Statement of Objectives

1.0 Background

The Naval Research Laboratory (NRL) Space Applications Branch performs basic and applied research and development in support of Navy and other DoD projects with specific expertise in the areas of space-based systems and related ground-based systems. Currently, the Space Applications Branch is heavily involved with the NAVSTAR Global Position System (GPS). Specific interests include precision time/frequency standards for both space and ground operation, electronic design of satellite on-board and ground receiving equipment, quantum electronic design of atomic frequency standards, mathematical techniques for orbit determination and prediction, computer-assisted data analysis, radio-wave propagation, computer-controlled real-time receiving systems, remote sensing, microprocessing, communications, and software techniques. These projects can vary and may involve long-term development while others emphasize short time-frame deliveries of advanced technology systems.

2.0 Scope of Work

NRL requires technical, engineering and scientific expertise and capabilities in the areas of research development test and evaluation (RDT&E), analysis and applications of emerging scientific technologies for the development of Naval Space Systems. Generally, these can further be described as follows:

- Development of appropriate hardware and systems
- Systems analysis, planning and management, engineering, data analysis and planning for the collection education and documentation of space experiments and operational data
- Modeling and simulation
- Test and evaluation
- Logistics support

This may also include independent concurrent engineering of specified space systems, subsystems, components and procedures. These cases may include any of the following:

- Test and evaluate work in progress
- Initiate alternative or parallel inquiries
- Or otherwise verify the technical validity of concepts designs, components and procedures

Some of the tasking under the effort will be required to be performed at the Sensitive Compartmented Information (SCI) Level.

The estimated level of effort per identified labor category is listed as follows:

Labor Category	Hours Per Year
Senior Research Engineer	5,454
Theoretical Physicist	55
Timing Engineer	6,880
Conference Manager	346
Research Physicist	1,040
Computer Scientist	2,080
Mathematician	2,080
Systems Engineer	1,040
Electronics Technician	1,040

Approximately 90 person trips are anticipated for each year as follows:

- Twelve (12) trips to Boston, MA for three (3) people.
- Twelve (12) trips to Los Angeles, CA for three (3) people.
- Two (2) trips to San Francisco, Ca for two (2) people.
- Ten (10) trips to Cape Canaveral, FL for one (1) person.
- Four (4) trips to Colorado Springs, CO for one (1) person.

For proposal purposes, travel expenses are estimated to total up to $114,748 per year and are subject to the Joint Travel Regulations (JTR).

The following types of hardware may be required throughout performance: atomic clock hardware, precise time measurement instrumentation, microwave susceptibility evaluation apparatus, and thermal/electrical control/monitoring apparatus. Purchase of such hardware is subject to the COR's approval and is estimated to cost up to $50,000 per year for proposal purposes.

3.0 Performance Objectives

- Assign an effective mix of personnel to adequately support NRL to include: senior engineer(s), theoretical physicist(s), timing engineer(s), conference manager(s), research physicist(s), computer scientist(s), mathematician(s), systems engineer(s), and electronics technician(s).

- Develop highly stable clock designs and identify factors influencing their operation for application to GPS and other systems where improved clock stability will provide enhance system results.

- Develop precise time and time transfer techniques required to synchronize clocks on a global basis for GPS and other systems working at the nano-second level.

- Perform experimental and theoretical work on atomic clock systems with the aim of obtaining a frequency stability of 1 part in 10E15 for space applications and the NAVSTAR GPS and fabricate necessary clock hardware.

- Utilize celestial mechanics as applied to earth satellites for the purpose of obtaining accurate trajectories for GPS work.

- Investigate precise navigation techniques as applied to GPS with the aim of evaluating errors in order to improve accuracy.

- Utilize general relativity theory as it applies to clocks in satellites, on earth and in space so that more accuracy can be obtained with GPS and other time dependent systems.

- Conduct technical analyses for advanced sensing concepts that consist of identification and evaluation of alternative technical issues, critical phase point review of potential problems, trade-off studies with attendant risk analysis and recommendations for specific approaches.

- Develop and prepare test plans, test reports and other documentation in order to facilitate the execution of the project.

- Perform experimental tests utilizing laboratory equipment and compile test results in formats for further analysis and/or inclusion in a report.

- Provide software engineering support and technical assistance for space systems technology assessments using existing software packages.

- Design, develop and maintain additional software analytical tools for specific problems where existing software packages are inadequate.

- Develop databases for efficient use of scientific data and ease of information transfer to other systems.

- Design and test electronic equipment having low vulnerability to jamming and other interferences.

- Provide support in organizing and conducting technical meetings.

- Coordinate and organize a yearly Precise Time and Time Interval (PTTI) conference with an average of 170 attendees.

