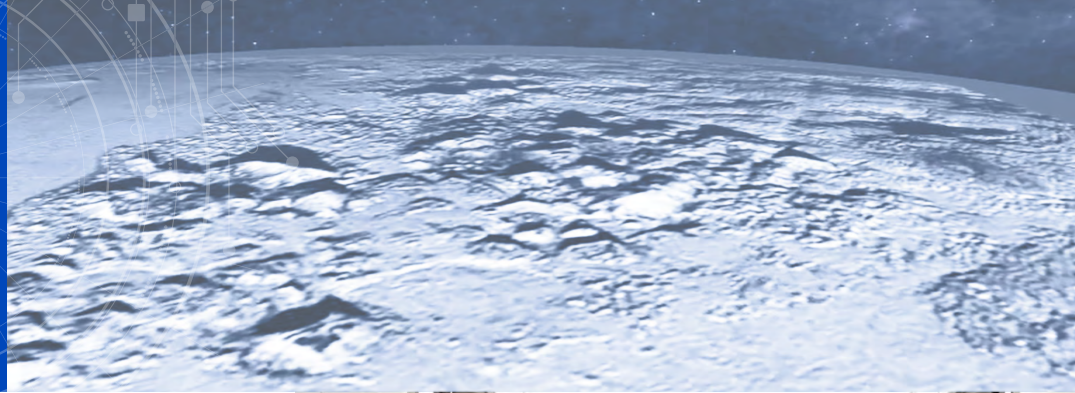# SwRI®
## SOUTHWEST RESEARCH INSTITUTE

# Space Flight Systems

Southwest Research Institute® (SwRI®) is a world-renowned supplier of mission-critical systems for the aerospace industry. With a long history of successful space flight missions, we have core competencies in software development, computer networking, real-time operating systems, and systems engineering.
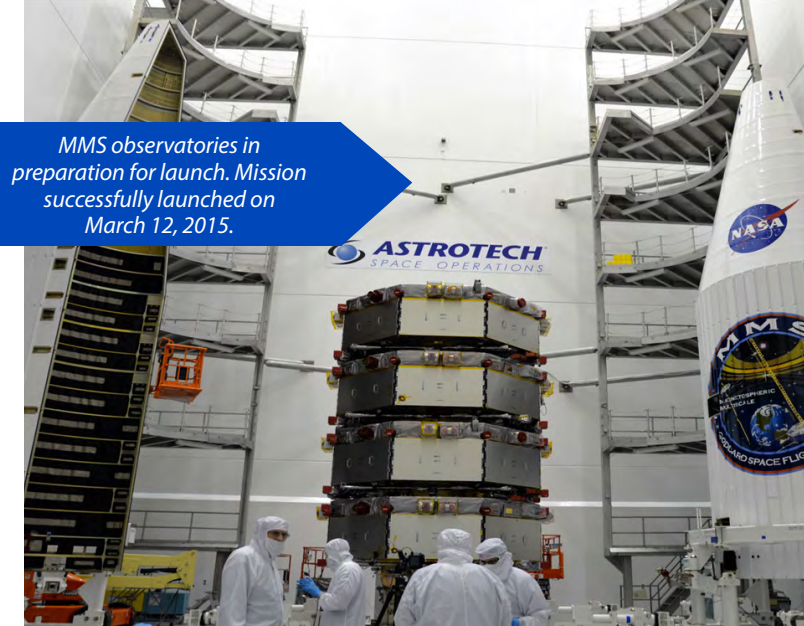
## Space Flight Software

With more than two decades of experience, we have developed software and systems for many government and commercial space flight missions:

- Earth observing systems
  - Magnetospheric Multiscale (MMS) mission
- Satellite Systems
  - Cyclone Global Navigation Satellite System (CYGNSS) mission
  - Polarimeter to UNify the Corona and Heliosphere (PUNCH) mission
- Ultraviolet imagers and spectrographs
  - New Horizons mission to Pluto
  - Rosetta mission to Comet 67P/Churymov-Gerasmenko
  - Juno misson to Jupiter
- X-Ray instruments
  - Fermi Gamma-Ray Space Telescope
  - Swift Gamma-Ray Burst mission
- Avionics and command and data handling software
  - Many government and commercial missions
- Space networking modeling and simulation
  - Architecture design, modeling and simulation
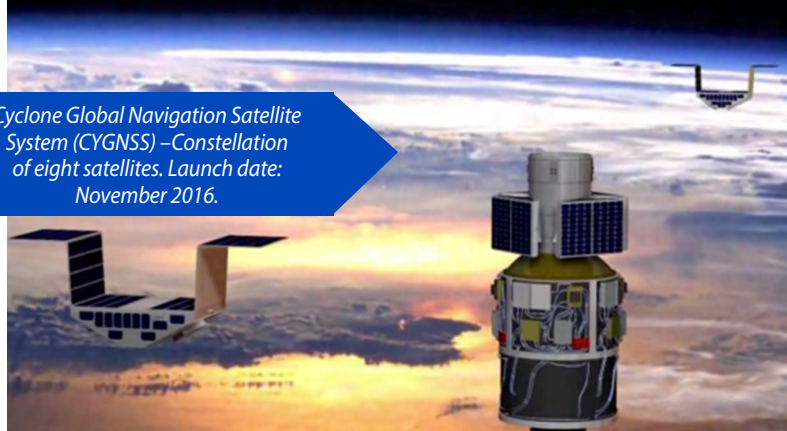  - Integration and testing

