

New Space Opportunities in the US

Created by [Dr. Ioana Cozmuta](#) for Business Finland

DISCLAIMER

The content of this report is not comprehensive. The authors do not carry any liability for the further use and interpretation of data from this report.

OUTLINE*

click on any outline item to go to that particular topic

[The New Space Landscape](#)

- [New Space: The Numbers](#)
- [Global Space Economy](#)
- [NASA's strategic thrusts for New Space future developments](#)
- [Major NASA partners in the US](#)
- [Beyond Earth's Orbit](#)
- [US Space Sectors and Policies](#)
- [Remarks](#)

[Current Study](#)

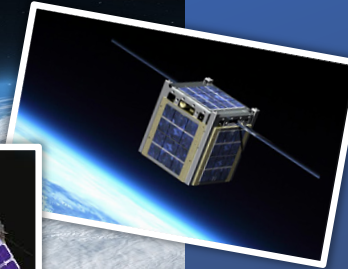
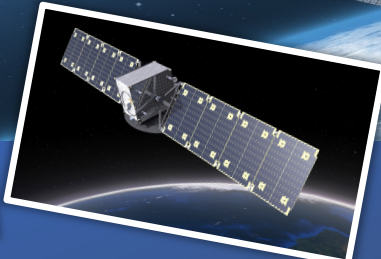
- [Study areas and market sizes](#)
- [Small Satellite architectures and supply chain](#)
- [Finnish Offerings](#)
- [Earth Observation](#)
 - [Synthetic Aperture Radar](#)
 - [Hyperspectral Remote Sensing](#)
 - [Airborne Remote Sensing: Drones](#)
- [Space Technology](#)
- [Connectivity and IoT](#)
- [Urban Development](#)
- [Bioeconomy](#)
- [Safety](#)

[Challenges and Opportunities](#)

The New Space Landscape

[+ back to OUTLINE](#)

New Space: The Numbers



***1U: de-facto platform for new space applications**



The small satellite standard has become the de-facto platform for new space applications. Image shows multiples 1x, 2x, 3x of 1U (10cmx10cmx10cm)

[← back to OUTLINE](#)

***2009-2018 Space Startup support:**
\$18Billion total private investments
534 VC funds investing in space

***Satellite Connectivity from Space aims to deliver Internet for all**



7,518 satellites approved by FCC in 2018 to be launched by SpaceX in 2019 to provide internet connectivity from space.

Micro-launchers have lower entry barriers and represent an opportunity for countries who want to be New Space players. The launch solutions aim to capture a share of the LEO small-satellite delivery market.

***Earth Observation data market included value added services- to reach \$8Billion by 2027**



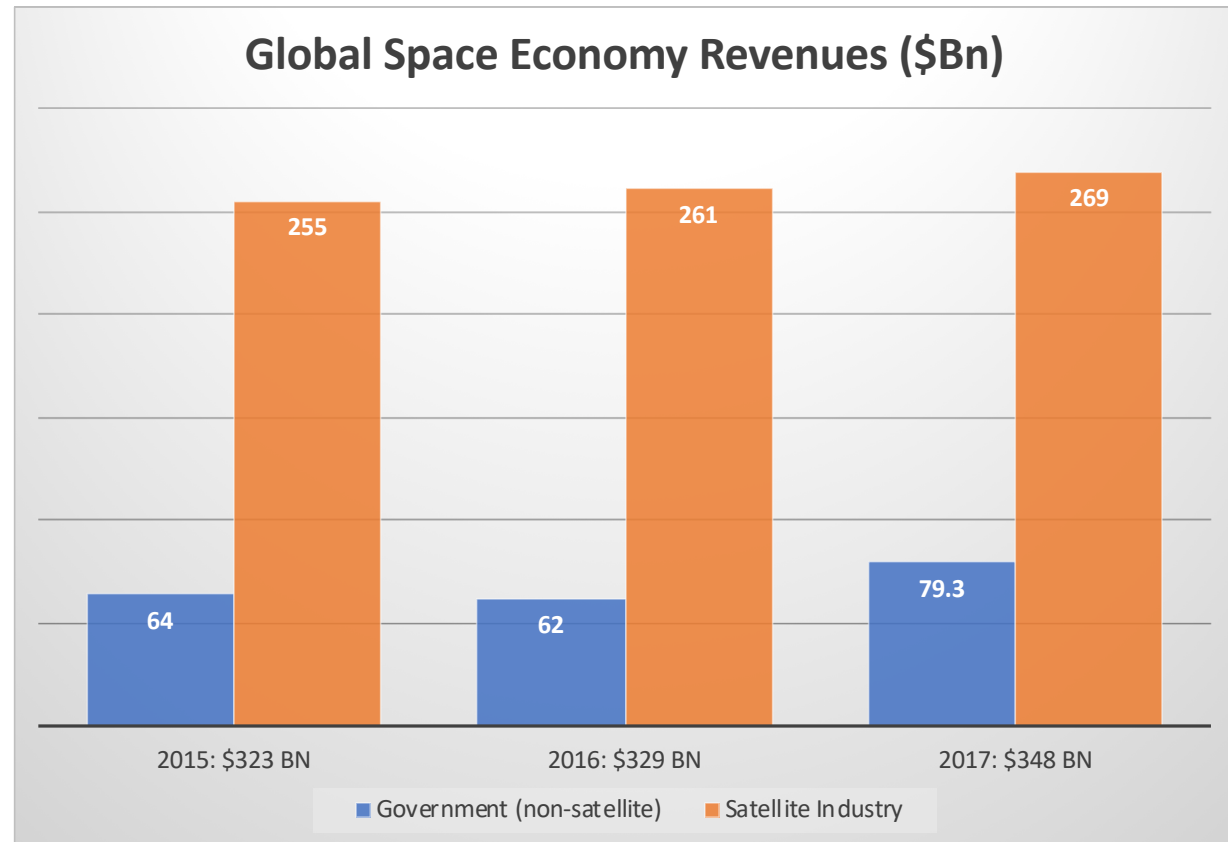
The advent of small satellite constellations coupled to the internet, cloud storage, and advanced processing and distribution methods has changed Earth Observation from a science to a commodity

***North America dominates the commercial launch market**



Between 2016 and 2018, SpaceX global market share for newly awarded commercial launch contracts has increased from 30% to ~65%. The industry is seeing fast paced developments from other key players such as Blue Origin and Virgin Orbit.

Global Space Economy

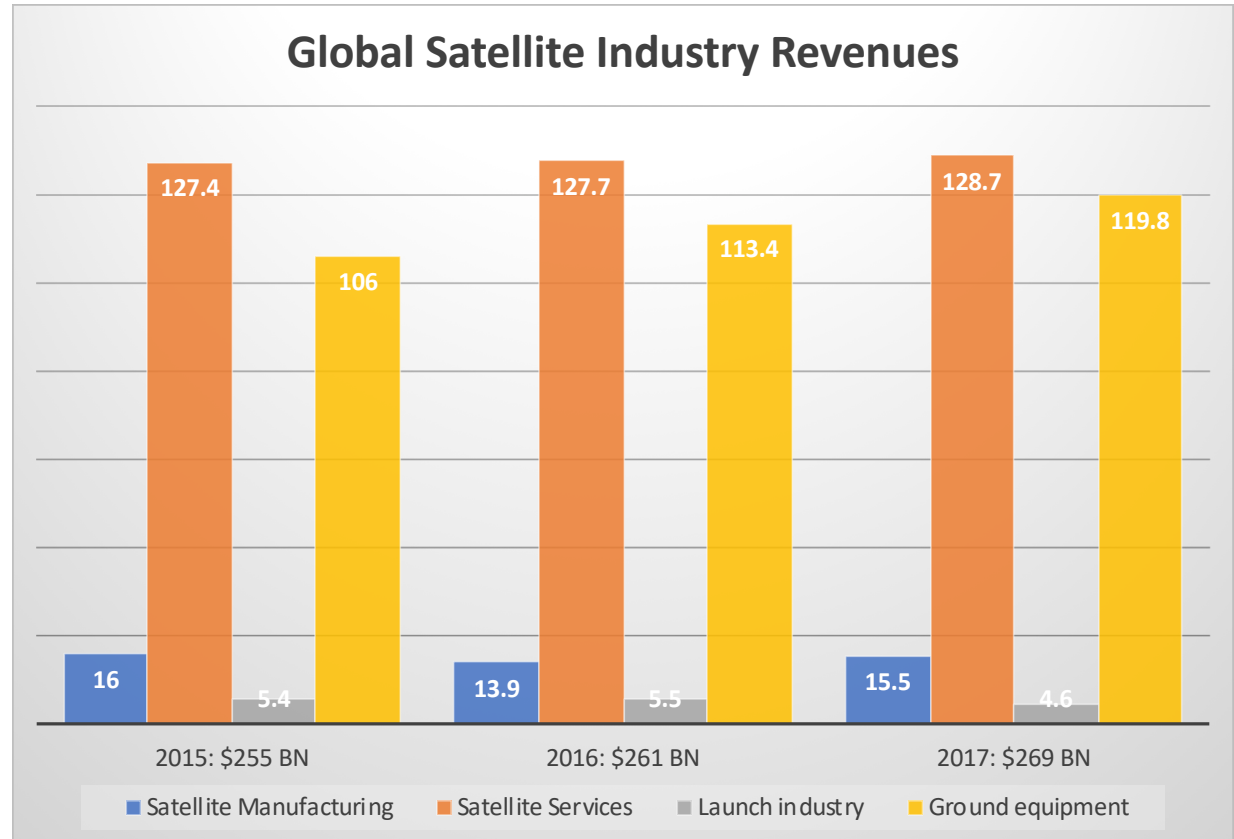


Number of countries investing in space is at a steady increase from 70 in 2016 to 80 in 2018
 The US is by far the world's largest space spender with a budget ~35-45Bn

Sources: SIA; Space Foundation; Tauri Group; Bryce Reports; Macrotrends Reports; Eurocast Reports; Euroconsult Reports; The Space Report

* US Government total space budget

Global satellite industry



The US holds ~44% market share of global satellite industry

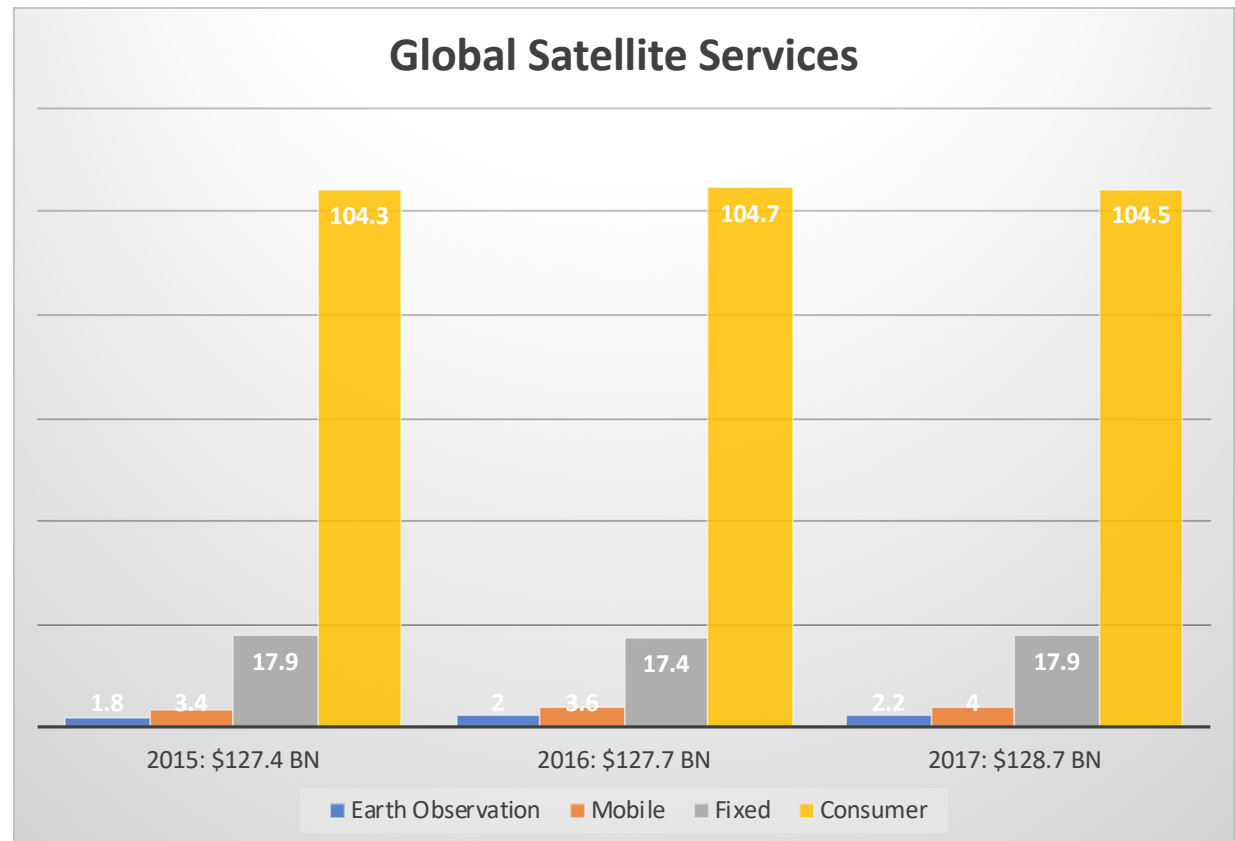
US entities operate ~600 satellites

More launches using less expensive launch vehicle types

Overall satellite industry growth is ~2% due mostly to small satellites (<500-800kg)

