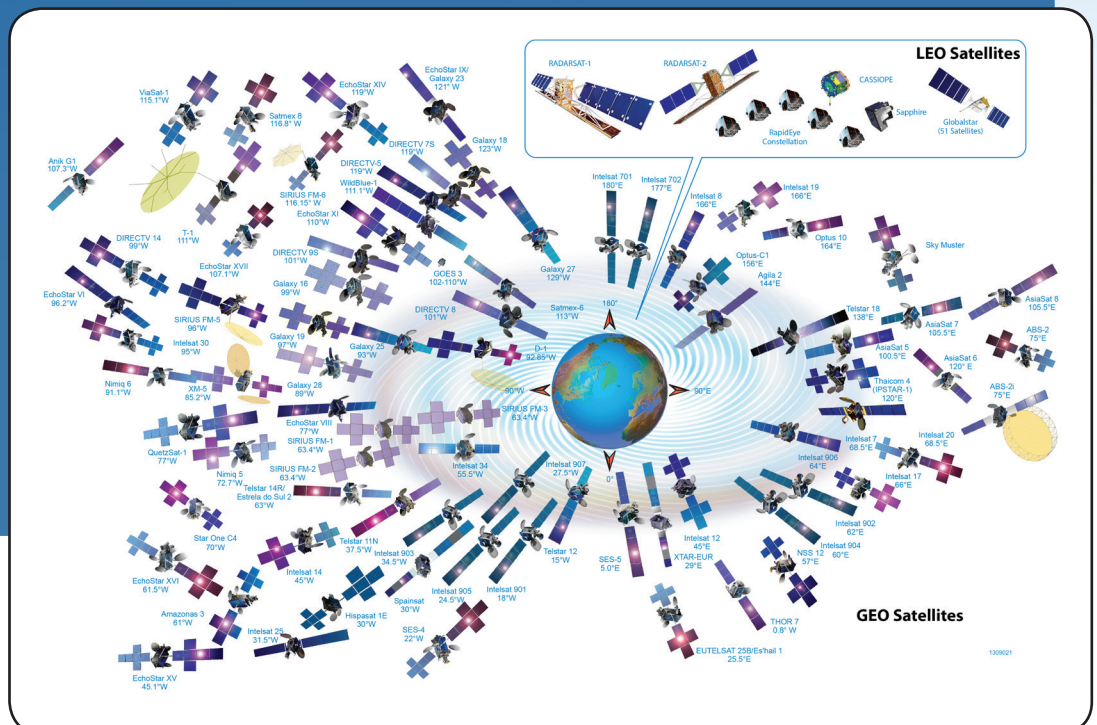


SSL 1300 Spacecraft Bus for RSDO Applications

CORE SPACECRAFT MISSION HERITAGE

The SSL 1300 spacecraft bus has been launched to GEO orbit more than 100 times, beginning in 1989. Today there are roughly 80 SSL 1300s providing service in orbit and more than 20 in production. Its success is built on a foundation of a robust modular bus, a commitment to quality and continuous improvement, and over 50 years of industry-leading innovations for communications and electro-optical (EO) spacecraft design, tracing back to the original Synchronous Meteorological Satellite and up to the most advanced GEO infrared (IR) imaging spacecraft today, including MTSAT-1R. Designed as a GEO communications and remote sensing platform, the SSL 1300 bus features a modular panel construction for straightforward spacecraft tailoring, which is key to its success as a platform for a wide variety of missions. By leveraging an active production line (currently averaging 6-8 deliveries and launches a year), the SSL 1300 may be considered a “build-to-print” bus, requiring minimal non-recurring engineering and very low technical/schedule risk.

- The SSL 1300 series heritage hardware/software is backed by over 2000 years of reliable on-orbit operation and proven performance
- The Data Handling System (DHS) hardware architecture (Rad-750 processor based) has demonstrated high on-orbit reliability





SSL 1300 Spacecraft Bus for RSDO Applications

Complete in-house cradle-to-grave capability

- Materials Development and Testing, Design/Analysis, Manufacturing and Inspection, Assembly Test (TC/TVAC/Static/Vibe/Acoustic)
- Graphite composite structure, honeycomb panels, load bearing, central cylinder
- 1300 satellite family is modular and scalable to higher power and more payload capacity

Type and power capability of electrical power subsystem

- 145-Ah Lithium-Ion battery (18-cell each)
- Direct energy transfer with single power bus regulated at 100 V plus 31 V low voltage bus
- Two conventional 3-panel solar array wing design
- All panels are fully populated with advanced Triple Junction Gallium-Arsenide (GaAs) cells

