PEO-FW FANTOM Behavior Integration (A2E) Assessment Event (AE)
Q&A Telecon Transcript
20 OCTOBER 2026

1. Is FANTOM integrated and interoperable with CJADC2? If USSOCOM is integrating AI, has it established standardized data models, open data service APIs, CJADC2-compliant interfaces, cloud modernization, and IPv6 capabilities?

The A2E program shares data with other joint-service systems, although specific interoperability details were not provided due to sensitivity. FANTOM is not currently implementing AI capabilities, but future AI-enabled playbook development and execution are under discussion. The integration of AI into FANTOM is anticipated to be several years away. Specific information regarding CJADC2 compliance, cloud modernization, IPv6, and the requested interface standards was not provided.

2. Is TRL 6+ with flight-demonstrated code a hard eligibility threshold for Phase 1 or a preference? Would a Behavior Service demonstrated in SITL/HIL with unmodified PX4 firmware, but not yet flown, be considered for Phase 3?

TRL 6+ flight demonstration is not a hard eligibility requirement. The Government prefers mature, previously developed capabilities that can be integrated into FANTOM with minimal additional development. Selected behaviors are expected to undergo software-in-the-loop or laboratory-based testing. Flight testing is not currently required for the assessment and may occur later, subject to scheduling and resources.

3. Is a Service that Behaviors call, such as a decentralized task-allocation service used by Area Search or Multi-Target Custody, in scope, or must every submission be a complete standalone Behavior?

Independently reusable services supporting behaviors may be considered. The Government recommends demonstrating such a service through a functioning behavior that uses it. Proposed capabilities should be modular and independently executable through the FANTOM API without requiring an entire external autonomy stack. All necessary supporting functionality should be contained within the submitted implementation, subject to available computing resources.

4. Will the SDK User Guide and the FANTOM Services view of the MBSE model be released to Phase 1 submitters before 5 November? If so, when and under what agreement (NDA, DD Form 2345, or CUI)?

The Government intends to release the SDK User Guide and supporting architecture documentation through the SOFWERX event webpage after the required approvals are completed. The documentation is expected to help industry understand FANTOM services and interfaces. The actual SDK software will not be released before vendor selection because of CUI requirements. The precise documentation release date and any required access agreements were not established.

5. Would a mission-data protection service be in scope under FANTOM's "Other Services" category if it uses mission-state events, such as loss of link, loss of control, or platform custody, to trigger protection of mission data? Does the SDK expose those events to third-party services?

The A2E architecture could support exposure of the necessary mission-state information if the capability is determined to be of interest. SDK updates may be required to support the proposed actions and associated data exchanges. The specific protection actions, required interfaces, and applicability of the proposed service would need to be defined collaboratively.

6. Does FANTOM already have a task-allocation or team-coordination service? If so, is it centralized, leader-based, or decentralized, and is the capability gap in the allocation logic or the Behaviors that consume it?

FANTOM has decentralized task-allocation capabilities. Swarm members collaborate without relying on a centralized or leader-based allocation mechanism. The specific capability gaps in the existing allocation logic or consuming Behaviors were not identified.

7. Is a Service that supplies external contact tracks to Behaviors in scope for Phase 1, such as passive detections from a ground-based sensor delivered through CoT or SAPIENT? Does the SDK define an interface or data model for ingesting off-platform tracks, and can a Service run off-platform?

FANTOM's world model maintains information that includes target tracks and other environmental data. The Government has not fully defined the process for ingesting externally generated tracks from sources such as ground-based sensors. Additional SDK interfaces could be developed if a proposed capability demonstrates sufficient value. Industry was encouraged to submit a white paper describing the proposed approach. Specific CoT or SAPIENT support, interface definitions, and off-platform execution requirements were not confirmed.

8. Is a behavior-assurance and evidence Service that validates other Behaviors and produces flight-readiness evidence an extension category the Government would evaluate, or is this assessment focused exclusively on the named Behavior and Planner areas?

The Government expressed interest in independently validating autonomous behaviors and encouraged submission of a white paper describing the proposed assurance capability. Existing validation approaches include laboratory testing followed by flight testing against representative operational conditions. The specific evaluation category and acceptance criteria for an independent assurance service were not established.

9. For a Service with a lower integrated TRL but a mature core capability, would a credible path-to-TRL-7 maturation plan be evaluated, or is TRL 6+ flight demonstration a mandatory entry requirement?

