REQUEST FOR SPECIAL TEMPORARY AUTHORITY

Spaceflight, Inc. ("Spaceflight"), pursuant to Section 25.120 of the Commission's Rules,[1] hereby requests Special Temporary Authority ("STA") to permit it to deploy and operate a spacecraft (Sherpa-FX1) including its Rapidly Reconfigurable Avionics (R2A) system, for a duration of less than twenty-four hours[2] to take place in a single occurrence now scheduled between December 1, 2020 and January 31, 2021.[3]

Overview

As described in greater detail in the attached Technical Annex, Sherpa-FX1 is a non-propulsive, free-flying spacecraft that, through the R2A, is intended to deploy auxiliary spacecraft after Sherpa-FX1 has been itself deployed by the launch vehicle. Sherpa FX1 will also carry up to 4 approximately 1U-sized, hosted payloads, subject to the providers of those payloads securing their own separate authority for their missions from the Commission or the Federal Aviation Administration ("FAA"), as applicable. Before being deployed, Sherpa-FX1 will be affixed to the Falcon 9 launch vehicle that is currently scheduled to occur within above-stated launch period.

Sherpa-FX1 will be placed in sun synchronous obit (SSO) at a target altitude of 525 km ± 25km at an inclination of 97.59 degrees. At that point and after a subsequent delay in accordance with SpaceX requirements, the R2A will initiate a timed sequence

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[1] Spaceflight also respectfully requests a waiver of Section 25.113(g) of the Commission's rules, requiring orbital deployment approval and operating authority to be applied for and granted prior to orbital deployment and operation of a space station. In this case, given: (1) the short operational life of the Sherpa-FX1; (2) the similarity of its function to that of an upper stage launch vehicle; (3) the descriptions contained herein and in the associated attachments of the spacecraft operations and debris mitigation plans that might otherwise be presented for approval as part of an application for approval for the orbital deployment and operation of a space station; and (4) the overall public interest of the mission that is presented, Spaceflight urges that the underlying purpose of the rule sought to be waived is met and that the grant of the requested waiver will serve the public interest.

[2] The actual mission time of the Sherpa-FX1 is expected to last less than 6 hours from launch and separation from the Falcon 9 launch vehicle, at which point a programmed stop will be executed as a part of the on-board mission sequence. Radio transmissions may last longer, but no more than twenty-four hours, at which point the batteries on the spacecraft that support such transmissions will be exhausted. Accordingly, authority for this somewhat longer timeframe is requested.

[3] The timeframe set forth above reflects the current launch period assigned for the Spaceflight launch. Accordingly, Spaceflight is herein seeking STA to cover the entire launch period that has been provided to it by the launch vehicle provider and to allow for any slippage of that may occur in SpaceX's launch schedule. However, as described herein, the period of radio transmissions for which STA is sought will occur over a period of less than twenty-four hours. Spaceflight will notify the Commission as its launch period is narrowed to a particular day as soon as that information is confirmed to it by the launch provider.

of procedures to begin the deployment of its own payloads and the communication that is the subject of the instant requests will commence.

Radio Frequencies To Be Employed

Spaceflight seeks authority to permit it to establish a one-way telemetry link from the Sherpa-FX1 to the Globalstar constellation during the period of spacecraft deployment. The Sherpa-FX1 will utilize the NearSpace Launch EyeStar S3 Radio (EyeStar S3 Radio), consisting of an L-band transmit antenna, an S-band receive antenna and a GPS L-band receive antenna. The L-band transmitter is a component of the EyeStar S3 Radio, a slightly upgraded model similar to that used for Spaceflight's SSO-A mission.[4] Globalstar will use its own licensed network to downlink the telemetry and is responsible for securing FCC authority to receive signals from the Sherpa-FX1.[5] The L-band link will permit the Spaceflight technical team to monitor the deployment of the small spacecraft onboard Sherpa-FX1. This data will be disseminated both to Spaceflight's customers and to the Combined Space Operations Center (CSpOC) .

Spaceflight also seeks authority for the operation of an S-band receive antenna to be connected to the Sherpa-FX1 to enable it to receive signals from a NearSpace Launch owned and operated S-band transmit station.[6] The purpose of this S-band link is to enable the Sherpa-FX1 L-band antenna to be shut down from the ground if required to avoid any unanticipated harmful interference and/or as a final failsafe if the L-band antenna is not shut off within twenty-four hours by operation of its on board timer or loss of battery life.

The Sherpa-FX1 is also equipped with a GPS L-band receive unit to enable it to be more easily tracked. Authority for that unit is also hereby requested. The specific radio frequencies sought to be employed and associated properties are shown the table below:

[4] SAT-STA-20180523-00042

[5] The Sherpa-FX1 does not transmit signals to the ground, except through the Globalstar constellation network.

