Using Networking Protocols in the Design of a Nanosatellite

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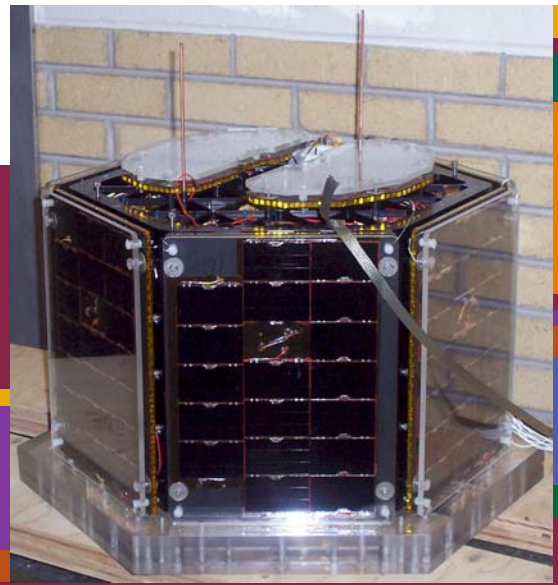

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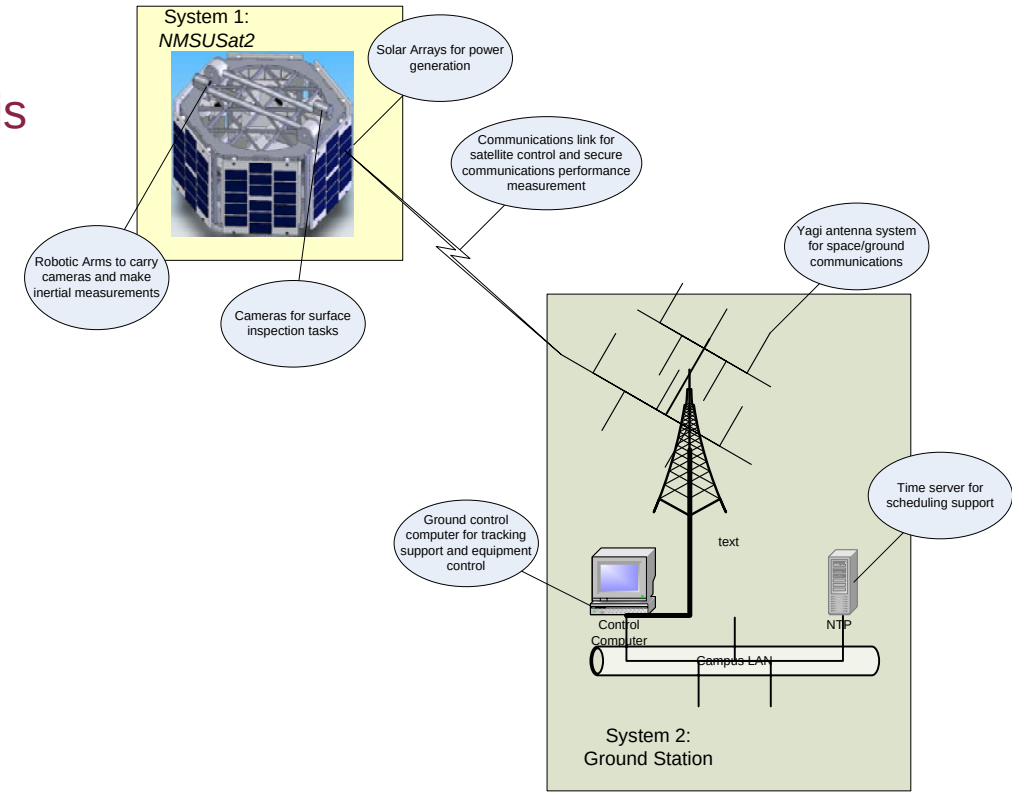
NM STATE

Topics

- Mission Background
- Nanosat Data System
- Networking Environment
- Future Vision

