SpaceTech

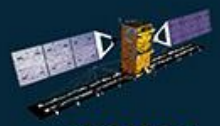
SpaceTech

- 위성
- 발사체
- 관제

- 지구측정
- 우주탐사
- 데이타활용
- 다양한 응용
- 우주군대

HOW HEAVY IS A SATELLITE?

LARGE SATELLITE



RADARSAT-2

>1000 kg

RHINO

MEDIUM SATELLITE

CASSIOPE

500-1000 kg

BUFFALO

MINI SATELLITE

SCISAT

100-350 kg

LION

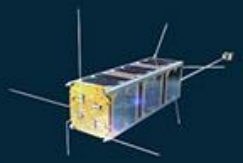
MICRO SATELLITE

M3MSat

10-100 kg

WOLF

NANO SATELLITE including CUBESAT



Ex-Alta 1

1-10 kg

RACCOON

1 kg per unit

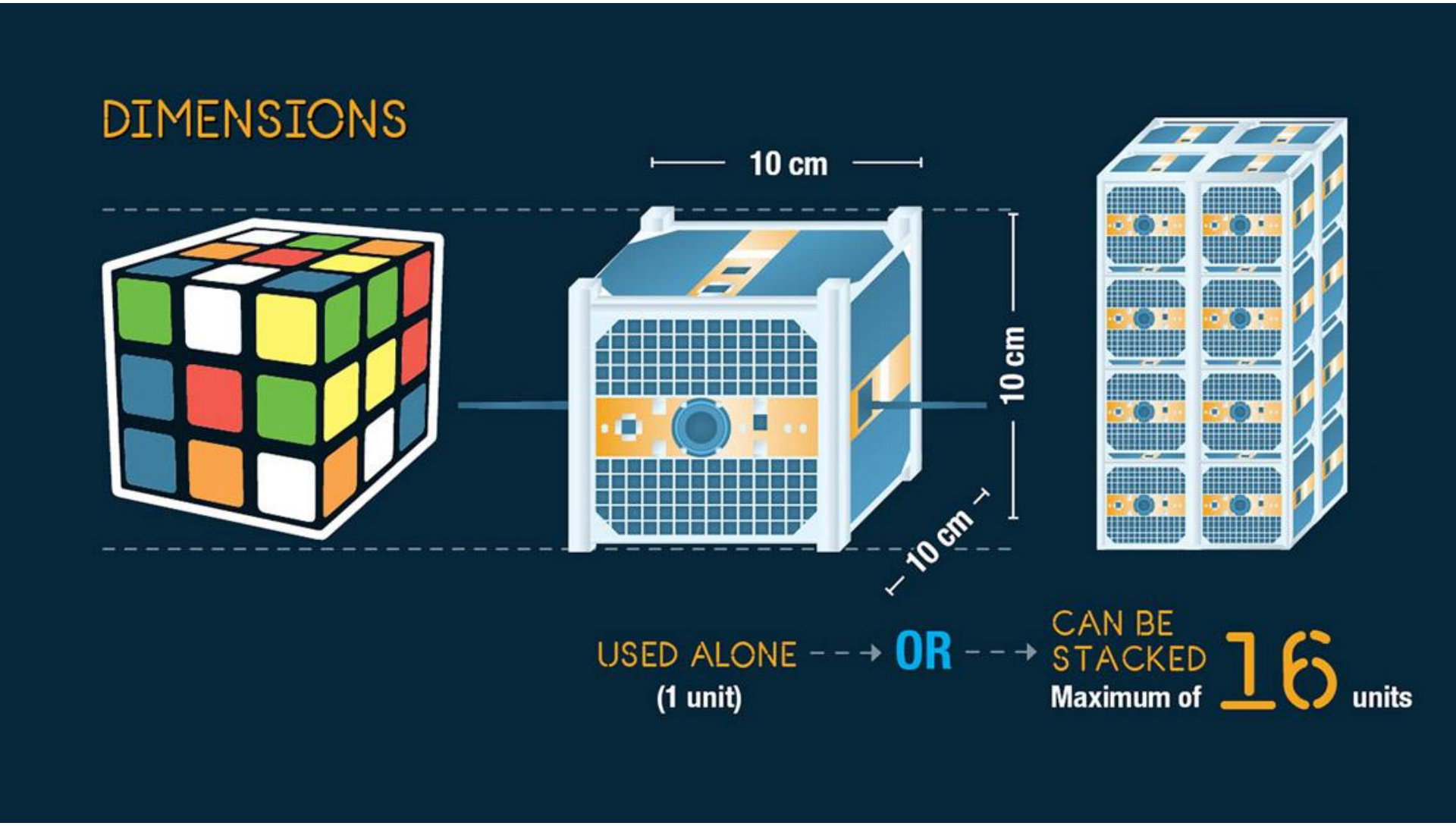
DUCK

Note: These weights are approximations.

Canadian Space Agency | Agence spatiale canadienne

Canada

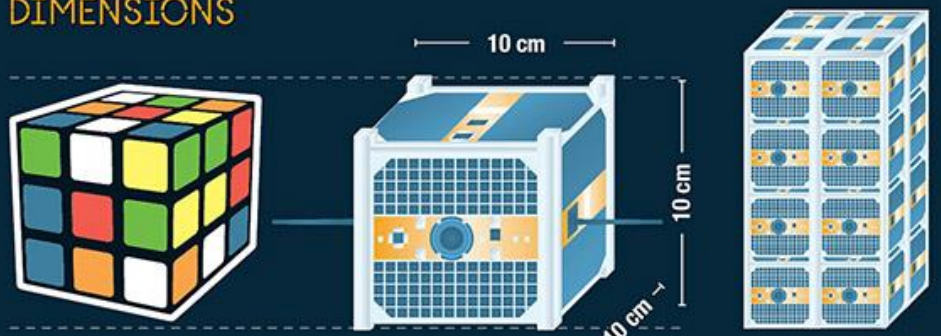
Cubesat


DIMENSIONS
10 cm
10 cm
10 cm
USED ALONE
(1 unit)
OR
CAN BE STACKED
Maximum of 16 units

CUBESAT IT'S HIP TO BE SQUARE!

A CUBESAT is a MINIATURE CUBE-SHAPED SATELLITE.

DIMENSIONS



USED ALONE (1 unit) → OR → CAN BE STACKED Maximum of 16 units

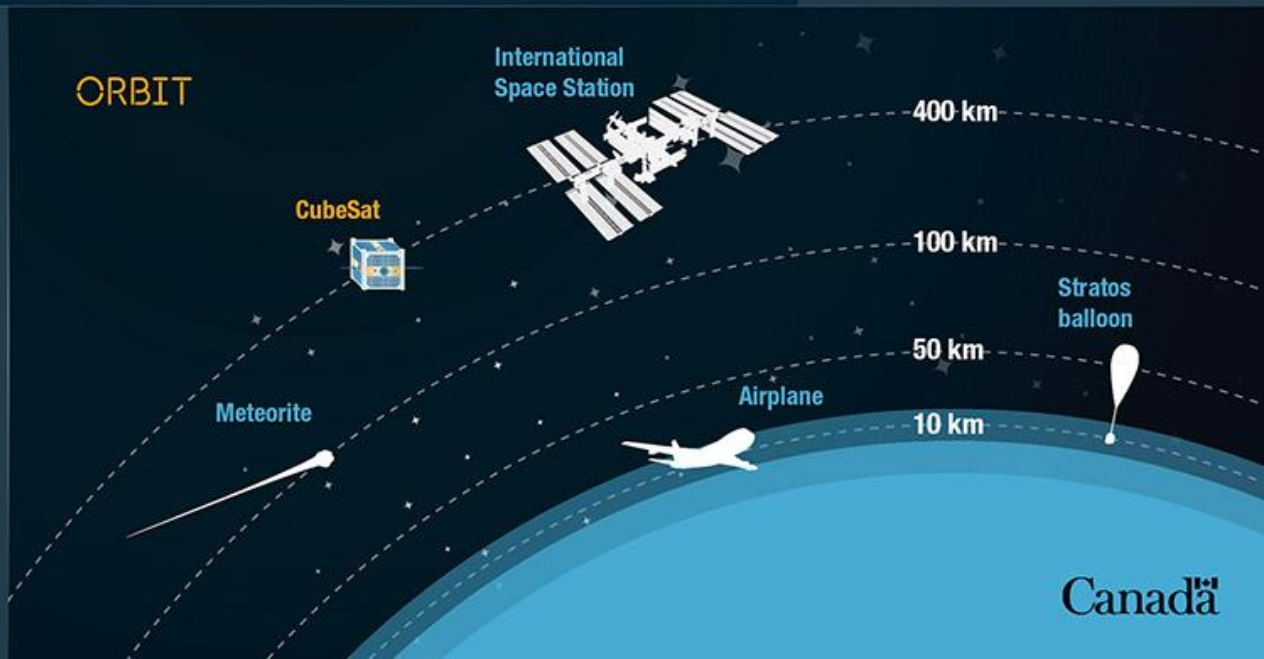
ADVANTAGES

- **BUILT RAPIDLY** (within 24 months)
- **SIMPLE TECHNOLOGY** purchased off-the-shelf
- **SIMPLE TO DESIGN**
- **NO SPACE DEBRIS** they burn up in the atmosphere upon reentry
- **LOW COST**

