

**2013 Undergraduate Student Unmanned Aerial Systems Competition  
Association for Unmanned Vehicle Systems International  
Final Request for Proposal (update 31 October 2012) v5.0**

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## SECTION A CONCEPT OF OPERATIONS

An earthquake has impacted a small island nation in the Caribbean. Several boatloads of pirates who have been operating in the area have landed and are attempting to take advantage of the ensuing chaos. The overwhelmed local government has put out a call for help and the US Marines have responded. Their tasking includes humanitarian relief and security. Your unmanned aerial system (UAS) is supporting their mission with intelligence, surveillance and reconnaissance (ISR). In order to support them, your UAS must comply with Special Instructions (SPINS) for departure and arrival procedures, and then remain within assigned airspace. It will be tasked to search an area for items of interest, and may be tasked to conduct point reconnaissance if requested. Additionally, the UAS may be tasked to relay data from a third party Simulated Remote Information Center (SRIC). Immediate ISR tasking may be requested outside currently assigned airspace, causing the UAS operators to request deviations.

## SECTION C STATEMENT OF WORK FOR SEAFARER CHAPTER OF THE ASSOCIATION OF UNMANNED VEHICLE SYSTEMS INTERNATIONAL STUDENT UNMANNED AERIAL SYSTEM COMPETITION (DESCRIPTIONS AND SPECIFICATIONS)

### 1. Introduction

- 1.1. This statement of work (SOW) defines the tasks to be performed by the competitor in performing all aspects of the Student Unmanned Aerial System (SUAS) competition.
  - 1.2. The Seafarer Chapter of the Association for Unmanned Vehicle Systems International (AUVSI) continues the Student Unmanned Aerial System (UAS) Competition aimed at stimulating and fostering interest in unmanned systems, technologies and careers. The focus is on engaging students in systems engineering a total solution to a challenging mission, requiring the design, fabrication and demonstration of a system capable of completing a specific autonomous aerial operation.
  - 1.3. Student teams will be judged based on their system performance, and top teams will earn prize money. Opportunities for interaction with top UAS designers, engineers, scientists and leadership will be provided.
  - 1.4. The principal thrusts of the competition are the safe application and execution of Systems Engineering to develop autonomous operation in successful mission accomplishment.
  - 1.5. The major graded items/events are:
    - 1.5.1. Final Journal Paper
    - 1.5.2. Oral Presentation /Flight Readiness Review
    - 1.5.3. Flight Demonstration
2. Scope. This is a Performance-Based competition. Multiple government agencies, prime contractors, engineering firms and Universities are observing and judging this competition. Contestants may be awarded prizes for major graded items/event, overall performance or individual aspects of a graded item/event.
3. Requirements. The Statement of Work for this competition is laid out in paragraph format in line item number order to facilitate tracking and task identification. Technical support tasks, documentation and products should be provided in accordance with the Statement of Work.
- 3.1. System Design & Development (SDD). There are no graded events during SDD – this SOW task is entirely to aid the competitor to understand the requirements and the systems engineering process. Each team will establish its own Plan of Action and Milestones (POA&M) to complete SDD within the time available before the graded Flight Demonstration.

- 3.2. Fact Sheet. Six weeks prior to the competition (May 9, 2013) a one-page fact sheet providing basic descriptions of the air vehicle and systems shall be submitted to AUVSI Seafarer Chapter. It shall include frequencies used for air vehicle control (manual or autonomous) and payload control/imagery receipt, fuel and/or battery type and air vehicle dimensions including gross weight, launchers, vehicles, and other large equipment that the team will bring to the competition and which equipment will be taken to the airfield. A specific format for the fact sheet will be posted at the competition web site.
- 3.3. Journal Paper. Each team shall electronically submit a journal paper that describes the design of their entry and the rationale behind their design choices. The acceptable means of electronic submittal is posting in the team's folder on the competition SharePoint site. The paper shall include an abstract, description of the systems engineering approach, descriptions of the UAS design, test and evaluation results (including payload and navigation system performance), and safety considerations/approach. Systems engineering includes mission/requirements analysis, design rationale, and expected performance. Design descriptions are required for the air vehicle, ground control station, data link, payload, mission planning, data processing and method of autonomy and target types supported by autonomous cueing/recognition (if utilized). Specific attention shall be paid to safety criteria. The journal paper shall include a photo of the UAS air vehicle. The journal paper (including proof of flight video or statement) must be received by AUVSI Seafarer Chapter no later than May 30, 2013.
- 3.4. Oral Presentation. The Oral Presentation will not be a restatement of the Journal Paper. Instead, it will take the shape of a Flight Readiness Review (FRR) during which the competitors will present the judges with
  - 3.4.1. System Safety Overview
  - 3.4.2. Results of developmental test (DT)/Evidence of likely Mission Accomplishment
  - 3.4.3. Pre-Mission Brief
  - 3.4.4. A static display describing the elements above
  - 3.4.5. Only systems presented in the FRR, inspected by safety inspectors, and included in the preflight brief will be permitted to fly.
- 3.5. Flight Demonstration.
  - 3.5.1. Takeoff - Takeoff shall take place within one of two designated Takeoff/Landing areas, depending on wind direction. This area will be paved asphalt surface, roughly 100 ft wide, with no height obstacles. Systems utilizing launchers and/or not performing wheeled landing may utilize the grass immediately adjacent to the runway; however, grass area will not be prepared. Takeoff from moving vehicles is prohibited. Launchers will be inspected by competition safety inspectors before they are allowed for use in the competition. After takeoff, the air vehicle shall maintain steady, controlled flight at altitudes above 100 feet and under 750 ft MSL (Note: airfield elevation is approximately 10 ft MSL). Takeoff under manual control with transition to autonomous flight is permitted. Extra credit and a cash award will be provided for autonomous Takeoff.

3.5.2. Waypoint Navigation – Air vehicles shall autonomously overfly selected waypoints and remain inside assigned airspace, and avoid no-fly zones. Teams will fly a predetermined course that includes changes in altitude and in heading, to the search area.

