



INFORMATION SYSTEMS

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)

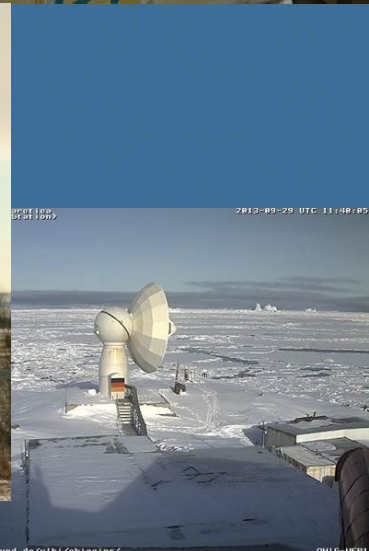
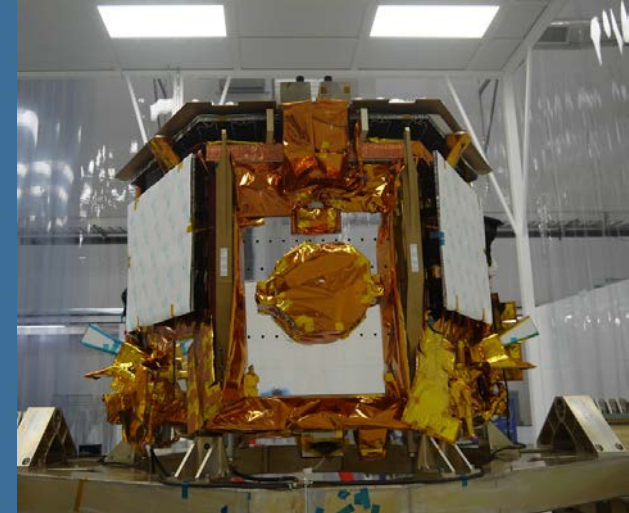
O'Higgins (Antarctic)