Sources: SIA; Space Foundation; Tauri Group; Bryce Reports; Macrotrends Reports; Eurocast Reports; Euroconsult Reports; The Space Report

Global satellite services



Consumer: TV, Radio, Broadband

Earth Observation: Agriculture, Change Detection, Detection Mitigation, Meteorology, Resources

Sources: SIA; Space Foundation; Tauri Group; Bryce Reports; Macrotrends Reports; Eurocast Reports; Euroconsult Reports; The Space Report

NASA's strategic thrusts in the next decade

1. Expand Utilization of Near-Earth Space

- Provide safe and affordable routine **access to space**
- Enable **extension, reuse, and repair** of near-Earth assets
- Expand **near-Earth infrastructure** to support human and science exploration beyond LEO

2. Develop Efficient & Safe Transportation Through Space

- Provide cost-efficient, reliable **propulsion for long duration missions**
- Enable **significantly faster**, more efficient deep space missions
- Enable long-duration crew transport

3. Increase Access to Planetary Surfaces

- Safely and precisely **deliver humans & payloads to planetary surfaces**
- Increase **access to high-value science sites** across the solar system
- Provide efficient, highly-reliable **Earth sample return** reentry capability

4. Enable Humans to Live and Explore on Planetary Surfaces

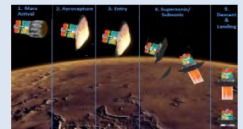
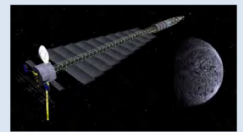
- Enable humans to **survive** on other planets
- Provide efficient/scalable **infrastructure** to support exploration at scale
- Increase crew effectiveness and **access to diverse, high-value sites**

5. Enable the Next Generation of Science Missions

- Expand access to new environments and measurement **platforms** to enable high-value science
- Enable **substantial increases** in the quantity and quality of science data returned
- Enable **high-power measurements** for long duration science missions

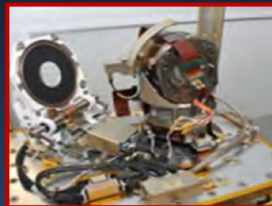
6. Grow & Utilize the U.S. Industrial and Academic Base

- **Transfer NASA technology** to grow the U.S. industrial & technology base
- Open and **foster new space markets** for U.S. commerce
- **Drive U.S. innovation** & expand opportunities to achieve the NASA dream



NASA activities
to support
near-Earth
space
utilization

Expand Utilization of Near-Earth Space



**Laser Communication
Relay Demonstration**



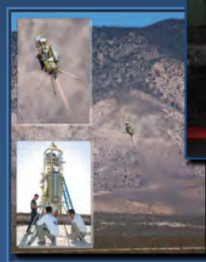
**Nano-Composite
Overwrapped
Pressure Vessel**



Low Cost Upper Stage



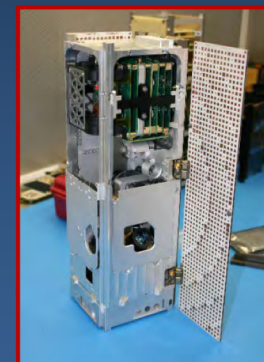
**Cubesat Proximity
Operations Demo
(CPOD)**



**Flight Opportunities -
120 payloads flown of
200 planned to fly**



**Optical Communications
and Sensor (OCSD)
Demonstration**



**Integrated Solar Array
and Reflectarray
Antenna (ISARA)**



**MIS, Orbital ATK, SSL
on contract for In
space Robotic
Manufacturing
ground development**



**Boeing XS-1
project
will use
STMD
composite
cryogenic
tanks**



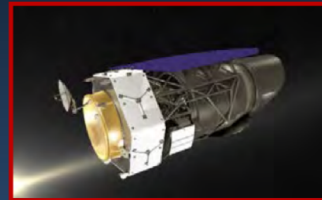
[Images used are credited to: NASA STMD]

NASA activities
to support
next
generation of
science
missions

Enable the Next Generation of Science Missions



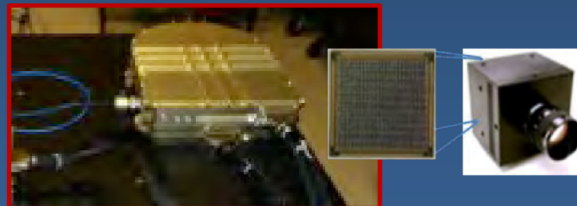
**Deep Space Atomic Clock
integration readies for launch**



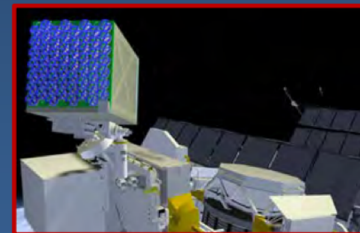
**Coronagraph achieves TRL5,
resulting in measurements
100x better than existing tech**



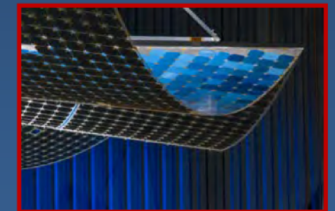
**High Performance
Spaceflight Computing
contract awarded to Boeing**



**Hardware integration for
testing of Deep Space Optical
Communications**



**SEXTANT launch for "galactic
positioning system"**

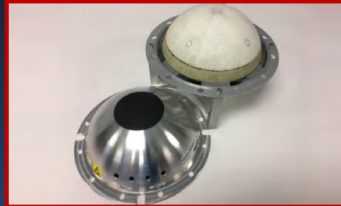


**Extreme Environment Solar
Power selections made to
Johns Hopkins/APL and
Orbital ATK**

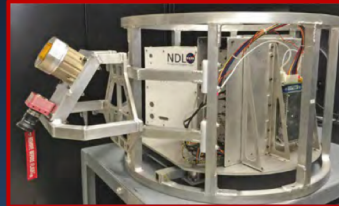
[Images used are credited to: NASA STMD]

NASA activities
to support
access to
planetary
surfaces

Increase Access to Planetary Surfaces



**Conformal Ablative TPS
launch: orbital entry test of
heat shield material**



**CoBALT launch:
open-loop campaign
completed**



**Hypersonic Inflatable
Aerodynamic Decelerator**



**Adaptable,
Deployable Entry &
Placement
Technology SR-1**

***Enable Humans to Live and Explore on
Planetary Surfaces***



**Spacecraft Oxygen Recovery:
Phase II contracts awarded to
Honeywell and Umpqua**



**Kilopower: hardware delivery
for nuclear testing**



**Human Robotic Systems:
demonstrating humanoid robot
with cognitive skills**

[Images used are credited to: NASA STMD]

NASA activities
to support in-
space
transportation

Develop Efficient & Safe Transportation Through Space



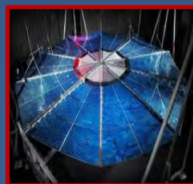
Spaceflight demo of ROSA on ISS



**Green Propellant Infusion Mission
readies for launch**



**RRM3: Radio Frequency Mass
Gauge prepared for flight demo**



**Solar Electric Propulsion cont.
development and qualification**



**Maturing technologies for
smallsat thrusters**



**Nuclear Thermal
Propulsion: Alternate fuel
reactor**



**eCryo: Cryocooler completes
environmental tests**

[Images used are credited to: NASA STMD]

Major NASA partners in the US



[Images used
are credited
to: NASA
STMD]

[+ back to OUTLINE](#)

Beyond Earth's Orbit

Asteroid monitoring & mining

- identify, track, characterize
- prospect, select, mine

Moon and Mars

- exploration, settlement
- leverage on commercial capabilities

Space Resources

- top candidates: water, metals (platinum)
- Use space resources to manufacture in space for space and for terrestrial use

Demand: sustainable supply of raw materials and natural resources

The diagram consists of three overlapping circles. The top circle shows Earth from space with the text 'Demand: sustainable supply of raw materials and natural resources'. The bottom-left circle shows an asteroid with the text 'Supply: asteroids, Moon, Mars, etc'. The bottom-right circle shows a futuristic space station or manufacturing facility with the text 'In-Space Economy: rocket fuel, raw materials, life support, manufacturing'.

Supply: asteroids, Moon, Mars, etc

In-Space Economy:
rocket fuel, raw materials, life support, manufacturing

[← back to OUTLINE](#)

US Space Sectors and Policies*

Sector	Activities	Players
Civil Space	International Space Station Hubble Telescope Space Weather Space Situational Awareness	NASA NOAA USGS
Commercial Space	Launch Industry Earth Observation Communications Space Tourism	SpaceX, ULA Iridium Digital Globe Virgin Galactic
National Security -Military -Intelligence	GPS Military communication satellites Signals Intelligence Reconnaissance	Air Force Army Navy DOD

Year	Topic	Policy
2003	Remote sensing	US Commercial Remote Sensing Space Policy
2004	GPS	US Space-based positioning, navigation and timing policy
2018	Space traffic management	Space Policy Directive 3, National Space Traffic Management Policy
2010	Commercial regulation	Space Policy Directive 2: Streamlining regulations on commercial use of space
2013	Space transportation	National Space Transportation policy

Issues:

1. Export control
2. Space situational awareness
3. Space traffic management
4. Radiofrequency spectrum management

*https://aerospace.org/sites/default/files/2018-11/Gleason-Alver_SpacePolicy_11162018.pdf

[← back to OUTLINE](#)

Remarks

- The Global Space Economy was valued at US\$ 360 Bn in 2018 and projected to grow at a CAGR of 5.6% to value US\$ 558 Bn by 2026.
- Small satellites are expected to account for the highest market segment contributor followed by markets for reusable launch vehicles, especially those with the ability to place payloads in LEO orbits.
- The market for satellites is anticipated to be the largest category because ongoing government investments (North America/US, Europe, Asia Pacific) to support these emerging markets.
- US also is by far the world's largest space spender with a budget ~35-45Bn
- US New Space market accounts for the largest share of the total global expenditures
- US also has strong recent activity in policies supporting space commercialization
- The New Space Investment Landscape needs to see the full cycle closing, in particular an increase in M&A's
- For companies aiming to do business in the US, responsibility relies on them to ensure compliance with US New Space regulations, spectrum use, ITAR, EAR, etc

[⬅️ back to OUTLINE](#)

Current Study

[+ back to OUTLINE](#)

Evaluate if there is a market opportunity for Finnish companies and what actions should be taken towards the US market to create new business leads and help Finnish companies with matchmaking

Create a market study of the US New Space Economy, determine market opportunities for Finnish companies and outline steps necessary to facilitate those opportunities

OBJECTIVE

STUDY AREAS

1

2

3

4

5

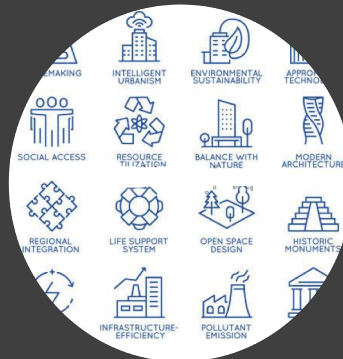
Space
technology

Connectivity
and IoT

Urban
development

Bioeconomy

Safety



[← back to OUTLINE](#)

Market size

Connectivity/IoT	Autonomous mobility ¹⁻⁴	Assets under Management ⁵	Automatic Identification Systems ⁶	Maritime Analytics ⁷	Airplanes ⁸	Weather forecasting ⁹	Logistics ¹⁰
Market size	\$65.3Bn by 2027	\$111.2 Tn by 2020	\$225 Mn by 2020	XX	\$15.7Bn by 2020	\$3.8Bn by 2022	\$15.5 Tn by 2023
CAGR	29%	6%	4.3%	16.5%	7.1%	7.2%	7.5%

Urban development	Infrastructure (Smart City) ¹¹	Pollution Control ¹²	Traffic mgmt ¹³	Waste mgmt ¹⁴	Urban planning & development ¹⁵	Impact on global warming ¹⁶
Market size	\$2Tn by 2020	\$98.17Bn by 2025	\$59.48 Bn by 2022	\$435Bn by 2023	\$302Bn by 2025	\$1.4Tn
CAGR	14%	5%	21%	6.2%	5%	*bonds*

