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
- 3 orthogonal reaction wheels
- 4x 18650 2800mAh Li-Ion Batteries
- EPISEM radiation monitoring payload
- StenSat UHF transmitter
- Novatel OEMV-1 GPS receiver
- AstroDev Li-1 UHF transceiver for crosslink

9 electrical subassemblies inter-connected via a single backplane PCB
Mission Overview

Operations are autonomous

Activities are either time or time & position based
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
Questions?