Launching Large Constellations

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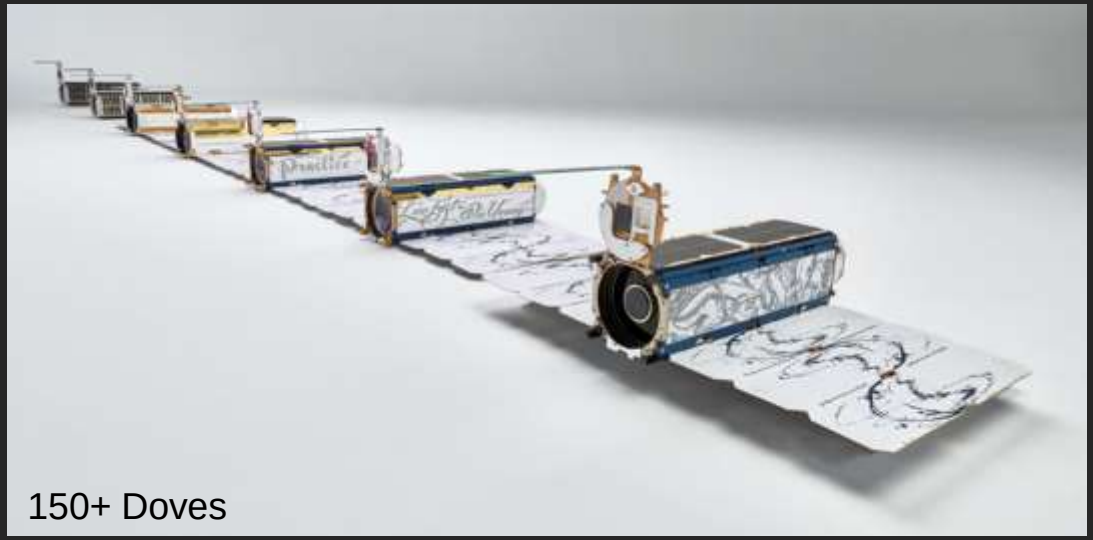
Dongtaijinai'er Salt Lake, China MAY 3, 2016

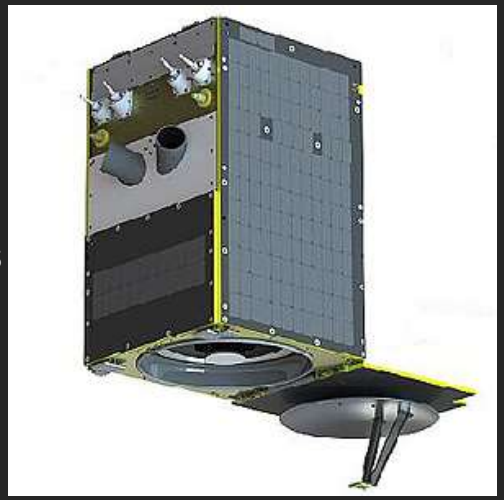
OUR SATELLITES

5 x RapidEye evolved SSTL-100



150+ Doves

7+ Skysats




SUGAR CANE
HARVESTING
RIO GRANDE
JANUARY 18, 2016


SUGAR CANE
HARVESTING
RIO GRANDE
MARCH 24, 2016


SYDNEY
MARCH 10, 2016
planet

LARGE CONSTELLATIONS

1. PLANET'S EXPERIENCE
2. MISSION & SYSTEM DESIGN
3. LAUNCH & BEGINNING OF LIFE
4. OPS & END OF LIFE

PLANET'S EXPERIENCE

(Aug 2017)

19 launches

17 successful

2 failures (Falcon 9, Antares)

8 different rocket families (+2 soon)

