

National Aeronautics and
Space Administration



NASA

COMMERCIAL CREW PROGRAM

Bringing Exploration Forward
Space Tech Expo 2014

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Topics of Discussion

Background

Design Maturation Through Current Space Act Agreements

Design Certification

Nationwide Effort

Commercial Crew Program

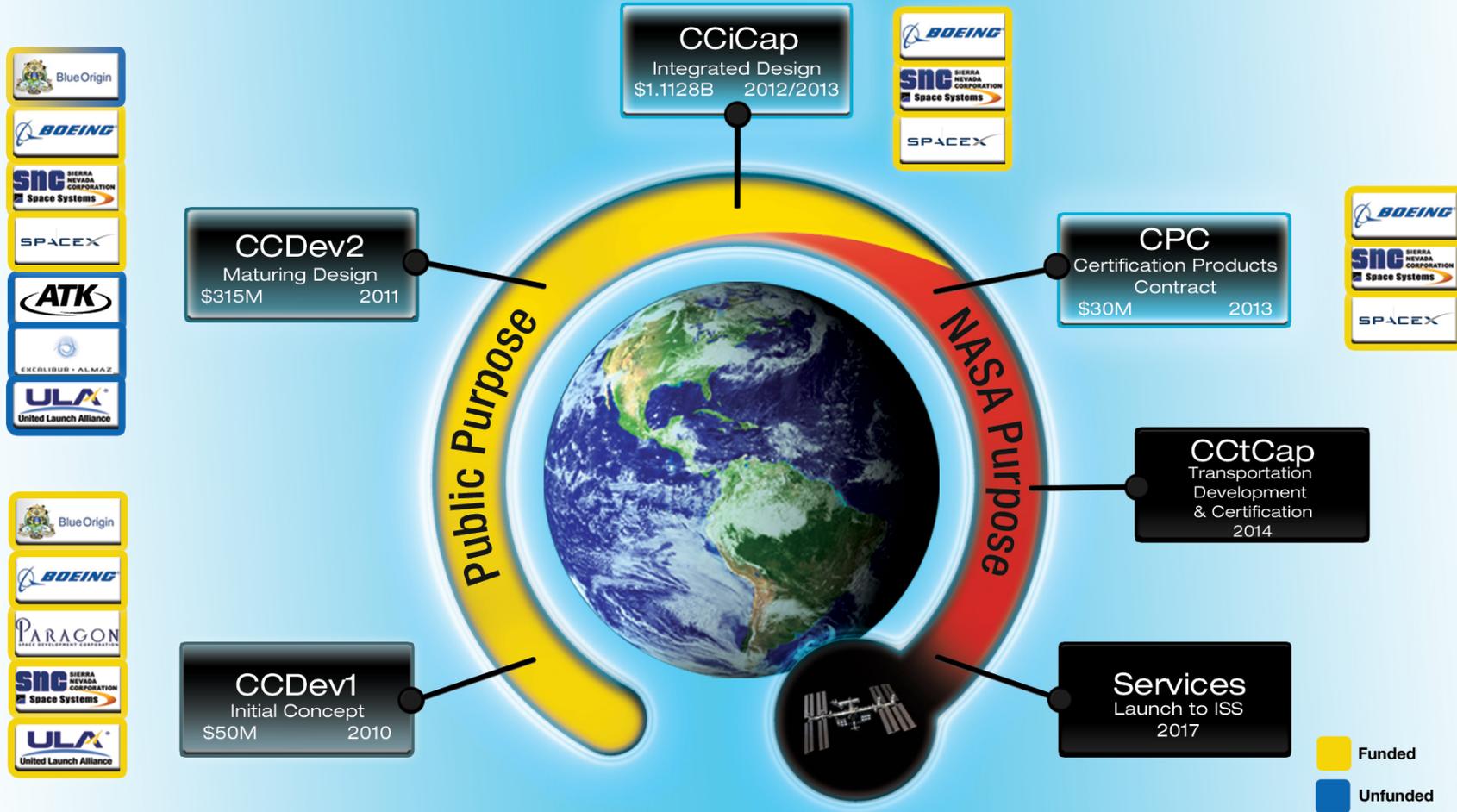
Mission Statement

NASA's Commercial Crew Program (CCP) is **facilitating** the development of safe, reliable and cost-effective human space transportation capabilities to and from low-Earth orbit by private industry in the United States.

