Atlas V Launches WGS SV-1

AV-011/WGS SV-1

United Launch Alliance is proud to be a part of the WGS SV-1 mission with the U.S. Air Force Space Command's Space and Missile Systems Center (USAF/SMC). The WGS SV-1 mission marks the eleventh Atlas V launch and the first launch of an Atlas V 421 configuration.

The WGS SV-1 mission is the first installment of the Wideband Global SATCOM (WGS) system. WGS will be an important element of a new high-capacity satellite communications system that will provide enhanced communications capabilities to our troops in the field for the next decade and beyond. WGS will enable enhanced and more flexible execution of Command and Control, Communications Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR), battle management, and combat support information. WGS will also augment the existing service available on the UHF F/O satellites by providing additional information broadcast capabilities via Global Broadcast Series (GBS).

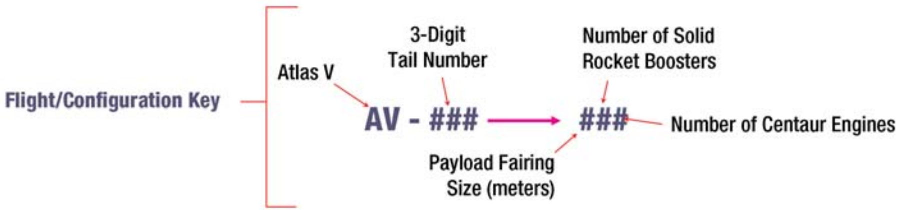
My thanks to the entire Atlas team for its dedication in bringing WGS SV-1 to launch, and to the USAF/SMC for selecting Atlas for this important mission.

Go Atlas! Go Centaur!

James V. Sponnick
Vice President, Atlas Programs

Atlas V Launch History

Flight	Config.	Mission	Mission Date
AV-001	401	Eutelsat Hotbird 6	21 Aug 2002
AV-002	401	HellasSat	13 May 2003
AV-003	521	Rainbow 1	17 Jul 2003
AV-005	521	AMC-16	17 Dec 2004
AV-004	431	Inmarsat 4-F1	11 Mar 2005
AV-007	401	Mars Reconnaissance Orbiter	12 Aug 2005
AV-010	551	Pluto New Horizons	19 Jan 2006
AV-008	411	Astra 1KR	20 Apr 2006
AV-013	401	STP-1	8 Mar 2007
AV-009	401	NROL-30	15 Jun 2007



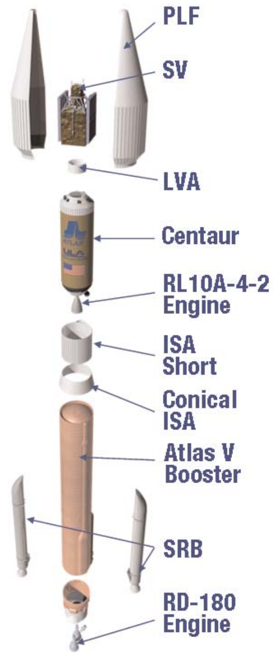
AV-011 Configuration Overview

The Atlas V 421 consists of a single Atlas V booster stage, the Centaur upper stage, and two solid rocket boosters (SRB). The Atlas V booster and Centaur are connected by means of the conical and short interstage adapters. The SRBs are connected to the booster by a thrust pin and structural thrusters.

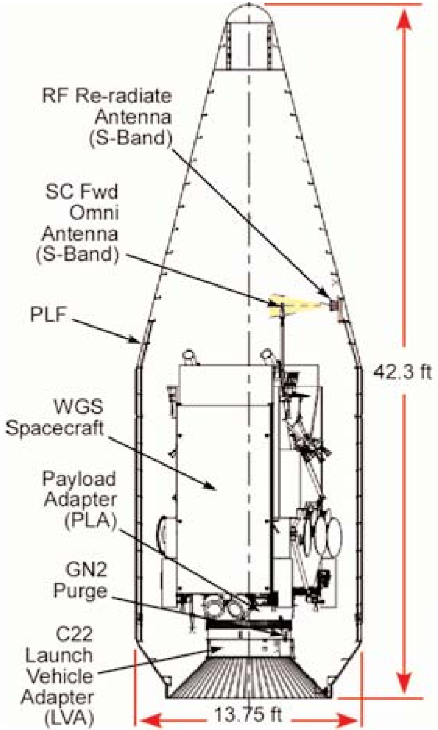
The SRBs are 61.28 in. in diameter, 67 ft long, and are constructed of a graphite-epoxy composite. Their throttle profile is designed into the propellant grain. The SRBs burn for 90 seconds, and are then jettisoned.

The Atlas V booster is 12.5 ft in diameter and 106.5 ft long. 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 which is 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 booster and Centaur phases of flight. The boost phase of flight ends 6 seconds after BECO, when the separation charge attached to the forward Interstage Adapter (ISA) is fired and eight retrorockets push the spent Atlas booster stage away from the Centaur upper stage.

The Centaur upper stage is 10 feet in diameter and 41.5 feet long. The 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 that produces 22,300 lb of thrust. The cryogenic tanks are insulated with a combination of helium-purged insulation blankets, radiation shields, and closed–cell polyvinyl chloride (PVC) insulation. The Centaur forward adapter (CFA) provides the structural mountings for vehicle electronics and the structural and electronic interfaces with the satellite vehicle (SV). The WGS SV-1 mission uses the 4-m- (14 ft)-diameter extended payload fairing (EPF). The LPF 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 192 ft.



