Solar Imaging Radio Array (SIRA)

Mechanical
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"When we ask for advice, we are usually looking for an accomplice."
Marquis de la Grange (1639-1692)

Competition Sensitive

Requirements / Objectives

- **Mission unique bus structure**
- **12-18 micro-satellites required**
  - Separation system required
- **Comm:**
  - 0.5m x 0.5m flat phased array, articulated (cost)
  - **Ø0.5m dish antenna, fixed (mass)**
- **Propulsion**
- **ACS:**
  - **3-axis stabilized**
  - Possible momentum wheels – Dynacon MicroWheel 200
- **Power:**
  - 0.8m² minimum array area, **articulated**
- **Launch Vehicle:**
  - Delta II 2925-10 with **bi-prop fourth stage**
- **Operational Scenario:**
  - **BASELINE: Point antenna at earth, articulate solar array, triangle bus, 3 stacks of 6**
  - OPTION #1: Off point s/c to download data, triangle bus, 3 stacks of 6
  - OPTION #2: Spin s/c, comm antenna fixed on earth, hexagonal bus, 4 stacks of 4

Launch Vehicle

DELTA II	MASS (kg) TO ORBIT (C3 ~ 0 km2/sec2)	COST $M FY02
2920 - 10	625	67.0
2920H - 10	875	
2925-10	1240	
2925H-10	1495	75.2
2926-10	1085	
2926H-10	1315	

Orbital Sciences MicroStar Bus (Former Proposals)

MicroStar™ Satellite Platform

Technical Specifications

Core Bus Features

Bus Dry Mass	58.6 kg
Payload Mass Capability	68.0 kg
Redundancy	Single string
Orbit	700-1,000 km, all inclinations
Launch Vehicle Compatibility	Pegasus, Taurus, SELVS I and II
Typical Mission Lifetime	3-5 years
Delivery	24 Months ARO

Structure

Bus Dimensions (Δ x H)	104 x 16.5 cm
Payload Support Module Dimensions (Δ x H)	104 x 33 cm
Construction	AlBeMet/Al Honeycomb
Shape	Dual-faced cylinder

Power Subsystem

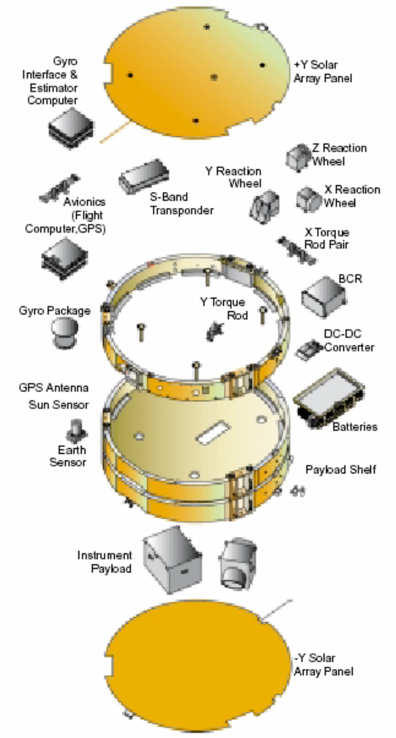
Payload Power	50 W orbit average
Bus Voltage	14 VDC unreg, 28 V reg
Solar Arrays	2 GaAs
Batteries	10 A*hr NiH_2 CPVs

Attitude Control Subsystem

Stability Mode		3-axis
Pointing Capabilities:	Control	± 0.6°
	Knowledge	< 1°
	Rate/Stability	<0.01°/sec

Command & Data Handling Subsystem

Flight Processor	68302
Rad Tolerant	15 K rad
Data Storage Capacity	3 MB
Interface Architecture	RS-422/RS-485
S-Band Uplink/Downlink Rates	2 Kbps/2 Mbps



