

**FEDERAL COMMUNICATIONS COMMISSION**  
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**Mitigation of Orbital Debris in the New Space Age**

**Comments Provided By**

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## **INTRODUCTION**

The Association of Space Explorers (ASE) is an international nonprofit professional and educational organization of over 400 flown astronauts and cosmonauts from 38 nations. Membership in ASE is open to individuals who have completed at least one orbit of the Earth in a spacecraft.

ASE member countries include Afghanistan, Austria, Belgium, Brazil, Bulgaria, Canada, China, Costa Rica, Cuba, Czech Republic, Denmark, France, Germany, Hungary, India, Israel, Italy, Japan, Kazakhstan, Malaysia, Mexico, Mongolia, Netherlands, Poland, Romania, Russia, Saudi Arabia, Slovakia, South Africa, South Korea, Spain, Sweden, Switzerland, Syria, Ukraine, United Kingdom, United States and Vietnam.

ASE fully supports activities aimed at making operations in earth orbit safe, efficient, and collegial. ASE applauds this effort by the FCC to develop a comprehensive plan to manage orbital debris and make Space Traffic Management (STM) a reality.

## **OVERVIEW OF COMMENTS**

For those currently operating spacecraft in earth orbit the need for reducing orbital debris and Space Traffic Management is a foregone conclusion. Earth orbit is a busy place! Since the late 50's when one satellite was lifted into orbit on one booster, now over a hundred satellites ride the same rocket to space. Once a primary payload is typically deployed, the other riders are ejected from "corn cob launchers" as the booster continues on its path. The number of active satellites is quickly approaching 2,000 with many commercial companies planning constellations that will easily double that figure. Unfortunately, the number of pieces of debris has steadily increased as well. Where the debris catalog included around 27,000 separate pieces measuring 10 centimeters or larger, that number is in the process of being revised. Recent studies have shown that a piece of debris measuring only a few millimeters in size can be potentially lethal to an active satellite. Estimates suggest the true debris catalog of lethal objects would number near 500,000.

Even a modest number of satellites and debris represents a significant computational challenge to avoid collisions. Because there are just simply not enough frequent observations of everything in earth orbit, the uncertainty of positions and orbits results in large error ellipsoids around the expected position of each object. When calculations are performed looking for potential conjunctions (intersecting error ellipsoids) so many "potential" collisions are identified that they are routinely ignored. It is vital that this situation be remedied before a major accident occurs.

Although individual countries may take the initial steps toward a solution, the only real answer in the end is an international partnership. Observations from all over the world need to be collected, verified, and added to a "data lake" of observations to make sure good tracks are available on everything of interest in orbit and to reduce the individual error ellipsoids as much as practical. A central body, probably under the auspices of the United Nations, will ultimately be needed to perform these functions and to issue warnings when viable conjunctions are predicted. However, this NPRM represents an opportunity for the FCC to assume an initial leadership role to begin putting a holistic program together. Accomplishing all of this will be a major endeavor involving an expansion of tracking sites on the ground and in space, the collection of observational data, screening of the data, the addition of observations into the "data lake", the calculation of potential conjunctions in the future, and the issuance of warnings when a potential event is identified. Just coordinating all of this as an international effort will be a major undertaking!

Avoiding an incident requires one or both parties to change their orbits, if possible, to remove any possibility of a collision. Just as with ships at sea and aircraft in flight, rules are required for either a Central Controlling Authority to direct a maneuver be made or for one to be made voluntarily. Further, these rules must have applicability long before satellites arrive in orbit. Policies and procedures must be in place to support mission planning, launch, post insertion, on orbit operations, and retirement/deorbit.

ASE applauds the FCC in taking a leadership role in addressing both orbital debris and Space Traffic Management. Addressing these challenges will require a well thought out and structured program. ASE believes the FCC is in a position through its licensing authority to put many of the needed policies and procedures in place, and to coordinate needed functionality and support from other federal agencies. Further, ASE sees this as an opportunity for the USA through the FCC to develop a template for a larger international undertaking to address orbital debris and Space Traffic Management as was done years ago for aviation.

