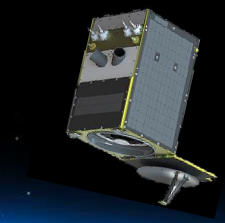
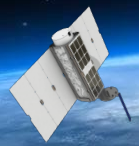
Planet's Communication Network

Employing agile aerospace to download 25+ TB daily imagery from the Dove constellation

Kiruthika Devaraj | June 09, 2021

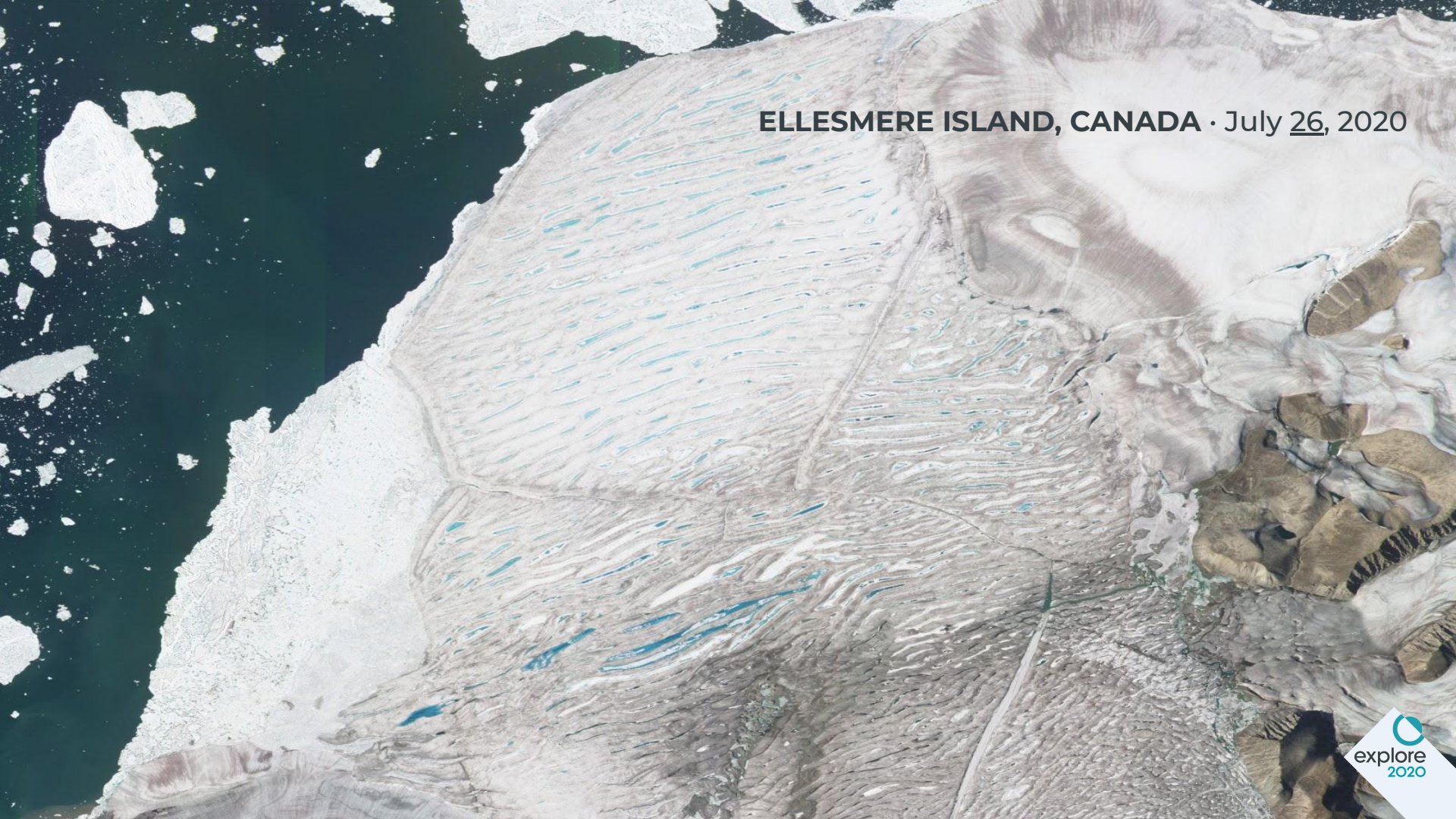
21st Century Problems






TRINITY, CALIFORNIA • September 8, 2020
explore
2020

explore 2020



ELLESMERE ISLAND, CANADA · July 26, 2020

explore 2020


ELLESMERE ISLAND, CANADA · July 31, 2020
The environment is in crisis.
explore 2020

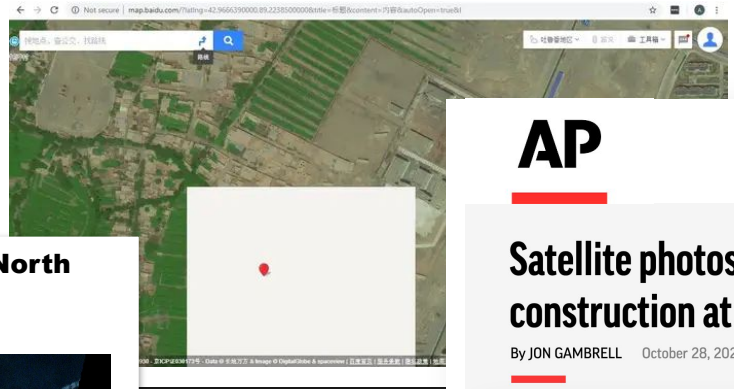
CNN politics

Satellite images indicate Russia is preparing to resume testing its nuclear-powered cruise missile

By Zachary Cohen, CNN
Updated 11:38 AM ET, Tue October 20, 2020

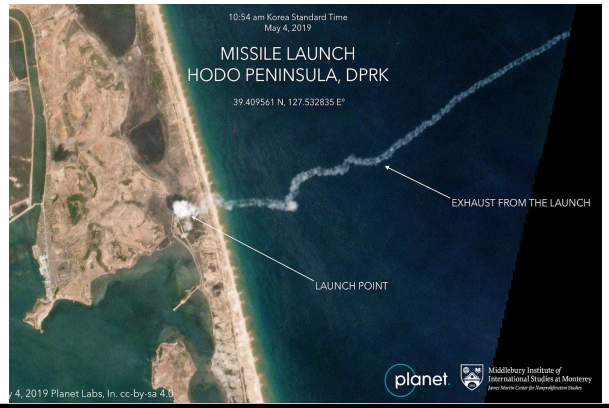
BuzzFeed News

Blanked-Out Spots On China's Maps Helped Us Uncover Xinjiang's Camps



CNN

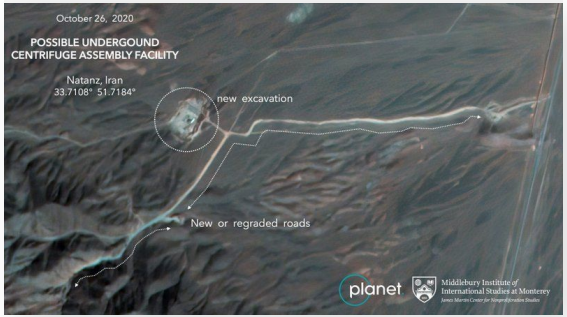
Exclusive: Images show North Korea missile launch as Pyongyang tests Trump



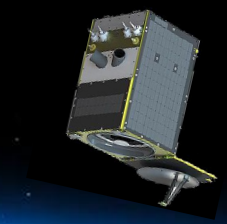
AP

Satellite photos show construction at Iran nuclear site

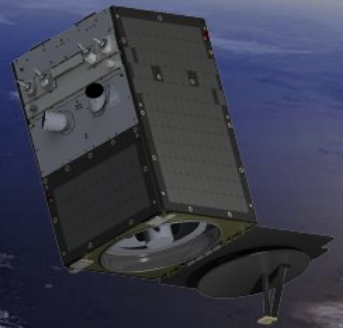
By JON GAMBRELL October 28, 2020



You can’t fix what you can’t see.



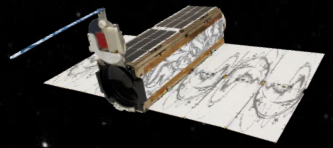
planet.