- Prepare briefing materials to include, but not limited to, viewgraphs, slides, photographs, brochures, and video to support program and/or project objectives.

- Prepare Special Studies Reports as required.

- Prepare monthly on-site/off-site reports.
- Prepare monthly Progress and Status of Funds reports.
- Prepare quarterly technical reports.
- Prepare final technical reports for each task order.
- Prepare reports for non-routine meetings attended.

4.0 Operating Constraints

- To provide technical expertise in areas of emphasis that may not be available “in-house”, the Contractor may subcontract and employ the services of consultants in meeting this Statement of Objectives. However, the use of subcontractors and consultants not agreed to during contract negotiations shall be subject to the advance review and approval by the government.
- Some analyses are likely to be time-critical, and accordingly, the Contractor shall be prepared to assemble a team of experts to begin such efforts on short notice.
- Changes in emphasis and significant changes in program direction are inevitable with respect to approved projects. These changes may result in short-turnaround requirements, as well as mid-performance de-scoping of a Task Order (TO) statement of work. The contractor shall be responsive to such changes as they are defined by the issuance of TOs, including new, revised or terminated effort. Ending a given TO, or any portion thereof, shall not be considered a termination or partial termination as defined in the Federal Acquisition Regulation (FAR) or its Supplements.
- The contractor shall perform specific work as funded by individual TOs. Each TO will include, at a minimum, the estimated level of effort; the applicable funding; the TO ceiling for labor, travel and materials; the period of performance; the required deliverables; and any special instructions applicable to the given TO. The contractor and/or subcontractor shall not be reimbursed for any work performed without a fully executed TO. Work beyond either the established ceiling or period of performance will not be reimbursed.
- The contractor shall maintain all Contractor Acquired Property (CAP) and Government Furnished Property/Equipment (GFP/GFE) in an operational state.

5.0 Personnel Qualifications

Research Physicist – Significant experience with the NAVSTAR Global Positioning System programs and their associated operational theory and hardware. Specific and demonstrated expertise in the areas of celestial mechanics, general relativity, precise time and time transfer techniques, precise navigation techniques, space object detection, interferomatric radar theory, RF theory and highly stable clock design. MS in Physics or Electrical Engineering and Five (5) years of experience.

Senior Research Engineer – Significant experience with the NAVSTAR Global Positioning system, the GPS clock program, military communications, precise timing, coding/encryption, system survivability, military systems, precise timing systems, communications system and subsystem design and precise navigation techniques. BEE and Five (5) years of experience.

Theoretical Physicist – Specific and demonstrated expertise in theoretical physics, mathematical techniques for calculations in remote sensing, error analysis in precise time and navigation systems, tracking, satellite orbit prediction, atomic clock density matrix formalism, space dynamics, general relativity and celestial mechanics. PhD in Theoretical Physics and Five (5) years of experience.

Timing Engineer – Strong background as a timing expert in order to provide expert time-system and applications engineering (or applied physics) for tasks involving precise time and frequency for military systems. These tasks include studies on precise clocks and frequency standards, systems incorporating their use, methods of utilizing timing and timing systems and the interpretation and definition of timing requirements. The position requires expert knowledge of precise clock technology, precise time measurement statistics and errors and navigation systems applications requiring installation, software support, data collection and data analysis. BS in Physics or Engineering with Five (5) years of experience.

Computer Scientist – Expertise in data analysis, statistical techniques and computer programming including FORTRAN. BS in Computer Science with Five (5) years experience, Two (2) of which involve expertise for systems involving precise timing.

Mathematician – Knowledge and use of numerical analysis tools in performing statistical analysis to include but not limited to: sampling theory, correlation analysis and analysis of time series. BS in Mathematics with Five (5) years experience in statistical data modeling and timing data analysis.

Systems Engineer – Experience in the development of measurement, estimation or control software. This may or may not be related to precise position and timing hardware. Computer experience should include C/C++ (or Java) and Labview. Experience in Matlab and an understanding of both Windows and Linux OS is highly beneficial. BS or BA in Engineering, Physics or Computer Science with Five (5) years of experience.

Electronics Technician – Experience with designing, fabricating and general maintenance of timing systems. An understanding of vacuum systems and master clocks is necessary. High School Diploma and Five (5) years of experience.

Conference Manager – Strong background and experience in organizing conferences. Experience to include, but not limited to: coordination with the Executive Committee throughout the organization and planning phases, negotiating contracts with hotels and expo companies, coordination of liability insurance, pre and post-conference meetings with hotel personnel, coordination of print and web communications and materials for mailing lists, programs and reminders for papers, and final reports to the Executive Committee.