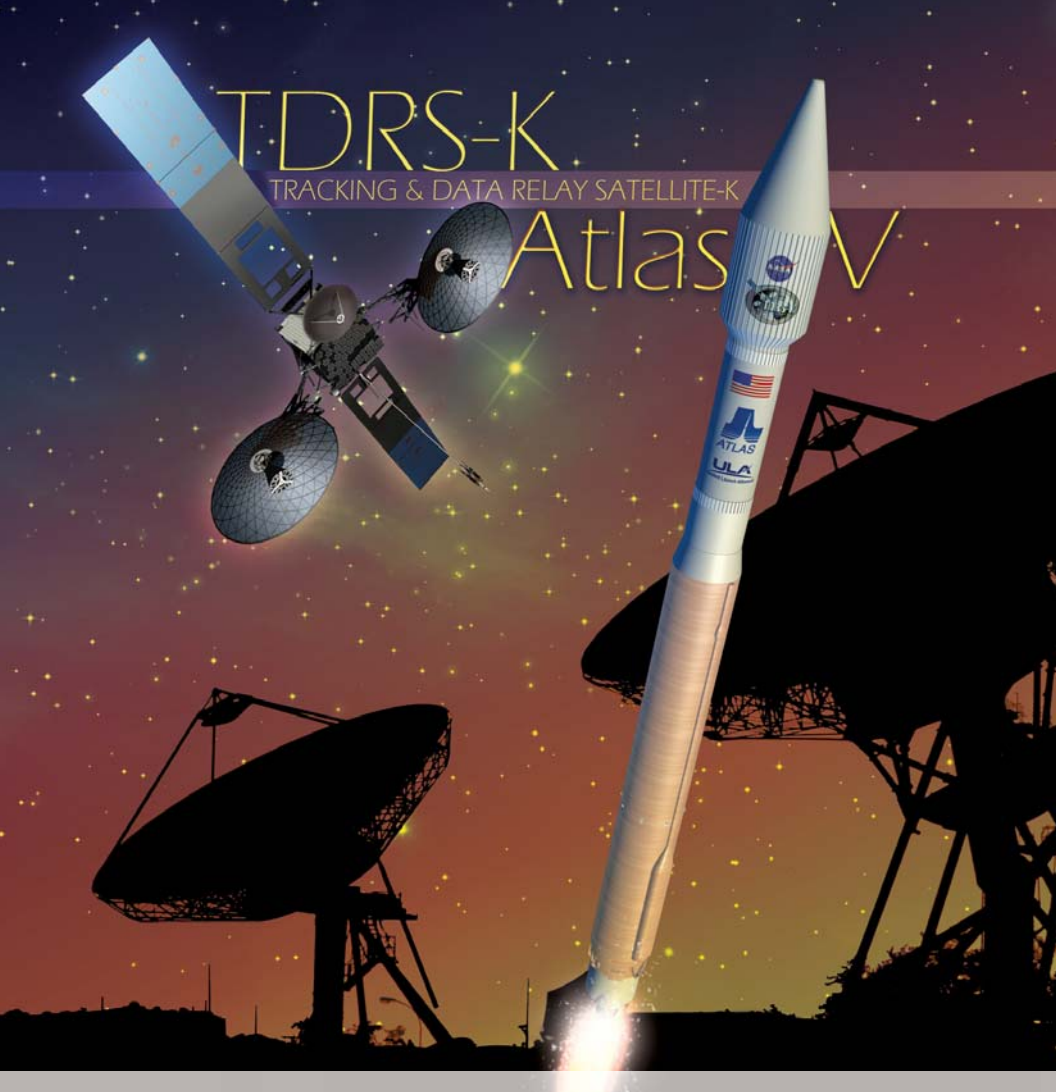


MISSION OVERVIEW

SLC-41
CCAFS, FL

ULA®
United Launch Alliance

ATLAS®

The ULA team is proud to be the launch provider for the Tracking Data and Relay Satellite-K (TDRS-K) mission. The TDRS system is the third generation space-based communication system used to provide tracking, telemetry, command and high-bandwidth data-return services for the National Aeronautics and Space Administration's (NASA) Space Network.

The TDRS project office at NASA's Goddard Space Flight Center manages the TDRS-K development effort and our direct customer for this launch is the NASA Launch Services Program (LSP).

The ULA team is focused on attaining Perfect Product Delivery for the TDRS-K mission, which includes a relentless focus on mission success (the perfect product) and also excellence and continuous improvement in meeting all of the needs of our customers (the perfect delivery).

Launched together with our NASA partners, the TDRS-K mission marks the first 2013 Evolved Expendable Launch Vehicle (EELV) launch. My thanks to the entire team for their dedication in bringing TDRS-K to launch and also to NASA for entrusting ULA to deliver this critical capability to orbit.

Go Atlas, Go Centaur, Go TDRS-K!

Jim Sponnick
Vice President, Mission Operations

TDRS-K SATELLITE | Overview

The Tracking and Data Relay Satellite System (TDRSS) is a space-based communication system used to provide tracking, telemetry, command, and high-bandwidth data return services. The TDRSS, also referred to as the NASA Space Network, consists of satellites in geosynchronous stationary orbits and the associated TDRS ground stations located at White Sands, NM and Guam. Aboard each satellite are multiple antennae that send and receive signals to and from the ground to multiple satellites simultaneously. As a result, the TDRSS provides a wide variety of services to meet customers' needs and demands.

