

The 21st Annual AIAA/USU Conference on Small Satellites

It's the Mission that Matters

Presenting: The McLogan Group

Panel Moderator

Bob Meurer - Conference Technical Chair

It's the Mission that Matters

- ⌘ A dialog among recognized experts in the employment of small satellites to perform space missions.
- ⌘ Discussion topics include the utility of small space missions, the metrics by which they should be measured, and the mission areas and technologies that are best suited to smaller space systems.

Science & Exploration Missions
Technology Development Missions
Access to Space
Operationally Responsive Space
Education and Workforce Development

Ground Rules:

- ⌘ The panelists are asked to express their thoughts on each issue (reason and logic) with conviction, clarity and passion.
- ⌘ The opinions expressed in this panel represent those of the panelists and may not represent the opinions of their agencies.
- ⌘ After the initial round of answers, panelists are free to interrupt other panelists to make a point – an active dialog is the objective.
- ⌘ The moderator is allowed to take all sides and has the final word.

Audience Participation

- ⌘ Introducing an Audience Feedback Device
 - ✧ Buttons to select Answers A-E
 - ✧ Remove the Battery Tab
 - ✧ Activate the unit
- ⌘ When a question is projected you will have ~20 seconds to register your vote
- ⌘ You may change your vote during the 20 second period, but the system will only register one vote per device
- ⌘ After you vote, the system will project the results of the poll

Panelists



⌘ **Dr. Pete Worden, Director**
✧ NASA Ames Research Center



⌘ **Sir Martin Sweeting, Director**
✧ Surrey Satellite Technology Ltd.



⌘ **Mr. Juice Jensen, Director**
✧ Lockheed Martin Space Systems



⌘ **Dr. Peter Wegner**
✧ AFRL Space Vehicles Directorate

ISSUE #1

It's the Mission That Matters!

Thesis: It's the Mission That Matters!

- ⌘ Small satellites are but one piece of a larger system that enables users to achieve goals that might otherwise not be technically possible, affordable, or as timely as systems employing larger spacecraft. Small satellites may be an enabling, even disruptive technology, but it is the mission they perform that matters in all cases. That mission may be providing the first images of a disaster event, connecting remote regions of the globe to medical assistance from other countries, enabling a warfighter to see over the hill in real-time, or robotically exploring the surface of a near-Earth asteroid. Whatever the application, the utility of a small space mission is the metric by which small satellites are ultimately measured, and thereby will gain further acceptance.

Audience Question

- ⌘ What is the Single Most Promising and Useful Mission Area for Small Satellites?
- ⌘ Is it...
 - A. Communications –
Store-&-Forward, Telephony, Data Relay
 - B. Earth Observation –
Imaging, Science, and/or Weather
 - C. Space Science – Astrophysics,
Heliophysics, and Planetary Exploration
 - D. Navigation and Timing –
Military or Civilian Uses
 - E. Technology Maturation –
Development and Validation

⌘ **Vote Now**

Panelist Questions

- ⌘ Do you agree with the audience's selection?
 - ✧ If so, why?
 - ✧ If not, why not?

- ⌘ Why isn't ... a more useful application for small space systems?

Panelist Questions

- ⌘ **Dr. Worden:** You have experienced the utility of small satellites in both military and civil missions. The DoD emphasis on Operationally Responsive Space appears to be taking the lead in fostering greater use of small space systems. Should NASA be using small satellites to develop more frequent mission opportunities in Earth and Space Science?
- ⌘ **Dr. Wegner:** The concept of Operationally Responsive Space germinated from government and industrial interest over the past 20 years in small satellites. Isn't ORS the best new use of small satellites since the days of the TRANSIT system?

