Commercial Crew Program Overview

(Tailored Somewhat for C&T)

JSC / Don Pearson

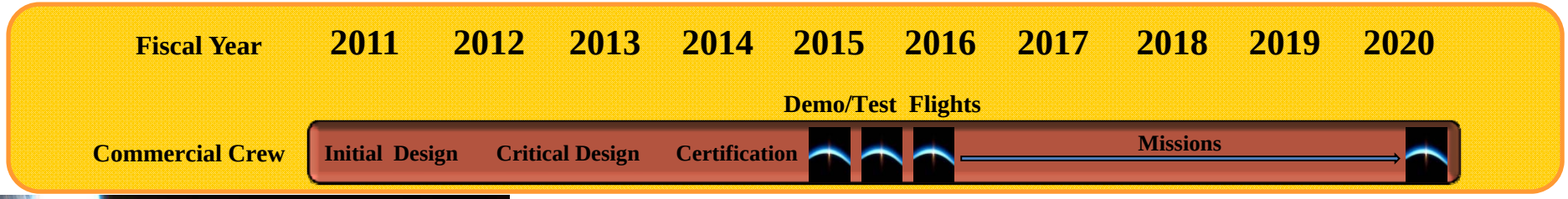
Apr 16, 2012

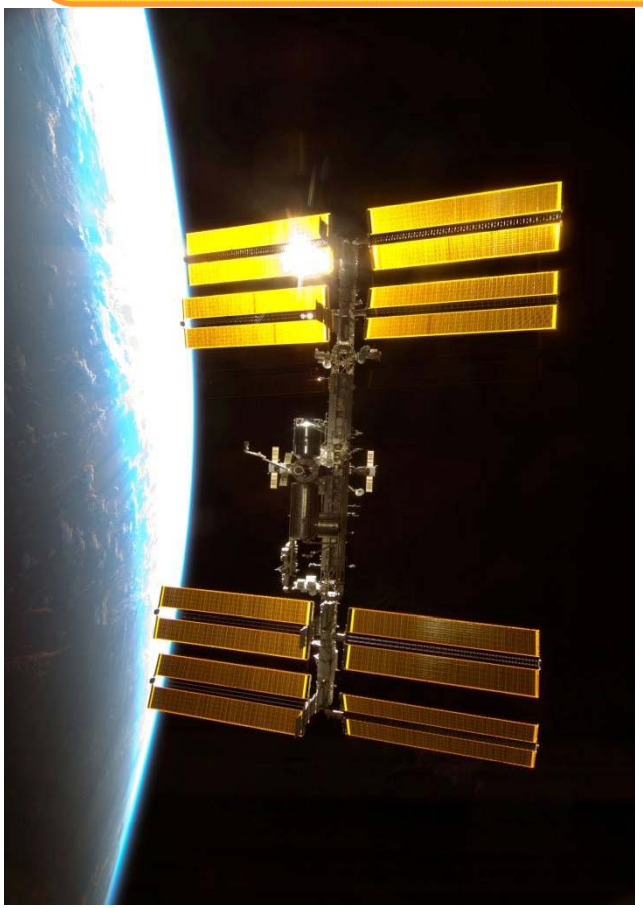
The Commercial Crew Program

The Commercial Crew Program (CCP) is leading NASA's efforts to develop the next U.S. capability for crew transportation and rescue services to and from the ISS by the mid-decade timeframe. The outcome of this capability will stimulate and expand the U.S. space transportation industry.

The CCP logo is derived from the NASA flight crew symbol as the foundation for the Program. The red/white/blue swoosh illustrates an American led capability. The star depicts a future vehicle emerging from the overlapping double C's representing the CCP.

