

Addendum 3: Radar Sensor Provider

12.4 Data Products

A. Data Products

1. (Threshold) Provider shall utilize Company services to develop Radar tracking products capable of delivering coverage in support of JCO nominated satellites. These products must support high-fidelity, real-time monitoring to ensure precise tracking and situational awareness. Proposal submissions should detail the service capabilities, specifically addressing the required quantity, quality, and applicable orbital regimes.
2. The JCO created the JCO Data Requirements document that **must** be adhered to in support of population of data to the UDL in support of JCO mission operations. Vendors can access the document at:
https://docs.google.com/document/d/1WoZlMrf1YHQFV8Gehnw1aQxsFaa3V3lBW7_tkK4LT4E/edit?usp=sharing
3. (Threshold) The JCO will provide an unclassified 'High-Rate Revisit' (HRR) list to the UDL, made available to the providers via the UDL notification message. The providers should price bids for objects in Near-Earth (NE) (defined as a period of less than 225 min), Deep Space (DS) (period greater than 225 min) and super-Geosynchronous Earth Orbit (XGEO) (including cis-lunar) orbits or launches, as supportable by their analytical tools. The JCO Command and Control (C2) operations centers may modify the HRR list at any time and the Provider will have a 10 minutes during duty hours to adjust the focus of its processing outputs.

When responding to the JCO Radar Provider PWS, vendors are asked to:

- Describe the cost of each package as a function of the Service License Agreement (SLA) distribution options if multiple service levels are offered.
- Include details regarding sensor surveillance architecture proposed including processing delays for metric data delivery from sensor to UDL and, as applicable, product delivery to the UDL, estimated accuracy as a function of noise+bias (range, doppler, millisecond timing), and as applicable, covariance and orbit determination accuracy.
- Provide a quote for collection and/or processing of "catalog" by orbit regime, as well as other purchasing variations for additional capabilities, specifically near-earth (period less than 225 min), deep space, XGEO/cislunar separately. Include any cost increase or decrease for rates for catalog maintenance or other variations in separate bids.
- Include a list of all that will be utilized to support JCO-related tasks.

The table (starting on page 2) outlines Provider requirements related to data, tasks and products for JCO sensor provider operational support. Responses to this PWS may be provided in the "Provider Response" column in this table for each requirement:

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Table 1: JCO Radar Sensor Provider Requirements

Para. / Task Name	Threshold (text)	Objective (text)	Provider Response
a. Data Delivery Timelines	<p>For 90th percentile of observations delivery metric data from sensor to UDL in 30 minutes or less.</p> <p>May be waived if sensor provides support for a critical JCO mission gap.</p>	For 95th percentile of observations delivers metric data from sensor to UDL in 5 minutes or less.	
b. UDL Data Delivery	<p>Fulfill data requirements outlined in UDL Schema Requirements by adhering to JCO requirements and data formats.</p> <p>Reference the link in this document to the JCO Data requirements.</p> <p>Populate the UDL sensor schema for each sensor, with WGS-84 latitude, longitude, and height above the ellipsoid, measured from the computational center of the sensor and should be accurate to less than 1 meter</p> <p>Populate Radar Cross Section (with uncertainty information)</p> <p>Report sensor updates to the UDL team within 3 days, with DOK and all data curation teams in copy, and initiate UDL sensor card updates within 3 days of change.</p> <p>Provider data must be delivered to the Global Data Marketplace (GDM) endpoint associated with the JCO data purchase.</p>	<i>Same as threshold</i>	
c. HRR Tasking	<p>Receive/ingest the HRR UDL notification message to update sensor tasking to your network.</p> <p>During normal (sensor operator duty hours) duty hours, update HRR tasking to sensor network within 10 minutes of HRR update via the UDL notification schema.</p> <p>During off-duty hours update within 2 hours of the next shift start time.</p>	Same as threshold but receive and process the HRR list via UDL notification messaging autonomously and update tasking across sensor network within 10 minutes of receipt. This applies to 24/7 HRR updates.	

