



Autonomous Navigation for Small Unmanned Aerial Systems (sUAS) Assessment Event (AE) Q&A Telecon

Opening Comments:

We have received a number of questions and I wanted to just give a few comments before we went through line by line. We have received questions from some US Government agencies about this event illustrating that there may be some confusion about the progression of the assessment event itself. This event is intended to assess the available algorithms for autonomous navigation, path planning, and obstacle avoidance etc. in situations without reliable GPS positioning signals. The intended operation is on a small uncrewed aerial system (sUAS) for the remainder of this call performing SOF-peculiar Intelligence, Surveillance and Reconnaissance missions. ISR for short for the rest of this call. The assessment will progress in two phases. First, a written phase with deadlines posted on the website if you've registered through the SOFWERX website as well as SAM.gov, that has the proposing application or necessary adjustments to existing path planning algorithms for the mission described in the Assessment Criteria which is also found on the same website.

Following review of written proposals, the strongest proposals will be invited for an oral presentation of the written proposal content with the ability to include more details and descriptive content of the background and technical plan. The oral presentation is intended to be virtual through a SOFWERX Zoom connection and can include presentation slides, written materials, videos, or anything viewable through the camera on your end during the oral presentation. Invitees to oral presentations may also choose at their own discretion and their own costs to travel to SOFWERX, with zero funding from SOFWERX, to present in person at the SOFWERX facility in Tampa, FL.

Presentation attendance is not a selection criterion in this solicitation and there have been dozens of awards of previous SOFWERX solicitations that have resulted from solely virtual presentations. There is no disadvantage to virtual presentations for the oral presentation, it is a level playing field for both virtual and in person attendees. For those proposers in the Tampa Bay region, it may be more efficient to come in person. For those outside the Tampa Bay region, it is expected to be more time and cost efficient present virtually.

There may be some who are invited for oral presentations but are unable to convey their technology through videos, written materials, and oral presentations. In this case, we are able to offer an opportunity to demonstrate their technology at a test range within 60 miles of SOFWERX facility. SOFWERX is unable to provide funding for travel costs for the oral presentation, or any equipment purchases, or other expenses associated with that; the only space provided will be range space. We don't believe this provides an advantage to anyone solely utilizing videos or other presentation material during the virtual presentation. Proposals will, like stated in the solicitation, be judged on the merits to address assessment criteria and achieve the goals outlined. This is not a "flyoff", or other demonstration of that form; it merely augments the written proposal and oral





presentation. It is possible or maybe even likely that zero demonstrations will be required during the oral presentation phase of this solicitation.

Now that we've reinforced the assessment process, I'd like to turn the focus towards execution questions posted on Slido. Based on some questions already posted there, I'd like to offer a few overarching introductions.

SOCOM only fields some of the sUAS available across industry and algorithms sought in this solicitation will ultimately be deployed on one of those existing SOCOM systems. SOFWERX and the SOCOM team do not want to artificially constrain industry as a variety of futures integration or fielding circumstances are possible. As such, our preference is to execute on the sUAS choice of the company proposing. We all know and understand that autopilots on sUAS can be different among aircraft and several nuanced phenomena can be experienced in situations like this. SOCOM seeks to minimize the risk for future integration onto specific sUAS fielded for SOF-peculiar missions by trying to anchor all these autopilots to a common reference point. In general, the PX4 autopilot codebase is a good representation of autopilots used and most OEMs seem to understand how their unique autopilots relate and compare to the PX4. The expressed desire for PX4 compatibility really relates to keeping projects tied to a common anchor point, which is open source and free for use across the community.

There are several questions about derivative autopilots and autopilot modifications. Autopilots may need to be modified to accept additional input streams into the state estimation to make this all work; however, we don't want to jeopardize the flight dynamics and stability of existing autopilot software. Further, the system should still work with GPS, when GPS is available; the goal is to augment existing capability with added robustness.

Lastly, the intended execution of this effort is one where a proposer selects their desired aircraft, performs the work proposed, and uses that equipment in the execution of testing milestones throughout the project. There are not limits to the proposal and someone could propose to execute while utilizing government furnished property for the sUAS; but this assessment event does not provide information for what is available or when as it was not the intention for the government to furnish property for this demonstration. As such, many of the questions asking for details on the sensors and compute available, the payload interfaces, those questions are in general not answerable and presuppose a circumstance specifically the provision of government furnished property that this event did not intend.

1. Is there an altitude ceiling that the sUAS may not exceed?

Not at this time, although we are envisioning small UAS and not to be flying at commercial altitudes or anything like that. I'd say that the intended operation is at a very modest altitude. Trying to stay within the sUAS capabilities.





2. What is "Currently available sUAS"? Can the vendor choose the sUAS for this assessment as some blue sUAS may be too small for solutions considered.

To the second question – yes. To the first question – Primarily this means that we don't intend or expect you to develop a new sUAS. We intend to add existing capability to sUAS that is already out there, with the ultimate goal of getting transitioned on a SOCOM sUAS system.

3. Would cyber security considerations be part of this project?

Cyber security is always a consideration. This is a proof of principle, so I don't think cyber security is the emphasis of this project, but obviously we need to get there eventually if we're going to put this in the field.

4. Could you please provide more information on UAS of interest. Is it an open platform? What sensors and compute are resident on the platform?

