Microsystems Technology Office
Broad Agency Announcement
Technologies for Mixed-mode Ultra Scaled Integrated Circuits (T-MUSIC)
HR001119S0016
January 4, 2019

Foreword

In June 2017, the Defense Advanced Research Projects Agency (DARPA) announced the Electronics Resurgence Initiative (ERI), a five-year, upwards of $1.5B investment in the future of domestic, U.S. Government (USG), and Department of Defense (DoD) electronic systems. ERI recognizes and addresses long-foreseen obstacles to Moore's Law – the transistor scaling trend that has allowed for 50 years of rapid progress in electronics. To address these issues, ERI kicked off a major investment that draws on the contributions of several ongoing DARPA programs and creates new, long-term technology investments. Through novel research and development (R&D) in semiconductor materials and integration, architectures, and designs, ERI programs will promote circuit specialization as a complement to transistor scaling. The success of these efforts will depend on constructively enmeshing the technology needs and capabilities of the defense enterprise with the commercial and manufacturing realities of the electronics industry.

The first annual ERI Summit, held in July 2018, featured four workshops designed to generate ideas for future ERI programs. Three key issues emerged from the workshop discussions: the need to support domestic manufacturing options and enable them to develop differentiated capabilities for diverse needs; a demand to invest in chip security; and a desire to create new connections between the various ERI programs and to demonstrate the resulting technologies in defense applications. ERI Phase II will build on the existing ERI programs to address all of these challenges, with the goal of supporting a domestic semiconductor manufacturing industry that can implement specialized circuits, demonstrate that those circuits can be trusted through the supply chain and are built with security in mind, and are ultimately available to both DoD and commercial sector users.

To create unique and differentiated domestic manufacturing capabilities, potential areas of exploration in ERI Phase II include the integration of photonics and radiofrequency (RF) components directly into advanced circuits and semiconductor manufacturing processes. DARPA has announced the Photonics in the Package for Extreme Scalability (PIPES) and Technologies for Mixed-mode Ultra Scaled Integrated Circuits (T-MUSIC) within this area. To provide for trustable electronics components, potential Phase II areas of exploration include electronics that can enforce security and privacy protections as well as technologies to enable traceability for electronic components from design through to use. DARPA has announced Guaranteed Architecture for Physical Security (GAPS) within this area.

To integrate mixed mode electronics into advanced onshore semiconductor manufacturing processes in ERI Phase II, the Technologies for Mixed mode Ultra Scaled Integrated Circuits (T-MUSIC) program will advance the underlying technology for RF transistors and circuits in CMOS and SiGe that has been left behind by traditional digital CMOS scaling. The DoD has capability demands that far exceed the requirements of the commercial world in terms of speed, fidelity, capacity, and precision. These characteristics directly impact the performance and differentiation on essentially all DoD electronic systems in advanced RF sensors and high capacity communications. T-MUSIC will also provide an advantage for US-based foundries as leading suppliers of commercial wireless system-on-a-chip (SoC) integrated circuits. T-MUSIC will provide the foundation for enduring U.S. leadership in mixed-mode electronics technology

by developing next-generation terahertz (THz) mixed-mode devices based on the advanced CMOS fabrication platform.

Together with the ongoing ERI programs, including the "ERI Page 3 Investments" announced in 2017, ERI Phase II is the next step in creating a more robust, secure, and heavily automated electronics industry that will provide a foundational contribution both to U.S. national security and to the needs and ambitions of the commercial sector, with new capabilities emerging in the 2025 to 2030 timeframe. DARPA is eager to receive proposals from entities that can help to achieve this goal. For further reference, an updated list of ERI programs, solicitations, and events is available via https://www.darpa.mil/work-with-us/electronics-resurgence-initiative.

Table of Contents

PART I: OVERVIEW INFORMATION

- **Federal Agency Name**: Defense Advanced Research Projects Agency (DARPA), Microsystems Technology Office (MTO)
- **Funding Opportunity Title:** Technologies for Mixed-mode Ultra Scaled Integrated Circuits (T-MUSIC)
- **Announcement Type:** Initial Announcement
- **Funding Opportunity Number:** HR001119S0016
- **Catalog of Federal Domestic Assistance Numbers (CFDA):** 12.910 Research and Technology Development
- **Dates:** (All times listed herein are Eastern Time)
    - Posting Date: January 4, 2019
    - Proposers Day: January 8, 2019
    - Abstract Due Date: January 25, 2019 – 1:00 PM EST
    - FAQ Submission Deadline: February 18, 2019 – 1:00 PM EST
    - Proposal Due Date: March 12, 2019 – 1:00 PM EST
    - Estimated period of performance start: August, 2019

Concise description of the funding opportunity: The DARPA Microsystems Technology Office is soliciting research proposals for the development of advanced RF mixed-mode foundry processes, building blocks, and novel high frequency mixed-mode devices on a CMOS fabrication platform. It is expected that such advances will enable new DoD applications including high capacity, robust communications, radars, and precision sensors.

- **Anticipated Funding Available for Awards**: Approximately $70M of funding is anticipated for awards made against this BAA, with a distribution of:
    - $55M for Technical Area 1 (TA-1) including TA-1A and TA-1B
    - $15M for Technical Area 2 (TA-2)
- **Anticipated individual awards**: Multiple awards are anticipated. TA-1A is considered to be a large portion of the overall program effort and it is expected that at most two large awards will be made in this technical area. It is expected that multiple smaller awards will be made targeted to both TA-1B circuit demonstrations and TA-2 exploratory work.
- **Anticipated funding type:**
    - 6.3 for TA-1A and TA-1B
    - 6.2 for TA-2
- **Types of instruments that may be awarded:**
    - TA-1A and TA-1B: Procurement contract or other transaction.
    - TA-2: Procurement contract, grant, cooperative agreement, or other transaction.
- **Agency contact:**
    - Dr. Young-Kai Chen, Program Manager
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PART II: FULL TEXT OF ANNOUNCEMENT

I. Funding Opportunity Description

The Defense Advanced Research Projects Agency (DARPA) often selects its research efforts through the Broad Agency Announcement (BAA) process. This BAA is being issued, and any resultant selection will be made, using the procedures under Federal Acquisition Regulation (FAR) 6.102(d)(2) and 35.016 and 2 C.F.R. § 200.203. Any negotiations and/or awards will use procedures under FAR 15.4, Contract Pricing. Proposals received as a result of this BAA shall be evaluated in accordance with evaluation criteria specified herein through a scientific review process.

DARPA BAAs are posted on the Federal Business Opportunities (FedBizOpps) website, http://www.fbo.gov/, and, as applicable, the Grants.gov website at http://www.grants.gov/. The following information is for those wishing to respond to the BAA.

The Microsystems Technology Office at DARPA seeks innovative proposals to develop integrated, ultra-broadband, mixed-mode electronics with embedded advanced digital CMOS (Complementary Metal-Oxide-Semiconductor) electronics in a U.S. domestic foundry fabrication platform. This advanced analog radio frequency (RF) mixed-mode electronics platform would provide ultra-wide instantaneous bandwidth, higher spur-free dynamic range (SFDR), and finer data converter resolution with more effective number of bits (ENOB) than the current state of the art. The incorporation of embedded digital CMOS electronics, with an end goal of an advanced 22 nm or smaller processes, will result in highly integrated digital processing and intelligence on one chip to provide differentiating capabilities for DoD systems. T-MUSIC will provide the foundation for enduring U.S. leadership in mixed-mode electronics technology by further developing next-generation THz (terahertz) mixed-mode devices designed for integration with an advanced CMOS fabrication platform. This is expected to greatly enhance Department of Defense (DoD) capabilities in advanced RF sensors and high capacity communications.

A. Background

RF mixed-mode electronics form the critical frontend interface used to convert analog wireless signals to a digital representation and vice versa. Frontend performance directly impacts overall system capabilities such as the detection sensitivity, range, signal discrimination, and operating frequency coverage. These system parameters impact virtually all DoD electronic systems including communications, radar, signals intelligence (SIGINT), and electronic warfare (EW). Current commercial RF mixed-mode systems on a chip (SoCs) are implemented on a digital CMOS platform for wireless applications, which operate at low microwave bands. The capability to operate at higher frequency with larger signal bandwidth and higher resolution is currently constrained by the performance of the existing CMOS technology platforms.

Following the trend of Moore's Law over the past five decades, digital CMOS scaling has focused on increasing integration density to process high computing workloads in a single chip. This successful scaling has been achieved by reducing the size and power consumption of the underlying transistors. However, scaled digital CMOS transistors can no longer support the high switching speed and voltage required to convert fast analog signals in fine resolution over a large

dynamic range and wide operating frequency. The resulting technology bottlenecks restrict many DoD applications in operating frequencies, signaling bandwidth, fidelity, detection sensitivity, and energy efficiency. To fully advance the RF mixed-mode interface, new innovations in integrated microelectronics are needed to move beyond the traditional progression of Moore's Law scaling in digital CMOS technologies.

B. Program Description

The objective of T-MUSIC is to enable disruptive RF mixed-mode technologies by developing high performance RF analog electronics integrated with advanced digital CMOS electronics on the same wafer. This will enable next generation RF mixed-mode interfaces with an unprecedented combination of wide spectral coverage, high resolution, large dynamic range, and high information processing bandwidth.

Through the T-MUSIC program, DARPA seeks to: 1) advance RF and mixed-mode devices to support ultra wide RF frontends from HF to 100 GHz; 2) integrate those devices with high density digital CMOS electronics at the wafer scale to enable embedded digital intelligence; 3) develop and explore ultra-high resolution broadband mixed-mode circuit building blocks for DoD-relevant applications; 4) explore innovative device topologies and materials to implement THz devices in an advanced digital CMOS fabrication platform; and 5) establish a domestic ecosystem that facilitates enduring DoD access to differentiated capabilities for high performance RF mixed-mode SoCs.

Improvements in key transistor performance parameters such as current-gain and maximum power-gain cutoff frequencies (f_T and f_{max}) as well as intrinsic noise produce measurable performance enhancement at the SoC and system level. T-MUSIC seeks proposals to integrate high frequency, low noise electronics, such as heterojunction bipolar transistors (HBTs), with high density CMOS onto a wafer. Such an effort would leverage prior investments in digital CMOS processes and tool sets in U.S. onshore foundries. For example, by aggressively scaling in the lateral and vertical dimensions in SiGe HBTs, speed can be increased to over 500 GHz of f_T.[1] Furthermore, the speed and RF performance of co-integrated digital CMOS could be concurrently enhanced using silicon-on-insulator (SOI) structures to reduce interconnect parasitics and RF leakage.

T-MUSIC foundry performers will provide multiple project wafers (MPWs) with engineering process design kits (PDKs) to circuit design partners to identify optimal device topologies for critical RF mixed-mode circuit functions for future DoD applications. Once selected for T-MUSIC, the foundry (TA-1A) and design (TA-1B) performers will establish collaboration under an Associate Contractor Agreement (ACA) (See Section III.D. "Associate Contractor Agreement Clause") prior to contract award. In addition, the TA-1A and TA-1B performers will establish all appropriate industrial agreements regarding restrictions on the usage of IP (intellectual property) blocks in the design activities. Targeted performance metrics of selected critical mixed-mode building blocks, such as phase-locked loops (PLLs), analog-to-digital converters (ADCs) and ultrafast frequency dividers are established to guide the T-MUSIC technology developments. It is

[1] B. Heinemann *et al.,* "SiGe HBT with f_T/f_{max} of 505 GHz/720 GHz," 2016 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, 2016, pp. 3.1.1-3.1.4. doi: 10.1109/IEDM.2016.7838335

intended that the resulting IP and associated design documents will become part of a shared DoD design repository. This close partnership between the DoD community and U.S.-based RF mixed-mode foundries will provide a discriminating mixed-mode capability, leveraging previous U.S. government investments across the past decade.

