Therese Jones - SIA and Moderator

- What is in FCC guidelines and how it related to operator perspective
- Commented on NPRM hoping all govt agencies would work together but when draft order came out majority of members felt important to have a discussion about where FCC was not consistent with NASA standards

Dan Oltrogge - AGI

- FCC requirements are "fairly stringent but not detailed"
    - What algorithm is used to compute that?
    - What data is used feeding into the algorithm?
- Depending on objects in orbit regime one could choose a different metric to best suit their operations needs
- Estimated actual collision probability is likely the best metric available
    - Minimizes fuel usage
    - More complex to estimate (accurately)
- Each of these concerns can lead to Pc estimates that are multiple orders-of-magnitude from the actual Pc
- Three long term sustainability sustainability space debris mechanisms:
    1. Avoid predictable collisions (prevention)
    2. Remove massive debris (remediation
    3. Don't create new debris (mitigation)
- SSA and STM standards are foundational while LTS guidelines address mechanisms
- The FCC R&O
    - Lots of disagreement but in his analysis he notes that it does "move the needle" in a material way should those clauses become the rule

Marlon Sorge - The Aerospace Corporation

- Issue is that when trying to put together a set of rules you're trying to do a "balancing act"
    - Not practical
    - Balancing between things you're trying to protect and trying to accomplish
- Trying to prevent debris environment to become worse -> in long term to make sure it doesn't get out of control
    - I.e. 25year rule
    - Collision probability, essentially going after the same thing the 25 year rule was trying to accomplish
- Collision avoidance - protect satellite from something iminitnet to you
    - Warning? Will someone hit me?
    - Short term is important
    - Long term perspective of this "not as important as PMD"
        - Staying in orbit 25 yrs vs 100 yrs

- From long term perspective if you have a satellite that you're worried about you're more likely to do something about it
- Post mission disposal rate is very critical to control environment especially in LEO
- Different users of space and their problems (such as debris) are different
    - "Capabilities vs resources of access to vs potential impact on environment are different
    - What one makes sense for one doesn't necessarily make sense for the other
- Multiple deployments are also an issue
    - Relatively small objects being launched
    - One can see why that's a challenge
- Trying to figure out these rules and what makes sense and how to find a balance is a challenge only compounded by the fact that one must find a way to not just develop the rules within a single country like the US, but also how to get other countries or international organizations to do something similar
    - Space is international in nature

John Janka - ViaSat

- "Have very different perspective from SIA on this"
- "Safe space will be at risk if FCC totality of circumstance test is not employed on a going forward basis"
    - Radical changes occurring in the near term on how space is used
- We are getting caught up in politics -> needs to be put aside to enable first step towards space safety and the new space era to move forward
- 3 steps:
    1. Minimize creation of orbital debris
    2. Unwanted collisions between spacecraft and other objects of 10cm or larger can cause massive debris clouds, those smaller can disable spacecraft and lead to more collisions that cannot be avoided
        a. Tracking debris is important but does not obviate the need to avoid creating additional and unnecessary orbital debris
    3. Cleaning up debris
        a. Terrific goal but from ViaSat perspective should stop "littering space" first
- FCC should consider that no matter the size of a constellation and the aggregate risk created by it, it should only focus on risk analysis for only one satellite
    - This makes no sense to ViaSat
    - If this were applied there would be 100 expected collisions for each 100k satellites in orbit
- Important to ViaSat are collision avoidance capabilities
    - Those above a certain altitude spacecraft need to have manoeuvrability, sufficient propellant, need to be suitably resilient from small objects and reliable so that we know they're able to avoid collision

- Cubesats
    - Putting non-maneuverable cubesats into densely populated orbits is like putting go-karts on the highway
    - Could potentially operate up to 600km according to ViaSat where they could deorbit if there were an issues
- The tragedy of the Commons is why the FCC cannot rely on industry standards, which have no teeth and there is a natural incentive on behalf of some in the industry that expect that others will "clean up" their mess
- The FCC draft R&O will create case-by-case and has two choices
    1. Analyze the applications that are before them and move them forward while this rule is pending, in which case its a case-by-case analysis
    2. Stop licensing
- No one has brought solutions to FCC and there are 1200 pages of advocacy and the industry is still engaging in "navel gazing"
- Why do those who profess an interest in safe space oppose regulation that would lead to that very result and why