## **STRUCTURE OF ASE COMMENTS**

**ASE is providing comments as requested in response to this NPRM. After each of the NPRM sections, selected requests by the Commission will be shown in italics followed by ASE's comments. Each ASE comment will be numbered to support referencing in later sections without repeating the text.**

## **NPRM TEXT WITH ASE COMMENTS**

*The Commission seeks comment on the suitability of various orbital debris mitigation guidance and standards for application to non-Federal satellite systems.*

*The Commission seeks comment on whether there are any areas in which proposed requirements may overlap with requirements that are clearly within the authority of other agencies, so that we may seek to avoid duplicative activities.*

*The Commission asks whether exceptions to applications of the Commission's rules as proposed or other exemptions may be appropriate in any particular circumstances.*

### **ASE Comment #1: A Central Controlling Authority**

A Space Traffic Management and orbital debris program will require a Central Controlling Authority to coordinate and regulate all associated interrelated activities. It is our opinion that the FCC through its licensing and regulatory authority has the opportunity to provide that initial leadership and management oversight while the government decides which agency should be the Central Controlling Authority for the long term.

**ASE Comment #2:** As outlined in this NPRM, the FCC should make the reduction, control, and tracking devices for orbital debris part of spacecraft licensing.

### **ASE Comment #3: Spacecraft and Object Categorization**

A clear set of definitions are required for all objects in earth orbit. In order to establish a set of guidelines for operations, objects must be categorized so that a set of priorities can be formulated. An initial set of categories would be:

**Crewed Spacecraft:** An aerospace vehicle containing human beings completing all or part of its mission in earth orbit.

**Active Spacecraft:** A spacecraft operating in earth orbit capable of performing maneuvers to change its orbit. Active spacecraft, crewed and un-crewed, have the ability to use propulsive devices and consumables to effect orbit change. Spacecraft remain classified as “Active” until the ability to perform such maneuvers has been lost either due to mechanical failure or the expenditure of all propulsive consumables.

**Passive Spacecraft:** A spacecraft operating in earth orbit not capable of performing maneuvers to change its orbit. Spacecraft remain in a “Passive” classification as long as they are determined to be operational. When that functionality is lost (inert objects), they are reclassified as “Space Debris”.

**Space Debris:** This category includes all inert objects in earth orbit that are both natural and man-made in origin.

#### **ASE Comment #4: Spacecraft Ownership**

All spacecraft have owners from the time of their manufacture, through launch, on orbit operations, and retirement/deorbit. The timeframe from manufacture through retirement/deorbit will be referred to as the spacecraft’s lifetime. Ownership and responsibility exist for the entire lifetime of a spacecraft as follows:

1. Government developed spacecraft belong for their entire lifetime to the government that paid for their development, manufacture, and operation.
2. Commercial spacecraft (spacecraft built under contract for a commercial entity) are owned by the procuring company unless such company ceases to exist. If the procuring company no longer exists, ownership transfers to the country of origin.
3. Spacecraft developed for an academic institution belong to that institution unless the institution ceases to exist. If the academic institution no longer exists, ownership transfers to the country of origin.
4. Spacecraft developed for a private party belong to that party unless the private party ceases to exist. If the private party no longer exists, ownership transfers to the country of origin.
5. The sale or transfer of a spacecraft from one owner to another also transfers ownership and the associated responsibilities.

Spacecraft owners are responsible for the safe operation of their vehicles for their entire lifetime. Ownership and responsibility continue even after functionality is lost due to failures or the expenditure of consumables. Spacecraft transitioning from active to passive to space debris remain the responsibility of their owners.

#### **ASE Comment #5: Flight Rules (Operational Rules)**

The purpose of flight rules (operational rules) is to establish a pre-agreed to set of actions to be taken when events occur. Rules are typically based upon a scenario which requires action by one or more parties to avoid an undesirable outcome. Specific rules result from the review and debate of alternative courses of action and are ultimately agreed to by the parties involved. In that way, when a situation does occur time is not wasted reviewing options and debating. Instead action is taken in a timely manner to secure a positive outcome.