4 TYPES OF MISSIONS

- Technology demonstration
- Scientific research
- Educational project
- Commercial

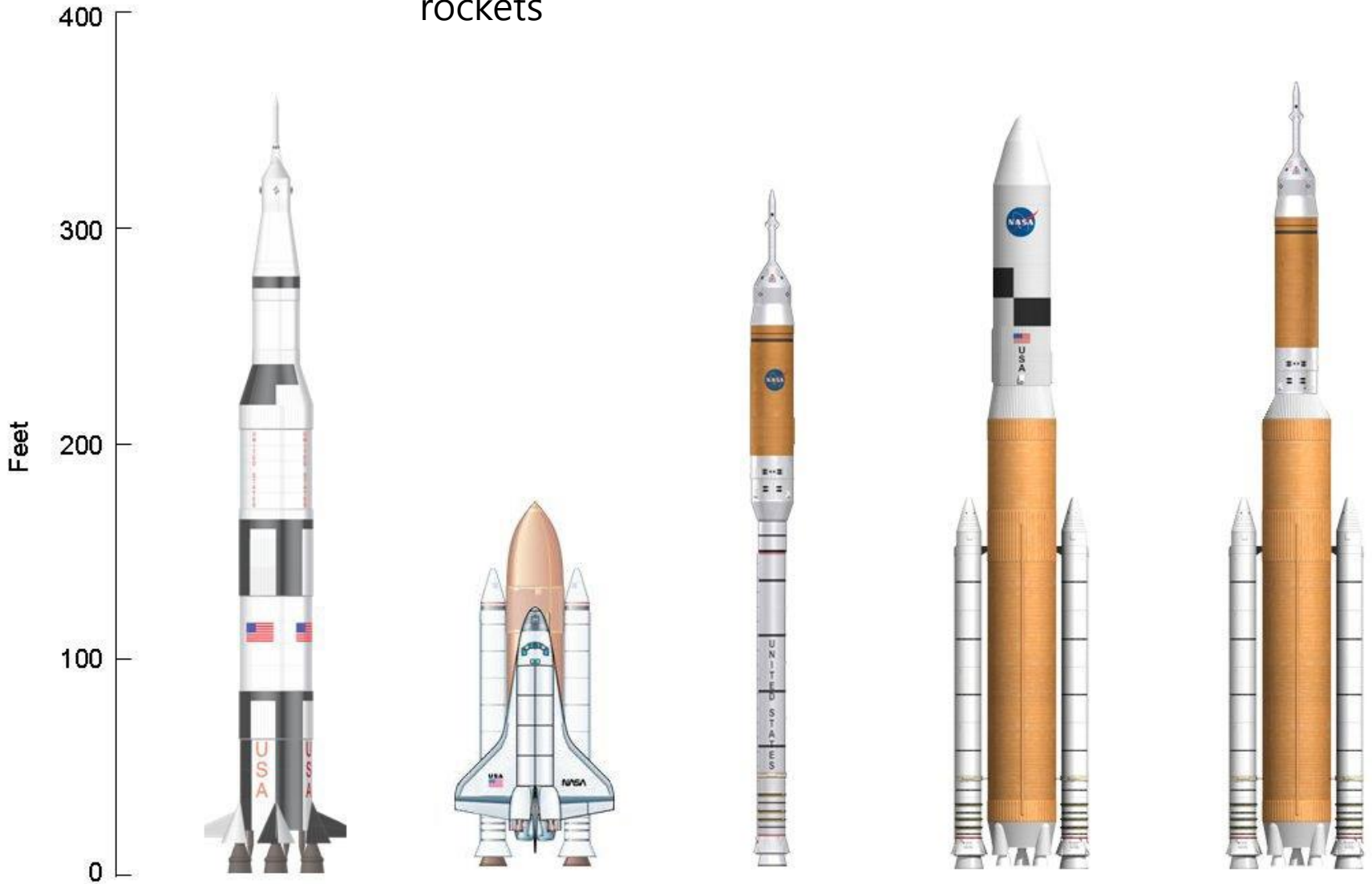
ORBIT

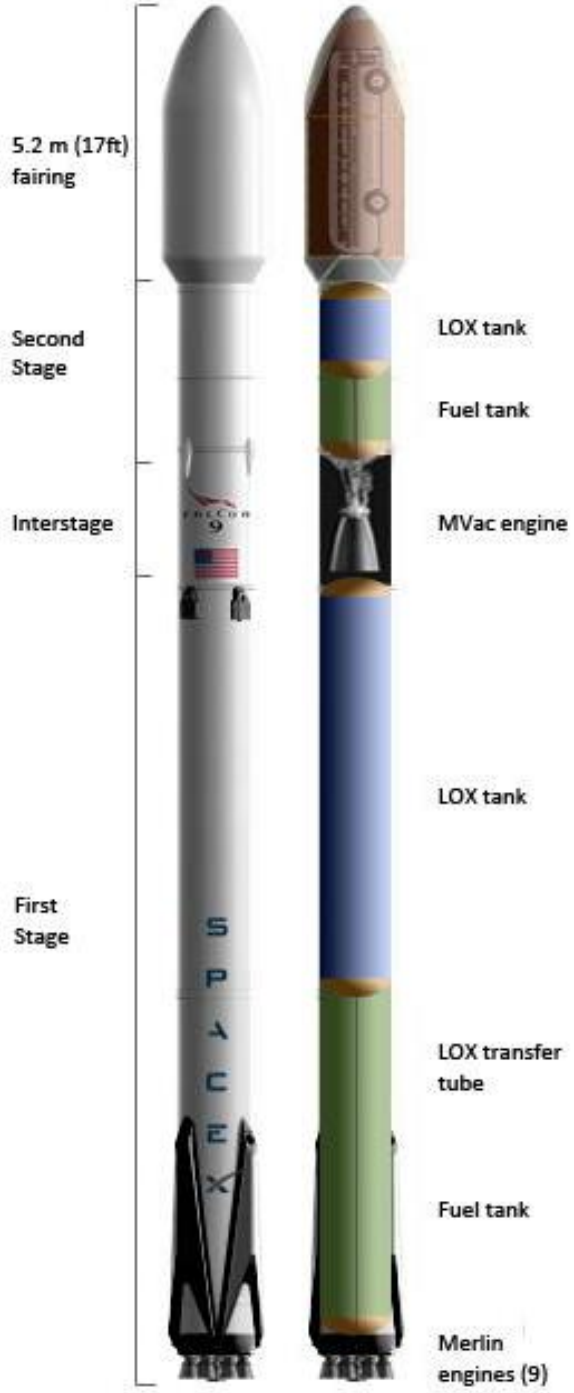


Canadian Space Agency | Agence spatiale canadienne

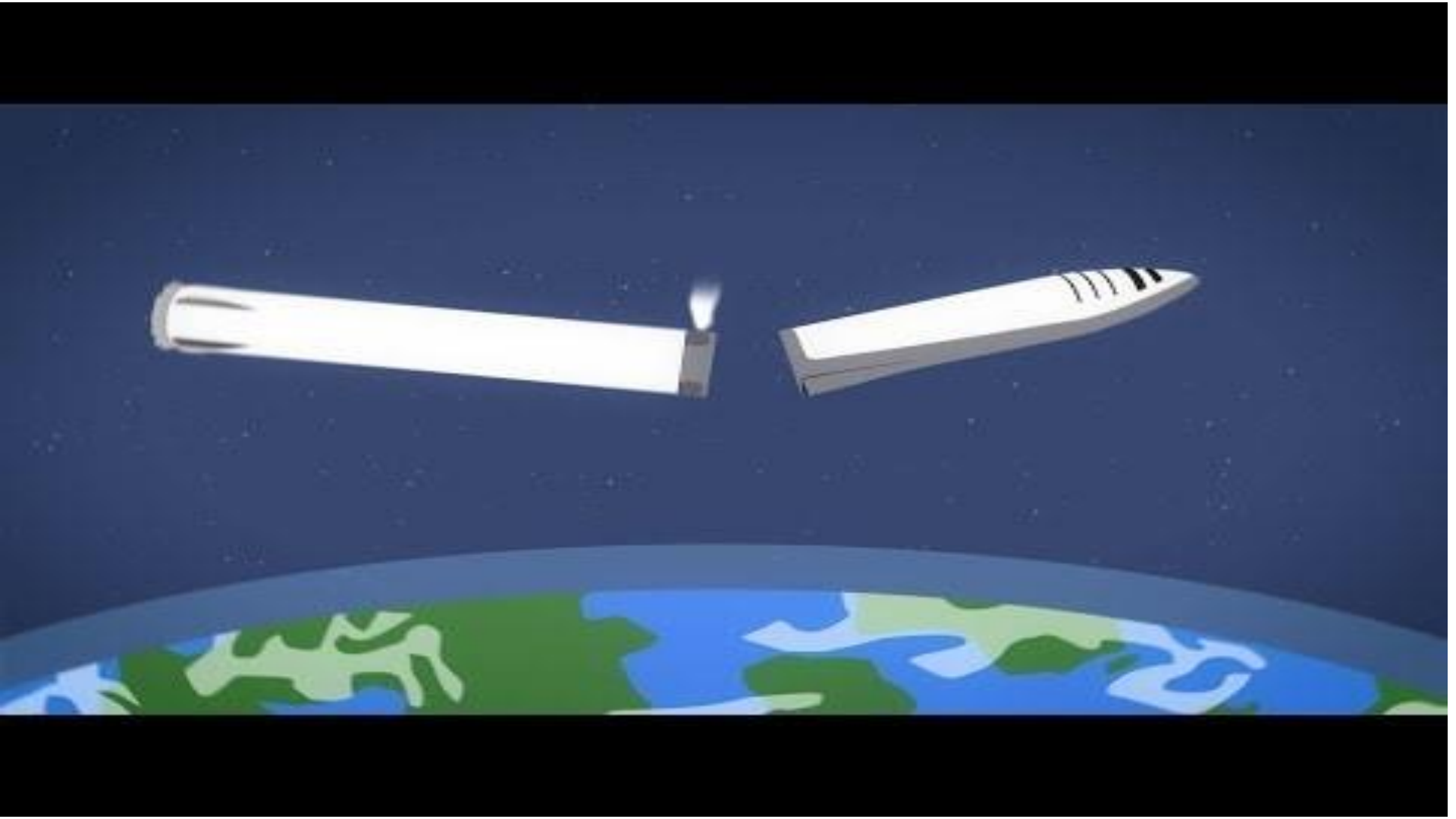
Canada

A Saturn V, Space Shuttle, and three Ares rockets




5.2 m (17ft) fairing
Second Stage
Interstage
First Stage
LOX tank
Fuel tank
MVac engine
LOX tank
LOX transfer tube
Fuel tank
