Appendix A to Part 960—Application Information Required

To apply for a license to operate a remote sensing space system under 51 U.S.C. 60101, et seq. and 15 CFR part 960, you must provide:

1. Material Facts: Fully accurate and responsive information to the following prompts under "Description of Licensee" and "Description of System." If a question is not applicable, write "N/A" and explain, if necessary.

2. Affirmation: Confirm by indicating below that there will be, at all times, measures in place to ensure positive control of any spacecraft in the system that have propulsion, if applicable to your system. Such measures include encryption of telemetry, command, and control communications or alternative measures consistent with industry best practice. If you answer "yes" to Part B 4.d.vii. indicating you'll have propulsion, you must provide the affirmation here.

3. Your response to each prompt below constitutes a material fact. If any information you submit later becomes inaccurate or incomplete before a license grant or denial, you must promptly contact the Secretary and submit correct and updated information as instructed by the Secretary.

Part A: Description of Applicant (Operator)

1. General Applicant Information

a. Name of Applicant (entity or individual):

- Company, university, person

b. Location and address of Applicant:

- Physical address (not a P.O. Box)

c. Applicant contact information (for example, general corporate or university contact information):

- Physical address (not a P.O. Box), email, telephone number

d. Contact information for a specific individual to serve as the point of contact with Commerce:

- Company representative with authority to speak for the company, permanent faculty (not students), outside legal counsel that possess authorization to represent the company: Name, Physical address (not a P.O. Box), email, telephone number

e. Contact information for a specific individual to serve as the point of contact with Commerce for limited-operations directives, if different than main point of contact, in the event that the applicant will receive a license in Tier 2 or Tier 3:

- 24/7/365 representative with authority to invoke limited operations

f. Place of incorporation and, if incorporated outside the United States, an acknowledgement that you will operate your system within the United States and are therefore subject to the Secretary's jurisdiction under 15 CFR Part 960:

- "N/A" if this does not apply, otherwise provide the requested information

2. Ownership interests in the Applicant:

a. If there is majority U.S. ownership: report any domestic entity or individual with an ownership interest in the Applicant totaling at least 50 percent:

- "N/A" if this does not apply, otherwise provide the requested information. If you answer "N/A" here you must answer "b." below.

b. If there is not majority U.S. ownership: report all foreign entities or individuals whose ownership interest in the Applicant is at least 10 percent:

- If the answer to "a." above was not N/A, the answer here is "N/A"

c. Report any ownership interest in the Applicant by any foreign entity or individual on the Department of Commerce's Bureau of Industry and Security's Denied Persons List or Entity List or on the Department of the Treasury's Office of Foreign Asset Control's Specially Designated Nationals and Blocked Person List:

- "N/A" if this does not apply, otherwise provide the requested information

3. Identity of any subsidiaries and affiliates playing a role in the operation of the System, including a brief description of that role:

- "N/A" if this does not apply, otherwise provide the requested information

Part B: Description of System

1. General System Information

a. Name of system:

- This will be the system name on the license. It should be the same as the name used for other licenses (FCC, FAA, etc.) or when contracting launch services

b. Brief mission description:

- At a minimum, this should address:
    - -- What will the system do in space?
    - -- How will the data obtained be used and by who?
    - -- Provide affirmation that the mission will or will not include non-Earth imaging

2. Remote Sensing Instrument(s):
a. Sensor type (Electro Optical, Multi-Spectral (MSI), Hyperspectral (HSI), Synthetic Aperture Radar (SAR), Light Detection and Ranging (LIDAR), Thermal Infrared (TIR), etc.):

- Identify all sensors. If yours is not listed, clearly state what it is
- Do not include any star trackers of other navigational sensors

b. Imaging/frame rate in Hertz; pulse repetition frequency for SAR or LIDAR:
- Answer in Frames per Second (FPS) for area/snapshot models.
- For line scan sensors, please annotate as such and provide a line scan rate in hertz, noting that this not the same as the definition of FPS for area/snapshot models.

c. Spatial resolution in meters (show calculation for the anticipated finest ground spatial distance (GSD), impulse response (IPR), or other relevant appropriate unit of resolution):

$$\mathbf{GSD} = \frac{\mathbf{p} \cdot \mathbf{H}}{\mathbf{f}}$$

- **Ground Sampling Distance (GSD) – projection of a pixel to the ground**
- **Pixel pitch (p) – the linear dimension of a focal plane pixel**
- **f – focal length of the telescope**
- **H – the lowest satellite operational imaging altitude**