Attitude control architecture

- Heritage three-axis momentum bias system with robust 4-wheel control
- Flight proven Heritage Ring Laser Gyros (RLGs, 2x) for inertial guidance
- Advanced 2:1 Star Trackers for precision attitude knowledge
- Heritage suites of redundant Sun Sensors

Communication systems

- UHF, L-, X-, Ka-, Ku-, S-, C-bands

Command & data handling

- Distributed data handling architecture with 2:1 redundant RAD-750 central control processors
- MIL-STD-1553B serial data bus, and lower-level RS-485 buses data architecture
- RS-485 routers, with Serial Interface Modules
- Command (CMD) and Telemetry (TLM) AES-encryption capability

Means of spacecraft thermal control

- Standard passive thermal control system with dual-bore matrix heat pipes in communication panels
- Optical Solar Reflectors (OSRs) used on communication panels

Propulsion

- Pressure-fed liquid system using hypergolic bipropellants (MMH and N2O4) with 2,272-kg capacity tanks, and helium pressurant
- 12 Heritage Attitude and Orbit Control (AOCS) thrusters

Technical Specifications

Payload Accommodation Features

Payload Mass	Up to 500 Kilograms (Could go higher)
Payload Power	2857 Watts (Could go higher)
Payload Pointing	Roll 83, Pitch 137, Yaw 90 arc-sec.
Payload External Volume	Nominal: 2.4m x 2.2m x 3.1m high
Payload Internal Volume	4 sections, ea. 2.4m x 1.2m x .31m

Bus Features

Orbit	GEO (MEO, LEO)
Stability Mode	3 axis, dual redundant momentum bias
Pointing Knowledge	< 60 (3s) arc-sec
Pointing Control	< 200 (3s) arc-sec
Ps @ 15 years	.85

Command & Data Handling

Architecture	Rad 750 Processor, MIL-STD-1553B, RS485
Downlink Formats	CCSDS, STDN
Downlink Band	S-Band
Data Storage	Up to 5.6 Tb
Downlink Rate	350 Mbps

Power

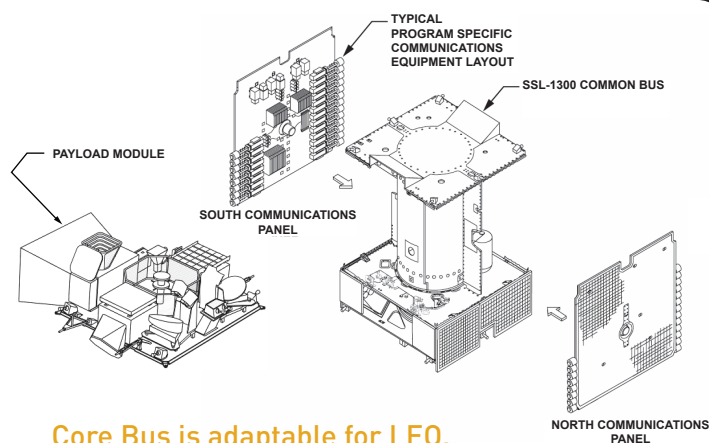
Bus Voltage	Regulated 100V plus 31V
Battery	Lithium-Ion 145 Amp hour
Solar Array	Triple Junction GaAs/19 m ²

Propulsion

Type	Chemical Bi-propellant
Propellant Capacity	2272 Kilograms (Up to 3800 Kilograms)
Max Delta V	4073 meters/sec

Structure

Structure	Composite & Al honeycomb
Bus Dry Mass	916 Kilograms (Payload dependent)
Lowest Structural Mode	14.2 Hz lateral, 35 Hz longitudinal
Compatible Launch Vehicle(s)	H-2A, Altas V, Delta IV, Ariane V, Falcon 9



Core Bus is adaptable for LEO, HEO and GEO Imaging Missions

SSL 1300 Spacecraft Bus for RSDO Applications

LAUNCH VEHICLE COMPATIBILITY AND ORBIT CAPABILITY

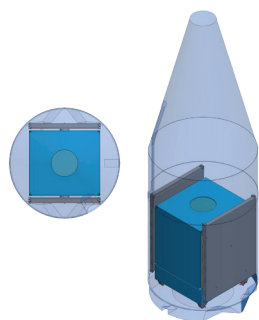
- SSL, Palo Alto, California has either integrated or launched spacecraft on all of the candidate launch vehicle families
- As our spacecraft design is compatible with all candidate Launch Service Providers, we can typically offer a very late launch vehicle selection date
- Contract baseline delivery schedule, ARO through launch and on-orbit checkout, showing all major reviews