WGS SV-1 Spacecraft



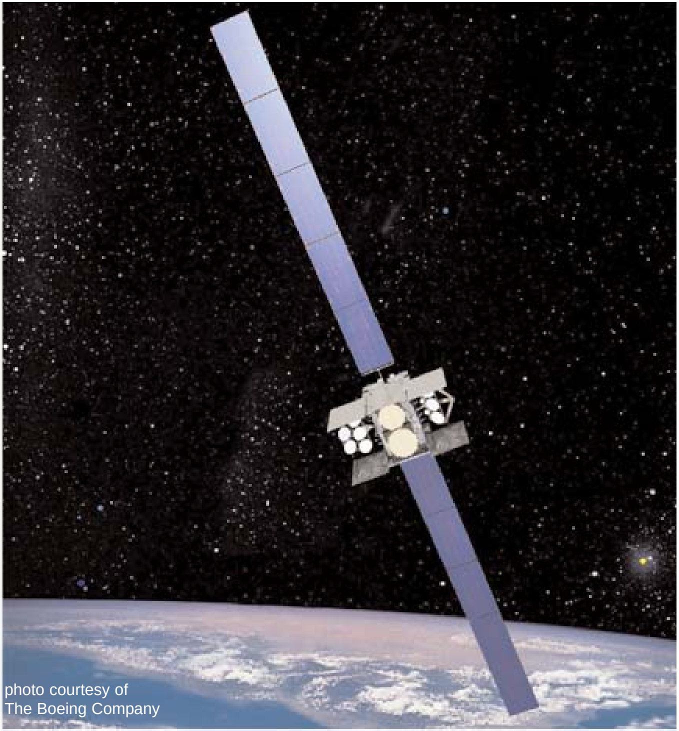


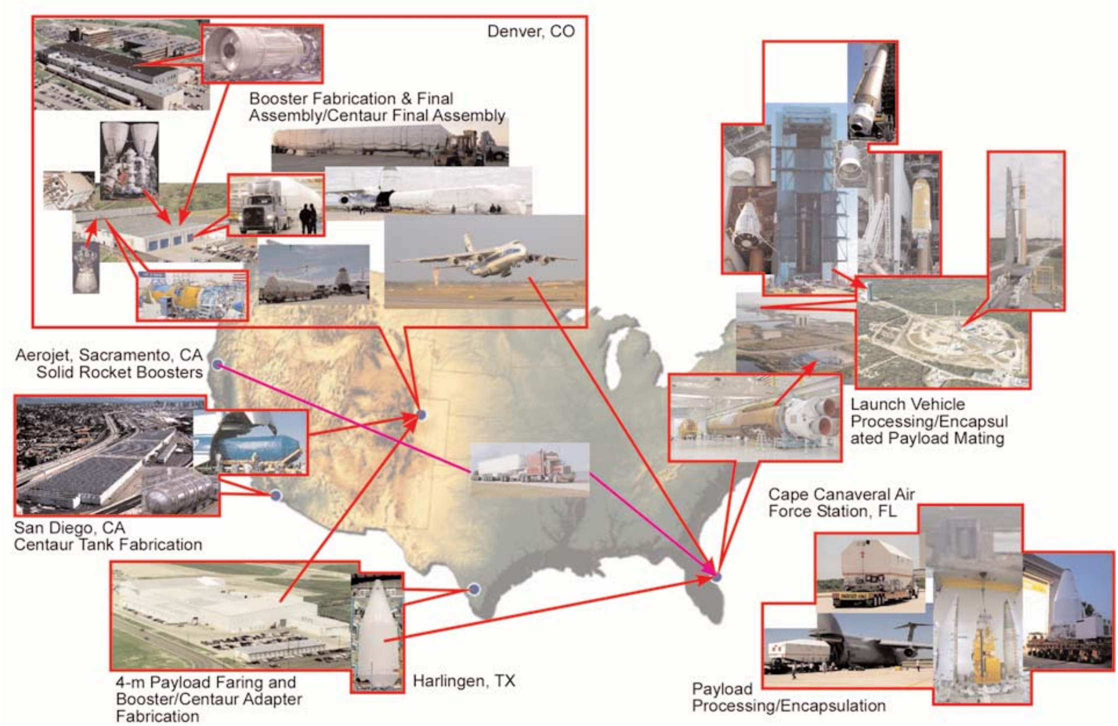
photo courtesy of
The Boeing Company

WGS SV-1 Overview

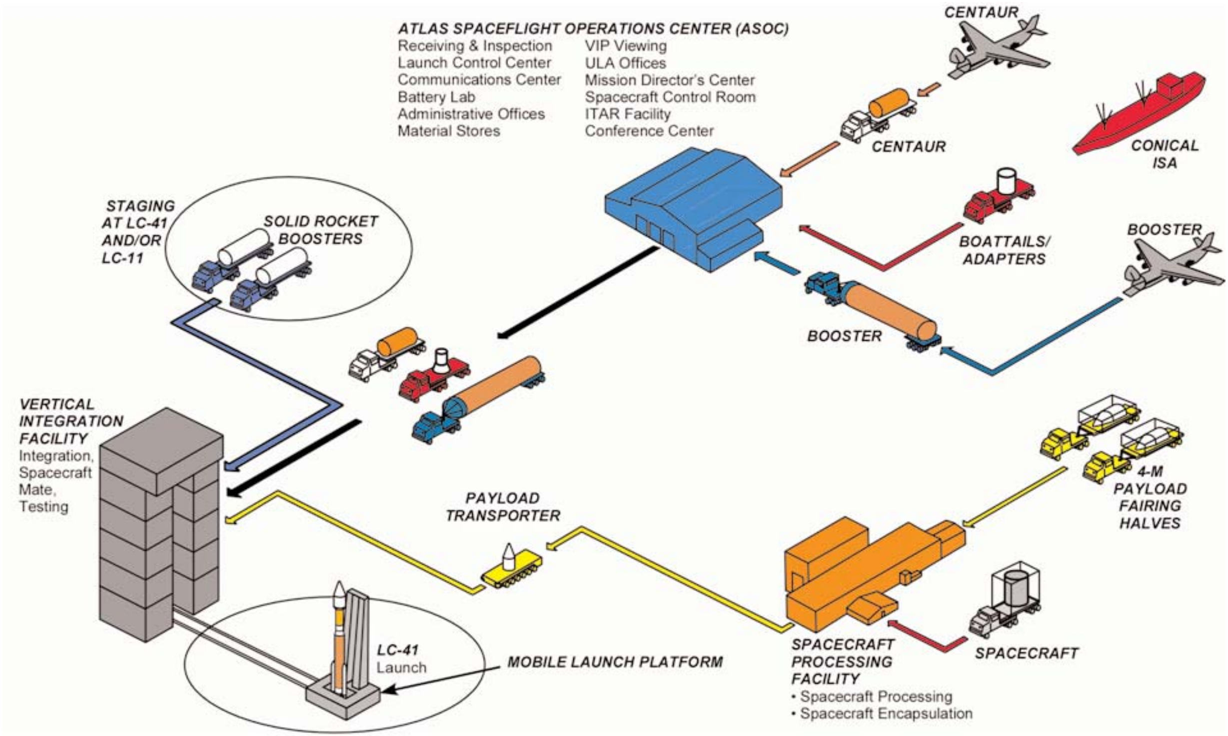
The WGS SV-1 spacecraft (SC) is an approximately 12,718-lb communications satellite. The SC is mated to the Centaur upper stage by means of the space vehicle contractor (SVC)-provided spacecraft launch vehicle adapter (SCLVA), separation system, and electrical harness, and a ULA-provided mission-peculiar C22 Launch Vehicle Adapter (LVA).
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.
Command and Control of WGS is accomplished from four Army Wideband Satellite Operations Centers (WSOCs). 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 will be accomplished by the 3rd Space Operations Squadron (3 SOPS) at Schriever AFB in Colorado Springs, CO using WGS mission-unique software and databases.

