Collaborate to Operate: Coriolis Mission Ops

Ground System Architectures Workshop (GSAW 2005)
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Mission Description

- **Coriolis satellite launched in January 2003**
  - **98.7 degree inclination**
  - **101 minute orbital period**
- **Spectrum Astro (now General Dynamics) satellite procured by USAF Space Test Program**
- **Hosted instruments:**
  - **Naval Research Laboratory (NRL) WindSat experimental polarimetric microwave radiometer to measure ocean surface wind speed and wind direction from space**
  - **Air Force Research Laboratory (AFRL) Solar Mass Ejection Imager (SMEI) to monitor coronal mass ejections**
- **3 year design lifetime, with extension possible**

WindSat Instrument

Ground Architecture

- Different system elements funded and procured by different agencies (ONR, IPO, etc.)
- Budget constraints drove need to keep costs to absolute minimum
- Resulting architecture:
  - No dedicated ground assets, except distribution network—everything else (control center, ground station) accommodated by upgrades to existing infrastructure
  - Extensive use of COTS hardware and software
  - Geographically distributed ground system developed, operated, and maintained by diverse group of independent agencies and contractors

Geographic Distribution

Operations Concept

- **Decentralized operations mirror ground architecture**
- **Nominal support every orbit:**
  - **USAF RDT&E Support Complex (RSC) performs satellite T&C functions using AFSCN ground stations**
  - **Payload data recovery via autonomous dumps over NOAA Fairbanks or KSAT Svalbard ground stations**
- **Automated data distribution via commercial TCP/IP links to meet 4 hour data delivery requirement**
- **Day-to-day tasks managed by distributed government-contractor operations team**
  - **Divided into self-managed segments**
  - **Weekly telecon to manage cross-segment issues**

Coriolis Segment Breakdown

Satellite T&C

GENERAL DYNAMICS

Payload Data Recovery

KONGSBERG

Payload Data Distribution

AMERICOM GOVERNMENT SERVICES

telenor

Raytheon

AT&T

Qwest Spirit of Service™

HARRIS

verizon

Satellite and Instrument Sustaining Engineering

GENERAL DYNAMICS

Payload Data Processing

Ops Collaboration – An Example

- **On December 16, 2004 AFRL was receiving SMEI data from Fairbanks, but not Svalbard**
- **AFRL identified problem to ops management team during regular mission operations telecon**
- **Team determined from KSAT pass reports that data was leaving Svalbard and only larger data files were missing at AFRL**
- **Team contacted Harris-Omaha and requested they investigate CONUS distribution network**
- **Harris isolated problem to network server and performed restart**
- **SMEI data flow restored within two hours of telecon**

Results to Date

- **Payload Performance:**
  - **WindSat in "Quasi-operational" phase**
  - **SMEI in Forecast Phase**
- **Data recovery performance on par with legacy systems (> 99%+)**
- **Costs are order of magnitude less than legacy**
- **Adaptive to change—T&C and payload data recovery contractors have changed hands since launch with no measurable impact**

Why Does it Work?

- **"Raging Incrementalism", Dr. Mike Gorlick, 2004**
  - **GSAW paper on embracing rapid technological change**
  - **"Hyperexponential progress has profound implications for all facets of system operations"**
  - **"Total system life cycle cost is dominated entirely by the operations and maintenance costs"**
- **Coriolis operations and ground system adhere to these Gorlick principles:**
  - **Virtue of "good enough"**
  - **Readily available commercial hardware**
  - **Open standard protocols**
  - **Modularity**

Why Does it Work? (Continued)

- **"The Wisdom of Crowds", James Surowiecki, 2004**
  - **Book on the promise and peril of collective intelligence**
  - **"Groups are remarkably intelligent, and are often smarter than the smartest people in them"**
  - **"The odds of a homogeneous group of people reaching a good decision are slim at best"**
  - **"Diversity helps because it actually adds perspectives that would otherwise be absent"**
- **Coriolis operations community aligns with these Surowiecki principles of the "wise" group:**
  - **Diversity**
  - **Independence**
  - **Decentralization**
  - **Aggregation**

