heritage Committee under UNESCO. The Committee operates under World Heritage Convention, ratified by 194 countries.[60] The role of the committee is to implement the convention, manage the World Heritage fund, decide the World Heritage list, monitor the conservation of the enlisted Heritages and take actions when these Heritages are improperly protected by the State parties.[61] Thereby the World Heritage committee ensures that State parties take active steps to protect the listed World Heritages. This obligation of the State Parties is mentioned under Article 5 of the WHC.[62] The WHC defines 2 types of Heritages namely, Cultural Heritage[63] and Natural Heritage.[64] Any Heritage under contention must satisfy at least 1 of the 10 Outstanding Universal Value (OUV) criteria given under the Operational Guidelines to be enlisted as World Heritage.[65] Considering the above criteria, there have been groups such as UNESCO's AWHI that are currently working on emphasizing the importance of Astronomical Heritage and whether the Dark skies satisfy the criteria under the Operational Guidelines to be enlisted as a World Heritage Site. The AWHI was formed in 2004 and in 2008 signed a MOU with IAU. As a part of the MOU, the IAU established a Working Group on Astronomy and World Heritage that conducted "Thematic studies on Heritage sites of Astronomy" in 2010 and 2017.

The Thematic Studies of 2017 found few challenges in designating Dark skies as World Heritage as per the WHC namely;

- The Dark Skies lack Physical Boundaries and do not belong to a Particular State Party or any of its territory
- They can't be afforded an OUV status under WHC as it implies an anthropogenic approach of affording the OUV status to the Universe, resulting in a paradox.[66]

For this purpose, the study suggested to consider certain Sites/Observatories across the world having

potential OUV relevant to the practice of Astronomy, Social uses and Representation of Astronomy under the World Heritage list.[67] Potential Astronomical Heritage sites such as Baikonur Cosmodrome in Kazakhstan to Aoraki–Mackenzie International Dark Sky Reserve in New Zealand etc. are properties located within territories of Countries and intersect both cultural and scientific value.[68]

The Study concluded that while Dark skies in themselves cannot become World Heritage Sites, however their protection and management is essential to preserve the scientific and cultural value (OUV) of Astronomical Heritage Sites that have potential of being listed as a World Heritage site in Future.[69]

5.2 Applicability of World Heritage Convention to Outer Space Activities

Designating an Astronomical Heritage Site as a World Heritage will ensure that State parties are mandated to adopt policies as per Article 5 of the WHC to protect them from light pollution caused by these Satellite Constellations.[70] Such policies would primarily require them to regulate their National Space Activities under Article VI of OST. Article 6 of the WHC obligates all State parties to refrain from directly or indirectly damaging the World Heritage Sites situated in another Country.[71] This implies that even other countries must regulate their national space activities to ensure that they don't damage these Astronomical Heritage Sites.

Thus it is important to analyze whether WHC is applicable to Space activities conducted under the aegis of OST?

Article III of the OST mandates State parties to conduct Space activities in accordance with the International Law.[72] Considering the *Res communis* status of Outer Space, General International law cannot automatically apply to outer space activities in toto.[73] Rather only those principles of International Law compatible with this Status of Outer Space can be applicable to Outer Space Activities.[74]

In such a case the WHC is not going to change the status of Outer Space rather it is only going to ensure that Space activities under National Jurisdiction of State parties to the OST do not impede or deteriorate the value of the Astronomical Heritage Sites, if they are listed as per WHC.

Considering commonality, somehow both the OST and WHC emphasize on the community aspect of preserving certain values for the enjoyment of all mankind through the means of International cooperation. This is reflected in "Province of mankind" and "Non-Appropriation" principles of OST[75] and similarly in the Article 6 of WHC.[76]

Finally, considering the need for applying WHC, the OST is not a Self-containing regime.[77] There are legal lacunae present in this regime on dealing with Light Pollution caused by Satellite constellations and its effects on Astronomy. The only provision that emphasizes on Environmental Protection is Article IX of OST. However even this provision fails to clearly define whether light pollution caused by these Satellite Constellations can be considered as "Harmful contamination" or as "Adverse change to the Environment of Earth".[78] Further there is no mention of the term "Heritage" in the OST. Only The Moon Agreement mentions the term, defining the Moon and other Celestial Bodies as "Common Heritage of Mankind".[79] This Agreement too addresses only celestial bodies and has failed to receive considerable signature or ratification. Therefore it is only logical to use other branches of international law to complement the lacunae or inadequacy of space law.[80] Thus the application of the World Heritage Convention will protect the Astronomical Heritage Sites around the world and will regulate the Space activities to ensure that they don't deteriorate the value of such enlisted Heritage Sites.

5. Conclusion

The way forward is clear for the regulators and Satellite Operators. The Space Industry must first start addressing these challenges at relevant International Forum such as The UNCOPUOS 63rd Session in 2021, WRC 2023 and 45th Session of the World Heritage Committee to build International consensus. Secondly there must be reforms in Radio Regulations of ITU and National Policies to consider the impact of light pollution caused by these Satellite Constellations on the Dark Skies with emphasis on equitably capping the number of such satellites orbiting the LEO. Finally it is pertinent to protect the Dark skies and the associated Astronomical Heritage Sites by recognizing Astronomical Heritage Sites as World Heritage under World Heritage Convention. Implementing these measures soon will ensure that the dark skies are protected for the generations to come.

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