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<p>d. Sensor Accuracy</p>	<p>Maintain accuracy outlined below: Range Residuals: 40 meters Range Rate Residuals: 5 m/s Doppler Residuals: 5 m/s Timing Sigma: .004 seconds Angles Sigma: 360 arcseconds</p>	<p>Same as threshold, except for Range Residuals: 30 meters</p>	
<p>e. Calibration Tasking Fulfillment</p>	<p>Access the JCO sensor calibration list can be found in the JCO onorbit list provided to UDL by curation providers under JCO user access.</p> <p>The following requirement must be met for each sensor provider for 50% of their sensor network nightly:</p> <ul style="list-style-type: none"> a. The Provider shall choose satellites that are included in the "JCO Current Calibration Satellites List" referenced above. Each sensor in the Provider's architecture that contributes to the JCO will be required to pass curation standards within a business week. b. The provider must work with Bluestaq, in a timely manner, to ensure that all sensors providing observations are correctly defined within the UDL sensor schema. c. Current curation standards for optical systems are: <ul style="list-style-type: none"> i. For each day, that a sensor is actively providing data to the JCO, it must: ii. Provide at least 4 tracks, with 25 observations each, of MEO GNSS satellites. For short tracks (less than 25 observations), the sensor must provide additional tracks such that at least 100 observations are obtained per day. iii. If the sensor is limited to LEO, then: provide at least 4 tracks, with 25 observations each, of LEO calibration satellites. For short tracks (less than 25 	<p>Same as threshold but the requirement must be met for 100% of the provider sensor network</p>	

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	<p>observations), the sensor must provide additional tracks such that at least 100 observations are obtained per day.</p> <p>iv. In case the sensor cannot provide LEO or MEO observations, then; provide at least 6 tracks, with 25 observations each, of GEO calibration satellites. These must be distributed between 3 different calibration satellites to minimize the impact of satellite maneuvers. For short tracks (less than 25 observations), the sensor must provide additional tracks such that at least 150 observations are obtained per day.</p> <p>v. Collection passes shall be conducted with a minimum of one-hour gap between each.</p>		
<p>f. Sensor List to Data Curation Teams</p>	<p>Each provider must provide JCO data curation teams with a list of JCO contracted sensors each month; this list must include any sensor supporting JCO operations.</p>	<p><i>Same as Threshold</i></p>	
<p>g. Revisit Rate Requirements</p>	<p>Collect against JCO HRR objects, prioritizing by rank (rank 0 being the highest priority, 5 being the lowest).</p> <p>HRR ranks for GEO objects are outlined below:</p> <p>Rank 0: Stare at the object for requested period (no more than 4 objects at one time)</p> <p>Rank 1: 15-minute revisit rate</p> <p>Rank 2: 45-minute revisit Rate</p> <p>Rank 3: 2-nour revisit rate</p> <p>Rank 4: 2 collects / 24 hour period with 12 hour gaps</p> <p>Rank 5: 1 collect / 24 hour period</p> <p>LEO HRR requirements; Collect ranks 1-3 at every available pass.</p>	<p>Same as threshold but coverage gaps are:</p> <p>Rank 2: maximum of 20 minutes</p>	

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	<p>Collect rank 4 four times per day and rank 5 twice per day based on visibility from sensors to object.</p> <p>Maximum gap times for Rank 4 is 12 hours outside of solar exclusion</p> <p>Maximum gap times for Rank 3 is 4 hours outside of solar exclusion</p> <p>Maximum gap times for Rank 2 is 45 minutes outside of solar exclusion</p> <p>Maximum gap times for Rank 1 is 15 minutes, with the ability to stare outside of solar exclusion.</p>		
<p>h. Sensor out of limits reporting and correction</p>	<p>Perform internal analysis and periodic maintenance to ensure sensors maintain accuracy requirements.</p> <p>Monitor curation communication in JCO chatrooms for updates and coordination.</p> <p>Should the sensor provider be notified by JCO C2, a JCO fusion provider, or a curation provider that the sensor is performing poorly based on the accuracy requirements outlined, take the following action:</p> <ol style="list-style-type: none"> 1. Trouble shoot the sensor and remedy within 4 hours of notifications 2. Remove the sensor from JCO operations and conduct recovery actions within 2 hours of fault identification. 3. Notify JCO C2 of the fault, recovery action, and timeline 4. Coordinate with JCO C2 and the curation providers to verify accuracy of sensor prior to introducing data into JCO operations. 	<p><i>Same as Threshold</i></p>	

