

# 저궤도 위성기술 동향과 한국의 가능성

LEO Technology Trend & Opportunities for Korea

20.08.2020

최경일, KTsat

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 1989~1990 영국 Univ. of Surrey 위성통신공학과, 석사  
 1995~1999 프랑스 Telecom Paristech 통신시스템 공학박사

1990~1994 한국 KAIST 인공위성연구센터 연구원  
 우리별 1호/2호 시스템 엔지니어 / 지상국장 역임

1995~1999 프랑스 CNES 국립우주국 PhD Researcher

1999~2000 독일 Eumetsat 유럽기상위성센터 System Engineer

2000~2020 프랑스 Eutelsat S.A. System Engineer / NonGEO System Lead

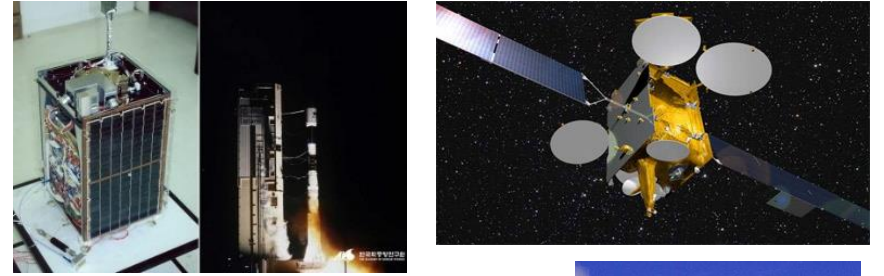
2020 현재 한국 케이티셋 KTsat Chief Technology Officer

2001~2020 ASCoF 프랑스 한인과학기술자협회 회원

2012~2020 EKAMA 유럽 한인 항공우주 전문가 그룹 회원

2013~2020 I-DREAM 유럽 동반성장 연구회 회원

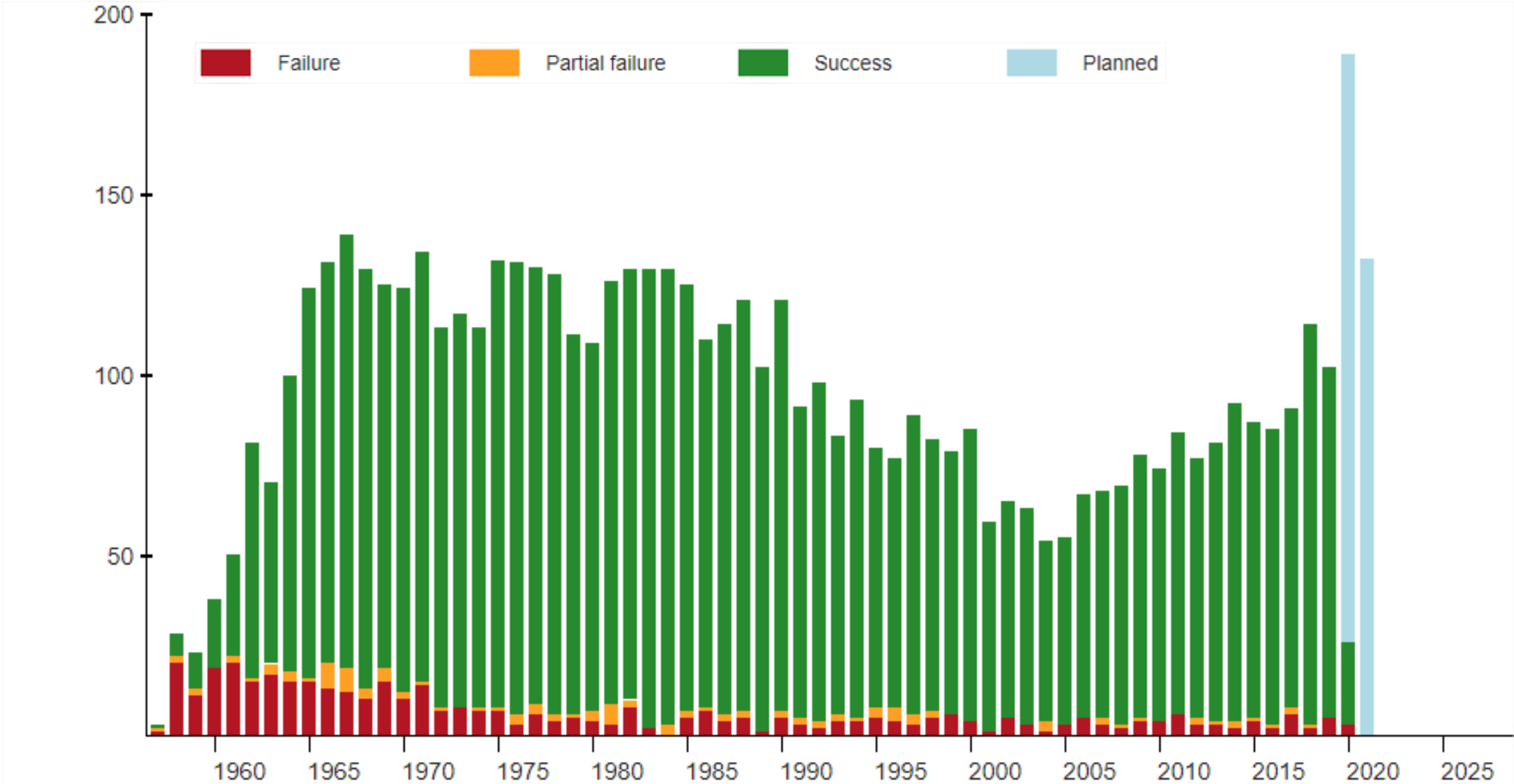
1992 대한민국 국민포장 수상 || 세종상 과학기술부문 수상



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- ▶ 한국의 가능성과 도전 - 정책 제언

# World Launch Records since Beginning... 로켓 발사 숫자



# Space Agencies in numbers    전세계 우주국 현황

	Name	Initialisms/Acronym	Country	Budget M\$	Employees	Founded	Astronaut	Sat Ops	S. Rocket
Name	Initialisms/Acronym								
Mohammed bin Rashid Space Centre	MBRSC (ex. EIAST)	National Aeronautics and Space Administration	United States	22,629	17,000	1958	Yes	Yes	Yes
Comisión Nacional de Investigaciones Espaciales	CNIE	China National Space Administration	China	11,000		1993	Yes	Yes	Yes
Space Research and Remote Sensing Organization	SPARRSO								
Belarus Space Agency	BSA	European Space Agency	ESA	7,430	2,200	1975	Yes	Yes	Yes
Bolivian Space Agency	ABE								
Bulgarian Space Agency	ИКА-БАН	German Aerospace Center	Germany	4,233	8,127	1969	Yes	Yes	Yes
Colombian Space Commission	CCE	CNES	France	3,024	2,500	1961	Yes	Yes	Yes
Asociación Centroamericana de Aeronáutica y el Espacio	ACAE								
Croatian Space Agency (Hrvatska Svemirska Agencija)	CROSA	Russian Federal Space Agency	Russia	2,770		1992	Yes	Yes	Yes
Czech: Ministerstvo dopravy České republiky	Min. of Transport								
Danish National Space Center	DRC / DRKI	Indian Space Research Organisation	India	1,900	20,039	1969	Yes	Yes	Yes
National Authority for Remote Sensing and Space Sciences	NARSS								
Egypt Remote Sensing Center (defunct)	EASRT-RSC	Italian Space Agency	Italy	1,800	200	1988	Yes	Yes	Yes
Hellenic Space Center (Ελληνικό Κέντρο Διαστήματος)	ΕΛΚΕΔ	Japan Aerospace Exploration Agency	Japan	1,699	1,545	2003	Yes	Yes	Yes
Hungarian Space Office	MUI								
National Institute of Aeronautics and Space	LAPAN	Korea Aerospace Research Institute	South Korea	519	910	1989	Yes	Yes	Yes
National Space Agency of the Republic of Lithuania	RMK-IVK								
Lithuanian Space Agency									es
Luxembourg Space Agency									es
Malaysian Space Agency									es
National Remote Sensing Center									
Centre Royal de Recherches et de Technologie Spatiales (القنصلية الفضائية)	CRRTS								
New Zealand Space Agency	NZSA	Canadian Space Agency	Canada	297	670	1989	Yes	Yes	Yes
National Aerospace Development Administration	NADA (ex. KCST)	Mexican Space Agency	Mexico	250		2010	Yes	Yes	Yes
Paraguayan Space Agency (Agencia Espacial de Paraguay)	AEP								
Portugal Space Agency	—	Belgian Institute for Space Aeronomy	Belgium	224		1964	Yes	No	No
National Space Organization	NSPO								
Romanian Space Agency	ASR	Instituto Nacional de Técnica Aeroespacial	Spain	211		1942	Yes	Yes	Yes
Space Research Institute of Saudi Arabia (Arabic: معهد بحوث الفضاء)	KACST-SRI	Swiss Space Office	Switzerland	177		1998	No	No	No
Serbian Office for Space Sciences, Research and Development	SERBSPACE								
Centre for Remote Imaging, Sensing and Processing	CRISP	Netherlands Institute for Space Research	Netherlands	110		1983	Yes	Yes	No
Soviet space program	CCCP								
Syrian Space Agency	SSA	Swedish National Space Agency	Sweden	100		1972	Yes	Yes	Yes
Geo-Informatics and Space Technology Development Agency	GISTDA								
Centre national de la cartographie et de la télédétection	CNCT	Norwegian Space Centre	Norway	97		1987	No	Yes	Yes
Turkmenistan National Space Agency	TNSA								
United Nations Office for Outer Space Affairs	UNOOSA	State Space Agency of Ukraine	Ukraine	80		1992	Yes	Yes	Yes
United States Space Force	USSF	Austrian Space Agency	Austria	75		1972	No	No	No
Uzbek State Space Research Agency (UzbekCosmos)	USSRA (UzbekCosmos)								
Azerbaijan National Aerospace Agency	AMAKA	Polish Space Agency	Poland	62		2014	Yes	Yes	No
National Space Science Agency	NSSA								
National Commission for Aerospace Research and Development	CONIDA	Brazilian Space Agency	Brazil	47		1994	Yes	Yes	Yes[12]
United Arab Emirates Space Agency	UAESA								
Bolivian Agency for Space Activities	ABAE	Comisión Nacional de Actividades Espaciales	Argentina	45		1991	No	Yes	Yes
Space Technology Institute (Viện Công nghệ vũ trụ Việt Nam)	VAST-STI	Pakistan Space and Upper Atmosphere Research Commission	Pakistan	45		1961	No	Yes	Yes
		Philippine Space Agency	Philippines	38		2019	No	Yes	No
		National Space Research and Development Agency	Nigeria	32		1998	No	Yes	No
		Australian Space Agency	Australia	32		2018	No	Yes	Yes
		Israeli Space Agency	Israel	15		1983	Yes	Yes	Yes
		South African National Space Agency	South Africa	12		2010	No	No	No
		Turkish Space Agency	Turkey	4		2018	No	Yes	No
		Mohammed bin Rashid Space Centre	Dubai, UAE			2016	Yes	Yes	No