Mission Background

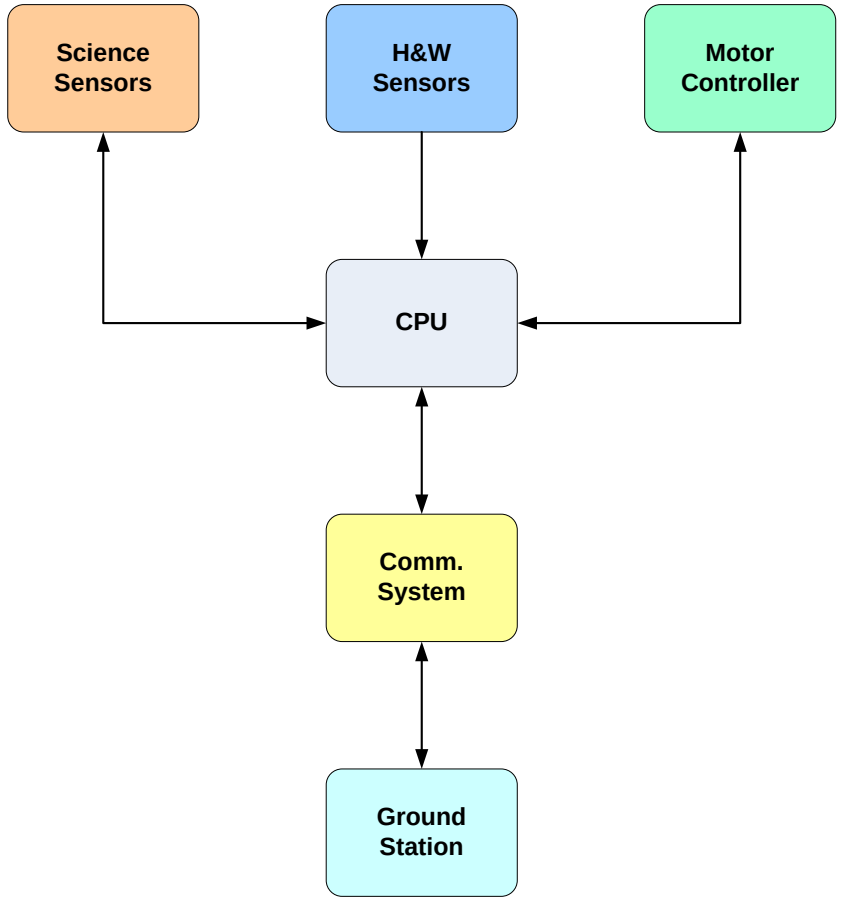
- **Project Mission Statement**
  - The mission for the *NMSUSat2* is to perform science and technology experiments, in a time-sharing fashion, from LEO using a university designed and built nanosatellite.
- **Project Technology Demonstration**
  - Satellite Inspection
  - Measure Inertial Properties
  - Secure Communications
- **Project Space Science Measurement**
  - Atmospheric UV Albedo Measurement



College of Engineering

Nanosat Data System

- Data Source/Sinks
  - Science sensors
  - Health & Welfare Sensors
  - Motor Controller
- CPU
  - 100 MHz, network-ready CPU
  - Embedded Linux O/S



Satellite Data System

Nanosat Data System

Photomultiplier science sensor with integrated power supply voltage conversion and signal processing.

- Design goal: all sensors use standard computer interfaces
  - Current science sensor uses RS-232
  - Would not take major re-design effort by the OEM to make the interface into a networked interface (Ethernet, Bluetooth, etc.)

Networking Environment

- Linux O/S Environment
  - Kernel compiled with AX.25 and KISS support
  - Linux Ham user space tools
  - TNC Setup as an Network Interface with IP Address