3.5.2.1. Waypoints - GPS coordinates (ddd.mm.ssss) and altitudes will be announced the day prior to the flight competition. However, because of the dynamic nature of modern warfare, it is possible that additional waypoint(s) and/or search area adjustment(s) will be required.

3.5.2.2. Enroute Search – Air vehicles will be required to fly specific altitudes while identifying several targets along the predefined entry route. One of the targets will be directly along the route when the vehicle is required to be at 500 ft MSL ( $\pm 50$  ft). Another target will be up to 250 ft from the center of the flight path while the vehicle is required to be at 200 ft MSL ( $\pm 50$  ft). The team will be given the position of the off-center target. UAS shall not vary from the flight paths ( $\pm 100$  ft tolerance) briefed during the mission planning in order to obtain an image of the target; flight path deviations shall not be permitted as to avoid being shot down by hostile or friendly forces. Enroute way points shall be achieved in order.

3.5.2.3. Targets - Targets will be constructed of plywood of a given size, basic geometric shape, and color. For an example, see figure 1. Each target will be a different shape and a unique color; a different color alphanumeric will be painted on each target. There are an unknown number of targets in the area. The additional target will be more reflective of a realistic surveillance target. The minimum dimension of the targets (length or width) will be 2 feet, and the maximum dimension will be 8 feet. Alphanumerics will be sized to fit within the overall dimensions of the target varying between 50-90% of the length/width of the target and between 2-6 inches in thickness, and will vary in color and contrast. The alphanumerics of the targets can be arranged to spell a “secret” message. Any team that can spell the message will receive bonus points and a cash prize.

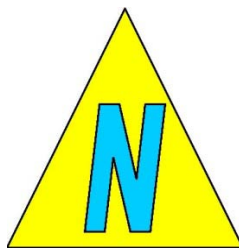


Figure 1

- 3.5.3. Area Search - once transitioning into the predefined search area via the entry/exit route, the air vehicle shall autonomously search for specific targets of interest. Air vehicles may search the area at any altitude between 100 and 750 ft MSL. Targets will be distributed throughout the search area. Competitors shall record the characteristics (location, shape, color, orientation, alpha, alpha color) of all observed targets on a target data sheet (and/or in electronic form) and provide this data to the judges at completion of the mission.
- 3.5.3.1. While executing the search mission, the team will be provided with a new search area (within the existing no fly zone boundaries) allowing you to locate “pop-up” targets. The “pop-up” target will be in the form of a human engaged in an activity of interest.
- 3.5.3.2. There will be a minimum of 200 ft margin between the search area and the no fly zone boundary.
- 3.5.4. Landing - Landing shall be performed completely within the designated takeoff/landing area. Transition to manual control is permitted for landing. Extra credit and a cash award will be provided for autonomous landing. Control in landing will be graded. Mission completion is when the air vehicle motion ceases, engine is shutdown, and the target data sheet and imagery have been provided to the judges.
- 3.5.5. Total Mission Time - Total mission time is the time from declaration of mission start from the judges and permission to turn on transmitters until the vehicle has safely landed, transmitters are shut off, and target data sheet (or spread sheet) is handed to the judges. Accuracy of results and time required to submit results will be measured. Missions completed between 20 and 40 minutes will receive some bonus points for each minute less than 40 minutes (must land vehicle, crashed and/or terminations do not earn bonus points); however, no additional points will be awarded for mission times less than 20 minutes. Significant points will be deducted for each minute over 40 minutes mission time, up to 60 minutes total where it is mandatory to turn in results. It should also be noted that each team will be given 40 minutes time to set up equipment prior to the beginning of the mission. After 40 minutes, the judges may declare mission start, regardless of the team’s readiness to launch the mission. If 40 minutes has elapsed and the air vehicle has not achieved flight, the mission will be terminated.
- 3.5.6. “Real time” actionable intelligence. Extra credit will be given for providing complete and accurate information (actionable intelligence) during flight within the search area: once that information is provided, it cannot be modified later. Intelligence is actionable only if all six target characteristics (shape, background color, alphanumeric, alphanumeric color, orientation, and location) provided at that time and recorded on the target data sheet is correct. This will not be considered to be “real time” intelligence unless designated as such. Credit for “real time” actionable intelligence will only be given for one target.
- 3.5.7. Simulated Remote Information Center (SRIC). Prior to the takeoff, the position of

an SRIC will be provided. Extra credit and a cash award will be given if the appropriate data is relayed from the SRIC to the ground station via the air vehicle.

#### 4. General Requirements.

#### Key Performance Parameters

Parameter	Threshold	Objective
Autonomy	During way point navigation and area search.	All phases of flight, including takeoff and landing
Imagery See para 3.5.2.3 for target characteristics	Identify any two target characteristics (shape, background color, orientation, alphanumeric, and alphanumeric color)	Identify all five target characteristics
Target Location	Determine target location ddd.mm.ssss within 250 ft	Determine target location within 50 ft
Mission time <sup>(1)</sup>	Less than 40 minutes total Imagery/location/identification provided at mission conclusion	20 minutes Imagery/location/identification provided in real time
Operational Availability (A <sub>o</sub> )	Complete 50% of missions within original tasking window (no more than one time out) <sup>(2)</sup>	Complete 100% of missions within original tasking window (no time outs used)
In-flight re-tasking	Add a fly to way point	Adjust search area

*Note 1: Time is measured from judges permitting activation of transmitters to the aircraft being shut down and providing the judges the completed mission report & associated imagery. There is a separate requirement for 40 min set up time.*

*Note2: **Due to limited competition time, time outs may not be possible and teams that cannot complete their mission within the original tasking window may not be given another mission window. No team will receive more than two opportunities to fly (one time out)***

Key Performance Parameters are the most important requirements. KPPs make up the vast majority of the scoring possible for the mission performance portion of the competition. Failure to meet any threshold will be heavily penalized. Performance beyond the threshold up to the objective will receive some bonus points.

“Shall” indicates a requirement that is a threshold (mandatory). Failure to meet this requirement will result in no points being awarded in this area.

“Should” indicates a requirement that is an objective. Demonstrating these requirements will earn extra points, but the basic mission can be achieved without meeting it.