TRL 6+ flight demonstration is not a mandatory entry requirement. The Government is primarily seeking mature, previously developed technologies that can be readily integrated into FANTOM. Proposed behaviors must function independently through the FANTOM API without relying on external autonomy-stack components. The specific evaluation process for a path-to-TRL-7 maturation plan was not defined.

10. Can an Extension Service operate strictly in read-only mode by subscribing to Behavior states, decision outputs, and constraint data through the SDK without command or tasking authority? Does the SDK expose this information to third-party Services in simulation and recorded flight logs?

The SDK exposes a substantial amount of information to Behavior Services, and the available interfaces are described in the supporting user documentation. The Government requested additional information explaining the purpose and operational value of a strictly read-only service. Availability of all requested data in simulation and recorded flight logs was not confirmed.

11. For the Phase 3 Assessment Event, must a demonstration show live integration with FANTOM Core through the SDK, or is a demonstration using representative data acceptable? Will a reference Behavior or sample dataset be provided?

The assessment is intended to demonstrate that submitted capabilities can integrate with the FANTOM baseline and perform their intended functions. The Government expects laboratory-based integration and simulation testing, rather than flight demonstrations during this phase. The SDK includes baseline implementations and simulation capabilities that become available to selected participants under appropriate CUI controls. Acceptance of a demonstration using only representative data, and availability of a separate reference Behavior or sample dataset, were not established.

12. Does the Government currently have funding available to process awards? If so, which organization holds the funding, and what is the risk that funding will be unavailable after selection?

Funding is available and has already been provided to SOFWERX. Selected vendors will enter into participation arrangements through SOFWERX and receive stipends for integration and assessment activities. The specific risk of funding becoming unavailable after selection was not addressed.

13. What middleware do FANTOM Services use for communication, and what are the container constraints regarding runtime, CPU architecture, GPU availability, and permitted base images?

FANTOM Services communicate using Data Distribution Service (DDS) publish/subscribe messaging, with IDL-defined data structures. The system supports containerized development and deployment using Docker and Podman, with Docker Compose currently used in the environment. Target hardware is primarily NVIDIA-based ARM64 processors with GPU capabilities. GPU utilization may be considered depending on the proposed capability and available platform resources. Specific permitted base images and detailed resource constraints were not provided.

15. Is SDK pipeline and artifact-governance tooling a relevant standalone contribution to this assessment, including software supply-chain security, open-source dependency evaluation, component policies, SBOM generation, and traceability?

USSOCOM has an existing DevOps and DevSecOps pipeline intended to support software development, integration, and testing. The Government does not currently require a separate standalone software supply-chain or artifact-governance capability for this assessment.

16. How are Behaviors packaged and versioned, and is a simulation environment available for evaluation before the assessment event?

FANTOM Behaviors are integrated as containerized software components, with Docker and Podman supported. The SDK includes simulation capabilities for laboratory evaluation. However, the actual SDK and associated simulation environment will not be made available to vendors until after down-selection and establishment of appropriate CUI safeguards. Specific Behavior versioning requirements were not provided.

17. What cybersecurity and compliance requirements, including CUI handling and NIST SP 800-171, apply during initial proposal submission compared with subsequent evaluation, integration, or award stages?

The FANTOM environment operates at the CUI level. Initial proposal submissions are not required to complete the software vulnerability evaluation that will apply to selected capabilities. Vendors selected for integration will need to satisfy applicable cybersecurity requirements, including vulnerability scanning and appropriate CUI handling. Specific NIST SP 800-171 obligations for each acquisition stage were not defined.

18. If the FANTOM Core SDK is unavailable before the 5 November submission deadline, will an interface specification or example Behavior be provided for integration planning? Will a simulation or testing environment be available before the assessment event?

The Government intends to release SDK documentation, including user guidance and service architecture information, as quickly as possible following approval. Actual SDK software and associated simulation capabilities will be provided only after vendor down-selection and establishment of appropriate CUI safeguards. The SDK includes example capabilities and laboratory simulation support. The availability date for any separate interface specification or example Behavior was not established.

19. Is a perception or tracking Behavior focused on sensing and tracking, without swarm coordination or task allocation, an appropriate submission?

A perception or tracking capability may be submitted if it aligns with an identified assessment category. Such capabilities could be added to the architecture, although independently focused perception or tracking is not the primary objective of this assessment. The Government remains interested in understanding potentially relevant approaches.