[6] NearSpace has been authorized for what Spaceflight understands was a similar mission. *See* 0105-EX-CM-2019

	L-band Downlink to Globalstar
Data Rate	100 bps
Modulation	BPSK
Center Frequency	1616.25 MHz
Bandwidth	2.5 MHz
Transmit Power	0.10 W (max)
Transmit Antenna	Patch
Receive Antennas	Patch S-Band Receive: 2456 - 2478 MHz L-Band (GPS) Receive: 1227.60 MHz to 1575.42 MHz
EIRP	-8 dBW
Encryption	AES-128

Regarding the L-band link, the selected Eyestar S3 Radio has an absolute temperature operating range between -40◦ C and 60◦C. If found to be outside of that range for too long, the transmitter will stop working. The vendor has provided measurements of the spectrum use which demonstrate that out of band emissions are minimized, specifically, the Eyestar S3 Radio unit transmits 99.00% of its radiated power within 1.8817 MHz of the specified 2.5 MHz bandwidth.

Responsibilities of Owners/Operators of Spacecraft to be Deployed and Hosted Payloads

The small spacecraft to be deployed and each of the up to four hosted payloads are owned and to be operated by Spaceflight's customers or, in some cases, their customer operator. Each customer is expressly required under its agreement with Spaceflight to obtain and/or require its customer operator to obtain all licenses, authorization, clearances, and permits from their applicable administrations that may be necessary to operate its individual spacecraft or hosted payload.[7] A list of those customers or, if different, operators, and authorizing administrations is attached as Exhibit D hereto. If any customer/operator is unable to provide its spacecraft for launch, a non-separating mass model will be substituted.

[7] As neither the Space Domain Awareness Inc. nor the Celestis, Inc. payload has any RF operation, Spaceflight will require the owner of each payload to secure authority from the FAA to be attached to the Sherpa-FX1.

Coordination with Other Federal Agencies

Spaceflight has completed pre-coordination with the following U.S Government agencies: NTIA, NASA, NOAA, the Air Force, and the Navy. Each agency has provided Spaceflight with an informal go-ahead to proceed.

Comparison to Spaceflight's SSOA Mission

While substantially similar to Spaceflight's previously approved and successful SSOA mission, Sherpa-FX1's mission also includes several advancements that improve upon that design, including as related to mitigation of the risks of orbital debris. Certain key similarities and differences between the two missions are summarized below:

Key Similarities:

- Both missions deploy multiple customer spacecraft to be separately licensed by customers at the FCC or other applicable national administrations.
- For both missions, Spaceflight transmits an L-band signal from its deployer to the Globalstar constellation.
- Spaceflight's Sherpa-FX1 will separate from the Falcon 9 launch vehicle just as SSOA.
- The probability of recontact between all spacecraft to deployed by Spaceflight was determined by Spaceflight using the same high-fidelity simulation that was used for the SSOA mission and with comparable, in this case, more favorable, risk results.

Key Differences

- There will be a means to cut off transmission of Sherpa-FX1's RF transmissions by command from a terrestrial ground station. This will allow a positive means of stopping RF transmissions in the event of electromagnetic interference.
- No titanium isolation system will be used. This change improves the reentry casualty risk assessment.
- Sherpa-FX1 is compliant with orbit lifetime requirements without the use of a deorbit device.

Exhibits

A more detailed technical showing is attached as Exhibit A. A list of customers/operators for the spacecraft to be deployed and hosted payloads, along with authorizing administrations, is attached hereto as Exhibit B.

A Recontact Probability Analysis relative to the customer spacecraft to be deployed by Sherpa-FX1 is attached hereto as Attachment 2.

An Orbital Debris Assessment Report ("ODAR") for the Sherpa-FX1 is attached hereto as Attachment 3.

Conclusion

Spaceflight urges that grant of the instant request for Special Temporary Authority will be in the public interest. Such grant will permit Spaceflight to continue to provide its new and innovative deployment technology for small spacecraft, thereby providing a cost-efficient means for placing them into their designed orbits.

Attachment 1

Exhibit A

SPACEFLIGHT'S SHERPA-FX1 AND R2A AVIONICS DESCRIPTION

28 July 2020

1 Overview

Spaceflight, Inc, (Spaceflight) is planning a free flyer mission (the "Mission") for its Sherpa free flyer spacecraft ("Sherpa-FX1") which contains a Rapidly Reconfigurable Avionics ("R2A") system to affix and command the deployment of approximately 14 customer spacecraft into Sun Synchronous Orbit (SSO). Spaceflight provides the launch capacity, structure, separation systems, and integration services for the customer spacecraft.