Through TA-2, T-MUSIC also seeks foundational breakthrough research in ultra-broadband transistors well beyond the near-term advances in foundry technologies. The program will demonstrate THz transistors with novel device topologies and materials by exploiting advanced nano-scale digital CMOS processing platforms. Simulations of these highly scaled devices indicate THz transistor speed can be attained using processes in an advanced silicon CMOS platform. The scalability in integration density and circuit performance of the THz devices shall be demonstrated in high speed digital divider circuits at input frequency up to 400 GHz by the end of the program. TA-2 teams will perform independent research and development and, as such, ACAs with other T-MUSIC teams will not be required.

C. Program Structure

The T-MUSIC program is a four-year effort beginning in FY19 and ending in FY23. It will have an 18-month Phase 1, 18-month Phase 2, and 12-month Phase 3. The program will have three technical areas (TA-1A, TA-1B and TA-2) that will run concurrently. The program seeks to develop wafer-scale technology on a silicon CMOS-based foundry platform. Proposals for heterogeneous integration techniques with separately-fabricated compound semiconductor transistors such as III-V, II-VI, GaAs, InP or GaN are not appropriate for the T-MUSIC program and will not be considered responsive to this BAA.

TA-1A: Ultra-broadband Mixed-Mode Foundry Technology
The TA-1A technical area will develop advanced mixed-mode technologies with high speed low noise RF analog transistors co-integrated at wafer scale with embedded advanced digital CMOS electronics (≤ 22 nm) on the same wafer in a U.S. onshore foundry.

TA-1B: Ultra-broadband Mixed-Mode Building Blocks
TA-1B is a design-focused technical area that is tightly coupled with TA-1A. TA-1B will implement advanced broadband RF mixed-mode building blocks while assisting with the co-development of the TA-1A foundry technologies through iterative engineering multi-project wafer (MPW) runs provided by the TA-1A team(s). The goal of this partnership is to align the TA-1A process technology with emerging and best-practice design techniques to provide superior performance of TA-1B mixed-mode building blocks for DoD-relevant applications. The advanced mixed-mode IP designs will establish the foundation of a mixed-mode IP library repository for the DoD user community[2].

Given TA-1A and TA-1B are anticipated to be funded with 6.3 (Advanced Technology Development) funding, the research being carried out by all team members (prime and subcontractors/for-profit, non-profit and universities) will be considered restricted research. See Part II(II)(B), “Fundamental Research,” below.

[2] The IP library repository itself is not a topic of the T-MUSIC BAA.

TA-2: Advanced THz Mixed-Mode Devices
TA-2 has a more fundamental focus in which new types of RF mixed-mode transistors will be explored to demonstrate transistor f_T up to 1 THz in a scalable CMOS platform.

Given TA-2 is anticipated to be funded with 6.2 (Applied Research) funding, the research being carried out by non-profit and university performers (prime and subcontractors) will be considered fundamental research. See Part II(II)(B), "Fundamental Research," below.

D. Technical Areas

1. Technical Area 1 (TA-1): Ultra-broadband Mixed-Mode Foundry Technology

The goal of Technical Area 1 (TA-1) is to develop a US-based foundry technology platform with >600 GHz transistors and dense (≤ 22 nm) digital CMOS on the same wafer to enable high performance, low noise mixed-mode circuit performance with 50 GHz of instantaneous bandwidth and 8 ENOB by the end of the program. TA-1 is further broken down into two sub-areas, TA-1A and TA-1B.

The detailed metrics for TA-1 are shown in the Table 1 below:

Table 1. T-MUSIC TA-1 Metrics

T-MUSIC		Phase 1	Phase 2	Phase 3
Objectives		•Develop >350GHz transistors •Co-integration with CMOS •PDK development	•Develop >400GHz transistor with digital CMOS •Yield improvement	•Develop >600 GHz transistor with ≤ 22nm CMOS •Ultra-broadband circuits
TA-1: Ultra-broadband Mixed-Mode Foundry Platform				
TA-1A Technology	Transistor f_T/f_{max} [a]	≥ 350/500 GHz	≥ 400/600 GHz	≥ 600/700 GHz
	Embedded Digital CMOS [b]	≤ 90nm node ≥ 200 mm wafer	≤ 45nm node ≥ 200 mm wafer	≤ 22 nm node ≥ 200 mm wafer
	PCM Yield Per Wafer [c]	50%	70%	90%
TA-1B Building Blocks	Demo Circuit #1: ***PLL*** [d]	Phase Noise @ 30GHz < -90 dBc/Hz @ 100kHz offset < -100 dBc/Hz @ 1MHz offset **(Measurement)**	Phase Noise @ 30GHz < -90 dBc/Hz @ 100kHz offset < -110 dBc/Hz @ 1MHz offset **(Measurement)**	Phase Noise @ 30GHz < -100 dBc/Hz @ 100kHz offset < -120 dBc/Hz @ 1MHz offset **(Measurement)**
	Demo Circuit #2: ***ADC*** [d]	Architecture simulation and building block demo **(Demo 16ENOB 1GSps ADC)**	≥ 256 levels (8 ENOBs) @50 GSps, 25 GHz IBW **(Demo: THA[d], ADC)**	≥ 256 levels (8 ENOBs) @100GSps, 50 GHz IBW **(Measurement)**
	Demo Circuit #3: ***Frequency Divider***	100 GHz **(Measurement)**	150 GHz **(Measurement)**	200 GHz **(Measurement)**
	Circuit Yield Per Wafer [e]	50% (of divider)	70% (of PLL)	90% (of ADC)

(a) *Proposal must define the test structure for extrinsic f_T and f_{max} to include practical parasitics of the gate and interconnect. f_T and f_{max} will be extracted from measurements at >20 GHz*
(b) *The advanced CMOS node requirement for embedded digital circuits*
(c) *PCM: foundry-defined Process-Control Monitor (i.e. testers, transistors, 59-stage ring-oscillators)*
(d) *PLL: Phase-Locked Loop; ENOB: Effective Number of bits; IBW: Instantaneous Bandwidth; ADC: Analog-to-Digital Converter; THA: Track-and-Hold Amplifier*
(e) *Within-wafer yield with more than 10 demo circuits per wafer*

TA-1A proposals should provide in-depth discussions on the technical approaches and rationales to address: device structure, modeled and simulated performance, critical process development, integration of embedded digital CMOS, process control monitors (PCMs), PDKs, and risk mitigation paths to attain the performance metrics for each phase. Factors

impacting the RF mixed-mode transistor performance, such as f_T, f_{max}, broadband minimum noise figure (NF_{min}), and1/f noise corner frequency (f_c), should be addressed with modeling and simulations. Tabulated performance goals along with the program metrics should be provided over three phases. The models and documentation of device, PDKs, and IP cells developed under T-MUSIC will be contributed to a DoD design repository available for DoD design community.

TA-1A foundry performers are required to demonstrate high speed transistors and the success of the wafer-scale co-integration of embedded dense digital CMOS electronics. In addition, by working closely with the TA-1B design teams, simple demonstration circuits will be designed into the PCM cells to be fabricated, tested, and reported to TA-1B performers throughout each program phase. The device performance and fabrication yield of PCMs (i.e. test elements, transistors and 59-stage ring oscillators) should be demonstrated to meet the performance goal in each phase.

TA-1B performers are required to propose and implement at least all three TA-1B Demo Circuits as shown in Table 1 with associated circuit architecture, design, and analysis to show the path to meet (or exceed) the program goals. The proposed effort should provide in-depth discussion on the technical approaches and rationales to address proposed circuit topologies, critical function blocks and operations, impacts of transistor speed and noises, energy consumption, and robustness of the building blocks. Critical factors impacting the performance of three benchmarking circuit building blocks, such as close-in phase noises, broadband noises, timing jitter, instantaneous bandwidth, input bandwidth, linearity and mismatches, should be discussed with supporting models and simulation. Simulation should also demonstrate the impact of TA-1A on performance and power consumption for the innovative circuit architectures proposed in TA-1B. The proposal should clearly state the key differentiating elements of the approach over state of the art and how T-MUSIC enables the performance. The estimated performance of these building blocks should be tabulated along with the program metrics over the three phases. The metrics called out in the TA-1 timeline for each phase should be used to determine the performance goals of the building blocks and the associated yield numbers for each MPW run.

TA-1B performers are also expected to provide technical guidance and support to the critical elements in the TA-1A PCM development and periodically exchange the test results with the TA-1A performer(s) as the feedback to guide the foundry technology development.

Proposing additional circuit building blocks, especially for DoD applications, is encouraged. However, these should be priced as separate options, and due to the limit of the available reticle space of an MPW run, the additional circuit building blocks may or may not be fabricated depending on the decision of the T-MUSIC Program Manager.

In addition to Classified Information (please see “Security Information” section), T-MUSIC performers should also comply with the controlled technical information regulation (please see “Disclosure of Information and Compliance with Safeguarding Covered Defense Information Controls” section).

Coordination between TA-1A and TA-1B:

It is expected that the TA-1A and TA-1B performers will establish Associate Contractor Agreements (ACAs) and, if necessary, other mutual non-disclosure agreements (NDAs) and/or Design Kit License Agreements (DKLAs) at the inception of the program to share the PDK and IP library. Each TA-1A foundry team will be required to provide a PDK at the beginning of each phase to the TA-1B design teams to design benchmarking circuitry and/or critical PCM test cells.[3]

TA-1A proposers should provide the required information (e.g. reticle size or the available die area) and organize and aggregate the proposed MPW runs for TA-1B design partners. The expected schedule and milestones are outlined in Section E.

Proposers must submit to TA-1A and/or TA-1B independently. **A single proposal addressing more than one Technical Area will be deemed non-compliant and, as such, will NOT be reviewed or considered for selection.** Besides the proposed technical approaches, it is expected that the coordination plan of TA-1A (with regards to MPW/PDK development and fabrication runs) and TA-1B (with regards to pivotal PCM elements and expected feedback means to foundry technology development) should be clearly outlined in the respective proposals.

2. Technical Area 2 (TA-2): Advanced THz Mixed-Mode Devices

The goal of Technical Area 2 (TA-2) is to develop revolutionary THz devices to advance progress in semiconductor devices beyond the TA-1 foundry technology. Similar to TA-1, there are three phases for TA-2: Phase 1 (18 months), Phase 2 (18 months) and Phase 3 (12 months). TA-2 has a more fundamental focus in which new types of RF mixed-mode transistors will be explored to attain high transistor cut-off frequencies to THz. It is expected that these transistors will exploit the advanced materials, device structures, and integration processes in an advanced digital CMOS fabrication platform.

TA-2 is independent of TA-1, and proposals submitted to TA-2 must be separate and standalone from any submission to TA-1. **A single proposal addressing more than one Technical Area will be deemed non-compliant and, as such, will NOT be reviewed or considered for selection.** Submitting to TA-1 does not require a submission to TA-2 and vice versa.

[3] As discussed in Section III.D. below, ACAs are agreements between TA-1A and TA-1B performers specifically for the purpose of ensuring the necessary exchange of information takes place so that the each party can successfully carry out the tasks delineated in their respective Statements of Work (SOW). Mutual non-disclosure agreements (NDAs) and/or Design Kit License Agreements (DKLAs) are agreements between TA-1A and TA-1B performers (designers and foundries) specifically for purposes of establishing the control (handling/disclosure restrictions, marking requirements, etc.) of information – for example, PDKs being provided by foundries to designers. In all cases, the Government is not a party to such agreements (although copies of ACAs must be provided to the Contracting Officer prior to contract award).

