HEAD
AEROSPACE GROUP

2020

Jillin-1 Overview

JL1GF02B, Paris, France, April 10th,2020

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About HEAD

HEAD Aerospace (HEAD), founded in 2007, is a privately owned space company with headquarter in Beijing. HEAD has extended presence globally including subsidiaries in Hong Kong, France and the Netherlands as well as hosting global business development teams in United Kingdom, Morocco, Tunisia and South Africa.

Over the last 12 years, HEAD has been providing upstream space products in China by introducing a significant number of space products and services of international aerospace companies into China. This traditional activity has allowed the company to maintain a sustainable revenue to develop diversified activities since 2017 including providing geospatial solutions based on Earth observation satellites and operating our own Internet-of-Things (IoT) constellation.

Thanks to our access to 30+ Earth observation satellites, HEAD has a unique positioning to be a key player in the geospatial market and act as a prime contractor to provide complex turnkey integrated geospatial solutions. The international team is managing more than 50 distributors worldwide to market satellite imagery collected by Chinese commercial and government Earth Observation satellites. Our offer includes direct receiving station for near real time access to satellite imagery, centralized geodata hub of satellite imagery and processed geospatial data in the country for government and commercial users. Our geospatial solutions cover various vertical markets including agriculture, forestry, energy, mining, environment, water, transportation and defense, but also address horizontal needs at a city or a region scale, such as urban planning based on up to date satellite imagery and intelligent city management enabled by changes detected by regular captured satellite images. With more than 20 launches scheduled by 2022, HEAD will have access to more than 80 Earth observation satellites enabling our customers to receive several times per day new images over their area of interest at very high resolution.

Head Aerospace (Head) has the exclusivity on the distribution of the image and video captured by Jilin-1 Constellation.

The following document is a general overview of the satellites in operation and the application. The purpose of this document is to provide the technical specifications and some of applications of those satellites.

It is important to note that numerous satellites are expected to be launched thus an upcoming improvement of the revisit leading to several times per day.

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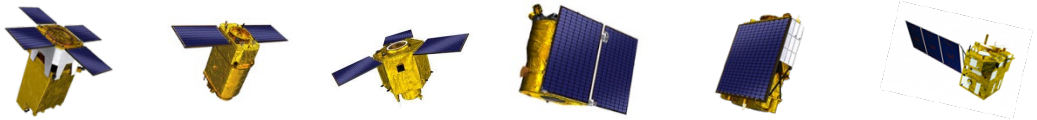
Available Products and Technical Specification



Satellite	JL1KF01	JL1GF02 A JL1GF02 B	JL1GXA	JLGF03A	JL-GP01/02	JL1SP-3/4/5/6/7/8 @6sats
Launch	2020	2019	2015	2019	2019	2015-2019
Altitude	481 km	535 km	650 km	572 km	528 km	535 – 656 km
Orbit	SSO	SSO	SSO	SSO	SSO	SSO
Res./PAN	0.50m	0.75m	0.72m	1.06m	5m	0.92m Video: RGB
Swath	136km	40 km	11.6 km	18.5km	110km	19 x 4.5 km
Revisit	Daily Revisit @4 sats together			4 Days	2 Days	Twice/per day

GeoSoluciones

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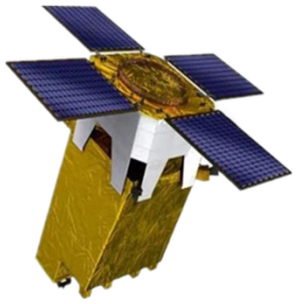
Jilin-1 KF01	
On January 15, 2020, the "Jilin 1" Wide-Swath 01 satellite independently developed by the company was successfully launched. The satellite is a new type of optical remote sensing satellite developed by the company. It has High-resolution, ultra-wide swath, high-speed storage, high-speed data transmission and other features. 	
Weight	1.25t
Orbit	Altitude: 481.56km
	Type: Sun-synchronous
	Period: 94.3 minutes
Sensor bands	Panchromatic: 450-800 nm
	4 multispectral: Blue: 450-510 nm Green: 510-580 nm Red: 630-690 nm Near-IR: 770-895 nm
Spatial resolution	PAN (nadir):0.5 m
	MS (nadir): 2.00 m
Dynamic range	12 bits
Swath width	>136 km
Onboard storage	16Tbit
Revisit time	Daily revisit together with JL-GF02A/02B & JL-GXA otherwise 7 days
Location accuracy without GCPs	<20m
Maximum side-slip angle	± 45°
Imaging mode	push broom imaging