For More Details …

Working Group Session 9D
"Teaming Early, Teaming Often—
Lessons Learned and Future Trends in Collaboration"

Wednesday
March 2, 2005
1:00 – 5:00 PM

- **Detailed case study on Coriolis Mission Ops**
- **3 other detailed case studies on collaboration**
- **Mediated panel discussion on future collaboration**

BACKUP SLIDES

Legacy Program circa 2000

Satellite T&C

Payload Data Distribution

AMERICOM GOVERNMENT SERVICES

Payload Data Recovery

Satellite and Instrument Sustaining Engineering

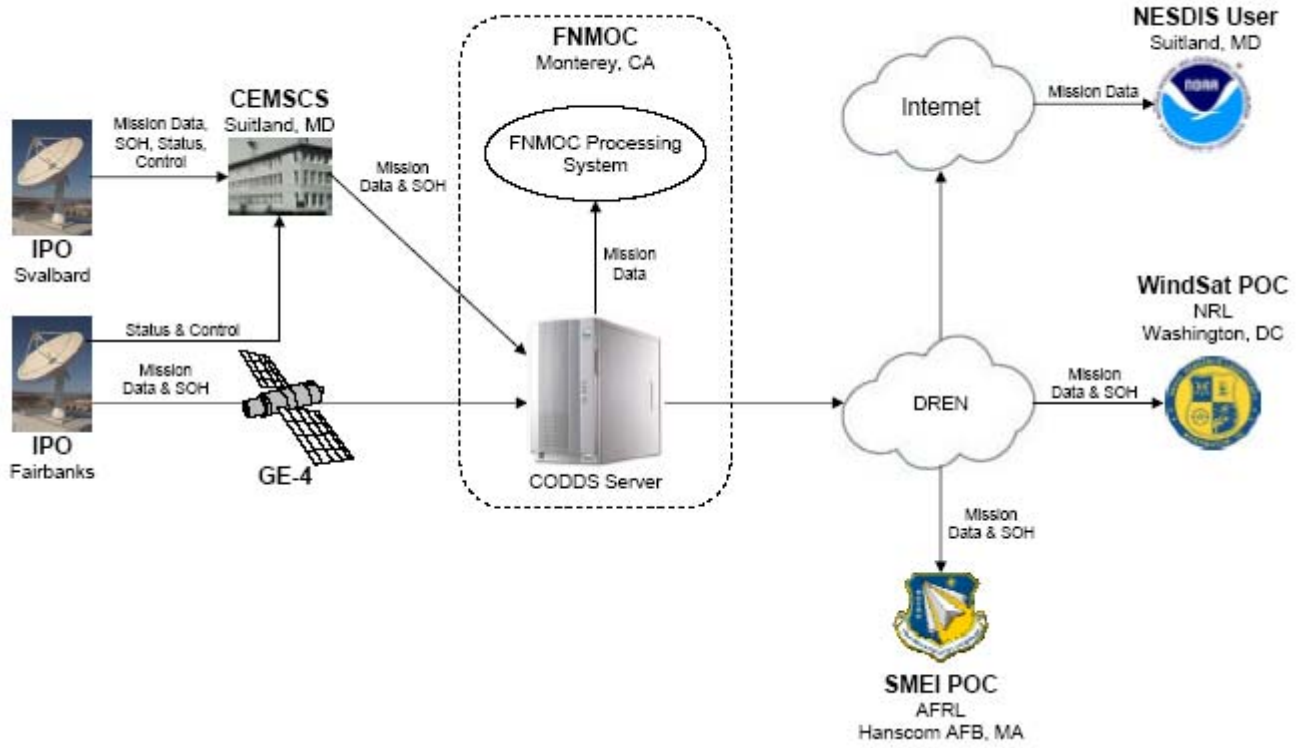
LOCKHEED MARTIN

NORTHROP GRUMMAN Space Technology

THE AEROSPACE CORPORATION

Payload Data Processing

Data Distribution Architecture



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