EELV Secondary Payload Accommodations

CubeSat Workshop

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SP Issues

- **Primary payload's lack willingness to fly SPs**
- **Launch vehicle team has a risk avers mind-set**
- **SPs electrically quiescent from encapsulation thru primary mission**
- **Need to establish enveloping SP specs for Mission Analysis**
  - Enveloping environmental standard, separation shock limits, Loads
- **Need for defined SP qualification methodology and certification**
- **Include lessons learned from STP-1**
  - Need to certify sep systems
  - Must do "test-like-you-fly" in the SIL (for new H/W)
  - Simplify avionics electrical I/F for recurring integration
  - Simplify the integration process (time and money)

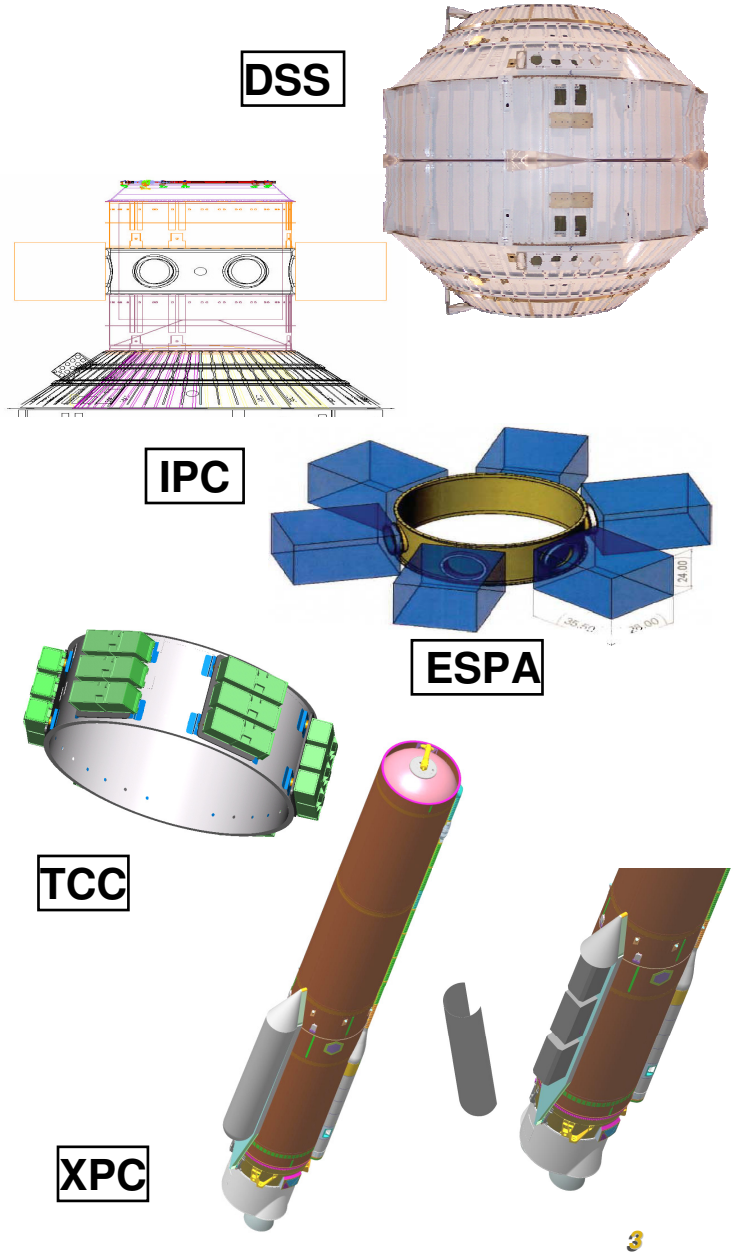
Atlas Rideshare Options

- **Dual Spacecraft System (DSS),** 1500-3500 lb

- **Integrated Payload Carrier (IPC),** 400 lb ea.
  - Supports Larger Secondary Payloads
  - ESPA Flight Proven on STP-1 (Feb '07)
  - Being used for NASA LCROSS mission

