Cibola Flight Experiment

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7 Cities of Cibola: sought after by Spanish explorers between 1563-1596

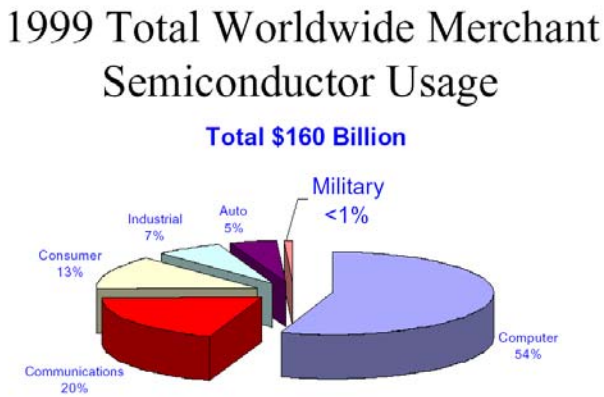
Overview

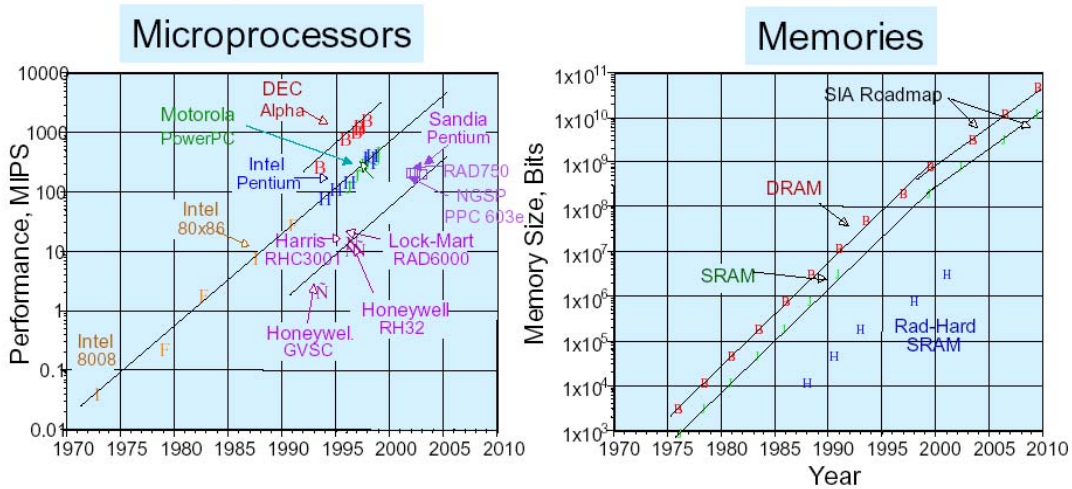
- Partnership
- CFE Payload
- SSTL spacecraft
- Summary

Partnership for Space Flight

- Cibola Flight Experiment is a DoD SERB ranked payload funded by DOE/NNSA/NA22 and built at LANL
- CFESat is an small ESPA-class satellite being built by SSTL for LANL
- STP is providing integration and launch services on STP-1 mission