284 satellites deployed

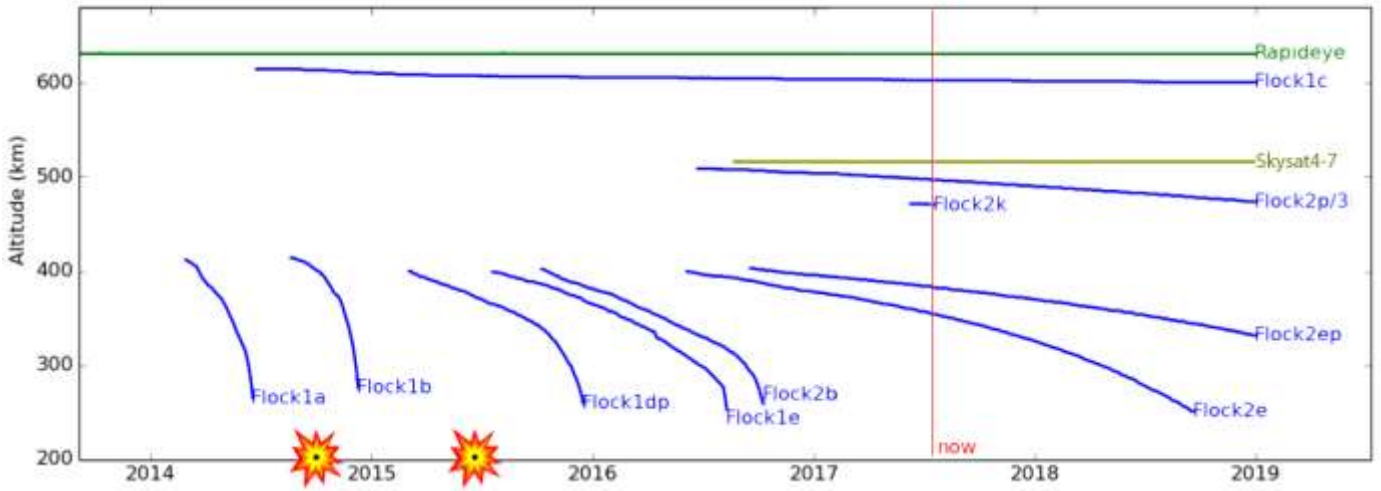
7 SkySats

5 RapidEyes

272 Doves

170 operational

SYSTEM & MISSION DESIGN



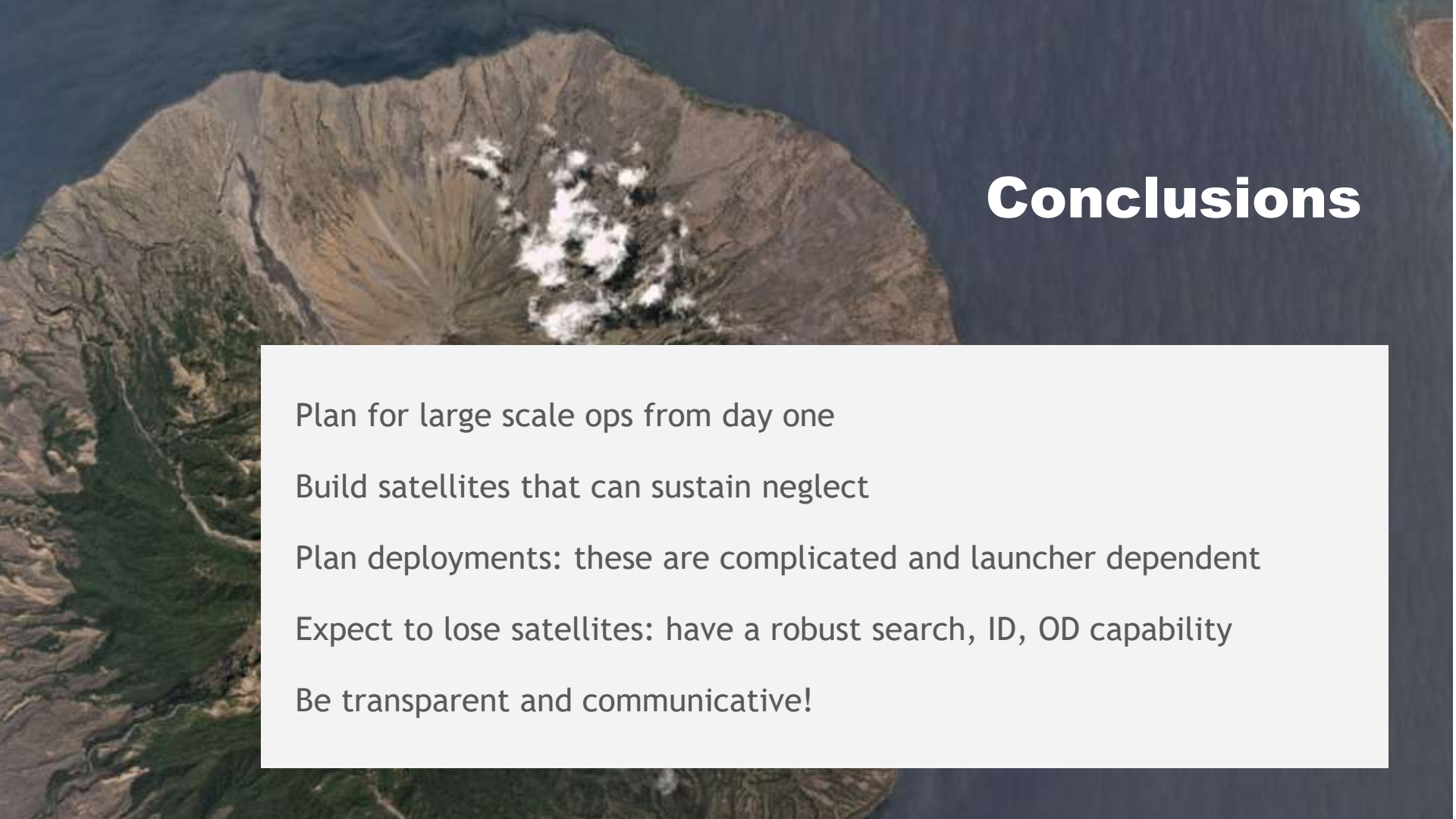
Launch as low as your mission allows	475-525 km is ideal altitude For Doves
Satellite robust to neglect	A long-term-stable safe mode
Reliable, simple comms system	30 deg beamwidth UHF, low power transceiver, broadcast option
Independent orbit determination	Time of flight ranging and GPS

LAUNCH & B.O.L.

Deployment strategy to reduce collision risk	Strive for maximum spread in along-track dV. ISS relatively easy for this.
Have good pre-launch orbit estimates	Triple check ephem formats and reference frames! Have a process for quick updates on launch day
Coordinate with other payload operators/JSpOC/LV operators	Know who is on your launch. Establish communications with them and talk as objects are sorted out. SSA sharing agreement with JSpOC
Have robust search strategies in place	Plane tracking mode
Plan for self-interference early on	Different RF channels Round robin comms

OPS & END OF LIFE

Maintain good ephemerides and make these available	Time of flight ranging, GPS Ephemeris made publicly available All ephemerides pushed to SDA
Minimize collision risks	Perform automated Probability of Collision assessments on all CDMs “Min interaction area” for high PoC collisions (> 1e-4) IN FUTURE: Integrate LeoLabs tracking data, differential drag avoidance maneuvers
Have a post mission disposal plan, and execute it	For Doves this is atmospheric reentry



Conclusions

Plan for large scale ops from day one

Build satellites that can sustain neglect

Plan deployments: these are complicated and launcher dependent

Expect to lose satellites: have a robust search, ID, OD capability

Be transparent and communicative!