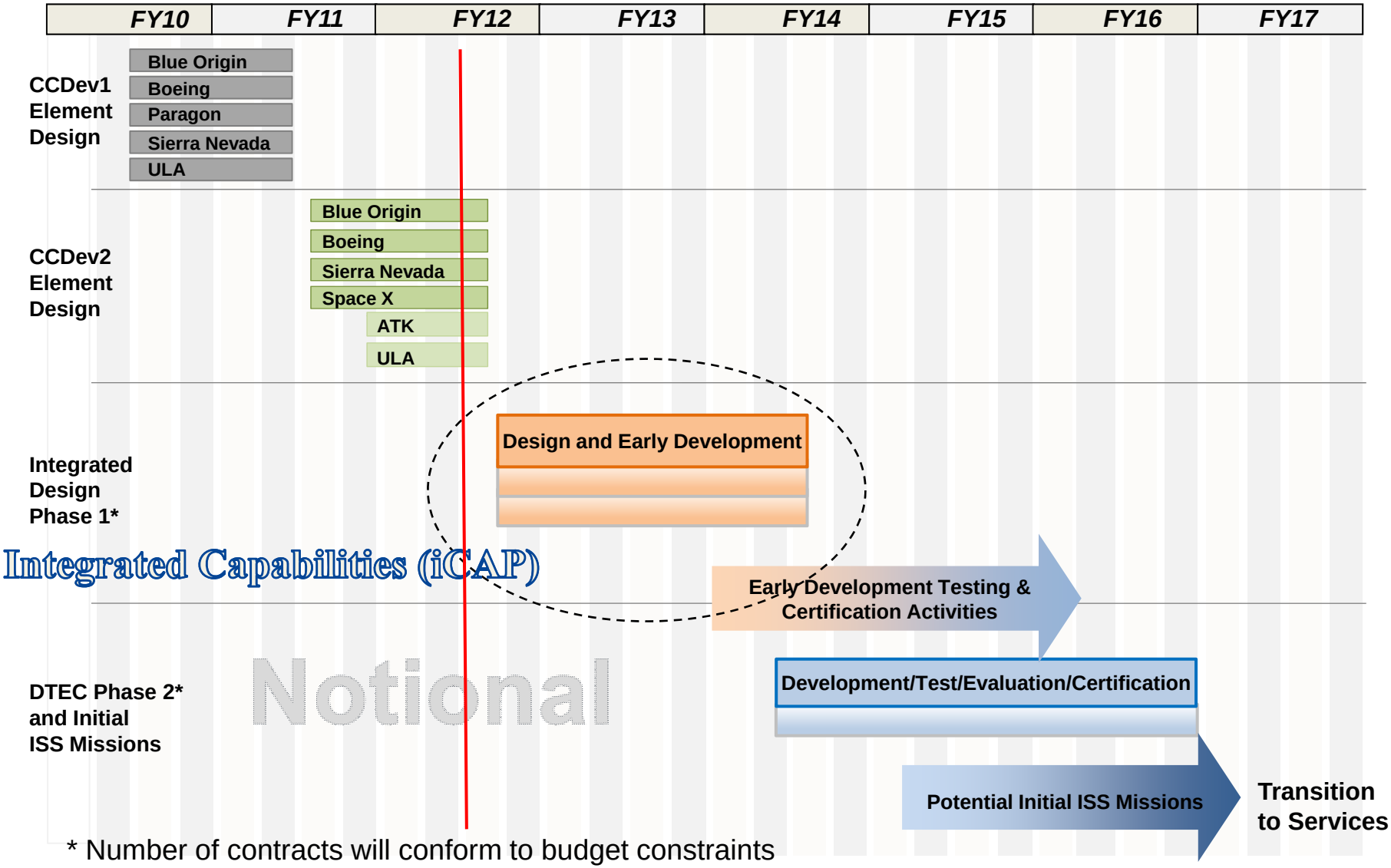
Commercial Crew Program Approach





- The 2010 NASA Authorization Act established commercial crew as the primary means for ISS crew transportation.
- The Program objective is to facilitate the development of a U.S. commercial crew space transportation capability with the goal of achieving safe, reliable, and cost effective access to and from low Earth orbit (LEO) and the International Space Station (ISS).
  - Develop and implement a strategy that stimulates U.S. space transportation industry and encourages the availability of space transportation services to NASA and others
  - Mature the design, development, demonstration, and certification of U.S. Crew Transportation Systems (CTS) capabilities
  - Utilize an alternate business approach by investing in U.S. aerospace industry CTS design and development
  - Develop CTS certification requirements and strategies to help ensure safe transportation for NASA crew
  - Provide Partners access to NASA's technical expertise and resources for development issue resolution

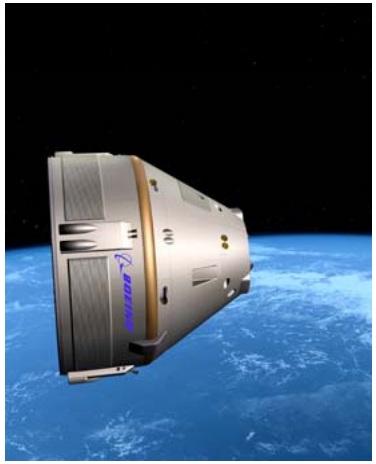
CCP Strategic Path for Acquisition



* Number of contracts will conform to budget constraints

Commercial Crew Development (CCDev2)

Phase 2:
Maturing Design Elements



- Four Companies
- $269M in Space Act Agreements
- $66.3M Milestone Payments made to date
- Completes in FY 2012
- 3 of the 4 to Internal Integrated PDR State
- 1 of the 4 to Internal SRR State