The Mission is scheduled to be launched by Space Exploration Technologies Corporation (SpaceX) on a Falcon 9 launch vehicle between 1 December 2020 and 31 January 2021. Sherpa-FX1 will separate from the Falcon 9 upon receipt of a separation command from the launch vehicle once the launch vehicle reaches the destination orbit, targeted at 525 km, with a margin of± 25km. The R2A will be activated upon separation of Sherpa-FX1 from the launch vehicle after the launch vehicle reaches the destination orbit, nominally to an altitude of 525 ± 25km.

Once activated, the R2A executes an onboard mission sequence to deploy all spacecraft. The R2A also activates the EyeStar S3 Radio (provided by NearSpace Launch, and more fully described below) and specifically, the L-band transmitter that sends deployment confirmation telemetry to the Globalstar constellation for relay by commercial Globalstar and NearSpace Launch data services to Spaceflight. The Mission is anticipated to last less than six hours, and all communications will stop at or less than 24 hours after launch. R2A is equipped with an S-band receiver, also contained within the EyeStar Radio, to allow a kill-command to be sent from a ground station operated by NearSpace to deactivate the transmitter in the event of radio frequency interference. The R2A will also have an on-board timer to cut off its transmissions several hours after the end of the planned deployment cycle. If all else fails, battery life is expected to be exhausted by 24 hours into the mission. The R2A will remain affixed to Sherpa-FX1 assembly for the duration of the Mission.

2 Sherpa-FX1

Sherpa-FX1 is a non-propulsive, free flying spacecraft that is designed to deploy auxiliary spacecraft. Like previous SHERPA[1] and SSO-A[2] missions, Sherpa-FX1 consists of several structural elements to mount both microsatellites and CubeSat dispensers. Four 12U-equivalent CubeSat dispensers, and two 6U-equivalent dispensers can attach to the body of Sherpa-FX1. Sherpa-FX1 also has the capability to attach a microsatellite on the outboard end (when attached to the Falcon 9) of the structure. Finally, Sherpa-FX1 will carry the aforementioned EyeStar S3 Radio, consisting of the S-band receive, L-band transmit antenna, the GPS L-band receive antenna. Additionally, Sherpa-FX1 will carry up to four non-separating customer payloads on its structure. The internal volume of Sherpa-FX1 will contain R2A sequencer and batteries. Sherpa-FX1 will be attached to a single port on a SpaceX-provided payload ring. The Falcon 9 will have multiple rings with SpaceX's own customers stacked above and/or below the ring to which Spaceflight's Sherpa-FX1 is attached. Once a separation signal is received by Sherpa-FX1's separation system from Falcon 9 avionics, Sherpa-FX1 will separate.

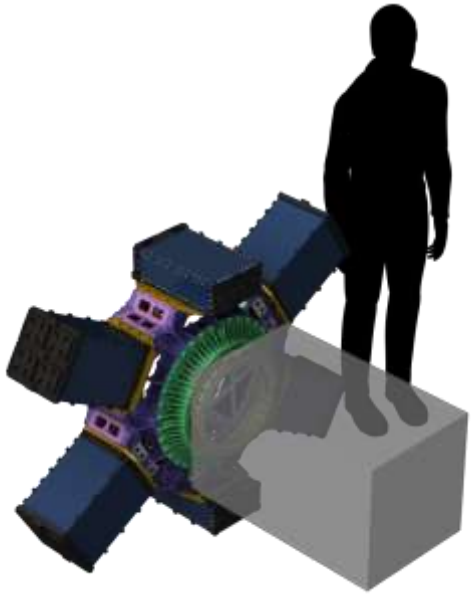

Figure 1: Physical architecture of Spaceflight's Sherpa-FX1 with customers on a Falcon 9 Rideshare mission. The Spaceflight customers are indicated by gray shape (microsatellite) and are cubesats integrated into the blue dispensers. These customers will be deployed by the Spaceflight R2A system, which is housed within the internal volume of the Sherpa-FX1 structure, once Sherpa-FX1 is separated from the Falcon 9 vehicle. The EyeStar Radio and up to four 1U-sized non-separating, hosted payloads contained on the structure of Sherpa-FX1, are shown in the areas colored purple. These will deorbit with Sherpa-FX1.

[1] SAT-STA-20150821-00060
[2] SAT-STA-20180523-00042

3 Rapidly Reconfigurable Avionics (R2A)

R2A is the avionics subsystem of Sherpa-FX1. After Sherpa-FX1 separation from Falcon 9 and a subsequent delay in accordance with SpaceX requirements, R2A will initiate its own separation sequence to deploy approximately 14 Spaceflight customer spacecraft from Sherpa-FX1 and send telemetry back to Spaceflight.

