

The background of the slide is a blurred American flag, showing the stars and stripes in shades of blue, white, and red.

Welcome to
RS3
3rd Responsive
Space Conference

Sponsored by

**AIAA LA and Orange County Sections and
Space Systems and Space Transportation
Technical Committees**

Los Angeles, CA April 25–28, 2005

Email: ResponsiveSpace@smad.com

Web: www.ResponsiveSpace.com

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AIAA Orange Co. Section	Harry “Bob” Weldge Chair, Orange County Section

If you need anything during the conference, find one of us and we'll find it for you !

We would like to thank the following people for making this conference happen:

The **Responsive Space Conference Organizing Committee** for doing the day-to-day planning and setting up the conference

Regina Jenkins for handling an infinite number (more-or-less) of administrative details

Susan Graven for planning coordination

Demetrice Munford and **Christopher Maruyama** for all of the conference artwork

Donna Klungle, Jenny Greer, Demetrice and **Christopher** for creating all of the publications and documents and creating the CD-ROM Proceedings volume between now and Thursday noon

Michael Walsh for handling the computer set ups

Microcosm Publications Department and **Galorath** for duplication of the CD-ROM's

The volunteers who are helping with all aspects of the conference over the next 3 days:

Phil Ridout, Tobenette Holtz, Bob Weldge, Igor Jaremenko, Dee Kilmer, Jose Mancera, Ryan Coolley, Channin Chow, Rose-Mary Mendoza, Rachel Larson, and **Suzy Hyun**

And, of course, the **AIAA LA** and **Orange County Sections** and **AIAA Space Systems** and **Space Transportation Technical Committees**, who have made this conference possible along with the corporate sponsors on the next slide



**Sponsors make the conference possible.
Please buy a spacecraft or launch vehicle from these good people.**



- **Parking**
 - \$8 Self parking with in-and-out privileges. From Century Boulevard turn onto Concourse Way (just west of hotel). Proceed 100 feet to the parking gate. Take parking ticket. Obtain validation stamp from conference registration desk.
 - Valet parking is \$12. From Century Boulevard turn onto Concourse Way and make an immediate left to the valet service.

- **Notes for Presenters**
 - You should already have turned in everything for the Proceedings CD-ROM — both paper and presentation material
 - If you haven't, leave now and turn the material in at the registration desk
 - Electronic projection is preferred
 - Viewgraph projector is available as a back-up
 - You will NOT be allowed to connect your computer to the projection equipment
 - All material to be projected electronically must be turned in now at the registration desk
 - We want to test it and be sure everything works
 - Please meet with your session chairperson 15 minutes before the first morning or afternoon session on the day of your presentation in the main meeting room (Grand Ballroom) for final instructions
 - Presentations are 20 minutes long — Total
 - 2 minutes for introduction and transition
 - 15 minutes for your talk
 - 3 minutes for Q&A
 - If you run over, it will take us an extra 5 minutes to pull your remains out of the shark tank beneath the trap door — this causes further delay and consternation among your former colleagues

- **Side Meeting Room Available**
 - See Regina or Susan to sign up

- **Proceedings**
 - Complete conference proceedings will be available to all participants on a CD-ROM at no additional cost
 - Abstracts
 - Papers
 - Viewgraphs
 - Conference information
 - Attendee list
 - Information from Sponsors
 - CD-ROM will be available at the wrap-up session, Thursday, April 28, at 3:30 pm
 - Will include all material handed in as of **now!**
 - Use the ticket in your registration pack to pick up your CD on Thursday
 - If you have to leave before CD distribution, please complete an address card (available at Registration Desk) and we'll mail it to you

- **Win a \$100 gift certificate for AIAA books**
 - We want to find out how well the conference works for you and how to make it better
 - On Thursday we'll have a drawing for a gift certificate worth \$100 toward any AIAA book purchase
 - To enter, just fill out a questionnaire, available Thursday
 - We'll have the drawing at the Wrap-Up session

**It's a busy conference. We're going to work really hard
to stay on schedule. Please help us.**



When: Thursday, April 28, 2005, 4:30 to 9:30 pm, immediately following RS3 here in the Westin Hotel

What: Panel Discussion:

*Implementing the NASA Vision
for Space Exploration*

Who: **Al Diaz**, NASA Associate Administrator, Science Mission Directorate (moderator)

