Exploration Announcement

10-Year Lunar Architecture (LunA-10) Capability Study

STRATEGIC TECHNOLOGY OFFICE

DARPA-EA-23-02

August 15, 2023

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EXPLORATION ANNOUNCEMENT OVERVIEW INFORMATION

- **Federal Agency Name** – Defense Advanced Research Projects Agency (DARPA), Strategic Technology Office (STO)
- **Funding Opportunity Title** – 10-Year Lunar Architecture (LunA-10) Capability Study
- **Announcement Type** – Exploration Announcement (EA) Master Solicitation & Topic Area 1 (TA-1)
- **Funding Opportunity Number** – DARPA-EA-23-02
- **Dates (All times are Eastern Time)**
  - Posting Date: August 15, 2023
    - TA-1 Questions Due Date: August 22, 2023
    - TA-1 Abstracts Due Date: September 6, 2023, by 4:00 PM
    - TA-1 White Paper and Technical Presentation Due Date: September 25, 2023, by 4:00 PM
    - TA-1 Anticipated announcement of Selectees: October 10-12, 2023, Pittsburgh, PA, in association with the Lunar Surface Innovation Consortium Fall Meeting.
  - Closing Date: August 14, 2024
- **Purpose:** This represents the master solicitation for the LunA-10 Exploration Announcement (EA); and solicitation for the first EA Topic Area (TA), TA-1. The Defense Advanced Research Projects Agency (DARPA) will release EA Topic Areas against this master solicitation, and will only accept proposals under each TA. No proposals will be accepted against this master solicitation; all proposals submitted in response to this solicitation will be in response to the embedded TA-1, not the master solicitation. Funding decisions are reserved at each TA level.
- **Concise description of the master solicitation funding opportunity:** The LunA-10 program will rapidly solicit innovative and revolutionary approaches to design integrated, multi-service commercial nodes for mass-efficient lunar infrastructure supported by analytical frameworks intended for future use by the United States and all nations with a declared commitment to the peaceful use of the Moon per the Artemis Accords.
- **Multiple awards are anticipated**.
- **Types of instruments that may be awarded** – Research Other Transactions (OT) under the authority of 10 U.S.C. § 4021
- **Agency Contact**
  - Technical Point of Contact: Dr. Michael Nayak (Program Manager)
    - LunA10@darpa.mil
  - Security Point of Contact: Mr. Mark Bryant (Program Security Representative (PSR))
    - mark.bryant.ctr@darpa.mil
    - Phone: 571-218-4448

- ATTACHMENT A: TA-1 Research Other Transactions Authority Agreement.
- ATTACHMENT B: TA-1 Budgeting spreadsheet
- ATTACHMENT C: TA-1 Other Transactions Certifications

EXPLORATION ANNOUNCEMENT
Defense Advanced Research Projects Agency (DARPA)
10-Year Lunar Architecture Capability Study
(LunA-10)

1. MASTER SOLICITATION Program Information

1.1. Background and Vision

It is the year 2035, and a thriving lunar economy exists on the Moon. How did we get there?

DARPA supports a future model where the National Aeronautics and Space Administration (NASA), international governments, and commercial industry can rapidly scale up lunar exploration and commerce, enabled and supported by the deployment of an efficiently combined, integrated lunar infrastructure framework. An integrated framework would upend the current technical paradigm, whereby each lunar lander or activity must organically support all required resources such as survival power, communications, and data storage.

The 10-Year Lunar Architecture (LunA-10) program aims to study the rapid development of non-terrestrial technology concepts designed to move away from individual scientific efforts within isolated, self-sufficient systems and toward a series of shareable, scalable, resource-driven systems that can operate jointly, creating monetizable services for future lunar users in a mass-efficient manner.

DARPA has a rich history of technological innovation leading to invaluable civil applications such as the Internet, miniaturizing Global Positioning Systems (GPS) receivers for everyday use, and mRNA vaccines. DARPA now seeks to galvanize the setup of a future civil lunar framework through the early development and system-level design of integrated pathfinder infrastructure to catalyze widespread activity on and around the Moon over the next ten years (2025-2035), as well as out to 2050.

To achieve this, DARPA sees overlap potential in multiple areas under current exploration. For example, an independent market analysis of the future lunar economy[1] posits specific key sectors that must be developed into services to sustain a long-term presence on the Moon:

1) Construction;
2) Mining;
3) Transit (referred to herein as Mobility);
4) Energy;
5) Agriculture;
6) Medicine;
7) Robotics;
8) Life sustainment;
9) Experiments (defined herein as lunar/planetary science);
10) Communications;
11) Digital infrastructure for modern lunar computing[2] and;
12) Position, Navigation, and Timing[2] (PNT).

[1] "Lunar Market Assessment: Market Trends and Challenges in the development of a Lunar Economy". Scatteia and Perrot, PriceWaterhouseCoopers (PWC), 2021.
[2] Not included in the PWC analysis, but possibly of importance to the long-term lunar economy.

Note that this is not an exhaustive list, and not all sectors listed above can be categorized as infrastructure, which is the focus of LunA-10 (see Section 6.2). However, they present a way to frame the problem: many services are needed to field a commercial-owned and operated lunar infrastructure, and an underlying common framework that emphasizes integrated models of economic activity may be the "rising tide" that lifts all lunar vessels. Note, due to mass constraints associated with lunar launch and landing, mass efficiency should be a primary factor considered in all prospective designs.