Support technologies for WGS include the xenon-ion propulsion system (XIPS), highly efficient triple-junction gallium arsenide solar cells, and deployable radiators with flexible heat pipes. The XIPS is 10 times more efficient than conventional bipropellant systems. Four 25-cm 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 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.

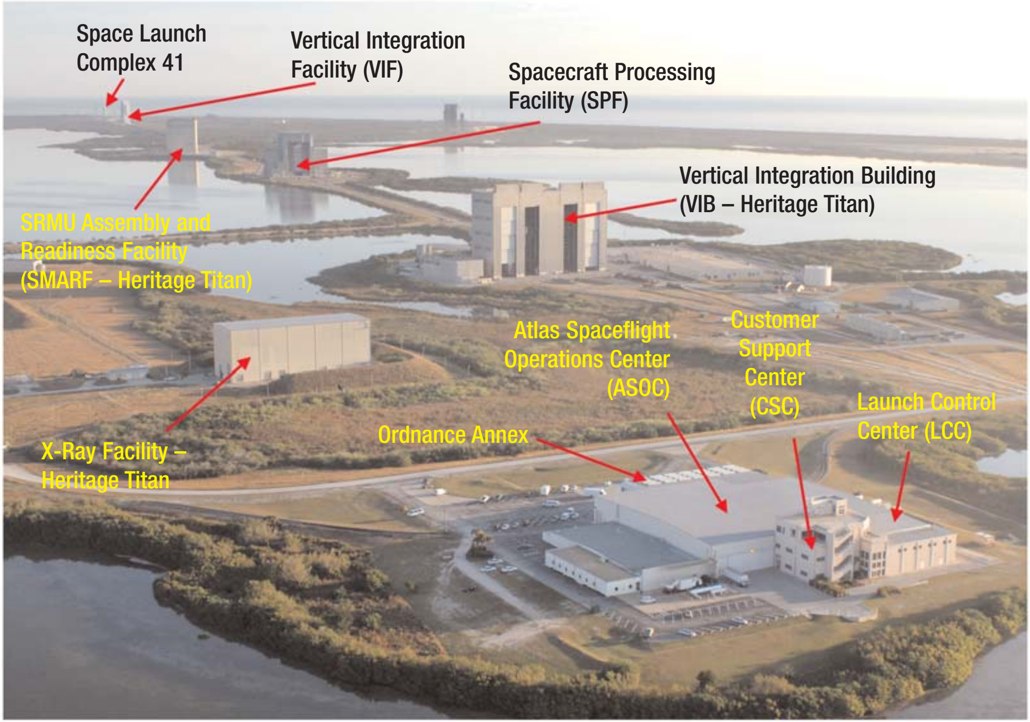
Atlas V Processing Overview



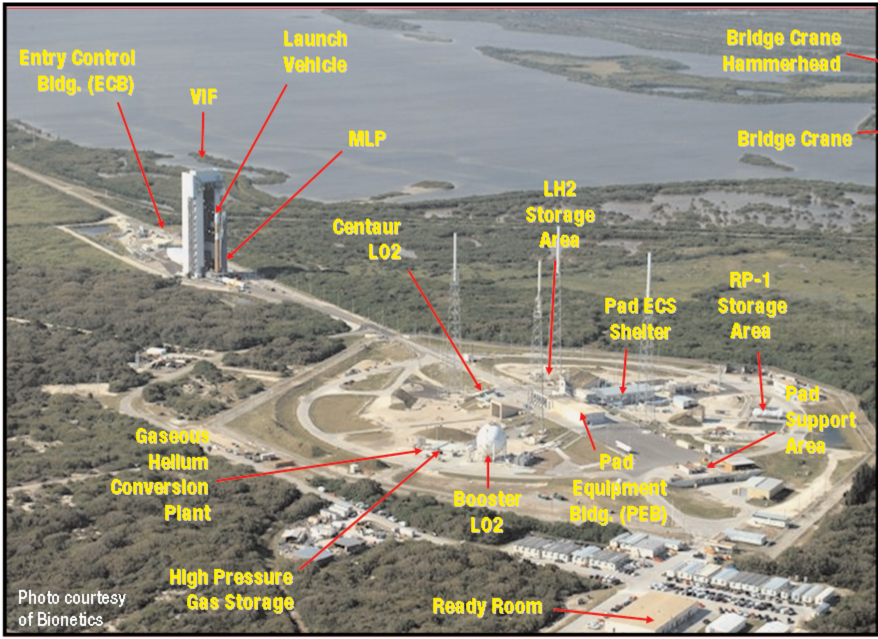
Launch Site Processing Overview

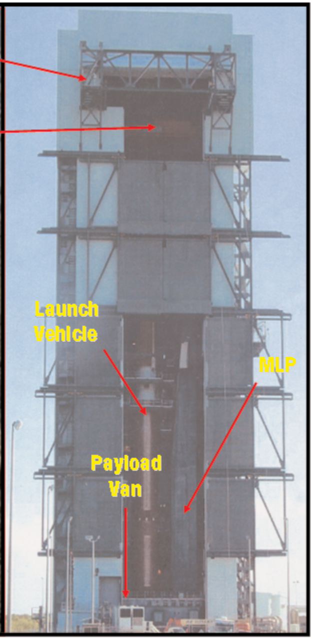


Launch Site Overview



SLC-41 Overview

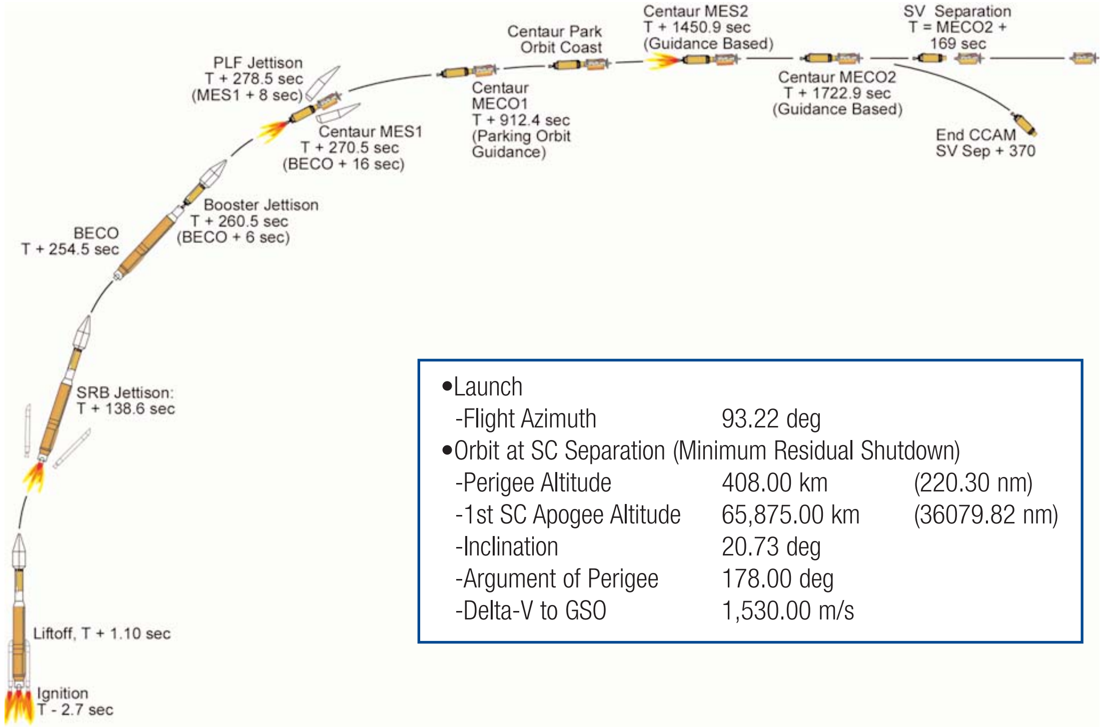




Southwest View of Space Launch Complex 41

South View of the Vertical Integration Facility (VIF)

Mission Profile



- Launch
  - -Flight Azimuth 93.22 deg
- Orbit at SC Separation (Minimum Residual Shutdown)

-Perigee Altitude	408.00 km	(220.30 nm)
-1st SC Apogee Altitude	65,875.00 km	(36079.82 nm)
-Inclination	20.73 deg	
-Argument of Perigee	178.00 deg	
-Delta-V to GSO	1,530.00 m/s	

Mission Overview