CCP is **enabling** the eventual purchase of a NASA certified crew transportation system for International Space Station services.

CCP is **leading** NASA's hybrid approach of investment and contracting.

Commercial Crew Program Evolution



BLUE ORIGIN CCDev2 Initiative



BE-3 engine testing in West Texas.



Artist concept of Blue Origin's Space Vehicle.



BE-3 engine testing in West Texas.

The Blue Origin crew transportation system is comprised of a reusable biconic Space Vehicle (SV) launched first on an Atlas V launch vehicle.

Blue Origin is simultaneously developing its own Reusable Booster System (RBS). The capsule is designed to ride on multiple launch vehicles, including the Blue Origin RBS.

FUNDED MILESTONE PROGRESS:

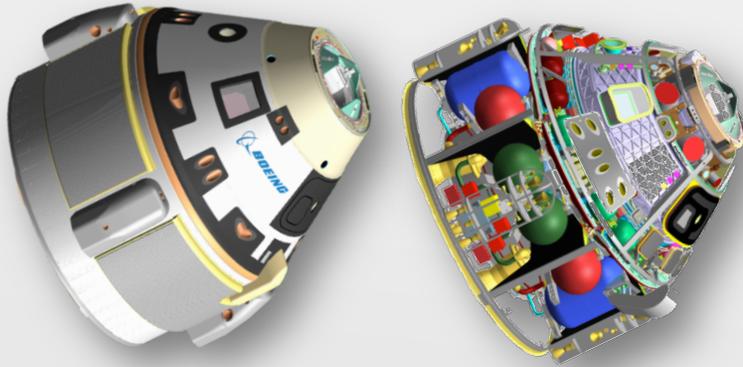
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| • Kickoff Meetings | Complete |
| • RBS Engine Thrust Chamber Assembly (TCA) | |
| Interface and Test Plan Review | Complete |
| • Space Vehicle Mission Concept Review | Complete |
| • Space Vehicle SRR | Complete |
| • Partial-Throttle RBS Engine TCA Test | Complete |
| • Pusher Escape Ground Firing | Complete |
| • Pusher Escape Pad Test | Complete |
| • Full-Throttle RBS Engine TCA Test | Complete |

Total NASA CCDev2 Investment: \$22M

UNFUNDED MILESTONE PROGRESS:

- | | |
|---|------------|
| • BE-3 Engine Test | Completed |
| • Subscale Prop Tank Assembly Review | March 2014 |
| • Space Vehicle Subsystem interim Design Review | March 2014 |

BOEING C*Ci*Cap Initiative



Artist concepts of Boeing's CST-100.



Artist concept of integrated CST-100 and Atlas V rocket



CST-100 water contingency landing scenario testing.



Launch abort engine hot-fire test in California.

Boeing's crew space transportation system is comprised of the reusable CST-100 spacecraft, Atlas V launch vehicle, mission operations and ground systems.

Boeing is continuing to develop its integrated space transportation system with design reviews and hardware testing.

CURRENT PROGRESS:

- | | |
|---|------------|
| • Certification Plan Review | Complete |
| • Avionics Software Integration Lab (ASIL) | Complete |
| • Service Module Propulsion System CDR | Complete |
| • Launch Vehicle Adapter CDR | Complete |
| • Emergency Detection System Standalone Testing | Complete |
| • Pilot-in-the-loop Demo | Complete |
| • Spacecraft Primary Structures CDR | Complete |
| • Software CDR | April 2014 |
| • CDR | June 2014 |
| • Spacecraft Phase 2 Safety Review Board | July 2014 |

Total Expected NASA C*Ci*Cap Investment: \$460M

SIERRA NEVADA CORP. CCIcap Initiative



Artist concept of SNC's integrated Dream Chaser spacecraft and Atlas V rocket.

Captive-carry flight of the Dream Chaser engineering test article.



View from inside the Dream Chaser cockpit during first free-flight test.

First free-flight of the Dream Chaser in California.



SNC's crew transportation system consists of the Dream Chaser lifting body spacecraft, the Atlas V launch vehicle, mission operations and associated ground systems.

The SNC Dream Chaser is a reusable, piloted lifting body spacecraft, derived from the NASA HL-20 spacecraft design.