LunA-10 aims to facilitate the fusing and co-optimization of as many infrastructure sectors as possible onto standard payloads that can be delivered to the lunar surface and, in the future, scale up to the size of ubiquitous infrastructure for the Moon. As one example (of many possible combinations): Energy; Position, Navigation, and Timing (PNT); and communications needs may be combined via a single infrastructural laser system designed to provide optical power beaming, laser communications (lasercom), and PNTOC[3]. On the other hand, challenges include heat rejection for dense multi-service systems or system mass per kilowatt transmitted, while accommodating pointing and tracking for lasercom and waveform generation equipment for PNTOC.

LunA-10 aims to create quantitative joint multi-service system design(s) created by credible teams of engineers actively working on near-term commercial lunar investments. To enable such designs, key factors remain unclear:

- The dependence of both performance and persistence (defined as the ability to survive while providing a service at a high duty cycle) on the particulars of the lunar environment, such as radiation, latent lighting at the poles, electrostatically charged dust, etc. For example, an energy-sharing solution that relies on near-constant sunlight from Permanently Lit Regions at the lunar poles would not be a persistent solution at the lunar equator.
- The magnitude, quality, and configuration required to create a critical mass, such that the service becomes self-sustaining and commercially viable;
- The appropriate metrics for quantifying progress towards critical new capabilities and what specifically constitutes a breakthrough in paradigm;
- Where a technical solution has been posed, the logistical tail and associated funding that would enable its widespread fielding, beginning with mass/cost to launch from Earth.
    - This is especially problematic where the user base is unclear (for example, lunar PNT) or dependent on a density of lunar activity that may not exist for several years.
- Conditions limiting lifetime and duty cycle, testing to validate key unknowns and assumptions, and likely failure mechanisms.

Regular technical exchanges between all performers and the Government Integration Team (Section 6.4) are required to integrate multiple mission sets and create lunar infrastructure concepts that can be delivered in as few surface units as possible. It is **not** expected that a performer's proprietary Intellectual Property (IP) will need to be shared with any other performer. However, Non-disclosure agreements (NDAs) may be required to facilitate and maximize information sharing between performers to achieve program goals. Proposers should acknowledge

[3] PNTOC: Position, Navigation and Timing (PNT) over Optical Communications.

in all proposals submitted their ability to sign Associated Contractor Agreements (ACA) or NDAs. The ultimate frameworks and integrated system designs will be Government owned, but every LunA-10 performer will have unlimited rights of use.

All developments in the LunA-10 initiative are grounded in and will support existing policies and directives related to lunar and cislunar exploration, research, commercial development, and protection, including the Outer Space Treaty, the Artemis Accords, the National Space Policy of the United States of America, Space Policy Directives, the U.S. Space Priorities Framework, and Department of Defense Directive 3100.10 Space Policy. This new model for operations in the lunar and cislunar environment is in support of the National Cislunar Science & Technology Strategy (2022)[4] and is envisioned to advance the responsible and safe use of the lunar/cislunar environment while complementing existing NASA and international partner (Artemis Accords[5]) lunar investments.

2. EA AUTHORITY

This EA may result in the award of a Research OT, which can include not only commercially-available technologies fueled by commercial or strategic investment, but also concept demonstrations, pilots, and agile development activities that can incrementally improve commercial technologies, existing Government-owned capabilities, and/or concepts for broad defense and/or public application(s). The Government reserves the right to award a Research OT under 10 U.S.C. § 4021 or make no award. In all cases, the Government agreements officer shall have sole discretion to negotiate all agreement terms and conditions with selected proposers. Cost sharing is not required, but is strongly encouraged.

3. ELIGIBILITY INFORMATION

3.1. Eligible Applicants

All responsible sources capable of satisfying the Government's needs may submit an Abstract that DARPA will consider.

3.1.1. International Participation

Participants must comply with any necessary non-disclosure agreements, security regulations, export control laws, and other governing statutes applicable under the circumstances.

3.1.2. Federally Funded Research and Development Centers (FFRDCs) and Government Entities

FFRDCs and Government Entities (e.g., Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations and may not be able to propose to this EA. DARPA invites FFRDCs and Government Entities with relevant experience to join the Government Integration Team; details will be released in a future Request for Information (RFI). Government Entities are encouraged to use LunA-10 insights to further internal investments and participate maximally; however, all participating government entities must be self-funded.

3.2. Organizational Conflicts of Interest

A contractor cannot simultaneously provide scientific, engineering, technical assistance (SETA),

[4] Specifically: (1) supporting R&D to enable long-term growth and (2) expanding international S&T cooperation.
[5] The *Artemis Accords* describes a shared vision for principles, grounded in the Outer Space Treaty, to create a safe and transparent environment which facilitates exploration, science, and commercial activities for all of humanity to enjoy. Details are available at https://www.nasa.gov/specials/artemis-accords/index.html.

advisory and assistance services (A&AS), or similar support and also be a technical performer.

If a prospective proposer believes a conflict of interest exists or may exist (whether organizational or otherwise) or has questions on what constitutes a conflict of interest, the proposer must send their contact information and a summary of the potential conflict via the specific e-mail address identified in this EA before time and effort are expended in preparing any submission documentation.

4. AWARDS

4.1. General Guidelines

Upon favorable review of the proposal and subject to the availability of funds, the Government may choose to award a Research OT for LunA-10 under each respective TA.

