



NAVAL
POSTGRADUATE
SCHOOL

Mobile CubeSat Command & Control (MC3) Ground Stations

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This Brief is Classified:

UNCLASSIFIED

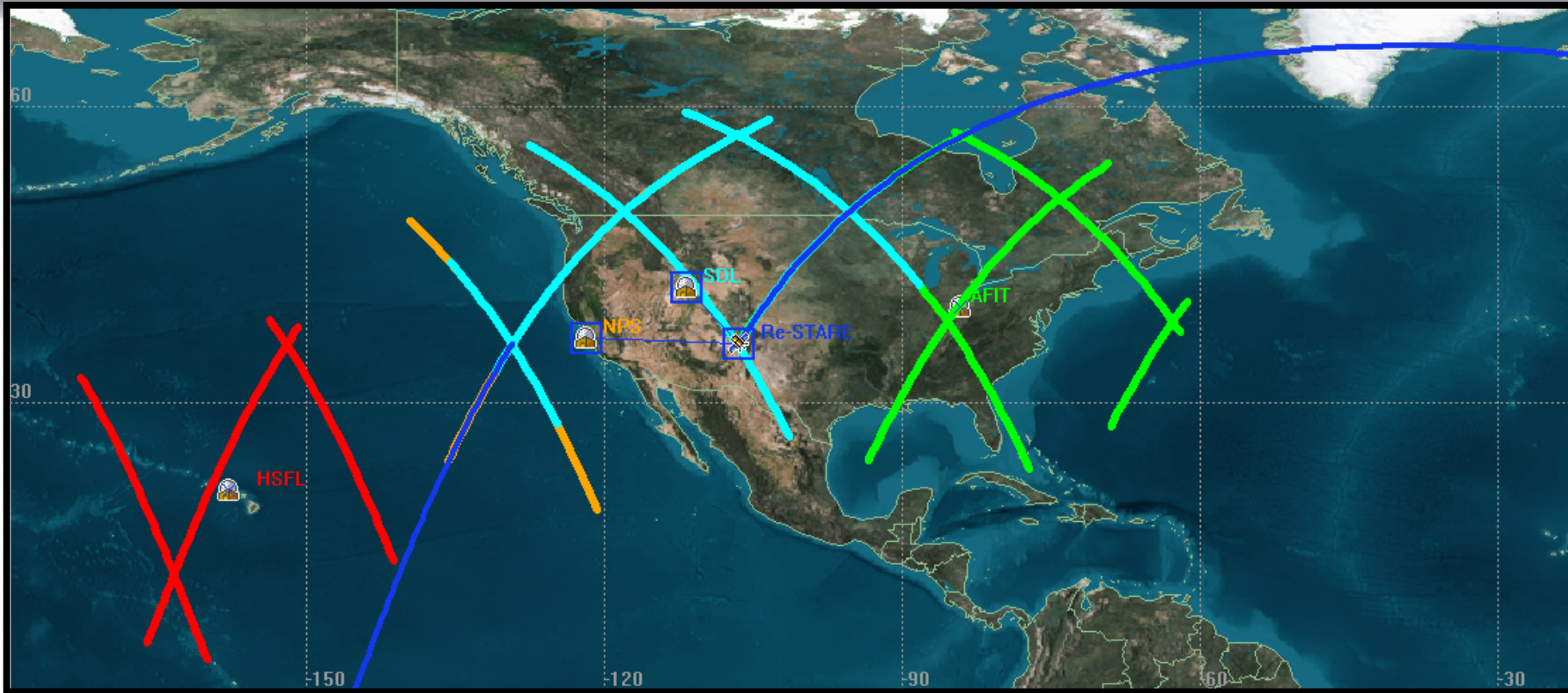
Excellence Through Knowledge

The Mobile CubeSat Command and Control (MC3) System is a network of fully autonomous ground stations which support the NRO's Colony Program.