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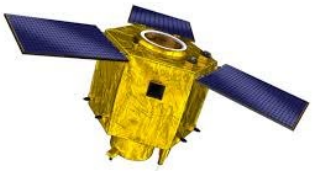
Jilin-1 GXA	
Jilin-1 GXA Satellite, launched on October 7th, 2015, is a home-developed high-resolution commercial remote sensing satellite created by the company. It's mainly used for high-resolution scanning image acquisition. 	
Weight	<420 kg
Orbit	Altitude: 656 km
	Type: Sun-synchronous
	Period: 97.7 minutes
Sensor bands	Panchromatic: 400-800 nm
	4 multispectral: Blue: 450-520 nm Green: 520-600 nm Red: 630-690 nm Near-IR: 690-800 nm
Spatial resolution	PAN (nadir): 0.72 m
	MS (nadir): 2.88 m
Dynamic range	10 bits
Swath width	>11.6 km
Onboard storage	100GB
Revisit time	Daily revisit together with GF02A/02B & KF1 otherwise 3.3 day
Location accuracy without GCPs	200m
Maximum side-slip angle	± 45°
Imaging mode	Conventional push broom, large-angle side sway, stamp mosaic and stereo imaging

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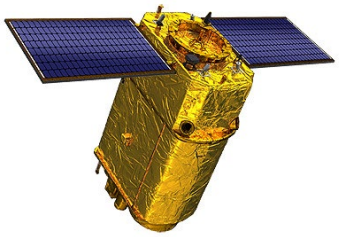
Jilin-1 GF02A/02B

On November 13th, 2019, "Jilin 1" high resolution 02A satellite independently developed by the company, was successfully launched. On December 7th, 2019, "Jilin 1" high resolution 02B satellite was successfully launched. The satellites are new optical remote sensing satellites developed by the company, and it has the characteristics of high resolution, large width, high positioning accuracy, and high-speed data transmission.



Weight	220kg
Orbit	Altitude:535 km
	Type: Sun-synchronous
	Period: 95.3 minutes
Sensor bands	Panchromatic: 450-800 nm
	4 multispectral: Blue: 450-510 nm Green: 510-580 nm Red: 630-690 nm Near-IR: 770-895 nm
Spatial resolution	PAN (nadir):0.75 m
	MS (nadir): 3.00 m
Dynamic range	12 bits
Swath width	40 km
Onboard storage	12.8Tb
Revisit time	Daily revisit together with JL-KF01 & JL-GXA otherwise 4 days
Location accuracy without GCPs	20m
Maximum side-slip angle	± 45°
Imaging mode	push broom imaging

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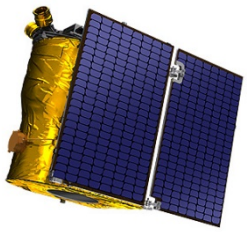
Jilin-1 GF03A Satellite	
On June 5th, 2019, “Jilin-1” high resolution 03A satellite independently developed by the company, was successfully launched in the yellow sea. The satellite uses lightweight structural design, highly integrated electronics system, high resolution/ ultra-lightweight/ low-cost camera and other innovative technologies, and it has the characteristics of low cost, low power consumption, low weight and high resolution. 	
Weight	<40 kg
Orbit	Altitude:572 km
	Type: 45° inclined circular orbit
	Period: 96.1 minutes
Sensor bands	Panchromatic: 450-700 nm
	4 multispectral: Blue: 450-510 nm Green: 510-580 nm Red: 630-690 nm Near-IR: 770-895 nm
Spatial resolution	PAN (nadir):1.06 m
	MS (nadir): 4.24 m
Dynamic range	12 bits
Swath width	18.5 km
Onboard storage	400GB
Revisit time	Daily and ~week gap
Location accuracy without GCPs	100m (CE90)
Maximum side-slip angle	± 45°
Imaging mode	push broom imaging, multiple target push broom imaging