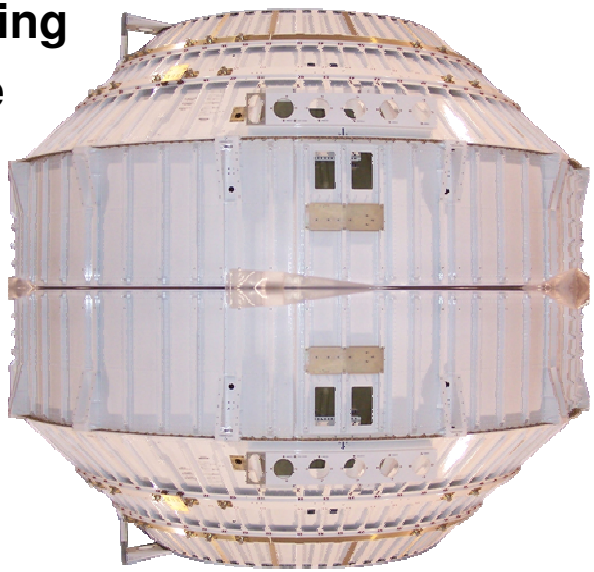
- **Small Class Carriers**
  - Type-C Carrier (TCC), 35 lb
  - Aft Bulkhead Carrier (ABC), ~300 lb
  - Secondary Payload Carrier (SPC), 220 lb

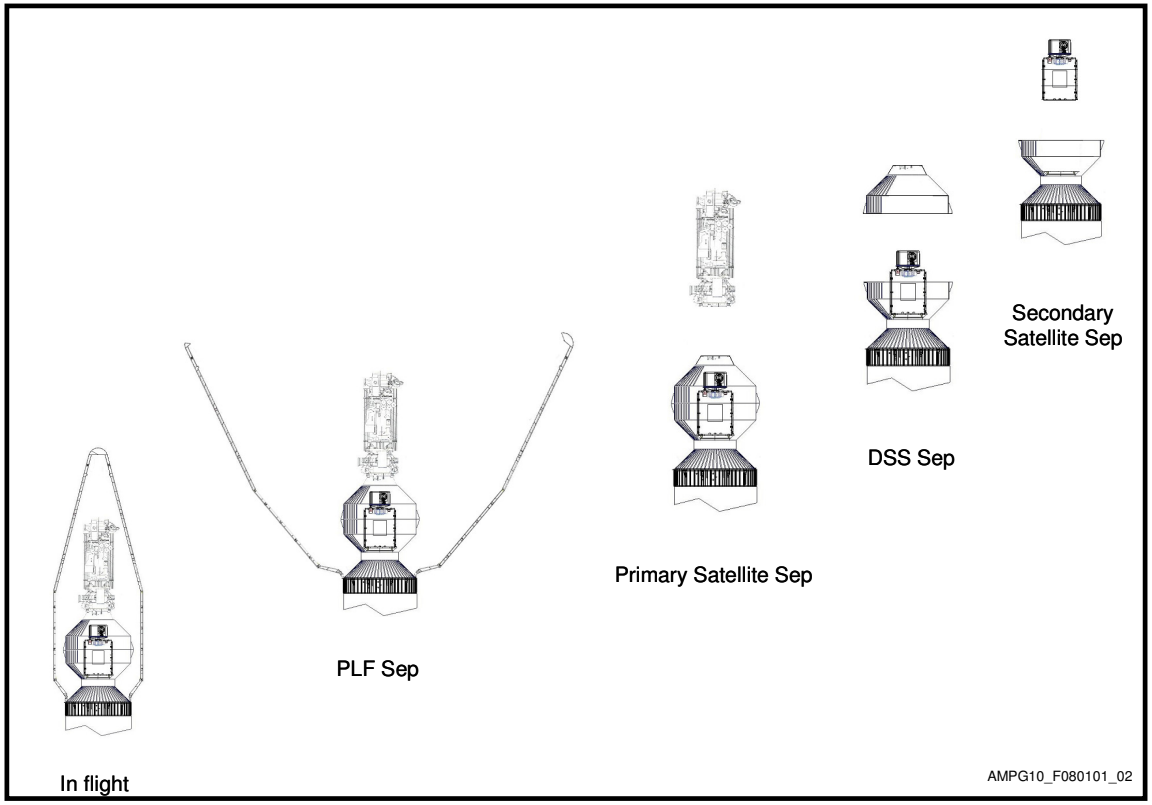
- **X-ternal Payload Carrier (XPC)**
  - Supports Sub-orbital Flight Test, ~1500 lb Requirements



DSS for large class Dual Payloads

- DSS consists of a qualified structure in a 4M fairing
- Sep system at the midline frees the SP for inside the carrier
- ILC late '09