The WGS SV-1 mission will be flown from Launch Complex 41 (LC-41) at Cape Canaveral Airforce Station, Fla. on an Atlas V 421 configuration vehicle (tail number AV-011) with two solid rocket boosters (SRB) and a single engine Centaur. The payload will be encapsulated in a 4-meter diameter extended payload fairing (EPF) and integrated to the Centaur upper stage using a modified C22 payload adapter (PLA) and a space vehicle contractor (SVC)-provided spacecraft launch vehicle adapter (SCLVA), separation system, and electrical harness.

The WGS SV-1 payload consists of a single communications satellite. The 2-burn minimum-residual-shutdown mission will fly an easterly trajectory from LC-41 with a 93.22° flight azimuth. The separation event will release the WGS-SV-1 spacecraft into a supersynchronous transfer orbit with a 250.4 nmi perigee, an apogee no greater than 40,932 nmi, and a 20.33° inclination.

Launch begins with RD-180 engine ignition approximately 2.7 seconds before liftoff (T-2.7 seconds). SRB ignition takes place at T+0.8 seconds.

Liftoff occurs at T+1.1 seconds. Shortly after the vehicle clears the pad, it performs its pitch/yaw/roll program. Maximum dynamic pressure occurs 66 seconds into flight.

Mission Overview (cont.)

The SRBs burn out at T+90 seconds, and are jettisoned at T+138.6 seconds. Booster engine cutoff (BECO) occurs at 254.5 seconds.