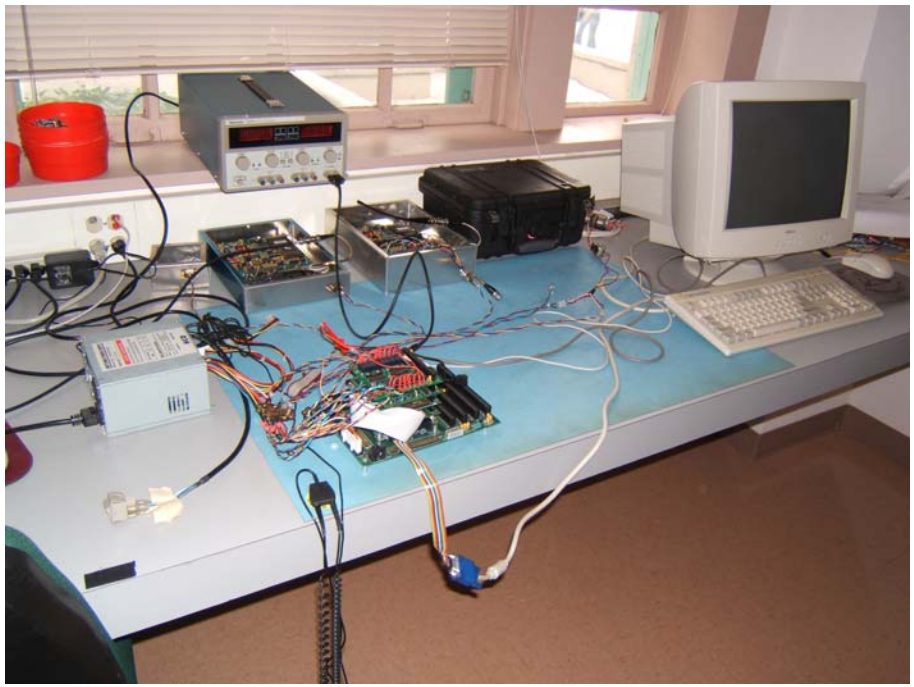
Networking Environment

- Protocol Environment
  - *Network Time Protocol* to maintain CPU synchronization with the ground station (needed because satellite operations are schedule driven)
  - *Secure Shell* to provide authorized access to the satellite
  - *Multicast Dissemination Protocol* to support file transfers for data and schedules

Networking Environment

- Constraints
  - Because of the limited power available on the satellite bus, the data rates are limited to 1200 or 9600 baud.
  - Limited Contact due to Flight Path

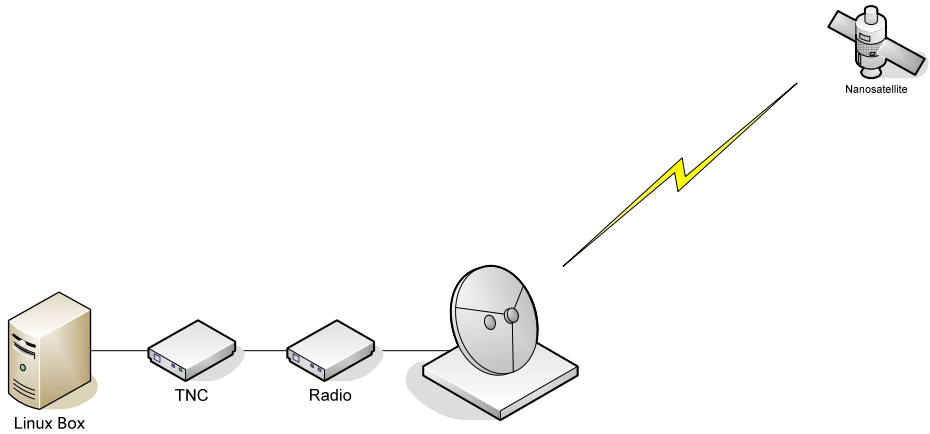
Networking Environment



Nanosat “flatsat” lab for component testing

- Connection between Test computers using IP over AX.25
- Connection between Computers Using SSH, NTP, Etc.

Networking Environment



- Simple Ground Station Setup
- Ground Station and Nanosatellite to have IP Addresses

Future Vision

- Distributed Analog-to-Digital Conversion
  - Can distribute ADC functionality into the subsystems directly and then transfer converted values and not analog voltages
  - Current technology permits distributed ADC via USB bus connections; it would be easy to make this a networked connection.

Future Vision

- Networked Sensors
  - Move from RS-232 and USB to a network-centric sensor
  - For the nanosatellite design, it would be very helpful to have integrated power and data flow over the same bus wires to make integration easier and quicker.

Future Vision

- Access to sensor network for Docking Satellites after Authentication
- Standardization of Communications and quick connection between different satellites
- Addition to or Reconfiguration of Satellite based on present nodes
- Space Routers