Panelist Questions

- ⌘ **Mr. Jensen:** Small satellites are widely touted as potential platforms to augment or replace national capability in the event of early failure or hostile action. GPS satellites began at ~700 kg, but have ballooned to over two metric tons. Are small satellites still candidates for navigation & timing missions.
- ⌘ **Dr. Sweeting:** You have been a pioneer in developing small space systems in an academic based organization that has led to a lengthy series of “Know-How Transfer” programs. Isn't education the #1 product of all of the SSTL small satellite missions?

Issue #1 Wrap-up – Multiple Choice

- ⌘ Over the next decade, which mission area will see the greatest activity in terms of numbers of small spacecraft built to perform that mission?
- A. **Communications** –
Store-&-Forward, Telephony, Data Relay
 - B. **Earth Observation** –
Imaging, Science, and/or Weather
 - C. **Space Science** – Astrophysics,
Heliophysics, and Planetary Exploration
 - D. **Navigation and Timing** –
Military or Civilian Uses
 - E. **Technology Maturation** –
Development and Validation

⌘ **Audience – Vote Now**

ISSUE #2

Picking the Right Missions

Thesis: Picking the Right Missions

- ⌘ In an era of tight budgets and with prospects for still greater funding constraints in the future, small space missions may become more prevalent than in years past due solely to their relatively lower cost.
- ⌘ Space technology has changed so dramatically, the realm of the possible has likewise changed enabling new missions previously considered implausible. Small space missions offer significantly more utility than their predecessors of just a decade ago. Gary Payton said, “Small Satellite Deliver Big Performance”
- ⌘ How then should we go about selecting missions for small satellites? What are the relevant metrics?

Audience Question

- ⌘ What are the relevant measures of value by which we should assess the utility of small satellites within a given mission area? Is it...
- A. **Information Throughput – Bits per fortnight?**
 - B. **Economic Return on Investment, i.e. \$'s Earned per Kg of Spacecraft Mass?**
 - C. **Humanitarian Benefit – Lives Saved / Tragedies Averted?**
 - D. **Payload Mass Fraction or Other Measure of Bus Efficiency?**
 - E. **All of the above?**

⌘ **Vote Now**

Panelist Question:

- ⌘ What Particular Attributes Make Small Satellites a More Attractive Option in Your World, i.e., What Is Their Single Best Characteristic?
 - ✧ **Lower Cost of Entry – They Simply Cost Less**
 - ✧ **Significantly Shorter Development Schedules**
 - ✧ **Mission Enabling Characteristics, i.e.,**
 - **Improved Temporal Resolution – Constellation Solutions**
 - **New Scientific Possibilities – Distributed Aperture**
 - ✧ **Risk-Benefits Ratio – Ability to Push the Envelope**
 - ✧ **The Challenge of Putting 10Kg of Technology in a 5Kg Box**

Issue #2 Wrap-up – 1 to 10 Scale?

- ⌘ On a scale of zero to ten, zero meaning no change – right where we are today with a relatively few small space missions each year, and ten being metaphysical change leading to a quantum increase in the number of small space missions being flown. What is the market trend for small satellite missions?
- A. 0 = No Discernable Change
 - B. 3 = Slight Increase in the Number of Missions
 - C. 5 = Moderate Change Leading to Increased Flight Rate
 - D. 8 = Significant Trend Toward Market Dominance
 - E. 10 = Metaphysical Change (Can I Get an Hallelujah!)

⌘ **Audience - Vote Now**

Panel – Same Question

⌘ One number answer...

- ✧ Dr. Worden
- ✧ Dr. Wegner
- ✧ Mr. Jensen
- ✧ Dr. Sweeting

⌘ The Answer is ...

ISSUE #3

The Key to More and Better Small Satellite Missions is Bounded by the Technology

Thesis: Technology is the Key

- ⌘ With budgets continually tightening throughout the industry it is critical to have focused goals where IR&D dollars can be spent.
- ⌘ For those in the audience who are working on small satellite technologies, yet looking for the greatest return on investment (something Luca Maresi told us yesterday that we address <3% of the time), where would you suggest they invest in new technology for the greatest future payoff?