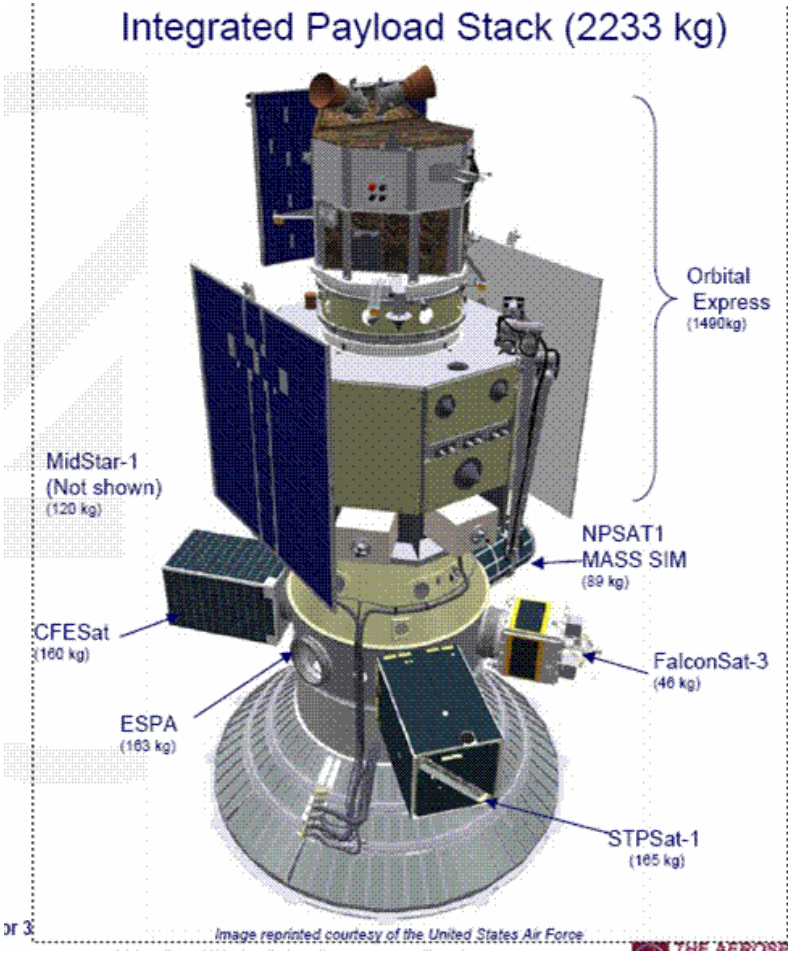




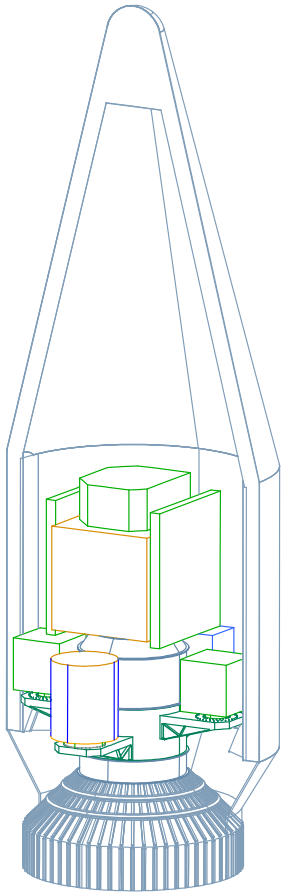
IPC / ESPA Mission Concept

- **STP-1 released a primary and 5 SPs**
  - Orbital Express (primary) with MidStar-1 at 492km circular, 46 deg incl
  - NPSAT1, STPSat-1, CFE, FalconSat-3 at 560km circular, 35.4 deg incl

