



Delta IV Heavy Deployment of  
**DSP-23**  
Delta Launch Vehicle Programs







# Introduction



United Launch Alliance (ULA) is proud to launch the Defense Support Program Satellite (DSP-23) mission aboard a Delta IV Heavy launch vehicle from Space Launch Complex 37B at Cape Canaveral Air Force Station.

The Northrop Grumman-built DSP satellites have been the spaceborne segment of North American Aerospace Defense Command (NORAD's) Tactical Warning and Attack Assessment System since 1970. DSP satellites use infrared sensors to detect heat from missile and booster plumes against the Earth's background. Air Force Defense Support Program satellites provide early detection and warning of missile launches and nuclear explosions to National Command Authorities and operational commands.

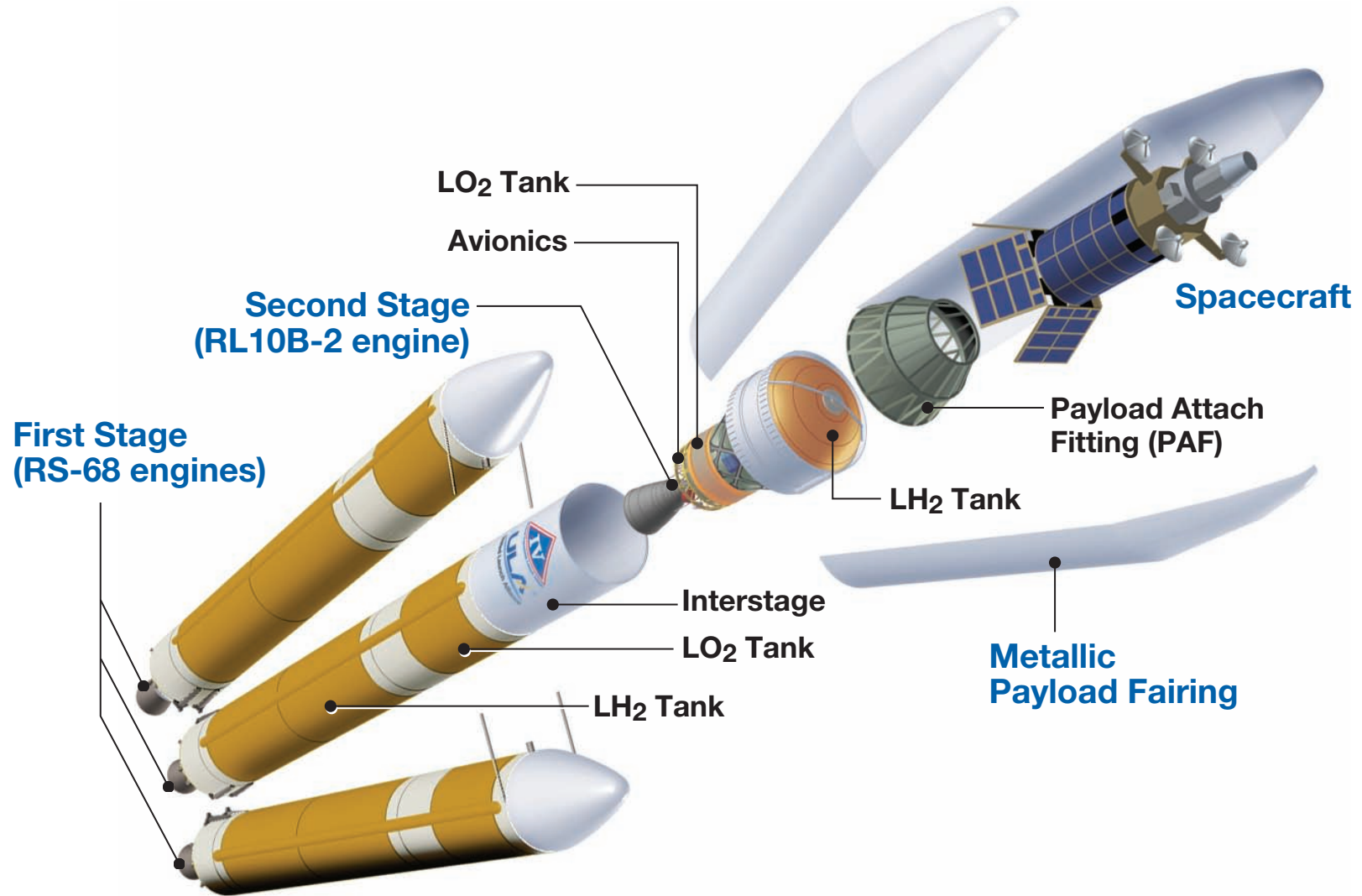
The DSP-23 launch will be the first operational satellite launch atop a ULA Delta IV Heavy Evolved Expendable Launch Vehicle (EELV). United Launch Alliance is proud to launch DSP-23, the last satellite of this constellation that has been the cornerstone of North America's early warning system for more than 35 years.