CCDev2

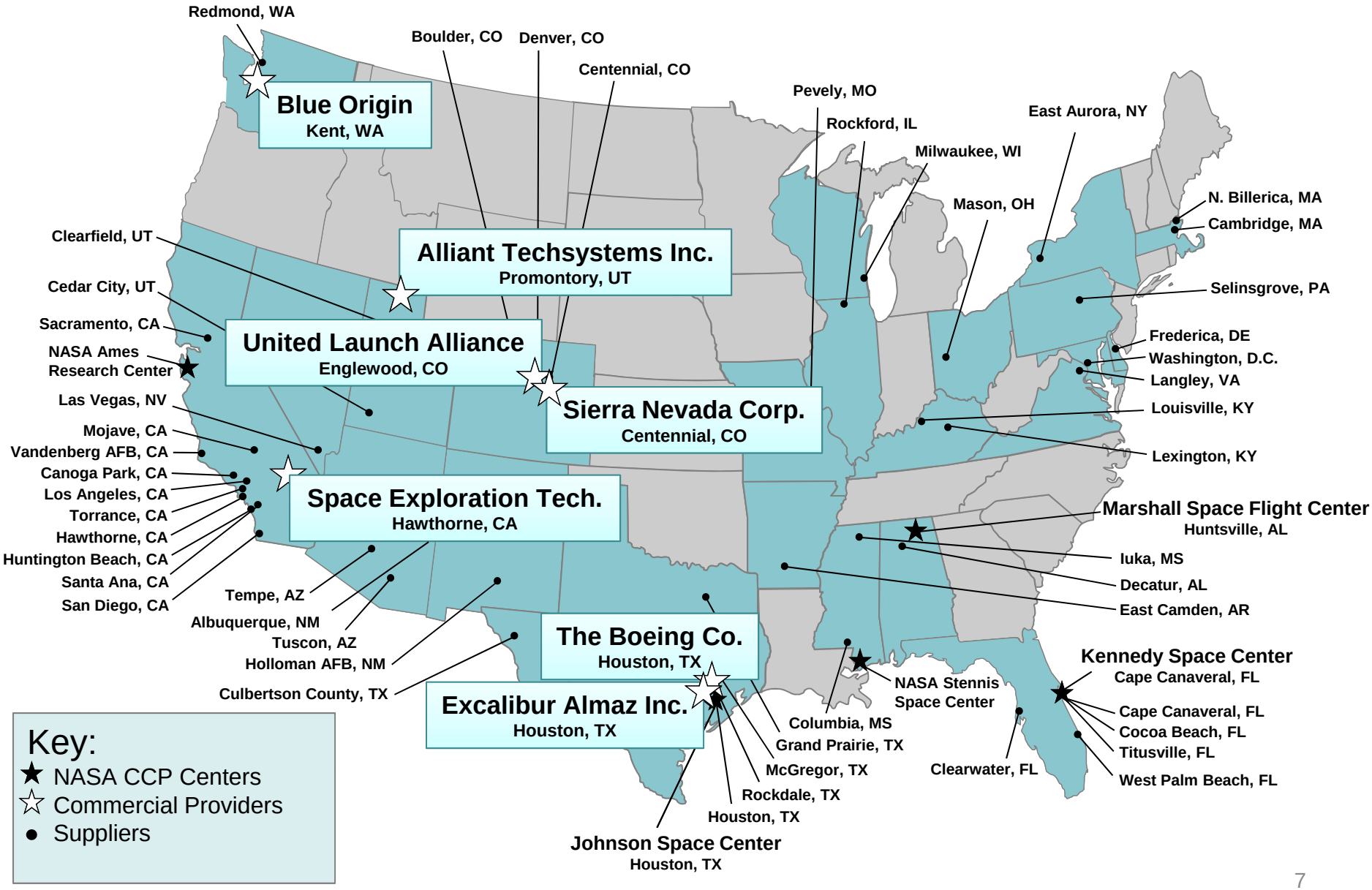
4 Funded SAAs

- ***Blue Origin: Pusher Escape Design and Space Vehicle System Requirements Review***
- ***Boeing: Vehicle PDR and Software PDR***
- ***Sierra Nevada: Early PDR and ETA Free Flight Test***
- ***Space X: Launch Abort Design and Vehicle PDR***