“May” indicates a permissible implementation, but is not a requirement

“Will” indicates actions to be taken by the competition judges or other information pertaining to the conduct of the competition.

- 4.1. Safety. Flight operations of any type involve some level of risk to personnel and property. It is the responsibility all personnel involved in flight operations to identify, evaluate and mitigate risks to the maximum extent possible. Systems that do not meet the requirements listed below will not be permitted to fly.
  - 4.1.1. The Maximum takeoff gross weight of the air vehicle shall be less than 55 lbs.
  - 4.1.2. The system shall provide sufficient information to the judges to ensure that it is operating within the no-fly/altitude boundaries on a continuous basis.
  - 4.1.3. The air vehicle shall be capable of manual override by the safety pilot during any phase of flight.
  - 4.1.4. The air vehicle shall automatically return home or terminate flight after loss of transmit signal of more than 30 sec.
  - 4.1.5. The air vehicle shall automatically terminate flight after loss of signal of more than 3 minutes.
  - 4.1.6. The return home system, if installed, should be capable of activation by the safety pilot.
  - 4.1.7. The flight termination system shall be capable of activation by the safety pilot.
  - 4.1.8. Flight termination for fixed wing aircraft without an alternate recovery system (like a parachute) shall select:
    - 4.1.8.1. Throttle closed
    - 4.1.8.2. Full up elevator
    - 4.1.8.3. Full right rudder
    - 4.1.8.4. Full right (or left) aileron
    - 4.1.8.5. Full Flaps down (if so equipped)
    - 4.1.8.6. For other than fixed-wing air vehicles, similar safety requirements will be assessed which result in a power off recovery in minimum energy manner at a spot on the ground no more than 500 ft radius over the ground from the point of the termination command.
  - 4.1.9. The Fail-safe check will demonstrate flight termination on the ground by switching off the transmit radio for 30 seconds or 3 minutes (whichever applies) and observing activation of flight terminate commands. Questions regarding conduct of the safety check may be sent to [Robert.T.Ross@gmail.com](mailto:Robert.T.Ross@gmail.com).
  - 4.1.10. The maximum airspeed of the air vehicle shall not exceed 100 KIAS.
  - 4.1.11. Batteries used in the air vehicle shall contain bright colors to facilitate locating them in the event of a crash.



- 4.1.12. All vehicles will undergo a safety inspection by designated competition safety inspectors prior to being allowed to make any competition or non-competition (i.e. practice) flight. All decisions of the safety inspector(s) are final. Safety inspections will include a physical inspection, fail-safe check, and flight termination check.
- 4.1.13. Physical inspection of vehicle to insure structural integrity, including:
  - 4.1.13.1. Verify all components adequately secured to vehicle. Verify all fasteners tight and have either safety wire, locktite (fluid) or nylock nuts.
  - 4.1.13.2. Verify propeller structural and attachment integrity.
  - 4.1.13.3. Visual inspection of all electronic wiring to assure adequate wire gauges and connectors in use. Teams shall notify inspector of expected maximum current draw for the propulsion system.
  - 4.1.13.4. Radio range checks, motor off and motor on.
  - 4.1.13.5. Verify all controls move in the proper sense.
  - 4.1.13.6. Check general integrity of the payload system.
  - 4.1.13.7. Verification of Academy of Model Aeronautics (AMA) Fail-safe mode operation covered by manual override and pilot commanded flight termination.
- 4.1.14. Officials will disqualify any entry that they deem to pose an unreasonable safety hazard.
- 4.1.15. Officials will confer with representatives of the host facility, and any entries that, in the opinions of the officials or of the representatives of the host facilities, pose an unreasonable risk to the integrity of the host facility will be disqualified. Seafarer Chapter of AUVSI and the host organization, their employees and agents, as well as the organizing committee, are in no way liable for any injury or damage caused by any entry, or by the disqualification of an entry.
- 4.1.16. Takeoff shall not be from moving vehicles.
- 4.1.17. Launchers will be inspected by competition safety inspectors before they are allowed for use in the competition.
- 4.1.18. At least 25% of the upper, lower, and each side surface of the vehicle shall be a bright color to facilitate visibility in the air and in the event of a crash.
- 4.1.19. The system shall not exceed more than one motor vehicle and one trailer at the launch site.
- 4.1.20. No more than ten team members, one advisor and one pilot will be allowed at the mission area.
- 4.1.21. Exotic, unusual fuels/batteries or components shall not be used. All designs and systems will undergo a rigorous safety inspection before being permitted to proceed. Any fuel/battery combination deemed high risk in the opinion of judges

will be disqualified.

4.1.22. No objects shall depart from the aircraft while in flight.

#### 4.2. Air Vehicle

4.2.1. The system shall be limited to one air vehicle in the air at any time.

4.2.2. The system shall not deploy or employ its own ground based sensors. (Note: there is an objective to interoperate with a third party Simulated Remote Information Center (SRIC).)

4.2.3. The system shall be capable of commanded altitude changes.

4.2.4. The air vehicle shall be capable of heavier than air flight.

4.2.5. The aircraft may be of any configuration except lighter-than-air and shall be free-flying, autonomous capable and have no entangling encumbrances such as tethers.

4.2.6. Aircraft shall comply with the 2011 Official AMA National Model Aircraft Safety Code except as noted below

4.2.6.1. Autonomous operation is authorized.

4.2.6.2. Aircraft take-off gross weight shall be less than 55lb.

4.2.6.3. FREE FLIGHT - does not apply

4.2.6.4. CONTROL LINE - does not apply

4.3. Environmental. If conditions fall outside environmental requirements or if the judges feel environmental conditions are unsafe (such as approaching thunderstorms), the competition will be suspended. Teams are expected to be able to compete within the required environmental conditions.

4.3.1. The air vehicle shall be capable of takeoff and landing in crosswinds to the runway of 8 kts with gusts to 12 kts (when using the most favorable runway/direction for runway dependant systems).

4.3.1.1. The air vehicle shall be capable of operating during all mission phases in tower reported surface winds of 15 kts with gusts to 20 kts

4.3.2. The system shall be capable of completing mission objectives in temperatures up to 110 deg F at the surface.

4.3.2.1. The system shall be cable of completing the mission after exposure to temperatures of 100 deg F for up to 10 hours.