The metrics for TA-2 are shown below:

Table 2. T-MUSIC TA-2 Metrics

		Phase 1 (18 months)	Phase 2 (18 months)	Phase 3 (12 months)
Objectives		•Develop new device structure	•Scale device and materials	•Increase integration Level
TA-2: Fundamental: Advanced THz RF Mixed-Mode Devices				
	Transistor f_T/f_{max}[(a)]	≥ 600/600 GHz	≥ 800/800 GHz	≥ 1000/1000 GHz
	Demo Circuit: 1/4 prescaler	≥ 100 GHz	≥ 200 GHz	≥ 400 GHz

(a) *Proposal must define the test structure for extrinsic f_T and f_{max} to include practical parasitics of the transistor and interconnect. f_T and f_{max} will be extracted from >20 GHz measurement*

Today's advanced CMOS devices, such as 10 nm or 7 nm FinFET technology, cannot provide as good RF or analog performance as the legacy vertical SiGe heterostructure bipolar transistors and it is challenging to co-integrate them for better performance beyond what TA-1 plans to develop. TA-2 will explore innovative lateral device concepts by leveraging the advanced process techniques of advanced CMOS platforms. The goal is to demonstrate a THz transistor that is fabrication-process-compatible with advanced FinFET CMOS platforms. The success of TA-2 will be evaluated by the transistor cut-off speeds and the demonstration of a small, but high-speed prescaler circuit.

TA-2 proposals should provide in-depth discussions on the technical approaches and rationales to attain THz transistors by addressing: novel device structure, model and simulated performance, critical process development using advanced CMOS fabrication platform, and risk mitigation paths to attain the performance metrics for each phase. Factors impacting the THz performance, such as f_T, f_{max}, device structures, parasitic elements, critical dimensions, fabrication processes, broadband minimum noise figure (NF_{min}), and1/f noise corner frequency (f_c), should be addressed with estimated performance supported by modeling and simulations. The expected performance goals and associated critical device and process parameters should be tabulated along with the program metrics over three phases.

E. Schedule/Milestones/Deliverables

TA-1: A high-level timeline of the expected TA-1 development is detailed with expected schedule and milestones in Tables 3 and 4.

TA-1A: A multi-project wafer (MPW) run will occur at month 9 of each phase to validate the PDK, device models, and building block designs. The TA-1A proposers should include the MPW runs as a part of the proposed T-MUSIC TA-1A development tasks and provide the proposed MPW service to TA-1B teams and/or additional government design teams at no additional cost[4]. It is expected that TA-1A and TA-1B partners will hold frequent critical design reviews and test reviews to facilitate the coordination and cooperation necessary to advance the T-MUSIC technologies.

[4] Effectively, this means the MPW runs will be procured (provided for) under the TA-1A contract(s) and then provided to the TA-1B performers as Government Furnished Property (Services).

The TA-1B building block designs will be sent to TA-1A foundry team at the 7th month of each phase to begin the fabrication of MPWs at the 9th month of Phases 1 and 2. In each phase, the fabrication of MPWs will be completed within six months of TA-1A foundry teams receiving design tape-in. The MPW design and fabrication cycle in Phase 3 is reduced as seen in Table 4. The resulting designs will then be tested and validated by the TA-1B design teams and by a government test team to be completed and reported a month before the end of each phase.

Throughout each phase, a new PDK development will be carried out simultaneously and verified along with the new device technologies such that the delivery of the updated PDK at the end of each phase will support the circuit design in the next phase. Thus, the "PDR/CDR" elements for the PDK are intended to close the loop between the Foundry team and Design team. At the end of Phases 2 and 3, the PDK should be developed sufficiently for commercial and Government design teams to be able to perform designs using the foundry technology. This process will allow commercial and Government transition partners to fully utilize the technology developed under T-MUSIC.

TA-1B: Preliminary and critical design reviews of the demonstration circuits should indicate how fabricated circuits will attain their target metrics in each phase. Delivery of prototype devices (hardware) to the Government in month 16 of each phase (month 10 in Phase 3) will allow the Government to independently verify performance of the demonstration circuits to provide the feedback to TA1-A foundry team.

TA-2: TA-2 is intended to create a spiral of device simulation and design required to develop a new high speed RF mixed-mode device and then scale that device in a manner that can be tightly integrated with high density CMOS logic on the same wafer. As such, specific schedules for multiple short fabrication loops in each phase are left up to the proposer to specify. It is suggested that these short loop runs in some way coordinate with quarterly program reviews, teleconferences, and twice annual in-person program meetings. End of phase milestones are required deadlines.

The notional schedule, milestones, and deliverables of Phase 1 and 2 are shown in Table 3 and those for Phase 3 are shown in Table 4. It is critical that the timelines of multiple partners are aligned to facilitate coordination of MPW runs. Therefore, if a deviation from Tables 3 or 4 is proposed, proposals must justify the reasons.

Table 3. Schedule, milestones and deliverables for Phase 1 and 2

Phase	TA-1				TA-1B		TA-2	
1, 2	TA-1A Foundry Technology		TA-1A Foundry MPW		TA-1B Building Blocks		TA-2 THz Devices	
Month	Task	Deliverables	Task	Deliverables	Task	Deliverables	Task	Deliverables
0	Kickoff							
1	NDAs/DKLAs in place							
2	Draft PDK.+1	**Draft PDK.+1**	PDK.0 ready	**PDK.0 Release**	**Design starts**		Draft PDK.+1	**Draft PDK.+1**
3	PDR: fab plan	PCM, Test cell					PDR: fab plan	PCM, Test cell
4	**Short Loops**	**SL Plan, PDR**	MPW PDR		MPW PDR	Simulation	**Short Loops**	
5								
6			MPW CDR	PCM Test cells	MPW CDR	Layout; Simul.		
7	SL CDR	SL Test Report	**MPW Tape-in**		**MPW Tape-in**		SL CDR	SL Test Report
8								
9			**MPW start**	Report	MPW CDR	**Test plan; Doc**		
10								
11	SL CDR	SL Test Report			**PDK.+1 CDR**	Comments	SL CDR	SL Test Report
12								
13								
14			**MPW Out**		**MPW Test start**			
15	SL CDR	SL Test Report	PCM Test	PCM Report			SL CDR	SL Test Report
16	**SL Complete**		MPW CDR	**PDK.0 Update**	MPW CDR	**Test result**	**SL Complete**	
17	**PDK.+1 Update**	**PDK.+1Release**				Test report	**PDK.+1 Update**	**PDK.+1Release**
18	Phase Review							

- PDK: Process Design Kit; SL: Short Fabrication Loop; PDR: Preliminary Design Review; CDR: Critical Design Review; NDA: Non-Disclosure Agreement; PCM: Process Control Monitor.

Table 4. Schedule, milestones and deliverables for Phase 3

Phase	TA-1				TA-1B		TA-2	
3	TA-1A Foundry Technology		TA-1A Foundry MPW		TA-1B Building Blocks		TA-2 THz Devices	
Month	Task	Deliverables	Task	Deliverables	Task	Deliverables	Task	Deliverables
0	Kickoff							
1	Draft PDK.+1	**Draft PDK.+1**	PDK.0 ready	**PDK. Release**	**Design starts**	Simulation	**Short Loops**	**Draft PDK.**
2	PDR: fab plan	PCM, Test cell	MPW PDR	PCM Test cells		Layout; Simul.	PDR: fab plan	PCM, Test cell
3	**Short Loops**	**SL Plan, PDR**	MPW CDR		MPW CDR			
4			**MPW Tape-in**		**MPW Tape-in**			
5			**MPW start**	Report		**Test plan; Doc**	SL CDR	SL Test Report
6	SL CDR	SL Test Report	MPW CDR		MPW CDR			
7		CDR			**PDK.+1 Review**	CDR. Comments		
8								
9	**SL Complete**	PCM, Test cell					**SL Complete**	SL Test Report
10	SL Test	SL Test Report	**MPW Out**	PCM Report	**MPW Test start**	Test results	**PDK. Update**	**PDK. Release**
11	**PDK.+1 Update**	**PDK.+1 Release**	**PDK.0 Update**	**PDK. Release**	MPW CDR	**Test Report**	SL CDR	Test Report
12	End of Program Review							

- PDK: Process Design Kit; SL: Short Loop; PDR: Preliminary Design Review; CDR: Critical Design Review; NDA: Non-Disclosure Agreement; PCM: Process Control Monitor.

F. Additional Deliverables

The T-MUSIC program requires further deliverables in addition to those listed in the previous section:

1. Technical Reports
Technical reports shall be submitted on a monthly basis beginning within two weeks after the kick-off meeting and two working days prior to each subsequently scheduled program event, such as technical review meetings.

2. Monthly Financial Reports
The financial report shall describe resources expended, resources available, any deviation from planned expenditures, and any potential issues requiring the attention of the Government team. This report shall be provided within 10 days from the end of each month.

3. Technical Review Meetings/Program Review Meetings
Technical review meetings will be held quarterly with the T-MUSIC Program Manager, usually as a teleconference. Program reviews with all performers will be held semi-annually and will replace the technical review meeting. Technical reports corresponding to these program events can be submitted as annotated slide presentations. Technical reports for the months without specific program events shall be submitted as text documents. All reports shall include a technical and management work plan that documents the project schedule including milestones and is updated as required.

4. Final Report
After the end of each phase, the report shall summarize the effort in a comprehensive text document.

G. Government Furnished Equipment/Property/Information

TA-1A: None.

TA-1B: As previously discussed, TA-1A MPW runs to TA-1B performers (as coordinated via the TA-1A/TA-1B ACAs).

TA-2: None.

H. Intellectual Property

It is expected that the data/software developed under T-MUSIC will have the following minimum data rights:

- TA-1A: Government shall have no less than Limited/Restricted Rights (or similar if an Other Transaction).

- TA-1B: Government shall have no less than Government Purpose Rights (or similar if an Other Transaction).
- TA-2: Government shall have no less than Government Purpose Rights (or similar if an Other Transaction).

See also Section IV.B.3, "Other Transaction Request, if applicable" and Section IV.B.11, "Intellectual Property."

II. Award Information

A. General Award Information

Multiple awards are anticipated. The amount of resources made available under this BAA will depend on the quality of the proposals received and the availability of funds.

The Government reserves the right to select for negotiation all, some, one, or none of the proposals received in response to this solicitation, and to make awards without discussions with proposers. The Government also reserves the right to conduct discussions if it is later determined to be necessary. If warranted, portions of resulting awards may be segregated into pre-priced options. Additionally, DARPA reserves the right to accept proposals in their entirety or to select only portions of proposals for award. In the event that DARPA desires to award only portions of a proposal, negotiations may be opened with that proposer. The Government reserves the right to fund proposals in phases with options for continued work at the end of one or more of the phases, as applicable.

Awards under this BAA will be made to proposers on the basis of the evaluation criteria listed below (see section labeled "Application Review Information," Sec. V.), and program balance to provide overall value to the Government. The Government reserves the right to request any additional, necessary documentation once it makes the award instrument determination. Such additional information may include but is not limited to Representations and Certifications (see Section VI.B.4., "Representations and Certifications"). The Government reserves the right to remove proposers from award consideration should the parties fail to reach agreement on award terms, conditions and cost/price within a reasonable time or the proposer fails to timely provide requested additional information. Proposals identified for negotiation may result in a procurement contract, grant, cooperative agreement, or other transaction, depending upon the nature of the work proposed, the required degree of interaction between parties, whether or not the research is classified as Fundamental Research, and other factors.

Proposers looking for innovative, commercial-like contractual arrangements are encouraged to consider requesting Other Transactions. To understand the flexibility and options associated with Other Transactions, consult http://www.darpa.mil/work-with-us/contract-management#OtherTransactions.

In accordance with 10 U.S.C. § 2371b(f), the Government may award a follow-on production contract or Other Transaction (OT) for any OT awarded under this BAA if: (1) that participant in the OT, or a recognized successor in interest to the OT, successfully completed the entire prototype

project provided for in the OT, as modified; and (2) the OT provides for the award of a follow-on production contract or OT to the participant, or a recognized successor in interest to the OT.

In all cases, the Government contracting officer shall have sole discretion to select award instrument type, regardless of instrument type proposed, and to negotiate all instrument terms and conditions with selectees. DARPA will apply publication or other restrictions, as necessary, if it determines that the research resulting from the proposed effort will present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense. Any award resulting from such a determination will include a requirement for DARPA permission before publishing any information or results on the program. For more information on publication restrictions, see the section below on Fundamental Research.

B. Fundamental Research

It is DoD policy that the publication of products of fundamental research will remain unrestricted to the maximum extent possible. National Security Decision Directive (NSDD) 189 defines fundamental research as follows:

> 'Fundamental research' means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons.

