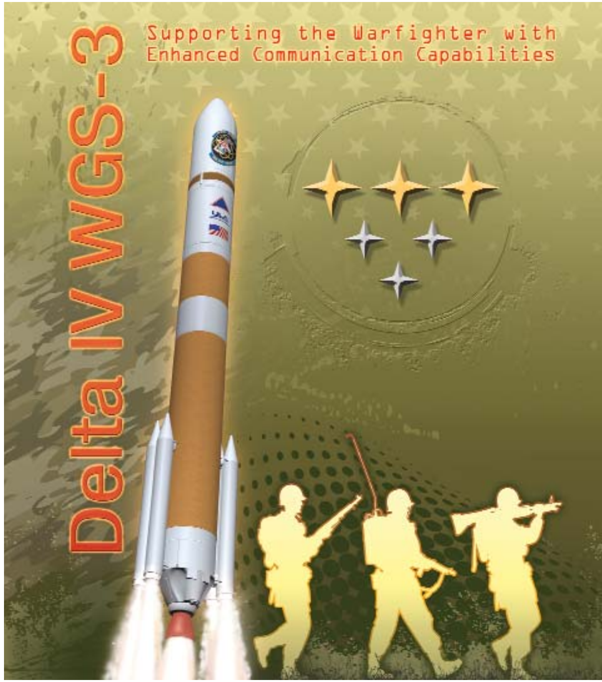
United Launch Alliance

Delta IV Launches WGS-3

Mission Overview



Delta IV Medium+ (5,4)

Cape Canaveral Air Force Station, FL

Space Launch Complex 37

DELTA

Delta IV/WGS-3

United Launch Alliance (ULA) is proud to be a part of the WGS-3 mission with the U.S. Air Force Space Command's Space and Missile Systems Center (AFSPC/SMC). The WGS-3 mission marks the 11th Delta IV launch and the first launch of the Delta IV Medium+ (5,4) launch vehicle configuration.

The WGS-3 mission is the third installment of the Wideband Global SATCOM (WGS) system. The WGS satellites are an important element of a new high-capacity satellite communications system providing enhanced communications capabilities to our troops in the field for the next decade and beyond. WGS enables more robust and flexible execution of Command and Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR), as well as battle management and combat support information functions. WGS-3 augments the existing service available through the UHF F/O, WGS-1, and WGS-2 satellites by providing additional information broadcast capabilities.

My thanks to the entire ULA team for its dedication in bringing WGS-3 to launch, and to the AFSPC/SMC for selecting Delta for this important mission.

Jim Sponnick
Vice President, Delta Product Line

Delta IV Medium+ (5,4) Vehicle

Configuration Overview

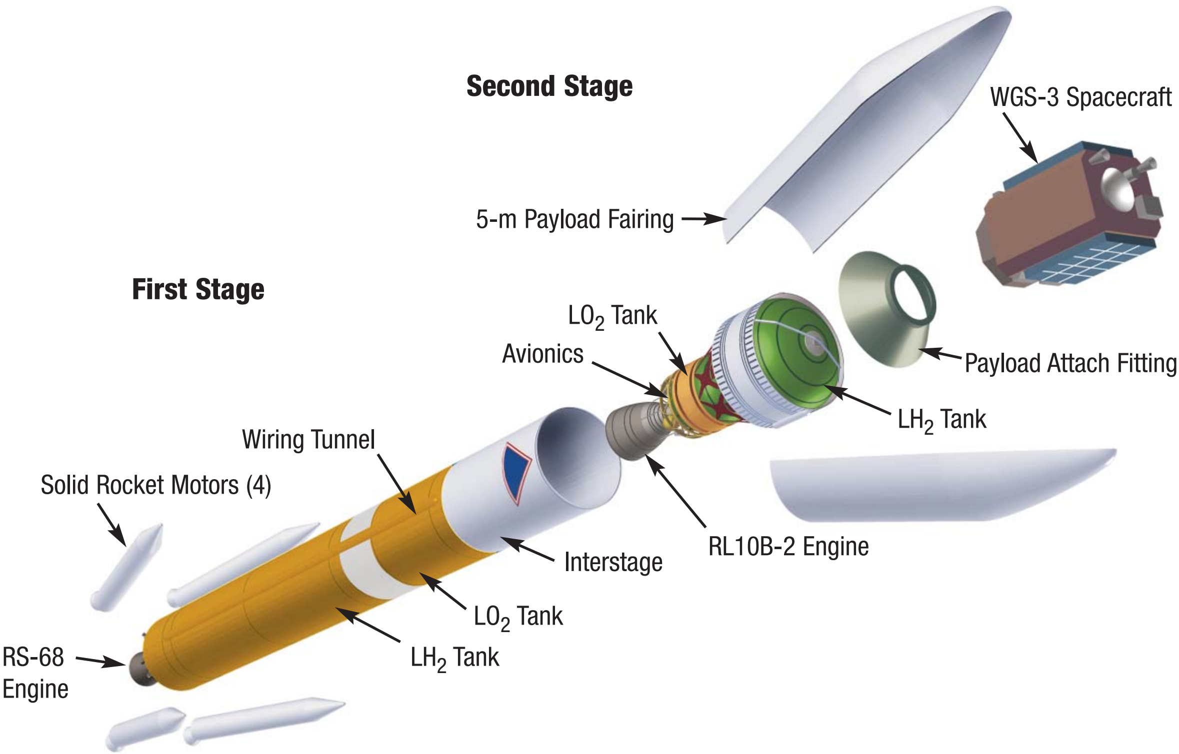
The Delta IV M+ (5,4) consists of a single Delta IV common booster core (CBC), the Delta cryogenic second stage (DCSS), and four solid rocket motors (SRMs). The CBC and the DCSS are connected by a composite cylindrical interstage adapter (ISA). The SRMs are connected to the booster by two ball-and-socket joints and four structural thrusters.