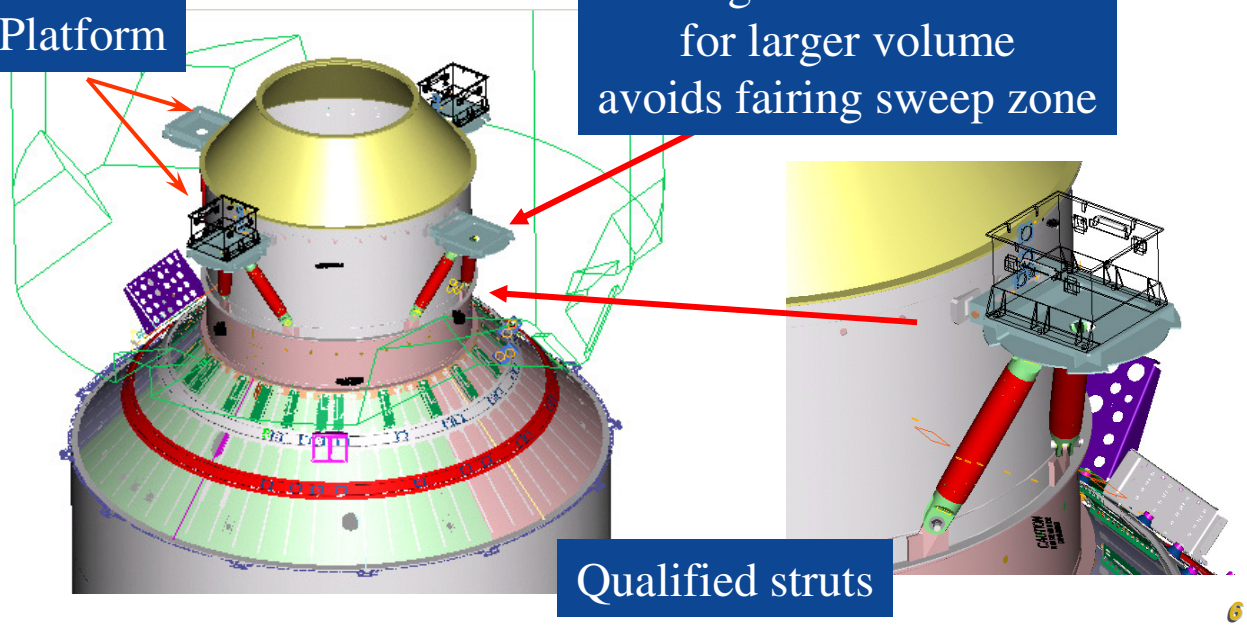
- **Most commercial launches are GTO**
  - Approx. at 27 deg w/ a retrograde orbit that is either + or – a ½ deg.
  - Perigee is nominally 185 nm up to 300 nm
  - Apogee is GTO up to 100k nm
  - Upper Stage do degrade over time.
  - Tend to circularize at perigee & gradually lower till extinction.
- **Currently Funded by AFRL to simplify the integration process.**



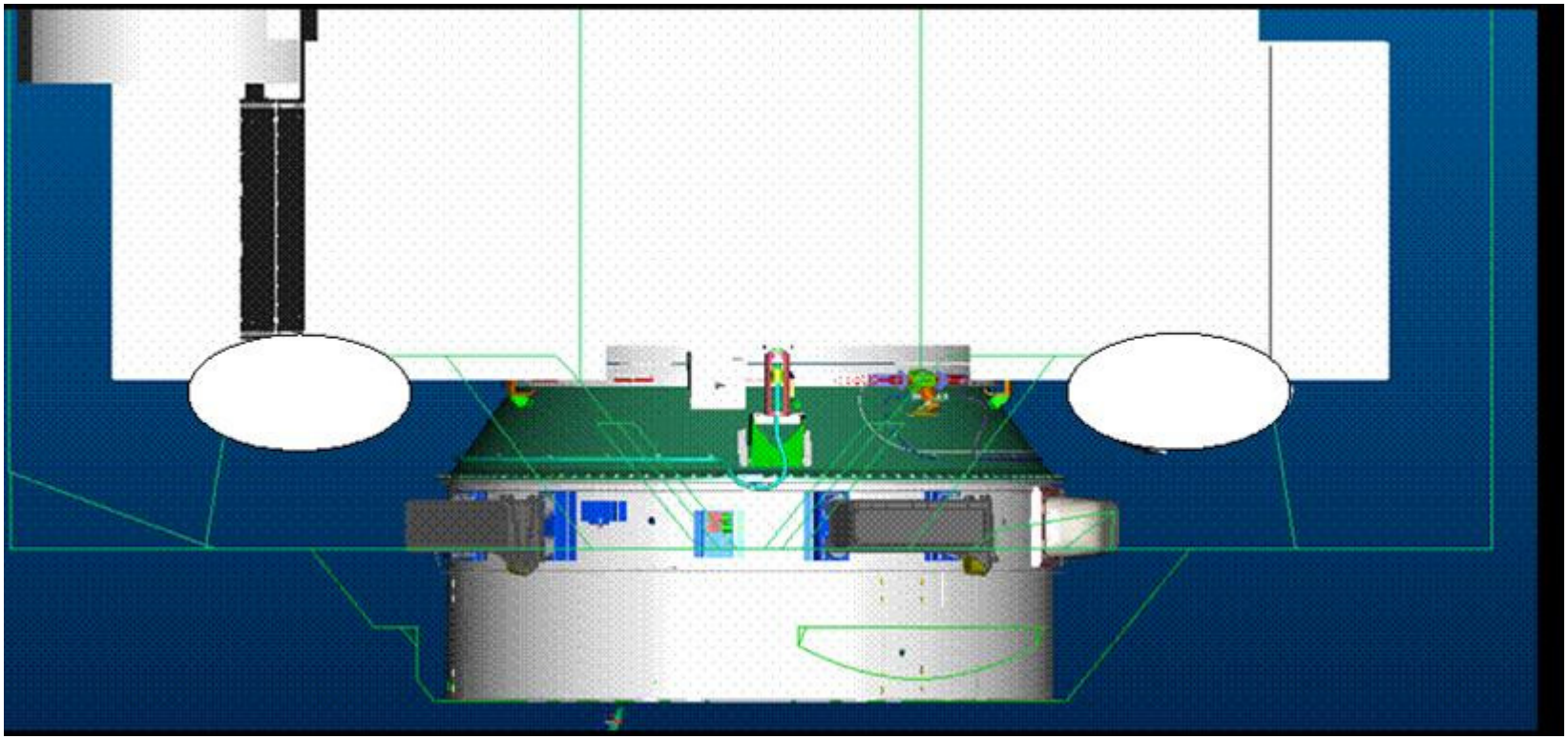
SPC for 100 kg class (Atlas)