As of the date of publication of this BAA, the Government expects that program goals as described herein may be met by proposers intending to perform fundamental research and proposers not intending to perform fundamental research or the proposed research may present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense. Based on the nature of the performer and the nature of the work, the Government anticipates that some awards will include restrictions on the resultant research that will require the awardee to seek DARPA permission before publishing any information or results relative to the program.
Proposers should indicate in their proposal whether they believe the scope of the research included in their proposal is fundamental or not. While proposers should clearly explain the intended results of their research, the Government shall have sole discretion to select award instrument type and to negotiate all instrument terms and conditions with selectees. Appropriate clauses will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate. This clause can be found at http://www.darpa.mil/work-with-us/additional-baa.

For certain research projects, it may be possible that although the research being performed by the awardee is restricted research, a subawardee may be conducting fundamental research. In those cases, it is the awardee's responsibility to explain in their proposal why its subawardee's effort is fundamental research

III. Eligibility Information

A. Eligible Applicants

All responsible sources capable of satisfying the Government's needs may submit a proposal that shall be considered by DARPA.

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

a) FFRDCs

FFRDCs are subject to applicable direct competition limitations and cannot propose to this BAA in any capacity unless they meet the following conditions: (1) FFRDCs must clearly demonstrate that the proposed work is not otherwise available from the private sector. (2) FFRDCs must provide a letter on official letterhead from their sponsoring organization citing the specific authority establishing their eligibility to propose to Government solicitations and compete with industry, and their compliance with the associated FFRDC sponsor agreement's terms and conditions. This information is required for FFRDCs proposing to be awardees or subawardees.

b) Government Entities

Government Entities (e.g., Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations. Government entities must clearly demonstrate that the work is not otherwise available from the private sector and provide written documentation citing the specific statutory authority and contractual authority, if relevant, establishing their ability to propose to Government solicitations.

c) Authority and Eligibility

At the present time, DARPA does not consider 15 U.S.C. § 3710a to be sufficient legal authority to show eligibility. While 10 U.S.C.§ 2539b may be the appropriate statutory starting point for some entities, specific supporting regulatory guidance, together with evidence of agency approval, will still be required to fully establish eligibility. DARPA will consider FFRDC and Government entity eligibility submissions on a case-by-case basis; however, the burden to prove eligibility for all team members rests solely with the proposer.

(1) Non-U.S. organizations and/or individuals may participate to the extent that such participants comply with any necessary nondisclosure agreements, security regulations, export control laws, and other governing statutes applicable under the circumstances.

(2) For classified proposals, applicants will ensure all industrial, personnel, and information systems processing security requirements are in place and at the appropriate level (e.g., Facility Clearance Level (FCL), Automated Information Security

(AIS), Certification and Accreditation (C&A), and any Foreign Ownership Control and Influence (FOCI) issues are mitigated prior to submission. Additional information on these subjects can be found at http://www.dss.mil.

B. Organizational Conflicts of Interest

FAR 9.5 Requirements
In accordance with FAR 9.5, proposers are required to identify and disclose all facts relevant to potential OCIs involving the proposer's organization and *any* proposed team member (subawardee, consultant). Under this Section, the proposer is responsible for providing this disclosure with each proposal submitted to the BAA. The disclosure must include the proposer's, and as applicable, proposed team member's OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposer has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposer's judgment and to prevent the proposer from having unfair competitive advantage. The OCI mitigation plan will specifically discuss the disclosed OCI in the context of each of the OCI limitations outlined in FAR 9.505-1 through FAR 9.505-4.

Agency Supplemental OCI Policy
In addition, DARPA has a supplemental OCI policy that prohibits contractors/performers from concurrently providing Scientific Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS) or similar support services and being a technical performer. Therefore, as part of the FAR 9.5 disclosure requirement above, a proposer must affirm whether the proposer or *any* proposed team member (subawardee, consultant) is providing SETA, A&AS, or similar support to any DARPA office(s) under: (a) a current award or subaward; or (b) a past award or subaward that ended within one calendar year prior to the proposal's submission date.

If SETA, A&AS, or similar support is being or was provided to any DARPA office(s), the proposal must include:

- The name of the DARPA office receiving the support;
- The prime contract number;
- Identification of proposed team member (subawardee, consultant) providing the support; and
- An OCI mitigation plan in accordance with FAR 9.5.

Government Procedures
In accordance with FAR 9.503, 9.504 and 9.506, the Government will evaluate OCI mitigation plans to avoid, neutralize or mitigate potential OCI issues before award and to determine whether it is in the Government's interest to grant a waiver. The Government will only evaluate OCI mitigation plans for proposals that are determined selectable under the BAA evaluation criteria and funding availability.

The Government may require proposers to provide additional information to assist the Government in evaluating the proposer's OCI mitigation plan.

If the Government determines that a proposer failed to fully disclose an OCI; or failed to provide the affirmation of DARPA support as described above; or failed to reasonably provide additional

information requested by the Government to assist in evaluating the proposer's OCI mitigation plan, the Government may reject the proposal and withdraw it from consideration for award.

C. Cost Sharing/Matching

Cost sharing is not specifically a requirement of this BAA; however, it is strongly encouraged for TA-1A proposals, where there is a reasonable probability of a potential commercial application related to the proposed research and development effort.

For more information on potential cost sharing requirements associated with the use of Other Transaction (OT) authorities, see http://www.darpa.mil/work-with-us/contract-management#OtherTransactions.

D. Associate Contractor Agreement Clause

This same or similar clause will be included in all TA-1A and TA-1B awards against HR001119S0016:

(a) It is recognized that success of the T-MUSIC research effort depends in part upon the open exchange of information between the various Associate Contractors involved in the effort. This clause is intended to ensure that there will be appropriate coordination and integration of work by the Associate Contractors to achieve complete compatibility and to prevent unnecessary duplication of effort. By executing this contract, the Contractor assumes the responsibilities of an Associate Contractor. For the purpose of this clause, the term Contractor includes subsidiaries, affiliates, and organizations under the control of the contractor (e.g. subcontractors).

(b) Work under this contract may involve access to proprietary or confidential data from an Associate Contractor. To the extent that such data is received by the Contractor from any Associate Contractor for the performance of this contract, the Contractor hereby agrees that any proprietary information received shall remain the property of the Associate Contractor and shall be used solely for the purpose of the T-MUSIC research effort. Only that information which is received from another contractor in writing and which is clearly identified as proprietary or confidential shall be protected in accordance with this provision. The obligation to retain such information in confidence will be satisfied if the Contractor receiving such information utilizes the same controls as it employs to avoid disclosure, publication, or dissemination of its own proprietary information. The receiving Contractor agrees to hold such information in confidence as provided herein so long as such information is of a proprietary/confidential or limited rights nature.

(c) The Contractor hereby agrees to closely cooperate as an Associate Contractor with the other Associate Contractors on this research effort. This involves as a minimum:

(1) Maintenance of a close liaison and working relationship;
(2) Maintenance of a free and open information network with all Government identified Associate Contractors;
(3) Delineation of detailed interface responsibilities;
(4) Entering into a written agreement with the other Associate Contractors setting forth the substance and procedures relating to the foregoing, and

promptly providing the Agreements Officer/Procuring Contracting Officer with a copy of same; and,

(5) Receipt of proprietary information from the Associate Contractor and transmittal of Contractor proprietary information to the Associate Contractors subject to any applicable proprietary information exchange agreements between associate contractors when, in either case, those actions are necessary for the performance of either.

(d) In the event that the Contractor and the Associate Contractor are unable to agree upon any such interface matter of substance, or if the technical data identified is not provided as scheduled, the Contractor shall promptly notify the DARPA T-MUSIC Program Manager. The Government will determine the appropriate corrective action and will issue guidance to the affected Contractor.

(e) The Contractor agrees to insert in all subcontracts hereunder which require access to proprietary information belonging to the Associate Contractor, a provision which shall conform substantially to the language of this clause, including this paragraph (e).

(f) Associate Contractors for this T-MUSIC research effort include

Contractor	Technical Area

Note: It is intended that ACAs be established, after selections and prior to contract award, between:

Performer	ACA With
Each TA-1A performer	Each TA-1B performer
Each TA-1B performer	Each TA-1A performer

IV. Application and Submission Information

PROPOSERS ARE CAUTIONED THAT EVALUATION RATINGS MAY BE LOWERED AND/OR PROPOSALS REJECTED IF PROPOSAL PREPARATION (PROPOSAL FORMAT, CONTENT, ETC.) AND/OR SUBMITTAL INSTRUCTIONS ARE NOT FOLLOWED.

A. Address to Request Application Package

This announcement, any attachments, and any references to external websites herein constitute the total solicitation. If proposers cannot access the referenced material posted in the announcement found at www.darpa.mil, contact the administrative contact listed herein.

B. Content and Form of Application Submission

1. Abstract Format

Abstracts should follow the format described below in this section. The cover sheet should be clearly marked “ABSTRACT” and the total length of Section II should not exceed 5 pages. All pages shall be printed on 8-1/2 by 11 inch paper with type not smaller than 12 point. Smaller font may be used for figures, tables and charts. The page limitation for abstracts includes all figures,

tables, and charts. No formal transmittal letter is required. All abstracts must be written in English.

Section I. Administrative

A. Cover sheet to include:
(1) BAA number (HR001119S0016);
(2) Technical area(s);
(3) Lead Organization submitting abstract;
(4) Type of organization, selected among the following categories:
Large Organization, Small Disadvantaged Organization, Other Small Organization, HBCU, MI, Other Educational, Other Nonprofit;
(5) Proposer's internal reference number (if any);
(6) Other team members (if applicable) and type of organization for each;
(7) Proposal title;
(8) Technical point of contact to include:
Salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail;
(9) Administrative point of contact to include:
Salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail;
(10) Total funds requested from DARPA, and the amount of cost share (if any); AND
(11) Date proposal abstract was submitted.

(Note: An official transmittal letter is not required when submitting a Proposal Abstract.)

Section II. Abstract Details

A. Innovative Claims
Summary of innovative claims for the proposed research. This section is the centerpiece of the abstract and should succinctly describe the uniqueness and benefits of the proposed approach relative to the current state-of-art alternate approaches.

B. Technical Approach
Technical rationale, technical approach, and constructive plan for accomplishment of technical goals in support of innovative claims and deliverable production.

C. Deliverables
Deliverables associated with the proposed research and the plans and capability to accomplish technology transition and commercialization.

D. Other Research
General discussion of other research in this area.

E. Cost and Schedule
Provide a cost estimate for resources (e.g. labor, materials) and any subcontractors over the proposed timeline of the project, broken down by Government fiscal year.

2. Full Proposal Format

All full proposals must be in the format given below. Proposals shall consist of two volumes: Volume I – Technical and Management Proposal (3 sections), and Volume II – Cost Proposal (4 sections). The submission of other supporting materials along with the proposals is strongly discouraged and will not be considered for review. All pages shall be printed on 8-1/2 by 11 inch paper with type not smaller than 12 point. Smaller font may be used for figures, tables and charts. The page limitation for full proposals includes all figures, tables, and charts. Section II of Volume I, Technical and Management Proposal, shall not exceed 20 pages. There is no page limit for Volume II, Cost Proposal. All full proposals must be written in English.

A summary slide of the proposed effort, in PowerPoint format, should be submitted with the proposal. A template slide is provided as Attachment 2 to the BAA. Submit this PowerPoint file in addition to Volumes I and II of your full proposal. This summary slide does not count towards the total page count.

a. Volume I, Technical and Management Proposal

Section I. Administrative

A. Cover sheet to include:

(1) BAA number (HR001119S0016);
(2) Technical area(s);
(3) Lead Organization submitting proposal;
(4) Type of organization, selected among the following categories:
Large Organization, Small Disadvantaged Organization, Other Small Organization, HBCU, MI, Other Educational, Other Nonprofit;
(5) Proposer's internal reference number (if any);
(6) Other team members (if applicable) and type of organization for each;
(7) Proposal title;
(8) Technical point of contact to include:
Salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail;
(9) Administrative point of contact to include:
Salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail;
(10) Total funds requested from DARPA, and the amount of cost share (if any); AND
(11) Date proposal was submitted.

