



Communication Solutions

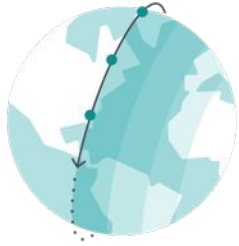
Ryan Kingsbury
www.planet.com

Dongtaijinai'er Salt Lake, China MAY 3, 2016

A LINE SCANNER FOR THE PLANET



END-TO-END SYSTEM



132

SATELLITES

475_{KM}

ALTITUDE

**SUN
SYNCHRONOUS
ORBIT**

25

GROUND STATIONS

9

SITES

1.3_M
IMAGES PER DAY

1000s

**OF VIRTUAL
MACHINES**

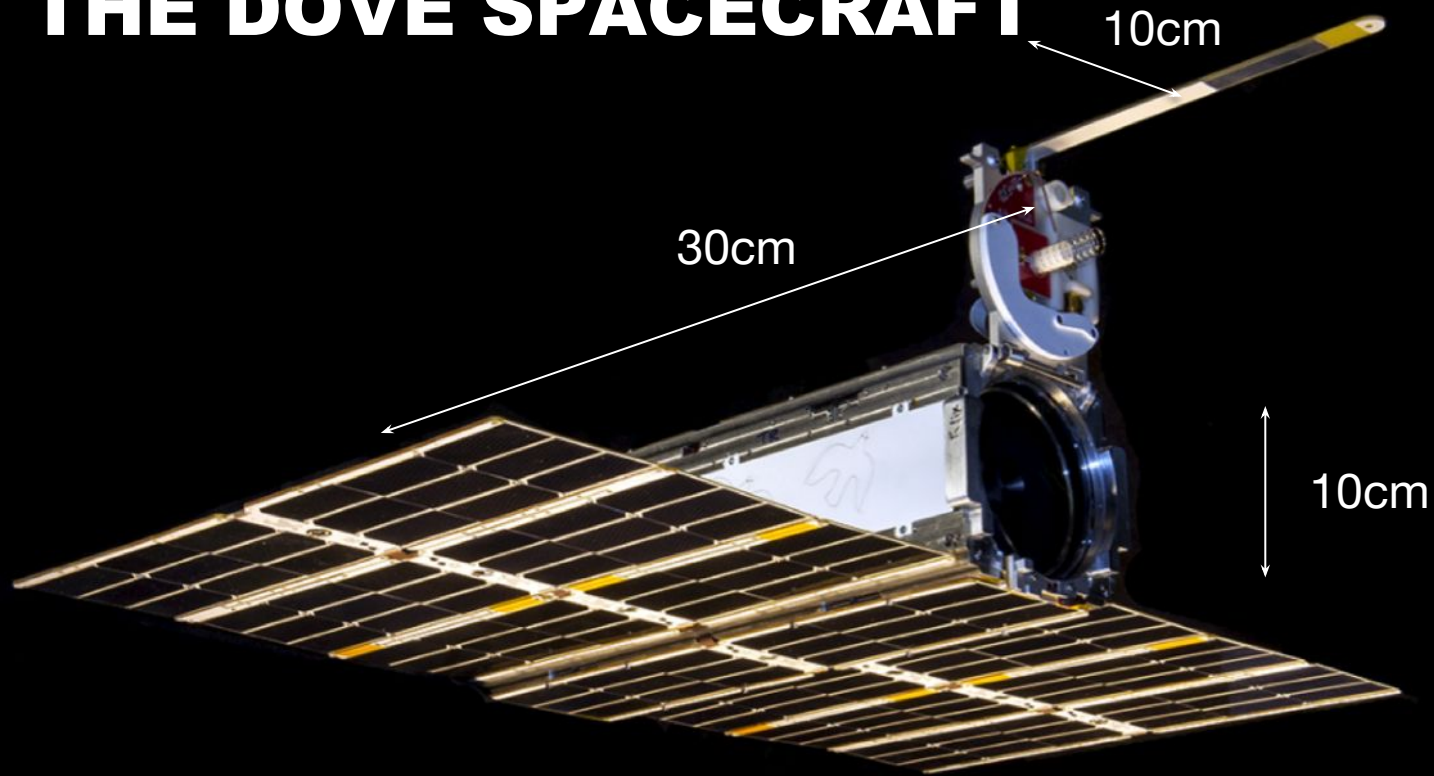
7_{TB}

**DOWNLINKED
DAILY**

API

**FOR DATA PIPELINE
AND PLATFORM
ACCESS**

THE DOVE SPACECRAFT





Satellite Radio: UHF

TI Wireless Transceiver Microcontroller (CC1110)

- Power amplifier: RFMD 1 watt output
- Monopole antenna
- Ground station is identical hardware and software
- Presented at CubeSat Summer Workshop 2014
 - Design will be open-sourced soon
 - Follow-up presentation at SmallSat 2016