PLANET'S MISSION

To image the whole world every day,
making change **VISIBLE, ACCESSIBLE AND ACTIONABLE.**

Planet's Industry-Leading Constellations

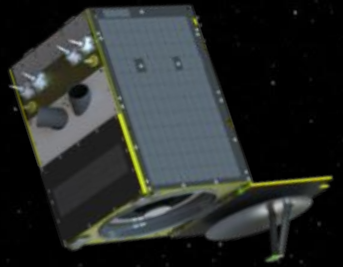


130+
PlanetScope Dove Satellites

Doves

SATELLITES	GSD	CAPACITY
130+	**3.7 m**	**200 million km²**/day

ORBIT ALTITUDE	8 SPECTRAL BANDS
475 km	**Coastal Blue, Blue, Green I, Green II Yellow, Red, Red Edge, Near Infrared**



21
SkySat Satellites

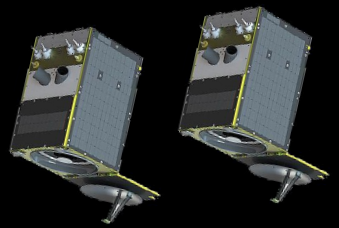
SkySat

SATELLITES	GSD	CAPACITY
21	**0.65 m**	**400 K km²**/day

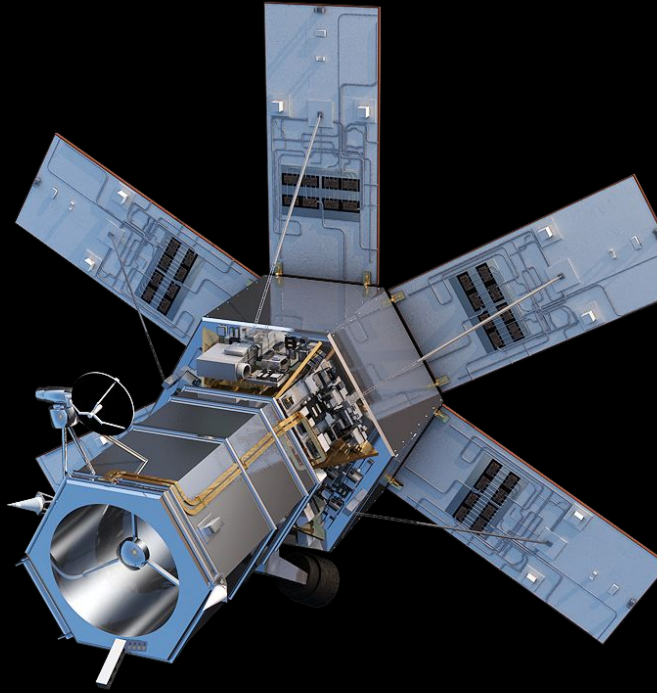
ORBIT ALTITUDE	SPECTRAL BANDS
450 km	**RGB, PAN** and **NIR**

