BROAD AGENCY ANNOUNCEMENT FOR CONTRACTS, GRANTS, COOPERATIVE AGREEMENTS, AND OTHER TRANSACTIONS DAAD19-00-R-0010
AMENDMENT 0002

1. The purpose of this amendment is to update Technical Point of Contact information, to update Research Area 4.2: Molecular Genetics and Genomics, add Area 4.4: Neurophysiology and Cognitive Neuroscience, revise research area 8: Physics, revise research area 10: Computational and Information Sciences and to expand Part II -Other Programs: Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs).

2. The following changes are made to the subject BAA:

a. (Page 6) Research Area 2.1 Delete Dr. Michael Stroscio from Technical Point of Contacts. Dr. Dwight Woolard and Michael Gerhold remain.

b. (Page 6) Research Area 2.2, Change the Technical Point of Contact from Dr. Michael Gerhold to Dr John Zavada, email: Jzavada@aro.arl.army.mil, 919-549-4238.

c. (Page 7) Research Area 2.3, Add Technical Point of Contact Dr. John Zavada, email: Jzavada@aro.arl.army.mil, 919-549-4238.

d. (Page 11) Research Areas 2.6 and 2.7, Change the Technical Point of Contact from Dr. James Harvey to Dr. Dev Palmer, email: dpalmer@aro.arl.army.mil 919-549-4246.

e. (Page 16) Change Research area 4.2 to read as follows:

4.2 Molecular Genetics and Genomics. This program emphasizes basic research in molecular genetics and genomics. This includes identification of gene function, and nuclear and mitochondrial DNA replication, mutagenesis, oxidative stress, and DNA repair. Additionally, basic research in gene regulatory pathways, gene regulation, and molecular adaptation to adverse environmental conditions will also be supported. This program also supports research on biomaterials and bioproduction methods. Finally, this program also supports research to reduce DNA damage in military personnel, for improving performance of military personnel, and advances in biotechnology. This includes molecular responses to pathogens, pathogen identification, and pathogen inactivation, and basic research on mitochondrial regulation and biogenesis. In particular, this program is interested in supporting the biotechnology of micro arrays, including both genomic- and proteomic-based platforms, for real time detection of pathogens or physiological states that would reduce or interfere with human performance.

Technical Point of Contact: Dr. Micheline Strand, e-mail: strandmk@arl.aro.army.mil, (919) 549-4343.

f. (Page 17) Add Research Area 4.4 as follows:

4.4 Neurophysiology and Cognitive Neuroscience: Research in the perception and cognition subfields of neurophysiology and the cognitive neurosciences, covering several or all areas of electrophysiology, psychophysiology, sensory and perceptual physiology, computational neurobiology, psychophysics, neuropsychological, and integrative neurobiology is of interest. Specific examples can include physiological, neuro-psychological and/or cortical/cognitive mechanisms underlying successful completion of complex task behaviors applicable to non-laboratory environments under non-ideal conditions, to include both amelioration of induced losses as well as enhancement in defined perceptual, cognitive and/or motor abilities. Investigations can span the gamut from multi-unit recordings through evoked potentials and neuro-imaging technologies to humoral and psychological correlates of both central and peripheral nervous system function. Non-medical research designed to elucidate the fundamental physiology underlying cognition and possible non-invasive methods of monitoring cognitive states and processes is appropriate. Perceptual and/or psycho physiological implications of mind-machine interfaces ranging from optimizing auditory, visual and/or somatosensory display and control systems based on physiological or psychological states through modeling of individual cognitive dynamics and decision making can be included.

Technical Point of Contact: Dr. Elmar T. Schmeisser e-mail schmeisseret@aro.arl.army.mil (919) 549-4318

g. (Page 17) Research Area 5.1, Change the Technical Point of Contact from Dr. Robert Reeber to Dr William Lampert, email: LampertWV @aro.arl.army.mil, 919-549-4325

h. (Page 21) Research Area 6.3 Change the Technical Point of contact from Dr. Robert Launer to Dr. Mou-Hsiung Harry Chang, email: ChangMH@arl.army.mil.

i. (Page 22) Research Area 6.4 Change the Technical Point of Contact from Dr. Julian Wu to Dr Robert Launer, email: launer2arl.aro.army.mil (919) 549-4309.

j. Page 23) Research Area 6.6 change the Technical Point of Contact from Dr Stephen Davis to Dr Michael Coyle, email: CoyleJM@aro.arl.army.mil 919-549-4256.

k. (Page 23) Research Area 6.7, Change the Technical Point of Contact from Dr. Julian Wu to Dr John Lavery email: Lavery@aro.arl.army.mil 919-549-4253.

l. (Page 26) Research Area 7.2, Change the Technical Point of Contact from Dr. Mohammed Zikry to Dr Bruce LaMattina, email: LaMattinaB@aro.arl.army.mil 919-549-4379.

m. (Page 30) Revise Research Area 8: Physics as follows;

RESEARCH AREA 8
PHYSICS

8.0. The objective of the Physics Program is to develop and exploit the physics knowledge base for new Army needs and capabilities. The future promises dramatic changes in military capability as a result of physics research. In support of this goal, the interests of the Physics

Division are primarily in the following areas: Condensed Matter Physics; Theoretical Physics and Nonlinear Dynamics; Quantum Information Science; Atomic and Molecular Physics; and Optics, Photonics, and Image Science. Physics disciplines which impact these areas include: (i) Condensed Matter Physics, (ii) Interface/Surface Physics, (iii) Atomic, Molecular, and Optical Physics, (iv) Materials Physics, (v) Cross-Disciplinary topics, and (vi) Classical Phenomenology. There is little direct interest in Relativity and Gravity Physics, Elementary Particles and Fields Physics, Nuclear Physics, Astronomy, and Astrophysics since they generally have no impact on the research areas of Army needs. Nevertheless, the possible relevance of topics within these other physics disciplines is not absolutely discounted and discussions of potential exceptions are welcome.