- Geographically distributed ground stations provide continuous coverage for 30+ CubeSats
- Provide “hands on” educational opportunities in satellite communications, networking, and coding
- Ground station hosts adapt their government furnished hardware to further their own research in small satellites
- **Foster government and civilian institutional partnerships in the Small Satellite community**



MC3 Node Locations:

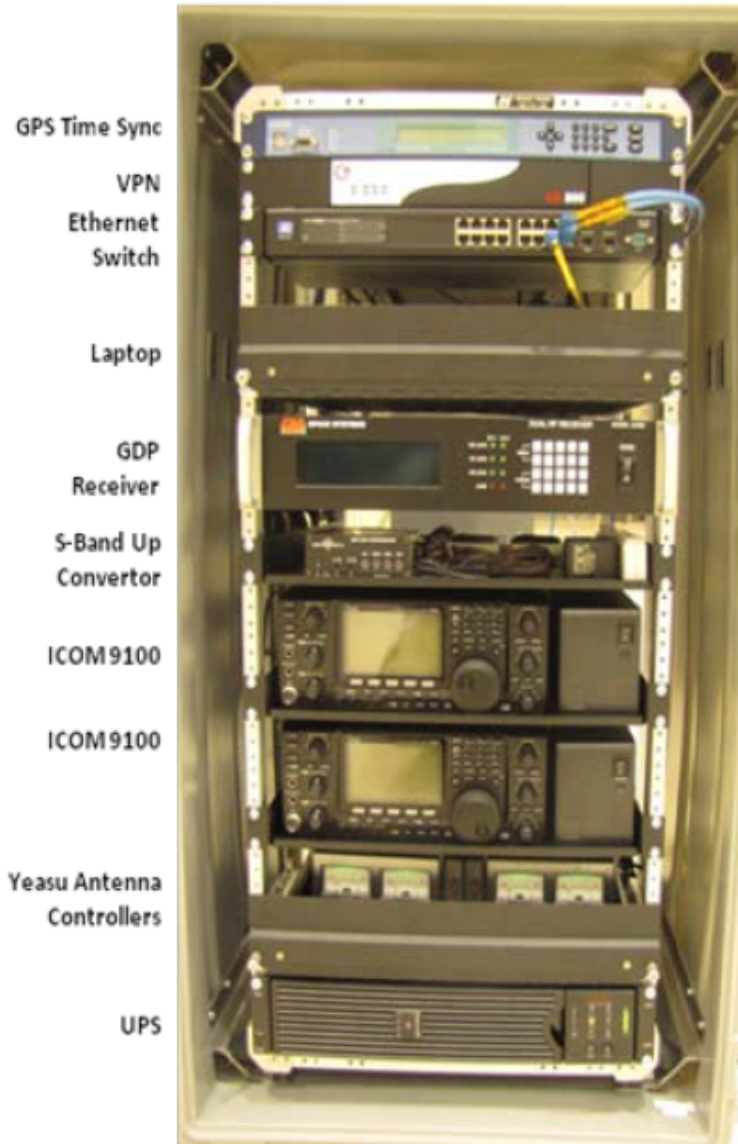


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Space Dynamics
LABORATORY
Utah State University Research Foundation





