United Launch Alliance

Atlas V Launches DMSP F18

Mission Overview

Atlas V 401

Vandenberg Air Force Base, CA

Space Launch Complex 3E

ATLAS

AV-017/DMSP F18

United Launch Alliance (ULA) is proud to be a part of the Defense Meteorological Satellite Program (DMSP) F18 mission with the U.S. Air Force Defense Meteorological Systems Group (DMSG).

The DMSP F18 mission is the eighteenth DMSP installment. DMSP satellites provide strategic and tactical weather prediction, which aids the U.S. military in planning operations at sea, on land, and in the air. The satellites are equipped with a sophisticated sensor suite capable of imaging cloud cover in visible and infrared light and measuring precipitation, surface temperature, and soil moisture. The DMSP spacecraft can collect this specialized global meteorological, oceanographic, and solar-geophysical information in all weather conditions. The current constellation is comprised of two spacecraft in sun-synchronous, near-polar orbits.

My thanks to the entire Atlas V team for its dedication in bringing DMSP F18 to launch and to the USAF/DMSG for selecting Atlas V for this important mission.

Go Atlas! Go Centaur!

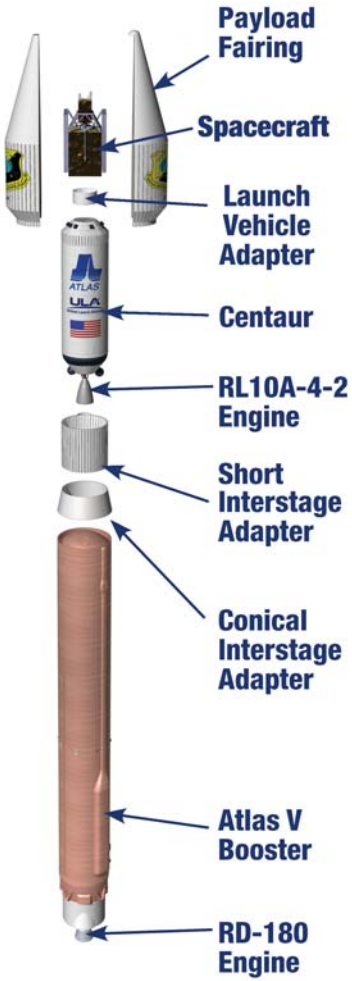
Mark Wilkins
Vice President, Atlas Product Line

AV-017 Configuration Overview

The Atlas V 401 configuration consists of a single Atlas V booster stage and the Centaur upper stage. The Atlas V booster and Centaur are connected by the conical and short interstage adapters (ISAs).

The Atlas V booster is 12.5 feet (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 V 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, highly purified kerosene) and liquid oxygen, and it delivers 860,200 pounds (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 boost phase of flight ends 6 seconds after propellant-depletion-commanded booster engine cutoff (BECO), when the separation charge attached to the forward ISA fires and eight retrorockets push the spent Atlas booster stage away from the Centaur upper stage.

The Centaur upper stage is 10 ft in diameter and 41.5 ft long. 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 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 SC. The DMSP F18 mission uses the 4-meter (m) (14-ft) diameter large payload fairing (LPF). 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 PLF is approximately 189 ft.