The disciplinary boundaries of the ARO are not sharply drawn as shown by the joint support of a number of efforts by the Physics Division and other ARO Divisions. In addition, it is not necessary that a potential chief investigator be associated with a Physics Department to receive support from the Physics Division. For example, the Physics Division has provided most of the ARO investments in laser research and the chief investigators within the laser program were often associated with Departments of Engineering.

Potential offerors are encouraged to contact the appropriate Technical Point of Contact (TPOC) for preliminary discussions on their ideas. The TPOC may invite the offeror to submit a pre-proposal.

8.1. Condensed Matter Physics. The properties of novel inorganic, organic, and hybrid materials and composites are determined by the structure and composition of the constituent materials and the modified physical phenomenology within them. The condensed matter physics thrust investigates and exploits such phenomena to demonstrate new or enhanced functionalities that could be exploited for use by the Army. There are three major areas of interest within the condensed matter physics work package.

8.1.1. *Nanometer-scale physics*. Specific interest is in the experimental investigation of physical phenomena operative in nanometer-sized materials. The objective is twofold: to investigate and control nanoscale phenomena in well-defined nanometer-sized environments and to elucidate how these phenomena are modified and may be exploited when such nanostructures are assembled into novel composite materials. Related interests include collective and cooperative nanoscale phenomena and understanding the evolution of atomic to thin film to bulk behavior. Emphasis of this program is on the demonstration of revolutionary capabilities that could be used in a broad variety of Army-relevant applications, including novel optical and infrared materials and innovative electronic and optoelectronic devices.

8.1.2. *Electronic and Photonic Band Engineering*. Interest continues in the use of electronic band engineering for the demonstration of militarily relevant device functionalities such as infrared emitters based on quantum cascade lasers and lasing without inversion in multiple quantum well semiconductors. Of greater interest is the continuing development and use of photonic band engineered materials for applications including novel microcavity lasers and LEDs, enhanced microwave components, and low emissivity materials. The objective is to use electronic and photonic band engineering independently and together as adjustable design

degrees of freedom to develop devices and materials with unique functionality. Methods of solving the inverse problem, finding optimal design rules based on prescribed performance objectives, are of particular interest. Applications include infrared emitters and detectors, low observables, and microphotonics for smart sensors.

8.1.3. *Multifunctional Probes and Control*. In order to characterize and control phenomena in semiconductor heterostructures and nanostructures, it is important to combine the high spatial resolution of nanoprobes with the ultrafast temporal or adjustable spectral resolution of optical probes. The objective is to observe and control the dynamical evolution of physical phenomena in these materials at all relevant length- and time-scales. Although development of nanometer-scale pump-probe techniques and other probes of local behavior is still sought, the exploitation of such tools to demonstrate feedback and control of phenomena is of increasing interest.

Technical Point of Contact: Dr. Henry Everitt, e-mail: everitt@aro.arl.army.mil, (919) 549-4369

8.2 . Theoretical Physics and Nonlinear Phenomena. The Theoretical Physics and Nonlinear Phenomena program is very closely coupled to experimental science as well as to ARO's programs in mathematics, chemistry, biological chemistry, materials science, and engineering sciences. The program thus encompasses a broad base including research in electron physics, photon physics, classical and quantum mechanical systems, and statistical physics. It includes first-principles derivations of thermo mechanical strengths of alloys for armor and armor penetrators; electronic band structure calculations of materials for electronic, magnetic, optical, and optoelectronics applications, including those that result from quantum well and multiquantum well structures for signal generation, signal processing, propagation and detection of signals. Also of interest are many-body theoretic approaches that address the electron correlation problem in extended molecular and condensed matter systems to provide the means to predict reaction kinetics, nonequilibrium dynamics, and application to the "alloy problem." There is interest in quantum optics research to explore the role of coherent states, squeezed states, etc. which may provide new tools for improved information processing and means to control information. Statistical physics interests go beyond thermodynamics, into non-equilibrium structures and their metastability, into information theoretic formulations, and into decision algorithms to connect the underlying physics to real world applications via proper modeling, instrumentation and data analysis.

8.2.1. *Theoretical Condensed Matter Physics*. The program extends beyond the topical areas of conventional solid-state physics. It includes research in liquid crystals (for displays, information processing, etc.), atomic clusters, quantum well structures, superlattices, and metastable structures such as quasi crystals and alloys. It explores fundamental interactions such as electron-phonon coupling, spin-phonon coupling, and polaritons. In addition, it studies the role of elementary interactions such as spin waves in ferrites and plasmons in multiquantum wells for coherent THz radiation generation. Also of interest are the experimental demonstrations and mathematical underpinnings of enhanced retro reflection and super-enhanced retro reflection of light, which may have unique applications for secure light-wave communication in the battlefield. Another area of interest is the study of "cooperative behavior" which appears in many different forms in solid-state physics, optics, and elsewhere.