What follows are an initial set of flight rules (operational rules) for review and debate. The list is not intended to be complete, but simply to serve as a starting point for a more extensive effort.

General Flight Rules (Operational Rules):

1. Crewed spacecraft have priority over all other vehicles and objects in orbit.
2. Active spacecraft (un-crewed) will maneuver to avoid conjunctions with crewed spacecraft, passive spacecraft, and debris.
3. Active spacecraft will advise the Central Controlling Authority well in advance of any planned maneuvers.
4. If a conjunction is predicted between two active spacecraft, the spacecraft with the longest remaining active lifetime will maneuver.
5. Every effort will be made to notify affected parties at least 72 hours in advance of any predicted conjunctions.

#### **ASE Comment #6: Mission Planning**

Spacecraft owners are responsible for conducting conjunction studies in association with the Central Controlling Authority to ensure no conflicts will exist during launch, post insertion, and on orbit with their primary payload, any secondary payloads, boosters, or jettisoned hardware.

Mission Planning Flight Rules (Operational Rules):

1. Studies will be performed during mission planning to ensure no conflicts are presented during launch, post insertion, or on orbit with other orbiting spacecraft.
2. A final conjunction study will be performed 30 days prior to flight to verify that no conflicts have developed during the planning cycle.

#### **ASE Comment #7: Launch**

Spacecraft owners are responsible for conducting conjunction studies near the planned launch date in association with the Central Controlling Authority to ensure no conflicts will exist during launch, post insertion, and on orbit with their primary payload, any secondary payloads, boosters, or jettisoned hardware.

Launch Flight Rules (Operational Rules):

1. One week prior to launch, a conjunction study will be performed to ensure no conflicts will exist on launch day.
2. If the day/time of launch is changed due to weather, scheduling issues, mechanical problems, or other causes, a conjunction study will be performed to ensure this change does not result in a conflict.
3. If a potential conflict is indicated, launch day/time will be adjusted in conjunction with the Central Controlling Authority to avoid this conflict.

### **ASE Comment #8: On Orbit**

Spacecraft owners are responsible for conducting conjunction studies in association with the Central Controlling Authority to ensure no conflicts will exist during launch, post insertion, and on orbit with their primary payload, any secondary payloads, boosters, or jettisoned hardware. Because spacecraft do not always end up in the orbits intended during mission planning and launch, it is necessary to perform a conjunction study once all payloads reach orbit if a deviation has occurred. Further, conjunction studies will be performed periodically for all objects in earth orbit to verify no conflicts have developed.

If a maneuver is planned for an Active Satellite, that activity will be coordinated with the Central Controlling Authority to verify the maneuver does not result in a conjunction. Once the planned maneuver has been completed, if the resulting orbit is not as expected, a conjunction study will be performed to verify no conflicts were created.

#### On Orbit Flight Rules (Operational Rules):

1. Spacecraft owners will perform a conjunction study in association with the Central Controlling Authority once their payloads have reached orbit if any of the orbits are different than intended.
2. Spacecraft owners will advise the Central Controlling Authority of any debris placed in orbit as a result of their activities.
3. Spacecraft owners will advise the Central Controlling Authority of any planned maneuvers by their spacecraft well in advance of such activity.
4. Spacecraft owners will perform a conjunction study in association with the Central Controlling Authority before any planned maneuvers are performed to verify that no conflicts will be created.
5. Spacecraft owners will advise the Central Controlling Authority of any change in the functional status of their spacecraft.
6. Crewed spacecraft will have priority over all other vehicles and objects in orbit.
7. Active spacecraft will maneuver to avoid conjunctions with passive spacecraft and debris.
8. If a conjunction is predicted between two active spacecraft, the spacecraft with the longest remaining active lifetime will maneuver.
9. Every effort will be made to notify affected parties at least 72 hours in advance of any predicted conjunctions.