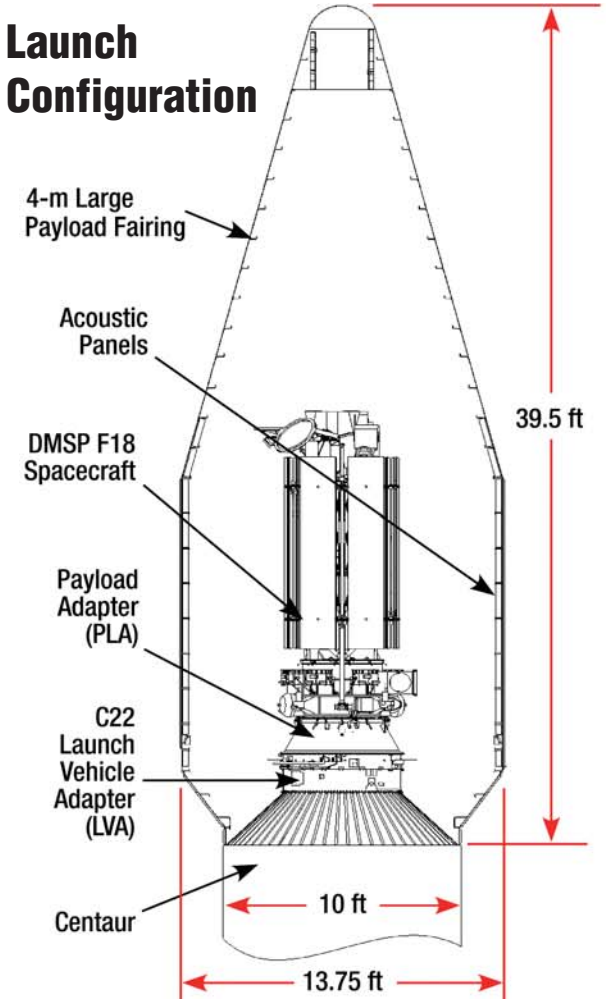


DMSP F18 Spacecraft

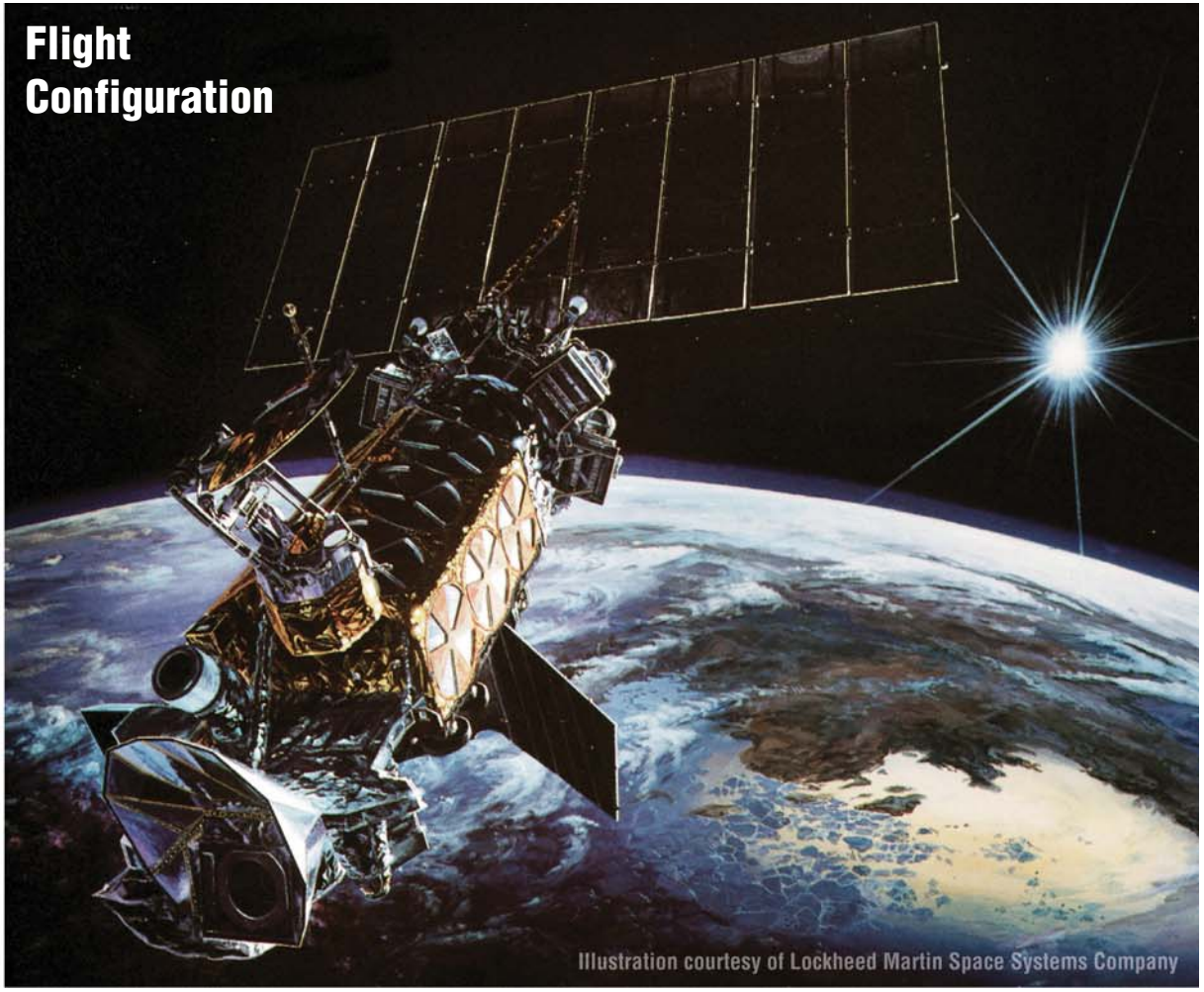
United Launch Alliance

ATLAS

Launch Configuration



Flight Configuration



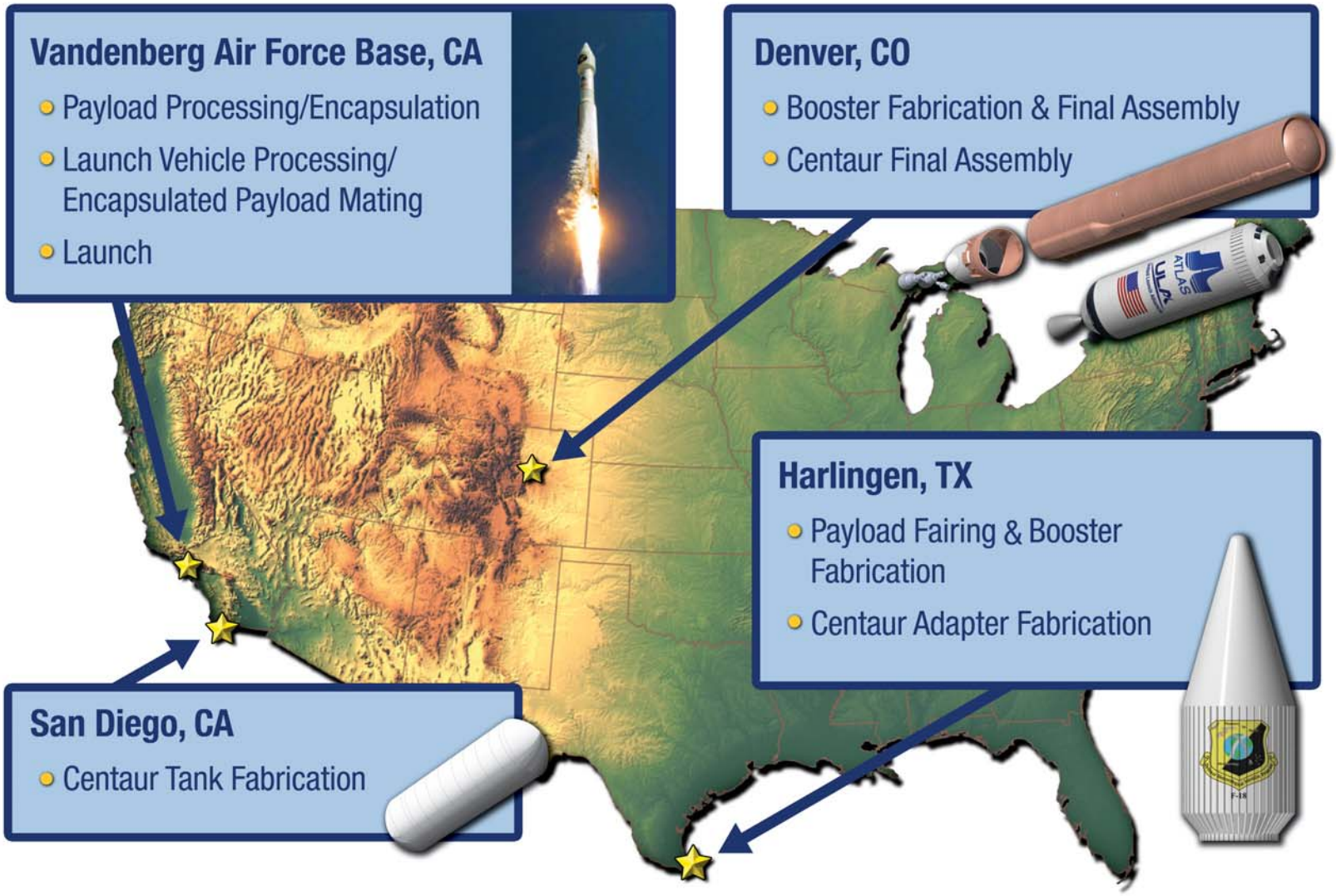
DMSP F18 Overview

DMSP is a space- and ground-based system to collect and disseminate timely global environmental data to the Department of Defense and other governmental agencies. This environmental data consist of visible and infrared cloud cover and other specialized meteorological, oceanographic, and solar-geophysical information required to support the war fighter. DMSP satellites "see" environmental features such as clouds, bodies of water, snow, fire, and pollution in the visual and infrared spectra. The data can be used to determine cloud type and height, land and surface water temperatures, water currents, ocean surface features, ice, and snow. DMSP data are processed on the ground, interpreted by meteorologists, and ultimately used in planning and conducting U.S. military operations worldwide.