The Agreements Officer reserves the right to negotiate directly with the proposer on the terms and conditions prior to execution of the resulting OT agreement, including payment terms, and will execute the agreement on behalf of the Government. A copy of the draft OT agreement is attached to this EA for review (Attachment A). To speed up negotiations, proposers must include a signed OT at the time of the White Paper and a Technical Presentation submission, **with minimal changes from Attachment A**, to which they are willing to sign up immediately if chosen for award. Only a Government Agreements Officer has the authority to enter into or modify a binding agreement on behalf of the United States Government.

To receive an award:

a. Proposers must have a Unique Identity ID number and register in the System for Award Management (SAM). Proposers are advised to commence SAM registration as soon as possible.

b. Proposers must also register in the prescribed Government invoicing system (Wide Area Work Flow: https://wawf.eb.mil/xhtml/unauth/registration/notice.xhtml).

c. Proposers must be determined to be responsible by the Agreements Officer. They must not be suspended or debarred from an award by the Federal Government nor be prohibited by Presidential Executive Order and/or law from receiving an award. Proposers shall complete the attached Research OT Certifications (Attachment C) and submit at the time of White Paper and a Technical Presentation submission.

d. Being asked to negotiate an award does not guarantee that an proposer will receive an award. The Government reserves the right not to make an award.

4.2. Controlled Unclassified Information (CUI) and Controlled Technical Information (CTI) on Non-DoD Information Systems

A program-specific CUI Guide will be established and provided to successful proposers to help them determine CUI thresholds for information relevant to and technologies developed under the program. DARPA will review each successful proposal to determine the potential for the generation of CUI. Until that determination is made, all material generated under the LunA-10 program should be considered CUI and protected accordingly. No public presentations or publications are permitted except by express permission from the DARPA Program Manager and must be first submitted to DARPA to be cleared for public release.

Further information on Controlled Unclassified Information identification, marking, protection, and control, including processing on Non-DoD Information Systems, is incorporated herein and

can be found at http://www.darpa.mil/work-with-us-additional-baa. CTI is not anticipated for this program, but foreign proposers are encouraged to understand U.S. export law and have a plan to obtain export licenses if necessary. Possible methods include teaming with a U.S. prime and/or having a U.S. subsidiary/parent company. Upon selection for award, the program-specific CUI guide will be provided to the performer to observe and follow.

4.3. Representations and Certifications

All proposers must submit DARPA-specific representations and certifications for Research OT awards to be eligible to receive an OT award. See Attachment C.

4.4. Competition Sensitive Information

DARPA policy treats all submissions as competition sensitive and discloses their contents only for evaluation. Restrictive notices notwithstanding, during the evaluation process, support contractors may handle submissions for administrative purposes and/or to assist with technical evaluation. All DARPA support contractors performing this role are prohibited from conducting DARPA-sponsored technical research and are bound by appropriate non-disclosure agreements. DARPA may solicit input on technical aspects of the proposals from non-Government consultants/experts who are strictly bound by the applicable non-disclosure requirements.

4.5. Procurement Integrity Act (PIA)

All awards under this EA shall be treated as Federal Agency procurements for purposes of 41 U.S.C. Chapter 21. Accordingly, the EA competitive solicitation process and awards made thereof must adhere to the ethical standards required by the PIA.

5. EA DEFINITIONS

"Data" refers to recorded information, regardless of form or method of recording, which includes but is not limited to technical data, software, mask works, and trade secrets. The term does not include financial, administrative, cost, pricing, or management information and does not include inventions.

"Government Purpose" means any activity in which the United States Government is a party, including cooperative agreements with international or multi-national defense organizations or sales or transfers by the United States Government to foreign governments or international organizations. Government purposes do not include the rights to use, modify, reproduce, release, perform, display, or disclose technical data for commercial purposes or authorize others to do so.

"Government Purpose Rights" means the rights to use, duplicate, or disclose Data, in whole or in part and in any manner, for Government Purposes only and to have or permit others to do so for Government Purposes only.

"Limited Rights" means the rights to use, modify, reproduce, release, perform, display, or disclose Data, in whole or in part, within the Government, to include Government support contractors.

"Other Transaction" refers to the type of OT that may be awarded as a result of this EA. This type of OT is authorized by 10 U.S.C. § 4021 for Advanced Research projects directly relevant to pursuing development and application of dual-use technology.

"Restricted Rights" applies only to noncommercial computer software and means the Government's right to use, modify, reproduce, perform, display, release disclose or transfer computer software are restricted, except that the Government may use a computer program on a

limited number of computers and make the minimum number of copies of the computer software required for safekeeping (archive), backup, or modification purposes. The Government will not transfer the software outside of the Government or for any purpose other than the Goblin program, except that the Government may allow the use of the noncommercial computer software outside of the Government under a limited set of circumstances, including use by a covered Government support contractor in performance of its covered Government support contract (management and administrative support), and after the contractor or subcontractor asserting the restriction is notified in writing as far in advance as practicable that a release or disclosure to particular contractors or subcontractor is planned to be made.

"Small Business Concerns" is defined in the Small Business Act (15 U.S.C. § 632).

TOPIC AREA

6. LunA-10 TA-1 SOLICITATION

6.1. Program Description/Scope

LunA-10 TA-1 will help to enable the near-term maturation of lunar technologies and capabilities necessary for future architecture objectives. The study will result in the design of system-level solutions that (1) fuse multiple necessary lunar services and (2) deliver a quantitatively defendable analytical framework for future lunar infrastructure that (3) leverages technology overlap between potential services to the maximum extent possible.