PUBLIC EPHEMERIDES

http://ephemerides.planet-labs.com/

Updated hourly, and pushed to Space Data Association (SDA)

TEAM EMAIL

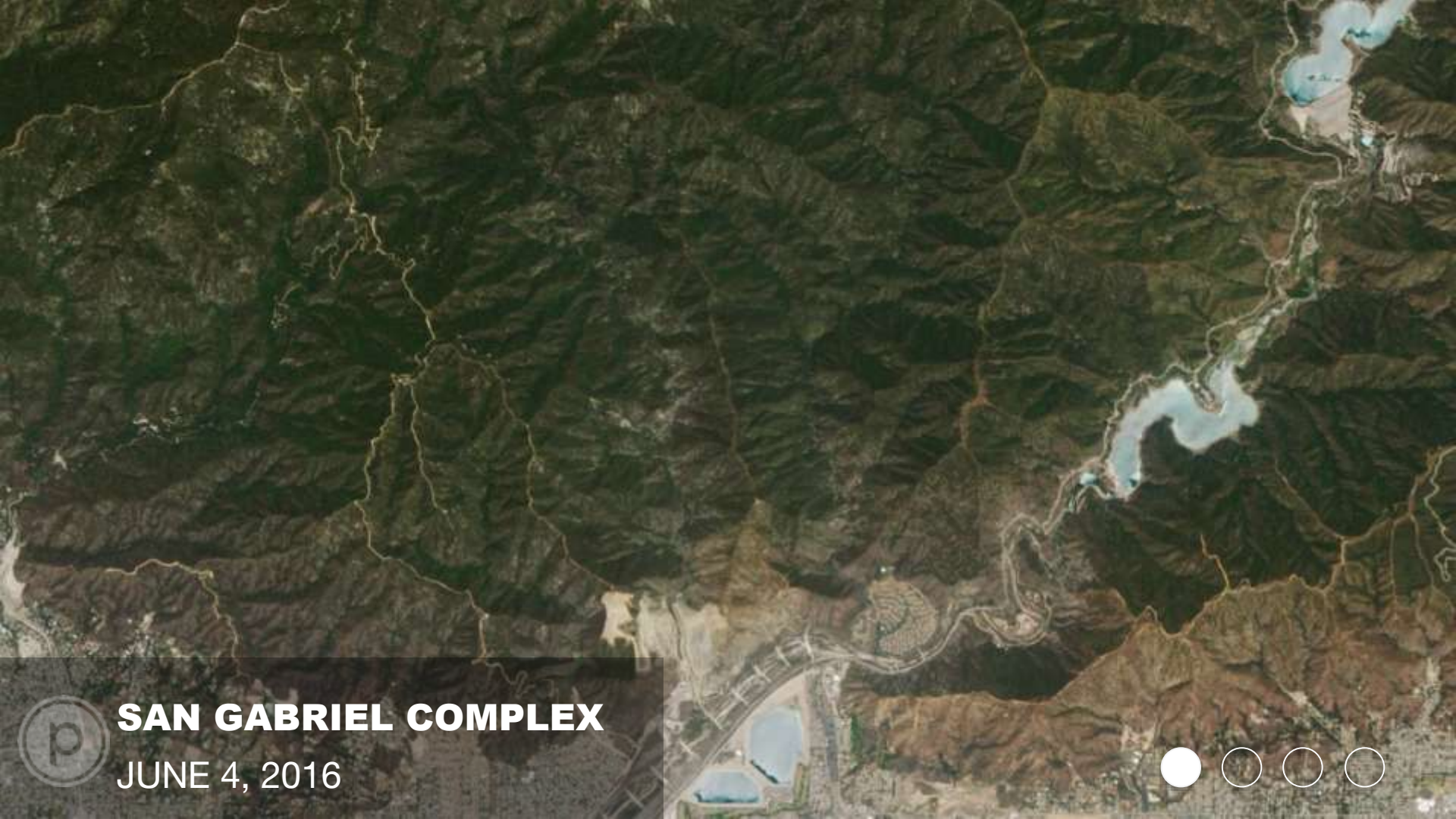
orbital-neighbors@planet.com


BONUS: PRETTY PICTURES

PULAU PINI, INDONESIA
UNDATED

PULAU PINI, INDONESIA

JUNE 22, 2015



SAN GABRIEL COMPLEX

JUNE 4, 2016

SAN GABRIEL COMPLEX

JUNE 22, 2016


SAN GABRIEL COMPLEX
JUNE 22, 2016


CUPERTINO, CA
JUNE 15, 2017
planet


VIRGIN ISLANDS
MAY 26, 2017
planet