Microwave communications equipment and gimbaled antennae are the primary payload of each TDRS. The TDRSS is capable of providing near continuous high bandwidth (S, Ku, and Ka band) telecommunications services for Low Earth orbiting spacecraft and expendable launch vehicles, including the Hubble Space Telescope and the International Space Station. The TDRS System is a basic agency capability and a critical national resource.

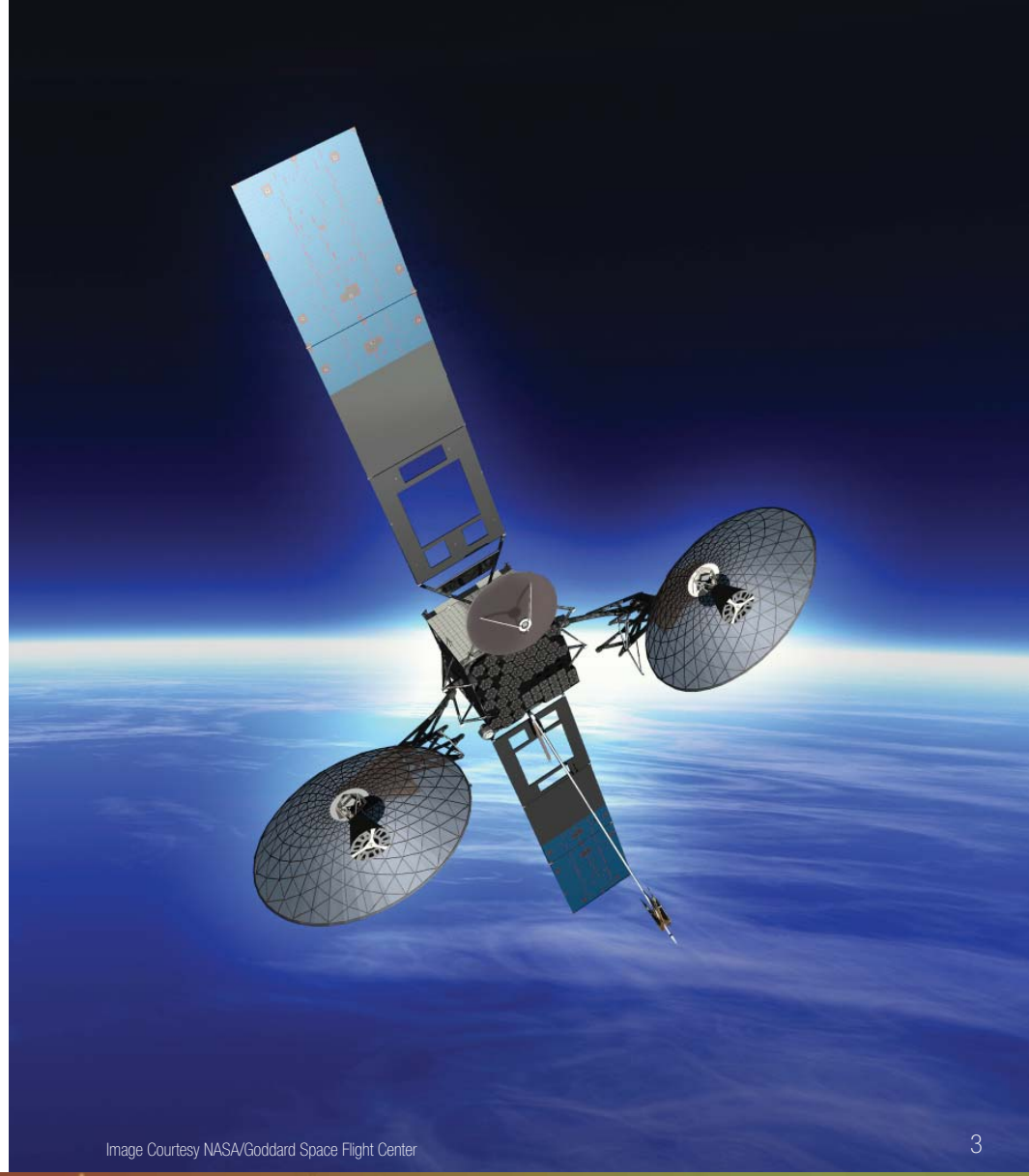


Image Courtesy NASA/Goddard Space Flight Center

ATLAS V 401 LAUNCH VEHICLE | Overview

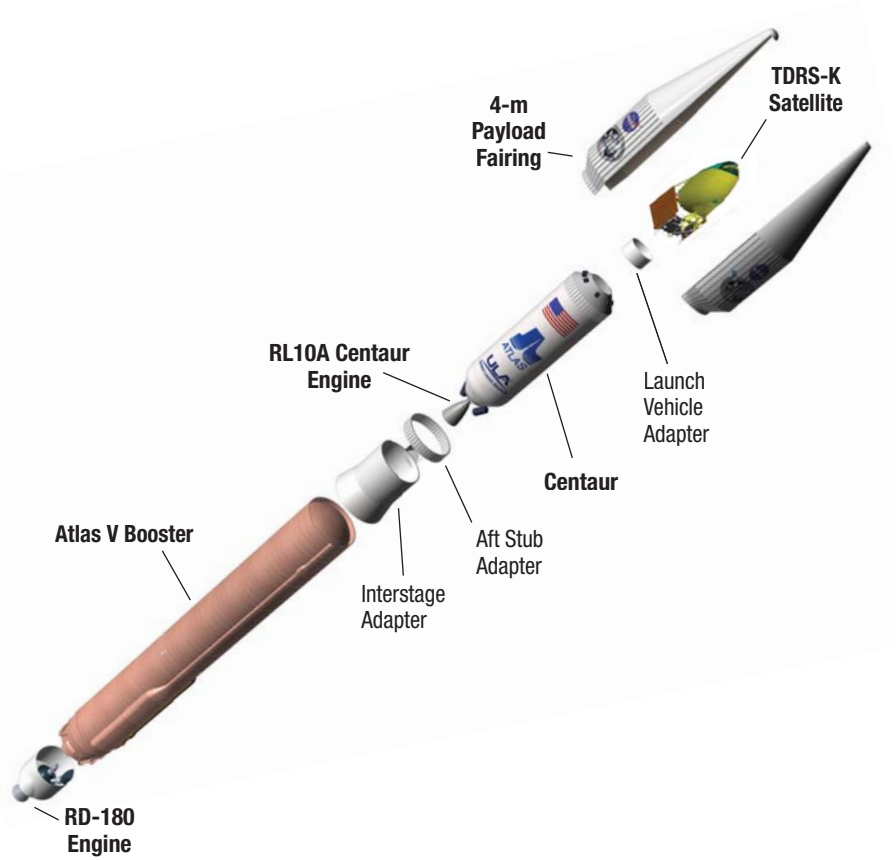
The Atlas V 401 consists of a single Atlas V booster stage, the Centaur upper stage, and a 4-m diameter payload fairing (PLF).

The Atlas V booster is 12.5 ft in diameter and 106.5 ft in length. The booster's tanks are structurally rigid and constructed of isogrid aluminum barrels, spun-formed aluminum domes, and intertank skirts. Atlas booster propulsion is provided by the RD-180 engine system (a single engine with two thrust chambers). The RD-180 burns RP-1 (Rocket Propellant-1 or highly purified kerosene) and liquid oxygen, and delivers 860,200 lb of thrust at sea level. The Atlas V booster is controlled by the Centaur avionics system, which provides guidance, flight control, and vehicle sequencing functions during the booster and Centaur phases of flight.

