

Deploying an Innovative

In-Situ Technology Test Bed (ISTTB)

Redefine Technologies

Along with Space Access Technologies & University of Colorado & NASA Ames

Presented by:

Steve Wichman - President of Redefine Technologies 720-317-5182 steve.wichman@redefine.com



New Technologies

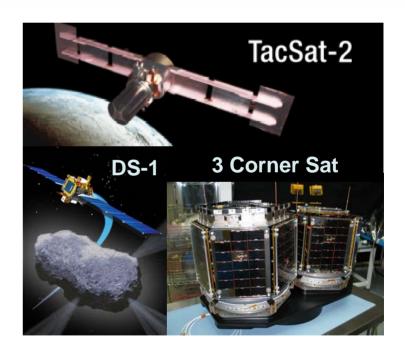
- Software
 - RTI: Dynamic Mission On-orbit Control Kit
- Hardware
 - Space Micro: Proton 300K
 - Design_Net: Modular Reconfigurable Avionics
- Components
 - AeroAstro: Miniature Star Tracker



Flight Testing

- Convince someone
- TacSat or NMP
- Univ. class

- Whole' satellites costs \$\$\$
 - Management
 - Integration
 - Schedule





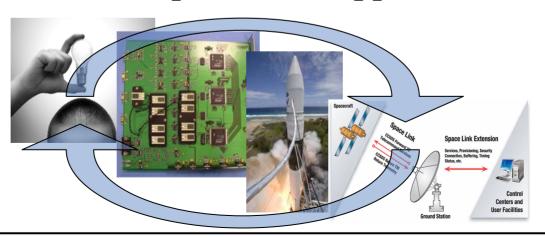
Self Manifest TM

Designer

Programs Office

- You choose when you fly
- Test early
- You design your experiment
 Test thoroughly

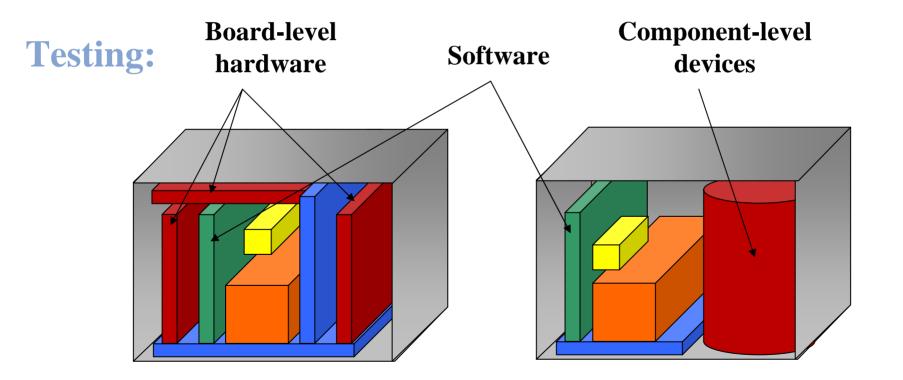
 - Inexpensive launch
 - Multiple launch opportunities





Technology
into Future
Resources

In-Situ Technology Test Bed (ISTTB)



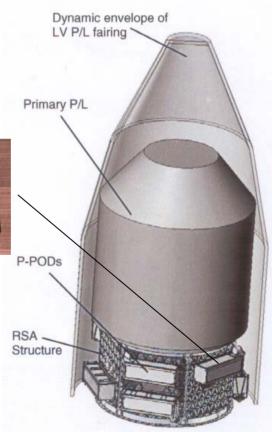
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RideShare and ISTTB

- Excess capacity on existing launches
- Regular, reliable and repeatable

- P-PODs, nanosatellites
- And now, ISTTB gives...
 - Software
 - Board-level hardware
 - Component-level devices

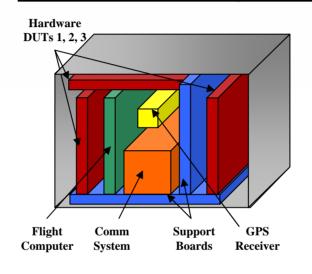


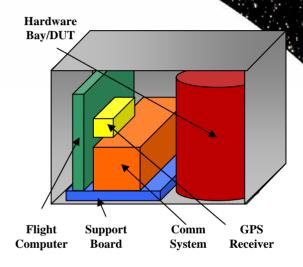


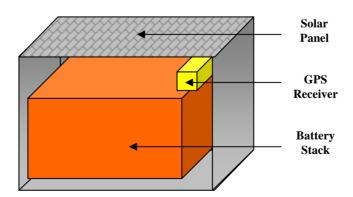
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Resources

