Payload Design Criteria for the Space Test Program Standard Interface Vehicle (STP-SIV)

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Purpose

- Introduction to STP-SIV Program
- Describe STP-SIV Mission Capabilities
- Present Standard Spacecraft to Payload Interface
STP-SIV Introduction

- **Space Development & Test Wing (SDTW) Mission**
  - “develops, tests, and evaluates Air Force space systems, executes advanced space development and demonstration projects, and rapidly transitions capabilities to the warfighter”

- **SIV is a new capability for the SDTW**
  - Moving away from “one-of-a-kind” spacecraft

- **Benefits of standard interface**
  - increase spaceflight opportunities
  - lower cost by minimizing NRE
  - reduce risk for SDTW missions and potential customers
## Spacecraft Capability

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit Altitude</td>
<td>400 – 850 km</td>
</tr>
<tr>
<td>Orbit Inclination</td>
<td>0° – 98.8°</td>
</tr>
<tr>
<td>Launch Mass</td>
<td>≤ 180 kg (ESPA driven)</td>
</tr>
<tr>
<td>SV Stored Volume (cm)</td>
<td>60.9 x 71.1 x 96.5 (ESPA driven)</td>
</tr>
<tr>
<td>Reliability (at 7 months)</td>
<td>0.90</td>
</tr>
<tr>
<td>Stabilization Method</td>
<td>3-axis</td>
</tr>
<tr>
<td>Pointing Modes</td>
<td>Nadir, Sun Pointing, Inertial, Safe</td>
</tr>
<tr>
<td>Attitude Knowledge</td>
<td>0.03° 3σ (goal 0.02° 3σ) +Z</td>
</tr>
<tr>
<td>Attitude Control</td>
<td>0.1° 3σ (goal 0.03° 3σ)</td>
</tr>
<tr>
<td>Bus Voltage</td>
<td>28 V ±6</td>
</tr>
<tr>
<td>Comm Frequency</td>
<td>SGLS</td>
</tr>
<tr>
<td>Command Rate</td>
<td>2 kbps uplink</td>
</tr>
<tr>
<td>Telemetry Rate</td>
<td>2 Mbps downlink</td>
</tr>
<tr>
<td>Data Storage</td>
<td>8 Gbits</td>
</tr>
<tr>
<td>Payload Volume</td>
<td>0.14m³</td>
</tr>
<tr>
<td>Payload Mass</td>
<td>60 kg</td>
</tr>
</tbody>
</table>

![SIV in Stowed Configuration](image-url)
Spacecraft Design

2 fixed arrays
1 gimbaled array
30 A-hr Li Ion battery

Payload Module flexibility reduces cost & schedule for payload accommodation

3-axis control with Star Tracker & GPS
Mechanical Interface

- Accommodates 60 kg of total PL mass
- PIP provides standard mounting grid
- 0.14 m$^3$ Payload Volume
- $3\pi$ steradian unobstructed FOV, $+Z_{PL}$ (nadir), $+X_{PL}$

Payload Interface Plate (PIP)
- 2.54 cm (1") mounting grid

Stowed SIV showing PL volume
Power / Electrical Interface

- 100W orbit average power (OAP), nominal operations
- Each PL is provided 3 switched power feeds
  - Each power feed provides unregulated 28 +/-6 Vdc
- Overcurrent protection for each power feed
  - H/W monitors and disables if current exceeds 5.94 A
  - Software selectable limits can be set < 5.94 A
  - Resettable
Data Interface

- Support four unique PLs
- Same Interface for each PL
- 8 Gbit EDAC for PL Data

Standard Payload Interface

- Each payload provided with identical data services:
  - 1 RS-422 (UART) Command/Message channel
  - 1 RS-422 (UART) Real-Time Telemetry
  - 1 RS-422 (Optional UART or Sync) High Rate Data
  - 8 Analog Inputs to S/C
  - 8 Discrete Inputs to S/C
  - 8 Discrete Outputs from S/C
  - 1 FPS

Power Switching Board
Provides 3x 28V ± 6V to each payload

Spacecraft Integrated Avionics Unit (IAU)
Telemetry and Commanding

- Telemetry and mission data encapsulated in a CCSDS compliant Channel Access Data Unit (CADU)
  - Virtual Channel IDs (V_cid) allow separation of PL data
  - Application IDs (A_pid) identify high rate, real-time, analog, and discrete data
- Payload memory partitions resizable during flight
- Commanding via two types of schedules
  - Real-time schedule = absolute time execution sequence
  - Script schedule = relative time execution sequence
- SC Status message available to PL at 1 Hz
  - Provides SC Ephemeris, Attitude, GPS Time, PIP Temp
Thermal Interface

- PIP accepts up to 100W of PL heat dissipation
- PIP temperature controlled between -9° and +39° C
  - Spacecraft blankets tailored per mission requirements
- Thermostatically controlled heaters
- Four temperature sensors for SOH monitoring
Manifesting Payloads on STP-SIV

- SDTW identifies candidate payloads for STP-SIV
  - DoD Prioritized PL list
  - Reimbursable PLs
- SDTW performs bundling study
  - Identify payloads with compatible mission reqts
- BATC performs more detailed compatibility study
  - Payload to SC
  - Payload to payload
  - Verifies Payload Suite within SC design limits
  - Identify potential mission risk
- Memorandum of Agreement between SDTW and PL
- Signed Space Flight Plan
- For More Information
  - dodstp.rideshare@kirtland.af.mil
Summary

- SIV is a new capability for SDTW
  - Builds on lessons learned from previous STP missions
- SIV defines standards between PLs and SC
  - Mechanical
  - Power / Electrical
  - Thermal
  - Data
- STP-SIV User’s Guide provides detailed interface definition
- Points of Contact
  
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