Market size

Bioeconomy	Natural resources monitoring ¹	Climate change monitoring ²	Forest management ³	Bioenergy ⁴	Smart Agriculture ⁵
Market size		\$20Bn by 2022	XX	\$246.52 Bn by 2024	\$13.5Bn by 2023
CAGR		10%	X	5.89%	13%

Safety	Security and surveillance ⁶	Maritime safety ⁷	Oil spill detection ⁸	Coastline monitoring ⁹	Cybersecurity ¹⁰
Market size	\$68.3 Bn by 2023	\$23.67 Bn by 2021	\$177.63 Bn by 2025	\$35.5 Bn by 2022	\$170 Bn by 2022
CAGR	13%	7.21%	4%	3%	10%

Space Technology	Software ¹¹	Remote Sensing ¹²	Space Technology ¹³	Drones ¹⁴	Hyperspectral Imaging ¹⁵
Market size	\$2.37 Bn by 2021	\$18 Bn by 2023	\$558Bn by 2026	\$13Bn by 2020	\$21.33 Bn by 2023
CAGR	1.6%	10%	5.6%	7.6%	17.5%

New Space platform: Small Satellites



BUILDING BLOCKS

ANTENNAS

CIRCUIT BOARDS

SENSORS

ELECTRONICS

TRANSPONDER

BATTERY PACK

STRUCTURE

SOLAR PANELS

SUPPLY CHAIN

SUBSYSTEMS

- Structure
- Power
- Propulsion
- GN&C
- Telemetry & tracking
- Command and data handling
- Thermal management
- Payloads(SAR, Hyperspectral)

ASSEMBLIES

- Antenna
- Batteries
- Computer
- Star Tracker
- Electronics
- Heat Pipe

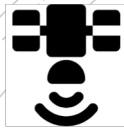
COMPONENTS

- Amplifiers
- Solar Cells
- Optical
- Resolvers
- Magnetometers
- Reaction Wheels

PARTS&MATERIALS

- Ball Bearings
- Slip rings
- Screws
- Gaskets
- Aluminum
- GaAs
- Mylar, Rayon

FINNISH OFFERINGS



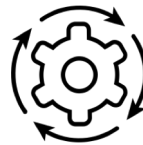
PAYLOADS

- RF, microwave and mm-wave technology
- Radar altimeters
- High sensitivity radiometers for Earth orbiting spacecraft and deep space probes



APPLICATIONS/USES

- In-orbit demonstration
- Asteroid prospecting
- Target detection systems/mine fuses



OPERATIONS & SOFTWARE

- Build and operate your own satellite or fleet;
- Design the mission and satellite
- Software for system critical decisions



SERVICES

- AR productivity improvements for remote support of problem solving
- Testing facilities (embedded electronics, mechanical and thermal design)



SUBSYSTEMS

- Navigation receivers and signal processing
- Sounding rocket guidance systems
- Satellite structures
- Satellite and launcher computers
- CubSats platform scalable to 12U
- Launcher fairings and structures
- adapters and separation systems



PARTS & MATERIALS

- Glass micro bonding for glass and silicon substrates
- Black silicon photodiodes
- Mechanisms, slip rings, multilayer insulation

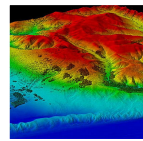
[← back to OUTLINE](#)

EARTH OBSERVATION



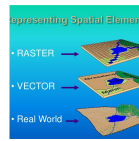
[← back to OUTLINE](#)

EARTH OBSERVATION: SUPPLY CHAIN



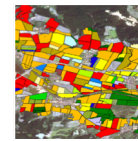
Satellite Data Collection

- Planet Labs
- Spire
- EagleView
- NASA
- USGS



Data storage/conversion/processing

- SpaceNet
- SpaceMetric
- MapBox
- Descartes labs
- AstroDigital



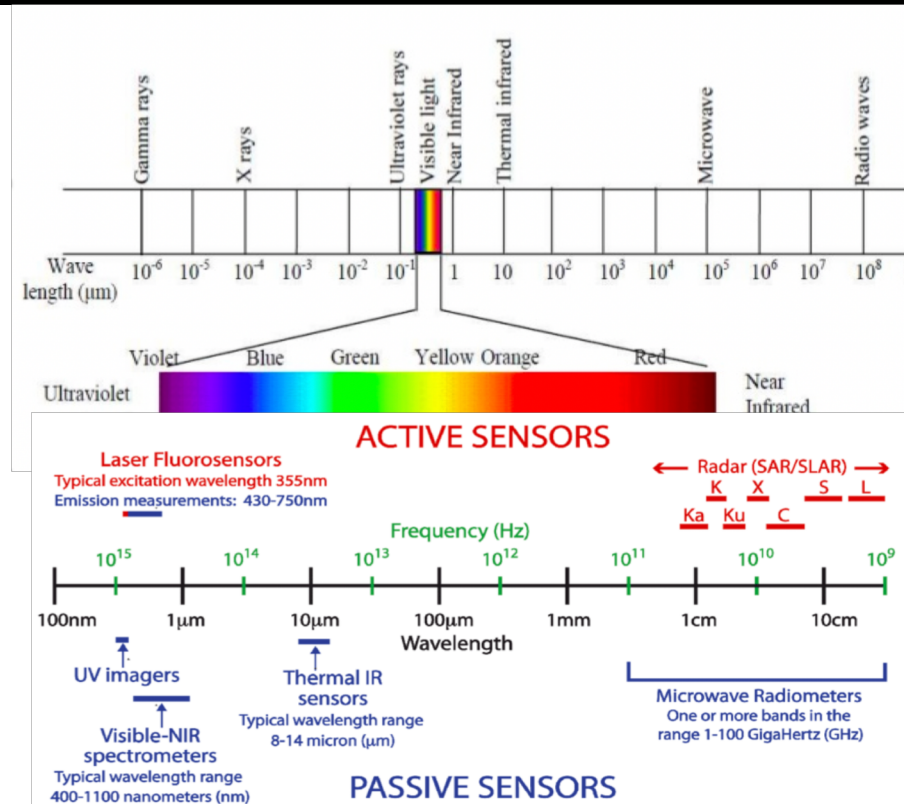
Data Analytics

- Geospatial Insight
- Utilis
- AerospaceLab
- SkyAI
- TellusLab
- Orbital Insight
- Spaceknow
- Swiftera

New Space is a nascent space industry segment. Supply chains and value added services grow as new use cases continue to be identified and developed and as new market segments are being captured.

EARTH OBSERVATION VIA REMOTE SENSING

- Earth-observing satellites take "pictures" by reading and recording reflectance values collected from wavelengths along the EM spectrum
- Satellites carry instruments capable to take measurements from space that show what is happening on Earth
- Measurements can be active or passive
 - Synthetic Aperture Radar (SAR) on Envisat is an active instrument
 - Medium resolution imaging spectrometer (MERIS) is passive
- Earth Observation vs Airborne Remote Sensing
 - Airborne remote sensing: high spatial resolution images (20 cm or less);
 - EO : high coverage area; low cost per unit area of ground coverage; continuous operation



SYNTHETIC APERTURE RADAR



[← back to OUTLINE](#)

Synthetic Aperture Radar



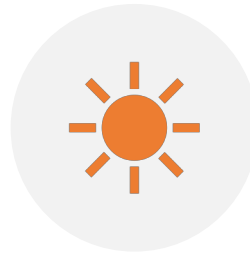
Image courtesy: NASA

- Synthetic Aperture Radar is an active remote sensing technique uses EM radiation in the microwave range (0.3-30 cm) to acquire 2D fine spatial resolution images (landscapes, etc).
- The radar is typically mounted on a moving platform (airborne or space) and the motion of the platform simultaneous to the time taken for the radar pulse to reflect back to the antenna leads to a *synthetic* aperture, larger than the physical aperture of the antenna.
- Typical resolutions are about 10 cm for airborne systems, few millimeters for ultra-wideband systems and sub-millimeter resolution for terahertz SARs.
- Can also be used in an “inverse” manner (observing a moving target with a stationary antenna)

Major applications:

- mapping of the surface of the Earth: topography, oceanography, glaciology, geology, forestry, environmental monitoring, tactical assessment
- mapping of the surface of other planets or cosmic objects (asteroids, etc)

Synthetic Aperture Radar



X-BAND



10X10; 3X3 OR 1X1
METER RESOLUTION

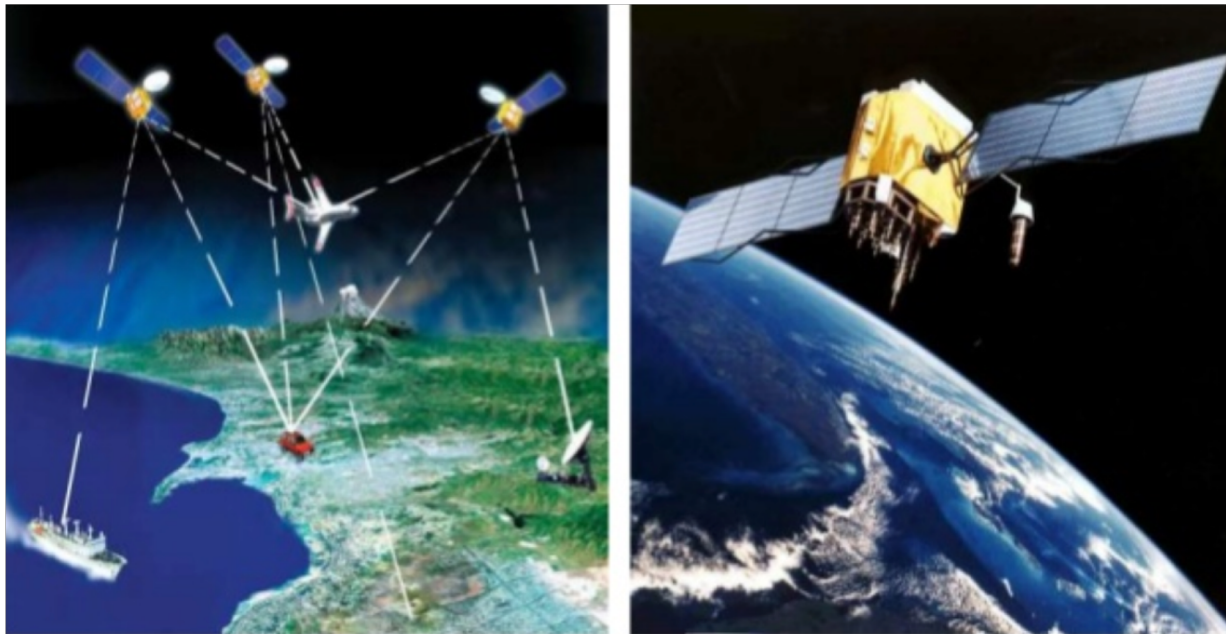


CONSTANT UPDATE



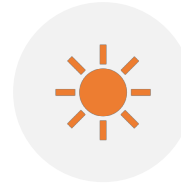
GLOBAL COVERAGE

HYPERSPECTRAL REMOTE SENSING



[⬅ back to OUTLINE](#)

Hyperspectral imaging



MULTI SPECTRAL IMAGES
PRODUCE FEW BROAD
WAVELENGTH BANDS



HYPERSPECTRAL IMAGE
SENSORS PRODUCES
NARROWER WAVELENGTH
BANDS (100 TO 200 OR
MORE) ENABLING A
CONTINUOUS SPECTRUM TO
BE DERIVED FOR EACH IMAGE
CELL



HYPERSPECTRAL IMAGES CONTAIN
HUGE AMOUNTS OF INFORMATION:
AFTER SENSOR IS ADJUSTED AND
CORRECTED FOR TERRAIN AND
ATMOSPHERIC CONDITIONS, THE
RESULTS ARE VERIFIED AGAINST THE
COLLECTED SPECTRUM VALUE TO
CATEGORIZE THE TYPE OF VEGETATION
OR MINERALS OR OTHER FEATURES.



HYPERSPECTRAL IMAGES ARE
FINDING THEIR IMPORTANCE
IN DIFFERENT FIELDS BEYOND
REMOTE SENSING
APPLICATIONS WHERE IT WAS
TYPICALLY USED.

Hyperspectral imaging –

AIRBORNE APPLICATIONS

- hyperspectral data must be correlated to locations on the ground
- system must include the sensor, plus additional hardware and processing to synchronize the sensor data with flight information, such as heading, speed, inertial information and location gathered from a combination of inertial measurement unit and global positioning system (GPS) data.
- systems must all be synchronized so that the HSI data can be mapped to a ground location, i.e. georectification.
- Some applications also require orthorectification, which takes into account the topography of the imaged area.