KARI



South Korea

519

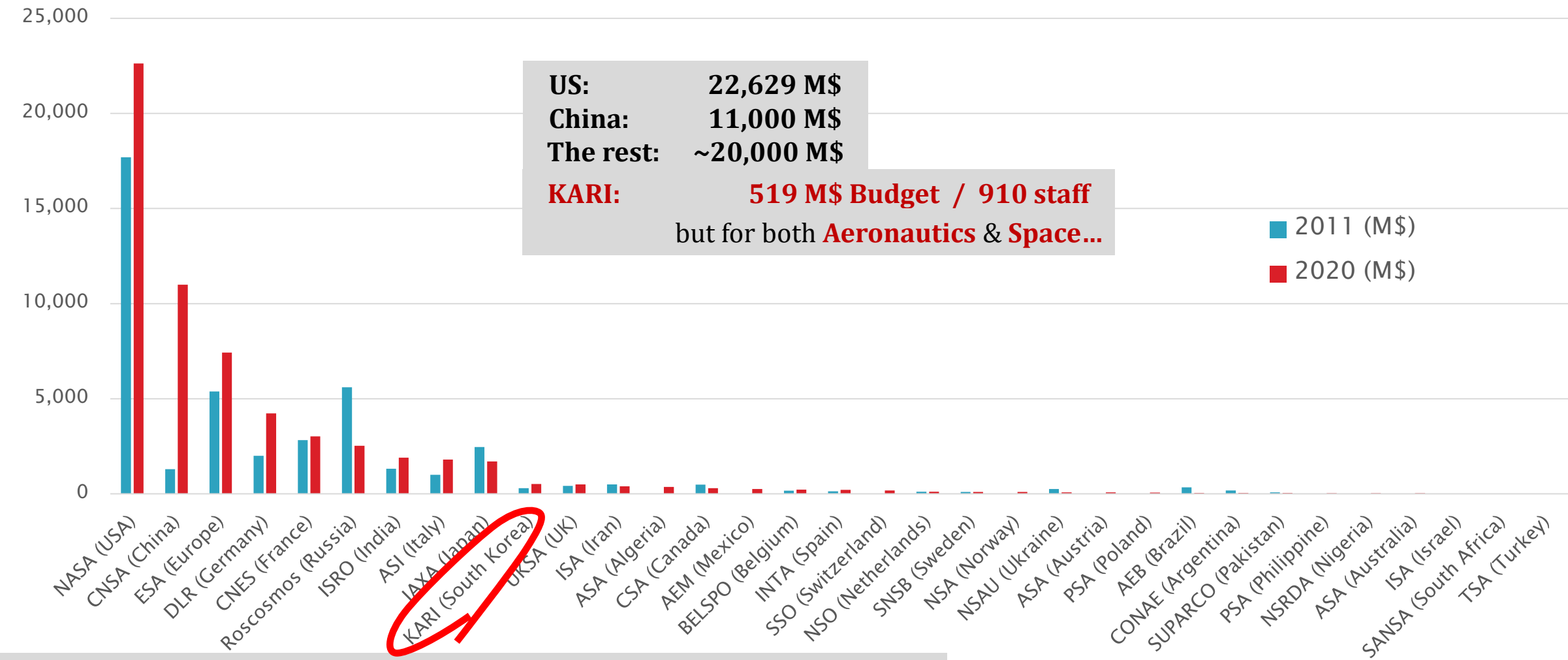
910

[R1] [https://en.wikipedia.org/wiki/List\\_of\\_government\\_space\\_agencies](https://en.wikipedia.org/wiki/List_of_government_space_agencies)

[R2] KARI - 2018년 우주산업실태조사 보고서

[R3] 각 국가별 우주국 연간 보고서

# Space Agency Budget (MUS\$) in 2020    전세계 우주국 예산

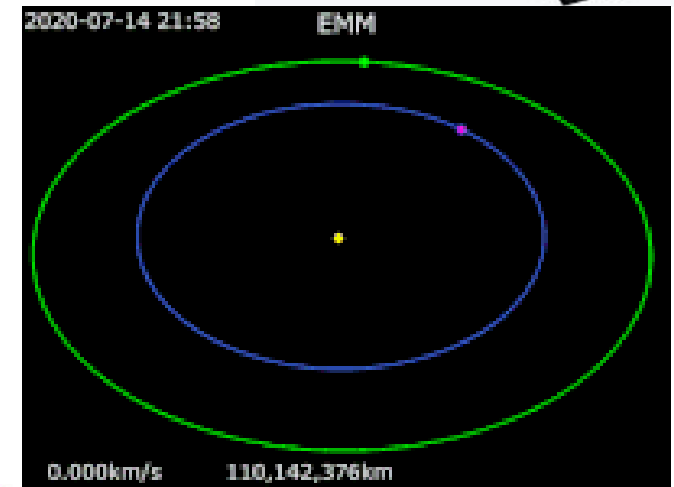
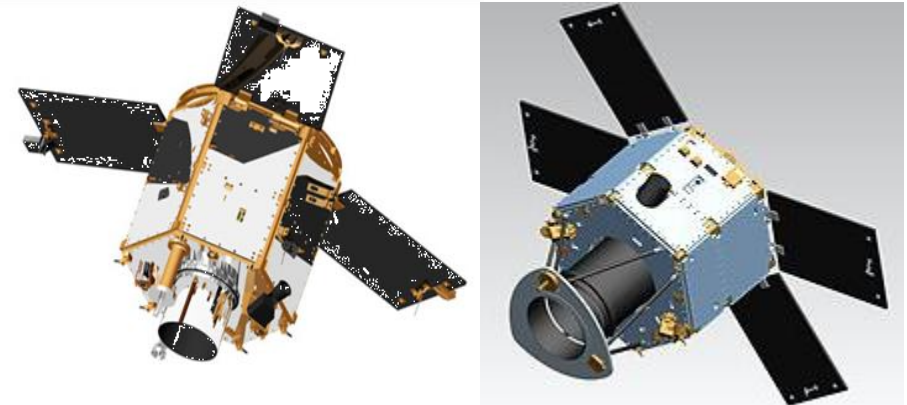


[R1] [https://en.wikipedia.org/wiki/List\\_of\\_government\\_space\\_agencies](https://en.wikipedia.org/wiki/List_of_government_space_agencies)  
[R2] [https://www.reddit.com/r/GlobalPowers/comments/6jvzmq/event\\_mexican\\_space\\_agency\\_funding\\_increased\\_new/](https://www.reddit.com/r/GlobalPowers/comments/6jvzmq/event_mexican_space_agency_funding_increased_new/)  
[R3] [https://fr.wikipedia.org/wiki/Agence\\_spatiale\\_alg%C3%A9rienne](https://fr.wikipedia.org/wiki/Agence_spatiale_alg%C3%A9rienne)  
[R4] [https://fr.wikipedia.org/wiki/Liste\\_des\\_agences\\_spatiales](https://fr.wikipedia.org/wiki/Liste_des_agences_spatiales)  
[R5] <https://spaceq.ca/canadian-space-agency-budget-increases-20-for-2020-21/>



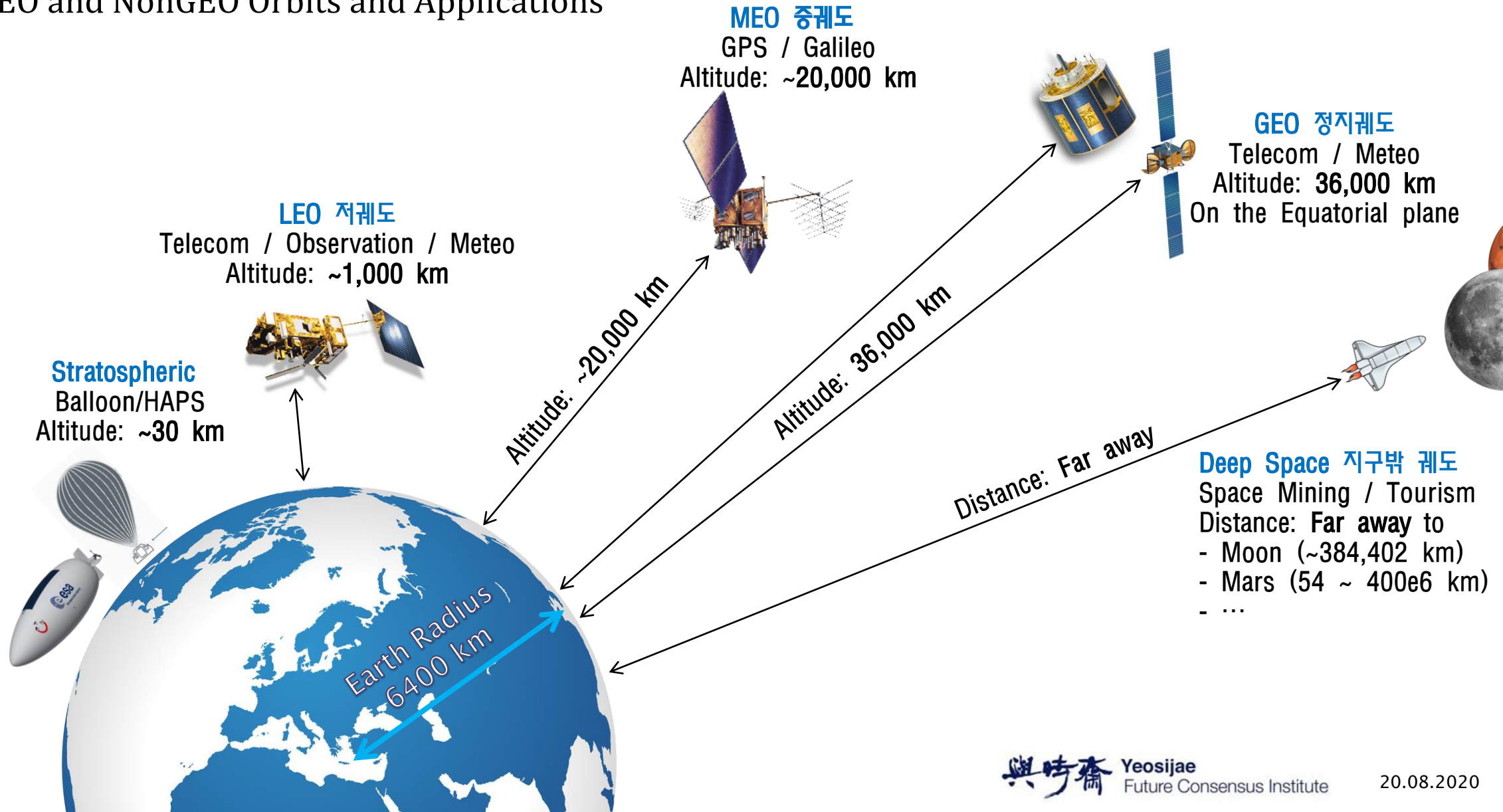
# Mohammed bin Rachid Space Centre, Dubai