Space-Based Processing



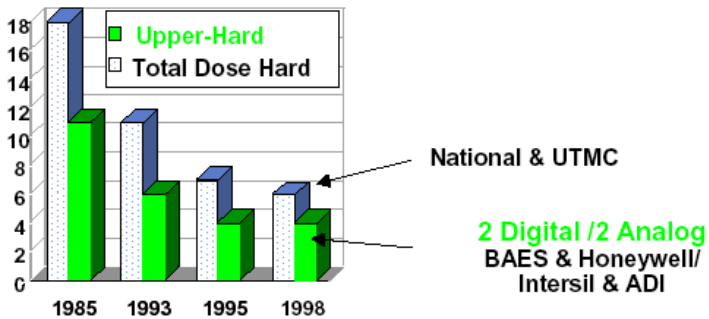


Exponential increase in cost to fabricate

Average cost of .35µ 200mm Fab= $880/M

Average cost of .25µ 200mm Fab=$1329/M

# of Rad-Hard manufactures



*DTRA 1999

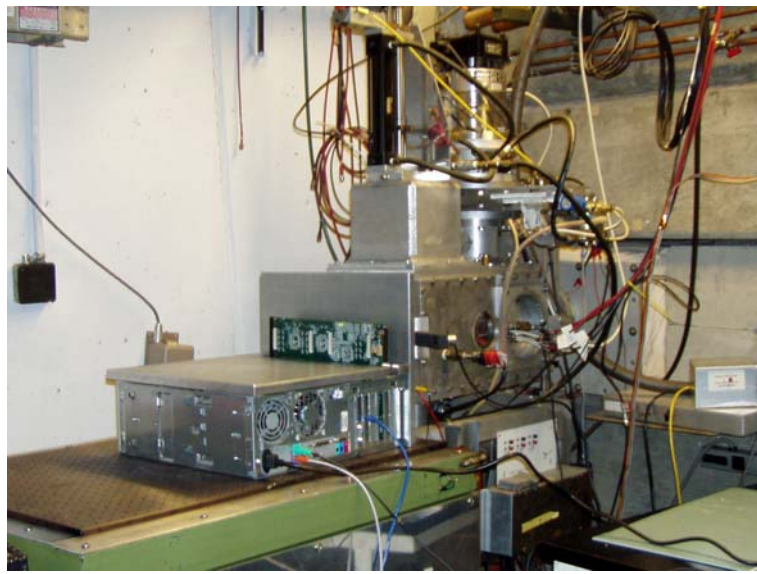
Rad-Hard Lags 2-3 Generations Behind Commercial

- Milspace small % of market
- Disappearing Rad-Hard foundries
- Eroding Rad-Hard Market
  commercial space weak
- Low Volume Demand

->difficult times ahead for space

Engineering Challenge "COTS In Radiation Environment"

- LANL recognized early the potential power of SRAM-based FPGA's and became the partner for radiation effects testing for XQVR Virtex (300 & 1000) enabling use in space for on-board processing
  - Determined radiation performance for both static and dynamic operational modes
    - Total Ionizing Dose (TID)
    - Single Event Latch-up (SEL)
    - Single Event Upset (SEU)
  - Developed and validated several radiation mitigation techniques to improve reliability
- LANL has developed the expertise and tool set to work with these and future generation FPGA's



Radiation testing of the SLAAC1-V board at Crocker Nuclear Lab November '02

But Will Commercial Parts Work?

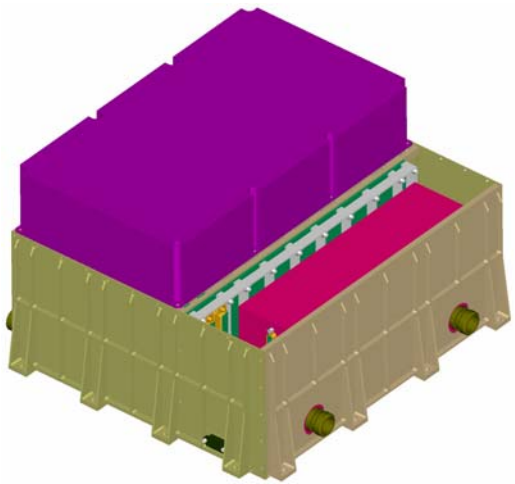
- LANL-Xilinx effort has demonstrated that Virtex parts have potential for space use
  - Has transitioned this information to industry
- A space demonstration will be required before operational systems will use
  - JPL has sent a Virtex on the Mars Explorer Rover--but will be short use in low radiation environment
  - Australia flew an older chip on a testbed on FEDSat

➢ An aggressive space demonstration will reduce risk for other space missions

CFE Payload

Objectives:

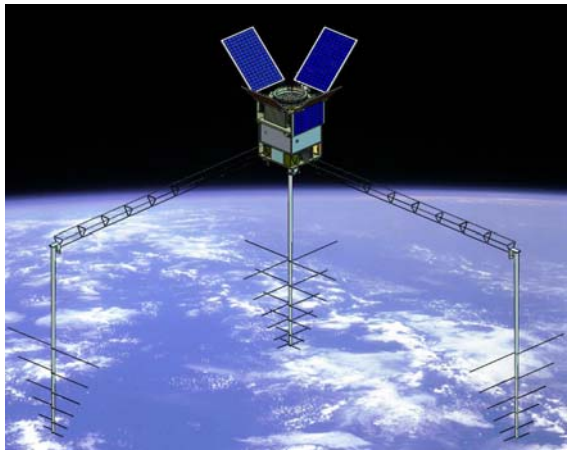
- Validate space operation of commercial parts and raise technology to TR levels 7
- Validate SEU mitigation techniques
- Demonstrate responsive, flexible, multi-mission RF payload
  - Detect, characterize VHF/UHF EMP & lightning signals