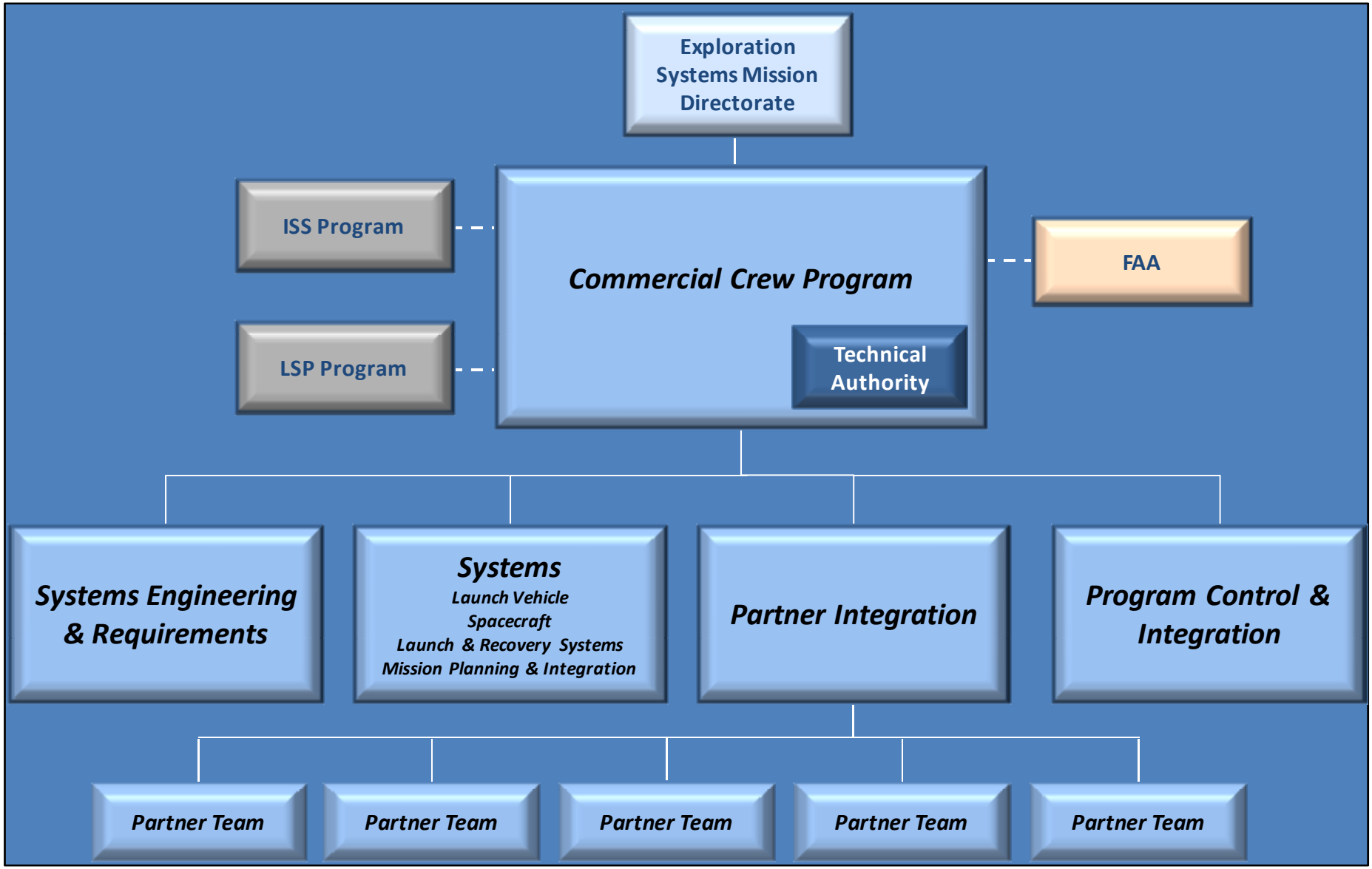
3 Unfunded SAAs

- ***ULA: Design Equivalency and Systems Requirement Review***
- ***ATK/EADS: Initial Systems Design and Program Design Review***
- ***EAI: Internal Systems Requirement Review and Design and Test Status Reviews***

CCP Commercial Providers and Suppliers



Program Structure



Organizational Roles and Responsibilities

Technical Authority

Engineering
Safety and Mission Assurance
Crew Health & Medical

Commercial Crew Program

Program Management
Risk Management
Program Change Board
Milestone Review and Approval
Crew Transportation System Certification Approval
CoFR Concurrence
Technical Authorities and Governance Implementation

Admin Support

Personnel Actions
Training
Awards
Secretarial Support

Systems Engineering & Requirements (SE&R)

- Technical management, systems engineering and integration for Program requirements
- Evaluation of independent assessments of safety or technical issues
- SE&R Board

Systems

- CTS certification methodology development, implementation & management
- Verification of CTS goals and requirements
- CTS Gap Analysis/Management
- Launch Vehicle and Spacecraft technical expertise
- Launch and Recovery Systems expertise
- Mission Planning and Integration expertise

Partner Integration

- Day-to-day insight methodology development, implementation & management
- Government resource allocations with Partners
- End-to-end CTS evaluation
- CCDev2 implementation
- Provide NASA tech support & experience
- Provide integration & subsystem support for DDT&E
- Participate in design & safety reviews
- Communication & data sharing w/ certification team

Program Control & Integration (PC&I)