UHF
450 MHz TX
915 MHz RX



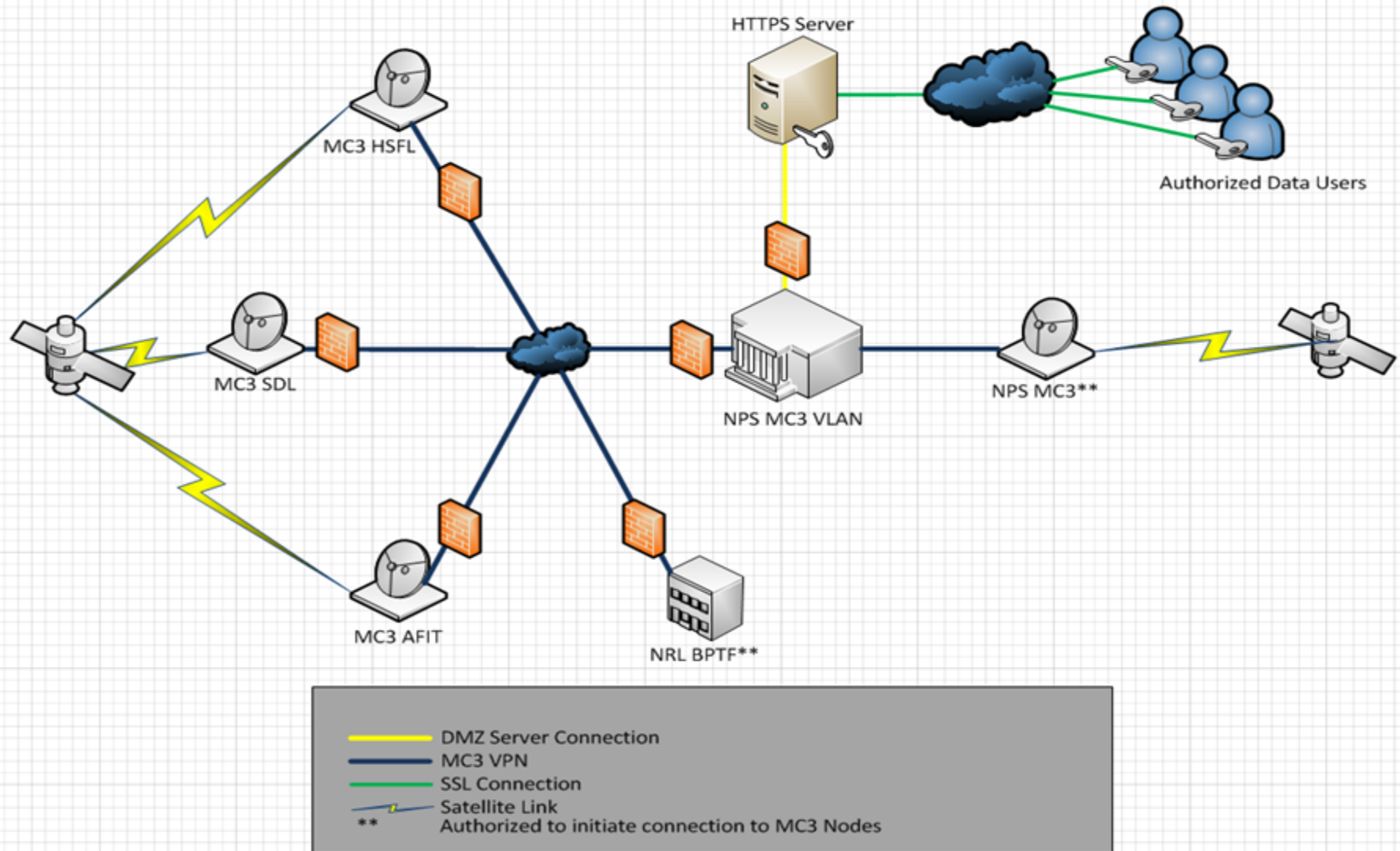
S-BAND
2.1 GHz TX
2.2 GHz RX



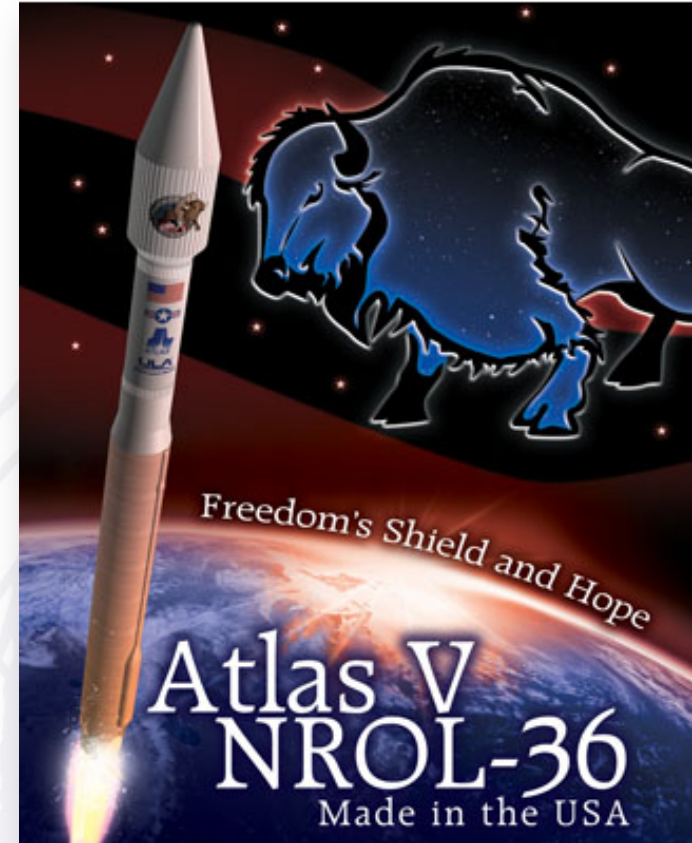
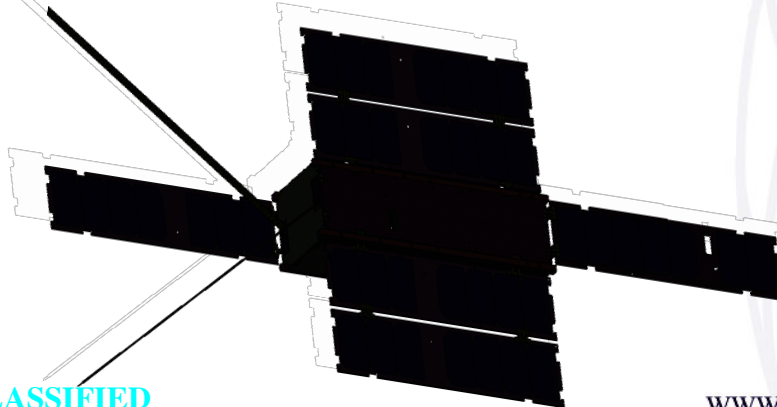
Ground Station Software