The Centaur upper stage is 10 ft in diameter and 41.5 ft in length. Its propellant tanks are constructed of pressure-stabilized, corrosion resistant stainless steel. Centaur is a liquid hydrogen/liquid oxygen- (cryogenic-) fueled vehicle. It uses a single RL10A-4-2 engine producing 22,300 lb of thrust. The cryogenic tanks are insulated with a combination of helium-purged insulation blankets, radiation shields, and spray-on foam insulation (SOFI). The Centaur forward adapter (CFA) provides the structural mountings for the fault-tolerant avionics system and the structural and electrical interfaces with the spacecraft.

The TDRS-K mission is encapsulated in the 4-m (14-ft) diameter extended payload fairing (EPF). The EPF is a bisector (two-piece shell) fairing consisting of aluminum skin/stringer construction with vertical split-line longerons. The vehicle's height with the EPF is approximately 192 ft.

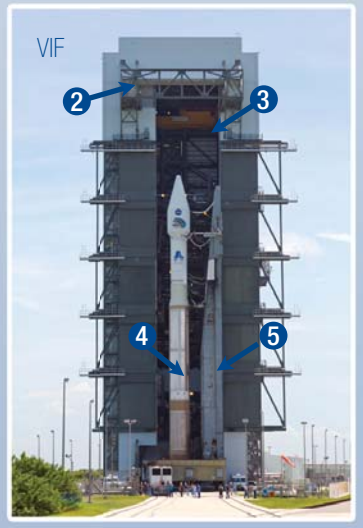
ATLAS V 401 LAUNCH VEHICLE | Expanded View

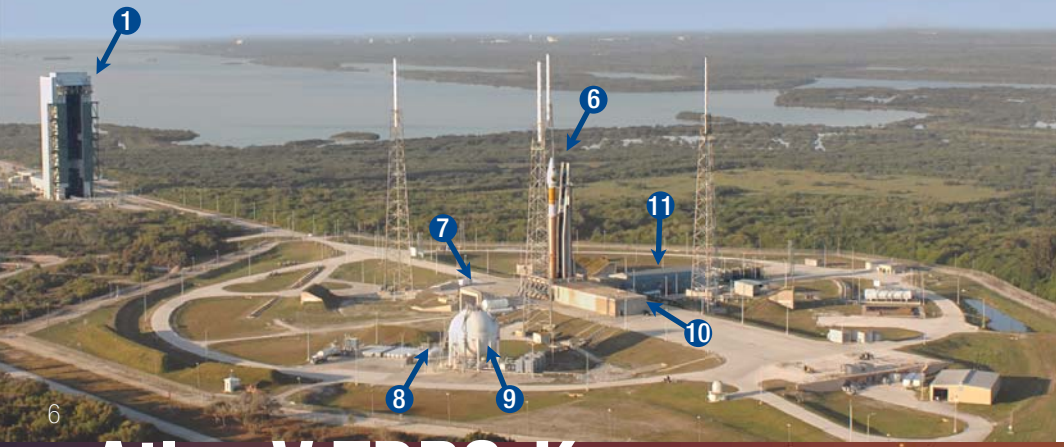


Atlas V TDRS-K

SPACE LAUNCH COMPLEX 41 (SLC-41) | Overview

1 Vertical Integration Facility (VIF) (See inset)
2 Bridge Crane Hammerhead
3 Bridge Crane
4 Launch Vehicle
5 Mobile Launch Platform (MLP)
6 Launch Vehicle
7 Centaur LO_2 Storage
8 High Pressure Gas Storage
9 Booster LO_2 Storage
10 Pad Equipment Building (PEB)
11 Pad ECS Shelter





ATLAS V TDRS-K | Mission Overview

The TDRS-K mission will be flown on an easterly trajectory from Space Launch Complex 41 at Cape Canaveral Air Force Station (CCAFS), FL. The TDRS-K satellite will be released into a highly elliptical geosynchronous transfer orbit (GTO).