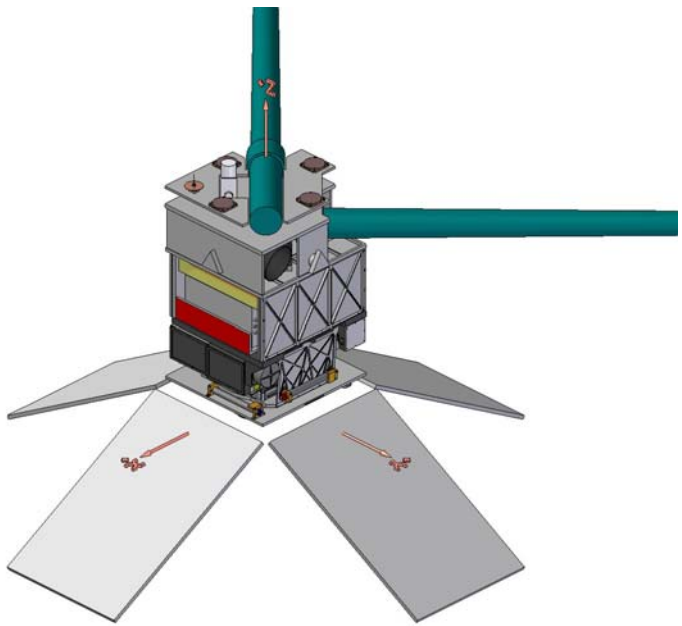
Components:

- RF receive antennas-L'Garde
- Analog Radio receiver
- FPGA-based on-board processor
  - Xilinx Virtex FPGA (XQVR1000)
  - SEAKR custom power supply
  - BAE RAD6000 processor

CFESat Built by SSTL



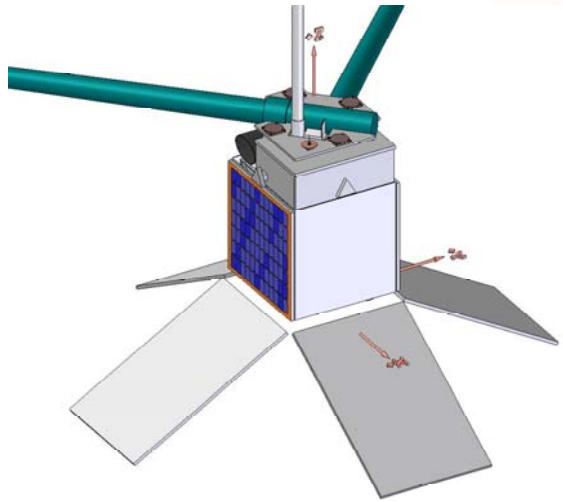
- Fits the ESPA Volume of 24x24x38”
- Weight: ≈ 165 kg
- Provides 110-130W orbit averaged
- 3-axis stabilized

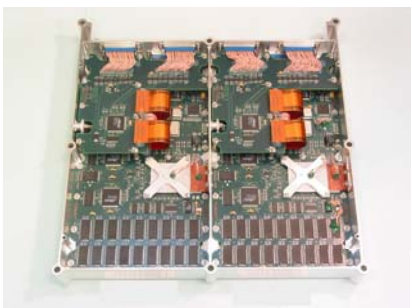


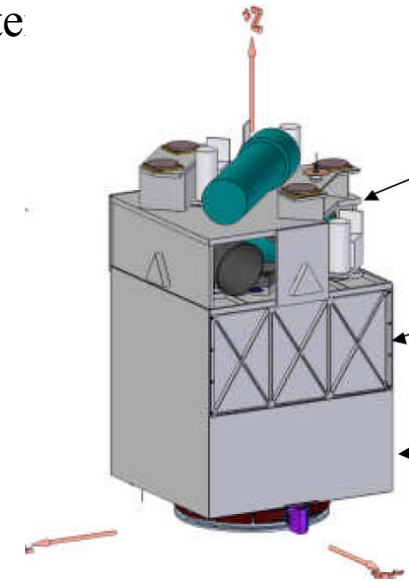
- Based upon DMC & Topsat satellite designs
- On-orbit lifetime: ≈ 3-4 yr
- SSTL to build and deliver in 21 months
- LANL integration to payload