- Program Documentation
- Configuration Control
- Schedule Development & Maintenance
- PPBE Planning
- Budget/Resources
- Agreements/Contracts Management
- Acquisition Planning
- IT Systems Support

Partner Team | **Partner Team** | **Partner Team** | **Partner Team**

Program Personnel

Updated 11/29/11

(FA /VA1)

Mango, E.	Program Manager	321-861-0150
Jett, B.	Deputy Program Manager	281-244-8843
Ordway, W.	JSC Associate Director	281-483-6626
Engelauf, P.	Program Executive (FAA/ISSP)	281-483-4416
Vacant	Deputy Director	
Collura, M.	Associate Director (Tech)	321-867-2204
*Hawkins, T.	Associate Director (Mgmt)	321-861-3957

Technical Authority

Sullivan, S.	CE	321-861-3681
Schenfeld, S.	Actg Dpty CE	281-244-7753
Johnson, S.	CSO	281-483-9814
Minnear, J.	Dpty CSO	321-861-3690
Richardson, M.	CH&M	281-483-7483
Berdich, D.	Dpty CH&M	281-483-6382

Admin Support
(FA/VA1)

Aguilar, N.	Secretary	281-483-0933
Drake, T.	Admin Splst (dtl)	321-861-0648
Feagan, C.	Exec Secretary	321-861-2737
Miller, P.	Secretary	321-867-6540
Pate, C.	Secretary	281-483-0031
Reynolds, S.	Admin Ofcr	281-483-0819
Smith, E.	Adm&Stgc Mgr (dtl)	321-867-7312

Program Control & Integration
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Lucht, K.	Mgr	321-861-1089
Elsner, S.	Dpty Mgr	281-244-7609
Zeitler, P.	Dpty Mgr	321-861-0256
Belson, D.	Prog Analyst	321-867-3652
Biesack, M.	Config Mgmt	321-867-6288
Booth, V.	Tech Edit/CM	321-861-5404
Borden, D.	Tech Intg/SharePt	321-867-0806
*Burlein, T. (mtx)	Procurement	321-867-3484
*Colloredo, L.	Acquisition	321-867-0826
Green, M.	Policy/Plng	321-867-2581
Gregor, C. (mtx)	Prg Anlyst	321-861-9623
Hegemier, T.(mtx)	Analyst	281-483-9813
Hibbs, Q. (mtx)	Res Analyst	321-867-9868
Hunt, Z. (mtx)	Pricing	281-244-1585
Lauderdale, S.	Prog Analyst	321-867-2747
Repa, J. (mtx)	Prog Resrcs	281-244-8489
*Rudig, R.	Acquisition	321-867-1189
Scott, C.	Strategic Intg	321-861-3970
Shreve, D.(mtx)	AO/CCDev2	321-867-3456
Sims, B.	StrategicComm	321-861-7725
Wall, C. (mtx)	Pricing	281-244-8221
Ward, D.	Schedule Intg	321-867-0832
Waters, M.	Brd Secretariat	321-861-4229
Wilson, S.(mtx)	Pricing	281-244-7578
Vacant		

Systems Engineering & Requirements
(FA-B/VA311)

Hanan, P.	Mgr	321-867-7612
Gerace, C.	Dpty Mgr/TRB	321-867-8053
Peters, J.	Dpty Mgr/Rsk Mgr	281-483-3823
Bayt, R.	1140/50808	281-244-0055
Burns, E.	1150	281-483-8736
Cole, D.	1100/1120	321-867-0834
*Intriago, R.	APT	321-867-2856
Owens, S.	Rqmts/Verific.	321-867-2935
Peltier, D. (TBD)	1110	281-483-5362
Thomas, R.	1130	321-867-0783
Totton, D.	SRP/PSA	281-244-8307
Vacant		

Partner Integration
(FA-C/VA411)

Thurston, S.	Mgr	321-861-9102
Jones, B.	Dpty Mgr	281-244-1098
Cipo, Z.	Secretary	321-867-6624
Burnum, J.	Dpty PM ATK	256-544-4008
Cain, S.	SpaceX	321-867-6404
Caliendo, G.	PIT Mgr Boeing	321-867-6489
Cowart, J.	PIT Mgr Space X	321-867-4815
Dempsey, B. (dtl)	Dpty PM Boeing	281-483-0915
Lane, B. (mtx)	*PIT Mgr Blue*	*281-483-7846*
Malloy, C.	PIT Mgr ULA	321-867-3778
May, H.	Dpty PM ULA	321-861-0663
McKinnie, J.	Dpty PM SpaceX	281-483-0792
Segarra, L.	Dpty PM SNC	321-861-3585
Snopkowski, M.	Dpty PM Blue	321-861-3319
Tenbusch, K.	PIT Mgr ATK	321-861-9318
Thorn, V.	PIT Mgr SNC	281-244-7097
Tran, H. (dtl)	Tech Intg	281-483-8045
Waechter, S	Tech Intg Lead	281-244-6582

