

Headquarters U.S. Air Force

Integrity - Service - Excellence

ORS-5 System Acquisition Successes and Regrets



**Colonel Shahnaz M. Punjani
Space Rapid Capabilities Office**

August 2018

U.S. AIR FORCE



U.S. AIR FORCE

ORS-5 OV-1

Mission Objectives

- Provide continuous GEO SSA from LEO platform
- Risk Reduction for SBSS Follow-On
- Demonstrate ORS principles



- Innovative use of Time Delayed Integration (TDI) technology to maximize search volume
- Continuous un-cued rapid GEO belt search to detect new insertions/changes and provide precise regional awareness
- Baffle design reduces solar gap
- Uses Multi-Mission SOC (MMSOC) Ground System Architecture for mission control
- OPAL Mission Processing

pointing angle



AFSCN



End Users:
USSTRATCOM (NSDC)
JFSCC (JSpOC & 18 SPCS)
NASIC

Low-Cost Launch Service





ORS-5 Background

U.S. AIR FORCE

- Continuous non-taskable GEO belt search to provide space situational awareness
- Equatorial, 600 Km altitude
- 3 Year Design Life
- Class “C” operational demo with Medium Risk
- 120 Kg satellite built by MIT/LL
- Minotaur IV launch vehicle built by Orbital-ATK
- MMSOC 2.1 ground system built by Lockheed Martin



Autonomous Operations, Low Cost Launch, Expedited Acquisition



U.S. AIR FORCE

Space Vehicle

- **October 2013: USSTRATCOM tasked ORS Office to develop solution options to satisfy urgent Space Situational Awareness need**
- **February 2014: ORS EXCOM approved program**
- **June 2014: USSTRATCOM approves requirements**
- **June 2014: Contract awarded to MITLL**

- **Balancing technical risk with schedule**
 - Flight software development
 - System Capability Demonstration
 - Rigorous engineering unit testing
 - FlatSat flight vehicle test bed



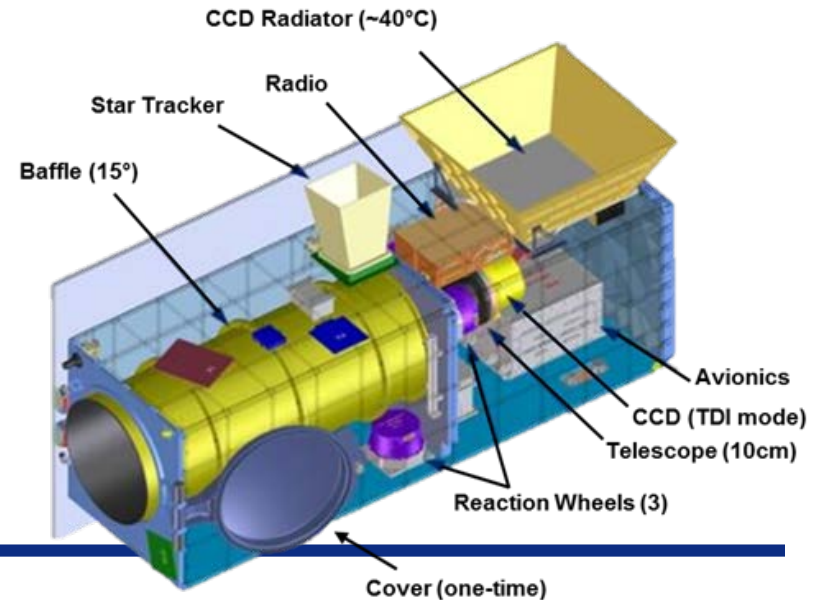
ORS-5 Prior to 26 Aug 2017 Launch



Space Vehicle Successes

U.S. AIR FORCE

- Stable requirements baseline ensured developers stayed on track
- Pathfinders for the integration and test campaign were instrumental to maintain schedule
- The Engineering Design Unit was key in identifying issues in spacecraft design
- FlatSat allowed quick mitigation of flight software discrepancies and user interface issues