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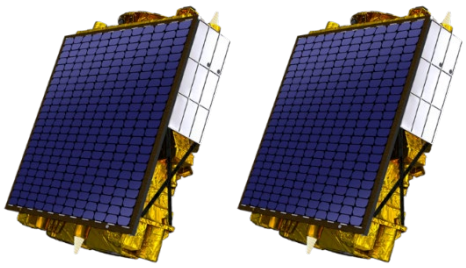
Jilin-1 GP01/02

On January 21st, 2019, "Jilin 1" Hyperspectral 01/02 satellites independently developed by the company, was successfully launched. The satellites are new spectrum remote sensing satellites developed by the company, and it has the characteristics of hyper spectral channels, large swath, high positioning accuracy, and high-speed data transmission.



Weight	205kg
Orbit	Altitude:528 km
	Type: Sun-synchronous
	Period: 95.3 minutes
Sensor bands	B0:450-800nm; B1:403-423nm; B2: 433-453nm; B3: 450-515nm; B4: 525-600nm; B5:630-680nm; B6: 784.5-899.5nm; B7:485-495nm; B8: 615-625nm; B9: 650-680nm; B10: 698.75-718.75nm; B11:732.5-747.5nm; B12: 773-793nm; B13: 855-875nm; B14: 660-670; B15: 677.5-685nm; B16: 750-757.5nm; B17: 758.75-762.5nm; B18:935-955nm; B19:1000-1040nm
	SW1:1195-1225nm;SW2:1360-1390nm;SW3:1550-1590nm;SW4:1610-1690nm; MWIR:3700 nm~4950nm; LWIR:7500nm~13500nm
Spatial resolution	B0~B6(nadir):5 m; B7~B12(nadir):10 m; B13~B19(nadir):20 m
	SW1~SW4; MWIR (nadir): 100 m; LWIR:150m
Dynamic range	B0~B19: 12 bits; SW1~4,MWIR,LWIR: 14bit
Swath width	110 km
Onboard storage	12Tb
Revisit time	2 days
Location accuracy without GCPs	100m
Maximum side-slip angle	± 45°
Imaging mode	push broom imaging

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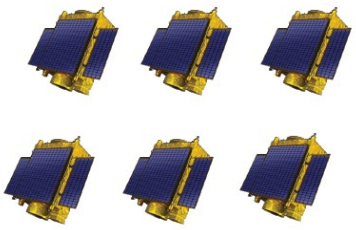
Jilin-1 SP03/04/05.06/07/08	
Video mode possibilities begin in January 2017 with JILIN-1 Video 03 satellite, it offers a resolution of 0.92m for RGB video. JILIN-1 video 04/05/06 launched in November 2017 and 07/08 in January 2018 are same satellites as 03 used to increase revisit time. 	
Jilin – 1SP03/07/08	
Weight	210 kg
Orbit	Altitude: 535 km
	Type: Sun-synchronous
Sensor bands	Video Mode: RGB
Ground Sampling Distance	0.92 Color Video
Dynamic range	8 bits
Swath width	19km X 4.5km
Revisit time	Together with SP04/05/06 twice per day
Off-pointing angle	± 45°
Jilin – 1SP04/05/06	
Weight	210 kg
Orbit	Altitude: 528 km
	Type: Sun-synchronous
Sensor bands	Video Mode: RGB
Ground Sampling Distance	0.92 Color Video
Dynamic range	8 bits
Swath width	19km X 4.5km
Revisit time	Together with SP03/07/08 twice per day
Off-pointing angle	± 45°

