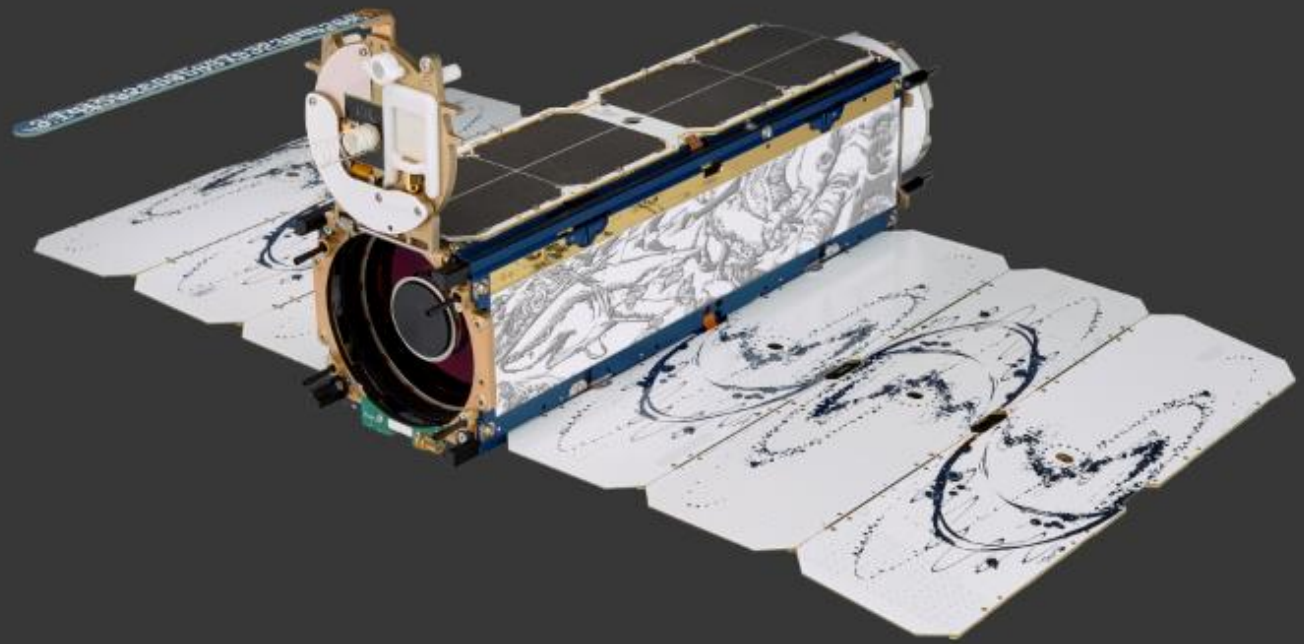

planet.
SEE CHANGE.
CHANGE THE WORLD.
Mike Safyan
2016 ITU Symposium and Workshop on Small Satellites
Mailiao Refinery, Taiwan May 31, 2016

Image the whole world every day, making change visible, accessible and actionable.

THE DOVE SPACECRAFT



END-TO-END SYSTEM

100+
SATELLITES

3 - 5M
RESOLUTION
4-BAND IMAGERY

15
GROUND STATIONS

150M
KM² PER DAY

1000S
OF VIRTUAL MACHINES

5+ TB
DOWNLINKED DAILY

API
FOR DATA PIPELINE AND PLATFORM ACCESS

OUR CONSTELLATIONS

CONSTELLATION	DOVE	RAPIDEYE
Constellation	100+*	5
Image capture capacity	150 million km²/day	6 million km²/day
Ground Sampling Distance (GSD)	3-5 m	6.5 m
Pixel Resampled	3 m	5 m
Telescope and Camera	Bayer mask CCD sensor	Push broom imager
Spectral Bands	Red, Green, Blue and NIR	Red, Green, Blue, Red Edge and NIR

*Over 150 Dove satellites launched to date, approx. 50 currently operating

Frequency Table

Function	Common Name	Frequency Band	Bandwidth	Allocation /Class
High Speed Downlink	“X-band”	8025-8400 MHz, space-to-Earth	66.8 MHz (2 channels)	EESS (EW)
High Speed Uplink	“S-band”	2025-2110 MHz, Earth-to-space	1.31 MHz	EESS (EW)
Ranging, TT&C Downlink	“UHF”	401-402 MHz, space-to-Earth	60 kHz	Space Operation (ET)
Ranging, TT&C Uplink	“UHF”	449.75-450.25 MHz, Earth-to-space	60 kHz	Space Operation, (EW)*

*450 MHz is filed under Article 4.4 (No Interference / No Protection), and thus no Coordination required