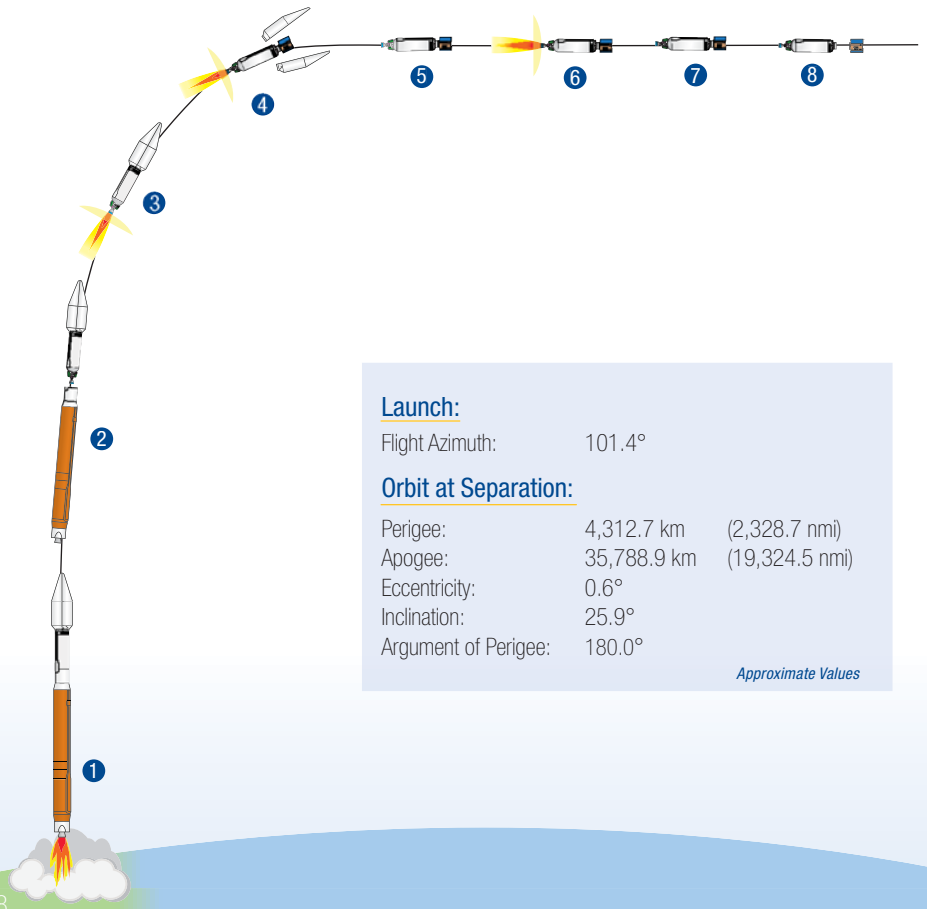
The mission begins with ignition of the RD-180 engine approximately 2.7 seconds prior to liftoff. Liftoff occurs at T+1.1 seconds. Shortly after the vehicle clears the pad, it performs its pitch/yaw/roll maneuvers.

Following maximum dynamic pressure, the RD-180 is throttled down to 95%. Guidance steering is enabled approximately 140 seconds into flight. At 212 seconds, the vehicle throttles up to a constant 5.0 G-level. Approximately 10 seconds prior to booster engine cutoff (BECO), the Atlas V throttles down to a constant 4.6 G's. BECO occurs 242 seconds into flight followed by Centaur separation approximately 6 seconds later.

Approximately 4 minutes into flight, the Centaur stage ignites its main engine (MES-1) which begins a 14-minute burn to place the vehicle into a parking orbit. Eight seconds into the first Centaur burn, the payload fairing is jettisoned.

Following an 82-minute coast, the Centaur main engine is ignited for a second burn (MES-2), nearly 59 seconds in length. Two seconds after main engine cutoff (MECO-2), the Centaur begins a spacecraft separation attitude alignment and spins up to 5 RPM. TDRS-K is released approximately 106 minutes after liftoff.

FLIGHT PROFILE | Liftoff to Separation



Launch:

Flight Azimuth: 101.4°

Orbit at Separation:

