“Platforms Designed for Big Data Provisioning with Small Satellite Constellations”

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Small Satellites  Big Data
FROM: Monolithic

- Cost Measured in Hundreds of Millions to Billions of Dollars
- Years to Build
- Extremely Complex
- Launch or Other Failures Catastrophic
To Minute:
SmallSats are Here to Stay
How Small is Small?

Image of an almost completely frozen Lake Superior taken by AeroCube-4, a 1U CubeSat.
How Small is Small?
Femtosatellites or “Sprites”

- Sprites are the newest iteration of smaller satellites.
- Designed to be disposable with a short life span.
SmallSats Enable:
Advanced Robotics
SmallSats Enable: Operationally Responsive Space

Enabling Operationally Responsive Space

Breaking Old Paradigms and Giving JFCCs the First Realistic Opportunity for Responsive, Dedicated Space Capabilities at the Operational and Tactical Level

Space Capabilities Delivered Directly to the Operational and Tactical Warfighter

Tactical Ground Station:
- Format and uplink tasking to spacecraft

Operational Theater

CONUS Mission Ops Center

SIPRNET

Warfighter:
- Send tasking to spacecraft
- Receive mission information

Spacecraft:
- Collect and process mission data
- Downlink data & geolocation product
- High-speed & narrow-band downlinks

ATK
Outernet's goal is to provide global free access to the internet through geostationary and Low Earth Orbit satellites.
SmallSats Enable: Business Model Disruption

Example: Black Sky

- Transitioning from an *imagery sales* business model to an *information-as-a-service* business model
- They deliver timely, relevant, and actionable information so you can make swift and informed decisions.

Observe

Analyze

Act
SmallSats Enable: Business Model Disruption

Past

Main Frame Computer

Present

Cloud Computing

Mobile Devices

High Performance Computing
SmallSats Enable: Democratization and Commoditization of Low Earth Orbit

Commercial Investment Growth
- 2016 - $990 million
to
- 2020 - $2.52 billion

Outstripping the government's ability to lead this industry, the commercial world pushes the space proposition to commercial markets such as agriculture, finance and energy with Business Intelligence Products.
SmallSats Enable: Big Data Analytics for Multi-Source, Persistent Observations

Imagery & Data  
Model or Algorithm  
Geospatial Visualization

Streaming Data from Space – Persistent Coverage – Big Data Analytics – Analysis-as-a-Service – Knowledge and Answers!
Provides the Global Scale Platform for Multi-Satellite Data Fusion for Business Intelligence Products
Team of 40 (16 PhDs)
$8.3m in VC investment
Los Alamos National Laboratory Founding Team (license granted in 2014)
7 Years and $15M of US Government funding at LANL
Decades of experience in machine learning, remote sensing, large-scale computing
Full coverage: in space…

LANDSAT 8 30m/pixel
SENTINEL 2 RedEdge/NIR 10m/pixel

- 1.8 trillion pixels per band (RE1, RE2, RE3)
- Built from 22 trillion pixels per band captured from 2015 to 2016 (120 TB)
... and modality

- 680 billion pixels
- Built from synthetic aperture radar (SAR) range/azimuth measurements captured from 2014 to 2017 (86 TB)

SENTINEL 1 SAR 20m/pixel
...and through time

MODIS 2000-2015  526,694,400 pixels/frame
Current satellite constellations

**MODIS**
Daily
250m-1000m/pixel
RGB, NIR/SWIR, Thermal

**Landsat**
Weekly
30m/pixel
RGB, NIR/SWIR, Thermal

**Sentinel-1, 2, 3**
Weekly
10-60m/pixel
S1: SAR
S2,3: RGB, NIR/SWIR

**Planet RapidEye**
Monthly
5m/pixel
RGB, NIR

**PlanetScope**
3m/pixel
RGB, NIR

**NAIP**
Annually
1m/pixel
RGB, NIR
5 Petabytes over a Multi-decade archive of analysis-ready images, co-registered to be self consistent

- Co-register images for accurate alignment
- Convert to standardized map projections
- Remove clouds and correct for shadows
- Adjust for camera angle and sun angle
- Calibrate sensors against self and neighbors
- Compensate for atmospheric degradations
Platform Interface – Search and Raster
Platform Output – Analysis Ready Data

Meta-data

Raster values
Analytical Roadmap for object identification, change detection and pattern of life prediction
ML search and analysis:
Enabling Data Fusion for Primary Intelligence
Thank You! FOLLOW US!

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