### **ASE Comment #9: Vehicle Retirement/Deorbit.**

Spacecraft owners are responsible for conducting conjunction studies in association with the Central Controlling Authority to ensure no conflicts will exist during launch, post insertion, and on orbit with their primary payload, any secondary payloads, boosters, or jettisoned hardware. For spacecraft that are still active at the time of their retirement from service (still have maneuvering capability) they may be deorbited or placed into a “retirement orbit”. In either case, such activities will be planned well in advance and coordinated with the Central Controlling Authority. As with any other maneuvers performed on orbit, it is essential to avoid conjunctions with other spacecraft and debris in orbit.

#### Vehicle Retirement/Deorbit Flight Rules (Operational Rules):

1. Under normal circumstances, spacecraft owners will notify the Central Controlling Authority 6 months prior to any retirement/deorbit activities.
2. A conjunction study will be performed in association with the Central Controlling Authority to ensure the planned maneuver(s) do not result in any conjunctions.

3. As with any other on orbit maneuver, if the resulting orbit is not as planned a conjunction study will be performed to identify any resulting conflicts.

### **ASE Comment #10: Liability**

The owner(s) of a spacecraft are responsible for its safe operation from launch through retirement/deorbit. These responsibilities include a free and open exchange of information as well as adherence to the flight rules (operational rules). If a collision occurs due to a failure to comply with one or more rules, the owner(s) of the offending spacecraft will be liable for damages to the other party, loss of revenue, and the damages caused by any resulting debris.

Further, collisions do not vaporize the objects involved. Instead, large numbers of pieces (debris) are generated each at orbital speed in slightly different orbits. If a collision resulted from a spacecraft owner failing to maneuver, that owner is now responsible for all debris generated as a result of the collision. Even though the owner of the offending spacecraft could argue that a maneuver was not performed due to the low probability of a collision given the size of the error ellipsoids, that will not compensate for the losses experienced by the injured parties.

It will clearly be in the best interest of all parties operating in earth orbit to reduce uncertainties in orbits and positions as soon as possible. By doing so, consumables won't be wasted on maneuvers that really aren't required thus extending mission lifetimes as long as practical and massive financial judgements will be avoided.

## **CONTROL OF DEBRIS RELEASED DURING NORMAL OPERATIONS**

*The Commission proposes to require disclosure by applicants if such devices are used to deploy their spacecraft, as well as a specific justification for their use. In addition, the Commission proposes that the disclosure include information regarding the planned orbital debris mitigation measures specific to the deployment device, including the probability of collision associated with the deployment device itself. The Commission seeks comment on this proposed informational requirement.*

*The Commission also seeks comment on how this proposal might overlap with informational requirements of other agencies and how we might streamline and minimize informational burden on applicants while mitigating space debris.*

**ASE Comment #2:** As outlined in this NPRM, the FCC should make the reduction, control, and tracking devices for orbital debris part of spacecraft licensing.

**ASE Comment #11:** ASE supports the concept of orbital debris being the responsibility of the original owner just as with a spacecraft. Further, since spacecraft that experience failures or lose power effectively become debris, ownership and liability should be retained.

## **SAFE FLIGHT PROFILES**

*Quantifying Collision Risk. The Commission proposes that applicants for NGSO satellites must demonstrate that the probability that their spacecraft will collide with a large object during the orbital lifetime of the spacecraft will be no greater than 0.001. The Commission seeks comment on whether, if a spacecraft's orbital debris mitigation plan includes maneuvering to avoid collisions, the Commission should, consistent with current licensing practice, consider this risk to be zero or near zero during the period of time in which the spacecraft is maneuverable, absent contrary information.*

**ASE Comment #12:** Due to the impossible task of predicting precise orbits for large numbers of spacecraft over long periods of time, a better solution would seem to be frequent observations over shorter periods of time.

**ASE Comment #13:** Simply because a spacecraft is maneuverable should not in and of itself relieve the owner of supporting and performing conjunction studies periodically. The ability to maneuver is of little value if one doesn't know a maneuver is needed.

