



Commercial Orbital Transportation Services (COTS) Lessons Learned



Emerging Commercial Suborbital Capabilities Workshop

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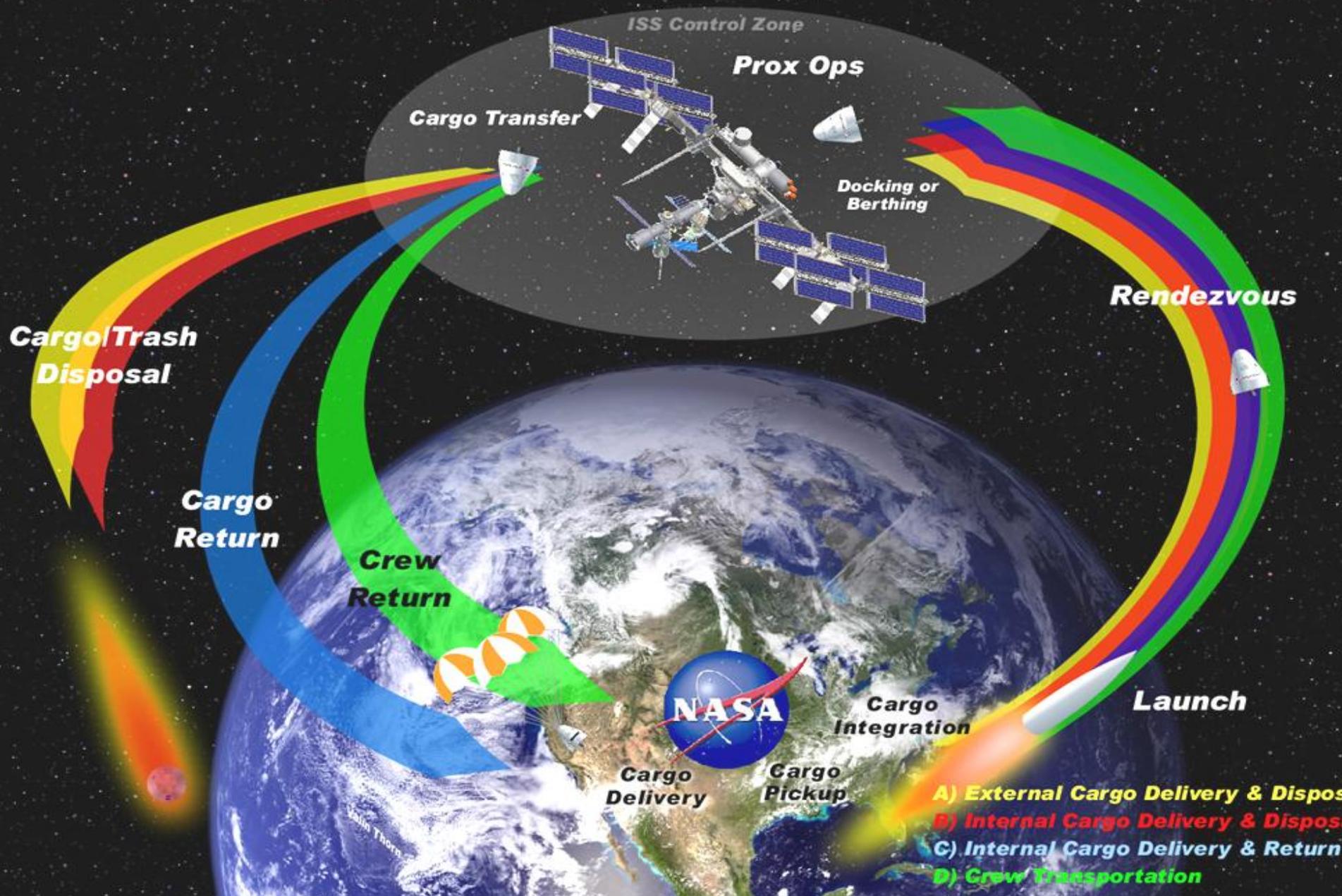
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Commercial Orbital Transportation Services (COTS) Overview



- Commercial Crew and Cargo Program established in November 2005.
 - Implement U.S. Space Exploration policy with investments to stimulate commercial space industry
 - Facilitate U.S. private industry development of cargo and crew space transportation capabilities with goal of achieving safe, reliable, cost effective access to low-Earth orbit
 - Create market environment where commercial space transportation services are available to Government and private sector customers
- \$500M initially budgeted in FY 2006-FY2010 as investment.
 - First round competition for funded Space Act Agreements (SAAs) awarded August 2006
 - SpaceX awarded \$278 million
 - Rocketplane Kistler awarded \$208 million (terminated October 2007 for failure to meet milestones)
 - Second round competition awarded February 2008
 - Orbital Sciences Corporation awarded \$170 million
- An additional \$300M was budgeted in FY11 for new milestones to reduce NASA's risk; \$118M awarded to each SpaceX and Orbital Sciences.