NASA
LandSat-8

Planet
Doves

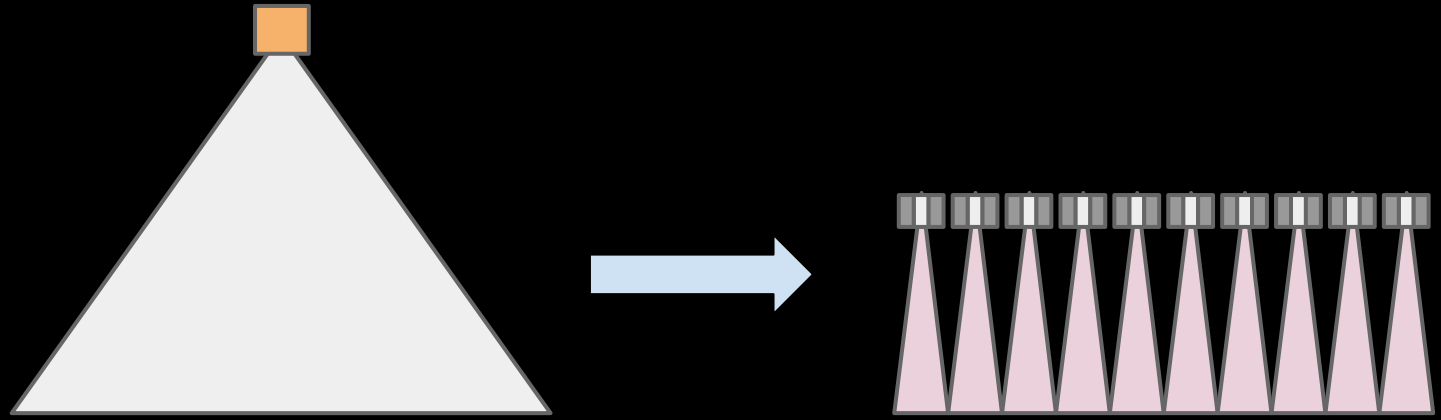


Planet
SkySats



Digital Globe
WorldView-4

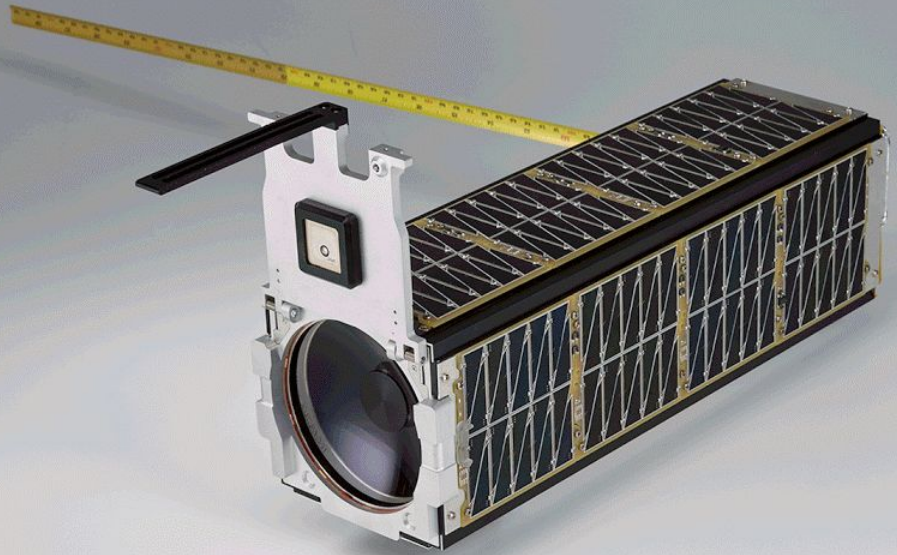
Planet's Approach to Earth Observation

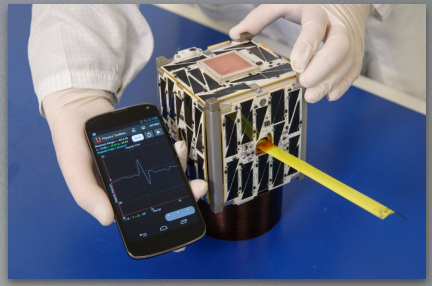


Large complicated spacecraft → resilient, upgradable constellation

Build + Launch + Operate + Serve

Agile Aerospace

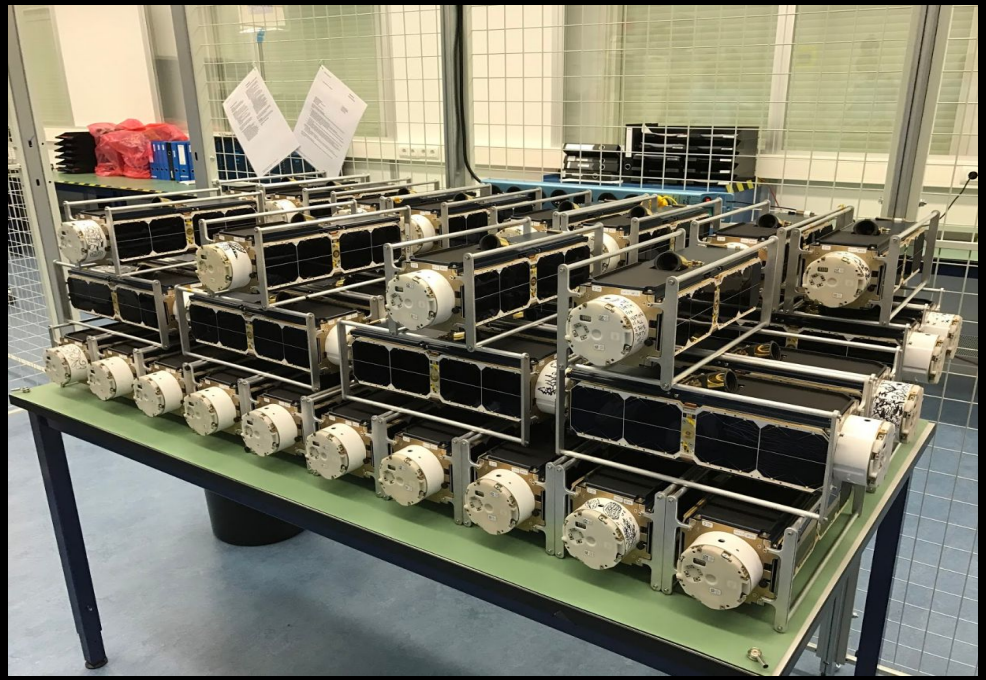


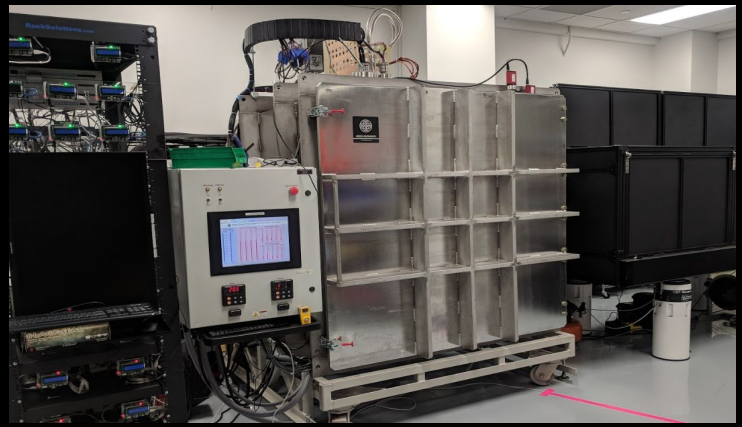


14 Dove builds in 7 years

- Continuous iterations
- 3-6 month design lifecycle
- Focus on infusion and integration
- Leverage other industries' R&D

Lean Manufacturing





Mid-scale production

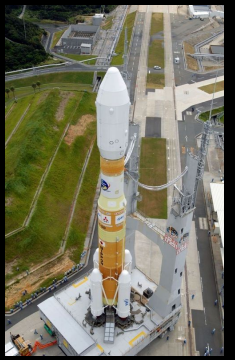
(similar to medical devices or early Tesla)

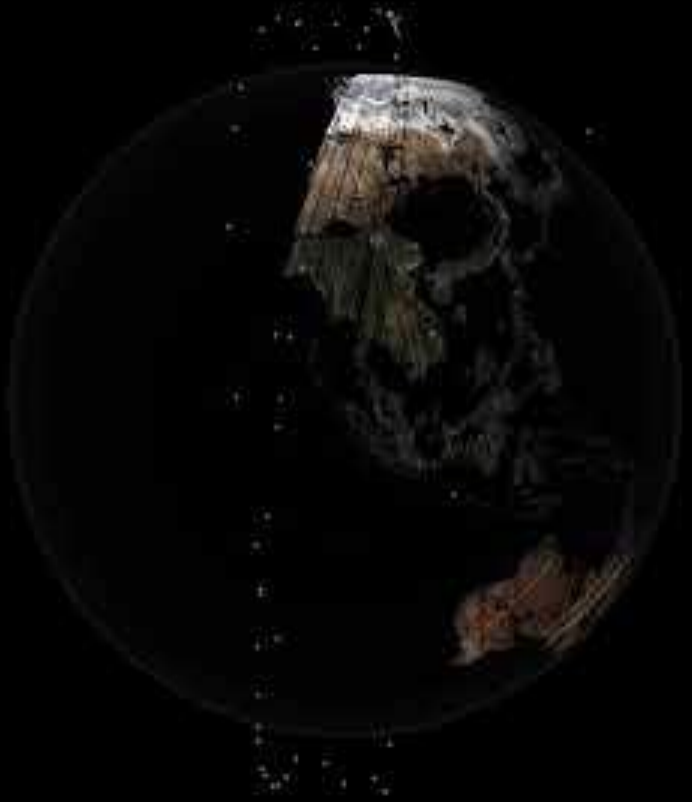
Focus on automated testing

Frequent Launches

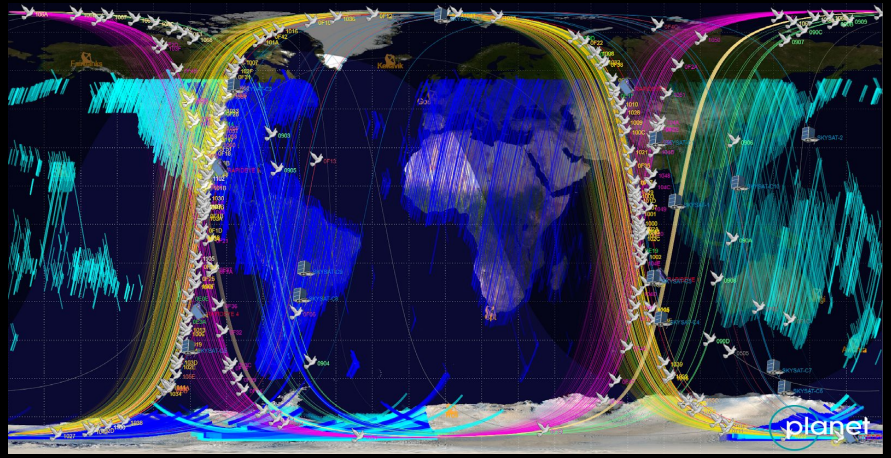
Space is an extension of the lab

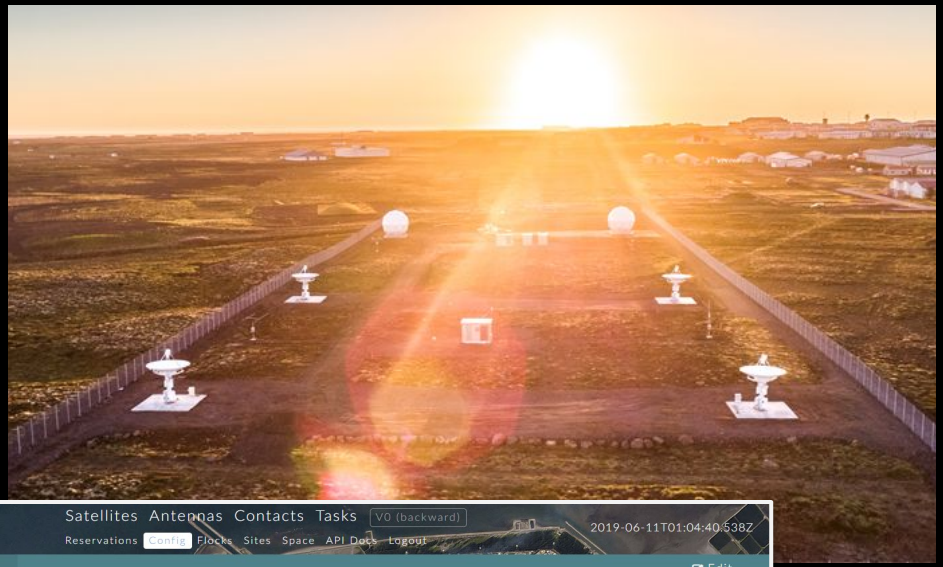
- 436 satellites deployed
- 32 launches
- 3 failures (F9, Antares, Electron)
- 10 rocket families

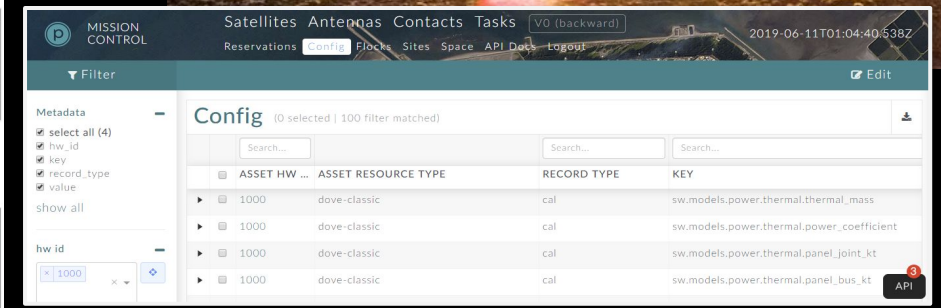




Reliable and automated communication network!