*The NASA Standard applies the 0.001 metric on a per spacecraft basis. The Commission invites comment on whether this metric should also be applied on an aggregate, system-wide basis, i.e., 0.001 for an entire constellation.*

**ASE Comment #14:** ASE believes that each spacecraft and object should be treated as a unique entity.

*The Commission also seeks comment on whether it should specify a size for what is considered a large object, or whether it should continue its current case-by case approach, which in practice typically results in consideration of catalogued objects.*

**ASE Comment #15:** The object catalog ("data lake") should include all spacecraft and objects large enough to be considered lethal debris.

*The Commission also seeks comment on whether it should adopt a specific metric for collision with small debris, that is, debris consisting of small meteoroids or other small (approximately <10 cm) debris.*

**ASE Comment #16:** Ideally, conjunction studies would be performed with everything in the object catalog ("data lake"). Although that should be the goal, real world limitations will need to be considered.

*The Commission seeks comment on whether it should incorporate the NASA probability metric into our rules, such that an applicant must certify that for each spacecraft, the probability of accidental collision with small objects that would cause loss of control and prevent post mission disposal is less than 0.01.*

*The Commission seeks comment on whether this metric should be applied on a per spacecraft basis, or in the aggregate. Additionally, should the Commission limit this proposed requirement to operations in certain highly-populated orbits, or to large constellations with more than 100 satellites, for example?*



**ASE Comment #14:** ASE believes that each spacecraft and object should be treated as a unique entity.

*First, the Commission proposes to revise the wording of the rule to require that, instead of identifying satellites with similar orbits, the orbital debris mitigation statement must identify the planned and/or operational satellites to which the applicant's satellite poses a collision risk, and indicate what steps have been taken or will be taken to coordinate with the other spacecraft or system and facilitate future coordination, or what other measures the operator may use to avoid collision.*

**ASE Comment #17: Management Oversight**

It is unrealistic to assume that any voluntary exchange of information among satellite operators would be sufficient for them to coordinate operations to avoid conjunctions. Only a Central Controlling Authority with direct oversight and control of a Space Traffic Management Program could ensure not only the accuracy of the data needed, but also the issuance of appropriate warnings and confirmation that potential conflicts have been avoided.

*Second, the Commission proposes to extend this rule to all NGSO satellites, rather than only those that will be launched into the LEO region, since overlap in orbits among NGSO spacecraft in other regions could equally result in collision creating orbital debris.*

**ASE Comment #18: Space Traffic Management Domain**

As already discussed, earth orbit is a very busy place. Spacecraft start from the earth and pass through an infinite number of orbits enroute to their operational orbits. Over time maneuvers are performed, orbits degrade, and space weather all impact where objects are really located. All objects in earth orbit must be considered as part of the earth orbit domain.

*Orbit Selection. First, for any NGSO satellites planned for deployment above the International Space Station (ISS) and that will transit through the ISS orbit either during or following the satellite operations, the Commission proposes that the applicant provide information about any operational constraints caused to the ISS or other inhabitable spacecraft and strategies used to avoid collision with crewed spacecraft.*

*Third, the Commission seeks comment on whether we should also require a statement concerning the rationale for selecting an orbit from operators of satellites that will remain in orbit for a long period of time relative to the time needed to perform their mission.*

*The Commission asks whether to require applicants to include an additional disclosure regarding orbit selection based on such risks, or to provide assurances on how the applicant plans to reduce these risks.*

*The Commission also asks whether we should seek additional information or assurances from applicants in more narrow circumstances, for example, where they seek to deploy a large constellation in certain sun synchronous orbits that have an increased likelihood of congestion.*

*Fifth, in lieu of an informational requirement, should the Commission require all NGSO satellites planning to operate above a particular altitude to include propulsion capabilities reserved for station-keeping and to enable collision avoidance maneuvers, regardless of whether propulsion is necessary to de-orbit within 25 years?*

*The Commission seeks comment on these questions, as well as on any additional changes to our rules and policies that may help operators avoid collisions and ultimately reduce the risk of debris generation in heavily-used or otherwise critical orbits.*