More than one multi-service (integrated) system may be part of a framework, and more than one framework may be generated given different technical solutions.

For each integrated system solution, performers will create new benchmarks and metrics defining performance parameters directly tied to an aggregate "critical mass" that will likely result in a self-sustaining, monetizable, commercially owned-and-operated lunar infrastructure. Performers will create System Concept Review (SCR) level designs of each integrated system, identify key enabling technologies or necessary innovation in quantitative terms, and analyze cost, logistical and technological challenges facing the aggregate frameworks thus composed.

Input is sought from both lunar technology providers and lunar technology users. Solutions that are stand-alone or are not designed to integrate with other concepts or larger architectures are specifically excluded. Not all solutions need to be lunar surface-based; in fact, multiple sectors are expected to be better suited for orbital solutions. Both will be considered and analyzed under LunA-10 TA-1. However, terrestrial-based solutions are not of interest.

LunA-10 TA-1 targets a portfolio of lunar providers and users who will, together, define a series of future integrated lunar frameworks that take advantage of commercial development and non-governmental funding streams. Each integrated system design and framework will be backed by a quantitative analysis of needs, validated analysis for anticipated use case(s), concepts of operations, scaling analysis for foundational systems, and metrics for integrated system performance. Performers will identify current investments and future technical challenges toward achieving these goals.

Specifically, the LunA-10 TA-1 teams will:

1) Work in integrated teams defined within the program to design fused and integrated system-level solutions across multiple necessary lunar services. Ultimately deliver quantitatively defendable, integrated analytical frameworks for future lunar infrastructure that leverage technology overlaps between multiple commercial lunar services to the maximum extent possible.
2) Create new benchmarks and metrics defining performance parameters for each system solution, directly tied to an aggregate critical mass for a self-sustaining, monetizable, commercially owned-and-operated lunar infrastructure, with the "turning point" critical mass defined in unambiguous terms.
3) Analyze cost, logistical and technological challenges facing the integrated framework(s), and identify key enabling technologies or necessary innovation in quantitative terms.
4) Analyze the scaling of fundamental system nodes up to the infrastructure level.

5) Create a System Concept Review (SCR) level design of the integrated systems.

The envisioned lunar architecture is not intended to support human exploration or scientific experimentation that does not have commercial value. As the U.S. agency responsible for these areas, NASA has published clear roadmaps to achieve key goals by 2035. DARPA's LunA-10 TA-1 effort is instead focused on a complementary objective: to create off-Earth economic vibrancy through monetizable commercial services provided to a wide variety of users intending to operate on and around the Moon.

To achieve the technical goals of TA-1, LunA-10 will select companies that:

1) Have a clear vision and technically rigorous roadmap/business plan for providing or using one or more lunar services with known needs and interfaces,
2) Have a concept for integrated infrastructure that can be delivered to the Moon given the right investment profile, and can defend that concept with technical rigor and concrete metrics for system design and infrastructure performance specific to the lunar environment,
3) Can provide access to excellent multi-disciplinary engineers whose breadth of technical experience encompasses the anticipated technical challenges for a series of multi-service infrastructure nodes and are capable of credible, fast-paced engineering and feasibility analysis updated on a weekly cadence.

DARPA anticipates making final analytical frameworks for lunar infrastructure available to the public to the maximum extent possible. The goals defined above are to 1) broadly catalyze the future lunar economy, 2) increase opportunities for multi-service overlap, and 3) create monetizable lunar infrastructure services implemented by commercial companies for various lunar users. Therefore, companies with business plans for the Moon, known needs and interfaces, and mature teams of multi-disciplinary engineers are essential to program goals.

This Exploration Announcement (EA) calls for TA-1 Abstracts to be submitted by **September 6, 2023**, 4:00 PM Eastern Time (ET). Abstracts will be reviewed by the Government; if selected, the proposer will be asked to provide a ten-page White Paper and a Technical Presentation to be submitted by **September 25, 2023**, 4:00 PM ET. The Government will review these and, if selected, may result in an award of an Other Transaction (OT), not to exceed $1,000,000, for a period of performance of 7 months. This EA encourages solutions from all responsible sources capable of satisfying the Government's needs, including large and small businesses, non-traditional defense contractors as defined in 10 U.S.C. § 3014, and research institutions as defined in 15 U.S.C. § 638. Eligibility instructions for international, Federally Funded Research and Development Corporations (FFRDCs) and U.S. Government entity participation are provided in Section 3.1.

Key program dates for TA-1 are as follows:

- Month 0, Nov '23: Kickoff (Nov 16-17, Washington, D.C.).
- Month 2, Jan '24: Enabler Workshop; details to be released separately.
- Month 4, Mar '24: Initial Integrated Systems Concept Reviews (SCR).
- Month 5, Apr '24: LSIC Spring meeting outbrief (Apr 22-24, Laurel, MD).
- Month 6, May '24: Final Integrated Systems Concept Reviews.

- Month 7, Jun '24: Final report and closeout activities.

LunA-10 TA-1 requires a highly collaborative environment that ingests multiple perspectives; **all performers must join the program and start work simultaneously.** Proposers should pay close attention to acquisition and contracting timelines; **DARPA explicitly reserves the right to terminate awards if negotiations are not completed in time to maintain these timelines**.