20. What mechanisms are available for FANTOM Extension Services to access continuously changing platform, sensor, target, environmental, and mission data and maintain the location-state information required by Behaviors and Planners?

FANTOM Services can consume vehicle position, state, health, capabilities, performance constraints, and speed information. Similar information is available for peer vehicles within the swarm. The architecture also provides access to world-state and target-track information. The specific interface and state-maintenance implementation details will be described further in SDK documentation.

21. What mechanisms allow an Extension Service to publish derived information for use by existing Behaviors and Planners? Are real-time or event-driven updates supported through defined interfaces?

FANTOM Services communicate through DDS publish/subscribe messaging using IDL-defined data models. The architecture is designed to support information exchange between services and extensions, with additional SDK interfaces developed as requirements emerge. The specific interfaces for publishing the proposed derived information, including supported real-time and event-driven update mechanisms, were not confirmed.

22. Is FANTOM currently compliant with the USAF Autonomy Government Reference Architecture (A-GRA), and is future compliance planned?

FANTOM was developed as a separate autonomy architecture optimized for smaller UAS platforms. The Government distinguished between architecture compliance and compatibility. Data interoperability with systems using A-GRA is supported at the A2E system level rather than through direct FANTOM Core compliance. A commitment to future A-GRA compliance was not established.

23. Beyond the Behaviors and Planners identified in this Assessment Event, what high-priority operational mission areas or capability gaps are driving FANTOM's near-term development priorities?

FANTOM's primary mission focus is collaborative autonomy for small UAS conducting intelligence, surveillance, and reconnaissance missions, including operations in contested or communications-degraded environments. The Government is seeking reusable, mature capabilities to expand its library of autonomous mission Behaviors. Additional high-priority mission areas beyond those identified in the assessment were not specifically established.

24. Within those priority mission areas, which technology capabilities or technical approaches does the Government consider most valuable for industry to develop, mature, integrate, or demonstrate through FANTOM?

The Government prefers mature autonomous capabilities that have already been developed or demonstrated for other platforms, programs, or autonomy frameworks and can be integrated into FANTOM with limited additional development. Modular Behaviors and reusable services are of particular interest. New capabilities may also be considered, but existing, independently executable technologies are the principal focus. A further prioritized list of technical approaches was not provided.

25. Will the FANTOM SDK materials themselves be CUI, and is CMMC Level 2 required at submission or only at award?

The executable SDK software is CUI, while supporting documentation is expected to be releasable as unclassified information after approval. Selected vendors must have appropriate CUI handling capabilities before receiving the SDK. CMMC Level 2 is not required for initial submission. Whether CMMC Level 2 will be required at award remains under consideration.

26. Does FANTOM provide an inter-vehicle link abstraction with delivery guarantees and link-quality telemetry? Can Services exchange small peer-to-peer messages at hundreds of bytes per second, and can Behaviors continue executing during communications partitions?

FANTOM supports inter-vehicle communication and distributed collaboration while minimizing communications overhead. Behaviors are expected to continue functioning when communications are interrupted, with capabilities degrading appropriately as connectivity becomes unavailable. The Government identified dynamic bandwidth management as a potential area for future extensions. Specific delivery guarantees, link-quality telemetry, and supported peer-to-peer message rates were not provided.

27. Does a Behavior receive a fused team track picture with consistent track identifiers across vehicles, or individual vehicle-local tracks? Is track fusion provided as a FANTOM Service?

Behaviors can access target-track information maintained within FANTOM's world model, along with information concerning other swarm participants. The Government did not specify whether track information is fused across the swarm, how track identifiers are reconciled, or whether track fusion is provided as a dedicated FANTOM Service.

28. For Multi-Target Custody and Search/ID/Track, what representative numbers of vehicles and targets, target speeds, and sensor types should be used? Which vehicle-to-target ratio is most important?

The Government is interested in capabilities that maintain custody of multiple targets using multiple collaborating vehicles. The solution should accommodate scenarios involving more targets than vehicles and more vehicles than targets. Specific representative quantities, target speeds, sensor configurations, and preferred operating ratios were not provided.

29. Which companion computer is representative of the Group 2–3 A2E platforms, including processor, CPU/GPU, RAM, and power budget?

