

Frequently Asked Questions (FAQ)
Resilient Networked Distributed Multi-Transceiver Communications
(RN DMC)
Broad Agency Announcement (BAA) HR001120S0049
7/8/2020

Q1: I have questions on the RN DMC long range communications. Will the RN DMC be operated in long-range ground-to-ground terrestrial (both LoS and BLoS) and ground-to-aircraft (assume LoS)? What are the RN DMC long range communications operational scenarios and roughly ranging?

A1: RN DMC will be tested in all of the scenarios described in the BAA. The BAA tests were developed to be generally representative of operational scenarios.

Q2: If you are able to provide the range of selected funding amounts by phase, FY, etc., that would be most helpful.

A2: Funding amounts will not be provided for this program.

Q3: Could you please tell me if this is a new requirement, or if there is a current or previous contractor who has performed similar services? If available, can you please send along the incumbent contract or task order number?

A3: This is a new program/requirement. No previous work has been completed under this effort.

Q4: Please confirm that it's ok to submit:

- 1) an unclassified FOUO proposal?
- 2) an unclassified FOUO technical volume and cost volume proposal with a SECRET tech volume appendix?

If so, should we would plan to

2.1) submit the unclassified cost volume and tech volume, with the classified appendix omitted via the DARPA website

2.2) in parallel submit a SECRET classified CDROM with both the full unclassified proposal information (cost volume and tech volume) and the SECRET tech volume appendix submitted as per BAA instructions?

A4: 1) Unclassified (with no FOUO) submissions are preferred, but FOUO submissions will be permitted. Please coordinate with Mr. Carlos Johnson (carlos.johnson.ctr@darpa.mil) on how to submit a proposal containing FOUO.

2) Per page 33 of the BAA 'All submitted proposals must be unclassified. Classified submissions will be deemed nonconforming and will not be evaluated.'

Q5: Can you provide any information regarding DyNAMO and Protected Forward Comms?

A5: These are ongoing programs. Public information about these programs is available at the DARPA website, www.darpa.mil.

Q6: Our organization has an IDIQ with DARPA. We typically use that IDIQ if security level allows. RN DMC fits that. The cost proposal process for the BAA is very different than the normal IDIQ task order cost proposal. Do we still need to provide the cost volume per the BAA?

A6: This Broad Agency Announcement (BAA) for Program RN DMC is a completely separate and stand-alone solicitation and is not associated with any other DARPA contract. Yes, a cost volume per the Section IV “Application and Submission Information” needs to be followed. Specifically, please see page 29-32 of the BAA for Volume II, Cost Proposal instructions and details of what your cost breakdown proposal should include. Potential proposers to this solicitation should follow all instructions as outlined in the BAA.

Q7: The BAA indicates Other Transactions will be used for awards. As a UARC, are we eligible for OTA funding or will there be another vehicle and do we care?

A7: Please see Section II “Award Information” on page 21 of the BAA. Proposals identified for negotiation may result in a Procurement Contract or Other Transactions, depending on the nature of the work proposed, etc. UARC’s are not prohibited from receiving an Other Transaction, however, you will need to ensure the work being completed is allowable under your UARC contract with Army, Navy, etc. Proposers should read all references regarding eligibility for Other Transactions as detailed in the BAA.

Q8: Do we need to include anti-tamper protection for the tiles?

A8: Anti-tamper is not specifically stipulated in the BAA. Per the expectations in the BAA on pages 6-7, proposers should ‘Describe an approach that maximizes both information security and physical security, while allowing the blue tiles to remain unclassified and attritable’.

Q9: Is DARPA or are performers responsible for the Service-specific phase 3 implementation and demos?

A9: Performers will be responsible for planning for and supporting the test. It is assumed that this test will be conducted at a government facility.

Q10: Do you intend to distribute or post the 6/22 slides?

A10: Program overview slides from RN DMC proposer’s day are posted on the DARPA opportunities page, <http://www.darpa.mil/work-with-us/opportunities>.

Q11: For performance of the work, in all three phases but especially Phase 1, how many and what model(s) of terrestrial tactical radios can be provided as Government Furnished Equipment (GFE)?

