

NanoSatisfi's Responses to Request Number 21501 and Further Information Regarding Application
Number 0532-EX-PL-2013

November 7, 2013

1. We will need a NOAA determination and approval for any operation of cameras aboard the cubesats.

On October 30, 2013, NOAA granted approval for the operation of the camera on board the ArduSat-2, which is scheduled to be launched December 8, 2013. See File No. NS-2013-L3 (Oct. 30, 2013), <http://www.nesdis.noaa.gov/CRSRA/licenseHome.html>. NOAA approval will be sought for each satellite that will fall under the experimental license and attached to the application when granted.

2. Please provide a tentative schedule of cubesat construction, launch integration dates and proposed launch dates and providers. Include the exact number of cubesats that you expect to launch.

NanoSatisfi intends to launch a total of 15 satellites into low-Earth orbit. (These 15 satellites do *not* include the 2 satellites that are separate from this market trial and that we have already launched under Special Temporary Authority. See Call Sign WG9XFC, File No. 0917-EX-ST-2012.) The first of the 15 cubesats planned for the experimental authorization is scheduled for launch **December 8, 2013**; the remaining cubesats will be launched opportunistically based on launch vehicle availability and capacity. A summary of planned launches and operations appears in the table below.

Summary of Cubesat Experimental Launches and Operations								
Satellite	Size	Number to be Deployed	Altitude	Schedule of Construction	Proposed Launch Date	Launch Service Provider Point of Contact	Launch Vehicle Operator	Mission
ArduSat-2	2U	1	380 km-410 km	Constructed	Dec. 8, 2013 (confirmed)	NanoRacks LLC	Orbital Sciences	Cygnus ORB-1, ISS resupply mission
ArduSat-2x	3U	1	600 km or lower	Under Construction	Q1 2014	In negotiations with CalPoly Launch Services, NanoRacks, SpaceX, and ISIS Launch Services	TBD	Currently negotiating a DNEPR launch (600 km)
ArduSat-2x	3U	Up to 13 more	600 km or lower (we will submit a new application if higher)	See Tentative Construction and Launch Schedule	See Tentative Construction and Launch Schedule	In negotiations with CalPoly Launch Services, NanoRacks, SpaceX, and ISIS Launch Services	TBD	Secondary payload on existing mission or as cargo during a resupply mission to the ISS

Orbit Altitude

Although we originally requested authority to launch satellites into orbits as high as 900 km, see File No. 0539-EX-PL-2013 (filed Aug. 6, 2013), we are now modifying our request to ensure that we receive approval in time for our **December 8, 2013** launch. In our October 31, 2013 meeting, staff expressed concern that orbits higher than 600 km would not decay sufficiently quickly on their own, and that the Commission would require details regarding any deorbiting device. We are thus amending our application, simultaneously with this response, to only request authority for orbits lower than 600 km at this time.

In the event that an opportunity arises to deploy at an orbital altitude greater than 600 km, we will submit a new application at that time, and we will include detailed information regarding the de-orbit device and the specific launch.

This flexibility is very important because one particular aspect of this experiment is to assess rapid turnaround times and opportunistic launch slot assignments. For example, our second satellite, which we launched this summer, was possible because we picked up a launch slot that became available on very short notice (<8 weeks) at a very reduced price, which we took advantage of. Given the particular type of satellite standard NanoSats is using (CubeSats), we expect that such opportunities will present themselves on a somewhat irregular basis, which is why our construction schedule is so much ahead of our launch schedule – so that we always have “hot spares” available. Likewise, an advanced construction schedule reduces our production costs by allowing us to build more units in each individual production run.

Ultimately, we plan for an opportunistic mix of orbit heights between 400 km (mostly through NanoRacks and their International Space Station related launch services) and 800 km. Again, if and when the opportunity arises to place a satellite in orbit above 600 km arises, we will submit a new application and provide more detailed information regarding the de-orbiting device at that time.

Orbit Inclination

With regard to inclination, we expect a mix of polar and/or sun synchronous orbits (through the launch service providers from CalPoly and ISIS, leveraging often Russian and Indian launches where possible) and inclinations between 40 degrees and 60 degrees (through the launch service providers NanoRacks and SpaceX mostly). Again, as part of the experiments performed, we will investigate the practical implications for random orbit and inclination selection based on short term availability.

These satellites will have inclinations ranging from 30 to 98 degrees. We envision that our final constellation for this experiment would consist of satellites in the following orbits:

Model Constellation	
Inclination	Number of Satellites
98	4
65	3
52	4
45	2
Total	13

Operations at variance with these parameters may occur depending on launch vehicle capacity and destination; NanoSatisfi will inform the Commission of any material variations from these anticipated orbital parameters following in-orbit placement.