*The Commission seeks comment on whether we should adopt an operational rule requiring NGSO satellite operators to provide certain information to the 18th Space Control Squadron or any successor civilian entity, including, for example information regarding initial deployment, ephemeris, and any planned maneuvers.*

*The Commission also proposes that applicants for NGSO systems certify that, upon receipt of a conjunction warning, the operator of the satellite will take all possible steps to assess and, if necessary, to mitigate collision risk, including, but not limited to: Contacting the operator of any active spacecraft involved in such warning; sharing ephemeris data and other appropriate operational information directly with any such operator; and modifying spacecraft attitude and/or operations. The Commission seeks comment on this conclusion and note that, as proposed, this is an informational requirement, and would not require that all satellites have propulsion or maneuverability.*

*Recognizing that this is an emerging area from the perspective of collision avoidance, the Commission seeks comment concerning effectiveness and suitability of this or other particular maneuvering technologies under real world conditions, and on whether it should implement any specific disclosure requirements with respect to this or other types of emerging maneuvering technology.*

*The Commission seeks comment on whether it should include in our rules any additional informational requirements regarding such launches.*

**ASE Comment #6: Mission Planning**

**ASE Comment #7: Launch**

**ASE Comment #8: On Orbit**

**ASE Comment #9: Vehicle Retirement/Deorbit**

**ASE Comment #17: Management Oversight**

**ASE Comment #18: Space Traffic Management Domain**

## **POST-MISSION DISPOSAL**

*In addition to these questions, the Commission seeks comment generally on how to prevent satellites from becoming sources of orbital debris during the period following their mission lifetime and before disposal through atmospheric re-entry.*

**ASE Comment #9: Vehicle Retirement/Deorbit**

**ASE Comment #10: Liability**

## **ASE Comment #18: Space Traffic Management Domain**

### **PROXIMITY OPERATIONS**

*The Commission also seeks comment on whether the proposed notification requirement regarding maneuvers, described above, is sufficient in the context of proximity operations, or whether the rules should include anything more specific regarding information sharing about proximity operations with the Air Force's 18<sup>th</sup> Space Control Squadron or any successor civilian entity.*

**ASE Comment #6: Mission Planning**

**ASE Comment #7: Launch**

**ASE Comment #8: On Orbit**

**ASE Comment #9: Vehicle Retirement/Deorbit**

**ASE Comment #17: Management Oversight**

**ASE Comment #18: Space Traffic Management Domain**

### **OPERATIONAL RULES**

*Orbit Raising. Because orbit-raising maneuvers are performed by satellites intended for non-geostationary orbits as well as for the geostationary orbit, and the number of satellites engaging in orbit-raising maneuvers may increase if other proposals in this NPRM are adopted, the Commission proposes and seeks comment on expanding the provision to include NGSO system operations.*

*The Commission tentatively concludes that it is in the public interest that these types of telemetry, tracking and command communications, critical to effective spacecraft maneuvering, be coordinated as necessary to avoid interference, rather than being authorized only on a non-harmful-interference, unprotected basis. The Commission seeks comment on revising its existing rule regarding orbit raising maneuvers to require coordination of such operations to avoid interference events and to extend the application of the rule to NGSO satellites as well as GSO satellites.*

**ASE Comment #6: Mission Planning**

**ASE Comment #7: Launch**

**ASE Comment #8: On Orbit**

**ASE Comment #9: Vehicle Retirement/Deorbit**

**ASE Comment #17: Management Oversight**

**ASE Comment #18: Space Traffic Management Domain**

### **LIABILITY ISSUES AND ECONOMIC INCENTIVES**

*The Commission also seeks comment on whether the agreement would be required to be completed no fewer than 90 days prior to the planned date of launch. In rare instances, this may require applicants to begin the agreement process prior to grant. The Commission seeks*

*comment on these timing matters, including on whether the timeline should be based on the date on which the satellite is integrated into the launch vehicle in preparation for launch, rather than launch date.*