- PRECISION AGRICULTURE: site specific management tactics to maximize yield and resources while reducing environmental impacts such as over-fertilization and broad application of pesticides. Pinpoint areas requiring attention (water, weed, pathogen treatment, nutrient adjustment). Crop monitoring for nutrients, water-stress, disease, insect attack and overall plant health.
- REMOTE SENSING: In remote sensing technology it is very important to distinguish earth surface features, each features have different spectrum band. Multi spectral satellite can capture image up few bands for example Landsat 7 have 8 bands. But multi spectral imaging satellite can capture earth surface in more than 200 bands which helps scientist to differentiate objects that were not possible in multi spectral imaging because of spectral resolution.
- ENVIRONMENTAL MONITORING: Hyperspectral imaging is becoming widely popular for tracking changes in the environment. It is commonly used to understand surface CO2 emissions, map hydrological formations, tracking pollution levels, and more.
- OIL AND GAS¹: detection of onshore oil seeps (The Geosat Committee Inc. documented the spectral characteristics of seeps and associated oil-impacted soils and constructed a spectral library to enable deployment of the application to other geographical areas. This oil-focused spectral library may be the first of its kind in the commercial sector and includes signatures with varying amounts of oil, tar, vegetation, soils,...)

Hyperspectral imaging – GROUND APPLICATIONS

- **IN-PROCESS MONITORING:** better sorting, recognition of defects, and identification and elimination of health hazards, offering significant overall improvements to standard machine vision. The added spectral information increases the ability to detect and identify targets.
- **SEED VIABILITY STUDY:** By using the hyperspectral image and plotting the reflectance spectrum one can conclude that whether those seed are viable or not viable. Seed might be looking same through naked eyes but its viability will be trace down by the hyperspectral image.
- **ENVIRONMENTAL MONITORING:** Hyperspectral imaging is becoming widely popular for tracking changes in the environment. It is commonly used to understand surface CO2 emissions, map hydrological formations, tracking pollution levels, and more.
- **FOOD QUALITY CONTROL:** Hyperspectral imaging is widely used in the food sector. It is used in different discipline of food industry, bruise detection in apples, freshness of the fish, citrus fruit inspection, distribution of sugar in melons, and sorting of potatoes.
- **MEDICAL DIAGNOSE:** Early disease detection and disease prevention are very important for the healthy body. Hyperspectral imaging technology can be used to detect the early of various types of cancer or retinal disease.
- **FORENSIC SCIENCE:** Hyperspectral imaging technology can differentiate fine spectral resolution, which makes it suitable in the forensic laboratory. It can be used in different way: questioned document analysis, arson investigation, bloodstain visualization (differentiation from dark marks), fiber comparison, gun powder residue, visualization, duct tape examination, fingerprint enhancement, and TLC plate visualization.
- **PHARMACEUTICALS:** Hyperspectral imaging technique is widely used to enhance the quality control. It is used widely to control the counterfeit or illegal drugs, managing the packaging of medicine and mixing of the powder.
- **BIOTECHNOLOGY:** Hyperspectral technology has become popular in the biological and medical applications. It is easy and quick to acquire the data that can be used in the laboratory. Mostly they are used in the study of the wound analysis, fluorescence microscopy, and cell biology.
- **THIN FILMS:** As hyperspectral imaging can distinguish tiny object, it has been widely used for the quality control of the Thin Film manufacturing process.

Hyperspectral Earth Remote Sensing

OFFERING	WHAT	HOW	Existing New Space Players
<i>High Spatial and Spectral Resolution Data from Distance (Imaging spectroscopy)</i>	Water resource changes Mapping of strategic minerals Ecosystem science and natural resource management Changes in the environment Precision agriculture Detection of on-shore oil seeps Tracking of pollution levels Mapping of terrestrial vegetation Mapping of man-made materials	Hyperspectral image sensors produce narrow wavelength bands enabling a continuous spectrum for each image cell	Galileo Group Inc HyperSat LLC Orbital Sidekick Waypoint Telescope Precision Hawk

CUSTOMERS	INTEREST	Website
Galileo Group LLC	Precision agriculture, species mapping, phenotype data, vegetation management, hydrocarbon detection, mineral mapping, coral reef and wetland monitoring, vegetation management, aquatic vegetation mapping, invasive species, oil spill mapping	https://galileo-gp.com/
Lumasense Technologies	Thermal imagers and systems; gas sensing and monitoring	https://www.lumasenseinc.com/EN/home/home-lumasense-technologies.html
USGS/NASA SV Innovation Center	For land managers and policy makers to make informed decisions about natural resource monitoring and the environment	https://geography.wr.usgs.gov/InnovationCenter/about.html
Suez water technologies	Water treatment technologies, refining, upstream oil and gas; power; pulp and paper; metals and mining (robust, environmental friendly production), compliance with safety regulations	https://www.suezwatertechnologies.com/
Resonon	Completely integrated turnkey solutions for georegistered hyperspectral data. Precision agriculture, biotech, environmental monitoring, security and defense, quality control for thin film manufacturing (solar panels)	https://resonon.com/
TE connectivity	Advanced connectivity and sensors solutions for a safer, sustainable, productive and connected future	https://www.te.com/usa-en/home.html
NOAA: FIREX program NOAA: Atmospheric Division (ATDD)	Fire Influence on Regional and Global Environments Experiment Air quality, climate and dispersion related research directed towards issues of national and global importance	https://www.esrl.noaa.gov/csd/projects/firex/ http://www.atdd.noaa.gov/
Anandarko	Deliver a competitive and sustainable strategy to develop, acquire and explore oil and natural gas resources while meeting environmental standards	https://www.anadarko.com/
Kearfoot Corporation	Guidance, navigation and motion control. Underwater, maritime vessels, land vehicles, spacecraft.	https://www.kearfott.com/
Surface Optics	Characterization, control and exploitation of the optical properties of surfaces	https://surfaceoptics.com/

Hyperspectral Asteroid Remote Sensing

OFFERING	WHAT	HOW	Existing New Space Players
<i>Detection, discovery, characterization and mapping of Space Resources</i>	Detection of water, platinum and other valuable asteroids Mapping of off-planet strategic minerals Tracking asteroids for Earth impacts Computing asteroid and comet orbits and their odds of Earth Impact Resources for in-situ utilization	Hyperspectral image sensors Other detection methods Computational algorithms Risk assessment	Aten Engineering Asteroid Initiatives B612 Foundation Ceres Robotics Miles Space

CUSTOMERS	INTEREST	Website
USGS/NASA SV Innovation Center	Assessment of natural resources (mineral, energy and water) extended to space. USGS has identified preliminary areas where specific knowledge is needed.	https://minerals.usgs.gov/science/astra/index.html
NASA JPL Center for Near Earth Object Studies	Water treatment technologies, refining, upstream oil and gas; power; pulp and paper; metals and mining (robust, environmental friendly production), compliance with safety regulations	https://cneos.jpl.nasa.gov/
Deep Space Industries	An asteroid mining company developing the technologies to find, harvest and supply the asteroid resources	http://deepspaceindustries.com/
Miles Space	Developing a satellite to orbit the moon and then head to a deep space asteroid to compete for Cube Quest Challenge	https://miles-space.com/
Off World	Developing universal industrial robots to do the heavy lifting on the Moon, asteroids and Mars	https://www.offworld.ai/
Planetary Resources	Pursuing technology that will enable asteroid mining	https://www.planetaryresources.com/
Trans Astra Corp	Services for asteroid mining, space solar power, space tourism and manufacturing in space	http://www.transastracorp.com/

AIRBORNE REMOTE SENSING: DRONES



[← back to OUTLINE](#)



Drone
architecture
and value
chain



BUILDING BLOCKS
PROPELLORS (STANDARD, PUSH)



MOTORS



ANTENNA



RECEIVER/TRANSMITTER



CONTROLLERS (ESC, FLIGHT)



GPS MODULE



POWER DISTRIBUTION



LANDING GEAR



BATTERY



CAMERA

VALUE CHAIN*

DESIGNS

~3Bn/yr

SALES AND MARKETING

ASSEMBLY

~3Bn/yr

PRODUCTION

VALUE ADDED SERVICES ~14 Bn/yr

PILOTING

~10Bn/yr

OPERATIONS

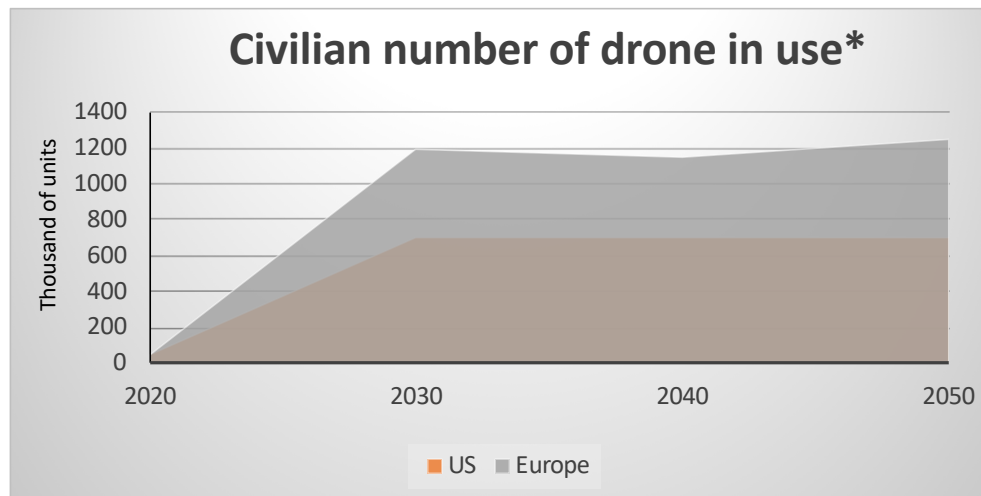
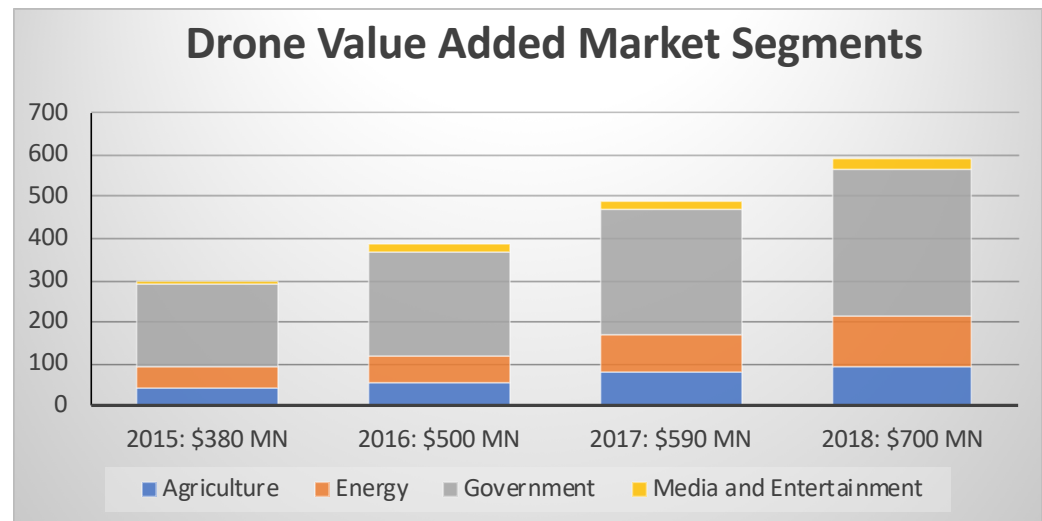
MAINTENANCE

INSURANCE ~5Bn/yr

*by 2035

DRONES- Market forecast

***Global Aerial Drone Market
is forecasted to be \$13 Bn
by 2020 with 70% for
military/defense and only
30% civilian***



**Civilian drones in use include nonmilitary government use (police, maritime surveillance, etc)*

***As commercial fleets are
built, drone services and
product sales could
approach \$50 Bn per year
by 2050***

Drones major applications and players

OFFERING	WHAT	HOW	Existing New Space Players
<i>Unmanned Aerial Vehicles, aircraft without human pilot aboard</i>	Search and rescue operations: situational awareness; harsh weather environments Public safety and law enforcement Defense Critical infrastructure inspection and monitoring precision agriculture media and entertainment; retail surveying/mapping Insurers (will sell drone coverage and are considering the use of drones for inspecting damage from storms and natural disasters)	Robotic aircraft typically piloted remotely; fully autonomous drones are under development. They can vary in size and shape but have the same main parts (battery, microcontroller, motor, sensors) Made of smart phone parts, they are valuable for their mobile hardware and internet connectedness. They can serve as platform for applications, software and business models.	INOVA Drone Nimble Aircraft Aerial Productions Raven Black Swift Technologies Precision Hawk