- **Simple, flexible solution to fly 4 multiple SPs**
  - Kit-able platforms allow 1 to 4 SPs per flight
  - SP mass for 100 kg w/o test (200 kg design)
  - SP volume of ~76x76x76 cm (30x30x30 in.) or more
  - Stiffened C-29 adapter
  - Structural design and analysis in progress
- **Funded under ELC at present**



Type-C Carrier (TCC) for 35 lbm class



Pico satellite (CubeSat™)

- **4-6 pods per flight**
  - Individual deployment
  - Deployment TLM instr.
  - Kit-able brackets & cabling on C-29 adapter
- **Funded under IRAD**

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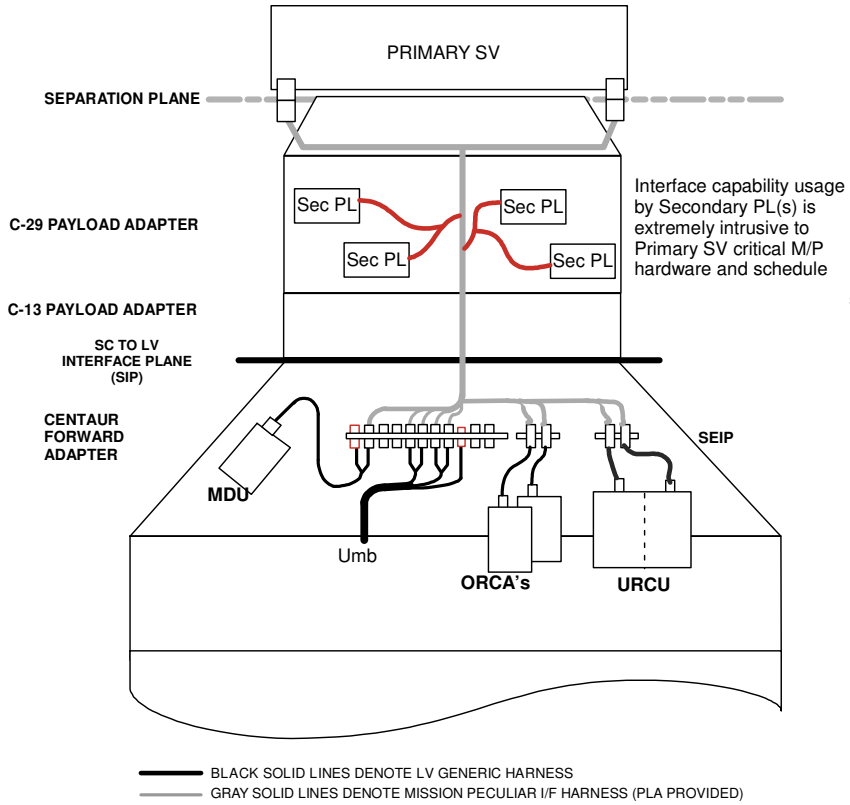
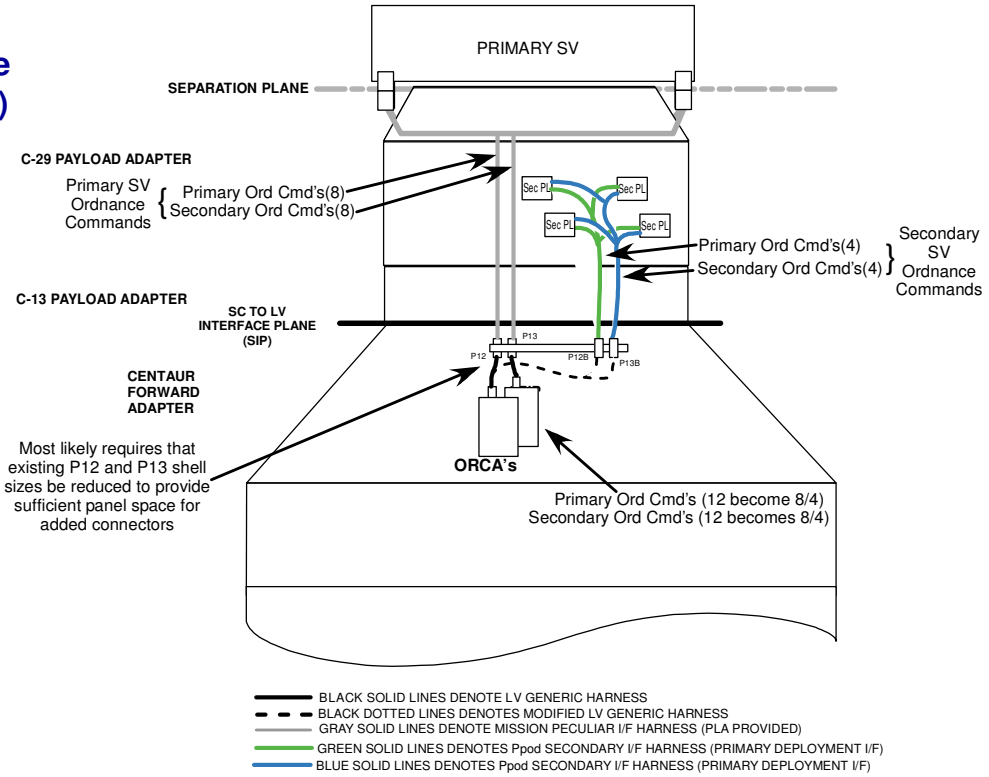
Avionics-SEIP Reallocation for SPs (SPIP)