At this time, we are not releasing the specific constraints of SOCOM-fielded UAS. We don't think that is necessary. These types of assessment events will involve proof of principle, so we don't find it required that we need to specifically integrate under narrow circumstances. We don't want to constrain industry in that fashion, in that circumstance. The UAS of interest is a general UAS. Blue UAS is a good model, but there is no constraint required for industry in this case. If it's an open platform depends on your choice, and the sensors and compute available also depend on your choice. We don't want to constrain industry, but we also have the long-term goal of getting to something NDAA-compliant and DOD-fieldable.

5. Can you talk more about metrics for evaluation? Landing zone selection for example could mean just landing and taking off anywhere in the vicinity.

There are specific assessment criteria posted on the website, so the metrics for evaluation are exactly what's written on the website. The objective of the sUAS is to observe a point of interest (POI), so the landing zone selection should be able to maintain some kind of awareness of what that point of interest is doing. Landing zone selection doesn't just mean anywhere in the vicinity, but rather at a place where you can observe the point of interest.

6. Is the expectation for systems to operate just using visible and IR cameras? Are active sensors (e.g. LIDAR) acceptable?

There are no constraints for the sensors that are acceptable to be used. We do know that there is a Size Weight and Power (SWAP) penalty for using things like LIDAR, but we are not restricting the sensors that are used at this time. Secondly, I would say pay attention to cost, which is ultimately a factor. There is some ROM cost and production information in the assessment criteria and in the template for submission. Obviously, fewer sensors drive lower costs, and there are some advantages there, but if those are outweighed by performance, then you are welcome to propose LIDAR sensors.

7. Could you provide more information on the test environment? As you may know, GPS denied system performances are impacted by the feature availability.

This is correct, we have not identified test locations for the execution of the event. Those proposers that are awarded will be doing testing throughout the execution of their contract. We have not identified specific locations – we have some high possibility, leading candidates. Any oral presentation will occur within 60 miles of SOFWERX. So, it will be Florida. You can imagine things like Spanish moss hanging from the trees, large live oak





trees, open prairies, things that are typical in Florida that anyone can see as they are driving around the state. I agree that GPS system performance is impacted by feature availability, however, our SOCOM operators operate across the globe in all different environments, from completely rural to completely urban, and everything in between. So, ultimately, we are seeking a system that can work for them, so if there are performance degradations then we will just have to understand those, assess the merits of the approach.

8. Is it the intent to utilize a GFE sUAS for the demo or is it expected that each vendor will bring their own? If GFE, can you tell us what it is ahead of time?

You're welcome to propose GFE. It was not our intent to do that. And as such, we don't have any specific specifications to provide you with.

9. For the "ROM unit production cost and estimated monthly production capacity" asked for in the White Paper, is it to include costs for the UAS platforms as well?

That is not the intent, but obviously we will be considerate of what those UAS costs are.

10. Will the LZ be characterized by unique features (e.g. landing pad)? If so, will images be provided for these features, or just satellite image of the POI area?

There are a number of questions here looking at a specific mission that has exactly defined parameters and targets and landing zones, but that's not the vision of this assessment event. We don't want to artificially constrain industry, and we also don't want to artificially constrain the ultimate operators who will use it. The landing zone will likely not be identified by any unique features, and it will likely be selected by the software itself with some sort of view of the point of interest. Images of the point of interest can be provided. That is the vision that we'll train up on.

11. Is it required that the UAS will have to land on top of certain features (e.g., landing pad) or just in proximity to the point of interest?

The purpose of this is to maintain observation of the point of interest, so there's not going to be any landing pad provided. It will need to identify something already in the environment that's suitable to land on. The desire is to maintain view of the point of interest, so you can assume that there will be some way to do that. The UAS will have to learn to land on top of something.

12. Will the demonstrator have a priori knowledge of the characteristics of the POI prior to launch, or is it expected to have ATR on board to identify the POI?

There are two questions in here: one is the augmentation to oral presentation and the other is what's planned to be executed during the contract. In both circumstances, there'll be some indication of the point of interest, maybe a picture, it's a red truck or maybe it was this building. That said, it's not expected that it will be a one-to-one image matching situation where the UAS has already flown and seen that thing from that location, building, those conditions. There needs to be some amount of artificial intelligence to align what you're looking for with what you know about where it's supposed to be. So, there will be some a priori knowledge, but it will depend on what we're looking for in the mission. That will come out through the test planning process for those contracts that are awarded.





13. Does the aircraft used for evaluation need to meet NDAA compliance? Please also describe the terrain/flight profile at the evaluation

Duplicated question; see other answers for more information

14. Will visible/daylight AND nighttime IR images of the POI be provided?"

We will need to figure that out during the execution of the actual awards. The plan is to have some reference images of the point of interest. I can't say for sure whether that will be visible daylight or nighttime infrared. Hopefully, that indicates that you'll need the flexibility within the proposal process.

15. Are we correct to assume a VTOL sUAS will be used?

Yes, that is a correct assumption. Is it a mandatory requirement? No, but it was SOCOM's intention to go after a VTOL small UAS and not be requiring runways or launchers or recovery hooks or anything like that.

16. Will the observation Landing Zone be pre-designated, selected by Operator based upon telemetered imagery or chosen autonomously by the sUAS?

Ultimately, it would be great to get fully autonomous by the small UAS. In the proof of principle, going stepping-stone would say operator select from a few choices is good. I would say it's unlikely to be pre-designated, and the sUAS will need to find something/somewhere on its own.