CUSTOMERS	INTEREST	Website
3D ROBOTICS	ENTERPRISE DRONE SOFTWARE PLATFORM FOR CONSTRUCTION, ENGINEERING, MINING AND GOVERNMENT	https://3dr.com/
Black Swift Technologies	Precision Aerial Mapping with cm level results at 40% of the cost of traditional surveying.	http://www.blackswifttech.com/
VITEC group	Leading global provider of premium branded products and solutions for image capture and content creation market	https://www.vitecgroup.com/
Cradlepoint	Cloud delivered 4G LTE network solutions for business, service providers and government organizations	https://cradlepoint.com/
General Dynamics	Advanced business aircraft and business aviation services	https://www.gd.com/
Unmanned Systems Source	E-commerce warehouse with the fastest growing selection of unmanned parts, products, components and systems. Positioned as a single source of supply and information. Provides supply chain solutions for many companies/customers.	www.unmannedsystemssource.com
NASA Airborne Science Program	Wildfire, glaciology, Antarctic observations, pollution (smoke-clouds), earth observations, flooding, melting Greenland impact.	https://airbornescience.nasa.gov/
NOAA FIREX program NOAA Atmospheric Division (ATDD)	Fire Influence on Regional and Global Environments Experiment Air quality, climate and dispersion related research directed towards issues of national and global importance	https://www.esrl.noaa.gov/csd/projects/firex/ http://www.atdd.noaa.gov/
Geotech Environmental Equipment Inc/Lepton UAS	Designs, manufactures and distributes UASs, UAVs or drones for law enforcement, military, environmental protection, oil and gas, mining, agriculture and other applications	http://www.leptron.com/
FEMA (Federal Emergency Agency)	Disaster recovery (wildfire, hurricanes, etc), search and rescue operations.	https://www.fema.gov/
American Bureau of Shipping	Remote inspection to evaluate condition of a structure/asset from a stationary location	https://ww2.eagle.org/en.html

SPACE TECHNOLOGY



[← back to OUTLINE](#)

Space
Technology
software,
sensors,
subsystems

New Space companies

[Loft Orbital](#): end to end integration for space missions

[Galactic Sky](#): software defined satellite platform; rapid execution on orbit to demonstrate true utility and viability skipping the traditional process of building a spacecraft, integrating it with a ground system and waiting for the launch opportunity

[Blue Canyon Technologies](#): complete spacecraft services (satellites bus)

[Analytical Graphics \(AGI\)](#): R&D for commercial modeling and analysis software moving through space and time

[Satellytics](#): Uses science, software and technology to identify problems before they become disasters, environmentally, financially, or otherwise ensuring that any money is spent in prevention and remediation are direct and effective.

[Accion Systems](#): ion electrospray propulsion

Customers:

[Caterpillar](#): Develops infrastructure, energy and natural resource assets. World's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel -electric locomotives; robotics. Industry segments: Construction Industries, Resource Industries; Energy & Transportation.

[Space System Loral/Maxar Company](#): SSL is a global leader in integrated space technologies, delivering advanced systems for communications, exploration, data gathering, and next-generation services. Based in the U.S., the company designs and manufactures innovative spacecraft and space-related systems with an advanced product line that includes high-power geostationary satellites, state-of-the-art small satellites, and sophisticated robotics and automation solutions for remote operations.

[The Aerospace Corporation](#): Independent, not for profit corporation operating the only federally funded research and development center for the space enterprise, performs objective technical analysis and assessment (research, design, development, acquisition, operations, program management)

[United Launch Alliance](#): rocket manufacture and launch services provider

[Blue Origin](#): suborbital and orbital launch services, rocket technology, sub-orbital flights for entertainment or research

[SpaceX](#): rocket manufacturer and launch services provider. ISS cargo and crew transportation via Dragon.

Software for Space Applications

OFFERING	WHAT	Existing New Space Players
<i>System engineering</i> <i>Lifecycle analysis</i> <i>Quality management</i> <i>Safety and security</i>	System's thinking for data analysis and software development; End product quality monitoring Dynamic of complex systems, interfaces, etc Data science (analysis of space images, etc) Safety management consultancy	Orbit Logic The Hammer's company QubeStation Kubos Kratos A.I Solutions All Source Analysis Space Claim

CUSTOMERS	INTEREST	Website
AGI	R&D for commercial modeling and analysis software moving through space and time	http://agi.com/home
NVidia	Broad interest in software for space applications such as space resources, space weather, space mining	https://www.seti.org/press-release/nasa-fdl-leverages-public-private-partnership-push-new-boundaries-space-science-artificial
Autodesk	Space mining, in-situ resource utilization	www.autodesk.com
Aerospace Corporation	risk assessment for satellite constellations; cyber defense (real time monitoring capabilities) monitoring of space radiation environment and weather AI platform that designs real life solutions mission design (space missions)	https://aerospace.org/
Ansys	Engineering simulations across entire product lifecycle from digital exploration to prototyping to operations and maintenance	https://www.ansys.com/products/3d-design/ansys-spaceclaim
Space Works Engineering	Aerospace software development and engineering services focused on future flight and space exploration technologies	http://spaceworkseng.com/
Northrop Grumman	Logistics, autonomous systems, cyber security, launch, etc	http://www.northropgrumman.com
Raytheon Corporation	Mission support, command and control; cybersecurity;	https://www.raytheon.com/
Space Weather	Daily monitoring of solar flares, geomagnetic storms, Earth's aurora, and all forms of space weather	http://spaceweather.com/
Alanax Technologies	Modelling and simulation of ground and satellite communication networks	http://www.alanax.com/

Insurance Industry

OFFERING	WHAT	HOW	Existing New Space Players
<i>Insurance and reinsurance for space and from space</i>	Space Insurance (launch, in-orbit, space tourism) Property Insurance (terrestrial) Insurance sharing across multiple payloads Space Operations Insurance Insurance for satellite missions	Underwriting methodology based on managing technical and policy risks Use of satellite data Combining insurance procurement and risk assessment services	Assure Space Delos Space Geoshare AXA XL XS Space Insurance

CUSTOMERS	INTEREST	Website
CHUBB	Wildfire protection, airports and aircrafts, aviation operations; satellites, agriculture, cleantech, construction	https://www.chubb.com/us-en/
Space Florida	Spaceport Florida is one of the “test beds” of the New Space Industry from many different perspectives including insurance	http://www.spaceflorida.gov/
Safeco Insurance	Property insurance (including flood, wildfire)	https://www.safeco.com/
Travelers	Individual and business insurance; prepare and prevent perspective	https://www.travelers.com/
Nationwide	Individual and business insurance; prepare and prevent perspective	https://www.nationwide.com/
AXA XL	A unique and comprehensive suite of insurance products for space operations	https://axaxl.com/
AIG	Insurance for aerospace	https://www.aig.com/business/insurance

Glass Microbonding & Hermetic Packaging

OFFERING	WHAT	HOW	Existing New Space Players
<i>Glass micro bonding for casing and protecting miniature components; hermetic packaging</i>	No use of adhesive circumvents outgassing issues currently limiting the spectrum of ISS utilization/experiments because of human proximity Space applications where equipment is frequently not serviceable, so it needs to be robust and long lasting Space power generation Extreme environment science	Non-additive and heatless (will not change coating properties) RF transparent; Can be remotely probed (RFID/GPS) or even reprogrammed Hermetically sealed High-temperature capability	Alpha Space Infinite Composites Martin Materials Solutions Sienna Technologies Acktar

CUSTOMERS	INTEREST	Website
HP SpaceBorne Computer ¹	Electronics for space computing and data centers	www.hpe.com
SpaceBelt	Electronics for space data centers	http://spacebelt.com/
Space Systems Loral	Electronics for geo satellites and small satellites; etc	http://sslmda.com/
Nanoracks	Offer alternative to current outgassing adhesives for a variety of payloads to operate on the ISS	http://nanoracks.com/
Honeywell Technology Center	MEMS for small sats and cube sats (micro thrusters, etc)	Http://htc.honeywell.com
NASA Space Technology Mission Directorate, SMD, JPL	NASA formation flying (multiple spacecrafts operating in close proximity)	https://scienceandtechnology.jpl.nasa.gov/precision-formation-flying
NASA (STMD, SMD) DOD Air Force USGS Innovation Center	Ground Facilities Diagnosis for Space Technology (arc-jet, propulsion) Lunar Surface operations Mining and mineral extractions Space Power generation Extreme environment science, Environmental monitoring on ISS	https://www.nasa.gov/centers/ames/research/technology-onepagers/arcjetcomplex.html https://www.nasa.gov/centers/wstf/testing_and_analysis/propulsion_systems/engine_testing.html https://geography.wr.usgs.gov/InnovationCenter/index.html
TE connectivity	Advanced connectivity and sensors solutions for a safer, sustainable, productive and connected future	https://www.te.com/usa-en/home.html
AZ Technology	Organic Coatings, Optical Devices	http://www.aztechnology.com/
Bigelow Aerospace	design, development, and construction of habitable space structures; sensors; ECLS; communication; materials; bonding and packaging; radiation detection; space weather;	http://bigelowaerospace.com/

Junction Black Silicon Photodiodes

OFFERING	APPLICATIONS
<i>junction black silicon photodiodes with external quantum efficiency (EQE) greater than 96% over a broad range of wavelengths (250 nm to 950 nm)</i>	Radiation detection sensors -terrestrial use: monitor UVA/UVB dosage rates; ozon layer -space use: space weather, flare activity Scientific applications: UV shock layer radiation characterization; astrophysics, heliophysics Astrophysics and medical applications: X-ray detection Optical secure satellite communications Flame detection Monitor UV lamps in air purification systems for replacement needs; UV sources for UV curing processes

CUSTOMERS	INTEREST	Website
HP SpaceBorne Computer ¹	Radiation detection sensors (UVA/UVB dosage rates), flare activity to avoid disk frying	www.hpe.com
SpaceBelt	Radiation detection sensors (UVA/UVB dosage rates), flare activity to inform level of required protection	http://spacebelt.com/
Space Systems Loral	Optical secure satellite communication (formation flying, stationkeeping satellite to satellite)	http://sslmda.com/
Honeywell Technology Center	MEMS for small sats and cube sats (micro thrusters, etc)	Http://htc.Honeywell.com
NASA Space Technology Mission Directorate, SMD, JPL	NASA formation flying (multiple spacecrafts operating in close proximity) Safety devices for flame detection ECLSS	https://scienceandtechnology.jpl.nasa.gov/precision-formation-flying https://www.nasa.gov/mission_pages/station/research/experiments/280.html https://www.nasa.gov/centers/marshall/history/eclss.html
NASA (STMD, SMD) USGS Innovation Center	Space Weather UV shock layer radiation characterization Lunar Settlement Absorptivity of the atmosphere	https://www.nasa.gov/subject/3165/space-weather/ https://www.nasa.gov/centers/ames/aerothermodynamics/facilities.html https://geography.wr.usgs.gov/InnovationCenter/index.html
United Launch Alliance	Monitor rocket launches and testing	https://www.ulalaunch.com/
Lockheed Martin	Missile Signatures, optical secure satellite communications; flare activity;	https://www.lockheedmartin.com/en-us/capabilities/space.html
Bigelow Aerospace	design, development, and construction of habitable space structures; sensors; ECLS; communication; materials; bonding and packaging; radiation detection; space weather;	http://bigelowaerospace.com/

AR Onsite Help

OFFERING	WHAT	HOW	Existing New Space Players
<i>Onsite help using AR and video streaming</i>	Augmented Reality based remote collaboration solution for industry and professionals. Customer service and field support teams in unbeatable response time. Safe, multi-channel communication protocol.	Remote customer support with Augmented Reality and live video	AEXA aerospace EON Reality

Space customers	INTEREST	Website
NASA ISS Technology Demonstrations	Manned space flight; remote medical help; remote repairs on space station	https://www.nasa.gov/mission_pages/station/research/tdemo
Bigelow Aerospace	Remote assistant, “front desk for future space hotels”	http://bigelowaerospace.com/
Axiom Space	Manned space flight; remote medical help; remote repairs on space station	https://axiomspace.com/
Blue Origin	Suborbital and orbital launch services, rocket technology, sub-orbital flights for entertainment or research	https://www.blueorigin.com/
Nanoracks	Remote support for payload integration, space safety qualification	http://nanoracks.com/

Terrestrial customers	INTEREST	Website
Farmers Insurance	Helping claim adjusters with insurance claims	https://www.farmers.com/
ATHEER	Center of the growing ecosystem of enterprise Augmented Reality solutions	https://atheerair.com/
ZOHO CRM	AI assistant prioritization helping the sales process	https://www.zoho.com/crm/
Lemon and Orange	Improve marketing campaigns with AR fitting rooms	http://lemonorange.pl/en/offer/augmented-reality/

Recommendations:

- Integration capabilities through ZenDesk or Salesforce are important to access a broad customer base
- Emphasis should be placed on the quality of the connection and spotless communication with end customer

Connectivity and IoT

*“The Internet of Things refers to the ever-growing network of physical objects that feature an IP address for internet **connectivity**, and the communication that occurs between these objects and other Internet-enabled devices and systems.”*

https://www.webopedia.com/TERM/I/internet_of_things.html



*Murata Wireless Technologies: <https://www.murata.com>

[↩ back to OUTLINE](#)



Connectivity and IoT
*autonomous mobility;
asset management;
tracking of ships;
airplanes; overlapping
weather patterns;
logistics*

New Space companies

[Blink Astro](#): Reaches remote M2M devices (spotty cellular zones, offshore platforms, remote farming locations, etc) through a secure and affordable global coverage network of small satellites orbiting Earth at 700km and enable sensor data upload to deliver information for tracking of shipments, improving crop yield, monitor energy production and transport, monitor the environment, etc.
CUSTOMERS:

[Kymeta](#): world's first electronically steered, flat-panel satellite terminal for high-throughput, mobile communications. Provides connectivity for rail, construction, civilian armored vehicles, disaster relief, mining, first responders, trucking, buses, etc.