The width of the impulse response (IPR) in the ranging direction is determined by the bandwidth of the transmitted signal and is calculated using the following equation:

$$\Delta r = \frac{c}{2B}$$

where, Δr is the width of the IPR in meters, c is the speed of light, and B is the bandwidth of the transmitted signal.

d. Spectral range in nanometers:
The lowest wavelength sensed to the highest. EX: 380-900 nm; Provide GHz range for SAR
e. Collection volume in area per unit time per spacecraft: provide an estimate of the maximum number of square kilometers of which the system can provide data/imagery per hour or per minute. If this is a fast-framing system, consider each recorded frame as a separate image collected:
Square km/unit of time

f. Ability of the remote sensing instrument to slew, point, or digitally look off-axis from the x, y, and z axes of travel:
Describe planned capability or state N/A if none

3. If any entity or individual other than the Applicant will own, control, or manage any *remote sensing instrument* in the System:

Provide specific information or if none state N/A

a. Identity and contact information of that entity or individual:
Provide specific information or if none state N/A

b. Relationship to Applicant (i.e., operating under Applicant's instructions under a contract):
Provide specific information or if none state N/A

4. Spacecraft Upon Which the Remote Sensing Instrument(s) is (are) Carried

a. Description:
Provide specific information, note this is NOT the launching rocket, it is the physical satellite bus or object the sensor will be on when imaging.

b. Estimated launch date(s) in calendar quarter:
EX: NET 4 QTR 2023, NET May 7, 2025;

c. Number of spacecraft (system total and maximum in-orbit at one time):
Total number is: ##
Maximum on orbit is: ####

d. For each spacecraft, provide the following (or if an entire constellation will have substantially the same orbital characteristics, provide these values for the entire constellation and note whether or not all spacecraft will be evenly spaced)
i. Altitude range in kilometers:
EX: 450 km circular; 340-450 km NOTE: The lowest & highest imaging operational altitude must be provided here.

ii. Inclination range in degrees:
EX: 51.6 degrees; 95-98 degrees

iii. Period (time of a single orbit):
EX: 97.3 minutes

iv. Longitude of the ascending node:
The longitude of the ascending node is the angle from a reference direction, called the origin of longitude, to the direction of the ascending node, measured in a reference plane.

v. Eccentricity:
The orbital eccentricity of an astronomical object is a dimensionless parameter that determines the amount by which its orbit around another body deviates from a perfect circle. A value of 0 is a circular orbit, values between 0 and 1 form an elliptic orbit, 1 is a parabolic escape orbit, and greater than 1 is a hyperbola.

vi. Argument of perigee:

The Argument of Perigee is defined as the angle within the satellite orbit plane that is measured from the Ascending Node to the perigee point along the satellite's direction of travel. The value of the Argument of Perigee can be anywhere from 0 to 360 degrees.

vii. Propulsion (yes/no). (If "yes," you must complete question #2, the affirmation, in the beginning of this application):
If yes, describe the propulsion mechanism. If propulsion is present, how will it be used to speed up the de-orbit process?

viii. Ability of the spacecraft to slew, point, or digitally look off-axis from the x, y, and z axes of travel:
Note this is the slew of the spacecraft vice the instrument in the question above. One, both, or neither may be able to slew.

5. If any entity or individual other than the Applicant will own, control, or manage any *spacecraft* in the System

a. Identity and contact information of that entity or individual:
Provide specific information or if none state N/A

b. Whether that entity or individual is a U.S. person:
Provide specific information or if none state N/A

c. Relationship to Applicant (i.e., operating under Applicant's instructions under a contract):
Provide specific information or if none state N/A

6. Ground Components

a. Location of Mission Control Center(s) with the ability to operate the system, including where commands are generated:
Provide specific physical address. Include country, if overseas (you may use the chart below)

b. Location of other Ground Station components of the system, meaning facilities that communicate commands to the instrument or receive unenhanced data from it, and facilities that conduct data preprocessing:
Provide specific physical address and the entity who operates the Ground Station. Include country if overseas. (use the chart below). If no physical address can be provided, enter in the Lat/Long coordinates.