Current

S/C support is thru the Standard Electrical Interface Panel (SEIP) on the Centaur Forward Adapter (CFA)

Creates a "Christmas-tree" harness w/ SPs





New Block-change

Block Change will "T" separate a portion of the EELV S/C Interface Spec (SIS) to support SPs with the application of "pig-tail" cables.

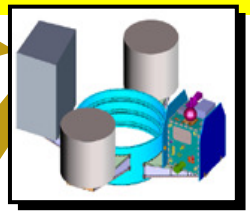
Causes "no change" to the primary S/C harness.

Creates the Small Payload Interface Panel (SPIP)

SP System Integration

NLT L-16 mo SP Mission Feasibility Study → NLT L-13 mo Payload Compatibility Certification → NLT L-10 mo SP Mission Service Award → NLT L-9 mo Combined Mission Integration Kick Off → SPs Receipt for Integration TLYF NLT L-6 mo (L-3 for reflights)

SP Match-mate, & I/F testing in SIL for new H/W

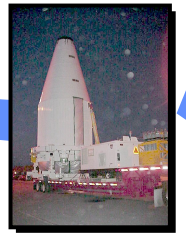


L-24 mo Primary Mission ATP → Primary Payload Receipt at Launch Site → Primary Payload Integration

Start SP integration at Lnch Site, NLT L-1.5 mo

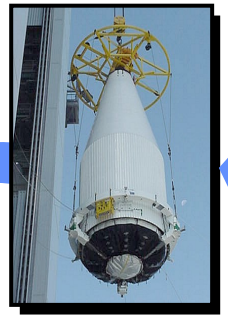
Encapsulate Payloads

PLF Receipt

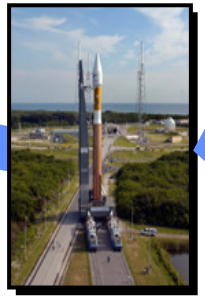


Transport Encapsulated Payloads To VIF

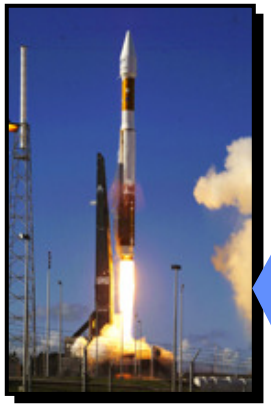
Encapsulated P/L Hoist & Mating Ops



Integrated Launch Vehicle Testing



Roll Vehicle to Launch Pad

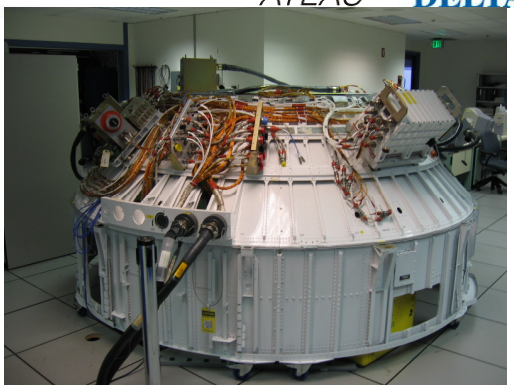


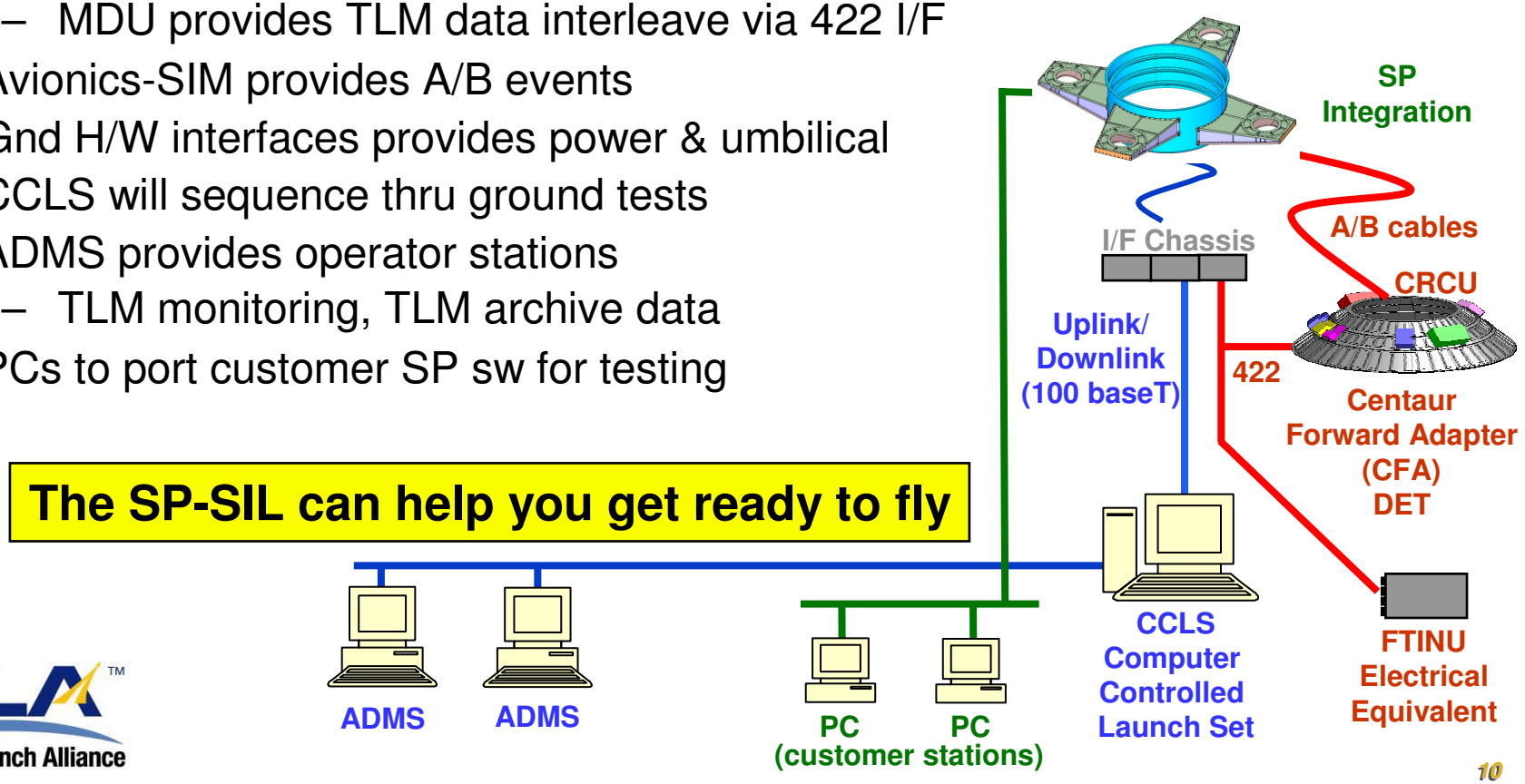
Launch

(NLT – No Later Than)

SP System Integration Lab (SIL)