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<p>i. UCT Collection and Delivery</p>	<p>Utilize sensor network to collect SDA data on Uncorrelated Track (UCT) objects.</p> <p>Identify the UCT in the UDL radar schema by flagging the UCT to “true.” Observations and candidate satellites may be considered a UCT under the following both conditions:</p> <p>Observations that do not correlate to something in the 18 SDS public catalog at time of collect when tasked on a nominated satellite.</p>	<p>Same as threshold, but report UCT objects in orbit near nominated HRR satellites, prioritizing any that may be consistent with a potential threat and report these objects via chat to the JCO C2 team.</p>	
<p>j. Dynamic Tasking</p>	<p>Support dynamic tasking via JCO chat or JCO operational channel (voice) during vendor support duty hours.</p> <p>Tasking updates must be processed within 1 hour of tasking.</p> <p>Tasking must scheduled and either be awaiting visibility, priority or be complete within this 1-hour timeframe.</p>	<p>Support dynamic tasking 24/7 from JCO UDL collectrequests available in the UDL.</p> <p>These sensor requests are either direct to a sensor or incorporated into the sensor entity tasking/scheduling solution for immediate execution.</p> <p>This tasking focuses on high priority JCO needs and must be executed within 20 minutes of JCO request (depending on visibility of sensor to tasked object).</p>	
<p>k. Tasking Response</p>	<p>Respond to JCO dynamic tasking via JCO chat or JCO operational channel (voice) during vendor support daily hours.</p> <p>Respond that tasking will be fulfilled along with an expected timeline for fulfillment.</p> <p>Response must be made within 30 minutes of JCO operator request.</p>	<p>Support both dynamic and HRR tasking responses via the UDL collectresponse schema.</p> <p>Reply using the UDL schema with relevant information for the JCO to understand when the tasking may be fulfilled.</p> <p>For HRR Tasking, reply with tasking messages (collectresponse) forecasting the HRR execution for each object based on pending sensor availability, weather, tasking priority, and sensor visibility.</p> <p>HRR tasking responses must be provided withing 4 hours of HRR</p>	

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		<p>tasking updates during vendor duty hours, or by noon the following duty day outside of vendor duty hours.</p> <p>For dynamic tasking, the task response must occur within 10 minutes of task request via the UDL collectrequest and collectresponse schemas.</p>	
l. l. Sensitivity	<i>Not Applicable</i>	<p>The below applies during nighttime collection:</p> <p>GEO sensitivity for HRR list objects will enable custody of deep space satellites down to 1 m size, 50 cm encouraged.</p> <p>LEO sensitivity for HRR list objects will enable revisit down to 20 cm in size, 10 cm encouraged.</p> <p>Resolution must support at least 10 km separation between a 1 m and 10 m pair of objects at GEO.</p> <p>Resolution must support at least 10 km separation between sub 1 m objects at LEO.</p>	
Sensor Outage Reporting	<p>Notify JCO C2 (via ops channel or chat) if HRR collection may not be maintained as planned, or if a dynamic task will not be executed due to weather or another sensor outage within 1 hour prior to revisit violation or task execution, or immediately upon noticing impact.</p>	<p>Currently unavailable, but in the future the below may be implemented:</p> <p>Provide M2M messages via UDL to report sensor outages due to weather or any other purpose. This data will inform the JCO team of sensor availability across the network at any given time. Updates must be provided hourly.</p>	