FANTOM operates on a separate mission computer that provides guidance to the aircraft's flight-control computer. The representative mission-computing environment is based on NVIDIA ARM processors with GPU capabilities. Available memory, processing capacity, and power are limited and must be evaluated for each proposed capability. Specific computer models, RAM quantities, and power budgets were not provided.

30. For white paper submissions, should vendors follow the prompts in the white paper template or the nine questions in the assessment criteria?

Vendors may deviate slightly from the white paper template to clearly describe their capabilities, provided the applicable assessment criteria are addressed. A separate white paper is required for each proposed Behavior. The Government increased the white paper limit to three pages, with approximately one page describing the company and capability background and two pages explaining the proposed Behavior, its functionality, and expected performance.

31. Will there be a stipend-funded SDK evaluation period before the December session, similar to the 2025 A2E cycle?

The Government intends to provide stipends to selected vendors to support integration of existing capabilities into the FANTOM baseline. SDK access will be provided after down-selection and establishment of appropriate CUI safeguards. A separate stipend-funded SDK evaluation period before the referenced December session was not confirmed.

32. What will next-phase development involve regarding contracting vehicles, timelines, typical award sizes, and the ability of nontraditional small businesses to receive direct awards rather than working through a prime contractor?

Following successful integration and demonstration, the Government anticipates considering longer-term licensing arrangements for capabilities that could be deployed across multiple platforms. Licensing may account for runtime use and sustainment requirements. Existing contractual arrangements may simplify future acquisition, while establishing new contract vehicles may require additional time. Specific acquisition vehicles, award sizes, timelines, and direct-award procedures were not established.

33. May vendors form teams consisting of autonomy software providers and Group 2 platform manufacturers or integrators? Should teams submit one white paper or separate papers?

Teaming is permitted. Vendors submitting as a team should provide one consolidated white paper for each proposed Behavior rather than separate submissions for the same capability. This approach is intended to eliminate duplicate submissions and simplify the evaluation process.

34. For the Weather Data Service, what horizontal, vertical, and temporal resolution is required or expected?

The Government has not established fixed spatial or temporal resolution requirements. Vendors should propose resolutions appropriate for small UAS operations and justify their applicability to the intended mission. Wind conditions are particularly important because of their effects on vehicle performance and battery consumption.

35. Beyond temperature, wind, precipitation, and cloud levels identified in the assessment criteria, are additional weather variables required, such as icing, visibility, or turbulence?

Wind, cloud cover, and turbulence are important considerations for the intended small UAS operating environment. Turbulence and adverse wind conditions may increase battery consumption and affect vehicle performance. Precipitation may also be relevant. Icing was considered less significant because the targeted vehicles generally operate at lower altitudes. No additional mandatory weather-variable list was established.

36. Are probabilistic or ensemble forecasts, deterministic forecasts, or both required?

Both probabilistic and deterministic forecasting approaches are acceptable. The Government has not established a mandatory preference between the two. Proposed forecasting capabilities should support the intended mission objectives.

38. The assessment requests a notional architecture diagram showing the proposed Service integrated with FANTOM Core, referencing the SDK User Guide or the FANTOM Services view of the MBSE model. Can these resources be shared, and how should vendors request access?

The Government intends to provide the SDK User Guide and supporting FANTOM architecture documentation through the SOFWERX event portal. The materials must complete the necessary approval process before being made available for download.

39. For Multiple SUxS Target Custody, what specific capabilities are required, and how are they prioritized within this focus area?

The Government seeks the ability to maintain custody of multiple targets and distinguish among them using collaborating unmanned platforms. The capability should coordinate target assignments and custody as vehicles and targets move, including scenarios with unequal numbers of vehicles and targets. No specific sub-capability was identified as having a higher priority than the others, and a detailed ranked feature list was not provided.

40. Is the Government establishing a marketplace or other incentive structure for third-party Behavior development? How should industry plan long-term business investments in FANTOM participation?

The Government intends to expand a reusable library of Behaviors that can support future autonomous missions without requiring all new capabilities to be developed by the FANTOM Core team. Selected vendors may receive integration stipends, and successfully demonstrated commercial capabilities may be considered for future licensing across multiple platforms. No formal marketplace, vendor incentive structure, or long-term procurement commitment was established.

41. What is the anticipated acquisition path after the Assessment Event? Has the funding or award amount been identified, and what award range, number of awards, and obligation timeline are contemplated?

