Early Results of the CASCADE Technology Demonstration Payload on CASSIOPE

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CASSIOPE Mission

CASSIOPE Mission consists of:
CASSIOPE Spacecraft
Mission Ops Centre
  Rothney Astrophysical Observatory (RAO)
    Calgary (Canada)
CASCADE Ground Terminal
  RAO
TT&C Stations (SSC)
  O’Higgins (Antarctic)
  Inuvik (Canada)
  Svalbard (Norway)
ePOP Science Ops Centre
  University of Calgary (UoC)
CASSIOPE

CASSIOPE consists of:
  CAscade
    Ka-band Comms
    Payload Demo (termed CX)
  SmallSat Bus
    Generic Bus Development
  Ionospheric Polar Explorer
    Space Weather Science Payload
  aka ePOP (enhanced Polar Outflow Probe)
CASSIOPE Launch

Launch Sept 29th 9 am Pacific
325 x 1500 km orbit
81 deg inc.
51 years after Alouette 1
First Falcon 9 v1.1
First launch from Vandenberg
CX Concept

CX is a tech demo payload focusing on
High speed store and forward
Ka-band receive & transmit
Modulator/Demodulator
Data Storage Technology
Evaluation
Low Error Rate
CX Payload

CX demonstrates 2 channels of CASCADE

Each channel has a data rate of 350 Mbps
Right Hand Circular Polarized
Separated in frequency

CX operates in half-duplex mode

Data Storage Unit
storage of 1 Tb over four sub-units

Connection added to the ePOP Payload
allow science data download via CX
CX Operation

Key feature of CX is use of a beacon to minimize data loss/errors.

Measurement of Beacon levels allows adjustment of transmit power, start/stop transmission of data/fill.

Depending on number of errors CX can use backhaul, schedule additional pass to re-transmit.
CX On-Orbit Results

CX units commissioning started after confirmation of thermal maintenance of CX panel

Unit commissioning interleaved with Bus/ePOP commissioning
   Payload Control Software
   Master Oscillator
   Receive Chain (Demodulator and Frequency Generation Unit)
   Transmit Chain (Modulator and Travelling Wave Tube Amplifiers)

Ground Terminal Commissioning
   Antenna pointing calibration using Sun, Wild Blue and CASSIOPE
   Antenna power output calibration
CASCADE On-Orbit Results

End to End Data Transfer
Uplink from GT to CX
Upper plot shows Demodulator lock throughout pass
Lower plot shows Beacon power transmitted
CX On-Orbit Results

End to End Data Transfer
Downlink from CX to GT
Upper plot shows Beacon signal strength received
~ ¾ through plot Beacon strength goes below min criteria
CX transmits fill during period
CX On-Orbit Results Summary

Several end to end transfers now completed proving:
  Gigapackage format for transporting large amounts of data
    A relatively high error level can be corrected in the files
    moved through the satellite
  Technique for using a 30GHz beacon to assess 20 GHz data
    link (and vice versa)
  A qualified payload design and architecture
  A qualified Ground Terminal system design

ePOP science data transfers also completed
  CX provides a much higher transfer rate (350 Mbps, vs 4 Mbps)
Acknowledgements

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Thank You!