NASA Pre-solicitation Notice: Request for Information/Public Comment Period in Preparation for Addition of the Integration of Advanced Concepts and Vehicles into the Next Generation Air Transportation System under the Research Opportunities in Aeronautics (ROA) NASA Research Announcement (NRA)

Description:
The National Aeronautics and Space Administration (NASA) Headquarters, Aeronautics Research Mission Directorate (ARMD), is preparing a major addition to the “Research Opportunities in Aeronautics” (ROA) NASA Research Announcement (NRA), (NRA number NNH07ZEA001N).

In keeping with the current structure of the ROA NRA, ARMD plans to amend the NRA by adding an Appendix with the details of the requirements for the study of Integration of Advanced Concepts and Vehicles into the Next Generation Air Transportation System. The ROA NRA can be accessed at the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) Web site http://nspires.nasaprs.com/.

Preparatory efforts to add the Integration of Advanced Concepts and Vehicles into the Next Generation Air Transportation System to the ROA NRA included a Pre-proposal Conference on August 9, 2007 in Washington, D.C.

Appended below is a draft of the solicitation for this ROA NRA topic. NASA welcomes any comments or recommendations to improve the solicitation. In addition, perspective proposers may submit questions about the solicitation. Answers will be posted publicly to an FAQ on NSPIRES. The comment period will be open until 5 p.m. Eastern Daylight Savings Time on Tuesday, August 28, 2007. Respond with comments to the Point of Contact, Dr. John A. Cavolowsky at NASA-roa@nasa.gov.

It is possible that the content of this solicitation could be significantly changed when it is officially released. Tasks may possibly be added or removed.

A general description of the research effort follows.
Background:

The National Aeronautics R&D Policy, dated December 20, 2006, states, “as the science and application of aeronautics progressed, an interdependence developed among the aircraft, the air transportation system, and the people who use these systems, resulting in a multi-dimensional, highly integrated aeronautics enterprise.” Furthermore, “design or modification of any of these individual systems or parts, without consideration for the collective effect on the enterprise, may result in adverse or unintended consequences. Treating the entire system as a whole is complex but necessary.”

The Joint Planning and Development Office (JPDO) was instituted by the Vision 100 Century of Aviation Reauthorization Act (Public Law 108-176) to address the challenges facing air transportation in the United States by engaging multiple agencies that would collaborate to plan, develop, and implement the Next Generation Air Transportation System (NextGen). The JPDO has formulated initial versions of the NextGen Concept of Operation (ConOps) and Enterprise Architecture, and will continue to refine these as it progresses toward NextGen. These documents provide details regarding “what” NextGen is, as envisioned for operation in 2025. The ConOps provides a broad vision for the air traffic system and the vehicles that fly within it. To realize that vision, the ConOps must be informed with tangible details of the “how” to accomplish NextGen – this “how” is the focus of NASA research in support of NextGen.

NASA’s role is discussed in a white paper that may be downloaded from the Aeronautics website, http://www.aeronautics.nasa.gov/. The white paper states that the greatest impact of NASA’s current research investment will manifest itself in the long-term, designated Epoch 3 in NextGen plans, which represents the fully operational implementation of NextGen in 2025. Critical trades and research areas must be investigated to refine the ConOps and enable implementation by 2025. Examples of issues that NASA will be addressing, in partnership with other JPDO agencies and the broader aeronautics community, include:

- Identification of actions and responsibilities best suited to be moved from the ground-based air navigation service provider to the aircraft, particularly for separation assurance
- Allocation of roles to humans versus automation in fulfilling management and control responsibilities
- Impacts of uncertainty on traffic flow management
- Stability of aircraft gate-to-gate 4D trajectories
- Development of prognostic analysis capabilities to identify potential inadvertent safety impacts of NextGen concepts, approaches, and technologies
- Improving aircraft efficiency and performance within the constraints of environmental compliance, addressing both the current aircraft fleet and future aircraft concepts (e.g., low-boom low-drag supersonic aircraft, runway independent vertical take-off and
landing vehicles, high-lift configurations for rapid climb-out and descent, very light jets)

- Identification of research priorities based on optimal integration of the new vehicles referenced above and NextGen characteristics within the air transportation system, resulting in definition of vehicle performance requirements, airspace system technologies, and operating procedures
- Identification of the safety requirements of advanced concepts and operations in NextGen