•CUSTOMERS: Toyota, Intelsat, Panasonic, Inmarsat, Sharp, Intellian, O3B.

[Metavoyant](#): Data Analytics for space applications

Customers

[Connectivity Lab at Facebook](#): affordable internet via satellites

[GlobeComm](#): Smart connectivity solutions to address customer issues across a broad spectrum of areas, including system design and integration, managed communication services including mobile and IoT, media services and mission critical networks.

[CloudConnect by Iridium IoT](#): voice and data connectivity anywhere in the world. maritime, aviation, government/military, emergency/humanitarian services, mining, forestry, oil and gas, heavy equipment, transportation and utilities

[OrbComm](#): leading global provider of IoT and M2M communication solutions that remotely track, monitor and control fixed and mobile assets

[International Container Terminal Services](#): Leader in port management, operations and development; acquiring, developing, managing and operating container ports and terminals worldwide.

[Maerks](#): Connecting global trade; supply chain design; tracking and shipping including cargo services; freight forwarding (ocean shipments, airfreight, inland transportation); network, logistics

[SITA](#): World's leading specialist in air transport communications and information technology; Air traffic management, online platforms, aviation weather

Major SV IoT players*



[Images used are credited to:
[Plug And Play Technology Center](#)]

*Plug and Play [IoT platform](#)

Connectivity and IoT - customers

autonomous mobility; asset management; tracking of ships; airplanes; overlapping weather patterns; logistics

Autonomous mobility	Assets under Management	Automatic Identification Systems	Maritime Analytics & Tracking	Airplanes	Weather forecasting	Logistics
Drive.ai Frisco Transp Manag Assoc (TMA) Waymo City of Arlington (TX) City of Frisco (TX) The Star in Frisco, TX Hall Group Fiat Chrysler US Kymeta Nissan Res Ctr SV Aptiv Baidu Mobileye GM Cruise Automation Iridium HERE Northrop Grumann	Satelitycs PG&E CITRIX VMWare Orange/OSV SES GlobeComm ORBCOMM Iridium IoT Deloitte Chubb Traveler Progressive American Modern Maritime International Ericsson ABB/Transformers	Intelsat Iridium Satellite Communications CITRIX VMWare Orange/OSV SES GlobeComm ORBCOMM Iridium IoT Traveler Progressive Chubb American Modern Maritime International Ericsson ABB/Transformers	Buffalo Automation AutoNaut AIG ExactEarth Spark Cognition Maritime International ICTSI Ericsson ABB Marine Inmarsat Eniram ORBCOMM EMC/Global Eagle Maersk Comsat	AIREON NAV Canada Iridium Satellite Communications NATS USA NavAir Harris NASA ARMD FAA Raytheon Aircraft Honeywell Northrop Grumann SITA Comsat	Allianz Iridium Satellite Communications CITRIX VMWare SES GlobeComm ORBCOMM NAV Canada NOAA	Intelsat Iridium Satellite Communications CITRIX VMWare Orange/OSV SES GlobeComm ORBCOMM Iridium IoT Connectivity Lab@Facebook Maritime International Ericsson ABB/Transformers

In space autonomous mobility

OFFERING	WHAT	HOW	Existing New Space Players
<i>Providing launching, tracking, monitoring and servicing of in-space assets</i>	Tracking and monitoring Autonomous diagnostic systems (terrestrial and on-orbit) Autonomous space plane Autonomous launch vehicle Teleportation	Use CubeSats to diagnose malfunctions or failures in and repair larger conventional satellites Manipulable robotic arms Self-propelled transport CubeSat	Amods Phantom Express (Boeing) Relativity Space Envobius

CUSTOMERS	INTEREST	Website
ULA	In-space transportation systems	https://www.ulalaunch.com/
NASA Space Technology Mission Directorate	Space transportation, Leo infrastructure	https://gameon.nasa.gov/
Maxar Technologies	next-generation propulsion, space robotics, on-orbit servicing, on-orbit assembly, and protection of space assets through cybersecurity and monitoring of space systems	https://www.maxar.com/our-company/meet-maxar
Momentum Space	Powering in-space transportation systems	https://momentus.space/
Iridium	Satellite servicing for extension of operational lifetime	https://www.iridium.com/solutions/iot/
Caterpillar	In space robotics and mining	https://www.caterpillar.com/

Terrestrial Autonomous Mobility

OFFERING	WHAT	HOW	Existing New Space Players
<i>Satellite based communication IoT, autonomous driving and asset mapping</i>	Global web based monitoring and control Design and manufacture of tracking devices CM level accuracy Worlds first electronically steered, flat panel satellite terminal Antennas (K-band)	Multiband, multi-constellation RTK GNSS receiver Automate switching between cellular and satellite networks Ground stations Open platform, dual core processor	Blue Sky Network Orbital Tracking Corp Swift Navigation Kymeta

CUSTOMERS	INTEREST	Website
Baidu	Robotics and autonomous driving	http://research.baidu.com/
Mobileye	road experience management mapping platform ; collision avoidance	https://www.mobileye.com/en-us/
GM Cruise Holding	self-driving vehicles to safely connect people with the places, things, and experiences they care about	https://getcruise.com/
Waymo	Self driving technology	https://waymo.com/
Aptiv	Safer, greener, connected solutions for the future of mobility	https://www.aptiv.com/
Zenuity	Automated driving	https://www.zenuity.com/
BMW/ HERE	Mapping data, gps navigation software; world's leading location platform	https://www.here.com/

Tracking of Ships and other assets

OFFERING	WHAT	HOW	Existing New Space Players
<i>Satellite tracking everywhere, anytime</i>	Global automatic identification system Weather forecast Global tracking Fleet management	Satellite based data and analytics with coverage of remote regions Geospatial data Enterprise AI software solutions	Blue Sky Network Orbital Tracking Corp Swift Navigation Exact Earth Spark Cognition

CUSTOMERS	INTEREST	Website
SpaceX	Tracking the SpaceX Fleet that does not go to space	https://www.spacexfleet.com/
Spire	Port operational improvement, port alerting, vessels database (track and visualize), dedicated connectivity	https://spire.com
American Bureau of Shipping	Rapid Response damage assessment	https://ww2.eagle.org/en.html
Clear Metal	Global Supply Chain Visibility for (real time inventory level visibility) for shipments	https://www.clearmetal.com/
EMC Global Eagle	Remote communication; fast content delivery; onshore and offshore communications;	http://emcconnected.com/
Navis	Tracking of fragile, large, awkward and valuable items assets	https://www.gonavis.com/
Intelsat	Coverage and flexibility, connectivity; Connected ships/Smart Ships; Broadband on the highseas	www.intelsat.com
Orbcomm	leading global provider of industrial IoT and Machine to machine (M2M) communication solutions that remotely track, monitor and control fixed and mobile assets (including heavy equipment)	https://www.orbcomm.com/
Maersk	Connecting global trade; supply chain design; tracking and shipping including cargo services; freight forwarding (ocean shipments, airfreight, inland transportation); network, logistics	www.Maersk.com
Buffalo Automation	Autonomous boats	http://www.buffautomation.com/
ICTSI	Port management and operations, container and terminal services.	https://www.ictsi.com/default
Eniram	Fleet, voyage and vessel energy efficient management	https://www.eniram.fi/
ABB Marine	Sensors, autonomous shipping, fuel efficiency	https://new.abb.com/marine
Comsat	secure, world-class global satellite connectivity solutions to government, military and commercial maritime customers operating in land, aeronautical and maritime service environments.	https://www.comsat.com/

Aeronautics and Airplanes

OFFERING	WHAT	Existing New Space Players
<i>Advanced electronics solutions; global air traffic, communication and aviation safety</i>	Advanced electronics/harsh environments RF and microwave technology Digitization; secure connectivity Global surveillance, ADS-B	Slingshot Aerospace AireOn Agile Aero

CUSTOMERS	INTEREST	Website
Nav Canada	global airspace monitoring, collision avoidance, improved air traffic scheduling, global communications	www.navcanada.ca
FAA	US air traffic and aviation safety, air travel regulation, unmanned aircraft systems, commercial space transportation	www.faa.gov
SITA	World's leading specialist in air transport communications and information technology. Air traffic management, online platforms, aviation weather	https://www.sita.aero/
Raytheon Aircraft	Largest manufacturers of aircrafts in the world. Raytheon Aircraft produces one of the widest ranges of aircraft of any manufacturer in the world: from six-seat, single-engine, propeller-driven aircraft, to light and medium twins, to large corporate turboprop twins, and small and mid-sized business jets -- as well as military and special-mission conversions of some of its aircraft, and turboprop commuter airliners. Raytheon's new 'Aviation Warrior' system is helping to make pilots all-knowing and all-seeing, with state-of-the-art situational awareness technology that can be worn by the pilot.	http://home.iwichita.com/rh1/hold/av/avhist/bch/raytheon.htm https://www.raytheon.com/capabilities/products/aviation-warrior
AIREON	An international joint venture with NavCanada targeting the deployment of a space based Automatic Dependent Surveillance-Broadcast (ADS-B) system that will expand air traffic surveillance (safety, operational, cost) to all regions of the globe (with no need for ground infrastructure)	https://aireon.com/
Harris	Air Traffic Management, Analytical Instrumentation, Antenna Products, Avionics, Broadband Communication, Piezoelectric Ceramics, night vision, robotics, smallsat solutions, space antennas, space payloads and electronics; SATCOM; undersea systems	https://www.harris.com/
NavAir	Aviation systems, unmanned	http://www.navair.navy.mil/
Comsat	Secure, world-class global satellite connectivity solutions to government, military and commercial maritime customers operating in land, aeronautical and maritime service environments.	https://www.comsat.com/
NASA ARMD Aeronautics Research Institute (At NASA Ames Research Center)	Safe, efficient global operations; innovation in commercial supersonic aircraft; ultra-efficient commercial vehicles; alternative propulsion and energy; real-time system-wide safety assurance; autonomy for aviation	https://www.nasa.gov/aeroresearch/leadership https://nari.arc.nasa.gov/

Urban Development

“**Urban development** refers to *urbanization* with its different dimensions and perceptions: physical (land use change: urban sprawl, increase in artificial surfaces), geographical (population&employment concentration), economic (markets, agglomeration economies&knowledge spillovers) and societal (social&cultural change).”

http://www.wikialps.eu/doku.php?id=wiki:urban_peri-urban_development

[⚡ back to OUTLINE](#)



New Space companies

Customers:

URBAN DEVELOPMENT
infrastructure development and maintenance; pollution; traffic patterns; waste management; urban planning and development; workforce of the future; population and refugee migration patterns; impact of global warming and rising sea levels

[Speedcast](#): Reaches remote M2M devices (spotty cellular zones, offshore platforms, remote farming locations, etc) through a secure and affordable global coverage network of small satellites orbiting Earth at 700km and enable sensor data upload to deliver information for tracking of shipments, improving crop yield, monitor energy production and transport, monitor the environment, etc.
CUSTOMERS: Schlumberger

[Swiftera](#): Real time urban imagery company

[Ragnarok Industries](#): specialized in polar satellite broadband service connectivity for in-flight WiFi, maritime vessels, remote oil, gas and mining, search and rescue, coastal patrol

[ScepterAir](#): Actionable real-time air quality and air pollution information via satellites and other sensors

[Slingshot Aerospace](#): developing specific, repeatable solutions to geospatial information challenges. Next generation of signal processing AI.