The Government confirmed that funding is available through SOFWERX for selected vendors to integrate existing capabilities into the FANTOM baseline. Integration stipends may be up to $250,000 per vendor, with amounts dependent on the proposed capability and required integration effort. Future licensing or acquisition arrangements would be addressed separately after successful demonstrations. The anticipated number of awards and specific funding obligation schedule were not provided.

42. For Prioritized Network Data Transmission, are there defined latency, jitter, packet-loss, and time-synchronization requirements for communications between the UAV and the operator?

The Government emphasized minimizing communications overhead and maintaining autonomous operation in degraded connectivity environments. Specific latency, jitter, packet-loss, and time-synchronization metrics were not provided.

43. Does the existing FANTOM Core system have an A-GRA-to-FANTOM Core translator?

FANTOM Core does not directly provide the described architecture translation capability. Data translation and interoperability with A-GRA-based systems occur through the A2E ground station at the broader A2E system level.

44. Can an Extension Service operate from a ground station, such as a weather service hosted at the ground control station that sends results to the aircraft, or must all Extension Services execute onboard?

FANTOM's mission-autonomy services and Behaviors are designed for execution on edge platforms. The Government stated that the autonomy functions operate onboard rather than depending on offboard processing. Specific acceptance criteria for a ground-station-hosted Extension Service were not established.

45. Is FANTOM designed to operate from cloud to edge with graceful degradation, and must tactical workloads continue executing when cloud connectivity is entirely unavailable?

FANTOM is designed to execute mission-autonomy functions on edge platforms. Mission execution does not depend on continuous cloud connectivity. The architecture is intended to maintain autonomous operation and degrade gracefully when communication with other platforms becomes intermittent or unavailable.

46. When collaborating UAS lose communications, how does FANTOM manage distributed task allocation, conflicting decisions, and mission-state reconciliation when connectivity is restored?

FANTOM includes mechanisms for resolving conflicting world states and decisions when communications are available. Specialized Behaviors can continue operating during extended communications outages. When connectivity is restored, the system can reconcile conflicting information and resume collaborative operations as appropriate. Behavior execution must account for intermittent connectivity and the associated loss of collaborative capabilities.

47. How does FANTOM execute operator intent, and how is that intent delivered to the system?

Operators provide mission objectives through a ground-station interface. These objectives are represented through predefined playbooks consisting of plays, roles, Behaviors, and event-driven triggers. FANTOM's distributed mission-management capability selects and executes the appropriate plays to achieve the objectives. Behaviors receive the applicable objectives and determine how to control vehicle movement, sensors, and payloads to accomplish the assigned mission.

48. How is "flight-demonstrated" defined for TRL 6+? Does code executed offboard while controlling a live drone qualify, or must the code have flown onboard a Group 2–3 aircraft?

TRL 6+ flight demonstration is not a mandatory qualification for this assessment. The Government will consider mature capabilities that have been demonstrated in simulation or laboratory environments. The specific distinction between offboard and onboard flight demonstration was not defined.

49. For commercial software integrated as an Extension, what licensing and data rights does the program expect?

The current assessment funding supports integration of an existing capability rather than development of entirely new intellectual property. If the Government elects to use a successfully integrated capability beyond the assessment, a separate licensing arrangement may be negotiated. Intellectual property and data rights will be evaluated individually, including whether the technology was developed commercially or under a Government contract. Commercially developed capabilities that remain vendor-owned may be licensed for future Government use.

50. How is the Playbook executed, and how is operator intent delivered to FANTOM?

Operator intent is expressed through mission objectives and predefined playbooks. Each playbook contains plays that define mission roles, associated Behaviors, and triggers controlling transitions between Behaviors. Mission management selects plays based on the objectives, while the participating vehicles execute the assigned Behaviors at the edge. The playbook is a configurable mission definition rather than executable source code.

51. Does consensus require communication between swarm members?

Communication is necessary for certain distributed consensus and coordination functions. However, FANTOM is designed to continue operating when communications are degraded or unavailable. During those conditions, the system may lose some collaborative capabilities but can continue executing appropriate local Behaviors. Operations can adapt when communications are restored.

52. Does task allocation consider future tasks within a play and optimize for overall mission success, or is allocation performed reactively based on immediate conditions?

FANTOM currently has multiple task-allocation methods at different levels of maturity. The Government indicated that the distinction between forward-looking optimization and immediate task allocation requires further technical discussion.