4.3.3. The system shall be capable of operating in fog conditions of visibility of 2 miles or greater with no precipitation.

4.3.4. The system shall be capable of operating during typical electromagnetic emissions

at a military airfield. (Although the competition will attempt to prevent emissions at the frequency and channel used for command and control, the competition staff will be operating hand held General Mobile Radio Service (GMRS) radios at 462.7 MHz in close proximity to aircraft and ground stations. Additionally video crew and others may be operating GMRS radios on the airfield. Teams should also anticipate that numerous mobile devices (phones, PDAs, computers, etc.) will be operating on the airfield.

#### 4.4. Ground Control.

- 4.4.1. Automatic Detection/Cueing, Classification, or Identification (ADCCI). The system should be able to automatically perform ADCCI with a false alarm rate that does not exceed the detection rate. (Note: ADCCI may be performed by any combination of the air vehicle side or the ground control side.)
  - 4.4.1.1. The system should be able to automatically detect at least three targets and cue the operator to identify and/or classify it, within 250 ft with a false detection rate that does not exceed the correct detection rate. (Note: cueing or detecting a target does not require any specific characteristics be provided, but instead must provide an indication to the operator of the location of a likely target.)
  - 4.4.1.2. The system should be able to automatically classify (at least two characteristics, within 250 ft) three targets with a false classification rate that does exceed the correct classification rate.
  - 4.4.1.3. The system should be able to automatically identify (all target characteristics within 250 ft) two targets with a false identification rate that does not exceed the correct identification rate. (note: unless the system indicates that it has insufficient information to identify a target that it had classified, classification attempts will also be regarded as identification attempts when calculating false alarm rate.)
- 4.4.2. The system should be able to provide imagery and actionable intelligence in real time (while vehicle is still in the air).
- 4.4.3. The ground control system displays shall be readable in bright sunlight conditions.
- 4.4.4. The system shall display “no fly zones” to the operators and judges.
- 4.4.5. The system should display search area boundaries to the operators and judges.
- 4.4.6. The system shall display current air vehicle position with respect to the “no fly zones” to the operator and judges. (*Note: failure to meet this requirement will result in disapproval to fly in the competition.*)
- 4.4.7. The system shall display altitude (ft-MSL) to the judges and operator.
- 4.4.8. The system shall display knots indicated airspeed (KIAS) to the judges and

operator.

- 4.4.9. The system should output target data (location (ddd.mm.ssss) & characteristics) in a format provided in attachment 2.
  - 4.4.9.1. Each identified target on the spreadsheet should have an associated image in a jpeg format with a name target $n$ .jpg (where  $n$  is the target number).
  - 4.4.9.2. The ground control system should be able to output this target data to USB memory stick format. *(Note: hardcopy backup is highly encouraged.)*
- 4.4.10. The system should have the capability to adjust mission search areas in flight. If the system has the capability to change mission search areas in flight, the new boundaries should be displayed to the operator.

#### 4.5. Payloads

- 4.5.1. The UAS shall capture target images that can be displayed to the judges. The images may be provided to the judges during the conduct of the mission or when handing in the mission report sheet.
- 4.5.2. The system should have the capability to capture imagery for up to 60 deg in all directions from vertically below the air vehicle.
- 4.5.3. Images should be provided to the judges in jpeg format.
- 4.5.4. The air vehicle should carry an RF communications relay payload capable of receiving data from a third party Simulated Remote Information Center (SRIC) RF transmitter and communicating the data down to the team's ground station for data capture and display. The Interface Control Document for the SRIC is provided as attachment 3.
  - 4.5.4.1. The SRIC has a directional antenna and will be located in the search area. The air vehicle should be capable of remaining within the beam width (SRIC location will be provided at the same time ingress route and search area information is provided), at an altitude within the competition altitude restrictions for the duration of time it takes to obtain the data from the team folder on the SRIC and relay to the ground station.

#### 4.6. Mission

- 4.6.1. During the entire mission, air vehicles shall remain in controlled flight and within the no-fly boundary. A specific no-fly boundary definition and diagram will be provided. Any vehicle appearing uncontrolled or moving beyond the no-fly boundary shall be subject to immediate manual override. Failure of manual override will result in flight termination. Points will be deducted for flying in no-fly zones or

over flight of the crowd area.

- 4.6.2. After takeoff, the air vehicles shall attain and remain in flight at an altitude between 100 and 750 ft MSL for the duration of the mission. Decent below 100 ft MSL (except in the recovery area) or above 750 ft MSL shall require manual override. Failure of manual override will result in flight termination. Points will be deducted for flying above or below these altitude limits
- 4.6.3. Once in autonomous flight, the vehicle shall operate with no direct pilot control to flight controls or power. The sensor payload may be manually controlled while under autonomous flight, the team will be directed to provide in-flight mission update to the vehicle.
- 4.6.4. Transportability. The system shall be transported from the staging area to the mission site within 10 minutes of notification and availability of competition provided transportation (if requested).
- 4.6.5. The system shall be disassembled and transported off of the designated mission site within 20 minutes from the end of the mission.
- 4.6.6. The mission will end as previously defined, or when any of the following occur:
  - 4.6.6.1. The judges order the end of the mission.
  - 4.6.6.2. The team captain requests the end of the mission.
- 4.6.7. Advisors may operate as safety/RC pilots and may communicate to the team in the safety pilot role. Advisors shall not coach the team on nonsafety/RC aspects of the conduct of the mission.
- 4.6.8. Set-up. The system shall be capable of beginning the assigned mission within 40 min of arrival of the designated mission control sight. Preflight/safety briefings may take place during the set-up time.