- ▶ DubaiSat-1 (30.07.2009) – 20 MUSD investment
  - MBRSC owned / **Satrec Initiative** developed Small Sat (SI-200 bus)
  - Earth Observation – 2.5m resolution @ 700 km altitude
  - Launched by Dnepr PC20 from Kazakhstan
- ▶ DubaiSat-2 (21.11.2013)
  - MBRSC engineers made with **Korean Support**
  - Earth Observation
  - Launched by Dnepr
- ▶ KhalifaSat (29.10.2018)
  - Launched on H-IIA 202 from Tanegashima, Japan
  - Earth Observation - 70cm resolution @ 613 km altitude
- ▶ Hope Mars Mission (19.07.2020)
  - Collaboration with Univ. of Colorado Boulder, UC Berkeley & Arizona State Univ.
  - To study Martian Atmosphere & Climate



# Orbital Resources & Applications 인공위성 궤도자원 및 응용분야

## ▶ GEO and NonGEO Orbits and Applications





# LEO Projects of Today    현재의 저궤도 프로젝트들

## ▶ Earth Observation – Optical

- PlanetLab
- SkyBox Imaging
- UrtheCast
- Axelspace (Japan)
- BlackSky – LeoStella
- ...



## ▶ Earth Observation – RF: SAR & Radio occultation

- Capella
- Synspective
- Spire
- PlanetiQ
- ...



## ▶ Earth Observation – RF: Passive Radio

- HawkEye 360
- Kleos Space, Unseen Labs, ...



## ▶ Telecom - Broadband

- OneWeb
- Starlink
- O3b mPower
- Leosat
- Kuiper
- ...



## ▶ Telecom - IoT

- Astrocast (ex Else)
- Hiber (ex Magnitude Space)
- Kepler Communications
- Myriota
- Spire, ...



ASTROCAST



## ▶ Telecom – Cloud / Blockchain

- SpaceBelt, SpaceChain,
- ...



# LEO Projects of Today    현재의 저궤도 프로젝트들

## ▶ New Launchers

- ABL Space – RS1
- Aevum Space – RAVN-X
- Ariane Works – Themis
- Arianespace – Vega, Vega-C, Ariane 6, ...
- Astra – Rocket 3.0
- Black Arrow – Black Arrow
- Firefly – Alpha, Beta,
- IHI Group - Epsilon
- Landspace – SL-1
- One Space – SRV-1
- Orbex
- PLD Space
- Relativity Space – Terran 1
- Rocket Factory Augsburg
- Rocket Crafters
- Rocket Lab - Electron
- Skyroot Einrodge – Vikram 1
- Skyrora
- SpaceX – Falcon 9, BFR, ...
- Virgin Orbit – Launcher One



## ▶ In Orbit Services

- D-Orbit - ION
- ExoLaunch
- Momentum – Vigoride, Argoride
- NanoRacks
- Open Cosmos
- Precious Payload
- Spaceflight Industries



## ▶ Balloon Based Launchers

- Space Ryde
- Zero to Infinity

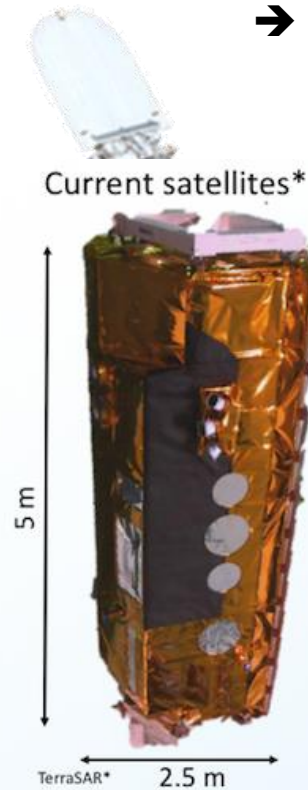
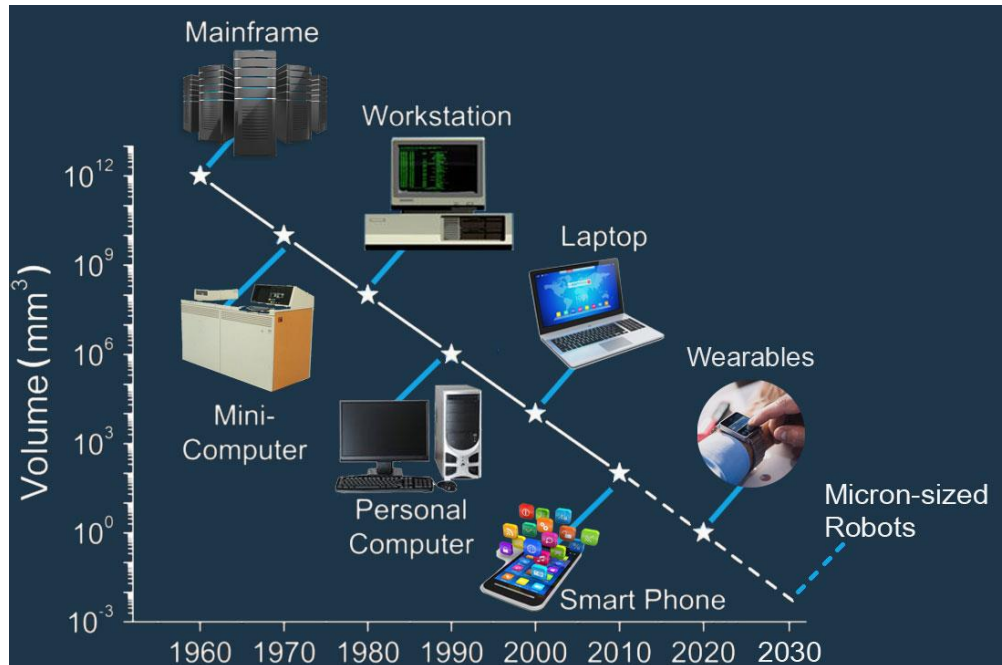
# New Space Evolution 뉴 스페이스 혁신

## ▶ Technology Trend

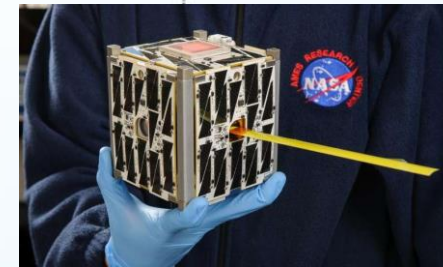
- **High Speed / Low Power** Electronics / Computing Power
- Everlasting Equipment **Miniaturization**
- High Degree of **Automation & Robotics Potential**
- **Cubesat** Standardization → Fast Prototyping
- Evolutionary Ground Infrastructure  
→ Space Democracy

## 기술부문 혁신

**고속 / 저전력** 전자회로 및 컴퓨터 기술의 발전  
지속적인 장비들의 **소형화**  
**자동화 / 로봇화**의 진전  
**큐브셋**의 표준화 → 빠른 프로토타입 실현  
혁신적인 지상시스템 인프라의 구축  
→ 우주기술 보급의 민주화



Human



Capella (at launch)



Capella (in space)



[Ref.1] <https://www.zurich.ibm.com/st/smartsystem/>

[Ref.2] <https://spacenews.com/capellas-first-satellite-launching-this-fall/>



# New Space Evolution 뉴 스페이스 혁신

## ▶ Business Trend

- **Cubesat** Standardization → Capex Efficiency
- **New Application Ideas** → Business Opportunities
- **Private Investment** with High Efficiency in Mind
- Artisanal Manufacturing → **Automated Factory**  
(GEO Sat: **2 years** → Starlink Sat: **2 weeks**)

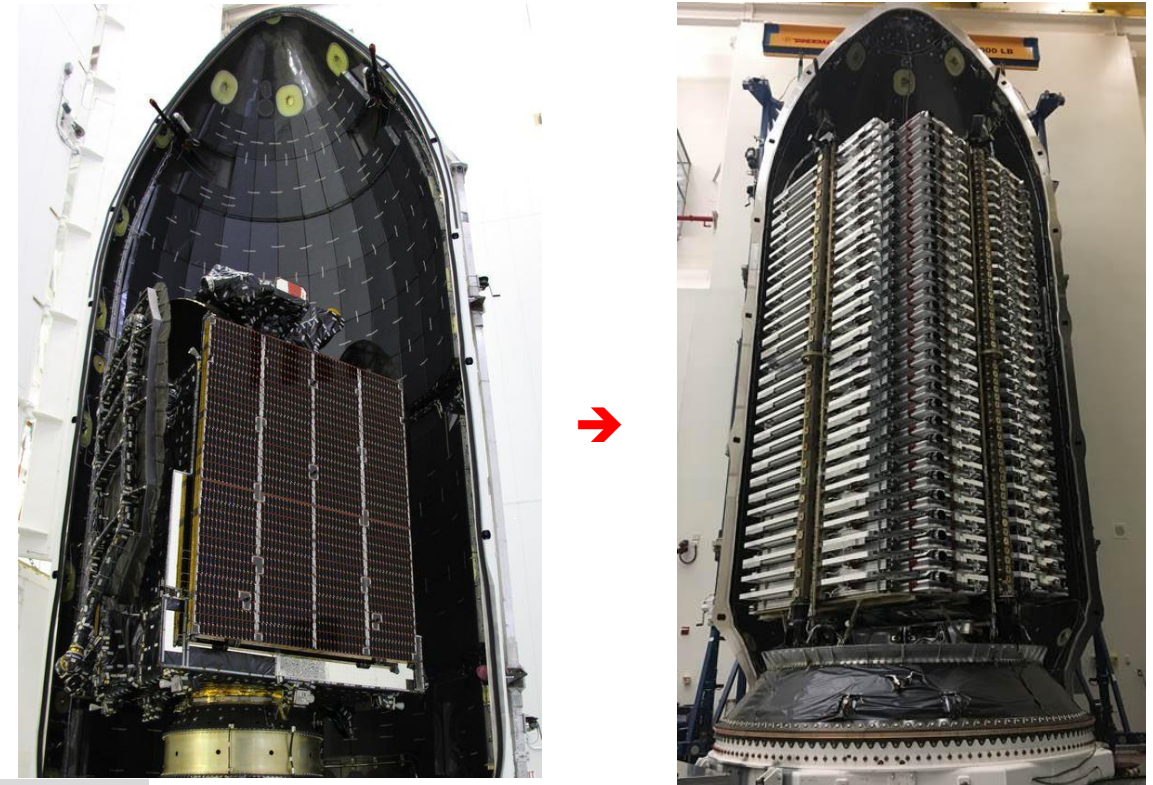
## 사업부문 혁신

## 큐브셋의 표준화 → 비용 절감

## 새로운 응용분야 아이디어 ➡ 새로운 비즈니스 모델

## 효율성을 중시하는 민간기업의 투자

장인정신의 수공업에서 **공장식 위성제작**으로 비용절감  
(Custom GEO 위성: **2년** → Starlink 위성: **2주**)



