



**RedeFine
Technologies**

Spinning
Technology
into Future
Resources™

Testbed for Responsive Experiments And Demonstrations in Space (TREADS)

Launching Responsive Space Opportunities

Presented by:

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Sponsors/Partners

- NASA Phase II grant (STTR NNA07BC02C)
- Space Access Technologies
- Design_Net Engineering
- Space Micro Inc.
- Colorado Space Grant Consortium
- University of Colorado – Boulder



Who we are...

- Redefine Technologies, Inc.
- Started '04
- Skills:
 - Ground and flight software
 - Embedded systems (DSPs, FPGAs, processors, etc)
 - Spacecraft Design (5 sats incl help on PnPSat, TacSat2)
- Design_Net, ICS, AGI, USSPACECOM, NASA, AFRL's Univ Nanosat Program
- New small satellite service - TREADS



Agenda

- Overview of TREADS
- Differences between TREADS and similar platforms
- How TREADS can help ORS goals
- What kind of missions can be flown on TREADS



TREADS

Testbed for Responsive Experiments And Demonstrations in Space

TREADS is a 'full-service' technology and science demonstration platform.

- Allows new instruments to be quickly and easily integrated onto our spacecraft and launched into space!
- Mini-SIV, mini-Tacsat for commercial/civil/DoD payloads
- SBIR/R&D Test Platform



Our Focus

- Commercial, civil and DoD customers
- Testing new technologies
 - Quick demonstrations and risk-reduction
 - SBIR/BAA/PRDA/Procurement/IR&D
 - Increase TRL = “first to market” or maintain funding
 - Baseline science/tactical capabilities = get the 'essential mission' started
- Small payloads
- Lowering costs for technology demonstration



Satellite Overview

- Satellite bus for payloads from 0 to 40kg (88 lbs)
- Volume: approx. 57cm (22.5”) o.d. x 45 cm (18”) tall
- Total payload average power: 100W
- 'Technology slots' available for 1 to 5 instruments
 - Several 'customers' per flight
 - Don't need a dedicated s/c – 'per-slot' basis
 - Don't have to be chosen (i.e. prime/sub)
- “Turn-key” solution: integration, launch, mission ops
- Multiple: bus sizes, vehicles, launch opportunities



General Interest

- Your technology is the primary payload
- Board-level electronics, S/W or full component
- 100% dedicated test time (given power limits)
- You decide when you fly!
- Early flight heritage
- Jump start development/deployment
- New radiation and environmental testing platform:
GTO, LEO, MEO



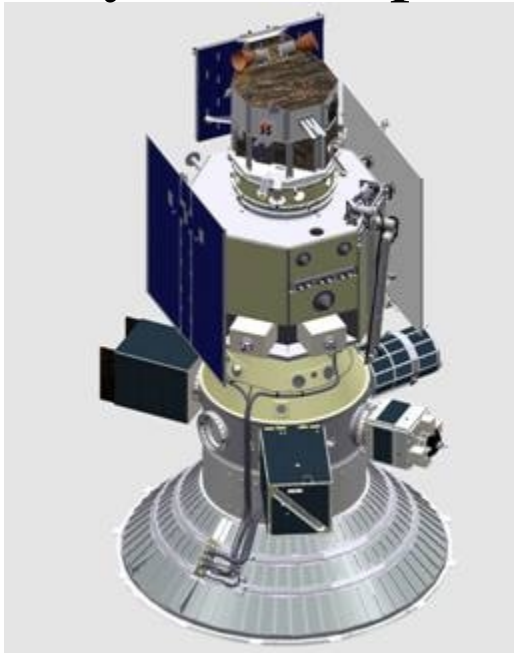
Spacecraft Bus

- What does the spacecraft look like?
 - First, some background info...
 - Rideshare = providing low cost testbed opportunities

