Commercial Orbital Transportation Services (COTS) Demonstrations

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National Aeronautics and Space Administration
National Direction

• National Space Exploration Policy/Vision for Space Exploration, Jan 2004
  – [The United States will] Promote…
    commercial participation in exploration…
    to further U.S. scientific, security, and economic interests.
  – [The NASA Administrator will] Pursue
    commercial opportunities for providing transportation
    and other services supporting the International Space Station
    and exploration missions beyond low Earth orbit.

• NASA Authorization Act of 2005
  – The Administrator shall establish a program to develop a sustained human presence on the Moon…
    to promote exploration, science, commerce…
  – The Administrator… shall develop a commercialization plan to support the human missions to the Moon and Mars, to support low-Earth orbit activities…

• NASA Administrator Mike Griffin,
  American Astronautical Society, Nov. 15, 2005
  – If we are to make the expansion and development of the space frontier an integral part of what it is that societies do, then these activities must, as quickly as possible, assume an economic dimension as well… To this end, it is up to us at NASA to use the challenge of the Vision for Space Exploration to foster the commercial opportunities which are inherent to this exciting endeavor.
NASA ISS Obligations

• Need
  – NASA has an immediate and long term obligation to service the International Space Station (ISS)

• Status
  – Vision for Space Exploration to retire Space Shuttle by 2010 results in using remaining flights for ISS assembly, plus one flight possibly for Hubble Space Telescope
  – Baseline barter and purchase agreements for International Partner space transportation capabilities (Progress, Soyuz, ATV, HTV) are no longer sufficient to meet projected ISS operational needs
  – There is a shortfall and gap in accommodating ISS resupply needs until CEV and cargo variants become available by 2014

• Solutions
  – Commercial transportation services is the preferred approach if proven reliable and cost effective
  – CEV and foreign purchases of space transportation capabilities are alternatives to meeting service obligations to ISS if commercial services are unavailable
Program Objectives

• The Commercial Crew & Cargo Program Office (C3PO) has been established at the Johnson Space Center to implement Phase I of the COTS Project

• The specific objectives are:
  – *Implement U.S. Space Exploration policy with an investment to stimulate commercial enterprises in space*
  – *Facilitate U.S. private industry demonstration of cargo and crew space transportation capabilities with the goal of achieving reliable, cost effective access to low-Earth orbit*
  – *Create a market environment in which commercial space transportation services are available to Government and private sector customers*
$500M budgeted in FY06-FY10 as investment for demonstration of commercial orbital transportation capabilities

COTS Project executed in two phases:
- Phase 1: Technical Development/Demonstration funded Space Act Agreements (SAA)
- Phase 2: Competitive Procurement of Orbital Transportation Services

Phase 1 competition executed Jan-Aug 2006

Phase 1 SAAs include option for crew transportation demonstrations
- Pending successful cargo demonstrations and additional NASA funding

COTS Phase 1 is NOT a procurement or contract for products and services – It is NASA’s catalyst for technology demonstrations where the potential high return on investment outweighs the associated financial risk
NASA Commercial Crew & Cargo Program

Commercial Orbital Transportation Services

Potential ISS Market
$300-700M/year
Innovative Features

• Phase 1 Competition
  – Utilize NASA’s Space Act authority vs. FAR contract
  – Emphasize management team skills vs. company past performance
  – Business plan and financial criteria similar to private investment models
  – Broadly targeted technical goals for the general space transportation market
    ▪ Firm requirements/processes where necessary for ISS certification and human safety
  – Encourage private investment to enable multiple awards and maximize coverage

• Space Act Agreement
  – Companies retain maximum rights to intellectual and personal property allowed by law
  – FAA licensing and cross-waiver liability provisions
  – Fixed-price performance milestone payments
    ▪ Series of incremental milestones based on objective criteria
  – Restricted termination provisions
COTS Participants

- Received 21 proposals from 20 companies across the full spectrum of industry
- Down selected to 6 companies for final evaluation and negotiations
  - Andrews Space
  - SpaceDev
  - SPACEHAB
  - Transformational Space Corp. (t/Space)
  - Space Exploration Technologies (SpaceX)
  - Rocketplane-Kistler (RpK)
- Discussions with COTS participants are ongoing for NASA technical assistance via potential unfunded SAAs