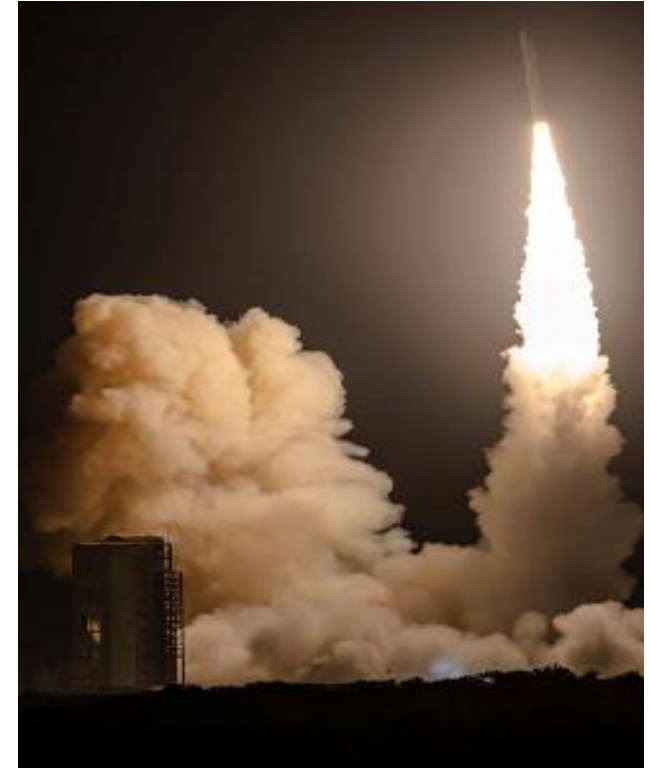
U.S. AIR FORCE

Launch Service

- Utilized commercial launch services with fixed price contract
- First Minotaur IV launch at Cape Canaveral
- Launched from Launch Complex-46
 - First use in nearly 20 years
 - Space Florida led refurbishment
- Pathfinder in Feb 2017
 - Refined launch and safety procedures
 - Developed lightning mitigation procedures
- Successfully launched SV on 26 August



SPACE FLORIDA





Space Vehicle/Launch Vehicle Integration

U.S. AIR FORCE





Launch Vehicle Successes & Regrets

U.S. AIR FORCE

Successes:

- **On time launch at low cost**
- **Flexible and motivated team allowed for launch vehicle processing outside of normal work hours**
- **Team overcame last minute obstacles in order to ensure an on-time launch**

Regrets:

- **Better communication with launch range could have mitigated lightning and interface issues**
 - **Roles/responsibilities between program office, contractors, range, safety were not well defined**
 - **Did not bring in 45 Launch Group to act as a liaison to the range and safety office**
 - **Lightning protection system would have reduced launch vehicle processing risks**
-



U.S. AIR FORCE

Ground System

- **First use of Multi-Mission Space Operations Center (MMSOC) 2.1**
- **Multiple concurrent developments with ground systems at Kirtland and Schriever AFB as well as ORS-5 mission unique software**
- **Compatibility testing done later**
- **Launch and Early Orbit activities flown at Kirtland AFB**
- **Delayed Schriever transition due to hardware/software development issues**





Ground System Successes and Regrets

U.S. AIR FORCE

Successes:

- **Alternate Factory Compatibility Test (FCT) approach allowed a commanding test to meet schedule constraints**
- **MMSOC 2.1 developments on ORS-5 set the success for future Air Force spacecraft missions**

Regrets:

- **Concurrent development on all software platforms increased timelines for integration**
 - **Small, geographically separated software teams not often available for integration activities**
 - **Not streamlining integration through the RSC suites**
 - **Long-line requirements and process not fully understood by all stakeholders**
-



U.S. AIR FORCE

Operations

- **SMC/AD and LinQuest provided training and initial training at Kirtland AFB**
- **Launch and Early Orbit ops at Kirtland AFB with 1st Space Operations Squadron (1 SOPS) crews and SMC contractors**
- **Mission transition delays to Schriever due to hardware and software changes impacted ability to use mission data**
 - **Increased contractor ops timeline at Kirtland**
- **1 SOPS currently operating ORS-5 at Schriever AFB**





Operations Successes and Regrets

U.S. AIR FORCE

Successes:

- **RSC contractor operators adapted and supported increased requirements for training and procedure development**
- **Operators made successful first contact with the spacecraft**
- **Automation development mitigated operator manning challenges**
- **Operator buy in and trust enabled successful Launch & Early Orbit (L&EO) and Operational Test (OT)**

Regrets:

- **Impacts to the change in operational squadron not fully assessed**
 - **Lack of secure data line at Kirtland AFB delayed early use of data to customer**
 - **Processes and procedures were not delivered in time to support early training sessions as it was still unknown how the system would operate**
 - **Expectation management and risk acceptance at senior operator level**
 - **Different configurations between the RSC and SAFB**
-



Mission Capability

U.S. AIR FORCE

- **Performs autonomous scan of Geo-belt once every 104 minutes**
- **Provides data to 18 Space Control Squadron, National Air and Space Intelligence Center (NASIC), and National Space Defense Center (NSDC)**
- **Meets current Space-Base Surveillance System (SBSS) Blk 10 sensitivity performance at GEO**
- **Geo RSOs collected at a variety of phase angles allowing for additional pattern of life analysis**
- **Rapid revisit of RSOs supports change detection for SSA I&W**
- **Orbital geometry allows for minimal sun-exclusion compared to other space based SSA sensors**



Stakeholder Successes and Regrets

U.S. AIR FORCE

Success:

- **Set the template for developing and transitioning future operational prototype systems**

Regrets:

- **HQ guidance to expedite demonstration/prototype mission onboarding was insufficient**
- **Stakeholders not of the same risk mindset for small programs**
- **Tailoring needs to be approved at appropriate levels and continued through personnel changes**



U.S. AIR FORCE

Conclusions

- It's all about the data
- Consider the number of variables
- Tailoring needs to stick
- Cultural mindset for small satellites needs to change
- Balance the high risk with the exquisite
- Provides tipping and cueing information to the warfighter
 - IOC: May 2018

