Commercial Cargo Operations for the ISS

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- Under the joint NASA / Orbital Commercial Orbital Transportation Services (COTS) program, Orbital has developed the “Cygnus” Advanced Maneuvering Space Vehicle, Which is Designed to Meet the Stringent Safety Requirements for International Space Station (ISS) Operations.
  - Developed through Space Act Agreement with NASA’s Commercial Crew and Cargo Program

- The Cygnus Spacecraft Will Provide Cargo Resupply to the ISS Program under the Cargo Resupply Services Contract
  - 8 CRS Flights from 2014 to 2016
Leveraging Commercial Cargo to Lower Launch Costs

- The Cygnus vehicle is comprised of two major elements

  - **Pressurized Cargo Module (PCM)**
    - Heritage: Multi-Purpose Logistics Module (ISS); ATV
    - Total Cargo Mass: 2,000 kg, 2700 kg
    - Pressurized Volume: 18.7 m³, 27 m³
    - Berthing at ISS: Node 2 Common Berthing Mechanism

  - **Service Module (SM)**
    - Heritage: Orbital GEO and LEO missions
    - Power Generation: 2 Fixed Wing Solar Arrays,
    - Power Output: 3.5 kW (sun-pointed)
    - Propellant: Dual-mode
    - Compatible with Antares

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Current Cygnus Configurations Provide Foundation to Future Applications

Cygnus is an Advanced Maneuvering Space Vehicle, Designed and Certified to Meet the Stringent Safety Requirements for ISS Operations

Service Module (SM)
- Heritage: STAR Bus, LEO Star
- Provides all vehicle utility services
- Multi-string fault-tolerant computer system
- Manages on-orbit maneuvering and autonomous rendezvous to the ISS
- 3500 W solar array power generation and significant battery capability (20,000 W-hrs)
- N2H4/NTO dual-mode propulsion system used in Orbital communications satellites
- 32 Thrusters in 3 Fully 6-DOF Strings
- Can be adapted for use in beyond LEO missions and other payloads

Pressurized Cargo Module (PCM)
- Supports cargo requiring a pressurized environment
- Designed and built by Thales Alenia Space with direct heritage to ISS modules

Orbital Proprietary Information
Antares Wallops Launch Site and Operations Collaboration between NASA, Wallops, and MARS

Horizontal Integration for Efficient Processing

Transporter/Erector/Launcher System Designed for Safe, Rapid Transfer of LV to Pad
- Cygnus Mission Control is located in the Orbital Mission Control Complex in Dulles, Virginia.
- After being launched into low-Earth orbit by Antares, the Cygnus spacecraft will transport its cargo to the ISS.
- After the cargo delivery is complete, Cygnus is loaded with disposal material and steered to a safe destructive reentry.
NLP Vaccine-21 Activation
Spheres Experiment
Fresh Fruit Delivery
Cygnus System Facilitates Exploration Goals

- **Affordability** - Evolutionary approach with utilization of existing space qualified systems and cargo missions to ISS, provides lower cost under tightening budget constraints

- **Early Schedule** - Utilization of existing capability provides opportunity for near-term mission support. Potential to “piggy-back” on currently planned CRS missions (8 missions through 2016)

- **Maturity / Reliability** - Cygnus heritage and redundancy provides reliability

- **Technology Advancement** - Cygnus utilization provides new technology risk reduction in flight environments

- **Flexibility** - Cygnus system elements are adaptable to evolving mission needs, goals and requirements

- **Partnership** - Involvement of Cygnus concepts in NASA Exploration assessments promotes commercial / NASA / international partnership
Cygnus Provides an Affordable and Near-Term Capability To Support NASA Goals
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