*Procurement Development Team

Colloredo, L. - Chair	
Burlein, T.	Ouellette, F.
Canfield, A.	Rudig, R.
Curiel, R.	Shockley, W.
Delai, J.	Simon, T.
Flowers, A.	Stott, N.
Hawkins, T.	Thomas, D.
Intriago, R.	Williamson, J.
Obrady, K.	Horn, S. – Legal Counsel

Systems
(FA-D/VA511)

Thompson, B. Mgr 321-861-3996

Launch Vehicle Systems

Martin, D.	Mgr	321-867-9498
Hutcherson, D.	Dpty Mgr	321-861-9105
Flugstad, C.	Rsk Mgr	321-861-1082
Ise, Dayna	Sys Lead SpaceX	256-544-4123
Femminineo, M	Sys Lead ULA	321-861-3943
Stover, B (dtl)	Sys Lead ATK	321-861-8554

Spacecraft

Ordway, W.	Actg Mgr	281-483-6626
McPhillips, C.	Dpty Mgr	321-867-6403
Bell, D.	Sys Lead SNC	281-483-7807
Campbell, J.	Sys Lead Boeing	321-861-3810
Garske, M..	Sys Lead SpaceX	281-483-0790
Kerr, J.	Rqmts/Rsk Mgr	281-244-5071
Lane, B. (mtx)	*Sys Lead Blue*	*281-483-7846*
Oliu, A.	Integration	321-861-3042

Launch & Recovery Systems

Thompson, B.	Mgr	321-861-3996
Healey, E.	Dpty Mgr/Sys Ld SN/ATK	321-861-6366
Broadaway, C.	Sys Ld Blue/SpcX	321-861-7676
Jones, M.	Sys Lead ULA	321-861-4337
Mosteller, T. (mtx)	Sys Lead Boeing	321-861-9307

Mission Planning & Integration

Hassmann, D. (dtl)	Mgr	281-244-1000
Pearson, D.	Dpty Mgr	281-483-8052
Lane, B.	PM Blue	281-483-7846
Machula, M (dtl)	FAA Liaison	832-474-5901

Legend
KSC (CS & Cntr)
JSC (CS & Cntr)
MSFC (CS & Cntr)

Requirements and Process Implementation Approach

http://commercialcrew.nasa.gov/

CCT-PLN-1100: *Crew Transportation Plan*

Program summary of roles, responsibilities, and interfaces between the Commercial Crew Program and Commercial Partners in the development of a certified Crew Transportation System.

CCT-DRM-1110: *Crew Transportation System Design Reference Missions*

Summary of potential reference missions for the Crew Transportation System.

CCT-PLN-1120: *Crew Transportation Technical Management Processes*

Summary of technical management processes that support certification and expectations for evidence of compliance.

CCT-REQ-1130: *ISS Crew Transportation Certification and Services Requirements*

Requirements to transport NASA crew to the International Space Station.

SSP 50808: *ISS to Commercial Orbital Transportation Services Interface Requirements*

Requirements to interface with the International Space Station.

CCT-STD-1140: *Crew Transportation Technical Standards and Design Evaluation Criteria*

Summary of expectations and criteria used in the evaluation of technical standards.

CCT-STD-1150: *Crew Transportation Operations Standards*

Summary of expectations for minimum criteria and practices for operations.

Comm & Tracking

- Commercial Crew: "Hands Off"
  - "Level 2" type requirements
  - Verification
  - Certification
  - "Insight" and "Oversight"

- Commercial Providers (CPs) design C&T architectures
  - May "sub-contract" with NASA for unique services
    - TBD use of TDRS, ground stations (varies with CP)
    - Multi-access vs Single access?
    - Communications with ISS for "integrated ops" via C2V2 and "big loop"

- Commercial Crew Program (CCP) : FCC / NTIA discussions
  - NASA missions to ISS
  - Not "non NASA missions"

- FAA licensing is goal for first NASA mission to ISS
  - Federal regulations then in force (e.g. public safety)
  - No ability to regulate crew safety

1130 Requirements

- Each Requirement has an OPR
  - (Systems) Office of Primary Responsibility
    - Responsible for
      - Requirement
      - Rationale
      - Verification
  - Stakeholders
    - Significantly affected by changes to this requirement
    - Other Systems Offices and ISS

Example Requirements (1130)

- **3.1.1.2 Simultaneous Operation of Spacecraft (MP&I)**
  - The CTS shall simultaneously operate two spacecraft to allow an ISS NASA crew handover. [R.CTS.002] [I]
    - *Rationale: The launch of the next rotation mission will occur prior to the departure of the current increment crew working on the ISS, resulting in a direct crew handover period where two commercial spacecraft would be docked to the ISS for approximately 7 to 10 days. The infrastructure in the CTS vehicle, the CVCC, communication network, and other required assets must be sized to accommodate two operational spacecraft (one docked and one in free-flight mode or both docked).*