- To run a SP Integration verification we need to test
  - from the ground system to the SP,
  - from the Atlas Vehicle Avionics to the SP
  - track and analyze TLM from the SP
- The CFA provides all the SP standard cabling
  - electrical I/Fs (power, A/B sequencing) using a CRCU
  - MDU provides TLM data interleave via 422 I/F
- Avionics-SIM provides A/B events
- Gnd H/W interfaces provides power & umbilical
- CCLS will sequence thru ground tests
- ADMS provides operator stations
  - TLM monitoring, TLM archive data
- PCs to port customer SP sw for testing





The SP-SIL can help you get ready to fly

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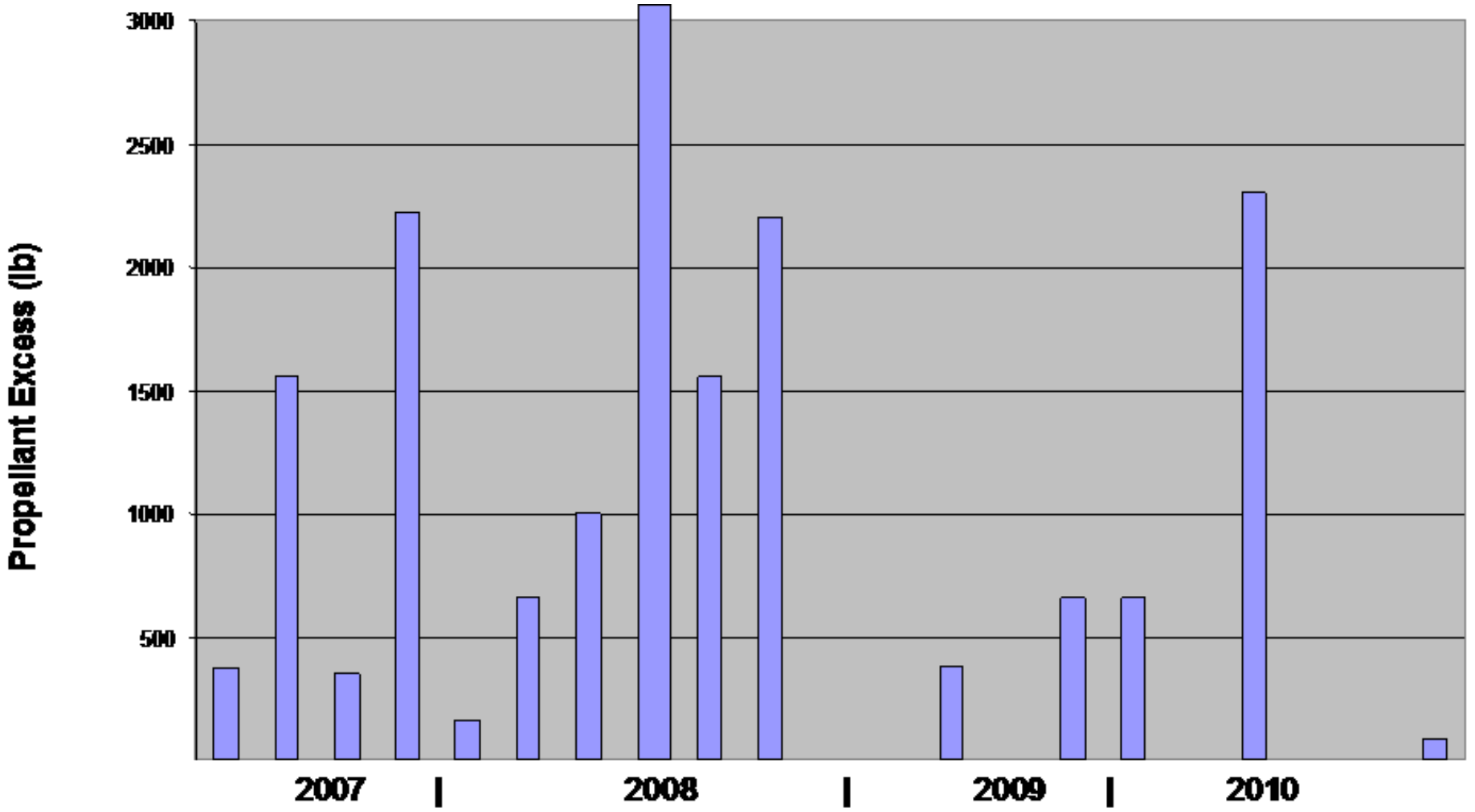
Sample of Mission Margins



- Mission opportunities are available
- Most are GTO, for now
- Carriers are being developed now for ILC in '09