A11: For solutions that require GFE, the requested GFE should be specified in the submitted proposal. GFE will be provided subject to availability limitations.

Q12: What is the highest level of security clearance required for a vendor to obtain full technical specifications on any or all of the tactical radios of interest to the RN DMC program? Are any of them *not* available via the JTNC portal?

A12: Proposers are responsible for determining what tactical radio specifications they will need to develop their solutions and for obtaining and following any necessary tactical radio or waveform specific security classification guides.

Q13: Is the metric that limits 'Maximum capacity of communications links between local mosaic transceivers' an aggregate limit or a limit on an individual link between two tiles?

A13: It applies to an individual link between two tiles.

Q14: Is frequency translation above 10 GHz acceptable?

A14: Yes. 10 GHz is an objective, and it is certainly permissible to exceed this objective. It is expected that the difficulty of implementing a distributed coherent system, as well as the unit cost of a tile will increase with frequency.

Q15: Is it acceptable to exceed the Table 6 metric 'Maximum ratio of the instantaneous BW of augmented or transformed tactical signal to instantaneous of non-augmented tactical signal' if the signal is translated to higher frequencies or if it is a spread signal with low power spectral density?

A15: The purpose of this metric is to drive solutions towards compliance with Federal Communications Commission (FCC) regulations. If a proposed approach cannot meet this metric, the proposal should explain how the augmented or transformed signal will be compliant with FCC regulations.

Q16: Regarding Phase 3 costing: Can this be a rough order of magnitude (ROM) since we don't know the specification of what the transition partner would want developed.

A16: No. Proposers should make reasonable assumptions about a Phase 3 implementation. The demo should be assumed to be similar in complexity to the Phase 2 'Relay Field Test'.

Q17: The BAA does not specify a maximum bandwidth to relay to/from tactical radios (just that relay system must use $\leq 3x$ tactical BW). Is there a desired bandwidth capability or should a proposer choose a tactical waveform to suite their system trade-space?

A17: The only bandwidth consideration in the BAA relates to the cited System Engineering metric in Table 7 of the BAA.

Q18: Is it reasonable to assume that individual tiles are soldier radios?

A18: The individual blue tiles are portable transceivers.

Q19: Is it reasonable to assume that each individual tile will be accompanied by an ATAK?

A19: No ATAK or any other device that interfaces the blue tiles is assumed. An ATAK was illustrated as a notional accompaniment to a gold tile in the Proposer's Day brief.

Q20: Is a recording of the June 22 meeting available? I would really like to learn more about the MOSAIC program, and hopefully submit a responsive proposal.

A20: No. Any current DARPA opportunities can be found here: <http://www.darpa.mil/work-with-us/opportunities>.

Q21: The DCT/DCR depicted in the BAA figures assume a point-to-point tactical communications link. The routing tables for tactical networking radios are not generally available from an unmodified radio and may even be classified. How will the gold and blue tiles associated with a tactical networking radio determine which gold or gold/blue cluster of tiles to beamform towards when there are multiple other tactical radios?

A21: As stated in the BAA on page 7, proposers are expected to 'Describe a network layer approach or an operational process that supports the long-range interconnection of two local ground tactical networks through RN DMC'. Proposers may assume that they will know the general direction of the mosaic of tiles that they will beamform towards. DARPA is interested in proposed approaches to networking that support more complex architectures, including routing through an arbitrary number of mosaic clusters. Proposals may include approaches to support more complex networking than will be required for the Table 1 test events. All proposed networking approaches should be consistent with the objective of low-cost attritable blue tiles.

Q22: The BAA mentions SATCOM waveforms, however it doesn't seem feasible to equip a satellite already in orbit with a gold tile. What is the CONOPS for using RN-DMC with SATCOM systems? How would Figure 1 be modified to depict this for a SATCOM system?

A22: The RN DMC concept for future satellite systems is that they carry blue nodes only, similar to High Altitude Platforms, UAVs and Balloons.

Q23: The BAA mentions the ATAK visualization tool -- is interfacing with ATAK desired or required for any of the field tests?

A23: Interfacing with ATAK is not required.