6.2. TA-1 Thrust Areas

It is anticipated that three sectors are cornerstones to accomplishing the envisioned lunar goals:

1) Transit/Mobility[6]
    i. Specifically excludes downmass. The study of enabling logistics is encouraged.
2) Energy
    i. Specifically includes wireless power beaming and specifically excludes surface nuclear fission.
3) Communications
    i. Includes three scales: local area surface to surface, surface to lunar orbit, and to/from Earth.

A successful LunA-10 TA-1 team will likely incorporate some expertise in these vital cornerstone sectors and their specific technical strengths. However, this is not an all-encompassing list[7]. Proposers should specify what other sectors they believe are required to create monetizable commercial services provided to a wide variety of users intending to operate on and around the Moon and their expertise in those areas.

Due to mass constraints associated with lunar launch and landing, mass efficiency should be a primary factor considered in proposed designs and as a measurable metric.

Proposers are not expected to outline all multi-service systems required to achieve the overall lunar vision. However, proposers should outline at least one, which DARPA will use to determine their suitability to be one of the LunA-10 companies designing integrated lunar frameworks. Successful proposers will then contribute to designing several multi-service systems during the program; performers should expect to ingest other companies' perspectives and contribute them to others. Ultimately, LunA-10 will create a "best in breed" set of integrated lunar frameworks at the SCR level, with well-defined component system nodes and metrics for performance.

6.3. Acquisition Strategy

The Government's aim is to lower the administrative burden of entry, reduce program risk, foster competition, and have performing teams begin work faster. The Government will use the acquisition process detailed in this EA to facilitate this objective. The dates for each step of TA-1 are listed on Page 3 of this solicitation. The requirements for Abstract, White Paper, and Technical Presentation submissions are detailed in Section 7 of this EA.

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[6] Mobility is defined, for the purposes of this solicitation, as having three components. *Upmass* refers to mass lifted from the lunar surface into Low Lunar Orbit (LLO). *Downmass* refers to mass delivered to the lunar surface from LLO. *Crossmass* refers to transport of mass across the surface, from rover-based ground delivery to sub-orbital solutions.

[7] For example: The National Geospatial Intelligence Agency (NGA) recently announced an initiative to create a new Lunar Reference System to provide prevision and accuracy necessary for future lunar navigation. https://www.nga.mil/news/NGA_Leads_Development_of_Navigational_Reference_Sy.html

6.4. Government Integration Team and Execution Cadence

To drive and increase cooperation amongst LunA-10 TA-1 performers, DARPA will engage a diverse Integration Team from across the U.S. Government. Performers can expect to present to and receive feedback from this team weekly. They will then need to update their quantitative engineering analysis by the next week to allow rapid iteration and exploration incorporating multiple perspectives. All LunA-10 performers will also meet for a half-day every two weeks to incorporate group perspectives and evaluate integrated frameworks. To maintain this cadence, it is highly recommended that proposed teams are primarily composed of multi-disciplinary engineers committed to at least the 0.5 Full Time Equivalent (FTE) or 50% workload level.

The majority of meetings will occur virtually. Three in-person integration meetings between all performers are planned at the end of Months 2, 4, and 6 (in conjunction with the Enabler Workshop, initial, and final framework-level SCR). Performers should send two key representatives to these meetings, with the rest of their team able to participate virtually. For budgeting purposes, two meetings in Washington, D.C., and one in San Francisco, CA, may be assumed.

DARPA intends to provide economic expertise as part of the Government Integration Team to help analyze and validate definitions of critical mass for a lunar economy; teams may suggest other ways to utilize this expertise throughout the program. No other GFE/GFI will be provided.

6.5. Program Structure and Deliverables

LunA-10 TA-1 will be executed in a single Phase lasting seven (7) months. Five primary metrics will be measured at the final SCR conducted near program completion:

1. The existence of a defined end state that constitutes an aggregate “critical mass” for a self-sustaining, monetizable, commercially owned-and-operated lunar infrastructure; all solutions will be aimed at realizing this end state;
2. Designed multi-service systems show sufficiently realistic mass budget fidelity to convincingly close their design;
3. Key technical risks and challenges are well understood, with convincing technical ways forward to address those risks in a revolutionary (not iterative) manner;
4. The designed system shows a sufficiently rigorous basis for a calculated lifetime estimation given a near-100% duty cycle and details envisioned component-level hardware testing that will validate relevant assumptions in future development phases;
5. A concrete and detailed plan for system scaling to the infrastructure level and any additional challenges anticipated with that deployment, with particular attention to differing environmental conditions across the Moon.

Performers should define their anticipated deliverables to achieve these metrics. In addition, the following deliverables are required:

1. SCR artifacts for each multi-service system;
2. Scaling study to infrastructure-level functionality;
3. Public (Distribution A, unlimited) non-proprietary presentation for LSIC Spring Meeting (April 22-26, 2024, Laurel, MD) on LunA-10 progress;
4. A proprietary final report and a non-proprietary version of that same report;
5. Detailed Lunar Infrastructure Analytical Framework(s) and integrated design(s) for multi-service functionality and infrastructure deployment.

6.6. EA Procedure

In response to this solicitation, proposers are asked to submit a 3-page Abstract as described in Section 7. This process allows DARPA to ascertain (1) whether the proposers understand the key challenges of LunA-10 TA-1 and (2) whether they are capable of modifying their proposed multi-service concept in conjunction with inputs from other teams. Specific evaluation criteria used by DARPA to make the assessment can be found in Section 7. If DARPA finds that both of these conditions are met, it may invite the proposer to submit a ten-page White Paper and Technical Presentation, as described in Section 7, where the proposed technical solution will be evaluated. Specific evaluation criteria used to make the assessment can also be found in Section 7.