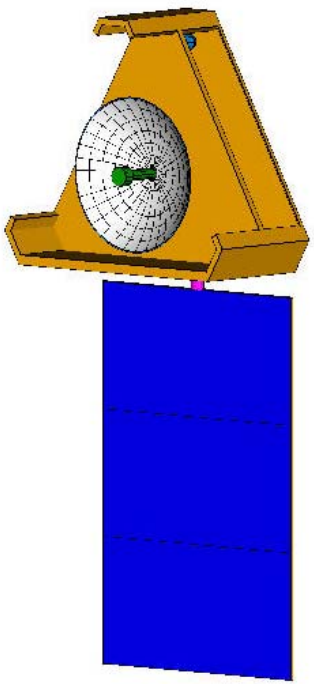
OPTIONS

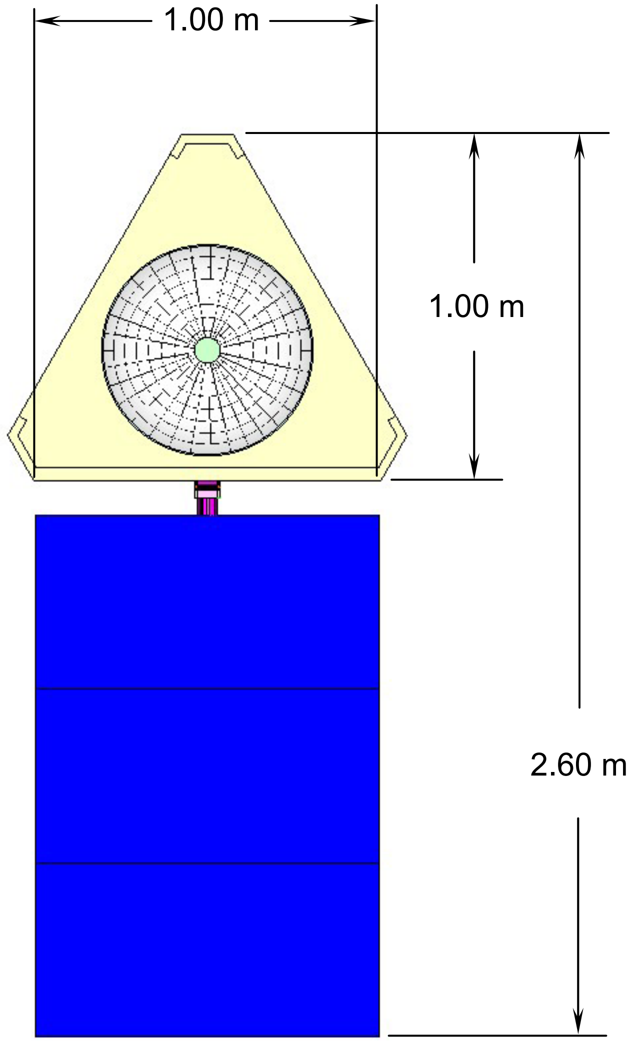
- Custom structural ring configuration for flexible payload accommodations
- Increased power (up to 270W BOL) provided by second set of solar arrays for certain orbit/payload combinations
- 1553/1773 payload data interface to accommodate existing high-level interfaces
- Reduced pointing accuracy function (10° accuracy per axis) for missions requiring less precision
- Payload data storage enhancement (256 MB of storage)
- Propellant capacity of 26 kg hydrazine with 4 thrusters of 0.9 N each for orbit maintenance
- Mission operations and data delivery for two years

S/C Configuration

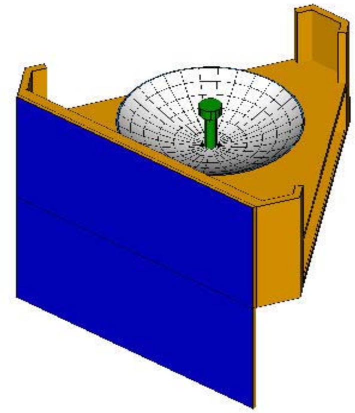
BASELINE

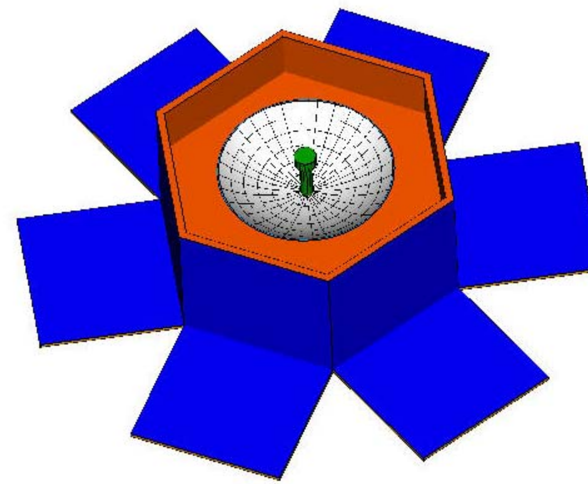
•Comm Antenna fixed on Earth
•Articulated Solar Array