CFESat Components

- Triple-junction GaAs solar arrays
- AEA Li-ion battery
- OBEC386
- Dual Solid State Data Recorders
- GPS receiver
- Uplink/downlink receivers
- Telescoping payload antenna booms
- PSC Motorized Light Band sep syste
- Dual star trackers
- Reaction wheels and torque rods







- Split into three regions:
  - Boom Bay
  - Payload Bay
  - Stack Bay

CFESat: High Performance, High Density=> Challenge

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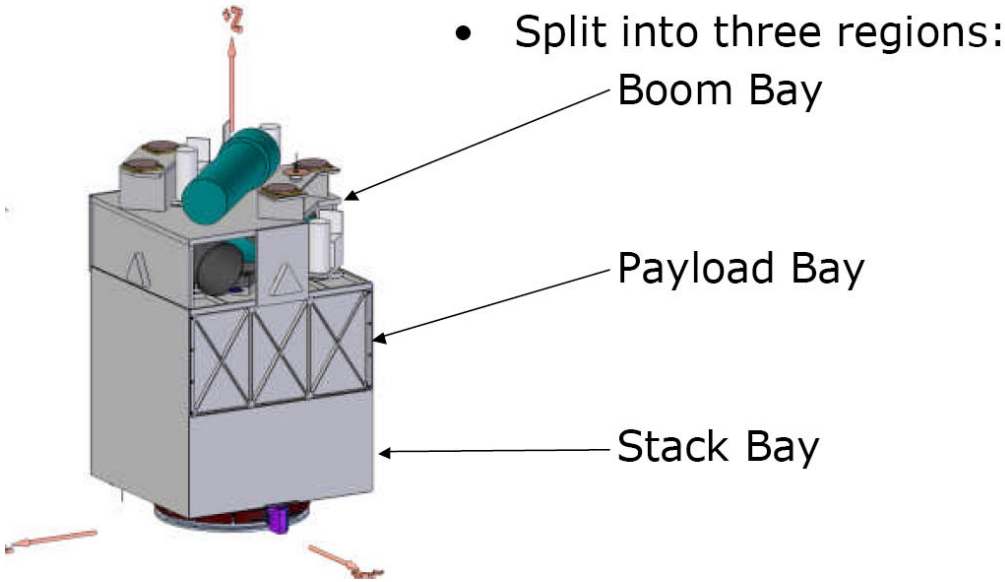
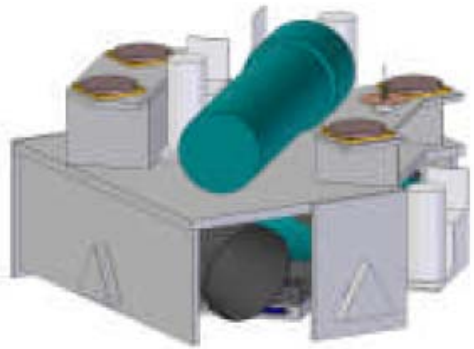
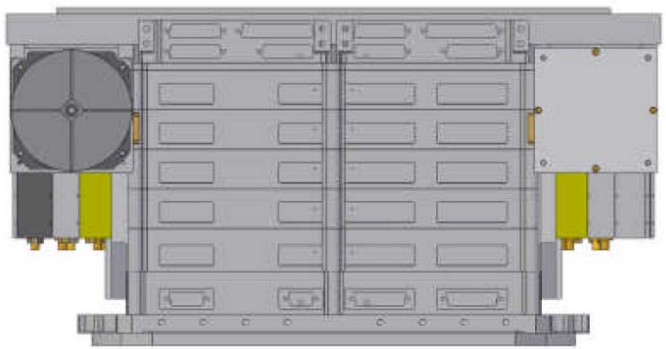
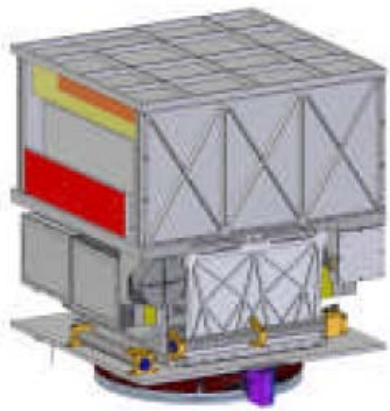




