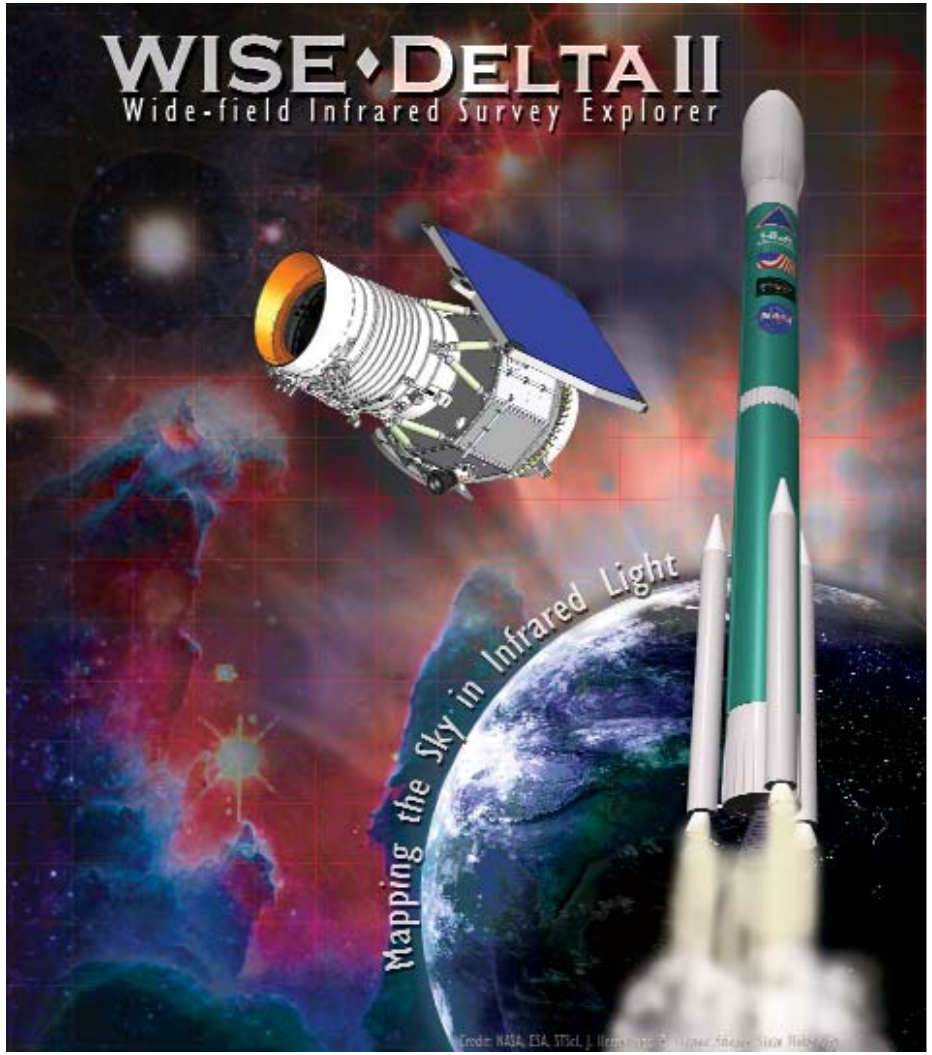
United Launch Alliance

Delta II Launches
Wide-field Infrared Survey Explorer
Mission Overview



Delta II 7320-10C

Vandenberg Air Force Base, CA

Space Launch Complex 2 West

DELTA

WISE

JPL

Wide-field Infrared Survey Explorer

United Launch Alliance (ULA) takes great pride in launching the Wide-field Infrared Survey Explorer (WISE) mission for the Jet Propulsion Laboratory (JPL). WISE will be launched aboard a Delta II 7320-10C launch vehicle from Vandenberg Air Force Base (VAFB), CA.

ULA provides the Delta II launch service under the NASA Launch Services (NLS) contract with the NASA Kennedy Space Center Launch Services Program. We are pleased that NASA once again selected the Delta II for this mission after many successful commercial and government launches to Earth orbit and destinations throughout the solar system. My congratulations to the entire Delta team for its continued efforts in achieving this milestone.