53. Is USSOCOM interested in adapter solutions that enable platform integration during this assessment or a future assessment?

The FANTOM SDK supports platform-specific adapter services that connect the autonomy architecture to aircraft hardware, flight-control systems, sensors, and external software. The Government intends to expand SDK extension capabilities as requirements evolve. Specific interest in selecting standalone adapter solutions during this assessment or a later event was not established.

54. Does FANTOM have an established format for three-dimensional avoidance volumes, including geometry, time validity, and severity, or should industry propose one?

FANTOM maintains world-model information that includes environmental constraints such as no-fly zones. The specific data model for three-dimensional avoidance volumes, including shape, time validity, and severity attributes, was not described.

55. Is the Government interested in technology that monitors autonomous system behavior and determines whether execution remains within defined operating parameters?

The Government expressed interest in independent behavior-assurance and monitoring capabilities. Industry was encouraged to submit a white paper describing how a proposed solution could evaluate whether autonomous behaviors are functioning as intended. Existing validation methods rely on laboratory testing followed by flight testing in representative environments.

57. Does FANTOM provide a user interface or C2 system, or is there a target solution for one?

FANTOM does not provide a dedicated operational user interface or C2 system. It includes a common air-to-ground command-and-control interface that enables integration with external human-machine interfaces and C2 systems. The SDK also provides a simulation interface for laboratory testing. The A2E program currently uses a Government-provided interface.

58. Will evaluators give additional consideration to weather capabilities already validated in military operations, such as hazard products used by an Air Operations Center?

The Government prefers mature, previously developed capabilities that can be integrated into FANTOM with limited additional development. Specific evaluation weighting for weather technologies previously validated in military operational environments was not established.

59. What simulation environments does FANTOM integrate with, and how can vendors demonstrate Behaviors before installation on aircraft?

The FANTOM SDK includes a laboratory simulation environment that supports testing of autonomous Behaviors before flight integration. Vendor capabilities are integrated as containers and evaluated through software-based functional testing. Laboratory and bench testing are expected during the assessment, with flight testing occurring in later phases as resources and schedules permit.

60. Would a Service already operating in accredited DoW environments at IL5 or IL6 reduce integration and certification risk?

The Government identified CUI as the expected information protection level for the FANTOM environment. Specific evaluation benefits or reduced certification requirements associated with existing IL5 or IL6 accreditation were not discussed.

61. Should the Weather Data Service and Route Planner share a common spatial and temporal model so routes can be evaluated against changing weather hazards along their planned execution timelines?

FANTOM supports environmental information and reusable path-planning services that can be selected by different Behaviors. However, the Government did not establish a requirement for Weather Data Services and Route Planners to share a common spatial and temporal model.

62. Will FANTOM expose event-level provenance linking sensor-data freshness and confidence to Play triggers, Behavior decisions, and swarm-state transitions so an independent Service can assess mission-thread integrity under DDIL conditions and reconstruct decisions?

Not all requested provenance information is currently available through FANTOM. The Government indicated that additional SDK capabilities could be developed to expose the necessary information. Industry may propose an approach identifying required data elements and interfaces, with potential collaboration to address identified gaps. Specific implementation commitments were not established.

63. If a vendor develops a capability using Government funding, who retains the intellectual property rights, and can the vendor subsequently license the capability to the Government?

The stipend is intended to support integration of existing capabilities rather than development of new intellectual property. Vendors retain ownership of independently developed commercial intellectual property. If the Government elects to use such a capability beyond the assessment, a licensing arrangement may be negotiated. Technologies previously developed under Government contracts may involve Government purpose rights and will require case-by-case review.

64. Can the Government describe the existing FANTOM autonomy stack, including available services, onboard versus offboard execution, and SDK interfaces for vendor Behaviors, Planners, and Services?

FANTOM is a modular, platform-agnostic mission-autonomy architecture designed for execution on edge platforms. Its services include mission management, vehicle management, communications, environment and world-state management, perception, and platform-specific adapters. Behaviors provide lower-level mission execution, while Playbooks coordinate their use to achieve operator-defined objectives. Services communicate using DDS publish/subscribe messaging and defined interfaces. Behaviors may use path-planning services, control vehicle guidance and sensors, and access platform and swarm-state information. Vendor extensions are integrated as containerized components through the SDK. Additional architectural and interface details will be provided through the supporting SDK documentation.