Q24: Must proposing teams provide their own tactical radios for use in the field tests or can GFE radios be proposed?

A24: Please see A11.

Q25: The second option for field testing permits the proposer to leverage government assets including test platforms and testing facilities, however a list of available platforms and facilities was not provided. Will there be an opportunity during the execution of a program to iterate with the government and V&V team to determine the specific assets and sites?

A25: The government will determine the test site. Performers who select this second option will have the opportunity to provide feedback to DARPA regarding potential government platforms and test sites.

Q26: Can a high-altitude lighter-than-air platform be proposed for Phase 1 long link testing?

A26: Yes, provided that two way communications and performance against all 'End of Phase 1' metrics in BAA Tables 6-8 can be validated.

Q27: Table 2 specifies the due date of the Long Link Test Report at month 15, which would necessitate having the long link test prior to that. This considerably compresses a potentially aggressive schedule -- could the LL test and report be proposed closer to the end of the 18 month Phase 1?

A27: Proposers may suggest modifications to the schedule, but most include rationale for the change.

Q28: Table 5 has metrics for both SNR enhancement and interference suppression. Must these two metrics be simultaneously satisfied? Can a joint metric of SINR (signal to interference plus noise) enhancement be proposed?

A28: The objective is to satisfy both metrics simultaneously. No modifications to the BAA metrics will be made at this time.

Q29: In Table 5, how is mean sidelobe level suppression defined?

A29: with respect to the measured main lobe power. The mean is the average taken over 360 degrees minus the 3 dB null to null BW of the main lobes.

Q30: In Table 6, does carrier frequency extent refer to the tactical radio waveforms, the internode signaling or both?

A30: It only refers to the tactical radio waveform which is input into RN DMC. It does not apply to the internode signaling. Also, it is permissible for the blue tiles to frequency translate above the 10GHz limit (see Q/A14).

Q31: Table 6 specifies a max IBW ratio metric for nodes that must be bi-directional. If blue tiles use FDD, does the augmented/transformed IBW include the IBW in both directions?

A31: The metric applies to each direction distinctly.

Q32: Regarding II.I.B, Program Metrics (pg. 19, Table 5.), Interference suppression: We need to validate the interference suppression metric of 20 (30) dB for M-1 interferers, by Validation Method "Test" in Phase 1. Does that mean that the V&V team will use up to 9 interferers to validate the metric for M=10 mosaic transceivers during the Long Link Test in Phase 1?

A32: Yes.

Q33: Regarding II.I.B, Program Metrics (pg. 20, Table 7.) "SWaP and SWaP-C limits of prototype/production transceiver": What about AC/DC power consumption? Is there a nominal power source in mind? For blue tile transceivers, should we assume that a battery is available to support the mission duration metric?

A33: Performers will be expected comprehensively define test architectures including the power sources for tiles. For tests that involve walking users carrying tiles, it is expected that batteries will be used as power sources for the blue tiles.

Q34: Regarding II.VI.B.1. Meeting and Travel Requirements (pg. 39, Table 9), Long Link Test: Location is "Government Location" for Long Link Test. But can't the performer define a location (e.g., non-military airspace), if they choose to run the test themselves?

A34: Yes.

Q35: For option 2 in terms of Government resources for testing in Phase 1, may performers also select use of Government Military Airspace and use of the performer's supplied aerial demonstration vehicle in the Government Military Airspace?

A35: Proposers recommending this approach should provide evidence that their aerial vehicle would be approved for flight testing, including RF transmission to and from the vehicle within Government Military Airspace.

Q36: For the Signal to Noise Ratio enhancement requirement of 50% (75%) of ideal performance (N2M), can we ignore the polarization misalignment effects? In another word, can we assume that all antennas are linearly polarized and are perfectly aligned?

A36: Per BAA Table 6, performance against this metric will be validated by test. Idealized assumptions do not apply.

Q37: For the 3 currently operational tactical waveforms, what is the maximum data rate we should assume since the data rate has direct impact to link margin?

A37: The maximum data rate supported by the waveform given the link parameters which include the RN DMC system gain.