I congratulate the entire Delta team for their significant efforts that resulted in achieving this milestone.

A handwritten signature in black ink that reads "Dan Marin". The signature is written in a cursive, flowing style.

Dan Marin  
Director, Delta EELV Program  
United Launch Alliance

# Vehicle Configuration Delta IV Heavy



- Provide early detection and warning of missile launches and nuclear explosions to National Command Authorities and operational commands
- Demonstrate auxiliary payload for the SABRS Validation Experiment (SAVE)

## BACKGROUND

The Red, White, and Blue background represents the flag of the United States of America: White signifies purity and innocence; Red, hardiness and valour; and Blue signifies vigilance, perseverance, and justice. The gold fringe signifies honor.

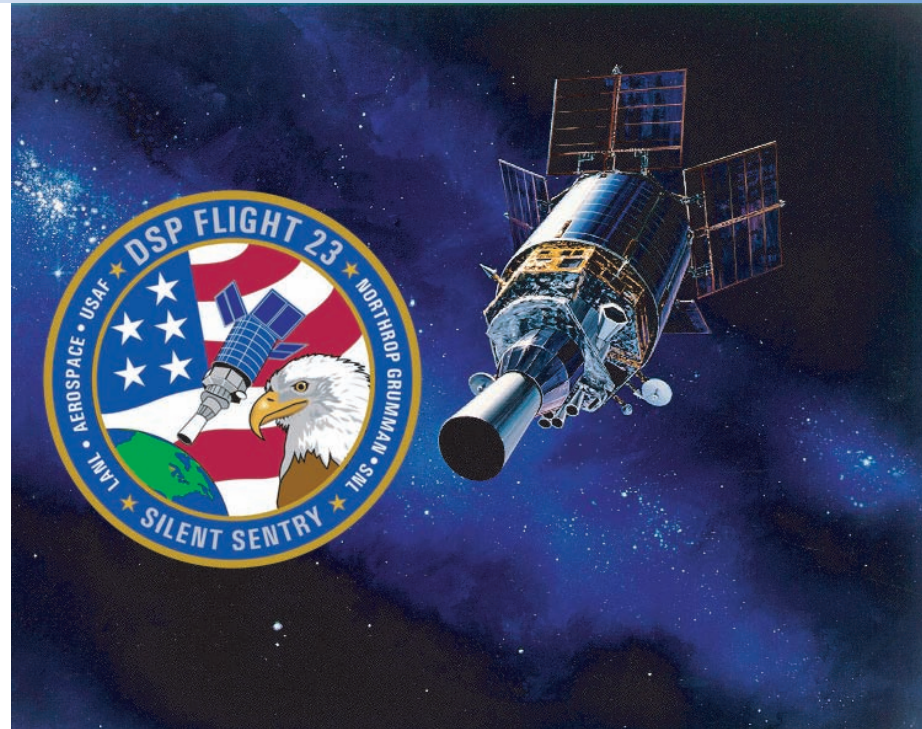
## BANNER

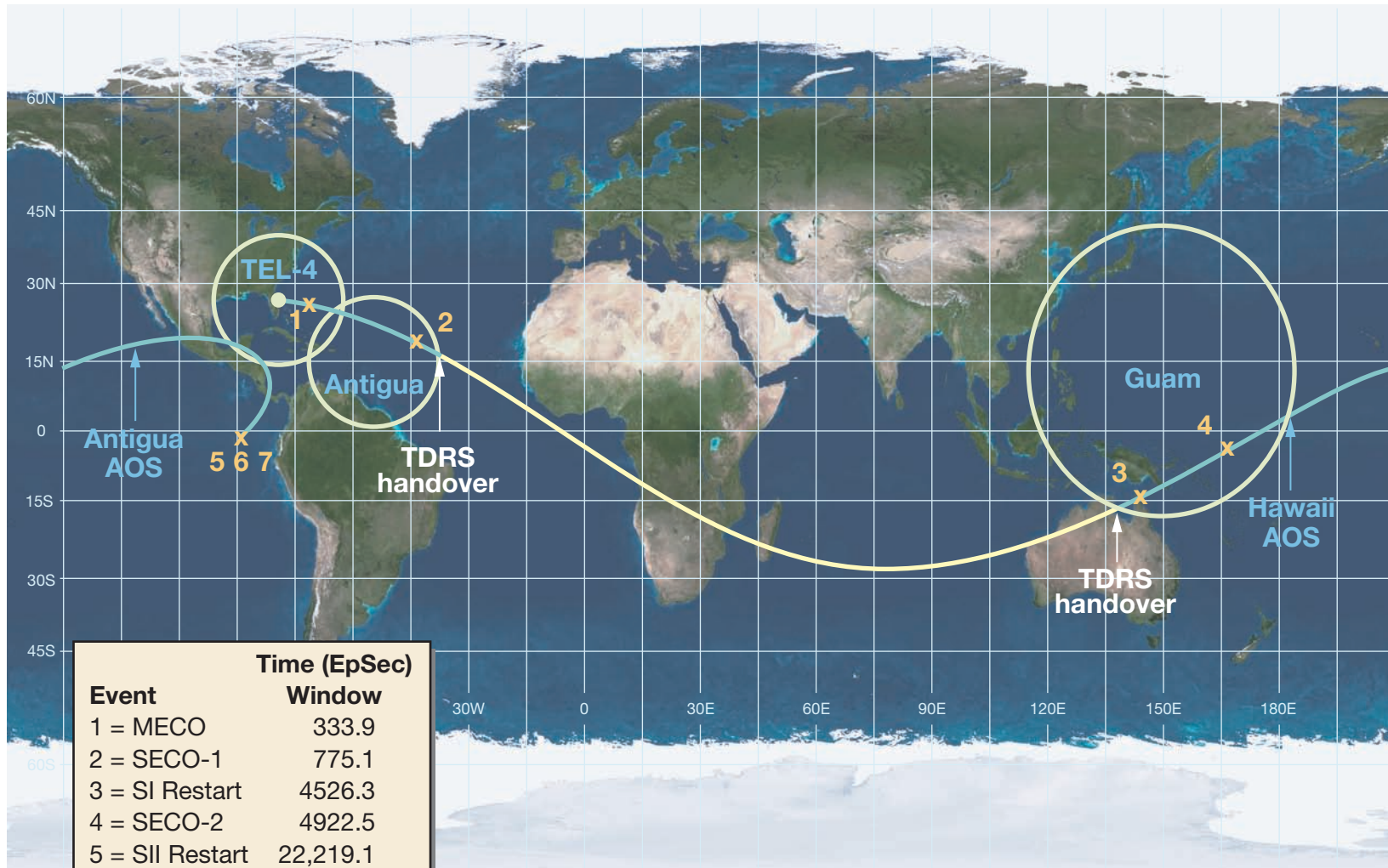
The banner proclaims this mission: DSP-23 — Silent Sentry. Along with the mission name, the DSP-23 satellite team members are listed and consist of the USAF, Aerospace, Northrop Grumman (spacecraft and sensor contractor for the infrared mission), and the Sandia and Los Alamos National Laboratories (nuclear detection mission). Four gold stars can be seen in the banner and represent the DSP team's qualities: Constancy, Consistency, Commitment, and Excellence. These team qualities successfully pave the path to

