Orbital Debris Prevention and Mitigation Efforts among Major Space Actors

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Orbital Debris Prevention and Mitigation Efforts among Major Space Actors

Commonalities and the Search for Customary International Law

Marc G. Carns

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It may be a pretty tough neighborhood in the not-too-distant future.[1]

∴

1 General William Shelton, former Commander, Air Force Space Command, National Space Symposium, 12 April 2011.

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Preface

This is the published version of a doctoral work that began in late 2019 and was successfully defended for my doctoral degree in February 2022 through the University of Nebraska. However, the concept of this work began much earlier, around 2015, when I first began pursuit of my LL.M. with a focus on space law. I had advocated in my earlier work that nations needed to be more aggressive in efforts toward the removal of space debris from our orbital environment, going so far as to argue that even absent formal treaties, there were grounds in customary international law for even non-consensual removal. I presented that theory at the International Astronautical Congress in 2017 to a receptive audience and was published by the United States Air Force Judge Advocate Law Journal that same year.

Over the next two years, I was fortunate to engage regularly with Professor von der Dunk, my eventual supervising attorney for this work, on advancing a portion of that original concept into a much larger undertaking. In particular, I was fascinated by the efforts of mature spacefaring nations and organizations in their attempt to address the problem of debris absent any formal guidance or requirements forcing their hand to do so. It became evident that these nations and organizations recognized that in the absence of formal rules, the preservation of the orbital environment remained critical for our advancement as a species. We rely heavily on our scarce orbital resources for much of the way we live out our lives. Without a deep respect for the health of our orbital environments, much of the necessities of our daily lives, such as GPS, banking, communications, healthcare, transportation, information … all of it could come to an immediate halt with the right orbital disaster.

Based on that, I undertook to fill at least an initial gap in some of the available information, primarily assessing and comparing how the major spacefaring nations and the European Space Agency (ESA), absent any formal treaty law, have implemented their own orbital debris mitigation and prevention programs in an effort to do their part to preserve our most valuable orbital regions. My analysis then looked for common themes among them that might, without us having originally recognized it, risen to the level of establishing customary international law. Were that the case, our reliance on soft-law guidelines might be reduced, and our ability to aggressively advocate that there were existing legally binding rules would benefit the entire international community. This is by no means and end to the work, but my hope is that it is at least a kernel from which many discussions can be had and important conceptual advances can be made.

Much like that long road to establish the start of this concept, getting here was no easy feat and took an extraordinary amount of support. I owe so many so much appreciation. And while I am not able to name them all, I would be remiss if I did not take the opportunity to thank some. Most importantly, I would like to thank my wife Sandra and my children, Michael and Lauren, for their enduring support throughout this effort. My wife held everything together and gave me the greatest support I could possibly ask for. My children never complained about the time I was working and showed enormous appreciation for the time we did have together. I am so thankful for them every day. My parents, Michael and Victoria, sister Michelle and her family, my brother and sister-in-law, Kris and Sarah Williams, and my extended family Susan and Charles Kelley, also wholeheartedly supported me, offering encouragement and feedback whenever I needed it!

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Finally, I would like to thank my fellow legal colleagues in my prior role whom I worked with from 2019-2022 through the duration of this work. They were endlessly supportive and responded to the needs of my clients when I was absent to focus on this effort. I owe special thanks to Mr. Brock Dahl, Mr. Ben Kastan, Mr. Brian Ryckman, Mr. Matthew Colson, Ms. Charity King and USAF Major Carolyn Carmody. Last but not least, the support staff, Ms. Shannon Nixson, Ms. Barbara Chavez and Ms. Laura Heatherly-Reiss, who navigated the demands on my schedule. Everyone involved helped make this possible without complaint and have my great respect and deep gratitude.

Disclaimer

Any opinions of the author expressed in this book are the author's alone and do not reflect any official position of the United States government or the Department of Defense.