B. Official transmittal letter.

The transmittal letter should identify the BAA number, the proposal by name, and the proposal reference number (if any), and should be signed by an individual who is authorized to submit proposals to the Government.

Section II. Detailed Proposal Information

A. Executive Summary (no more than 2 pages)

An executive summary outlining the proposed effort. The executive summary should be concise and to the point. Tables, graphs and diagrams can also be used as supplemental material along with narrative to convey the information. The executive summary must contain:

1. Innovations made by the proposed work.
2. A high-level overview of the proposed work;
3. Any proposer defined critical metrics used to define success;
4. Milestones (both DARPA-mandated and proposer-defined);

B. Technical Approach

This section is the centerpiece of the proposal and should succinctly summarize the innovative claims for the proposed research and clearly describe the proposed approach without using any jargon. This section should demonstrate that the proposer has a clear understanding of the state-of-the-art and should provide sufficient justification for the feasibility of the proposed approach(es). This section should include a detailed technical rationale, technical approach, and constructive plan for accomplishment of technical goals in support of innovative claims and deliverable creation.

For TA-1A proposals, the Technical Approach should clearly articulate:

1. The technical approaches to scale mixed-mode transistors to achieve the program metrics in each program phase.
2. The fabrication process development to co-integrate these ultra-fast mixed-mode transistors with advanced CMOS.
3. Fabrication yield improvement strategy.
4. Technical risks and risk mitigation approaches for each risk.
5. The coordination plans to release PDKs, MPW fabrication schedule, incorporation of critical basic mixed-mode test cells and PCMs in each MPW and exchange test cell results with TA-1B performers to successfully accomplish their respective goals and objectives.

For TA-1B proposals, the Technical Approach should clearly articulate:

1. The notional circuit architectures to realize the T-MUSIC demo circuit goals in each program phase.
2. Estimation of the require mixed-mode transistor technology characteristics such as active transistors and back-end-of-line interconnect to support the proposed circuit architectures.
3. Technical risks and risk mitigation approaches.
4. The coordination plans to support PDK development and MPW design iterations with TA-1A performers by co-implementing critical basic mixed-mode test cells and PCMs in each MPW, exchanging technology requirements and test cell results to successfully accomplish their respective goals and objectives.

For TA-2 proposals, the Technical Approach should clearly articulate:

1. Novel device concept to achieve THz

2. The compatibility to be integrated in the advanced CMOS technology platforms such as FinFET and beyond.
3. Technical risks and risk mitigation approaches for each risk.

C. Statement of Work (SOW)

In plain English, clearly define the technical tasks/subtasks to be performed, their durations, and dependencies among them. The page length for the SOW will be dependent on the amount of the effort. The SOW must not include proprietary information. For each task/subtask, provide:

1. A general description of the objective (for each defined task/activity);
2. A detailed description of the approach to be taken to accomplish each defined task/activity;
3. Identification of the primary organization responsible for task execution (prime, sub, team member, by name, etc.);
4. The completion criteria for each task/activity - a product, event or milestone that defines its completion.
5. Define all deliverables (reporting, data, reports, software, PDK, design files, MPW runs, number of wafers/devices to be tested by the government team, etc.) to be provided to the Government in support of the proposed research tasks/activities.

*Note: Each Phase of the program must be separately defined in the SOW. Include a SOW for each subcontractor and/or consultant in the **Cost Proposal Volume**. Do not include any proprietary information in the SOW(s).*

D. Results and Technology Transfer

Description of the results, products, transferable technology, and expected technology transfer. This should also address mitigation of life-cycle and sustainment risks associated with transitioning intellectual property for U.S. military applications, if applicable. See also Section IV.B.11, "Intellectual Property." If there are no proprietary claims, this should be stated.

E. Ongoing Research (no more than 2 pages)

Comparison with other ongoing research indicating advantages and disadvantages of the proposed effort.

F. Proposer Accomplishments (no more than 2 pages)

Discussion of proposer's previous accomplishments and work in closely related research areas relevant to T-MUSIC.

G. Facilities (no more than 1 page)

Description of the facilities that would be used for the proposed effort.

H. Teaming (no more than 1 page)

Describe the formal teaming arrangements which will be used to execute this effort. Describe the programmatic relationship between investigators and the rationale for choosing this teaming strategy. Present a coherent organization chart and integrated management strategy

for the program team. For each person, indicate: (1) name, (2) affiliation, (3) abbreviated listing of all technical area tasks they will work on with roles, responsibilities, and percent time indicated, (4) discussion of the proposers' previous accomplishments, relevant expertise and/or unique capabilities.

I. Schedules and measurable milestones

Schedules and measurable milestones for the proposed research. Clearly tie the larger milestones with the metrics and milestones of the program as described previously. Where the effort consists of multiple portions which could reasonably be partitioned for purposes of funding, these should be identified as options. Additionally, proposals should clearly explain the technical approach(es) that will be employed to meet or exceed each program metric in each phase and provide ample justification as to why the approach(es) is/are feasible. The milestones must not include proprietary information.

J. National Security Impact Statement (not to exceed 2 pages)

To reduce the potential for unintended foreign access to critical U.S. national security technologies developed under this effort, describe:

- How the proposed work contributes to U.S. national security and U.S. technological capabilities. The proposer may also summarize previous work that contributed to U.S. national security and U.S. technological capabilities.
- Plans and capabilities to transition technologies developed under this effort to U.S. national security applications and/or to U.S. industry. The proposer may also discuss previous technology transitions to the benefit of U.S. interests.
- Any plans to transition technologies developed under this effort to foreign governments or to companies that are foreign owned, controlled or influenced. The proposer may also discuss previous technology transition to these groups.
- How the proposer will assist its employees and agents performing work under this effort to be eligible to participate in the U.S. national security environment.

Section III. Additional Information

Information in this section may include a brief bibliography of relevant technical papers and research notes (published and unpublished) which document the technical ideas upon which the proposal is based. Copies of not more than three (3) relevant prior papers may be included in the submission.

b. Volume II, Cost Proposal – {No Page Limit}

All proposers, including FFRDCs, must submit the following:

Section I. Administrative

Cover sheet to include:

(1) BAA number (HR001119S0016);
(2) Technical area(s);
(3) Lead Organization submitting proposal;

(4) Type of organization, selected among the following categories:
Large Organization, Small Disadvantaged Organization, Other Small Organization, HBCU, MI, Other Educational, Other Nonprofit;
(5) Proposer's internal reference number (if any);
(6) Other team members (if applicable) and type of organization for each;
(7) Proposal title;
(8) Technical point of contact to include:
Salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail (if available);
(9) Administrative point of contact to include:
Salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), and electronic mail (if available);
(10) Award instrument requested:
Cost-Plus-Fixed Fee (CPFF), Cost-contract—no fee, cost sharing contract—no fee, or other type of procurement contract (*specify*), Grant, Cooperative Agreement, or Other Transaction;
(11) Place(s) and period(s) of performance;
(12) Total proposed cost separated by basic award and option(s), if any, by calendar year and by government fiscal year;
(13) Name, address, and telephone number of the proposer's cognizant Defense Contract Management Agency (DCMA) administration office (*if known)*;
(14) Name, address, and telephone number of the proposer's cognizant Defense Contract Audit Agency (DCAA) audit office (*if known*);
(15) Date proposal was prepared;
(16) DUNS number;
(17) TIN number;
(18) CAGE Code;
(19) Subcontractor Information;
(20) Proposal validity period (120 days is recommended); AND
(21) Any Forward Pricing Rate Agreement, other such approved rate information, or such documentation that may assist in expediting negotiations (if available).

Attachment 1, the Cost Volume Proposer Checklist, must be included with the coversheet of the Cost Proposal.

Section II. Detailed Cost Information (Prime and Subcontractors)

The proposers', to include eligible FFRDCs', cost volume shall provide cost and pricing information (See Note 1), or other than cost or pricing information if the total price is under the referenced threshold, in sufficient detail to substantiate the program price proposed (e.g., realism and reasonableness). In doing so, the proposer shall provide, for **both the prime and each subcontractor**, a "Summary Cost Breakdown" by phase and performer fiscal year, and a "Detailed Cost Breakdown" by phase, technical task/sub-task, and month. The breakdown/s shall include, at a minimum, the following major cost items along with associated backup documentation:

Total program cost broken down by major cost items:

A. Direct Labor
A breakout clearly identifying the individual labor categories with associated labor hours and direct labor rates, as well as a detailed Basis-of-Estimate (BOE) narrative description of the methods used to estimate labor costs;

B. Indirect Costs
Including Fringe Benefits, Overhead, General and Administrative Expense, Cost of Money, Fee, etc. (must show base amount and rate);

C. Travel
Provide the purpose of the trip, number of trips, number of days per trip, departure and arrival destinations, number of people, etc.;

D. Other Direct Costs
Itemized with costs; back-up documentation is to be submitted to support proposed costs;

E. Material/Equipment
(i) For IT and equipment purchases, include a letter stating why the proposer cannot provide the requested resources from its own funding.
(ii) A priced Bill-of-Material (BOM) clearly identifying, for each item proposed, the quantity, unit price, the source of the unit price (i.e., vendor quote, engineering estimate, etc.), the type of property (i.e., material, equipment, special test equipment, information technology, etc.), and a cross-reference to the Statement of Work (SOW) task/s that require the item/s. At time of proposal submission, any item that exceeds $1,000 must be supported with basis-of-estimate (BOE) documentation such as a copy of catalog price lists, vendor quotes or a written engineering estimate (additional documentation may be required during negotiations, if selected).
(iii) If seeking a procurement contract and items of Contractor Acquired Property are proposed, exclusive of material, the proposer shall clearly demonstrate that the inclusion of such items as Government Property is in keeping with the requirements of FAR Part 45.102. In accordance with FAR 35.014, "Government property and title," it is the Government's intent that title to all equipment purchased with funds available for research under any resulting contract will vest in the acquiring nonprofit institution (e.g., Nonprofit Institutions of Higher Education and Nonprofit Organizations whose primary purpose is the conduct of scientific research) upon acquisition without further obligation to the Government. Any such equipment shall be used for the conduct of basic and applied scientific research. The above transfer of title to all equipment purchased with funds available for research under any resulting contract is not allowable when the acquiring entity is a for-profit organization; however, such organizations can, in accordance with FAR 52.245-1(j), be given priority to acquire such property at its full acquisition cost.

F. Consultants
If consultants are to be used, proposer must provide a copy of the consultant's proposed SOW as well as a signed consultant agreement or other document which verifies the proposed loaded daily / hourly rate and any other proposed consultant costs (e.g. travel);

G. Subcontracts

Itemization of all subcontracts. Additionally, the prime contractor is responsible for compiling and providing, as part of its proposal submission to the Government, subcontractor proposals prepared at the same level of detail as that required by the prime. Subcontractor proposals include Interdivisional Work Transfer Agreements (ITWA) or similar arrangements. If seeking a procurement contract, the prime contractor shall provide a cost reasonableness analysis of all proposed subcontractor costs/prices. Such analysis shall indicate the extent to which the prime contractor has negotiated subcontract costs/prices and whether any such subcontracts are to be placed on a sole-source basis.

All proprietary subcontractor proposal documentation, prepared at the same level of detail as that required of the prime, which cannot be uploaded to the DARPA BAA website (https://baa.darpa.mil, BAAT) or Grants.gov as part of the proposer's submission, shall be made immediately available to the Government, upon request, under separate cover (i.e., mail, electronic/email, etc.), either by the proposer or by the subcontractor organization. This does not relieve the proposer from the requirement to include, as part of their submission (via BAAT or Grants.gov, as applicable), subcontract proposals that do not include proprietary pricing information (rates, factors, etc.).

