

Remote Sensing License Tiering

Q2 2023

Per 15 C.F.R. § 960.6, the National Oceanic and Atmospheric Administration (NOAA) Commercial Remote Sensing Regulatory Affairs (CRSRA) categorizes each private space-based remote sensing system it licenses based on an analysis of whether the system produces or is capable of producing unenhanced data already available from other entities.

- A system with the capability to collect unenhanced data substantially the same as unenhanced data already available from entities or individuals not licensed under this part, such as foreign entities, is categorized as Tier 1;
- A system with the capability to collect unenhanced data substantially the same as unenhanced data already available, but only from entities or individuals licensed by CRSRA, is categorized as Tier 2; and
- A system with the capability to collect unenhanced data not substantially the same as unenhanced data already available from any domestic or foreign entity or individual is categorized as Tier 3.

Currently, CRSRA has:

- 74 Tier 1 licenses
- 1 Tier 2 license
- 22 Tier 3 licenses

When determining whether unenhanced data are substantially the same as other unenhanced data, factors include but are not limited to: spatial resolution, spectral bandwidth, number of imaging bands, temporal resolution, persistence of imaging, local time of imaging, geographic or other restrictions imposed by foreign governments, and all applicable technical system factors listed in Appendix A of 15 C.F.R. Part 960 and Part D of a NOAA license. The tables below outline certain foreign systems and their known capabilities that make available the finest unenhanced data across various types of imagery. Therefore, CRSRA currently uses the below systems as a starting point to differentiate Tier 1 licenses from Tier 2 licenses for several common sensor types.

These parameters are derived exclusively from open-source research and reflect data that are *available*, as the term is defined at 15 C.F.R. § 960.4.

This information is provided as a reference for the public, and CRSRA intends to provide regular updates. However, CRSRA continually evaluates data availability from foreign and other CRSRA-licensed systems and uses that analysis, considering all applicable factors (not only those listed here), when categorizing any system.

Satellite or Constellation	Country	Resolution ¹ Spectral or Other Information
PANCHROMATIC (PAN)		
Pléiades Neo-3, -4	France	0.30 m
KOMPSAT-3A	S. Korea	0.40 m (processed) ² 0.54 m (raw)
SuperView	China	0.50 m
Jilin-1 Optical VHR	China	0.30–1.2 m
MULTISPECTRAL (MSI)		
Aleph-1	BVI/ Argentina	0.7–1.0 m 5 bands between 400–900 nm
Pleaidés Neo-3, -4	France	1.2 m 6 Bands between 400–880 nm
Superview-1	China	2.0 m 4 bands between 450–890 nm
Jilin-1 GP01/02	China	5.0 m 16 bands between 400–900 nm 7.5+ nm
COLOR and VIDEO		
Zhuhai-1 OVS-2, 3	China	0.9 m (video)
Jilin-1 Video	China	0.92 m (RGB color video)
CE-SAT-I	Japan	1.0 m (color)

¹ Resolution types listed in this column refer to spatial resolution, measured in centimeters (cm) or meters (m), spectral resolution, measured in nanometers (nm), and/or thermal accuracy or resolution, and measured in Kelvin (K). As other types of resolution become relevant to the listed capabilities, they will be added to this column.

² Kompsat-3A is equipped with an 80 cm aperture AEISS camera and 8.6 m focal length telescope. 528km altitude. Native resolution is 54 cm and the oversampled data is processed to produce 40 cm resolution at nadir. Source: ESA EO Portal. Retrieved 22 September 2021.

Satellite or Constellation	Country	Resolution ³ Spectral or Other Information
HYPERSPECTRAL (HSI)		
Shakuntala	India	10 m Approximately 150 bands between 470–900 nm Spectral bandwidth varies
Zhuhai-1 Orbita OHS-2, 3	China	10 m 32 bands between 400–1,000 nm 2.5–15 nm ^{4,5,6}
CHRIS (Compact High-Resolution Imaging Spectrometer) PROBA-1	ESA	Configurable 17 m or 34 m 200 bands between 415–1050 nm ⁷ 1.25 nm @400 incr. to 11 nm @1050 nm
Aleph-1	BVI/ Argentina	25–30 m Up to 600 bands between 400–900 nm ⁸ 5 nm FWHM
ENMAP	Germany	30 m VNIR: 96 bands between 400-1030 nm 6.5 nm FWHM (spectral bandwidth) SWIR: 136 bands between 950–2450 nm 10 nm FWHM
HISUI (Hyperspectral Imager Suite)	Japan	20 m x 30 m 185 bands between 400–2500 nm VNIR: 10 nm, SWIR: 12.5 nm

³ Resolution types listed in this column refer to spatial resolution, measured in centimeters (cm) or meters (m), spectral resolution, measured in nanometers (nm), and/or thermal accuracy or resolution, and measured in Kelvin (K). As other types of resolution become relevant to the listed capabilities, they will be added to this column.