Objectives:

The goal of this ROA NRA topic is to help guide future NASA research related to the Next Generation Air Transportation System (NextGen) based on a user perspective. Accordingly, the objectives are to research the issues associated with deploying new or advanced air vehicles within NextGen in order to:

- Understand how advanced vehicles will operate within NextGen
- Understand the tradeoffs involved for both vehicles and the air transportation management (ATM) system associated with different levels of safety
- Indicate the most productive areas for future research for vehicles, ATM and safety

This research effort should conduct systems analyses to understand the issues associated with the deployment of new and advanced concepts and vehicles in NextGen, including interactions, impacts, and safety tradeoffs among operational procedures, characteristics of advanced vehicles, and the performance of NextGen. The study should develop procedures for operating these vehicles within the air transportation system described by the Concept of Operations (ConOps) and adapt or develop models as required to perform the necessary analyses. The analysis of these procedures should consider characteristics of both the NextGen air traffic system and the vehicles, with an eye to modifying both vehicles and ATM system concepts to increase performance and compatibility with the ConOps. The assessment should address issues that include (1) how the procedures and concepts of operations for these vehicles impact the performance of the overall system, (2) approaches to ensuring the safety of the vehicles and the system, and (3) the effects of environmental and other constraints.

The intent is to understand issues, not to downselect concepts and procedures. The study should provide insights into key questions regarding NextGen operations under a number of scenarios that may include the following: the introduction of new classes of vehicles, different concepts of operations of these vehicles, the adaptability of the ATM and vehicles to upset conditions such as the occurrence of severe weather conditions and unexpected disturbances, various technical approaches to ensuring the safety of the vehicles and the system, limits on energy use and reliance, and a range of increasingly strict environmental constraints. Sensitivity analyses will enable a better understanding of the effects of component, vehicle, operational, and system-level characteristics on the
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performance of the air transportation system, namely capacity, efficiency, robustness, safety, and local and global environmental effects.

The result of these analyses will be used to understand the key issues that must be addressed in research programs and in managing the portfolio of technology investments to support the realization of NextGen,

The Airspace Systems Program leads the work addressed by this ROA NRA topic area, with crosscutting research and development from NASA’s entire Aeronautics portfolio, including the Fundamental Aeronautics Program and the Aviation Safety Program. The results of this research effort will help to inform the work identified in key milestones of ARMD programs and projects and the aeronautics community’s efforts in support of the JPDO and NextGen.

NASA has coordinated this study with other relevant studies, including NextGen trade studies sponsored by the JPDO as well as other NASA ARMD related efforts. The exchange of information between the groups working on these various studies is encouraged.

The results of this crosscutting technical effort are also intended to establish the initial elements of a framework for a system-level analysis capability to answer questions that involve the interactions of air traffic, vehicle, safety, and environmental issues. Recommendations arising from this study should recognize that an ultimate goal is to establish in the future a set of NextGen system analysis tools that will model the relevant technologies and concepts being developed in all ARMD technical program areas, with an overarching view of the design, application, and integration of NextGen technology and concepts.

In summary, the desired outcomes of this ROA NRA topic are:

- An improved understanding of operations under NextGen, from the standpoint of vehicles, operations, and air traffic management
- Results that help inform NASA research in support of NextGen
- An initial framework for an analysis infrastructure to examine NextGen technologies

Approach:

The approach to this study encompasses the following:

- Select and describe a set of advanced vehicles that could be operating in the 2025 NextGen
- Develop procedures describing the operation of these vehicles within the NextGen ConOps
- Identify and address the safety attributes and methodologies associated with each set of procedures
• Conduct modeling and analyses to determine the impact of the procedures and vehicles on the operation of NextGen and the tradeoffs involved

• Assess the implications of the analysis to identify critical issues for future research on technologies needed to achieve NextGen

Since NextGen is a highly interactive system coupling airspace, air portals, vehicles, and safety, the study emphasizes an integrated approach that considers characteristics of the vehicles, the concepts of the NextGen ConOps, and their interactions. Examining operation of a range of advanced vehicles in NextGen should ensure that issues will be addressed in a manner valid for the 2025 time frame projected for the full realization of NextGen.

The results of this comprehensive, large-scale system study are expected to be of high value to the broad aeronautics community, including NASA, other government agencies, industry, academia, and others. To that end, the study will engage stakeholders and other interested parties, and the results of the study will be widely disseminated to ensure the greatest possible benefit.