Panelist Question:

- ⌘ What Subsystem is the single most limiting factor on Small Satellites? If the entrepreneurs in the audience are ready to invest in mission enabling technology, where should they put their investment?
 - A. Power – to Run the Payload
 - B. Attitude Determination & Control
 - C. Data Handling – Management & Throughput
 - D. Thermal Control
 - E. Payloads & Sensors
 - F. Other?

Audience Question

- ⌘ What technology should be the primary focus of research and development efforts in order to diversify and improve small satellite utility?
 - A. Power – to Run the Payload
 - B. Attitude Determination & Control
 - C. Communications & Data Handling – Management & Throughput
 - D. Thermal Control
 - E. Payloads & Sensors

⌘ **Vote Now**

ISSUE #4

ORS – Path to the Future?

Thesis: ORS – Path to the Future?

- ⌘ Over the past two decades, a debate has raged over the need for CheapSats, SPINSATs, and TacSats in support of the military warfighter. In 2007, the Air Force put forth the first dedicated budget for Operationally Responsive Space, an architecture that despite some fuzziness in the definition, is commonly associated with small spacecraft.
- ⌘ More Recently, Col. Tom “Dingo” Doyne Proposed Coalition–ORS, a concept that builds on the legacy of cooperation between Western nations in developing military armament – aircraft, ships and artillery.

Panelist Questions:

- ⌘ **General Worden:** You have a distinguished military background. Is ORS the wave of the future in military space in the U.S. and does it have the legs to extend to military alliances around the world?
- ⌘ **Dr. Sweeting:** Earlier this year the U.K. sponsored a military space conference that included a presentation by Col. Doyne on Coalition-ORS. Is this a concept that NATO nations such as your own might embrace?

Panelist Questions:

- ⌘ **Dr. Wegner:** You have been an advocate and leader in advancing the ORS concept. You work at Kirtland AFB where the Air Force recently stood up a joint ORS Office. What do ORS advocates still have to prove if the concept is to survive?
- ⌘ **Mr. Jensen:** Lockheed Martin has been involved from the outset with AFRL's Autonomous Nanosatellite Guardian for Evaluating Local Space (ANGELS) program. Is the state of our space technology such that a satellite of 15 to 25 kgs can truly perform an operational mission and is this an example of ORS?

ISSUE #5

Access to Space

Thesis: Access to Space

- ⌘ The attendees to this conference have bemoaned for years the non-availability of access to space for university missions. Indeed, this audience challenged Dr. Michael Griffin last year to invest in the education of our students by providing dedicated flights for academic missions. And again this year, the issue was raised.
- ⌘ Articles have been published publicly challenging the intentions of NASA in supporting the university community.
- ⌘ From this very stage, yours truly took up the charge to establish a Civil-Academic Space Test Program.

Final Audience Question

- ⌘ Who bears the responsibility for doing more to build up our future workforce, i.e., education of students through hands on experience?

- ⌘ Is it...
 - A. University Leadership
 - B. Students
 - C. Industry
 - D. The Government
 - E. Shared Responsibility of all Four

- ⌘ **Audience Vote Now**

Panelist Questions:

- ⌘ Same question

- ⌘ Who should be running this program?
 - ✧ NASA, AF, NSF, Dept. of Education?

- ⌘ What would be the single most effective action to improve the situation from where we are today to where you think we should be – what are the next steps ?

Panelist Predictions:

- ⌘ Provide a prediction that is related to the focus of this panel discussion.
 - ✧ Predictions on:
 - **What are the top 3 areas where there will be significant funding available in small satellites over the next 5 – 10 years**
 - **What are the top 3 technology advancements that would open up greater opportunities for the small satellite community. i.e. if a company were to come to the table with one of these advancements they would have a good hold on the market**

Thanks to the Panelists!

Thanks to the Panelists for their participation and candid comments.