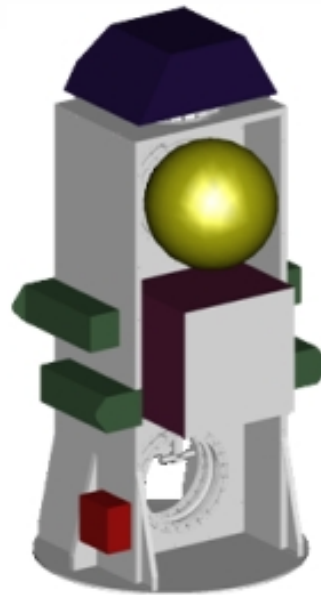


Taking Advantage of Rideshare

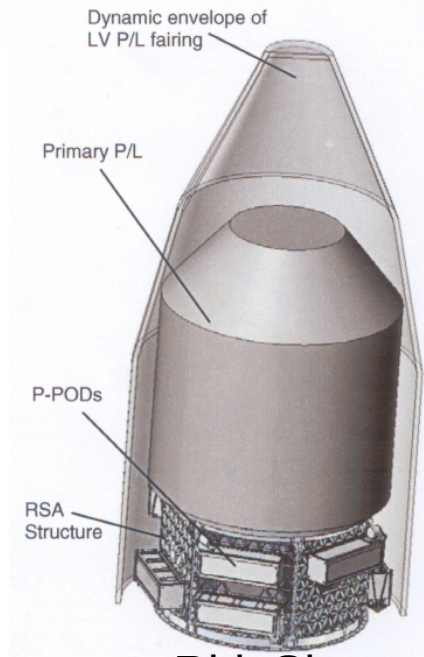
- Payload adapters to take advantage of excess capacity



EELV Secondary Payload Adapter (ESPA)



NASA's Multiple Payload Ejector (MPE)



RideShare Adapter (RSA)



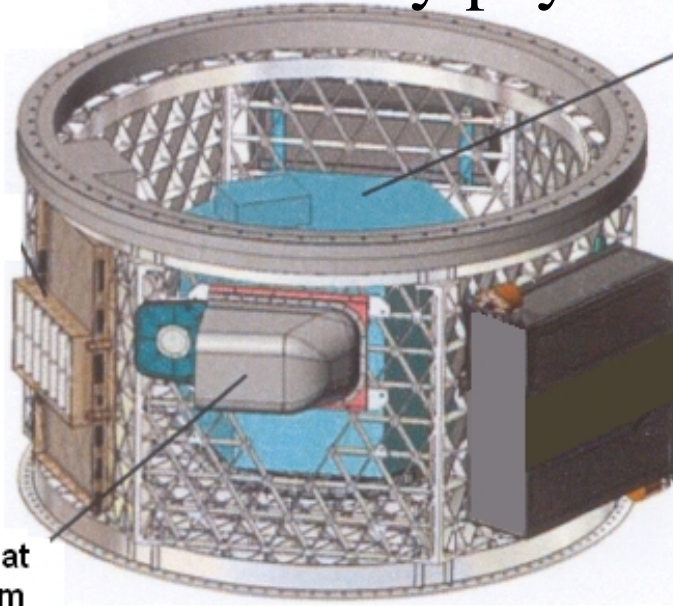
Payload Adapter Specifics

- All have:
 - 1 primary payload and 15” interfaces for secondary payloads
- ESPA secondaries
 - 1 to 6 small satellites (each <180kg (400 lbs))
- MPE secondaries
 - 1 to 6 'smaller' satellites (not all 180kg)
 - 1 to 3 tertiary payloads (Cubesats)
- RSA secondaries
 - 1 'half-ESPA' footprint small satellite (<90kg (200 lbs))
 - 1 to 3 tertiary payloads (Cubesats)



