



# Merit Review

SilverSat Limited's response to NASA's  
Announcement of CubeSat Launch Initiative  
Solicitation Number: NNH18ZCQ001O

# Agenda

- Overview of SilverSat Limited
- Mission Concept
  - Concept of Operations
  - Block Diagram
- Mission Goals and Objectives
- Mission's Primary Focus on Education
  - Significant Student Participation in Project
  - Significant Student Participation in Proposal
  - Student Educational Opportunities
  - Student Educational Outreach
  - Education Sustainability

# Agenda (continued)

- Mission's Secondary Focus - Technology Demonstration
  - Secure IP transaction from the satellite - Tweeting from space
- Mission Outcome
- Conclusion

# Overview of SilverSat Limited

- Multi-year community-based non-profit serving Silver Spring area tweens and teens.
- Goals include STEM enrichment “to discover and expand knowledge”\* and leadership development among tweens and teens, including those from underrepresented and underserved groups in STEM fields.
- Diverse student participation -> different perspectives on the different challenges we face throughout this program.
  - 21 Students in grades 7 - 11
  - Mix of public, private and homeschooled students
  - Greater Silver Spring area: DC, Maryland and Virginia
  - Many different personal interests and aspirations

\* NASA 2018 Strategic Plan, NASA Vision - p.6

# Overview of SilverSat Limited (continued)

- Our background will allow us to contribute to NASA’s “diverse workforce”\* in the future.
- We have students in this program with many different areas of expertise that contribute to our progress and allow us to be more efficient in creating our CubeSat.



\* NASA 2018 Strategic Plan, Strategic Goal 4.4: Manage Human Capital - p.39

# SilverSat Mission Concept

**SilverSat is a space photo tweeting CubeSat that:**

Takes photos of Earth during its orbit and, when in contact with a ground station, the SilverSat CubeSat logs into Twitter and posts its photos and mission data as Tweets.



# Concept of Operations

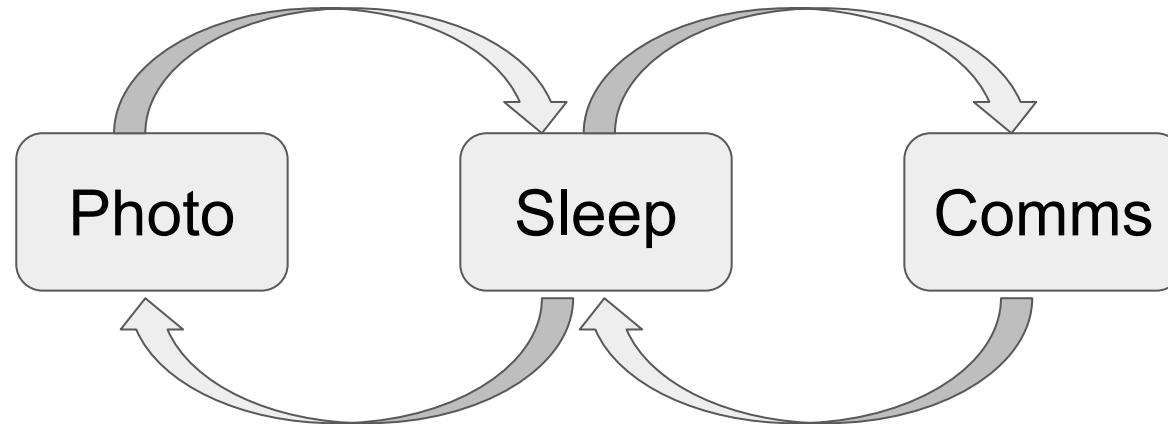
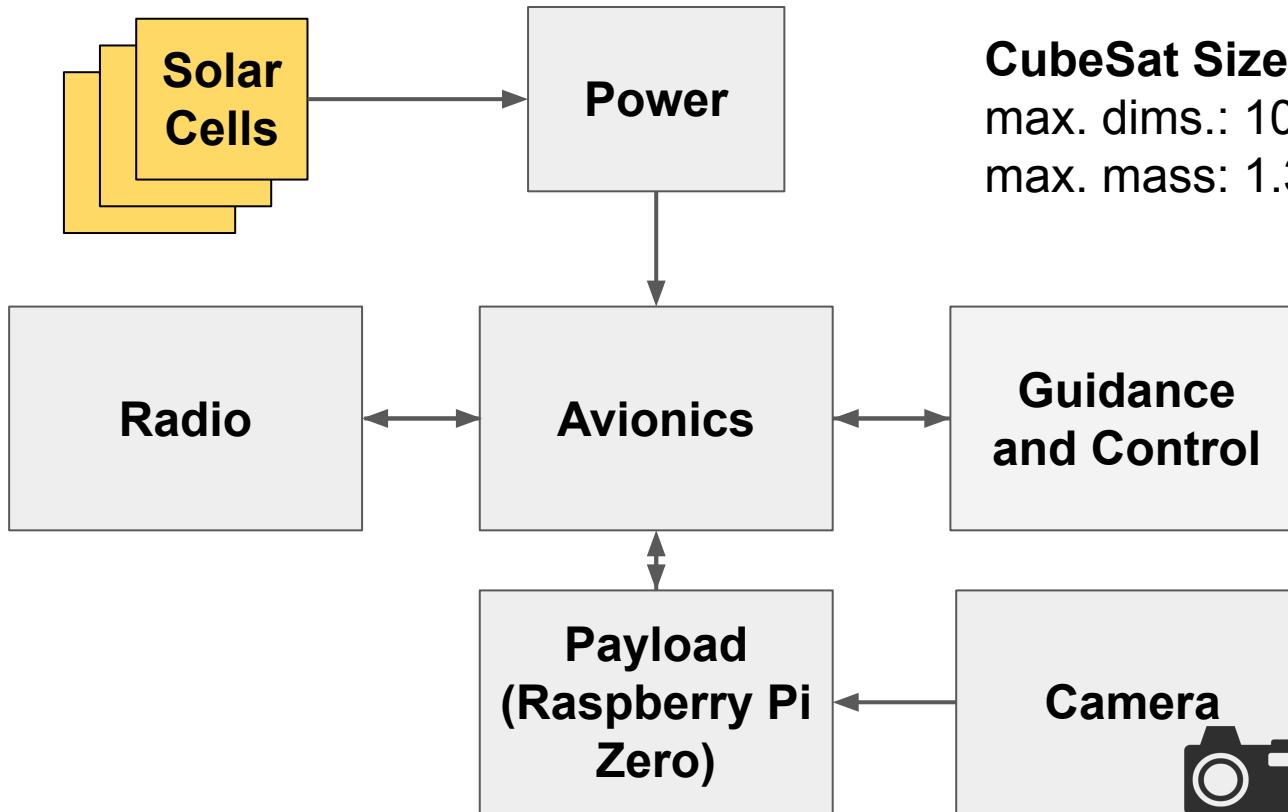