- Payload Box
 - C&DH
 - Comm
 - Thermal
 - DUT Bay
- Battery Box
 - Power
 - ADS

ISTTB Flight Boxes



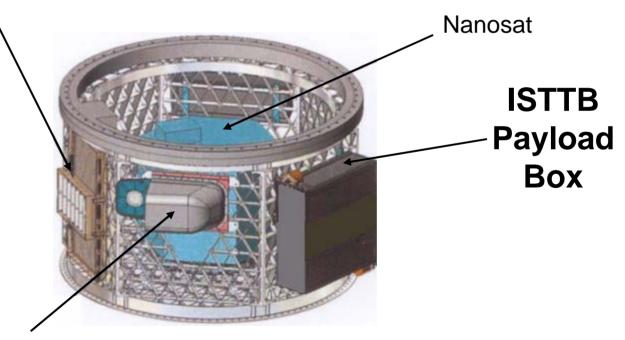




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Resources

Mounting to RSA

ISTTB Battery Box



P-POD or RocketPod

into Future Resources 151

Mission

- What does this satellite do? How does it work?
 - Identify early testing needs
 - You design and run the most relevant experiments
 - Self Manifest TM that technology on a launch
 - Sensors read real-world environment
 - Dosimeter card
 - Voltage, current, temperature
 - Position and attitude
 - Support Board: send and receive test patterns to your device
 - Flight computer will collect test results
 - Mission Operations will retrieve your data

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Test Bed DUTs

(Devices-Under-Test)

- Software
 - Dedicated flight computer
 - 1, 8 or 16 MB memory available
 - GPIO and other data bus clients
- Board-level hardware
 - 3.3V, 5V power for a 3U size card
 - (x3) cPCI slots (other interfaces coming soon)
 - Support board with GPIO and 'data suppliers'
- Component-level devices
 - 28 V power
 - 4000 cm³ (260 in³) @ 2.0 kg (4.4 lbs)
 - Iso-grid mounting pattern
 - Your choice of interfaces: USB, I2C, SpW, serial, GPIO, Eth



Examples of Tests

- Software
 - Get real voltage and current readings and react to them
 - Base decisions on real GPS output
- Board-level hardware
 - T3RSS (NASA Ames)
 - Dynamic test pattern generator on the support board and a 'comparator' after the board
- Component-level devices
 - Reactions wheels or torque coils
 - Read attitude sensors and see how it affects the RSA

Benefits

- Each DUT gets:
 - 100% dedicated test time = Primary Payload
 - Multiple flight opportunities = 1-3 per year
 - Manifest to launch readiness in 1-9 months
 - Real-world testing environment
 - *Complimentary* and/or *alternative* option to cyclotron beam testing for electronics
 - Real thermal cycles in a vacuum
 - Real launch environments



Benefits (cont)

- Each DUT gets:
 - Affordable business opportunity
 - No payload on-board considered a "national or scientific emergency" (i.e. Hubble, GPS, NOAA, etc)
 - Increase your TRL $(6 \rightarrow 7/8)$
 - Flight heritage = jump start your product line
 - Incremental Program Office approach
 - Test early
 - Actually get the latest-and-greatest

Resources 15

Future of ISTTB

- Commercial companies
 - Validate flight software/hardware/components
 - Flight test prior to 'real-science' or 'real-tactical' missions
 - Multiple flights per year
- ORS, DARPA, NRL, NASA
 - Rapid technology testing use the latest-and-greatest instead of keeping it on the shelf
 - Concentrate on the technology/science
 - Eliminate much of the management/integration overhead

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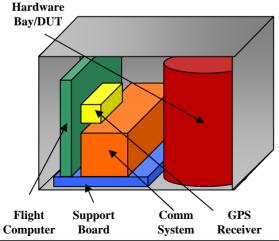
Hardware

Questions?

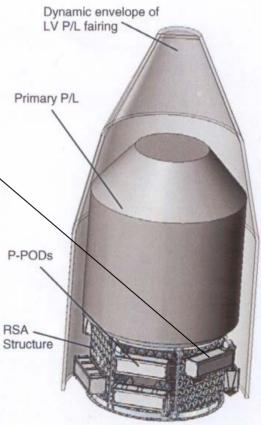
Electronics
ISTTB

Flight Comm Support GPS
Computer System Boards Receiver

Hardware ISTTB







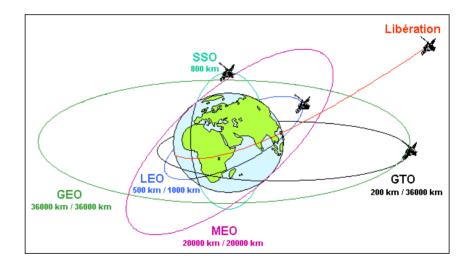


- What is the price of an ISTTB ride? *
 - S/W and Board-level hardware
 - \$100K \$400K
 - Component-level device
 - \$300+