17. What are the weather requirements as regards rain, wind & fog?

Initially, we don't want to overburden industry. Obviously, rain, wind, fog, and a whole lot of other weather conditions can negatively affect performance. Our requirements for this effort are not going to require it to work in every situation, every time. I would assume that initial weather requirements are going to be for our flight conditions that will be common for testing. However, we will need that path for operability in rain, wind, and fog eventually because our operators operate in those conditions.

18. Will the satellite image have sufficient feature points and resolution to discriminate it from surroundings?

I'm not sure I understand this question – satellite imagery is going to be what you're typically used to. I don't think we are going to have access to high end imagery, only the publicly available satellite imagery. As for specific feature points, we are expecting those to be identified by UAS to track its own position, and then match the description of the POI to what is observed. There's a lot of different options and we are not providing that to industry.

19. Will the sUAS provided by SOCOM have a GPS receiver and antenna installed and interfaced with the PX4 autopilot for use in emergency situations?

We are not restricting industry that they are not able to request GFE. GFE was not the intention of this government event, but you are allowed to propose that. So if you do request that you should specify in your proposal that you want GPS receiver, antenna, PX4 autopilot. Yes, I would say that sUAS should have all of this interfaced with the autopilot in order to maintain control, in case of emergency during testing, or other things. We will have safety pilots during testing, and those pieces of equipment will be required for the safety pilot to do their job.



20. Can you please identify the Ground Station (GS) software package that will be used by the remote SOF pilot?

We're not dictating that any particular ground station software be used. Whatever is comfortable. Obviously, we would want something that's close to transition. There are a variety of open-source or near-open-source COTS and GOTS things that are available. We encourage you, if you're choosing a custom one, to include its relevance to transition.

21. Could you clarify what you mean by "derivative autopilot"?

In this case, we're really trying to keep some sort of commonality. SOCOM systems use a variety of autopilots. It just seems like people know how their autopilots relate to the PX4, and that's a common frame of reference, so we're trying to use that to minimize the reintegration work required later on, if we get to that point.

22. Is the identification of a suitable landing zone something that would use a human in the loop, or should the system do this fully autonomously?

Autonomous navigation landing zone is a pretty heavy lift and so as you're proposing please describe low band width, or maybe an option where the robot chooses a few options and the human chooses a final answer – this is probably a reasonable compromise. If you are able to do this fully autonomously and you trust your technology, then you are more than welcome to propose that. I don't think we will make that a requirement, I don't believe "fully autonomous" was written in the requirements, I will have to go back and look.

23. In what way does the system need to maintain observation of the object of interest? Does it need to track? Does Lidar suffice or does it need to be EO?

I would say initially we don't want to constrain industry and say that, so I would say we would just need to observe the system using the organic sensors. Tracking is a good question, we do not have an answer right now, that would be something we would have to figure out during the execution of any awarding of contract.

24. Will the sUAS be following a predefined mission plan and then lose GPS signal mid-flight or will it start without GPS?

In proof-of-principle, we don't have to boil the ocean. It doesn't need to do everything all the time for every circumstance. That said, our special operators depend on these things to work in many circumstances, so it's important that we have the maximum capability that we can get. Certainly, as a steppingstone, a mission plan that loses GPS signal mid-flight could be an option, but I would say more likely we're going to be starting without GPS at launch. It might not even be that GPS is gone, but it might just be that GPS isn't trustworthy at this time, for a variety of reasons. You're certainly welcome to propose whatever you want. I would assume there are people out there that are going to be proposing that it starts completely without GPS, and I would look at that with consideration for how you expect to compete in those circumstances.

25. Does this White Paper only allow for non-proprietary submissions? Form states "Submit your White Paper - unclassified and non-proprietary solution"

Going through SOFWERX, we are an unclassified facility, so we do only solicit non-proprietary submissions.





26. What is the total grant set aside for this and will there be more than one award under different categories or one category covering all aspects for one award?

We're not ready to disclose the total funding for this effort yet. It is not a grant. It is a business-to-business contract between SOFWERX and whoever proposes. That allows for flexibility in terms of milestone payments. It's not a pure grant where they grant the money, and you can kind of do whatever you want throughout the execution. This is more of a development contract. We do anticipate more than one award. I don't anticipate them to be different categories, we just plan to make multiple awards.

[Added written content after live call] We don't intend to portion out the objectives across multiple categories. We expect proposers can meet all objectives in a single contract.

27. Will the satellite image contain the initial launch position? Will the resolution of satellite images remain the same throughout runs?

Yes, the satellite image will contain an initial launch position. Our units operations will be planned, so we will probably have satellite imagery before we operate in the area. That said, I don't know that we'll have the initial launch position specifically identified on an initial satellite image, other than for developmental testing purposes. You will need to be able to operate without necessarily knowing exactly where the launch will be, but I think it's safe to assume that an operator is going to have a larger satellite image. I don't expect us to be getting updates of satellite image imagery, so the resolution will remain the same during the run.

28. Can you provide some examples of the obstacles to avoid during the flight?

Routine things like buildings, vegetation, wires, telephone poles. If you choose to demonstrate during the oral presentation is pretty open because it looks like Florida. It's out in the middle of nowhere so we don't have to worry about obstacles. Examples of obstacles that may need to be avoided include anywhere that SOCOM operates; so urban environments, desert environments, jungle environments, all these and all the obstacles that you can imagine occurring there. I would say human infrastructure, telephone poles, wires, bridges, just about anything.