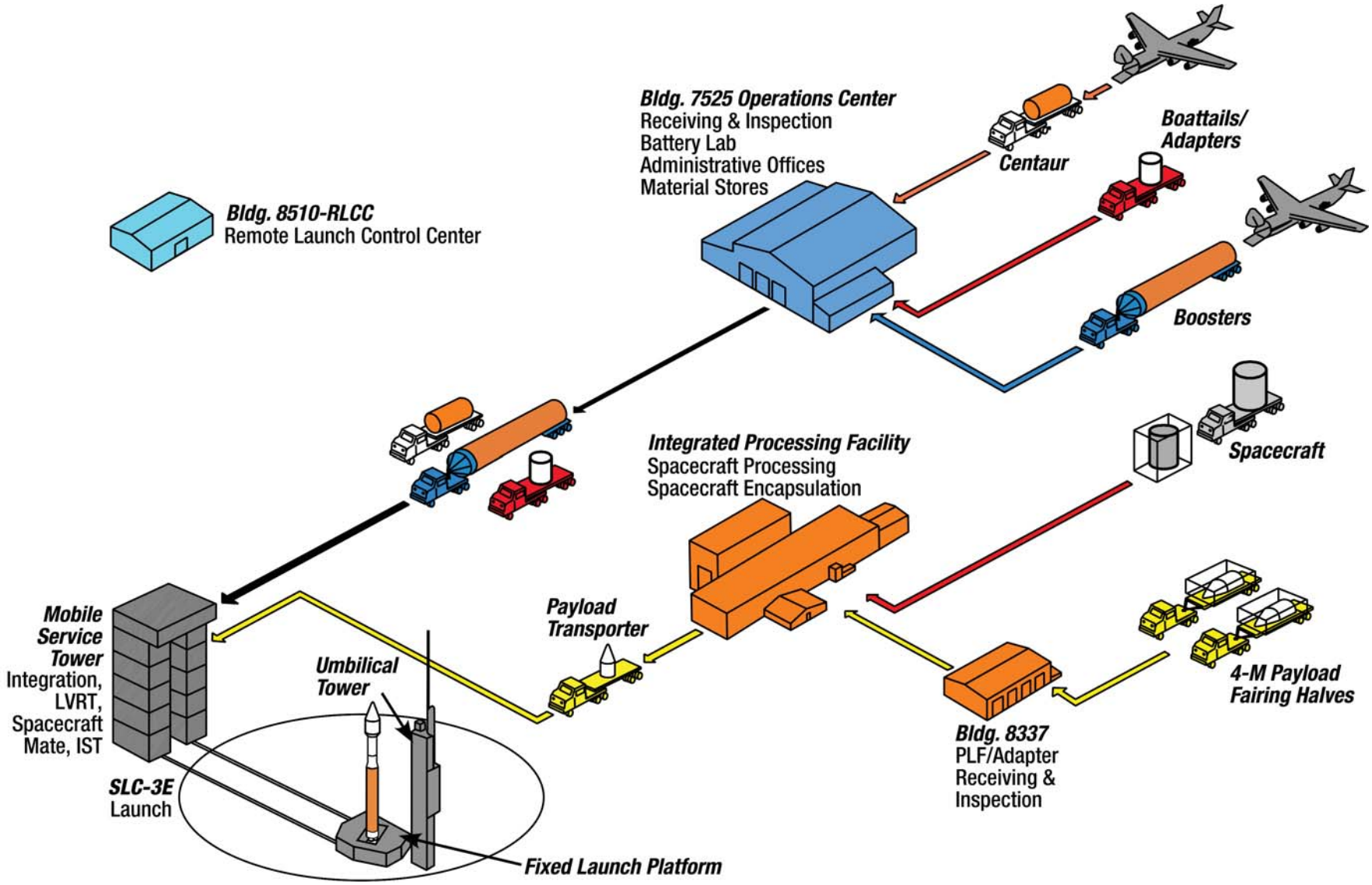
DMSP satellites are in near-polar, sun-synchronous orbits at an altitude of approximately 462.8 nautical miles (nmi) (857.1 kilometers [km]). Each satellite has an orbital period of about 101 minutes and crosses any point on the Earth up to twice a day, thus providing nearly complete global coverage of clouds every 6 hours. The visible and infrared sensors collect images of global cloud distribution across a 3,000-km swath during both daytime and nighttime conditions. The coverage of the microwave imager and sounders are one-half the visible and infrared sensors coverage. They cover the polar regions above 60 degrees twice daily and the equatorial region once daily. The space environmental sensors record along track plasma densities, velocities, composition, and drifts.

DMSP is composed of the space segment; the command, control, and communications segment (C3S); and the user segment. The principal function of the space segment is to continually acquire environmental data through its satellite sensors. Mission data downlinks include stored data and real-time transmissions. Raw sensor data are stored onboard the satellite for delayed transmission to the C3S. Subsequently, the data are relayed to strategic elements of the user segment for ground processing into environmental data records and analysis. Raw data can also be transmitted directly from the space segment to tactical elements of the user segment for ground processing and analysis.