Vernon L. Thorp
NASA Program Manager
United Launch Alliance

United Launch Alliance

WISE
Science Objectives

DELTA

- Conduct an all-sky infrared survey
- Find the most luminous galaxies in the universe
- Find the closest stars to the sun
- Provide an important catalog for the James Webb Space Telescope (Hubble follow-on)
- Features
  - Four imaging channels covering 3-25 microns wavelength
  - 40-cm telescope operating at <17° Kelvin
  - Two-stage solid hydrogen cryostat
  - Operational life: 7 months (110% margin)
  - Four TDRSS tracks per day

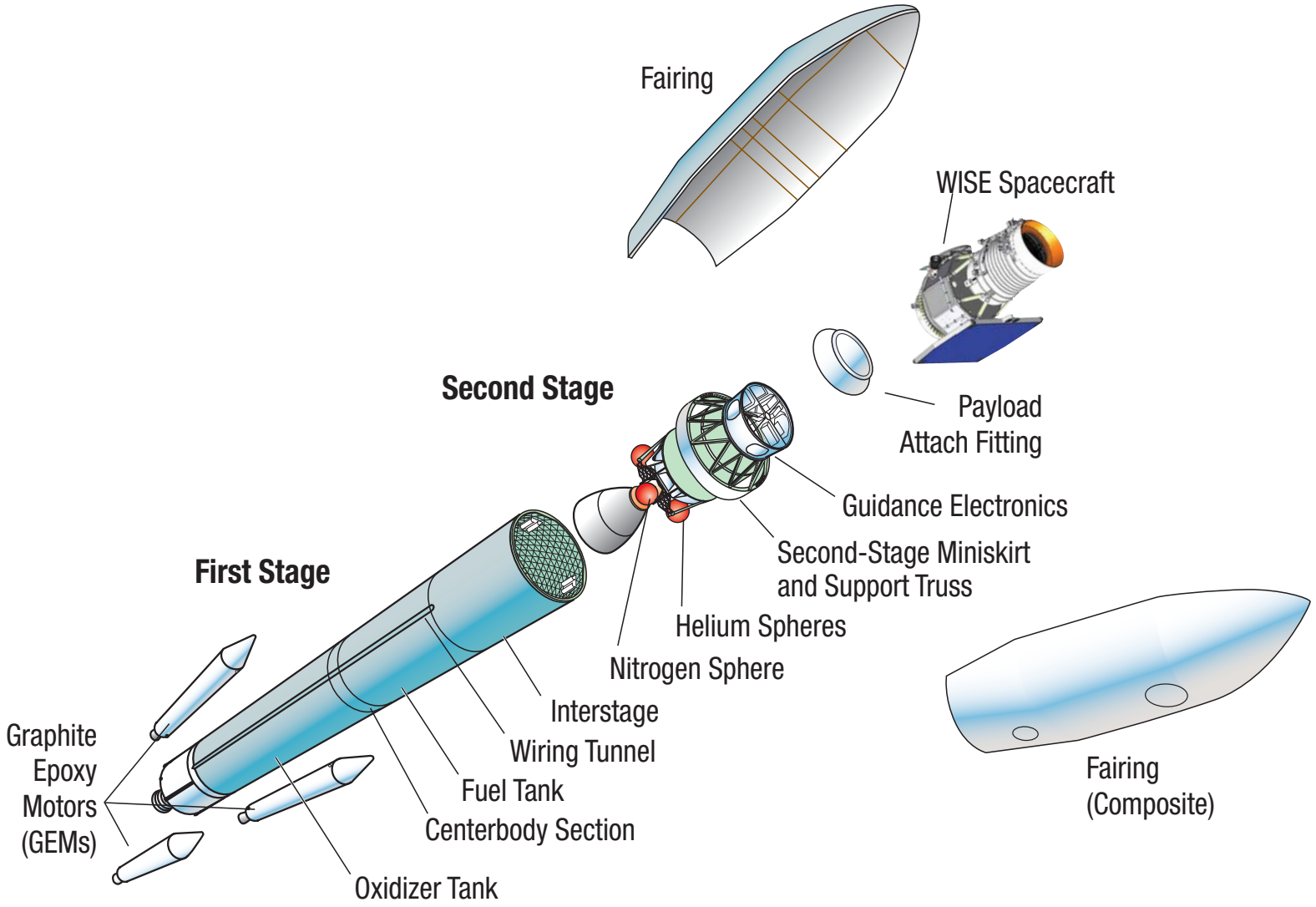
WISE
Launch Statistics

- Launch Period: Dec 2009 – June 2010
- Vehicle Configuration: 7320-10C
- Launch Location: Space Launch Complex 2 West (SLC-2W)
- Spacecraft (SC) weight: 1,485-lb (674-kg)
- Orbit: Circular, 6,912-km, at 97.5°
- Mission-Unique Requirements:
  - SC separation camera
  - Payload Attach Fitting (PAF)/Payload Fairing (PLF) cleaning to 500A
  - Pad command lockout testing
  - Cryogenic solid hydrogen SC processing
  - Delta II first flight of Tracking and Data Relay Satellite System (TDRSS)