Closer Look at RSA

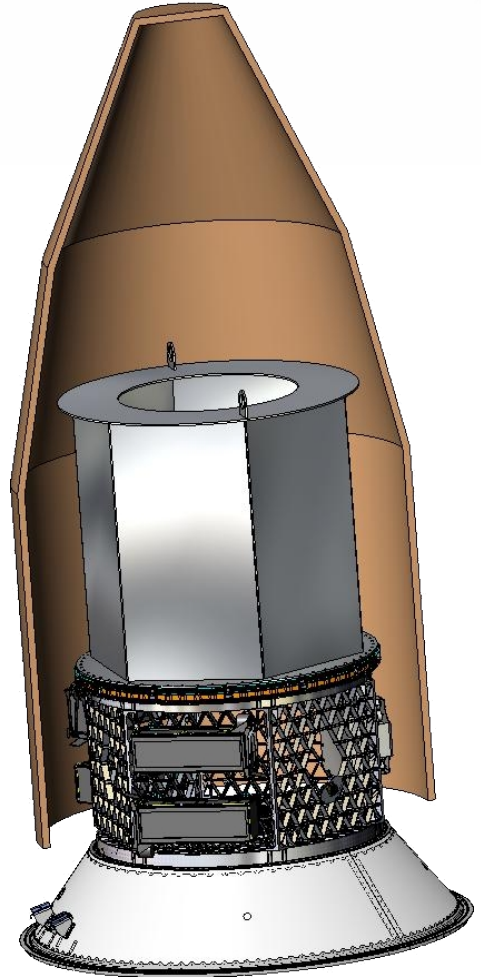
- 'Half-ESPA' sized satellite
- P-PODS (Cubesats)
- Space for tertiary payload on sides



Nanosat Platform

P/L Adapter Platform
(i.e. RSA, MPE, ESPA, etc)

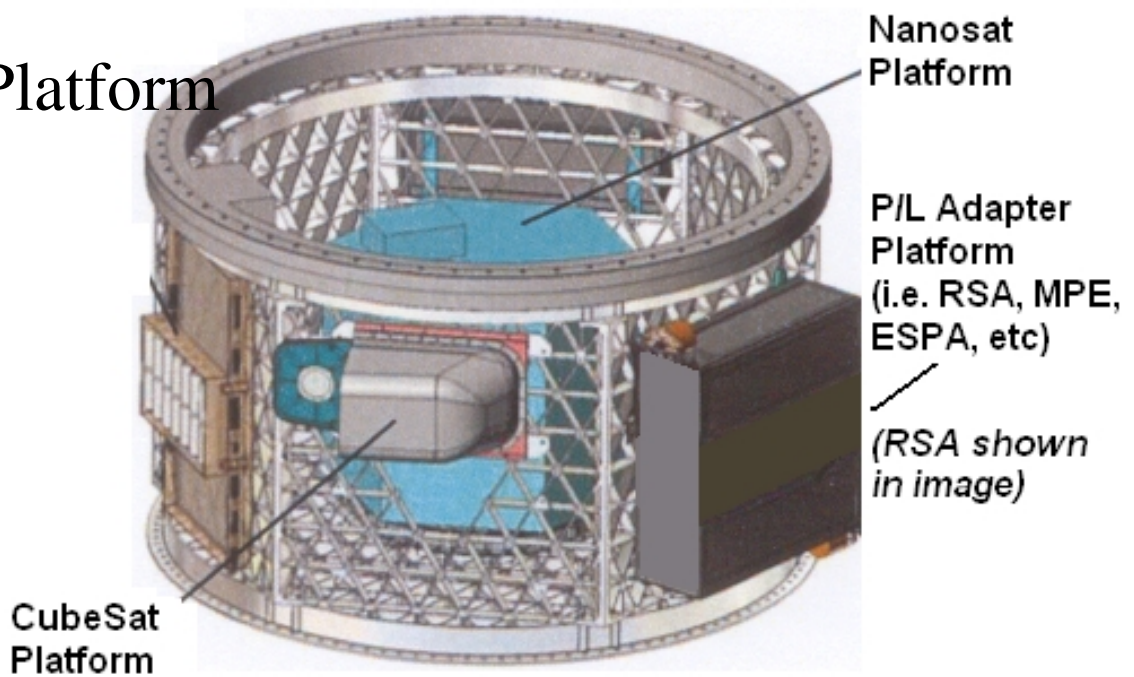
(RSA shown in image)





