C-UAS Equipment Placement

Field Guidance for State and Local First Responders

FOREWORD

The National Urban Security Technology Laboratory (NUSTL) is a federal laboratory organized within the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T). Located in New York City, NUSTL is the only national laboratory focused exclusively on supporting the capabilities of state and local first responders to address the homeland security mission. The laboratory provides first responders with the necessary services, products, and tools to prevent, protect against, mitigate, respond to, and recover from homeland security threats and events.

NUSTL provides independent technology evaluations and assessments for first responders, thereby enabling informed acquisition and deployment decisions, and helping to ensure that responders have the best technology available to use in homeland security missions.

Visit the NUSTL website at www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory, or contact NUSTL@hq.dhs.gov for more information.

PURPOSE AND HOW TO USE THIS GUIDE

This document helps you choose and document suitable locations for counter-unmanned aircraft systems (C-UAS) equipment such as radar, radio frequency (RF) sensors, and cameras.

Use it:

- When searching for new sites (e.g., stadiums, critical infrastructure, public events).
- Alongside the **Site Access and Contact Information** (see page 9) and **Field Worksheet** (see page 10) to record what you see.
- As a quick reference in the field.

This guidance is **not** a replacement for the manufacturer's manuals. Always follow equipment-specific safety and setup instructions.

CORE CONCEPTS IN PLAIN LANGUAGE

These ideas show up throughout C-UAS siting. Keep them in mind:

- **Area of Regard (AOR)**

  The 3-D volume of airspace the sensor is meant to watch (e.g., "from the stadium to 2 km out, from 0 ft AGL up to 1,000 ft AGL"). Good siting starts with a clear AOR.

- **Clutter**

  This includes unwanted radar or sensor returns: cars, trees, waves, fans in stadiums, wind turbines, etc. Too much clutter creates false tracks or hides real drones.

- **Line of Sight (LOS)**

  C-UAS sensors (radar, RF, EO/IR cameras) work best when there is a clear line of sight between the sensor and the drone. Buildings, trees, or terrain that block LOS reduce detection range and create blind spots.

- **Noise Floor**

  The total background electromagnetic "static" from the natural and man-made sources. Higher noise makes it harder to see weak signals (small drones far away).

- **Signal to Noise Ratio (SNR)**

  How strong the drone's return or RF signal is compared to the noise. Better siting – clear LOS, fewer reflectors, less interference – improves SNR and detection.

STEP BY STEP: EVALUATING A POTENTIAL C-UAS SITE

1. Define the Mission

Before choosing a rooftop or hill:

- What asset are you protecting?
  - Stadium, government building, power plant, public gathering, etc.
- What is the priority direction that threat UAS may approach from?
  - Nearby park, highway, open field, waterfront?
- How far out does the system need to detect?
  - Example: "We want detection at least 1–2 km out from the stadium."

Document this in your Field Worksheet under "**Notes**"

2. Identify Candidate Locations

Look for:

- Nearby tall buildings, towers, or hilltops with a view of the protected area.
- Locations closest to the center of the AOR or to likely approach paths.
- Sites that are reachable, safe, and legally accessible.

Common examples:

- Stadium light towers or roof decks.
- Adjacent office building roofs.
- Nearby hospital or residential towers.
- Natural terrain features (ridgelines, hills).

3. Assess Line of Sight and Height

At each candidate spot:

- Walk to the proposed sensor location.
- Visually check:
  - Can I see the protected area and likely approach paths?
  - Are there taller buildings or hills blocking key directions?

For radar and cameras:

- Higher is usually better, but too high can:
  - Limit your ability to aim down into close in areas.
  - Increase clutter from streets and nearby roofs directly below

Good practice:
Position the radar or camera so it can "look out" over the AOR rather than straight down into the building it sits on.

4. Look for Clutter and Reflectors

Avoid pointing sensors at:

- Heavy traffic corridors (highways, busy streets), if they are present in the main beam.
- Dense trees, objects moving in the wind.
- Water surfaces (river, bay) create strong reflections.
- Wind turbines or large moving machinery.
- Massive flat, reflective surfaces (like glass/metal buildings, large rooftop HVAC units) that can reflect radar energy and cause false returns or "ghosting."

If these features are present:

- See if you can shift the sensor location or adjust azimuth/elevation to reduce their impact.

Note major clutter sources on the Field Worksheet under "**Notes"**

5. Check for Other RF or Radar Sources

C-UAS radars and RF sensors can be affected by:

- Nearby **cell towers**, broadcast antennas, Wi-Fi, and other RF emitters.
- Other **radars** (airfield radars, marine radars, weather radars).
- High power radio labs or test ranges.