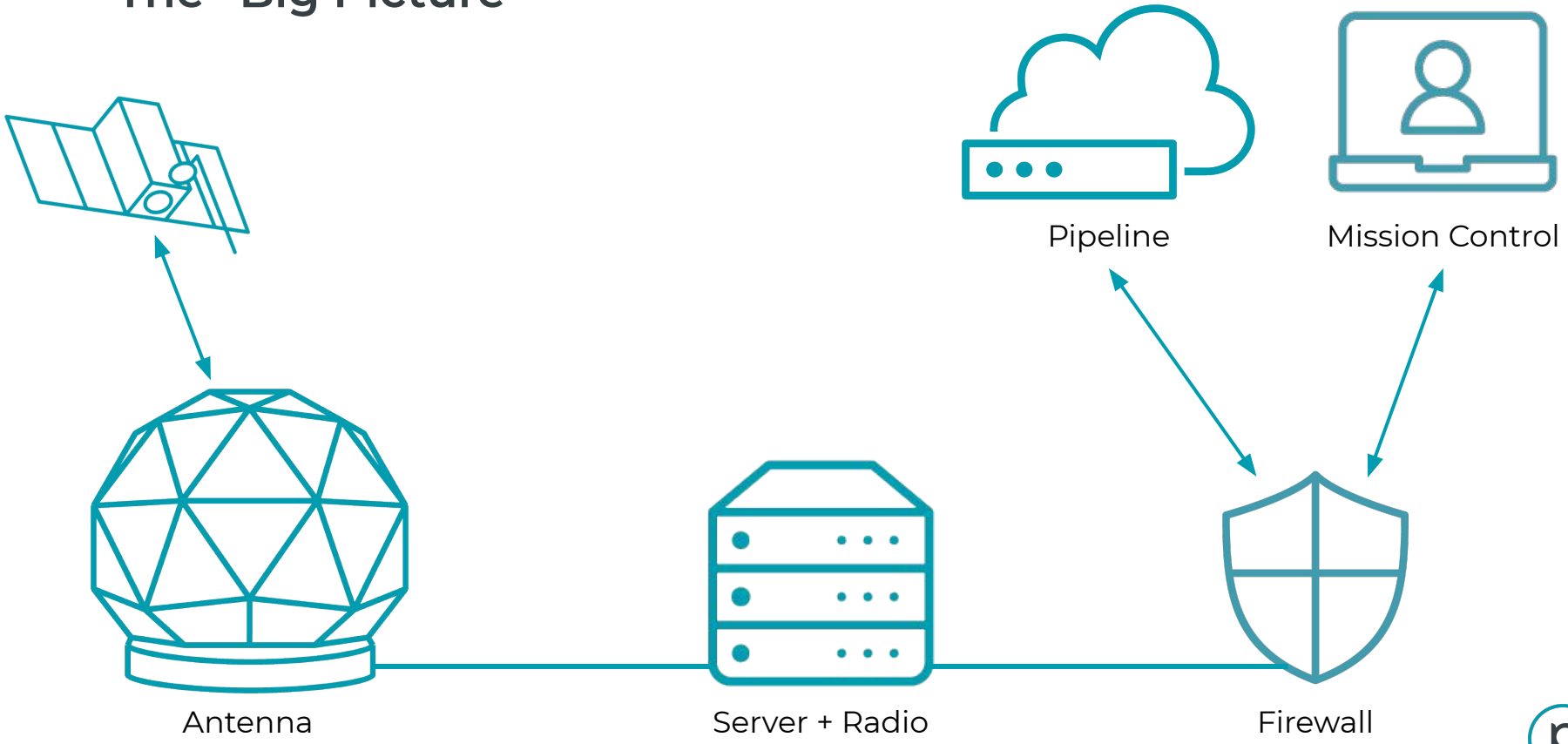




Fleet-level automation that adapts to each satellite

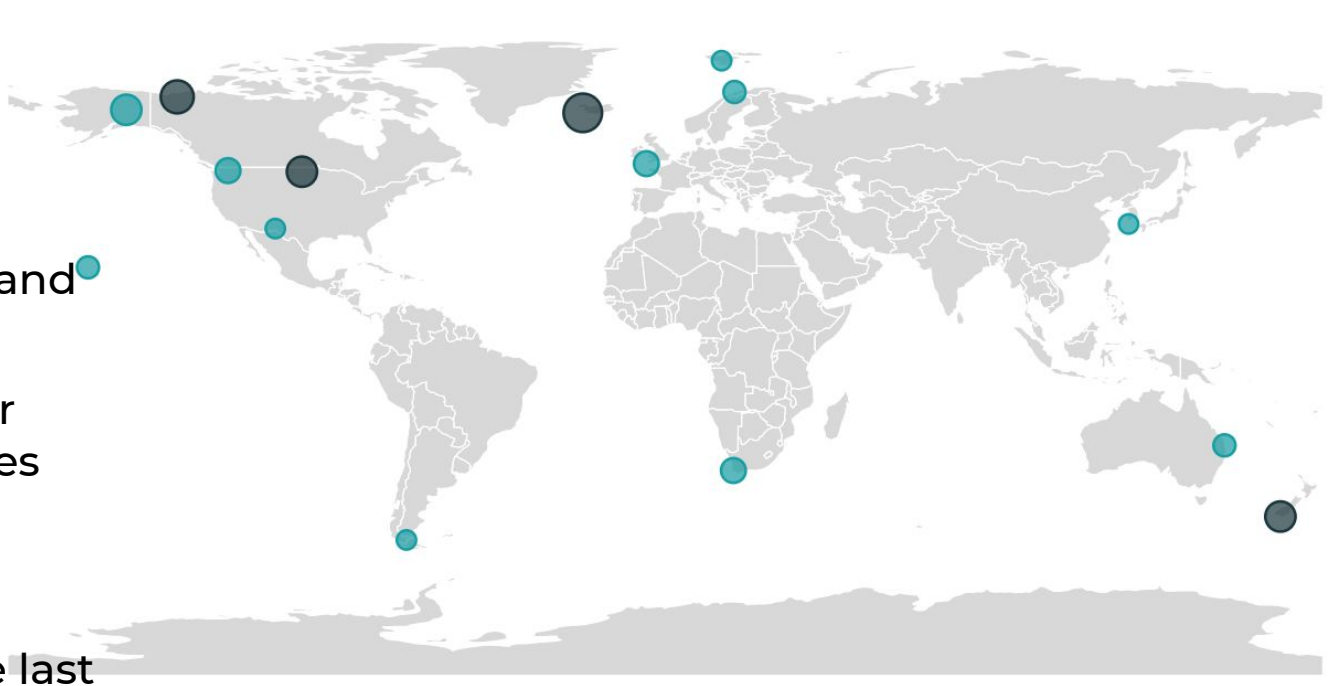
Models to measure & predict

The “Big Picture”



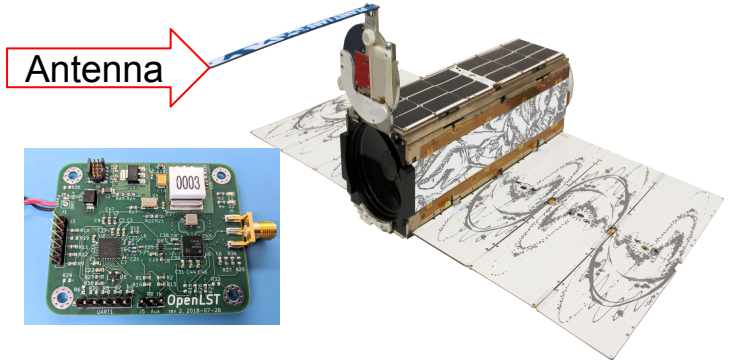
Planet's Global Ground Station Network

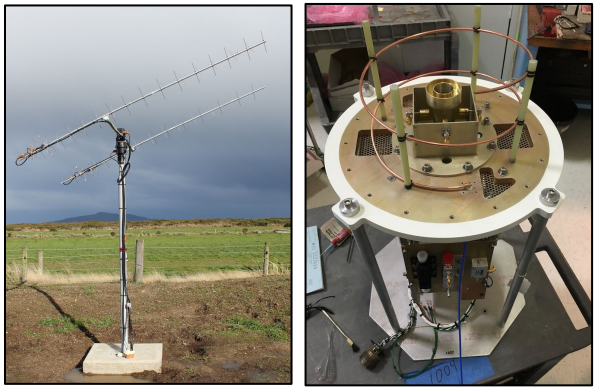
- 16 sites with 46 antennas
- TT&C used for telemetry, tasking, and command
- High speed used for downlinking pictures
- 95% uptime, fully autonomous
- >4 PB of data in the last 5 years



OpenLST: Low Speed Transceiver (LST)

- LST is used for TT&C and ranging
- Successfully flown on over 400 satellites with hundreds of cumulative years of on-orbit operation
- Operates at UHF band at 3600 bps
- 1000s of daily contacts with satellites
- OpenLST is an open, proven radio design for communicating with remote instruments or satellites using low-cost commercial components