## Capabilities and Experience

- Reusable flight core:
  - Established command and data handling application software that can be reused for new programs
  - Reduced non-recurring engineering (NRE) costs
- Processors:
  - BAE Systems' RAD6000 (IBM POWER), BAE Systems' RAD750 (PowerPC), Motorola 603E (PowerPC), Freescale MPC8548E, Atmel TSC695 (SPARC ERC32), Atmel AT697F (SPARC LEON2), Aero ex-Gaisler GR712RC (SPARC LEON3), ARM Cortex, Harris RTX2010, Intel 8051, RISC-V
- Operating Systems:
  - VxWorks, RTEMS, uCOS, Linux and custom executives
- Device Drivers:
  - Spacewire, Ethernet, MIL-STD-1553B, I2C, SCSI, Flash, EEPROM, CRAM, MRAM, PCI, Serial (various)
- Backplanes:
  - VME, CompactPCI, I2C and custom
  - Bootstrap software



*MMS observatories in preparation for launch. Mission successfully launched on March 12, 2015.*
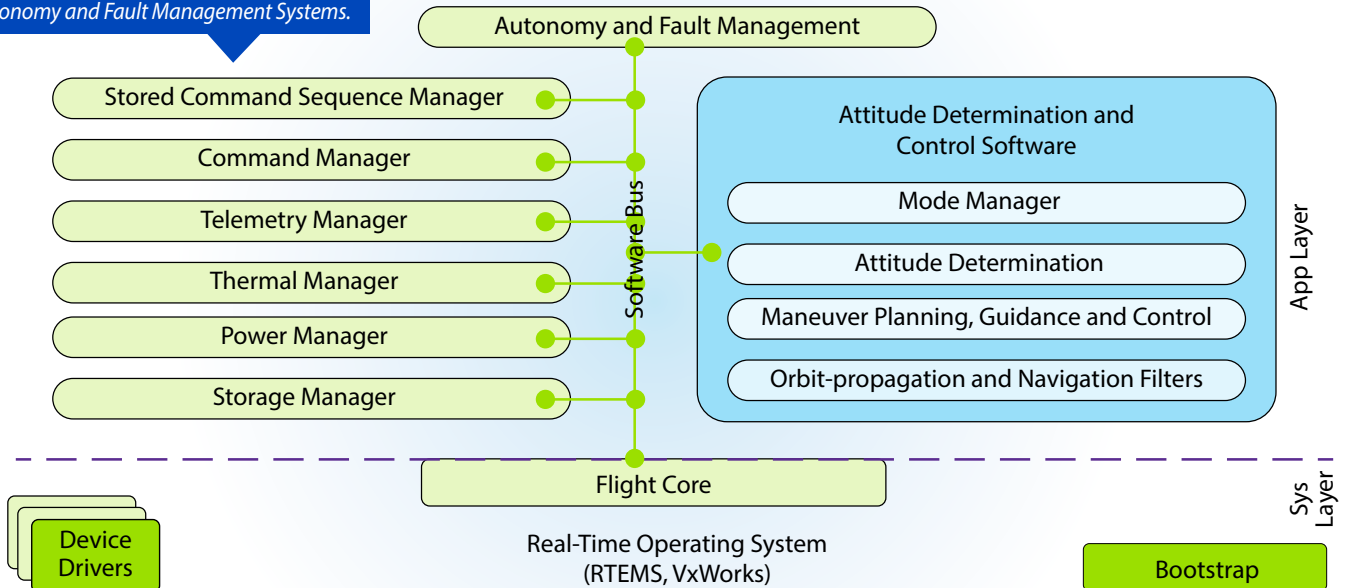


*New Horizons Mission – Launched in 2006. Successful Pluto fly-by in July 2015.*



*Cyclone Global Navigation Satellite System (CYGNSS) –Constellation of eight satellites. Launch date: November 2016.*

Advanced science. Applied technology.

**Autonomy and Fault Management**

Stored Command Sequence Manager

Command Manager

Telemetry Manager

Thermal Manager

Power Manager

Storage Manager

Software Bus

**Attitude Determination and Control Software**

Mode Manager

Attitude Determination

Maneuver Planning, Guidance and Control

Orbit-propagation and Navigation Filters

App Layer

Flight Core

Sys Layer

Device Drivers

Real-Time Operating System
(RTEMS, VxWorks)

Bootstrap

## Mission Roles

- Instrument and spacecraft flight software development
- Ground systems development
  - GSEOS
  - ITOS
  - ASIST/FEDS OASIS
  - LabVIEW
  - LabWindows
  - CVI
- System engineering
- Independent review, verification, and validation

## Edge Computing

- Explore how to solve demanding computational problems on resource-constrained platforms
- Deploy machine learning (ML) models on space-grade HW platforms
- Decisions at edge intelligently reduce data volume and help solve bandwidth limitations
- Applications include space, UAS, connected vehicles, and smart cities

## Systems Engineering

- Capability Maturity Model Integration (CMMI) level 3
- System design and architecture
- Requirements and software lifecycle management
- Modeling and simulation
- DO-178 (software considerations in airborne systems and equipment certification)
- Extensive experience working with other organizations to support joint/shared flight software development

## Satellite Cybersecurity

- Penetration testing of space systems
- Zero trust architectures
- Micropatching secured to space assets
- Secure over-the-air updating
- Encryption of satellite communications
- Secure booting
- Intrusion detection systems

## We welcome your inquiries. For more information, please contact:

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