The program encompasses research in both classical and quantum domains, from macroscopic (phenomenological/ mean field) to microscopic levels of description of the mechanisms involved. In addition to analytical techniques, it includes the development of new computational methodologies. For example, the use of the principle of maximum entropy, functional integral methods in many-body physics for predicting electron dynamics in quantum well structures, and variants of the density functional method.

8.2.2. *Nonlinear Dynamics*. Nonlinear interactions that are useful for Army applications appear not only in optics but in other parts of physics, such as in magnetism in the form of magneto static solitonic waves for millimeter wave signal processing, in semiconductor multi-quantum well plasmas for generating coherent THz radiation, and in general when an interaction potential significantly deviates from a harmonic form. Defects, both unintentional and intentional, can play major roles. A general theory of "band structure" calculation that takes defects and defect structures correctly and accurately into account will be useful not only for semiconductor science but also for optics and even micromechanics. Many of the elementary excitations of solid-state physics could be investigated in light of information processing to increase S/N, density of information and speed of processing. The Theoretical Physics program makes an effort to develop these potentialities vis a vis realistic materials that can embody them, and thereby transition these studies to the Materials Science and Engineering Sciences Divisions for actual implementation.

8.2.3. *Nonequilibrium Dynamics*. Many aspects of the field of nonequilibrium statistical physics have significant unresolved scientific issues. These issues are not just of academic interest; they impact engineering sciences, from growth of new materials to implementations in neural nets, and also have potential implications for what is dubbed "smart" or "intelligent" systems that have adaptive learning capabilities. This is a vast area of investigation, but our Theoretical Physics program focuses on realistic goals in this area. The physics to be studied should be coupled with actual material mechanisms. In magnetism, this may translate into the study of the coupling of spins to phonons to provide a realistic relaxation mechanism and the associated resonant linewidths. We are interested in magnetic superlattice type structures that can respond to mm waves by forming magneto static and magneto optic waves that have sufficiently long lifetime and propagation distance for signal processing functions. Also, significant theoretical contributions can be made to the science of alloys, via a quantum mechanical calculation of the characteristics of the bonding charge between nearby atomic constituents. This would provide some guidance to "engineer" grain boundaries with specific brittle fracture characteristics needed for Army and civilian applications.

Technical Point of Contact: Dr. Mikael Ciftan, e-mail: ciftan@aro.arl.army.mil, (919) 549-4236

8.3. Quantum Information Science. Quantum mechanics provides the opportunity to perform highly nonclassical operations that can result in exponential speed ups in computation or ultra-secure transmittal of information. This work package seeks to understand, control, and exploit such nonclassical phenomena for revolutionary advances in computation and secure communication. There are three major areas of interest within this work package.

8.3.1. *Fundamental Studies***.** Experimental investigations of the wave nature of matter, including coherence properties, decoherence mechanisms, decoherence mitigation, entanglement, nondestructive measurement, complex quantum state manipulation, and quantum feedback are of interest. The objective is to ascertain the limits of our ability to create, control, and utilize quantum information in multiple quantum entities in the presence of noise. Of particular interest is the demonstration of the ability to manipulate quantum coherent states on time scales much faster than the decoherence time, especially in condensed matter systems where scalability to many quantum bits and quantum operations is promising. Theoretical analyses of nonclassical phenomena may also be of interest if the work is strongly coupled to a specific experimental investigation, as may proof-of-concept demonstrations in atomic, molecular, and optical systems as described in the Atomic, Molecular, and Optical Physics program.

8.3.2. *Quantum Computation*. Quantum computing will entail the assembly and manipulation of hundreds of quantum bits. The objective is to demonstrate tremendous speed up of computations, and experimental demonstrations of quantum logic performed on several quantum bits operating simultaneously would represent a significant advance toward that ultimate goal. Demonstrations of quantum feedback and error correction for multiple quantum bit systems are also of interest. In addition to the algorithm for factoring, there is particular interest in developing algorithms for solving an NP-complete problem for use in resource optimization and in developing quantum algorithms to simulate complex physical systems.

8.3.3. *Quantum Communication***.** The ability to transmit information through quantum entanglement distributed between spatially separated quantum entities has opened the possibility for an ultra-secure means of communication. Beyond quantum cryptography, the objective is to demonstrate quantum communication of information based on distributed entanglements such as in quantum teleportation. Of particular interest would be the demonstration of long-range quantum entanglements, entanglement transfer among different quantum systems, and long-term quantum memory.

Technical Point of Contact: Dr. Henry Everitt, e-mail: everitt@aro.arl.army.mil, (919) 549-4369.

8.4. Atomic and Molecular **(**AM**)** Physics. Research in atomic and molecular physics will create fundamentally new capabilities for the Army, as well as providing the scientific underpinnings to enhance existing technologies. Topics of interest include atom optics and laser cooling and trapping for ultra sensitive detectors; nonlinear atomic and molecular processes for sensor protection and optical processing; and the study of transport and optical properties of increasingly complex molecules for potential use in hybrid or composite materials.