Merlin engines (9)
SPACEX

Falcon 9

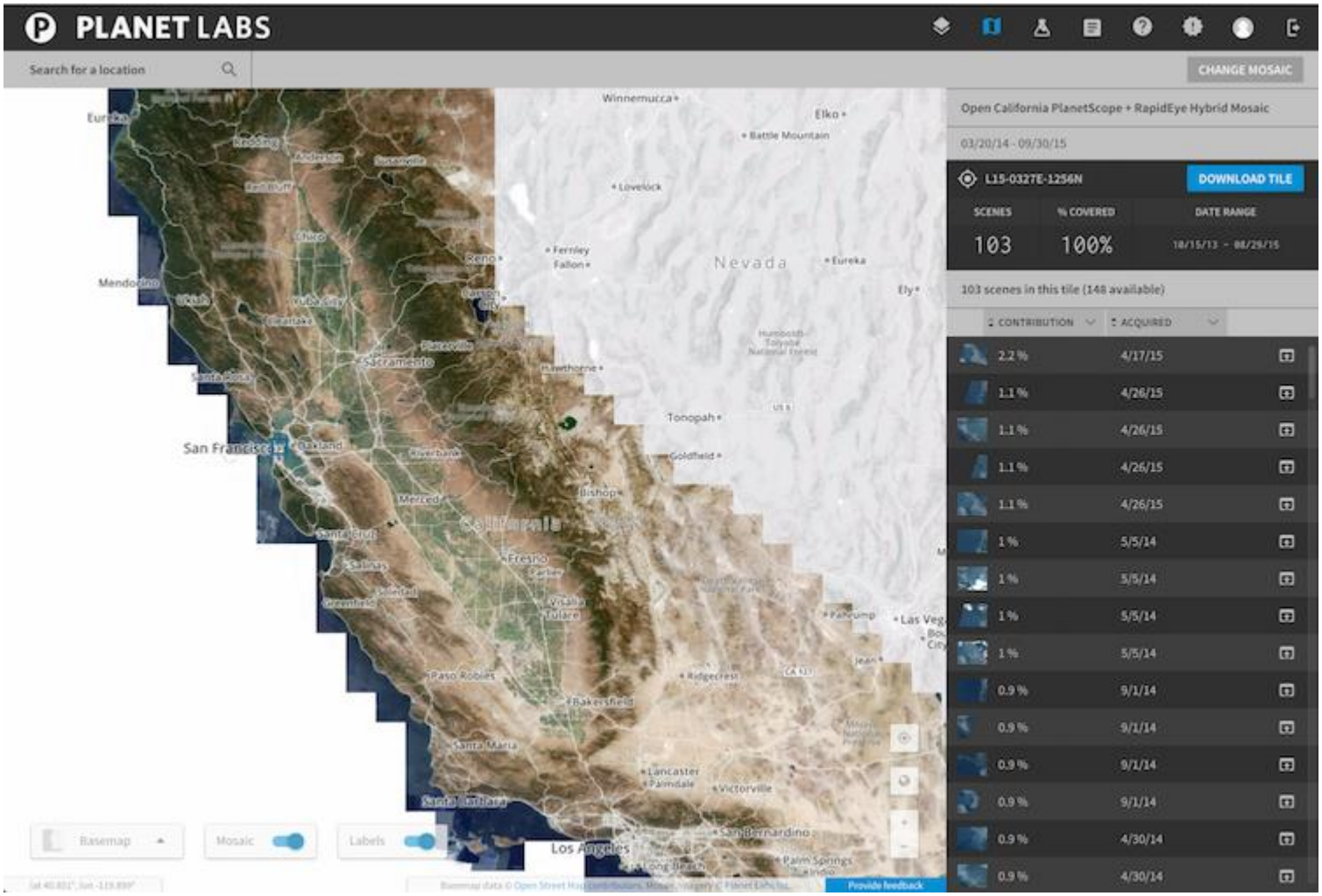



한국 로켓 개발의 역사
KSR-Ⅰ
1단/고체
6.7m
0.42m
1.25t
101km
8.8t
1993년
KSR-Ⅱ
2단/고체
11.1m
0.42m
2t
124km
30.4t
1998년
KSR-Ⅲ
1단/액체
14m
1m
6t
79.5km
13t
2002년
나로호
(KSLV-Ⅰ)
2단/액체(1단),
고체(2단)
33m
2.9m
140t
2750km(1단 기준)
170t(1단)/7t(2단)
2013년 1월30일
한국형발사체
(KSLV-Ⅱ)
3단/액체
47.5m
2.6m(3단), 2.9m(2단),
3.3m(1단)
200t
-
300t(1단)/75t(2단)/7t(3단)
2018~2021년 예정
KOREA
KSLV II
구분
로켓단/연료
길이
지름
무게
비행거리
추력
발사연도
〈자료:한국항공우주연구원〉