Charity Weeden - Astroscale

- Close conjunctions are a regular occurrence and bound to become more so
- Rules need to be updated, it is necessary and urgent - it is in the best interest of all space operators to minimize the creation of new orbital debris (SPD-3)
- Satellite operators have a duty of care obligation that any updated that should drive behavior should draw behavior and not dictate technology to be used and that core to responsible space operations is transparency of operations and orbital data ensuring satellite is trackable and identifiable
- Satellite should have deorbit plan
- Be a good orbital neighbor, don't run into things and don't let things run into you, get your things out of the way when you're done with it - not in 25 years but ASAP
- Agree with dan on how details on how to measure metrics is critical to the conversation
- FCC is safeguarding the public interest
    - Highlighted today by virtue of our reliance for security, commerce and connectivity to continue operating and communicating during a global pandemic
- Active debris removal - direct retrieval is becoming an option to satisfy regulatory requirements and to safeguard and assure a continuity of operations
- FCC mentions debris direct retrieval should technology be mature and case-by-case basis - a step in the right direction
- What the order doesn't answer is how many dead satellites especially in the 400-650 zone is an operator allowed to have in orbit at any one time, this is why metrics and compliance is so critical

    - Concerned that a 400-600km range will be a victim of unintended consequences of pushing everything down to the magic 25-year line

Questions:

1. Whether you measure collision probability in aggregate or from an individual satellite (it looks like it will be covered in the FNPRM). With constellations of many thousands of satellites there's certainly an increased collision risk although a lot of NGO operators would certainly argue that they're doing their best right now to work with government agencies to simulate their constellations and voluntarily avoid collisions as best as possible when designing their constellations. What steps forward do you think can be taken from a regulatory perspective or voluntarily to encourage industry to be better actors and is there some intermediary between the individual vs aggregate constellation 1/1000 probability chance?

John

- Start with the facts - understanding the aggregate risk presented by a constellation
    - Determined mathematically by certain models
    - The risk is bigger the larger the constellation it is (cars on a freeway reference)
    - Is risk acceptable if not then what is constellation going to do to minimize the risk
- Appropriate question: is the risk acceptable? If not then what is that constellation going to do to minimize that risk

2. Can operators even evaluate this 1/1000 risk in aggregate in a way that is acceptable to the FCC clear for others when filing their applications and other measures that could be taken to mitigate risk for large constellations

Dan

- There are established methods for computing risks however the bigger question is what data is available to operators and SSA data centers to feed them
    - Been a lot of process in commercial industry that can be leveraged on safety of flight tools and better data
- Data quality- we have good data but with some of this new SSA centers and algorithms, data fusion, and crowdsourcing of data we can get to the other side of this curve and dismiss a lot of potential collision risk because you can show that it won't happen - too far

Marlon

- John brings up good point on question of what's acceptable

    - Many different ways in which debris environment and associated risks could evolve and it's a continuum
    - Problem when developing rules and standards - what's acceptable and what's not
        - Where are the overall average risks? Where do we think the environment is going to evolve given different kinds of behavior? Where do we draw the line?
- 25 year rule/0.0001 probability of collision - preventing the growth of the environment in the long term to keep it manageable
    - The issues involved in protecting your satellite immediately vs protecting the environment are not always the same thing

Charity

- FCC put in the NPRM - what do you think of aggregate vs individual satellites
    - Not sure what more is going to be asked in the FNPRM that hasn't already been looked at

3. Whether the maturation of active debris removal business cases might overcome some of the resistance in changing this collision probability rule

Charity

- FCC in rule will consider direct retrieval should the technology at application be mature and on a case-by-case basis
    - Good model for developing companies for what is the cost leaving your stuff up there vs having a service come take it out of orbit

4. Revisiting the 25 year rule, within SIA many members recognize the 25 years as too long and haven't been able to come up with a proposal to decrease it, anyone have any ideas on what this could look like? When reviewing other countries guidelines have you found anything or have any ideas on how to decrease the 25 year rule?

Dan

- When looking at collision probability thresholds that an operator would choose to protect mission, their financial stream and their customers is fundamentally different threshold from that one might pick for a long term sustainability
- Orbital debris lifetime is a central tenant - a knob we can adjust to keep things sustainable
- People worried about their mission because predicted lifetime is 25.01 yrs have to look at context - its a tool to help us be sustainable

- Now that we have large constellations in the area below the 25 yr limit, a lot of the satellites which might naturally decay will end up conjuncting repeatedly with large constellations going into that very area
    - Not about long term sustainability but about making sure that we have bandwidth to identify those serious conjunctions
    - If you want to find a needle in a haystack you need to get rid of the hay

Charity

- Industry is ahead of game
- Space Safety Coalition does identify 5 years as a ceiling and in practice many satellite operators aim for 10 or less years so this shouldn't be surprising to regulators
- Its about the congestion, collision warnings that would be happening that has the real effect on the industry

5. People were surprised by the indemnification addition, is there even a case law for the FCC to do this? Is there precedent from any other country to include indemnification in their licensing process and where did the FCC get this idea from?

