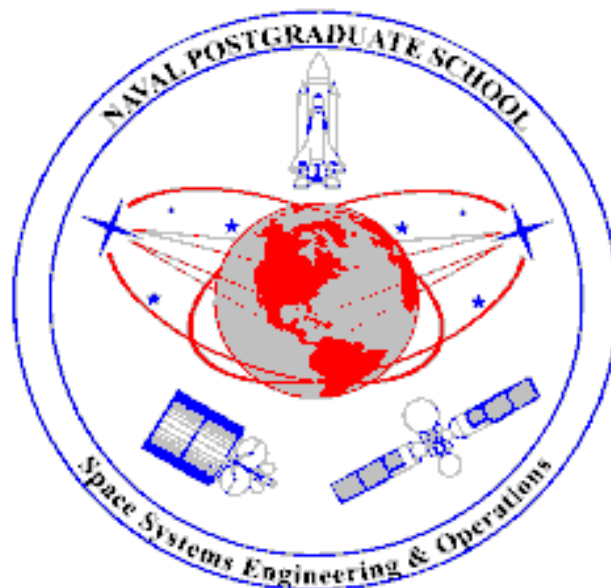# Mobile CubeSat Command and Control
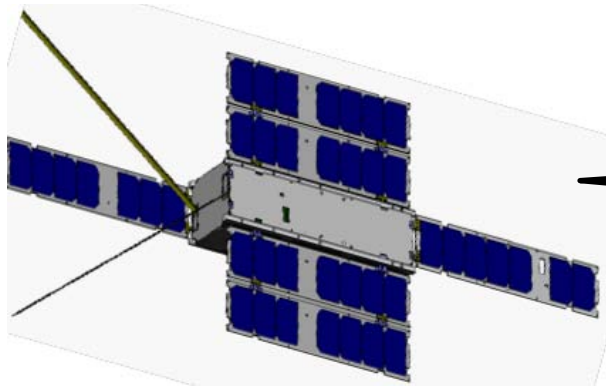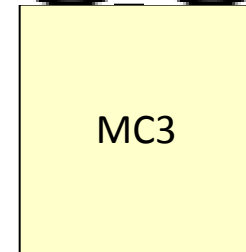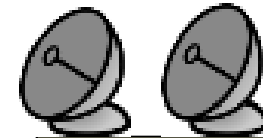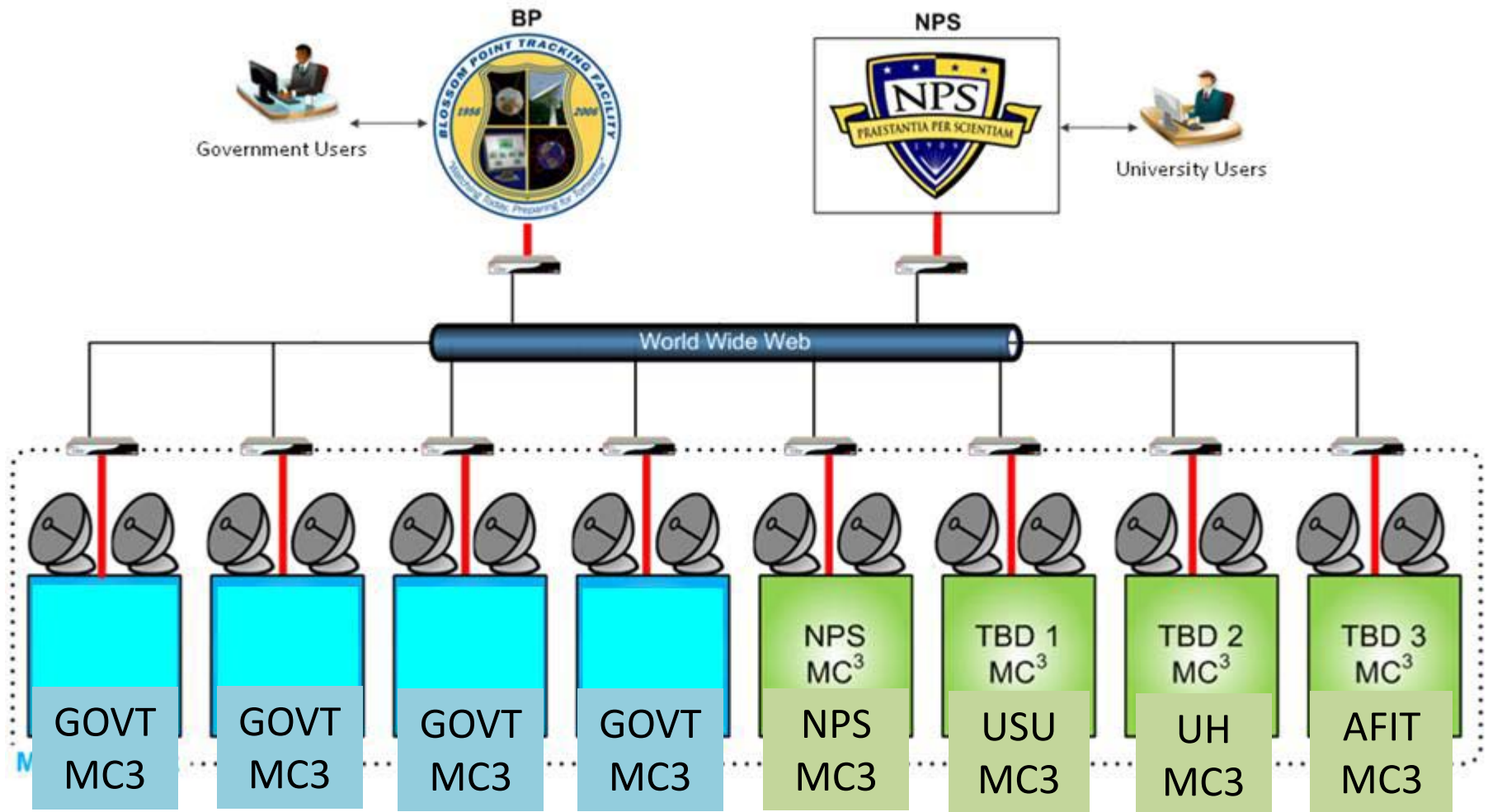
Mobile CubeSat Command and Control