CURRENT PROGRESS:

- Integrated System Safety Analysis Review #2 Complete
- Certification Plan Review Complete
- CDR Incremental Design Review Complete
- Wind Tunnel Testing Feb. 2014
- Main Propulsion & RCS Risk Reduction & TRL Advancement Testing May 2014
- RCS Risk Reduction & TRL Advancement Testing June 2014
- RCS Test Incremental Test July 2014
- ETA flight testing and free flight TBD

Total Expected NASA CCIcap Investment: \$227.5M

SPACEX C*Ci*Cap Initiative



SpaceX's upgraded Falcon 9 launches a commercial payload.



Dragon test article used for parachute testing.



Astronaut fit-check of the Dragon spacecraft.



Dragon production at SpaceX headquarters in California.

SpaceX's crew transportation system is based on the Dragon spacecraft and Falcon 9 launch vehicle originally developed for International Space Station cargo missions.

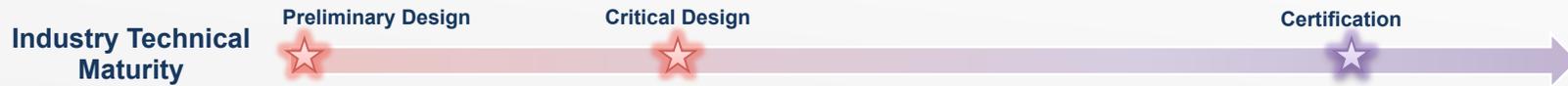
Initially designed to carry cargo, the Dragon 's components are being modified for added safety and crew accommodations.

CURRENT PROGRESS:

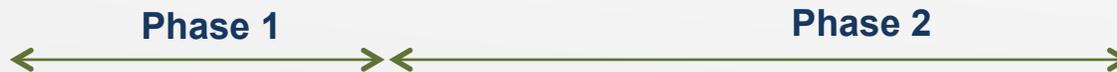
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|--|------------|
| • Safety Review | Complete |
| • Flight Review of Upgraded Falcon 9 | Complete |
| • Dragon Parachute Crane Drop Test | Complete |
| • Dragon Parachute Helicopter Drop Test | Complete |
| • Delta Ground Systems PDR | Complete |
| • Integrated CDR | April 2014 |
| • Dragon Primary Structure Qualification | May 2014 |
| • Pad Abort Test | June 2014 |
| • In-Flight Abort Test | Aug. 2014 |

Total Expected NASA C*Ci*Cap Investment: \$480M

Certification Strategy



Certification for ISS Crew Transportation



Alignment with NASA certification requirements



Verification, validation, test and final certification

Certification to include at least one crewed ISS mission



*Number of awards to conform to budget

ISS Crew Transportation Services



Certification Products Contracts (CPC)

Objective

The delivery, technical interchange and NASA disposition of early lifecycle certification products that are specifically related to an integrated Crew Transportation System (CTS) for International Space Station Design Reference Missions (DRM).

The contract requires two deliverables, initial and final for the following products:

- Alternate Standards
- Hazard Reports
- Verification & Validation (V&V) Plan and variance requests to NASA requirements
- Certification Plan

Current Status

In December 2012, Boeing, Sierra Nevada Corp. and SpaceX were each awarded contracts for \$10 million or less, covering the submittal and discussion of specific early lifecycle certification products.

- Round 1 is complete for all contract deliverables and all partners
- Evaluation of deliverables for all partners simultaneously was a significant challenge during Round 1
- Round 2 is in progress with final deliverables received Jan. 22, 2014
- CCP goal set to assess final deliverables by April 22, 2014

Commercial Crew Transportation Capability (CCtCap)

Objective

Develop and certify a commercial Crew Transportation System (CTS) that can provide safe transportation of NASA crew to the International Space Station as soon as possible, with a goal of no later than 2017. The CTS development will enable the purchase by NASA of commercial services to meet NASA's station crew transportation needs, once the capability is certified by the agency.

Competition

- Phased acquisition using competitive down-selection procedures
- CCtCap allows for a full and open competition
- Firm fixed-price, performance-based, with fixed-price Indefinite Delivery/Indefinite Quantity (IDIQ) element

Current Status

- Proposals Received Jan. 22, 2014
- CCtCap Award August 2014

Summary

NASA's Commercial Crew Program is continuing to execute the plans established at the program's inception in April 2011.

The program is headed into a critical phase during the next year where we will be transitioning into a full-up certification and services contract.