The Small Satellite Reliability Technical Interchange Meeting
A Public-Private Initiative to Increase Small Satellite Reliability
14-15 February 2017

Thank you for participating in the Small Satellite Reliability Initiative (SSRI) Technical Interchange Meeting (TIM). Please note the following information.

Challenge- At present, CubeSat components and buses are generally not appropriate for missions where significant risk of failure, or the inability to quantify risk or confidence is unacceptable. However, in the future we anticipate CubeSats will be used for missions requiring reliability of 1-3 years for Earth missions and even longer for Planetary and Heliophysics missions. In addition, SmallSats could be developed using CubeSat components and subsystems but will not have the CubeSat form factor. Both CubeSats and SmallSats could then be used where their attributes enable or enhance mission objectives or provide other meaningful benefits—e.g. lower cost, increased coverage (spatial, temporal, spectral), agility, resiliency, etc. Historically, it was understood and accepted that "high risk" and "CubeSat" were largely synonymous; expectations were set accordingly. But their growing potential utility is driving an interagency effort to improve and quantify CubeSat reliability, and more generally, small satellite mission risk.

Approach- The Small Satellite Reliability Initiative (SSRI) targets this challenge. The Initiative seeks to define implementable and broadly accepted approaches to achieve reliability and acceptable risk postures associated with several SmallSat mission risk classes—from "do no harm" missions, to those associated with missions whose failure would result in loss or delay of key national objectives. These approaches will maintain, to the extent practical, cost efficiencies associated with small satellite missions and consider constraints associated with supply chain elements, as appropriate.

We will address this challenge from two architectural scopes—the mission- and system-level, and the component- and subsystem-level. The mission- and system-level scope targets assessment approaches that are efficient and effective, and mitigation strategies that facilitate resiliency to mission or system anomalies while the component- and subsystem-level scope addresses the challenge at lower architectural levels.

An interagency team has been discussing this challenge and potential approaches to resolve it over the past several months. We realize however, that approaches to the challenge should be collaboratively defined by industry and government; the TIM is the first formal collaborative engagement. Whereas a government team has defined and will present initial recommendations, keep in mind these recommendations are conversation starters. We encourage debate and dissention. Really.

Targeted TIM Outcomes- We seek to answer the following questions before the 5:00 PM, February 15:

1. No uniformly accepted CubeSat-SmallSat risk posture definitions exist. Accordingly, what classifications should we define to categorize the breadth of targeted reliability and risk postures for small satellite missions— from "do no harm" missions, to those associated with missions whose failure would result in loss or delay of key national objectives?
2. What implementable approaches to achieve reliability and acceptable risk postures associated with these classifications should we recommend? They should maintain, to the extent practical, cost efficiencies associated with small satellite missions and consider constraints associated with supply chain elements, as appropriate. The approaches could be considered guidelines.
3. What investments have the potential to advance small satellite reliability?
4. What next steps should SSRI take to broaden small satellite mission potential?

A Few Guidelines-

- **Think beyond proven and traditional methodologies to novel, innovative, and transformational solutions.**
- The TIM is a "safe zone". No ideas or concepts are too extreme.
- The TIM is a "marketing free" zone from 8am to 5pm. We will intently focus on achieving the targeted outcomes.
- Let's get to know each other and collaboratively achieve TIM objectives.

Agenda: Small Satellite Reliability Technical Interchange Meeting
14-15 February 2017, Avery Library, Caltech