Colony II Bus

MC3

- The MC3 ground station network will connect multiple government and university nodes together via a Wide Area Network.
- Utilizes Common Ground Architecture (CGA) software to command, control, schedule, and monitor spacecraft operations.

2

Program Overview

Hardware Overview

- The MC3 can communicate with up to two CubeSats simultaneously (one S-Band, one UHF)
- The MC3 contains two ICOM 9100 radios for transmitting, a GPS Time Synchronizer, a two-channel GDP Receiver, an S-Band upconverter, two Yaesu Antenna Controllers, four antennas (2 S-Band, 2 UHF), a laptop, and a VPN/firewall

GPS Time Sync
VPN
Ethernet
Switch
Laptop
GDP
Receiver
S-Band Up
Convertor
ICOM 9100
ICOM 9100
Yeasu Antenna
Controllers
UPS
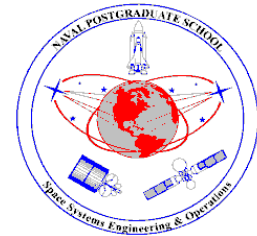
Hardware Continued

| Nomenclature	Purpose
ICOM 9100 radio (2)	Transceiver
GDP radio	Receiver
Yagi Antenna	450 MHz antenna
917 Yagi Antenna	915 MHz antenna
1975-23 Yagi Antenna	1925-2100 MHz antenna
2227-21 Yagi Antenna	2210-2245 MHz antenna

Table 1.   MC3 Radios and Antenna

WAN Integration

- Each node is connected to the WAN through a VPN with a static IP
- Details unique to LAN/IT system at Universities
- Each MC3 has unique IP addresses assigned for:
  - VPN/Firewall
  - MC3 Laptop
  - GPS Receiver
  - GDP Radio
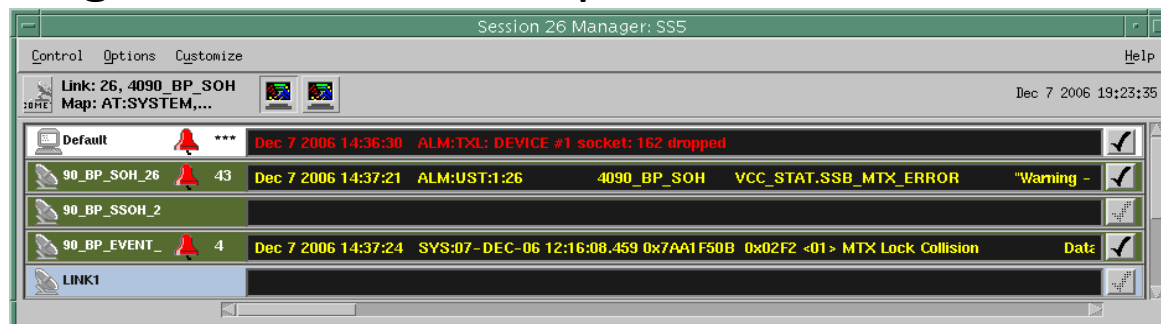 - Additional Computers (optional)