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Archive and Imagery Coverage

Archive data

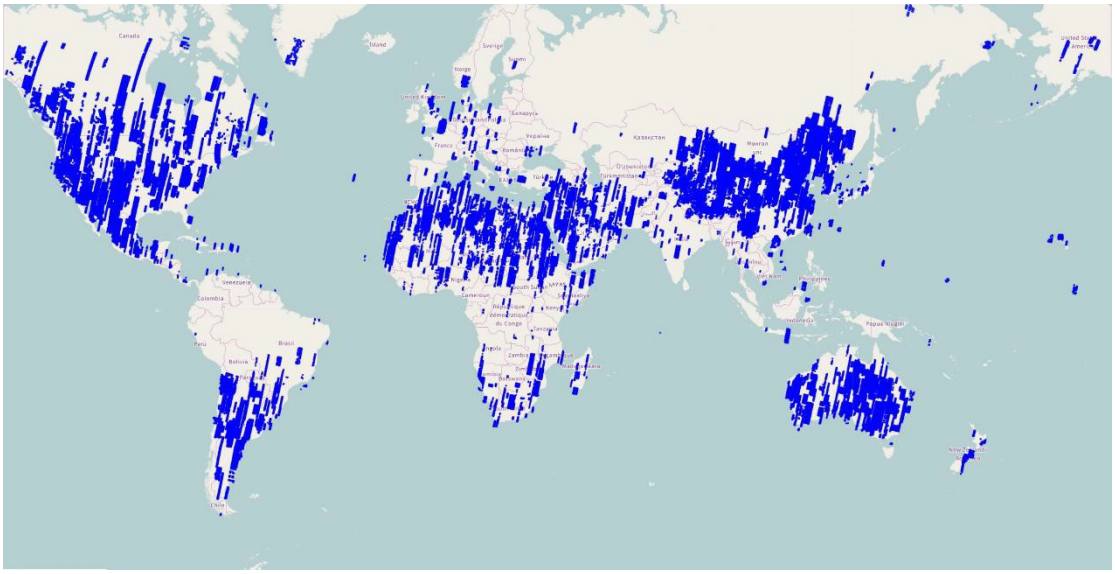
As of April 22, 2020, the global remote sensing archive image data are shown in the following table.

Serial Number	Resolution (m)	Archive Data Coverage area (km²)	Quality Level
1	0.75	20.356 million	A
2	5	91.953 million	A

Note: The data level of Jillin-1 Satellite in this table defaults to the company's Level A product that meets the following quality control criteria: The geolocation accuracy is better than 10m, the cloud cover is less than 10%, and the off-pointing angle is <15 degree, there is no radiometric quality problem. No stitching seam, false color and other geometric quality problems, the image color is moderate the texture is clear.

The diagram of global coverage archive data

As of April 22, 2020, the global archive data distribution is shown in Figure 1 and Figure 2.