NASA is not interested in proprietary or point solutions to future vehicles or NextGen systems or concepts, but rather the results of a system-level analysis that highlights issues for further research and can be shared with the aviation community. All results, including relevant software, should be documented and delivered to NASA in nonproprietary form. Where practicable, analytical tools should be validated by correlation of the models with the performance of the existing national airspace system (NAS). Progress, results of analyses, and plans for further work shall be periodically reviewed with NASA and with NextGen stakeholders. The use of proprietary models should be minimized, consistent with the objectives of the study.

Teaming is encouraged in order to engage a broad variety of viewpoints and capabilities.

In order to enable the production of useful early results, and maximize the benefits of interactions with the community of NextGen stakeholders, the work has been organized into the following tasks:

• Task 1. Identify and categorize the potential attributes of a selection of several (of order three to five) classes of advanced vehicles as they affect operation in NextGen projected for 2025

• Task 2. Develop procedures for how each class of these vehicles will operate in NextGen, as envisioned in the ConOps

• Task 3. Establish a set of metrics to assess the impact of the performance and safety attributes and procedures on operation of NextGen

• Task 4. Identify appropriate analytical tools to support the study and modify or develop models, as necessary, to enable analysis of the effects of these procedures
Task 5. Identify and analyze the interactions between each of the procedures and the concepts described in the NextGen ConOps (i.e., determine the effects of operating advanced vehicles in NextGen and the effects of NextGen concepts and constraints on operation of the advanced vehicles)

Task 6. Address key safety design parameters, including assumptions on overall stability, performance margin and the ability to recover from upsets, and requirements for prognostics to be used within the safety assessment using the construct proposed for the NextGen Safety Management System

Task 7. Assess the system-level effects of the procedures and characterize the tradeoffs among operational safety and performance procedures, characteristics of advanced vehicles, the performance of NextGen, and environmental and other constraints in order to identify critical issues for design and implementation of NextGen

Task 8. Identify key issues for further research, including requirements for further refinement or development of models to address these issues

Task 9. Conduct workshops to review the study approach and results with stakeholders and other interested parties, with a view to broadening the perspective and knowledge base of the study

Task 10. Document the results in a publishable final report

Task 1 – Vehicles and Attributes
The candidate classes of vehicles under consideration include advanced vehicles such as very light jets (VLJs), very large transports, uncrewed aerial systems (UASs), supersonic transports (SSTs), lighter-than-air vehicles, cruise-efficient short takeoff and landing (CESTOL) transports, long-range and high-speed rotorcraft, space launches, and other unconventional aircraft. It is recommended that the three-to-five vehicle classes selected for the analysis should represent the most likely candidates to have a significant impact on operation of NextGen in 2025.

Examples of the vehicle attributes of interest for this study include the operational envelope, sensitivity to weather effects (turbulence, icing, temperature, winds), maneuver limitations, sensitivity of performance and fuel efficiency to altitude and other factors, runway requirements, departure and approach constraints (e.g., climb and descent limitations), and environmental impacts. The postulated descriptions of the vehicles should be representative of the class and adequate for the purposes of this study – namely, to develop and analyze procedures for operation of these aircraft in NextGen. Appropriate descriptions may in many cases be derived from NASA studies of advanced vehicle concepts and other sources.

Task 2 – Operational Procedures
Procedures for employment of these advanced aircraft will describe how the vehicles will operate and the constraints imposed on them by requirements and system concepts embodied in NextGen. The starting point for this description should be the NextGen ConOps. The procedures should flow from the ConOps, the attributes of the vehicles, and
the performance desired by the users of these vehicles. The procedures should address the safety of operations associated with a broad range of weather, traffic density, and other conditions, and could vary according to these conditions.

The development of the procedures must consider not only the needs for safe and efficient operation of these vehicles, but also their interaction with other operations in NextGen; an example is the effect of the limited speed performance of VLJs operating in the same altitude regime and utilizing the same runways and approaches as faster airliners and business jets. The procedures should include a detailed description of how each type of vehicle will operate, including air traffic management, flight trajectories, safety assurance, and terminal operations. The procedures, along with the NextGen ConOps and the characteristics of the vehicles, form the basis for the subsequent modeling, analysis, and assessment tasks of this study.