Configurations

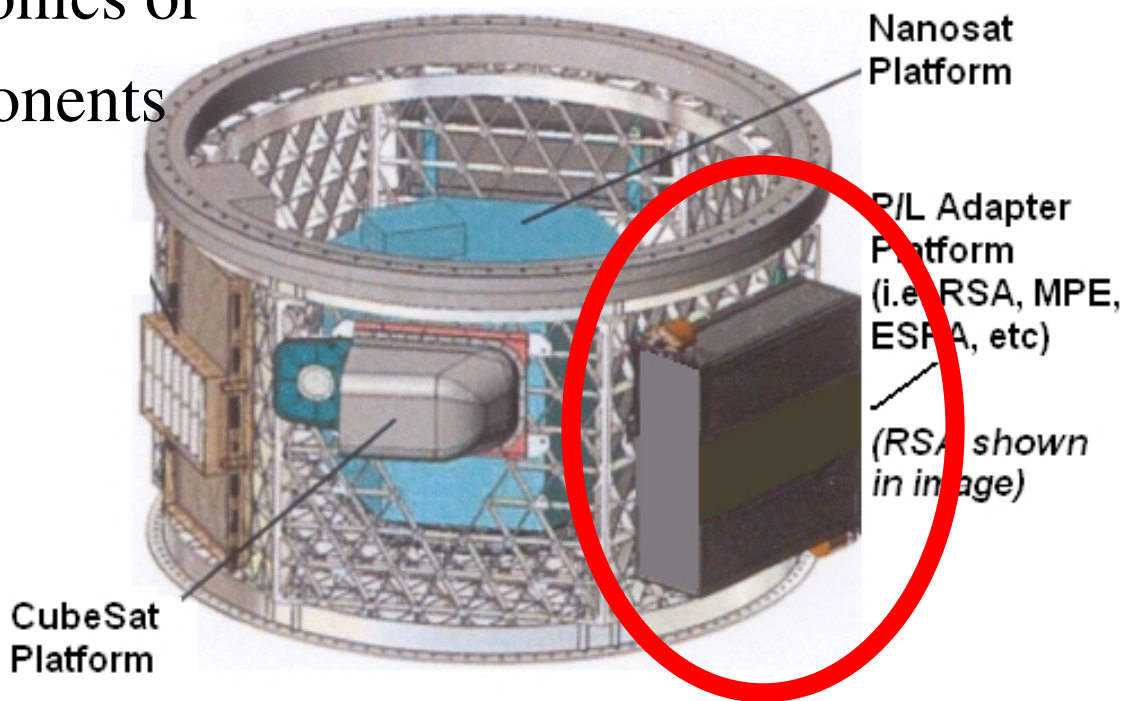
- 3 TREADS configurations to keep costs low and perform to customer specifications
 - CubeSat Platform
 - Payload Adapter Platform
 - Nanosat Platform





Payload Adapter Platform

- Payload Adapter Platform
 - Full power and comm capabilities to test:
 - board-level electronics or
 - stand-alone components





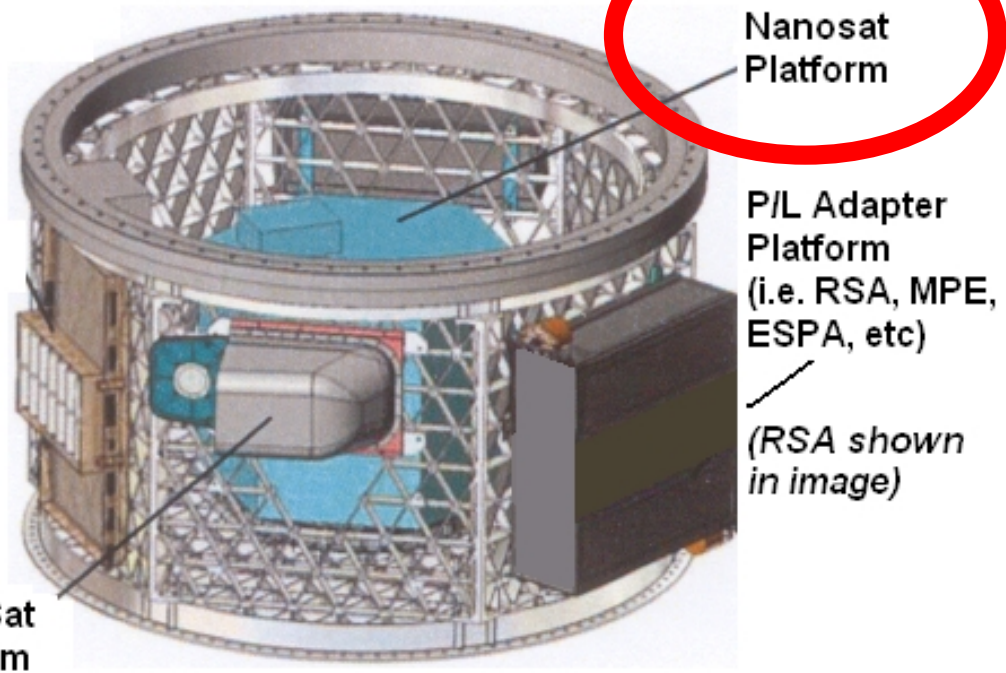
Payload Adapter Platform (cont)