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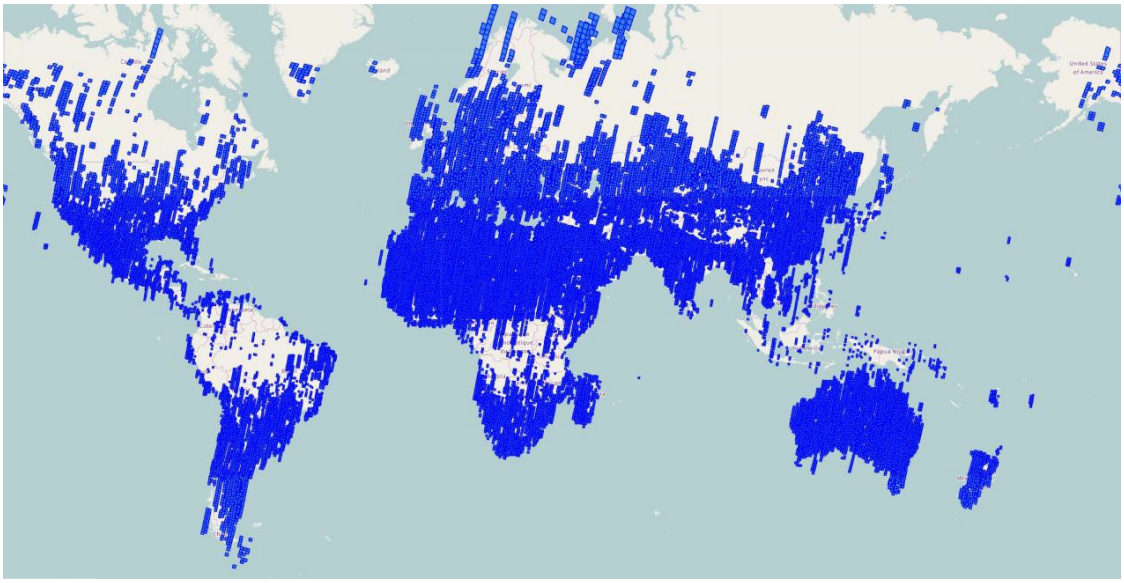

Global archived data distribution of 5m

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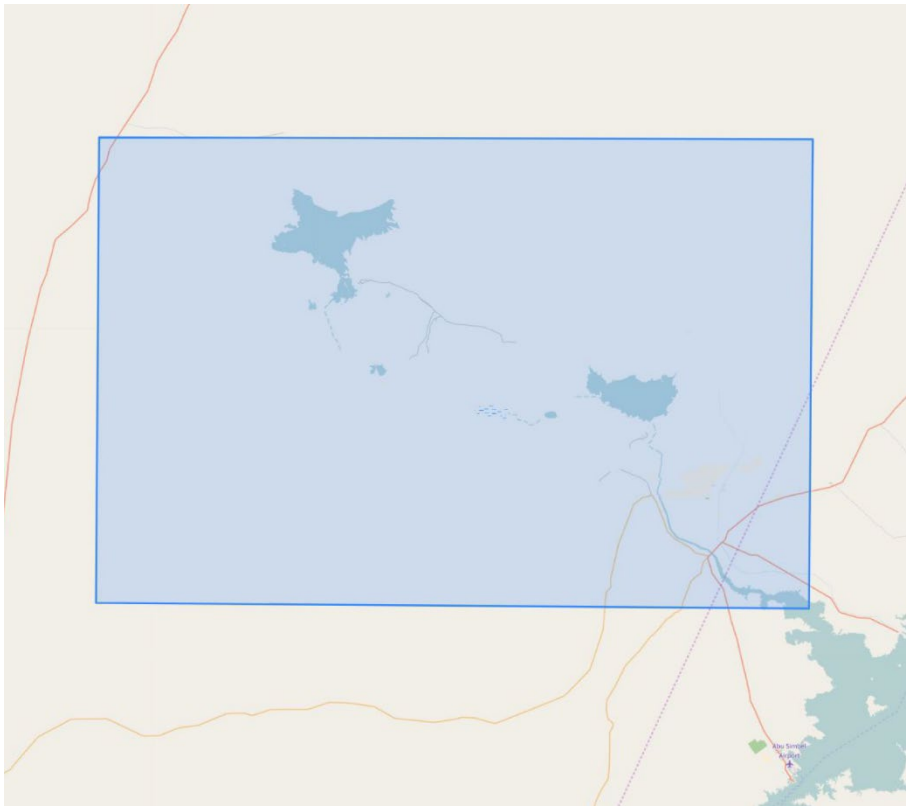
Stereo Coverage Analysis – Case study

The JL-1 GF-02A &02B offer possibility to collect stereo images. The following case study analyzes an Area of Interest (AoI) of 14,400 square kilometers. The area spans about 160 kilometers in the direction of the satellite cross track and about 110 kilometers in the direction of the track. It needs multiple
transit shots to cover it.