[Ref.1] <https://www.youtube.com/watch?v=uqC8CuFoPsU>

[Ref.2] <https://www.pinterest.fr/pin/474074298248817526/> → [musk-says-starlink-economically-viable](#)

# New Space Evolution    뉴 스페이스 혁신

## ▶ Business Trend

- Space Economics
- **Total Cost = Satellite + Launch + Operations**

## 사업부문 혁신

위성 시스템의 비용분석

	Traditional Space	New Space
위성의 가격		
- 정지궤도 통신/방송 위성	60 ~ 200 Million USD	
- 정지궤도 기상위성	100 ~ 300 Million USD	
- 저궤도 관측위성	20 ~ 500 Million USD	
- 저궤도 군사위성	50 ~ 800 Million USD	
- New Space 소형위성 / Cubesat	0.5 ~ 5 Million USD	0.5 ~ 5 Million USD
발사비용	50 ~ 200 Million USD	0.3 ~ 4 Million USD
운영비용	<ul style="list-style-type: none"> <li>- 위성발사 및 초기운영 보험료</li> <li>- 지상국설치 및 유지보수 비용</li> <li>- 위성 수명기간 운용 비용</li> </ul>	<ul style="list-style-type: none"> <li>- 위성발사 및 초기운영 보험료</li> <li>- 지상국설치 및 유지보수 비용</li> <li>- 위성 수명기간 운용 비용</li> </ul>
<b>총 비용</b>	<b>200 ~ 1,000 Million USD / 10 years</b>	<b>2 ~ 10 Million USD / 10 years</b>



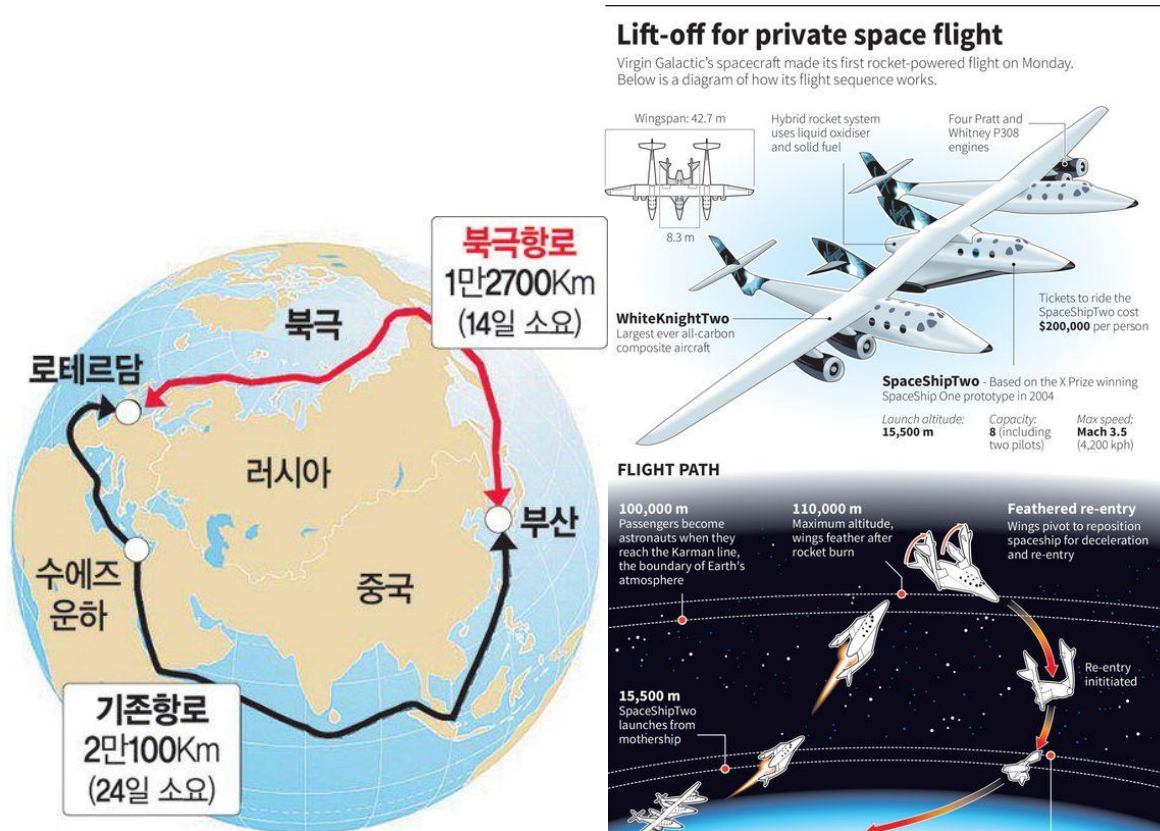
# New Space Evolution 뉴 스페이스 혁신

## ▶ Market Trend

- **Polar Maritime** Routes → Polar Region to be covered
- **Space Tourism** → Sub-orbital & Inter-Continental
- Hybrid & Integrated System Requirements

## 시장의 변화

**북극해양 항로** 개발 → 북극지역의 통신/관측 서비스 필요  
**우주여행 시대** → 저궤도 여행 / 대륙간 연결비행편  
하이브리드 / 멀티미션 시스템의 시장 요구



## Space X intercontinental rocket flights Estimated BFR flight times



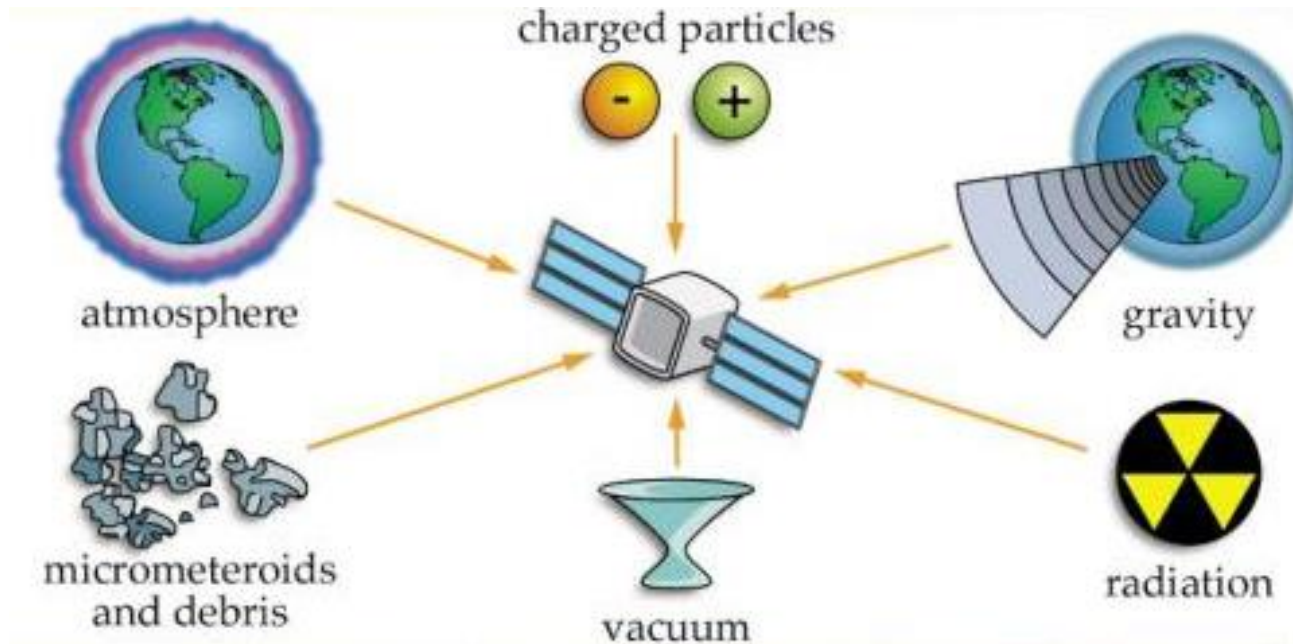
[Ref.1] <https://news.zum.com/articles/7736352?t=t>

[Ref.2] <https://www.pinterest.fr/pin/308848486920196011/>

[Ref.3] <https://www.networkbeyondborders.com/blog/who-will-be-the-1st-expat-to-try-this-rocket-in-2022--40>

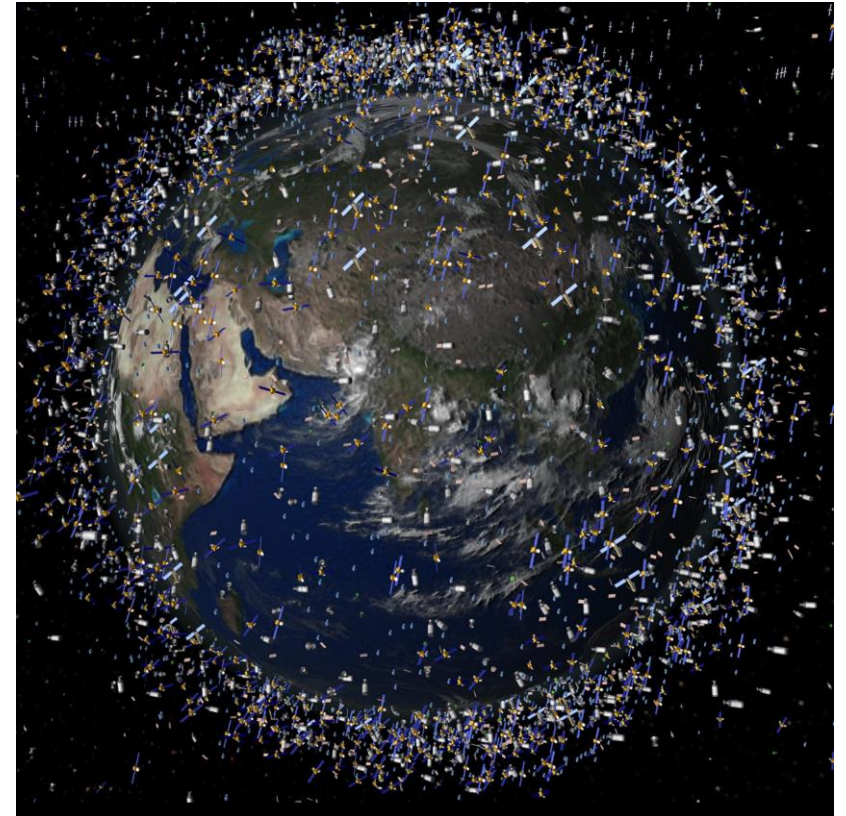
# New Space Evolution? 뉴 스페이스 혁신?