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Abbreviations

ADR	Active Debris Removal
AFB	Air Force Base
AFSPC	Air Force Space Command (US)
ASAT	Anti-Satellite
ASI	Italian Space Agency
BNSC	British National Space Agency
BSS	Broadcasting-Satellite Service
CASC	China Aerospace and Science and Technology Corporation
CCP	Chinese Communist Party
CGPHESE	Consultative Group of Potentially Harmful Effects of Space Experiments
cm	Centimeters
CNES	Centre National D'études Spatiales (French Space Agency)
CNSA	China National Space Administration
COSPAR	Committee on Space Research
CPR	Common Pool Resources
CSM	Conjunction Summary Message
CSpOC	Combined Space Operations Center (US)
DA-ASAT	Direct Ascent-Anti Satellite
DAMAGE	Debris Analysis and Monitoring Architecture to the Geosynchronous Environment
DART	Double Asteroid Redirect Test
DBS	Direct Broadcast System
DLR	Deutsches Zentrum für Luft- und Raumfahrt e.V. (German Space Agency)
DoD	Department of Defense (US)
DoS	Department of State (US)
DoT	Department of Transportation (US)
EAC	European Astronaut Center
ECSAT	European Centre for Space Applications and Telecommunications
ECSS	European Cooperation on Space Standardization
ELDO	European Launch Development Organization
EOM	End of Mission
EOMDP	End of Mission Disposal Plan
ESA	European Space Agency
ESAC	European Space Astronomy Center
ES-MCAT	Eugene Stansbury-Meter Class Autonomous Telescope
ESOC	European Space Operations Center
ESRIN	ESA Centre for Earth Observation

ESRO	European Space Research Organization
ESSTI	Ethiopian Space Science and Technology Institute
ESTEC	European Space Research and Technology Center
ETRSS	Ethiopian Remote Sensing Satellite
EU	European Union
FAA	Federal Aviation Administration (US)
FAA/AST	Federal Aviation Administration Office of Commercial Space Transportation (US)
FCC	Federal Communications Commission (US)
FMEA	Failure Mode and Effects Analysis
GDP	Gross Domestic Product
GEO	Geostationary Orbit
HAND	High Altitude Nuclear Detonation
HAPS	Hydrazine Auxiliary Propulsion System
HAX	Haystack Auxiliary Radar
HEO	High Earth Orbit
HUSIR	Haystack Ultra-wideband Satellite Imaging Radar
IAA	International Academy of Astronautics
IADC	Inter-Agency Debris Coordination Committee
IAEA	International Atomic Energy Agency
ICJ	International Court of Justice
ICSU	International Council of Scientific Unions
IGO	International Governmental Organization
ILA	International Law Association
ISO	International Organization for Standardization
ISS	International Space Station
ITSO/INTELSAT	International Telecommunications Satellite Organization
ITU	International Telecommunications Union
JAXA	Japanese Space Agency
JFSCC	Joint Force Space Component Commander
JSASS	Japan Society for Aeronautical and Space Sciences
JSpOC	Joint Space Operations Center (US)
kg	Kilogram
km	Kilometer
LEO	Low Earth Orbit
LTS	Long-term Sustainability
MEO	Middle Earth Orbit
MFA	Ministry of Foreign Affairs (China)
MIIT	Ministry of Industry and Information Technology (China)
mm	Millimeter

MOF	Ministry of Finance (China)
NASA	National Aeronautics and Space Administration (US)
NASDA	National Space Development Agency of Japan
NGSO	Non-Geostationary Orbit
nm	Nautical mile
NMI	NASA Management Instruction
NOAA	National Oceanic and Atmospheric Administration (US)
NPC	National People's Congress (China)
NRC	National Research Council (US)
NPRM	Notice of Proposed Rule Making
NSC	National Space Council (US)
NSP	National Space Policy (US)
NSPD	National Space Policy Directive (US)
NSS	NASA Safety Standard
ODMSP	Orbital Debris Mitigation Standard Practices (US)
ODPO	Orbital Debris Program Office
OMB	Office of Management and Budget
OOS	On-Orbit Servicing
OST	Outer Space Treaty
PCIJ	Permanent Court of International Justice
PECS	Plan for European Cooperating States
PLATO	Planetary Transits and Oscillations of Stars
RSA	Russian Space Agency
RRAMP	Re-entry Risk Assessment and Mitigation Plan
SASAC	State Owned Assets Supervision and Administration Commission (China
SASTIND	State Administration of Science, Technology, and Industry for National Defense (China)
SDA	State Data Association
SDARS	Satellite Digital Audio Radio System
SDMP	Space Debris Mitigation Plan
SDMR	Space Debris Mitigation Report
SKKP	Main Centre for Reconnaissance of Situation In Space (Russia SSA)
SPCS	Space Control Squadron
SPD	Space Policy Directive
SSA	Space Situational Awareness
SSC	Space Safety Coalition
SSN	Space Surveillance Network
SST	Space Surveillance and Tracking
STA	Science and Technology Agency (Japan)
STM	Space Traffic Management

SWE	Space Weather
TESS	Transiting Exoplanet Survey Satellite
TW&E	Threat Warning and Assessment
UCP	Unified Command Plan (US)
UN COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UN	United Nations
USD	United States Dollar
USSF	United States Space Force
USSPACECOM	United States Space Command
USSTRATCOM	United States Strategic Command