Stereo regional demand scope

On-track stereo imaging

Within the 10 degree off-nadir angle, the JL1-GF02 satellites shot covers the Stereo area once and requires 5 transits in 17 days, of which the High-resolution 02A transits four times and the High-resolution 02B transits once. As shown in Figure 2, is a picture of an area coverage strips.

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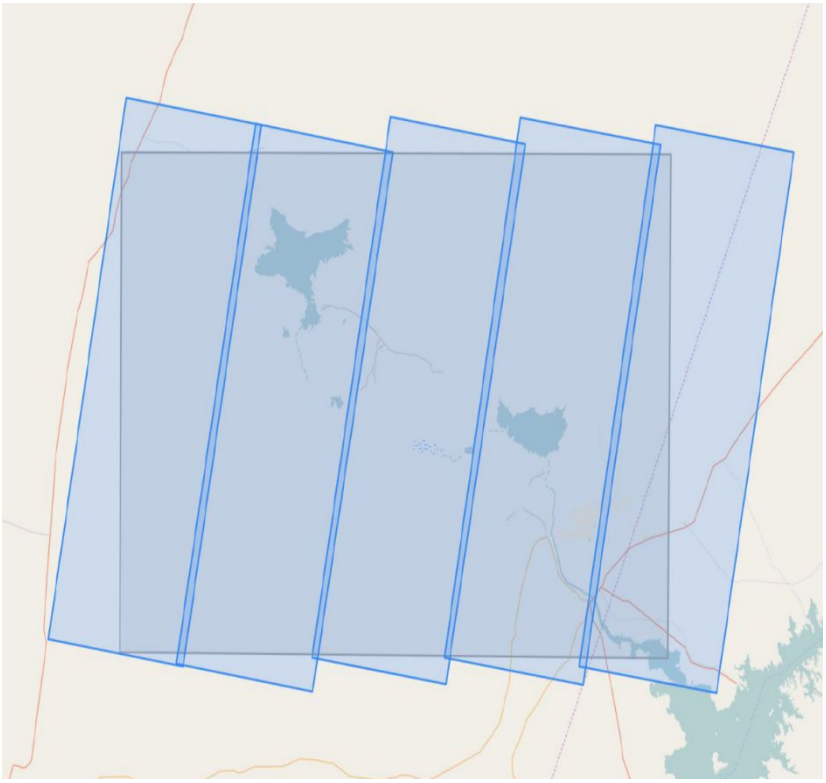

Stereo area strips 10-degree off-nadir angle overlay

Since high-resolution JL01-02A/B performs the on-track stereo imaging task, it can cover about 60km in a single track direction. Therefore, for the actual coverage task implementation, the long strip from north to south needs to be divided into two sub-strips. JL01-GF02 satellite stereo Covering the Stereo area once requires 10 transits in 34 days. Due to the generally good cloud cover in this area, we will not consider the influence of weather factors for the time being.

Satellite's Area covered by a single transit

Satellite Type	Single coverage Area (Square Meters)
High-resolution Jillin-1GF02A (Dual Images)	40*60 = 2400
High-resolution Jillin-1GF02B (Dual Images)	40*60 = 2400