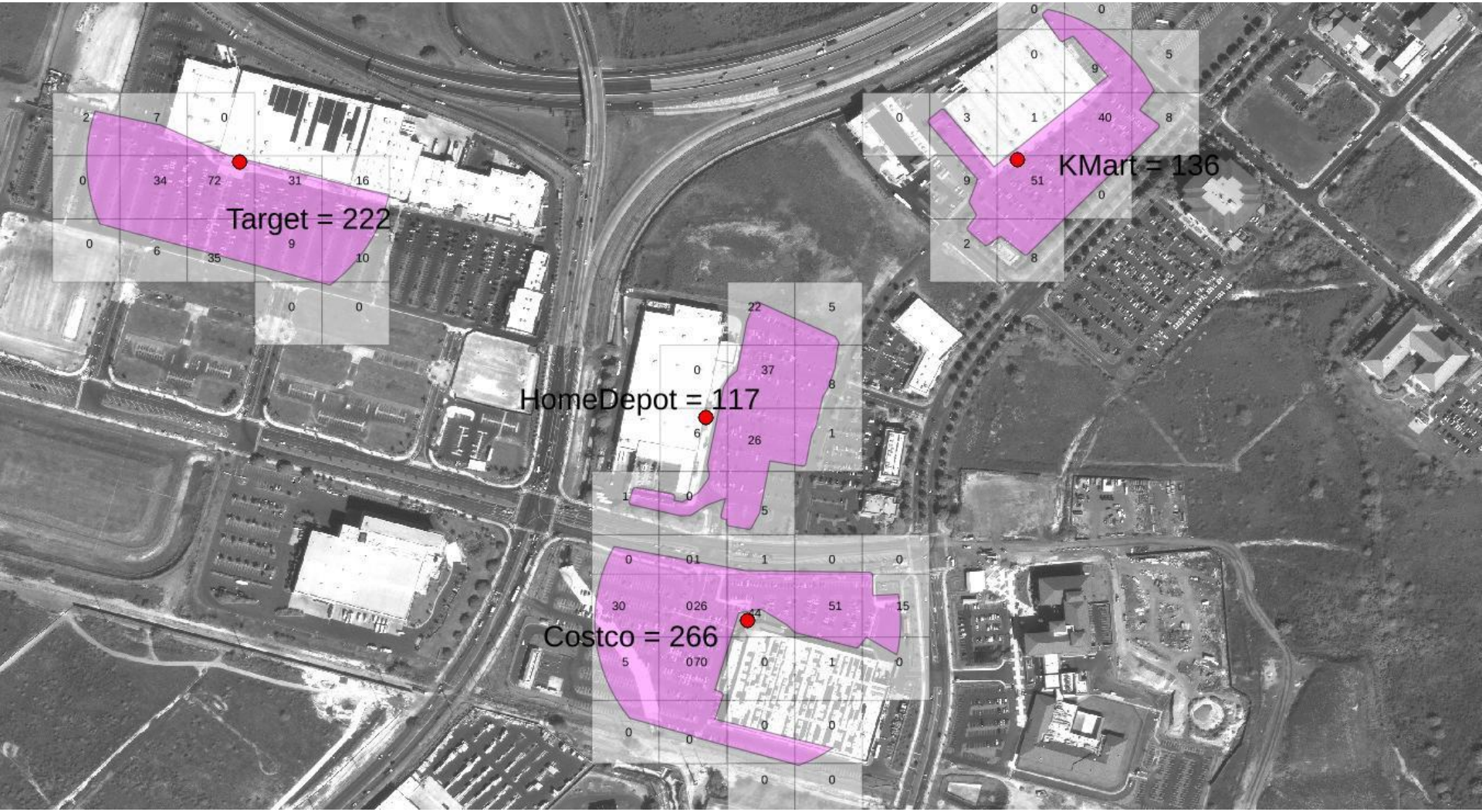

한국형발사체와 나로호 비교
나로호
한국형발사체(안)
2009년, 2010년 (3차발사 추진중)
발사 목표
2021년(예정)
5025억원
개발 예산
약 1조5449억원
2단형 (액체/고체)
발사체 구성
3단형(액체4기/ 액체/액체)
러시아 개발 (기술 자립도 50%)
엔진 기술
75톤급 액체엔진 개발(독자개발)
390명
전문인력
1000명
발사대 구축, 운용능력 확보
우주센터
발사대 확충, 시험설비 구축
러시아 위주
국제협력
협력 다변화
100kg
탑재위성 무게
1500kg
300km
위성 고도
600~800km
140t
총중량
200t
33.5m
총길이
약 50m
2.9m
직경
약 3m
나로호
대한민국
1.5t 실용위성
3단
5~10t 추력 액체엔진 1기
2단
75t 추력 액체엔진 1기
1단
75t 추력 액체엔진 4기

Earth Observation

Planet Labs, Terra Bella, Urthecast, Digital Globe, Astro Digital

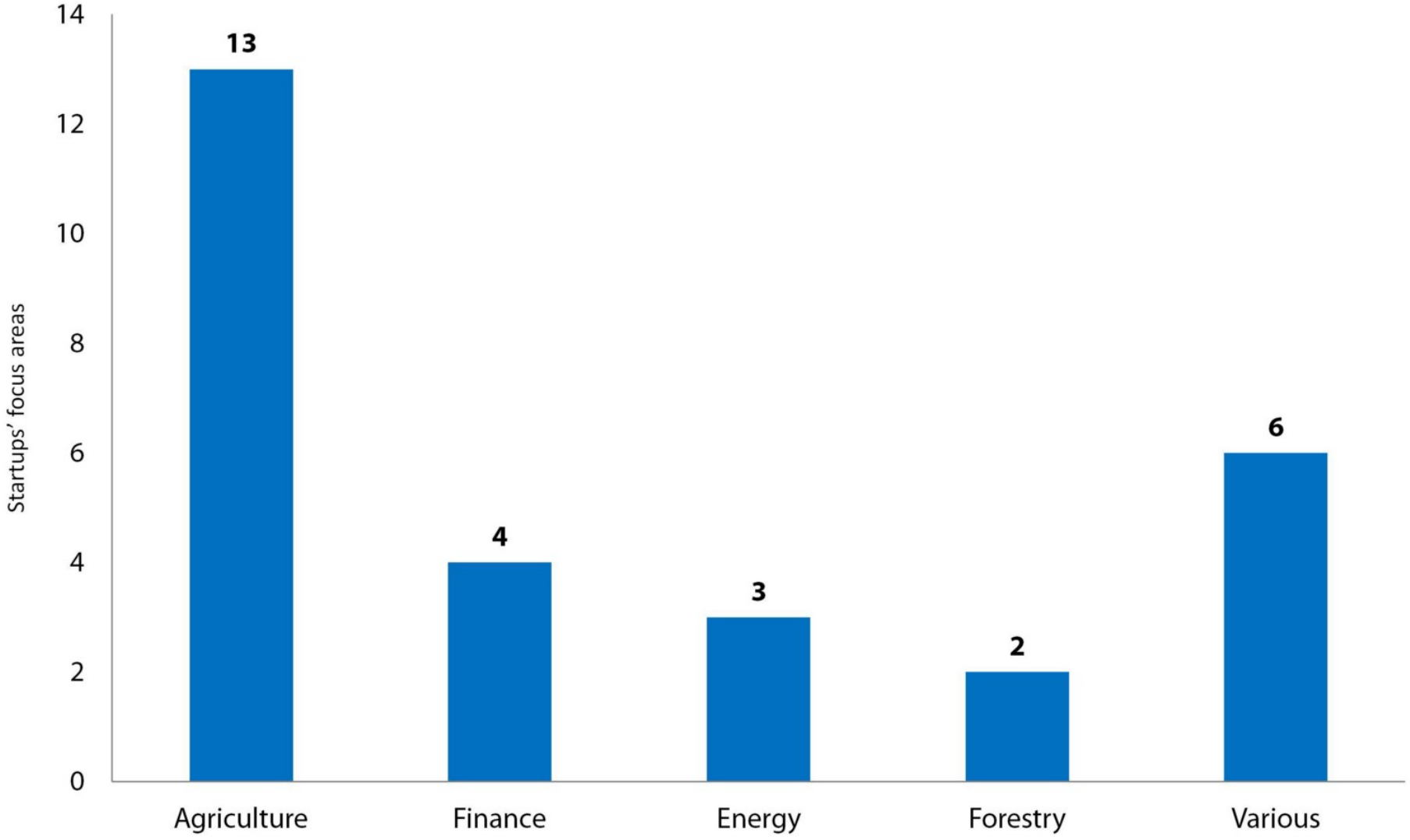


Satellite imagery analytics is a hot topic



Orbital Insight's algorithms automaticly counting the number of cars on retaliers' parking lots