Type	Operator Name and Address	Coordinates
MCC		
Domestic		

Foreign		

c. If any entity or individual other than the Applicant will own, control, or manage any *mission control center(s)* with the ability to operate the System
Provide specific information or if none state N/A

i. Identity and contact information of that entity or individual:
Provide specific information or if none state N/A

ii. Relationship to Applicant (i.e., operating under Applicant's instructions under a contract):
Provide specific information or if none state N/A

7. Information Applicable to Multi-Spectral Imaging (MSI) and/or Hyper-Spectral Imaging (HSI). Applicants must complete this section only if the response in Part B section 2.a. is "MSI" and/or "HSI."

a. Number of spectral bands: EX: MSI 3 bands; HSI 100 bands

b. Individual spectral bandwidths (to include range of the upper and lower ends of each spectral band in nanometers): EX: MSI: (380-450nm, 560-620nm, 730-900 nm); HSI: 100 bands (380-880 nm, each band is 5 nm wide)

8. Noise Equivalent Target (NET). Applicants must complete this section only if the response in Part B 2.c. is 5 meters or less, and the answer in Part B section 2.a. is neither "SAR" nor "LIDAR." NET is the primary parameter used by the U.S. Government to describe an Electro Optical sensor's light sensitivity performance for a target at the same distance from the sensor as is specified as the minimum operating altitude in Part B section 4.d.i. If NET cannot be calculated, simply report the expected minimum detectable ground target radiance in watts:

$$NET = (\Delta\lambda \times A_{pix} \times (SR \text{ or } OA)^2 \times NESR) / ((F_L)^2 \times (0.4)^Q)$$

a) $\Delta\lambda$ = Difference between lowest and highest wavelengths in meters used in integration (equivalent to Bandwidth)
b) A_{pix} = pixel area in square meters ((pixel pitch)^2 or pixel pitch squared)
c) SR = Slant Range (Range Between Sensor and Target) in meters
d) OA = Orbital Altitude in meters (if the orbit is elliptical, we will need the apogee (maximum orbital altitude) and perigee (minimum orbital altitude))
e) NESR = Noise Equivalent Spectral Radiance
f) F_L = Focal Length in meters

g) Q = Q (Quality)

NESR = (N_R x h x c) / (Ω x A_{pix} x α x B x λ x t_{int} x T x D)

a) N_R = Read Noise in electrons or electrons root mean square per pixel
b) h = Planck Constant ($6.62607015 \times 10^{-34}$ Joules·second)
c) c = Speed of Light in meters per second (2.99792458×10^8)
d) Ω = Steradian/Solid Angle
e) A_{pix} = pixel area in square meters ((pixel pitch)^2 or pixel pitch squared)
f) α = Aggregation Factor in ratio

The "Aggregation Factor in ratio" refers to the number of pixels combined to make a more sensitive equivalent of a pixel. For example, if four pixels are combined into one more sensitive pixel, then your aggregation factor would be 4 (4/1, the equivalent of 400% in a ratio).

g) B = Bandwidth in meters
h) λ = Wavelength in meters
i) t_{int} = Integration Time in seconds
j) T = Transmission in ratio

D = Integration Duty Cycle in ratio

9. Information Applicable to Light Detection and Ranging (LIDAR) if used for remote sensing. Responses should include the calculations used to derive the reported parameters. Applicants must complete this section only if the response in Part B section 2.a. is "LIDAR."

a. Type (linear scanning or flash LIDAR (Geiger)):
EX: Linear; Geiger

b. Laser wavelength and pulse frequency:
Provide wavelength in nanometers
Provide frequency in MegaHertz (MHz)

c. Laser pulse width:
Pulse Width is a measure of the time between the beginning and end of the pulse, typically based on the full width half maximum (FWHM) of the pulse shape. Also called pulse duration. The amount of time between the start of one pulse and the start of the next.

d. Spectral linewidth:
The linewidth (or line width) of a laser, e.g. a single-frequency laser, is the width (typically the full width at half-maximum, FWHM) of its optical spectrum. More precisely, it is the width of the power spectral density of the emitted electric field in terms of frequency, wavenumber or wavelength.

e. Z/Elevation accuracy in meters:

Provide answer in meters

10. Information Applicable to Synthetic Aperture Radar (SAR). Applicants must complete this section only if the response in Part B section 2.a. is "SAR."

a. Azimuth resolution (ground plane):
Azimuth resolution describes the ability of an imaging radar to separate two closely spaced scatterers in the direction parallel to the motion vector of the sensor. Hence the beamwidth is taken as the azimuth resolution depending also slant-range distance to the target for these systems.