Charles Elachi, Jet Propulsion Laboratory Director

Scott Hubbard, Ames Research Center Director

Chris Scolese, Goddard Space Flight Center Deputy Director

How: Attendance is limited — Register soon at the RS3 registration desk

MONDAY, APRIL 25, 2005

- 3:00 pm – 5:00 pm **REGISTRATION**
- 4:00 pm – 6:00 pm EXHIBITS OPEN
- 5:00 pm – 7:00 pm **RECEPTION.** Sponsored by Goodrich

TUESDAY, APRIL 26, 2005

- 7:00 am – 5:00 pm **REGISTRATION**
- 7:00 am – 8:00 am **CONTINENTAL BREAKFAST AND NETWORKING SESSION.** Sponsored by Ball Aerospace
- 7:45 am – 6:00 pm **EXHIBITS OPEN**
- 8:00 am – 8:30 am **WELCOME AND INTRODUCTIONS** — Dr. James R. Wertz, General Chairman
- 8:30 am – 9:30 am **KEYNOTE ADDRESS** — Lieutenant General Daniel P. Leaf, Vice Commander, Air Force Space Command
- 9:30 am – 10:00 am **BREAK.** Sponsored by Michigan Aerospace
- 10:00 am – 12:00 pm **RESPONSIVE SPACE: MEETING THE WARFIGHTER'S NEEDS.** Moderator—BrigGen Larry D. James, AFRL/SMC/CV
PANEL: Doug Stetson, NASA/JPL
 Lloyd Feldman, OSD/OFT
 Col. Elizabeth M. Durham-Ruiz, USSTRATCOM
 Brig. Gen. Elaine Knight, Air Force Space Command
- 12:00 pm – 1:30 pm **LUNCH.** Sponsored by MicroSat
 Speaker: Lieutenant General Brian Arnold, Commander, Space and Missile System Center
- 1:30 pm – 2:55 pm **RESPONSIVE SPACE MISSIONS: APPROACHES, APPLICATIONS, AND EXAMPLES I**
 Chair — Paul Kolodziejewski, Schafer, Inc.
 How to achieve responsive missions will be discussed from an applications, business and analytic perspectives. Approaches, with an emphasis on reconfigurability, will be addressed.
- 1002) Changing the Value Proposition of Operational Space Missions
 — Wade Larson, MDA Space Groups
- 1003) On-Demand Science Missions — John J. Webb, Instarsat LLC
- 1004) Design and Analysis Approach for a Rapid Response Hyperspectral Imaging Mission — Thomas G. Chrien, Raytheon
- 1006) A TacSAT Experimentation Update and the Phase 3 Standardized Bus — Mike Hurley, NRL

TUESDAY, APRIL 26, 2005 (continued)

- 2:55 pm – 3:25 pm **BREAK.** Sponsored by BroadReach
- 3:25 pm – 5:10 pm **RESPONSIVE SPACE MISSIONS: APPROACHES, APPLICATIONS, AND EXAMPLES II**
Chair — Dr. Richard Van Allen, Microcosm, Inc.
- 2001) Coverage, Responsiveness, and Accessibility for Various “Responsive Orbits” — James R. Wertz, Microcosm
 - 2002) Responsive Space Operations Architecture Development Status Report — LtCol Patrick Frakes, NSSO
 - 2004) Small-Satellite Surveillance Missions Providing Unique Military Capabilities — Stuart Eves, Surrey Satellite
 - 2005) Responsive, Multi-functional Morphing Space Systems—A New System Paradigm
— Terry A. Weisshaar, DARPA/DSO
 - 2006) Commercial Suborbital Spaceflight and Its Relevance to Responsive Space — Jeff Foust, Futron Corp.
- 5:10 pm – 7:10 pm **RECEPTION AND NETWORKING.** Sponsored by Northrop Grumman

WEDNESDAY, APRIL 27, 2005

- 7:00 am – 5:00 pm **REGISTRATION**
- 7:00 am – 8:00 am **CONTINENTAL BREAKFAST AND NETWORKING SESSION.** Sponsored by Colbaugh & Heinsheimer
- 7:45 am – 6:00 pm **EXHIBITS OPEN**
- 8:00 am – 10:05 am **RESPONSIVE SPACECRAFT**
Chair — Colonel Norm Anderson, AFRL/VS
Approaches to making satellites more responsive will be addressed with an emphasis on modularity and testbeds. An example of an extremely rapid and successful program will be highlighted.
- 3001) CubeSats as Responsive Satellites — Armen Toorian, California Polytechnic State University
 - 3002) KUTESat-2, A Student Nanosatellite Mission for Testing Rapid-Response Small Satellite Technologies in Low Earth Orbit — Trevor Sorensen, University of Kansas
 - 3003) AeroAstro’s SMARTBus™: A Low-Cost Modular Approach Enabling Responsive Space Missions
— Scott McDermott, AeroAstro
 - 3004) The SSTE-4: DSX Flight Experiment: Design of a Low-Cost, Responsive R&D Space Mission with Responsive Enabling Technologies — Dan Cohen, Planning Systems
 - 3005) The Little Probe that Could: Four Months from ATP to Launch — Ken Center, Design_Net Engineering
 - 3006) HexPak—A Flexible, Scalable Architecture for Responsive Spacecraft — Michael Hicks, Lockheed Martin