- Stays attached to 2nd stage
- No attitude control
- Complete satellite-in-a-box
- Standardized box sizes
- Typical missions:
 - Electronics/software testing
 - Limited pointing requirements (i.e. Space weather measurements, attitude sensors, etc)



Nanosat Platform

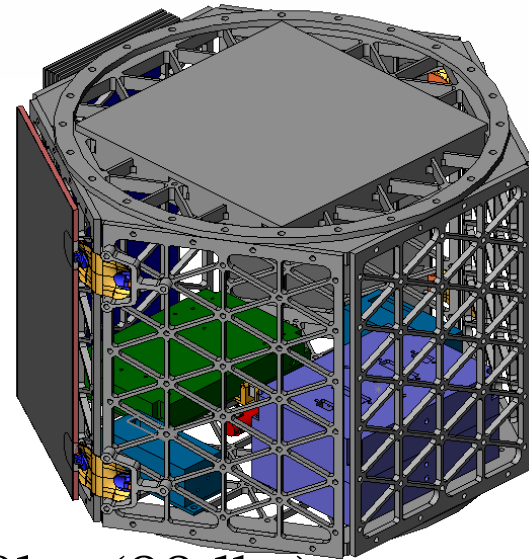
- Half-ESPA/Nanosat Platform
 - Half-sized option (comparing to SIV)
 - Example payload:
 - Star trackers
 - Reaction wheels
 - Communication
 - Electronics
 - Optics
 - Science instrument
 - other





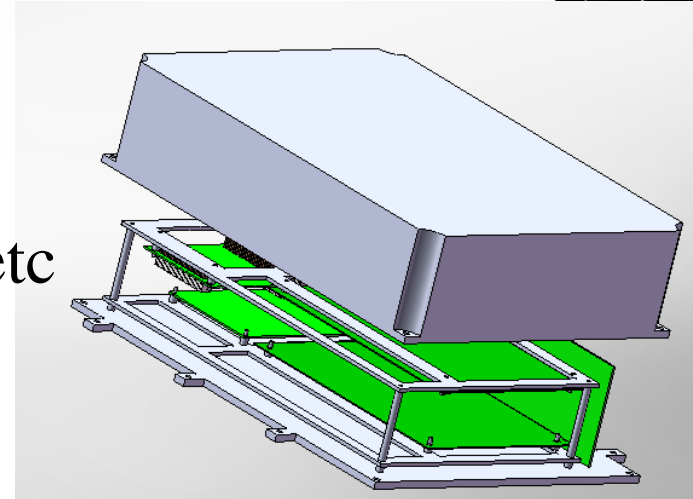
Nanosat Platform (cont)

- Deployable
- Full 3-axis attitude control
- Same standardized box sizes
- Typical missions:
 - Electronics/software testing
 - Standalone components up to 40kg (88 lbs)
 - Earth/Space Situational Awareness/Astronomy
 - CONOPS Development Sat (ISR, tactical comm)