A Rough Order of Magnitude (ROM), or similar budgetary estimate, is not considered a fully qualified subcontract cost proposal submission. Inclusion of a ROM, or similar budgetary estimate, may result in the full proposal being deemed non-compliant or evaluation ratings may be lowered;

H. Cost-Sharing

The amount of any industry cost-sharing (the source and nature of any proposed cost-sharing should be discussed in the narrative portion of the cost volume).

I. Fundamental Research

Written justification required per Section II.B, "Fundamental Research," pertaining to prime and/or subcontracted effort being considered Contracted Fundamental Research.

Note 1:
(a) "Cost or Pricing Data" as defined in FAR 15.403-4 shall be required if the proposer is seeking a procurement contract per the referenced threshold, unless the proposer requests and is granted an exception from the requirement to submit cost or pricing data. Per DoD Class Deviation 2018-O0012, dated 13 April 2018, the threshold for obtaining certified cost and pricing data is $2,000,000. Per DFARS 215.408(5), DFARS 252.215-7009, Proposal Adequacy Checklist, applies to all proposers/proposals seeking a FAR-based award (contract).
(b) In accordance with DFARS 215.403-1(4)(D), DoD has waived cost or pricing data requirements for nonprofit organizations (including educational institutions) on cost-reimbursement-no-fee contracts. In such instances where the waiver stipulated at DFARs 215.403-1(4)(D) applies, proposers shall submit information other than cost or pricing data to the extent necessary for the Government to determine price reasonableness and cost realism; and cost or pricing data from subcontractors that are not nonprofit organizations when the subcontractor's proposal exceeds the cost and pricing data threshold at FAR 15.403-4(a)(1).

(c) Per Section 873 of the FY2016 National Defense Authorization Act (Pub L. 114-92), "Pilot Program For Streamlining Awards For Innovative Technology Projects," small businesses and nontraditional defense contractors (as defined therein) are alleviated from submission of certified cost and pricing data for new contract awards valued at less than $7,500,000. In such instances where this "waiver" applies, proposers seeking a FAR-based contract shall submit information other than certified cost or pricing data to the extent necessary for the Government to determine price reasonableness and cost realism; and certified cost or pricing data from subcontractors that are not small businesses or nontraditional defense contractors when such subcontract proposals exceed the cost and pricing data threshold at FAR 15.403-4(a)(1).
(d) "Cost or pricing data" are not required if the proposer proposes an award instrument other than a procurement contract (i.e., cooperative agreement, grant, or other transaction).

Note 2:
Proposers are required to provide the aforementioned cost breakdown as an editable MS Excel spreadsheet, inclusive of calculations formulae, with tabs (material, travel, ODC's) provided as necessary. The Government also requests and recommends that the Cost Proposal include MS Excel file(s) that provide traceability between the Bases of Estimate (BOEs) and the proposed costs across all elements and phases. This includes the calculations and adjustments that are utilized to generate the Summary Costs from the source labor hours, labor costs, material costs, etc. input data. It is requested that the costs and Subcontractor proposals be readily traceable to the Prime Cost Proposal in the provided MS Excel file(s) – although this is not a requirement, providing information in this manner will assist the Government in understanding what is being proposed both technically and in terms of cost realism. An example MS Excel template is included in the announcement, although it is not mandatory to use. NOTE: If the PDF submission differs from the Excel submission, the PDF will take precedence.

Section III. Other Transaction Request, if applicable

All proposers requesting an Other Transaction (OT) must include a detailed list of payment milestones (Milestone Plan). Each milestone must include the following:

- Milestone description
- Completion/Exit criteria (to include identifying all associated data deliverables excluding those specifically providing project status)
- Due date
- Payment/funding schedule (to include, if cost share is proposed, awardee and Government share amounts)
- For each data deliverable, identify the proposed Government data rights (keeping in mind the how each data deliverable will need to be used by the Government given the goals and objectives of the proposed project)

It is noted that, at a minimum, milestones should relate directly to accomplishment of program technical metrics as defined in the BAA and/or the proposer's proposal. Agreement type, expenditure or fixed-price based, will be subject to negotiation by the Agreements Officer. Do not include proprietary data.

Section IV. Other Cost Information

Where the effort consists of multiple portions, which could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates.

The cost proposal should include identification of pricing assumptions of which may require incorporation into the resulting award instrument (i.e., use of Government Furnished Property/Facilities/Information, access to Government Subject Matter Experts, etc.).

The proposer should include supporting cost and pricing information in sufficient detail to substantiate the summary cost estimates and should include a description of the method used to estimate costs and supporting documentation.

Cost proposals submitted by FFRDC's (prime or subcontractor) will be forwarded, if selected for negotiation, to their sponsoring organization contracting officer for review to confirm that all required forward pricing rates and factors have been used.

3. Proprietary Information

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.

4. Security Information

a. Program Security Information

Proposers should include with their proposal any proposed solution(s) to program security requirements unique to this program. Common program security requirements include but are not limited to: operational security (OPSEC) contracting/sub-contracting plans; foreign participation or materials utilization plans; program protection plans (which may entail the following) manufacturing and integration plans; range utilization and support plans (air, sea, land, space, and cyber); data dissemination plans; asset transportation plans; classified test activity plans; disaster recovery plans; classified material / asset disposition plans and public affairs / communications plans.

A Controlled Unclassified Information (CUI) guide may be issued as part of any procurement contract, based on the funding type used, the type of awardee, and the scope of the contract.

b. Unclassified Submissions

DARPA anticipates that submissions received under this BAA will be unclassified. However, should a proposer wish to submit classified information, an *unclassified* email must be sent to the

BAA mailbox notifying the Technical Office PSO of the submission and the below guidance must be followed.

Security classification guidance and direction via a Security Classification Guide (SCG) and/or DD Form 254, "DoD Contract Security Classification Specification," will not be provided at this time. If a determination is made that the award instrument may result in access to classified information, a SCG and/or DD Form 254 will be issued by DARPA and attached as part of the award.

Classified submissions shall be transmitted in accordance with the following guidance. Additional information on the subjects discussed in this section may be found at http://www.dss.mil/.

If a submission contains Classified National Security Information as defined by Executive Order 13526, the information must be appropriately and conspicuously marked with the proposed classification level and declassification date. Similarly, when the classification of a submission is in question, the submission must be appropriately and conspicuously marked with the proposed classification level and declassification date. Submissions requiring DARPA to make a final classification determination shall be marked as follows:

> "CLASSIFICATION DETERMINATION PENDING. Protect as though classified _____ *(insert the recommended classification level, e.g., Top Secret, Secret or Confidential).*"

NOTE: Classified submissions must indicate the classification level of not only the submitted materials, but also the classification level of the anticipated award.

Proposers submitting classified information must have, or be able to obtain prior to contract award, cognizant security agency approved facilities, information systems, and appropriately cleared/eligible personnel to perform at the classification level proposed. All proposer personnel performing Information Assurance (IA)/Cybersecurity related duties on classified Information Systems shall meet the requirements set forth in DoD Manual 8570.01-M (Information Assurance Workforce Improvement Program).

When a proposal includes a classified portion, and when able according to security guidelines, we ask that proposers send an e-mail to HR001119S0016@darpa.mil as notification that there is a classified portion to the proposal. When sending the classified portion via mail according to the instructions, proposers should submit six (6) hard copies of the classified portion of their proposal and two (2) CD-ROMs containing the classified portion of the proposal as a single searchable Adobe PDF file. Please ensure that all CDs are well-marked. Each copy of the classified portion must be clearly labeled with HR001119S0016, proposer organization, proposal title (short title recommended), and Copy _ of _.

Proposers choosing to submit classified information from other collateral classified sources (i.e., sources other than DARPA) must ensure (1) they have permission from an authorized individual at the cognizant Government agency (e.g., Contracting Officer, Program Manager); (2) the

proposal is marked in accordance with the source Security Classification Guide (SCG) from which the material is derived; and (3) the source SCG is submitted along with the proposal.

Confidential and Secret Information
Use transmission, classification, handling, and marking guidance provided by previously issued SCGs, the DoD Information Security Manual (DoDM 5200.01, Volumes 1 - 4), and the National Industrial Security Program Operating Manual, including the Supplement Revision 1, (DoD 5220.22-M and DoD 5200.22-M Sup. 1) when submitting Confidential and/or Secret classified information.

Confidential and Secret classified information may be submitted via ONE of the two following methods:

- Hand-carried by an appropriately cleared and authorized courier to the DARPA CDR. Prior to traveling, the courier shall contact the DARPA Classified Document Registry (CDR) at 703-526-4052 to coordinate arrival and delivery.

OR

- Mailed via U.S. Postal Service (USPS) Registered Mail or USPS Express Mail. All classified information will be enclosed in opaque inner and outer covers and double-wrapped. The inner envelope shall be sealed and plainly marked with the assigned classification and addresses of both sender and addressee.

The inner envelope shall be addressed to:

Defense Advanced Research Projects Agency
ATTN: Program Security Officer, MTO
Reference: HR001119S0016
675 North Randolph Street
Arlington, VA 22203-2114

The outer envelope shall be sealed with no identification as to the classification of its contents and addressed to:

Defense Advanced Research Projects Agency
Security & Intelligence Directorate, Attn: CDR
675 North Randolph Street
Arlington, VA 22203-2114

Top Secret Information
Use classification, handling, and marking guidance provided by previously issued SCGs, the DoD Information Security Manual (DoDM 5200.01, Volumes 1 - 4), and the National Industrial Security Program Operating Manual, including the Supplement Revision 1, (DoD 5220.22-M and DoD 5200.22-M Sup. 1). Top Secret information must be hand-carried by an

appropriately cleared and authorized courier to the DARPA CDR. Prior to traveling, the courier shall contact the DARPA CDR at 703-526-4052 to coordinate arrival and delivery.

Sensitive Compartmented Information (SCI)
SCI must be marked, managed and transmitted in accordance with DoDM 5105.21 Volumes 1 - 3. Questions regarding the transmission of SCI may be sent to the DARPA Technical Office PSO via the BAA mailbox or by contacting the DARPA Special Security Officer (SSO) at 703-812-1970.

Successful proposers may be sponsored by DARPA for access to SCI. Sponsorship must be aligned to an existing DD Form 254 where SCI has been authorized. Questions regarding SCI sponsorship should be directed to the DARPA Personnel Security Office at 703-526-4543.

Special Access Program (SAP) Information
SAP information must be marked in accordance with DoDM 5205.07 Volume 4 and transmitted by specifically approved methods which will be provided by the Technical Office PSO or their staff.

Proposers choosing to submit SAP information from an agency other than DARPA are required to provide the DARPA Technical Office Program Security Officer (PSO) written permission from the source material's cognizant Special Access Program Control Officer (SAPCO) or designated representative. For clarification regarding this process, contact the DARPA Technical Office PSO via the BAA mailbox or the DARPA SAPCO at 703-526-4102.

Additional SAP security requirements regarding facility accreditations, information security, personnel security, physical security, operations security, test security, classified transportation plans, and program protection planning may be specified in the DD Form 254.

NOTE: prior to drafting the submission, if use of SAP Information Systems is to be proposed, proposers must first obtain an Authorization-to-Operate from the DARPA Technical Office PSO (or other applicable DARPA Authorization Official) using the Risk Management Framework (RMF) process outlined in the Joint Special Access Program (SAP) Implementation Guide (JSIG), Revision 3, dated October 9, 2013 (or successor document).

5. Disclosure of Information and Compliance with Safeguarding Covered Defense Information Controls

The following provisions and clause apply to all solicitations and contracts; however, the definition of "controlled technical information" clearly exempts work considered fundamental research and therefore, even though included in the contract, will not apply if the work is fundamental research.

DFARS 252.204-7000, "Disclosure of Information"
DFARS 252.204-7008, "Compliance with Safeguarding Covered Defense Information Controls"
DFARS 252.204-7012, "Safeguarding Covered Defense Information and Cyber Incident Reporting"

The full text of the above solicitation provision and contract clauses can be found at http://www.darpa.mil/work-with-us/additional-baa#NPRPAC.