65. Which test ranges are used for FANTOM testing? Are Test Resource Management Center (TRMC) resources used, and if so, which resources?

The Government conducts testing at multiple ranges throughout the United States. Future testing is expected to include more capable range environments supporting multiple aircraft and operations above the limitations normally associated with Part 107 operations. Specific test ranges and any TRMC resources were not identified.

66. Does the Radio Adapter Service expose dynamic link-budget information and telemetry, including LPI/LPD state, packet loss, and bit-error rate, through DDS IDL interfaces so Behaviors can throttle FMV or switch to covert peer-to-peer communications during contested electronic warfare?

FANTOM uses DDS messaging for service communication and supports inter-vehicle communications. The Government indicated that radio control and related electronic-warfare capabilities have not been a primary focus of current development but may become relevant to future Behaviors. The availability of the specified radio telemetry, associated DDS interfaces, and automatic communications-control functions was not confirmed.

67. Does USSOCOM's existing DevSecOps process include software integration testing, emulation, and hardware/software integration testing using laboratory or bench hardware?

The planned DevSecOps process includes software-level functional and integration testing using appropriate test tools. Capabilities that successfully complete software testing would progress to laboratory or bench testing, followed by flight testing when appropriate. The DevSecOps pipeline has recently been established, and transition

of the FANTOM development process into that pipeline is planned. Full pipeline integration is not required for the current assessment.

68. Can Playbook triggers enforce RF emission control by commanding Radio Adapters to switch to covert waveforms without disrupting distributed swarm consensus?

Radio control and emission-control functions are not currently a primary development focus. The Government recognizes their potential operational importance and expressed interest in proposals involving emission-control Behaviors. The required radio interfaces and technical capabilities remain under consideration. The specific ability to change waveforms through Playbook triggers while preserving distributed consensus was not confirmed.

70. When RF jamming reduces inter-vehicle communications to hundreds of bits per second, can FANTOM maintain distributed consensus through low-overhead waveforms, or must Behaviors transition to degraded local execution?

FANTOM is designed to minimize inter-vehicle communications overhead and continue operating when connectivity degrades. Behaviors may transition from collaborative operation to independent local execution when insufficient information is available to maintain coordination. Opportunities exist to improve adaptive bandwidth utilization. Specific data-rate thresholds and the conditions determining when distributed collaboration must transition to local execution were not established.

72. Will the Phase 3 Assessment Event simulation environment support hardware-in-the-loop integration for benchmarking third-party LPI/LPD software-defined radios and Radio Adapter Services against contested electronic-warfare profiles?

The Government's current laboratory environment cannot simulate all operational conditions. Radio Adapter Services and electronic-warfare capabilities are considered potentially valuable, but they are not the immediate focus of this assessment. Additional work in this area may be considered during future development. Specific hardware-in-the-loop test capabilities and contested electronic-warfare benchmark requirements were not confirmed.

73. Who is expected to use FANTOM Core, given adoption of A-GRA by portions of the USAF, Navy, Marine Corps, and international partners? What is the business rationale for industry investment in FANTOM integration?

FANTOM is being developed to support the A2E program's autonomy requirements, particularly for Group 2 and Group 3 unmanned aircraft. A-GRA was evaluated but was not selected as FANTOM's internal architecture because of its complexity and suitability considerations for smaller UAS platforms. The Government distinguished FANTOM's mission focus from architectures commonly associated with larger aircraft. Data interoperability with A-GRA systems is supported at the A2E system level. Specific long-term customer adoption and procurement projections were not provided.

74. Does the Government prefer a vendor offering weather, routing, and target-custody capabilities as interconnected Services using a shared model, or separate point solutions?

FANTOM's architecture supports modular, reusable Behaviors and Services. The Government prefers capabilities that can be integrated independently into the existing autonomy framework without requiring an entire external autonomy stack. A specific preference between a shared multi-service solution and separate point solutions was not established.

75. Are unmanned maritime vehicles, including unmanned surface and subsurface vehicles, within the scope of the FANTOM program?

FANTOM is currently focused on airborne unmanned systems supporting A2E mission requirements. Although the architecture could potentially be adapted for unmanned surface or subsurface vehicles, no current requirement or Government demand has been identified for those applications. Future expansion into maritime environments may be considered if an appropriate requirement emerges.

76. For independent autonomous Behavior assurance, which outcomes should be measured: mission-objective completion, ISR effectiveness, target custody, swarm coordination, constraint compliance, or resilience under DDIL conditions?