29. How does the UAS choose the landing location? Does that need to be fully autonomous or is there a pilot in the loop to make a decision?

The UAS is responsible for choosing the landing location so they can continue to observe the point of interest. The more autonomy, the better. That said, as proof-of-principle going for an intermediate stage to provide options to a pilot that get sent back to the UAS in a low latency, low communication bandwidth fashion could be a good building block to get towards where we need to be.

30. Assessment indicates satellite map will be provided (within 5km of launch point). Will Digital Elevation Map be provided, as well (e.g., DTED)?

That's not out of the question. It takes a little more effort to get DTED data, but you're more than able to take advantage of that. I think this location should have plenty of open space to utilize DTED data, if you do plan to make that a key part of the technology, so there's no restriction against using that. Just keep in mind that there are advantages to not requiring it, so make sure the juice is worth the squeeze in those circumstances.





31. How far away with the Point of Interest be from the landing zone? Are there zoom requirements for the EO/IR camera or thermal sensor?

The goal here would be to have UAS select the distance of the landing zone based on the sensors available. Unfortunately, we do not have enough definition to answer this question, we will have to figure out the mechanics during the execution of the award.

32. Can you confirm accessibility for UK companies?

I'll have to take this one as a follow-up. We have had some interest from foreign partners and foreign opportunities, I just don't know that we have the approval to answer that right now. Our goal is a big tent, and we hope to use the best technology from wherever it comes in the world. But, do recognize that the government has constraints in terms of where we're allowed to source things, so please be patient with us as we work through the specifics there. We hope to include UK companies, but we need to follow up and make sure that we've got all the boxes checked for that.

Additional Written Response: The program manager confirmed that foreign partners are eligible to compete for this assessment event.

33. Will the platform and any augmentations need to meet NDAA guidance and require an ETP?

NDAA is National Defense Authorization Act, which prohibited the purchase for DoD missions of small UAS from certain covered countries. No, we did not put meeting that as a requirement. That said, we're looking at three-to-six-month development cycle and the transition after that, so I don't know that there's a lot of time to spiral an exception of policy (ETP) or rework something to meet NDAA guidelines, so it's obviously a risk item that something that would delay transition, and timeliness does matter in these sorts of acquisitions. So, I don't want to say there's a requirement to meet NDAA guidance, but that will certainly be a part of how likely this system is to transition, so keep that in mind.

34. What current TRL is expected to be pitched at the November phase 3 assessment?

In terms of duration, we're looking at three to six months of trying to move into a transition period as quickly as possible. That's what SOFWERX is known for, what SOCOM is known for. That said, there is room for improvements or tweaking or adjustments of existing algorithms to make them truly work, or at least work for a lot of circumstances. TRL is a pretty vague metric in itself for what it means to different people, and I'm reticent to actually put out a number for what's to be pitched. We're trying to get something transitioning in a relatively short period of time. We recognize that things are not 100% viable at this exact moment and that there might be some additional work required to get them over to SOCOM.

35. Will the take off point and the target destination be included in the satellite image we are given?

This goes from two different angles. The first is if you're talking about a takeoff point to your target destination for an augmentation to your oral proposal, I'd say no, we will make that up on the fly with you guys if you end up getting to the oral presentation phase and then choose to do a demonstration. If you are awarded a contract under the solicitation, the takeoff point, and target destination will be defined in the formation of a test plan. I





would assume there is some sort of satellite image of the overall area and some sort of image of the point of interest. But keep in mind the point of interest could be base of a building, a hole in the ground, a truck, a mobile object, a temporary structure like a tent, or something more permanent like a house, so some of these things appear in satellite images but some of them may appear at a rate that is faster than the satellite imagery can be refreshed. There's a good chance that we will have a satellite area defined, but there is also a chance that some specific points of interest may be mobile.

36. "Is the point of the sUAS to fly within a forest, buildings etc. while avoiding obstacles or to simply fly above them? "

In this case I would say there are no restrictions on industry for what they propose. Flying within a forest presents a reduction in your visibility. I don't view this as being an indoor operation because while there are some, there are not that many buildings that are 5km long. So 5km to me indicates outdoors because of the number of places that we can have outdoors, whereas the number of buildings or indoor areas where you will have 5km is very limited. There is also an option to fly above obstacles, there is no restriction that you are not allowed to fly above them. Keeping in mind that a lot of special operations are delicate and sensitive, minimizing how easily we can be seen above the horizon, as well as how easily we can be heard.

37. How will the point of interest be called out? Will it just be a lat/lon location? Will there be an object at that location that could be recognizable?

SOF operators operate in all kinds of places, doing all kinds of different missions. Sometimes I'm looking for, you know, mobile things like a truck, I'm looking for a tent, I'm looking for a building, I'm looking for a crater. There are all kinds of things they could be looking for. Expect to be given some sort of approximate location, some sort of image or something, to try and match to. So, yes, the goal is that there will be an object that will be recognizable. Then you'll have some sort of area knowledge to look for this needle in the haystack.

38. Is it possible to have a beacon at the launch point?

This would obviously be a little less desirable for special operations forces that might be trying to conceal their location. Is there a constraint against it in this solicitation? No, but there's some obvious disadvantage to SOF forces during operations to have a beacon illuminating their position. That said, there's plenty of people who have offered the concepts about LPI/LPD beacons, and we're not going to discount that those could be a good option to mitigate the deleterious effect of the beacon near a special operations unit.