United Launch Alliance

Delta II 7320-10C Launch Vehicle

DELTA



WISE
Mission Requirements

United Launch Alliance

DELTA

- Orbit Criteria (defined at ascending node after spacecraft separation)
  - Semi-Major Axis: 3,732 ± 5.4-nmi (6,912 ± 10-km)
  - Eccentricity: 0.00133 ± 0.0005
  - Inclination (True-of-Date): 97.5 ± 0.03°
  - Argument of Perigee: 69 ± 30°
  - Mean Local Time (MLT): 17:57:30 ± 7.5 min (Launch Period 1)
05:57:30 ± 7.5 min (Launch Period 2)
- Launch Parameters
  - Site: Vandenberg AFB SLC-2W
  - Launch Period 1: 01 Nov 2009 – 28 Jan 2010
    - Window: 14:09:12 – 14:24:12 UTC daily*
  - Launch Period 2: 01 Jan 2010 – 21 Jun 2010
    - Window: 02:09:12 – 02:24:12 UTC daily*
- Payload Weight (not including PAF and separation system): 1,484.8 lbs (673.5 kg) Not-to-Exceed

* Launch window may decrease due to launch vehicle dispersions and Mission Assurance/Range Safety Collision Avoidance (COLAs)

WISE
Mission Requirements (Concl)

United Launch Alliance

DELTA

• Second-Stage Probability of Command Shutdown (PCS)	≥ 99.865%
• SC and Launch Vehicle (LV) Separation	
- Attitude	
• $+Y_{SC}$ axis	Pointed toward the sun vector within a half cone angle of 10°
• $+Z_{SC}$ ($+X_{LV}$) axis	Minimize inertial velocity vector angle
- Tip-off	
•Combined X_{SC} and Y_{SC} axes	< 3-deg/sec (3-Sigma)
•$+Z_{SC}$ ($+X_{LV}$) axis	≤ 2-deg/sec (3-Sigma)
• Contamination and Collision Avoidance Maneuver (CCAM)	Prevent re-contact with spacecraft and ensure deposition of contaminants on spacecraft less than 10 Angstroms
• Second-Stage Disposal	Place stage in orbit with perigee greater than 2,000 km (1,079.9 nmi) and apogee less than geosynchronous orbit (GEO) minus 200 km (~19,215 nmi)

Flight Mode Description
Boost-to-Orbit

- 7320-10C launch from VAFB SLC-2W
- Flight azimuth of 196°
- Three GEM solid motors ignited at liftoff
- Separation of three GEM solid motors at 99 seconds for range safety
- Dog-leg maneuver (100 to 140 seconds) performed to attain required orbital inclination
- Main engine cutoff (MECO) occurs at first stage propellant depletion; nominally at 264.2 seconds after liftoff
- Second stage separated 8 seconds after MECO; ignited 5.5 seconds later
- Payload fairing jettisoned when free molecular heating rate ≤ 0.1 BTU/ft^2-sec (1,135-W/m^2)
- Command receiver decoders (CRDs) turned off at 438 seconds
- Second-stage first burn places vehicle in a 100 x 299 nmi (185 x 553 km) orbit with an inclination of 97.5°
    - In view of TDRS-E and TDRS-W satellites

United Launch Alliance

Sequence of Events
Boost-to-Orbit

DELTA

Event	Time (Seconds)
Liftoff	0.0
Mach 1	35.7
Maximum Dynamic Pressure	50.0
GEM Burnout	64.0
GEM Jettison	99.0
Begin Dog-Leg Maneuver	100.0
End Dog-Leg Maneuver	140.0
Main Engine Cutoff (MECO)	264.2
First-Stage Separation	272.2
Second-Stage Ignition	277.7
Jettison Fairing	296.0
CRD Turnoff	438.2
Second Stage - First Cutoff (SECO-1)	622.5