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<p>m. Correlation Requirements</p>	<p>If correlation is supported, follow the JCO observation correlation process outlines here</p> <p>This process ensures that correlation is attempted and makes use of the JCO Correlation message (not developed at this time).</p>	<p><i>Same as threshold</i></p>	
<p>n. State Creation and Delivery</p>	<p>Maintain internal state database (or catalog) and update state information as new metric observations are provided.</p> <p>Fuse metric data (RF, EO, Radar) to update object states, prioritizing JCO HRR objects.</p> <p>Post state update cadence (posting state vectors and TLEs to UDL) for HRR objects to UDL upon state update generation, driven by new metric information to for a state update.</p> <p>State updates must occur automatically in the fusion system and also have the capability to support manual intervention through residual plots for manual differential corrections.</p> <p>Both State Vectors and TLEs must be generated.</p> <p>Deliver state updates to UDL must adhere to the UDL statevector and elset schemas defined in the UDL, and include sigma values.</p> <p>Post state update information as requested by JCO C2 to JCO mission systems (MMB and/or chat).</p> <p>Elsets must meet AstroStandards compatibility requirements, to include the below:</p> <ul style="list-style-type: none"> • Mean elements with Kozai mean motion and ephemType set to 0 	<p><i>Same as threshold, and additionally generate ephem Type 4 SGP4-XP TLEs</i></p>	

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	<ul style="list-style-type: none"> • epehmType2 with Brower mean motion is acceptable as well • Coordinate frame is TEME of Date (or TEME of Epoch) • If converting from SP vectors, do not use single point conversions from a state vector to a TLE, instead propagate the vector and fit the TLE over a larger percentage of the orbit 		
<p>o. Maneuver Alerting</p>	<p><i>Not Applicable</i></p>	<p>Deliver maneuver alerts to the UDL and as appropriate (HRR ranks 0-2) report maneuvers in JCO chat rooms.</p> <p>Maneuver Alerting is defined as the initial identification and alerting of a satellite maneuver and should be identified through residuals rather than waiting for a state update.</p> <p>This alert should be sent as quickly as possible to JCO chat or voice, or M2M to a JCO COP, while minimizing false alarms.</p> <ul style="list-style-type: none"> • Ideally, maneuver alerts drive geographical and phenomonology diverse sensor tasking to drive towards fast maneuver recovery (post maneuver state generation). 	

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<p>p. r. Launch Tasking and Collection</p>	<p>Support launch tasking by receiving nominal states prior to launch and posturing for the launch event, AND by receiving updates during the launch and orbit-raising to dynamically task in order to support collection.</p> <p>Tasking and data delivery timelines outlined must be maintained.</p>	<p>In addition to threshold requirements, execute search volumes to acquire launched objects to support launch, orbit raising and orbit insertion collection.</p>	
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B. Orbital Analytics Support

1. (Threshold) Provider shall provide an expert system analyst to utilize its analytical services to process purchased SDA data in support of orbital analytics, feature analytics, and visualization functions across operations. Expert system analyst support must be forward-leaning and proactively support JCO throughout mission execution. This includes but is not limited to the following support:
 - a. (Threshold) Analyst will continuously monitor the JCO Mission Systems (MMB and chat) and/or JCO video conferences throughout normal hours of operation.
 - i. (Threshold) JCO-Americas operating time is Monday-Friday, 1430Z 0730 to 2230Z, with 30 min required for changeover receipt on the front end of the time period.
 - ii. (Threshold) Analyst will be available to support another JCO Global site (Pacific and/or Meridian) for 8.5 hours (operations period and changeovers). JCO-Pacific operating time is 2300Z to 0700Z and JCO-Meridian operating time is 0700Z-1500Z in the Nov 2023 period of performance, with 30 min required for changeover receipt on the front end of the time periods.
 - b. (Threshold) When Analyst receives a request for information from the Chat or Voice reporting from JCO leads, they shall A) acknowledge receipt of the request in the corresponding Chat Thread within 30-minutes of transmit of

