Small Satellite 2012
Spaceflight Secondary Payload System (SSPS) and SHERPA Tug - A New Business Model for Secondary and Hosted Payloads
Spaceflight Overview

• Spaceflight, Inc. spun off from Andrews Space in 2009

• Our mission is to provide routine low cost access to space by simplifying the launch integration process
  – Standardized interfaces
  – Commercial pricing and services
  – Regular flight opportunities on a range of vehicles

• Signed MOU with Innovative Space Logistics (ISL) in 2011 to provide global network and access to foreign launch opportunities

• Spaceflight currently has eight payloads under contract to launch on four different launch vehicles
  – Antares
  – Soyuz
  – Dnepr
  – Falcon 9
Spaceflight Service Structure

- Arrange launch opportunities for the secondary payload market
- Contract directly with the launch service provider and secondary payload operator
- Provide Mission Management and Integration for all secondary payloads
- Integrate the payloads with the launch vehicle
- Certify the secondary payload for launch
Commercial Mission Pricing

- Spaceflight commercial pricing based on payload size and mass from CubeSats to MicroSats
- Commercial mission pricing from Low Earth Orbit to Low Lunar Orbit

<table>
<thead>
<tr>
<th>Payload Type</th>
<th>1U</th>
<th>3U</th>
<th>6U</th>
<th>12U</th>
<th>24U</th>
<th>8-15 inch</th>
<th>15-24 inch</th>
<th>24 inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (max) cm</td>
<td>10.0</td>
<td>34.0</td>
<td>36.6</td>
<td>36.6</td>
<td>68.0</td>
<td>70</td>
<td>98</td>
<td>125</td>
</tr>
<tr>
<td>Height (max) cm</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>22.6</td>
<td>22.6</td>
<td>30</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Width (max) cm</td>
<td>10.0</td>
<td>10.0</td>
<td>22.6</td>
<td>22.6</td>
<td>22.6</td>
<td>30</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Mass (max) kg</td>
<td>1.0</td>
<td>5.0</td>
<td>10.0</td>
<td>20.0</td>
<td>40.0</td>
<td>70</td>
<td>190</td>
<td>300</td>
</tr>
<tr>
<td>Price – Orbital (LEO)</td>
<td>$125k</td>
<td>$325k</td>
<td>$595k</td>
<td>$995k</td>
<td>$1,795k</td>
<td>$2,950k</td>
<td>$4,950k</td>
<td>$6,950k</td>
</tr>
<tr>
<td>Price – Orbital (GTO)</td>
<td>$250k</td>
<td>$650k</td>
<td>$995k</td>
<td>$1,950k</td>
<td>$2,950k</td>
<td>$5,500k</td>
<td>$7,950k</td>
<td>$9,960k</td>
</tr>
<tr>
<td>Price – Orbital (GSO / LLO)</td>
<td>$490k</td>
<td>$995k</td>
<td>$1,990k</td>
<td>$3,250k</td>
<td>$5,950k</td>
<td>$9,950k</td>
<td>$15,900k</td>
<td>$19,900k</td>
</tr>
</tbody>
</table>
## Launch Availability (as of August 2012)

<table>
<thead>
<tr>
<th>Date (CY)</th>
<th>Orbit</th>
<th>Type</th>
<th>Containerized Payloads</th>
<th>Adapter Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1U</td>
<td>3U</td>
</tr>
<tr>
<td>Q2 2012</td>
<td>250 x 265 km, 51.6°</td>
<td>US</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Q2 2012</td>
<td>650-700 km circular, SSO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Md 2012</td>
<td>550-600 km circular, 65°</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H2 2012</td>
<td>600 x 700-900 km, SSO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H1 2013</td>
<td>600 km circular, 52°</td>
<td>US</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H1 2013</td>
<td>750-800 km circular, SSO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H1 2013</td>
<td>600-800 km circular, SSO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H1 2013</td>
<td>800-850 km circular, SSO</td>
<td>European</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Md 2013</td>
<td>600-700 km circular, SSO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H2 2013</td>
<td>~2000 x 36000 km, GTO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H2 2013</td>
<td>600-700 km circular, 8°</td>
<td>Indian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H2 2013</td>
<td>650-700 km circular, SSO</td>
<td>European</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H2 2013</td>
<td>450-550 km circular, 79°</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Q4 2013</td>
<td>600 x 700-900 km, 97.8°</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H1 2014</td>
<td>600-700 km circular, SSO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H1 2014</td>
<td>400-450 km circular, SSO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H2 2014</td>
<td>450-550 km circular, 79°</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Q3 2014</td>
<td>720 km circular, SSO</td>
<td>US</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Q3 2014</td>
<td>GTO / GSO / LLO</td>
<td>US</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Q4 2014</td>
<td>600 km circular, SSO</td>
<td>US</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H1 2015</td>
<td>600-800 km circular, SSO</td>
<td>Russian</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Q2 2015</td>
<td>600 km circular, SSO</td>
<td>US</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Spaceflight Secondary Payload System (SSPS)