## 5. Place of Performance

- 5.1. Contestant Facilities. Competitor must identify the facilities they used for system integration and flight test and include the information with the proof of flight video or statement.
- 5.2. Government Facilities. The Seafarer Chapter of AUVSI SUAS Competition flight phase will be conducted aboard NAS Patuxent River, MD Webster Field Annex.
  - 5.2.1. All personnel attending the SUAS Competition must be cleared for access to Webster Field. For team members, faculty, or guests that are United States citizens, the following information must be submitted in the team's SharePoint folder on the competition web site by 9 May 2013: Name, Date of Birth, Place of Birth, and Social Security Number. For International Teams or U.S. Teams with foreign nationals (non-U.S. Citizens) a letter on College or University

letterhead and signed by a school official must be submitted by 9 May 2013. A sample of the letter to be submitted, data requirements, and forwarding instructions will be sent to team contacts in February 2013. International Teams must begin the process early to obtain passports and visas so that the required data can be submitted to gain access to Webster Field and to obtain the visas to allow international travel. In past competitions some teams have not been able to travel because they delayed in obtaining passports and visas. If teams require letters of invitation to the competition, a request for a letter should be made to Jim Curry. All foreign nationals and those U.S. citizens who were born outside the U.S must submit a copy of a passport, visa, or naturalization certificate.

## 6. Performance Metrics

### 6.1. The major graded items/events are:

- 6.1.1. Final Journal Paper
- 6.1.2. Oral Presentation
- 6.1.3. Flight Demonstration

### 6.2. Each item/event will be measured in four respects:

- 6.2.1. Autonomy. – The degree to which the system can operate without human intervention will be evaluated as part of the judges' discretionary score.
- 6.2.2. Systems Engineering. A methodical approach to deriving performance requirements, allocating functionality to subsystems, system design, adjustments made due to test & evaluation.
- 6.2.3. Mission Accomplishment. The ability to meet the top-level system requirements that enable mission accomplishment.
- 6.2.4. Safety. A system safety approach that identifies risk to mission performance, material safety and personnel safety, then implements mitigation strategies to reduce those risks.

## SECTION I COMPETITION CLAUSES

1. **PROOF OF FLIGHT.** Based on experience from the 2005 competition, we now require validation that team air vehicles have flown prior to arrival at Webster Field. A video that shows your air vehicle in flight or a statement signed by a faculty member of your university or school that verifies your system has successfully flown at least once shall be submitted with the journal paper. The proof of flight video or statement will identify the facility (or facilities) used for system integration and flight test.
2. **OFFICIAL RULES, SUBMISSIONS, AND FEES**
  - 2.1. The official source for all information concerning rules, interpretations, and information updates for the Seafarer Chapter of AUVSI 2013 Student UAS Competition is the World Wide Web home page at: <http://www.auvsi-seafarer.org> .
  - 2.2. An application form is available on the website. A completed form with entry fee is due to AUVSI Seafarer Chapter no later than January 15, 2013. Entry fee and application form shall be mailed to:  
James Curry  
21487 Great Mills Road, Suite A  
Lexington Park, Maryland 20653
  - 2.3. The submission shall be in English and is not considered official until the entry fee of five hundred U.S. dollars (\$500 Check or Money Order) has been received by AUVSI Seafarer Chapter. If a team decides to withdraw from the competition, they must inform the Seafarer Chapter (via email or post a document titled "Withdrawal" in the team's SharePoint folder on the competition web site) no later than 30 May 2013 at which time the registration fee will be refunded. After this date, no refunds or credits to future competitions will be granted. As the competition format cannot handle an unlimited number of entries, the **organizers reserve the right to limit the total number of entries that are allowed to compete by declaring the competition closed to new entries before the due date above.** Flight Competition/Mission phase may be further limited based upon results of journal paper, static display/oral brief and safety inspection. As with all official information, this announcement (should it be necessary) will appear on the official website.
  - 2.4. Full-time undergraduate or high school students including no more than one graduate student shall compose the team. If a faculty advisor, non-student or AUVSI Staff is used as the air vehicle pilot they are not counted as team members. Members from industry, government agencies, or universities (in the case of faculty or additional graduate students) may advise the team; however, they may not directly contribute in the creation of the design, test, paper or oral presentation. The faculty member/advisor will sign a statement that the team consists of no more than one graduate student and submit it with the team list discussed in Section C, paragraph 5.2.1. No more than ten people from each school will be covered by competition expenses (food, shirts, etc.). Faculty/advisors are limited to participation as a safety pilot during the competition. Students shall present data analysis, etc. Participants shall be enrolled at their schools for at least 12 credit hours or more per quarter/semester

during winter 2012 and/or spring 2013 to be considered "students" unless cleared by the Competition Director (Winter 2012/ Spring 2013 graduating seniors are not considered as graduate students for this competition).

- 2.5. The student members of a joint team shall make significant contributions to the development of their entry. Only the student component of each team is eligible for the cash awards. One student member of the team shall be designated as the "team captain." Only the team captain will speak for the team during the competition run. Teams registering to compete shall indicate on their application form the name of the individual or organization to whom prize checks will be made payable.

### 3. TIMELINE:

The 2013 competition will be a simplified model of the US Department of Defense system acquisition process. The competition rules will simulate a Performance Specification and Statement of Objectives. These will initially be released as a Request for Information (RFI). What this means is that this is a draft of the final specification & rules. Potential competitors are invited to provide comments or questions by 29 September 2012. This will be followed by a virtual "University Day" (modeled after industry day). This will consist of a phone conference that all competitors can dial into to hear directly from the judges and to ask questions. The competition rules will then be modified based on the feedback and put out in its final form that simulates a Request for Proposal. It is the intent of the judges to keep these requirements stable for the rest of the competition, but we reserve the right to make changes we deem necessary.

Date	Item
September 13, 2012	Draft Request for Proposals Released (Competition rules simulating a performance specification and statement of objectives).
September 29, 2012	Deadline for comments or questions. Post questions to team's SharePoint folder on the competition web site.
October 2, 2012	University Day (4:00 PM, EDT, phone conference with competition judges. Call in instructions posted on website. <a href="http://www.auvsi-seafarer.org/news-events/UniversityDay.aspx">http://www.auvsi-seafarer.org/news-events/UniversityDay.aspx</a> )
October 23, 2012	Request for Proposal Released (Final competition rules).
January 15, 2013	Completed entry form and registration fee received by AUVSI Seafarer Chapter.