Photo: Take pictures of the Earth from space

Comms: Communication with ground station; automated tweet of photo, status

Sleep: Idle, conserve power, wake for photo or communication

# CubeSat Block Diagram



**CubeSat Size: 1U**

max. dims.: 10cm x 10cm x 11cm  
max. mass: 1.3kg

# Overview of SilverSat Limited's Proposed Mission

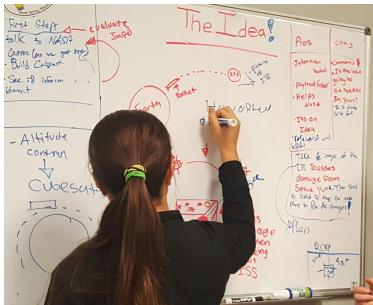
## Mission Goals and Objectives

- Primary Goal - Education - Promote Awareness of Space Exploration
  - SilverSat will use a popular social media platform to promote awareness of and interest in Aeronautics, Space, and Science among tweens and teens.
    - SilverSat members will post information about CubeSat project and details about mission development
    - SilverSat members will write code to allow CubeSat to take and post photos from space
- Secondary Goal - Technology Demo
  - SilverSat will “Tweet from space” and transmit data, including photos, through the ground station’s connection to the Internet.

# Mission's Primary Goal - Education

- **Significant Student Participation in Project**

- Student focus was primary reason for founding of SilverSat Limited.
- Students came up with mission idea.
- Students participate in all major decisions involving project.
- Students make up each of the major system teams and work with adult volunteers.
- Students have built a test drone and will build the final CubeSat themselves.
- SilverSat is an initiative led by parents and students focused on future space exploration and discovery.



# Mission's Primary Goal - Education

- Our team consists of multiple subgroups working simultaneously to create the prototype of our CubeSat.
- The subgroups include:
  - **Power** - Working to supply power to the CubeSat
  - **Avionics** - Working on the computers allowing for us to control the CubeSat
  - **Systems** - Working on overall systems design and project management
  - **Payload** - Working to develop code to Tweet and take pictures
  - **Communications** - Working to connect between the CubeSat and groundstations
  - **Flight Software** - Working to develop code to control the CubeSat
  - **Guidance and Control** - Working to help keep the CubeSat stabilized in space, making sure it is pointing in the right direction
  - **Mechanical** - Working on the CubeSat structure and assembly
  - **Indicator (drone prototype)** - Working to create a way for us to see our prototype CubeSat in the air