DSP's operational orbit. The eagle conveys the proud and long-lasting legacy that the DSP satellite has had, and the eagle's eye conveys the sharp visual acuity of the of the DSP satellite while providing nationally critical, infrared strategic and tactical missile warning. The two stars on the left and three stars on the right shown in the flag represent the 23 satellites built and flown over a 37-year period.

## SILENT SENTRY

The nickname conveys DSP satellite's service as a guard on-watch at it's orbital post, serving this nation gallantly as the missile warning detection "eye" on the world.





Event	Time (EpSec)
1 = MECO	333.9
2 = SECO-1	775.1
3 = SI Restart	4526.3
4 = SECO-2	4922.5
5 = SII Restart	22,219.1
6 = SECO-3	22,400.0
7 = SV Sep	22,792.0

## Launch Parameters

- Date 8 November 2007
- Time 20:44 hr:min EST
- Launch Window Duration 126 min
- Location CCAFS (SLC-37B)
- Vehicle Configuration Delta IV Heavy
- Orbit Ascending Node; Direct Injection to GEO

## Spacecraft Weight

- SV 5179 lb
- IUS Adapter and Payload Adapter 2431 lb

## Target Orbit (immediately following SV separation)

- Drift Rate 1.5 +2.1/-1.5 deg/day West
- Eccentricity 0 + 0.004
- Inclination 4.0 ± 0.3 deg
- RAAN (True of Date) (for CY 2007) 284.90 ± 17 deg
- Equivalent Circular Orbit Altitude\* 19,385.6 nmi