Date	Item
May 9, 2013	<ol style="list-style-type: none"> <li>1) Fact Sheet submitted to AUVSI Seafarer Chapter. Team information (Section C, paragraph 3.2)</li> <li>2) Statement concerning no more than 1 graduate student. (submit with team roster, Section I, para. 2.4)</li> <li>3) Security information on team members (Section C, paragraph 5.2.1)</li> <li>4) Letter with additional security information on Foreign National team members (Section C, paragraph 5.2.1)</li> </ol>
May 30, 2013	<ol style="list-style-type: none"> <li>1) Journal paper received by AUVSI Seafarer Chapter (including proof of flight video or statement). It is the responsibility of the team to ensure that their paper is received on time. Post to team's SharePoint folder on the competition web site.</li> <li>2) Last day to withdraw from competition and receive registration refund.</li> </ol>
June 19-23, 2013	<p>2013 Undergraduate Students Unmanned Aerial Systems Competition. (Note: preliminary schedule as follows, subject to change based on number of teams participating and weather.):</p> <p>19 June: check in/orientation at approx 1700 EDT  20 June: Safety inspections &amp; FRRs, possible window for short check flight in evening  21 June FLY  22 June FLY, Banquet/awards at approx 1900 EDT  23 June, Backup fly in morning, backup awards for flight competition and overall award at backup lunch)</p>

SECTION J LIST OF ATTACHMENTS

Attachment 1 Flight Readiness Review Criteria

Attachment 2 Electronic Data Format

Attachment 3 Student Unmanned Aerial Systems Competition Network Connection Interface  
Control Document

## SECTION L INSTRUCTIONS, CONDITIONS, AND NOTICES TO COMPETITORS

### 1. GENERAL

All submittals will be electronic via the team's folder on the competition web site, except the initial application and fee. Contact the competition director (Joe Brannan ([brannanjd@hotmail.com](mailto:brannanjd@hotmail.com)), (410) 610-3505) to set up your team's folder.

1.1. Format: In order to maximize efficiency and minimize the time for proposal evaluation, it is required that all competitors submit their proposal in accordance with the format and content specified. The electronic proposal shall be prepared so that if an evaluator prints the proposal, it meets the following format requirements.

1.1.1. 8.5 x 11 inch paper

1.1.2. Single-spaced typed lines

1.1.3. Not less than 1 inch margins

1.1.4. Not smaller than 10-point Times New Roman font in text

1.1.5. Electronic submission in pdf format is desired, but not required.

1.1.6. Each page of the journal shall have the team name and page number in the footer

### 2. COMPETITOR INFORMATION

2.1. Cover Letter. Identify at a minimum the Competitor Team Name, University affiliation, and abstract of proposal including basic descriptions of the air vehicle and systems. The description shall include frequencies used for air vehicle control (manual or autonomous), payload control, imagery receipt, type of fuel, battery type, and air vehicle dimensions including gross weight. This letter does not count towards the page count.

### 3. TECHNICAL

Note: Do not reiterate the SOW tasks descriptions as that is ineffective in supporting the competitor's proposal.

3.1. Journal Paper – Shall consist of no more than 20 pages total. Pages beyond 20 pages will not be judged.

3.2. Oral Presentation. (Flight Readiness Review - FRR). Typical FRR criteria are described in attachment 1. The Oral Presentation (FRR) will be reviewed by a panel of AU VSI Seafarer Chapter judges and will be conducted in an open-air environment, with only minimal overhead protection from sun light and/or rain. All team members present should participate.

3.2.1. The Oral Presentation (FRR) should follow a simple outline:

3.2.1.1. Team Coordination. Briefly review team members' experience, effectiveness of coordination.

3.2.1.2. A brief description (only sufficient for the judges to understand the basic elements of the system).

3.2.1.3. System Safety Overview. Review identified risks; avoidance, mitigation strategies.

3.2.1.4. Results of developmental test (DT). Discuss test planning, what tests were performed, the results, any corrective actions taken, impact they

had on system implementation. This scope can include sub-system and system level simulation and testing performed during bench, laboratory, ground and flight test efforts to acquire test data and evaluate performance of: components or subsystems, air vehicle integration, ground control system integration, full UAS integration, and mission performance.

3.2.1.5. Evidence of likely Mission Accomplishment. Review demonstrated performance based upon either system or subsystem level development tests that supports successful mission accomplishment during the flight demonstration.

3.2.1.6. Pre-Mission Brief.

3.2.2. Duration. The Oral Presentation (FRR) shall be limited to no more than 15 minutes, plus a 5 minute period for the judges to ask question of the team presenters.

3.2.3. Static Display. Upon completion of the Oral Presentation (FRR) question and answer period, the judges will be provided a brief 5 minute review and inspection of the team's UAS, including air vehicle exterior (and interior if available), ground station, safety check lists, and other supporting evidence of readiness.

3.3. Flight Demonstration. Each team will arrive prepared to begin flight operations. The team will be called forward, set-up at the flight line during their preparation time, then commence start procedures once their demonstration time begins. Flight demonstrations should follow procedures briefed during the FRR.

## SECTION M EVALUATION FACTORS FOR AWARD

### 1. GENERAL

#### 1.1. The major graded items/events are:

- 1.1.1. Journal Paper
- 1.1.2. Oral Presentation (FRR)
- 1.1.3. Flight Operation

1.2. For grading purposes, the Flight Operation is the most important, with the Journal Paper and Oral Presentation of lesser importance, but equal to each other.

### 2. COMPETITOR INFORMATION

2.1. The Competition judges will evaluate on a graduated basis the competitor's compliance to the requirements set forth in this solicitation.