# Mission's Primary Goal - Education

- **Significant Student Participation in Proposal**

- Students are working on all aspects of the Response to Announcement of Opportunity.
- Students have given presentations for funding requests.
- Students took a lead role in preparing the Merit Review.
- Students are working on Feasibility Review.
- This will “inspire the current and next generation of explorers.”\*



\* NASA 2018 Strategic Plan, Strategic Goal 3: Address National Challenges and Catalyze Economic Growth - p.23

# Mission's Primary Goal - Education

- **Student Educational Opportunities**

- Students are exploring\* all aspects of satellites, CubeSat technology, communication systems, coding, project development, and circuits.
- As students self-select which aspect of the project they want to focus on, they are getting more specialized education and hands on experience in areas such as building, soldering, and electronics.
- Students are being given leadership opportunities on a regular basis.
  - Students lead the beginning and end of each meeting
  - Students assumed leadership of each sub-group
  - Students from each sub-group report out each meeting on their group's progress and challenges

\* NASA 2018 Strategic Plan, Strategic Goal 2: Extend Human Presence Deeper into Space and to the Moon for Sustainable Long-Term Exploration and Utilization - p.16

# Mission's Primary Goal - Education

- **Student Educational Outreach**

- Students will be able to share their knowledge and “enhance public understanding of, and participation in, the Nation’s space program”\* through the use of a social media platform by:
  - Posting of project information on SilverSat website
  - Sharing of project updates and developments
  - Having CubeSat take and post pictures from space
- Students chose the mission since it was interesting and related to everyone in the group. They thought that using social media was the best way to reach their peers.

\* NASA 2018 Strategic Plan, Objective 3.3 Inspire and Engage the Public in Aeronautics, Space, and Science - p.29

# Mission's Primary Goal - Education

- **Education Sustainability**

- Through outreach to Montgomery County Public Schools (MCPS), SilverSat and its student members will offer assistance to MCPS's STEM curriculum.
  - MCPS 5th grade curriculum includes a CubeSat unit
- This helps create a “sustainable program”\* that can be used to continue our overarching mission past the time we complete our CubeSat, enabling future generations to learn about technology and space.



\* NASA 2018 Strategic Plan, NASA Vision and Mission- p.6

# Mission's Secondary Focus - Technology Demo

- By “Tweeting from space” SilverSat demonstrates the immediate dissemination of information from the satellite.
  - CubeSat distributes scientific data directly to the user community.
  - Mission operations center need only be involved for commanding, scheduling, and monitoring health and safety of the mission.
  - Demonstrates the use of commercial Internet services and social media as part of mission operations.
  - Aligns with NASA’s position as “a champion of free and open access to scientific data.”\*

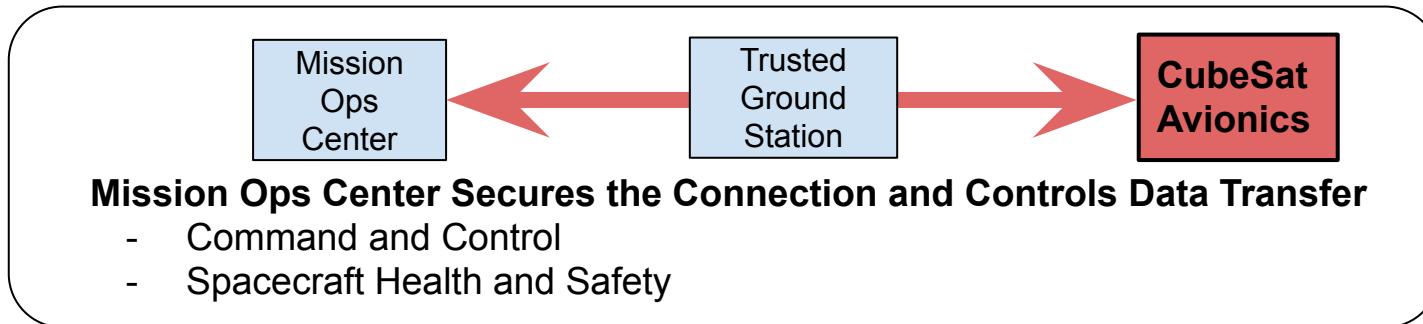
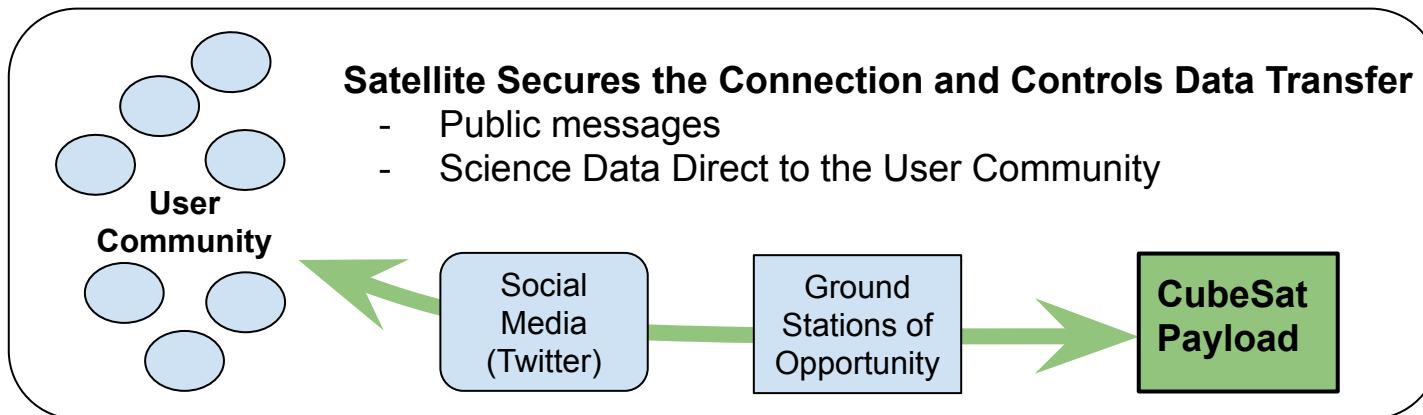
\* NASA 2018 Strategic Plan, Goal 1 Summary - p.9