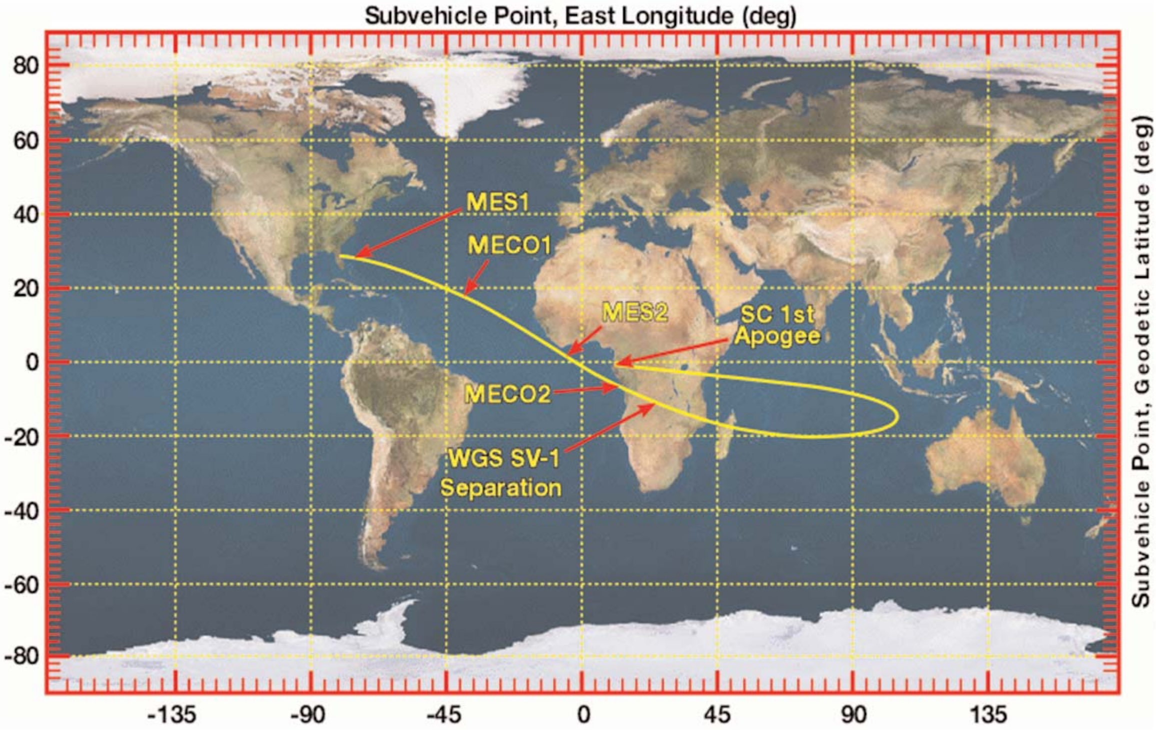
Telemetry data is gathered by TEL-4, Jonathan Dickinson Missile Tracking Annex (JDMTA), Antigua, Diego Garcia, and Guam Tracking Stations. The Tracking and Data Relay Satellite System (TDRSS) will also participate in gathering telemetry during the WGS SV-1 mission.

Centaur separation is 6 seconds after BECO. Centaur main engine start (MES1) occurs 10 seconds after the separation event at 270.5 seconds. Payload fairing jettison takes place at 278.5 seconds; 8 seconds after MES1. At 912.4 seconds Main Engine Cutoff 1 (MECO1) occurs and Centaur has achieved its parking orbit.

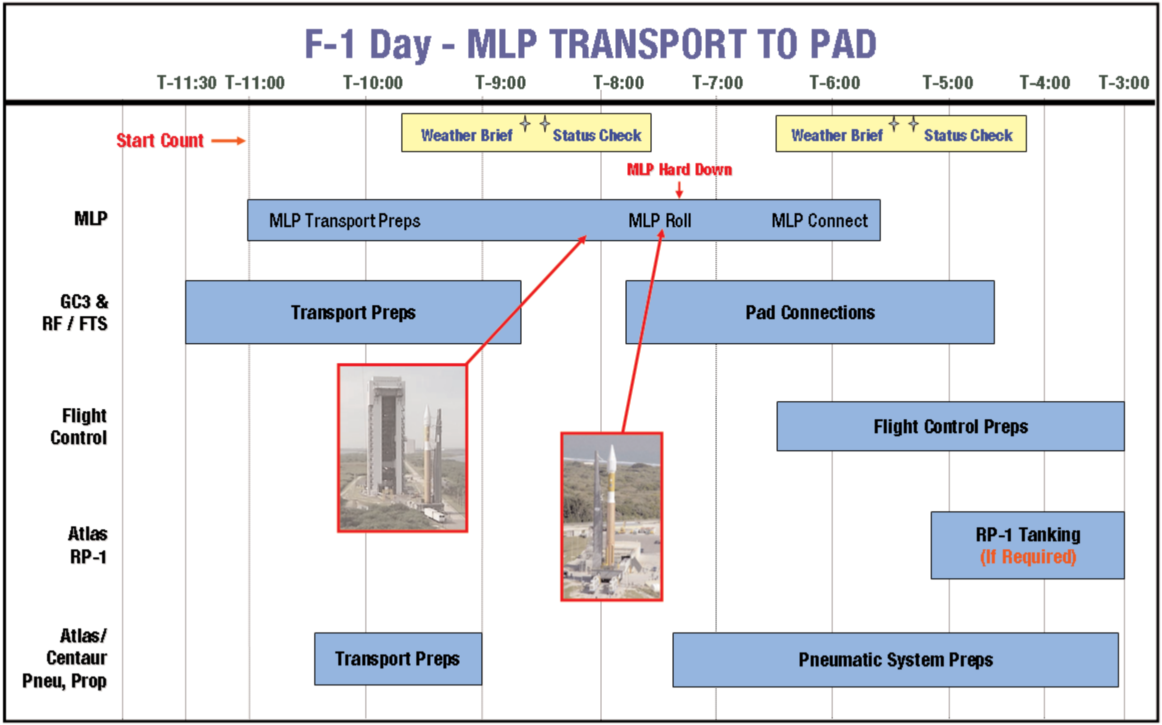
After a 9-minute coast phase, Centaur reorients itself for MES2. MES2 begins at 1450.9 seconds. MECO2 takes place at 1722.9 seconds.