Ground stations run a GOTS Linux-based software program developed over the last 30 years by the NRL. This software enables stations to run fully autonomously with either remote or local control.

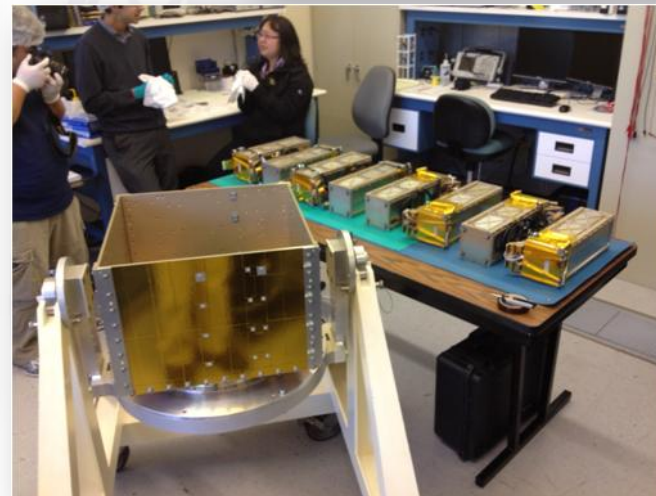
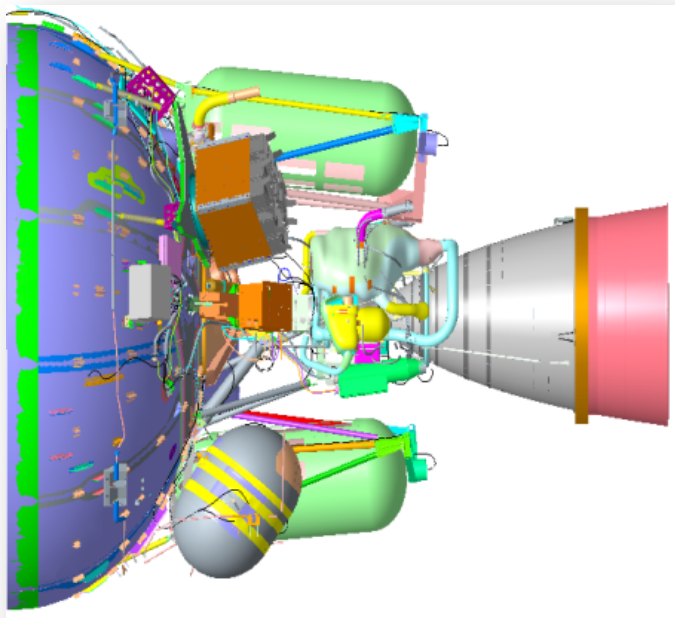
Software Capabilities	Description
Ground Station Equipment Control	<i>provides control and status of ground station equipment.</i>
Ground Control	<i>Provides a GUI that allows for modification of ground site parameters, equipment priorities and availability.</i>
Operations and Control	<i>Supports and provides automatic scheduling and control of MC3 nodes. Determines satellite contacts based on ephemeris, or time based events.</i>
Resource Equipment Management	<i>Allocates equipment to support future data collects for overhead passes. Produces a perform file that sets the hardware to be used in a satellite contact.</i>