The SRMs are approximately 60 in. in diameter and 53 ft. long, and are constructed of a graphite-epoxy composite. Two of the SRMs have thrust vector control (TVC) capabilities. The SRMs burn for approximately 94 seconds and are jettisoned at roughly 100 seconds into the flight.

The Delta IV booster tanks are structurally rigid, and constructed of isogrid aluminum barrels, spun-formed aluminum domes, machined aluminum tank skirts, and a composite centerbody. Delta IV booster propulsion is provided by the RS-68 engine system. The RS-68 burns cryogenic liquid hydrogen and liquid oxygen, and delivers 663,000 lb of thrust at sea level. The booster's cryogenic tanks are insulated with a combination of spray-on and bond-on insulation, and helium-purged insulation blankets. The Delta IV booster is controlled by the DCSS avionics system, which provides guidance, flight control, and vehicle sequencing functions during CBC and DCSS phases of flight. The boost phase of flight ends 6 seconds after main engine cutoff (MECO), when the separation charge in the interstage adapter is fired and 16 pneumatic actuators push the spent Delta IV CBC stage and the DCSS apart.

The DCSS stage propellant tanks are structurally rigid and constructed of isogrid aluminum ring forgings, spun-formed aluminum domes, machined aluminum tank skirts and a composite Intertank Truss. The DCSS is also a cryogenic liquid hydrogen/liquid oxygen-fueled vehicle. It uses a single RL10B-2 engine that produces 24,750 lb of thrust. Like the CBC, the DCSS cryogenic tanks are insulated with a combination of spray-on and bond-on insulation, and helium-purged insulation blankets. An equipment shelf attached to the aft dome of the DCSS liquid oxygen tank provides the structural mountings for vehicle electronics. The structural and electronic interfaces with the spacecraft (SC) are provided by the payload attach fitting (PAF). The WGS-3 mission uses a 5-m diameter payload fairing (PLF). The PLF is a composite bisector (two-piece shell) fairing. The vehicle's height, with the 47-ft tall PLF, is approximately 217 ft, 7 in.