Actions:

- Look around and **photograph antennas and dishes** on the roof or nearby structures.
- Ask site personnel about large transmitters on the building.

Record details under "**Known radio transmitters on roof or site"** and attach photos.

2.4Ghz Parabolic dish

915Mhz Yagi

Axial-mode helical antenna

Patch antenna

Figure 1 Examples of High Gain Antennas

6. Power, Mounting, and Access

You must be able to install, operate, and maintain the equipment safely.
Record the following in your worksheet:

- Roof/Location access
  - Describe exactly how to reach the roof or location:
    - "Elevator to 10th floor → locked door → interior stair to roof hatch (key from security)."
  - Who controls keys, key cards, or access codes?
  - Any restrictions (escorted access only, permitted hours, union rules).
- Power
  - Is there a **power outlet or panel** on the roof?

- If yes, note:
  - Voltage and AC type (e.g., 120 VAC, 20 A circuit).
  - Plug or connector type.
  - Approximate distance from the outlet to the intended C-UAS installation point (measure or estimate in feet/meters).
- If no:
  - Note if temporary power (generator, battery) is possible.

- Mounting and Physical Security
  - Roof type (e.g., concrete, gravel, membrane, metal).
  - Available mounting structures (parapet walls, railings, equipment racks, masts).
  - Ability to securely bolt or clamp equipment.
  - Options to lock down or cage equipment against tampering.
- Safety
  - Guardrails or parapet walls present?
  - Trip hazards (cables, ducts, uneven surfaces)?
  - Weather exposure (high winds, icing, pooled water)?
  - Structural concerns (older roofs, soft spots)? If any safety issues are present, note them clearly.

7. Obstructions and Special Conditions

Identify anything that could block LOS or limit performance:

- High perimeter walls, elevator overruns, or stair towers.
- Rooftop mechanical units (e.g., chillers, air handlers, large ducts).
- Nearby cranes or construction.

For each:

- Note height relative to sensor (higher, same, lower).
- Note direction (e.g., “14 ft wall along west edge, blocks LOS toward downtown”).

Record this under “**Are there any obstructions to note?**” with a short description.

8. Photos and Documentation

Photos make future planning much easier. For every candidate site:

- Photos of the installation site
  - Looking outward in the main directions of interest.
  - Close-up of the exact mounting area.
- Photos of overall roof/landscape
  - From the proposed sensor location, take panoramas or 4 compass point shots (N, E, S, W).
- Photos of antennas and RF sources
  - Capture all visible antennas, dishes, towers, and major cables.

Record

- Date and time.
- GPS coordinates if available (phone or handheld GPS).
- Building name and floor/roof level.

Make sure the above are captured in the worksheet fields marked:

- “Photos taken of installation site (Yes/No)”
- “Photos of overall roof/site landscape (Yes/No)”
- “Photos of various antennas (Yes/No)”

SENSOR-SPECIFIC NOTES

Radar (C-UAS Surveillance Radar)

- Needs **clear LOS** to the airspace to be monitored.
- Typically benefits from **elevated locations** (rooftops, towers, hills).
- Avoid:
  - Large reflective surfaces in the main beam (buildings, water).
  - Pointing directly at heavy traffic if it fills the beam.
  - Locations very close to other powerful RF emitters on the same band.
- Be aware of **trade-offs**:
  - Raising the radar improves range but may reduce coverage of very close, low altitude drones.
  - Using settings that reduce clutter may also reduce maximum range.

Always follow the radar vendor's **safety distances and exposure limits**.

RF Detection Sensors

- Benefit from **good LOS** toward drone flight paths and are often more tolerant of partial obstruction than radar.
- Perform best away from:
  - Strong, nearby RF sources (cell towers on the same roof, broadcast antennas).
  - Enclosed spaces or metal structures that shield signals.
- Taller placements often see more RF energy but may also pick up more urban noise.

EO/IR Cameras

- Require **direct visual line of sight** to the drone or to designated sectors.
- Place where the camera can:
  - Rotate and tilt freely without hitting or being obstructed in view by walls or railings.
  - Avoid persistent glare from the sun or bright lights.
- Consider:
  - Night performance (e.g., ambient lighting, IR illumination if used).
  - Weather exposure (e.g., need for housing, wipers, or heaters).

PUTTING IT ALL TOGETHER: EXAMPLE FIELD WORKFLOW

Before Site Visit

- Review mission and AOR.
- Print this guide.