OPTION #1

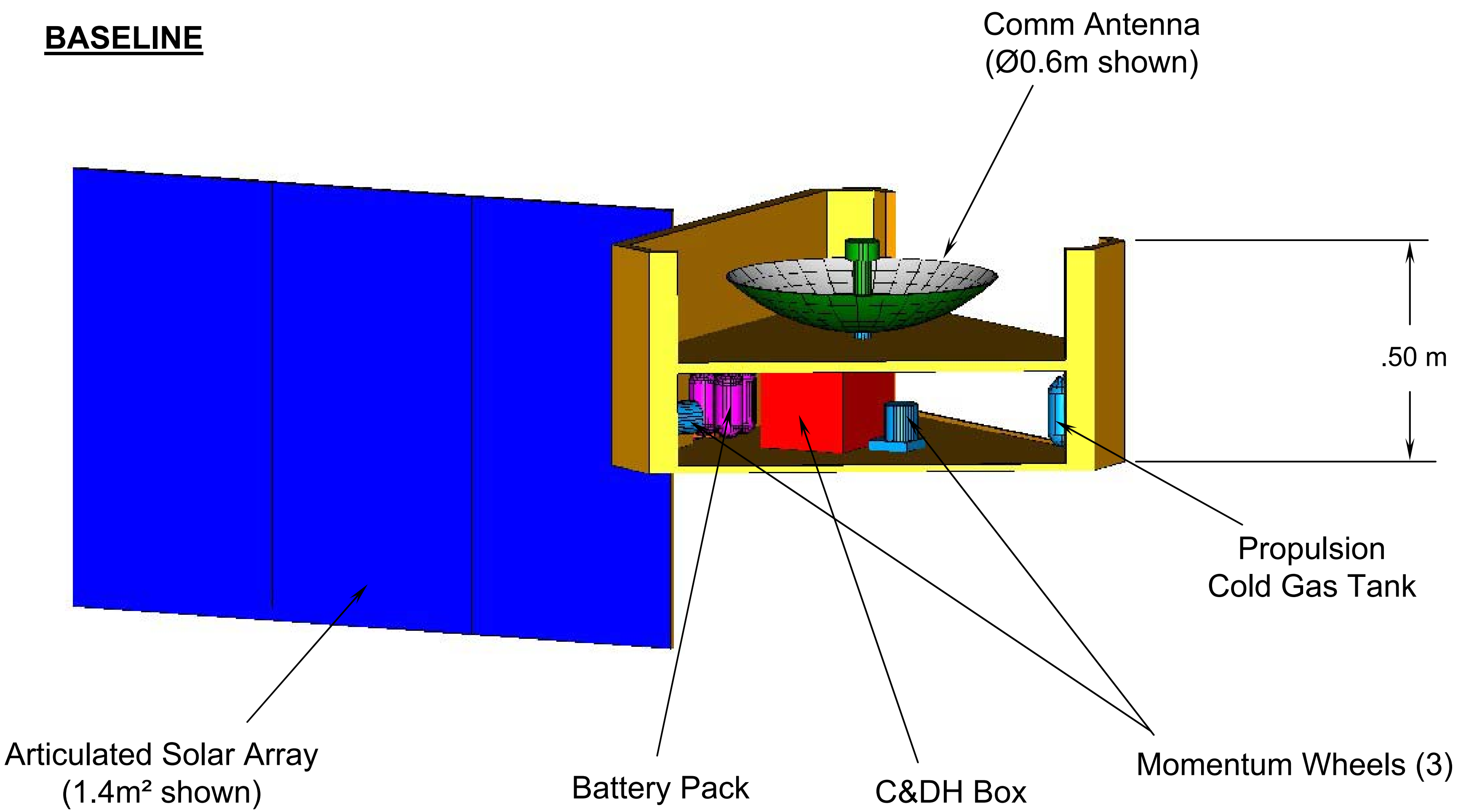




OPTION #2

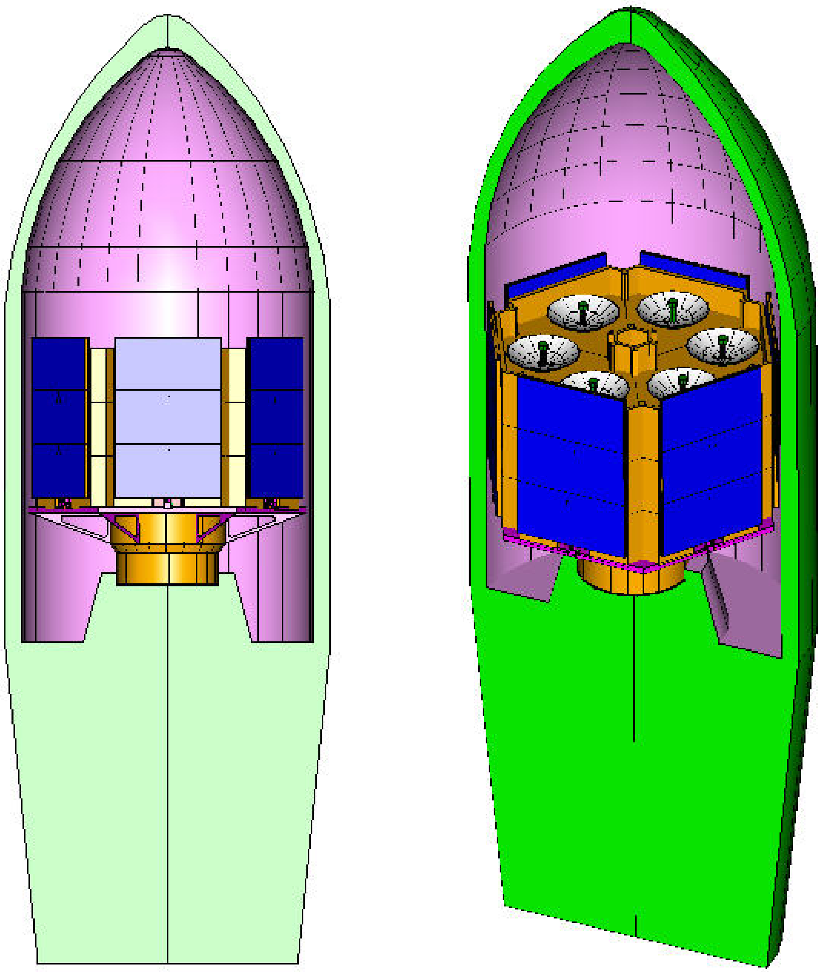
S/C Component Layout

BASELINE

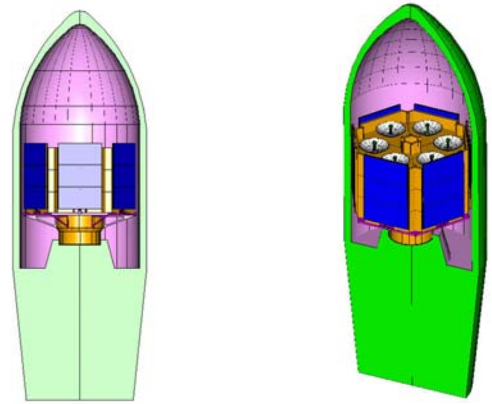


Launch Configuration
Delta II – 2925H-10

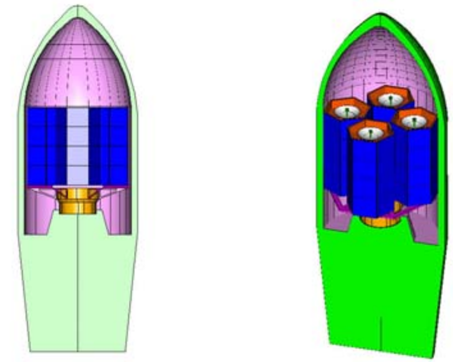
BASELINE



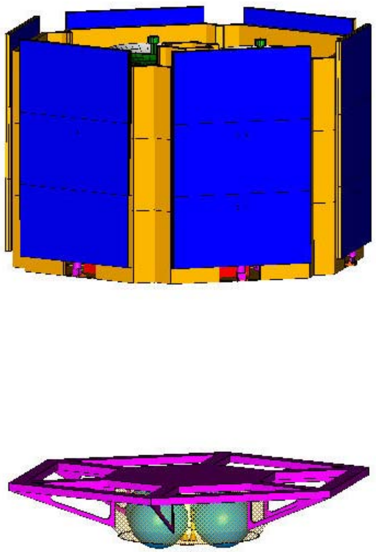
OPTION #1



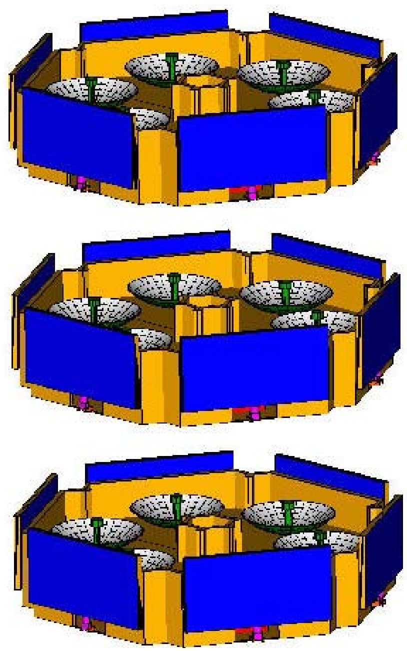
OPTION #2



Deploy Sequence

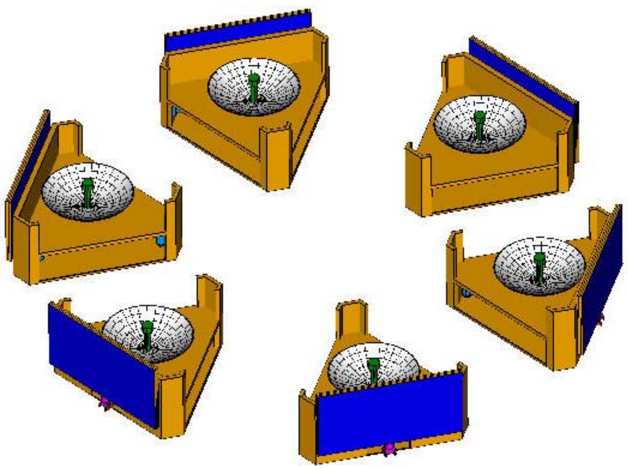


Separation of Fourth Stage



Separation of Stacks
- Top layer forms top 1/3 of sphere
- Middle layer forms middle 1/3 of sphere
- Bottom layer forms bottom 1/3 of sphere

Separation of MicroSats



Separation spring force adjusted to provide initial ΔV to accomplish satellite placing on sphere

Mass & Cost

- **Propulsion Module**
  - Mass – 87kg
  - Cost – $0.55M FY03
- **Spacecraft (structure, comm mounts, solar array)**
  - Mass – 11.74kg
  - Cost -