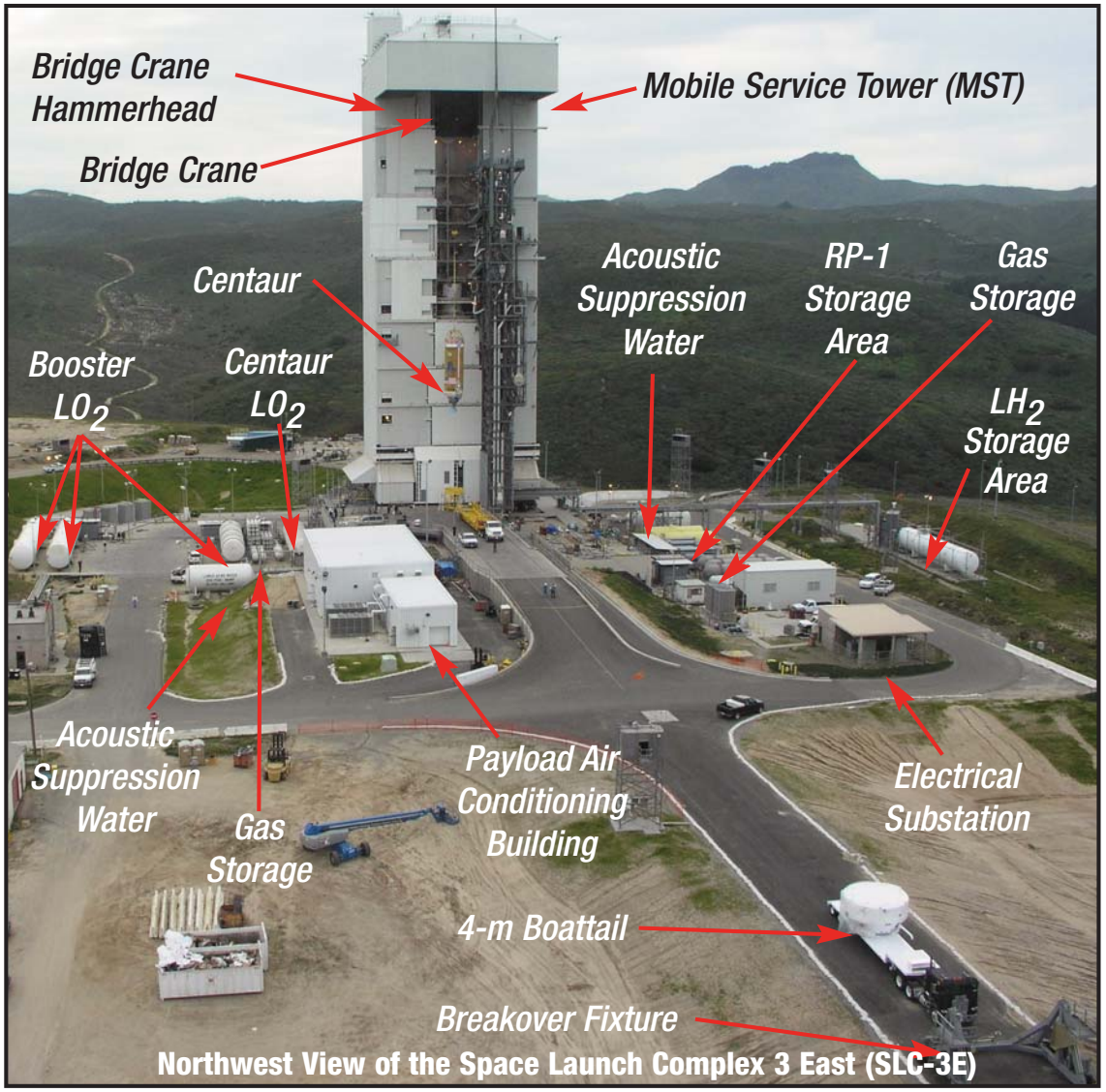
Atlas V Processing Overview



Launch Site Processing Overview

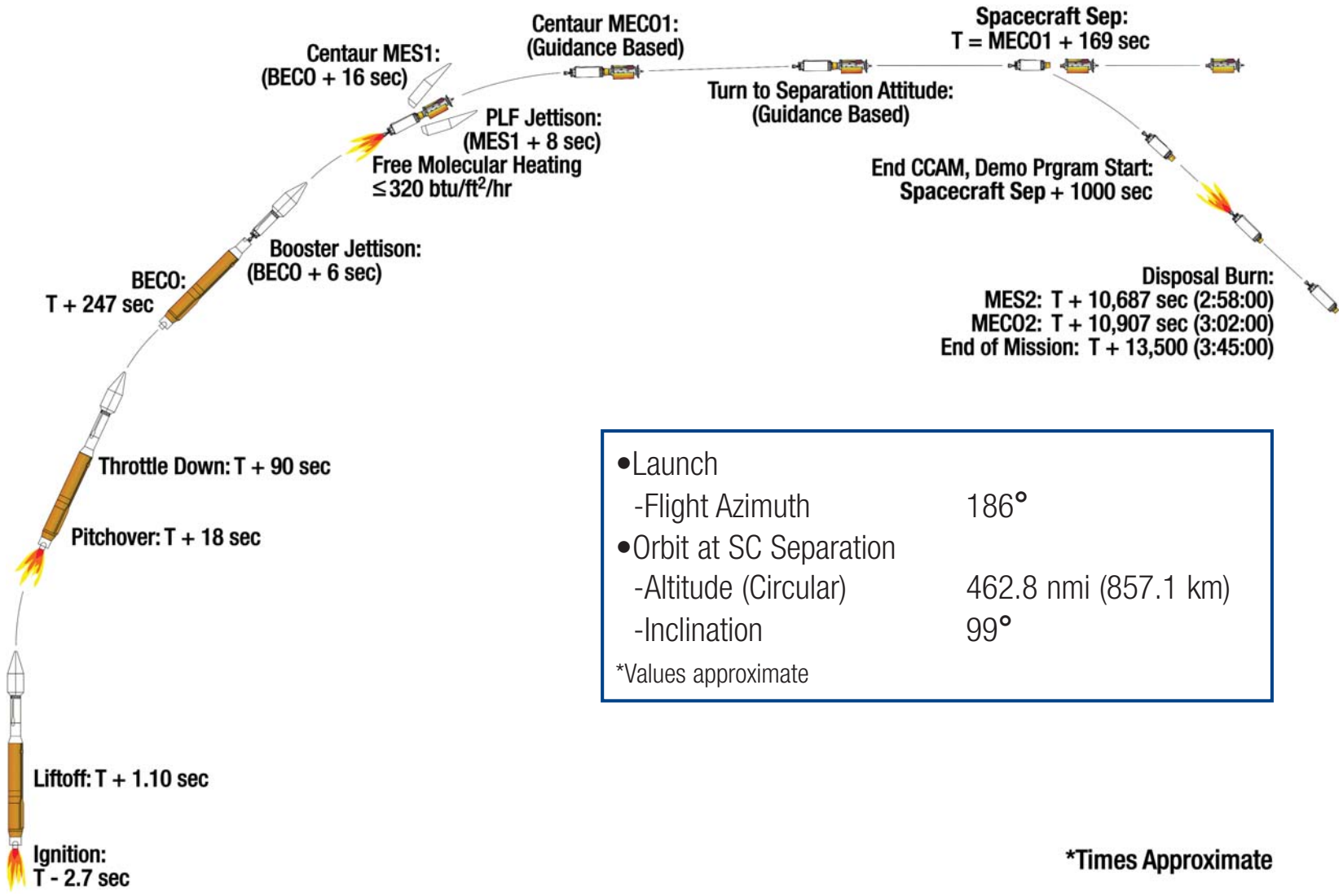


SLC-3E Overview



Northwest View of the Space Launch Complex 3 East (SLC-3E)

Mission Profile



•Launch	
-Flight Azimuth	186°
•Orbit at SC Separation	
-Altitude (Circular)	462.8 nmi (857.1 km)
-Inclination	99°

*Values approximate

*Times Approximate

Mission Overview

The DMSP F18 mission launches from Space Launch Complex 3 East (SLC-3E) at Vandenberg Air Force Base (VAFB), CA on an Atlas V flying in the 401 configuration (tail number AV-017). The payload is encapsulated in a 4-m diameter large payload fairing (LPF) and integrated to the Centaur upper stage using a modified C22 payload adapter (PLA) and space vehicle contractor (SVC)-provided spacecraft launch vehicle adapter (SCLVA), separation system, and electrical harness.

The DMSP F18 payload consists of a single weather satellite. The Atlas/Centaur portion of the DMSP F18 mission concludes with the centaur collision and contamination avoidance maneuver (CCAM). Following spacecraft separation, Centaur performs demonstrations designed to qualify expanded Centaur operational capabilities. Following those capability demonstrations, Centaur places itself in a heliocentric disposal orbit, blows down its consumables, burns off its maneuvering propellant, and secures mission operations.

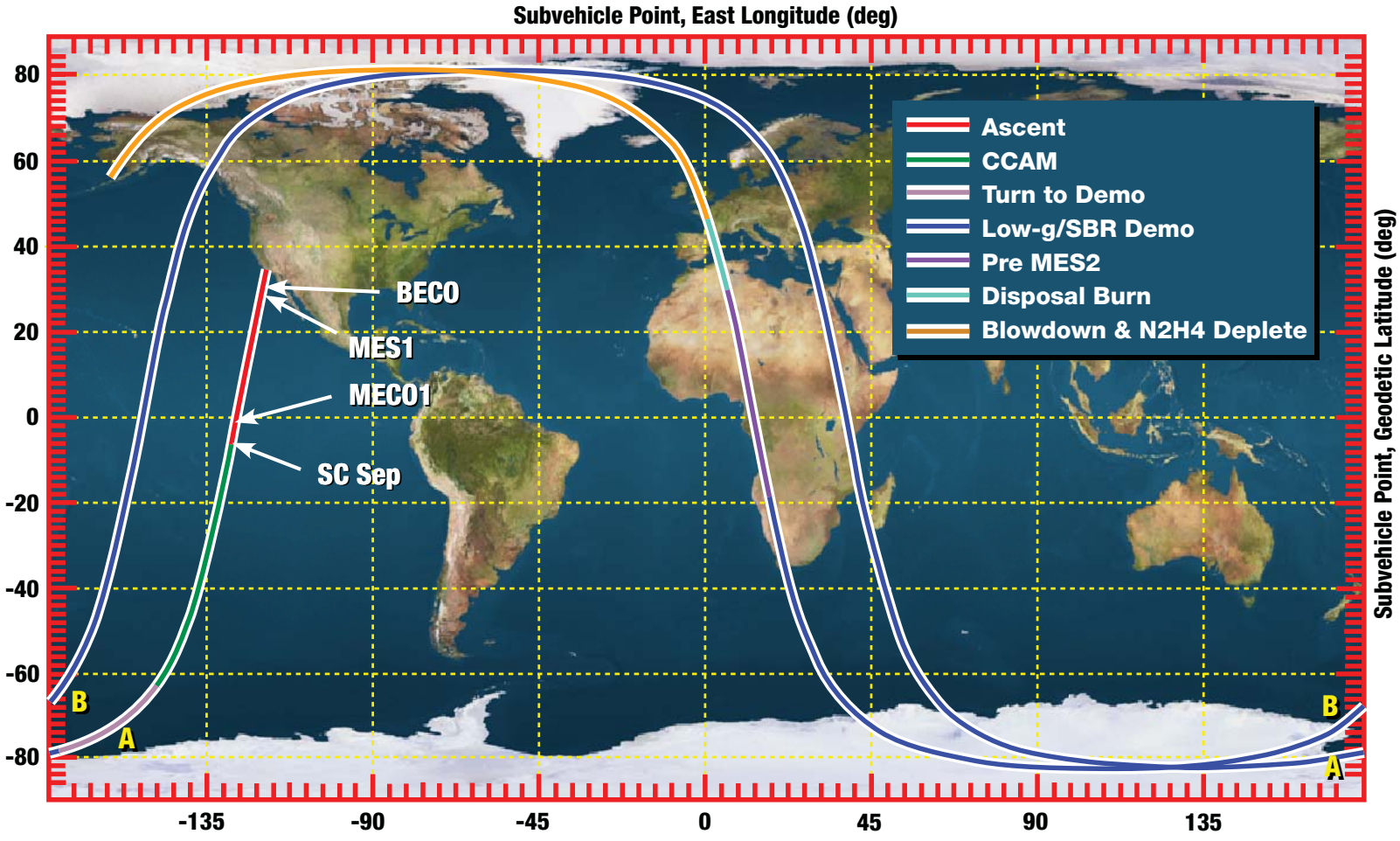
Launch begins with RD-180 ignition approximately 2.7 seconds before liftoff. Liftoff occurs at T+1.1 sec, after telemetry indication of healthy RD-180 startup. Shortly after the vehicle clears the pad, it performs its pitch/yaw/roll program. Maximum dynamic pressure occurs at approximately 88 seconds. BECO occurs at approximately 247 seconds.