Charity

- UK has clause for in-orbit activity
- In the US the FAA does this as well for launch, but there are upper limits
- It's about “carrot and sticks” - so if you're putting a value on a clean orbit or an unsustainable orbit that actually helps satellite operators understand the real cost involved

6. There have been many questions regarding the proposed bond requirement, does anyone know of other countries that have done something similar? How could it be enforced? We don’t know the cause of a lot of satellite failures, that’s one of the main concerns right now and how this might be implemented.

Charity

- In the nuclear decommissioning industry, oil and gas, offshore industry are all analogies to bond decommissioning - good lessons learned here

John

- What should the consequences be if somebody doesnt do what they promise to do? Should you be able to make commitments to the federal government in your application, commitments that form the basis form an authorization that you get and not follow through? No, then what should be done?
    - Nobody has come up with solutions
    - If you don't care for the bond then what should occur?

Therese

- Aerospace released a paper and one of their solutions was a carbon credit system where companies could get so many credits and then buy new credits if they did not successfully dispose of their satellites

Marlon

- Aerospace paper was thought-provoking paper gives us practical options with advantages and disadvantages and how one could scale that with different aspects - How to implement?

Charity

- In the application process for PMD, how does one measure that? How about actuality?
- In the draft rule, if one were to go above 90% or 1/1000 PC that is a self-report and the FCC would look at modifying the license because of that

7. Has there ever been a case of operators being held responsible for any irresponsible actions in space and how would that play out in terms of this order? (If one were not implement proper collision avoidance maneuvers)

Dan

- Some cases where if someone should be doing close avoidance and there are warning, that is irresponsible but even if the government has an edict for what the collision probability should be and the operator rigorously adheres to that using whatever algorithm/data is available there is still a chance of collision

8. Is there some form of international government association that could be using active debris removal spacecraft that can capture debris? Is it only going to be the job of private companies? If companies fail at correctly assessing their plans and expected results could this incentivize them to buy services from an active debris removal company?

Charity

- No international organization exists to pool resources and sending up debris removal services
- There are numerous companies that are looking at this technology/business plans/policy that could potentially provide a good service for commercial operators and help them adhere to any regulations that are coming

9. A lot of these regulations are based on existing standards, we've talked about some of the gaps that exist in the order and NPRM, are there any other major areas that need to be addressed by the FCC or another regulatory body in the US government to get on the right track for orbital debris mitigation?

Dan

- Need for standardizing and requiring certain algorithms
- FCC document does well in consistently pointing to NASA DAS Software to do some of these assessments but on collision probability it is not so standard
- Addressing the problem of SSA data and having it be of quality so it can support decisions

Charity

- STM scheme should not be discussed at FCC, DoC also has stake given SPD-3, all this needs to happen in parallel and now

John

- OECD paper from last week says that with expected dramatic increase of operational LEOs in the next few years, it is not a question if a defunct satellite will collide with debris but when
- Start with national decisions - implement them - then over coming years work to build some international consensus with the US taking charge

Marlon

- Working on things sooner rather than later is critical
    - Will be harder and more difficult the longer we wait
- Critical to choose direction to go based on actual analysis based on assessing what is going to be of value and what is not

Closing remarks

Dan

- Need to get going on STM, what we have today has deficiencies that must be overcome
- In terms of the FCC proposed rules there is the long term sustainable flavor that the rules are meant to address
- “Put a plug in” for having much better SSA data than we currently do and trying to reduce the false alarms so that operators can focus on what is truly important and get enough good data to compute collision probability and casualty risk

Marlon

- What's come out of the FCC effort is the discussion about it, which is absolutely critical in getting people interested in what's going on, decision makers see what the questions are and being able to put on the table what we need to be doing and where we need to be going to do that
- A lot of the international community that understands this is critical because space does not have any national boundaries - one bad actor can mess it up for everyone

John

- Hopes that FCC releases rule quickly so the industry develops

Charity

- Chris Johnson, SWF quote: “If you don't have a regulatory compliance plan as part of your business plan you don’t have a business plan”
    - If you don’t have a regulatory compliance plan AND an airtight disposal plan you don't have a business plan
- 3 key takeaways: Prepare for unexpected: design your spacecraft for capture should an in-orbit anomaly occur, Expedite disposal plan for a directory entry into the atmosphere as soon as mission is complete, and join like-minded responsible operators in developing further best practices