Agriculture is the most popular focus area of value-added services startups



Source: Crunchbase, CB Insights Frontier Tech Report

AGRICULTURE

DEFENSE & INTELLIGENCE

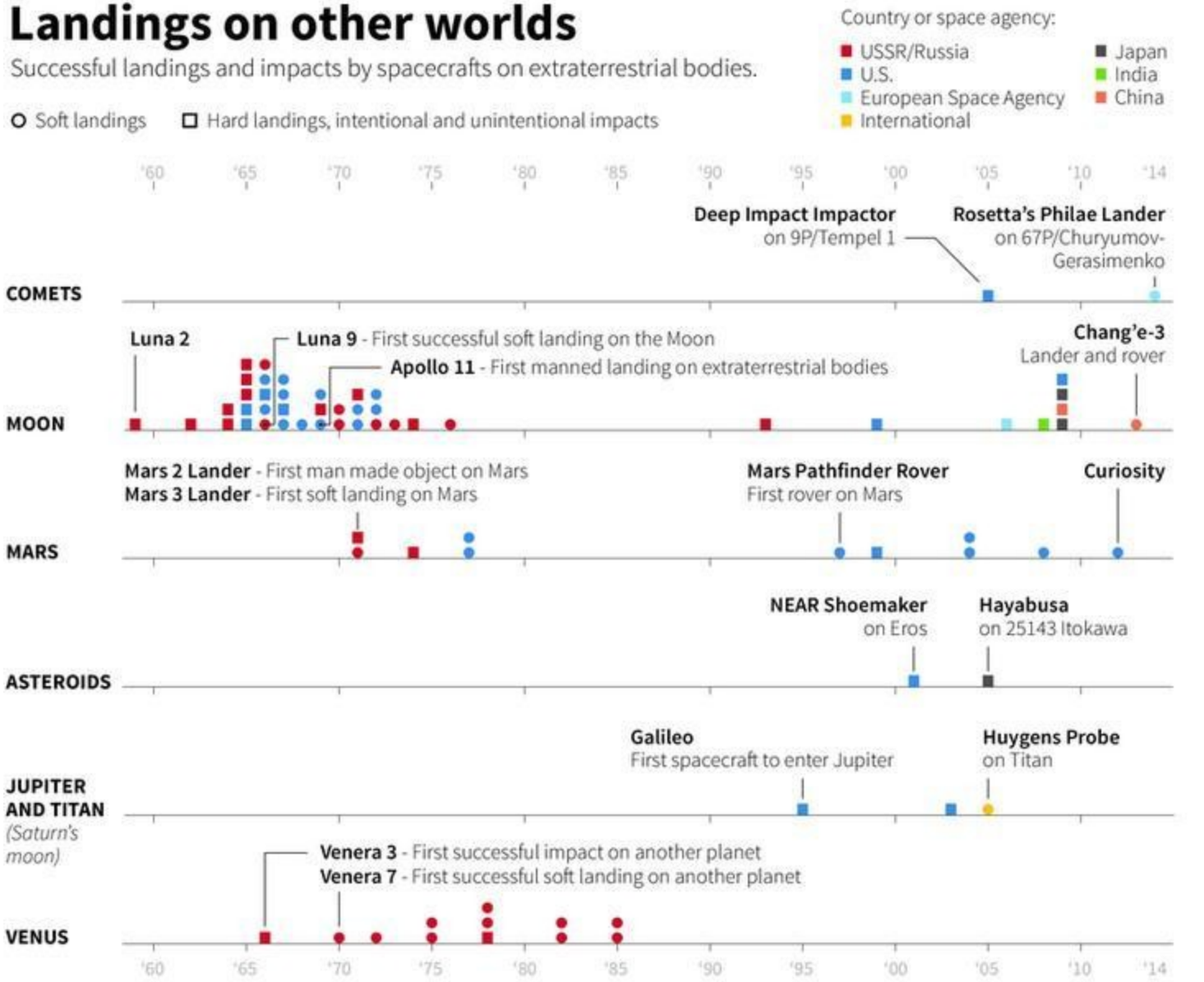
ENERGY & INFRASTRUCTURE

INSURANCE

MARITIME

Landings on other worlds

Successful landings and impacts by spacecrafts on extraterrestrial bodies.



Source: NASA, National Space Science Data Center.

C. Inton, 13/11/2014

REUTERS

Launch Vehicles + Space Tourism + Moon Exploration

SPACEX
BLUE ORIGIN
STRATOLAUNCH SYSTEMS
Masten
ASTROBOTIC
ROCKET LAB
Virgin GALACTIC
S3 SWISS SPACE SYSTEMS
WORLD VIEW
Vector Space
moon express me the moon is me
FIREFLY SPACE SYSTEMS
BLOOSTAR
ARCA

Satellites + Subsystems + Miscellaneous

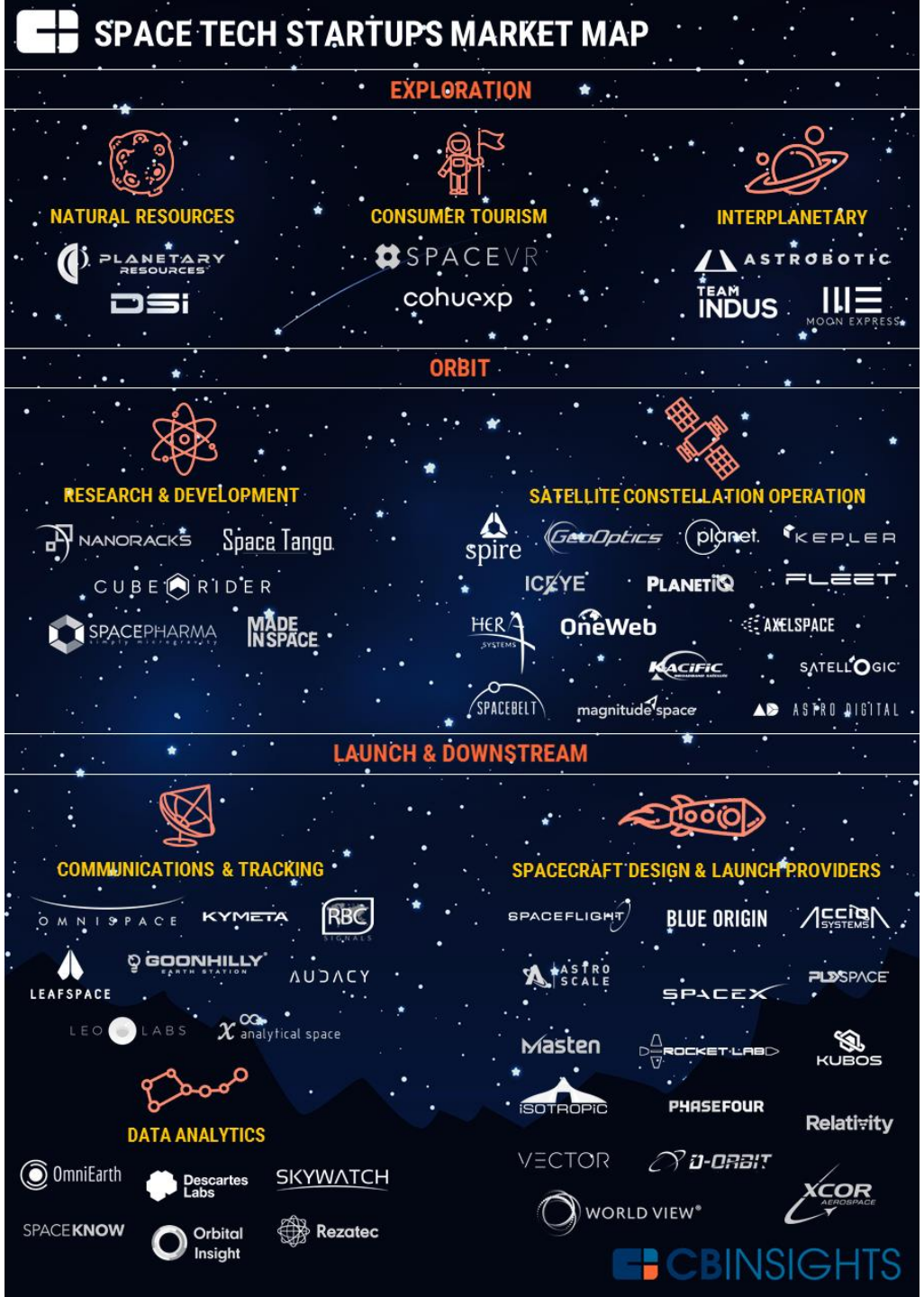
Terra Bella
planet.
DAURIA AEROSPACE
spire
OneWeb
SPACEVR
URTHECAST
AXELSPACE
OmniEarth
PLANETIQ CRITICAL DATA FOR A SMARTER PLANET
LEOSAT
ASTRO SCALE
aquila space
PLANETARY RESOURCES
ICEYE
TEMPUS GLOBAL DATA
DSI DEEP SPACE INDUSTRIES
NovaWurks
SpacePharma
BLACKSKY
SATELLOGIC
HERA
OUTERNET HUMANITY'S PUBLIC LIBRARY
ACCION SYSTEMS
PHASEFOUR