Funded Space Act Agreement

Funded Space Act Agreement
SpaceX COTS Concept

Description:
- Falcon 9 Launch Vehicle
- Dragon Crew/Cargo Spacecraft

Proposed Features:
- Flexible crew and cargo configurations
- Recoverable launch vehicle and spacecraft
- Capability A/B/C demonstration planned for completion by September 2009

NASA Investment:
- Capabilities A/B/C - $278 M
- Capability D Option - $308 M
SpaceX Milestone Highlights

- **FY06**
  - Program Management Plan/Kickoff
- **FY07**
  - System Requirements Review
  - Preliminary Requirements Review
  - Financing Round
  - Critical Design Review
- **FY08**
  - Financing Round
  - System/Design/Test/Readiness Reviews
  - Orbital Test Flight 1
- **FY09**
  - Delta System/Design/Test/Readiness Reviews
  - Orbital Test Flight 2
  - Orbital Demonstration Mission to ISS
Rocketplane Kistler COTS Concept

Description:
- K-1 Launch Vehicle
- Orbital Vehicle
- Pressurized/Unpressurized Cargo/Crew Modules

Proposed Features:
- Reusable launch and orbital vehicles that return
- Modular crew and cargo configurations
- Launch site

NASA Investment:
- Capabilities A/B/C - $207 M
- Capability D Option - $200 M
- demonstration planned for Modular crew and cargo configurations
- Reusable launch and orbital vehicles that return
- K-1 Launch Vehicle
- US ISS mod and K-1 Launch Vehicle
- OV/CM berths with
- Launch site for low-cost operation and
- Minimum on-pad time
- Launch site for reprocessing and
- reprocessing
- LAP Returns to
- Liftoff
- Ascent
- OV travels to ISS

Ascent
- OV to reprocess & relaunch
- Capabilities A/B/C
- OV to relaunch & relaunch
- OV to processing & relaunch
- OV to processing & relaunch
Rpk Milestone Highlights

- **FY06**
  - Program Management Plan/Kickoff
  - Financing Round
- **FY07**
  - System Requirements Review
  - Financing Round
  - Critical Design Reviews
- **FY08**
  - Financing Round
  - System/Design/Test/Readiness Reviews
  - Launch Vehicle Complete/Ship
  - Certification of Flight Readiness
- **FY09**
  - Risk Reduction Orbital Test Flight
  - Orbital Demonstration Mission to ISS (internal/pressurized)
  - Orbital Demonstration Mission to ISS (external/unpressurized)
COTS Flight Demonstrations

- **Cargo Demo Flight 1 to ISS (Jan)**
- **Cargo Demo Flight 2 to ISS (Mar)**
- **Pre Demo Flight 1 Risk Reduction Flight (Nov)**
- **Cargo Demo Flight 3 to ISS (Sep)**
- **Crew Demo Flight 1 (Jun)**
- **Crew Demo Flight 2 (Dec)**
- **Crew Demo Flight 3 (Apr)**

**Timeline:**
- **2007**
  - Cargo Demo Flight 1 (Sep)
  - Pre Demo Flight 1 Risk Reduction Flight (Nov)
- **2008**
  - Cargo Demo Flight 2 (Jun)
  - Cargo Demo Flight 3 to ISS (Sep)
  - Crew Demo Flight 1 (Jun)
  - Crew Demo Flight 2 (Dec)
- **2009**
  - Cargo Demo Flight 1 to ISS (Jan)
  - Crew Demo Flight 3 (Apr)
- **2010**
  - Cargo Demo Flight 2 to ISS (Mar)
- **2011**
- **2012**

**Milestones:**
- Funded Milestone
- Optional Milestone
Summary

• U.S. space policy directs pursuit of commercial opportunities for providing transportation and other services low Earth orbit and beyond
• COTS Project established to implement policy
• COTS strategy
  – Phase 1 -- Assist industry with system development/demonstrations (COTS Demos)
  – Phase 2 – Procure commercial services for ISS logistics support
• COTS Demonstrations competition completed in 10 months
• Two industry partners selected for funded Space Act Agreements
  – SpaceX & Rocketplane-Kistler
  – Unfunded Space Act Agreements in work with other competitors
• COTS budget of $500 M thru 2010, with pay for performance milestone approach
• Cargo flight demonstrations planned for 2008 and 2009
  – Crew flight demonstration options for 2011-2012
• Commercial cargo transportation services potentially available as early as 2009-2010
• Successful COTS partners may open new space markets and provide reliable, cost effective cargo and crew transportation services - a new era for commercial space