Flock 1 (USASAT-30F) API

	ITU	FCC	Launch
May 2013			launch contract signed
Jun 2013		license submitted	
Jul 2013	API submitted to FCC		
Aug 2013			
Sep 2013			
Oct 2013			
Nov 2013	API marked received		
Dec 2013		license granted	
Jan 2014			launch to ISS
Feb 2014			deployment
Mar 2014	API/A published		
Apr 2014			
May 2014			
Jun 2014			
Jul 2014	BIU filed		
Aug 2014	API/B published		

API Comments

- Comments from 20 Administrations received in response to USASAT-30F API identifying potential for interference
- Mostly X-band (8 GHz) and S-band (2 GHz) concerns
- We responded to all 20 administrations either asking for, or providing, additional information to further discussions
- Only a handful of Administrations had meaningful responses
- The most rigorous discussions occurred with Administrations where we were seeking to license and operate Earth Stations

USASAT-30F Notification

- Notification submitted via FCC May 2015
- ITU date of receipt June 2015
- Part I-S published September 2015
- Part II-S published May 2016
- Also, Part III-S (!) published May 2016
  - Mistake in calculating X-band PSD resulted in violation of limits. X-band PSD is actually OK, good reminder to double (or triple!) check your calculations
  - Forgot to mark 449.75 – 450.25 MHz Under Article 4.4
- Corrected Notification re-submitted August 2016

Licensing Challenges

- Things that stay the same:
  - Basic design of the satellites
  - Frequency bands used
- Things that change:
  - Launch manifest (orbits, # of satellites, launch schedule launch vehicles)
  - Numbers and locations of Earth Stations (both U.S. and non-U.S.)
  - Some RF characteristics (e.g. antenna properties, output power, bandwidth, modulation + FEC)
  - CONOPS (e.g. addition of radio ranging, constellation spread, improved Earth Station pointing)

Lessons Learned

- ITU filing can be highly complex!
  - Reach out to ITU BR, experienced satellite operators or consultants/lawyers for assistance
- Don’t get upset if Administrations provide comments on your filing
  - Most issues can be quickly resolved (e.g. non overlap of frequencies)
- Requirements for API Mod are very narrow (modification of reference body or modification of direction of transmission)
  - Most likely not applicable to your mission, move to Notification instead
- Don’t forget to file Bringing into Use (BIU)


MONITORING
PORT ACTIVITY
CAPE TOWN, SOUTH AFRICA
MARCH 9, 2016


MONITORING
PORT ACTIVITY
CAPE TOWN, SOUTH AFRICA
MARCH 14, 2016


MONITORING
PORT ACTIVITY
CAPE TOWN, SOUTH AFRICA
MARCH 15, 2016


SUGAR CANE
HARVESTING
RIO GRANDE
JANUARY 18, 2016


SUGAR CANE
HARVESTING
RIO GRANDE
MARCH 24, 2016

BUILD 7

FEBRUARY 19, 2014

Build 7—launched after just 2 years of development—was Planet's first mass-produced satellite. It consisted of a custom telescope mated to an 11-megapixel CCD camera.