Performers should not anticipate an Oral Presentation in conjunction with the submission of the White Paper and Technical Presentation; the written material will be evaluated by DARPA.

Based on White Paper and Technical Presentation content, DARPA will decide which proposers will be asked to participate in LunA-10 TA-1 and will enter into negotiations for a potential OT with those proposers. The Government will not pay proposers responding to this EA for the costs associated with Abstract, White Paper, or Technical Presentation submissions.

DARPA will use the following process:

1) **Frequently Asked Questions (Optional):** Potential proposers are encouraged to e-mail questions to LunA10@darpa.mil. A comprehensive list of questions and answers will be compiled, updated, and available online at http://www.darpa.mil/work-with-us/opportunities. All questions must be received by the FAQ submission deadline specified in this EA. Questions sent after this date may not be answered.

2) **Abstracts (Required. Result if successful: Invitation to submit a White Paper and Technical Presentation)**: Through this solicitation, the Government requests proposers to submit Abstracts as specified in Section 7 of this EA. The Government will review all submitted Abstracts in accordance with the evaluation criteria listed in Section 7. Selected proposers will be invited to provide a ten-page White Paper and Technical Presentation to the Government. Proposers must submit an Abstract(s) in response to this solicitation to be considered for participation in LunA-10 TA-1. Proposers will not be invited to submit a White Paper and Technical Presentation or be included in any further program progression without participating in the Abstract stage of the solicitation. Attachments A, B, and C are not required at the Abstract stage.

3) **White Paper, Technical Presentation, and Attachments (Required. Result if successful:**

Selection): Proposers who submit Abstracts to this EA may be invited to submit a ten-page White Paper and a twenty-slide Technical Presentation to the DARPA program team. Required content and format are detailed in Section 7; updated requirements, including submission details, will be outlined in the invitation to submit from DARPA. The Government will review all White Papers and Technical Presentations in accordance with the criteria in Section 7. Based on the Abstract, DARPA may provide a list of questions in its invitation to allow proposers to better explain technical content; if requested, these answers must be provided in the Technical Presentation. In addition, Attachments A, B, and C must be submitted at this time. Proposers must only propose a Research OT with fixed payable milestones (Attachment A). (Note - Fixed payable milestones are payments based on the successful completion of the milestone accomplishments agreed to in the milestone plan; see Attachment A to this solicitation).

4) **Selection (Result if successful: Award):** DARPA will review White Papers and Technical Presentations to determine which proposed solutions sufficiently meet the evaluation criteria in Section 7. Upon favorable review, and subject to the availability of funds, the Government may award a Research OT under 10 USC § 4021 with fixed, payable milestones for selectees totaling no more than $1,000,000. Upon receipt of a notification letter, successful proposers should be prepared to immediately support the award announcement by virtual attendance at the Lunar Surface Innovation Consortium (LSIC) Fall Meeting, October 10-12, 2023, in Pittsburgh, PA.

5) **Award.** DARPA will follow a 30-days-to-award OT model. Program kickoff is scheduled for Nov 16-17, 2023. Due to the highly collaborative nature of the integration work in LunA-10 TA-1, proposers will **not** be permitted to join LunA-10 TA-1 late. Proposers should pay close attention to acquisition and contracting timelines; **DARPA explicitly reserves the right to terminate awards if negotiations are not completed in time to maintain these timelines**. The absolute minimum of changes to the template Research OT (Attachment A) is highly recommended to help shorten the negotiation period.

7. GUIDELINES FOR WHITE PAPERS AND TECHNICAL PRESENTATIONS

7.1. General Guidelines

a. Do not include elaborate brochures or marketing materials; only include information relevant to the submission requirements or evaluation criteria.

b. The use of a diagram(s) or figure(s) to depict the essence of the proposed solution is encouraged.

c. Proposers are responsible for clearly identifying proprietary information. Submissions containing proprietary information must have the cover page and each page containing such information clearly marked with a label such as “Proprietary” or “Company Proprietary.” NOTE: “Confidential” is a classification marking used to control the dissemination of U.S. Government National Security Information as dictated in Executive Order 13526 and should not be used to identify proprietary business information.

d. Questions can be sent to LunA10@darpa.mil before **August 22, 2023**, 4:00 PM (ET). Questions sent after this date may not be answered.

e. Abstracts must be submitted by e-mail to LunA10@darpa.mil no later than **September 6, 2023**, 4:00 PM (ET). Proposers who wish to send their abstracts via more secure means may e-mail LunA10@darpa.mil to request a secure link no later than September 5, 2023, 4:00 PM (ET).

f. Submissions sent by any other means than an e-mail to LunA10@darpa.mil, or a DARPA-provided secure link, will not be considered, reviewed, or evaluated.

g. All Abstracts, White Papers, and Technical Presentations shall be unclassified.

h. LunA-10 TA-1 is an unclassified program with the potential for Controlled Unclassified Information (CUI) restrictions. A CUI guide will be provided to all successful proposers. Proposers should identify any non-U.S. citizens anticipated to work on the program in their White Papers.

i. DARPA has not identified any International Traffic in Arms Regulations (ITAR) restricted technologies related to the thrust areas specified in this solicitation. Performers should plan on explicitly addressing specific reasons for ITAR restrictions on their designs and portion marking those design aspects that may be ITAR restricted, if any. Responses broadly marked as ITAR, without specific portion markings on ITAR-restricted items, may be deemed **non-compliant** and not reviewed.