⁴ Full Width Half Maximum (FWHM)

⁵ HSI spectral resolution range varies across spectral coverage and from satellite to satellite. (Sources: Apollo mapping, Zhuhai Orbita)

⁶ Minimum operator specified spectral resolution: <https://www.obtdata.com/en/zhuhai1.html>

⁷ CHRIS is capable of producing (filtering) up to 200 spectral bands but is constrained to acquiring just 19 bands at a time. The CCD offers the ability to: increase spectral bandwidth by summing sets of row-signals in the shift register before read-out, to bin pairs at the output port to increase across-track spatial resolution by a factor 2, and to restrict images to half swath widths to increase the number of spectral bands that can be read out. Source: <https://earth.esa.int/eogateway/instruments/chris/description>

⁸ Aleph-1 is capable of producing (filtering) up to 600 spectral bands but is constrained to acquiring just 29 bands at a time. Source: Satellogic: <https://www.euspaceimaging.com/wp-content/uploads/2020/10/Satellogic-Aleph-1-Data-sheet-final.pdf>. Accessed 26 Feb 2021.

Satellite or Constellation	Country	Resolution ⁹ Spectral or Other Information
ULTRAVIOLET (UV) 280–400 nm¹⁰		
Sentinel-5P Tropomi	European Space Agency	7 kilometers (km) 270–320 nm
SHORT WAVE INFRARED (SWIR) 1200–3000 nm		
Sentinel-2A, 2B	European Space Agency	20 m • 2 bands centered at 1610 nm (91 nm spectral bandwidth) and 2185 nm (175 nm spectral bandwidth) 60 m • 1 band centered at ~1375 nm (30 nm spectral bandwidth)
ENMAP	Germany	30 m 136 bands between 950–2450 nm 10 nm FWHM
MID-WAVE INFRARED (MWIR) 3000–8000 nm		
TBD	TBD	TBD

⁹ Resolution types listed in this column refer to spatial resolution, measured in centimeters (cm) or meters (m), spectral resolution, measured in nanometers (nm), and/or thermal accuracy or resolution, and measured in Kelvin (K). As other types of resolution become relevant to the listed capabilities, they will be added to this column.

¹⁰ This table is limited to sensors that detect light in the UV-A and UV-B wavelengths as shorter UV wavelengths are fully attenuated by the atmosphere

Satellite or Constellation	Country	Resolution ¹¹ Spectral or Other Information
LONG WAVE INFRARED (LWIR) 8000–14000 nm		
Aleph-1	BVI/ Argentina	90 m 1 band between 8000–14000 nm
CBERS-4 IRMSS ^{12,13}	China / Brazil	80 m 1 band between 10400–12500 nm
NIGHT-TIME IMAGING (NTI)		
EROS B	Israel	0.70 m PAN: 500–900 nm
Jilin-1 SP03-8	China	0.92 m Blue: 437–512 nm, Green: 489–585 nm, Red: 580–723 nm
NON-EARTH IMAGING (NEI)		
HEO Robotics	Australia	Spatial resolution varies 400–1000 nm

¹¹ Resolution types listed in this column refer to spatial resolution, measured in centimeters (cm) or meters (m), spectral resolution, measured in nanometers (nm), and/or thermal accuracy or resolution, and measured in Kelvin (K). As other types of resolution become relevant to the listed capabilities, they will be added to this column.

¹² [2020 Joint Agency Commercial Imagery Evaluation—Remote Sensing Satellite Compendium](https://www.usgs.gov/2020-joint-agency-commercial-imagery-evaluation-remote-sensing-satellite-compendium) (usgs.gov)

¹³ The HuanJing-2B (HJ-2B) IRMSS-2 CRESDA sensor program acquires MWIR/LWIR data at 48/40 meters spatial resolution but has not made this data available. See distributor SpaceWill (en.spacewillinfo.com)

Satellite or Constellation	Country	Information Density	Slant Range, Azimuth Resolution ¹⁴
SYNTHETIC APERTURE RADAR (SAR)¹⁵			
X-Band (9.2–10.4 GHz)			
ICEYE	Finland	115 bits/m ²	0.5 m, 0.05 m
TerraSAR/ TanDEM/PAZ	Germany/ Spain	39 bits/m ²	0.5 m, 0.25 m
COSMO SkyMED 2 nd Generation (CSG) ¹⁶	Italy	59 bits/m ²	0.17 m, 0.3 m
C-Band (5.25–5.57 GHz)			
Tianxian ^{17,18} (Chaohu-1)	China	8.39 bits/m ²	1.0 m, 0.5 m
Gaofen-3 ¹⁹	China	6.1 bits/m ²	0.9 m, 1.0 m
L-Band (1.215–1.30 GHz)			
ALOS-2 ²⁰	Japan	2.7 bits/m ²	1.8 m, 1.0 m

¹⁴ Slant range and azimuth resolution figures provided for reference only.