The Government recognized resilience under degraded or denied communications as an important consideration for applicable Behaviors. Existing assurance methods emphasize laboratory functional testing and flight testing under representative operational conditions. The Government did not establish a definitive set of assurance metrics or a priority ranking among the proposed performance outcomes.

77. What is the preferred submission channel and point of contact for an independent behavior-assurance technical paper? Would A2E welcome a proposal for read-only, evidence-driven assessment using FANTOM DDS interfaces?

The Government encouraged submission of a white paper describing an independent behavior-assurance capability. Read-only approaches may be considered, but the Government requested further explanation of their operational value and intended function. General event submission information is provided through SOFWERX. A specific technical point of contact and confirmation of the proposed read-only DDS assurance approach were not established.

78. Is the Government interested in using natural-language inputs through the user interface to communicate human intent and control desired Behaviors?

Natural-language interaction has been discussed as a possible future capability, but it is not a current FANTOM development priority. The Government indicated that natural-language interfaces may become more relevant as the technology matures, potentially within a multiyear development timeframe.

79. What is the anticipated stipend amount?

Integration stipends may be up to $250,000 per selected vendor, depending on the proposed capability and required integration effort. The funding is intended to support integration of existing technology into FANTOM rather than development of new capabilities from the ground up.

80. Should a Planner optimize routing and timing together, such as meeting a time-on-target requirement while minimizing energy consumption?

FANTOM supports reusable path-planning services and includes interest in energy-related Behaviors. The Government did not specify whether routing, time-on-target constraints, and energy consumption must be optimized jointly or separately.

81. Is FANTOM Core planned for USSOCOM Group 3 or larger aircraft, or is it intended only for Group 1 small UAS?

FANTOM is currently focused on Group 2 and Group 3 unmanned aircraft. Group 1 platforms are not the present priority because of processing, size, weight, and power limitations, as well as current operational requirements. Expansion to other platform categories may be considered in the future.

83. The Government indicated that a stipend would support integration. What is the anticipated amount or range?

The Government indicated that integration stipends may be up to $250,000 per selected vendor. Actual funding amounts will depend on the proposed Behavior, its complexity, and the integration effort required. The stipend is intended for integration of existing capabilities rather than new technology development.

84. Is the referenced $250,000 stipend the total funding available across all vendors and capabilities, or may each selected vendor receive up to that amount?

The $250,000 figure is not the total amount available across all vendors. Stipends may be provided on a per-vendor basis, with the amount determined by the specific capability and required integration effort.

85. How are missions modeled, encoded, and expressed within FANTOM?

Missions are expressed through operator-defined objectives and configurable Playbooks. A Playbook consists of plays, roles, Behaviors, and event-driven triggers that define how mission objectives are achieved. Playbooks are configuration files rather than source code and may be modified for different missions. Mission-management services select appropriate plays, while Behaviors execute the required control and planning functions on edge platforms.

87. Does FANTOM currently include a Service that enforces Play constraints during runtime, including communications outages? Would a standalone Constraint or Assurance Service be considered for this assessment?

FANTOM maintains information concerning vehicle capabilities and operating constraints, and the Government expressed interest in technologies that independently monitor or assess autonomous Behavior performance. Industry was encouraged to submit proposals describing such capabilities. The existence of a dedicated runtime Play-constraint enforcement Service and the eligibility of a standalone Constraint or Assurance Service were not confirmed.

88. For Track Custody, should a proposed Behavior output vehicle waypoints and sensor commands, or only vehicle-to-target assignments that existing FANTOM Planners convert into flight paths?

FANTOM Behaviors can generate vehicle guidance and control sensor and payload functions. Behaviors may also use separate path-planning services, allowing planning capabilities to be reused across multiple Behaviors. The Government did not establish a specific required division between vehicle-to-target assignment, waypoint generation, and sensor-command generation for Track Custody submissions.

89. Does FANTOM expose link quality, message age, and neighboring vehicle-state freshness to Behaviors so they can determine when to remain collaborative or transition to local execution?

FANTOM is designed to maintain autonomous operation during communications degradation and supports access to relevant vehicle and peer-state information. The Government acknowledged the need to determine when sufficient information is available to preserve collaborative execution versus transitioning to independent local Behaviors. The availability of the specific link-quality, message-age, and neighbor-state freshness fields was not confirmed.