# The Future of the Microsatellite Program in Canada

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# Introduction

- Canadian Space Agency SmallSat/MicroSat program began in 2003. Plan:
  - 3 small satellites (<250 kg) launched every 2 years
  - 3 microsatellites (<75 kg) launched every 2 years
- Objective:
  - Provide low cost access to space for Canadian scientific payloads

# Outline

- Discussing Microsatellite program
  - Dynacon completed Phase A in June 2005
- Overview of microsatellite missions
- Microsatellite mission requirements
- Design Approach for microsatellite bus

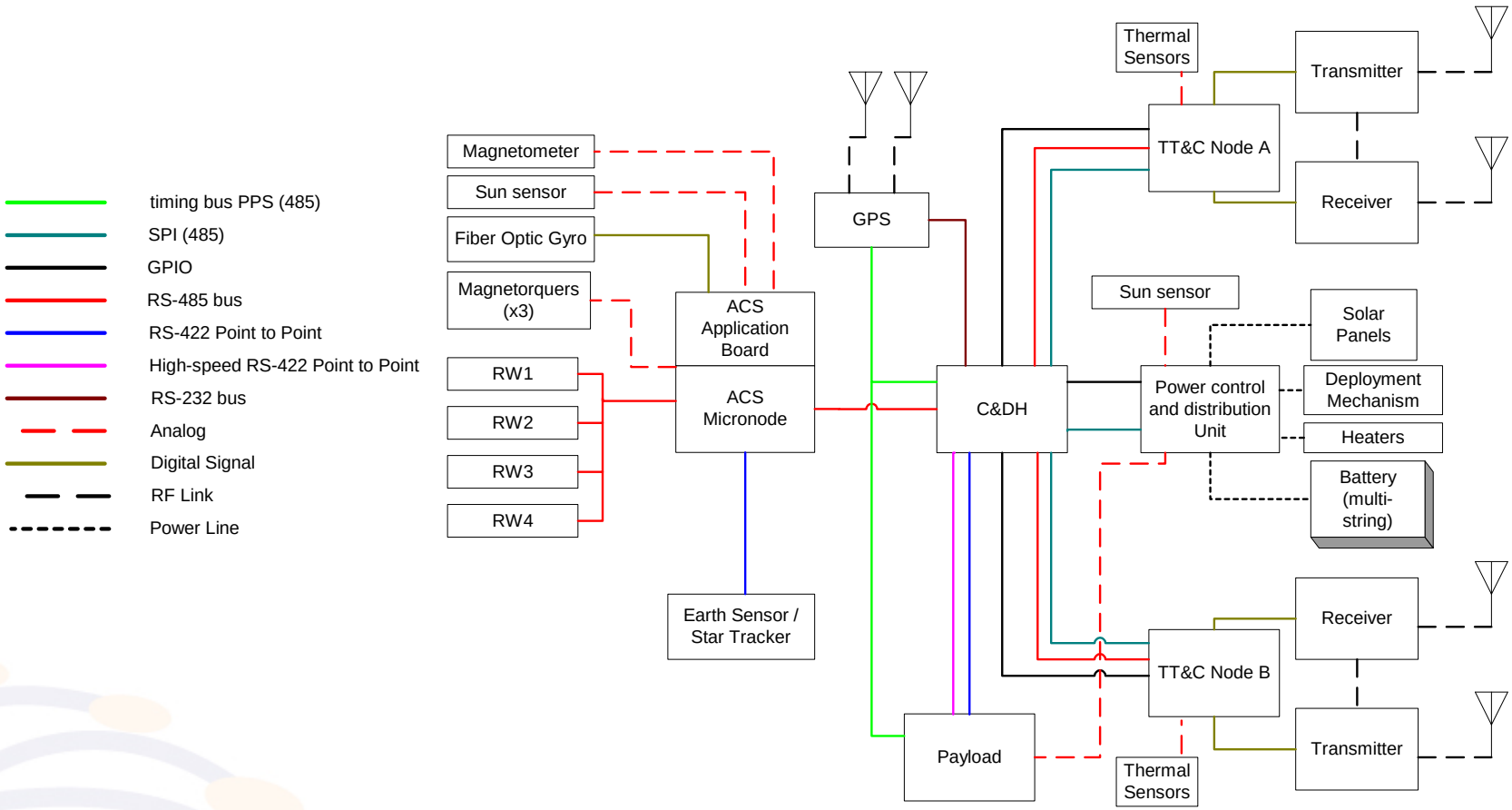
# Microsatellite Missions

- NEOSSat (Near Earth Orbit Surveillance Satellite)
  - NESS (Near Earth Space Surveillance)
    - CSA mission to discover Near Earth Asteroids and comets
  - HEOSS (High Earth Orbit Space Surveillance)
    - DRDC mission to identify and track satellites in MEO and higher orbits
- Radar Altimeter Satellite
  - Monitor sea wave height to allow ship operators to avoid areas with large waves
- Technology Demonstration satellite
  - Provide flight opportunities for industry to space qualify new technology and establish flight heritage