Flight Mode Description
Coast and Restart

- Following second-stage cutoff, vehicle reoriented to desired coast attitude
- Following the coast period, vehicle reoriented to restart burn attitude
- Second-stage restart occurs at 3,100 seconds in view of Hartebeesthoek (HBK) Tracking Station and TDRS-E and TDRS-Z satellites
  - Restart burn duration of 8.5 seconds
  - At the end of the restart burn, second stage is in a 282.1 x 289.6 nmi (522 x 536.3-km) orbit with an inclination of 97.504°
- Following second-stage restart burn, vehicle reoriented to SC separation attitude
- SC separation occurs at 3,320 seconds in view of HBK tracking station and TDRS-E and TDRS-Z satellites
  - Relative separation velocity of 1.69 fps (+1.26 fps to spacecraft and 0.43 fps to second stage)
  - Elevation angle from HBK is 5.2°
  - At the first ascending node the SC in desired orbit with a semi-major axis of 3,732.46 nmi (6,912.5 km) and eccentricity of 0.00133 with an inclination of 97.5°

United Launch Alliance

Sequence of Events
Coast and Restart

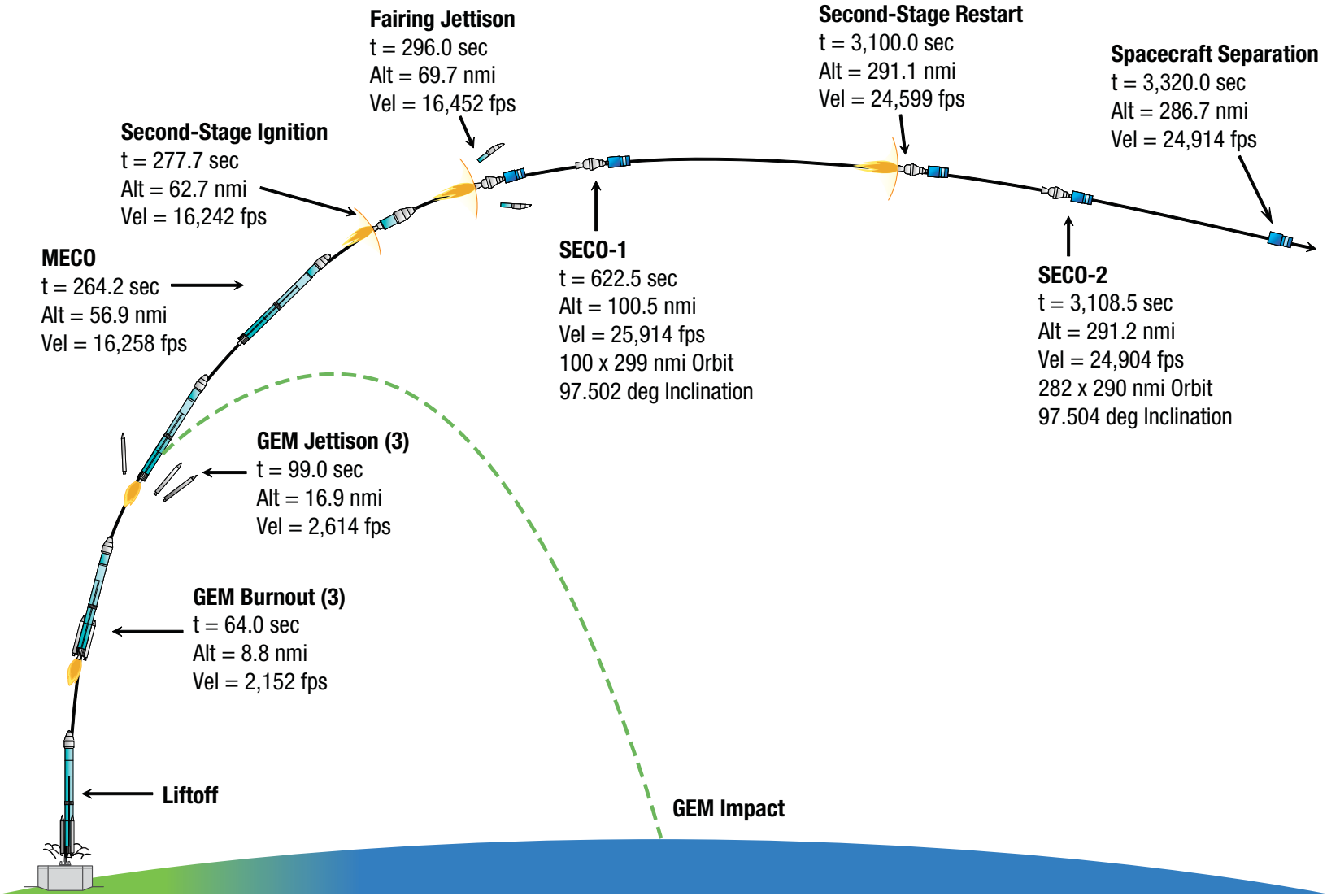
DELTA

Event	Time (Seconds)
Second Stage-First Cutoff (SECO-1)	622.5
Begin Maneuver To Coast Attitude	675.0
End Maneuver To Coast Attitude	885.0
Begin Maneuver To Restart Attitude	2,550.0
End Maneuver To Restart Attitude	2,950.0
Second-Stage Restart Ignition	3,100.0
Second Stage - Second Cutoff (SECO-2)	3,108.5
Begin Maneuver To Separation Attitude	3,160.0
End Maneuver To Separation Attitude	3,260.0
SC Separation	3,320.0
SC First Ascending Node	3,564.6