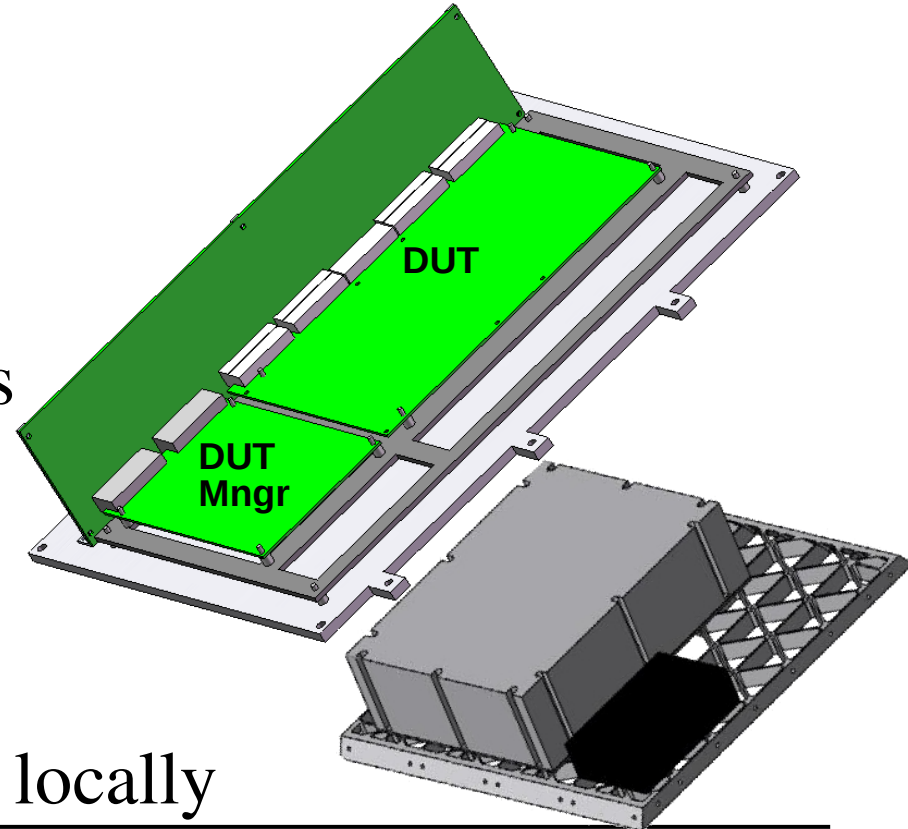
Supporting a DUT

- Various DUT interfaces
 - 3U, 6U, PC104, custom box
 - cPCI, 1553, SpaceWire, RS422, etc
- Rad-hard flight computer
 - exercise DUT and record data
- Communication link
 - Downlink results, uplink new configurations
- Lifetime
 - Standard: 6 months, Extended: >1 year



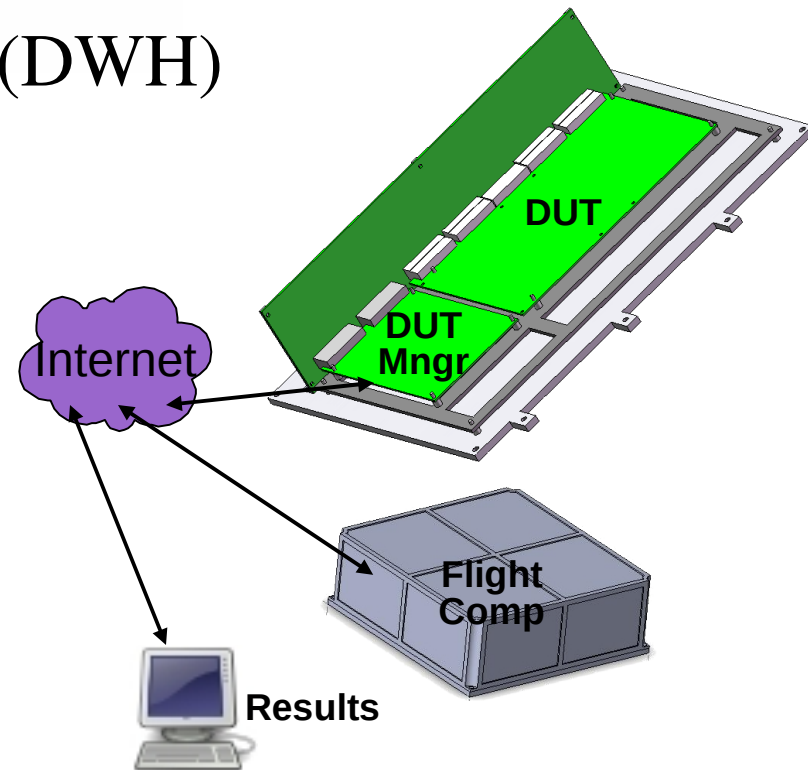
TREADS CONOPS

- Customer receives a test bench of the actual flight configuration
 - DUT Box + panel
 - DUT Manager
 - Each backplane is custom
- Customer designs their tests
 - How often to run DUT?
 - What interfaces to exercise?
 - What info to collect?
- Customer writes code, tests locally