\* Based on a 3443.9-nmi Earth Radius



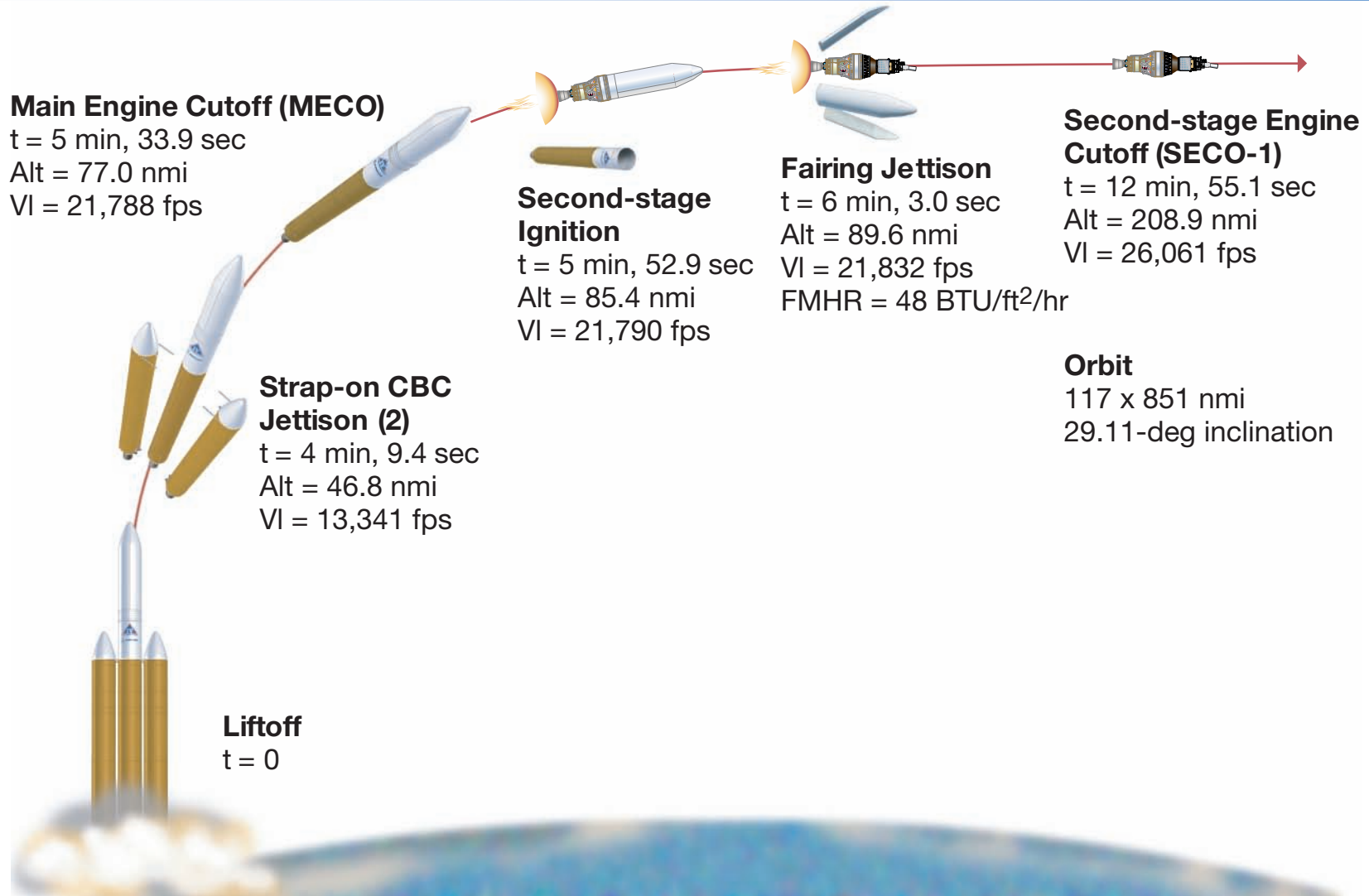


# Flight Mode Description

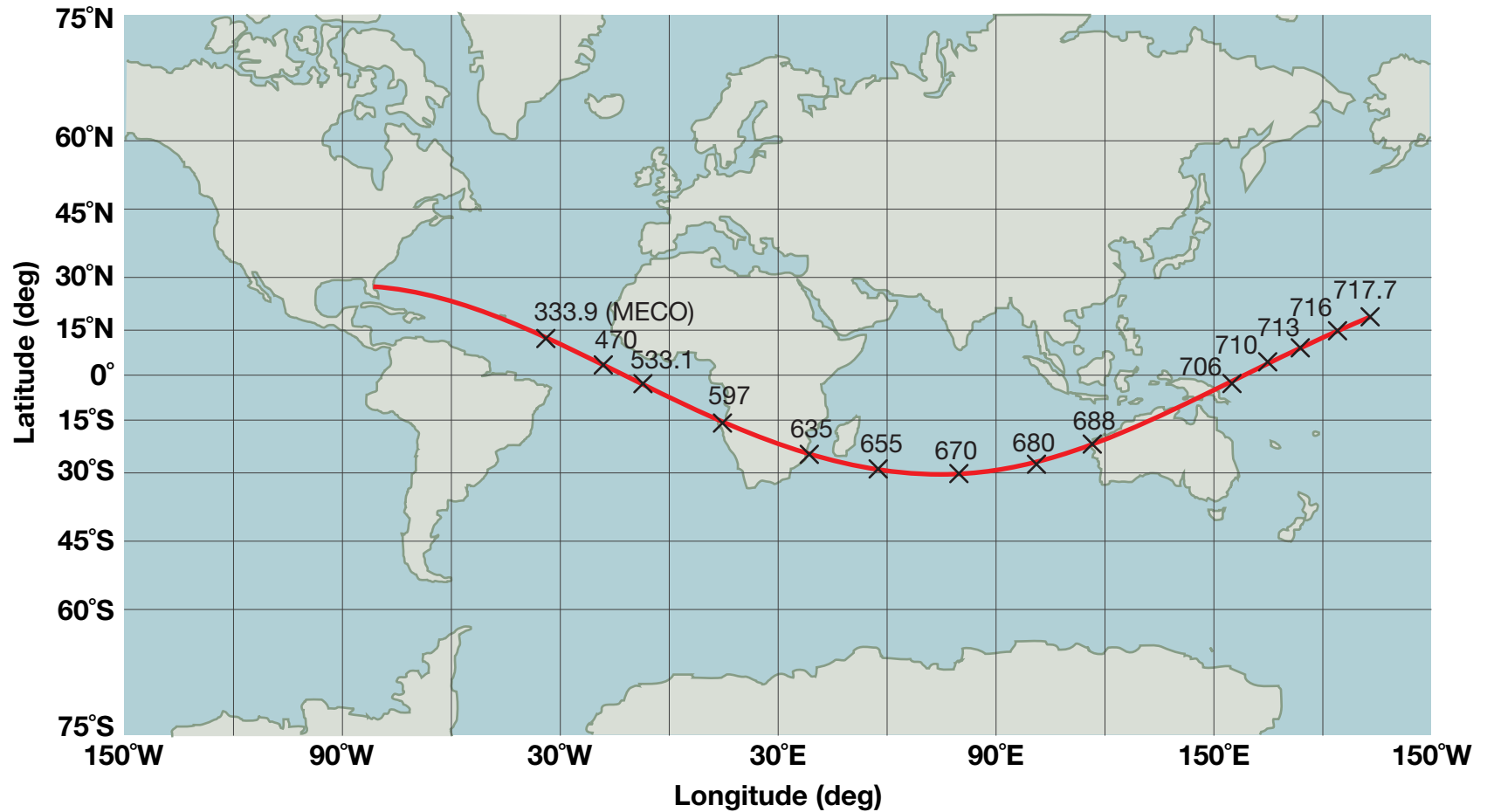
## Liftoff Through SECO-1



- Delta IV Heavy/DSP-23 launch from Eastern Range SLC-37B
- Flight azimuth: 95 deg
- Direct flight azimuth mode employed (combined pitch/yaw)
- Boost trajectory designed to meet controllability, structural, and environmental constraints as well as continuous telemetry coverage
- Core CBC throttle-down initiated approximately 50 sec into flight
- Core CBC throttle-up initiated after strap-on CBC cutoff and separation
- Payload fairing jettisoned approximately 10 sec after Stage II ignition
- Stage II first burn places vehicle in a 117 x 851 nmi park orbit inclined at 29.11 deg
- SECO-1 occurs in view of the Antigua tracking station



Event	Time (hr:min:sec)
Liftoff	0:00:00.0
Initiate CBC Core Throttle-down	0:00:50.0
Maximum Dynamic Pressure (358 psf)	0:01:21.4
Mach 1.05	0:01:23.9
Initiate CBC Strap-on Throttle-down	0:03:55.3
CBC Strap-on Engine Cutoff	0:04:06.3
Jettison CBC Strap-ons	0:04:09.4
Initiate CBC Core Throttle-up	0:04:10.3
Initiate CBC Core Throttle-down	0:05:22.9
Main Engine Cutoff (MECO)	0:05:33.9
Stage I/II Separation	0:05:39.9
Stage II Ignition	0:05:52.9
Jettison Fairing	0:06:03.0
SECO-1	0:12:55.1