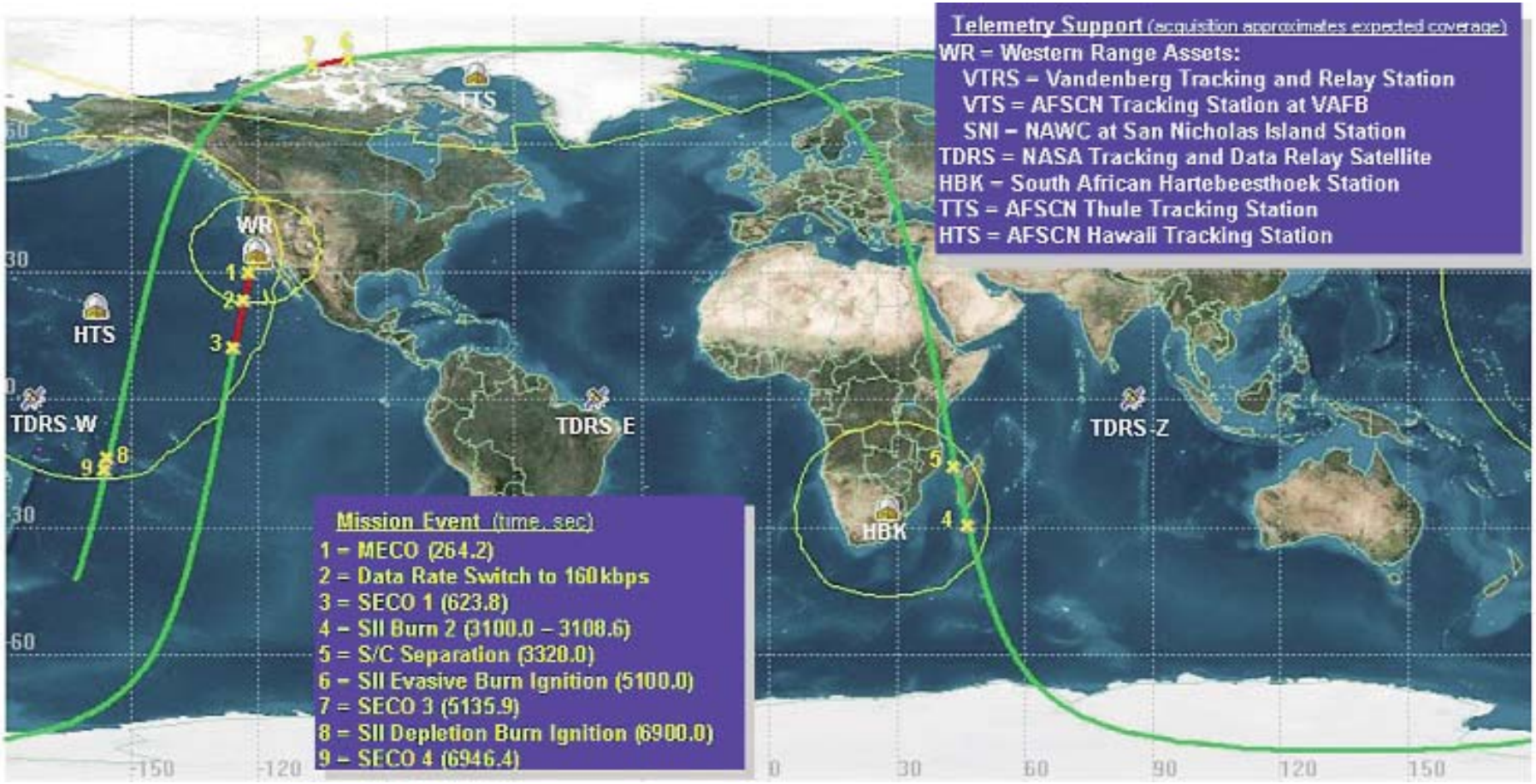
United Launch Alliance

WISE
Flight Profile

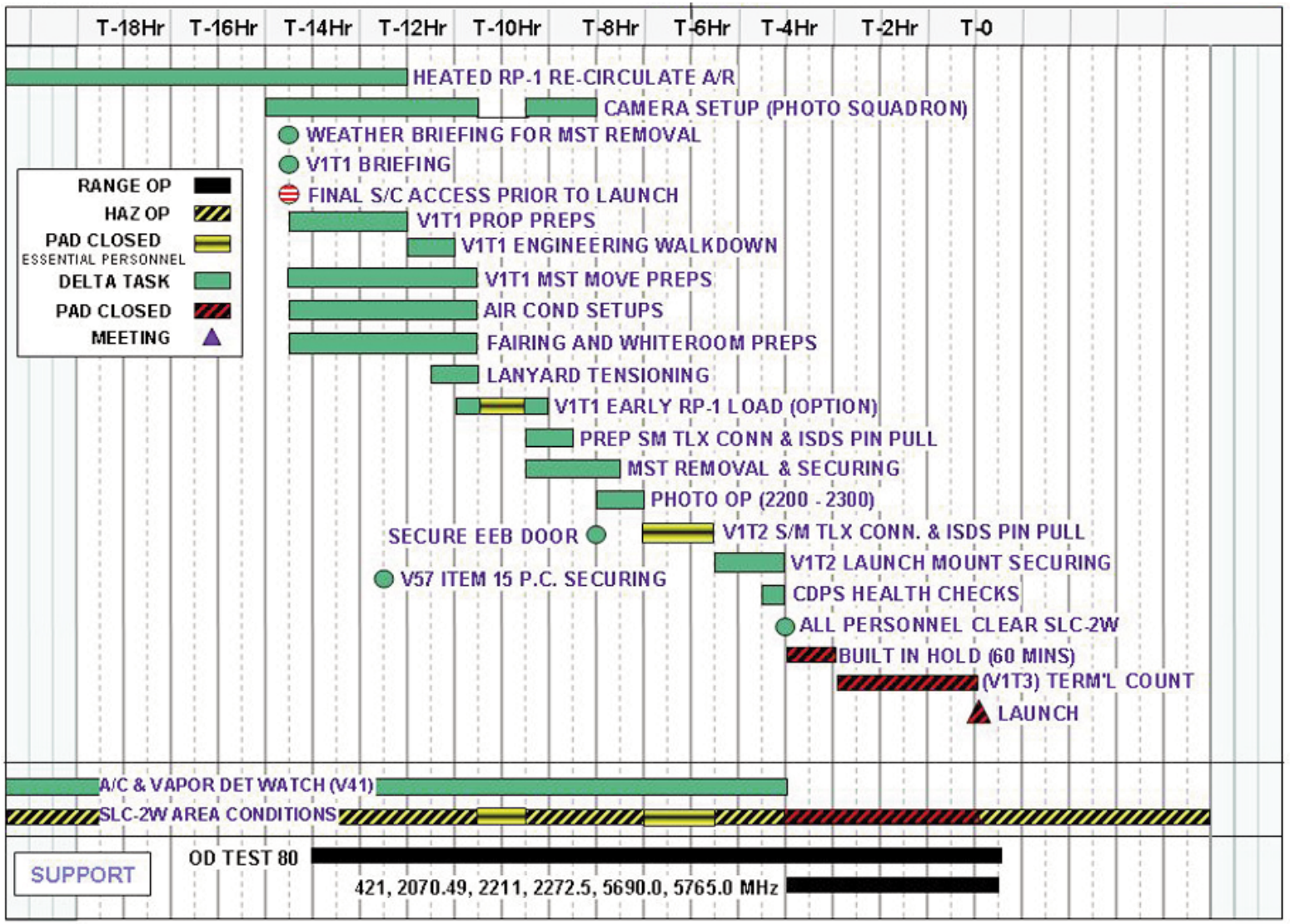
DELTA



WISE
Orbit Trace



Delta II Countdown (T-0 Day)



Delta II Terminal Count (T-0 Day)