WEDNESDAY, APRIL 27, 2005 (continued)

- 10:05 am – 10:35 am **BREAK.** Sponsored by AirLaunch
- 10:35 am – 12:20 pm **RESPONSIVE TECHNIQUES FOR INTEGRATION AND OPERATIONS**
Chair—Chris McCormick, BroadReach Engineering
Advances in integration and operations that lead the way to more responsive missions will be discussed.
- 4001) Key Elements of Rapid Integration and Test — Terrance Yee, MicroSat Systems
 - 4002) A Prototype Capability for an Automated Checkout, Control and Maintenance System (ACCMS) to Enable Responsive Ground Operations — William H. Findiesen, Boeing
 - 4003) Software as a Tall Pole in Achieving Rapid Configuration and Integration — Ken Center, Design_Net Engineering
 - 4004) The Multi-Mission Satellite Operations Center — Capt. Mekesha Sells, Schriever AFB
 - 4005) Standardization to Optimize Integration and Testing — Col. Norm Anderson, AFRL
 - 4007-Alt) Responsive Space Center of Excellence — John Hicks, NNSA-Kansas City Plant
- 12:20 pm – 1:50 pm **LUNCH.** Sponsored by Lockheed Martin
Speaker: CAPT. Daven L. Madsen, USN, Chief, Architecture Division, National Security Space Office
- 1:50 pm – 3:10 pm **TECHNOLOGY PANEL:** Moderator — Joe Sciabica, AFRL
PANEL: Peter Wegner — JWS Program
Mike Hurley — NRL
Bruce Underwood — NASA
LtCol Randy Ripley — SMC Det 12
TBD — DARPA
- 3:10 pm – 3:40 pm **BREAK.** Sponsored by Scitor Corporation
- 3:40 pm – 5:05 pm **TECHNOLOGY THAT FEEDS RESPONSIVE SPACE MISSIONS**
Chair — Mark Webster, Ball Aerospace
New methodologies and technologies that support more responsive satellite development will be discussed, with an emphasis on plug and play.
- 5001) Space Plug-and-Play Avionics — Don Fronterhouse, AFRL/VSSE
 - 5002) PNP Transceiver-FNT — K. D. Brown, NNSA-Kansas City Plant
 - 5003) Small Cell Lithium-Ion Batteries: The Responsive Solution for Space Energy Storage —Chris Pearson, AEA Technology
 - 5004) Reconnaissance Payloads for Responsive Space — Charles Cox, Goodrich Corp.
 - 5006-Alt) How Not to Design an Avionics System — Jason Holt, BYU

WEDNESDAY, APRIL 27, 2005 (continued)

- 5:05 pm – 7:00 pm **RECEPTION AND NETWORKING**
- 7:00 pm – 9:00 pm **CONFERENCE BANQUET.** Sponsored by Boeing
Speaker: Dr. Pedro “Pete” Rustan, Director, Advanced Systems and Technology, NRO