39. Can the UAV have a 4G or 5G datalink?

We're trying to do this mission without continuous operator control, so the data link would need to be for the safety pilot and the goal here is to get the UAS being largely autonomous. So, if the 4G/5G data link is for a safety pilot, I don't see a huge problem with that. But ultimately, I'm not sure how operationally relevant that would be, and I would emphasize that this effort is about autonomy, not maintaining continuous operator control during the execution.





40. Our technology does not require a preloaded set of images for navigation. Will we be given extra points for not having this information as a requirement?

There are advantages to technology that requires fewer inputs in order to provide the same performance, so please make that argument in your proposal and we'll evaluate all of them on their merits based on the set of criteria.

41. What is the expected distance that the sUAS must travel? What are the flight-time requirements?

We didn't put a time requirement, because the point of interest will move and vary depending on what we're doing. We said up to five kilometers, which would mean 5 kilometers each way, so a total of a maximum of 10 kilometers. Again, we're looking at fairly small UAS where that occupies a good chunk of their flight endurance

42. Why does the UAS have to land at the POI? Can it not loiter in the air?

The goal here to have a UAS land to observe a point of interest is to have this technology be a building block for future applications which might require landing. Yes, it can loiter in the air, but that also increases visibility and limits the endurance and persistence of that sensor to observe the point of interest. That's why we're seeking the landing capability.

43. Must line of sight to POI be maintained once SUAS has landed?

Yes, we're trying to maintain some sort of observation, so we would need to select the landing site that's somehow suitable. We understand that in every geographic circumstance that might not always be possible, so we'll just have to sort that out here in the testing. For the purposes of your proposal, I would assume that's achievable, provided it's combined with a reasonable landing spot.

44. Will you want water takeoff/landing capabilities or should we not worry about it?

There wasn't a vision to do water, and even if there was water, we would envision that it would take off from some sort of floating structure. We don't expect to be launching from water at this point.

45. Do we focus on single autonomous sUAS mission or rather thinking of swarm idea?

For this event, for this solicitation, we're envisioning one UAS to perform this mission. We don't expect to be doing multiple vehicles at this time.

46. Is there a minimum altitude for the sUAS to fly?

No, I don't think we plan to constrain industry. I would say there is value in getting above the audible sensitivity of a human so that the UAS could be flying outside of audible range. So, if whatever you propose does not work in that circumstance, then perhaps that would indicate it's maybe not going to stack up well against someone else's proposal. So, keep in mind there's an operational utility to that, and if it's crawling really slowly along the ground and is basically a ground robot, then that loses some of the capability that a small UAS inherently has.

47. Is the environment expected to be fully gps denied or just intermittently denied? i.e. will the UAS have a global absolute position at launch?

I hesitate to answer this one, because there are a couple different angles where this question could be coming from, so I don't want to provide faulty guidance. I would say,





propose what you think you need. Ultimately, SOCOM needs to be able to operate in a fully GPS-denied environment. But again, this is proof-of-principle. Does it have a fully GPS-denied capability right out of the gate? Maybe not.

The last piece of it indicates sort of a different question: will the UAS have a global absolute position at launch? That is the expectation, that when the operator launches them, they have some understanding of their position. I would say it's fair to assume the UAS has some understanding of its position at launch.

48. How much time is allocated for each pitch at the AE?

More to follow on that. Hopefully we'll know more as we get a look at how close the written goals are to complete, how many of those we have to do, and what kind of time is available. It will also matter how many are electing to come in person, and how many are requesting to do a demonstration to augment the oral presentation. I don't there's a page count on the written proposals, which is the first stage that's due in a couple weeks. But, the recommendation is to keep it to about 3 pages, so we're not looking for a 1,500 page dissertation on this.

Additional Written Response: Information on the duration of oral presentations will be provided to those competitive proposals invited. This should not be required to develop a strong written proposal.

49. What is the expected duration of the period of performance?

Part of it depends on the award, but three to six months is the type of time frame that we're looking at. Eye is towards follow-on transition in late this fiscal year and early next fiscal year. So, it's a fairly short duration. We're not expecting a five-year development effort.

50. One could win a contract with the white paper and verbal presentation only, and we can elect to come do a demo, if we think it will help us win? Not mandatory?

That is correct, and you're not at a disadvantage by doing a virtual presentation if you are selected for the oral presentation phase. Demo is an option, at your own expense, but we're not requiring companies to take on that expense.

51. Can we use a non-NDAA compliant aircraft?

Already answered, see question 33.

52. Is there any guidance on crew requirements and simplicity of deployment? i.e. how many people required for setup/transport? Does it need to fit in a vehicle?

The guidance here would be small, and if there's a question about whether it fits in a vehicle, we're probably thinking a little bit too big. These should be almost person portable and closer to single operator. We're thinking very small, one person to deploy and operate, and not only could fit in a vehicle but could fit in a backpack or something closer to that.

53. Is the UAS intended to be expendable? Does it need to make it home or is it expected to be abandoned?

Expendable means different things to different people. I would argue that the small UAS that we're looking at are intended to be expendable in the grand scheme of things, when compared to the cost of human life. But, on the flip side, we are expecting to make round trips of up to 10 kilometers, returning to the launch point.





54. Are there any requirements for how long the ROI must be in view before returning home? If so, can you provide a range?

There are no requirements for persistence at this time, though this would obviously have a mission impact. For the purposes of our testing and demonstration as a proof of principle in this SOFWERX event, we'll refrain from constraint. You can expect refinement of this number later after execution of a successful development effort.