- ▶ The **Space Environment** is still Hostile
  - Space Radiation / Charged Particles
  - Micrometeoroids & Space Debris
  - No Maintenance / Replacement Possible
  - Vacuum



**우주환경**은 여전히 우호적이지 아니다

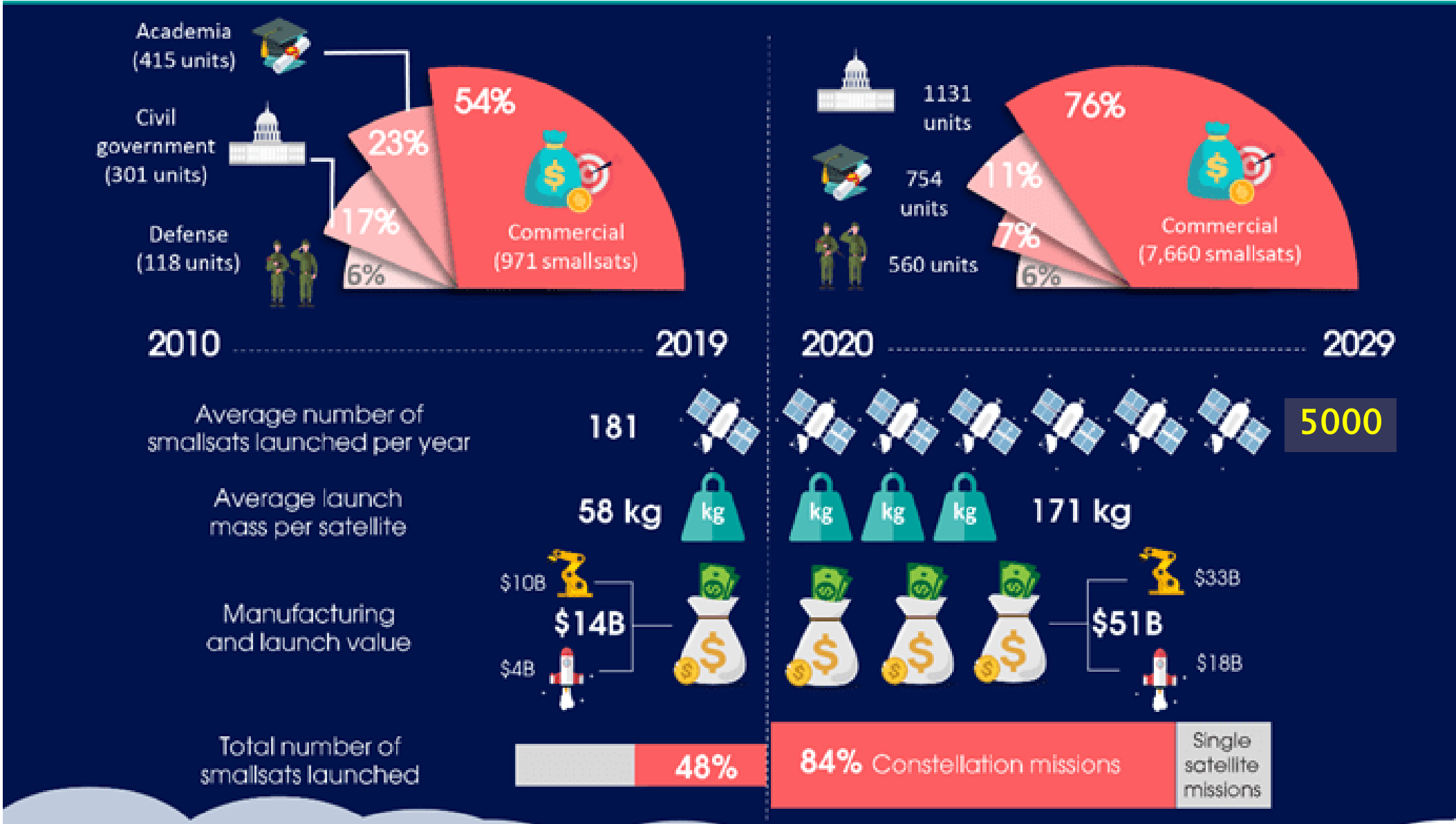
우주 복사 환경 / 전하 입자들  
초소형운석 및 우주 쓰레기들  
유지보수 및 교체의 불가능  
진공



[Ref.1] <https://www.slideserve.com/sheri/the-space-environment>

[Ref.2] <https://www.nationalgeographic.com/science/space/reference/space-junk/>

# Small Satellite Market 소형위성 시장





# Small Satellite Launch Prevision 소형위성 발사 예상

## EUROCONSULT'S PROSPECTS FOR SMALL SATELLITES MARKET 4TH ED.

45,000

Global connectivity  
Lower latency  
Broadband  
High value differentiator



TELECOM

900

TECHNOLOGY

Cubesats for in-orbit demonstration  
and educational purposes

7,000  
SMALLSATS  
WILL BE LAUNCHED

SATELLITES <500KG TO BE  
LAUNCHED BETWEEN 2018-2027

1,500



EARTH OBSERVATION

High frequency change detection via AI  
Daily Revisit  
SAR and VHR commercial data  
Value-added services for various markets

850

INFORMATION (M2M,  
IOT, AIS, ADS-B)

Low data rate/narrowband  
for data collection  
from ground sensors like  
remote devices and vehicles



PROSPECTS FOR THE SMALL SATELLITE MARKET

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# Small Satellite Landscape 소형위성의 풍경

## BUILD



## LAUNCH



## OPERATE



## APPLICATIONS





# Funding,... 네, 투자유치가 매우 중요합니다.

- ▶ Seraphim Space Fund closes at 91 MUSD invests in US, Finnish Geospatial Satellite Companies



# Private Space Investments 민간 투자 활성화





## ▶ Earth Observation – Optical

- PlanetLab
- SkyBox Imaging
- UrtheCast
- Axelspace (Japan)
- BlackSky – LeoStella
- ...



## ▶ Telecom - Broadband

- OneWeb
- Starlink
- O3b mPower
- Leosat
- Kuiper
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- Hiber (ex Magnitude Space)
- Kepler Communications
- Myriota
- Spire, ...



ASTROCAST



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- HawkEye 360
- Kleos Space, Unseen Labs, ...



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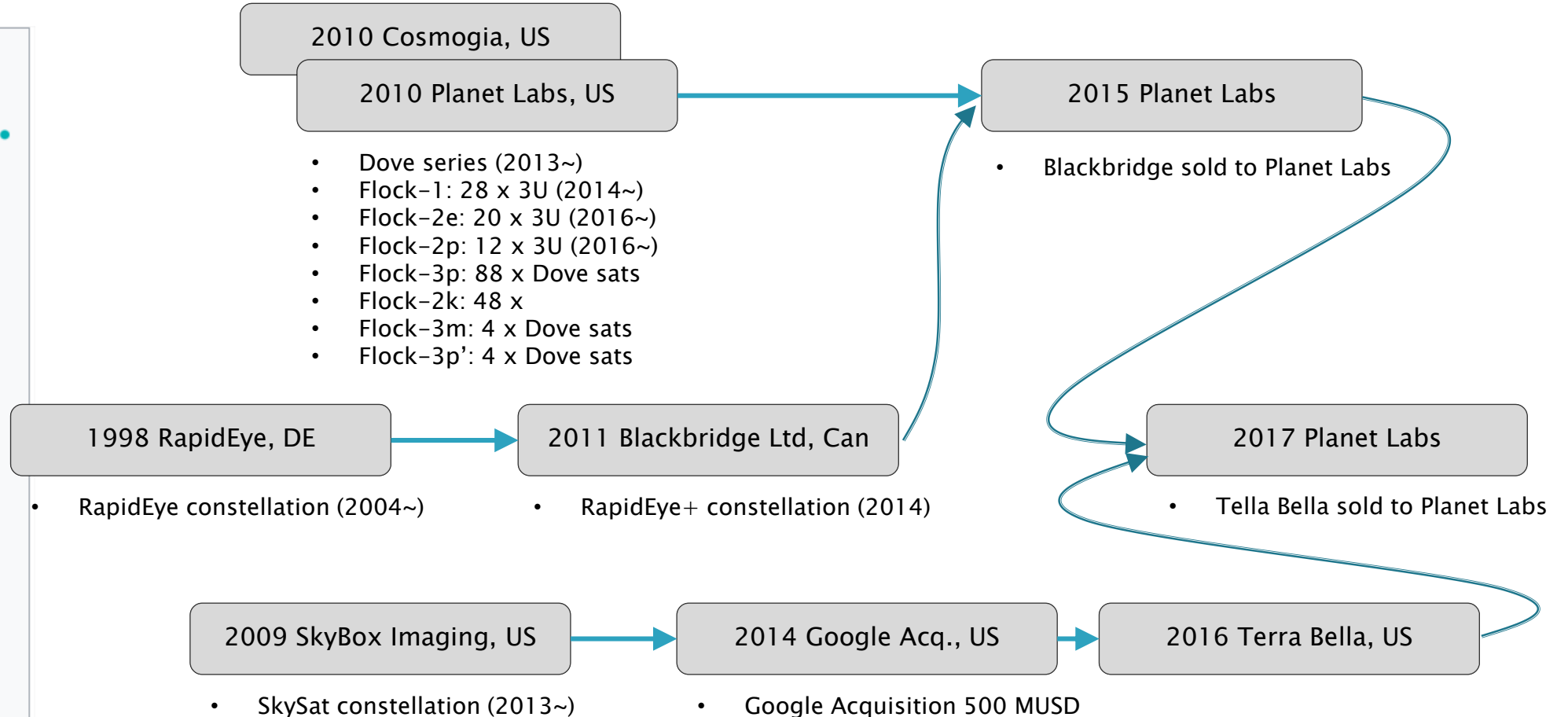
- SpaceBelt, SpaceChain,
- ...