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

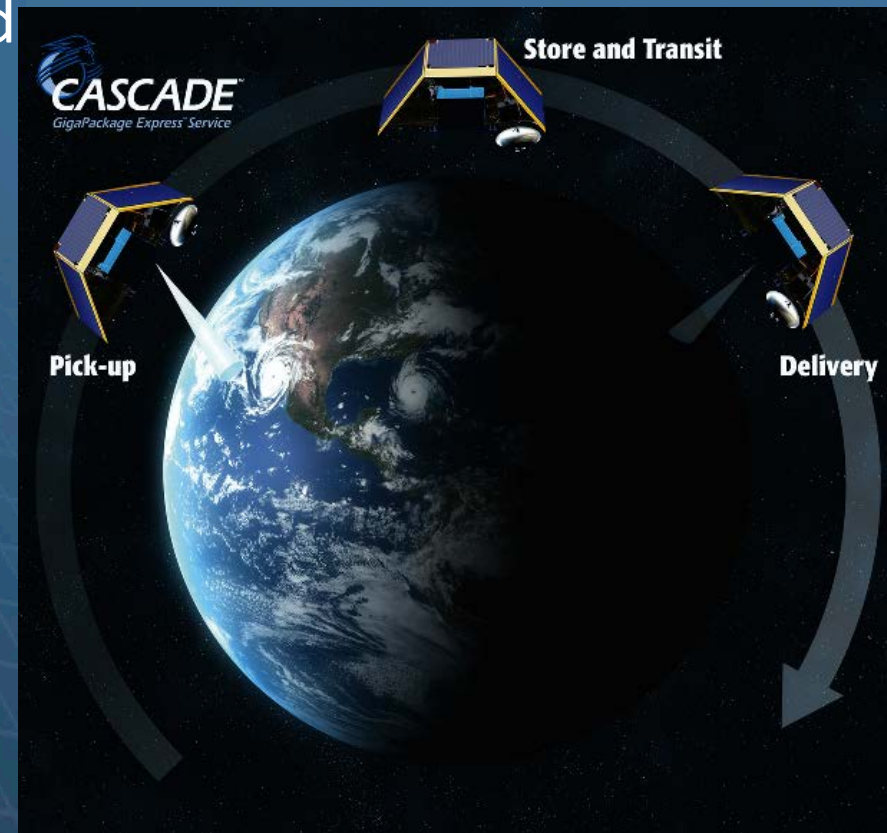
Ka-band receive & transmit

Modulator/Demodulator

Data Storage Technology

Evaluation

Low Error Rate



CX Payload

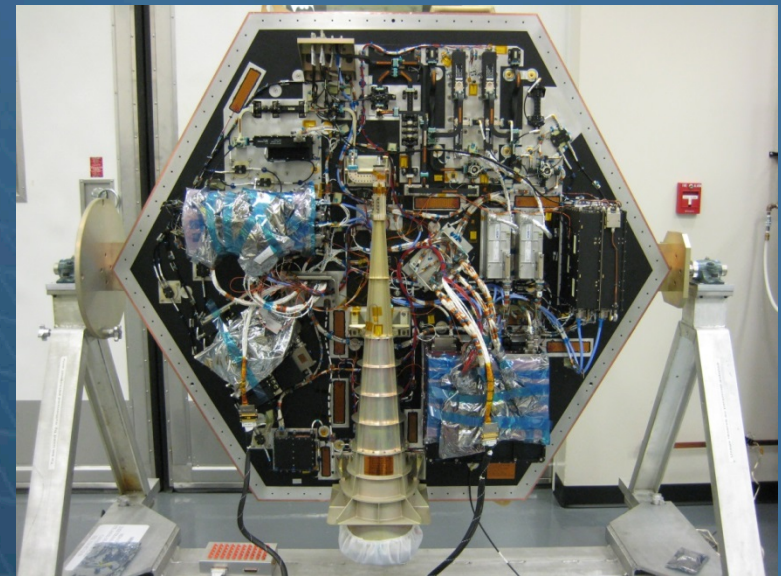
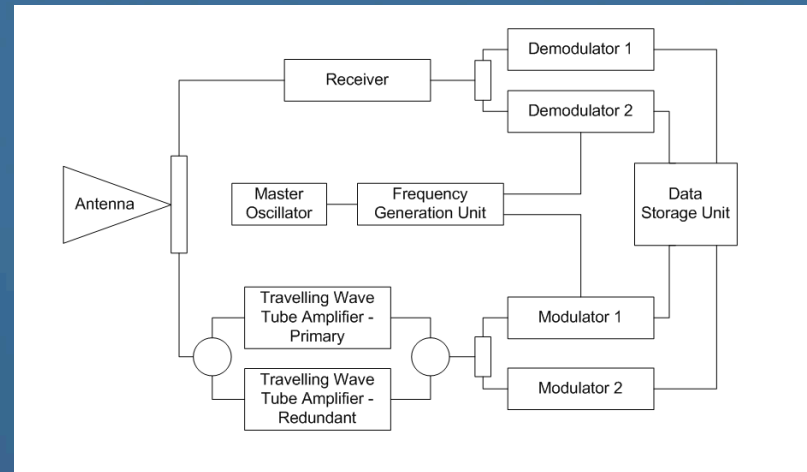
CX demonstrates 2 channels of CASCADE