THURSDAY, APRIL 28, 2005

- 7:00 am – 8:00 am **CONTINENTAL BREAKFAST AND NETWORKING SESSION.** Sponsored by SpaceX
- 7:45 am – 2:30 pm **EXHIBITS OPEN**
- 8:00 am **REGISTRATION**
- 8:00 am – 9:50 am **RESPONSIVE RANGE PANEL**
Moderator — Paul Klock, 30th Space Wing
What are the impediments to responsive launch (from a range perspective) and what can be done?
PANEL: Herb Bachner, FAA
 Col Mike Coolidge, SMC
 Thomas “Jay” Pittman, NASA WFF
 Darin Skelly, NASA
 LtCol Rich Lamb, 30 SW/DS
- 9:50 am – 10:20 am **BREAK.** Sponsored by Teledyne Brown Engineering
- 10:20 am – 12:05 pm **LAUNCH VEHICLES & OPERATIONS**
Chair — Col Mike Wolfert (Ret), Andrews Space
- 6001) Aquarius Low Cost Launch Main Engine Study — Andrew E. Turner, Space Systems/Loral
- 6002) Operationally Responsive Space is Here Now Using Minotaur Class Vehicles
— Mitch Elson, Aero Thermo Technology; Lt. Col. Randall Riddle, Kirtland AFB
- 6003) The Evolution of Space Launch Booster Designs in the 21st Century — Matt Steele and Warren Frick, Orbital
- 6005) Operationally Responsive Space: The Vision Launch Architecture Is Dependent On The Requirements
— Slater Voorhees, Lockheed Martin
- 6006) A Rocket-Powered Technology Demonstrator for Responsive Access to Space
— Daniel R. Raymer, Conceptual Research Corp.

THURSDAY, APRIL 28, 2005 (continued)

- 12:05 pm – 1:35 pm **LUNCH.** Sponsored by Raytheon
Speaker: Major General (Ret) Robert S. Dickman, Former Deputy UnderSecretary AF, Military Space,
New Executive Director of AIAA
- 1:35 pm – 3:30 pm **AF/DARPA FALCON PROGRAM UPDATE**
Moderator — Dr. Steve Walker, DARPA
- 3:30 pm – 3:45 pm **WRAP-UP SESSION** — (CD-ROM OF ALL PAPERS, INCLUDING ALTERNATES, AVAILABLE TO PARTICIPANTS)
- 3:45 pm **CLOSE OF RS3**
- 4:30 pm – 6:30 pm **NASA TOWN MEETING REGISTRATION/NETWORKING**
(RECEPTION FOR NASA/JPL TOWN HALL MEETING PARTICIPANTS)
- 6:30 pm – 9:00 pm **NASA / JPL TOWN HALL MEETING** — DINNER AND PANEL

Introduction to RS3

***The Need for
Responsive Space***

**Los Angeles, CA
April 25 – 28, 2005**

James R. Wertz, General Chairman

Email: ResponsiveSpace@smad.com

Web: www.ResponsiveSpace.com



- What Does Responsive Space Mean?
- Why is It Needed?
- What are the Characteristics of Responsive Space?
- What Missions Need to be Responsive?
- New U.S. Space Transportation Policy — 1/6/05
- The Challenge for Responsive Space



What Does Responsive Space Mean?

- **Responsive Space**

- *“Rapidly generate and maintain space superiority and strike capabilities that produce desired war-fighting effects that are there and available when needed.”*

Maj. Gen. Tom Taverney, April 12, 2004

- **Responsive Launch**

- Launch systems within a day of identified need
- Initial emphasis on small payloads, may apply to larger payloads later

- **Responsive Space Systems**

- Return data from payloads within the first 1–2 orbits after launch
- Elements that need to be addressed:
 - Spacecraft bus
 - Operations and Control
 - Payloads and sensors
 - Data dissemination

- **Responsive Missions**

- Significantly less than a decade from an identified need or new capability to something ready to fly — the Plug-and-Play 6-Day Spacecraft
- A day or less for assets available on the ground to being operational on orbit

**In any current or potential conflict, space assets can be brought to bear only if they are already operational. We can not reconstitute assets which fail or launch new assets in response to world events.
This is the problem which must be solved.**

Why is “Responsive Space” Needed?

- **Responsiveness has become critical to many modern systems**
 - War in Iraq
 - Tsunami in southeast Asia — where were the debris fields that carried people out to sea?
 - Much shorter time frame for most information-based technologies
 - “Instant answers” to many issues available on the Internet or web
- **Space assets are a major contributor in many areas**
 - Military, commercial, science, engineering, education, exploration
- **But, however important space assets may be in today’s world, they aren’t responsive**
 - Apollo went from a dream to landing people on the Moon (including developing the largest rocket ever built) in 8 years
 - Today, major unmanned programs take well more than a decade, and even small satellite missions can take 5 to 7 years
- **Many would regard Iridium as a technical success, but a business failure**
 - Why? — Largely because it took too long to build and deploy and was made irrelevant by the rapid growth of ground-based systems
 - The lack of multiple LEO communications constellations (and the consequent economic impact) is, in part, a direct result of the lack of responsiveness in our industry