*Finally, the Commission seeks comment on whether any such requirement should be limited to U.S.-licensees, as U.S. licensees generally have a manifest connection to the United States, or whether there are any circumstances in which non-U.S. licensees should also provide indemnification.*

*The Commission also seeks comment on whether any distinctions could be made between on orbit liability and spacecraft re-entry liability, since on-orbit liability is addressed through a fault regime and reentry liability is addressed through a strict liability regime under the Convention on International Liability for Damage Caused by Space Objects (Liability Convention).*

#### **ASE Comment #10: Liability**

#### **ASE Comment #19: Financial Impacts**

Liability in the context of this discussion can result in the payment of significant amounts of money in direct damage compensation, loss of revenue, and punitive fees. It is quite possible that the threat of legal action resulting from a collision may be the best motivator for spacecraft owners and operators to play by the rules.

#### **SCOPE OF RULES**

*Non-U.S.-Licensed Satellites. The Commission generally proposes that the new and amended rules discussed in this NPRM should be applicable to non- U.S.-licensed satellites seeking access to the U.S. market. In other words, an entity seeking access to the U.S. market must continue to submit the same technical information concerning the satellite involved as is required to be submitted by U.S. satellite license applicants. The Commission seeks comment on this proposal.*

#### **ASE Comment #20: International Applicability**

It is the hope of ASE that the FCC will engage the United Nations Committee for the Peaceful Uses of Outer Space as a partner in this endeavor. Controlling orbital debris and making Space Traffic Management work for everyone operating in earth orbit will clearly require extensive international cooperation. As with operations on the seas and in the air, this can only work if we are all in this together.

#### **REGULATORY IMPACT ANALYSIS**

*Changes in Satellite Design. Another method of reducing orbital debris would be for the Commission to regulate how satellites or satellite system are designed.*

**ASE Comment #2:** As outlined in this NPRM, the FCC should make the reduction, control, and tracking devices for orbital debris part of spacecraft licensing.

*Changes in operations and disposal procedures. This is the approach proposed in the individual rule sections above.*

*Use of Economic Incentives. In this NRPM, the Commission asks whether there are other economic incentives available that the Commission could offer that would help achieve the public interest in this area.*

*Active Collision Avoidance. The Commission could also potentially reduce orbital debris by requiring all operators to engage in active collision avoidance, which would involve coordination and maneuvering of spacecraft by operators to limit collisions with other objects in space.*

**ASE Comment #6: Mission Planning**

**ASE Comment #7: Launch**

**ASE Comment #8: On Orbit**

**ASE Comment #9: Vehicle Retirement/Deorbit**

**ASE Comment #10: Liability**

**ASE Comment #17: Management Oversight**

**ASE Comment #18: Space Traffic Management Domain**

**ASE Comment #19: Financial Impacts**

## **RECOMMENDATIONS**

**ASE Recommendation #1:** ASE encourages the FCC through this NPRM to assume the role of Central Controlling Authority until the government decides which agency should be the Central Controlling Authority for the long term. Only through the efforts of strong leadership can a workable Space Traffic Management and orbital debris program be successful.

**ASE Recommendation #2:** Due to the international nature of this effort, ASE recommends that the FCC include the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) as a partner in this effort.

**ASE Recommendation #3:** Efforts should continue to address all technical aspects of Space Traffic Management and Orbital Debris.

**ASE Recommendation #4:** The FCC and COPUOS should host a conference to form a list of actions needed by the international community to address all Space Traffic Management and Orbital Debris issues.

## **SUMMARY**

ASE applauds the efforts of the FCC through this NPRM to address the myriad of issues surrounding Space Traffic Management and orbital debris. Accomplishing all of this will be a major endeavor

involving licensing and certification, an expansion of tracking sites on the ground and in space, the collection of observational data, screening of the data, the addition of observations into the “data lake”, the calculation of potential conjunctions in the future, and the issuance of warnings when a potential event is identified. Just coordinating all of this as an international effort will be a major undertaking! ASE looks forward to supporting the FCC in this effort.