8.4.1. *Atom Optics*. Matter waves offer new or increased capabilities in a number of areas. For example, cooling, trapping and coherent control of atoms and molecules may provide ultra sensitive sensors such as gyroscopes for inertial navigation, or ultrahigh resolution lithography. In addition to the wavelength advantage of matter waves, they also have additional degrees of freedom such as mass that might provide new sensing capabilities. The use of matter waves and Bose condensates requires basic research to better understand issues such a decoherence and

optimal trapping techniques, and it requires the development of techniques to transmit, combine, interfere and otherwise manipulate matter waves. Laser cooling and trapping of atoms also may provide proof of principle demonstrations of key components of quantum computing.

8.4.2. *Molecular Physics*. The molecular or chemical physics program is distinguished from programs in chemistry of materials science by its focused interest not on synthesis but on underlying phenomenology such as electronic transport, magnetic permeability's, and/or linear and nonlinear optical properties of well-defined molecular systems and their functionalized variants. The objective is to ascertain the sensitivity of underlying phenomena to controllable molecular parameters while also ascertaining fundamental limits or ultimate extrema of such parameters in a given class of molecules.

8.4.3. *Fundamental Atomic and Molecular Physics*. The Division also has a general interest in exploring fundamental atomic and molecular physics topics that may have an impact on technologies of interest to the Army. For example electromagnetically induced transparency allows propagation of light through a medium that is normally strongly absorbing, and it may also provide unique access to nonlinear effects that could lead to very efficient frequency multiplication and tunable sources of electromagnetic radiation. The understanding of the physical mechanisms behind long range, white light propagation of ultra-short, ultra-intense pulses is another example of a topic of interest with unresolved atomic and molecular physics issues.

Technical Point of Contact: Dr. Henry Everitt, e-mail: everitt@aro.arl.army.mil, (919) 549-4369.

8.5 Optics, Photonics, and Imaging Science.
The Army of the 21st century will rely more on sensing, imaging processing, and autonomous target tracking and recognition than ever before. The objective of this work package is to investigate fundamental physical phenomena that will lead to revolutionary advances in these areas. The Physics Division emphasizes fundamental science that uses photons and their properties (e.g. coherence, wavelength, polarization) in ways that will significantly improve information processing capabilities for the Army in the coming decades. Much like the breakthroughs in integrated electronics that brought revolutionary changes to computing and signal processing, a key objective is to integrate elemental optical components into "integrated optics" or "photonics" for smart, adaptive, reconfigurable sensing and image processing. Another objective is to improve the imaging capabilities of the Army by extending beyond the visible and infrared regions to consider advantages of the THz and ultraviolet regions. The Division has an interest in the identification and resolution of basic research issues that would demonstrate the utility of these approaches.

8.5.1. *Unconventional Optics and Imaging*. The Division has an interest in extracting more information from emitted, scattered, and reflected electromagnetic radiation. Of particular interest is the exploitation of coherence and correlations in the electromagnetic field. The degree of coherence can affect or improve the ability to image objects, transfer information, and recognize targets. When a laser beam passes through a scattering medium, the degree of

coherence is altered depending on the amount of randomness and the scattering processes involved. Multiple scattering and partial coherence depends on both volume effects and scattering from many interfaces. A number of such physical effects have been observed and explained, but many issues need investigation. Other areas of interest include hybrid optical/digital systems to minimize aberrations in classical optics, adaptive optics to mitigate against atmospheric distortions, new approaches to coherent or ballistic imaging through turbid and scattering media, and imaging enhancement technologies such as hyper spectral imaging, infrared polarimetric imaging, and THz imaging. Also of interest are other approaches that would increase the resolution or contrast of scenes, or otherwise improve the information quality of the images in the presence of noise and clutter.

8.5.2. *Fundamental Optical Physics.* A variety of topics in classical, nonlinear, and quantum optics are of interest. Photonic band engineering may be used to control the flow of light in fiber, optical materials, laser resonators, and integrated optical systems much more efficiently and compactly than today's component-based technologies. Investigations and utilization of novel nonlinear optical phenomena, such as solitons, vortices, and left handed materials, are of interest and show potential for optical information processing. Relativistic, extremely short and high intensity laser pulses show potential for a new frontier in optical physics, with applications including high harmonic generation, nanolithography, 3-D internal design, micromachining, particle beam acceleration and control, and light filaments. Theoretical and experimental research is needed to describe and understand how matter behaves under these conditions, from single particle motion to the effects in materials, and how to generate these pulses and use them effectively.

8.5.3. *Photonics*. The word "photonics" has been used in a broad sense by the optical science community to define the development of photon-based devices and circuits to perform certain imaging and information processing tasks in a manner superior to or impossible by their electronic counterparts. The Physics Division seeks revolutionary changes in ways photons can be used to perform a variety of such tasks, including signal processing, computation, imaging, and information display. Of particular interest are unique, niche applications for photonics that surpass or replace their electronically based counterparts and that are of direct relevance to the needs of the military. Any super parallelism promised by photonics needs to be demonstrated and exploited in order for photonic solutions to replace existing electronic ones. It is clear that the field of photonics is a very rich frontier for physics research with high potential for device and system technologies. Therefore, the emphasis of this work package is to explore the basic physics and to demonstrate proof-of-concept demonstrations that will ultimately find indispensable military and civilian application.