# Smallsat Earth Observation - Optical

## ▶ Planet Labs ([www.planet.com](http://www.planet.com))

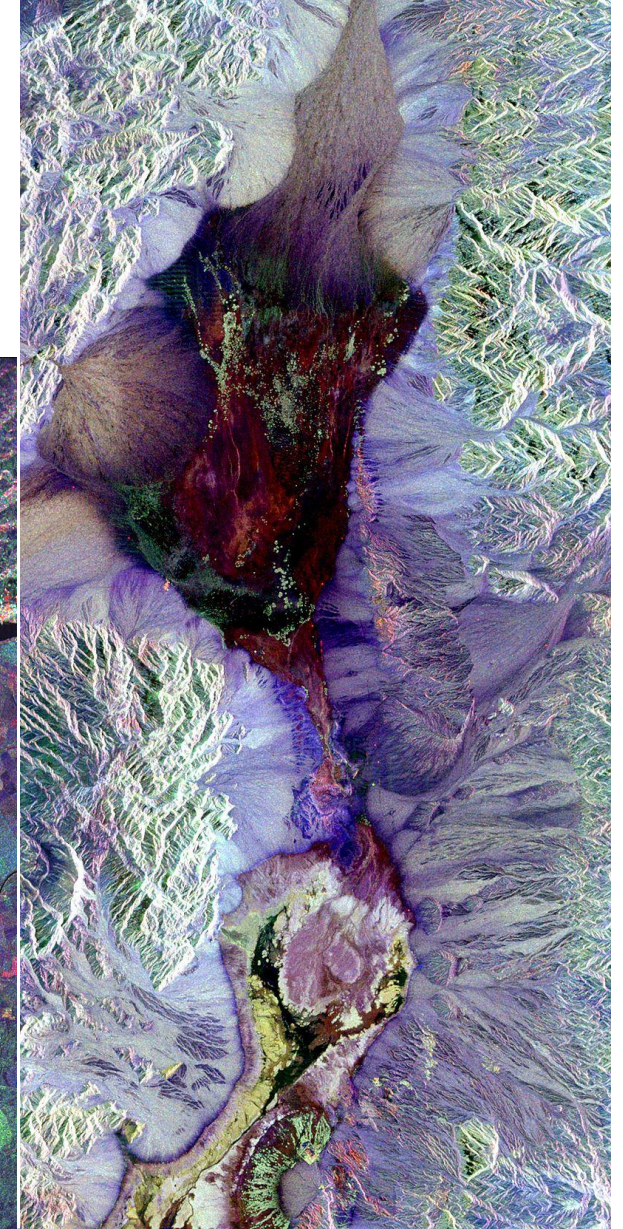
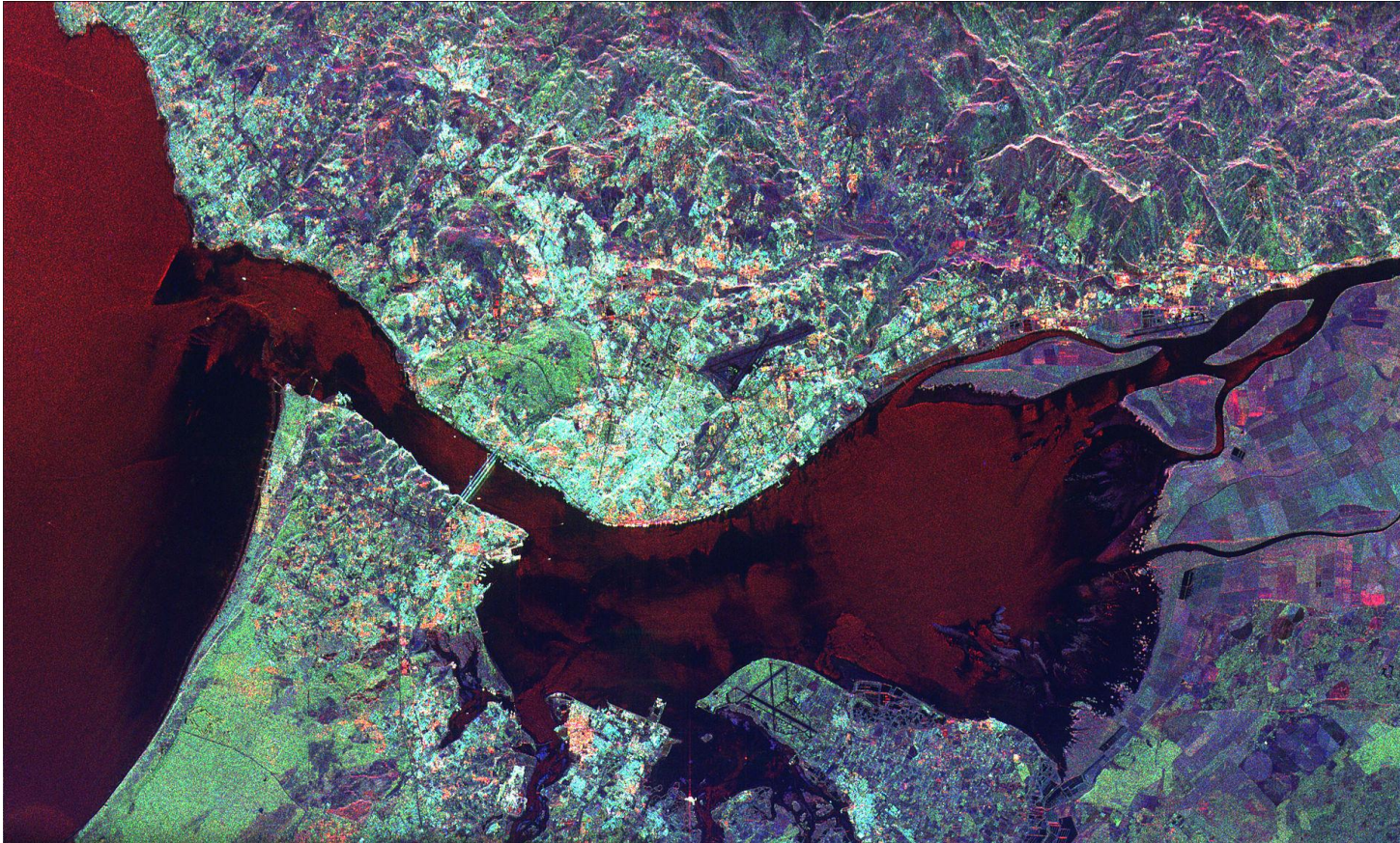
	
Type	Private
Industry	Spacecraft design Robotic spacecraft Earth observation satellite Image processing
Founded	December 29, 2010 <sup>[1][2]</sup>
Founder	Will Marshall, Chris Boshuizen, Robbie Schingler <sup>[1][2]</sup>
Headquarters	San Francisco, CA, U.S. <sup>[2]</sup>
Number of locations	6 offices (USA, Germany, Netherlands, Canada) <sup>[2]</sup>
Area served	Worldwide
Key people	Will Marshall (CEO) Robbie Schingler (CSO) <sup>[3]</sup> David Oppenheimer (CFO) <sup>[1]</sup> Andy Wild (CRO) <sup>[1]</sup>
Products	"Dove", "RapidEye", and "SkySat" imaging satellites
Services	Satellite-based Earth imaging and analytics
Number of employees	480 (as of March 2018) <sup>[4]</sup>
Website	<a href="http://planet.com">planet.com</a>





# Smallsat Earth Observation – RF Radar

- ▶ SAR (Synthetic Aperture Radar)
  - Iceye (<https://www.iceye.com/>)
  - Capella (<https://capellaspace.com>) : constellation with 0.5m resolution





# Smallsat Earth Observation – RF Radio Occultation

## ▶ GNSS-RO (Radio Occultation) Needs

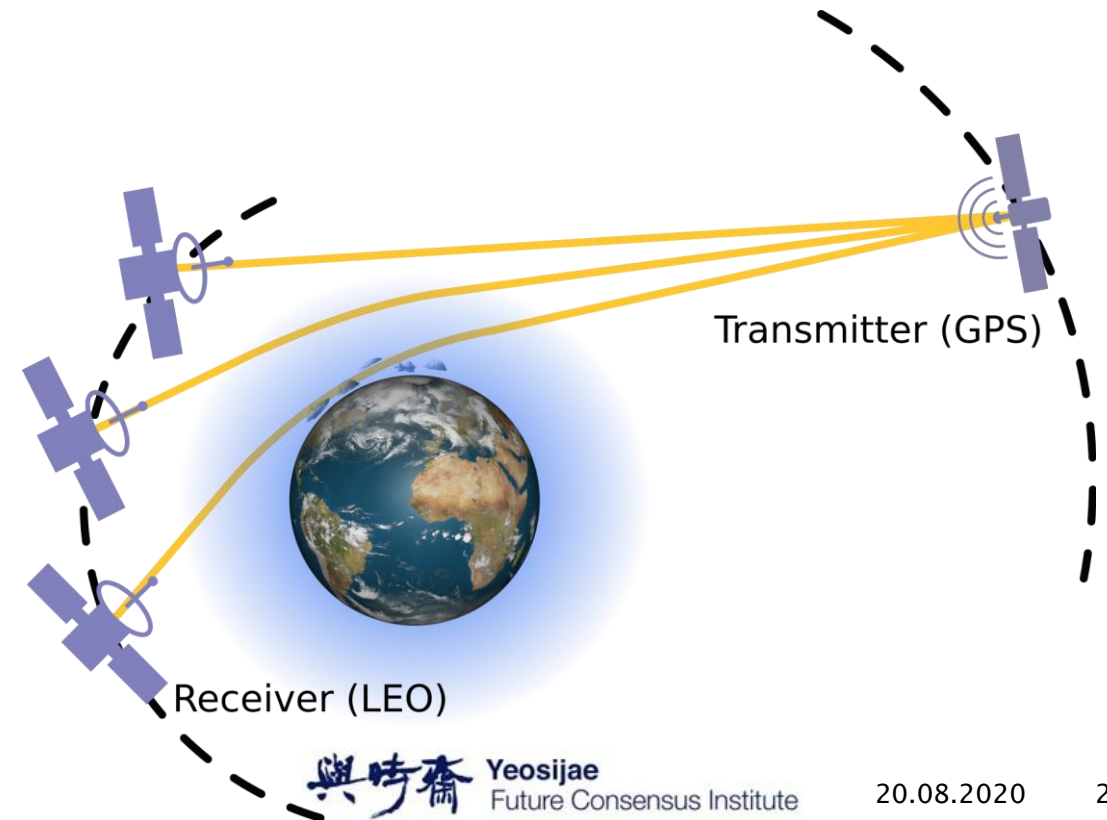
- Radio Occultation observation via refraction of GNSS signals varying upon air pressure, density, humidity & temperature...
- According to [SpaceNews](#), NOAA (National Oceanic & Atmospheric Administration) obtains > 2,000 soundings done daily but wants to perform more than 20,000 soundings/day
  - COSMIC (2006) / COSMIC-2 constellation currently working (US-Taiwan System)
  - 2<sup>nd</sup> Commercial Weather Data Pilot contract awards to
    - **GeoOptics**: Cicero satellites (1<sup>st</sup> one launched in Jan. 2018)
    - **PlanetIQ**: 18 – 22 satellites by mid 2022
    - **Spire**: 80 cubesats