7.2. Abstract Content

a. Abstracts should not exceed three (3) single-sided 8.5" by 11" written pages using 12-point Times New Roman font with 1" margins all around.

b. Multiple abstracts from one proposer are acceptable, provided they are each independently complete per the guidelines in this section and address significantly different multi-service concepts and technical approaches.

c. Abstracts must include the following:

1. **Title page**: Proposer Name, Title, Date, Point of Contact Name, E-Mail Address, Phone, Address, and CAGE Code. (Title Page does not count against page limits but is a maximum of one page with all the information below). Also, on the title page:

   - The proposer shall include a statement that no people on the proposer's team work for DARPA as Scientific Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS), or similar support services, as DARPA has a policy prohibiting such people from working as a technical performer. For questions see Section 3.2.

   - The proposer shall include a statement that their contracting support staff are aware of the timelines of the LunA-10 TA-1 program and are capable of negotiating a Research OT award in good faith with the Government in 30 days or less.

- Identify whether an ACA is acceptable (yes or no) and whether the proposed technology will require an ACA from other LunA-10 TA-1 participants (yes or no).

2. **Summary of Proposed Approach:** Provide a summary of the proposed multi-service concept and the accompanying technical approach. Summarize key innovative claims, and provide a direct connection between the proposed concept and the program goal of enabling a future lunar infrastructure. Highlight the novelty and uniqueness of the proposed work with respect to prior efforts and how it may be adapted with additional contributing expertise from other LunA-10 TA-1 team members.
3. **Summary of Current State of the Art:** Present a summary of the current state of the art for the specific technology and its current or near-term implementation on the Moon (to include publicly announced initiatives from other entities). Summarize the proposers' body of work and ongoing investigations into this area, which will be leveraged in the proposed LunA-10 TA-1 effort.
4. **Proposed design and unique insights:** High-level quantitative analysis of the proposed multi-service concept and an initial design that would validate the proposed concept. The design should be detailed enough to demonstrate that the proposer understands the technical challenges, unique insights, mitigations for anticipated risks, and the ability to integrate their design with other concepts.
5. **Technology Challenges**: Identify this proposed approach's specific technical challenges and primary risks. What are the early mitigations to ensure success or measure failure, and how will these be quantified during LunA-10 TA-1?
6. **Team and Teaming**: Describe why the proposer believes their team and organization have the ability to be successful at achieving the goals of LunA-10. Detail the proposers' approach to teaming and expected contributions to any integrated system design that is ideated during the program. Identify specific contributing engineering personnel or subcontractors expected to comprise the team. Identify their roles, their level of effort in the percentage of total time dedicated to LunA-10, and how their qualifications contribute to the technical approach. Identify specific mitigations or pre-negotiated arrangements to ensure contracting timelines can be met across all subcontractors, if applicable.
7. **Budget:** Provide a one-sentence summary of the expected budget amount.

7.3. White Paper Content

a. White Papers should not exceed ten (10) single-sided 8.5" by 11" written pages using 12-point Times New Roman font with 1" margins all around.

b. White Papers must include the following:

1. **Title page:** Proposer Name, Title, Date, Point of Contact Name, E-Mail Address, Phone, Address, and CAGE Code. (Title Page does not count against page limits but is a maximum of one page with all the information below). Also, on the title page:
    - The proposer shall include a statement that no people on the proposer's team work for DARPA as Scientific Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS), or similar support services, as DARPA has a policy prohibiting such people from working as a technical performer. For questions, see Section 3.2.
    - The proposer shall include a statement that their contracting support staff are aware of the timelines of the LunA-10 TA-1 program and are capable of negotiating an OT award in good faith with the Government in 30 days or less.
    - Identify whether an ACA is acceptable (yes or no) and whether the proposed technology will require an ACA from other LunA-10 TA-1 participants (yes or no).
2. **Summary of Proposed Approach:** Provide a summary of the proposed multi-service concept and the accompanying technical approach. Summarize key innovative claims, and provide a direct connection between the proposed concept and the program goal of enabling a future lunar infrastructure. Highlight the novelty and uniqueness of the proposed work with respect to prior efforts and how it may be adapted with additional contributing expertise from other LunA-10 TA-1 team members. The summary shall be no more than one (1) page and is included in the ten (10) page limit.
3. **Summary of Current State of the Art:** Present a summary, with relevant references, of the current state of the art for both the specific technology and its current or near-term implementation on the Moon (to include publicly announced initiatives from other entities). Summarize the proposers' body of work and ongoing investigations into this area, which will be leveraged in the proposed LunA-10 TA-1 effort. The summary shall be no more than one (1) page and is included in the ten (10) page limit.
4. **Proposed design and unique insights:** High-level quantitative analysis of the proposed multi-service concept and an initial design that would validate the proposed concept. The design should be detailed enough to demonstrate that the proposer understands the technical challenges, unique insights, mitigations for anticipated risks, and the ability to integrate their design with other concepts. This must include all of the following components:
    a. *Scaling*: How does the proposed concept scale up in capability?
    b. *Commercialization*: What is the business case for commercialization and monetization of the proposed concept? What is the anticipated "critical mass" at which this becomes profitable and self-sustaining?

c. *Minimum Viable Experiment*: Working backward from the infrastructure vision, what is the minimum prototype demonstration needed on the lunar surface to prove the critical technology at the heart of the concept? How will this prove the feasibility and resolve key unknowns for the larger concept?

d. *Potential for integration with other program concepts*. What are the best areas for system-level integration with other infrastructure nodes or concepts? How might an advance in a different technical area translate into an advance for the proposed concept?

e. *Metrics*. What are the critical technical measurement metrics needed for both the small-scale prototype demonstration and the larger infrastructure scale? Explain how, if successful, these are significantly ahead of the current State of the Art to justify DARPA funding.

