EDSN - Edison Demonstration for SmallSat Networks

EDSN Development Lessons Learned

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Mission Goal: Demonstrate that a swarm of satellites is capable of collecting multi-point science data and transferring the data to the ground.

Objectives:
1. Flight demonstrate one-way space-to-space data transfer whereby at least 2 satellites transfer data to a third satellite, which then transfers the data to the ground
2. Flight demonstrate a system to collect multi-point science measurements, transfer science measurements to another satellite and transfer to the ground
3. Flight demonstrate a reaction wheel based pointing system
4. Assess the viability of satellites built with Commercial Off The Shelf (COTS) components to operate for 60 days
Satellite Overview

- Nexus S Smartphone as main processor
- Parallax P8X32A Propeller chip for data & command routing
- MicroHard MHX2420 for S-band downlink
- 4x 18650 2800mAh Li-Ion Batteries
- StenSat UHF transmitter
- EPISEM radiation monitoring payload
- Novatel OEMV-1 GPS receiver
- AstroDev Li-1 UHF transceiver for crosslink

9 electrical subassemblies inter-connected via a single backplane PCB
Lieutenant EPISEM

Activities are either time or time & position based

Operations are autonomous
Development Approach

• Technology Demonstration mission
• Decoupled mission objectives
• Multiple attempts at technology demonstration
• Redundancy through number of units
• Autonomous satellite operations
• Consumer grade COTS components
• Concurrent engineering including design, testing & troubleshooting
• Multiple units including DevSats, FlatSats, EDUs & Flight spares
• Focus on testing versus design analysis
Development – DevSats & FlatSats

Development Satellites (DevSats)
- COTS development kits
- Identical processors
- Monitor power and data lines
- Rapid and low cost development
- Software development

Flat Satellites (FlatSats)
- Identical PCBs to EDUs
- Reconfigurable
- Turn on/off subassemblies
- Monitor power and data lines
- Allowed rapid repeated testing for multiple PCBs
- Stress testing and characterization
Development – EDUs & Flight

Engineering Development Units (EDUs)
• Early complete satellites
• RF cables on 2 units
• Early Qualification testing
• Software regression testing
• Mission simulation testing
• Risk reduction

Flight Units
• Modifications from EDUs
• Flt 1-2 Qualification
• Flt 3-12 Acceptance Testing
• 10 day Mission Simulation using flight parameters
• Select top 8 units for flight
• Spare flight units
Lessons Learned

- Tracking components and units
  - Paper travellers used required overhead
  - Recommend a more automated system
- Procedures for multiple people
- Procedure detailed tuned to task
- Credible descopes
- Stakeholder involvement
- Renting common GSE equipment
- Combined weekly stakeholder meeting
- Project pace enabled by co-location and daily tags
- Dedicated schedule with daily review and weekly status
Anomalies and Resolutions

• Workmanship
  – Inspection, buddy system, sparing
• COTS parts
  – Sparing, subassembly testing
  – Connector issues
  – Higher grade Auto/Ind grade
• Connector saver for external ports

• MOSFET issue
  – Internal ESD
  – Known vendors
• Software development tools
  – JIRA Track bugs
  – Regression testing
• DevSats, Flatsat, EDUs
• Ground Support Equipment
  – Account for interaction affects
  – Testing of software
EDSN Development Lessons

• Development of multiple Cubesats is possible and cost effective
• Development approach and processes change
• Configuration Management is essential
• Concurrent engineering required twice as many units
• Testing early and often resolved issues
• Swarms and constellations allow tailoring of risk posture
• Integration and testing of multiple units has additional considerations
EDSNN

Questions?