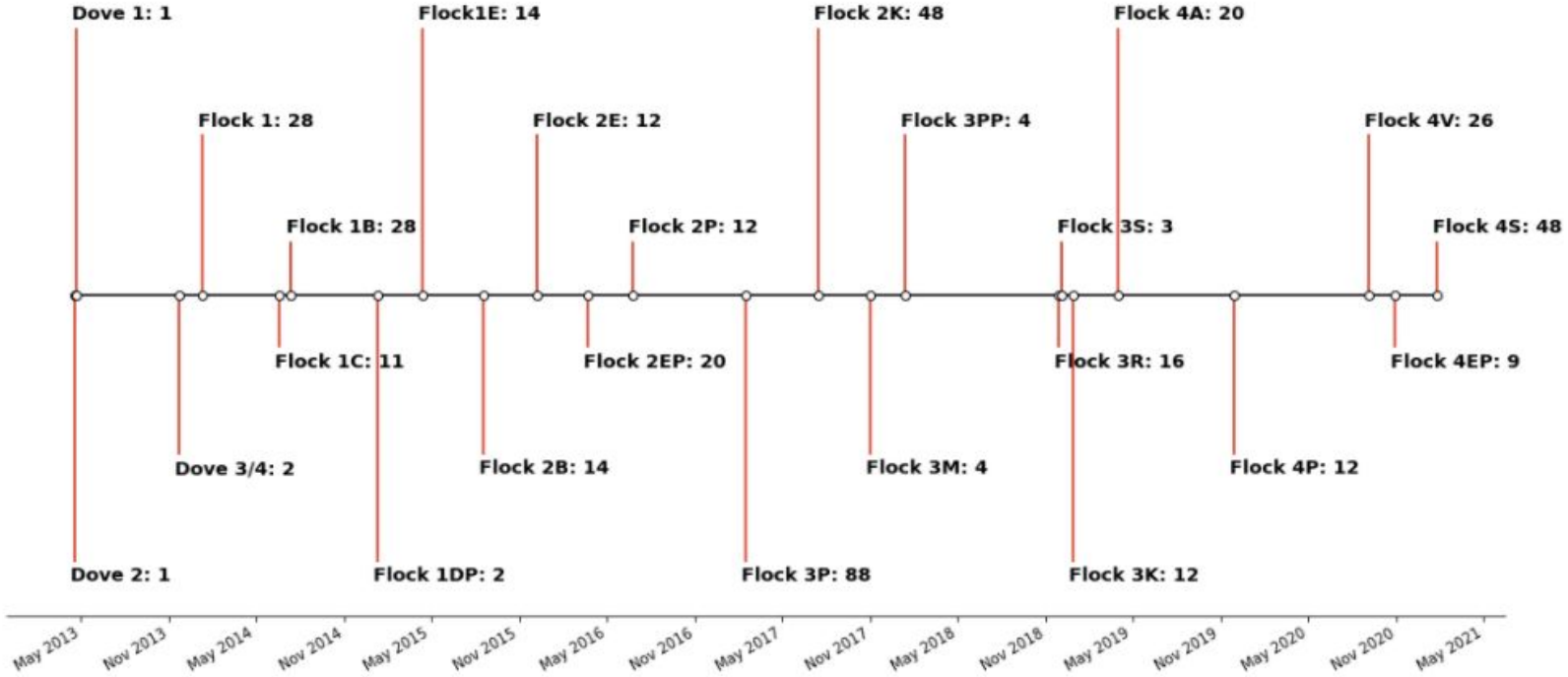




35 ground antennas

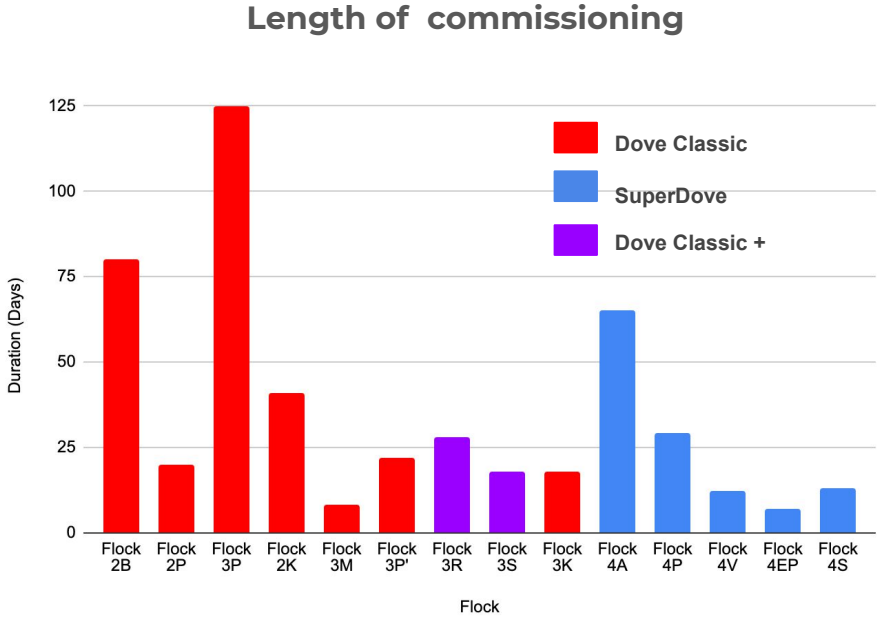
https://github.com/OpenLST/openlst

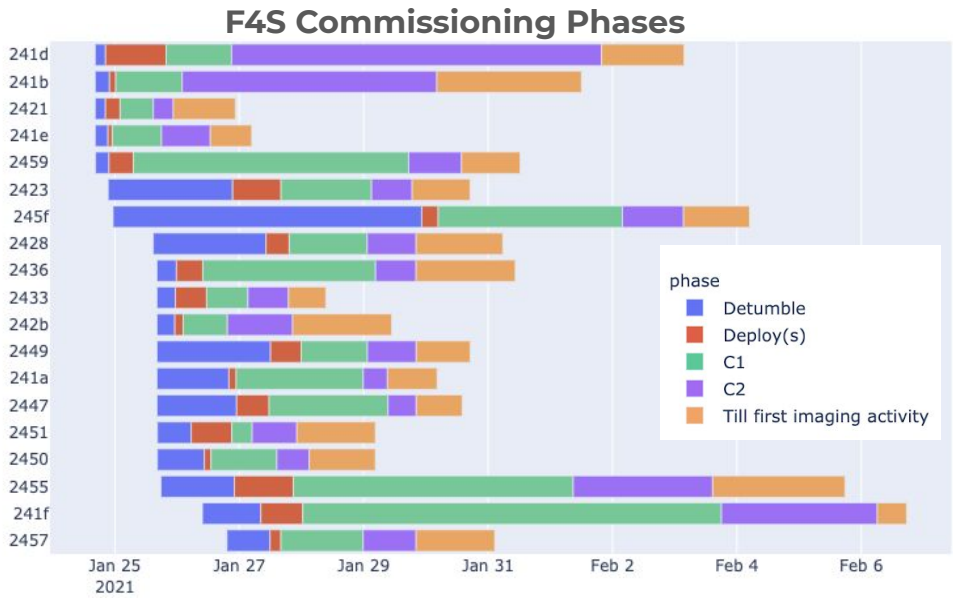
Planet Successful Dove Launch Timeline



Total # of Doves Successfully Launched: **436**
Number of Successfully Launched SuperDoves (B14): **121**

Frequent LST contacts + automated commissioning

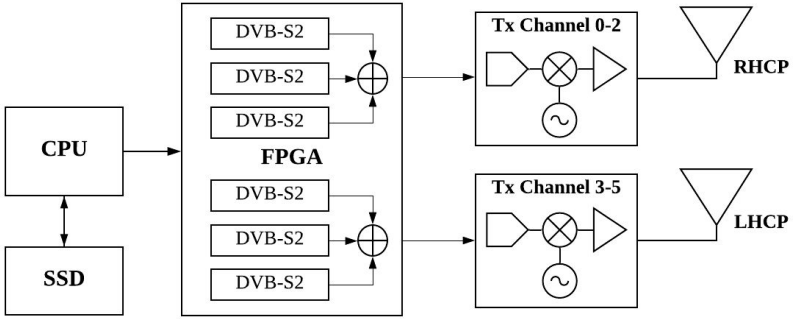




Max time to first contact: < 30 mins
Length of commissioning for the latest 48 satellites = **13 days**
(first launch - last batch satellite first image)

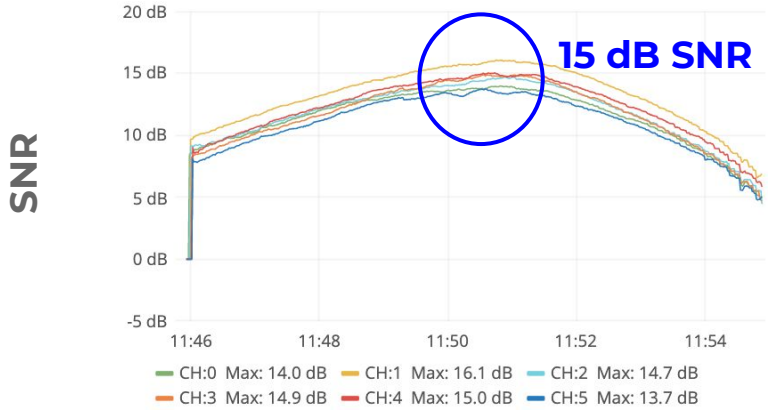
High Speed Downlink (HSD2)

- Image downlink at X-band
- DVB-S2 with adaptive modulation and coding to optimize downlink
- Compact, low power (0.25U, 20W for frontend, 30W for FPGA/SSD)
- Dual circularly polarization
- Ground antennas ~5m
- 1.8 Gbps peak throughput and 500 GB downlinked per satellite per day!