Azimuth Resolution=$\lambda/(2*\rho)$ where λ=transmit frequency wavelength and ρ is the aspect angle (subtended synthetic aperture angle) for calculating resolution

b. Range resolution (ground plane):
Range resolution is the ability of radar system to distinguish between two or more targets on the same bearing but at different ranges. The degree of range resolution depends on the width of the transmitted pulse, the types and sizes of targets, and the efficiency of the receiver and indicator.

Range Resolution=c/(2*B*COS(Ø)) where C=the speed of light, B=Radar pulse bandwidth, Ø=grazing angle for calculating resolution

c. SAR Signal-To-Noise Ratio (SNR):
Signal-To-Noise (SNR) – This is the standard parameter used to determine if there is enough power to collect a target at a given distance at a desired resolution. It is also used to determine the access and range of a SAR system.

$SNR = (P_T \text{ x } (A_A)^2 \text{ x } (E_A)^2 \text{ x } \sigma \text{ x } R_R) / (8 \text{ x } \pi \text{ x } (SR)^3 \text{ x } \lambda_{CF} \text{ x } k \text{ x } T_O \text{ x } N_F \text{ x } L_S \text{ x } V_p \text{ x } \text{cosine}(T_E))$

a) P_T = Average Transmitted Power in watts
b) A_A = Antenna Area in square meters
c) E_A = Antenna Efficiency in ratio
d) σ = Radar Cross Section in square meters. Assumption is (desired resolution in meters)^2
e) R_R = Range Resolution in meters
f) π = Pi (3.14159)
g) SR = Slant Range (Range Between Sensor and Target) in meters
h) λ_{CF} = Wavelength of the Transmitted Center Frequency in meters
i) k = Boltzmann's Constant in Joules per kelvin (1.38×10^{-23})
j) T_O = Noise Temperature in kelvin
k) N_F = Noise Figure in ratio
l) L_S = System Losses in ratio
m) V_p = Platform Velocity in meters per second

n) T_E = Target Elevation Angle in degrees

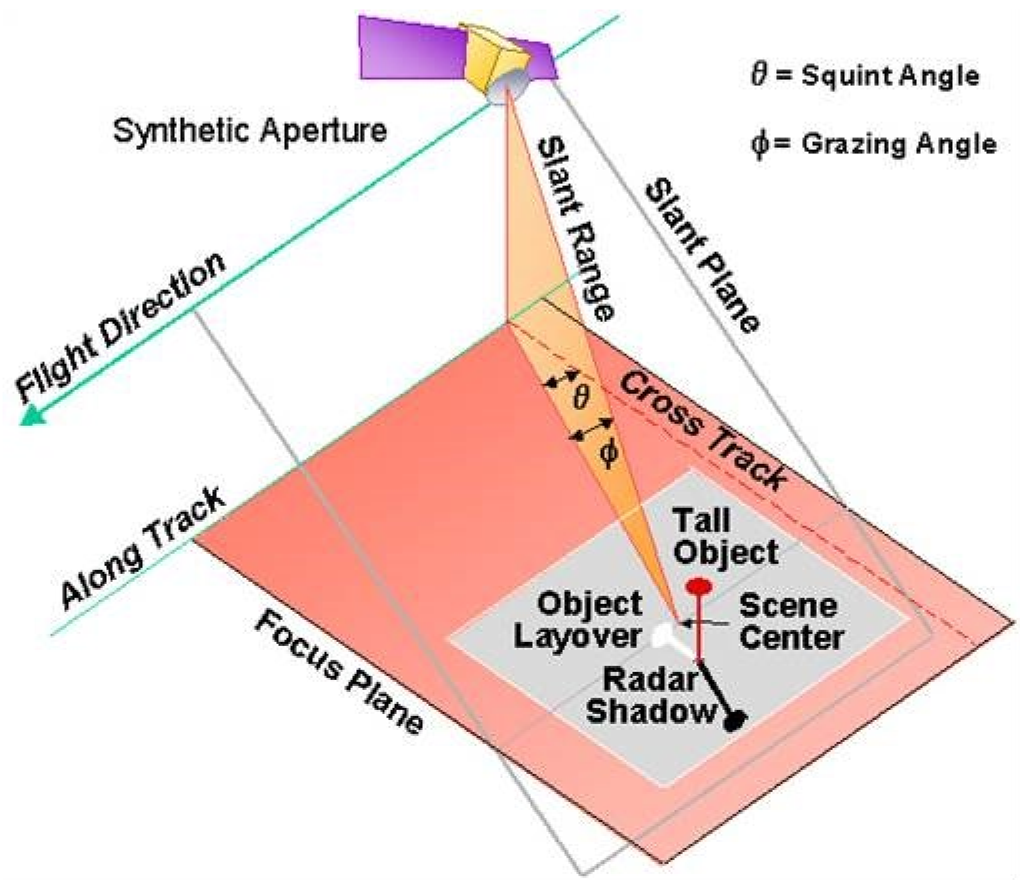
d. Polarization Capability (i.e. dual polarization, quad polarization):
EX: Dual; Quad