Compliance with the above requirements includes the mandate for proposers to implement the security requirements specified by National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, "Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations" (see https://doi.org/10.6028/NIST.SP.800-171r1) that are in effect at the time the BAA is issued.

For awards where the work is considered fundamental research, the contractor will not have to implement the aforementioned requirements and safeguards; however, should the nature of the work change during performance of the award, work not considered fundamental research will be subject to these requirements.

6. Human Research Subjects/Animal Use

Proposers that anticipate involving Human Research Subjects or Animal Use must comply with the approval procedures detailed at http://www.darpa.mil/work-with-us/additional-baa.

7. Approved Cost Accounting System Documentation

Proposers that do not have a Cost Accounting Standards (CAS) complaint accounting system considered adequate for determining accurate costs that are negotiating a cost- type procurement contract must complete an SF 1408. For more information on CAS compliance, see http://www.dcaa.mil/cas.html. To facilitate this process, proposers should complete the SF 1408 found at http://www.gsa.gov/portal/forms/download/115778 and submit the completed form with the proposal. To complete the form, check the boxes on the second page, then provide a narrative explanation of your accounting system to supplement the checklist on page one. For more information, see (http://www.dcaa.mil/preaward_accounting_system_adequacy_checklist.html).

8. Section 508 of the Rehabilitation Act (29 U.S.C. § 749d)/FAR 39.2

All electronic and information technology acquired or created through this BAA must satisfy the accessibility requirements of Section 508 of the Rehabilitation Act (29 U.S.C § 794d)/FAR 39.2.

9. Grant Abstract

Per Section 8123 of the Department of Defense Appropriations Act, 2015 (Pub. L. 113-235), all grant awards must be posted on a public website in a searchable format. To comply with this requirement, proposers requesting grant awards must submit a maximum one (1) page abstract that may be publicly posted and explains the program or project to the public. The proposer should sign the bottom of the abstract confirming the information in the abstract is approved for public release. Proposers are advised to provide both a signed PDF copy, as well as an editable (e.g., Microsoft word) copy. Abstracts contained in grant proposals that are not selected for award will not be publicly posted.

10. Small Business Subcontracting Plan

Pursuant to Section 8(d) of the Small Business Act (15 U.S.C. § 637(d)) and FAR 19.702(a)(1), each proposer who is a small business concern and seeking a procurement contract that has subcontracting possibilities is required to submit a subcontracting plan with their proposal. The plan format is outlined in FAR 19.704. As of the date of publication of this BAA, per FAR 19.702, the threshold for submission of a small business subcontracting plan is $700,000 (total contract amount including options).

11. Intellectual Property

All proposers must provide a good faith representation that the proposer either owns or possesses the appropriate licensing rights to all intellectual property that will be utilized under the proposed effort.

a. For Procurement Contracts

Proposers responding to this BAA requesting procurement contracts will need to complete the certifications at DFARS 252.227-7017. See www.darpa.mil/work-with-us/additional-baa for further information. If no restrictions are intended, the proposer should state "none." The table below captures the requested information:

Technical Data Computer Software To be Furnished With Restrictions	Summary of Intended Use in the Conduct of the Research	Basis for Assertion	Asserted Rights Category	Name of Person Asserting Restrictions
(LIST)	(NARRATIVE)	(LIST)	(LIST)	(LIST)

b. For All Non-Procurement Contracts

Proposers responding to this BAA requesting a Grant, Cooperative Agreement, Technology Investment Agreement, or Other Transaction for Prototypes shall follow the applicable rules and regulations governing these various award instruments, but, in all cases, should appropriately identify any potential restrictions on the Government's use of any Intellectual Property contemplated under the award instrument in question. This includes both Noncommercial Items and Commercial Items. Proposers are encouraged use a format similar to that described in Paragraph a. above. If no restrictions are intended, then the proposer should state "NONE."

12. Patents

Include documentation proving your ownership of or possession of appropriate licensing rights to all patented inventions (or inventions for which a patent application has been filed) that will be utilized under your proposal for the DARPA program. If a patent application has been filed for an invention that your proposal utilizes, but the application has not yet been made publicly available and contains proprietary information, you may provide only the patent number,

inventor name(s), assignee names (if any), filing date, filing date of any related provisional application, and a summary of the patent title, together with either: (1) a representation that you own the invention, or (2) proof of possession of appropriate licensing rights in the invention.

13. System for Award Management (SAM) and Universal Identifier Requirements

All proposers must be registered in SAM unless exempt per FAR 4.1102. FAR 52.204-7, "System for Award Management" and FAR 52.204-13, "System for Award Management Maintenance" are incorporated into this BAA. See http://www.darpa.mil/work-with-us/additional-baa for further information.

International entities can register in SAM by following the instructions in this link: https://www.fsd.gov/fsd-gov/answer.do?sysparm_kbid=dbf8053adb119344d71272131f961946&sysparm_search=KB0013221.

14. Funding Restrictions

Not applicable.

C. Submission Information

DARPA will acknowledge receipt of all submissions and assign an identifying control number that should be used in all further correspondence regarding the submission. DARPA intends to use electronic mail correspondence regarding HR001119S0016. Submissions may not be submitted by fax or e-mail; any so sent will be disregarded.

Submissions will not be returned. An electronic copy of each submission received will be retained at DARPA and all other non-required copies destroyed. A certification of destruction may be requested, provided the formal request is received by DARPA within 5 days after notification that a proposal was not selected.

All administrative correspondence and questions on this solicitation, including requests for clarifying information on how to submit an abstract or full proposal to this BAA should be directed to HR001119S0016@darpa.mil. DARPA intends to use electronic mail for correspondence regarding HR001119S0016. Proposals and abstracts may not be submitted by fax or e-mail; any so sent will be disregarded. DARPA encourages use of the Internet for retrieving the BAA and any other related information that may subsequently be provided.

1. Submission Dates and Times

For consideration during the initial round of selections, proposers are required to follow the deadlines specified below. Proposers are warned that the likelihood of available funding is greatly reduced for proposals submitted after the initial closing date deadline.

a. Abstract Due Date

Abstracts must be submitted to DARPA/MTO on or before 1:00 PM, Eastern Time, January 25, 2019. Abstracts received after this time and date may not be reviewed.

b. Full Proposal Date

Full proposals must be submitted to DARPA/MTO on or before 1:00 PM, Eastern Time, March 12, 2019, in order to be considered during the initial round of selections.

Additionally, proposals may be submitted after the above due date until 1:00 PM, Eastern Time, April 8, 2019. If deemed compliant, such proposals will be reviewed at the Government's discretion, contingent upon the availability of funds.

Proposers are warned that the likelihood of available funding is greatly reduced for proposals submitted after the initial closing date deadline.

c. Frequently Asked Questions (FAQ)

DARPA will post a consolidated Question and Answer (FAQ) document on a regular basis. To access the posting go to: http://www.darpa.mil/work-with-us/opportunities. Under the HR001119S0016 summary will be a link to the FAQ. Submit your question/s by e-mail to HR001119S0016@darpa.mil. In order to receive a response sufficiently in advance of the proposal due date, send your question/s on or before 1:00 PM, Eastern Time, February 18, 2019.

2. Abstract Submission Information

Proposers are strongly encouraged to submit an abstract in advance of a full proposal in order to provide potential proposers with a rapid response and to minimize unnecessary effort in proposal preparation and review. DARPA will acknowledge receipt of the submission and assign a control number that should be used in all further correspondence regarding the abstract.

All abstracts sent in response to HR001119S0016 shall be submitted via DARPA's BAA Website (https://baa.darpa.mil). Visit the website to complete the two-step registration process. Submitters will need to register for an Extranet account (via the form at the URL listed above) and wait for two separate e-mails containing a username and temporary password. After accessing the Extranet, submitters may then create an account for the DARPA BAA website (via the "Register your Organization" link along the left side of the homepage), view submission instructions, and upload/finalize the abstract. Proposers using the DARPA BAA Website may encounter heavy traffic on the submission deadline date; it is highly advised that submission process be started as early as possible.

All abstracts submitted electronically through the DARPA BAA Submission website must be uploaded as zip files (.zip or .zipx extension). The final zip file should only contain the document(s) requested herein and must not exceed 50 MB in size. Only one zip file will be accepted per abstract; abstracts not uploaded as zip files will be rejected by DARPA.

NOTE: YOU MUST CLICK THE 'FINALIZE PROPOSAL ABSTRACT' BUTTON AT THE BOTTOM OF THE CREATE PROPOSAL ABSTRACT PAGE. FAILURE TO DO SO WILL RESULT IN YOUR ABSTRACT NOT BEING OFFICIALLY SUBMITTED TO THIS BAA AND THEREFORE NOT BEING REVIEWED.

Please note that the DoD-issued certificate associated with the BAA website is not recognized by all commercial certificate authorities, resulting in untrusted connection errors/messages. You can either bypass the warning (possibly by adding https://baa.darpa.mil to your listed of trusted sites, or darpa.mil as a trusted domain), or visit DISA's site to download the Root Certificate Authority (CA): http://dodpki.c3pki.chamb.disa.mil/rootca.html.

Technical support for DARPA's BAA Website may be reached at BAAT_Support@darpa.mil, and is typically available during regular business hours, (9:00 AM - 5:00 PM EST Monday - Friday).

Note: DO NOT SUBMIT ABSTRACTS TO GRANTS.GOV.

3. Proposal Submission Information

The typical proposal should express a consolidated effort in support of one or more related technical concepts or ideas. Disjointed efforts should not be included into a single proposal. Proposals not meeting the format described in the BAA may not be reviewed.

a. For Proposers Requesting Grants or Cooperative Agreements (TA-2 Only):

Proposers requesting grants or cooperative agreements must submit proposals through one of the following methods: (1) electronic upload per the instructions at https://www.grants.gov/applicants/apply-for-grants.html; or (2) hard-copy mailed directly to DARPA. If proposers intend to use Grants.gov as their means of submission, then they must submit their entire proposal through Grants.gov; applications cannot be submitted in part to Grants.gov and in part as a hard-copy. Proposers using Grants.gov do not submit hard-copy proposals in addition to the Grants.gov electronic submission.

Submissions: Proposers must submit the three forms listed below.

SF 424 Research and Related (R&R) Application for Federal Assistance, available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_SF424_2_0-V2.0.pdf. *This form must be completed and submitted.*

To evaluate compliance with Title IX of the Education Amendments of 1972 (20 U.S.C. A§ 1681 Et. Seq.), the Department of Defense is using the two forms below to collect certain demographic and career information to be able to assess the success rates of women who are proposed for key roles in applications in science, technology, engineering, or mathematics disciplines. Detailed instructions for each form are available on Grants.gov.

Research and Related Senior/Key Person Profile (Expanded), available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_KeyPersonExpanded_2_0-V2.0.pdf. *This form must be completed and submitted.*

Research and Related Personal Data, available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_PersonalData_1_2-V1.2.pdf. *Each applicant must complete the name field of this form, however, provision of the demographic information is voluntary. Regardless of whether the demographic fields are completed or not, this form must be submitted with at least the applicant's name completed.*

Grants.gov requires proposers to complete a one-time registration process before a proposal can be electronically submitted. If proposers have not previously registered, this process can take between three business days and four weeks. For more information about registering for Grants.gov, see www.darpa.mil/work-with-us/additional-baa. See the Grants.gov registration checklist at http://www.grants.gov/web/grants/register.html for registration requirements and instructions.

Once Grants.gov has received a proposal submission, Grants.gov will send two email messages to advise proposers as to whether or not their proposals have been validated or rejected by the system; IT MAY TAKE UP TO TWO DAYS TO RECEIVE THESE EMAILS. The first email will confirm receipt of the proposal by the Grants.gov system; this email only confirms receipt, not acceptance, of the proposal. The second will indicate that the application has been successfully validated by the system prior to transmission to the grantor agency or has been rejected due to errors. If the proposal is validated, then the proposer has successfully submitted their proposal. If the proposal is rejected, the proposed must be corrected and resubmitted before DARPA can retrieve it. If the solicitation is no longer open, the rejected proposal cannot be resubmitted. Once the proposal is retrieved by DARPA, the proposer will receive a third email from Grants.gov. To avoid missing deadlines, proposers should submit their proposals in advance of the final proposal due date with sufficient time to receive confirmations and correct any errors in the submission process through Grants.gov. For more information on submitting proposals to Grants.gov, visit the Grants.gov submissions page at: http://www.grants.gov/web/grants/applicants/apply-for-grants.html.