After MECO2, Centaur reorients its attitude for the separation event. The WGS SV-1 separates at 1891.9 seconds.

Mission Ground Trace



Countdown Timeline



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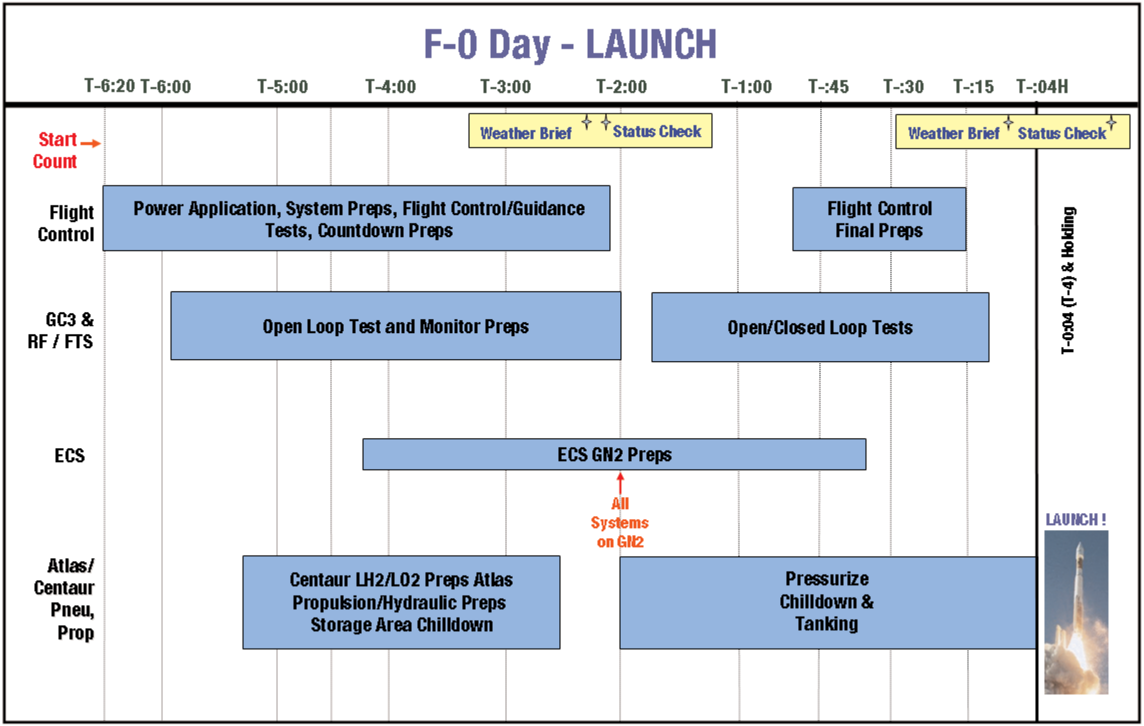
Countdown Timeline (cont.)