Mission Overview (concl.)

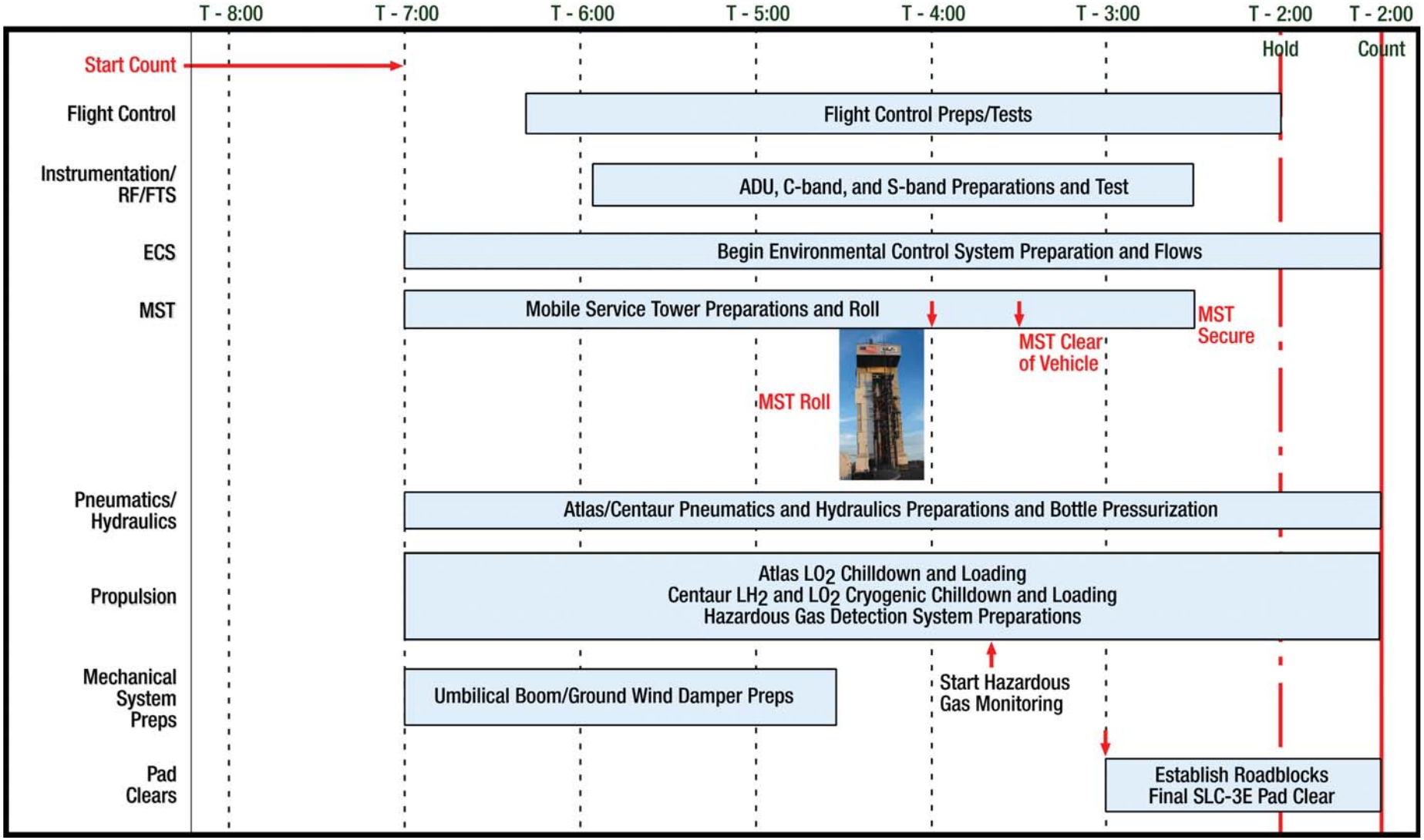
Centaur separation is 6 seconds after BECO. Centaur main engine start (MES1) occurs 10 seconds after the booster separation event. Payload fairing jettison takes place approximately 8 seconds after Centaur MES1. After approximately 11 minutes, Centaur main engine cutoff 1 (MECO1) occurs and Centaur achieves its orbit. After MECO1, Centaur reorients its attitude for the spacecraft separation event. The DMSP F18 spacecraft separates 169 seconds after MECO1. Preparations for the turn to CCAM attitude begins 4 seconds after spacecraft separation. Approximately 16 minutes after spacecraft separation and once the CCAM has been completed, Centaur turns to its demonstration attitude. The demonstration phase lasts until about 2 hours 45 minutes after launch. The mission's disposal phase begins with MES2 at roughly 2 hours 58 minutes into the mission. The second burn puts Centaur on an Earth-escape trajectory. MECO2 occurs at approximately 3 hours 2 minutes into the mission. The mission ends after blowdown of the propellant tanks and burn off of residual hydrazine (N_2H_4), which are completed by 3 hours 45 minutes into the flight.

Primary Centaur data collection is provided by TDRSS after loss of signal from TRS. During the DMSP F18 mission, telemetry data from the SC and LV are gathered by a mobile telemetry receiving station (MTRS-2), Building 836, TRS (Oak Mountain), and VTS (call sign COOK) tracking stations in the VAFB area; San Nicholas Island (CA); JADE (Nuku Hiva, French Polynesia); MCMR (McMurdo, Antarctica); LION (England); POGO (Greenland); FBKS (Fairbanks, AK); PIKE (Schriever AFB, CO); and HULA (HI) tracking stations.