Ground Stations

RBC SIGNALS
ATLAS Space Operations
SPACEFLIGHT
Leaf Space Simplify access to Space
KSAT KONGSBERG Kongsberg Satellite Services

Value-added Services

Orbital Insight
Descartes Labs
Weather Analytics
VRESSON
CARTODB Geospatial on the cloud
SPACE_KNOW
Ursa
mavrx
MEASURE
MapBox
ENVIEW
rezatec
Open Weather Map
AERO STATE
ASTRO DIGITAL
RS Metrics
WINDWARD
AIRPHRAME
SLANTRANGE IMPROVING AGRICULTURE FROM ABOVE
farmshots
ceresimaging
VINSIGHT


SPACE TECH STARTUPS MARKET MAP
EXPLORATION
NATURAL RESOURCES
PLANETARY RESOURCES
DSI
CONSUMER TOURISM
SPACEVR
cohuexp
INTERPLANETARY
ASTROBOTIC
TEAM INDUS
MOON EXPRESS
ORBIT
RESEARCH & DEVELOPMENT
NANORACKS
Space Tango
CUBE RIDER
SPACEPHARMA
MADE IN SPACE
SATELLITE CONSTELLATION OPERATION
spire
GeoOptics
planet.
KEPLER
ICEYE
PLANETIQ
FLEET
HERA SYSTEMS
OneWeb
AXELSPACE
KACIFIC
SATELLOGIC
SPACEBELT
magnitude space
ASTRO DIGITAL
LAUNCH & DOWNSTREAM
COMMUNICATIONS & TRACKING
OMNISPACE
KYMETA
RBC SIGNALS
LEAFSPACE
GOONHILLY EARTH STATION
AUDACY
LEOLABS
analytical space
DATA ANALYTICS
OmniEarth
Descartes Labs
SKYWATCH
SPACEKNOW
Orbital Insight
Rezatec
SPACECRAFT DESIGN & LAUNCH PROVIDERS
SPACEFLIGHT
BLUE ORIGIN
ACCION SYSTEMS
ASTRO SCALE
SPACEX
PLDSPACE
Masten
ROCKET LAB
KUBOS
ISOTROPIC
PHASEFOUR
Relativity
VECTOR
D-ORBIT
WORLD VIEW
XCOR AEROSPACE
CBINSIGHTS

Exploration: Companies in this category are — literally and figuratively — aiming for the moon, and beyond.

Natural Resources: Asteroids and other planets contain valuable natural resources. Planetary Resources has received nearly $50M in assorted funding to develop robotic space exploration aimed at the eventual mining of asteroids.

Interplanetary: Google has promised its $30M Lunar XPRIZE to the first team to land a rover on the moon. Among those companies trying to land on the moon, Moon Express has received nearly $50M in assorted funding to build its natural resources- and data-collecting lunar robot, and has contracted with Rocket Labs as its launch provider. However, Rocket Labs lags behind its competition, having not yet launched a test rocket.

Consumer Tourism: Companies in this subcategory are making space tourism an immediate priority, focusing on space for the rest of us (who can pay for the pleasure). SpaceVR plans to launch micro-satellites into orbit to allow consumers to experience space via virtual reality.

Orbit: The majority of satellites and spacecraft orbiting Earth fall into two "layers" of space: Low Earth Orbit (LEO) and Geostationary Orbit (GEO).

Research & Development: Companies in this subcategory are conducting scientific experiments in space, manufacturing items in-orbit, or working to better understand humanity's effect on space — think space debris. NanoRacks helps researchers study the effects of microgravity and space radiation on test items.

Satellite Constellation Operation: With production costs falling steeply for micro-satellites, investors and founders are looking to launch satellite constellations that will be able to provide communications infrastructure and remote sensing data, among other use-cases. OneWeb is launching a satellite constellation to provide global mobile and internet connectivity, and Softbank is pushing for a merger between the company and Intelsat, another major satellite operator.

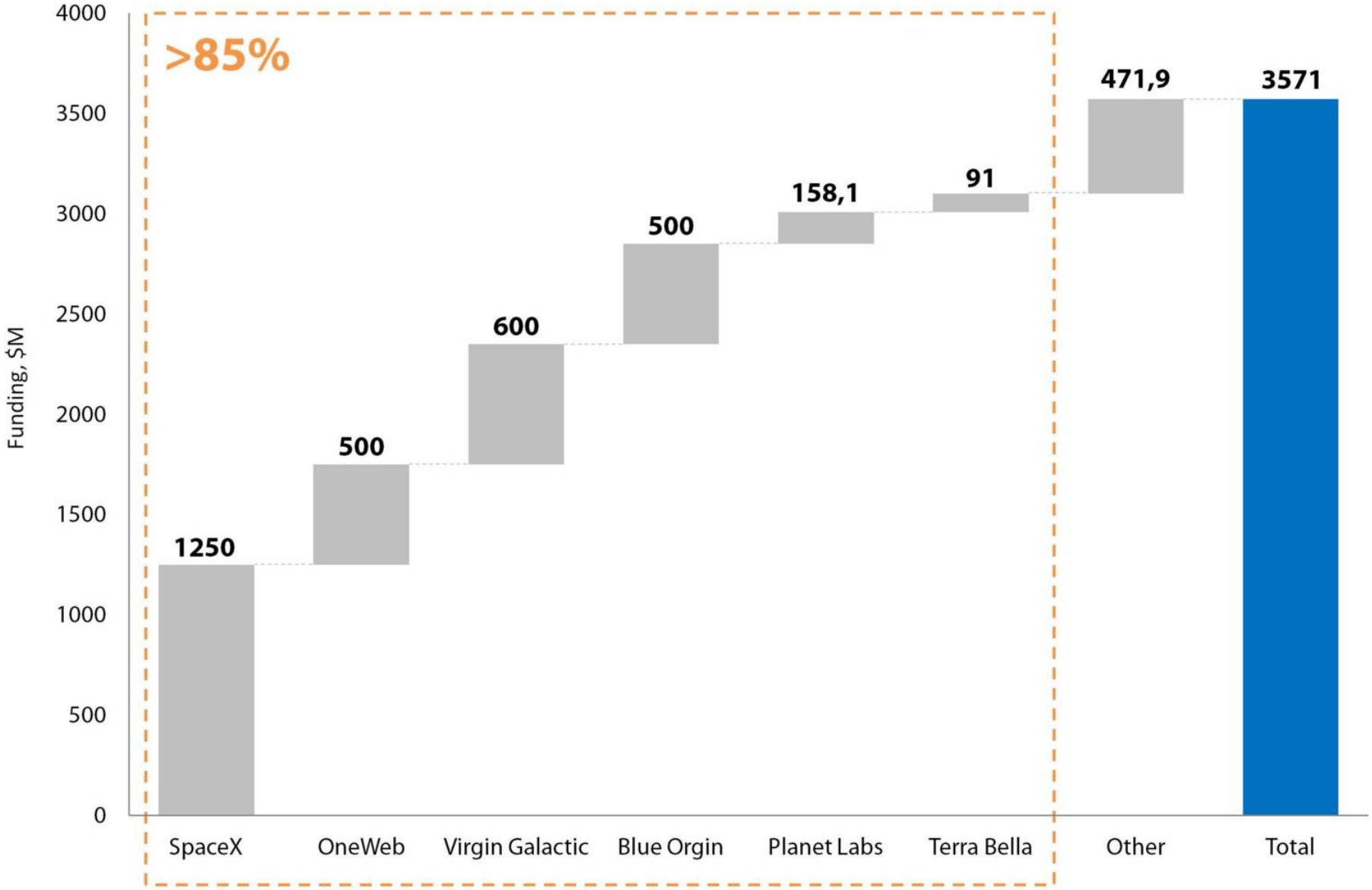
Launch & Downstream: A number of space tech companies are still in the rocket and launch testing phase, while other space tech companies offer satellite coordination services and/ or data analysis with feet firmly planted on the ground — or, downstream.