- **3.5.1.7 Communications after Landing (MP&I)**
  - The spacecraft shall provide two-way voice communications between the crew and the CVCC until recovery forces have removed the crew from the vehicle. [R.CTS.095]
    - *Rationale: The crew should have periodic two-way voice communications with the operations team that will be coordinating the search and rescue and other crew survival efforts during this timeframe. The communication will need to be maintained until the search and rescue and recovery teams have recovered the crew for nominal and off nominal landing scenarios, such as an emergency deorbit (reference requirement 3.5.3.4). This requirement does not preclude the use of portable devices as part of a strategy to provide two-way voice communications between the crew and the CVCC until recovery forces have removed the crew from the vehicle.*

Example Requirements (1130)

- **3.8.1.1 Voice Communication with Crew (Spacecraft)**
  - The CTS shall provide single failure tolerant two-way voice communication between the CVCC (s) and the spacecraft crew from pre-launch through landing and during aborts. [R.CTS.113]
    - Rationale: Two-way voice communication between the CVCC (s) and the crew is required to execute the mission and resolve anomalies should they occur. The intent of this requirement is to provide single failure tolerance in both the ground and onboard communications systems in order to ensure communications availability during all flight phases. This requirement is not meant to imply 100% continuous communication for all phases of flight. On-orbit communications coverage requirements will be dictated by the specific design requirements of the spacecraft.

- **3.8.1.2 Communications Coverage (Spacecraft)**
  - The CTS shall provide 90% communications coverage (voice and telemetry) during the ascent flight phase and 65% during the entry flight phase. [R.CTS.114]
    - Rationale: Historically, the ascent and entry phases of human space flight have been the timeframe of greatest risk for LOC. For ascent, there are a multitude of abort options and timely systems responses that ground personnel can assist with leading to the requirement near continuous communications that can be accommodated by ground and/or space based communication assets. For entry, although the risk is high, there are fewer options available for the crew and thus the requirement for continuous communication is less than that for ascent. The entry communication analysis should be focused on critical events (separations, chute deployment, key navigation events) and the final phase of landing where the risk is the highest.

Questions?

National Aeronautics and Space Administration
NASA
SAME CREW...NEW RIDE
COMMERCIAL
CREW

Backup

Blue Origin CCDev2 Project

Description: Crew Transportation System (CTS) comprised of a reusable biconic Space Vehicle (SV) launched first on an Atlas V launch vehicle and then on Blue Origin's own Reusable Booster System (RBS).

Mature SV design through System Requirements Review (SRR), mature the Pusher Escape System, and accelerate engine development for RBS.

Current Progress:

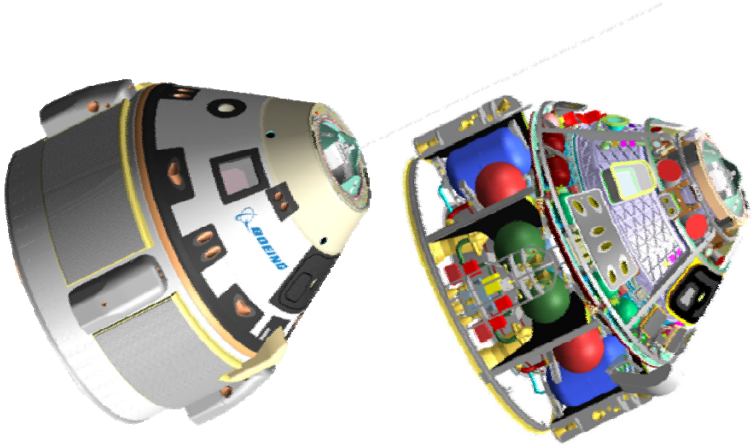
- Kickoff Meetings — Complete
- 1st Quarterly Review — Complete

Future Work:

- SV Mission Concept Review
- SV SRR
- Pusher Escape Ground Firing
- Pusher Escape Pad Escape Test
- RBS Engine Thrust Chamber Assembly Test

NASA Investment: $22M

Boeing CCDev2 Project



IDR 4 Point of Departure

Landing drop tests at Ivanpah dry lake bed

Description: Commercial Crew Transportation System (CCTS) comprises the reusable CST-100 spacecraft, launch services, and ground systems. CST-100 is compatible with multiple launch vehicles. CST-100 capsule is reusable for up to ten missions.

Mature CCTS design through PDR and perform development tests.