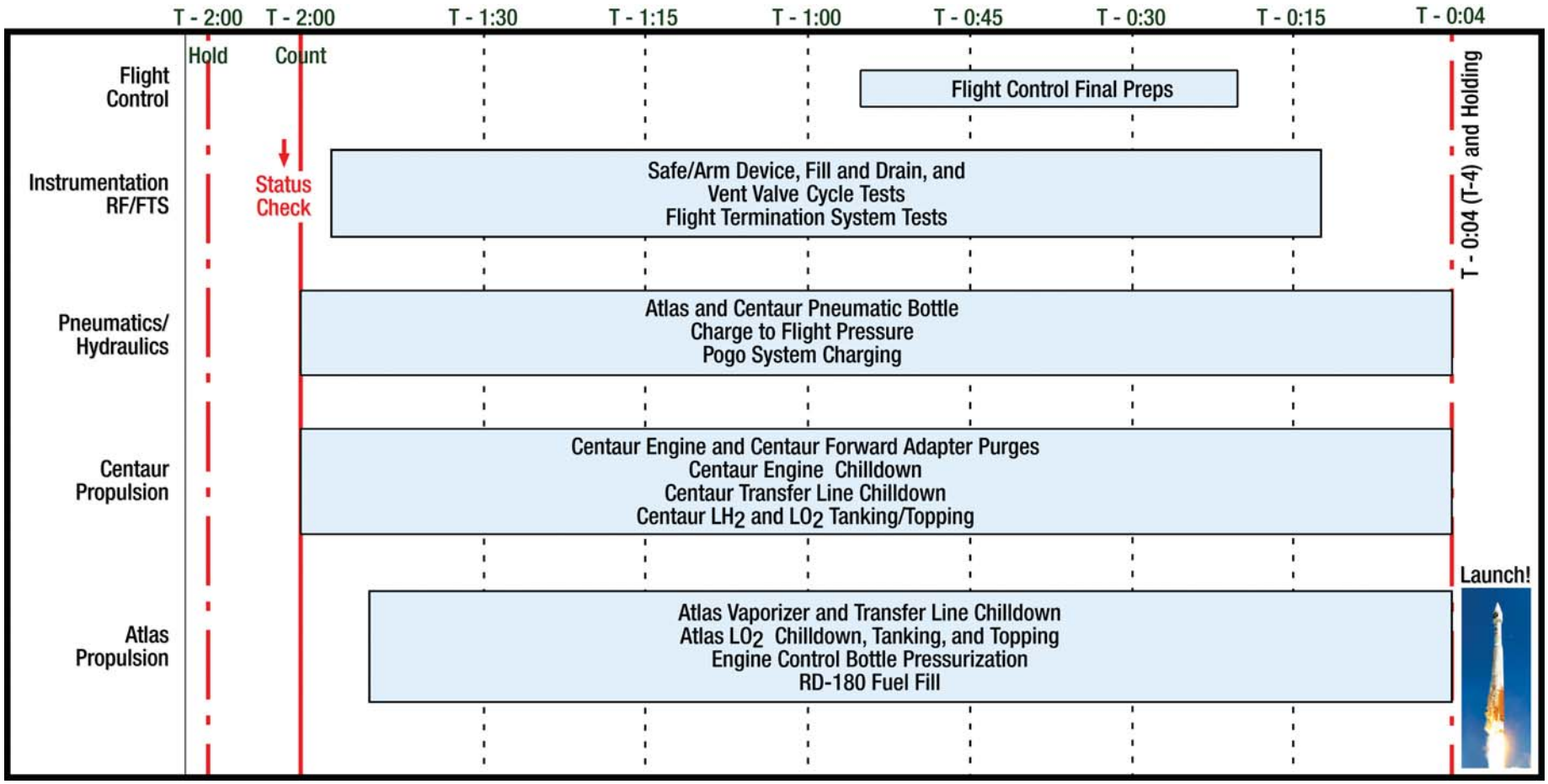
Mission Ground Trace



Countdown Timeline



Countdown Timeline (concl.)



United Launch Alliance

Plus Count Key Events

ATLAS

Mission Elapsed Time (sec)	Mission Elapsed Time (hr:min:sec)	Action
0	+00:00:00	T=0 (Engine Ready)
24	+00:00:24	Oak Mountain/TRS AOS
81	+00:01:21	San Nicholas Island AOS
247	+00:04:07	BECO Detected
253	+00:04:13	A/C Separation
263	+00:04:23	Centaur Main Engine Start 1
271	+00:04:31	Payload Fairing Jettison
403	+00:06:43	MTRS-2 LOS
818	+00:13:38	Building 836 LOS
845	+00:14:05	Oak Mountain/TRS LOS/Roll to TDRS "E"
845	+00:14:05	TDRS AOS
878	+00:14:18	VTS (Cook) LOS
859	+00:14:19	San Nicholas Island LOS
898	+00:14:58	IIP Vanish
920	+00:15:20	Centaur Main Engine Cutoff 1
1089	+00:18:09	SV Separation
1093	+00:18:13	Turn to CCAM Attitude
1147	+00:19:07	Switch to QPSK
1987	+00:33:07	Switch to BPSK
2287	+00:38:07	Switch to TDRS 275
3560	+00:59:20	Roll Reversal 1
4655	+01:17:35	TCS (Lion) AOS
4756	+01:19:16	Roll Reversal 2

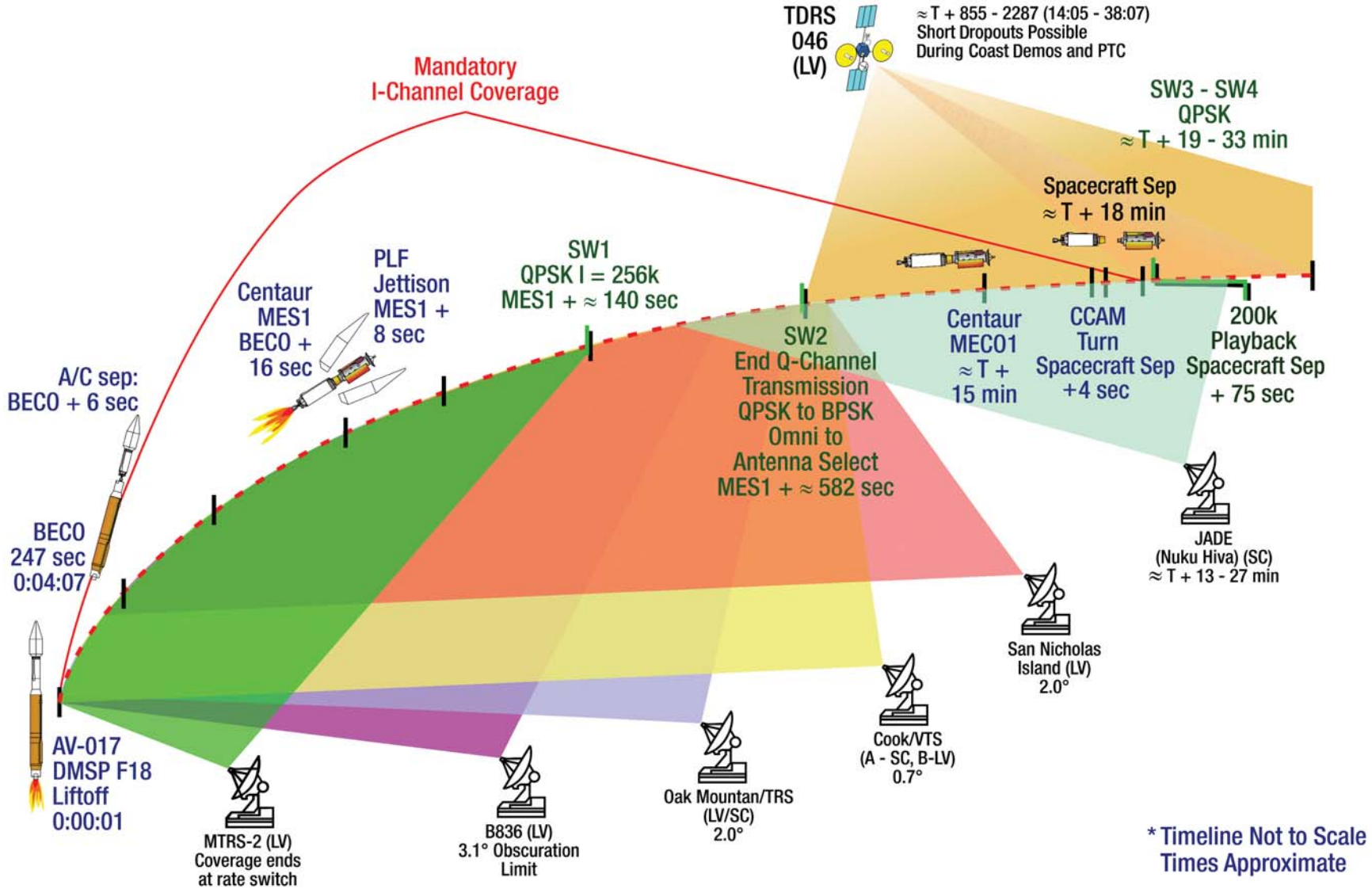
*Times approximate

Plus Count Key Events (concl.)