NASA Commercial Crew/Cargo Project Commercial Orbital Transportation Services



- A) External Cargo Delivery & Disposal
- B) Internal Cargo Delivery & Disposal
- C) Internal Cargo Delivery & Return
- D) Crew Transportation

SpaceX COTS System



- Falcon 9 Launch Vehicle with Merlin 1C 9-engine first stage and Merlin-Vac second stage
- Dragon Spacecraft will provide pressurized and unpressurized cargo delivery **and return**
- Cape Canaveral LC-40 Launch Site
- Space Act Agreement awarded August 2006 and amended in May 2011 for milestone payments up to \$396M
- December 8, 2010 - Successfully completed their first COTS demonstration mission which launched the Dragon, completed two orbits, and was safely recovered
- Next COTS demonstration mission is scheduled for later this year



Falcon 9



Dragon



Launch Site at Cape Canaveral SLC 40

Orbital COTS System



- Taurus II Launch Vehicle with Aerojet AJ-26 engines (2) & Castor® 30 2nd stage
- Cygnus Spacecraft will provide pressurized cargo delivery and disposal
- Mid-Atlantic Regional Spaceport (MARS) at the NASA Wallops Flight Facility (WFF) Launch Site
- Space Act Agreement awarded February 2008 and amended in December 2011 for total payments of \$288M
- Taurus II maiden flight demonstration mission is scheduled for later this year followed by a berthing demonstration mission to ISS early next year



Taurus II



Cygnus



MARS/Wallops Launch Site

Acquisition Approach



- NASA's plan was to ultimately purchase *commercial* transportation services, as opposed to a Government developed capability.
- Acquisition Planning Team researched the Federal Acquisition Regulations (FAR) and other U.S. laws and policies for guidance on how to structure the acquisition.
- Dialoged with industry on strategy, received positive and constructive feedback from industry endorsing the proposed new acquisition approach.
- Team decided to pursue the acquisition of commercial space transportation capabilities in two phases.
 1. The first phase included development and demonstration of transportation capabilities – COTS. Space Act Agreements were used.
 2. The second phase included purchasing end-to-end ISS cargo delivery services – Commercial Resupply Services (CRS). FAR Part 12, firm-fixed contracts were used. SpaceX awarded 12 missions for \$1.6B and Orbital Sciences awarded 8 missions for \$1.9B.

Space Act Agreements (SAA's)



- Most of the terms and conditions of the COTS SAAs were specially crafted to optimize the *commercial* development nature of the agreements for the mutual benefit of NASA and the partners.
 - NASA defines the needs, reliability, and safety expectations of the transportation system
 - Commercial companies define the concept of operations and all of the detailed requirements and specifications for the entire system
 - NASA becomes a true partner in the commercial venture, providing specific expertise, lessons learned, and other requested information
- The ability to customize the agreements for these specific purposes is perhaps the single largest advantage of the SAA
- The primary purpose of the COTS agreements is to stimulate the commercial space industry to develop and demonstrate space transportation capabilities. The agreements are for demonstrations and not for the acquisition of goods or services. This distinction is key in enabling the use of SAAs.

Advantages of the COTS Partnership



1. Enables a portfolio investment in multiple, diverse commercial partners.
2. Leverages NASA investment with additional company provided capital.
3. Enables known/limited cost risk using pay for performance milestones.
4. Mitigates cost impacts due to evolving requirements.
5. Enables streamlined/flexible acquisition process.
6. Simplifies program management/oversight with objective milestone success criteria.
7. Minimum requirements encourage innovation and enables reduced/appropriate level of NASA oversight/insight.
8. Maximizes incentive to hold cost and schedule.
9. Commercial friendly intellectual/physical property and data rights.
10. Limited termination liability.
11. FAA licensing/liability/indemnification/enforcement.

Some Lessons Learned



- In October 2007, NASA terminated its \$207 million SAA with Rocketplane Kistler (RpK) for failure to meet milestones just over a year after award
 - RpK could not meet its aggressive financing plan
 - No termination liability associated with cancelling the SAA
- NASA does not have the statutory authority to transfer Government Furnished Equipment (GFE) under the SAA.
 - It is difficult to determine, at the beginning of the development effort, all the potential equipment that may be required by the partners
 - NASA can loan government equipment, under certain conditions
- NASA saw significant growth in service prices from those projected in the COTS proposals to those finally negotiated in the CRS contracts.
 - If possible, it is advisable to wait until further into development (or post development) to purchase services
 - Having the COTS and CRS contracts work in parallel, will enable the delivery of cargo sooner than if the efforts had been conducted serially
- NASA allowed the commercial partners to set very aggressive schedules which have not been met.

COTS Partnership Summary



- The COTS model for public-private partnerships is fundamentally different than traditional Government contracting in many ways.
- Our partners are continuing to make progress in developing and demonstrating their space transportation capabilities.
 - Two new launch vehicles
 - Two new spacecraft
 - Launch and ground systems
- Modest investment by NASA compared to traditional approaches.
- Enabled development of globally competitive launch vehicles, reducing flight costs to government and commercial customers – could provide researchers lower cost access to space.
- Partnership fundamental to success.

Commercial Spaceflight Development



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- Link to COTS Space Act Agreements (SAA's) -
<http://www.nasa.gov/centers/johnson/news/contracts/cots.html>