Satellite Radio: S/X-band

- S-band uplink
 - 250 kbps BPSK
 - Needed for downlink adaptive coding and modulation
- X-band downlink
 - 12.5 Mbps up to 100+ Mbps
 - 8.2 GHz at 2 watts
 - DVB-S2 standard with Generic Stream Encapsulation
 - Fixed 24 Msps symbol rate
 - Upgrade to 56 Msps on next sats
 - Variable modulation: QPSK, 8PSK, 16APSK, 32APSK
 - Variable FEC: 1/4 up to 9/10
 - GSE allows IP connectivity to satellite





Ground Station: UHF

- TT&C only
- Uplink at 450 MHz, up to 100 Watts
- Downlink at 401.3 MHz
- Encrypted 4800 baud GFSK
- Yaesu G-5500
- Separate M2 yagis
- Open-source radio design



Morehead State University



Ground Station: S/X-band

- 5m dish
- Combined S/X feed
- Up to 100 W S-band uplink
- 29 dB/K at X-band
- COTS DVB-S2 receiver for X-band



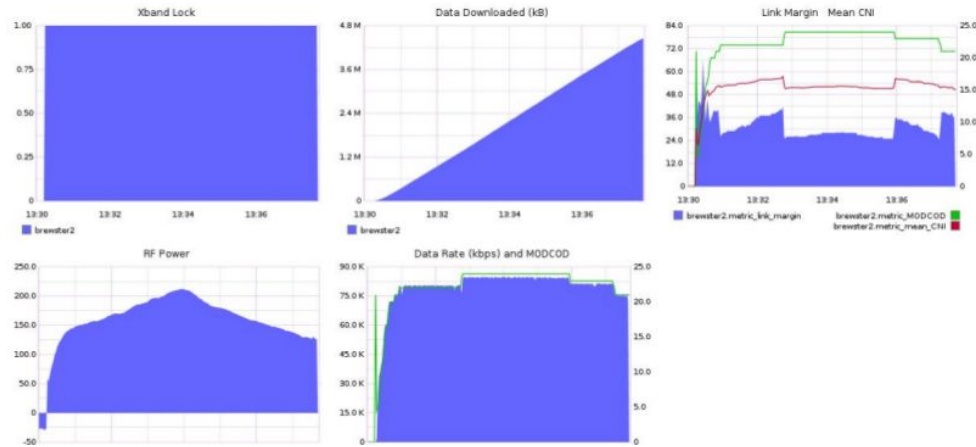
Brewster, Washington



Typical Pass (S/X-band)

- 55 degree max elevation
- X-band lock for 435 seconds = 7.25 min
- Variable data rate up to 84 Mbps
- Modcod up to 24
- Downloaded: 4.2 GBytes = 650 pictures
- Pictures uploaded to AWS for rectification

RF GRAPHS



An aerial photograph of Capetown, South Africa, showing the harbor, city, and surrounding landscape. The harbor is filled with ships and piers. The city is densely packed with buildings and roads. The surrounding landscape is hilly and green.

MONITORING PORT ACTIVITY

CAPETOWN, SOUTH AFRICA

MARCH 9, 2016



A satellite image of the Capetown port area in South Africa, showing various ships docked at piers and the surrounding urban landscape. A black speech bubble is overlaid on the image.

MONITORING PORT ACTIVITY

CAPETOWN, SOUTH AFRICA

MARCH 14, 2016





MONITORING PORT ACTIVITY

CAPETOWN, SOUTH AFRICA

MARCH 15, 2016



An aerial photograph of a sugarcane field. The field is a mosaic of dark green, mature cane and lighter green, harvested areas. A network of thin, light-colored lines, likely roads or irrigation canals, crisscrosses the landscape. In the upper center, a black rectangular box with a downward-pointing arrow contains the text "SUGAR CANE HARVESTING" in white, bold, sans-serif capital letters.

SUGAR CANE HARVESTING

A circular logo featuring a lowercase letter 'p' in a serif font, centered within a thin circular border.

RIO GRANDE

JANUARY 18, 2016





SUGAR CANE HARVESTING

 **RIO GRANDE**

MARCH 24, 2016





SAN GABRIEL, CA
JUNE 5, 2016



An aerial photograph of the San Gabriel Mountains in California. A large, irregular area of the mountain range is covered in thick, white smoke, indicating an active wildfire. A red line is drawn across the landscape, tracing the perimeter of the fire. The surrounding terrain is rugged and mountainous, with some green vegetation visible in the lower elevations. In the bottom right corner, there are two small white circles, one outlined and one solid, likely representing camera interface elements.

SAN GABRIEL WILDFIRES



SAN GABRIEL, CA
JUNE 23, 2016