### 3. BASIS FOR AWARD

- 3.1. Journal Paper
- 3.2. Oral Presentation (FRR)
- 3.3. Flight Operations

3.3.1. Judges will award points for meeting threshold and objectives as outlined in Section C

3.3.2. Judges may award cash barrels for these (or other) requirements (**subject to change, based on sponsorship funding**):

- 3.3.2.1. Any team that achieve flight will receive a cash prize
- 3.3.2.2. A cash prize for any team that conducts the waypoint navigation and area search phases of the mission autonomously (KPP threshold, autonomy).
- 3.3.2.3. Any team that achieves the following "stretch" objectives will either receive a cash prize or share a cash prize with the other teams that achieve that objective, whichever is less.
  - 3.3.2.3.1. Autonomous takeoff (KPP objective, autonomy).
  - 3.3.2.3.2. Autonomous landing (KPP objective, autonomy).
  - 3.3.2.3.3. Obtain an image and correctly identify 4 of 5 parameters for the "off flight path" in-route target (Section C, paragraphs 3.5.2.2 & 4.5.2).
  - 3.3.2.3.4. Obtain an image, correctly identify, and provide the location within 250 ft of the "pop-up" target during the area search phase. (Section C, paragraph 3.5.3).
  - 3.3.2.3.5. Successfully perform automatic target detection/cueing on at least three targets in the search area (Section C,

- paragraph 4.4.1.1).
- 3.3.2.3.6. Successfully perform automatic target classification on at least three targets in the search area (Section C, paragraph 4.4.1.2).
  - 3.3.2.3.7. Successfully perform automatic target identification on at least two targets in the search area (Section C, paragraph 4.4.1.3).
  - 3.3.2.3.8. Identify a target (2 characteristics) within 50 ft (KPP objective, target location)
  - 3.3.2.3.9. Identify (2 characteristics, within 250 ft) all targets (KPP imagery) within the primary search area.
  - 3.3.2.3.10. Provide all target data in electronic format for at least 2 targets, including image (objectives, Section C, paragraphs 4.4.9.1 & 4.4.9.2)
  - 3.3.2.3.11. Provide “real time” actionable intelligence on one target (Section C, paragraphs 3.5.6 & 4.4.2)
  - 3.3.2.3.12. Complete a mission identifying at least 50% of the targets in the primary search area, with no time outs (KPP  $A_o = 100\%$ ) within 40 minutes (KPP threshold, mission time).
  - 3.3.2.3.13. Successfully relay all appropriate data from the SRIC (objective, Section C, paragraph 3.5.7)
  - 3.3.2.3.14. Successfully provide the “secret” message spelled out by the targets (Section C, paragraph 3.5.2.3)

3.3.3. An award will be given to the best overall safety approach/execution

3.4. Overall award for the best combined score from Journal, Oral Presentation (FRR), and Flight Operations.

## **Attachment 1 Flight Readiness Review (FRR)**

The FRR is a multi-disciplined technical review to ensure that the subsystem or system under review is ready to proceed into formal test. The FRR assesses test objectives, test methods and procedures, scope of tests, and safety. The FRR verifies the traceability of planned tests to program requirements and user needs. The FRR determines the completeness of test procedures. The FRR assesses the system under review for development maturity, effectiveness, and risk to determine readiness to proceed to flight testing.

The FRR should answer the following questions:

- Will the planned flight test verify all directly traceable requirements?
- Is the configuration of the system under test sufficiently mature, defined, and representative to accomplish planned test objectives and or support defined program objectives?
- Have all planned preliminary, informal, functional, unit level, subsystem, system, and qualification tests been conducted, and are the results satisfactory?
- Have all applicable flight/system limitations been defined and agreed to?
- Is the planned test properly resourced (people, test article or articles, facilities, data systems, support equipment, logistics, etc.)?
- Have the crew members been trained properly?
- Has a discrepancy identification and reporting system been defined and agreed to?
- Have Go/No-Go criteria been agreed to?
- What is the fall-back plan should a technical issue or potential showstopper arise during testing?
- Has a final reporting process been defined and agreed to?
- What is the expected result and how can/do the test results affect the program?
- What are the risks associated with the tests and how are they being mitigated?

FRR success criteria:

- A. Identified risk level is acceptable.
- B. The judgment that previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests.

Test and evaluation is critical to evaluating the system. The FRR ensures that the testing to be conducted properly evaluates the system and that the system is ready to be tested.

## Attachment 2 Electronic Data Format

Name the file using the initials of your school or team as a text file (.txt).

9 fields, tab delimited, new target on each line

Field 1: Target Number, two digits, starting at 01 and increment by one for each additional target. Target number is assigned by team.  
Example: 01, 02, 03, etc.

Field 2: Latitude in the following format, first character N or S, two digit degrees (use leading zeros if necessary), followed by space, two digit minutes, followed by space, two digit seconds followed by decimal point and up to 3 digits (thousandths of a second)  
Example N30 35 34.123

Field 3: Longitude in the following format, first character E or W, three digit degrees (use leading zeros if necessary), followed by space, two digit minutes, followed by space, two digit seconds followed by decimal point and up to 3 digits (thousandths of a second)  
Example W075 48 47.123

Field 4: Target orientation, up to two characters: N, NE, E, SE, S, SW, W, NW

Field 5: Target shape, list geometric shape as appropriate:  
Example, rectangle, square, triangle

Field 6: Target color, as appropriate.  
Example: Red, Orange, Yellow, etc.

Field 7: Alphanumeric, as appropriate  
Example: A, b, 2, &

Field 8: Alphanumeric color, as appropriate  
Example: Red, Orange, Yellow, etc.

Field 9: Name of jpeg file with image of target

Example for two targets

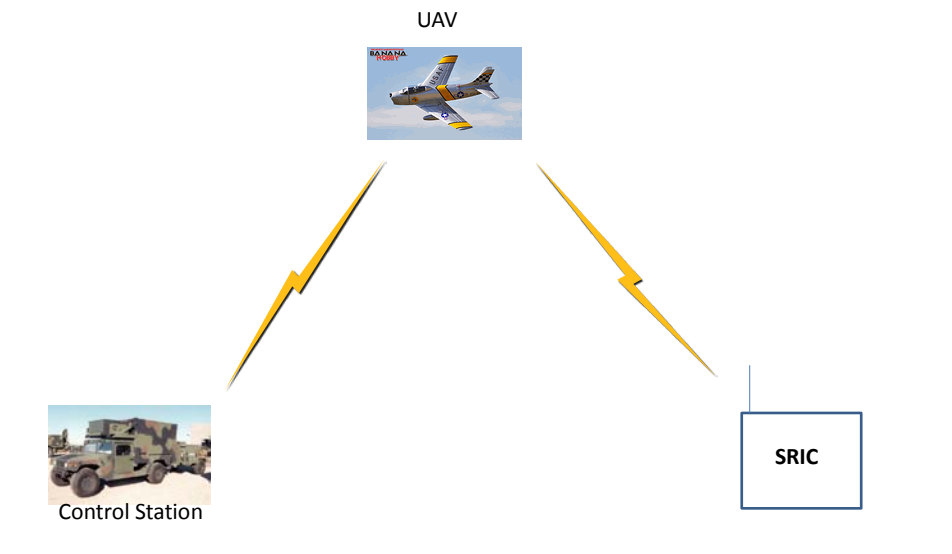
01	N30 35 34.123	W075 48 47.123	N	rectangle	red	A	orange	target1.jpg
02	S34 00 12.345	E002 01 12.345	SE	square	orange	4	yellow	target2.jpg