Task 3 – Metrics
Analyzing the impact on NextGen will require identification of a set of metrics, including measures that address the potential safety and environmental impacts of introducing new vehicles and procedures. Where appropriate, these metrics should correspond to or be related to the metrics developed under sponsorship of the JPDO to evaluate the performance of NextGen under various conditions; in some cases the metrics for this study will reflect a greater level of detail, flowing down from the JPDO metrics.

Development of metrics should reflect system safety indicators. As NextGen evolves, identifying and gauging the safety risk of the system will transform from the more traditional forensic approach (analysis of accidents and incidents) to a prognostic process. It is recognized that identifying parameters that will best gauge system safety will evolve with prognostic techniques. The indicators selected for this study will necessarily rely on the current state of understanding of this issue and on the information available today to assess the safety of the future system.

Task 4 – Models
The analysis and assessment efforts will rely on simulation and other methods to answer complex, cross-discipline, multivehicle system interactions involving air traffic management, vehicles, safety, and environmental issues. This integrated analysis should focus on the key performance metrics and their interrelationships with aircraft performance, system capacity, efficiency, predictability, systems interoperability, implementation risk, throughput, workload, safety, and environmental considerations (e.g., noise and emissions), to name some – these represent the dimensions of the trade space.

Initial work to select modeling methods should identify and define critical trade spaces to be analyzed, including options within the trade spaces and the approach to analyzing the options. System trades involving unique performance characteristics of new or advanced aircraft and their operational benefits and impacts will be one appropriate aspect. Initial input to defining this multidisciplinary trade space is expected to be provided by
recognized subject matter experts. Proposers will be responsible for convening subject matter experts as they see fit to complete the study.

Fast-time models and simulations may be used to examine the system-level performance metrics and their sensitivity to operational performance and safety procedures, vehicle technologies, and other considerations (such as environmental constraints).

The analysis infrastructure is expected to rely in part on NASA and JPDO simulation capabilities (for example, the NASA Airspace Concept Evaluation System, or ACES) to test detailed procedures and relate them to total system throughput and other performance metrics. These models are available to answer some of the questions posed for this study. The level of effort and timeframe of this topic area necessarily impose a need to use or adapt existing models as much as possible. NASA will provide descriptions of available models that may be suitable for use in this study.

JPDO-sponsored studies and development of modeling tools to date have focused largely on system-level trades to answer questions about “what” should be included in NextGen and how well the system will perform. It is likely that additional tools may be brought to bear under this ROA NRA topic that will examine the “how” – that is, which technology and conceptual design options for NextGen must be investigated to best provide the desired capabilities.

When new or modified models are needed, they will be identified and may be developed as part of the study. These models should remain compatible as far as practicable with the key metrics and structure established for NextGen. Scenarios for analysis and evaluation may be developed, in part, from analyses sponsored by the JPDO. Considering available time and resources, it is not expected that significant model development will be supported under this study.

Task 5 – Analysis of Procedures
To properly understand the impacts of candidate procedures, they must be examined in the context of the concepts envisioned for NextGen, the characteristics of the vehicles, the operating environment (such as weather conditions and traffic density), and the relationships among these elements. The focus of this task, therefore, is to identify, for each vehicle category and set of procedures, the issues that drive the sensitivities among these elements, at least in a relative sense. The question to be answered in this task can be summarized as, “What are the relationships among vehicle characteristics, effectiveness of candidate procedures, and attributes of NextGen?”

The analysis will consider modifications to the vehicles or the NextGen ConOps that could improve the effectiveness of the procedures in terms of performance or compatibility with NextGen. The analysis should also serve to identify and refine the candidate procedures that are most appropriate for each type of vehicle, considering the tradeoffs involved and compatibility with NextGen. This task will require identification and analysis of aspects of operating in the NextGen environment that provide the greatest
potential benefit or represent the most substantial risk for each class of advanced vehicles, particularly to include off-design point operations and off-nominal conditions.

The results of the analysis of procedures should also include a description of how the procedures fit within or impact on the ConOps, recommended modifications to the ConOps, if any, and a description of the procedures in terms that elaborate on applicable elements of the ConOps.