8.5.4 *Image Science*. The ubiquitous presence, especially in Army scenarios, of structured or target- like clutter is a major impediment to all target recognition systems, including both automatic systems and humans. In many Army scenarios and systems, the performance of image analysis systems is limited by the algorithms, signal processing strategies and models, rather than the sensors or processors. Even though there has been a large investment in automatic target recognition algorithms, significant shortcomings exist, leading to the need for a renewed emphasis on the theoretical underpinnings. To this end, the Division is interested in innovative research which addresses the following objectives: (i) development of a set of

scientific metrics which quantify image content, image complexity, and the performance of image recognition and classification techniques, (ii) development of metrics for structured and target-like clutter, (iii) development of metrics for assessing and validating synthetic scenes. The ultimate goal is to develop image science to the point that the performance of automatic target recognition systems in arbitrary real-world scenarios can be predicted. The emphasis of the Image Science program is on the underlying issues of information science and image analysis. Other ARO programs are concerned with the development of the detectors and algorithms themselves.

Technical Point of Contact: Dr. Richard Hammond, e-mail: hammondrt@aro.arl.army.mil, (919) 549-4313.

8.6. Surface and Interface Physics. Surfaces and Interfaces are important for many phenomena such as film growth, Fermi-level pinning, and quantum confinement effects. The ARO physics program in this area supplements other physics programs such as Nanoscience and Atomic/Molecular Physics. Novel demonstration projects are considered that are multidisciplinary in the sense of allowing a new capability in surfaces/interfaces and ultra thin film physics. Often projects in this area result from special workshops and focused sessions at major scientific conferences.

Technical Point of Contact: Dr. Jack Rowe, e-mail: rowe@aro.arl.army.mil, (919) 549-4332

n. (Page 36) Area 9.4 Delete.

o. (Page 39) Delete Area Areas 10.4: Fuzzy Logic; 10.5: Combat Service Support (CSS) Technology Applications; and 10.9, Information Infrastructure.

p. (Page 44) Research Area 11.7, Change the Technical Point of Contact from Dr. Jagedeesh Pamulapati to Dr. Herbert Pollehn, email: hpollehn@arl.army.mil, (301) 394-461.

q. (Page 48) Research Areas 11.17 an 11.18, Change the email address for Mr. Romeo del Rosario to romeo@arl.army.mil. Delete Mr. Paul Fisher.

r. (Page 54) Area 11.38: Augmentation Awards For Science and Engineering Research Training: Delete.

s. (Page 56) Research Area 11.44, Change the Technical Point of Contact from Dr.Tommy Wong to Jim Gillespie, email jgillesp@arl.army.mil (301) 394-1880.

t. (Page 58) Research Area 11.47, Change the Technical Point of Contact from Dr. Stefan Svensson to Dr. Ken Jones, email: kajones@arl.army.mil (301) 394-2005.

u. (Page 59) Research Area 11.53, Change the Technical Point of Contact from Dr. John D. Bruno to Dr. Stefan Svensson, email: svensson@arl.army.mil (301) 935-6969.

v. (Page 65) Area 14.0 Change the Technical Point of Contact from Mr. Douglas Tyrol to Wendy Leonard, email: Leonard@arl.army.mil 410-278-5813.

w. Add Research Areas 10.4: Sensor Network Communications and 10.5: Wireless Mobile Communications.

x. Revise Research Area 10: Computational and Information Sciences as follows:

B. ARMY RESEARCH LABORATORY DIRECTORATES

RESEARCH AREA 10
COMPUTATIONAL AND INFORMATION SCIENCES

10.1. Military Extensible Markup Language (milXML). Extensible markup language (XML), a subset of standard generalized markup language (SGML), was approved by the World Wide Web Consortium in 1998, with the hope that XML would offer a more efficient way to publish Web pages. Gradually, developers found out that the power of defining their own tags separate from the file contents meant that data could be defined and easily exchanged. Web publishing is now spreading to more data interchange situations. Now XML is taking on e-commerce. Commerce XML (cXML) initiative is launched with the goal of fitting the document schema into the data-flow environment.

The electronic business XML (ebXML Initiative™) creates a single global XML framework solution. The ebXML is hoped to revolutionize how business transactions are tracked, affecting worldwide impacts, removing paper from the process and by empowering people to create whole new work models.

Financial products markup language (FpML) is a new protocol to enable e-commerce activities in the field of financial derivatives. The synchronous markup language (SyncML), which leverages XML, is the common language for synchronizing all devices and applications over any network. With SyncML, networked information can be synchronized with any mobile device and mobile information can be synchronized with any networked application. These developments will prompt one to conceive a military XML (milXML) that will assist military strategic and tactical transactions. The ARL would like to receive research proposals to explore the possibility of defining and developing a milXML protocol that is consistent with security and bandwidth issues in CONUS, joint, and coalition operations.

Technical Point of Contact: Dr. Som Karamchetty, e-mail: skaramch@arl.army.mil, (301) 394-3198

10.2. Information Science and Technology. The ARL is interested in basic and applied research resulting in technologies that support state-of-the-art capabilities for the war fighter in the analysis, assimilation, and dissemination of real and simulated digitized battle space information. Areas of interest include, but not limited to:

a. Intelligent software agents.
b. Course of action analysis and comparison.
c. Software reuse.
d. Embedded training on the use of the system.
e. Automated distribution of operational orders.
f. Collaborative technologies for distributed work environments.
g. Data visualization.