Current Progress:

- Delta Systems Definition Review — Complete
- Phase 0 Safety Review — Complete
- Landing Air Bag Drop Demonstration #1 — Complete
- Phase 1 Wind Tunnel Tests — In Work
- Interim Design Review (IDR) – 4 — Complete
- 1st Quarterly Review — Complete
- Atlas V selected for development flights

Additional Milestones funded for further risk reduction in meeting Program goals:

- Software PDR
- Orbital Maneuvering and Abort Control (OMAC) Hot Fire Test
- Service Module (SM) Cold Flow Test

NASA Investment: $112.9M

Sierra Nevada Corporation (SNC) CCDev2 Project

SNC has assembled a world-class team

Description: Dream Chaser is a reusable, piloted lifting body derived from NASA HL-20, launched on an Atlas V. SNC will fabricate an atmospheric flight test vehicle, conduct analysis and risk mitigation, and conduct significant hardware testing.

Mature Dream Chaser CTS design through a Preliminary Design Review (PDR) with some subsystems to Critical Design Review (CDR).

Current Progress:

- System Requirements Review — Complete
- Canted Airfoil Fin Selection — Complete
- Cockpit Based Flight Simulator — Complete
- Vehicle Avionics Integration Laboratory — Complete
- 1st Quarterly Review — Complete
- SSDRs and SDR Kickoff — Complete

Additional Milestones funded for further risk reduction in meeting Program goals:

- Captive Carry Interface and Landing Gear Test
- ETA Captive Carry Flight Test Readiness Review
- ETA Captive Carry Flight Test
- ETA Free Flight Test

NASA Investment: $105.6M

SpaceX CCDev2 Project

Description: The CTS is based on the existing Falcon 9 launch vehicle and Dragon spacecraft which have been designed since inception for crew carriage with relatively minimal modification. Both the longest-lead and most safety-critical system is the Launch Abort System (LAS).

Mature the flight-proven Falcon 9/Dragon transportation system focusing on developing an integrated, side-mounted LAS.

Current Progress:

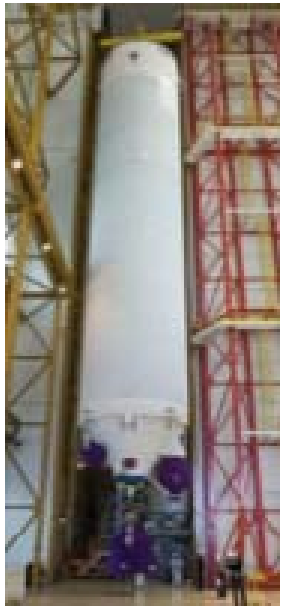
- LAS Propulsion Conceptual Design Review — Complete
- Design Status Review 1 — Complete
- LAS Propulsion Component PDR — Complete
- 1st Quarterly Review — Complete

Future Work:

- Crew Accommodation Concept Prototype and In-Situ Trial 1
- Design Status Review 2
- Crew Accommodation Concept Delta Prototype and In-Situ Trial 2
- LAS Propulsion Component Test Articles Complete
- LAS Propulsion Component Initial Test Cycle
- Concept Baseline Review

NASA Investment: $105.6M

Alliant Techsystems (ATK) CCDev2 Project



Description: ATK is developing the Liberty Launch Vehicle. Liberty includes an ATK five-segment solid rocket motor as a first stage, and Astrium (an EADS Company) is providing the core stage from the Ariane 5 rocket, including the Vulcain 2 engine as Liberty's upper stage.

Mature the design of the Liberty through technical integration meetings and design reviews.

Current Progress:

- Kick-off Complete

Future Work:

- Technical Interchange Meeting
- Launch Systems Initial System Design (ISD)
- Technical Interchange Meeting 2
- Program Status Review (PSR)

Unfunded Agreement

United Launch Alliance (ULA) CCDev2 Project

Description: Atlas V uses a standard Atlas Booster, zero to five strap-on solid rocket boosters (SRBs), and a Centaur in either the Single-Engine Centaur (SEC) or the Dual-Engine Centaur (DEC) configuration.

Review and evaluate the human certification plan for the Atlas V and mature the related design to an SRR level.

Current Progress:

- Kick-off — Complete
- Design Equivalency Review Summary — Complete

Future Work:

- Probabilistic Risk Assessment Review
- Tailored Systems Requirements Review
- Systems Requirements Review

Unfunded Agreement

Excalibur Almaz Inc. CCDev2 Project

Description: EAI is developing a spacecraft capsule based on heritage hardware. The EAI concept is to use the company's planned tourist space vehicle in concert with an intermediate stage and fly the integrated vehicle on a commercially available launch vehicle.

Current Progress:

- Development Program Kickoff Review — Complete

Future Work:

- Systems Requirements Review
- Launch Vehicle Compatibility Review
- Test Status Review
- Design Status Review

Unfunded Agreement