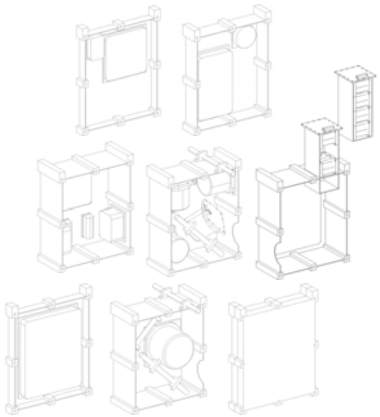
# Mission Requirements

| Parameter | NEOSSat | Radar Altimeter | Technology Demonstration |
|---|---|---|---|
| Payload Mass | 19.3 kg | 25 kg | 30 kg |
| Volume | 900 x 250 x 250 mm | 400 x 400 x 230 mm | TBD |
| Power Average / Peak | 11 W / 11 W | 32 W / 55 W | 30 W / 60 W |
| Payload Voltage | 28 ± 6 V | 28 ± 6 V | 28 ± 6 V |
| Orbit | 630 to 700 km altitude, sun-synchronous, dawn-dusk | 500 to 800 km altitude, 70° inclination, circular | 600 to 850 km altitude, sun-synchronous |
| Attitude Stability Mode | 3-axis inertial stabilized | nadir pointing | nadir pointing |
| Attitude Pointing Control | 72 arcsecond (NESS), 300 arcseconds (HEOSS) | 1° with respect to nadir | 1° with respect to roll, pitch, and yaw |
| Attitude Pointing Stability | 0.5 arcsec (over 100 seconds) | TBD | TBD |
| Downlink Data Rate | 2 Mbps, S-Band | 1 Mbps, S-Band | 1.5 Mbps, S-Band |
| Uplink Data Rate | 4 kbps, S-Band | 4 kbps, S-Band | 4 kbps, S-Band |
| On-Board Data Storage | 1GB | 128 MB | 256 MB |
| Launch Vehicle | Compatible with multiple launch vehicles (DNEPR, Rockot, Taurus etc) | | |