Technical Point of Contact: Dr. John W. Gowens, II, email: gowens@arl.army.mil, 301-394-1722.

10.3. Wireless Information Assurance and Survivable Communications. The ARL is interested in receiving proposals that address the underlying science and technology survivable and secure communications over wireless networks, information infrastructure protection, and survivable systems engineering. The objectives of the research are to provide secure, survivable, and assured communications over wireless networks, including highly mobile networks. Research interests include, but should not be limited to, advancing the state of the art in the following areas:

a. Research on automated vulnerability assessment and intrusion detection tools and techniques.
b. Genetic algorithms used to spawn and control intelligent agents for information assurance.
c. Information hiding in images and text (steganography and watermarking).
d. Key distribution and security in a mobile wireless ad hoc network.
e. Tools and techniques for automating the creation and distribution of interoperable vulnerability knowledge bases.
f. Tools and techniques for automated and analysis and correlation of anomalies, probes, and detections from multiple sites and to support post-incident forensic analysis.
g. Network management and visualization tools that support real time planning and control of tactical nets as well as tools for intrusion detection and forensic analysis in hybrid networks.

Technical Point of Contact: Mr. Greg Cirincione, e-mail: cirincione@arl.army.mil, (301) 394-4809

10.4. Sensor Network Communications. ARL is developing communications devices and technologies for unattended sensors. These unattended devices must work for long periods on limited battery power, use Anti-Jam and Low Probability of Detection waveforms, perform ad-hoc networking for autonomous self-healing routing, and provide network security for authentication, data integrity and privacy. Areas of interest include, but not limited to:

a. ad-hoc network protocols
b. security protocols
c. robust AJ/LPD waveforms
d. energy efficient modems

e. energy efficient RF front-ends
f. low power signal processing
g. small broadband antenna
h. forward-error-correction

Technical Point of Contact: Ronald Tobin, e-mail: rtobin@arl.army.mil, phone: (301) 394-2184

10.5. Wireless Mobile Communications: The ARL is interested in receiving proposals that address the underlying science and technology for mobile wireless communications networks, especially the mobile tactical domain, and including sensor networks. The objectives of this research are to enable Army multimedia communications among highly mobile users, sensors, and robotic platforms under adverse channel conditions, with desired quality of service on demand. Research areas of interest include, but are not limited to, advancing the state of the art in the following areas:

a. Bandwidth and energy constrained mobile transceiver design.
b. Cross-layer designs, especially with respect to physical layer and media access layer interaction.
c. Multi-antenna methods, including space-time processing, for mitigating multi-user and intentional interference, while achieving very high capacity.
d. Techniques for overcoming electronic warfare and jamming threats.
e. Frequency agile systems.
f. The combination of channel equalization and coding techniques.
g. Wideband modulation methods such as orthogonal frequency division multiplexing.
h. Ultra wideband systems, including coexistence issues and system overlays.
i. Sensor networking systems, including signal processing and communications interactions, distributed detection and estimation, and networking protocols.
j. Ad hoc mobile networking protocols and procedures.

Technical point of contact: Dr. Brian M. Sadler, email: bsadler@arl.army.mil, 301-394-1239.

10.6. Atmospheric Effects Modeling and Simulation. The ARL is interested in receiving proposals that address the technology and technical barriers for improving the state of the art of critical scientific areas that affect atmospheric modeling and simulation. The objectives of the research are to mitigate the effects of weather and battle-induced atmospheres on combat materiel, personnel, and doctrine; to optimize the performance of friendly forces under realistic battlefield conditions; and to enhance the use of smoke, camouflage, concealment, deception, and low-observable technology. Research interests include, but should not be limited to, advancing the state of the art in the following areas:

a. Research on and models of the propagation of acoustic energy in the atmospheric environment under neutral and battlefield conditions.
b. Atmospheric effects decision aids for acoustic systems.
c. Sound detection and ranging techniques.
d. Computer, artificial intelligence, display, and man-machine interface techniques in weather intelligence concepts.

e. Unified weather packages of atmospheric effects decision aids for potential use in automated systems of the different battlefield functional mission areas.

f. Atmospheric effects decision aids consolidating the effects of realistic battlefield conditions and operations, systems, and sub-systems.

g. Models of electromagnetic propagation through the atmosphere at UV through millimeter-wave lengths under natural and battlefield conditions for mitigating atmospheric effects on Army systems.

h. Research on and models of atmospheric effects on images and scenes under natural and battle-induced conditions.

i. Obscuration models for battlefield conditions, including weather, natural and battle-induced smokes, and dust.

j. Atmospheric effects decision aids for the use of smoke, camouflage, decoys, and low observables.

k. Incorporation of the effects of weather, clutter, and battlefield obscurants into target acquisition.

l. Atmospheric effects decision aids for mitigating the effects of natural and battle-induced atmospheres on target acquisition.

m. Simulation of battlefield environmental effects for distributed simulation and high-level architecture.

n. Advanced numeric modeling techniques that use state-of-the-art computer technology, such as parallel processing.