* Subject to change

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- What orbit will ISTTB fly in?
 - Variety of orbits:
 - LEO (low inclination to polar)
 - MEO
 - GTO
 - Depending on where the other payloads are going





- Length of an ISTTB mission?
 - The ISTTB may orbit for years depending on orbit
 - Standard test time is 3 months



- ISTTB's telemetry capability?
 - Uplink and downlink
 - Throughput #s: ??? (kb/sec per pass duration)
 - Depending on orbit/COMM chosen

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FAQ #5

- What attitude will ISTTB adopt?
 - The RSA does not have attitude control*
 - The second stage = gravity-gradient

* Unless that is what you're testing



- What capabilities does the Support Board include?
 - Pseudo-custom board to suit your needs
 - Data provider FPGA to pump data to your device
 - Data comparator FPGA to compare device output to expected output then report differences
 - GPIO, USB, I2C, SpW, serial
 - Read GPS, sensors
 - Actuating device: camera, relay



- How many ISTTB flight opportunities?
 - 1 to 3 per year
 - Depending on extra room available and primary customer payload (i.e. classified)

- What was your initial purpose to develop the ISTTB?
 - NASA Ames redundancy research = Triple³
 Redundant Spacecraft Subsystems (T3RSS)
 - T3RSS board is proposed as the first payload
 - Open the opportunity to others...

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- When is the first ISTTB flight?
 - 2009-2010 timeframe



- What are other options?
 - TacSat
 - NMP
 - Old options:
 - NASA's Orbiting Technology Testbed Initiative (OTTI)
 - Space Environment Testbed (SET)

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FAQ #11

• (your question)



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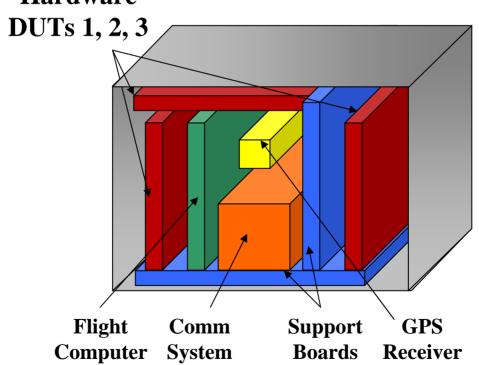


Backup Slides

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Electronics ISSTB

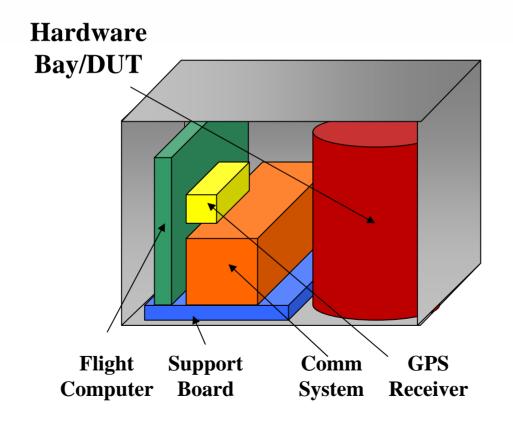
Hardware





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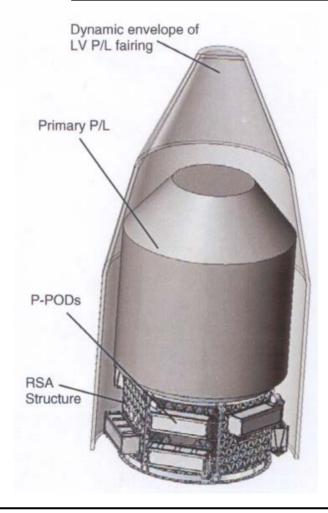
Hardware ISSTB





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Launch Vehicle



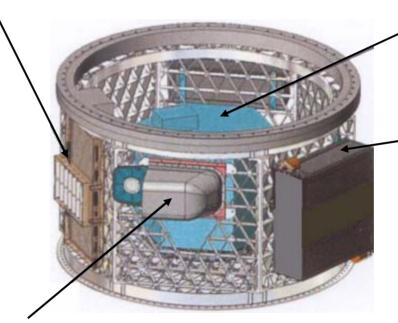


Rideshare Adapter

Battery Box

Nanosat

ISTTB



P-POD or RocketPod



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