Communications & Tracking: Companies in this subcategory work to coordinate and track orbiting spacecraft, primarily satellites. A select few companies are combining IoT with space tech, and developing networks that will communicate via satellite. Kymeta is one such company, and has raised upwards of $200M to bring satellite connectivity to vehicles on Earth.

Data Analytics: Satellites generate tremendous amounts of data, and companies in this subcategory try to make sense of it all. It should be noted that these companies are typically industry generalists, with a focus on satellite data aggregation and analysis as opposed to specific industry use-cases. Orbital Insight analyzes satellite data to predict economic and environmental trends, among other use cases, and has raised nearly $30M in total funding.

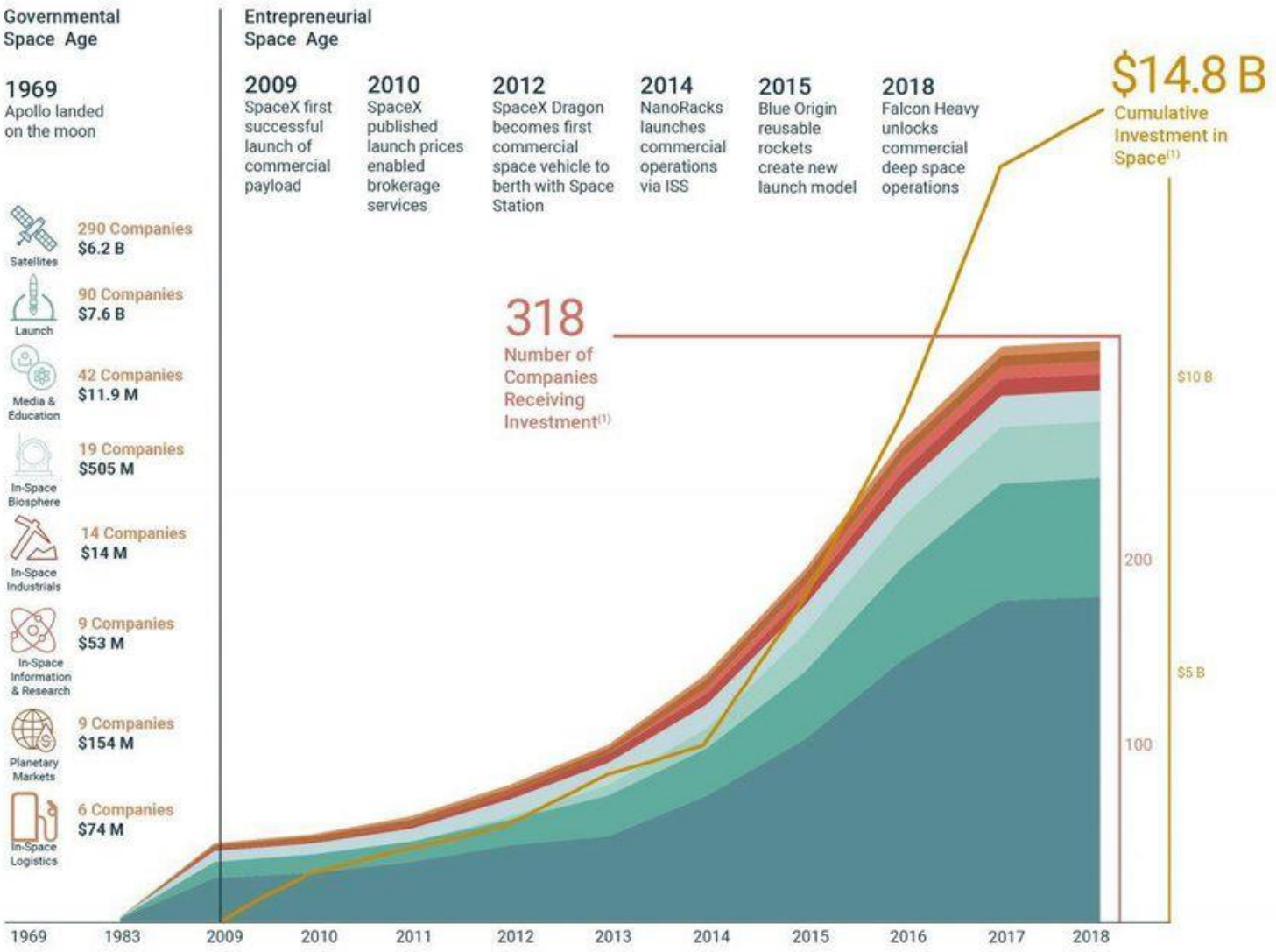
Spacecraft Design & Launch Providers: Spacecraft designers are involved in the design, engineering, and manufacturing of rockets and satellites. Launch providers deliver payloads, such as micro-satellites, to outer space for clients. The two are grouped together because spacecraft designers like SpaceX or Blue Origin hope to use innovative and reusable rocket technology to deliver client payloads.