55. How is the UAS directed to return?

The intent of this proof of principle is for the UAS to autonomously decide to return. We won't constrain industry at this time, though this will affect the mission later. It's certainly possible to use a timer, for example, wait 60 seconds observing the point of interest and then begin return.

56. Non-proprietary solutions: implies we should not submit tech solutions that are patent-pending?

We cannot provide advice for protecting your company's unique intellectual property as you navigate the different protection tools such as trade secrets or patents.

57. What is the priority: avoiding obstacles, autonomous mission or detecting e.g. landing zones, objects? Can please point from the high to low expectancy.

I don't think we can prioritize all those functions, we need them all to be successful. I think we can emphasize that this is primarily about autonomous navigation and we're willing to take risk on computer vision / image recognition. I think we can accept risk in the object detection by employing a rudimentary object detection model. That said, all of the subfunctions required to maintain position awareness, avoid obstacles, plan a path, identify a landing zone, plan a path home are equally important.

58. What is the award amount? \$50k, \$100k, \$1 mil?

There is not a fixed award amount, industry can propose what they need and argue the merits. We are anticipating this to be approximately \$100k - \$400k range but will not exclude those who propose outside of that. Propose an approach and argue the merits and value of your approach.

59. Is there a requirement in terms of velocity? Is there a minimum velocity to accomplish the mission

There is no minimum, we aren't constraining industry at this point in development. That said, one must ensure that adequate endurance can be achieved to complete the mission. Further, higher velocity provides benefits to the user at the mission level. Again, argue the merits of your approach and take care that this will be a parameter that users will likely pay attention to throughout execution.

60. Are the vendors required to demonstrate a User Interface for easy-to-use manual command?

This question is a bit vague and can be taken in multiple ways. First, the oral proposal augmentation demo will not focus on user interface. The proposer will do the operations and the focus is on autonomy and position tracking. Second, this effort is about autonomous navigation, not the development of novel operator interfaces during manual operations. Third, operators will be concerned about how they interact with the autonomy. This is important and will be an emphasis during development, but recall that this is a





proof of principle. Further, user interface often requires user input and must dovetail to specific hardware / software for the fielded system. Expect to require changes later after user input. If your approach has interface merits, argue how those provide value in your proposal on top of the merits of your approach to the primary challenge, autonomous navigation.

61. What is the smallest object that the UAV will need to avoid in the landing zone?

The SUAS will need to avoid natural and manmade obstacles that compromise its ability to complete the mission. I don't think we're talking about booby traps designed to trick the system; this is mainly about keeping the vehicle operational in the environment (rural, suburban, urban) in spite of various obstacles.

62. What is the time allowed to process the satellite image(s) prior to mission initiation to identify it's geographic location and distinctive features?

Image(s) of the object will not necessarily be satellite and will be provided day of – few hours prior. The test site will be identified weeks in advance and companies can access open source imagery during that time.

63. A statement is made that “The SUAS will launch with an approximate range and bearing”. Range & bearing relative to what?

Range and bearing from the launch location.

64. Is the requirement to “integrate without modifying the existing autopilot” in conflict with “integrate utilizing PX4 or derivative autopilot”?

It is in conflict if the autopilot has no common pedigree with PX4. Again, PX4 is an open source autopilot that many industry understand how their specific autopilot relates to. Selecting an autopilot with no relationship to that introduces the possibility of added risk. Additionally, the hope here is to focus on the development of autonomous navigation for a platform that can already robustly maintain stable flight. Using the limited funds available to explore autopilots at the expense of navigation is counter to our intent.

65. What is the SOCOM definition of a “Derivative Autopilot”?

A known relation of differences so that risk of integration on a future vehicle can be understood.

66. Does interfacing a separate Navigation Flight Processor (NFP) with the Pixhawk PX-4 qualify as a “derivative autopilot”?

This is tough to answer without understanding what specifically you are proposing. If you are proposing to intercept the typical GPS stream heading into the autopilot state estimator and provide a different stream as output from the navigation flight processor, then probably it is still a derivative autopilot. In that case, you would not be adjusting the gains tuned for stable flight and we could assess the risk of integrating the NFP causing a lot of rework on the aircraft stability. That said, there are a lot of approaches conceivable and I could be misunderstanding your question. Your question also introduces a second line of question, distinct processors. There are several disadvantages to separate processors, not the least of which are reductions in payload and endurance. Please pay attention to those tradeoffs and be prepared to argue the merits of your approach because the costs can be significant.





67. "Will the sUAS provide electrical power to operate the AutoNav Subsystem components? If so, what is the limitation on electrical power demand (Watts) & Watt-hrs?"

Yes, the SUAS will provide power. As stated before, we did not envision GFP/GFE in this solicitation and cannot provide any specifics until it is requested. We anticipated that industry would provide their own SUAS.

68. What is the mass we may add to the sUAS for AutoNav?

We are not providing a maximum constraint. Mass comes at the expense of payload and endurance and is desired to be minimized.

69. What is the volume constraint for added GPS-Free navigation equipment?

Again, not constraining that, but it is desired to be minimized. Ideally, no additional volume is required and you can make use of the existing sensors on the SUAS.

70. What is the maximum altitude and operation boundaries within which the sUAS is allowed to operate?

We're tracking down altitude limits for the specific test range. That will be made available during test planning for successful offers. You can anticipate something around ~1000' above ground level for the proposal as we are looking for small, expeditionary VTOL systems, but hard limits may differ when we dive into test planning.