    - Copies 1-4 (ETU, Prototype, 2 flight units) - $0.66M FY03
    - Copies 5-n – $0.46M FY03
  - Delta
    - Deployable solar array add (Option #3):
      - 3.2kg
      - Copies 1-4 (ETU, Prototype, 2 flight units) - $0.04M FY03
      - Copies 5-n – $0.03M FY03
    - **Deploy & articulate solar array add (BASELINE):**
      - **12.6kg**
        - **The increase in mass is due to solar array deployment and articulation. The mass of the drive (9.3kg) is an average of several single axis drives. As the study refines a drive that will fit the mission requirements could be the MOOG type 2 or Ball EMS 221. These weigh-in at 3.0kg and 4.5kg respectively.**
      - **Copies 1-4 (ETU, Prototype, 2 flight units) - $0.70M FY03**
      - **Copies 5-n – $0.60M FY03**

Option #2
Most basic structure for mass and cost

Risk

- **Separation System**
  - Sep-systems have been utilized on spacecraft for many years. The likelihood of a sep-system failing is very small. However this risk is mentioned because of the number of separations required.
  - Fall Back
    - Stack / Stack separation – try to re-initiate. Try separation of individual MicroSat.
    - MicroSat / MicroSat separation – try to re-initiate
  - Consequence
    - Stack / Stack separation – loss of MicroSats in stack. Could be somewhat mitigated if the fall back plan is successful
    - MicroSat / MicroSat separation – loss of individual MicroSats
- **Solar Array**
  - Deployment of solar array. Again, solar array deployments are standard events. The likelihood of failure is very small. This risk is mentioned because of the number of deployments.
  - Solar array drive failure. Again, solar array drives are standard mechanical systems on satellites. The likelihood of failure is very small. This risk is mentioned because of the number of drives.
  - Consequence – partial to total loss of power to MicroSat.