5. **Technical Challenges:** Identify specific technical challenges and primary risks associated with this proposed approach. What are the early mitigations to ensure success or measure failure, and how will these be quantified during LunA-10 TA-1? Risks must be articulated quantitatively against the technical challenges and be ranked according to impact and likelihood. The summary shall be no more than one (1) page and is included in the ten (10) written page limit.

6. **Team and Teaming:** Detail the proposer's team and organization, and explain the ability to achieve the goals if selected successfully. The proposer may include past experience, organizational capabilities, team members' qualifications, or anything demonstrating competence in executing program objectives. Identify teammates or subcontractors expected to comprise the team. Identify specific contributing engineering personnel or subcontractors expected to comprise the team. Identify their roles, their level of effort in the percentage of total time dedicated to LunA-10 TA-1, and how their qualifications contribute to the technical approach. The summary shall be no more than two (2) pages and is included in the ten (10) pages limit.

7. **Data Rights:** Identify if the proposed patent or data rights to be given to the Government under this agreement are any different from the following:

   - All software and simulations developed under the program are designated as Government Purpose Rights (GPR);
   - All integrated system designs will be Government owned, with performers having unlimited rights of use;
   - For IP developed prior to the start of the agreement that will be directly utilized during program activities, clearly identify that IP and the anticipated level of IP rights that will be given to the Government.

7.4. Technical Presentation Content

a. The Technical Presentation highlights unique insights, presents completed work, justifies the proposed metrics, and discusses risks.

b. The Technical Presentation should be no more than 20 slides, including the title and concluding slide. Excess slides will be deleted and not reviewed.

c. Only Microsoft PowerPoint or PDF formats will be accepted.

d. The total file size must be less than 8 GB.

e. Speaker notes included in the presentation will not be reviewed.

7.5. Abstracts – Process and Basis of Evaluation

Abstract evaluation criteria are listed in descending order of importance. Individual Abstracts will be evaluated against the evaluation criteria described below:

a. **Technical Rationale and Approach**: The proposed technical understanding is accurate and identifies key technical challenges and risks. The proposed concept is multi-service, with the potential for ingesting additional perspectives and integration into a broader infrastructure framework. Where possible, technical approaches to challenges are supported by brief calculations or physical estimates.

b. **Team and Teaming:** If selected, the proposers demonstrate an ability to work with other teams and achieve the goals of LunA-10 TA-1. NDA/ACA posture is compatible with the program goal of developing joint integrated multi-service system designs. The engineering personnel proposed have a wide breadth and depth of experience in areas pertinent to designing systems for the lunar environment. Multi-disciplinary engineers are resourced at a sufficiently high level to maintain the execution cadence required to meet program goals.

DARPA will evaluate Abstracts using the evaluation criteria listed above and not against other Abstracts submitted in response to this EA. The Government will endeavor to complete the evaluation of Abstracts within five business days of the closing of the submittal period. As stated above, proposers are required to submit an Abstract for evaluation by DARPA to be considered for any subsequent award. DARPA will respond to the 3-page Abstract with a statement as to whether DARPA is interested in receiving a White Paper and Technical Presentation. If DARPA is not interested in an Oral Presentation, it will state this in an e-mail to the proposer. Upon review of the Abstracts, the Government may elect to invite all, some, or none of the proposers to submit a White Paper and Technical Presentation. **Only Abstract proposers invited by DARPA to submit a White Paper and Technical Presentation are eligible to provide these**.

7.6. White Papers and Technical Presentations – Process and Basis of Evaluation

Evaluation criteria are listed in order of importance. White Papers and Technical Presentations will be evaluated against the evaluation criteria described below:

a. **Technical Rationale and Approach**: The proposed technical understanding is accurate, unique key insight(s) specific to the proposer's design is clearly identified, and technical approaches to challenges are supported by brief calculations or physical estimates. Key technical challenges and risks are correctly identified.

b. **Metrics:** The appropriate metrics to measure capability, scaling, commercialization, and other quantities relevant to the program goals, are well-defined, suitably aggressive, and potentially achievable with the presented Technical Rationale.

c. **Team and Teaming:** If selected, the proposers demonstrate an ability to work with other

teams and achieve the goals of LunA-10 TA-1. The engineering personnel proposed have a wide breadth and depth of experience in areas pertinent to designing systems for the lunar environment. Multi-disciplinary engineers are resourced at a sufficiently high level to maintain the execution cadence required to meet program goals.

d. **Data Rights:** Extent to which data, hardware, and software ownership/IP/rights assertions allow the Government to realize the program's objectives, including the transition to other Government agencies and commercially operated lunar lander providers. Data rights and NDA/ACA posture are compatible with the program goal of developing joint integrated multi-service system designs.

After completing the evaluation, DARPA will: 1) make a seven-month award for LunA-10 TA-1; or 2) inform the proposer that its proposed concept/technology/solution is not of interest to the Government. If DARPA does not intend to issue an award to an proposer, DARPA may provide brief informal feedback to the proposer regarding their submission.