Commercial Resupply Services

- Development of the capability to commercially resupply the ISS began in 2006 with the Commercial Orbital Transportation Services (COTS) project
- COTS culminated with two cargo delivery demonstrations to ISS
  - SpaceX May 2012
  - Orbital September 2013
- Commercial Resupply Services contractors began delivering cargo to the ISS in October 2012
- Vehicle launches to the ISS account for ~15% of the global launch market (for 2013-14, 25 out of ~168 launches)
- Development and operations of the domestic ISS commercial cargo providers SpaceX and Orbital have stimulated the global competition in launch services
- Redundant commercial cargo supply acquisition for ISS has proven its value to NASA and to the ISS mission

SpaceX

The Dragon spacecraft, designed and manufactured by SpaceX, can carry as much as 6,000kg of pressurized and unpressurized cargo to ISS, and return as much as 3,000kg downmass.

The Falcon 9 (v1.1) launch vehicle is designed and manufactured by SpaceX. Both stages of the two-stage-to-orbit vehicle use liquid oxygen and rocket grade kerosene propellants. The F9 v1.1 can lift approximately 13,000kg to the altitude and inclination of the ISS from its launch site in Cape Canaveral.

SpaceX has successfully launched 6 missions under the CRS contract.

Orbital ATK

The Cygnus spacecraft, developed by Orbital ATK, is capable of delivery more than 2,000kg of pressurized cargo to the ISS. After a nominal docked period, it destructively re-enters the atmosphere loaded with disposal items from ISS.

After two successful CRS flights, the Orbital ATK Antares launch vehicle suffered a launch failure in October 2014 at the start of the Orb-3 mission. Orbital ATK is planning to fly the Orb-4 cargo delivery mission on a ULA Atlas V launch vehicle, while preparing an upgraded Antares for return-to-flight in spring 2016.

International Space Station

SpaceX Cargo - Contracted & Actuals

Mission	Actual Launch Date (A) or Current Launch Date/Window	Cargo Actuals		Comments
		Upmass (kg)	Return/ Disposal (kg)	
SpX-1	10/2012 (A)	450	846	Mission Completed
SpX-2	03/2013 (A)	865	1216	Mission Completed
SpX-3	04/2014 (A)	2116	1811	Mission Completed
SpX-4	09/2014 (A)	2338	1648	RapidSCAT
SpX-5	01/2015 (A)	2393	1853	Cloud Aerosol Transport System (CATS)
SpX-6	4/2015 (A)	1950 (est)	TBD	Pressurized Cargo; No external cargo planned
SpX-7	06/19/2015 – 07/2/2015		.	International Docking Adapter-1
SpX-8	08/06/2015 – 09/04/2015			Bigelow Expandable Activity Module (BEAM)
SpX-9	11/11/2015 – 12/10/2015			International Docking Adapter-2
SpX-10	01/03/2016 – 04/01/2016			Stratospheric Aerosol and Gas Experiment-III (SAGE-III)
SpX-11	04/01/2016- 06/28/2016			Pressurized Cargo; External Cargo Planned
SpX-12	08/11/2016- 11/08/2016			Neutron Star Interior Composition Explorer (NICER)
SpX-13	TBD			Atomic Clock Ensemble in Space (ACES)
SpX-14				Materials International Space Station Experiment (MISSE-X)
SpX-15				Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS), Total and Spectral Solar Irradiance Sensor (TSIS) Extension Mission

Total Upmass: ~10,112kg

Total Downmass: ~7,374kg

International Space Station

Orbital Cargo – Contracted & Actuals

Mission	Actual Launch Date (A) or Current Launch Window	Cargo Actuals		Comments
		Upmass (kg)	Return/ Disposal (kg)	
Orb-1	10/2012 (A)	1462	1466	Mission Completed
Orb-2	03/2013 (A)	1664	1741	Mission Completed
Orb-3	04/2014 (A)	Lost	N/A	Mission Lost Due to Anomaly
Orb-4	10/15/2015 – 11/14/2015			First mission with longer pressurized cargo module (PCM); Atlas V401 planned launch vehicle
Orb-5	03/30/2016– 04/29/2016			Planned 1st Spacecraft Fire Experiment (Saffire) payload; Antares230 with RD181 engines planned launch vehicle; Atlas V401 as backup launch vehicle.
Orb-6	06/30/2016– 09/28/2016			Saffire #2 payload; Antares230 with RD181 engines planned launch vehicle
Orb-7	TBD			Saffire #3 payload; Antares230 with RD181 engines planned launch vehicle. L-18 mo. establishes the 90 day launch window
Orb-8E	TBD			Contract extension mission; Antares230 with RD181 engines planned launch vehicle; L-18 mo. establishes the 90 day launch window

Total Upmass: ~3,126kg

Total Disposal: ~3,207kg

CRS-2 Status

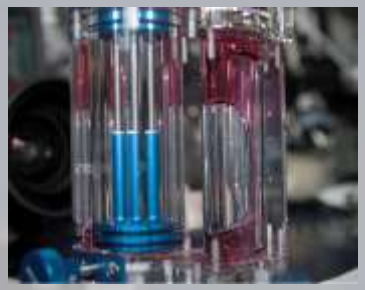
- Draft CRS-2 RFP released Jun 16, 2014 to allow 2-3 months for industry feedback
- Pre-solicitation conference with industry held Aug 7, 2014 with 23 different organizations participating
- RFP released Sept 25, 2014 with proposals due Dec 2, 2014
- Competitive Range determination is planned for Apr 2015
- Selection expected Jun 2015
- CRS-1 contracts extended for 4 flights in 2017

Science Enabled by CRS

Twin Study

Rodent Research

Combustion



Fluids

One Year Mission

Protein Crystals

SPHERES

Education

Cubesats

Bose-Einstein Condensates

Plant Growth

3-D Printing

External Science Payloads Enabled by CRS