Proposers electing to submit grant or cooperative agreement proposals as hard copies must complete the same forms as indicated above.

b. For Proposers Requesting Contracts or Other Transaction Agreements

Proposers requesting contracts or other transaction agreements must submit proposals via DARPA's BAA Website (https://baa.darpa.mil). Note: If an account has already been created for the DARPA BAA Website, this account may be reused. If no account currently exists for the DARPA BAA Website, visit the website to complete the two-step registration process. Submitters will need to register for an Extranet account (via the form at the URL listed above) and wait for two separate e-mails containing a username and temporary password. After accessing the Extranet, submitters may then create an account for the DARPA BAA website (via

the "Register your Organization" link along the left side of the homepage), view submission instructions, and upload/finalize the proposal. Proposers using the DARPA BAA Website may encounter heavy traffic on the submission deadline date; it is highly advised that submission process be started as early as possible.

All unclassified full proposals submitted electronically through the DARPA BAA website must be uploaded as zip files (.zip or .zipx extension). The final zip file should not exceed 50 MB in size. Only one zip file will be accepted per submission and submissions not uploaded as zip files will be rejected by DARPA.

NOTE: YOU MUST CLICK THE 'FINALIZE FULL PROPOSAL' BUTTON AT THE BOTTOM OF THE CREATE FULL PROPOSAL PAGE. FAILURE TO DO SO WILL RESULT IN YOUR PROPOSAL NOT BEING OFFICIALLY SUBMITTED TO THIS BAA AND THEREFORE NOT BEING REVIEWED.

Classified submissions and proposals requesting assistance instruments (grants or cooperative agreements) should NOT be submitted through DARPA's BAA Website (https://baa.darpa.mil), though proposers will likely still need to visit https://baa.darpa.mil to register their organization (or verify an existing registration) to ensure the BAA office can verify and finalize their submission.

Please note that the DoD-issued certificate associated with the BAA website is not recognized by all commercial certificate authorities, resulting in untrusted connection errors/messages. You can either bypass the warning (possibly by adding https://baa.darpa.mil to your listed of trusted sites, or darpa.mil as a trusted domain), or visit DISA's site to download the Root Certificate Authority (CA): http://dodpki.c3pki.chamb.disa.mil/rootca.html.

Technical support for DARPA's BAA Website may be reached at BAAT_Support@darpa.mil, and is typically available during regular business hours (9:00 AM - 5:00 PM EST, Monday - Friday).

c. Classified Submission Information

See Section IV.B.4, "Security Information," for guidance on submitting classified abstracts and proposals.

4. Other Submission Requirements

Not applicable.

V. Application Review Information

A. Evaluation Criteria

Proposals will be evaluated using the following criteria, listed in descending order of importance:

1. Overall Scientific and Technical Merit

The proposed technical approach is innovative, feasible, achievable, and complete.

The proposed technical team has the expertise and experience to accomplish the proposed tasks. Task descriptions and associated technical elements provided are complete and in a logical sequence with all proposed deliverables clearly defined such that a final outcome that achieves the goal can be expected as a result of award. The proposal identifies major technical risks and planned mitigation efforts are clearly defined and feasible.

The proposer's prior experience in similar efforts clearly demonstrates an ability to deliver products that meet the proposed technical performance within the proposed budget and schedule. The proposed team has the expertise to manage the cost and schedule. Similar efforts completed/ongoing by the proposer in this area are fully described including identification of other Government sponsors.

2. Potential Contribution and Relevance to the DARPA Mission

The potential contributions of the proposed effort are relevant to the national technology base. Specifically, DARPA's mission is to make pivotal early technology investments that create or prevent strategic surprise for U.S. National Security.

The proposer clearly demonstrates its plans and capabilities to contribute to U.S. national security and U.S. technological capabilities. The evaluation will consider the proposer's plans and capabilities to transition proposed technologies to U.S. national security applications and to U.S. industry. The evaluation may consider the proposer's history of transitioning or plans to transition technologies to foreign governments or to companies that are foreign owned, controlled, or influenced. The evaluation will also consider the proposer's plans and capabilities to assist its employees and agents to be eligible to participate in the U.S. national security environment.

In addition, the evaluation will take into consideration the proposed technology transition strategy and the extent to which the proposed intellectual property (IP) rights will potentially impact the Government's ability to transition the technology, as applicable.

3. Cost and Schedule Realism

The proposed costs are realistic for the technical and management approach and accurately reflect the technical goals and objectives of the solicitation. The proposed costs are consistent with the proposer's Statement of Work and reflect a sufficient understanding of the costs and level of effort needed to successfully accomplish the proposed technical approach. The costs for the prime proposer and proposed subawardees are substantiated by the details provided in the proposal (e.g., the type and number of labor hours proposed per task, the types and quantities of materials, equipment and fabrication costs, travel and any other applicable costs and the basis for the estimates).

The proposed schedule aggressively pursues performance metrics in the shortest timeframe and accurately accounts for that timeframe. The proposed schedule identifies and mitigates any potential schedule risk.

Specifically for this program, for which simultaneous impacts to the commercial sector and DoD are expected, the level of performer cost share will be considered as a significant element of the Cost Realism evaluation. DARPA recognizes that undue emphasis on cost may motivate proposers to offer low-risk ideas with minimum uncertainty and to staff the effort with junior personnel in order to be in a more competitive posture. DARPA discourages such cost strategies. It is expected that the effort will leverage all available relevant prior research in order to obtain the maximum benefit from the available funding.

B. Review and Selection Process

1. Review Process

It is the policy of DARPA to ensure impartial, equitable, comprehensive proposal evaluations based on the evaluation criteria listed in Section V.A, and to select the source (or sources) whose offer meets the Government's technical, policy, and programmatic goals.

DARPA will conduct a scientific/technical review of each conforming proposal. Conforming proposals comply with all requirements detailed in this BAA; proposals that fail to do so may be deemed non-conforming and may be removed from consideration. Proposals will not be evaluated against each other since they are not submitted in accordance with a common work statement. DARPA's intent is to review proposals as soon as possible after they arrive; however, proposals may be reviewed periodically for administrative reasons.

Award(s) will be made to proposers whose proposals are determined to be the most advantageous to the Government, all factors considered, including the potential contributions of the proposed work to the overall research program and the availability of funding for the effort.

It is the policy of DARPA to ensure impartial, equitable, comprehensive proposal evaluations based on the evaluation criteria listed above and to select the source (or sources) whose offer meets the Government's technical, policy, and programmatic goals. Pursuant to FAR 35.016, the primary basis for selecting proposals for acceptance shall be technical, importance to agency programs, and fund availability. In order to provide the desired evaluation, qualified Government personnel will conduct reviews and (if necessary) convene panels of experts in the appropriate areas.

2. Handling of Source Selection Information

DARPA policy is to treat all submissions as source selection information (see FAR 2.101 and 3.104), and to disclose their contents only for the purpose of evaluation. Restrictive notices notwithstanding, during the evaluation process, submissions may be handled by support contractors for administrative purposes and/or to assist with technical evaluation. All DARPA support contractors performing this role are expressly prohibited from performing DARPA-sponsored technical research and are bound by appropriate nondisclosure agreements.

Subject to the restrictions set forth in FAR 37.203(d), input on technical aspects of the proposals may be solicited by DARPA from non-Government consultants/experts who are strictly bound by the appropriate non-disclosure requirements.

3. Federal Awardee Performance and Integrity Information (FAPIIS)

Per 41 U.S.C. 2313, as implemented by FAR 9.103 and 2 CFR § 200.205, prior to making an award above the simplified acquisition threshold, DARPA is required to review and consider any information available through the designated integrity and performance system (currently FAPIIS). Awardees have the opportunity to comment on any information about themselves entered in the database, and DARPA will consider any comments, along with other information in FAPIIS or other systems prior to making an award.

VI. Award Administration Information

A. Selection Notices

1. Abstracts

DARPA will respond to abstracts with a statement as to whether DARPA is interested in the idea. If DARPA does not recommend the proposer submit a full proposal, DARPA will provide feedback to the proposer regarding the rationale for this decision. Regardless of DARPA's response to an abstract, proposers may submit a full proposal. DARPA will review all full proposals submitted using the published evaluation criteria and without regard to any comments resulting from the review of an abstract.

2. Proposals

As soon as the evaluation of a proposal is complete, the proposer will be notified that (1) the proposal has been selected for funding pending contract negotiations, in whole or in part, or (2) the proposal has not been selected. These official notifications will be sent via email to the Technical POC identified on the proposal coversheet.

B. Administrative and National Policy Requirements

1. Meeting and Travel Requirements

All key participants are required to attend the program kickoff meeting. Performers should also anticipate regular program-wide PI Meetings and periodic site visits at the Program Manager's discretion.

2. FAR and DFARS Clauses

Solicitation clauses in the FAR and DFARS relevant to procurement contracts and FAR and DFARS clauses that may be included in any resultant procurement contracts are incorporated herein and can be found at www.darpa.mil/work-with-us/additional-baa.

3. Controlled Unclassified Information (CUI) on Non-DoD Information Systems

Further information on Controlled Unclassified Information on Non-DoD Information Systems is incorporated herein can be found at www.darpa.mil/work-with-us/additional-baa.

4. Representations and Certifications

If a procurement contract is contemplated, prospective awardees will need to be registered in the SAM database prior to award and complete electronic annual representations and certifications consistent with FAR guidance at 4.1102 and 4.1201; the representations and certifications can be found at www.sam.gov. Supplementary representations and certifications can be found at http://www.darpa.mil/work-with-us/additional-baa.
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5. Terms and Conditions

A link to the DoD General Research Terms and Conditions for Grants and Cooperative Agreements and supplemental agency terms and conditions can be found at http://www.darpa.mil/work-with-us/contract-management#GrantsCooperativeAgreements.

C. Reporting

The number and types of reports will be specified in the award document, but will include as a minimum quarterly technical and financial status reports. The reports shall be prepared and submitted in accordance with the procedures contained in the award document and mutually agreed on before award. Reports and briefing material will also be required as appropriate to document progress in accomplishing program metrics. A Final Report that summarizes the project and tasks will be required at the conclusion of the performance period for the award, notwithstanding the fact that the research may be continued under a follow-on vehicle.

D. Electronic Systems

1. Wide Area Work Flow (WAWF)

Unless using another means of invoicing, performers will be required to submit invoices for payment directly via to https://wawf.eb.mil. Registration in WAWF will be required prior to any award under this BAA.

2. i-Edison

The award document for each proposal selected for funding will contain a mandatory requirement for invention disclosures (and associated elections, confirmatory instruments, etc.) and patent reports to be submitted electronically through i-Edison (https://public.era.nih.gov/iedison).

VII. Agency Contacts

Administrative, technical or contractual questions should be sent via e-mail to HR001119S0016@darpa.mil. All requests must include the name, email address, and phone number of a point of contact.

The technical POC for this effort is:

Dr. Young-Kai Chen
DARPA/MTO
ATTN: HR001119S0016
675 North Randolph Street
Arlington, VA 22203-2114
Email: HR001119S0016@darpa.mil

VIII. Other Information

A. Proposers Day

The T-MUSIC Proposers Day will be held on January 8, 2019 in Arlington, VA. Advance registration is required for the physical meeting. See DARPA-SN-19-16 posted at www.fbo.gov for all details. Attendance at the T-MUSIC Proposers Day is not required to propose to this solicitation.

B. Protesting

For information concerning agency level protests see http://www.darpa.mil/work-with-us/additional-baa#NPRPAC.