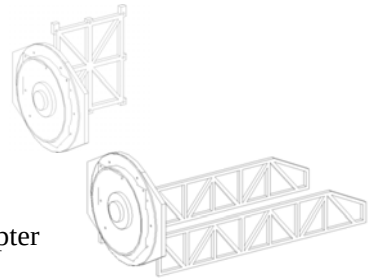
# Electronic Architecture



# Mechanical Design Approach

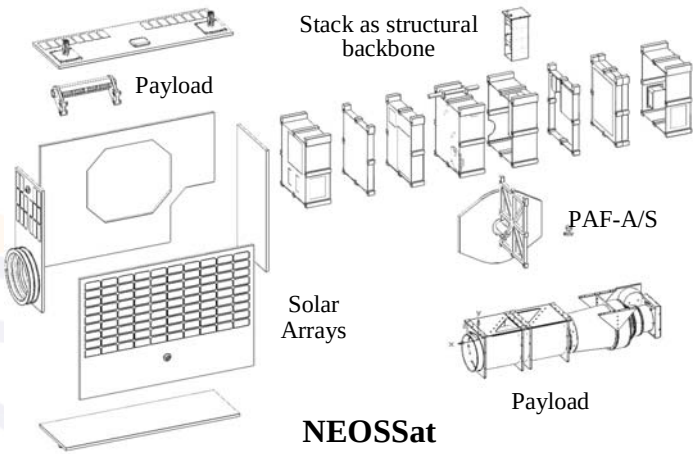


Generic Tray Stack Modules

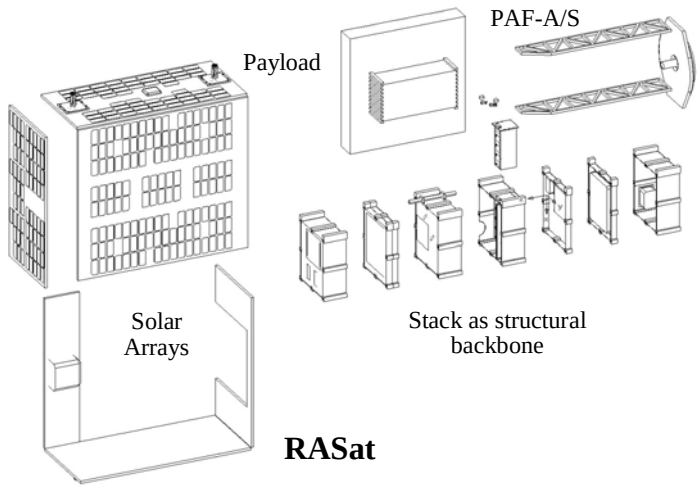


PAF Adapter and Substructure

**Solar Panels** **Payload**




**NEOSSat**




**RASat**

# Launch Load Considerations

| Launch Vehicle | Min Natural Frequency | Quasi-static Loads | Sinusoidal Vibration Loads | Random Vibration | Factors of Safety |
|---|---|---|---|---|---|
| **Taurus** | Axial 35 to 45 or > 70 Hz; Lateral 25 Hz | Axial 8.0 g Lateral 2.5 g | --- | 0.004 $g^2$/Hz at approx 100 Hz 12.6 $g_{rms}$ | --- |
| **Minotaur** | Axial 35 to 45 or > 70 Hz; Lateral 25 Hz | Axial 8.0 g Lateral 2.5 g | --- | 0.004 $g^2$/Hz at approx 100 Hz 3.5 $g_{rms}$ | --- |
| **Rockot** | Axial 33 Hz; Lateral 15 Hz | Axial 8.1 g Lateral 0.9 g | Axial 0.8 g Lateral 0.5 g | 6.8 $g_{rms}$ | $FS_u$ = 1.25 $FS_y$ = 1.1 |
| **Dnepr** | Axial 20 Hz; Lateral 10 Hz | Axial 8.3 g Lateral 0.8 g | ≤ 0.6 g at ≤ 20 Hz | 0.022 $g^2$/Hz at 100 Hz 6.3 $g_{rms}$ | $FS_u$ = 1.5 for flight loads |
| **Delta IV ESPA** | 35 Hz | Axial 8.5 g Lateral 8.5 g | --- | 0.024 $g^2$/Hz at 100 Hz 6.04 $g_{rms}$ | --- |
| **Atlas V ESPA** | Axial 15 Hz; Lateral 8 Hz | Axial 5.5 g Lateral 0.4 g | Axial 2.0 g Lateral 2.0 g | --- | --- |
| **Cosmos-3M** | --- | Axial 6.8 g | ≤ 0.6 g at ≤ 100 Hz | 0.040 $g^2$/Hz at 100 Hz 7.6 $g_{rms}$ | $FS_u$ = 1.30 |
| **Worst Case** | **Axial 70 Hz Lateral 35 Hz** | **Axial 8.5 g Lateral 8.5 g** | **Axial 2.0 g Lateral 2.0 g** | **0.040 $g^2$/Hz 12.6 $g_{rms}$** | **$FS_u$ = 1.50 $FS_y$ = 1.10** |

- Design Core structure for worst case loads
- Design mission specific structure for launch vehicle

# Conclusion

- Multimission Microsatellite bus developed
- Avionics core common to all missions
  - C&DH computer
  - TT&C system
  - Power system electronics
  - ADCS computer
- Modular set of avionics that are selected as required
- Primary structure tray stack common to missions
- Mission specific secondary structure and PAF