R1: <https://scied.ucar.edu/radio-occultation-for-teaching-box>

R2: <https://www.eodc.eu/data-services/wegc-gnss-ro/>

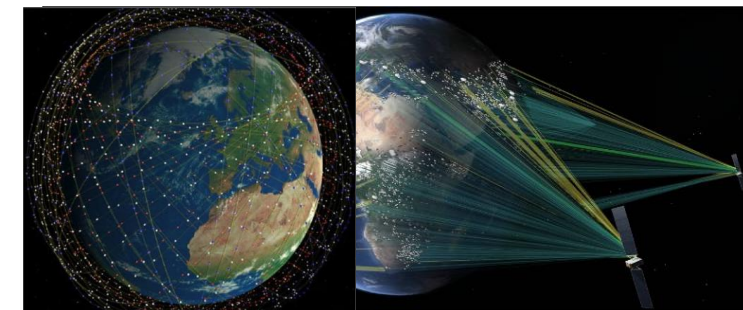
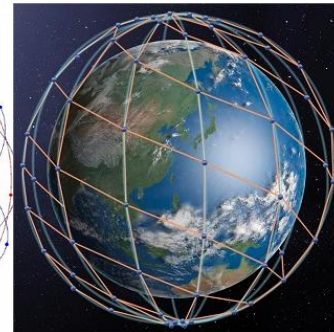
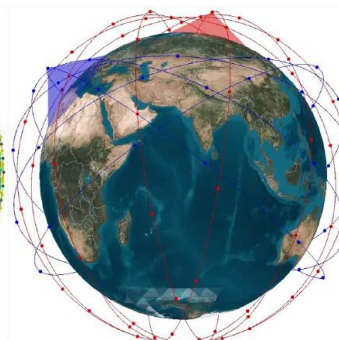
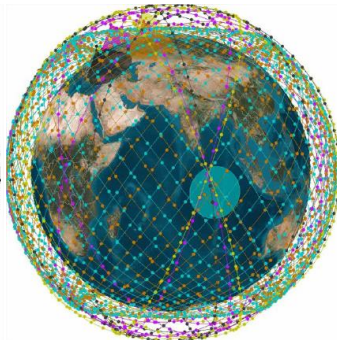
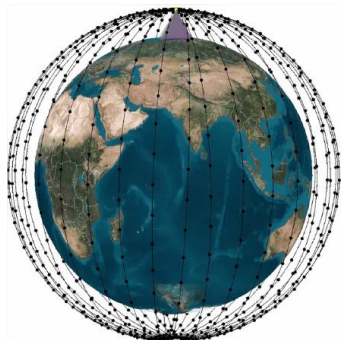
R3: <https://www.cosmic.ucar.edu/what-we-do/gnss-radio-occultation/>

R4: <https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2014SW001133>



# Smallsat Telecommunications - Broadband

	OneWeb	StarLink	Telesat	Leosat	Kepler	Kuiper	O3b mPower
Origin	OneWeb, US	SpaceX, US	Telesat, Can	Leosat, FR	Kepler, Can	Amazon, US	O3B, SES, Lux
No. of Sat.	<del>720</del> → 2,862	12,000 + 30,000	117 → 1,571	<del>108</del>	140	3,236	11
Constellation	<del>18 Polar planes 86.4°</del>	83 planes Inclined + polar	6p/2s @100°/99.5° 5p/9s @1200°/37.4°	<del>SSO</del>	Piggyback	98 planes @589–629km	7 sat Equatorial
Orbits	1200 km	1100~1325km	1000~1200 km	LEO	LEO	LEO	8063 km MEO
U/L & D/L	Ku-band	Ku-band	Ka-band	Ka-band spots	Ku-band	Ku-band	Ka-band
Gateway	Ka-band	Ka-band	Ka-band	Laser / Ka-band	Ku-band	???	Ka-band
ISL	NO	YES (no 1 <sup>st</sup> Gen.)	Laser Comm.	Laser Comm.	Not yet	Not yet	
Sat. Manufact.	Airbus	SpaceX	TBD	TAS	ACS / Kepler	???	
Sat. Mass	145 kg	386 kg					
Product	Broadband	Broadband	Broadband	B2B broadband	S&F	Broadband	Broadband 4000 trx/sat
Budget	3.5 BUSD	10 ~ 15 BUSD	N/A	3.5 BUSD	< 100 MUSD	N/A	N/A



# Smallsat Telecommunications - IoT

Company	Country	Fund. \$M	Partners	Targeted service	User bands	Active sats	Current satellite type
<a href="#">AirspaceIX</a>	USA		NovaWurks for P/F	Space Cloud, Space Private Network	upto 6 GHz	None	5 kW class
<a href="#">Aerial &amp; Maritime</a>	DEN	12	Spinoff of GomSpace / Deal with AISTECH Srl (E)	AIS, ADS-B	1090 MHz (ADS-B)	?	3U Gomspace
<a href="#">Aireon</a>	USA	50	JV Iridium & several national navigation auth.	ADS-B	1090 MHz (ADS-B)	75	Iridium NEXT (hosted P/L)
<a href="#">AISTECH</a>	ESP	?	?	AIS, ADS-B	162 MHz (AIS)	2	Gomspace
<a href="#">Astrocast</a>	CHE	7	Thuraya (tech, regulat, sales, distribution)	DTO IoT	L-band	2	3U
<a href="#">exactEarth</a>	CAN	15	Iridium	AIS	162 MHz (AIS)	58	Iridium NEXT (hosted P/L)
<a href="#">Fleet Space</a>	AUS	4	CNES (TCR for first satellites)	Backhaul IoT	L/S-band	2	1.5U
<a href="#">Helios Wire</a>	CAN	4	Echostar M&A (10.2019)	DTO IoT	S-band	2	16U Astro Digital (hosted P/L)
<a href="#">Hiber</a>	NLD	5	Iridium	DTO IoT	400 MHz	2	6U ISIS
<a href="#">Hiotee</a>	FRA	0	?	?	?	0	?
<a href="#">Kepler Comms</a>	CAN	21.5	Iristel (telco)	DTO IoT, store & fwd data	Ku/S-band	2	3U Clyde Space / Kepler
<a href="#">Kinéis</a>	FRA	0	CNES / CLS	DTO IoT, AIS	401 MHz	0	16U TAS/Nexeya
<a href="#">Lacuna Space</a>	GBR	?	Semtech	DTO IoT	ISM UHF (LoRa)	1	6U NanoAvionics M6P
<a href="#">Myriota</a>	AUS	17	exactEarth (investor + space segment) + Optus	DTO IoT	161 / 400 MHz	1	3U SpaceQuest
<a href="#">OQ Technology</a>	LUX	?	?	DTO IoT	?	?	?
<a href="#">Sat4M2M</a>	GER	5	ESA/DLR	DTO IoT	ISM UHF	1	ISS embarked
<a href="#">Sky &amp; Space Global</a>	GBR	16	Globalsat	DTO IoT, voice, low data comms	?	3	6U Gomspace
<a href="#">Spire</a>	USA	150	Global Fishing Watch	AIS, ADS-B, GPS-RO	1090 MHz (ADS-B), 162 MHz (AIS)	~50	3U Spire
<a href="#">Swarm</a>	USA	25	SweetSense	DTO IoT	149 MHz ?	4 (illegal)	0.25 U
<a href="#">LinkSure Network</a>	China	52		Free WIFI for all		1	272 total satellites foreseen.
<a href="#">COMMSAT</a>	China			IoT		7 (TBC)	
Hongyan (Wild Goose) – CASC	China		CASC satellite manufacturer	Broadband & IoT	L-band / Ka-band		Hongyan constellation 60 satellites by 2022 > 300 sat in total
Hongyun / Xingyun	China		CASIC platform	IoT narrow band			156 mini-satellites @ 1000 km
<a href="#">SkyLo</a>	USA	103 M\$	Softbank,	IoT via GEO			
<a href="#">Lynk</a>	USA		37 partners inc. 27 MNOs with 1.5 B subscribers	NB-IOT via LEO (600 - 960 MHz)	Sub GHz LTE		Test on Northrop Grumman Cygnus cargo tug Bluewalker-1 Demosat
<a href="#">AST &amp; Science</a>	USA	110 M\$	Vodafone, Rakuten & several other MNOs	NB-IOT like proprietary system via LEO, but compatible with standard mobile phone	?		
<a href="#">SkyWalker by Head Aero</a>	China			AIS, ADS-B, Industrial IoT	AIS / ADS-B / Sub GHz	3	48 sats



# Smallsat Telecommunication – Cloud / Blockchain

- ▶ **SpaceBelt Data Security as a Service**
  - By Cloud Constellation Corp.
  - A network of 10 LEO satellites ([Youtube video](#))
- ▶ **Space Web Services (SWS)**
  - By Airspace Internet Exchange (AirspaceIX)
  - Polar LEO 120 satellites (5 KW class)
- ▶ **SpaceChain: Open Source Space Blockchain Node**
- ▶ **Black Sky Geospatial Intelligence Service**



## ▶ Smallsat Paradigm Re-alignment

- 1980: **Cheaper**, Faster, Better
- 2000: **Faster**, Better, Cheaper
- 2020: **Better** (& Smaller), Faster, Cheaper

## ▶ **Space as a Service (SaaS)** for **Customers** 고객을 위한 우주 시스템의 서비스화

- Over-Supplied Capacities → 춘추전국 경쟁시대 **Increased Competition**
- Segmented Services → 융/복합 시스템 서비스 **Integrated/Hybrid System Services**  
→ 인공지능/데이터 분석 서비스 포함 **AI / Data Analytics included**
- Pay per Use Economy → 정기권 이코노미 **Subscription Economy**
- Service Provider's Market → 고객을 만족시키는 시장! **Customer Satisfaction Market**
- **Government Driven** → 정부와 민간의 협력 증대 **PPP (Public Private Partnership)**
- Regional Players → 글로벌 시장 **Global Players → Spatial Players**
- Immediate Service Apps → 장기적 우주개척 및 활용 추구 **Long-term Space Exploration & Exploitation**



# Space for Korea 한국의 가능성과 도전

## ▶ 성공적인 LEO 프로젝트들의 비결?

- 저궤도 위성기술이 특별하여 성공적인 사례는 없습니다.
- 현재 진행중인 LEO 프로젝트들은 모두 Application Call 입니다.
- 기초과학의 호기심과 아이디어의 싸움입니다.
- 충분한 투자와 지원을 받았음에도 절반이상은 실패합니다.
- 지속적인 범 국가차원의 지원이 기본 인력들을 지켜냅니다.