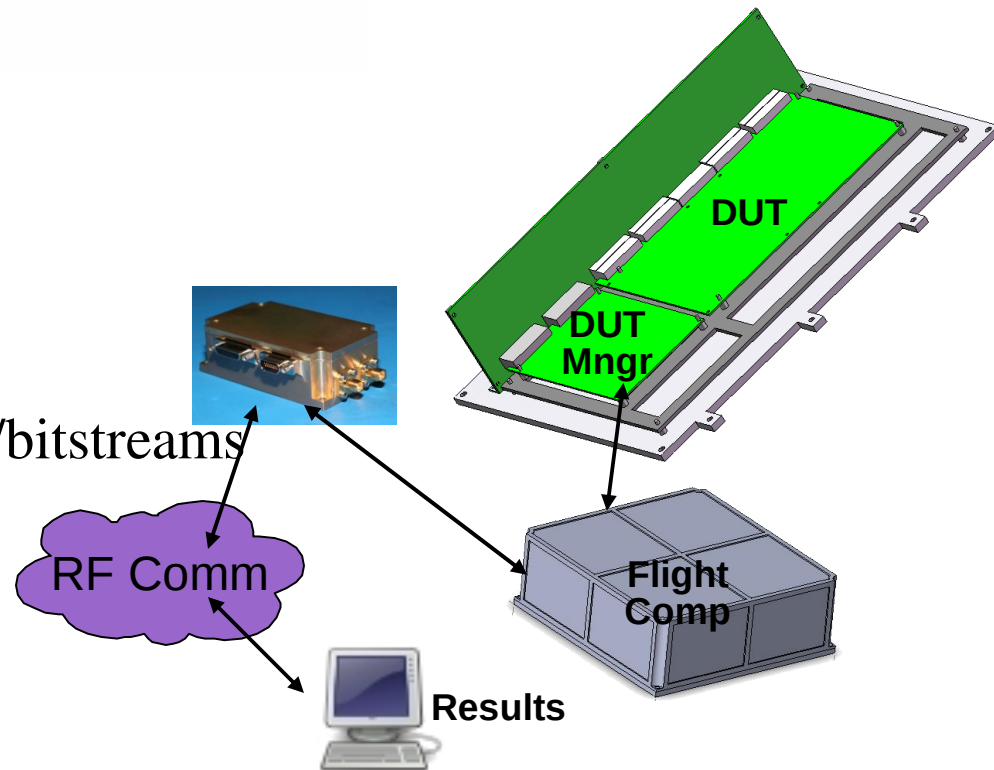
CONOPS (cont)

- Customer 'plugs' their system into the TREADS Distributed Wiring Harness™ (DWH)
 - Pre-integration testing step
 - While 'still on-the-bench'
- Simulates:
 - End-to-end data flow
 - Variable processor loads
 - Commanding sequence/infrastructure



CONOPS (cont)

- Final I&T, vib and thermal/vac
- Launch
 - Automated checkout
 - Run tests
 - Downlink results
 - Upload new test scripts/bitstreams
 - Re-run tests





Differences

- TREADS focuses on 'turn-key' solution to flying commercial and civil (and military) payloads
 - Tacsats and SIV focus on only military payloads
 - Tacsats and SIV focus on military needs, not 'payload needs', i.e.
 - require standardized interfaces
 - components are specific for a cohesive mission
 - but TREADS needs to handle unlimited interfaces depending on customer needs – it's their mission



Differences (cont)