Tentative Construction and Launch Schedule

The Tentative Construction and Launch Schedule Table below indicates our anticipated schedule for our mid-case scenario of 13 satellites launched in 2014.

Tentative Construction and Launch Schedule				
Schedule	Q1 2014	Q2 2014	Q3 2014	Q4 2014
Construction	2	5	7	0
Launch	1	2	4	6

Based on launch availability, this schedule may be accelerated or delayed, but all satellites under this experiment will be launched by the second quarter of 2015 at the latest (and NanoSatisfi expressly acknowledges that it does not have any right to continued authorization following expiration of an experimental authorization). The maximum number of satellites we expect to launch under this experiment is 15; at a minimum, we plan to launch 8 satellites.

Launch providers

NanoSatisfi is currently in negotiation with a small number of launch services providers, in particular CalPoly Launch Services, NanoRacks, SpaceX and ISIS Launch Services with the goal to procure a packaged price for multiple launches.

NanoRacks has been the launch service provider for NanoSatisfi's first three launches, using the Japanese rocket H2B as well as the American rocket Cygnus 1 (for the planned December 8th launch). Negotiations for Nanoracks's launch services via the International Space Station are ongoing. We are also in negotiations with other launch vehicle operators. For example, CalPoly Launch Services has deep experience in launching CubeSats internationally (including the handling of any potential export regulations). We are currently negotiating a specific DNEPR launch in Q1 as well as a packet of 10 launch slots, using CalPoly's existing US and European assets. NanoSatisfi is also in negotiations with ISIS Launch Services for a combined contract of delivering 10 launch slots as well as manufacturing a substantial portion of the 3U satellites to be launched. Finally, NanoSatisfi is in discussions with SpaceX about their launch services. SpaceX had their CubeSat negotiations on hold until the end of the summer to focus on their Grashopper program; however, NanoSatisfi has resumed discussions started earlier this year to leverage SpaceX's Falcon 9 launches.

Generally, we plan to launch between 2-4 satellites on a single launch vehicle to reduce cost and administrative burden. However, this goal has to be balanced with the advantages of more diverse orbits and inclinations.

3. Please provide any SpaceCap analysis data files that have been completed as in your previous license.

We are simultaneously emailing a SpaceCap analysis data file for the UHF frequencies (400-403 MHz) related to the first mission, the ArduSat-2 scheduled to launch on December 8, 2013. We will follow up in the very near future with the SpaceCap analysis data file for the S-Band frequencies (2.4-2.48 GHz) related to this same launch.

4. We encourage you to concurrently contact the FCC International Bureau directly to discuss any current testing and future plans for non-experimental service operation.

Discussions have been initiated with the FCC International Bureau with regard to NanoSatisfi's future plans for non-experimental service operation. All services contemplated by this application are purely experimental and are designed to test the technology and market demand for the services capable of being rendered. NanoSatisfi expressly acknowledges that it has no right or expectation of continued authorization following expiration of an experimental authorization.

5. During our October 31st meeting with Staff, Staff requested that we include information regarding the frequencies we will be passively monitoring to track nautical and aeronautical activity.

Both the ArduSat-2 and the ArduSat-2X will passively monitor Automatic Identification System ("AIS") signals at 161.975 MHz and 162.025 MHz for purposes of tracking nautical activity. Our satellites will not emit any signals at these frequencies. Moreover, no new equipment will be required onboard subject vessels because vessels with gross tonnage of 300 tons or greater are required by international law to carry a functional AIS beacon transmitter on-board. See The International Convention for the Safety of Life at Sea, Dec. 2002 Amendments (Dec. 2002), available at <http://bit.ly/15vyqx5>.

Only the ArduSat-2X will passively monitor Automatic Dependent Surveillance Broadcast ("ADS-B") signals at 978 MHz and 1090 MHz for purposes of tracking aeronautical activity (the one ArduSat-2 will not have this capability). As with the nautical tracking function, our satellites will not emit any signals at these frequencies. Similarly, no new equipment will be required on board subject aircraft because certain aircraft already transmit ADS-B signals.

6. We are simultaneously amending our Form 442 to update our transmitting equipment information and our requested orbit altitude.

Manufacturer	Model Number	Number of Units	Experimental	Purpose
NanoSatisfi	GS-SDR-1	12	Yes	Base Station
AstroDev	Lithium	15	No	UHF Satellite Transmitter
AstroDev	Beryllium	15	No	S-Band Satellite Transmitter

Originally, we inadvertently only listed 12, rather than 15, AstroDev Lithium UHF (400-403 MHz) transmitters (1 for each satellite), and we inadvertently omitted the AstroDev Beryllium S-Band (2.4-2.48 GHz) transmitter.

We are also updating our application to reflect that we are requesting orbits lower than 600 km. If and when the opportunity to place a satellite in orbit above 600 km arises, we will submit a new application with more specific information at that time.