71. Are there any specific technologies that are preferred for maintaining observation of the point of interest?

No, other than to use the sensors already existing on the SUAS.

72. What is considered satisfactory maintaining of observation of the point of interest?

We have not established a pass fail criteria, but persistent sensing is not the key proof of principle sought. Landing with a view of the point of interest, observing for 60 seconds continuously, and then returning to launch point is satisfactory.

73. Is there a minimum/maximum speed at which this navigation should happen?

See question 59.

74. Can the sUAS connect to the ground station computer for anything other than ground station control?

I'm not sure I understand this question. During testing, we expect to utilize a safety pilot who can resume manual control in the event of unexpected behavior. The emphasis of this effort is to have a SUAS launch with a line of bearing and approximate range, search for a point of interest, observe it, and return home without requiring trusted GPS to maintain position or continuous operator control. Connectivity at launch and final recovery is expected, but during autonomous navigation, it is expected that minimal, if any, connectivity is required. Connection might be required to display candidate landing zones to an operator, but again, the desire is to minimize connectivity requirements as much as possible.

75. Can any information be supplied remotely to the sUAS while navigating?

I would suggest that information is constantly being supplied to the sUAS by the sensors on the device. I would also emphasize that the system should operate without continuous operator control and not be guaranteed to receive ground station information or GPS



information. The more independence and autonomy, the stronger your proposal. You're welcome to propose an approach where other sensors are providing data, including non-traditional RF signals of opportunity or sensors other than typical EO/IR sensors on the sUAS. I would suggest that a second sort of ground station or controller does not meet the intent of decoupled autonomy.

76. Will the ground station computer be provided? If not, are there any restrictions on what we can bring?

You may propose that the government provides a ground station, but that was not envisioned in our solicitation. We anticipated offerors would provide their own sUAS and ground control station. There are no restrictions on ground station; however please note that we're looking to transition this technology to the field rapidly. The further a ground station is from tactical kit, the more risk your proposed approach introduces to transition and the less competitive you'll be.

77. What type of point of interest is to be identified? E.g., buildings, tanks, personnel, storage tanks, artillery, munitions, missiles?"

The point of interest could be any of those. It could include civilian vehicles, civilian infrastructure. You can anticipate in testing under these efforts that it will be something like a vehicle, tent, off road vehicle, small building; but ultimately, we'll need to detect the points of interest that you mentioned and more.

78. What signal is to be fed into the existing autopilot for waypoint-to-waypoint navigations purposes? E.g., desired waypoint, bearing?

I don't understand this question. Yes we want desired waypoint to be input to the sUAS and then the sUAS will autonomously navigate to it without GPS or operator control. The waypoint may just be a range and bearing from the launch point.

79. Is the autopilot capable of performing an autonomous landing? Is an altitude profile required to be generated for the autopilot to track?

It was envisioned that offerors will propose their sUAS of choice. Many, though not all, options in the market have this capability, including integrated with the PX4 autopilot software. It is your choice which vehicle you integrate. There is no required altitude profile. Whatever you want to make the sUAS operate safely.

80. The solicitation mentions the SUAS must navigate around obstacles. What type of obstacles? E.g., building, electrical wires, poles, trees, tree limbs?

Those are all possible obstacles. SOCOM operators work in every climate and environment and encounter all types of obstacles in the built and natural environment.

81. Will AutoNav Providers be permitted to alter the Ground Station's embedded software?

Yes, the government is not dictating the ground control system. Further, the ground station should not affect flight stability or autopilot tuning.

82. What does it mean to "modify the existing autopilot"?

This effort is about autonomous navigation and expects to utilize an existing vehicle capable of stable flight. Modifying the autopilot code to affect the stability and reliability of the basic vehicle positioning and flight adds risks to transition of the technology. We





discourage that to ease transition and increase applicability across a range of sUAS options.

83. Will there be a standard vehicle we can use, to adapt our GPS-Free navigation equipment? or can we bring our own integrated flight platform?

There is no government standard beyond what is described. It was envisioned that offerors would bring their own sUAS, though you may propose GFE/GFP.

84. Given that this Assessment Event is meant to be held virtually, will a simulation environment be given or how will the metrics be held constant?

This is not a fly off. "Metrics" in our mind relate to competitiveness of solicitation. All offerors are provided the same deadline, assessment criteria, and access to question and answer per the solicitation on the event.

85. Does the obstacle avoidance require a known set of waypoints to and the UAS navigates to those without GPS?

I'm not sure I understand this question. The sUAS is expected to operate and navigate without GPS. It is expected to avoid obstacles during navigation. The operator will be provided a range and line of bearing from an initial launch area to search for a point of interest. It will not be required to map to certain GPS coordinates in the initial proof of principle. Ultimately, that capability could be useful and could be used as an argument in favor of your proposed approach.

86. What communications from drone-to-controller (and vice versa) are allowed during the assessment? (e.g., communication bandwidth, latencies, update rates)

The communication link is standard based on the radios of the selected system. We expect to maintain a safety pilot with line of sight control to resume manual control in the event of anomalous or unexpected behavior. Otherwise, the system should not require any drone to controller communication during execution of the mission.

87. What are the processor specifications for "currently available SUAS" (e.g., volatile and non-volatile memory, CPU/GPU FLOPs)?"