- Spaceflight is developing a common Spaceflight Secondary Payload System (SSPS) that can fly on a range of EELV-class launch vehicles.
- Derived from a five port ESPA Grande ring to provide launch for up to 300 kg spacecraft.
- Uses a series of external adapters to carry a wide range of payloads.

ESPASpacecraft

ESPA Grande Ring (42” Height)

TBD NanoSats

DecaPODs (10x 3Us each)

ESPA Class Spacecraft (15 inch Lightband)

Includes sequencer, data recorder, cameras and telemetry system to operate SPSS.
• Spaceflight, working with its launch services provider, has developed initial payload integration flows and timelines.
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- **Secondary Payloads Integrated with SSPS Shelf**
  - Mechanical Interface Checks
  - Electrical Interface Checks

- **Install Privacy Cover** (if required)
  - Mechanical Interface Checks
  - Electrical Interface Checks

- **Install Shelf to SSPS Ring**
  - Mechanical Interface Checks
  - Electrical Interface Checks

- **SSPS Functional / Modal Testing**
  - Full Electrical Interface Checks
  - RF Testing
  - EMI/EMC Testing
  - Mission Simulation
  - Modal Testing

- **~4 weeks of buffer**

- **Mate SSPS and Primary Payload**
  - Mechanical Interface Checks
  - Electrical Interface Checks

- **Payload Encapsulation / LV Mate**
  - Mechanical Interface Checks
  - Electrical Interface Checks

- **LV Flight Readiness Review**
  - ARM spacecraft
  - Battery trickle charging
  - Verify RF compatibility

- **PLF Closeout & Countdown Operations**
**SHERPA Introduction**

- SHERPA leverages the Spaceflight Secondary Payload System (SSPS) to incorporate a propulsion system, solar arrays and ADCS (e.g. reaction wheels, star tracker)

- SSPS slated for first flight in 2013 on Falcon 9

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Antares</td>
<td>F9</td>
<td>F9</td>
<td>F9</td>
</tr>
<tr>
<td></td>
<td>SSPS Q1 2013</td>
<td></td>
<td>SHERPA Demo Q4 2013</td>
<td>SHERPA Com’l Q4 2014 / Q2 2015</td>
</tr>
</tbody>
</table>

Provider of Routine Low Cost Access to Space
SHERPA Performance

- Spaceflight / Andrews is developing two versions of SHERPA:
  - SHERPA 400 targeted towards LEO missions
  - SHERPA 2200 is capable of 2200 m/s of deltaV to support GTO to GEO missions, as well as deep space missions

- SHERPA Supports:
  - Payload repositioning
  - Hosted payloads for up to one year mission duration

- Contact Spaceflight to learn more about SHERPA’s capabilities to meet your mission requirements
SHERPA Exploded View

- SHERPA is a modular vehicle that leverages SSPS systems and components.

LLB 62.010 lower half

Avionics Deck
- GN&C (flight computer, etc.)
- ADCS (RWAs, star trackers, IMU, etc.)
- EPS (battery, solar panel, etc.)
- telemetry & communications
- payload interfaces (RS422, power, etc.)

Custom ESPA Ring

Propulsion Deck
- Propellant and pressurant tanks
- Primary thrusters
- RWA de-spin thrusters

LLB 62.010 upper half
SHERPA Services

- SHERPA provides power, data and communications services to payloads to support hosted and deployed payloads.
Summary

• Recent accomplishments:
  – Launch Service Agreements with Orbital Sciences, Progress, Kosmotras and SpaceX
  – Payload Delivery Agreements with NASA Ames, Commercial Customers and the USAF Space Test Program
  – Development of Spaceflight Secondary Payload System to standardize launch integration approach and provide additional flexibility for secondary payloads
  – Development of SHERPA tug to expand mission flexibility with first flight targeted for 2014 to Sun Synchronous Orbit
  – Payload User’s Guide (Rev C) recently released with additional mission integration information
www.spaceflightservices.com