**How do we make space responsive?
If we’re successful, how do we take advantage of this new capability?**

- **Responsive** — Provide information to the end user within 24 hours of an identified need
- **Flexible** — Provide multiple types of data (from different spacecraft) for any location on Earth at any specified future time
- **Low Cost** — Total mission cost < \$20 million/spacecraft
 - Includes launch, spacecraft, payload, and mission ops
 - Allows systems to be built to inventory
- **Short Duration** — Less than 6 months planned mission life
 - Reasonable to launch in response to tactical needs
- **Small Spacecraft** — Total mass < 1000 lbs, possibly < 500 lbs
 - Reduces both launch and mission cost
- **Single Function** — 1, or at most 2, payloads per spacecraft
 - Allows matching response to the identified need
- **Low Altitude Orbit** — 200 to 400 km altitude
 - Allows small payloads to provide better performance
 - Instrument 1/4 to 1/2 the size of a comparable resolution instrument at 600–800 km

This is a personal list intended to provide a point of departure for discussion.

- **Can be assigned to operational commands for tactical applications**
- **Assets safely deployed in CONUS can reach any location in the world in 90 minutes from launch, 12 to 24 hours from initial request**
 - Several month duration with little operational support required
- **Flexible response, global reach**
- **Can monitor inherently hazardous environments**
 - Monitoring on the ground or even with UAVs causes inherent risk of dispersal of toxic material and may endanger operations personnel
 - Space system eliminates or reduces need to put personnel in hazardous environments
- **Can overfly hostile territory**
 - without warning
 - without being a hostile act
 - with little or no chance of being shot down
- **Consequences of a launch failure are minimized**
 - Launch failure of a traditional surveillance satellite may cost \$100's of millions and take months or years to replace
 - Launch failure of a small space mission will cost <\$20 million, can be replaced in hours, and minimizes collateral damage
 - Both launch vehicles and payloads built to inventory (like cruise missiles)
 - Failure of ground, air, or near-space assets may compromise operational systems, or cause unintended casualties, whereas failure of a space asset causes no collateral damage

What Missions Need To Be Responsive?

- **Military missions** — rapid and continuous battlefield intelligence that's "responsive and flexible" (the quote is from Gen. Tommy Franks assessment of the new strategy for the Iraq war — March 22, 2003)
 - Without responsiveness, space will be less relevant to future military users
- **Disaster monitoring** — immediate answers to What, When, Where, and How
- **Commercial missions** — ground-based (rather than space-based) sparing, 0-g manufacturing based on needs defined today
 - For space to remain relevant, the next major set of commercial systems must succeed
 - We all share responsibility for the death of the LEO communications revolution
- **Science** — observations of transient phenomena; responsive science with tomorrow's experiment based on today's results
- **Education** — experiments launched while the student is still a student, or at least still in astronautics
- **Crewed missions** — can we make them safer by having responsive launch available?
 - Inspection missions launched when needed to evaluate potential problems
 - Consumables/spare parts brought up as needed to extend on-orbit life or fix problems

Answer: All of 'em.

- *“The fundamental goal of this policy is to ensure the capability to access and use space in support of national and homeland security, civil, scientific, and economic interests. To achieve this goal, the United States Government shall:...*
 - 2) *Demonstrate an initial capability for operationally responsive access to and use of space — providing capacity to respond to unexpected loss or degradation of selected capabilities, and/or to provide timely availability of tailored or new capabilities — to support national security requirements;”*

- *“5) Before 2010, the United States shall demonstrate an initial capability for operationally responsive access to and use of space to support national security requirements. In that regard, the Secretary of Defense, in coordination with the Director of Central Intelligence, shall:*
 - a) *Develop the requirements and concept of operations for launch vehicles, infrastructure, and spacecraft to provide operationally responsive access to and use of space to support national security, including the ability to provide critical space capabilities in the event of a failure of launch or on-orbit capabilities; and*
 - b) *Identify the key modifications to space launch, spacecraft, or ground operations capabilities that will be required to implement an operationally responsive space launch capability.”*

“How can we take space and bring it... to the operational and tactical level of war.

Launch vehicles that carry 1,000-pound payloads...

Launch these satellites reliably in hours... put them into orbit over a focused point on the earth..”

– Gen. Lance Lord, Commander, Air Force Space Command

“From notification of desire to launch to actual launch ‘measured in hours and days, not weeks and months’”

“...build a stockpile of small satellites and booster rockets [to be] dispatched very quickly to respond to the combatant commander’s needs.”

– The Hon. Peter B. Teets, Under Secretary of the Air Force

**We can do better. We must do better.
Let’s get RS3 underway and find out if we’ve made progress!**