000 Flight time (sec)

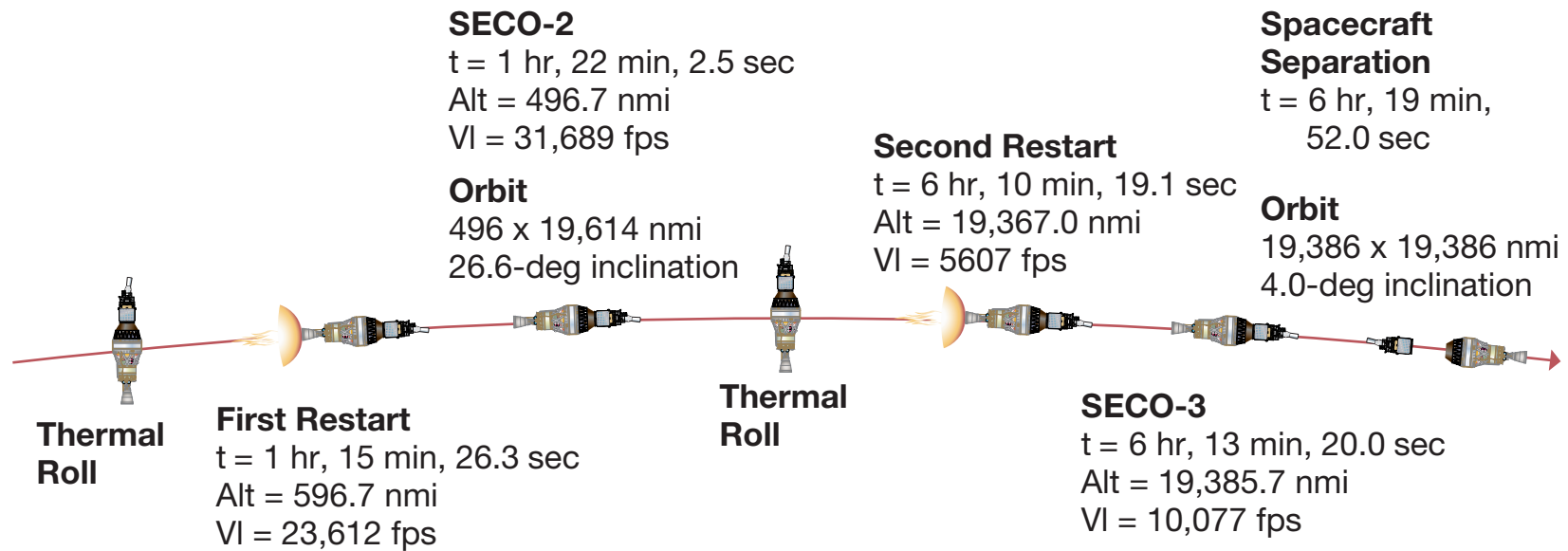
X

- Following SECO-1, the vehicle is reoriented normal to the ecliptic
- A thermal roll maneuver of approximately 1 deg per sec is performed during the coast period
  - This roll is reversed in direction half-way through the coast
  - First coast TM coverage provided by TDRSS (TDRS-E and -Z)
- Following the roll, the vehicle is reoriented to the restart attitude
- The first restart burn of the second stage occurs near the ascending node of the park orbit in view of the Guam tracking station
- SECO-2 occurs approximately after a 396-sec burn, placing the vehicle into a 496 x 19,614-nmi altitude, 26.6-deg inclination transfer orbit

- Following SECO-2, the vehicle is again oriented normal to the ecliptic
- A thermal roll maneuver of approximately 1 dps is performed during the coast period
  - This roll is reversed once, half-way through the coast
- Eclipse constraints during the transfer orbit may restrict launch window duration depending on the launch date
- Following the roll, the vehicle is reoriented to the second restart attitude
- The second restart burn occurs near apogee of the transfer orbit in view of the Hawaii, Vandenberg, TEL4, and Antigua tracking stations
- SECO-3 occurs after about a 181-sec burn and is followed by a reorientation to the spacecraft separation attitude