BUILD 10

NOVEMBER 5, 2015

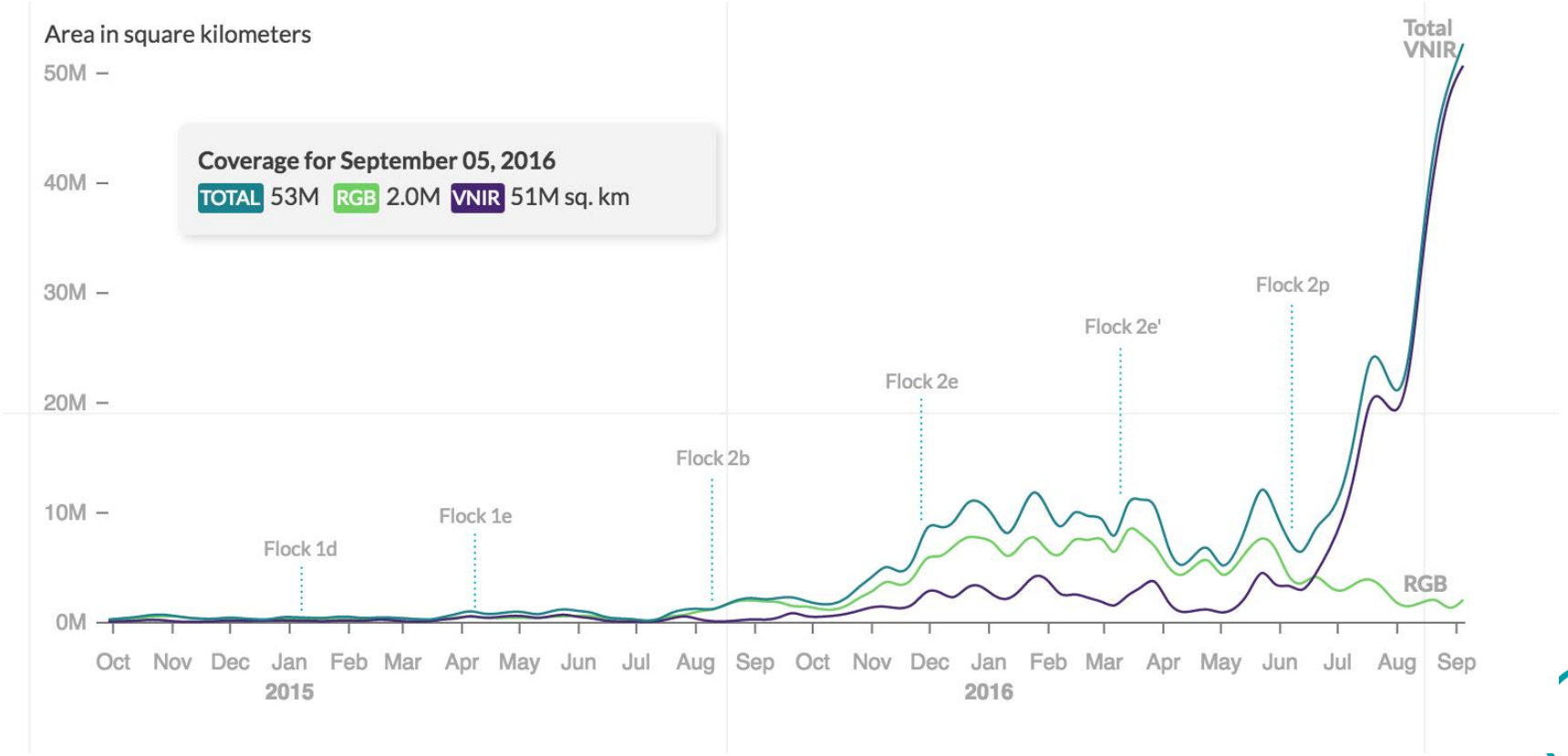
Build 10 introduced an improved carbon-fiber telescope and horizon sensors for more precise attitude control. These innovations resulted in a sharper image, increased signal to noise, and more usable pixels.

BUILD 13

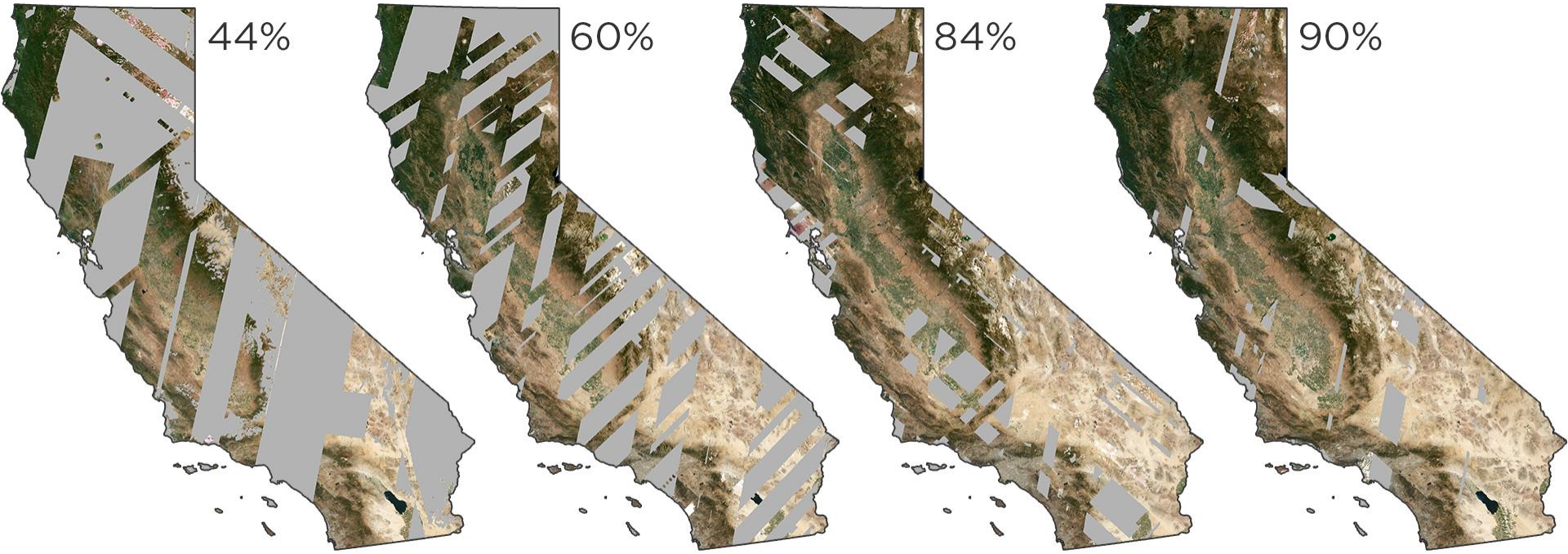
SEPTEMBER 4, 2016

Build 13 is Planet's most advanced satellite. It employs a 2nd-generation custom telescope, 29 megapixel camera, and star tracker. Together, these enhancements resulted in a greatly increased field-of-view and better edge-to-edge sharpness. In addition, a field programmable gate array processes data onboard, allowing the high throughput necessary for collecting near infrared data.