To ensure smooth implementation and integration of the MC3 Network, NPS has received and verified operation of all four University MC3 racks. Currently coordinating configuration of VPNs. Upon completing MC3s will be shipped to Universities starting early Spring 2012.
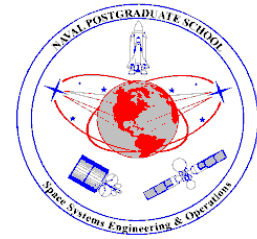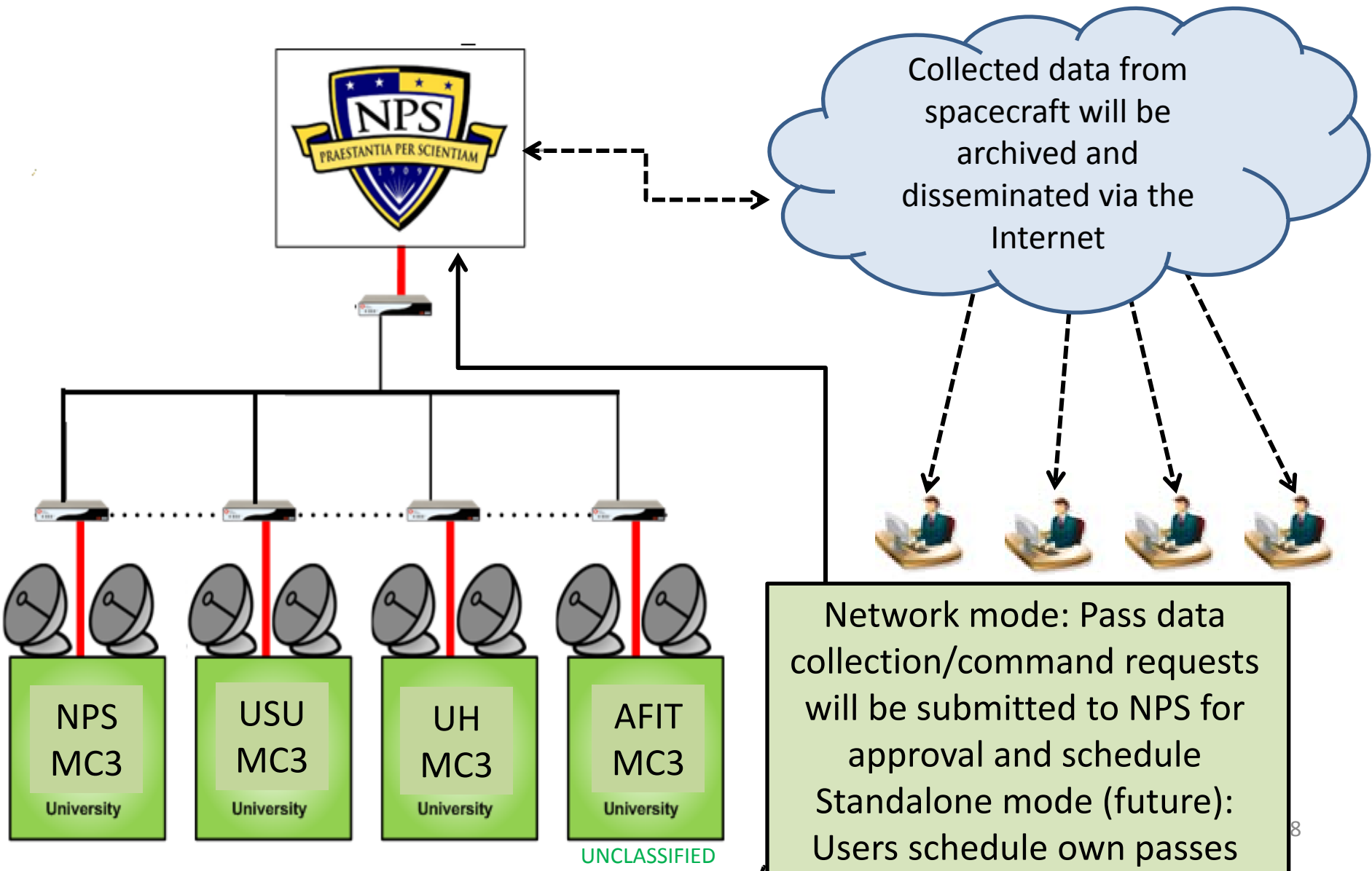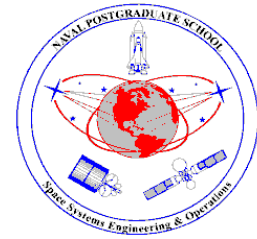
CGA Software

- CGA has been in operation since 1982 on a wide variety of NRL satellite programs
- CGA runs on CentOS (Linux).
- CGA is Government-owned open architecture software which can be coded for any aspect of spacecraft operations
- **<u>Can be run autonomously;</u>** user inputs schedules - CGA will automatically assign resources on the network to track and pass data/commands when the satellites are over a node
- Only recently utilized outside of government operations, thus steep learning curve to become proficient in all CGA capabilities

Concept of Operations

Collected data from spacecraft will be archived and disseminated via the Internet

NPS

NPS
MC3
University

USU
MC3
University

UH
MC3
University

AFIT
MC3
University

Network mode: Pass data collection/command requests will be submitted to NPS for approval and schedule Standalone mode (future): Users schedule own passes

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Schedule

Task	Date
Test and Configure all University MC3s	Feb-May 2012
Ship MC3s to USU, HU, AFIT	Mar-May 2012
On-site Install and Configure	May-Jul 2012
Complete MC3 Network Integration and Testing	Jun-Jul 2012
Colony II Launch (STARE)	Aug 2012