[National Geospatial Intelligence Agency](#): delivers world-class geospatial intelligence that provides a decisive advantage to policymakers, warfighters, intelligence professionals and first responders

[NOOA](#): Weather forecast; climate data; fisheries; oceans and coastal monitoring; sanctuary permits; marine aviation; charting;

[Honeywell](#): invents and manufactures technologies that address world's most critical challenges around energy, safety, security, productivity and global urbanization. uniquely positioned to blend physical products with software to support connected systems that improve buildings, factories, utilities, and aircraft, and that enable a safer, more comfortable and more productive world. Our solutions enhance the quality of life of people around the globe and create new markets and even new industries. As a Fortune 100 company with \$40.5B in sales in 2017, Honeywell has established a track record of strong financial performance over time

[Boskalis](#): cleanup sediment; leading dredging and marine experts, decommission offshore platforms and pipelines; emergency response, asset tracking, salvage operations, coastal defense and riverbank protection, industrial scale maritime transport, subsea operations, windfarm installation, land reclamation

Population and Refugee migration patterns

OFFERING	WHAT	Existing New Space Players
<i>Predict migration, guide refugees, inform decision makers</i>	Satellite based data and analytics with coverage of remote regions Geospatial data Enterprise AI software solutions	Terra Bella- Planet

CUSTOMERS	INTEREST	Website
Children of War Foundation	Provides access to surgical intervention, rehabilitation, sustainable humanitarian aid, health prevention education and post-operative care to children. Provide information critical to refugees (water, food, healthcare, safety)	http://www.cowf.org
Booz Allen Hamilton	Building community resilience; integrating emerging technology, public policy, and efficient operations	https://www.boozallen.com/ ; https://www.boozallen.com/about/social-impact.html
National Center for Border Security and Immigration	Understanding of immigration determinants and dynamics; foster international trade, border security	http://www.borders.arizona.edu/
Office of Refugee Resettlement	The Refugee Agricultural Partnership Program (RAPP) improves the supply and quality of food in urban and rural areas through refugee farming.	https://www.acf.hhs.gov/orr https://www.acf.hhs.gov/orr/programs/rapp/about
Ford Foundation Center for Social Justice	Future of Work, Cities and regions, natural resources and climate change, civic engagement and government	https://www.fordfoundation.org/about/the-ford-foundation-center-for-social-justice/
Knight Foundation	Smart cities (harnessing the growth of digital technology to improve how communities respond, connect and engage with residents Public spaces: engage and connect residents to each other and the places they live	https://knightfoundation.org/programs
Terra Bella Planet	Pioneering the search for patterns of change on Earth to address economic, environmental and humanitarian challenges	https://www.planet.com/terrabella/

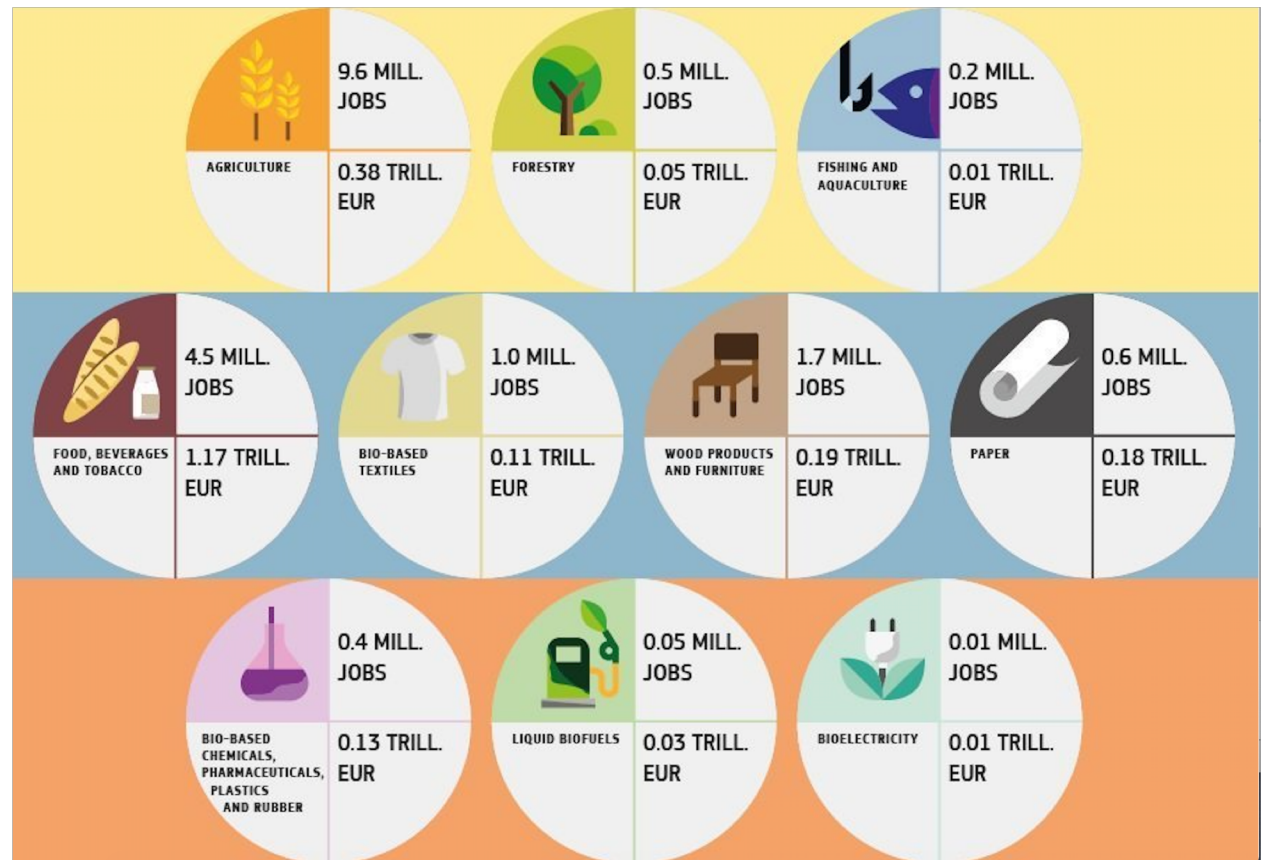
Workforce of the Future

CUSTOMERS	INTEREST	Website
Working Nation	Understanding the patterns of various variables that impact resource depletion in a certain region of the globe to predict potential population relocation events Provide information critical to refugees (water, food, healthcare, safety)	https://workingnation.com/
Orbital Insight	Geospatial analytics for resource (water) scarcity, measure anomalies in patterns of life	https://orbitalinsight.com/
Ford Foundation Center for Social Justice	Future of Work, Cities and regions, natural resources and climate change, civic engagement and government	https://www.fordfoundation.org/about/the-ford-foundation-center-for-social-justice/

Bioeconomy

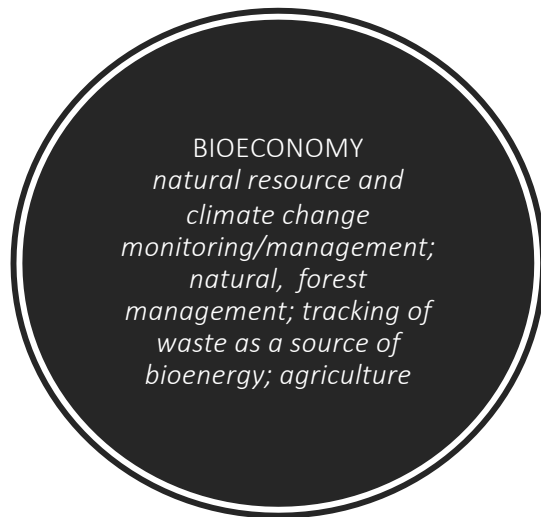
“**Bioeconomy** refers the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy.”

<http://www.bio-step.eu/background/what-is-bioeconomy/>



*European Commission 2016 Bioeconomy report (<https://www.european-bioplastics.org/european-commission-2016-report-on-the-bioeconomy/>)

[↩ back to OUTLINE](#)



New Space companies

[Orbital Insight](#): monitor global oil supply from production to consumer pricing; accurate yield and production estimates for US corn and soy;

[Forest+](#): advanced tools for the protection and management of forests; building positive value around forests and the people who live and work within; helping to ensure the legality and sustainability of commodities

[Farmshots](#): map out potential signs of disease, pests, poor nutrition to detect crop problems; prescription maps for fertilizer and crop protection application; multiple platforms analytics and data

Customers:

[Agrian](#): captures all the data points needed to farm precisely and effectively, including field mapping, planting and yield mapping, crop protection, nutrient management and variable-rate application, and move that data to the parties and equipment that need it; technological advances in the seed and input industries; library of input history for an entire operation, making it easy to answer questions and share information with documentation and simple to conduct internal operational reviews to improve sustainable practices

[GeoAgro](#): Organize farm information in maps. Keep records with GPS and pictures of field visits. Integrated and analyzed; monitor crops remotely; precision seeding; optimize management decisions for agricultural zones; yields, profits

[FarmersEdge](#): Data collection from farms (weather stations, telematic devices, integration on one platform);

[NOOA](#): Weather forecast; climate data; fisheries; oceans and coastal monitoring; sanctuary permits; marine aviation; charting;

[Wilbur Ellis](#): distribution of nutrients for livestock, pet food and aquaculture industries; distribution of crop protection, seed and nutritional products; precision agriculture

[Monsanto/Bayer](#): Global modern agriculture company that develops products and tools to help farmers around the world to grow crops while using water, energy and land more efficiently

Climate Change

CUSTOMERS	INTEREST	Website
Heising Simons Foundation	Advance sustainable solutions in climate and clean energy	https://www.hsfoundation.org/
Amazon Sustainability/Climate data	Leveling the playing field to allow access and analysis to massive datasets at global scale	https://blog.aboutamazon.com/sustainability/unlocking-sustainability-insights-around-the-world
NASA Earth Exchange	Downscaled climate projections	https://nex.nasa.gov/nex/
NASA Globe Observer	Track changes in clouds, water, plants, and other life in support of Earth system science	https://observer.globe.gov/
Bank of America	Climate change, transportation and water infrastructure	https://promo.bankofamerica.com/powerto/environment?cm_mmc=GBAM-Integrated--Google-PS--pollution--NB_Finance_Progress--Phrase_Climate_Change&gclid=Cj0KCQiAr93gBRDSARIsADvHiOrQCOpX7e202vQ5-x3SAG5nTVABwxQgOY8U4RJVkU-paDkhsvPfNFMaAhoxEALw_wcB
AutoNaut	Wave propelled unmanned vessel to monitor water quality, marine life	http://www.autonautusv.com/
Boskalis	emergency response, asset tracking, salvage operations, coastal defense and riverbank protection, industrial scale maritime transport, subsea operations, windfarm installation, land reclamation	www.Boskalis.com
Latham Watkins/Latham Sustainability	conserve natural resources and energy; decrease global carbon footprint; measure environmental impact;	https://www.lw.com/AboutUs/LathamSustainability
Maersk	pollutant tracking, ocean monitoring, wind monitoring	www.maersk.com
Southern Company	Clean, safe energy; natural gas distribution; including carbon-free nuclear	https://www.southerncompany.com

OFFERING	WHAT	HOW	WHO
<i>Natural resources monitoring</i>	Methane and CO2 tracking microsattellites	Satellite methane detection service	Bluefield
<i>Tracking of waste</i>	residential and industrial waste pickup and storage, recycling, hazardous waste	Opportunity for new space based solutions	Waste Management
<i>Real Time Urban Imagery</i>	All the time in real time imagery		Swiftera (OHB Systems)

Forest Management

OFFERING	WHAT	HOW	Existing New Space Players
<i>Management and protection of forests</i>	Mapping and inventory of forest plantations Carbon modelling of forestry Forest management and planning Valuation and appraisal of forest assets	Global satellite monitoring providing global map data	Forest + by EO

CUSTOMERS	INTEREST	Website
American Tree Farm System	certification for getting more good forestry on more acres and keeping it by following sustainable forest management practices and techniques	https://www.treefarmssystem.org/
American Forest Management	Long term land utilization, reforestation, quality forest inventory; wildlife management; timber sales	https://americanforestmanagement.com/
Northwest management	Forest land management, water resources and hydrology; fire and hazard mitigation	https://northwestmanagement.com/client-services/forest-land-management/
Milliken Forestry Company	Forest asset management (planning, management, appraisals); forest certification; endangered species consulting	https://millikenforestry.com/
Steigerwaldt Land Services	Forest land management, appraisals, natural resources and the environment	http://www.steigerwaldt.com/
USDA Forest service	manages and protects 154 national forests and 20 grasslands in 43 states and Puerto Rico. The agency's mission is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. Satellite imagery, geospatial analytics, weather prediction, climate modeling, forest fire detection remote sensing and image analysis, fire sensor technology	http://www.fs.fed.us/pnw
Inland forest management Inc	Forestry services, wildfire and fuels	http://inlandforest.com/
Saratoga Land Management Corp	Forest land and wildlife management	http://www.saratogaland.com/
Rayonier	Planning forest growth; forestry management, fire prevention	https://www.rayonier.com/
Texas A&M Forest Service	Wildfire and disasters preparedness; forest and land management; urban forestry	http://texasforestservice.tamu.edu/