Technical Point of Contact: Dr. Alan Wetmore, e-mail: awetmore@arl.army.mil, (301) 394-2499.

10.7. Database Technology. Explore ideas and prototype tools for advanced data management concepts, including schema integration and data warehousing in a standardized data environment, enable transparent access to multiple heterogeneous databases, data mining and knowledge discovery in large distributed databases, automated query formulation strategies using data element thesaurus capabilities, integration of data encyclopedia tools with data and process modeling tools, and automated support for electronic records management and digital signature. Implement and experiment with simultaneously and transparently accessing and manipulating data from any different databases, to include support for imaging, multimedia, object-oriented, and traditional applications. Investigate new ideas, and design, implement, and evaluate prototype data management tools which support the Army Information Architecture, Army modernization efforts, and the Army's Future Combat System (FCS).

Technical Point of Contact: Ms. Pat Jones, email: pjones@arl.army.mil, 410-278-5840

10.8. Software Engineering: In an open systems environment, develop concepts for prototype components of software engineering technologies which reduce software life-cycle costs, increase modularity and interoperability, increase productivity of software design/development and support organizations, and improve the quality, reliability and reusability of delivered components, systems, and products. Explore methodologies and technologies (e.g., object-oriented), which achieve substantial improvement and cost reduction in software development, requirements analysis and definition, software management, complexity, and quality metrics,

reuse, re-engineering, maintenance. This includes tools and techniques (e.g., intelligent agents, wrappers) to aid in migrating or interfacing legacy systems to Java-based or other state-of-the-art systems. Topic includes any software engineering technologies, which aid in the Army's efforts to digitize the battlefield and its tactical command and control systems.

Technical Point of Contact: Ms. Pat Jones, email: pjones@arl.army.mil, 410-278-5840.

10.9. Technology for Course of Action (COA) Analysis. The ARL is interested in basic and applied research resulting in technologies that support state-of-the-art capabilities for the war fighter in the analysis, assimilation and dissemination of real and simulated digitized battle space information. The Computational and Information Sciences Directorate is leading the ARL's Digitization and Communications Science thrust. One aspect of the effort is the development of methods for providing data for warfare (and operations other than war) to the commander's planning staff in a manner that can be readily used. The ARL is soliciting proposals for technology to provide automated tools for the future force that support planning, commander-staff-subordinate collaboration, dissemination of mission intent, mission monitoring, and adaptation.

In particular, current COA analysis methods may lack the sophistication and speed required to guarantee that understandable information is provided in a timely manner to intended recipients. The ARL seeks approaches to analysis of COAs that address the domain of the Army command and control systems vis-à-vis tactical operations centers and that can be extended across the spectrum of operations to be encountered by the future Army.
Areas of interest include: techniques for automation augmented planning and decision-making; analytical tools to increase decision cycle speed; approaches to integration of the results of multiple war games and simulations for consideration of many COAs in near real time; COA analysis approaches accounting for incomplete data; identification of data structures required for battlefield analysis of COAs produced in the near-term C2 infrastructure; approaches to evaluation of COA systems (e.g., with regard to utility and quality); interface with standardization efforts involving C2 message elements; systems to check COAs against standards (e.g., the principles of war, historical "sanity") or criteria (e.g., the commander's intent, supportability); statistical techniques (e.g., nonparametric hypothesis testing) for COA comparison; operations research methods for COA evaluation (e.g., multi-attribute utility analysis).

Technical Point of Contact: Mr. Richard Kaste, e-mail: rck@arl.army.mil, (410) 278-7781.

10.10. Battlefield Environmental Research. The ARL is interested in basic and applied research resulting in technologies that support state-of-the-art capabilities for the war fighter in the measurement, analysis, assimilation, and dissemination of real and simulated digitized battle space weather and atmospheric information. Areas of interest include, but are not limited to:

a. Micro scale atmospheric boundary layer meteorology, at resolutions below 1 km that consider urban and vegetative canopy effects.
b. Diagnostic tools for determination of realistic spatial variability of atmospheric parameters in limited but complex domains.

c. Electromagnetic and acoustic propagation, especially electro-optical EM propagation, and infrasonic acoustic propagation.

d. Atmospheric aerosol properties and behavior, including mineral, biological and liquid components.

e. Efficient distributed weather forecasting technology for hosting on future Army tactical computer platforms.

f. Methodology and applications for the use of satellite remote sensing of environmental conditions.

g. Environmental decision support technology (tactical decision aids) for transforming weather information into mission planning and battle decision intelligence.

h. Physically accurate weather visualization tools.

Technical Point of Contact: Dr. Jon Mercurio, email: jjmartin@arl.army.mil, (301) 394-2500.

10.11. Scalable Computational Sciences. Research and development proposals are required in the areas of multi-disciplinary computational approaches on high performance computers to address challenges in simulating practical Army applications. Specific areas of interest include: (i) innovative and scalable methodologies (including finite element methods, particle methods, etc.) for computational mechanics Computational Fluid Dynamics (CFD), Computational Structural Mechanics (CSM), Computational Electromagnetics and Acoustics (CEA), and Computational Chemistry and Materials (CCM), etc.); (ii) innovative space and time discretization numerical algorithms including scalable equation solvers for a wide class of nonlinear computational mechanics problems; (iii) computational methods for interdisciplinary applications (example: structure-medium interaction, Eulerian-Lagrangian, etc.); (iv) multi-scale computational approaches (example: Macro-meso-micro approaches, molecular dynamics-continuum mechanics coupled approaches, etc.); (v) computational methods to address innovative structures for Army applications (designing, manufacturing, testing, verification and validation); and (vi) data mining for scientific applications.