- TREADS is manifested on a 'per-slot' basis
 - Tacsats and SIV follow full-satellite acquisition procedures = full of contractual, oversight, I&T and operational headaches!
 - Tacsats and SIV need to be 'full'
 - Can't justify the expense to fly a small instrument
 - Unlikely to fly 'unrelated instruments' that don't contribute to mission
 - TREADS reduces the acquisition overhead and is sized to fly any sized payload you need



Differences (cont)

- TREADS has 3 platforms and multiple* launch options
 - *TREADS Payload Adapter Platform could fly on any vehicle/flight with a payload adapter
 - *TREADS Half-ESPA could fly on any vehicle/flight with a 15” adapter
 - SIV is specific to the ESPA launch vehicles on DoD launches
 - The SIV and Tacsat buses are one size



Differences (cont)

- TREADS flies as secondary payload – lower costs
 - So does SIV but splitting costs among several customers yields opportunities for...
 - board-level electronics in the \$500K range
 - an entire 'Half-ESPA' Platform in the \$5M range
 - Tacsats and SIV are much more (especially after overhead of 'dedicated satellite' acquisition process)



Helping ORS

- TREADS can help the ORS mission...
 - Given: ORS has already determined the 'correct' ORS satellite bus size to accommodate 80% of the missions
 - TREADS offers an alternative set of bus sizes
 - Distributed Wiring Harness (DWH)
 - Cost sharing and manifest sharing with commercial components
 - OTS 'turn-key' procurement
 - Quick response testing with multiple flights per year



ORS 'Missions'

- Risk-reduction
- Incremental Mission Objectives
- Mini-Tacsat/SIV
- SBIR/R&D Test Platform
- Actual Mission Objectives
- Pre-Emergency Planning
- CONOPS Development
- Deploying in Limited Time

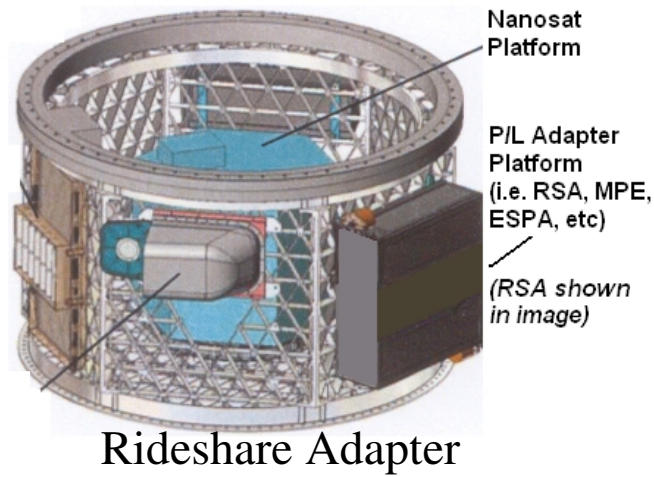


Summary

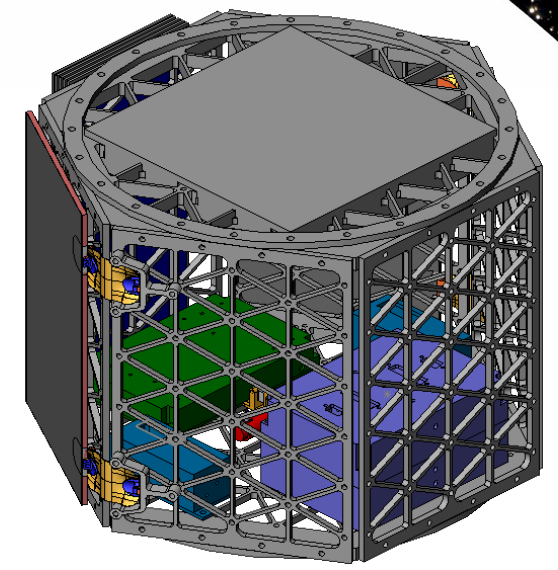
- TREADS can help the ORS mission...
 - TREADS offers multiple, alternative bus sizes
 - Distributed Wiring Harness (DWH) for pre-integration costs savings
 - Variety of quick response missions (besides just technology demonstration)
 - OTS 'turn-key' procurement



TREADS



Questions?



Half-ESPA Platform

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