Delta IV Medium+ (5,4) Vehicle



WGS-3 Spacecraft

Configuration Overview

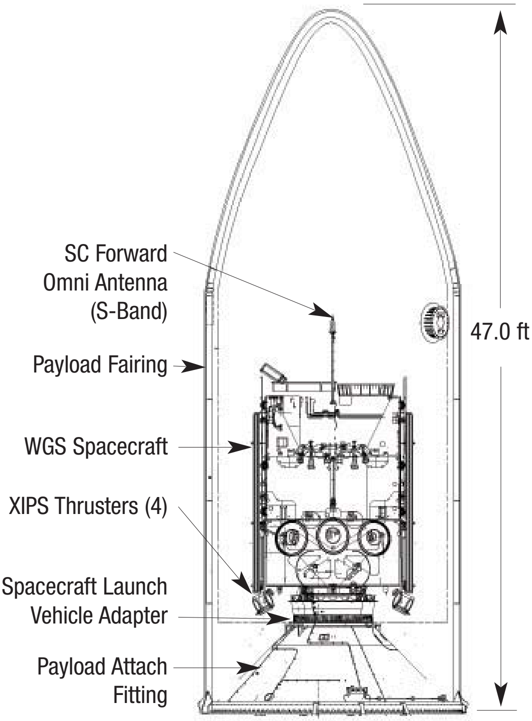
The WGS-3 spacecraft is an approximately 13,200-lb communications satellite. WGS supports communications links in the 500 MHz range of the X-band and 1 GHz range of the Ka-band spectra. WGS can filter and route up to 4.875 GHz of instantaneous bandwidth. Depending on the mix of ground terminals, data rates, and modulation schemes employed, a WGS satellite can support data transmission rates between 2.4 and 3.6 Gbps.

WGS has 19 independent coverage areas that can be positioned throughout its field of view. This includes eight steerable/shapeable X-band beams formed by separate transmit/receive phased arrays; 10 Ka-band beams served by independently steerable diplexed antennas (three with selectable RF polarization); and transmit/receive X-band Earth-coverage beams. WGS can tailor coverage areas and connect X-band and Ka-band users anywhere within its field of view.

Four Army Wideband Satellite Operations Centers (WSOCs) provide command and control of WGS. Each Global SATCOM Configuration and Control Element (GSCCE) has the capability to control up to three satellites at a time, using X-band or Ka-band telemetry and command links. Spacecraft platform control is accomplished by the 3rd Space Operations Squadron at Schriever Air Force Base in Colorado Springs, CO, using WGS mission-unique software and databases.

Support technologies for WGS include the xenon-ion propulsion system (XIPS), which is 10 times more efficient than conventional bipropellant systems, highly efficient triple-junction gallium arsenide solar cells, and deployable radiators with flexible heat pipes. Four 25-cm XIPS thrusters remove orbit eccentricity during transfer orbit operations. The thrusters are also used to perform orbit maintenance and any required station-change maneuvers during the mission's life. The triple-junction gallium arsenide solar cells provide on-orbit electrical power for the spacecraft. The deployable radiators' flexible heat pipes provide increased radiator area, resulting in a cooler, more stable thermal environment for the spacecraft.

WGS-3 Spacecraft



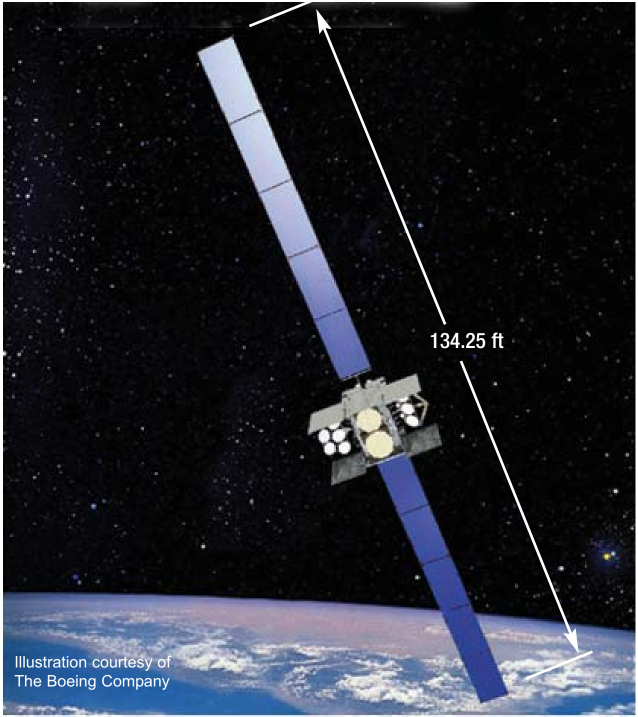


Illustration courtesy of
The Boeing Company

WGS-3 Mission Overview

The WGS-3 mission will be flown from Space Launch Complex 37 (SLC-37) at Cape Canaveral Air Force Station, FL on a Delta IV Medium+ (5,4) vehicle with four SRMs and the single-engine DCSS. The payload will be encapsulated in a 5-meter diameter payload fairing and integrated to the DCSS using a ULA 1575-5 payload attach fitting and a space vehicle contractor (SVC)-provided spacecraft launch vehicle adapter (SCLVA) with separation system and electrical harness.