Crop Monitoring

OFFERING	WHAT	HOW	Existing New Space Players
<i>Provide actionable intelligence to farmers at a reasonable cost</i>	Aerial imagery and mapping; Evaluation of soil quality and fertility Monitoring crop development and growth Identification of environmental stresses Yield forecasting Harvest planning Detection and Control of weeds and invasive species Optimized use and distribution of chemicals Water use and irrigation strategy	Geo-reference information (satellite imagery, drone-based surveillance, weather forecast, ground based sensors)	Planet (https://www.planet.com/) Geosys (https://www.geosys.com/) Descartes Labs (https://www.descarteslabs.com/) Farmshots (http://farmshots.com)

CUSTOMERS	INTEREST	Website
ADM Farmview	Commodity market updates; processing facilities; financial advice	https://www.adm.com/products-services/farmer-services
Willbur Ellis	pest diagnosis, yield monitoring, soil analysis, water management, nutrition, and regulatory and environmental issues; Provides most advanced crop production technology available	http://ag.wilburellis.com/About/pages/Home.aspx
Farmers Edge	Global leader in decision agriculture: developing data driven technologies that help farmers run efficient operations while producing more food for a rapidly growing globa	https://www.farmersedge.ca/
GeoAgro	Help the farming business to adopt technologies and precision ag processes. Reduce the gap between available equipment technology and what is effectively applied. Transform farm data into maps and knowledge to take better decisions. Organize farm information in maps. Keep records with GPS and pictures of field visits. Integrated and analyzed. Monitor crops remotely. Precision seeding. Optimize management decisions for agricultural zones; yields, profits	http://site.geoagro.com/en
Agrian	captures all the data points needed to farm precisely and effectively, including field mapping, planting and yield mapping, crop protection, nutrient management and variable-rate application, and move that data to the parties and equipment that need it. technological advances in the seed and input industries library of input history for an entire operation, making it easy to answer questions and share information with documentation and simple to conduct internal operational reviews to improve sustainable practices	https://home.agrian.com/
BP	Global modern agriculture company that develops products and tools to help farmers around the world to grow crops while using water, energy and land more efficiently. Several new programs. Check Biojet fuel production at the East and Gulf Coast Jet Trading	Patrick Grady, Commercial Manager

Agriculture

CUSTOMERS	INTEREST	Website
Bayer/Monsanto	Global modern agriculture company that develops products and tools to help farmers around the world to grow crops while using water, energy and land more efficiently	https://monsanto.com/company/
Willbur Ellis	distribution of nutrients for livestock, pet food and aquaculture industries distribution of crop protection, seed and nutritional products precision agriculture	http://www.wilburellis.com/portfolio/
Farmers Edge	Developing data driven technologies that help farmers run efficient operations while producing more food for a rapidly growing global population Data collection from farms (weather stations, telematic devices, integration on one platform);	https://www.farmersedge.ca/
GeoAgro	Help the farming business to adopt technologies and precision ag processes. Reduce the gap between available equipment technology and what is effectively applied. Transform farm data into maps and knowledge to take better decisions. Opportunities: crops monitoring; direct scouting to problem areas; maps of seeding, fertilizing operations and yields; quality of operations, controlling rates, speed, reduce negative impacts; recognize zones with productive potential; phototoxicity damage control via satellites	http://site.geoagro.com/en
Farmshots	Analyzes satellite and drone imagery of farms: 1. map out potential signs of disease, pests, poor nutrition to detect crop problems 2. prescription maps for fertilizer and crop protection application 3. analytics available on multiple platforms	http://farmshots.com/
Agrian	Holistic platform combining: precision, agronomy, sustainability, analytics and compliance 1. captures all the data points needed to farm precisely and effectively, including field mapping, planting and yield mapping, crop protection, nutrient management and variable-rate application, and move that data to the parties and equipment that need it. 2. technological advances in the seed and input industries 3. library of input history for an entire operation, making it easy to answer questions and share information with 4. documentation and simple to conduct internal operational reviews to improve sustainable practices	https://home.agrian.com/
Green Policy	democratizing access to information about the changing planet; eOs eco operating system to share news and green best practices	https://www.greenpolicy360.net/w/GreenPolicy360-eOS

AgTech Hub: The Mixing Bowl

AGTECH LANDSCAPE 2018



In-field Sensors & Systems

Post-Harvest Monitoring & Efficiency

Automation	UAV for Ag	Big Data Aggregators	Livestock / Herd Management - Software	Freshness	Food Safety Track & Trace	Food Recovery
VRT Applications	Imagery Systems	Data Analytics (Platform)	Animal Health Technologies	Cold Chain Monitoring	ERP	B2B Marketplace
Input Efficiency	Field Monitoring Sensors & Solutions	Imagery Analytics	Crop / Farm Management Software	Quality Management	Supply Chain	Trading & Finance
Sensors	Adaptive Irrigation	IOT Field Monitoring Platforms	Equipment / Asset Tracking	Supply Chain Analytics	3rd Party Logistics	Market Information

[Images used are credited to:
[The Mixing Bowl](http://TheMixingBowl.com)]

© SEANA DAY & THE MIXING BOWL

WWW.MIXINGBOWLHUB.COM

Seana Day
Seana@mixingbowlhub.com

SAFETY



[↩ back to OUTLINE](#)

SAFETY

*Safety; security and surveillance;
monitoring of high value assets; maritime
safety (wind patterns, typhoon and
hurricane tracking, position and size of
icebergs, topographic changes in
coastlines and river deltas, oil spill
detection, coastline monitoring)*

New Space companies

[Digital Globe](#): world's leading provider of high-resolution Earth Imagery, data and analysis

[Innoflight](#): advancing cyber security for space systems

[LeoSat](#): massive satellite constellation to reinvent the secure data transfer service

[Space Vault](#): world's first savings account to enable anyone to securely save, earn interest and support the space industry

[Aireon](#): space based global air traffic surveillance

[Blue Sky Network](#): advanced satellite asset tracking for intelligent fleet management

[Terra Bella- Planet](#): pioneering the search for patterns of change on Earth to address economic, environmental and humanitarian challenges

Customers:

[National Environmental Satellite, Data and Information Service](#): provide secure access to global environment data and information from satellites

[Secure World Foundation](#): promoting cooperative solutions for space sustainability and the peaceful uses of outer space

[TrustComm](#): provider of innovative, secure satellite communications application solutions

[Cisco](#): internet communication and protocols, disaster monitoring; interplanetary internet;

[Iridium](#): A technology innovator and market leader, Iridium, in collaboration with its vast partner network, is advancing the way global enterprises conduct daily mission-critical activities through reliable, low-latency communications services. Asset tracking

[BP](#): Near-real time infrastructure (including pipeline) threat analysis; detect activities and objects that may disrupt operations; hydrocarbon leak;

Natural (flood, etc) and man-made (oil spills) catastrophes

OFFERING	WHAT	HOW	Existing New Space Players
<i>Prevent and warn</i> <i>Protect vulnerable communities</i> <i>Enable sustainable resilience</i>	Aerial/Space imagery Weather data Mapping and monitoring Prepare and respond Evacuation and containment solutions Global resilience	Constellation of small satellites Sensors for high resolution data acquisition Global coverage, time trends Data and analytics platform	Cloud to Street Planet IQ Orbital Microsystems

CUSTOMERS	INTEREST	Website
American Bureau of Shipping	Rapid Response damage assessment, offshore exploration and production, remote inspection to evaluate condition of a structure from a stationary location	https://ww2.eagle.org/en.html
FEMA (Federal Emergency Agency)	Disaster recovery (wildfire, hurricanes, etc), search and rescue operations.	https://www.fema.gov/
State of California Climate Change	Understand impact, Implement sound environmental practices, adapt, protect population	https://www.climatechange.ca.gov/
NOAA	Weather forecast; climate data; fisheries; oceans and coastal monitoring; sanctuary permits; marine aviation; charting;	https://www.noaa.gov/
USGS	Minimize loss of life and property from natural disasters	https://www.usgs.gov/
CL solutions	Bioremediation (oil fields, storage tanks, gas stations)	https://cl-solutions.com/
Satellytics	Monitor geographically dispersed assets for threats, prioritize risks, concentrate resources	https://www.satellytics.com/solutions
Sea Bird Scientific	Oil spill monitoring; sensors could be integrated with other platforms	https://www.seabird.com/
BP (customer of Satellytics)	Near-real time infrastructure (including pipeline) threat analysis; detect activities and objects that may disrupt operations; hydrocarbon leak; water and waste management tracking and optimization	www.bp.com
NASA Airborne Science Program	Wildfire, glaciology, Antarctic observations, pollution (smoke-clouds), earth observations, flooding, melting Greenland impact.	https://airbornescience.nasa.gov/
Maxar Technologies	Earth observation, advanced analytics, insights from machine learning	https://www.maxar.com/our-company/meet-maxar
Comsat	secure, world-class global satellite connectivity solutions to government, military and commercial maritime customers operating in land, aeronautical and maritime service environments.	https://www.comsat.com/

Wildfire protection

OFFERING	WHAT	HOW	Existing New Space Players
<i>Provide actionable intelligence to local governments and first responders</i>	Aerial imagery and mapping; Fire management plans Monitoring of assets to prevent ignition Identification of environmental triggers	Geo-reference information (satellite imagery, drone-based surveillance, weather forecast, ground based sensors)	Delos Space Prometheus' Shield

CUSTOMERS	INTEREST	Website
CalFire	Safeguards the people and protect property and resources of California	http://www.fire.ca.gov/
California Air Resources Board	Monitor and guide local air pollution control districts to protect public health from harmful effects of air pollution	https://ww2.arb.ca.gov/homepage
Consumer Fire Products	Wildfire protection	http://www.consumerfireproducts.com/wildfire-accessoriesservices.html
Wildfire Defense	Wildfire risk management (monitor, response, training)	https://wildfire-defense.com/wds_risk.html
Nationwide Private Client	Pre catastrophe, disaster preparedness, wildfire and other risk solutions	https://www.nationwideprivateclient.com/
NASA Airborne Science Program	Wildfire, glaciology, Antarctic observations, pollution (smoke-clouds), earth observations, flooding, melting Greenland impact.	https://airbornescience.nasa.gov/
NOAA FIREX program Atmospheric Turbulence and Diffusion Division (ATDD)	Fire Influence on Regional and Global Environments Experiment Air quality, climate and dispersion related research directed towards issues of national and global importance	https://www.esrl.noaa.gov/csd/projects/firex/ http://www.atdd.noaa.gov/
PG&E	Monitor use of resources; detect leaks or hazards; prevent and mitigate	http://www.pgecorp.com/corp/index.page
Fire Rescue	Rescue, imaging, monitoring, emergency response, training	https://www.firerescue1.com/

New Space: challenges and opportunities

New Space companies have the opportunity to operate at the cusp of a “blue ocean”:

- Government leadership ebbs away to make room for incoming commercial players (SpaceX, Blue Origin, Virgin Galactic, Bigelow Aerospace, etc) and a myriad of startups pushing forward this nascent industry
- The spectrum of space based applications is transversal to many terrestrial markets segments, opening up countless unexplored possibilities
- Thinking out of the box and creatively on ways to engage players in markets that have not been traditionally “touched by space” yet are true adopters of innovation or seeking to reinvent themselves
 - Covered in current study: *connectivity and IoT, urban development, agriculture, bioeconomy and security.*
 - Earth Observation (EO) application areas with most promising development: location-based services (20%), agriculture (5%) and infrastructure (3%)
 - Two rapidly growing EO applications are (a) Forestry, with its two major competing industries, logging and deforestation has the advantage that it does not require the high resolution of the other applications thus being easy to use

Major elements that remain a challenge:

- Launch availability
- Ease of space certification
- Navigation of the regulatory landscape
- Spectrum demand and allocation
- Meeting the demand for use cases: the customer expectation that NewSpace companies have fully operational constellations is yet still to be met
- Proving competitive offerings/pricing schemes and consistent quarterly revenue
- Clearly define what the offering is and resist temptation to do everything. Show alignment between business model, G2M and team expertise.

[!\[\]\(83f22ed94ec5517769dd76d702c6bfd8_img.jpg\) back to OUTLINE](#)



Gravity free regards!

[Email](#) for questions or comments

DISCLAIMER

The content of this report is not comprehensive. The authors do not carry any liability for the further use and interpretation of data from this report.