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

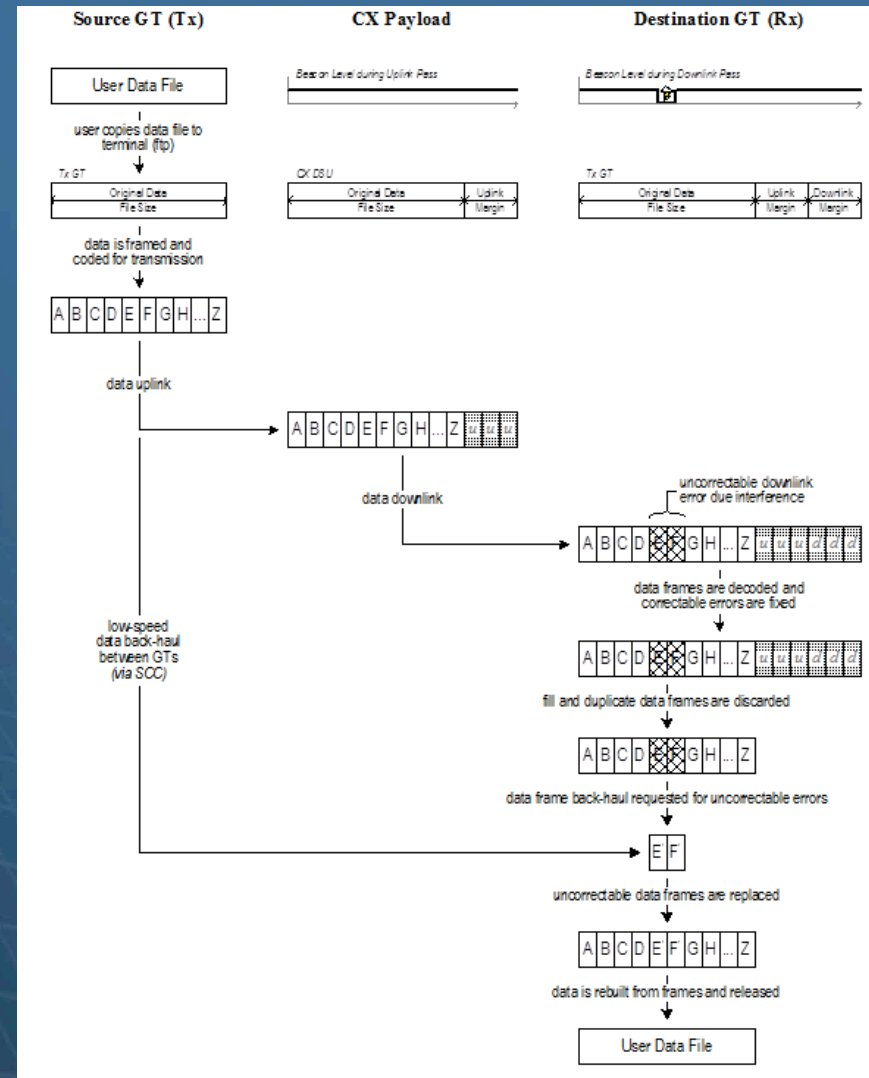


CX Operation

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

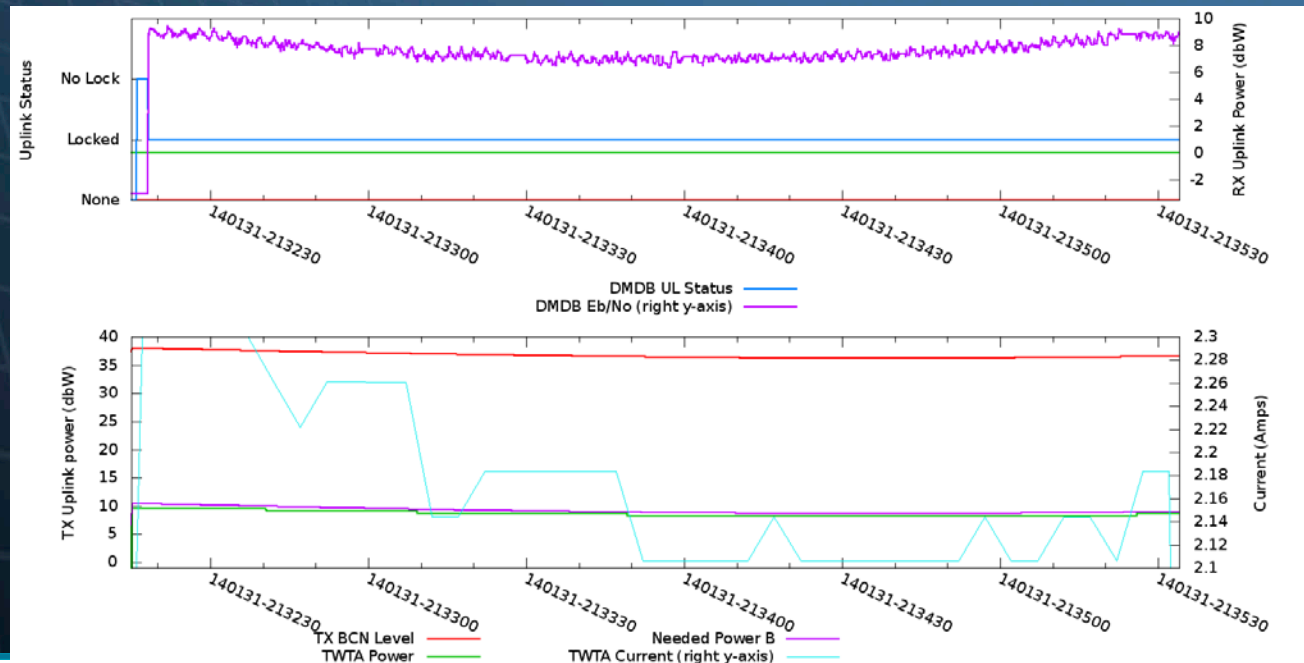
CASCADE On-Orbit Results

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

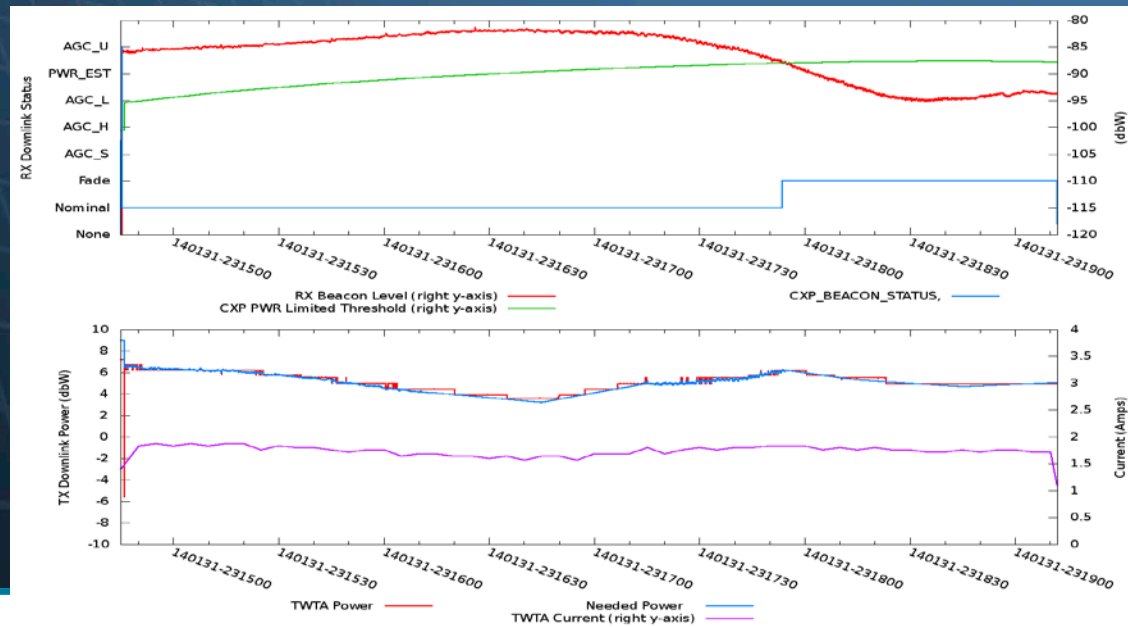
End to End Data Transfer

Downlink from CX to GT

Upper plot shows Beacon signal strength received

~ 3/4 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

The CASSIOPE mission and CX Demonstration was enabled by Canada's contributions from the Canadian Space Agency (CSA) and the Industrial Technologies Office (ITO)

Thank You!