# Mission's Secondary Focus - Technology Demo

- SilverSat demonstrates using modern IP security and authentication techniques directly from space.
  - Satellite now becomes a node in an ‘Internet of (spaceborne) Things.’
  - Satellite takes control of securing the connection and transferring scientific/public data.
  - Ground station just provides a connection to the Internet: analogous to using public WiFi.
    - Allows for less-trusted ground stations of opportunity to be used
  - Separate data path used for commanding and spacecraft health/safety.
    - Maintains a split between public and trusted mechanisms within the spacecraft
  - An enabling technology for NASA’s use of emerging commercial communications networks (AWS Ground Station, commercial satellite networks).
  - Supports NASA’s goal to “Advance revolutionary technologies for NASA and the Nation, involving commercial space products, specifically for utilization of near-Earth space.”\*

\* NASA 2018 Strategic Plan, Strategic Objective 3.1, p. 24.

# Mission's Secondary Focus - Technology Demo



# Mission Outcome

- Participation in the SilverSat project will provide its student members with exposure to space technologies, project development, and leadership skills, which they will pass on to their peers.
- The SilverSat mission aligns with NASA's Strategic Goal of enhancing the public understanding of and supporting student participation in the Nation's space program.
- The SilverSat mission explores new ways of distributing data using commercial services and social media.

# Conclusion

- SilverSat's proposed mission addresses educational and technological developments encompassed by NASA's strategic goals and objectives as identified in NASA's Strategic Plan.
- SilverSat's proposed mission involves significant student participation in all aspects of the development of its proposal, project design, and implementation.
- SilverSat's proposed mission seeks to promote awareness of space technology to the next generation of space explorers through the use of social media.

# Thank You

- SilverSat Limited would like to thank you, the reviewers, for your time and your feedback.
- We wish to also thank those individuals and organizations that have supported our efforts to date:
  - The Maryland Space Business Roundtable
  - Rockville MakerSpace
  - Steve Morris, Catylator, LLC.

*SilverSat Limited logo designed by Brent Almond, Designer Daddy*

# Questions & Comments

# Backup Slides

# Concept of Operations: Photo

Only as many as can be communicated back to earth. Usually one per transmission window.

SpaceTrack will track SilverSat from launch.

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Unknowns: Are there places we want to avoid? Land/sea, specific lat, lon, day, night.

What size? Resolution, detail, dimensions? Choose a size that can be communicated readily in most transmission windows.

Daylight detection: Photoresistor, voltage across solar cells

# Concept of Operations: Comms

Upon receiving the uplink from the Silver Spring ground station, the CubeSat will establish internet connection over radio to ground station; receive instructions/commands; login to twitter; post picture and status (GPS, battery level, light-dark, radio-signal) to twitter.

Transmission window length: 3-8 minutes. Depends on our orbit

Transmission window frequency: 3-4 times a day. Depends on our orbit

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Unknowns: How much data can we transmit in a given time window?

What happens if we don't have enough time to send down a picture?

# Concept of Operations: Sleep

Conserver Power: Shut down payload, Radio in receive, transmit beacon periodically

When, where: Can we wake on ground-ping, lat, lon, time?

When, where: Periodic wake? Duration? 1 minute? 5 seconds?

When, where: Can we predict each comms / photo time on ground and send?

How much power is saved? How fast is power used in photo, comms, sleep?  
Is sleep mode worth it?