The WGS-3 payload consists of a single communications satellite. The two-burn, minimum-residual-shut-down mission will fly an easterly trajectory from SLC-37 with an approximately 101-degree flight azimuth. The separation event will release the WGS-3 spacecraft into a supersynchronous transfer orbit with a 237-nautical mile (nm) perigee, an apogee radius of approximately 36,167 nm, and an approximately 24-degree inclination.

Launch begins with RS-68 engine ignition approximately 5.5 seconds before liftoff (T-5.5 seconds). SRM ignition takes place at T-0.02 seconds after telemetry indication of healthy RS-68 startup.

Liftoff occurs at T+0.0 seconds. Shortly after the vehicle clears the pad, it performs its pitch/yaw/roll program. Maximum dynamic pressure occurs approximately 50 seconds into flight.

The SRMs burn out at approximately T+94 seconds, and are jettisoned in pairs at T+100 and 102 seconds. Payload fairing jettison takes place at approximately 206 seconds. MECO occurs at approximately 246 seconds.

WGS-3 Mission Overview (concl'd)

DCSS separation is about 6 seconds after MECO. DCSS main engine start occurs 13 seconds after the separation event. At approximately 20 minutes into the mission, second stage engine cutoff 1 (SECO-1) occurs and DCSS has achieved its parking orbit.

After an 8-minute coast phase, DCSS reorients itself for its restart. Restart ignition takes place approximately 28 minutes into the mission and lasts about 3 minutes. After SECO-2, DCSS re-orients its attitude for the separation event.

The WGS-3 spacecraft separates about 41 minutes after launch. The turn to Collision and Contamination Avoidance Maneuver (CCAM) attitude begins about 3 minutes after the separation event. The DCSS mission ends 79 minutes after launch after blowdown of the propellant tanks and burn off of residual hydrazine.

Telemetry data are gathered by TEL-4, Jonathan Dickinson Missile Tracking Annex (JDMTA), Antigua, Hartebeesthoek (HBK), and Diego Garcia Tracking Stations. The Tracking and Data Relay Satellite System (TDRSS) will also participate in gathering telemetry during the WGS-3 mission.

United Launch Alliance

Delta IV Launch History

DELTA

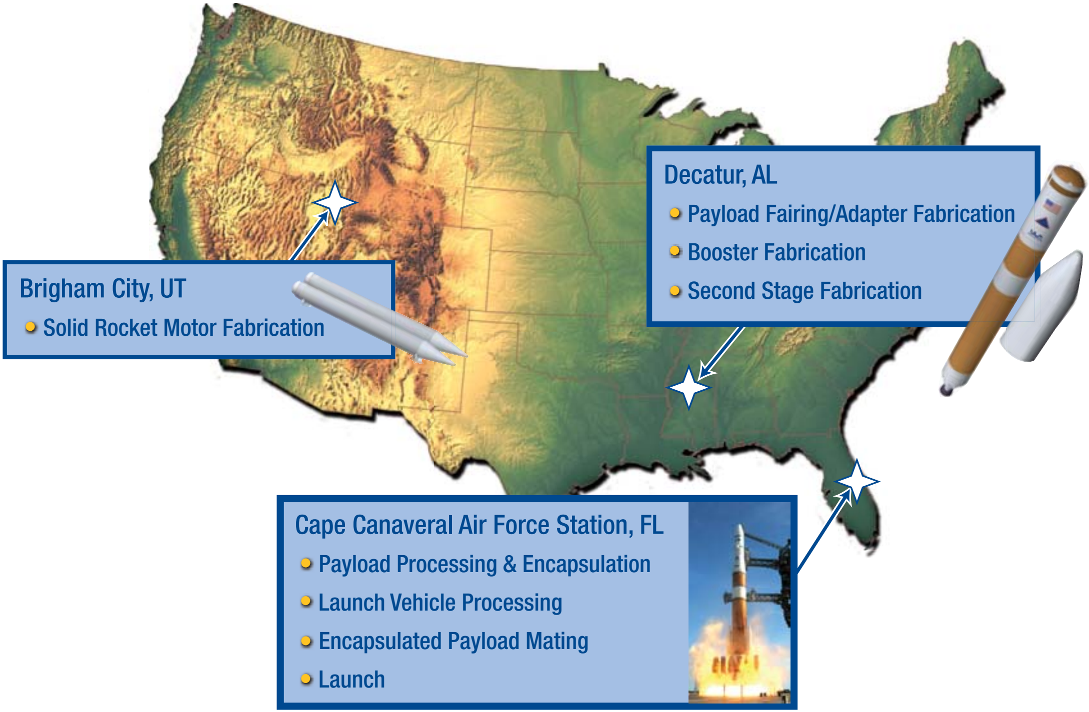
Flight	Configuration	Mission	Launch Date
Delta 293	Medium+ (4,2)	Eutelsat W5	20 Nov 2002
Delta 296	Medium	DSCS III A3	10 March 2003
Delta 301	Medium	DSCS III B6	29 Aug 2003
Delta 310	Heavy	Heavy Demo	21 Dec 2004
Delta 315	Medium+ (4,2)	GOES-N	24 May 2006
Delta 317	Medium+ (4,2)	NROL-22	27 Jun 2006
Delta 320	Medium	DMSP F17	4 Nov 2006
Delta 329	Heavy	DSP-23	10 Nov 2007
Delta 337	Heavy	NROL-26	17 Jan 2009
Delta 342	Medium+ (4,2)	GOES-O	27 Jun 2009