Q38: Are the Technical Performance Metrics in Table 5 evaluated in the Lab or in the field demos? In either case, would the government selected V&V Team be providing a test plan and procedure early in the program?

A38: Performance against the metrics will be evaluated in both lab and field demo environments. The V&V team will interact regularly with the performers as they develop the detailed performance assessment approach.

Q39: Since the RN-DMC system is for relaying the tactical radio messages, is there a requirement for the maximum RN-DMC added latency?

A39: There is no current requirement for latency. Performers will be expected to design and test systems that work with their proposed waveforms and radios.

Q40: Can the “Local Telemetry” communication among Gold and Blue tiles be operating on a separate frequency that can coexist with the main communication?

A40: Yes.

Q41: What is the minimum and maximum tactical waveform carrier frequency that should be supported by the Gold tile assuming an SDR implementation? What is the maximum bandwidth for the tactical waveform that the RN DMC system should be designed to support for Phase 3 and beyond? If available, please provide a list of the desired tactical waveforms that RN DMC proposals should eventually interoperate with.

A41: Table 7 in the BAA specifies metrics for frequency extent. There is no program defined maximum bandwidth for the tactical waveforms. A list of waveforms that could potentially work with RN DMC was presented at Proposer’s day. This was not an exhaustive list and was not intended to convey recommended waveforms to proposers.

Q42: Shall we assume that interoperability with “currently operational tactical waveforms” indicates a requirement to interoperate with complete and unmodified tactical radio systems inclusive of current PHY, MAC, and any additional upper layers unmodified? Or does the use of the term “waveform” suggest that the PHY will be unmodified but that minimal tweaks may be needed to some tactical radios to the MAC and upper layers to support relay operations? Examples may be modification of underlying timing to support the longer delays due to hundreds of kilometers of signal propagation or offering out of band information that may inform or optimize the RN DMC system operation.

A42: As RN DMC does not have ‘requirements’, the answer to the first question stated is no. While it is desirable to minimize modifications of MAC and other upper layers for the purpose of facilitating eventual transition, the key objective should be a system that enables the test architectures described in the ‘Program Structure’ section of the BAA.

Q43: When a transmission is sent from a tactical radio to the Gold tile, is there an expectation that one or more tactical waveforms would require a direct transmission back from the Gold tile

to the tactical radio that is locally originated at the Gold tile and not relayed from the remote tactical radio? An example might be an acknowledgement necessary to maintain timing requirements. Similarly, are there one or more tactical waveforms that would require transmissions to the receiving tactical radio originated from the associated Gold tile and not being relayed directly from the transmission originating tactical radio?

A43: These are design level questions for which yes or no answers will not be provided. The performers will design their systems and the designs will be regularly reviewed by the DARPA.

Q44: Please provide a reference or recommendations for the digitization of these waveforms (e.g. sampling rate, etc.) in terms of preserving enough quality for successful decode at the receiving tactical radio? It is assumed that this answer is dependent on the specific tactical waveforms that will eventually be used, but we are seeking guidance to create a solution that would work sufficiently across a breadth of tactical waveforms and not just the 3 or more that we select for Phase 1-2.

A44: A43 also applies to this question.

Q45: Is the Mean side lobe suppression stated in Table 5 for the transmit beamforming, receive beamforming, or both?

A45: Transmit beamforming.

Q46: Is the 50% threshold for signal to noise ratio enhancement stated in Table 5 measured in the absence or presence of intentional interferers?

A46: Performance against this metric will be assessed both with and without interferers.

Q47: Please describe the 10 Kbit/sec limit from Table 5 on the telemetry link in more detail.

- a. How will non-packetized transmissions be counted such as ultrawideband chirps for location determination or transmissions for the purposes of timing synchronization?
- b. An average throughput not to exceed 10Kbit/sec is difficult to interpret in the absence of more information about the amount of data being relayed from the tactical radio or the duty cycle of transmissions assuming it used for more than just synchronization and location determination between Blue tiles. Can more information and context be provided on this requirement?
- c. For the active recovery of transmissions particularly for multi-hop relay, it would seem desirable that blue tiles may utilize the telemetry link as one approach to recover transmissions that are not successfully decoded at some or perhaps any of the blue tiles. However, this 10Kbit/sec limit may prevent this depending on external factors. Will this type of traffic directly derived from tactical radio transmissions be excluded from the 10Kbit/sec limit even when sent over the telemetry link between local Blue tiles?
- d. Is the fundamental objective here to minimize detectability? Would it be possible to violate the 10Kbit/sec limit but still demonstrate that the approach to the telemetry

link does not meaningfully incur additional risk of detection (e.g. due to being significantly less detectable than the long-range relay transmissions)?