Task 6 – Safety Assurance
Of particular importance to this study will be the development of an improved understanding of safety attributes (such as assumptions on overall stability, performance margin and the ability to recover from upset or unforeseen conditions, and requirements for prognostics) associated with a diversity of vehicles and procedures operating in different NextGen scenarios, and to draw meaningful inferences at this early stage of the design of NextGen. An important focus will include identification of off-nominal conditions that impact operations of new and advanced mix of aircraft under various scenarios, and deriving the implications of particular safety margins resulting from these conditions.

System safety should be informed by an integrated view of the current system as it is transitioned to the future state. Therefore, it will be critical to verify that historical risks are directly addressed and not exacerbated by the integration of advanced vehicles and concepts in the operational environment under projected traffic levels, operating environments (such as adverse weather and traffic densities), and the identification of other conditions not readily classified from historical risks.

While a complete safety hazard analysis cannot be completed for each candidate procedure, the use of the NextGen Safety Management System should be used to provide relative assessments of safety implications and identify critical safety issues. This approach is based on identifying the hazards associated with an element of the system (in this case, the elements are vehicles, procedures, and tradeoffs), using the safety risk methodology to determine the potential severity and likelihood of each hazard, while identifying mitigation strategies for the hazards that pose the greatest risk, evaluating the effectiveness of the mitigation strategies, and assessing the potential safety impacts and tradeoffs between safety assurance and system performance.

The purpose of this task is to gain insights and to identify issues and tradeoffs. It is expected that much of the analysis will be quantified in a relative rather than absolute sense, and that some assessments may rely on expert opinion or extrapolation from current data.

Task 7 – System-level Assessment
The focus of this task is to understand from a total system viewpoint the issues that drive how the advanced vehicles will operate and the tradeoffs involved in accommodating them under various conditions. Proceeding from the results of the analysis of the individual procedures, this task will derive the implications for the system as a whole,
including the inference of critical trades that must be addressed within the system envisioned by the ConOps. These trades may result in recommended modifications to the vehicles, the procedures developed in Task 2, the NextGen ConOps, or safety trades in Task 6.

The intent of this analysis is to further the understanding of operations under NextGen, user needs and performance requirements, effects of environmental and other constraints, and their implications for the portfolio of research and analysis efforts required to enable NextGen. It is not to support selection of a particular set of options for system design and research. Tradeoffs will generally be assessed on the basis of efficient employment of the vehicles in question, impact on other users of the airspace, modifications to the vehicles to accommodate safe and efficient operation of NextGen, and modifications to the ConOps to efficiently and safely accommodate a diversity of advanced vehicles.

In addition to customary performance metrics, other effects that should be considered when appropriate include the following, within the concepts set forth in the ConOps:

- Impact on allocation of functions between air and ground and between humans and automation
- Impacts of the broad range of vehicle attributes on traffic flow management and 4D aircraft trajectory management, and airportal (terminal and ground) operations
- Identification of potential safety impacts on NextGen concepts, approaches, and technologies, as well as candidate mitigation strategies
- System performance and efficiency within the constraints imposed by environmental compliance
- Impacts on attributes, design issues, and operation of future air vehicles
- Limitations imposed by reliance on existing or adapted analytical models.

It is desirable that the assessments be linked not only to the particular vehicles examined, but also to generic attributes (as may be appropriate), so that the results of this task can be applied to other types of vehicles that may emerge in the future. This may be achieved through sensitivity analyses of the impact of component, vehicle, operations, and system-level characteristics on overall system performance, such as capacity, throughput, safety, local and global environmental effects, robustness, and efficiency.

Task 8 – Issues for Further Research

Key issues for further research should flow from the conduct of the study; these will include topics for which further knowledge needs to be developed and topics for which new or improved analytical methods or models are required. It is expected that the potential tradeoffs involving different vehicles and procedures will identify many of the critical issues for future research.

The recommendations for further research should include an indication of the criticality of the issues to be addressed and how conditions that may evolve in the future will affect...
this criticality. Some research topics, for example, may become less important as we better understand a particular vehicle parameter that is no longer significant to the performance of an advanced vehicle within the future NextGen environment. Other research topics may be critical to meeting a particular level of traffic volume, as another example. The tradeoffs and sensitivities established in Task 7 should identify the technologies, analyses, and issues that are most critical to operation of the advanced vehicles and to the design and operation of NextGen as a whole under various conditions, and hence the research topics that should enable resolution of the most critical tradeoffs.