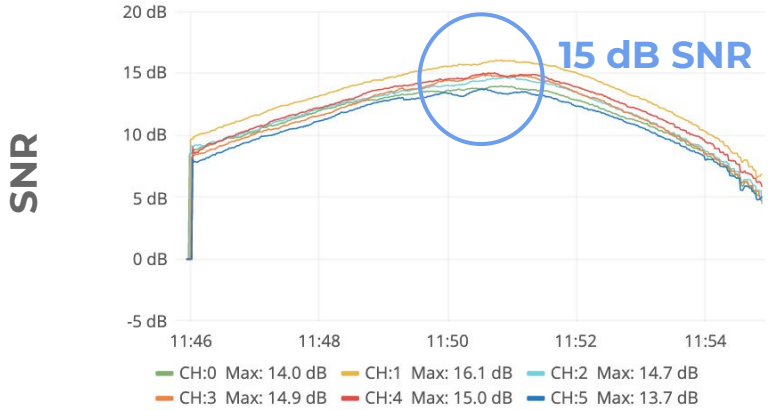


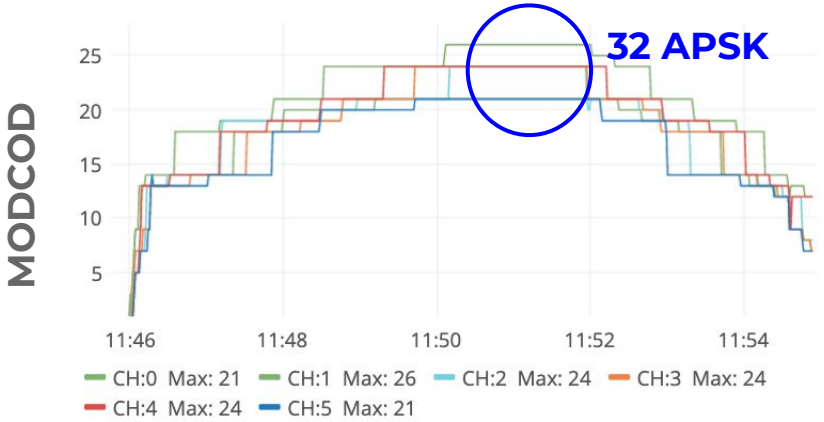
Ground Antenna

The optimized system parameters maximize the radio throughput at all slant ranges

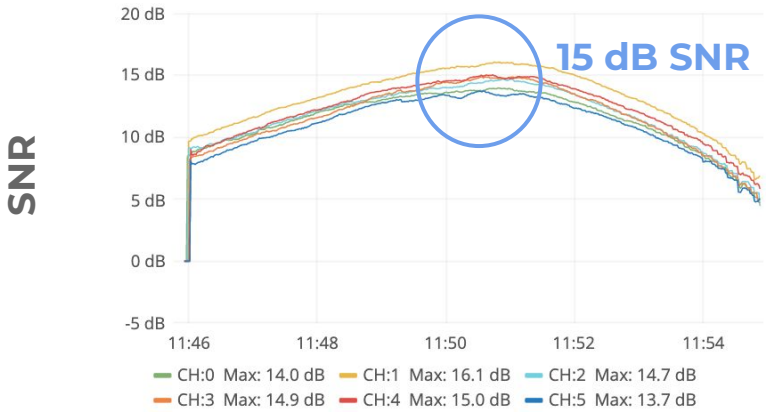


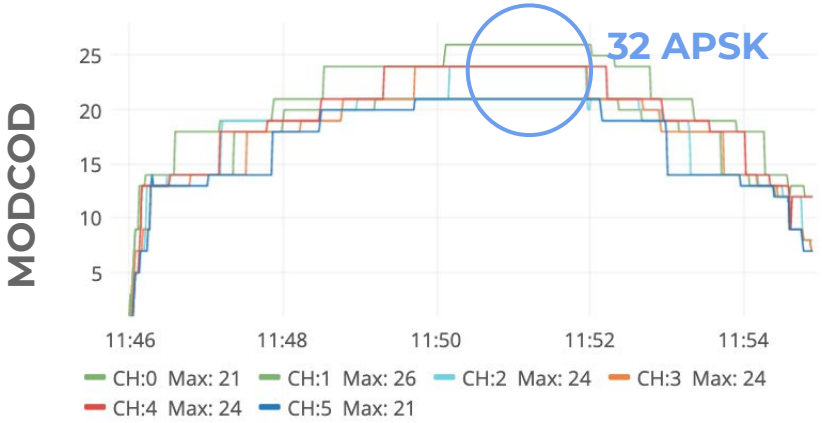
Adaptive coding and modulation dynamically adapts data rates on each channel based on link conditions

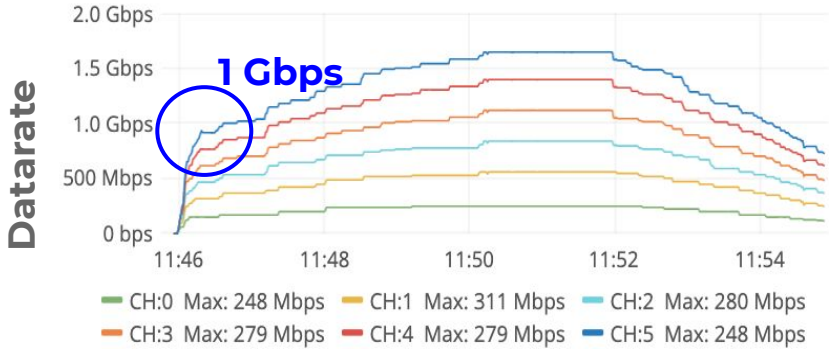




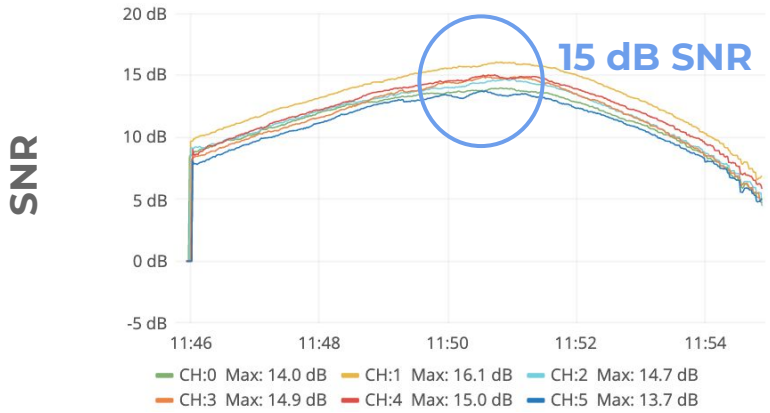
Typical ground station passes achieve >1.3 Gbps average rates and download >65 GB