DAY 1		
7:30 AM	Check-in	
8:00	**Welcome, Logistics**	Harald Schone/ JPL
8:10	Why are we here? Ground rules. Reliability initiative genesis and execution strategy. Current state vs. targeted future state. TIM objectives and success criteria.	Michael Seablom/NASA HQ Michael Johnson/NASA GSFC Pat Beauchamp/JPL
SmallSat Reliability Initiative Drivers		
8:25	Government Talks (15 minutes) – Invited NASA science talk. Science mission drivers #1 – Invited NASA science talk. Science mission drivers #2 – Invited NASA science talk. Science mission drivers #3 – Invited DoD talk. DoD operational mission drivers – Invited NOAA talk. NOAA drivers – Government talks questions/answers	Pat Beauchamp/JPL, facilitator John Baker/JPL Larry Kepko/ NASA GSFC Jason Hyon/JPL Charlene Jacka/AFRL Dan Mamula/ NOAA John, Larry, Jason, Charlene, Dan
10:00	**Break**	
SmallSat Reliability- Lessons Learned from Spaceflight Missions		
10:20	(15 minutes each) Invited industry presentation #2: Univ. of Michigan Invited industry presentation #3: Planet	Tom Fairbanks, facilitator James Cutler Michael Rubel
Risk Classification		
10:50	Subject Matter Expert (SME) Sub-team *Risk Classification* presentation	SME Sub-Team
11:10	Full session discussion Part 1: Approaches to risk classification (cont., Day 2)	All
11:45	**Lunch**	
Subject Matter Expert Sub-Team Study Status		
12:45 PM	Recommendations to date: SME Sub-Team full study out brief (20 mins)	SME Sub-Team
1:15	Full session discussion	All
Topic 1: Mission/System Level Assurance Approaches		Richard French, facilitator
1:45	SME Sub-Team Topic 1 Out-brief	SME Sub-Team
2:05	Industry talks (15 minutes each) – Industry Topic 1 presentation 1: Tyvak – Industry Topic-1 presentation 2: GeoOptics – Industry Topic-1 presentation 3: Surrey Satellite Technology US	 Austin Williams Thomas Yunck Will Thompson
2:50 3:50 4:05	**Splinter: Topic 1, Group 1**- **Mission/System Level Assurance Approaches.** Applying a holistic approach to SmallSat/CubeSat mission assurance that combines systems and component level thinking. **Splinter: Topic 1, Group 2**- **Mission/System Level Assurance Approaches-** For each classification level, what is the appropriate level of testing (i.e. TVAC, Vibration, etc.)? What is the appropriate build and sparing policy? _____ **Break/ Reconvene** **Full session debriefs and discussion**, Topic 1	Splinters convened concurrently All
Day 1 Debrief		
4:35	Debrief, Open Items, Outcomes status check	Erica Sullivan, facilitator
4:50	Announcements, Day 2 Plans	Harald
5:00	Adjourn	
7:00	**Dinner**: Alma De La Rosa; 41 Hugus Alley Pasadena, CA 91103	All

DAY 2		
	Day 1 Recap	
8:00 AM	Day 1 findings, Questions, Issues, Success Criteria Check Day 2 Plans	Harald Schone
Topic 2: Subsystem/ Component Level Assurance Approaches		
8:30	15 minute talks – SME Sub-Team Topic 2 out brief – Government Topic-2 Presentation: Los Alamos National Laboratory – Industry Topic-2 Presentation: Pericle Communications – Industry Topic-2 Presentation: Vulcan Wireless	SME Sub-Team Tom Fairbanks Jay Jacobsmeyer Kevin Lynaugh
9:30	**Break**	
10:50	**Splinter: Topic 2, Group 1- Assurance Approaches, Component/Subsystem Level-** At what point do changes and iterations made by a subcomponent vendor require a re-qualification of that subcomponent? What types of data should be collected from SmallSat/CubeSat subcomponent vendors to perform a Bayesian assessment? **Splinter: Topic 2, Group 1- Assurance Approaches, Component/Subsystem Level-** What is the proper piece part pedigree (i.e. mil spec, automotive, commercial) for the different SmallSat/CubeSat classes? _____ **Full session debriefs and discussion, Topic 2**	Splinters convened concurrently All
11:45	**Lunch**	
Topic 3: Future Investments		
12:45 PM	Discussion on investments that have the potential to advance initiative objectives	Erica Sullivan, facilitator
Topic 4: Collaboration and Knowledge Sharing		
1:25	Full session discussion: How to intentionally collaborate and/or share knowledge to advance SmallSat mission potential	Bruce Yost, facilitator All
2:25	**Break**	
Risk Classification Part 2		
2:45	Full session discussion, cont.: Approaches to risk classification	SME Sub-Team
Findings Summary, Open Issues, Next Steps		
3:15	TIM summary findings, Outcomes status check, Action items	SME Sub-Team
4:15	Next Steps, Closing Comments	Pat, Michael, Harald
4:30	Adjourn	

Dinner Arrangements- Please join us the evening of February 14 for dinner in downtown Pasadena at Alma De La Rosa. We have a reserved the entire heated patio for 7pm. The cost for the dinner is $45/person including gratuity. Our apologies for this being a bit steep, but we have the misfortune to have our event at Valentine's Day.

Menu- Heirloom carrot soup, followed by a choice of grilled Pacific salmon with avocado butter or a Prime baseball cut top sirloin. Dessert will be caramel pudding. We are permitted to bring our own wine and we have the corkage waived.

Everything yields to diligence.
-Antiphanes