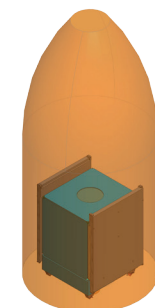
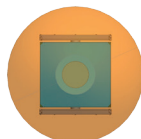
Atlas V launch



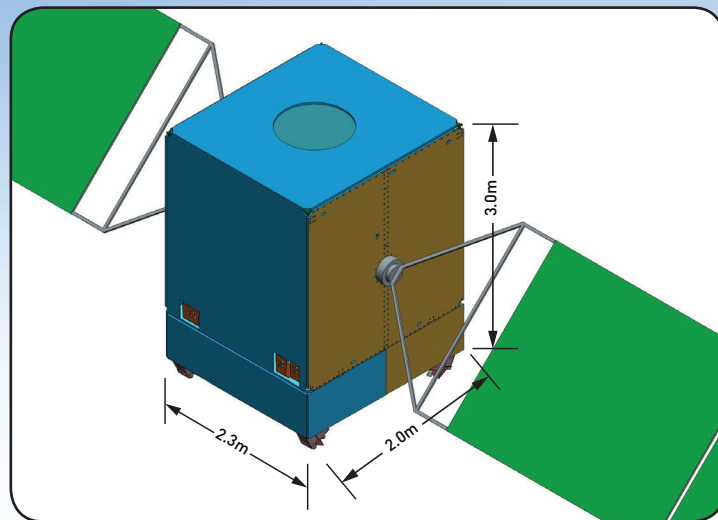
Falcon 9 launch



Atlas V

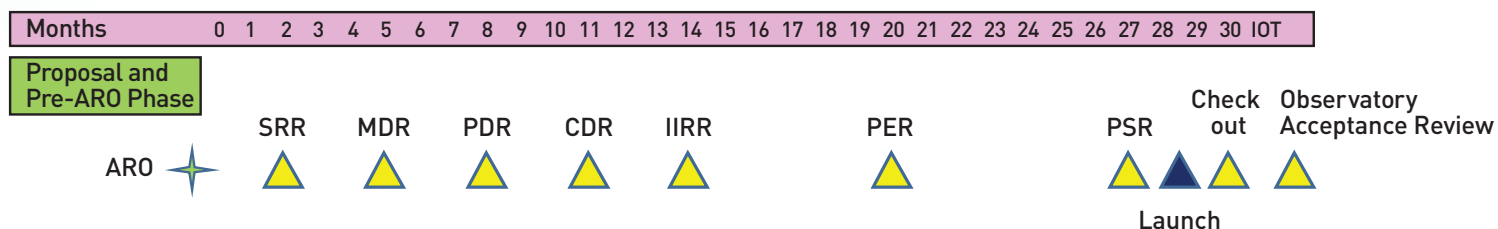


Falcon 9



IMPLEMENTATION SCHEDULE

Milestones and Reviews





SSL 1300 Spacecraft Bus for RSDO Applications

FACILITIES OVERVIEW AND USE PLAN

- SSL can accommodate 10K cleanroom requirements within our typical 100K cleanroom highbay by localized dedicated tenting, as employed on previous contamination sensitive missions GOES 8-12 and MTSAT 1R. For small spacecraft buses, SSL has dedicated 10k facilities used to build spacecraft in our small LEO manufacturing facility
- Approximately 100,000 sq. ft. cleanroom capacity
- >165,000 sq. ft. general manufacturing space
- Facility of 1.3M square feet spanning 37 buildings and approximately 79 acres
- SSL's Palo Alto, California facility contains two spacecraft Thermal Vacuum chambers, a DFAN acoustic facility, and spacecraft vibration tables
 - Dedicated environmental test teams provide focused and effective test implementation
- Available Add-On Capabilities
 - Ground systems, On-orbit data processing,
 - On-orbit operations support, Hosted payloads,
 - Increased data storage, Higher power payloads



Rapid Spacecraft Development Office (RSDO)
NASA Goddard Space Flight Center
Mail Code 401.1
Greenbelt, MD 20771 USA
Phone: 301-286-1289
Email to: rsdo@rsdo.gsfc.nasa.gov