A variety of processors are available. The government is not proposing a standard. Further you can modify a standard sUAS to increase processor capability, but bear in mind this introduces risk and taxes payload and endurance; ultimately reducing our ability to transition.

88. Do you want to see a water takeoff/landing?

The envisioned missions and airspace do not include water. That said, SOCOM operates in all environments around the world, including maritime and littoral environments. Proposals that include water offer discriminating increases in capability and you are welcome to present that as additional merit to your approach, provided it does not come at a cost to the primary goals outlined in the assessment criteria.

89. What provisions are available for telemetry, either downlink or stored on-board SSD, for post-assessment playback and analysis?

It is up to the offeror to select an sUAS for demonstration. We are not requiring a particular set of parameters. It is expected that during test planning for awarded efforts, we'll collaboratively identify some capability to record data in order to analyze the data.



90. What is the size of the test area for small, medium and large?

These terms are undefined. We are pursuing a POI at a range of ~5km. The test area for awarded efforts will exceed that length. The area for oral presentation augmentation is likely smaller, 100s of meters in any direction.

91. Will all launch/recovery need to be done from the ocean? That is, are shore launch areas available?

The envisioned missions and airspace do not include water. That said, SOCOM operates in all environments around the world, including maritime and littoral environments.

Proposals that include water offer discriminating increases in capability and you are welcome to present that as additional merit to your approach, provided it does not come at a cost to the primary goals outlined in the assessment criteria.

92. Can the UAS be equipped with GPS as a fallback option in instances where other nav algorithms fail?

It is expected that the sUAS will retain GPS for safety pilot intervention and it will only be electronically disabled through software during testing. We do not intend to jam GPS during testing. That said, our transitioned product will operate regardless of the GPS signal condition (fully trustworthy, jammed, spoofed, absent) and we will be using this as a primary goal during evaluation.

93. "Is stealth (acoustic, visible) important?"

SOF often undertake high risk, sensitive missions on behalf of the nation. As such, signature is an important consideration for special operations.

94. Can we get a KML file/ box of the area for the assessment?

Specific geography for the oral presentation augmentation will be provided to selectees upon scheduling of the oral presentation window. Test planning for awarded efforts will provide geography and locations for testing during the effort.

95. Will the layout of the course be available prior to the event? If so, how much earlier?

Specific geography for the oral presentation augmentation will be provided to selectees upon scheduling of the oral presentation window. Test planning for awarded efforts will provide geography and locations for testing during the effort. There is no course, it's an open test range with a point of interest.

96. Will the test be done in a virtual environment?

No.

97. Can you go over again about the virtual assessment?

Please review the transcript. You may reread the transcript as many times as necessary.

98. What is the expected coverage / resolution of the provided satellite image?

Imagery will only be of commercial quality (e.g. Google Earth). No higher resolution data will be provided.

99. How much is the 5km requirement weighted in the evaluation criteria?

There is no specific weighting function applied. We consider the merits of the system to provide autonomous navigation at a relevant distance. If that distance challenges but your approach offers superior performance at lesser ranges (~3km), then argue the merits of your proposed approach.





100. It sounds like one could be awarded a contract under this call without doing the flight demo, we could CHOOSE to demo our capabilities with the flight demo?"

There is no requirement to augment an oral presentation with a demonstration. This is not a fly off. The written proposal is very important. You can be very successful with a strong written proposal and a virtual oral proposal; argue and demonstrate the merits of your technical approach.

101. Does the platform need to be fixed wing or multi-rotor?

The platform must be VTOL and is intended to be transportable by one or two operators. We will consider larger systems provided that strong justification for the necessity of that size and the existence of a reasonable transition to smaller systems is provided.

102. Can adjustments to UAS algorithms be made after we're provided ROI description? i.e optimize for finding a "red truck"?

Not sure if that's a typo, we've been using POI for point of interest, which could be a "red truck." We expect some amount of training for an image recognition algorithm may be needed. There are no specific time limits, but you can reasonably anticipate it to resemble a pre-mission work up by an operator. For example, intel provided this image of a POI in this approximate area, please perform an ISR mission while retaining standoff for forces.

103. Will the GPS jamming be in the form of no usable GPS signal, or incorrect/malicious GPS position return, or both?

Awarded efforts in this program will electronically disable the GPS signal during testing. Future efforts may examine discrimination of spoofed GPS signals, but that is likely out of scope for this effort. This effort should focus on autonomous navigation without continuous operator control.

104. Is there an expected timeframe for the phase 4 Awards to deliver within?

See question 34.

105. Is the sUAS required to remain in uncontrolled airspace? If not, is the airspace going to be cleared or deconflicted?

The airspace for testing will be controlled during testing for those efforts awarded. We're still finalizing arrangements for oral presentation augmentation demonstrations.

106. Will the target within the AOI be stationary or could it be mobile within the AOI?

Initially the point of interest will be stationary (though relocatable). Later testing may explore moving points of interest.

107. Once the sUAS identifies the POI, are there any requirements on data that should be sent back to the operator? For example, images of the POI?

This would be of great utility to the operator in the ultimate deployment of this technology. That said, we're building the fundamentals here with autonomous navigation and that sort of logic is likely next steps after the autonomous navigation foundation is laid. We believe the timeline and cost to be aggressive, but we always seek maximum warfighter value. If you can deliver above and beyond the initial requirements outlined in the assessment on schedule, you should feel unconstrained in your ability to propose that. The assessment criteria will be more important than features beyond the listed criteria.