# Attachment 3

## Student Unmanned Aerial Systems Competition Network Connection Interface Control Document

### SUAS Simulated Remote Information Center (SRIC) Operations



Prepared by:  
AUVSI SUAS Team  
22707 Cedar Point Road  
Patuxent River, MD 20670  
Revised 12 September 2012

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## Change Page

Date	Rev	Change Description
9-16-11		Initial DRAFT Release
9-19-11		Added antenna beam calculations and model numbers
10-3-11		Incorporated judge's comments
4-1-12		New logon procedures
4-10-12		Editing updates
9-12-12		Editing updates

# 1. General

## 1.1 Scope

This document provides or references the data definitions required for transfer of data from the Simulated Remote Information Center (SRIC) to the competing team's UAS. These definitions encompass the data link and message interfaces.

## 1.2 Equipment Definition

The SRIC will comprise of a laptop computer running Microsoft Windows 7, a Linksys Model WRT54GL Wireless Broadband Router, a 10 dB attenuator, and a TRENDnet Model TEW-A014D High-gain directional antenna. The SRIC block diagram is shown in Figure 1 below:

## SUAS SRIC Block Diagram

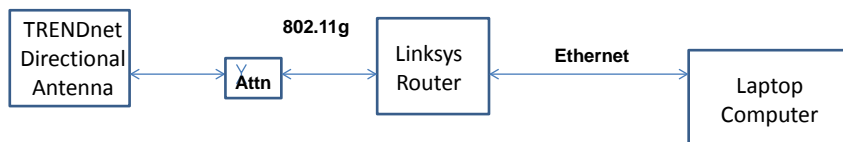


Figure 1

24 October, 2011



The Linksys WRT54GL Router and the Linksys URL are shown in Figure 2 below:

## Linksys 802.11b/g Wireless Broadband Router



Figure 2

[http://homedownloads.cisco.com/downloads/WRT54GL\\_V11\\_DS\\_NC-WEB,0.pdf](http://homedownloads.cisco.com/downloads/WRT54GL_V11_DS_NC-WEB,0.pdf)

The TRENDnet Model TEW-A014D High-gain Directional Antenna and the TRENDnet URL are shown in Figure 3 below:

## TRENDnet Directional Antenna



Figure 3

[http://www.trendnet.com/products/proddetail.asp?prod=145\\_TEW-AO14D&cat=92](http://www.trendnet.com/products/proddetail.asp?prod=145_TEW-AO14D&cat=92)

## 2.0 APPLICABLE DOCUMENTS

2.1 **Specification: IEEE 802.11g Specification available at:**

<http://standards.ieee.org/about/get/802/802.11g.html>

2.2 **The SUAS 2013 Rules:** The SUAS Request For Proposal (RFP) is available from the AUVSI Student Competition website.

## 3.0 INTERFACE DESCRIPTIONS

### 3.1 Logon Procedures

1. The antenna location and the wireless network name will be provided on the day before the competition (practice day).
2. The router IP address, netmask, and static IP Address, network passphrase, and folder name will be provided by the SUAS judge at the start of setup on the taxiway.
3. **NOTE:** Students will be allowed to test the network connection during the practice day.
4. The student teams shall use Wired Equivalent Privacy (WEP) encryption when accessing SRIC.
5. When flying in the specified area, connect to the network. The router will be located on wireless channel 1 at 2.412 GHz.
6. Enter the provided network passphrase.
7. Dynamic Host Configuration Protocol (DHCP) will be enabled. If dynamic IP is not used, a static IP address will be provided.
8. After network connection is confirmed, enter the provided IP address. An example is below: [FTP://192.168.1.110/auvsi/team1](ftp://192.168.1.110/auvsi/team1).
9. Open the folder and read the included text file to receive the code phrase. This folder will be read only.
10. Provide the code phrase to the SUAS judges.



### 3.2 Antenna Pattern

The directional Antenna pattern is shown below:

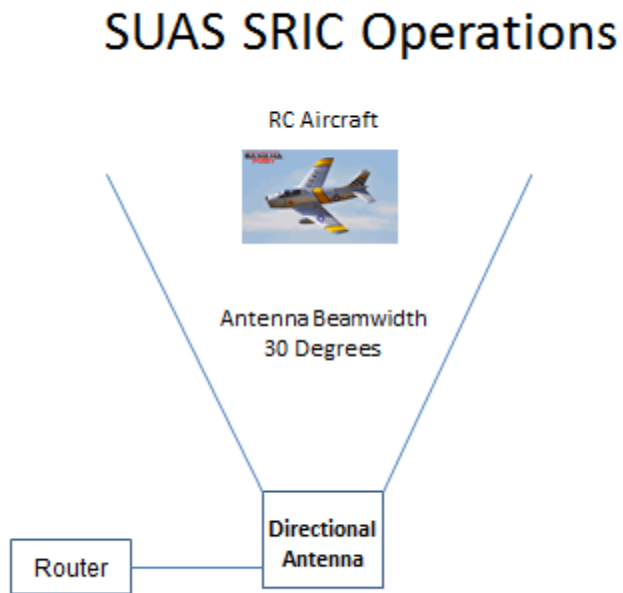


Figure 4 Directional Antenna Pattern