- **Colony II Program:**
 - Bus Provider: Boeing
 - 20 buses over 3 years
 - Features: flight processor, EPS with 70W peak power (20 min), high-performance ADACS with star cameras, TT&C Radio, AES 256-bit software encryption
- **STARE Launch:**
 - September 2012
 - Space-based Telescopes for Actionable Refinement of Ephemeris (STARE)
 - **First Colony II to orbit**

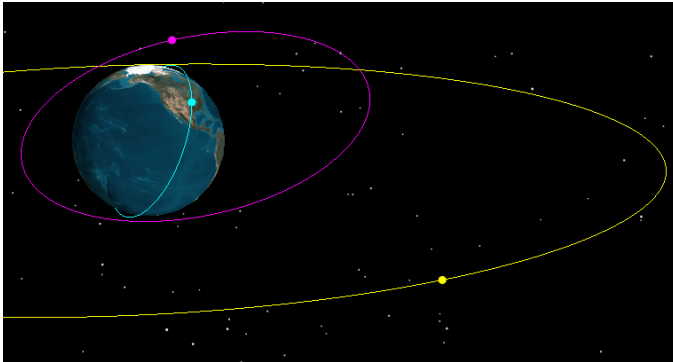


- 8 CalPoly P-PODs integrated into NPSCuI for OUTSAT mission on NROL-36
- **11 CubeSats in one launch!**

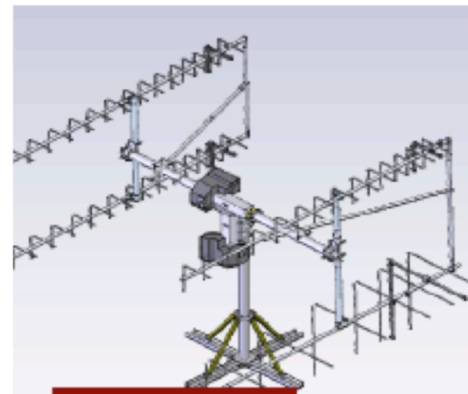




MC3 Path Forward



**Access to LEO, MEO,
and GEO CubeSats**



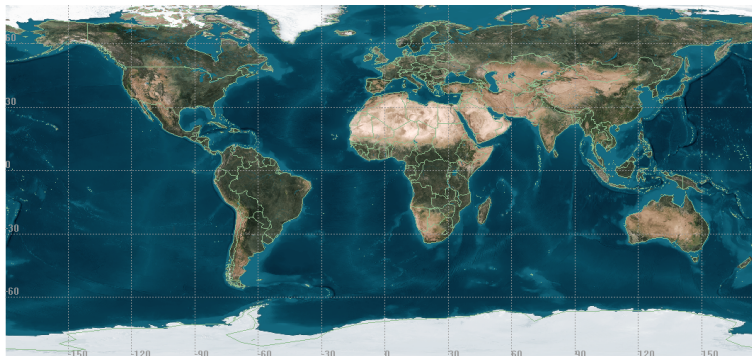
AZEL1000SCB

Better Pointing



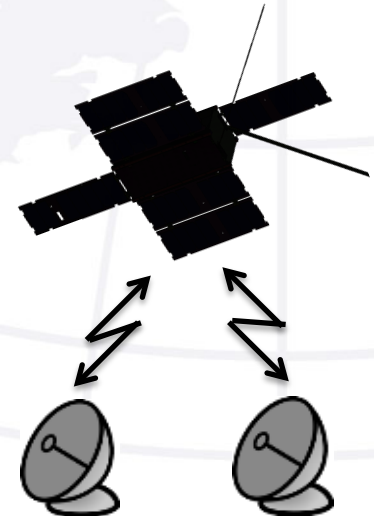
AZEL1000S

More Gain



Increased Coverage

**Optimized
Scheduling/
Performance**





QUESTIONS?

Contact Information

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