3.1 RF System Design

R2A has an L-band transmitter, an S-band receiver, and a GPS L-band receiver. The L-band transmitter broadcasts through one simplex patch antenna to the Globalstar constellation using a NearSpace Launch the Eyestar S3 Radio, a slightly upgraded model to that used for Spaceflight's SSO-A mission. The Eyestar radio has an absolute temperature operating range between -40◦ C and 60◦C. If found to be outside of that range for too long, the transmitter will stop working. The Eyestar radio unit transmits 99.00% of its radiated power within 1.8817 MHz of the specified 2.5 MHz bandwidth. The EyeStar S3 Radio also includes an integrated Novatel GPS receiver module that works in conjunction with a GPS patch antenna. Other radio property details are shown below.

Table 1. Radio Properties

	L-band Downlink to Globalstar
Data Rate	100 bps
Modulation	BPSK
Center Frequency	1616.25 MHz
Bandwidth	2.5 MHz
Transmit Power	0.10 W (max)
Transmit Antenna	Patch
Receive Antennas	Patch (S-Band, GPS)
EIRP	-8 dBW
Encryption	AES-128

3.2 RF Concept of Operations

The L-band avionics systems are set to beacon data to the Globalstar constellation from activation until cut off by a timer set to shut off transmissions once the deployments of all customer spacecraft are complete. The duty cycle for the L-band system is a transmission up to 10 seconds every 20 seconds (30 seconds of broadcast time per minute; a 50% duty cycle). The EyeStar S3 Radio has an S-band uplink that can receive a "kill command" from the NearSpace Launch ground station.

The L-band transmitter will continue to broadcast until the earliest of the following:

- Programmed stop (via R2A's onboard mission sequence);
- Kill command from S-band ground transmitter;
- Battery depleted (less than 24 hours after starting).

The S-band receive antenna's purpose is solely to receive the kill command from the ground if necessary.

4. Hosted Payloads

In addition to the microsatellite and CubeSat customer spacecraft which will be separated from Sherpa-FX1, there will be up to four, approximately 1U-sized, hosted payloads. These hosted payloads (along with the L-band and S-band antennas that are Sherpa-FX1 avionics components) will be non-separating and will deorbit with the Sherpa-FX1 structure. As is the case with the spacecraft to be deployed by the Sherpa FX1, the providers of the hosted payloads are required to obtain all licenses, authorization, clearances, and permits from their applicable administrations) that may be required for their operation and inclusion as hosted payloads on the Sherpa-FX1 and will only be included on the Sherpa-FX1 if providers of those payloads provide Spaceflight with satisfactory evidence thar that the same have been received. The only hosted payloads that will have active radio transmission will operate completely independently from the Sherpa-FX1 and the R2A avionics.

The planned hosted payloads consist of the following:

- A payload to be provided by Space Domain Awareness Inc.. This payload does not have RF transmission but has LED lights. This payload is designed to provide for improved orbital identification and debris mitigation and is being flown for demonstration purposes.
- A payload to be provided by Keplerian Technologies that consists of a UHF transponder to communicate with that company's ground stations.
- A payload to be provided by NearSpace Launch, separate from the EyeStar S3 Radio baselined on R2A, that consists of an L-band transmitter that communicates with the Globalstar constellation and an S-band uplink to receive the kill command from the ground if necessary.
- Another non-transmitting payload provided by Celestis, Inc. that will consist of a container of capsules containing cremated human remains.

Attachment 1
Exhibit B: Manifest

Spacecraft Name	Spacecraft Type	Operator	Country Of Operator	Quantity	Comment
Astrocast	CubeSat	Astrocast	Switzerland	5	
PTD-1	CubeSat	Tyvak Nano-Satellite Systems, Inc.	USA	1	US Government mission: NTIA License
UMBRA-2001	Microsatellite	Umbra	USA	1	
Hawk-2a, -2b, 2c	Microsatellite	Hawkeye 360	USA	3	
ARCE-1A, -1B, -1C	CubeSat	USF Institute of Applied Engineering	USA	3	
P2-10	CubeSat	US Department of Defense	USA	1	
Celestis 17	Hosted Payload	Space Memorial Services	USA	1	No separation. No RF transmission
SOARS	Hosted Payload	KeplarianTech, Tiger Innovations Inc.	USA	1	No separation
EyeStar-Tag	Hosted Payload	NearSpace Launch	USA	1	No separation
ELROI	Hosted Payload	Space Domain Awareness, Inc.	USA	1	No separation. No RF transmission