## ▶ 한국의 성공적인 우주개발 정책을 위한 제언

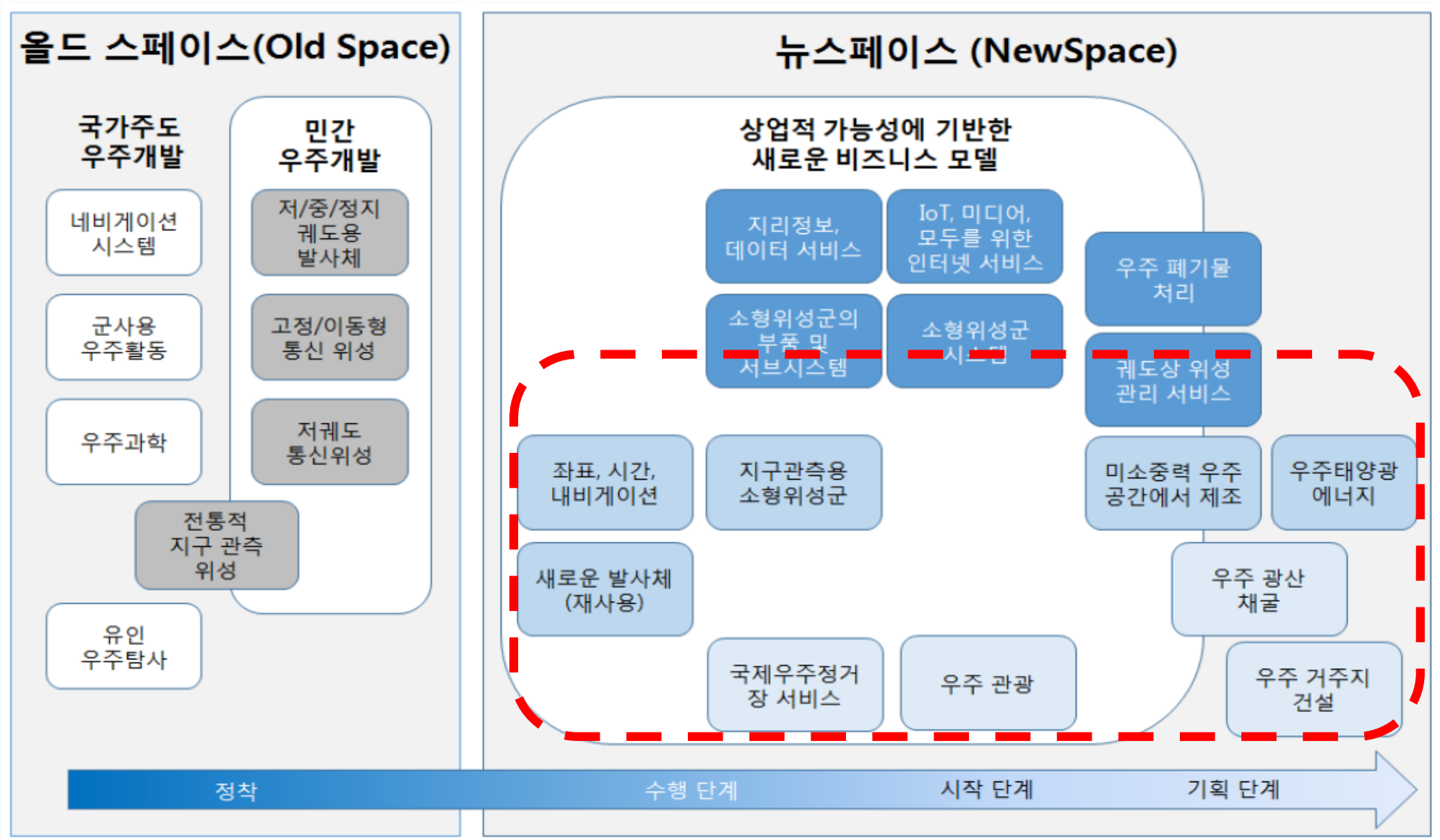
- 한국의 기업, 연구소, 기관들은 최선을 다하고 있습니다.
- 장기적이고 **일관된 우주개발 정책** 수립
- 지속적이고 연계성이 있는 우주개발 프로젝트 발주
- 전문 인력양성 / 인력수급
- 중소기업 진흥/육성
- 우주개발에 대한 정부/민간 협력관계 구축
- 투자 활성화
- 국산화 - 무엇을 국산화 할 것인가? HW? SW? 시스템?

- ➔ 지금까지 진행되어온 혁신의 결과입니다.
- ➔ 기술이 응용분야를 만들지 못합니다.
- ➔ 불편함을 감수하면, 아이디어는 없습니다.
- ➔ 실패를 두려워하지 않는 투자가 필요합니다.
- ➔ 민간기업의 성공은 국가의 지원없이는 불가능합니다.

➔ 주어진 조건에서...

- ➔ 범정부차원의 **컨트롤타워**: 우주청, 우주군사령부,...
- ➔ **R&D 우선과제**로 프로토타입 실현까지 지원
- ➔ 민간과 정부차원의 전문가 인력 양성 **및 유지** !!
- ➔ 정부발주 시스템의 **X %** 는 무조건 중소기업들에게.
- ➔ **연구/개발 인력을 유지할 수 있는 조건** 확보.
- ➔ 정부는 R&D, 민간기업은 산업화/사업화
- ➔ 세제혜택, 실패에 따른 문제보다 **성공의 혜택이 많아야..**
- ➔ **일자리를 창출하고 투자를 유치**할 수 있는 조건이라면...

# Space for Korea    한국의 가능성과 도전

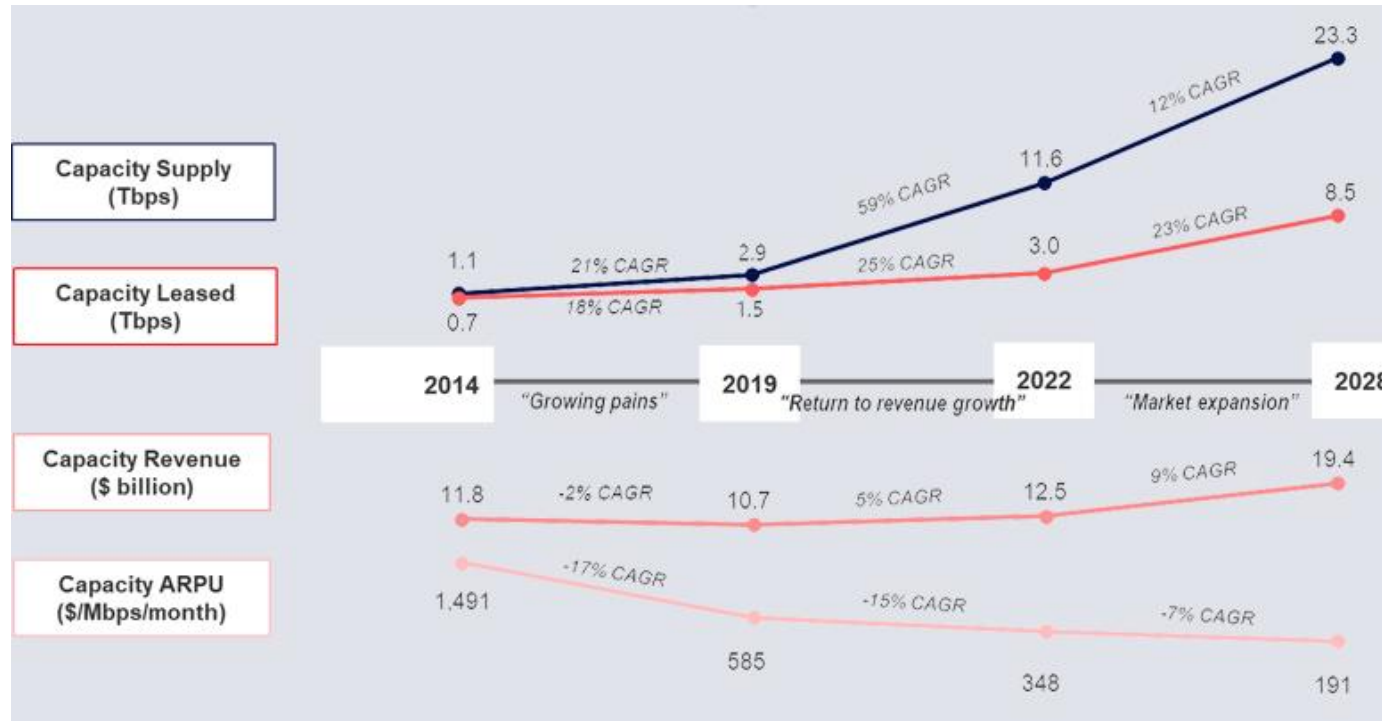


국가 아젠더와  
정책의 뒷받침

# Space for KTsat 케이티넷과 뉴스페이스

## ▶ Current GEO Satcom Situation

- DTH: Satellite Video in Decline vs. Explosion of OTT → Demand is there somewhere...
- Internet & Data: More & more mobile platform
  - Internet via Satellite – no meaningful growth
  - **[LEO constellation on its rise]** → [GEO satcom] ← **[Terrestrial mobile]**
- Remote Connectivity: sustaining alone with specific needs: SCPC, Military, ...
- Euroconsult predicts next potential growth will come from **maritime & aero IFC**.





# Space for KTsat 케이티샷과 뉴스페이스

- 궤도 및 주파수 자원 확보: GEO/LEO, Ku-band, Ka-band, Q/V-band, Optical Laser Comm, ...
- 고객중심 기술투자: Maritime, Aero/IFC, Gov/Military, ...
- 신성장 기술투자: QKD/Security, Optical, 5G Hybrid, Data Analytics, In-Orbit Services, ...
- 위성통신 중계기 임대에서 **글로벌 / 범우주적 통신인프라 사업체로 성장**



# Space Hope for Korea



감사합니다 !!