



# Commercial Crew and Cargo Program

## Commercial Orbital Transportation Services

### Overview

Through a revolutionary program begun in 2006, NASA's Commercial Crew and Cargo Program is investing financial and technical resources to stimulate efforts within the private sector to develop and demonstrate safe, reliable, and cost-effective space transportation capabilities. In a multiphase strategy, the program is helping spur the innovation and development of new spacecraft and launch vehicles from the commercial industry, creating a new way of delivering cargo – and possibly crew – to low-Earth orbit and the International Space Station.



As NASA sets its sights on exploring once again beyond low-Earth orbit, the ability for private industry to take on the task of providing routine access to space and the International Space Station is of vital importance. NASA's Commercial Crew and Cargo Program is the catalyst for this expanding new industry.

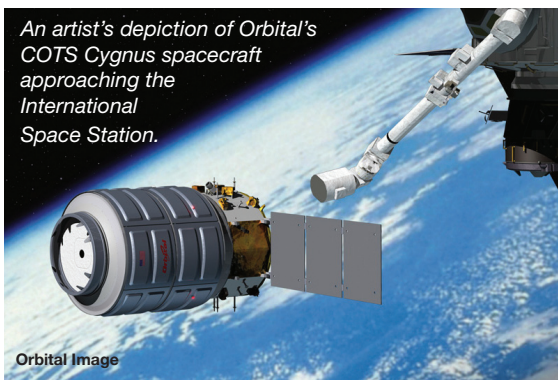
The first phase of this strategy is known as Commercial Orbital Transportation Services (COTS). Under COTS, NASA is helping commercial industry develop and demonstrate its own cargo space transportation capabilities to serve the U.S. government and other potential customers. The companies lead and direct their own efforts, with NASA providing technical and financial assistance.

NASA is investing approximately \$500 million toward cargo space transportation demonstrations. A unique aspect of the COTS program is that the companies are paid incrementally as they reach certain milestones. This encourages steady progress toward their goals.

COTS was created with four different capabilities that companies could pursue:

- Capability A: External/unpressurized cargo delivery and disposal
- Capability B: Internal/pressurized cargo delivery and disposal
- Capability C: Internal/pressurized cargo delivery and return
- Capability D: Crew transportation (currently not funded)

Two companies have funded COTS agreements with NASA: Space Exploration Technologies (SpaceX) and Orbital Sciences Corporation (Orbital). Since their competitive selection, these two companies have been working vigorously to develop technologies and capabilities to complete orbital space flight demonstrations in 2010 and 2011. The International Space Station Program has already purchased future cargo delivery services from both of these companies to resupply the station through 2015.



NASAfacts



## Orbital Sciences Corporation

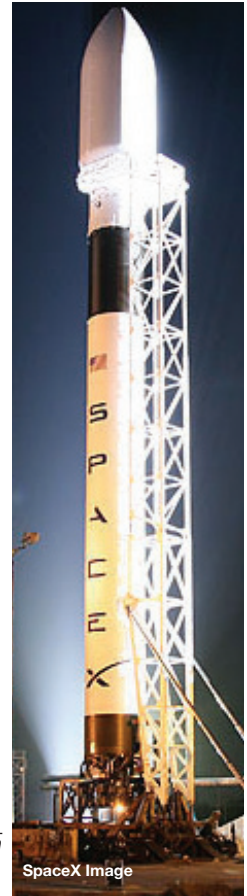
Just 100 miles up the coast from where the Wright brothers first flew their airplane at Kitty Hawk, North Carolina, Orbital is planning to launch its new COTS system at the Mid-Atlantic Regional Spaceport (MARS), located at NASA's Wallops Flight Facility in Virginia. Founded in 1982 with the goal of making space technology more affordable, accessible, and useful, Orbital has grown to become a leading developer and manufacturer of space and rocket systems. Its COTS system design is based on the new Taurus II rocket with a liquid oxygen (LOX)/kerosene (RP-1) first stage powered by two Aerojet AJ-26 engines. The Taurus II second stage is ATK's Castor 30 solid propellant motor derived from their flight-proven Castor 120. The spacecraft, known as Cygnus, is derived from Orbital's heritage DAWN and STAR spacecraft projects and International Space Station cargo carriers.

*An artist's depiction of Orbital's Taurus II rocket on MARS launch pad.*

## Space Exploration Technologies (SpaceX)

At Florida's Cape Canaveral, within sight of where every NASA human spaceflight mission has launched, SpaceX is planning to launch its new COTS system. Established in 2002, SpaceX is well into the development of a new family of launch vehicles, and has already established an extensive launch manifest. SpaceX is based on the philosophy that simplicity, low cost, and reliability go hand in hand. SpaceX personnel have a rich history of launch vehicle and engine experience, and are developing their Dragon cargo and crew capsule and the Falcon family of rockets from the ground up, including main- and upper-stage engines, cryogenic tank structure, avionics, guidance and control software, and ground support equipment. SpaceX launch vehicles and spacecraft are designed for refurbishment and reuse that, if successful, would make them the world's first fully reusable launch vehicles.

*An image of SpaceX Falcon 9 rocket on Pad 40 at Cape Canaveral, Florida.*



## By the Numbers

### Launch Vehicle

	Orbital Taurus II	SpaceX Falcon 9
Height	40.1 m	48.1 m
Diameter	3.90 m	3.66 m
Mass at Launch	275,000 kg	313,000 kg
Payload to International Space Station Orbit	5,200 kg	9,800 kg
First Stage		
Thrust	3.45 MN (775,000 lbs)	3.80 MN (854,000 lbs)
Propellant	LOX and RP-1	LOX and RP-1
Second Stage		
Thrust	320 kN (72,000 lbs)	414 kN (93,000 lbs)
Propellant	Solid propellant	LOX and RP-1

### Cargo Spacecraft

	Orbital Cygnus	SpaceX Dragon
Height	5.1 m	5.1 m
Diameter	3.05 m	3.66 m
Maximum Pressurized Cargo		
Up Mass / Volume	2,000 kg / 18.75 m <sup>3</sup>	3,310 kg / 6.8 m <sup>3</sup>
Down Mass / Volume	2,000 kg / 18.75 m <sup>3</sup> Disposed	2,500 kg / 6.8 m <sup>3</sup>
Maximum Unpressurized Cargo		
Up Mass / Volume	0	3,310 kg / 14 m <sup>3</sup>
Down Mass / Volume	0	2,600 kg / 14 m <sup>3</sup> Disposed

Reflects configurations of the first resupply missions to the International Space Station.

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FS-2009-06-009-JSC