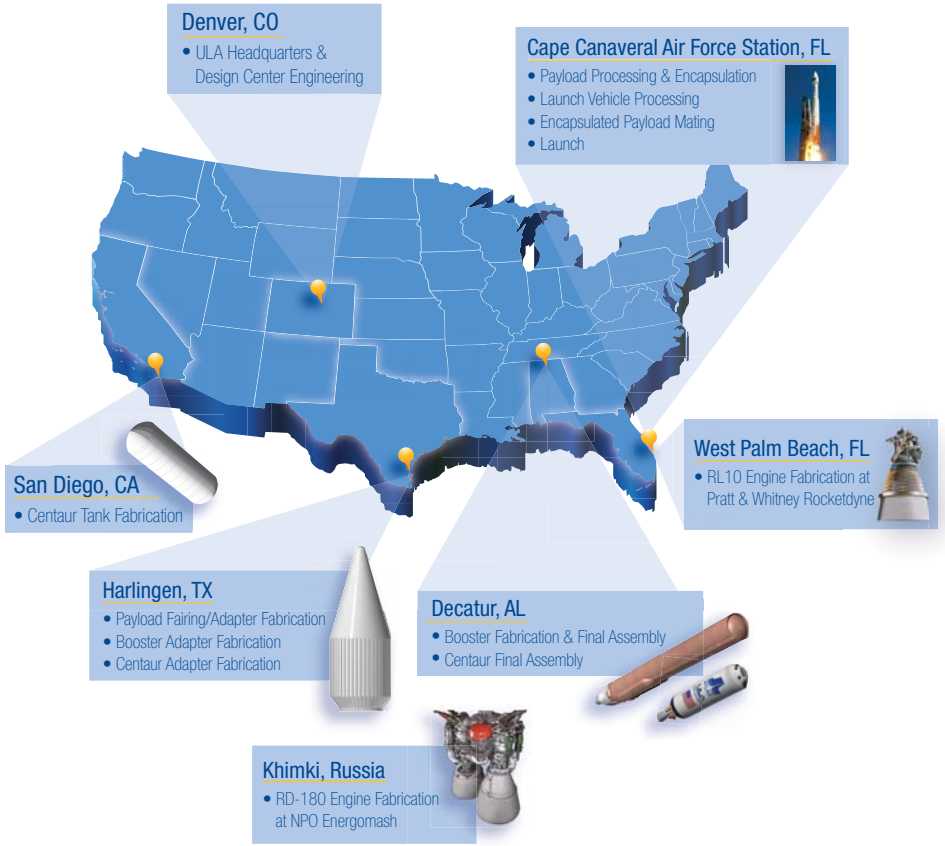
Perigee:	4,312.7 km	(2,328.7 nmi)
Apogee:	35,788.9 km	(19,324.5 nmi)
Eccentricity:	0.6°	
Inclination:	25.9°	
Argument of Perigee:	180.0°	

Approximate Values

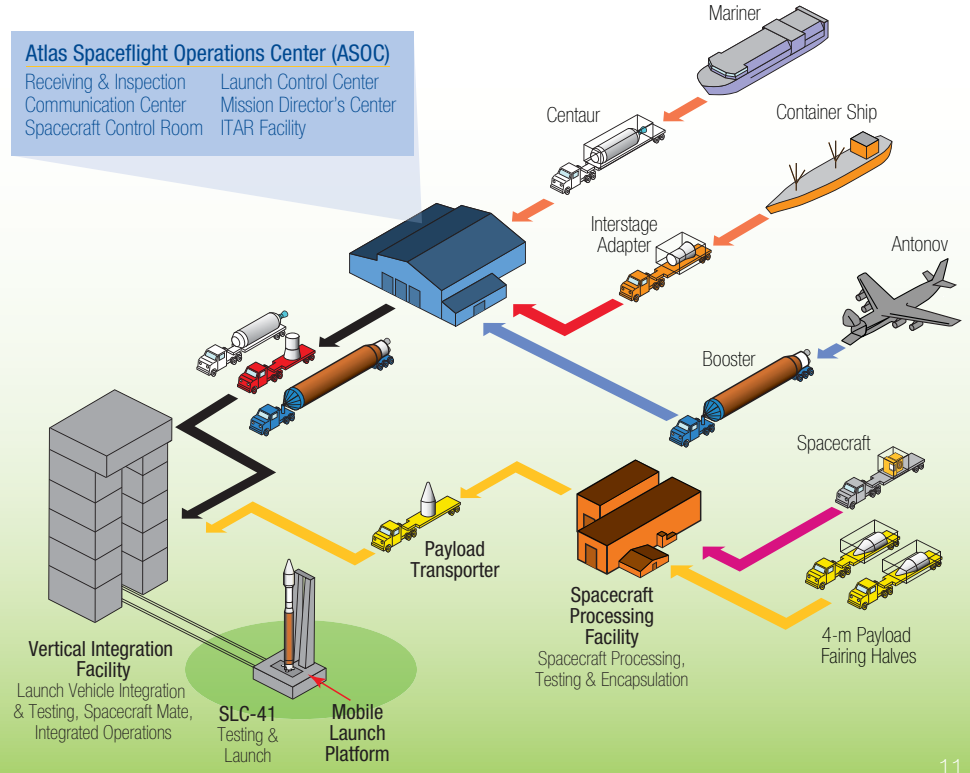
SEQUENCE OF EVENTS | Liftoff to Separation

	Event	Time (seconds)	Time (hr:min:sec)
1	RD-180 Engine Ignition	-2.7	-00:00:02.7
	T=0 (Engine Ready)	0.0	00:00:00.0
	Liftoff (Thrust to Weight >1)	1.1	00:00:01.1
	Begin Pitch/Yaw/Roll Maneuver	17.6	00:00:17.6
	Maximum Dynamic Pressure	91.4	00:01:31.4
2	Atlas Booster Engine Cutoff (BECO)	242.0	00:04:02.0
	Atlas Booster/Centaur Separation	248.0	00:04:08.0
3	Centaur First Main Engine Start (MES-1)	258.0	00:04:18.0
4	Payload Fairing Jettison	266.0	00:04:26.0
5	Centaur First Main Engine Cutoff (MECO-1)	1,093.9	00:18:13.9
6	Centaur Second Main Engine Start (MES-2)	6,017.0	01:40:17.0
7	Centaur Second Main Engine Cutoff (MECO-2)	6,075.7	01:41:15.7
8	TDRS-K Separation	6,361.7	01:46:01.7