The findings should also identify the limitations on the study that resulted from the lack of additional knowledge or tools for analysis of NextGen issues, and recommendations for further development of models and other analytical techniques. These recommendations should describe the rationale for new or improved models and how they would support the development of a modular infrastructure to better understand the effects of technology on development of NextGen.

Task 9 - Workshops
Workshops to review the study approach and, later, the results, will provide for interaction with stakeholders and broaden the perspective and knowledge base of the study. These workshops will also afford an opportunity for coordination of this study with parallel studies on critical NextGen trades and other relevant topics. The workshops are also expected to serve as a mechanism for coordination with on-going NASA studies of key trades and other issues. Attendance at the workshops is expected to be by invitation, to include members of government, academic, and industry entities involved in relevant parallel studies and development of NextGen.

Task 10 – Study Output
The major output of the study will be a publishable final report. The following topics shall be addressed in this report:

a. Types of vehicles considered, rationale for selection of the vehicle classes analyzed, and their attributes relevant to operation in NextGen

b. Operational procedures considered for each type of vehicle, including performance and safety attributes

c. Metrics and analytical methods used to assess the impact of these procedures on NextGen, including rationale for the metrics and methods selected

d. Analysis of the impact of the procedures on effective operation of the advanced vehicles and on operation of NextGen. This will include consideration of safety assurance, as well as a description of the procedures in terms of the ConOps and any recommendations for changes to the ConOps

e. Assessment of effective procedures for operation of advanced vehicles in NextGen and their impact on performance of the system and on the ConOps, including a description of the trade space and tradeoffs involved, and relative sensitivities to key parameters involving the advanced aircraft and the procedures
f. Overarching conclusions concerning operations of advanced vehicles in NextGen and implications for critical research needed to achieve NextGen

g. Limitations on the study imposed by availability of data and use or adaptation of existing analytical tools

h. Key issues for further research, including the need and recommended framework for development of models and other analytical methods

Deliverables:
The list of deliverables and schedule of performance shall include the following:

1. Study approach plan, including models to be employed and developed, issues to be analyzed, and resource and task plans (2 months after approval of award)

2. Workshop to review early results and plans for completion of study (4 months after approval of award)

3. Workshop with a report of interim results and further plans in chart format (10 months after approval of award)

4. Workshop to review draft final results (16 months after approval of award)

5. Draft final report in written format (17 months after approval of award)

6. Revised final report and recommendations, including approach, methodology, results of analyses, sensitivity analyses, etc. (18 months after approval of award)

7. Documentation of methods and models used in the study, including source code, executable software for models developed or modified as part of the study, software design documentation, modeling results, input data and sources, and list of references (18 months after approval of award)

8. Monthly reports of progress and issues

9. Informal bimonthly technical reviews with government representatives

Unique Evaluation Criteria:
The following topic-unique criteria will be applied to the evaluation of intrinsic merit of each proposal, as prescribed in the Guidebook for Proposers Responding to a NASA Research Announcement, January 2007 Edition.

- Breadth of the multidisciplinary team that is organized to conduct the study
- Discipline knowledge of aircraft and air transportation systems, including the comprehensive suite of performance, operations, and safety attributes
- Integrated approach for analysis and modeling of operational procedures for advanced vehicles in the Next Generation Air Transportation System including address of the use of NASA and other publicly available tools
- Approach to collaboration with NASA and other NextGen stakeholders in execution of the study

Period of Performance and Estimated Level of Funding:
Expected budget for this ROA NRA topic area is $6 million, with a period of performance of 18 months. A single award is expected, but multiple awards are possible. Award is targeted for the first quarter of calendar year 2008, with expected completion in the third quarter of calendar year 2009.

Point of Contact:
Questions or comments about plans for the addition of this ROA NRA topic may be forwarded by e-mail to Dr. John A. Cavolowsky at <NASA-roa@nasa.gov>.

As part of the preparatory efforts to add the Integration of Advanced Concepts and Vehicles into the Future National Airspace System to the ROA NRA, ARMD conducted a Pre-proposal Conference on August 9, 2007. Interaction with the broad aeronautics community at the Pre-proposal Conference supported refinement of this ROA NRA topic. Results of the conference interactions are available to the public through the ARMD Web site: http://www.aeronautics.nasa.gov/ or http://www.aeronautics.nasa.gov/nra.htm.