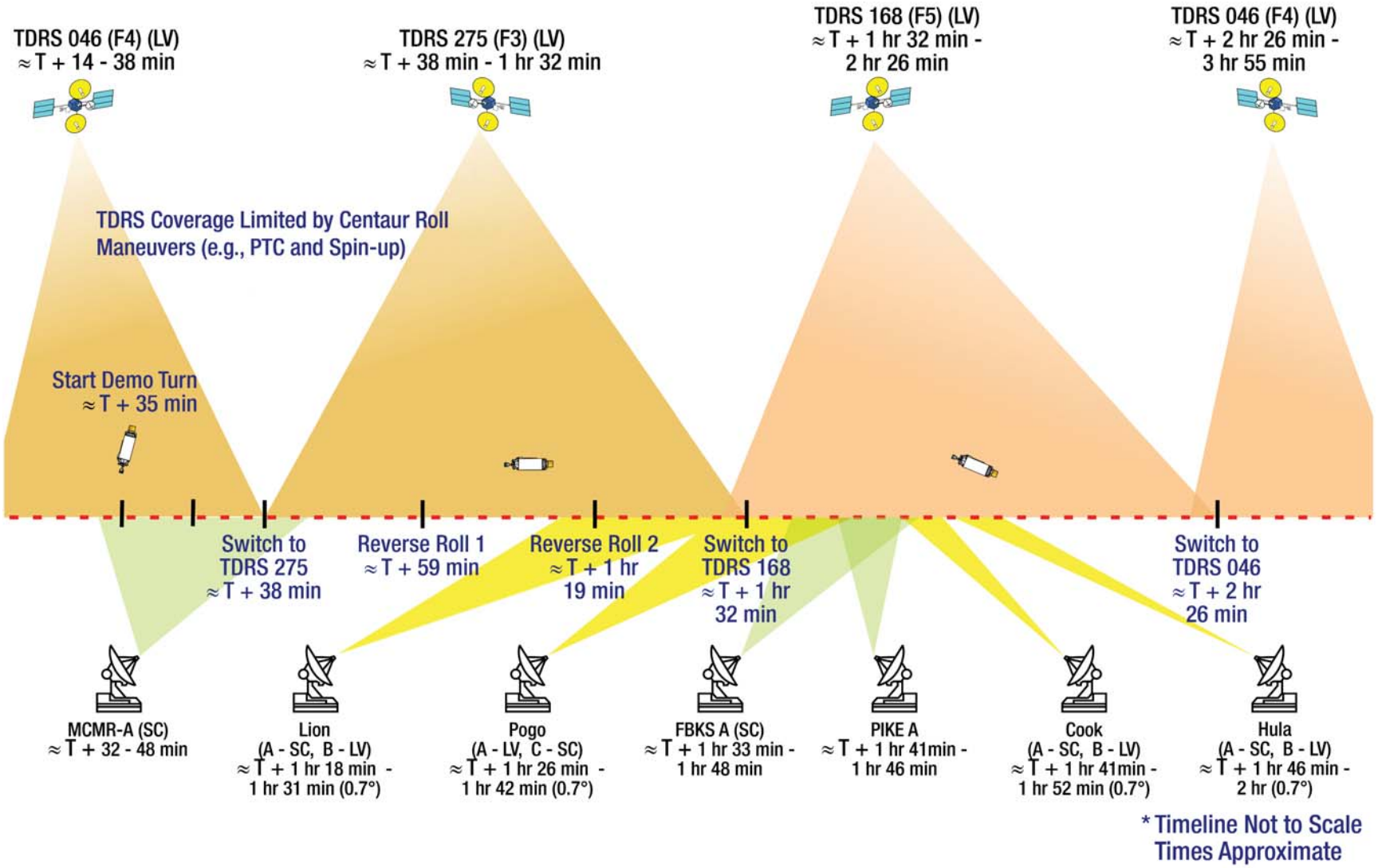
Mission Elapsed Time (sec)	Mission Elapsed Time (hr:min:sec)	Action
5170	+01:26:10	TTS (Pogo) AOS
5460	+01:31:00	TCS (Lion) LOS
5500	+01:31:37	Switch to TDRS 167
6055	+01:40:55	VTS (Cook) AOS
6095	+01:41:35	TTS (Pogo) LOS
6330	+01:45:30	HTS (Hula) AOS
6740	+01:52:20	VTS (Cook) LOS
7225	+02:00:25	HTS (Hula) LOS
8747	+02:25:47	Switch to TDRS 046
10593	+02:56:33	TCS (Lion) AOS
10687	+02:58:07	Centaur Main Engine Start 2
10857	+03:00:57	Escape C3 > 0
10907	+03:01:47	Centaur Main Engine Cutoff 2
10967	+03:02:47	Switch to QPSK
11020	+03:03:40	TTS (Pogo) AOS
11114	+03:05:14	Begin Blowdown
11197	+03:06:37	Switch to TDRS 167
12050	+03:20:50	TCS (Lion) LOS
12504	+03:28:24	End Blowdown
12807	+03:33:27	Switch to TDRS 046
13264	+03:41:04	N_2H_4 Depletion
13504	+03:45:04	Centaur End of Mission (EOM)
14104	+03:55:04	Transmit Orbital Parameter Message (OPM); EOM +10 min

*Times approximate

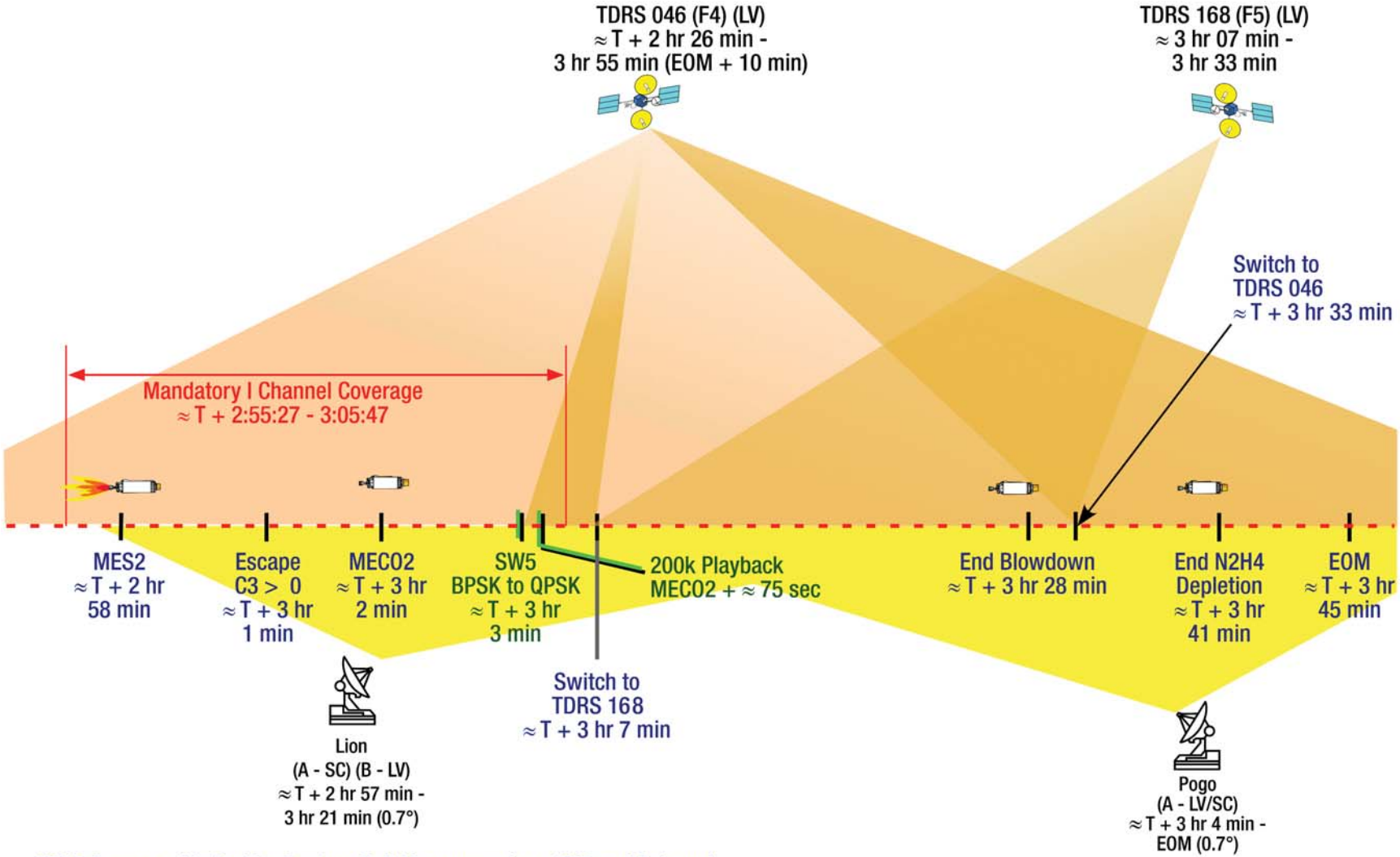
Expected Telemetry Coverage



Expected Telemetry Coverage (cont.)



