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Letter to the Editor

Space Access: Still the Major Issue for the Small Satellite Community

Dear Editor,

The utility of small satellites, and particularly the nanosatellite class, is increasing in large part due to technological advances, increased sophistication in commercial off-the-shelf-components, and a mindset change in satellite design driven by adoption of the CubeSat specification.[1] Yet space access opportunities for satellites with mass in the nano range or less (< 10kilograms) are limited to rideshare opportunities on small, medium, and heavy lift space launch boosters serving primary payloads. In this context, nanosatellite sponsors/developers are forced to accept suboptimal orbits or in a worse case, be de-manifested due to late-stage concerns by the primary payload sponsor. In the early 21st century, space access remains the major obstacle to expansion of the U.S. economic sphere into space. This discussion gives some reasons why space access remains a major issue and suggests it is in the best interest of the small satellite community to engage with emerging dedicated nanosatellite launch providers.

Space Launch Insights: Even if the most optimistic plans of new commercial launch providers are successful, launch costs will still be a significant part of overall mission cost, and remain outside the reach of the average university, small company and citizen. As long as CubeSats must share a ride to orbit on rockets with a high value primary payload, launch providers/sponsors will impose constraints on secondary payloads to minimize perceived risk. Constraints like sub-optimal orbits, late stage de-manifesting or prohibition of propulsion capability (for CubeSats)[2], although understandable, marginalize the innovation value-add proposition of small satellites.

In response to this state of affairs, NASA has responded by creating incentives to increase space access opportunities in addition to that already provided by its CubeSat Launch Initiative (i.e. the ELaNA program) through the Nano-Satellite Launch Challenge.[3] NASA's funding of the Nano-Satellite challenge and selection of the Allied Organization to manage it, the Space Florida Small Satellite Research Center (SFSSRC),[4] are positive developments. However, in addition to the technical challenges, teams are responsible for obtaining a launch license, costs associated with range safety compliance and range services and liability insurance. These are significant barriers to entry. Implementing a nano-satellite launch architecture would be a complex, multi-year process of which licensing and range associated costs would be a significant portion of the overall program costs. The test and systems engineering necessary to comply with FAA Part 417 Flight Safety requirements alone are daunting and beyond resources of small companies. To obtain a license, launch providers must purchase third party liability insurance, the policy value set by FAA based on a worst-case scenario known as Maximum Probable Loss (MPL), using a complex analysis that considers proximity to populated areas, launch providers experience, vehicle design, flight safety approach and many other factors. Additionally, teams must bear costs to complete a National Environmental Policy Act (NEPA) assessment required to obtain a launch license from a specific site. The outcome of any NEPA action is uncertain, thus adding to program risk. Further costs are incurred due to systems engineering activities required to satisfy specific launch range authorities, along with the actual tracking and logistics services provided by the range.

Should space launch be this costly and complex? The current launch licensing, range use certification and cost structures are reflective of the established space launch architectures, whose roots and operations culture date back to the dawn of the space age. The United States as a signatory to The Outer Space Treaty (OST) of 1967 is responsible for activities conducted in space by governmental agencies or by non-governmental entities. The U.S. fulfills its OST treaty obligations through domestic policy and law codified in Title 51 United States Code, Subtitle V, Chapter 509, Commercial Space Launch Activities[5]. Enforcement of Title 51 is through regulations issued under the Code of Federal Regulations (CFR), Title 14, Aeronautics and Space, Chapter III, Subchapter C, Parts 411-1199.[6] The federal agency that enforces these regulations is the FAA Office of Commercial Space Transportation (AST). AST's mission is to protect public safety while ensuring commercial space launch operations are conducted in a manner consistent with U.S. national security and foreign policy interests. In terms of domestic public safety, acceptable risk for space launch is driven by the Expected Casualty (Ec) – which shall not exceed an expected average number of 0.00003 casualties per mission (Ec < 30 X 10-6), "limited to thirty expected casualties per million missions."[7] A launch provider must quantitatively demonstrate that the totality of the launch architecture in a nominal launch operation at the intended launch site does not violate this criterion prior to obtaining a license.

In the international context, space launch capability is inherently dual-use technology, and triggers policy reviews during licensing of space launch systems due to proliferation concerns. Some business models contemplate private spaceports outside of U.S. territory, to reduce costs driven by MPL, NEPA and other overhead. Such models are incompatible with U.S. policy under the Missile Technology Control Regime (MTCR). Hence, a new U.S. launch entrant really has only two options -- using existing land based ranges, or launching from a sea-based platform.