Delta IV Naming Convention

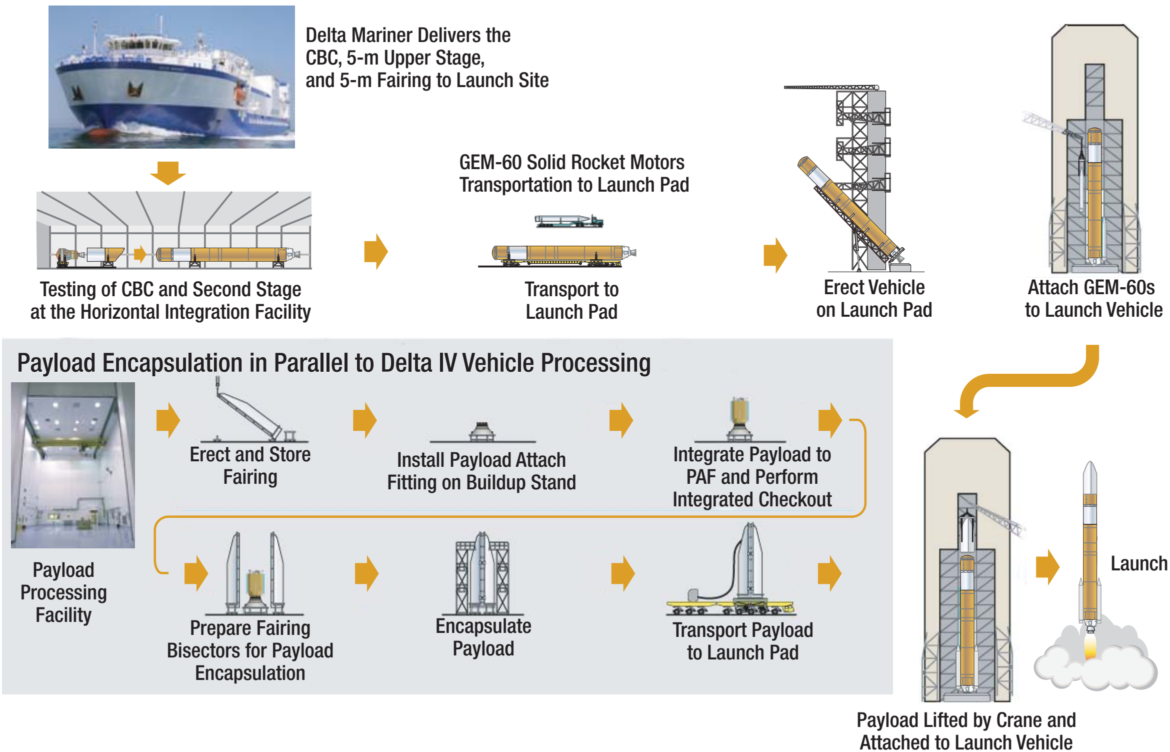
Delta IV Medium+ (5,4)

- Vehicle Class
- Payload Fairing Diameter (in Meters)
- Number of Solid Rocket Motors