¹⁵ The SAR primary performance characterization metric has been changed from ground range detected (GRD) square pixel resolution to Information density C (bits/m²) as defined by the Radar General Image Quality Equation (RGIQE) = $\beta \cdot \text{LOG}(1 + \text{SNR})$ where β = bandwidth per unit area on the ground at lowest acceptable grazing angle ($\beta = \text{SQ RT}(\beta_{\text{Range}} * \beta_{\text{Azimuth}})$), SNR = the signal-to-noise ratio = $1/(\text{Noise Equivalent Sigma Zero (NESZ)})$ with MNR = 0 (1 dB). Results are considered comparable if they are within 25%. Slant range resolution provided for reference only and may not represent best resolution as in some cases azimuth resolution may be superior.

¹⁶ Published CSK/CSG commercially available resolution statistics: e-geos Price List February 22, 2021 (Page 6).

¹⁷ “Chinese partnership to create Tianxian SAR satellite constellation”, Andrew Jones, SpaceNews, 8 October, 2021. <https://spacenews.com/chinese-partnership-to-create-tianxian-sar-satellite-constellation/>

¹⁸ Earth Observation Satellites Technical Specifications (Brochure), HEAD Aerospace, Viewed 22 December 2022. The Hisca-1 Tianxian concept demonstrator has 1 meter spatial resolution, while the newer Chaohu-1 has 0.5 meter resolution.

¹⁹ Data disseminated through HEAD Aerospace: <https://head-aerospace.eu/eo-satellites>. Resolution is 0.9 x 1.0 m

²⁰ Advanced Land Observing Satellite-2: ALOS-2 - Satellite Missions - eoPortal Directory (esa.int)

Satellite or Constellation	Country	Resolution (type) ²¹ Spectral or Other Information
LIDAR		
TBD	TBD	TBD

²¹ Resolution types listed in this column refer to spatial resolution, measured in meters (m), spectral resolution, measured in nanometers (nm), thermal accuracy or resolution, and measured in Kelvin (K). As other types of resolution become relevant to the listed capabilities, they will be added to this column.

Change Log

Publication Date	Page	Description of Change
Q2 2023	1	Revised number of licensed systems in each tier
	2	Removed redundant summary of systems capabilities
	2-7	Formatting in third column (Resolution) has been revised to remove the type of resolution (spatial, spectral, or thermal accuracy) from parenthesis in each entry. This change was made because the unit of measure, which is described in the footnotes, indicates the type of resolution cited and the parenthetical references were used inconsistently in prior versions.
	2-7	The revisit rate column has been removed.
	2-7	Metrics for “Best US” have been removed.
	2	Removed footnote pertaining to Cartosat-3. The footnote stated “India’s Cartosat-3 satellite collects PAN imagery with up to 0.25 m resolution and MSI at 1.1 m but does not meet the criterion for availability (data access is “very constrained”) therefore it cannot be used as a commercial benchmark. Source: http://database.eohandbook.com/database/instrumentsummary.aspx?instrumentID=917 .”
	2	Removed footnote pertaining to TripleSat. The footnote stated “TripleSat (DMC3, SSTL S1-4) was removed. Although SSTL S1-4, the fourth satellite in the constellation, was initially launched in 2018 into a lower (580 km) orbit versus DMC3A/B/C (645 x 670 km orbit) the overall performance of the constellation is advertised as 0.80 – 1.0 meter. At 80 cm, it is no longer benchmark level.”
	2	The redundant footnote regarding KOMPSAT-3A’s spatial resolution has been removed.
	2	The Jilin-1 Optical VHR constellation entry has been revised to reflect the most recent advertising from HEAD Aerospace, including an improvement in spatial resolution.
	2	Removed footnote pertaining to Pléiades NEO-3 and -4. The footnote read, “Airbus Pleiades Neo-3 and -4 entered operations in November and December 2021.”
	2	Removed footnote pertaining to Jilin-01 GP01/02. Footnote stated “Jilin-1 GPO1/02 removed. 4 MSI bands with 100 m spatial and 30-80 nm spectral resolution is below benchmark.”
	3	A new system has been added to the hyperspectral benchmark list.
	4	Removed footnote pertaining to Cartosat-3. Footnote stated “India’s Cartosat-3 collects 5.7 m MWIR data which is not commercially distributed. Source: http://database.eohandbook.com/database/instrumentsummary.aspx?instrumentID=917 .”
	4	Removed footnote pertaining to Kompsat-3A. Footnote stated “S. Korea’s KOMPSAT-3A satellite collects 5.5 m MWIR data which is not commercially distributed.”
	4	Information from footnote pertaining to Sentinel-2A, -2B bands moved into table cell and reformatted.
	5	Spatial resolution for HEO Robotics was replaced with “varies.”

	6	Revised heading of third column to accurately reflect column content (Information Density).
	6	Information density and azimuth resolution reported for ICEYE increased to 115 bits/m ² and 0.05 m based upon new product availability as described in ICEYE, "A Revolution in Synthetic Aperture Radar (SAR) Data Earth Observation," Q2 2023, ICEYE-BDS-BRO-339. https://www.iceye.com/hubfs/Downloadables/SAR_Data_Brochure_ICEYE.pdf . Accessed July 17, 2023.
	All	Minor editorial revisions