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- the tasker, B) shall briefly describe their anticipated course-of-action (COA) with timelines.
- c. (Threshold) When Analyst receives a request for information from the Chat or Voice reporting from JCO C2 leads, they shall A) acknowledge receipt of the request in the corresponding Chat Thread within 15-minutes of transmit of the tasker, B) shall briefly describe their anticipated course-of-action (COA) with timelines.
 - d. (Threshold) During crew support hours, the orbital analysis support must include interpreting metric (position, velocity data). Orbital analytics tools will be capable of orbit determination as well as initial orbit determination with no initial seed state.
 - e. (Threshold) Orbital analyst supporting each crew shall provide feature analysis support, including interpreting imagery, signals, and behavioral analytics.
 - f. (Threshold) Orbital analyst supporting each crew shall provide graphical / visualization support.
 - g. (Threshold) Provide sensor tasking support in NRT during SME/crew-support periods on objects of interest, including UCTs, close approach objects, new HRR objects, launches, searches, or other events.
 - h. (Threshold) The Provider shall support the following SSA Data analyses in near-real time on nominated satellites using data sources that may not originate from the analytical Provider.
 - i. (Threshold) Radar messages with uncertainty information
 - ii. (Objective) ManueverDetection in UDL
 - iii. (Objective) Conjunction messages in UDL
 - iv. (Objective) StateUpdate messages in UDL (with covariance information)
 - v. (Objective) ELSET (Two Line Element (TLE)) messages in UDL
 - vi. (Threshold) Radar Cross Section (with uncertainty information)
 - vii. (Threshold) Provider sensors (locations of contributing sensors); sensor schema in UDL
 - viii. (Threshold) Sensor status (e.g., sensor OPSCAP)
 - ix. (Threshold) Tasking status
 - x. (Objective) Other data types as applicable to the Protect & Defend mission
 - i. (Threshold) Provider shall maintain separation in data sets in accordance with data rights across various user groups (e.g., UK user group may have access to different data sets from US user group). Additional time and materials may be priced to establish separate network enclave(s), as required.
 - j. (Objective) Provider shall enable network access to analytical processing enclaves on US servers from global outstations with minimal delay

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- k. (Objective) Provider shall maintain separation in data sets in accordance with data rights across various user groups (e.g., UK user group may have access to different data sets from US user group). Additional time and materials may be priced to establish separate network enclave(s), as required.
 - l. (Threshold) Initial tool familiarization training shall be provided for all govt users, though Govt Current Operations leads are battle management / Current Ops personnel focused on prioritization, Space Domain Awareness (SDA) resource allocation, threat and space flight safety event comprehension and implications, and reporting; and not expected to be power users of IODET capabilities, as that role is executed by commercial SMEs in operations. However, govt leads should be capable of understanding all products from tools that may be reported up / out and their application and implications on space activities.
 - m. (Objective) Advanced / Power user training for full use of all capabilities of tools, including manual piece separation, manual orbit determination, dynamic trajectory update through forced motion circumnavigation, etc. It is understood that several of these functions may be automated/in-the-background during nominal operations, but advanced / SME users are expected to be able to pull the system out of automated processing for manual override and review of complex scenarios, as needed.
2. (Threshold) All data – including processed products - will be published to the UDL data repository or JCO defined interfaces.
- a. (Threshold) Data submission in compliance with UDL formats
 - b. (Threshold) Providers shall begin working to submit products machine-to-machine using methods defined by JCO Dragon Army as available to be made available in the JCO Mission Management Board (MMB). If posting directly to MMB is unavailable, Providers should use Chat as tertiary backup.
 - c. (Threshold) Provider shall reach out to the Air Force Research Lab Dragon Army Integration Team to work a single sign on (SSO) log in to the MMB, if one is not already activated, within 24 hours of proposal acceptance.
 - d. (Threshold) – In event that a processing system is to be offline, the provider will send notifications 2 weeks in advance, or within 2 hours for unexpected outages which will result in an extended outage to JCO Site Lead and program management office.
 - e. (Objective) Provide UDL status messages to convey planned and unplanned outages, ETROs and system health messages

C. Deliverables

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Description	Frequency
Space Surveillance Data – Steady-State Monitoring	NRT through PoP
Space Surveillance Data – UCTs	NRT through PoP
Space Operations Analyst Support – 1 FTE	8.5-hour shifts/5 days per week
Advance Sensor Change/Removal Notification	2 weeks prior to anticipated change
Monthly status reports (MSR) emailed to designated JCO Global Coordinator, Program Management Office, and JCO Ops Integration	Monthly, by the 10th of each month
Processing Issue, Outage Notification	Within 24 hours of Occurrence