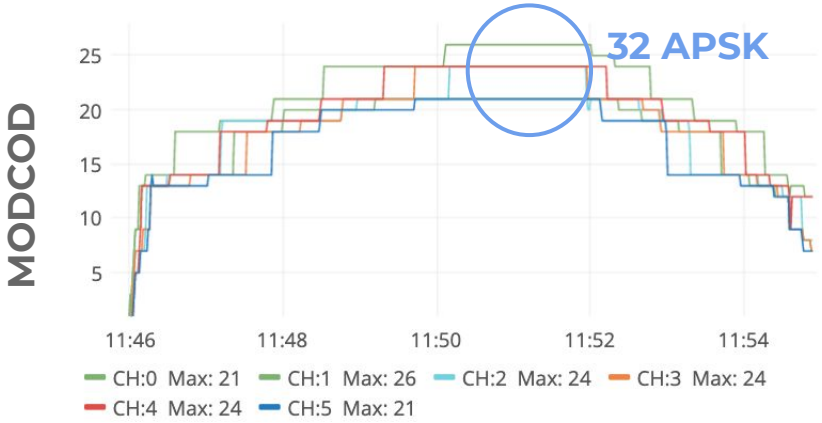


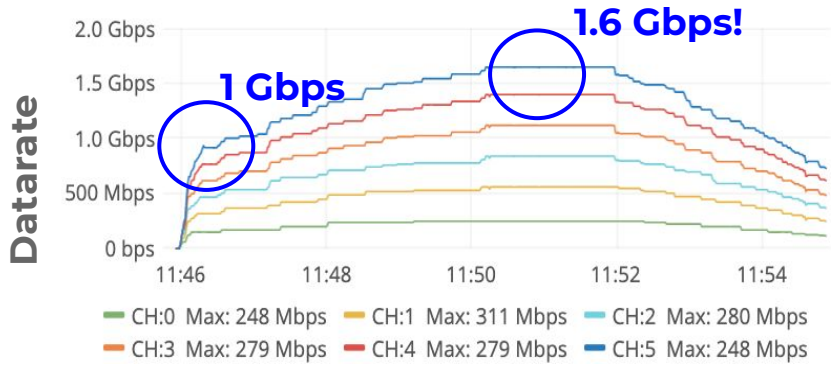




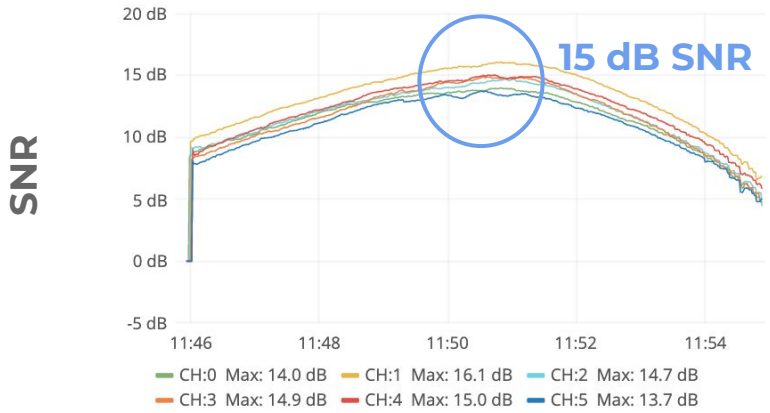
Typical ground station passes achieve >1.3 Gbps average rates and download >65 GB

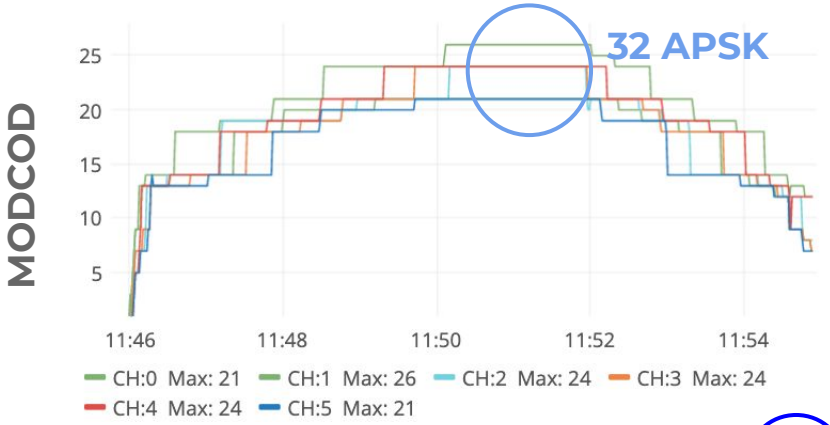


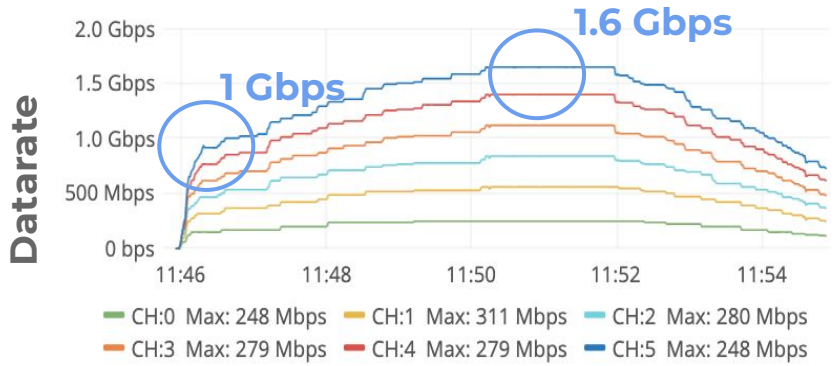


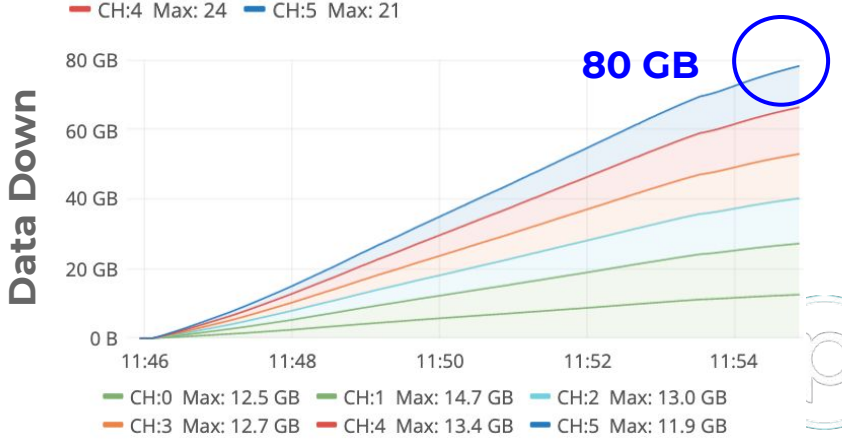


Typical ground station passes achieve >1.4 Gbps average rates and download >65 GB