e. Complex data: Preservation of phase history data in standard format? (yes/no):
Yes or no

f. Center frequency: MHz or GHz

g. Squint and Graze angles (include maximum and minimum), or other parameters that determine the size and shape of the area of regard of the sensor collection footprint at the ground:

Squint Angle - SAR geometry diagram showing squint angle θ. Note that θ is in the focus plane
Grazing Angle - SAR geometry diagram showing grazing angle Φ. Note that Φ is the acute angle opposite to the right angle in the orange triangle defined by the slant and ground planes



11. Information Applicable to Thermal Infrared (TIR). TIR is defined as collecting in the spectral range of 3.0–5.0 and/or 8.0-12.0-micrometers. Applicants must complete this section only if the response in Part B section 2.a. is "TIR."

a. Estimated relative thermometric accuracy in degrees Kelvin (+/- x degrees of actual):
Degrees Kelvin

b. Noise Equivalent Differential Temperature (NEDT), or if NEDT cannot be calculated, simply provide the expected temperature sensitivity in terms of minimum resolvable temperature difference in degrees:
NEDT (noise equivalent differential temperature) is the key figure of merit which is used to qualify midwave (MWIR) and longwave (LWIR) infrared cameras. It is a signal-to-noise figure which represents the temperature difference which would produce a signal equal to the camera's temporal noise. It therefore represents approximately the minimum temperature difference which the camera can resolve. It is calculated by dividing the temporal noise by the response per degree (responsivity) and is usually expressed in units of milliKelvins. The value is a function of the camera's f/number, its integration time, and the temperature at which the measurement is made.

Part C: Requests for Standard License Condition Waivers or Adjustments

Standard license conditions are listed at 15 CFR 960.8. 960.9, and 960.10 for Tier 1, Tier 2, and Tier 3 systems, respectively. If requesting that any of these be waived or adjusted, please identify the specific standard license condition and explain why one of the following circumstances applies:

1. The requirement is not applicable due to the nature of the Applicant or the proposed system;

2. The Applicant will achieve the goal in a different way; or

3. There is other good cause to waive or adjust the condition.

OPTIONAL:
You may submit evidence of the availability of unenhanced data that is substantially the same as unenhanced data you propose to produce with your system. The Secretary will

take any such evidence into account, in addition to other evidence of availability, when determining the appropriate tier for your system under § 960.6.

Appendix B to Part 960—Application Submission Instructions

A person may apply to operate a private remote sensing space system by submitting the information to the Secretary as described in Appendix A of this part. This information can be submitted in one of three ways:

1. Complete the fillable form at the Secretary's designated website, presently at www.nesdis.noaa.gov/crsra.

2. Respond to the prompts in Appendix A of this part and email your responses to crsra@noaa.gov.

3. Respond to the prompts in Appendix A of this part and mail your responses to: Commercial Remote Sensing Regulatory Affairs, 1335 East-West Highway SSMC-1/G-101, Silver Spring, MD 20910.