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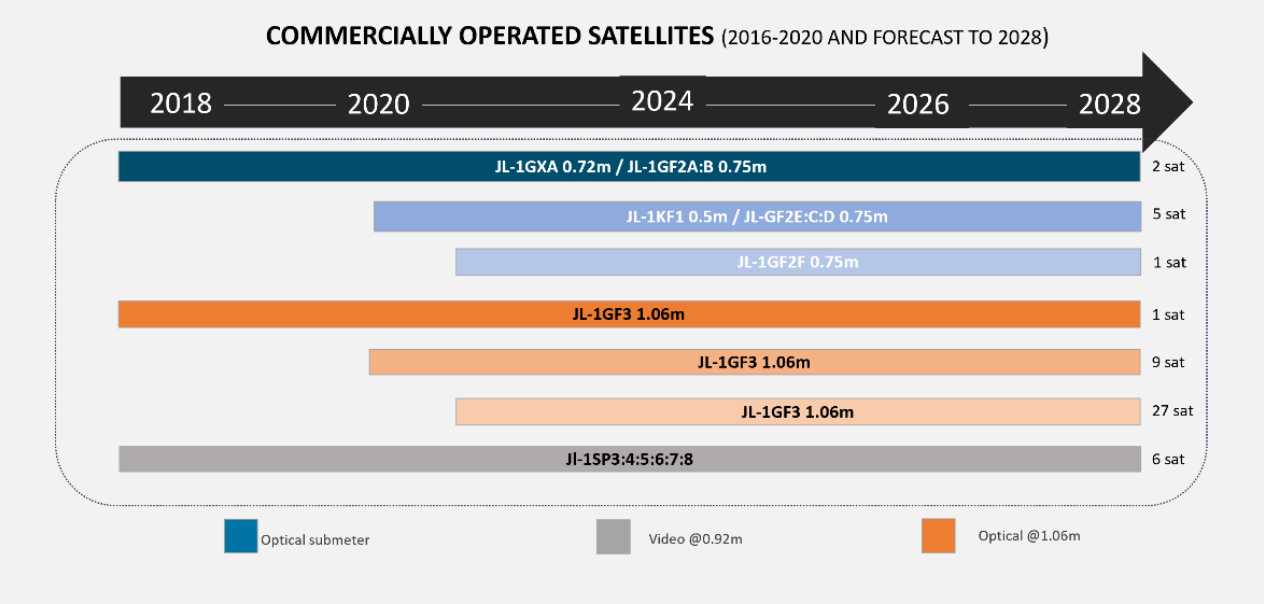
Launch Schedule

Phase I: Until 2021, 60 in-orbit satellite. It has the remote sensing data acquisition capability of multi-orbit, multi-spectral, multi-type. See details in table 1.



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Phase II: Until 2030, 158 in-orbit satellite. To form all-day, all-weather, full spectrum data acquisition capability, can provide the worldwide highest temporal and spatial resolution of space information products. With the continuous progress of the company's satellite development technology, the phase II is expected to be completed by the end of 2025, see details in table 2.

Constellation deployment planning phase I

No.	Date	Model	Resolution (m)	Total amount
1	2020.02	——	--	60
2	2020.06	JL-GF02E	0.75	
	2020.08	JL-GF02C:D:F	0.75	
	2020.09	JL- GF03 (1.06m)	1.06	
	2021.02	JL-1GF03	1.06	
3	2021.04	JL-1KF1B, JL-GF03	0.5 / 1.06	
	2021.06	JL-GF04 JL-GF03	0.5 / 1.06	
	2021.010	JL-GF03	1.06	
	2021.012	JL-GF03	1.06	

Constellation deployment planning phase II

No.	Date	Model	Resolution (m)	Total amount
1	2022.04	JL-GF03	1.06	158
	2022.08	JL-GF03	1.06	
	2022.12	JL-GF03	1.06	
	2022.12	JL-GF04	0.5	
2	2023.04	JL-GF03	1.06	
	2023.08	JL-GF03	1.06	
	2023.12	JL-GF03	1.06	
	2023.12	JL-GF04	0.5	
3	2024.03	JL-GF05	<1	

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	2024.06	JL-GF04	0.5	
	2024.09	JL-GF05	<1	
	2024.12	JL-GF04	0.5	
4	2025.03	JL-GF05	<1	
	2025.06	JL-GF04	0.5	
	2025.09	JL-GF05	<1	
	2025.12	JL-GF04	0.5	

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