ATLAS V PRODUCTION & LAUNCH | Overview

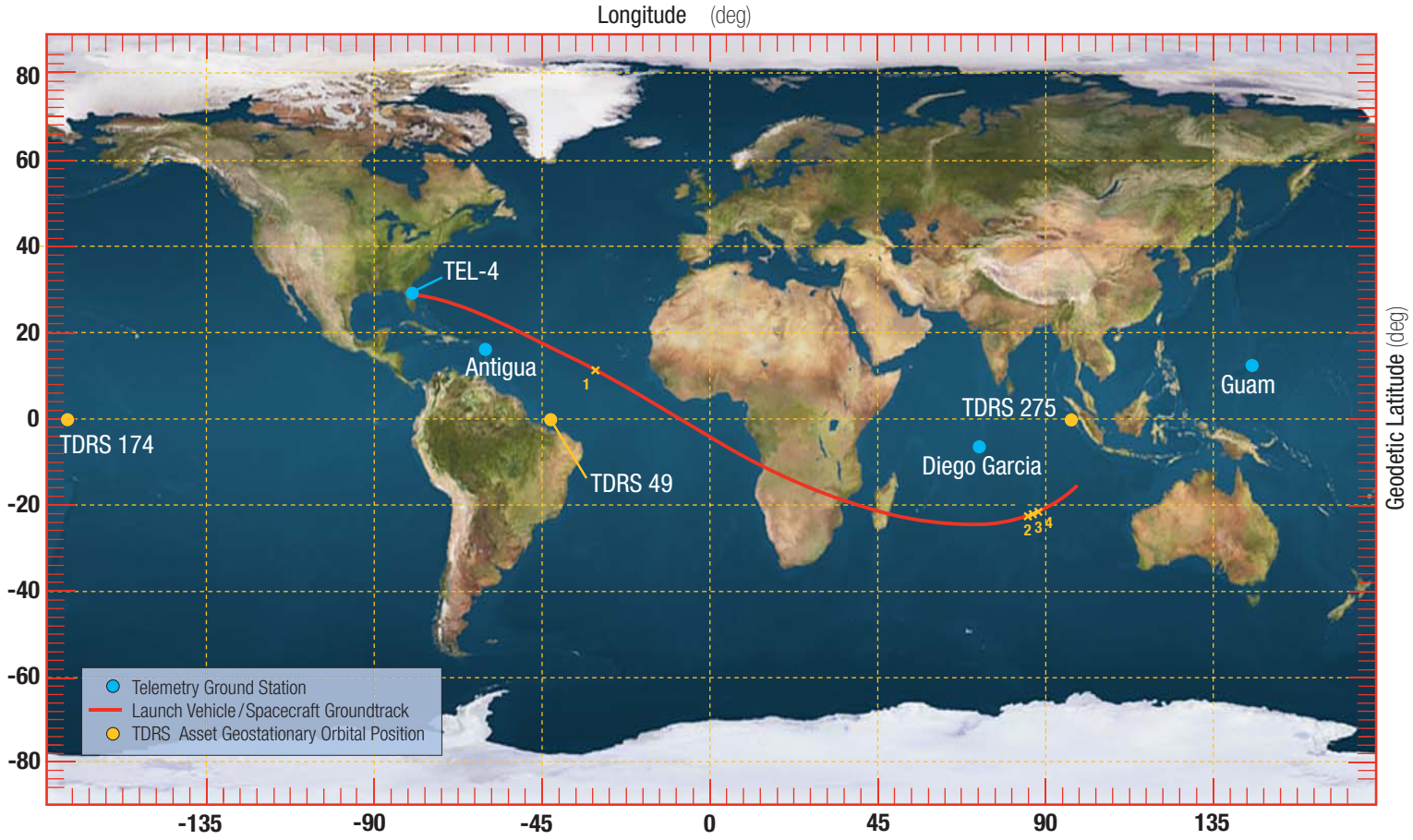


ATLAS V PROCESSING | Cape Canaveral

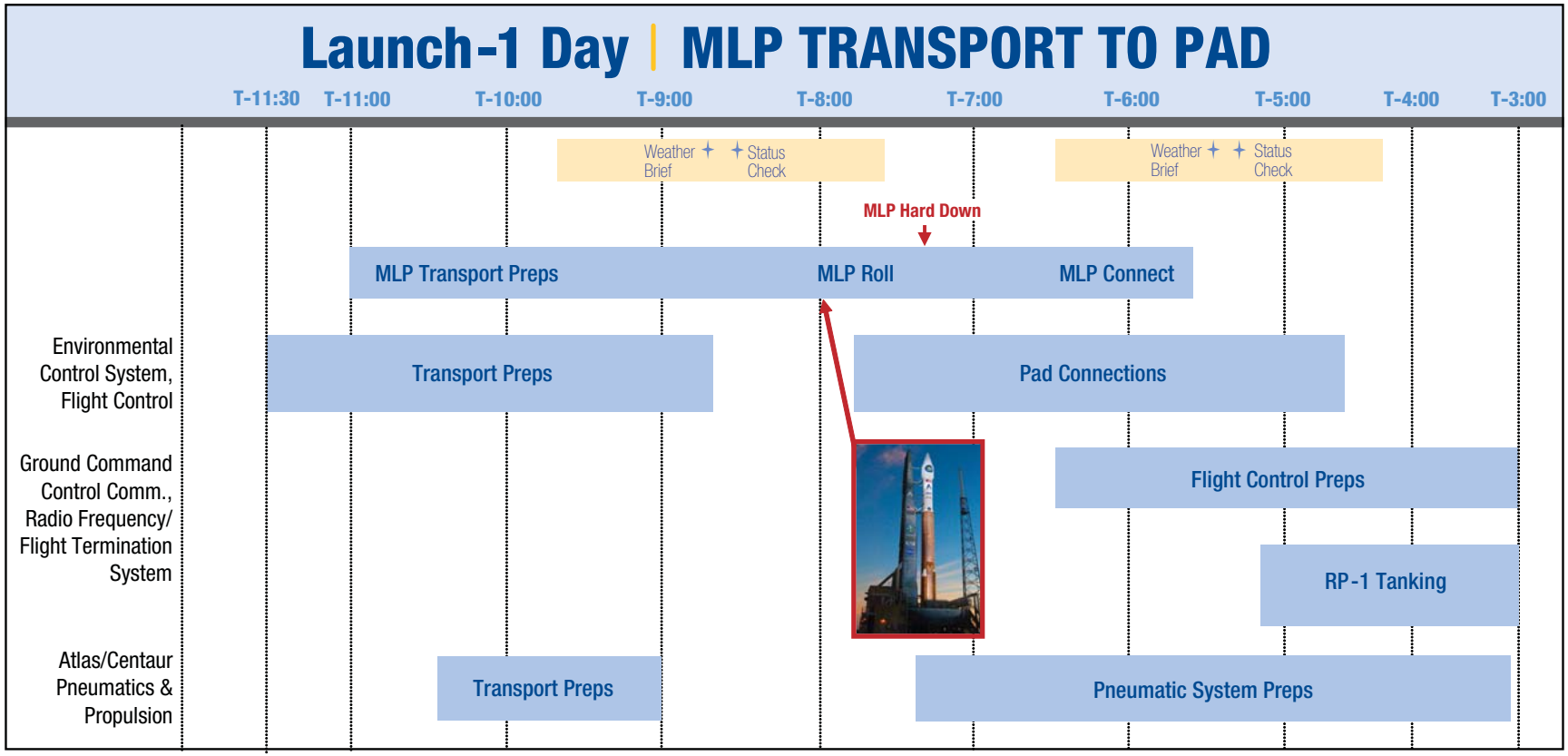


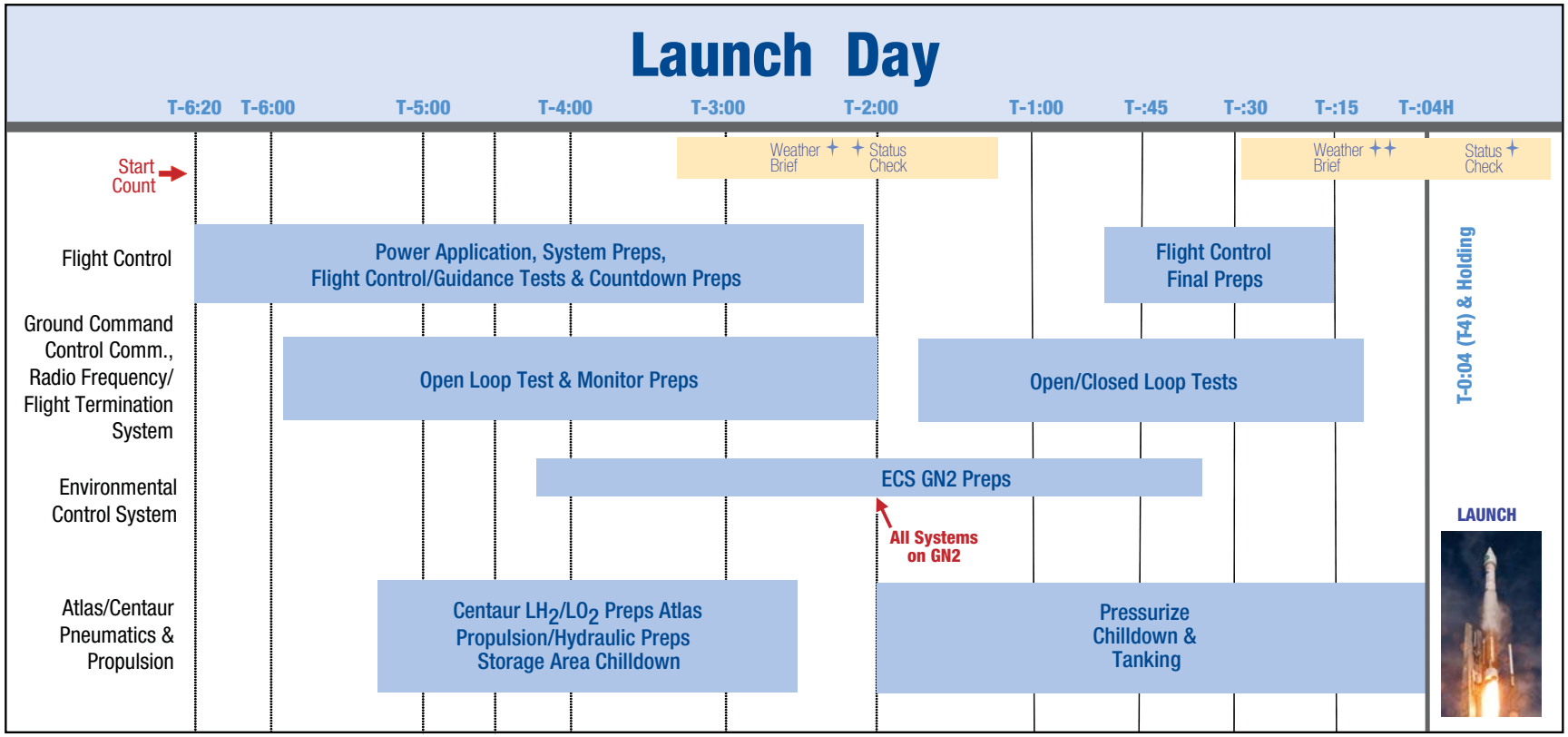
Atlas V TDRS-K

GROUND TRACE | Liftoff to Separation

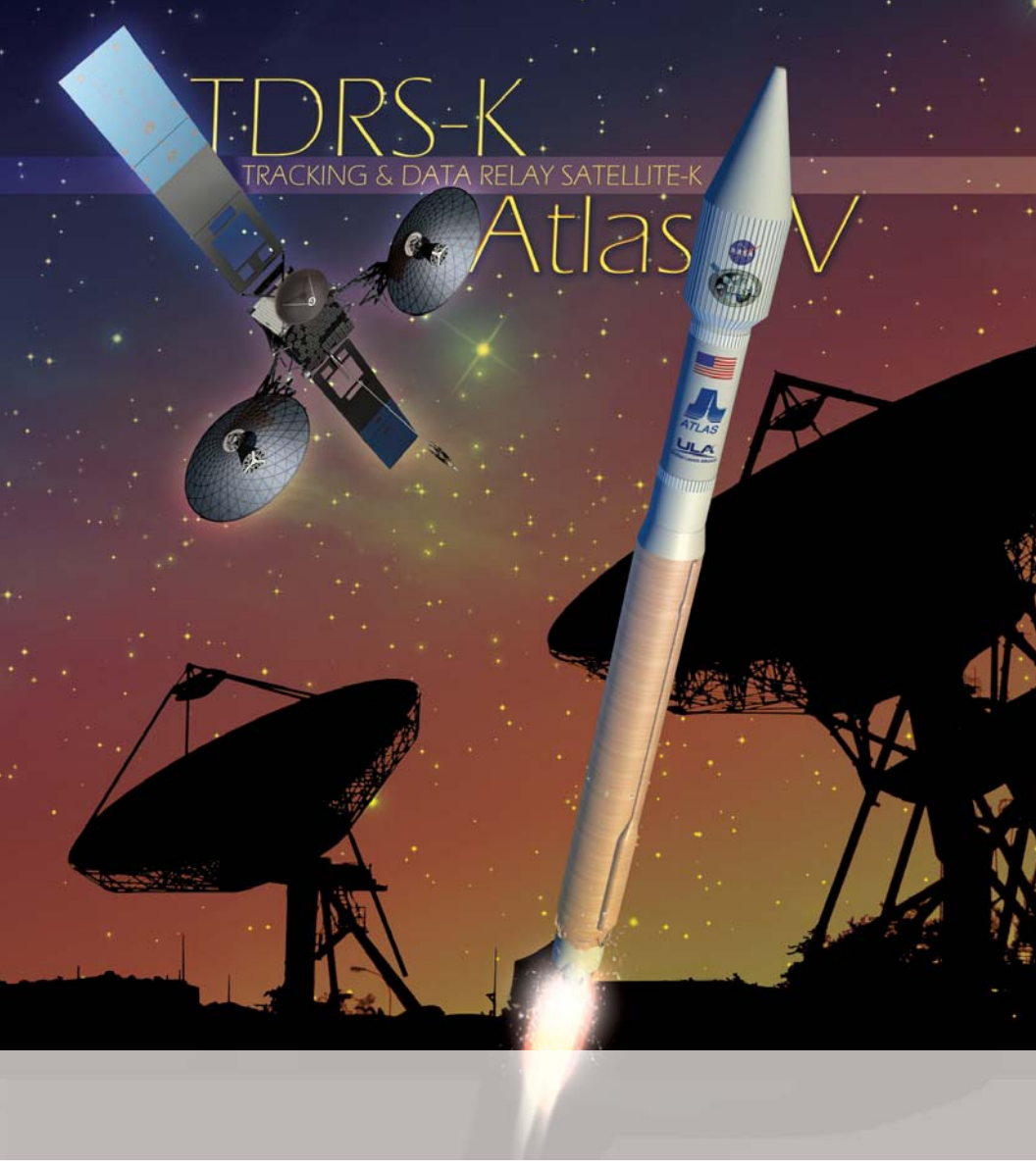


1 = MECO-1 (0:18:13.9) | **2 =** MES-2 (1:40:17.0) | **3 =** MECO-2 (1:41:15.7) | **4 =** TDRS-K Separation (1:46:01.7)


Launch-1 Day | MLP TRANSPORT TO PAD
T-11:30
T-11:00
T-10:00
T-9:00
T-8:00
T-7:00
T-6:00
T-5:00
T-4:00
T-3:00
Weather Brief
Status Check
Weather Brief
Status Check
MLP Hard Down
MLP Transport Preps
MLP Roll
MLP Connect
Environmental Control System, Flight Control
Transport Preps
Pad Connections
Ground Command Control Comm., Radio Frequency/ Flight Termination System
Flight Control Preps
RP-1 Tanking
Atlas/Centaur Pneumatics & Propulsion
Transport Preps
Pneumatic System Preps



Atlas V TDRS-K



United Launch Alliance | P.O. Box 3788 Centennial, CO 80155 | www.ulalaunch.com