Power law in SpaceTech investments



Source: Crunchbase, CB Insights Frontier Tech Report

Equity Investments in Space From 2009 To Present

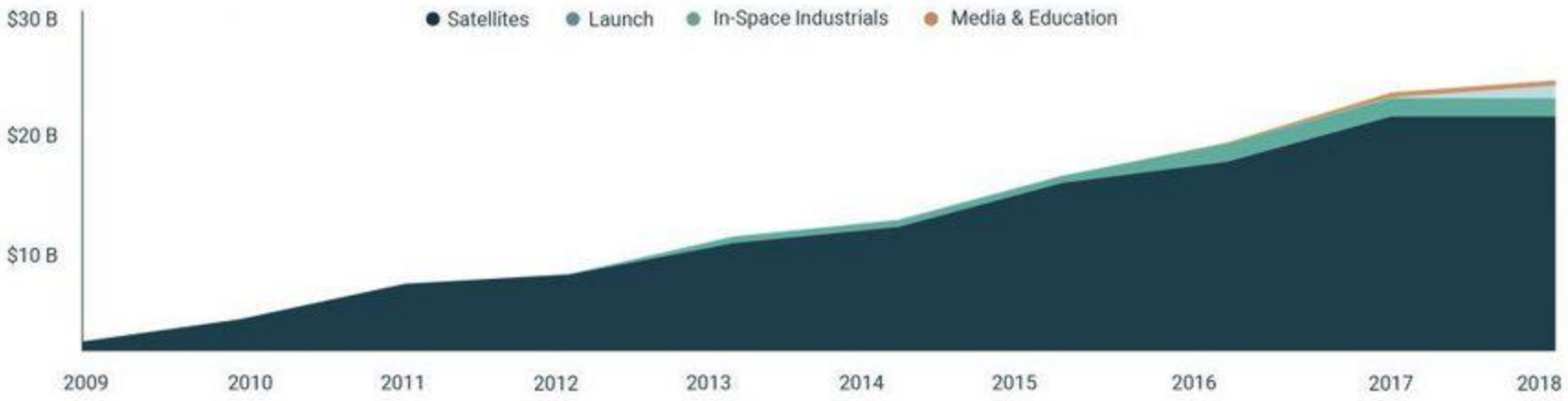


(1) Cumulative non-governmental equity investment

SPACE ANGELS

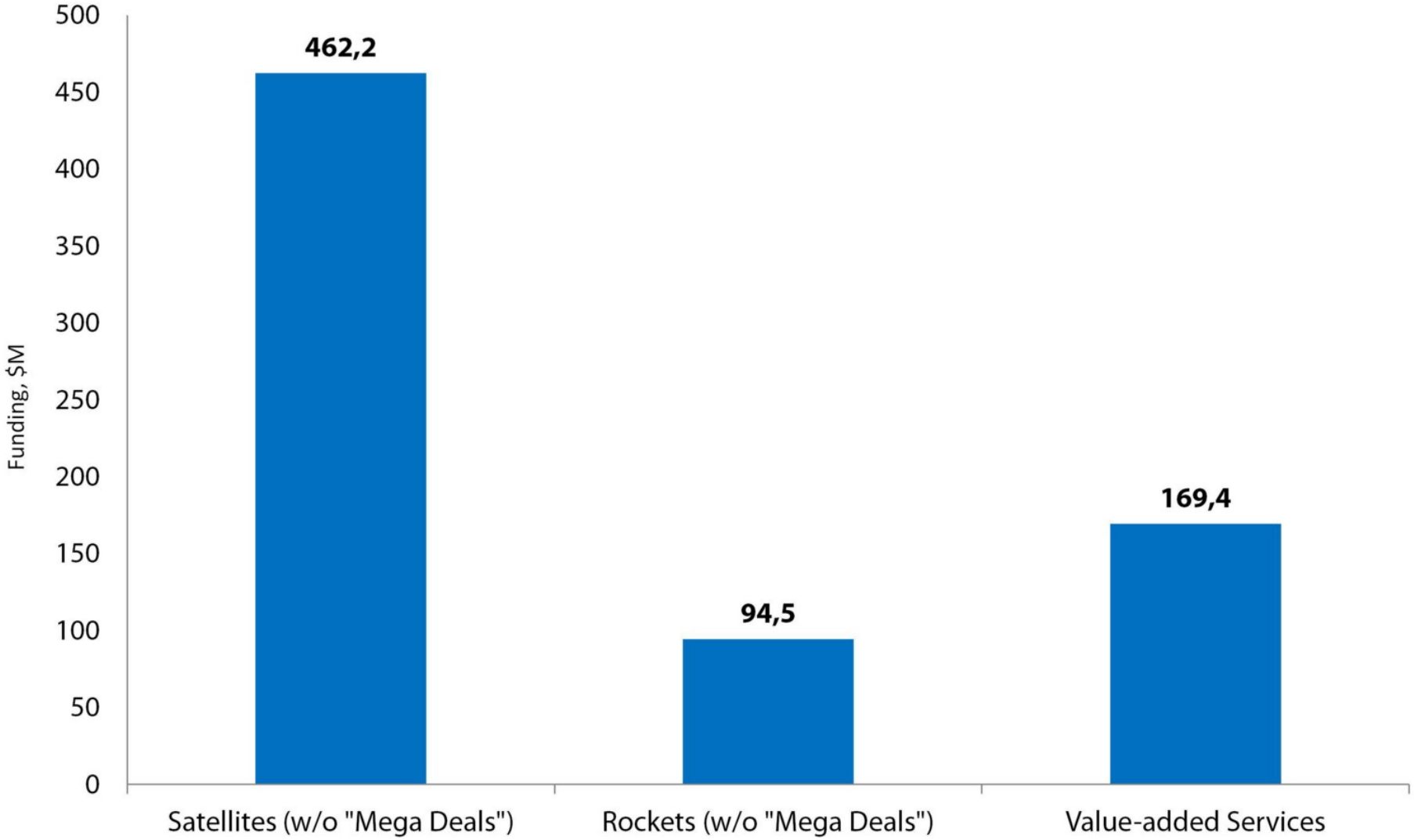
Venture Capital Activity

Cumulative Exits by Sector



Exits remain driven by satellites, given that this is an established market with many cash-rich incumbents looking to outsource innovation to Space ventures.

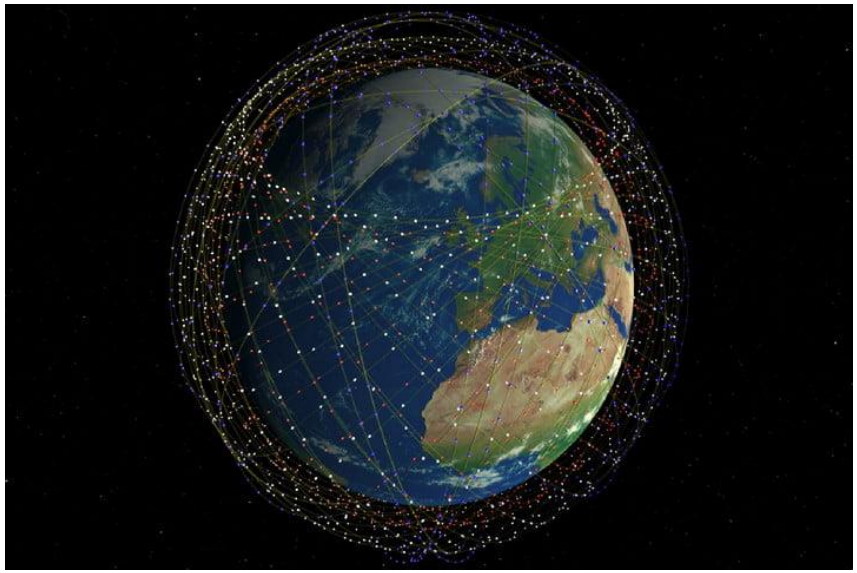
"Satellite" is the most popular investment thesis in SpaceTech at the moment



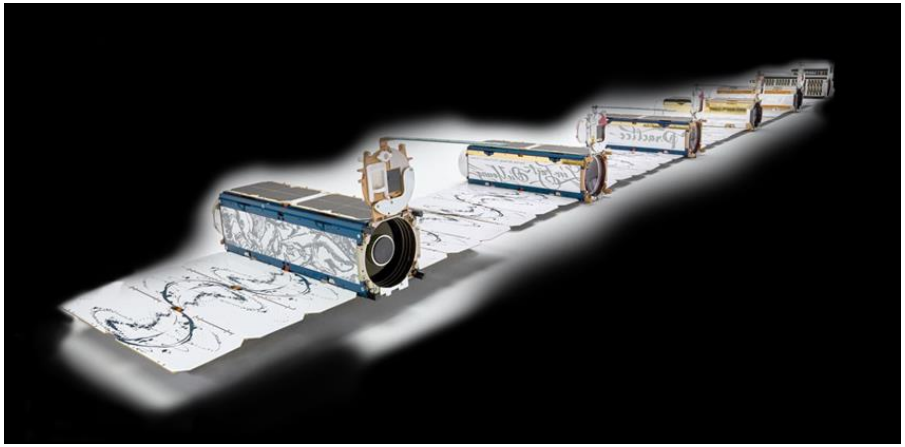
Source: Crunchbase, CB Insights Frontier Tech Report

Space X

- SpaceX got the green light this week from US authorities to put a constellation of nearly **12,000** satellites into orbit in order to boost cheap, wireless internet access by the 2020s.

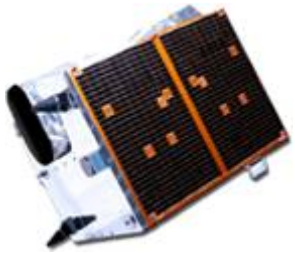


planet.



130+ PlanetScope
3m resolution

5 RapidEye
5m resolution



13 SkySat
0.72m resolution

BlackSky Global

Subsidiary of a Spaceflight Industries, recently raised $25M to launch a constellation of 60 remote sensing satellites of sub-meter resolution providing up to 90 revisits daily.
Taking into account that low number of launch opportunities is one of the key microsatellite-related companies barriers to entry, and, consequently, Spaceflight Industries is one of the major launch services providers — BlackSky look pretty attractive.
Moreover, company is also developing its "platform" capabilities (full-stack approach detailed above) with acquision of OpenWhere, startup working on geospatial data platform and API to deliver data/insights to customers.

Spire

This startup is deploying “first commercial weather satellites” constellation utilizing GPS-RO technology, already launched 12 satellites and signed a number of launch contract with Rocket Lab to launch around 40 more.

Despite that selling weather data (or forecasts) is quite challenging, market is evolving and weather opportunity might become a multibillion one.

Spire already raised $66,5M, hired some senior people from the industry, closed a deal with Indonesian governement and is on it’s way towards capturing the market, while competitors (PlanetiQ) are just going to be launched this year

Orbital Insight

Company's vision is to build a some kind of "macroscope" to gather insights on worldwide-scale processes, combining satellite imagery and deep learning for a variety of customers from asset management firms to non-profit organizations, such as World Bank, and government/intelligence clients.

Speaking of competition, while algorithms are not quite an advantage and a barrier to entry for others at the moment (due to availability of open-source computer vision frameworks), established partnerships and a qualified team are, and this is where Orbital Insight seems to have a head start.