- A47:
- a. Assuming a chirp that transmits no data, the signal will be assessed against the program metric for low probability of detection.
 - b. No.
 - c. A43 applies to this question.
 - d. Low detectability is an important reason to minimize telemetry traffic.

Q48: RN DMC System Level Metrics in Table 6 of the BAA states that the maximum ratio of instantaneous bandwidth of augmented or transformed tactical signal to instantaneous bandwidth of non-augmented tactical signal shall be less than 3x. The discussion in Proposer's Day suggested this limitation was at least in part due to practical considerations of spectral availability.

- a. If a proposer chooses to use higher frequencies which are less spectrally constrained or leverage spectrum which is unlicensed in most markets, could the 3x limitation be relaxed if significant benefits to the primary goals of the program can be demonstrated as a result of doing so?
- b. Are there any specific frequency bands that are preferred by DARPA to be used for the inter-cluster Blue tile relay communications and/or telemetry links aside from the preference for >10GHz and requirement for >3GHz?
- c. Shall we assume that the bandwidth utilized for the telemetry links is not included in the 3x requirement (since it is covered by a separate 10Kbps limit) and that this 3x limit exclusively relates to the coherent augmented/transformed tactical signal relay transmission? We believe this is how it reads but want to confirm.

- A48:
- a. Please see A15.
 - b. No.
 - c. Yes.

Q49: Per the manufacturability metrics, shall we assume that there is no external power available to Blue tiles and that the Blue tile battery is included in the SWaP-C limits stated along with the remainder of the Blue tile components? Is the complete Blue tile enclosure including fins as needed for heat dissipation included in the SWaP-C requirements? What environmental operational conditions and/or certifications will be required for the Blue and Gold tiles (e.g. temperature, humidity, vibration, etc.)?

A49: External power may or may not be available. The Blue tile battery is not considered part of the SWaP-C limits, but the enclosure is. Potential operational conditions may vary significantly, as tiles may be hand carried by soldiers or marines, deployed to ships, aircraft or satellites.

Q50: Can anything more be said about the "normal mission comms load" as stated in Table 7? Can an example be given in terms of the total amount of transmissions that will be required and the raw amount of digitized tactical waveforms (e.g. in megabytes) that will be sent in a 72-hour period?

A50: No

Q51: It assumed that an ideal, eventual RN DMC implementation may support adjustable “knobs” to make dynamic trade-offs between detectability, link range, location resolution, latency guarantees, throughput, jammer tolerance, battery life, and other factors to meet the unique requirements of the mission at hand. But for initial implementations can you summarize the prioritization of these factors? As foundational system-level design trade-offs are made, it is desired to optimally align with the objectives of the program.

A51: All of these factors are potentially important. A rank ordering of the factors identified in Q52 will not be provided.

Q52: What is the maximum latency per relay hop and in total across a significant number of relay hops that the RN DMC system may add to the end-to-end communication between tactical radios including the time required for RF propagation?

A52: The maximum latency per hop and in total across a significant number of relay hops is expected to be application and waveform dependent.

Q53: What is the maximum total distance across multiple relay hops that a RN DMC system should be designed to support?

A53: The maximum total distance across multiple relay hops envisioned for an operational version of RN DMC is arbitrary. The design for the RN DMC program should at a minimum support the key Phase 1 and Phase 2 test events described in the ‘Program Structure’ section of the BAA.

Q54: What is the maximum single relay hop distance that the RN DMC system should be designed to support? 50km+ per hop is stated clearly but is there a practical maximum that can be identified so that reasonable tradeoffs can be considered in the implementation?

