System Engineering Challenges for Satellite Hosted Payloads

Commercially Hosted Infrared Payload (CHIRP)

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Colonel Bob Newberry
• The US Government has flown four hosted satellite payloads within the past decade
  • 2005: FAA, GPS Wide Area Augmentation System (WAAS)
  • 2008: USCG, Maritime Automatic Identification System (AIS)
  • 2009: OSD, Internet Router In Space (IRIS)
  • 2011: USAF, Commercially Hosted IR Payload (CHIRP)

• These program present unique Program Management challenges which emphasize the need for robust System Engineering

• This briefing reviews the most recent of these programs with the Air Force’s CHIRP program
• The CHIRP program originated as risk mitigation for the AF’s missile warning satellite program in 2005
  • The Space Based Infrared System (SBIRS) had experienced substantial cost and schedule delays

• Director for Acquisition, Technology and Logistics (AT&L) directed the AF to undertake an alternative program
  • “develop a viable competing capability”
  • “perform technology risk reduction, perform system definition, and evaluate alternative sensor architectures”

• Program evolution:
  • 2005: Alternative Infrared Satellite System (AIRSS)
  • 2007: Redesignated as 3rd Generation IR System (3GIRS)
  • 2008: CHIRP contract awarded to SES Americom
  • 2009: 3GIRS descope; funds moved to developmental planning budget via Operationally Responsive Space
  • 2010: Funds moved to SBIRS budget
  • 2011: CHIRP launch
1. Intense scrutiny from external reviewers
   • Program drew immediate attention within and outside the AF
   • 76 Distinguished Visitors briefings early in program
   • 40 budget re-plan options through FY07
   • 39 media articles in 1st year
     • 1st SMC Industry Day covered by the media
   • 2 GAO reviews in first 2 years

![Media Coverage of AIRSS Program](image-url)
2. Constant budget turbulence
   • FY06: Started with no funding
     • Reprogrammed $7.2M
   • FY07: 34% budget cut
     • From $103M to $68M
   • FY08: 67% budget cut
     • From $225M to $75M
   • FY09: Program cancelled
     • Minimally funded for liabilities
   • FY10: Minimally funded
     • Covered contract liabilities
   • FY11-12: Minimally funded
     • Funded CHIRP fly-out
3. Program started as a “bolt from the blue”
   • No planning prior to program start
   • No cadre in-place to staff program office
   • No technical requirements defined for program
   • No agreements in place for teaming
Programmatic challenges overshadowed program
General commercial practices defined interfaces at start
Immature data standards
Contractors initially working separately
• Multiple contractor interfaces persisted after CHIRP award

System Engineering Challenges
Adding CHIRP to a commercial COMSAT sounded easy but…

- Spacecraft unable to handle heat from CHIRP (added a radiator)
- CHIRP telescope baffle interfered with host UHF antenna (6” cut off baffle)
- Limited ability to test CHIRP after integrated on host
- Initial launch load estimates were unrealistic (i.e. 28G’s)
- Unknown contamination risk during launch (minor concern to COMSATs)
- Needed host telemetry data merged into CHIRP data stream
- CHIRP data to be encrypted leaving host (government supplied equipment)
- Needed encrypted link to move CHIRP data to mission ground station

The combined system engineering team solved these problems, and many others

Hosted payloads are attractive but the technical hurdles are significant
System Engineering Practices

- Use of commercial best practices despite cultural barriers
- Well documented test plans
- Rigorous Configuration Control Boards (CCB)
- Timely Failure Review Boards
  - On call 24/7
  - Staffed by government, contractor and Aerospace
- Aerospace published Terms of Reference (TOR) for:
  - Sensor handling
  - Contamination mitigation
- Government SE on-site support for critical tests
- Daily 8am telephone tag-ups
  - Government, contractor and Aerospace participation
CHIRP Results

- Jul ‘08: Contract award
- Jun ‘09: Started environmental/calibration tests
- Jul ‘10: Delivery to Orbital
- Dec ‘10: Mated to SES-2
- Jun ‘11: Spacecraft I&T completed
- 21 Sep ‘11: Launch

**CHIRP Payload**  
**Ariane-5 at Kourou**  
**CHIRP on SES-2**