Highlighting these realities is not criticism of the current operational and regulatory regime; it merely notes that placing large payloads into space requires large rockets and their associated policies and culture, while placing small payloads into orbit can be accommodated by much smaller launch systems, i.e. "Big Space vs. Small Space".

Moving Forward: Economic viability of a dedicated nano-micro launch service requires a different culture of operation and regulation. In addition to the current NASA prize incentive, ways to lower MPL, NEPA and other costs would ease barriers to entry. For example, implementation of a sufficiently remote, temporary ocean-based range may reduce these types of costs. The Mobile Ocean-based Range (MOR) is a concept of an on-demand launch corridor located in international waters for the exclusive use of emerging nano-micro launch providers vying to win the NASA nano-launch challenge. The MOR provides a controlled space for teams to build sufficient systems engineering capacity and attain regulatory milestones sufficient to attempt an orbital mission. Entrants would be pre-approved for ITAR and MTCR compliance to operate in the MOR. The government would directly or in-directly provide range clearance and tracking services and some logistical support. The concept is fraught with policy and practical implementation challenges, but is an example of what a dialogue between small satellite community and emerging nano-launch providers can lead to.

There are concepts of operations issues that if resolved in a coordinated process, would lend to closing the business case of dedicated nano-launch and improve perception that CubeSat-class satellites can be responsibly utilized in the low Earth orbit. One is payload integration and interfaces. The poly-picosatellite orbital deployer (P-POD) was developed by CalPoly to isolate the CubeSat from launch vehicle and primary payload.[8] Is a P-POD needed when CubeSat-class satellites are the primary payload? Another example is manifesting approach. Some nano-launch providers envision several nanosatellites co-manifested, while others contemplate over thirty. What is appropriate, and is the nano-launch provider business case the only driver? An issue that becomes complex very quickly is radio frequency coordination. Radio frequency interference will be an issue particularly for business models intending to deploy dozens of nanosatellites. Should nano-launch providers simply require end users to show documentation or complete frequency coordination for the entire manifest?

Conclusion: Only a few years ago, one would risk their credibility if they suggested the CubeSat was a viable platform for interplanetary missions. The author recently attended the first annual Interplanetary CubeSat Workshop (iCubeSat), 29-30 May 2012. The comments of keynote speakers Mason Peck, the NASA Chief Technologist, and Sara Seager, MIT, Professor of Physics and Planetary Science, left no doubt that the CubeSat is a viable platform for certain classes of interplanetary missions. However, on several occasions during the workshop, the issue of space access (lack thereof) was raised. Rideshare, along with the associated constraints, will remain the predominant space access option for missions that utilize CubeSat-class satellites.

The existing regulatory, operations and cultural paradigm of Big Space Launch is in place for understandable reasons, but it limits the innovation and economic benefits of small satellites. The community of small satellite developers and users, along with the nascent dedicated nano-satellite launch providers, have a common interest. Working together to achieve consensus objectives on the range of policy, regulatory and economic issues impeding small space launch is a necessary first step before engaging with government stakeholders. Thereafter, a public-private dialogue should commence, to achieve a mutually acceptable environment conducive to establishment of a small space launch sector. The resulting increase of space access will mobilize the full innovation potential of the small satellite community and lead to new space applications limited only by our imagination.

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References

1. Woellert, K., Ehrenfreund, P., Ricco, A., Hertzfeld, H., CubeSats: Cost-effective science and technology platforms for emerging and developing nations, Advances in Space Research, doi:10.1016/j.asr.2010.10.009
2. NASA Launch Services Program Level Poly-Picosatellite Orbital Deployer (PPOD) and CubeSat Requirements Document, LSP-REQ-317.0, Rev. A, Oct 13, 2011
3. NASA, Centennial Challenges, www.nasa.gov, accessed June, 2012
4. Space Florida, http://www.spaceflorida.gov/nano-sat-launch-challenge, accessed June, 2012
5. US GPO, Unites States Code, 2011 Ed., www.gpo.gov, accessed June, 2012
6. US GPO, Code of Federal Regulations,2012 Ed., www.gpo.gov, accessed June, 2012
7. FAA Advisory Circular, Expected Casualty Calculations for Commercial Space Launch and Reentry Missions, AC No: 431.35-1, Aug 30, 2000
8. CalPoly, P-POD Mk III Interface Control Document (ICD) http://www.cubesat.atl.calpoly.edu/