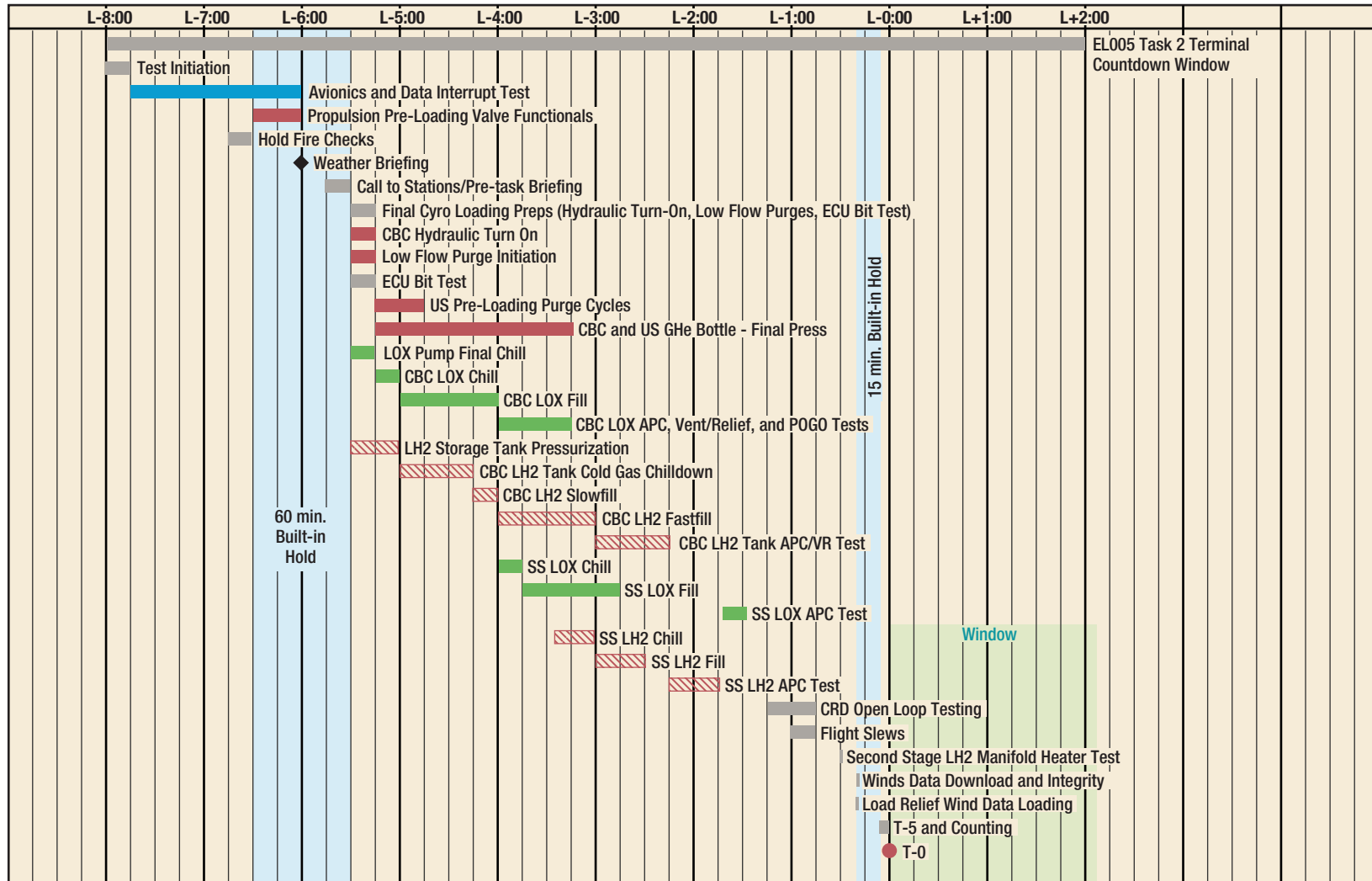
- Nominal spacecraft separation occurs 22,792 sec (6 hr, 19 min, 52 sec) after liftoff
- The nominal separation attitude points the spacecraft +Z axis opposite to the inertial velocity vector
- Nominal separation roll orientation aligns the LV +Z axis +28 deg from nadir about the LV +X axis
- Nominal relative separation velocity is 1.31 fps
- For approximately 2 hr around separation, the spacecraft is in view of the Sun
- Spacecraft separation occurs approximately 392 sec after SECO-3 in view of the Hawaii, Vandenberg, TEL4, and Antigua tracking stations
- Nominal orbit parameters following spacecraft separation

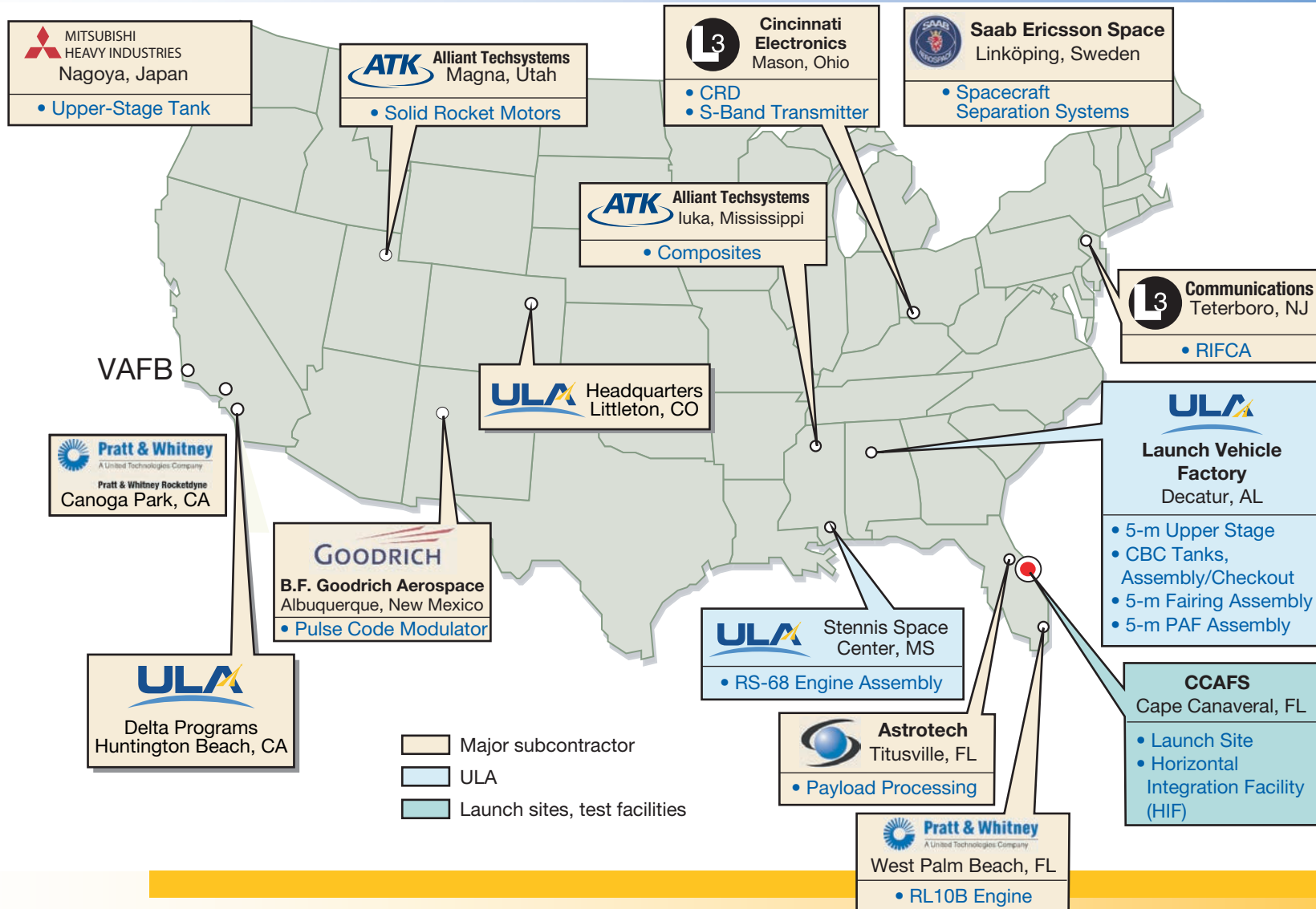
Semi-major Axis	22,830 nmi
Eccentricity	0.0000
Inclination	4.000 deg
True-of-Date RAAN	284.90 deg