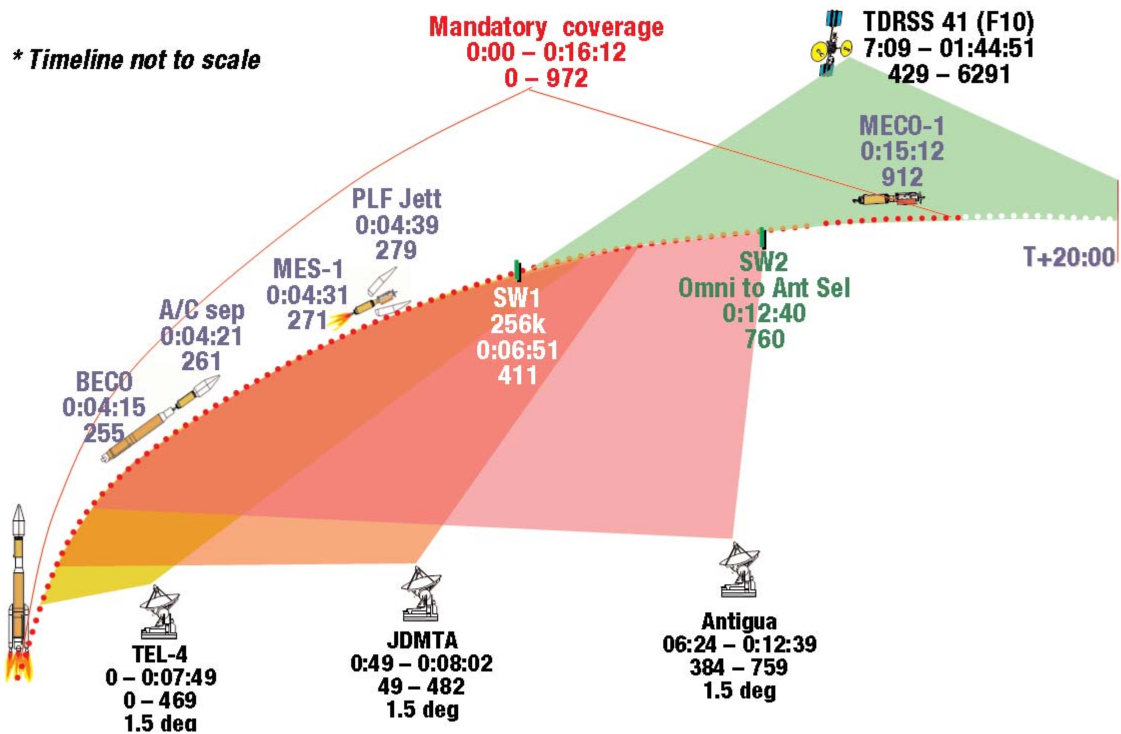
ATLAS



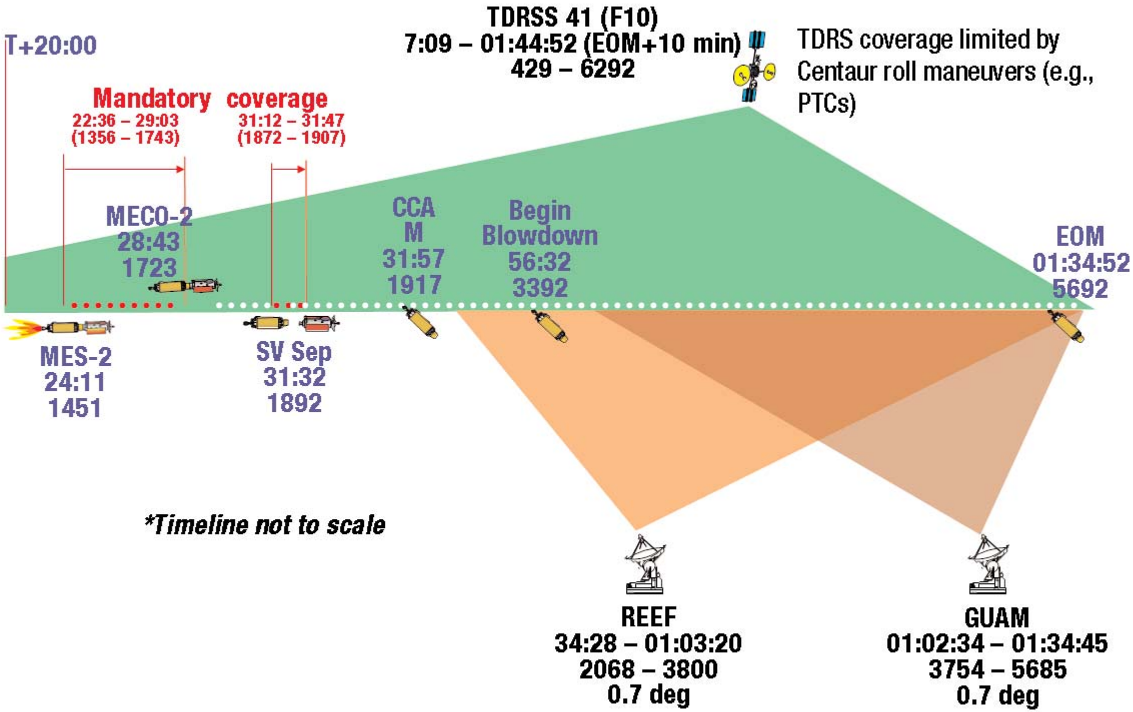
Plus Count Key Events

MET (sec)	MET (hr:min:sec)	Action
0.	**+00:00:00.**	**T=0 (Engine Ready)**
49.	+00:00:49	JDMTA AOS (1.5 deg)
90.	**+00:01:30**	**(Mark Event 1) SRB Burn Out**
138.6	**+00:02:19**	**(Mark Event 2) SRB Jettison**
254.5	**+00:04:15**	**(Mark Event 3) Atlas Booster Engine Cutoff**
260.5	**+00:04:21**	**(Mark Event 4) Atlas/Centaur Separation**
270.5	**+00:04:31**	**(Mark Event 5) Centaur First Main Engine Start (MES1)**
278.5	**+00:04:39**	**(Mark Event 6) Payload Fairing Jettison**
384.	+00:06:24	Antigua AOS (1.5 deg)
410.5	+00:06:51	Switch Date Rate from 512k to 256k (MES1+140 sec)
429.	+00:07:09	TDRS 041 AOS
469.	+00:07:49	TEL-4 LOS (1.5 deg)
482.	+00:08:02	JDMTA LOS (1.5 deg)
759.	+00:12:39	Antigua LOS (1.5 deg)
759.5.	+00:12:40	Switch from OMNI to Antenna Select (MES1+489 sec)
912.4	**+00:15:12**	**(Mark Event 7) Centaur First Main Engine Cutoff (MECO1)**
1450.9	**+00:24:11**	**(Mark Event 8) Centaur Second Main Engine Start (MES2)**
1722.9	**+00:28:43**	**(Mark Event 9) Centaur Second Main Engine Cutoff (MECO2)**
1891.9	**+00:31:32**	**(Mark Event 10) SV Separation**
1916.9	+00:31:57	Begin CCAM
2068.	+00:34:28	DGS (REEF) AOS (0.7 deg)
3391.9	+00:56:32	Begin Blowdown
3754.	+01:02:34	GTS (GUAM) AOS (0.7 deg)
3800.	+01:03:20	DGS (REEF) LOS (0.7 deg)
4923.8	+01:22:04	Expected N2H4 Depletion
5685.	+01:34:45	GTS (GUAM) LOS (0.7 deg)
5691.9	+01:34:52	End of Mission (Arm Uplink Interrupt)
6291.9	+01:44:52	End TDRS 041 Coverage (EOM+10 Minutes)