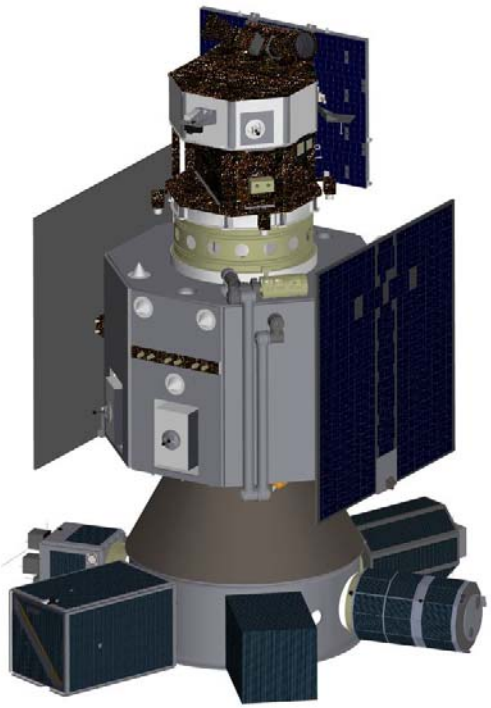




CFE Launch Opportunity

STP-1 Mission

STP was provided a Medium Class launch Vehicle by AFSPC. STP's goal is to launch the STP-1 mission in Sep 2006.



CFE

Mission Manifest

- Primary Spacecraft is Orbital Express (DARPA)
- EELV Secondary Payload Adapter with 5 Spacecraft
  - MidSTAR-1 (Naval Academy)
  - FalconSat-3 (USAF Academy)
  - NPSAT-1 (Naval Post Graduate School)
  - STPSat-1 (STP-built w/ NRL & AFRL P/L)
  - CFE (Los Alamos Nat'l Labs)

ESPA

Preliminary Schedule

	Tentative Dates
• System Requirements Review:	• 3-5 Mar ‘04
• ICD Review	• ≈15 June ‘04
• Preliminary Design Review :	• 25 Aug ‘04
• Critical Design Review:	• 10 Nov ‘04
• Ship Spacecraft to LANL:	• 3 Nov ‘05
• Ship & Integration Readiness Review:	• 3 Nov ‘05
• Satellite to Payload Integration and Test: 3 months	
• CFESat system environmental testing: 3 months	
• Pre-ship to Launch Site Readiness Review:	• 25 May ‘06
• Launch	• Sept ‘06

Summary

- LANL has done extensive R&D to qualify commercial reconfigurable FPGA's for space use in on-board processors
- LANL is building the experimental CFE payload
- SSTL is designing and fabricating the CFESat based upon previous DMC and Topsat satellite designs
- STP manifested CFE on STP-1 for flight September 2006.

CFE Rapid Access to Space

- Payload under development for 3 years as secondary payload
- CFE "goes it alone" on satellite and spaceflight
  - "Go" to procure spacecraft: mid-February 2003
  - Procurement on street for bidding: 25 June
  - 5 weeks allowed for bidding process
  - 2 weeks to review proposals and make selection
  - Start preliminary paperwork for TAA: mid-Aug
  - Start manifest for flight on STP-1: 16 Sept
  - Spacecraft contract in place: 25 September
  - Paperwork submitted to DoS for TAA: 12 October
  - CFE manifested on STP-1: 30 October
  - DOS approves TAA through PDR but requires TTCP: 4 Dec
  - Approved TTCP through PDR: 9 January
  - ➢ **Go --> procurement --> manifest --> DoS approval in under 11 months**

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