Event	Time (hr:min:sec)
Begin Thermal Roll	0:25:51.0
End Thermal Roll	1:06:32.0
First Restart – Stage II	1:15:26.3
Second Cutoff – Stage II (SECO-2)	1:22:02.5
Begin Thermal Roll	1:28:17.0
End Thermal Roll	5:58:07.0
Second Restart – Stage II	6:10:19.1
Third Cutoff – Stage II (SECO-3)	6:13:20.0
Spacecraft Separation	6:19:52.0

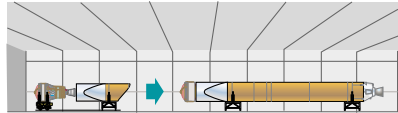




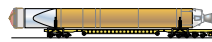
# Delta IV Hardware Flow at CCAFS



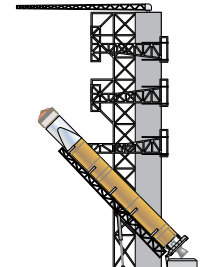
Delta Mariner delivers CBCs, 5-m upper stages, and 5-m fairings to launch site



Horizontal integration and testing of CBC and second stages



Transport to launch pad

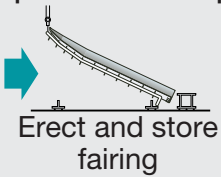


Erect vehicle on launch pad

## Payload encapsulation in parallel with Delta IV vehicle processing



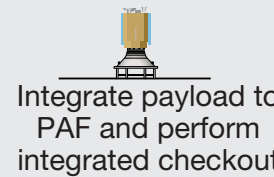
Payload processing facility



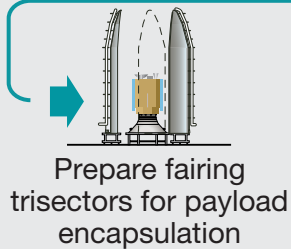
Erect and store fairing



Install payload attach fitting on buildup stand



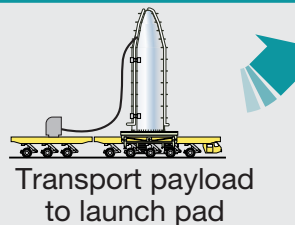
Integrate payload to PAF and perform integrated checkout



Prepare fairing trisectors for payload encapsulation

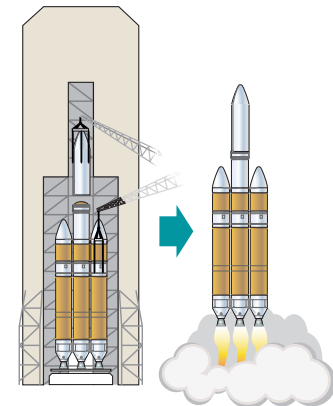


Encapsulate payload



Transport payload to launch pad

Payload lifted by crane and attached to launch vehicle



Launch





**ULA™**  
United Launch Alliance



**DSP-23**

Defense Support Program-23

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