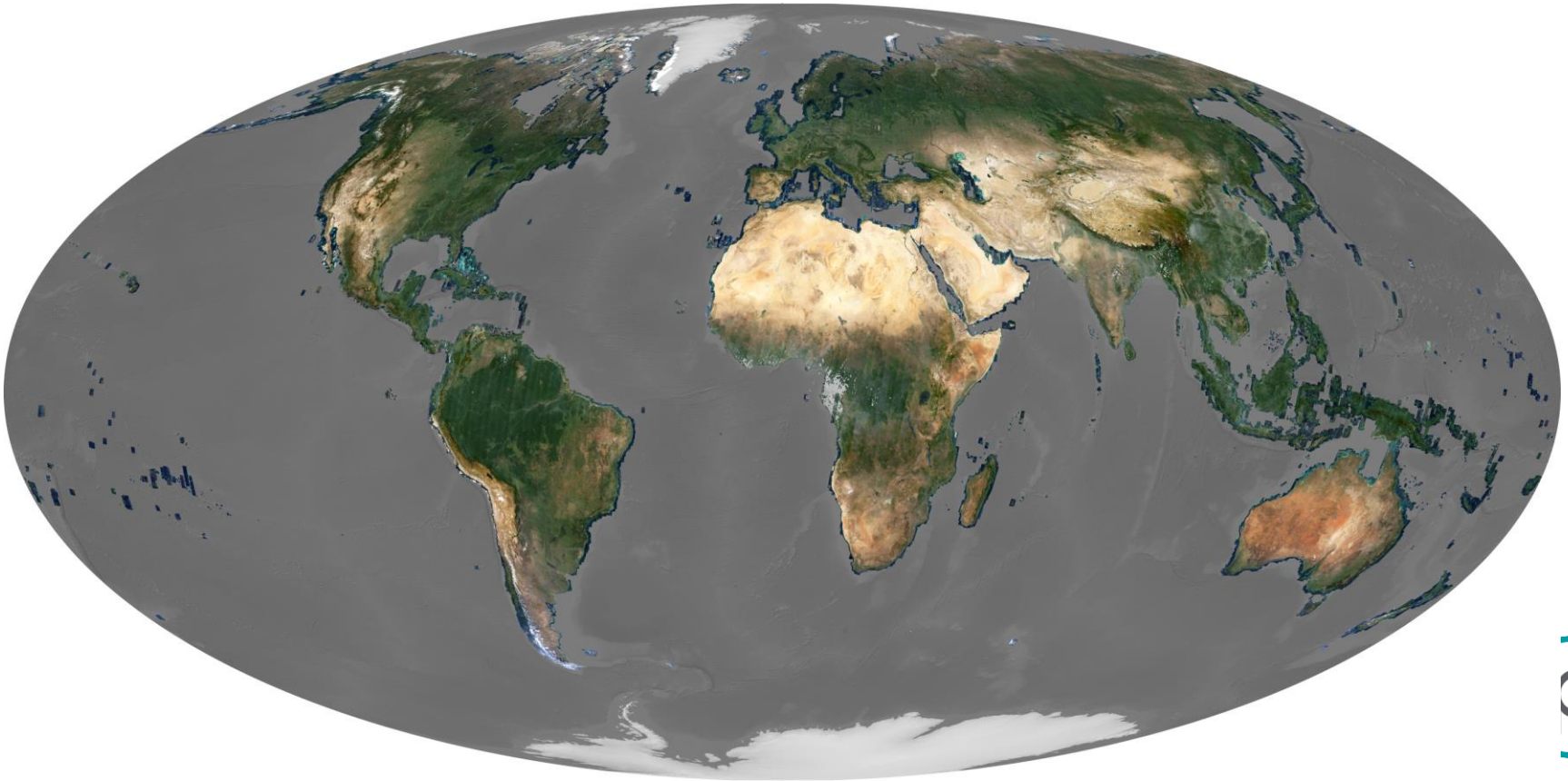
Land Surface Imaged (Doves Only)



Weekly Mosaic Coverage (2016)



Global Mosaic (July – Sep 2016)




THANK YOU
VISIT US AT PLANET.COM
London Array Wind Farm, United Kingdom, APR 17, 2016