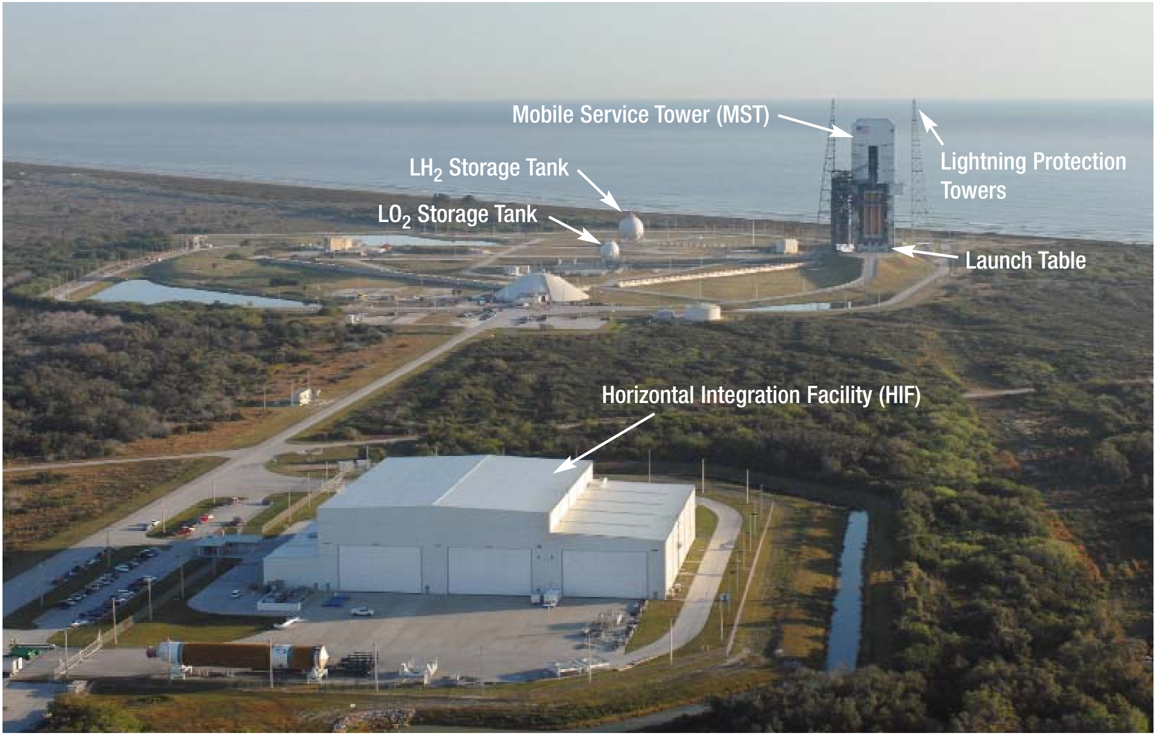
Delta IV Processing Overview



Delta IV Hardware Flow at the Eastern Range



Launch Site Overview



United Launch Alliance

WGS-3 Flight Profile

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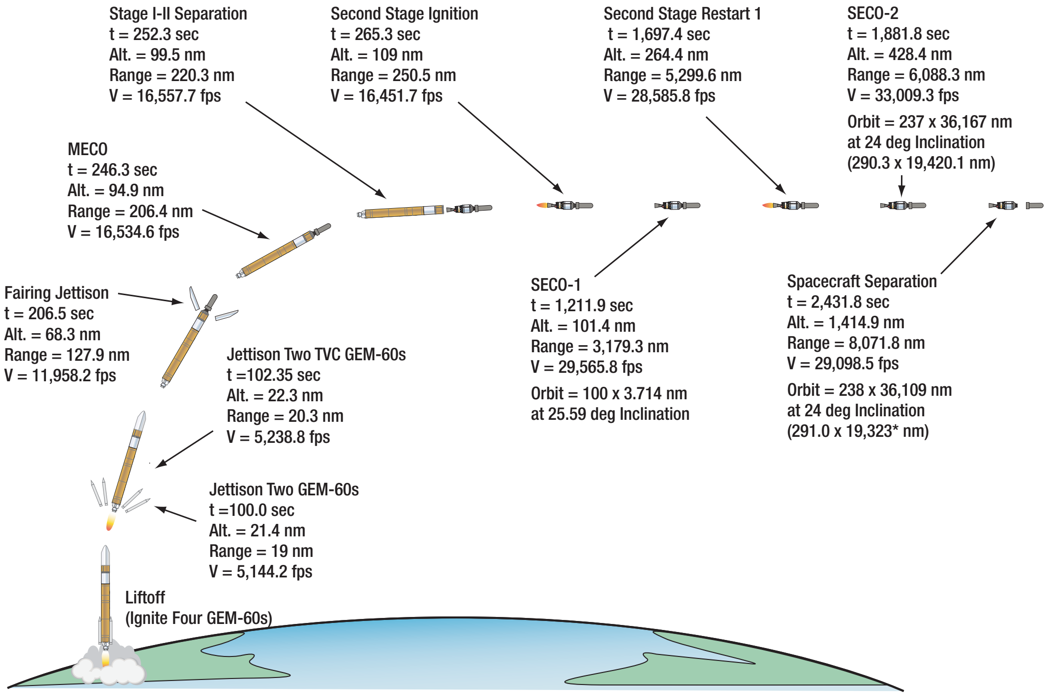
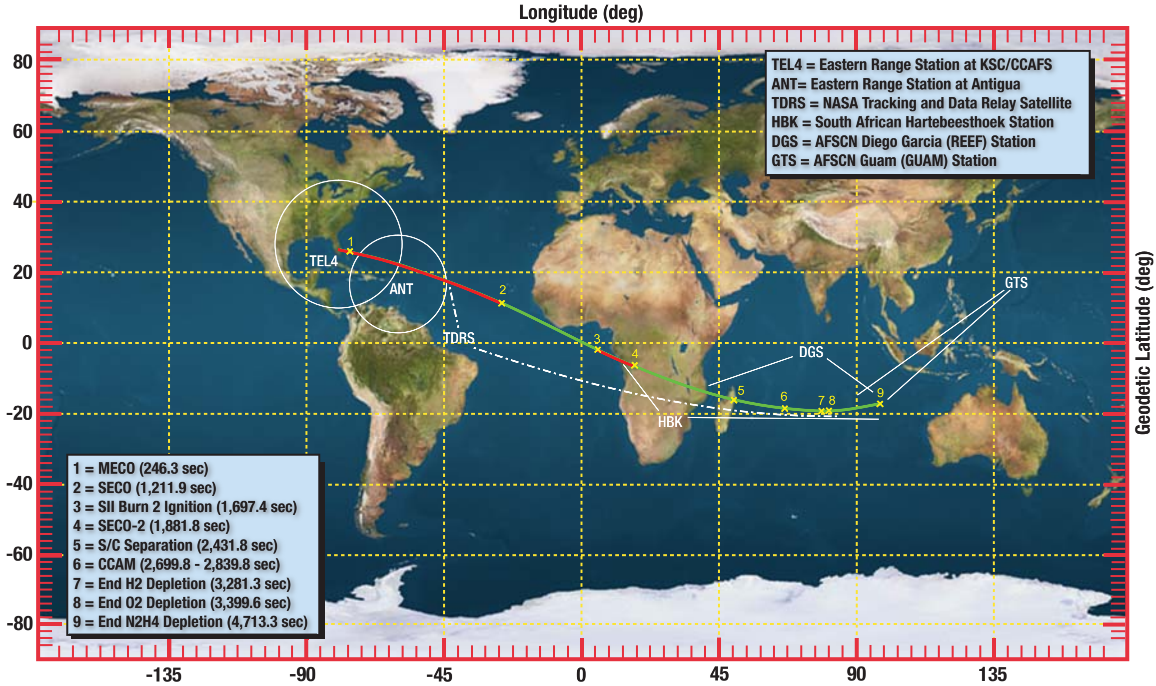


WGS-3 Ground Trace



Sequence of Events

Liftoff to Spacecraft Separation

Event	Time After Liftoff (Sec)
Stage I Liftoff	0.0
Mach Number = 1.05	35.9
Maximum Dynamic Pressure	49.9
(2) GEM60 Burnout (Fixed Nozzle)	93.7
(2) GEM60 Burnout (TVC Nozzle)	94.1
Jettison (2) GEM60 Casings (Fixed Nozzle)	100.0
Jettison (2) GEM60 Casings (TVC Nozzle)	102.4
Jettison Fairing	206.5
Initiate Booster Throttle-Down	239.3
Main Engine Cutoff (MECO)	246.3
Stage I-II Separation	252.3
Stage II Ignition Signal	265.3
First Cutoff - Stage II (SECO-1)	1,211.9
First Restart - Stage II	1,697.4
Second Cutoff - Stage II (SECO-2)	1,881.8
Spacecraft Separation	2,431.8

Delta IV Countdown (T-0 Day)