On Site

- Meet building/security/engineering contacts.
- Walk to candidate roofs or high points.
- For each candidate location:
  - Evaluate LOS and height.
  - Check clutter, reflectors, and nearby RF.
  - Record access, power, and obstructions.
  - Take required photos.

After Site Visit

- Compare candidate locations:
  - Which offers the best coverage of the AOR with acceptable clutter?
  - Which is safest and easiest to access and maintain?
- Flag top 1–2 locations for detailed engineering review and vendor input

KEY TAKEAWAYS

- **Start with the mission and AOR** requiring C-UAS coverage, not with the rooftop that is easiest to reach.
- **Line of sight, height, the noise floor, and clutter** are the main drivers of C-UAS sensor performance.
- Good documentation **(worksheet and photos)** makes future deployments faster and safer.
- When in doubt, **move, elevate, or re-aim the sensor** to reduce clutter and improve LOS.

SITE SURVEYING RESOURCES:

Site Access and Contact Information

Field	Details
Building address	
Entrance location(s)	
Describe how roof or location(s) of interest are accessed	
Who holds the key or access codes to the roof location(s)?	
Building security manager's name, phone number and/or email	
Building engineer's name, phone number, and/or email	
Exact location of interest within site or building	

Field Worksheet

Instructions: Answer each question "Yes" or "No." "Yes" means the condition is satisfactory or acceptable. "No" means there is a problem, concern, or follow-up action required.

#	Questions	Yes/No	Notes
1	Is the primary area to be protected clearly visible from this rooftop (e.g., mass gathering, stadium, perimeter, approach routes)?		
2	Are the most likely UAS approach directions covered from this location?		
3	Is the required airspace volume (height and distance) within the sensor's field of view from this spot?		
4	Does the sensor location have a clear line of sight to the airspace of interest (no buildings, walls, or trees blocking the view)?		
5	Is the view toward the protected area free of blocking hills, towers, or tall buildings?		
6	Is this rooftop high enough to see over nearby obstacles toward the protected area?		
7	From this height, can the sensor cover the area of interest without being forced to look almost straight down into roof/street clutter?		
8	Can the radar/camera tilt and pan as needed to cover the entire area of interest from this position?		
9	Have you identified any nearby RF emitters (antennas, towers, repeaters) that could affect your system and noted them in your documentation?		

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#	Questions	Yes/No	Notes
10	Based on observed/known RF sources, is the RF environment acceptable for your sensor (no strong interfering signals in its operating bands)?		
11	Is your planned jammer or RF equipment placement far enough from critical RF infrastructure (public safety radios, data links, etc.) to avoid harmful interference?		
12	Have you recorded any known RF bands and approximate power levels of nearby emitters (if available)?		
13	Is the main radar beam direction largely free of constant-motion clutter (busy roads, moving trees, water surfaces, wind turbines)?		
14	Is the radar view mostly free of large flat reflective surfaces (glass buildings, metal facades, water) that could create strong reflections/multipath?		
5	Is there adequate separation from other radars or high-power RF systems that could interfere with your sensor?		
16	Is safe roof access available (stairwell/elevator/ladder with proper controls, escort, or keys/codes as required)?		
17	Is electrical power available on the roof at or near the intended sensor location?		
18	Is the available power suitable for your equipment (correct voltage and connector type)?		
19	Is there a stable, secure mounting point where equipment can be fixed to resist wind and accidental bumps?		
20	Are cable runs (power/network) from the mounting point to power/entry points practical and safe?		

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Science and Technology

#	Questions	Yes/No	Notes
21	Is the rooftop area structurally sound and safe to work on (no weak surfaces, obvious damage, or soft spots)?		
22	Is the work area free of significant trip hazards and has adequate protection at edges (rails, parapets, or other fall protection as required)?		
23	Is the area free of overhead high-voltage power lines or other obvious electrical hazards near the equipment location?		
24	Is the area free of close-proximity high-power RF transmitters that present a personnel safety concern?		
25	Can the counter-UAS equipment be physically secured (locks, enclosures, or controlled access) to reduce tampering or theft?		
26	Have you completed the full site survey worksheet (if required for this mission)?		
27	Have you taken photos of the proposed installation spot?		
28	Have you taken overview photos of the roof and surrounding landscape?		
29	Have you taken photos of nearby antennas, dishes, towers, or other RF structures?		
30	Have you recorded GPS coordinates for the sensor location (if possible)?		