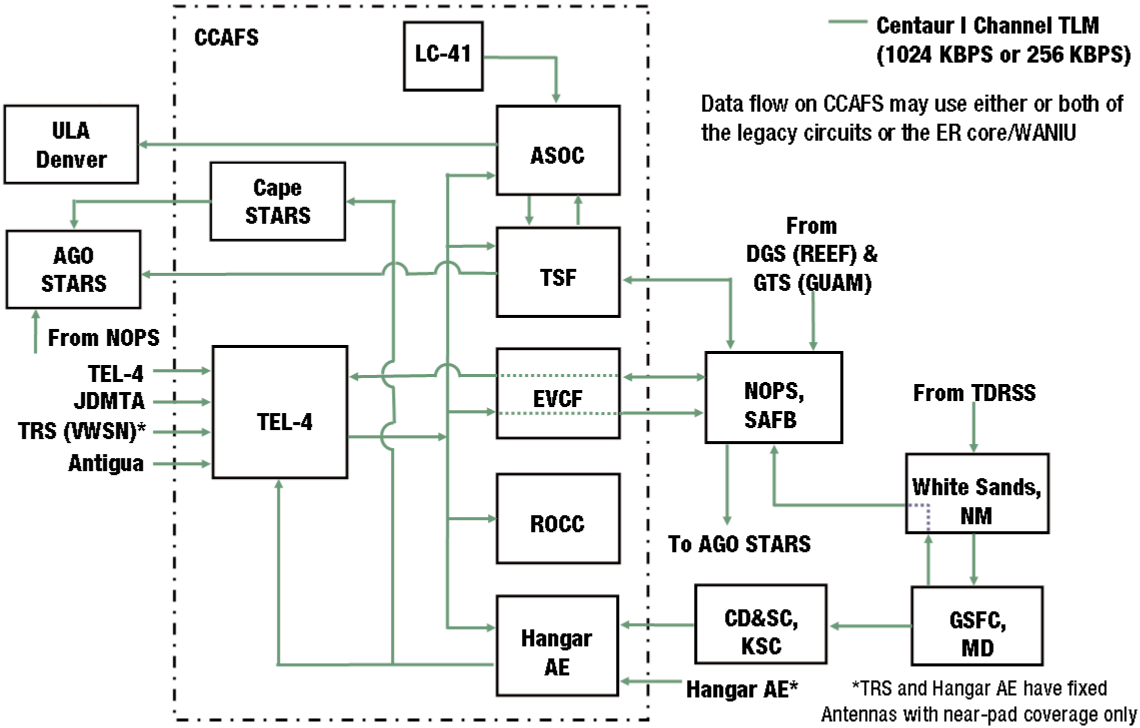
Expected Telemetry Coverage



Expected Telemetry Coverage (cont.)



I Channel Telemetry Flow



Abbreviations & Acronyms

3 SOPS	3rd Space Operations Squadron
A/C	Atlas Centaur
AFSCN	Air Force Satellite Control Network
AGO	Aerospace Group Offices
AOS	Acquisition of Signal
ASOC	Atlas Spaceflight Operations Center
BECO	Booster Engine Cut Off
BPSK	Binary Phase Shift Key
C4ISR	Command and Control, Communications, Computers; Intelligence, Surveillance, and Reconnaissance
CCAFS	Cape Canaveral Air Force Station
CCAM	Collision and Contamination Avoidance Maneuver
CCLS	Computer Controlled Launch System
Ch	Channel
DGS	Diego Garcia Station
ECB	Entry Control Building
ECS	Environmental Control System
EDT	Eastern Daylight Time
EELV	Evolved Expendable Launch Vehicle
EOM	End of Mission
EPF	Extended Payload Fairing
ER	Eastern Range
EVCF	Eastern Vehicle Checkout Facility
F/O	Follow On
FTS	Flight Termination System
Gbps	Gigabits per second (billions of bits per second)
GC3	Ground Command Control & Communications
GMT	Greenwich Mean Time
GN2	Gaseous Nitrogen
GSCCE	Gapfiller Satellite Configuration and Control Element
GSO	Geosynchronous Orbit
GSFC	Goddard Space Flight Center
GTS	Guam Transmitter Station
INU	Inertial Navigation Unit
ISA	Interstage Adapter
Isp	Specific Impulse
JDMTA	Jonathan Dickinson Missile Tracking Annex
Jett	Jettison
KBPS	Kilo Bits Per Second
LC	Launch Complex
LH2	Liquid Hydrogen
LO2	Liquid Oxygen
LOS	Loss Of Signal
LVA	Launch Vehicle Adapter
Max Q	Maximum Dynamic Pressure
MBPS	Mega Bits Per Second
MECO	Main Engine Cut Off

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Abbreviations & Acronyms (cont.)

ATLAS

MES	Main Engine Start
MD	Maryland
MD	Mission Director (USAF)
MLP	Mobile Launch Platform
N2H4	Hydrazine
NHS	New Hampshire Tracking Station AFSCN (Call Sign - BOSS)
NM	New Mexico
nmi	Nautical Mile
NOPS	NRO Operations Squadron
NRO	National Reconnaissance Office
PEB	Pad Equipment Building
PLA	Payload Adapter
PLF	Payload Fairing
Pneu	Pneumatics
Prop	Propulsion
PTC	Passive Thermal Control
QPSK	Quadrature Phase Shift Key
REEF	Diego Garcia Tracking Station
ROCC	Range Operations Control Center
RF	Radio Frequency
RP-1	Rocket Propellant – 1 (Kerosene)
SAFB	Schriever Air Force Base
SATCOM	Satellite Communications

SC	Spacecraft
SCLVA	Spacecraft Launch Vehicle Adapter
Sep	Separation
SMC	Space and Missiles Systems Center
SRB	Solid Rocket Booster
STARS	Space Launch Operations (SLO) Telemetry Acquisition and Reporting System
SV	Space Vehicle
SVC	Space Vehicle Contractor
SW	Switch
TDRSS	Tracking & Data Relay Satellite System
TLM	Telemetry
TRS	Telemetry Receiving Site
TSF	Technical Support Facility
UHF	Ultra High Frequency
ULA	United Launch Alliance
USAF	United States Air Force
Vac	Vacuum
VIF	Vertical/Vehicle Integration Facility
VWSN	Visual Warning Site, North
XIPS	Xenon Ion Propulsion System
WANIU	Wide Area Network Interface Unit
WGS	Wideband Global SATCOM
WSOC	Wideband Satellite Operations Centers

Notes