A54: The practical maximum is highly application dependent, as long range use cases could include ground to aircraft and communications to satellites.

Q55: Is it assumed that the Gold tile will decode an indication of source “address” of the tactical radio communication and likewise the desired destination “address” on a per transmission basis from the actual tactical communication (e.g. packet header or otherwise) for one or more tactical waveforms? Or alternatively, will identifiers for the tactical radios and/or associated Gold tiles be configured out-of-band? If this information must be decoded from the tactical radio transmissions, are there any other classes of information that may need to be decoded from the transmission. It is understood that the “payload” of the transmission will be end-to-end encrypted, but this question focuses on whether any information outside of the payload needs to be decoded and acted upon by the RN DMC system.

A55: Please refer to A21.

Q56: As we recall, during the Proposer’s Day webcast, it was stated that the upper-layer functions of end-to-end encryption and routing would be leveraged from the existing tactical

radio. While its role for encryption is clear, does routing in this context suggest that the tactical radio will have visibility to and influence over the underlying relay and routing of transmissions within the RN DMC system? Or will the tactical radio routing control be unaware of the RN DMC system?

A56: Please refer to A21.

Q57: Shall functions like cluster formation/optimization of sets of Blue tiles for coherent Tx/Rx, route discovery/optimization, and similar be fully automated by the RN DMC system, minimally controlled by technicians or otherwise, or largely controlled by technicians or otherwise? For the purposes of Phase 1, 2, and 3, please describe the degree to which these operations can be manually performed and pre-configured versus dynamic and self-assembling and self-discovering.

A57: Full automation of coherent Tx/Rx is expected for all key test events in BAA Table 1. With regard to routing discovery/optimization, please see A21.

Q58: What information if any will be provided to the RN DMC system (e.g. out of band to Gold tiles) to facilitate identification of endpoints in an upcoming transmission? For example, will approximate location to focus discovery or maximum range to discover be provided to minimize the search domain and minimize unnecessary detection of relay nodes particularly in cases where the desired endpoint is not reachable? For phase 1, 2, and 3, please describe the degree to which knowledge about the endpoints can be statically pre-configured.

A58: The RN DMC designs should support beamforming based on an assumption of general knowledge of the target receiver or receive mosaic which will not be quantified here. Please refer to A21 for network related considerations.

Q59: The BAA states that for demonstrations that specific tile quantities shall be used. For example, in Phase 1, 10 mosaic tiles will be used for the Long Link Test. As we recall in the Proposer's Day, ≥ 10 mosaic tiles would be used. Is it allowed to use more than the stated number of tiles during tests to meet the criteria and/or show superior performance to other implementations through more effective coordination?

A59: Yes.

Q60: Using Figure 5 in the BAA as a reference, is relative location determination of the Gold and Blue tiles only necessary separately within each local cloud/cluster (e.g. as shown in the diagram with two separate ground-based white cloud graphics) or is it intended to be achieved globally across all gold and blue tiles shown in the figure including those on ground, at altitude, and independent of whether there is a nearby Gold tile? For example, does the gold tile associated with the ground-based blue tile cloud/cluster on the left of the drawing need to have a relative position of any of the aerial blue tiles or of the remote ground-based Blue tile cluster in the contested RF environment on the right of the diagram? Slide 11 of the Proposer's Day Technical slides seems to suggest this may be local cluster relative location determination

exclusively, but we wanted to confirm. If more global relative location is required, is it appropriate to assume that the resolution requirements would be relaxed?

A60: The relative positioning objective that the blue tiles are within the same mosaic cluster.

Q61: The BAA calls for the max ratio of instantaneous BW of augmented - to - non-augmented signals to be no more than 3, with a goal of 1. If one could demonstrate a spread waveform approach that improves LPD and AJ performance, that meets coherent beam-forming SNR enhancement goals, but exceeds that ratio due to spreading, would it be interesting and seriously considered?

A61: See A15.

Q62: The security classification guide (SCG) delivered upon request by DARPA security is for the Protected Forward Communications (PFC) Program. Is this the correct SCG for RN DMC?

A62: Yes. The PFC SCG has been approved as a classification guide for RN DMC.