Technical Point of Contact: Dr. Andrew Mark, e-mail: amark@arl.army.mil, (410) 278-9761.

10.12. Knowledge Management and Business Intelligence Systems. Integrated enterprise systems that include web-based portals of entry, enterprise data repositories, integrated data environments, advanced data and text search engines, integrated enterprise ERP applications, and advanced data discovery software for the analysis and display of context-rich information is critical for knowledge management and business intelligence. Interest includes knowledge fusion of heterogeneous data and multimedia types, data mining, text mining, knowledge agents, knowledge brokers, knowledge visualization systems, federated knowledge warehouses, and knowledge standards.

Technical Point of Contact: Dr. Dana Ulery, e-mail: ulerydl@arl.army.mil, (410) 278-8609

10.13. Information Technology. ARL is interested in proposals that focus on new, innovative uses of Internet web technologies and Lotus Domino/Notes as a primary user interface into a wide variety of enterprise-wide business applications that use Army Standard Systems. In

particular, the research should focus on methods and tools that improve developers' abilities to provide new applications across varied user platforms and operating systems while dealing with legacy systems and legacy systems data. ARL is interested in proposals that focus on technologies that can be applied to life-cycle management of heterogeneous electronic records to enable compliance with directives and regulations such as the Modern Army Records Keeping System (MARKS) and National Archives and Records Administration (NARA) requirements.

Technical Point of Contact: Mr. Kenneth Calabrese, email: kcalabrese@arl.army.mil, (301) 394-5442.

y. (Page 63) Research Area 13.5 Change the Technical Point of Contact from LTC Buck Tanner to, Dr. Edward Schmidt email Schmidt@arl.army.mil (410) 306-0663.

z. (Page 65) Research Area 14: Human Research and Engineering, Change the Technical Point of contact from Mr. Douglas Tyrol to Wendy Leonard, email:leonard@arl.army.mil (410) 278-5813.

aa. (Page 65) Research Area 14.1: Knowledge Management Techniques for Preparing Adaptive Commanders and Teams: Delete.

bb. Page 65) Research Area 15: Change the Technical Point of contact from Dr. Gary Farley to LTC Edward Healy, email: e.a.healy@larc.nasa.gov, 757-864-3091.

cc. (Page 66) Part II Conference and Symposia Grants HBCU and MI, Change 1.c to 1.d. Insert 1c. as follows:

The Army has an interest in awarding cooperative agreements, grants and contracts to HBCU/MIs that will enhance the Army's ability to support the HBCU/MI in conducting advanced research and development in science, math and engineering with potential application in support of the Army war fighter. Areas of interest include but are not limited to the following:

- Continued support of the 3 HBCUs and 3 MIs currently under education and research partnership agreements with ARL.
- Professional development for faculty to participate in ARL research and development activities and to develop methods for integrating these activities into their curricula.
- Participation in Summer Faculty/Sabbatical Leave research programs and Intergovernmental Personnel Act (IPA) appointments at ARL laboratories.
- Support for graduate student research on HBCU/MI campuses or at ARL laboratories (i.e., MS or Ph.D. degree programs relevant to the ARL mission).
- Opportunities for supporting research conducted by newly hired tenure track faculty at HBCU/MIs.

- Support of M.S. and Ph.D. candidates while completing thesis' and dissertations on ARL approved topics.
- Opportunities for HBCU/MIs to conduct research symposia, workshops, and other related technical assistance programs that provide "hands on " training and information to HBCU/MIs.
- Awards for Centers of Excellence at HBCU/MIs (i.e., research and education centers relevant to Army transformation).
- Summer internship opportunities for undergraduate and graduate students at ARL laboratories.
- Instrumentation and equipment upgrade of science laboratories.
- Faculty special training.

The Army is interested in receiving novel proposals that address innovative techniques for increasing the number of minority students attending college with math and science literacy i.e. summer programs, Saturday academies, online and distance education, special partnerships with local schools and college preparatory schools, etc.

Program interests cover a broad spectrum including funding to augment projects resulting in technologies that support state of the art capabilities for the war fighter. The Army is also committed to support for outreach programs that increase the available pool of SME prepared students to act as research assistants and pursue graduate degrees in math science and engineering.

Proposals are requested that address these and other areas of mutual concern.

dd. Add to 1.d " After consultation with the appropriate Technical Point of Contact, HBCU/MI' s should submit proposals through personnel listed in 3 below.

ee. (Page 67) 2. Eligibility: Change the website to read http://www.wd.gov/offices/OCR/minorityinst.html. Add the sentence; "Questions concerning the list must be directed to the Integrated Postsecondary Education Data System (IPEDS) Inquiry Line (202-205-9576) in the Office of Civil Rights, U.S. Department of Education, not to the Department of Defense."

ff. (Page 67) 3. Points of Contact: Change Dr Val Emery to Dr. Vallen L. Emery, Jr.