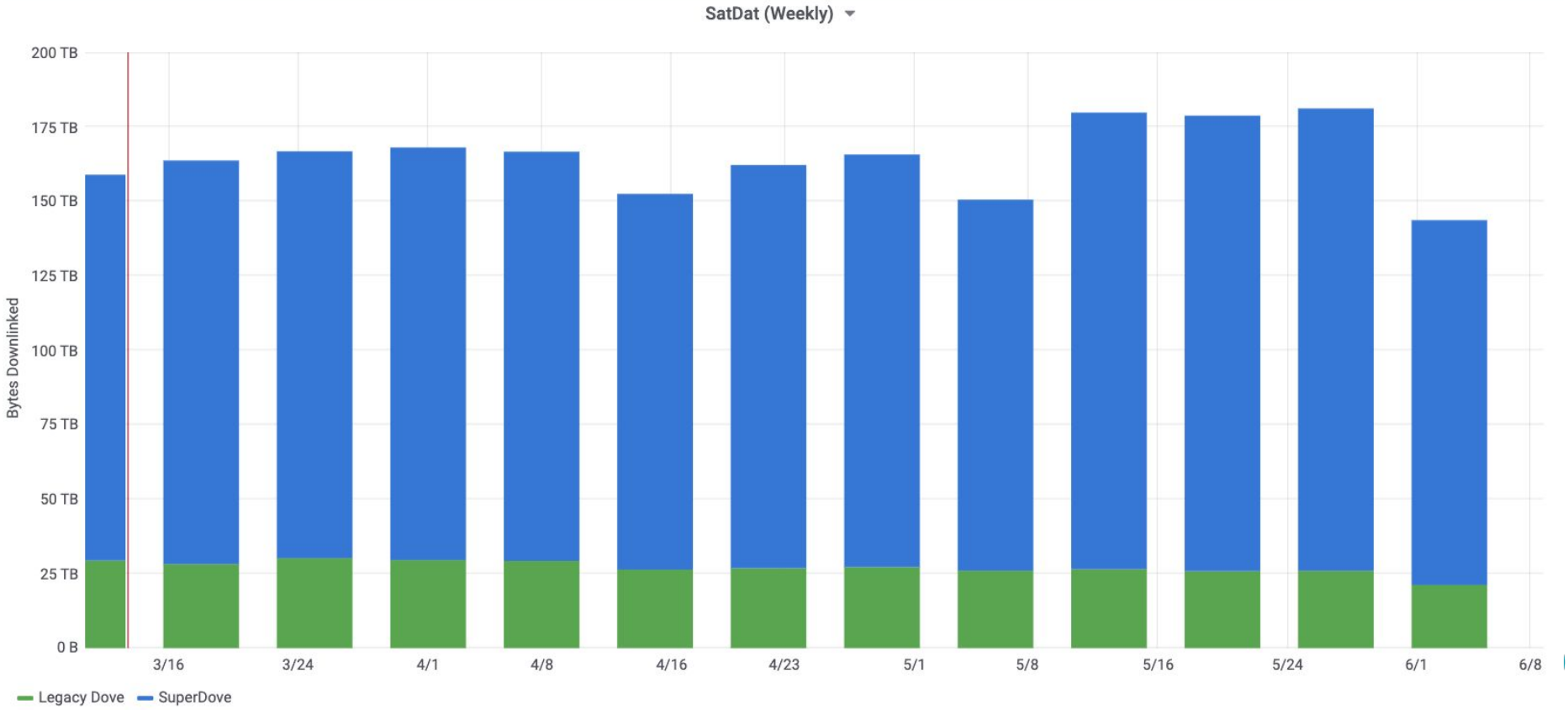




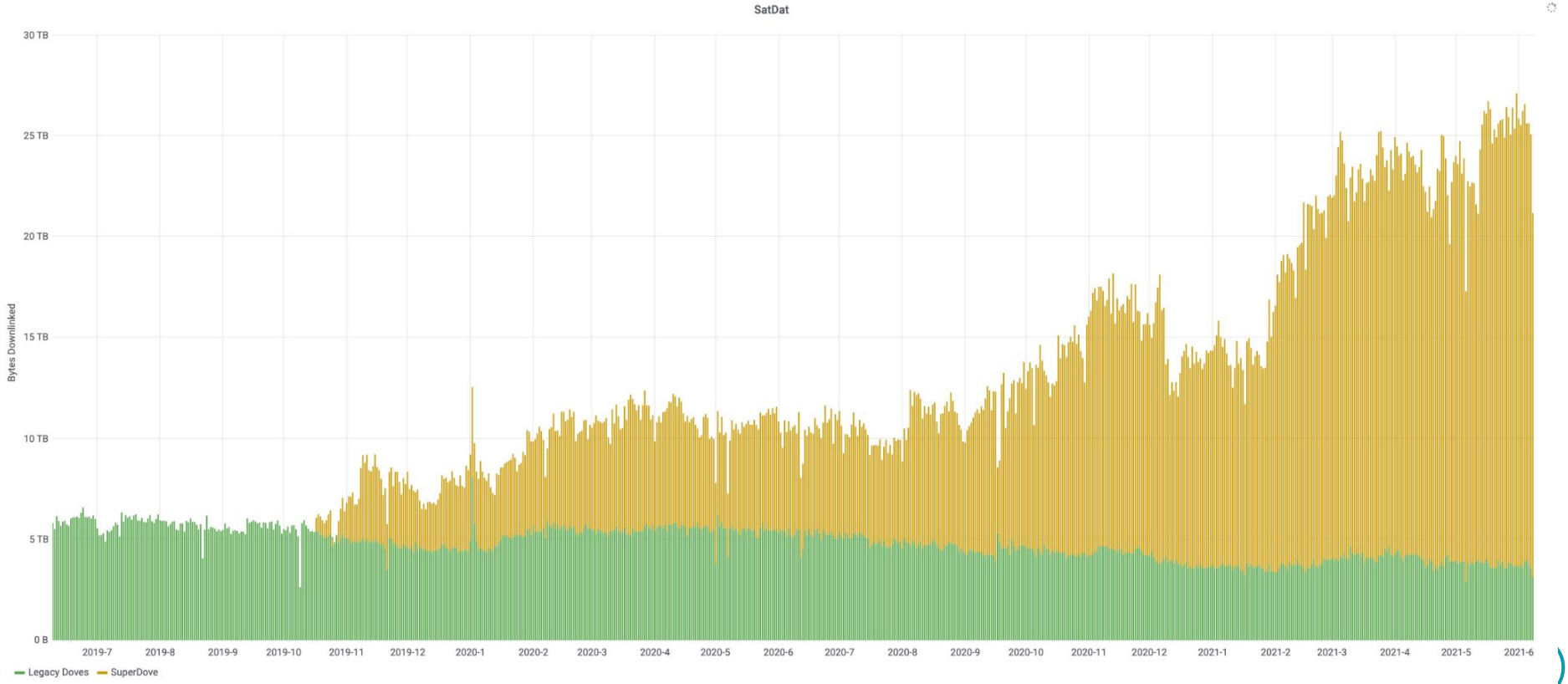




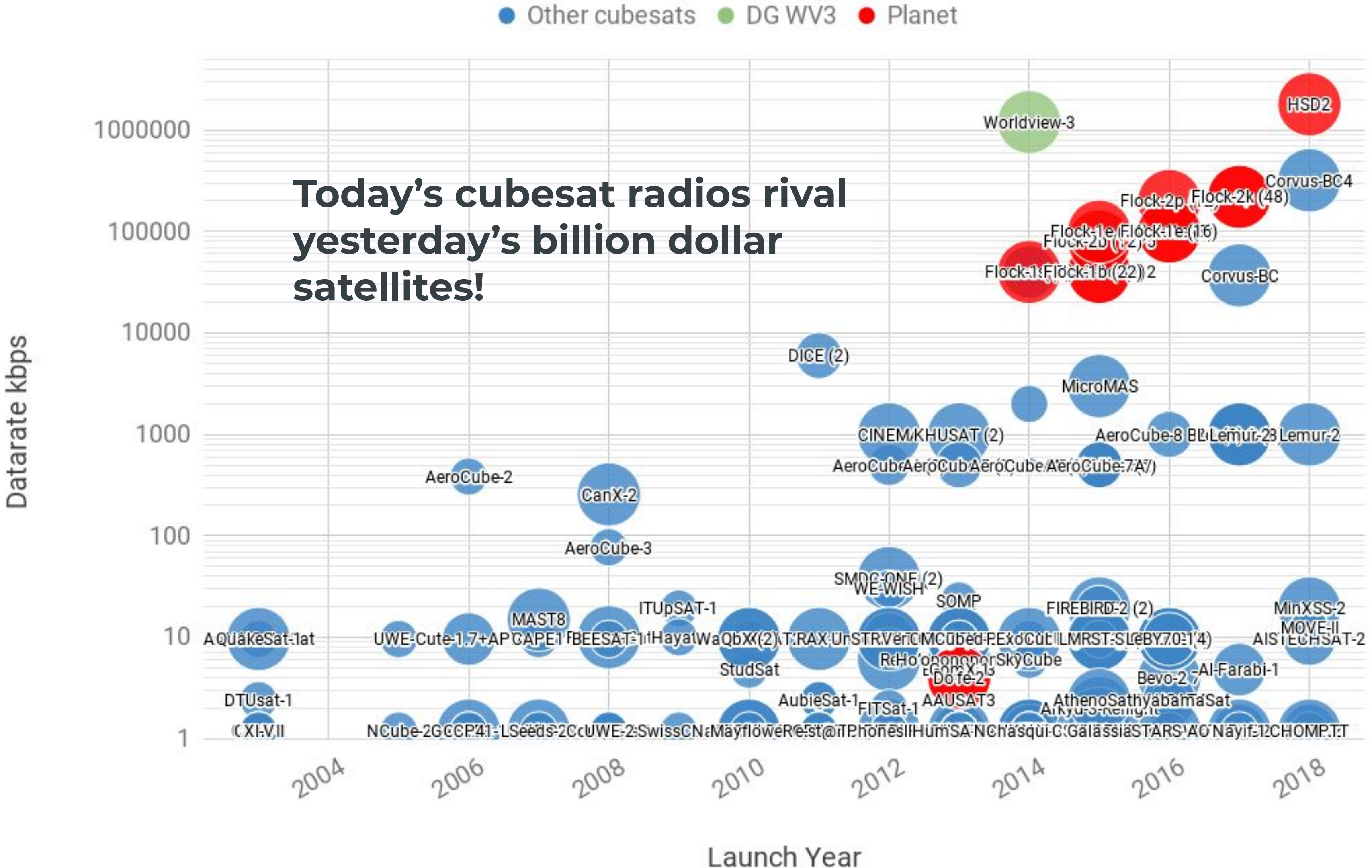
Planet Doves Downlink ~175 TB of Images Weekly!



Planet Doves Downlink 25+TB of Images Weekly!



Today’s cubesat radios rival yesterday’s billion dollar satellites!



EO Communication Needs Bottomline!

- Reliability
- Automation
- Agility
- Frequent Access
- High Throughput!