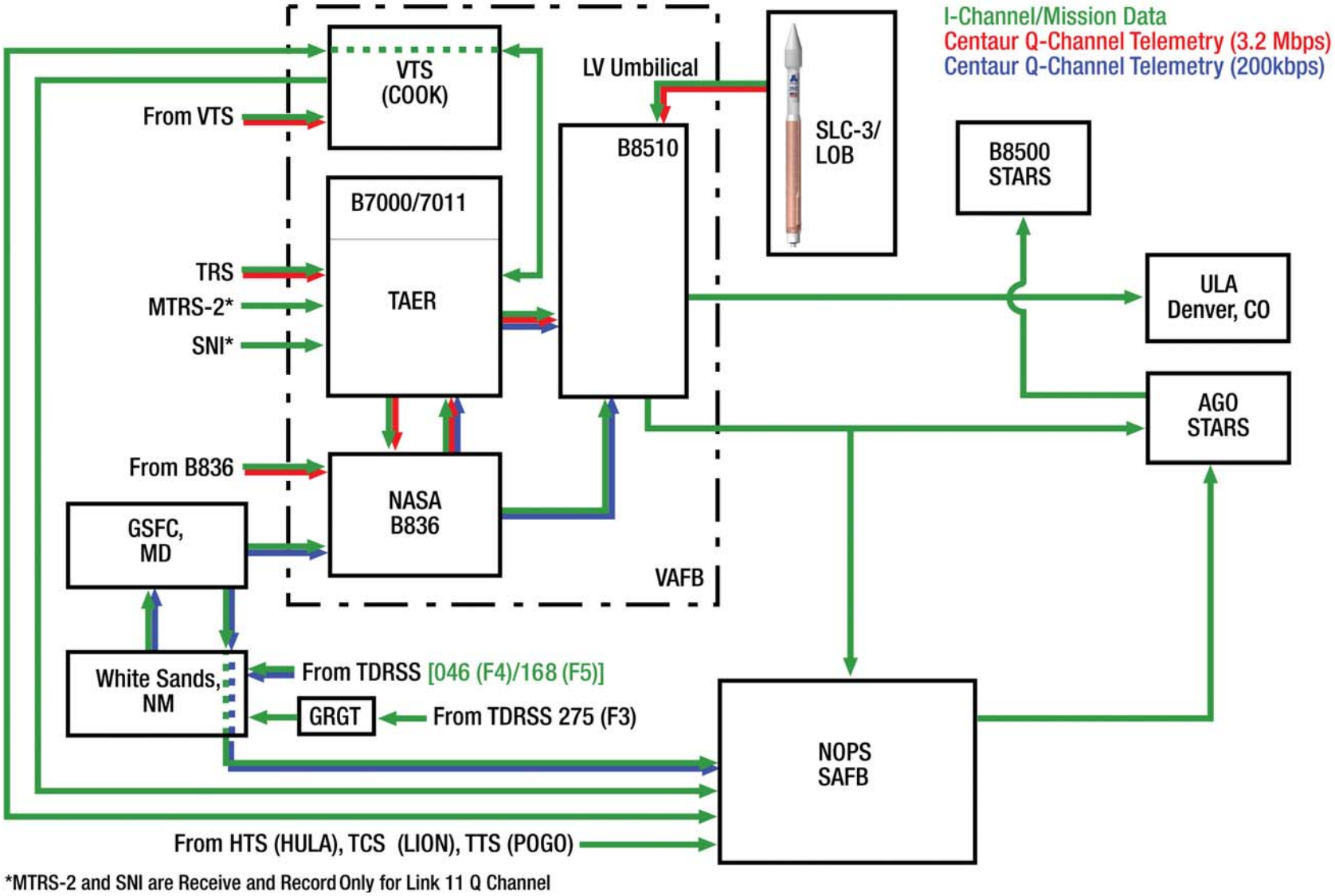
Expected Telemetry Coverage (concl.)



TDRS Coverage Limited by Centaur Roll Maneuvers (e.g., PTC and Spin-up)

* Timeline Not to Scale
Times Approximate

Telemetry Flow



*MTRS-2 and SNI are Receive and Record Only for Link 11 Q Channel

Abbreviations & Acronyms

A/C	Atlas/Centaur
ADU	Automatic Destruct Unit
AGO	Aerospace Group Offices
AOS	Acquisition of Signal
AV	Atlas V
BECO	Booster Engine Cut Off
BPSK	Binary Phase Shift Key
B “xxxx”	Vandenberg Building Number
CA	California
C3S	Command, Control, and Communications Segment
CCAM	Collision and Contamination Avoidance Maneuver
CFA	Centaur Forward Adapter
CO	Colorado
DMSG	Defense Meteorological Systems Group
DMSP	Defense Meteorological Satellite Program
ECS	Environmental Control System
EOM	End of Mission
FTS	Flight Termination System
GRGT	Guam Remote Ground Terminal
GSFC	Goddard Space Flight Center
HTS	Hawaii Tracking Station
IIP	Initial Impact Point
IR	Infrared
ISA	Interstage Adapter
IST	Integrated Systems Test
JADE	Nuku Hiva (French Polynesia)
kbps	Kilobits Per Second
km	Kilometer
LPF	Large Payload Fairing
LH_2	Liquid Hydrogen
LO_2	Liquid Oxygen
LOB	Launch Operations Building
LOS	Loss Of Signal
LPF	Large Payload Fairing
LSB	Launch Support Building
LV	Launch Vehicle
LVA	Launch Vehicle Adapter
LVRT	Launch Vehicle Readiness Test
M	Meter
Mbps	Megabits Per Second
MCMR	McMurdo, Antarctica
MECO	Main Engine Cut Off
MES	Main Engine Start
MD	Maryland

Abbreviations & Acronyms (concl.)

MST	Mobile Service Tower
MTRS	Mobile Telemetry Receiving Station
N_2H_4	Hydrazine
NASA	National Aeronautics and Space Administration
NM	New Mexico
nmi	Nautical Mile
NOPS	NRO Operations Squadron
NRO	National Reconnaissance Office
OPM	Orbital Parameter Message
PLA	Payload Adapter
PLF	Payload Fairing
PTC	Passive Thermal Control
PVC	Polyvinyl Chloride
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RLCC	Remote Launch Control Center
RP-1	Rocket Propellant – 1 (kerosene)
SAFB	Schriever Air Force Base
SC	Spacecraft
SCLVA	Spacecraft Launch Vehicle Adapter
Sec	Second
Sep	Separation
SLC-3E	Space Launch Complex 3 East
SNI	San Nicholas Island
STARS	Space Launch Operations (SLO) Telemetry Acquisition and Reporting System
SVC	Space Vehicle Contractor
SW	Switch
TAER	Telemetry Analog Equipment Room
TCS	Telemetry & Command Station
TDRS	Tracking & Data Relay Satellite
TDRSS	Tracking & Data Relay Satellite System
TLM	Telemetry
TRS	Telemetry Receiving Site
TSF	Technical Support Facility
TTS	Thule Tracking Station
TX	Texas
ULA	United Launch Alliance
USAF	United States Air Force
VAFB	Vandenberg Air Force Base
VTS	Vandenberg Tracking Station